Introducing Building-Typology in the Decision-Making Process: a Strategy of Adaptive Reuse for Refugees in Turin

Cities as Assemblages

Proceedings of the XXVI International Seminar on Urban Form 2019

2-6 July 2019, Nicosia, Cyprus

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Preface

The Art of Assemblage and Deformation

by Alessandro Camiz, Member of the Conference Organising Committee
Özyeğin University

> "The compound may be actually other than the constituents from which it has resulted."
> Aristotle, *On Generation and Corruption*, I, 10.

After two years finally the Proceedings of the XXVI International Seminar on Urban Form, Cities as Assemblages, which we organised from the 2nd to the 6th of July 2019 in Nicosia, Cyprus, have come to light. The Cyprus Network of Urban Morphology (CyNUM) , which organised on behalf of ISUF the XXVI International Seminar on Urban Form, was founded in 2015 as a bicommunal organisation involving actively researchers from both sides of the divide (Camiz, 2017). Following the bicommunal spirit of CyNUM the conference took part both in the Republic of Cyprus and in the UN Buffer zone in Nicosia. Different sessions and events were distributed at the Filoxenia Conference Centre (Nicosia), at the Home for Cooperation (Buffer Zone), at Chateau status (Buffer Zone) and at the Goethe-Institut Cyprus (Buffer Zone). Unfortunately, it was not possible to organise a conference session within the northern side of the divide, we were able instead to plan a guided tour therein. Nevertheless, the conference, both symbolically and practically kept together the two sides of Cyprus. After the conference, came the pandemic, and this created a restraint to the proceedings' timeline. The reasons for this extensive delay should be clarified and are mostly due to the lockdowns adopted by most governments during the COVID-19 pandemic. These dramatically slowed down each step of the long list of actions required for a publication: the gathering of economic resources, the choice of a publisher, the collection of papers, the organisation and editing of the three volumes, the correction of proofs and finally the design of the volumes. In normal conditions each one of these steps could have taken a few months, but within the global lockdowns that we faced in 2020 and 2021, each one took from six to ten months. We edited the proceedings so to allow individual DOI and SCOPUS indexing for each paper. This last part of the process, which we decided to adopt from the very beginning, was indeed one of the reasons for the length of the entire operation: but we to believe that it was worth waiting. We can indeed now insert the proceedings of ISUF 2019 in the shortlist of the ISUF conference proceedings that have been SCOPUS indexed. We should mention as an example the XIX International Seminar on Urban Form, *New urban configurations,* which was held in Delft, The Netherlands, from the 16th to the 19th of October 2012 (Cavallo, Komossa, Marzot, Berghauser Pont and Kuijper 2014). As a note, the timeline for the publication of XIX International Seminar on Urban Form's proceedings

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Delft (two years) does not differ from that of the XXVI International Seminar on Urban Form. We should indeed thank the conference's chair, Nadia Charalambous, for her rock-solid patience during the conference's organisation and in the long editing process of its proceedings.

We edited the proceedings by distributing uniformly the sessions dedicated to design and planning and the theoretical ones among the three volumes, so to not specialise each volume but to blend the different topics in an *assemblage* of theory and practice. This second volume contains the papers related to the conference sessions dedicated to: *Theory: Emergence, relations theories, the social sciences, and urban morphology*; *Methods: Embedding different approaches into the study of urban morphology*; *Urban Design: Urban morphology, building typology and design* and last, but not least, the special focus session entitled *Urban conflict and divided cities*. Obviously, it is not possible to mention all the authors in such a short space, so we remand to the volume's index and the individual papers for those details. Nevertheless, we will mention a few of them, so to represent here symbolically the topic of each session, and to illustrate briefly to the reader the wide scope of the XXVI International Seminar on Urban Form, both in provenance of the authors and in contents. We will also discuss briefly in the conclusions the different aspects of the *notion of assemblage*, and how they may be related to the conference's topics. Within the session, *Emergence, relations theories, the social sciences, and urban morphology*, we should mention Qi Mu's contribution, *A relational thought on the traditional rural settlements in China Taking Dawan village as a case study*, which examined the relations between physical spaces and social forms, outlining the role of local elites in the village preservation and development. Francois Racine considered the link between planned built environments and city forms in Canada, in the different case studies of Boyce-Viau, Quartier Saint-Sulpice, and Place Valois. This paper, entitled *The influence of urban design theories in the transformation of urban morphology: Montreal from 1956 to 2018,* recognised an emerging trend in the influence of morphological and typological analysis on the urban design process. Within the session *Methods: Embedding different approaches into the study of urban morphology*, Meng Zhou and Ying Zheng presented *The analysis on the evolution of the Old-type Lilong housings in Tianjin*, where using the Italian typology methods, they described the diachronic evolution and the variants of the Lilong courtyard house building type. In *Housing Estates and Ordinary Peripheries. Mapping Adaptability of Urban Forms,* Isabel Ezquerra, Carmen Diez-Medina and Javier Monclus examined the urban transformations of two housing estates in Zaragoza in the last fifty years and, by using a multi-scalar approach, outlined the importance of the recognizable urban parts in the urban design practice. Within the session, *Urban Design: Urban morphology, building typology and design*, Lian Tang and Wowo Ding, in the paper entitled *Analysis Method of Historical Urban Fabric for Urban Design*, studied the urban fabric of Nanjing's historical area, and adopting quantitative analysis methods, derived some indexes to be used for the urban design and regeneration practices. Chrystala Psathiti used a multi-layered and non-hierarchical multi-scale methodological approach, assembling axial map analysis, spacemate diagrams, J-graphs, ABCD spaces and other social correlations to analyse the morphology of secondary school buildings, in the paper entitled, *Assemblages and Built Form: The case of secondary school buildings in Cyprus.* Within the special session dedicated to *Urban conflict and divided cities,* Luchuan Deng and Feng Song used a two-agent model to analyse the boundary issue in paper titled *The relationship between power, morphological characteristic areas, and their boundaries: Case study on the conservation areas in Cardiff, Wales.* Finally in the paper entitled *The Emergence and Extinction of a City Dividing Line: Study on Urban Morphology Along the "Secondary Borderline" in Shenzhen, China*, Xia Liu examined the evolution of urban forms along the Shenzhen Secondary Borderline from 1980 to 2018, finding that these were strongly determined by the different economic models adopted on the sides of the divide.

In each of these papers, and more in general in the entire conference, the authors considered in depth the different aspects *of the notion of assemblage* as suggested by the conference's title, *Cities as Assemblages*. Within the conference we could indeed recognize different interpretations of the notion of assemblage in a dialectic confrontation between practice and theory. The assemblage of different analysis methods is probably the most coherent approach considering ISUF's interdisciplinary character (Whitehand, 2018). We should not ignore though those studies interpreting the city itself as an assemblage of different parts, cultures, and social groups, which is somehow the very essence of an urban environment. Another emerging interpretation is based on the assemblage of the analysis methods and the design process itself. This last assemblage is extremely relevant and perhaps should be considered as one of the most important aspects of ISUF's mission: changing in better the way our built environment is determined by embedding urban morphology studies in the design and planning practices.

After examining a selection of the papers, and how they relate to the *notion of assemblage*, we can now go back to the opening quote, and consider how the assembled parts may become a resulting unit, by building a critical parallel between the notion of *assemblage* and *collage artistic practice*. Colin Rowe stated that the "collage is a method deriving its virtue from its irony, because it seems to be a technique for using things and simultaneously disbelieving in them." (Koetter and Rowe, 1979). This disbelief is one of the possible evolutions of the assembled parts into a new unit. It could be argued that assemblage and collage are quite different techniques. The paper collage, which often is taken within the urban morphology and architecture research fields as an analogy of the assemblage technique, does not allow the deformation of the collated contents, these are restrained in their surface, and may be only cut into different forms and collated into new configurations. Using the assemblage practice instead it is possible to deform the assembled contents, and this deformation, or if you wish disbelief, is central for the attribution of meaning to the assembled parts. In the past the deformation technique has been widely used in the assemblage of architectural elements, both to adapt the chosen model to the site, but also to resignify the model by scaling, rotating, capsizing, breaking, and remounting its parts (Camiz, 2020). Moreover, the history of town planning is rich of examples of such a procedure, where the designers often used ancient models by deforming them, but not too much, in order to facilitate their recognition by the public. The Crescent, Regent Street and Circus at Bath designed in by John Wood the Elder in 1754 and completed in 1768 by John Wood the Younger, represents a meaningful example of such a compositional technique. Surprisingly all the urban spaces designed in Bath were inspired by models deriving from Constantinople: Constantine's forum for the Circus, the Sigma for the Crescent, and the Mese for Regent Street. The designer though, deformed and assembled them into a new configuration creating an urban part which transcends its architectural models. That same urban space became later a model for other projects such as "Les Espaces d'Abraxas" at Marne-la Vallée, Paris, designed by Ricardo Bofill Taller de Arquitectura (RBTA) in 1982. Even though the architect used here explicitly the theatre as an architectural model, it is clear that her referred the columned urban space of "Le colonnes de Saint-Christophe" (Cergy, France, 1986) to the Circus in Bath. Piranesi extensively used the deformation of the assembled elements in his *Pianta di Roma e del Campo Marzio.* Here he stretched the city limit to include the *Pons Milvius*, carved it and imposed it on a paper with the captions, added over it another scaled map partially rolled up, and overlapped architectural fragments and a rotated dedicatory inscription on top. In this etching the author extensively adopted the assemblage of different elements applying the deformation technique.

Deriving this deformation technique from the architectural composition domain, it is possible to introduce it into the research practice. Each research, even though obviously related to

previous models and analysis methods, should deform those components and assemble them into a new configuration, in order to avoid the replica of former studies, and rather become an improvement of those research methods, an improvement which can then be adopted as a model for future studies.

We hope that the studies in the field of Urban Morphology, will not just assemble existing techniques, such as the Conzenian, Muratorian, Space Syntax and quantitative Morphology, just to mention a few, but more and more will deform them in relation to the context, both for the understanding of the past and for the design of new meaningful urban spaces.

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Theory: Emergence, Relational Theories, The Social Sciences and Urban Morphology

A Relational Research Approach to Urban Morphology

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Keywords: relational theory, urban morphological approaches, combined methodological frameworks, Limassol.

Abstract: This paper presents a relational research approach to the study of urban form by using assemblage theory as a broad theoretical framework for urban morphology and the social processes that are involved in the shaping of the urban form. The argument is made that the physical and human aspects of a city are inextricably linked and should therefore be analyzed together as they jointly define the identity of a city. It is also made clear that an analysis that is devoid of historical processes or of the distribution of variations across a population cannot fully explain the emergence of cities and the processes of persistence and change.
The fact that assemblage theory is a generic, non-specific approach, should be viewed as a strength rather than a weakness. This genericity has been shown to be extremely valuable in making inferences about the causal pathways that lead to the physical and social form of cities (Charalambous and Geddes, 2015); it is also a characteristic which is advocated as beneficial when making analytical choices and providing normative guidelines (Batty, 2013; Bettencourt, 2013).
The proposed theoretical framework and its analytical requirements are matched by the main morphological approaches. Such a framework was tested for a diachronic analysis of Limassol (Geddes, 2017); the effectiveness of the framework in this research and the choice of specific methods and tools depending on the context is discussed with reference to the interdisciplinary potential of combining approaches under such a relational framework.

1. Introduction

The array of elements that make up a city, the relations between them, and the causal pathways that give a city its identity or characteristics, remain difficult to describe, map and analyze coherently. This problem is intensified in contemporary cities which may be characterized by new forms of closure and exclusion (Wacquant, 2008), increasing social, economic, political and spatial fragmentation. In particular, the modern city has seen a shift in its physical form and has moved from an urban fabric which was dense and continuous to one that is more diffused, discontinuous, open and atomized (Levy, 1999).

A key problem in our ability to understand the complexity of the urban form is the long-standing isolation of the analytical approaches developed in different countries and research environ-

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ments. Such approaches are characterized by specific national trends and have seen the emergence of separate schools of thought. There are essentially four main approaches to the study of the urban form: the *configurational* approach, the *historical-geographical* approach, the *process typological* approach, and the *spatial analytical* approach. Each of these tends to be associated with a main research center or with individual researchers, and all have traditionally been applied in isolation. However, in recent years a number of studies, initiatives and events (Kropf, 2009; Oliveira *et al.*, 2014; Zhang, 2015; Scheer, 2016), have explored bridges between the different approaches to assess the viability of a common framework and of a multidisciplinary analytical approach. However, there are still limited analyses and elaborations of how the approaches are interlinked and how they can be brought together within a comprehensive framework.

Furthermore, the advancement of such comparative and multidisciplinary work is fraught with the difficulty of analyzing urban growth and the human intervention in such growth that has occurred throughout centuries of urbanizations. Attempts to embed the temporal process in theorizations and methodologies for the study of cities' transformations are discussed in theoretical debates and do exists in empirical studies, but remain limited and are still not fully developed and exploited.

This paper proposes using a relational approach, specifically assemblage theory (DeLanda, 2006), as a broad framework to construct a comprehensive analytical approach to enable the encompassing of the multifaceted elements and processes that lead to the emergence and transformation of cities. It focuses on the development and testing of a transdisciplinary methodology to understand what happens to cities' form and functioning as they grow.

Within the scope of this study is the identification of the need for enhancing the research on the relationship between the physical elements of a city and social changes that occur in the urban environment over time. The extent to which the material and social spheres, and the impact of the one onto the other, should be considered and analyzed within the field of urban morphology in the theoretical premises. A theoretical framework is then set and a methodology for analysis developed based on the key elements of the various analytical approaches. The aim is to establish an effective way of identifying the key processes that lead cities to display their common as well as their specific urban characteristics. The methodology is then applied to the case of Limassol, Cyprus, in order to identify the key features and processes of its growth.

The main findings ensuing from the space syntax analysis, the historical research and interviews are then presented. The analysis is specifically concerned with key physical elements of the city and their properties (the street network and its configuration), key socio-economic factors, and the reasoning behind planning decisions. This approach aims to produce new insights into the complex relationship between the spatial and social dimensions of the city and into the processes of change displayed in the patterns of the city through time. The results are discussed with regards to the extent to which the framework enables the identification of causal pathways of development, and how the growth process impacts on the form and functioning of the city.

2. Theoretical Premises

Cities are invariably a collection of material entities, but they are also a system of human activity and interaction. Whether the two are separate dimensions where the material and the spatial, and their organization, act as a background and a context to human relations, or whether

the two are inextricably linked and influence each other is still an open question in the scholarship on cities. Spatial organization and structuring as a reflection of social relations, cultural trends and economic factors, is a long-established idea which spans the work of urban sociologists from diverse backgrounds, such as Simmel (2004), Lefebvre (1991) and Logan and Molotch (2007). What is still highly debated is whether the organization of space and the physical form of the city has an impact on society. The analysis of the relationship between urban space and society was initiated by Charles Booth (1897). Many of the issues identified by Booth's study on the distribution of social classes in London informed urban sociological studies developed by the Chicago School in the 1920s. This body of work, analyzing the distribution of various social characteristics within cities, remains pioneering in its view of urban contexts as structured in time by habitual social practices (Charalambous, 2018). Despite the criticism of stereotyping social groups, such social approaches continue to be the foundation of socio-spatial theorizations of the city and of understanding the role of the urban environment in producing social outcomes (Tonkiss, 2005).

When analyzing cities' historical evolution, urban theorists have tended to focus on physical aspects, while sociologists have highlighted the impact of population groups on the form of the city and the significance of prosaic and routine social activities in shaping the identity of a city (Charalambous, 2018). The focus of urban scholars on physical aspects is particularly evident in the various approaches of urban morphology, which persist in setting the physical form (street, buildings, plots, areas, lines, etc.) as the key feature for analysis. While all urban morphological approaches have invariably included, to different extents, socio-economic aspects in their frameworks, analyses and interpretations, the view remains that the physical form should be used as a common reference in urban analysis (Kropf, 2009). The question remains as to whether this is enough to deliver fruitful findings and understanding of the processes of urban development. The authors takes the view that, as Hillier and Vaughan argue, the city is one single entity where the physical and the social "act conjointly to produce significant outcomes" (Hillier and Vaughan, 2007) and that a way to address this issue is to bring the different perspectives and combine the tools used by different approaches under a common framework based on relationality. This offers the opportunity to put the physical and social aspects of cities on the same par.

Relational theories, such as Actor-Network Theory (ANT) (Latour, 2005) and Assemblage Theory (DeLanda, 2006), highlight a number of key issues in the knowledge domain of urban development, in particular regarding the mechanisms of emergence and transformation of city forms. They effectively argue how both material and human elements play an 'equal' role in emergence, how the connections between these define the nature of assemblages and how multiple scales and relations determine transformation processes. Both these relational theories suggest that to develop a research approach which can respond to the challenge of analyzing the processes of urban development which shape the city, it is necessary to:

1. assess the relationships between material and human components;
2. account for historical processes;
3. analyze different scales of relationships between parts and the whole;
4. understand how groups are formed and redistributed; and
5. construct a narrative where the variety of actors is represented.

Assemblage theory is a philosophy and as such it offers a holistic understanding of the city which is able to overcome the traditional divisions of specialization of the various fields which

deal with urbanity. The points above provide the theoretical basis and general guidelines to respond to the problem of the city and its key ontological issues. However, the fact remains that relational theories tend to be highly generic in proposing analytical approaches: exactly what elements, scales and interactions should be taken into account for analysis remains open for debate. This is not necessarily a shortcoming, but something that should perhaps be viewed positively as enabling those with specific information and skills to develop analytical approaches best suited to the study of the urban form and to specific case studies (Batty, 2013; Bettencourt, 2013). In order to develop an analytical approach, it therefore necessary to draw from the specific approaches that have so far been used for the study of the urban form.

The authors maintains that looking to philosophical approaches, such as ANT and Assemblage Theory, which address ontological issues and build upon scientific and empirical facts, provides the theoretical framework to deploy a trans-disciplinary methodology to analyze cities diachronically and to make inferences about the causal pathways that lead to the physical and social form of cities and to how cities perform (Charalambous and Geddes, 2015).

All urban morphological approaches offer certain analytical benefits, but also have shortcomings, mostly relating to their ability to account for wider structural factors in their analysis of form. This is perhaps understandable as all the approaches which specifically deal with form tend to originate from the field of urban studies – more concerned with local processes – than from the field of sociology – more concerned with global processes. However, all also seem to be open to the possibility that inferences can be made with regards to wider factors influencing the evolution of form. All the approaches can be applied 'statically' to analyze the urban form at one specific point in time, but their basis can be used as the foundation for diachronic analysis.

To give a clearer overview of the commonalities and differences of the approaches, the key physical and social elements and the way they view relationality is summarized in table 1.

Table 1. *Components of the urban form and their relationality identified by the different urban morphological approaches. Source: Authors.*

Approach	Physical Features	Social Features	Spatial Relations	Human-Physical Relations	Temporal Relations
Historical Geographical	- Site - Town plan (Street, Plot, Building)	- Function - Land Use Pattern	- Street Pattern - Plot Pattern - Building Pattern	- Social and Economic Context	- Cyclical change
Process Typological	- Building - Urban Tissue - District - City	- Cultural Context - Historical Context	- Aggregation	- Intention - Construction	- Derivation (Cyclical Reproduction, Modification of Form)
Configurational	- Street - Open Space	- Use - Occupation - Movement	- Network Structure - Interconnectivity	- Perception - Movement Economy - Cultural context	- Cyclical Growth - Diversification
Saptia Analytical	- Plot - Parcel - Census Tract - Built up Area - Route	- Use	- Network Structure	- Flows	- Feedback (Continuous Readjustment)

Clearly, there is no single aspect of either physical form or social feature which is common to all the different approaches, although different components and relations tend to recur through two or more approaches. Function and use are clearly the social aspects that are consistently adopted for analysis. Temporal relations seem to be the most consistent across the approaches (though using somewhat different semantics): cyclical/continuous processes and change, modification, diversification or readjustment are compatible descriptions of emergence and transformation. However, different scales and degrees of determinism are clear in the variety of views of the human-physical relationality offered by each approach.

This is why an overarching theoretical framework which establishes the extent to which local and global processes should be given consideration in analytical attempts is needed: assemblage theory provides such a theoretical framework. It sustains the argument that the physical and human aspects of cities are inextricably linked and should therefore be analyzed together as they jointly define the identity of a city. It also makes clear that an analysis that is devoid of historical processes or of the distribution of variations across a population cannot fully explain the emergence of cities and the processes of persistence and change. Which physical and human elements, how to identify interactions, how to measure connectivity, what scales, variables and historical processes should be considered have to be informed by the various morphological and social approaches mentioned above.

3. Methodology

Assemblage theory affirms that social entities are constructed through very specific historical processes, which indicates the need for diachronic analysis. This need was met by building a systematic spatial history of the city, an approach concerned directly with the relationship between spatial and locational factors at specific times in the past as described by Baker (2003), and by contextualizing such history with a narrative.

The analytical requirements and the related tools selected to perform the analysis from the various sociological and urban morphological approaches are summarized in table 2.

Based on the analytical requirements mentioned in the theoretical premises and the available tools, a research strategy was developed proposing to deliver two parallel accounts of Limassol's development. On the one hand is a narrative which describes, through historical research, how the city has grown and changed; on the other hand, is a spatial history of the city, which focuses on systematically and quantitatively analyzing the development of the city's street network and its built form at specific points in time. The research strategy including methods and tools is summarized in figure 1.

Spatial History

The spatial history was composed of three layers of information relating to the material components of the city: an analysis of the spatial properties of the street network, an analysis of a physical property of the built form (block size) and an analysis of a socio-economic property of the built form (land use). The first analysis was carried out through a configurational, space syntax approach (Hillier and Hanson, 1984; Hillier, 1996; Griffiths, 2012), while the second two analyses were carried out through a historical-geographical approach (Whitehand, 2001;

Oliveira, 2016) focusing on the timeline and distribution of specific land uses of a large size. The spatial history comprises seven points in time (1883, 1933, 1960, 1974, 1987, 2003 and 2014). One further layer of information relates to the social components of the city: an analysis of distribution of social groups across the city was carried out through a geographical approach typical of the Chicago school, whereby contemporary census data (from 2011) were summarized and mapped according to administrative areas. Of the spatial history, only the configurational - space syntax - analysis is presented within the scope of this paper.

Table 2. *Summary of methodological tools used for each analytical requirement. Source: Authors*

Analytical Requirement	Qualitative Tools	Quantitative Tools
Historical Process and Temporal Aspect	- Historical Narrative - Review of Secondary Sources on Development	- Spatial History - Space Syntax Analysis - Block-Size Analysis - Land-use Analysis
Different Sales and Relationship of Part-to-Whole	- Illustrative Case Studies - How They Relate to the Whole City	- Space Syntax Analysis - Assessment of Fringe Belt Formation
How Material and Human Elements are Connected Together	- Fabrique Urbaine - Analytical Linkages between Historical Sources and Physical Development	- Statistical Correlations between Physical and Social Factors
How Groups are Formed and Redistributed	- Historical Analysis of Events that lead to Group Formation - Analysis of Primary Sources in Relation to Case Studies' Developments	- Basic Statistical Analysis of Historical Social Factors - Details Statistical and Geographical Analysis of Groups' Distributions
A Narrative where the Variety of Actors is Represented	- Conversations with Stakeholders	- Quantitative Information Relating to the Nature of Groups in Different Areas

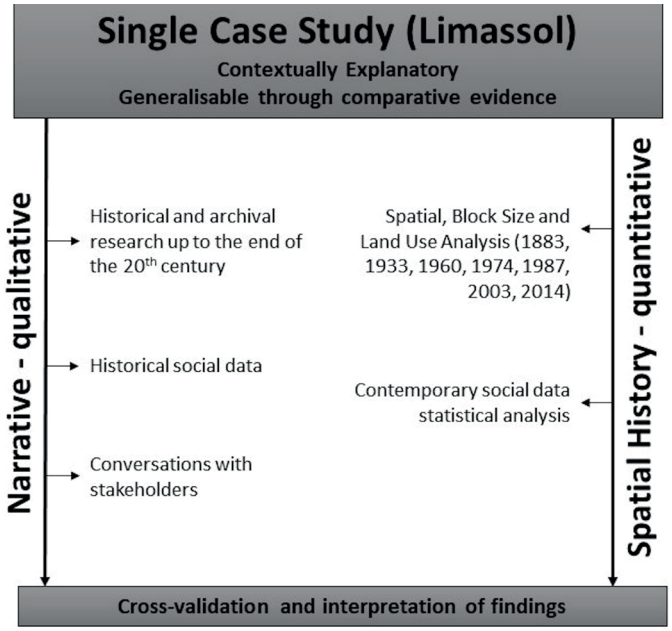

Figure 1. *Research strategy Source: Authors*

Space syntax methodology provides an analysis of the city at different scales and has the ability to highlight how the main structure of the city changes over time by quantitatively describing patterns of spatial layout and by measuring the accessibility level of all elements in the system. The most important measures of space syntax are *integration*, representing 'to-movement' or the accessibility of a specific element within the system, and *choice*, representing 'through-movement' or 'betweenness' (the number of times a segment falls on the shortest route between all pairs of segments within a specified radius). Measures can be calculated at the city-wide scale or at any given radius; the city-wide, 'global' measures taking into account all elements in the system and the 'local' measures taking into account all elements within the given radius. In *multi-scale* analysis (Versluis, 2013) – all the segments which have both the highest global and local values, constituting areas which are likely to have the highest levels of both vehicular and pedestrian movement, as well as the greatest mix of uses, are identified. Another property of these measures is that maximum values tend to be representative of what is known as the foreground structure of the city – the network of linked centers at all scales, while mean values tend to be representative of the background structure – the network of residential spaces (Hillier, 2002, 2012).

Narrative

Narratives are a main tool of historical research, but they are not commonly used in urban analysis, especially for contemporary times. In the context of this study's framework, the meaning of 'narrative' as a research method is taken from ANT, which requires to provide a description where all the actors involved in the process of emergence are accounted for and their actions are outlined. The aim of the narrative is to fully depict the state of affairs of an assemblage (in our case the city) by being specific and accurate while capturing the broad-ranging connections and capacities exercised by different agencies and components. In this study, a combination of tools, typical of more 'classic' social and historical research using narrative as a qualitative method is employed, researching primary and secondary sources, including photographic and cartographic material, and press archives, as well as through holding interviews with expert stakeholders.

4. Findings from the spatial history of the city

Previous spatial analyses of Limassol's growth have pointed out that uncontrolled urban development led to an uneven expansion of the city, creating a fragmented structure and leaving many gaps in the urban fabric (Kritioti, 1988). The space syntax analysis provides us with an array of information about the overall structure of the city and its development through time. Figure 2 shows that as the city develops, its core (highlighted by the thick black lines) shifts towards the ring roads and new areas of nearby villages. The core also becomes more scattered and includes more of the distant areas in the northern edge of the city. As time goes by, the seafront seems to lose its importance and at present it no longer belongs to what is deemed the 'spatial' center of the city.

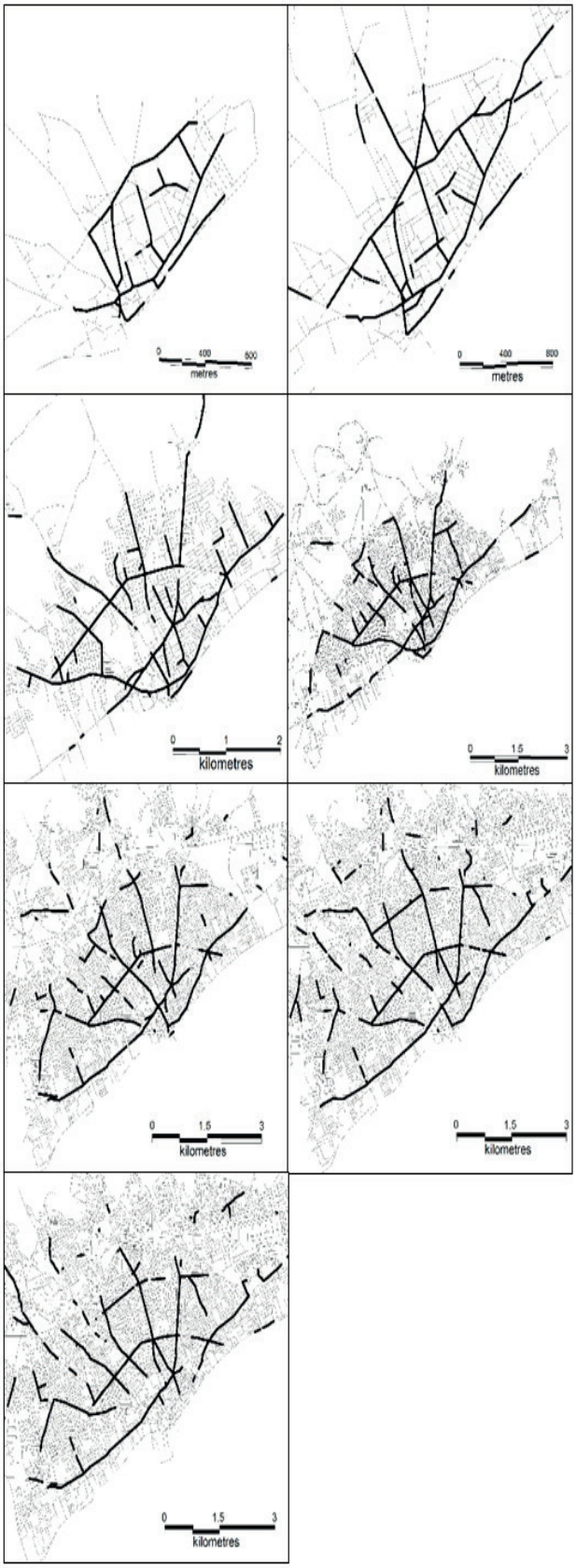

Figure 2. *Multi-scale accessibility analysis of Limassol (left to right and top to bottom: 1883, 1933, 1960, 1974, 1987, 2003 and 2014). Source: Authors*

This configurational analysis tells us how continuous or fragmented, and how accessible, are the foreground and background structures of the city (Hillier, Yang and Turner, 2012). These properties can be visualized as a star diagram (figure 3) (Hillier, Yang and Turner, 2012). This diagram has the capacity to compare the relative importance of the foreground, main circulation system of the city, and the background residential network. It shows that the city constantly has a longer horizontal axis, which tells us that the foreground system dominates the city. It also shows that the background, residential system loses its continuity and integration more sharply than the foreground system, and that the latter has a clear peak in integration in 1960-1974. Furthermore, it is evident that change in these properties seems to stabilize after 1987, with less dramatic changes, but a small improvement in the integration of the background network matched by a small decrease in that of the foreground network is visible in 2014.

A brief comparison of the spatial properties between the city as a whole and the historical town center (table 3) reveals that the background structure within the town center is more continuous and more resilient to change as the lower decrease in mean choice shows, while its integration has a striking continuity and is now back to the levels of the late 19th and early 20th century. The decrease in both continuity and accessibility of the town center's foreground network is much sharper than for the whole city. This indicates that its strength is more susceptible to the impact of growth and that its role in distributing and attracting long range movement is more effectively diminished by the incorporation of new routes and new areas in other parts of the city.

If we look at local to mid-range measures for the whole city and the town center (table 4) we will notice that, after initial development, integration values drop from 1933 onwards, which indicates that local neighborhoods on average become less and less integrated even within their local area. The picture is different for the town center taken as a separate unit – values here

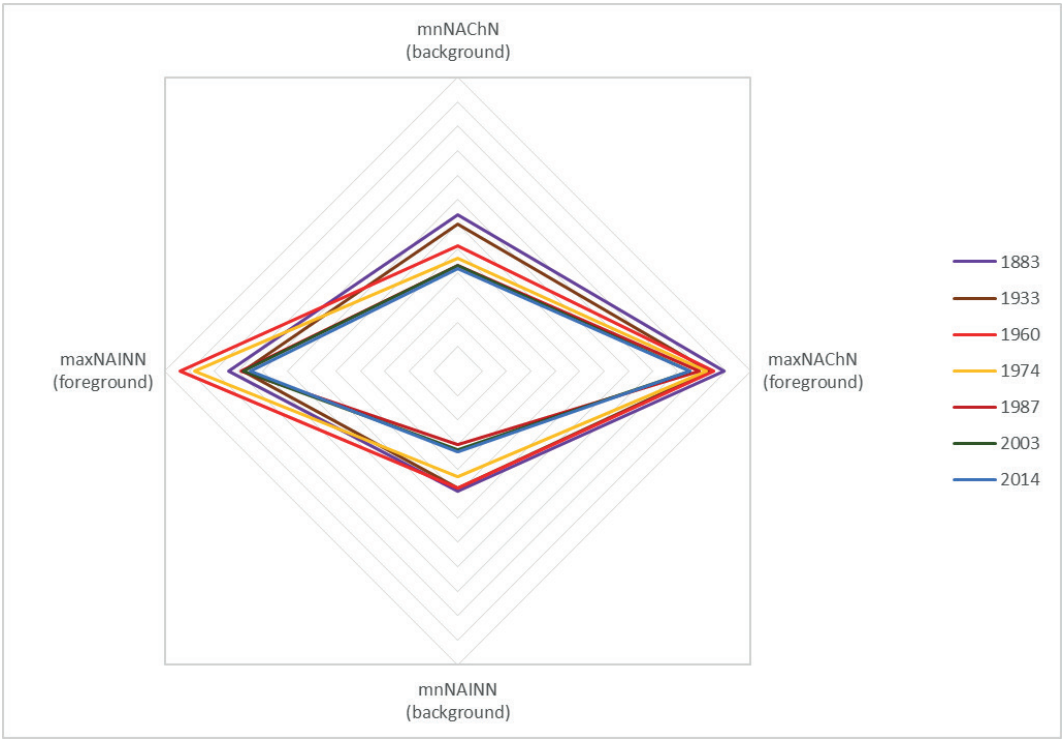

Figure 3. *Star diagram of the changing properties of foreground and background structures of Limassol from 1883 to 2014. Source: Authors*

are more variable over time and are generally high, meaning that while shifts do occur in its properties as an attractor of movement and a to-destination, it steadily functions well as a local neighborhood. The values drop somewhat in the years during which it is known to have decayed, but have recently risen again.

Through the historical process, the global structure of the city has shifted from the historical centre outwards. As indicated by previous studies in similar contexts (Shpuza, 2009), the city's overall integration tends to decrease with growth. The spatial analysis highlights the two key problematic patterns of the city: the domination of the foreground structure over the background one and a lack of sub-centers. More importantly, it shows that recent redevelopments on the waterfront has not reintegrated the town centre within the spatial core of the city and have not altered the dominance of the foreground structure or significantly improved city-wide accessibility. Small improvements have occurred in the localized area of the town center, but certainly, no significant positive impact has occurred across the city.

Table 3. *Comparative table of mean and maximum global choice and integration values of the whole city and the town center over time. Source: Authors*

	mnNAChN		mnNAInN		maxNAChN		maxNAInN	
	Whole City	Town Centre	Whole City	Town Centre	Whole City	Town Centre	Whole City	Town Centre
1883	1.24	1.26	1.09	1.10	1.69	1.70	1.54	1.54
1933	1.20	1.24	1.08	1.10	1.63	1.63	1.48	1.48
1960	1.11	1.20	1.08	1.08	1.65	1.58	1.74	1.59
1974	1.06	1.14	1.03	1.03	1.62	1.50	1.68	1.50
1987	1.03	1.11	0.90	1.07	1.59	1.45	1.49	1.34
2003	1.03	1.09	0.92	1.07	1.55	1.42	1.48	1.33
2014	1.02	1.11	0.93	1.10	1.55	1.42	1.45	1.35

Table 4. *Comparative table of mean local choice and integration values of the whole city and the town centre over time. Source: Author*

	mnNAIn						mnNACh					
Year	WC 800	WC 1200	WC 1600	TC 800	TC 1200	TC 1600	WC 800	WC 1200	WC 1600	TC 800	TC 1200	TC 1600
1883	1.20	1.14	1.12	1.20	1.50	1.12	1.12	1.14	1.12	1.13	1.16	1.18
1933	1.44	1.23	1.17	1.33	1.35	1.37	1.19	1.19	1.21	1.15	1.19	1.21
1960	1.17	1.12	1.11	1.37	1.37	1.38	1.12	1.14	1.15	1.16	1.19	1.2
1974	1.10	1.04	1.03	1.43	1.45	1.44	1.11	1.12	1.13	1.16	1.19	1.13
1987	1.02	0.96	0.94	1.34	1.33	1.33	1.09	1.1	1.11	1.16	1.18	1.19
2003	0.98	0.93	0.91	1.30	1.29	1.28	1.09	1.10	1.11	1.16	1.18	1.18
2014	0.99	0.94	0.92	1.34	1.33	1.32	1.09	1.10	1.11	1.16	1.18	1.19

5. Findings from the narrative of the city

Limassol was little more than a village in 1815, when the traveler William Turner states that Limassol "is a miserable town consisting of 150 mud houses of which 100 are Greek and 50 Turks" (Turner, 1820). During the second half of the 19th century Limassol began to grow and expand substantially. This was reflected in the construction of the earliest functional spaces outside the edge of the city: the Greek cemetery of Agios Nikolaos and the Muslim cemetery at the western edge of the city.

With the end of the Ottoman period, Limassol developed as a city of proto-industrialization, as the economy benefited from the stationing of British troops in the district, with consequent development of establishments and retail facilities in the town. During Ottoman times the bazaar and the main commercial street were in the western side of the town (Severis, 2006) and on the coastal road (Serghides, 2012). However, as the British settled in, the commercial center started shifting towards the east. The reasoning – if any – behind the location of these various components of the city remains unknown and an official masterplan of any kind to refer to was not drawn by the British (Interview 1). From the beginning of the 20th century, physical and social change in the city sped up with the Government providing financial assistance to the municipality in order to support certain public works, especially those relating to improvements for the shipping industry.

At the same time, the first promenade along the coastline was constructed. The houses along the seafront that formed a 'wall' against the sea were removed – this is the time when Limassol first 'opened up' to the sea. The purpose of this was to support shipping, with loading and unloading being the main activity taking place along the promenade. However, this area was quickly turned into a social and recreational space during quiet times for the industry and during holidays (Serghides, 2012).

During the colonial period and in the years following independence up to the 1974 war, Limassol's urban population grew ten-fold. Although there was a steady population increase in the whole island following British infrastructure works in all towns, the relative distribution of population between town and country did not change drastically until the 1920s. This was a period of depression in agricultural prices, which saw migration into towns leading to an increase in the urban population at twice the rate of the rural population between 1921 and 1946 (Kritioti, 1988).

The increase in population in the 1920s, coupled with industrial development also led to the establishment of other uses and facilities in the city. Serghides sustains that socio-economic changes and building activities were putting pressure on local authorities to produce a comprehensive plan (Serghides, 2012). It is at this time that the bye-pass (figure 4) was planned and then constructed at the beginning of World War II.

This is a key piece of road infrastructure which will permanently influence the form and further development of Limassol's street network. The reasoning behind the development of the road is, however, unclear. It has been stated to the authors that the road was planned for military purposes during war times (Interview 1) or simply as a ring road to avoid traffic in central Limassol due to its expansion (Interview 3), or rather that it was built with the intention of avoiding having to circulate British military vehicles through the city thus causing increased congestion, but ultimately quickly became used for common traffic purposes (Interview 4).

In 1947 Sir Patrick Abercrombie took part in a planning event where he gave his opinions about the current state of the city, as well as its present and future needs. He stressed the need

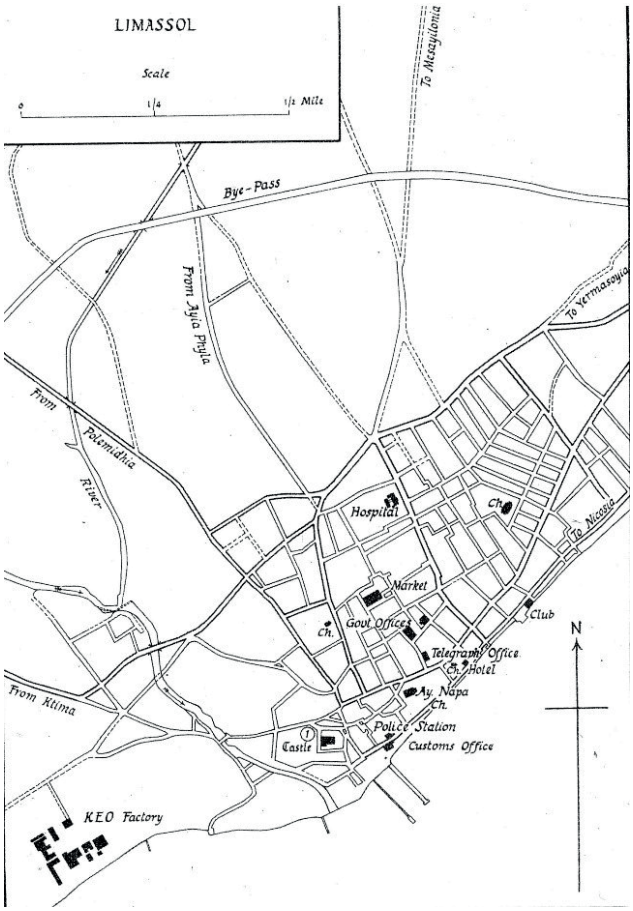

Figure 4. *Tourist map of Limassol 1947. Source: Mangoian and Mangoian (1947)*

to carry out a study of the city and to build up the empty areas within it; he suggested that construction should be remodeled in order to set a commercial center for the city, which should be pedestrianized. Furthermore, he stated that the road network should be reorganized with long-term views. Serghides (2012) points out that similar problems remain evident to the present day; in fact, it is not until 2014 that pedestrianization of the center is implemented, while empty areas within the urban environment remain common.

From the 1950s the expansion of the city continued radially; at this time, the road of Gladstonos, bounding the historical center had started becoming a focal point of entertainment. This seems to indicate a shift of the leisure area from the coastline towards the north as the city expanded and a new boundary was created by the new ring road. Residential densification in the took place through the development of small detached homes by the middle classes, a trend different from that taking place in contemporary Europe. A tourist map of 1974 (figure 5) poignantly shows the densification of the city following independence.

The Town and Country Planning Law was published in 1972, but it will not be enacted and local plans not drawn until 1990. Because of this, development continued to be dispersed and unregulated. At this time, the ring road (bye-pass) of Makariou starts competing with the center and coastal area as a business, retail and recreation center. This was partly because works were taking place on the coastline to construct the beach and expand the promenade, but also because of the growth of the city to the north. This indicates a further shift of the center towards the north, as commercial activities also appeared on the main routes connecting the historical center with Makariou. Residential development continued to follow a model of de-

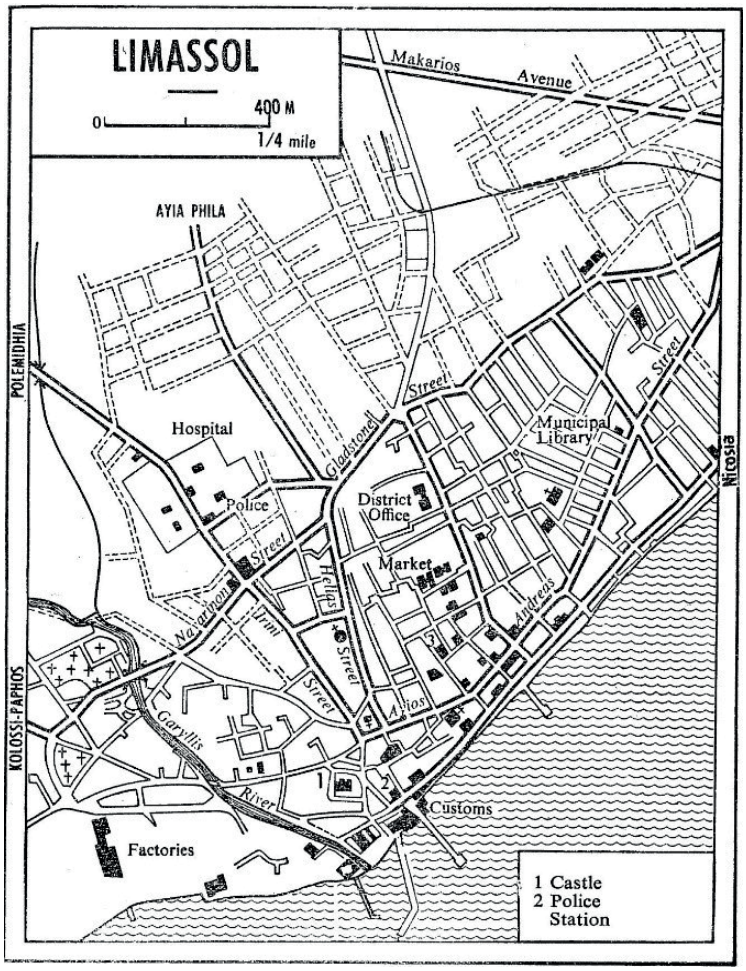

Figure 5. *Tourist map of Limassol 1974. Source: Cyprus (Cyprus. 4th edn, 1974)*

tached homes and 'garden city' neighborhoods, which, according to Serghides (2012), failed to acquire a specific character due to the large number of empty spaces within them.

Following the 1974 war Limassol saw an unpreceded population growth with an almost 30% increase between 1973 and 1976. The greatest portion of development during this period was constituted by residential construction to accommodate refugees, which included housing estates in peripheral areas of the city. A true building explosion commenced around 1979: the city expanded significantly and finally engulfed nearby villages – the growth of the city during the 20th and 21st centuries is summarized in figure 6.

Despite the great need for housing, density did not particularly increase; in fact, the city sprawled as housing estates were placed in peripheral areas where the Government already owned the land or was able to purchase it cheaply, while the private sector, within a loose system of building regulations, was concerned with meeting market demands for detached homes.

Road infrastructure works of the 1980s and 1990s included the construction of the motorway and the second ring road, completed by 1987 and 1990 respectively. Why priority was given to the motorway remains unclear, though national-level policy would have played a significant role; one suggestion is that it was because of the influx of refugees into Limassol and its consequent expansion (Interview 2), another that private and economic interests played a role (Interview 1).

The year 1990 was also a turning point as planning legislation was finally enacted and the first local plan was produced; attention shifted back to the town center and the coastal area,

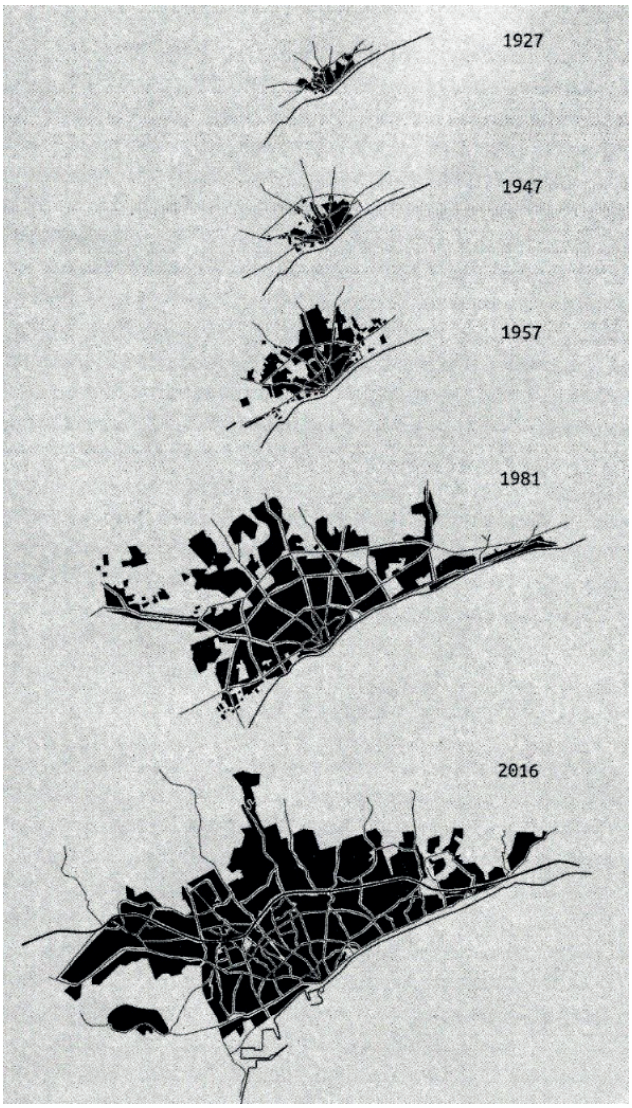

Figure 6. *Growth of the city 1927-2016. Source: Lianou and Christofinis (2016)*

which had decayed during the 1980s because of the focus put on new development in other areas of the city. During a strong local leadership from the middle of the 1990s to the middle of the 2000s, which thoroughly engaged in the regeneration of the town center, coupled with activism from local residents (Rakoczy, 2007), the city has undergone much renewal. However, there remains some criticism that this is prioritized towards temporary, visitor, recreational and tourist uses, rather than focusing on a long-term, more sustainable regeneration aimed at bringing back permanent residents into the town center.

A piece-meal system of planning was in place until fairly recently, a factor which has greatly contributed to the sprawling nature of the city and to the continued existence of large empty areas within its form. Structural factors clearly played a role in how the city developed as did the local economy and the balance of power between institutions and private interests.

Throughout the city's growth, the local administration has given priority to maintenance, improvement and widening of existing roads, as well as construction of major new routes. Certain necessary establishments, such as slaughterhouses, the hospital, markets and the like were also prioritized by the local Government at certain stages. However, while zones are designated for specific uses, the development of residential areas and their road infrastructure has been

left to the private sector, with public facilities being added on at a later stage. All this seems to have led to a situation where the creation of long routes associated to some large land uses tends to lead the expansion process. Residential developments then follow, producing 'patches' of compact grids between and along major routes.

Regeneration and development projects in the center and along the waterfront since the 1990s aimed at addressing this issue. As mentioned above, these have brought renewal and vitality to the center, but criticism to the priorities set by the recent projects has also being raised. Despite improvements made to public consultation processes in 2007, the feeling remains that a proper dialogue between citizens and planning authorities does not yet exist (Interview 1) and that often the requests and interests of land owners are met to the detriment of the public good (Interview 2).

Aside of guidelines set by local plans, there is no system in place to assess the impact of a single development on the whole city (Interview 3) and there are opinions that in many cases decisions are made which do not reflect the requirements of the plans or the views expressed in public consultations (Interview 2).

The widespread feeling about recent development in Limassol is that the flurry of activity is a highly positive trend. The redevelopment of the promenade was seen as particularly successful (Interview 5) and regeneration efforts as bringing Limassol to its best developmental phase (Interview 4) with its historic center blooming and booming once again (Interview 1). The Limassol Marina and the regeneration of the old port were also seen as positive interventions, but these were also fraught with reservations and discontent about their design, in particular the connections made between various redeveloped areas (Interview 1, 2 and 5). Regeneration of the town center also provoked mixed feelings with some seeing it as highly positive and successful (Interview 1 and 4), some thinking the effort was minimal (Interview 2).

When questioned about the balance of regeneration and development between the coastal area and other areas of the city, few were aware of any projects taking place outside the historical center or the coastline. Some thought that projects outside of the center, such as the linear park along the river, were positive (Interview 1); others thought that nothing of particular significance was taking place beyond the coastal area (Interview 2). While all expressed generally positive views about the regeneration of the coastal area, when asked about future priorities for Limassol almost all answers included the need to focus on local neighborhoods, mentioning the need to: make each neighborhood self-sufficient (Interview 1); build squares and green spaces (Interview 2), something that would make any city's neighborhood prettier and healthier (Interview 3); embellish the neighborhoods (Interview 4); strengthen other areas (Interview 5).

Cumulatively, the interviews give the impression that the recent developments were beneficial to their own local areas and that due to their central and coastal location, the wider population benefits from them. However, the general view remains that these have not addressed the broader problems of the city and have not significantly altered neither its problematic structure nor local neighborhoods' access to better facilities.

6. Discussion and conclusions

The quantitative spatial history of the city provided the basis to identify certain characteristics of change in the city through a long time span, in particular with regards to the nature and

functioning of the street network (presented here) and to the location of specific land uses at certain points in time (Geddes and Charalambous, 2017).

The centrality of cities has been shown to be a process (Hillier, 1999) and it is certainly not surprising that in Limassol this has shifted over time to 'relocate' to a more geographically central area characterised by higher accessibility. The decrease in the extent and continuity of the multi-scale core was also to be expected as this is in line with previous research showing that global accessibility and legibility tend to decrease over time as the city-system grows, and that this is the case for many Mediterranean port cities that have grown rapidly in recent years (Shpuza, 2009).

The configurational analysis highlighted two key problematic patterns which were validated by the qualitative analysis:

- the domination of the foreground structure over the background one, which is validated by literature and experts' observations that the city developed radially and with a 'fan-shaped' pattern causing commercial uses to be dispersed along major roads;
- a lack of subcenters which have the spatial potential to sustain local activity, which is validated by experts' comments that attention needs to be given to local neighborhoods, that local public spaces were never constructed and that a concentration of commercial uses was directed towards the center and vehicular roads.
- A small recent improvement in the accessibility of the historical town centre and in the balance between the foreground and background network, which is validated by experts' positive views of coastal and central regeneration projects as benefiting the whole city.

The discrete benefits of developing the narrative were that it described the wider context within which the case study is set and gave an historical overview of Limassol's development from a variety of viewpoints. Furthermore, the various tools used to build a narrative provided information where more objective data gathering was not possible or viable. However, the narrative was itself a useful tool because it revealed different perceptions of the city and different interpretations of its development.

The spatial history was clearly able to pick out a variety of problems in the functioning of the contemporary city, highlighting how these relate to the impact of growth, the nature of the expanding street network and recent interventions in the urban fabric. However, identifying the causal factors of such growth, aside of the specific spatial relations of various physical elements of the city, would not have been possible solely through quantitative analysis. Many of the characteristics and processes identified through the configurational analysis could only be contextualized through the historical narrative and verified through the interviews with expert stakeholders. In particular, the various global and local scales of causality which initiated specific phenomena of growth and development could only be identified through the narrative. On the one hand, at the global scale, is the impact of international relations and world economic changes on urbanization, population influx into the city and location of residential development; on the other hand, at the local level, is national economic resources and needs, planning legislation and policy, as well as corporate and individual private interests in real estate. The interaction of macro-level political processes with specific physical and human components, the destabilizing events of conflict interacting with other destabilizing processes of shifting land values, the national and local level planning policies, and the micro-level properties of the street network and the built fabric all conjointly led the specific form of the city.

These findings point to the fact that stark dichotomies between critical views of structural factors and the historical process being the fundamental causal determinants of urban characteristics, or, at the other end of the spectrum, the bottom-up view that urban form is shaped by everyday life and routine activities, is perhaps neither useful for the understanding of form and functioning, nor for the identification of causal factors. Using a broad framework, informed by assemblage theory, can be more productive in revealing the complexities of causal pathways. This has provided us with the ability to identify when and where structural properties and the temporal aspect influence city form. It allowed us to understand and interpret how human and physical components are connected together and it enabled us to identify the scales at which causality is initiated and mediated.

The narrative provided a baseline for reading, interpreting, validating and making inferences about the findings from quantitative analyses. Without the implementation of a comprehensive framework to understand the relationality of the city, it would have been impossible to empirically verify the existence of problems and developmental characteristics and processes identified solely through the application of an individual approach. The framework was key in understanding the contemporary socio-physical identity of the city and what caused this identity, as well as informing the identification of issues, potentials and priorities which can aid planning.

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Urban Fabrics Change and City Boundaries: Comparing Urban Form

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Keywords: urban, fabrics, boundaries, form, enclaves.

Abstract: Usually, a boundary produces differences, it considers the duality of the inside and the outside. Limits have the potential to mark the transition between different modes of existence. The dynamics of urban evolution make the limits of cities change according to its social, economic and morphological evolution and recognizes the city as a mixture of communities, interactions, places, and commons. In this sense, a morphological development review evidences that changes of urban form within a city are accentuated when boundaries are exceeded or modified. For this work, Borgo Dora in Turin serves to exemplify how urban form is linked to the city's old boundaries and urban history. A morphological comparison of three enclaves taken from different sides of the city's historical and natural boundaries brings to light how urban fabric changes as the city grows and how the morphology of the city changes depending on the context constraints. The first extract refers to an enclave located within the historic consolidated city center. The second enclave comes from the area developed after the historic Roman wall. The last enclave analyzed is a piece of the city overcoming the natural boundary marked by the river. These three extracts become a manifestation of the urban form of different periods and a guideline of the city's morphological evolution.

1. Introduction

The transition from city to countryside has always been an important interface of human existence. Boundaries have always defined urban. A boundary in general terms produces differences, it considers the duality of the inside and the outside. This ambivalent role of dividing and connecting make limits or boundaries fascinating to study. Limits transmit and control exchange between territories and have the potential to mark the transition between different modes of existence (Longley, 1994). The dynamics of urban evolution make the limits of cities change according to its social, economic and morphological evolution and recognizes the city as a mixture of communities, interactions, places, and commons.

In the specific context of the city of Turin, the process of producing and transcending boundaries is central to understand the city's morphological development. This paper recognizes one area of the city that exemplifies the relation between urban form, boundaries, and context. It also presents three enclaves in the city to exemplify how urban form is linked to a city's old

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boundaries and urban history. The limits in the city of Turin recognized for this study can be classified into three types: Historical ones, Natural ones and administrative ones. Each one of these boundaries influence in diverse ways the morphology of the city. The first set of boundaries refers to the historical Roman wall and the two toll walls or customs barriers (1856 and 1912 respectively). The Natural boundaries recognized refer mainly to the rivers that cross the city: Po, Dora, and Stura. Within this classification, it should be noted that hills in the city represent another type of natural boundary. The last type of boundary refers to the administrative one, that divides an area of 130.01 km² into 8 boroughs or circoscrizioni and 92 statistical zones (Figure 1). What happens to the morphology of the city when a boundary marked by its historic walls and rivers is overcome? How does this morphology change?

Figure 1. *Boundaries in the city of Turin*

2. City boundaries

Roman wall: The construction of the first city walls is part of the planned urban arrangement of the Roman military settlement established in the area where now the city of Turin stands. This plan also foresaw the internal layout of the city with regular blocks. The first part of the wall was constructed between 15 and 30 AD and was located on the north side of the settlement. In the following decades, the eastern sections of the wall were built, and by the end of the first century AD, the erection of the wall was completed. The Roman walls in the city of Turin enclose a quadrangular space of about 700 x 750m divided into relatively similar blocks. On each side of the wall, a door was placed where the two main road axes: (Cardo Maximus and Decumanus) ended. The thickness of the wall was about two and a half meters in the base and it reduced its dimensions progressively as it went up. The wall was characterized by the presence of octagonal towers. This wall influenced the development of the city since it worked as a physical limit to urban growth and a divider between urban and rural zones.

First Toll wall: The first belt was designed as part of the plan of Enlargement of the city in 1853 for defensive reorganizational urban purposes. The Toll wall was more than 3 meters high and contained toll booths or barriers. The wall closed to the east side of the Po river and did not enclose the entire municipal area. The Toll wall created a tax regime that favored the development of external areas regarding construction costs and land prices. The productive, industrial and commercial development of the city during the years that followed the implementation of the wall taxes was located outside the wall. Beyond the Po river, the barrier continued for about 4.5 kilometers not as a wall but as an iron gate over a masonry base. The wall was dismantled completely in 1912 and replaced with a new one that englobed almost all the massive urban development of the previous decades.

Second Toll wall: This boundary was created as part of the General Regulatory Plan of 1906. The wall was proposed as a response to a need for control of duties. The territory it enclosed doubled the first one and in this case, the boundary created is not only material but also administrative since its construction was approved by the law in 1912.

Interesting guidelines of a place's history can be expected when areas near the recognized boundaries are studied. A review of historical maps proves that changes of urban form within the city of Turin are accentuated when boundaries are exceeded or modified. Borgo Dora serves to exemplify how urban form is strictly linked to the city's old boundaries and urban history. The terms Borough or "Borgo" and township or "Borgata" refer to settlements external to the oldest center of a city. In Turin, the "Borghi" refers to ancient settlements formed in rural contests while the "Borgata" have their origins in the 19th century as a response to the first toll wall (Davico, 2014). Borgo Dora belongs to the type settled outside the historic wall and inside the first toll wall, in the north side of the city. This side of the wall developed later than the south, east and western sides due to royal orders. The proximity of river Dora facilitated the placement of production activities and channels for many agricultural and industrial uses. These conditions had a repercussion in the urban form that came as a result of the aforementioned circumstances. What is more, the urban form of the settlement was affected by three specific structures found in the area: Cottolengo complex, Arsenale Militare and the Railway station. In this case, boundaries represent historic-spatial products of the relationship between urban and non-urban activities (Keil & Shields, 2013). It is evident that the channels used for industrial and agricultural activities left a mark that can still be appreciated today in the morphology of the Borgo. This area became a space of negotiation between history, context, and new morphologies when the wall left behind its role of hard-line divider (Figure 2).

Figure 2. *Extract from Piano regolatore della citta di Torino, 1817; extract from Pianta della Citta e Borghi di Torino, 1852.*

3. Methodology

The study uses an area of the city located between the recognized and defined borders to exemplify and prove the correlation between urban fabrics and city boundaries. An analytical approach and deductive observation of historical maps helped defined the area used to exemplify the phenomena. In the second stage of the study, a comparative study of three enclaves taken from different parts of the boundaries helped understand the differences in urban form and their relation to the boundaries. In the context of urban analysis, cartographical images are crucial for the analytical deconstruction of urban formation (Conzen, 1960; Caniggia and Maffei, 2001). A comprehensive representation of the chosen pieces of the city as the first and fundamental step employed for the morphological analysis. Later, the deconstruction of the maps compositional variables helped the interpretation. The approach chosen for the morphological analysis regards the following variables:

– *Streets and their arrangement in a street system:* The characters of streets are influenced by other urban elements: by the plots on both sides of them, by the height, placement in the lot and uses of the buildings, by the presence or absence of vegetation elements, by the space given to pedestrians and the space given to cars. Streets represent the most stable element of urban fabrics since they show more resistance to urban transformation than plots or building systems.

- *Plots & open spaces in them; the patterns they generate and their aggregation to the street blocks:* The plot systems in cities separate public realm and private domain and are defined by streets. In an urbanization process, the definition of plots and large division of territory have tangible repercussions in the urban form because they condition the cities future developments in terms of building types, open spaces, and urban landscapes. The process of subdivision and incorporation of plots in cities is rarely regular and they depend greatly on existing conditions. Generally, the dimensions of street blocks and plots increases as the city grows from its confines of the historical center. This characteristic can be perceived in the comparison done for this study.
- *Buildings found in the chosen enclaves:* Building systems constitute the most visible and recognizable element of urban morphology. A city is made of different types of buildings that could be classified depending on the variables taken into consideration. For this work, the typical and atypical buildings were recognized.

The distinct layers of elements identified in the variables compose the urban built-up area of each enclave selected. All these elements represent an integral part of the city plan where they evolved. The methodology employed a comparative analysis of the variables aforementioned to grasp an understanding of how the chosen fabrics changed when a boundary marked by historic walls or rivers was overcome. Through the study of the historical development of the enclaves and their borders and limits, effects in the urban form of the city can be deduced. The study aligns with Conzen's use of plans as a source for historical morphological research. An effort to look at the buildings and plots as an integrated entity defined by the streets was made. The circumstances of the development of the chosen enclaves are explicable through their period and context of development (Conzen, 1960). In this sense, a place's current conditions and structure is explained by examining its development.

4. Analysis/Results

The comparison of the three enclaves of 500 m x 500 m taken from different sides of the found boundaries brings to light how urban fabric changes increase as the city grows and how the morphology of the city changes depending on the context constraints. All three enclaves are taken from the north side of the city, an area where natural and historical boundaries convene.

The first extract refers to an enclave located within the historic consolidated city center (Figure 3). In this map, the regular street grid is evident and the high number of possible intersections and connections within the different blocks facilitate social interactions (variable a). The position of the buildings inside their plots define the conditions of the other elements of urban form. The continuous alignment was a common morphological composition that defined many historical centers, including Turin's one, but in the twentieth century, an increasing number of questionings to these alignments generated infinite variations that can be perceived in the second and third analyzed enclave. The amount of open spaces in this enclave is mainly constrained within the inside courtyards of the building system and some open spaces for permanence can be recognized. Public spaces system combines street systems with open spaces. In this enclave, elements recognized as piazzas appear as part of the morphology. Morphological diversity in these elements can be found and their character is defined by the formal conditions of its surroundings and its internal composition. The presence of these open spaces in the urban tissue has a morphological and social repercussion in the context. These spaces become focal points for social interactions

(variable b). The building types that relate and define the compact morphology share the typological characteristics of the specific area. One of the most distinctive aspects of the city of Turin that deals with typology is its circuit of arcades. This system does not only link streets and important squares but also contributes to the city's character and unity. The use of this type of architectural element has a significant unifying effect in the urban image; linking and blending different architecture styles (variable c).

The second enclave comes from the area developed after the historic Roman wall. In this area, the grid in the street system begins to mutate into a less rigid system. As a consequence, the hierarchy of some streets change and a marked axis becomes evident (variable a). The presence of organically shaped streets in the enclave is a response to the use the area had in the past; a historic water channel located in the area generates amorphous plots. The open areas in this enclave are not limited to the courtyards in the buildings but appear as open public spaces used for market purposes and parking spaces (variable b). The presence of atypical buildings that start to take distance from the historic typologies is more evident in this area.

The last enclave analyzed is a piece of the city overcoming the natural boundary marked by the river Dora. In this area, the street system presents one hierarchical axis and the open spaces appear as big empty voids; many of these voids do not have a specific function but are used informally as common spaces. The lots are remarkably bigger than in the other enclaves analyzed (variable a, b). The end of the 1970s brought radical changes to the city due to the dismantled of many industrial sites. The General Plan of Development in force foresees urban regeneration projects for abandoned industrial spaces that create some of the recognized voids in the enclave. The current spatial situation has made the place dispose to deal with many problematic situations like delinquency and perception of insecurity. Some elements of the buildings in the area follow the typical arcades typology. However, the later arcades show some variants to the typology as the arcade modules are broken and the use of flat ceilings became popular. The last attempts to replicate and follow this typology were unsuccessful, especially in these areas outside the city center since its use does not respond to the context (Hinse, 2014) (variable c).

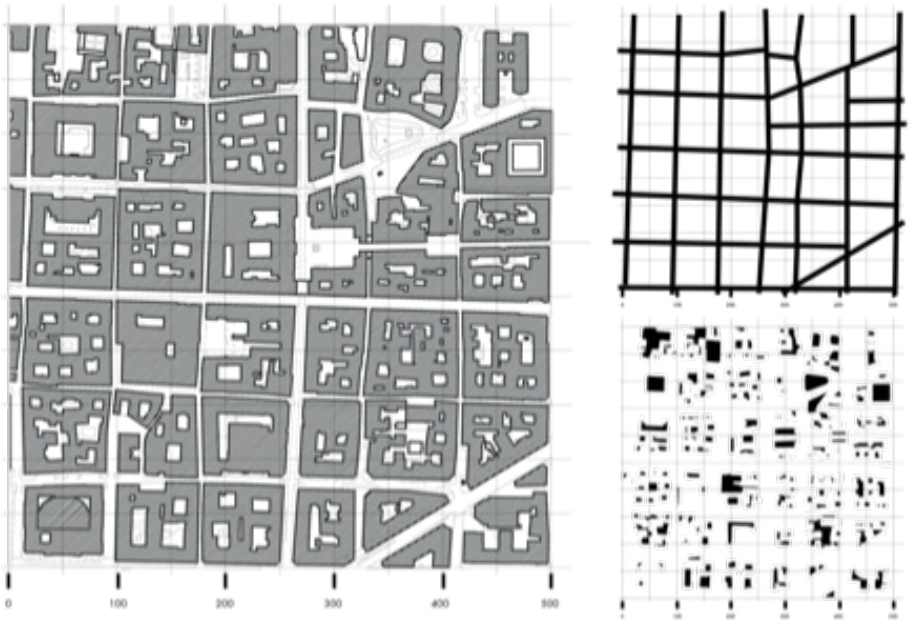

Figure 3. *Enclave 1.*

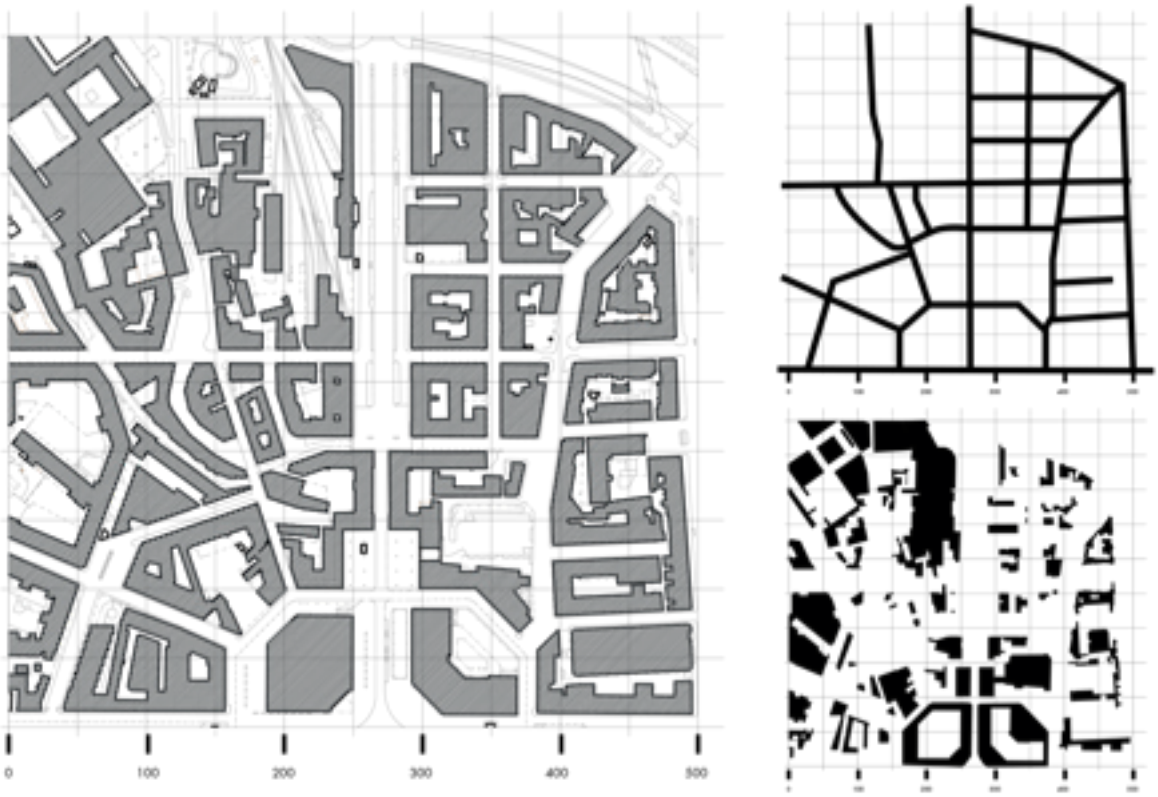

Figure 4. *Enclave 2.*

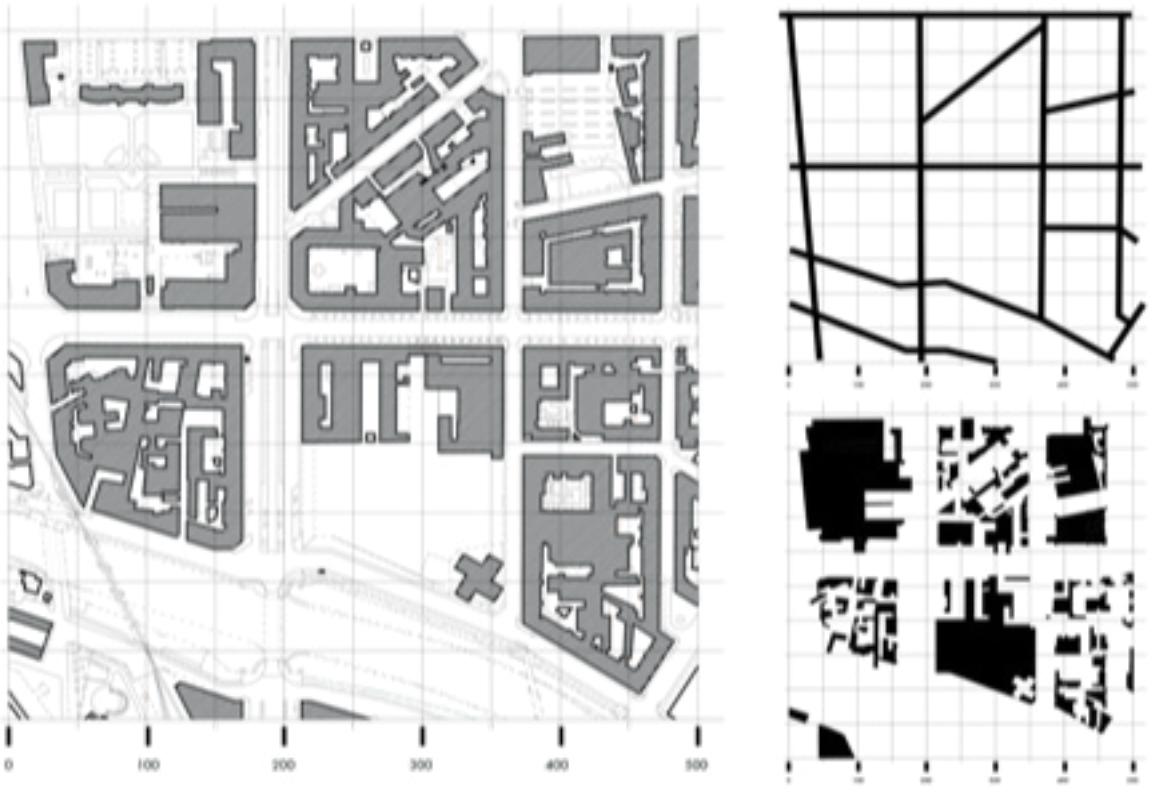

Figure 5. *Enclave 3.*

5. Discussion/Conclusion

As exemplified, limits or boundaries have the potential to mark the transition between different modes of existence in terms of time and terms of space. In all the analyzed enclaves, the relationship between plots and the block plans of buildings assumed a fundamental role that defined the area and in more general terms, the city. Developments that respond, morphologically and socially, to the conditions of a limit are a positive way of overcoming the spatial or segregate aspects that come with the definition of a boundary. The current physical conditions of the city are the result of various events that changed its morphology in time. The reconstruction of these changes is evident when historical maps are compared. The urban redevelopment projects carried out in the studied example at the beginning of this paper made exactly this. Borgo Dora was subject to redevelopment projects in the first years of this century, the goal of these projects was to rebuild the urban fabric torn in the 60s and 70s and to potentiate the commercial activities in the area, creating successful social encounters. Nowadays the character of the Borgo is still popular and its morphology is easy to read and recognize. As for the analyzed enclaves, the variables used for the analysis decomposed the layers of the urban form in pieces to get a general understanding of how these systems work individually and collectively. The morphological features of the studied urban places can be reduced to a logical system of explanation, which can lead to an understanding of the relationship between urban communities, recognized boundaries and the physical fabric they create as social needs transformer over time (Conzen, 2009). The physical consolidation process of development in cities relies on temporal and social terms, which means it takes them time to develop and consolidate. In this sense, boundaries represent an important element that links the physical dimensions of cities to the temporal and social ones. Limits have always defined the urban and when these limits are overcome, the modifications that come to the urban fabric are accentuated.

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The Action of Social and Economic Agents in the Production of Urban Land Use

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Keywords: Urban space production, Urban morphology, Public investments, Urban land use.

Abstract: In order to understand the structure of urban space, it is first necessary to identify the processes that originated its spatial structure and the patterns they produce from it. Conzen (2009) emphasizes that the spatial patterns characteristic of a city are determined by the land use and by the types of constructions. Therefore, based on the unequal nature of urban growth, we intend to present in this research, the changes that occurred in urban land use that bordered the axis of SC 401 and SC 404 from the 2000s, as a response to economic cycles during that period in Florianópolis, a city located in the South of Brazil. Since the 1970s, the State of Santa Catarina Island has presented a series of public investments that have been determining the consequent and excessive capacity of valorization of urban land to the present day. The implantation of these investments directly reflects the production of the urban space, from the moment its location promotes changes in the morphological structure of the city, modifying the physical or built form, the interdependence of the plan, the urban fabric and the use of the soil, through action of the social and economic agents that shape and/or transform it.

1. Introduction

The understanding of aspects and variables that are interrelated in the production of urban spaces from the implementation of public investments is essential in the search for better practices of intervention in the process they represent. This is because if "there is production of the space and production of the activities in the space, human activities are located differently in the space, creating a morphology" (Carlos, 2016, p. 62). Yet, if the production "has social relationships as a content, there is also a location in the space" (Carlos, 2016, p. 62), which is different from the human activities carried out in the urban space.

This way, from these locations, modifications occur in the location urban morphology in their flows and displacements, as well as towards the worth (or not) of land use.

Therefore, location reflects directly in social relationships, thus the access to a "piece of land" will depend on the possibility of payment of the land area location that a determined population might afford. This location for itself will be linked to accessibility in relation to the privileged places in the city such as schools, health centers, leisure areas, or basic urban in-

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frastructure network in the local (water network, light, sewage, pavement and transportation, among others). For Villaça (2001, p. 333):

> The dispute over locations is a dispute over optimization (not necessarily minimization) of energy and time waste. Segregation and displacement time control of individuals it allows are decisive in this dispute. However, men do not dispute while "individuals", but while classes and this dispute will determine the intra-urban structure in any modes of production [...].

In this process of spatial appreciation, the State plays a major role in the capital reproduction, because "it will indicate the modes of space occupation by the society, based on mechanisms of private appropriation" (Carlos, 1994, p. 89).

Villaça (2001), shows that in Brazil, historically, the State action upon the control of the real estate market occurs mainly through the location of its instruments, that considering the highest layers of income, on the other hand, are followed by the commerce and private services first. Second, it comes the infrastructure production, distributed according to its institutional buildings, benefiting regions that concentrate higher income population, and at last, but not less impressive, the urban legislation.

According to Carlos (1994, p. 192), "the State policies, which under the capital's point of view are rational, are planned to serve the interests of the collective capitalism". This way, "the State joins the capital, and at the same time in which it serves the ruling class interests, since it acts directly in the productive process. Such fact expresses in the space in such a different manner". (Carlos, 1994, p. 192).

> The State promotes urban improvements and controls the constructive potential, acting as a differential income generator in the land market, and the Real Estate capital, on the other hand, benefits, aggregating greater value to land – and, therefore, obtaining "differential appreciation of land use"–, besides limiting its access to the low income population by means of markup (Lima, 2011, p. 255).

Villaça (2001, p. 78) still states that, "the lots have different prices because their worth are different, and not because they produce different income". For the author, "the appreciation of the vacant lot is a worth increase resulting from the production of the city and in the city. Vacant lots do not generate different income. The location, or 'land location' has worth; its price, therefore, is the monetary expression of this worth" (Villaça, 2001, p. 78). Yet, he says that, "the changes of use or urban changes do not generate different incomes, but land price adjustments or updates, and price ranging" (Villaça, 2001, p. 78).

It is understood that, when it comes to urban structuring, road investments favor accessibility and promote the real estate appreciation. The same way, it is argued that the location of public institutional equipment, whether they are hospitals, schools or administrative buildings can be reproduced spatially from the moment they act as poles that generate the real estate appreciation of their contiguous areas equally. Therefore, they have an effective relationship towards these aspects.

The municipal Master Plan for itself represents the influence of the urban legislation in the planning of different periods of analysis, then, they reflect the action of the State under the perspective of the implementation of public investments carried out in the town, as well as guidelines for urban development. The implementation of the City Statute (Federal Law n.10.257 July 10th, 2001) and the compulsory Participative Master Plan was only implemented in the beginning of the 2000s.

Then, taking this into account, the relationship of the relevant legislation (Master Plans) versus the resulting urban form "as the construction of an individual and collective history" (Carlos, 2016, p.64), in which "the material conditions of production materialize through the city plan, the streets layout, the roads design, the access lanes convergence, etc" (Carlos, 1994, p. 97).

In order to understand the spatial process of the urban production and its importance in ordinary life, studies with morphological approaches appear to be an important tool for the analysis that try to identify changes in the physical context of urban plans, together with the investigation of the agents responsible for this process. This process, which reflects the reproduction of social relationships in determined time and space is carried out through the action of different agents that are producers of this space, whether they are production modes owners, landowners, real estate promoters, the State or social groups excluded. Their actions strengthen in the urban structure like modes of individual and collective appropriation that take determined time and space.

The understanding of this urban structure as a spatial result, has been discussed in the scope of urban morphology by authors Conzen (1960, 2004) and Whitehand (2011) from the English School of Urban Morphology. They encouraged people to read the city urban plan in their studies, by means of their physical spatial elements such as: streets, urban plots and buildings that together with the use of soil and issues related to the urban land appreciation reflect the structures that shape the urban tissue of a specific city, as well as the identification of the processes and actors' actions, which are responsible for this transformation.

This research was developed in the city of Florianopolis, which is located in Santa Catarina state, in the South region of Brazil, due to a series of investments that were carried out from the decade of 1970 that clearly represent a "turning point in the intra-urban space", "defining and consolidating the processes that had been administered for at least half of a century" (Sugai, 2015, p. 104). "Many of these social-spatial processes that consolidated in the decade of 1970 have already been noticed, even though timidly, in the last decades, and they defined the structuring of the urban space of Florianopolis" (Sugai, 2015, p. 105).

In line with the data collected regarding the investments location and considering the social-economic data of the population residing in the areas analyzed, the first activity regarding the morphologic study of both regions was carried out with the survey of the primary elements of the urban form, using the historic geographic approach:

a. Format and variation of the lot shape, observing the degree of differentiation used for the minimum plot of spatial organization, resulting from its format;
b. land use: identify the use changes occurred in the lots;
c. relative dimension, format, location (formal relationship with the site) and the implementation (physical relationship with the land) of open spaces: verify the solutions used for these plans.

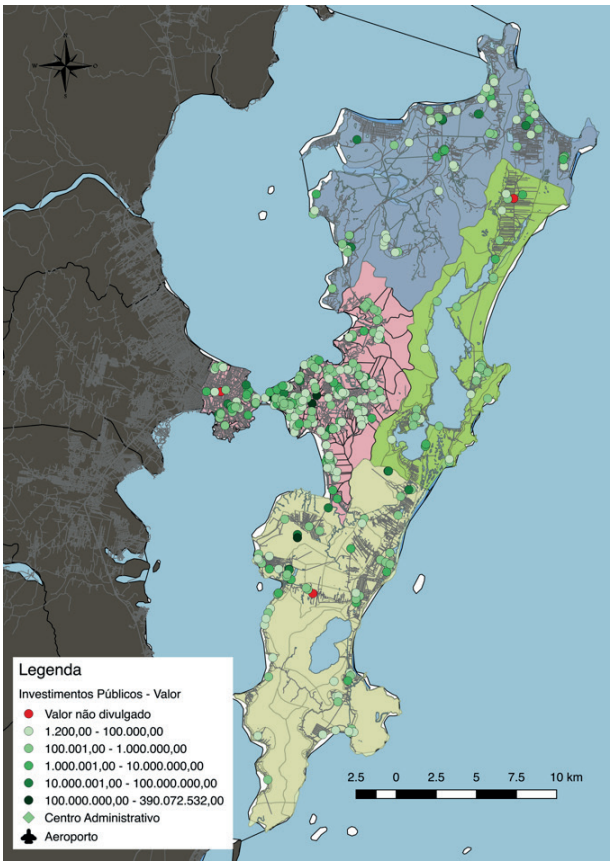
Activity 2 carried out the land market study with the identification of existent uses and the changes that occur in the tissue analyzed from 2000. For this to be done, two generic Plants of Values elaborated in the city in this period were considered when it was possible to identify the venal value of properties in order to verify their appreciation.

2. The action of social and economic agents in the production of urban land use of Florianópolis

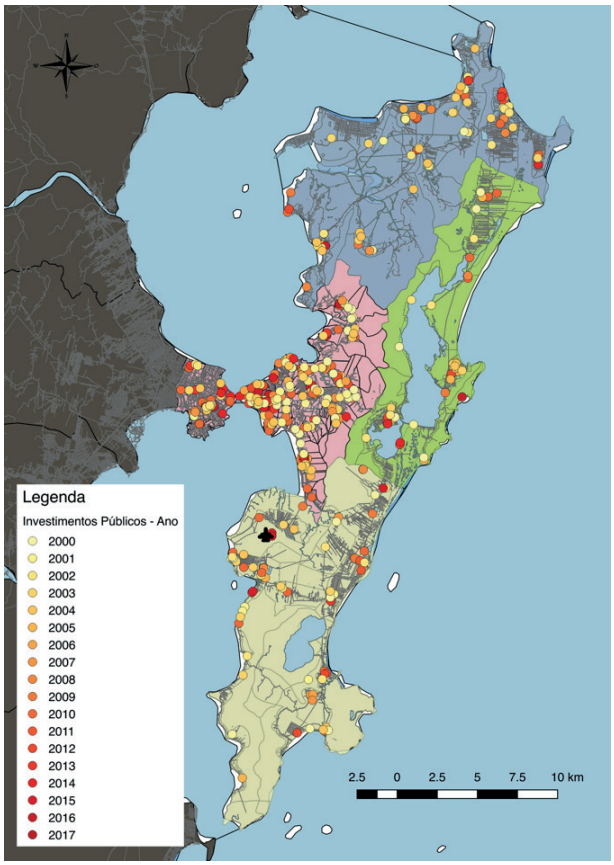
From the moment in which the State legislates upon land use and occupation, it is acting in the structuring and valuation of urban land. Therefore, does the analysis of the distribution of public investments in Florianópolis, "indicate the differences between the characteristic and the role these investments assume in the process of production and in the dispute of the intra-urban space" (Sugai, 2015, p. 183)? Yet, does it show the tendency towards the development for certain regions of the city? Do the investments and development occur in such an equal form?

Considering only the works concluded, the study identified 383 new investments in the city whose value is higher than one hundred and twenty million dollars. The Municipal government was the public sector that made the highest value feasible for the city, totalizing fifty thousand dollars and the body that implemented the largest number of new works, that is, 300, distributed throughout the territory of Florianópolis. Followed by the Government of the State (forty thousand dollars in 66 works), and in the end, the Federal Government (thirty thousand dollars in 17 works).

Evaluating its location by the administrative regions (Maps 01 and 02 and Graphic 01), it was observed that, regarding the number of works, the Headquarter region obtained the highest percentage of investments in the three public sectors. Yet, the Headquarter region, together with the North region, showed greater availability of resources by the State (the same percent-



Map 1. *Public Investments in Florianópolis – data per value – 2000-2017. Source: Own elaboration.*



Map 2. *Public Investments in Florianópolis – data per year – 2000-2017. Source: Own elaboration.*

age invested, 41%). By contrast, the East region was the least favored administrative region in both analyses, regarding the number of works as well as investments. If we analyze the Continent Headquarter administrative region separately from the Island administrative region, the data confirm what was presented in the end of last century. From the 444 works implemented in the city, only 39, that is 9%, are located in the Continent. Yet, if we evaluate the value invested, this percentage reaches a quite lower value. Only 7% of all resource available for the city was implemented in the Continent region.

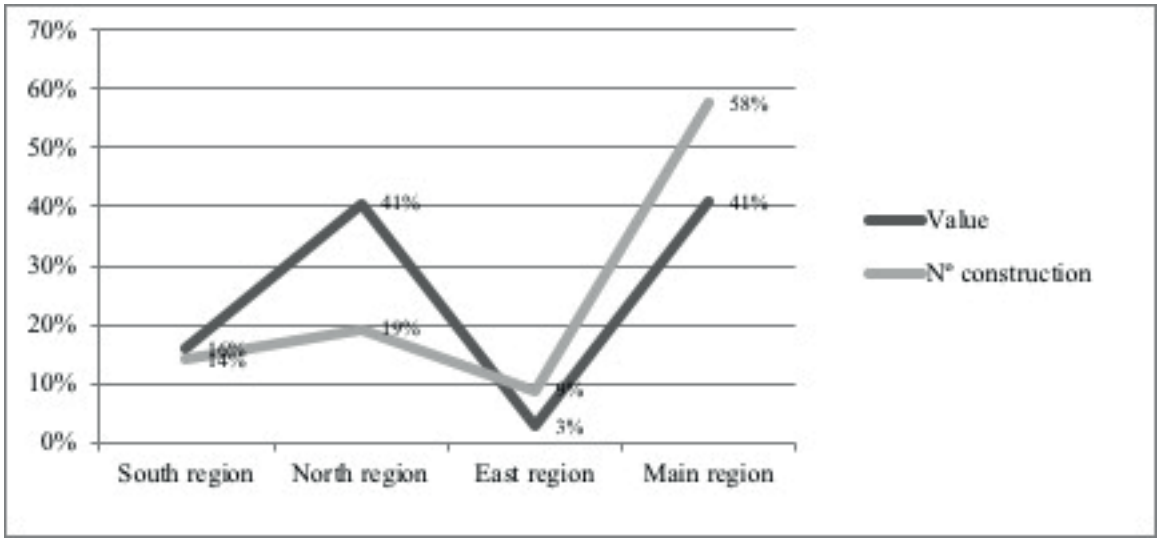
This information corroborates the rates presented in the previous century (Sugai, 2015), which already indicated the lack of resources for the Continent region of Florianópolis, and its consequent segregation before the Island. For local communities in the Eastern and Continent regions of Florianópolis, the restrictions of these investments represent the limited scope of the State before any kind of investments for the population.

By evaluating the population dynamics of the city, it was observed that the Headquarter administrative region shows the largest population in the city, that is, 249.477 inhabitants according to the data of Census 2010 (Table 01 and Map 03), together with the largest number of public investments in its three sectors, but it was the region which showed the lowest growth rate when compared to other regions.

In the meantime, districts Itacorubi, João Paulo and Saco Grande (Map 04), presented a population growth superior to 30%, and their population have an average monthly income of 2 to 3 minimum wages. From these ones, district Itacorubi connects with the East region of the Island through SC-404, and districts João Paulo and Saco Grande connect downtown with the north of the Island through SC-401, the least and the most favored regions by public investments, respectively.

Therefore, due to the characteristics found, the second stage of analysis was applied in both cases selected in the mapping of public investments: SC-401 (Road José Carlos Daux) in the pathway between Saudade Avenue and Haroldo Soares Glavan road, and on SC-404 (Road Admar Gonzaga) between Saudade Avenue and Condomínio Portal do Itacorubi Street.

SC-401 connects the north of the Island, which is the region the State favored the most in its



Graphic 1. *Distribution per administrative region of the investments carried out in the city from 2000, per value and number of works. Source: Own elaboration.*

Table 1. *Demographic growth rate x new public investments concluded – 2000-2010. Source: Own elaboration.*

Administrative region / Districts	Population		Growth Rate	Average Income*	Number of Works
	Census 2000	Census 2010			
Headquarter Region	228.869	249.477	8%	380	58%
East Region	18.434	25.882	29%	267	9%
North Region	42.353	67.795	38%	293	19%
South Sul	42.529	61.650	31%	257	14%

**Amounts in dollars*

three sectors. The axis where districts João Paulo (36%) and Saco Grande (34%) are located, the population growth was superior to 30% in the period between 2000 and 2010 (Demographic Census IBGE, 2010). On SC-404, which connects the East of the Island, and the least favored region by the State, district Itacorubi (34%), also presented a population growth over 30% (Map 04).

Based on the works developed by Conzen and Whitehand, in their studies on the changes of the city and its representation, the investigation of the resulting spatial arrangements was concentrated in the identification of land use of the plots that surround SC-401 and SC-404, thus these are the lots that face the two axes defined. In this latest, 117 and 86 plots, implemented from 2000, were mapped on SC-401 and SC-404, respectively.

3. The influence of Public Investments in the construction of Urban Space of SC-401

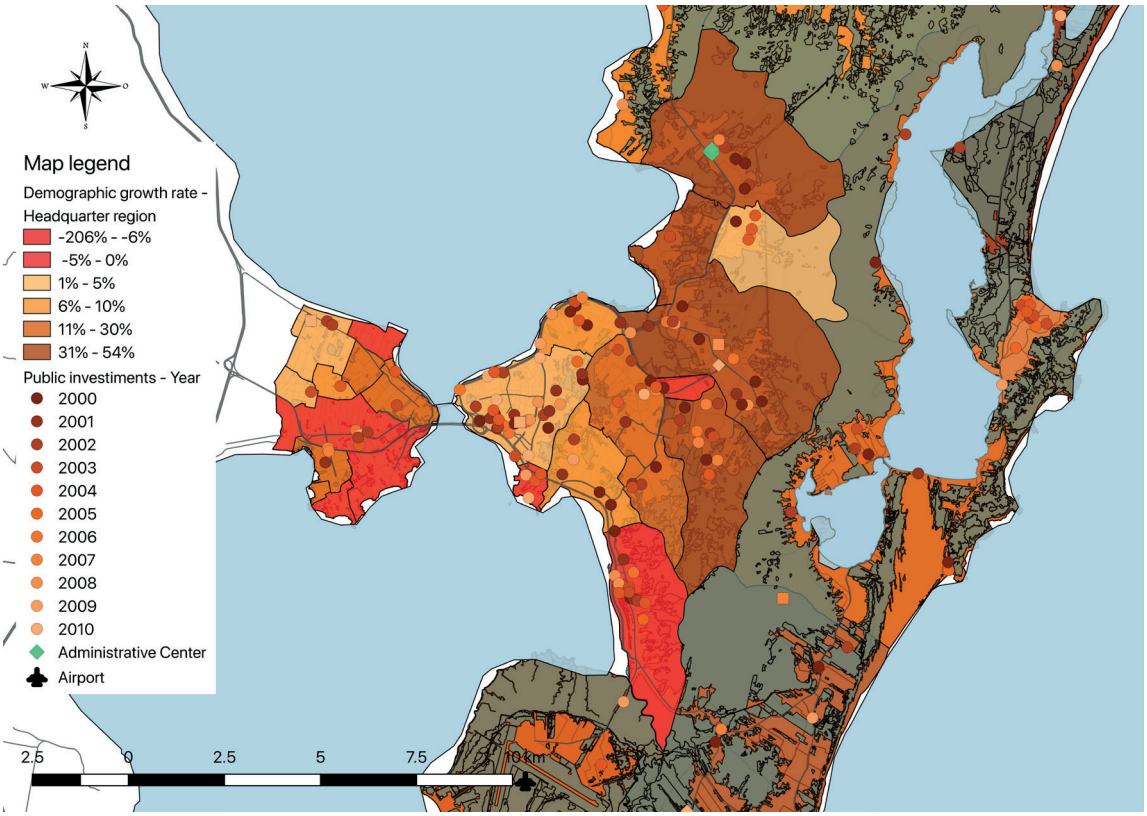
From 117 plots identified on SC-401 (Road José Carlos Daux) in the lane between Saudade Avenue and Haroldo Soares Glavan road, 40 (34%) are non-used plots, 63 lots, that is, 54% are for commercial use, 10% are for institutional use and only 2% are for residential use (Map 05).

The majority of the agents responsible for the production of space SC-401 since 2000 were landowners, with 51% of production. Secondly, the real estate promoters, 20% only real estate agencies and 12% constructors and incorporators. The State, through Foundations/Institutions showed a representation of 15% in the production of the space in SC, and the City Hall of Florianópolis and the State Government showed only 1% each (Map 06 and Graphic 02).

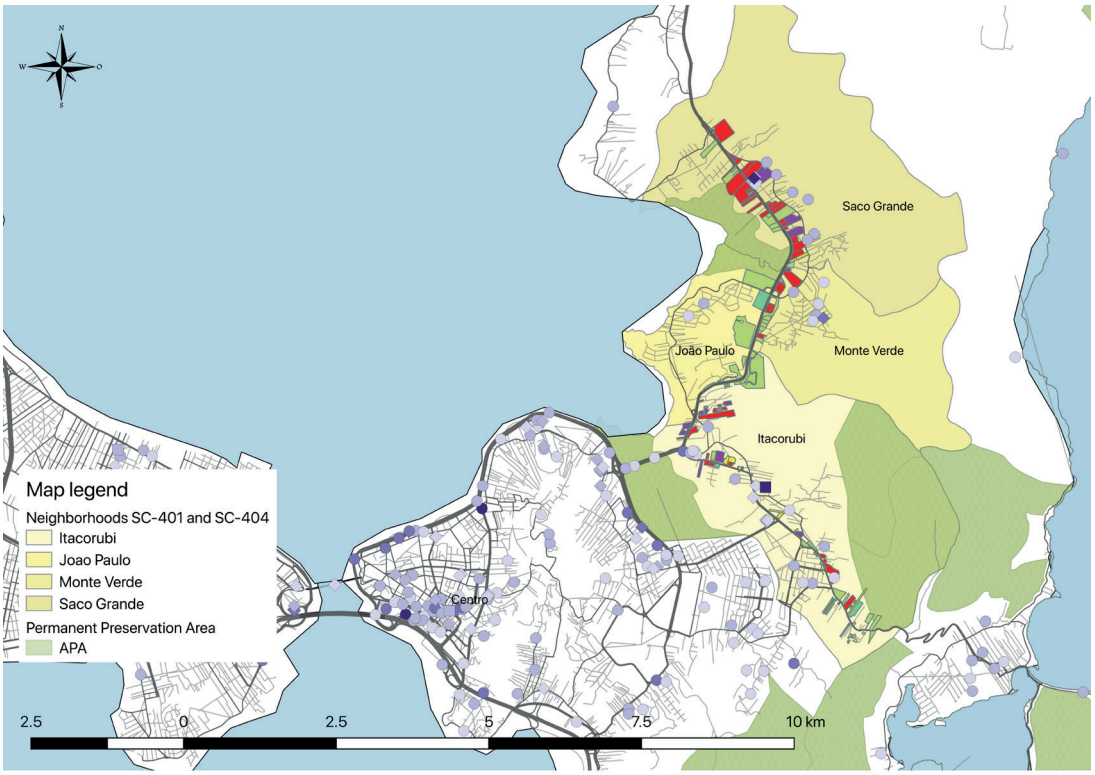
As a perspective of occupation, we can say that from 40 non-used plots, 47% are private properties, that is, belonging to landowners, 25% are the construction companies/incorporators possession and 13% correspond to real estate agencies, totalizing 38% for the real estate promoters. 15% of the lots belong to the State, where 10% belongs to the City Hall and 5% belongs to the government of the state.

SC-401 owns only one investment implemented directly on the lane, the Administrative Center in the state of Santa Catarina. But only in this equipment, more than 4 million dollars were invested, in different works that occurred from 2008 to 2017. There were several works and maintenance of the building of the old Bank of the state of Santa Catarina (BESC) so that necessary adaptations were developed for administrative activities of the state. In this case, the location of this equipment has always been institutional.

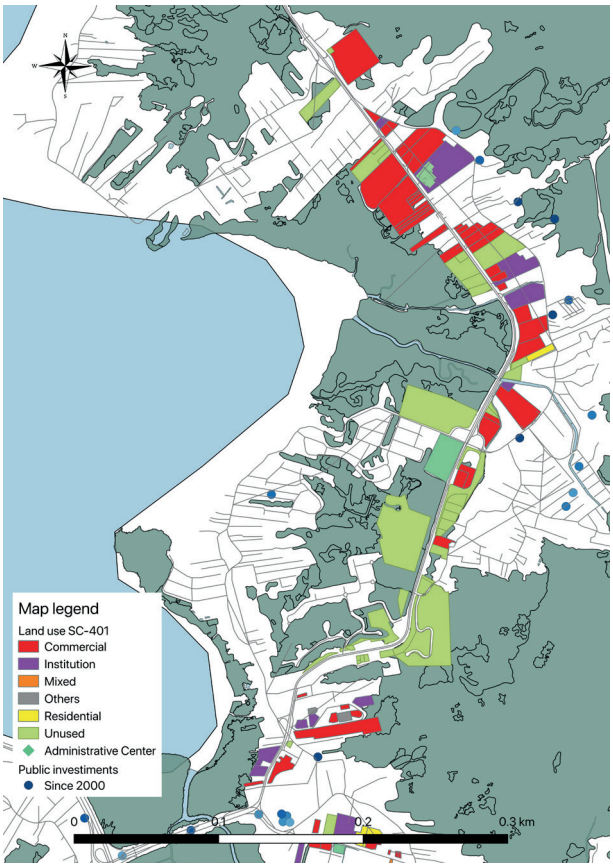
The use in the immediate surroundings of this investment is formed by plots entirely commercial, and yet, three non-used lots, that is, with perspective of being used. The landowners



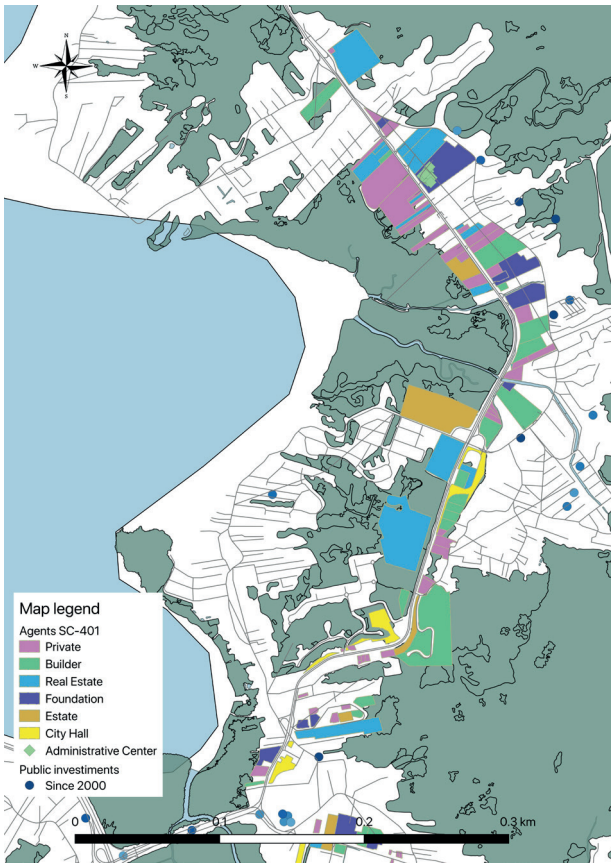
Map 3. *Demographic growth rate x new public investments – Headquarter region – 2000-2010.*
Source: Own elaboration.



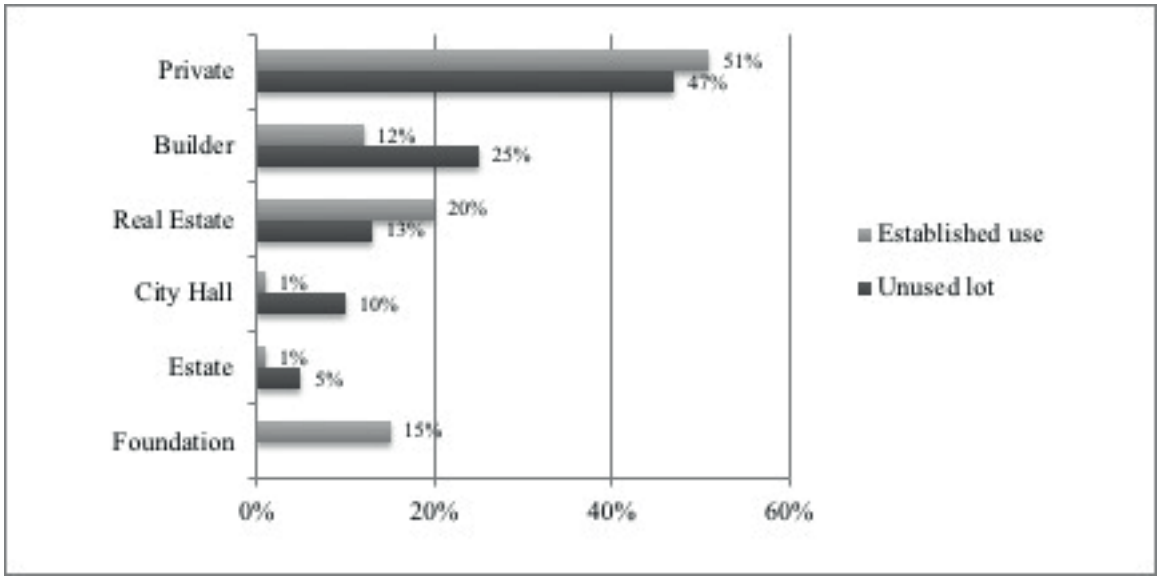
Map 4. *Demarcation of the regions selected for morphologic analysis.*
Source: Own elaboration.



Map 5. *Land use on SC-401 since 2000. Source: Own elaboration.*



Map 6. *Agents on SC-401, since 2000. Source: Own elaboration.*



Graphic 2. *Percentage of agents in the production of the space on SC-401 since 2000 and future occupation from the possession of non-used plots. Source: Own elaboration.*

and real estate promoters were the agents promoters of the space, and the real estate promotors own the lands that are available for construction.

In addition, there was the construction, enlargement and improvement by the City Hall of three nurseries, together with the construction of a Fundamental School, a Professional Training Center and a Health Center for the residents of district Saco Grande in the region nearby SC-401. The only work related to infrastructure was the construction of sidewalks on a lane of Virgílio Várzea street.

Overall, the plots of SC-401 have always had large areas. The plots mapped in the study have in average 12 thousand m² each, in areas that vary to 100 thousand m². In the case of the examples below, the plot in green had, originally, a total area of 73.699,08 m². With its division in 2001, the plots were left with an area of 68.699,08 m² and two of them with an area of 2.500,00 m². But the plot in yellow, of a total area of 118.845,76 m², was demarcated in 2002 in five lots of approximately 2 thousand m² each, keeping a larger plot with 108.674,58 m². The first one belonging to real estate promoters and the second one to landowners.

4. The influence of Public Investments in the construction of Urban Space of SC-404

On SC-404 (Road Admar Gonzaga) between Saudade Avenue and Condomínio Portal do Itacorubi street, 86 plots were identified, from which ones 19% are non-used lands, 52% are of residential lots, 21% are of commercial use, 6% are of institutional use and only 2% are of commercial and residential use (Map 07).

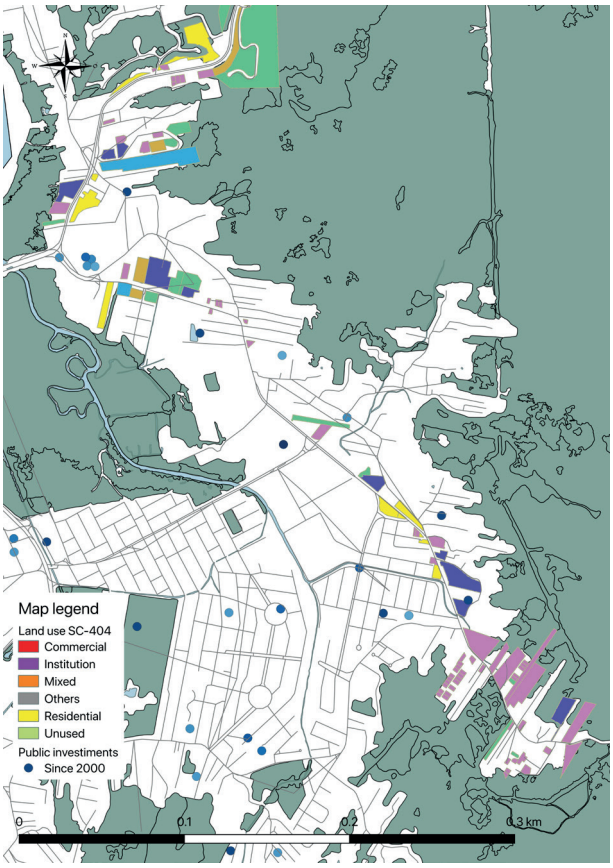
As in the case of SC-401, the main agents in the production of the SC-404 space, in century XXI were landowners, with a percentage of 64% (Map 08 and Graphic 03). But in the second position, it is the State that through Foundations and Institutions (15%), City Hall (2%) and the Government of the State (2%), was responsible for 19% of the production on the lane. With a little lower percentage, 17% is the production of the space carried out by real estate promoters, that is, 15% in the majority, implemented by construction companies/incorporators.

Non-used lands on SC-404 totalize 16 plots. From these ones, 50% belong to the State, 38% to the City Hall, 6% to the Government of the State and 6% more belong to Foundations/Institutions. 44% belong to private owners, to landowners, and only 6% belong to real estate promoters.

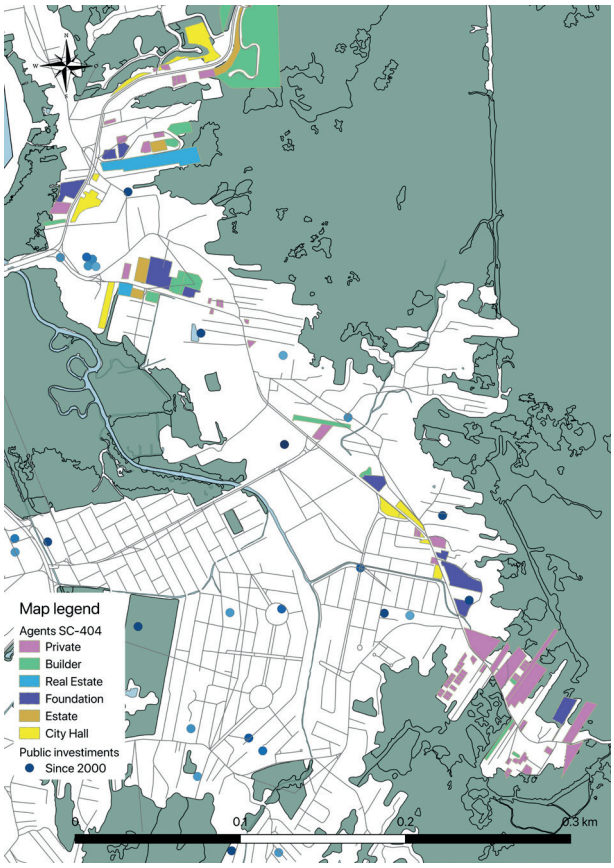
SC-404 owns more than one implementation of investment, that also totalize availability of more than 4 million dollars in the region, as what occurred on SC-401, thus its location is distributed in different pathways. Except two main investments (described below), these are investments basically related to urban infrastructure, implemented by the city, as the construction of channels to minimize the problems resulting from strong rain, the improvement of the sewage system and the implementation of a pedestrian crosswalk and the enlargement of the bridge. Besides these ones, there was, for instance, the construction of computing labs and the coverage of a multi-sports court in a Fundamental School of the city.

The improvement of campus UDESC (University of Santa Catarina State) of the State Government, estimated in 23 thousand dollars and the works of the town in the São Francisco de Assis cemetery estimated in 45 thousand dollars, were the two main investments carried out directly on SC-404.

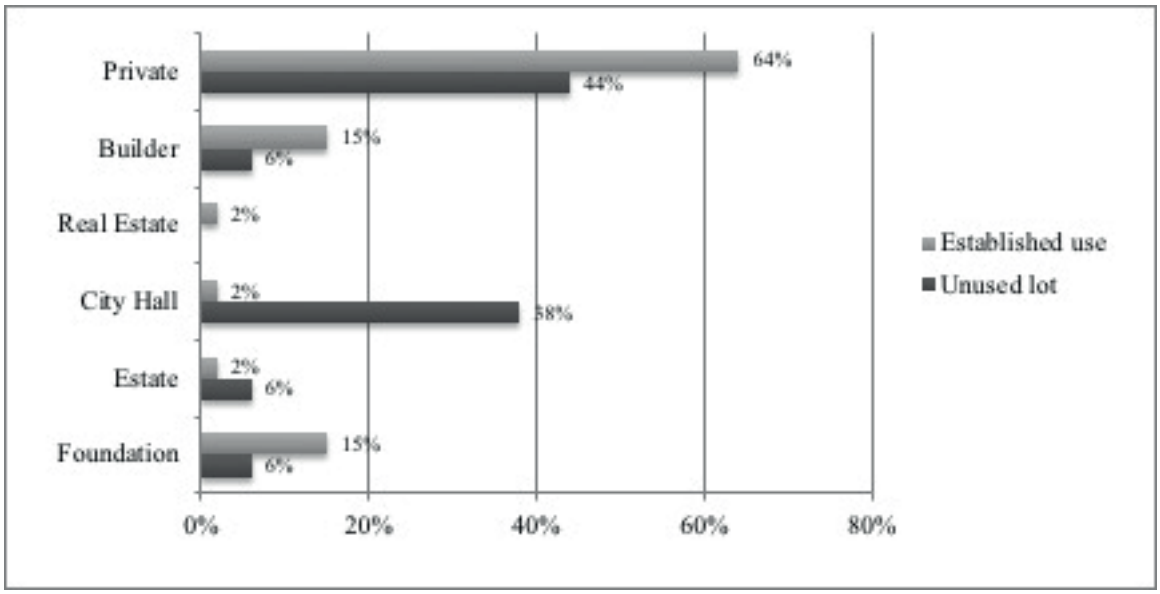
The immediate surrounding of this equipment was built in such a different manner, because of the type of equipment each of them represents for society. The region including the Ceme-



Map 07. *Land use on SC-404, from 2000. Source: Own elaboration.*



Map 08. *Agents of SC-404, since 2000. Source: Own elaboration.*



Graphic 3. *Percentage of space production agents of SC-404, since 2000, and future occupation from the ownership of non-used plots. Source: Own elaboration.*

tery presents the hotel, commercial, institutional and residential use. Yet, there is one non-used plot belonging to the State. The State, in its majority, followed by real estate promoters were the agents acting in this case. Just one landowner acted in the space production. But in the region which immediate surrounds UDESC, the residential use predominates, and the real estate promoters and landowners (constructor companies/incorporators) were the agents responsible for this process.

The Master Plan of 2014, Complementary Law n. 482, regulated the surroundings of the region where the Cemetery, Community Institutional Area, following the tendency to the local due to the use that the equipment shows. Nearby, a Mixed Residential Area, allowing the construction of up to 5 floors and a Mixed Central Area of up to 6 floors were defined in its majority and other lands in order to densify the region.

The immediate surrounding of the University of Santa Catarina State, predominates the same way it does in an Institutional Community Area due to public buildings that already existed in there. The Mixed Central Area predominates on the other side of the lane, where buildings of up to 6 floors are allowed.

And regarding the size of the plots, in this demarcation on SC-404, as explained below, the original plot 45431,41 m² received its demarcation into four new lots of 8043,14 m² to 19145,74 m². But in average, the plots of SC own around 3.500 m².

5. Final considerations

The axes of SC-401 and SC-404 are the lanes that mainly connect to the Northern and Eastern regions of the Island, and the second one is the most favored region by the action of the State and the least favored, respectively. The axes of these lanes concentrate three important equipment in which the State and Municipal governments act directly. In its surrounding, it varies as for land use and according to the characteristics that each investment presents.

SC-401, lane that connects the administrative region Headquarter to the region with the largest number of investments, in the North, presents in its axis of analysis, the implementation of a single public investment, an institutional equipment implemented by the State, which concentrated by itself more than 4 million dollars. Its immediate surrounding is formed basically, by commercial and institutional plots, in which the landowners were the responsible actors for this development, followed by real estate promoters (real estate agencies and constructing companies/incorporators). The lots that have not been built yet, also belong to landowners, followed by lots that belong to the City Hall, the State and Foundations/Institutions. In this case, the percentage of lots that can still be built reaches 1/3 of the plots, and from this, the State will able to direct its actions.

SC-404, lane that connects the Administrative Headquarter for the least favored region by the state, in the East, has in its axis two main equipment where some works were carried out. All these investments totalized nearly 70 thousand dollars. One of them, towards public service (cemetery), presents mixed surrounding with commercial and institutional functions mainly, where the commerce and institutional buildings are uses directly related, where the State and real estate promoters were the responsible actors in this production. The other one, an educational equipment State University from the Government of the State, presents a basic residential surrounding in which landowners and the State were the responsible actors for this development. 50% of the lots that have not been built yet, also belong to the City Hall, to the

State and to the Foundations/Institutions, that is, the spatial arrangement established on SC-404 had and will still have strong influence upon the State.

Regarding land use, on the Northern axis, the average land venal worth is 45 dollars, while on the Eastern axis the average land venal worth is 70 dollars. But the m² land average worth commercialized on SC-401 is more than 200 thousand dollars, and on the Eastern axis the land uses worth are 40% lower than the ones practiced on the Northern axis, in which the m² land average cost is 130 thousand dollars.

Therefore, the location of the investment is an economic variable, thus on the axis where the connection between the regions that receive the action of the State occurs, administrative Headquarter and North region – SC-401, the landowners and real estate promoters acted strongly, and the State concentrates today great part of the lands which are still available for commerce. The land sale worth is twice the worth commercialized on the axis that connects the Headquarter to the East of the Island, which is the least favored region by the State. The location of the land, which is for a specific use is appreciated by its production and the regions that are linked to it.

Yet, the production of urban space developed from the morphological structure of the city demonstrates the interdependence of the plan, urban tissue and land use, through the action of social and economic agents that shape/change it.

The results found in this present study make feasible the comprehension of the reflexes of the State action upon the construction of urban space by means of its public policies and it shows if this process occurred in line with the plans proposed by land organization and, how this reflected on their implementation. More than encouraging the reflection upon its own planning process, it was possible to identify interfaces between different areas of intervention in the space of the city and in what proportion the local power has autonomy to determine land models, ignoring the political processes dependence.

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Respect History, Respond to History

The Historical Evolution of Urban Contexts in Jiangwan Area and the Design Method of KIC Plaza

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Keywords: History process, Urban contexts, Plaza, Design analysis.

Abstract: Jiangwan area is one of the 12 historical and cultural protected areas in Shanghai, with a hundred years of industrial civilization and municipal civilization. Since the end of 20th century, the knowledge innovation industry has been booming in Jiangwan area. A large number of historical sites need urban renewal to adapt to new functions. Studying the historical evolution of urban contexts is of great significance to the renewal and shaping of historical sites. KIC Plaza is one of the earlier successful design explorations.
This paper takes a representative period from the historical evolution of the urban contexts in Jiangwan area and describes the major changes and characteristics of the urban contexts in stages as a basis for analyzing how the design of KIC Plaza responds to history. Then introduction of the social background and base design conditions at the beginning of the project will be given to distinguish the main task of the design. Finally, by comparing the implementation of KIC Plaza and the program, to explore the "built" and "not built" in the historical dimension.

1 The Historical Evolution of Urban Contexts in Jiangwan Area

1.1. *The Sprout of Urbanization*

At the beginning of the 20th century, the Jiangwan area was mainly covered by farmland and river which was a typical landscape of rural area in Southern area of Yangtze River. There are nearly 90 villages on this land. Local residents are mainly engaged in agriculture and handmade cotton textile industry. Large-scale towns such as Jiangwan Town and Shenjiaxing have produced more comprehensive public service facilities such as teahouse, textile workshops and carpentry workshops.

In 1908, Ye Yiquan, a Zhejiang merchant, invested in the Wanguo Racecourse in Jiangwan Town and built a private garden in the northeast. At that time, there were only racecourses in the concession, and the Chinese were not allowed to walk in the racecourse or build one. The construction of the Racecourse made Jiangwan Town become the center of the area. Facilities such as commerce and transportation were also rapidly revolving around the Racecourse, formed the early town center.

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Around 1920, traders began to build a number of roads to transport goods from the wharf. In 1917, the Xitiyuhui Road opened to traffic. In 1921, Yinxing Road started to be built in the northeast. Since 1922, Songhu Road, Xiangyin Road, Xiang Yin West Road (Handan Road), Huangxing Road and Qimei road (Siping Road) connected this area and the adjacent area, which formed the Wujiaochang center. With further development of commerce and trade, Wujiaochang gradually became a trading center, marking the sprout of urbanization.

1.2. *The Initial Formation of Urban Contexts*

In 1930, the Central Government's "the Greater Shanghai Plan" stimulated the large-scale urbanization in Jiangwan. As an advisor to the Construction Committee of Shanghai Central District, Architect Dong Dayou formulated a Radial and straight road network with symmetric structure and designed a large number of municipal buildings such as municipal government, libraries and museums in the city center with his team. Jiangwan Stadium was also designed and built during this period, and was known as the largest stadium in Far East.

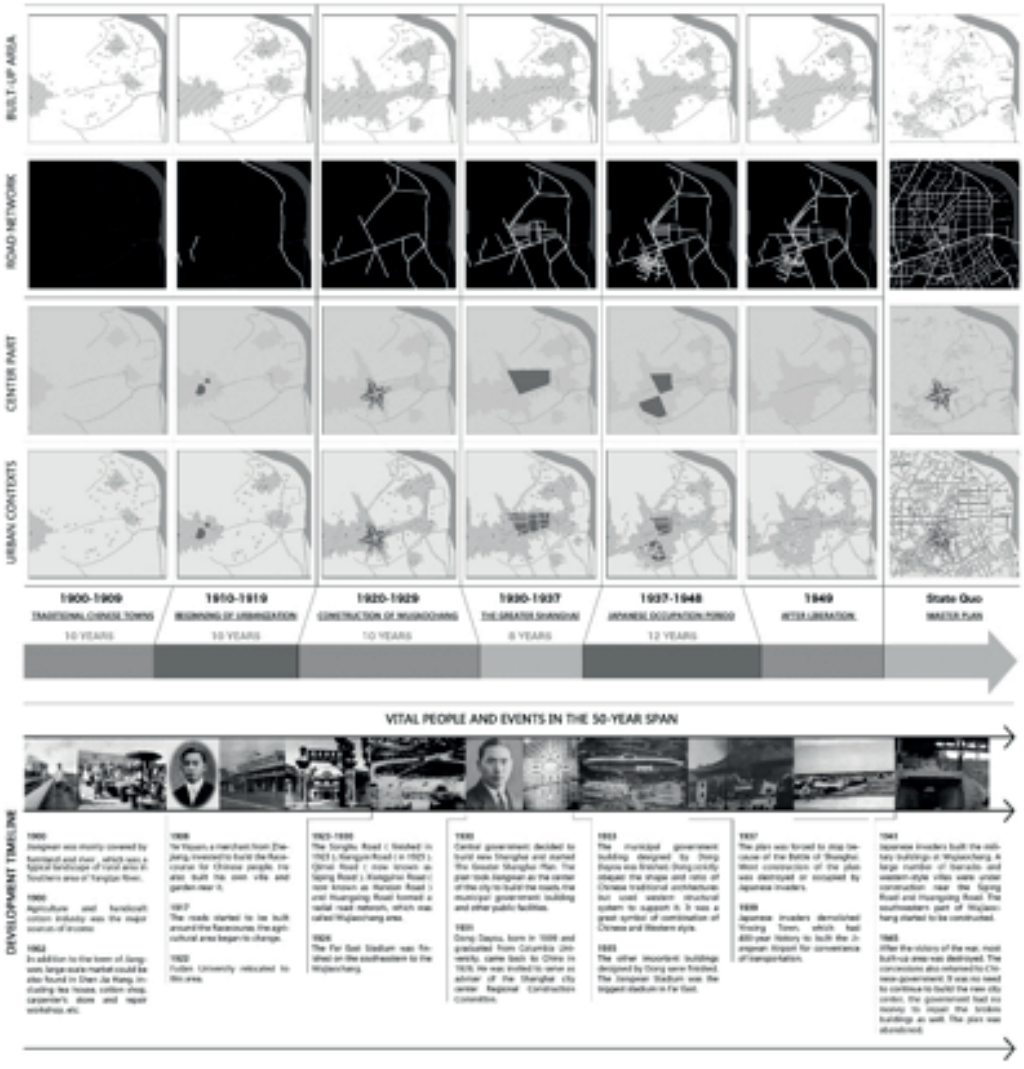

Figure 1. *Historical Evolution of Urban Contexts in Jiangwan Area.*

In addition to public buildings, a large number of new residential areas were promptly completed. The modern urban contexts with dense buildings and interlaced roads was initially formed and the land use functions in Jiangwan area also changed significantly.

1.3. *Drastic Changes and Decline of Urban Contexts*

In 1937, when Anti-Japanese War broke out, the "the Greater Shanghai Plan" under construction had to be temporarily stopped, and a large number of completed buildings and roads were destroyed in the war. Commercial buildings in Wujiaochang Center were occupied by the Japanese army, they also built headquarters building at the southeast corner, Wujiaochang gradually become the Japanese military base. In addition, Japanese designers built a large number of barracks and western-style villas and laid dense road network between Huangxing Road and Siping Road.

After the victory of the Anti-Japanese War in 1945, as the concession was withdrawn," the Greater Shanghai Plan" was also suspended indefinitely due to shortage of funds. The Jiangwan area lost its central status and gradually declined.

1.4. *Urban Spatial Characteristics of the Planned Economy Era*

After entering the planned economy period, the Chinese government listened to the suggestion of the Soviet experts that business is a manifestation of consumerism and started to vigorously develop industry. According to the "Shanghai General Plan" in 1950, a large number of industrial facilities and supporting residential areas were built in Jiangwan area, but the central road network pattern in "Greater Shanghai Plan" was preserved. However, in order to meet the housing needs of an increasing number of workers in the city, Large-scale residential areas blocked the streets, damaged the axes and the remaining municipal buildings gradually overwhelmed by the workers' villages.

2. Design of KIC Plaza and Construction Background

2.1. *Project Overview*

The KIC Plaza is located in Yangpu District, Shanghai, which is surrounded by Guohe Road in the east, Guoding Road in the west, Waizoumatang in the south and Sanmen Road in the north. It is jointly owned by Hong Kong Shui On Group and Yangpu Knowledge Innovation Center Investment and Development Co., Ltd. and designed by SOM. Chuangzhi Tiandi Plaza is a central district with a site area of about 6.8 hectares and is adjacent to Jiangwan Stadium, one of the important historical buildings in Shanghai. It is a modern office park centered on a large sunken open plaza.

2.2. *Social Background*

In the period of Planned Economy Era, Jiangwan vigorously developed its industries and occupied a larger proportion of industrial land and residential land in urban functions. After the industrial relocation in the 1990s, vacant factories, old municipal buildings and large-scale low-quality residential areas were left behind, and the development declined gradually. At the

end of the 20th century, Yangpu District put forward the development strategy from "industrial Yangpu" to "knowledge Yangpu", and vigorously developed the knowledge innovation industry.

There are 14 colleges and universities in Jiangwan area. Combined with the original road network and universities distribution characteristics, the government tried to transform this area of separate universities into an integrated community of learning, working and living with a north-south and east-west corridors. Located at the intersection of east-west and north-south knowledge corridors, KIC is a hub of the entire Knowledge Innovation Zone and a pioneer in the "Three-Zone Linkage" project.

2.3. *Design Conditions*

As for land use functions, there are a large number of built-up settlements (partially removable) and abandoned industrial buildings and warehouses around and in the site. Commercial and public activities have very limited land use. In addition to three historic sports buildings, the stadium blocks are almost covered with greenery.

In terms of road traffic, the major roads built on the "the Greater Shanghai Plan" in 1935 were basically preserved, but the roads in the site are more chaotic due to the expansion of industrial facilities. The planned two subway lines, one passing through the middle of the site, one close to the border of the site, and a public transport terminal provides a large number of people for the development of commercial facilities.

2.4. *Evaluation of Former Design Layout*

The former urban design program has many problems. First of all, it stays in a traditional business mode. Generally speaking, the building density is too low and the interface is discontinuous. The design focuses on the visual node shape and almost is a graphical design that is not suitable for the behavior model of the knowledge innovation community.

The front plaza of the stadium is dominated by the greenery and supplemented by small-volume buildings. For historic buildings stadium, it takes "completely avoiding" strategy and doesn't respond well to history although fully respects for history. As a result, up to 300 meters of the stadium facade was shown unobstructed to all, which cannot achieve the best viewing results. In addition, without the interface along the road, high-speed road traffic will influence the public place.

Besides, Jiangwan Stadium is well-structured and only needs reasonable repairs. In public places sufficient conditions, building sports facilities in the north is not intensive and reasonable.

3. Design Methods in Historical Perspective

3.1. *Isomorphic Morphology*

In the KIC Plaza, there are nine single buildings in a concealed layout along the boundary of site. The shape of the building uses the same morphology, each building is composed of different lengths of bar-shaped body. Relying on the side of the stadium, there is a thinner bar-shaped body, and near the side of Songhu Road, the vertical traffic body sticks between two bar-shaped bodies to form a massive whole body. The texture between the various small areas is similar, but with diversity, without losing the overall sense.

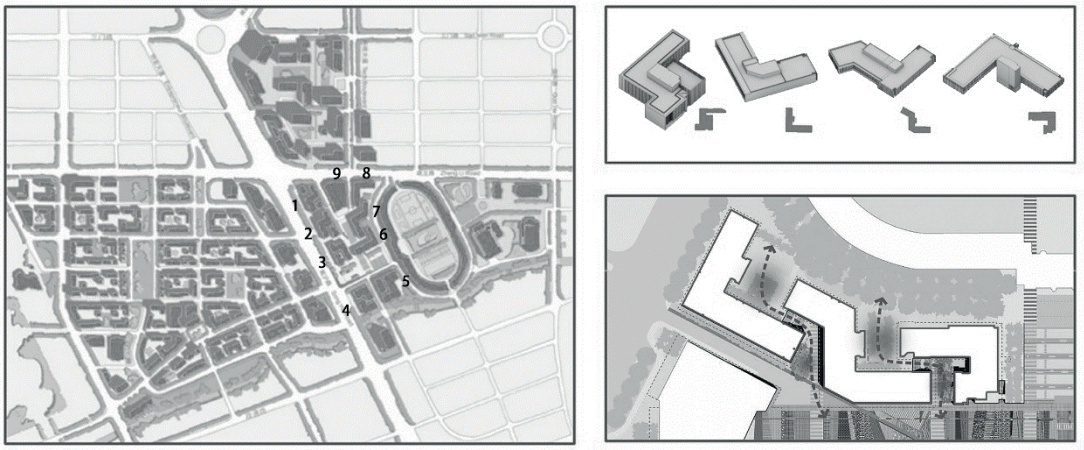

Figure 2. *Isomorphic Morphology.*

Because of the irregular boundaries and changeable directions, the amount of bar has also changed adaptively at the turning point of the border. Such as building No. 6, 7 and 8 formed good interface both on the stadium and the Tech Plaza sides, and formed relevant continuous courtyard between each other. The conference center at the end of Tech Plaza is formed by the superimposition of bar-shaped bodies on both sides of the Songhu Road and the stadium. It not only meets the functional requirements but also plays a role of transition.

3.2. *Continuous Interface*

Chuangzhi Tiandi has good continuity of building interface along the boundary and the inner square. Located on the northeast side of Songhu Road, the main interface is a large-scale glass curtain wall facade. The separatioThe Songhu Road interface opened in front of the West Gate of Stadium. Similarly, the interface is continuous glass surface interrupted at the main entrance of Tech Plaza and other channels with the stone wall, staircase, balcony and other "mutation elements", making the length of glass facade reasonable and the entire square not too closed and monotonous. It is special that the entrance of Tech Plaza singled out the volume, eliminating a large gap above the entrance to maintain a continuous interface at the same time produce gray space, play a delimiting role between the two plazas.

In addition, the opened gap on the Songhu Road creates a "frame" that limits the subject of viewing. The contrast between the blue glass material and the beige stone of the stadium facade, also between the simple and homogeneous glass façade and the carving details of the stadium highlights the historical building. The distance from Songhu Road to the interface is only 20

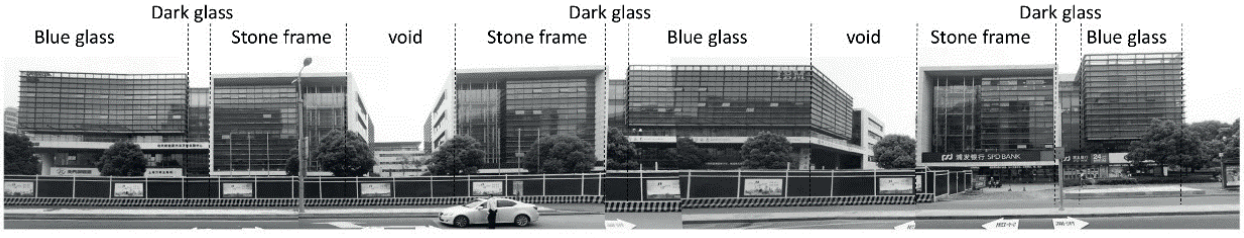

Figure 3. *Collage of Interface along Songhu Road.*

meters, while the façade of Stadium is 180 meters away from the road, creating a contrast in space, causing people's eyes to jump and fall onto the main facade of the stadium.

3.3. *Sunken Plaza*

KIC Plaza adopts the totally sinking method, which is mainly limited by the elevation of historical protected buildings. The sunken plaza can improve the building capacity and improve the building economic efficiency.

Setting broad steps in front of great architecture can highlight its greatness, such as Michelangelo's Roman Town Hall Plaza. The elevation of Songhu Road is slightly higher than the stadium ground elevation, and the stadium is far away from Songhu Road. After planting the sidewalk trees, the visibility of the stadium facade on Songhu Road is not good. Only the plaza sinks can have space to build stairs and create a more open space for viewing. However, only sinking the square will lead to the fragmentation of the spatial relationship between the buildings and the square. The surrounding buildings all co-operate around the square, and can be entered from the elevation of the ground and the base of the sunken square at the same time, so that buildings and squares together to form a whole plaza.

Sunken plaza also has a positive effect on the psychology and behavior of users. In order not to obstruct the visibility of the stadium main façade on the Songhu Road, the plaza can only generate three-side enclosure, and the open side faces the urban express traffic road. The heavy traffic and noise will inevitably generate huge influence. The plaza, which is five meters deep, gives a feeling of enclosure and psychological insecurity experientially and isolates noise and pollution caused by high-speed traffic. With the promotion of underground connectivity project in Wujiaochang, a large number of people will come from Jiangwan Stadium subway station and underground passageway in the future. So sinking the plaza to the elevation of the subway station exit can lead the flow of people more directly and efficiently.

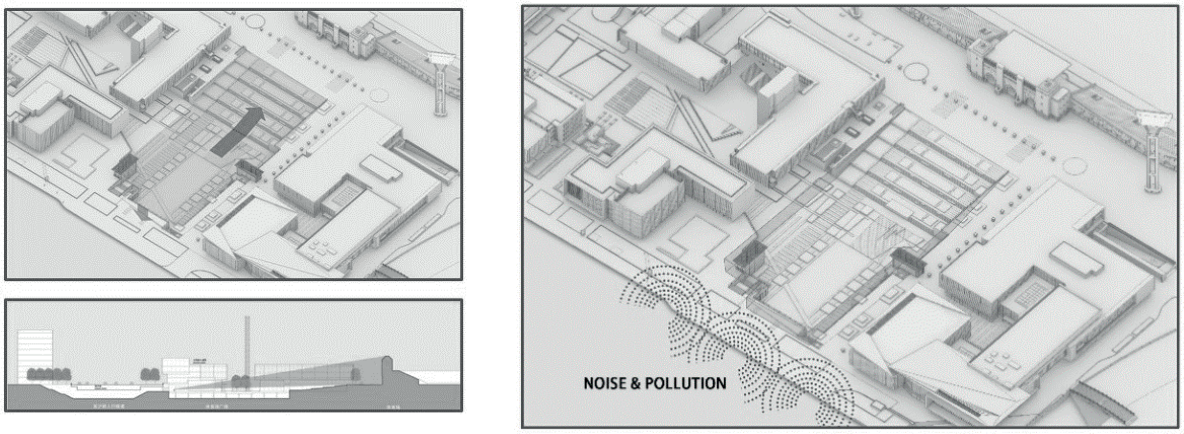

Figure 4. *Steps in front of the Façade & Enclosed Plaza to Block Influence.*

4. Design Adjustments in the Historical Dimension

4.1. *Unfinished Tower Landmark*

Comparison of design and implementation status, one of the most significant adjustments is that the high tower landmark in the plaza is unbuilt. KIC is composed of two rectangular plazas, and the axes of the Main Plaza and Tech Plaza are in an orthographic relationship. From the point of view of the axis layout, the relationship of KIC is similar to that of Augustus Square and Trajan's Square, which are perpendicular to each other in the ancient Roman Empire Plaza complex. The Axis of Augustus ends with the main façade of the Mars basilica, look through the colonnaded porch and the Arc de Triumph on the west side of the plaza, the horse-riding bronze figures can be seen vaguely in Trajan's Plaza as the first hint of axis transformation. After entering Trajan's Plaza, you can see the tall spire of Trajan's Column of Power as the second hint of axis transformation, emphasizing that the visitors are already on the axis of Trajan's Plaza and the space behind the Temple of Trajan serves as an ending point.

In SOM's design, the stadium façade serves as an ending of the Main Plaza. Looking to the tower in the Main Plaza, its middle part is blocked by the overhanging body volume above the entrance of Tech Plaza, suggesting the relationship of Main Plaza and Tech Plaza. After entering the Tech Plaza, the whole tower displays and commands the Tech Plaza which is ended at a "frame-like" conference center. The space element of "tower" should have played a role of activating an inward-looking plaza, but was canceled due to the height limitation requirement. In the field research, it was also found that although the landscape and scale of Tech Plaza is superior to the Main Plaza, but people's activities are obviously less than those in the Main Plaza.

4.2. *Weakened Axial of Technology Plaza*

Initially, the KIC Plaza was dominated by the axis of Tech Plaza. The landscape ran through the Main Plaza with emphasis on the connections between the buildings at both sides. There were playground, staircases and equipment spaces near the landscape axis. The scale of big steps in front of the stadium also were reduced by beveling. Designers thought this is a meeting place for the public to provide diverse sports, commercial and cultural activities, giving a cordial and relaxed atmosphere. In the implemented program, the half area of the Main Plaza was paved, and all the public sports facilities were shrunk and moved aside. The axial direction of Tech Plaza was cut off at the entrance. The passageway facing the stadium facade, strengthened the main axis, forming a memorial plaza space. The relevance of the Tech Plaza to the Main Plaza diminished, and the building links on both sides were fragmented.

The paved way with a 30 degree angle to the Songhu Road re-established the relationship between these two plazas. This axis guided line of sight through the overhanging body above, directly accessed to Tech Plaza, forming a "view corridor". As a result, the continuity of the main axis of the stadium was visually emphasized in the design. "Greenery in the Stadium – the West Gate facade of the stadium – view frame on Songhu Road – two high-rise office buildings opposite the road – University Road", this 1.1km long main axis highlighted the important historical position of Jiangwan Stadium. While, as for the experience of users, using alignment of corridors on the sunken interface to emphasize the link of buildings on both sides.

5. Summary

The Jiangwan area is a witness to the modern history of our country, it has complex and vivid urban contexts. The evolution of urban contexts in Jiangwan area shows distinct stages: the rising of ethnic capitals started the process of early urbanization; the implementation of "the Greater Shanghai Plan" greatly accelerated the expansion of urban contexts; the war turned the urban areas to military function; after the liberation, it gradually declined due to the shift of city center.

This process has left a wealth of historical resources, they provide the reference for the design and update and bring the technical and methodological challenges. The design of KIC Plaza respects history, makes reasonable repairs and utilization of Jiangwan Stadium. It reflects the value of old buildings and provides them with broad landscape space in the contexts. As for the design of new buildings, it does not avoid the historical protected buildings but responds to history actively. It integrates traditional and modern science, technology and culture. The design of KIC Plaza is forward-looking, providing convenience for connecting with underground space in traffic, and guiding the follow-up design and construction by using clear axial control in development.

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New Theoretical Models and Governance for Territorial Complexity

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Abstract: Today's cities, metropolitan areas, are "complex urban regions" where varied episodes and dissonant experiences reach a very high intensity; an intensity that clearly shows us that the traditional identification and planning criteria are today strongly under discussion.
The new settlement models assume the appearance of "nebulas". The new way of "functioning" of the city, the new form that urban armor is taking, produces deep changes in the social and spatial configuration of the material and immaterial relations of the community.
The aim of the research lies in investigating the potentialities inherent in the transport infrastructure system and in the settlement-functional system both in representing paradigms for the reading and interpretation of metropolitan areas, and at the same time in becoming tools through which to direct their development.
The research has the task of verifying the possibilities and methods through which the infrastructures and mobility services and the qualitative and quantitative consistency of activities and innovative functions can be assumed as indicators of the degree of "metropolitanity". of a territory and, consequently, be identified as "strategic levers" by which to guide the government and the urban transformations.

1. Introduction

This article starts from a research done at the University of Rome "La Sapienza"[1], from the preparatory studies for the PTCP of the Province of Rome[2] and relates the updated results obtained inside the interdepartmental agreement between the Marconi University of Rome and the Neapolis University of Pafos[3].

The morphogenetic elements (land orography, river engravings and infrastructure), with their strength and their stability in time, are the support frames to an intuitive interpretation of the urban configurations, of the settlement systems, identifying the realities in which we live.

1. The research has been published in: Bellone, C (2012) 'I nuovi paradigmi interpretativi per la definizione della dimensione morfologica del territorio metropolitano. Le infrastrutture di trasporto come criteri di identificazione e come strumenti strategici ed innovativi nella pianificazione urbanistica di un'area metropolitana' (Orienta Edizioni, Roma) ISBN: 978-88-96467-22.

2. Bellone C. "Il Piano territoriale di coordinamento della Provincia di Roma", in *Urbanistica Dossier* N. 13/1998

3. The agreement was signed in April 2019.

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The metropolitan areas, instead, are "complex urban regions" where variegated diverse episodes and dissonant experiences reach a very significant intensity; an intensity clearly showing us how the identification criteria are now heavily under discussion.

Looking at a "bird's eye" a metropolitan area (applications like Google Heart help us a lot, but it can be done also with the traditional cartography), and in particular the one of Rome, we realize how "many of the boundaries and partitions continuing to mark our mind maps" have crumbled; territories and cities are no longer so distinct in the physicality of space.

The starting point should be, of course, to identify / define the actual physical "signs" of transformations affecting the metropolitan territories, to interpret and bringing them back, as much as possible, within general identification criteria (aggregates).

The two hypotheses from which the research was inspired are the following:

The first is that the functionality of the network road, as a tool to create new territorial opportunities, becomes a privileged tool to contribute to the identification of settlement patterns and consequently assumes a fundamental role for the interpretation and the territorial planning;

the second hypothesis is that the understanding of the phenomena (including social ones), linked to the construction of the urban-settlement system, represents a strategic resource for grasping the logic guiding the spontaneous settlement choices.

The knowledge about the configuration of urban spaces (of settlement features, territorial morphology, functional structure of the urban conurbations and infrastructures) and about the process produced by this configuration, allows to reach actions able to implement the New Urban Agenda objectives (NUA) [4].

2. Methodology

The research on "New theoretical models and governance for territorial complexity" deals with the fundamental questions of the interaction between the territorial system and the mobility network. It try to understand the influence that the offer of infrastructures can have for the location of economic activities and how the accessibility factor influences the demand for location of functions in the various zones of the metropolitan area.

It is important to take in mind as the demand for transport derives from the exchanges established among various economic activities, concerning people and goods; transports and land use are strongly correlated to the balanced interaction between the offer of transport networks and building land and the demand for traffic flows and location of activities and families[5].

The research has a dual scope:

- the first, experimental, aimed to the "definition of qualitative / quantitative parameters" able to determine the "accessibility classes" and the configuration of "territorial zones" (for the mobility system) and "families of dynamic functions", including the types of functions and their accessibility (for the settlement-functional system) .
- the second, experimental and cognitive, aimed to interpreting the spatial model of the Roman metropolitan area (which here coincides with the administrative boundaries of the Rome Province).

4. http://habitat3.org/the-new-urban-agenda/ ultimo accesso 2019-04-09.

5. E. Cascetta, P. Ferrari, B. Montella, A. Nuzzolo, P. Rostirolla, *Obiettivi, strategie e metodologie per il piano comunale trasporti di Napoli, Giornata di lavoro: Pensare e agire metropolitano*, Roma, 23 aprile 1998.

2.1. *Accessibility classes and territorial areas*

We reach a definition of accessibility classes for territorial areas, with the construction of a metropolitan quality matrix divided into two parts, one concerning the settlement system – functional and the other the mobility system (fig.1). In this way it is possible, providing a territorial status to information, to trace the profile of each territorial area.

The definition of "accessibility classes" arises from the need to make a choice expressing the degrees of accessibility characterizing the various territorial areas. These classes are intended as assessment categories of the services offered by the mobility system within each of the areas. In this phase, the evaluation of the territorial distribution of accessibility degrees has a theoretical value, since it does not derive from the comparison with the different relationship needs expressed by the activities and functions families.

The next operation was to define the process of assigning the accessibility class to each territorial area. The belonging of a territorial area to a specific class of accessibility is defined as the product of successive comparisons within the "types of area" to which it the territorial area belongs.

The types of area are intended as evaluative summaries relating to the "thematic areas" and the "key issues" and therefore represent the tools for expressing the summary judgment on the endowment and on the quality of the infrastructures and the service that concern a specific territorial area.

The "types" were divided into four levels, expressing different judgments : high (A), good (B), medium (C), low (D) looking to the presence, consistency and quality of existing infrastructures and services.

Specifically, it is considered that a territorial area is endowed with a "high accessibility" when the levels of qualitative / quantitative consistency and modal co-presence are between the high and good values; consequently the criterion of distinction between "high accessibility" and "good accessibility" is identified in the presence, indifferently referred to the qualitative /

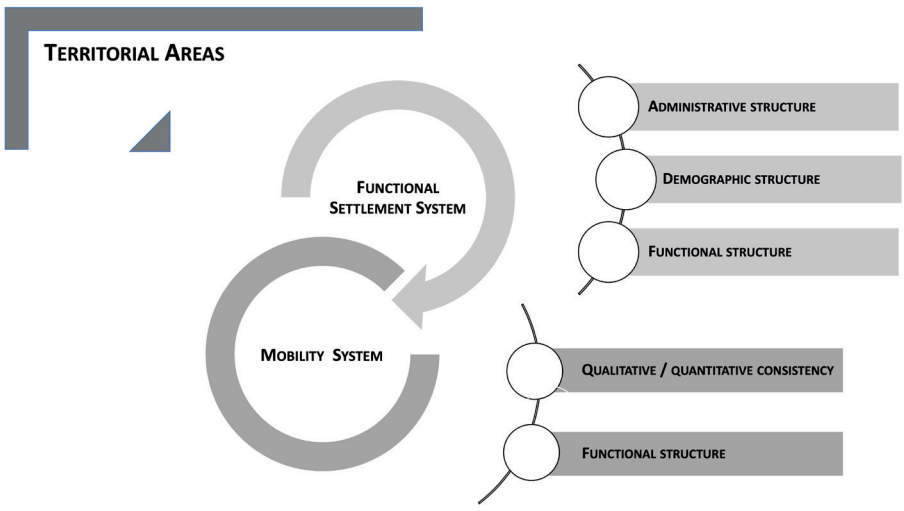

Figure 1. *the structure of the Metropolitan Quality Matrix.*

quantitative consistency or to the modal coexistence, of an average value level. With regards to the definition of the characteristics constituting the "average accessibility", the existence of a level of qualitative / quantitative consistency of average value and of modal presence of medium or low level is taken as the criterion; in this case it is believed that, in relation to the provincial dynamic of values, a lower degree of multi-modality and inter-modality does not constitute a threshold of relevance to configure the characteristics of a lower-level accessibility class. This element of discrimination is instead identified in the lower level of qualitative / quantitative consistency; in particular the "low accessibility" is exclusively defined as a function of this last parameter, since it is considered that, in the presence of a low qualitative / quantity, the presence of several mobility subsystems as well as a greater degree of inter-modality are not, however, decisive.

2.2. The "Families" of dynamic functions, the accessibility, the characteristic requirements of each function, the relationships between functions and the metropolitan context

The research has attempted to provide, through interpretative hypotheses of the processes of redistribution of activities and the levels of relationships and interconnections between the activities themselves, some possible categories of dynamic functions, which are listed below:

A) Productive Activities
A1) Industry
A2) Trade
A3) Private services
A4) Institutions (public services)

In this case, an analysis of the quantitative consistency of the Productive Activities present in each individual municipality and, therefore, in each Area was performed.

The number of Local Present Units was assessed according to the following structure: a) number of Local Present Units close to 3,000; b) number of Local Present Units close to 2,000; c) number of Local Present Units close to 1000.

B) Research and Development
B1) Specialized hospitals
B2) Research Centers (Public Bodies)
B3) Research Institutes
B4) Public and private universities
C) High level services
C1) Airport areas
C2) Airports
C3) Logistic platforms
C4) Courts
C5) Courtesy
C6) Hospital centers
D) Activities for culture and leisure
D1) Large Parks and Protected Green Areas
D2) Archaeological areas

D3) Multifunctional infrastructures (convention centers and multifunctional centers)
D4) Uncommon sports facilities (Baseball fields, Skating rinks, Velodromes, Motocross tracks, Autodrome etc.)
D*)Theme Parks
D * 1) Aquatic Parks
D * 2) Amusement parks
E) Large commercial services
E1) Department stores
E2) Shopping centers
F) Advanced technologies production
F1) Electronics, telecommunications and aerospace systems industry

2.3. *Compatibility and incompatibility analysis of function requirements and accessibility types*

It is important to highlight the relationships between the requirements of the various functions (production activities, research and development, high level services, culture and leisure activities, theme parks, large commercial services) and the types of accessibility, to arrive to have a picture of the macro-functions, grouping functions with similar characteristics, based on the location advantages of each of them, relative to transport modes and the environmental, technological, social aggregation and dimensional requirements.

The combination of the specific requirements of each function results in a macro-function, which has relative degrees of accessibility. For example, functions such as, high level services, research and development, production of advanced technologies, can have a global and direct accessibility, while activities for culture and leisure, theme parks, large commercial services, can have a local direct accessibility.

Urban systems are very complex, because they are characterized by several exchanges with the environment and with other urban systems, in terms of resources, information, energy: for example, production sub-system is only one of the structural components of the urban[6] systems and it is of considerable interest to understand changes taking place in metropolitan context.

To make an analysis of the requirements of compatibility and incompatibility between the localization of the functions and types of accessibility it should be carried out an analysis of the competitive positioning of each zone of the metropolitan area, and an evaluation of the attractiveness of each activity, expressed by the number of occupied and the prevailing specific area of interest (national, metropolitan, local ...)[7].

By examining each of the dynamic functions, we can proceed with the study of the compatibility of a function with respect to its location and its requirements.

If we observe as in a given place there are some characteristics of localization, which are linked with the requirements of a function to be allocated and related to the level of potential accessibility to it (global, local, direct, indirect accessibility), we can plan the functional layout of the territory in an integrated view of the various elements constituting it.

All the functions, generally, must have the requisites of environmental quality, technological, social aggregation and dimensional ones, however, based on the found or possible accessibili-

6. D. Katz e R.L. Kahn, *Psicologia delle organizzazioni*, Etas Kompass, 1968.
7. Area di prevalente interesse specifico internazionale, nazionale, metropolitano, locale.

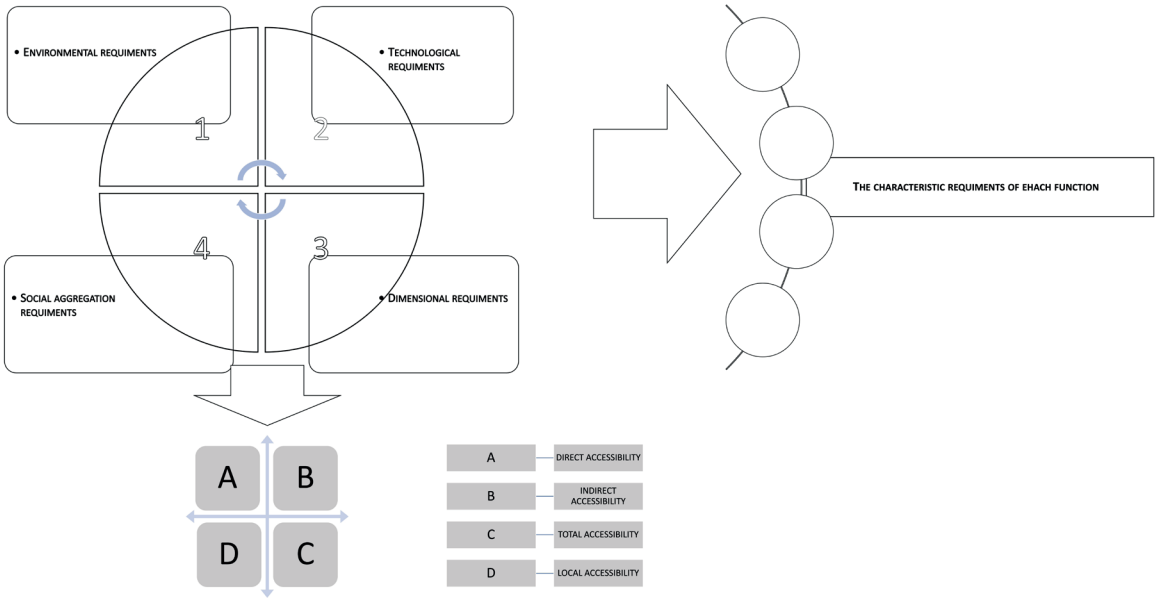

Figure 2. *The basic concepts for defining the compatibility and incompatibility profile between function requirements function and accessibility types.*

ties, with the support of other interventions, they can be located in appropriate sites for their needs and constitute macro functions, in which similar functions are recompressed.

The productive activities, including Industry, Commerce, Private Services, Public Institutions and Research and Development (Specialized Hospitals, Research Centers, Public Bodies, Research Institutes, Public and Private Universities), for example have, surely, all four categories of requirements and need global, local and direct accessibility: they are included in the macro-function A.

Top level services (airport areas, airports, logistics platforms, Law Courts, District Law Courts, hospital centers), activities for culture and leisure (large parks and protected green areas, archaeological sites), multi-functional infrastructures (congress centers and multifunctional centers), Rare sports facilities (Baseball fields, Skating rinks, Velodromes, Motocross tracks, Autodrome etc.) and theme parks (Aquatic Park and amusement parks), have all the requirements listed above, and need all the accessibility levels: they are included in macro-function B.

The function category Large commercial services (department stores, shopping centers) has the aforementioned requirements, but could have local and direct accessibility so they are included in macro-function C and the production of advanced technologies (electronics, telecommunications and aerospace systems), must have all the requirements and global and direct accessibility so referring to macro-function D.

2.4. *The characteristic requirements of each function*

The requirements examined for each function refer, as already explained in the diagram, to four categories:

1. environmental requirements
2. technological requirements

3. dimensional requirements
4. social aggregation requirements.

Environmental requirements include:

– the quality of the surrounding space: it defines the optimal value of the level of territorial quality required by the functions for the turning of the relative activities,
– the good position of the function: it expresses the location of a function within an infrastructural and spatial fabric and how much is it favourable to the function.

The technological requirements have been divided into the following elements:

– connection with the mobility network,
– accessibility levels,
– offer of services.

The dimensional and social aggregation requirements are very specific, precisely because the functions are not standardized, but they dependent on the specificity of different bonds and characteristics, on the extremely variable number of opportunities that each type of function requires, changing from area to area. In the category of social aggregation the relationships between the areas and activities can be attributed by identifying the levels of strict interrelationship that the various functions must have between them.

The requirements listed above were connected to the specific features of individual functions in order to search for macro-functions.

2.5. The relationships between functions and the metropolitan context

Therefore, within the Research we consider useful to identify a set of fundamental relationships, understood as strategic reading criteria, to obtain the identification of the relational logics, linking the functions and the "reference areas".

In relation to the areas of reference and in line with the considerations made in the previous paragraph, within each of them, the following basic concepts have been identified working based on the following relations:

Relations with the urban context

– Relations with urban settlement fabric,
– Relations with the building assets by specific function,
– Relations with the residential building stock,
– Relations with the infrastructural mobility network.

Relations with the production context

– Services Distribution,
– Goods Demand,
– Goods Supply,
– Locations selection,

– Integrated and dynamic functions.

Relations with the infrastructural context

– Consistency of infrastructure offer,
– Infrastructural demand,
– Infrastructural efficiency.

Relations with the mobility system

– Accessibility
– Transport inter-modality,
– People and goods movement,
– Traffic flows.

In the following Figure 2 the relations between the functions and the metropolitan context are grouped into two categories : the localization and the functional one.

3. The case of Rome Metropolitan Area

After analyzing functions and sites compatibility, and in which to allocate the functions, taking into account the different levels of accessibility and relationships established by the functions with the metropolitan context, it is useful to observe the specific case of Rome Metropolitan Area[8], in order to have a confirmation of the above described methodological theory, starting from the analysis of Rome province and the municipality of Rome.

Based on the obtained data, it is possible to envisage scenarios for the planning of functions, closely linked to the supply of infrastructures in the area and which could lead to the transformation of the same, in a less spontaneous and more reasoned process, taking into account, of course, every function accessibility or need.

First of all, it is necessary to underline the Families of "dynamic" functions characterizing the Province that have been identified and located in the following categories:

AA- Archaeological areas
A- Airports
AP- Port areas
CC- Shopping centers
C- Department stores
D- Amusement parks
H- Hospitals
L – Logistic platforms
PP- Large Parks and Protected Green Areas
P- Local law Courts
R- Research Centers
S- Multifunctional infrastructures

8. It refers to the PTCP of the Province of Rome and to the preparatory studies.

TT- Law Courts
T- Rare sports facilities
HT- Industries for the production of advanced technologies

With regard to "Production Activities", the evaluation was expressed as follows:

a) high concentration, in the Reference area, of productive activities (number of local Units close to 3000);
b) average concentration, in the Reference area, of productive activities (number of local Units close to 2000);
c) low concentration, in the Reference area, of productive activities (number of local Units close to 1000);
d) very low concentration or absence, in the Reference Area, of productive activities (number of local Units close to0).

The result of the survey allowed us to express summary evaluation considering both the *quality* and the *quantity* of the functions present in each individual Area.
The overall evaluation was therefore expressed:

a) high presence of specific functions;
b) medium presence of specific functions;
c) low presence of specific functions;
d) very low presence or absence of specific functions;
e) areas of maximum concentration of production and research activities, for which the requalification and upgrading is envisaged through the realization of scientific and technological parks (Provincial General Territorial Plan for the Rome Province).

Numerous matrix have been created reporting and analysis in depth the various data connected to the dynamic functions families, the types of functions, the activities.

Accessibility compared to Function categories

From the data analysis of data, relating to the types of functions present in the Roman provincial metropolitan area, the percentages of total and partial direct accessibility and indirect accessibility have been defined with respect to each function, with the relative levels of accessibility (high, good, medium low). Two areas of analysis have been distinguished : the Province and Rome Municipality. We found that, in the provincial area, function D (cultural activities and leisure) has a greater value than the others, with reference to the total direct accessibility, followed by the category of function C (higher level services), also with a high percentage of total direct accessibility. Instead, the data relating to the other functions A (productive activities), B (development and research), D * (theme parks), E (large commercial services) and F (hi tech production) reveal a low total direct accessibility.

Total direct accessibility of the Province with respect to the categories of functions

With regards to total direct accessibility within the territory, it can be seen that the function, which presents a higher percentage is F (hi tech production), followed by E (large commercial

services) and B (development and research), while functions A (productive activities) and C (high-level services) have intermediate values of total direct accessibility and function D (cultural activities and leisure) low values.

Total direct accessibility of Rome Municipality with respect to the categories of function

The data relating to partial direct accessibility, relative to function D (cultural activities and free time), show high level of this type of accessibility, while functions A (productive activities) and C (higher level services) have an average percentage value and the functions E (large commercial services) D * (theme parks) present a low one.

Partial direct accessibility of the Province with respect to the function categories

In the territory the function F (hi tech production) has a high percentage of direct partial accessibility, while the rest of the functions, except the D * (theme parks) with a low value, presents a media percentage of partial direct accessibility.

Partial direct partial accessibility of Rome Municipality with respect to the categories of functions

Indirect accessibility, referring to the Province, reveals that C (high level services) and D (cultural and leisure activities) have a high percentage of accessibility of this type, the E function (large commercial services), a medium value and other functions, a low value of indirect accessibility.

Indirect accessibility of the Province with respect to the categories of functions

In the territory, functions E (large commercial services) have a high percentage value of indirect accessibility, while functions F (hi-tech production) and D (cultural and leisure activities) have an average percentage and functions A (productive activities) and B (development and research) low percentage.

Indirect Accessibility of Rome Municipality with respect to the categories functions

Total, partial, indirect, direct accessibility percentages for each function can be grouped into high, medium and low values, both for the Province and for Rome Municipality.

Rome Categorie Functons	Accessability Percentages		
	High	Medium	Low
Total Direct Accessibility	B (71%), E (76%), F (100%)	A (47%), C (24%)	D (18%)
Partial Direct Accessibilty	F (100%)	A (46%), B (38%), C (23%), D (38%), E (31%)	D* (8%)
Indirect Accessablity	E (100%), F (69%)	D (31%)	A (15%), B (8%)

The compatibility of localization policies for residential and productive settlements with sustainable mobility

Since the offer of infrastructures and transport services and the structure of the territory greatly influence mobility, it can be said that, in the province of Rome, the dichotomy between the role of the capital and the rest of the territory has caused an unbalanced territorial distribution of productive and residential settlements and problems in the mobility sector.

The Roman provincial basin is of great importance for the national, interregional, regional and local level exchanges and requires an efficient mobility network, which today, from the analysis, seems poorly suited to the demand for public transport by rail and by road.

Often, the public transportation lines are underutilized or overused, the railway infrastructures are not technologically advanced and they overlap each other, furthermore they have a radial and concentric structure respect the city; moreover the public transport by bus too presents overlapping lines in the south and east of the province and a single-central organization with respect to Rome.

To overcome these mobility problems, we need:

- improve transport performance, through plant and network innovation;
- develop an integration of the different transport systems;
- manage and reduce the congestion due to traffic.

From this all, a more rational reorganization of the territory and a more immediate socio-economic development can result, but it will be necessary to proceed to the existing railway lines improving, an increasing in investments for the transport sector and the stipulation of new agreements between the various actors of transport planning, to achieve better quality and efficiency objectives.

> *The location of particular production initiatives in a given territorial context, can be favored by the existence of particular economic and human resources, and it can encourage the development of infrastructures and services for businesses, contributing to further strengthening the development of the industrial sector and at the same time enrich the local economy.*

The factors encouraging the localization of functions in Roman provincial territory are the external economies, represented by the service offer, by the efficient connection transport and infrastructure systems. From a research carried out by the Industrialists' Union of Rome and the Province and by the Chamber of Commerce, Industry, Handicraft and Agriculture of Rome, among the advantages and disadvantages, which can influence the localization of companies, figure, with the high scores: as advantages, the relations with the internal market (66.3%) and the distribution and sales networks (55.4%); as disadvantages, the connections and infrastructure (59.8%), and this analysis is true for the economic operators, for the exchange and distribution of goods, for the information and movement of workers and for the recruitment of personnel.

4. Conclusion

An efficient and functional communications network enables a metropolitan area to initiate and support technological and productive innovation processes, and the same is true considering the people and goods transport systems. The political objective, therefore, should address

the territory rebirth, creating new infrastructures, redeveloping some areas and creating new opportunities for localization of metropolitan functions, because the competition between different productive realities is no longer played on the territorial level, but on the network resources and opportunities one, and it is a political necessity to develop means which can give the territory a remarkable level of attraction, supported by the inclusion of functions promoting the territory in a marketing perspective.

It is essential to identify the strategic elements to set up the development, starting from the dynamic aspect of exchanges and relationships, from the technological characteristics, from the infrastructural potentialities and creating "networks of networks".

A place identification is given, not only by its administrative boundaries but, above all, by factors concerning the social, economic and cultural behaviours. It is interesting to understand "to what extent" the territory is able to influence the economic development of each individual area and not only why the economic development is more intense in certain areas than others. It is in this way that the concept of space becomes an essential factor in the processes of local development and it influences the entrepreneurial processes, the company organizational models, their innovative performances and, more generally, the entire growth capacity of the individual territorial local[9] systems.

The relations between metropolitan functions / activities, "are identified in the traditional relations: daily and stable (commuting), residence / work and residence / vast service areas, which still constitute the prevailing basis of dependence between central area and hinterland and the articulation of these second parts in the local functional sub-systems".

The high level activities and the functional relationships between these activities and the production structure have increasingly acquired a propulsive role in stimulating technological, informational and decision-making impulses for the development of companies and production, constituting one of the main innovation factor of the metropolitan layout transformation.

Most of the "service" activities, developed due to the greater metropolitan dimension, connect with the area's central activities, looking for central positions for their development. The rapid transformations, which have taken place in recent years, have caused changes, especially in metropolitan areas, these changes impacted also the relations which the areas themselves had with the outside and with their internal territory. This emphasizes the theme of urban centrality, which contains levels of physical-functional concentration, given the presence of activities in the central areas and the decentralization in more external zones of productive activities, wholesale trade, and goods traffic.

The aforementioned decentralization, however, is not far from the central zones; the dispersion of service activities in the metropolitan area keeps strong ties with the decision-making centers and we see the creation of settlements along the arteries and nodes based on the main routes and the transport system hubs.

It seems important differentiate the various economic, social and cultural functions of the service sector, to better understand the influences they have on the dynamics of the metropolitan area development, given that we have moved from a service sector aimed at consumption or at the choices of industries for locations, instead today, we have a "always changing" service sector, able to influence economic relations and localization phenomena.

If a concentration of service industry realities takes place around production core centers, located in central zones, it is advisable to delocalize them in peripheral areas, so to decongest

9. Unione degli Industriali di Roma, *I sistemi produttivi metropolitani. Da satelliti a pianeti. Lo sviluppo industriale del nord-est e del sud-est di Roma*, Roma, giugno 1994.

the central areas and revitalize the periphery and the metropolitan structure creating a new polarity system, that will become the base of new developments.

On one side, positioning, almost exclusively, in peripheral areas the productive activities of the service sector has functionally pauperized them, creating in some cases degradation situations, causing a negative impact on the service industry offer at local level and on the demand for these services by local business operators.

On the other side, there are benefits deriving from the agglomeration process, related to its ability to promote innovations, so that we can be induced to encourage or, at least, not to prevent, this process of concentration of advanced services, taking also into consideration the needs of innovative processes, driven by both quantitative and qualitative economies of scale.

In summary, it looks like the characteristics of human capital and the technological level – both incorporated in the products and in the production processes (i.e. the functional mix expressed in terms of technical-productive structures, and, above all, the entrepreneurial and organizational capacity in the most broad sense) – can determine the potential innovative, of individual areas and / or regions.

The relationships between functions and localization features highlight the need to define "invariants" in urban system transformation processes, "it is the preference different service activities have to locate in certain urban sectors, where it exists an optimal combination of accessibility levels, availability and cost of areas, general settlement quality and, finally, potential for vertical and horizontal integration with other service activities".

It is necessary to create the physical-spatial conditions for the conquest of modern urban functions, relevant for the structural underway transformations; to reduce agglomeration diseconomies for these functions; to control the dichotomizing effects of these processes; to pursue, through new tools and strategies, urban integration; to rediscover, based on new structural and economic contents, the road to a new quality of the metropolis.

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A Relational Thought on the Rural Heritage Reservation in China

The Contingences in Traditional Villages, Taking Dawan Village as a Case Study

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Keywords: Relational space, rural settlement, urban morphology.

Abstract: The debate on the social-spatial turn have influenced the understanding of space in a dominant way in the past decades (Lefebvre, 1991), thus the absolute conception of space as a container for objects and processes shifted towards inclusive and multifaceted knowledge (Löw, 2016). The relations between spaces and social processes have been recognized, and this shift requires a more complex and scientific methodology for analysis (Heley & Jones, 2012).

Urban morphology has been first considered as a methodology to address the urban design practices in order to reproduce organically the space, then it attempted to understand the built environment in an analogical way in social, historical and physical terms (Oliveira, 2019). Therefore, adopting the urban morphology and social relational theories to analyze the built environment as an assemblage is core to understand the spatiality in physical and social terms in continuous transition processes.

We try to include the above-mentioned notions in Chinese rural context because they performed the relationality due to their independence on geographical conditions, the intrinsic relation with the social forms, and the cultural and social practices occurred in everyday life (Zwerger 2006; Peng, 1992). In this paper, we analyze how the spatial polices have impacted on the urban form through Dawan village as a case study for its representativeness and generality, adopting the urban morphology approaches as an instrumental device to create the linkages between social form and space. Firstly, we trace its morphological formation and the traditional paradigm of the space making. Secondly, we look at the current dynamics in the spatial polices preservation and development from which the social and spatial inequality have been generated in a transitional society. By identifying the changed actors and relations in the new round of rural development, this paper proposes a holistic framework to understand relationally today's rural heritage in China.

1. Introduction

Alongside the social-spatial turn emerged after the 1980s, the relations between spaces and social processes have been recognized (Lefebvre, 1991; Löw, 2016; Heley & Jones, 2012). The relations between the physical space and the contributors of different dimensions that define the evolutionary processes of the space have become the core of the studies in different disciplines.

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The studies regarding the rural context, however, has not been the centre of the debate due to its heterogeneous geographical and spatial materiality. The gradual shift towards the rural is an global trend to break the dichotomous division of various types of built environments, particularly in an era that requires the sustainable development in a holistic way.

The studies of understanding the spatiality in Chinese rural settlements were stimulated by scholars from the architecture and urban planning (Peng 1992; Luo 2008). In the debates about the relation between the built environment and the natural, social and political settings, arguments arose focalizing on the morphological characters of rural settlements from geographical and cultural perspectives (Xi *et al.*, 2015) , the typologies of the vernacular architecture (Zhao *et al.*, 2013) and its relation with the social forms (Yu, 2015).

Urban morphology has been recognized as an instrumental device to frame preservation priorities (Whitehand & Gu, 2007). The notion about the urban landscape "spirit of the succession of societies that inhabits it" (Conzen, 1966; Whitehand & Gu, 2010) can be applied and testified in rural context, that meet merely the issues related to the rural decay which have been gradually emerged as a subject in the last decades.

In fact, the awareness to preserve the rural settlements have been emerged at the international level, particular attention has been paid to the preservation policies and the issues related to the spatial transformations in developing countries (Xi *et al.* 2015; Oakes 2013; 2016). However, the main scholar gap has been appeared in how to relate the current emergent spatial polices have influenced synchronically by the preservation and the valorization processes within local cultural conditions and social-political agenda.

2. Methodology

The research firstly adopts morphological analysis from historical and geographical perspective to investigate the urban evolution of the village in relation with the social forms occurred throughout history, that gives a convincing support to understand how the rural society has generated the space making paradigm in given geographical context.

Moreover, in analyzing the shifts of the paradigm of space making, and in accordance with the spatial polices led by the recurrent preservation and valorization approaches, the morphological analysis has been applied as an instrumental device in understanding the up-to-date dynamics and relations in producing the space in traditional villages, exploring the most recent cognition of the preservation of rural heritage and the tensions emerged during the rural revitalization.

3. Analysis

Dawan is a village inhabited by Miao people. It is located 49 km from the Municipality of Tongren and 8 km from the core township Panxin, which provided a relatively convenient mobility condition for the village. The overall landscape and the compacted urban form have been conserved. And thanks to its well-preserved traditional settlement and representativeness in rural heritage preservation, it has been subjected to various preservation and valorization policies. It is important to understand today's traditional rural settlement not only by the classic methodologies in understanding the built environment, but also by looking to the current dynamics and relations of the tensions, in which the traditional village is experiencing drastic changes.

3.1. *A historical and geographical approach to understand the traditional paradigm of space making*

The historical morphological analysis is assisted by official documents and local chronicles. In order to trace the formation of the village, a set of semi-structured interviews with local inhabitants were conducted. The first phase of settlement developed at the beginning of the dynasty Ming, when the ancestor Teng came from Hunan province and settled down in today's Dawan. The last phase of development was in the second half of the 1900 in conjunction with the modern construction of the new road and parking area in the 1980s.

As other traditional villages inhabited by ethnic minorities in Southwest China, the proliferation of the space in the village obeys patriarchal social forms and environmental settings, which are determined by the social-historical changes that can be read through an in-detailed morphological analysis (including the two-dimensional layout that comprises the street system, plot pattern and building block plans, building forms, and the pattern of land and building utilization). The presence of the courtyard plays an essential role that has impacted strongly the organic unity of the overall landscape of the village. Representing the rural settlements inhabited by Miao people, the village consists of a scattered settlement, arranged in an organic form following the contour of the irregular hilly ground inhabited by 113 residents. More than 80%[1] of the young people are working in cities in different regions as emigrant workers.

Each building has a courtyard facing to the South, which has defined the composition of an semi-opened space for the dwelling. The urban fabric is thus made up by the mosaic of plots of the individual properties. Each plot includes the dwelling, the courtyard and the related open areas, these three elements give the order and the unity to the urban landscape, so as to define the road network in the village (Figure 1).

3.2. *A gaze upon the traditional paradigm of space making*

The *ganlan* building has been the popular building typology in the village, as in the Southwest regions due to its adaptability to the local climate and geographical conditions (Zhao *et al.*, 2013; Guo, 2015; Luo, 2008). The basic module with "I" form is a standard space for the daily demands which composed of the main hall, that in case of Miao is usually used as main living room for collective activities, and the side rooms. In accordance with the increased number of family members and the demands for living spaces, additional stilted buildings are erected forming the shape of "U" and "L" shapes of the building complex that create a varied distribution of functions. There are two main building typologies present in the village:1) the basic typology, consisting of a central "hall" and two lateral compartments 2) the many variations of the basic type caused by the addition of other rooms, either in a lateral position, in front of the courtyard, or through two additional stilted buildings attached or detached from the main body to form a "U" building. Moreover, all the constructions and the restorations are in charge of individual families with spontaneous projects (Figure 2).

This analysis helps us to investigate the traditional paradigm of space making in Chinese rural context, which is essentially based on the needs of individual families in the agricultural society. The increase of family member and the consequential separation of the families have been the main motivation that stimulated the construction of the dwellings. Afterwards, the

1. The data is obtained according to the interview with Teng family, which was conducted during the field survey in Septembre, 2018.

Figure 1. *Basic spatial morphological unit of Dawan. Source: elaborated by the author based on the data obtained during the field survey in September 2018.*

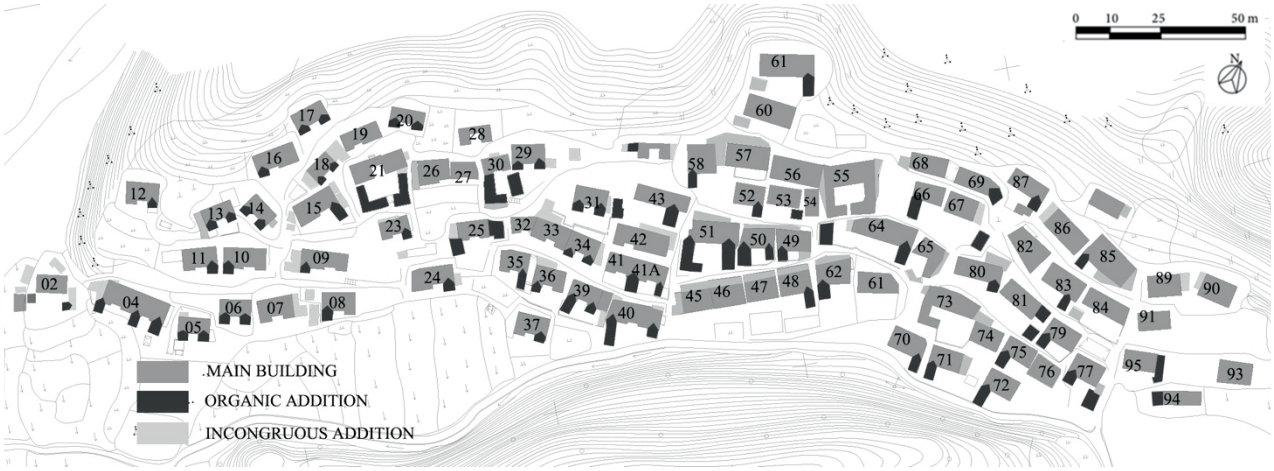

Figure 2. *Sequences of space making processes in Dawan. Source: elaborated by the author based on the data obtained during the field survey in September 2018.*

modern life style and the increased needs for a more specialized space distribution have been collaged into the existing building typologies, that resulted in a series of modularized but temporal constructions with the incongruous feature.

3.3. *Understanding the up-to-date spatial policies in traditional villages*

It is important to study the rural heritage preservation as social processes, rather than a simplified and outdated reading from physical and spatial perspectives. The Chinese countryside has been experiencing a shift from the productivist to the post-productivist period since 1980. Consequently, the spatial policies in the rural context have been nourished by the Chinese urban planning realm, which has been strictly connected to the aim of poverty reduction. In addition, spatial policies impacted in rural context has been described as "the extension of state-sponsored urban planning regimes into rural jurisdictions" (Bray, 2017), where the urban planning has been considered as an instrumental tool to solve the rural problems in specific rural contexts. Such planning policies can be divided into the generic

one, which aims at improving the built environment in the whole territory; and the sectorial one, which has specialized thematic goals, such heritage preservation for traditional villages, the exploitation to the village with ethnic minority characters, etc. Despite some of the objectives in the two types of plans have been overlapped, and in some of the cases controversial (e.g., the fully exploitation of the cultural and historic value in order to approach to a tourism oriented development paradigm; the construction of a new image for the new rurality for a nation in transitional period; and the demands to reduce the rural poverty) the multifaceted finalism has never been changed.

In the case of Dawan, two types of plans have been attempted to modify the spaces in both physical and social terms. The first one is the "Village Rectification Plan (VRP) approved in 2011, which aims at improving the appearance of the village considering both environmental, aesthetic and cultural heritage preservation issues. The second one is the Overall Plan for the Protection and Development (OPPD) elaborated by the Urban-rural Planning Institute of Tongren in 2017. However, this plan has not been implemented due to problems and conflicts at the administrative level. The quality of the planning and design institutions is extremely important. The trend of the professionalization of the "rural planners"(who were previously urban planners in an urban context) is evident.

In the VRP, several subjects regarding the measures of building restoration and the public space requalification have been taken into consideration. In many of the objectives[2], the emphasis to "*rationally develop the internal space of the village, in order to form a characteristic landscape, establish a comfortable ecological environment, so as to build economic, beautiful and safe dwellings*" (VRP 2011). In reality, the renovation and reparation of the dwellings are in charge of the individual dwellers, except for the unified beautification for the façade of the kitchen and the hygienic services, which are supported by government's funds. Since the renovation of the dwellings relies on the individual capability and financial affordability, the outcome varied dramatically. In general, for the historic buildings in wooden structure, it has been declared that load-bearing structure of the house should be inspected and reinforced. For the modern buildings in concrete and brick materials, the "style unification" is proposed under the premise of ensuring the quality and safety of the building.

Contradictorily, both the highway road accessed to the village and the internal paths have been hardened with concrete due to the consideration of the "*dirt road could cause incidents*"[3]. In addition, all the courtyards have been renovated with the same approach, despite their importance in representing the spatial composition and greening the space.

When it comes to the public spaces and facilities, a village square with 1068 square meters has been placed near the village committee. A library and a public toilet are placed and attached with the activity center to meet daily needs of the inhabitants. In addition, the road hardening has been emphasized in terms of both hygienic condition improvements and comprehensive landscape beautification. Moreover, during the planning and implementation

2. The objectives of the plan are: "a realize reasonable village structure, a perfect function matching, a convenient transportation, a convenient condition for production and living". In order to make Dawan Village clean and beautiful after the rectification, gradually improve the external traffic construction, drainage organization, give play to the advantages of regional transportation, and promote the economic development of villages and towns. Moreover, it is important to rationally develop the internal space of the village and town, form a characteristic landscape of the village, and establish an elegant and comfortable ecological environment of the village, build economic, beautiful and safe dwellings. It is emphasized also the Improvement of the infrastructure and the restructuring of the agricultural sectors to bring forward the village's development.

3. The data is obtained according to the interview with Teng family, which was conducted during the field survey in Septembre, 2018.

processes, despite the public participation has been highlighted as a condition based on the VRP which would be implemented[4](VRP, 2011) , and the ordinary inhabitants have been rarely involved in such activities actively due to the dominant role of the village committee and the local elites.

The attempts to renovate the built environment of Dawan have been continued with the designation of the pilot village of national ethnic Characteristic village in 2014 by the Administration of Ethnic Affairs, and the Chinese traditional village at national level in 2016 by the Ministry of Housing and Construction.

As one of the Chinese traditional villages, Dawan started to have its own Overall Plan for the Protection and Development (OPPD) elaborated by the Urban-Rural Planning Institute of Tongren in 2017. Although this plan has not been approved yet, we can analyze the logic and the attempts that tried incorporate the heritage value and the overall improvement of the living and environmental conditions in the village. According to this plan, the village is forecast as a 'village scenic spot', as well as 'Agritourism experience zone' and 'Water entertainment centre'.

Agritourism played an important role in the future development, some building renovation projects have been emerged to meet the demands of tourism development. Cultural resources and the peculiarity of the ethnicity of Miao community has been exploited, thus an exhibition center and a cultural gallery are designed as spaces for cultural display of the local events and objects based on the existing conditions. The overall idea of the OPPD focuses on the innovation of a systematic "Point-Linear-Area" preservation and development system. A set of objects identified for the protection will contributes to a dispersed point system, which is linked by the creation of the historic paths and cultural itinerary as the connection passing through the whole settlement (Figure 3). The objects identified for the protection include ancient river course, ancient trees, ancient well, which are in adjacent with the planned public spaces such as incineration area, the paddy field, central place for meeting, trying to create spaces for both ritual and ordinary daily activities. Furthermore, basic infrastructure and spaces for the administration are incorporated with modern buildings, which have been separated from the historic settlement in order to keep the original characteristics of the overall historic feature of the village.

Apart from the above mentioned comprehensive design strategy, in the OPPD, a series of principles for building restoration and preservation have been taken into account based on OPPD. In case of Dawan, according to the preliminary survey carried out by the Urban-rural Planning Institute of Tongren, only one building complex was recognized as to be restored. Other dwellings are all subject to the so-called "rehabilitation". Furthermore, for those dwellings not in tune with the historic feature of the built environment, are proposed to be "renovated" with guidelines[5].

4. In order to demonstrate the democratic, fair, normative and authoritative nature of the planning, so as to ensure the overall and the long-term interests of development, safeguarding the public interest is urgently needed for further improvement, it is necessary to establish a scientific institutionalized system for the assessment. The supervision and management of planning and public participation are crucial processes. The preparation of the plan should fully collects the opinions of the public and allows the public to participate effectively in the planning processes. It is important to establish a supervision and management mechanism to supervise the implementation of the plan. Source: VRP 2011, Chapter 6.2.

5. I. the wooden frame of the window should be polished with sandpaper. The decorative elements such as window frame and pattern should adopt local ones II. the wooden surface needs to be cleaned with sandpaper and brushed with varnish. The damaged wood materials should be replaced III. the damaged wooden doors should be replaced by new traditional ones iv. railings should be cleaned, polished with sandpaper and painted with varnish v. concerning the roof, the grey tiles should be repaired.

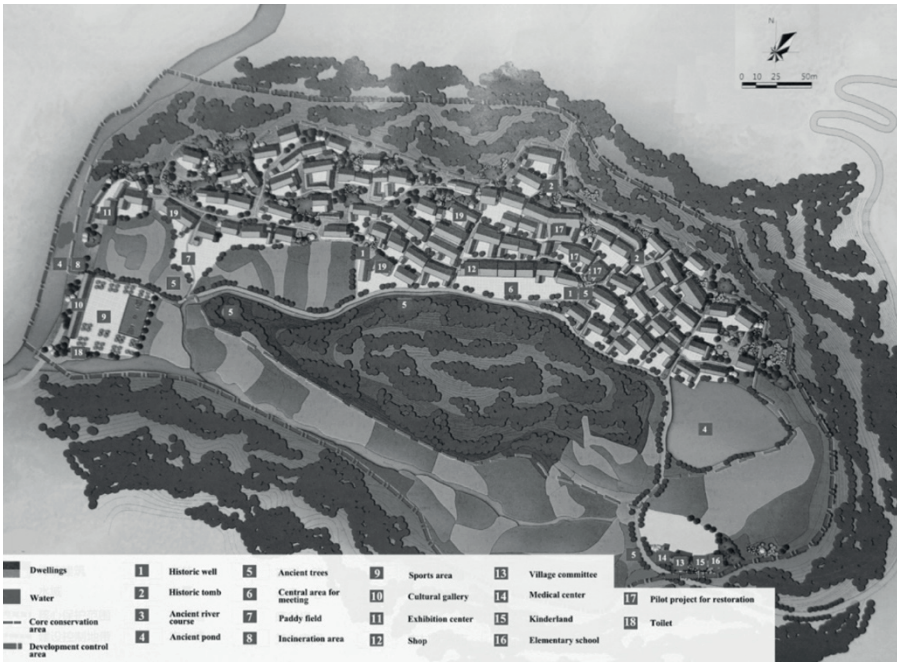

Figure 3. *Master plan of the Overall Plan for the Protection and Development of Dawan. Source: Municipality of Tongren, 2017.*

3.4. *Inheritance, Controversies and Relations*

In a top-down planning system, the objectives are assigned horizontally and vertically to each administrations, with homogenous aims and methods. The space making processes has been transformed by the modern planning processes in traditional villages, some of the approaches have been maintained in the current cultural and political settings, especially those interventions and practices based on individual families (Figure 4). It is worthy to notice that, the role of local elites has been maintained in the preservation and development arena. Local elites have demonstrated a dominant capacity in leading potential resources and the decision making processes. For one thing, they attempted to create dialogues among the inhabitants and administrations, trying to attract beneficial polices from the upper level administrations by performing as negotiators. They support the planning polices to be implemented successfully at village level. For another, they are identified as beneficiaries in the new round of rural development. Therefore, how to maximize the profit at village level to include all the inhabitants is still a problem to be resolved. Moreover, the quality of the planning and design institutions is extremely important.

4. Discussion

4.1. *A Changed Paradigm and the Homogenous Approach in the Space Making*

According to the interviews, we found that the current plans were in one months with very superficial preliminary investigation and scare human resource. The homogeneous objective to exploit the historic and cultural resource of the Miao community, despite of the outstanding

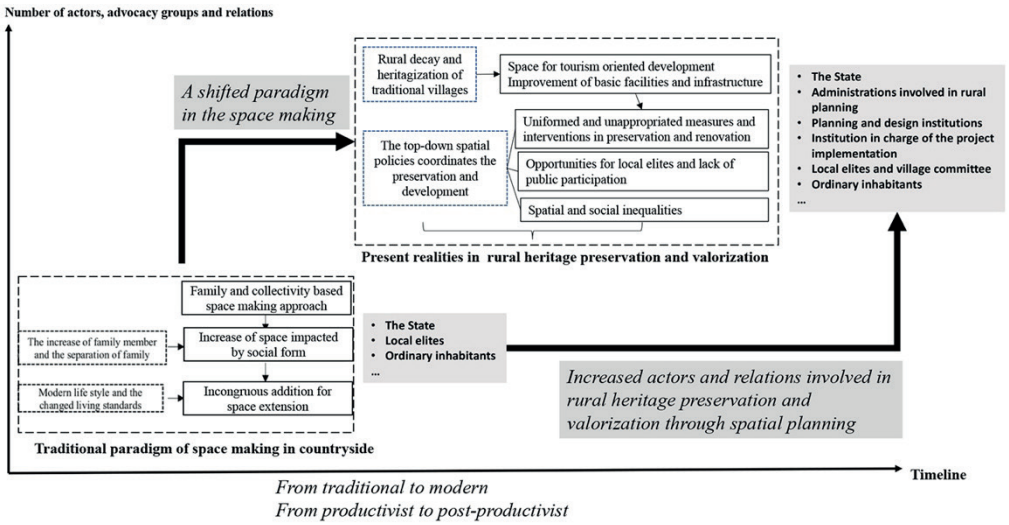

Figure 4. *A framework to understand the shifted paradigm of space making in traditional village. Source: elaborated by the author.*

presence captured by the media of different nature. The current outcome of the past plans and programs showed an extremely tourism-oriented approach.

Teng Jicheng, as the cultivated village leader presents a hesitated idea towards different spatial plans in Dawan. The interviews shows that he knows clearly the potential benefits behind the heritage plans and the renovation projects, but he also claims that:

> the exterior parts of the kitchen and toilets have been refurbished with a uniformed way... from some aspects it is good that the government doesn't have enough funds to complete the project on the ordinary dwellings... however, the buildings will have same appearance under the unified projects.

Family Teng, a beneficiary of the current social and political condition showed their preoccupation on the emergency to preserve the Miao culture in contemporary transitional society, which is not limited in the reason in the case of Dawan, the issue can be categorized into two level of current phenomenon i) The influence of the globalization that involves all types of built environment through the transformation of social, cultural and political conditions having affect on the modern life style ii) Domestically, the long-term unbalanced social and economic development, and the consequential longstanding cultural assimilation that involves the debate about the "Minority" and the "Majority", that the latter have been always the rule-makers. The discourse here is not related to the neat "post-colonial" era of the heritage making(Svensson 2006), but rather a localized relation between the decaying heritage assets (including both tangible and intangible terms) and a dominant and rigid heritage setting conditioned by a set of heterogenous principles, regulations that in many of the cases are vague, which will modify the physical spaces into an ideal model one.

4.2. *Problems in Building Renovation and Restoration*

Given the fact that the approval of the OPPD of Dawan has been suspended, the recovery process has been carried out according to habitus and tradition spontaneously. Most of the

preservation and restoration projects are carried out voluntarily by the villagers, except for the unified beautification for the façade of the kitchen and the hygienic services supported by government's funds. Up to now, apart from rare cases, all the interventions have been simple maintenance and had followed the traditional construction methods. The buildings No. 2 e No. 4, which are the works of greater impact started a few years ago, with methods of transformation very close to traditional methods, are an example. More in general, the people interviewed will affirmed that the traditional way of construction have been recognized by villagers as a necessity for Dawan, for the purpose of both cultural conservation and future tourism development. Currently, renovations or new building constructions are ongoing following a formal-informal mixed way of land use regulations and social judgement.

4.3. *An Hesitated Attitude towards the Planning for Heritage in Rural*

There is a strong presence of local elites in Dawan, whose role is the protector of Miao culture. Teng Jicheng, who was the former vice director of the Tongren Archive has been decisive in heritage preservation and has contributed to the stimulation of the local development by developing and utilizing his own political and cultural position. The buildings No. 2 and No. 4, the two well-preserved and recently rehabilitated buildings complex belonging to Teng Jicheng and Teng Dengfa brothers, are designated as built heritages according to the values identified by a "Dynamic Heritage Archive of Dawan", where a number of photographs, objects of different nature and value have been collected. The designation and the preservation processes have been led by the family Teng, especially Teng Jicheng who is able to gain the support from the Municipality.

The role played by local elites has represented a double-sided position in the village preservation and development. Being beneficiaries in terms of social position, they promoted the Miao culture by their practices, and they succeeded in attracting the financial support and the attention from the upper level administrations. However, the benefit is quite strictly limited within the sole lineage that has not been spread all over the whole village. The newly restored buildings are all related to the Teng Family, who aware of the tendencies and the potentials in tourism development of Dawan thanks to their family networks. However, other dwellings of ordinary families remain under unlivable conditions or are abandoned although some governmental measurements have been launched under the name of poverty alleviation. The distinctive physical conditions of the dwellings in Dawan have mirrored a neat social and spatial inequality even from the perspective of a village scale.

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Rituals, Stories and Confucian Classics

The Construction of Eastern Capital Luo in Zhou Dynasty

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Keywords: Urban Emergence, Rituals, Confucian Classics, Technological History, Urban Systems.

Abstract: Although many cities had already emerged and existed, the Eastern Capital City Luo (洛邑, *built in the 11th century B.C.*) of the *Western Zhou* Dynasty (c.11th century- 771 B.C) in ancient China was one of the earliest cities with detailed historical writings of its emergence and construction. This article will explain this ideal urban morphology of a foursquare city, city location of the "center" of the land and the world, and urban systems of numerous rank orders not only by the planning ideology, but by analyzing the "scientific" and "technological" rituals and stories written and explained repeatedly by later Confucian scholars with their progressive knowledge of geography, astronomy, technologies, economics and politics. With a criticism of Confucian scholar's knowledge system, I would argue that numerous Confucian explanations had reconstituted the history and urban morphology ideal about traditional Chinese urban morphology of the capital city and I would distinguish the ideologies, discourses and history of the original urban forms in this article.

1. Introduction

Although many cities had already emerged and existed, the Eastern Capital City *Luo* (洛邑, *built in the 11th century B.C.*) of the *Western Zhou* Dynasty (西周, *c.11th century- 771 B.C*) in ancient China was one of the earliest cities with relatively detailed historical writings of its emergence and construction. As many examples told by Joseph Rykwert in his book *The Idea of A Town*, the story or history of constructions of *Luo*, which were always related to an ideal urban morphology of ancient China, also took some rituals and ceremonies before the construction. The emergence of cities including the capital city at that time is closely related to the system of royal and military power, marking a systematization of civilization and the political orders around *Shang* to *Zhou* Dynasties.

*Zhou Li (*周礼, *The Rites of Zhou)* is one of the earliest documents that reflect the primitive political thought including ideas of the cities and their system,[1] which were also discussed

1. Although the scholars' research on dating the completion of *Zhou Li* and *Kao Gong Ji* is still inconclusive, whose possible time ranges from Western Zhou Dynasty to Han Dynasty, we can judge from the archaeological materials and the literature to say that *Kao Gong Ji* failed to become a powerful model for guiding the construction of cities of *Zhou* Dynasty regardless of the completion time and it was not a real reflection of the construction of the city *Luo*.

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briefly in Rykwert's book. The first sentence of the book and of each chapter said:"*When the king establishes the capital, exact orientations should be determined, the urban and rural areas should be well planned, the official systems should be set up and people is foremost important".*Two passages about *"Craftsmen's Construction of the Capital"* in *Kao Gong Ji (Book of Diverse Crafts, the sixth and the last chapter of Zhou Li)* respectively reflect the rules of the craftsmen to build cities and the ideal layout of the kingdom capital. The text is extracted as follows:

> To build the capital city, the craftsmen would first measure a flat piece of land with water-level measuring tools, and then erect a surveyor's pole vertically to observe the shadow of the sun. Record the shadow at sunrise, at sunset and at noon, observe the North Star at night, and then determine the exact orientation of the north, south, east, west.
> The capital city built by craftsmen will be a foursquare area with Nine Li (traditional Chinese mile) on each side and with three gates on each side. There would be nine north-south thoroughfares and nine east-west thoroughfares, all of which were nine tracks in width. On the left side of the palace is the ancestral temple, and on the right is the Temple of Land and Grain. In front of the palace are the royal court and behind the palace are the market, the court or market is a square of a hundred steps on each side.

This urban form was also depicted to diagrams by later Confucian scholars (Figure 1). Many contemporary scholars in archaeology, history and architecture have studied this institutional description. By comparing the documents and archaeological findings, however, we can see that the ideal concept fails to match with the reality, the strictly hierarchical system of the capital and local cities presents a different state when "the ritual collapse" *(*礼崩乐坏*)* occurred in the Eastern Zhou Dynasty (Figure 2). But this illustration is very vital at the theoretical level.

In this paper, I do not want to focus on the morphology of the city itself because many researches have already done it. Instead, I want to explore the ritual and ceremony in the construction process of the eastern capital *Luo*, which, to a certain extent, lead to the above-mentioned orthogonal urban morphology in people's mind. Although there are differences between the ideology and the reality about the urban form, the construction of *Luo* is an event mentioned in both Confucian classics and historical writings, and the event itself is truly testable. However, the specific process of this event and the method of city construction are not exact, because the early texts such as *Zhou Li* and *Shang Shu* (尚书*, The Book of History)* were very brief. These books, however, had become an orthodox Confucian Classics in the Western Han Dynasty (in the time of Emperor Wu, 156B.C.-87B.C.) and been enriched with numerous annotations by later Confucian scholars. Thus, the originally simple narrative of the activities and rituals started have more details in Confucian books of later generations since Han Dynasty. In this article, I'll focus on the concepts "the center of the land" and "the center of the world", to discuss the "scientific" and "technological" rituals to find the "central position" geologically or politically hold in the construction of the capital city, and thus to critically analyze our existing knowledge, which include the original and the derived texts of the construction activities at that time.

2. Rituals and Stories: Confucian Explanations of the Construction

Whether it is *The Rites of Zhou*, *The Book of History*, or *The Historic Records (*史记*, Shi Ji)*, their original texts are a few words about the story or history of establishment of *Luo* at the beginning of Zhou Dynasty, which means that we only know the "event" but are not sure of the "details". This problem is also the one faced by Confucian scholars before and after the works became classics. Therefore, they constantly interpret the "deep meanings in the sublime words "

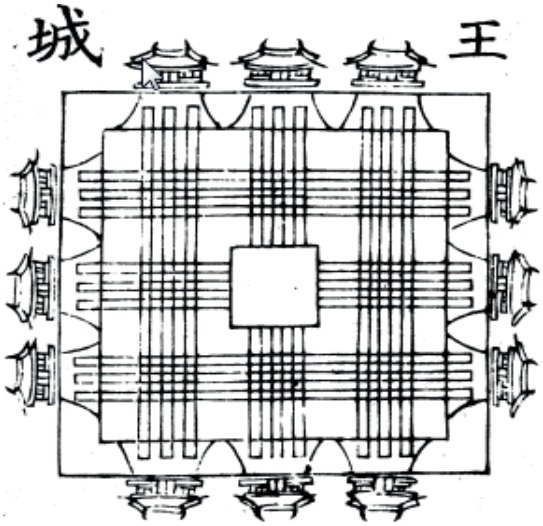

Figure 1. *A Diagram of the Ideal Form of the Capital City.*

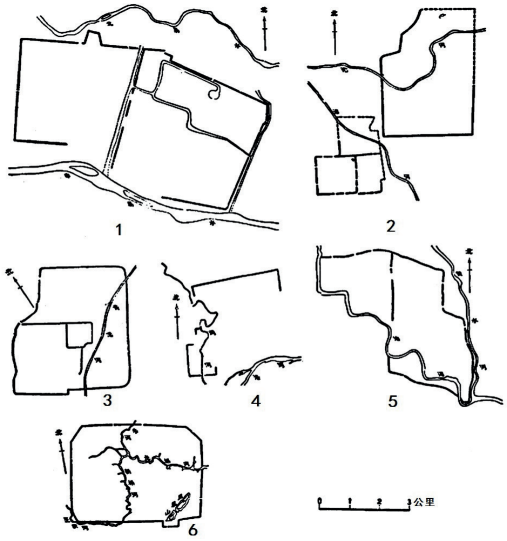

Figure 2. *Several Actual Forms of Cities in Zhou Dynasties.*

in the classic literature by making notes to the scriptures and annotations to those notes from one generation to another. By "stories", however, I mean I regards those narratives may be history, may partly be or may not, which should be analyze with a critical idea.

Due to limited length I will select the annotations of three representative scholars *Zheng Xuan (郑玄,127-200), Jia Gongyan (贾公彦, 7th Century)* and *Jiang Yong (江永,1681-1762)* respectively in the late *Western Han* Dynasty, *Tang* Dynasty, and *Qing* Dynasty. With the evolution of knowledge, I want to examine how the later scholars differently interpret the same event after the related knowledge got evolved. In fact, these interpretations about finding the central postion of the land has become the knowledge base we now understand. These knowledge involves relatively primitive astronomy, geography, the history of scientific thoughts and even political and cultural studies. Apart from Chinese scholars, the most well-known should be *The History of Chinese Science and Technology/ Science and Civilization in China* written by Joseph Needham, which mentions some scientific and technological questions including those occurred in urban construction process faced by ancient Chinese scholars from the perspective of the history of science. But here I want to return to the original texts written by these three scholars and analyze the intellect and knowledge background later.

The institutional text quoted above have basically outlined the basic processes and ideal forms of the early Chinese capital city. However, when the later generations of scholars interpret *Zhou Li*'s first sentence "*When the king establishes the capital*", they emphasized that the capital city *Luo*, established in the Zhou Dynasty, was built at "the center of land" through a series of technical methods. This original statement indeed shown in the third chapter of "the Office of The Earth" in *Zhou Li*, as it said:

> Measure the land and revise the shadow with Gui (note: a kind of traditional measuring scale) to find the central position of the land… the position where the shadow on the summer solstice is one chi (note: a traditional Chinese unit like English foot) and five cun (note: a traditional Chinese unit like English inch) can be called the center of the land. It is the point where the heaven and the earth, the four seasons and various climates, Yin and Yang meet. Therefore, it is rich in natural resources, where the capital city built to control the territory of thousands faraway.

There are two problems with this text if we take it with a modern scientific view. First, it mentions the length of the shadow without telling the height of the object itself, so we cannot calculate the exact position it is; Second, it doesn't tell us the time of observation, the location may vary because the shadow varies in length over the course of a day. Since Zhou Dynasty, scholars started to explore or, I may say, hypothesize the exact method took by Zhou's people in this story. Before Han's Confucian *Zheng Xuan*, numerous scholars and Confucians had put forward their ideas of this measuring method but Zheng Xuan is a synthesizer of all those opinions and he've gotten high achievement in astronomy at that time. Now we put three of them all together to discuss the evolution of their perception of the event.

2.1. *Zheng Xuan*

According to Zheng Xuan's interpretation, the method by Zhou Gong *(周公, The Duke of Zhou)* to make sure the center of the land was to erect a *Biao (a kind of traditional Viewing Tablet)* of eight feet *(chi)* high on the ground at high noon, and to record the directions of the shadow on the north, south, west and east during different times, as well as the length of the shadow as shorter or longer as the solar altitude changes with the help of *Gui (a kind of traditional Measuring Scale)* of one foot and five inches long. When the shadow faces exact north at noon on the summer solstice, and it is one foot and five inches long, just as long as the length of one *Measuring Scale*, and then the position of this *Scale* is at the center of the land. By this way, Zheng Xuan has pointed out that the exact noon of summer solstice will be the time of measuring, that is the time be representative among the whole year. The one-foot-and-five-inches shadow at noon is exactly the same as the length of that Measuring Scale, which is why Zheng Xuan emphasizes the relationship between the length of the shadow and the length of *Gui*. Comparing the length of the shadow with the length of the *Gui*, the principle is that the actual measurement is carried out on the ground.

Zheng Xuan and several of his previous scholars believed that at noon of the summer solstice, the projection of the shadow of the eight-foot tablet will coincid with the length of *Gui*. If this interpretation is translated from the point of view of modern science, then the determined noon altitude angle on the summer solstice implies a latitude, and the definition of noon time implies a longitude. At that time, however, they did not have the scientific thought of altitude and longitude but regarded the earth as a piece of square land with each side of thirty thousand miles. Under such idea, they came up with the thought that the shadow length differs one *li* when the actual distance along south-north direction differs one thousand *li (traditional Chinese mile)*. Under this theory, Zheng Xuan can explain the latitude factor of the central position, but in fact it is not good enough

to justify the longitude problem. He even borrow the theories from Yin-Yang and Five-element Theory to explain how the central position in the east-west direction was determined.

2.2. *Jia Gongyan*

The question that Zheng Xuan has difficulties to answer got responded by Jia Gongyan in Tang Dynasty. Jia thought when Zhou Gong messured the shadow, he putted five *Biao* (*Viewing Tablets*) in five different places. The central one was placed in the area of *Luo*, the other four were placed one thousand away at the exact north, south, west and east respectively. Jia's explanation, in fact, was not what Zhou's people had done but *Zu Geng (祖暅, 456-536)*, an astronomist of Southern Dynasties *(420-589)*, which means Jia's retelling of the story owes to his own contemporary systems of knowledge.

Scholars of Southern and Northern Dynasties has already realized that the descriptions of the construciton activities in the Confucian Classics is very simple and the explanation by the later confucian scholars is not always right. Zu Geng, an astronomist of Southern Dynasties, adopted an measuring method of solar shadow with five surveyor's poles. First, put the south pole at noon according to the water clock (hourglass), then put another pole at the end of shadow of the south pole as the central one. At the midnight, locate the north pole by observing the North Star from the middle pole and then check if the three poles are in the straight line. He believes that if the three points are in a straight line at this time, then the line where it is located constitutes the correct orientation in a longitude, otherwise its position is not centered.

This method can determine the middle point in the east-west direction. The middle line in the east-west direction had been established, then the middle line in the north-south direction was determined at the spring and autumn equinox. When the sun rises in the east, set the eastern viewing pole by observating the sun from the central pole; when the sun goes down in the west, set the western viewing pole by the same way like the one above. The same with the longitude aspect, he believes that if these three points are in a straight line at this time, then the line where it is located constitutes the correct orientation in an latitude, otherwise the position of the middle pole is not centered.

The core problem of Jia's explanation, however, is that the method of measuring is first used by the astronomist of South and North Daynasties rather than the rulers of Zhou Dynasty, which means the methods are almost drawing wrong conclusions by false analogy. It's totally a retold "story" rather than the exact history reflected the fact. Like Zheng Xuan, they all put forward the time of "noon" to measure shadows. However, due to the scientific and technological concepts at that time, they did not necessarily realize that the local time in different longitude was different, but adopted the constant concept of time, believing that the noon time in different places on the earth happened at the same time. Otherwise, the difference in midday shadow length between different longitudes in the same day should be negligible.

3. Criticism of the Story: Jiang Yong and other Qing's Scholars

As I have just analyzed the astronomical descriptions of two representative scholars of Han and Tang dynasties, their scientific descriptions are not adequate to describe the activities of geodetic surveying, either intentionally or unintentionally. Based on modern knowledge of geography, an eight-*chi*-high object getting a one-chi-five-*cun* shadow at noon in the summer solstice equals to the situation happened in the latitude where the solar altitude is 78.5 degrees,

which is 35-36 degree of north latitude. The latitude and longitude of "the center of the land" was determined respectively by the solar altitude in the day of summer solstice and the local time of noon. The noon of a place is closely related to its longitude. To get a certain length of shadow, the longitude span will not be very large. Thus we can say, the center of the land determined by the astronomically technological rituals were actually determined by the ideology of Zhou's people and this ideology is more of geography than astronomy, which is as Jiang Yong, a Confucian scholar in Qing Dynasty once said,

> The so-called Center of the Land has already been known from the geographical features of the regions people lived., rather than making a one-foot-five-inch earth measuring scale first, and the place where the shadow of the summer solstice is equal to it is in the central position. Actually, the King had already decided Luo to be the location of the capital, erect the tablet with 8 feet tall, shadow grows one foot and five inches to be the shadow at the central position. The rulers regarded making the scale as a law, the data used in the measurement are conceptually determined by the King, not by the shadow.

This statement is closer to the facts at the beginning of Zhou Dynasty than the depictions of Zheng Xuan and Jia Gongyan. Especially when we draw the scope of the Chinese activities in the historical records, from the core culture scope of the *Three Emperors* and *Five Emperors* to the *Xia, Shang and Zhou* dynasties, we will find that Luoyang is indeed in the geographical center of the Chinese civilization at that time. But the more realistic issue is that Zhou people lived on the western edge of the core civilization circle. When they finally conquered the Shang Dynasty, they needed to further move the political and military forces eastward. On the other hand, they need to manage the land and people of the Shang Dynasty; on the other hand, it also inherits the central district of Xia and Shang Dynasties. Whether in the natural environment, civilized development or urban system, this area has outstanding advantages, which is convenient for strengthening political, economic and transportation links and control to other places. Therefore, choosing *Lou* to be the capital city is a very realistic choice, and not the result of finding central position of the land, the ceremonies of all kinds of measurements are largely not historical facts.

However, when we've done criticism to the depictions of scholars of Han and Tang dynasties based on their knowledge systems, our further question is what kind of rituals and activities took place before the construction of the city *Luo*.

4. Rituals and History Legalization of the Construction of the Capital City

This section will focus on the original historical narrative of the construction of *Luo* by the rulers of *Zhou* Dynasty. I will first sort out the text of the earliest narrative from *He Zun* inscriptions *(*何尊铭文*)*, *Shang Shu (*《尚书》*)* to *The Historical Records (*《史记》*)* in the early Western Han Dynasty. *He Zun* was a bronze vessel of the early Western Zhou Dynasty, which was made by an aristocrat named *He* in the early Western Zhou Dynasty. The inscription on the inner side of the bronze ware said:

> In April of the fifth year of the King Cheng of Zhou, the King began to build a capital city in Cheng Zhou (Luo)... After the King defeat the Shang, he said to the heaven, "I live in the central nation and thus rule the people".

The book *Shang Shu* is a collection of the earliest historical documents with high degree of credibility, which include 28 documents retold by Dr. Fusheng in the early years of Han Dy-

nasty after the book burnt by First Emperor of Qin. There are three documents related to the events of Luo's construction, which can be simply cited as follow:

> Zhao Gao (An Admonition to Zhao): It was February, Zhao Gong (the Duke of Zhao) went to the area of Luo to inspect the construction site before Zhou Gong. He led many Shang people to determine the location of the new capital at the confluence of the Luo River and the Yellow River. When Zhou Gong arrived, he sacrificed two oxen to the god in the southern suburbs. And the other day a sacrificial ceremony with an ox, a sheep, and a pig was held in the new city. On the seventh day, Zhou Gong ordered the people of the former Shang Dynasty to build Luo.
> Kang Gao (An Admonition to Kang): It was March, Zhou Gong (the Duke of Zhou) held the foundation ceremony of a new capital at the eastern nation, and people from all directions attended the event, who all express the willingness to obey the management of the Zhou Dynasty.
> Luo Gao (An Admonition in Luo): Zhou Gong said to the King:"I arrived at Luo in the morning and then did divination in several different areas around, Luo is the most auspicious place".

The above cited documents are relatively primitive documents formed in the *Zhou* Dynasty or little later. Through these more primitive texts, it can be known that the main activities before the urban construction activities were the senior officials of the two Duke levels, including Zhaogong and Zhougong, who came to the site to inspect, measure, divination, sacrifice, sacrifice, especially divination and sacrifice. It is very ceremonial and is considered to be an activity that communicates with God, obtaining the legitimacy of construction activities. What is more noteworthy is that the above-mentioned many texts are not only in the literature and historical sense, but also have a very strong ritual nature. In particular, the admonitions I quoted not only provide us with core historical information, but more importantly, the text itself is preached and taught in the process of building a city as a propaganda and education, that ceremony also played an important role at that time.

Finally, the above ordinary Confucian literatures had become the classics of Confucianism after the Emperor Wu of the Han Dynasty, and they were the focus of scholars of later generations. It was also during the period of Emperor Wu of the Han Dynasty that an important his-

Figure 3. *He Zun, a Ritual Wine Vessel and Its Inscription.*

torical work *"Historical Records"* concisely retell the history of the construction of *Luo* at Zhou Dynasty on the basis of previous literature:

> The King Cheng lived in Feng and ask Zhao Gong to rebuild the city Luo to obey the former King Wu's wishes. Zhou Gong re-divinated, made field investigation, and finally completed the construction. He said: This is the center of the world. It is almost the same for people from all directions to come here paying tribute.

In this narrative, the concept of "the center of the land"(地中) has become "the center of the world"(天下之中), which is not only a simply literary change but actually a political transform in the ideology.

5. Conclusion

How to find out "the center of the land", the two Confucian scholars of Zheng Xuan and Jia Gongyan have made a lot of efforts to explain the classical words of "*the position where the shadow on the summer solstice is one foot and five inches can be called the center of the land* ". Of course, in the respect of the scriptures, they tried to restore a kind of technically "geometric" activity from the limited narrative of the Confucian Classics, which try to make people believe that what was originally used as a concept and discourse by Zhou Gong was actually the fact and "the central position" was actually measured by rigorous technical measurements.

Compared with scholars in Han and Tang Dynasties, the discussion of Confucian Classics in the Qing Dynasty is more in line with the actual situation of the construction of *Luo*. Qing scholars said directly "the center of the land is actually the center of territory and the politics of power". This statement solved the problem, especially in astronomical and geological aspects, previous scholars faced, wiped off the embellishment of scientific and technological activity, and touched directly the core issue of system of enfeoffment. Therefore, this series of activities is very ritualistic, no matter it is the story of measurement of the land and the earth told by later generations of Confucian scholars, or the history of investigation, divination and sacrifice that actually took place at that time. To a large extent, it is a ritual of legalization and propaganda of existing concepts and decisions. During the process, the idea of "the center of the land" started to change into "the center of the world", which finally became a key concept in traditional Chinese politics and urban morphology of the capital city.

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The Influence of Urban Design Theories in the Transformation of Urban Morphology: Montreal from 1956 to 2018

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Keywords: Urban morphology, urban design, planned built environments, schools of thought, Montreal.

Abstract: Research on Canadian urban design, despite some notable exceptions, is relatively limited. This paper explains from an urban form perspective the practice of urban design in Montreal by studying three representative projects built during the past six decades. Through the analysis of these projects, the principal aim is to understand how urban design approaches have evolved over time and how they have influenced the morphology of the city. The main findings of the research show that the schools of thought that have nurtured urban design practices over time have especially influenced the link between planned built environments and city forms.

1. Introduction

The traditional process of formation and transformation of urban form has created layers of urban fabric organized according to simple rules of aggregation. This vernacular process based on construction techniques inherited from past experiences explains the relative equilibrium between homogeneity and diversity that characterizes the urban fabric of a city like Montreal. But what happens when these mechanisms disappear and are replaced by learned practices that are associated with the practice of urban design? Since 1956, i.e. when the concept of urban design was first introduced in North America (Krieger and Saunders, 2009), design practices on the city scale have progressively replaced the traditional typological evolution process and its central role in the formation and transformation of the urban fabric. The urban design projects carried out in the last 60 years on the Island of Montreal can be understood as laboratories of Quebec and Canadian urbanism. The present research focuses on urban design practices in Montreal since 1956 and the influence of these design approaches on the formation and transformation of the urban fabric of the city. In this context, this paper wishes to identify how the production of urban design practice, which is referred to as "planned built environments", has influenced the urban form of Montreal through time. This research is an important means of developing a critical awareness of urban design's impact on the existing fabric of the city.

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A review of urban design literature and of reports found in the archives of the Planning Department of the City of Montreal (Centre de documentation Marie-Morin) reveals that three major schools of thought have influenced the practice of urban design in the city. The first approach is Modernism. For that movement, planning and architecture are a way to bring about social reform (Le Corbusier, 1923, 1957). The promotors of this school of thought reject the historical city because they judge that it is obsolete and also reject any direct reference to the form of the traditional city. The design emphasis is on pure geometrical forms and the establishing of homogenous landscapes (Banham, 1966). The second approach is Postmodernism (Rossi, 1984; Ellin, 1999; Talen, 1999). It represents a criticism of modernist reductionism and tends to embrace and value diversity (Venturi, 1966). The promotors of this movement favor a return to lost urban traditions, and this is reflected in a rather eclectic design approach. Postmodern urban designers have postulated theories of "how to plan" (Koetter and Rowe, 1979). Finally, the Contemporary approach has as its objective the reconstruction of the city itself. This movement is based on historic knowledge (Panerai, *et al.*, 1999: Oliveira, 2016; Kropf, 2018). The aim of some contemporary urban designers is to reconcile the aesthetic and spatial quality of modern architecture with city form. It is important to note that in Montreal, there is actually a shift to a movement that includes increasing consideration of sustainable development.

2. Theoretical framework

To understand how planned built environments are structured and to study their relationship to urban form, research needs to bridge the gap between the discipline of urban morphology and the practice of urban design (Whitehand, 2017). The definition of a theoretical framework is important to generate categories in which to analyse and compare the three cases studied selected in this article, that are representative of the evolution of urban design approaches in Montreal. These categories must establish uniform criteria to analyse how the projects are organised and to compare them with the same premises to determine their contribution to city form. The subject matter of this research is the morphological system of relationship 'contained' in the material and spatial form of planned built environments. This system is influenced by the ideas that have shaped the practice of urban design throughout history. To study the physical-spatial mode of organisation of planned built environments, the research uses a methodological approach derived from the literature in urban morphology that borrows some concepts from structural analysis that has influenced this discipline as a theoretical structural approach to urban form.

In 1969, M.R.G. Conzen developed a method to study the "town plan". The town plan is composed of the topographical arrangement of the area and is also structured by the street plan that delimits blocks subdivided by private plots. Block-plans and buildings complete the organisation of a specific town plan (Conzen, 1969). Caniggia and Maffei represent the Italian school of typo-morphology that has developed a framework by theorising the constituents of the urban tissue (Caniggia and Maffei, 2001). Depending on its topography, vegetation cover, and hydrography, a specific site is the first condition for generating the aggregation of a specific urban tissue. Linear elements connecting different parts of the site usually appear, i.e. types of routes (matrix, planned, connecting, break-through routes) that constitute the road network linking different nodal points and the polarity of the urban tissue. The land along these routes constitutes the pertinent strips that are divided into plots to host various building types gradually forming the blocks. Usually the plot division adapts to the different building types

composing the traditional urban fabric, mainly residential, resulting from past experiences of adaptation to ever-changing human needs. The notion of typology is used by Caniggia and Maffei to understand regularities in the evolution of building types through time (Devillers, 1974). Lévy has gone further in this theorisation. The urban fabric is made up of the components that Conzen, Caniggia and Maffei have defined, i.e. site, road network, plot subdivision, and types of buildings, but Lévy adds another component in the definition of urban form, namely open spaces. Levy also highlights the role of building layout in the materialisation of urban form. The specific relation of buildings to the site, to the street, to the plot, and to open spaces are key elements in studying and understanding the spatial structure of the urban fabric (Lévy, 1992).

3. Methodology

Figure 1 uses the components of urban fabric to schematize the structure of planned fabric. The basic components of planned fabric include the site (S), the road network (R), the plot subdivision system (P), the built framework (BF), and the network of open spaces (OS) that are shown as interrelated elements in the figure. The figure also presents the importance of building layout, i.e. the relationship between buildings and the site (B/S), between buildings and roads (B/R), between buildings and plots (B/P), and between buildings and open spaces (B/OS), so as to foster an understanding of the formal and spatial structure of any planned built environment. The two directional arrows between the built framework (BF) and the building (B) show a change of scale in the structuring of planned fabric, passing from the general built environment of a planned fabric to a certain category of building type integrated in the fabric, like Russian dolls. Usually planned built environments fall within a context (C) which, by its very nature, is one of the components of an element on a larger scale, i.e. the form of the urban fabric and of the city as a whole. The hypothesis guiding this research is that the organisational concept of planned built environments is dependent on the influences of urban design theories; these schools of thought affect specifically the relationship of planned environments to city form. The description of the case study structure stems from the organisational scheme that highlights the cognitive operations of planned fabric design (Racine, 2016).

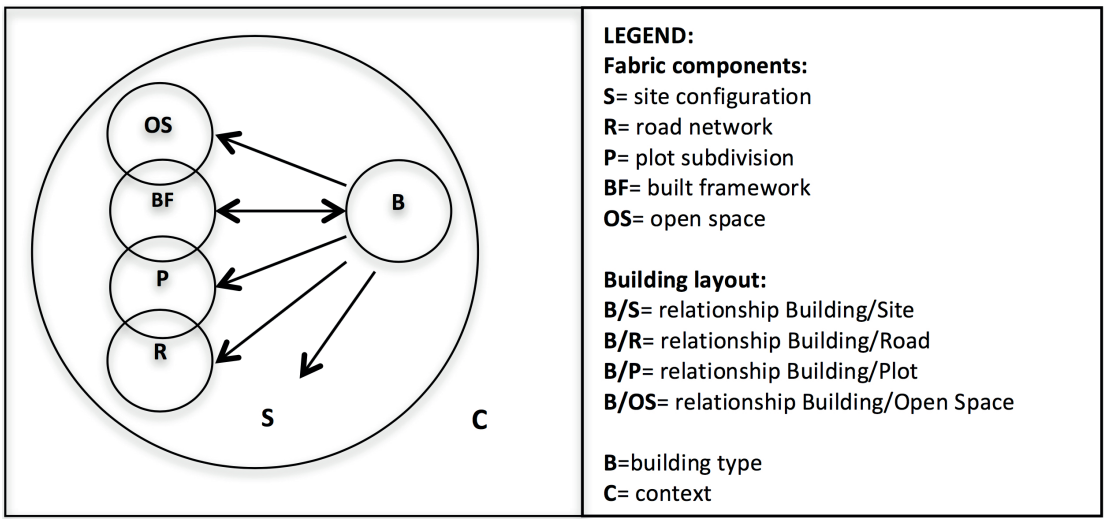

Figure 1. *Synthetic representation of the organisation of planned fabric and its relation to urban form (Racine, 2016).*

The first project studied here is Habitations Boyce-Viau (1969-1971), awarded an honorable mention by the Canadian Housing Design Council. The project was recognised as representative of the first experiences of modern urban design in Montreal (Bergeron, 1989). One of the first postmodernist projects built in Montreal, Quartier Saint-Sulpice (1983-1986) is the second project analysed in this research project. In the 1980s, the project won an architectural and urban design competition and was recognised as representative of the new trend in urban design by the Quebec Order of Architects (OAQ, 1983). Place Valois (2001-2006), awarded a prize for the incorporation of its architecture into the city, is the third project selected for analysis. The approach developed in Place Valois is classified by Marsan as representative of "contemporary urbanism" (Marsan, 2016). The next section presents an analysis of the three projects selected. It summarises how the components and their organisation in the project relate to the morphology of the surrounding urban fabric (*context*) and how the project has transformed the urban form in general.

4. Analysis / Results

4.1. *Habitations Boyce-Viau (1969-1971)*

The Habitations Boyce-Viau project is part of the Myriade I large-scale housing program launched by the City of Montreal in the 1960s. The goal of this municipal program was to build 1,600 housing units on a number of sites located in older Montreal neighbourhoods dating from the 19th and early 20th centuries. The new housing was intended to counter the spread of what authorities deemed to be substandard dwellings, while increasing the affordable housing stock. The City entrusted the program's full implementation and administration to the Office Municipal de l'Habitation de Montréal (OMHM). However, the latter had to comply with the plans and specifications prepared by the City's Service de l'Habitation, which was also in charge of setting out the eligibility criteria for allocation of families to the new subsidised housing. The choice of a contractor and the contractor's architects was made either through competitive tendering or the standard call for tenders (Service de l'Habitation, 1969).

Figure 2. *Physical location of the projects: (A) Habitations Boyce-Viau (1969–71); (B) Quartier Saint-Sulpice (1983–86); and (C) Place Valois (2001–06).*

The project was designed to create a balance by offering units of various sizes so as to reflect the diversity of households in need of relocation. A half hectare of the site had to be reserved for the development of a public playground (Figure 3). The two city blocks located southwest of the intersection of Boyce Street and Viau Street, owned by the City of Montreal, were sold to the Office Municipal d'Habitation de Montréal (OMHM) in 1969. For its contractor, the OMHM chose Secant, the construction company associated with Philip David Bobrow and Michael Fieldman, the architects who won the competition (Service de l'Habitation, 1969).

With a view to ensuring the diversity of households required by the Service de l'Habitation, the architects developed five three-storey apartment complexes, where each floor was accessed via indoor stairways. Each model comprised a range of units, including studio apartments and one to five-bedroom units, the larger ones being on two floors. Household diversity was encouraged by the floor plans, designed to group together units of varying sizes. The grouping of these L-shaped apartment complex models allowed for the definition of an overall plan that included open space for residential use.

The Canadian Housing Design Council awarded an honourable mention to the Habitations Boyce-Viau project "for its socioeconomic provisions and objectives" (Service de l'Habitation, 1971). It recognised the project's quality as being superior "even to some costlier housing projects". Although established according to the free plan principle, the L-shape of the buildings enabled architects to define the layout of open spaces. The outdoor areas defined by this spatial arrangement allowed for the establishing of various semi-public courtyards and a network of pedestrian paths to connect them. These semi-public spaces are situated on concrete slabs, below which is located the parking area. The slabs are adorned with plant troughs and urban furniture. The remaining open spaces are vegetated and include pedestrian paths. The coefficient footprint of the project is 30%, while the density is 95 units per hectare. Despite the high density, "open air spaces seemed sufficient" (Service de l'Habitation, 1971).

Synchronic and diachronic analyses show that the organisation of Habitations Boyce-Viau broke with the urban form system in place at the time of the neighbourhood's creation. The project is characterised by an inward-facing organisation that contrasts with the neighbourhood's typical elongated, rectangular city blocks. The degree of integration of the surrounding urban fabric is affected by the inward orientation of buildings on the site. The apartment complexes cluster around semi-public courtyards that have little contact with the adjacent road network. The playground does not act as a pivot or a meeting point, as originally intended by the designers. On the northern side, a fence makes it impossible to walk from the dwellings to the playground. On the southern side, Hochelaga Street, a wide urban artery, constitutes an additional obstacle to comfortable pedestrian access. This results in a semi-privatisation of the courtyard, the pedestrian path, and the park space defined by designers. Visitors have the impression that they are entering courts and gardens that can be used by residents only. A kind of social control is established between buildings and over semi-public courtyards (Jacobs, 1993). This is not the case for the central courtyard, where the adjacent building walls are generally blind. Finally, it is important to note that the absence of a hierarchy of open spaces makes it difficult for residents to appropriate these open areas.

The functionalist modernist design is expressed in a clean separation between the car traffic level and the vegetated environment of pedestrian paths where the buildings are located. Vehicle access stops at the four exterior visitor parking lots and the underground parking facility located below the semi-public courtyard slabs. The segregation between pedestrian space and vehicle space, relegated to the underground and to the site's periphery, results in pedestrian paths serving the single purpose of allowing residents to access the entrance of their homes.

It should be observed however that the buildings' architectural composition and size may be integrated into existing building types in the neighbourhood. Nevertheless, the hierarchy of building façades differs, the façades overlooking streets being the same as those fronting the semi-public courtyards. The homogenous architectural expression does not help to guide visitors through the site: they cannot distinguish the fronts of buildings, usually public, from the rear, which is typically the more private area in urban environments.

The designers' objective to promote household diversity by mixing unit types was not entirely achieved. The entrances of the collective buildings face either an interior courtyard, a green space, or the sidewalk of an adjacent street, precluding encounters between residents in the same yard serving as a communal space. The implementation of a modernist urban design approach has resulted in an introverted project that is poorly connected to its built environment and its historical context. Isolated from the neighbourhood, the project is showing signs of deterioration due to the aging of its buildings, which need repair. Meanwhile, a reflection on the links between the built ensemble and the adjacent neighbourhood is also in order.

4.2. *Quartier Saint-Sulpice (1983-1986)*

In 1962, Humphrey Carver, director of the committee in charge of housing policy at the Canada Mortgage and Housing Corporation (CMHC), a federal organisation, wrote: "[...] vast stretches of family housing in older districts cannot remain in use unless they become comparable to newer suburbs in terms of street safety [and] the existence of pleasant green spaces [...]" (our translation) (Bergeron, 1989). During the 1980s, the City of Montreal launched Operation 20,000 Homes, aimed at countering the flight of middle-class families to the northern and southern suburbs of Montreal Island. Through this program, the City sought to control the quality of its projects by organising urban design competitions between teams composed of

Figure 3. *Habitations Boyce-Viau (1969-1971).*

developers and architects, on strategic lands owned by the City. The objective was to promote housing types and building ensembles that had the potential to attract families.

A technical committee within the City was composed of planning professionals tasked with reviewing the projects submitted. Integration within the building context, coherence in relation to volumetry, and the positioning of buildings within city blocks were the urban criteria used by the City. The quality of the overall architectural composition was also assessed. Following this technical evaluation, the project was presented to the executive committee for final approval. The City could at this point sell the land to the designated developer as a prelude to the project's launching. The contract stipulated that any change exceeding 10% in relation to the original program required a second assessment by the executive committee.

Under the terms of the competition, the developer was required to put forward a project of a certain degree of architectural quality in order to increase his or her chances of being awarded the site acquisition contract. Starting in the 1980s, this method has enabled a number of architects and urban planners to develop expertise in the design of built ensemble plans. Another spinoff of this type of contract-awarding process is that it is very competitive and hence results in developers proposing quality housing projects. Consequently, they need to work with planning professionals with expertise in urban design. This process has also raised awareness among architects about their project's architectural and urban integration, inasmuch as this criterion is an integral part of the assessment criteria.

The architectural quality of the projects carried out in the context of Operation 20,000 Homes exceeds that of most projects implemented in recent decades by private companies, whose only constraint has been to meet zoning regulation requirements (SHDU, 1988). In 1983, the firm Poirier, Cardinal architectes et urbanistes was awarded the contract for the development of Quartier Saint-Sulpice, located in Domaine André-Grasset. With a view to promoting a diversity of housing types, the ground floor units included part of the half basement space. Top floor units included a mezzanine with an outdoor terrace, a singular component crucial to diversifying Montreal housing types. Walk-up type staircases were installed indoors. The overall project was characterised by a uniform use of cladding materials, namely brick and wood.

In terms of urban fabric, Quartier Saint-Sulpice is designed to establish a relationship between the city blocks that are typical of the south of the project and the residential ensembles found on the northern side (Figure 4). The project was incorporated into a site bordering a busy highway to the south. The street grid was continued on the other side of Autoroute Métropolitaine – an obstacle to the continuity of the urban fabric. Straddling the classic city island and the scenic road network of "garden suburbs", Quartier Saint-Sulpice is characterised by a hybrid system of implantation and services. The overall project met the expectations of Operation 20,000 Homes as regards quality and type diversity. The spatial quality of each housing unit was innovative for its time.

The rows of trees along the streets, the fine definition of dwelling entrances, as well as the presence of a private back garden are testimony to the architects' sensitivity to the morphology and the Montreal housing types. This new sensitivity to local history can be explained by the influence of postmodernist ideologies on Montreal urban designers. Certain architectural elements, such as semicircular arches and brick corbels, also reflect this influence of postmodernist expression in architecture.

Contrary to the architects' wish to include a web of pedestrian paths in the project, similar to those found in garden suburbs, only one footpath was developed within the continuation of a street, close to apartment complex style housing. The intention was partly to discourage transit traffic through these streets. Establishing a local network of streets allows for a controlled

use of the automobile within the residential ensemble. Side streets remain peaceful during off-peak hours. A row of trees separates the sidewalk from roads reserved for vehicles and creates a screen of vegetation between the street and housing units. However, the buildings turn away from the major adjacent avenues and a continuous scree slope blocks the view. In accordance with the functionalist vision, these routes are reserved for fast traffic only.

The overall plan places emphasis on the consistent implanting of basic organisational elements, as defined by the designers, along streets and plots. Side building access to parking allowed designers to develop landscaped street-front entrances. The front setback area features plant life, and stairs provide access to the ground floor, which is slightly higher than ground level. It should be noted that by virtue of the orientation of their vegetation and their position in the overall urban grid, these parks seem to be intended for residents of the adjoining neighbourhoods and are therefore semi-public in nature. This status does not allow for their appropriation by all neighbourhood residents as public spaces. Establishing dwellings near the street has enabled the creation of backyards as a private space available to residents.

The Quartier Saint-Sulpice grid is hybrid in nature, resulting in a sort of collage oscillating between the city blocks located farther south and the more scenic layout of parks and gardens, similar to the garden suburbs that can be found on the outskirts of the Island of Montreal. In this sense, urban designers attempted to offer a built ensemble that is denser than the pavilion environment of the suburbs, while incorporating a quality vegetation frame that differentiates the project from suburban building development setups. Finally, it should be noted that condominium buyers have higher incomes than the average defined by the initial program. However, the objective of the City's Operation 20,000 Homes to attract households back to the city was met, with 85% of households coming from outside the city in 1987 as opposed to 55% in 1983.

Figure 4. *Quartier Saint-Sulpice (1983-1986).*

4.3. *Place Valois (2001-2006)*

In 2001, the City of Montreal launched a development plan for the former railway right-of-way, crossing the Hochelaga-Maisonneuve neighbourhood from east to west. This project came about in the context of the disappearance of industrial complexes that were established in the neighbourhood and the decommissioning of the railway that served them. The four objectives of this project were to reinforce the commercial continuity of Ontario Street (one of the neighbourhood's main streets); to take advantage of the particularities of a historic sector that was urbanised at the turn of the 19th century; to improve the general quality of the living environment and the attractiveness of the neighbourhood; and to integrate the local stakeholders' development objectives and constraints (Eide, Fianu, 2001).

The City Planning Department gave Atelier In Situ, Eide, Fianu architects (Atelier BRAQ), and landscape architect Nicole Valois the mandate to prepare a development plan for the space located at the intersection of Ontario Street, Valois Avenue, and the railway. The designer group was invited to propose a space to "create and formalise the sense that the intersection had the potential of becoming a centre for the sector as a whole". To this end, urban designers proposed to create a new public square inspired by the distinct Montreal tradition of town squares. The urban designers' proposal referred to an existing square, place de la Paix, whose proportions are similar, and they replicated it in the Place Valois project.

The designer team recommended the establishment of the new square on the largest city island northeast of the intersection of the railway and Ontario Street (Figure 5). This entailed the purchase by the City and the demolition of a triangular building in order to free up space needed for the laying out of the new public area. The idea was also to use the line of the former railway tracks to create a new footpath (green link) and to reconstitute the urban fabric by redefining the city islands through which the railway tracks ran. The tracks were used in large part to create a new green link, along which a number of urban planning operations could be implemented. The development involved dividing up the new green link into segments depending on the characteristics of the city islands through which it ran. On the basis of these segments, a range of subsidised housing projects could be incorporated into the new pedestrian pathway using the former railway that led to the new Valois square.

Following the development of the initial overall design by the City of Montreal and pursuant to the decentralisation of urban planning services, the urban planning department of the borough of Mercier-Hochelaga-Maisonneuve took over the project. Based on the design created by In Situ, Eide, Fianu architects, and Nicole Valois, Peter Soland drew up the Valois square development plan. The area was restored to the public domain to mark the neighbourhood's industrial past and the passage of freight trains through the Ontario-Valois junction. Soland designed the Simon-Valois square as a contemporary public space. The pavement, the layout of urban furniture, and strips of vegetation echoed the line of the former railway tracks. The Valois square project displays some characteristics of European urban planning practices. This was a novelty in Montreal. The square was developed before the surrounding housing projects, as a basis for the neighbourhood's revitalisation.

The Place Valois urban design project has met the majority of its objectives. The criss-crossing of blocks of buildings and the former railway reveals the sector's industrial past, and this feature was preserved and showcased by the project. The trace of the railway running through the city fabric was highlighted by the square's development (Schème Consultants, Atelier Urban Soland 2003). Place Valois is part of the history of the city's creation: it is located where

the urban grid meets the geometry of the railway tracks, as well as the former Hochelaga and Maisonneuve neighbourhoods.

The public square is seen as an open space within the built fabric. The coherence of the square's shape is attributable to the shape of the walls that define its frame. The typical street encircling Montreal's public squares was designed to serve as a terrace for adjoining businesses. Façades clearly delimit the space by creating obvious boundaries (Lynch, 1960). Designers drew a parallel between a rail yard where railway tracks converge and a public square where citizens meet.

The green link also evokes a genuine journey along the historic line and connects a range of blocks that were once occupied by industries. The break between buildings encourages citizens to continue their path to the green link promenade. The promenade is dotted with references to railway history, such as paving stones and historic objects. The integration of new housing projects on each side of Place Valois was strictly monitored by the Service d'urbanisme de l'arrondissement. As a result, buildings consolidate the urban grid by adding contemporary touches while showcasing the site's history. The façades overlooking the railway right-of-way are given similar importance to that of façades facing the street in order to provide a certain architectural quality and public space status to the green link path. The concept of continuity was also explicit in the former railway right-of-way's development.

The orthogonal grid of the neighbourhood was preserved and even reinforced. The built front around the square structures the public space, enhances it on the level of Ontario Street, and attributes a new centrality to the neighbourhood itself. The project as a whole highlight the economic revitalisation fostered by the urban design project. Business activity has picked up on Ontario Street, and green spaces can be found along the green link. The Valois project establishes a strong dialogue with the existing built environment.

The Place Valois project has generated positive economic, social, and morphological spinoffs. The organisation of Montreal's urban grid and the setting up of new public spaces have stimulated residential construction and a large number of housing operations along the former rail-

Figure 5. *Place Valois (2001-2006).*

way right-of-way that constitutes the reorganisation line. However, the neighbourhood's status changed promptly following the project's implementation, resulting in protest movements against gentrification of the area. This phenomenon commonly occurs when the general quality of a living environment and the attractiveness of a neighbourhood increase. The borough has solved this problem by promoting some social housing operations along the new green link.

5. Discussion / Conclusion

The analysis of Habitations Boyce-Viau highlighted the introverted nature of its implantation and of its architectural expression. The project was implemented in a context where City authorities chose to rapidly build subsidised housing ensembles as a means to solve social issues (unemployment, decrepit dwellings, and so on). The unrestricted on-site implantation of buildings, with no plot division constraints, the segregation between pedestrian and automobile spaces, and the placing of housing units in a green space are a partial reflection of the ideas presented in the Athens Charter (Le Corbusier, 1957).

The Quartier Saint-Sulpice residential project evokes a type of spatial organisation that straddles the garden suburb and the traditional town. The reinterpreting of the typical housing units of Montreal in the constitution of a residential habitat demonstrates the existence of a movement for the free reinterpretation of historic models in urban design practice. The context of implementation has also changed. The project targeted a specific clientele in order to counter the exodus of households to the Island of Montreal's northern and southern suburban communities. In addition, the awarding of the contract by the City reflects the establishing of quality-related criteria where public authorities assess projects in terms of their architectural quality and their relationship to the urban environment. The influence of postmodernist theories and discourse in the designers' desire to create a built environment that straddles the fine line between the real and the imagined city is manifest in these projects.

As regards Place Valois, an important change can be noted in relation to the degree of integration of the contemporary project into the urban fabric. The design approach was inspired by the history of the place and made explicit reference Montreal urban types, namely its public square tradition. The industrial past of Hochelaga-Maisonneuve nurtured the design process through the keeping and showcasing of certain features. The Place Valois project also reflected the City's desire to act on a larger scale in the organisation of its territory by creating a new centrality for the neighbourhood. This project, focused on the public square, has initiated an urban planning process aimed at protecting the existing built environment and enhancing the quality of Hochelaga-Maisonneuve's network of public spaces.

Despite a limited sampling, this paper on urban projects realised in Montreal since 1956 reveals a certain trend characterising the evolution of the urban design theories underlying these projects. For a work that served as a basis for the publication of two articles focusing on six other projects, Maude Gilles and Simon Wuilmart put together a database that supports the conclusions of the current article (Racine, 2016, 2018). The research shows that contemporary schools of thought have valued a tighter relation of planned built environments to city form and that designers use the context and its latent spatial potential for physical integration to ensure the sustainability of the new urban ensemble (Kostourou, Karimi, 2017).

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Assemblages of Anthropocene Landscapes

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Keywords: Assemblages, Anthropocene landscapes, knowledge spatialization.

Abstract: The Anthropocene reveals itself in urban landscapes. The multidimensional effects of global change – rapid urbanization processes, heavy rain events, droughts, resource scarcity, and the acceleration of social injustice – all confront urban and natural systems and their inhabitants with increasing challenges. People are once again being forced to rethink the circumstances and components that have led to these transformations. Because of the strong interconnectivity between these urban and natural phenomena, revised approaches to Anthropocene landscapes require us to think in terms of dynamic categories, i.e. relationships and interactions between nature and culture and between human and non-human actors, and then to focus on their spatialization. Landscape architecture has the competence to link different types of disciplinary and social knowledge as well as creative design practices and spatial transformations, thus materializing knowledge about robust urban landscapes. This paper argues for an integrative approach that links assemblage and post-human theories with systems thinking, landscape design and interactive methods in order to foster innovation in changing landscape architectural theory and practice. We wish to promote an understanding of urban transformation as a process of materialized knowledge reflection, adaptation and innovation. This article outlines conceptual approaches to deciphering the assemblages (or links) of Anthropocene landscapes. They should also show how the "agencies" of landscapes can be stimulated and how more capacity for action can be achieved with regards to dealing with the challenges of the Anthropocene.

1. Introduction

Dealing with the multidimensional effects of global change as well as the irreversible human impact on an entire planet that is high industrialized and geo-effective means dealing with wicked problems and uncertainty in the Anthropocene epoch. This is also a historical moment – in June 2019 the international panel of scientists in the Anthropocene Working Group (AWG) formally defined a new geological slice. According to Zalasiewicz (in Subramanian, 2019) 'The Anthropocene works as a geological unit of time, process and strata'. The Anthropocene has led to an accelerated global metabolism that has changed our environment profoundly. Furthermore, nature is no longer seen as an infinite resource. What is new is that human action has become a major factor in planetary balances and imbalances (Renn and Scherer, 2015, 13) The Anthropocene reminds us that viewpoints and times are changing. Likewise, there is an

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interest in a better understanding of the deep evolutionary processes of the earth's history (deep time) and the depth of its geological strata, geomorphology (deep ground), this time linking scale with today's accelerated processes (Giseke, 2018).

We are faced with the challenge of adapting our knowledge production to these upheavals, putting our ears to the ground, as it were. Floods and droughts, as well as the immense consumption of water and food, make it clear that we are part of complex material, energy, capital and information flows (Renn and Scherer, 2015, 13). This is even more challenging because we need to learn to grasp our knowledge as the result of long-term and ad-hoc processes of development at the same time. Following Chakrabarty (2015, 158) '[…] as we learn to acknowledge our place in the depths of time, in geological and evolutionary time, we also begin to connect our localized problems with some of the broader issues, and therefore we will be in the position to intervene in these development processes'.

In addition to increasing the awareness and management of natural, social and political risks, the Anthropocene concept also allows for a deeper understanding of how nature and technology interact. Indeed, there is no single coherent narrative, but several. According to Dürbeck (2018, 2), the Anthropocene debate serves as a bridging approach and ranges from natural and social sciences to humanities and public discussions. From the perspective of cultural studies and environmental humanities, the human with its geophysical force is being questioned in a subject-object-dichotomy, titled as the interdependence-narrative. The Anthropocene debate reminds us to adjust our knowledge production as well as our knowledge systems. On the one hand, the position of the human as a critical thinking and active component is still anchored in modernism, while on the other hand in the passive nature that needs to be cultivated, adapted and transformed for social needs or in terms of ecology to be protected against human impacts. In Dürbeck's argumentation this follows the narrative of the Anthropocene as a cultural concept that aims to think about the human with a post-human approach (Dürbeck, 2018, 13). These critical theoretical approaches have been primarily developed in the humanities and social sciences as 'the non-human turn' (Grusin, 2015). This was stimulated by the work of Donna Haraway with the figure of the 'cyborg' as a hybrid of human and non-human (1990) and Bruno Latour's Actor-NetworkTheory (ANT) (1998 [1991]), which describes the distribution of an "agency" among a heterogenous network of human and nonhuman actants. To overcome the separated positions of nature and culture, and subject and object, it is necessary to focus on critical arguments which stimulate the assertiveness of the Anthropocene.

However, this article is about assemblages of Anthropocene landscapes, focusing on their systemic and transformative relations and understanding them as linkages between positions and concepts that had previously been treated as dichotomies. Anthropocene discourses manifest a hybridization of separate categories such as culture and nature, city and landscape, human and non-human actors, and material and immaterial. It thus addresses both a profound material, concrete, spatial and theoretical dimension. Therefore, Klingan and Rosol (2019, 13) describe the Anthropocene as 'becoming empirical of a new influence relationships'. We argue that this empiricization can be found in landscape.

Why in landscape? Firstly, the transformation pressure on landscapes worldwide is extremely great, triggered by territorial rearrangements as a result of the many effects of the Anthropocene period such as extreme weather events, massive urbanization, overused areas, a lack of resources and the loss of species. Indirectly, the Anthropocene shows a high degree of interdependence among conflict fields, e.g. through periodic and sudden disaster or long-term changes in and of landscapes. These act locally and globally at the same time, and are dependent on a variety of very different systemic, spatial, social, cultural and natural constellations.

Secondly, as a general multidimensional concept, landscape includes both the matter and the idea, in other words it embodies the nature-culture dichotomy in itself. Seen from the Anthropocene perspective, landscape is obviously not only a geophysical surface that can be formed. Instead, 'a landscape possesses an efficacy of its own, a liveliness intermerged with human agency' (Bennett, 2011, 15). Thirdly, following the definition of human geography for landscape morphology, 'it is the material formation of the landscape, its shaping and reshaping, in which social structures and cultural world are enfold' (Oxford reference, n.d.). Similar to sociospatial perspectives on urban space, landscape morphology embeds social, cultural and economic practices. Furthermore, we also understand landscape as practice, as an object, an actor and a knowledge-archive at the same time. This approach to landscape includes socio-natural and socio-technical linkages. Combining both approaches, assemblages of Anthropocene landscapes are treated as an enhanced field of research and practice. Grasping the knowledge of these assemblages in their materiality and idea and in their morphology and practice, there is a need to focus on the mutual relationships between different systems, components, actors and processes. This theoretically and empirically includes their immediate relationship to society, nature and technology, and their capability to act and to represent knowledge at the same time (Wieck and Giseke, 2017).

2. Methodology

The transformations of Anthropocene landscape – as we argue from the discipline of landscape architecture – can no longer be dealt with using morphological and functional problem solutions in research and design practice. Rather, they require an interplay of systemic approaches and scenario thinking that abandons previous categories and classifications, and develops productive units and stimulates and designing links. In changing the perspectives towards human-non-human relations, it is equally clear to us that we need to adapt our knowledge to these transformation challenges. There is a growing demand for a landscape architecture that understands which knowledge systems shape our thinking and what kind of new knowledge we need to tackle the wicked transformation challenges of the Anthropocene in order to develop hybrid design solutions. Landscape architecture has to face the challenge of identifying and qualifying interfaces of this interaction, reassessing them and stimulating processes. This is not only an academic exercise but a very ontology-oriented practice of landscape architecture that stresses empirical knowledge.

Three conceptual approaches are introduced here: the actor-networktheory, assemblage theories, and systemic thinking and design.Together, they are considered to be suitable for focusing on the transformative relationships inherent in Anthropocene landscapes. The Department of Landscape Architecture and Open Space Planning at the TU Berlin uses these approaches in teaching and research in order to make them productive for landscape architectural design and new linking cultures. This also aims to contribute to the development of a fundamental theoretical and methodological position for landscape architecture in the Anthropocene period.

3. Assemblages of humans and nonhumans – the ANT

The increased interest in designing with an eye for natural processes and non-humans provoked by the Anthropocene discussion has led to a new perspective of the social. With the development of the ANT, Bruno Latour mentions symmetric relationships between humans and nonhumans. These hybrids foster a new understanding of nature-culture and subject-object

relations, seeing nature and society as being network-building or collective (Latour/Callon in Belliger, 2006, 38). It creates a path to re-inject things and matters of concern 'into our understanding of the social fabrics [...] through a network-like ontology' (Latour, 1996, 3). Non-humans therein are to be understood variously as animals, plants, affectivity, bodies, organic and geophysical systems, materiality and technologies (Grusin, 2015, vii). They are all embedded in acting programs, and they share responsibility. Sharing responsibility in a symmetric thinking of acting networks is what Latour also calls 'the farewell to the sublime' (Latour, 2016). There is no more acting competence of humans than the agency of nonhumans. Rather, as Grusin (2015, xv) argues interpreting Latour, that the distribution of agency is not only among non-humans, but across a heterogeneous network of human and non-human "actants", i.e. networks of actors who take action. With this balanced perspective, ANT focuses on coevolving, coexistence and collaboration. In other words, for Latour it is a rethinking and repositioning of society as a whole, as a complex assemblage of human and non-human actors. This readjustment of thinking about society is also named as the process of building a network, as communicative action towards a balance of interests, as translation.

As a contribution to the development of a linkage theory of landscape architecture in the Anthropocene, we adapt Latour's approach of translation to better understand how this balanced status in landscape can be achieved as a co-evolutionary process – in reflecting, describing and transforming Anthropocene landscapes. It helps us to clearly formulate collective goals for assemblages of human and non-human actors as a design for robust hybrid landscapes.

4. Vibrant matters – Assemblage theories

While ANT reflects in a more socially critical way about which collectives of human and non-human actors develop in 'coherent moves' (Latour 1999, 194), the approaches of assemblage theories focus more on the nature of the connections between heterogeneous components as well as their materialization and spatialization. For designing Anthropocene landscapes this provides a basic understanding of the materialized nature of relations and of the interactive competence of the materiality itself.

Assemblages are defined as a multitude of linkages between actors, components and processes. They permeate all areas of life in which humans, nature and technology meet. Thus, they stimulate a reflective translation of landscape architectural work. Assemblage concepts, first developed as social theories, help us to focus on the mutual relationships of landscape components and their effects, their spatialization and their constant moves. Therefore, assemblage approaches can be seen as a theoretical instrument for decoding relationships in landscapes and their socio-materialized knowledge.

Two assemblage approaches are selected here in order to highlight the competence for assemblage thinking as concepts for describing and designing Anthropocene landscapes.

First, attention is given to the political scientist Jane Bennett, who provides a manifesto for a new materialism which decodes the capacity to act on things – a 'vibrant matter' – that pulse and connect again and again (Bennett, 2010). Her approach is on affective things forming assemblages or the distributive agency of things and systems. Bennett positions this vital materialism as a supplement and complement to historical materialisms that were developed as a counterposition to global capitalism (Bennett, 2015, 223). In Bennett's understanding, the landscape itself is a vibrant matter that positions nature and culture as an agency of heterogenous assemblages, as a locus which is always a human/non-human collective (Bennett, 2011, 23).

The interactivity of these matters is provided by both, i.e., by systems and things. This includes Bennett's positioning as things with an inherent "thing-power" (i.e. the power of interaction that things have) that aims to theorize a materiality as force and power. It further involves the agency or efficacy in dependence on 'collaboration, cooperation or interactive interference of many bodies and forces' (Bennett, 2010, 21).

The second assemblage approach introduced here is McFarlane's argumentation for the materialized production of knowledge. Taking McFarlane's learning as a translocal assemblage concept emphasizes the need for people to interact with themselves and also with the environment. McFarlane (2011, 16) argues that 'learning is a distributive process that foregrounds materiality and spatial relationships of learning'. His concept of learning as a process of translation, coordination and dwelling implies possibilities for socio-material configurations of human and non-human components. Following Latour, who said that we had started to be affected, McFarlane points out that humans learn to perceive policy through a practiced ability and thus respond to changing contexts.

The 'vibrant matters' of Bennett's assemblage approach can be used as a superordinated, materialized image of Anthropocene landscapes. They include both a materialized agency to act and to interact in assemblages. Taking this together with McFarlane's socio-materialized knowledge, the Anthropocene landscape in its relations, materialities, meaning and acting represents a resonance space for the transfer of knowledge. This reflection promotes the development of adapted categories in understanding, describing and designing active competences and agencies of hybrid and robust landscapes across multiple scales and times.

5. Systemic thinking and design

Systems thinking, as it developed in the 20th century, has shifted from a reductionist to a holistic approach aimed at dealing with complex features. Systems thinking in general becomes evident in many disciplines, based on an understanding that the 'whole' of a given condition is not the sum of its parts but is rather a product of interactions between the parts.

Accordingly, the Oxford English Dictionary (n.d.) defines a system as 'A set, or assemblage of things connected, associated, or interdependent, so as to form a complex unity'. Shaked and Schechter also simply define a system 'as a functionally related assemblage of interacting, interrelated, or interdependent elements forming a complex whole.' They stress that 'The variety of systems falling under such a definition is endless, encompassing natural systems such as the human body, the earth, and space; human-made systems ranging from tiny hi-tech chips to global commercial conglomerates; conceptual systems like ethics and policy; and many more. [...] systems thinking provides a means of seeing the system as an integrated, complex composition of many interconnected components that need to work together for the whole to function successfully' (Shaked and Schechter, 2017, 9).

We assume that the conceptual framework of systems thinking and design is extremely useful for creating a better understanding and shaping of Anthropocene landscapes or the urban-natural hybrids, their different subsystems, their elements and their relations, and interactions. Systems thinking offers scientific ways to approach complex features and it also becomes even more evident in many disciplines for addressing real-life-problems (Giseke et al., 2015).

Translated to the concept of Anthropocene landscapes, systems thinking not only allows us to describe them as systems, i.e. to think about them as systems, but to think about them from the standpoint of systems (Boardman and Sauser, 2008, xix) and the interrelations of different subsystems. Systems thinking thus offers a methodological approach to Anthropocene

landscapes, enabling various disciplinary, sectoral, thematic and spatial perspectives in parallel to a set, or aggregate of things, be they natural, artificial, or social, that form a contextualized, concrete, spatial whole. This might include geological formations such as mountains, rivers and the wind, as well as physical elements shaping urban form. Analog to this, they can be described as a social system or as the intake and output of certain materials and related infrastructural systems. All of this stakes out a specific territory that consists of both material components on the one hand, and immaterial components such as values on the other.

Nevertheless, systems thinking offers tools to increase our understanding (and ability to design) Anthropocene landscapes as hybrid natural, technical and social features.

6. Analysis/Results

This paper argues for an integrative approach linking assemblage and post-human theories with system thinking, landscape design and interactive methods in order to foster innovation in changing landscape architectural theory and practice. Three projects from research and teaching in landscape architecture are introduced here to show how the linking of theories and design practice can promote interactive approaches for designing assemblages of Anthropocene landscapes.

7. Isar Camp – Rethinking and designing collectives

Rethinking and transforming the Bavarian Isar as a riverine landscape in the Anthropocene is a challenging task for master's students in the current Landscape architecture design studio 'Isar – Designing Anthropocene Natures'. In the studio students are asked to design their 'own' river landscape assemblage with its relations and exchange processes as a collective, following Latour's processes of actor-network building. This task also opens a debate about a possible and more symmetric coexistence between rivers and humans in the Anthropocene (Kropp, 2015). The following questions were raised concerning the Isar landscape: Why do we see the river only as a wild, alpine one, neglecting its technical reshaping? Which multifaceted dimensions does the river represent, having a closer look at it? How does the river deal with the contracting demands of being wild, natural, controlled and productive at the same time? Which of these demands are obvious and visible, and which rather invisible? How does the collaboration and coexistence of human and non-human take place? To get answers to some of these questions, an Isar Camp was organized for 30 Students so that they could deepen their theoretical approaches and to get in touch with the river.

The Isar Camp was an experimental field. It involved walking along the Isar river, readings, discussions, posing questions, generating collectives by using found pieces, reflecting, collecting, building and linking information and actors. Using the process of actor-network building and Latour′s collectives as a starting point, the students were asked to link critical theoretical approaches and field research to performative and systemic design work. To create statements from human and non-human actors and stimulate the taking of another perspective, we used the technique of asking questions. The textual work and immersion in the Isar Camp was an experimental set-up with the goal of creating new Isar narratives, including the materialized knowledge of the Isar itself in terms of geophysical forces, human impacts and technological development. Packed with findings from the Isar landscape that serve as material and symbolic, human and non-human actants in a riverine-collective, the students were asked to physically

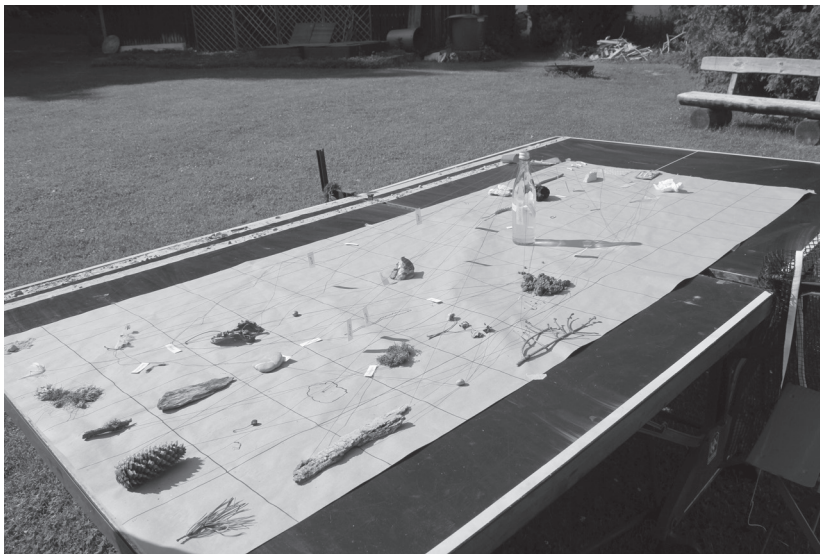

Figure 1. *Isar Camp collectives – Building networks as experimentation order for future design collectives, left: Anne Arndt, Karoline Dorothea Haerter, Cian Lorcan Hansen-Ennis, right: Kami Hattler, Joel Schreyer, 2019.*

create an experimental arrangement of possible actor-arrangements by using their findings following Latour's process of building a network; see figures 1 and 2 (Latour, 1996; Latour, 1999, 194, 195; Belliger and Krieger, 2006, 40, 41). Based on these concrete physical arrangements, the students were able to discuss the more general collective problems, sub-programs and transformation goals of the different actors, i.e. humans, birds, fish, currents, flooding, turbines, a nuclear power station, a sewage treatment plant, an airport, alluvial forests, e.g. To further develop design ideas that often dealt with ambivalent and contradictory interests, the first design questions were developed, for example, How can we make the deep time degradation processes of plastic visible, perceptible and conscious? How could we set up a new language for materialized relations between humans and non-humans? And, how can we develop agencies if birds are the main actors who are responsible for building the collective and are simultaneously involved in a network of interests, practices and regulations?

8. K.I.E.S – Designing of agencies

Following the assemblage approaches of McFarlane and Jane Bennett, the master's thesis of Elisabeth Stieger (2017) shows the relevance of complex knowledge structures in the Anthropocene and their challenges for landscape architecture. As a separate and innovative question, gravel was treated as an actor in the two knowledge systems of the eco- and technosphere, and the claim was formulated to develop another type of knowledge for the material in combination with both. The empirical object of the work is the Gotha gravel complex – as a geological formation with natural geological knowledge and as a deposit in buildings and infrastructure with technological-economic knowledge. The disclosure of the potential of the gravel is conducted through the discovery of the natural process transformation and storage, as well as the technical process extraction, conversion and custom storage. This analysis related to the socio-materiality and the 'vibrant matters' of assemblages has led to the synthesized design concept of the gravel plant in Gotha (see Figure 3). As a result, a new deposit was designed that is formed by terraces which inform visitors about the accumulation of gravel in the riverbed and about the various gravel mining stages in the construction industry. Furthermore, the compartments of the deposit hold information through different filling levels, showing the material in all stages and with changing granularity linked to the demand of the construction industry and resulting demolition quantities, all the stages of which belong to the eco- and the technosphere. The

Figure 2. *Isar Camp collectives – Building collectives as experimentation order with birds, water, infrastructures, plants, humans, objects, institutions and norms, Andreas Ebert, Jörn Gertenbach, Nils Belting, 2019.*

ongoing transformation processes of the Gotha landscape due to the coherent moving of gravel have also been made visible in the deposit to aid in the future processes of dismantling and recycling the concrete into its original parts by electrodynamic fragmentation.

The potential of the material as a raw material and building material, as well as its ability to combine both, are made visible and experienceable. Furthermore, the design involves the possibility of participation via an app, and also extends the perspectives of gravel as a raw material and building material, not only in its acting competences but as agencies as well.

9. Fostering systemic thinking: Linking food as a component of the urban infrastructure in Kigali

In 2014 the Rapid Planning research project started. Its purpose was to develop a rapid trans-sectoral urban planning methodology, specifically targeting supply and disposal infrastructure and aiming at creating synergies within the urban metabolism and its material flows. The sectors covered by the project include energy, water, waste water/sanitation, solid waste and urban agriculture/food. DaNang in Vietnam, Kigali in Ruanda and Assiut in Egypt are partner cities in this action-oriented research project.

How can possible synergies between various material flows that are necessary to supply

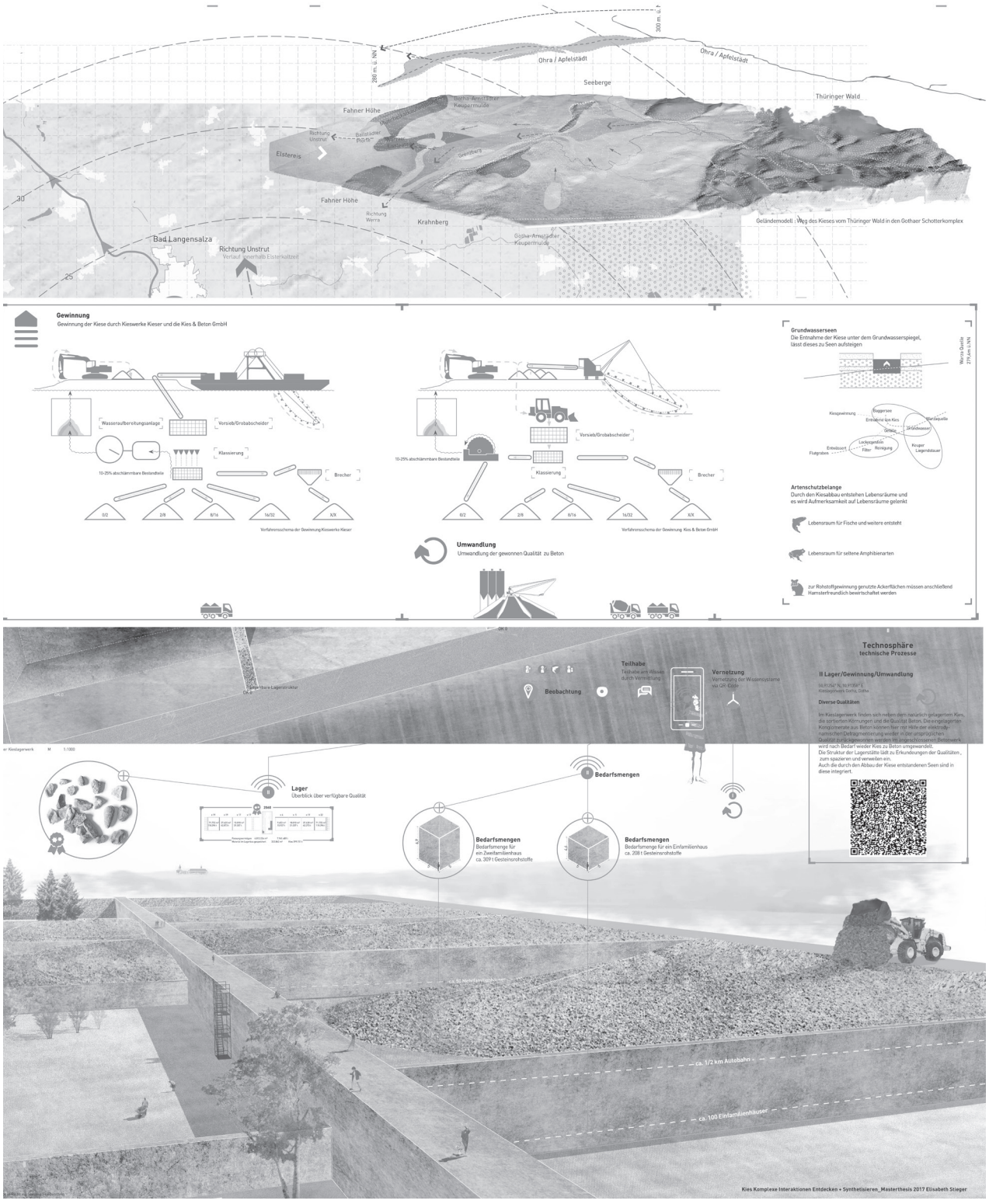

Figure 3. *K.I.E.S. – Discovering, extracting, distributing and synthesizing interactions of gravel in gravel complex of Gotha, Elisabeth Stieger, 2017.*

cities be generated? Which trans-sectoral infrastructure systems are required? Which new assemblages have to be generated to do so? These questions have been raised by a broadly interdisciplinary team. For the first time, the food system has been systematically included here in the canon of urban infrastructure and was considered as a central material flow in addition to water, energy and waste.

Compared to traditional supply and disposal infrastructures, food supply is quite complex, and with its five components of production, processing, distribution, consumption and leftovers it may be called a hybrid or an assemblage in itself, as it brings together very heterogeneous components. There is, however, a range of direct interfaces with urban planning to which attention first has to be given.

Within the project, a so-called entry project – i.e., a small-scale project stimulating change – has brought together different actors for the first time, thus starting a process of linking different material flows of infrastructural systems in the informal settlement of Agatare. The settlement extends over steep slopes directly down to the wetlands, which are used primarily for agricultural purposes, among other things, by a cooperative of around thirty farmers, who produce vegetables and supply the local markets. We had workshops with the wetland farmers as well as with residents who live nearby. One result was a micro-concept for linking different infrastructure systems such as waste water disposal, organic waste and food production through a local improvement of the different systems. The concept includes, among other things, the test implementation of cleaning boxes for the gray water of private households, the development of the rainwater storage capacity at the neighboring school, the creation of purchase points for garbage collected separately, the erection of sales points for agricultural products and a project to produce more fertilizer for the Wetland Farmer Cooperative through composting. Thus, new linkages between the informal settlement's different subsystems such as waste water, organic waste and food production have been created as a micro-scale showcase (see Figure 4).

10. Discussion/Conclusion

This paper argues for an integrative approach that links assemblage and post-human theories with system thinking, landscape design and interactive methods in order to foster innovation in changing landscape architecture theory and practice. It promotes an understanding of landscape transformation as a process of materialized knowledge reflection, adaptation and innovation. Furthermore, it presents conceptual approaches for deciphering assemblages of Anthropocene landscapes, and for stimulating their systems, collectives and agencies to interact in order to attain more acting ability in dealing with the Anthropocene challenges. In tackling this, we have to do two things in parallel: Develop a deeper understanding of the materialized knowledge of landscape and adapt our landscape architectural research and practice in favor of the future development of landscape assemblages. The three projects presented here stress this need for a deeper reflection of knowledge spatialization and the need for designing co-evolutionary transformation processes for the creation of robust and hybrid landscapes.

Anthropocene landscapes as assemblages can be addressed through translating. According to Latour (in Belliger, 2006), Haraway (1990) and McFarlane (2011), translating means linking different actors, their roles and processes to increase knowledge from different knowledge archives, to rearrange it and to reintroduce it into theory and space. Represented through these projects and argumentation, we make the translation work productive for landscape architecture theory and practice. Translating is also the active process of network building and linking heterogeneous actors – systems, things, knowledge, humans and non-humans. This translation work of building collectives was actively called upon at the Isar Camp and used to develop different design strategies for Anthropocene riverine landscapes. Based on the experimental arrangement, various actors – like plastics, fish, birds, treatment plants, European laws, phosphorus, farmers, language, water reservoirs, meadows – their diverging roles and functions as

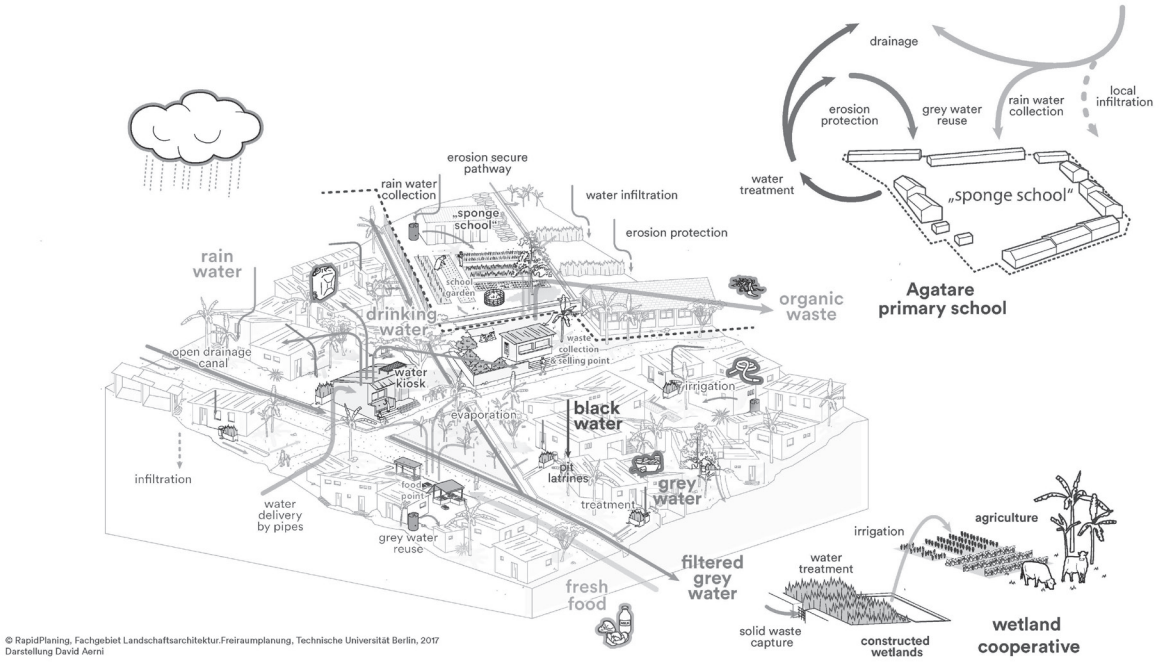

Figure 4. *Metabolic linkages between Agatare settlement and the wetlands, Rapid Planning Project, 2017.*

well as their contradictory sub-programs have been made visible and activated in the preliminary work of designing new collectives. The approach of Latour's collectives and their communicative actions make it possible to anticipate different systems, actors, needs and impacts, and to formulate their collective goals as a stimulating design strategy that balances or permits contradictory interests.

The spatialization of post-dualistic knowledge in landscapes is one of the main competences of spatial design disciplines. Through thinking, designing and constructing we bring our knowledge and interpretations about landscape morphologies and practice into being. Furthermore, through describing and designing we add norms, standards and rules of perception, use and appropriations in the landscapes. We also stimulate metabolic processes, cultural activities and social encounters. Simultaneously with this expert knowledge, there is also a knowledge inherent and represented in landscapes that is stored in its materiality, geophysical processes and infrastructural impacts. The translation work landscape architects have to do is decoding knowledge from other disciplines as well as from the existing Anthropocene landscape, bringing it together and recoding it into space and form. Designing and design thinking will thus play a key role in integrated and systemic knowledge production from different human actors, academic disciplines, administrations and communities, as well as from landscape in itself.

Furthermore, with this knowledge that is primarily focused on assemblages we are able to address different questions to the landscape and more hybrid design. The transformation challenges of the Anthropocene require a practice of landscape architecture that adapts, anticipates and develops systems, relations and actors of landscape assemblages in a spatial and material sense. This aspiration combined with Latour's sense of sharing responsibility invokes landscape architecture practice to become involved in the design of co-evolutionary processes and developing landscapes that can react more robustly to transformation challenges, and to help shape

them. The Rapid Planning project has tested how more interactive, small-scale infrastructure can be connected to livelihoods, stimulating metabolic exchange processes locally and linking them with social, economic and political issues on the regional scale as well. In the case of the urban food system, it was possible to show how fertilizer could be generated from organic waste and directly linked to local food production.

Another issue for designing assemblages of Anthropocene landscapes is the mirroring and training of human perception, experience, awareness and participation. When urbanization and climate change provide the metadata, it must be broken down into manageable information. That means we have to do "digestive work" (Marres, 2016, 269)! A possible consequence for the practice of design is to connect people to the relations of natural processes with urban metabolism, infrastructural services or changing urban aesthetics, cultures and economies in order to bring them closer together. As presented in the K.I.E.S. project, the gravel with its agencies combining knowledge and competences from both eco- and technospheres is made visible. With the design of a new gravel deposit, people can experience the transformation processes of gravel connected to their own use of the material in the construction sector. As Stieger (2017, 109) mentioned, '…here, people can watch the construction and reconstruction of their own geological layer'. Assemblage approaches make it possible to describe the properties of gravel and activate its knowledge in its natural and economic processes, to visualize its potential for transformation and to create new syntheses of these properties in order to increase the agency of the material.

If landscape architecture creates more of these successful closer links between systems, knowledge, things, relations and actors, robust and liveable landscapes will arise where – from time to time, during heavy rainfall events – one can get his or her feet wet. We learn to swim in the river only when it is not contaminated by pollutants. In such an intimate introduction to complex interrelations, there is a chance to overcome our supposed comfort, and to create a more robust everyday aesthetic. This would enable us to share and experience the beauty, power and liveliness of the Anthropocene landscape and raise more awareness about the related, and sometimes planetary, processes. So, get out of your comfort zone!

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Methods: Embedding Different Approaches into the Study of Urban Morphology

Redefining Urban Potential through a Morphological Perspective

by Ilaria Geddes
University of Cyprus

Keywords: urban potential, urban morphology, spatial-analytical model, strategic planning, Nicosia.

Abstract: This paper presents the first research output of the project *Urban Potential in the Evolution of Nicosia's Public Realm*. This consists of a set of criteria and their relative importance, which identify the potential of the public realm to perform as a sustainable local centre. The set of criteria will be used in subsequent work to assess data requirements for a GIS-based model of Nicosia that will be analysed to identify local areas which have the greatest urban potential.
The problem addressed by the research is presented to explain the reasoning behind the need for a framework to identify urban potential. It is suggested that a new definition of urban potential, which goes beyond the limited scope of capacity to accommodate population growth and infrastructure, is needed to effectively assess the capability of the public realm to sustain a thriving urban life. Morphological characteristics of the public realm were identified as key elements of potential for sustainable development.
The research aims at developing an effective methodology to identify areas of the public realm which have the potential to develop into sustainable local centres. In Nicosia, local neighbourhoods have struggled not just to thrive but to even develop any structure due to poor planning regulation, ineffective assessment methods and the nature of the real estate market. The new definition and selected criteria can aid planning authorities devising a framework to support a hierarchy of sustainable local centres within the Nicosia metropolitan area.

1. Introduction

This paper presents the first research output of the project *Urban Potential in the Evolution of Nicosia's Public Realm*. The output consists of a set of criteria and their relative importance, which identify the potential of the public realm to perform as a sustainable local centre. The set of criteria will be used in subsequent work to assess data requirements for the development of a GIS-based model of Nicosia that will be analysed to identify local areas which have the greatest urban potential. It will then be used to evaluate the relevant strengths and weaknesses of each case study area to act as a sustainable neighbourhood centre and to propose the most effective interventions for their improvement.

The issue addressed by the research is the development of an effective methodology to iden-

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tify areas of the public realm which have the potential to develop into sustainable local centres within the metropolitan urban area of Nicosia. The public realm as the place of social and economic exchange is a vital part of city life, which enables movement across the city, encounters between residents and visitors, as well as trade and enterprise, delivering goods and services to the community. As such, the public realm, comprising our streets, roads, squares, public spaces and sidewalks along with their related infrastructure, is the most important factor in sustaining thriving local neighbourhoods. However, in Cypriot cities, local neighbourhoods have struggled not just to thrive but to even develop any structure or identity due a lack of planning regulation, minimal stakeholders' involvement in planning, ineffective assessment methods and the structure of the real estate market (EUKN, no date; Ioannou, 2016; Geddes, 2017).

Urban sprawl is particularly acute in Cypriot cities and even more so in Nicosia due to its unique inland location on a plain. A variety of factors have led to this intense sprawling phenomenon in Cyprus: the lack of planning regulation until relatively recently, the structure of the real estate market, societal and cultural trends in terms of housing typologies, the dominance of car usage, the process of parcellation and land fragmentation all contributed to ribbon development (Ioannou, 2016). This in turn hindered the development of structured neighbourhoods and sub-centres within the city: outside of the historical centre, areas often lack a clear concentration of land uses which would form a local centre with secondary smaller concentrations of commercial activities and other facilities. Such a dispersed form with no clear sub-centres within the metropolitan area has also led to difficulty in planning and sustaining an effective public transport system due to low densities. Suburban development with its building typologies which do not provide continuous frontages of retail or other commercial and service uses, coupled with economic recession, significantly and negatively impacts street life and the vibrancy of streets (Ioannou, 2016).

Cypriot cities are dominated by the structure of their main vehicular roads and are characterized by a patchwork of residential areas. The main road network is highly congested and commercial uses peppered throughout it. This leads to a vicious circle by which, on the one hand, residential areas are dependent on car use to access commercial areas for supplies and circulation across the city. On the other hand, the main road network of the city and its commercial establishments are also dependent on car use and movement from far and wide in order to sustain themselves, as they cannot rely on surrounding residential densities or commercial concentrations to provide enough trade (Geddes, 2017).

Suburban development in Cyprus is characterized by sprawl and a decentralized environment, which lack the compactness associated with traditional European urban cores. In Cyprus, what sustainability means and how it can be achieved in a context where suburban environments are people's preferred lifestyle choice must be carefully evaluated. All urban fabric outside of the historical cores is low density and local suburban centres do not actually exist, though some areas show potential characteristics of this. If a hierarchy of centres is to develop, then these areas must be identified and provided with the capabilities to grow into effective, sustainable local centres if the benefits of contemporary suburban environments are to outweigh their negative socio-economic and environmental impacts.

Ioannou (2018) has highlighted how the degree of car dependency in Cyprus challenges not only scholars' common understanding of walkability and social interactions in the urban environment, but also how criteria for walkable neighbourhoods might need to be adapted to the specific context of Cyprus. Here compact environments with little provision for parking are seen as discouraging social contact and walking is often viewed as mandatory and unpleasant unless undertaken exclusively for leisure purposes in areas where walking facilities tend to

segregate pedestrians for safety rather than sharing the space with other modes of transport. Considering such challenge, it may be more promising to set criteria and to propose changes which not only minimize obstacles to pedestrians and reduce unpleasantness, but also impose little behavioural change – the idea suggested by Marshall of everyone doing only a little less than their perceived advantage for the benefit of the community (Marshall, 2006).

Planning regimes in Cyprus are now changing towards a direction conforming with the EU acquis, which includes a move towards greater sustainability through increased densities, the development of public transport systems, support for sustainable modes of transport, development of green areas, and stakeholders' consultation processes. While a variety of interventions and further changes to planning regulation might be required to aid the revitalisation of local neighbourhoods within cities, there are still no strategic plans, which prioritise, on an evidence base, firstly which areas should be the focus of revitalisation efforts and, secondly, what the interventions should involve.

The research project aims at identifying local centres within Nicosia's metropolitan area that have the greatest potential to develop into thriving sustainable neighbourhood centres, which can support social interaction and long-term economic exchanges. It does this through three research phases. The first phase, presented here, establishes criteria defining a sustainable local centre and selects those necessary to define potential; the second phase is a GIS-based analysis of urban data across the whole city to select areas with the greatest potential. The final, third phase analyses the case study areas in order to evaluate their assets and shortcomings, and to propose solutions for their improvement.

2. Defining urban potential for sustainable local centres

Along broad lines, there is general agreement in the literature as to what constitutes either a city centre or a local centre. Levels of residential density around a concentration of land use mix that includes commercial, service, civic and entertainment facilities as well as some form of landmark is the picture that one forms of a 'centre' while reading through the literature. Such a picture is populated with images of activity in the open spaces along which the various uses are allocated: people walking or cycling, cars and buses passing by, shoppers getting in out of stores, commuters heading to or coming back from work and the like. The size and extent of such concentrations and their relative importance as commercial hubs and locations of transport interchange is what differentiates centres across a hierarchy, which ranges from district centre, city centre, town centre and local centre depending on the size of the city within which they are embedded.

The idea of the urban neighbourhood as a spatially contained unit of meaningful social interactions has undergone a series of theorisations and reviews which continue to the present day and which have stereotyped it as the ideal level of city life and debunked it as a shallow, unrealistic concept of the complexity of urban interactions. Lynch's view is that city design can be enhanced "by means of separations, the placement of local centres, the diversion of main traffic ways, the exploitation of irregularities of terrain, and other differentiations of physical character" (Lynch, 1984, p. 248). The objective of setting a definition for the purposes of this research is not to identify or define existing or potential neighbourhoods, but to select areas which might become the focal point of a neighbourhood and support its development and the wider functioning of the whole city by providing and enhancing local social contacts and services, draw investment from businesses along with demand for housing in its vicinity, increase

legibility of the neighbourhood, mitigate adverse urban conditions, and increase local engagement with the built environment.

A broadly accepted definition of sustainability when it comes to urban environments does not actually exist (Griffiths *et al.*, 2008), therefore, when assessing sustainability, studies focus on a range of socio-spatial factors which are known to contribute to the long-term socio-economic success of the areas under study. Such areas might vary in scale and while some studies might consider whole neighbourhoods, most tend to focus on a localised area, which offers the concentration of retail and service activities. These areas might comprise a high-street and/or a public space along with street sections connecting to it and offering secondary concentrations of active land uses. While it is acknowledged here that a local neighbourhood centre often extends beyond the limited scope of a single street or public space, such a contained unit of study offers the opportunity to accurately measure its properties and thus its potential as the focal point of a larger centre within a residential neighbourhood. As such, the definition below sets the extent of the areas to be identified by this project and the basis for assessing their urban potential.

Sustainable Local Centre*: an area comprising a street, a street section or a public space, or a combination of these, which has the capacity to sustain socio-economic interactions in the long term and to provide its user population with easy access to resources that meet their practical and social needs.*

The term *urban potential* is rarely used within either academic or planning literature. When used it is often characterised by a specific factor of the urban environment. This might be growth in relation to population increase and its necessity for expansion of the built form, or it might be development in terms of the capacity of a specific urban unit to accommodate and support new housing, facilities and infrastructure (Adeel, 2010; Sabbar *et al.*, 2016). Assessment and evaluation of capacity and suitability for planned urban development, in particular housing development, is common within English planning practice (Cheshire East Council, 2015; Bristol City Council, 2018). The term *urban potential* by itself is also used to refer to the positive aspects of urbanisation and the benefits, especially economic ones, it might bring to communities at the national and local level when exploited through effective and sustainable means of enabling and supporting urbanisation (Asian Development Bank, 2015; Siba, 2016).

It remains, however, that the term is used loosely and without a formal definition. Interestingly, it tends to be applied to the process of and capacity for urbanisation - the potential of land and population to (be) urbanise(d) rather than to the capacity of the urban form to support its population and the socio-economic activities which are inherent to cities. This latter meaning is the one that we are concerned with and, while there are parallels in the literature, we are faced with a lack of a sound basis to understand, identify and appreciate *the potential of the urban*. This is at the core of the research project: to develop such a basis and to establish criteria which give researchers the means to understand *urban potential*. Such understanding is derived from existing knowledge about the characteristics that make a local centre lively, appreciated by its users and ultimately sustainable. There are many examples of vibrant local centres, which have a long history of performing successfully in meeting the needs of the local population; these have done so not through offering immutable, universal characteristic, but through adapting to change in the face of transport innovation, retail transformations and economic cycles. Identifying the factors which support this adaptability is key to assessing potential.

In order to focus the selection of criteria on the elements that may enable an area to perform sustainably in the future, a definition is set here which reflects the aims and objectives of this research. This definition, given below, is not meant to be exhaustive or to replace other, more technical or economic definitions, but rather to fill in a gap in how we identify and appreciate

what different urban areas have to offer and how they can be exploited to improve sustainability in cities.

Urban Potential*: the capability of an urban area to sustain socio-economic interactions in the long term and to provide its user population with access to resources that meet their practical and social needs.*

It must be highlighted here that core to this definition is the potential, future capability of the area rather than its existing capacity to meet required needs. The research is not concerned with identifying areas which are already sustainable and meeting all of the criteria, but those which, through planning and design interventions and investment, have the greatest chances to become sustainable local centre. This is vital in the case of Nicosia where, as discussed above, a hierarchy of local centres does not at present exist. Existing areas, which provide facilities commonly associated with local centres, could be easily identified through local knowledge by expert professionals or even by the general population. However, this would not guarantee that such areas hold the required potential. The research attempts to formally identify these areas through an empirical assessment of their characteristics.

3. Methodology

The methodology for setting the criteria comprised two parts: a literature review carried out by the author and a two-phase consultation process. The literature review aimed at researching current definitions of 'urban potential' and the state-of-the-art on what constitutes a sustainable local centre, with a particular focus on low-density urban environments and at establishing criteria which make a neighbourhood centre successful in social, economic and environmental terms. As the terminology 'urban potential' is not standard and the extent of a local centre is limited to a street, a street section, a public space or a combination of these, for the purposes of this project, the review of the literature focused on high streets, non-residential streets and public spaces. Research terms included: successful, sustainable, inclusive public realm, public spaces, local centres, commercial centres, commercial streets, high streets and neighbourhood centres. A comprehensive picture of the issues involved in local centres' sustainability was developed and a list of criteria, which the state-of-the-art indicates as defining a sustainable local centre was drawn. Particular attention was given to low-density contexts and how other studies apply to the case of Nicosia is discussed within the review.

The first phase of the consultation included a series of conversations with local planning professionals to discuss their views of what constitutes a sustainable local centre, the second was a questionnaire to assess the relative importance of different criteria in constituting a sustainable local centre. The conversations involved three planning officers at the Department of Town Planning and Housing (TPH), and the head of the Planning Board, which is in charge of developing the Local Plan for the Nicosia Metropolitan Area (NMA) and Area Plans, which address in more detail specific areas within the NMA. The conversations required the interviewees firstly to discuss whether there was a policy in place to establish a hierarchy of local centres within the NMA and more generally to develop and improve existing local centres. Secondly, interviewees were asked to state their views as to what constitutes a sustainable local centre and what specific characteristics they seek in an area to define it as a successful local centre.

The initial set of criteria based on the findings from the literature review was adjusted following the conversations. The criteria were then listed in a questionnaire for scoring by respondents on a scale of 1-5 and the results plotted on a grid to calculate the average importance of the criteria. The questionnaire received 79 responses. A final list of prioritised criteria was

then created according to weather they were deemed necessary (a score of 4 or above), desirable (a score of 3 to 4) or not essential (a score of under 3). The criteria were also scored for their 'implementability' from 1 (easy to implement) to 3 (hard to implement) according to whether they could be easily achieved through intervention or require significant time and infrastructure change. The final list comprises all criteria deemed necessary, which received a score of 4 or above, and are prioritised according to whether they are hard to implement (higher priority) or easy to implement (lower priority). The implementability scores were not based on an empirical assessment, but were set by the researcher simply on their professional understanding and assessment in order to inform prioritisation of criteria and the selection of the study areas based on a pragmatist approach to the research method.

4. The literature on sustainable local centres

The combined effort of the research on successful town centres, high streets and public spaces has seen the production of various design guidelines to achieve spaces which are not simply used as thoroughfares, but are desired destinations and foster social interaction (CABE Space, 2007; Department for Communities and Local Government, 2012). Good design of the public realm, its management and maintenance are all elements that contribute to the sustainability of local centres. However, as previously mentioned, there is no agreed definition of 'sustainability' when it comes to urban environments (Griffiths *et al.*, 2008). Researchers therefore tend to develop study-specific definitions, or shift their focus on other characteristics which encompass sustainability, for example 'adaptability' (Griffiths *et al.*, 2008) as the term which identifies generic socio-spatial factors that contribute to long-term socio-economic success of an area. Other terms which are often used and measured within academic and policy literature are 'vitality' and 'viability' (URBED (Urban and Economic Development Group), 1994; ODPM (Office of the Deputy Prime Minister), 2005). The former is often measured as the amount of activity in an area, often pedestrian activity, and the latter as the ability to attract investment.

Research shows that these two characteristics are inextricably linked as high rates of activity, especially pedestrian footfall, sustain commercial potential and thus businesses are attracted to invest in areas which are likely to provide passing trade (Griffiths *et al.*, 2008). It is the intensity, array and variety of activities taking place in the public realm that determine the extent to which an area functions as a 'centre' – a nodal point of trade exchanges, civic functions and transportation corridors. Hillier (1999) defines 'live centres' as those areas of the public realm which disproportionately attract pedestrian and/or vehicular movement because of their high level of spatial accessibility within the urban system. Furthermore, Hillier (2009) provides a definition of 'spatial sustainability' based on the configurational ordering of spaces in a city. He states that the generic form of the city is characterised by a foreground network of streets – the main circulation system within a city. This foreground network comprises centres and sub-centres across different scales and is embedded in the larger residential system. This structure influences the pattern of movement of people in the city and is a by-product of economic and social forces which attempt to minimise travel time and increase inter-accessibility between spaces. This pattern results in certain areas of the public realm being favoured as a route between other spaces at given scales or as destinations in their own right (Hillier *et al.*, 1993). As a consequence, land uses which are dependent on movement to sustain themselves – retail in particular - locate themselves in areas of high accessibility. In turn, such uses attract more

movement, creating a cyclical process by which the potential of certain areas to draw activity is created and reinforced by the configuration of the city's structure and the distribution of land uses. This process results in certain areas acting both as routes and destinations due their level of accessibility (Griffiths *et al.*, 2008).

The relevance of movement, and its relationship to land uses, in the ability of urban areas to adapt to changes and continually sustain urban life is also highlighted by Jones et al. (2007) who conceptualised the high street as both 'link' and 'place'. In their study and related design guide (Jones, Boujenko and Marshall, 2008), the authors point to the fact that streets should be embedded within an integrated urban structure and should incorporate a variety of uses which serve not only the local neighbourhood, but also provide resources at different urban scales. Much of the argument for sustainability of local, mixed-use streets is based on the catchment area of the residential neighbourhood for retail and commercial uses to rely on residents walking to the facilities. However, it has been recognised that economic viability can only be sustained when an area is easily accessible by a wider population from farther afield and that vitality of an area is also determined by the availability of other facilities, such as healthcare and education, within a greater radius than those usually assessed for walkability (Jones, Boujenko and Marshall, 2008; Vaughan and Geddes, 2014). The issue of scales is particularly important in the context of Cyprus, where much of the urban environment outside of historical centres is suburban in character, even in central locations, and levels of car dependency are particularly high. Research on suburban town centres' vitality shows that the provision of a wide range of uses at different scales supports activity levels (Vaughan and Geddes, 2014) and that achieving suburban sustainability requires an understanding of how the micro scale relates to larger scales of movement (Hall, 1997).

It is clear from the literature that sustainable town centres require certain structural characteristics that are often determined by their historical evolution as elements within the wider network of places in a city. These characteristics come down to different aspects of their accessibility at different scales and the related distribution of land uses influenced by the movement generated by the form of the city's network of spaces. Residential density in and around town centres also influences the viability of a place to become sustainable. While accessibility, land use mix and density seem like indispensable requirements for town centre sustainability, many other factors play a role in their success and provide planners with the means to strengthen and improve the public realm of local centres. Carmona (2015) suggests that a new normative is needed to design successful public spaces, which encompasses both design and governance. He summarises the characteristics of such places with the following criteria: evolving, balanced, diverse, delineated, social, free, engaging, meaningful, comfortable and robust; these concepts provide a baseline to develop a vision for local centres. When it comes to identifying whether the public realm truly has the potential to sustain socio-economic interactions, Gehl (2011) gives evidence regarding how social activities relate to the design of public spaces: these are dependent on whether the public realms offers desirable conditions for necessary outdoor activities, for optional, recreational activities, and for social activities. In order to achieve these conditions places must enable to move about easily, to linger in them, to take pleasure in them and to meet other people. Their design can foster social contact, as well as facilitate necessary and recreational activities, and is fundamental in creating spaces which are well-used and lively. Walking, standing and sitting, as well as seeing, hearing and talking are the key activities that take place in public space; they are the prerequisites for all other types of activities to take place (Gehl, 2011). Protection from crime, vehicular traffic and unpleasant weather, as well as access to good weather and aesthetic quality, also play a role in characterising public space as sustainable.

UK policy guidelines give further details and examples of the characteristics which make high streets and town centres well-used and pleasant spaces to visit (CABE Space, 2007; Department for Communities and Local Government, 2012). These highlight that spill-over from local businesses onto the public realm, such as shops' displays, outdoor seating areas of cafes and restaurant enhance outdoor activity, though they should be balanced with sufficient space for passers-by. Pedestrianisation in suitable areas can be an extremely powerful tool to improve the quality of spaces and their commercial potential. Interactive infrastructure from urban art, to water features and play areas provide users with experiences that go beyond simple shopping and necessary commutes. Green infrastructure, the temporary use of empty units and the presence of civic facilities increase a more varied social scene both during day and night. Where possible, historical heritage should be exploited and emphasized, while well-designed, uncluttered shared spaces can promote an open feel and more cooperative relationship between pedestrians, motorists and other road users. Furthermore, a key aspect to sustaining activity, but also of regenerating and improving spaces, attracting users and making the space known to potential visitors is a regular occurrence of events. This might comprise one-off or regular community projects and local businesses events, a regular market, street performances or more formal events such as festivals and concerts.

Many of the above requirements for successful spaces can be implemented through relatively minimal investment and management: certain types of events, urban art or primary seating for example are cost-effective ways of enhancing a local centre and are not necessarily required a priori in the identification of urban potential. Other infrastructural elements are somewhat more costly and require more resource and management input: the development of green or blue infrastructure, larger events, redesign and decluttering of pedestrian facilities, traffic-calming measures and so on. These are therefore a welcome existing asset in the public realm of areas which may be candidate for investment to be developed as a local centre. However, they can also be implemented if the area offers key characteristics and other resources which make it a viable sustainable centre. Finally, certain elements like the orientation of frontages, the units' size or the presence of historical heritage are hardly possible to create. These should therefore be considered extremely important assets for a sustainable centre. However, their lack should not completely preclude the selection of an area with potential in the context of Nicosia. In an environment where the areas under consideration are located outside of the historical centre in relatively recent neighbourhoods and most often only exclusively offer large units, historical heritage might not be present. The size of units should be assessed relatively to the average size in other commercial and mixed-use areas, while consideration should be given to more recent architectural heritage or to the possibility of creating new heritage through urban art or architectural developments.

5. Findings from the consultation and questionnaire

There was significant variety in what decision-makers thought were the most important characteristics of a sustainable local centre. In the case of the first interview with planning professionals from the Department of Town Planning and Housing (TPH), this was a group interview and thus the responses from the second and third interviewee were offering additional information rather than proposing alternative characteristics as more relevant to the ones mentioned by the first interviewee. Therefore, in this case, the primary characteristics are those reported by

the most senior planning officer, additional ones are those reported by the other two planning officers. Primary characteristics mentioned by senior planning officer at the TPH were:

- Accessibility potential from surrounding residential area
- Availability of services to residents
- Easiness of access to health services
- Easiness of access to educational services

The senior officer highlighted that, due to the situation in Cyprus of car-dependency and lack of effective public transport system, accessibility should be independent of public transport and should therefore focus on servicing other transport modes, such as driving, walking and cycling. Furthermore, the officer stressed that it is of particular importance that educational facilities should be easily accessible as they are the ones that provide the greatest opportunity for people to walk to and from them and also to facilitate families' schedules and their management. While job locations were viewed as potentially important, the senior officer's belief was that these could not be controlled and may therefore be dispensable in the identification of potentially sustainable local centres. Additional characteristics mentioned by planning officers at the TPH were:

- Walkable access to services
- Accessibility by public transport
- Density of facilities and residences to sustain access and commercial viability
- Continuity of pavements and ease of street crossing

While all officers were in general agreement as to the key characteristics which make up a sustainable local centre, the researcher noted that priorities differed among them, in particular in relation to accessibility by car or public transport. Dedicated parking was viewed as necessary by some while others proposed that greater effort should be put into facilitating public transport access and discouraging car use. This, as well as the focus given to the accessibility of educational facilities, seemed to be determined by the personal situation of the interviewee: even as planning professionals a level of prioritisation was likely to be influenced by individuals' age and childcare commitments.

Speaking with the head of the Planning Board, priorities for a sustainable local centre were viewed from a more strategic perspective. How the centre broadly related to the area, rather than its specific properties in terms of accessibility and facilities, was seen as the most important factor for sustainability. More specific, the following properties were mentioned:

- A multi-scalar relationship with the surrounding area
- A consistent typological character with the surrounding area
- It embeds community life and provides a range of uses, not just commerce
- It should comprise a public space
- It caters for the diversity of the population
- It should contain primary elements, such as a civic building, a landmark, etc.

The criteria included in the questionnaire were initially ordered simply according to their average score as given by respondents (table 1).

To be noted from these results are the fact that a combination of spheres (accessibility, de-

sign, services) involved in quality and performance of public spaces are comprised within the top ten criteria. However, services and facilities that are considered most important are those relating to children and public toilets rather than retail as it is most often thought. Accessibility on foot and by public transport feature much higher than accessibility by car and many design features are considered very important, in particular green infrastructure and characteristics that foster social identity, interaction and connectivity (public space, seating, linkage of key urban elements). Organised social activities (market, events, etc.) are also deemed important as sustaining a local centre. Further down the line, but still with high scores of 4 and above, services and facilities cluster together as important factors: a mix of uses, daily retail, leisure, entertainment and catering, as well as dedicated car-parking. Certain design characteristics are also found at this level of importance (forms of weather protection, consistency of area character).

Of medium importance, scoring between 3 and 4 points, are the remainder of services (night-time venues, occasional retail, service uses, educational and health infrastructure), along with other design features, such as public art, orientation and size of frontages, as well as accessibility by car.

The only two criteria, which could be considered not important scoring under 3 points, are high residential densities in the surroundings and on-street car parking. These are perhaps surprising, but their low score may be due to the specific context of Cyprus. On the one hand, while in the literature density is often seen as a pre-requisite for high levels of activity and vitality in the public realm, perhaps respondents in Cyprus feel that this is not necessary or that it should not be considered a requirement in a context where the urban environment is consist-

Table 1. *Criteria ordered by average score from 5 (extremely important) to 1 (not important at all).*

	Criterium	Score
1	The area should be easily accessible on foot.	4.85
2	Some form of green infrastructure such as trees, flower pots, plant displays or a green space should be present in the area.	4.79
3	The area should provide safety from traffic, ease of walking and street crossing.	4.78
4	Public seating such as benches or architectural features should be available in the area.	4.77
5	The area should be easily accessible by public transport.	4.6
6	Public toilets and baby changing facilities should be available in the area.	4.53
7	The area should comprise a public space.	4.47
8	The area should provide facilities for children such as a garden, playground, public library or playroom, or private enterprise offering activities.	4.45
9	The area should connect two key elements of the urban environment, such as public spaces, civic buildings, entertainments venues, transport nodes, etc.	4.39
10	Some form of regular events, such as a market, festival, street performances or other initiatives should take place in the area.	4.38
11	The area should comprise a mix of uses and not be focused exclusively on one or another.	4.25
12	The area should comprise daily retail uses, such as food shops or convenience stores.	4.2
13	The area should comprise leisure and entertainment uses, such as cafes, restaurants, theaters, cinemas, etc.	4.13
14	A dedicated off-site car park should be available next to the area.	4.08
15	Some form of protection from weather conditions other than private units should be available in the area.	4.06
16	The area should have a consistent character (such as architectural styles, street typologies, a civic or cultural identity).	4.01
17	Some form of public art should be present in the space.	3.91
18	The area should provide uses which are available at night time, such as restaurants, bars, entertainment venues, etc.	3.86
19	Access to building units should be facing the public realm.	3.84
20	The area should provide services, facilities and resources which serve not only the local population but also other users residing farther away.	3.78
21	The area should comprise service uses, such as banks, pharmacies, offices, etc.	3.59
22	The area should have educational institutions within walking distance (400m).	3.27
23	The area should comprise at least a primary element such as a civic building or a landmark.	3.23
24	The area should be easily accessible by car.	3.22
25	The area should have health facilities, such as hospitals or clinics, within a short driving distance (1200m).	3.2
26	Building units of different uses should be small.	3.15
27	The area should comprise occasional retail uses, such as clothing or electronic shops.	3.1
28	The area should have educational institutions within a short driving distance (1200m).	3.01
29	The area should have high residential densities in its surroundings.	2.97
30	On-street car parking should be available in the area.	2.85

ently low-density and unlikely to change in the short to medium term. On the other hand, on-street car parking is widespread and considered simultaneously a benefit and a blight. In this case, the background and self-selection of respondents - being mostly from higher educational backgrounds and from fields related to urban planning or simply interested in improving the environment – may play a role as they may mostly belong to the group considering it a negative aspect of the Cypriot urban environment and not conducive to walkability and sustainability.

In terms of services and facilities, transport infrastructure (public transport, car parking, etc.) and daily retail uses (food shops, convenience stores, etc.) were classed as most important (figure 1) by the majority of respondents with transport scoring 30.4% and 26.6% as most important and second most important, and daily retail scoring 22.8% and 24.1% as most important and second most important.

Occasional retail uses were seen as least important, scoring 45.8% and 31.6% in the least important (figure 2) and second least important categories respectively.

The importance assigned to other services (catering uses, service uses, leisure uses and children services) were fairly evenly spread across the range of importance and could perhaps be clustered together as of medium importance, although leisure uses and children services scored quite high in the most important category (20.3% and 17.7% respectively).

6. Conclusions: urban potential criteria

As revealed by the literature on which the set of criteria for consultation was based, there are three key domains of local centre sustainability: accessibility, provision of services and facilities, and design characteristics. While covering all criteria would result in an 'ideal' or fully sustainable centre, here we are looking to identify what constitutes urban potential: what characteristics are a pre-requisite or most beneficial for an area to have the capability to be devel-

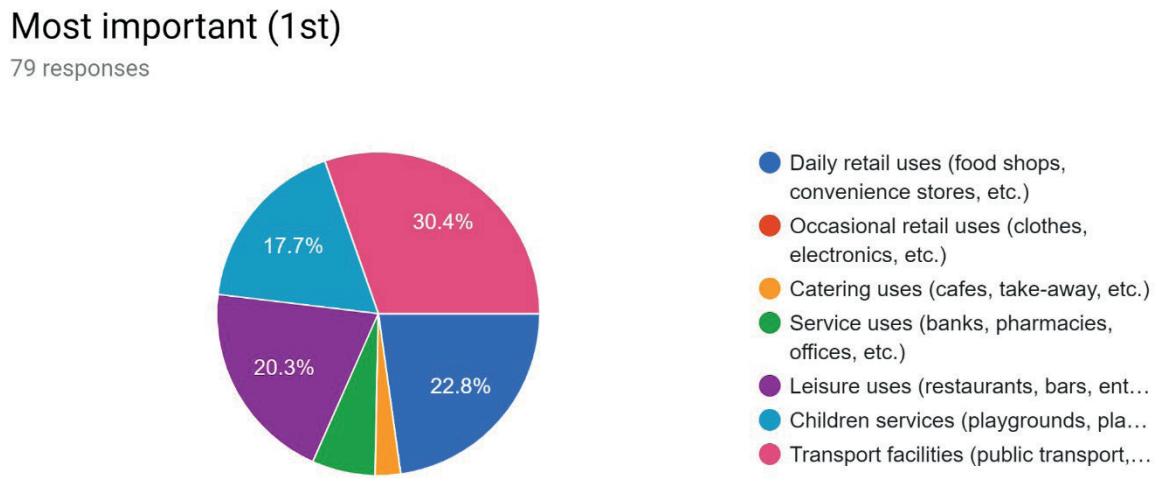

Figure 1. *Proportion of services classed as most important.*

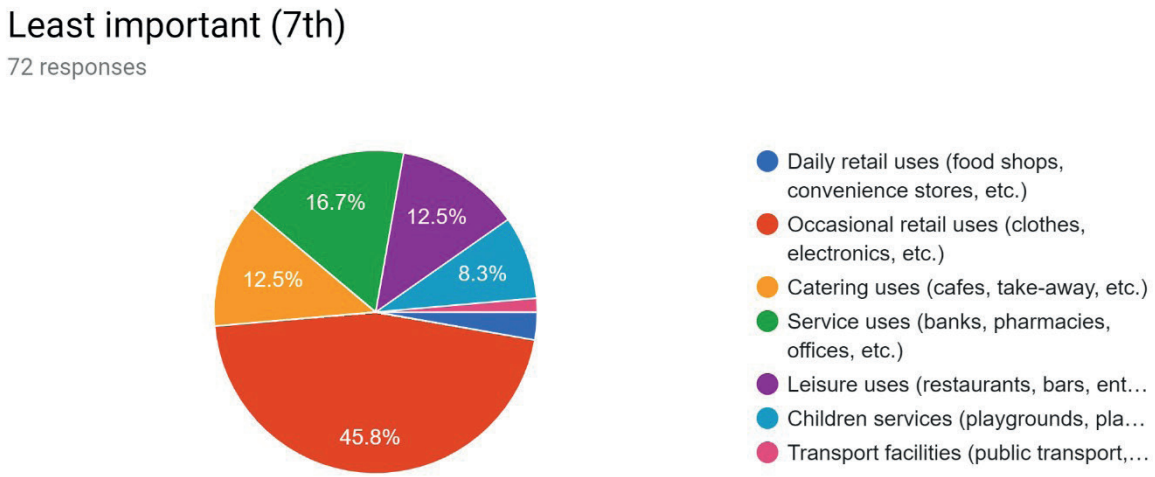

Figure 2. *Proportion of services classed as least important.*

oped into a sustainable local centre. As such, a model is proposed by which urban potential is constituted by combination of the most important criteria belonging to each sphere (figure 3).

Accordingly, the criteria within each sphere are presented in table 2 along with their score and the implementability value set by the researcher.

To draw the final list of urban potential criteria, it was decided that this should comprise all criteria deemed necessary, which received a score of 4 or above, and should be prioritised according to whether they are hard to implement (higher priority) or easy to implement (lower priority). The resulting list prioritised by implementability and score is shown in table 3.

The above list of criteria will form the basis to develop the spatial-analytical model of Greater Nicosia and will be used to select the areas of the public realm which have the greatest urban potential. Each criterium will be matched with a data set and the model analysed to assess which areas meet all or most of the criteria and ordered according to their level of urban potential based on a score, depending on the number of criteria, priority of criteria and relative value of their characteristics matching the criteria (e.g. how easily accessible, how great a mix of uses, how much green infrastructure, etc.). The details of the methodology to develop the spatial model and perform the analysis will be presented in an introductory document explaining the GIS-based model as part of next phase of the research project.

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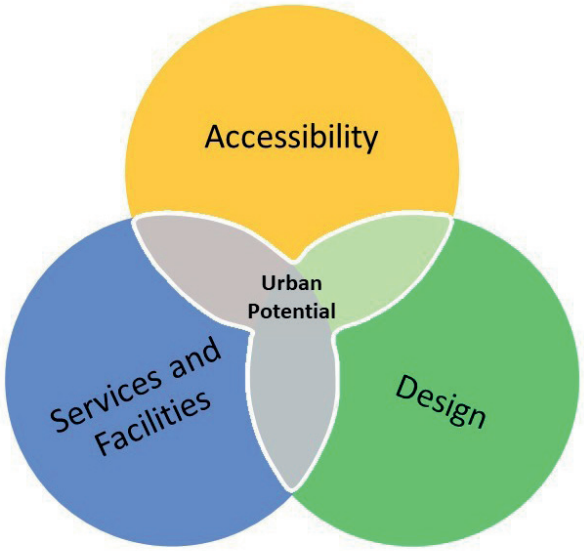

Figure 4. *Spheres of sustainability and urban potential.*

Table 2. *Criteria grouped by sphere and ordered by average score from 5 (extremely important) to 1 (not important at all) with their level of implementability from 1 (easy to implement) to 3 (hard to implement).*

Sphere	Criterium	Score	Implementability
Accessibility	The area should be easily accessible on foot.	4.85	3
	The area should be easily accessible by public transport.	4.6	3
	The area should be easily accessible by car.	3.22	3
Services/Facilities	Public toilets and baby changing facilities should be available in the area.	4.53	2
	The area should comprise a public space.	4.47	3
	The area should provide facilities for children such as a garden, playground, public library or playroom, or private enterprise offering activities.	4.45	2
	Some form of regular events, such as a market, festival, street performances or other initiatives should take place in the area.	4.38	1
	The area should comprise a mix of uses and not be focused exclusively on one or another.	4.25	3
	The area should comprise daily retail uses, such as food shops or convenience stores.	4.2	2
	The area should comprise leisure and entertainment uses, such as cafes, restaurants, theaters, cinemas, etc.	4.13	2
	A dedicated off-site car park should be available next to the area.	4.08	2
	The area should provide uses which are available at night time, such as restaurants, bars, entertainment venues, etc.	3.86	2
	The area should provide services, facilities and resources which serve not only the local population but also other users residing far the away.	3.78	2
	The area should comprise service uses, such as banks, pharmacies, offices, etc.	3.59	2
	The area should have educational institutions within walking distance (400m).	3.27	3
	The area should have health facilities, such as hospitals or clinics, within a short driving distance (1200m).	3.2	3
	The area should comprise occasional retail uses, such as clothing or electronic shops.	3.1	2
	The area should have educational institutions within a short driving distance (1200m).	3.01	3
	On-street car parking should be available in the area.	2.85	2
Design	Some form of green infrastructure such as trees, flower pots, plant displays or a green space should be present in the area.	4.79	1
	The area should provide safety from traffic, ease of walking and street crossing.	4.78	2
	Public seating such as benches or architectural features should be available in the area.	4.77	1
	The area should connect two key elements of the urban environment, such as public spaces, civic buildings, entertainments venues, transport nodes, etc.	4.39	3
	Some form of protection from weather conditions other than private units should be available in the area.	4.06	1
	The area should have a consistent character (such as architectural styles, street typologies, a civic or cultural identity).	4.01	2
	Some form of public art should be present in the space.	3.91	1
	Access to building units should be facing the public realm.	3.84	2
	The area should comprise at least a primary element such as a civic building or a landmark.	3.23	2
	Building units of different uses should be small.	3.15	2
	The area should have high residential densities in its surroundings.	2.97	2

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Table 3. *List of urban potential criteria in order of importance.*

No.	Criterium	Score	Implementability
1	The area should be easily accessible on foot.	4.85	3
2	The area should be easily accessible by public transport.	4.6	3
3	The area should comprise a public space.	4.47	3
4	The area should connect two key elements of the urban environment, such as public spaces, civic buildings, entertainments venues, transport nodes, etc.	4.39	3
5	The area should comprise a mix of uses and not be focused exclusively on one or another.	4.25	3
6	The area should provide safety from traffic, ease of walking and street crossing.	4.78	2
7	Public toilets and baby changing facilities should be available in the area.	4.53	2
8	The area should provide facilities for children such as a garden, playground, public library or playroom, or private enterprise offering activities.	4.45	2
9	The area should comprise daily retail uses, such as food shops or convenience stores.	4.2	2
10	The area should comprise leisure and entertainment uses, such as cafes, restaurants, theaters, cinemas, etc.	4.13	2
11	A dedicated off-site car park should be available next to the area.	4.08	2
12	The area should have a consistent character (such as architectural styles, street typologies, a civic or cultural identity).	4.01	2
13	Some form of green infrastructure such as trees, flower pots, plant displays or a green space should be present in the area.	4.79	1
14	Public seating such as benches or architectural features should be available in the area.	4.77	1
15	Some form of regular events, such as a market, festival, street performances or other initiatives should take place in the area.	4.38	1
16	Some form of protection from weather conditions other than private units should be available in the area.	4.06	1

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Visualizing the Past of Luoyang Old Town within A Multi-layered Historic Environment

Diachronic Analysis Based on Morphological Translation of Historical Information

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Keywords: Morphological Translation of Historical Information, Diachronic Analysis, Multi-layered Historic Environment, Luoyang Old Town.

Abstract: In contemporary society, exploring the emergence and transformation of urban space, function, and culture under the influence of time is imperative for studying urban form. Hence in this research paper, the connection of physical components with social environment is built. In this regard, the ancient town's past is visualized through dominant spatial elements and their relatedly recessive functional and cultural context. For this purpose, historical information was morphologically translated, creating a significant contribution to the integrative visualization of the ancient space and function as well as the process of their transformation. This historical information had been obtained through archaeological excavation and immovable relics, studies of historical literature, and illustrations of historical maps and aerial photography. By taking the old town of Luoyang as an example, a typical ancient Chinese town that existed within a multi-layered historic environment, this research primarily utilized the spatial network model called 'patch-corridor-matrix', which comes from the theory of landscape ecology, to map a spatial structure of the old town form. Based on the generated map, functional and cultural elements were marked according to both top-down domination and bottom-up autonomy mechanisms working on the urban form. The above-mentioned analysis regarding spatial, functional and cultural elements was then applied to different historical periods. By such diachronic analysis, a visualized network of the ancient town's past in a historically sequential order was eventually constructed. As a multidimensional information-based system of urban form, this study provides a spatially and functionally viable historic reference for potential urban restoration.

1. Introduction

The origin and development of a city are a continuous process under the influence of time. That means urban form, as assemblages of space and time, is the best witnesses of history. Therefore, the connotation of urban form is not only existing materials but also the connection and evolution logic between current urban form and the past. Either complete or incom-

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plete, original or transformed urban forms record the inheritance and continuity of cities. In contemporary society, to study urban form, visualizing the past of cities becomes imperative.

1.1. *The Past: a Typical Ancient Chinese City within a Multi-layered Historic Environment*

Located in the central plain of China, the Heluo area centered on Luoyang had been the cradle of imperial China. As a result, ancient Luoyang is the earliest city lasting the most dynasties, also the origination of the Silk Road. During the evolution of Luoyang for thousands of years(Figure 1), the city site had gone through several changes because of dynasty changes. Luoyang Old Town is the only one ancient city still existing in Luoyang which built on the ruins of Luoyang city in the Sui and Tang dynasties in 1217(Jin dynasty). It likes an ancient city museum spanning more than 3000 years, overlapping several ancient cities in space and time, accumulating city forms layer by layer. Therefore, Luoyang Old Town is within a multi-layered historic environment and can be the best object to research the urban form by visualizing its past.

1.2. *The Now: an Old Town Area with Identifiable Historic Texture*

Nowadays, Luoyang Old Town was separated by a transverse modern road into north and south parts, which led to dissimilation in the direction of development. The northern half of the town only remains the framework structure of ancient city form like alleys and hutongs, while historical buildings all disappeared. However, in the southern half of the town as an historic precinct for official conservation, the general morphological pattern of the ancient city and the texture of historical courtyards are still in existence with the loss of historical function and culture. All in all, Luoyang Old Town is an area in which the past can be seen in general (Figure 2).

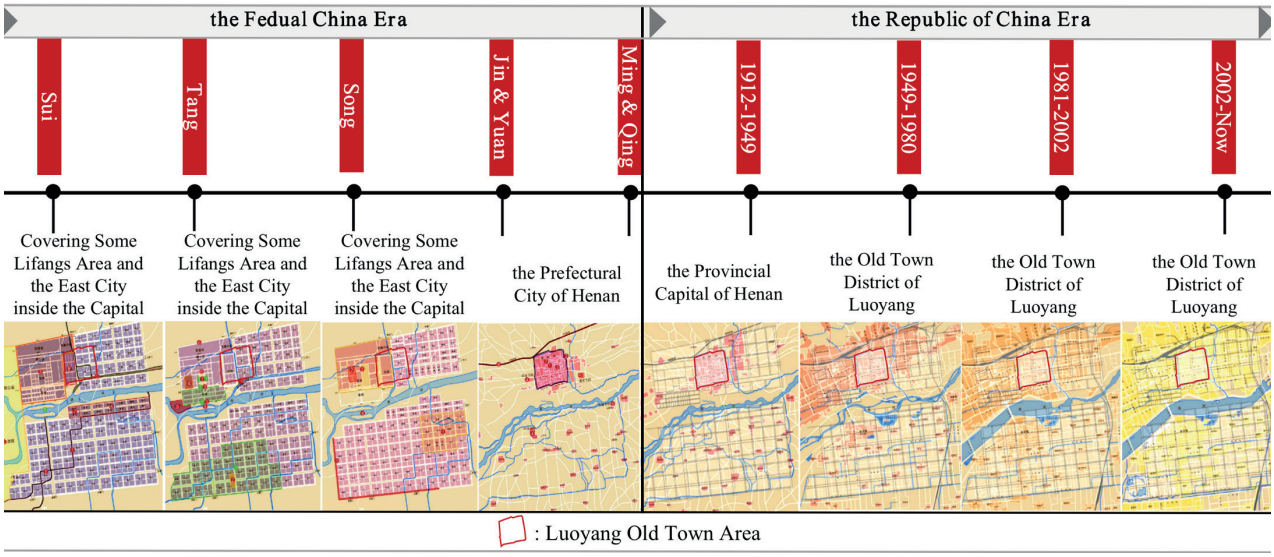


Figure 1. *Evolution of Luoyang Old Town area.*

Figure 2. *Current satellite image of Luoyang Old Town area.*

2. Methodology

2.1. *The Method of Visualizing the Past: Morphological Translation of Historical Information*

In order to visualize the past of a city, material and immaterial historical information was systematically translated into morphological elements. Since the past was mapped visually and quantitatively, the historical information can be correlated with the present urban form.

As for the technology roadmap for translating historical information, identifying and classifying historical information objects is the first step. A compound object of historical information is obtained through immovable relics, archaeological sites, studies of historical literature, and illustrations of historical maps and aerial photography. Different accessibility and locatability of historical information determine the different roles they play in contributing to morphological translation systems (Table 1).

In the process of practical operation (Figure 3), as historical existences, immovable relics and archaeological sites become the spatial reference coordinates above all for morphological translation of historical information system. Then, historical maps from Chinese local chorography is the kernel object to translate, becasue the spatial and functional information on historical form are accessible, reliable, and abundant in this kind of regard. Historical aerial photography as a hardly accessible resource with accurate spatial location and scale of historical elements also can be a core object of morphological translation. Finally, the historical literature and pictures play important roles as supplementary evidence for the whole system. Different historical information regarding a same historical element is joint together as a compound object, which is a mutually supportive and complementary mechanism to locate the spatial position of one single element accurately.

2.2. *Content of Morphological Translation: Dominant Spaces + Recessive Functions and Culture*

Visualizing the past of an ancient city can be achieved through the morphological translation of historical information. Then what is the content of morphological translation in ancient

town visualization? As far as an ancient Chinese city is concerned, its whole city function can be roughly summarized as five function systems: governance, economy, religion, transportation, and habitancy. These non-material function systems and their corresponding material spaces are the research content of ancient town form. As for origin and evolution of urban form, it starts with non-material functional needs, leading to emergence and change of material spaces, in which non-material culture is shown. Therefore, the research content of urban form is not only dominant material spaces but also recessive non-material functions and culture in spaces.

Table 1. *Characteristics of elements in the historical information system.*

Historical Information Systems	Accessibility of Historical Information	Spatial Location Characteristics of Historical Information Elements	Roles in Morphological Translation of Historical Information
Immovable relics	Easily accessible	Offering accurate spatial location and scale of relics	Providing realistic spatial reference coordinates for the morphological translation system
Archaeological sites	Easily accessible	Offering accurate spatial location and rough scale of relics	Providing realistic spatial reference coordinates for the morphological translation system
Historical maps	Accessible	Offering rich, systematic, intuitive spacial relationship of historical information, but lacking spatial accuracy and needing supplementary evidence	Providing core historical information for morphological translation system, and constructing a complete but rough morphological framework for the system
Historical aerial photography	Hardly accessible	Offering rich, systematic, intuitive spacial relationship of historical elements, providing accurate spatial location and scale	Providing core historical information for morphological translation system, and constructing a complete and accurate morphological framework for the system
Historical literature	Accessible	Providing the relative spatial location relationship and scale data of historical elements	Textual and oral supplementary evidence for the morphological translation system
Historical picture	Not easily accessible	Providing the partial spatial location relationship of historical elements	Image supplementary evidence for the morphological translation system

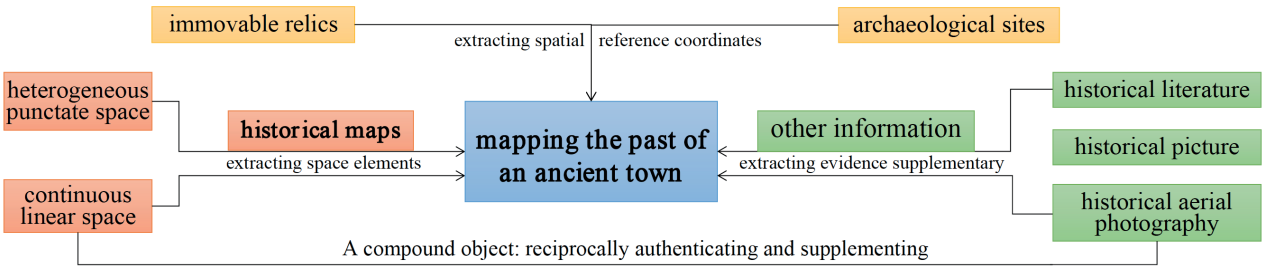


Figure 3. *Technology roadmap for morphological translation of the historical information system.*

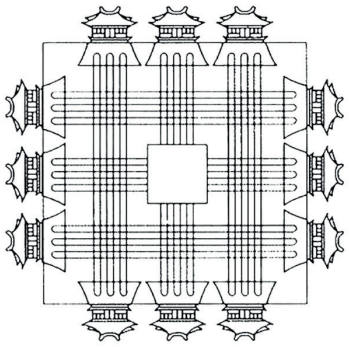
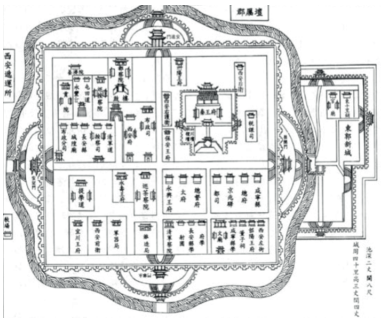
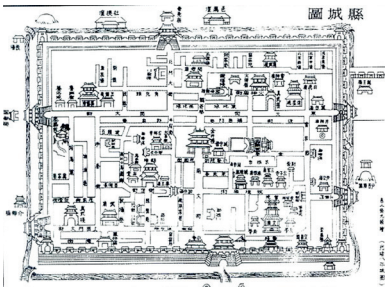
2.3. *Images of a Morphological Structure from Chorographies of Ancient Chinese Cities*

Which kind of morphological model can be used to research the form of ancient Chinese cities? In geometry, there are basic morphological elements: points, lines, and planes. In the study of urban field, Kevin Lynch (1960) put forward five spatial elements as 'the images of the city': paths, edges, districts, nodes, and landmarks. Christian Norberg-Schulz (1970) proposed three elements of space in *Existence, Space and Architecture*: places, paths, and fields. As for Conzen (1960), he thought that the town plan contains three plan element complexes: streets and their arrangement into a street system; plots (or lots) and their aggregation into street blocks; and buildings in the form of block plans. However, to study the form of an ancient Chinese city, the models mentioned above about modern spatial elements are not that suitable. The morphological images of ancient Chinese cities need to be traced back to the original construction records.

Chorography is the art of describing or mapping a region or district in ancient China compiled by feudal authorities. A city's morphological information recorded from local chorographies, especially a historical map, is like a structure-type 'text' which had been filtered and summarized as the core of ancient city form. Moreover, this morphological structure has stable similarities in every local chorography (Table 2).

According to the identical morphological structure 'text' showed in those historical maps from local chorographies, two kinds of images about morphological attributes in an ancient Chinese city can be summarized: the heterogenous punctate images and the continuous linear images. They established the relationship between space and function, containing the research content of morphological translation. Specifically, heterogeneous punctate images referred to punctate spaces highlighted on historical maps, like religion spaces, power spaces, military spaces, and culture spaces. they were core functional spaces implanted by feudal rulers to achieve their top-down domination. Meanwhile, those continuous linear images shown on maps, like city walls, watercourse, streets, and hutongs, acted as the main framework of city form planned by feudal rulers. Continuous linear images have both functions of barrier and interconnection, separating things from one side to another and linking those heterogeneous punctate images in the area. On the other hand, the surrounding historical contexts, which did not be shown on maps, mostly were residential spaces with more specific morphological details. In this regard,

Table 2 . *Historical maps recorded from local chorographies of ancient Chinese cities.*

The map of Royal City from the Rites of the Zhou·Records on the Examination of Craftsmanship	the historical map of Xi'an City from the Shaanxi Chorography of Ming Dynasty	the historical map of Pingyao City from the Pingyao Chorography of Qing Dynasty
		

the local people have been modifying and elaborating the morphological structure through bottom-up autonomy.

2.4. *Introducing the Patch-Corridor-Matrix Model from Landscape Ecology*

The above-mentioned morphological structure network of heterogeneous, continuous images and related historical contexts are consistent with the connotation of the 'patch-corridor-matrix model' from landscape ecology. It is a concise and operable model for identifying and comparing landscape structures, analyzing the relationship between spatial structure and its function, updating and improving the landscape condition. Thus, the landscape network model was introduced as the basic model to study the morphological structure network of an ancient Chinese city (Table 3).

Firstly, as a basic unit of spatial pattern, a patch has the spatial homogeneity in its own and the spatial heterogeneity in the background matrix. When it comes to the morphological structure network of an ancient Chinese city, patch elements are related to those heterogenous punctate images like power spaces, military spaces, religion spaces, commercial spaces. In the process of morphological translation of historical information, the collection of patch elements covers the current existences and the locatable disappearings about those heterogenous punctate images in historical maps.

Secondly, as a long and narrow strip unit different from surroundings, a corridor plays the role as a conduit and barrier. When it comes to the morphological structure network of an ancient Chinese city, corridor elements refer to those continuous linear historical images in Chinese chorography such as city walls, streets, axes, and watercourses. As for the collection of corridor elements in the morphological translation, the current existences and the locatable disappearings about those continuous linear historical images are all indicated.

Table 3. *High relevance in morphological attributes between structural images of ancient Chinese cities and the patch-corridor-matrix model from landscape ecology.*

Two Images about Morphological Attributes	Five Functional Systems	Functional Spaces		Mechanisms of Morphogenesis	Morphological Elements	Morphological Network Model of Ancient Towns
Continuous linear images from historical maps in ancient Chorographies	Governance	Defense space		Top-down domination	Corridor elements	morphological network of patch-corridor-matrix
	Governance	Axis space				
	Transportation	Road space				
	Transportation	Watercourse space				
Heterogeneous punctate images from historical maps in ancient Chorographies	Governance	Power space			Patch elements	
	Governance	Military space				
	Governance	Storage space				
	Religion	Religion space				
	Religion	Education space				
	Economy	Workshop space				
	Economy	Commercial space				
	Habitancy	Garden space				
Background environment	Habitancy	Residential space		Bottom-up autonomy	Backgrouond matrix	

Finally, a matrix is a background system surrounding patches and corridors with a high degree of connectivity. The Matrix in morphological structure network shows the local context of an ancient city, the living surrounding of residents, and the functional and cultural environment of a historic region. As for the process of translating historical information, morphological inheritance of the historical matrix is shown by the unique texture of old towns collaged in contemporary cities.

Generally, multi-layered morphological network of an ancient Chinese city can be constructed by diachronically analyzing the historical patches-corridors-matrix structure.

3. Diachronic Analysis through the Patch-Corridor-Matrix Model

3.1. *The Morphological Structure of Luoyang Old Town during the Sui and Tang Dynasties*

Luoyang Old Town was firstly built in the Jin and Yuan dynasties, on the old site of Sui and Tang dynasties. Firstly, according to the spatial coordinates of more than 60 archaeological sites, the historical information from the historical map describing the Luoyang city in the Sui and Tang dynasties was morphologically translated on the current vector topographic map(-Figure 4).

In addition, by combing the archaeological sites of Sui and Tang dynasties in the city scope of Jin and Yuan dynasties, the morphological correspondence of Luoyang city between the Sui Tang dynasties and the Jin Yuan dynasties can be identified. Now within the scope of the Luoyang Old Town (Luoyang city in Jin and Yuan), there are relics of the Xuanren Gate, walls of the East City, and the Hanjia Granary City belonging to the Sui and Tang dynasties. According to the morphological translation of historical information, the west part of the Luoyang city in the Jin and Yuan dynasties (Luoyang Old Town) can be considered as the East City and the Hanjia Granary City in the Sui and Tang dynasties; the east part related to six square-like Lifangs, which were residential units of ancient capitals in feudal China. According to historical literature, the East City was a centralized enclosure for imperial administration, the Hanjia Granary City was for national grain storage, and the Lifangs were full of famous mansions, temples, and courier hostels.

During the Sui and Tang dynasties, there were rich watercourse systems in Luoyang Old Town with a Dushui Jian, which was a governmental agency in charge of national water transportation in feudal China. Therefore, old town area was one of water transportation nodes in the Sui and Tang Grand Canal System and an international trade center in the ancient capital. There were also some big courier hostels, many restaurants, and grocery stores in streets. it reflected the flourishing post station culture developed by the Grand Canal in this area. Because of the abundant water system, there were many gardens described by *the Records of Luoyang Famous Gardens*, so that Luoyang had a popular garden culture in that period. Also, located in the east of the Imperial Palace and the Imperial City, the East City was dotted with many critical imperial offices. it demonstrated that Luoyang Old Town area was a center of imperial power. Besides, many temples of various religions like Buddhism, Zoroastrianism, and Taoism were recorded so that there was also a center of religious communication. In general, the past of Luoyang Old Town during the Sui and Tang dynasties was visualized through the morphological network of that period. It is not only about the morphology of space but also about the morphology of function and culture. All these above-mentioned spaces, func-

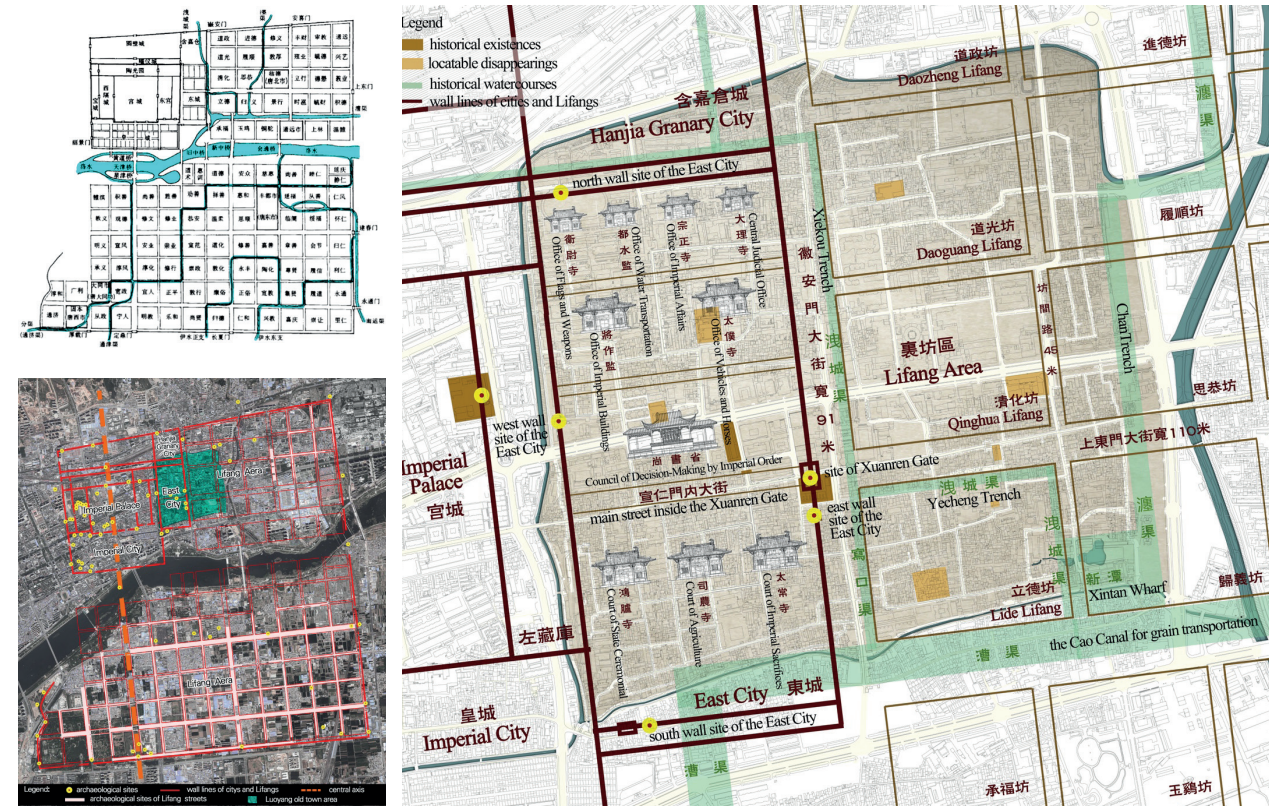


Figure 4. *Morphological translation of the historical information about Luoyang city in the Sui and Tang dynasties and the morphological structure of Luoyang Old Town area during the Sui and Tang dynasties.*

tions and cultures showed that Luoyang Old Town during the Sui and Tang dynasties is an essential node of water transportation in the Grand Canal System, an international trade center, and also assemblages of post station culture, garden culture, imperial power culture, and religious communication culture.

3.2. *The Morphological Structure of Luoyang Old Town during the Jin and Yuan Dynasties*

In the late Song dynasty, Luoyang suffered its fair share of destruction, and the city was burned down. Then, the Jin dynasty began to build a new prefectural city on the ruins, which related to the original construction of Luoyang Old Town. According to *The Chorography of Henan • Historical Sites in the Song and Yuan Dynasties, 'the Jin people built the new Luoyang along the west of the Chan River, which bordered the south wall of the East City on the south, the west wall of the East City on the west, and the north wall of the East City to the north'*. City walls and moats eclosed the newly-built city of Luoyang in the Jin and Yuan dynasties. By cross-shaped main streets leading to four city gates on each side, the city was divided into four parts – the southeast corner, the southwest corner, the northeast corner, and the northwest corner. As a result, the main morphological structure of 'Four Corners and Four Gates' was constructed.

In general, Luoyang city in the Jin and Yuan dynasties made a significant contribution to the morphogenesis of Luoyang Old Town. Through translating historical maps and other information of that period, the morphological network of patch-corridor-matrix was visualized(Figure

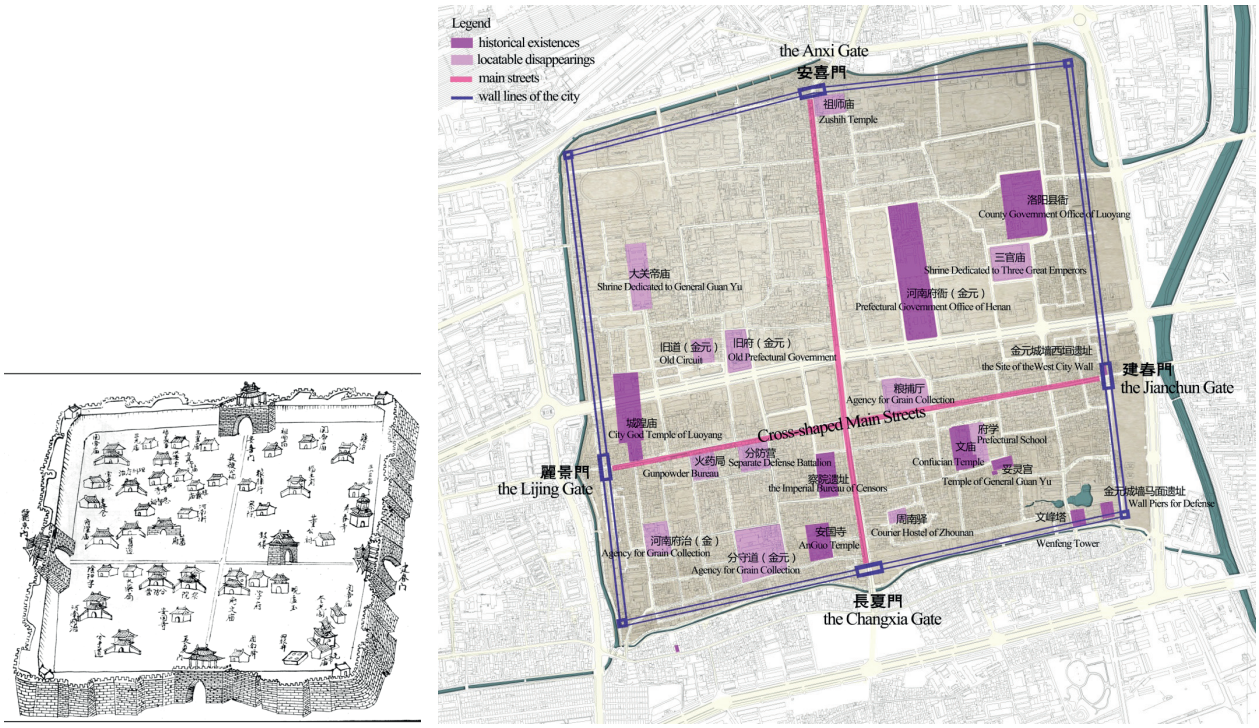


Figure 5. *Morphological translation of the historical information about Luoyang city in the Jin and Yuan dynasties andthe morphological structure of Luoyang Old Town area during the Jin and Yuan dynasties.*

5). Specifically, the continuous corridor spaces, such as cross-shaped main streets and city walls, constructed the morphological framework of Luoyang Old Town. Meanwhile, heterogeneous patch spaces with different functions and culture showed the inside form of this city. As a prefectural city in feudal China, Luoyang Old Town assembled a large number of power spaces concerning ancient administrative agencies. They became the core elements to control the primary form of the city for top-down domination. There were also many religion spaces such as the City God Temple, the Anguo Temple, and the Zushih Temple, as well as educational spaces such as the Confucian Temple, the Prefectural Academy of learning. It showed the evolution of religious culture with a change of city status from a capital to a prefectural, and the popularity of education during the Jin and Yuan dynasties.

3.3. *The Morphological Structure of Luoyang Old Town during the Ming and Qing Dynasties*

In 1368, the Ming army conquered and occupied Luoyang and regraded it as another prefectural city of Henan. Because the Imperial Guards in Henan was introduced in Luoyang during that period, which were vital stormtroopers in the Central Plains during the Ming dynasty, Luoyang had made great efforts to transform and strengthen the external defensive fortifications. For example, all the earth walls were replaced by brick walls. Outside the city, four semicircular bastions named 'the Luniform City' were built to guard four city gates. Moats around the city were reorganized by introducing water from the Chan and Jian Rivers in surroundings. Inside of the city, more other streets and lanes were built in each corner, so that a more elaborate structure of city form eventually showed up known as 'Nine Streets, Eighteen Alleys, Seventy-two Hutongs.'

Meanwhile, in the Ming dynasty, King Yi and King Fu were successively enfeoffed in Luoyang, and the ruins of their palaces still exist nowadays.

In general, the construction of Luoyang in the Ming and Qing dynasties provided a comprehensive explanation for the current form of Luoyang Old Town. In that historical period, the most significant number of immovable relics, the most abundant historical literature, and the most precise historical maps has significantly contributed to the morphological translation (Figure 6). Covering the existences and the locatable disappearings, the collection of patch elements in that period included twelve administrative authorities, fifteen Buddhist temples, nine Taoist temples, eight halls of fame, seven mansions and courtyards, seventeen academies of classical learning, and three courier hostels. The collection of corridor elements in Ming and Qing was similar to what it was like in the Jin and Yuan dynasties, including the cross-shaped main streets and the capillary-like hutongs for connection, as well as the walls and moats for obstruction. Meanwhile, the courtyard-style matrix of Luoyang city in the Ming and Qing dynasties had a direct effect on the current form of Luoyang Old Town. It is exactly because of the bottom-up inheritance and continuation of the matrix space from generation to generation that the historical texture of Luoyang has been preserved in the rapid urbanization up to now.

The first task of an ancient Chinese city is to rule not only politically and militarily, but also economically and culturally. As a site of both prefecture and county governance in Henan during the Ming and Qing dynasties, Luoyang was the feudal power center of Henan. Also, there were many temples for local beliefs. At the same time, because of many academies springing up, accessibility of education was comprehensively emphasized and promoted. Almost all large-scale public activities were firmly related to those heterogeneous public spaces. The assemblage of space, function, event, behavior, and rule in one morphological element shows the whole connotation of urban form. When it comes to the inherited matrix of residential courtyards, it highlighted the most fundamental culture in ancient China: living in a traditional courtyard.

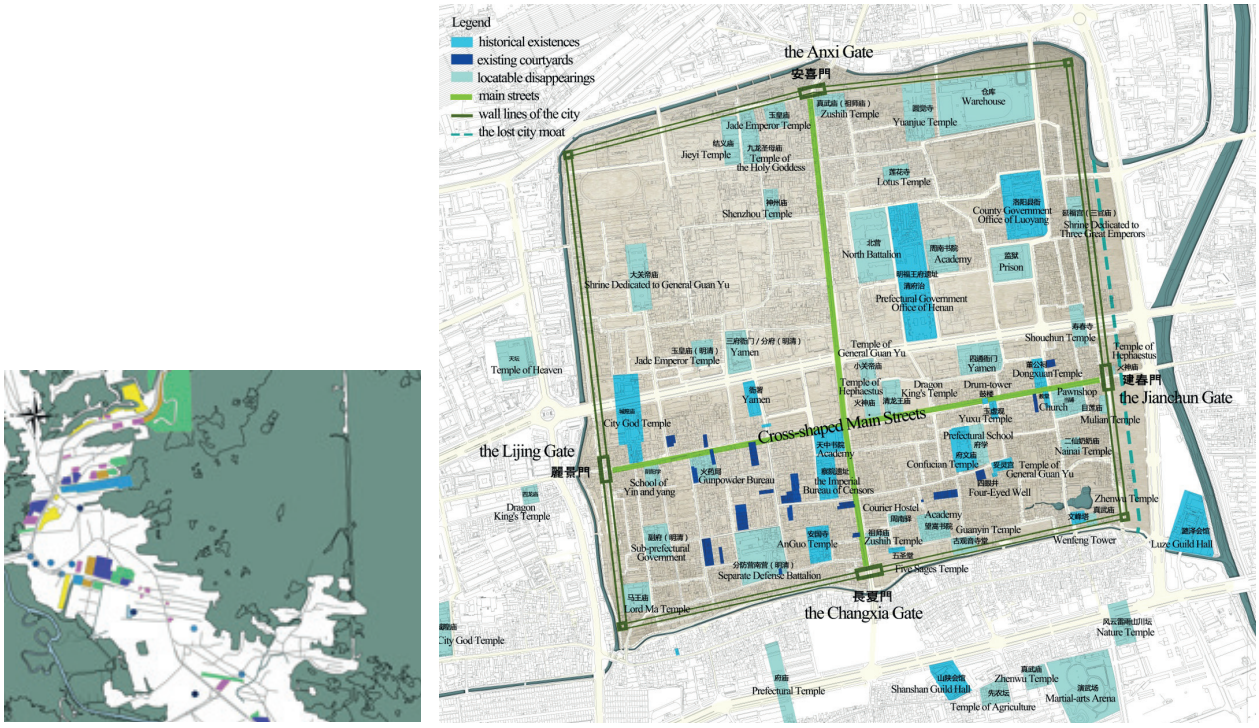


Figure 6. *Morphological translation of the historical information about Luoyang city in the Ming and Qing dynasties and the morphological structure of Luoyang Old Town during the Ming and Qing dynasties.*

3.4. *The Morphological Structure of Luoyang Old Town during 1912-1980*

During the period of the Republic of China, the feudal domination acting on ancient cities was finally abolished. Luoyang acted as a provincial governance center for a short time and was eventually downgraded as the old town district.

There are abundant historical literature, maps, and aerial photography about Luoyang during 1912-1980. Through the morphological translation of the historical information, it can be found that the spatial form of Luoyang Old Town remained basically constant in that period. Most of the buildings in today's Luoyang are redbrick multi-storey houses rebuilt after 1970s for urbanization, but all of them were reformed in strict accordance with the original pattern of black-brick courtyards foundation that belongs to the Ming and Qing dynasties. Therefore, although the background matrix of the old town has undergone a great transformation in term of architectural appearance and structure, the morphological texture of the ancient town is still inherited with some slight differences.

However, in the process of urbanization, the variation and deviation were mainly concentrated on the form of function and culture. Concerning heterogenous patch elements, the feudal power and religion spaces were modernized in term of function, to set up schools, factories, and parks for local residents (Figure 7). For example, the City God Temple was firstly changed to the Zhongshan Park and eventually transformed into the Heluo Middle School. With regard to continuous corridor elements, there were also some changes. As a symbol of the feudal regime, city walls were demolished so that the bricks from walls could be used for surrounding transformation. Also, in that period of national struggle, a unique underground system of air-raid shelters has been built, which is another linear structure of the morphological network. According to the *Luoyang Chorography*, there are 426 air-raid shelters, 438 entrances and exits, and 144 air vents for shelters.

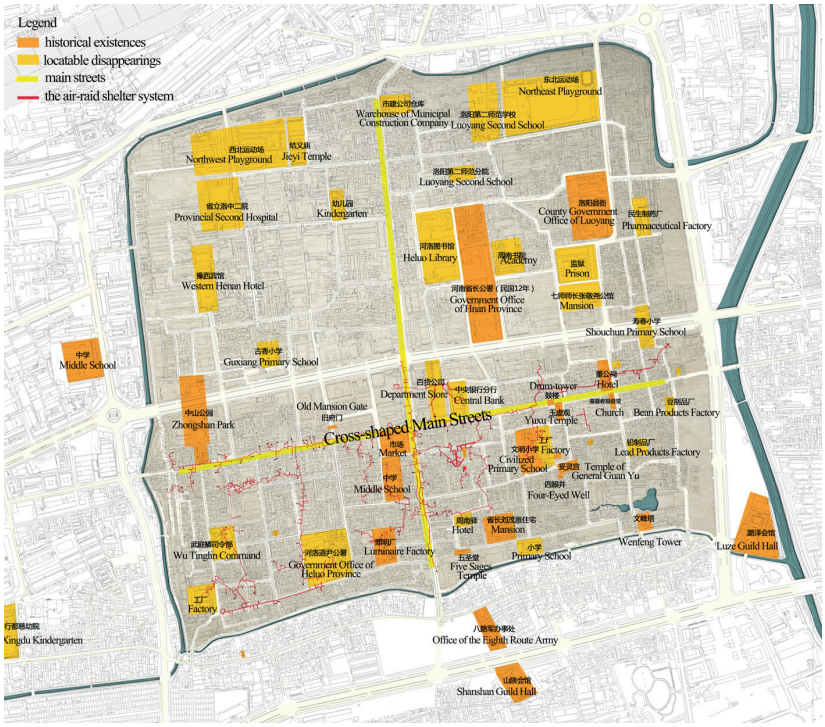


Figure 7. *Morphological translation of the historical information about Luoyang city in 1912-1980 and the morphological structure of Luoyang Old Town area during 1912-1980.*

In general, the new air-raid shelter system gives us a glimpse of the Luoyang's struggle during 1912-1980. When it comes to other old city form, morphological elements of the ancient town were mainly transformed in term of functional modernization. Compared with the Qing dynasty, the core function of the old town during 1912-1980 was still political, but the power center of Luoyang began to move out from the inside city. After the withdrawal of feudal power spaces and religion spaces, modern spaces for locals' needs, such as commercial spaces, industry spaces, and public service spaces, occupied their spatial positions with just a slight reformation of their spatial forms. During that time, shopping, catering, banking, and other modern life facilities were all along the cross-shaped main streets. However, the inadaptability of development orientation and the lack of policy constraints determined that light industry was not suitable for the healthy development of the old town in the later time. Commercial spaces and other public spaces in the old town were also correspondingly falling into decay.

4. Results: a visible morphological network System

Urban morphology is a result of the diachronic influence of time. Every space in an old town contains its traceable morphological genes derived from its process of morphogenesis. By exploring original images of a city and comparing them with the recent situation, the way for history to self-express in modern cities can be comprehended. Through the morphological translation of historical information, there was diachronic analysis for the 3000 years' past of Luoyang Old Town from the Sui dynasty to the Republic of China era. As a result, a visible morphological network of the old town within a multi-layered historic environment was constructed (Table 4).

The origin of Luoyang Old Town's form could be earliest traced back to the Sui and Tang dynasties. The walls, canals, and streets of the East City and Lifangs in that period provided a reusable form framework for the construction of a prefectural city in the later Jin and Yuan dynasties. As for the form of function and culture, Luoyang Old Town was an administrative center of the imperial capital adjacent to the Imperial Palace and the Imperial City. At the same time, the abundant resources of water in this area made it a canal traffic node in the capital, and a center of the international trade and the domestic post system, with the fascinating garden landscape.

With the eastward migration of China's capitals after the Tang dynasty, the political and military statuses of Luoyang dropped, and its city scale and functional hierarchy accordingly declined. The fundamental form of Luoyang Old Town structured by city walls, city gates, cross-shaped streets, moats, and hutongs, was generated in the Jin and Yuan dynasties taking advantage of some form framework Left over from the Sui and Tang dynasties. It is a typical morphological pattern of prefectural cities in feudal China and still exist in today's Luoyang Old Town. Later, the morphological attributes of patch and corridor elements have stayed stable generally, and the courtyard-type texture of the background matrix has been inherited mostly. However, the diachronic transformation of urban form mainly regarded to the gradual modernization of the architecture style and building function. After the Song dynasty, the feudal power culture, canal culture, religion culture, garden culture, and post-culture implanted in Luoyang Old Town had gradually disappeared. Luoyang Old Town has been going through a modernized transformation in function and has evolved into a district of historical habitation with modern education, leisure entertainments, public events, commercial activities in a contemporary city.

Table 4. *A Visible Morphological Network System of Luoyang Old Town.*

Material dominant space	Non-material recessive function and culture			
	Sui Tang	Jin Yuan	Ming Qing	1912-1980
	canal culture			
	power culture	power culture	power culture	power culture
	religion culture	religion culture	religion culture	
	garden culture		garden culture	
	post culture		post culture	
		academy culture	academy culture	academy culture
			court-yard culture	court-yard culture
				air-raid shelter culture
	business culture			business culture

5. Conclusion

Visualizing the past of an ancient city is a process of continually accumulating and elaborating the morphological network by diachronic analysis. As a space-time research system based on historical information, it provides historical references for the appreciation of current urban morphology and the optimization of the future.

- Based on the ancient thought of constructing an ancient city in Chinese chorographies, the leading and organizing roles of heterogeneous patch spaces in morphological structure, and the conduit and barrier roles of continuous corridor spaces were proposed. Then, by introducing the 'patch-corridor-matrix' network model from landscape ecology into urban form research, the morphological structure of patch-corridor-matrix about an ancient city during one historical period can be sorted out comprehensively.
- Try to understand the internal logic of urban morphological evolution through diachronic analysis. In the process of gradual urbanization, function has become the first term to be transformed for promoting the adaptability of ancient town form. However, with functional modernization, the historical patch spaces still have stable heterogeneity, and the historical corridor spaces also reflect constant attributes of barrier and interconnection. Meanwhile, the historical matrix spaces hold great inheritance in term of morphological pattern and texture to counter the urbanization of traditional living.

– By analyzing the historical origin of the present urban form, the self-expression of history through the ages can be glimpsed. Recognizing those various traces of history left behind in modern cities contributes to expanding the range of heritage conservation content. For example, within those transformed but locatable historical spaces, the historical authenticity of stable spatial attributes, like heterogeneity, conduit property, barrier property, also should be valued.
– Mapping the past of an ancient town aims to build a visible spatial and functional database of its historical information. Through GIS platform, all collected historical information is systematically input and recorded to realize the digitalization of heritage. It provides visible reference and guidance from historical information for contemporary designing, planning, transforming, managing, and adjusting. The past, the modern, and the future of the urban form are linked closely beyond time and space.
– Due to the limitation of historical information collected currently, visualizing the past of an ancient town must be an open morphological system that needs to be supplemented, updated, and perfected constantly.

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Study on Typo-Morphological Characteristics and Evolution of Guangxiao and Liurong Temple Historical District in Guangzhou, China

by Pengyu Zhao
Tongji University

Keywords: Morphological Characteristics; Historical District; Temple.

Abstract: Liurong Temple and Guangxiao Temple, located in the same block, are the two most important temples in Guangzhou City. With the rapid urbanization process, the historic preservation of its surrounding neighborhoods is facing enormous challenges. Today, this district presents a highly complex picture both in terms of urban morphology and programme. Based on the site investigation and morphological analysis, this paper describes the following morphological features of the block: fragmentation and collage of the street network, border barriers brought about by closed territories such as monasteries, diversified architectural types, and interrupted public space system. According to historical research and comparison of urban fabric in different periods, the author find out that the overlapping of following great changes in different historical stages constitutes today's urban form: the evolution of Guangzhou city wall, the construction and disappearance of the six-vein canals brought about changes in traffic modes, the occupation of monasteries by the army, factory expansion in the period of planned economy, development of real estate in commodity economy era.
The author attempts to reveal the establishment, disintegration, and reorganization of boundaries on urban form at different scales, which is more influenced by social force and the migration and settlement of different populations. This research will inspire the formulation and improvement of policies in the preservation and regeneration of Guangxiao and Liurong Temple district.

1. Introduction

Many East Asian cities share the same characteristics: the city centre, which gathers commercial and cultural activities, spreads around with temples as its core. However, with the decline of the importance of religious sacrificial activities in daily life, the urban areas with temples as the core often face the decline of vitality. The historical blocks with Guangxiao Temple (光孝寺) and Liurong Temple（六榕寺）as the core, located in Guangzhou City（广州）in the Pearl River（珠江）Delta, are currently encountering such problems. Based on Typo-Morphological Approach, this paper investigates and analyses the current situation and historical research of the block, in order to get the current situation and problems faced by the block, and the evolution of urban form development, providing a reference for the further protective planning and renovation of the block.

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2. Overview of the Guangxiao-Liurong Block

Located in Yuexiu（越秀）District, Guangzhou City, this block is adjacent to the traditional axis of the Qiyi Road（起义路）, backed by Baiyun Mountain (白云山), facing the Pearl River, and has a long geographical and cultural history. There are two ancient temples in the block, Guangxiao Temple and Liurong Temple, which are sacred places of Buddhism in Guangzhou.

Guangxiao Temple is located in No. 109 Guangxiao Road, Guangzhou. It covers an area of more than 30,000 square meters. It has the longest history, the deepest influence and the largest scale in Lingnan area.1 In the history of Guangxiao Temple, there were many famous monks. They were the famous ancestral court of Zen Buddhism and the Taoist hall for translating scriptures. They were also good places for literati to sing and paint elegantly. Therefore, Guangxiao Temple occupies an important position in the history of Chinese Buddhism and the history of Chinese-foreign exchanges, and has far-reaching influence on Lingnan's politics, economy and culture. Liurong Temple, located on Liurong Road in Guangzhou, is a famous ancient temple with a long history at home and abroad. The Pagoda in the temple is lofty, the trees are lush and the cultural relics are gathered together, leaving many famous people's footprints in history. Liurong Temple was named for the inscription of the temple in Su Shi（苏轼）2. It is also called Guangzhou Buddhist Four Holy Places with Guangxiao, Hualin(华林寺) and Haichuang Temple（海幢寺）. Liurong Temple, like the flower Pagoda（花塔）in the temple, has always been praised by people. In addition, its historical status and the name of Guangxiao Temple are known as " Guangxiao is famous for its trees, while Jinghui（净慧）3 stands out for its pagoda".

The study takes 603,000 square meters of blocks around the two temples as the research scope. The specific scope is as follows: Jiefang（解放）North Road in the east, Renmin（人民）North Road in the west, Zhongshan（中山）Six Road in the south, Dongfeng（东风）West Road in the north. The four roads are the main roads of the city, and the blocks are nearly a shape of square. Among them, the Southeast part, as a part of "Wuxianguan（五仙观）– Huaisheng Temple（怀圣寺）– Liurong Temple Historical and Cultural Block", was included in the "Protection Planning of Guangzhou Historic and Cultural City". There are many other streets with good protection of traditional style and features in the block. Residential, commercial, religious and cultural functions are mixed in the neighborhood, with a total of seven communities: Pengjiaxiang (彭家巷) Community, Daogucang (稻谷仓) Community, Wenyuanxiang(文园巷) Community, Jiunanhai（旧南海） Community belong to Liurong Street, Taojiaxiang（陶家巷） Community, Zhushouxiang（祝寿巷）Community belong to Guangta（光塔）Street.

3. Typo-Morphological Analysis

3.1. *Plots and Spatial Structures*

The road in this block is divided into three levels: (Figure 1)

– Motor lane: road for motor vehicles in the block, the ground is generally asphalt road. They are Panfu Road(盘福路), Haizhu North Road (海珠北路), Liurong Road, Jinghui Road, Guangxiao Road, Guangde Road (广德路), Jiangjun West Road（将军东路）, Yingbin Road（迎宾路）, Shiyi Avenue (市一大道), Pengjiaxiang Road, and Bailing Road (百灵路). Among them, Panfu Road and Haizhu North Road are connected to form the central axis running through the north and south of the block, which divides the East and west

of the block. The main city road and Bailing Road are connected to form the axis running through the East and west of the block.
– Pedestrians. Pedestrians are the only roads in the block for pedestrians and bicycles, and the ground is usually paved with slate or other pavement. Their ends are usually connected to the motor lane.
– Alleys: only for pedestrians, relatively narrow, generally the end of the road.The b and c streets retain the small-scale characteristics of traditional streets and lanes.

The plots are as follows:

– Temples and religious facilities. The main plots in this block are Guangxiao Temple and Liurong Temple. (The purple plot in Figure 4 is Guangxiao Temple on the left and Liurong Temple on the right.) Among them, the area of Liurong Temple is approximately rectangular with regular boundary and surrounded by streets on all sides. However, the shape of Guangxiao Temple is complex, its boundary is uneven, and it is not near the street on both sides. It is interlaced with the surrounding land.
– Public service facilities. The main plots are Guangzhou First People's Hospital, which covers a large area in the northwest of the plot, and Yinghuang Hotel, Guangdong Province, which covers a large area in the east. Four other secondary and primary schools are scattered across the streets.
– Other residential and commercial plots. Each of these plots occupies a relatively small area, which is generally divided by the street network, and some of the communities are closed communities.

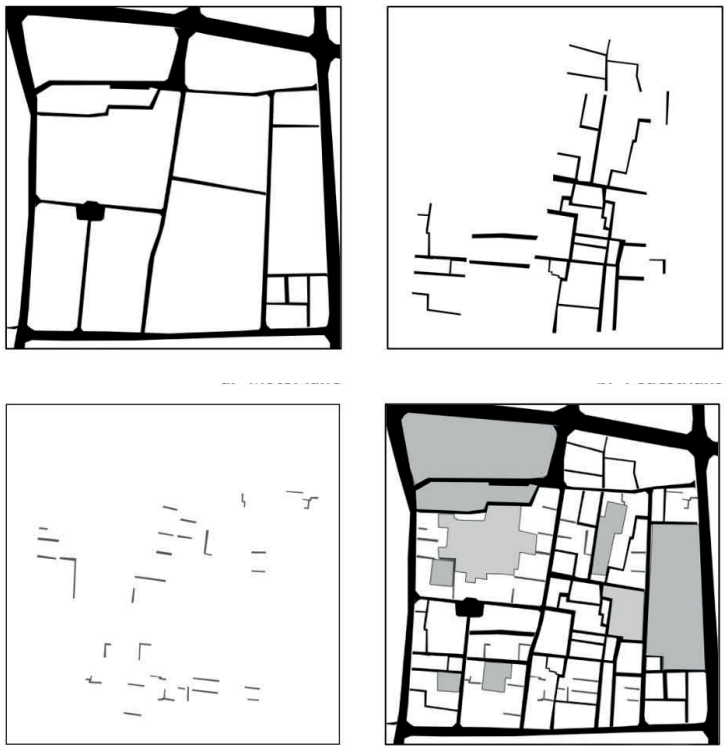


Figure 1. *Spatial Structures Analysis (a. motor lane; b. pedestrians; c. alleys; d. plots).*

From plots and street diagrams, we can see that the street network of this block is fragmented. Although the block is basically a grid network, there are only two streets running through the whole block, and the rest of the streets are end-to-end. This is particularly evident in alleys. A large number of lanes are cul-de-sacs , and most of them are distributed along the East-West direction. Considering the characteristics of land division, one of the main reasons for the "fragmentation" is that there are a large number of monasteries and public service facilities in the block, which have closed walls to separate the interior and exterior, forming a lot of barriers at the border.

3.2. *Street Space Analysis*

The above characteristics of "fragmentation" are more obvious in the areas around the two temples, so we mainly select the areas around the two temples for street space analysis.

3.2.1. *Liurong Road and Cangqian Street*（仓前街）

The above characteristics of "fragmentation" are more obvious in the areas around the two temples, so we mainly select the areas around the two temples for street space analysis.
Liurong Road, 12 meters wide, is a one-way road for motor vehicles from south to north. Liurong Temple is located in the middle section of Liurong Road, so Liurong Road is one of the necessary places for tourists to visit Guangzhou. There are shops selling Buddhist supplies and providing services related to Fengshui (风水) and fortune calculation near Liurong Temple. On one side of the road, there is a 3-meter-high wall of the Yingbin hotel, and only a sidewalk on the side of the Liurong Temple.

Cangqian Street is located between Haizhu North Road and Liurong Road. It is 5-7 meters wide and paved with stone slabs. On both sides of the road are multi-storey residential buildings with Buddhist supplies and shops in religious and geomantic industries on the ground floor.

3.2.2. *Haizhu North Road and Jinghui Road*

Haizhu North Road, 10 meters wide, is a one-way motor vehicle line from south to north. On both sides of the road, there are 2-3 storeys of residential buildings, whose street space is refrigeration equipment shops. Nine-storey residential buildings are distributed on both sides of the intersection of Haizhu North Road and Jinghui Road.
Jinghui Road is a one-way motor vehicle line from east to west with a width of meters. On both sides of the road, there are 5-9 floors of mixed commercial and residential buildings, and the street floor space is shops.

3.2.3. *Guangxiao Road and Zhongshan Six Road*

Guangxiao Road, 9 meters wide, is a one-way motor vehicle line from south to north. The south end is a 22-storey high-rise building, and the other sections are low-rise shops on both sides. The northern section is adjacent to Guangxiao Temple, and there are many shops selling vegetarian food and Buddhist utensils. Zhongshan Sixth Road, 16 meters wide and four lanes in both directions, is a main road in Guangzhou. The 2-4-storey arcades on both sides of the eastern section of the road are well preserved, while the style and features of the west section of the arcade buildings have been destroyed.

Fig. 2.1.

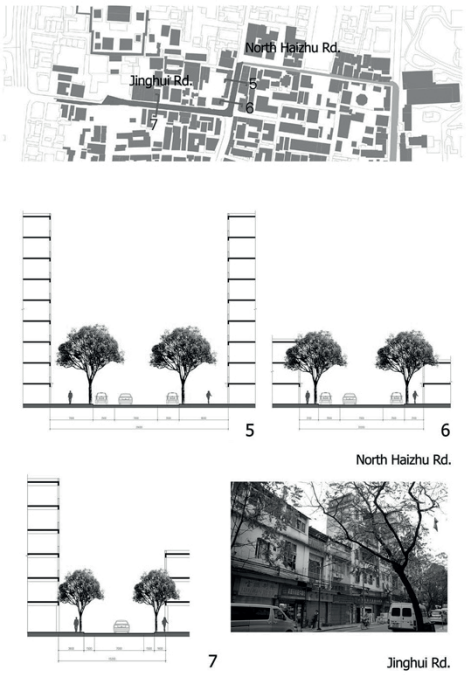
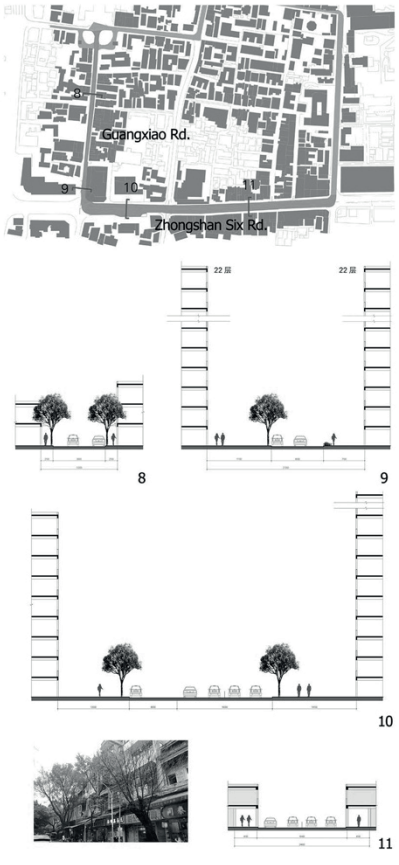


Fig. 2.2.



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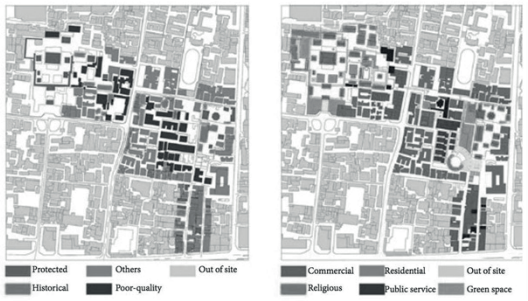

Fig. 2.4.

Fig. 2.5.

Figure 2. *Street Space Analysis (fig. 2.1 Liurong Road and Cangqian Street; fig. 2.2 Haizhu North Road and Jinghui Road; fig. 2.3 Guangxiao Road and Zhongshan Six Road; fig. 2.4 Classification of Architectural Types: by Function; fig. 2.5 Building Height).*

3.3. *Analysis of Building Types*

Although it is a historic block, the stock of historic buildings in this block is limited. Historic buildings are mainly distributed on both sides of Huiji West Road （惠吉西路）. The building heights along Guangxiao Road, Jinghui Road, Haizhu North Road, Cangqian Street, Liurong Road and Zhongshan Six Road are obviously different. Zhongshan Sixth Road is a well-preserved arcade street, while Guangxiao Road has some arcades, which form a continuous pedestrian space together with the canopy of shops along the street. Most of the buildings along the street are 3 stories or less, with pleasant scale. Jinghui Street – Haizhu North Road – Cangqian Street is an important link between the two temples, along which there are a large number of 4 – 6 storeys of residential buildings.

"Residential space + ground floor commercial space", this type of building constitutes the base of the whole block. Existing buildings can be divided into two periods before 1949 and after 1949 for morphological-typological analysis:

3.3.1. *Bamboo House4 Joint-Row Residential Area – Matrix of Texture (1941-1949)*

Demolition of city walls and construction of roads were the main urban construction in the period of the Republic of China, but a comparative analysis of the road network system recorded by historical maps shows that it did not change the urban fabric of Guangzhou. Although the buildings in Guangzhou were basically renovated during the Republic of China, it was the renovation and construction of the old texture in the late Qing Dynasty. This is because the land ownership system of Guangzhou City during the Republic of China was a multi-compound structure: Public ownership and private ownership coexist, but private ownership is dominant, the boundaries of residential areas are difficult to change, the plane remains unchanged, and increasing the number of floors is the only way to improve the construction intensity. Self-built housing projects are common in this old city renewal. Most of its builders are ordinary citizens. Due to the limitation of site and capital, the bamboo house joint row residential area has become the most important type of residential area in the city. Bamboo dwellings are the "matrix" of texture in our research area, and other types of dwellings are mosaic.

The bamboo house in the Republic of China is a brick-concrete structure. The width of the bamboo house is limited to 4 meters. Most of the load-bearing bodies are brick masonry. It is the type "variation" of the traditional bamboo house in adapting to some social and economic characteristics of the Republic of China. This kind of construction experience transforms the traditional residential type from bungalow to apartment building. Architectural types are based on the traditional bamboo tube houses fixed in the Ming and Qing Dynasties. The plane form basically remains unchanged, but changes have been made in the number of stories, building structure, elevation form and decoration, and materials. It's basically a one-story apartment. Sometimes several families build their own houses together, each floor needs an independent entrance and staircase to the ground.

3.3.2. *Multi-storey Residential Buildings (1950-1979)*

During the period after the founding of the People's Republic of China, urban land was basically allocated by the state to land-use units for use indefinitely and gratuitously. The two most common flat forms of building and residence are corridor-to-corridor type and ladder-to-lad-

der type. In the past 20 years, the number of building floors has increased to 3-5 floors, and some of them have been upgraded to 5-7 floors of residential buildings. The size of the house has increased, and the appearance of the house still follows most of the simplicity of the 1950s. The exterior wall is mainly decorated by plaster. The exterior facade can be decorated by material, color and components. The structure is mainly brick-concrete structure, and it was not until the 1970s that reinforced concrete structure was gradually used. At this stage, the contradiction between supply and demand caused by population increase and land restriction promotes the emergence of high-rise patio houses. Its excessive volume destroys the texture of the original low-rise bamboo house and multi-storey building. Since 1980, Guangzhou's real estate industry has been restarted and dilapidated multi-storey buildings have been replaced.

4. Historical Research and Urban Form Evolution

4.1. *Temples: from outside the city wall to inside the city*

It can be seen from the historical map that before the formation of the size of Guangzhou City today, two ancient temples in the plot had been formed, both of which were outside the city site at that time. During the three hundred years of the Northern Song Dynasty, Guangzhou City was expanded and renovated many times. During the Qingli (庆历) and Xining (熙宁) reigns of the Northern Song Dynasty, three cities (Central City, West City and East City) were built. The Guangxiao Temple and the Six Rong Temple are also surrounded by the walls of the Western City. The whole block is enclosed by the city wall, which promotes the formation and development of the surrounding buildings.

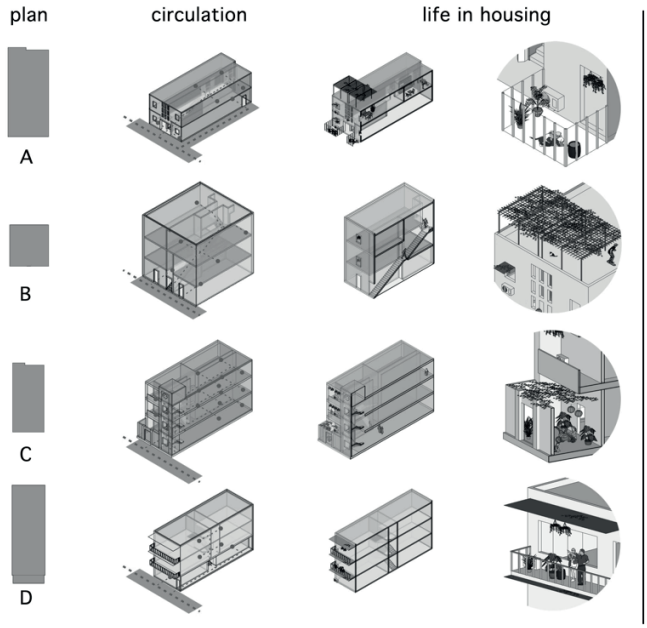

Fig. 3.1.

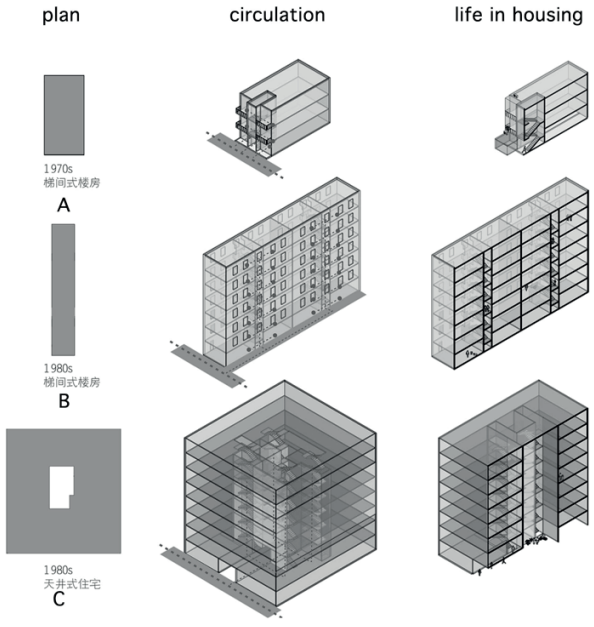

Fig. 3.2.

Figure 3. *Architectural types (fig. 3.1. Architectural types before 1949; fig. 3.2. Architectural types after 1949).*

4.2. *Shipping: The Impact of Traffic Mode on Urban Form after Song Dynasty*

In the Song Dynasty, the existing river network in the city was used to build revetments, dredging into drainage canals running through the city, which were like veins, called "Six-vein canals"（六脉渠）. The city also dredged West canal (西濠), East canal (东濠), Yudai canal(玉带濠), which led to the Pearl River, and built an inner harbor wharf to facilitate shipping. The document records, "The width of the Six-vein canal can accommodate the navigation of ships".

Two important temples in the region are connected by the Six Veins Canal to the developed water network in the Pearl River Delta. Therefore, it can be inferred that the main traffic arriving at the area at that time was vessel, which brought the possibility of commercial development along the Six-veins canal.

At that time, there were probably two ways of arriving from outside the city: 1. From the Pearl River through East canal to the shore outside Hefeng Gate (和丰门) and reach the block by land. 2. From the Pearl River through West canal and Yudai canal(, it enters West City in Fucai Gate (阜财门), and then reaches the block through the three western veins of the Six-Vein Canal. Accordingly, the connection between the commercial agglomeration and combination water system brought by the temples and the whole Pearl River Delta is the main driving force for the development of the block.

4.3. *Six-vein Canal and the Urban Form of the Block*

Located in the northwest corner of West City, it is an important area linking West canal both inside and outside the city. There are links with Fengmen and Weiyuan Gate outside the city. At the same time, there are two channels flowing through the Six-vein Canal. In Song Dynasty, the channel of Six-vein Canal was wide, and the buildings began to be built by water. From today's texture patterns of the two layers of Guangxiao Road and Haizhu North Road, we can roughly infer the layout of buildings by water at that time (Figure 3-3). Afterwards, when the adjacent water was occupied, the construction of houses began to extend to both sides. Gradually, roadways and road networks began to take shape.

4.4. *Border Generation: Segmentation of Temples*

The area of Liurong Temple and Guangxiao Temple has changed in past dynasties, especially after the Ming Dynasty, among which Liurong Temple is the most prominent. In 1373 (six years in Hongwu（洪武） period of Ming Dynasty), half of the temple area was requisitioned as Yongfeng barn（永丰仓）. Since then, the gate has been changed to the east, and the area of the temple has been shrinking. Six ancient banyan trees5 are no longer situated in the wall of the temple because of the reduction of the area of the temple. The eastern half of the Liurong Temple was designated as the provincial Commander-in-chief's Office6 (提督府). The original Jinghui Temple is quite large in scale and covers a wide area. The Mountain Gate faces south. Archives record that the length and width of the temple are greater than one kilometer. The street pattern around Liurong Temple was basically formed at this time.

After the Qing Dynasty, Yongfeng barn was renamed Yuxin barn, and part of the original barn in the west of Liurong Temple was changed to the Eight Banners Army garrison（八旗营）, and roads were built in the barracks, forming the pattern of "three lanes" today. The southern part of the Liurong Temple was transformed into the right General Court and the

Commander-in-chief's Office was changed into the General's Office（将军府）. In the fifth year of Qianlong （乾隆）(1740), monks bought the land beside the temple with heavy money and built Zen Hall, dining room, guest house, warehouse, kitchen and garden, which is called "Renaissance".

4.5. *Formation of collage texture*

After the founding of the People's Republic of China, there was a lack of traditional industry and Commerce in the region. In order to improve the economic water level, a large number of factories have appeared in the block. In order to solve the housing problem, high-density collective housing and workers' dormitories of factories have been built, including Yuejin Machinery Factory and the Seventh Machinery Factory. Large-scale buildings have destroyed the stable urban fabric of the block. After the 1990s, along with the development of commodity economy and real estate, the main roads began to construct shopping malls and office buildings, which gradually formed the texture of today's high-level collage. Small-scale buildings in the late Qing Dynasty coexisted with new high-rise buildings built in the past decade.

5. Conclusion

Through the above analysis and historical study of the current urban form, the following key factors in the historical process have the greatest impact on the current urban form:

- Evolution of Guangzhou City Wall: The boundary between the West and the North of the block is shaped by the old city wall, and it changes constantly in the course of history. Today, the city wall no longer exists, but the elevated circular highway still follows the trend of the city wall, constituting today's land boundary.
- Water network shaping road network: The main road in the block was built along the six-vein canal, and the old water network has evolved into today's road network system.
- Changes in the boundary between the two temples: From the above historical evolution, we can find that the two temples have undergone repeated process of "expansion-occupation" from the state of almost adjacent to each other, and now they have formed a state of dense high-rise building isolation and poor accessibility lane links between the two temples. The formation and change of borders are the important reasons for the fragmentation and collage of the local urban form.
- Soviet-style Compound: The transplantation of the Soviet planning model of Soviet-style Compound (factories + residential areas) in this area has brought about a large number of closed communities. The resulting borders still exist today. In the era of commodity economy, the development of real estate has also brought about a large number of closed management communities.

These factors affect the past of the block, and provide inspiration for how to regenerate the block in the future.

Notes

Lingnan area（岭南地区）: refers to the culture of Guangdong and the nearby provinces in Southern China.

Su Shi（苏轼）(1037-1101): Literator, painter and calligrapher of the Northern Song Dynasty, one of the most famous poets in China.

Jinghui（净慧）: alternative name of Liurong Temple

bamboo house（竹筒屋）: Bamboo house, as its name implies, is called bamboo tube house because of its narrow and small facade, long and deep, and shaped like bamboo tube. Bamboo house is also called "shop house". The bamboo house in Guangzhou came into being in the 19th century. At that time, Guangzhou's industry and Commerce entered a period of rapid development. The population of the city increased rapidly, the inner city began to be tense, and the land price increased. Under this situation, the bamboo house, a commercial and residential building form, emerged as the times require and became one of the traditional residential forms in modern Guangzhou. Ordinary citizens are their inhabitants. Beginning from the beginning of the 20th century, with the development of industry and Commerce in Guangzhou, bamboohouses or shop houses have also developed rapidly.

In Chinese language, "Liurong" means "six banyan trees". The six banyan trees in the temple are the origin of the name of the temple.

Provincial commander-in-chief（提督）: The Chinese pronunciation is "Tidu", A military officer in the ancient army, usually the highest military officer in a province in the Ming and Qing Dynasties.

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Typology Research from Traditional Courtyard Housing to Old-type Lilong Housing in Tianjin, China

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Keywords: Lilong housing, Tianjin, classification, typological process, evolution.

Abstract: Lilong housing was the most representative dwelling house in modern Tianjin. It was generally thought that the Lilong housing was derived from the Chinese traditional courtyard housing. There are two kinds of lilong housing according to the extent of impact from traditional courtyard housing: the old-type Lilong and new-type Lilong. The former showed most characteristics similar to traditional housing, which the detailed interpretation about the evolution was neglected. Besides, the traditional courtyard housing and old-type Lilong housing in Tianjin have various forms that are ignored by previous research. Based on the method of Italian typology, this paper take the concept of level to build a uniformly classification system, bringing the two types of dwelling house into a same method. On this basis, this paper further analysis the typological process between the traditonal courtyard housing to old-type Lilong housing, also on the four levels. It is supplement to the history research on residence in Tianjin

1. Introduction

The traditional courtyard housing in Tianjin has been formed in 400 years since the castle of Tianjin was built in early 15th century (Figure 1a). Due to the easy accessibility to southern provinces by the Canal and Bohai, richness of resources, and the large number of immigrants in, the local architectural culture and construction technology have been promoted deeply. Tianjin courtyard housing was generally same as Beijing Siheyuan, which belong to the same dwelling system. A large amount of traditional courtyard housing constituted the urban texture of Tianjin. In 1860, Tianjin was opened to outside world, experiencing a great change in modernization and urbanization. The urban texture of Tianjin has undergone tremendous changes. As the most important component of the urban fabric, urban dwellings changed from traditional courtyard houses to modern Lilong housing, which is a new type of residence that is different from traditional courtyards.

Lilong housing developed from traditional courtyard houses, retaining the spatial layout of the central courtyard of it. Both are organized in a square courtyard, which is surrouned by a number of independent building entity, such as the main house, the wing room and the reversely-set house, forming a global dwelling house. The traditional courtyard architecture is deeply rooted. Scholars often called it the old-type Lilong housing. On the other hand, under the con-

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text of various social upheavals, some Lilong was impacted by western culture, showing the characteristic of row house as unit repetition. In a unit, the central courtyard disappeared, and the room layout is functionally oriented and connected compact to each other.

1.1. *Research on traditional courtyard housing and Lilong housing in Tianjin*

Compared with the Beijing Courtyard housing, the shape and space of Tianjin courtyard housing, also called "sihetao" (Teng, Jin, 2002), is more liberal due to the unique geographical and cultural. The most obvious feature of Tianjin traditional Courtyard is in the layout, in which the "jiandao" (arrow street) on the side to organize the traffic of different courtyards. There are both tandem and parallel transportation system at the same time in a dwelling house (Zhang, 2007). The courtyards also organize on width besides in depth (Teng, Jin, 2002). In addition, most streets including lane and hutong in the old city of Tianjin, are not straight, along which most courtyards arranged, the orientation and scale are limited, forming a special urban texture in Tianjin.

There are many studies on Tianjin Lilong hosuing, mainly focusing on the spatial form and its type, including external and internal space. The research on external space has accumulated more results, mainly focusing on the new-type Lilong. Wang, Shen and other scholars put forward different methods according to space texture (Jiang, 1993; Wu, 2013), architectural layout (Wang, Chen, 1987; Shen, 1993) and the lane structure (Wang, Chen, 1987; Sun, 2007; Li, Xu, Wu, 2000) . The study on internal space mainly refers to the the number of surrounding building entities in a courtyard in Old-type Lilong. In 1963, it was proposed that the old-type Lilong housing still follow the "house enclosing courtyard" and emphasize the traditional pattern of axis symmetry in "Tianjin Lilong Investigation Report". According to the number of building entities enclosing the courtyard, the Old-type Lilong was divided into four-side type, three-side type, two side type, one -side type and lock type, whose forms are also analyzed separately. Subsequent scholars followed the classification method (Wang, Chen, 1987; Li, Shu, 2010)

Above all, there are some shortage. On the one hand, the study on two residential types lacks uniform standards so that cannot be compared from a unified research perspective. On

Figure 1. *The classifications on overall layout (a.The traditional courtyard housing; b. the old-type Lilong housing).*

the other hand, there is a lack of specific interpretation on the evolution process from the traditional courtyard to Lilong housing, that is, the morphological evolution mechanism of the two residential types transformation process.

2. Typological method

Urban morphological research has a common hypothesis that there is a systematic organization in the texture, or organic attributes, in which the part and the whole, that is, the building type and texture are interdependent (A. Levy, 1999).

The British Conzen School defines the core of texture research as a town plan composed of different plan elements, and the whole of these elements is defined as a plan unit. In contrast, the Italian Cannigia School adopted an organic approach. The type of building and urban fabric is considered to be a typological process, a process that begins with the basic unit (Conzen M.R.G, 2009).

This paper uses the Italian typological process method represented by S. Muratori and G. Caniggia, introducing important concepts: type, level and typological process.

2.1. *Type*

The type of building is defined in Italian urban morphology, including two aspects: the inner essence and the external characteristics. Intrinsically, a type refers to a group of buildings that are dominated by the same architectural concept in the architectural culture in the same historical period and region. The architectural concept includes all the expectations in builder's mind before the existence of the house. While the architectural concept is determined by the specific architectural culture (Caniggia G., Maffei G.L., 2001).

In terms of extrinsic features, a building type refers to a group of buildings with certain or a series of common features. These common features include similar functions, similar structural distribution planes, and similar construction purposes. The extrinsic character is determined by the intrinsic nature of the type of building, ie the architectural concept (Caniggia G., Maffei G.L., 2001).

2.2. *Level*

Caniggia interprets the human environment as built object and divides it into four dimensions that are related to each other : buildings, building group, city, and region. Each built object is a complex entirety consisting of an element, elementary structure, structure system, and organism. Therefore, the built environment is an organism composed of all parts, and each component is also an organism (Moudon A.V., 1994). The organism is the research object, the element refers to the small-scale composition in the direction of the organism and related; the structure refers to the combination of elements not directly related to the organism; the system refers to the secondary organism which has a certain relationship with the organism. Caniggia uses the city as an organism, the block as a system, the block as a structure, and the building as an element; and interprets the interdependence and interaction between the four levels from the smallest-scale: building (Caniggia G., Maffei G.L., 2001).

2.3. *Typological process*

As a time-related factor, diachronic study the origin of building types. The type of building in the later period was based on the type of building in the earlier period. Both its intrinsic nature and its extrinsic characteristics are inherited from early types. By analyzing the early types, it is possible to derive architectural concepts such as the reasons for the type construction and the way of use (figure2).

The study of typological process is to compare the phenomenon of building type in the diachronic system from the synchronic prospective (Shen, 2010). The synchronic system refers to the classification of existing building types based on the current period. The type of building diachronism refers to the causal relationship between the same type of building and its past form. Therefore, the classification method using type processes must be guided by source and process.

3. Classification based on level

The traditional courtyard houses and old-type Lilong housing in Tianjin are centered on the courtyard space, with the surrounding buildings forming the whole residential group. The composition in a residential group is very complex and there are multiple levels (figure 3). First of all, multiple courtyards may be contained in a residential group. Secondly, in a courtyard there are many buildings. Further, a building entity contains multiple rooms.

The difference between the two types is that the traditional courtyard is built separately by a family, and the old-type Lilong housing is built uniformly on a scale, which is made up of repetitive units. In order to classify and analyze under the same standard. a residential group is regarded as an organism in the traditional courtyard housing and old-type Lilong housing. Thus, a courtyard is regarded as structure system. The relationship between different courtyards will be discussed in this level. The building entity is taken as the elementary structure, the relationship between building entities is included. The room is the element.

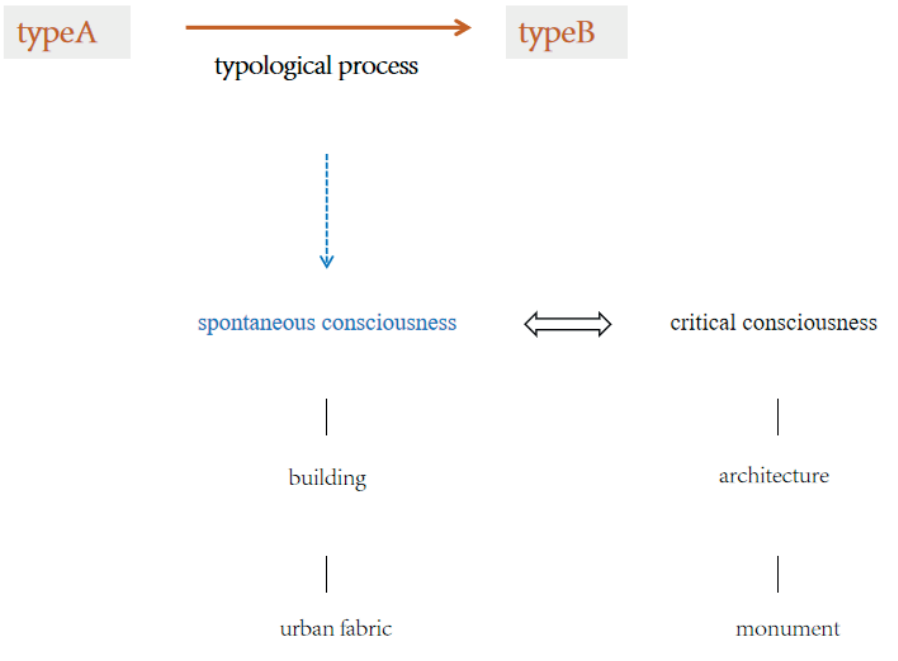

Figure 2. *The typological process.*

3.1. *Structural system: courtyard*

In a residential group, the relationship between different courtyards determines the most important spatial structure. According to the number of courtyards, the traditional courtyard can be divided into one-courtyard house, two-courtyard house and multiple-courtyard house, which includes three or more courtyards. The old-type Lilong housing is divided into one-courtyard housing and two-courtyard housing (figure 4). In Tianjin, the relationship between different courtyards is more complicated and diverse. In addition to the tandem traffic organization between different courtyards, that is, arriving at the backyard through the front yard, there is also parallel traffic, a unique form in Tianjin, which is to set up an arrow on the side of two courtyards. The privacy of the two courtyards is not affected by each other.

3.2. *Elementary structure: building entity*

In this level, the relationship between building entities will be discussed. The number of enclosed building entities is most important. Attention was only paid to the number of enclosed building entities in previous studies, according to which the traditional courtyard housing can be divided into four-side housing, three-side housing, two-side housing and one-side housing. The old-style houses are divided into four-side housing, three-side housing, two-side housing and one-side housing (figure 5). Also, the buildings in different locations are named according

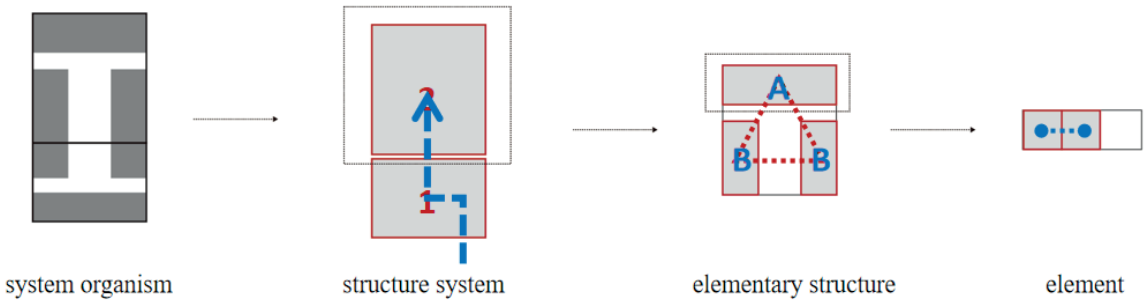

Figure 3. *The level in the courtyard house.*

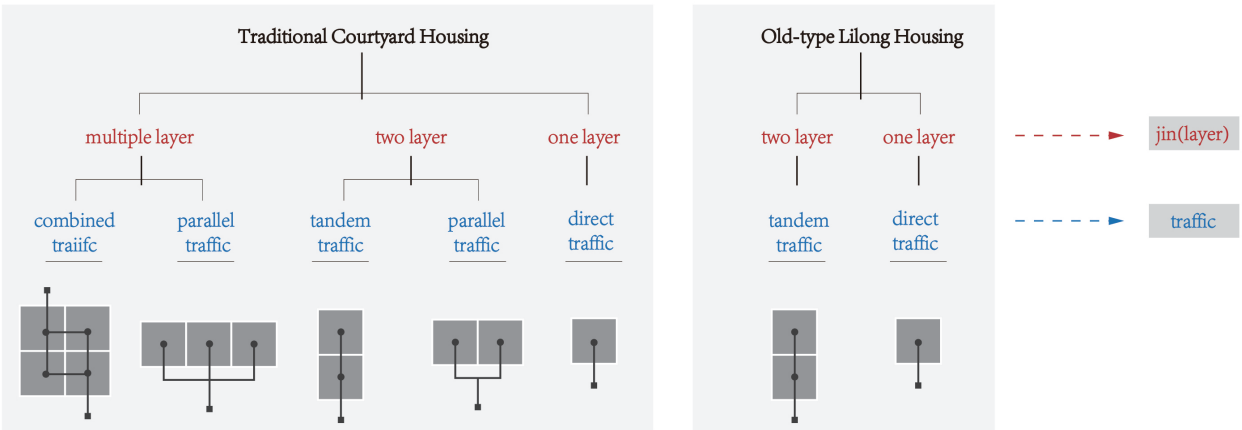

Figure 4. *The classification on structural system: courtyard.*

to the hierarchical relationship between the buildings. The main-room building, in the most central position of the courtyard usually facing south, used for the parents of the big family, is named A, which means the highest grade,. The wing-room building is located on the side of the courtyard for the children to live in, followed by B. The downside building is located at the entrance and faces north for guests to live or perform other functions. The lowest level is C. According to the method above, in traditional courtyard, the four-side housing includes one type: A+B+B+C; the three-side housing includes three types: A+B+B, B+B+C, A+B+C. The two-side housing includes three types: A+B, B+B, B+C. The one-side housing includes B type. In old-type Lilong housing, the four-side house includes A+B+B+C, the three-side housing includes two types: A+B+B, B+B+C. The two-side housing includes B+B and A+B, the one-side housing B type.

3.3. *Element: Room*

The room is taken as element. In the traditional courtyard in Xigu, there are four basic types of room arrangement in a single building entity. The room is named according to the different characteristics. The living room and bedroom directly connected to the courtyard are "M", and the living room and bedroom accessed through other rooms are "m". The living room and bedroom are the main functions. The ear room directly connected to the courtyard is "S", and the ear room that enters through other rooms is "s". Since the traditional courtyards are mostly made of wood, the rooms are arranged in three or five room on width. Therefore, the traditional courtyard includes the five room type named "three bright rooms with two dark rooms" (s-m-M-m-s, S-m-M-m-S) and three room type named "one bright room and two dark rooms" (m-M-m). That is to say, there is an entrance in the central room, the dark rooms on two sides enters through the central room. The bright room in center is used as receiving guests and the living room. The dark room is used as a more intimate function such as study room and bedroom. In addition, there is a special type of room, which is attached to both sides of the main house, known as ear room. The most obvious difference between "three bright rooms with two dark rooms" and "one bright room and two dark rooms" is the ear room. Therefore, in a single building, different rooms also assume different functions and have different connections to the external space.

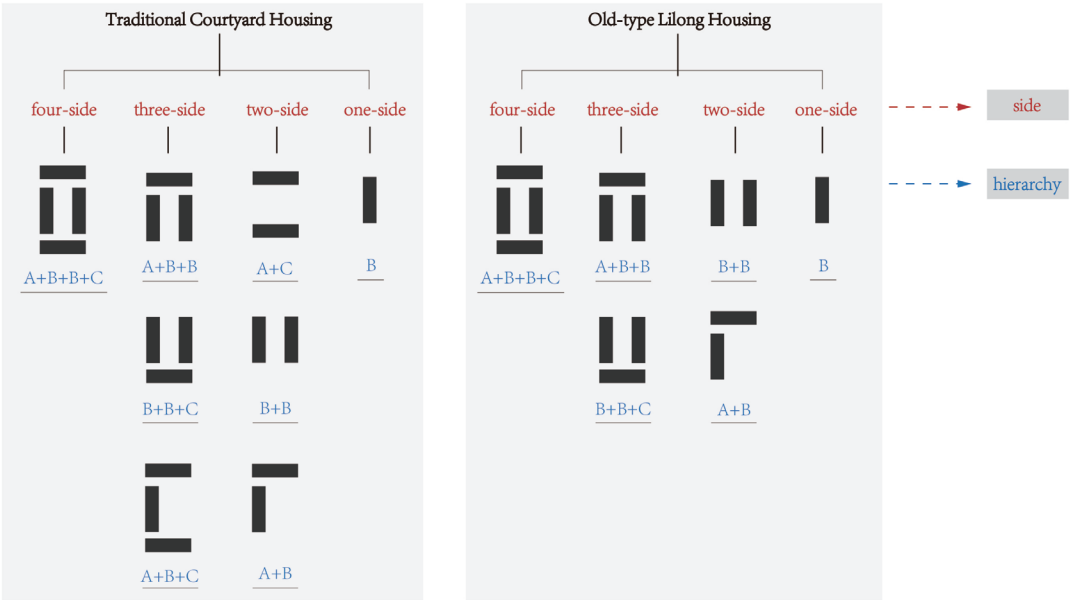

Figure 5. *The classification on Elementary structure: building entity.*

In the old-type Lilong housing are included three types: "three bright rooms with two dark rooms" (M-m-M-m-M) and "one bright room with two dark rooms" (m-M-m), double-room suite (M-m) and one-room-for-one-family type (M) (figure 6). The "three bright rooms with two dark rooms" (M-m-M-m-M) has the difference between the traditional courtyard housing and old-type Lilong housing. The later is more liberal. The width of the ear room is similar to that of the main room and the bed room. Besides, it can be accessed directly from the courtyard. It can also be used as main function such as a living room and a bedroom. In addition, in the type of the two-room suite, there are two directions the room connected in the old-type Lilong housing, both on width and in depth. While the one-room-for-one-family type (M) is the most common form in the old-type housing, which various functions in a family like living room, bedroom, storage are combined in one room.

4. Typological process analysis based on four levels

The typological process analysis from the traditional courtyard to the old-type Lilong housing is based on the classification study above. In this paper, one example will be taken to explain the process.

The four-side courtyard housing is a typical form of the traditional courtyard in Tianjin (Figure 7a). On one hand, it has the general characteristics of the northern courtyard dwelling housing system in China. With two courtyards, the front yard is narrow and the back yard is more spacious, which assumes the main function in a family. This kind courtyard has enough lot to build up, which can reflect the builder's personal will. The room arrangement is "one bright room with two dark rooms", which is the traditional form. On the other hand, it also has the unique feature. The arrow street is set up to organize the traffic of two courtyards, which is the most obvious difference in Tianjin to Beijing.

The two-side Lilong housing is the most important and typical form of the old-type Lilong housing (Figure 7b). Two building entities are contained in each courtyard. Compared with the traditional courtyard, it still encloses a courtyard by wall and buildings, retaining the courtyard space. In a building entity, the room arrangement takes the one-room-for-one-family type, which is the most effective way that can contain more families.

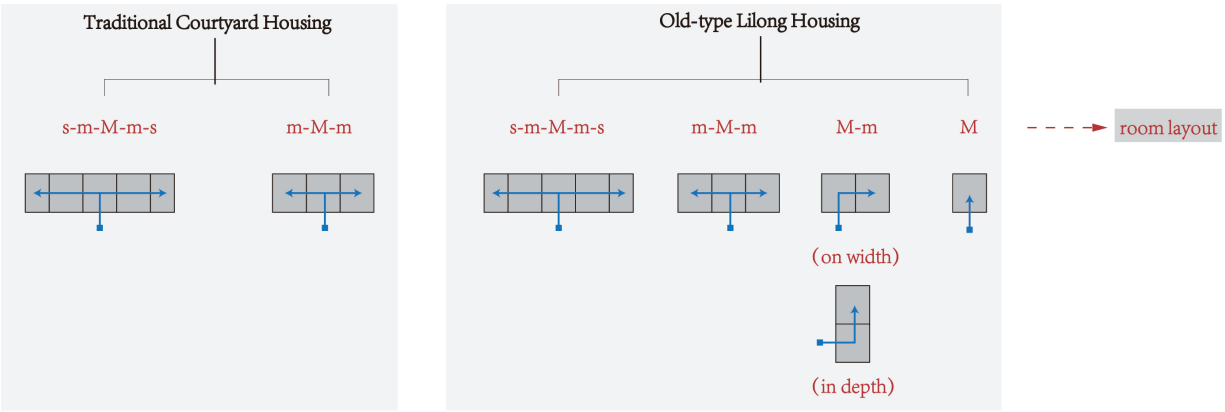

Figure 6. *The classification on Element: Room.*

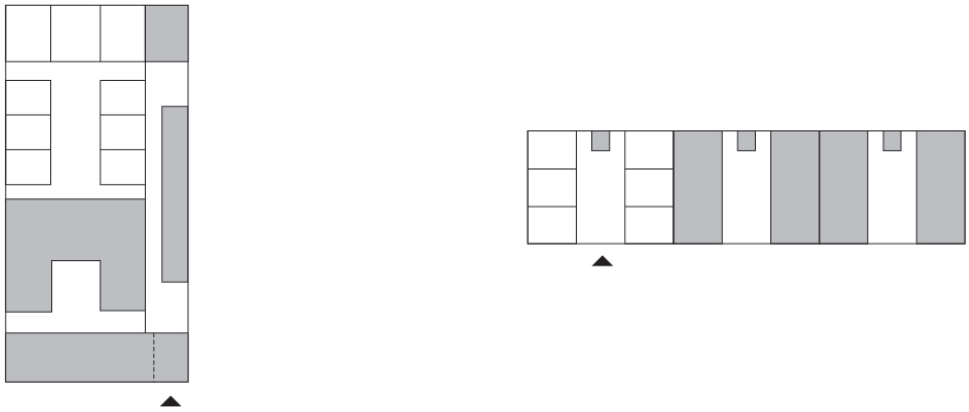

Figure 7. *a.The four-side courtyard housing b.The two-side Lilong housing.*

4.1. *Organism: Residential group*

The whole residential group is enclosed by walls and buildings. In this level, only the relationship between courtyards is discussed. Due to the increasing need for cost savings and decreasing privacy requirements, some old-type Lilong housing do not have a courtyard door or continuously enclosed wall, but the building entities retain the traditional form. In this way, however, courtyard is the important space to organize the space and assume daily life. Thus, the space characteristics and function of courtyard have not changed.

From our-side courtyard housing to two-side old-type Lilong housing, the repetition of courtyard occurred (figure 8). The layout of courtyard is also diverse when repeating. . In one piece of Lilong, the courtyard units are arranged side-by-side type, head-to-tail type, back-to-back type, face-to-face type, same way type, and quadrilateral type.

In general, the courtyard is generally replicated in the width direction. In one piece of Lilong, the courtyard units are arranged side by side, head-to-tail, back-to-back, face-to-face, in-situ, and quadrilateral (figure 9). When the social environment in Tianjin changes and the population increases, the living needs rise sharply, courtyard repetition is the easiest way to accommodate more families without no special design.

4.2. *Structural system: courtyard*

In this study, the four-side courtyard housing contains two courtyards wih a arrow street, and two-side old-type Lilong housing contains only one courtyard. From the former to the latter, the most important change that has occurred is to remove the arrow (figure 10). The arrow is a unique form in the traditional courtyard of Tianjin. On the one hand, the arrow street occupies lot width, which is the most important factor determining the land price. More importantly, the existence of the arrow is due to the hierarchy between the courtyards and privacy requirements. In the old-type Lilong, the homogenized living mode makes the hierarchy disappear. Therefore, the arrow disappeared.

Besides, from the traditional courtyard housing to old-type Lilong housing, it can be seen that the partition wall between the two courtyards disappears and the courtyard space merged(-figure 11). This also means the homogenization of the living space. In the traditional courtyard

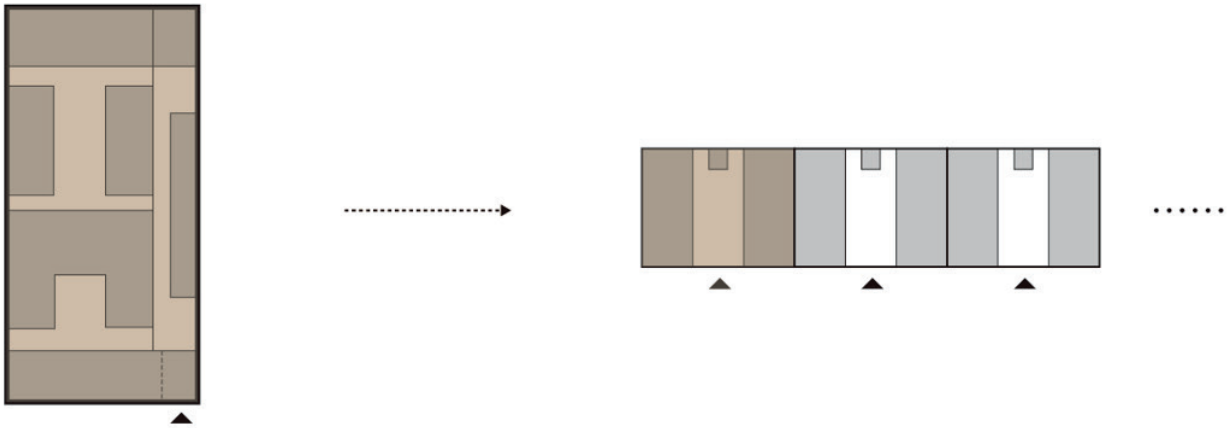

Figure 8. *The repetition on organism residential group.*

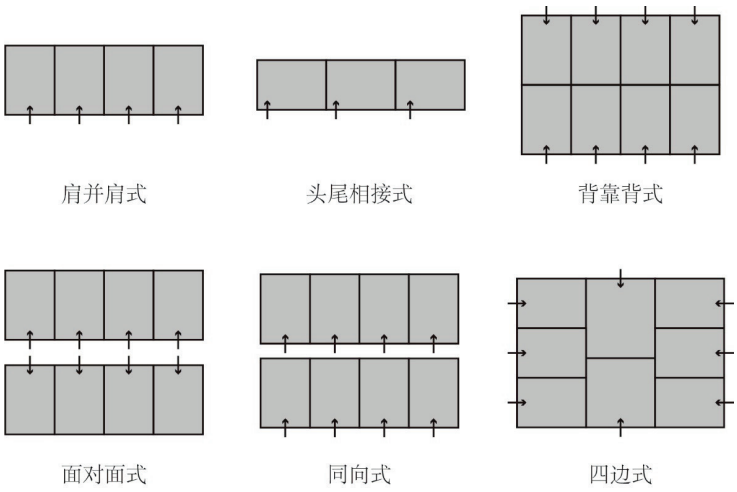

Figure 9. *The form repetition*

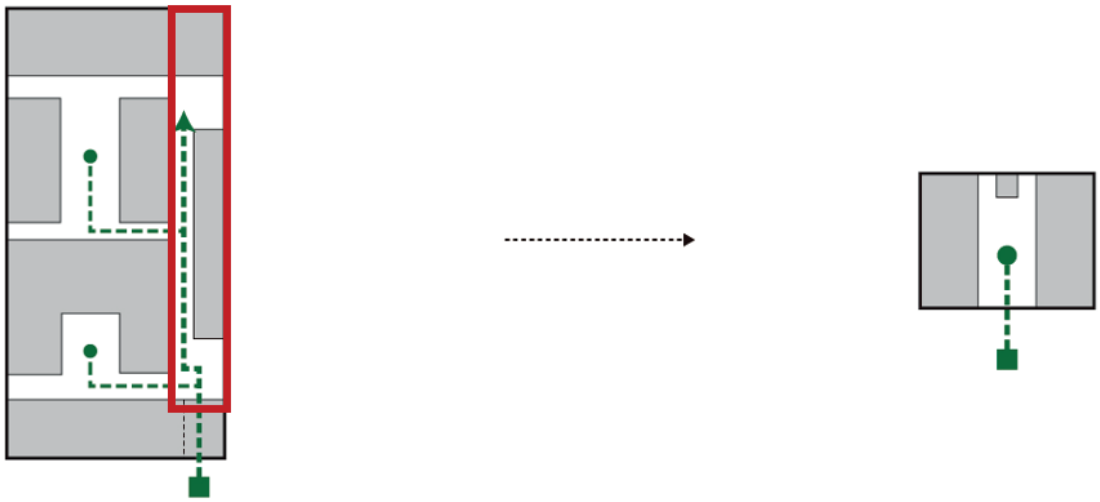

Figure 10. *Arrow street removed on structural system courtyard.*

housing, the courtyard space is graded. The backyard is ranked higher than the front yard. The front yard is a narrow rectangular shape, and the backyard is close to a square, assuming the main life function. In the two-side old-type Lilong housing, the hierarchy disappears. All residents can share a same courtyard space.

4.3. *Elementary structure: building entity*

In this level, the building entities in one courtyard are discussed. From the four-side courtyard housing to two-side old-type Lilong housing, the proportion of has remained basically unchanged in one courtyard. However, the building entity is removed inside the courtyard(figure 12). In this case, the main room building entity has been removed in a courtyard, breaking the hierarchy and forming a more homogeneous living mode. In the traditional courtyard housing, the existence of the main room makes the space allocation more complicated. The main room is higher than the two wing room buildings on the both side, while the two are the same. In the old-type Lilong housing, the main room building entity is completely removed. The courtyard space has also changed from the original T shape to rectangle shape, a more simple, homogeneous space. From the perspective of the proportion of buildings in the entire courtyard, the two types are basically similar. But the later is a new mode of living that is more homogeneous.

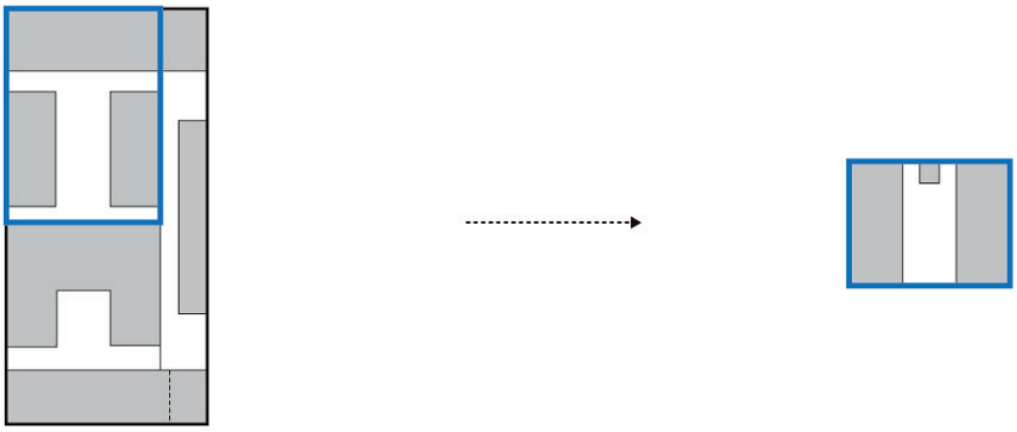

Figure 11. *Space merging on structural system courtyard.*

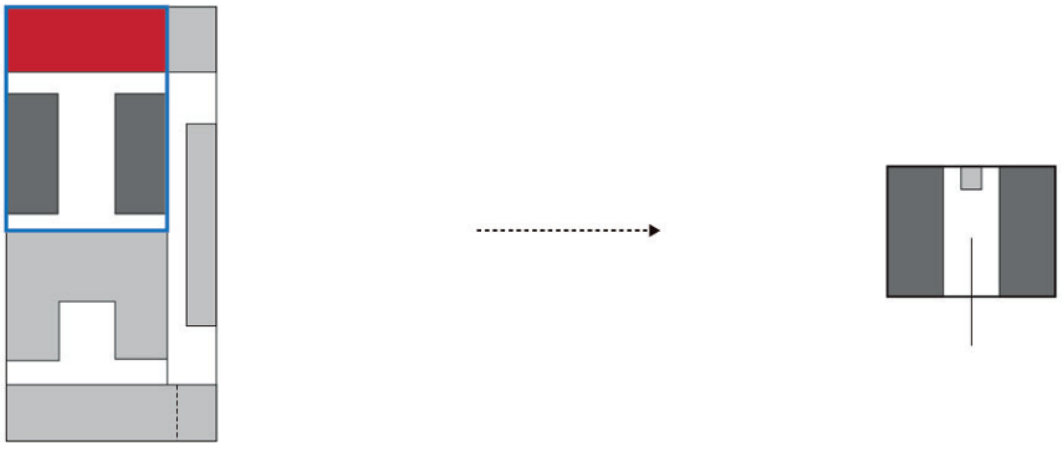

Figure 12. *Building removed on Elementary structure: building entity.*

4.4. *Element: Room*

In this case, the room changed from "one bright room with two dark rooms" (m-M-m) to one-room-for-one-family type (M). The change between two types of room arrangement is to remove the rooms on both sides(figure 13). The former type accommodates one family unit and the living room connects two bedrooms. It can separate the living space of parents and children. The function is very detailed. As the number of households in a building entity increases, the space occupied by each family unit decreases. The emergence of the M type is for larger living needs. In this form, the functions of living room and bedroom are combined in one room.

5. Discussion

This paper supplements the research of urban texture with architecture as the entry point. The morphological study and classification of the traditional courtyard housing and the old-type Lilong housing are supplemented in detail. By interpreting the evolution from traditional residences to modern residences, it fills the gap in the history of Tianjin's residential development.

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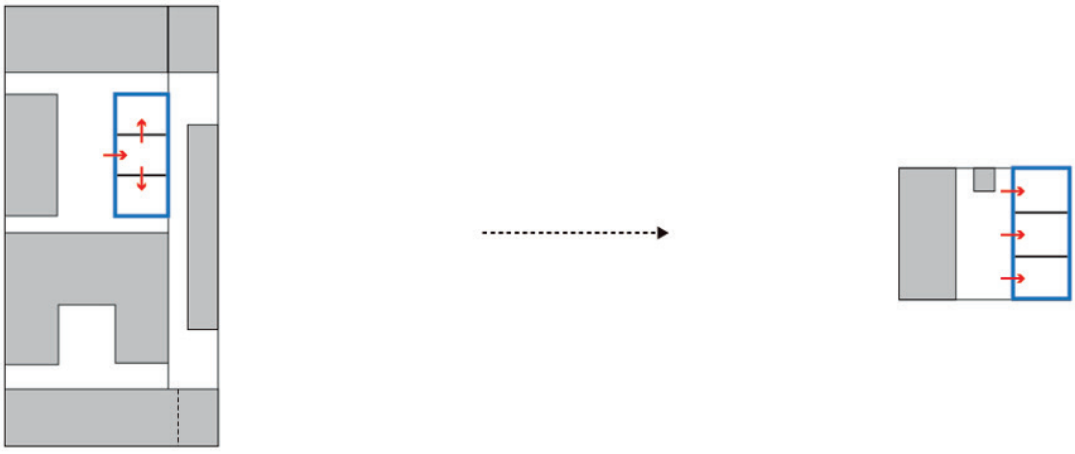

Figure 13. *Room change on Element room.*

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Housing Estates and Ordinary Peripheries

Mapping Simultaneous Forms of Urban Growth

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Keywords: Mapping, comparative cartographic analysis, housing estates, "ordinary periphery", urban quality.

Abstract: Using adequate and updated representation tools is essential to analyze certain aspects of urban morphology, focused on the ability to adapt urban forms to the new conditions of contemporary cities. Specialized literature studies the housing estates that were projected in the peripheries of European cities between the fifties and seventies of the twentieth century. Whereas less attention has been paid to the "ordinary peripheries" that gradually were developed around them in that exceptional period of urban growth.
This text offers a comparative study of the urban evolution in the last fifty years of two housing estates of Saragossa and the peripheries that grew gradually around them, with a focus on their urban quality. It is about contrasting a unitary action —housing estate— against another form of urban growth that results from a gradual development —"ordinary periphery"—. This analysis tries to overcome the critical views on the housing states, which usually take as model the urban quality of the traditional city without considering other types of peripheral urban growth.
The objective is to explore, using various intentional representation techniques, the transformation processes that both forms of extension of the city have undergone. This methodology will help to assess their urban quality and to detect the opportunities or difficulties they show for updating fifty years after their construction.

1. Introduction

Collective housing estates – *polígonos, grand ensembles, Großsiedlungen*, etc– are repeatedly debated from different perspectives on the national and international scene (Urban, 2012; Wassenberg, 2013). It is increasingly common to consider the processes of change they have experienced in relation to their urban integration and their degree of obsolescence (Ferrer i Aixalá, 1996; López de Lucio *et al.*, 2004). These approaches aid to offer solid diagnoses for possible intervention strategies.

Recent studies also propose comparisons between different housing estates from the same city, from different cities of a country or from different countries (Díez Medina *et al.*, 2018; Ezquerra, Monclús and Díez Medina, 2018). However, there are not many works that relate them to the "ordinary peripheries" which were configured in their surroundings. Namely, a comparison between the spatial characteristics of a form of urban growth characterized by an

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unitary planning, design and construction – housing estate – with another that results from gradual urban growth, more or less controlled and planned – "ordinary periphery" – Both forms of urban growth have built most of the current "inner peripheries" developed between the fifties and seventies in Spanish

This analysis explores the advantages and disadvantages of both forms of urban growth. The intention is to overcome the critical views on the housing estates – where functionalist principles of modern urbanism were generally applied –. These criticisms usually take as reference the traditional city without considering other forms of peripheral urban growth.

The Spanish society underwent a radical change in the fifties and so on, its cities. In parallel to the new urban processes and the consolidation of modern planning, there is a transformation of the traditional forms of urban planning. They moved from relying on alignments and heights to adopting mechanisms of typological and functional zoning. The new forms of urban growth by polygons turned out into "a fragmented and discontinuous condition that contrasted with the continuity of the ancient city" (Moneo, 1982). The new hierarchical planning tried to alleviate the lack of land for equipment, which the previous procedure had scarcely contemplated. Fernando de Terán pointed out that the complexity of these processes caused the spatial confusion in which most of Spanish cities grew during those two decades, just when their greatest development took place (1996, pp. 176-177). As he said, "cities were marked by that motley and discordant physiognomy, composed of heterogeneous pieces which were badly assembled, aggravated by the elevation of heights and volumes that the pressure of private initiative pulled out" (Terán, 1996). López de Lucio has reviewed the issue of collective housing focusing on the public space. He refers to it as "the privileged space of daily life and life experience of almost the entire population" (2013, p. 11). The urban landscape drawn by these housing estates is characterized, in the words of the author, by the lack of definite limits between public and private space, in addition to providing vast and undifferentiated free spaces.

Saragossa presented as well an accelerated demographic and urban growth in those years (Adiego *et al.*, 1984a). The "Plan General de Ensanche" was proposed in the 1930s – unlike other Spanish cities. It considered a relatively limited scope, while real urban growth was coming about through actions in "parcelaciones" or "particular neighborhoods" intended for the working-class in an unplanned context (Monclús *et al.*, 2012). The growth by polygons or "residential fragments" was the urban practice that can be identified as predominant after the Civil War. They were usually of small entity and public promotion, responding to the housing problem without configuring new spaces on an urban scale.

In the seventies, these "new fragments" planned through partial plans would eventually be imposed. The role that they played in the configuration of the contemporary city of Zaragoza is important, perhaps greater than in other Spanish cities in that period (del Caz, Gigosos and Saravia, 2004; Ordeig Corsini *et al.*, 2011).

2. Methodology. Cartographic comparisons

The use of mapping techniques as an instrument of analysis and project, that is, as an operative tool that transcends mere representation or communication, is not a recent practice. Giambattista Nolli already approached the reflection on the definition of public space or the complexity of uninhabited landscapes in his Pianta Grande di Roma (1736-48). At the end of the seventies, the Roma Interrotta exhibition took as its starting point this plan to promote the debate on urbanism at a time when the complexity of the urban project was opposing to the poverty of the

masterplan. Then, Colin Rowe recovered techniques of "figure-ground" for the representation of the city that Joseph-Paul Kleihues, among others, collected in his masterplan for the IBA in Berlin in 1987. More recently, the British collective URBED uses cartographies of this type as a tool for communication and citizen participation in the preparation of urban proposals (Bambó Naya and García, 2017).

Many studies on the urban landscape support as well the analytical cartography. They are inscribed in the tradition of German, Anglo-Saxon and French Geography. Mention should be made of the work of Otto Schlüter who introduced the concept of Kulturlandschaft in the academic terminology at the beginning of the 20th century. He was one of the pioneers of morphological analysis, which Carl O. Sauer disseminated and developed two decades later, forming the basis of current research on the subject (Díez-Medina, 2017).

Nowadays, digital technology offer many possibilities in the field of conceptual and methodological research. The trend towards the development of the operational dimension of mapping implies, among other issues, the concern for the specificity of each place, the willingness to expand the tools of conventional cartography by opening the use of digital tools and new representation technologies. In short, an understanding of mapping as an instrument that extends the horizon of applied research in the academic and professional world, as it happens in other disciplines and cultural studies.

This work takes into account all these approaches. It departs from the recognition of the importance that the representation technics have both to think and project the city and to intervene in it. Thanks to the development of new methodologies and disciplines related to mapping, the updating and renewal of the most conventional mapping techniques has opened new research and reflection frameworks for years. We consider incorporating these innovations into the analysis and the project as important as to refine the intentional use of traditional or canonical representation methods. Contrary to what it might seem, explorations of graphic representation techniques with operational and projective perspectives are not frequent in the field of urbanism. This fact has led some authors to distinguish mapping (wayfinding/wayfaring), as a more creative approach, from cartography (map-making), fundamentally representative (Roberts, 2012).

Descriptive cartography usually prevails on the creative one. However, creative cartography is the one that helps to establish diagnoses, identify problems and discover the potentialities of the places, which are fundamental aspects to recognize the opportunities of urban intervention. On the other hand, to develop a study not only based on quantitative parameters, but also qualitative, it is necessary to reconsider the concept of "map" and take into account the representation possibilities that new digital technologies offer nowadays (Salerno, 2017).

This paper is part of a broader research, which aims to develop an advanced mapping of contemporary residential urban landscapes, with the aim of contributing to offer transversal, interdisciplinary and integrating visions. This is a comparative analysis, still in process, of two different forms of peripheral urban growth, in which different instruments of representation are explored.

Carrying out an "operational" research based on a systematic graphic and cartographic analysis is not an easy task. We work with very different cases of study and we also take into account the transformation processes experienced by the urban fragments studied over time, so the preparation of a specific cartography is as necessary as complex, even more due to the heterogeneous available sources. Therefore, we consider it essential to develop forms of representation and analysis that unify the graphic material and favor the analytical comparison. The identification of the most appropriate tools and techniques – both canonical and recent – that help to

identify and analyze the weaknesses and opportunities arising from the evolution and transformation of the urban environments we compare here, is part of the research itself .

Two paradigmatic examples of the city of Saragossa are chosen for this analysis. Due to their construction date, scale, typological diversity and urban morphology, they show enough contrast to enrich the comparison and extract more solid conclusions.

3. Analysis. Two housing estates, two neighbourhoods: simultaneous forms of urban growth

The two housing estates selected for this analysis are Andrea Casamayor (1954-1957), which is in Las Fuentes neighbourhood, and Balsas de Ebro Viejo (1964-1968), between the Arrabal and Picarral neigbourhoods (Ezquerra, Monclús and Díez Medina, 2018) (Table 1).

The first one is developed in a working-class area that the Plan of 1934 points as a zone of expansion of the city. Before the construction of this set, this sector had only had an incipient development linked to the industry in the south. The housing estate – open planned – was built practically surrounded by orchards, in two 216x60m superblocks framed in the layout defined by the Plan of 1943. This is why it is coherent with the fabric and the scale of Las Fuentes neighbourhood which arose in parallel. It developed very quickly, resulting in a fairly homogeneous plot of urban blocks with average height of five plants (Figure 1). The 1968 Plan demanded a partial planning for the area – practically consolidated – that continued being developed by subdivisions, following the Ordinances of 1939 and without reserving spaces for equipment (Adiego *et al.*, 1984).

The housing estate of Balsas de Ebro Viejo was promoted to provide housing for the workers of the cose industrial complex of Cogullada. It was part of one of the three Partial Plans that were drafted for the construction of state housing, according to the Plan of 1957. A central "L" shaped spine of facilities organizes the public area of the set. On both sides of this powerful structure are the different typologies of housing.

Picarral neighbourhood, characterized by its lack of continuity with the existing core, was born as an industrial area linked to the railway, with some areas compatible with housing in the east (Adiego *et al.*, 1984b, p. 56) (Figure 1).

Most of the housing estates were located in areas with a very low level of urban accessibility. The peripheral situation of both study cases is evident in the first image, However, the initial situations of each one are very different. Andrea Casamayor set was built in a new expansion area. The aerial view of 1956 shows its initial condition of isolation, close to the Vizconde Escoriaza housing estate and both surrounded by orchards. The plans of the evolution show how the growth of the neighbourhood of Las Fuentes was not so gradual. In just 10-15 years (1965-1980)

Table 1. *Housing estates.*

Housing estate	dwellings	Ha	building tipology	h.	others
Andrea Casamayor (1st phase)	400	2.93	16 linear blocks	4	2 shops
Andrea Casamayor(2nd phase)	390		11 linear blocks+"L"	5	church +2 shops
Balsas de Ebro Viejo (1st phase)	1208	12.6	29 linear blocks +	5	Shops+offices
			19 "L" blocks+5 towers	12	+equipments

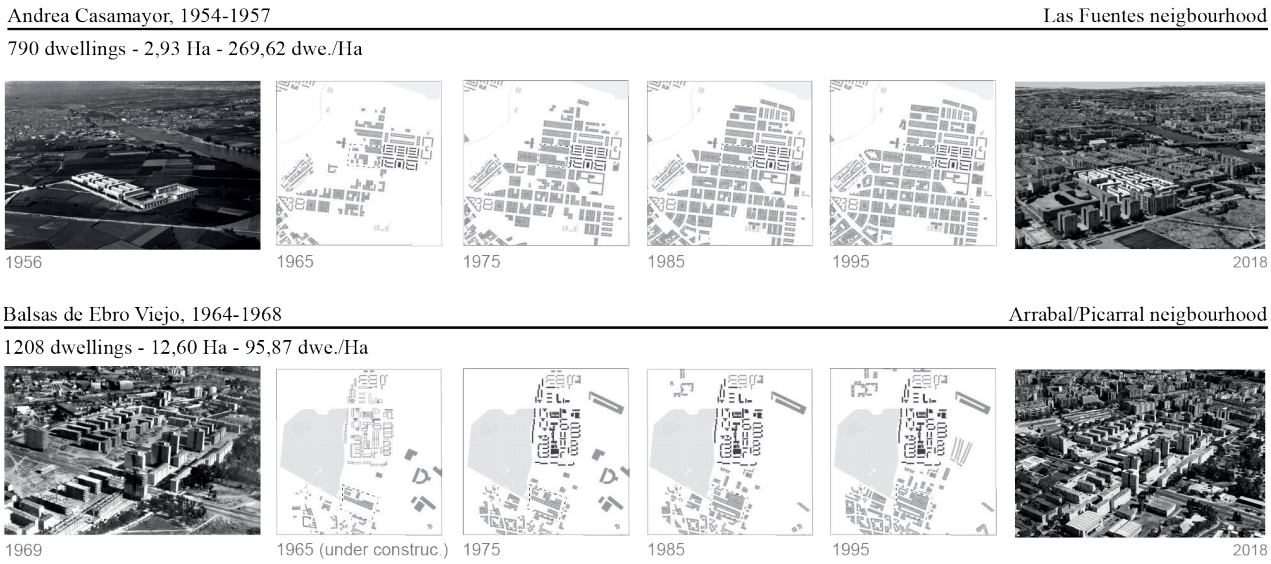

Figure 1. *Developments of both neigbourhoods from the housing estates construction until nowadays. Sources: maps – the authors; historic aerial views – Gran Archivo de Zaragoza Antigua; actual aerial views – Google maps.*

the neighborhood had already surrounded the housing estate completely. On the other hand, Balsas de Ebro Viejo was built next to the first suburb of the historic city, on the other side of the river. This area also had a strong industrial activity due to the railway that had divided the residential growth in two different parts: the historic Rabal and the Picarral area, linked to the industry, in the west; and a new neighbourhood, which emerged next to the rail station in the east. It was not until 1943 that these areas were taken into account in the general planning of the city. Despite this, a disordered and unplanned growth continued characterizing both of them. The housing estate of Balsas de Ebro Viejo started after the definition of the polygon in 1956 next to an area defined as green zone that occupied the grounds of the old riverbed. Subsidized housing groups were relevant in the development of this area. In both cases, Andrea Casamayor and Balsas de Ebro Viejo, the subsequent urban growth substantially changed the relative position with respect to the historic center. However, a much more heterogeneous and less compact tissue surrounds the second one.

It is interesting to study deeply the current level of accessibility of the housing estates in relation to the moment of their construction (Figure 2). It is important to understand to what extent isolation continues characterizing its situation, even in cases where it moves from being "peripheral" to "pericentric". On the other hand, the analysis of the relationship with the roads also allows checking whether the built road system has contributed to reinforce a possible situation of "enclave", by acting as fracture elements with the adjoining tissue, which hinders integration. Defining the same initial year for all the study cases, contributes to the homogenization of the cartographies and facilitates the comparison between them. The year 1957 has been chosen for three main reasons. First of all, the availability of cartographic sources. Secondly, the first General Urban Plan of Zaragoza was approved in 1959, so it could be considered an important date in the urban planning growth of the city; finally, this analysis is part of a broader research that includes more case studies. Most of them were designed and built between the second half of the 1950s and the first half of the 1960s. In the case of Andrea Casamyor housing estate, the fact that the layout of the neighbourhood responded to a unitary project —1943 Plan—, contributed to the urban fabric absorbing the anomaly of this set. The inner roads of

Figure 2. *Comparative cartographies between 1957/2018. Sources: the authors.*

the neighbourhood have not undergone significant transformations or enlargements since the seventies. However, the road system has changed considerably in the edges of the neighborhood, as well as the connections with the city through the construction of large infrastructures (the bridges, the second and third belts, etc.). In the second case, a main road of the urban network goes through the set from west to east and divides it in two different parts. Despite of being part of the initial project, it hinders its understanding as a unitary piece. The strong presence of the car, which was also taking into account since its conception, has also impoverished the general atmosphere. The currently situation shows a progressive integration in the urban structure of the city and in a neighbourhood that is undergoing a substantial renovation in recent years.

Among the indicators commonly accepted as critical aspects of the housing estates, density is considered directly related to the urban quality of these sets. Although there is no unitary criterion that relates densities and edificabilities of the housing estates with their urban quality, it is clear that to advance in the clarification of this issue it is important to deep in a type of analysis that helps to find relationships between morphology, diversity typological, density and urban quality. It is in this context where we consider most important to carry out the analysis of the housing estates in parallel with the growth of the ordinary peripheries. We have chosen a representative area of the neighborhood of Las Fuentes for this purpose. This area was built in the surroundings of the Andrea Casamayor housing estate in nearby dates. In addition to the quantitative data, that allow a quick and objective comparison, this initial analysis explores the possibility of linking databases to a conventional cartography, in order to incorporate information into a graphic document that helps to identify possible problems and opportunities for improvement (Figure 3). Through Geographic Information Systems (GIS),

heights, number of dwellings and accesses are associated with drawings, which allows drawing conclusions regarding the density of the housing estate in relation to the neighbourhood that was consolidated around it. In addition, the drawings show the morphological diversity. Urban blocks, semi-closed urban blocks, blocks in H, towers in H, etc., make up the neighbourhood, compared to the homogeneity of the housing estate, consisting exclusively of linear blocks. The drawings allow us to understand the differences that the quantitative data also reflect. If we only take into account an area equivalent to that of the housing estate, including two residential urban blocks, not only density of the ordinary periphery is greater, but also occupation and edificability. However, other issues should be taken into account to complement this data. The dwellings typology, the existing uses, the accesses and the configuration of the ground floors, which ultimately contributes to the urban quality of the public space (Gehl, 1987).

These issues can also be analyzed from a perceptual point of view (Figure 4). Comparing the street views of both forms of urban growth offers remarkable differences. The often-criticized features of housing estates such as the lack of definition of their interblock space, their homogeneity and even rigidity, the lack of activity on the ground floor, etc. are evident in these drawings, even more in the case of Andrea Casamayor set. They contrast with the images of the ordinary periphery. It is not intended, however, to arrive at a strict assessment of both of them, but to show that they both have positive and negative aspects and, above all, that these can be complementary. We have in mind some of the contributions that, using more intuitive representation systems based on parameters that are sometimes difficult to quantify, have contributed to enrich the analytical tool of mapping. We refer to contributions of very different types, such as the psychogeographic guides of Guy Debord and Asger Jorn, the collective maps

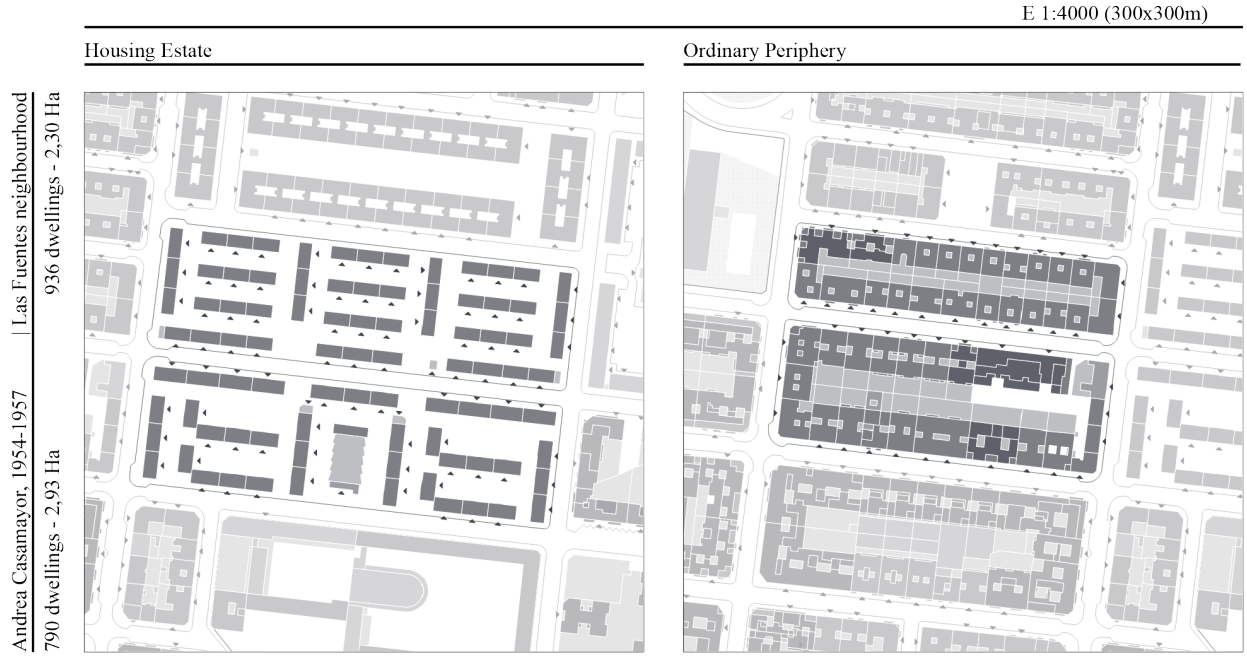

Figure 3. *Mapping two simultaneous forms of urban growth. Andrea Casamayor housing estate and Las Fuentes neighbourhood. Sources: the authors.*

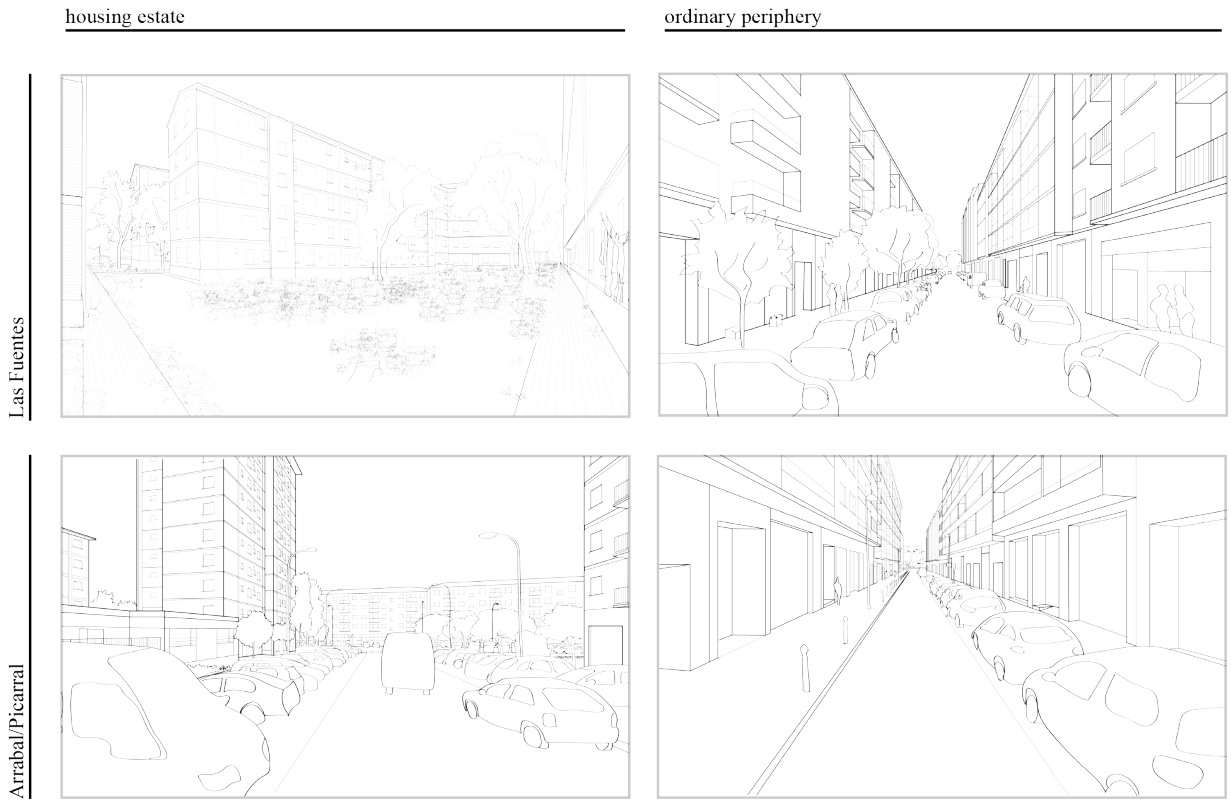

Figure 4. *Comparative street views. Different sensorial experiences. Sources: the authors.*

of Kevin Lynch (Lynch, 1960), the emotional cartographies of Christian Nold, the quantitative information diagrams of Edward Tufte, or the explorations of Dolores Hayden. As James Corner says, "the function of mapping is not so much to reflect reality as to engender a reformulation of the worlds in which people live". (Corner, 1999).

In summary, the comparison of the initial and current situation shows how the relative initial situations of the housing estates have changed with the growing of the city. The two case studies analyzed in this work also reflect the different conditions that housing estates can present themselves —dates, scale, typology diversity, etc.—. Andrea Casamayor housing estate illustrates how respecting the urban plan have favored the process of integration of the set in the neighbourhood. However, the urban road system also considered in the case of Balsas de Ebro Viejo, hinders the understanding of this set as a unitary piece and also creates a fragile barrier in the neighbourhood. On the other hand, the monofunctionality typical of the housing estates of its generation, which is more evident in the case of Andrea Casamayor, leads it to suffer the typical problems of most of them: interblock spaces without activity, obsolescence, lack of activity and lack of maintenance. In contrast this case, Balsas de Ebro Viejo presents a major typological functional diversity. Nevertheless, the equipment central spine of the set acts as a barrier and most of the interblock spaces are colonized by cars.

4. Conclusion

On the one hand, this analysis shows how some housing estates constitute recognizable urban pieces in the peripheral urban landscape, as opposed to the disorder and densification observed in the immediate ordinary peripheries. Generating an own identity could be considered as a positive factor. However, the eventual isolation is a problem in those cases in which they are configured as enclaves, both formally and functionally.

On the other hand, it allows us to rethink the criticisms that housing estates frequently receive about the quality of their urban space. The most common, which has to do with their high densities, should be qualified when it is compared to the increasing densities of the neighborhoods. The ordered and controlled-scale spaces of the housing estates contrast with the weakly planned and often motley growth of their environment. Cartographic representations also reveal important weak points, such as the excessive homogeneity and morphological and functional rigidity of these sets, as well as the lack of activities and urban life that "interblock spaces" present.

The final goal is to explore how both forms of urban growth can be complemented and improved. This question becomes even more interesting at a time when the "inner peripheries" of our cities require an urgent integrated urban regeneration.

Combining traditional representation methods with more advanced ones converts graphic explorations into "operational" instruments of research on the urban quality. This should be made with the intention of adapting each tool to the aspects to be explored and the results of the analysis to be communicated. The flexibility in the use of different forms of representation makes it possible to reconcile and relate the information obtained from various sources with more personalized ones, such as field visits and data collection. In order to take advantage of all this material it is essential to explore the possibilities offered by various cartographic representation techniques. From the most conventional ones, revisited and adjusted to the objectives of our study (analysis, evaluation and diagnosis), to the most innovative ones, which incorporate studies of geographers and sociologists, whose value has been demonstrated in research works and intervention practices that are giving rise to a new generation of studies on the subject. The use of Geographic Information Systems, such as QGis, has considerably facilitated the processing and visualization of georeferenced data, helping to draw urban tissues very intentionally and to show the morphological plurality.

The cartographies of these two models of peripheral growth at different times aid to compare the processes that both, in parallel, have experienced over time. Furthermore, they help to detect, among others issues, which cases show a greater ability to adapt to changing circumstances. The multi-scalar approach facilitates the study of different qualitative and quantitative aspects in each one of the proposed scales. Keep digging into the cartographic exploration of these two models will allow a refined comparison between them until now not raised. On the other hand, the analysis of these two housing estates of the city of Saragossa in parallel to the "ordinary peripheries" that grew and consolidated around them, offers important clues to explore various possibilities of updating and urban regeneration. This could be very important at a time when these neighborhoods demand a requalification.

5. Acknowledgments

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The Transformation of Haikou Urban Form and the Dual Ownership of Arcade-Shophouse

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Keywords: Pudi, Shophouse Street, Urban Planning, dual ownership, Port City.
Conference topic: Theory 1: emergence, relational theories, the social sciences and urban morphology.

Abstract: The aim of this study is to thoroughly examine the process of the development of Haikou City between 1858 and 1939, during which it became a prosperous city following the opening of its port such that it became modern with its distinctive arcade shophouse cityscape. The municipal construction in early 20th century in Haikou referred to the experience of the municipal road planning in the western cities. However, the implementation of its urban plan didn't rely on the financial operations as in the western cities, but the fundraising from the tenants of shophouse. The fundraising triggered a dual ownership dispute between the landowner and the tenant at the beginning of the 20th century, which greatly affected the development of urban form during this period.
Based on the first-hand historical archives of Haikou during the Republican period, this paper explores the dual ownership dispute emerged when Haikou transited from a traditional fort city to a modern one, which reflected the conflict and compromise between the tenants and landowners. This paper reveals that the dual ownership of stores was the key and also the hidden danger for the implementation of the urban plan in Haikou during this period, and it had an important influence on the urban form transformation in Haikou. Haikou formed a modern urban form during this turbulent period, which paved the way for its transformation from a traditional city to a modern city. This paper further explores the far-reaching effects of the modern municipal construction and public participation in urban form, clarifying the urgency and significance of the research.

1. Introduction

Arcade-shophouse has become a form of urban heritage in Haikou is related to its wide distribution across cities along with its artistic value together with its underlying history and culture. This paper is clarifying the nexus between this form of architecture and the socio-economic cultural process.

The geography and history of the city of Haikou culminates in it having both similarities and differences with arcade-shophouse in other coastal cities throughout southeast China. As a result of this, the city of Haikou can only be truly understood when reference is made to its

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history and the changes imposed upon it by the various groups of people which came to its shores. This study offers an insight into the development of Haikou city from the perspective of a complex and intertwined landlord and Tenant and. This chapter also seeks to delineate landlords and tenants into categories and in doing so endeavors to explain their economic status and business network and, by extension, their respective roles in the development of the city from both a physical and social standpoint.

2. Methodology

This research amalgamates the disciplines of history, sociology, cultural anthropology, and ethnography and geography and typology. It studied the transformation of the city via its history and reconstructed the urban history relying upon historical archives such as urban maps, landscape paintings, literature and other archived documents such as government and municipal documents, and it was based on the methodology of literary research and document analysis. Furthermore, this research adopted the anthropology method with direct observation, surveys and oral interviews through intensive fieldwork which laid the foundation for it. Also, this research used the geographical methods of urban typology and morphology, for the purpose of analyzing urban form and the transformation of the arcade shop-house and city form. Thirdly, Aldo Rossi's concept of Urban Typology, Spiro Kostof's Urban Pattern and Michael R.G. Conzen's Urban Morphology will be used to analyze the urban transformation.

Primary Material obtained includes official records from the Haikou City Archives, Haikou Urban Construction Archives, Hainan Provincial Museum Collection, urban streets and buildings surveying and oral history. Materials including maps of various periods in Haikou City, Haikou Chamber of Commerce files, and the private data from descendants of returned overseas Chinese was also very instructive in formulating a reasoned conclusion to this study.

3. Analysis/Results

3.1. *Background*

Haikou was a military base called Suo designed to counter pirates and eight kilometres away from Haikou was the political and economic centre of Hainan called Qiongzhou Fu city (Figure1). After the Second Opium War concluded in 1858, the Qing central government were coerced into signing the Tianjin treaty which opened numerous ports along the Eastern and Southern coasts of China including Haikou. By virtue of this treaty, Haikou began its rise to prominence from a military outpost into a commercial hub. The geography and the form of the city will be discussed and the stage set for the following discussion pertaining to the rise of the Haikou Suo (Figure2) and simultaneous fall of Fu city. Simultaneously, further context is provided which sets the scene for the transformation of the form of Haikou city itself. As a consequence, this part will use both literature analysis along with maps, survey and overlaying research.

3.2. *Immigrants and oversea Chinese*

99% of the residents in Haikou were immigrants from Mainland China; the three biggest waves of migration are as follows. Firstly, during the Ming Dynasty in 1359, Qiongzhou Fu was estab-

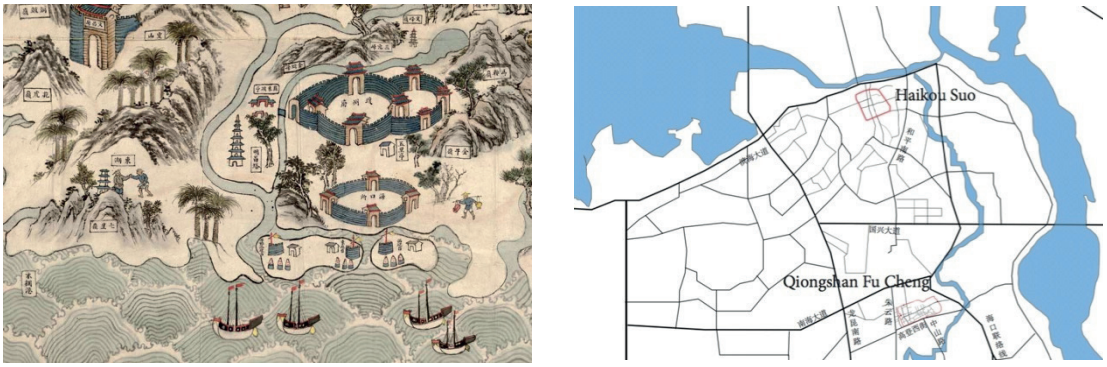

Figure 1. *Haikou Suo City and Qingshan Fu City diagram.*

Figure 2. *Haikou Suo city map in Ming Dynasty and Late Qing Dynasty*

lished which was a pivotal juncture in the history of social and economic development of the region because many immigrants brought with them advanced culture and technology and this augmented the natural improvement in local commerce and trade. During the Qing Dynasty from 1644-1912, the central government strengthened its control over the region and constructed coastal defense facilities and in doing so fostered substantial political, economic and cultural progress. Thirdly, Hainan Island is also home to many overseas Chinese who ventured to Southeast Asia in the early half of the 20th century and returned to Hainan after experiencing success abroad in order to contribute to local development which commenced a period of hybrid culture.

After the Qing government signed the Tianjin Treaty in 1858, the doors were cast open wide for all and sundry to enter China. A significant amount of overseas immigrants ventured into Southeast Asia responding to the demand for labor in rubber plantations and tin mines. Additionally, travelling overseas also became a popular trend in the shearly part of the 20th century[1] (Figure3). Many individuals living in Hainan sought greener pastures abroad in order to make their fortune across Southeast Asia in countries such as neighboring Vietnam before making their way across the world to areas such as the California and Australia to make their fortunes in their respective gold rushes.

1. Tang lingling 唐玲玲(2014)".Hainan Jiapu YImin Renkou Shiliao yu Yanjiu" 海南家谱移民人口史料与研究(Historical Data and Research on Emigrant Population of Hainan). Intellectual Property Press.

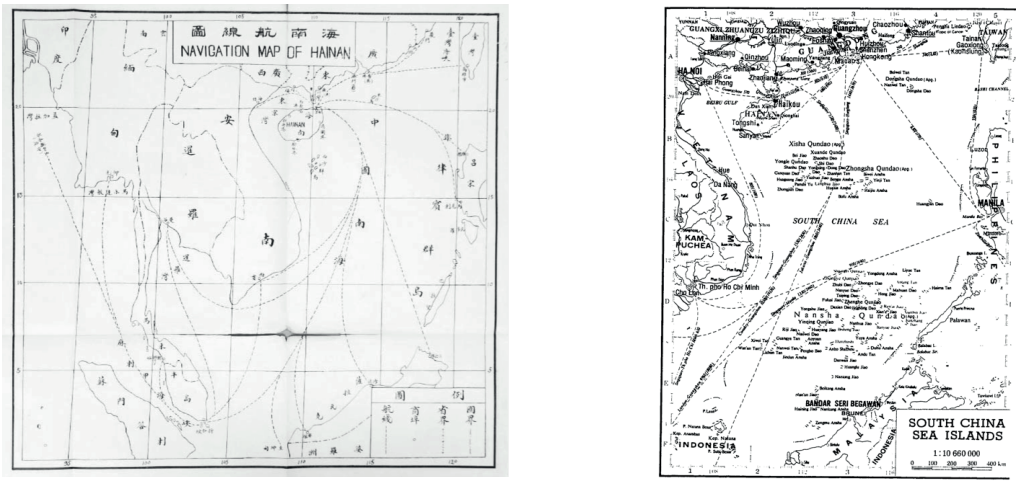

Figure 3. *The Geographical context of Hainan Island and Haikou city.*
(Navigation map of Hainan before 1949 and after, Atlas of the people's republic of China 1989).

3.3. *Municipal constructionand private investment*

The motivations underpinning the construction of the arcade shop-houses in Haikou are three fold and are ultimately connected. It was intrinsically tied to the function of a competitive housing market because enormous remittances from Overseas Chinese resulted in an increase in consumption which augmented the development of urban commerce and shipping. Simultaneously, Overseas Chinese invested in real estate and business in Haikou because they considered it to be a vibrant hub which would provide them with a terrific return on their outlay and real estate speculation became quite popular in the early part of the 20th century as a result. Secondly, the government came to the sudden realization it needed to invest in infrastructure to facilitate the trade and commerce which resulted in the flourishing of Hainan yet lacked the requisite capital to do so. As a result, it relied upon private investment of landowners and Overseas Chinese to enhance the quality of infrastructure by contributing to projects such as road expansions. As a consequence, arcade shop-houses became a vital form of investment for property owners and compensation for road expansion whilst promoting the construction of the municipality. Thirdly, they were a representation of social status and resulted in improved quality of life and health outcomes at that particular point in time.

Secondly, attracting a large number of Overseas Chinese investors was crucial to facilitate commerce and real estate speculation which ultimately resulted in more landlords agreeing to the road expansion. Due to the numerous advantages of the arcade shop-house, the extensions of roads and streets alike could be implemented seamlessly.

However, in the process of city renewal such as expanding the road and building the arcade-shophouse along the streets, some landlords are reluctant to pay for the building, so the "Pudi" has become one of the main financing channels to promote the building.

As Ni Shenbao suggested the term "Pudi" reflected a certain degree of folk autonomous tradition. At the beginning of the 20th century, the cities with prosperous trades often had commercial traditions –"Pudi", that is, the right of tenant's permanent rent of property. The tenant had the right to renew the rent permanently, and the homeowner was not allowed to increase the rent at well. The shopper could transfer the shop to others and charge the fee. "Pudi" refers to all tangible or intangible assets such as furniture, cargo, font size, signboard, customer group, commercial credit and renting property of renting or dumping to others when the shop is closed for business

Figure 4. *Photo of Boai road before 1920 and Photo of Zhongshan road before1949. Source from Hainan island photo album*

or unable to take advantage of it. Fuhai Jin argued that the "Pudi" right was attached to the "Pudi". If there is no "Pudi", there is no right of "Pudi" In all, the owner of "Pudi", who pays the rent to the landlord, obtains a permanent lease.

The Pudi in Haikou was a commercial tradition and can be resold to other tenants. Which is called "Dingshou". For example, when the auction of "Lianantang" (No. 200, Bo'ai Road) was auctioned, Wanxuantang shop bidled Pudi and bid for 3,800 yuan. There were three existing records of the shop's purchase and sale. The first time was that the tenant Fuyu shop had increased the Pudi fee and sold it to Jinsheng Store after building the arcade-shophouse. The second time, "Jinsheng Store" added the furniture. For the third time, the traffic shop was heavily in debt and auctioned the Pudi to Wanxuantang Store. It can be seen that Pudi was a monopoly between tenants and merchants in the private sector, and had nothing to do with the landlord. This Pudi resale included not only the cost of remodeling the house, but also furniture and even non-material resources such as brands and customers.

Because of the existence of the power of Pudi, the businessman was in order to obtain the rights of Pudi (without rising rent and permanent renewal rights). Voluntary or forced to fund the demolition of the street building and the construction of the arcade-shophouse, the huge amount of funds increased the amount of Pudi rights. The number of Pudi rights-funded stores was one-third of the total number of stores. It contributed a lot in the expansion of the road and the construction of the arcade-shophouse street at that time.

The financing channel of Pudi rights not only made the municipal project go smoothly, but also made some tenant merchants more willing to invest in the construction of the arcade-shopshouse. From their larger business interests, they had created a richer urban landscape. The vision of not increasing rents and unlimited renewals of rent had made some tenants willing to build larger arcade-shophouses with more beautiful facades.

4. The influence of Pudi right on the form of the arcade-shophouse

The exterior wall decoration of Haikou Zhongshan Road is rich and varied. In pursuit of luxury, the treatment along the street is divided into three sections: the lower section is the pillar of the building, the middle section is the second floor, and the upper section is the Pediment with

Chinese and Western style mix and match. The facade of the shop is not only a publicity front that shows the nature of the shop, but also a face showing the strength of the business, because it implies the taste and size of the shop.

4.1. *Commercial space segmentation of the same facade*

The shop facing the street in front of the Chaozhou Clubhouse (light gray) was rented to No.25 Yuyong Commercial Shop and No. 27 and 29. In 1925, due to the expansion of the road, the No.25 Yu Yongji shop covered two two-story arcades and spent 8620 yuan on the ocean. As the street-facing arcade had a street-facing terrace and a façade decoration, it cost more. Therefore, it was estimated that the cost of the arcade-shophouse is 5,000 yuan. The 27-year-old Wenchang's Liu Changsheng shop bought the former tenant's Pudi1380 yuan. In 1926, the tenant built the building. It costed 900 yuan, so Pudi had a total of 2,180 yuan.

As shown in the figure, although the shops No. 25, 27, and 29 belonged to the plot of the Chaozhou Guild Hall, and they were not built by the landlords, but by the tenants and merchants themselves, so the facades were different. Shops Nos. 25 and 29 occupied the shops facing the street, and Shop No. 27 only used one passage on the street to the second floor of the 29th store building. The entire plot was divided into three pieces according to the size of the rent. The second floor of the No. 27 shop frontage passage had become a part of the second floor of Shop No. 25, which was connected by the street balcony on the second floor of Shop No. 25. From this projection, it was very likely that the No. 25 shop Yu Yongji dominated the construction of the arcade-shophouse of the 25th store and the 27th store, and shared the cost of building. After discussing with the host of the landlord Chaozhou Guild Hall, the construction amount was written into the Pudi right of the store.

From the perspective of the façade analysis, the whole plot was not represented by the unified construction of the landlord, nor was it the simple division of the land ownership formed by the separation of the land, but the independent construction and cooperation of the shops based on the property rights. The entire plot therefore presents a complex facade form. Shop No. 25 and Shop No. 27 shared a facade with columns to divide the facade space, allowing the 25 and 27 to simultaneously gain more promotional benefits from the commercial facade.

5. The facade conflict caused by the tenant building a mezzanine

This plot was also the industry of the Chaozhou Guild Hall. The entire plot was a 2-3 storey building that presents the texture of the bamboo house. The atrium divided the boundaries between commercial space and living space. As shown in the figure, light gray is commercial space, the entrance to the gate is on Zhongshan Road, and the living space is accessed from the gate of Daxing Road. Zhongshan Road No.31 is a Nanshun shop of Fu Zunwu, an ancestral home of Wenchang. It was a factory that produces rubber shoes and sold shoes. According to the test shop, the construction of the arcade-shophouse was in 1926, far before the establishment of the shop written in the "Zhongshan Laozi Shop" in 1930, so the shop should be established in 1926 or earlier than 1926. "Nanshun Shoes Factory" differed from other rubber workshops in that they imported a machine from abroad to produce more advanced rubber products, and therefore the rubber shoes they produced were well-known in Hainan Island.

No. 31 shop Nanshun shoe factory was under the original Pudi1400 yuan (Pudi registered on January 1, 1923), and in August 1926, due to the expansion of the road, the tanent build an ar-

cade-shophouse which cost 750 yuan. in order to increase the building area, although there are only two layers from the facade, tanent added a mezzanine in the middle, so the building became a total of three layers. This also needed to reach a unified height requirement for the arcade-shophouse façade. So two different heights on the same plan appear on this arcade-shophouse plan. The plan of the third floor was unified with the height of the arcade-shophouse entrance of the surrounding arcade-shophouse. At the intersection with the arcade-shophouse corridor, the height was lowered from the 5.15 meters by 4 steps to 4.5 meters.

This was because the government has extended the establishment of the arcade-shophouse to clearly define the uniformity of the height of the arcade. Therefore, although the No.31 Nanshun shops hoped to expand the area through the mezzanine, they must also maintain the uniformity of height of the arcade, as the elevation shows.

6. Different shops share the same façade

The entire plot was the industry of the Wenchang Club. The tenant before the No. 49 shop and the rich shops was the South China Pharmacy, next to the Rongan Pharmacy (later the Chongye Pharmacy) and the Oriental Pharmacy. Across the street from these pharmacies is Yongan. Therefore, Zhongshan Road was a pharmacy, forming a combined effect of the industry. From the space point of view, the ventilating and lighting of these pharmacies were better than the general store conditions. The depth of the house was not long and the atrium were used for ventilation and lighting. And why the South China pharmacy of the No. 49 shop had not renewed the lease, but the Xiefengsheng shop had obtained Renting rights? Because of the long time distance, this can only be speculated based on clues.

According to the record of the Pudi rights registration form, the premise of the company's acquisition of the store is that Pudi had a total of 3,000 yuan and a cost of 3,700 yuan for the construction of the arcade-shophouse. Zhongshan Road was the most prosperous commercial street at that time. The shops were tight, and it was very likely that the company had obtained the lease rights of the shop by investing in the construction of the arcade-shophouse. And looking at Lin's Wansheng commercial store Lin Deqing's Pudi rights also had the record of building an arcade-shophouse. Therefore, in 1926, the opportunity to expand the arcade-shophouse was extended. Many landlords and tenants were reluctant to invest in the arcade-shophouse. Some merchants believed that the rights of Pudi could protect their interests, that is, permanent renewal, so they built an arcade-shophouse. Therefore, it is considered that the permanent lease right of the shop is obtained.

As the picture shows. No. 51 shop Chongye Pharmacy was connected with the facade of No. 53 shop Oriental Pharmacy. The arcade-shophouse, which was built by two pharmacies, became the most magnificent arcade-shophouse facade on Zhongshan Road. Although the carvings on the pillars and the arcade-shophouse corridors were different, the whole pediment were integrated into the city, forming a unique combination of symmetrical European mountain flowers and Chinese reliefs.

7. Discussion/Conclusion

The financing channel of Pudi rights not only made the municipal project go smoothly, but also made some tenant merchants more willing to invest in the construction of arcade-shophouse

shops, and from their business perspective, they had created a richer urban landscape. Overseas Chinese had lived abroad for a long time, and had seen or lived in a foreign house. Therefore, when returning to the hometown, most of the overseas housing styles were used to emulate the object, making the arcade-shophouse facade style Southeast Asian.

This paper attempted to cut into the relationship between urban form change and double ownership of shops, to explore how the order and structure of the city transited from traditional to modern, and how this change affected the spatial form of the city. The irony is that Pudi was a traditional civil system, but it had become the main reason for the construction of modern roads. Therefore, the urban space of Haikou reflects not only the pursuit of the government's modern city, but also the pursuit of merchants' value for shops.

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Micro-urbanism

Interaction between Architecture and Urban Structure. A New Approach in Urban Morphology

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Keywords: micro-urbanism, interaction, architecture, urban structure.

Abstract: Micro-urbanism is a complex area in the field of architecture and urbanism as a new discipline and approach in urban morphology. The concept of micro-urbanism as it is, does not exist as the phenomena of the interaction between architecture and urban structure (more precisely the urban tissue types), thus the definition of the term and elements themselves are parts of the research process described in the current paper. The study is going to define the micro-urbanism as a new approach in urban morphology and describe its urban and architectural elements with correlations and the methodology of understanding (a combination of methods and taxonomy). The research itself has an interdisciplinary nature, via macro and micro scales of the selected case studies deals not only with the structure, but also with an architectural context: how the building relates to the structure and vice versa; how this can change the city landscape and what are their interactions – history and social context of the build area. Such reciprocity is considered as a phenomenon of micro-urbanism. The selected case study areas are going to present the methodological steps and typology.

1. Introduction

Although an urban structure, an urban tissue and build environment (especially urban architecture) have been studied and presented separately so far, they can only be examined in their interaction if the target is to create a complex image that considers the town, not broken down into its elements, but in its unity.

An architectural element being a unique manifesto or a coherent ensemble complements the urban morphology and typology studies and introduces micro-urbanism. Micro-urbanism is a complex area of architecture and urbanism, which also appears as a new discipline and approach in urban morphology. More precisely assigning it to the 'phenomena' is the task of complementary research on urban tissue typology (See: urban tissue catalogue – Figure 1).

The term micro-urbanism can derive from the context of the macro-environment and microenvironment of the cities. It has to be considered that the task of the approach is to study architectural manifestos (in a broader sense of built environment) and to associate with urban tissue types moreover to isolate the possible repetitive patterns. Thus, the macrostructure/urban fabric is completed by architectural and additional details (more likely that the two-dimensional projection results a volume/three-dimensional character). The function of the mi-

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cro-urbanism analyses is to seek answers to the questions: how and in which quality the urban structure is connected to urban architecture and natural environment, and vice versa; what aesthetic and formal, typological qualities and rules can form it.

The urban characteristics of a town determined by spatial variations of the components of urban tissues (streets, greenery, public spaces, urban blocks, plots and buildings). However, we can understand the process of urban formation, the structure of the city, and the architectural context of urban fabric if we know the factors that shape the individual collage structure of cities like the natural, social, economic and historical aspects. This coherence points out how the cityscape changes in relation to the structure and how this interaction reverses.

This interaction is a phenomenon of micro-urbanism regarding the established urban tissue types (Figure 1) in Central-Europe (1867-1918) as the base for the further studies [the selected urban tissue types are going to be discussed in the Analyses section]. The forms of the street network patterns, urban blocks, plots and green surface elements and their mutual relationship were analysed in the urban fabrics classification (urban tissue typology). The principles of aesthetic harmony in urban rehabilitation, infill and contemporary design may also be outlined by the pattern of the development system. They are determined and classified tissue types and structures established between 1867 and 1918 moreover they are architectural manifestations that change over time.

Beyond the phenomena of the Austro-Hungarian Monarchy we may refer to it as Central-Europe[1]. Analysing the transformation of the Central European towns from the middle of the 19th century until the early 20th century similar features and significant differences may be discovered in most of the studied towns. The background of the modernization was the same progress as that of developing with the same political and economic structures.

In the modern sense urban development, which developed in the second half of the 19th century, had often ignored the fact that the built environment is embedded in the natural environment (Kropf, 2017, pp. 26-27). Although the trends in the last decades of the 19th and the first decades of the 20th century revealed the opposite in design practice in the so called Central-European area. Appropriate survey maps at the turn of the centuries provided such foundation that moderated the domination of forced regularity and radial paths in those areas where the morphology of the terrain did not allow it.

The conscious harmony between nature and the built environment has enabled the selection of case studies combining historical and contemporary urban, natural and built environmental factors. All these determine the unique character of towns including preserved and neglected urban built heritage, various urban tissue characters, possible urban rehabilitation areas, former greenfield investments, progressively varying urban and natural landscape characters.

Among the aspects of micro-urbanism there seems to be identity partly based on the visual perception of the given city and partly on Lynch's approach. According to the perception a city identity is made up of the urban landscape. An urban landscape is a combination of elements of the cityscape/built environment, a specific semantic domain in the field of architecture and urban planning. In addition to the repetitive patterns of micro-urbanism the harmonious interaction between the inherited and contemporary built environment depends on the equilibrium of the rhythm of traditional and contemporary infill. The relationships between components (whether vertical or horizontal articulation) are important. Regarding its significance,

1. According to Moravánszky, both of the historians, Péter Hanák (Közép-Európa két koncepciója. Regio – Kisebbségtudományi Szemle 1(1). 1990) and Szűcs Jenő (Vázlat európa három történeti régiójáról. Magvető, Bp., 1983) formulated those factors, which are dividing the three sections (East, Central, West) of Europe. These factors could be the distinctive similarities in e.g. urbanization, modernization as well.

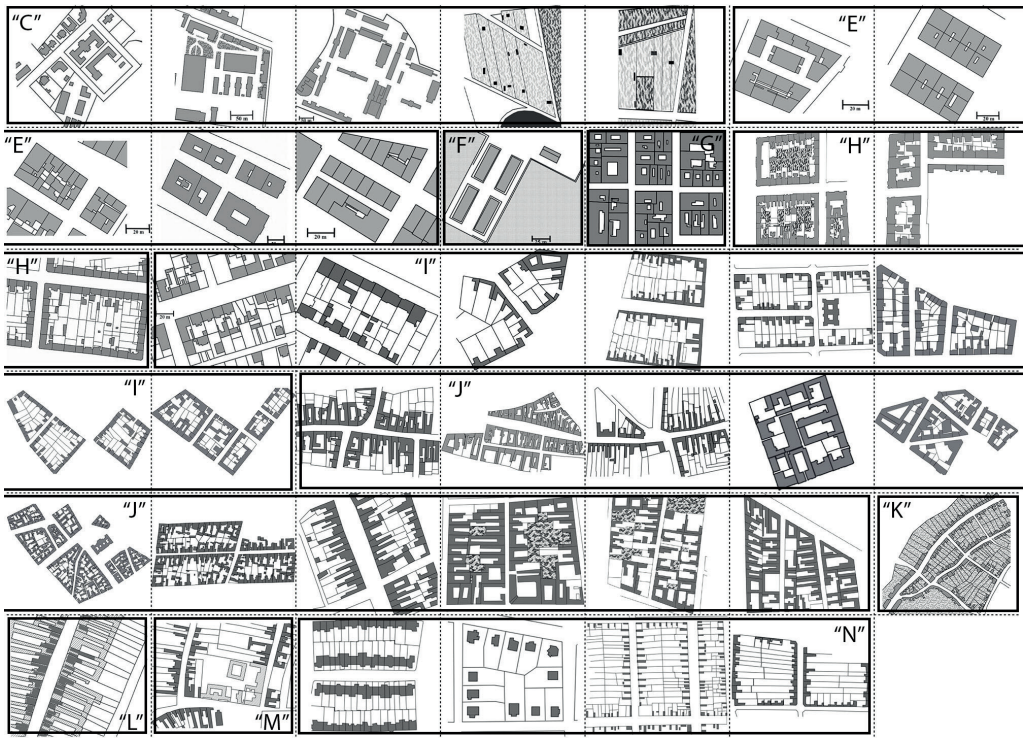


Figure 1. *The developed urban tissue types in Central-Europe (1867-1918). The urban tissue type catalogue is based on the study of 70 towns (Lovra, 2017).*

this kind of interpretation of the identity aspect is still outstanding. Therefore, micro-urbanism thereby reflects not only the urban design and architecture of a certain era, however, it may also influence design decisions nowadays by understanding the modalities.

The goal is not to rebuild the past but to understand the structural and façade dynamics in order to create a harmonious infill or adequate urban rehabilitation.

2. Methodology

The macrostructure of the town shows the urban structure along with its urban tissue types and complementary green spaces. However, the microstructure covers the vertical articulation of the visible (façade) elements (structure and details) of the building as a whole. Therefore, such as in the integrated urban typology the methodology of the analyses is a combination of M.R.G. Conzen's and G.F. Caniggia's research approach. Although it also takes into account the architectural aspects and the architectural typology of the Italian urban morphology school.

The urban structure (specifically: road network pattern), urban tissues (11 major types) and façade (vertical and horizontal articulation) and floor plan elements create a collage with a unique combination of repetitive elements. Thus, the basic principle of micro-urbanism overwrites L. Benevolo's doctrine claiming that each city is unique (Benevolo, 1994) and suggests that the cities of Central-Europe whose modern urban structure and urban tissues formed between 1867 and 1918 are unique patterns' combinations of morphological elements – collages.

The collage-nature of towns has enabled the examination of the urban elements of the areas and to interpret the structure as a whole as well as to construe the similar spatial arrangement of the elements. The similarities found in their built environment allow the assessment

based on the aspects and criteria of micro-urbanism. Furthermore, changes in the cityscape and structure can be followed as accurate impressions of a given era. Whenever cities were studied, similar urban landscape characteristics were developed between 1867-1918. Consequently, the specific combinations of the structure and the built environment are typical for the era.

Micro-urbanism belongs to typo morphology of which theoretical aspects are the spatial features, history and architectural elements of the city. Typology is a tangible form of conceptual thinking and urban patterns may be used to identify development patterns. The morphological schema including built-in and non-built-in areas and built environment can be partly determined by archetypes of spaces, road networks and green spaces.

The elements of micro-urbanism contain depictions of the layout of the city (a combination of the urban tissue, built and natural environment, urban structure), buildings: building structure, façades and their vertical and horizontal layouts.

According to Muratori and Caniggia, buildings, like towns, must be divided into four parts: "elements, elementary structures, structure systems and systems organism. Every component has to be read as being interrelated to others on an immediately larger and immediately smaller scale (...)" (Caniggia – Maffei, 2001, p. 73). Segmentation of the façade can be described by defining elements, structures, and systems where a section may be vertically and horizontally articulated. When looking at elements and proportions of a façade, the entire façade should be taken into account.

Continuing Muratori's and Caniggia's thoughts, but also considering the built environment of the former Austro-Hungarian Monarchy, it may be concluded that a building is the highest level of complexity without further classification. In the analysis of façade proportions, a building may be considered a structural system and the elementary structures mean the complex elements of the façade.

The previous urban tissue typology also neglected the exact numbers and it examined the relationships and proportions between plots, plot series and the road network in context. Therefore, micro-urbanism also views proportions as orientation.

According to the urban morphology and the integrated method the steps of urban tissue analysis (Lovra, 2017) is started with (1) street network determination. Then it is followed by (2) the analysis of plots and buildings (shapes, relations between plots and buildings related to the street networks), (3) plot series (shapes, relation to street network) and additional spaces (open spaces, green spaces adapted to the blocks). The urban tissue (urban pattern) becomes completed by the (4) green and open spaces.

1. The street networks refer to the structural changes of this period. The identification of urban network schemas (simple tissue) is important in terms of further studies and urban tissue determination. A simple tissue is determined by the examination on maps and plans of those areas in different towns that went through structural changes in the research period.
2. Analysis of plots and buildings: the nature of relations of plots and buildings to each other, their relations to the street front (shape of plots, construction, buildings with/without internal courtyard, development in unbroken rows, floor plan of the buildings, etc.)
3. Plot series (blocks): shapes, the relationship between the blocks and street networks, open spaces and green areas (green areas will have high importance in urban typology)
4. Green spaces in the town (parks, alleys): location, conditions

The analyses of point 2 through point 4 are not presented visually and textually by the examination. Therefore, their results are manifested in different urban tissues.

59 The urban tissue catalogue is based on the determination of similar pattern clusters that may be found in the towns. The determination of the urban tissue is based on the previously determined points, from points 1 to 4.

In addition to the urban fabric characters, the urban tissue catalogue (See: urban tissue catalogue – Figure 1) based on the integrated urban morphology method listed the towns where these urban tissue types were found. Studying these towns and their neighbourhoods where the relevant fabric appears, the diverse manifestation of the built environment can be found.

The architectural elements of Zagreb and Budapest have to be examined in case of type (Ha) urban fabric as the type occurs in these two cities to such an extent that it may be considered to be dominant (even in the determination of urban types).

(Ha): Regular street network, grid-like dynamics (oblong grid: gridiron system). The parcels are regular and divided into two or three sections. In the first section the building is located (for residential use). Its façade is tightly constructed on the street line forming an unbroken row of buildings. The method of development is in accordance with the plots next to each other (plot series or urban blocks). There seem to be similar layout shapes (rectangular central core with one or two extending elements, 'L' or 'U' shape). Furthermore, the courtyard, an open (green) area/backyard and the communal courtyard garden is located behind the residential building (multi-dwelling unit). The buildings form a closed block; the wings of the buildings are not formed in complete separation. The internal part closed from the public is a connected network of the communal courtyard gardens.

Having understood the characteristics of the urban fabric we assign the precise building type and examine its nature while collecting the repeating patterns.

Repetitive patterns provide an opportunity to create another typology that handles cities in complexity.

In case of urban tissue type groups 'G' and 'H' the planning requirements and recommendations are the strictest. As these types represent a unique value among the dualist urban tissue type groups. If the development, structural and architectural transformation and construction are planned in such an environment then the following recommendations have to be taken into account: the layout of the buildings and the urban block have to be considered and the original site-building dynamics have to be followed. The dynamics of the vertical and horizontal façade elements have to be taken into account because the buildings in this built environment show a large variety, though the rhythm and the dynamics of the tectonics and the colour combinations create a certain type of uniformity and enable the streetscape harmonious. The paved courtyards, green spaces located within the wings of the buildings in the middle of the large urban block or even the strict compact construction also acts as identity-shaping elements. The precondition of the urban development of these urban tissues is to follow the structural rules of urban tissues.

Townscape changes are specific imprints of the era. In case of the selected towns similar townscape characters evolved. The dominance of the unified capital, Budapest (1873) was significant not only in economic, social, political and cultural levels, but its influence was shown in the townscape creation as well. At this period a certain degree of universalisation began. It mingled with the local elements and the original built environment due to the architects worked in the territory of Austria-Hungary (Central Europe) and the urban regulation challenges of modernizing towns. The style movements applied in the town spread quickly into other towns because the same engineers, who designed buildings in the capital, often worked in other towns. Partial universalisation of the townscape became inevitable. The era was marked by rapid alternation of architectural styles. According to Eve Blau, even the urban history or

the background is different of the studied towns it is possible 'to trace lines of development and persistent widely circulation concepts and models. These then provide a backdrop for considering the diverse build and unbuilt projects and the discourses of the architects and planners who imagined the modern world of Central Europe' (Blau-Platzer, 1999, p. 15).

3. Analysis

The examination of the case studies as well as the comparison take into account the main urban elements featuring identity and their relationships. Analysing the transformation of Central European cities from the middle of the 19th century to the beginning of the 20th century similar features y*et al.*so significant differences can be discovered. The reason for this is the progressive urban development of the second half of the 19th century which was a period of manifestation and consequence of industrialization and the new socio-economic and political situation.

Historical stratification does not always show significant differences in the urban structure during the urban development period from 1867 to 1918 (Figure 2). However, changes in the built environment refer directly to the (urban) development over time, as evidenced by the dynamics of construction periods and the layout of buildings. Subotica's city centre reached its final form at the end of the eighties of the 19th century, and the changes may be harking back to the periods of building constructions (Figure 3).

Subotica was characterised by its urban polycentrism which remained visible after the regulation for street networks. The dominant urban tissue types in the downtown area were 'Jf', 'Je', 'Jc'. The town-forming forces including streams and wetlands can be seen in the urban structure since they determined the line of the streets and location of the parks and green areas in the urban agglomeration. In case of the 'Jc' and 'Je' the line of the streets is semi-regular or irregular, thus the planning options are limited. The new development should follow the straightened line of the street and fill the entire plot. According to the regulations the façade dynamics of these districts are an important feature thus a new development should follow the rhythm and does not extend beyond the maximum height of the surrounding buildings (Figure 3).

The urban tissue catalogue based on the integrated urban morphology analyses of 70 towns describes the urban fabric types. Among them the 'Je' is dominant in the wider downtown of Subotica. One is manifested in perimeter buildings (with side wings) with gateways accessing into the block interiors connected by cross passage houses. It is characterized by joined groups of backyard separated from each other by the wings of the blocks. The plots partly kept their

Figure 2. *Historical stratification. Identification of the changes in the urban structure of Subotica from 1851 to 1882, based on MV ZK 645, IAS F.277.*

Figure 3. *Downtown of Subotica represents various building periods (from the mid of 19th century till the contemporary infill).*

original (pre-regulation) shape and arrangement. They together with the buildings are creating a densely built-up area where the public buildings are dominating. It is typical for the central area of town in lower altitudes. The street network is partly regular with dominant roads and streets which follow their pre-regulation line. There seem to be a development in an unbroken row with accentuated gaps (vacant lots).

The list of the towns where the type can be found points out the potential case studies: Subotica, RS; Senta, RS (in some details); Vršac, RS; Pančevo, RS; Zrenjanin, RS; Kecskemét, HU; Baja, HU; Miskolc, HU; Munkachevo, UA; Timișoara, RO; Novi Sad, RS; Târgu Mureș, RO; Hódmezővásárhely, HU (regular street network, more regular plots); Osijek, HR; Sombor, RS; Debrecen, HU.

Although in the urban tissue analysis the number of the case studies was 70, in the micro-urbanism studies it has to be reduced to 20-30 due to the more complex façade-elements and architecture.

Steps of the micro-urbanism analysis: 1) Identification of the urban tissue type from the previously established catalogue. 2) Based on the general features of the urban fabrics, the central core of the city can be precisely divided into urban tissue type zones (the differences of the micro-urban structure is more accentuated in the town centre). 3) We determine the repetitive (similar) patterns as façade division and architectural style by studying the built environment of the different cities in the zone including the same urban tissue types. Façade analyses may include studies on proportion and architectural details.

In the proportion studies, a building is considered as a structural system and the elementary structures are the gate (G), the window area (W), floors (F), the ceiling. And functioning as elements their smaller details are considered. The proportion studies or rates of the structural systems according to the height (H) or length of the building (B) give quantitative data about the width and height relationships of the houses and the façade segmentation like (a) street

front installation rate (horizontal division): gate(G)/building(B); (b) façade proportions; (c) horizontal length ratios relative to total façade length.

4. Results and conclusions

In Subotica in the last quarter of the 19th century the slow pace of urbanization accelerated and at the turn of the centuries a rapid urbanisation started marked by construction of a series of Hungarian Secessionist buildings and others, although it remained somewhat detached from the local social and architectural context. The newly built downtown represented an architectural overstatement that was somehow disproportionate to the size and significance of the town. The alternation of architectural styles is quite frequent in case of the urban tissue type 'J' not only in Subotica, but in most of the towns where they occur in the downtown area (like in Subotica, RS; Zrenjanin, RS; Kecskemét, HU; Miskolc, HU; Munkachevo, UA; Timișoara, RO; Novi Sad, RS; Târgu Mureș, RO; Debrecen, HU).

Based on the architectural style combinations mainly the historic styles (so-called 'neo' styles) are frequent. The pre-1867 architecture and the Secession are represented in less percentage, not inclusively the Hungarian one but in some cases the Viennese one as well.

We have to be aware that around 1900 there were three slightly intertwined movements in Hungarian architecture. The most compact was traditionalism that meant the use of historical styles in a more modern form. The second movement included liberals who supported the ideas of modernism in the spirit of decadent movements in Europe but hidden as pioneers of national expression. Its first leading figure was Ödön Lechner followed by his students (in Subotica the architect of the town hall and the synagogue – Dezső Jakab and Marcell Komor). The third movement was called youth and its leading personality was Károly Kós who was about to create a more original national expression, with the ideology and forms of art and craft movements and applying the national romanticism of Scandinavian architecture. The diverse architectural movements will be reviewed also in further studies but also mentioned in the very paper.

Variety is the specificity of this urban tissue type, while in case of types 'H' and 'G' the urban closure is more uniform. The proportions of the façades, the dynamics of the façade elements are harmonious with minor interruptions (see the example of Pest and Zagreb, but even Rijeka could be cited as an example). Of course, these qualities are not only products of a short building period (these districts were built in a decade), but also the regulations that define the zones of the urban structure, and specify the type of the building and height of the construction in the zones.

In case of Subotica and similar lowland towns like Novi Sad or Debrecen despite the regulations were not as strict and precise as that of the capitals and more significant towns. If we look at the image of cities today, the diversity of both contemporary and historic infill has remained. Due to the lack of proper regulations there seems to be no exact building rhythm to be followed which would indicate the direction of the new constructions.

In the wider downtown another special urban tissue type has to be considered due to the integration of one or more buildings into the existing urban structure and pre-compromise urban tissue. The urban tissue type 'M' is characterized by the unique feature that the buildings and building-series from the dualist period were wedged in the pre-compromise urban tissue. Thus, the urban fabric does not limit the creative freedom by either structural way, or in the context of the built environment.

The numerical information about the proportions of each urban tissue types also occur in the towns where these types are represented. Therefore, a catalogue (Figure 4.) could be made

on the basis of the collected urban closure images and details (characteristics). This catalogue would illustrate the alternate but repeatable patterns referring to the architectural style, fragmentation and details.

5. Discussion

Research on micro-urbanism combines several disciplines related to urban and architectural studies like urban morphology, typo-morphology, urban history and theory, architectural history and theory, planning history and theory. And further social sciences are included as well since urban and architectural evolution cannot be defined without the knowledge and understanding of historical and social aspects.

The historical aspect refers to the changes in the townscape of the cities examined. The second half of the 19th century not only caused changes in the urban structure but also created an architectural language of urbanization at the end of the century. Ákos Moravánszky states that historicism is the Amtsprache (official language) of urbanization in Central Europe (Moravánszky, 1995, p. 14). According to Caniggia and Maffei's conclusions, the typological process [as micro-urbanism also belongs to the type-morphology] is interpreted as 'succession of changes in time with distinctions and applicable mutual spatial influences (...). History is a system of time-space individuals that are comprehensible in its formation and transformation processes' (Caniggia – Maffei, 2001, p. 56).

Table No1. - example

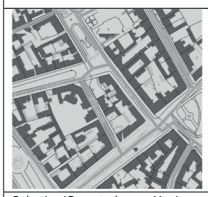
URBAN TISSUE TYPE	AREA and MAPPING				
	Scheme (section)	Description	Examples in case study towns Subotica (Case study area No1)		
			Contemporary map – section (GIS 2019)	Historic map (1867-1918) - section	Location in the town
'Je'		One is manifested in perimeter buildings (with side wings) with gateways accessing into the block interiors connected by cross passage houses. It is characterized by joined groups of backyard separated from each other by the wings of the blocks. The plots partly kept their original (pre-regulation) shape and arrangement. They together with the buildings are creating a densely built-up area where the public buildings are dominating. It is typical for the central area of town in lower altitudes. The street network is partly regular with dominant roads and streets which follow their pre-regulation line. There seem to be a development in an unbroken row with accentuated gaps (vacant lots).		[due to copyright reasons, Source: IAS F-086 088]	
			Subotica (Case study area No2)		
			Contemporary map – section (GIS 2019)	Historic map (1867-1918) - section	
				[due to copyright reasons, Source: IAS F-086 088]	
			... Case study areas in Subtica	...	
			Based on the same tissue ('Je') case study areas in: Zrenjanin, RS; Kecskemét, HU; Miskolc, HU; Munkachevo, UA; Timişoara, RO; Novi Sad, RS; Târgu Mureş, RO; Osijek, HR; Sombor, RS; Debrecen, HU;		
REPETED CATALOGUE WITH THE URBAN TISSUE TYPES – according to the case study towns (20-30 of them). Based on the dominant urban tissue types in the wider downtown.					

Table No2. – example

URBAN TISSUE TYPE	ARCHITECTURAL details an RATIOS (repetitive patterns) – all of the towns					
	Building period (approximately)	Details (No1)	Details (No2)	...	Ratios - not exact but approximately From - to	Façade (collection of pictures)
'Je'	1880-1900	Gate area (G)	Window area (W)	...	gate(G)/building(B) window (W)/building	
				...		

FINAL TABLE – MICROURBANISM PATTERNS CATALOGUE

Figure 4. *The catalogue (example).*

Similar design principles directly influenced the planning of Central Europe. Therefore, Stübben, Sitte, Wagner, their students and followers have an impact on the structure of cities. Due to the identification of the principles and effects applied in a particular town, the analysis of urban structure and practice at the turn of the 19th and 20th centuries is complemented by the analysis of urban structure. With particular regard to the built-up zones where different building types were constructed. Moreover, due to the regulations they created practical urban development trends.

Referring to the regulation of Budapest described below, a four-part study was published about the building types (K. Császár, 1908) and zones of the capital in 1908 which was divided into four building zones at that time. The four zones, though, was not enough to regulate the entire area of Budapest, created a framework in which combinations of different types were found. Subsequent regulations refined the growth of the zones.

In 1908, there were nine different building (architectural) types in the four zones of Budapest. They were the followings: 1) unbroken row of houses (buildings – rental palaces) with side wings; 2) unbroken row of houses (buildings – rental palaces) without side wings with the common yard; 3) unbroken row of family houses; 4) front-garden construction; 5) unbroken row of rental stores and storehouses; "6) if there seem to have been fewer than four family dwellings in an unbroken row there would have been a transitional type of unbroken row of buildings and villas such as twin or triple villa. It is so called a villa group whose one form is the group of four villas in which there are four villas are grouped around a common yard, and in fact, the four ones form a whole on fours sites that meets in one common point; 7) the construction of a rental villa is reasonable in a busier place, on a more expensive land, where free view or free air movement would still be desirable" (K. Császár, 1908, p. 69); 8) holiday home type. Type 9) is not strictly a layout-based differentiation but based on the function of the buildings. Thus workshops, cleaner factories and economic buildings should be included in this group. The author of the study, Ferenc K. Császár, states that the 'zone conditions based on structural and health requirements, and the building types are [based] on floor plan distinctions' (K. Császár, 1908, p. 69).

On the basis of building types and refined zoning, the number of urban tissue types (overall 41 types) may be reduced, the 11 main types have remained but the subtypes have merged. Thus, micro-urbanism does not arise in the examination of the differences within the urban tissue types, which belong to the same main type, but focuses on the mutual analysis of the types of buildings (and their architecture) and the urban tissue types.

The study about the development of the system of micro-urbanism is a complementary work related to urban tissue typology and urban topology. Understanding it we can see the unity of the methods and their results applied in urban creation of the former Austro-Hungarian Monarchy.

The urban tissue analyses are repeatable, meaning that by the proposed integrated methodology and steps everybody could make analyse and define the urban tissue type. The dualist urban tissue type catalogue is a good reference, since there the type can be also identified by its features and indication.

6. Acknowledgements

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Archives: Muzej Vojvodine Zbirka Karata [MV ZK], Istorijski arhiv Subotica [IAS].

The Evolution of the Plan in U.S. Settlement Examples

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Keywords: Plot, evolution, town foundation, stability, US.

Abstract: Does the original plan of a city have an effect on the subsequent evolution of the block and lot pattern? This research will compare four cases of city centre changes over a minimum of 150 years each to determine the effect of origin form in the stability of the plan. "More stable" means that the original pattern of blocks has stayed clear and constant throughout the period of time, and "less stable" means there are many instances of change, including disruptive change that compromises the original pattern substantially. The different plan types include: 1) Grids and plot patterns planned for a specific building type that was common at the time (Waco, TX); 2) Grid patterns with plots that were incorrectly sized at their origin (Cincinnati, OH and Salt Lake City, Utah); and 3) Areas where the original plan was farm allotments (Providence).
While four cases are not enough to make a definitive finding about the evolutionary differences because of different original patterns, this framework could be replicated easily in many places around the world. If the differences in the relative stability of the block patterns can be demonstrated, it would make a case for the best kind of new city foundations, which would be flexible and yet stable.

1. Introduction

This paper reports on a study of four cases of town foundation in the United States, and the subsequent development of the area of those original foundation blocks or allotments. The cities are Providence, RI, founded in 1638, Waco, TX, founded in 1846, Cincinnati, OH, founded in 17--, Salt Lake City, founded in 1847. The research question is to study the short-term (150 to 200 year) evolution of American grid foundations. Initially the expectations were that there might be different kinds of evolutionary patterns based on different origin patterns of the plan matrix. That conclusion cannot be supported by the data we collected and analyzed, however, there were several important observations from these four cases.

The elements that are part of most urban morphology studies, if the data are available, are *built form*--buildings, monuments, paving, eg.); *plan matrix*--the land subdivision, including the land given over to public infrastructure; and land --the natural and reconfigured landscape that underlies the place) (Scheer, 2016) These elements are then analyzed and interpreted as patterns that can be compared and related to history and culture to build up a knowledge base. After identifying, measuring and mapping these data points, morphologists work to interpret

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patterns that can be seen not only in the place under study, but also occurring in multiple places concurrently.

According to theories of urban morphology, the physical city is in constant flux, with buildings being torn down and replaced quite commonly. The three elements (built form, the plan matrix and the land) change at different frequencies, as has been noted in most theories of urban morphology. (Panerai *et al.*, 2004; Moudon, 1986; Caniggia and Maffei, 2001). Although buildings can be very long lived, their endurance is much shorter than the plan matrix. For example, the current street pattern of lower Manhattan has endured from the 17th century, but there are no buildings that survive from that time period.

This paper exams only one of the elements of urban morphology – the plan matrix. Just as with built form, once a plan is initiated, it also undergoes evolution. Figure 1 outlines some of the common ways in which that evolution occurs, e.g, lots that are combined or subdivided (Conzen, 2004). An evolutionary change in the plan matrix is also correlated with the city's responses to the cultural and economic conditions, but when the plan matrix is altered, it means that most of the built form has also been destroyed.

Figure 1a shows the several categories of change that a plan may undergo over even very short periods of time. These are generally operations involving changes at the lot and block level: vacating alleys, combining and recombining original lots, subdividing blocks with alleys, subdividing larger lots.

Disruption of the plan matrix is not like these stepwise evolutions, however, which are carried out by individual actors in a slow evolving dance. It is a radical restructuring caused by deliberate action of a powerful agent or a catastrophe (Figure 1b). Just as evolutionary changes reflect subtly shifting conditions in the environment, disruption signals a radical change in those same conditions: a new regime has taken control, or a powerful agency has started a slum clearance program, or a new superhighway must be built through a neighborhood. With a disruption to the plan matrix, most of the built form is also destroyed. The most dramatic changes, which also cause a plan disruption, are those that change the landform itself: cat-

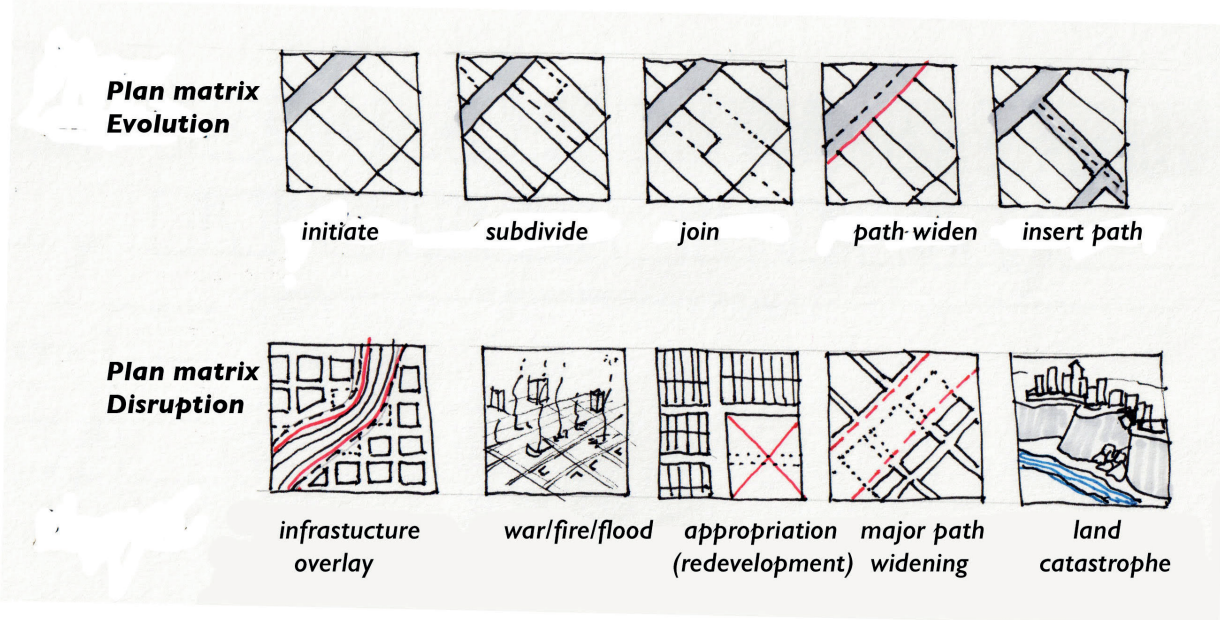

Figure 1a e 1b.

aclysmic events like earthquakes, landslides, and floods, or a man-made land-altering event like leveling a hill to fill in a harbor (e.g. Boston, Seattle, New York).

Many American cities sported some form of geometric layout as part of their original foundation, usually a grid (Reps, 1965). Until the 1940's, new subdivisions also took the form of an addition to the grid, perhaps only slightly modified. (Southworth, 1997, pp. 106-107). In most cases the initial blocks were subdivided into lots, which were somewhat regular. These lots were built to accommodate, in size, the expected urban building type of the period. The same kind of planning occurs today in suburban subdivisions, where the lots are sized to accommodate a particular scale and type of single-family house. (Scheer 2010, pp. 47-50)

Town planning, from Miletus to today, meant laying out an orderly plan of streets and lots in advance of building. The grid plans that underlay many historic areas in the U.S. were often speculative, built as a way to quickly survey property for rapid settlement (Reps, 1965). Grid towns are one example where a particular formal pattern is seen over and over, often grouped in a particular era. Minor changes in grid dimensions and overall scale of layout can reveal new meanings when many places across the world are compared.

2. Methodology

The primary methodology of urban morphology is to collect, compare, and measure maps of places at different time intervals, comparing them for physical changes. Frequently, study areas are also compared to similar places elsewhere. The purpose is to identify and explain the patterns of development, as well as to understand and reveal the physical and non-physical forces that drive change. (Scheer, 2016). In this study, four cities were selected that were founded in the 19th century, with one (Providence) founded earlier but significantly rebuilt in the 19th century. Maps of the city from the 19th century that indicate their early plans were overlain with contemporary GIS maps of the same area, using the GIS map as the registration marker, and to provide information about the scale. Only the extent of the original plan was studied, although all the cities have greatly expanded since that time and most expanded very quickly soon after they were initially surveyed.

The following were compared: from the early maps: the number of blocks in the initial survey, the total physical extent of the survey, the size of regular blocks, the number of irregular and regular blocks, the physical location (e.g., on a navigable river) and the degree of orientation off north of the entire physical plan. Three of the cities were founded with rectilinear grid and Providence was developed on an irregular grid that developed from 17th century allotments.

The original city plans were then compared to two time periods: late 19th century plans (from Sanborn maps) and 2018 or 2019 Google aerials and GIS maps. The data specifically collected in all cases was the number of regular blocks preserved (block perimeter and surrounding streets) vs not preserved and the number of irregular blocks preserved. A check of the extent of the persistence of original lot boundaries was also made.

3. Analysis/Results

3.1. *Individual city analysis*

Providence, Rhode Island

The Providence Plantation was original founded by Roger Williams in 1638, with long narrow allotments similar to the burgage lots common in England at the time. These bordered the west side of the head of Narragansett Bay (Fields, 1902). Because this part of the area was on a hill, Providence city centre developed across the bay from the original foundation. By 1830, these lots were overwritten with an irregular grid, which was subdivided for individual houses and institutions. However, the allotment property boundaries provided many of the boundaries for 1830 streets and blocks. Remarkably, the surrounding streets of the original allotment and the original internal streets were all retained from 1638 into 2019.

The majority of the changes from the 19th century to 2018 are to blocks that have been either subdivided or combined. Most changed are blocks that are along the waterfront, especially where bridges were built, and waterfront parks or highways exist today. There are residential buildings and some institutional buildings that remain from 1840. The relatively small-scale grid, which has seen some consolidation, has nevertheless resisted larger typologies. Many lots are rom 19th c, most of them are residential.

Cincinnati, Ohio

Cincinnati was founded on a navigable Ohio River in 1802. Its purpose was initially as a place for shipping, connecting to both the Mississippi river as well as the Erie Canal. The foundation plan was a grid consisting of mostly square blocks, which ignored the steep drop off from the bluff to the riverfront itself. Riverfront blocks and streets, which were the significant economic drivers in the 19th c, did not survive into the 20th century, at first being replaced a large interstate and then with a combination stadium, and later two stadiums, a park, a buried highway, and some housing projects.

The original regular blocks had 8 large lots, were quickly subdivided and built up with a very dense fabric, which persisted until the decline of the city in the 1940s and 1950s. All but a tiny part of this fabric has been demolished, with blocks consolidated into three or two lots to accommodate much larger typologies and new developments by 2019. Interstate highways and railroads slid along the edges of the original grid and disrupted it below the waterfront bluff area.

Waco, Texas

Waco was founded along the navigable Brazos River in 1846. Its original grid is relatively small, but it also took a long time to fill out. A suspension bridge (still extant) was built across the river in 1870, and it resulted in a torrent of new business and development in Waco, serving farm to market traffic for ranchers and cotton farmers. (Waco History Project, 2019)

The original fabric is relatively small grained, with small blocks and small lots. The lots were usually combined to make larger lots as the city built out. It became very dense with one and two story buildings by the early 20th c. A railroad was built right through the middle of the original grid, disrupting its continuity. The grid is somewhat persistent, but with very few small or

even double lots remaining. The lots do not seem to have formed a background matrix for any kind of 20th or 21st century development.

The most remarkable transformation was the overwriting of the town's city hall square, which was a central location near the warehouses and the downtown activities. Stores used to line the square itself, which was an entire city block, much like the historic courthouses popularly preserved in Texas. In Waco, this square was obliterated and replaced with parking lots, a convention center and hotels. The city hall building still exists as it was rebuilt, in 1933 but its "urban square" is gone and its surroundings are considerably diminished, following an urban renewal project in the 1950's. (Waco History Project).

Waco's original grid provides some organization for the city, but the city itself is greatly "thinned out" – taking on the density and form of suburban offices jammed into a 19th c grid. No historic buildings survive in the original grid area. The biggest disruptions avoided the original grid, but surrounded it with interstate highway.

Salt Lake City

The City of the Great Salt Lake was founded in 1847, just a year after Waco, Texas. It was a city built on a religious intention, founded by Mormons and their prophet, Brigham Young. Young went on to found over 300 towns in the western territories of Utah, Arizona, Idaho, Nevada, and California. The size and extent of the plan was quite unusual, and the orientation of lots on the blocks was also unique. The city was not founded next to the Jordan River, but some distance away, apparently to provide for agriculture. The river was slight, and not navigable, but did provide for many small canals and channels. (Nelson, 1952).

Despite its large size, after its founding Salt Lake was engulfed with thousands of religious immigrants, who quickly filled the original plat and necessitated two more town plats within five years. The original large lots were very quickly subdivided into 8 to 10 lots each. The city densified especially in the original blocks downtown, with two to four story buildings quickly providing lot coverage and the original large blocks often divided with half alleys to provide access to their interiors.

The original plat with 10-acre blocks has seen little disturbance, the most being the two blocks that have been joined together in the late 20th c., one for the convention center and one for the Temple Square. The enormous size of the original blocks has allowed for contemporary downtown building types to accrue without joining smaller blocks together. Highways and railroads were built along the river, and proposals for cross-town freeways were dismissed.

The original odd configuration of the lots can still be read in the contemporary plan, as it provides a superstructure to further subdivision in almost every block. Of the original three public squares (parks), only one survives as a park, the others are now a high school and the City-County building.

4. Discussion/Conclusion

The research question, whether different patterns of grids or foundation plans had different level of persistence, cannot be answered in this research. The comparison of the four cities in inconclusive in regard to this question, although the cities shows a great many similarities, despite their differences in extent of original foundation, number of blocks and block sizes.

Some important distinctions were also observed, but could not be attributed to the original foundation plan.

Turning to the data itself (Table 1) we see that the most stable plan is Salt Lake City, which is also the youngest place examined. The grid there has been very well preserved (79%) compared to other places. The distinction it has are 1) the blocks and the streets were exceptionally large in size, so that making room for density and for larger building types in the 20th c. has not required joining of blocks except in a few cases, 2) the interstate highway and the railroads did not intrude physically anywhere near the original plan area, despite its large extent. These were placed along the river, which was actually peripheral to the plan, and proposals for cross-town highways were rejected, partly due to topography, 3) the extent of the original plan is much larger than the other cities, yet it was built out very rapidly – with two years – due to the flood of Mormon immigrants.

Waco, like Cincinnati, has far more change – with only 34% of the original blocks still preserved. Cincinnati has a similar percentage. "Regular" blocks, being the ones that were most common in size and orientation, were far more likely to survive. Salt Lake did not really have "irregular blocks", except for public spaces and all of Providence was irregular, so comparison here is difficult.

Block size varies greatly across the four cities, from Salt Lake's very large blocks, to Waco's very small ones. Providence had a variety of block sizes, which varied from 200 feet x 200 feet to 700 feet x 300 ft. Block sizes were not a dominant reason that particular blocks did or did not persist, except perhaps in Salt Lake, as stated above.

We observed that the most prominent loss of the integrity of early plans had three causes:

– With the exception of Providence, the building types rapidly evolved in the other three cities, so that by the late 19th century, all the original lots had been subdivided and built out with a much higher density than apparently anticipated in the original plans. These three cities developed as "downtowns" while this part of Providence developed as a residential area, and still has houses intact from 1840 and earlier. The density of commercial land uses was apparently not anticipated in any of the three places – the lots were usually large, as if for individual houses or buildings, not an urban layout with abutting buildings.

Table 1. *Comparison of four cities.*

	Providence	Cincinnati	Waco	Salt Lake City
Date of foundation/plat	1636	1802	1846	1847
Age in 2019	383	217	173	172
Blocks:				
Block size (not street)	varies	400 x 400	50 x 165 (x2)	660 x 660
Number total	118	53	69	113
Regular blocks	N/A	28	58	109
Regular blocks preserved	N/A	22 (38%)	20 (34%)	86 (79%)
Irregular blocks	118	25	11	4
Irregular blocks preserved (Percent)	69 (58%)	3 (12 %)	2 (18%)	3 (75%)
Extent of original plat	416 ac	288 ac	117.6 ac	1415 ac
Grid Orientation degrees	5 NW	30 NE	45 NE	0 N
Location	Harbor/bay	River- navigable	River – navigable	Mountain Valley

- The blocks along the edges of the waterfront or the edge of the plat itself were far more vulnerable to change. In Salt Lake, some of the blocks with steep elevations were never built out as regular blocks, despite the plan. In Cincinnati and in Waco, the blocks on the riverfront were vulnerable, especially in Cincinnati, where topography and flooding also provided opportunities for rapid change of the street and block network. In Providence th topography was also an issue, with lower areas next to the waterfront suffering the most disruption. Similarly, blocks in the center of the plat were more stable.
- Regular blocks were more stable than irregular blocks, that is those that were not the standard size for whatever reason. Areas in Waco that were most vulnerable were blocks surrounding the old City Hall Square, which was egregiously destroyed. Public squares in Salt Lake were also changed.
- A fair number of the property lines in the three gridded cities -- Salt Lake, Waco and Cincinnati – are still readable as the background to further subdivision. In Providence, there are many blocks where property boundaries have been preserved, again, in residential circumstances.
- Interstate highways and railroads were overlain on cities without regard to the patterns of lots and blocks beneath them. They constitute a genuine "disruption" of the fabic and plan matrix wherever they occur, although they skirted the boundaries of the original plan in three of the four cities (not the waterfront of Cincinnati).

All four of these cities developed with a geometric order, although Providence was more fluid and irregular. Despite this regularity, there was a good deal of shuffling around in the 175-200 years of urban development – streets closed, streets created, block and street fabric disappearing entirely for new development. The only pattern that seems more stable is Salt Lake, with its huge dimensions accommodating the 20th c development that created hollowed out density, high rise towers, parking lots and garages, where a dense fabric had once been.

The blocks in these cities, except for residential Providence, now host new typologies, with many blocks under one or two owners rather than the 30 or forty that might be common in the late 19th c. Most do not have continuous block faces as they once did (or twice did). The lessons for contemporary planning are not clear – how do we plan for the rapid change we might expect? How can we return to walkability in cities which already have the block infrastructure to support it?

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Defining Plot Pattern in Jinjiafang: Conzenian Approach to a County-Level Walled City in China[1]

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Keywords: Conzenian approach, town-plan analysis, plot pattern, building type, China.

Abstract: The plot is one the three essential plan elements of urban built-up area in the Conzenian approach of town-plan analysis, featuring as an invisible yet vital aspect in the understanding of the political, social and economic agents of urban form. However, due to the lack of true ground plan, particularly scientifically-surveyed cadastral maps, the study of urban plot pattern has been a major challenge in the morphological analysis of traditional Chinese cities. This paper attempts to introduce an experimental method of plot pattern study based upon multi-resources field investigation. Taking Jinjiafang, a well-preserved historic district in the Shanghai Walled City as an example, the study managed to construct a plot pattern map through five different resources. Three types of land use pattern were further discovered on the plot pattern map, with the small-piece, mixed-used land development as the dominant type. The preliminary findings of the study reveal that the Shanghai Walled City is not merely a remnant of traditional built form, but had undergone a thorough redevelopment during the 19th and early 20th centuries. Methodologically, the paper argues for a critical site-based survey in the study of the built environment where historical archives are insufficient but the historic townscapes are well preserved.

1. Introduction: Conzenian town-plan analysis, contribution and limitation

In his iconic paper *Alnwick, Northumberland: A study in Town-Plan Analysis* first published in 1960, M. R. G. Conzen proposed a systematical analysis of urban-up area by subdividing it into three distinct complexes of plan elements: (1) the street-system primarily shaped by the public forces; (2) the plots shaped by the specific political, social and economic mechanism during specific period; and (3) the building shaped by the construction activities of private landowners (Conzen, 1960). Compared with other methods of urban form analysis, the most innovative part of Conzenian town-plan analysis is the recognition of an invisible element, that is the plot pattern, as an integrated part of urban form (Moudon, 1997). This has, on the one hand, involved the political, social and economic agents in the understanding of urban form, while on

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the other hand, has helped to identify the various historical layers shaped in different times. By including both chronological and socio-economic information in the analytical framework, the Conzenian town-plan analysis is particularly useful for the study and conservation plan of the historical cities with a rich accumulation of physical remnants through history.

However, the full application of Conzenian town-plan analysis heavily relies on the existence of large-scale, scientifically-surveyed maps through history. It also relies on the establishment of a comprehensive, open database which allows the morphological analysis and comparison among different cases. These two conditions have largely restricted the global adoption of Conzenian approach. In China, despite the fact that the Conzenian school of urban morphology was introduced to the academic world in the 1990s, its usage was largely limited to the several prominent historic cities with relatively rich materials (Chen, 2012; Zhang, 2015; Whitehand, Conzen & Gu, 2016). For most Chinese cities, there are no scientifically-surveyed maps up until the early 20th century, l*et al.*one large-scale maps with the information of land plot and building fabric. The limited number of the studied cases has, in turn, affect the scientific nature of the morphological analysis of the individual case.

2. What is Jinjiafang, and why its plot pattern is important?

The walled city of Shanghai is among the numerous traditional Chinese cities with rich history but limited historical record. The human settlement of this area can be traced back at least to the 11th century. In 1553, a city wall was constructed around the county government with a diameter of 1 mile, identifying the political center of Shanghai in the coming four centuries. Although Shanghai is probably the most extensively studied city in the world, the major academic interests have been focused on the International Settlement and French Concession while the walled city has long been ignored. Largely due to the lack of urban fabric analysis, in the conservation plan for the "Shanghai Walled City Historical and Cultural District" sanctioned by the Shanghai Municipal Government in 2005, the "core protection section" only included 1/4 of the walled city, leaving the majority of the historic fabric to the threaten of demolish and redevelopment.

Facing the increasing risk of the disappearance of the oldest urban area of Shanghai, we initiated a "digital preservation" project in early 2017, attempting to keep a record of the existing

Figure 1. *The aerial photo of Jinjiafang, 2017 (photograph: He Wei).*

urban fabric of the walled city. The Jinjiafang survey is the first stage of this project. This area is located in the northwest quadrant of the walled city, still keeping the urban fabric of the early 20th century (Figure1). In early 2016, the urban renewal project was re-started after the initial relocation in 2003 had been suspended due to the financial problems of the developer. As this area was not included in the "core protection section", and there is no officially designated cultural heritage and outstanding heritage architecture, it is very likely to be torn down and redeveloped in the redevelopment plan.

In effect, Jinjiafang is a crucial part to understand the history of the Shanghai walled city. This area remained undeveloped in a land use map of Shanghai in 1888, while in the land price map of 1947, it had achieved the highest level in the walled city which was close to that in the French Concession. This indicated that Jinjiafang might be among the most modernized part in the walled city, yet still carry some features of the pre-modern agricultural landscape. In this sense, the plot pattern of Jinjiafang is important as it might be able to explain the development of the walled city from the very ancient times to the recent. But so far, we haven't found any historical maps and document recording this area's land property information.

This paper, thus, is intended to introduce the result of our survey in two aspects: one is the process that we traced the plot pattern based on the multi-resources on-site information; the other is the preliminary result that we worked out through the analysis of the plot plan. It further intends to open a discussion about the study of historic human settlements with limited historical documents, which is the majority cases in the world. As many of these towns/settlements are now encountered extensive reconstruction projects, and will presumably disappear in the coming decades.

3. Methodology

The premise of this study is that through multi-resources on-site investigation, particularly with the assistance of new technology, researchers are able to obtain the information of urban plot pattern. The specific detecting process, though, depends on the condition case by case. In the Jinjiafang area, we managed to obtain information from the following five resources:

1. 3D surface model created from aerial photos. Aerial photography has been a widely adopted digital preservation technology, being fast, informative, and relatively cheap. But this technology still has apparent defects in the survey of high-density built fabric. After several rounds of tests, we successfully built a surface model with the roof measurement with a deviation of less than 10%. A ground floor plan, roof plan as well as a digital mass model was built based on the information obtained from the surface model. This basic information would further be used to study the plot pattern and building types.
2. The street directory map of 1947. This map contained all the information about the street address of each house, shop, and factory in Shanghai (Figure 2). The names and number serial of the lilong neighborhoods helped us to recognize the boundaries of each lilong which supposed to be developed upon one property, as most names of *lilongs* originally engraved at the main entrance had been cleaned up during the Cultural Revolution (1967–1977). This map provided a base for the further study of plot pattern and building types.
3. Boundary stones. The erection of boundary stones at the corners of each property has been a long-term practice in the rural and urban settlements in China, being compensation of the lack of official land survey. In the Jinjafang area, we discovered 63 boundary stones

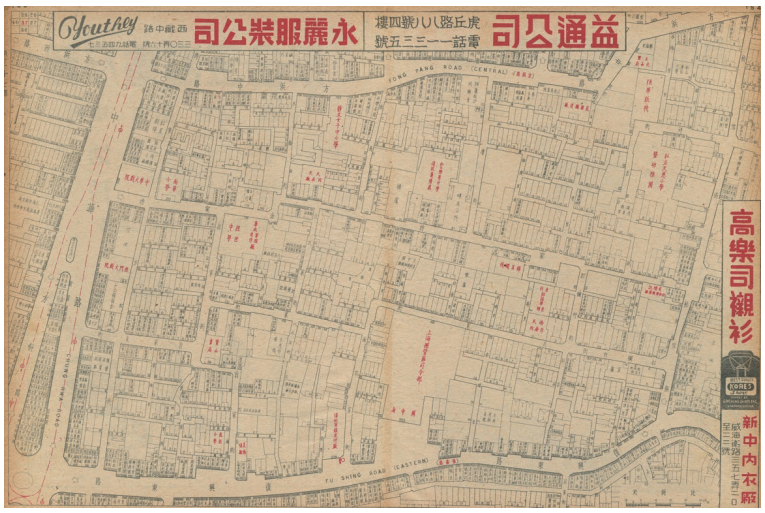

Figure 2. *The 1947 Street Directory Map of Shanghai.*

in total, among them 43 with an inscription indicating the name of the landlord. The location of the boundary stones served as the most solid evidence for the boundary of each urban plot. However, due to the lack of study of the history and variation of styles of boundary stones, it is quite difficult to tell the erection time of these stones.

4. Identification of architectural details and materials. Buildings built in different details and materials suggested they either built at different times or by different construction teams, thus by different landowners.
5. On-site interviews. During the past three months, we managed to interview five households in the Jinjiafang area. Two of them are the descendants of the original house owners and have been living here for five generations (more than 100 years), three have been lived here since the early 1940s. The family stories, photos, and other private collections showed the process of land development, the transformation of room subdivision, and the change of residents through history. Although we don't have accurate statistics at the moment, our general impression was that among the 4000 households of this community before the 2016 relocation, more than half of the families who used to live here before 1949 had moved out, and only around 10% of the current households have certain relationship with the original landowners. This data indicated a tremendous social transformation since the end of World War II. However, compared with the condition in the foreign settlements, the walled city still contains the social continuity to a certain extent.

Based on the five resources mentioned, we worked out a draft urban plot pattern of Jinjiafang (Figure 3). (1) and (2) are used together to construct a preliminary base map of land subdivision, with (3) as the most solid evidence for some of the plot boundaries. (4) and (5) are used as subsidiary resources only. The land subdivision lines with (4) and (5) as the only evidences were marked in middle gray in the map. Sometimes, the information we obtained from each resource was not comprehensive, sometimes the information from the various resources could be a conflict with each other. When the confliction occurred, the subdivision lines were marked in light grey, and all the information were recorded as an alternative narrative.

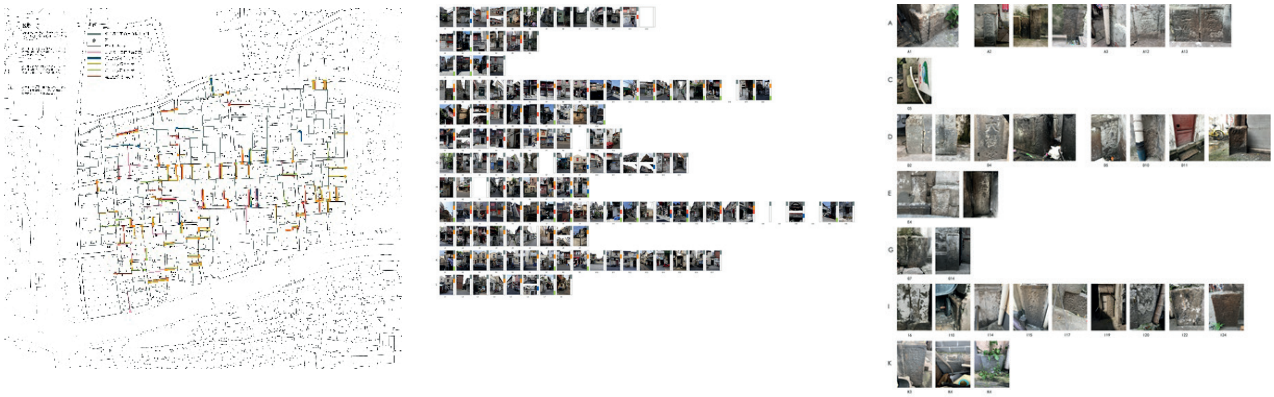

Figure 3. *Land subdivision and the five resources.*

4. Analysis/Results

According to the draft plot pattern of Jinjiafang, we recognized 149 pieces of urban plots. Based on the information obtained from various historical maps, we can further identify three types of land use patterns in this area (Figure 4):

- Land for religious purpose. In Jinjiafang area. There are two pieces of land for religious purpose. One is the American Anglican Church (Tianen Tang), the other is the Guandi Temple (temple for the god of war)–Yuhua Daoist Palace complex, both occupied large piece of land. The two institutions first appeared in the 1870 Map of Shanghai, both moved from the eastern section of the Walled City in the 1860s. This suggested that probably due to the economic growth after the Taiping Rebellion (1851–1863), religious institutions started to search for large, relatively cheap land in the western section of the walled city which was still undeveloped at the time. The establishment of the two religious institutions might, in turn, stimulated the urban development of this area after the 1870s. Today, the American Anglican Church was used as a kindergarten, and the Guandi Temple–Yuhua Daoist Palace complex was occupied by a primary school and the temple halls had been demolished in early 1990s to make space for the playground.
- Land for large-scaled lilong development. *Lilong* neighborhood, featured with extensive and orderly tenant townhouses subdivided by a system of alleyways (*long*), has been considered as a dominant housing type in Shanghai in the late 19th and early 20th centuries. However, in the Jinjiafang area, we only found four pieces of large-scale *lilong* neighborhood, occupying around 10% of the total area. Three of the four *lilongs* – Ruyi Li, Zhaofang Li, and Tairui Li – can be found as early as the 1910 Map of Shanghai. This might lead to two hypotheses. First, the *lilong* neighborhood, which was a real estate development method advocated by the foreign landowners in the International Settlement in the 1870s, had been accepted by Chinese landowners as early as the late Qing Dynasty, and had been introduced to the Chinese walled city by 1910. Second, the large-scale *lilong* neighborhoods had never been the dominant land development method in the walled city, a phenomenon totally different from the foreign settlements.
- Land for small-scale mixed-used development. This is the dominant land use pattern in the Jinjiafang Area (Liu, 2018). We counted more than 100 pieces of land of such pattern, occupying around 70% of the total area. Among them, there are further four sub-types

Figure 4. *Land use pattern of Jinjiafang.*

of mixed-used pattern: (1) small-scale *lilong* neighborhood containing only one alleyway; (2) semi-detached *shikumen* townhouses (usually along the streets); (3) small-scale *lilong* with shophouses along the streets; (4) residence of the landowners, sometimes combined with tenant houses and shophouses (Figure 4). The small-scale mixed-used land, in effect, shaped the unique townscape of the Jinjiafang area, featured with a constantly changing of the street front due to the rich types of land use and the narrow width of land along the street.

It is worth noting that in the Jinjiafang area, the residence for the landowners is an important building type. These residences usually had rich Western-style decoration on the façade, yet still kept the Chinese-style courtyard layout, a "combination of the best part of Chinese and West" that was prevailed among the early 20th century Chinese elite. They usually located in the center of an urban plot, with their massive volume and polished materials distinguished from the rest of the built environment. We may further recognize three sub-types of such residences in Jinjiafang area, namely, (1) independent courtyard house; (2) landowner's mansion in the *lilong* neighborhood; and (3) *lilong* or *shikuman*-style mansion.

In the social aspect, these landowners' mansions witnessed the transformation of the traditional self-contained lineage settlements in Shanghai in the late 19th and early 20th centuries. One example is the Shen Family Residence located in the south-west section of Jinjiafang (Figure 5). The house is a large five-bay courtyard house constructed before 1905. According to our interviews with the descendants of the Shen family, they originally owned the entire piece of land of the block. In addition to the self-occupied courtyard house, they built a line of shop houses alongside the West Gate Avenue (today's East Fuxing Road), thus the plot served both as accommodation and economic resources of this family. After the first generation passed away, these properties were subdivided among the two sons, with the elderly son got three bays of the five-bay house together with three shops, and the second son got two bays and three shops. A brick wall was erected after the property was subdivided. This method still followed the traditional way of "the elderly son got more" in the family subdivision process. During the early 20th century, the elderly son of the second generation further developed the land to the north of their own house into three *lilong* neighborhoods.

The second case is the Wu family residences located in the north-east section of Jinjiafang (Figure 6). The first generation of this Family, Wu Chengbang, was the founder of Wuchengji publishing company. He purchased a piece of land in Jinjiafang in the late 19th century when

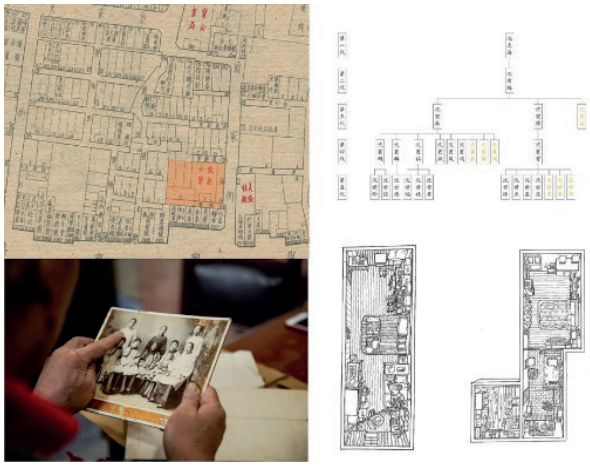

Figure 5. *The Shen family tree, photos and interior space.*

Figure 6. *The Wu family, photos and interior space.*

it was still rather undeveloped. In the early 20th century, three semi-detached *shikumen* houses were erected, two are two-bays, one is three-bays. In 1935, Wu Chengbang managed to purchase another piece of land with some distance of the three old houses, as a gift to the elderly son for the marriage of the elderly grandson. Thus, the four sons of the second generation of Wu family each inherited one *shikumen* house, with the elderly son got the newly built one. Compared with Shen family, Wu family had a relatively modern way of lineage settlement, with each core family achieved a certain degree of privacy and independent. But the traditional "elderly son got more" (in this case should be "the elderly son got the best") still worked. Furthermore, according to the memory of 96-year old Ms Wu, who is the wife of the second grandson of Wu Chengbang, the Wu family still cooked and ate together until the 1940s, a symbol of "being one family" in the traditional Chinese society.

5. Discussion/Conclusion

The preliminary findings of the urban plot pattern, land use pattern, and the building types of Jinjiafang reveal that the Shanghai walled city is not merely a remnant of traditional built form as was widely-accepted. Rather, it had undergone a thorough redevelopment in the late 19th and early 20th centuries. In the Jinjiafang area, we can observe how an undeveloped area in the western suburbs of the walled city was transformed into a high-density residential–commercial urban district. The establishment of the French Concession to the west of Jinjiafang could be a stimulating agent of its booming in the second half of the 19th century. This process started with the move-in of the church and temple, followed with large-scale development of *lilong* neighborhoods.

The dominant land development method, however, is small-scale mixed-used land development, with wealthy people's residences, middle-class townhouses and shophouses all mixed together. Such method of development was unique in the history of Chinese city, and is also different to the foreign settlements of Shanghai, shaping the distinctive townscape of the Shanghai walled city. During World War II, such mixture turned out to be even dense, with many *lilong* houses being changed into workshops, factories, and public facilities.

Methodologically, the study argues for a critical site-based survey in the study of traditional cities and settlements where historical archives are insufficient but the historic townscapes are well preserved. In the Jinjiafang case, we used five different resources of information to detect

the plot pattern. The problem here is, only (1), (4) and (5) are the resources that be generalized to other existing urban fabric in China. Street directory map and boundary stones, though being the most efficient resources in the Jinjiafang case, are very likely not available in other cases. Thus, further study should be conducted to obtain experience on how to use architectural details as clues for land subdivision.

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From Rome to Modernity: Updating of Mediterranean City Centre through Urban Plot Analysis. Urban Renewal in Ciutat Vella, Valencia

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Keywords: urban morphology, historical processes, city transformation, urban pattern.
Conference topic: Theory 1: emergence, relational theories, the social sciences and urban morphology.

Abstract: Ciutat Vella, the current city centre of Valencia, represents its historic old town and the complete city till the 19th century. Initially a Roman settlement by Turia river banks founded in 238 BC, following historic moments extended the city involving Visigoth and Muslim occupations and the Christian re-conquest. Subsequent surrounding belts were formed along these periods and the flood, river centered plain by the Mediterranean coast favored an almost perfect fried-egg extension shape. In the 19th century first extensions of the city over the walls and their demolition promoted the first sanitation works into the walled city. Some great urban renewal in a Haussmannian way were execute in the 19th century – calle de la Paz – and in the 20th century – Avenida del Oeste – as well, updating the old town to modern times. By analyzing the urban plots surface and shape is possible to observe the urban genesis throughout the ages. In addition, the plot conformation made possible the final setting of those two bigger urban interventions among the existing city. In conclusion, Valencia becomes an almost urban prototype of historic urban growth in Northern Mediterranean.

1. Introduction

The principal, ultimate fact to draw the character of Valencia is its geographical location. It lays on the coastal Mediterranean plains in the area, where the periodical river floods created flat lowland to be controlled and rich soils for agricultural production as well. But these areas by the coast were unhealthy due to the existence of wide extensions of marshes and fens unable to be inhabited. That is the reason why the majority of human settlement by the Valencian coast are in fact inland settlements. And, in addition, the inland river banks were chosen for that proposal.

Deepening into the hydrographic system, among the series of rivers coming from de center of the Iberian Peninsula (historic Castille) to the Valencian coast, *Turia* River in the centre and *Xúquer* River a little further to the south are the main water streams in the region. In addition, *Turia* River is on the geometrical bisector of Valencian gulf. So, Valencia, as many of the ancient cities on this coastal strip, were established on the river banks at least 6 km from the coast line.

On the other hand, the historic issues complete Valencia foundation to be understood. According to archaeologist researches there was a strategical reason for the Roman foundation of

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Valentia. The Romans decided to create a disturbing third urban centre in the area, in order to compete with two former Iberian tribal centres in *Arse* (Roman *Saguntum* and current *Sagunt*) and *Leiria* (roman *Edeta* and current *Llíria*). Both of them, continuously fighting for the territory hegemony were stopped in their proposals by the Roman conquerors.

As a brief historical overview, after the Roman foundation in 238 BC Valentia started to grow and became the main centre to the South of the capital city of *Tarraco* (current *Tarragona*) in the *Tarraconensis* Roman province in Hispania. After the Roman Empire fell down, the city was shortly abandoned till the arrival of Northern Visigoth tribes, who re-founded it to become one of the main archdioceses in the East of the Visigoth Kingdom. In 711 the Muslim troops entered the Iberian Peninsula through Gibraltar strait, covering very quickly almost the whole part of it. So, *Valentia* became *Balānsiya* easily, becoming again the main urban centre in the East of Al-Andalus. Finally, the Christian conquest in 1238 was the origin of the creation of the Christian Kingdom of Valencia and the starting point for a forthcoming XIV gold century for the city. In that moment, Valencia became the biggest city in the Iberian Peninsula and the artistic centre of the Crown of Aragon. Thereby, Valencia was the main connection port to Aragon overseas territories in the Mediterranean, specially the Southern half of Italy, and reaching Greece and Aegean islands. The union of Castille and Aragon Crowns in 1492 represents the final point of the city slow decline to its third position into the country.

2. Analysis/Results

Different plot analysis regard the study of their size, their shape, their location into the blocks and, finally, their façade connections to the surrounding public spaces.

The starting point to the analysis treats the study of each one of the historic periods focusing on the plots following the four characteristic points described previously.

2.1. *Roman diverted continuity*

The Roman area of *Ciutat Vella* lays on its North-East quarter, around the cathedral. This is located in the same place where the main mosque of the Muslim city stayed, nearby the former Visigoth cathedral as well.

Beneath the existing city the Roman basements remain uncovered. Just only some parts from the most important buildings were discovered, such as the Circus, the Forum, or even parts of the *Cardō* and *Decumanus* main streets.

When the Roman city was abandoned, a thick layer of demolition materials was formed, blurring the urban alignments and plots. So, after the Visigoth re-foundation, new buildings and streets were drawn over the rubble in a certain reference to the ancient city bellow.

In this area blocks are quite different in size and shape, but there is a certain repeated geometry, proportions and size close to the rectangular series of the former Roman blocks. So, the studied size of the urban pattern draws a hypothetic rectangular block of 40x30 meters. The present blocks as a reflex that pattern bellow cover a range of measures between 90 to 30 meters long by 60 to 20 meters wide. Concerning the plots, the general shape is rectangular, with several variations in length and width, but with the constant presence of the right-angle. However, a repeated set of six plots per block can be observed in several blocks. So, as a synopsis, a prototype of Roman block can be defined as a rectangular shape composed of six plots in two main, long façades series of three buildings.

But, as said before, the Roman city was abandoned, demolished by plundering in pillages to obtain building materials, and finally re-founded on the rubble. An important part of former Roman buildings were reused, but the basements stay still near two meters deep under the present city.

2.2. *Muslim inner heritage*

The Muslim way of building an urban area can be observed in several parts of *Ciutat Vella*. A pattern of narrow, winding streets combined with big, green spaces in the courtyards into the blocks characterized almost a third of the city. In the natural edges by the Muslim walls specially can be observed a Muslim way to create urban space by a series of small irregular squares that articulate the urban pattern of the streets close to the walls.

In opposition to a more or less Roman continued existence that gave to Visigoth city a certain modulation, it is not possible to find a module or series into the formation of the Muslim area. This point reinforces the fact that the Roman city was enlarged by a new urban pattern from scratch: that is the real Muslim evidence. As there is no module into its genesis, there is no range of measures or geometries possible to be found.

In this area there is not a general pattern for block or plot shapes. Old buildings were built by their own, occupying non regular plots, forming blocks by addition of them. Every building had, on the other hand, different, inner free spaces as own courtyards that finally added diversity to the urban pattern. This scheme can be found in the outskirts of the Roman city. Due to such a lack of previous plan or geometry, there is no range of measures for neither the blocks nor the plots, as can be seen in the plan.

Concerning the plot shapes, in the same way than the urban pattern and the blocks, there is no serial sample and every plot is different as well.

2.3. *Christian wide expansion*

After the conquest in 1238 a new great wall surrounding the Muslim city was planned, covering more than the double in surface than the existing city. An ambitious program was developed by drying the Southern, smallest branch of the river in Muslim times to gain a huge new urban area.

The new walled city initially consists of the converted Muslim city extending connections to the main gates of the city walls, defining new streets. The space among these new radial streets and the wall was not occupied at a time. The final vacancy great areas to be filled in were built in the sixties, by replacing small, minor buildings into new residential modern blocks.

Those vacancy spaces were built while the Christian city was built, and show different urban patterns depending on different origins. Those nine main urban patterns –identified by local nearby names- can be described in detail from North-West to South-East following a line into that "Christian crescent" as follows:

1. *Soguers*: This is the first Northernmost area, and one of the latest to be built in a historic grove till 19th century. In that moment, a set of 4 blocks in a grilled street pattern 70 m wide cover that vacancy space with some facilities for the city. Due to their measures they all were provided with large green spaces inside.
2. *Mercedaris*: The next adjacent area to the South lays on the northern side of one of the extended urban axis in the Christian city going out to the West, *carrer de Quart* coming from

carrer dels Cavallers (Knghts' st). This street links Ciutat Vella's heart right to *Portal de Quart*, the second historic gate of Valencia in importance. The first one is *Portal de Serrans*, the northern gate in Muslim times that originated the old *carrer de Serrans*, the fringe street between Roman and Muslim cities going into Ciutat Vella from the North. This area is centered between the neo-gothic church of Mercedian Order from the 19th century and the west slope of the Christian wall. It is the last huge area to be occupied in Ciutat Vella in the 60s: new residential buildings composing huge blocks around 60 x 60 meters were built, in a total of 9 pieces.

3. *Velluters Nord*: Between Portal de Quart and the southern gates the mediaeval quarter of *Velluters* was developed. It was an area well watered by former irrigation ditches what decided the settlement of several craft workshop devoted to velvet (*vellut* in local language). In the northern side of all this area, just near *Portal de Quart* appears an homogeneous urban pattern in a grill seized 60 m long by 30 m wide, in horizontal composition East-West. As it has a mediaeval origin, shapes of both plots and block are not strictly regular.
4. *Velluters Sud*: On the other hand, the southern side of *Barri dels Velluters* is developed following a in a complete different urban pattern than that the adjacent northern one. A grill sized 60 m long by 40 m wide, but this time in a North-South location represents a pattern leading to southern gates of *CiutatVella*.
5. *Eix Boatella*: By the main gate of the Muslim city an outskirts area was settled called *Boatella* from Muslim times. It had a central axis extended progressively to South, creating a sort of long, North-South blocks around 70 m log by 50 m wide. This area fronts to the East to *carrer de Sant Vicent*, the ancient Roma Via Augusta going South. This is one of the longest streets in Valencia, and takes its name from the martyr's path of the saint in Lower Empire Roman times.
6. *Sant Pau*: West of *carrer de Sant Vicent* lays another urban pattern, different to the previous one, with some block 70 m log by 30 m wide in an East-West situation. This area, next to the first enlargement plans in Valencia, *Primer Eixample*, was quite redesigned by building substitutions.
7. *Barri dels Peixcadors*: One of the oldest urban areas of the Christian town was this, the area where several fishermen's houses were located in connection to a water channel linking to the river. This area disappeared in one of the first huge urban transformations of the old town by the beginning of the 20th century. Four great blocks were built in the area where modest, smaller 30x20 m blocks existed. A certain outline of them was extended West and can be observed in still present blocks.
8. *Universitat*: A central area West to the Muslim city is characterized by an urban grill sized 50x30 m East to West location, and some blocks around these measures still stay from the Renaissance ages, when the city had a hard connection to artistic streams throughout its trade links with Italy.
9. *Sant Bult*: The Easternmost area between Muslim and Christian walls corresponds to a suburb out of the Muslim city, renamed after the conquest as *Barri de Sant Bult*. A higher spontaneous urban pattern from mediaeval times shows some blocks 70x25 m in both North-South and East-West situations.

As described above, those nine different urban patterns completed the Christian city, the final extension of Valencia Old Town till the 19th century. On the other hand, along this century arrived to Valencia the increasing streams of urban refurbishments following Haussmann works in Paris.

The increasing population in the city by the 19th century changed the living conditions into the walled area. Even though the street pattern lasted over time, the buildings started to be replaced by taller ones in storeys and deeper ones into the block. These changes produced an overcrowded built reality where living conditions on sunlighting and ventilation were gradually worst.

In parallel to sanitation and public health reasons, urban refurbishments into city centres were an indispensable condition for the cities to have an approval in their extensions plans in Spain, or *Planes de Ensanche*. As in many other cases, the plans to enlarge the city of Valencia over the walls had to include refurbishment plans for its inner city.

There are two main interventions covering the whole period of reforms into the city. Those are the opening of *calle de la Paz* in the 19th century, and *avinguda de l'Oest* in the mid of 20th century. Both them follow Haussmann criteria of intervention by opening hard lines throughout the existing city. Those plans were possible due to the geometry of the existing plots and blocks built in the city through centuries, as seen before. Thus, an analysis of the urban genesis in both interventions shed light on the importance of the existing city and the geometry of former blocks and plots. In addition, the listed buildings in both areas are the ultimate reality to support the planned lines.

In a detailed comparison of both interventions, as shown in the figure, the historic areas of old town are completely recognizable. The 19th century intervention –*calle de la Paz*- was open on the fringe area between Roman and Muslim cities, and the sizes of the blocks and the existence of listed buildings talk about the high heritage level in the area. And in the other case, the 20th century intervention -*avinguda de l'Oest*- was initially opened but never completed as the whole plan established crossing the entire city. In addition, the greater sizes of the blocks and

Figure 1.

Figure 2.

the lower number of listed buildings talk about a newer area into city centre than the other one. Its characteristics describe the mediaeval urban pattern built in *Barri dels Velluters* into the Christian city.

3. Conclusion

After this general overview focusing on the main cases of urban morphological genesis in Valencia *Ciutat Vella* and the main interventions on urban renewal, two clarifying conclusions appear as a summary. The first, basic conclusion is the fact that attending the study of plots and their aggrupation into blocks the evidence of the city formation into historical periods can be heavily recognized.

On the second hand, the case of Valencia represents a near centric circles scheme built throughout the history in a "fried-egg scheme". Into this concept, the Roman city settlement is the central egg yolk, the Muslim embracing ring around it is the egg-white side and the final bigger Christian crescent city and walls are the outermost perimeter side of this *fried-egg* scheme.

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Unpredictable Predictabilities: a New Town Development in Taiwan

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Keywords: Urban morphology, new town development, land consolidation, plot, building type.

Abstract: In the post-war era, to alleviate drastically-increased population in the metropolitan area in Taiwan, Linkou, the first new town planned by Urban and Housing Development Committee (UHDC), is served as a paradigm of modern urban planning and conducted through the approach of land readjustment. Decades passed, however, the gap between post-war planning and the physical environment has formed excursive townscape in the new town.
In this study, according to land conditions in Taiwan, building lots are recognised as one of the plan elements additionally besides town-plan analysis and the compositional hierarchy of built form, which are applied to assessment. Results show that over-subdivided plots caused another reorganisation in only two years after land readjustment. Moreover, high-intensity apartments accounted for 40% among all building types, creating unexpected forms under the TOD concept. By identifying plan units in Linkou new town, this study makes a clear picture that land readjustment emphasises neither the relation of streets, plots and buildings, nor the lack of appropriate development strategies under socio-economic conditions. Thus, it helps to explain indistinct correspondences between elements, which adds unpredictable variations to the supposedly predictable planning, and the gap between post-war planning and the physical environment.

1. Introduction

Planned cities are based on strong demand for specific backgrounds and contexts. For example, the garden city, launched around 1900 by Sir Ebenezer Howard, is built in response to urban problems caused by industrialisation in the 19th century and this ideal type of new-planned community were then manifested at Letchworth and Welwyn in the UK (Howard, 1902; Hall, 2000). The concept of the garden city has also been widely adopted around the world and continuously stimulated the development of new towns. Specifically, the term, new town, often refers to planned towns built after World War II under the New Towns Act 1946 in the UK. Following World War II, 28 projected new towns were developed partly to house a large number of people whose homes had been destroyed by bombing during the war and partly to move some population out of urban slums.

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Modern urban planning theories and practices can hardly be separated from urban issues caused by industrialisation and urbanisation in the 19th century. Cases in Taiwan are no exceptions. Linkou new town, the first projected new town by UHDC, is planned to create a multi-functional community with employment, culture, education and residence. It is served as a paradigm of modern urban planning to alleviate the drastically-increased population in Taipei metropolitan area, which led to issues of crowded living spaces, soaring housing prices and inadequate public facilities in the 1950s and 1960s.

Linkou new town is conducted through "land readjustment", which the whole process from initiative to planning and implementation is taken care of by the local authorities, and served as a solution to transform the structure of boundaries and facilities within the chosen area (Larsson, 1997). The tool of urban development enables the assembly of privately-owned land, as well as the delivery of necessary infrastructure and services.

However, soon after replotting, Linkou new town faced the challenge of unexpected developments against the original planning. The lack of connections and legal regulations between plots, building lots and building types caused unpredictable predictabilities in the new town development. Outcomes of the land adjustment did not seem to meet needs of new town developments. Plots tend to be over-subdivided. Thus, finely-divided plots need consolidations to conduct planned unit developments (PUD) under the market mechanism. Jointly, building types were mixed and diverse, resulting in an incremental volume of roads and inadequate public facilities. Nearly 30% of plots were reorganised in only two years after the land readjustment was done. Phenomena demonstrate that the land readjustment only sticks to the reorganisation of plots without appropriate development strategies. Hence, unclear correspondences between plots, building lots and building types could lead to the excursive townscape, underestimated infrastructure capacity and delayed periods.

With the objective to clarify the unpredictable predictabilities between planning and practices, this study takes the new town conducted through land readjustment as a case, which simplifies difficult conditions of plots and forms suitable building lots supposedly and enables us to focus on the relation between plots, building lots and building types in the physical environment under relatively pure circumstances.

2. Methodology

To assess physical forms of urban areas, streets, plots and buildings are served as principal elements of the built form (Conzen, 1985; Oliveira, 2014). These complexes of plan elements are related to each other in a compositional hierarchy (Kropf, 2009), providing a consistent framework for comparison of different aspects of urban form (Kropf, 2014), and distinct combinations of elements are identified as plan units (Conzen, 1960).

In accordance with the unique condition in Taiwan, despite plots and buildings, building lots are another factor that should be taken into consideration in the process of identifying plan units. Building lots are regulated by the land use control and zoning under urban planning and limited by the land condition which is given by reorganized plots; what is more, they are also the basic units for constructions including the building itself and open spaces. Therefore, it can be referred that a building lot is a significant joint in the construction process to carry out building patterns in the physical environment. Finally, this study applies the systematic analysis of constituent elements and revised with the real condition in Taiwan to deconstruct

the relation of built form in Linkou new town. Plan elements include plots, building lots and building types (see Table 1).

2.1. *The classification of plots*

By means of the land readjustment, each plot should be divided into a suitable size and shape, which is defined by boundaries of streets and ownerships (Slater, 1981). However, in Linkou new town, the plot subdivision seems to base on the share of landowners but lacking of correspondence to the overall good of physical environments. Therefore, plot patterns usually go against the need of building patterns, including building types and building lots, causing additional and unexpected transformation for undesirable plot patterns after the land readjustment.

In this study, several cases of plot pattern changes were documented in the cadastral data of Linkou new town. Conditions include single land subdivision, single land consolidation and multiple times of land subdivision/ consolidation, in order to maximise the benefits of constructions (See Figure 1).

2.2. *The classification of building lots*

Building lots are the basic units in the construction process in Taiwan. Since there is no particular legal compulsory in "one plot must be equivalent to one single building lots", landowners can specify several plots or part of single plot as a building lot without any additional registration for plot pattern changes. As a result, further information of how building lots are composed of is judged by the number of plots and the areas which are documented in approved building permits.

Types of building lots in Linkou new town can be divided into two categories, including building lots with a single plot or with over two plots (See Figure 2).

2.3. *The classification of building types*

The land readjustment areas in Linkou new town are all covered by an urban planning, which achieves its planning objectives by way of the land use control and zoning with its permissions and restrictions toward building types. Building types are mainly defined as the planning form of residential buildings (Rossi, 1966). In Linkou new town, residential buildings types can be divided into four categories by the number of households and floors, including detached houses (for single family), semi-detached houses (for double-dwelling family), terrace house, and apartments.

Table 1. *The meaning of plan elements used in this study.*

Plan elements	Meaning
Plot	The basic unit of land use, which is defined by plot boundaries to separate land ownerships.
Building lot	The area which a building construction is permitted and it is mainly composed of buildings and external areas.
Building type	The most obvious character in a building lot and the main component of a city. It usually refers to the basic of the physical built environment.

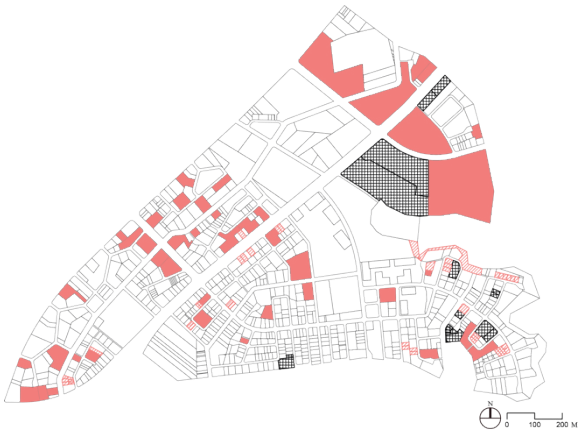
In this study, a detached house is a free-standing residential building for a single family. A semi-detached house is a single family dwelling house built as one of a pair that share one common wall. Terrace house and apartments are both with more than three residential units. Apartments can be further catagorised into three subtypes, including apartments below 5 floors, apartments between 6 to 15 floors and apartments above 16 floors, which are based on the Building Act in Taiwan (see Figure 3).

3. Analysis

3.1. *Cross-comparison of plot patterns and building lot patterns*

In the case of changing plot patterns, land consolidations and subdivisions are meant for reorganising the abnormal conditions and forms of building lot patterns in order to enhance the land use value and to maximise benefits of constructions. By cross-analysing the relationship between changes of plot patterns and the composition of building lots, morphologically different types of plan units can be identified. The plan unit layout helps to conclude how the flexibility between these two plan elements affects the following decisions of which building type should be built.

According to Table. 4, 71.43% of plots maintain its replotted form after the land readjustment and provide suitable building lots. However, there are still 9.69% of plots going through

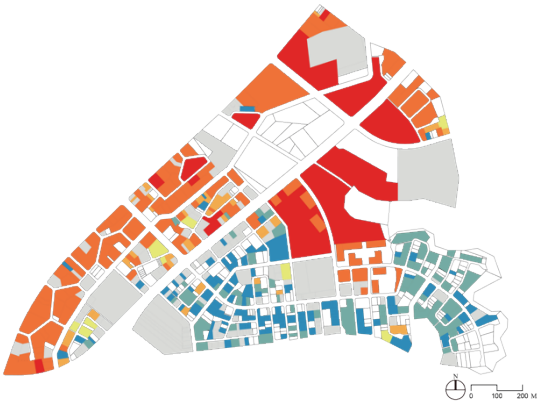


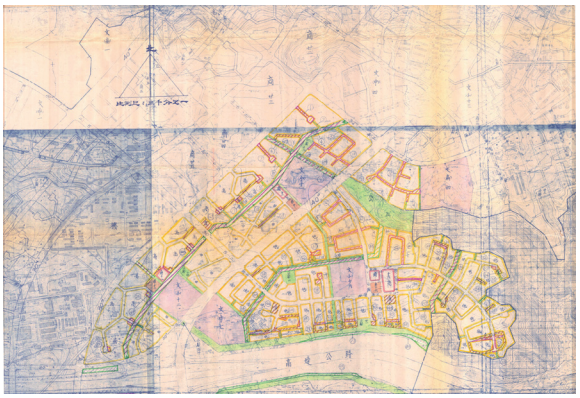
Coding	Plots pattern	Demonstration
P0	Plot: original status	
P1	Plot: single land consolidation	
P2	Plot: single land subdivision	
P3	Plot: multiple times of land changes	

Coding	building lots pattern	Demonstration
BL1	Building lot: composed of a single plot	
BL2	Building lot: composed of over two plots	

Figure 1. *Plot patterns in Linkou new town after the land readjustment.*

Figure 2. *Building lot patterns in Linkou new town after the land readjustment.*





Coding	Building types	Coding	Building types	Zoning	Building coverage ratio/ Floor area ratio	Allowed land uses and building types
B1	Detached house	B4	Apartment below 5 floors	First residential district	40% / 120%	Detached houses, semi-detached houses
B2	Semi-detached house	B5	Apartment between 6 to 15 floors	Second residential district	50% / 150%	Detached house, semi-detached houses, terrace houses and apartments
B3	Terrace house	B6	Apartment above 16 floors	Fifth residential district	60% / 300%	

Figure 3. *Building types in Linkou new town after the land readjustment.*

Figure 4. *Zonings in Linkou new town after the land readjustment.*

single land consolidation to compose a fine building lot(P1-BL1), and 7.02% of plots maintain their status but proving a building lot with over two plots(P0-BL2, 29 plots compose 14 building lots). Both these two types of relationship make similar effects on optimising building lots by receiving a larger area or a better condition (see Table 2 and Figure 5).

Among various relationships between the two plan elements, the most complicated situation is that 2.18% of plots, which underwent multiple times of land changes, still provide a building lot with over two plots. After the complicated reorganising process, the former plot pattern and condition have been evidently improved, and so the land value is raised to benefit development profits. Most of which are established as apartments between 6 to 15 floors, above 16 floors, or even high living-density communities.

Through the implementation of land readjustment, the immediate impact on the composition of building lots lies in the environmental factors such as the area, forms and other conditions of plot patterns. Since urban planning in Taiwan lacks considerations toward spatial construction patterns, building lots which are formed by original plots, tend not to meet the maximised profits. Therefore, the additional process of reorganising plots is even more necessary after the land readjustment. Furthermore, the flexible composing relationship between plots and building lots may also delay the construction period or cause uncertainty in building types and living density, weakening the control of the total amount of development under urban planning.

Table 2. *Statistics of cross-comparising plot patterns and building lot patterns in Linkou new town.*

Type	P0				P1			
	Number	%	Area(m²)	%	Number	%	Area(m²)	%
BL1	295	71.43%	394,196	64.11%	4	9.69%	150,916	24.54%
BL2	29	7.02%	13,668	2.22%	-	-	-	-
Total	324	78.45%	407,864	66.33%	40	9.69%	150,916	24.54%
Type	P2				P3			
	Number	%	Area(m²)	%	Number	%	Area(m²)	%
BL1	13	4.84%	5,218	0.85%	7	1.69%	42,842	6.97%
BL2	13	3.15%	2,892	0.47%	9	2.18%	5,140	0.84%
Total	26	7.99%	8,110	1.32%	16	3.87%	47,982	7.81%

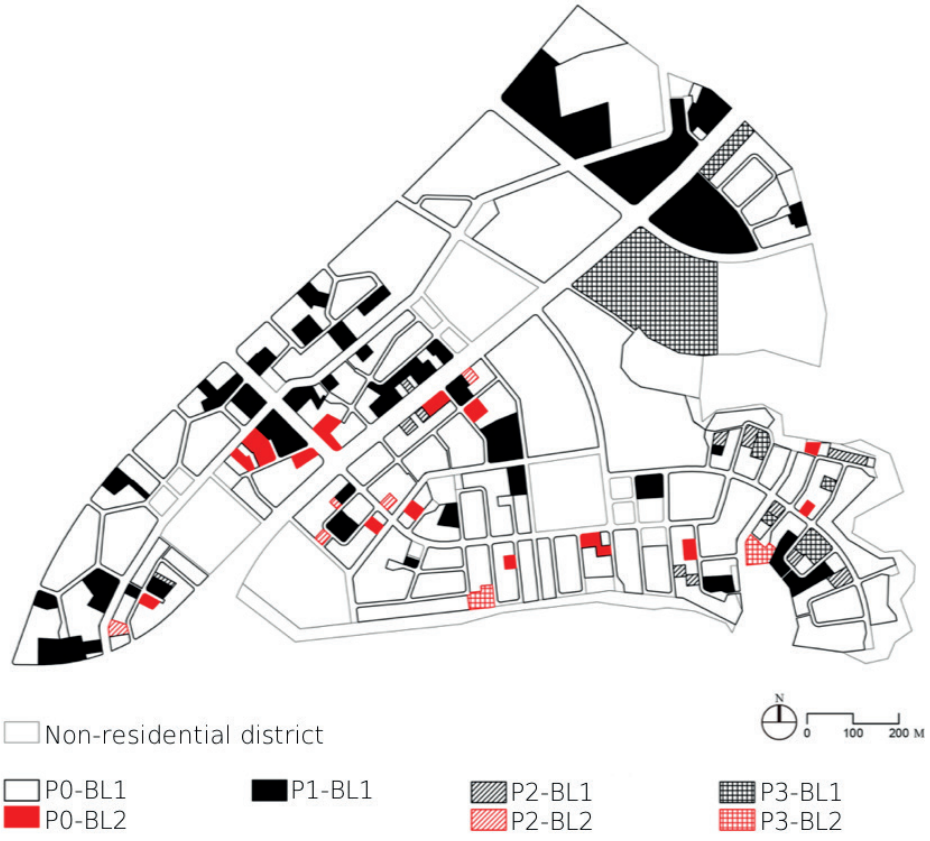


Figure 5. *Plan units of cross-comparising plot patterns and building lot patterns in Linkou new town*

4. Cross-comparison of building lots and building types

Building lots are with different land values, according to patterns and conditions of plots, and thus affecting developers' decisions in building types of pursuing maximised profits. Therefore, through cross-analysing relationships between the formation of building lots and the chosen of building types, this study is able to generalise inductive interactions between the plan elements by identifying plan units un the selected areas.

4.1. *High living-density community*

There are 49 plots of residential use (accounting for 36.23% of plots of residential use in Linkou new town) in the high living-density community. The building lots are mostly large and with an average area of approximately 3,900 square meters and a maximum area of 39,708 square meters. The community is also adjacent to the main road, and thus, the above mentioned great conditions of the land should possess great value for high-intensity development.

Building types in this community are mainly apartments above 16 floors (accounting for 44.53% in this area) and apartments between 6 to 15 floors (accounting for 38.28% in this area), including the Linkou public housing and the Linkou Universiade athletes' village, which converts into social housings after the game.

Although large-scale public housing projects are planned to carry out on the north at the planning stage of Linkou new town, it is merely limited to the street patterns instead of forms of plot patterns in response to the development. Therefore, excessive plot subdivisions make it even harder to implement the original building plan or to trigger the advance of planning and constructions. The construction period has been pushed back, causing limited public housing supply, not to mention the establishment of green spaces and public facilities.

Half of the current developments require reshaping of plots to provide suitable building lots. It can still be easily recognised that in the large blocks with no building constructions, plot patterns are abnormally chaotic and uneven (see Figure 6(a)) that may cause difficulty in constructions in the future.

4.2. *Medium living-density community*

Comparing with the high living-density community, there are 137 plots of residential use in this area (accounting for 32.31% of plots of residential use in Linkou new town) in the medium living-density community. Building lots are mostly in small and medium sizes with an average area of 1,363 square meters. Building types are mainly apartments above 10 floors (accounting for 39.21% in this area) and terrace houses (accounting for 26.26% in this area). Besides, most of them located in the first and second rows nearby the secondary road on the west side of the community.

If the intensity of building types is differentiated in accordance with the road level, building patterns should decreases inwardly in order by rows, so as to form a townscape with apparent levels and different functions. In fact, there are hardly any differences in building types of the first and second rows nearby roads. What makes it even worse is that large-scale and high living-density building types occur in the inner blocks, which increase the externalities toward the capacity of public facilities and cause spatial order confusion of land-use intensity (see Figure 6(b) (c) (d)).

Furthermore, there is a lack of consideration of how plots, building lots and building types are coordinated in the planning process of land readjustment. Consequently, the form of plots along main roads are relatively over-subdivided and can barely meet spatial requirements for high living-density building types. In order to make the best of profits, developers were forced to reshaping the plots additionally to provide suitable building lots for planned unit developments (see Figure 6(e) (f)).

4.3. *Low living-density community*

According to the land use control and zoning in the low living-density community, only low-intensity building types such as detached houses, semi-detached houses, terrace houses and apartments below 3 floors are allowed to be built in this area. With the urban design of cul-de-sac and curved streets, garden city alike communities are formed and in attempts to segregate pedestrians and local traffic from through traffic. Thus, building lots with an average area of 825.7 square meters are capable enough.

Although forbiddenness of high-rise buildings are carried out in this area, by providing a building lot of several plots, dozens of detached houses or semi-detached houses can be built in a single large building lot, causing households to significantly increase (see Figure 4(g)(h)(i)).

In addition, the building type, which building lots are composed of more than two plots, is mostly semi-detached houses (accounting for 4.08% in this area) to manage to the separated ownership. However, it again reveals that there was less concern about the connection between plot subdivisions and the ownership of building types when making plans so that land changes would be needed even after the land readjustments.

5. Conclusion

Land readjustment is a tool of comprehensive urban development with an aim to promote land uses and improve living qualities in the area (Hong & Needham, 2007). At the same time, regulations towards building types are established to control the townscape and the quality of constructions effectively.

However, through the case of Linkou new town, it is clear that merely did the current land readjustment limit to the rearrangement of plots, giving unnoticeable concern about regulating diverse relations between plots and building lots which directly affect how developers make decisions on building types, and leaves uncertainty and unpredictability in the physical environment. According to the result of this study (see Figure 7), most of the plots maintain original status and provide as building lots directly (P0-BL1), of which are mostly detached houses (P0-BL1-B1) and semi-detached houses (P0-BL1-B2) of low land-use intensity. Those plan units are the primary way of assembling plan elements and the ideal built form of realising urban

Table 3. *Statistics of cross-comparising building lot patterns and building types in Linkou new town.*

Type	P0-BL1		P1-BL1 / P2-BL1		P3-BL1		P0-BL2		P2-BL2		P3-BL2	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
B1	166	15.09%	64	5.82%	3	0.27%	7	0.64%	6	0.55%	1	0.09%
B2	294	26.73%	66	6.00%	42	3.82%	12	1.09%	4	0.36%	28	2.55%
B3	33	3.00%	60	5.45%	-	-	-	-	-	-		
B4	53	4.82%	4	0.36%	-	-	2	0.18%	-	-	-	-
B5	139	12.64%	46	4.18%	1	0.09%	13	1.18%	-	-	-	-
B6	19	1.73%	26	2.36%	11	1.00%	-	-	-	-	-	-

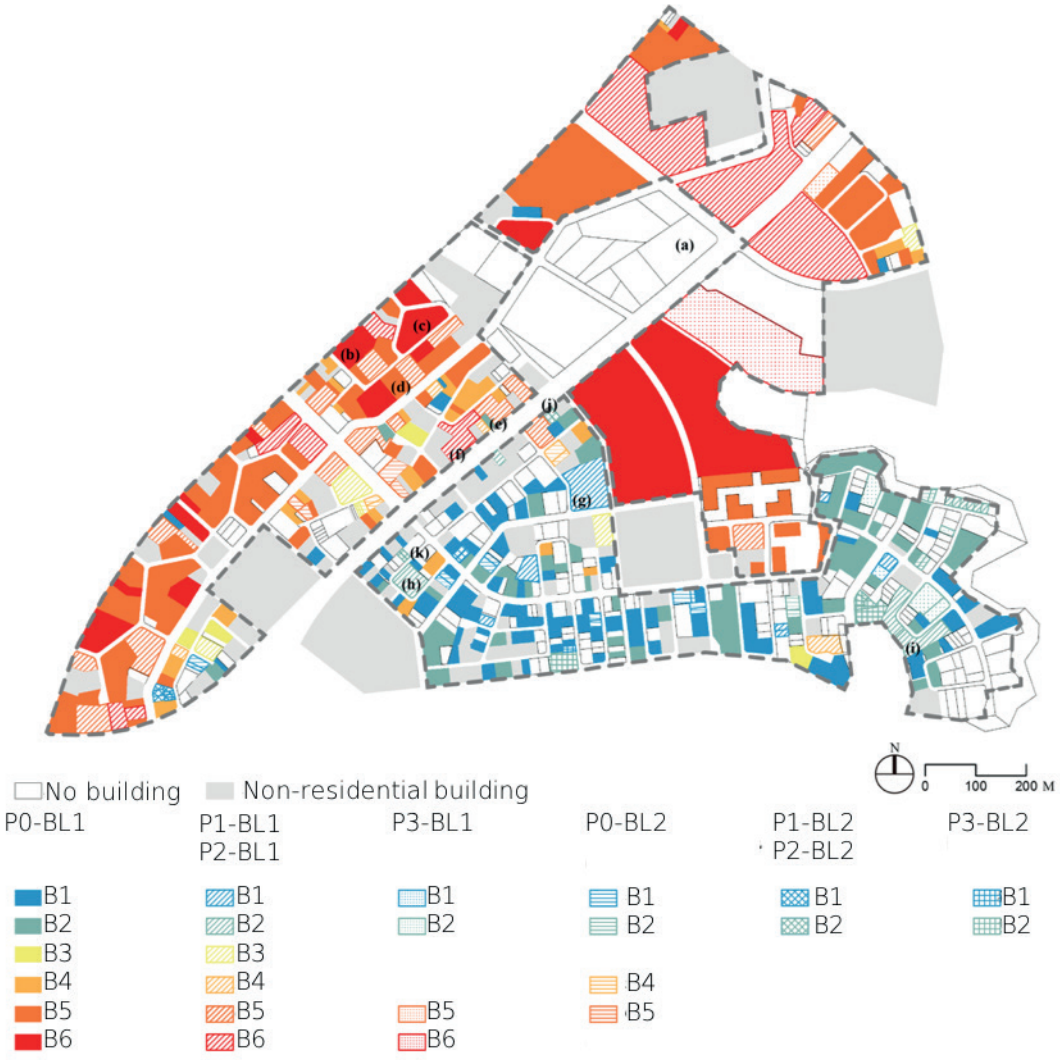


Figure 6. *Plan units of cross-comparising building lot patterns and building types in Linkou new town.*

planning in the physical environment. In this case, the relationship between plots, building lots and building types are well-connected and considered to form a city which is predicted and expected under planning.

However, there are unpredictable plan units constructed of variant plot patterns and building lot patterns; and thus, providing building types exceeding expectations. Among those cases, the most obvious one is the formation of "P0-BL2-B2" and "P0-BL2-B5", which stick to its status but changing the original land condition by composing a building lot of more than two plots, making the building type of apartments between 6 to 15 floors even possible. It shows that human interference may breakthrough limits of over-subdivided plots and other land conditions to make better sites for constructions which are not likely to happen in the original plan.

Another issue worthy of discussion is how suitable building lot conditions can be planned to satisfy the building patterns of which are planned. Cases of "P0-BL2-B2", "P1-BL1-B1", "P2-BL1-B2", "P2-BL2-B1", "P2-BL2-B2", "P3-BL1-B1", "P3-BL1-B2" and "P3-BL2-B2" all generate detached houses and semi-detached houses, and yet, additional processes were implemented due to the gap between planning and practices, causing serious negligence in townscape disorder.

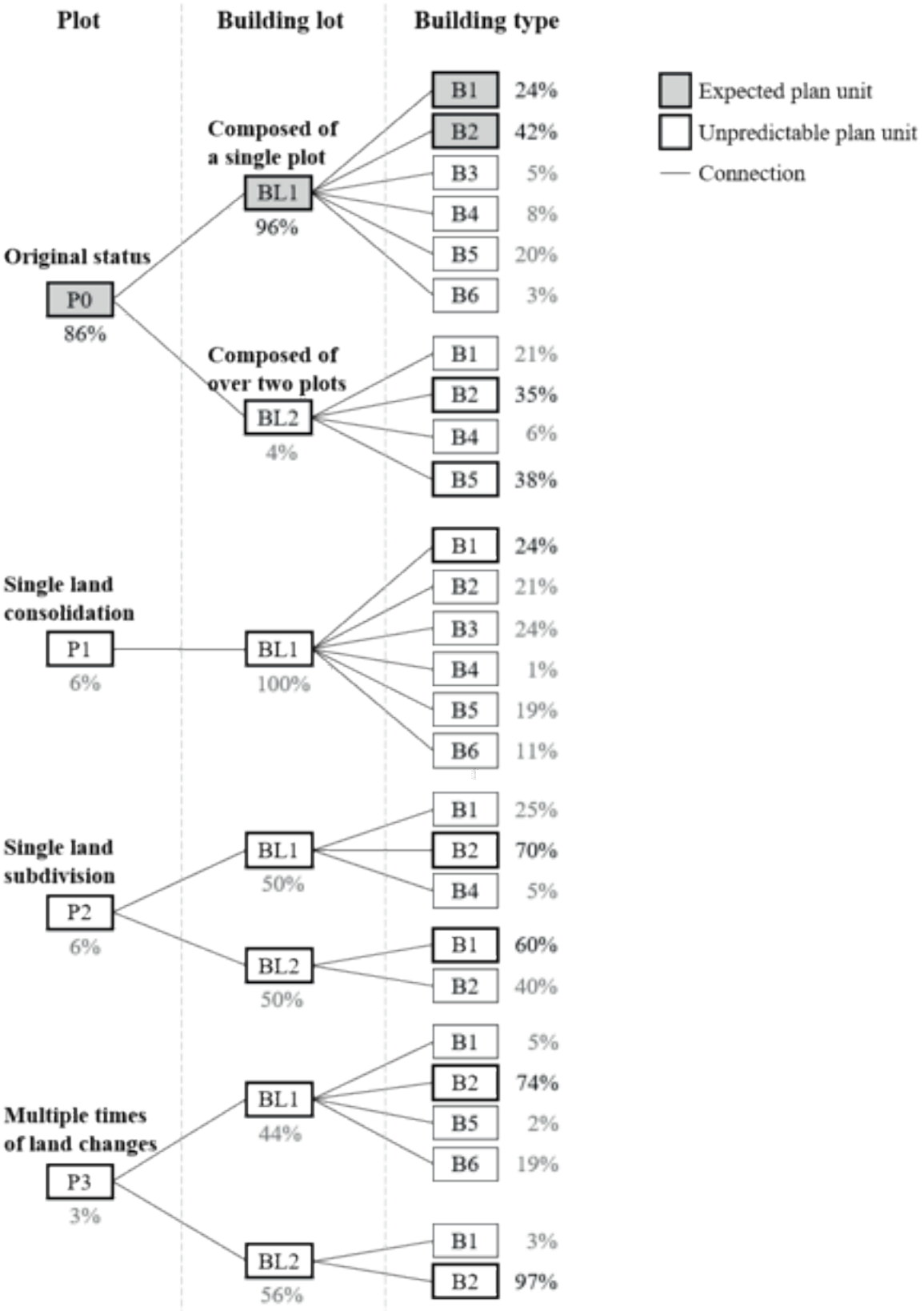


Figure 7. *The process of forming plan units in Linkou new town.*

Eventually, unpredicted and increased land-use intensity may result in an underestimation in the capacity of public facilities, delay in construction periods, obstruction in the townscape, etc., leaving urban planning disconnecting the built environment. The above situations demonstrate that when there is no single, linear, regulated correspondences between the plan elements, un-predictabilities in the procedure of replotting may cause undesirable townscape. In conclusion, in Taiwan, whether the townscape follows urban planning, the strong-bound relation between plots, building lots and building types are one of the major factors must be taken into consideration during planning with an aim to eliminate the gap between ideal planning theories and physical built environments.

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A Study on Effective Utilization Evaluation of Greenery for River Landscape

Using Semantic Segmentation Method for Extracting Landscape Elements

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Keywords: River Landscape, Physical/Psychology Evaluation, GIS, Semantic Segmentation, Deep Learning

Abstract: River landscape always play an important role in urban environment and human's daily life. In order to understand river landscape better and create its values, we need powerful tools to help for evaluating present river landscape and predicting changes on landscape by urban renewal activities in future.

In this study, at first, we use Semantic Segmentation (SS) method to recognize the occupancy ratio of buildings (OB) and visible green elements (OG) of over 300 locations of the whole Ota-river basin and discuss its relationship with urban form in Hiroshima. Then we focus on the shielding relationship between greenery and buildings. As a further discussion, the values of OB and OG are calculated, using 48 landscapes extracted from over 300 locations. Also, the ratio of invisible buildings area shielded by greenery (IBsG), as a new proposing of physical evaluation, is calculated using a simulation based on GIS data of the same 48 landscapes. Then IBsG is compared with OB and OG, for discussing the effective utilization of greenery, and suggesting a possibility to improve better river landscape in a more economical way in urban planning.

1. Introduction

Human beings are always closely associated with the river from of old. Especially nowadays, since the river is being considered as one of the most important elements of the natural landscape in the urban area with high artificial density, its new values are getting attention, for instance, not only providing the public with amenity of waterside entertainment space, but also solving social problems, including emotional purification function and so on. In order to understand river landscape better and create its values, we need powerful tools to help for evaluating present river landscape and predicting changes on landscape by urban renewal activities, for managing and planning river landscape, and for monitoring and assessing the effects of change on the landscape in future.

In the process of urban development and urbanization, the landscape of the river has changed greatly. Along with these changes, the impressions of the surrounding residents on the river

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landscape are also changing. In other words, the impact caused by surrounding land use, urban planning regulations, development status, etc. on the "psychological evaluation" of river landscape is not paltry.

During our previous studies[1–3], we have established effective references among urban planning (Up), physical evaluation (PHe) and psychological evaluation (PSe). Particularly, the function of physical quantitative indexes (PHqi) serving as bridges to connect the PSe with Up, has been recognized. We also discussed deficiency about certain indexes of urban planning. Therefore, we tried to define new PHqi to provide a quantitative basis for urban planning.

Also, according to the past studies[1–3], we confirmed that the occupancy ratio of artificial landscape elements (OA) and the occupancy ratio of visible green elements (OG) as physical quantities, play decisive roles in the psychological evaluation of the landscape.

In addition, as a result of the progress of convolutional neural networks and deep learning methods since 2012, it has become easier to recognize the area of a segment from an image.

On the basis we mentioned above, in this study, at first, we use Semantic Segmentation (SS) method to recognize the occupancy ratio of buildings (OB) and visible green elements (OG) of over 300 locations of the whole Ota-river basin. Also, we predict the overall distribution of landscape evaluation and discuss its relationship with urban form in Hiroshima.

Then we focus on the shielding relationship between greenery and buildings. As a further discussion, the values of OB and OG are calculated, using 48 landscapes extracted from over 300 locations. Also, the ratio of invisible building area shielded by greenery (IBsG), as a new proposing of physical evaluation, is calculated using a simulation based on GIS data of the same 48 landscapes. Then IBsG is compared with OB and OG, for discussing the effective utilization of greenery, and suggesting a possibility to improve better river landscape in a more economical way in urban planning.

2. Analysis of the Ota River Basin by Semantic Segmentation (SS) Method

2.1. *Study Subjects: Photographs of river landscape*

Landscape views toward-bank of the 5 branches (except the Otagawa flood control way) of Ota river (Figure 1), which is running through the urban area of Hiroshima city, were photographed on August 11th, 13th, and 14th, 2016. Each photograph had been set as a 60° field of view, totally,

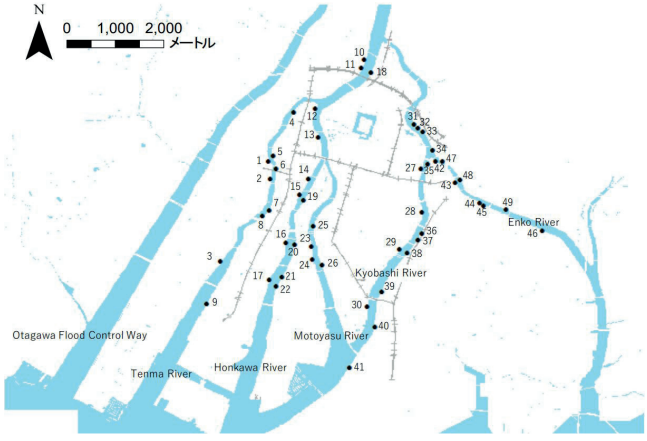

Figure 1. *Locations of Ota River Landscape Samples*

255 photographs were taken for covering the entire basin with, since some locations can not get close enough or the sight have been shielded by grasses.

Hereinafter, Tenma river is numbered as river no.2, Honkawa river as river no.3, Motoyasu river as river no.4, Kyobashi river as river no.5 and Enko river as river no.6. The shooting points is divided into left and right by river current. (For example, following the current direction of Tenma river, those points which located at right side will be short for R2, left side will be short as L2.)

2.2. *Methodology*

The deep learning method makes it possible to execute a series of flows (end-to-end) from the input of river landscape image to detect the region of interest (abbreviate ROI). The parameters can be optimized by transfer learning on the basis of pre-trained convolutional deep neural networks. Once deep learning is done, it can be used as a predictor to image segmentation for other images excluding the training images. The SS method includes a method of creating a neural network from scratch and a transfer learning method with a limited number of images on the pre-trained network. In this paper, we use a SS method by transfer learning. Semantic segmentation methods include FCN-Alex (23 layers), FCN-VGG 16 (47 layers) [Long 2015], and SegNet-VGG 16 (91 layers) [Badrinarayanan 2016]. In the cases of the river landscape used this study, the average ratio of the ROI for a building / green area is about 10 to 12%. The region of the building is not uniform in color or surface texture and has heterogenous features in each building. The green region represents trees lined along the river, lawns and plants on the riverbed, and mountains region that look like a distant view, and has homogeneous features.

Assuming the network structure is too deep that an overly complex representation is set, it could cause the parameter space becomes too large, and then the computation for optimization takes extra time.

In this paper, we use a SS method based on the FCN-AlexNet, which has fully convolutional network [Long 2015]. We propose a method to extract three classes of regions, including buildings and greens that affect psychological evaluation, and also including the background, means other physical elements of river landscape except buildings and greens.

If it is possible to construct a predictor for SS by deep learning of river landscape, recognition of building/green region becomes possible regarding with other images excluding training ones, and the ratio of each class can be calculated automatically in pixel units.

Fig.ure 2. *Image of Semantic Segmentation (SS) Method.*

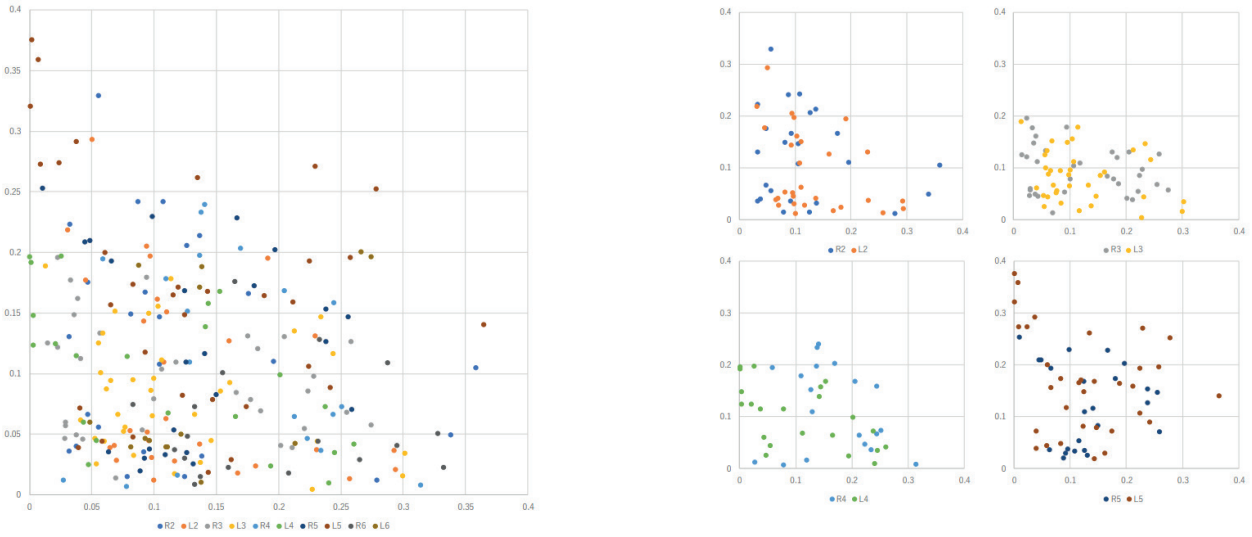

Figure 3. *Plot of OB and OG of Ota river.*

2.3. *Discussion*

The following Figure 3 shows the results of SS automatic recognition results of 255 photos of the entire Ota River and examples of four rivers respectively. The horizontal axis is OB and the vertical axis is OG. It can be seen from the distribution that the buildings are distributed in the interval of 0-40% (mainly distributed in 0-30%), while the green distribution is in the interval of 0-60% (mainly distributed in 0-25%, only two samples which distributed in 40%-60% has been omitted).

Almost all samples were distributed in the lower left area of the (0,40%) -(40%, 0) diagonal line, for those photos were carried out with the revetment as the center line. The lower half of photos are revetment and water surface, the upper half of photos are sky, buildings, green, and other elements that total up to 50% each. Therefore, in general, the area of buildings and greens does not exceed 40%. In the case of no.2, Tenma river, shows clearly that samples are evenly distributed within the (0,40%) -(40%, 0) line. Specifically, when the river is narrower, samples' distribution is close to (0,40%) -(40%, 0) line; when the river is wider, the samples' distribution is close to the origin. When the river passes through the center of Hiroshima City, the distribution of the samples is located at the lower right area of the (0,0) -(40%,40%) line; in the upper part of the river, the distribution of the samples is located at the upper left area of (0,0) -(40%,40%) line. In the case of no.5, Kyobashi river shows a similar trend except those samples located nearing the Shukkeien garden area, for the green area is particularly large so that buildings are completely shielded by greens, so the distribution of samples is close to (0, 40%) point or even exceeds it. Also, samples located nearing the Hiroshima station area, due to the high-rise slab constructions and greens both are abundant, the distribution of samples is exceeding (0, 40%) -(40%, 0) line, and total up even close to 50%. On the other hand, no.3 Honkawa and no.4 Motoyasu, also can be seen that each river shows different trend, for they pass through the CBD of Hiroshima City, the over amount of buildings and lack of greens, samples mainly distributed in the range of (OB=30%) *(OG=20%).

2.4. *Investigation of Results*

In this section, we will further verify the results of the automatic identification. According to the results of the cluster analysis based on the amount of buildings area and the amount of visible greenery area, it can be divided into 9 groups and then, 48 scenes were selected from each group as study subjects. Figure 1 shows the shooting locations of the selected landscape scenes.

The relationship between the automatic recognition result of the selected 48 samples and the result of the manual calculation of PHe is shown in a) and b) of Figure 4.

It is shown that the correlation coefficient between the automatic recognition result and the manual calculation result is very high. However, since the slope of the two regression lines is k = 1.0922 for green and k = 1.0402 for buildings, the physical evaluation value is on average larger than the value obtained by the SS method. From this it can be inferred that there are some areas that are not recognized. For example, in the case of green, landscapes 25, 31, 32, 33, and 35; and in the case of buildings, landscapes 4, 19, 41, etc. show a significant trend.

An example of the building and green recognition results obtained by the SS method is shown in Figure 5. Referring to these figures, unrecognized buildings are mainly parts seen from the gaps of trees, which the colors are similar to other elements, such as revetment and sky. In addition, unrecognized green is mainly because of the influence of light and shadow, for example dark shrubs with very low brightness as green, or conversely, the lawn with lighter color than normal green.

On the other hand, in the case of a building, the landscapes 34 and 35 show opposite trends, which is because elements outside the building are misidentified as buildings.

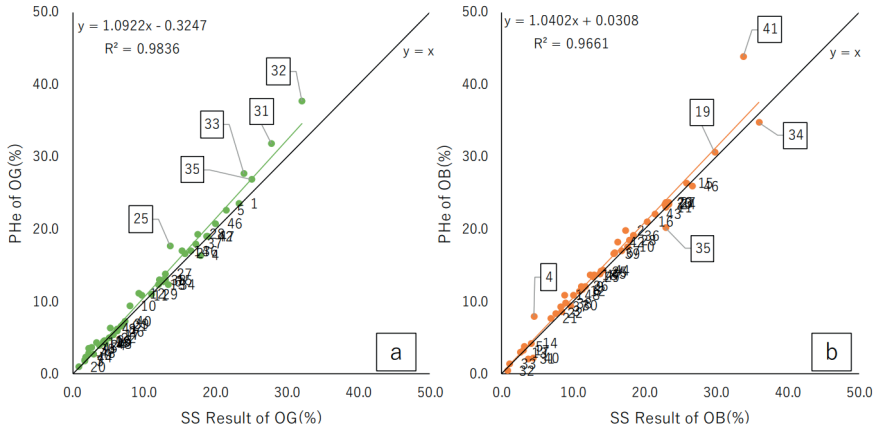

Figure 4. *SS Recognition Result of Selected 48 Samples.*

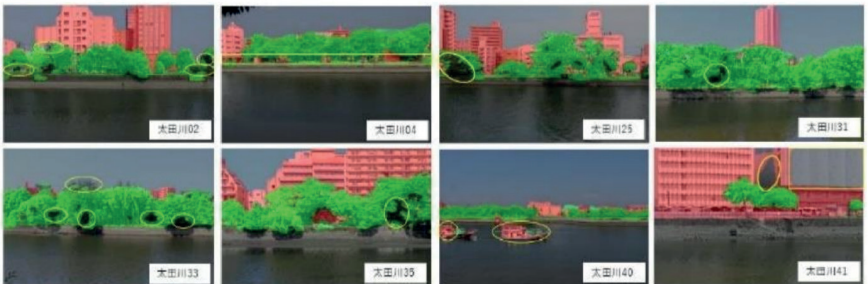

Figure 5. *Examples of SS Recognition Result.*

3. Discussion of Relationships between PHe and PSe

3.1. *Methodology to Obatin PSe*

For PSe, the psychological experiment using these scenes was conducted by 47 students of architecture major of Hiroshima University in June 2017. The questionnaire included a total of 18 items, which divided into individual evaluation items and comprehensive evaluation items. In this study, the items Q1. the amount of greenery and Q2. the amount of buildings as individual evaluations, and Q18. satisfaction as a comprehensive evaluation was selected for discussing.

3.2. *Methodology to Calculate PHe*

For PHe, the values of occupancy ratio of landscape elements were applied as PHqi of scenes. In the procedure of the calculation[1) 2)], firstly we allocated the whole scene to 6 kinds of landscape elements, such as Greenery (shrubs and trees) and Buildings, then we analyzed the landscape by calculating the proportion of each element area to the area of entire scene by Auto-CAD software.

3.3. *Discussion of Relationships with Greenery, Buildings and Satisfaction*

The results of PSe items Q1, Q2 and Q18 are shown in Figure 6. It is divided into 4 areas by line Q1=3 and Q2=3. Scenes located in area A have rich amount of greenery and poor amount of buildings, scenes located in area B have rich amount of both greenery and buildings, scenes located in area C have poor amount of greenery and rich amount of buildings. Few scenes located in area D with poor amount of greenery and buildings. Also, the evaluation values of Q18 are shown that all the scenes with scores below 2.5 are located in area C except scene 42, whereas all the scenes with scores above 3.5 are located in area A and B, except scene 39. It can be inferred that scenes with rich amount of greenery are easier to get better satisfaction, while the scenes with rich amount of building are easier to get worse satisfaction, which is consistent with previous studies3). Therefore, discussing the shielding relationships between greenery and building can help creating better river landscape.

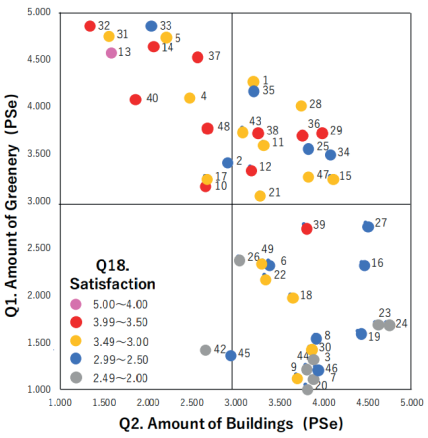

Figure 6. *PSe of Q1, Q2 and Q18.*

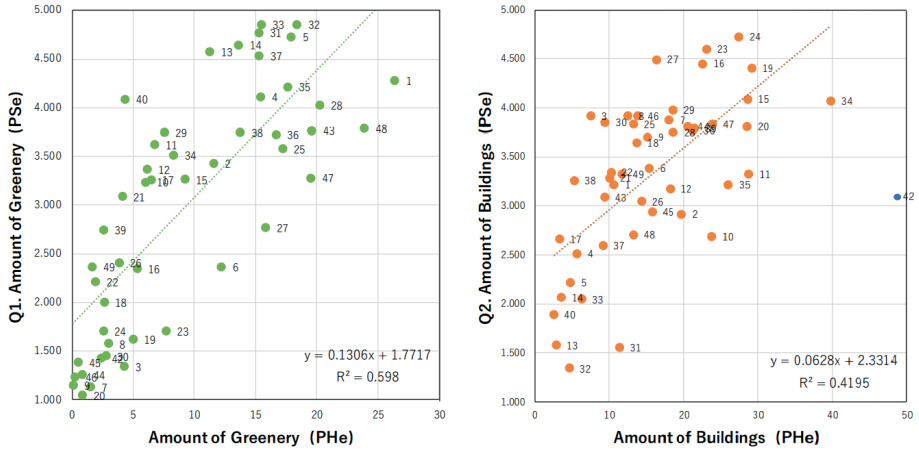

Figure 7. *The Relationships Between PSe and PHe.*

3.4. *Discussion of Relationships between PHe and PSe of Greenery and Buildings*

Figure 7 shows the scattergram of PHe and PSe of 48 scenes. X axis shows PHe value of each scene and Y axis shows PSe value. According to the results, the correlation between the physical quantities and the psychological quantities obtained from the landscape photographs, is 0.773 for greenery and 0.648 for buildings (in condition of scene 42 being excluded). It is convinced PHe can represent PSe of landscape photographs to a certain extent, so we can use the PHe to discuss the amount of greenery and buildings.

4. Effective utilization of greenery on CG pictures simulation created by GIS

4.1. *Methodology of Creating CG Pictures Simulation by GIS*

There is a problem of using landscape photographs for evaluation that we can only photograph and evaluate existing landscapes but not future landscapes still in planning. By using CG pictures, which are obtained from the 3D-space-simulation-model created by GIS, based on urban planning data, we can predict the image of future landscapes and evaluate them. The effectivity of CG pictures for river landscape evaluation has been improved by our previous studies. Speaking to another purpose of using CG pictures, because of that a landscape can be analyzed layer by layer, so we can discuss the shielding relationship between greenery and buildings.

Figure 8 shows the procedures for creating a CG picture. First, we built a 3D-space-simulation-model based on the building's information such as shapes and height as 3m*F from GIS data, in which, F means the number of storeys, the height of each storey is assumed as 3m. Then, through 3D analysis function of GIS, the prospective area of sight from each viewpoint (photograph shooting location) to the opposite bank landscape is drawn out. After that, through Google Maps and field surveys, the greenery data in prospective area is sorted out and added to the 3D model. There are three kinds of greenery patterns (Figure 9) used in this study. Finally, the CG picture is scoped to capture keeping the same viewpoint and same direction as the landscape photographs, and then added other landscape elements such as sky, mountains, revetment and so on to complete the them (Figure 10).

Also, for Up, the occupancy ratio of land cover (Figure 11) of greenery in prospective area has also been calculated, to discuss the relationship between land cover and visually greenery of each scene.

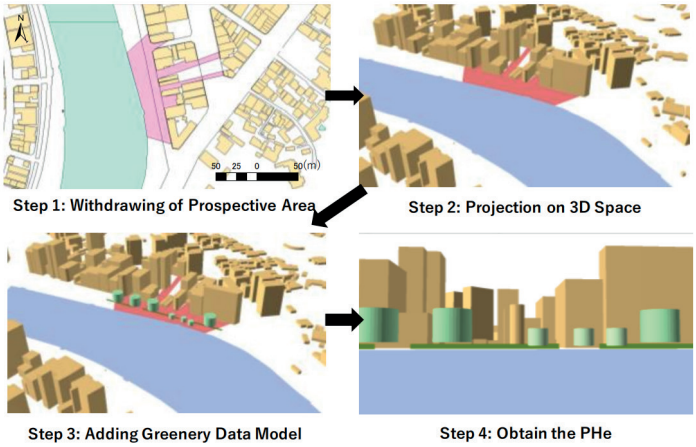

Figure 8. *Procedures for Creating a CG Picture.*

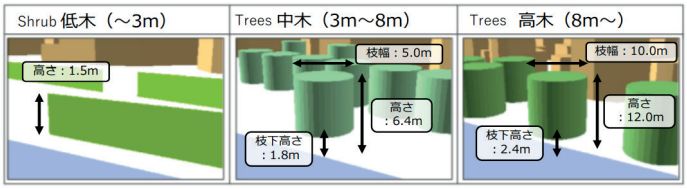

Figure 9. *3D Model of Greenery Patterns.*

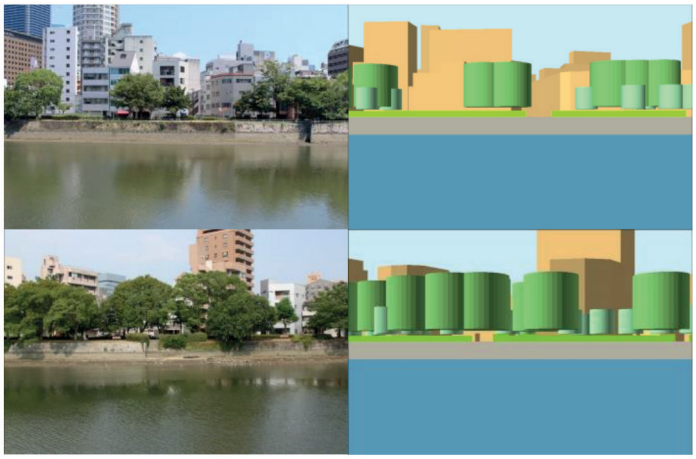

Figure 10. *Examples of Photographs and CG Pictures.*

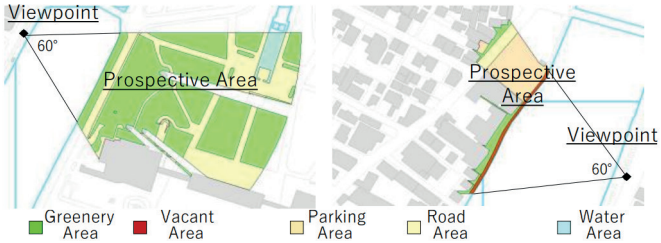

Figure 11. *Examples of Land Conver.*

4.2. *Definition and benchmark of IBsG*

In this section, we discuss the definition and benchmarks of IBsG, shown in Figure 12. IBsG is the ratio of the parts of buildings area that are shielded by greenery, as it is shown in Formula as follows:

$$IBsG=X/Y*100\%$$

In the formula, X is the area of buildings overlaped with the greenery area (pink area of step 4 in Figure 12). There are two kinds of Y. When Y is the summation area of greenery, we call it IBsG-G; when Y is the summation area of building under the assumption that there is no greenery (brown area of step 3 in Figure 12), we call it IBsG-B.

There are six kinds of simple example models of buildings shielded by greenery, as also shown in Figure 12. When the values of both IBsG-B and IBsG-G are high, the utilization of greenery can be considered as effectively. In this way, we can identify locations where we need to improve, and come up with reasonable greenery plans for improvement that will make it more economical.

In addition, not only greenery efficiency on economic but on land use should also be considered, for land use is very stringent in urban areas especially in central district.

4.3. *Discussion of Relationship between IBsG-B and IBsG-G*

IBsG-B and IBsG-G of 48 scenes are shown in Figure 13. According to the cluster analysis results, they were divided into four groups, exactly located in four areas divided by the line IBsG-B=30% and the line IBsG-G=80%.

Scenes in Group1(G1) with high IBsG-G value and low IBsG-B value, mean that although the greenery amount of these scenes is very poor, it is used effectively. To improve these scenes, the quantity greenery should be increased. Scenes in G2 with high value of both IBSG-B and IBsG-G, mean that the greenery is abundant and also be used effectively that can be consid-

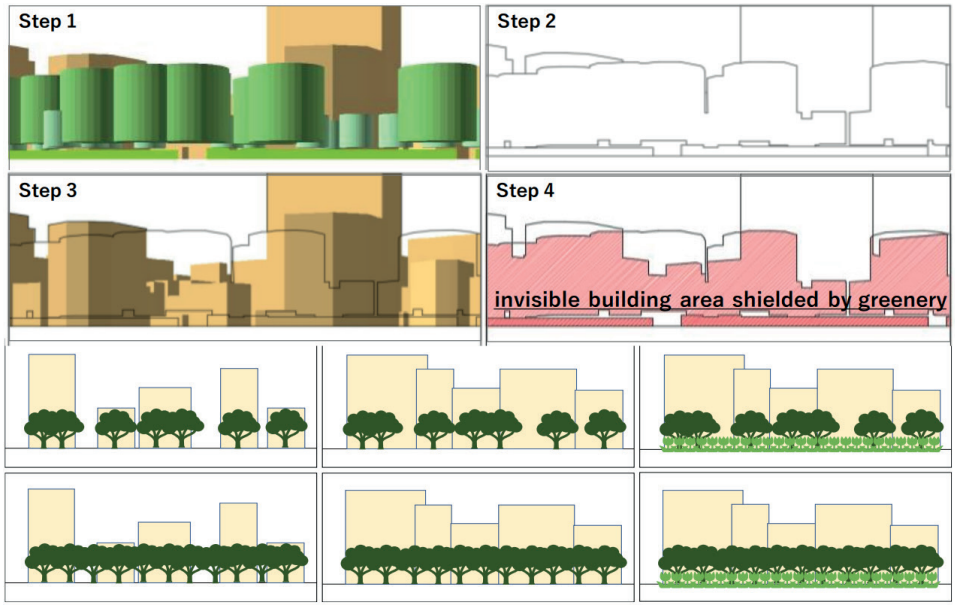

Figure 12. *Conception of IBsG.*

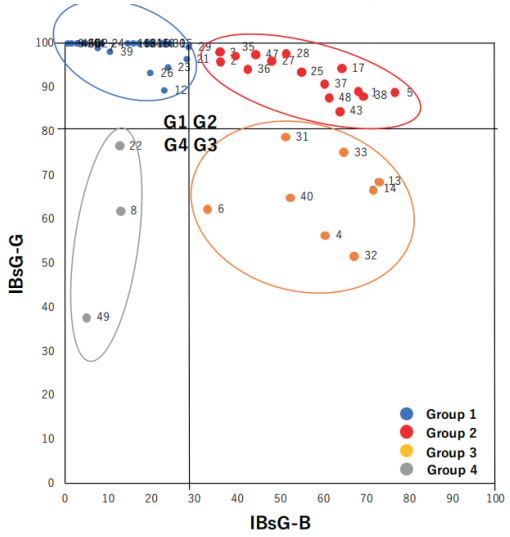

Figure 13. *Scattergram of IBsG.*

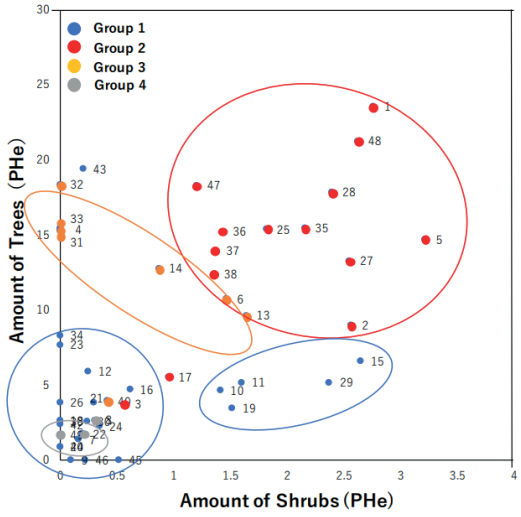

Figure 14. *Amount of Trees and Shrubs.*

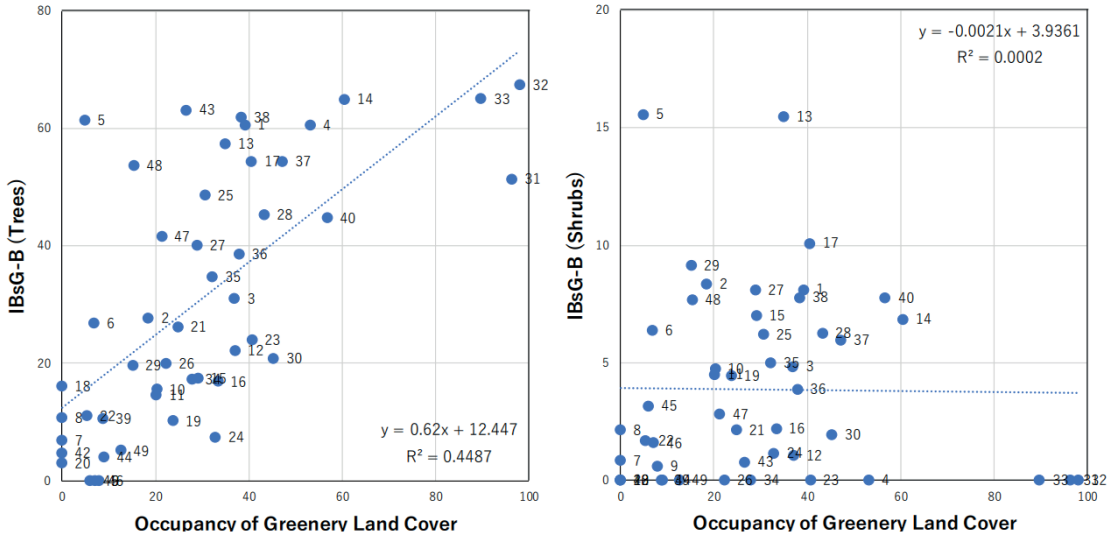

Figure 15. *Relationship Between Land Cover of Greenery and IBsG-B.*

ered as good and does not need improvements. Scenes in G3 with low IBsG-G values and high IBsG-B values, mean that the greenery is abundant but inefficient, so improvement plan should be constituted individually. Scenes in G4 with low value of both IBSG-B and IBsG-G, mean that the greenery amount of these scenes are poor and also the utilization efficiency is low, so that it is necessary to be improved greatly. Comparison between the amount of trees and shrubs of these 48 scenes, in Figure 14, which also shows the cluster analysis results as the same with Figure 13. It is known that for those scenes with abundant amount of trees, the IBsG-B values are also high. But for those scenes with abundant amount of shrubs, the IBsG-G values are high. It is convinced that shrubs are very effective in supplementing the shielding area by trees, especially for landscapes with sufficient greenery quantity but low efficiency, so that planting shrubs can effectively increase the greenery utilization under low-cost conditions.

4.4. Discussion of Relationship betwee IBsG and Land Coverage of Greenery

The relationships between the land cover of greenery and IBsG-B by trees or shrubs are shown in Figure 15. According to the results, the correlation between visual greenery and greenery coverage, is 0.670 for trees, 0.014 for shrubs. Scenes located in upper left corners, provide reference scenarios for how to maximize the IBsG with limited greenery coverage in different conditions. For example, scenes such as 5, 13 and 48, show better efficiency of greenery with few land covers, due to the good setting and match of trees and shrubs.

5. Conclusion

In this study, we tried to use the SS method to automatically identify the physical evaluation and verified its validity in actual scenes. Therefore, it can be expected that the automatic identification of SS can greatly reduce the workload of manual calculation and can perform a wide range of automatic calculations. In the future studies, we will use the results of SS recognition to conduct a more comprehensive and in-depth analysis of the landscape distribution of the entire Ota River, and propose the basis for landscape planning reference.

Furthermore, we discussed the effective utilization of greenery through a new PHqi defined as IBsG, by CG pictures, which are obtained from the 3D-space-simulation-model created by GIS, based on urban planning data for future landscape planning. The effective utilization of greenery has been estimated by both greenery and buildings, and land cover has also been considered. In the future studies, the effective utilization of greenery will be discussed subsequently, to make clear the scientific relationship between PHe and PSe of greenery, so that we can find a way to get PSe values as high as possible under same PHe conditions.

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Balance Between Construction and Conservation

Research on Rational Design Approach in Waterfront Ecological Sensitive Area

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Keywords: Urban Space, Urban Design, Urban Ecology, Ecological Design Approach, Urban Form.

Abstract: Waterfront ecology sensitive area is a specific urban space should be focused and discussed. Many urban ecologists, designers, and planner describe key research questions and frontiers for urban ecology, design and planning. They usually focus on the relationship between urban ecology and urban construction. However, through analysis the consequences of previous research, we can find a barrier which insulate the urban construction and ecology conservation of many previous researches. Therefore, how to design cities where people, urban development and ecology can both flourish? How to make balance between urban construction and ecology conservation? Does there exist any potential design or planning approach or concept can be used to achieve this balance?
Based on above questions, this research aims to provide a rational urban design approach and framework based on a comprehensive digital ecology analysis sandbox which combine the multi-source urban big data and digital techniques, such as water quality, health and ecological security data and MIKE 21model. Xianghu lake waterfront area was selected as case study to verify the approach and research consequences. Through the research, urban designer and planner can understand the reason and influence mechanism behind these issues more scientifically and clearly. Meanwhile, main methods and design approaches which demonstrate by the research may contribute for further ecological sensitive and sustainable urban design.

1. Introduction

During the urbanization process, there is an inherent tension between urban construction and ecological environment conservation. (Lin and Li, 2019) On the one hand, due to ecological vulnerability and potential ecological security risk, urban development and construction is usually restricted in ecological high-sensitive area. On the other hand, specific and graceful scenery of ecological sensitive area usually attract more urban development and activity. (DeFries, Hansen, Turner, Reid, & Liu, 2007; Jing, Liu, Cai, Liu, & Zhang, 2018; Li *et al.*, 2013) However, as Lin and Li (2019) indicated that generally many local governments pay more attention to immediate economic benefits from urban development than other factors. This situation is prominent in China. Economic benefits leaded urban development pattern usually breaks the

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balance between ecology and urban construction, and result many environment issues, such as pollution, urban waterlogging and biodiversity loss (Kiss and Kiss, 2018). Simultaneously, protection-leaded ecological sensitive area development pattern builds a 'wall' between urban development and environment ecology (He, Tian, Gao, & Zhao, 2014). The contradiction between urban construction and ecological conservation is intensified by this negative relationship. Therefore, how to make a balance between urban construction and conservation? How to balance the economic benefits and ecological quality? Does there exists any methods can be used to balance the development and protection during the design and planning process?

For above questions, many urban ecologists, designers and planners demonstrate the frontiers for urban ecology, design and planning field. These previous researches can be divided into three main types based on their research questions and objects. The first type of research is focus on the urban ecology only. This kind of research consider the urban ecological environment as a complete system. For example, Douglas (2012) in his research indicated that the urban ecology is to examines how the characteristics of the urban landscape mosaic, a various part of it. These researches have contributed to the recent development of landscape ecology (Yu *et al.*, 2019). These researches mention to analysis the ecology part of whole urban system, and they attempt to understand both internal and external mechanism between ecological factors and whole urban system (Kiss and Kiss, 2018). Unfortunately, these researches set urban ecology factors as a priority and might ignore the bidirectional influence between urban development and urban ecology. Another type of researches admitted urban ecology as a transdisciplinary science. These researches criticize current conventional urban planning which often focuses more on development demands, economic growth than on ecological sustainability (Nassauer *et al.*, 2014). These researches illustrated a remarkable improvement in urban ecology research field, because they attempt to build a bridge between urban planning and ecology. However, based on the consequences of these researches, we can find a common point in here is that the ecological theories and landscape ecology are still in prior position. Therefore, urban construction and ecological environment conservation is still considered unequally during the urban development process (Wu, Xiang and Zhao, 2014). Recently, based on the progress of technology and methodology in urban design, development and research field. A new kind of research appearing in the relationship between urban construction and urban ecology filed. These researches mention to understand the deep interrelationship between urban development and urban ecology through adopt the advanced techniques and methods, such as GIS (Geographic Information System) (Lin and Li, 2019). These researches focus on the advanced technology and methodology, and the influence of these new technology in relevant research filed. These researches provide an opportunity to understand the deep interaction between urban construction and ecology conservation, and thinking how to make balance between construction and conservation during urban development process.

Based on above, this research aim to find a rational urban design approach which can be involved in urban planning process to make balance between urban construction and ecological environment conservation during urban development. For achieve this aim, multi-source urban big data was adopted to construct a digital ecological analysis sandbox in here. Afterwards, waterfront area of Xianghu lake was selected to conduct case study, due to the ecological environment is more sensitive in waterfront area and the issues is the area is more representative. During the research, water quality, health, ecological security, etc. was examined. Meanwhile, MIKE 21 model was used to simulate water network flow field. According to the analysis consequences, rational approaches were researched and adopted during the

urban design process to make balance between urban construction and ecology conservation in the ecological sensitive area.

2. Methodology

Through adopted the digital methodology, multi-source big data of urban ecology filed is combined and calculated in here to build a digital ecological analysis sandbox. (Figure 1) The main methods during this process is demonstrated in below.

Micro-climate analysis: This method mentions to analysis the interaction between urban form and urban micro-climate. Different urban form might result different micro-climate condition. Thus, through adopted the micro-climate analysis method in urban design process can improve the comfort level of urban physical environment in a place. Micro-climate analysis is divided into two aspects in here. (1) The thermal environment of research area is measured through two steps. Firstly, satellite remote sensing data of 1984, 1991, 2003 and 2015 was acquired through LANDSAT of United States Geological Survey (USGS). Then, Computer simulation technology was adopted to establish urban spatial model, and software such as ENVI-met, ECOTECT and RayMan were used to simulate and evaluate the thermal environment (Stewart, 2011). By analyzing the simulation results and comparing the differences of thermal environment under different urban spatial morphological indexes and spatial morphological types, the coupling correlation between urban spatial morphology and urban thermal environment is concluded (Coseo and Larsen, 2014). Afterwards, site investigation method is adopted to collect Surface temperature, air temperature, relative humidity and other meteorological data, and through combine the land function of the research area and various spatial morphological indicators to analysis the interactive mechanism between urban 3D morphology and urban micro climate. (2) The method for measurement the wind environment is includes three steps. The first step is use field research method to calculate the spatial morphology indexes in research area as the basis factors of wind environment case study. Afterwards, computer numerical simulation method was also used to establish the space model of the central area and conduct numerical simulation for the wind environment (Bruse and Fleer, 1998). Then, CFD software scSTREAM was adopted to generate the simulation results and comprehensively analyze the space distribution characteristics of the wind speed at the pedestrian height (Murakami *et al.*, 1999). Afterwards, conduct multivariate linear regression analysis on the wind speed parameters and space form parameters of blocks with data analysis software SPSS, and discuss the correlation between each space form index and the wind speed level at the pedestrian height, further evaluate the characteristics and causes by comparing the differences of wind environment in different types of space units.

Surrounding Surface Runoff Analysis: The surface runoff can be considered as the main aspect of non-point source pollution in an area. Urban non-point sources are the main sources of water pollution, which have the characteristics of sudden, high flow and heavy pollution. During the urban construction process, the surface will be changed from nature to hard. Therefore, through analysis the surface runoff situation can reduce the urban non-point source pollution. In this research, GIS (Geography Information System) was adopted to conduct the surface runoff analysis (Singh *et al.*, 2010). Firstly, the basic site information which include altitude, topography and current river system is imported to the GIS platform. In addition, the local hydrologic data and rainfall data was also adopted to analysis the site surface runoff. Then, Arc Hydro Tools was used to analysis the direction and catchment line of the site.

MIKE 21model: is a computer program that simulates flows, waves, sediments and ecology in rivers, lakes, estuaries, bays, coastal areas and seas in two dimensions. It was developed by DHI. MIKE 21 contains a series of modules, which in combination cover nearly the full range of possible water quality and ecological applications. Therefore, MIKE 21 can be used for design data assessment for coastal and offshore structures, optimization of port layout and coastal protection measures, cooling water, desalination and recirculation analysis, environmental impact assessment of marine infrastructures, water forecast for safe marine operations and navigation, coastal flooding and storm surge warnings, inland flooding and overland flow modeling. Through MIKE 21 software package, the concentration field, water level, water depth and X&Y velocity field of main pollutants in Xianghu were simulated, and the comprehensive evaluation of water status was obtained to guide the optimization of shore shape and shoreline and site selection of wetlands during the design process. In this research, MIKE 21 model was used to conduct the comprehensive simulation of water ecological environment through following steps. Firstly, MIKE 21 model was adopted to conduct the simulation of concentration field of major pollutants, water levels, water depth and flow velocity in X&Y direction. Afterwards, multi-factor superposition analysis was conducted to integrate the simulation of above aspects. Then, the key optimization and protection ecological sensitive areas were determined through comprehensive evaluation of multi-factors. Finally, the reverse simulation verification was conducted to justify the analysis consequences. Through adopt the MIKE 21 model, the water ecological environment in research site can be comprehensive evaluated. The evaluation and simulation consequences of MIKE 21 model provide a meaningful and scientific foundation to support the rational urban design approach in ecological sensitive area.

COD method: In environmental chemistry, the chemical oxygen demand (COD) is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution. (Clair *et al.*, 2003) It is commonly expressed in mass of oxygen consumed over volume of solution which in SI units is milligrams per litre (mg/L). A COD test can be used to easily quantify the amount of organics in water. The most common application of COD is in quantifying the amount of oxidizable pollutants found in surface water (e.g. lakes and rivers) or wastewater. COD is useful in terms of water quality by providing a metric to determine the effect an effluent will have on the receiving body, much like biochemical oxygen demand (BOD). COD method was used to evaluate the water quality of the research area. During the research, 16 water quality sampling points was selected to acquire the water sample. Based on a standard method which is described by International Organization for Standardization (ISO) for measuring chemical oxygen demand in ISO 6060. In this research, potassium dichromate was used to test the water sample. Potassium dichromate is a strong oxidizing agent under acidic conditions. Acidity is usually achieved by the addition of sulfuric acid. The reaction of potassium dichromate with organic compounds is given by:

$$\mathrm{C}_n\mathrm{H}_a\mathrm{O}_b\mathrm{N}_c + d\mathrm{Cr}_2\mathrm{O}_7^{2-} + (8d + c)\mathrm{H}^+ \longrightarrow n\mathrm{CO}_2 + \frac{a + 8d - 3c}{2}\mathrm{H}_2\mathrm{O} + c\mathrm{NH}_4^+ + 2d\mathrm{Cr}^{3+}$$

where *d=2n/3+a/6-b/3-c/2*. Most commonly, a 0.25 N solution of potassium dichromate is used for COD determination, although for samples with COD below 50 mg/L, a lower concentration of potassium dichromate is preferred. In the process of oxidizing the organic substances found in the water sample, potassium dichromate is reduced (since in all redox reactions, one reagent is oxidized and the other is reduced), forming Cr3+. The amount of Cr3+ is determined after oxidization is complete, and is used as an indirect measure of the organic contents of the

water sample. Based on the COD method, the water quality of the research area was tested. The measurement results of water quality will be used to justify the design scheme and compare with the simulation results of research area after urban construction.

Pollution load index: is the total amount of pollutants that enter a water body from point and surface sources within a certain period of time. Pollution load is an important index for water quality evaluation, prediction and water pollution control. The Pollution Load Index (PLI) is obtained as concentration Factors (CF). This CF is the quotient obtained by dividing the concentration of each metals. The PLI of the place are calculated by obtaining the n-root from the nCFs that were obtained for all the metals. With the PLI obtained from each place. During this research, pollution load index method was adopted to calculate the pollution load of the site through the formula in below.

$$V(t)\frac{dc}{dt} = Q_{in}(t) \bullet C_{in}(t) - Q_{out}(t) \bullet C(t) + S_c + kV(t)C$$

V(t) – The amount of water at time *t*(m3); dc/dt – Rate of change of COD, ammonia nitrogen and other parameters; Qin(t) – Streamflow at time *t*(m3/a); Qout(t) – The outflow at time *t*(m3/a); Cin(t) – The inflow concentration at time *t*(mg/L); Cout(t) – The outflow concentration at time *t*(mg/L); C(t) – Lake concentration at time *t*(mg/L); Cs – Pollution from external sources; k – The comprehensive degradation coefficients of COD and ammonia nitrogen.

Through calculate the pollution load index, the pollution load ability of the research area can be acquired to provide a reference for discover rational urban design approach in ecological sensitive area.

Case selection and study: Based on above measurement methods, Xianghu Lake area was selected to conduct the urban ecological research for discover the rational urban design method and justify the research consequences and possible ecological sensitivity design method. Xianghu Lake research area locate in the East of China. The site is near Qiantang river and Hangzhou city (Figure 2). In 2018, Hangzhou local government launched an urban development project around Xianghu Lake. According to this development project, the surrounding waterfront area will be constructed to a national tourism resort. However, Xianghu Lake is a part of whole Qiantang river system, and the ecological environment is sensitive in Xianghu Lake area. If the ecological environment of Xianghu Lake is negative impacted during the construction process, it will result a ecological chain reaction for whole Qiantang river system. How to balance the interest between economic and ecological dimension can be considered as an urgent issue during the development process. Therefore, based on this practical problem, we select Xianghu Lake as the case study in here to integrated analysis the ecological environment of the site through digital methods and techniques. Then, based on the evaluation consequence to discover the rational urban design approach in the waterfront ecological sensitive area.

2.1. *Results*

Based on the consequences of comprehensive analysis of ecological environment in the research site through digital ecological analysis sandbox. This research verified that the ecological environment will be impacted during urban construction process again. Through simulate the different design proposals of the site, we find that some proposal might negative influence the local ecological environment in different extent. This result is discussed by many previous researchers, and this finding can be considered as common knowledge at same time. Based on this concept, the ecological protection is always set as a priority during urban design, planning

and construction process. However, according to the evaluation process, this research found something different. During the designing proposal simulation process, we find that some proposals not only without any negative impact on local ecological environment, but also improve the ecological quality in some extent. Based on this finding, we attempt to make a link between urban design and ecology and find a rational urban design approach in ecological sensitive area.

2.2. *Result of water surface runoff*

Based on GIS platform, firstly, the internal morphology of Xianghu lake surface runoff system was summarized in detail. Through consequence visualization process, we can find that Xianghu waterfront ecological area is located at the intersection of Qiantang river, Puyang river and Fuchun river. Thus, the surface runoff in Xinghu waterfront area us a complex network. Meanwhile, through site investigation, we find that the surface water and groundwater are abundant in the region. The ecological environment of Xianghu waterfront area is mainly composed of rivers, lakes, rivers, canals and ponds. In addition, based on the analysis results of basic geography factors, such as altitude, terrain and mountain distribution, we also find that the mountain has multiple catchment lines to provide an effective water supplement in whole Xianghu area.

As the methodology part indicated that surface runoff is the main route of non-point source pollution in an ecological sensitive area. Therefore, some purification measures are needed to prevent the non-point source pollution in the area. In addition, the multiple catchment lines should be considered during the urban design and construction process to prevent the water from shrinking. Based on that, the urban construction should avoid interdict the main surface runoff.

2.3. *Result of water quality*

Water quality is the major ecological factor to reflect the situation of whole waterfront ecological environment. Through MIKE 21 software package, the concentration field, water level, water depth and XY dimension velocity field of main pollutants in Xianghu were simulated. The results indicated that the water velocity in the south of the lake and along the narrow coast of the lake is mostly 0.04m/s, which is prone to eutrophication and algal bloom. Furthermore, based on the calculation results of COD, the single factor evaluation method was further adopted to evaluate the water quality of the lake. The results reflected that Xianghu water quality is classified as grade IV or V in national standard (GB 3838-2002), and the main exceeding factor is TN compared with grade III water quality. (Table 1) The water quality of the southern river is of class IV and V, and the main pollutant factors are CODMn and nh3-n. The water quality of the farmland section near qiantang river is better than that of the urban section.

Based on above results, we find that increasing the dikes and islands in the lake is conducive to enhancing the variability of water flow field and cultivating the diversified ecosystem of Xianghu lake, and the comprehensive evaluation of water status was obtained to guide the optimization of shore shape and shoreline and site selection of wetlands during the urban design process.

2.4. *Result of Pollution load ability*

Based on the methods which was demonstrated in methodology part, the direct catchment area of Xianghu lake covers an area of 19.25km squared, of which the planned urban land area is 12.81km squared and the mountainous and hilly area is 6.44km squared. After weighting the

Table 1. *Water quality measurement results. Source: Made by Author.*

Sample Point	CODMn	TP	TN	NH_3-N	COD
1	1.85	0.0103	1.52	0.54	5.6
2	2.44	0.0079	1.55	0.46	4.7
3	3.08	0.0251	3.11	1.22	2.6
4	2.28	0.0091	1.71	0.33	5.5
5	2.32	0.0085	1.60	0.42	5.5
6	2.36	0.0079	1.63	0.44	5.1
7	2.20	0.0090	1.44	0.4	5.8
8	2.96	0.0062	0.86	0.45	5.4
9	1.75	0.0123	1.48	0.41	6.6
10	1.40	0.0054	1.27	0.35	5.6
11	2.36	0.0094	1.28	0.31	5.7
12	2.36	0.0079	1.63	0.44	5.1

urban non-point source pollution load, the comprehensive output coefficients of COD, TN and TP were 320kg/(ha.a), 40kg /(ha.a) and 7.0kg /(ha.a), respectively. According to the water area of Xianghu lake is about 10.6km^2. The comprehensive degradation coefficient of COD, TN, ammonia nitrogen and other pollutants is 0.05d^{-1}, and the safety coefficient is 0.75. Therefore, under the condition of surface class III water quality as the target, the sewage carrying capacity of the lake is: COD: 3789t/a; TN: 157 t/a; TP: 32 t/a. The load of non-point source pollution in Xianghu catchment area is: COD: 1068t/a; TN: 133 t/a; TP: 23.3 t/a. Based on above measurement results, the current pollution carrying capacity is slightly larger than the non-point source pollution load in the catchment area around Xianghu lake.

Therefore, the above numerical value of pollution load ability of Xianghu Lake can be considered as the critical value and deadline during the urban design and construction process.

2.5. *Result of waterfront ecological health*

Waterfront ecological health can be considered as a multi-level complex index system which involve basic water quality characteristic, water network from, hydrological characteristics, ecological system and ecological landscape. Thus, based on the functional zoning and systematic structure analysis of Xianghu lake as a tourist resort, the ecological health risk evaluation index system of Xianghu lake is constructed. The established health evaluation factors include 17 evaluation indexes of hydrology and water resources, water system structure, ecological function, ecosystem health and tourism landscape value. (Table 2)

The health score of Xianghu Lake was 2.95, and the health evaluation level was good. These indexes also can be used to guide the urban design and construction.

Table 2. *Weight and assignment of waterfront ecological health measurement index. Source: Made by Author*

Standard	Weight	Index	Weight	Assignment
Water quality Characteristic B1	0.43	Nemerow multi-factor index (C11)	0.64	3
		Nutrition index (C12)	0.26	2
		DO (Dissolved Oxygen) (C13)	0.10	1.55
Hydrological characteristics B2	0.16	The lowest ecological water satisfied level (C21) Runoff into the lake (C21)	0.75	4
		Water renewal cycle (C22)	0.25	3
Water network from B3	0.07	Lake basin stability (C31)	0.25	3
		Lakeshore stabilit (C32)	0.25	3
		Vegetation integrity (C33)	0.25	3
		Form of shoreline and revetment (C34)	0.25	4
Ecological System Index B4	0.26	Green belt plant coverage (C41)	0.09	4
		Phytoplankton diversity (C42)	0.06	3
		Native plant retention rate (C43)	0.07	4
		Natural water proportion (C44)	0.39	2
		Habitat quality index (C45)	0.39	3
Landscape Ecological Index B5	0.08	Aesthetic measure (C51)	0.33	4
		Landscape accessibility (C52)	0.33	3
		Lakeside green belt width (C53)	0.34	4

2.6. *Result of urban micro-climate*

Temperature is an index which may also influence physical feeling of people, especially during the summer. Thus, the thermal environment is also measured in the waterfront area to ensure a comfortable waterfront physical environment in the pedestrian level. Through measurement of both thermal and wind environment, we find in the lake area there is a cold island zone running from northeast to southwest in the site and surrounding areas, and the heat island area is concentrated in the northwest and northeast areas. In addition, the wind speed in the area along the river is concentrated in the range of 2~5m/s, and the wind comfort presents the characteristics of subsection change. Meanwhile, there also exist many hot island zone and quiet wind, weak wind zone in the surrounding area of Xianghu Lake, due to the wind corridors are blocked by surrounding mountains. Furthermore, the air pollution is closely related with the wind environment and impact on urban physical environment. Thus, based on the measurement results, the southwest side of Xianghu lake is easily affected by air pollution.

Based on above analysis results, we can believe that the wind is the best solution for issues of both thermal environment and air pollution. Thus, wind corridors should be reasonably constructed to adjust wind direction and reduce the site's heat island effect during the urban design and construction process.

3. Discussion: Rational Design Approach in Ecological Sensitive Area

As the introduction part of this paper demonstrated, during the rapid urbanization process, there exist a serious contradiction between urban construction and ecological environment. In the past decades, many urban researchers, designers and planners are all believes ecological conservation have priority during the urban planning and construction process. In China, the "protected areas" are also known by the term "ecological rea line" (ERL), which mainly focuses on green spaces in urban areas. (Lin and Li, 2019) The ERL means that the ecological deadline for urban development and design. This concept results the "conservation" become the "overlords" during the design and development process. However, through above analysis, we have to better understand the ecology and sustainability of cities. Based on the digital measurement method and techniques, we can understand the interrelationship between urban ecology and urban construction deeply. Therefore, we argue that relationship between urban construction and ecological environment conservation is not antagonistic. A win-win relationship can be achieved between construction and conservation. Therefore, take Xianghu Lake waterfront ecological sensitive area as an example, we discussed a rational design approach framework to make balance between construction and conservation.

Water purification process: is a comprehensive system, it includes purification microunits, corridor and interarea three steps. These three parts will refine water and rain step by step to reduce the potential pollution threat. Water purification methods by land block treatment, underlying surface treatment, and ecological water system treatment: the green roof, sunken green space and rainwater garden; underlying surface treatment includes road retention canals, permeable paving and municipal drainage pipelines; and ecological water system treatment includes ecological purification group, waterfront wetland and rainwater storage pond.

Block and Building Water purification Strategy: there three main aspects are including in here: (1) multiple greening combinations can minimize surface runoff and improve water quality; (2) increase green roof, reduce hard pavement, reduce urban rainwater runoff, and reduce urban rain flood risk. It is recommended that the green roof rate reaches 50%. (3) It is suggested that the rainwater collection and treatment rate can reach 80%.

Urban green space and permeable floor design approach: there two strategies including in here: (1) Three-dimensional greening includes vertical greening, roof lawn, roof garden, balcony greening, etc. (2) Pervious floor can quickly infiltrate into the surface, effectively replenish groundwater, mitigate the urban heat island effect, and protect the urban natural water system from damage.

Optimization embankment and waterfront: Based on the simulation results of MIKE model package, the existing embankment types are optimized accord to different water height. In addition, all embankment optimization method will also enhance the waterfront vitality and ecological environment.

4. Conclusion

Urban ecology in China started in the early 1980s, China's urban ecology has focused on environmental pollution and eco-cities. It means that the ecological conservation still has a priority

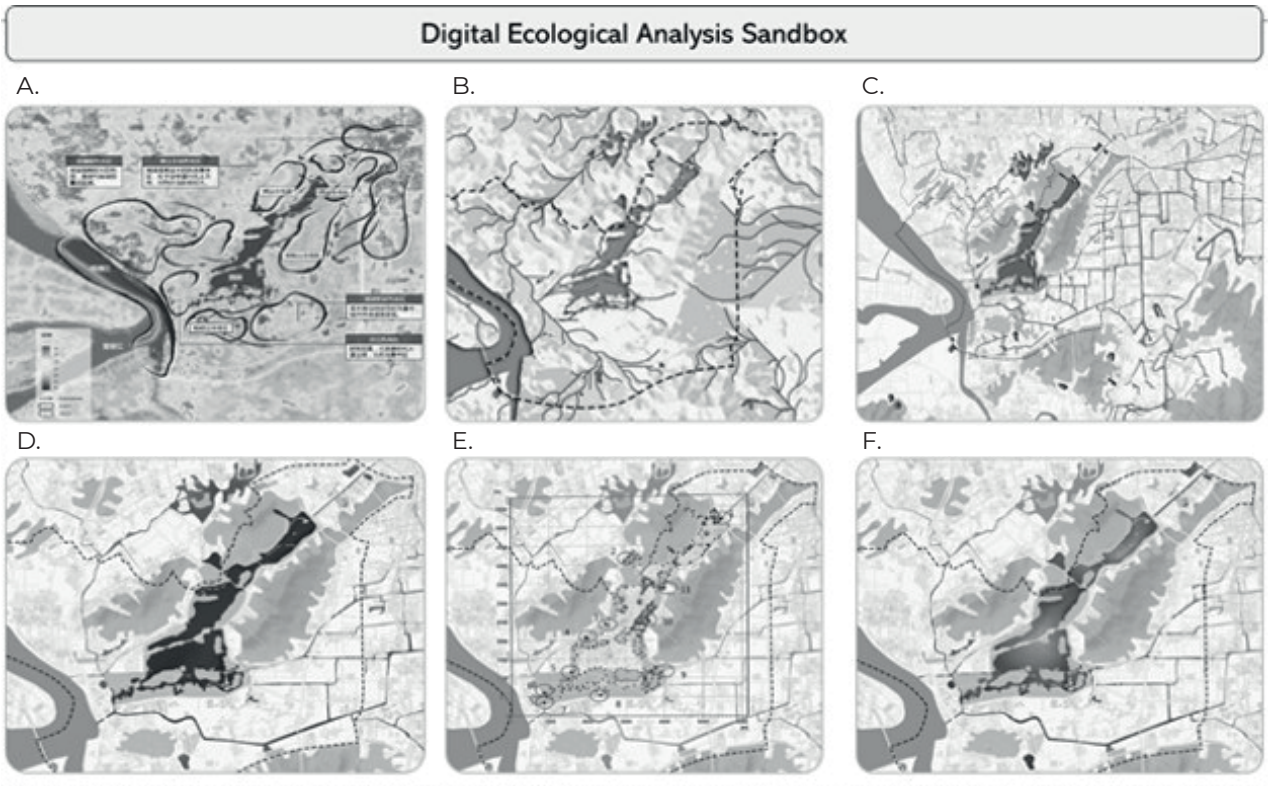

Figure 1. *Digital Ecological Analysis Sandbox. Source: Author Make (a. Micro-climate analysis method; b. Sorrounding Surgace Runoff Analysis; c. Water quality evaluation; d. Pollution load analysis; e. MIKE 21 model; f. Water ecology health evaluation).*

during the urban construction process. If we related with the urban development background in China, this situation might be correct, due to the ecological system still under the risk of destruction during the urban construction process. However, due to the speed of urbanization is slow down, the relationship between urban construction and ecological conservation should be rethought under new background. Therefore, this research through build a digital ecological analysis sandbox to conduct an integrated evaluation of a waterfront ecological sensitive area. Afterwards, based on the evaluation consequence, we demonstrate a possible rational design approach in ecological high-sensitive area to balance the urban construction and conservation. However, these approaches can be considered as an ideal concept, more verification and exploration should be conducted in the future.

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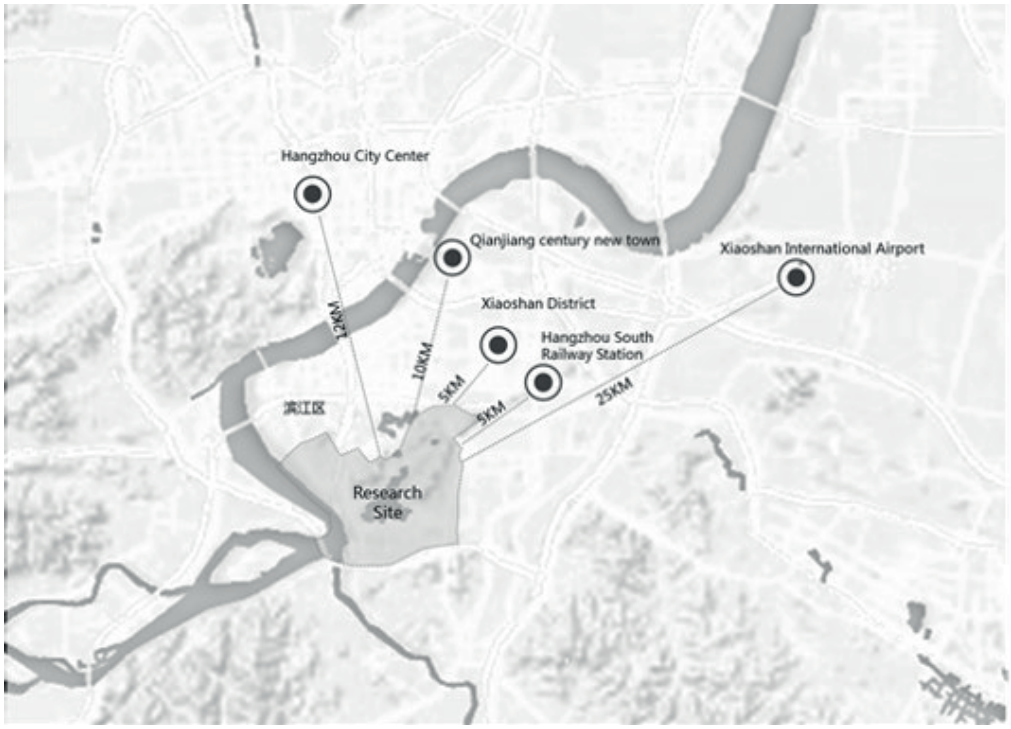

Figure 2. *Location of the research site. Source: Author Make.*

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Study on the Layout of Green Space and its Rainwater Surface Runoff Performance within the Residential Street-Block of Nanjing, China

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Keywords: green space, layout, residential street-block, rainwater surface runoff.

Abstract: Green space plays an important role in the microclimate and rainwater cycle of the built environment. However, traditionally, urban morphological research rarely discusses the green space and the relationship between green space element and other morphological elements, such as building fabric and plot pattern. Previous studies of rainwater surface runoff control have also focused on the green space itself, and the research model is too far from the real urban form.

In the traditional city, the layout of the green space in the block is basically internal. When the traditional plot pattern of the block is broken in the modern city, the building fabric is totally changed. It also led to a more diverse layout of green space. This paper focuses on the urban green space layout characteristics of the contemporary residential street-block of Nanjing, China. The abstract models are constructed according to the layout of green space of the real residential street-block. Two block series are in calculation to analyze the impact of different types of green layout on the runoff.

1. Introduction

More and more, people realize that the green space plays an important role in the microclimate of the built environment and the health of the citizens. In urban rainwater circulation, green space has an irreplaceable role in ecological and economical aspects.

However, on the one hand, for a long time, urban morphological research rarely discusses the green space as an independent element of urban form, not to mention the relationship between green space element and other morphological elements, such as building fabric and plot pattern. For example, the morphological analysis of M.R.G. Conzen (1960) is mainly based on the three fundamental physical elements: streets, plots, buildings and their related open spaces. In Kropf's opinion (2014), the elements and levels of urban form are much more complicate, but the green element is still excluded. Osmond (2010) built a hierarchy of open space, the green space was subdivided as an element of open space, but did not analyze the relationship with other elements. On the other hand, previous studies on the control of surface runoff in rainwater have also focused on the green space itself, including area expansion or improvement of temporary water storage capacity. Although recent studies have found that the interaction

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between the layout of green space and other elements of urban form has a significant impact on the absorption of rainwater, the research model is either too macroscopic or far from the real urban form (Kim &Park, 2016; Zellner, 2016).

Therefore, the study of the relationship between green space elements and other urban morphological elements is not only conducive to the development of urban form research, which can also provide morphological support for the research of urban rainwater surface runoff control.

In the traditional city, the layout of the green space in the block is basically internal. When the traditional plot pattern of the block is broken in the modern city, the building fabric is totally changed. It also led to a more diverse layout of green space. This paper focuses on the urban green space layout characteristics of the contemporary residential street-block of Nanjing, China. Firstly, due to the division of the street, a street block is relatively independent in both form and surface runoff, forming a clear basic spatial unit of relationship study. At the same time, a street block is the most important area for the source control of urban rainwater, and the proportion of residential blocks is the highest in all types of urban blocks, and the layout of green spaces is highly constrained by the building fabric within the residential blocks. Therefore, residential block is also the most important type of block for urban rainwater surface runoff control.

2. Methodology

In contemporary Chinese city, residential areas have long been influenced by the theory of residential quarter planning. A residential quarter is a residential plot, and a residential quarter is composed of at least one "residential building group" according to the size of the plot. In the residential quarters built in 1980-1993, the standard only made a limit of 1-2 m^2 public green area per person within the quarter. After 1993, the green coverage in a residential quarter should not less than 30% in new developed area or not less than 25% in rebuilt area, and need to be arranged in three levels: the center garden of residential quarter, green space of the group and green space around the building. The center garden of residential quarter and the green space of the group shall not be less than 4000m2 and 400m2, and, respectively, the width of the short side of the green space shall not be less than 8m. However, in reality, the setting of road density by urban road planning makes the size of the block become the main limiting factor for the size of the residential plot. In most of the residential blocks (which means more than 50% area is residential plots), the actual size of most residential quarter is between the scale of "quarter" and "groups" or only a "group" size set by the norms. "Quarter" and "group" gradually evolved into "neighborhood block". Therefore, except for meeting the requirements of the green coverage, the classification of the green space arrangement in the site plan of the residential quarter is increasingly blurred. At the same time, under the constraints of the building and planning related norms such as economics and sunshine standards, most of the residential building fabrics are constructed of paralleled stripe buildings, which constitute a further constraint on the layout of the green space.

Since the shape and size of the block is mostly determined by the street system, we can get a standard square block with 264*264m (Figure 1) according to Chinese "Code for transport planning on urban road" (width of road: Main road 50m, Sub-main road 40m, Branch road 20m; Density of road: Main road 1.2km/km , Sub-main road 1.4km/km^2, Branch road 4km/km^2). Considering the actual size of buildings, roads and green area, the cells are set to a square of 6m

x 6m for the further runoff calculation. Filtering according to the ± 10% interval of this area, 9 residential blocks in Nanjing old city area were screened out. (Figure 2)

We can see that the green space is distributed much homogenously around the residential buildings. So the abstract models are constructed according to the layout of green space. The surface materials include building (20% coverage), permeable green area (40% coverage) and impervious ground. Two block series are in calculation by the software called "Hydro-block v1.0" (Liu, 2019), to analyze the impact of different types of green layout on the runoff (the amount of runoff per cell and the max depth of water within the block).

3. Analysis and Results

3.1. *Series I: Dispersed green area*

The block with homogeneously dispersed strip buildings cannot place concentrated green area. The calculations examined four position of the green area in two directions of slope of block: in back (upside) of the building, in front (down side) of the building, in both sides of the building and interlace arrangement (Figure 3, Series I-a, b, c, d).

In the case of up-down slope, the reduction of surface runoff is in back > both sides > staggered arrangement > in front. At the same time, the interlace arrangement of buildings and green spaces in the water flow direction also helps to reduce the surface runoff (Figure 3, Series I-e). In the case of left-to-right slopes, there is little difference in the eight layouts as well as the up-down slope. Compared with the block SI-b4, it can be seen that the building fabric change has little significant influence on the surface runoff in the layout of dispersed green area.

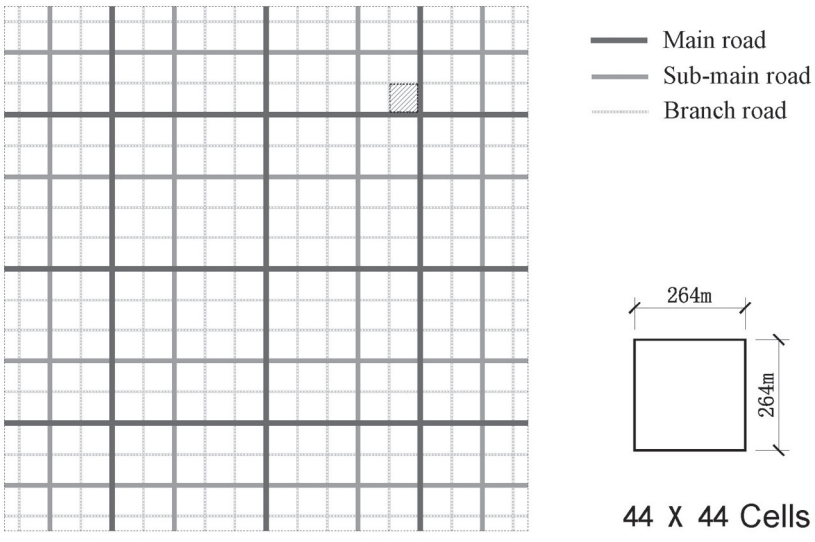

Figure 1. *Homogenized orthogonal road system.*

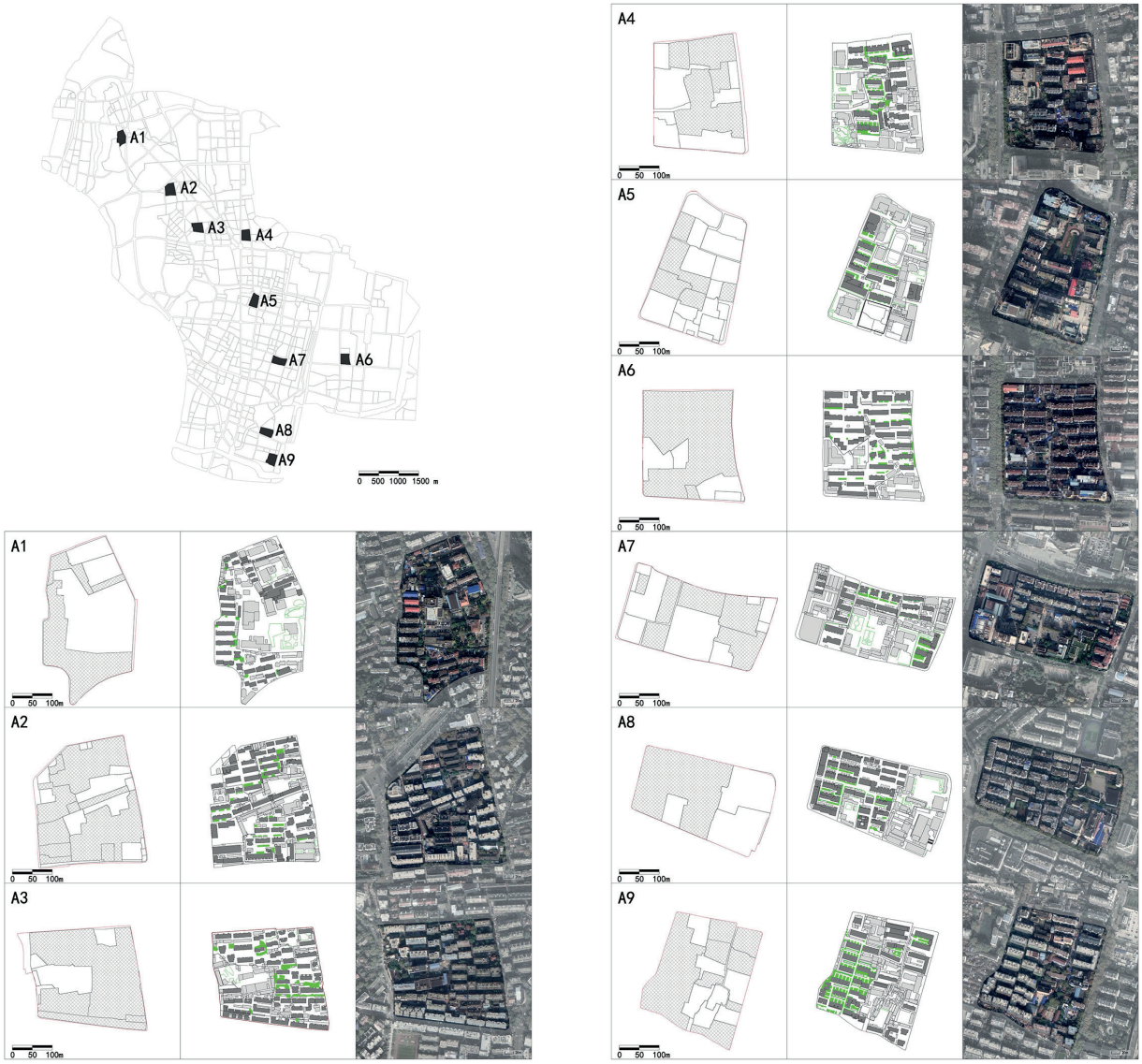

Figure 2. *Typical residential blocks in Nanjing old city.*

3.2. *Series II: Mixed green area layout*

Previous study shows that the green area around the block can markedly reduce the runoff, so we also examines if mix the concentrated and dispersed layout of green area can combine their advantages.

In the blocks of homogeneously dispersed stripe buildings fabric (Figure 3, Series II-a, b, c, d), the mixed layout significantly reduces the surface runoff compared with the simply dispersed layout. For example, the runoff per cell of S II-b1 is only 30% of S I-b1. However, the maximum water depth of the mixed green space layout is significantly larger than the purely dispersed green space. (Figure 3, Series II-f)

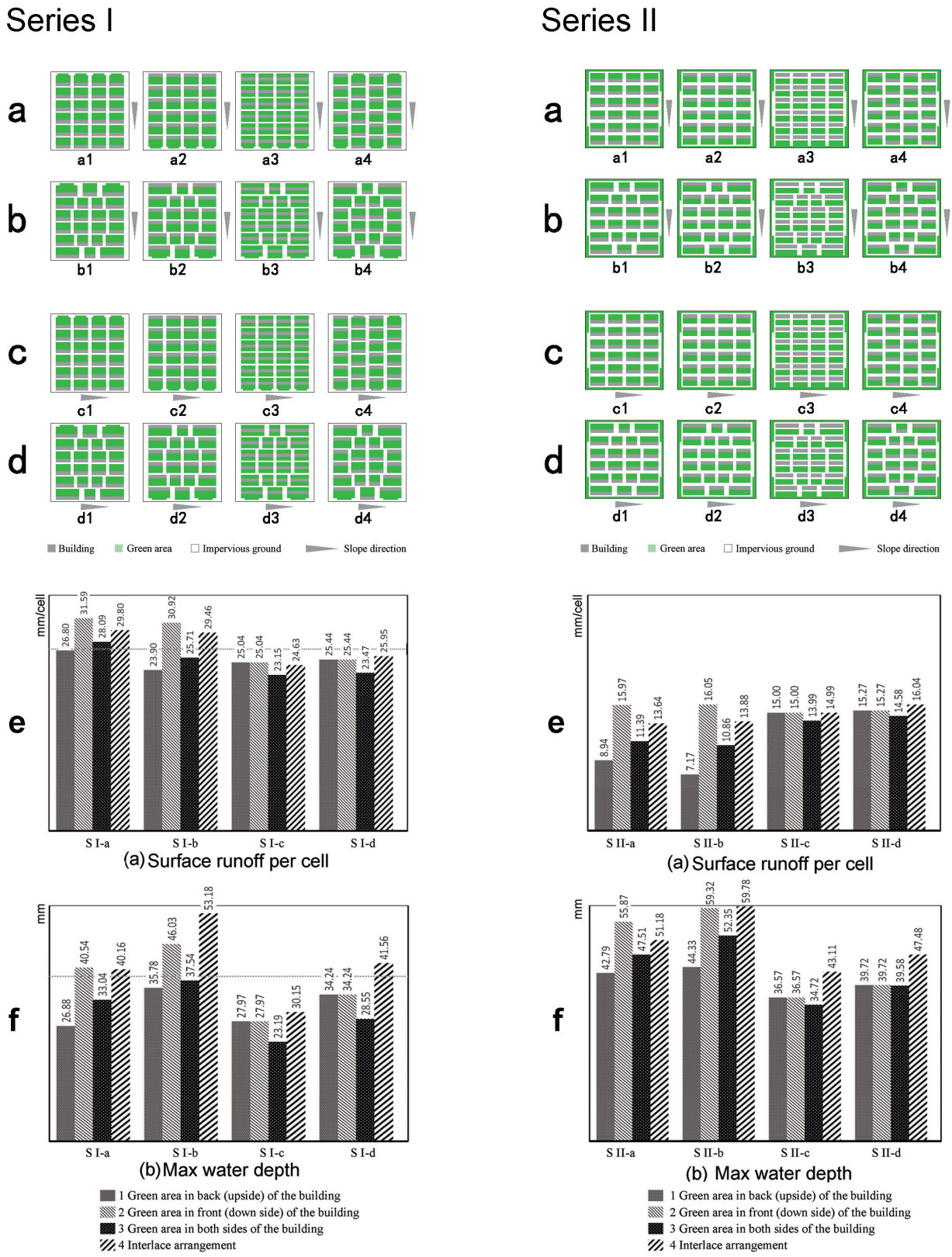

Figure 3. *Residential block models and the surface runoff calculation.*

3.3. *Impact of rainfall intensity and soil type*

In this model, two different types of soil samples were selected for the calculation. The initial infiltration rate of soil type A decreases relatively moderately, and the stable infiltration rate is relatively high. The initial infiltration rate of soil type B drops sharply and the stable infiltration rate is low.

Under the same soil type, the lower intensity of the rainfall, the more obvious the differences are showed in the runoff reduction of the different layout of the blocks. In the same intensity rainfall events, the better permeable soil of type A reduces the surface runoff much stronger than type B, and the difference of the surface runoff of different layouts is also much more obvious in soil of type A than type B. For example, In the case of soil of type A, the surface runoff per cell of block S II-b2 in the 2, 10, 50, and 100-year recurrence interval is 4.29, 2.24, 1.64, and 1.50 times of block S II-b1 block. However, in the case of soil of type B, the difference between the two blocks is within 5% (Figure 4).

4. Conclusion

Under the same building fabric and site topography, the positional relationship between green space and buildings will affect the surface runoff of rainwater and the depth of water in the site to varying degrees. The green space layout of existing residential blocks is mostly on the north and south sides of the building. This is not an optimal layout for the reduction of surface runoff. The surrounding green space around the block can play the role of surface runoff reduction more efficiently.

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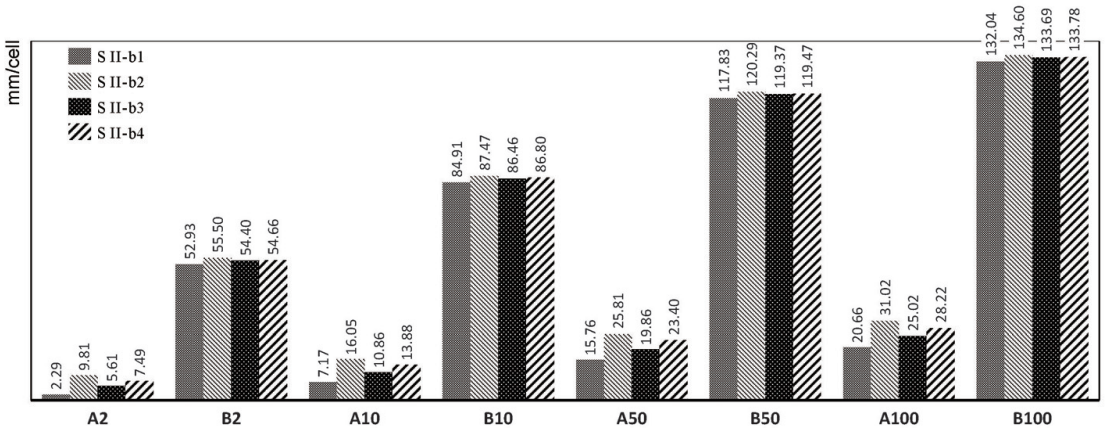

Figure 4. *Runoff per cell under different rainfall intensities and soil types.*

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Space Syntax and Walking in a Historic Waterfront Neighborhood-Case Study of Shang Hai Hong Kou port

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Keywords: urban morphology, land use, space syntax.

Abstract: Due to the change of transportation mode and the lag of renewal and construction, it is a common problem that the historic waterfront neighborhood loses its vitality gradually. Walking actives have the built environment on the walking activities have been long proved. However, the relationship between accessibility and walking activity hasn't been examined, especially in the historic waterfront neighborhood which has a more complicated urban form. This research used space syntax to measure the accessibility of Shang Hai Hong Kou port area. The result showed that 90% percent of the sDNA index can explain the real pedestrian flow. And retail commercial such as restaurant can make up for the lack of vitality due to inadequate accessibility.

1. Introduction

Recent years, researchers from urban planning and transportation and urban design have been studying how urban form is related to the daily travel behaviors such as walking, to promote the urban vitality and microeconomic environment of the community. Active transportation is consistently positively associated with urban form variables of greater mixed land-use, street connectivity, residential density, and combinations of these variables (Sallis J.F., 2004). Urban form is related to total amount of physical activity for both recreational and transportation purposes (Brownson R.C., 2004; Frank L.D., 2005; Giles-Corti, 2003; Hoehner C.M, 2003; Saelens B.E., 2003). One of the ways in which active travel is promoted is by altering the characteristics of the built environment in which the individuals live and move, as it has been shown that the built environment has a clear influence on travel behavior and active travel in particular (Handy *et al.* 2002; Forsyth *et al.* 2008; Brownson *et al.* 2009). While daily walking behavior has been shown to be associated with features of the built environment such as density and land-use mix, it is also associated with walking and accessibility. However, the measurement of active accessibility is not straightforward and it can represent significantly different features of the built environment.

Accessibility is an important aspect of the built environment. With the difference of research question and problem, the definition of accessibility is not completely consistent. There are also many ways to measure accessibility such as distance measures, topological measures, gravity measures, cumulative-opportunity measures and time-space measure (Pirie, 1979). In 1976, Bill Hiller

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came up with the concept of "space syntax", which is based on the theoretical basis of people's direct perception and experience of space (especially walking activity) in movement. It emphasizes the influence of visual perception permeability of space in cities and towns on summarizing the movement of people in a systematic sense. Since Many studies have demonstrated the applicability of spatial syntax in interpreting accessibility (Yong Chen, 2014; Oh, Chung-Won, 2012; Rungpansa Noichan, 2018). It is helpful to analyze how residents understand and feel these complex spatial patterns in the medium and micro spatial dimensions. However, less attention has been paid to the correlation between specific descriptive characteristics of accessibility, such as integration, choice and depth, and the walking behavior patterns of people in specific areas.

Hongkou port, as the mother river of Hongkou district of Shang Hai, is an important development axis of the evolution from Jiangnan water town to modern industrial and commercial city. At the same time, it is the only waterfront area with small-scale spatial characteristics in the downtown area of Shanghai. The history of Hongkou port roads construction can be traced back to 1848, when Chinese Americans built residential areas along with Zhapu road and Tanggu road. In 1863, the American concession was established here. In the second half of the year, the British and American concessions merged into the public concession and began to build roads along the river. In order to meet the integrity of the development of the road network, river reclamation is a common method in this period. At the beginning of the 20th century, the public concessions began to expand in a wide range to the north, and the road network gradually began to thicken and form a large number of branch roads. Since the 1940s, in order to form larger plots, many branches have disappeared and the density of the road network has decreased. Due to the rich historical development background, Hongkou port area has a large number of historical buildings, such as: residential, industrial plants. The Lilong buildings in the south of the region are well preserved, while the historic buildings in the north are seriously damaged, some industrial buildings have been transformed and updated into new entertainment spaces.

However, due to the change of transportation mode and the lag of renewal and construction,

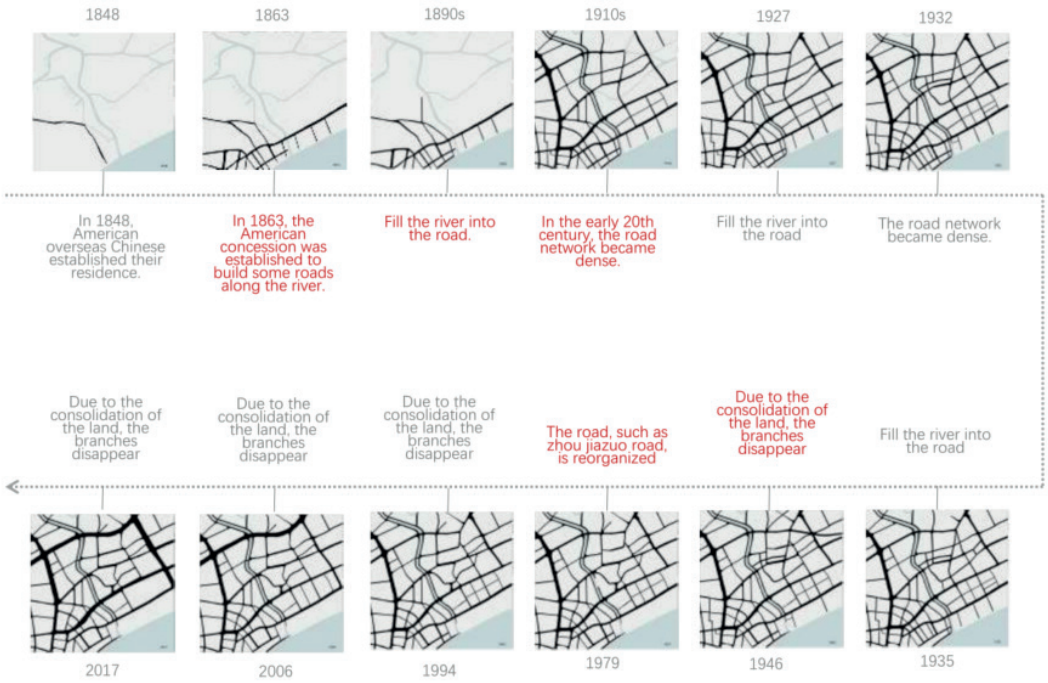

Figure 1. *The evolution of water network and road network of Hong Kou Port from 1848 to 2017.*

a series of problems such as the decline of living environment, insufficient municipal facilities and weak economic development, have been caused.

This study contributes to understanding relationships between the syntactical properties of street design and walking behavior by examining whether space syntax measures in Historic waterfront neighborhood is associated with the walking patterns of residents in these communities, thus discovered the potential which revives the region vitality. It was hypothesized the GIS-based walkability index would be related to household travel patterns such as levels of walking and driving.

2. Methodology

This paper compares the changes of the road network and land use model in Hongkou port area since 1910, and explores its influencing mechanism. Then, through the synchronic study of activities, the distribution characteristics of local residents' outdoor walking activities were analyzed, and the correlation between them and regional spatial morphological variables was discussed.

2.1. *Data and software*

All data are brought into a geo-database using ArcGIS software. ArcGIS is used to store, compute centrality indices and used to visualize the results. Spatial accessibility variables computed using Spatial Design Network Analysis (sDNA) 5 are used in this study. It is a set of multi-level spatial analysis techniques for urban networks. SDNA calculate centrality closeness and betweenness centrality on network with user defined radius with different metrics: Euclidean, Angular, and Topological distance as travel budget.

2.2. *Mean Angular Distance (MAD)*

MAD is defined as the mean (averaged per link) of the angular distance from each origin link to each possible destination falling within the network radius of the origin.It is an accessibility measure, in that lower values of MAD indicate straighter paths to destinations within the radius. Thus,

$$SAD\ (x) = \Sigma_{y \in Rx}\ d_{\theta}\ (x,y)\ P(y)$$

Where SAD(x) is the SAD for link x, z ∈ Ry is each other link y in Rx the radius surrounding x, d θ (x,y) is the shortest possible angular distance along a route from x to y, and P(y) is the proportion of y falling within the radius.

Angular Betweenness (BtA)

Angular betweenness measures the frequency with which each link x falls on the shortest angular path between each pair of other links y and z, provided the Euclidean distance from y to z is within the network radius. For BtA, the network radius can be regarded as a kind of maximum trip length. Thus,

$$\boldsymbol{BtA(x)} = \sum_{y \in \mathbf{N}} \sum_{z \in \mathbf{Ry}} \mathrm{P}(z) OD(y,z,x)$$

Where BtA(x) is the angular betweenness of link x, N is the set of all links in the network, Ry is the set of all links within the defined radius of link y, P(z) is the proportion of y falling within the radius from y, and OD(y,z,x) is defined as

$$\boldsymbol{OD(y,z,x)} = \begin{cases} 1, if\ x\ is\ on\ the\ shortest\ angular\ path\ from\ y\ to\ z \\ 1/2, if\ x \equiv y \not\equiv z \\ 1/2, if\ x \equiv z \not\equiv y \\ 1/3, if\ x \equiv y \equiv z \\ 0, otherwise \end{cases}$$

The 1/2 and 1/3 contributions to OD(y,z,x) handle the cases of routes which terminate on the link of interest, and routes from a link to itself. (1/3 represents the average traffic for each point on a link assuming traffic is generated by the product of origin and destination link proportion). All measures were computed with sDNA software (Chiaradia *et al.* 2014, Cooper *et al.* 2014).

2.3. *Built environment*

Topological relationship between line segments is quantified by a series of configuration morphological variables integration, choice, connectivity, control and depth-through a digital model. Other spatial information of the region, such as land use, storefronts along the street, distribution of historical buildings, etc., are mainly obtained through on-site surveys, historical maps, local Chronicles and other documents. Since privious researches have consistently proved the significant effect of walkability on walking behavior.

We also used other variables such as nocturnal activity point, block entrance, public green space, street activity (the positive features include the scale relationship between street and building and the presence or absence of landscape and plants, and the negtive features include empty of the retail and if there are any construction being built), Street interface(The continuity of the buildings along the street).

2.4. *Walking activities*

The survey of walking activities in the region mainly includes the working days and weekends when the weather is fine, and records the pedestrian traffic volume and walking stay position of residents in different time periods. Pedestrian's gender (male of female) and age were also recorded. Age is divided into three categories: no more than 20 years old which most of them are students, older than 20 but no more than 60 who are mostly still work,so we hypothesised that these two groups will have more commute travel during weekday and more leisure travel during weekend; people who are older than 60 are mainly retired, so we hypothesised that most of their's walking activities will be leisure. Specifically, the walking activity data were obtained from the record of the total walking flow at 35 observation points (each observation point included data collection of two sidewalks on both sides of the street) in the region in 5 periods of the daytime (7:00-9:00,9:00-11:00,11:00-13:00,14:00-16:00, 16:00-18:00) in one working day and one weekend day.

3. Analysis/Results

3.1. *Urban morphyology*

We compared the changes of building texture in hongkou port area from 1948 to 2017. The study found that Wusong road, Xinjian road, Changzhi road, Zhoujiazui road and other roads were widened on a large scale. The buildings of some plots were demolished, and the whole plot became an empty land or green land.As a result, the density of buildings in 2017 was much lower than in 1948.

Historical buildings are an important part of regional cultural resources. Therefore, we investigated the construction time of all historical buildings in the region. The 1920s and 1930s were the period of the fastest development in the region, with large-scale construction of lilong buildings and warehouses. After 1950s, there weren't lots of new buildings, mainly were renovation and reconstruction. After 1980s, multiple plots were merged to produce large-scale commercial residential buildings.

Nowadays, most of the land use are residential, office building are located in the central area while the retail and shopping mall are all located in along the Huang Pu river. Most of the buildings in the area are for residential use, while the buildings along the street are mixed for commercial and residential use, the lower floors are used for retail. Apart from daily food and groceries, the main business types in the residential area are small workshop industries such as hardware processing and warehousing of logistics companies. This type of business mainly serves local residents, and there is no obvious division between them. Commercial land is mostly single office buildings for rent, and there are also large commercial hotel complexes.These formats are relatively independent and have clear spatial distribution boundaries with residential areas.

Most commercial types are small restaurants, but also some grocery and retail stores, 24-hour convenience stores, entertainment and leisure and some small hotels. Most business types are small restaurants, but also some grocery and retail stores, 24-hour convenience stores, enter-

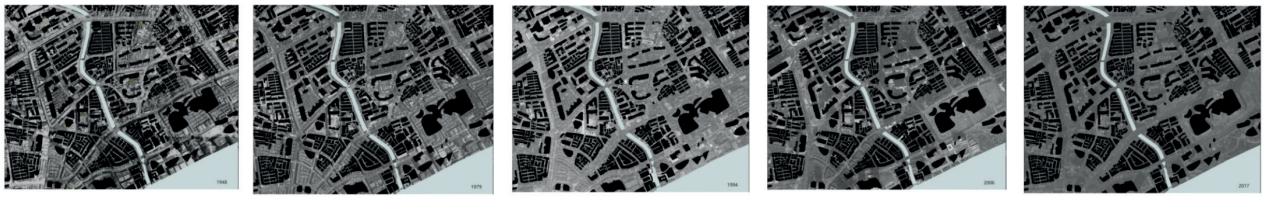

Figure 2. *The building texture in Hong Kou port area from 1948 to 2017.*

Figure 3. *Historical building construction period.*

tainment and leisure and some small hotels.Retail is so concentrated in the streets that there are some streets with no retail on either side. The main types of local shops are daily catering and consumption for residents.Most of these shops are small, poorly equipped and less attractive to migrants.In addition, the lack of accommodation services inside the base also has a negative impact on the diversity of the local population and the tourist experience.

Based on the scale of the street and the buildings around the street, whether there is landscape or green plants on the street, we evaluated the active streets within the study area.On the other hand, if the retails along the street are dilapidated or vacant, or there are buildings under construction around the street, we will consider these as relatively negative factors.

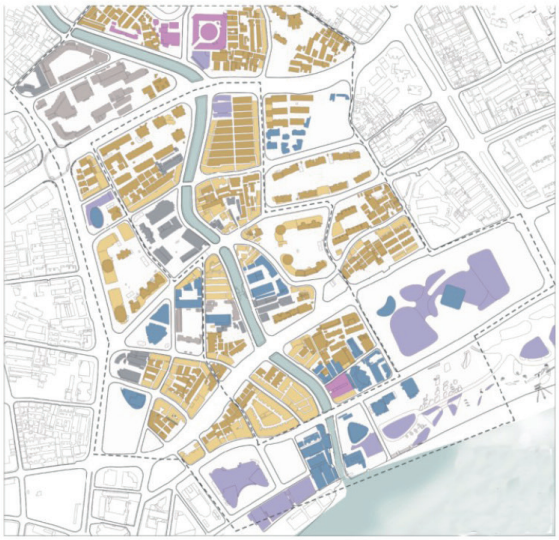

Figure 4. *Land use of Hong Kou Port.*

Figure 5. *Historical building construction period.*

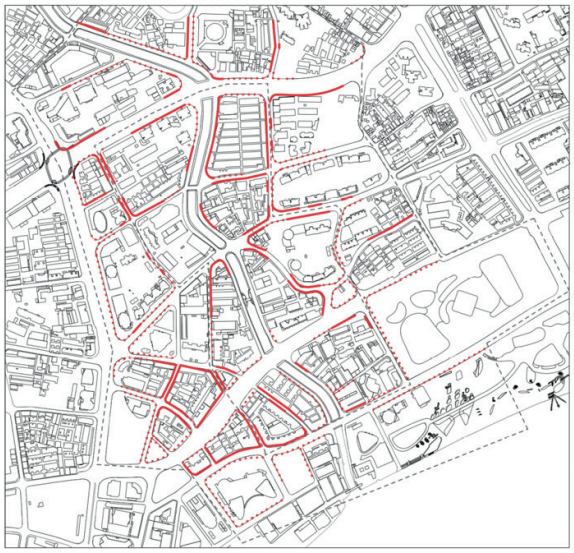

Figure 6. *Positive streets.*

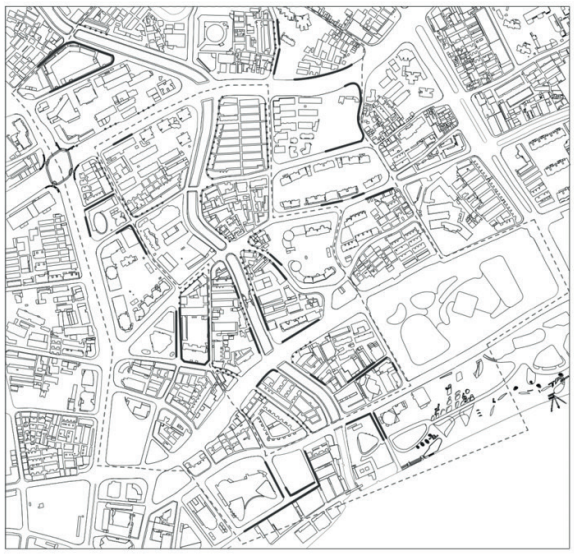

Figure 7. *Negative street.*

3.2. *Space syntax*

We analyze the accessibility of the pedestrian network in hongkou port area with a radius of 300m,400m,500m and 800m respectively, and study their MAD and BtA respectively. According to the data, the MAD and BtA values of different streets have little difference. Compared with the other two completely different areas of Shanghai road network under the same conditions, we can find that the street network in hongkou port area is relatively uniform due to the small difference in accessibility, and no aggregation area with high accessibility has been formed.

We fitted the accessibility value calculated by sDNA with the actual observed human flow data, we found that the data fitting degree of 7 observe points was low, so we deleted them. The reasons for the low fitting degree may be due to emergencies, mean errors, or the demolition of buildings around the street.

3.3. *Data analysis*

Linear regression models were used to measure the correlation between built environment and walking behavior. Since all of the VIF value are no more than 10, there were no collinearity situation.

Walkability and BtA(R=300) are significantly correlated with average hourly pedestrian flow.

R=300 BtA of Hong Kou port

R=500 BtA of Hong Kou port

R=500 BtA of Xu Jia Hui

R=500 BtA of Xu Jia Hui with underground connection

Figure 8. *BtA value in different radius*

coefficient [a]

模型		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	CERR	Beta	t	sig.	tolerance	VIF
1	(常量)	36.654	89.749		0.408	0.684		
	Avg_MAD300c	-0.468	0.283	-0.333	-1.652	0.103	0.344	2.903
	Avg_BtA300c	0.010	0.062	0.035	0.155	0.878	0.280	3.571
	Avg_MAD500c	0.480	0.303	0.333	1.585	0.118	0.316	3.161
	Avg_BtA500c	0.016	0.015	0.266	1.100	0.276	0.239	4.188
	Retail density	149.249	282.372	0.066	0.529	0.599	0.907	1.102
	walkability	0.353	7.964	0.005	0.044	0.965	0.918	1.089

a. Dependent variable: total number of people per hour

Figure 9. *Coefficient result.*

4. Discussion/Conclusion

Patterns of land use and street network have been linked with a wide variety of behavior and environmental consequences. In particular, commercial development with separate uses has been associated with commute walking, leisure walking, and public health. Improvements in the measurement of land use could contribute to advances in research in health, transportation, and behavioral and social science disciplines. Because there are socioeconomic and racial/ethnic disparities in most health outcomes related to land use, it is important to understand the health effects of environmental variables in diverse populations. The purpose of the present article was to develop, test, and apply a method of neighborhood selection for environment and health studies combining walkability and socio-demographic factors.

Based on the results of spatial syntax, we can find that the street index value of MAD and BtA is relatively similar, and the overall road network structure is relatively homogeneous. There's no cluster area with high accessibility been formed. Therefore, we believe that road network density cannot simply be used as an indicator to evaluate the accessibility of an area, because it is still not contributing to establish a place where a large number of people can be attracted and gathered. And based on this case study, the traditional residential water-front areas have difficulties to be transformed into agglomerative commercial district due to the grid – like uniform shape of the road network. In places with low accessibility, the concentration of people is mainly due to the land use mode and the concentration of a large number of retail businesses. For local residents who are familiar with the road network structure, there is no negative impact, but it is not attractive to potential tourists in the future. That also means these retail businesses won't have a chance to grow.

Since the 1980s, many roads have been widened, which made the area enclosed by four main roads closed, making it more difficult for peripheral pedestrians to enter. On the other hand, due to the lack of crosswalks, the pavement in the road network is not continuous, which further increases the difficulty for this area to communicate with the outside. This indicates that the degree of pavement continuity has a significant impact on the accessibility of the entire street network.

In addition, the roads in the waterfront area are parallel to the river, while the number of branches directly perpendicular to the river is very small, which directly affects the accessibility of the riverside area.

Analysis of accessibility in the context of the research has revealed that the impact of proximity to the commercial land use on the distribution of walking activities is continuously weakening, while the integration of streets is becoming more and more important. The results of the morphological analysis of temporal-spatial evolution can be used for the prediction of their future development.

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City's Perceived Image and Urban Waterfront Morphologies

A City Branding Strategy Approach

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Keywords: urban morphologies, perceived image, city branding, symbolic economy.

Abstract: The management of spatial planning processes by composing a spatial narrative concerns the act of symbolic economy that aims to create a competitive place identity with benefits and opportunities for sustainable economic investments. The process may be linked to mechanisms of symbolic economy having cultural and political intentions. Thus, the cultural assets may be treated as active elements in the formation of the perceived image of a place and spatial elements of the desired imaginary content that this image defines. The proposed paper analyzes the paradigms of Mediterranean cities' waterfront as highly performative in the perceived image of the cities' urban cores, related to capital investment and the production of cultural concepts. Specifically, it examines brand equity as this has been defined by a set of regulatory fields in existing city branding research. The proposed methodology contributes to the creation of a spatial narrative and places the urban morphologies at the core of urban branding strategies. Thus, the structured space is treated as an activator of spatial developments, of capital investments and of cultural symbols. The process of investigation concerns the capital investments where urban morphologies seem to control perceptions and to form a competitive cultural identity as a strong economic core and a catalyst for consumer behavior.

1. Introduction: Urban waterfront morphologies and the city's perceived image

The planning process of composing a spatial narrative concerns the act of symbolic economy that aims to create a competitive place identity with benefits and opportunities for sustainable economic investments. The reading method adopted for examining the place brand equity of selected Mediterranean cities' waterfront is based on the notions of symbolic economy, competitive place identity and the argument that the city's imaginary is readable within its spatial narrative.

Within this general frame of reference (both symbolic and morphological) the paper analyses the cities' waterfronts as highly performative cores of the city's perceived image. The analysis has been carried out as a cultural and spatial investigation of the morpho-imaginary process that determines the consumer's behavior.

The methodology of analysis of place brand equity estimation is based on the hypothesis that the composition of a waterfront's spatial narrative concerns an act of symbolic economy "writ-

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ten" within its building fabric. In this interpretation, "the reading" corresponds to the structure itself and it is perceived as a cultural asset with political intentions. Moreover, a comparative framework between cities' waterfronts, based on the regulatory fields of place brand equity (Michael, 2018) and their building fabric may have several advantages over places' competitive identity. First, the place brand equity may influence positive perceptions that indicate the basic structural rule of a narrative that is *the imaginary*. Second, may influence the consumer behavior.

In this study we introduce a new approach for examining the competitive identity of a place through urban morphologies and a set of regulatory fields of place brand equity. In particular, the places' brand equity estimation will be compared between the selected Mediterranean cities' waterfront and their potential for further cultural and economic development will be discussed.

2. Competitive identity and the importance of symbolic economy in urban waterfront morphologies

Urban waterfront development is a well-established phenomenon in urban design discourse, internationally. This phenomenon is gradually rising as a central topic in the most Mediterranean cities during the last decade both on academic level and design projects (see Gospodini, 2001; Breen and Rigby, 1996; Bruttomesso, 1993; Craig-Smith and Fagence, 1995, etc.). The intense interest in communicating the positive perceptions that indicate the basic structural rule of a narrative, corresponds to the traces of a place' morpho-imaginary. Such traces have a direct impact on almost all aspects of a city's cooperation with other places and an important role in its economic upgrading. The "reading" approach of the building fabric combines the structure itself and the acts of symbolic economy. In this competitive framework, the term of symbolic economy includes two parallel systems of production: (a) the production of space with the synergy of capital investment and cultural concepts; and (b) the production of symbols (as elements of concept depiction which both construct a means of commercial exchange and a language of social identity) (Zukin, 1995 in Σουλιώτης Ν., 2013). This process of composing a competitive identity of a place through its image and cultural assets, that is the city branding process, is attracting the keen interest not only of research and academic community (Anholt, 2004, 2007, 2010; Dinnie, 2011; Klingmann, 2007; Kavaratzis & Ashworth, 2005; Middleton, 2011) but of the tourism industry also (Gallarza, Saura, & Garcia, 2002; Tapachai & Waryszak, 2000; Vaughan & Edwards, 1999; Walmsley & Jenkins, 1993). At the same time has the objective to attract visitors, investment, and new talented residents for relocation (Ashworth G., 2009; Ashworth & Voogd, 1990; Lash & Urry, 1994).

From this conceptual interpretation of the built environment, two fundamental approaches are identified (Critchley, 2014; Kavaratzis & Ashworth, 2005), the political economic approach which focuses on the material nature of society and the symbolic economy. These approaches concern the rejection or acceptance of the building fabric to spatial representations and spatial narratives.

The demand of places to develop comparative advantages against other places lead to the composition of spatial systems, where the size, color and the overall unique and different form of planning manage an enriched imaginary content (Michael, 2008). This constructed message is created with the intention to produce the desired associations by projecting the vision of a place. At the same time, the landmark-symbol seeks the communicative process (the form and the spatial planning) which will lead to certain target groups. Furthermore, innovative designs attempt through

dominant to the cityscape building constructions to create a homogeneous set of impressions. The experience of "unique" situations is interpreted to the composition of "unique" constructions where architecture and urban design seems to play, in the planning process, the game of shapes and dominant images (Michael, 2008). The pompous spatial traces are easily then transformed into a symbolic building image, a cultural asset that leads to the city that belongs.

3. The methodology of analysis of place brand equity through a set of regulatory fields

In City Branding strategies, the enrichment of the conceptual content of an architectural object with cultural, different, innovative, distinct references is interpreted as a process of creating a visual trace a spatial symbol with a conceptual content. At the same time, the architectural object aims to easily be transformed into an image and a landmark responding to the central issue of the self-identification of populations while the architectural object produces political and economic meanings which are attached to its symbolic content. Thus, by controlling the perception processes, strong economic cores and catalysts of consumer behavior are created. This process could be interpreted as place brand equity enhancement and it is supported by the following two dimensions: A) The ability to influence perceptions and B) The challenge of consumer behavior (Florek, 2015)

The paper follows a methodology of analysis through a set of regulatory fields that concerns the evaluation of place brand equity of notes and urban cores by the existing research (see Table 1; Michael, 2018). According to this it investigates the performance in the perceived image of urban waterfronts of the selected Mediterranean cities.

4. The estimation of place brand equity of urban waterfront morphologies to Mediterranean cities

The waterfront of Limassol, is a highly performance urban core in the perceived image of the city. While its spatial projection dominates in an aerial view its visual exposure is also wide at the eye level along the entire length of the costal line. The aerial outline exploration identifies that its linear composition attempts to unify a limited number of landmarks with "show off" spatial characteristics. It is noteworthy that, while the unique design of the tall buildings is projected to the urban outline causing at the same time emotions of "astonishment", it has no return on new developmental actions or on the social recognition. Additionally, the presence of tall buildings as visual traces on the urban waterfront is not supported by the spatial narrative of Cypriot coastal cities where "sea and sun" are the key benefits, the comparative advantages and the dominant reason for visitation. Moreover, the coastal front expresses intentions of visual integration but its existing linear spatial elements are tourism infrastructures with insignificant, underdeveloped, low quality urban morphologies.

Limassol Marina seems to be "The Activator" of the coastal development which attracts new investments, supportive or in continuity to its function. Its conceptual context (*the imaginary*), the urban symbols and the positive associations refer to an economically and technologically advanced urban fabric, enriched with unique experiences for the visitors.

According to the above, the place brand equity of Limassol waterfront is estimated through conceptual meanings that challenge positive associations of a modern and technologically ad-

Table 1. *Set of Regulatory Fields of Place Brand Equity of Notes or Urban Cores to Spatial Narrative (Michael, 2018).*

A/A		
A1	Social/ Political	Social acceptance and the effect on the urban cultural landscape
A2	Cultural/ Symbolic	Cultural acts on the urban landscape (i.e. upgrading of cultural environment, promotion of values and symbols, etc.).
A3	Conceptual	Challenging positive associations in the urban cultural landscape (i.e. technologically developed landscape, energy-advanced cultural landscape, etc.).
A4	Qualitative	Qualitative effect on the urban cultural landscape (i.e. creativity, uniqueness, liveliness etc.).
A5	Environmental	Effect on the environment (i.e. the impact on sustainable development, the impact on existing environmental values, etc.).
A6	Developmentally	Ability to challenge new investments and actions in continuation or in a supportive way of Activators' function with lasting effect.
A7	Response to the city's vision and to specific target groups.	Challenge visitation, investment activity and habitation with conceptual and functional content compatible with the imaginary and target groups.
A8	Competitive according to architectural and urban design	Competitive dynamics (i.e. unique designs, non-replicable, recognizable, symbolic, correlated with the desired imaginary content).
A9	Design which is Spatial Projected	Distinct designs from dominant perspective views, with a visual trace that can be easily transformed into an image, a sign and a landmark.
A10	Emotional Responses to Unique Experiences	Challenge emotional responses which identify a place through unique experiences.
A11	Spatial Correlation	Spatial correlation with the cultural, local symbols and spatial pathways.

vanced urban environment. At the same time Limassol's urban waterfront morphologies promise unique experiences to visitors and new residents. Nevertheless and despite its ability to attract developmental actions, a set of tall buildings to the cityscape has negative impact on environmental assets and limited social acceptance. Moreover, the Limassol's perceived image raises the following questions: Which is the imaginary that the city wants to project? What are the spatial symbols which support the city's imaginary? And which cities Limassol attempts to compete with? In other words, which are the symbolic spatial elements that compose its competitive identity and at the same time display a competitive imaginary content?

We argue that city's urban scale doesn't permit to compete other destinations where their spatial narrative refers to the production of tall buildings such as Dubai or Singapore. More

important to that, Limassol's imaginary is able to be correlated with its existing cultural and natural assets, creating at the same time perceptive spatial symbols to the city's narrative.

In Cyprus so far, the phenomenon of urban waterfront morpho-imaginary design as a means of economic development in the framework of between cities' competition, identifies Marina of Ayia Napa as a new developmental "Activator", a new urban core westward oriented from the existing port and tourist center of Ayia Napa. The development aspires to attract new residents, investors and new visitors while its spatial projection and its unique and distinctive character reveals the need to compete with other destinations. In the context of spatial dominance both in aerial view and in eye level, two towers are raised to the city's outline. Moreover, the building fabric is extended towards the sea, while an Event Center and Residential Villas promise multi-sensory experiences. The design seems to challenge further economic activities and at the same time to increase the place brand equity of the city. However, and despite the emphasis of the urban morphology on important place assets such as the "sea and the sun", the spatial correlations of Marina with other urban cores seems to be limited.

It seems that, the place brand equity estimation of Marina of Ayia Napa reveals conceptual meanings of a modern place that challenges unique experiences to visitors and new residents through recognizable spatial symbols. The "reading" process of its urban morpho-imaginary identifies through dominant perspective views, a distinct design and a visual trace that can be easily be transformed into an image and a sign. However, the question that could be raised concerns the lasting effect of its perceived image to attract capital investments and visitation when the «astonishment effect» will no longer exist.

According to the above paradigms of cities' waterfront we can develop a two-fold argument: First, one of the key factors affecting new urban waterfront developments concerns «show off» morpho-imaginary actions. Second, cities' waterfront have become attractors of a highly competitive economic environment in which traditional factors (i.e geography, physical infrastructure) that once affected the location of a new business to a specific place, matter less than ever (see Sassen, 2001 in Gospodini, 2001).

In this framework of cities' competition it is rather significant to describe the waterfront morpho-imaginary development of other than Cypriot Mediterranean cities, such as Rhodes, Chania, and Valetta. The «reading» of their projected images corresponds to a spatial narrative with traces of different historic phases. Such traces are not necessarily represented by archaeological remains, but by property boundaries, routes and rows of trees in the urban context. The estimation of their place brand equity (according to the regulatory fields mentioned above), is a reference to a building cluster that consists spatial symbols enriched with cultural content, socially accepted, non-replicable, recognizable and distinct from dominant perspective views. Their visual trace has been transformed into an image and a sign with a lasting effect in visitation and capital investments. Moreover, their spatial narrative concerns correlations of cultural and local symbols that promise experiences of "unique situations" timeless and associated with the waterfront's perceived image.

Following the cases of successful destinations such as of Barcelona, the composition of the city's waterfront morphology concerns a holistic city branding strategy. Barcelona's spatial narrative reflects a solid message with conceptual correlations of an advanced cultural-modern place and a strong tourist destination with a lasting effect. Although its development involve "show off" actions, such as the involvement to the design of "star-architects", or the introduction of morphologically notable architectural elements, urban notes and cores to the city's *imaginary,* the strategy implemented established networks of relationships through pathways of development of traditional and new centers. This approach describes the wider transformation

of Barcelona in a multi-center field with strong associations and symbolic meanings integrated to urban notes and cores (see Rowe, 2006, p. 164). This city branding strategy was highly performative in the perceived image of the city's urban core and attracted new residents, architects, technology specialists and visitors in general. This reflects the communication dynamics of architecture and urban morphologies in projecting the imaginary of the city.

All the above discussion allows us to suggest a strategy that will implement the set of the regulatory fields of place brand equity to urban waterfronts of Mediterranean cities with the potential for further cultural and economic development.

5. Conclusions

The analysis of the place brand equity of selected Mediterranean cities' waterfront emerges that the best approach to city branding strategies is the emphasis to their strong historical background and new cultural developmental processes that is the cultural orientation. The apparent repetition of morpho-imaginary design processes that promotes "show off" buildings does not support their competitive identity. On the contrary, their projected image could be easily replicated by other places eliminating at the same time its comparative advantage.

The implementation of the set of regulatory fields of place brand equity to Mediterranean cities' waterfronts could be a chance to change the established "show off" urban design practice. The new approach could treat their cultural assets as an active elements of their desired imaginary composition. Furthermore, could be a challenge to improve the cities' perceptions and at the same time form a relationship between the sea and the building fabric. Finally, the urban waterfront of Mediterranean cities could be placed on the urban map of Europe as competitive destinations with distinct perceived image.

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Cityzoom's Visual Dominance Analysis: Visibility in Urban Environment

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Keywords: Urban Morphology, Visual Preponderance Analysis, Computational Simulation.

Abstract: The preservation of historical areas is frequently impregnated with passionate arguments and very few objective data. In this paper, it is argued that objective data could emulate less passionate discussions and lead to more consistent conclusions. Strategies aimed at preserving the visual relevance of historical buildings (Lehnerer, 2009) may, in some cases, prevent new designs to be built in old and traditional areas. Visualization Models can help to structure public opinions based upon quantitative and qualitative assessments of the urban scene. CityZoom's Visual Dominance Model quantifies the visual impact of buildings from multiple points of view and indicates the positions from where targeted buildings or urban scenes would be more or less visible. The Model is applied in a case study in the city of Porto Alegre to demonstrate how analytical assessments of visual impact could be used to mediate discussions on new objects in preservation areas. The analysis has indicated that CityZoom's visual dominance parameters can be quantitatively used to describe the visual impact of new buildings and therefore help urban planners and users to be less subjective and more assertive when discussing urban preservation strategies.

1. Introduction

Contemporary Urban Planning Systems present, more often than not, deploy strategies aimed at preserving the visual protagonism of landscapes or historical buildings through viewing corridors, visual basins or viewsheds (Lehnerer, 2009). In many circumstances, the application of such strategies do not take into account that new buildings may not substantially affect or even contribute to the visual prominence of a historical building. Sometimes, regulation strategies may end up generating excessively rigid building constraints and thus inhibiting the social and economic development of city sectors.

The visual impact of new objects on historical buildings is related to the study of visual perception of urban objects in different settings. The creation of objective criteria for the cityscape analysis has been supported by different theories (Gestalt, etc). Lynch (1960) defined that places are understood and interpreted from specific physical elements of the existing space, represented in mental images which are constructed from the visual memory of reference points. Cullen (1961) proposed the concept of serial vision to illustrate the complex and fragmented way in

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which urban scenarios unfold before an observer's eyes. Benedikt (1979) diffused the concept of isovist, a basic modeling of the available field of view from a specific point of view, which enabled the conversion of visual perception into quantifiable metrics (Morello, 2017). Turner *et al.* (2001) introduced the concept of Visual Graph Analysis (VGA), shifting the focus from geometric measures towards connectivity and graphs measures: while isovists describe how visual conditions vary across space, VGA describes the relationship of a point with the whole structure of intervisible points (Izaki, Derix, 2017).

City Information Modeling software commonly offer visibility and/or occlusion analysis models: CityEngine enables the simulation of the field of view of a passer-by (CityEngine, 2019), ArcGIS supports the assessment of objects viewed from different stand points (ArcGIS, 2019) and CityZoom software quantifies the visual impact of buildings from multiple points of view (NTU-UFRGS, 2019). These computational tools can be applied to describe the visual impact of urban scenes based on quantitative assessments of the visual impact of new buildings upon the existing urban environment.

CityZoom, developed by the Urban Technology Group (UTG -UFRGS), supports the impact analysis of cityscapes regarding urban strategies, policies and regulations. CityZoom enables the 3D modeling of urban fabrics, the 3D simulation of urban rules, the environmental analysis (shading and lightning) and 3D visual perception analysis (Turkienicz *et al.*, 2008). Cityzoom's Visual Dominance Analysis Model computes the relative dominance, in an observer's field of vision, of different objects during a route travelled by this observer.

In this paper, two visual impact methods supported by Cityzoom's Visual Dominance Model are used to investigate the interference of new buildings in historical preservation areas. These methods were applied in a case study for a set of blocks of the city of Porto Alegre, Brazil, in which new buildings proposals were simulated near a historical building. The visual dominance of simulated buildings and the historical building were computed with CityZoom's Visual Dominance Model and a comparative analysis performed.

The description of the analysis is divided into three sections. In the first section, Cityzoom's Visual Dominance Model is described and the methodology of the analysis is presented. In the second section, the results of the case study are presented. The last section presents the discussion and conclusions.

2. Methodology

CityZoom's Visual Dominance Model is based on the representation of visible and occluded spaces defined by Benedikt (1979), in which, given a region D of the space where inside is located a point of view x and material surfaces Sm, an isovist (Vx) is defined as the set of all points within D which are visible from x, i. e., $Vx = \{ v \in D: v \text{ is visible from } x \}$. For a point located on a surface Sm to be visible, it is necessary that no other surface obstructs the direct connection between the analyzed point and the point of view x. This definition can also be extended to a set of Vx in order to represent the visibility of an observer traveling a certain path. In this case, the visible surface areas of the various isovists are superimposed and the space covered by them is considered visible.

The definition proposed by Benedikt (1979) considered, exclusively, the two-dimensional space. Therefore, in order to create a three-dimensional representation, it would be necessary to describe the reach of the observer's field of view in the vertical plane. Considering a horizontal viewing angle equal to 360° and a vertical viewing angle equal to 180°, a half sphere representing

the visible space from a point of view is obtained, with its dimensions given by the maximum range of the observer's vision (Dalton; Dalton, 2015; Thiel, 1997). In order to simulate the human vision, Cityzoom's Visual Dominance Model utilizes a specific viewing direction, such as proposed by Derix *et al.* (2008): the viewing angles are constrained around the viewing direction according to the limitations of the human vision. This delimitation of the viewing angles results in a conical field of vision, which is used to define as visible the surfaces exposed directly to it. A Gaussian distribution centered in the viewing direction can be used to gradually distinguish what is in the central view, rich in details and of greater importance to the model, and what is in the peripheral vision, with few details and less importance.

In order to enable the computation of performance measurements for each part of buildings' façades, Cityzoom disaggregates the surfaces of 3D models into sets of triangles. Each of these triangles is an object capable of storing information about its geometry (perimeter and area), its performance (shading, illuminance, visual dominance) and the objects to which it belongs (building, lot surface, street surface). This computational model enables the description of a building's visual dominance using two different sub-models.

In the View Plane sub-model (upper half of Figure 1), the field of view of an observer in a specific position is represented in a View Plane which is disaggregated in pixels. CityZoom identifies the triangles "address" appearing in the View Plane, enabling the Visual Dominance of a building to be calculated as the quotient between the area (in pixels) occupied by the analyzed building in the View Plane and the total area of the View Plane.

In the Point Cloud sub-model, each one of the façades' triangles receives the information of its visibility from a specific point of view. By calculating, for the façade of a building, the area corresponding to all its visible triangles, it is possible to obtain the total visible facade area of the analyzed building from a specific point of view. The simulation of multiple points of view using a point cloud and the computation of the visible facade area of a selected target building – i.e. building whose visible facade area will be computed the analysis – for each element of the point cloud enables the visualization of how much facade area of the targeted building is visible from different points of an urban area. The Point Cloud sub-model is illustrated in the bottom half of Figure 1.

Such descriptions of buildings' Visual Dominance can be used to quantify the visual impact of new buildings upon existing scenarios. Test scenarios were defined where new buildings occupy the background of a historical interest building and differential visual impacts of these new buildings were measured, according to the following procedure:

- 1. Modeling of the scenarios: the 3D model of the analyzed area is generated in CityZoom from shapefiles containing the information of topography, roads, islands, lots and buildings.
- 2. Definition of the observer's point of view: for the View Plane sub-model, points of view are defined in the 3D model in order to simulate possible paths traveled by an observer around the area of visual interest. For the Point Cloud sub-model, an area was defined to receive a set of equidistant points representing an observer's possible point of view.
- 3. Simulation of new buildings: new buildings are simulated near the building of historical interest using the CityZoom's Urban Rules Simulation tool.
- 4. Visual Dominance Analysis: the Visual Dominance can be quantified following the simulation of the observer's view for each of the simulated points of view (View Plane sub-model) or by assessing the visible facade area of targeted buildings from different points of view using the Point Cloud sub-model. The results are represented for each

simulated scenario, colored according to the amount of the targeted building's facade area it visualizes.

– The Cityzoom's Visual Dominance Model was applied in a case study for a set of blocks located in the *Quarto Distrito area* in Porto Alegre. The analyzed area contains a Methodist Church listed as a municipality's building of cultural and historic interest. The City Urban Rules allow, in the neighboring lots, the construction of new buildings with greater height and gross floor area than today's existing ones. The visual interference of these new buildings with respect to the church can be assessed computing the visual dominance of these targeted buildings. The case study modeled the analyzed area in CityZoom and simulated new buildings in the background of the historical church.

3. Analysis/Results

The Viewing Plan method compared different scenarios of Visual Dominance whereby the historical church and the new buildings are associated. Figure 2 presents the location of the simulated points of view for the View Plan method and a comparison between the existing views of the historical church and the simulated viewpoints from the same position. Figure 2 also

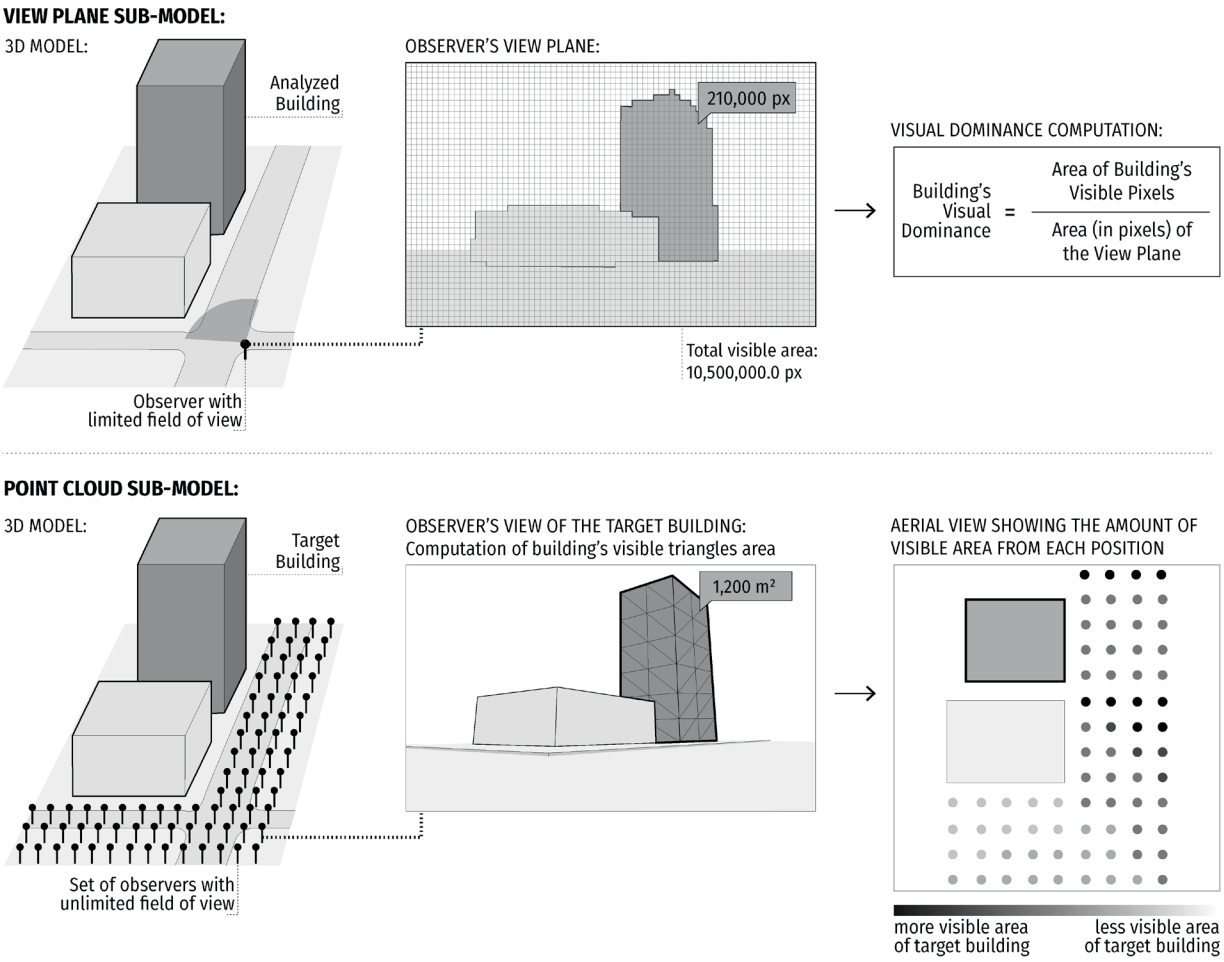

Figure 1. *CityZoom's illuminance analysis sub-models: View Plane and Point Cloud.*

presents the modeled buildings for each simulated scenario and the observer's Viewing Plan for these simulated scenarios: the historical church is represented in black color, while the church's existing neighboring and the simulated buildings are represented in gray.

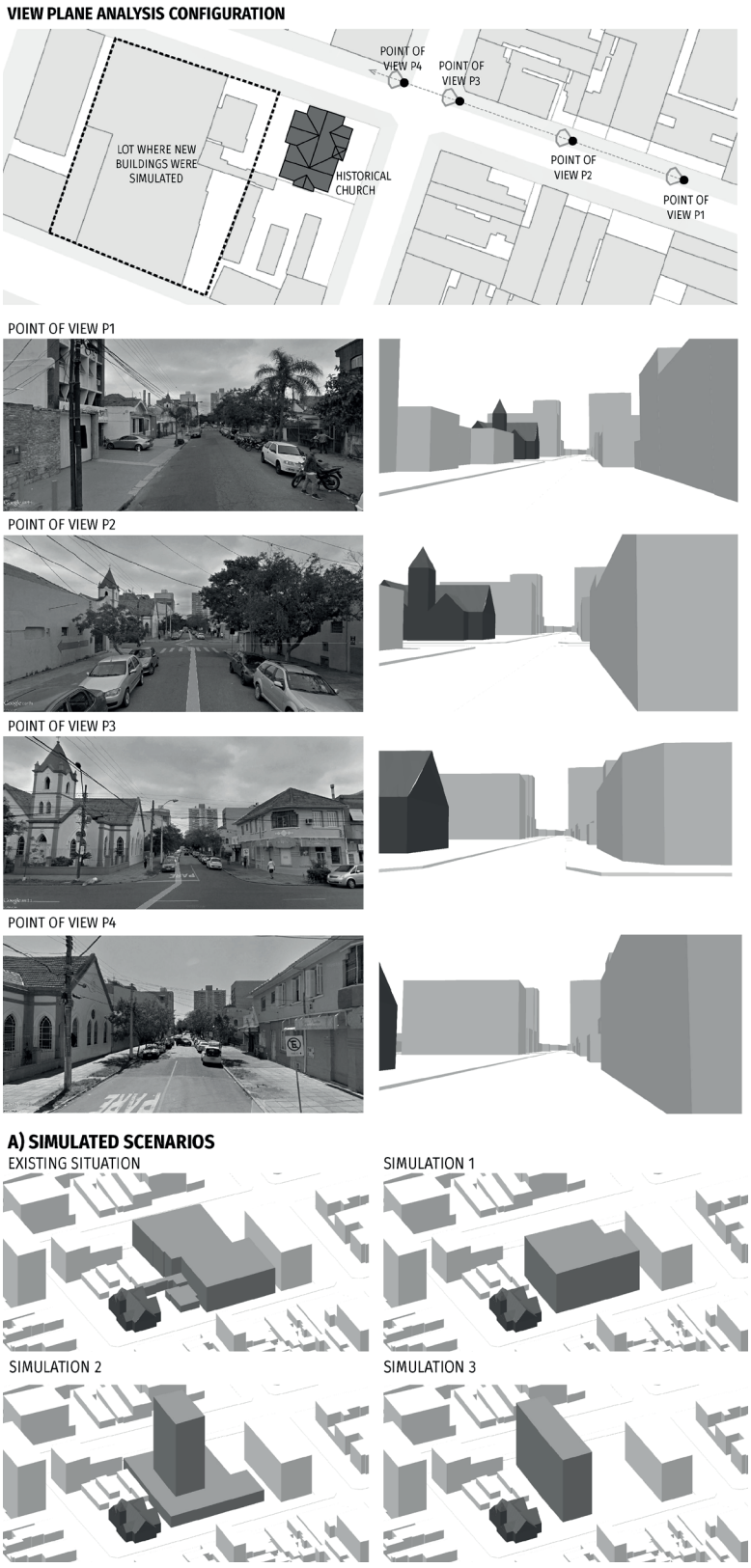

Figure 2. *Analysed points of view and simulated neighboring buildings (images of the existing situation taken from Google Earth).*

In the upper half of Figure 3, images are organized in a table, in which each column represents a modeled scenario (the existing situation and three simulations) and each line contains the View Plane from one point of view: the upper lines present points of view which are farther from the church (P1 and P2), while the lower lines present closer points of view (P3 and P4). The bottom half of Figure 3 describes how the Visual Dominance changes as the observer travels from Point of View 1 (P1) to Point of View 4 (P4). Bars indicate the point of view strength with respect to a particular building in that it occupies more or less area of the observer's field of vision from that specific point of view. The graph indicates that a) the visual dominance of the historical church increases as the observer travels from position P1 to position P4 and b) the proportion of dominance values do vary from different positions.

Figure 4 presents the results of the Point Cloud application, with Aerial Views of the analyzed 3D Model and an isometric perspective zooming in the area around the targeted buildings. Each horizontal row of images of Figure 4 correspond to a modeled scenario, while each column presents the resultant analysis using a specific building as target: on the left column, the histori-

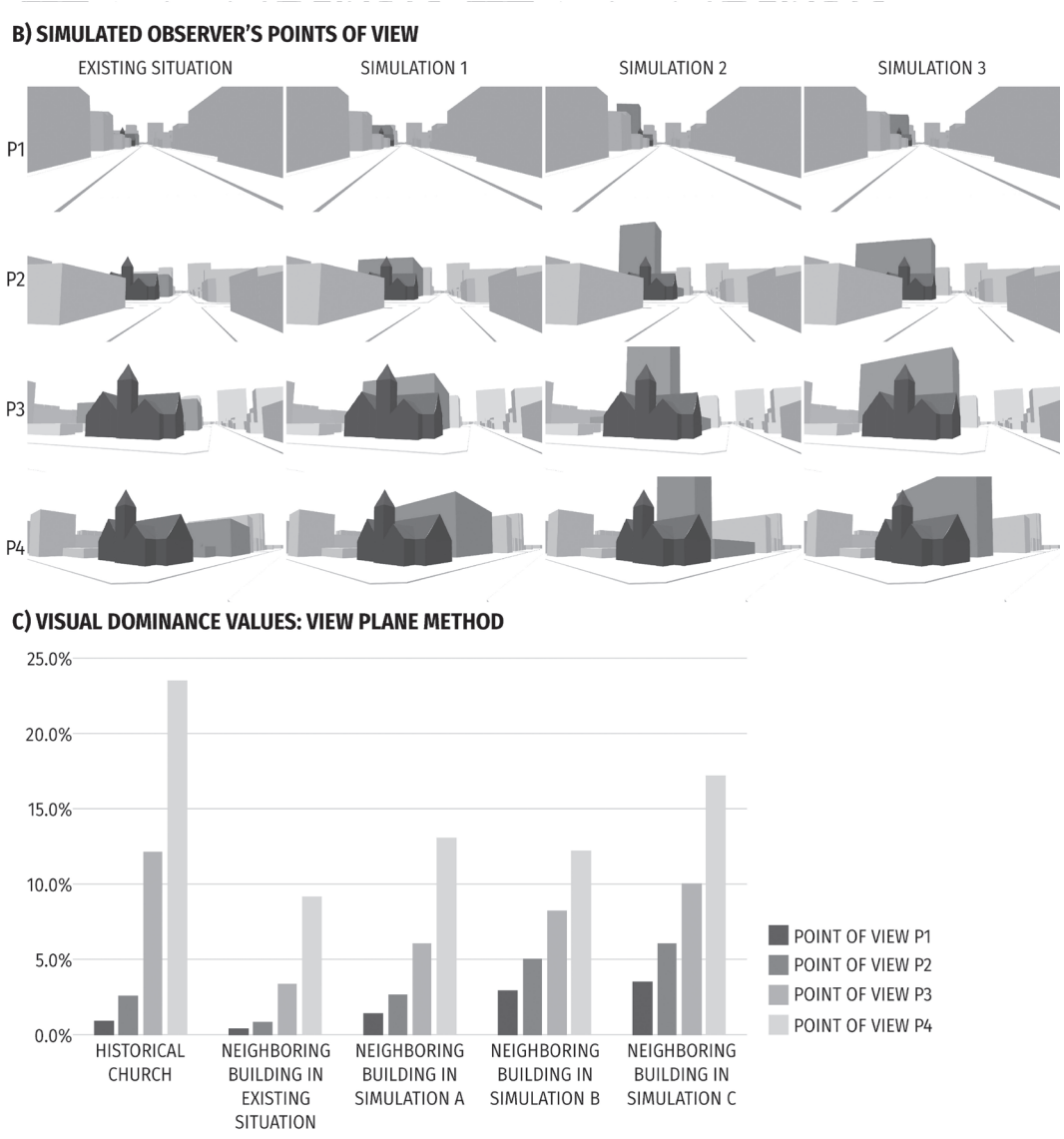

Figure 3. *Observer's Points of View and Visual Dominance values for each point of view according to the View Plane sub-model.*

Figure 4. *Results of the Point Cloud Analysis: aerial view and isometric perspective representing the visibility of target buildings (colored in black) from each position of the surrounding area.*

cal church and, on the right column, the neighboring buildings. In the Aerial Views, each point is colored according to the visualized area of the targeted buildings: the darker the colors the higher percentage of the targeted building's facades is visualized. In the isometric perspective, the same color scale is complemented : the taller bars represent viewpoints from where the higher percentage of the facade area is visible.

If the observation value of the church does not significantly change, the simulated buildings's observation value is significantly different to each scenario: the taller buildings of simulation 2 and 3 become visible from farther away and can be seen along a great length of the street axes which are adjacent to the historical church. In other words, at long distances the church do not have as great protagonism as the new buildings: simulation 3 features the highest percentage of " protagonism" with respect to the two other simulations. At short distances this protagonism is substantially shared with the new buildings.

The point-cloud analysis demonstrates that the prevalence of the new buildings along the examined route (P1 to P4) also extends to the adjacent neighbourhood. Figure 4 shows that a new "new landmark" was established in the studied context, somehow "competing" with the church. The level of visual competition varies according to the simulated building's shape.

4. Discussion/Conclusion

This paper aimed to demonstrate that the Cityzoom software could be used to quantitatively describe the visual impact of buildings in historical preservation areas, enabling the comparison between a) the visual dominance of existing buildings and proposed ones; b) the visual dominance of specific buildings from different regions of a given urban area. The achieved results demonstrated that CityZoom software can numerically capture differential visual dominances present in urban scenes. CityZoom can effectively support discussions on built form thresholds and urban form regulations if the tool and its functionalities are heuristically used to enlarge the planner's or the user's perception of the built environment. In fact, both the planner or the user usually retrieve localized perceptions of the urban space: CityZoom analytical tool allows these agents to acquire a precise awareness of the simultaneous impacts imposed by new buildings on historical areas. The first methodology offers a dynamic description of the space depicted from different *snapshots* of a specific route whereas the second methodology supports the assessment of the relative visual value of specific urban regions with respect to landmarks and/or significant landscapes.

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Urban Design: Urban Morphology, Building Typology and Design

Study on the Optimization Design Strategy of Urban Fragmented Space From the Perspective of Architectural Typology

by Xie Shujiao
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Keywords: Architectural Typology ; Urban Fragmented Space; Optimization Design
Conference topic: Urban Design: urban morphology, building typology and design/planning

Abstract: In the relational theories and researches, it is widely recognized that the urban space should be valued while the urban fragmented space, also as a part of the public space, which is closely and inseparably related to people's daily life, got very little attention in the process of rapid modernization. Such space is often ignored both by users and designers.
This paper takes the fragmented space in Shanghai as an example, applying the theory of architectural typology and urban morphology to define the urban fragmented space and analyse the formation cause, spatial forms and elements. Through the filed investigation and theory research, it concludes the existing problems of urban fragmented space such as the low spatial utilization efficiency, environmental pollution and poor spatial quality.
It proposes the optimization design strategy from the aspects of function definition, interface and detail design, scale control and the application of new technology.It hopes to have a positive effect on the design and development of the contemporary urban public space, improving the quality of urban space and providing a more comfortable and energetic space for citizens.
This paper is subsidized by NSFC project which is named as<Research on Technical System of "Downtown Factory"Community-oriented Regeneration in Yangtze River Delta Region>,NO.51678412.

1. Introduction

The urban scattered space is an important part of the public space of modern cities. Chinese cities are still in the process of urbanization, and the scale of cities is expanding, resulting in a variety of urban scattered spaces. These spaces are created by the influence of history and nature factors. They are widely scattered in every corner of the city.

The scattered space of the city not only occupies more and more urban space, but also continues to affect the urban space invisibly. Based on the current situation of scattered space in Shanghai, this paper analyzes the causes, forms, and existing problems and proposes a design strategy for how to optimize the urban scattered space.

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2. Methodology

2.1. *Theoretical research*

The author has studied and analyzed the existing literature and data. On this basis, the collection of data were carried out for specific problems.

2.2. *Practical research*

1) Observing and participating. Observation is the first step into the scattered space. The combination of theoretical research and practical research is the main research method in this paper.

2) Chatting and drawing. The spatial form and elements of the scattered space are different from the designed space. Whenever I saw a typical example of scattered space, I stopped and recording its shape.

3. Analysis/Results

In the city, some scattered space can be rationally developed and utilized by people, forming an active space that can satisfy people's needs and provide cheap and safe public facilities for the citizens. Some scattered spaces are disorderly, not properly utilized, and even lead to insecurity[1].

3.1. *Definition*

Then, the urban scattered space to be studied in this paper has the following basic features:

1. The scattered space is the outline of the shape without the boundary.
2. The scattered space is an unconcentrated space that has not been designed and used by the citizens.

3.2. *Causes of formation*

The process of urbanization produced some urban spatial functions. There will always be vacant and abandoned space. This is the cause of the formation of urban scattered space. Urban development pays more attention to the urban construction unit, and it is easy to ignore the relationship between the building and the surrounding space so that there will be scattered space between the buildings.

And due to natural causes, some special areas appear in the city, forming elevations, sloping fields, basins and rivers. Due to these inevitable natural factors, the city is cut into different interfaces, resulting in spatial faults.

3.3. *Spatial form*

Urban scattered space has various forms and varies widely in cities. Therefore, the study of urban fragmentation space based on the basic of theory of typology can also be classified from different angles according to different standards and methods:

Classified by use

- Commercial scattered space: Commercial scattered space mainly refers to all kinds of street vendors . This kind of street trade stalls is a means of earning a living for some people in the society and outsiders in the city.
- Leisure scattered space: There is still a large proportion of people in modern cities who lack space suitable for their ideal activities. These people who have neglected their own needs will gather in other places, which, although the environment is simple, can meet the basic needs of daily activities.

Classification by location

- Connection zone between buildings: The form of scattered space between buildings is expressed as a buffer between public buildings, between public buildings and private buildings, between private buildings and private buildings. Part of this space is rationally utilized as a supplement to urban greening and the basic functions of the city. However, a large part of it shows a negative side[2].
- Traffic attached space: The development of modern cities has led to new development in transportation facilities. However, there has also been a certain amount of urban scattered space around it. The surrounding space under the urban viaduct not only bears the traffic function, but some people at the bottom of the society make a living and live here. The existence of these spaces is used by people, reflecting the lack of public space in China.
- Urban waterfront space: Urban waterfront space is an important part of the city. Some of the people at the bottom of the society choose to build houses and live in places where the environment is quiet. Due to the low quality of these bottom-level personnel and the weak awareness of environmental protection, the accumulation of domestic garbage and pollution of water resources have brought certain potential hidden dangers to urban development.

Classification according to morphological type

- Linear scattered space: Linear scattered space refers to a limited open space between narrow urban streets and buildings. The expansion of the linear scattered space is easily restricted, developed in depth.
- Triangular scattered space: This kind of space is a relatively regular triangular-like public open space formed by three straight lines. This type of space is less used by people. It is often used as a transition space, leisure space, or lawn.
- Quadrilateral scattered space: This type of space is a relatively regular quadrilateral-like public open space formed by four straight lines. Such spatial forms are most frequently found in urban forms, and are more easily organized into regular spatial forms.
- Circular scattered space: This kind of spatial boundary is a public open space formed by arcs. It is designed in combination with urban architecture and urban streets, and is often seen in the corners of streets and resident courtyard space[3].

3.4. *Existing problems*

- (1) Environmental pollution. In such an environment, the effects of atmospheric pollution and various harsh climates will inevitably have adverse effects on the health of residents. These harmful substances not only pollute the urban environment but also endanger public health.
- (2) Low utilization. Most of the scattered space is not well designed, and the accessibility is not strong. As time goes by, people will gradually forget the waste of urban space. This type of fragmented space is not attractive to public activities of urban residents.
- (3) Low space quality. Some of the spatial traits of the scattered space also provide opportunities for these criminals to escape from arrest . Such a region will give people a feeling of discomfort and insecurity. This vicious circle makes the negative side of the scattered space of the city more unattractive.

4. Discussion/Conclusion

4.1. *Design strategy*

- 1) Function optimization. Inject the corresponding functions into this type of space, and then design them after improvement. Only in this way can the actual meaning of reuse be generated. Scattered space is a special space with special qualities in the city. Its reuse is a more demanding goal to promote urban public life and improve environmental quality.
- 2) Improvement of the spatial interface. Make up the crippled spatial interface with a pleasant visual experience. All the elements that make up the scattered space of the city can be utilized and transformed to break the rigid spatial interface of the scattered space of the city and alleviate the depressed hearts of people in the busy city life.
- 3) Enhance spatial accessibility. In the design of the building, this part of the scattered space is used as an extension of the building to enhance its accessibility and give them some fuzzy functionality. For example, planting plants on a large concrete surface; using lighting, color, and texture to add architectural details.
- 4) Apply new technology. The development of science and technology has also provided fresh blood for the new development of the city.Space functions can no longer meet the new demands of the times, taking ECO Japan's new underground garage as an example. The design of the ECO bicycle garage utilizes the scattered space in the city to improve the chaotic street traffic in the city and saves a lot of space on the ground.

And the limited urban space does not leave too much available urban space for our new world, so the undesigned or forgotten urban scattered space in these cities provides new development for the city. As designers, we have the responsibility to reinterpret these potential space, improve urban land use and achieve a good and recyclable development of the city.

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A Study on Temporal and Spatial Characteristics of Shopping Behavior of Migrant Workers in Nanjing

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Keywords: Urban migrant workers, Shopping activities, travel distance, Spatial-temporal characteristics, Nanjing.

Abstract: In the process of rapid urbanization in China, population mobility of migrant workers has become a typical economic phenomenon. Shopping, as the core of consumption behavior of migrant workers, combines the whole picture of their lives together with their housing and employment. Based on the first-hand data of the questionnaire survey on migrant workers in Nanjing City in 2019, this paper summarizes the time characteristics of shopping activities such as frequency, time and duration, as well as the spatial characteristics of travel distance, the activity circle and hierarchical structure. The results show that the higher the grade of goods, the lower the frequency of shopping, the farther the average travel distance is and the longer the shopping time. The hierarchical structure of shopping trip space presents the characteristics of 'polarization and decentralization'. In addition, this paper also points out that the low-grade commodity shopping are more sensitive to family structure and average monthly income and age of families while the high-grade commodity shopping are more sensitive to gender, average monthly income and age of families. The purpose of this study is to better meet the consumption needs of migrant workers, and to provide reference for China's commercial space planning.

1. Introduction

During the process of rapid urbanization, population mobility has become a widespread economic phenomenon. Along with the reform of the household registration system, the transformation of industrial structure, the change of farmers' concept, and the break of urban and rural barriers, a large number of rural surplus labor force has merged into a large-scale army and an unstoppable migrant workers' tide. In this context, the empirical research on the migrant workers in the city, such as housing, employment, shopping and so on continue to receive attention. At present, there are relatively many studies on the housing and employment problems of migrant workers, but there is almost no research on their shopping characteristics. As a kind of marginalized group that travels between urban and rural areas, the migrant workers in urban areas are inseparable to the urban system in the economic and industrial aspects, although they are isolated and excluded to some extent in the social and cultural fields. The important component of the force has a great impact on the urban consumption structure. For this reason, the

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study of its shopping characteristics not only helps to better grasp the consumption needs of migrant workers in addition to daily living and employment activities, but also helps to provide reference and basis for the formulation of relevant industrial policies, the guidance of activities and the planning of commercial space, so as to further improve the dual and marginal issues of migrant workers who are non-agricultural and non-industrial, migrating between urban and rural cultures, and provide targeted strategies for this group to eventually integrate into the city and take root in the city.

On the other hand, the research on shopping activities has started relatively early in foreign countries, focusing on the theoretical level and the application of new technologies. It focuses on the construction of quantitative research and mathematical models, and the theory and method system are relatively complete. Earlier research on consumer shopping activities in China has always focused on the macroscopic material and spatial aspects. There are relatively more discussions on the scale of commercial facilities and their spatial structure (Wu Mingwei, 1999), and the introduction of central theory into the urban commercial center system. In the study of spatial structure (An Chengmou, 1990), domestic related research began to focus on consumers themselves. The content mainly includes the differentiation of consumer shopping activities and the exploration of spatial laws and the construction of measurement models. The single or discrete structure of feature or time characteristics is dominant, and the research results of shopping activities under the coupling of time and space are lacking. In addition, the cities selected and paid by domestic scholars in the research scope are mainly concentrated in in the first-tier cities, such as Beijing[1], shanghai[2] , there are relatively few empirical studies involving other regions and cities. In addition, although the research focusing on special groups has accumulated a lot in research objects[3], the research on migrant workers is relatively less. The study of shopping activities based on space-time behavior has become the key to understand the economic and social phenomena such as urbanization, urban development and urban consumption structure. Therefore, this paper intends to focus on the migrant workers in Nanjing. Through the combination of "specific groups + specific behaviors", macroscopically grasp and quantitatively reveal the shopping activities of migrant workers in Nanjing from the perspective of time and space.

2. Methodology

2.1. *Research objects*

The migrant workers studied in this paper refer to the economic temporary population from the countryside, that is, the rural surplus labor force that enters the city for employment with the main purpose of making a living and making a profit, which is distinguished from the "middle and high-end immigrants" such as literary and artistic workers, middle and high-level managers and so on.

2.2. *Research area*

Nanjing was taken as an empirical research object. According to the location difference, six migrant workers' gathering points in three different locations in the city center, suburbs and outer suburbs of Nanjing were selected as survey samples. The questionnaire survey on the shopping activities of migrant workers was conducted in Nanjing during the period from January to

March 2019. In the city center, Lu xiying Community in Gulou District and Hong miao Street in Xuanwu District were selected. In the suburbs, Ding jiazhuang Farmers Market and Ma qun Street in Qixia District were selected. In the far suburb, Yin xiang in Jiangning District and and New City in Liuhe District were selected.

3. Data

3.1. *Data sources*

In this study, a questionnaire survey was conducted, and 50 questionnaires were distributed at each gathering point. The questionnaires were filled with migrant workers in the area. A total of 300 questionnaires were distributed, of which 263 were valid questionnaires, and the recycling efficiency reached 87.6%, meeting the needs of the survey. The content of the questionnaire includes two parts: the basic social attributes of migrant workers and the time and space characteristics of shopping activities.There are many discussions about the influence factors of consumers'socio-economic attributes on shopping activities abroad, including commodity type (Clark, 1970), consumption location (Lentnek, 1975), income difference (Llod and Jennings, 1978), age difference, racial difference and so on. Based on the previous research results,

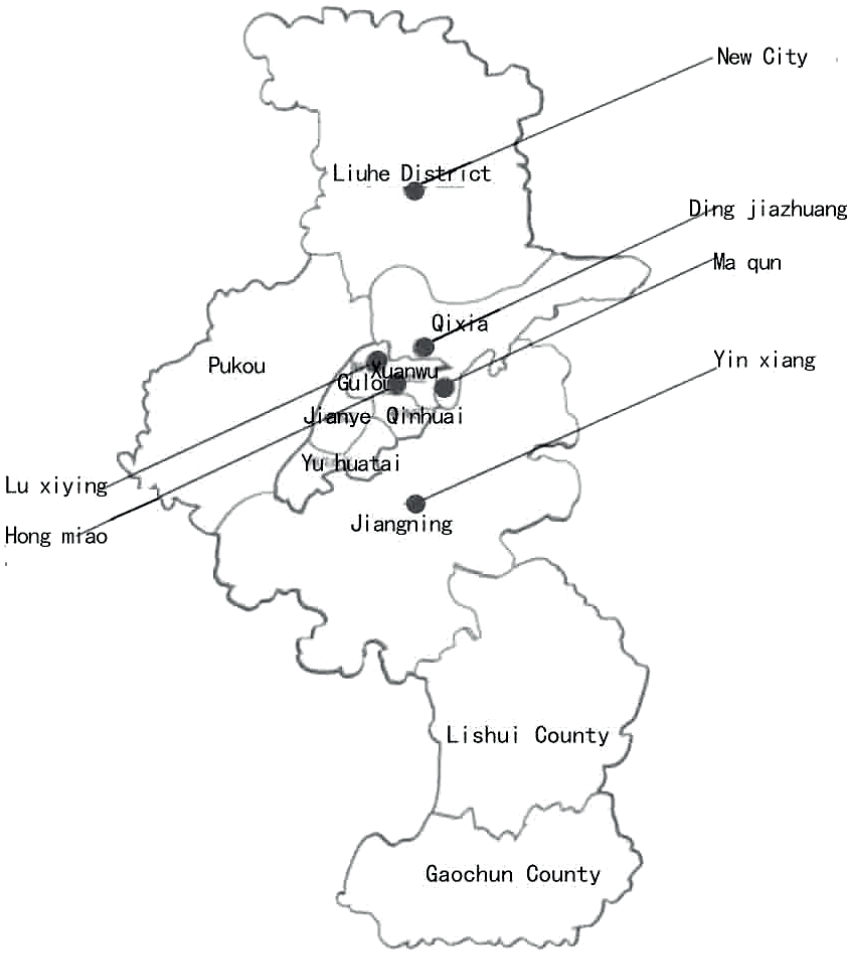

Figure 1. *Shows the location distribution of research objects in Nanjing.*

this paper mainly considers the social and economic attributes of migrant workers in Nanjing, including gender, age, education level, occupation and average monthly income of family. In terms of time and spatial characteristics of shopping activities, it mainly considers shopping content, shopping time, shopping frequency, purchase location and shopping distance. In addition to the first-hand data acquisition, this paper also combines the relevant information of urban planning, and through POI data analysis of the distribution of shopping facilities at all levels, based on which we discuss the spatial and temporal characteristics of shopping behavior of migrant workers in Nanjing.

3.2. *Characteristics of Sample*

The proportion of men and women in the sample is balanced. The majority of young and middle-aged people aged 18-40 (61.4%) are aged 18-40, the proportion of the elderly is relatively small (only 6.54%) and the education level is relatively low (65.1%). Most of the respondents are engaged in commercial services (39.6%) or non-fixed occupations (30.9%). The monthly income of families is generally low, and the most of the low-income families are between 3000 and 8000 yuan (57.9%,The lowest income in Nanjing in 2018 was 2200 yuan per person/month), and the family structure was mainly nuclear family (40%), which was much higher than that of couple family and united family (20% and 13.8% respectively). Sample survey of migrant workers can be summarized as young, low-income, small-scale nuclear families, low educational level.

4. Analysis

4.1. *Overall time characteristics of shopping activities of migrant workers in Nanjing*

Time is an important factor affecting individual shopping activities, which is often closely related to the spatial distribution structure and quantity of commercial facilities, residents' shopping habits and needs, modes of transportation and convenience. According to many existing studies at home and abroad[1][2][4], combined with the actual situation of urban migrant workers' shopping, vegetable food, daily necessities, clothing, household appliances were selected to represent four different grades and different types of goods from low to high, and the time characteristics of urban migrant workers' shopping activities were analyzed from the frequency characteristics, time characteristics and time-length characteristics.

Frequency Characteristics

In general, the higher the grade of goods, the lower the frequency of purchasing. The frequencies of vegetable and food purchases with the lowest commodity grade were 4.06 times per week, daily necessities purchases were 2.56 times per month, basically 2-3 weeks, clothing purchases were 3.92 times per year, and the average frequency of purchasing household appliances was only 1.56 times per year, and the average frequency of purchasing household appliances was once every six months. From the frequency of shopping types, it can be seen that the shopping frequency of migrant workers in Nanjing city presents the characteristics of daily renewal in vegetable food, monthly renewal in daily necessities, quarterly renewal in clothing and accessories, and annual renewal in large household appliances. Generally speaking, the frequency of shopping for different types of goods of migrant workers in Nanjing is slightly lower than that

of previous scholars' research on urban residents' shopping activities except clothing. This is because most of the migrant workers studied in this paper are engaged in labor industries such as commercial services or non-fixed occupations in the city, their income is relatively low, and their living and eating are provided by the unit. At the same time, in order to save money, they often dare not spend too much outside of their lives, which to some extent reduces the frequency of shopping for high-grade goods.

Period Characteristics

Shopping time is often related to the business hours of commercial facilities and the nature of people's work and living habits. As can be seen from the table, on the whole, the shopping activities of migrant workers in Nanjing on weekends are generally higher than those on working days. As far as commodity types are concerned, the distribution differences of vegetable food shopping activities in working days and weekends are relatively small, while the distribution of the other three types of commodities is quite different, and the four types of shopping activities occur relatively less at night (after 20:00).

According to the specific analysis, the shopping activity time of vegetables and foods is on the two small peaks of the working day before the workday morning (5:00-8:00) and after the afternoon work (17:00-20:00). It can be seen that this kind of necessities are often purchased by way of work due to their short shopping time and close distance, while rest days are mainly concentrated in the morning (5:00-11:00). Daily necessities are relatively time-consuming due to shopping. They are mainly concentrated after work in the afternoon (17:00-20:00), and on weekends (14:00-17:00). When purchasing clothing and large household appliances, migrant workers pay more attention to the price, quality and types of goods, so they have certain requirements for shopping hours. For this reason, shopping activities are mostly concentrated in the afternoon and evening of weekends (14:00-20:00) (Table 1).

Time-Length Characteristics

In addition, the shopping time of migrant workers in Nanjing is positively correlated with the commodity grade. The higher the commodity grade, the more shopping time they spend. 72.5% of the people who buy vegetable food say that the shopping time is less than 0.5 hours, while 62.5% of the respondents who spend time on daily necessities choose 0.5-1 hours. Clothing and household appliances are abundant in variety and expensive, so that people tend to spend more time on travel and comparison. For this reason, the shopping period is mostly on weekends, and the duration is between 1hour and 3 hours (78.6%).

4.2. *Overall Spatial Characteristics of Shopping Activities of Migrant Workers in Nanjing*

The Hierarchical Structure of Shopping Space

W. Christaller pointed out in the theory of central geography that commercial centers have hierarchy and centrality, that is, the higher the grade, the fewer the number of commercial centers, the stronger the centrality, the more kinds of goods, the higher the service grade, and its functions and service scope as a commercial center can cover low-level commercial centers. At present, many scholars have proved through empirical research that the shopping space of commodities is hierarchical circle structure, which has also been confirmed in this study. The

Table 1. *Contains the time distribution of shopping behavior of different commodities.*

Periods	person-time	vegetable food		daily necessities		clothing		household appliances	
		Percen-tage	person-time	Percen-tage	person-time	Percen-tage	person-time	Percen-tage	
Working day	5:00-8:00	54	11.2%	8	2.0%	6	1.6%	5	1.5%
	8:00-11:00	46	9.5%	27	6.7%	20	5.2%	34	10.5%
	11:00-14:00	17	3.5%	12	3.0%	24	6.3%	13	4.0%
	14:00-17:00	32	6.6%	36	8.9%	32	8.4%	27	8.3%
	17:00-20:00	49	10.1%	48	11.9%	36	9.4%	29	8.9%
	20:00-23:00	22	4.6%	24	6.0%	15	3.9%	15	4.6%
	total		45.5%		38.5%		34.8%		37.8%
weekends	5:00-8:00	56	11.6%	18	4.5%	12	3.1%	12	3.7%
	8:00-11:00	72	14.9%	51	12.7%	36	9.4%	36	11.1%
	11:00-14:00	36	7.5%	24	6.0%	37	9.7%	36	11.1%
	14:00-17:00	41	8.5%	72	17.9%	80	20.9%	61	18.8%
	17:00-20:00	36	7.5%	53	13.2%	61	15.9%	39	12.0%
	20:00-23:00	22	4.6%	30	7.4%	24	6.3%	18	5.5%
	total		54.6%		61.7%		65.3%		62.2%
	合计	483	100%	403	100%	383	100%	325	100%

average travel distance of migrant workers in Nanjing is positively correlated with the grade of shopping commodities when they are shopping for vegetable food, daily necessities, clothing, and household appliances. The average travel distance is 1.06 kilometers, 1.32 kilometers, 4.66 kilometers and 5.46 kilometers respectively (this distance is the cognitive distance of residents) (Figure2). Based on the empirical study of the travel distance of urban residents in shopping activities by scholars, the average travel distance of migrant workers in Nanjing is far longer than that of residents in Shanghai, Beijing, Shenzhen and other cities in terms of low-grade necessities such as vegetable food[1][2][[4]. W Zongqing and others expressed the W.Christaller market area series as follows[5]:

$$Ni=Kn-1 \qquad (1)$$

(i=1, 2, 3, …, m; n=1, 1.5, 2, 2.5, 3, 3.5, …) In the formula: k = 3, 4, 7, respectively, representing the principles of market, transportation and administrative management; Ni denotes the number of level I market areas; n denotes the level of market areas. According to the model, we can calculate the spatial rank series of shopping activities of migrant workers (Ni) under the principles of market, traffic and administrative management, and determine the market level of different commodities (Table 2)

It can be seen that: (1) When migrant workers carry out shopping activities of different kinds of commodities, the travel space basically conforms to the hierarchy relationship in the theory of central land. High-grade commodities travel for a long distance while low-grade commodities travel for a short distance. (2) There is a large span between the travel space grade of low-grade commodities (vegetable food, daily necessities) and of high-grade commodities (household appliances, clothing), the difference is 2-3 grades. (3) There are obvious polarization phenomena among different type commodities of the same grade, the travel space span of different commodities of the same grade is small. For example, both household appliances and clothing belong to high-grade commodities, but the difference of travel space grade is only 0.5. (4) The shopping activities of vegetable food and daily necessities are mainly concentrated in the community-level shopping circle, and have a clear tendency to live nearby, while the shopping activities of clothing and household appliances are mainly concentrated in the district shopping circle (Figure2).

5. The Spatial Circle Structure of Different Types of Goods Shopping

5.1. *Community shopping circle concentration: vegetable food and daily necessities*

From the travel distance of commodity shopping activities, the spatial structure of vegetable food shopping activities and daily necessities shopping activities of migrant workers in Nanjing is very similar, showing the characteristics of concentration of community shopping circles (Figure 3). The survey data show that the convenience and proximity of travel distance are the most important factors when shopping for these two types of goods. The proportion of shopping activities of these two kinds of commodities within 0.5KM of spatial distribution is 43.9% and 34.4% respectively, and the proportion of travel distance of vegetable shopping activities within 0.5KM is much lower than that of relevant studies on urban residents by other scholars; the proportion of shopping activities of these two kinds of commodities within 1km reaches 75.0% and 60.9% respectively, which means that the strong concentration zones of these two types of commodity shopping activities are within 1km. Within 2km, 92.6% of the shopping activities of

Table 2. *Contains the evolution of spatial hierarchy of shopping trips of migrant workers in Nanjing.*

Grade	Vegetable food	Daily necessities	Clothing	Household appliances
R_i	1.06	1.32	4.66	5.46
N_i	176.19	113.62	9.12	6.64
n	(6/5/3.5)	(5.5/4.5/3.5)	(3/2.5/2)	(2.5/2.5/2)

The brackets are the corresponding hierarchical relationships of different types of commodities under the principles of market, transportation and administration respectively. (The area of Nanjing built-up area is about 1398.69KM2, R = 21.10KM, Rmax = 2/3R = 14.07KM

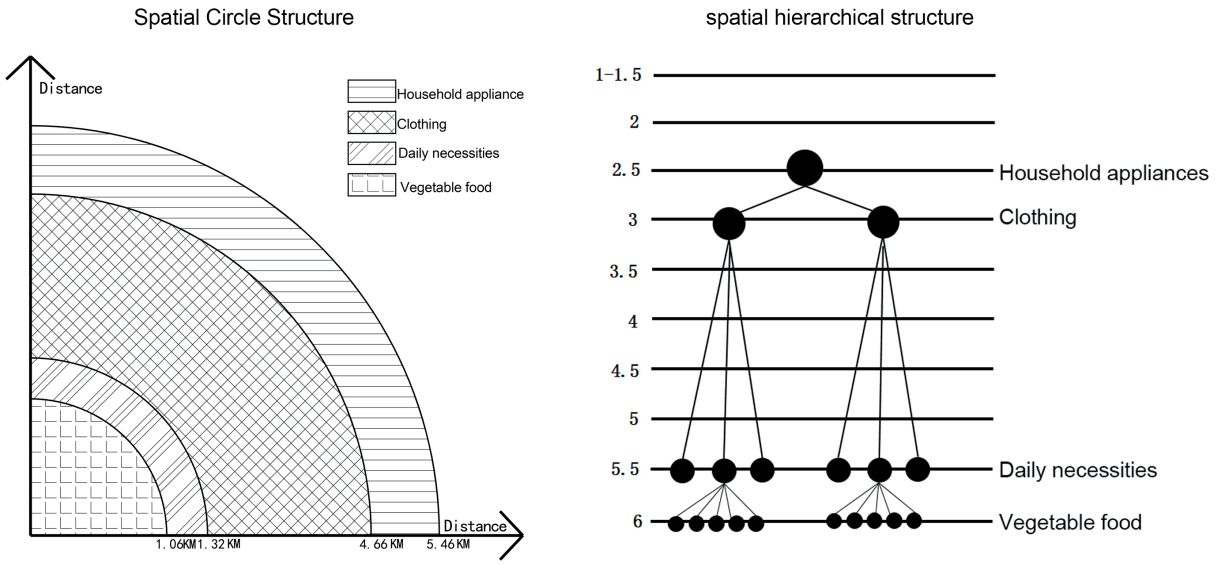

Figure 2. *Shows the spatial circle structure and spatial hierarchical structure of different types of goods shopping.*

vegetable food commodities and 82.0% of the shopping activities of daily necessities constitute the basic activity space of these two types of shopping activities. Shopping activities of vegetable food commodities outside 2km rarely occur, while within 2km-3km, the shopping activities of daily necessities still occupies a certain proportion. Compared with vegetable food, the shopping activities of daily necessities have the trend of expanding the scope of behavior space and extending the travel distance outward. On the preference of shopping places, 72.9% of migrant workers prefer to go to vegetable markets and other places to buy vegetables food, 81.3% of migrant workers like to go to stores to buy daily necessities. Based on the Poi data of shopping facilities in Nanjing, it can be clearly seen that the distribution density of supermarkets and convenience stores is much higher than that of vegetable food shopping facilities such as vegetable markets (Figure 4). That is to say, the travel distance of vegetable and food shopping activities is relatively far, largely due to the insufficient distribution of related shopping facilities at the material and spatial level, rather than the popularity of "one-stop" consumption mode.

From the time of commodity shopping trip, vegetable and food products reached their destination within 10 minutes had the highest proportion of shopping trips (40.5%). Within this time range, residents are less sensitive to time, and more consideration is given to the price, type and quality of commodities, while the range of insensitive areas of daily necessities shopping activities is expanded to 15 minutes (56.1%). Within 30 minutes, 91.5% of vegetable food shopping activities and 87.8% of daily necessities shopping activities were concentrated respectively. It can be considered that this period of time is a strong concentration time for migrant workers to purchase these two kinds of commodities. However, the upper limit of travel time tolerated by migrant workers is higher than that of vegetable food, which is about 60 minutes (93.5%).

5.2. *District shopping circle concentration: Clothing and Household appliances*

From the travel distance of commodity shopping activities, the shopping space of migrant workers purchasing clothing and household appliances shows the characteristics of district shopping circle concentration. The proportion of purchasing clothing goods within 1km is 27.4%, while that of household appliances is only 16.8%, which is significantly lower than that of vegetables

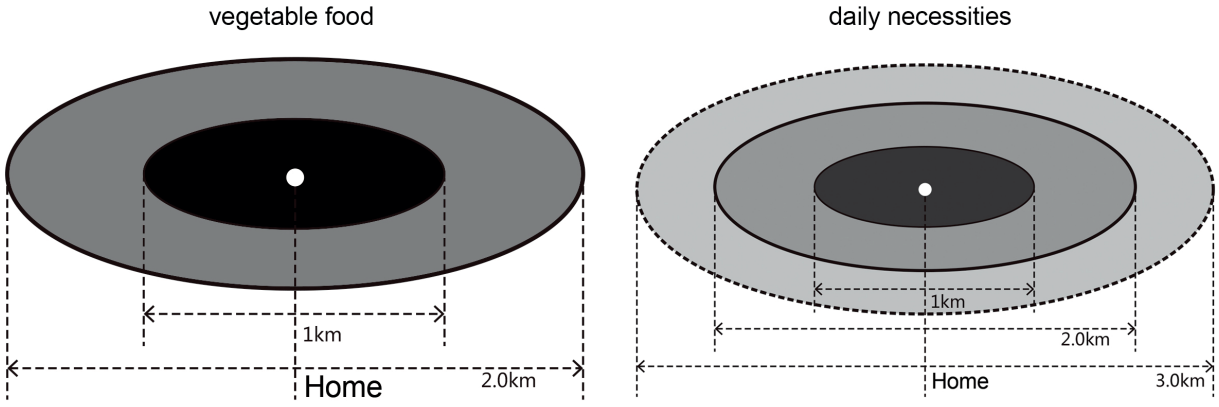

Figure 3. *Shows the circle structure of vegetable food shopping activities and daily necessities shopping activities.*

and daily necessities. Within the range of 3km, the basic activity space of clothing is formed, and within 5km, it is the basic activity space of household appliances, and the travel distance of shopping activities of household appliances has the trend of extending outward compared with of clothing. There is a certain proportion of shopping activities in all distances beyond 5km, but the proportion of shopping activities is not very high. In addition, 16.2% and 15.9% of migrant workers go to shopping places other than 10km when they buy clothing and household appliances. The price cost is the most important factor (44.3%) when the migrant workers are shopping for clothing goods. For the sake of low price, they prefer to buy clothing wholesale market (16.5%) as well as small clothing shops near the street (28.6%). Based on the distribution of wholesale market in Nanjing, the number of related commercial facilities around the survey site is not large and the distribution is relatively scattered, so there will be a certain proportion of long-distance shopping activities (Figure 4). In addition, 68.4% of migrant workers in the city say they prefer to go to department stores with moderate prices for clothing shopping activities in order to improve the quality and types of goods. The location distribution of such department stores also greatly affects the distance and length of shopping trips for migrant workers (Figure 4). In the shopping activities of household appliances, because of the high price of such goods, the number of purchases in peacetime is small, and the price is less affected by the shopping circle grade, so the quality of the goods has become the most important factor (55.6%) for migrant workers. When purchasing such goods, it shows obvious characteristics of district-level professional stores pointing. Combining with POI data, we can see that such purchases in Nanjing can be seen. The distribution of facilities is scattered and the density is not high, but each district has a core gathering place.

From the travel time of commodity shopping activities, migrant workers are not sensitive to the travel time of purchasing clothing and household appliances. A certain proportion of shopping activities occur in each time period. Generally speaking, within 60 minutes constitute the basic time range of these two types of shopping activities (clothing is 80.2%, household appliances is 80.4%).

6. Analysis of the correlation between temporal and spatial characteristics of shopping activities and basic attributes of migrant workers

The spatial and temporal characteristics of residents' shopping activities are not only influenced by the distribution of urban shopping facilities and their shopping habits, but also by

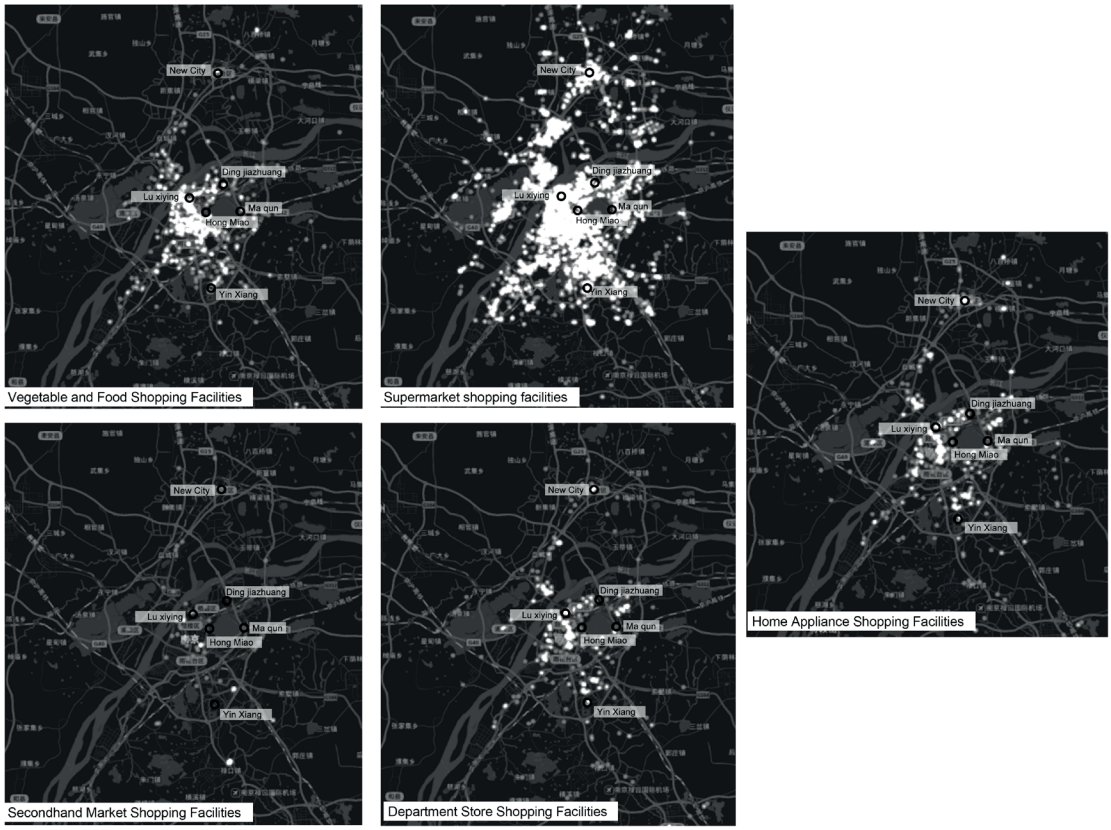

Figure 4. *Shows the POI distribution map of shopping facilities in Nanjing.*

the differences of their own socio-economic attributes. This paper uses SPSS 24.0 data analysis software to analyze the samples in the questionnaire from gender, age, family income to explore the correlation between the temporal and spatial characteristics of shopping activities and personal attributes of migrant workers.

6.1. *The correlation analysis of spatial characteristics and basic attributes of urban migrant workers' shopping activities*

The correlation between the time characteristics of shopping activities of migrant workers and their basic attributes is mainly manifested in the following aspects: (1) Gender aspect: when shopping for clothing goods, the frequency of women's shopping is much higher than that of men's, and the travel time spent is higher than that of men's. (2) Income aspect – the urban migrant workers whose monthly family income is in the middle level are more willing to spend more travel time to buy clothes, which is related to the fact that relatively low-income people pay more attention to clothing price factors, and the higher the average monthly family income, the higher the frequency of shopping on vegetable and food commodities; (3) Family structure aspect: in the frequency of purchase of essential foods such as vegetables and foods, daily necessities, the number of solitary people is much lower than that of the main family and the joint family. This is because most of the migrant workers living alone take part-time work as their focus of life, and their living and eating are mostly provided by their work units.

6.2. *The correlation analysis of spatial characteristics and basic attributes of urban migrant workers' shopping activities*

The correlation between the spatial characteristics of urban migrant workers' shopping activities and their basic attributes is mainly manifested as follows: (1) Gender aspect : there is no big difference in the average travel distance of urban migrant workers' shopping activities in low-grade commodities, but in high-grade commodities, the average travel distance of women in clothing commodities is significantly higher than that of men, and in household appliances. Shopping distance is lower than that of men. (2) Age aspect: In the shopping trips of low-grade goods, the average shopping distance (over 65 years old) of seniors is higher than that of younger and middle-aged people due to the relatively abundant time of seniors. In the purchase of clothing and accessories, the average shopping distance of middle-aged and young people (18-40 years old) is much higher than that of middle-aged and old people (over 40 years old), but the shopping distance of household appliances is slightly lower than that of middle-aged and old people (Table 3). (3) Income aspect: the higher the income is, the farther the shopping trip distance is. The proportion of urban migrant workers whose average monthly income is less than 5000 yuan choosing to go shopping within 0.5km is obviously higher than the average level (27.6%). The proportion of urban migrant workers whose average monthly income is more than 8000 yuan chooses to go shopping within 1-2km is obviously higher than the average level (25.6%).

7. Conclusion

7.1. *Summary of Research*

(1) The frequency of shopping activities of migrant workers in Nanjing City in this paper generally shows that the higher the commodity level, the lower the shopping frequency and the longer the shopping time. Compared with urban residents, the frequency of shopping of other three types of goods is relatively low except clothing. In the shopping period, in addition to vegetable food, the shopping activities of the other three types of goods on weekends are generally higher than the working days, and the purchase of high-grade goods is concentrated in the afternoon of the weekend (14:00-20:00). Meanwhile the higher the commodity grade, the less sensitive it is to shopping travel time and shopping activity duration.

(2) The shopping distance of migrant workers in Nanjing is positively correlated with the grade structure of commodities. The higher the grade of commodities, the farther the average travel distance is. The hierarchical structure of shopping space shows the characteristics of "polarization and decentralization". The shopping activities of vegetable food and daily necessities are mainly concentrated in the community shopping circle, while the shopping activities

Table 3. *Contains the age differences in shopping space of different types of goods.*

		18-40岁	40-65岁	65岁以上
Average travel distance	vegetable food	1.0km	1.0 km	1.5 km
	daily necessities	1.3 km	1.3 km	2.0 km
	clothing	5.9 km	2.5 km	1.6 km
	household appliances	5.5 km	5.8 km	4.1 km

of clothing and household appliances are mainly concentrated in the district shopping circle, while the travel distance conforms to the multi-core and multi-center commercial space structure of Nanjing. Due to the insufficient distribution of shopping facilities in the vegetable market, rather than the popularization of "one-stop" consumption mode, the average travel distance of migrant workers in the vegetable and food commodities shopping is much longer than that of residents in Shanghai, Beijing and Shenzhen. Nanjing wholesale market, middle and low-end department store market and professional household appliances market are less in quantity and relatively scattered, which to some extent promotes the long-distance travel of migrant workers.

(3) The temporal and spatial characteristics of shopping activities of migrant workers with different attributes show certain differences. The shopping characteristics of low-grade goods are sensitive to family structure and average monthly income of families and the age. The temporal and spatial characteristics of high-grade goods shopping are sensitive to gender, average monthly income of families and the age.

7.2. *Research Prospects*

At present, this paper only discusses the temporal and spatial characteristics of the shopping activities of migrant workers in Nanjing as well as the correlation of their personal attributes. The next step is to analyze the rules and spatial and temporal differences of the shopping activities of migrant workers in Nanjing under the time-geographical thinking of "space-time" coupling, and to construct the decision-making influence model of migrant workers' shopping activities from the subjective and objective aspects .

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Does Neighborhood Street Connectivity Influence Crime Safety in Neighborhoods?

Evidence from Salt Lake City, Utah

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Keywords: Crime, street connectivity, methodological discussion.

Abstract: Crime and fear of crime has been a rising concern in cities. In the United States, safety concerns have been a hot topic for political disagreement, real estate price fluctuations and others. In the past decade, there has been a lot of research on street connectivity and its relationship to crime, and researchers have come up with seemingly conflicted results. Much of these differences are due to differences in methodology. In this study, I analyze all crime incidents in Salt Lake City in the year 2018, using three separate methodologies. Results imply that increased street connectivity is strongly correlated to low urban crime rates.

1. Introduction

Residential neighborhood culture has shifted in the last four decades. Where parents would freely allow children to move about in their community without adult supervision, this changed at the dawn of the millennium (Altheide, 2002). Children are less commonly left to go around their neighborhoods by themselves, and this is perhaps a direct safety outcome. Although violent crimes and property crimes have decreased significantly since 1993 (http://www.pewresearch.org/fact-tank/2019/01/03/5-facts-about-crime-in-the-u-s/), cities still strive for lower rates of both traffic accidents and crime. In the year 2016 alone, it is estimated that there are 386.3 violent crimes per 100,000 people, and 2,450.7 property crimes per 100,000 households (Uniform Crime Reporting Statistics Annual Report, 2017).

Street subdivisions are the starting point of a neighborhood design. In Salt Lake City, the Plat of Zion was used as the city's first masterplan to build an agrarian community in 1833. Blocks were set in a grid-iron layout, which was high street network connectivity. Grid-iron connectivity suited purposes in the mid to late nineteenth century, but as time evolved, the purpose of inner city blocks changed. New neighborhoods were designed with curved streets, cul-de-sacs, dead ends and so forth, to build the sense of privacy. Agrarian functions moved to rural areas. Over the next century, new neighborhoods came up with different street layouts – grid-iron, lollipop or cul-de-sac, curvilinear or mixed design. Currently, Salt Lake City's urban fabric has multiple street layouts, and it is important to know if there is a role of street layouts in affecting safety.

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Past research has talked in depth about crime safety and urban design, which forms the underlying theme for CPTED (Crime Prevention Through Environmental Design). This literature review will also provide an overview of methodologies to understand network connectivity, especially in the context of crime outcomes.

1.1. *Street Connectivity & Crime*

Connectivity in neighborhoods, and its relationship to crime, has been much discussed in academic literature. Connectivity in neighborhoods has been measured by qualitative concepts such as 'permeable street layout' or through-movement where neighborhood outsiders can enter into the core (Cozens, 2008; Nubani & Wineman, 2005; Armitage, 2011; Armitage, 2006). Connectivity has also been measured using quantitative concepts such as intersection density, street density, and number of cul-de-sacs per unit area in the neighborhood. Some studies have found that there is no relationship between street connectivity, and crime incidents (Ward *et al.*, 2014; Nubani and Wineman, 2005). But most of the studies researching this phenomenon have concluded that street connectivity has a strong relationship to crime outcomes.

Some studies have found that more connectivity, or a more efficient network, increases the probability of crime. In other words, cul-de-sac neighborhoods (also called lollipop neighborhoods), appear to have fewer crime incidents than those which have grid-iron layout, providing a greater possibility of through movement. This is based on the hypothesis that risk of crime is more on streets that are expected to be used more frequently; that is higher intended usage of roads *invites* risk (Armitage, 2017; Johnson & Bowers, 2010). This group of studies argue – potential offenders are likely to stake out their entry and exit points from a particular place or street, and having more than one end of a street open facilitates free movement (Johnson & Bowers, 2010). Studying a sample of more than a hundred thousand homes in England, Johnson & Bowers (2010) were able to quantify street connectivity and crime – an average private road (one with a dead end, may or may not be a cul-de-sac) has 43% fewer burglary incidents than a local road (connected on both ends); and for each additional connection to another road, chance of burglary rises by 3%. Additionally, some researchers found differences in crime between true cul-de-sacs, sinuous cul-de-sacs and leaky cul-de-sacs (Armitage, 2010; Johnson & Bowers, 2010; Hillier, 2004). Sinuous cul-de-sacs are those where all houses within the loop cannot be seen from the entry point, as in Fig. aa. Fig bb is a true cul-de-sac. Leaky cul-de-sacs are those which have a formal or informal footpath emerging from the cul-de-sac. The sinuous ones appear safest, where visual and physical discontinuity makes the place safer. Leaky cul-de-sacs apparently are less safe, as they have more than one entry/exit point, thus making it prone to risk (Cozens, 2008).

Other researchers have found opposite outcomes, trying to understand links between connectivity and crime (Utah Street Connectivity guide, 2018; Hillier & Raford, 2010; Hillier & Sahbaz, 2008; Harries, 2006; Porta *et al.*, 2006; Jacoby, 2006; Haughey, 2005; Batty, 2004). Most researchers in this group used principles of Space Syntax to measure connectivity. Space Syntax, an idea coined by Hiller and Hansen (1989) focuses on lines, not points – and streets, not junctions (Batty, 2004). Space Syntax is theory that is based on an eye-level perspective, measured by axial lines and visibility graphs. Jacoby (2006) used examples from Venice, Oxford Street in London, and Trafalgar Square – also in London – to argue why greater connectivity leads to lesser crime. The author pulls references from Newman's "defensible space" (1972) and Jacobs' "eyes on the street" (1961) to discuss why increased connectivity would see a decrease in crime incidents. A hybrid model consisting of space syntax theories, and ranking streets by hierarchy

Fig. aa Sinuous cul-de-sac

Fig. bb Typical cul-de-sac

Figure 1.

(Porta *et al.*, 2006) compared six cities across the world, and also concluded that connectivity and crime are inversely related. A combination of high residential density, and mixed landuse is observed to be a greater deterrent of residential crime compared to a suburban cul-de-sac (Hiller & Raford, 2010; Hillier & Sahbaz, 2010; Harries, 2006; Haughey, 2005).

This apparent contrast of conclusions is clustered by the choice of methods. Johnson and Bowers (2010) used a combination of GIS and hierarchical linear modelling (HLM) to understand the aforementioned relationship. As a measure of connectivity they used presence and density of cul-de-sac, which is a proxy for reduced connectivity. Armitage (2010) used photography and qualitative methods to study crime in places with and without cul-de-sacs. Both concluded that increased connectivity leads to increased crime. However, some researchers had exactly opposite findings – Porta *et al.* (2006), Hillier and Sahbaz (2008) used space syntax theory, which measures connectivity by number and density of street segments. Both methods of analysis are quantitative, and researchers use additional control variables in their models to arrive at conclusions. The basic difference in outcome is perhaps due to the difference in methodology – one uses cul-de-sacs, and the other method uses street segments as a measure of connectivity. Part of this research's objective is to identify how differences in methodology lead to differences in outcome, and part of it is identifying the benefit of using each methodology.

1.2. *Walkability and neighborhood crime*

Crime incidents have also been studied through the lens of walkability in a neighborhood (Frith *et al.*, 2017; Koohsari *et al.*, 2014; Foster *et al.*, 2014; Carr *et al.* 2010; Foster *et al.*, 2010). This is perhaps because, walkability and connectivity as concepts have many variables in common – such as visibility, distance to destinations within neighborhoods, and so on. Results were varied. Carr *et al.* (2010) found positive correlation between Walk Score (measurement of walkability of a neighborhood) and crime; Foster *et al.* (2014) found positive correlation between walking frequency and crime incidents, Frith *et al.* (2017) found that nonlocal pedestrian activity also increased crime frequency.

1.3. *Other measures of Street Connectivity*

Connectivity has also been measured in relationship to traffic outcomes. Traffic volume, traffic speed and traffic incidents have often been measured through the lens of connectivity. In this

context connectivity has been measured by intersection density, length of street, link-node ratio, and total length of streets per unit area.

Like crime safety, the relationship of traffic safety and street connectivity is conflicted. Some researchers (Utah Street Connectivity guide, 2018; Mohan *et al.*, 2017; Osama & Sayed, 2017; Zhang *et al.*, 2015; Moeinaddini *et al.*, 2014; Gladhill & Monsere, 2012; Rifaat *et al.*, 2011; Marshall & Garrick, 2011;) have discussed the role of connectivity in influencing traffic crashes and fatalities within and around neighborhoods. Although most have identified some relationship – either positive or negative, between street connectivity and traffic crashes, there are some authors (Gladhill & Monsere, 2012) who conclude that there is no relationship between the two. Yet, whatever be the traffic outcome, their method of measuring connectivity is different from measuring crime and connectivity. Three studies that support greater connectivity in road network has been associated with more crashes, used ArcGIS or ArcView and GLM (general linear model) to arrive at their conclusions. They used intersection density and link-node ratio to arrive at their conclusions. Other researchers have measured traffic outcomes by using a geographically weighted regression model (GWR) in combination with ArcGIS or ArcView.

For studying traffic safety, intersection density appears to be the dominant variable to measure connectivity (Osama and Sayed, 2017; Moenaddini *et al.*, 2014; Rifaat *et al.*, 2011; Mohan *et al.*, 2017; Cai *et al.*, 2016; Marshall and Garrick, 2011). Each of these studies used more factors in addition to intersection density to measure connectivity such as blocks (area of blocks, number of nodes per block, number of blocks per unit area), streets (network density, street density, length of road, length of motorway, length of primary, secondary, local roads), street pattern (gridiron, warped, looped, mixed, curvilinear street), and interaction between streets and intersection (link-node ratio, sidewalk connectivity). All of the variables ultimately aim to measure street connectivity. In this paper, I have used traffic concepts to measure connectivity, to provide a third method to answer the research question.

1.4. *Methodological gap*

There remains a methodological gap in understanding the relationship between street connectivity, and objective safety in neighborhoods. As seen from past literature, it is evident that especially in the relationship between crime incidents and street connectivity, whether increased connectivity increases crime or decreases crime is hotly debated. A deeper look into the literature reveals that connectivity in relation to crime has been measured in two completely different ways – one cluster of researchers has used number of cul-de-sacs as a proxy for low connectivity, another cluster of researchers has used connectivity of street segments as a proxy for measuring connectivity. Using separate ways of measuring connectivity can have different outcomes. Marshall & Garrick (2011) have elucidated that different ways of measuring connectivity can give different results. For example, the authors found that street networks with higher intersection density correlate with fewer crashes across all levels of severity. On the other hand, they also concluded, that increased street connectivity (measures by link-node ratio) was significantly associated with an increase in crashes. This apparent contradiction is perhaps observing, that ways to *measure* connectivity has an effect on the outcome. The authors concluded that the two variables may not be measuring the same exact thing

It appears that the difference in contexts and measuring connectivity has resulted in the difference in outcome. In this research, I will use three separate factors (cul-de-sacs, space-syntax principles, and intersections) as measures of connectivity, and interpret and

explain how different constructs affect different outcomes. The advantage of using the same context and data for the analysis is that this process will remove some of the variability. Resolving the methodological conflict will allow me to answer the main research question, free from methodological bias.

2. Methodology

The main research question that will be answered in this research is – *Does street connectivity in residential neighborhoods affect crime rates in neighborhoods?*

I hypothesize that an increase in neighborhood connectivity leads to a decrease in crime following the theory of "eyes on the street", where Jacobs (1961) states that having more people use a street reduces the possibility of crime on that street.

2.1. *Data*

The Salt Lake City Police Department (SLCPD) has recorded over thirty-seven thousand crime incidents in the year 2018, out of which about five thousand are violent crimes. Crime rate per person and crime rate per unit area are the two dependent variables I have used for this research. This is a quantitative project, and I have depended on multiple softwares to arrive at conclusions. Some of these softwares are Arcmap and ArcCatalog, IBM SPSS (for statistical analysis), DepthmapX (developed by Space Syntax research group), Autocad, and Microsoft Excel.

2.2. *Study Area*

This study is focused in Salt Lake City at the scale of neighborhoods. Census block groups are to be used as proxy as "neighborhoods". Weiss *et al.* (2007) compare different ways to measure boundaries – census block groups, homogeneity in housing type, plot size, density, other built environment features, and level of connectivity or segregation of a place. The authors conclude that there is no one perfect way of measuring neighborhoods, but the lack of remarkable differences between the methods mean that any one of the methods could be used to delineate neighborhoods, without much difference in the outcomes. The purpose of this research is to find out relationship between street network connectivity and crime rate. Naturally, I will conduct this research at the neighborhood scale. I will study all neighborhoods within the city. Salt Lake City is a mid-sized city in the south-west quadrant of the United States, and home to approximately two hundred thousand people. The city is a part of the north-south contiguous Wasatch Front, and a major city in the Great Basin Region. The city is the headquarters of the Church of Jesus Christ of Latter Day Saints. A strong network of transit connects the city from north to south. The regional population is expected to double by year 2040, and this undoubtedly requires a well-functioning city to accommodate the growth. By understanding how street connectivity and network can influence safety outcomes, this research will help plan for a safer city.

This research question will be answered by estimating three different regression models for three different ways of measuring connectivity 1) space syntax principles 2) presence of cul-de-sacs and 3) intersection density. I will use the same crime data from Salt Lake City, to eliminate possible differences in change of context.

Figure 2. *Location of Salt Lake City and Utah in the context of United States*

2.3. *Crime Data*

Crime data for visualization purposes is publicly available from SLCPD. To obtain a data format that is compatible with ArcGIS software, I have used the crime data publicly available from SLCPD. Crime incidents are grouped under four headings: violent crimes, property crimes, quality of life, and other 911 calls. "Quality of life" includes drugs, liquor and disorder related disturbances, 'property crime' includes crime in homes and cars, and all other crimes with actual or risk of physical harm is considered violent crime. Each of the incidents have a latitude and a longitude location with it.

Crime incidents are typically spatially correlated, which are also called 'crime hotspots', which is clustering of crimes over a certain area (Schumacher and Leitner, 1999). An established method of understanding clustering is by estimating the Moran's Index or the Moran's I. The Local Moran's I (of a particular neighborhood in this case) defines clustering in relation to its immediate neighbors (other neighborhoods in this case). The Global Moran's I is clustering in relation to the entire dataset, in this the for the entire of Salt Lake City. I estimated both indices of Salt Lake City crime data in ArcGIS. Both indices were significant at 95% confidence level, with p-value < 0.001. This shows that crime incidents have strong spatial relationships.

2.4. *Other variables (Census data)*

Population / Population density: Population of a neighborhood has been previously seen to influence crime and safety outcomes. I hypothesize, that total population or population density in the context of Salt Lake City has some influence on the outcomes of neighborhood safety. For this research, a census block group is used as a proxy for neighborhoods. Hence, total population and population density per acre within the block group is added to the regression models.

Percentage of Hispanics and Blacks: Presence of blacks is observed to have effect on crime rates in neighborhoods. The argument is, presence of minority and / or disadvantageous groups lead to increase in crime. In the context of Salt Lake City, Hispanic population has prominent presence. In early regression models, I used different combinations of race and ethnic groups – such as Asians, Pacific Islanders, Alaskan Natives, and American Natives. The combination of Hispanics and Blacks seemed to be most responsive in the regression models. This data is from the published US census data of 2010.

Median Income of Neighborhood & Percentage of neighborhood parcels below poverty: Income and poverty have a close relationship with crime. Prevalence of violent crimes is higher in low income neighborhoods, and prevalence of property crime is prevalent in higher income

neighborhoods. Nevertheless, total crime in low income neighborhoods is appreciably higher than in high income neighborhoods. I use the median income per block group and the fraction of poverty parcels (properties) in each block group in the regression models. Information about median income of each neighborhood is from projected census information, 2017. Data on poverty levels is derived from census 2010.

Youth population (15-25) in the neighborhood: Presence of young people appears to be a strong predictor of crime occurrences within residential neighborhoods. Literature has sometimes included young adult population (18-25), sometimes juvenile population (15-18). For a comprehensive understanding of crime occurrences, I have included all youth population between 15 and 25 years of age. A percent of youth population in relation to total population of each block group is calculated, and used as a control variable in the regression models.

Total renter occupied housing units: The fraction of owner occupied households in a neighborhood has been observed to influence crime rates. This is an important control variable in the analysis, and should be included. Census data was last published in 2010, and in the last few years, housing characteristics in Salt Lake City has undergone an impressionable change. However, the lack of other reliable source of renter data has resulted in using census data in regression models. Renter occupied and owner occupied household information is available for each block group. I use the percent of owner occupied households in the analysis.

Neighborhood area: Some researchers have found that area of the neighborhood, number of blocks in the neighborhood, average block length has influence on the rate of crime. Each of these variables are closely correlated, and using one accounts for the others. For all three models, I have used area of the neighborhood as a control variable.

3. Analysis/Results

To arrive at conclusions, I have built three separate statistical models. Each of the models uses the basic concept of previous methodologies, but have strictly depended on quantitative methods. For dependent variables, I have used crime per person, and crime per acre. Mapping crime per acre clearly shows that crime incidences are clustered.

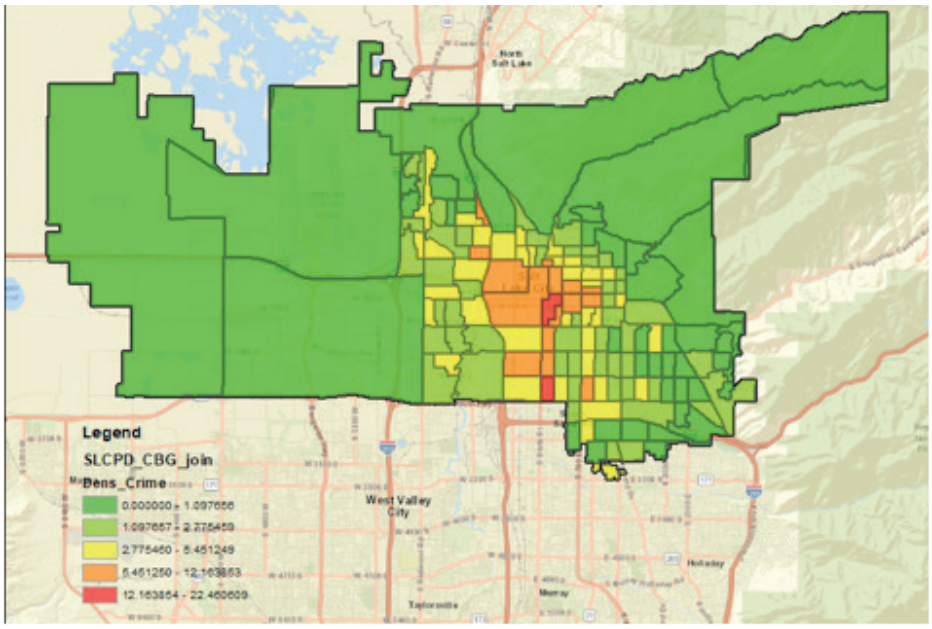

Figure 3.

Model I

The first model uses the presence of cul-de-sac as measure of low connectivity. I have emulated Johnson and Bowers (2010) where they used presence, count and density of cul-de-sacs to arrive at their conclusions. Borrowing their methods, I will use the presence of cul-de-sacs as a proxy for low connectivity. Johnson and Bowers manually counted cul-de-sacs, and characterized neighborhood street patterns to arrive at their conclusions.

Street network data was bought from TomTom, a private map making agency who create data for navigation systems. After appropriate data cleaning and cutting, I mapped Salt Lake City street network data in ArcGIS, using appropriate coordinate systems. I used GEOIDs, which are unique numbers for each block group, to match data from different sources. The street network data has a combination of street segment (as road networks) and points (intersections). Points include 4-way, 3-way and dead ends or cul-de-sacs. To select cul-de-sacs, I used "Select dangles" function in ArcGIS, and exported the selection to a new layer. I then calculated number of dead-ends or cul-de-sacs in each of the neighborhoods. I also calculated cul-de-sac density in each of the neighborhoods, as a predictor for the final model. I exported data from ArcGIS into SPSS (version 19), and used linear regression for analysis

Model I Results

The dependent variable for the model is Crime per person. Since number of people in every neighborhood is very different, comparing total number of crimes across neighborhoods as the dependent variable is avoided. Instead, a crime rate will provide more comparable means. Crime per person gives a statistic about the possibility of crime per each individual. The R-square for this model is 0.415. Some critiques may infer that robustness need to be stronger. I expect that changing kind of regression analysis may help a better fitted model. The following table provides a summary of the results.

Variable	Standardized Coefficient	t-coefficient	p-value
Total Cul-de-sacs	0.451	6.342	0.000***
Total Households	0.854	5.698	0.000***
Total Population	-0.865	-5.401	0.000***
Percentage of Hispanics & Blacks	0.353	3.597	0.000***
Percentage of renter occupied households	-0.001	-0.008	0.993
Youth percentage	-0.088	-0.656	0.513
Area of neighborhood	-0.06	-0.935	0.351

The most important finding of this analysis is that number of total cul-de-sacs in a neighborhood is strongly correlated with crime rate in every neighborhood, that is increase in number of cul-de-sacs in a neighborhood sees an increase in crime rates in that neighborhood. Percentage of minority communities – especially Hispanics and Blacks, is positively correlated to crime rate – increase in fraction of Hispanics and Blacks also increases crime rate. Increase of number

of households see an increase in crimes, but increase in population sees a drop in crime rate. This apparent anomaly can be related to "eyes on the street", where homes attract property crime, but more residents create more opportunities for vigilance, which decreases crime.

Model II

Depthmap X software, developed by the Space Syntax group of researchers, is based on the principles of space syntax (Hillier & Hanson, 1989), which uses axial lines and visibility graphs to produce a measure of connectivity. The software uses street network layers, and produces two main outputs – connectivity score and integration score. The scores are not of the segments, but of the intersection between streets. The connectivity score is a whole number, which indicates the number of segments the intersection is connected to. The integration is a mathematical expression which denotes the normalized distance from any space of origin, to any other space in the data set (Space Syntax website). Conceptually, it can be understood as a measure of relative asymmetry and relative depth.

I converted the street network layer from shapefile format (ArcGIS) to Autocad format, which I then exported into the depthmapX. Here I calculated the connectivity and integration scores in the entire area of study – in this case Salt Lake City. I converted the information into a format which is compatible with ArcGIS, and imported the data into ArcMap. To the best of my knowledge, space syntax information has not been aggregated to neighborhood level for analysis. Past work with space syntax and crime has been conducted at the individual units. But, for the sake of consistency, I have aggregated the information to the neighborhood level. Again, using ArcGIS analysis, I sum connectivity and integration scores from each intersection in a neighborhood to a single connectivity and integration score for every neighborhood. I exported this information into SPSS, and conducted linear regression.

Model II Results

Model II results were inconclusive. I estimated two separate models for two dependent variables. The first dependent variable is crime rate per person, but it did not explain a relationship between crime and connectivity. The second model with dependent variable as crime rate per acre showed a relationship similar to that of Model I and Model III, where increase in connectivity leads to decrease in crime. However, more analysis is required of space syntax principles to arrive at a conclusion.

One reason of this could be because of aggregation of data at the neighborhood level. Perhaps, aggregating connectivity and integration scores do not express something different at the neighborhood aggregation scale, and are best analyzed as individual data points.

Model III

As explained in the literature review, intersection density and link-node ratio is often used to measure connectivity in the context of traffic outcomes such as crashes. Unanimously, all studies using intersection variables to study probability of traffic incidents occurring, used general linear regression (GLM) to arrive at their conclusions. However, GLM is used when there are categorical variables, which is common for traffic crashes. But, in understanding crime safety, crime rates are continuous variables. For that reason, I will use linear regression, controlling for multi collinearity.

In ArcMap, I created two new variables – intersection density and link node ratio. The formulas for each calculation is provided below.

Intersection density of a neighborhood = {(3way intersections + 4way intersections + dead-ends) / Area of the neighborhood}

Link-node ratio of a neighborhood = {Total links (road segments) in the neighborhood / Total nodes (intersections) in the neighborhood}

From TomTom data (previously described), I extracted 3way intersections, 4 way intersections and dead-ends or cul-de-sacs. A summation function added them up providing one number for each neighborhood, which was then divided by the total area of the neighborhood (in acres) to give the intersection density. This is exactly according to the principle of traffic analysis. However, while calculating "links" I have deviated from the traditional way of calculating links as explained by Ewing (1996). Conventions in traffic analysis calculate connections between any two intersections as a link, irrespective of the geometry of the road segment. However, calculating links as different numbers at every change in direction is an established convention in urban design (Space Syntax principles). For straight line connections between two intersections, I will calculate it as one link. For connections that change in direction between two intersections (such as curved streets), I will calculate them as more than one link.

I exported data from ArcMap to SPSS for statistical analysis, and the results are described in the table below.

Model III results

The dependent variable for this analysis is crime per person. Since total crime is widely varied across neighborhoods, it is normalized as a rate per person, for ease of comparability. The main explanatory variable is intersection density. Link-node ratio was added in the initial variables, but were removed in the final model because of strong correlations with both "intersection density". The R-square for the final model is 0.558, and the adjusted R-square is 0.538. This means the predicted model aligns with the data with as much as 54%. The following table provides a summary of the results.

Variable	Standardized Coefficient	t-coefficient	p-value
Intersection density	-0.123	-2.023	0.045*
Total Households	0.78	8.121	0.000***
Total Population	-0.867	-8.243	0.000***
Percentage of Hispanics & Blacks	0.365	5.564	0.000***
Youth percentage	0.11	0.193	0.847
Area of neighborhood	-0.055	-0.988	0.325

The most important result of this analysis is that, increase in crime rate per person is associated with decrease in intersection density, or increase in intersection density is associated with decrease in crime rate. Increase in intersection density per unit area is associated with increased connectivity, so this model clearly shows that increased street connectivity can be correlated

to decreased crime rate. This is in agreement with Model I results. Furthermore, like Model I, increase in fraction of Hispanics and Blacks also increases crime rate. Increase of number of households see an increase in crimes, but increase in population sees a drop in crime rate. This apparent anomaly can be related to 'eyes on the street', where homes attract property crime, but more residents create more opportunities for vigilance, which decreases crime.

4. Discussion/Conclusion

This study has implications in criminology theory and crime-reductive planning. The research question about the influence of street connectivity on design is not new – yet, researchers have seemingly ended up with conflicting results. Part of the attempt of this paper was to understand how context and choice of methodologies shape outcomes. To address the contextual question, I used data from Salt Lake City for three models. Some part of Salt Lake City has a grid iron layout, also known as the Plat of Zion. Other parts – the relatively newer neighborhoods have a combination of grid (following continuity from the old plan) and dead ends and cul-de-sacs.

In brief, results are heavily weighted towards the hypothesis – more connectivity within neighborhoods is correlated to lesser risk of crime. Results clearly show that the presence of cul-de-sacs and dead ends increase the possibility of crime, and this is in accordance with Hillier & Raford, 2010; Hillier & Sahbaz, 2008; Harries, 2006; Porta *et al.*, 2006; Jacoby, 2006; Haughey, 2005; Batty, 2004 – who use Space Syntax theories to measure connectivity. However, Johnson & Bowers (2010) established a difference between leaky cul-de-sacs, sinuous cul-de-sacs and linear cul-de-sacs for analysis, and the concluded that the geometry of cul-de-sacs can predict burglary. With the current dataset, it was impossible to segregate these three kinds of dead ends or cul-de-sacs. I will attempt at least a segregation between sinuous and linear cul-de-sacs in later models, and it will be interesting to see how that could potentially change outcomes.

On the other hand, borrowing from traffic theories, intersection density was used to measure connectivity. Regression analysis shows that lower intersection density leads to lower crime rates per person. This result is also in accordance with researchers who have used Space Syntax theories to arrive at conclusions. To the best of knowledge, using intersection density to find the relationship between crime and connectivity has never been conducted before. I have attempted to translate methodologies across disciplines, and provide a third perspective to the problem. However, using principles of Space Syntax at the aggregate level (consistent with two other methodologies) have provided inconsistent results. Past research on this topic has analyzed connectivity scores and integration scores from space syntax at an individual level. Regression analysis with crime rate per person as the dependent variable shows no relationship between integration scores of connectivity (space syntax). Regression analyses with crime rate per unit area has different results, that is increase in connectivity is correlated to less crime. Using two crime rates (dependent variables) gives inconsistent results, although they are possibly measuring the same thing.

This research contributes to the academic argument of crime versus connectivity. As shown in literature, different ways of measuring connectivity lead to different outcomes. By controlling for context, I am removing much of the variations. Academically, this is a contribution for understanding the role of street connectivity in planning neighborhoods. Apart from this, there are also policy implications of the research. Implementing strategies for high connectivity within neighborhoods can automatically lead to a reduction of crime. This has implication is better quality of life for the residents.

Although it is attempted to make the research as robust as possible, there are some limitations to the choice of regression. The regression used here (linear regression) is not the ideal choice of regression. Estimated Moran's I shows that there is a strong clustering between crime locations, that is there are crime hotspots. A preferred regression would be a spatial regression, using statistical softwares such as R or STATA. I have used linear regression in SPSS. However, previous literature has shown that using linear regression instead of spatial regression will not change the direction of the relationship, but can change the strength of it. Additionally, the structure of Salt Lake City is unique because of the combination of grids and curves, and the combination of high density downtown and medium density residential neighbors within close range. The three models might produce different results when the context is a dense, dominantly grid iron city (such as New York) or a typical American suburb.

As next steps, I will separate violent and non-violent crimes, and consider if non-violent crimes such as burglary, property crime, car break-ins, fraud have a different predictive value than violent crimes such as robberies, gun-violence, domestic violence, sexual crimes and so on. Additionally, I will explore other statistical analysis methods such as spatial regressions (using softwares R and STATA), and see if the results differ.

In Models I & III, total number of households and total population of the neighborhood are significant predictors of the model. Total number of households invite crime, but more number of people increase the possibility of vigilance, hence have a negative effect on crime rate. In earlier models, median income, percent of poverty and percent of minority (Hispanics and Blacks) were strongly correlated. Including all three factors in the model were giving faulty results, so I used factor reduction function in SPSS to keep one of the three variables. I finally estimated the model with percentage of Hispanics & Blacks, and which also accounts for income and poverty. Percentage of Hispanics and Blacks were significant predictors of crime rate – increase in one variable is correlated with decrease of the other. Thus, in more affluent neighborhoods, crime rate is automatically low.

To summarize, the results of this study support the hypothesis that increase in connectivity is correlated to a decrease in crime. The precise mechanism for this is not simplistic or linear, so future research in the outlined direction is required.

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Applicability of Isovists and Visibility Graph Analysis for Evaluation of Urban Vulnerability to Crime

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Keywords: criminality; isovist; VGA; visibility; space syntax.

Abstract: The study aims to investigate the applicability of 2D and 3D isovists, as well as Visibility Graph Analysis (VGA), for evaluating urban vulnerability to crime. The methodology is based on correlations between number of crime occurrences and measurements of 2D and 3D isovists, and mean values of visual integration (VGA). The 2D isovists were produced using DeCoding Spaces Toolbox for Grasshopper and the 3D isovists were generated using algorithms within Rhinoceros and Grasshopper. VGA maps were drawn DepthmapX. Nine street segments of Boa Viagem, a neighborhood in the Brazilian city of Recife known for high rates of robberies, were selected for this study. Although the number of samples is small, the results suggest that criminals prefer much more visually integrated spaces with low occlusion and fewer spatial cavities.

1. Introduction

The present paper investigates relationships between visibility and crime in public spaces in Recife, a city in the Brazilian State of Pernambuco.

Visibility is, etymologically, the property by which bodies are perceived in space (Michaelis, 2016). Likewise, visibility is closely related to the notion of isovist – the visible field from a given point in space, considering the barriers that limit it (Benedikt, 1979). This concept was first introduced by Michael Benedikt in 1979 in the journal *Environment and Planning* and is considered one of the primary scientific methods for correlating space and visibility. In the 1990s and early 2000s, with advances in the development of computational tools for spatial analysis, the notion of isovist was taken up by Alasdair Turner and his colleagues at University College London. Turner *et al.* (2001) developed Visibility Graph Analysis (VGA) and expanded the notion of isovist by considering not only the visibility of a point but all the points contained within space.

Criminality, etymologically, comes from crime that is transgression of the law, violation of the rules that society considers indispensable to its existence and organization. The Brazilian Criminal Code (Brazil, 1940) classifies crime into eleven categories: (1) against a person, (2) against physical property, (3) against immaterial property, (4) against organization of work; (5) against religious sentiment and respect for the dead, (6) against customs, (7) against family, (8) against

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public safety, (9) against public peace, (10) against public faith, and (11) against public administration. Crimes against property (robbery and theft) involve occurrences at a specific point in space.

Thus, visibility, crime and space are intrinsically related, but the relations between them are still under-investigated, as can be seen from a brief review of the literature. Studies related to aspects of configuration of space that facilitate or restrict occurrences of crime within an urban environment have focused on numerous factors, such as interface, constitution, density, integration, typology, physical and visual permeability, as well as the proportion between public and private spaces. However, the role of visibility in crime occurrence has been somewhat neglected, suggesting the need for further studies in this field. Even though there is growing concern surrounding this topic and the number of studies of urban morphology and crime has increased since the 20th century, researchers still know little about the way criminals perceive the city and partake in it when committing crime. The present study thus considers how isovists and Visibility Graphics Analysis (VGA) can help us to better understand relations between space, visibility and crime occurrence, taking as a case study the neighborhood of Boa Viagem, in the Brazilian city of Recife.

The neighborhood of Boa Viagem, in the Southern Zone of Recife, has recently registered high crime rates, considered by some local agencies one of the highest in the country (Pernambuco, 2011). An attempt has been made to provide social protection by way of numerous architectural and technological solutions such as electric fences, surveillance cameras or high walls separating the private and public realms. Private spaces have thus been slowly converted into fortified enclaves, whilst public spaces have been transformed into unsafe places. These transformations are much more evident in middle- and upper-class neighborhoods of Recife.

However, in Boa Viagem, these transformations are much more significant. Most of them have occurred since the second half of the 20th century. Until the 1950s, this neighborhood was predominantly composed of summer houses with direct access to streets and transitional spaces, such as private gardens and terraces. In the early 1950s, the first high-rise buildings were built and far fewer houses were replaced by vertical buildings that still established a close relationship between public and private domains. From the 1980s, in contrast, Boa Viagem became a vertically dense territory, after successive urban laws contributed to its current urban configuration (Figure 1). This territory, which initially had houses and high-rise buildings closer to the streets, became a space characterized by vertical gated communities. At ground level, buildings have also lost what Jane Jacobs calls their "street eyes" (Jacobs, 2011, p. 35) and have gained closed-circuit television (CCTV), which promises "security" for the owners.

Figure 1. *The neighborhood of Boa Viagem in the 1920s (Source: IBGE), 1970s (Source: Blog Caderno Recifense) and 2000s (Source:Skyscrapercity).*

Consequently, a cause-and-effect relationship has been established. While these architectural and technological transformations safeguard private spaces, they also foster insecurity in the public realm, thereby contributing to the increase in the number of occurrences of crime. The rigid interface between public and private domains (electric fences, gates and high walls built as a protective measure) may create opportunities for criminals to commit thefts in public spaces, as there was a significant increase of 18.4% in robberies and thefts between 2015 and 2016. (Pernambuco, 2011). The role of interface in crime occurrence has been extensively investigated by Monteiro and Cavalcanti (2015). However, this cannot be the only reason why Boa Viagem is more vulnerable to crime than in the past, at least from a morphological point of view. Discussions of the relationship between visibility (visible field of space) and crime are still scant, as can be seen from a brief review of the literature.

2. Literature review

A growing number of studies seek to understand the role played by the spatial configuration of cities in the occurrence of crime. These date back to the 1960s and 1970s.With advances in computational spatial analysis tools, between 1980 and 2000, the number of investigations in this field considerably increased, allowing us to assess numerous attributes of space that contribute to crime. These studies have predominantly addressed a variety of attributes such as use, interface, constitution, density, integration, typology, physical permeability, visual permeability and the proportion of public and private spaces. Visibility, however, remains under-investigated.

In the 1960s, Jane Jacobs addressed the influence of urban morphology on safer urban spaces, which would be guaranteed by clear definition between public and private spaces, as well as diversity of uses and high density. Jacobs (1961) also argued that anonymous people should be considered a source of security instead of a danger. In her view, the presence of anonymous citizens in public spaces contributes to social surveillance and, consequently, urban security. In contrast, Newman (1972) argued that anonymous people were a potential source of danger and proposed to restructure urban layouts as a strategy for establishing urban security. Newman (1996) believed that urban space should be segmented into mini-neighborhoods, with gate-controlled access, stimulating territoriality among residents. He also argued that low density and less variety of uses were features that could make public spaces safer.

It should be noted that, from the 1960s to the 1990s, studies of space and crime focused on the contradictions between permeability and defensibility of space as a crime prevention strategy (Jacobs, 1961; Newman, 1972; 1996). By contrast, in recent decades, researchers have attempted to understand qualitative and quantitative attributes of urban space that promote or restrict crime (Hillier and Sahbaz, 2008; Monteiro and Cavalcanti, 2015). Despite the diversity of factors analyzed in these studies, consideration of the role of visibility in crime is notably lacking.

In the 2000s, various studies addressed the issue of urban crime using space syntax theory. Hillier (2004), for instance, argued that the answer to the title of his article (Can streets be made safe?) lies in space syntax research. Hillier (2004) compared previous studies developed by Jacobs and Newman and argued that the indiscriminate use of concepts proposed by Oscar Newman had been responsible for creating fragmented, underutilized and less visible urban spaces. According to Hillier (2004), understanding of the relationships between space and crime should consider two crucial syntactic aspects: visibility and integration. In another related study, Hillier and Sahbaz (2008) suggested that solutions aiming to establish safer urban spaces have been divided into two types: enclosed spaces (enclosure as a form of protection) and open spaces (permeability,

accessibility and visibility as a form of security). Hillier and Sahbaz (2008) suggested that different spatial characteristics imply different types of crime. For instance, places with a high level of co-presence contribute to petty thefts, while empty and less visible spaces encourage acts that require more time (vehicle thefts, and so forth.).

In 2015, in Recife, Monteiro and Cavalcanti (2015) investigated the possibility of evaluating urban vulnerability to crime, taking Boa Viagem as a case study. Their study established various factors classified as directly proportional to security, which means that the larger the numerical values, the lower the vulnerability. This classification was divided into qualitative and quantitative aspects. The qualitative aspects are related to mix of uses, urban interface (level of visual permeability), constitution (direct access between public and private spaces) and population density, while the quantitative aspects are more related to space syntax metrics such as global and local integration. The analysis considered urban segments and the number of crimes per segment occurring between 2010 and 2012. It concluded that, where the level of local integration and the length of the segment were greater, the number of crimes in the segment was higher, as can be explained by the fact that, in large urban blocks, people's behavior is observed by criminals over a longer period, giving them time to act (Monteiro and Cavalcanti, 2015).

Although the literature is scant, it can be seen that visibility has rarely been addressed as an aspect that can influence the occurrence of crime in urban spaces, with the exception of studies developed by Bill Hillier, who has dedicated some of his research to the impact of visual integration on urban crime. Hillier (2004) concluded that spaces with a higher level of visual integration are used more by citizens and hence more secure. Apart from Hillier, very few researchers have adopted the same approach. The present study, therefore, is motivated by a notable lack of studies on relations between visibility, crime and space. Space and its limits constitute a complex arrangement that can be perceived by the observer. The "capacity of perceiving space through the sense of vision" has been defined as visibility (Michaelis, 2016). Visibility, therefore, presupposes a subject (the observer) and an object (the border), even though it is very far from our visual field. In architectural space, walls, doors and furniture act as elements that delimit the visual field, while, in urban space, buildings, walls, gates and other elements perform the same function. Walls and buildings make up a certain visual field which is the result of a barrier system. This consequently establishes possible visual and social interactions within space.

Visibility thus encompasses formal-spatial attributes, as well as social implications. In relation to the formal-spatial attributes, several methods have been developed, namely: [1] 2D isovist 2D; [2] 3D isovist; and [3] visibility graph analysis (VGA).

2.1. *2D Isovist*

The notion of isovist was first introduced by Tandy (1967) in *The Isovist Method of Landscape Survey*, but it was developed in the field of geography. In the 1970s, Benedikt (1979) introduced the notion of isovist into the field of the built environment (architecture and planning) and defined isovist as the visible field from a specific point in space, given the barriers that limit it. This field corresponds to the "set of all points visible from a given vantage point in space and with respect to an environment" (Benedikt, 1979, p. 47). From the point of view of geometry, it consists of a polygonal shape with a greater or lesser degree of concavity, which means that spaces with similar areas, but different polygonal configurations generate isovists with different degrees of concavity. Benedikt (1979) calls this property occlusivity which represents the extent to which "environments are partially covering one another" (Benedikt, 1979, p. 53). This attribute is important because spaces with greater occlusivity create environments with more blind points (non-visible points in space),

a crucial aspect for security and social surveillance. However, the concept of isovist proposed by Benedikt (1979) had the historical limitation of allowing for only two-dimensional analysis.

2.2. *3D Isovist*

Morello and Ratti (2009) developed new techniques for measuring the perception of urban spaces. Their study expanded the concept of isovist to assess the spatial qualities of urban environments related to visual perception (such as legibility and imageability) by incorporating the third dimension. The 3D isovist proposed by Morello and Ratti (2009) is based on the concept of spatial openness, which is the volume of a solid defined from a certain point in space. The visible field thus constitutes the volume observed from a given point, generated by rotation of the view through all directions of the solid (360°). It enables, for instance, the measurement of fundamental properties such as volume and maximum radial distance, as well as quantification of so-called elongated properties, such as compactness, concavity and convexity.

2.3. *Visibility Graph Analysis (VGA)*

Visibility was first introduced into Space Syntax by Alasdair Turner, Maria Doxa, David O'Sullivan and Alan Penn in 2001, when they revisited the concept of isovist to develop VGA, a methodology for visibility analysis assisted by computational methods. Turner *et al.* (2001) believed that the concept of isovist could be computationally improved and embedded in spatial analysis tools such as DepthmapX. In VGA, the space is first decomposed into a grid of points and, then, analysis of interconnections (or intervisibility) between them is established. Finally, the intervisibility is quantified. As a result, a color gradient map (from red to blue) is generated to distinguish the more intervisible spaces (represented in red) from the less intervisible spaces (represented in blue). The space, therefore, is fully intervisible when, from any one point, it is possible to see all the others (Turner *et al.*, 2001).

In addition to these techniques, it is important to note recent advances. (1) Varoudis and Psarra (2014) have been developing three-dimensional isovists using parametric design tools; (2) Varoudis and Penn (2015) have expanded the concept of VGA to what they call Augmented Visibility Graph Analysis (AVGA), a visibility analysis that considers transparent surfaces and other transparent types of; and (3) Real Time 3D Isovist, a methodology assisted by computer systems that allows urban isovists to be immediately generated and visualized while the observer moves through public spaces. This new method has been developed at the Bauhaus-University Weimar by the Computational Planning Group, as part of the DeCodingSpaces Toolbox for Grasshopper (Abdulmawla *et al.*, 2017).

Spatial analysis methods and techniques are thus essential for helping us to answer questions regarding how criminals see the city and take advantage of it to commit crimes, as well as how cities can be structured to facilitate or curb crime. The present study, therefore, investigates the applicability of isovists and visibility graph analysis for evaluation of urban vulnerability to crime.

3. Methodology

The methodology is based on correlations between the number of thefts and robberies occurring in street segments of Boa Viagem and various metrics, such as measurements taken from 2D isovists (area, perimeter, occlusion, compactness); qualitative attributes of 3D isovists

Figure 2. *Segment 1 (Padre Carapuceiro Street), 2 (Faustino Porto Street), 3 (Poeta Zezito Neves Street), 4 (Boa Viagem Avenue), 5 (Hélio Falcão Avenue), 6 (José Moreira Leal Street), 7 (Engenheiro Domingos Ferreira Avenue), 8 (Ribeiro de Brito Street) e 9 (Ernesto de Paula Santos Street).*

(fewer or more cavities); and mean values for visual integration (VGA). The data (number of thefts and robberies) was given by professor Circe Monteiro, previously published in his article (Monteiro and Cavalcanti, 2015).

First, a Kernel map was created to evaluate densities and patterns of crime within the territory or, in other words, regions with higher or lower density of crimes occurring between 2010 and 2012. Secondly, based on the Kernel map, nine street segments of Boa Viagem were selected, representing a minimum statistical sample – 1% of the total number of robberies and thefts. (Figure 2 [1-9]) This selection considered three different densities of crime: high density (more than 10 events); medium density (between 1 and 10 incidents); and low density (no occurrences). In Figure 3 [A], segments 1, 2 and 3 represent urban spaces characterized by high density of crimes. Segment 1 is in Padre Carapuceiro Street – one of the main access routes to the largest shopping center and the largest gated community in Boa Viagem. Segment 2 corresponds to Faustino Porto Street, where one can see the constant presence of private security guards, probably due to the proximity to the largest private school. Segment 3 corresponds to Poeta Zezito Neves Street, where there is a notable presence of large buildings and a low number of users. Segments 4, 5 and 6 correspond to urban spaces that register a medium density of crime. Segment 4 is on Boa Viagem Avenue, near Boa Viagem Beach. Segment 5 (Hélio Falcão Avenue) is between two heavy-traffic routes in the neighborhood: Ribeiro de Brito Street and Ernesto

de Paula Santos Street. Segment 6 corresponds to the José Moreira Leal Street and segments 7, 8 and 9 to sectors of Engenheiro Domingos Ferreira Avenue, Ribeiro de Brito Street and Ernesto de Paula Santos Street, where no robbery or theft occurred during the period analyzed. It is important to note that these three segments have great importance for the neighborhood. Segment 7 cuts through the whole territory longitudinally and segments 8 and 9 connect Boa Viagem to major nearby neighborhoods, such as Imbiribeira and Ipsep.

Finally, 2D and 3D isovists, as well as Visibility Graph Analysis (VGA), were produced, for each street segment. Statistical correlations were also established in order to understand relationships between different variables (Tables 1 and 2).

4. Results

As mentioned before, the results are obtained from correlations between two quantitative variables: the number of crime occurrences and occlusivity, compactness, perimeter, visual integration (VGA) and compacity (metrics extracted from 2-dimensional isovists and visibility graph analysis). The two variables are correlated if changes in one cause changes in the other, either positive (ratio directly proportional) or negative (ratio inversely proportional). Correlations between all these measures and the occurrence of crime were identified, for normalized values between 1 and 5), as shown in the scatter plots below (Chart 1).

4.1. *2D Isovists*

Values for occlusivity, compactness, perimeter and area were extracted from the 2D isovists. Occlusivity concerns the extent to which barriers in space restrict the view of the totality of the space, or, in the words of Benedikt (1979, p. 08), 'how much the environments are hiding each other'. Thus, spaces with a high occlusivity value (such as a dense forest) are less intervisible, while spaces with low occlusivity, or near zero, are more intervisible spaces, which provide greater dominance of the visual field in its totality.

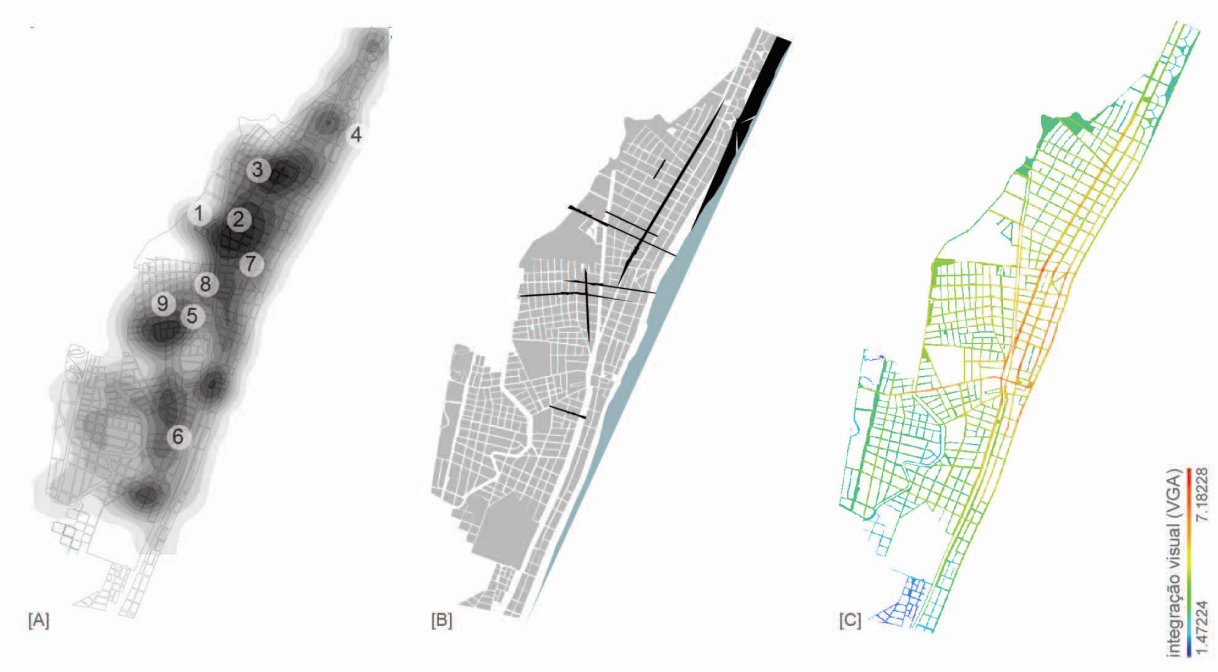

Figure 3. *[A] Kernel map and the nine segments, [B] 2D isovist per segment, [C] VGA map.*

Table 1. *Results for normalized values.*

Segments	Crimes	Occlusion	Perimeter	Area	VGA	Compacity
1	14	3 .08	2 .72	1 .27	3 .32	1 .15
2	14	1 .57	1 .61	1 .07	2 .22	1 .84
3	14	1	1	1	1	5
4	6	4 .50	5	5	1 .64	3 .28
5	6	2 .06	1 .92	1 .18	2 .61	2 .09
6	6	1 .37	1 .30	1 .04	2 .60	3 .09
7	0	5	4 .43	1 .88	5	1
8	0	2 .45	2 .23	1 .15	3 .74	1 .21
9	0	2 .99	2 .61	1 .21	3 .58	1 .03
Standard deviation		1.3754	1,3654	1,2852	1,2026	1,3615

Table 2. *Results for non-normalized values.*

Segments	Crimes	Occlusion	Perimeter	Area	VGA	Compacity
1	14	2220 .87	2,598 .62	19,837 .86	3 .35	0 .037
2	14	751 .10	1,252 .30	7,401 .69	3 .01	0 .059
3	14	185 .79	499 .53	3,180 .31	2 .63	0 .160
4	6	3615 .78	5,378 .09	243,017 .93	2 .84	0 .105
5	6	1225 .09	1,623 .43	14,143 .25	3 .13	0 .067
6	6	549 .92	870 .90	6,007 .67	3 .12	0 .099
7	0	4098 .66	4,694 .84	56,319 .36	3 .88	0 .032
8	0	1599 .31	2,005 .71	12,494 .74	3 .48	0 .039
9	0	2137 .68	2,468 .83	16,104 .42	3 .44	0 .033

Correlation of occlusivity values and the number of occurrences of crime, show that there is a tendency for more crimes to occur in spaces with lower occlusion values, which means that spaces with low occlusion (high intervisibility) are potentially more vulnerable to crime. This is made even clearer by the scatter plot (see Figure 1A). It is a common belief that criminals prefer much more occlusive spaces to attack their victims, as there is a greater possibility of hiding or evading detection. But the results show the opposite: criminals prefer places that afford them greater appropriation of the visual field of the space in its totality.

In Boa Viagem, the urban fabric – a slightly deformed orthogonal mesh, predominantly composed of streets and long avenues – causes the isovists to assume an elongated shape with large areas and perimeters. The correlation between the isovist area and crime is almost perfect, indicating that there are more robberies and thefts in isovists with smaller areas (Graphs 1B and 1D). Committing crimes in smaller visual fields is possibly another strategy used by criminals. This result suggests that they prefer to have victims at a short social distance. According to Edward T. Hall (Hall in Gehl, 2014, p. 34), 'we can see people 100 meters away, and if the distance is smaller, we can see a little more'. According to Gehl (2014, p. 34) 'we recognize a person at a distance of 50 to 70 meters', the same distance from which we enter the field of hearing and

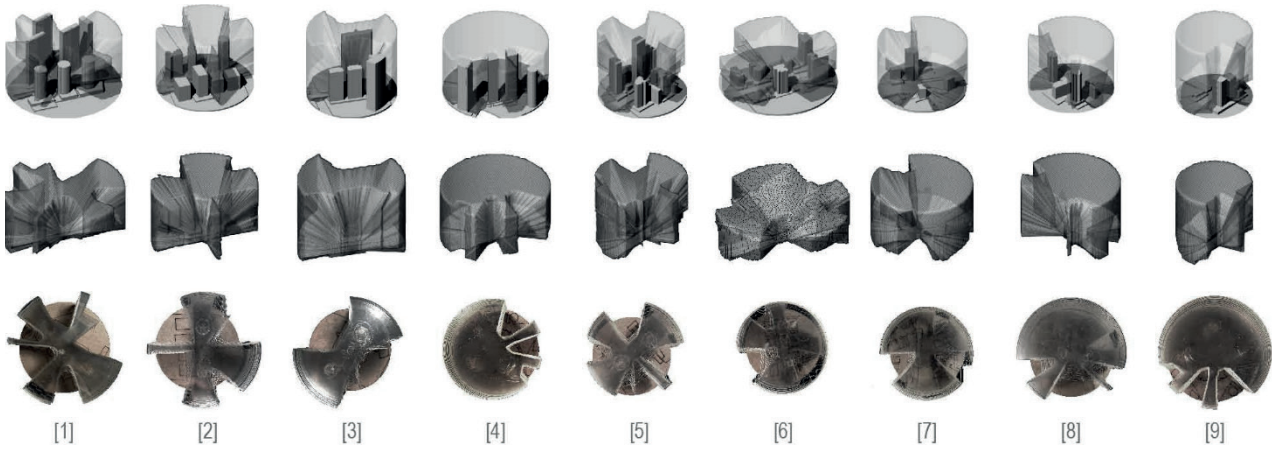

Figure 4. *3D isovists electronic model of the 9 segments analyzed within the environment (first line) and without the surroundings (second line) and photos of the physical model in acrylic (third line).*

can hear screams. 'At a distance of 22 to 25 meters, we can read correctly facial expressions and dominant emotions'. But experience only becomes interesting and exciting from a distance of less than ten meters, and preferably at even smaller distances, when we can use all our senses (Hall in Gehl, 2014, p. 34). Criminals, therefore, seem to prefer smaller visual fields because they can use all their senses to commit crime.

4.2. *3D Isovists*

The three-dimensional isovists were generated with the aid of the parametric design tools Rhino and Grasshopper. The modeling considered existing buildings in the surroundings of each segment. The intent was also to explore attributes such as the three-dimensional occlusion, visible volume and surface of each 3D isovist. However, it was not possible to extract metrics using the DeCodingSpace Toolbox for Grasshopper (Abdulmawla *et al.*, 2017), since the algorithm is still in development.

The qualitative analysis was performed on the basis of observation of the existence of a larger or smaller number of cavities. This evaluation was conducted using digital fabrication of 3D isovists produced in acrylic. There were more cavities in isovists corresponding to streets where more crimes occurred, leading to the conclusion that there may be a relation between three-dimensional occlusion and the occurrence of crimes. As crimes usually occur on the ground floor, residents of vertical buildings can act as vigilantes, inhibiting criminal activity, particularly those residing on the first floor. According to Gehl (2014, p. 41), "the contact between the buildings and the street is possible in the first five floors. Contact with the city quickly dissipates from the fifth floor '.

Three-dimensional visual field cavities generated by visual obstacles, such as septa, walls, and other elements present in the urban environment can thus help to increase the occlusion of the three-dimensional field of vision of the first floors of buildings, making urban space even more vulnerable to the occurrence of crimes.

4.3. *Visibility Graph Analysis (VGA)*

The DepthmapX software package was used for visibility graph analysis, establishing a grid of points in the open space and analyzing the intervisibility between them. In the case of Boa

Viagem, a grid of 60,940 points was created, with each point in space corresponding to an integration value. The integration values ranged from 7.18228 to 1.47224. The visual integration values for the nine segments analyzed were obtained from the average values of all points contained in the space of each segment. The mean values were later correlated with the number of crimes occurring in each segment. It has been observed that in Boa Viagem there is a tendency for crimes to occur in spaces with lower visual integration values, which may indicate that criminals prefer to commit crime along the streets rather than on the corners, where visual integration is higher (Graph 1E). Likewise, they prefer compact and rather than large open spaces, in which visual integration is higher.

Overall, urban grids in which the proportion of unbuilt spaces is larger than the proportion of built spaces, such as in the modern city of Brasília, have a larger visual integration value. By contrast, the irregular or informal grids of traditional cities, where the proportion of built spaces is higher than the proportion of unbuilt spaces, have a lower visual integration value. However, in both cases, the corners spaces will always have higher visual integration values than spaces along the street.

It is therefore possible that, before committing a crime, criminals prefer to observe their victims from the corners so as to have greater visual control over them. However, they may prefer to act unseen in less visually integrated spaces, such as in the middle of urban blocks, not giving the victim time to react or to escape in other directions, as facilitated by the corners.

5. Discussion

The occurrence of crimes in cities is obviously not determined by a single morphological aspect of urban space, such as visibility, neither by all variables of urban form. Urban crime is one of the problems triggered by the fragility of the city's social function. Social problems such as unemployment and deprivation of basic public services, especially health and education, con-

Figure 5. *Prototype of Segment 1 3D Isovist*

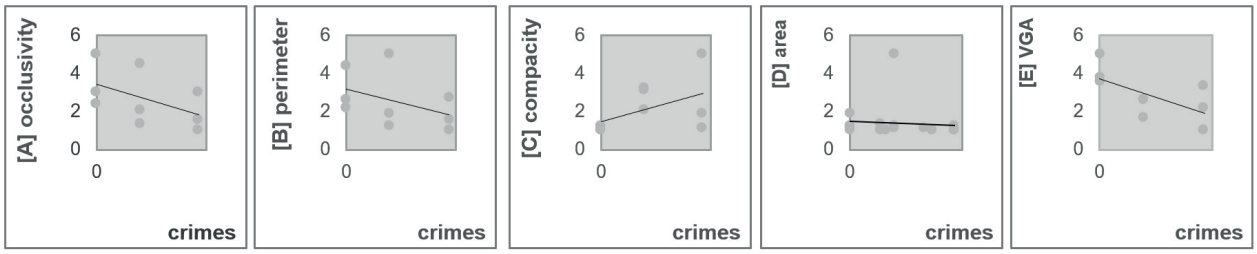

Figure 6. *Correlation graphs between crimes and occlusivity [A], perimeter [B], compacity [C], area [D] and VGA [E]*

tribute to increased criminality. Society, therefore, seeks to protect itself within enclosed private spaces. However, the constitution of visual barriers has a significant impact on the visual and social field of a space, because this alters the configuration, morphological properties and, consequently, the social relations to be established in urban space, through changes in the way we perceive it.

According to Hall (2005), "the space shaped by our vision is important in the establishment of human and socio-spatial relationships and responsible for its appropriation. The nature of the visual space is much more complex than the nature of the auditory space, for example, because a sound barrier at a certain distance causes less impediment than a visual barrier". Hall (2005, p. 79-88) also noted that the amount of information transmitted by our vision is much higher, when compared to any other sense. Using the sense of sight, human beings perform various functions, such as identifying food, friends and the physical state of materials from a certain distance. Also, the sense of vision orients us within a space and gives us enough information to avoid obstacles and dangers, to create tools, and to take care of ourselves and others. However, it is important to distinguish two concepts: the visual space and the visual world. The visual space is everything we see, while the visual world is our perception of what is being seen: danger, comfort, safety, and so forth. Peripheral vision is thus also an essential concept for human safety, since, even without perfect visual acuity in these regions, it is possible to identify imminent dangers and even elements secondary to vision.

Criminals probably, therefore, use all the sensory capabilities provided by the eye to commit crime and the configuration of the space may facilitate or restrict this. Further research in this field is essential and even more complex relations between the morphological attributes of space, perception and environmental psychology need to be investigated.

6. Conclusion

In short, this paper has sought to identify relationships between visibility and crime, as well as to test the applicability of isovist and visibility graph analysis in evaluation of urban vulnerability to crime, aiming to contribute to local and international studies.

Although the number of samples is small, the results suggest that criminals prefer to commit crimes in low occlusive urban spaces and choose spaces along the streets instead of spaces located at the corners. They also opt for more compact spaces with a smaller area and a smaller visual field perimeter, to the detriment of large open spaces. In order to facilitate crime, they operate in spaces where people commute and select less occlusive and compact urban spaces so that they can have greater visual dominance of their victims. These results demonstrate that iso-

vists and visibility graph analysis do have great potential to assess spatial vulnerability to crime, as well as to propose solutions to mitigate the occurrence of crime in the built environment.

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Chaining Design within Beirut's Human Ecologies

Experimental Chaining on our Collective Landscape

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Keywords: chaining, chaos theory, cultural diversity, environmental sustainability, productive land-cityscape, socioeconomics.
Conference topic: Focus 1: urban conflict and divided cities.

Abstract: Urban morphology is now at an apex as those within the field are aiming to transform it in ways that fit into the emerging needs of the coming era. Through chaining of the ever-changing dynamic, relationships of human ecologies and their footprint over space may be examined. The proposal seeks to examine how space can trigger a domino effect, chaining the changes of human behavior and interaction over space. In order to achieve this end a new architectural synergetic model is utilized, influenced by disciplines such as anthropology, sociology, environmental psychology, policymaking, and free-market economics. In this synergetic model, time works as a mechanism to bring change, as the project implies radical increment, Trojan horse-like strategies, mighty unfoldings and malleable ecology strategies, opening a series of – uncertain but more sustainable – possibilities for the future of the city. In this way, the project may become the turning point on the unpredictable chaos model of the city and its potential future. Policymaking and socialization, alongside with the idea of time, become tools in creating the necessary protocols in order to prepare essential conditions and space, with the possibility for underlying, existing and proposed human ecologies to take over. The spaces which would be provided by these policies and social norms, accompanied by the human cognition, encourages emerging camaraderie and cultural diversity, while discouraging urban conflicts. This is enforced through the medium of planned urban landscaping. The landscape design of an area becomes the main transformative factor, as well as the "ground" on which all the processes, (cultural, financial and spatial regeneration) take place. In all, the proposal strives to utilize the very complex relationships, fluxes and uncertain behavioral reactions as an alternative tool, along with the factor of time, in creating a variety of possibilities and scenarios that may happen within an urban and architectural setting.

1. Principles and Assumptions

1.1. *The urban system is a chaotic system*

Chaos is when the present determines the future, but the approximate present does not approximately determine the future. In general, chaos means a state of disorder.

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By R.L. Devaney, a system behavior to be characterized as chaotic, the following properties are necessary:

1. sensitive dependence on the original conditions*.
2. must be topologically transient (or any two open sets, some points from one set will eventually hit the other set).
3. must display a dense set consisting of all the system's periodic trajectories.

An urban system is extremely susceptible to the initial conditions. The urban system does not exist without the human behavior and the urban actors. Well known through psychology and social sciences such as sociology or anthropology, the urban actors (people) themselves are behaving on many different stimuli. The act on given spatial forms, politics and policies is affects by global events, financial potentiality affects the urban development, while sometimes overlaps the actual need of its people, which leads to demonstrations and confrontation.

The sets of systems within the urban system are always overlapping. As stated above, a change on a local or a global scale can affect the whole system's topology. This means for example that a change in the trading system will affect the amenities system and therefore the spatial footprint or interpretation of the social patterns that express each system. Therefore, the two systems will eventually "hit" each other.

In addition – and more literally –, urbanity is always changing its physical spatial form, and therefore the behavior of the system has a topological transient, maybe not as meant by even sciences but more in a literal, yet philosophical transition. We can consider the main trading district or the "center" of the city as an example. Both are moving into the topographical place, which has greater potential by time and era, while other changes such as a popular entertainment center, a new trading center, or a new trans-local infrastructure (such as an airport or a port) can change the dynamics between the motilities of the urban fabric over time.

The behaviors of trading or social gathering are on themselves individual orbits (or trajectories), as well as they form a part of the urban system. Each trajectory is orbited around specific attraction poles. For example, the trading system is orbited around poles such as ports, commercial centers or trading streets or neighborhoods. Social gatherings are usually orbited around activities networks, places that allow a sense of security, open spaces and or artificial environment usually linked to commercial, political or religious systems. Moreover, each and every urban actor can be considered as a unique trajectory of a point or set to the system (see fig. 1 and 2 below) and therefore that a set of multiple unique urban actors can be identified of a topological space and therefore a dense set, with more or less, periodical trajectories. Following the above, an urban system can be characterized as a chaotic or dynamical (disordered) system by R.L. Devaney.

* The requirement for sensitive dependence on the initial conditions implies that there is a series of initial conditions with a future effect (positive measure) that do not converge over a specific known result or periodic behavior of any time or spatial schedule (period of any length) [rephrase of the scientific explanation].

1.2. *This paper is perceived upon a basis of a simplified, yet very complex and open bottom-up planning*

All sciences are based upon assumptions in order to be able to process complex things or systems. The generalizations first made are then translated into conclusions and verified upon many different systems the assumption was first based upon. This research, examines a specific

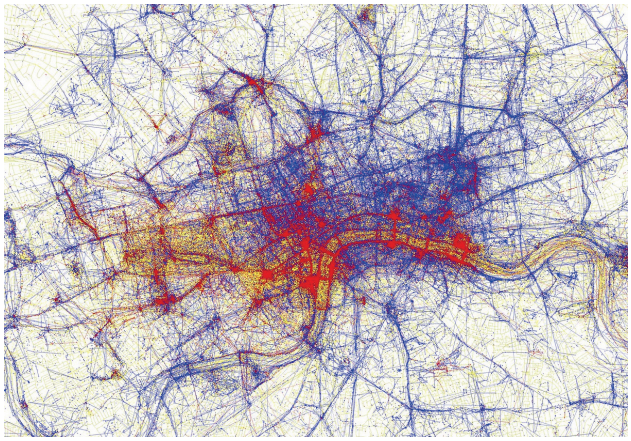

Figure 1. © *2010 Eric Fischer. London: Locals and Tourists by Eric Fischer (Oakland-based artist and software developer). Tourists and locals experience cities in strikingly different ways the map is based on where each group takes photos*

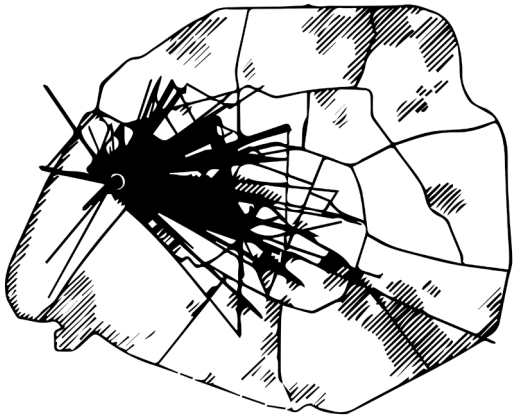

Figure 2. © *1952 Henry Chombart de Lauwe. Routes taken during one year by a female student living in the 16th arrondissement of Paris / Paul Henry Chombart de Lauwe, 1952.*

space in more generalized terms, that could apply in many similar occasions and examples, yet is very locally specific. Although this happens, the methodology or ideology (if preferred) used is universal and catholic. The extremely complicated urban systems of the area are simplified into many activity networks, social groupings in a less detailed way (in order to be as objective as possible, without compromising any of the groups), polarities and dynamic systems. Along these lines, someone is able to examine them as objectified mechanisms that will produce their own spaces and bring the makeshift and bottom_up participatory planning, that the area is in need of, at any given time or era.

The planner rejects the identity role as a designer and becomes an arranger or a "maestro" of urban dynamics, civic fluctuations, polarities, social norms or policies and underlying potentials that one can observe at each given area at each specific time. In that way, the planner is not expressing formally and deterministically the existing social structure, rather than the planner acts upon a basis that uses spatial disciplines as a tool of disputing its existing structure and revising its future one, with unpredictable results guided by the new potentials, policies, new fluxes and attractors he manages to establish.

1.3. *Spatial changes effect behavioural patterns or trajectories*

In psychology is generally accepted that; the group dynamic is the result of the individual dynamics of the members, where each individual reproduces the group dynamics in a different scale. This reflects the groups' chaotic behavior on each individual member. On the urban scale the system dynamic shall be the result of the dynamics of each set of urban actors and their reaction to spatial dynamics and polarities.

1.4. *Strange attractors*

In order to guide that system one needs to advocate creative ways to incorporate uncertainty and irresolution into urban planning. The idea of collectives among others can be considered as attractors for re-engaging with the city-making in order to create urban continuity and cohe-

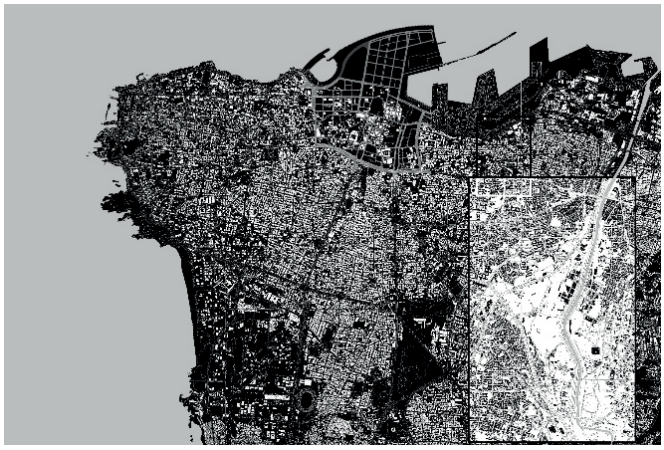

Figure 3. *The city of Beirut on Black, the Sea on Grey and the Area Under Study on White.*

sion. Other ways can be considered the strategic approaches of radical increment, trojan horse, mighty unfoldings and malleable ecology strategies, that allow the confrontation of transition as a constant urban uncertainty (Stratis, 2014). The idea of attractors makes it no predictable, rather than measurable factors that play an active role in guiding the change.

2. Personal Thoughts or Narratives

Seeking on the theme of divided cities the most appealing for me, would be the one in my homeland Cyprus. That would be either the city of Nicosia or the city of Famagusta. The dilemma there, would be that I would be incapable of observing the situation from a top view and equitably. I would rather be emotionally driven on my try to be as objective as possible. On the search for other similar urban conditions, one would confront cities such as Belfast, Mostar, Beirut, Jerusalem, Nogales, amongst others.

Considering a list of similar cities, I came to the conclusion that I should choose the most familiar one and one that I would act on a mental level, rather than a physical one. Beirut seems the most appropriate in that case. Having a previous experience of the city, both academic and a visitor approach provided some significant information needed. Although, that is true, the main reason for choosing Beirut (see Figure 3) was the personal conclusion of the many similarities in the mental and social structures between Cyprus and Lebanon.

As such, Beirut would be a great opportunity to examine the chaining design. Knowledge of the social structure, was already impeded on me.

In that way, the social knowledge is given, while the emotions can be detached and the observer's eye would be more objective and pure in that way. In addition, the needed sensitivity could be given on issues that could bother the urban actors or ones experiencing at first hand this partition.

3. Background on Literature Review

Contemporary city planning is a discipline experiencing ongoing. Although this happens, it is a major trend that town planning departments, all over the globe, are using design methodologies that follow a top-down approach, which declines to search for the hidden underlying

factors, that is unable to explore human relations or work with ecosystems that are usually ignored within an anthropocentric system that denies realizing its name. Moreover, on top-down approaches there is a variety of moves by architects according to their political or ideological tendencies (Tschumi, 1996). In other words, there is a political agenda served by the architects, while the locals or the natural systems of the urban site are never actually answered or even accessed.

In order to perceive something, architects and urbanists tend to refer to conceptualization as a method of designing. Conceptualization is a permanently tentative method, in which data information and various viewpoints are analyzed and synthesized into a responsive comprehensive and coherent spatial concept. This concept although, lies upon the formulation of basic fictions desires, intentions and hopes within a negotiated space. (Weiss, 2017, pp. 44-51- A. Betsky)

4. Context

Urban planning more than any other kind of design within the architectural practice needs to reinvent itself and not only arise with a responsive plan to contextual information and disparate viewpoints on society living and urban fabric, rather than to become a tool for social criticism and social change.

The main focus of this thesis towards the spatial design disciplines is a reinterpretation of its design procession, contextual information analysis. Furthermore, an objective is the change of a specific spatial viewpoint into a more varied scope with the incorporation of divergent viewpoints and scopes from other disciplines. This happens in order to provoke a spatial negotiation of planning with its living environment.

This spatial Manifestation is a proposed process to be followed by consecutive master plans in time while it is dealing with an onsite approach and participatory design. Is a proposal seemingly against the master plans, but it rather incorporates new perspectives into it? This is a prosthetic procedure that does not change the concept of planning or designing but its effect on the physical form and spatial expression and the collectives' negotiation with politics, economy and society.

This is not a new idea, rather one that derives from postmodern considerations. As stated, "I welcome the problems and exploit the uncertainties. Architects can no longer afford to be intimated by the puritanically moral language of orthodox [...] architecture. I like elements which are are hybrid rather than 'pure', compromising rather than 'clean', distorted rather than 'straightforward', ambiguous rather than 'articulated', perverse as well as impersonal, boring as well as 'interesting', conventional rather than 'designed', accommodating rather than excluding, redundant rather than simple, vestigial as well as innovating, inconsistent and equivocal rather than direct and clear" (Venturi & Scully, 1977).

The idea of the proposed design lies on how Anthropocene can be used in order to accommodate or produce human ecologies or how human ecologies and civic ecosystems overtake the Anthropocene. Consequently, this design process examines how the collective landscapes are formed and how those can be guided through a series of chaining effects, by only changing the initial conditions to any chaotic urban system.

By changing our attitude as designers and becoming willing to be less ambitious and more modest, we are still able to outcome with some beneficial predictions on the urban futures. The only requirement is a different view on determinism. There is no more reason to forecast the future of an urban project amongst a chaotic city, rather looking for a probability or a series of

possibilities on its urban futures, incorporating uncertainty into their response. The purpose of the forecast is no longer to determine the behavior of the actors in a specific time in the future, for that is impossible, rather trying and predict possible scenario outcomes and study the system's behavior sensitive to tiny attractors. Applying probabilities rather than certainties is a real change in one's perspective. By applying those ideas, there is a whole world between theory and practice that needs to be examined.

5. Purpose

This research's aim is an approach that emphasizes on the dynamic relationships and fluctuations or fluxes through and time and their effects on society, civilization, economy, sustainable development and the environment.

This paper examines, how can a citric on the masterplan or special (town) planning provide an alternative concept of designing. This alternative concept needs to approach the city with a more complex system of analysis, in order to provide a planning that is conscious towards the environment, human ecologies and dynamic civic ecosystems, without excluding the actors' participation in designing.

In a case of conflicted sensitive mentality, into an area with memories of spatial division and contradiction, it is examined how almost insignificant and momentous changes (or better a combination of the two) can change collective memory and its collective landscape.

6. City Model Approach

The major idea followed throughout this thesis is that one is not acting as a designer, rather s/he is orchestrating the fluctuations and dynamics of the area, encouraging or discouraging specific behaviors. This is achieved through gathering existing programs, encouraging their development and expansion, while adding new subsidiary programs.

By creating an imagery toolkit for the public, one cultivates the eye of the public, while favoring the pure enjoyment of complexity, understood as the collection of compositional elements organized according to a complexity principle, where the hybrid programmatic mishmash readily offers itself as an entertaining spatial alternative to stringent minimalism. Among other things, this approach, activates references outside the realm of architecture and urbanism, not as hard-to-grasp metaphysics of form but as vessels that convey meaning where everyone seems to be able to join in. (WEISS, 2017, p. 47)

There are four ideas behind this thesis. The first is the chaos model (chaotic system and strange attractors) and the idea of becoming the leaking point to which the future takes a different torque, explained above. The chaos idea is explained in detail above (see. Principles and Assumptions, Personal Thoughts and Narratives), (see. Fig.4) The second is the synergetic model within different disciplines (as seen in fig.5). The third is the Work Focus Levels (see. Fig.6) with three major aims to be entrepreneurship, landscape recovery and cultural metissage. The fourth, after the idea of 'changing' is the Strategic Layering (see. Fig.7) between economies, landscape and the public sphere. The idea is that if someone works on the literal one, the ground and therefore the layer of the landscape a chaining effect will generate incentives and economic resources and regenerate the urbanity of the area. All in all, this thesis does not follow the idea of controlling space, rather

than guiding this chaotic system, while trying to become the melting pot where the Anthropocene and the Anthropocentric are in a synergy with each other.

Figure 4. *The proposed understanding of the city is through the idea of Chaos. Any project, including the one intended by the author as a theoretical experimental implementation in the city of Beirut, Lebanon can be perceived as such. The project aims to become the dot seen on the diagram above that by changing the initial conditions (any contemporary conditions of a city) can manage not to predict, rather guiding the future of it.*

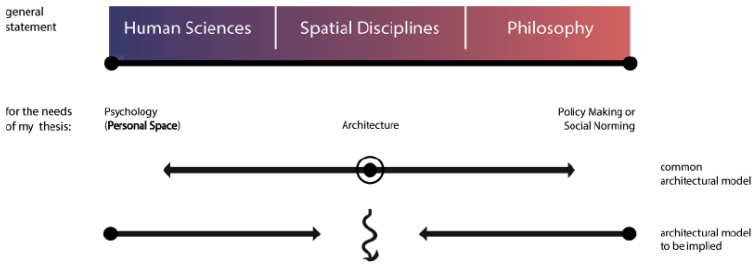

Figure 5. *The idea that other disciplines can provide tools to be used by architectural urbanism becomes a major idea. By rejecting traditional methods of working on the city from an architectural or town planning point of view, towards other aspects of the city such as economy or social studies, a new purer design can emerge. Using other disciplines and their knowledge can help in changing the physical environment of the city and guiding its futures.*

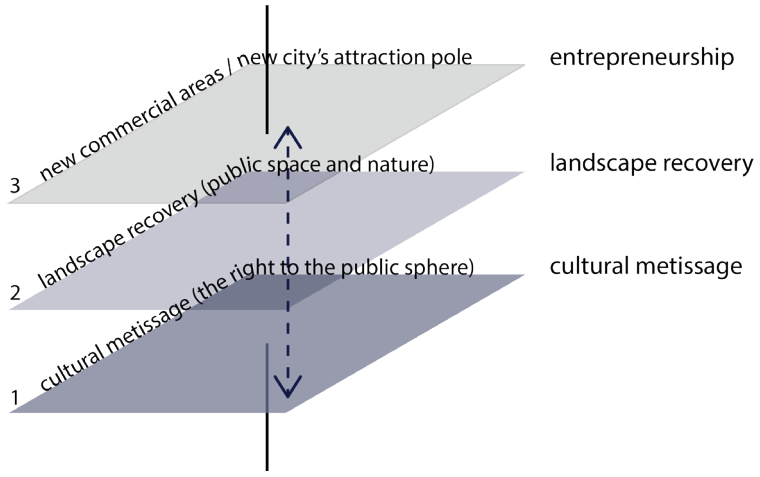

Figure 6. *The cognitive model used for this specific environment and this study is that of three layers that are to be changed through this method. Entrepreneurship, Landscape recovery and Cultural Metissage become the major principles or goals that drive this proposal to answer the urban development question.*

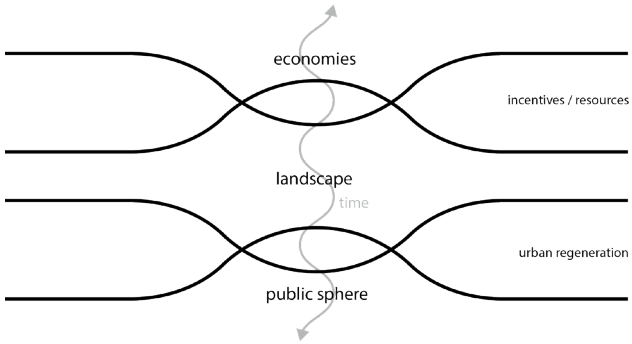

Figure 7. *In order to understand the changes one hopes to achieve on the layers to be changed a strategic approach implementation becomes of high importance. One working on the strategic levels of Economy, Landscape and Public Sphere can shape or guide the changes for the future. The landscape becomes the ground (literal or metaphorical) that accommodates the changes that can trigger those changes.*

7. Methodology

Following the Literature Review and Previous Global Secretariat Knowledge, this method is working with existing knowledge in order to create a strategic model on finding solutions for reviving the urbanity within the city.

Historical research is being processed in order to investigate the facts and events that led to today's city's formation and better understand the reasons that areas with great potential remained a residue within a city of events. In the case of Beirut, a specific site was chosen to be taken under study.

Quantitative research is done for facts connected to environmental aspects of the city. Those are being compared and cross-checked from multiple sources. Furthermore, that data is used in order to bring a solid case to proposed elements such as SUD systems, wetlands, ecosystem restoration methodologies, techniques and approaches, such as phytoremediation, in order to prove that those are possible according to the quantitative measurements. Stimulation and both virtual and physical modeling of the area is used to produce geological and hydrological data and confirm them by cross-checking the two models. For the virtual model, a manual 3D model deriving from two different contour files provided by the Lebanese Government and Lebanese American University (LAU) layered with the 3D model provided by Google Earth through Rhino is used. In addition, through ArcGIS and with a data source the Aster V2 with an accuracy at forty by forty meters (40x40m) provides watershed data, that are used with monthly average temperatures and rainfall data from previous literature and Beirut's International Airport data.

Qualitative research is done during the period of this thesis, as references, influences and observations are being kept in a sketchbook. That sketchbook works as a motivational research map, both for the urban actors, as well as for the author. Many of the things commended there are presented within this thesis. Through this motivational research is attempted to identify and map forces and influences that actors may not be aware of (cultural and sociological forces), as well as political events taking place within the Middle East Mediterranean Sea basin that might influence the site. For those observations, the assumption that the urban and social structures between Beirut and Cyprus' cities such as Nicosia and Limassol, are actually very similar, while behaviors along the Green Line might similarly be understood in both countries.

8. Hypothesis

The hypothesis as addressed above, becomes an overlap of three main levels, affecting the urban development and its ongoing processes and events amongst its urban actors and agents. The economic and productive ecology, the natural and artificial landscape and the human ecology, all combined producing what is called collective landscape. A mixture of the Anthropocentric and Anthropocene approaches both into one unified urban productive system or a way of reading the urban context.

Firstly, lies the system of the economic and productive ecologies, which comes as a result of a previous action. The methods for one to work are not clear, as it is one of the chaotic systems, while some suggestions can be made as to the direction to work on, while its results are quantitative. Secondly, lies the physical landscape (either natural or artificial, urban, rural etc) system. This is the one objectified scientifically, providing secure methods to work with, and measurable results. Finally, the third system is the human ecologies, cultural metissage including both sygchrotism and sygchoresis. This is the most chaotic of the three, as it is including more actors, uncertain methods to act and unpredictable results. Moreover, this is the one system of the three that suffers from the war effects, as human memory and archives are expending the time that trauma and its long-term effects affect the system. In addition to that post-war mentality still being carried out by the actors, there are ongoing partitions and conflicts within both the urban and political expression of the society of the actors.

To summarize, this method is dealing with three overlapping systems or for the needs of approaching the city of Beirut. Three levels the designer has to work with. The first level is coming with a network of actions that could provide incentives on reclaiming the land from public, while protecting the area from aggressive real estate. It is also the one that will ensure any future evolution of the area. This first level, is also called to solve an issue appearing mostly on the third one, which is the socioeconomic injustice observed on the social fabric linked to the third level. The second, is clear and tangible. It is the level that becomes the ground – both literally and metaphorically – that all the events by and for the urban actors take place. This level is as well linked to the third through mostly physical divisions and the social groupings, casts or enclaved areas. The third level is the one that needs to be the starting point for change, in that way the dynamics and pressures of the other two levels are linked and almost sealed into specific connections and links. Within, this level, the designer is called to deal with mental and ideological issues, address a post war mentality, a weak government power, link the urban actors to the place, and deal with all socioeconomic injustice and physical or psychological enclaving. It is very important for the success of a project the determination of the locals. To conclude the expected results, one of the most important parameters is the link between actors and place.

9. Mapping the City

One of the most fascinating facts for the city, is that social living has imprinted itself in the urban tissue (see Figure 8). Along with the figure-ground of the area under study (see. Fig.3). A typology analysis proves to be a quick tool to understand each area's status and social life. Governmental buildings seem to try to symbolically overrule themselves on space, be the means of scale (big in size) and identifiable morphologies (designed as unique shapes) according to the era that were designed and constructed. Religious buildings are found in a dense tempo, while they seem to be "stack" among the residential buildings, but differentiate themselves from them

with a small public space to be attached to the road, pushing the buildings further to the center of each city block. Education buildings, similarly are found as complexes of small rectangular buildings, along with the main school "L" or "U" shape typologies that shape an inner yard in the center of each complex.

The most fascinating fact, maybe it is the easy recognition of each built morphology and their social categorization. New residences seem to be overwhelming big compared to the traditional housing of the traditional neighborhood, while the rural residence lose and of low density, as it is attached to yards and agricultural land pieces. The refugee settlements, low in height are extremely dense with very little free space between mostly used as parking or pathways. Finally, the slum area is characterized by its small coverage region and the vis-a-vis series of housing attached to each other.

Other important elements examined are the city's structure in terms of urban morphology. Space syntax proves to be an extremely powerful tool for analyzing quantitative elements, such as the streets, roads, speed and traffic, etc.

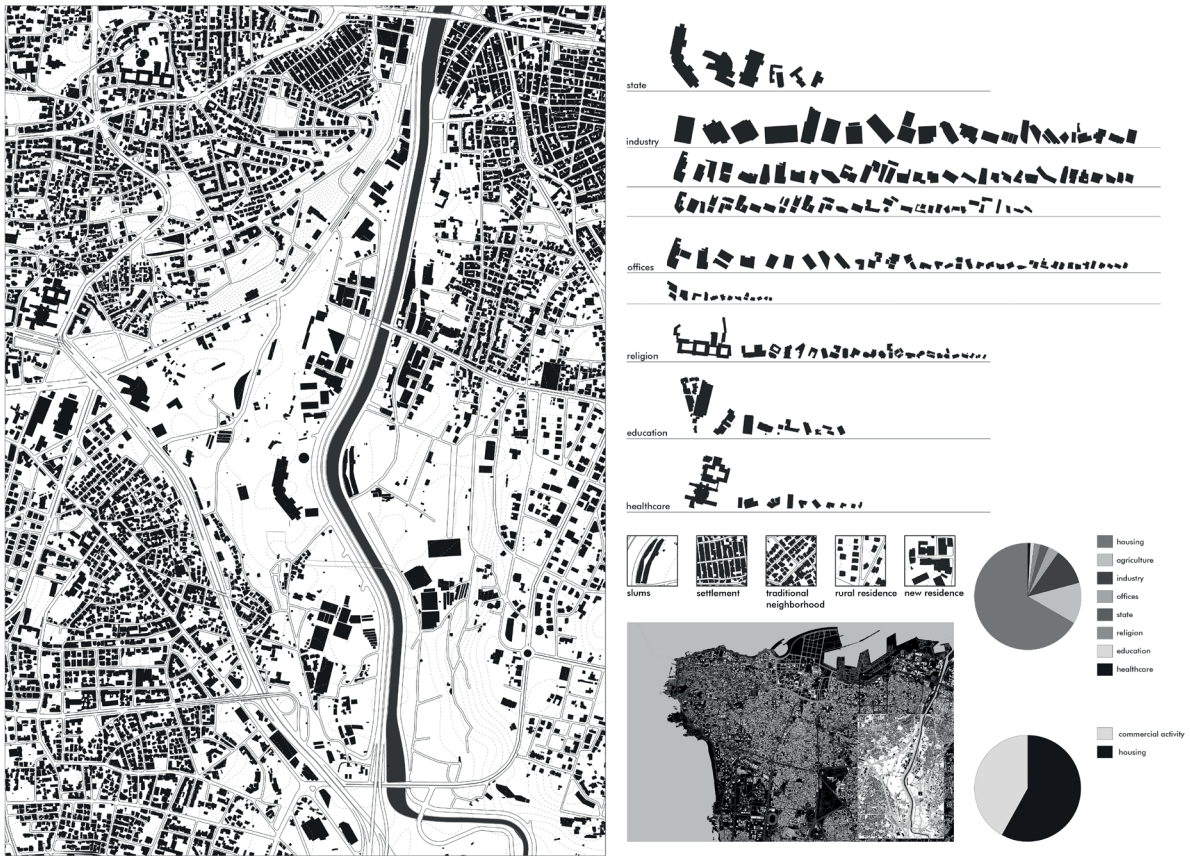

Figure 8. *Left: Figure-ground of the Chosen Site. In black the built environment, the black line is the stream canal; lines depict roads. Urban Morphology Analysis of the Chosen Area. Right: As on Figure Ground: Taxonomy and Categorisation of Ground Level Use among the buildings, according to their uses. Five major typologies read from figure-ground imprinting social life. Pie Charts of the Ground Floor Uses according to each type and compared to ground housing.*

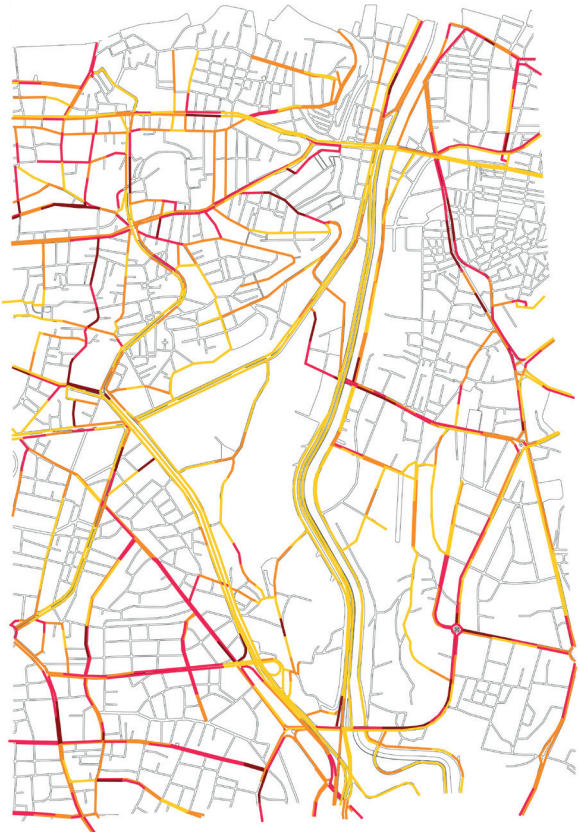

Figure 9. *Traffic / Speed through Space Syntax Method.*

Figure 10. *Urban Grid / City Mesh through Space Syntax Method*

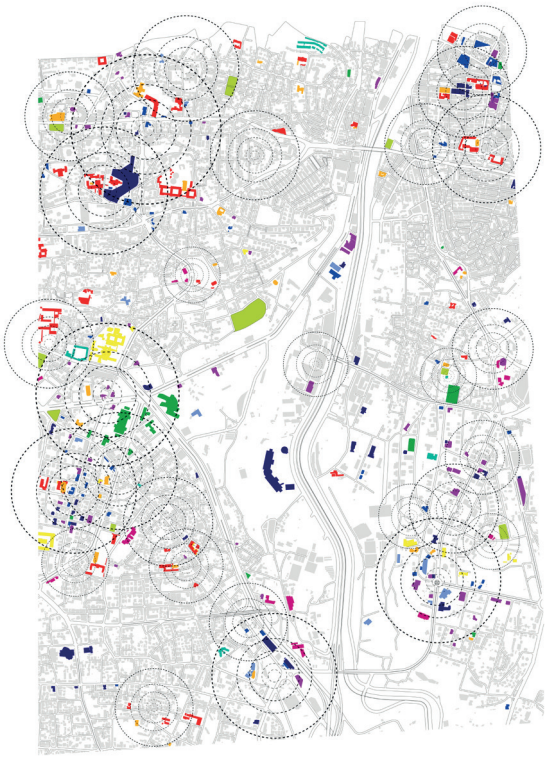

Figure 11. *Ground Floor Uses through Combining Data and Information from Visit, Locals, Google Maps and Wikimapia and Google Search by Road Names' Amenities.*

Figure 12. *Surface Patchwork through Visit and Satellite Information.*

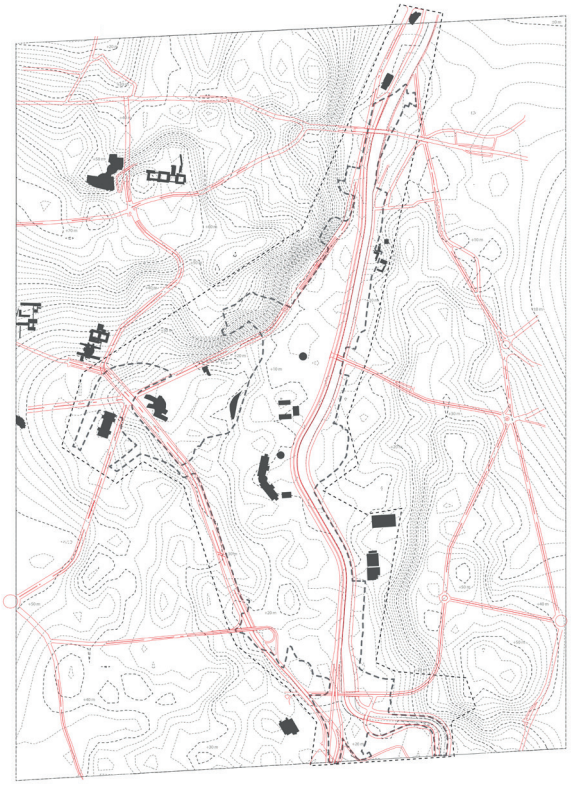

Figure 13. *Topography deriving from the Virtual Model.*

Figure 14. *Spatial Memory / Visual Influence, Cognitive Map deriving from Qualitative and Quantitative Processes.*

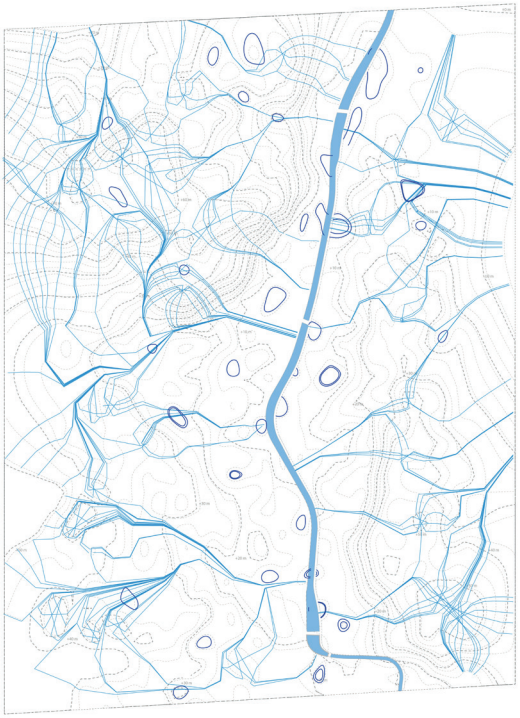

Figure 15. *Watershed, Storm Water Hydrological System deriving through the method of parallel to contours.*

Figure 16. *Flood Risk, Flood Hazard Area deriving through previous state maps, ArcGIS data and the Virtual Model.*

A mapping of 'ground floor uses' provides a cartography of social structures and urban actors' living, providing its own conclusions. Moreover, mapping of the natural features of topography, orology, watershed, hydrological stormwater system and flood hazard analysis, provide important information for the environmental aspect of the city. In addition to it, a surface analysis of the area under study, provides information about the earth and ground absorption of the rainwater on its aquifers, as well as a social pattern of formal or informal activities on the area under study.

Final, a cognitive map of the area, designed based on locals' perception as to the landmarks of the area under study (mostly important buildings, historical buildings or elements, squares and parks) and a spatial analysis through the virtual model of the area and a planar and sectional analysis of the areas surrounding or adjacent to those landmarks. A cognitive map represents at least three correlated elements. The unique modules or elements information consisting the environmental space, the relationships between cognitive distance, direction, immediacy and familiarity of space, as well as any information as to the social environment and possible eventing with the actors found within it (Kosmopoulos, 2000, p. 97). Those three elements, all in all, are what provides this cognitive mapping.

Concluding, the important outcomes, although, do not derive from each mapping analysis in itself, rather the combination and the overlapping of them. In that way, the observations become multiscale and complex in a way that is easy to "read" or understand. Those conclusions, deriving from the over-layering of those maps is what becomes later a significant tool on developing a matrix or atlas of strategies to be used, while the necessities of the locals become what could eventually become the "(strange) attractors" polarities that could bring the change aimed in the initial hypothesis.

10. Conclusions

Understanding the city through the filter of Architectural Urbanism provides a dynamic network of event-ing in the city. This begins with urban morphology and by adding more layers of what actually creates, forms or changes the city can provide useful tools for guiding its future.

A city such as Beirut shall take into consideration multiple factors, far more complex and hidden, than other European or American cities do not require. In post-conflict societies, the conflict never ends, rather it passes into generations to come as an integral part of the socioocultural and political values. In order to push forward an alternative participative model of forming public, collectives and memorialization and deterritorialize the city, the disengagement from the formal (as a result of anesthetizing the public space in an effort of dominating the collective) and engagement in the political are necessary (Fadi, Fouad, & Lana, 2012, p. 330). This can happen through deterritorializing the physical presence of the memory.

In the minds of people, invisible borders are present – hidden points of access, divided sectors, boundary-crossing checkpoints, or sect territories. Any consideration about planning the formal space is including considerations about how the fluent form of cultural memory has already invisibly monumentalized (Fadi, Fouad, & Lana, 2012, p. 327). It is important that the public is participating in the formation of collective memory as a result of an underlying procedure passing through generations, either by perceiving it in areas of initial planning or not, through Trojan Horse approaches.

Trojan horse strategies, are a cover-up of the project's intentions, while having a façade that seems very different, even innocent towards many urban agents, or actors (depending on the

viewpoint or the use of Trojan horse strategy and its agent). Intentions to increase places for the public sphere through public green spaces, can be a covered up effort of increasing land value for the real estate, and vice versa.

Strategies proposed within this paper include amongst others, radical increment. This is a process that generates urban character and identity on its effort of accumulating, as a way of catalyzing change. A series of actions that pique the interest of project investors, while gradually introduces changes into the habits of actors, is a multiphase strategy (Stratis, 2014).

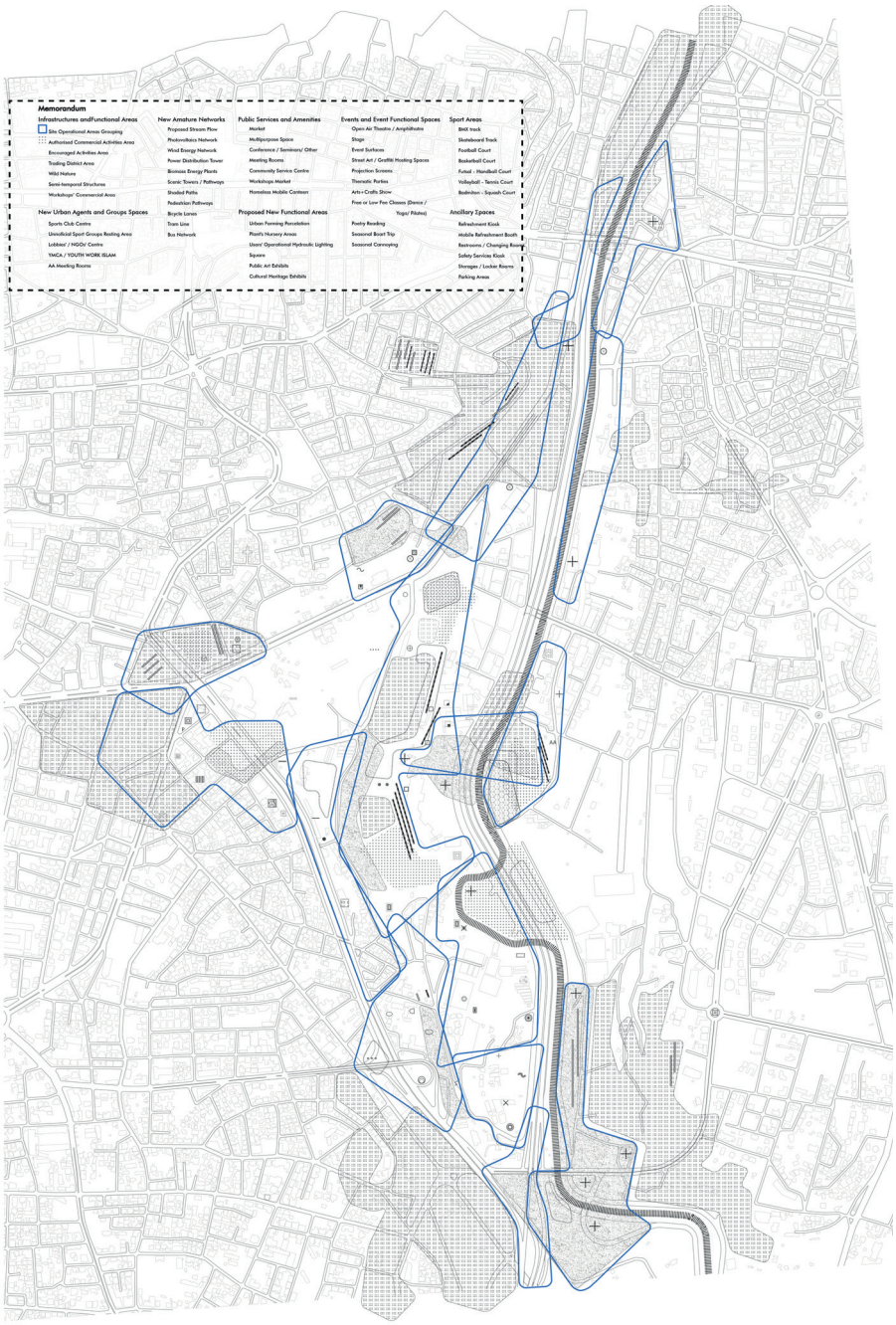

Figure 17. *Initiatives Map. Understanding the city through Chains of production, economy, social studying and physical environment. Subdividing the area into "thematic" subcultures according to different treatments and attractors' usage. Their intersection areas are hybrid spaces affected by attractors gathered in each (spatially subdivided) territory.*

Mighty unfolding strategies, act as a precursor of the future final result of the proposals, operating in this state of transition within the implementation of a project. It, seemingly, neutralizes the vast effects of its end-state (Stratis, 2014), while preparing the ground for both institutionalized (politics) and actors to accept and embrace the change. Furthermore, it allows a degree of improvisation and change in the initial plan.

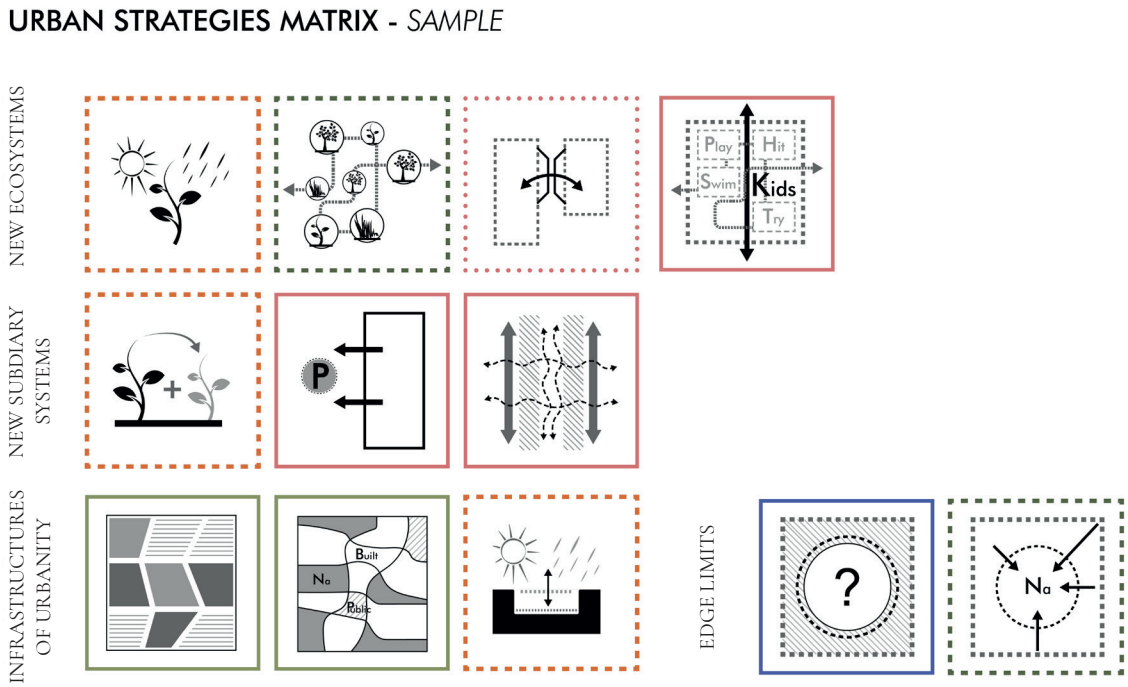

Figure 18. *The Urban Strategies Atlas and Matrix deriving from the analysis as a way of acting in the city, changes its initial conditions and influence its future.*

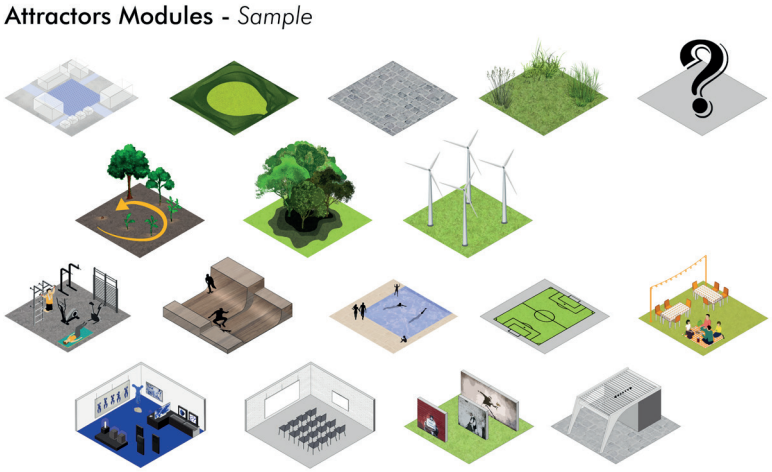

Figure 19. *The Attractors Matrix for Guidiung the Areas future. This is a participatory toolkit, given to locals in order to map their will on area-under-study's future.*

Finally, implying a malleable ecology strategy, as a reforming policy of maintaining and supporting the futures of a proposal. This strategy strives to invite actors and agents on the maintenance of the proposal (STRATIS, 2014). In Beirut, the commons within social groups or sects (e.g. young groups, religious sects (YMCA, YOUTH WORK ISLAM, skateboarder groups, BMX groups, graffiti artists, lobbyists etc.) can play that role.

All in all, it is very significant that we understand the city as a chaotic system subdivided into smaller production, financial, social or spatial systems that act as a chain. Small physical territories can be described by one of those systems (needed to be examined more locally), while the overlap with adjacent similar or contradictory chains and their juxtaposition is what eventually provides the complexity to the city. This can be a strong tool to create the "attractors" and strategies atlas mentioned above.

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Bridging Configurational, Streetscape and Urban Fabric Analysis: the Street as a Keystone

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Keywords: Street Configuration, Streetscape, Urban Fabric, Street-based analysis.

Abstract: There is a growing body of research bringing together concepts and methods from distinct approaches of urban morphology studies. The underpinning idea is that urban form is multifaceted and the combination of different descriptions might provide a "better result than any one on its own" (Kropf 2017). Configuration, streetscape and urban fabric analysis represent the three main streams of research on urban form. Kropf (2017) proposed the street as a possible keystone able to bridge different approaches. Based on Kropf's theoretical proposition, we suggest here a methodological response. New methodological procedures allow a quantitative description of the street considering its three main aspects: the skeletal streetscape, the urban fabric from the pedestrian point of view and the configurational properties. These three methodologies, sharing the same spatial unit, allow a straightforward cross analysis of, respectively, compositional, contextual and configurational indicators. Their application on the cities of the French Riviera is used as a case study in order to show how different facets of the urban form from might be independently and conjointly explored.

1. Introduction

More than 80 years after the Athens Chart (CIAM), in October 2016 a "New Urban Agenda", also known as *The Quito Papers*, has been proposed at the United Nation Conference on Housing and Sustainable Urban Development ("Habitat III"). This new manifesto for the future of cities is based on three main principles: *the open city*, *the city to the citizens* and *urban design* as a tool for making cities more equitable. As highlighted in this document, urban design regains a central role which should not be limited to the notions of planning, zoning and regulations but also to the small scale of the design of a single street and its physical properties (Sassen *et al.* 2017).

The street should become the centre of the debate among practitioners and researchers; it represents the mean through which different disciplines in urban studies and design might communicate and interact providing a better understanding of urban spaces and their influence on the overall functioning of cities.

When focusing on urban morphology studies, the importance of streets in urban physical form is anything but overlooked: in the last decades a growing number of quantitative approaches have been focusing and developing street-based and street-related measures in theoretical and empirical studies.

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Three main quantitative approaches might be recognised: street configuration investigating the spatial organisation of streets and its relationship with human flow (Hillier and Hanson, 1984; Porta *et al.*, 2006, etc.); street design focusing on the qualitative and quantitative analysis of the intrinsic characteristics of streetscapes and their effect on human perception (Ewing and Handy 2009, etc.); street and urban form patterns at wider scales with a typo-morphological approach and more closely related to urban planning (Marshall, 2005; Berghauser Pont and Haupt, 2010; etc.).

While the first two research directions have been independently developed, cross-analyses between these three aspects have recently been proposed in urban morphology. Several authors have proposed techniques for integrating street-network configurational properties and morphometric descriptors. Four main approaches might be highlighted:

- Juxtaposition of outcomes from specific approaches as in the works of Gil *et al.* (2012), Berghauser Pont *et al.* (2017), where classificatory approaches are separately implemented for different urban components (i.e. street configuration and block typologies) and the combined cartography of the outcomes allows analysts to visually compare and discuss the results and their spatial co-occurrences.
- Incorporation of configurational variables into typo-morphological multivariate analysis as in Marshall (2005), Vialard (2013), etc. or, reversely, the introduction of built form measures in configurational analysis such as weighted centrality assessment as in Sevtsuk and Mekonnen (2012) or in Place Syntax in Stahle (2007).
- Mix as in Oliveira (2013), Ye et Van Ness (2014) where configurational and morphometric indicators/procedures are combined in the same spatial unit providing elaborated measures.
- Statistical relationship such as the work of Peponis *et al.* (2007) investigating the correlation between configurational and morphometric descriptors at the scale of the entire city.

Although these approaches propose interesting insights into the relationship between different aspects of the urban form, the central role of the street is only partially considered. Indeed, these combinatory approaches come from the domain of urban morphology and planning where the traditional street-block/aerial point of view is privileged, whereas configuration and urban design give prominence to streets and pedestrian perception from the streets.

For these reasons, the simple combination of procedures independently developed with different points of view (aerial/street) and goals might not always be the best practice. Moreover, important statistical biases might be introduced when forcing the convergence of analyses using diverse underlying spatial units. As highlighted by Kropf (2017), when the goal is to combine different approaches, urban form analysis should be reconceptualised.

The first goal of this paper is thus to propose a literature review of recent computer-aided procedures in the three aforementioned domains of research, whenever the analysis is focussed on the street. Its second goal is to show that the street segment can be a possible shared unit of analysis, bridging the three domains and avoiding theoretical and statistical inconsistencies found in many cross-analyses.

This paper is organised as follows. Section 2 briefly describes the main notions and approaches developed in street network configurational studies. Section 3 presents urban design GIS procedures for the analysis of the *skeletal* streetscape. Section 4 focuses on recent developments of bottom-up and street-based procedures for the identification of typologies of urban fabrics renewing the traditional approaches of typo-morphology. Finally, Section 5 shows how the implementations of three of the aforementioned procedures using the same spatial unit

definition, the street segment, might allow a coherent exploratory data analysis of different facets of the urban physical form. Conclusions are discussed in Section 6.

2. The Configurational Approach: the Street within a Complex Street Network

Inspired by the seminal works of the Centre for Land Use and Built Form Studies at the University of Cambridge, Hillier and Hanson (1984) developed a coherent theoretical framework and methodological procedures for the implementation of graph theory to the physical organisation of spaces, named Space Syntax (SSx). The object of the analysis is the configuration of spaces both at the building level and the urban grid aiming at measuring the capacity of a spatial arrangements to produce encounter patterns. Space is simplified as the juxtaposition of voids separated by visual physical obstructions: at the urban scale, they analyse the spatial structure of the network of public spaces.

SSx theory develops the idea that physical boundaries strongly influence the visibility and perception of enclosed spaces and, consequently, human movement. Focusing on those areas available for pedestrians and delimited by buildings, an innovative reconceptualisation of the complexity of the urban space is proposed. The urban open space is partitioned into convex polygons approximated with visual axial lines; the relationships established between these lines through their intersections allow performing configurational analysis similarly to graph analysis previously elaborated by Freeman (1977) in the domain of complex social networks.

Configuration is defined by the same Hillier "*as, at least the relation between two spaces taking into account a third, and, most, as the relations among spaces in a complex taking into account all other spaces in the complex*". For this reason, "*Spatial configuration is thus a more complex idea than spatial relation, which needs to invoke no more than a pair of related spaces*" (Hillier *et al.*, 1987). This is an essential concept that SSx (as well as other configurational analyses) derives from a systemic approach: the importance of an element is defined by its relative position within the whole system. SSx protocol provides a quantitative description of the spatial properties for each street (more precisely each axial line) within urban space: this method opened the way to a deeper understanding of the relationship between urban form and human movement. The resulting set of indicators have been also proved to be able to capture important aspects of socioeconomic and behavioural phenomena such as land use, retail distribution, crimes etc.

While SSx segment analysis investigate the dual[1] graph representation of the axial network, where axes are represented by nodes and intersections by arcs, a second group of configurational analysis have been more (relatively) recently proposed considering a primal graph representation of the street network. Multiple Centrality Assessment by Porta *et al.* (2006a) and the metrical/directional centrality indicators by Peponis *et al.* (2007) independently developed graph theories from structural sociology (Freeman, 1977) on the traditional representation of street networks proposed by transportation models. Street networks in the primal approach are modelled by graphs where junctions and streets are respectively represented by nodes and arcs.

Further developments and proposals have been considering alternative modelling possibilities: street names, angular analysis, continuity analysis, Intersection Continuity Negotiation, natural roads etc (for an overview, see Fusco and Tirico, 2016). Each of these approaches pro-

1. The recent work by Marshall *et al.* (2018) detects some inconsistencies in the scientific literature in the use of the notions of *primal* and *dual* representation of the network graph (for further details see in Marshall *et al.* 2018 section 3.2); nevertheless, "*a definitive conclusion on this issue awaits a dedicated review of all relevant kinds of graph and their relations*". For this reason, in this work we still use the conventional primal/dual graph distinction as originally proposed by Porta *et al.* (2006).

poses alternative ways to interpret the human movement behaviour in urban space simplifying two elements: the street representation and the modelling of shortest paths.

Graph analysis approaches applied to these different modelling procedures might highlight different street network properties; specific advantages and limitations are associated to each modelling procedure and the choice of the specific method is strictly dependent on the purposes of the research.

A detailed description and comparison of every configurational analysis approach developed in the last twenty years goes beyond the goal of this work. Fusco and Tirico (2016) propose a categorisation through the combination of three fundamental aspects: (i) graph representation (ii) street network modelling, and (iii) network metrics.

After a first broad differentiation between primal and dual model of the street network as previously described, two further aspects should be considered.

> The first one concerns the modelling of the network, i.e. the way we identify the physical elements of the street network. There are at least four different options: topological elements (defined by connections which are consistent through deformation and magnification/ reduction of the urban space), angular elements (defined by directions which are consistent through magnification/reduction but won't resist deformation), dimensional elements (segments of a given length, which won't resist neither deformation nor magnification/reduction), socially defined elements (like street names or any other cognitive and social recognition of form elements, which depend on the social representation of urban space). A second additional aspect to be considered is the way distance between form elements is defined within the network: it can be topological (number of connections, whatever the nature of the connections is), angular (modelling the psychological impedance to change of direction in movement) or dimensional (metric or temporal distance on the network, modelling the physical impedance to movement) (Fusco and Tirico 2016, p. 2).

Based on these large methodological choices, configurational approaches developed specific vocabularies to describe network configurational properties. On one side Peponis, Porta and Sevtzuk adopt the traditional parameters and names originally proposed by Freeman (1977) (such as Reach, Betweenness, Closeness and Straightness). On the other, Space Syntax and derivatives use the vocabulary specifically developed by Hillier and Hanson (1984) (such as Node Count, Integration and Choice). Nonetheless, configurational indicators are comparable when differences in vocabulary are overlooked.

Independently of the specific methodological approach, the goal underlying configurational studies consists in finding the best generalisation of human behaviour allowing to describe the overall movement patterns within urban spaces. The only way to prove the superiority of a specific methodology (*if one exists*) requires its validation through empirical data collected of pedestrian counts. The debate comparing and evaluating the goodness of a specific configurational procedure is far from being closed, and we expect in the next few years a growing number of studies supported by the diffusion of advanced tracking technologies providing new sources of information (i.e. cameras, Wi-Fi, GPS tracking systems).

Despite the awareness among urban morphologists about the importance of the '*network effect*' in the determination of pedestrian flows and socioeconomic phenomena, recent studies highlighted how research still need to better understand how this effect works (Omer and Kaplan 2018). Configurational approaches have been conceived and traditionally assessed in homogenous areas (usually compact monocentric cities). Contrasting results emerge when the same analyses are carried out on case studies presenting main morphological differences.

Berghauser Pont and Marcus (2015) observed different associations between pedestrian vol-

umes and network properties when considering three districts of Stockholm (two in the centre and one in a semi-central area). Lerman and Omer (2016) apply a similar analysis to two sub-areas of Tel Aviv: significant variations are detected between traditional and contemporary neighbourhoods. Analogous conclusions are reached when studying retail distribution in cities with different urban planning developments as in Omer and Goldblatt (2016) or within different sub-regions of the same city as in Remali *et al.* (2014).

As demonstrated in these recent works, configurational properties on their own they are not enough to explore the multifaceted characteristics of the urban physical form and their impact on behavioural and socioeconomic phenomena. It is therefore evident how the combination with other approaches becomes essential for a better understanding of the urban morphological system.

3. The Urban Design Approach: the Streetscape

Urban design focuses on the description of the urban form at a small scale ranging from the design of individual façades, to the street environment and up to a small urban fragment. It is an interdisciplinary domain at the middle ground between architecture, urban morphology and planning. Urban design "*is concerned with the extension of architecture beyond the design and construction of individual buildings and with the attainment of environmental quality, broadly defined*" (Rowley, 1994). While urban typo-morphology was mainly initiated by the European schools, urban design finds its origins in the North American context of the late50s[2].

The notion of urban design is a multifaceted concept at the crossway of several domains (Rowley, 1994). While configurational studies are associated to the human movement in public spaces, urban design studies are related to environmental psychology, human perception, cognition, behaviour and more recently, health. Studies in urban design traditionally investigate the relationship of morpho-functional descriptors with walkability, liveability, physical activity, appeal, perceived safety etc.

Within urban design literature, numerous perceptual qualities have been described and their importance have been widely debated in the last decades; nonetheless, it is only in more recent years that urban design literature has attempted to objectively measure perceptual qualities, rather than simply assert their importance (Ewing et Handy, 2009). Ewing et Handy (2009) propose a systematic approach to operationalise design notions through quantitative measures. Not all urban design qualities might be reinterpreted in quantitative terms; some are more amenable to measurement than others.

Based on the importance assigned in the literature, Ewing et Handy (2009) select and successfully operationalise five main notions (*Imageability*, *Enclosure*, *Human scale, Transparency*, *Complexity*). They propose 28 indicators such as counts and proportions of specific micro-grained features which might be observed in urban spaces. The correlation of these indicator with walkability measure is then investigated. Similarly, Purciel *et al.* (2009) operationalise streetscape measures using a variety of GIS data sources; in this study a set of "*objective and theoretically-grounded indicators*" quantify physical and functional variables of 588 block-faces in New York and correlated to pedestrian counts.

2. in 1957, the American Institute of Architecture established a Committee on Urban Design and the creation of the first course of urban design at Harvard University in 1960. The seminal works of Lynch (1960) and J. Jacobs (1961), Alexander (1977), are joined by north European authors as Cullen (1961), Ghel (1971), etc.

GIS algorithms are also developed in the works of Harvey et Aultman-Hall (2015) and Harvey *et al.* (2017). These authors differentiate between *skeletal* and *skin* components of a streetscape. "*The former supplies the spatial structure for a scene, defining the size and shape of space; the latter embellishes with visual texture*". Despite the fuzzy boundary between the two aspect, skeletons of streetscapes are defined as the spatial distribution of massing of surrounding buildings, providing spatial proportions that may be elemental to perceptions as comfortable urban spaces (Harvey et Aultman-Hall 2005). This intrinsic geometrical/compositional description of the physical form as perceived from the street might be closer to the notion of perceived volumes of Alexander (1933). Based on this definition of skeletal streetscape, several variables are proposed and implemented: measures such as facades set-back, height, cross-sectional ratio between height and width, façade frequency etc. are measured on vector representation of buildings and street centrelines. These variables are finally individually correlated to different phenomena such as crash severity and perceived safety (Harvey and Aultman-Hall, 2005).

In a more recent work Harvey *et al.* (2017) measure 12 streetscape skeleton variables on more than 120 thousand block-length streetscapes in three north-eastern U.S. cities: Boston, New York, and Baltimore. Cluster analysis is then used to identify four streetscape skeleton classes that are also consistent between cities: upright, compact, porous, and open which is proposed as alternative to the functional classification traditionally proposed by transport planners (arterial, collector, and local).

These last works focus on GIS procedures applied to vector data describing the physical layout of the built form along the street edges; we should also mention that, in the last few years, data science is contributing to urban design with innovative algorithms for the operationalisation of more qualitative measures from street view images. These highly sophisticated approaches based on imagery analysis will provide in the next years interesting insights assessing and developing the traditional notions proposed by the seminal works of urban designers.

Algorithms for street view image processing propose a pedestrian perspective in the analysis of urban spaces as alternative to traditional satellite/aerial images. Similarly, GIS skeletal streetscape represents the street-based alternative for traditional urban morphology analysis. Nonetheless, while the former requires sophisticated algorithms and large volumes of data, the latter is based on simpler geo-processing algorithms on vector representations of the urban form elements. Further research should investigate the relationship between *skeletal* and *skin* attributes of the streets and their relative importance on human behaviours.

The skeletal streetscape is not only the interface between private and public or street and block spaces. It might be also considered as the interface between urban design and urban morphology (traditionally focusing on different aspects and scales of the urban form) and, as we discuss in the next section, the starting point for the identification of the urban fabric from the pedestrian point of view.

The streetscape as defined in the aforementioned works has received less attention in urban morphology studies which have traditionally privileged aerial approaches based on street-block measures. Vialard's work (Vialard, 2013) is an exception: from the original definition of block-face in Purciel *et al.* (2009), Vialard specifically focuses on the interface between streets and blocks. "*The block-face emerges as the morphological element that naturally associates the properties of the street network and the properties of the buildings*" (Vialard, p. 36). Nonetheless, the notion of block-face is conceived and operationalised following the classical block-centred approach typical of urban typo-morphology (i.e. absence of the third dimension, implementation of built form indicators using street-block barycentre as reference, etc). Moreover, classification

of block-face is obtained mixing geometrical descriptors with street network configurational properties going beyond the definition of the streetscape in urban design.

Urban designers like Purciel *et al.* (2009) or Harvey and Aultman-Hall (2005) correlate detailed local urban morphometric variables with pedestrian counts or human behaviour/perception similarly to what proposed in street network configurational studies. In both cases, these works overlook the importance of the urban morphological context. As configurational analysis needs to investigate the 'network effect' in different urban contexts, similarly, urban design should investigate the role of a specific street design indicator within different urban contexts: variables as height, length or continuity of facades along streets might play different roles in historic centres, planned or peripheral neighbourhoods etc. The identification of the urban morphological context becomes necessary in urban design especially when streetscape measures are implemented on large geographical extents (as in the works of Harvey) encompassing a wide heterogeneity of urban fabric typologies and morphological regions.

Remali *et al.* (2014) go in this direction. They investigate both street design and configurational properties in relationship to socioeconomic descriptors of three emblematic neighbourhoods of Tripoli (Libya) with three different planning historical developments. Here again, the expert-based identification of archetypical neighbourhoods is a fundamental step in the analysis of street characteristics in different urban physical subspaces.

As we discussed in the previous section, both configurational properties and urban design morphometric descriptors, when applied to large urban areas encompassing a wide variety of urban forms, might show different correlation values with pedestrian counts and socioeconomic variables. The identification of the morphological context becomes an essential phase of the analysis which might contribute to the understanding of the effects of the street network and/or of the streetscape within a wider urban area.

4. Typo-morphological Approach: the Urban Fabric seen from the Street

The implementation of GIS-based analyses in urban morphology studies finds its theoretical background in the British, Italian and French schools where the notion of typo-morphology has been developed. Typology refers to the systematic study of architectural forms, and the direct relationship that the building has with the plot and its serving street, while the notion of Morphology denotes the study of larger urban structures and patterns (the urban fabric, the morphological region). The final goal of typo-morphological studies is to recognize the spatial structure of an urban fragment, village, town, city or metropolitan area by examining the patterns of its component parts (Mudon, 1994).

Classical typo-morphological schools privileged qualitative approaches, with emphasis on the historical process of production of observed urban forms. Quantitative analyses were limited by both the computational power and data availability to small urban fragments. Only in the last few decades, quantitative computer-aided procedures have known a fast development providing more robust and scientific support to this discipline, allowing the identification of urban fabrics and morphological regions within vast study areas.

When observing the quantitative procedures recently developed in urban typo-morphological studies, a three-step *modus operandi* might be recognised (i.e. Gil, 2012; Song, 2013; etc.). Step A) A specific spatial unit, a subset of urban elements and a scale of the analysis are chosen. Step B) A set of size and shape descriptors quantify the characteristics of the urban form (morphometric

descriptors) within each spatial unit. Step C) The implementation of multivariate analysis procedures supported by graphical representations or more sophisticated classificatory approaches.

The development of these quantitative multivariate protocols offer two main advantages:

> firstly, they allow for the definition of types based on multiple variables in a precise and repeatable manner, enabling the study of large samples and the comparison between both cities and regions; secondly, they frame design choices in terms of types without being fixed and so open up for design explorations where the relation between the variables can be challenged to propose new types (Berghauser Pont *et al.*, 2017).

Two main limitations might be highlighted when implementing the traditional three-step classificatory approach at the neighbourhood level. Firstly, the definition of the spatial partitions: a large number of urban typo-morphological studies focus on specific emblematic morphological regions traditionally delimitated by the expert knowledge of the analyst or they adopt exogenous spatial partitions (i.e. administrative units).The second is that these works traditionally focus on the spatial distribution of urban form elements overlooking the importance of the street both as a point of view from which urban form is perceived and as a spatial constrain along which humans move and explore the urban fabric of a city.

To overcome these limitations (individually or conjointly considered), researchers have recently proposed new approaches for the bottom-up pedestrian-based delimitation and description of different types of the urban fabric. These automatic procedures allow the spatial aggregation of fine-grained spatial units in coherent spatial patterns (urban fabrics) without a predefined delimitation of their spatial extents (which could result in whole morphological regions).

Song et Knaap (2007) and Song *et al.* (2013) propose a *location-based* definition of spatial units: Euclidean buffers are traced around each location, morpho-functional indicators are calculated, factor analysis and classification finally allow the identification of typologies of neighbourhoods. Location-based approaches use a more consistent definition of neighbourhoods focusing the analysis and classification to the relative *immediate* urban context.

While in these works the context surrounding specific locations is evaluated with Euclidean buffers, Berghauser Pont and Marcus (2014, 2017), propose a similar location-based approach to measure and classify built form context introducing network-constrained distances. From each location, a set of built-up density descriptors is implemented on a network-based floating catchment area.

Combining measures of network-constrained accessible built form (as in Stahle *et al.*, 2007; Sevtzuk, 2012; etc.) with the Spacematrix graphic classification (Berghauser Pont and Haupt, 2010), a new approach for the bottom-up identification of density typologies is described and implemented in the recent works of Berghauser Pont *et al.* (2017). Through this innovative approach, each location is associated to a typology of built-up density context.

All these approaches share a similar methodological innovation modifying the first of the three steps of the aforementioned procedure: instead of defining fixed spatial units for the subsequent morphometric measures, they consider a larger moving area centred on each location (point, street, parcel etc.). These procedures implement a smoothing operation of the individual fine-grained morphometric characteristics considering the local surrounding area to each location under study (Euclidean or network-constrained).

Bottom-up identification of morphological context might be also obtained through the modification of the third step of the traditional classificatory approach, like in the procedure proposed by Hamaina *et al.* (2012). The first two steps remain mainly the same as previously described: definition of a fine-grained spatial unit (generalised Thiessen tessellation based on

built-up footprints) and implementation of morphometric measures including both traditional density measures (such as GSI and FSI) and innovative visual measures generated by empty spaces (such as isovists and sky view factors). The third step represents the innovative component: instead of traditional classificatory analysis, the authors implement spatial clustering approaches (geographical self-organised maps Geo-SOM) allowing the identification of twelve categories of urban fabrics coherently distributed in the urban space.[3]

Nonetheless, the street perspective is only partially integrated in Hamaina *et al.* (2012): several innovating indicators of visibility of the built form are integrated, overlooking the street network connections among spatial units. On the contrary, the works of Berghauser Pont and colleagues consider street network constrained measures (accessible densities) with the traditional aerial point of view and thus overlook the street perspective of the built volumes.

To overcome these limitations, a third bottom-up procedure approach have been recently proposed by Araldi and Fusco (2017; 2019): Multiple Fabric Assessment (MFA). MFA allows the identification of urban fabric typologies and the analysis of their spatial organization integrating both the analysis of the urban streetscape (similarly to the works of Harvey) and the location-based network-constrained approaches. The procedure might be summarised as follow: i) definition of a street-based partition of the urban space and implementation of skeletal streetscape morphometric descriptors. ii) identification of location-based network-constrained autocorrelation patterns of streetscape morphometric by means of specific spatial statistics approaches. iii) Clustering of morphometric spatial patterns through Bayesian methods in order to identify and characterize typologies of urban fabrics.

This third protocol modifies the traditional three-step procedure intervening on the second phase: instead of classifying raw indicators, MFA highlights spatial patterns of morphometric indicators on a fine-grained partition of the space. The street point of view is considered twice: the first time for the identification of the spatial unit in relation to which morphometric indicators are computed; a second time in the network-based calculation of patterns.

In Fig.1 we summarised the traditional three-step procedural approach of quantitative typo-morphological analysis and the three alternatives for a bottom-up identification of urban fabrics. Differently from traditional approaches, these procedures do not need an *a priori* and expert based knowledge and definition of the space study and of its sub regions (similarly to configurational analysis). We claim that, without introducing bottom-up approaches, traditional classificatory schemes either produce classes of urban form components (missing the spatial dimension of the urban fabric) or characterize exogenously defined spatial units.

5. The Street as a Bridging Element

In the previous sections, three main quantitative approaches for the study of the urban physical form from the street point of view have been outlined: 1) configurational/relational, 2) compositional/geometrical, and 3) contextual/typo-morphological. The three Cs represent three approaches able to describe different facets of the urban public physical space. While the first two have been naturally conceived and implemented for the description of street properties

3. The only limitation of this approach is associated to the application of measures such as isovists and sky view factors, which might limit the spatial extent of the analysis. The example of Hamaina is indeed implemented on a small urban fragment of 5 square kilometre area.

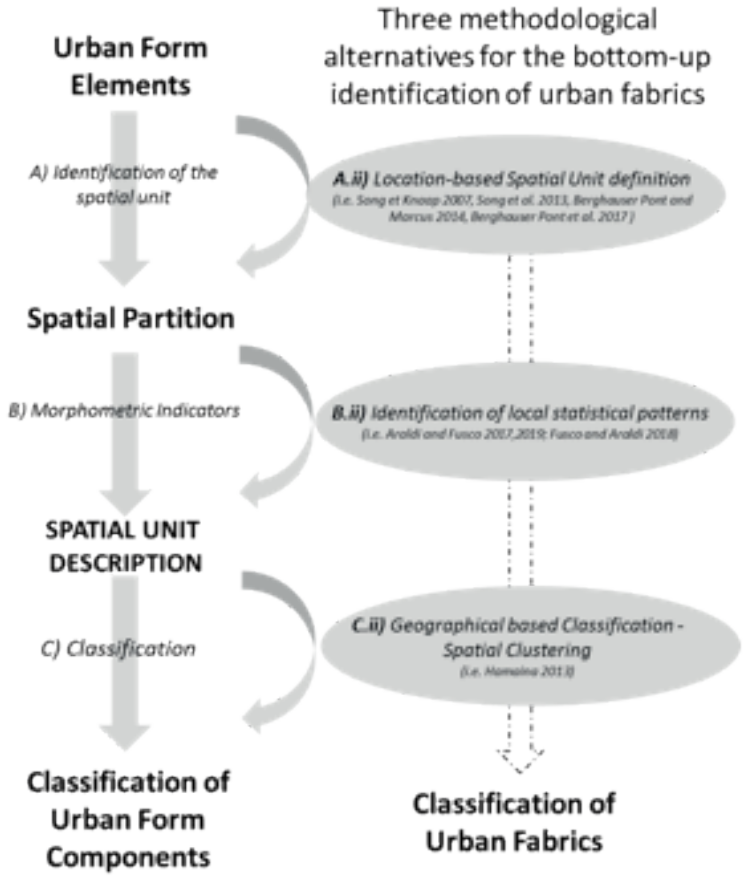

Figure 1. *Traditional three-step identification of urban morphological patterns (left) and three methodological alternatives for bottom-up approaches, which become necessary to identify urban fabrics.*

within urban space, the third has been only more recently developing new bottom-up street-based protocols.

By using the street segment as a common spatial unit, we can implement and combine these three procedures. In this section, we implement the *three Cs* on the primary approach where the street segment is defined as the centreline segment between two intersections. Several reasons motivate this choice: firstly, "*the dominant network model is the one that represents the street junctions as vertices in the graph and the linear street segments as its edges*" Marshall *et al.* (2018). Secondly, using street network centrelines and the primal approach would allow the identification of configurational properties independently of the physical shapes or sizes of the built forms surrounding the street segments (isolating configurational properties and morphometric measures). Thirdly, the use of centreline plays the important role of geometrical reference when studying the streetscape from the street point of view (measures of setback, parallelism of facades, etc. use as reference street edges and/or street centrelines). The use of visual axes as in SSx or alternative street-like representations of the street network would provide a distorted reference system for streetscape descriptors.

Our case study is the street network of the French Rivera, on which we implement Multiple Centrality Assessment (Porta, 2006), skeletal streetscape indicators (similarly to Harvey, 2017 and Araldi and Fusco, 2017) and Multiple Fabric Assessment (Araldi and Fusco, 2017, 2019). Figure 2 shows some of the results describing the cities of Cannes and Antibes and their inner municipalities: configurational properties (Reach, Closeness and Betweenness Figure 2-left), streetscape morphometric indicators (Street acclivity, Building Setback and

Facades Misalignment Figure 2-centre) and urban fabric typologies (the nine families of urban fabrics described in Fusco and Araldi, 2017, Figure 2-right).

Beyond the mapping of each descriptor, we can provide several statistical exploratory analyses of the relationship between several urban features like Peponis (2007). The coherence of these analyses is assured by the shared level of the individual street segment and the integration of a morphological contextual variable. For instance, in Figure 3 the conditional boxplots show the distribution of some streetscape indicators and configurational properties (local Reach [300m], Betweenness [1200m], building frequency and building setback) within different urban fabrics. Similarly, Figure 4 provides the conditional density distribution (left) and prevalence (right) of configurational properties within different urban fabrics.

Similarly, other measures such as qualitative pedestrian counts or socioeconomic occurrences might be straightforwardly correlated to individual morphometric measures on the overall space study considering different urban morphological regions. This approach might propose new insights in the analysis of the network and urban design effects conditional to urban morphological regions as introduced in the first section. Other innovative statistical modelling approaches might also be implemented (such as Network Constrained Geographically Weighted Regression, Multilevel Linear Modelling, etc.).

The street becomes a bridging element between different urban quantitative approaches (the three Cs) but also between close and still different disciplines such as urban design and urban morphology. Transport studies, social sciences, environmental psychology and many other fields in urban studies might also benefit from this coherent, multivariate and multiscale description of the urban form.

6. Discussion/Conclusion

In this work we described how different approaches for the analysis of the urban form might be implemented and bridged within the common framework of the street point of view. Configurational analyses and urban design studies of streetscapes have been using street-based approaches very early. Typo-morphological research has also integrated the street in its theoretical approaches (and above all by the authors of the Italian school) but quantitative analyses have traditionally relied on aerial block-based approaches. We showed how typo-morphological analyses have recently been renewed by street-based and bottom-up approaches for the identification of urban fabrics as perceived from the street.

Configurational, urban typo-morphology and urban design can now converge on a common definition of the basic spatial unit, the street segment, allowing a coherent analysis of the multifaceted reality of the urban physical form. As the application to the French Riviera shows, cross-analyses of the different aspects of urban form become much easier and avoid the methodological inconsistencies associated with different conceptual frameworks of the urban space.

Of course, this does not mean that the street-based approach should become the only reference in urban morphology. The block-based approach is still essential in the analysis of the urban morphogenesis, and urban planning is still concerned with blocks and plots more than with streets (even if this could be a shortcoming of contemporary planning practice). The final goals of urban form analyses justify the approach to be privileged. What the paper suggests is that when the goal is the explanation of human phenomena taking place on public space (like pedestrian flows, pedestrian perceptions, car accidents, retail activity, crime, etc.), a common framework becomes necessary and the street segment is the most natural one. By calculating

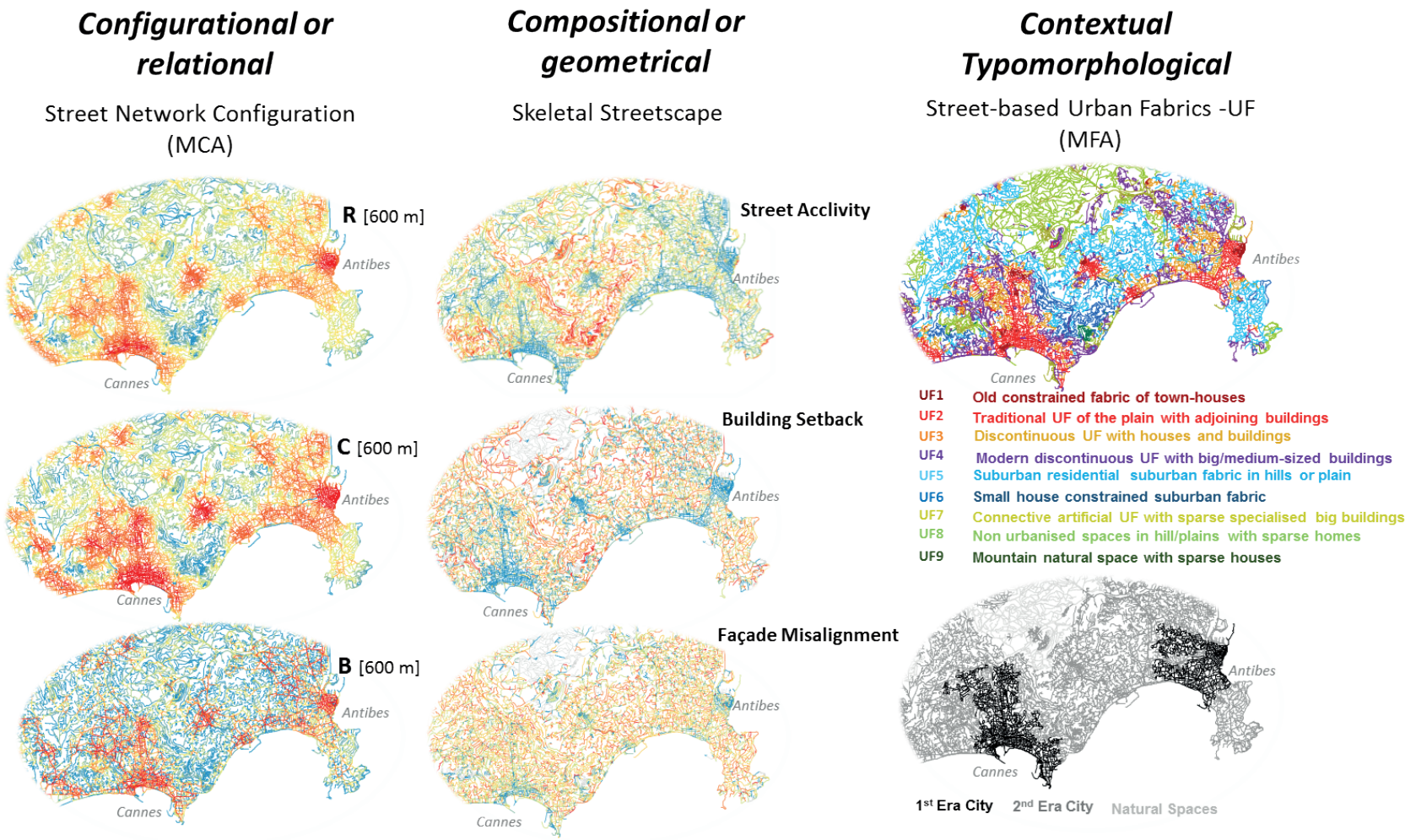

Figure 2. *From the left to the right: implementation of street network indicators (MCA-Porta et al. 2006), skeletal streetscape indicators (Harvey et al. 2017,), typologies of street-based morphological regions (MFA-Araldi and Fusco 2017,2019).*

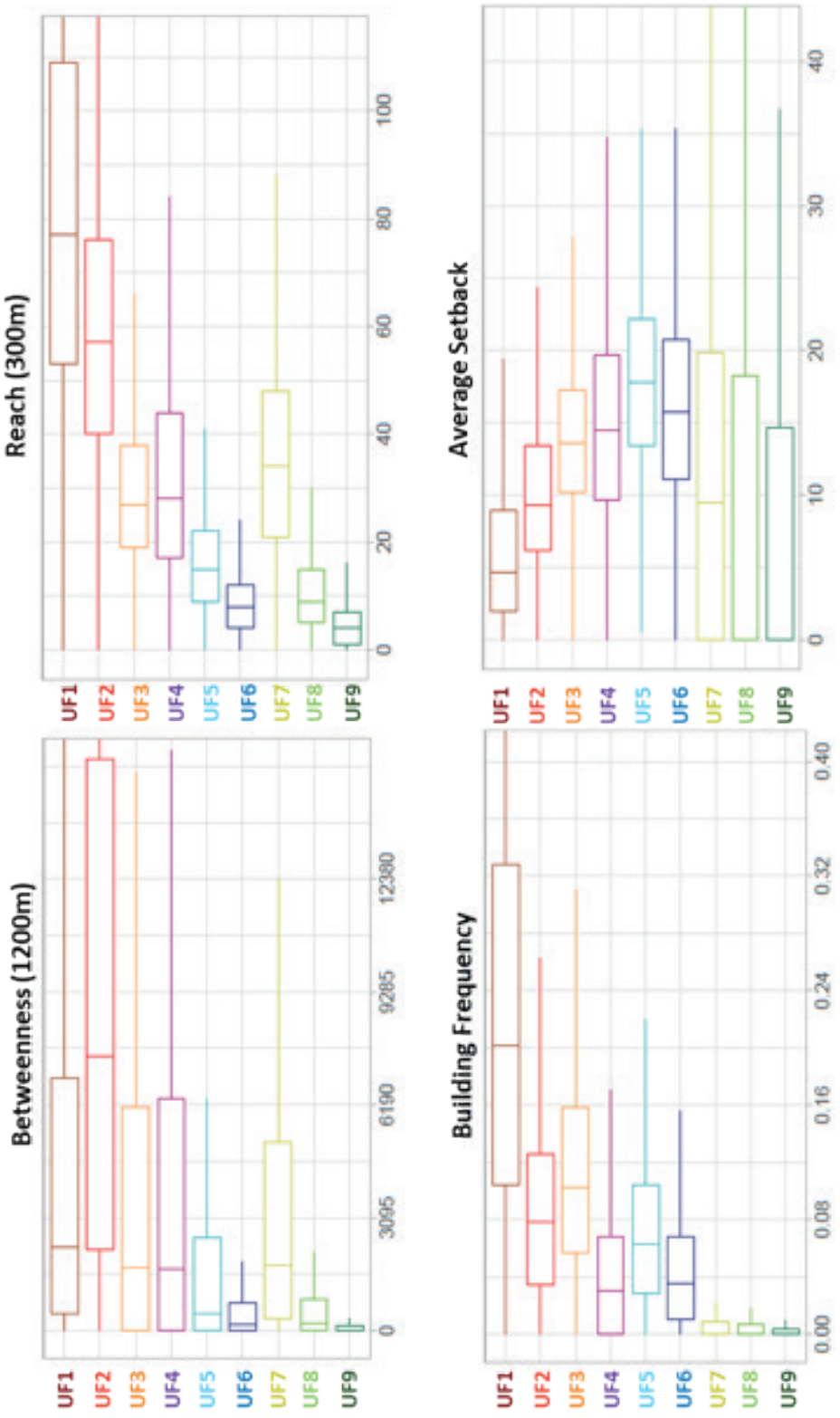

Figure 3. *Example of EDA: conditional box-plot of two configurational indicators (Betweenness[1200m] and Reach[300]) and two skeletal streetscape indicators (Building Frequency and Average Setback) considering nine typologies of urban fabrics.*

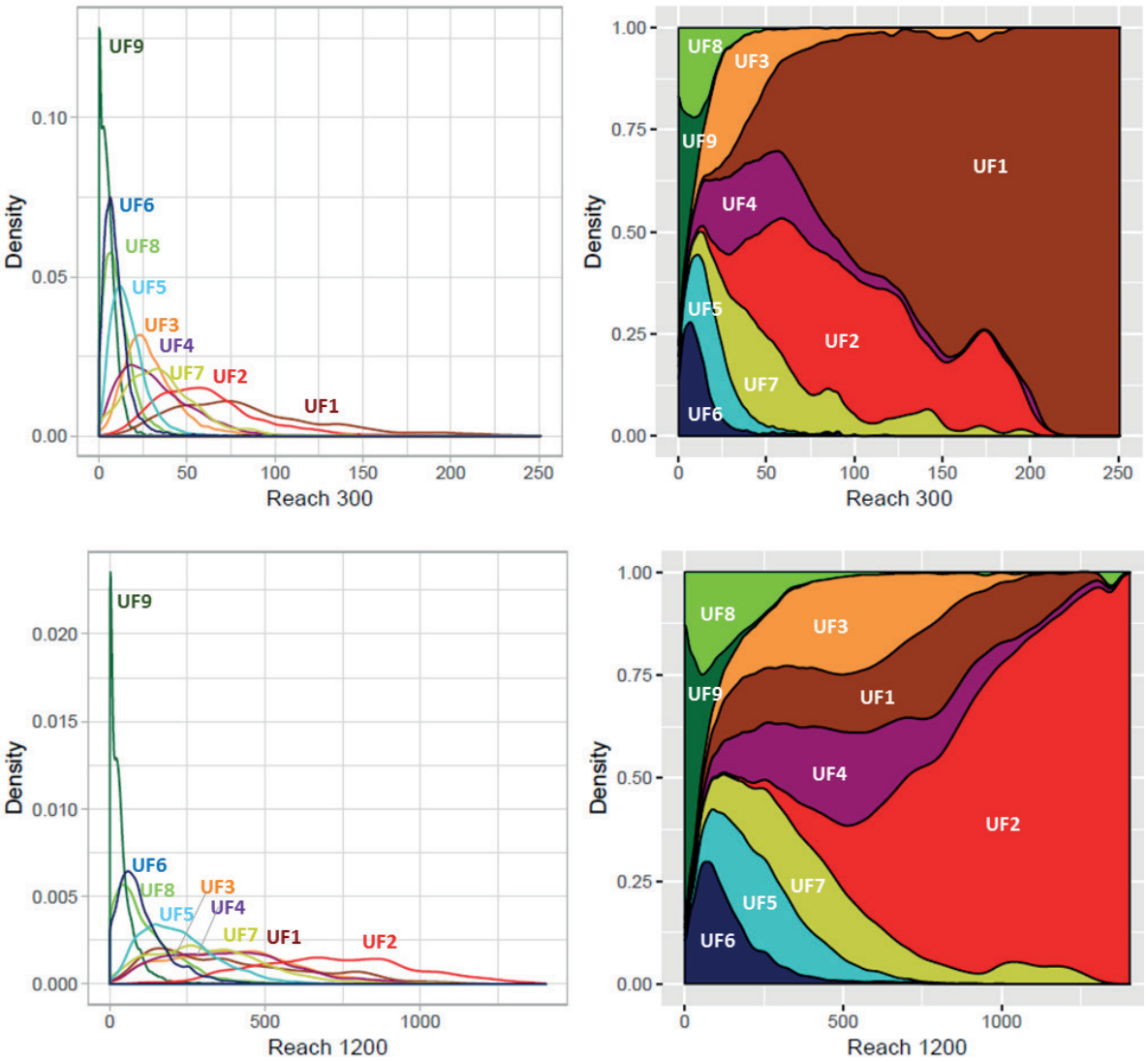

Figure 4. *Example of EDA: conditional density distribution of two configurational indicators (Reach[1200m] and Reach[300]) considering nine typologies of urban fabrics. (left: densities- right: prevalence).*

configuration properties, streetscape features and urban fabric characteristics, the analyst is finally able to determine the relative importance of the position within the street network, the quality of the local design and the wider urban form context on observed human phenomena. A precise assessment of the role of urban form in the aforementioned research domains is left as future research endeavour in urban studies.

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Evolution and Enlightenment of Neighborhood

Street System Morphology in Slope Areas in Southwest of China

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Keywords: Sloping neighborhood, Street system, Evolution, Southwest area of China.

Abstract: Street system is one of the important elements of town plan, which is of great significance to the study of urban morphology. From the perspective of regional exploration, this paper analyzes the typical neighborhood street system in slope areas in southwest of China in the four periods of 1949-1957, 1958-1977, 1978-1998 and 1999 to present, with the multi-story residential areas as a sample. The author adopts qualitative and quantitative methods to have a comparative study of the street system form, street length, width and density, plane line type and other morphological elements in the four time periods. It can be concluded that over the past half century, the street system of sloping neighborhood has experienced four stages of development: chaotic period, budding stage, mature phase and differentiation stage. According to the Conzen School, all the morphological changes and innovations in the city reflect the special social, political, economic and cultural requirements of the time. Therefore, in order to understand the inherent law of street system morphological evolution in sloping neighborhood, this paper discusses the dynamic mechanism of street system form change from four aspects: fundamental impetus, internal driving force, extrinsic motive and environment binding force. This article explores the implications of street system evolution of sloping neighborhood, which may be a positive reference for the construction of sloping neighborhood in the new era of the 21st century.

1. Introduction

Neighborhood, CBD and Fringe Belt are the three Spatia Units which make up the whole urban landscape [1]. Neighborhood is the "Basic type" of urban form, which determines the form of our living city to a great extent [2]. The study of neighborhood can be through four elements: plot, street system, architectural layout, architectural three-dimensional shape [3]. Road is the key factor to form the neighborhood itself, and its system has certain stability, which is of great significance to the study of urban form [4].

There is a lot of literature on residential street system. Some scholars discuss the forms of neighborhood roads, such as Discourage Through Traffic in the Peri neighborhood unit [5] and Redburn's man-car diversion [6], hierarchical road system, Culs-de-sac. Many scholars start from the relationship between people and vehicles in the road mode. For example, Lin Zhongkai and others have summarized the Chinese road model as three modes: coexistence of people and vehicles, partial diversion of people and vehicles, and complete diversion of people and

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vehicles. Some scholars start with the relationship between road form and housing, such as Cervero, R. The relationship between road form and living commuting mode is discussed [7]. Some scholars have studied the historicity of residential street systems. For example, Pierre Filion summarizes the North American settlement network as a curved road network from a grid and a modified Grid or Modified Grid, Curvilinear, and a few main streets around a common center (Curvilinear: Surper-blocks Around a Common Centre). The gradual journey to the modern and improved new road network (Contemporary) [8]. Mulong has made a systematic study on the road form of American residential area, and holds that in the 20th century, the shape of American residential road has gone through the development process from grid (Grids) to curved (Curves) to circular (Loops) [9]. Zhang Lili and others believe that China has improved it since the introduction of "neighborhood units" in the 1960s, until the neighbourhood street system has become more diverse in the 1990s. Generally speaking, Neighborhood Street System Morphology has been discussed in the aspects of road system, relationship between man and car, historical evolution and so on, but its main research object is located in western [10], or plain cities. The change process of neighborhood street form in this study area is not known and is worthy of further study.

The purpose of this study is to determine the neighborhood street form in the southwest of China, and how they change over time. According to the Konzern School's view, all forms of change and innovation in the city reflect the special requirements of the social, political, economic and cultural time at that time. Due to the special geographical location and the relative lag of the social and economic development in the southwest of China, the road construction and development of the region are different from the developed regions. In this paper, we try to find out the laws and features of the neighborhood street development in the Southwest, and to explore the power mechanism behind it.

2. Methodology

2.1. *Sample area*

Chongqing, Sichuan, Guizhou, Yunnan, Tibet and so on belong to the mountainous areas of southwest China. Chongqing is selected as the main case of this study. It is a typical mountainous super-large city, which is located in the upper reaches of the Yangtze River in China. Its unique mountain geomorphological conditions determine that the street shape of the city neighborhood is different from that of other plain cities. In the past 100 years, compared with the changes of other cities in the southwest region, the development mode of Chongqing residential area has many similarities and is more complex.

2.2. *Sample History*

In 1949, the People's Republic of China was liberated. In the early days of the founding of the People's Republic of China, there is a large demand for urban construction. In order to alleviate this problem, and to stabilize the social order rapidly and restore the production, the residential area planning and construction in this period will adhere to the "Favorable for production and convenience for life" principle. With the continuous improvement of the overall housing construction system, the implementation of the policy of "unified investment, unified planning and design, unified management" has effectively promoted the construction of residential are-

as. In the early stage of liberation, the focus of urban construction in southwest China was to save the crisis, ensure the safety of life and improve the living conditions, so the construction was carried out in a simple and easy way.From 1960 s to 70 s, the construction of residential areas in China was slow due to the influence of politics, economy and natural disasters at home and abroad. Most of the residential areas in southwest China are unit settlements established by enterprises. In 1978, China entered the period of reform and opening up, and the state began to carry out housing reform attempts. Enterprise units gradually become the main force of housing investment by self-financing to develop residential areas. Real estate development companies are also beginning to appear. In order to improve the planning and construction level of urban housing in China, the state put forward the policy of "unified planning, rational layout, comprehensive development and supporting construction" in the 1980s. After the 1990s, with the rapid development of economy, the rapid growth of urban population has challenged all aspects of the city, and the development of housing planning has been impacted. Commercial housing began to appear. After 1998, with the introduction of the Circular on further deepening the Reform of Urban Housing system and speeding up Housing Construction, the distribution system of unit welfare housing has been completely abolished. In southwest China, housing is becoming more commercial and market-oriented.

In different urban development periods, the neighborhood road system has a unique material and cultural landscape. The chronological superposition of local social, political, economic, and cultural factors at the time led to changes in the shape of the residential road. Defining the boundaries of different morphological cycles provides a better understanding of the neighborhood road patterns during that period. Different scholars have different understandings of the division of the morphological cycle. For example, Bao Ming divides the living form of contemporary China into pre-foundation (1860-1948), pre-reform and opening (1949-1978), initial stage after reform and opening up (1979/1990), and large development stage (1991/1997). Diversified development stage (1998/2005) and quality improvement stage (2006-present). Cui Qian divided the historical process of the unit settlement into the burgeoning stage before the founding of the People's Republic of China from 1930 to 1949, the development stage of 1949-1978, the dissolution stage from 1978 to 2000, and the differentiation stage from 2001 to the present. It can be seen that the morphological cycle is closely related to major political events and national policies.

This paper summarize the previous division of time, taking into account major political and economic events, national policies and the particularity of southwest mountain areas. The road shape change process of residential area in southwest mountainous area is divided into four parts: 1949-1957; 1958-1977; 1978-1998; 1998-present.

2.3. *Variables*

The factors that affect the street shape are road network form, road length, road width, road network density and plane line type. In this paper, the plan of Neighborhood samples built in 1949 in the main urban area of Chongqing is collected, combined with google satellite map and field investigation, the five variables of residential areas in four different periods are analyzed.

The form of road network is linear, tree-shaped, radiate, grid-shaped and so on. The length of the road is the total length of the driveway through the residential area. The width of the road refers to the main width of the driveway in the residential area. The density of the road network is the ratio of the total mileage of the road network to the area of the road network in a certain

area, and its unit is km/km2.. road area ratio is the ratio of road area to built area. There are three main elements of plane line type: straight line, transition curve and circular curve.

3. Analysis/Results

3.1. *The chaotic period (1949-1957)*

	Oishi village	Handan Steel Village	Coal Mine Design Institute Dormitory	Model village	Songlinpo	Special steel manufacturer
						
Base area	0.55ha	2.42ha	2.02ha	2.71ha	3.09ha	1.04ha
road system	Road network without planning	Road network without planning	Community – home	Community – home	Community – home	Community – home
Road network shape	/	/	Grid	Grid	Culs-de-sac	Culs-de-sac
Plane line type	/	/	straight line	straight line	straight line	Straight line + easing curve
The density of road network	/	/	27.36 km/km² Road area ratio 10.94%	47.58 km/km² Road area ratio 26.70%	36.80 m/km² Road area ratio 13.57%	41.64 m/km² Road area ratio 12.49%
The road length	/	/	552 m	1289 m	1138 m	434 m
Road width	/	/	4 m	5 m	7 m, 2 m	3 m

Road system

At the beginning of the founding of the people's Republic of China, there was a serious shortage of housing. At this stage, the road planning of residential areas is in a neglected position, and there is no corresponding road network planning. After the completion of residential construction, except for the unusable part of the mountain area, the rest of the space exists in the form of roads. When the road and the site are mixed together, the surface is almost completely hardened. As long as it can meet the traffic of the vehicle, it can be used as a road, forming a mixed space of passage and movement.

Road network shape

Most of the Neighborhood do not have a car network, and the Neighborhood with a road network are mainly Grid, Culs-de-sac. Among the selected samples, Coal mine design institute dormitory and model village living area road network form are Grid. The road network form of Songlin slope and special steel factory area is basically in the form of Culs-de-sac. Combined with the topographic characteristics of mountain area, the road system conforms to the contours to reduce the height difference. However, these two road network shapes rarely cover the entrance.

Plane line type

Most neighborhoods with road network are straight lines, and a few of them are the combination of straight lines and transition curves.

The density of road network

The area of dormitory land in coal mine design institute is 2.02ha, the density of road network in residential area is 27.36 km ≤ km^2, and the road area rate is 10.94%. The land area of residential area in Mengfan Village is 2.71 ha, the density of road network in residential area is 47.58 km / km^2, and the road area rate is 26.70%. The land area of Songlin slope residential area is 3.09 ha, the density of road network in residential area is 36.80m / km ~ 2, and the road area rate is 13.57%. The land area of special steel manufacturers is 1.04ha, the density of road network in residential area is 41.64 m / km ~ 2, and the road area rate is 12.49%.

The road length and opening

The length of dormitory network of coal mine design institute is 552m, the length of residential area of model fan village is 1289 m, the length of residential area of Songlin slope is 1138 m, and the length of road network of special steel manufacturer area is 434 m. During this period, there are many intersection points between the outer roads in the main urban area of Chongqing, and the degree of closure of the residential area is not high. For example, the road boundary of dormitory of coal mine design institute overlaps with that of external road, there is no clear entrance to residential area, people can enter the interior of residential area at will, and the privacy is extremely weak.

Road width

The width of the road network in the dormitory of the coal mine design institute is 4m, the width of the road network in the residential area of the model village is 5 m, the width of the road network in Songlingpo residential area is 2 m, the width of a small part is 7 m, and the width of the road network in the family area of the special steel plant is 3 m. The width here is the average width of a path. In detail, the same road is not equal in width. During this period, most of the road widths did not exceed 4 m.

Conclusion

At the beginning of the founding of the People's Republic of China, the residential road system is basically without system or planning; single form of road network; plane line type is mainly straight line; the density of the road network and the ratio of road area are high. Poor privacy of the road, and the road width is basically less than 4 m. The whole period is characterized by chaos.

3.2. *Budding stage (1958-1977)*

	Mold center living area	Fuqiang Four Village	Lamp Factory Dormitory Area	Xinhua Four Village	Berlin Three Villages	Politics and village
						
Base area	1.78ha	1.53ha	0.83ha	2.03ha	4.7ha	2.48ha
road system	Road network without planning	Road network without planning	Community – home	Community – home	Community – home	Community – home
Road network shape	/	/	Culs-de-sac	Culs-de-sac	Crossroad + Culs-de-sac	Crossroad + Culs-de-sac
Plane line type	/	/	Straight line + circular curve	Straight line + circular curve	Straight line	Straight line + easing curve
The density of road network	/	/	48.27 km/km² Road area ratio 19.31%	33.65 km/km² Road area ratio 8.86%	23.95 km/km² Road area ratio 9.58%	32.56 km/km² Road area ratio 13.03%
The road length	/	/	400 m	683 m	1137 m	809 m
Road width	/	/	4 m	4 m, 2 m	4 m	4 m

Road system

From 1958 to 1977, the internal road layout of the residential areas in Chongqing's main urban areas was mostly unsystematic and rarely planned. This article only lists 2 unplanned and unsystematic residential areas (Mold Center Living Area, Fuqiang 4 Village). The road is divided by the outline of the mountain, the vertical terrain and the vegetable plot, and the shape and size of the road are also different. The roads of the remaining 4 settlements in the six sample settlements are systematic. The boundaries of the roads in the residential area are clear, and the line widths of the same road are basically the same, such as Xinhua Village. The initial classification of roads began to appear, mainly including the two-level planning system of the residential area. There are a small number of vehicle roads in the three villages of Berlin and the three villages of politics and law, but the overall is mainly pedestrian roads with hard paving.

Road network shape

Road forms include Crossroad, Culs-de-sac, Grid, etc. Among them, the square grid network mainly appears in the strip residential building area; Culs-de-sac is more common in the layout of residential buildings such as scattered and free-style. The cross does not appear to be in a specific pattern. Taking the three villages of the political and legal districts of the Southwest University of Political Science and Law in Chongqing as an example, in the strip-shaped residential building area on the west side of the base, the road layout adopts a square-shaped road network form, and the road has a community-two-level planning system for the household road; In the area where the scattered residential buildings are laid out, the roads adopt the Culs-de-sac structure; in the area on the south side of the base, some roads adopt the shape of a cross-shaped road network.

Plane line type

They are mostly a combination of straight and circular curves. For example, the internal roads of Xinhua Village are cut by height difference, vegetable fields, green areas, etc. Most of the road boundaries are curved according to the direction of the mountain, while the road boundaries adjacent to the wall are linear. The road plane is completely determined by the terrain conditions of the base.

Road network density

The land area of the dormitory of the lamp factory is 0.83ha, the density of the road network in the residential area is 48.27 km/km^2, and the road area ratio is 19.31%. The land area of Xinhua 4 Village is 2.03 ha, the density of road network in residential area is 33.65 km/km^2, and the road area ratio is 8.86%. The land area of the three villages in Berlin is 4.7ha, the density of the road network in the residential area is 23.95 m/km^2, and the road area ratio is 9.58%. The area of land for political and legal construction is 2.48ha, the density of road network in residential area is 32.56 m/km^2, and the road area ratio is 13.03%.

Road length and opening

The length of the road network in the dormitory area of the lamp factory is 400m, the length of the Xinhua Sicun road network is 683 m, the length of the road network in the three villages of

Berlin is 1137 m, and the length of the road network in the village of Zhengfa is 809 m. There are many or seamless connections between the internal roads of the settlements and the external roads, and the privacy of the neighborhood is extremely weak. For example, in the three villages of politics and law, the internal roads on the southeast side of the settlement are completely seamlessly connected with the external roads, and the introversion is not strong.

Road width

The width of the road network in the dormitory of Dengtouchang is 4 m, the width of Xinhua Sicun Road is 2 m, the width of the network of Berlin Sancun Road is 4 m, and the width of Zhengfa Sancun Road is 4 m. At this stage, the road system in the residential area of Chongqing's main urban area began to have certain planning, and the road began to be flexibly set according to the terrain.

Conclusion

There has not been a structural change in the road system; elements such as the road system and the shape of the road network have begun to sprout.

3.3. *Mature phase (1978-1998)*

	Jiangong Dongcun	Zhiyuan Village	Coal Family Area	Xinhua Village Family Area	Building two village	Cummins family dormitory
						
Base area	2.48 ha	3.2 ha	1.78 ha	1.04 ha	6.01 ha	4.12 ha
road system	Community – group – home	Community – home	Community – home	Community – home	Community – group – home	Community – group – home
Road network shape	Culs-de-sac	Culs-de-sac	Grid	Grid	Ring road	Ring road+Culs-de-sac
Plane line type	Straight line + easing curve	Straight line + easing curve	Straight line + easing curve	Straight line	Straight line + easing curve	Straight line + circular curve

The density of road network	41.34 km/km² Road area ratio 18.97%	18.35 km/km² Road area ratio 11.01%	58.90 km/km² Road area ratio 23.96%	82.91 km/km² Road area ratio 33.16%	26.57 m/km² Road area ratio 19.84%	29.87 m/km² Road area ratio 12.27%
The road length	1026 m	860 m	1064 m	683 m	1597 m	1232 m
Road width	6 m, 3 m	4 m	4 m	4 m, 2 m	9 m, 6 m, 4 m	5 m, 4 m

Road system

From 1978 to 1998, the internal road layout of the residential areas in Chongqing's main urban areas had certain systems and plans. The sample roads surveyed are all systematic, and the road boundaries are clear. The line widths of the same road are basically the same. With the increase of the number of motor vehicles, the traffic forms of people and vehicles are mixed, forming a community-group-household Road three-level planning system. However, there are some residential road systems that do not have a grading plan, such as the Xinhua Village family area.At the same time, these road systems only appear in part of the settlement. Most of the roads in the residential area are not well planned, and the overall roads in the residential areas are systematically lacking.

Road network shape

There are four types of road layouts: Culs-de-sac, Grid, Ring road, and Crossroad. This article presents only 6 samples. Among them, the internal roads of Jiangong Dongcun and Zhiyuan Village basically adopt the form of Culs-de-sac road network. Jiangong Dongcun is a typical representative. It can be seen from the road map of Jiangong East Village in the above table that the residential roads of residential buildings are tree-like, connecting residential buildings in series. This road layout is better able to adapt to complex terrain conditions and is more flexible in shape. Due to the terrain conditions, the family area of Xinhua Village is completely in the form of Grid, and the family area of the Coal Science Institute also adopts the Grid form. Compared with the Culs-de-sac road network, the number of Ring roads is small. For example, the inner part of the second building is defined by Ring Road, and the residential area is more recognizable and private. The Cummins family dormitory area basically adopts the way of Ring road and Culs-de-sac, which can better adapt to the terrain and enrich the road form.

Plane line type

They are mostly a combination of straight lines and curves. For example, the second village of the building formed a Ring Road due to terrain, vegetation, surrounding buildings and other reasons. The road plane line conforms to the contour line.

Road network density

The land area of Jiangong Dongcun is 2.48 ha, the density of road network in residential area is 41.34 km/km², and the road area ratio is 18.97%. The land area of Zhiyuan Village is 3.2 ha, the

density of road network in the residential area is 18.35 km/km², and the road area ratio is 11.01%. The land area of the family of the Coal Science and Technology Institute is 1.78 ha, the density of the road network in the residential area is 58.90 km/km², and the road area ratio is 23.96%. The land area of Xinhua Village's family area is 1.04ha, the road network density in the residential area is 82.91 km/km², and the road area ratio is 33.16%. The construction area of the second building is 6.01 ha, the density of the road network in the residential area is 26.57 m/km², and the road area ratio is 19.84%. The land area of the Cummins family dormitory area is 4.12ha, the road network density in the residential area is 29.87 m/km², and the road area ratio is 12.27%.

Road length and opening

The length of the road network of Jiangong Dongcun is 1026m, the length of the road network of Zhiyuan Village is 860 m, the length of the road network of the family area of the Coal Science Institute is 1064 m, and the length of the road network of Xinhua Village is 683 m. The length of the road network of Building two village is 1597 m. The length of the road network of the Cummins family dormitory is 1232 m. There are clear entrances and exits in the inner and outer roads of the settlement, and the privacy is strong.

Road width

The width of the construction of Jiangong Dongcun is 6m and 3m, the width of Zhiyuan Village Road is 4 m, the width of the road network of the family of the Coal Family Area is 4 m, and the width of the road network of Xinhua Village Family Area is 4 m and 2 m. The width of the Building two village road network is 9 m, 6 m and 4 m. The road network width of the Cummins family dormitory is 5 m and 4 m. At this stage, the road system in the residential area of Chongqing's main urban area has become clearer.

Conclusion

At this stage, the characteristics of the roads with residential areas have almost appeared, the roads are clearly graded, and the shape of the road network is diverse, and it is in the molding stage.

3.4. *Differentiation stage (1998-至今)*

	Crown East and Garden	Huayu Windsor Town	Changjiahui	Xuelin Garden	Qingye	Chongqing Institute of Science and Technology
						
Base area	5.3 ha	6.9 ha	8.7 ha	6.34 ha	6.77 ha	15.89 ha

road system	Community – group – home	Community – group – home	Community – home	Community – group – home	Community – home	Community – home
Road network shape	Ring road	Culs-de-sac	Ring road	Ring road	Ring road	Ring road
Plane line type	Straight line + easing curve	Straight line + easing curve	Straight line + easing curve	Straight line + circular curve + easing curve	Straight line + easing curve	Straight line + easing curve
The density of road network	14.75 km/km² Road area ratio 7.31%	15.13 km/km² Road area ratio 6.55%	15.31 km/km² Road area ratio 6.12%	26.14 km/km² Road area ratio 17.94%	21.72 km/km² Road area ratio 9.95%	14.88 km/km² Road area ratio 12.10%
The road length	782 m	1044 m	1332 m	1657.3 m	1470.78 m	2365.14 m
Road width	6 m, 3 m	7 m, 4 m	4 m	4 m, 6 m, 8 m	5 m, 4 m	12 m, 7.5 m

Road system

Since 1998, the road pattern in residential areas has been diversified. At this time, the planning of residential road systems pays more attention to people's psychological needs, and fully considers the local cultural characteristics, rational use of topography, road landscape, residential Design and environmental planning go hand in hand [8].

Road network shape

During this period, the residential roads have matured and there are obvious planning grades. The Ring road and Culs-de-sac are mostly used. This road layout can better adapt to the complex terrain environment. Residential roads often meet fire protection requirements. With the increase in the number of motor vehicles, in order to ensure the safety of residents in the settlements, the residential areas began to implement closed management, control or even prohibit transit traffic, and achieve partial diversion of people and vehicles.

Plane line type

They are mostly a combination of straight lines and easing curves.

Road network density

Crown East and Garden covers an area of 5.3 ha, with a road network density of 14.75 km/km² and a road area ratio of 7.31%. The land area of Huayu Windsor Town is 6.9 ha, the density of road network in the residential area is 15.13 km/km², and the road area ratio is 6.55%. The land

area of Changjiahui is 8.7 ha, the density of road network in the residential area is 15.31 km/km^2, and the road area ratio is 6.12%. The land area of Xuelin Garden is 1.04 ha, the density of road network in residential area is 82.91 km/km^2, and the road area ratio is 33.16%. The land area of Qingye is 6.01ha, the density of road network in residential area is 26.57 m/km^2, and the road area ratio is 19.84%. The land area of the Chongqing Institute of Science and Technology is 4.12ha, the density of the road network in the residential area is 29.87 m/km^2, and the road area ratio is 12.27%. Road length and opening:

The length of the Crown East and Garden road network is 1026 m, the length of the Huayu Windsor Town road network is 860 m, the length of the Changjiahui road network is 1064 m, and the length of the Xuelin Garden road network is 683 m. The length of Qingye Road Network is 1597 m. The length of the Chongqing Institute of Science and Technology road network is 1232 m. The community strictly controls the interface with urban roads and conducts closed management of the community.

Road width

The width of the Crown East and Garden road network is 6 m, 3 m, the width of the Huayu Windsor Town road network is 4 m, the width of the Changjiahui road network is 4 m, and the width of the Xuelin Garden road network is 4 m, 2 m. The width of Qingye road network is 9 m, 6 m and 4 m. The width of the Chongqing Institute of Science and Technology road network is 5 m, 4 m. At this stage, the road system in the residential area of Chongqing's main urban area has become clearer.

Conclusion

At this stage, the road pattern of residential areas has diversified, and the road planning of residential areas has matured and is in a period of differentiation.

4. Discussion

According to the Conzane School, all the morphological changes and innovations in the city reflect the special requirements of society, politics, economy and culture at that time. Therefore, this paper discusses the dynamic mechanism of road morphological change in sloping land from four aspects: basic driving force, internal driving force, external driving force and environmental binding force, and tries to summarize the internal law of the evolution of sloping road form.

The basic driving force mainly refers to the technical process. With the acceleration of urbanization and the improvement of residents' consumption level, the use of private cars has increased, and the way residents travel has changed from walking to vehicles. At the same time, the development of other technologies, such as transportation mode and means, has also affected the change of road form in residential area to a certain extent, such as the widening of the width of residential road, and gradually produced the traffic form of man-car branch and man-vehicle mixed line.

The internal driving force is mainly reflected in the economic level. The transition from planned economy to market economy is affected by the commercialization of housing and the paid use of land. Under the action of market forces, the renewal and construction of urban

residential areas is the result of the choice of market economy, which affects the change of road form of residential areas. With China's market economy becoming more and more open, the proportion of investment in residential areas is increasing, and the Neighborhood Street System Morphology are becoming more and more diversified. The reform and opening up has prompted more and more developers to intervene in housing construction and make residential areas more privatized, such as increasing the control of imports and exports.

External driving force refers to social organization and political power. Urban spatial resources are an important factor for the government to formulate policies, direct intervention and effective organization through administrative power. Administrative power is one of the important ways for urban government to allocate spatial resources. The evolution of Neighborhood Street System Morphology is also the process of resource redistribution under the background of institutional change. From the unit residential area construction in the planned economy period to the commercial housing construction in the market economy period, the political system has always had a great impact on the change of the road form of the urban residential area.

The shape of Neighborhood road is also affected by local topography, climate and other environmental binding. The road form in mountainous areas has natural disadvantages. Because of the large height difference, the urban roads in mountainous areas are usually arranged along the foothills or riparian banks, or the road length is extended to overcome the natural height difference, resulting in a large non-linear coefficient (the ratio of road distance to spatial straight line distance), which makes the actual travel of vehicles longer.

It is worth noting that these factors do not act independently on the shape of residential roads, but interact with each other. Under the interaction of four factors, the current residential road form has been formed.For example, in terms of the street system, from the chaotic period of no planning and disorder to the differentiation period with the "community-group-household" planning structure, the street system inside the house becomes orderly.In the early days of the founding of the People's Republic of China, due to the low economic level and low level of motorization, the Neighborhood Street System Morphology was not considered. After the reform and opening up, with the improvement of the economic level, people are keen on motor vehicle driving, and the Neighborhood has formed a certain road system. However, since the government is the main body of urban steet and the developers manage the neighborhood steet, the two are not the same starting point of interest, and there is not enough regulation to restrict the relationship between neighborhood street and urban street. Therefore, the neighborhood street system is often separated from the urban street system. On the other hand, due to the topography of mountainous cities, the street system pays more attention to the echo relationship between the topography. Thus the street system has been neglected to some extent.

Taking the urban street network density as an example, the density of the street network is different due to the different scales, categories and terrain of the city. Obviously, the density of the street network in the four stages is greater than the street network density in the plain area during this time period. The same is true for the road area ratio.The street area ratio has a downward trend with the passage of time. Since the reform and opening up in 1978, the housing has been dominated by the market economy. Developers are more inclined to take larger plots and develop faster. Neighborhood street system is often surrounded by Neighborhood and is separated from urban street systems. At this stage, the density of street networks and the density of urban street networks have declined. With the advent of the automobile era, the width of the Neighborhood street has widened. Although the density of the street network has decreased, the street area ratio has increased due to the increase in width.

These factors may have one or two major factors. In mountainous areas, environmental binding plays a major role in street system Morphology. From the perspective of street system., the urban land use in Pingyuan City is in good condition. The street system in neighborhood generally adopts a square grid, with small road fluctuations, small non-linear coefficient and small driving distance. In mountainous cities, due to the large terrain, the street surface is often combined with natural terrain to form a free and irregular road. This kind of street system does not have a fixed form, and the change is large, such as a square-shaped street system, a branch-shaped street system, a ring street system, a cross-shaped street system, and the like. The non-linear coefficient (the ratio of the street distance to the spatial straight line distance) is large, and the actual driving distance of the vehicle is long.

5. Conclusion

From the perspective of regional exploration, this paper analyzes the typical neighborhood street system in slope areas in southwest of China in the four periods of 1949-1957, 1958-1977, 1978-1998 and 1999 to present, with the multi-story residential areas as a sample. The author adopts qualitative and quantitative methods to have a comparative study of the street system form, street length, width and density, plane line type and other morphological elements in the four time periods. It can be concluded that over the past half century, the street system of sloping neighborhood has experienced four stages of development: chaotic period, budding stage, mature phase and differentiation stage.

During the period from 1949 to 1957, most of the residential road systems were unsystematic and unplanned. The shape of the road network was relatively simple, with squares and branches at the end. The plane line type is mainly a straight line, and the part is a combination of a straight line and a gentle curve. The road network has a high density and a high road area ratio. The length of the road is not long, but there are many openings and the privacy is not high. The same road is not equal in width, and the width of the road is mostly less than 4m. Generally speaking, this stage is in the early stage of the founding of the country, showing a relatively chaotic character.

During the period 1958-1977, there was no structural change in the road system. Some roads have a preliminary classification, showing a two-level planning system of residential roads and household roads. The road network form is more free, mainly with crossroads and branches. The road network density rate is still high, and the road area ratio is slightly reduced due to the small road width. The length of the road is not long, the opening is more, and the privacy is not high. Although the construction of residential areas in China was slow due to the influence of political, economic and natural disasters such as the “Great Leap Forward” during the period, the road system began to sprout.

During the period from 1978 to 1998, the road began to be systematically planned, the road classification was obvious, and a relatively complete road planning system appeared. However, there are also a few residential areas that are still affected by topography and still use a mixed mode of roads. The road forms are more diverse, with square grids, crossroads, branches, and rings. Except for the density of the grid network, the density of the remaining forms of road network is almost the same, but the area ratio of all roads becomes higher. The main reason is that the road width is widened. Road openings are reduced and homes become more private. It can be seen that at this stage, the characteristics of the roads with settlements have almost appeared, and the road form has been formed.

After 1998, the welfare housing was gradually phased out, and the commercialization and marketization of housing were promoted. In the competitive environment of the market mechanism, while promoting the development of residential planning, the design also began to take people's needs as the starting point. The residential roads in this period have matured and are clearly graded. The combination of ring and branch ends is adopted. Overall, the road pattern of residential areas at this stage is more diversified on the basis of the original.

Street System Morphology is not formed at a time, but collaged over time. However, in each different era, the main form of living roads will appear, which reflects the characteristics of the times to some extent. In order to understand the inherent law of street system morphological evolution in sloping neighborhood, this paper discusses the dynamic mechanism of street system form change from four aspects: fundamental impetus, internal driving force, extrinsic motive and environment binding force. This article explores the implications of street system evolution of sloping neighborhood, which may be a positive reference for the construction of sloping neighborhood in the new era of the 21st century.

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Case Study of the Method of Establishing Continuity Between Relics and the Contemporary Urban Forms

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Keywords: Case Study; Relics; Urban Forms;Design Method.

Abstract: The starting point of this article comes from the author's special interest in a certain type of urban renewal project: how to reconstitute an urban form that has become fragmented by archaeological excavations.This paper compares two cases: the renovation of The Ruins of the Cathedral of São Paulo in Macau with its surrounding neighborhoods, and the renovation of the Carmo Convent in Lisbon, Portugal. In the case of Macau, architect Carrillho Da Graca was commissioned by the government to redesign the site of the Ruins of the Cathedral of São Paulo, which had been discovered by new archaeological discoveries at that time, and transform it into a Catholic Museum of Art. In the Lisbon case, architect Alvaro Siza renovated Ruins of the Carmo Convent and the surrounding Chiado neighborhood for 30 years and designed it as a complex of residential/museum/retail functions.In the two cases, by establishing continuity of complex street elevations around them, architects have refined the integration of complex historical layers. Similar renovation design strategies are used, which may provide possible hints for designers dealing with urban regeneration projects.

1. Introduction

Archaeological relics are no longer just the interest of a few experts and scholars. They are increasingly associated with the public's tourism and leisure activities. Therefore, a new task has emerged: how to present these cultural heritage to the public in an easy-to-understand way. In this case, these relics can no longer be presented on their own, but need more information media to explain. This leads to the contradiction between archaeologists and architects. Archaeologists are conservative, emphasizing that the intervention of future generations should be minimal and reversible. Unnecessary intervention not only pollutes the remnants of ensuciar, but also makes it more difficult to understand. From the perspective of urban form, how to reconstitute an urban form that has become fragmented by archaeological excavations.

When architects begin to design in the historical environment, they often need to deal with the relationship between two groups of "layers". One is the elevation relationship of the site, which is composed of the existing ground surface left by past manual activities, such as street, relic, square, landscaped terrace. The other is the elevation relationship of the building's floor. What is the relationship between the "floors" created by architects and the existing "stratum" in the site history? Is it overlapping or dislocation? Is it occlusion or separation? When the eleva-

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tion beneath the site is of some meaning, How can the architect organize the proper circulation in the building to form a continuous experience from the "floor" to the "stratum"?

The two cases selected in this paper have some similarities. Architects are from Portugal, and they all need solutions in the complex and harsh historical environment of the old city. Both of them have to give answers to how to reconstitute an urban form that has become fragmented by archaeological excavations. Both projects are in the vicinity of churches destroyed by fire and are used as critical public spaces in both cities. In this paper, two cases are restored to the specific site and historical background, focusing on how architects infiltrate the thinking of "floor" and elevation into the design process, and a glimpse of the two architects coinciding design methods.

2. Case I: Renconstructon of Chiado ,Lisbon, Alvaro Siza, 1989-2015

2.1. *Background: Rebirth after Two Fires*

The Chiado is the "soul of the city" of Lisbon. It is the traditional shopping and Cultural District of the city, and it has gathered the essence of Lisbon's old city's art and culture. Situated between Bairro Alto (uptown) and Baixa Pombalina (Pombaline Lower Town) , Chiado is frankly a transitional zone between the mountains and the downhills, with dramatic variations in street elevation. In urban fabric, this area is also the intersection of grid and irregular structure. This special urban unique was established in the urban reconstruction after the Lisbon Earthquake in 1755, which is one of the most destructive earthquakes in the history of humanity. It not only caused severe damage to Lisbon but also caused considerable controversy between theology and philosophy.

King Joseph I, who was over frightened, wanted to relocate his capital. But looking at the empty national treasury, the Prime Minister, Pombal, pushed out the public opinion and promoted the reconstruction of Lisbon's original site. He also personally managed its overall urban planning and layout. The abrupt rise of the level of the terrain, dimly minimized by the filling of the Baixa zone realized during the Pombaline reconstruction, was accentuated by an architectonic element: the Convent of the Holy Spirit. Both its dimensions and the place of its implantation made it a clear point of reference, which generated the design of the Pombaline mesh, which also assumes its long nascent façade as a determining element of the orientation of the new mesh.

The 1755 earthquake caused severe damage to the convent and destroyed about 5,000 books. The Carmo convent which had stood in the center of Lisbon since 1389 was intentionally left roofless as a reminder of the disaster. Today, the destroyed Carmo Church is used as an archaeological museum (Museu Arqueológico do Carmo). To prevent the recurrence of the tragedy, Pombal requires all buildings to meet the required standards and styles. All the Pombaline buildings must have a seismically protected wooden frame called "gaiola pombalina" (pombaline cage). The distinctively modern buildings in the Baixa Pombalina area are considered to be some of the first seismically sound constructions in the world.

Wood anti-seismic structure not only prevents earthquake disasters but also buries hidden dangers. In the early morning of August 25, 1988, a fire broke out in the grandella store in Chiado. The fire spread rapidly, and 18 buildings in the vicinity were hit hard, and the internal structure of the building was severely damaged. After the disaster, only the stone façade of the 18 buildings was well preserved – only one face was left. Just as the earthquake of 1755 brought

the Pombaline Plan to reshape the Lisbon city, the fire became a turning point in the fate of the Chiado area. In the period before the fire, the state of Chiado was of relative decadence and obsolescence. The crisis in the department stores, the difficulty of reconverting and updating some commercial establishments and the near disappearance of use as housing, together with competition from large shopping centers in other areas of cyber, have led to a state of progressive impoverishment, to the Lower Pombalina. However, despite the conditions of abandonment and insecurity, the difficulties of traffic and parking, Chiado had lost neither fascination nor evocative power.

In order to retrieve the vitality of this area, the mayor of the city, Nuno Krus Abecasis, made public the invitation addressed to the northern architect Alvaro Siza Vieira, the northern architect, to direct the work necessary for the rebuilding and recovery of Chiado.

2.2. *Urban design strategy*

After receiving the design task, Siza began research on the site. The actual appearance and urban fabric formed over 230 years are too precious for Alvaro Siza, and the new face after reconstruction should return to the old appearance of the 18th century. Moreover, the skeleton of the building should also be old-fashioned, crowded together side by side with the old neighbors, closely related to the old streets and alleys that people have been walking for more than 200 years, rather than just scratching their heads in the mirror. Going back to the past and respecting history is modernity with confident. Therefore, the Siza team made the following decision at the beginning: whatever that had been fire should be renovated and rebuilt, after the removal of rubble or parts of buildings that threatened to collapse.

However, in the urban fabric, Siza made a bold change. First, he introduced the opening of a pedestrian path between the rear of the buildings facing Garrett and Carmo streets and the support wall of Veiga Beirão School, establishing a ramp access to the southern gate of the Carmo Church. This passage can also be understood as an inner courtyard, opening two passages to Carmo Street and Garrett Street, respectively. From the sketch, we can see that this is the core concept of Siza's design. He wrote the following sentence in the design instructions: "(It's) A distribution platform. A landing over which everyone must pass and stop, an apparition from which to view the landscape". He emphasized the differentiation of the circulation here and the possibility of adding more crossing and staying. This is in line with the guiding principles laid by the Lisbon City Council for the Chiado reconstruction process: It must meet Chiado's condition as a link between Baixa Pombalina and Bairro Alto hill, whose interconnection must be improved. More importantly, Siza found the possibility of establishing a connection between the southern terrace of Carmo convent and the entire urban landscape. Besides, in block A surrounded by Ivens, Garrett, and Almada streets, Siza modified the shape of the original courtyard by changing the depth of the building to make it easier for people to stay. Another three passages have been opened up on the southern stairs, Ivens and Garrett Streets, allowing the inner courtyard can be accessed directly from the surrounding streets.

The most crucial element in the renewal of Chiado blocks, even in Alvaro Siza's view, is the introduction of Metropolitano's station and its entrance. By improving the accessibility of the neighborhood, the revival and transformation of the block can be achieved. Tunnels are built between Metropolitano Station (designed for the crossing of the streets Garrett and Ivens) and the Street of the Crucifixo. The metro entrance is located on Crucifixo Street, which was integrated into the building. Between the streets of Crucifixo and Nova do Almada, a route was opened up through stairs to connect the elevation difference between the two sides and

to encrypt the road network around the entrance of the metro station. In this regard, Siza said: "it will completely change the atmosphere of Rua do Crucifixo, which is, say, a street serving the Baixa pombalina and that becomes important in that the people come in and out of downtown and that is to change the penchant of commerce, and so on". In addition, providing for public parking for resident population and activities of the area is one of the basic principles set by Lisbon City Council to solve traffic problems.In this case, the architect's urban strategy can be simply summed up in three points: 1) A fine-grained street network with better accessibility and connectivity is set up to increase the mobility of people within the block; 2) Developing the inner courtyard in the block and create different personalities. For example, Block A is more suitable for staying, while Block B's courtyard has access and walking atmosphere; 3) Integration of Urban Infrastructure (Metro, Public Parking) and Architectural Design.

2.3. *Integration of Different Elevation: Discovery of 37.4*

Located in the intersection zone between Baixa (Lower Town) and Bairro Alto (Upper Town), the elevation difference varies dramatically in this block. The maximum elevation difference between Carmo Street and Calada do Sacramento reaches 23 meters. In the original situation, buildings with different elevations are connected by the gradient of stairs and streets. The most challenging part of the project is how to integrate the complex urban environment around the 23-meter elevation difference. Alvaro Siza gave a brilliant answer in the process of design and implementation over the next 26 years.

One of the earliest sketches of Siza reveals the intention of establishing a path through ramps and stairs to the site of the Carmo Church. As the first phase (until 2000) focused on the reconstruction of Chiado buildings, this path, which is the core of the whole design, was not included. Until the completion of the entire project in 2015, people were able to climb slowly from the backyard of Carmo Street to the foot of Carmo Church. For a long time, people had to take the famous Elevator de Santa Justa across the street to reach the church elevation. From the aerial map after the fire, it is clear to see that the elevator lounge bridge across Carmo Street and the Leonel house were not burned down. Through a lounge bridge, to the roof of Leonel's house, and a passage keeping a gap from the church, people can reach the main entrance to the church on Calada do Sacramento Street. The elevation of this path is about 41.0. In the 1989 design proposal, it has been found that Siza tried to restore the 37.4 height covered by soil, which corresponds to the elevation of the south gate of the Carmo church. Through this change in elevation, the importance of the covered south gate of the church is reappeared. The small building close to the south of the church was demolished, forming a small piazza in the empty space. Together with the south gate and the flying buttress structure of the church, it constitutes the quality of the public space here. This initially negative side passage space has a positive character in a specific city.

The public space at 37.4 elevations was finally implemented in 2015. As the elevation of the piazza has been reduced to 37.4, it is a difficult task to connect with the Elevator de Santa Justa by crossing the height difference of 3.6 meters between the roof of Leonel house in a relatively restricted space. In the original 1989 plan, a one-step staircase was placed under the flying buttress structure, connecting the height difference between the two sides. In the subsequent detailed plan, stairs and new escalators were integrated into the Leonel house building, which makes the front area of the south door more complete and spacious. However, the eastern side of the church is not within the scope of design, so there is no connection with

the broader urban landscape on the east side, and the piazza is slightly closed. In the final implementation proposal, Siza had the opportunity to further integrate the urban space on the eastern side of the church as the adjacent buildings were also included in the intervention.

2.4. *Interaction with Body, History and Urban Landscape*

In the 1989 proposal, through the crack between Leonel house and Carmo convent, individual standing in the new public space beside the south side door can see the red tile roof city building built on the hillside of Lisbon and Castelo de Sao Jorge on the distant hill, where the urban landscape of "City of Seven Hills" is displayed. After getting the chance to intervene in the eastern building, Alvaro Siza transformed the old sloping roof into a flat roof, which served as a green terrace. An elevator was also integrated into the structure so that visitors can go directly from Carmo Street to the roof terrace. Moreover, there is a considerable height difference of 9.4 meters between the roof terrace and the piazza at 37.4 elevations. To eliminate the height difference, Siza further subdivides the elevation. First, he restored the floor at a 30.3-meter elevation, which historically was a church garden. The roof terrace is connected by a ramp facing a distant hill view. The height of the garden also connects the outdoor patio of an adjacent restaurant. Three stairs and platforms at four different elevations are situated between the historical garden (30.4 meters elevation), square (37.4 meters elevation) and the roof of Leonel House (41.0 meters elevation), which makes people have to continually complete the body turning and sight line conversion in the narrow gap of 4 meters. Experience the pressure of the church's foundation structure close to the human body, as well as the openness of the urban landscape, the juxtaposition and contrast of the two feelings form a unique experience.

Also, the three stairs adopt three different design methods but form a consistent and relevant experience. The first steel double-running staircase is placed above the elevator exit, and the whole pieces of marble are used for the step. When walking among them, the temporary feeling brought by the steel structure on the material, coupled with the occasional experience of shaking, gives people a sense of being in the stairway of an archaeological museum or site of a relic. The upper staircase is a repeat of the stairs from the south gate of the Carmo Church to the East Garden in history. Alvaro Siza consciously displayed the remaining staircase ruins, while laying new staircases with marble. On the landing between the two stairs, Siza adopted the typical Lisbon-style plaza paving with 37.4 elevation square and 30.3 meters elevation platform in the back garden, suggesting the urban spatial attributes of view and stay here. The typical Lisbon-style plaza pavement was placed on the landing between the two stairs, which, like the 37.4 elevation square and the 30.3-meter elevation platform in the backyard, implies the urban spatial attributes of staying and enjoying the view.

Moreover, the last staircase integrated into the building makes people feel instantly immersed in Siza's well-known classical works. Semi-tall marble wainscot, the circular column which highlights the supporting function, overlapping staggered volumes, none of these traditional "Siza elements" is absent. The staircase was paved with marble again, and solid fences blocked the view until people reached the roof of Leonel House, which opened up again to view both the original urban landscape and the bustling crowds overlooking Carmo Street. The stairs were again paved with marble, and solid panels obscured the line of sight until the roof of Leonel house, where an individual can see both the city panorama and the bustling crowd overlooking Carmo Street.

3. Case II: Recovery and Conversion of São Paulo Ruins in a Museum Macau, João Luís Carrilho da Graça, 1995

3.1. *Background*

The ruin of Cathedral São Paulo is undoubtedly the most famous landmark of Macau, a former Portuguese colonial city on the South China Sea. The ruins now consist of the southern stone façade. Cathedral São Paulo is attached initially to São Paulo's College. Founded in 1594 and ended in 1762, the College is the first Western-style University in the Far East. In 1835, the cathedral was razed to the ground, and only the front façade remained. The diocese changed the space behind to a cemetery until the old Western Cemetery outside the city was completed. Since then, the area has been empty.

In the late 1990s, in order to improve the strategy of preservation and maintenance of urban cultural heritage and promote cultural tourism with cultural heritage, the Macau government carried out a series of renovation projects in many places of the city center, among which the archaeological excavation and renovation of St. Paul's Church is the most critical project.

In the early 1990s, the government carried out archaeological investigations and restoration of church ruins and found the foundations behind the church and the burial sites of priests. Portuguese architect João Luís Carrilho da Graça was commissioned by the Macao Government to work with archaeologists, historians, and museologists. After five years of archaeology, exploration, and construction, they finally completed the renovation of the ruin of Cathedral São Paulo and a New Catholic Museum of Art in October 1996.

3.2. *Definition of "Layers": Imagination of History and Reality*

The ruin of Cathedral São Paulo is undoubtedly the most famous landmark of Macau, a former Portuguese colonial city on the South China Sea. The ruins now consist of the southern stone façade. Cathedral São Paulo is attached initially to São Paulo's College. Founded in 1594 and ended in 1762, the College is the first Western-style University in the Far East. In 1835, the cathedral was razed to the ground, and only the front façade remained. The diocese changed the space behind to a cemetery until the old Western Cemetery outside the city was completed. Since then, the area has been empty.

It is undoubtedly necessary to construct a special relationship between archaeological relics and newly built space by arousing people's imagination of church space in the empty space. In an initial sketch, the architect's outline of these elements can be clearly perceived: a footpath hanging behind the ruins of the church facade, an empty church square, a staircase leading to the newly discovered underground archaeological ruins, and a street to the north of the site. These four elements are the four "layers" first defined by Carrilho for this design, which together constitute the "platform" of experience architecture and its surrounding areas.

Carrilho's intention to build a footpath on the back of the church remains very clear. To this end, he said in his design concept: "A 'passerelle' behind the façade allows one to see the city on one side and the other on the floor of the old church". Through the opening of the second floor of the church facade, Macau's urban landscape can be seen at a glance. More interestingly, it also creates a structure that echoes the vanished Choir terrace in history.

By comparing the process model with the final image, the architect canceled one staircase leading to the footpath and modified the last steel staircase of the other staircase at an angle.

When people climb up this staircase, through the hole in the facade of the church, they look directly at the distant Grand Casino in Portugal, which is another modern landmark of Macau. This new high-level landmark created a connection between the old and the new markers in Macau. On this "floor" of the Church Square, the architect uses square ground skylights to create a visual connection between people and the underground structural relics of the church. The window in the middle implies the position of the original structural pillar of the church, and the construction method of the lattice floor also involves the central space of the church. This layer does not correspond to the "floor" of the real church ground in history but constructs a new imagination space by suspending on it. The architect transformed the archaeological remains of the basement into a chapel and built a small museum with the remaining space. The location of the basement corresponds to the main altar of the old church. The ground of the church square is raised to form the roof of the tomb, and diffuse light sprays into the underground space from the gap in the slant. In this space, the ground is in line with the elevation of the North Street but lower than the remains of the tomb. The ruins are for visitors to see as if they were placed on a booth. None of Carrilho's newly implanted "layers" corresponds to the elevation of historical relics, but these layers correspond to the height of urban landscape and streets, creating a new "imagination" in the juxtaposition of history and reality. "Juxtaposition" is also found in the streets on the north and east sides. The architects reproduce the space scope of the original main altar and the East Ear Chamber on the ground by laying the floor pattern in the landscape, which makes people "imagine" the interior space as well as the fading space.

3.3. *Integration and Isolation: A Psychological Game*

In describing design concepts, Carrilho wrote: "refocusing the space of the old church, now affected by the presence around large and uninteresting buildings". The new design undoubtedly needs to define its interface with the surrounding complex urban buildings and streets. Instead of completely enclosing church squares and relics or exposing them, architects responded in different ways to each of the surrounding interfaces. The East and north sides of the site are street-facing, and the architect uses a right angle to form the architectural posture. Between the site and the eastern street, a pedestal is used to connect, without walls, which makes space more a part of the city streets rather than a separate space. From the upper to the lower ruins and museums, one can always see the residential buildings across the Northern street through the carefully designed openings of the architects. The northwest corner is more difficult to deal with. There are crowded houses and a Naju temple. Carrilho's design is ingenious in this difficult place. Relic stones are used to form courtyards between buildings and surrounding houses, which is quite similar to Japanese rock garden. The distance between the surrounding houses and the empty space of the church has increased both in sight and in mind, but these dilapidated houses can always be seen in one's eyes. It conveys a feeling that the church is gently melting into the surrounding houses, leaving only the so-called "archway" (façade of the church) standing there in isolation. During the whole experience of the project from street to site to basement space, one's eyes are filled with these ordinary scenes. They (buildings and their surroundings, below and above, inside and outside) are stitched together in people's minds, which greatly weakens the sense of weight and boundary of buildings. This is a psychological game about architectural experience.

4. Conclusion

In the two cases analyzed in this paper, both Portuguese architects have demonstrated a skillful design method that controls the body and sight, coupled with changes in the body's perception of materials, leading to continuous and climax experiences. But more importantly, the spatial experience is related to the site history and the urban landscape in a broader scope. In a seemingly simple way, Alvaro Siza introduced the magnificent view of the Seven Hills City into the one's experience, just as he did in the Galician Center for Contemporary Art. João Luís Carrilho da Graça, on the other hand, constructed historical/realistic montages in one's brain through precise control visually and physically.Historical research is the beginning of their elevation design. On this basis, by restoring or introducing the "new" elevation, the new "layers" is inserted into the fractured urban height, and the continuous urban space or architectural space can be formed. In the "new" elevation, the urban landscape adds new meaning to the memory of the old elevation.

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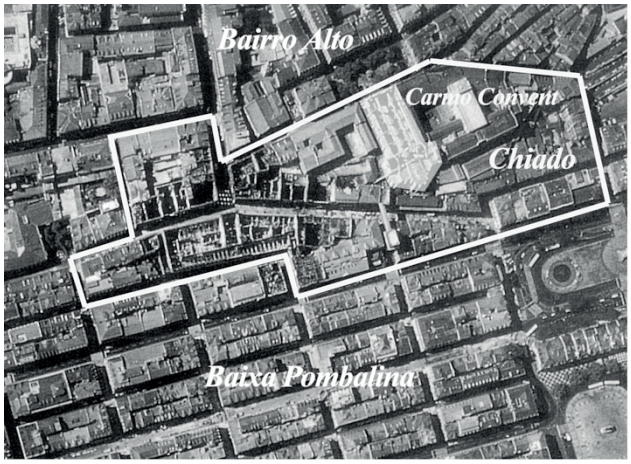

Fig. 1.1. *Satellite image after fire.*

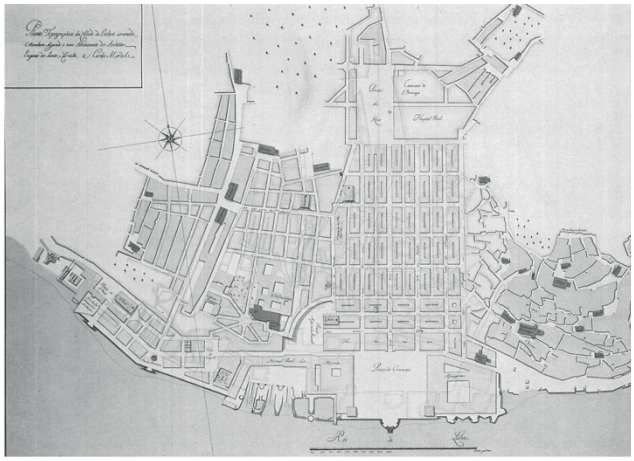

Fig. 1.2. *The Pombaline recontruction plan.*

Fig. 1.3. *Chiado after the fire.*

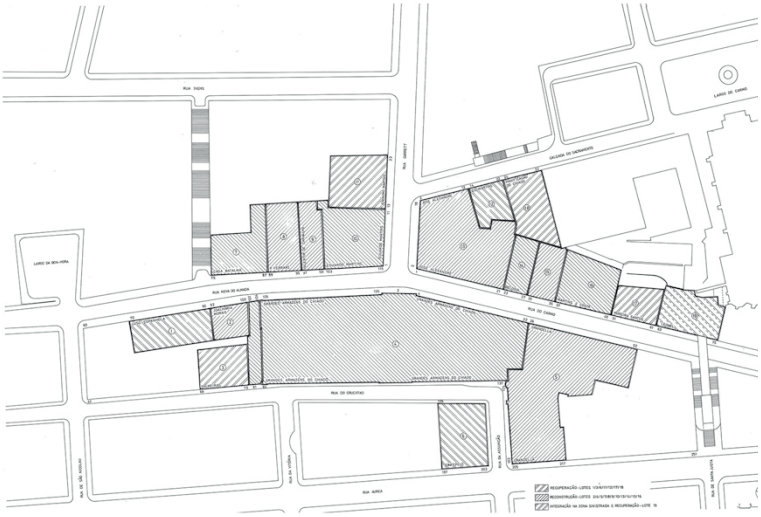

Fig. 1.4. *Original plan before the fire.*

Fig. 1.6. *Chiado street view after renovation.*

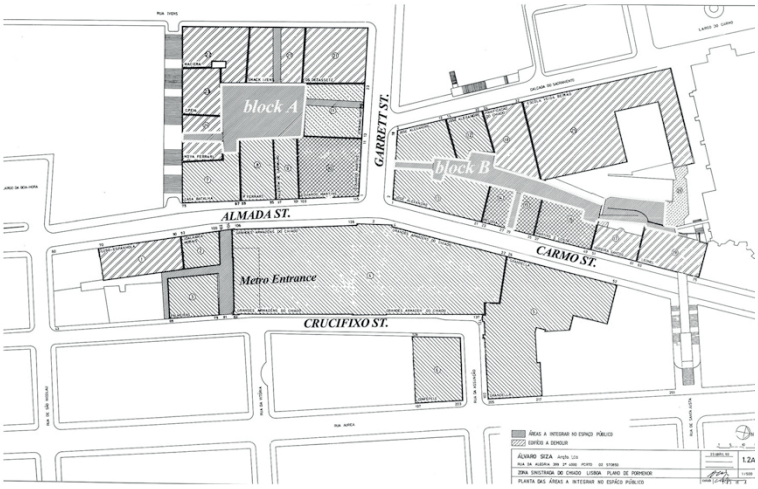

Fig. 1.5. *Plan of renovation.*

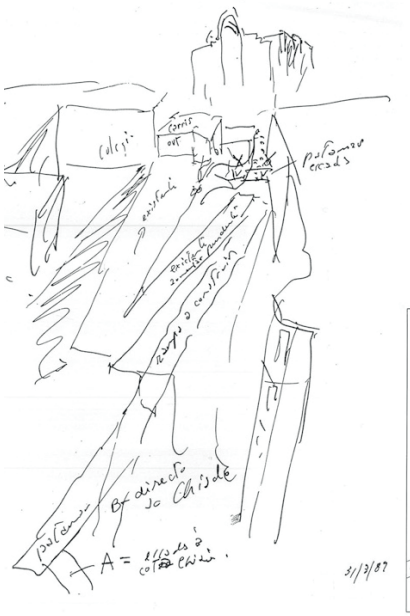

Fig. 2.1. *Alvaro Siza's sketch.*

Fig. 2.2. *Photo of Elevator de Santa Justa and Chiado in fire (up).*
Fig. 2.3. *Original plan before the fire (down).*

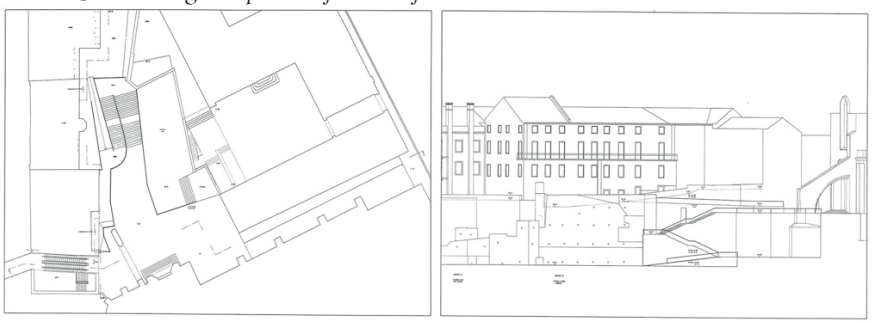

Fig. 2.4. *Plan and section of South space of Carmo church.*

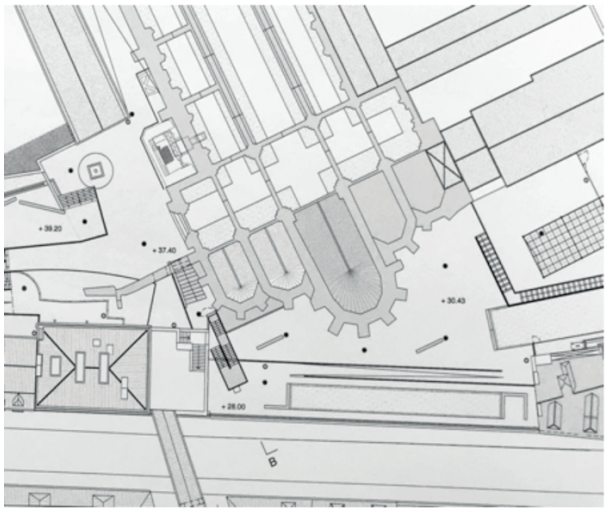

Fig. 2.5. *Final plan (2015).*

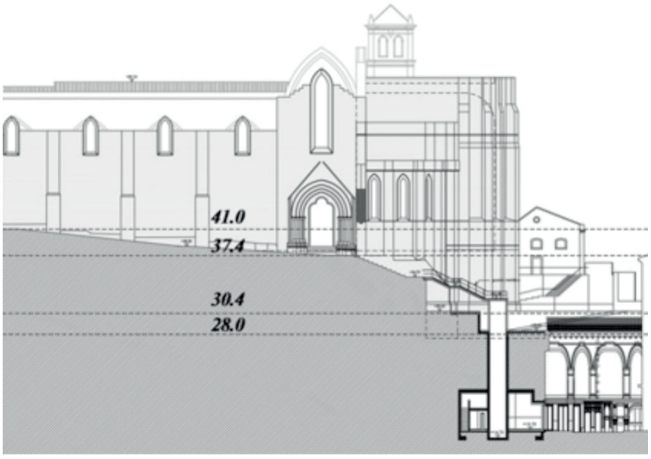

Fig. 2.6. *Section with different height levels.*

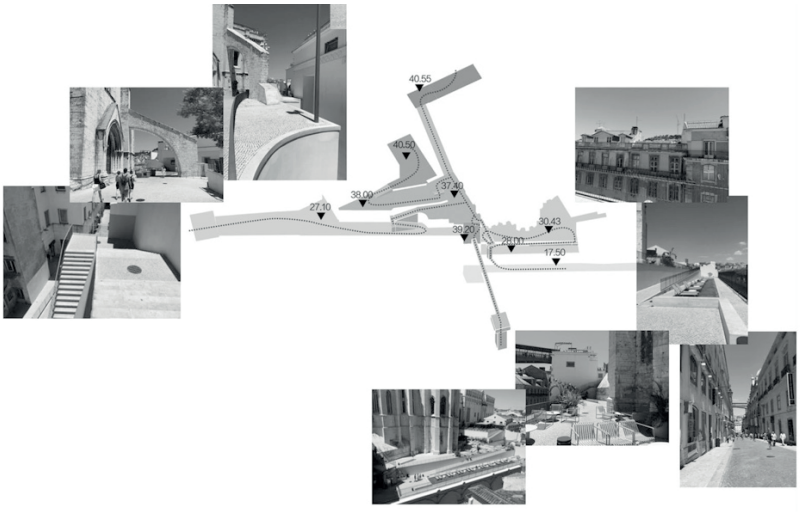

Fig. 2.7. *Diagram of the experience through the circulation.*

Fig. 3.1. *Original plan before the fire (down).*

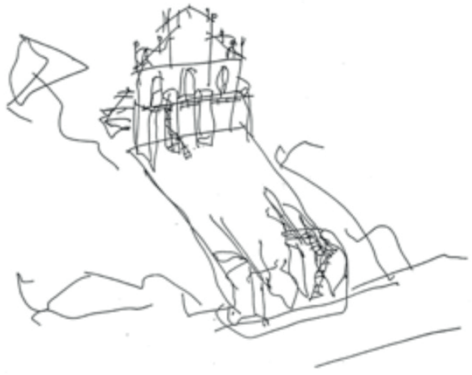

Fig. 3.2. *Sketch by João Luis Carrilho da Graça.*

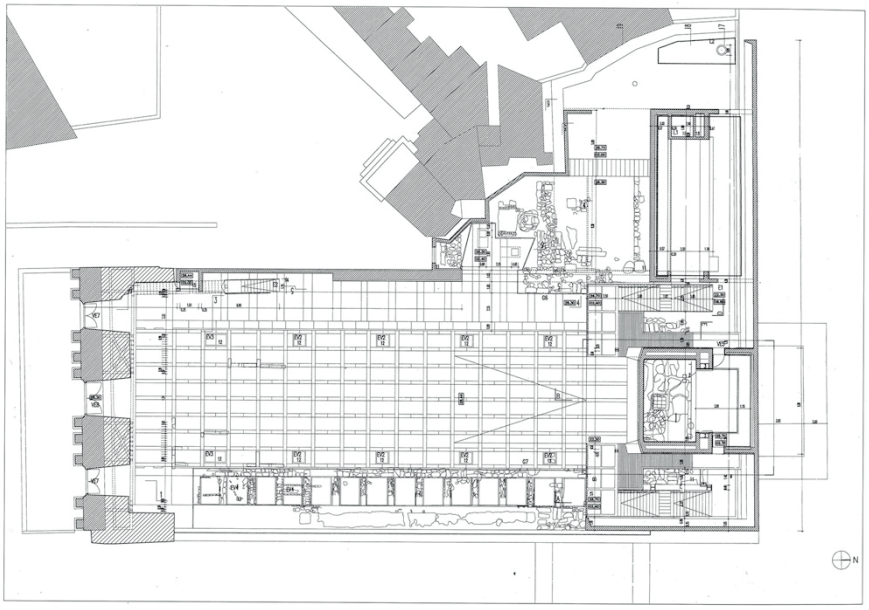

Fig. 3.3. *The plan.*

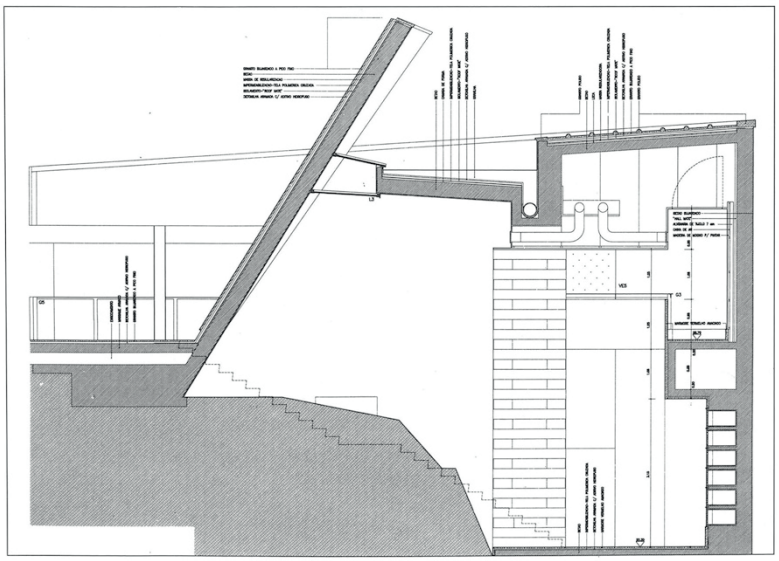

Fig. 3.4. *Section of the underground space.*

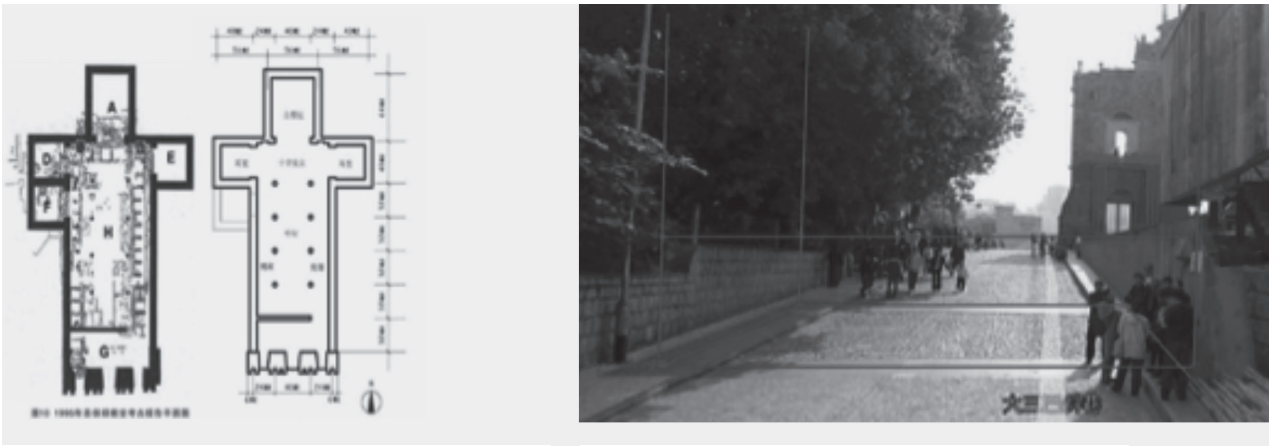

Fig. 4.1. *Church original Plane.*

Fig. 4.2. *"Juxtaposition" and imagnation.*

Fig. 4.3. *"Ordinary scenes".*

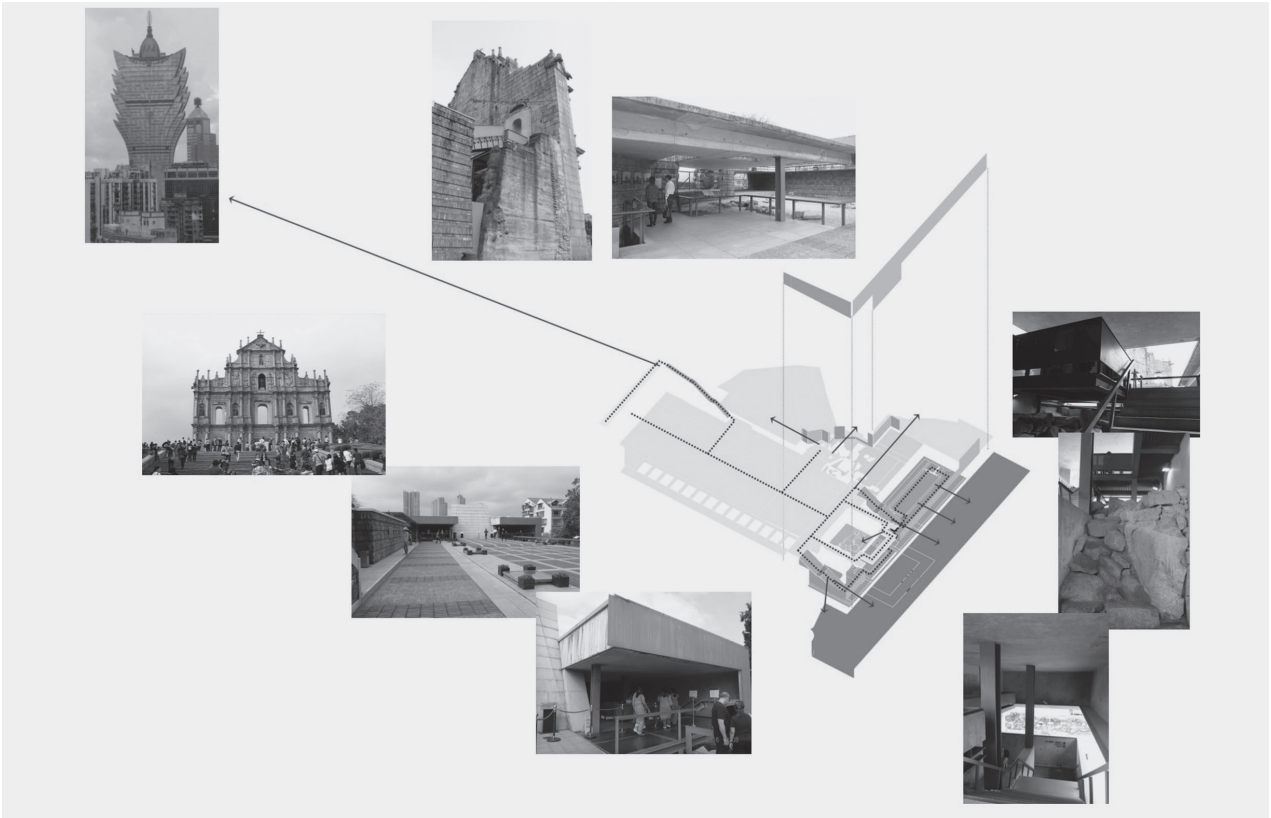

Fig. 4.4. *Diagram of the experience through the circulation.*

An Anonymous Byproduct: The Urban Morphology of the Motel in Quito

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Keywords: Motel, Type, Urban Morphology, Industrial, Byproduct.

Abstract: Since the 1970s, the industrial structures that once predominated the northern zone in Quito have become the canvas of a Las Vegas-like landscape. When tall walls and colourful signs mesmerize your eyes, you have reached the motel area. Misplaced from its original context and function, the motel was imported from the United States of America to Quito, moving from routes and rural areas to the periphery of the city. The original function of low-cost temporary accommodation changed to one related to the renting of rooms for sexual encounters, usually by the hour and by unlawful couples. Its built type mutated to later adapt to its new urban surroundings.
The motel can only be reached by car. Once the users drive into the enclosed parking lot their identity is hidden and they become anonymous. This typology merged into the industrial area of the city due to normative requirements, as a legal agreement not only between the owners of the motels and the authorities but with the predominantly conservative society. Based on analytical drawings, this paper explores the architectural, typological and urban qualities of the motel in Quito. It will be seen from above and street view, unveiling a unique by-product.

1. Introduction

In Ecuador's conservative society, sex has commonly been considered a taboo. Quito's catholic culture, reinforced by political and social parameters, encourages a behavioural standard in which sex is only accepted in marriage, mainly for reproductive purposes. Thus, any establishment categorized as a motel is directly related to unlawful and perverted sexual encounters, in rooms rented by hours and with particular architectural and urban characteristics. This social standard has evolved during the last 50 years.

Back in the 1970s there were few spaces used for sexual related purposes, mainly brothels. Additionally, there were few hotels and pensions used only for touristic purposes; the lodging industry was just starting to develop. Consequently, the necessity for a space that could be used for sexual encounters arose. Furthermore, during this decade, Ecuador was a developing country buried into political and economic turmoil as it was facing a dictatorship period, since president José María Velasco Ibarra assumed total power in 1944. He was followed by a series of unstable governments until 1976, including a military dictatorship by Guillermo Rodriguez Lara (Carrión,

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1992). These were repressive systems that condemned by threatening and persecuting any non-regularized activity. By the 1980s Ecuador recovered its democratic government. Nonetheless, a repressive society gives space for double standards and hidden purposes. Consequently, as in every dictatorship, society had to respond in a creative yet disguised way to embrace forbidden topics, mainly ones related to sex. New opportunities build up when non-politically correct activities happen and have the necessity to become anonymous. In the case of Quito during the 1970s, this necessity became an opportunity to create a type of building that could serve these purposes. But there were no references of buildings or even ideas for temporary accommodations that could satisfy the demand for spaces for sexual encounters, without prostitution services.

Owned by María de Lourdes Herzog, a Brazilian immigrant, one of the first known establishments for extramarital sexual encounters in Quito was named "Los Faroles" [The Lanterns]. This establishment started with 10 rooms, and after thirty years in successful business, it currently offers 66 rooms. There are no registered documents of the exact opening date, but newspaper records date it existed since 1978, when its opening caused controversy among the old-fashioned society according to peoples' interviews (Gómez, 2005). Los 'Faroles' was inserted near the actual industrial northern zone in Quito, along the Avenue 10 de Agosto, which is one of the main peripheral highways. The location of this first establishment resonates with the 'medicalization of the body' in modern cities; according to Michel Foucault: "*it implies that the sick need to be isolated, both physically and psychologically from the society they belong to before being treated*" (Foucault, 1969). On the one hand, this type of business was not wanted; it was treated as an undesirable sickness, isolating it not only because of its function, but also because of its acquired purpose. On the other hand, it was wanted to the point that it became a success and trailblazer. The architectural object was isolated to an alienated environment, atypical to lodging services, which unexpectedly developed an unknown typology. Without noticing, Maria de Lourdes Herzog not only translocated the American motel as the generic building of this business, but also, by inserting it in a new environment, initiated a transformation process.

1.1. *The Architecture of the Motel*

The American Motel is a low-cost accommodation located in peripheral routes, secluded from urban areas. The architecture of the American motel started in the urban sprawl after World War II, when economic and political changes generated an increasing human displacement along the United States of America. Its vast territory, although connected through a sophisticated system of vehicular arteries that demand long journeys, fostered the emergence of a new type of building. It is distributed along routes to satisfy the need of travellers for inexpensive overnight accommodations. Consequently, the motel passed through a series of transformations before becoming a consolidated building type; from basic Auto Camps, to Rural Cabins, Motor Courts and Motor Inns. Isolated from city's congested downtowns, Moto-Hotels, or Motels, became the convenient accommodation for truckers, nomads and travellers (Jackle, J., Sculle, K. & Rogers, J. 2002). Therefore, the motel became a low-cost typology for short-term lodging in peripheral rural areas destined for the travelling classes. The car, the parking lot, and the room conformed this building type isolated from the city's centre social demands.

The architectural features of the American motel and its isolated environment give it a mouldable condition as it could be used to hide a restrictive activity in Quito. Once imported to Quito′s conservative society, the motel ironically became the perfect typology to disguise its iniquitous necessities. As previously noted, the motel in Quito was intentionally placed in a border location and not for adaptive purposes; it needed to be isolated. In order to understand

the plot of its location it is imperative to review the Quito's urban growth plans during the past century. Economic growth during the 1950s – due to banana exportation – leads to a drastic increase of urban population and informal settlements, unveiling the urgency for control and legislation. Particularly in Quito, its population had tripled in just 25 years – in 1950 Quito had 209.932 inhabitants, whereas in the 1974 census the total number rose to 625.828 people (Cifuentes, 2016). Therefore, a new regulatory urban plan was developed in 1967, substituting the first urban plan designed in 1944 by the Uruguayan architect Jones Odriozola. The first plan was based on a land use division of the city which main purpose was to divide city into three main functional activities: residential, working and recreation. This plan divided the city into three main zones: south, destined for industrial activities; centre, for residential, financial and commercial uses; and north, eminently for residences. These zones included vast voids destined for recreation and public space. However, until 1967, the city grew in a spontaneous way, and public space and equipment were left unattended. Thus, the 1967 Master Plan approved through the 1165 Metropolitan Ordinance, included a set of four large 'unit system' instead of a divisionary system (Municipal Council, 1967). Consequently, mixed uses were assigned to the main areas of the city. While the south was considered mainly residential and industrial, the geographical centre of the city was divided into two: the Historic Centre as the administrative core of the city and, next to it, the hyper-centre, destined to residential, commercial and mainly financial purposes, transforming this area into the most equipped zone of the entire city. Finally, the north was equally programmed as the south: residential and industrial (Carrión, 1992). This 'unit system' has developed its own intricate way, where its land use assignation is its key organizational element.

Since then, in Quito, the use of land defined the city′s performance, and therefore, the distinct units were connected in order to function as a hole urban mass. Consequently, following the Master Plan′s studies and proposals, at the end of the twentieth century, new peripheral avenues were inserted in the city according to its new limits. Quito's irregular and mountainous topography led to a longitudinal growth, defining a unique urban morphology. 10 de Agosto Avenue serves it and it has been the commercial spine of the city since the nineteenth century. Since Odriozola's Regulatory Plan, four main longitudinal roads were established to unify and connect the city from south to north: Mariscal Sucre and Amazonas Avenues on the occident, and Eloy Alfaro and Simón Bolivar Avenues on the orient. These roads connect the industrial zones (south – north) bordering the city but not still being part of it (Figure 1). Hence, they defined the form of the peripheral areas of the city, where the motel was strategically located.

From 1973, a Directory Plan was supposed to be developed until 1993, in order to define and document the complete area of the metropolitan city of Quito. The new plan established the total area of the urban settlement of the city, including the peripheral industrial zones and the residential areas surrounding them (Carrión, 1992). During the 1990s, the motel in Quito was already acknowledged in people's imaginary as a restrictive commerce, and therefore it was categorized under normative definitions in the first Metropolitan Zoning Ordinance 001, approved on December 12, 1997 (Municipality of the Metropolitan District of Quito, 1997). Quito's Regulatory Use of Land Ordinances approved during the twenty-first century, establish that industrial land use includes factories, industrial commerce, car dealers and equipment for restrictive trade. According to normative definitions, the latter refers to "establishments that provide spaces for sexual services with or without lodging", without specifying the permitted type of services (Municipality of the Metropolitan District of Quito, 2002). Nevertheless, in the peripheries of the north, there are not cabarets, brothels, or the offering of prostitution services, as they are normed in other areas of the city.

2. The Urban Morphology of the Motel in Quito

The concepts of city and type are indispensable to analyse the urban morphology of the motel in Quito. Quito is and always has been political in its essence. The fragmentation and re-composition of the city's spaces and forms can never be separated from political implications. Although architecture is often aligned to the concept of uniqueness; unrepeatable by definition, type is an implicit concept in the generation of architecture. If we see an architectonic built form as a repeatable object, its desirable uniqueness essence changes to one conceived to being recreated, restructured and perfected through its repetition. But, in this research the motel type in Quito mainly relates to systems of organization rather than stylistic approaches. Hence it is important to distinguish between type as form and type as organizational structure. The first refers to the definition of the material object by its geometrical configuration. Usually form gives the building a geometrical attribution; a form based type. Nevertheless type, as organizational structure, is a non-material definition of the object as it refers to the particular relationships between the components that serve to a certain use, within any form. In this perspective, the principal conditions for the invention of the motel in Quito do not necessarily fit between the relationship of form and use. The study of the urban morphology of the motel in Quito inquires the relationship between the type's organizational structure and the industrial environment.

There are several methodologies and traditions on how urban morphological studies examine the creation of built forms, such as Caniggia's work on the city's diachronic phases of development and transformation. As Cataldi points out, one of the major contributions of Caniggia is the establishment of the method of processual typology (Oliveira, 2016, p. 116). It primarily focuses on the permanent re-negotiation of the connection between "body and environment" and the body's capability of reprogramming itself, demonstrating the reversibility of "manmade processes" (Cannigia, Maffei & Marzot, 2018). In fact, the motel in Quito as an architectural object re-negotiates its original connection to its original environment and gains a new opportunity to reprogram and convey its type organizational structure as it relates to its new environment. Nevertheless, in a Darwinian manner, the mutation of the motel and its adaptation with the industrial environment does not necessarily fit into a cyclic process of permanent renegotiation. Instead, two building types, the industrial shed and the motel, merge together in a symbiotic relationship with their environment.

Within this frame, the aim of this study is to explore the mutation of the original American motel building type and its further adaptation to the urban morphology of the industrial zone in Quito. Based on the new object interaction with the environment, this paper engages into a synthetic analysis of the Motel's opportunistic camouflage that allowed its mutation. The mixture of assigned land uses, such as industrial with residential zoning in the northern area of the city, where you mainly reach by automobile, generates a particular urban morphology. The relationships between the shed's building type and the urban fabric reveal nothing atypical at first sight, since the sheds that mainly represent its built form organize the urban morphology. The motel business' owners take advantage of the existing built form by hiding the motel services they offer inside the industrial shed. The desire and necessity of keeping their costumers' identity private, derives specific qualities and mutations of the motel type and its relationship to the environment. The original American motel couples with the sheds and adapts to the industrial land use in Quito creating a unique by-product that has not been architecturally documented yet.

3. Methodology

The area of study has a restrictive movement due to privacy issues as both, motels and industries are private property controlled by specific organizations. The industrial use of land in the north of Quito has 276.97 ha with a total amount of 19 motels. We delimitated the area of study to 108.95ha, which are a 39.33% of the industrial use of land, because this area contains the major aggrupation of motels. The area has 16 motels corresponding to the 84% of the total amount of motels in Quito's northern industrial area (Secretaría de Territorio, Hábitat y Vivienda. 2019).

On first instance the gathering of information was limited to Google Earth images and public regulatory ordinances. Because this is an understudied topic, methodologically we used conventional urban morphological techniques of map series analysis combined with drone technology – ortho mosaic photographs – to survey the area of study[1]. Two main points of view were used to structure the survey and the data analysis of the area: seen from above and street view. The secondary roads that connect groups of motels have minimum sized sidewalks turning them into non-pedestrian friendly roads. Consequently, the lack of constant pedestrian flow generates an atmosphere of insecurity. The streetscape skyline and performance was collected by a sequential set of photos, both by drone and by automobile.

Actualized GIS maps of the city's zoning and use of land regulation were the base maps in our research. However, field survey and observation were the main tools for collecting detailed information that complemented the GIS maps information of the ground floor composition of the industrial mega blocks. The industrial use of land is conformed by massive blocks compared to the residential city blocks. Whereas the average industrial block's measurement is 290 x 180 ml, the average residential block has 100 x 50ml (Gobierno Abierto, 2019). This is why we categorized them as mega blocks. Since the regulatory entities have unspecific data; the missing data was collected through drone flights during day and night. The drone flights gathered quantitative – pedestrian and vehicle flows- and qualitative information – building heights, building form, and building real use. Additionally, another important activity was visiting the sixteen motels as paying customers in order to collect specific information from the garage, the rooms and the service corridor. Meanwhile we managed to have unclassified interviews with motel's personnel to discover the service corridors' functionality as access is denied to clients.

Finally, the use of ground floor drawings including the collected data allowed us to identify and document the urban morphology and ground floor performance of the motel in Quito.

4. Analysis/Results

Based on the methodology we used to survey information, three main categories were established to classify the urban and typological findings.

1. There are no data protection and privacy laws in Ecuador concerning drone flights. During the survey, drone flights neither invaded private property nor took any ortho-mosaic photographs inside lots and buildings. No direct photographs were taken from people's faces. The photographs were taken from a 100-meter distance from the ground floor, and the distance from street view photographs varied from 10 to 20 meters. The drone was located on the street axis avoiding the capture of images inside private property.

5. Urban Findings Seen from Above

Since the 1970s, the selected case study of 108.95 ha. has had an established use of land that allows us an objective architectural survey of the area. Eloy Alfaro Avenue runs from south to north and flows almost parallel to 10 de Agosto. When it reaches the northern ravines of Quito, it adjusts to the topographical conditions, changing its direction back to south merging with 10 de Agosto Avenue, acquiring a spoon like shape and becoming a cutting limit between the residential and the industrial (Figure 1). Consequently, the industrial sheds are inserted inside this spoon like avenue. The main thoroughfares generate commercial frontages and the avenues' scale creates a non-pedestrian friendly neighbourhood, mainly occupied by industrial land use and vehicles. The urban mapping of the zone and top view ortho-mosaic photographs denoted a particular phenomenon: a contained industrial island surrounded by residences and topographical conditions.

The urban island is activated by a system of secondary roads that connect all of the mega blocks inside it to the main roads. The peripheral avenue surrounds a grid of secondary streets that, while adapting to the topography, they surpass the limits of each block and invade the lots. During the research, the ground floor drawing analysis of blocks where industrial sheds and motels co-exists, unveils that the secondary streets not only connect the city with the island's lots, but it becomes the thread that sews its urban fabric with the architectural objects in the mega blocks. Specifically, the street enters in every motel lot by surrounding, passing through or getting into the architectural object, to finally reconnect again with the grid system of streets. The architectural object benefits as the industrial non-pedestrian street system deploys directly inside it, allowing the user to reach their non-industrial facilities by automobile (Figure 2).

The urban island dramatically changes its urban performance throughout the day during all

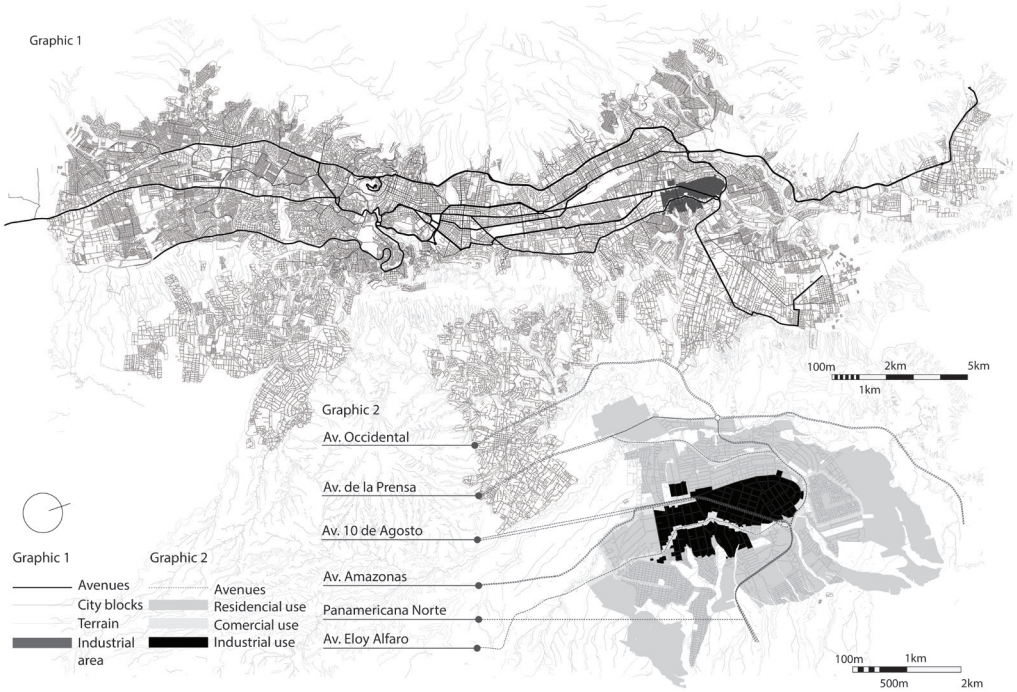

Figure 1. *Plan of Quito's Metropolitan Area, based on Arcgis maps obtained from the Municipality of Quito. Showing the main longitudinal road system, the block configuration and industrial land use in the northern area of the city of Quito. © Karina Cazar.*

Figure 2. *GROUND FLOOR DYNAMIC. Mapping of Quito's northern industrial land use area, based on Arcgis maps obtained from the Municipality of Quito complemented with field and drone survey. Showing the motels location inside the area of study and ground floor zoom into two main areas of motels' aggrupation. © Karina Cazar.*

week. From 9 am to 5 pm – average established office hours – the main vehicles in the area are trucks and medium sized cars that serve the storage and minor productions buildings. This is clearly seen from above, as the sheds maintain the same static, massive, industrial appearance. The trucks enter through the main avenues, cross the area through the grid streets, load and unload inside each lot, and leave following the same route. The motel camouflages under the shed form and there is no distinguishable difference between the industrial shed and the motel shed (Figure 3).

From dusk till dawn, the night top view uncovers differences between lots: some of them are invaded by neon lights revealing the disguised activities under some of the industrial sheds. Trucks flow decreases and regular sized private cars take over not only the streets, but also the area inside the colourful shining lots.

6. Urban Findings Seen from Street View

The motel's camouflage in the industrial shed is noticeable through street view as it unveils the elements that help it camouflage in pedestrian abandoned streets. The motel takes advantage of specific architectural elements to disguise itself during the day. Driving through the industrial mega blocks, some of the front enclosure walls are divided into three portions, where the middle one is displaced behind the other two, forcing the approaching car to make a "u" turn so it can enter into the motel's lot. The car hides behind the wall where there is no entrance control, but you are being observed through security cameras. In contrast, the surrounding sheds that accommodate industrial functions have typical guarded enclosures,

Figure 3. *CAMOUFLAGE. Top View of a section of the industrial island in the northern area of Quito, taken from drone ortho-mosaic images. Showing the industrial built form located between two main roads: 10 de Agosto avenue on the occident (upper road on the image) and Eloy Alfaro Avenue on the orient (lower road on the image).*

creating a contrasting streetscape. The industrial shed's grey shades juxtapose with the motel's unusual walls as most of them have attached signs. These signs on the peripheral walls start lighting up at evening and the word "Motel" appears everywhere. This new unified architectural element becomes the motel′s façade; as if following Robert Venturi's and Denisse Scott's Brown's conclusions from Las Vegas, the shed acquires a new way of exposing its new function. In the American motel the sign complements its façade with flashy logos and type fonts, without dividing walls between the street and the building. In the by-product of the motel the wall preserves the building′s need of privacy attaching discrete signs to its front enclosure walls. On the one hand, day street views of the motel in Quito show dull signs with 3D texts words, without a specific font type. Visually it looks like a usual industry brand with the motel's name. The sign doesn't have explicit images regarding the building's use. On the other hand, these architectural elements turn into striking screens during night, competing to persuade visitors to use their establishments and the motel as a building loses its disguised form (Figure 4). These are not ordinary facades; thematic objects such as palm trees and hearts next to the signs overwhelm the visitors. The enclosure walls have colourful decorative lighting that drastically contrast with the white and cold lighting of the rest of the industrial environment. When the users approach to these walls the feeling of hiding their identities arises; it is not politically correct to be seen there. Nevertheless, once the users drive through the façade walls their identity is disguised and anonymous.

Figure 4. *DAY & NIGHT PERFORMANCE. Street View collage images taken by drone flights. Showing three motel's day and night appearance. The upper images correspond to 'Venecia Motel', the middle images correspond to 'Flamingos Motel' and the lower images correspond to 'Lumini Motel'.*

7. Motel Type: Organizational Structure

A typological transformation takes place when the motel and the industrial shed become one. The shed loses its industrial value to accommodate the temporary lodging services of the motel by suffering a series of mutations. The reconfiguration of the shed, becoming a motel, has its own intrinsic relationship with the industrial environment. The motel business owners use the shed form as a container and mutate the motel by altering the sequence of its original organizational structure. The alienated object has a preconceived space organizational sequence: the parking lot, the service corridor/circulation system and the room. For instance, the parking lots in the American motel – specifically the motor inn – are separated from the room and the building. The exterior circulation corridors are the only transition space between the parking lot and the room; both guests and service staff use them (Jackle, J., Sculle, K. & Rogers, J. 2002). Once you enter the motel's lot in Quito, a lineal paired set of garage doors – some opened and some closed – flows besides the interior road where sidewalks disappear. The only thing left to do is to enter one of them and park. The garage door automatically closes behind your back and in the enclosed space of 5 per 3 meters, a narrow staircase guides you to the upper floor: the motel room. Sometimes there is a waiting time while the service cleans the room. Once the wooden door revolves, blocking the service connection to the room, you are allowed to enter. In this sequence of spaces, nobody saw the visitors' face. Therefore, the original motel's organizational structure is completely altered. In Quito, the introduction of the street into the motel's shed transforms its typological configuration and combines the space for the user with the space for the car. In this case, there are not parking lots but private parking garages

that are located as thresholds to the motel rooms. The private garages act as the transitional space between the street and the room, altering the original American motor inn circulation sequence. Furthermore, the mutation of the motel eliminates the exterior corridor and introduces an interior "invisible" service passage that can only be reached the moment the users leave the room. The same door divides the intersection of the room entrance and the service corridor; the motel staff reaches this private corridor by entrances isolated from the visitors' path. This organizational structure is found in fourteen out of the sixteen studied motels. The other two motels don't have the service-blocking door. Instead, they have two doors; one serving the users and other one destined for service staff. The motel in Quito symbiotically interacts within the industrial island due to the opportunistic mutations and the further adaptations of the motel by-product with the industrial street grid.

8. Discussion/Conclusion

By definition, the word opportunistic has negative connotations, referring to taking advantage of circumstances with dubious principles or ethics. In our use of this term, we explore the beneficial connotations this word implies as it leads to generative and creative uses of architectural and urban conditions that were used to mutate the American Motel in Quito. Opportunistic overlaps between forms, space, program, organizational structures and environment conveyed into the Quito's by-product of the motel type. Working opportunistically, the motel in Quito camouflages under the sheds of the industrial mega-blocks serving the society's necessity to keep morally forbidden sexual encounters anonymous. Then, it mutates re arranging its organizational structure and interaction with the user and the road. Finally it adapts to the industrial street grid, symbiotically working with its environment.

A society with double standards found an opportunity to normalize a restricted activity by using the American motel building type isolated in an industrial environment. This paper describes the formal evolution of the motel where the industrial urban environment was the perfect canvas for hiding a non-politically correct service under its sheds. The block analysis and streetscape photographs portray idyllic conditions for hiding this building type. The predominant shed forms in the industrial island allowed the camouflage of the new purpose given to the alienated type, producing an anonymous by-product.

Once the motel is placed into the industrial island, the holistic functioning of the original American motel mutates and creates its own space organizational sequence; not ruled by the shed's form. The fundamental relationship between use and form in the generation of type is not the main essence of the motel's by-product. The shed's form is not relevant to its new use since the organizational structure of the motel is the predominant element of this typology. Even though, some motels' façade look different form others, they share the same operative and organizational structure. The by-product of the motel in Quito embodies the merging of two different building types in which one of them – the American motel – reacts to the environment of the other one – the industrial shed – by opportunistically camouflaging, altering and adapting to it. The political and cultural implications explained in this paper created the conditions for the invention of the motel in Quito. Its atypical location shifts the surrounding urban context performance. During the day, the mobility and activity of the area mainly responds to industrial equipment and businesses. In fact, the motel remains anonymous disguised under the industrial sheds. During night, the industrial island turns into an active zone where the motel

changes its performance by incorporating atypical flows of users, services and atmospheres to the industrial zone.

Interestingly enough, the ambiguity of the motel in Quito's urban imaginary and collective memory lays on our society's double standards. It is a by-product that emerges from the business owners' creativity to maintain both its purpose and users anonymous. However, the motel's location, use and purpose are of common knowledge and it has been a successful business for decades. In fact, television shows and newspapers have produced short clips explaining and promoting the motel. Yet, it is still stigmatized becoming the stage of public scandals[2].

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2. "Lady Tantra", this was the given name to a public scandal where a husband discovered his wife's infidelity. He confronted her when she was driving out of a motel's entrance located in the northern industrial area of Quito. The case reached national and international diffusion; several communication mediums were used for the dissemination of the incident such as news and social media. The appearance of the motel in the video gave context to the event since most viewers easily deduced the motel's purpose in the scandal. This is just one example of multiple confrontations that have caused controversy in Quito.

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Decoding the Bazaar: Morphosyntactic Properties of the Bazaars in Tetovo

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Keywords: Tetovo, Bazaar, Space Syntax, Urban Morphology.

Abstract: Throughout history, Bazaars used to be the focal point of public life in different cities with Islamic background. Many of them are not any longer the places where the social and economic activities reach their peak. Although there have been many attempts for the regeneration and revitalization of the Bazaars, it proved difficult to recover their previous spirit. However, examples of successfull Bazaars can still be found.
What made the Bazaars so attractive in the past? Why some of the Bazaars lost their vitality, while others are still important social and economical hubs of cities? Were their typological or morphological properties; were the activities; or, the main reason for the vitality and vibrancy of the Bazaars was their relative location on the network of public spaces in the city? In order to answer some of these questions Tetovo and its two Bazaars is chosen as a case study. By utilizing Space Syntax as the core theory and methodology along with a combination of morphological approaches this paper investigates their properties and their distribution across the spatial configuration of Tetovo.
The research suggests that it is the network of public spaces and their configurational properties that generate the conditions for the emergence and functioning of the Bazaars. The Bazaars occupy the most central locations in the city and belong to the foreground structure of the spatial configuration. They appear at the intersection of the main arteries of the city, which connect the neighborhoods together into a whole, and at the same time connect the city to the other neighboring settlements into the region.

1. Introduction

In many Islamic cities, the Bazaar used to be the focal point of public life. Its roots can be traced since the first Persian cities or even since the first Neolithic cities. In middle Persian Bazaar (Wazar) and Armenian (Vačar) meant a marketplace or assemblage of shops where miscellaneous goods and services are bought and sold (M. Gharipour, 2012, 2). Throughout the centuries, until the beginning of the XXth century, the Bazaar retained its function as a commercial and social center. However today, the impact of the Bazaar on the public life has decreased significantly.

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There are many different and complex reasons why the Bazaar lost its attractiveness over the last few decades. First it was the Industrial Revolution, the accommodation of the automobiles and their occupation of the public space that lead to new planning ideologies which did not incorporate the Bazaar into their policies. Second it was the Information and Communication Technology with its new virtual public spaces creating new opportunities for social and economic interactions.

Whatever the reasons many of them are not any longer places where social and economic activities reach their peak. Although there have been many attempts for the regeneration and revitalization of the Bazaars, it proved difficult to recover their previous spirit. What made the Bazaars so attractive in the past? Were their typological properties; their morphological properties; the activities; or the main reason for the vitality and vibrancy of the Bazaars was their location?

To answer these questions and to reveal the interrelationship between the spatial configuration, elements of urban form and activities, Tetovo and its two Bazaars is chosen as a case study. The analysis is focused on the spatial configuration that evolved organically until the Second World War (WWII). This paper investigates morphosyntactic properties of the Bazaars and their distribution across the spatial configuration of Tetovo. We suggest that it is the central location of the Bazaars relative to the whole system of the network of public spaces the main cause for their emergence as social and economic centers and for their specific morphological properties.

2. Methodology

The Bazaar is rich and complex urban phenomenon. In order to reveal its morphosyntactic properties the research is based on a combination of methodological approaches. However, the configurational approach is at the core of this research. The Bazaar, is considered an emerging urban phenomenon and *Space Syntax* theory and methodology provides a solid base for understanding generative processes that lead to emergent urban phenomena. According to Hillier, microeconomic processes shape the foreground network of the city and vice versa (Hillier, 1999). Hillier and colleagues were able to show that the spatial configuration generates activity patterns and that the most central set of spaces are occupied by commercial and other movement seeking activities (Hillier, 1996, 49-60).

The hypothesis of this paper is that the Bazaars as commercial hubs of cities, occupy central set of spaces and that their specific morphological properties emerge due to their relative location on the network of public spaces. In order to reveal the interrelationship between spatial configuration, activities and elements of urban form in the context of the Bazaar, Tetovo and its two Bazaars is chosen as a case study. However, since one of the Bazaars of Tetovo – the *Lower Bazaar-Bunar* is totally demolished after the Second World War (WWII) and replaced with a new modernist spatial organisation and since the other Bazaar – the *Upper Bazaar* lost its significance over the last few decades, the research is focusing on the spatial configuration of Tetovo that evolved organically before WWII.

The configurational analysis of Tetovo and its Bazaars is based on the earliest map available dating from 1937. The analysis is supposed to reveal the position of the set of spaces that constitute the bazaars, relative to the whole system. *Depthmap* – a software platform developed at UCL is used for spatial network analysis.

The configurational analysis will provide a firm ground in order to understand the occurring patterns of the elements of the urban form – streets, plots and buildings –, activity patterns and

most important their interrelationships. Information on uses and activity patterns are based on maps and written documents that describe the evolution of Tetovo through centuries.

3. A Short History of Tetovo

Some research indicates the existence of prehistoric settlements in close proximity of Tetovo. However documents on Tetovo as a settlement date since the XIVth century. The medieval settlement grew at the crossroad of once very important links Prizren-Tetovo-Skopje and Skopje-Tetovo-Debar. As a result of its strategic location, Tetovo under the Ottoman Empire became an important trading and administrative centre and the capital of the region (XVth Century) attracting people from the neighbouring settlements and villages. Table 1, shows the gradual growth of population in numbers during the centuries.

The population was predominantly Muslim and Christian. Each community used to live in smaller residential (and administrative) units called *mahallah*'s. Christian *mahallah's* occupied the uphill of Tetovo in densely organised buildings facing the streets, while Islamic *mahallah's* were organised on the plain on larger plots with houses usually facing the courtyards (Dobrovic, 1950, 62).

Religion, Islam in this case, was deeply rooted into the ruling system of the Empire. But, with some limitations, in principle, the Ottoman Empire was tolerant towards its Christian citizens and Christianity in general. That attitude allowed communities other than Muslim to develop their own cultural and social identity. However, public life related activities and manifestations used to be a rarity. The Bazaar was the one of the few public spaces where people could engage in social activities. The Bazaar reached its full potential as social, economic, political and religious centre during the XIXth century. It was a period of rapid growth as the Ottoman Empire underwent reforms which brought equality to all population regardless of their religious background. According to Ami Boue, in the 40-ties of the XIXth century the population number was somewhere between 4000 and 5000. At the end of the century the number of the population reached 19200 (table 1). It was a period when the Bazaars reached their full development as trading and crafting zones. The socio-political progress and economic growth halted at the beginning of the XXth century due to World War I (Svetozarevic, 1999). Regression continued until the 3rd decade when Tetovo officially became the administrative centre of the Northwest region of Macedonia.

Regardless of socio-political and economic oscillations the spatial configuration of Tetovo evolved and continued to grow organically until World War II (WWII). After WWII new social-communist ideology was proposed to people. This new ideology, among other things, had no respect for the organic spatial configuration that evolved during the Ottoman period throughout the centuries. It was the time when zoning, regular street network and megalomanic interventions as a reflection of the new modern planning and ideology, were changing the physical appearance of the cities in former Yugoslavia (Ferati, 2011, 25). This stage of development had

Table 1. *Population growth in Tetovo through centuries.*

Century	XV			XVI		XIX			XX			XXI
Year	1453	1468	1545	1568	1838	1860	1890	1921	1931	1971	1994	2002
Population	1100	1200	1000	2500	4500	9000	19200	15119	16359	35792	50344	52915

its repercussions on the Bazaars as well. Tetovo was a bipolar city with the Bazaars constituting the centres. Unfortunately, The *Lower Bazaar – Bunar* was totally demolished and replaced with new modernist structure. The *Upper Bazaar* survived these interventions and transformations and still functions as an informal civic centre although with diminished impact on public life. However most of the new modernist ideas were never fully implemented and Tetovo continued to grow by a parallel bottom up self-organised and top down planned process.

Similar, approach with minor methodological modifications was adopted in planning policies in Macedonia after its independence at the end of the XXth century. Ideas, transformations and interventions based on previous modernist planning are largely mirrored in the new planning policies. The Upper Bazaar is still not recognised as an important and vital element of public life in Tetovo. Again, planning could not guide and could not even follow the development of the city. The asynchrony between planning and factual growth had negative repercussions on urban form and resulted in chaotic manifestations of the built environment.

4. Morphosyntactic Analysis of Organic Tetovo

The Islamic background of Tetovo is reflected on the spatial configuration as well. According to Hillier the most obvious difference between cities lies in their geometric structure (Hillier, 2001, 4) which is deeply related to human behavior and socio-cultural specifics of the population. The geometric structure of Tetovo before WWII was irregular, broken, with shorter axial lines, similar to the structure of Islamic cities (table 2).

Only few lines – streets penetrate across the city and connect Tetovo to the neighboring settlements. The configurational analysis in a city wide scale (RN) reveals the main routes, colored in red on the processed map (fig.1). It also reveals and explains the bipolar nature of Tetovo. According to Space Syntax theory there is a high correlation between the spatial configuration and movement (Hillier, 1993) and between movement and uses or activities (Hillier, 1996). Hillier and colleagues were able to show that relatively more people move across the most accessible spaces in the city and less on more segregated ones– streets (Hillier, 1999). So the main routes colored in red on the processed maps are also the main movement routes in the settlement (fig.1). The bazaars emerge exactly on the intersection of these main movement routes that connect Tetovo to its neighboring settlements, which indicates that their emergence is not coincidental but a direct consequence of the spatial configuration. They obviously belong to the foreground network and take advantage of the potential that the network provides in terms of

Table 2. *Comparison between the geometric structure of Arabian, USA and European cities derived from Hillier's Research and the geometric structure of organic Tetovo.*

Region	Cities	Avg. line nr.	Connectivity	Loc. Int.	Global Int.	Intelligibility
USA	12	5420	5.835	2.956	1.610	0.559
Europe	15	5030	4.609	2.254	0.918	0.266
Arabian	18	840	2.975	1.619	0.650	0.160
Country	City	Line nr.	Connectivity	Loc. Int.	Global Int.	Intelligibility
Macedonia	Tetovo 1937	130.8	3.407	1.962	0.762	0.134174

reaching a higher number of people. The *Lower Bazaar-Bunar* is located on the intersection of two main streets, "Kr. Petar II" ("Ilinden") and "Oslobodjenje" ("Iliria") which connect Tetovo to Gostivar and Skopje, respectively. The *Upper bazaar* is on the intersection of several routes that link the city to the surrounding villages. "Prizrenska" ("A.J. Zurcin") links Tetovo to the mountain villages, "Kr. Petar" ("G. Delcev") and "Nediceva" ("I. L. Ribar") to the villages on the North of Tetovo all the way to Gostivar; "V. Kradzic" ("M. Baftijari") is a link to the villages on the south of Tetovo; while "Kn. Milos" ("Lubotenksa") link the villages on the east of the city.

At the intersection of the main routes that lead to the Bazaars a star shaped open space evolved organically in order to accommodate various economic and social activities. Densely packed, one or two story high *buildings* totally occupy relatively small and rectangular *plots* with narrow frontages and enclose the open space of the Bazaars (figure 2 and figure 3). As we move away from the Bazaars, the plots are getting bigger, more irregular and buildings do not always occupy plot frontages.

The most strategic spaces within the Bazaars were occupied by commercial activities. Small buildings enclosing the open public spaces of the Bazaars were best suited to accommodate shops and workshops. On the other hand the open public spaces used to serve as open markets. But, beside their function as commercial centers the Bazaars were also administrative, political and religious centers. To mention but a few, the post office, the regional council, the tax administration office are all scattered around the Lower Bazaar (fig.4) while the district court is located in near vicinity of the Upper Bazaar (fig.4). As far as the religion is concerned, the map on figure 4 shows that religious establishments – mosques also belong to the rich and mixed use nature of the Bazaars. At the Upper Bazaar the mosque is next to the Bazaar and marks its entrance while on the Lower bazaar is part of the Bazaar. Obviously the religious authorities wanted to express their authority and influence the wider community (Ferati, 2012).

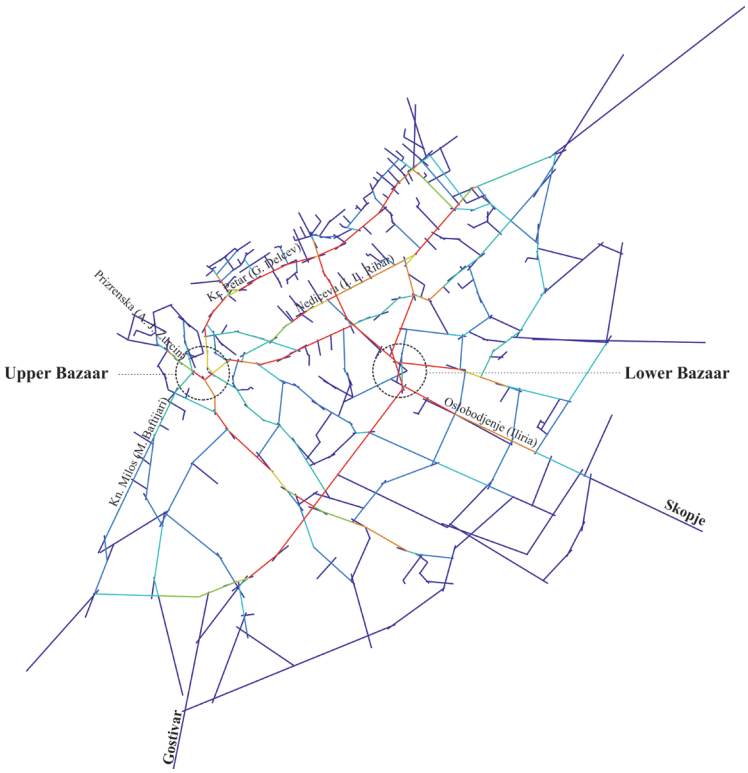

Figure 1. *Global Accessibility (RN).*

Figure 2. *Plot system, a. Upper Bazaar, b. Lower Bazaar – Bunar.*

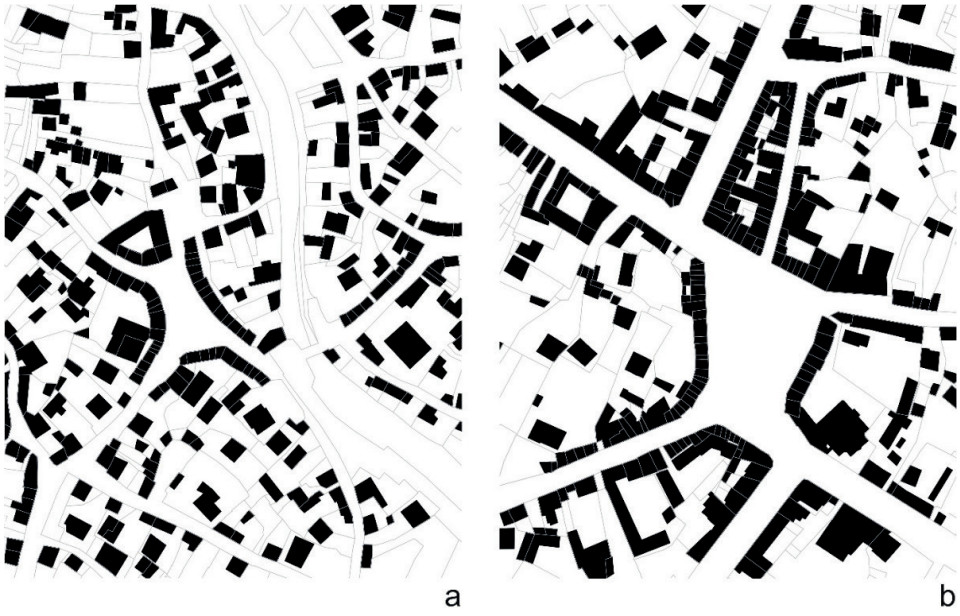

Figure 3. *Building system, a. Upper Bazaar, b. Lower Bazaar – Bunar.*

Both, the spatial configuration and the wide range of functions of the Bazaar used to generate high number of people passing through or visiting the Bazaars leading to different options for interactions that would eventually transform into social activities. The Bazaar was the main generator of life in the city (Svetozarevic, 1999). Beside the informal social activities, the most important ceremonies and celebrations used to be organized in the Bazaar. Figure 5, captures the vibrancy of the Upper Bazaar around 1936.

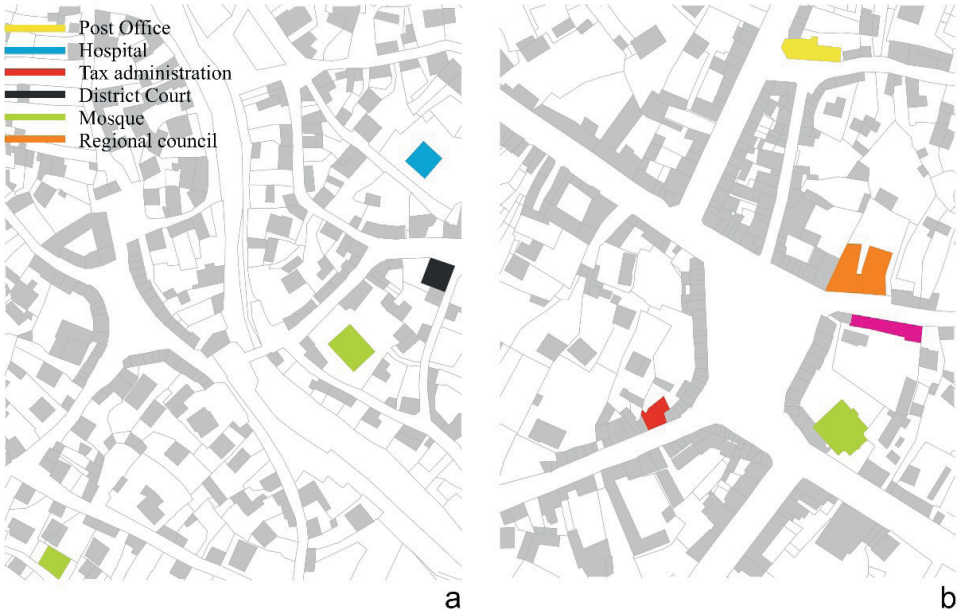

Figure 4. *Public uses, a. Upper Bazaar. B. Lower Bazaar – Bunar.*

Figure 5. *Upper Bazaar, Tetovo, 1936. retrieved from https://sq.wikipedia.org/wiki/Tetova#/media/Skeda:Tetovo,_razglednica,_1936.jpg*

5. Conclusions

The configurational analysis of Tetovo, shows that both Bazaars in Tetovo emerged on central locations at the intersection of the main arteries that connect the city to the neighbouring settlements. The Bazaar was the place to go to and to move through. Judging by Hillier's theory on centrality (Hillier, 1999) and natural movement (Hillier, 1993), movement flows along these routes as the most central have been relatively higher compared to the other streets in the city. High movement flows on the other hand carry the potential and initiate the emergence of movement seeking activities.

Obviously the Bazaars in Tetovo belong to the foreground network of public spaces shaped by microeconomic processes. However, beside their nature as spatial centres, the Bazaars used to represent economic, social, cultural, administrative, political and religious centres. The Bazaars took advantage of the potential that the spatial configuration provides in terms of reaching a higher possible number of people. Shops, workshops, catering and other commercial and movement seeking uses are clustered together on these specific central set of spaces. Public and Secular authorities also had in mind the central location of the Bazaars when choosing sites for the construction of administrative or religious establishments – mosques in order to serve or influence a wider community (Ferati, 2012).

The relations between spaces that lead to specific relations between spaces and people, eventually had impact on the relations between people and people. Strong movement flows and various activities which attract visitors generate multiple opportunities for social interactions, formal or informal. Social and cultural activities used to be an important part of public life unfolding in the Bazaars, even more so having in mind the dual character of the society divided into Muslim and Christian population with the Bazaars serving as a tool for minimizing differences and uniting both communities.

Different uses competing for a strategic location on the spatial centre of the city led to a specific arrangement and organization of buildings and plots. Densely packed small row buildings totally occupy the plots enclosing the streets and open public spaces of the Bazaars. Plots get bigger further away from the Bazaars and buildings occupy only a portion of the plots and not necessarily their frontages.

The results of the analysis should encourage further research of bazaars in other cities of North Macedonia in order to broaden our understanding of their spatial, economic and social dimension. Furthermore the findings should help the revitalization of existing ones or even designing new similar contemporary urban spaces.

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Genius Loci of Bazaar Street: Crafting Memory and imparting an Image to the City

A Case of Chandani Chowk

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> Think of a city and what comes to mind? It's Streets. If a city's street look interesting, the city looks interesting; if they look dull, the city looks dull.
>
> Jane Jacob

Keywords: Indian Bazaar Streets, Genius Loci, Memory of City, Imagibility, Global Image.

Abstract: The paper endeavours to conceptualize and explore the concept of Indian Bazaar Street having multiple layers, its relationship and dynamics with the city assemblage. The study demonstrates the Genius Loci of the bazaar street which is an amalgamation of meaning, beliefs, and values, assigned to the physical aspects that craft memory and imparts imagebility. Genius Loci cannot be predetermined but results from human interaction and experience with the environment. Chandani Chowk, a vivacious bazaar street in Delhi 6, India, is considered for detailed study and investigation of Genius Loci. Phenomenological method is used which describes the live experience from the perspective of the participants along with the role of various media in promoting the place. The study reflects that the notion of Bazaar Street is not just a two dimensional connect, but, a multi-dimensional element that is vibrant, democratic and a shared public place which facilitate economical, political and socio-cultural experience unique to the place with which the people associate and create memoirs. This paper concludes that the Indian Bazaar Streets is the reflection of the non-tangible values associated with the architecture which the people experience and memorize. It has a strong connect to the city as the people personalize and metaphorically own the place creating a collective memory and defining the representation of the city. It is therefore important to highlight the picturesque quality, the warm environment and the quirks of Bazaar Street to craft a memory that will help in imparting a unique global image.

1. Introduction

Cities are assemblage of places of social encounters and opportunities revealed in its tangible physical features which support the intangible aspects like culture, traditions and aspirations of the citizens. They create spaces that encourage social interaction resulting in formatting a unique relation between the user and the place, which helps to create memories associated with it. The main element in the city that supports myriad level of socio-cultural and economical en-

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gagement is the Street. The Street is a complex web-like tangible element, which binds together the intangible elements of the ever expanding city.

2. Street – A Genre

Street is an ancient spatial typology which remains appropriate even after undergoing the process of transformation due to urbanization. Rapport defines 'Street' as a functional element that is more or less narrow linear space limited by buildings found in settlements and used for circulation and sometimes other activities (Rapoport, 1987)[1]. Mehta describes 'Street' as an element that occupies half of the city, the prime infrastructure for movement, accessibility, connectivity and carrying services, but a quintessential public space to provide a setting for social interaction (Mehta, 2013)[2]. Jane Jacobs suggests; Streets are the barometer for the quality of public space of the city (Jacob, 1961)[3].

Street transform and adapt themselves over the time according to the context of the place that reflect the outlook, values and lifestyle of the people which assists to craft memory in the minds of the visitor. Today the term 'Street' is not just a Noun but also an Adjective because of the gravity and impact it poses. Anderson's 'On Streets', Appleyard's 'Liveable Streets', Moudon's 'Public Streets for Public Use' and Jacobs' 'Great Streets' have redefined street as a public space associated with values and experiences which is unique and assist in memory building of the place. Streets are associated with various activities majorly commercial. The street with economic activities along its edges in form of market is Bazaar Street. This is a major public space of every city that has a special character and is the manifestation of the place. This paper focuses on the Indian Bazaar Street that acknowledges the commercial, leisure and socio-cultural needs of the city and its people.

3. Bazaar Street – A multidimensional element

Bazaar is a term used for markets in the Eastern Countries which originated in the late 16th century derived from bazarro used by Italians and bāzār by Persian. Street with bazaars along its edges are Bazaar Streets. These are multidimensional with an amalgamation of intangible values assigned to the physical aspects imparting identity to the place. The memories of the bazaar street are associated with economic activities, social encounter, cultural events, history and built / unbuilt fabric that imparts sustainability and therefore memory. Memory is interpretated by scholars and experts in diverse ways. Sternbreg (1999) defined memory as a means to draw past experience in order to use it for the present[4]. Lynch (1961) depicts memory as 'legible'; a visual quality that can be understood through studying mental images which are result of people's memories[5]. Mehta (2013) states; more than any other element of the urban infrastructure, streets record and determine the history and impart memory of the place[6].

The paper interprets Bazaar Street as a locus of collective memory with special characters,

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qualities, edges, functions and activities creating a distinct identity i.e. its soul. It captures the importance of the bazaar street as one of those elements of the city that never dies, they simply evolve and transform retaining the distinct atmosphere due to the sprit of the place which is known as the Genius Loci.

4. Genius Loci: The spirit of the place

The concept was conceptualised in Roman mythology as a protective spirit of the place. Norberg-Schulz (1982)[7] reinvented the contemporary usage of 'Genius Loci' as the location's dictinctive atmosphere, or a spirit of the place, rather than a guardian spirit. He emphasised that the idiosyncratic atmosphere of the place is the memory which is in harmony with the human, built environment and the socio-cultural values. Smith (1997)[8] states Genius loci as an extremely complex and multidimensional concept, which involves the physical, psychological and social aspects of the environment and is multi-layered.

Theoretical base of this research came from ideas of phenomenologist architect Christian Norberg–Schulz, concerning place phenomenon (experience) and genius loci. Sense of place and genius loci can be defined as "the collection of meanings, beliefs, symbols, values, and feelings that individuals and groups associate with a particular locality" (Williams & Stewart, 1998)[9]. Relph's theory (Relph, 1976) has used the sense of place as a feeling of outsideness and insideness that people experience in the place[10]. Sense of place has not been a predetermined event, but result of human interaction with the environment. The factors which create sense of place, are divided into two categories: cognitive factors and physical characteristic (Steele, 1981)[11].

Memory may not be confused with the history of the place, memory is subjective and personal whereas history is factual and universal. Genius Loci of a place is both memory and history imparting exclusive identity to the place and the user to craft memory that depicts qualitative and phenomenological understanding of the place. Norberg describes that a 'space' is a 'place' when it reflects a distinct character and where life occurs. It is characterised by physical constitution, material, facade, relation between open and built, and synchronization of the natural and manmade elements with the user. As asserted by Kelvin Lynch the elements of space and character are interrelated which form an environmental image giving a sense of security and identity.

In the city assamblage the Genius Loci can be very prominently identified in the bazaar street which is not just a physical connect with economical activities but a ideal socio-cultural public space. Bazaar Street is a significant 'Existential Space' which comprises the relationship between user and the environment. The cases described below discusses the Bazaar Street over the globe that enhance the spirit of the place; the Genius Loci, through tangible as well as intangible features, justifying it as a shared public space with exclusive identity that crafts an image representing the city locally as well as globally.

Linking Road, Bandra, Mumbai, India located in heart of the city, was once a small fishing village occupied by East Indian community. In 1940s this street linking to major high-end

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residential hubs started developing into a market, and so called Linking Road, which today is a major destination for all pocket size. It is a landmark of the city with a major attraction not just to the outsiders who are attracted to the glamour and sparkle of the city as portrayed by the media, but also to the locals because of its democratic and vibrant nature.

Las Ramblas, Barcelona, Spain is a landmark that most tourists identify with the city. It is the central boulevard which cuts through the heart of the city centre, a vibrant and lively promenade with great social importance to the locals and the tourists. The street is a good amalgamation of traditional classic architecture with a picturesque appeal keeping the heritage rooted with modern day functions. The street stretch 1.20 km lined by tall palm trees and street lights designed by Antoni Gaudi. The Spanish poet Federico Garcia Lorca said, that Las Ramblas was the only street in the world which one feels like should not end.

Third Street Promenade, Santa Monica, US is a shopping haven and street-performer stage. With everything from fresh farmers-market produce to designer fashions and street artist performing, it is a shopper's nirvana where life pulses around each corner of the bazaar street. It is an excellent example to showcase how street market can be re-imagined to carter to the needs of the people.

Nga Bay market, Hau Giang, Vietnam is a floating market that started in 1915 where the canals and rivers meet the Nga Bay town. Sales begin in boats early in the morning and end by noon becoming the delta's busiest market. This is a unique bazaar street where the street is the river that caters to the needs of the local. The river provides the linearity, a shared public entity which binds the city together and also acts a mode of daily commute for the locals.

Grand Bazaar, Isfahan, Iran conceptually is not just a commercial centre, but a complete covered town unique to the place which cannot be seen in other parts of the world, with all facilities available behind the closed gates. The old Isfahan society was concentrated around the Bazaar where people who work in bazaar are closely related to each other with deep faith in religion, culture and traditions.

The study infers that every bazaar street is unique and represents the place in which it is located. This vibrant shared democratic public place imparts an identity to the place due to the tangible character associated with the intangible i.e. the ginius loci and creates a memory in the mind of the user, therefore image to the place.

To validate the above inference, Chandani Chowk, Delhi 6, a vibrant Bazaar Street from Mughal era which has transformed over the period but retaining its spirit i.e. the Genius Loci till today is selected for detailed study. Phenomenological approach is taken that describes the live experience rather than quantifying it, which facilitates to map the genius loci of the place. Studies illustrate that media also plays a prominent role to capture the Genius Loci and formation of image and memory of the place through several influential approaches such as television, cinema, poetry, stories, paintings, photography and social networking sites.

5. Bazaar Street: Chandani Chowk, Delhi 6, India

> ...Delhi, said Pir Sdr-ud-Din, was a city of djinns. Though it had been burned by invaders time and time again, millennium after millennium, still the city was rebuilt; each time it rose like a phoenix from the fire (Dalrymple, 1993).

Delhi, has always been the capital city, also mentioned in the Indian mythology as the city of Indraprasth established in 1453 BC. Since then, it has been the cause of many great historical

battles. It has been built, distroyed and rebuilt for multiple times, still holding on to life with a tenacity and purpose which is beyond comprehension and belief.(Ali, 2007) [12]. The city fabric has manifold layers evident in the remains; the 8th century Lal Kot by the Tomar Dynesty, the ruins of Qila Rai Pithora of Prithvi Raj Chauhan from the 11th century, Ghiyas-ud-din Tughlaq founder of Tughlaqabad in early 13th century, Firoz Shah Tughlaq built the city of Firozabad in 1354, in the 16th century Mughal rule was established in Delhi with every ruler designing a city of himself. Very prominent is the city of Shahjahnabad built by the Mughal Emperor Shah Jahan which exist even today and is referred as Old Delhi or 'Delhi 6.

Shah Jahan, the mughal emperor build the capital city, Shahjahanabad. A 8 km mud wall fortification was done with the construction of the Red Fort in 1639. There are various contemporary records that speak of the riches of the city and the profusion of its palaces, affluent havelis, a variety of markets, gardens, water bodies and avenues. The 3.50 km avenue of Chandani Chowk was designed with close supervision of Shah Jahan's daughter, Jahanara Begum, as a Bazaar Street in early 17th century. Chandani chowk was built with all its grandure stretching from Red fort at one end to Fatehpuri Masjid at the other other, which sprawlled organically. It was a multi-cultural space where hindus and muslims lived together, the mosques and the temples are the evidence of it. Originally the market had a canal in the middle of the street that reflected the moonlight and hence the name Chandani Chowk; the Moonlight Square romanticising to an almost dreamy environment. The bazaar was an quientessential socio-econimic place which has till today remembered and retained its historic and socio-cultural character[13].

In early18th century the downfall of Mughal Empior started, which gave rise to a new 'intellectual renaissance' with poets like Mir Taqi Mir, Mirza Ghalib emerging and creating beautiful poetry based on their experiences on streets and life of Chandani Chowk. The vibrancy of the Bazaar Street; Chandani Chowk is reflected in their poetry and literature expressing the character of the place. Mir Taq Mir writes, 'these are not Delhi's by-lanes, these are artist's canvas, Every sight I see looks like a painting'.

After the Sepoy Mutiny of 1857, the British siege the walled city, and took control of Shahjahanabad. Their intention was to change the architectural language of Chandani Chowk and to remind the people who their new ruler was. The town hall was constructed as a political statement of power by replacing the Sarai, the tank was replaced by a clock tower and the water channel along the street was concealed. Delhi was in its worst conditions during this period with the Mughal power on the verge of declining and Chandani chowk slowly being neglected. Eventually, in the durbar of 1911, Delhi was announced as the new imperial capital with construction of New Delhi with new concept by Edwin Luyten in 1912 (DUAC, 2017)[14].

Post Independence, the physical morphology of the original Chandani Chowk got tattered and people from all over started migrating for work opportunities and cheap accommodation, as a result once a glorious royal Bazaar Street became overcrowded but it was some unseen soul that kept the essence of the place alive. People still have their hearts in Chandani Chowk; "purani dilli" (old delhi) and value their relationships with the people and the place even though it has undergone massive physical transformations.

Today, this place is well connected with other parts of the metro city retaining and exhibiting its distinct character that reflects the era it was built, evolving and transforming accordingly that invites crowds from all around especially to experience the place. The triumph of the

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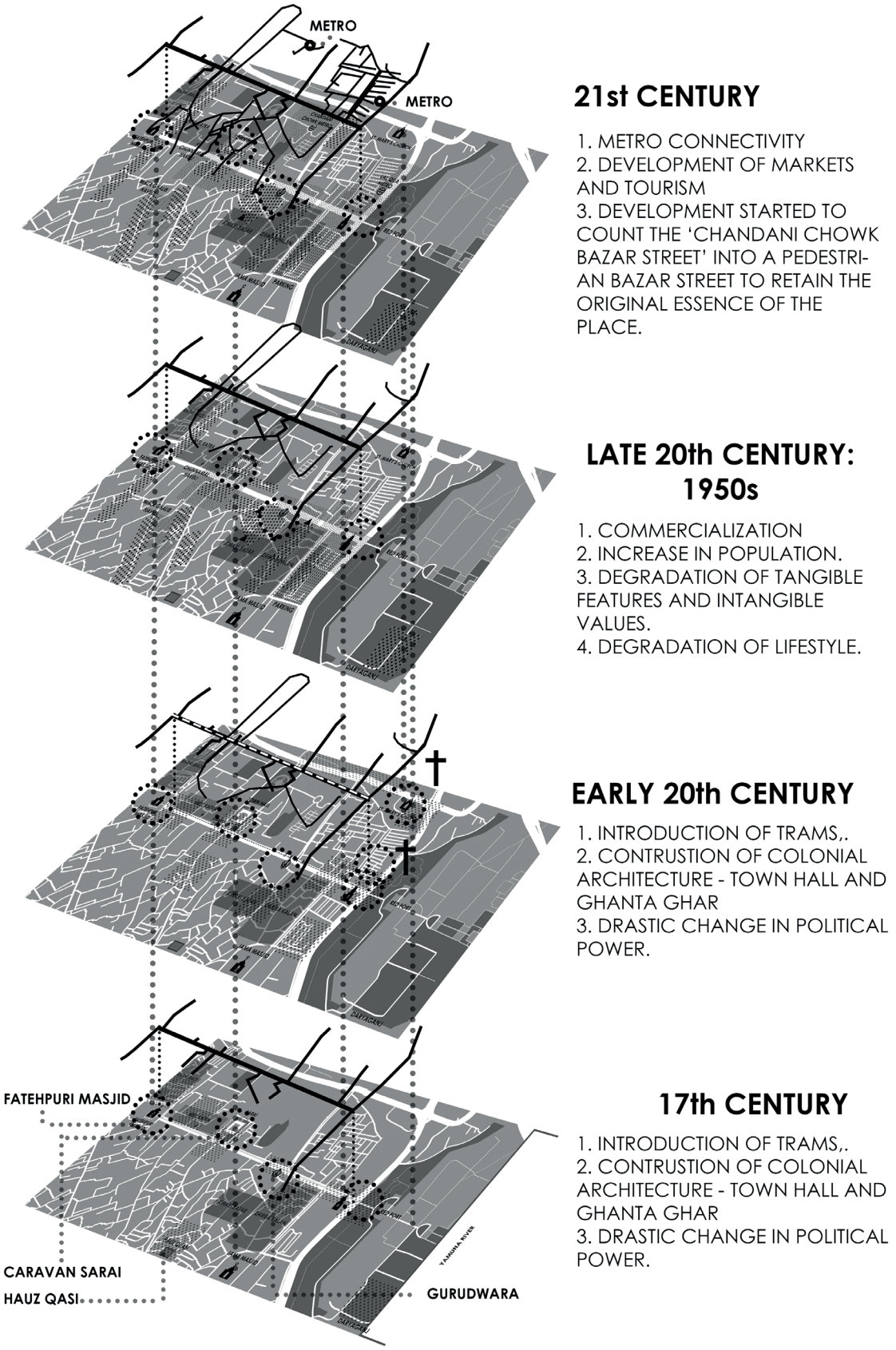

Figure 1. *Transformation of Chandani Chowk, retaining the spirit – Genius Loci (Source: Author).*

place lies in the fact that it has a great history and legacy behind with striking heritage of Red Fort as its backdrop. The permeable structure of the bazaar streets weave the whole place together showcasing an immeterial spirit in the material place. This street is connected with other important commercial bylanes which exist till today with same vibrancy and importance. The fascination of Chandani Chowk resides not only in the strong sense of mystery, but also warm and protectiveness it possesses with multiple unwinding lanes penetrating into deep endless 'inside', beautiful havelis representing the Mughal era, the courtyard houses, smell and flavours of authentic food and the glittering clothes. It is an iconic bazaar street with multiple layers of tangible and intangible aspects such as history, heritage, communities, culture and tradition which reflects its Genius Loci that has retained surviving the countless transformation, demolitions and reconstructions. As per Hindu Philosophy, the Spirit 'Aatma' is eternal, imperishable and beyond time, it does not die but gets transformed in another form, and is the innermost essential for human and place. It is the product of the life of the people, their experiences, observations and belongingness. Genius Loci is the Aatma of the place.

Chandani Chowk got the name from the concept of its design which was symbolized by water body with reflections of stars and the moon, that got destroyed during colonial rule with no evidence left, but the name continues, this is one of the major aspects of Genius Loci. The triumph of the place lies in the fact that it has a great history and legacy behind with striking heritage of Red Fort at one end and Fatehpuri Masjid at the other, with pulsating life narrated and portrayed through various medias.

The vibrant lanes connecting the Chandani Chowk like Paranthe Wali Galli serving variety of breads, Dariba Kalam for silver and gold traditional jwellary, Ballimaran Gulli for shoes and wooden items, Kinnari Bazar for intricate accessories, Khari Baoli for spice market, Khatra Neel the wholesale fabric market, Ninari Bazaar for accecories, Moti Bazaar for shawls, and Meena Bazaar for exclusive clothes have retained their living tradition and are continuing for the future generations. The success of this place lies in the democratic quality of the space enhancing the character of built and un-built associated with the intangible values that provides

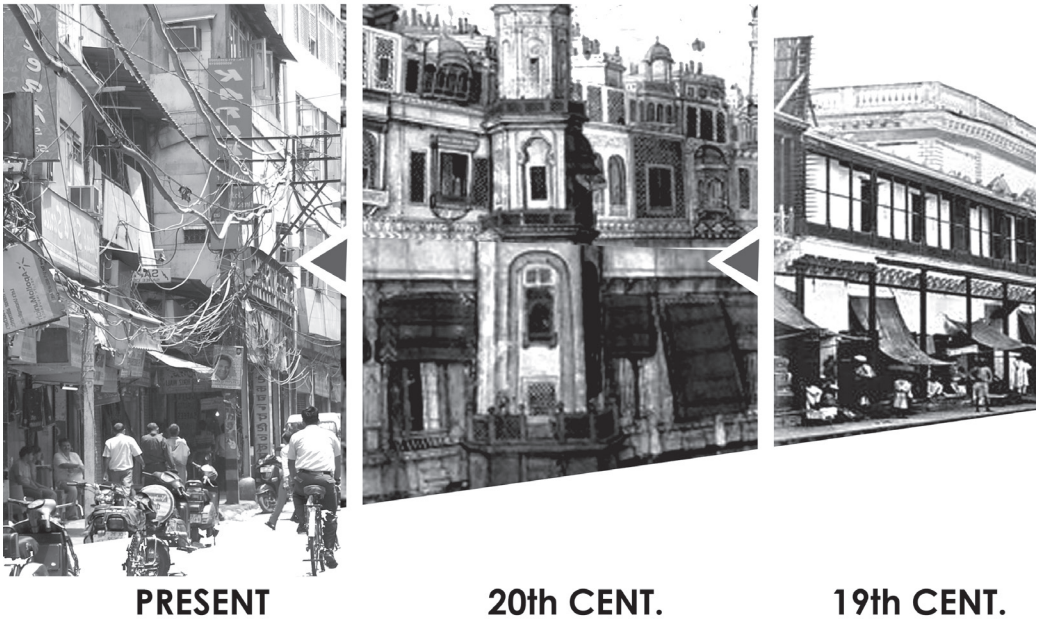

Figure 2. *Vivacious Bazaar Street: With unchanged intangible character (Source: Author).*

social interaction, cultural exchange, commercial gains along with trust, attachment, satisfaction, value for money, and entertainment; the true spirit of an Indian bazaar!

The eternity of the place lies in the local heritage reflecting the glorious Mughal era intervened by the British and later insertions to accomodate the present needs due to which the original physical character is diminishing, but the intangible values are prominently visible. Mansion, locally known as Hevelis, form an important component of the heritage along the street that showcases the essence and cultural heritage of the place, some famous havelis are: Chunnamal ki Haveli, Mirza Ghalib's Haveli and Zeenat Mahal. The Town Hall constructed in the colonial era replacing the original Sarai is preserved and authorities are planning to convert it into a museum. Opposite to the Sarai was a water tank which reflected the moonlight and the stars which has given the place it's name, replaced by the British with a clock tower; today has collapsed but the name 'Ghanta Ghar (Clock Tower)' still survives. The people and the street reflect the unique flavours of all relegion at one place echoing the spirit of chandani chowk, like the Jain temple just opposite to the Red fort, the Fetehpuri Masjid, St Stephen Church and the Sikh Gurudwara binding the community and the place together. The entire heritage precinct has dictinct architectural styles of different eras of monuments and havelis reflecting the transformation of the place as per the desires of the people.

As the atmosphere is energetic, influential and lively, it has become an inspiration to many artists and poets reflecting the romantic nature of the place in their literature. The haveli of Mirza Galib great poet (Ghazals) of 18th century lies right in the centre of the market where he wrote poetry and recited them in front of audiences, dwellers, shoppers and sellers. His Ghazals echo in these bazaars even today and create an ambience of love and romance. Ghalib is one of those personalities which should be credited in capturing the essence of the old bazaar and its vibe. It is because of his writings in the form of poetry, Ghazals and Shayaris that have been a peephole to history.

Figure 3. *Vibrant Bazaar Street – a shared public place.*

The variety of activities such as religious events, culinary activities, economic, sociolizing and cultural festivals along the street create an interesting experience for the user. During the festivals the street is transformed into fetes with light, decoration, music, food stall and shops selling specialised goods. Many specialised event take place at various location of the city from time to time; poetry competition at Mirza Galib's haveli, pegion flying competion on the terraces, kite flying festival a traditional event during the Mughal era and is a symbol of communal harmony and chandani chowk festival to name few, are organized every year to promote the tradition and culture of the place. The culinary culture of chandani chowk is celebrated with aroma of sweet and savoury, sold in the traditional eateries enhancing the experience of the user. Every food item sold has a unique story to tell; be it in history, skill and technique involved with the ingredients.

Chandani Chowk over the centuries has transformed, but not losing its intangible qualities embedded in the physical heritage. The bazaar has a very distinctive characteristic like oral tradition and expression including the language, performing art form known as kathak, social practices, rituals and festive events, trade and traditional skills which imparts unique image to the city. This distinctiveness has given identity to Delhi since the era of the golden city of Shahajahanabad till present which is the Genius Loci. Artists have been describing the city and capturing the Genius Loci through various media such as prose, poetry, shayaris, paintings and cinema.

6. Portray of Genius Loci through various medias

Cinema. Chandani chowk has been filmed in cinema to reproduce the era and captures the rich visual, physical, aesthetical quality and value of the place to represent it of the period to which the people in the real life can closely relate. The architectural vocabulary represented in the films symbolizes the permeable structure in the dense fabric with a vibrant bazaar representing the socio-cultural value that helps to associate to the long lasting memory that has crafted the image of the place.

Poems and Shayaris. The Bazaar Streets is well described by authors and poets since its inception till today that helps one to visualise and imagine the place which reference to its context. Mirza Ghalib, an 18th century prominent Urdu and Persian language poet; a symbol of Delhi's cultural heritage resided in Chandani Chowk has expressed his love for the character of the place through the exceptional poems (shayaris). His shayaris reflect the place by recreating the scenes he used to observe out of his window on the street. His poems capture the rawness of the local street beautifully reflecting the socio-cultural aspect and glorifying and popularising the city through the bazaar street.

Paintings and Photography. Various photographers and artists have captured the essence of Chandani Chowk in their lenses and paintings that freezes the quality and character of the place. Bazaar Street with heritage character and active interaction of people is preferred by the artist in their art to depict the spirit of the place.

The studies discussed reveal how the spirit i.e. the Genius Loci of the Bazaar Street are crafted due the various tangible as well as intangible attributes that are interrelated showing the experience and relation of the people with the place, assisting to crafts memory. As stated by Lynch "There seems to be a public image of any given city which is the overlap of many individual images. Each individual picture is unique, with some content that is rarely or never

communicated, yet it approximates the public image, which, in different environments, is more or less compelling, more or less embracing" (Lynch, 1960)[15]. As discribes by Jane Jacob (1992), for many urbanites the street represents only the outdoors,but in reallity it is not just a outdoor connection but a significant part of the urban scenario that describes an activity, a thing and even mannerisms of the place[16].

7. Conclusion

Modernism gave a wave of contemporary architecture style, substituting the vernacular style having unique regional identity, for showcasing a "modern image". Since then, what emerged was a global architecture which did not differentiate between regions and looked the same, be it situated in any part of the world.

Bazaar streets have proved to keep the culture and the interactions alive in the middle of the urban jungle. The study infers that the bazaar street is the most important component, a backbone for the market to prosper and connect the people economically and socio-culturally as it is dominated by the pedestrians due to the dynamic activities that engage the participants. These streets invite people and create conversations and communications which help in keeping the place alive at all times. It is imperative to understand that a bazaar street with unique character represents the city not only due to its physical parameters, but due to the unseen spirit of the place i.e. the genius loci which identifies the intangible characteristic of the city through tangible elements. This paper concludes that, the Bazaar Streets is the reflection of the non-tangible values associated with the physical architecture which people experience and memorize. It has a strong connect to the city as the people personalize and metaphorically own the place, creating a collective memory and defining the representation of the city. It is therefore significant to highlight the picturesque quality, the warm environment and the quirks of Bazaar Street which is the Genius Loci of the place to craft a memory that will help in imparting a unique identity to the bazaar street and so to the city and ultimately crafting memory of the place and a global image to the city.

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"Human Component" in Urban and Architectural Heritage Management: Russian Context

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Keywords: heritage management, democratization, Siberian heritage, human component, social science.

Abstract: The overall history of approaches to urban architectural heritage and the understanding of the notion fluctuates significantly in terms of attached meanings, justification and reasoning. Apparently, each of the approaches reflects the value system along with the socio-cultural situation of its period (Choay & O'connell, 2001). The history of attitudes in Russia illustrates this statement brightly (Deschepper, 2018; Ahmad, 2015). Currently, the human-values-oriented discourse dominates many scopes of academic and professional debates, and debates around "heritage management" are not an exclusion (Watson & Waterton, 2010). Stating heritage as a process, D. Harvey, among many other researchers, shifts the focus from the problem-solving paradigm to the identity-building potential of heritage (Harvey, 2010). Supposedly, the definition of such a controversial issue as the identity of the city through social narratives and connotations makes the notion more measurable and adds the degree of predictability to any operation within it. Following this logic, historical layers, embodied in the urban and architectural heritage of modern cities, include the particular "human component", both consciously and unintentionally, through the history of decision-making within heritage management. In this case, the certain "democratisation" of the decision-making process may ultimately lead to the positive feeling of attachment of people and their environments. The article examines the development and the state of the notion of "human component" in heritage management, focusing on Russian context, questioning the potential applicability of more "democratic" approach to heritage management, in particular case of Siberia, Krasnoyarsk.

1. Introduction

Over the past century, Russia has experienced two major political turning points, which among other factors led to the crisis of cultural identity, including the denial of past values and the rethinking of basic cultural norms and concepts. The architectural environment mirrored this process: for instance, cities in the Siberian region along the Yenisei river (Yenisey Siberia, see Figure 1) seem to have developed erratically, systematically destroying the historical heritage. Citizens do not feel an attachment to their environments (questionnaire, 2017). The recent

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precedent of almost "silent" demolition of the significant historical quarter in the Krasnoyarsk centre seems the evidence of the loss of link between the social and physical context.

Generally, heritage as the theme in its new understanding a "collaborative, dialogical and interactive, a material-discursive process" in terms of "connectivity ontology" and "assembling" (Assembling Alternative Futures for Heritage) (Harrison, 2015) role is quite "young" and needs careful consideration, regional and national adaptations. Harvey claimed, "we should explore the history of heritage, not starting at an arbitrary date like 1882, but by producing a context-rich account of heritage as a process or a human condition rather than as a single movement or personal project" (Harvey, 2010). He proposes to investigate the "heritageisation" as a process into a broader time perspective, propagating the more in-depth consideration of socially, technologically and historically framed and influenced notion of heritage, and sees in this discourse a potential to understand and define the production of identity, power distribution, agency and authority in the field. Moreover, the term "discourse" for Foucault is "a set of practices which systematically form the objects of which they speak", which emphasizes its importance (Foucault, 1972). The concept of process in relation to heritage could be found in the works of many authors (Caniggia & Maffei, 2001).

Thus, the chronological study of the history of thoughts, contexts and consequences may widely inform the understanding of relationships into the phenomenon and may ultimately lead to sustainable heritage process: "present tendency for nostalgia and finding solace in heritage is just the latest phase of a much longer trajectory" (Harvey, 2010). Starting from the nineteenth century, the amount of researchers, involved in Heritage Discourse has been expo-

Figure 1.

nentially growing, especially over the last years. However, in the international heritage discourse such remote and specific theme as the heritage of Eastern Siberia with Krasnoyarsk as a centre seems to have a limited presence, if not absent. Therefore, it seems particularly relevant to frame the heritage of Eastern Siberia and suggest the possible methods of its development.

Thus, the first aim of the article is the brief detection of preconditions and contexts for the development of human-values-oriented approach to heritage through the correlational analysis. The second aim is a suggestion of the possible methodology for the further search for possible sustainable heritage process in Siberia, relying on this detection. The third aim is the intensification of Siberian heritage discourse in the international science.

2. Methodology

At first, the brief correlational "timeline" of development of heritage discourse could be constructed, using the chronological dive into the correlational development of the field of heritage with the focus on the international and local levels along with the development of scientific thought. The location of the theme of the Yenisei Siberian heritage on the general genealogical timeline of heritage research would help to define how Siberia have been reacted to world trends, find ongoing tendencies, and define to what extent the tendencies could be applied locally. The methodological strategy of correlational research is employed (Groat & Wang, 2013).

Attempts to determine the "earliest" period of heritage concept researchers deemed "a daunting task" (Waterton & Watson, 2015). The emergence of science also has not been described systematically (Stepin, Gorochov & Rozov, 1999). Arguably, it is also challenging to identify the solid concept of heritage for a certain period, even in European culture. (Jokilehto, 2002) However, it seems possible to extract the brief common tendencies on the general level, which may help to construct the overall specificity of development, relying on the well-documented facts and literature. The critical literature review is divided into the widely recognised time segments, following the dominating models of thinking of each period. For each time segment, the correlation of trends in three fields are provided: the development of science, the development of heritage concept in the European (later – international) area, and the development of heritage concept in Russia and Eastern Siberia.

3. Analysis

3.1. *Ancient period*

It seems logical to limit this research: the social heritage connotations earlier than the Ancient period are rarely mentioned in literature. In antiquity, knowledge became systematic, theoretical and rational, had a significant humanitarian component both in form and in content. Humanities in the ancient period were developed on the base of philosophy (Solomatin, 2002). The early inherited amateur interest in heritage manifested itself in collecting the artefacts of past societies (Waterton & Watson, 2015). Heritage served the purpose of material evidence or sacred memorial. It is widely known that the Greeks, for example, occupied by the Romans, built their national consciousness on the glorified past, referring to the period before occupation. However, people widely used the stones from ancient ruins for new construction, doubtfully appealing to other than material reasons or attaching specific cultural values to the materials,

borrowed from the ruin; "the aim in this 'restoration' seems to have been mainly aesthetic" (Jukka Jokilehto, 1986). The territory of contemporary Russia was settled by the ancient tribes. Indeed, they left certain artefacts, but it is hard if not impossible, to find their particular attitudes to heritage and attached values in literature.

3.2. *Medieval period*

The development of religions is deemed a natural reaction to the decline of the Ancient world. For many centuries Church had a monopoly on culture and knowledge. Western Europe had risen to a relatively high intellectual level, during the period from the collapse of the Western Roman Empire to the beginning of the Renaissance (Solomatin, 2002). Harvey states: "Certainly the early Church always appeared very concerned with maintaining a symbolic link through the re-interpretation of pre-Christian sites [...] This idea of continuity, and control over a specifically presented heritage, is echoed in St Gregory the Great's instruction which called for Christian missionaries to "cleanse heathen shrines and use them as churches'"(Harvey, 2010). However, some British medieval churches were built with reference to former structure or footprint of the place. Such researchers as Lowenthal support the opinion that the importance of sight itself caused the reuse of materials or building on the particular place (Lowenthal, 1998). Generally, basic heritage ideas and the particular local cause-effect relationships between heritage and society continued to appear. Medieval Europe was inhomogeneous: the end of the Middle Ages is associated with different periods in different locations. The emergence of the Russian State is linked with the IX century, and the Medieval period here lasted up to the XVII century. It was no known traces of conscious heritage values in Russia of that time. The Medieval territory of Siberia was still inhabited primarily by nomadic tribes.

3.3. *Renaissance*

In the Renaissance, a new method of thinking, free, liberated from dogmas and scholasticism, was born, creating the prerequisites for the advancement of science to the forefront in spiritual culture, and the emergence of many scientific areas in the humanitarian sphere. The spirit of art left an imprint on the nature of scientific research: a broad intellectual and cultural movement of humanism along with "Classical natural science" were formed. This was linked with the creation of the system of ideals and norms of research (Stepin, Gorochov, & Rozov, 1999). In the early period stones of the Coliseum were still taken for new construction. Regarding the heritage concept, the remarkable date for the creation of the bill on the protection of the Roman ruins is 1462. At first, ruins became the physical evidence for the research in the architecture of the past. However, the possibility to restore or rebuild monuments illustrated the absence of priority of authentic value or shared concept of heritage. Heritage became romanticised: aristocrats built artificial ruins in the gardens, painters used motifs of ruins (Bush, 2017; Jokilehto, 2002). Renaissance, inspired by the ancient monuments and ideas of antiquity, brought the increasing interest to ancient heritage. Thus, the ideas of heritage started to penetrate deeply into the minds of Europe, linking heritage with national identities. Russia of that time still experienced the Medieval period. In Siberia, the first Russian stockade-towns (so-called "ostrog") were created. It is still too early to introduce heritage concept of Russia and Siberia.

3.4. *Enlightenment*

The idea of objectivity of scientific knowledge became the basic idea of classic natural science. The mind deemed sovereign and distanced from objective things. The procedures were universal and unchangeable. The idea to build an absolutely accurate and objective picture of nature, along with the search for evident, visual, experience-based ontological principles, dominated. A mechanical picture of nature was developed as a worldview, and as a General scientific picture of the world. (Stepin, Gorochov, & Rozov, 1999). Logically, the authentic value of "truth" in architectural heritage, as physical evidence witnessing the original history, became the natural part of its worldview. "Growing access to ancient monuments in the eighteenth century, especially through the Grand Tour, popularised the practice of collecting antiquities but also led to a greater understanding of medieval monuments in Britain, and subsequently their protection" (Orbaşli, 2017). Heritage awareness also aroused in Russia: Peter I was interested in the preservation and collection of "curious things". The common term for monuments did not exist in Russia ("curious things", "ancient rarities", "monuments of antiquity" etc). "Antiquity" was associated with the old "movable" valuables, older than 100 years (Burdin, 2013). The Northern war and following exaltation of the Russian State led to the prioritised attitude to the reconstruction of the past: the formation of Russian history as science began. The object of antiquity became a source of historical information. Decree of Peter I led to the emergence of archaeology. However, during the implementation of regular city planning, the choice between the old and the new buildings were made in favour of the new ones. Significant expansion of Russian borders and the development of new territories led to the emergence of scientific interest to monuments in the periphery. Siberia was the region where forts and mounds, "curious things", rarities and historical documents became extensively studied (Poliakova, 2005). Thus, Russia started to join European interest in heritage, with a noticeable delay. The first cities grew in Siberia. However, fires here frequently destroyed cities almost entirely, as buildings were primarily wooden, stone-made architecture appeared rarely.

3.5. *XIX century*

The science became disciplinary-organised. Specific disciplinary worldviews were formed (Stepin, Gorochov, & Rozov, 1999). The epoch of contrasting Positivism and subjective perspective of Idealism: "positivism was characterised by what many would describe as a 'naive' belief in a reality 'out there' that can be fully known" (Groat & Wang, 2013). Romantic Classicism, National Romantism and the love to antiquity characterised architecture and literature (Glendinning, 2013; Jokilehto, 2002). Ruins were excessively studied, depicted, described by travellers, philosophically reconsidered, etc. Euphoria, caused by their philosophical, meditative state, intensified the use of ruins in parks (Bush, 2017). "Scientific approach", dominating the worldview, continued to influence heritage, advocating "material honesty", authenticity in conservation. "John Ruskin's romantic views of ruins and the patina of age were combined with recommendations for minimal intervention and the notion of trusteeship – that heritage is passed down through generations" (Orbaşli, 2017). This core principle for SPAB: "it is better to repair than to restore, better to restore than to rebuild, better to rebuild than to embellish; in no case must anything be added and, above all, nothing should be removed" (Jokilehto). The basic approach, "philosophy of minimal intervention and 'honest repairs' that were clearly legible and discernible from the original historic fabric", has been dominated in the conservation

since then (Orbaşli, 2017). Generally, the heritage concept became an ode to the beauty of "pure science", search for honesty, purity and authenticity, supported by scientific knowledge.

In Russia, the first official decision of heritage protection appeared in 1826, during the period of Tsar Nicholai I, in some projects of laws, and associations (Kropotkine). Until the first quarter of the century, the government played a leading role in the preservation of monuments. With the emergence of civil society and the growth of national consciousness, the initiative to protect heritage passed to the scientific community. In the history of the heritage, the 19th century occupies a special place: the process of purposeful study and preservation of heritage began. The interest in the ancient heritage and Slavic monuments largely influenced the national culture. However, many unique monuments become the victims of amateur restoration; most scientists have not yet fully realised the value of authenticity. The initial appearance of the monument was deemed "truth". Thus, "purifying" often led to freeing from later historical layers, the lost fabric was often rebuilt. The connection of object with history or a particular era was the most critical criterion for valuation, the place and condition were important. Attention to old architecture was associated with the search for a national style (Poliakova, 2005). Siberia was a growing region with an increasing amount of stone-made buildings. In 1845 the Governor, who obliged to collect information about ancient buildings in one of the first Russian cities of Siberia, Yeniseisk, was selected in Siberia. Yeniseisk was rich in buildings of the XVIII century, which at that time were not considered monuments: only buildings erected before 1725 were listed (Tsarev, 2014). Description and listing became the immature primary tools for young heritage protection in Siberia.

3.6. *The end of the XIX century- the beginning of the XX century*

"Non-classic science" was formed. In contrast "the only one true" approach of first positivism, several descriptions of the same reality became allowed since each of them might contain elements of objectively "true" knowledge. Correlations between ontological postulates of science and characteristics of the method were comprehended. The new system of cognitive ideals and norms provided a significant expansion of the potential field of studied objects, starting the development of complex dynamic self-regulating systems, the idea of historical variability of scientific knowledge along with the relativity of truth in ontological principles dominated. The mind was no longer seen as distanced from the studied phenomenon, but being within and determined by it (Stepin, Gorochov, & Rozov, 1999). The Ancient Monuments Act of 1882 became the first substantial document, which marked the new level of importance of heritage preservation (Chippindale, 1983). This process has become conscious, relied on historical knowledge and numerous archaeological discoveries (Jukka Jokilehto, 1986). Active interest in the study and preservation of national cultural heritage was detected: "writing, rewriting and implementation of a suite of national and international heritage policies" (Waterton & Watson, 2015). The selection was most likely "to favour the spectacular over the mundane, the large over the small, the beautiful over the ugly and the unusual over the commonplace" (Ashworth, 1997, p. 97). The possibility of plurality in approaches started to affect also the field of heritage. Authenticity became not the only truth, taking into account multiple cultural layers of monuments and their correspondence to different political and cultural states of society.

In 1909, a "Society for the Protection and Preservation of Monuments of art in Russia" was founded (Koshman, 2011). The policy of preservation was defined by scientists, museum and cultural workers. At the turn of the century, the question of heritage protection received a public response, as evidenced by many publications. Heritage process was driven by societies:

any person could come to the meetings. Scientific activities in art, archaeology and history of architecture resulted in methods of protection. Aesthetic and historical values started to dominate the heritage process. Two complementary approaches, archaeological and artistic, were formed without confrontation. The attention was paid to the later historical layers (Poliakova, 2005). 1917 – 1927 was the time of formation of new directions and methods of heritage protection, changes in the perception of space and time: "the October Revolution was also a heritage revolution" (Deschepper, 2018). The heritage decrees of 1918-1920-is contradicted to the position of the Proletkult, which demanded the elimination of pre-revolutionary monuments as ideologically harmful (Burdin, 2013) "Conception of heritage clearly shifted from a vision of a heritage constituted from the past to a conception focused on newly built monuments and undeniably oriented towards the future" (Deschepper, 2018). Generally, the heritage policy was contradictory: "preservation and destruction took place concomitantly" (Deschepper, 2018). Heritage became the active conscious tool for political propaganda to control meanings and beliefs. The Soviet period was a brilliant example of the politicisation of the heritage concept. Radical heritageisation or deheritageisation of objects were linked with the ideological and political changes, switching the orientation of heritage concept from authentic value to historical: firstly "futurism", later "eternalism": "The government aimed to immediately create not only its own heritage but new cityscapes that were intended to last for eternity" (Deschepper, 2018).

Siberian authorities did not fully realise the importance of heritage: in 1901, the Minister's of Internal Affairs commanded to provide information about the monuments of antiquity from provinces, which resulted in completely inaccurate data. The attention of researchers of antiquity turned to the Eastern outskirts of Russia: they published scientific works on the monuments of the Siberian architecture, which marked the beginning of Siberian heritage. Members of the provincial branches of the Russian geographical society were active participants in the study of heritage; they did not stop their scientific research even during the civil war and during the post-war restoration of the economy of the Siberian provinces. The particular attention was paid to wooden heritage. Denike advocated the creation of the Siberian Institute of Art and the "catalogue" of all objects (Tsarev, 2014). The ideology of "alienation of the old world" influenced Siberia: the old buildings were opposed to the new ones, for which they became "annoying common background". Designers of the new generation in their creative effort to "create the picture of the future of the socialist city" entirely rejected the former artistic elements, recognising them as "typical low-quality background". In many projects of the 1930s, the town-planning activity was associated with the gap in the continuity of the formation of cities, which slowed down the heritage activities for several decades, leading to significant losses of the national historical and cultural heritage of Siberia (Tsarev, 2014).

3.7. *The middle of the XX century*

World War II, with its massive destruction of heritage, significantly influenced mindsets worldwide. For many researchers it was the time when the "conventional" concept of heritage was formed: "a time in which public memory was transformed and institutionalised" (Harvey, 2010; Jokilehto, 2002). The modernist "conviction that the untried is markedly superior to the familiar" (Peter Gay) with the affection to new technologies, contained the belief in material "honesty", echoed in conservation. The modernist hegemonic position of the architect was changed by the participatory, more emphatic approach with the attention to "ordinary" people. The Soviet concept of hertageisation changed significantly, shifting the focus from monuments of revolution to monuments of the past (Brandenberger, 2002). 1938-mid-1950s was the time for Creation

of Central and local authorities for the protection of monuments of architecture (Burdin, 2013). The hegemony was also partly shifted towards a more nuanced attitude to heritage. In 1947 the Council of Ministers of the RSFSR adopted the resolution "On the protection of monuments of architecture": "Consider historical and artistic heritage of national culture and the property of the Republic, the subject of state protection, works of ancient architecture" (Burdin, 2013). As Soviet Russia became overcentralized, the Siberian trends echoed the all-Russian ones, with some delay (Slabuha, 2014).

3.8. *The last third of the XX century*

The post-non-classic science with the radical changes in the scientific basis was born, postpositivism started to dominate the scientific world. Interdisciplinary and problem-oriented forms of research were exponentially growing. The specificity of modern science became determined by comprehensive research programs (Lakatos), in which various specialists participated, increasing interactions between parts of the open, self-developing systems and worldviews. Ideas, transmitted from other sciences, provoked changes in worldviews, the rigid lines between the worldviews were erased. Worldviews became interdependent fragments of the General scientific picture of the world. The variability in the behaviour of complex systems resulted in scenarios of possible development at the points of bifurcation (Stepin, Gorochov, & Rozov, 1999). Globalisation and market economy reinforced the necessity to clarify the differences between localities in order to provide survivability. In heritage "Emphasis has undoubtedly changed from a concern with objects themselves – their classification, conservation and interpretation – to the ways in which they are consumed and expressed as notions of culture, identity and politics" (Smith & Waterton, 2013). "The language of the 1964 Venice Charter, by comparison, is more cautious but also introduces the idea of the conservation professional making balanced judgments" (Orbaşli, 2017). An exponentially growing amount of heritage and intensive funding illustrated the growing interest: "1960s, 1970s and 1980s as timeframes that seemed to trigger a proliferating interest in the past – academically, politically and publicly" (Waterton & Watson, 2015). Postmodernism provoked the pluralism in approaches, "celebration of the regional, local and particular", the coexistence of multiple narratives of the place (Jencks, 1992). "Judgments about values attributed to heritage as well as the credibility of related information structures may differ from culture to culture" (Nara, 2016). Controversies within the field uncovered the oversimplified approaches to the complex phenomenon (Harvey, 2010). Harvey suggests: "development of the heritage process from the medieval world to the (post)modern, can be characterized in part by an increasing symbolic value". Heritage studies became a complex, interdisciplinary field.

In USSR, "heritage years" brought new conceptualisation, legislation and movements. Conservation finally became institutionalised, formalised and politicised. USSR was gradually opening to worldwide after the long period of isolation. Influenced by international charters, it intensified the protection and rethinking the heritage concept. In 1987, the Avant-garde buildings were "heritagised". The first official social union for heritage, VOOPIK, being created in 1965, provoked an increasing interest in society. The first search in attracting citizens to urban reconstruction unfolded in the USSR in the 80s. Over the next decade, Russian architects and sociologists created urban environmental research (Gutnov and Lezhava, Kaganov, Schenkov) and introduced the limited forms of participation, acceptable in Soviet conditions (Burdin, 2013). Since the 1970s, heritage occupied an essential role in urban policy and became a key component of broader strategies for renewal with a value beyond intrinsic, symbolic, societal

and cultural significance. The "partnership" of heritage and culture-led regeneration, emerging in the 1980s and 1990s reflected this. (Poliakova, 2005) In 1960s-1970s in Siberia, the questions of preservation in relation to the design of new large objects on the historical sites were raised. However, the heritage concept remained "conventional", based on historical and authentic values. The Central Governmental organisations in the identification and certification of monuments relied on the local research groups, busy with listing and describing (U. I. Greenberg group). Since the beginning of the 1990s, works on the identification and state protection of monuments has been paused. In the Eastern Siberia, heritage dramatically reduced its status. A number of monuments and memorial places were lost (Slabuha, 2014).

3.9. *The current state of the field*

The researcher now has to solve ethical problems, defining the boundaries of possible intervention. The internal ethics of science, which stimulates the truth and increment of new knowledge, continuously correlate with General humanistic values. Scientific knowledge is considered in the context of the social conditions and its social consequences, determined by the General state of the culture, its value-based orientations and worldviews. Historical variability of not only ontological postulates but also ideals and norms of knowledge is comprehended (Stepin, Gorochov, & Rozov, 1999). Heritage concept changed significantly: the shift towards human-values-based approach seems inevitable (Riegl, 2011). Araoz: "the core values of heritage are now increasingly deemed to reside in the cultural meanings and values humans invest in monuments and landscapes, not their physical substance" (Araoz, 2011). The concept enshrined in conventions and widely published (The Australia ICOMOS, 2013; Drury & McPherson, 2008; ICOMOS, 1999). However, the concept brought rather controversies and debates than particular approaches and doctrines. "The heritage debate has continued to flex and flow since the 1980s and has gained considerable momentum over the past three decades" (Waterton & Watson, 2015) Orbasli claims "SHIFT FROM THE CONSERVATION OF TRUTH TO THE CONSERVATION OF MEANINGS". "Conservation is increasingly becoming a process of negotiation, as the management of cultural heritage becomes based on models of consultation and participation, that are intended to give those 'affected' by a site a 'voice'"(Orbaşli, 2017). Heritage is "judged under ethical and moral criteria" (Munoz-Vinas, 2012). "More recently, heritage scholars have also started to concern themselves with processes of engagement and the construction of meaning" (Waterton & Watson, 2015). The ongoing obsession with democratisation, human rights and social justice, so active in Europe and relatively silent in Russia, inevitably turned the field of heritage studies towards the questions of control, power, decision-making, ethics, etc. Slabuha A. V., one of the most influencing professors in Siberian heritage, claims that the criteria valuation in Russian and Siberian heritage are vague and depend primarily on the views of particular experts. (Slabuha, 2014). The overall dominating concept of heritage and attached values in Russia and Siberia are not explicitly formulated in literature, nor practice. In heritage academic literature, the studies remain predominantly technical or descriptive.

Methodologically, Waterton and Watson separate the "operational issues" (technical issues and operations management), and critical analysis (sociological, cultural, social geographical and anthropological thought) in heritage research (Waterton & Watson, 2015). Two strands seem complementary and may ultimately result in the comprehensive heritage process in practice. For architectural research, Groat and Wang proposed the epistemological continuum with three primary positions: positivist/postpositivist tradition, constructivism, intersubjective position. (Table 1) (Groat & Wang, 2013). The continuum, proposed by Groat and Wang for archi-

tectural research and strands, suggested by Watson and Waterton for heritage studies, seem to have much in common and complementary, being mutually applied to the field of architectural heritage.

4. Conclusion

The history of the heritage concept fluctuates significantly: each of the attitudes reflects the value system and the state of scientific development of its period along with the socio-economic situation generally, and at the specific location in particular. The ideas of heritage have been informed by the trends in scientific knowledge throughout history. The current physical environment is the record of these ideas. Currently, heritage professionals almost unanimously consider architectural heritage process to be a powerful tool to influence the identity of a city with its ability to remove/reinforce specific memories and messages from the past, providing continuity. Indeed, architectural legacy contains essential national and cultural narratives to use. Generally, the history of experiences, in heritage, have the potential to widely inform current practice, being added into the framework of social, cultural and political connotations for architectural heritage. Such a framework for Siberian heritage would become an ultimate clue to the sustainable heritage process, serving the purpose of preconditions to heritage management.

Heritage concept in Russia and Siberia is relatively young; the concept of Siberian heritage has a minimal presence in the international literature. This relative isolation makes the implication of international scientific achievements quite limited. Theoretically, the heritage concept with valuation system and criteria in Russia generally and Siberia particularly is not formulated explicitly in the literature, which is visibly resulted in conservation practice. Yenisey Siberia stays practically far from participatory approaches to heritage. Thus, it is worth studying intensely the literature, law and precedents in Siberian heritage to formulate the current concept of Siberian heritage. The extensive studies of internationally recognised approaches and criteria should widely inform the research. For the architectural research, authors proposed the epistemological structures, which, being combined, might help to systematise the existing heritage

Objective ⟷ Subjective

	Positivism/Postpositivism		Intersubjective	Constructivism	
Epistemology	Knower distinct from object of iniquiry	Knowing through distance from object	Knowledge framed by understanding sociocultural engagement	Knowledge co-constructed with participants	Knowledge perpetually provisional
Ontology	Assumes objective reality	External reality revealed probabilistically	Diverse realities situated in sociocultural context	Multiple Constructed realities	Infinite realities

Table 1.

concepts, define the state of Siberian heritage process in relation to international achievements in the field and suggest the possible methods of its development (Waterton & Watson, 2015; Groat & Wang, 2013).

Practically, the role of the Russian State in the protection of cultural heritage has always been significant in comparison with many European countries, where the priority to a greater extent belonged to scientific societies and private initiative. However, the international tendencies, discoveries and policies influenced heritage concept and conservation practice, with some exclusions. Thus, being influenced by the global trends, such remote, specific, though dramatically growing regions as Yenisei Siberia tend to react to these trends with some delays: region had always been developed primarily according to the inner logic of socio-political and economic conditions. The sphere of heritage protection remains regionally-specific. However, globalisation with its current obsession to regional identities started to influence Russian practice: the request for a more participatory approach to urban projects recently appeared in Siberian reality both in governmental circles and among social activists, while the successful precedents, and established methods of inclusive approaches seem missing. Therefore, it seems impossible to directly apply successful international or even central Russian practices to the sphere to the Siberian territory. The changes in heritage process should be gradual and iterative, require careful consideration and testing to release its identity-building potential, restore the lost continuity and connection with the society naturally at the points of bifurcation (Stepin, Gorochov, & Rozov, 1999).

Thus, in addition to the theoretical framework, which explains the theoretical connotations for heritage management, the set of practical methods and experiments, which would help to extract the existing senses, meanings and moods of heritage places should be developed in order to fulfil the practical gap and adjust methodology to local conditions.

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A Typological Study in Urban Historic Preservation Area in Nanjing

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Keywords: building typology, urban regeneration, urban fabric protection, Nanjing.

Abstract: Building typology has played a rather important role in urban morphological research. Since typological process leading to morphological generation, understanding typological process is not only a part of morphological study, but also a part of work in urban design, especially in urban historic area preservation. Over the past 40 years, with the expansion of the city, many historic areas of cities in China have been gradually updated under the idea of protecting the types of historic fabric. It is valuable to evaluate how strongly related between urban fabric and building typology, and whether building types kept unchanging under the idea of urban fabric protection.
Firstly, based on the historic district at the south of Nanjing, this paper represents a morphological development during 1949-2018 to see its generation process, the idea, the policies and the dilemma in updating. Secondly, taking three areas developed in different periods as the cases, this paper has analyzed typological process by focusing on plans, usage pattern, structures, and representations of texture units, elevations and construction details. The results have shown the definition of typological process is important to clarify the urban morphological changing: on one hand for protecting the type of historic urban fabric, designers had to develop new building types to replace the old one, and on the other hand, using old building type has the value to protect historic urban fabric by preservation their representation, however, the structure and use types of houses have been changed afterwards in order to fit the contemporary situation.

1. Introduction

In opinion of urban morphology theory, the formation and evolution of cities were pushed by traditions, social and economic force. Urban Morphology study which is used to describe and analyse city building process can help urban designers to understand the mechanism of city's transformations and thus become a significant part in urban design, especially during urban renewal process nowadays. Building types, as root of urban form and outcomes of socio-economic reality, also plays an important role in the morphological research as well as in city regeneration practice.

China, as a country with a long history, has been facing the problem of city expansion and

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regeneration from the day the whole country stepped into modernization in 1949. Contrary to large-scale demolition and reconstruction in the context of historic city in early days, there are growing calls for protecting urban landscape and the type of historic fabric. Reusing and adaptation of traditional building types become the way to preserve and reform historic urban form through building typology. It balances new demands of realistic society and preservation of city historical memory form city form theoretically.

Urban renewal under the type protection criterion leads to the historic fabric appearing again in the modern city successfully. In the meanwhile, it brings the chance to reexamining the relationship between urban morphology and building typology. Since traditional urban form is defined by traditional building type, it's necessary to reproduce old building types for the reappearance of old form. However, traditional type which urban designers reproduced under the idea of protection is controversial. Visual sense is the prime factor to define the traditional type during the regeneration process nowadays to produce historic form, meanwhile the ways those building types function are totally different because the life changed.

Normally, the variant of building typology, including its appearance and function, is a result form changes of human behavior linking with the time expending. Building typology process is tended to be irreversible. An existing type is generally adapted and eventually changed to a new type because of external socio-economic development. Therefore, whether the building type beneath historic fabric today is the same traditional Chinese type, or it's a modification of a new type? Can the traditional type really come back to its origin to form historic fabric? What is the nature of today's rules of historic protection and how can designers respond? The relationship between types occurred during protection and the original Chinese type needs careful comparison.

2. Methodology

Studies firstly need to comb the process of urban renewal in historic area in China and clarify its lifestyle, social and economic force and idea of protection in the evolution of city building process and building typology process.

Urban historic preservation area in Nanjing was chosen because of its typicality in city updating process. The development has lasted since 1980, under the different ideas from giving priority for economic construction to historic memory protection, facing changes of demands form different social conditions. Morphology studies through historical maps can definite different periods during old town development in Nanjing and their predominant building type for city designs used to rebuild the city. Also, Comparison among various kinds of records about socio-economic reality and human behavior issue can lead to impetus factors that are promoting type's adaptation.

To understand the types comprehensively, use function with building plans and space structure, roof as fabric unit and appearance with elevations and construction detail need to be compared. In the morphology study, building constructed, plans, sections and outside images are usually used to describe a type form and for empirical comparisons to distinguish different types under different urban fabric. Material and dimensions, as well as the relationship between nothingness and essence in types are also necessary. However, because it is still not enough to describe the function and space structure clearly with those method, space syntax is introduced in the research. Structure of the type is also needed for the way of construction coming from social condition.

The research area in Nanjing has experienced 3 periods of regeneration based on the maps from 1949 to 2018. All of changes can be seen in today's map of Nanjing which is rich in tissue and representative (Figure 1). "XiaoXiHu" area which grows naturally from old city without any dramatic or revolutionary changes during the development of Nanjing historic area represents traditional texture. First period in the end of 20th century was under the idea of protection rehabilitation project for Confucius Temple historic tour area along with demolition and rebuilding modern flats in other worn areas. After entering the 21st century, fabric preservation has begun to wide attention and the modification of traditional building type turns in 2 directions. One leads to the Chinese villa in an area called "ChangLeDu" and the other produced an antiquing commercial block called "LaoMenDong". Those three areas of sample are selected and the characteristic of building types in each area is picked up to compare.

3. Urban renewal process in historic district at the south of Nanjing

Nanjing has more than 2,000 years of history. The fabric of this old city has experienced the Liuchao period (third to sixth centuries), and formed into a mature traditional urban fabric after the establishment of the Ming Dynasty Capital in Nanjing. At the time of the years from 1927 to 1937 when Nanjing was capital of the Republic of China, areas around Confucius Temple in Nanjing became major settlement of citizens and the start point o Nanjing's expansion. Before the founding of New China in 1949, those areas still maintained a large area of historic fabric formed by traditional Chinese courtyard buildings with high building density and sparse street network and mixed with residential and commercial functions.

Within the research area, the protection and development of historic area in Nanjing progresses from the Confucius Temple to the south until river bank of Qinhuai. And it skips the areas with less location advantage, as well as more complex property rights, such as "XiaoXiHu" area. The process can be divided mainly into 3 periods: first period started around Confucius Temple area in 1994-2004, second period represented by ChangLeDu project in 2004-2011, and the third is LaoMenDong project in 2011-2018.

From the view of housing adaptation during the morphology process between 1994-2018, types of residence happened between 1994- 2004 were tended to form homogeneous texture and replaced original traditional fabric. That fact was changed during 2004-2011, with the updating project of ChangLeDu area – a type raised to bring back the old city form within the context of modern lifestyle. Meanwhile, the function under traditional urban form was changed 3 times after tracing the representation of traditional fabric during the morphology process before 2018. They were commerce during the first renewal process, and changed to villa housing during the second period, finally turned back to an antiquing commercial block during the third period (Figure 2).

In first period, Nanjing's urban construction stepped into early stage of modernization and mainly aimed to promote urban economic development and improve the backward of people's lives after the reform and opening in 1978. Traditional texture was facing the problem of housing shortage along with poor quality and poor function. Recovery of the national economy has caused a large number of rural demobilized soldiers and foreign rural households to flock to cities to find job opportunities. The urban population of Nanjing has grown from 1.08 million in 1949 to 1.77 million, which the existing capacity cannot afford. In "XiaoXihu" area, extra houses were built out in every empty space between houses or in the courtyards to expand residential area. Also, courtyard houses were divided into small rooms to serve more families based on for-

Figure 1. *Satellite maps of research area in 2018.*

mer space division, and sometime new volumes were rebuilt on the original place. Also, living demands of city dwell also changed. Increasing density in "XiaoXiHu" led to a short of light and ventilation as well as little room for adding infrastructure to adapt modern lifestyle. And, with the size of urban families has shrunk from rural large family to 3 or 4 individuals, residential type with smaller living units and higher FAR during development is urgently needed. Apartment buildings were introduced and demolished parts of nature fabric in the old town, resulting in a homogeneous texture to meet the sunlight standard and vehicle traffic requirement.

In the meanwhile, in order to enhance the popularity of Nanjing's cities at home and abroad, to promote Nanjing tourism and meet the growing cultural needs of Nanjing citizens, Nanjing Municipal Government has carried out the "Qinhuai scenery belt construction project", focusing on reactivating the most traditional and popular area in the old city – Confucius Temple area. At that time, the Confucius Temple repaired its "Gongyuan" and the River Hall of the Qinhuai River based on their traditional scales. Also, under the guidance of protecting landscape and putting apart sight corridor in tourism area, height control zone was drawn and

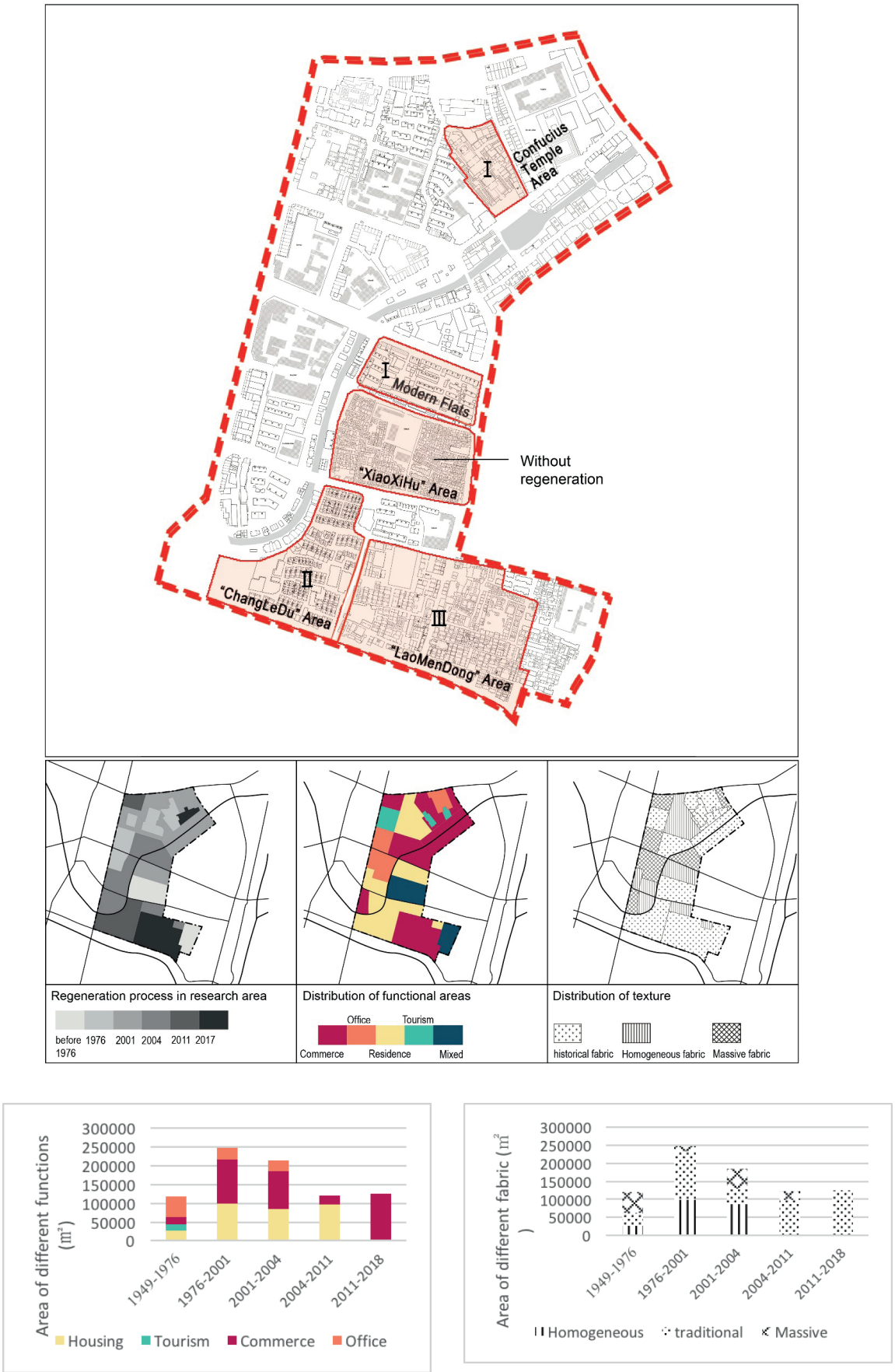

Figure 2. *Morphological process during 1949-2018, time sequence for reconstruction was followed by the serial number, while XiaoXiHu area remains unchanged.*

Figure 3. *Map of height control zone in research area.*

limited the surrounding new blocks of flats to the type of multi-storey or small high-rise dwelling (Figure 3).

With the rapid urban expansion since 21st century, a large number of residential were built inside and outside the old city. The problem of old city turned from lack of housing to crowed.

The development of the real estate industry and the diversification of the main urban construction led to high land prices. Implement of housing monetization in 1998 and urban construction project opening to market in 2003 bring a gradual boom in the real estate industry. And the urban construction enterprises are required to be responsible for their own profits and losses. Increasing cost of land makes the original low-density urban texture no longer able to resist the high-density development trend of the city. Commercial office building and modern flats have been replacing courtyard type since the beginning of 21st century. Before 2005, the traditional texture of north of the research area had been destroyed by the construction of high-intensity and high-volume rate. And with the demands of improving local living condition and economic development, two of the three historic areas left within the research area – ChangLeDu and LaoMenDong, which were listed as a protected traditional residential protection area in 1992, re-launched the renovation plan in 2004. After biding, ChangLeDu area was sold as a residential land with commercial and entertainment function at 11000 yuan/m2 in 2007 to an estate agent, compared with the land sold at 1000 yuan/m2 in 2006 inside old town of Nanjing intending as an apartment area with 2.1 FAR. All the original constructions were razed to ground after the area was sold out.

Meanwhile, as the idea of protecting cultural features has turn into public view increasingly since 2001., contradiction between protection and development is increasingly acute. Nanjing City Master Plan in 2001 required the protection of traditional dwellings to reproduce its characteristics and features under the current development system and get a certain economic return. With conservation Planning of Nanjing Historic and Cultural City in 2010 and regulatory detailed planning of the area, new constructions in ChangLeDu were asked

Figure 4. *Way to build ChangLeDu, (a) FAR in"ChangLeDu", Area was asked to be much more lower than general trend of normal housing project , (b) private street for resident only.*

to built under 9m, and using the same volumn and style of traditional courtyard type to preserve historic image of south old town. Finally, the courtyard-style type of modern luxury Chinese villa was introduced and formed a tradition alike texture of ChangLeDu' s structure. It used high price to deal with high land cost and low FAR need.

Building in ChangLeDu restructured the structure of roofs and courtyards in traditional types to enrich the layout of villa and maintain characteristic of traditional style. Original streets were also rebuilt with narrow lanes adding to regain the rich perception of traditional public space. However, renewal practice of ChangLeDu has been criticized for the lack of social justice. Demolition forced the local to leave their home with low compensation standard, and asked for high price (average 45,000yuan/m^2) from the wealth. Living standard in the old town was improved but not for the general public. Moreover, although the villa retains the traditional texture, ChangLeDu remains a chinese closed housing estate which cannot provide services to the public and bring the city memory back (Figure 5).

LaoMenDong historic commercial district was the third attempt at few remaining historic areas in south old town under the idea of fabric protection. As residential area with low rate of capacity no longer meet the demand of protecting traditional culture buried in historic fabric and more stringent idea of overall protection after 2010 "Nanjing Historical and Cultural City Protection Plan" has come up, Nanjing government has moved towards the development a of commercial district in the real issue of protecting tradition and self-financing.

Commercial district of LaoMenDong has become a public space for either tourism or local citizen. Traditional street and lanes space are reserved and linked to public courtyards within commercial areas. Small landscapes, such as waterscape of stream and slate bridges and old trees, of old city life were created deliberately in order to make up city memory. Buildings in LanMenDong were required renovation of the traditional courtyard house to meet the needs of modern functions and preserve the characteristics of the traditional style (Figure 5).

4. Connotation of traditional Chinese courtyard type

Traditional type of Chinese courtyard generates from lifestyle and construction structure buried in the building. The plan starts with space which tended to be relatively public like courtyard or livingroom specially for treating guests. A screen is set up to separate a small

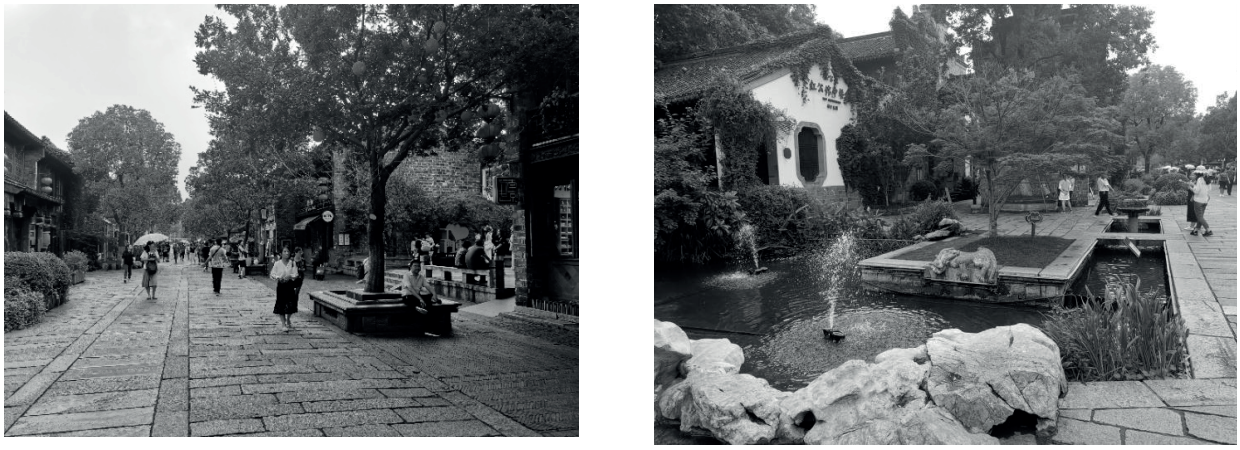

Figure 5. *Way to build LaoMenDong, (a) Public streets for citizens and tourists, (b) Landscape in LaoMenDong to create historic memory.*

space for the transit of the more public to the more private. Courtyard in the middle links front and rear building units, improving lightening and ventilation of the whole system. Wing rooms in the sides of courtyard, functioning as assistance rooms, are not necessarily exist. The back of the courtyard type was used as private space of family for living, communicating and rest. In the middle of the unit is the livingroom and diningroom for family members. Personal rooms are in the sides and lighting by courtyard. There is also a back door in the end of type or side of courtyard sometimes for informal travel.

The traditional building structure is formed with the arrange of special wooden frame in width. The combination of wooden frames forms a independent unit called "JIN" of house with the size limited for wood material and traditional rules of construction. The enclosure structure of traditional courtyard type is mainly wood and brick, independent of wood frame. Lightweight materials such as wooden doors, windows and panels are filled in the wooden frame and fixed directly to the structure. The brick wall is independent of the structure and is self-supporting by gravity and aviod the window opening.

Traditional courtyard type has its own precise construction to produce beautiful texture and graceful form in appearance. As it comes from lapping of small-scale components with purity, the joint forms of different element bring an aesthetics of Structure

5. Comparisons among building types happened in the urban renewal process

Combined with the historical review of the urban renewal of the old city of Nanjing, the historic protection has finally produced five key types of buildings after undergoing three renewal stages.

As the aim of this research is to study the role of types in the process of historic texture protection. Types in XiaoXiHu, ChangLeDu and LaoMenDong which formed similar traditional urban fabric are chosen. Building type in XiaoXiHu is considered as the typical example of traditional courtyard form as a reference for comparison because the area has not experienced the urban regeneration and contains well-preserved historical buildings. And types in ChangLeDu and LaoMenDong are the focus of study, which are produced under different ideas of protection with similar social background.

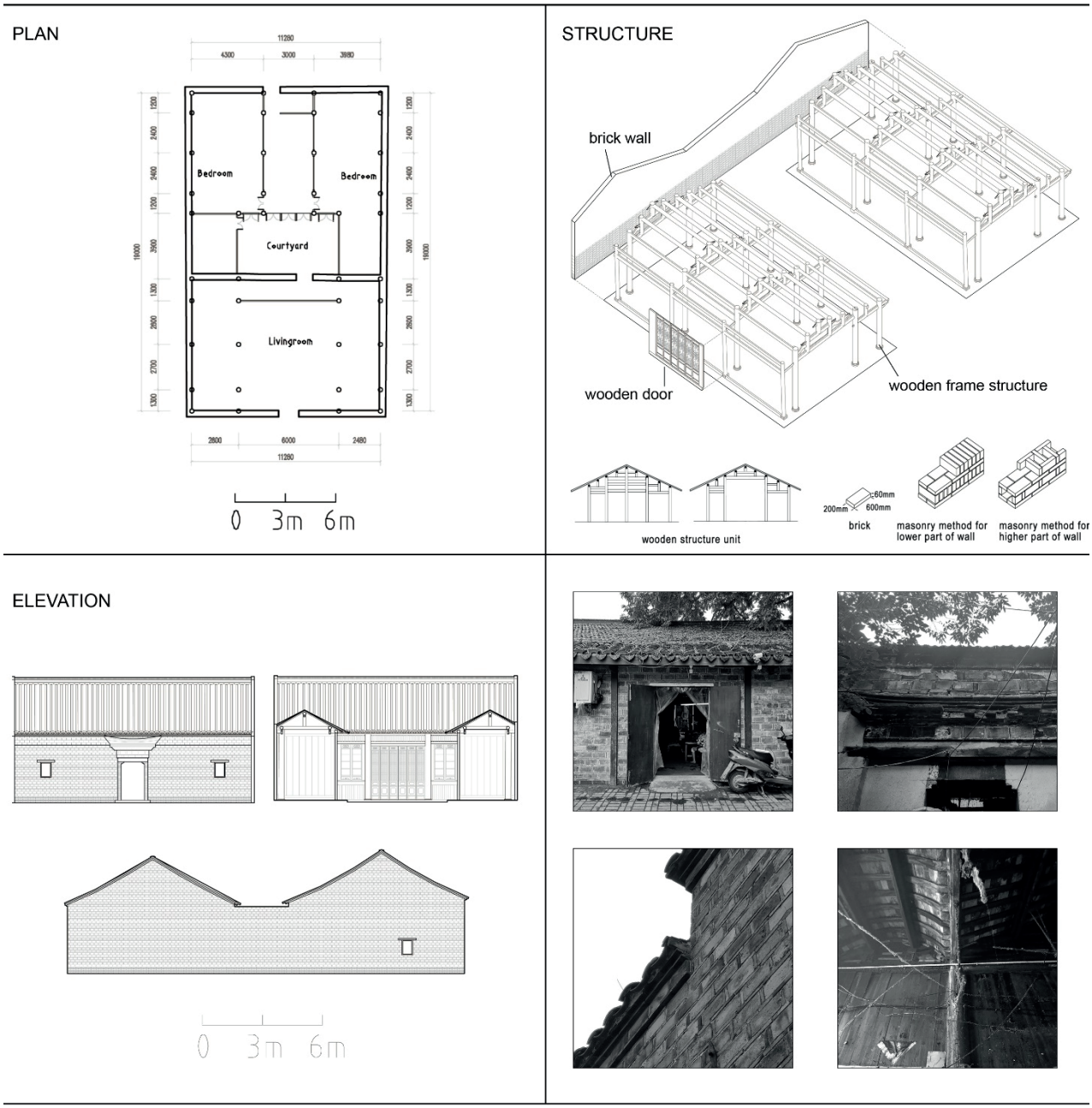

Figure 6. *Connotation of traditional Chinese courtyard type*

During the research, type in Confucius temple area and multi-storey residential area will be treated as a product of modern life to compare its function with others.

5.1. *Function adaptation behind change of lifestyle*

a. Change of space structure

The use structure of traditional courtyard is of axis type, and there are multiple small cores with equivalent connectivity in the overall structure. These cores are connected in series to form

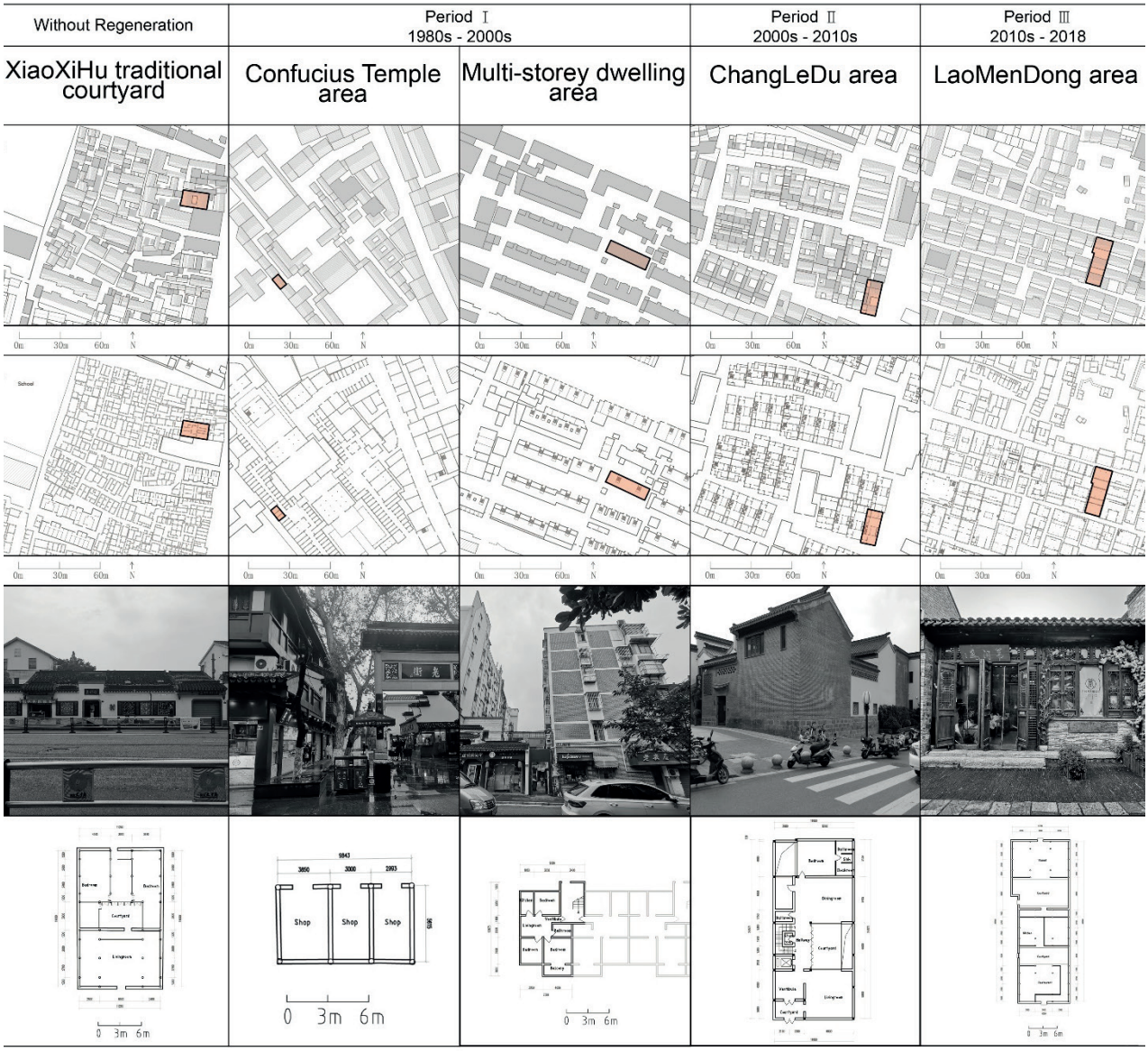

Figure 7. *Building types happened during urban renewal*

the axes of traffic, which is connected to all the spaces in the room. The overall structure of ChangLeDu is consistent with modern multi-storey apartments which is centripetal. Corridor space replaces courtyards and halls in traditional types and becomes the core of transportation. The connectivity of the Changledu corridor space is much larger than that of the traditional courtyard hall and courtyard.

Traditional courtyard types can be separated by courtyards and corridors with different private densities. Multi-storey houses and ChangLeDu are separated by halls with different private densities of outdoor streets and private houses. However, the change of privacy in the building is reflected only by the extension of a corridor space, so the perception of the change of privacy is weak.

As a commercial building, Lao Men Dong's building type is recreated in the form of traditional courtyard. For adding commercial use, the traditional courtyard which used to have only one ownership is divided into two ownership units according to the unit of "JIN to achieve more shops opening to the street. Thus, the use pattern in LaoMenDong is the same as its in

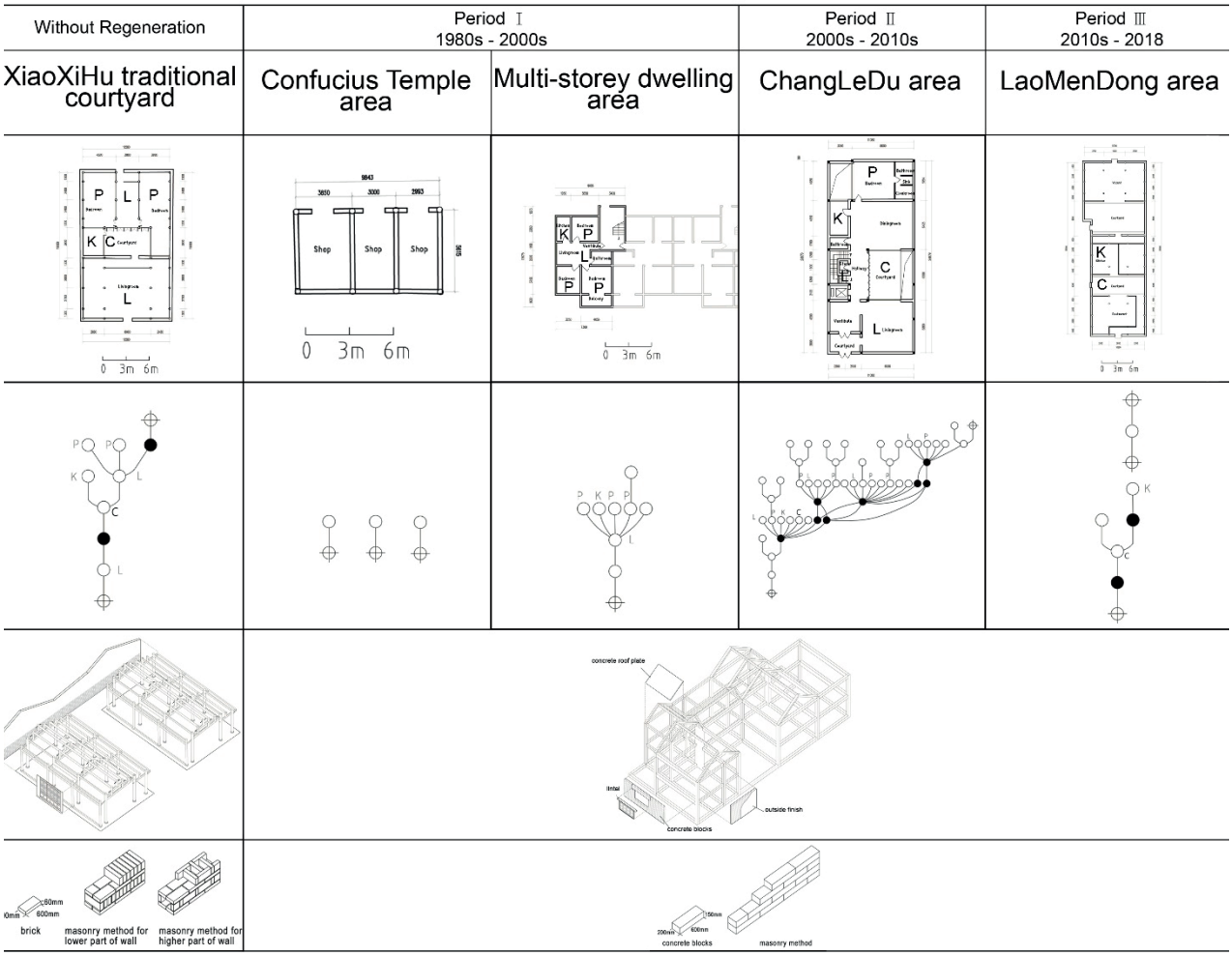

Figure 8. *Comparisons of functions among types*

Confucius Temple. The spatial structure within each ownership is similar to the traditional courtyard type. But the functional organization is different. For example, LaoMendong type uses corridors as traffic space, same as ChangLeDu. Because of its simple structure, there is no obvious axis or core in LaoMenDong type.

b. Changes in specific function

The courtyard in the traditional type integrates the functions of transportation and lighting and ventilation between "JIN". However, in the modern type of multi-storey type and ChangLeDu type, it become a simple use space and is located at the end of the space structure. In the case of the multi-storey type with tense residential area, the function of the courtyard will be abandoned.

As the core public space of each unit in the traditional type, livingroom integrates the functions of family gathering and transportation linking other space. Such mixed functions of livingroom are retained in the type of multi-storey dwelling with insufficient area and change to the core of the whole type. But in the Changle Du type, the traffic function of the livingroom is separated to the special traffic space, and the livingroom becomes the common use space, which is at the end of the space structure.

The corridor space is a small square space in the traditional type, which is separated by the partition wall in the livingroom and used to separate the space with different private density. In

Changledu type, corridor is the core traffic space of each floor. The space is striped, extending to the depth and connecting other spaces. ChangleDu also emerges special traffic space such as elevator shaft and stairwell, which integrates with corridor to connect other use space.

The kitchen of the traditional courtyard is directly connected to the courtyard, which is conducive to ventilation and emergency fire fighting. For the development of technology in kichen, it become close to the diningroom for easy meals serving in the multi-storey residential type and ChangLeDu type.

Private space of each type has always been at the end of the spatial structure to ensure the privacy of the space. At the same time, in order to improve the use quality of the space, the Changledu type has increased the spatial level in the private space, enriched the function of the private bedroom, and added the bathroom with dry and wet separation and the cloakroom to facilitate the user's life.

The space structure of traditional type varies in the history of protection. In residential buildings, due to the habit of functional partitioning of modern houses, the traditional mixed spatial functions are singularized, and the traditional type of use structure has changed from an axis multi-center structure to a centripetal structure. Commercial buildings have weaker requirements for spatial function segmentation, and the spatial structure of traditional courtyards has reservations. Moreover, due to changes of use habit in commercial and residential types, space use is also different. Types in ChangLeDu and LaoMenDong are the same as modern use pattern in period one of regeneration but not as the historic type.

5.2. *Materials and structures*

The form of Chinese traditional courtyard comes from the real expression of its own structure. The wooden frame requires that the weight of roof should be shared equally among the columns in the width span of the room, and to reduce length of wood beam should to save material. Therefore, the trisection in width of house has been formed. In the depth direction, the wooden frame is formed into a triangle by lifting the beam to span lond distance, so a Chinese-style sloping roof is produced. The traditional Chinese buildings are expanded their area by duplicating the unit, and the space between each "JIN" forms courtyard used for daylighting, ventilation and traffic.

Main facade of the building tends to use light material of wood which is easy to open holes for lighting and ventilation. And brick walls are mostly used for side facades of courtyard type which can separate the house from streets or neighbors to prevent fire from spreading among neighbors. A compact masonry method is usually used to stabilize the wall foundation on the lower part of the wall as well as an empty bucket masonry method is used to reduce the weight of the wall on the high part.

ChangleDu uses the frame structure of modern architecture, the material is mainly reinforced concrete. It immitates courtyard form because of the freedom of the frame structure in the modeling ability. Modern frame structure increases its span and bearing capacity by increasing the amount of reinforced concrete. The plasticity of concrete joint also simplifies the structure of beam-column joint in special-shaped. Therefore, when imitating the scale of traditional buildings, the frame structure has no requirement of falling columns in the direction of width, instead of forming trisection in width of house, it has become more economical with dichotomy. At the same time, there is no need to use complex wood frame form to form a triangle to increase the bearing capacity. In order to imitate the sloping roof of the traditional

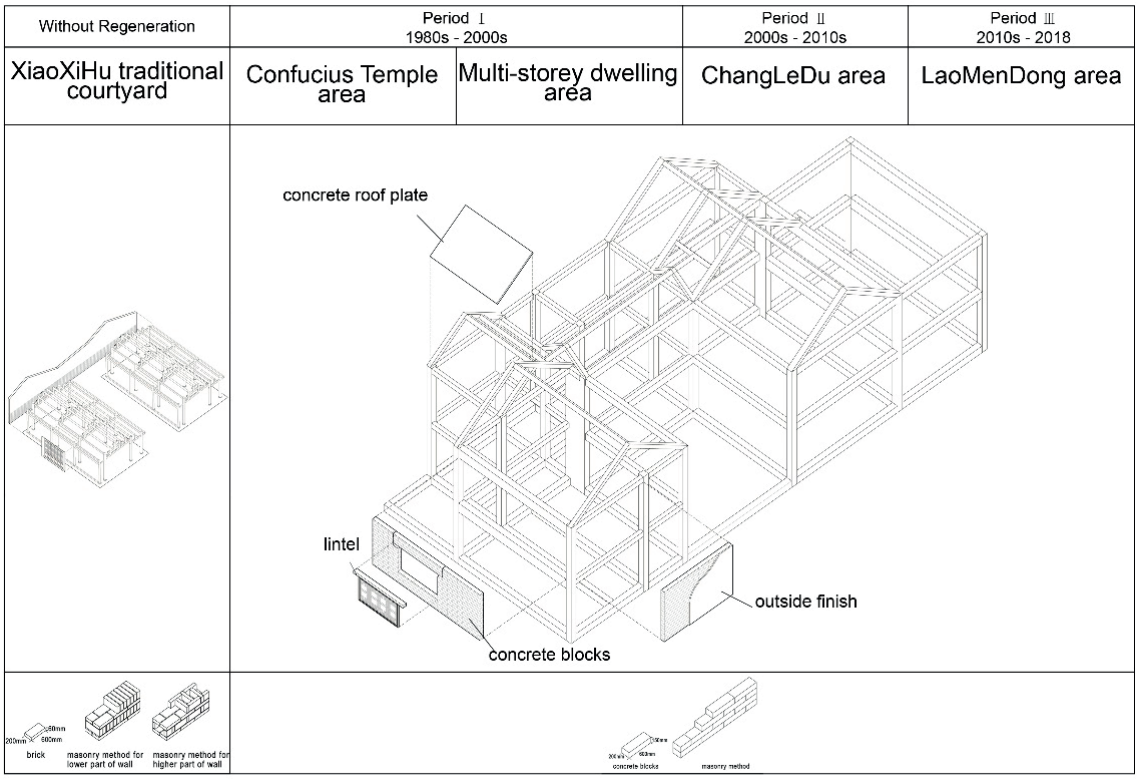

Figure 9. *Comparisons of structures among types*

courtyard, the frame structure of the roof of Changledu type directly constitutes the triangle three sides.

Compared with the traditional courtyard building, the structural logic of ChangleDu takes the whole building as a basic unit and digs out the central courtyard in a volume equivalent to two courtyard buildings.

The maintenance structure of Changledu is also dominated by concrete. The wall, doors and windows are filled between the frame structures. The walls are filled with modern lightweight blocks which are out of the traditional brick size. When the block is filled, the beam is erected and reserve a hole. The prefabricated door and window frame can be installed in, which reduces the problem of lighting and ventilation in the traditional courtyard. However, the advantages of the frame structure also bring about the homogeneity of the type of facade.

LaoMenDong mainly used the same reinforced concrete structure as type in ChangLeDu. However, the area used bricks which are similar with traditional bricks material in original type in outer layer of the wall to imitate construction.

The traditional courtyard type stems from its traditional structural approach. In the process of historical protection, the continuous development and optimization of structural technology and materials make the duplication of traditional structures become resource-consuming, which is not conducive to the capital operation of developers. So, when the ChangLeDu and LaoMenDong type was created with modern structure, the type of building in idea of structure changed dramatically. And, in the process of construction, some optimization methods using modern materials and technologies in enclosure structure will reduce the characteristics of traditional courtyard types.

5.3. *Representation in texture units*

In order to protect the traditional historic texture in the process of historical protection in China, the traditional roof types and courtyard forms are emphatically protected because the size and texture of the sloping roof and the existence of the courtyard form the basic feature of the whole texture area.

The roof units are similar in all three types. The textures of roofs are all form by slope roof with material of tile. Courtyard which treated as core feature of the traditianal type has been preserved, which sometimes change to flat roof to meet the needs of using in ChangLeDu. And the size of roof and courtyard is also contorled to imitate those in traditional type. And combination and dislocation of those units in large areas finally result in similar porosity in historical urban fabric.

Because the style of roof in modern architecture can be designed separately from the space structure and usage mode of buildings, also the roof is recognized as component unit of the traditional texture, it is simple and effective for designers to retain the combination of sloping roof (entity) and courtyard (virtual body) to reform historic fabric.

5.4. *Representation in sections*

Main facade of traditional type if axisymmrtric. It combines brick wall in the eave and texture of tile in the above the eave. The gate in the middle starts the transportation axis through the whole

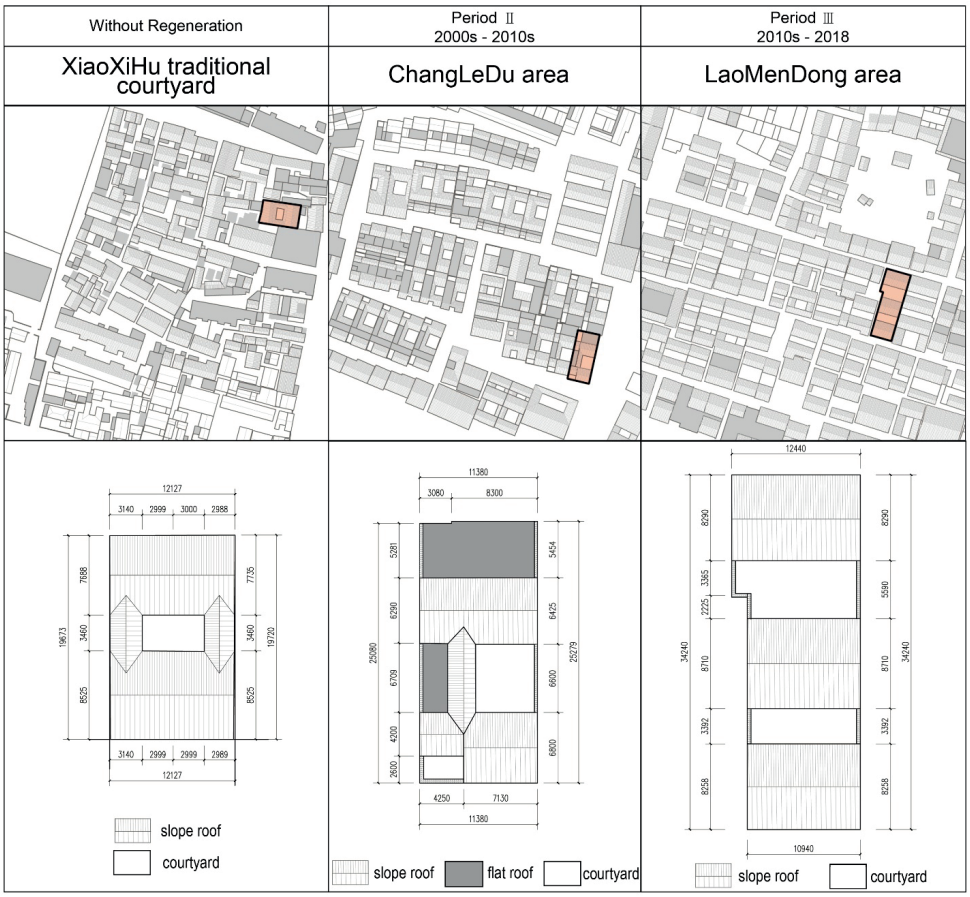

Figure 10. *Comparisons of texture units among types*

building. Small windows on the both sides are used for hall ligthing. Wooden facade of second "JIN" consists with large wooden door in the middle and large windows on the buth sides, filled in the whole flame to lingthening and ventilation of the livingroom and private room in the sides. The side facade of traditional is constructed by brick with few windows. The upper line shows the rhythm of slope roof and horizontal wall of courtyard. There are two layers on the brick wall, for the solid masonry method close to ground and light masonry method on the top.

Although the main facede of ChangLeDu type lacks the symmetry of the door and windows because of inner space. The façade is divided into two parts, the left side which is lower corresponding to the small courtyard of the entrance and the right side which is two floors high containing a livingroom in the frist floor and a bedroom in the second.it uses similar epidermal appearance of traditional type, such as door with same traditional form, floral windows which regardless sight difference in size and location for different lifestyle or Just decoration(Fig.12), and skin of external wall in brick divided into two layers The upperline on the side façade presents similar rhythm of traditional type. Except for the flower window of the courtyard wall, opening is avoided. The side façade uses both brick walls and white wall to increase the color and rhythm of the façade, and avoiding the volumetric cognitive errors caused by the two high-rise "walls" on the right side.

The facade restored the original traditional type of symmetrical relationship in LaoMen-Dong. Door is kept in the middle of the wall, and modern-sized windows in the left and right sides. There are different kinds of façade with various traditional features in LanMenDong. Inner courtyard facade is often used in the street facade with the demand of openness of business (Figure 12). The number of doors in side façade increases to add the publicity of the courtyard. The brick wall is still divided into two layers.

The overall shape and symmetry of the facade are the response of the structure and its corresponding space use. In the process of historical protection, the facade of LaoMendong type is

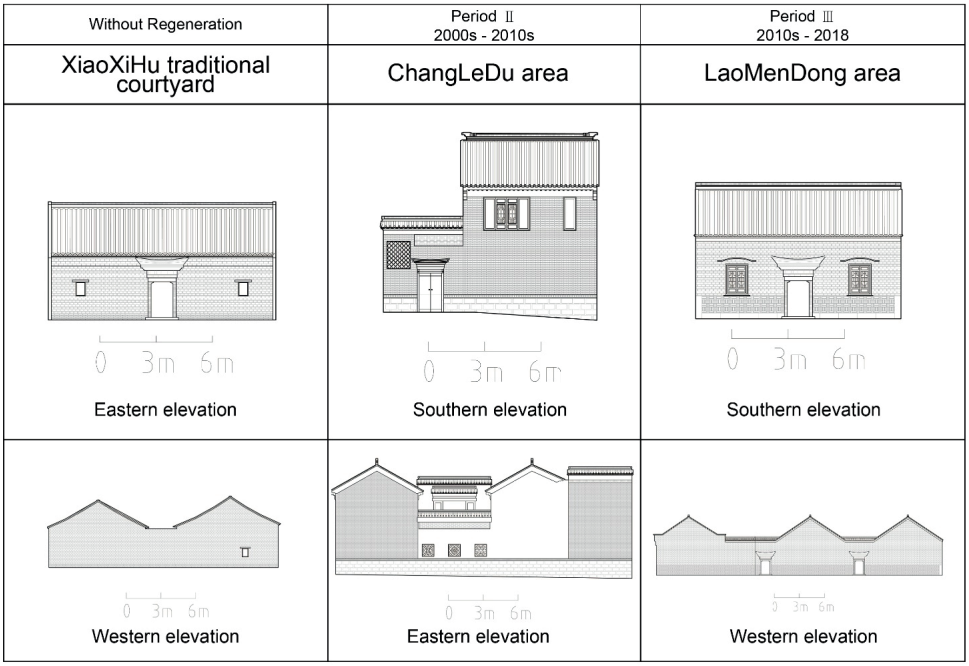

Figure 11. *Comparisons among types' elevations.*

almost the same as that of traditional type because it retains the structure of traditional courtyard type. The replacing structure of the Changledu type resulted in the difference façade with the traditional building type. However, features formed by components on the traditional type can be imitated by modern practices to recall the historic memory.

6. Representation in constructional detail

In the process of historical protection, due to the difference in structure and materials, the presentation of details in the Changledu and Laomendong types sigthly differ from those in traditional types. Due to the simplification of modern materials and structures, some of old architectural details are divorced from the needs of use and are imaged in modern types. Other parts of the details are optimized in material and structure and are retained in similar form. Their epidermal appearance in the constructional detail experience the preservation and translation during the renewal.

As the case of eaves in the 3 types, the appearance of them are highly similar with each other. All of them can be recognized as a traditional type for holding the same characteristic of slope

Elevations in ChangLeDu

Elevations in LaoMenDong

Figure 12. *Different elevations in ChangLeDu and LaoMenDong areas.*

tile roof slight out of eave wall for roof drainage. Different construction of 3 types showing the difference in detail. In type of traditional courtyard, out part of roof is supported by tiered bricks out of original eaves wall. LaoMenDong changes the tiered bricks to a Precast concrete member fixed in brick wall around eaves to hold the roof. ChangLeDu type, with the totally different structure, combines the support part with roof plate. Method of roof drainage is also changed in modern building practice by using gutter which allows the situation of an impossible traditional form because of completely different construction logic.

The appearance of brick wall in three types are similar with their texture and number of layers. Both type in traditional and LaoMenDong use real brick as material along with the type in ChangLeDu maintaining texture by facing brick imitating real brick. All of traditional type of walls are recognized aa three layers. The construction for the same reason results from needs of stabilized wall foundation and ease the weight of upper wall in both traditional and LaoMenDong type, while improving material is used in the latter. Type in ChangLeDu copies the image only for its different structure avoiding the self-bearing of wall.

Flower window from traditional type with no transparent material and uses grille to balance with privacy and lighting. The sash is directly linked with structure of wooden frame. The view through frame increase depth with light and shadow, become an artistic conception in the traditional type. Nowadays, with simplification of window strcture and the higher demands of

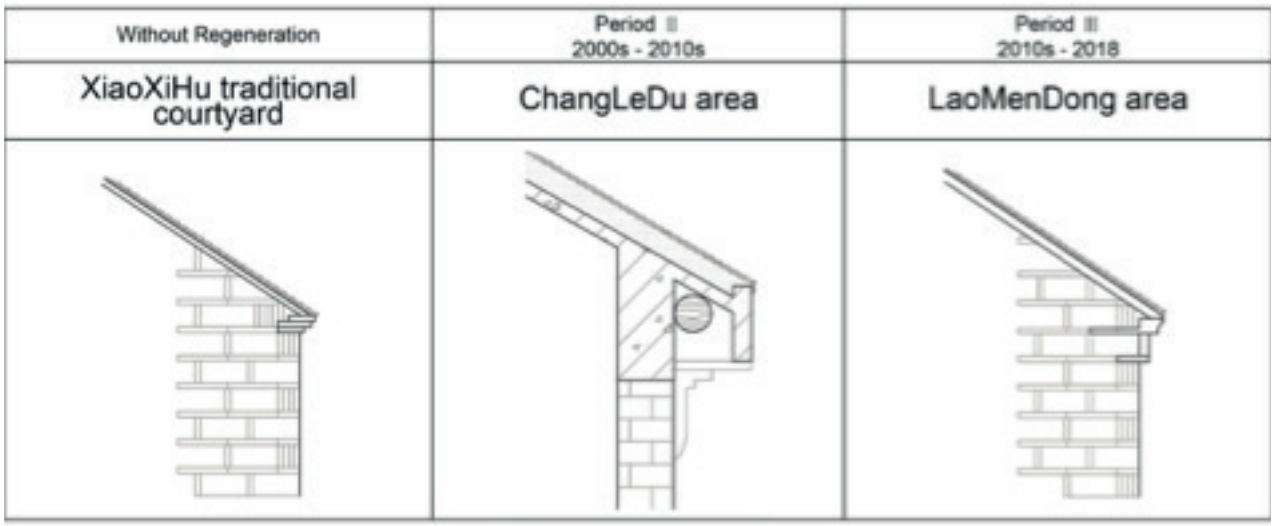

Figure 13. *Eaves and roof drainage*

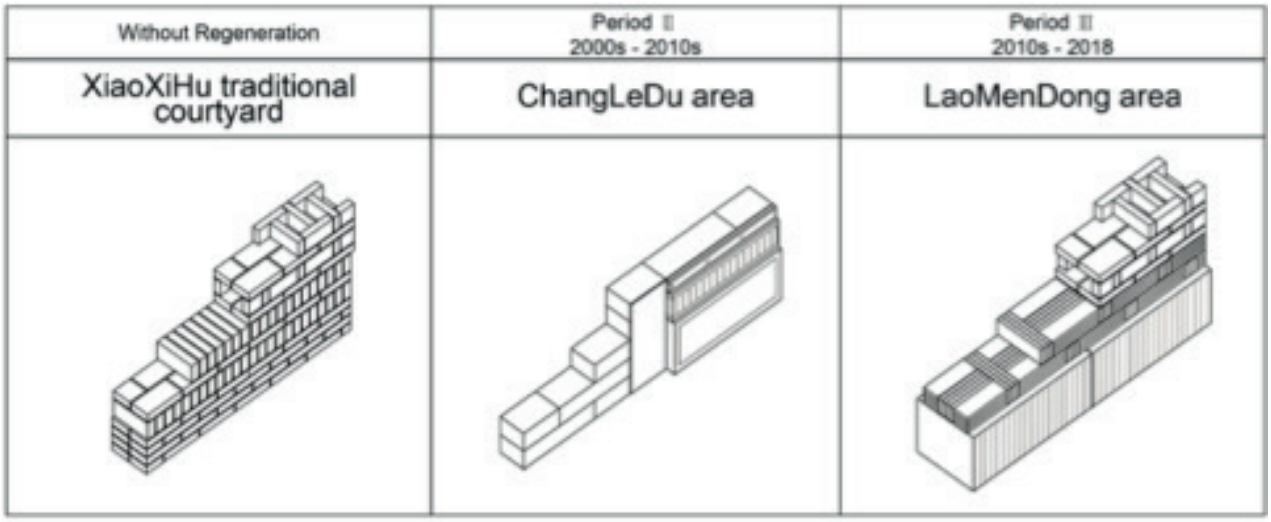

Figure 14. *Masonry methods in different types.*

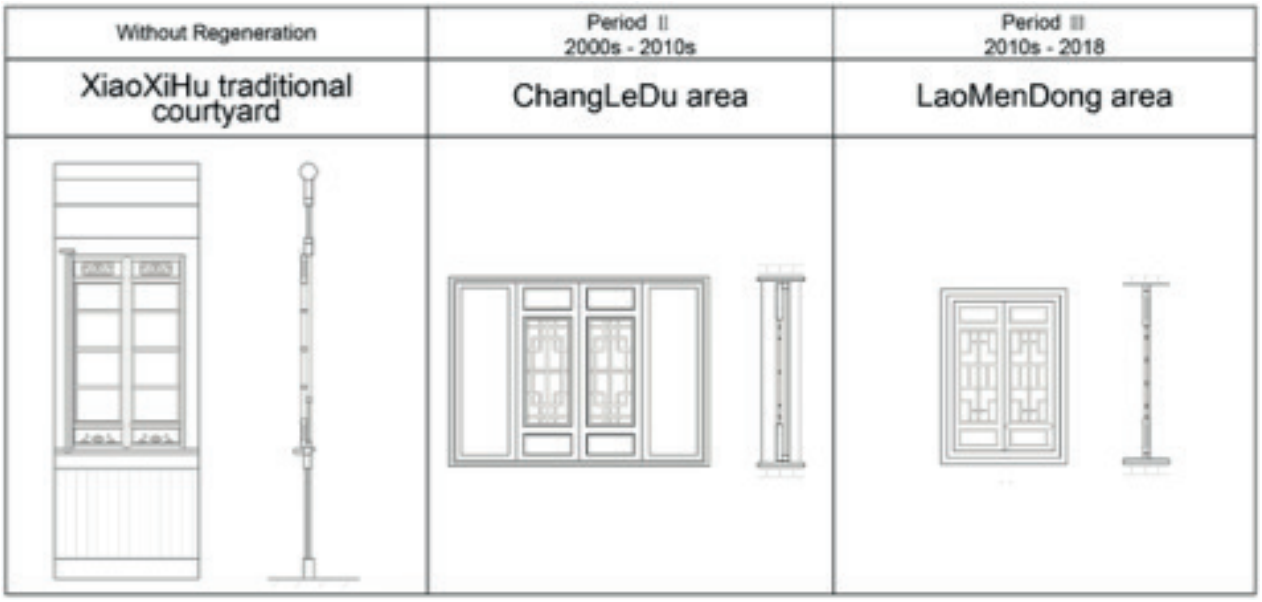

Figure 15. *Flower windows*

lightening, viewing and forming climate boundary in the house, the flower window has to add glass and has little advantage except for its artistic value.

7. Conclusion

Type is closely related to life. It reflects the social, economic and cultural background at that time, the habits of life and behavior, and the conditions of construction technology. Ancient China was sparsely populated and abundant in natural resources. Under the environment of advocating feudal class and etiquette, the traditional chinese type produced a courtyard building form with wood frame as the main structure, with characteristic of low volume ratio and axes and hierarchical division in space. However, in modern society, due to the high-density requirements of the city, the development of construction technology and the replacement of materials, the reduction of family size, the disappearance of feudal etiquette and the introduc-

tion of a new way of life, the traditional type lost its use value. The traditional type is replaced by the new multi-storey residential type, and the traditional residential texture is also eroded by the homogeneous texture of the residential quarter. The disappearance of traditional texture and traditional types has resulted in the loss of historical memory and destroyed the unique context of the city. In the 21st century, Nanjing began to protect the historic texture with original courtyard type, trying to re-apply the traditional type to life.

The protection of historic areas within old town of Nanjing during the 21st century mainly produces two types of buildings. One is a type of Chinese villa in ChangLeDu, the other is a type of commerical building in LaoMenDon. Although both types are similar in appearance to traditional types, but because of the different context of life, the types actually experinence modifications from the traditional type. These changes are mainly due to development in lifestyle and construction methods.

On the one hand, with continuation and change of life style, although ChangLeDu Residence inherits part of the traditional type of functional space, the organizational structure of space and the use of space have departed from the traditional building type, but close to the use of modern multi-storey housing. The function and layout of LaoMenDong's space have also changed to be commercial space that can be freely divided by the owners and used like type in Confucius Temple commercial area. So, the result of historic protection idea today never can change the modern generalized use pattern during first period of regeneration. The concept of type protection tries to restore the traditional type of life by using courtyard space, but in fact, the status of traditional courtyard as the key transportation and a core for the whole building has disappeared. Courtyard in the modern type has become a common functional space for modern usage habits, such as viewing and lighting. That is to say, even if the scenes of life in the traditional type can be preserved, the life behavior has disappeared.

On the other hand, the emergence of a new material and structure, such as reinforced concrete, simplifies and optimizes the construction of traditional types of complex wooden frames. Because the traditional building type tends to be the faithful response of its own structure, the structural change eliminates the original type characteristics based on the formation of the structure at the same time. In the logic of reinforced concrete structure of ChangLeDu type, the trisection in width of house becomes the dichotomy, the courtyard becomes the holes which can be taken out in the whole structure of the building, and the location and size of the elevation holes are freer. Meanwhile, LaoMendong reproduced the traditional materials in outer layer of the type and traditional characteristics which preserved in LaoMenDong are indeed more than the ChangLeDu model. As the reconstruction in original structure is both unaffordable and unnecessary in the process of historical protection and renewal, the structure of traditional types can not necessarily go back to the past, and the building type has changed in aspect of structure.

In fact, in the process of urban renewal, the protection and development of the traditional texture actually protects the roof texture and epidermal appearance of the building type. The two new building types retain the image and size of the sloping roof of the traditional building type, retains the texture produced by the roof tiles, and the virtual and real relationship brought about by the existence of courtyard. The shape of facade and the details of the building are transformed into the appearance of skin and protected. ChangLeDu's type uses contemporary materials or modern structural practices to translate the characteristics of traditional types into images, which conforms to the reality of economic interests in the process of modern development. LaoMendong's type, by retaining traditional material practices, slightly assists

modern components to simplify the details, preserves the structural details of traditional types to a certain extent, and makes the external characteristics of traditional buildings more vivid.

Therefore, the idea of tradition types preservation as a whole unnecessarily exists in today's historical renewal process. Representation type of the buildings may adapt into modern life but never can the use or structure type during the protection of city historic fabric. And, a new type has already arisen to support historic texture preservation when we consider all three elements together as a definition of one type.

8. Acknowledgments

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Analysis Method of Historical Urban Fabric for Urban Design

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Keywords: urban design, urban fabric, historical area, cartography.

Abstract: In the urban historical area regeneration, the key task of urban design is to inherit the characteristics of the historical fabric. Thus urban design makes guidelines to control the street structure/space, buildings layouts and buildings form/type, etc. according to the understanding of the morphological characteristics of the fabric. In this process, urban morphology plays a very important role in providing a scientific and systematic approach to the representation and explanation of the historical urban fabric. However, the subject and even the object of urban morphology are different from urban design. The analysis method of urban morphology is not enough to provide the most direct basis for the design decision of urban design. Therefore, taking the historical area in Nanjing, China as the case, the paper proposes a method to analyze the characteristics of the fabric at three hierarchies: street structure and space, plots and buildings layouts, building type and form. Morphological characteristic features of each hierarchy are selected, mapped and quantitative analyzed. Through quantitative analysis, the paper puts forward some characteristic indexes which can be used in urban design.

1. Introduction

Urban design shall inherit or continue the texture morphological features of historical urban blocks through physical forms in the renovation process, which is one of its major missions. For this reason, urban design guidelines were worked out to supervise street structure and space image, manage the modes by which buildings are organized, and monitor building volume and texture types. Urban morphology provides scientific and systematic methods and knowledge for urban design.

It makes a deep introduction to the morphological features of historical textures and their variants from the perspective of streets, blocks, plots and buildings by means of a systematic approach. Whitehand, Gu *et al.* discussed the applicability of morphological methods including plane analysis and type variants to describe the texture of historical Chinese cities in a series of morphological studies on the texture of historical Chinese blocks (Whitehand and Gu, 2007; Gu *et al.*, 2008; Gu and Zhang, 2014; and Whitehand *et al.*, 2016). Based on the typological theories of the Italian school, Li and Gauthier made a case study on the old blocks in Guangzhou, China, where a morphogenetic process was revealed after analyzing building types and their variants, and identi-

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fying relationships between issue configurations, inherited geomorphological conditions and old settlement patterns (Li and Gauthier, 2014). Such studies focus on architectural types involved in the development process of architecture.

In addition, the urban morphologic methodology is based on the epistemology that types are dynamically changing forms resulting from social, cultural, economic and other conditions in different historical periods. A host of studies were thus made to explore why morphological features were formed in different periods. The study mentioned in the previous paragraph is within the framework of morphology, involving such exploration to some extent. But some studies are beyond the historical morphological framework because they were not intended to interpret morphology and morphological changes as in the above works. Certain studies may be grouped together based on the same objective to analyze the formation causes in the historical process, including typical cases of the influence of historical social systems and family concepts on architecture and texture types (Ding Qingjun, 2008; Yong Zhenhua, 2010).

Both descriptive studies and cause analyses are objective works on forms or form evidence based on historical facts and conducted in the historical environments. However, a direct use of their findings is not suitable in urban design practice because knowledge of what the history was and how it was formed will not give an exact picture of the future. In this context, Han Dongqing proposed the third analysis method – formal interpretation. Compared with the former two, it based itself on morphological descriptions to turn it into a graphical mechanism of morphological generation, preparing for the formal generation of future urban design (Han, 2013). A formal interpretation of historical urban texture is to provide possible elements for future texture variants after distinguishing the morphological features and causes of historical architecture and texture. This is a move to inherit historical humanities while adapting to contemporary society, economy and culture. The paper was designed to explore methods for the formal interpretation of historical urban texture oriented to urban design.

2. Methodology

2.1. *Research Subject*

Urban fabric is the physical aspect of urbanism, emphasizing building types, thoroughfares, open space, frontages, and streetscapes but excluding environmental, functional, economic and sociocultural aspects.

2.2. *Descriptive hierarchy and objects of urban morphology*

In urban morphology, the word that most like urban fabric meaning is urban tissue. In Caniggian analysis, the urban tissue is the ensemble of aggregated buildings, spaces and access routes. Urban morphology emphasizes the cognitive hierarchy of street/block/plot/building. The primary elments of the urban fabric are plot, street, constructed space, and open space. The urban fabric consists of the relationships between the different elements (Levy, 1999). Caniggia, on behalf of the Italian school sorted architectural types that constitute urban texture and contribute to texture variants and changes in types into a descriptive hierarchy For the British school with Conzen as a representative, texture components in the texture component plan should include street and street systems, plot and plot combinations and building block planes. In summary, the descrip-

tive hierarchy was composed of streets, plots, external spaces and building types (building planes, structures, materials) (Kropf, 2014) and their induction and differentiation.

2.3. *Graphic technique of urban morphology – Plan analysis*

According to Conzen (Conzen, 1960), the definition of plan is the "topographical arrangement of an urban built-up area in all its man-made features", compring three coplexes of plan elements, streets, plots and the block plans of buildings. Street boundary, plot boundary and building boundary were included in the basic elements used in the plan analysis. The plane components are commonly re-described by zoning and typing methods with reference to analysis, classification and induction of these plane features and based on plot patterns, building patterns, and the identification of invariants in morphological variants (such as fringe belt). Alniwick led the English school to create a mature mapping method for plan analysis (Conzen, 1960).

2.4. *Exploration of Graphic Elements*

The graphic technique in morphology is descriptive, so that the same graphic technique cannot be used in different designs to deduce architectural forms. For example, a certain area has a certain plot pattern, but nothing can determine whether this pattern should or should not (can or cannot) continue. Therefore, the paper was completed by the method of first selecting a possible plan (or space) elements according to the morphological features of historical urban texture, then illustrating and quantifying the characteristics of historical texture elements and finally verifying the possibility of applying quantitative features into the design; which elements are worth describing and which features are worth preserving and continuing in the historical texture renovation; and which elements can be described and transformed are two major issues to be addressed. The former issue has almost been given a consensus in a large number of documents, which is the basis of the latter. The latter still leaves room for open discussions.

3. The Goal of the Urban Design in the Historical Urban Fabric Regeneration

In the process of the protection and regeneration of historical urban fabric, urban design takes on the task of form control, which is embodied in three levels: the whole fabric (view from the high point), building type and the public space. The overall goal of the urban design is, first of all, to continue historical characteristics, to determine how to continue and which forms and spatial images deserves to be conserved. Meanwhile urban design needs to take into account more stakeholders and formulate distribution strategies and implementation methods for morphological objectives.

There are generally several modes in the existing urban design. For example, in order to preserve the integrity of the historical urban fabric, there are three strategies. The first one is to completely regenerate new fabric based on the understanding of the historical fabric characteristics. The second one is to mend the fabric according to the preserving historical buildings. The third one retains the fabric characteristics, but increase the height of the buildings. For all these practices it is needed to summarize the morphological characteristics of the historical fabric, which includes the understanding and interpretation of the street structure, the building type, streetscape, and etc.

From the analysis of the goal of urban design, it can be seen that urban design mainly controls the appearance of the historical urban fabric. The function of the buildings should be

Table 1. *Urban design strategy and the morphological knowledge it needs.*

	Strategy 1	Strategy 2	Strategy 3	Goal of the urban design	Morphological Description/ explanation /interpretation
The integrity of the fabric	Completely regeneration	Height unchanged, partly regeneration	Height increased, regeneration	Historical fabric to be continued and identifiable	Morphological Characteristics of Fabric Structure Unit Relationship with plots
Building Type	Complete change in plan; Little change in roof	Little change in plan and roof	Change in plan and structure	Match with the fabric; meet the requirement of the public space and actual function	Architectural typology and design
Open Space	The space left after maximizing the residential area	Public space reorganization and expansion	Public space reorganization; Operation of the underlying business	Conform to historical spatial imagery; evoke memory	Streetscape characteristics Building detail, material

adapted to the contemporary usage while the appearance conforms to the characteristics of the fabric. So the interpretation focuses on the characteristics of the fabric, from the site plan perspective as well as the streetscape one.

4. The Morphological Characteristics of the Historical Urban Fabric

4.1. *Building Type*

Ridge of a Roof

A ridge of a roof is the peak where two opposing roof planes or sides meet (Figure 1). The right ridge is the highest point on a roof, represented by a horizontal line where two roof slopes intersect, seen from the front elevation of the building. The main ridge is also called "Large Ridge" as it is the largest, longest and most prominent among the ridges of a building. The roof ridge, especially the large ridge, is the key to a building. The ancient people by convention would take a bath and put on clean clothes to build the ridges of the house on auspicious days, and then throw steamed buns from the beams and step on a ridgepole. The importance of roof ridges may be traced back to the age when buildings were made of wood. Wooden frame structures have long prevailed in Chinese architecture mainly in that it has been recognized as the most reasonable and is a tested technical standard by choice (李允鉌,1982).

Gable

The exterior walls of old Chinese wood frame buildings only function as an enclosure and partition of internal and external space, but do not bear a load, as a folk proverb stated, "Exterior walls fall but houses do not collapse". A need for safety is found while constructing external walls or enclosing walls on which windows and doors shall not be opened arbitrarily, so the courtyard for lighting and ventilation shall not be left out. In China, a sole building is flanked by solid gables, a fireproof partition that prevents a fire from spreading quickly.

Plan layout

The separation of door and hall is the pivot of "the door and hall system" in ancient China, which is a major feature of Chinese architecture. All layout modes have been developed along with this basic principle, which is theoretically derived from the "courtesy" separating the inside and the outside, up and down, guests and hosts (李允鉌,1982). Doors become the exterior of the building and a representative form; The hall expresses what the house is and is the place where the real function needs to be. While the door and hall system was taken as a convention, sole buildings were abandoned in Chinese architecture. Each suite of "door and hall" refers to a level or section on the plane of the architectural complex, where the scene transits from one to another in an enclosed space. A door is often together with a house, constituting comparable size to a hall in a major building.

In response to the demand of commercial activities, outward buildings have been put up along the street, usually in multi-storey (Along the River During the Qingming Festival), building forms emerged at the historic moment.

Figure 1. *Historical photos in the early 20th century.*

In the plane organization, buildings rarely merge or centralize, are always separated and scattered. By increasing the number of buildings the plane can be scaled up, but with factors regarding "systematism" and "standardization", as well as demand for the structure, construction, fire prevention and seismic performance.

"Bay" and "Rafter"

"Modularity" and "standardization" are common in architectural design, causing the "structural plane" to be almost universal. With a fixed column grid, the number of "bay" and "rafter" is sufficient to show the plane form of a sole building. The part between parallel longitudinal column grids is generally called a compartment or bay, whereas the frame is laid between horizontal column grids and refers to the rafters. Standardized rafters have fixed positions and spacing with rarely random changes and thus can be used to work out the depth of the building.

Courtyard and Patio

The layout around the courtyard meets the demands for lighting and ventilation and is the most economical solution for combining the enclosing wall with the house. "Door", "hall" and "corridor" are the three major components in the plane of Chinese architecture, which together enclose the "courtyard". The "courtyard" is considered as a basic organizational unit in the architectural complex. The scale of an architectural complex is described with "the number of yards and houses" other than by the number of buildings.

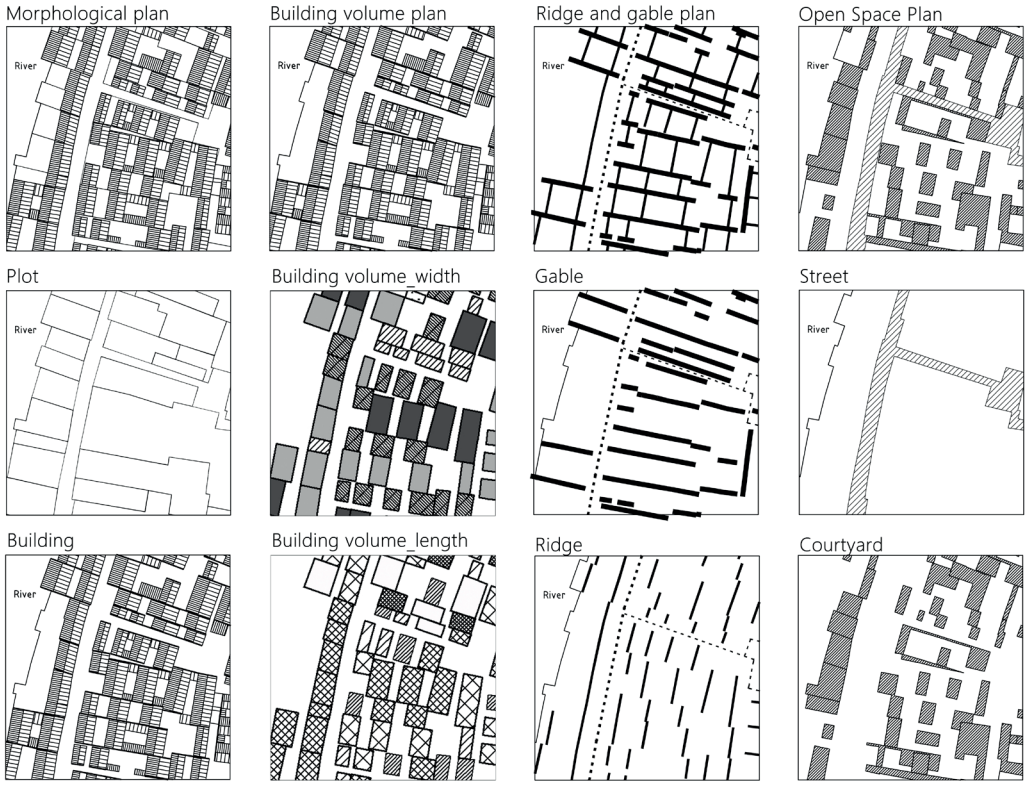

Figure 2. *Traditional feature extraction and interpretation.*

4.2. *Streets/Open Space*

Historical Chinese architecture was inclined to linear open spaces, such as streets, roadways, and alleys. "Roads" and "lanes". A road is created when a series of courtyards are connected in series in-depth. A lane is an auxiliary seamless transfer, forming another system in a well-organized building. It is recommended that the morphological features of streets and lanes in historical texture can be described through street structure, spatial scale (width and proportion), entity elements (interface, node, facility).

Street structure generally refers to the hierarchical organization of main streets, secondary by-lanes, public courtyards and households. The hierarchical organization includes the direction of main streets, the way in which secondary by-lanes are connected with main streets, the density of the secondary by-lanes, the relationship between the public courtyards and the secondary by-lanes, and the density of the public courtyards. Space syntax is a mature way to introduce street structure, except for the lack of accurate dimensions.

4.3. *Streetscapes*

Miao Pu found that the images of historical Chinese architecture featured "simple context" and "two-dimensional linear composition". For old architecture and cities, images were composed of "core parts" and "contexts", among which the core parts often account for a little, while the majority in the images were simple contexts (Miao, 1989). In some images of typical historical cities, a large number of bare exterior walls set off roof cornices and exquisite flower windows. The elements forming the context are similar and unified, but are not purely copies. Looking closely, there are delicate differences, which make the context not monotonous. And the Chinese people place more emphasis on "the form with stories," who, therefore, attach great importance to the symbols and cultural significance contained in the context. For example, Geomancy, regarded as a culture by ancient China, affects the orientation of the gate, the number of steps, the shape of the plane and other specific architectural forms. It was commonly seen in old images of Chinese architecture.

4.4. *Feature extraction and interpretation*

The above analysis shows that building volume, ridge, gable, courtyard and so on can become the characteristic elements of historical fabric. In contrast to the plan analysis of traditional urban morphology, these elements can be extracted independently and mapped. Then the length, width, area, density, etc. could be calculated (Figure 2).

5. Case studies: Quantitative Description of the Morphological Characteristics

Based on the understanding and extraction of the morhpological features mentioned above, the paper tries to extract and illustrate these features, and then quantify them. To do this, the paper selects a typical historical urban fabric of Nanjing City, puts forward a quantitative description of the elements of morphological features, and explores the possibly and feasibility of urban design to continue these elements, based on the 1929 aerial map (Figure 3).

Description and statistics of building volume: Combining the site survey of the existing buildings, the regular bay width of buildings are about 3.6m, 3.3m and 3m, and the horizontal

spacing between rafters is generally 1.1m. Statistics on the sizes of main buildings show that the areas of main buildings stay between 20-140 square meters, 75% of which are mainly 20-80 square meters. Buildings with the façade width of about 9-12 meters take up the highest proportion, corresponding to three bays Buildings with depth of about 7.7 m take up the highest proportion, corresponding to seven rafters.

Description and statistics of building sequences: Statistics on gable lines show that the lengths of gable lines vary from 2.5m to 73m, of which, 64% are less than 10m, 25% are 10m-30m, and 11% are more than 30m. Statistics on the directions of gables show that 88% of gables are vertical with adjacent roads, with only 12% of them independent of roads. Statistics on distribution locations and their coverage of different types show that the gables of 95.9% tissue are parallel with each other, and consistent with roads, which makes the tissue sequence can be identified, while the gables of only 4.1% tissue are slightly disordered. Gables are distributed in parallel but not entirely homogeneously. The length of the roof ridgeline corresponds to the facade width of the building volume, the roof ridgeline is vertical with the gable line and generally distributed in parallel between two gables, and 97% of roof ridgelines are parallel with the corresponding roads. The result coincides with the result of statistics on gable lines.

Description and statistics of building courtyard: Statistics on the area of courtyards in this sample area show that the average area of courtyards in combination with buildings reaches 50 square meters, with the home garden area of 1200-3000 square meters. In addition to home gardens, there are 192 courtyards distributed in an average area of 1 square meters in the building-covered area.

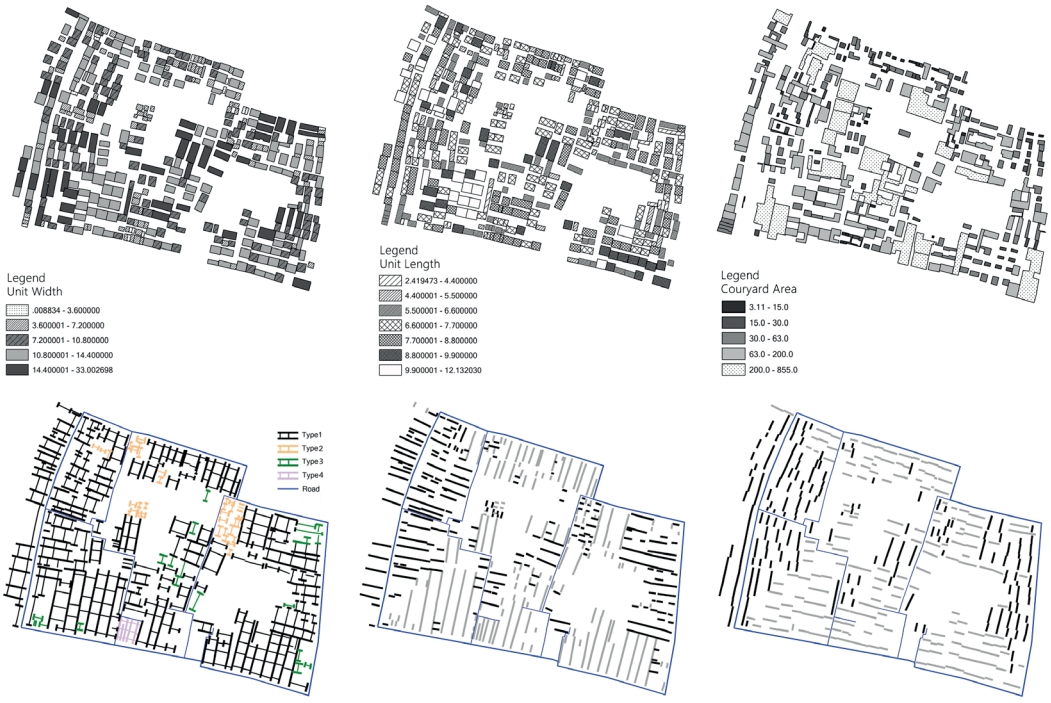

Figure 3. *Case studies of typical historical urban fabric in Nanjing, China.*

6. Discussion/Conclusion

The interpretation of urban fabric provides basis and knowledge for urban design. Different from description and explanation of the urban form, the interpretation reveals the logic of the form, tries to classify them, describes the relationship between the forms and tries to quantity the characteristics to provide a basis for the later urban design. Chinese historical urban form has unique morphological characteristics, which are the results of culture, politics and economy. The regeneration of historical urban fabric does not mean to give up modern life to return to the past time, but rather to preserve the traces of the history and arouse people's memory through the inheritance of historical "images". In this paper, a number of morphological elements are proposed, illustrated and quantified to come into being some indicators, through which urban design can control the form more effectively. This paper puts forward and demonstrates these elements, the effectiveness of these indicators is worth exploring in the follow-up research. Meanwhile how to translate them into the forms under the new social, economic, technical and other conditions will be the further design question.

7. Acknowledgement

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The Importance of Types in Disaster Area Reconstruction

by Maria Cristina Villefort Teixeira, Stael of Alvarenga Pereira Costa,
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Keywords: Reconstruction of disaster hit areas. Typological analysis.

Abstract: This work aims to analyze and evaluate the existing built types found in the Bento Rodrigues subdistrict of Mariana, located in the state of Minas Gerais, Brazil, in order to help direct housing construction/reconstruction for the local population after the rupture of a nearby tailings dam decimated the area. Bento Rodrigues was founded during the 18th century colonial period, with the discovery and exploitation of gold. After a period of decline, due to the depletion and exhaustion in the gold reserves, development was resumed with the implantation of iron ore mining companies from the 1970s on. In 2015, a rupture of one of the dams caused incalculable damage killing 19 people. The proposed construction of a new settlement, in an area close to the previous location, was therefore required to closely examine the original formation of the hamlet, taking into consideration the built types characterizing the place. As such, the periods of evolution were analyzed and the most recurrent types, in each of these historical phases, were identified. Familiarity with the types analyzed and their respective transformations over time would thus better contribute to mitigating the residents' losses and recapturing the historical and cultural aspects of the population in the new settlement.

1. Introduction

Bearing the name of its founder, Bento Rodrigues was founded in the late 17th century with the discovery of gold. By the beginning of the 18th century the hamlet was already in economic decline. The *Caminho dos Diamantes* (the Diamond route), which connects the cities of Ouro Preto and Diamantina, became the first axis of urban occupation in Bento Rodrigues, as well as offering accommodation for travelers. The village buildings exhibited typical rural characteristics. being generally located on large pieces of land in whose backyards orchards, vegetable gardens and animal rearing allowed the subsistence of the inhabitants.

The recovery of the local economy between the 1960s and 1970s was due to the exploitation of iron ore abundant in the region commonly referred to as the *Quadrilátero Ferrífero* and currently responsible for around 60% of national production. One of the mining companies, Samarco Mineração S.A., founded in 1977, commenced activities in the mines located about two kilometers from Bento Rodrigues.

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This mining complex housed several excavations and tailings dams, among them the *Fundão* dam, which collapsed on November 5, 2015, causing a huge environmental disaster, killing nineteen people and impacting thousands directly and indirectly. The tailings traveled about 600km along the *Rio Doce* to the Atlantic Ocean. In the midst of national chaos, the town of Bento Rodrigues became emblematic because it was the first to be hit by the mud and to have almost all its territory destroyed. Due to the toxicity of the tailings and the risk of further dam ruptures in the same complex, the villagers had to be evacuated to the municipal centre of Mariana. Another nearby site was chosen for the resettlement and re-housing of the population.

Following this bleak scenario, a typological analysis was carried out to facilitate the inclusion of cultural, economic and social aspects in the construction of the new settlement. The methods of the Italian School of Urban Morphology, which evaluate the types and their transformations, have proven to be efficacious in relation to informing the proposal presented for Bento Rodrigues. A similar scenario occurred in the reconstruction of villages in Yamakoshi, Japan in the aftermath of the 2004 Chuetsu earthquake, in which Masuo (2015) addressed historical, cultural and climatic aspects for the development of archetypes based on the traditional residences of the region.

The study presented here was produced from orthophotos taken in 1966 and 1986, satellite imagery from 2005 and 2015 and Google Earth Street View technology, as well as pre-disaster photographs made available by residents.

This article is part of a broader survey of types, appropriations of place and relations of identity, related to the sub-district and its items of transformation and permanence. Developed by the Landscape Laboratory at the School of Architecture at the University of Minas Gerais (LAP), the study aimed to identify the types that existed in Bento Rodrigues before the destruction of the Dam, so that environmental, cultural and social aspects could be considered in the reconstruction of the new settlement.

2. Typological analysis

The study of type was developed by the Italian School of Urban Morphology and discussions on the theme resurfaced in the 1940s, in contrast to, the prevailing ideology of the Modernist Movement. The Italian School, whose principles derive from the studies of the architect and professor Saverio Muratori (1910-1973), deals with questions of the formal structure of the building and relates this to the history of the city. The study of buildings and their transformations over time consists of a typological analysis, in which, the methodology of the Italian School determines the type of building most commonly representative of a culture. This type derives from what has been referred to as "spontaneous consciousness", that is, the reproductive capacity of an archetype that is inserted in the subconscious and thus reflects aspects inherent in the culture of its inhabitants (Pereira Costa; Gimmler Netto, 2015: 154).

Research conducted by Espirito Santo (2006: 29) corroborate this approach and view the building as a structure of anthropic space, characterized by its spatial scope. Thus, the components of a set are structured by human beings. The Typological Analysis described by the author also observes both the permanent aspects and the changes in the building. The diverse cultural elements are implicit in its formal composition, its implantation, facilities and uses on the plot of land.

The methodology of the Italian School, moreover, uses scale extension over four successive stages. They are as follows:

1. The isolated element (the building type).
2. The identification and degree of derivation.
3. Verification of the urban fabric.
4. The implantation and structuring of routes across the territory
(Pereira Costa; Gimmler Netto, 2015: 155).

In the present work, only the first stage will be contemplated, since the project will evaluate the reading of the building or typology as a means of analysis or study of types.

For the application of this methodology it is essential to define morphological periods, in order to establish the typological process. In fact, the changes and / or permanent aspects in the built environment, focused on the type over time, will be presented, as they reflect social and economic actions. For the study of Bento Rodrigues, the periods were established through available cartographic material that, in a certain way, was related to the historical evolution of the settlement.

The first period commenced with the founding of the village and extends until 1977, with the establishment of the Samarco Mining Company in the area. It is interesting to note that this phase did not manifest major changes in the local road structure, due to the previous economic stagnation. The second covers the period between 1977 and the 1990s, in which there was an expansion in the southwest portion of the village, due to the employment opportunities generated by the mining activities in the region. The third period, between the end of the 1990s and 2008, was characterized by increased world demand for iron ore. This fact is reflected in the expansion of Bento Rodrigues towards the highest region of the village and the densification of the southwest part. The fourth period comprises the financial crisis from the end of 2008 until the dam rupture in 2015 – a period that manifested little development in the village.

The constructions during the initial period followed a recurrent urban model and were typical of most buildings found in the first half of 18th century Minas Gerais. According to Vasconcellos (2004: 23), an analogy can be drawn with the indigenous constructions known as *"tejupabas"* which can be considered the original type or starting point for civil state architecture. These one-room residences were composed of four *pau-a-pique* (wattle and daub) walls, two wings roof and a door. Vasconcellos points out that this type of building had nomadic origins and constituted a system of rapid construction that used materials easily found in the vicinity.

More elaborate and aesthetic constructions gradually appeared as the population established its permanence. With increased needs and the provision of financial resources, what had once been a single room was transformed to meet the demands of the residents. Thus began to appear side by side, the dormitory and the living room with openings from the front facade to the outside. Occasionally, there were doors leading to the yard or evidence of balconies to the rear of the houses (Figure 1).

The original and basic types and the enlarged single-storey house are examples of the first morphological period of Bento Rodrigues. Later modifications, as quoted by Vasconcellos (2004), would respond to the needs of the residents and manifest themselves as processes specific to typological analysis.

The only example of an original type was identified in Bento Rodrigues. The approximately 30m² building hada four wings roof with only one door and window on the front facade and two other windows on one of the side facades. There was also a small rear porch that opened on to the yard.

Derived from the original type, the basic type was defined as the most representative archetype within the urban network. In Bento Rodrigues, the one-story house was the example

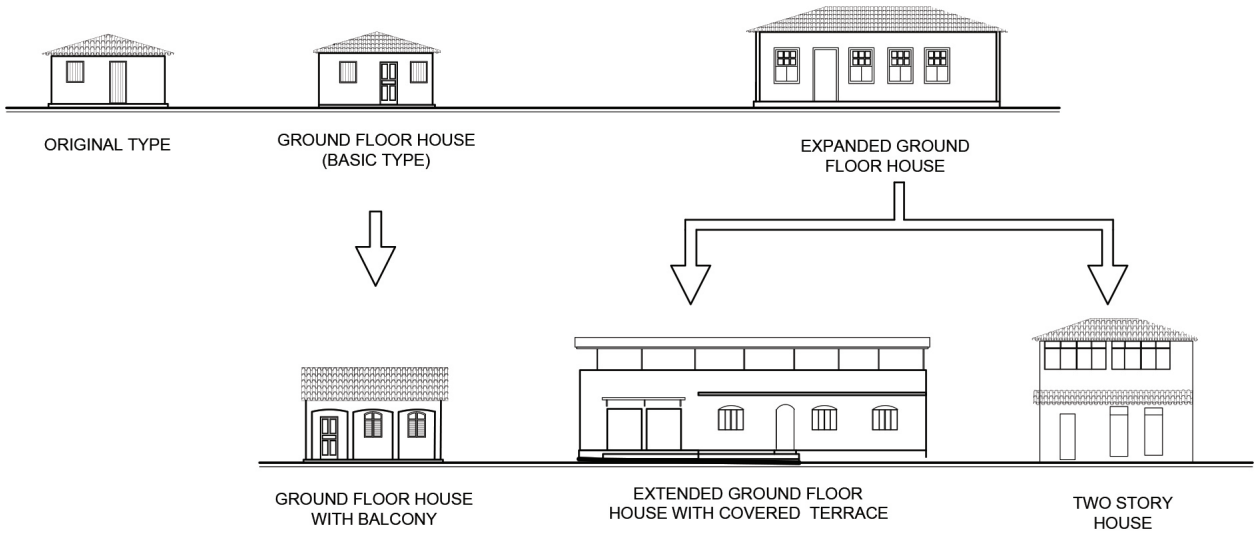

Figure 1. *The Typological process in Bento Rodrigues. Source: Landscape Laboratory, 2019.*

with the highest number of occurrences and, therefore, could be determined as the basic type, according to the guidelines of the typological analysis. Its structure did not differ much from the original type, except for the inclusion of a window on the front façade, suggesting greater internal compartmentalization. In this case, the lower floor consisted of a rectangle of 8 x 6 meters, the front and rear façades being the largest. The internal division presented a living room directly connected to the outside, and next to it was a room whose window faced the street. The rest of the room was composed of one or two bedrooms, a combined living room and kitchen and a bathroom. The kitchen was a very significant element, mainly due to the presence of the wood stove, which in addition to its usual use was, in most cases, a meeting place for family and neighbors on cold nights. In addition, another unique feature in these homes was the absence of a hallway.

These characteristics were not completely dominant but, in general, they represented traces of the culture of Bento Rodrigues over more than three hundred years of existence. They were not limited to housing models but reflected habits of the population, whilst architectural projects, in the case of the majority of the residents, had almost finished. As such, research on the types of the former settlement did not directly contribute to the design of the new residences. However, the types not only transformed themselves, the residents also contributed with the consequent re-signifying of the cultural legacy (Figure 2).

Every period of time produces differentiated types that, according to the Italian School, are portrayed in the modifications of the basic type, which characterize their diversifications and variations. The former are classified as diachronic and diatopic. The diachronic occur as modifications in the basic type, located in the same cultural area, but in constructions from different periods. On the other hand, diatopic diversifications are modifications of the basic type that reflect different elements and vary "according to the cultural and architectural heritage of different areas in the same period of time" (Pereira Costa, Gimmler Netto, 2015: 159). Synchronous variations occur in the basic type as a function of their adaptation to the urban fabric and the

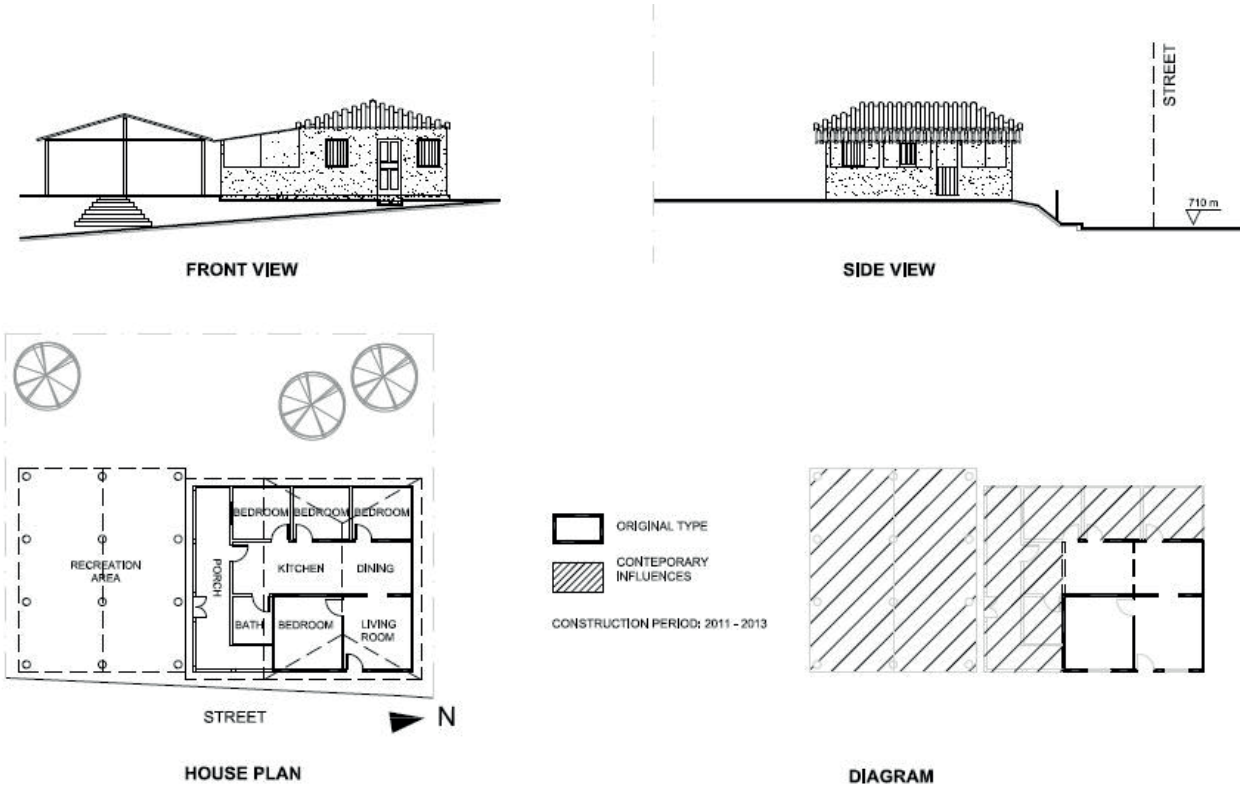

Figure 2. *A single-storey house: the basic type in Bento Rodrigues. Source: Landscape Laboratory, 2019.*

synoptic ones are transformations of the basic type occurring as a consequence of social and cultural needs.

Simultaneous synchronic and synoptic variation of the basic type, as exemplified in the enlarged one-story house, manifested itself significantly in Bento Rodrigues. Modifications were clearly evident with the addition of two windows on the front facade. These units also had the largest number of rooms and a dining room separated from the kitchen (Figure 3).

In the second and third periods, from 1977 to 2008, which paralleled the boom in iron ore mining and thus manifested a strong external influence, diachronic diversification emerged as the main characteristic of the changes that occurred, in which, the external elements stood out on the facade. The arched veranda became a striking element of the one-story house to which was added a tiled roof, whilst the front facade manifested a frame containing the windows and door.

The enlarged one-story house also featured the diachronic diversification characterized by a covered terrace without railings, or a second floor added as part of the house enlargement. It is important to emphasize that these residences maintained the characteristic core and incorporated aspects that conferred on them a certain "contemporaneity": a front veranda with archway, a covered terrace or second floor, a kitchen integrated into the canopy (divided by a half wall), frontal clearance and hallway, among others. These elements reflected relatively recent and external influences on the village culture – in combination with the desire for the new and the attachment to tradition. Consequently, the facades were characterized by changes in frames and doors or the construction of front balconies (Figure 4).

The last period, which covers the interval between the years 2008 to 2015, did not manifest significant transformations with regard to types. However, it can be observed that some res-

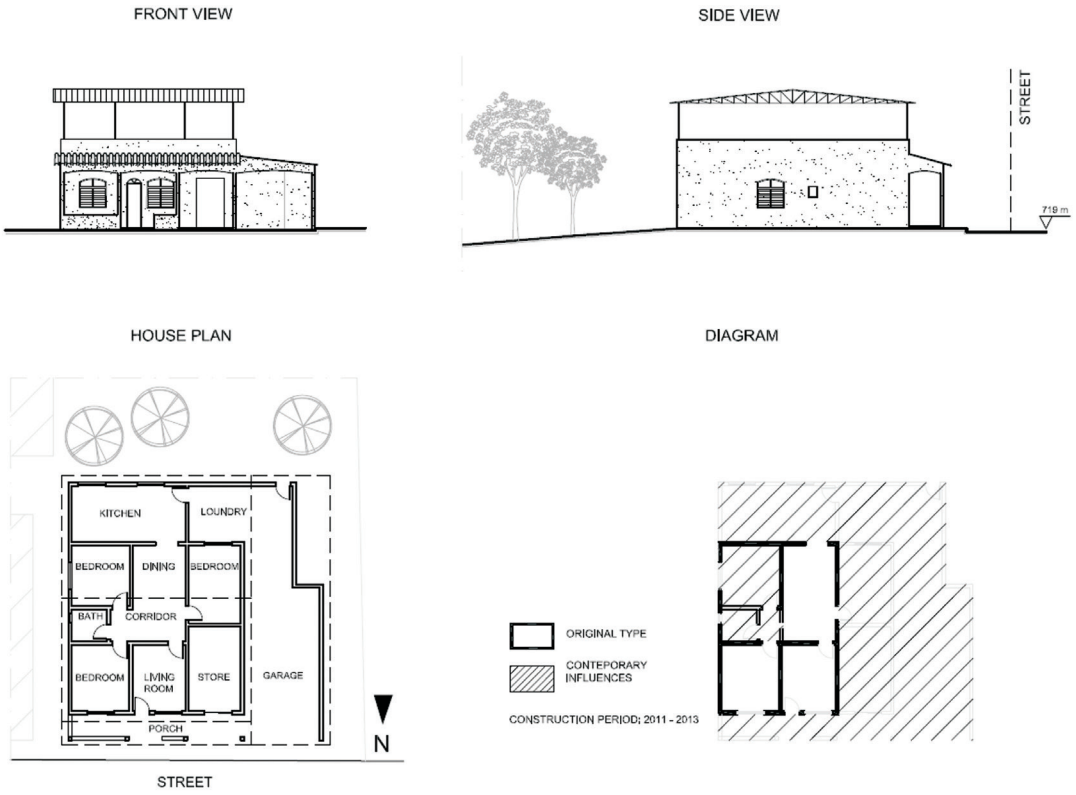

Figure 3. *A house with enlarged floor space: synchronic and syntactic variation of the basic type. Source: Landscape Laboratory, 2019.*

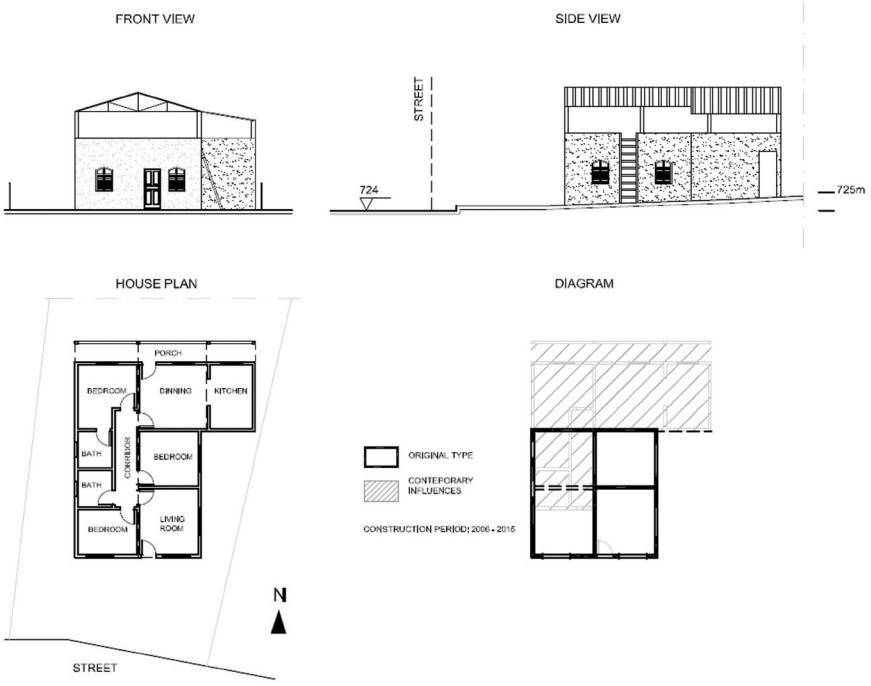

Figure 4. *A larger single-storey house with balcony and covered terrace: diachronic diversification of the enlarged single-storey house. Source: Landscape Laboratory, 2019.*

idences added a second floor, probably to house families formed by newly married offspring. This aspect was evident in the interviews granted by those affected by the mining disaster and verified *in loco*.

The study of the types also verified the issues related to the immediate building surroundings, or better, their implantation on the plot and the diverse activities realized there as appropriate for this integral part of the type. The interviews provided corroboration that the majority of the inhabitants had a garden, an orchard and raised small animals such as ducks, chickens and even bees. Some of the orchards had hundreds of trees with several species whose fruits were used to make jams, jellies, wines and spirits, all of which contributed to family subsistence.

Brosler and Bergamasco (2013: 23) highlight how rural ways of life represent an appreciation of popular knowledge which are imprinted on the constructive techniques and perpetuated up to the present day. It is from this perspective that the study of types constitutes a fundamental tool, not only for the reconstruction of materiality, but also for the reestablishment of cultural practices.

3. Perspectives for the new settlement

The urban project for resettlement was formulated on the results of a survey of expectations developed with the population. The selection of the area was also carried out in a participatory manner and decided by ballot. Currently, the process of village reconstruction is under development with completion forecast for 2020, according to the *Renova* Foundation [1](Renova Foundation, 2019).

Although the new site has different topographic and environmental features which contrast with the old village, the cultural references should contribute to the process of resettlement being smoother and less traumatic. Thus, the study of types listed the main aspects of dwellings on the destroyed site, where the basic core of the original type, which reflected Muratori's "spontaneous consciousness", prevailed in the building plans. There was thus the presence of arched balconies and an emphasis on the absence of hallways and facades. Elements such as the backyard, the wood stove and the houses in line with the stre*et al.*so stood out, allowing easy social interaction between residents. It is important that such characteristics should remain in the residences of the new settlement so that cultural and social conviviality may guarantee the sense of belonging within the community.

4. Acknowledgements

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1. The Renova Foundation is a private nonprofit making organization. It was constituted on March 2, 2016, by a Transaction and Conduct Adjustment Agreement (TTAC), and began operations on August 2 of that year. It has as its remit the repair of the damage caused by the rupture of the *Fundão* dam, which took place in November 2015 at the Samarco mining facility located in Bento Rodrigues – a town of Mariana sub-district in the state of Minas Gerais, Brazil.

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Research on the Catalytic Effect in the Urban Regeneration from the Perspective of Urban Morphology

Case Study and Practice

by Zhang Qu & Yichen Zhu
Tongji University

Keywords: Cultural Facilities, Urban Morphology, Catalyst, Urban Regeneration.

Abstract: Since the rapid urbanization in many cities around the world, it is required more urban space for the further development. In the regeneration process, introduction of cultural facilities plays a crucial role. Based on the urban catalyst study, the cultural facilities could increase the activities and attract economic investment. With the urban catalyst theory, the thesis provides a new respect to study urban morphology issue. It extends the potentialities of relational theories for urban studies as well. Moreover, at the end of the study, there is a conceptual urban design practice in Sijiqing District, Beijing, which illustrates the possible changing of the urban morphology by cultural catalyst.

1. Catalyst Effects in the Urban Regeneration Projects

In China, thanks to the rapid urbanization process, more urban space is required for further development. To solve this problem, on one hand, the city is expanding with new infrastructures and facilities constructed on the outskirt. On the other hand, declining areas are regenerated in order to make full use of the existing buildings. Of these two solutions, the latter process is more complicated and restricted than the former.

798, one of the most famous art districts in Beijing, is known as a successful case of regeneration in industrial area. It was once a state-owned electronic device factory. With the introduction of creative industry, 798 was gradually developed and the factory buildings were changed into galleries, art centers, artists' studios, and restaurants. The pattern of 798 was regarded as a model that could be emulated. A number of duplications are emerging in other cities, such as 791 art district in Nanchang and the Hongfang. As a part of urban regeneration plans, these projects are not merely cultural projects with art studios and other creative industries, but also commercial projects with apartments and SOHO.

The introduction of cultural facilities plays crucial roles in revitalization of decaying districts, and it could attracts more investment in the vicinity. At the same time, for local residents, the construction of cultural facilities improves their infrastructures and living environment. (Robert, 2000) Thus, cultural projects being catalyst is considered to be an effective approach in regenerating declining area. At present, an increasing number of cultural projects offer great

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opportunities to catalyze the urban regeneration. However, in certain cases, the cultural facilities did not spur other projects on the site as expected. On contrary, they were isolated from the surroundings. In Beijing, there are over 30 creative industry parks and more than 100 art studios based on antiquated factories or warehouses. Yet a large number of them are running down, some are even closed and the buildings fall into disuse again. According to visit study, two key factors have been adduced to explain this depression. One is the inadequacy of various groups. In certain cases, the regeneration was directed by top-down plans which attempted to implant creative industry on the flat ground. Yet, it ignored the principle that a well-operated cultural projects in the city required organic growth. The other factor is inflexibility of function. The business in those cases was no more than art studios and galleries. There was lack of emphasis on the need of local residents. As a result, the development of renovation area left much to be desired. Therefore, it is necessary to find out what is the key issue in a successful regeneration led by cultural projects, and how could cultural facilities attract more people and investment.

2. Rethinking of Catalyst Theory from the Perspective of Urban Morphology

To cope with this issue, urban planners and architects conduct researches in various ways. Urban catalyst theory is one of these studies, and it provides a unique respect of design strategies in the regeneration (Attoe, 1989). It regards the renewal process as a chemical reaction, and it concentrates on the interrelationship between new projects and various urban elements. In a few theses on urban catalyst, researchers are convinced that introduction of cultural projects would revitalize the decaying neighborhood. And practices of culture-led generation in Europe and America confirm this opinion (Levine, 1997).

2.1. *Regeneration Projects in the Consideration of Urban Morphology*

Commercial renovation of traditional neighborhoods is one of the key activities among the current urban renewal. As the most vigorous and dynamic city region, commercial district is often a most significant carrier of urban cultural memories and inheritances. The renovation of traditional commercial district provides a positive catalytic effect on the surrounding areas, and could soon stimulate the overall regeneration of the urban environment. Combined with unique cultural and historical resources, the transformed commercial district could produce chain reactions, promoting tourism and real estate development and becoming a popular and vibrant area itself.

After the War II, European countries and the United States have replaced the existing historical spatial programs through the renewal of commercial districts. The regional structures are revived with systematically rearrangements and restorations, and the purposes of revitalizing the urban central areas are gradationally achieved. One of the examples is the Beursplein commercial pedestrian street in Rotterdam, the Netherlands. This project has combined the commercial development with the renewal of the city. To heal the split and the city, Jerde collaborated to create a pedestrian street below the six-lane traffic barrier. The regeneration projects takes urban morphology consideration. Under gently curving glass canopies that protect shoppers against inclement weather, Beursplein echoes earlier times when the neighborhood was an upscale retail arcade. Beursplein reintroduced living, shopping, and entertainment into the heart of Rotterdam (Bianchini, 1993).

Through the improvement of the landscape environment and the guarantee of the progressive development of the surrounding constructions, the regional value has been greatly promot-

ed, which has brought about the revitalization of the declined districts and organically strung up the important places within the central areas. A domestic instance of the renewal project is Shanghai Xintiandi. Combined with traditional cultures, it has replaced the habitable space of Shikumen with new programs such as cultural exhibitions, characteristic dining and drinks, which provides a modern interpretation of the historical urban memories (Figure 1).

However, in recent years, the economic benefits of historic commercial district have become a big draw. The tourism and business resources have been over developed, a number of transformation projects, in the name of restoration and renovation, have been brought up. The original historical architectures have been demolished, which displaced are new constructions in the style of antiquity. The street of Song Dynasty and the street of Qing Dynasty have presented one after another, and numerous valuable historical blocks are degenerated to a "sham". Although it could bring certain economic benefits in a short term, the lack of traditional culture and the undermining of the authenticity of the historical heritage could eventually lead to business depressions and neighbourhood declinations. At the same time, the dislocations of the inhabitants and the replacements with tourists and businesses have generated the loss of traditional life style and customs in the historic district, and thus, the loss of vitality. Using performed antique activities to supplant the original real activities in the historical districts is another sort of false behaviour in a certain sense. A truly effective and properly performing neighbourhood should be natural and dynamic, rather than a stage for people who are employed to act. This is in fact an even serious damage to the historical heritage.

2.2. *Catalytic Effect from the Perspective of Urban Morphology*

Hackescher Markt (Hackescher-market) is located in the centre of Berlin. Formerly a rather neglected place, Hackescher Markt with its old buildings has been developed into a cultural and commercial centre. Among these historical buildings, Hackesche Hoefe (Hackesche-courtyard), a notable courtyard complex, is the most famous one. During the war, the Hackesche-courtyard was damaged in air raids. Since 1990s, the area around Hackesche-courtyard has been a vibrant urban renewal place of the New Berlin. The regeneration project was carried out by Weiss and Partner. The structure of courtyard was fully preserved. And the façade was restored including the new addition of the arch at the entrance. The function, including residential areas, crafts,

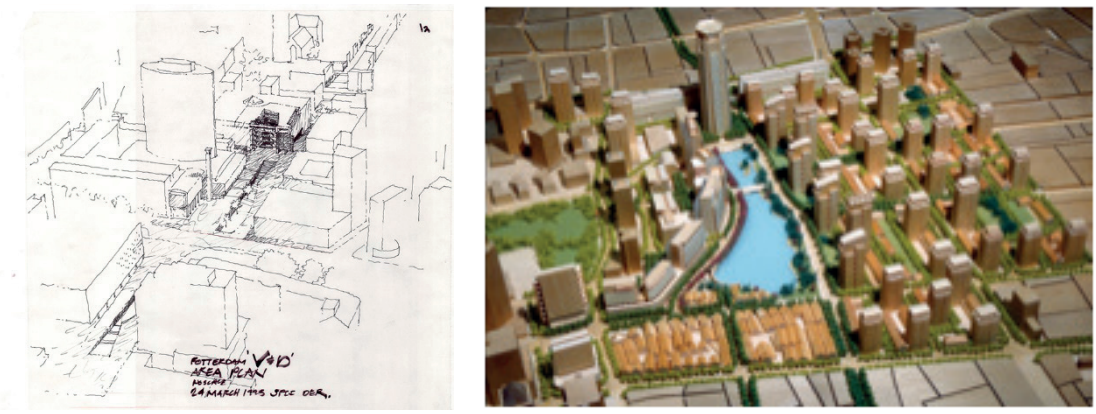

Figure 1. *Urban morphology in Beursplein project and in Xintiandi project. Source: (Left) Jerde Partnership, (Right) Skidmore, Owings & Merrill LLP.*

trade and culture was clearly organized in eight different courtyards. The successful project attracts thousands of visitors and citizens every year. The Hackescher-market indicates the five design strategies mentioned above.

The main purpose of regeneration is increasing vitality. As a catalyst project, it has to attract more individuals from external environment, and to release the flow outside (Attoe, 1989). It helps to bring positive effect to the surroundings and create more business opportunities. It is similar to the catalyst in chemical reaction. Thus, the location of the project should be chosen carefully, and it has to establish direct links between facilities. The Hackesche-courtyard is on the visiting route from museum isle to the business center. The courtyard has three entrances. The main entrance opens to the metro station and pedestrian area, which is crowded on market days twice a week. The rest two accesses guide the visitors to the Rosenhoefe(Rose-courtyard) and Sophienhoefe (Sophia-courtyard). There, the cultural atmosphere leads the visitors to walk through the courtyard. In small shops, they could find deliberated handcrafts. And cafeterias are popular meeting places. The continuous courtyards, like commercial corridors, chain the various activities. At the same time, the new accesses make shortcuts in the complex roads net. It is convenient to get to the metro station at a shorter distance. At the same time, the corridors bring more benefit to the backstreet, and lead to the development of neighborhoods (Figure 2).

To upset the balance in the decay area, a catalyst should have a creative cognition about the existing situation. For instance, the reuse of abandon buildings or landscape will spur the potential value of the field, and encourage others to invest in the following program. It is essential to the cultural project. On one hand, taking advantage of the urban remains is the best way to retain the memory for history. On the other hand, a number of cultural projects are funded by the government or foundations and the restoration of the historical architecture could save a large sum of money. The courtyard has been a typical housing in Berlin since the nineteenth century. A variety of courtyards consist the urban form in downtown area. In the traditional housing, the inner space belongs to the residents. The design of the Hackescher-market converts the private space into semi-public. The courtyard is not merely for storage and access, but multifunctional for commercial use, art activities and leisure. It becomes one of the most distinctive and creative places. This design strategy set an inventive pattern. In Munich, the Fuenf Hoefe (Five-courtyards), designed by Herzog and de Meuron, is a sequence of courts varying in size and shape with shops, restaurants and cafés. Though

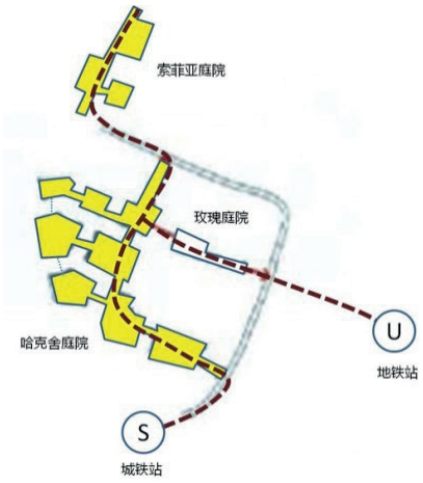

Figure 2. *Catalytic Effect from the Perspective of Urban Morphology. Source: (Left) Visit Berlin, (Right) the author.*

the stainless steel and glass furnish the interior faces, the existing structure makes a clear link to the tradition courtyard (Figure 3).

3. Design Practice

3.1. *Introduction*

Creative Beijing, a conceptual urban design project, applies the catalyst design strategies to the practice. The project is located in the West of Beijing. According to the planning, there will be one of the largest creative centres, in which it is purposed to construct the Broadway Theatre, creative studios, performing centers, residential area, etc. The existing properties on the site include automobile dealers, building material markets and urban villages.

The core projects are the Broadway Theatre and creative studios. They are given the priority in order to catalyze the overall regeneration. First of all, the large projects contribute to promoting the development plan and attracting more investigation. Then, the cultural facilities are proposed to foster art atmosphere. In addition, the increasing art and cultural activities will help to improve the living condition of the surroundings. With the development of art studios, it will encourage self-renewal of the private housing. Thus, the catalyst buildings push forward to the organic development on the site.

3.2. *Urban Morphology Study in the Design*

In the urban design phase, it mainly focuses on the foreseeing of the regeneration. The diagram illustrates how the project probably runs with the catalytic effect. The first step is introduction of catalyst. A former factory is moved to make room for the new theatre. At the same time, landscape architects create an active space for opening shows and other activities. The next step is promoting creative industry. The automobile sales are altered into experimental theatres which can hold dozens of audiences. The renovation projects lower the expense so that the young artists can afford to rent for exhibition and performance. The third phase is improving infrastructures. One of the significant programs is to organize shuttle bus service. In this phase,

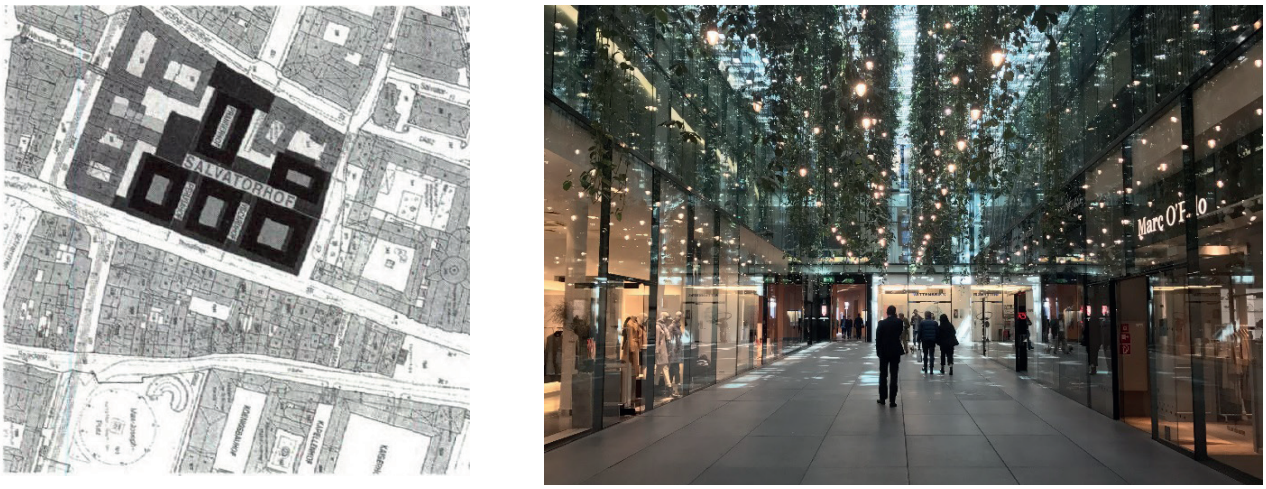

Figure 3. *Urban Morphology Study of the Project. Source: (Left) Herzog de Meuron , (Right) the author.*

commercial estate is involved in the following project, which ensures a sustained and sound development. At last, with an increasing number of individuals, residential project starts construction. The regulation supports mixed-use housing and self-renovation. Both measurements are beneficial to the bottom-up regeneration. The urban design result demonstrates a possible outcome of catalytic effect (Figure 4).

4. Architectural Design Phase and Catalytic Effect

In Creative Beijing, the cultural projects play a key role as catalyst. According to the study above, the five design strategies are present in the architectural design. A few particular instances are taken below (Sternberg, 2002).

4.1. *Attraction and Release*

The Broadway theatre will bring a great deal of visitors. Supposing that all the activities are limited in the hall, then the project can hardly catalyze the surroundings. Thus, the lobby is designed into a communication space. Looking out of the bay window, the audience will get in close touch with the sight outside. Furthermore, the sheltered platform provides a place for opening show. And the green pedestrian leads the way to the art district.

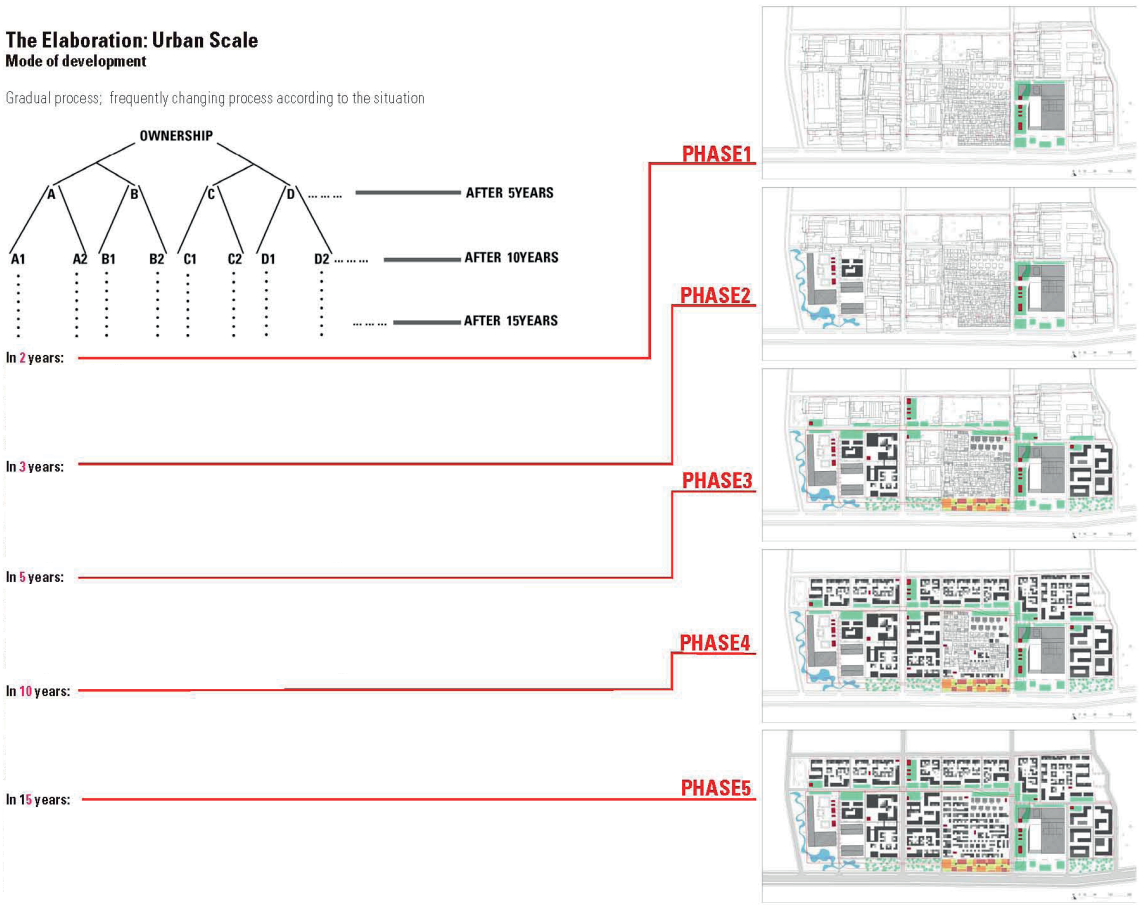

Figure 4. *Urban Morphology Study in the Design. Source: the author*

4.2. *Enjoyment*

The Broadway Theater does not merely bring joy on the stage, but also lead to various kinds of performances outside the theater. For instance, a theme park could exhibit posters and scenes of famous musical drama. It provides a temporary stage for drama amateurs. And it is also a direct way for the public to learn about art.

4.3. *Exemplary Design*

The creative center is purposed to be another catalyst building. It is based on a former car accessory market. In the restoration, the frame structure is preserved and the space is divided into standard 6m*18m units of two stories. The artists could arrange the functional parts in different ways, such as small offices, photo studios, exhibitions, living rooms, etc. The elevation, likewise, is designed by the tenants. The non-coincidence design reflects multicultural spirit in this district, and it has a possible influence on other projects as well.

4.4. *Cultural Atmosphere*

The creative center needs an atmosphere filled with art. The site is located in the south of the Yuanmingyuan. Since 1990s, young artists and freelance started to live and work around. Gradually the place was well known as an art village. From then, this district attracts a growing number of artists to settle down. The Creative Beijing offers opportunities for them, especially for the grassroots, to promote their artworks.

4.5. *Field Cognition*

Compared to large performing center, the form of the experimental theater is more flexible, and the operation cost is lower. The theater is converted from the car sales center. There are six buildings in this area, and most of them were built in the last decade. The theater takes advantage of the former exhibition hall. In addition, these scattered theaters help to catalyze the development in the surrounding.

5. Conclusion

The study concentrates on the interrelationship between new projects and various urban elements, which both make influence on the emerging urban form. According to the case study, the thesis would like to discuss two issues: how to observe the catalytic effect from the perspective of urban morphology, and how the cultural catalyst could be more effective to spur the surrounding development. In urban and architectural design, it is better to follow the five design strategies. By those meanings, it would be more effective for cultural facilities to spur surrounding development. With the urban catalyst theory, the thesis provides a new respect to study urban morphology issue. It extends the potentialities of relational theories for urban studies as well.

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Smart Plot Division

A Plot-based Strategy for the Refurbishment of Chinese Historic Urban Areas

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Keywords: plot division; historic urban area; urban refurbishment; plot pattern.

Abstract: Chinese historic cities have experienced drastic transformations since the socialist revolution of 1949, in which an essential change is the reconstruction of the plot pattern. The historic plot pattern in a majority of Chinese cities was heavily damaged by constant urban renewals, while the renewed plot pattern lost its historically morphological identity. The transformation of plot pattern is directly influenced by plot division which serves as not only a planning apparatus but also a key link in the land development system. The damage of historic plot pattern has shown that the current plot division mechanism is not necessarily in favor of the conservation and continuation of historic cities. Taking Nanjing Old South area as an example, this research analyzes the plot division mechanism which is widely applied in the renewal of Chinese historic urban areas. The current plot division mechanism, established under the land banking system is in favor of generating megaplot. In many cases, plot division is made based on specific projects, typically accompanied by deficient control on urban form. In this sense, it is necessary to establish a set of smart plot division strategy to promote the refurbishment of the historic urban area. Smart plot division aims at not only protecting and continuing the historically morphological characteristics but also fulfilling diversified land development needs in the historic urban area. The essence of the strategy is five patterns of plot division, corresponding to different land development intensity and morphological characteristics.

1. Introduction

Plot division is not only the foundation for establishing the index system of regulatory planning but also the main element in constituting the urban space. According to Conzenian urban morphology (Conzen M.R.G, 1960; Whitehand J.W.R, 2001), street pattern, plot pattern and building footprint constitute three main morphological elements of a town plan. On the other hand, plot division has a direct influence on the creation of good urban space, as practically the zoning plan or regulatory plan take control of three-dimensional urban form through plot based control indexes. Therefore, plot subdivision should not be left to chance, or determined by the particular market pressures of the moment, but should be planned intelligently, deftly and judiciously as an integral part of master planning and with the positive intent of generating place diversity (Adams, 2013).

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Nanjing South Historic Urban Area, also known as Old South area, is located in the south of Nanjing old city. Covering an area of 6.9 km^2, it was long in history the main civil life area and industrial and commercial center of Nanjing (Zhou and Zhang, 2010), preserving a large number of historic sites, monuments as well as the traditional cityscape. Since the 1980s this area experienced a large scale urban renewal, leading to a great transformation of historic urban form, especially the plot pattern. As most historic urban areas have been heavily damaged in the urban renewal, an urban refurbishment is considered increasingly urgent. Consequently, National Housing and Construction Department launched the Program of Ecological Rehabilitation and Urban Refurbishment in 2017, in which historic urban area is the main focus for urban refurbishment[1]. Taking Nanjing Old South Historic Urban Area as an example, this research makes a reflection on the plot division mechanism under growth supremacism. Under this background, the main issue is discussed that how a smart plot division strategy can be established to promote the refurbishment of the historic urban area.

2. Megaplot mode: a plot division mechanism for growth

Chinese cities established the state-owned land system in the 1950s, urban development in that period was generally based on specific projects which were determined by the unified governmental development plan. In a long time, there was not a developed plot division mechanism in Nanjing. The construction land of urban development could only be obtained from administrative land allocation. A typical case is two large scale industrial plots located in the southwest corner of the Old South area. Above all, the plot of Nanjing Cotton Mill is as large as 11.4ha, while the plot of Nanjing Printing and Dyeing Mill is 8.5ha. As both the factories were developed by the municipal government as key projects, the construction land was allocated through specific administrative approval. In this sense, most considerations were taken on practical requirements of industrial development, rather than the protection and continuation of historic urban form.

The rapid economic growth of China started from the 1990s. Since then the growth itself has become an imperative for governance, and it largely depended on land development. Under the Land Use Rights System, land supply is a powerful tool for local government to intervene in land markets, and proceeds from land supply greatly contribute to local revenue and financing of infrastructure construction. Under this background, urban planning was regarded as a tool to promote growth, and land leasing has become a major goal of making regulatory planning. The Technical Regulation of Nanjing Regulatory Planning in 2005 proposed three principles for plot division, including (1). The integrity and coordination of land use; (2). Clear land property: and (3). The convenience of land leasing. The third principle especially shows a trend of growth supremacism.

Megaplot mode as the core of the growth supremacist land development has three aspects of connotations: (1) the generation of the megaplot; (2) setting fewer control indexes on the urban form; and (3) project based plot division (Table 5.14). In order to attract investment, regulatory planning exerts minimum control on the spatial form of the urban (re)development. Compared with the zoning system of the United States, Chinese regulatory planning does not establish a developed standard of plot division. For example, there lack regulations on key indexes like

1. National Housing and Construction Department launched the Program of Ecological Rehabilitation and Urban Refurbishment in 2017, in which historic urban area is the main focus for urban refurbishment.

plot size, plot width as well as the rules of plot arrangement. In the 1990s, the Land Use Right system (LURs) regulates four ways of land leasing, including negotiation, auction, bidding, and listing. However, in a majority of cases, the municipal government tended to lease the land to developers in the way of negotiation which generally required much less land transferring fee than the other ways. On this condition, plot division was actually a compromise between the local government and the developers, which also explains the reason why developers sometimes can get large-scale land through the negotiation with the government.

It is since 2002 when Nanjing established the Land Banking system that plot division truly became a specific institutional procedure in regulatory planning. The municipal government makes the annual plan for land expropriation. In cooperation with regulatory planning, the expropriated land is redivided and released to the land market. Despite an improvement of the governmental control on the land market, Land Banking system has further promoted the megaplot mode. According to the statistics, more than 90% of plots redivided in the historic urban area since 2002 are larger than 5000m2, in which 9 plots are larger than 10000 m^2 [2].

3. The disintegration of the historic plot pattern

The plot division mechanism under growth supremacism, lacking effective protection of the historic urban form, has led to a radical transformation of plot pattern in the historic urban area. Megaplot becomes the dominant type in the land structure, while the traditional pattern of plot subdivision is eliminated.

The traditional plot pattern of the Old South area is composed of a large number of small scale plots. For example, a typical two-courtyard compound covers an area of about 600m^2 (Figure 1). Above all, the plot width is an important morphological index. The traditional plot has a small plot width, generally ranging between 10m and 16m. They are arranged along the street, forming a rhythmic plot series. Several plot series are filled in a block, constituting the subdivided plot pattern which is a typical feature of historic urban form.

Taking fewer considerations on the morphological integration with the historical environment, plot division under growth supremacism brings about a radical growth of plot size. According to the statistics, a majority of renewed plots are larger than 5000m2, which becomes the threshold value in defining the megaplot in the historic urban area. What's more, the trend of the megaplot is reinforced over the years. Taking the commercial plots as an example, the commercial redevelopment in the 1980s and 1990s was usually characterized by low-rise and mid-rise buildings with relatively low development intensity. A typical commercial plot during that period was about 3000 m^2. By 2000, the size of the commercial plot had a remarkable growth because of the prevalence of tower mode. Even so, a minimum plot subdivision in a block could still be kept. By the late 2000s when the commercial complex mode became popular, commercial redevelopment was completely based on the megaplot. For example, the Plot G4 along Zhongshan Road South, deriving from an amalgamation of three traditional blocks, reached an area of 38000 m^2 (Figure 1).

The growth of plot size results in a continuous reduction of plot number in one block, finally leading to the elimination of plot subdivision. Actually, plot series is important in keeping plot subdivision. It preserves the small plot scale and similar plot shape, and it also provides specific rules for the arrangement of plots. However, the plot division mechanism under growth

2. The statistics are from Nanjing Land and Resource Bureau (http://www.landnj.cn/LandBargainInfo.aspx).

Figure 1. *Growth of commercial plots in the historic urban area. Source: Own figure.*

supremacism cannot effectively preserve and continue plot series. Taking Mendong historic district as an example, a majority of its north section has been renewed due to the road reconstruction. The renewed plots range from 4000 m² to 6000 m², measured in the block without subdivision. The refurbishment of Plot Changledu in the southwest part was made after 2010, aiming at refurbishing historic urban ground plan and recover the traditional building scale. However, the refurbishment did not result in the plot subdivision. Instead, a megaplot was created in the demolition of the historic district. It is clear to see the big difference between the southern traditional plot pattern and the northern renewed one (Figure 2). In fact, this fragmented and megaplot-based land structure has been a typical morphological characteristic of contemporary historic urban areas, which not only undermines the traditional urban form but also suppresses the optimization of land structure and the quality of urban space.

4. The inefficient control on the spatial form

As Chinese regulatory planning system takes control of spatial form through plot-based indexes, plot division has a direct influence on the spatial form. However, the current plot division mechanism under growth supremacism leads to an inefficient control on the spatial form, obstructing the protection and continuation of historic urban form. Above all, inefficient control is mainly shown in two aspects: the building siting and the building form.

Traditionally, the building siting depends on the relative position of the building to the street frontage (Figure 3). Buildings are positioned on the street frontage, and share a common wall with adjoining buildings. This close plot-building relationship is the main reason to form the continuous street corridor which is a prominent morphological feature of the historic ur-

Figure 2. *Transformation of plot pattern in Mendong historic district.*
Source: Own figure.

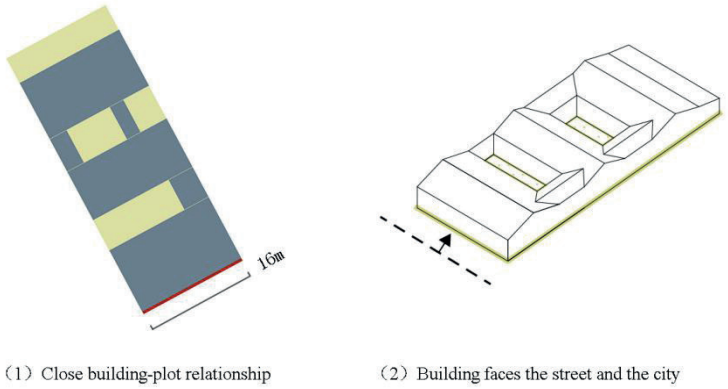

Figure 3. *Building siting under the traditional urban form.*
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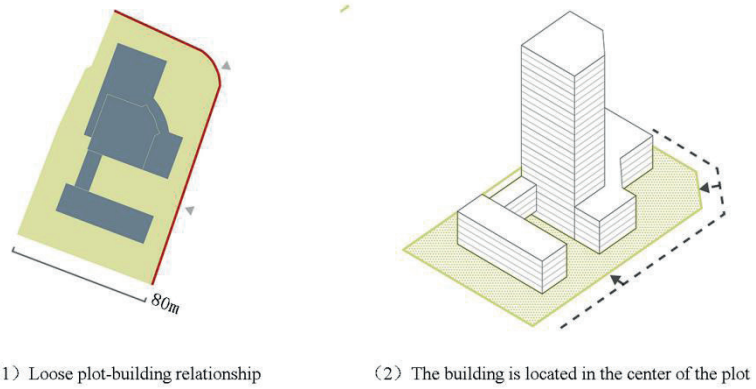

Figure 4. *Building siting of a commercial megaplot (Plot ICBC along Zhongshan Road South).*
Source: Own figure.

Figure 5. *Fragmented urban fabric of Old South area(Overlapping of the plot pattern and the building footprint). Source: Own figure.*

ban area. However, current regulatory planning only delimits the buildable area in the plot by setting the building setback line. As there is no compulsory build-to line set in the plot, the building siting becomes very ambiguous (Figure 4). For example, the current regulations on building siting don't answer questions like whether the buildings should be positioned on the street frontage, or which proportion of building facade should be positioned on the street frontage. In fact, the ambiguous building siting despite giving more flexibility to architecture design neglects the control and protection of historic urban form. Instead, more consideration is taken on functional issues. Buildings are more sited on the center of the plot rather than facing the street, which can be seen in many cases in the Old South area.

The control on the building form should cooperate closely with the urban design. However, the Old South area lacks an overall urban design for a long time. Within the individual plot, the architecture design is only regulated by basic planning conditions, including the building height limit and the building setback distance, taking a few considerations on the integration with the overall urban form. As a result, a fragmented urban fabric is formed (Figure 5). Currently, many different building types coexist in the historic urban area, but some of them can not fit for the historic urban form, including the highrise buildings, commercial complex, as well as industrial buildings. This problem is mainly manifested in the building height and the building layout. The regulation on building height limit was not established in the Old South area until 2000, and it has been readjusted for several times due to the changeable development orientation of the historic urban area. Thus, the practical control effect has been weakened. As a result, building layout has nothing to do with plot division, not mention with the street pattern (Frick, 2015).

Regulatory planning was originally established to solve problems of vast new development and constructions during the urban sprawl. Targeting the development of new towns, many regulations emphasize the flexibility instead of the rigidity so that the construction efficiency could be increased. However, these regulations are not necessarily fit for the protection and

renewal of historic urban area where a large number of morphological elements should be protected and transformed into compulsory plot-based morphological regulations in the regulatory planning.

5. The smart plot division strategy

In short, the plot division under growth supremacism damages the historic urban area in three aspects: (1) The prevalence of the megaplot leads to the elimination of the traditional plot subdivision, one basic morphological characteristics of the historic urban form; (2) The project-based plot division and land allocation mechanism fail to improve the land structure and the quality of urban space; (3) The rough control on spatial form aggravates the fragmentation of urban form. After 2010 the Old South area witnessed a change of development principle and started the overall conservation of the historic urban area. Under this background, the refurbishment of the historic urban form has become the main goal of urban development. It becomes more urgent to establish a smart plot division strategy to promote urban refurbishment (Table 1).

5.1. *Principle 1: Protecting and continuing the morphological characteristics*

Smart plot division strategy follows two principles. It should foremost protect and continue the morphological characteristics of the historic urban area. In order to integrate the smart plot division strategy with the existing regulatory planning system, the control of urban form should also be taken through a plot-based index system. Above all, this system includes three main indexes including plot shape, building siting, and building form, and each of them has subordinated indexes.

The primary goal of plot shape control is to protect and continue plot subdivision, the essential historically morphological feature. However, as the historic urban area is an evolving organism, apart from a few historic districts that should be strictly protected, vast general areas need to be refurbished or renewed. Due to the difference in development requirements,

Table 1. *Comparison of two modes of plot division. Source: Compiled by the author.*

Main characteristics	Plot division for growth	Smart plot division
Background	Redevelopment of the historic urban area	Refurbishment of the historic urban area
Plot-scale	Megaplot based(5000m2)	Medium and small plots based
Control of urban form	Minimum control on urban form	Conservation of historic urban form
Principle	Project-based	A balance between the historic conservation and the diversified development

the intensity of control on plot shape varies in different districts. Therefore, it is necessary to establish a multi-level strategy for the protection of the historic plot pattern.

In the Old South area, a three protection levels of historic plot, plot series and plot subdivision should be established, corresponding to different morphological zones in the historic urban area. Above all, the historic plot is the most strict protection level, emphasizing the protection of plot width, plot shape, and plot size. Plot series is key to form a regular plot pattern. In this sense, the protection of the historic plot pattern is based on the continuation of the historic plot series. Plot subdivision is the basic prerequisite in keeping the morphological feature of the historic plot pattern. Thus it is required to remain the plot subdivision as much as possible in the redevelopment of the historic urban area.

The other goal for the refurbishment of the historic urban area is to create a continues street corridor, making buildings face the street again instead of being self-centered. The key to realizing this goal is to establish a proper way of building siting. Learning from the tradition, building siting in the historic urban area should depend on the relative position of the building to the plot frontage. This principle can be further translated into three control indexes, including the setback distance, the proportion of the building facade that should be located on the building line, and the building interval.

Apart from the building siting, building type is also an important element to create a continuous street corridor. Building type contains two subordinated indexes, including building height and building (ground plan) type. The current conservation planning of the Old South area has already made strict regulations on the building height limit. But more considerations should be taken on the appropriateness of the building types if they can be integrated into the historic urban area. Especially, each morphological zone of the historic urban area should be designated with acceptable building types.

5.2. *Principle 2: Fulfilling diversified land development requirements*

Different from the historic districts which are relatively small scale and emphasize more a strict conservation, the development of the historic urban area should take full consideration of the functional and spatial diversity. As most of the Chinese historic urban areas range from 10km2 to 20km2, it means that apart from the historic conservation areas, a large proportion of the historic urban area needs to be renewed. Faced with the diversified development requirements, it is not encouraged to recover the nostalgic urban ground plan. Instead, it is better to establish a smart plot division strategy which has several plot patterns in meeting diversified land development requirements.

American Smart Code provides an important reference to Nanjing historic urban area on how to establish a multi-type plot division strategy. In recent years, more and more American cities have adopted Form-based Codes to replace the traditional zoning system in order to improve the control of spatial form (Talen, 2009). Above all, the Smart Code originally developed by Duany and Plater-Zyberk is the most representative Form-Based Code. It is a unified land development ordinance template designed to create walkable neighborhoods across the full spectrum of human settlement, from the most rural to the most urban, incorporating a transect of character and intensity within each. The essence of Smart Code is the Transect Zone. Based on ecological theory, it segments the rural-to-urban continuum into discrete categories that fit within the language of the current approach to land regulation (Duany. *et al.* 2009; Wang, 2013) (Figure 6). The standards of categories ensure that each zone has appropriate morphological characteristics and development intensity for its location.

Learning lessons from the Form-based Codes, the Old South area can be divided into four types of urban space, including historic districts, traditional areas, general redeveloped areas, and commercial centers. Besides the differences in urban function, development intensity, as well as building form, four types of urban space have different plot patterns, constituting a gradual transition from the traditional small scale plot pattern to the megaplot pattern. Meanwhile, each type of urban space has its own focus on the protection of the historic plot pattern:

(1) Historic districts: Protecting the historic plot pattern;

(2) Traditional areas: Respecting and protecting small scale plots and the morphological feature of plot subdivision, and encouraging the refurbishment of damaged plot pattern in traditional areas.

(3) General redeveloped areas: urban redevelopment should promote the development of medium scale based plot pattern. Plot subdivision as a basic morphological characteristic should be kept as much as possible in the plot redivision.

(4) Commercial center: Megaplot is also necessary for the development of the historic urban area, but its proportion should be strictly controlled. Meanwhile, it is encouraged to make a subordinate subdivision of the megaplot, creating small blocks to confine the building volume in the megaplot.

5.3. *Strategy: Transect of Plot Pattern*

Smart plot division strategy aims at not only protecting and continuing the morphological characteristics of the historic urban area but also fulfilling the diversified requirements of urban redevelopment. The former principle requires to establish a three-layer strategy for the protection of plot pattern, including historic plot, plot series, and plot subdivision. The latter requires to establish a multi-type plot division strategy in meeting the different development requirements. Under this background, a transect of plot pattern is proposed. It consists of five scenarios from the conservation area to the redevelopment area, including (1) Historic plot pattern; (2) Hybridization pattern; (3) Redivision pattern; (4) Megaplot based refurbishment and (5) Megaplot based redevelopment (Figure 7, Figure 8, Table 2).

The five types of plot pattern correspond to different locations, development intensity, and morphological characteristics, reflecting the requirements of developing a mixed and comprehensive urban area. Above all, Historic pattern and Hybridization pattern, characterized by the small scale plot, are mainly located in areas with traditional cityscape. Historic plot pattern with the highest protection level should protect the historic plot pattern strictly. Hybridization pattern should protect the morphological characteristics of plot series.

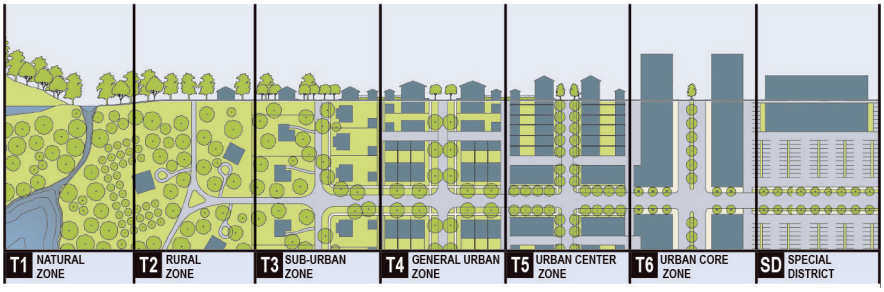

Figure 6. *Rural-to-urban Transect proposed by Smart Code. Source: Duany et al. 2009.*

As their plot patterns don't need to be redivided, the main ways of intervention are protection and minor readjustment. In comparison, the other three patterns of Redivision, Megaplot based refurbishment and Megaplot based redevelopment are located in redevelopment areas. They all derive from plot redivision but have different development intensities. Redivision pattern mainly developing medium scale plots, should maintain the characteristics of plot subdivision. Thus it is a preferred plot pattern for the redevelopment of the historic urban area. In addition, megaplot is still necessary for the redevelopment of the historic urban area, especially the renewal of a commercial center. But its proportion and size should be strictly controlled. What's more, five types of plot pattern have specific building siting and building form. Taking the building siting as an example, Historic pattern and Hybridization pattern should respect and preserve the historic frontage line, while the other three types of plot pattern should also endeavor to keep a continuous street frontage. This morphological control can be realized through three important indexes, including the setback line, building line, and the side building interval.

Historic pattern (P1)

Historic plot pattern refers to the plot pattern formed before 1949 and characterized by a traditional scale. It is mainly distributed in historic conservation areas. As one of the most typical morphological characteristic of the historic district, the historic plot pattern should be strictly protected, which indicates that very few plot amalgamation or changes are allowed in this pattern. Generally, the width of a traditional residential plot in Nanjing Old South area ranges from 8m to 16m. Thus the reference value (maximum value) of traditional plot width is set as 16 m. The historic frontage line should be respected and preserved. It means that the front and side setbacks are not permitted. As the historic plot pattern is almost located in historic districts, the eaves building height is limited under 7 m (no more than two stories). According to conservation regulation, traditional courtyard building is the preferred building type.

Hybridization pattern (P2)

Hybridization pattern, almost distributed in areas with traditional cityscape, refers to plot patterns with a mix of existing plots and redivided plots. The main goal of this pattern is to keep the existing subdivided plots as much as possible and respect the existing land property structure. Despite permission of a minor plot amalgamation, this pattern emphasizes the protection of historic plot series. Thus a typical plot width after amalgamation is 30 m, while the maximum plot width is 50 m. The width and shape of new plots on important street frontages, e.g, plot on the corner, should be carefully controlled. Considering the protected plot series and existing buildings, the townhouse is a recommended building type. Buildings are required to stand side by side and joined by common walls, so that a continuous street frontage can be formed.

Table 2. *Morphological index system of five patterns of plot division in the Old South area. Source: Compiled by the author. Above all, Building building limit is based on the regulations in Conservation Plan of Nanjing South Historic Urban Area.*

	Historic pattern	Hybridization	Redivision	Megaplot(Refurbishment)	Megaplot(Redevelopment)
General principle					
Protection focus	Historic plot pattern	Plot series	Plot subdivision	Small blocks, Renewal Units	Small blocks
Development intensity	Low	Medium	Medium-high	Low	High
Change of plot pattern	Little	Readjustment, Minor amalgamation	Renewal	Renewal	Renewal
Distribution	Historic district	Traditional cityscape area	General cityscape area	Traditional cityscape area	Commercial center, residential area
Plot form					
Plot size	Small	Small-medium	Medium	Small-medium	Large
Plot width	16	50	70	16	——
Building siting					
Setback	not permitted	not permitted	shallow	shallow	——
Building line	100%	100%	80%	100%	80%
Side building interval	not permitted	not permitted	permitted	not permitted	permitted
Building form					
Height limit zoning	10 m	18 m	12m-24 m	10 m	24 m
Building type	Traditional courtyard building	Townhouse	Townhouse, detached buildings	traditional courtyard building; townhouse	Microdistrict, complex, detached building

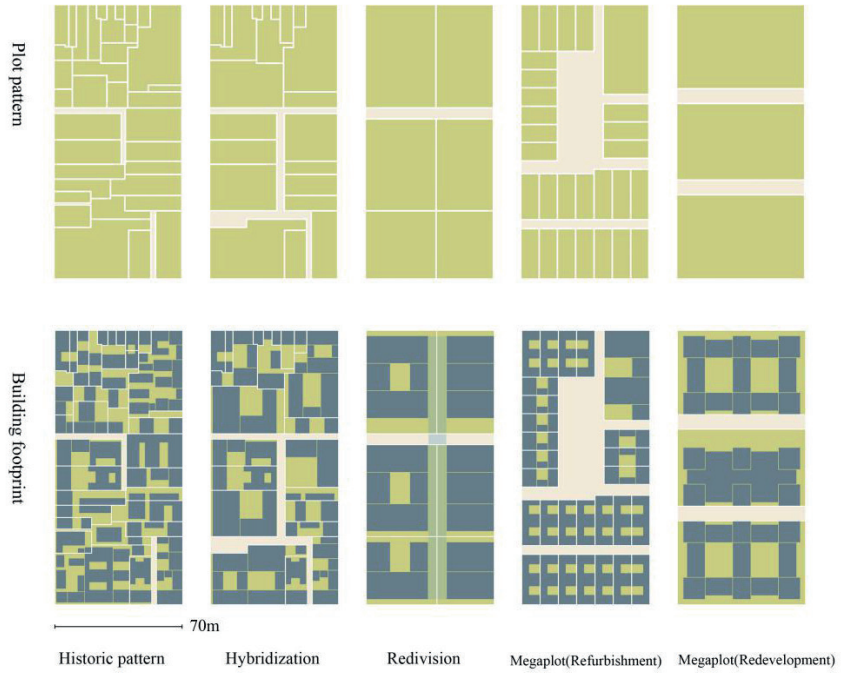

Figure 7. *Five patterns of smart plot division.*
Source: Own figure.

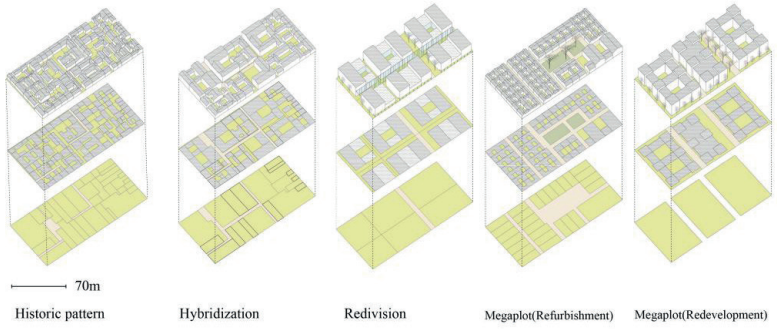

Figure 8. *Spatial form of five patterns of smart plot division*
Source: Own figure.

Redivision pattern (P3)

Redivision pattern refers to plot patterns that are totally redivided but still keeps the plot subdivision as a critical morphological feature of the historic urban area. It can be seen as a direct means of "learning from history" or better, learning from previous experience. This pattern is widely distributed in redevelopment-oriented areas where the contemporary cityscape is needed. Redivision pattern is characterized by medium-sized plots. In order to keep the plot subdivision, a typical plot width is defined as 50m, while the maximum plot width is 70m. The largest plot is not allowed to take up more than 50% of a block. Big plots are suggested to be located in the interior of a block so that more plot subdivision can be generated on the block boundary. As Redivision pattern corresponds to a mid-high development intensity, the building height is generally controlled between 12 m-24 m. As an intensive development mode, a shallow setback and side building interval are permitted. But at least 80% of the building line should be covered by buildings so that a continuous street corridor can be ensured. Redivision pattern regards plot subdivision as essential morphological elements that are in need of protection. But meanwhile, a mid-high development intensity can still be

achieved, with a highly mixed use in the vertical direction. Thus it is a suggested plot pattern for urban redevelopment.

Megaplot based refurbishment (P4)

Megaplot based refurbishment, typically distributed in the historic core, refers to the plot pattern with traditional scale and morphological features but being subordinately redivided in a megaplot. This kind of megaplot, having been damaged by large scale demolitions or renewals, is considered necessary to recover the traditional cityscape. Megaplot based refurbishment pattern is characterized by traditional plot size which ranges from 8m to 16m, in accordance with the traditional plot size. In order to meet contemporary living and traffic demands, a structure of small blocks should be developed within the megaplot so that better accessibility and more open spaces can be made. As a reconstructed plot pattern, a shallow setback is permitted. But side building interval is not permitted so that a continuous street frontage can remain. As the megaplot based refurbishment pattern is almost located in the historic core, the eaves building height is limited under 10m. Despite a low development intensity, megaplot based refurbishment pattern encourages mixed use of residence, commerce, and culture. In order to integrate well with the historical context, traditional courtyard and townhouse are considered as the preferred building types.

Megaplot based redevelopment (P5)

Megaplot based redevelopment refers to the block that is completely redeveloped without plot subdivision. With the highest development intensity in the historic urban area, megaplot based redevelopment is mainly distributed in the commercial center or residential area. As megaplot mode eliminates the plot subdivision, its proportion in the historic urban area must be strictly controlled.

Creating a structure of small-scale blocks is a basic requirement of Megaplot based redevelopment. On the one hand, it provides more pedestrian and open spaces inside the megaplot; on the other hand, the buildable areas are confined by small blocks. Thus the building volume can be reduced on the megaplot. Based on the practical situation of Nanjing Old South area, the reference value of the small-scale block is set as 70 m. The building height of this pattern can reach 24 m about six stories so that a relatively high development intensity can be realized. Typical building types of this plot pattern include microdistrict, complex, and detached buildings. It should be mentioned that historic buildings located within the megaplot shall be preserved as much as possible.

The selection of the five plot patterns is sometimes a balance between the ideal plan and the practical development conditions. Taking Plot G4 of Zhongshan Road South as an example (Figure 9), this is a megaplot with an area of 38600 m^2, deriving from an amalgamation of several original blocks and leading to the elimination of historic alleys and plot subdivision. Under the growth based plot division scheme and land development plan, a new massive commercial complex will cover the megaplot. However, there are two possibilities of plot redivision if the smart plot division strategy is applied in this case, Redivision pattern and megaplot based redevelopment. These two options are simulated. Megaplot based redevelopment pattern preserves and optimizes the historic street pattern. The megaplot is divided into five blocks(plots) with the average area of 7700 m^2. In contrast, Redivision pattern makes further subdivision, creating 10 medium scale plots which have the average size of 3850 m^2 and average plot width of 74 m. Comparing the three ways of plot

– Amalgamation of historic streets and plots

(1) Plot division under growth supremacism

–Protection and optimization of historic street pattern;
– Creation of small blocks in order to confine the size of megaplot

(2) Megaplot based redevelopment

– Protection and optimization of historic street pattern;
– Creation of small blocks in order to confine the size of megaplot
– Development of mid-small plots and protection of historic plots

(3) Redivision pattern

Figure 9. *Comparison of three patterns of plot division (G4 plot along Zhongshan Road South). Source: Own figure.*

redivision, it is clear that Redivision pattern can preserve a maximum of plot subdivision and is more in favor of the mixed land use. The suboptimal choice is the Megaplot based redevelopment, which effectively confines the plot scale and the building volume through creating small block structure. This kind of rational control is still obviously better than a rough plot division under growth supremacism.

5.4. *Institutional guarantee: Establishment of a dual control system*

The realization of the smart plot division depends on the optimization of the land development system. Currently there are mainly two institutional difficulties: First, how can the amalgamation of small scale historic plots be prevented; Secondly, how can new plots of proper scale be created. Under this background, a dual control mechanism is proposed as an institutional guarantee. It is composed of Renewal Unit system (RUs) and Land Banking system. Renewal Unit system aims at the protection of small scale historic plots and the promotion of self-led renewal. Land Banking system aims at creating new plots of proper scale, guiding the organic renewal of the historic urban area.

The authorization of Renewal Unit system is based on the block level. In the regulatory plan, each block should be designated with the permitted plot patterns. In the Transect of Plot Pattern, the Historic pattern (P1) and Hybridization pattern (P2) belong to the mid-small plot pattern and are suitable for the Renewal Unit system. The other three plot patterns in need of thorough redivision are still controlled by the current land banking system.

The realization of the smart plot division is based on the protection of small scale historic plots. The current land banking system, led by the local government, encourages large scale urban renewal. On the other hand, it's difficult for small landowners to obtain the land development right of their own property, indicating that self-led renewal is almost impossible.

Under this background, it is necessary to establish the Renewal Unit system for the protection of mid-small scale plots. The principle of this system is to loosen the restriction of land redevelopment on the local scale. In the form of individual declaration and governmental approval, the development right of small plots is authorized to property owners. Plots smaller than 5000 m^2 are all qualified to apply Renewal Unit system.

The procedure of Renewal Unit system has five main steps. (1) Personal declaration. Property owners or developers who are willing to make self-directed renewals make the application to the planning bureau. (2) Definition of Renewal Units. If the application is approved, the plots to be renewed are defined as Renewal Units. The plan of Renewal Units should also meet planning requirements determined in the regulatory planning. (3)Approval of renewal plan and coordination with the regulatory plan. The renewal plan should meet the requirements of urban refurbishment and regulations of regulatory plans, including the development goal, development intensity, building functions, and morphological regulations. According to the planning requirements, some plots could be renewed only after it provides some proportion of land for public service. The changes of property and control conditions brought about by the renewal should be readjusted in the regulatory plan. (4) Compensation of land value. The government and the renewal applicants should propose a compensation plan for the change of land value brought about by the renewal. (5) Finally, the applicants are authorized with the land redevelopment right of the Renewal Units.

Despite the establishment of Renewal Unit system, Land banking system is still indispensable for the redevelopment of the historic urban area. However, the current land banking system should be improved in order to promote the plot subdivision. Firstly, it is necessary to establish a specific procedure to integrate the regulatory planning, development requirements and appeal of existing property owners so that the scheme of plot division can be optimized. Secondly, the generation and allocation of mid-small plots should be promoted through joint allocation policy. There are two forms of joint allocation: (1) The joint allocation of a small plot in the historic urban area and a meg-

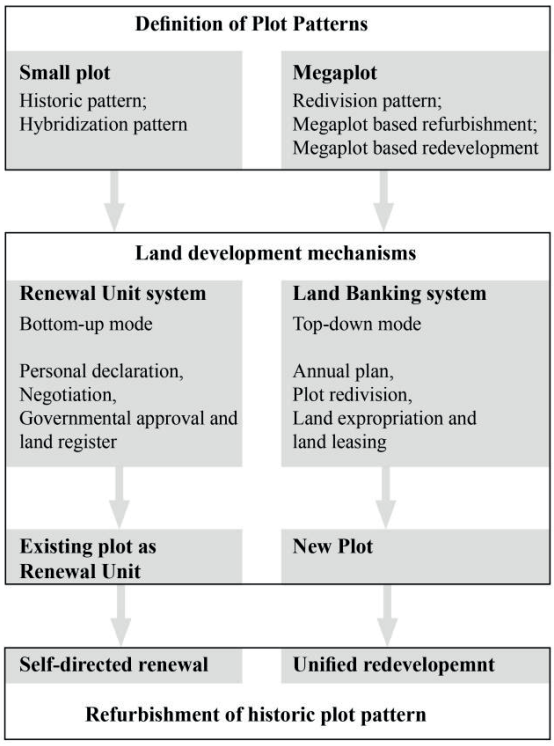

Figure 10. *Optimization of smart plot division mechanism. Source: Own figure.*

aplot outside the old city. In order to guarantee the morphological requirements of the small plot, the development intensity of the megaplot could be improved through the operation of Transferable Development Rights (TDR). (2) The joint allocation of several independent small plots which are not located next to each other not only ensures the scale of land allocation (so that the demand of land finance can be met) but also guarantees the continuation of plot subdivision.

6. Conclusion

The vitality of an urban area largely depends on the sustainability of urban fabric. The urban fabric serves as a gene element and a texture, connecting the macro and the micro, past and future (Tong, 2014). Despite invisible, plot division reflects the land property structure of a city, which is the basis on forming the urban form (Stimmann, 2009). The current plot division mechanism under growth supremacism is in favor of the production of megaplot and is in lack of control on the spatial form, failing to protect and continue the morphological characteristics of the historic urban area. As a result, the historic plot subdivision is damaged.

The refurbishment of the historic urban area means neither a large scale reconstruction of the old city nor a recovery of the nostalgic urban ground plan. The historic urban area is a developing organism. In this sense, urban refurbishment should not only continue the historically morphological features but also fulfill the diversified development requirements. The smart plot division strategy proposes five patterns of plot division, corresponding to different land development requirements and morphological zones. It emphasizes the protection and continuation of medium and small scale plots but also affirms the necessity of the megaplot in the redevelopment of the historic urban area. What's more, it endeavors to realize the integration of various plot types, aiming at creating a new structure of plot subdivision.

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Assemblages and Built Form

The Case of Secondary School Buildings in Cyprus

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Keywords: morphological analysis, building typology, relational theories, educational buildings, Cyprus.

Abstract: Traditional approaches to understanding built form & building typology tend to consider "space mainly as a shell or container, focusing on its morphological structures and functional uses" (Tornaghi & Knierbein, 2015, p.xv). Such consideration, however, ignores the complexity of physical form since it considers space as a container of action and a mere homogenous system. Thus, a more relational approach to space that embraces the embeddedness of various formal composition actions is required.
Thus, this paper aims to examine one of the most important ordinary building types in the urban landscape – school building – through a more relational approach to the consideration of urban form and built morphology. In that sense, this paper aims at addressing the extent to which school building type can be approached as highly relational system which is composed by both physical (i.e. dimensions, shape and size of the plot , functional composition etc) and with non-physical elements (i.e agency, processes, social rules etc) in a constant process of making.
A selected school building built in Cyprus after 2000 will serve as case study. The case study is used to test in a certain building type the conceptual and methodological framework proposed to grasp the relationality of built form. The methodology implemented for this study examines spatial and social processes through formal, typological, spatial and functional analysis of the school unit combined with data from on-site observations of space usage. The analysis of the school building is extended over scales. It explores formal composition and social agency, school's plot and adjacent street network, school plot and the overall school spatial, formal and functional composition, social agency within school and space usage behaviours.
This study's contribution is the introduction of a consistent way of approaching architectural urban morphology & building typology through a multi-layered and non-hierarchical multi-scale methodological approach that offers a starting point for incorporating a framework of analysis able to capture complex socio-spatial relations and the role of agency in urban form emergence.

1. Introduction

In recent years, relational theories such as Assemblage theory and Actor-Network Theory (ANT) have transformed how we conceptualize, describe and analyse the urban form. Namely, relational theories have highlighted the mechanisms of emergence and transformation of city

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form by recognizing the complexity of urban form as well as the importance of non-physical elements such as human groups, social actions or transpatial social decisions in the emergence of urban form. In that sense, there is a necessity to move away from the notion of space as a mere homogenous system and reach out to a relational ontology that considers space in 'terms of process, identity formation and becoming' (Kim Dovey & Fisher 2014, p. 59).

This paper attempts to develop a multidisciplinary conceptual and methodological approach that tries to address the relationality of built form. It also aims to highlight that built form is a dynamic entity composed of various socio-material parameters that are always in change.

An ordinary service building type that characterises the urban landscape, school building, is used as a case study through which the conceptual and methodological framework proposed is analysed and tested. School buildings in Cyprus offer a suitable case study, since they usually operate as separated islands in the city, while their formal structure is governed by social rules imposed by higher levels of administration and forms of agency.

The paper starts with a brief review of the existing body of literature dealing with the relational view of space. Then, the selected case studies and research methodology, followed by an explanatory analysis of the school's built form under investigation, aims to grasp built form emergence and is structured in 3 sections. Firstly, formal composition, plot properties and building density are discussed along with social guidelines inscribed in the building typology; secondly, spatial and functional composition are used so as to trace the ways in which the social programme and plot characteristics along with architects intuition work together to create a certain building form; thirdly, behavioural composition of the school is used so as to shed light to the ways the potentialities created by the school form are accommodated, used or shifted by means of agency and social control. The research's main findings, conclusions and suggestion for further work are then developed in a final chapter.

2. Assemblages and Building Morphology: A conceptual framework

Morphology refers the study of the physical form or the science of dealing with the very essence of forms (Bullock,*et al.* 1988). In the context of the built environment, urban morphology tries to conceptualise the complexity of the physical form and contributes to a better understanding of the physical complexities of cities at various scales (Larkham, 2005). As summarised by Oliveira (2016), urban morphology deals with urban complexity, which is structured according to a set of different elements such as urban tissues, natural context, street network, plot and building systems that are examined to increase resolution.

However, as Tornaghi & Knierbein (2015) stated, conventional approaches to the investigation of built form tend to ignore the ever-changing character of space and the on-going dynamics that occur beyond the apparent physical structure. In fact, as stated by Tornaghi & Knierbein (2015) such approaches tend to understand and analyse space mainly as a container of action and therefore they tend to focus only on its morphological properties and functional uses.

For these reasons, in recent years relational theories have transformed how we conceptualize, describe and analyse the urban form. Theories such as assemblage theory, actor-network theory and mapping controversies emphasise on the process of emergence, while they underscore the importance of considering associations of human and non-human elements. In fact, they highlighted the necessity of understanding the complexity of urban form as well as the importance of acknowledging not only physical elements, but also social elements such as human groups, social actions, transpatial social decisions etc in the emergence of the built form.

The discussion about the relational view of spaces goes back to Lefebvre's (1991) conceptions about the spatial triad. Lefebvre understands space through a three-fold division: the *perceived, conceived and lived* space. For Lefebvre, *perceived space* has socio-spatial significance and refers to the spatial practice which in a fact a social product. *Conceived space* is the representation of space and it is bounded to papers, elevation and perspectives. Finally, lived space is the representational space that is experienced through its association with images and symbols. Similarly, Harvey's (1973) classifies space into *Absolute, Relevant and Relational.* The *absolute space* refers to a stable and unchangeable space, *relevant space* is related with Einstein's work and non-Euclidean geometries, while *relational space* is in fact the space that does not exist outside of the process of its making and considers the simultaneous existence of the various actors involved.

The relational view of space is also famously traced by the concept of Assemblages proposed by the work of philosophers (Deleuze & Guattari, 1987). Assemblage is a mode of ordering relational and heterogeneous entities to work together for a certain time period to form a new whole. In that sense, assemblages are productive, since they constitute aggregations of different elements linked together to form a new whole. Assemblages are relational and heterogeneous where there are no pre-determined hierarches and thus they constantly produce new behaviours, new territorial organisational, actors and realities (Müller, 2015). However, the properties of an assemblage are irreducible to the properties of its parts. In that sense, a part can be detached from an assemblage and be attached to another. Thus, assemblages are defined both by the variable role of their components and the synthesising process in which the various components are involved. Specifically, the variable role of the components is addresses by means of their *material or expressive* nature, while their synthesising process is addressed through the processes of territorialisation and deterritorialisation. Territorialisation is the process that stabilises the identity of an assemblage, whereas deterritorialisation destabilises its identity.

Elaborating on assemblage thinking, DeLanda (2006) developed a theory of social assemblage. De Landa argued that social entities are in fact social assemblages and emerge by means of the interaction between heterogeneous elements. DeLanda argued that social assemblage can be used so as to understand and analyse complex entities such as cities. Specifically, he argued that cities can be approached as assemblages of both social and physical elements (i.e. people, networks, buildings, streets). The emergence of which involves various scales (not just the micro and the macro scale).

In a similar line of thought, Actor-Network Theory is interested in the socio-spatial ordering of entities beyond one universal principle (Müller, 2015). Actor-Network Theory constitutes an approach to social theory that emerged in the mid-80s primarily by Bruno Latour's work. Latour (2005) argued that society can only be considered as a type of connection among things that are not themselves social. In that sense, both human and non-human elements are particularly important in the investigation and understanding of the social, since both are approached as equally important in the emergence of the social (Latour, 2005). Therefore, in Actor-Network Theory scale is usually defined by means various actors' connectedness at multiple scales (not only micro and macro) (Charalambous & Geddes, 2015).

Departed from an Actor-Network perspective, Yaneva (2012) examined controversies behind the built environment. Yaneva argued that buildings cannot be considered merely as completed objects but rather as dynamic entities that cannot be viewed outside of the process of their making. In fact, building for Yaneva must be defined as dynamic networks that include the object, the actors, the association, influences, agreements, disagreements and all controversies evolving in time. However, as argued by Capille and Psarra (2015) Yaneva's focus is "almost exclusively in what is communicated about architecture in the

media" and thus her work is unable to offer a solid explanation how the use of architecture operates as a network.

It can be argued therefore, that such a framework can offer an alternative perspective in the understanding of built form & building typology, since it reveals the importance of acknowledging the complexity and relationality of built form. This relational view of the space can offer the possibility to understand built form not as a mere physical system but as an interaction with the otherness, as multiple, incomplete, different and always in the process of making (Tornaghi & Knierbein, 2015). However, as pointed out by Avidikios (2010), relational approaches present some methodological difficulties, since are mainly based on rather speculative accounts of phenomena. Additionally, the spatial context in which the various actors are situated and operate remained unaddressed, since space is approached as "endlessly malleable substance which takes its form only from the social and economic process" (Hillier, 2014, p. 3).

In an effort to enhance the methodological toolkit of relational theories, Charalambous and Geddes (2015) claimed that space syntax theory and method that explores the 'living relationality' of space can positively enrich relational theories and can offer additional methodological insights for the exploration of relational systems. Space syntax theory proposed by Hillier and Hanson (1984) acknowledges both spatial and social systems as highly relational. Specifically, according to Hillier and Vaughan (2007) Space Syntax, by considering spatial systems in a configurational way, is trying both to reflect on the objectivity of space and to anticipate the intuitive engagement of humans with it. In that sense, can offer a theoretical and methodological framework which can analyse space in a wide array of scales and at the same time by considering the social phenomena in the light of their spatial descriptions can potentially decode various social actions through their spatial descriptions.

Therefore, by taking into account the aforementioned theoretical and methodological insights suggested, the following points could be pointed out:

- Relational theories suggest that the built form should be considered a relational socio-material system composed of heterogeneous pieces that create a whole. However, the characteristics of the whole are not defined by the characteristics of the parts, and therefore the built form should be analysed both as a system with different parts as well as a single entity in a constant process of making.
- The built form should ideally be examined at different socio-material scales (not only on micro and macro scale) and across time. In other words, relationality across scales and time in a non-hierarchical manner should be adopted so as to capture complexity, emergence and temporality of socio-material constructs.
- Relational, socio-material entities consist of both physical-spatial and non-physical elements, elements that have to be taken into account for the analysis and investigation of the system.
- Spatial elements and physical properties should be considered, since they constitute such a complex system's main visible aspects. In this investigation, space syntax conceptual and methodological framework can assist in describing and analysing both the physical as well as the social aspects of space. Additionally, by adopting methods of systematic observation of human behaviour, proposed by space syntax theory, additional evidence for social – human activity and agency in space can be obtained. In that sense, quantitative and qualitative types of data should be used in order to address the complexity of socio-material systems.

By taking into consideration inferences depicted by the review of literature, this study develops a conceptual framework able to render the relationality of built form through various socio-material frames. In fact, it proposes a dynamic illustration of socio-material conditions across scales that describe a certain aspect of the built form at a certain point in time. Figure 1 illustrates the proposed conceptual framework in which social and spatial aspects are plotted on x and y axis respectively. X-axis accommodates social actions, processes, actors, decisions which operate both above and within space. Processes that occur above school such as decision by authorities are located on the right side, while local actions and interactions on the left side. Similarly, material-spatial parameters are placed on the y-axis. Wider spatial relations such as the location of the school within the city are placed on the upper part of the diagram, while more localised relations such as the formal and functional composition of the school unit itself on the lower part. This classification can vary according to the building typology under investigation and can also be used at different points in time.

This strategic placement of both social and material-physical aspects on a single diagram provides a way to visualise a dynamic relationship between factors that operate either within space or above space at various scales, either social or spatial. Therefore, the shape and the size of the diamond visualise the socio-material condition and the relationship between the scales of the interventions.

3. Methodology & Case Studies

The methodology implemented for this study combines various methods and techniques of analysis so as to trace a dynamic built form and avoid a linear understanding and hierarchical reading of phenomena.

An ordinary service building type that characterises the urban landscape (school building) is used to test the proposed conceptual and methodological framework proposed. School

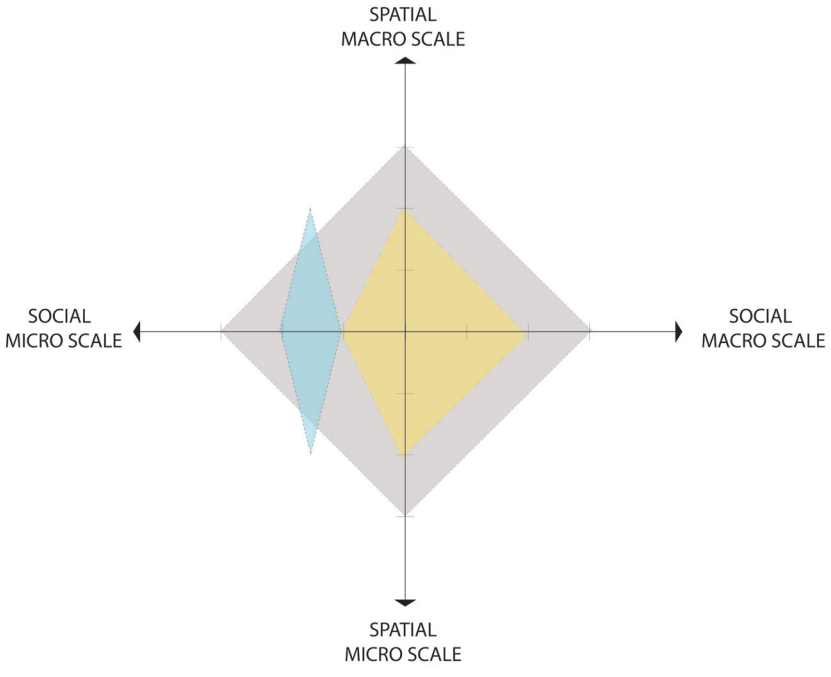


Figure 1. *Conceptual Framework of Analysis that captures relationality of socio-spatial factors across scales. Grey shades illustrate possible socio-material frames that could be examined.*

buildings in Cyprus offer a suitable case study due to the fact that their formal structure is governed by social rules imposed in the design process by higher levels of administration and forms of agency. At the same time, their horizontal development (they usually cover a large amount of a single city block) forces school buildings to act as separated islands in the city landscape since their interface with the street is minimised by means of fences and boundaries due to safety reasons.

The selected school under investigation is located in the city of Pafos, the western part of Cyprus. The school was built in 2002, has a medium size with approximately 448 students and students to teachers ratio 8.77. The school is characterized by a wide range of students' countries of origin, since only 28% of the students are Cypriot citizens. As a matter fact, approximately the half of the population of the school comes from non EU countries (46%) and 26% from EU countries.

The methods implemented so as to understand school building typology and grasp the emergence of socio-material entities across scales and time are the following:

1. Segment map analysis borrowed by space syntax methodologies for the analysis and investigation of the spatial structures of the city. Segment analysis derives from an axial line map which represents the potential lines of movement in an environment. Long axial lines broke into smaller segments at every intersection point so as to better capture the lived relationality of space. The measure of choice is particularly important since it depicts the potentiality for through-movement choices (higher choice depicts spaces with higher potentiality for being chosen as a movement path). The best predictor of vehicular & pedestrian movement proved to be Normalised Angular Choice (NACH) which gives a deeper understanding of spatial morphologies of cities (Hillier *et al.*, 2012) and uses the least angle change as the definition of distance. This method was also used to capture the school unit's spatial structure and movement potentialities as suggested by Sailer (2018).
2. Axial map analysis is used to identify layout's spatial intelligibility. In space syntax terms is the correlation of axial connectivity and axial global integration, where high intelligibility depicts a layout which can easily be red from its parts..
3. Formal analysis of the building typology under investigation.
4. 'Spacemate' diagrams, proposed by Berghauser Pont and Haupt (2004) which examines the relationship between density and built mass, is used so as to capture the building density of school scheme. It relates geometrical properties of a building such as the floor space index (FSI), ground coverage index (GSI), relative number of floors (L) and open space ratio (OSR). OSR is not considered here since as claimed by Steadman (2014) OSR is just another way of expressing the same data. The diagram plots on the y-axis FSI and on the x-axis GSI and the diagonal line illustrates the L values (the relative number of floors per scheme). Berghauser Pont and Haupt analysis highlighted that 'what to the eye seem to be similar morphologies become clustered within separate regions of Spacemate' (Steadman, 2014, p346).
5. Functional analysis of the different functional clusters assembled.
6. J-graphs & ABCD spaces analysis that visualise the relationship between functional clusters of the system. In space syntax, J-graphs are usually derived by convex map analysis and illustrate the relationships between various spaces and the movement potential between them. In that sense, spaces are classified into A,B,C,D spaces. A spaces are dead ends, B spaces have two connections and usually lead to an A space, C spaces have two or more connections and lie on a single ring, D spaces are lying into two different rings.

7. Schematic visualisation of the social programme given by the authorities and spatial representation of the relationships inscribed in the programme.
8. Empirical methods for capturing space usage behaviour suggested by space syntax observation manual (Grajewski and Vaughan 2001) combined a) qualitative feedback and b) snapshots method which in space syntax is the method that captures stationary, moving activities and interactions between user groups.

By layering the results of the various analysis, the paper aims to assess the interactions between transpatial and spatial elements that lead to the emergence of the built form and address space complexity and relationality.

4. Analysis – Results

4.1. *Multiscalar Socio-Spatial Analysis: Building Typology as a Temporal Relational Socio-Spatial Structure*

Drawing on existing research and elaborating on the conceptual framework proposed, this chapter aims at highlighting the ways through which relational ontology can be addressed. Figure 2 shows the frames created for the investigation of the school building typology. Frame 1 is a wide frame which includes all socio-material factors involved in the emergence of school build-

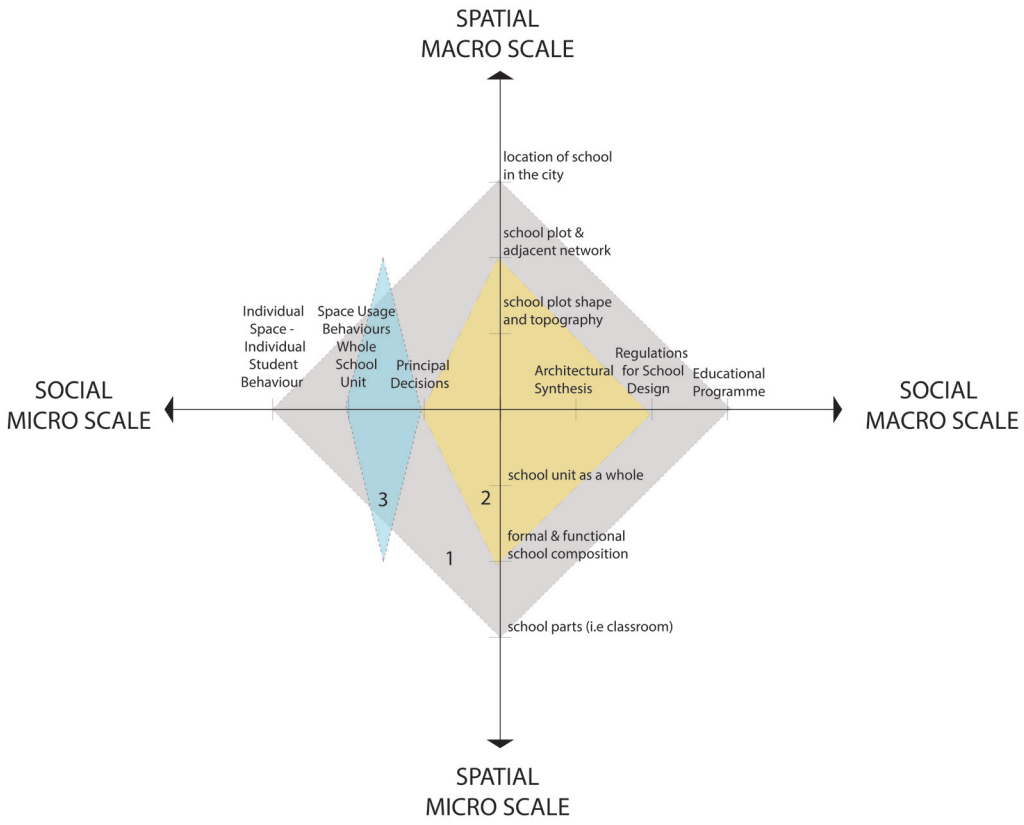


Figure 2. *Socio-Material frames considered so as to understand and examine the morphology of schools.*

ing typology (i.e the educational programme that defines to a certain extent requirements for the design of schools (Blackmore *et al.*, 2011), the location of the school in the city e.t.c). Through this frame, this study explores: Formal Composition, plots' characteristics & building density: Assembling closed and open spaces, social guidelines & regulations. Frames 2 & 3 are much more condensed frames and explore the relationship between built form, human behaviour and agency. Through those frames, this paper studies and Spatial & Functional Composition: Assembling social programme & plots' characteristics and Behavioural Composition & Emerged socio-spatial structure: The role of agency in socio-spatial territorialisation and potentiality of built form respectively.

4.2. *Formal Composition, Plot's Properties & Building Density: Assembling closed and open spaces, social guidelines & regulations*

This section examines the location of the school building in the urban context, plot's properties and building density, and regulation and social agency operates above space and do determine to a certain extent the school structure as a whole. The analysis is conducted in three distinct stages: a) segment analysis of the urban network in which the school is located, b) formal analysis of school unit c) building density.

Figure 3 shows school plot's location within the urban network as well as the potentiality of the adjacent network to attract movement flows. Specifically, Figure 3 shows segment analysis of the urban network and the metric used is normalised angular choice which models the routes with less angle change and depicts the segments with the highest opportunities for being chosen as movement paths from any single location to all other locations. Thus, it can be seen that the school is located in a part of the city that has high potentials of being chosen as a moment path either for vehicular as well as for pedestrian movement. This is particularly important in this case, since more than 58% of the school plot is covered by street network.

The vast majority of school's built structure of the school is attached to the adjacent street segment with the highest choice value. Only the right part of the school accommodates the various functional units organised around structured open-air circulation units & smaller court-

Figure 3. *Segment Analysis showing the distribution of Normalised Angular Choice; segments in cooler colours have lower NACH values, while segments with warmer colours have higher NACH values.*

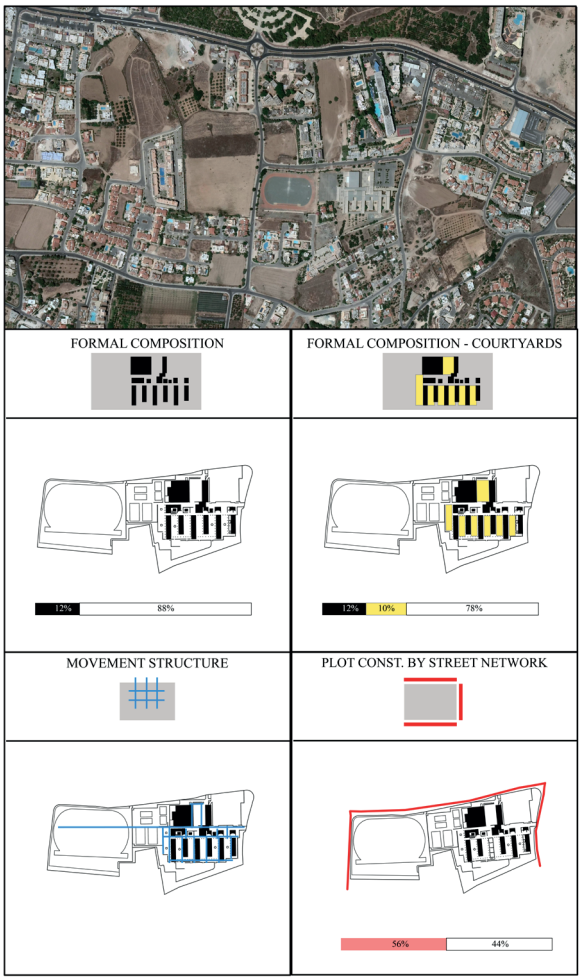


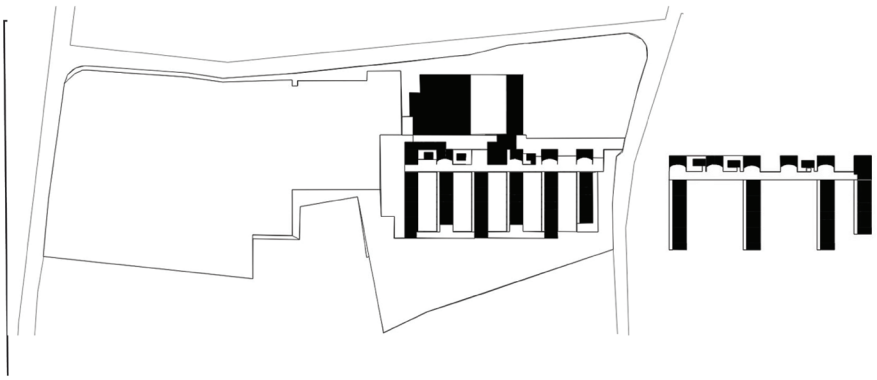
Figure 4. *Formal composition and main structuring principals.*

yards. Apparently, the majority of the school plot is open (88%), since only 12% of the school unit has closed areas.

In order to investigate more precisely the building density, this paper uses the spacemate diagram proposed by Berghauser & Haupt (2004). Figure 5 summarises the main values considered and presents the spacemate diagram in which the school building typology is positioned. The analysis shows that the school building typology is relatively very low on the diagram that can be considered a by-product of the relatively small percentage of buildable areas and the schools' open-air structure in Cyprus. The open-air design of the schools in Cyprus can also be considered a by-product of the weather conditions on the island and the standard dimensions of the outdoor sports area, which covers almost half of the school plot. Lastly, this structure seems that derives by the authorities' regulations, which specify that secondary schools should be maximum 2 floors, with an open-air structure and 50% of the functional distribution on the ground floor.

4.3. *Spatial & Functional Composition: Assembling social programme & plot's characteristics*

This section examines the synergies between functional & spatial composition of the school, plot shape, size and topography, regulations given by the authorities for the design of secondary



Plot Area	**37753 m²**
School Perimeter	**998 m**
Street Interface	**555 m**
Ground Floor Built Area	**5085 m²**
1st Floor Built Area	**2212 m²**
Sports Area	**18533 m²**
Spacemate Indexes, Berghauser Pont and Haupt (2007)	
Indexes by Analysing purely the form of the school	
FSI (floor space index)	**0.19**
GSI (ground space index)	**0.13**
OSR (open space ratio)	**4.57**
L (Number of floors)	**1.46**

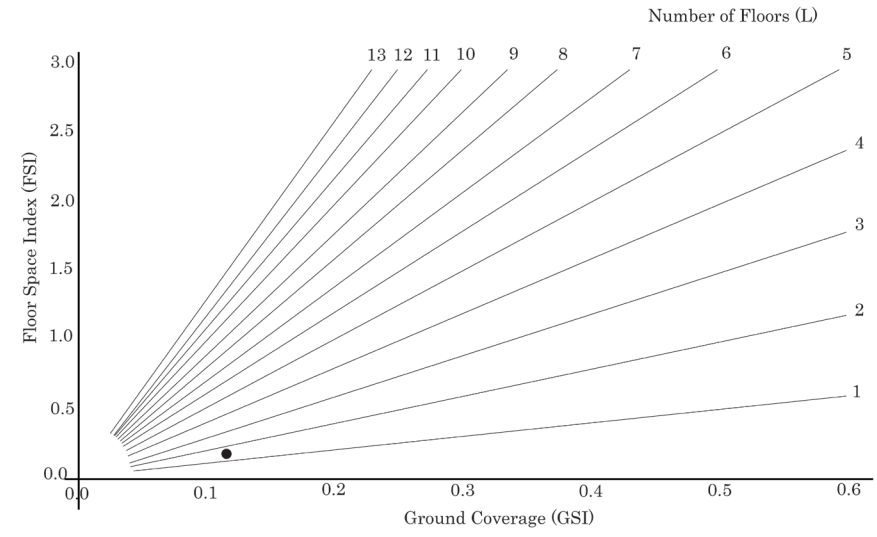


Figure 5. *School Building typology positioned in Spacemate diagram.*

schools in Cyprus, as well as architectural decisions. The analysis is achieved by implementing 3 different methods of analysis: a) conceptual representation of the programme given by the authorities b) functional mapping by classifying the building into various functional types (i.e classroom, special classroom, staircase, e.t.c), c) J-Graphs and a.b.c.d space analyses which cap-

ture the relationship between functional clusters as well as d) spatial-configuration mapping by means of segment analysis as suggested by Sailer (2018).

Firstly, the figure below conceptualises the physical-analogue representation of the programme given by the authorities in Cyprus for the design of every new secondary school building. The programme suggests creating 5 functional clusters closely articulated with each other by means of the outdoor space, circulation and courtyard. Into more details, the functional composition is divided into: entrance areas (1), administration and teachers areas (2), sports and multipurpose facilities that should be used by the wider community as well (3), outdoor areas, circulation and courtyards (4), classrooms, special classrooms, secondary and remote administrative facilities (5).

Based on the programme's visual representation, Figure 7 visualises the functional composition of the building being classified as suggested by the given social programme. At a glance it can be seen that the functional allocation followed the formal composition of the school as well as the unique plot characteristics. In fact, the outdoor sports area is accommodated on the lower level of the school and has significant height difference with the rest of the school, while it is 100% monofunctional. The rest of the school plot accommodates all the other uses which are organised in various functional clusters, where each morphological stripe accommodates a certain function. A central role for this building typology seems that plays the circulation spine of the system that connects all the functional clusters (figure 7).

The relationships between functional clusters can be further explored by means of J-Graph analysis. Figure 8 shows that the sports area is located 6 steps away from the administration area and school entrance, while it constitutes an a type of space which means a dead end. At

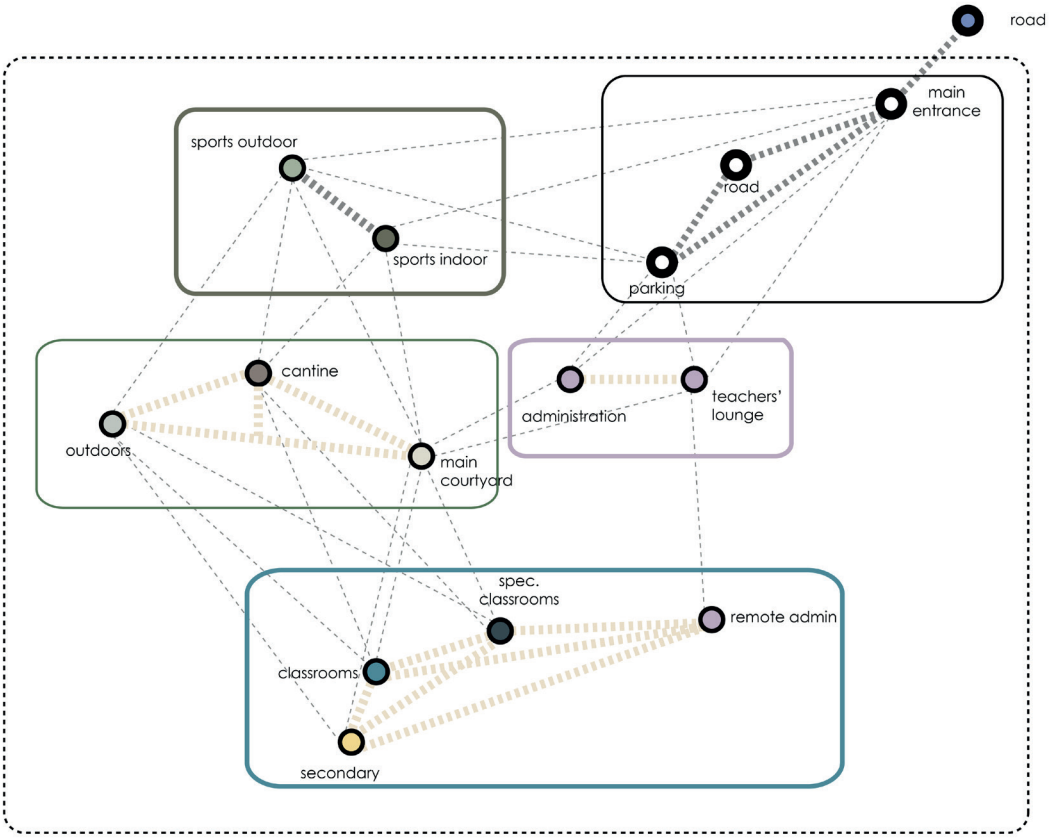


Figure 6. *Conceptual Visualisation of the functional relationship that are suggested by the general guidelines given by authorities for the design of secondary schools in Cyprus.*

the same time, the courtyards and circulation units on the ground floor are D types of space. This means that are spaces that offer high potentiality of movement choices and thus can work as connections that can potentially stitch together the various functional clusters. This can be further understood by considering segment analysis (figure 9). Segment analysis of the school structure depicts the two main movement corridors as the segment with the highest angular choice and thus could possibly offer high potential of movement in the overall structure of the school, since they are spotted with mainly red colours.

However, despite the two main movement corridors seems that work pretty well with the overall architectural synthesis, the school layout appears to be very unintelligible and relatively deep. In fact, the axial intelligibility of the layout is 0.20 which means that is very hard to read the overall structure of the school from its parts. This is might probably a by-product of the horizontal development of the school, the plot shape and topography along with the architects

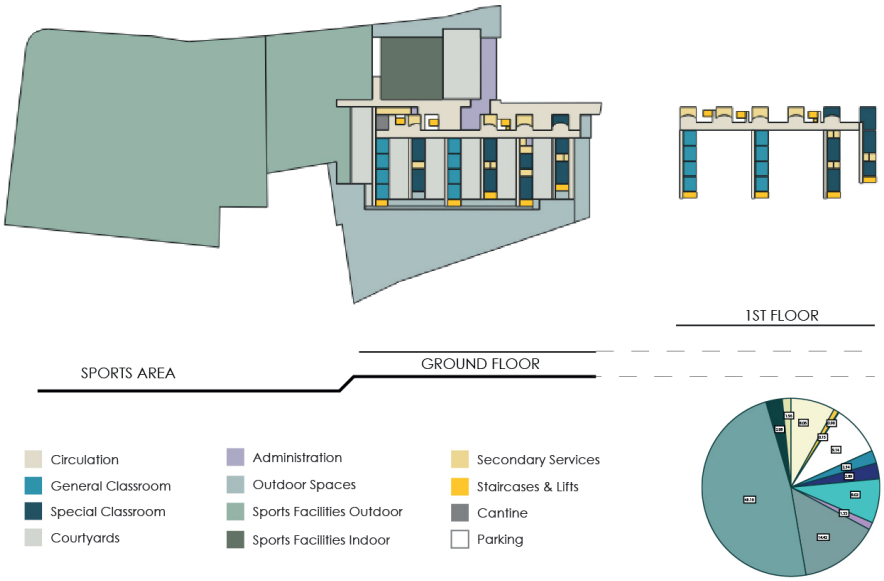


Figure 7. *Functional Composition of the school – Functional Clustering along topography of the plot.*

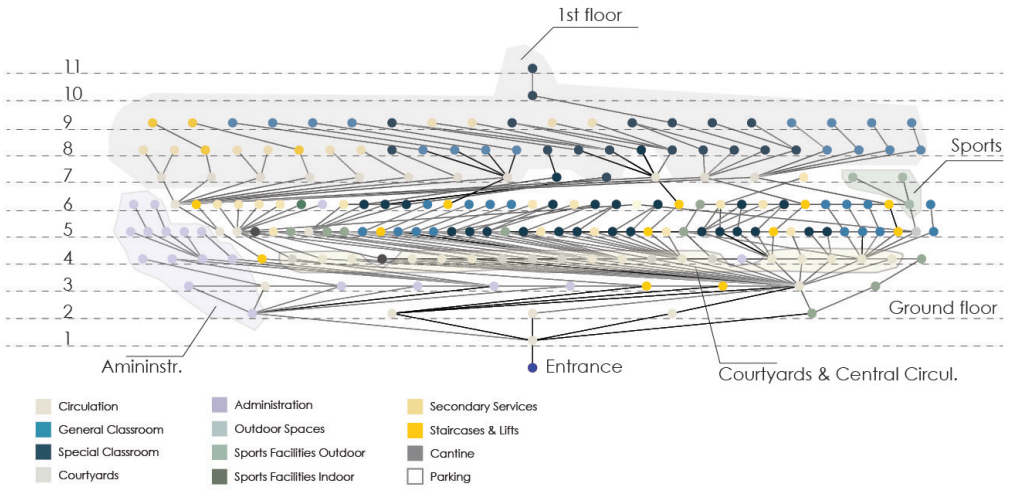


Figure 8. *J-Graph of the relationships between functional clusters from the entrance of the school.*

Figure 9. *Spatial Composition, Segment Analysis, Normalised Angular Choice.*

intention to locate the main school unit on the one side of the plot and the sports area on the other side of the plot and thus dividing the school unit into two completely different parts.

4.4. *Behavioural Composition & Emerged socio-spatial structure: The role of agency in socio-spatial territorialisation and potentiality of built form*

This section explores challenges further the flat ontologies of space by studying human spatial behaviour and agency. In fact, it hypothesises that the spatial, functional, operational parameters influence to a certain extent agency in space and power relations which in turn determine to a certain extent terrotorialization process and potentiality of built form.

Figure 10 highlights the density as well as the location of the different user groups within the school during normal school breaks (non-programmed behaviours). From the observation of human spatial behaviour appears that the main movement corridor – the spine of the morphological structure of the school – operates as the core of human spatial behaviours (concluded also by the segment analysis). Also, it is apparent that there are no recorded users in the sports' area, while the majority of users is mainly associated with the main building core. There is also strategic positioning of teachers in various points of the school.

Figure 11 shows the users composition in each functional cluster, while the size of the pipe represents the relative area of the functional clusters. Apparently, the vast majority of functional clusters accommodate both genders, while only in two cases seems that the areas are mainly accommodated by single genders groups. This happens with the area with the adult playground equipment which accommodated mainly male users and a part of the circulation unit close to administration area which accommodates mainly female groups. Interestingly, even though the sports area is the biggest only one type of user can be found, teachers.

In that sense, this controversy has been revealed by means of observations of human spatial behaviours, while users' qualitative feedback helped so as to trace the reasoning behind. Specifically, principal's qualitative feedback highlighted the issue of school's building and grounds safety (Pashiardis, 1997) as one of the primary factors that affect school leadership. In fact, the principal argued that by means of his power authority restricted students and teachers' zones of operation and thus prohibited the usage of the open-sports area during the school breaks.

This dynamic mapping highlighted that principals' actions influenced students' distribution in school as well as the spatial potentiality of school structure. In fact, the social rules applied achieved shrinkage of the open space available for students, while differentiated the relationship between built and unbuilt space and therefore influenced students' and teachers' zones of operation. This can be further understood if we reconsider the location of the school on the spacemate diagram with the new analogue of built to unbuilt area (figure 12). As it can be seen the location of the school in the diagram has shifted upwards.

Apparently, in cases where the relationship of functional allocation, topography and plot shape cannot offer spatial surveillance by articulating an intelligible layout (Axial Intelligibility of the school is R^2=0.20), social rules and micro-practices of power can be applied so as to

Figure 10. *Behavioural Composition of the school – Group Formation & Densities.*

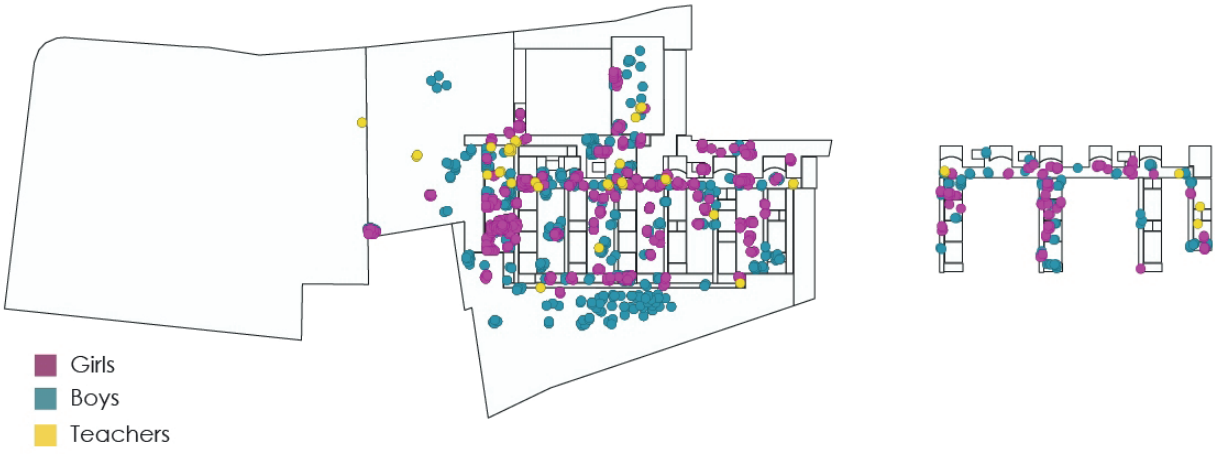
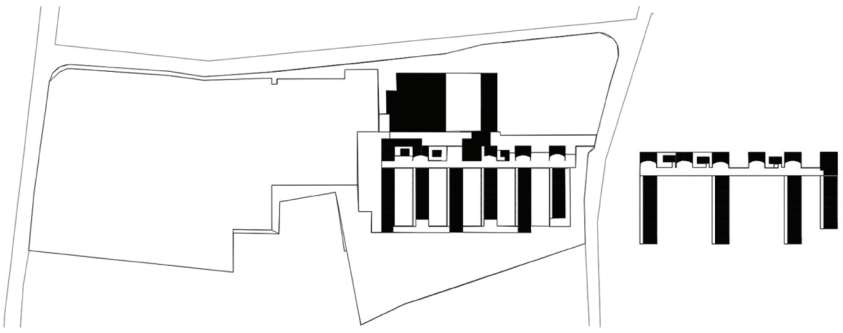


Figure 11. *Behavioural Composition of the school – Group Composition in functional clusters (the size of the circle represents the area of the functional cluster).*



Plot Area	**37753 m²**
School Perimeter	**998 m**
Street Interface	**555 m**
Ground Floor Built Area	**5085 m²**
1st Floor Built Area	**2212 m²**
Sports Area	**18533 m²**
Spacemate Indexes, Berghauser Pont and Haupt (2007)	
Indexes by Analysing purely the form of the school	
FSI (floor space index)	**0.19**
GSI (ground space index)	**0.13**
OSR (open space ratio)	**4.57**
L (Number of floors)	**1.46**

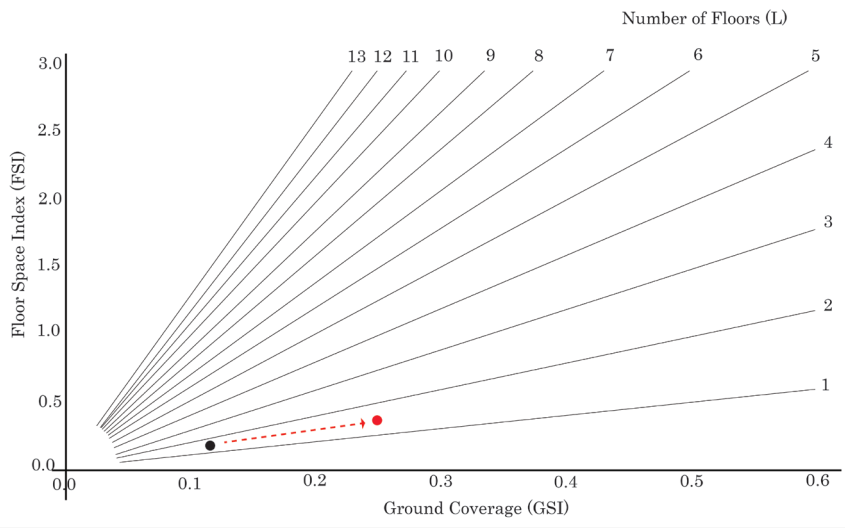


Figure 12. *Spacemate diagram which shows the different positioning of built form in the diagram achieved by considering power relation and social agency in space.*

restrict the potential zones of operation and thus achieve a new territorialisation of material and immaterial aspects involved and shape built form. Thus, built form cannot be considered as a fixed and complete object but rather as a complex object with spatial potentialities being reformed at any point in time.

5. Discussion/Conclusion

This paper aimed to provide a theoretical and methodological framework to conceptualise and quantitatively examine the ways in which relational theories can inform the study of urban form and building typology. Based on the review of existing literature and by considering the school building as an assemblage of various material and immaterial aspects across scales, this paper uses various methods and techniques so as to grasp the relationality and complexity of built form which is in a content process of emergence.

Conclusions suggests that "space [has to be considered] as constantly changing, as an outcome of the specific mutual relations between people and places and their contexts" (Tornaghi & Knierbein, 2015, p. 244). Arguably, the analysis highlighted that despite the fact that the physical form of the school building itself, as well as the location of the school building in the wider urban context didn't change, different socio-spatial dynamics were generated challenging the 'flat' ontologies to space. In that sense, it is becoming apparent that micro-practices of power should be integrated into the investigation of built form so as to be able to understand and capture 'the ways productive self-organised assemblages emerge from dynamic interactions between parts' (K Dovey & Fisher, 2014, p. 59)

The contribution of this study regards the simultaneous engagement of a wide array of methods that examined building typology as a socio-material construct across scales and were able to grasp the relationality, temporality and complexity of the built form. Additionally, against a hierarchical view of built morphology, this paper suggests that built form should be studied by investigating the socio-material relationship. Thus, it proposes a non-linear examination of built form that uses various socio-spatial frames across scales that capture a certain condition each time (i.e transpatial decisions about the school's location, the spatial and functional configuration, plot access, plot shape and geometry etc).

Limitations of this study include a restricted number of observations, yet small enough to draw conclusions. Ideally, this study would be repeated in other school building typologies across Cyprus and provide additional analytical and empirical data. Further explorations could also shed additional light on the relationship between street network, street plot, social actions and school usage patterns. Lastly, further elaboration of J-Graphs for the investigation of both spatial and social networks could benefit the research of relational built morphology.

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Space Syntax, Urban Transformation and Liveability
A Campus Case Study

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Keywords: Space Syntax, University campus, Urban transformation, Liveability.

Abstract: University campuses frequently occupy the leading edge of urban development, with sustainability as an increasing driver (Leal Filho, 2012). A university campus thus represents a useful 'living laboratory' to understand the formation and transformation of built form, towards more sustainable outcomes. The main campus of the University of New South Wales (UNSW) in Sydney, Australia was the focus of a space syntax study in 2007, during a wider project which examined landscape, microclimate and other quantitative and qualitative properties from an environmental and liveability perspective (Osmond, 2010b). The following decade saw significant changes to the campus fabric, affecting both buildings and public realm. This paper discusses the reapplication of space syntax to the 2017 UNSW campus, using the accessibility metrics of connectivity, integration and choice (Xia, 2013). The University's central mall was found to retain its status as the core 'people place', easily accessible from all parts of the campus. However, connectivity and integration values suggest that the post-2007 development of student housing has activated what was a poorly resolved area of the University, with potential for further revitalisation. Also after a decade, the campus boundaries have become less integrated, implying a more inward-looking focus. The research results suggest that the longitudinal application of space syntax methods can shed light on the interaction between urban development and liveability (social sustainability), at least for the microcosm that is a university campus. As well as prompting further research, this project has provided a practical knowledge base to help inform future campus development.

1. Introduction

The quality of higher education institutions is typically evaluated by reputation and satisfaction surveys, research outputs and student retention and graduation rates, which are influenced not only by academic factors but by the perceived quality (summarised here as *ambience*) of their campuses (Hajrasouliha and Ewing, 2016, Painter *et al.*, 2013). Ambience can be seen as one indicator of liveability and the social sustainability of buildings and urban environments. It refers to the experienced and perceived physical and psychological qualities of the environment and results from a complex composition of physical, physiological, psychological, sociological and cultural criteria (Osmond, 2007). Quantification of such qualities, where practically achievable, can inform both evaluation and design of built form.

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Space syntax is one such quantitative and evidence-based approach to explore the relations between urban form occupants/participants and their physical environment. Its basic principle is that the architectural structuring of space creates the material preconditions for patterns of movement, encounter and avoidance (Hillier and Hanson, 1984). Space syntax by definition concentrates on *configuration*, which provides "a partial and incomplete view of the relations between human beings and their created environments" (Hillier and Stutz, 2005: 12). Attributes such as building materials and design features, vegetation and microclimate are also part of what creates place out of space, but fall outside the space syntax system boundary; on the other hand, space syntax methods facilitate quantitative measurement of ambience attributes such as accessibility, walkability, permeability and integration or segregation of spaces across a physical environment (Charalambous and Mavridou, 2012).

The main campus of the University of New South Wales (UNSW) in the Sydney inner suburb of Kensington was the subject of a space syntax case study in 2007. Unsurprisingly after a decade, there have been significant changes in the campus fabric, and also in space syntax methodology and software capabilities. The objective of the present project is to revisit the space syntax analysis of the campus in the light of the extensive campus development over the past decade, to establish a recent knowledge base which can support further ambience-related research and additionally, may help inform future campus development.

The UNSW Kensington campus is located on a 38-hectare site about six kilometres south-east of the Sydney CBD, and as at 2018 accommodated close to 50,000 enrolled students and 6000 teaching and operational staff. The campus is characterised by dense built form, with buildings predominantly of four to eight storeys, a tight network of pedestrian and shared pedestrian/vehicular circulation and approximately 70% impervious surfaces (roofs and paved areas). Buildings are typically of concrete or brick construction, aligned along an east-west/north-south grid with an orthogonal pattern of open space between buildings. The site is bounded by, and morphologically strongly differentiated from, residential areas to the east, south and west, and a major racecourse and ancillary equestrian facilities to the north (Osmond, 2010a).

Leaving aside the many small and large refurbishments of existing buildings, major campus development projects from 2007 to 2017 comprised the following (see also Figure 1).

1. 2009: New College Village postgraduate student housing, including shared apartments and individual self-catered studios for over 300 residents.
2. 2010: 1021-bed UNSW Village student housing, replacing a number of single storey fibre cement buildings which housed administrative/operational and some teaching functions.
3. 2010: Six storey, 17,000 m^2 Lowy Cancer Research Centre.
4. 2011: Single storey double height Solar Industrial Research Facility.
5. 2012 Five storey, 15,000 m^2 Tyree Energy Technologies Building.
6. 2014: Reconstructed Kensington Colleges student housing, four to eight storey medium density buildings accommodating 900 students.
7. 2015: Eight storey, 23,500 m^2 Material Science and Engineering Building
8. 2017: Nine storey, 21,730 m^2 Biosciences Building Stage 1

Overall, the campus has become denser and more "urban", to accommodate a growing student population within fixed spatial boundaries.

2. Theoretical and conceptual framework

Space syntax both as a theory and a set of practical methods and techniques focuses on the architectural *configuration* of space, whether at building or city scale. Configuration refers to the "act of turning the continuous space into a connected set of discrete units" (Bafna, 2003: 17). Space syntax analysis provides the tools to describe, explain and interpret configured, inhabited spaces so their underlying social logic can be explained (Bafna, 2003). Space is first subdivided into two nonhierarchical classes, two-dimensional convex spaces and one-dimensional axial lines. A convex space is identified where "all points within that space can be joined to all others without passing outside the boundary of the space" (Hillier, 1988: 68), or from the observer's perspective, a space such that any two people located anywhere in that space can see each other. An axial line, on the other hand, may be understood as a line along which any two points are mutually visible.

Hillier points out that "people move in lines, interact in convex spaces, and experience space as a series of 'isovists'" (Hillier, 1998: 38). The isovist (Benedikt, 1979) – essentially the *visual field* – represents a third geometric element used in space syntax, for example as applied in visibility graph analysis (Turner, 2001).

The convex map decomposes open space into the least set of "fattest" convex spaces, i.e. in relation to their area: perimeter ratio; the axial map comprises "the least set of longest straight lines of sight and direct access" which pass through all the convex spaces (Hillier, 1993: 21). The topological *graph* associated with the axial and/or convex map is used to generate a series of metrics which form the basis of "classic" space syntax analysis. The values of these graph-based metrics are re-applied to the axial or convex *map*, and typically visualised as colours or intensity of grey scale (as here) and/or presented in tables.

These metrics provide a means of describing a space, for example a street or room, in terms of its position in the extended spatial network, and also to explain it *functionally*. Each space contributes to how all the spaces in the system affect one another, hence a global order emerges from local properties. In space syntax, the axial graph treats the lines of the axial map as nodes and the intersections as edges. Three commonly applied metrics are connectivity, integration and intelligibility, which may be calculated for an individual node (e.g. axial line) or averaged over the system as a whole. Table 1 lists the specific space syntax metrics used in this research.

Table 1. *Common space syntax metrics applied in this project.*

Metric	Description
Connectivity	A local measure of the number of axial lines directly accessible from a given axial lines, which generally equates to the number of street intersections.
Integration	Calculates the degree to which an axial line (street) is integrated with or segregated from the whole system (global or 'radius n' integration) or from a partial system consisting of streets a set number of steps away (local integration, often r3 = three steps).
Intelligibility	A measure of the correlation between connectivity and integration, used to estimate the predictability of the global structure of an environment through interpretation of its local configurational properties.
Choice	Choice measures movement flows through spaces and can help predict vehicular and pedestrian movement potential. Spaces located in shortest paths from all origins to all destinations will show high global choice.

3. Methodology

Axial maps of the UNSW campus were drawn as a separate layer on 2007 and 2017 AutoCAD plans of the campus, validated through fieldwork and analysed with the Depthmap space syntax software to generate data relating to connectivity, integration and choice, as defined above. UCL Depthmap 7.12 (Turner, 2007) was used for the original 2007 analysis; to ensure consistency, the 2007 axial map was re-analysed using a more recent version, Depthmap X (Varoudis, 2012), together with the 2017 axial map.

The UNSW campus includes pedestrian-only and shared pedestrian/vehicular routes, so separate analyses were conducted for the total movement network and the shared network in both 2007 and 2017. The *intelligibility* of the overall network and the shared vehicular/pedestrian routes was also calculated, as per Table 1 above.

Direct connections through building ground floors were included, and walls or fences where gates are normally kept closed were regarded as barriers. On the other hand, "desire lines" – unofficial shortcuts across lawns or other areas of open space – were ignored in the analysis.

An additional dataset collected in 2017 which was not considered in 2007 is the disability access through the campus, which includes the vehicular circulation network, some of the shared network, dedicated links through existing buildings and ramp access adjacent to existing stairways.

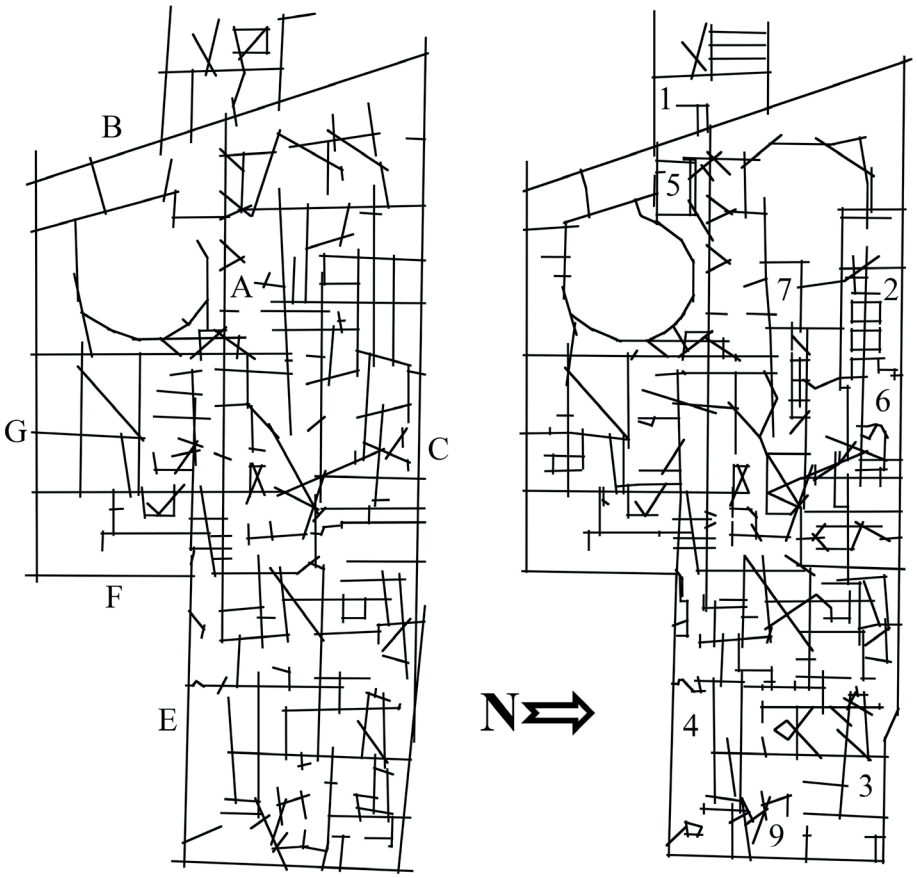

Figure 1. *Axial maps of the UNSW Kensington campus in 2007 (left) and 2017 (right), including both pedestrian-only and shared pedestrian/vehicular routes. The routes referred to in Table 2 below are listed on the 2007 map, and the major development projects discussed above are numbered on the 2017 map.*

4. Results and discussion

As noted above, the assessment focused on connectivity, integration, choice and intelligibility. Routes which have a greater number of intersections (i.e. higher connectivity) are shown as black and dark grey in Figure 2; conversely, poorly connected routes are depicted in light grey. The main difference between 2007 and 2017 is the greater number of routes through the campus, reflecting the need to provide access to a variety of new buildings. The most highly connected routes – the roads around the University's perimeter (high vehicle connectivity), the central pedestrian mall (highest pedestrian connectivity) and several shared north-south routes – remain much the same over the decade. On the other hand, fewer shared routes and more pedestrian-only paths are evident as the University has become physically denser and its student population has grown, particularly around the student accommodation to the north of the site.

Figure 3 depicts the degree of integration or segregation of the campus shared and pedestrian-only routes in 2007 and 2017; again, darker lines indicate more integrated spaces. Numerous space syntax studies have demonstrated that integration strongly correlates with the co-presence and observed movement of people (or, in the case of vehicular routes, cars) (Haq, 2003, Penn, 2003). More integrated spaces facilitate social *encounter* within an environment.

The UNSW campus grid, including pedestrian-only routes is relatively well integrated, with more segregated pathways providing access to individual buildings and other destinations. This contrasts with the University's less well integrated shared route structure, which was designed to allow vehicle access for deliveries and access to multi-storey perimeter parking without compromising the pedestrian setting. The most integrated pedestrian spaces are the campus central mall, Anzac Parade to the west and High Street to the north of the site. These streets interface with 10 pedestrian and vehicular access points to the campus (nine from High Street), which help to channel the movement flow between the University and the outside world. Notably, the number of High Street intersections with both campus and race course fell from 18 to 12 and the integration value decreased between 2007 and 2017, as new buildings along the campus boundary were constructed over previous pedestrian paths.

Another feature of the 2017 space syntax analysis was an exploration of disability access at UNSW (specifically, wheelchair access). Figure 4 depicts the axial map of wheelchair access via roads and ramps through the campus. Anzac Parade, High Street and Barker Street (to the south) are the most integrated spaces for vehicles and wheelchair access as they provide the most efficient routes to access the most destinations.

The main change between 2007 and 2017 consisted of a shrinkage of the campus integration core to the area around the central mall and its intersecting routes, as newly constructed buildings replaced former through-routes, and additional segregated pathways were opened up to service the new student accommodation and other projects. As with previous comments regarding changes to connectivity, the overall transition as shown in the integration maps has been towards a more pedestrian-focused campus. An example of this is the emergence of the UNSW Village pathway (Figures 2 and 3) as another high connectivity and relatively high integration value campus route.

One aspect which has not markedly altered is the relative segregation of what is known as "upper campus" (the eastern section) from the rest of the campus. This is a consequence of a 16 metre change in level over approximately 150 metres between "upper" and "lower" campus, which reflects the underlying geology. This change in level has ensured that the main links between the two parts of the campus remain via stairways.

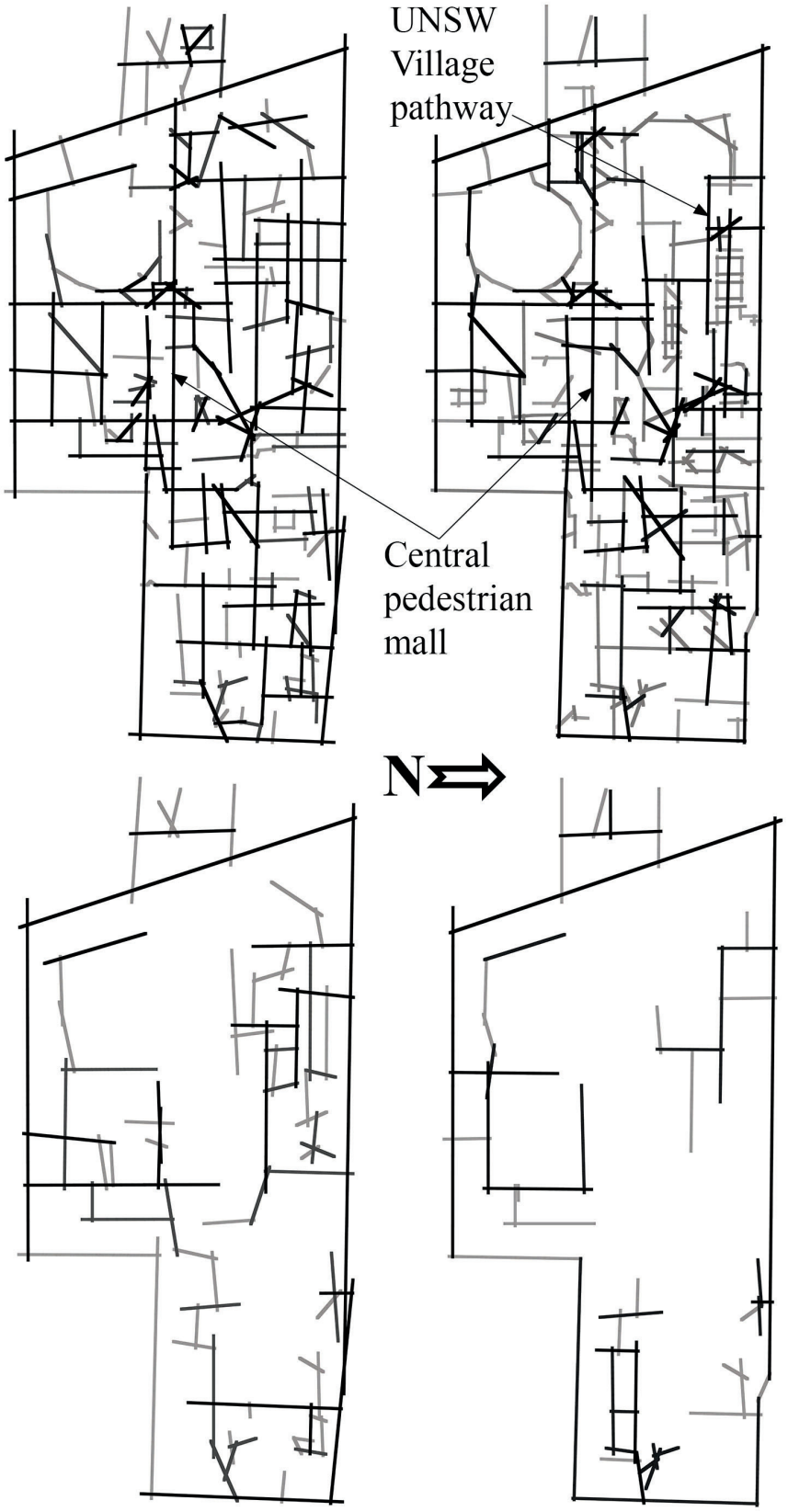

Figure 2. *UNSW campus connectivity. Top left = 2007, top right = 2017, pedestrian only plus shared routes. Bottom left = 2007, bottom right = 2017, shared vehicular/pedestrian routes. Darker lines indicate greater connectivity.*

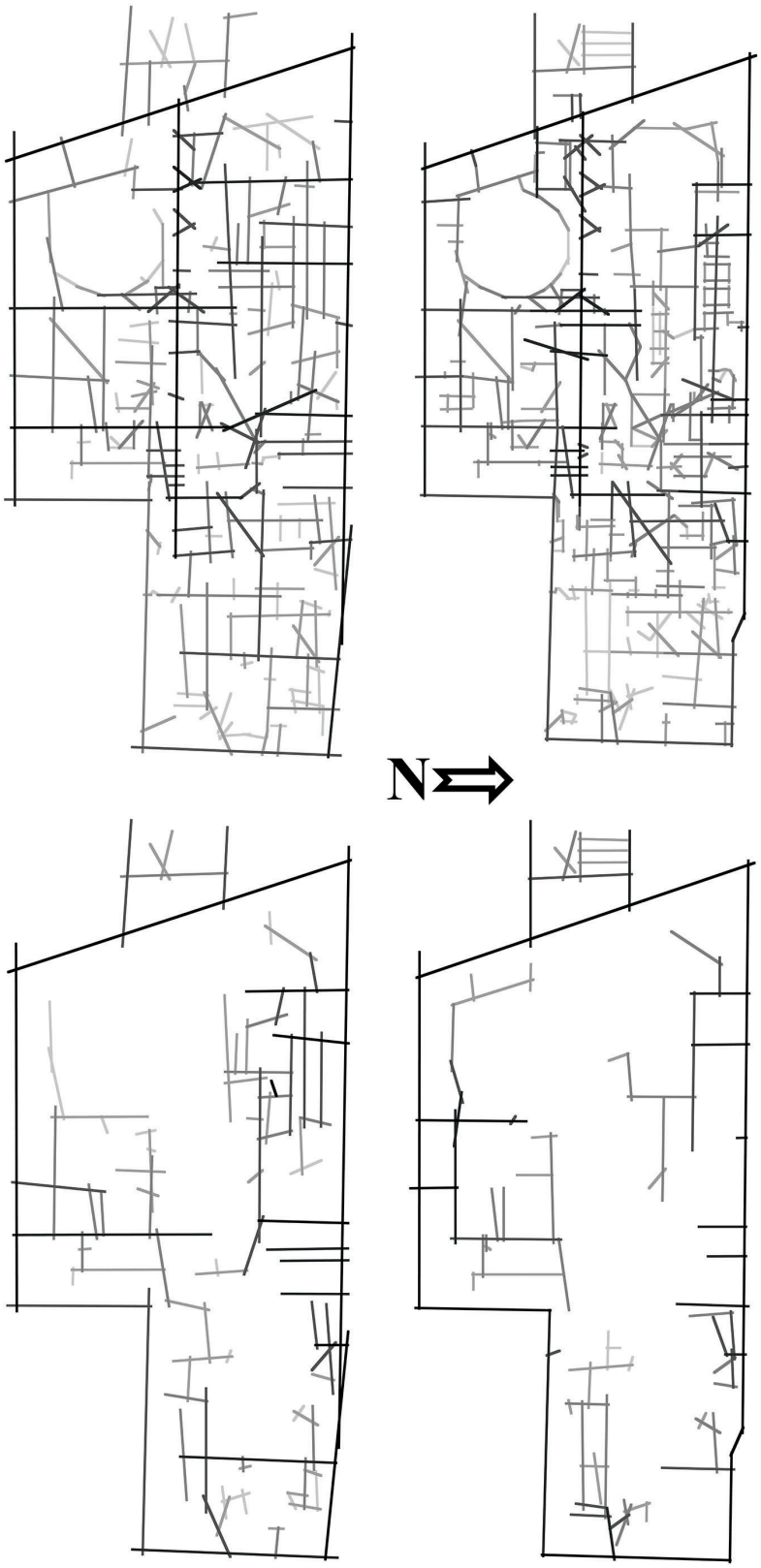

Figure 3. *UNSW campus integration. Top left = 2007, top right = 2017, pedestrian only plus shared routes. Bottom left = 2007, bottom right = 2017, shared vehicular/pedestrian routes. Darker lines indicate more integrated routes.*

Table 2. *Metrics for key external and internal routes (see Figure 1 for location of routes).*

	Spaces	2007		2017		
	Connectivity	Integration	Connectivity	Integration	Choice	
A	UNSW central mall	27	1.63	27	1.94	62891
B	Anzac Parade	8	2.18	9	1.90	47591
C	High Street	18	2.31	12	1.88	59146
D	Botany Street	5	1.60	7	1.33	20112
E	Oval Lane	6	1.50	6	1.35	18790
F	Willis Street	2	1.62	3	1.44	7722
G	Barker Street	8	2.02	6	1.65	15661
	UNSW Village pathway	N/A	N/A	17	1.33	13484

Table 2 indicates the values for connectivity, integration and choice for a set of key external and internal movement corridors. As noted in Table 1, choice measures predicted movement flows through spaces; this metric was not obtained for the 2007 data. The central mall and High Street show the greatest choice; certainly the observed pedestrian flows along this route reflect the high value calculated for this metric.

5. Conclusions

The objectives of this project were first to compare and contrast the UNSW Kensington campus of 2007 with the denser and more urbanised 2017 version, and second to develop a space syntax database of the campus to help support further research and to provide an input to the campus development process.

The main findings of this study include:

- The most highly integrated campus spaces in both 2007 and 2017 coincide with observed pedestrian and vehicular movement, with the University's central mall being a core example.
- Between 2007 and 2017 integration values fell for campus's bounding streets but increased for the central mall. This emphasises the importance of the mall as the 'heart' of the university, which is not merely a movement corridor but a destination for events such as markets and entertainments.
- However, it is noteworthy that the mall does not extend to the eastern end of the campus, which arguably contributes to the discernable segregation of the upper campus from the lower.
- Nevertheless, the upper campus precinct has become more integrated internally, likely as a result of clearer demarcation of pedestrian and vehicular movement corridors consequent on the construction of new buildings over the past decade.
- The analysis also indicates the presence of another arterial route, the UNSW Village pathway. This route is related to the residential part of the campus; its high connectivity and relatively high integration correlate with the social activities happening there already and point to the potential for additional placemaking in and around this space.

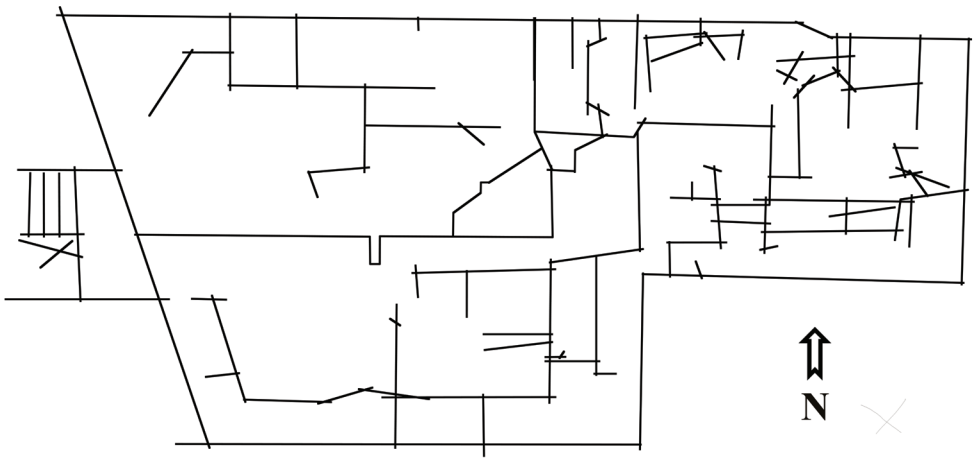

Figure 4. *Axial map of wheelchair access in and around the UNSW campus.*

– While the main campus routes are accessible, wheelchair access to the "fine structure" of the campus is heavily reliant on lift access and could be improved.

As noted in Table 1, intelligibility, the correlation between connectivity and integration, provides a measure of the predictability of the global structure of an environment through interpretation of its local configurational properties. Intelligibility assumes that cognition of small-scale spaces both precedes and facilitates cognition of large-scale spaces (Jiang *et al.*, 2000) – or what *can* be seen is a good guide to what *cannot* be seen (Hillier, 1996). This investigation found a relatively low level of intelligibility for the campus as a whole (and particularly for the shared pedestrian/vehicular system) in both 2007 and 2017. In other words, the local spatial structure is not particularly predictive of the global. The overall effect is not conducive to efficient wayfinding, which is consistent with the lived experience of the UNSW campus. On the other hand, the central mall is relatively more intelligible and individuals using this route can more easily orient themselves to the campus as a whole.

The project confirms that space syntax can provide valuable quantitative tools to illuminate the broadly qualitative relationship between the physical environment and human inhabitation of space, considered here as *urban ambience*. Further, longitudinal application of the methodology can shed light on the interaction between urban development, *liveability* (spaces which encourage human co-presence and interaction) and *sustainability* (reduction of vehicle use and improved pedestrian movement), taking the university campus as a microcosm of urban form more generally. There is, however, the proviso that a university campus is frequently developed on a single lot, so the circulation network is far more susceptible to modification than that of a typical precinct of similar size. But in summary, space syntax offers urban morphologists another useful way to understand the formation and transformation of built form, potentially with a view towards more sustainable planning and design outcomes.

As always, more questions could be asked, including how UNSW staff, students and visitors actually use and navigate the campus spatial network. So as with much space syntax research, the results can be further elucidated through application of qualitative environment/behaviour methods.

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The Interactive Relationship between Spatial Conditions and Visitors' Behaviour of Knowledge Cognition within Large and Small-Sized Museums

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Keywords: Museum, Spatial Conditions, Knowledge Cognition, Visitors' Behaviour, Space Syntax

Abstract: Museums primarily aim to convey social knowledge through their social conditions. The interpretation of knowledge amongst Museum visitors varies depending on spatial use and layouts designed to reflect contemporary social circumstances. Our study investigates the relationship between visual-spatial conditions (spatial size, use and layout) and visitors' behaviour within a museum, from a social-spatial standpoint. During the study, two London museums (The Victoria & Albert Museum and The Design Museum) with differing the spatial conditions were subject to the linear and multiple regression tests using Visual Graph Analysis (VGA) and by monitoring Visitors' viewing behaviour. The results are as follow; It was found that the size of a museum, in relation to its complexity affected the pattern of visitors' circulation and spatial distribution in terms of spatial information and knowledge cognition. Consequently, the behaviour exhibited by visitors changed in relation to spatial use and layouts of the museums. Furthermore, the linear and multiple tests revealed this relationship creates different patterns within the behavioural-spatial network of visitors in relation to the spatial-information system within the museums. In light of the study, it's plausible that museums create fixed and deterministic network in a rational way or interrelated and probable network in a natural way based on the aforementioned relationship from the social perspective. In other words, a Museum achieves varying levels of social education in a closed or opened way, is determined by its spatial-behavioural network with visitors reflecting the shape of the public's social experiences in a modern society.

1. Introduction

1.1. *The purpose of the research*

The primary function of a museum is social education through a spatial organisation. The spatial organisation that exists within museums resembles contemporary social characteristics. Museum visitors are affected by the spaces and act in varying ways depending on their spatial conditions; the characteristics of such behaviour can be interpreted from a social perspective. This study explains how visual-spatial characteristics affect people's movements within a museum, and how this experience can impact on the amount of knowledge visitors can garner. Architecture is defined as a combination of unifying or coherent forms of space and is a complex

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object that socially integrates users visually with their singular and multiple spaces; therefore, this study will concentrate on the relationship between spatial conditions and visitors' behaviour within museums, socially, to understand museum visitors' knowledge cognition from an individual and multiple standpoint.

1.2. *Research questions*

This study aims to collect in-depth knowledge on the correlation between visitor behaviour and spatial conditions within museums, treating it as an information system. In this sense, the study aims to compare visitor behaviour within two museums, which are differentiated in terms of their spatial conditions: 1) size, 2) spatial function, and 3) spatial layout. The research questions are as follows:

- a. How do spatial conditions differ in spaces providing museum information and acquired knowledge? To answer this question the study investigates how spatial size in large- and small-scale museums provides information through systems such as signs and displays.
- b. How do people gain knowledge depending on the spatial conditions within museums? To address this question, the study looks at how visitors use information systems according to spatial functions and layouts in exhibition spaces as well as throughout small and large layouts.
- c. How do spatial conditions impact visitor behaviour within museums? To elaborate on this, the study considers how individual and multiple spatial features affect and interact with visitors' behaviour in the small- and large-sized museums.

1.3. *Literature review*

This study aims to identify the patterns of interaction between spatial conditions and visitors' behaviour within museums. To understand the purpose of museums, this study uses the knowledge of museums (functions and spatial structures), society (social organisation, network, interaction), and human behaviour (information and communication) to identify visitor behaviour from the perspective of knowledge transfer and acquisition within museums. Space syntax theory was also introduced for quantitative analysis from a social perspective.

Firstly, this study inspects the prevailing academic theory that identifies different types of museum spatial conditions from a professional perspective. A museum's size significantly affects visitors' satisfaction (Jung, 2005). Thus, the efficiency and purpose of a museum's spatial use depend largely on its size (*Ibid*: 54). Furthermore, it has been observed that visitor behaviour is affected by the spatial layout in a museum. In research on museum spatial layouts, it has been argued that the movement of visitors is governed by the spatial layout and, as such, can be manipulated by adjusting the characteristics of those spatial structures (Choi, 1996). The various spatial types in a museum can help us to understand movement patterns from the viewpoint of spatial development and the connections that exist between different spaces. This phenomenon has also commonly been seen in circulation and exhibition spaces. A museum's spatial attributes can help to explain how spatial characteristics are related to function, layout, and subsequent visitor behaviour.

Secondly, this study uses organisation theory, network theory, and interaction theory to interpret the meaning of interactions between spaces and museum visitors from a socio-spatial viewpoint. A spatial organisation can affect a visitor's decision making. In 1998,

Scott introduced organisation theory, the purpose of which was to identify the types of communication among workers in the workplace. He suggested three organisational systems: rational, natural, and open systems based on how people generate information within a given type of communication system. He argued that the type of an organisational system can be defined by the pattern of people's communication in that group that is related to the pattern of their spatial use. Social networks and organisational structures can be used to explain the interaction between people and buildings in causal terms (Kurogawa, 1994). The spatial structure within a building can show the pattern of people's behaviour from a social perspective because the buildings are built with the needs of society and people of the same age in mind.

Moreover, this study refers to previous information and communication theories to identify visitor behaviour from the perspective of knowledge transfer and acquisition within museums. Altman and Rogoff (1987) classified the philosophical approach of theories on psychological and behavioural studies and commented on interactionism. In interactionism, the units of analysis can be categorised into *individual psychological characteristics* and *environmental characteristics*. From the physical environment of society, however both units interact with each other. The action of individuals is related to its environment, and the behaviour can be a symbol of the society (Blumer, 1962). These theories relate to how people learn according to their environment within a museum layout. A person's behaviour is a product of the communication that exists between that person and their surrounding environment, and people tend to offer feedback on knowledge recognition from their environment (*ibid.*).

Lastly, to explain how the quantitative research method is applied from the social standpoint to this study, space syntax theory is introduced. The theory was developed by Hillier and Hanson (1984). They argued that people could understand social attributes through patterns in spatial structures. The attributes of spatial structure can explain how people use spaces. They said that just as sentence spaces are combinations between unit spaces based on regulation, spatial combinations can constitute a pattern of spatial use that would produce social meaning (*ibid*: 209). The spaces can be a channel to deliver information; the process mimics the process of interpersonal communication to gain information in a society (Moon, 2004). Therefore, by utilising space syntax theory from a social viewpoint, we can answer many of the questions on people's movement in relation to spaces.

1.4. *Case studies*

To analyse the relationship between spatial conditions and visitor behaviour within museums, the study considered the size, spatial function, and layout as spatial conditions. To maximise our ability to observe the impact of size on visitor behaviour, only small – and large – sized museums were considered. Spatial layout encompasses spatial form as well as object layout. With respect to the research criteria, art and crafts museums which vary in size and spatial layout and with many signs and exhibition displays were selected.

Furthermore, since London is one of the birthplaces of the museum and one of the most renowned cities for studying museum architecture, it was selected for the case study. The Victoria and Albert Museum (a large-sized museum, LM-1) and the Design Museum (a small-sized museum, SM-1) were selected for the study.

To understand how visitors in museums garner knowledge and information, the spatial functions were categorised into circulation and exhibition spaces within both museums. Fur-

thermore, according to the number of signs and exhibitions, there were four spatial layouts: halls, passages, irregular exhibition layouts, and regular exhibition layouts.

The museum spaces looked at in the study can be categorised as follows:

- (1) circulation spaces: halls and passages
- (2) exhibition spaces: exhibition spaces with regular layouts, and exhibition space with irregular layouts

Table 1.

Classification	LM-1	SM-1
Floor plan (study area)		
Name	Victoria and Albert Museum	Design Museum
Type	Art and Craft	Art and Craft
(re-) Opening year	2006	2016
Location	London	London
Size	Large size (over 60,000 public area)	Small size (under 4,000 public area)
Sign (n)	74 (40 in circulation space, 12 in exhibition space)	45 (25 in circulation space, 20 in exhibition space)
Exhibition (n)	215 (34 in circulation space, 181 in exhibition space)	99 (12 in circulation space, 87 in exhibition space

2. Research Methodology

2.1. *Space syntax methodology: Visibility Graph Analysis (VGA)*

Observation study: movement snapshot, following people

From the observation study visitors' behaviour was derived into eleven behaviour types: Moving and static individuals, movement speed, visit rate, viewing rate of signs and exhibitions, viewing sign and exhibition attention rate, re-visiting, re-viewing sign and exhibition rate.

Table 2. *The factors of Visibility Graph Analysis (VGA).*

Visual connectivity
Visual connectivity measures the number of spatial elements, which are connected to a certain element. The visual connectivity is a local measurement, meaning it only takes into account the direct neighbours of a spatial element.
Visual clustering coefficient
The visual clustering coefficient measures people's decision making by considering all possible lines of sight in the neighbourhood of a location in a visibility graph. If most locations are mutually visible from a specific location, then the coefficient will approach 1. Many locations are not mutually visible from a specific location, then the coefficient will be closer to 0.
Visual control
Visual control picks out visually dominant areas. Each location is first assigned an index of how much it can see; the reciprocal of its connectivity. Then, for each point, these indices are summated for all the locations it can see. It should be apparent that if a location has a large visual field, it will pick up many points to sum, so initially, it might seem to have a high level of visual control.
Visual controllability
People dominate the visual controllability of a location. It would seem to operate similarly to visual control. Each of the cells is highly controllable, as the area of the visual field is small compared to the area viewable from the centre to which it connects, while the centre is less controllable, as it links only to the cells within its field, and they add a little extra visual field.
Visual integration
Visual integration is the value that reflects how entire spaces are related to certain spaces within them. It has the same approach with mean depth that calculates the arrival time to other spaces from a certain space in order to connect the entire space together. When moving, people tend to use spaces with a high integration value and thus the extent of encounters between people can be predicted with the integration value. Here, Integration is a global measure.
Visual step depth
Visual step depth calculates the steps necessary to get from one single element to all the others. When a point is chosen, it becomes the starting point to measure the visual step depth. The starting point is adjustable, so it is a flexible rate from an analysis viewpoint. The concept of step depth is a relational value. On the other hand, controllable spaces are locations that can be easily seen from other locations, but themselves cannot see much.

Intelligibility and Isovist
Intelligibility is the ratio between visual connectivity and integration, a value used to understand the difficulty in recognising a spatial structure. If intelligibility within buildings is low, people cannot recognise the spatial structure. This can cause unpredictable patterns of movement. An isovist is a 2-dimensional measurement used to calculate visual accessibility. It starts from the location of the target people or gates.

Correlations: Linear and Multi-regression analysis

Linear regression analysis is used to correlate the linear relationship between an independent variable and a dependent variable, one by one. A multi-regression analysis is used to correlate multiple relationships, between various independent variables and a dependent variable. The independent and dependent variables were consistently used in linear and multi-regression analysis, categorised in terms of circulation and exhibition spaces: to measure the impact of spatial structures on visitor behaviour and the relationship between the parameters, the value (average) and the R^2 (average, between 0,3 and 1)were respectively looked at.

Table 3. *The definition of Visitors' behaviour.*

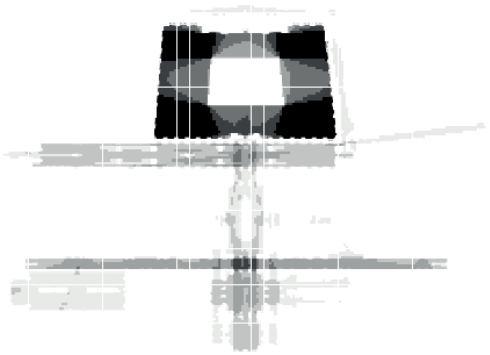
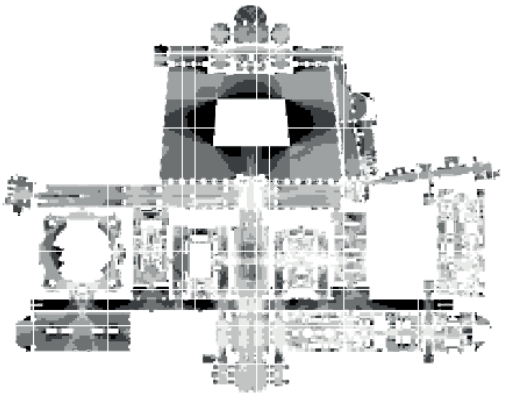
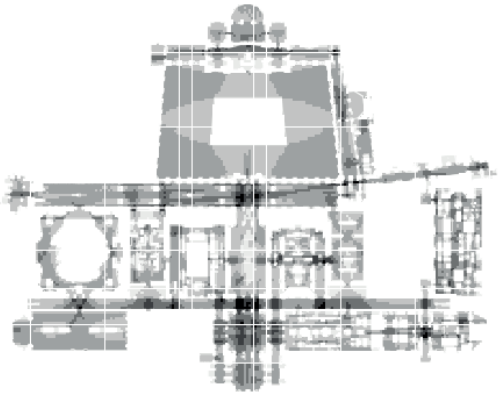
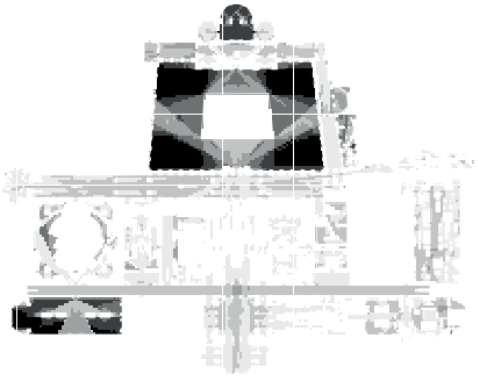
Terminology	Definition	Unit
Moving speed	Moving length / moving time	m/min
Visiting rate	The number of targets visited / the total number of targets	n/50
Viewing sign rate	The number of signs viewed / the total number of signs	n/n
Viewing exhibition rate	The number of exhibitions viewed / the total number of exhibitions	n/n
Viewing sign attention level	Viewing sign rate *the number of signs people stopped to view *the duration of pause	n/n*n*min
Viewing exhibition attention level	Viewing exhibition rate *the number of exhibitions people stopped to view *the duration of pause	n/n*n*min
Re-visiting rate	The number of targets re-visited / the total number of targets	n/50
Re-viewing sign rate	The number of signs re-viewed/ the number of signs	n/n
Re-viewing exhibition rate	The number of exhibitions re-viewed/ the total number of exhibitions	n/n

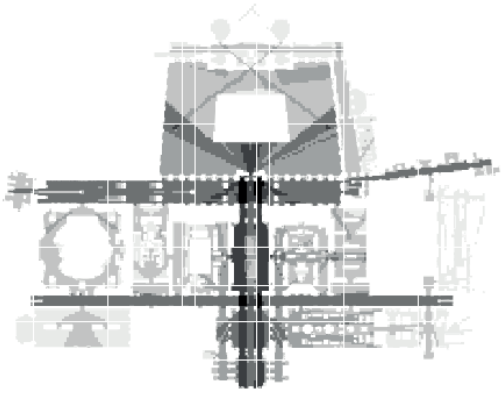
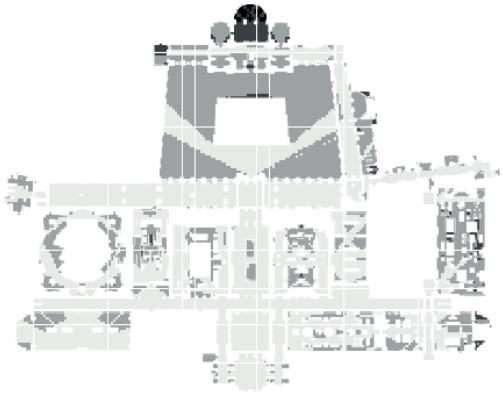
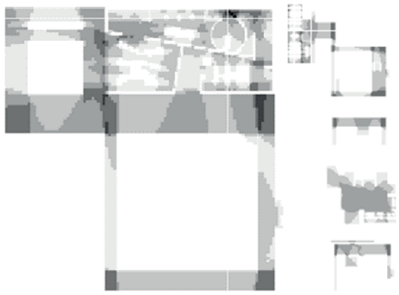
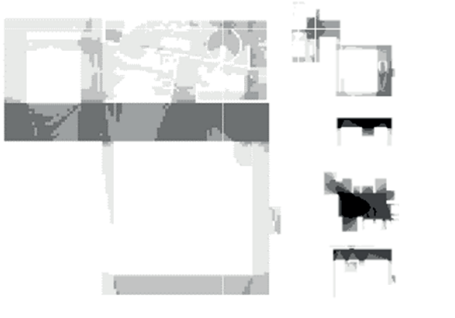
3. Analysis/Results

3.1. *Analysis of spatial conditions within the museums*

From the spatial analysis, it was found that most spatial conditions within SM-1 were superior because within LM-1 most spatial conditions were concentrated in the main hall. To be specific, in LM-1, the simple and large spatial layout created weak spatial conditions within LM-1. In SM-1, a small, complex layout was observed and thus, it could be said that much of this spatial layout had a strong character. This spatial relationship would provide a different spatial experience and allow people to gain knowledge in different ways.

Table 4. *Visibility Graph Analysis (VGA).*

			
Visual connectivity	302.49	Visual clustering coefficient	0.57
			
Visual control	1.0	Visual Controllability	0.17

			
Visual integration	3.98	Visual step depth	1.13
			
Visual connectivity	670.15	Visual clustering coefficient	0.74
			
Visual control	1.05	Visual Controllability	0.34
			
Visual integration	1.93	Visual step depth	0.98

** The more complex spatial layout becomes the higher spatial analysis in circulation and exhibition space are conducted.*

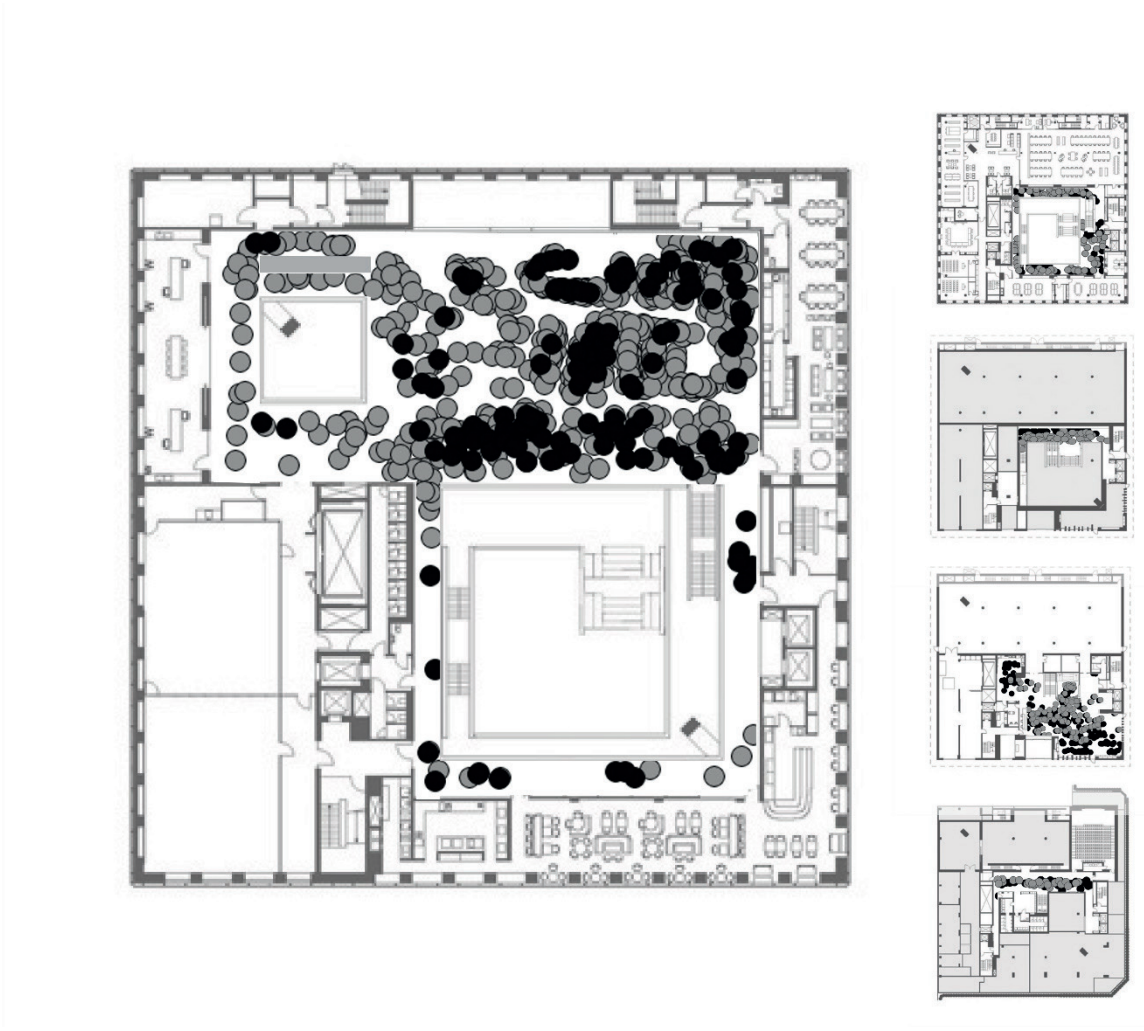
3.2. *Analysis of visitors' behaviour within the museums*

From the observation analysis, it was noted that spatial conditions within the museums strongly affected the visitors' behaviour, particularly with exploration and knowledge gathering. The routes visitors took to gather information and knowledge were different based on the size, function, and layout of the spaces in the museum. Also, spatial conditions impacted the way people behaved and thus their subsequent behaviour.

Moving and static snapshot in LM-1

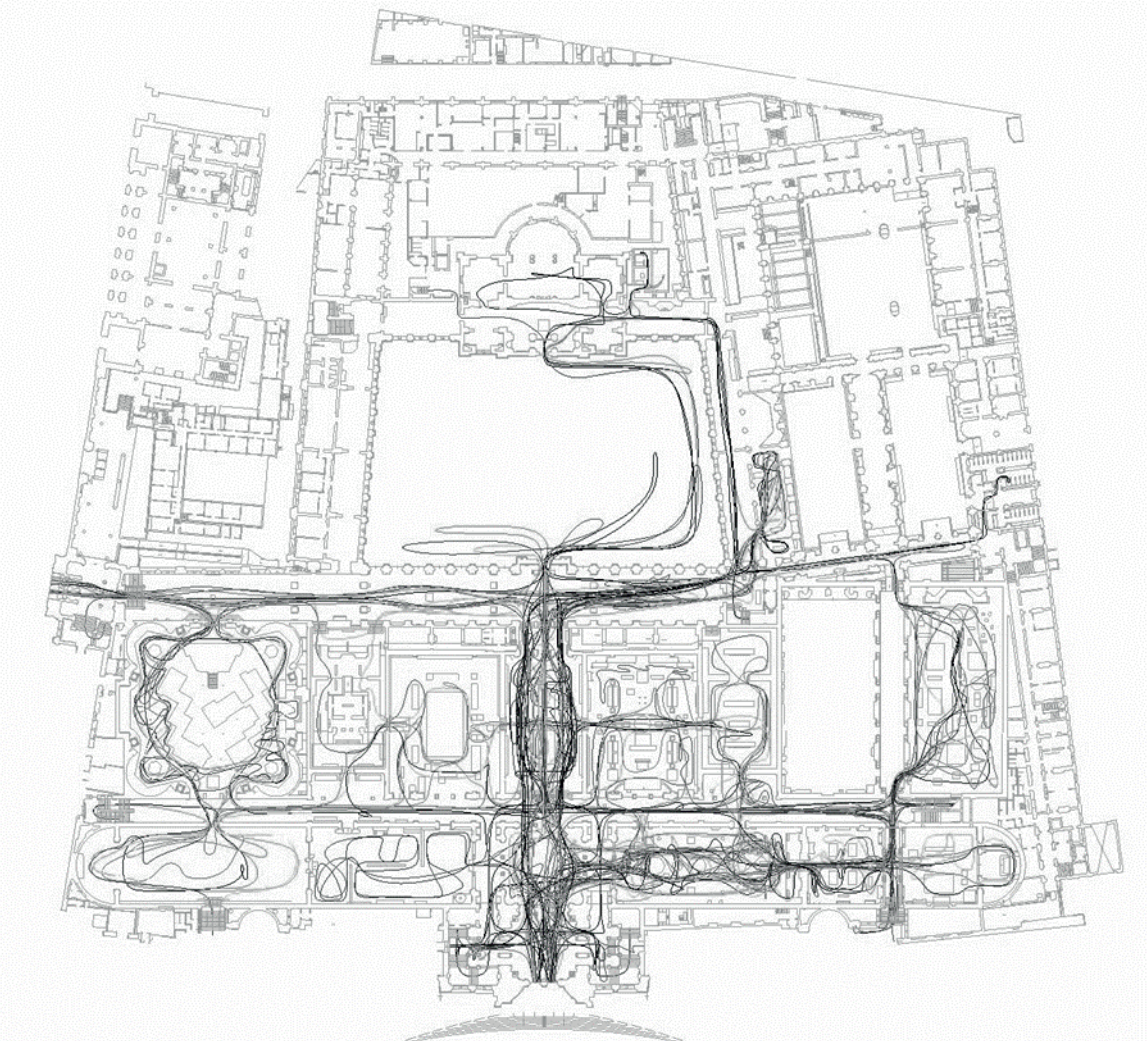
- The number of observed people was similar in circulation and exhibition spaces.
- In circulation spaces static people were concentrated in the halls and people usually moved around in the passages
- In exhibition spaces more people moved than were static. People were focused around exhibitions and more people were in the irregular layout exhibition spaces and show more diverse pattern than in regular layout exhibition spaces.

Moving and static snapshot in SM-1



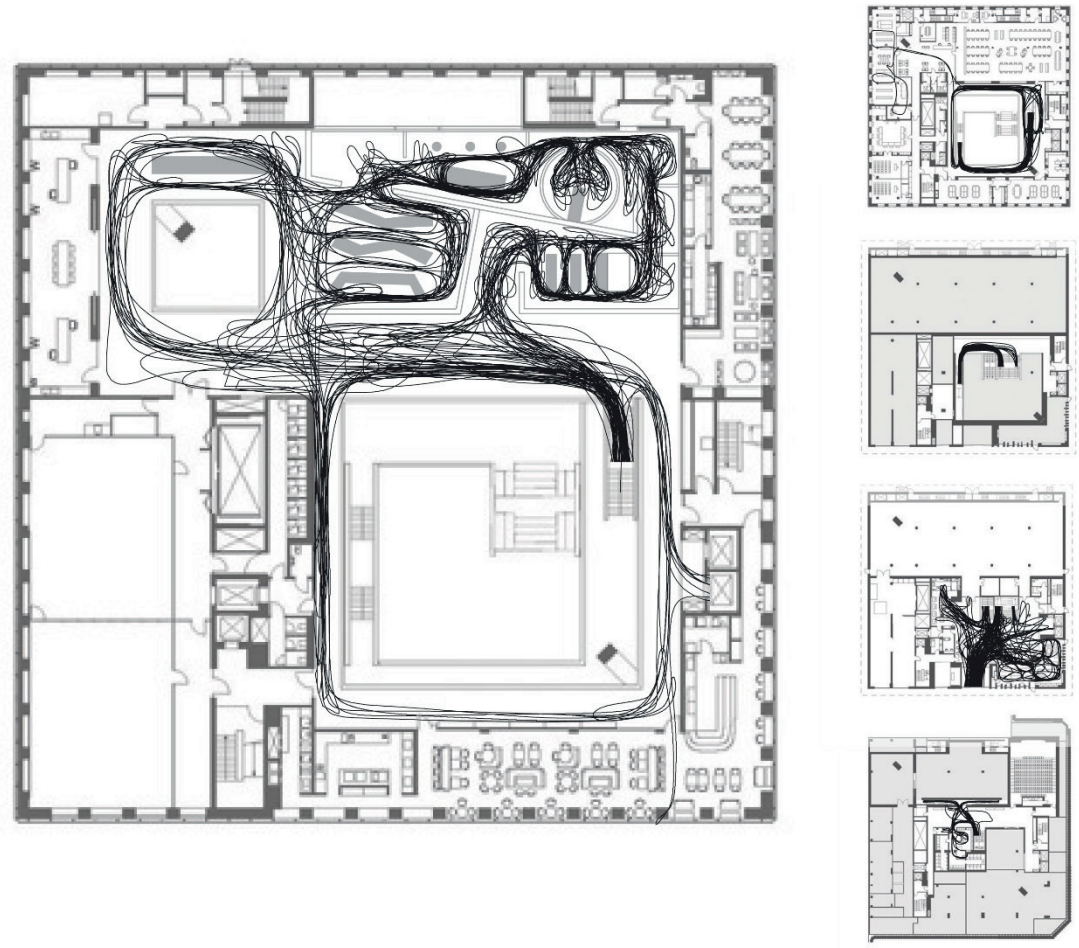
– There were more moving people during the snapshot count.
– In circulation spaces people were concentrated in the halls and the front part of the passages.
– In exhibition spaces people were focused around exhibitions and more people were in the irregular layout exhibition spaces than the regular layout exhibition spaces. In the irregular layout exhibition spaces there were more moving people than in the regular layout exhibition spaces.

Circulation pattern of visitors in LM-1



– The visitors' circulation was concentrated in the centre of the museum and the centre of the circulation spaces.
– The people were separated to two parts from the main circulation spaces. In the halls e were more complex pattern of movement.
– In exhibition spaces more people were concentrated in the spaces locate near the entrance. The irregular layout exhibition spaces had more complex movement than the regular layout exhibition spaces.

Circulation pattern of visitors in SM-1

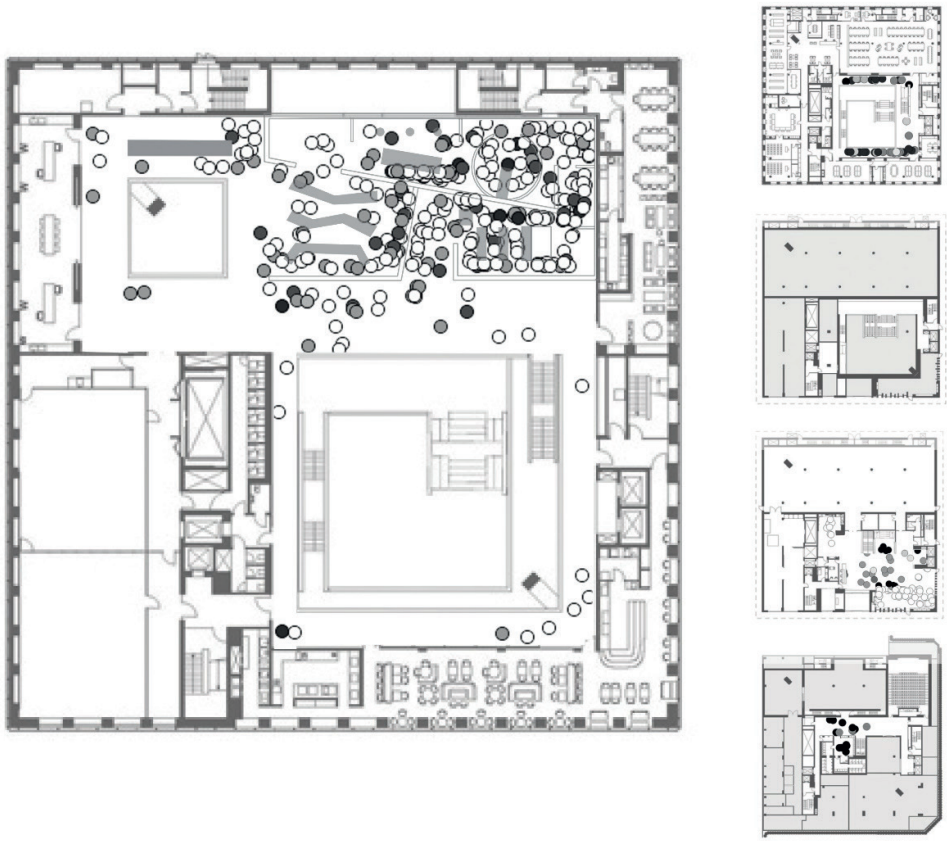


– People's movement was focused in main hall and it is separated in two ways in 2nd floor near gate to exhibition spaces.
– In the regular layout exhibition spaces, people showed similar, simple patterns of movement, while they showed complex patterns of movement in the irregular layout exhibition spaces

Quantity and duration of visitors' stops in LM-1

– People usually stopped within exhibition spaces.
– In circulation spaces, people stopped in front of the gates and in front of the halls that lead people to other spaces
– In exhibition spaces, people stopped more in the irregular layout exhibition spaces than in the regular layout exhibition spaces

Quantity and duration of visitors' stops in SM-1



- Stop duration was short despite the many number of stops.
- In the halls, people tended to stop for a relatively long duration since they had to check signs to find the way.
- In exhibition spaces, people sometimes stayed long, but it depended on the exhibition contents and the spatial layout.

3.3. *Analysis of spatial conditions and visitors' behaviour within the museums*

According to the visitor behaviour analysis, it is understood that the viewing behaviour in each museum's exhibition space is correlated with its spatial structure and physical characteristics. In other words, museum size, spatial functions such as circulation and exhibition, and spatial layouts were highly influential in determining the number of movements and static visitors, the visiting rate, the viewing sign rate and attention level, the viewing exhibition rate, and the attention level. Furthermore, it also affected visitors' re-visit rate, re-viewing sign and exhibition rate. *For more information, please refer the 'Discussion' due to the amount of paper.

Table 5. *The definition of Visitors' behaviour.*

Visitors' behaviour	circulation space	exhibition space
moving people	12.08	3.72
static people	12.97	3.16
moving speed	11.71	5.97
visiting rate	0.51	0.25
re-visiting rate	0.37	0.02
viewing sign rate	0.31	0.18
viewing sign attention level	0.61	0.11
viewing exhibition rate	0.14	0.09
viewing exhibition attention level	0.08	1.50
re-viewing sign rate	0.21	0.02
re-viewing exhibition rate	0.05	0.01

** The more complex spatial layout becomes the higher visitors' behaviour are conducted in circulation and exhibition spaces.*

	circulation space	exhibition space
moving people	14.30	17.42
static people	3.64	1.62
moving speed	53.03	13.79
visiting rate	0.51	0.51
re-visiting rate	0.42	0.04
viewing sign rate	0.43	0.46
viewing sign attention level	0.23	0.26
viewing exhibition rate	0.12	0.36
viewing exhibition attention level	0.33	2.54
re-viewing sign rate	0.33	0.04
re-viewing exhibition rate	0.10	0.02

** The more complex spatial layout becomes the higher visitors' behaviour are conducted in circulation and exhibition spaces.*

4. Correlations

4.1. *Linear-regression analysis*

From the linear regression analysis, it was found that the behaviour of visitors in terms of exploring and gaining information was clearly associated with individual spatial conditions within the two museums. Spatial impact and the relationship between spatial conditions and visitors' behaviour were superior in SM-1. However, there were differences in terms of spatial function and layout within both museums, related to their spatial size. More specifically, the spatial impact (B) visitors' behaviour was mostly concentrated in the exhibition spaces in LM-1. However, in SM-1, the spatial impact in the circulation spaces was more significant on visitors than in the exhibition spaces and the value of the spatial impact in both spaces are higher. Furthermore, the relationship between spaces and visitors (R^2) was also more significant in the circulation spaces than in exhibition spaces in both museums. The value of the relationship is higher in LM-1 but in the exhibition space, the value is higher in SM-1. *For more information, please refer the 'Discussion' due to the amount of paper.

Table 6. *B analysis*

[circulation space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	0.178	0.079	0.055	0.088	0.111	0.167	0.302	0.252	0.075	0.343	0.314
PCS	The location affected the relationship between circulation space layout and visitors' behaviour.										
HCS											
Average: 0.178											
SM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Averages	0.223	0.098	0.262	0.228	0.227	0.195	0.106	0.078	0.114	0.224	0.064
PCS	The location affected the relationship between circulation space layout and visitors' behaviour.										
HCS											
Average: 0. 165											

[exhibition space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	7.665	18.345	18.554	0.507	0.090	0.326	0.263	0.056	2.325	0.170	0.020
PCS	The location affected the relationship between circulation space layout and visitors' behaviour.										
HCS											
Average: 4.393											
SM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	15.649	3.172	33.594	0.419	0.089	0.540	0.830	0.410	4.244	0.080	0.066
PCS	The location affected the relationship between circulation space layout and visitors' behaviour.										
HCS											
Average: 5.372											

Table 7. *R^2 analysis*

[circulation space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	0.127	0.154	0.187	0.127	0.083	0.126	0.238	0.026	0.020	0.161	0.056
IRES	The location affected the relationship between exhibition space layout and visitors' behaviour.										
RES											
Average: 0.119											
SM-1	moving people	static people	moving speed	visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-visiting rate	re-viewing sign rate	re-viewing exhibition rate
Average	0.145	0.154	0.220	0.138	0.098	0.111	0.142	0.128	0.087	0.059	0.132
IRES	The location affected the relationship between exhibition space layout and visitors' behaviour.										
RES											
Average: 0.129											

[exhibition space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	0.127	0.154	0.187	0.127	0.083	0.126	0.238	0.026	0.020	0.161	0.056
IRES	The location affected the relationship between exhibition space layout and visitors' behaviour.										
RES											
Average: 0.119											
SM-1	moving people	static people	moving speed	visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-visiting rate	re-viewing sign rate	re-viewing exhibition rate
Average	0.145	0.154	0.220	0.138	0.098	0.111	0.142	0.128	0.087	0.059	0.132
IRES	The location affected the relationship between exhibition space layout and visitors' behaviour.										
RES											
Average: 0.129											

4.2. *Multi-regression analysis*

From the multi-regression analysis, it was found that the visitors' behaviour to explore and gain information was clearly associated with multiple spatial conditions within the two museums. To be specific, the association between spaces and visitors (B) was more considerable in circulation spaces than in exhibition spaces. Furthermore, the relationship between spaces and visitors (R^2) was more significant in circulation spaces. Moreover, the association and relationship between spatial conditions and visitors' behaviour were superior in SM-1, from multiple perspectives. *For more information, please refer the 'Discussion' due to the paper.

Table 8. *B analysis*

[circulation space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	26.254	63.841	72.093	2.561	1.488	1.804	2.234	2.080	0.685	0.780	1.045
PCS HCS	The location and surrounding area affected the relationship between circulation space layout and visitors' behaviour.										
Average: 15.897											
SM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	22.785	15.873	126.816	0.867	0.555	0.903	1.202	0.885	2.921	0.578	0.851
PCS HCS	The location and surrounding area affected the relationship between circulation space layout and visitors' behaviour.										
Average: 15.840											

[exhibition space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	8.280	22.361	14.981	0.552	0.159	0.786	0.284	0.241	22.300	0.219	0.063
IRES RES	The location and surrounding area affected the relationship between exhibition space layout and visitors' behaviour.										
Average: 6.386											
SM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
Average	38.475	4.576	50.989	1.006	0.312	1.673	1.369	1.090	13.955	0.178	0.165
IRES RES	The location and surrounding area affected the relationship between exhibition space layout and visitors' behaviour.										
Average: 10.344											

Table 9. *R^2 analysis*

[circulation space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
visual connectivity visual clustering coefficient visual control visual controllability visual Integration visual step depth	0.926	0.793	0.830	0.885	0.958	0.942	0.997	0.910	0.931	0.969	0.945
*p≤0.05	**p≤0.01								Average:	0.917	
SM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
visual connectivity visual clustering coefficient visual control visual controllability visual Integration visual step depth	0.993	0.924	0.987	0.997	0.974	0.976	0.934	0.992	0.836	1.000**	1.000*
*p≤0.05 **p≤0.01									Average:	0.965	

[exhibition space]

LM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
visual connectivity visual clustering coefficient visual control visual controllability visual Integration visual step depth	0.617	0.598	0.553	0.617	0.489	0.644	0.917	0.306	0.630	0.642	0.526
*p≤0.05	**p≤0.01								Average:	0.594	
SM-1	moving people	static people	moving speed	visiting rate	re-visiting rate	viewing sign rate	viewing sign-attention level	viewing exhibition rate	viewing exhibition attention level	re-viewing sign rate	re-viewing exhibition rate
visual connectivity visual clustering coefficient visual control visual controllability visual Integration visual step depth	0.778	0.932	0.860	0.732	0.591	0.784	0.891	0.896	0.916	0.604	0.946
*p≤0.05 **p≤0.01									Average:	0.812	

5. Discussion

It can be seen that the behaviour of visitors to a museum vary depending on the spatial conditions of the museum. The scale of the museum greatly affects the flow of visitors and their spatial distribution. To better understand this, the spaces of large-sized and small-sized museum were analysed by using space syntax theory and associated observation methods. The space syntax analysis showed that in the larger museum, LM-1, the integration and step depth values appeared to be high. Such spatial analysis indicates that in the most integrated spaces and shallow spaces, the behaviour of visitors tends to be vibrant in a concentrated manner, for spatial cognition. That is, most behaviour of visitors in the museum appeared to be passive. In the smaller museum, SM-1, figures for most spatial conditions were even higher. This means that visitors' most behavioural patterns were more active and diverse.

Analysis of visitors' behaviour from observations showed that in LM-1, the number of static people and the viewing sign rate were high. Such visitor patterns appear due to the increased need to understand the museum's spatial structure when the museum is larger. This indicates that in LM-1, most visitor behaviours appear to be passive, an attempt to verify the spatial information. But most other types of visitor behaviour appeared higher in SM-1, for example, proactive visitor behaviour centred around experiencing the space.

Moreover, visitor behaviour varied in accordance with the spatial functions in each museum. The space syntax analysis for the larger museum, LM-1, showed that spatial conditions other than the figure of visual controllability and visual step depth appeared to be higher in the exhibition spaces than in the circulation spaces. This indicates that a wider variety of visitor behaviours appears in the circulation spaces. In the smaller museum too, the figures for most spatial conditions were higher in the circulation spaces than in the exhibition spaces. This means that in SM-1 the circulation spaces have a greater spatial effect on visitor behaviour. In addition, compared to the larger museum, most of the analysis figures for each space were higher in the smaller museum.

Analysis of visitor behaviour showed that as was the case in the spatial analysis of the larger museum, most behaviour (excluding a small number of exhibitions viewing behaviours) appeared to be active in the circulation space. Such results indicate that the cognition of spatial information in a circulation space of a larger museum precedes exhibition viewing behaviour. In an exhibition space where the distance from the main hall is greater than the distance to a circulation space from the main hall, the cognition of spatial information precedes in the circulation space. This indicates that the visitors themselves can moderate the effect from the spatial structure. But in the circulation and exhibition spaces of a smaller museum, behaviour is mostly focused on movement for viewing the exhibition and associated activities. In addition, visitor behaviour in the circulation and exhibition spaces appeared to be higher in SM-1 than in LM-1. This implies that there are other spatial factors in the spaces that affect visitors' movement in smaller museums.

Furthermore, it was verified that the visitors' behaviour varied according to the complexity of the given spaces in museums of different sizes. An analysis of the space syntax shows that in LM-1, most spatial conditions other than the visual clustering coefficient and the visual step depth were concentrated in halls with a simpler structure than in passages. Similar results were found for SM-1 too but such results were mostly higher in SM-1. This shows that although there are differences in the figures, regardless of the size of the museum, visitor behaviour in a circulation space is affected greatly by the spatial structure of the halls which have more simple forms.

An analysis of visitor behaviour shows that in LM-1, in the halls, information verification

behaviour for the cognition of the spatial structure had an even higher value. Among the visitor behaviours, information verification behaviour to perceive the spatial structure had an even higher value. In the passages, behaviours that preceded the viewing of the exhibits were active. Similar behaviours were found in SM-1 as in LM-1 in circulation spaces but the visitors' moving behaviour was more proactive when they were searching for their destination. In addition, the figures were even higher in SM-1. This shows that while there may be some difference in numerical figures due to the museum size, visitor behaviours in circulation spaces are affected more by the spatial structure specifically when there is a simpler form. Regarding exhibition spaces, in LM-1, a larger museum, most viewing behaviours were active in exhibition spaces with regular layouts. An analysis of the space syntax shows that in LM-1, all spatial conditions excluding visual clustering coefficient and visual step depth were concentrated in the regular exhibition spaces. In SM-1, a smaller museum, all spatial conditions excluding visual connectivity were concentrated in the regular exhibition spaces. SM-1 mostly had figures higher than LM-1. This indicates that while there may be numerical figure-based differences due to the size of the museum, visitor behaviour in an exhibition space is affected more by the spatial structure in exhibition spaces, specifically when there is a simpler form. Furthermore, as the expectation, such effect of the space varies according to the size of the museum. An analysis of the visitor behaviour shows that in LM-1, in the regular layout exhibition spaces, the behaviour of verifying information to proceed with viewing the exhibition showed a higher figure, while in irregular exhibition spaces, behaviours for viewing were more active. In SM-1 also, similar behaviours were observed as in LM-1, however the behaviours were varied and more proactive. Such results showed a mostly higher value in SM-1, even though the visitors' behaviour was spontaneously different; this related to its location along with the influence of the main and middle gates within the two museums.

These analysis results show the various interaction types between different space types in museums and visitor behaviour. This was calculated from individual and multiple correlations that explain the spatial impacts and interactive behavioural relationships within the studied museums. Most importantly, most of the spatial impacts and behavioural relationships were observed in the circulation spaces, more so than in the exhibition spaces in both large- and small-sized museums. It is to precede to the viewing exhibitions, which is the museum's defined spatial function for social education. However, such characteristics carry a different meaning depending on each museum. In the larger museum examined in this study, behaviours associated with spatial and information perception were mostly observed. In the circulation spaces of larger museums, static behaviour associated with checking information had a high correlation with spatial structure. In particular, multiple spatial conditions affected visitor behaviour in combination, and the larger scale of the museum affected visitor behaviour through spatial perception.

From the individual and multiple correlations, it was calculated that people's static behaviour had a strong connection with the spatial conditions of the circulation spaces. Their behaviours mostly had a connection with the information cognition behaviour related to individual spatial conditions, which they exercised to move around and view exhibitions due to the museum's large size. Most information check behaviours in large-sized museum that showed strong relationship between spaces and visitors' behaviour was similar to the most visitors' behaviour. Those relationships affect visitors' behaviour more considerably in simpler circulation spaces such as halls. In the exhibition spaces, the effects of space on behaviour was smaller than in the circulation spaces, but the behaviour of checking spatial information had a high correlation with most spatial structures. In particular, with regard to the complexity of the space, various

spatial impacts and associations between various spaces and behaviours were observed for the circulation spaces, while in the exhibition spaces, a spatial impact and association between various spaces and behaviours were observed in spaces with simple forms. This means that visitor behaviour seems to vary in the exhibition spaces as a result of spatial complexity as they try to find their route through the museum. As such, larger museums in this study can be said to have a classical space-behaviour network which describes a fixed and determined type of a museum.

In the smaller museum examined in this study, proactive behaviour was mostly observed. In circulation spaces, there was a high correlation between the spatial structure and active behaviours attempting to perceive that structure. In particular, individual and integrated spatial conditions affected visitor behaviour at the same time and to a higher degree than in larger museums. This might be due to the spatial complexity of the small-sized museum. It was calculated that most people's behaviour had a strong connection with the spatial conditions within the museum. Likewise, visitor behaviour was impacted more by circulation spaces and these behaviours mostly had a connection with the behaviour to view exhibitions. Most behaviours related to of actively viewing exhibitions on small-sized museum that showed strong relationship between spaces and visitors' behaviour was similarly observed in most visitors' behaviour. Furthermore, this was also spontaneously observed from the result of individual and especially multiple correlations. Those relationships affected visitors' behaviour more considerably in the simpler circulation spaces, such as halls. In exhibition spaces, compared to circulation spaces, the effects of space on behaviour were smaller overall but a common factor was found: proactive behaviours for viewing were highly affected and correlated with individual and multiple spatial conditions. In particular, regarding the complexity of a space, it was found that regardless of the function or complexity of each space, a new spatial usage pattern based on the willpower of the visitor appeared. This means that visitor behaviour seems to be contextual in the exhibition space according to their intentions on the different spatial usage with the curators' initiative in the small sized museum. As such, smaller museums in this study had a classic but also new space-behaviour network and can be said to have an interdependent and unpredictable relationship between the museum space and the visitor. Such a result creates a new space-behaviour network.

Of course, spatial characteristics alone cannot fully explain the diversity of people's movements. Ironically, visitor behaviour can be said to have resulted from the spatial structure. When people experience a museum, their initial movements could be affected by the complex museum layout (Choi, 1996). They might then gain information and knowledge in different ways depending on the spatial conditions. Experiences can also affect various patterns of individual behaviour and, in turn, different knowledge and intentions could then form (Koo, 2013). Distinct patterns of behaviour would emerge, resulting in new ways of spatial usage not initially planned or considered. In other words, the museums analysed in this study can be said to provide a rational spatial network that delivers social knowledge in a manner that is determinant and desired by the public, whilst suggesting an unpredictable spatial network that delivers social knowledge in a manner that is interdependent and desired by the individual.

6. Conclusion

Museums have been spaces open to the public since they first appeared in the 18th century. They deliver the society's knowledge by a providing a space wherein the public can interact with different exhibits. These museum spaces have had various functions and forms over the

years from the perspective of knowledge delivery. The characteristics of such spaces depend on the relationship between society and the public. For example, a closed social system creates a unilateral flow of knowledge delivery; in such a case, the space would be "regulatory" (Foucault, 1975). In a regulatory space, the acquisition of knowledge by the public will be uniform. In an open social system, knowledge delivery is done multilaterally (*Ibid*). The public and the space become interdependent. Acquisition of knowledge in a flexible space would appear in a more varied and autonomous form.

Of course, today's society cannot be defined as one specific form. Modern society has a wide array of social knowledge delivery systems. Museum spaces can create spatial systems with various functions and forms based these different facets of society. At times, museums might create a space based on the closed nature of society with strict rules, to provide information and knowledge in a uniform manner to museum visitors. Meanwhile, museum spaces based on an autonomous relationship with society would provide knowledge in a varied way and create an interdependent system with visitors.

The spatial characteristics of museums can be interpreted from a social perspective by looking at the formative relations with visitors. For example, in the larger museum used in this study, a more regulatory method was used to deliver knowledge to visitors. That is, in its circulation spaces, behaviours for the perception of the spatial system came first. In the exhibition spaces, activities to perceive the content of the exhibit took up the largest share. In both of these spaces, when the structure was more complex, various forms of behaviour appeared while in simpler spaces most behaviours were geared toward the acquisition of knowledge. If such a space-behaviour network is interpreted from a social perspective, the circulation spaces of LM-1 can provide rational knowledge and information, while the exhibition spaces deliver diverse knowledge naturally based on their spatial conditions, which is the classical function of a museum. As spaces become more complex, spatial conditions affect the way information is gained throughout the museum.

However, in the smaller museum, it was observed that depending on the ease of perceiving the space, communication between the visitor and the space occurred in different ways. For example, there were many cases where the knowledge was delivered to visitors in a more interdependent manner. In particular, regarding the function and complexity of the space, there was a proactive new pattern of using space generated by the willpower of the visitor regardless of the character of the space. If this space-behaviour network is interpreted from a social perspective, the exhibition spaces of SM-1 can create information that orients people to their destination in more natural and diverse ways. Consequently, the circulation spaces of SM-1 can also create diverse information and knowledge depending on the visitors' diverse use of the spaces. In this sense, as spaces become more complex, the processes of gaining information become more natural and rational. Though at the same time, information gathering is affected by the spatial conditions and personal intentions which arise during the process.

Therefore, it can be said that LM-1 has more regular and naturally determinant spaces while SM-1 has more integrated and probabilistic spaces that are interdependent with visitors from the perspective of information and knowledge cognition. The behaviour that is defined by the character of the space and according to the traits of each museum can sometimes have an interdependent relationship with space such that visitors can affect the space and vice versa. It could be said that both museums have the ability to be an open space for everyone's knowledge and education in their own way.

This study has sought to understand visitors' behaviour from the perspective of information recognition within two museums, encompassing various spatial conditions related to size,

spatial function, and layout. It is important to suggest the social meaning of museum spaces and their interdependence on visitors from the perspective of knowledge cognition. However, this study was limited as it only looked at museum spaces and information systems of different scales and layouts from a physical point of view. In the future, studies should evolve to enable identification with other types of spatial characteristics, contents, and visitors' information. Furthermore, the study was conducted from a global perspective by using visual graph analysis only. Further local and in-depth analyses should be considered to targ*et al.*l floors and spaces.

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Focus: Urban Conflict and Divided Cities

Introducing Building-Typology in the Decision-Making Process: a Strategy of Adaptive Reuse for Refugees in Turin

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Keywords: Immigration, vacant buildings, building-typology, decision-making, regeneration.

Abstract: This study puts the architect's technical knowledge within a great horizon, that of the 21st-century migrant crisis. Today, in the local Turinese dimension there are two defined "crisis" conditions. On the one hand, the continuous and growing flow of people coming from countries of international conflict creates a mass of "new inhabitants", with housing and welfare needs. On the other hand, the economic crisis and the change in production systems have left the city running real "urban voids".
The purpose is to detect the optimum typology of vacant building located in Turin which can best accommodate the refugees. By typological understanding, the study will explore the finest strategy to adopt, on the one hand for the newcomers, without orienting them in random structures, on the other hand for the Turin territory, through a holistic approach of regeneration and revitalization of discontinuous areas.
To be able to accomplish the purpose, the study introduces the functional and formal building-typology in decision-making through a scientific method. This method, based on a multi-criteria mathematical model, was extracted from an article written by scholars from the University of Lisbon. Through the results of the study, it is clear that not all the vacant buildings are favorable for the maximization of the inclusion of migrants in the urban context. Study of building type becomes important in order to meet the common requirements of immigrants. Certain typologies are more adequate than others to host refugees and to catalyze a regeneration process of the city.

1. Introduction

This research strives to enhance the study of immigration and its implications at an urban and architectural level within the city. Today, we are facing the biggest refugee crisis and migration since the Second World War. Over the past year, more than 60 million people have been forced to flee their homes. Desperate conditions have forced the whole world to move. States must significantly increase the number of refugee resettlement places and divide equally in this effort' (Ban Ki-moon, 2016). The largest migration is taking place now, between 2007 and 2050 the cities will absorb 3.1 billion people. The unprecedented number of migrants and refugees on the move has put new pressure on the cities that are mobilizing to respond to the increase in popu-

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lation. Europe has 27 million migrants out of 490 million inhabitants. Today the phenomenon is amplified and made inevitable by the ongoing humanitarian crises: a global emergency, due to the conflicts that upset the Middle East, Asia and Africa. A phenomenon that according to the International Organization for Migration will not stop before 2050, when the world population, today of almost 8 billion, will settle on 9-10 million people. "The whole issue of migration allows us to rethink how cities should be (what they should look like). Never before has there been such a time when there is such a large-scale demand for how we build our cities and the whole world. For architects and urban planners, I think it's one of the greatest moments to get busy" (Kimmelman, 2016).

The city of Turin faces the arrival of immigrants every day, however the existing reception and assistance system is a set of isolated spheres, which are unable to communicate with each other. From the interview with the experts about the real functioning of the management of the immigrant and refugee issue in Turin, it is clear that there are lacks and inefficiencies regarding the present reception and accommodation facilities in legal and spatial level which give rise to rough urban conflicts. The existing accommodation centers are not enough to respond neither quantitatively nor qualitatively the demand of incoming requests. Moreover, the long bureaucracy slows down the overall procedure and the consequence is that immigrants are sent casually where there are places available, without orienting them in structures appropriate to each condition to that single case, to that family with specific and different needs. According to the analysis of the Italian reception system, three main issues emerges which require primary intervention for the improvement of the system. These can be listed as; the need to increase available places for accommodation, the need of a better structuring of the choice of living spaces for the new inhabitant, the need to differentiate actual spatial and social necessity by case-by-case assessment. The need therefore arises to point out the weaknesses of the current system, to highlight the profitable aspects of the existing network. It is within this chaotic and unmanageable landscape that, in the academic sphere, architects and urban planners question how, today, our cities can intertwine and absorb these great flows of people, without falling into ghettoizing and bankruptcy solutions acting on architectural and urban scale.

In the mean time, in this day and age, the city of Turin occurs as a vigorous post-industrial city. Starting from the 1970s, the "Fiat City" with its industrial foundations began to collapse and the city experienced the transition from Fordist to the post-Fordits model. The economic crisis and the change in production systems crisis hit the entire city leading the total abandon of major plants, leaving real urban voids in the urban fabric (Governa *et al.*, 2009). In this context, Turin is facing the challenge in defining the future of these urban voids on the way of becoming to a vibrant 21st–century city. Regeneration and reuse of the abandoned areas along with the building on it, is becoming a relevant strategy for building the future development of the city. In particular, 'adaptive re-use', the reuse of existing physical asset with a new purpose has become a significant and effective strategy for building sustainable communities.

In the light of the facts, this research aims at solving several aspects simultaneously. On the one hand it proposes the inclusion in the local context of hospitality centers that look at the different situations of the new inhabitants, at that individual case, at that family with specific needs, without orienting them in random structures but planning their placement in the urban space. On the other hand, the idea is to start a process of regeneration, recovery and revitalization of abandoned areas in the urban fabric. Innovation lies in connecting the two aspects, cities and new inhabitants, and in developing the capacity to make decisions that make full use of the opportunities existing in the territory and create additional value for the city itself. Nevertheless, where should start such initiative is a fundamental decision

to make in order to avoid plausible urban conflicts in advance. In this regard, this study attemps to experiment a new perspective with the intent of proposing a practical solution for the crisis. Hence it aspire to assist decision makers for overcoming the crisis through a well framed strategy. The purpose is to detect the optimum typology of vacant building located in Turin which can best accommodate the refugees. This study will classify building typologies in the city of Turin by identifying the similarities in spatial properties along with geographical characters of city's abandoned assets. By typological understanding, the study will explore the finest strategy to adopt, on the one hand for the newcomers, without orienting them in random structures, on the other hand for the Turin territory, through a holistic approach of regeneration and revitalization of discontinuous areas. To be able to accomplish the purpose, the study introduces the functional and formal building-typology in decision-making through a scientific method.

2. Methodology

The scientific approach described here is that of multi-criteria analysis, a scientific method that provides concrete support to the decision maker in the presence of multiple, often conflicting, objectives to be considered simultaneously. The advantage in the whole process is the achievement of a result that is consistent with multiple objectives and values, despite the complexity (Ferretti, 2012). For this study, in specific, the applied methodology was carried out starting from the article Costa AS, Figueira JR, Borbinha J., "A Multiple Criteria Nominal Classification Method Based on the Concepts of Similarity and Dissimilarity", which developed with the support of professors Lami IM (Polytechnic University of Turin), Greco S. (University of Catania), Figueira JR, Borbinha J. (University of Lisbon) and of Dr. Costa AS (University of Lisbon) who, in collaboration with the authors of the research have take care of the calculation aspects of the method. It is noted that the integration of this method with an urban problem stands as an innovative approach since hitherto it has not been put in practice in the field of urban policy.

This method, at first, requires selection, identification and definition of three aspects of the decision problem which are respectively actions, categories and criterions:

1. The actions are the "decision objects", in the present case, the 22 dismissed buildings present in the city of Turin characterized by different typological and geographical features.
2. The categories, "conceived to receive actions", are the 3 types of immigrants defined through an analysis of bureaucratic documents and semi-structured interviews with relevant actors.
3. The criterions, are established starting from the spatial and social needs of immigrants for the overall objective. They serve as an intermediary to define the performance of the actions in correspondence to the categories.

Through the interaction of these three aspects the goal is to find which building or buildings among all the listed actions can host in a more appropriate way each group of immigrants. Such tool in the decision-making process assist in taking into account several aspects simultaneously, nevertheless accommodativeness of a building type at first, with intent to adopt the most efficient course of action for a plausible intervention. The aim, in addition, is to contribute to the possible evolution of a building typology in the course of its transformation during a crisis situation.

2.1. *Selection of the actions*

The city of Turin hosts a wealthy number of buildings and abandoned areas, artifacts that are in a state of neglect and underuse, of public and private property. These buildings which are mainly industrial buildings, military barracks and hospitals, can potentially cover the needs of residences and services for immigrants which today grows as a serious problem. Through the recovery, reuse and reactivation of Turin's abandoned assets (disused or under used public, private, urban buildings), it is proposed to make them available to the territorial communities, generating a positive social impact. The selection of the dismissed buildings started from the analysis of the Urban Transformation Areas of the currently in force Master plan of the city of Turin (Aree Urbane di Trasformazione del PRG) in an attempt to understand the areas that are awaiting to accommodate series of interventions. In this context, twenty-two buildings were selected through a judgmental operation by the authors which is done through series actions: analyses of the Urban Transformation Areas defined by the Turin's present Master plan, morphological reading of the building and its context, building's ability to offer adequate space for the type of intervention proposed, its integration within the existing urban fabric of the city of Turin. All the selected buildings possess different spatial characteristics being a model of a dominant type and they are inserted in distinct urban fabrics of the city, nevertheless, they all satisfy the preconditions determined for the selection. The selected buildings are followings: Ex fonderia e smalterie ballada, Ex magazzino di artiglieria e difesa chimica, Ex casa di cura Bernini, Ex magazzino militare, Magazzino del genio militare, Caserma dogali poi alessandro la Marmora, Ex diatto automobili ed ex snia, Ex stabilimento metzger poi dreher, Ex birrificio metzger, Astanteria martini poi ospedale einaudi, Officine grandi motori, Ex fonderie nebiolo torino, Edificio in via bologna, Edificio in lungo dora voghera, Ex osi – ghia, Ex stabilimento venchi poi opificio militare, Caserma amione ex stabilimento scat, Cascina fossata, Ex ospedale maria Adelaide, Ex area buon pastore, Ex clinica san paolo, Ogr.

2.2. *Identification of the categories*

Defining immigration as a structured and repetitive process allows us to consider the "collective on the move" in an objective way. To outline this collective, we start from the definition of its rights. The formal documents define rights labeling the immigrant with a status, accordingly the needs derives from limitation leaded by the status. By retracing the journey of an immigrant in Italy, the necessary bureaucratic steps that allow him to be equated with an Italian citizen becomes very clear. Before the recognition of the status, an immigrant goes through a period of 'in between' time, in which his rights as a citizen are not guaranteed and the use of space, access to housing and work are unstable. Through a study of a real case, a simulation can be built, a story of what happened to a small collective and what will predictably happen tomorrow to other subjects. Therefore, the identification of statuses is established through an analysis of a real case of a Syrian family, composed of five members, gathered in Italy over three years. Eventually the number of migrants is fitted into three categories of new inhabitants in three different statuses. Each status differs by means of rights that they have access within the city. As a consequence, their needs during the 'in between' time vary one from another. The three identified statuses are as following:

– The asylum seeker: is the individual immigrant who intends to present or who has already completed the request for international protection at the Immigration Office after his

arrival in the city. From the moment the request is presented, up to the granting of an interview with the Territorial Commission, which will issue the judgment, a period of time ranging from 2 months to 12 months may pass. The asylum seeker is denied the possibility of traveling and the possibility of requesting family reunification. At a spatial level it is important to orient the applicant in a well-integrated collective structure within the city center, close to the Police Headquarters, Prefecture, where he must go often, and give him an easy access to the of public transport net.

– The refugee: according to the Geneva Refugee Convention (UNHCR, 2011), enjoys the same rights guaranteed to Italian citizens in matters of religious freedom, elementary education, access to the courts and legal assistance etc. The refugee can apply for family reunification for the spouse, minor children, older children and parents. This legal status is valid for 5 years, after which the refugee may obtain Italian citizenship. Those who obtain refugee status are surely have right to stay in the city for at least five years. The spatial need of getting out of a collective dimension and enter a structure where more individuality, autonomy and privacy can be guaranteed arises. The buildings used for this kind of spatial requirement are conceived with single or double rooms with the supply of some common services.
– The family reunification member: is considered as refugee's family member who arrives in Italy through the reunification procedure. This legal status is valid for minimum 2 years and holds the same rights of a refugee status. The reunified member strictly linked to the refugee who applies for reunification. In fact, involvement of this status is brings along the consideration of needs for a family and no longer a single person. The needs of a family unit are different from those of the asylum seeker and the refugee. At a spatial level, it is of primary importance to be able to establish their self permanently in the city having a possibility to live in their own apartment and maintaining the guarantee of assistance for training and integration into the world of work.

2.3. *Definition of the criterions*

The criteria constitute the operational translation of the objectives which make them measurable in order to able to compare the actions. In this specific application, the multiple criteria through which the choice must be made are strictly linked on the one hand, to the objective of integrating immigrants into the existing network of associations in the territory, and on the other to the objective of including them in the more appropriate structure at the formal typological level. In total, twelve criterions have been defined among which they can be divided into two main clusters depending on the nature of criterions. The first cluster is consisting of four criterions with spatial-typological nature and they express the need to take into account the correspondence of a dominant building type and the current physical state of the building. The second cluster is consisting of eight criterions with geographical nature and they express the need to take into account the geo-location of buildings with respect the network of services already existing in the urban fabric of Turin. These criteria were then minimized or maximized according to the needs of immigrants with different status and the criteria importance was assessed by the implementation of the method of cards (Figueira and Roy, 2002). The defined criterions are followings: Correspondence to the building typology A, Correspondence to the building typology B, Correspondence to the building typology C, Level of degradation, Distance from Police Headquarters, Distance from Prefecture, Public transportation, Distance from bureaucratic service, Distance from psychology service, Dis-

tance from education service, Distance from integration service, Distance from job placement service.

3. Spatial-Typological Criterions

3.1. *Identification of Building Types*

Typology is related to the classification of all sorts of objects depending on their similarity in the properties such as; form, character, trend, size, and hierarchy (Frank and Schneekloth, 1994). The understanding of type of architecture/building is an important part of this work. A building type more specifically is an abstract delineation of a group of buildings that posses similar formal properties. Any specific building can be traced back to the type since it stands as an exemplar of a cluster. The formal properties of a building type are intrinsically formed as a response to a need, an accomplished solution to a design problem, under certain conditions and period and accordingly are uniform in large geographic areas (Scheer, 2017). The relation between single element intended as building typology with the overall city is strong since the type of architecture/building are seen as the generators of the entire city (Muratori, 1959). Typological thinking, hence, become an instrument which not only enable the in-depth understanding of basic characters but supports reflections and perspectives about transformations. At this point of the research, first, three main ideal building types which could host best the immigrant groups are constructed. Later, each existing dismissed building in the city of Turin is associated to (at least one, maximum three) previously constructed ideal building types through the analysis of similarities in spatial properties determined by buildings former function. Three main ideal types are constructed from a study of recent successful case studies in European level that attempt to host and fulfill the needs of refugees in the best way. They are all housing projects based on reconversion and adaptive use coming from Germany. Finally, three ideal types are drawn after an in-depth study of floor plans and sections of the following projects: Refugee Accommodation Project in Munich (Type A), Light-Frame Construction Hall Emergency Program Project in Munich (Type B) and Permanent Housing for Refugees Project in Wedel (Type C).

Type A

This type is based on the plan of 'Refugee Accommodation Project' in Munich. This building typology can accommodate a large number of people in a collective dimension. The overall spaces are characterized by a low level of privacy. There are no individual rooms and the structure offers dormitories for 5-10 people for the sleeping area and common areas for other services such as: bathrooms, canteen, recreation rooms, classrooms for educational activities.The spaces are mainly flexible and open and the different areas are separated through light partitions. Ex-industrial and military buildings are suitably associated to this building typology.

Type B

This type is based on the plan of 'Light-Frame Construction Hall Emergency Program Project' in Munich. This building typology can accommodate a large number of people and is a mixed solution composed of collective and private spaces that is characterized by a high level of privacy. The structure offers single or double bedrooms, meanwhile, the living area is provided

in a shared dimension. Common services continue to be the canteen and recreation areas, in addition to a series of shared services such as study rooms, kitchens and laundries. Internal distribution has little possibility of modification. Ex-hospitals and military barracks are suitably associated to this building typology. It's use is mainly foreseen for the second phase of permanence, a transition phase, in the city of Turin, defined as resilience placement. The stay can vary from 6 months to 2 years depending on the level of integration of the immigrant.

Type C

This type is based on the project of 'Permanent Housing for Refugees Project' in Wedel. This building typology can accommodate a small number of people which needs a high level of privacy. The structure offers private apartments as living spaces with a total privacy. At the same time, common areas such as recreational areas and meeting rooms for the apartments continue to be shared, as well as laundry services, depending on the current needs. The interior configuration of the single apartments may vary according to the sort and number of family members. Assistance buildings, institutional building complexes, farmhouses and again some ex-industrial buildings are suitably associated to this building typology.

3.2. *Geographical Criterions*

Building typology-based criterions attempt to satisfy the fundamental spatial needs of the specified group of users, nevertheless they are inadequate alone. For a better integration of new comers into existing ecosystem, social and economic needs are necessary to be satisfied. This exigency requires a reflection on larger urban scale and an understanding of the pattern of what already exist in the city. Therefore, previous set of criterions are accompanied by location based geographical criterions since the location of a structure within the existing city network is considered as a determinant aspect for the social and economic efficiency of the intervention. Buildings are inserted in the existing urban fabric and their position in the urban scale and the relation with the city in which they are embedded have a significant contribution in their evolving meaning and value. In the light of these considerations, eight criterions have been identified. They represent the accessibility in terms of distance to certain fundamental key transit points and services, within the city of Turin, frequented from the arrival to the settlement of the immigrants. For each criteria, the specific location or locations of the existing service have been mapped and the distance between them with each dismissed building is calculated quantitatively through a metric scale ranging from 250m to 1500m.

Distance from Immigration Office

The Immigration Office is an operational body where the main bureaucratic procedures are performed: the request for international protection, the residence permit and the request to be included in a reception system. It is a crucial point in the process of obtaining refugee status, a place where the asylum seeker must go several times to complete and receive the necessary documentation.

Distance from the Prefecture

The prefecture is an office where an immigrant must go to obtain documents such as identity cards, social security numbers, health cards and citizenship for refugees.

Accessibility to public transportation network

The presence of a good connection with the public transport network is preferable for an immigrant to guarantee his mobility in the city, considering that he would not have the guarantee of being able to use a personal car. Refugees and family members with the recognized status are better suited to using the public transport network since they have lived in the city longer than newcomers and their mobility in the city is more articulated. This criterion describes each building in relation to the Turin public transport network, which includes buses and the underground.

Distance from bureaucratic procedures assistance

Assistance with bureaucratic procedures is designed to help understand the phases of the asylum request and the necessary documents. This service is offered by associations present in the city as well as in the information office of the Police Headquarters. This service is essential in the initial phase from the arrival in the city for the migrant who does not know the functioning of the Italian reception system.

Distance from psychological assistance

The psychological assistance has the function of helping the immigrants to overcome some traumas that they may have suffered in abandoning their country of origin and in making a trip often full of unexpected events and difficulties. Many associations offer these services, including specific services for minors or women, of a welfare and medical nature. Also this service acquires a lot of importance in the first phase of arrival in the city.

Distance from educational and training activities

The educational and training services are specifically defined to guarantee immigrants the learning of some necessary skills for their integration into the new arrival society. It is a service offered by numerous associations in the city that offer Italian language courses, extra-curricular activities, civil education and laboratories of various kinds. It is a service that requires long-term attendance, suitable for all types of status based on needs.

Distance from integration services

The integration service is guaranteed to offer immigrants assistance in the process of integration and social inclusion. These activities can be in the form of laboratories, cultural activities, recreational events or meetings of various kinds. This service acquires greater importance in the second phase of reception.

Distance from job placement assistance

The job placement service guarantees an immigrant support in the search for a stable job and in its insertion in the working world. This service is guaranteed by some associations that operate in the Turin area with activities such as internships, orientation programs and construction of a professional profile. This service must be taken into particular consideration for those who

have obtained refugee status and have the right to work and establish themselves in the world of work.

4. Analysis/Results

After the conclusion of selection of the actions, identification of the categories and definition of the criterions, following steps are pursued for the application of the multi-criteria analysis. First, each action (buildings) is assigned a value that defines its 'performance' based on typological and geographical attributes. Value is given by making use of the most appropriate (quantitative or qualitative) scale. Next, at least one best possible condition (reference action) is assumed for each category (new inhabitant) compared to the needs of the new inhabitant. Finally, after the construction of the mathematical functions with the elements and values described above following results are obtained.

Two buildings are corresponding for all the three type of users, four of them are corresponding to two type of users, ten of them are corresponding to only one type of user, and finally six building were not assigned at all. The overall result confirms that; Typology A is intended for the first reception phase, called "recovery placement", which offers a bed and services for a short period of time, as an emergency solution that can vary from a period of 1 to 6 months depending on the condition of the asylum seeker. The potential user of this type of space is in fact the asylum seeker, who has just arrived in the city, who needs a place to stay temporarily, in the waiting period for the recognition of the status, in which he does not have the possibility or the right to work and participate to city life. Typology B is corresponding to the users those who have already obtained refugee status and a residence permit for asylum; refugees with the status recognized pending acceptance of the reunion of a family member; asylum seekers who have exceeded 6 months of initial waiting to have the recognized status and need a greater level of privacy; asylum seekers who come with the family. Typology C is foreseeing users which are families with the residence permit for asylum and the members reunited with family reunification.

Starting from the obtained results two main assessments are made along with the detection of the best buildings to intervene. First, two buildings which have been detected suitable for all the three type of users are Ex Hospital of Maria Adelaide and Ex Warehouse of Artillery and Chemical Defense. First one belongs to only typology B cluster and latter to both typologies A and B. Accordingly, typology B seems to satisfy better the needs of different kind of users being offering a layout that stand as a compromise with flexible and mix-use spaces. Secondly, some buildings that belongs to all the typology clusters (A,B,C) results as 'not assigned' for any kind of user. Therefore, it is not granted that a building which can correspond to any kind of typology can necessarily respond the need of users. In conclusion, overall results illustrate that the building typology is significant and has a decisive influence in the matching, yet, it is not exclusive and it gain ground if accompanied by the geographical feature, thus, the position in the urban fabric.

5. Discussion/Conclusion

The city of Turin has been chosen as theoretical model to experiment a tool that can be used and redefined in many cities that are nowadays facing migration flows, trying to respond to the

increasing accommodation request. In the end, the research shows that an urban issue has to be faced by a typological point of view in order to intervene through a unitary management but differentiated case by case. The strengths of the strategy decision-making lie in having categorized the new inhabitants and in having made the choice of living spaces less casual. Through the results of the study, it is clear that not all the vacant buildings are favorable for the maximization of the inclusion of migrants in the urban context. Study of building type becomes important in order to meet the common requirements of immigrants. Certain typologies are more adequate than others to host refugees and to catalyze a regeneration process of the city.

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Power, Urban Landscape Units and Boundaries: a Case Study of the Urban Historical Conservation Areas in Cardiff, Wales

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Keywords: power, boundaries, Cardiff, urban historical conservation area.

Abstract: With a closer look on Cardiff, the Welsh capital, this paper tried to make a deeper observation on the major cause that created differences between boundary of urban landscape units and urban historical conservation areas. Based on former studies, this paper noticed the influence of researchers and governments as agents in the demarcation of conservation areas, realizing that the delimitation of landscape units and conservation areas were two different processes, their creations cannot be the same. By comparing the boundary of conservation areas and the boundary of landscape units, it was clear to see the existence of pre-judgement and standards made by agents on urban heritage. With the interaction of agents as power owners, the boundary made at last was largely a compromise, different from any boundary raised by individual agents. With this cognition, the paper made attempt on building up an extended two-agent model to further explain the boundary issue.

1. Introduction

In J.W.R.Whitehand (2009)'s published work, the issue of boundary was first made clear in the realm of urban morphology. Whitehand noticed the difference existed in boundary of conservation areas and landscape units, and he attributed this to the weak grounding in research on urban form. Before his study, Hiske Bienstman (2007) discovered that planning agencies could stretch the boundary of conservation areas decided by scholars in order to include certain buildings with less historical value. Peter J. Larkham (2011) made a major contribution on the boundary issue, pointing out the difference on the process of deciding boundaries. The delimitation of conservation area was regarded as a political process while the deciding of landscape units as academic process. In this way, boundaries created by them couldn't be the same. Moving a little bit ahead from Larkham, it was sensible to regard boundaries not as objective existence but subjectively decided by agents. And the boundary of urban landscape units could be seen as the researcher's boundary, as was described in Whitehand's (2009) paper.

Jones (2009) mentioned that boundaries were decided by power to create order in certain areas. In deciding conservation areas, researchers or governments as agents could be seen as power owners hoping to maintain a certain order for their own purpose. In practical examinations,

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agents' purposes were externalized as different pre-judgements and standards, under which different boundaries were created.

Since boundaries were created by power, it was reasonable to assume that the delimitation of conservation areas, with more than one agents participating, could be a process of power interaction. A standard frame of policy-making on conservation areas could be a three-agent model, including not only the researcher and the government, but the private property owners as well. However, due to the lack of date, this paper was only able to build up an extended two-agent model, including only researchers and governments. Agents were further considered with different levels of power, creating sub-agents of certain type. In a two-agent model, negotiations among agents could be the main path to balance the interest of them, so that a boundary that was acknowledged by everyone could be created. In this way, individual standards and pre-judgement were integrated and transformed into spatial order that could be different from any one of the boundaries raised by agents.

This paper used Cardiff city centre as a case study to reveal the practical path through which processes listed above take their effect. The Cardiff city centre was defined by Carter and Rowley (1965) as region limited by the railway to the east and south, the Castle and the Bute Park to the northwest and the civic centre to the north. However, this was only the boundary of the economic centre. Considering the political centre and important communities, the region of city centre could be a bit further north, including parts to the north of Boulevard De Nantes towards Blackweir Terrace.

2. Methodology

This paper applied the methods of Conzenian School of urban morphology to study the morphological features of boundaries in Cardiff. The paper analyzed the large scale topographical maps of Cardiff (mostly the ordnance survey and the insurance plan) and did a plot-by-plot survey in certain areas. Besides, literature on the history of Cardiff, Wales and UK were also carefully observed, together with British laws on urban heritage conservation and planning documents established by Cardiff Council. The conservation group of Cardiff Council offered crucial information to the researchers as well.

3. Analysis/Results

3.1. *The history and geography of Cardiff*

Situated on the north bank of the Bristol Channel, Cardiff has one of the best ports in South Wales. To the north of the city was the Brecon Beacons Mountain, and to the east and west was a long narrow corridor of plains by the sea. In the ancient times marshlands existed around Cardiff, making it hard for agriculture to develop (J. F. Rees *et al.*, 1960). However, the location of Cardiff by the river Taff made the Cardiff region just fit for invaders to build fortress. As a result, Cardiff was used as strongholds of invaders or colonizers instead of local rulers. Romans, Anglo-Saxons and Normans came from the sea and became masters of Cardiff one after another. Only when the discovery of coal in Victorian times did the driving force supporting the development of Cardiff changed from the sea to the mountain.

From 75 A. D. till 410 A. D. Cardiff was occupied by Roman Empire. The predecessor of Car-

diff castle was built in this time as a Roman fortress. After the retreat of Roman legions, Cardiff was desolated and residents disappeared (D. Morgan, 1991). When the Normans conquered Cardiff in years around 1080, a new fort was built with a wooden Keep inside the ruins of the Roman fortress. The Cardiff Castle was later developed near the Norman Keep, and a small market town next to the castle started to grow.

Limited by the geographical condition of Cardiff, the development of market town relied greatly on the stability of Cardiff Castle. In history the town grew when there were new invaders using Cardiff Castle as base for colonization and declined when native people successfully destroyed the castle. This regular process brought little development, neither physically nor economically, to the self-ruling borough (D. Morgan, 1991). Cardiff didn't receive any opportunity for development before the discovery of coal. From Figure 1 it was clear that development in the Victorian times contributed largely to the total development of Cardiff. In 19th century the population grew from 1801 in the year of 1800 to 300,000 in 1900 (J. F. Rees *et al.*, 1960).

3.2. *Conservation areas in Cardiff city centre: boundary raised by government*

Currently there were 6 conservation areas in Cardiff city centre. The earliest conservation areas were decided in 1975, namely the Windsor Place Con. Area and the St Mary Street Con. Area. In 1978 the largest conservation area 'the Cathays Park Con. Area' was decided to the north of them, including the political centre of Cardiff and large plots in the north. Charles Street Con. Area was decided in the year 1988, and the Churchill Way Con. Area was decided in 1991. In 1992 the latest conservation area in Cardiff city centre was decided as the Queen Street Con. Area. Their boundaries were published on Cardiff Council's website and were shown in Figure 2.

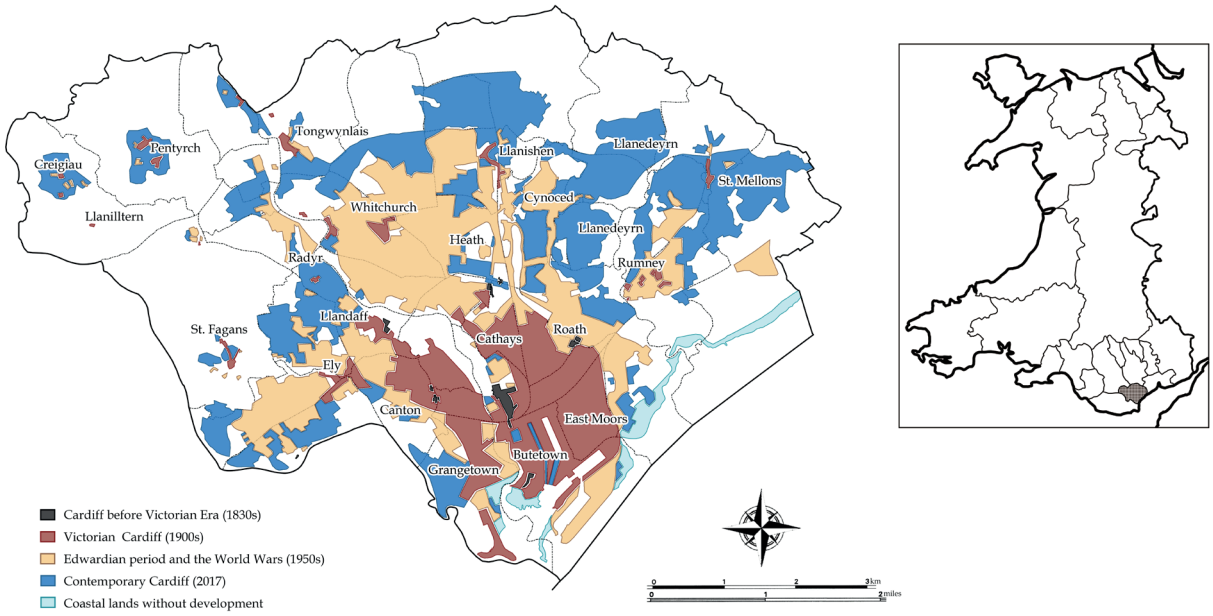

Figure 1. *he location of Caridff in Wales and its historical development. Based on ordnance surveys of 1830, 1900, 1950 and the 2017.*

3.3. *Landscape units in Cardiff city centre: boundary raised by scholar*

With a morphogenetic study on the landscape units in Cardiff, this paper created eight individual landscape units in Cardiff city centre. The main consideration in deciding landscape units were the authenticity and integrity of the landscape, while paying attention not to let the boundary of landscape units cutting through individual plots. These boundaries, to a certain extent, could be seen as the researcher's boundary of conservation areas.

The oldest landscape unit in Cardiff city centre except the castle was the Medieval Core ('I' in Figure 2). It was formed before Victorian times, stretching from the south gate of the Castle to Cardiff Central station. The area was used to be wall-protected, with four gates on each side of the walls. As can be seen in Figure 2, most of the plots or burgages before Victorian times situated in this area. However, since the great constructions brought by the Victorian period, there were few architectures before Victorian survived. In general, plots with ancient structure and the Victorian style buildings formed the unique landscape in the Medieval Core.

To the east of the Medieval Core, a new commercial street developed in days of the 19th century. Queen Street, as the name read itself, gained its importance thanked to the increase on population flow between London and Cardiff. Rapid development in Victorian times didn't actually destroy the plot structure; instead, many long-tail burgages were left unharmed on the north side of the street. The only unfortunate thing was that the once detached buildings on these plots were integrated into modern shopping centres in 1960s and 1970s (W. M. F. Grey *et al.*, 2003). Currently only the façade of old buildings could be seen. Even though, the medieval core and the Queen Street area were still regions where pre-Victorian plots existed and Victorian architectures remained, at least partly. Given the fact that most of the Victorian architec-

Figure 2. *The 8 landscape units (left) and the 6 conservation areas (right) in Cardiff city centre. Based on the ordnance survey, the field research, the google's 3d model of Cardiff and the documents of Cardiff Council.*

tures in Cardiff city centre had been demolished, these two areas could be most valuable for protection.

In later Victorian, the city started growing on the north and south side of Queen Street (H. Carter and C.R. Lewis, 1990). With wealthy people moving eastwards, in regions around Queen Street a number of detached and semi-detached houses were built. These houses were used as villas, commercial offices and wholesale, according to Carter (1965). In 1940s the Victorian houses extended all the way towards the Taff vale railway, yet only a small number of them survived. To the south of Queen Street only blocks on Charles Street, Guildford Crescent and Churchill Way were left unharmed.To the north of Queen Street more houses survived, mostly around the St. Andrew's Crescent, Park Grove and Colum Road. The four blocks in which the Victorian plots and houses still survived became an individual landscape unit. It was shown on Figure 2 with number "IV".

In the Edwardian years, the city built up its political centre in Cathays Park (D. Morgan, 1991). This area, the Civic Centre, was a new unit with large-scale Victorian and Edwardian buildings. The Cardiff city hall, the law court and the national museum of Wales were the most important landmarks and monuments in south Wales. On the east and north part of the Civic Centre situated the Welsh National government and Cardiff University.

In the later part of 20th century, the city experienced major reconstruction during which most Victorian blocks were destructed. The region to the southeast of Medieval Core experienced major change, with plot structure completely destroyed. Currently this area was filled with large shopping malls, hotels as well as stadiums, forming a unique landscape type. The construction of the St. David's shopping mall had the most profound influence on urban form, clearing all the remnants of the Victorian plots and houses. Fortunately, in the construction of Queen's arcade some of the features of plots were retained, leaving the north part and the south part of the Queen Street landscape unit still an entity. The landscape units of shopping malls and stadiums were shown as number "VI" in Figure 2.

The area to the west of the Medieval Core were lands gained from changing the course of Taff in 1850 and the south part of it was used to be filled with Victorian houses. After World War II the south part was transformed into the commercial centre and business zone where skyscrapers rise from the Victorian soil. The north part of this area had been used as playgrounds, sports fields and parks since 1850. In the last few decades of 20th century, the Principality Stadium was built to replace former fields. The constructions both on north and south part of the 'newly gained area' increased its building intensity. The large-scale-glass-covered skyscrapers or Principality Stadium that could sit millions of people gave out ethos different from the Victorian plots and 2-6 story buildings next to it. In area to the east of the Cardiff Castle the same story happened. Around the Capital Tower another business zone formed where head offices of international corporations situated. These two business zones, forming the so-called CBD of Cardiff, had very limited remains of the old structure.

Regions to the north of Colum Road was developed by colleges of Cardiff University in recent years. With large scale complex buildings, they were different largely from the Victorian houses next to them. This region was confirmed as an independent landscape unit, numbered as "V" in Figure 2.

Cardiff Central station was a special region in the study. It had Victorian plot structures and was rebuilt in 1932, but because of its special land use, the plot structure of Cardiff Central station was greatly different from other Victorian plots in Cardiff. As a result, area around the station was divided as a single landscape unit.

Landscape units above were decided under specific judgement and standards made by researchers. Boundaries were decided not to cut through plots, and when it came to streets, this

paper followed the instruction of Whitehand (2011). Boundaries would went through the middle of the streets if the plots on neither side were created as part of the street, or boundaries of landscape untis may go along the boundary of certain plots.

3.4. *Comparing the boundary raised by government and researcher*

Comparing the boundary of landscape units and the conservation areas led to the discovery of different standards and pre-judgements of agents. Apparently, differences existed in regions below: Queen Street, Colum Road, Windsor Place, Charles Street and Cathays Park.

In Queen Street Con. Area, the boundaries were different in two ways. First, the northeast part of the Medieval Core was included in Queen Street Con. Area instead of the St Mary Street Con. Area, where the other parts of the Medieval Core was situated. This was because the consideration made on the re-development of Queen Street as the "image of Cardiff". In order for a more completed development of Queen Street, the conservation group left the northeast part of the Medieval Core out of the conservation area in 1975 so that there wouldn't be too much regulations and obstacles on the development project. Second, the south boundary of the Queen Street Con. Area looked very different from the landscape units, cutting through several integrated plots of the shopping mall. The conservation group of Cardiff Council made few explanations on these issues during interview, but it may be understandable that this, similarly, had something to do with the regeneration of Queen Street as a whole. By the way, the need for ease on management might also lead to the acceptance of a simpler boundary of the conservation area. The conservation group hoped the boundary of conservation areas easy to handle, or there may be extra "administration effort" required. For this reason, the boundary of conservation areas could be different from the boundary of landscape units.

In Colum Road, the point was whether the conservation area should include the Victorian houses on both sides of the Colum Road. These buildings were built earlier than houses on Queen Anne Square, sharing the same building features with houses on the east side of North Road (A470) which were included in the Cathays Park Con. Area. At the Blackweir Farm Cottages, the boundary of conservation area went through the middle of the region, including only the Victorian farm houses while cutting the building Ambulance Depot apart. It was unsure if this was the actual location of the boundary or the technical problem since there were no explanations made by the authority.

In Windsor Place Con. Area, the main conflict existed on whether to include the regions to the north of St. Andrews Place. Regions to the north and south of the St. Andrews Place were built almost at the same time, with similar plot structures and building fabrics, which could be seen on Figure 2. However, the north part was divided into the Cathays Park Con. Area, while the south part in the Windsor Place Con. Area. This was caused by the time conservation areas decided. Since the Windsor Place Con. Area was one of the oldest conservation areas decided in Cardiff city centre, the decision made by conservation group at that time could be under a certain cognitive limitation. The south part might be regarded as more valuable at that time so that the Windsor Place conservation area included only the south part. In later reviews, there might be voice calling for an alteration on the boundary, but the conservation group made to retain for reasons of "consistency and to reduce the administration effort required to change them".

In Charles Street, things were a bit complicated. The boundary of conservation area did not parallel with the boundary of landscape units and included a place to its south where a new skyscraper was being built. The construction of the new skyscraper was granted in the year 2016,

before then the plot on the southernmost of the Charles Street Con. Area included small plots owned by different entities. The boundary of the conservation area was aimed to avoid including the plot owned by the Great Western Estates Limited. Though the real cause was unclear, it could be possible that this was the compromise reached by negotiation between the council and private property owners.

In Cathays Park Con. Area, problem existed in the region to the east of the castle. The plot between Kingsway and The Friary was included in the Cathays Park Con. Area. However, there situated the Hilton Hotel, which was largely modern styled with the height of 30 metres. The conservation group suggested it might be historic reason to divide that plot into the conservation area, and since the difficulties for alteration, the boundary remained.

By analyzing the differences between boundary of conservation areas and landscape units, it was clear to see that these two boundaries were different once they were put forward. The pre-judgement and standards made by planning agencies and researchers as agents were different. For the case of Cardiff, the conservation group focused on the ease for management and the development and regeneration of blocks. Queen Street, though one of the old regions in Cardiff city centre, was the last in Cardiff city centre to be listed as conservation area. The scholars regarded the authenticity and integrity of historic blocks as most important. Admittedly they were only power owners deciding boundaries, they tried to make the boundaries of landscape units reach the 'fact'. With different judgement and stand points on heritage, the boundaries created by agents couldn't be the same. That was to say, even before the negotiation, the boundaries made by government could differ from what scholars created. And the negotiation following would further make the boundary different from the original one raised by scholars.

3.5. *More agents with different level of power: extending the two-agent model*

By observing the difference of boundaries of landscape units and conservation areas, this paper made it clear using the simple two-agent model to explain the boundary issue. However, extending this model to include governments with different levels of power could make things more interesting. With the participation of more governmental agents, the boundary raised by government could be changed greatly.

The paper considered using the listed buildings in Cardiff as an example. In UK, listed buildings as a certain kind of conservation area had two levels: the statutory listed building and the locally listed building. Both were aimed at the protection of buildings with historical significance, but the former decided by national government while the latter decided by Cardiff council. In deciding statutory listed buildings, it was local government who submit lists of certain buildings and the Welsh ministers who made the decision whether or not to enlist the buildings. Welsh Ministers were granted the power to decide and compile the buildings that "are of special architectural or historic interest" (23 *Historic Environment (Wales) Act*, 2016). However, when deciding locally listed buildings, local government of county or town did not need to inform national government and could decide at its own will. In the planning guidance of UK department (*National Planning Policy Framework*, Ministry of Housing, Communities & Local Government, 2019) and Wales department (*Planning Policy Wales*, Ministry of Environment, Energy and Rural Affairs, 2018), local governments were empowered to enlist "historic assets of special local importance" (*Planning Policy Wales*, 2018). Local governments could even choose whether or not to list locally listed buildings. In Cardiff, the council have made the decision to establish Locally Listed Building for "locally significant architectural or historic interest to be recognized within the planning system" (Cardiff Council, 2019). By the way, researchers in

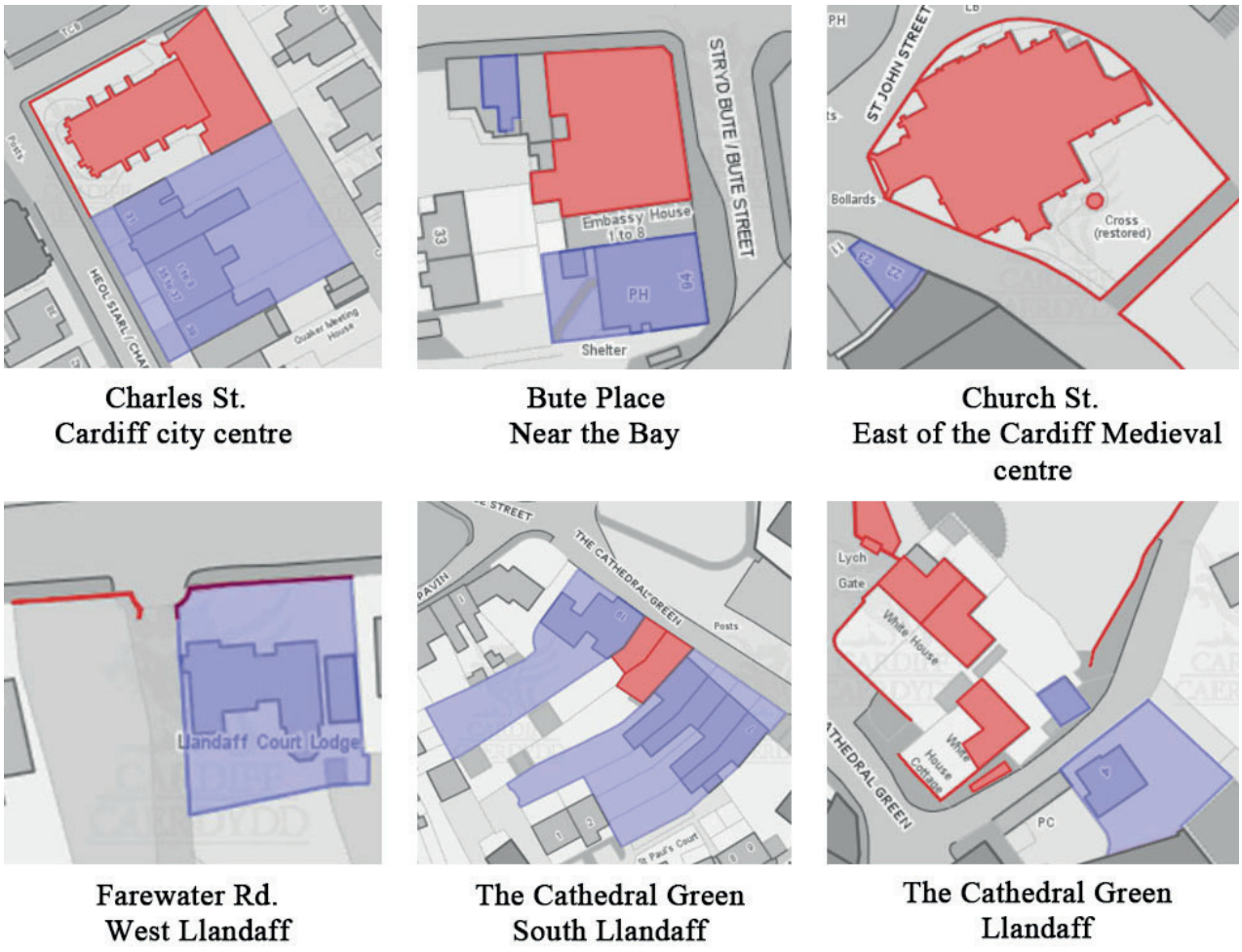

Figure 3. *Statutory listed building (red) and locally listed building (blue) in different part of Cardiff. Based on maps offered by Cardiff Council, 2019.*

Cadw (the Historical Environment of Waels) also took part in deciding the boundary of listed buildings (Advisory Panel for the Welsh Historic Environment, 38 *Historic Environment (Wales) Act*, 2016). In this way, the national government and local government acted as sub-agents in the policy-making process deciding the boundary of statutory listed building. Their boundaries integrated as the boundaries raised by the "government", which would be discussed between government and scholar in the following policy-making process. For locally listed building, there was still the simple two-agent model.

Since statutory and locally listed buildings may locate as neighbors in Cardiff, their social-economic environment could be almost the same. Consequently, it could be sensible to assume that the only difference between the policy-making processes of these two kinds of conservation areas was whether there were sub-agent existing in the decision making process.

Practical evidence confirmed the influence of sub-agent on boundaries. In Cardiff, statutory listed buildings had much stricter boundaries than their local counterparts. In the 1990's public general act which was also applicable in Wales, the boundary of statutory listed buildings was regulated as the boundary of the exterior walls of the building with objects fixed to it. Only in case of buildings earlier than 1948, could the boundary include object or structure in the curtilage (1(5), *Planning (Listed Buildings and Conservation Areas) Act*, 1990). As a result, the statutory listed buildings could be split from their own courtyards, walls and fences: in Cardiff, there

were walls, roads and bell towers confirmed as independent listed buildings, as was shown in Figure 3. However, there weren't any similar regulations made by Cardiff Council in deciding the boundary of locally listed buildings in Cardiff. In this way, boundaries of locally listed buildings went along the boundaries of plots, including curtilages of the listed building.

Though the yards of statutory listed buildings were not included in the boundary of protection, owners only had limited rights on making changes to them (5.10, Technical Advice Note 24: The Historic Environment, *Planning Policy Wales*, 2017). However, when restoring the statutory listed building or making change on them, owners could apply for finance support from the national government. It was unsure if there were the same support made by local government on locally listed buildings. In order to save money, the national government may ask for stricter boundary of listed building. For local government, since they were only partly responsible for the protection and finance of statutory listed building, they could stay mutual for this issue. Consequently, the government's boundary itself could be changed if there were governments with different level of power as sub-agents. This could be seen as the extended two agent model, with national and local government as two sub-agent under the type of 'government'.

4. Conclusion

The inclusion of agents in the policy-making process helped to explain the boundary issue. Using Cardiff as a case, this paper built up an extended two-agent model considering the demarcation of conservation areas. Boundaries were first created by agents under different judgement and standards, making them different with each other. Then through the process of negotiation and compromise, original boundaries raised by individual agent got integrated to the final boundary of the conservation area. The interaction of power through the negotiation process made it impossible for the final boundary looking identically as original boundaries raised by agents. That's why the boundary of conservation areas looked different from boundary of landscape units.

Besides, agents in the two-agent model could be split into sub-agents with different levels of power. Before the final negotiation, there might be negotiations between national government

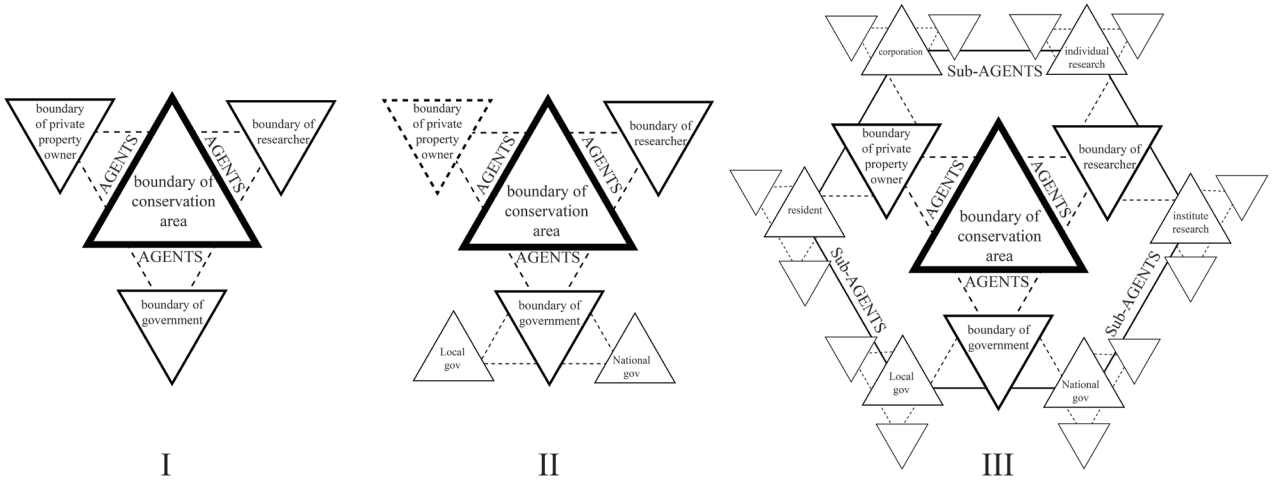

Figure 4. *Standard three-agent model; II. The extended two-agent model; III. The Infinite three-agent model.*

and local government as sub-agents. Scholars with different disciplines of study could also discuss with each other on the boundary of landscape units. When considered the influence of private property owners, this could lead to the establishment of a fractal geometry frame of the infinite three-agent model, as was shown in Figure 4 (III).

The major contribution of this paper was the closer observation of the policy making in Welsh cities and the creation of the extended two-agent model of decision making. The paper used Cardiff as an example to confirm the explanatory power of the model. At here it may be important for the paper to reiterate the conclusion Larkham made that the deciding of landscape units and conservation areas were different processes. With this knowledge, creating new standards of boundaries of conservation areas as well as letting more agents taking part in the deciding of conservation area could be important for heritage protection.

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The Emergence and Extinction of a City Dividing Line

Study on Urban Morphology Along the "Secondary Borderline" in Shenzhen, China

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Keywords: The Secondary Borderline, urban morphology, divided city, boundary, conflict.

Abstract: This paper studies the evolution of urban morphology alone the Shenzhen Secondary Borderline from 1980 to 2018. In 1983, an administrative line, commonly known as the "Secondary Borderline", was set up on the boundary of the Shenzhen Special Economic Zone (SZSEZ) which was established in 1980. The planned economic system is implemented outside the border, while the market economy system is implemented inside the Secondary Borderline in SZSEZ, where outsiders are required to apply for a "Special Zone Pass" before getting in. With the establishment of the market economy system throughout Shenzhen and China, the Secondary Borderline has become an obstacle to the city's development. On January 2018, the State Council finally agreed to abolish the 36-year-old borderline.

This paper summarizes the history of the Secondary Borderline from its appearance to being abolished and describes the conflicts brought about by the implementation of two different economic systems within and outside the line. Taking Tongleguan and Bujiguan Checkpoint as examples, based on historical research, the changes of urban fabrics on both sides of the border are graphically analyzed, and the impact of urban structure changes on the urban development of Shenzhen is analyzed.

The article concludes that the evolution of urban morphology along the Secondary Borderline are essentially forced by the transformation and integration of the economic models on both sides, which has certain reference significance for the formulation of development policies in other similar divided cities in the world.

1. The Emergence, Development and Extinction of the Secondary Borderline

The Secondary Borderline of Shenzhen, established in 1983, is a regional border management line established by the state. It refers to the isolation network and checkpoint between the Shenzhen Special Economic Zone (SZSEZ) and Baoan and Longgang districts of Shenzhen. It is a boundary between special economic zone and non-special zones within the territory of the country. The Secondary Borderline is relative to the 27.5 kilometre long frontline between Shenzhen and Hong Kong. Before 1997, the British and Hong Kong authorities ruled Hong Kong, and there were many incidents of fleeing and smuggling from Shenzhen to Hong Kong. Therefore, one of the most important aim of the Second Borderline is to reduce the pressure on the front line and ensure security of Hong Kong.

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This regional border management line, starts from Meisha Beizai Cape in Yantian District of Shenzhen in the east and ends in Nantou Anle of Bao'an District in the west, with total length of 84.6 kilometers. A 2.8-metre-high wire mesh was also erected along the line. The line includes nine checkpoints, 163 duty posts and 23 tillage openings, covering an area of about 430,000 square meters. The northern side of the Second Borderline is called "Guanwai", which means out of the borderline. The southern side is called "Guannei", which means inside the borderline. And the southern part of the Special Economic Zone is Hong Kong.

Since 1985, people traveling from the mainland to Shenzhen have to show the "Special Zone Pass of the People's Republic of China" and the Resident Identity Card. Institutionally, the planned economy system was implemented outside the Second Borderline on the north side, while the market economy system was implemented in the SZSEZ on the south side.

The Second Borderline is an artificial boundary established in the process of special political and economic development. During the development of SZSEZ, the land policy, household registration system, price level, industry type, environmental resources, municipal services and urbanization level inside and outside the Second Borderline are different. These differences have resulted in the difference of social and economic development level, citizen identity and social psychology inside and outside the borderline, and also caused the separation of urban structure and the fracture of urban fabric fracture.

With the return of Hong Kong in 1997, the SZSEZ began to implement integration reform both inside and outside the borderline. The roles of Hong Kong, Shenzhen and the Mainland are also changing. The need to establish borders in the special zone region is gradually losing. As early as 1998, at the "Two Sessions" in Shenzhen, some delegates and members proposed to revoke the "Second Borderline". After that, calls for the Second Borderline to be abolished continued. By 2003, Shenzhen had abolished the "Special Zone Pass" and mainland residents could enter the customs only by holding identity cards. In 2010, the State Council approved the expansion of the SZSEZ to the whole city, and Baoan and Longgang District was integrated into the Special Economic Zone. The Second Borderline exists nominally but dies actually. In September 2013, the gates and greenhouses at Meilingguan checkpoint began to be demolished. In June 2015, Nantou Checkpoint and Buji Checkpoint were dismantled, and facilities at other crossings were dismantled one after another. By 1st July, 2015, the demolition of the Secondary Borderline was basically completed. Tongleguan Checkpoint will be reserved as a museum among the 16 checkpoints on land.

The abolition of the Secondary Borderline is not just simply demolition. Over the past 30 years, the unbalanced development inside and outside the SZSEZ and the isolation and pro-

Figure 1. *Map of the Secondary Borderline.*

tection function of the Second Borderline itself have made the urban morphology and fabric inside and outside of the borderline cracked.

Even if the checkpoints are dismantled, the checkpoint areas remain the main traffic congestion points. The social and psychological gap caused by the unbalanced development inside and outside the borderline can not be solved in a short period of time.

On the other hand, the Second Borderline witnesses the unique historical process of Shenzhen's development. It is the memory of the city. In addition to its historical value, the Secondary Borderline also retains the unique hilly coastal landform and farming landscape of South China, which has important natural value. From the perspective of urban morphology, the urban fabric of this area along the borderline has also undergone special changes due to the influence of the line. The Secondary Borderline is not only a geometric line, but also a belt-shaped urban area.

2. Divided Cities

2.1. *Different Economic Systems inside and outside the Secondary Borderline*

In the late 1970s, under the long-term planned economy system, the growth rate of productivity in China was extremely low. The combination of the long-term low-speed growth of social wealth creation ability and the distribution pattern of equalitarianism has formed the social reality of widespread poverty. China has embarked on the road of reform and opening up through the establishment of special economic zones. The special economic zone of China is the product of the change of economic system from planned economy system to market economy system. Its basic function is to make a preliminary experiment for the transformation of the whole economic system of the whole country. The transformation of the two systems needs an intermediate buffer zone. SZESZ is the "buffer zone" connecting the two economic systems.

SZESZ was established in 1980. The market economy system shall be implemented inside SZESZ and the original planned economy system shall be implemented outside the special zone. The

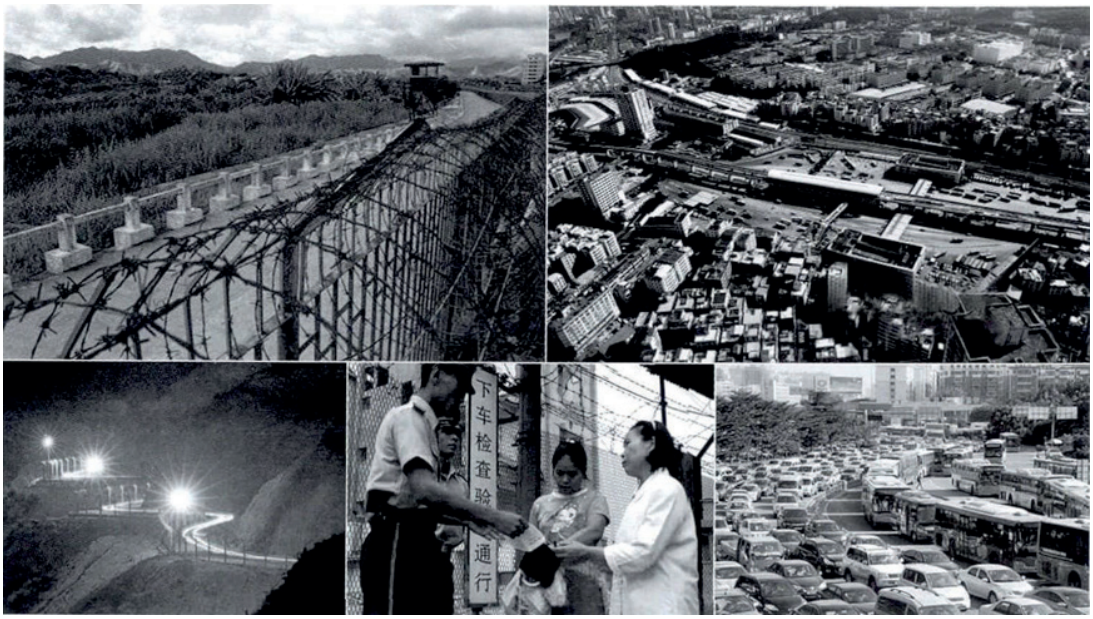

Figure 2. *Historical photos of the Secondary Borderline.*

establishment of special economic zones and the entry of foreign capital, especially Hong Kong's industrial capital, opened the prelude to the rapid development of Shenzhen. At the same time, the industrial structure and economic structure of Shenzhen have begun to transform.

2.2. *The Impact of the Secondary Borderline on Shenzhen City*

To some extent, the Second Borderline has "planned" Shenzhen into two cities. The Secondary Borderline has become an irrevocable pre-constraint in Shenzhen's urban planning.

Firstly, the Second Borderline affects road and public transport planning. The second Borderline checkpoint inevitably becomes a traffic bottleneck because of the huge traffic volume. The Secondary Borderline, as a long-term checkpoint for people and vehicles, has gradually evolved into a hub for urban transport transfer. Many checkpoints have become bus stops outside the SZSEZ to enter it. The gateway also has the function of frontier defense. The urban traffic congestion near the checkpoint is becoming worse. More importantly, for the planning and design of Shenzhen's group development, the Secondary Borderline has become an insurmountable obstacle for the unified planning of urban infrastructure, industrial layout and environmental protection. The checkpoint has become a shackle restricting the intensive integration of Shenzhen's space resources, economic and social development.

The traffic problem then affects the functional layout of the city. For a long time, most of Shenzhen's tertiary industry, headquarters economy and high-end industries have been concentrated inside the borderline. While the outside area of the borderline focuses on low-end industries such as processing trade and village-run industrial parks. Because of the poor surrounding environment and inadequate living facilities, high-level talents are reluctant to work and live outside the borderline. This further restricts the upgrading and transformation outside the original economic special zone.

As time goes on, the imbalance of development inside and outside the former Special Zone becomes more and more obvious. There are huge gap on both sides of the borderline on municipal appearance, people's livelihood, public services, business support, industrial structure and etc. Shenzhen is a small city, the existence of such a gap is unreasonable. The area outside the former SZSEZ is 1556 square kilometers, accounting for 80% of the total area of Shenzhen. During the period of rapid development of Shenzhen, the land and resources outside the former Special Zone were not rationally utilized, which also became an urgent problem to be solved in the development of Shenzhen. The unequal development also brings about the unequal livelihood and welfare of the people inside and outside the Secondary Borderline. It also affects the people's entrustment to the local government.

3. Urban Morphology along the Secondary Borderline

With the development of the city and the change of the urban form, the border management policy of the Secondary Borderline has become more and more open. In this paper, Tongleguan Checkpoint, Bujiguan Checkpoint and their surrounding areas are selected as the key areas of urban morphology research.

3.1. *Tongleguan Checkpoint*

Tongleguan Checkpoint is a large gateway at the west beginning of the Second Borderline. It is the gateway for Guangzhou-Shenzhen Expressway to enter the Special Economic Zone and the main access to Shenzhen Baoan International Airport. The northeast side of Tongleguan is Shenzhen Science and Technology Park, the northwest side is Bao'an Middle School, and the southwest side is a famous urban village, Tongle Village. Around Tongleguan Checkpoint, abolished gates, urban villages, old factories and a variety of lively urban life coexist. Tongleguan and its surrounding areas typically represent the fragment urban morphology and collage urban texture around the Secondary Borderline.

In June 2015, Tongleguan Checkpoint demolition project started at the same time as Nantouguan Checkpoint. The inspection building at Tongleguan Checkpoint has been retained as preservation of the historical memory of the Secondary Borderline.

According to the map, it can be observed that the urban fabric around Tongleguan Checkpoint is fractured and lacks of the integrity of urban planning. Traffic infrastructure nodes are confused. Some non-planned patches grow by themselves, i.e. the urban villages. Several plots near the checkpoint are self-contained and independent of each other, and lacking linkage.

Tongleguan is run through by the highest grade road in Shenzhen, G4 Expressway. This highway has brought huge traffic flow to Shenzhen and Tongleguan Checkpoint. But the expressway itself has split the urban texture of the surrounding areas of Tongleguan. The west side of the expressway has abundant formats, including schools, residential areas, public space, factories and so on. The eastern side of the industry is relatively monotonous, mainly office and factory. In the hierarchical analysis map, the author selected six plots around Tongleguan Checkpoint for graphic analysis. From the illustration, it can be seen that the most densely populated plots 3, 5 and 6 are mainly residential functional plots. Among them, plot 6 contains urban village, and its texture is growing towards the Secondary Borderline. This is the trace left by the surge in the demand for residential space inside the borderline since its establishment.

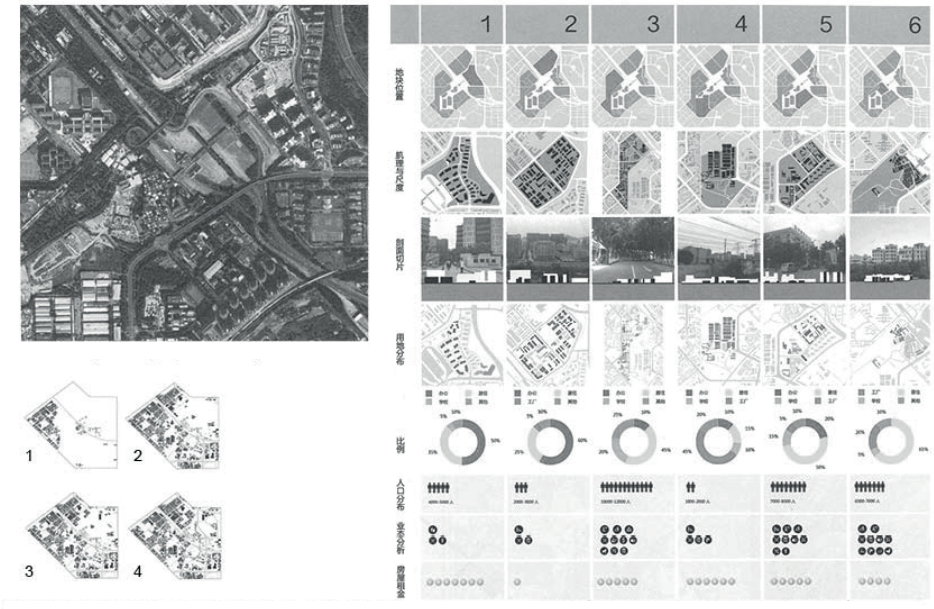

Figure 3. *Morphology Analysis of Tongleguan Checkpoint (3.1 Map of Tongleguan Checkpoint; 3.2 Plots research of Tongleguan Checkpoint; 3.3 Urban fabric development of Tongleguan Checkpoint).*

From the development of the urban fabric of Tongleguan, we can find out that the development trend of Tongleguan's surrounding areas is from point to area, and the system of architecture and road is gradually formed during its development. After the continuous construction land formed, the urban texture began to expand to some gaps left over between the built areas, which will make the urban fabric of the existing city gradually complete. Because of the existence of highway and the Second Borderline, the development process of urban texture near the junction is more like bottom-up, conditional spontaneous growth.

The current situation of Tongleguan Checkpoint is that the function of surrounding land is complex. There are more reserve land for development, which has good natural and ecological conditions. At the same time, there are also municipal supporting centralized land around Tongleguan Checkpoint, which has great potential for development.

3.2 *Bujiguan Checkpoint*

Bujiguan Checkpoint is located in the middle of the Second Borderline. It is also situated at the junction of Longgang Avenue and Buji Road. It is an important transportation hub connecting Longgang District and Luohu District. Near Bujiguan Checkpoint, there are Longgang Line Metro and Bus Connection Station. It is also the place where Guangzhou-Shenzhen Railway and High-speed Railway pass. So there are a lot of people and traffic passing through every day. The traffic congestion issue is a very serious problem in the morning and evening rush hour. Near Bujiguan, there are a large number of urban villages, which concentrate millions of migrants and migrant workers. This is a typical area of non-planned development along the Second Borderline in Shenzhen. Its spontaneous and original living conditions and unusual high-density settlement have special research value in urbanology and sociology.

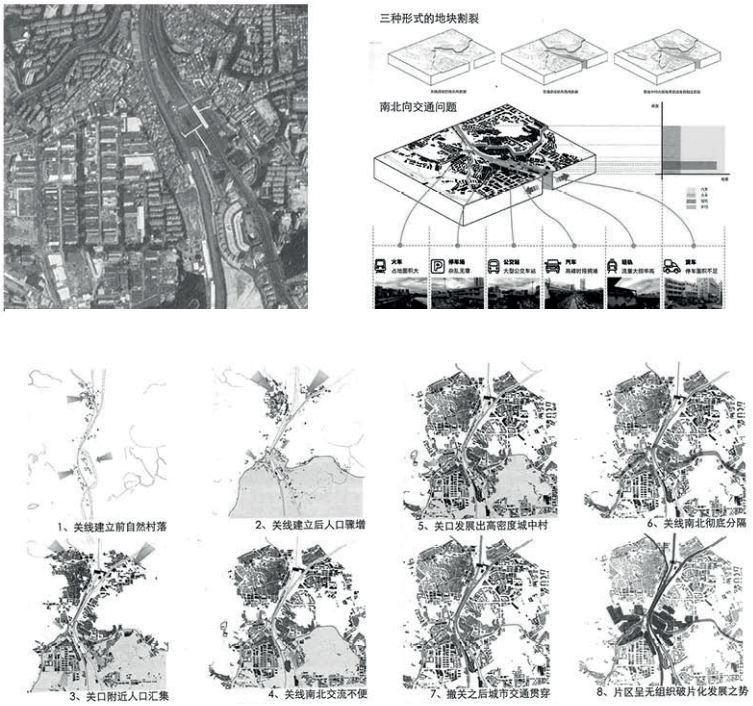

Figure 4. *Morphology Analysis of Bujiguan Checkpoint (4.1 Map of Bujiguan Checkpoint; 4.2 Morphology research of Bujiguan Checkpoint; 4.3 Urban fabric developmente of Bujiguan Checkpoint).*

On the map, similar to Tongle Guan, the urban texture on both sides of Buji Guan also shows the form of fracture zone. The urban morphology around Bujiguan is even more complex. There are four directions of fragmentation around Bujiguan Checkpoint. The comprehensive transportation lines split Bujiguan Checkpoint from east to west, and the Secondary Borderline itself split the plots from north to south. This situation leads to the weak accessibility of public facilities in different plots around the Secondary Borderline.

The functions of land around Bujiguan are mixed, and the urban storage land is concentrated. The quality of ecological environment around Bujiguan is not high, and the environment of the area is disorderly. The production mode of Buji area is mainly self-sufficient production mode of the bottom business along the street, which can meet the needs of daily life. But the communication between urban village and high-tech industry is weak. Business supporting services around Bujiguan are inadequate to meet the demand for use. Urban villages have high-density living space and lack of public space. Moreover, the narrow lane and turning radius in the urban villages threaten the safety of pedestrians and easily cause congestion.

The author restores the historical development process of the Bujiguan area. Before the establishment of the checkpoint, natural villages were distributed freely around the gateway. After the establishment, the population increased and gradually converged near the checkpoint. The communication between the north and the South has gradually become less smooth. More high-density urban villages developed near the checkpoint. With the development of the SZ-SEZ, the north and south of the borderline are completely separated. After the closure of the Bujiguan Checkpoint, the urban traffic was re-penetrated. The urban fabric around the checkpoint remained unorganized fragmentation.

There are still many opportunities for the development of area around Bujiguan Checkpoint. Located at Bujiguan, a transportation hub, the traffic is actually convenient. The village in the city has great potential to absorb people and has received the attention of the government. There are still a lot of storage land near the checkpoint for reconstruction.

3.3. *Research Summary Based on Urban Morphology*

According to the above analysis of Tongleguan and Bujiguan Checkpoint, the existence of the Secondary Borderline has indeed had a tremendous impact on the urban development of Shenzhen. The author summarizes the impact into the following two points.

First, the Secondary Borderline made the fractured urban texture. On both sides of the Secondary Borderline, the area has experienced high-density development and has already formed dense urban texture. As a special protective land, the area around the Secondary Borderline is not exploited regularly in a certain range. Therefore, in the linear area of 84.6 kilometers, the urban fabric along the borderline presents a relatively loose and disordered form. Urban villages, transportation hubs, industrial buildings and new residential buildings constitute different types of plots, which coexist and squeeze each other. The urban fabric has caused the present situation of fracture. In the future development of Shenzhen city, we also need to pay attention to how to repair the existing urban texture fracture and bridge the crack.

Second, the Secondary Borderline makd the self-organizing growth of non-planned patches. The urban village is the most characteristic urban social plot of Shenzhen, which is a migrant city developed in a short period of time. The density, organization and urban morphology formed by the self-growth of urban villages are the most attractive features of Asian cities. It is also the focus of contemporary architecture and urban studies.

Because the administrative divisions of the SZSEZ do not coincide with the Secondry Bor-

derline itself, there are some management vacuum zones along the borderline. These vacuum zones provide the possibility for the growth and spread of spontaneous settlements of migrants. The Secondary Borderline is also a typical specimen for the study of urban self-organizing growth. The development of urban villages is also a problem that should be paid attention to in urban development in the future.

4. Conclusion

The Secondary Borderline is the boundary left over from the special stage of political and economic development. It is the birthmark of Shenzhen's urban development. Almost everyone in Shenzhen has personal memories of the Secondary Borderline. The renewal of the city is not to erase the memory, but to find a breakthrough point to retain these unique city memories

The change of urban form along the Secondary Borderline is essentially due to the integration and transformation of economic models on both sides. Therefore, the urban fabric of the Secondary Borderline is basically divided. But there are many spontaneous growth plots around the borderline. According to the author's investigation, the removal of the Secondary Borderline has also brought new vitality to the development of Shenzhen.

First of all, the historical remains of the Secondary Borderline has increased the opportunities for residents to get close to nature and promoted the construction of open urban space. The spreading development of Shenzhen makes the urban fabric present a linear form mixed with hilly terrain. The choice of the Secondary Borderline is more or less a combination of the use of natural terrain, such as coasts, forests and waters. The area along the Secondary Borderline presents typical natural landform characteristics of coastal hills in South China. In recent years, Shenzhen citizens have spontaneously organized walking fitness leisure activities along the Secondary Borderline. Therefore, we can use the opportunity of removing and reforming the Secondary Borderline to repair the ecological environment and construct a strip of urban public space associated with the natural system.

Secondly, after the demolition of the Secondary Borderline, citizens can make use of existing infrastructure systems and nodes of the checkpoints. All the checkpoints along the Secondary Borderline are bound to be connected with the traffic routes. Almost all the large-scale checkpoints have concentrated many traffic lines and become the convergence point of infrastructure. After the clearance of the borderline, Shenzhen can take this opportunity to sort out and reform the original traffic settings, which caused stagnation, and to rationally replace the functions. Bujiguan Checkpoint has spontaneously become a regional transfer point connecting Futian, Luohu and Longgang Districts. The spontaneous turning around of Bujiguan Checkpoint provides practical enlightenment for the renovation of abandoned checkpoints.

The revocation of the Secondary Borderline and the reuse of the checkpoints also provides enlightenment for the development of other similar divided cities in the world.

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Morphogenesis and Segregation of the Agricultural and Industrial Residual in Beijing CBD

by Danning Jiang & Feng Song
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Keywords: Morphogenesis, the residual, segregation, urban sociology, urban.

Abstract: The study focuses on agricultural and industrial residual features in Beijing CBD in China to discuss issues of segregation and cohabitation in urban areas. The residual mostly refers to farmer houses and working-class dormitories of previous villages and factories, which isolate in the bustling Beijing CBD. The study firstly analyzes the urban construction process of Beijing, including development of CBD and related urban renewal and housing policies, providing historical background for the subsequent analysis. Using urban-morphology method together with the knowledge of human geography and sociology, then the paper focuses on the morphological process together with social process of the residual. Since it is involved with a long history and complicated social structure, urban conflicts such as demolition and relocation take place. Also, spatial and social segregation exist. The study proposes that the solution to these urban problems lies in the morphological and social process of the area. So it's vital for urban regeneration projects of the residual to combine urban morphology methods and sociology theories. Urban planners and designers should identify the morphogenesis first. In the meanwhile, social, economic and cultural background of all periods should be considered.

1. Introduction

Urban morphology is the implementation of the evolutionary approach on town landscape. It investigates time-sequence as much as spatial arrangement, particularly where successive changes of different character have affected the same area but with varying results. Morphological analysis mostly focuses on the built environment. The present townscape is the accumulated record of distinct morphological periods (Conzen, 1960). While economic and social background of each period are also considered.

In urban sociology, space is something more than an 'empty container'. It is read as a 'social construct'. It is the outcome of a sequence and set of operations. It is seen as the interpretation of human spatial organization as a social product (Soja, 1989). Social space is what permits fresh actions to occur, while suggesting others and prohibiting yet others (Lefebvre, 1991). Represented by Lefebvre, mental space (the space of the philosophers) and real space (the physical and social spheres in which we all live) are searched to be reconciled.

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Despite the term of 'space' has different meaning in these two disciplines, which is even called spatiality in sociology, the paper considers both town landscape and social space since the study mostly focuses on their methodology other than the object. It tries to combine urban morphology and sociology theories and approaches to figure out a way and build a framework to analyze urban problems more comprehensively. In Conzen's theory, an evolutionary approach, tracing existing forms back to the underlying formative processes and interpreting them accordingly (Conzen, 1960), would seem to provide the rational method of townscape analysis. In social-spatial dialectics, the organization and meaning of space is a product of social translation, transformation and experience. Social and spatial relations are dialectically inter-reactive, interdependent (Soja, 1989). Space-forming and space-contingent social relations would seem to provide the rational perspective of social problems. In the construction of community, David Harvey argues that a proper design of things can't solve all the problems in the social process. Community construction projects shouldn't isolate groups from the city as a whole. It should be a process of broader construction of a more universal set of values (Jewson, N., & Macgregor S., 1997), which would seem to provide a holistic view on urban regeneration.

Also, regarding the particular characteristics of urban construction in China, western theories of urban morphology and sociology don't exactly fit in. The social system, property rights, development stage and complexity of the history are all different. In that case, the paper takes an area in Beijing CBD for example to discusses segregation problem in China, which helps explore the applicable use of western methodology in Chinese context.

2. Background: Urban construction in Beijing

Beijing is a city with more than 3000-year history. From Yuan Dynasty (1272), it has been built as the imperial city and later the capital of China. After 1949, large-scale urban construction takes place in Beijing, from the old town to the suburb, resulting in a big city with more than 21 million citizens.

Regarding the research area, it developed from the suburb of old Beijing to an industrial area and now the central business district of modern Beijing. The constantly changing urban planning and construction have made the area involved with complicated urban landscape, history and social structure. Therefore, in order to better understand the area and the residual, historical background of urban construction in Beijing needs to be introduced first.

2.1. *Before 1950s: the old city of Beijing*

Until the establishment of People's Republic of China, urban construction was almost limited inside the old city wall (the 2nd ring road nowadays). Inside the wall was the imperial city while outside the wall were mostly spontaneously formed villages. The research area is outside the city wall. So it was an agricultural suburb with farmers and private land and houses. Besides villages, there were some inns and small restaurants in GuanDongDian. It was called East Suburb in 1930s. Not until 1958 was it called as ChaoYang District and began the urban construction.

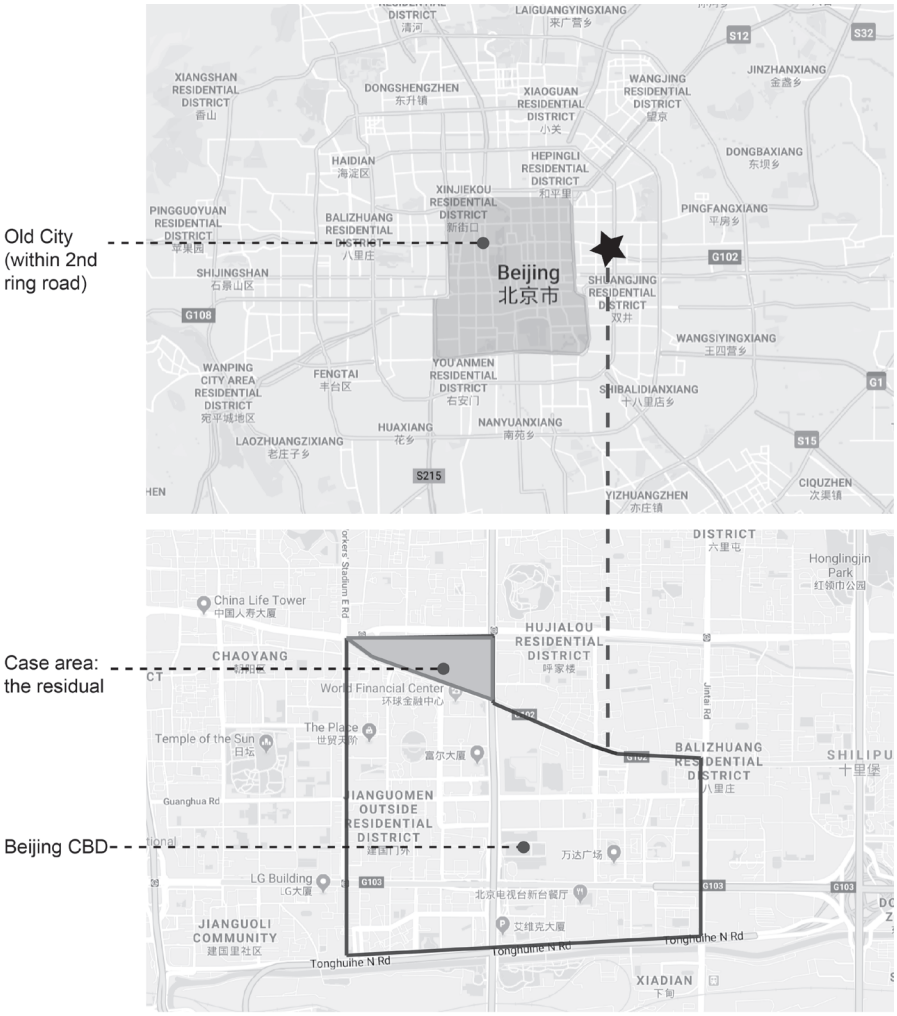

Figure 1. *Location of Beijing old city, CBD and the residual.*

2.2. 1950s-1980s: industrial area

<Key points of reconstruction and expansion of Beijing(draft)> was released in June, 1953. That's when industrial development was first considered in the urban planning of Beijing. According to the draft, administration center lied in the old city. Development of industry, agriculture, modern culture and urban construction were the main goal in the construction process. In 1958, <Master plan of urban construction of Beijing(preliminary)> made it more clear that Beijing should be built as an important industrial and scientific center. As the capital city, Beijing should rely on the base of industrial workers and be turned into the engine of national industry.

The East suburb was planned for the development of light textile and small-scale heavy industry. In the research area, the first Machine Tools Plant and 3501 Military Clothing Factory were built in early 1950s with workers' dormitories. Beijing Car Factory, Knitting Mill and Switch Factory were built in 1956-1958, resulting into new streets and residual areas. In 1960s, Beijing Vacuum Instrument Factory and Machinery Factory also entered the area. Besides, there were also pharmaceutical factory, dyeing factory, electric appliance plant and motorcycle factory. And most of the factories built their dormitories nearby.

2.3. *1980s-nowadays: business and cultural district*

After the opening-up policy in the late 1970s and industrial development since 1950s, the area has accumulated adequate infrastructure, good economic condition and complete street system. Beijing World Towers was built in 1990. In 1992, <Master Plan of Beijing (1991-2010)> first brought up the idea and strategy of the construction of Beijing CBD. The scope of Beijing CBD was formally defined in 1993 in <Beijing central area detailed planning>. Modern office buildings and skyscrapers began to rise up in 2000s, such as Beijing Financial Center, CCTV Headquarters, Jianwai SOHO, Yintai Center, Jiali Center, etc. Beijing CBD even has been planned to expand to the east with 3km^2 since 2009.

2.4. *Development of housing and renewal policies*

As for the houses, before 1949 they were all privately built. The socialization reform in 1956 began the process of house nationalization and socialistic welfare system establishment for housing distribution. People started to live in public houses and communities. However, public housing system put great pressure on central finance. Therefore, in 1978, housing reform was put forward by the government. In the following years, houses gradually started to be individualized and commercialized. In 1994, the State Council published <the Decision of reinforcing housing reform> in order to improve living condition and fit housing market into the socialist market-oriented economic system. Beside commercial residential buildings, low-rent housing and economically affordable housing for low-income individuals and families were built.

Urban renewal mainly took place in old Beijing city before 1980s. It was more like the emergency treatment on dangerous old buildings. In 1986, private construction of all institutes was forbidden. Together with housing reform, urban renewal projects became more and more prevailing in a larger scale. It started to take urban planning, historical preservation and environmental conservation all into consideration.

3. Morphogenesis: The residual in Beijing CBD

The development process of Beijing CBD was mostly pushed by strict urban planning and national development strategies. However, among the high-speed construction there is a specific area left with old landscape features, or as called residual features in urban morphology. It was faced with conflict and under negotiation among different interest groups for years. So it was not as developed as the surrounding area. The residual (the area with residual features) composes of Huashiying (in the northwest), Guandongdian(in the southwest) and Hujialou(in the east). The area as a whole is full of residual features from earlier periods and to some extent appear unaltered in all its essential characteristics (Conzen, 1960). Therefore, it fully exhibits the urban history of the area.

In this part, the paper tries to figure out a way to analyze morphological and social forming process together, which helps to understand current situation of the residual from the perspective of both townscape and social space.

3.1. *Morphological and social process*

Each period leaves its distinctive material residues in the landscape and can be viewed as a morphological period for the purpose of geographical analysis. (Conzen, 1960) There are 4 morphological periods in the residual.

Before 1950s, as introduced above, the residual was a part of the agricultural suburb. There were scattered agricultural land and houses. The houses were all individually owned and built. The locals were mainly farmers. According to the locals, the area was full of fragrant-flowered garlics, green Chinese onions and corns when they were little kids. Also, there were graveyards. Especially when Japanese invaded Beijing in 1930s-1940s, the area became a common grave. So it was called Huashiying before 1960s, meaning the place to burn the dead bodies.

In 1950s, villages in Baijiazhuang in the north was demolished and relocated to the area. The housing authority built lines of one-floor public houses for them in the area. And when 3501 military clothing factory located in the south, it equipped dormitories in the east and northeast of these public houses. There were 7 continuous residual areas for 3501 workers, lying from Hujialou to Baijiazhuang. Among the dormitories were small lodging houses and dining halls built by 3501 Factory. Similarly, No.5 Construction Company built their storied dormitory buildings in the south. Beside residential districts, the area also provided commercial function. In the west, a big market called Dongdaqiao Department Store was built in December, 1954. The residents in the area were partly farmers from Baijiazhuang and partly workers of 3501 factory and construction company. There were also a small percentage of the former local farmers. Those farmers both originally from Huashiying and from Baijiazhuang mostly got employed in the nearby institutes, became urban citizens and no longer did farming. Apart from the residual original farm houses, buildings partly belonged to housing authority and partly to institutes and companies.

In late 1970s and 1980s, storied houses were built by the housing authority around the one-floor-houses area. Most of them were used as settlement for people whose original houses was

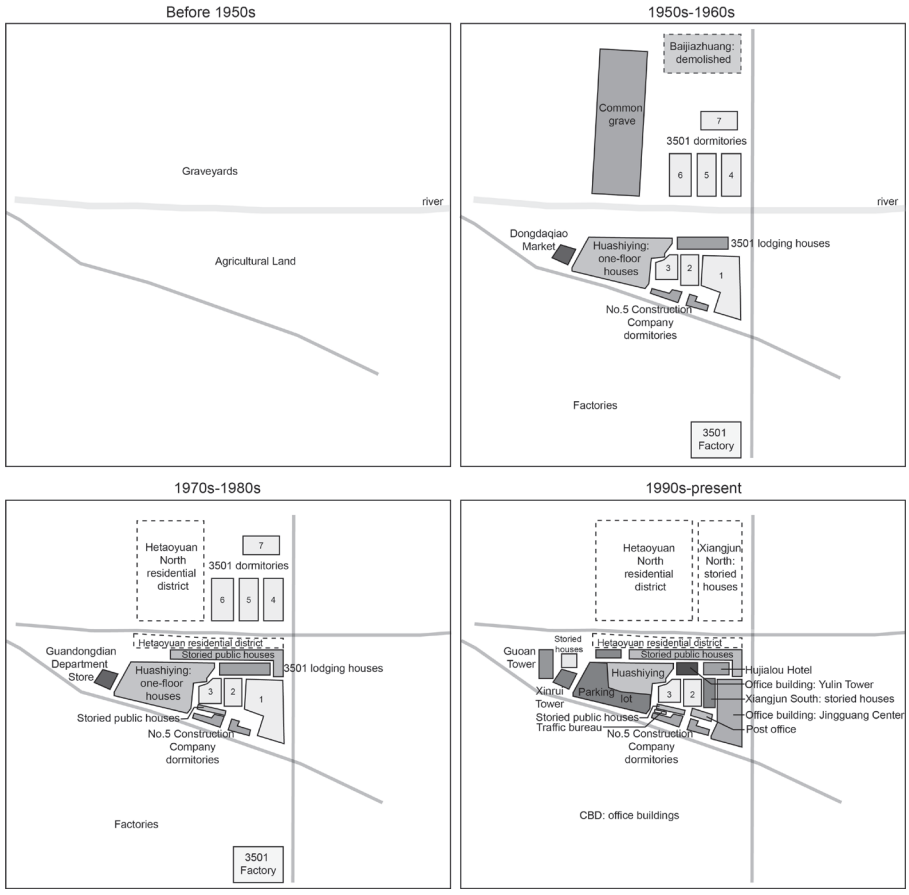

Figure 2. *Development process of the area.*

demolished somewhere else. Dongdaqiao Department Store was expanded to two floors in 1970s and five floors in 1989 with the new name of Guandongdian Department Store.

In the late 1980s and early 1990s, the residual area was faced with the first large-scale demolition. Dormitories in the southeast were dismantled. A skyscraper called Jingguang Center and three 25-floor residual buildings (Xiangjun South) were built instead in 1990. The lodging houses were changed into Hujialou Hotel and an office building called Yulin Tower later in 2000s. In 1993, some houses in the south in Huashiying were pushed down. It was turned into a parking lot and will be redeveloped in July, 2019. The factories in the region were all gradually demolished, relocated and redeveloped into office buildings. Dormitories in the region were also dismantled to build storied residential buildings. This is the period when more social groups crowded in especially after 2000. Householders have mostly moved away. Tenants and migrants flooded into Beijing and rent rooms in these one-floor houses and storied buildings. Office staffs and clerks began to work in office buildings.

3.2. *Existing townscape*

There are 667 one-floor houses and 14 storied buildings in the residual area, including public houses, individualized houses, individually built houses and properties of different institutes. One-floor public houses built in 1950s were charged by the housing authority. One-floor dormitories built in 1950s were charged by 3501 military clothing factory. The rest of the one-floor houses can be traced back to agricultural period or left by later individual construction. Storied buildings in the north are mainly charged by the housing authority. Others in the south belong to different institutes, such as the 5th Construction Company, the post office, traffic team, subsidiary food company and Hujialou Hotel. The storied building in the west belongs to the armed police. And high-rise office buildings were developed by real estate companies.

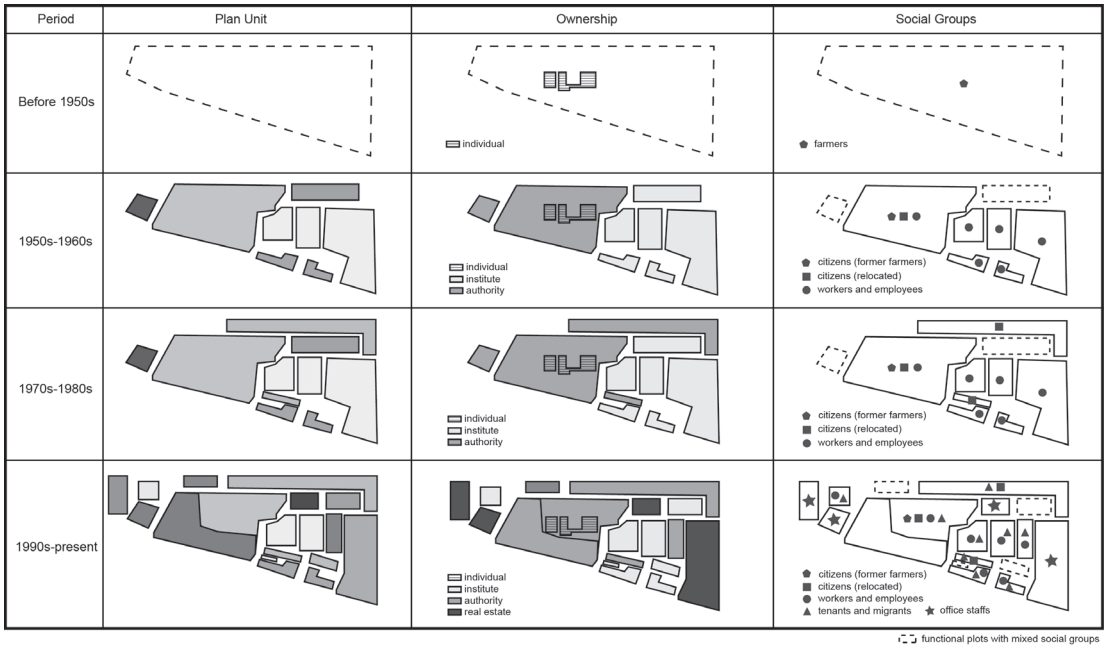

Figure 3. *Morphological and social process of the residual.*

Since the residual is left with mixed historical characteristics, the area can be divided into different units according to the date, house type, property right and land use, which constitute the complex existing townscape.

Overall, the closer to the center of the residual, the quality of the houses are poorer, the height are lower, and the infrastructure is more inadequate. The one-floor houses are not equipped with toilets. Public restrooms and rubbish stations scatter in the residual. Electric cables are exposed above the rooves. The facades of the old buildings have been repainted these years but there is still disordered construction in the house yards, affecting the appearance of the area.

Besides, the area provides commercial function, especially in Huashiying area. There are all kinds of small shops with street frontage selling groceries, mobile accessories, food, clothes, and providing the service of haircut and laundry. The number of these small commercial facilities has decreased since the government reinforced urban management and environmental improvement. In the past three years, about half of the stores have been closed. But still it constitutes a disordered commercial townscape in the area.

3.3. *Socioeconomic status*

There are approximately 900 people in Guandongdian community, 55% of whom live in one-floor houses. Only 10% of the residents are local people. The rest 90% of them are migrants from other provinces like Henan, Hebei and Anhui. They make a living by delivering meals, stuff, riding pedal tricycle, running small business, recycling and selling waste materials. They rent the one-floor houses together to save living costs. A 30m2 room can hold 10 people. They only have to pay ¥400-500 each.

The old workers in 3501 dormitories are paid and socially secured by the factory. Though the factory has been reorganized and no longer makes profit by making clothes, it shares the stocks of the office buildings in their former site. The old householders in Huashiying are employed by different companies or self-employed. Their economic condition differs case to case.

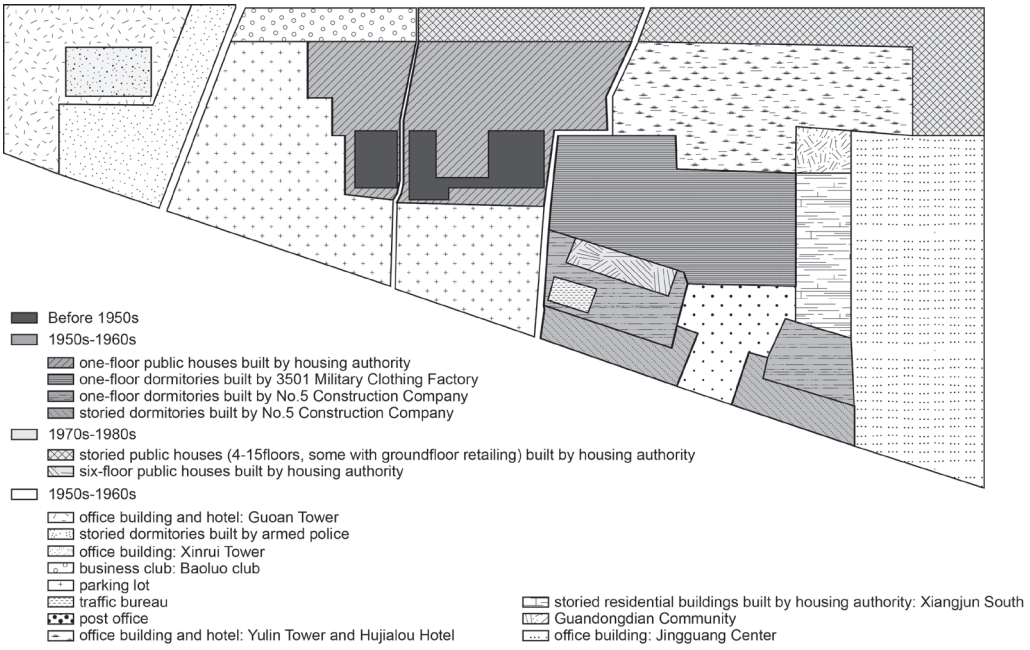

Figure 4. *Plan unit of the residual.*

The residual is administrated by Guandongdian Community. The community deals with all kinds of affairs related to local residents. Above the community is Hujialou sub-district office. It is in charge of security, environment and retail business of the district. Securities in Huashiying and people responsable for certain alleys are all employed by the sub-district office. Further above, sub-district office is led by government of Chaoyang district. Department of housing, urban management and security of Chaoyang government are all involved in the administration of the residual. In addition, since the residual is about to be dismantled to make it more like a part of CBD, CBD management committee, property management company, housing expropriation office, and land evaluation company are also related to the residual. And for the houses of the institutes, additionally they have their own way of management. For example, 3501 dormitories are managed by the factory and they have their own property management company. When dealing with urban problems of the residual, all these departments will cooperate to achieve better management. For instance, staffs of sub-district office, security office, urban management department, police and community will all participate in the environment inspection.

4. Segregation: Urban problems in the residual

Due to the morphogenesis, social structure is complex in the residual. And visual and social contrast exist between the residual and CBD. All these have caused different kinds of urban problems. Residents are faced with perceived isolation and lack of socialization due to different types of spatial segregation. CBD development plan plans to solve the segregation by dismantling and redeveloping the area. But it causes conflict and disagreement between the locals and the government.

4.1. *Isolation and segregation*

First of all, spatial segregation exists between the residual and the outside. The residual is metaphorically called the well of Beijing CBD. The height and quality of the buildings in the residual show a great contrast to those in the surrounding areas. Even the residents feel a little ashamed of where they live.

> It's hard to find another place as dilapidated as we are here. When guests especially international guests look down from the skyscrapers nearby, they will see the rooves covered with shabby bricks and asphalt felt. Certainly it will leave them a bad impression of Beijing". "So the guests are hardly arranged to live in Jingguang Tower which is closely next to us. When the guests have nowhere else but there to live, it will be highly secured and inclosed.

Secondly, social isolation exists both inside the residual and with the outside. Social segregation is the case where people are divided socially by their social status, religions, races and occupations. People with similar social attributes will gather together and create distinct boundaries. Sometimes people in different social groups will even be hostile to or discriminate each other. It can be measured by size of social network, frequency of social interactions, sense of belonging to the place, acquaintance to the people, adequacy of social relationships, engagement in social activities, existence of strong bonds, etc. (Nicholson, 2009).

Inside the residual, social segregation takes place among different social groups.

For the old workers of 3501 Military Clothing Factory, their social network is limited to their

own relatives and neighbors who are also old workers or their descendants. They hardly ever have contact with migrants and tenants in the neighborhood. And they never socialize with people in Huashiying area though they may sometimes hang out there and buy daily necessities. Their daily lives are made up of chatting in the neighborhood, buying groceries in the supermarket, taking a walk in the park, visiting their children and babysitting their grandchildren. Their activities are not limited inside the residual since supermarkets, parks and their children's houses can locate far away. They are highly bonded with the place and have strong sense of belonging. When they were asked about the history of the dormitories, they were very proud to recall their working experience and how the dormitories were best equipped. They think the life here is convenient and cozy. Though it's not well-furnished storied building, they are used to it.

> Our factory was a large-scale one with more than 50 branches all over the country. The total number of workers was over 3000". "The quality of the dormitories here was the best in the 7 dormitory areas. Every house cooked with natural gas while most families used coal and coal gas at that time.

For the residents in Huashiying area, the social network is more limited. Because the demographic structure is more complex, people there have weaker psychological bonds with each other. They sometimes chat with their neighbors. Most time they are with their family and do their own business. And since most of the original householders no longer live there, they are not as emotionally related to the place as people in 3501 dormitories do. Some interviewers expressed strong will and expectation to relocation. They would like to live in cleaner and bigger storied buildings in spite of the convenience of one-floor houses.

For the tenants and migrants, they live here for low rent and good location. Whenever demolishment was brought up or their business in Huashiying was under strict supervision, they will move to other places. Therefore, they are only temporarily connected to the place without strong social bonds and sense of belonging. Householders and the locals hardly ever have connections with them. They even accused the tenants of disturbing the order and illegal occupation of space.

With the outside, social segregation also takes place.

People working in CBD have little connection with the residual. They sometimes walk by to reach metro stations but ignore what's happening there. And residents in the residual also never go south to CBD area. The parks and supermarkets they are familiar with are all in the north. They are not interested and involved with space and activities in CBD, though it is modern and lively.

4.2. *Demolition and relocation*

The segregation shows the necessity of coalescing the residual into the development of Beijing CBD. However, the process of demolition and redevelopment can also be troublesome due to the complexity of the area.

After the large-scale demolition in 1993, there has been little progress on the urban renewal of the residual. The renewal project in 2005 was postponed due to the dissidence on compensation. Not until 2017 was the project brought up again when the government solicited opinions and began to prepare new compensation and relocation proposal. The first-edition proposal was published and posted in the beginning of 2019. Residents have submitted their feedback to the government in March. In May, surveying and mapping work began, preparing for land assessment. In the future, only when the proposal is revised to be approved by the majority of the residents, will the demolition begin. Then the government takes back the land and calls for developers' bids.

The current plan is to demolish the houses in the middle part of the residual. It involves about 300 people in one-floor houses and 50 people in storied buildings. 4 relocation sites were proposed near 4th and 5th ring road of Beijing. The compensation can be cash or a discount price on buying new houses. It is determined by the value of the original houses, estimated by evaluation authorities. Compensation for indoor furnishing, removal charges, temporary settlement and suspension of business are all included.

After on-site interview with some residents, it turns out that they are not completely satisfied with the proposal. First of all, for the elder used to living beside 2nd ring road, the relocation sites are too far for them. Public traffic is not as convenient as it is in CBD. The metro can't reach these sites while Hujialou metro station is within 5-minute walk and there are plenty buses passing by. And there is no medical facility there while Chaoyang Hospital is just within walking distance to the residual. What's more, the amount of compensation doesn't live up to residents' expectation.

However, the community and government hold a different standpoint. In their opinion, the relocation sites can be reached by metro (Line 7 under construction) in the future. The residents are just too accustomed to the life here to move away. The relocation sites and compensation are the result of long-term coordination, negotiation and revision. It will never completely fulfill all kinds of need and opinions of different stake holders.

5. Discussion: Regeneration strategy of the residual

The case above on the one hand shows how morphological process leads to social segregation. The forming process intangibly divides the area into parts of different units with different social groups. For the need of support (Paul Knox & Steven Pinch, 2010) and sense of belonging, isolation is created internally. The construction process in the region involved with economic development and mandatory planning of CBD creates spatial and social segregation between the residual and CBD externally. Therefore, it's hard to completely separate social problems from morphological features. Analyzing the social problem should rely on the study of morphogenesis. And urban morphology study should take social and economic problems into consideration.

On the other hand, the case also leads us to reflect on the solution to urban problems. Since they are determined by morphological and social process, the solution can lie in the morphogenesis. Analysis combining the methodology of urban morphology and sociology will help eliminate the existence of segregation and reduce conflict in urban regeneration process.

Urban regeneration includes three stages: clearing slums, rebuilding neighborhood and community regeneration (Guo, 2009). All these three stages rely on deep understanding of historical process and social structure. When clearing slums, it's evitable to negotiate with various social groups with various history. When rebuilding neighborhood, history of the area should be memorized and activated. When regenerating the community, spirit of the old community and the region it lies in should not be completely neglected.

Therefore, urban regeneration is not about simple physical design which will only lead to the destruction of historical and cultural diversity. It's about a comprehensive, historical, dialectical and caring view on the discovery, analysis and solving of urban problems. A deep morphology-oriented and sociology-perspective study should be accomplished before the proposal and implementation of any renewal projects. Analysis of morphological process will help explain the spatial composition and formation of social groups in the case area, making urban conflict and social segregation understandable. Concentration on urban construction process in the re-

gion will help interpret townscape of the case area with historical background, making the case area less isolated from the city after the renewal. Deep investigation on social status will help disentangle social relationships and needs of different stakeholders, making the negotiation in demolition more effective and less conflicting. A dialectical view of relationships between society and space will help understand people's interaction with space, making urban design more realistic and humanistic.

All in all, it's crucial to trace existing townscape back to its morphogenesis when regenerating urban areas. It's also important to understand the interaction between society and space when solving urban problems. The existing chaos and isolation in both spatial and social form can all be explained from the combined perspective of urban morphology and sociology, which should always be the first step to rebuild a problematic area and arise urban vitality.

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Formal City Grows in an Informal Way

by Chi Zhang
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Keywords: Formal, Informal, Xi'an, Muslim Quarter.

Abstract: The cities study today marked themselves a paradox that the "Scenario Planning" of the city are supported by developed regions, but the core factors of how city operation are remaining rooted by the developing regions. As to a specific city, even if it has perfect geometric shapes and urban boundaries, it is not actually working in a regular way. These formal rules or laws and informal disciplines seem to be wrapped in a magic box which decide the development of the city in negotiation methods. This paper is focus on a case study of the Urban Conflict of Muslim Quarter in Xi'an, China. Muslim Quarter is a historical block. Since 21st, Muslim Quarter has become an invisible and sensitive area, gradually forming a situation of regional autonomy. While adding benefits to the city, it has added a lot of contradictions and pressures.
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1. Introduction

Stable, or the lack of it, is always being most fundamental conception of a system but it also be relative balanced by several semi-activated elements, which is tagged as "MARGINALLY STABLE". People have made the progress so artificially and systematically that we could live peaceful in urban. However, it's still uneasiness for us facing the constant changing conditions. That's why we need to know how it formed in order to respond properly.

As for a specific case, the Muslim Quarter in Xi'an City could be a paradox of stable mixed by three mutual restraint powers: The Government as control, the Muslim as faith, the Citizens as freedom, which make the area an "Half-blood Slum". On the one hand, with its cultural, it has become one of the most important pillars of tourism in Xi'an and brought huge economic benefits. On the other hand, it has the same poor living conditions as other slums. The Muslim is not only a business area but also a residential place. However, it is sensitive to discuss about democratic renewal under the centralization, especially meet with the religious and ethnic issues that have a strong desire for autonomy. Therefore, none of the three actors can move the first step. "Acting" and "No-acting" become a balance game, when someone involves in, he needs to know the roles and rules here.

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2. Methodology and Analysis

2.1. *Image and structure*

The imagery of the Muslim Quarter is constructed by three elements: landmarks, houses and streets, which also help the roles delineate the area. The government building is for officers, the mosque and the houses are for Muslim, the streets are for citizens. According to the map, the government and the Muslim have their own power agency and confront each other and the streets seem to be the neutral place. The thing is who can take the advantages of the citizens to make it a protection or an opportunity.

As the consequence, we can abstract these roles and relationships in a triangular structure model. From the objective perspective, the Muslim Quarter located almost in the center of the city. Therefore, it attracted most resources and eyesight from city. No matter when the city is innovating or developing, it influences the efficiency of the process and will always be a site to test the results. Besides, the Muslim Quarter has made enormous benefits both in economy and culture. The Government must consider it together with the future of the Xi'an city. However, the Muslims has themselves managed by their religion and nation beliefs. As for them, they have settled here for hundred years since the city was not fully developed. Their determination of surviving in the city is no less than other citizens and just differ from some historical factors which bring the economic potential while also limit themselves to improv from the poor living conditions. From now on, there are 60,000 Muslims living here which mean that 3/4 of the entire minority population in the whole Xi'an City. This will never be a simple slum transformation issue. As to other citizens, they spare no effort to improve the surroundings to support the city and look forward to protecting every historical area, doing as narrators.

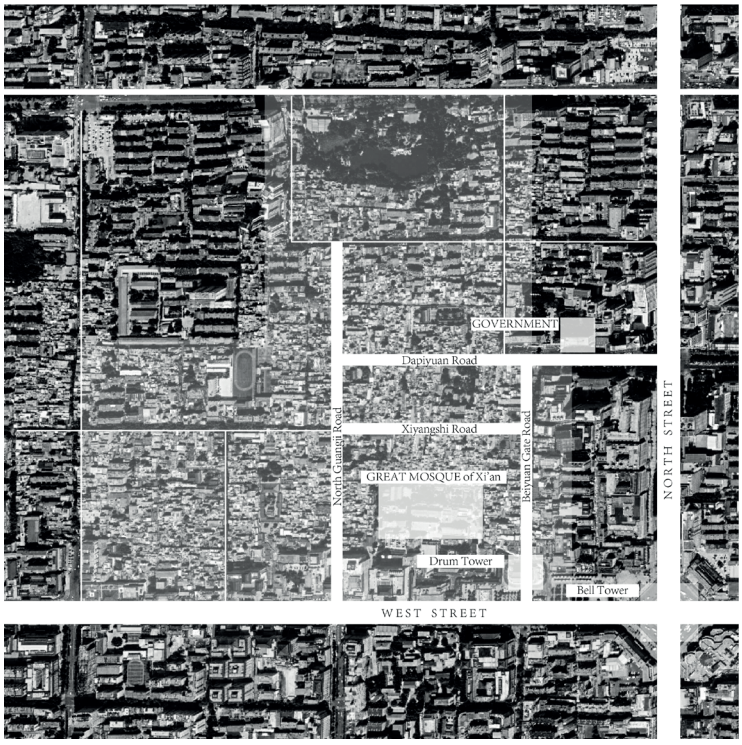

Figure 1. *The Mapping of Muslim Quarter in Xi'an.*

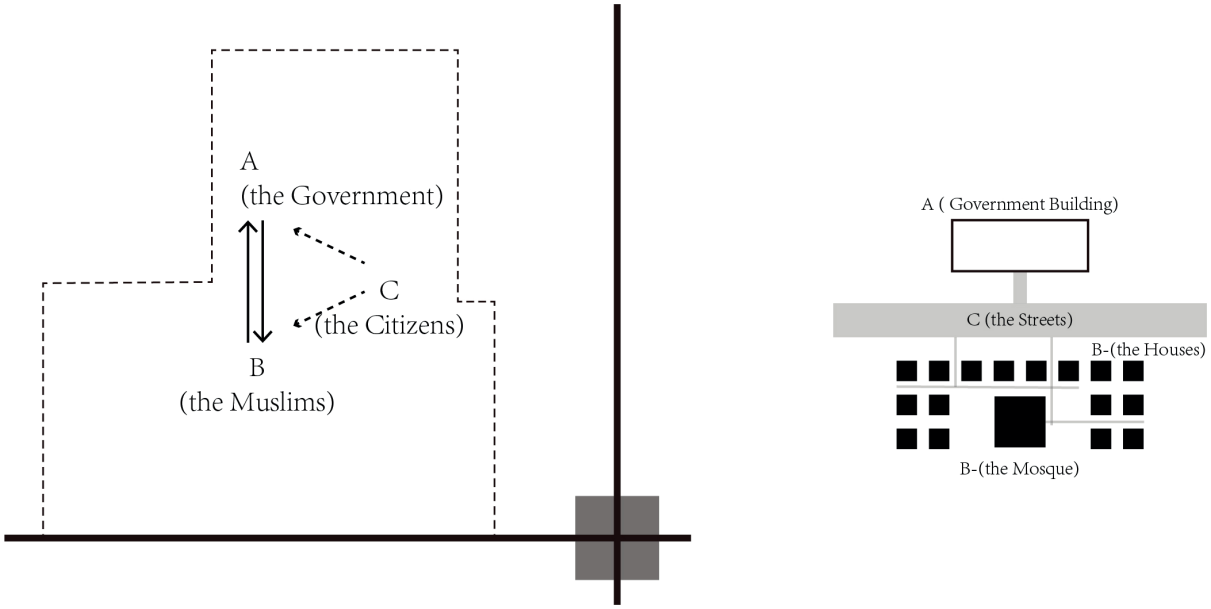

Figure 2. *The triangular structure of 3 Actors and The space structure*

2.2. *Acting as "half-blood" slum*

The inconsistency of container and content leads the Muslim Quarter acting as a "Half-Blood Slum". The Muslim Quarter has won a good reputation benefited from its history, culture, etc., which represent as contents. These intrinsic qualities are coming from the accumulation of inner culture and the belief of the nation and region. However, these culture self-esteems hindered the innovation of the area. As to a residential area, it has poor conditions of infrastructure, buildings, streets, environment and so on which bring unsafety, disease, and uncomfortable for living, called as the insufficient of container.

No-slum

The glory of the Muslim Quarter origins from its historic landmarks and nation belief. One of the most famous buildings is the Drum Tower (1380) which is the entrance of the Muslim Quarter, belonging to the Beiyuan Gate, one of three historical areas in the center of Xi'an. As time goes by, there also remain a large number of architectures, courtyards and arches as Ming and Qing dynasty aging hundred years old. Since from Tang Dynasty, Xi'an as the capital in China is prosperous due to the successful of Silk Road. During this period, foreign embassies, merchants and scholars came to do diplomatic activities and commercial life, constantly proliferating here such as Arab and Persian who are regarded as the ancestor of the Hui, later the Muslims. The Great Mosque of Xi'an (742) can be another landmark shows their nation belief. In 1956, the mosque was declared a Historical and Cultural Site Protected at the Shaanxi Province Level, and was later promoted to a Major Historical and Cultural Site Protected at the National Level in 1988. The mosque is still used as a place of worship by Chinese Muslims, primarily Hui people, today. Besides, people also can find different types of mosque in this area, totally in seven.

History and culture establish the self-esteem and self-confidence of the Muslims. Though several of these bustling streets which connecting these important architectures and squares, they are still united to live and multiply, holding regular religious activities, following the tra-

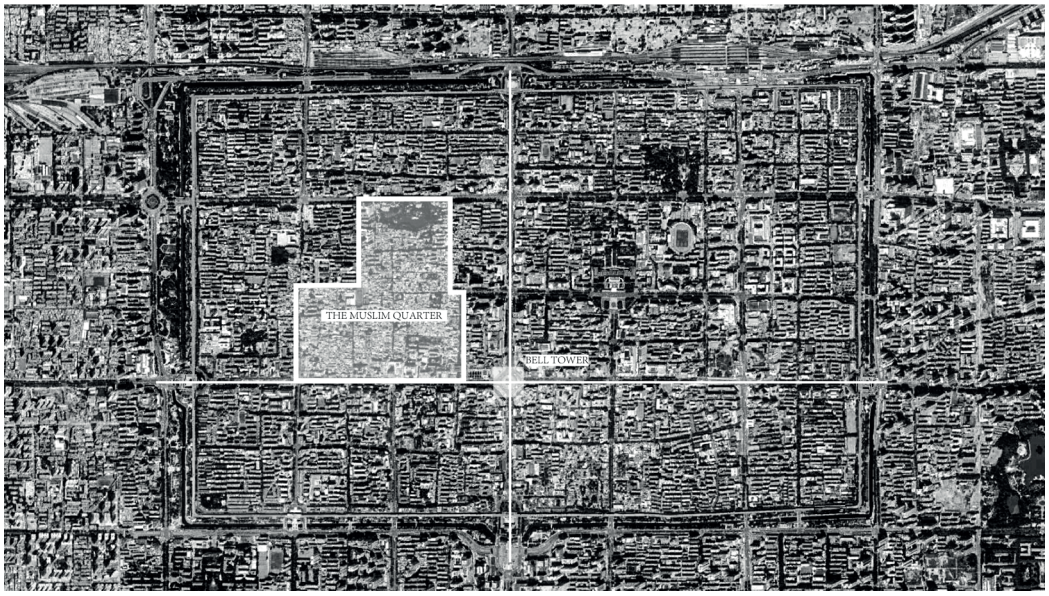

Figure 3. *The Muslim Quarter in City Scale.*

ditional customs, creating eating habits attracting a large number of tourists who can entirely enjoy the happiness of life. The inner world of the Muslim is so powerful that every soul has an unyielding spirit that propels him/her forward.

Slum

The perspective determines the horizon. As the matter of fact, the mainly function of the Muslim Quarter is residence for the Hui, but not the business for the tourism. Although there is no strict definition about the boundary of the Muslim Quarter, it's absolutely not the street level and the problem never can be covered up by such apparently prosperous. According to business street which have been developed previously, it has enclosed in area no less than 0.75 km^2. That also reflects the potential drawbacks of the Muslim Quarter and the necessity of government to transform it. It is obvious that when it comes to a quarter of the city level the economic benefit of some streets cannot worth a point, not to mention about the living conditions of 60,000 Muslims.

The opposite of the history is always being stale and conservative. Actually, the glory of the Muslim Quarter just like stars in the night, no matter how it shinning it will never reject the dark. There are some traditional courtyard houses in the historical district of Drum Tower, and most of the residents live here for generations. Some of these dwellings have been preserved well, but majority of the residential buildings in the block is not optimistic. With the continuous improvement of the material living needs of residents, in order to improve the existing living conditions, residents have carried out a large number of spontaneous construction activities on houses within their property rights which have caused great damage to the overall style of the historical block. At present, the Muslim Quarter stack lots of low-rise and multi-story residential buildings, and most of them are simple and rough. The houses are dense and crowded, the infrastructure is bad, the sanitation is poor, and the quality of the living environment is low. According to the trend of the population growth and the process of the urbanization leads to decrease the area of the slum, the Muslim Quarter will be naturally reduced under the lack of

living condition. In the rapid urban renewal, some slums are forced to die because of saturation of population, lack of resources, and even have not formed a nausea cycle.

2.3. *Conflicts and challenges as no-acting*

The Muslim Quarter is always in the state of "MARGINALLY STABLE". The appearance of the prosperous and harmonious carries a lot of pressure from slum which almost comes from themselves not outside. The Muslim have limited ability, meanwhile they can't easily transfer their rights to others because of history and belief reasons. Under such circumstances, they would rather choose to continue confront with the government, although they will eventually make a choice.

Conflicts

Shaanxi has been a mixed area between the Hui and the Han since ancient times and once had fierce conflicts in the history. At the beginning, in order to be harmonious, they all served as the ruling class of the Manchu. However, in the last years of the Qing Dynasty, along with the Hui and Han nationality. The level was growing stronger, and there was a constant conflict between land resources. The dispute of the lands reflected the landlord class of the Han and landlord class and the wealthy class of Hui competing for lands and markets. As a result of fighting, the contradiction between the Han and the Han nationalities had intensified, and the relationship between the Han and the Han had deteriorated. In 1862, the Dungan Revolt erupted out. The conflict ended in 1877, lasting 15 years, eventually led to large-scale massacre of Han and Muslims. In Shaanxi, 83.7% (~5.2 million) of the total loss occurred in the period of war as a consequence of mass migration and war-related death. Many civilian deaths were also caused by famine due to war conditions. At the same time, 17th May became a ceremonial ceremony held annually by the Xi'an Hui people to commemorate the compatriots who suffered the massacre during the Tongzhi reign.

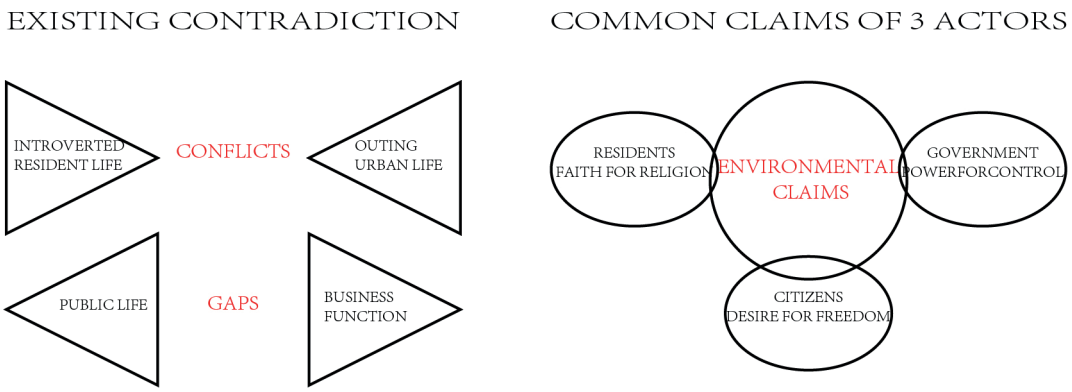

Figure 4. *The Relationship among Actors.*

Challenges

In the process of confrontation between the two sides, the common interests have become an important breakthrough. In the current situation, both the Muslim and the government wants to protect the culture in this area, the difference is that the former need an introverted life and keep their own rights to survive, the latter prefer an extroverted life serves to citizens and make more profits. In 2017, the government cooperating with OCT Group restarted to make the strategy of urban transformation and the Muslim Quarter was the core of the plan. It seems to be culture-oriented and replace "reform" with "protection and promotion". However, people are more willing to see specific details and actions rather than the concept or the idea to describe the future. It still makes no sense if the government only catches up the profits but avoids to solving the residential problems. Another example is a studio practice from Xi'an University of Architecture and Technology: the professor required students to use words, pictures, sketches and abstract drawings to describe the atmosphere of the Muslim Quarter from their own perspective before they did the design. They try to reveal the common points and record as design elements. I appreciated the latter's using of a bottom-up behavior to practice those great ideals which will give both the clients and ourselves a sense of safety. If we think further, there might be a participatory design method among the Muslims, citizens and government. Attempting to use the power from the public to counteract the conflicts among the actors. In any case, no one can stop the steps of social development. Urban renewal will definitely happen. But there is no piece of land in the city belongs to one side, and even the more powerful the right is the stronger restricted and resisted will take place.

3. Discussion/Conclusion

This paper fully discusses about the renewal of the slum in urban level. The author uses the concept in the theory of dynamical systems and control theory as "Marginal stability" to describe the relationship between the slum and the urban system. During the process of urban transform, not all the gray places as slums are just waiting for the aids from the governments, sometimes they even fight against each other, and finally form a mutually restrictive situation which construct a dynamic balance in critical state. With the case studying, the paper tries to figure out how to specific this situation and why it comes out?

The Muslim Quarter in Xi'an is such a sensitive place that with the no-acting of the government, the acting by themselves and intervention of the citizens, the three actors make it a "Half-blood Slum" in the city. Power of control, faith of brief and desire of freedom have become three strength to interact each other. All of them realize the potential of transformation, but no one could evaluate and take the risks. What they doing is like a way of collaging which avoids major problem of residents but only concern about the economic benefits. It would be a intriguing question that who will make the first step to break this deadlock or they will compromise together under the impetus of a historical event.

As mentioned in the article, although it is difficult to discuss about democratic renewal under the centralization, especially meet with the religious and ethnic issues that have a strong desire for autonomy, the urban renewal will definitely happen. There is no piece of land in the city belongs to one side, and even the more powerful the right is the stronger restricted and resisted will take place.

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Cities as Assemblages

These three volumes contain the proceedings of the XXVI International Seminar on Urban Form, Cities as Assemblages, which took place from the 2nd to the 6th of July 2019 in Nicosia, Cyprus. The conference explored how different theories and approaches can be embedded within the methodologies analysing the urban form. These theories provide a relational perspective for the analysis of the physical and social processes underpinning the shaping of cities, and address the inherent complexity of the urban form. The Cyprus Network of Urban Morphology (CyNUM), which organised on behalf of ISUF the XXVI International Seminar on Urban Form, was founded in 2015 as a bicommunal organisation involving actively researchers from both sides of the divide.

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