



Cognition and Use of the Built Environment, Tools and Methods of Analysis

by

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ABSTRACT

In this dissertation, *Cognition and Use of the Built Environment, Tools and Methods of Analysis*, the author claims that it is the key to improving the urban design that understanding the user's cognitive procedure of the built environment. Urban residents' cognition of the built environment has a traceable "figure-background" structure reflected in how they use the built environment. Understanding this cognitive process can help architects better design buildings and environments to meet users' multiple requirements. However, due to the current design flow, users' cognitive mechanism is always ignored. This research tries to discuss the cognitive structure constructing the built environment to the corresponding regularity and method and then applies the cognitive result to a specific project for a new design flow.

The dissertation includes two parts. Part I is to construct the cognitive process from the architecture to the built environment. Part II proposes the usage patterns according to the cognition structure of the built environment concluded in Part I.

In Part I, with the title *Analysis of the built environment: architecture scale*, the author introduces the phenomenon research method to analyze users' typical cognitive process and then presents the triple structure of understanding architecture and connects it to the cognitive procedure of the built environment. The three cognitive structures are built as following: (1) cognitive objectivity – intuition – material, (2) cognitive subjectivity – perception – space, and (3) cognitive intersubjectivity – consciousness – field, to contribute to the built environmental design.

In Part II, with the title *Analysis of the built environment: public space scale*, the author assumes the placement design strategies of new street furniture by PSPL as a research method and Space Syntax as the analysis tool for the urban place. It then proposes an integrated placement design flow of the urban facility from the city layer to the district layer to the place layer. Furthermore, the author sums up a series of elaborate placement schemes aimed at street furniture with different functions.

This dissertation supplies a design perspective from a user's view and emphasis that the essence of design is to build a bridge between people and the built environment. The author supplies a cognition paradigm for understanding the built environment in Part I and states a cognitive pattern that users understand the built environment with architecture as a starting point. Moreover, at the end of Part I, the author maintains that the architect's design process should integrate the inverse process of the user's cognition to architecture, and the built environment is the cognitive background. Finally, Part II uses the cognition paradigm constructed to achieve the methodology to deal with an actual design problem, the placement selection of new street furniture in the public space with different scales. Thus, Part I is the theoretical basement of Part II, and Part II is a further and detailed practical application.

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CONTENTS

ABSTRACT	i
ACKNOWLEDGMENT	ii
CONTENTS	iii

PART I

ANALYSIS OF THE BUILT ENVIRONMENT: ARCHITECTURAL SCALE

CHAPTER ONE

INTRODUCTION	2
1.1 Background.....	3
1.1.1 Crisis originary of contemporary architectural design.....	4
1.1.2 Dilemma of creation of China’s cold region architecture.....	5
1.1.3 Return of rationality of architectural consciousness with philosophical speculation	7
1.2 Research development in foreign countries and China.....	9
1.2.1 Overseas research status	9
1.2.2 Domestic research status.....	14
1.3 Research purpose and research significance.....	16
1.3.1 Research purpose	16
1.3.2 Research significance.....	17
1.4 Research overview	20
1.4.1 Concept	20
1.4.2 Content.....	21
1.4.3 Method	21
1.4.4 Framework	23

CHAPTER TWO

ANALYSIS OF THE ORIGINARY OF CONTEMPORARY ARCHITECTURE

UNDER IMAGE CONSCIOUSNESS	24
2.1 Speculation of the originary of contemporary architecture	25
2.1.1 Development research on the architectural originary	25
2.1.2 Unfold the originary of cold region architecture	29
2.2 Cognitive theory and method of image consciousness	33
2.2.1 Image consciousness as epistemology	33
2.2.2 Cognitive theory of image consciousness.....	37
2.2.3 Cognitive method of image consciousness	41
2.3 Application of image consciousness on construction the originary of cold region architecture.....	43
2.3.1 Relationship between the cognition of architectural originary and image consciousness image consciousness	43
2.3.2 Originary deconstruction of cold region architecture under image consciousness.....	46
2.3.3 Originary reconstruction of cold region architecture under image consciousness.....	51
2.4 Summary	55

CHAPTER THREE

PRESENCE OF MATERIALITY IN COLD REGION ARCHITECTURE UNDER IMAGE PERCEPTION	56
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3.1 Materiality as the presence of matter image	57
3.1.1 Nature of material	57
3.1.2 Apparent properties and perceptual experience	60
3.1.3 Matter re-enchantment and perceptual atmosphere	63
3.2 Surface as the construction of imagination	65
3.2.1 Concept of enclosure and definition of surface	65
3.2.2 4-dimension decompositions and surface flow	68
3.2.3 Time-space and behavior experience	71
3.3 Place as the origin of order representation	73
3.3.1 Classical order and humanistic rationality	73
3.3.2 Sensory experience and reality rationality	76
3.3.3 Cultural environment and behavior pattern	77
3.4 Summary	79
CHAPTER FOUR	
PERCEPTION OF SPACE IN COLD REGION ARCHITECTURE UNDER BODY IMAGE	80
4.1 Body-space for cold environment	81
4.1.1 Perception of space	81
4.1.2 Apercetion of body	84
4.1.3 Embodiment of space	86
4.2 Body behavior for cold experience	88
4.2.1 Displacement of body	88
4.2.2 Structure of behavior	92
4.2.3 Reappearance of experience	97
4.3 Internalized space based on cold region culture	101
4.3.1 Order for being-in-itself	101
4.3.2 Order for being-for-itself	103
4.3.3 Order for being	105
4.4 Summary	108
CHAPTER FIVE	
CONSCIOUSNESS OF FIELD IN COLD REGION ARCHITECTURE UNDER ONTOLOGY BEING	109
5.1 Priori of perceptual field to describe cold region phenomenon	110
5.1.1 Foundation to perception of cold	110
5.1.2 Association to experience of cold	114
5.1.3 Recipiency and synesthesia of cold	118
5.2 Structure of behavioral field to deconstruct cold region perception	121
5.2.1 Structure of behavior	121
5.2.2 Organization of behavior	125
5.2.3 Stretching of field	128
5.3 Association of conscious field to extend cold region consciousness	132
5.3.1 Foundation of behavior	132
5.3.2 Unfolding of synesthesia	135
5.3.3 Reproduction of imagination	138
5.4 Summary	140
PART II	
ANALYSIS OF THE BUILT ENVIRONMENT: PUBLIC SPACE SCALE	
CHAPTER ONE	
INTRODUCTION	142

1.1 Background.....	143
1.1.1 Role of street furniture in public space.....	143
1.1.2 Trend of city life studies.....	144
1.1.3 <i>Sm²art</i> project.....	145
1.2 Research problem.....	147
1.3 Research aims and research objects.....	147
1.4 Research scope.....	148
1.5 Research significance.....	148
1.5.1 Street furniture layer.....	148
1.5.2 People life layer.....	150
1.6 Research contribution.....	150
1.6.1 Theoretical layer.....	150
1.6.2 Practice layer.....	151
1.7 Research overall.....	152
1.7.1 Framework.....	152
1.7.2 Content.....	153
1.8 Summary.....	153
CHAPTER TWO	
LITERATURE REVIEW: STREET FURNITURE AND BEHAVIOR PATTERN	155
2.1 Introduction.....	156
2.2 Street furniture studies.....	156
2.2.1 Definitions.....	156
2.2.2 History and development.....	158
2.2.3 Placement of street furniture studies.....	163
2.3 Street furniture usage context studies.....	165
2.3.1 City public life studies.....	165
2.3.2 People environment-behavior studies (EBS).....	170
2.3.3 Street furniture with city public space study.....	171
2.4 Development tendency of street furniture.....	173
2.4.1 Flexible.....	174
2.4.2 Adaptable.....	174
2.4.3 Sustainable.....	174
2.5 Research phases and scope.....	176
2.5.1 Research phases.....	176
2.5.2 Research scope.....	176
2.6 Summary.....	177
CHAPTER THREE	
METHODOLOGY.....	179
3.1 Introduction.....	180
3.2 Overview.....	180
3.2.1 Identifying and confining research direction.....	180
3.2.2 Establishing demand forecasting model.....	180
3.2.3 Establishing placement forecasting model.....	181
3.2.4 Case studies in Turin.....	181
3.2.5 Finalizing and proposing plan principles.....	181
3.3 Application and extension of the city public life study.....	182
3.4 Integration and reorganization of the strategy of street furniture plan of relevant studies.....	183
3.4.1 Conform to the city operation rules: city spatial configuration.....	183
3.4.2 Integrate people movement customs: walking, staying, and sitting.....	184

3.4.3 Respect people psychological needs in public: security, intelligibility	185
3.5 Case studies.....	185
3.6 Methodology structure.....	188
3.7 Summary.....	188
CHAPTER FOUR	
URBANSCAPE.....	189
4.1 Introduction.....	190
4.2 Urban layer: general concept.....	191
4.2.1 Definitions.....	191
4.2.2 Classification.....	192
4.2.3 Nature and characteristic.....	194
4.2.4 Creation.....	195
4.3 Urban landscape: review of the development of design theories.....	196
4.3.1 Before the 20 th century.....	197
4.3.2 The 20 th century 1900s-1940s.....	197
4.3.3 The 20 th century 1950s-1970s.....	199
4.3.4 The 20 th century 1980s-1990s.....	203
4.3.5 The 21 st century onwards (today and the future).....	205
4.3.6 Summary.....	205
4.4 Urban landscape: general plan principles.....	207
4.4.1 City layer: deeply study urban spatial structures.....	207
4.4.2 District layer: unity.....	208
4.4.3 District layer: identity and regionalism.....	209
4.4.4 Local place layer: people-oriented.....	209
4.4.5 Local place layer: time and movement.....	210
4.4.6 Local place layer: sustainable development.....	211
4.5 Urban landscape: urban space (open public space).....	212
4.5.1 Open public space in urbanscape.....	212
4.5.2 Importances and re-emphases of street.....	213
4.6 Conclusion.....	215
CHAPTER FIVE	
STREET FURNITURE PLAN STRATEGY.....	217
5.1 Introduction.....	218
5.2 Plan flow framework.....	218
5.3 City layer.....	219
5.3.1 Axis.....	220
5.3.2 Topological structure.....	222
5.3.3 Visible space.....	227
5.3.4 Conclusion.....	231
5.4 District layer.....	231
5.4.1 Configuration neighborhood.....	232
5.4.2 Function neighborhood.....	236
5.4.3 Streetscape neighborhood.....	237
5.4.4 Conclusion.....	240
5.5 Place layer.....	240
5.5.1 Types.....	240
5.5.2 Layout.....	245
5.5.3 Activities.....	251
5.5.4 Conclusion.....	255
5.6 Conclusion.....	255

CHAPTER SIX	
CASE STUDY IN TURIN	257
6.1 Introduction.....	258
6.2 City layer studies.....	262
6.2.1 Economic activities.....	262
6.2.2 Traffic activities.....	267
6.3 District layer studies.....	268
6.3.1 Configuration structure.....	268
6.3.2 Functional mapping.....	272
6.3.3 Streetscape impacts.....	273
6.4 Place layer studies.....	275
6.4.1 Space analysis.....	275
6.4.2 Layout analysis.....	280
6.4.3 Facility analysis.....	284
6.5 Conclusion.....	287
CONCLUSION	289
REFERENCE	292
APPENDIX	309
Appendix 1.....	310
Appendix 2.....	311
Appendix 3.....	313

PART I

ANALYSIS OF THE BUILT ENVIRONMENT: ARCHITECTURAL SCALE

CHAPTER ONE

INTRODUCTION

1.1 Background

The philosopher Maurice Merleau-Ponty once wrote: “We are not looking at this work, but at the world, it shows.” As a “work,” architecture has provided people with a fundamental way of cognition of the world, participating in the process of people’s comprehension of the world through architectural experience and inspiring the unity and topological evolution of material and spiritual dependence. The material worldview based on technology has risen in the industrial age, causing the tearing and divergence of spiritual space and physical space: architectural images become calculable and operable visual effects, and architectural design is immersed in dazzling formal language. At the same time, due to the rapid increase of image information under the support of science and technology, architectural “reading” has begun to linger at an apparent level, and the pursuit of the meaning and value of architecture is drifting away from people. Architecture as a discipline, the main research content lies in the opening and extension of the mutual construction of human beings, and the acquisition of its power must be through the authentic experience in the life world. From the perspective of social development, consciousness, as the content of contact and communication between different individuals, has the ability to travel through time and space. Buildings that freeze consciousness have been carrying the existence and meaning of human beings since their appearance (see Figure 1-1 and 1-2). They are one of the macro channels through which people discover the world. They contain different modes that are related to each other in the world. It is impossible to abandon the “initial raw material” and discuss one spirit and material. Only by regaining the meaning and standing side by side with the appearance can we go back to the origin of architecture.



Fig. 1-1 Parthenon (Acred, M.L.(n.d.))



Fig. 1-2 Pyramid of Khufu ([@Linkenlaoshu].(n.d.))

Of all the art form issues, thinking about existence itself is the most fundamental, and it is also the way to find a way out when the appearance collapses. Although computers can produce unusual and complex patterns and forms, only the human mind, memory, and imagination can give meaning to the material world (Pallasmaa, 2014). With the migration of the times, the questioning of the origin of architecture has been answered many times. Obviously, as the foundation of function and form, it does not lie in adobe or steel. When placed in the study of architecture in cold regions, the exploration of the origin of architecture in cold regions is by no means confined to physical resistance to cold climates or reveries about cold culture, but rather a comprehensive acceptance of multiple relationships of existence (see Figure 1-3).

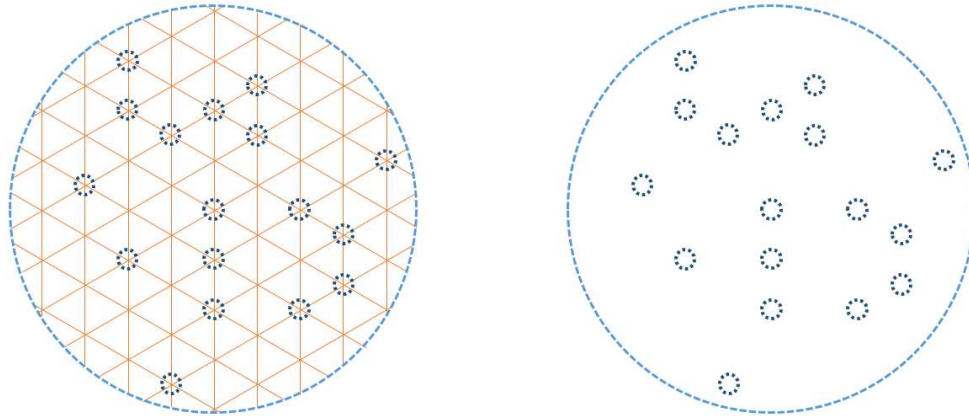


Fig. 1-3 Russell proposed that things were a synthesis of relationships. Objective facts could be expressed by a spatial network and knots as shown on the left, and the reality was a group of relationships to emphasize different subjective aspects as shown on the right. (Capon, 2016, p. 176)

1.1.1 Crisis originary of contemporary architectural design

(1) Cognition is lost in the image Since the failure of rationalism after World War II in the 20th century, architectural thought began to part ways with the mechanism. With various cultural practices, the media has instigated architectural creation, presenting a new trend of displaying reality as a spectacle and intertwining with image information. The traditional image-based architectural design and aesthetic interest faded with the sweep of the industrial wave and reborn in courage with the proliferation of technology, leading to a transcending pursuit of more novel and refined forms and perception of strange poses. The colorful representational language that emerges is the media-based mutation, inspiring architects to be full of enthusiasm for the attractive rendering world. Charles Jencks stated clearly in *Image Architecture, Incredible Power*: “A ghost is haunting the global village, the ghost of image architecture” (Jencks, 2005, p. 7). What it describes is that with the proliferation of types of visual media and the rapid advancement of digital technology, the transformation and characteristics of people’s cognitive methods: the role of appearance is infinitely amplified in the process of global economic expansion, and the value of meaning has also been unprecedented. Of dilution. Understanding architecture regards “seeing” as “purpose” and even “pursuit,” thus constructing a world embodied framework of “what you see is what you get.” Architectural design has changed from the past process of inspiring consciousness through images and turned to the superficial perception that succumbed to vision as a substitute for design goals. As a result, the advantages of the five senses of vision make the mental and spiritual world present a state of lack of design. The architectural aesthetic is up and down in the ocean of images, losing the attention and attraction of the public. Image, as the way of thinking and expression of architects, can be the starting point of architectural form, but it should never be the end of architectural existence.

(2) Being lost in technology With the significant improvement of people’s ability to control nature and the tremendous changes in social structure, technology has made continuous breakthroughs in architectural expression and has gradually become a contemporary architectural art tendency. Even a way of existence, following the “high-tech school” (High-Tech) once evolved into an unprecedented “paradigm” of globalization. By the 1970s, the once “impossible building” was realized, the boundary between reality and virtuality was blurring, and people seemed to have discovered a new way to materialize politics and power. However, while affirming the role of technology in promoting architectural theory and practice, we should not ignore that the abuse of technology has reduced architecture to a provocative representation of scientific

omnipotence. From the support of the former form to the form itself, what “technology first” implies is a flow of replacing the original thinking of architecture with the solution of architectural construction problems. At this time, the trend of blindly equating “high-tech” with “advanced” came along, ignoring and discarding the original value and meaning premise of technology in architectural problems. In this way, technology moved from behind the scenes of architectural design to the front of the stage, combined with the appearance and spectacle, and experienced a series of theoretical expansions. Its meaning went beyond the meaning of the building itself, making architecture the reality of technology. Architecture and technology have become the opposite ends of the cart before the horse in some “fashionable” designs.

(3) Thought lost in the matter From the orderly beauty of architecture to the simplification of minimalism, architectural design always revolves around realizing the understanding of beauty and the “preservation” of meaning through manipulating material levels. However, architecture has never been a tool for practicing various concepts. If the spirit is lacking, then the form will be worthless. In history, architectural ideas seem to have been continuously exported from a few architects to the public. Since the post-modernity of modern architecture has turned, irrationalism has risen, and architecture has rushed to a torrent of diverse and heterogeneous ideas in an instant. With the help of the times, many architects have become “victims of professional degeneration” (Norberg-Schulz, 2013, p. 45), constantly engulfing ideas with materials, creating endless new “isms.” Some doctrines cater to “thoughts,” while others try to express “feelings.” The task of bridging the original gap between contemporary architectural ideas and feelings has drifted away from the seemingly “method” from the original existing problem to the vacillation between form and function. Moreover, the “deconstructionism” that attempts to break the current order to trace its origin only shows the culmination of contradictions. The final result is nothing but the negation of all meanings. Architecture presents the original “stability and change” in the historical trajectory, but under the support of the rapid development of science and technology, it turns into “stimulating discoveries.”

In architectural cognition, relying on images and technology as tools, observing appearances has replaced deep reading. People’s “gaze” merely becomes a disseminated event, which is constantly translated and transcribed between various media, thus creating a “surreal” context, a mechanical and utterly artificial world whose roots cannot be traced. Today, when the material world is at its extreme, architects should see the collapse of architectural ideas hidden behind it. It reflects the past commendation of the materialization tendency to strip away the appearance and appearance to explore the conscious existence of architecture. It is also an in-depth reflection on the relationship between people and the world based on architecture. Furthermore, it reflects the society and society that architecture should be responsible for historical responsibility.

1.1.2 Dilemma of creation of China’s cold region architecture

(1) Absence of cultural consciousness Most cities in the Chinese cold regions are on the inland margins due to climate and geographical reasons, have relatively shallow historical accumulations and have not bred deep and systematic cultural awareness. For a century’s development, the urban architecture in the cold northeast region has experienced “intrusive” classicism and “immature” modernism, then leap forward to today’s complex and diverse directly (Mei, 2012, p. 20). The architecture in the Chinese cold region, as the comprehensive presentation of the human needs of the local environment, currently embodies people’s understanding of the place primarily focused on the inconvenience caused to live by some climatic factors, instead of being accepted

by people's minds and spirit from a moldable cultural role. Moreover, the design inspiration that can be drawn is relatively limited. In addition to the situational guidance and feedback resistance held by cold factors, it is always impossible to break away from the rough imitation of natural landscapes such as ice and snow. The poor understanding of the cold region leads to the innate deficiency of the relevant culture forming. Furthermore, the long-term economic and technological backwardness in the cold regions of our country and the obstruction of foreign exchanges have also severely hindered the development of cold regions. The material environment for current cold region architecture design has undergone tremendous changes. All fresh cultural thoughts and advanced technological concepts have intently flooded into the cold region cities' gates. Without systematic combination or reorganization, the immature cold region architectural culture blindly combined the external blowout information with an existing cultural anchor. At the same time, some architectural designers in the cold region, influenced by the cultural trend of spectacle images, begin to show enthusiasm on the feedback of the current aesthetic pictorial turn through form shaping from initial environmental fit. However, the culture displayed through architectural new representation still relies on the interpretation of surface images, which does not promote the deep cold region consciousness. People's emotional awareness of the cold region is blurred, resulting in the current cold region architectural culture is still in chaos, mixed and fuzzy.

(2) Crossover of excessive technology With the continuous development of technology and the pursuit of transcendence of the senses, architectural design in cold regions gradually tends to be made intentionally, which is challenging to move forward under the influence of formal paradox and presents the current thinking situation of over-focused on the architectural form: the architects work hard around the display of spatial entities. The integration of appearance, function, and energy-saving is considered to be the essence of architecture. The cold region architecture has become a tool in a comprehensive target system to pursue new hot spots one after another. Contemporary architectural culture is dominated by metaphysical materialism, falling into the value trap of using the material to define the meaning of architecture. Then, the digital progress brought about by various computer simulation technologies has created a new set of templates for evaluating and selecting buildings. All phenomena about the built environment in the perceptual world are gradually becoming a string of codes in the computer. Moreover, the cold region is summarized and abstracted as the infinitely extended information in the one-dimensional parameter space. The architectural differences in the interior space are disappearing under the influence of science, gradually flattening the world. The living space of the inhabitants in the cold regions is being pushed into a perfect black box separated from the environment.

Nordic architect Alvar Aalto had resisted this kind of orientation of application for image and technology instead of form since he was young. He was particularly scornful of the prophetic "formalism" that increasingly appears in America but is nothing more than a public pastime permeated with the taste of Hollywood. At the same time, he also despised what he called a "slave of technology" because, in his view, it was "impossible to create new forms out of nothing." (Schild, 1986, p. 226) Some famous architects preached that the new era meant technology became the skeleton of the building's existence, and images became the skin of the building's surface.

Nevertheless, a building with only bones and skin cannot become an actual building and make the architectural culture move forward. People feel overwhelmed by both a flood of colorful images and a mudslide of great technics and gradually lose themselves in the "fashion." It is fading that the inquiry on the originary of architecture. The architecture in the cold region is the complex human-oriented harmony of many factors

such as site climate, surrounding environment, regional culture, and characteristics of economic development. At the moment, it has been highlighted that the “contradiction” between the “in-situ” understanding of the originary of cold region architecture and the material presentation. The initial thinking of architecture has slid into out-of-control, which puts the cold-region architectural design in a dilemma of being instrumentalized and aestheticized.

1.1.3 Return of rationality of architectural consciousness with philosophical speculation

(1) Call from ethic The famous British poet W.H. Auden once praised the early modern architecture movement, which was like a blossoming spring, as a moment of “reverting from evil to righteousness and re-behavior.” In that era of rapid economic and technological development, the basic functional requirements of architecture have been maximized, and follow other sciences to move towards more refined measurement continuously. However, behind the dazzling world of images caused by various “isms,” it is clear that the promise of architecture to meet social expectations is far from being realized (Wilson, 2014, p. 9). Currently, architects’ imagination has got rid of the picture on the wall or even the virtual image in the computer. Then, after getting rid of technical shackles, constraining the architectural consciousness and how to solve this problem should be considered now. Obviously, people’s thinking should go deeper and farther. After all, only by breaking through all appearances can there be a chance to reach the essence of things.

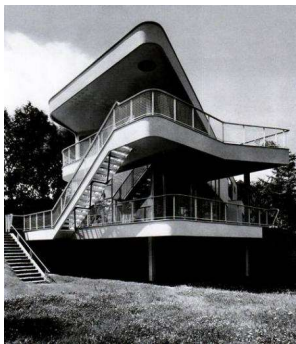
From the apparent perspective, architectural design is recalling the relationship between human-being and nature. This kind of description is precisely where the architectural origin is discussed by Japanese architects (Architectural Institute of Japan, 2012). Because the originary cognition of architecture is the ultimate interpretation of the fundamental purpose of architectural activities, in this way, all material garments have the foundation of their thought roots. At the same time, the spirit manifested through matter can also be so ethical. Otherwise, there will be buildings without souls that make cities look the same. People living in such an environment shaped by themselves will be separated from the most fundamental thinking, and the development of all consciousness will be out of the question. Therefore, the maintenance of ethical ecology requires continuous exploration and retrospection of the original depth of thought.

(2) Awakening of perception For a long time, people feel shocked to the soul when facing great architecture, and then, a certain deep level of consciousness is awakened. There is no way to find a corresponding explanation from “sturdiness, applicability, and beauty,” nor can they stop themselves from the deep and real touch from stone, wood, and concrete. Since the Vitruvian era, architects have begun to answer this thought, but it is difficult to be convinced that “symmetry, axis” can resonate and be confident. The dispute between pure empiricism and pure rationalism is always not disappeared and still today. Aalto believes: “there is nothing wrong with the practice of pursuing rationality in everything. The mistake is that the reasoning process is not deep enough... At this new stage of the modern architectural movement, we need to change the rational approach from the technical field. It is extended to the fields of humanities and psychology.” People have been looking for appropriate language to describe architectural consciousness. The description often stays in a specific picture: the Acropolis in the dusk, the stairwell of the Altas Art Museum At the turning point of the resting platform, the door courtyard of the Berlin Philharmonic Hall... It is not easy to obtain a good pattern even through comparison, summary, and data analysis. It cannot be denied that people’s cognition of the world is based on a particular experience of spatial form, which is not purely out of

thin air. As Aalto said, “there is no way to create something out of nothing,” but it could evoke everyone’s most basic emotion from the moment they were born. The field of experience has already existed before humans could produce language.

The field of experience is the most basic origin of a language, a feature commonly shared by humankind. Furthermore, the structure of this experience is the same as language, full of intentional expectation, memory, and the ability to communicate with each other. This most primitive state of mind includes spatial, emotional, and psychological components. Combining these components forms a code that projects mirror images onto people’s cognition and experience of the most basic form of architecture.

Moreover, what buildings can “touch” people is precisely those “images” that can resonate inside and evoke consciousness (see Figure 1-4), giving the static stone a dynamic vitality. Robert Venturi believes that architecture should be a tool for exchanging ideas, which is more dependent on feelings than poetry. It is like closing the door to architecture’s soul that refuses to talk about its experience and poetry. As a commitment to social sustainability, architecture is an artificial product of human existence. It reflects people’s thinking about the existing world, which serves as a carrier to solidify and spread the moment. Rational recognition is the premise of returning to a reasonable view and thinking about what architecture is. Paul Frankl once said: “visual impression, produced by the difference of light and color, is our most original concept of the house. People reinterpret this image as a form based on experience and define the spatial form of the house... Once we translate the visual image into a spatial concept surrounded by entities, we will interpret its purpose from the spatial form in the house. We will grasp its content and its meaning” (Hillier, 2008, p. 3).



a) Schminke House, (n.d.)



b) Day, (n.d.)

Fig. 1-4 The villa Designed by Hans Scharoun can call the association of Day from Michelangelo

(3) Foundation of philosophy The French philosopher Gilles Deleuze proposed that architecture was like a beam of light that cast philosophy from the altar of metaphysics to practical science, making philosophy a manifestation (Feng, 2013, p. 1). At the same time, the British architectural theorist John Ruskin also stated in *The Poetry of Architecture*: architecture should be entirely a product of thought, not a science composed of straight lines and circles. It should be “feeling more than rules,” “thinking beyond the eyes,” and use “the degree to cater to visual prejudice, triggers depth in thought” ... “architects are all metaphysicians” (Ruskin, 2014, p. 1). He rejected to treat architecture as the result of “function plus economy,” and clarified the long-standing architecture balance between “art” and “technique,” and then triggered the discussion on the attributes of “work” and “product.” When trying to strip away the appearance and discover the meaning of architecture from its origin, philosophical versatility is the basis for solving this problem and can make the answer conditional and systematic to find the

natural relationship between art and technology. Meanwhile, architecture has created a realistic carrier for the conceptualization or imagery of philosophy. In contrast, the architectural practice is also guided by philosophical concepts. As a result, the interactive influence between architecture and philosophy injects new strength into each other's development.

The German philosopher Edmund Husserl pioneered phenomenology in the early 20th century, called philosophy's basic idea. Furthermore, image consciousness appeared in his initial research as the enlightenment thought of phenomenology. Husserl tried to use image consciousness to answer the puzzle that has plagued European philosophy for centuries: the binary correspondence between seeing and feeling, perception and consciousness. It uses world-famous paintings such as "Water Lilies" as the fulcrum of philosophical practice based on the structure of image consciousness. The main intention of the boil down is: the subject and the object finally return to the original structure and actual occurrence of consciousness, and the object is judged by analyzing the appearance, and then the structure of consciousness generation is obtained. On this basis, he pointed out in his lecture in 1904: "The structure of image representation shows that it is more complicated than the structure of pure perception. Image consciousness is a kind of imagination, the ultimate goal of image perception and the original object." This description of the process of image consciousness is the theoretical basis for the deconstruction from the appearance to the originary after the artwork creation and was later applied by Martin Heidegger as a method of understanding the artwork. At the same time, the famous German thinker and scientist J.W. Goethe classified the essence of architecture as the incarnation of works of art, which also fits the current architectural aesthetic pursuit and spiritual appeal. Therefore, the phenomenology of image consciousness provides a possible philosophical methodology for the exploration of architecture originary.

1.2 Research development in foreign countries and China

1.2.1 Overseas research status

(1) Existence and space Phenomenological philosophy first entered the field of architecture around 1970, and the research of architecture phenomenology originates from exploring the relationship between man and earth in human geography. Yi-Fu Tuan once discussed how people perceive the environment, endow it with value (Tuan, 1990), and then study the experience description of different people in different places through phenomenological methods. It further explains the correlation and difference between "space" in the scientific sense, "place" in the humanistic sense, and the sense of placeness and puts forward the idea that people from perception through projection feel in place and finally internalize their perception concept of place. The essence of this concept is to realize the coexistence of thoughts and emotions through the experience of places (see Figure 1-5) and strive to build a humanist connection between the actual physical space experience and the "ambiguous" perceptual space experience. Edward Relph believes that the essence of "place" is a human-based response to "existence," mainly a kind of "unconscious" intention (Shen, 2016, p. 1). The foundation of a place is not a specific geographical position, nor does it depend on its functions by people in advance, nor does it derive from the mediocre worldly experience -- even though these are the foundations on which a place can be a place. The essence of a place is attached to the vast self-consciousness, and it is the sense of place that makes people feel the existence itself (Relph, 1976, p. 132). Intention makes the place the center of human existence and points all the materialized factors of place to the ultimate existence, which is both the cause and the result of place.

The phenomenological research in human geography before 1980, based on the philosophical vision of phenomenology to explore the inter-constructive relationship between human geographical experience and feeling “being in the world”, primarily focused on the humanistic category with the place, body, and experience as the core and turned geography from dry and traditional physical information to a vivid and rich interaction between people and the environment, regions, cities, landscapes, and even architecture. This tendency of humanistic regression is not just to abstract people into a bunch of experimental data or laws refined in accordance with reality but to truly and profoundly place people in the space. The relevant research has inspired the architectural originary and promoted its central research perspective to establish the sense of place from a general cognition to a fundamental human body.

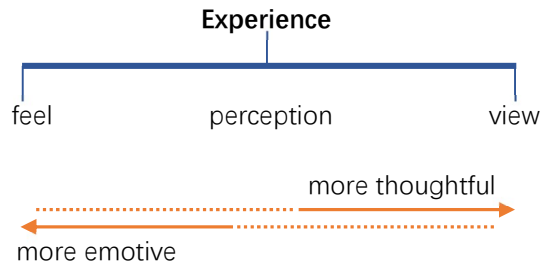


Fig. 1-5 The description of the relationship between emotion and experience (Tuan, 2001)

Under the profound influence of existential phenomenology, Christian Norberg-Schulz attributed architectural space’s existence directly to human beings’ existence and proposed that people’s behavior in the space was to orient in the space as a goal (Norberg-Schulz, 1985, p. 1). The construction of actual architectural space cannot happen on the drawing, which must be discovered and unfolded through users’ activities. Therefore, there is a unified cognitive relationship between the existence of the human and space. Moreover, the establishment of the relationship “scheme” (see Figure 1-6) requires the assistance of the media to be corrected and strengthened. This kind of method for constructing spatial cognition from a structural perspective is trying to fully clarify the essential differences in the developing world-image in human consciousness. It is more significant to understand architectural space than Siegfried Gideon’s thinking in Descartes’ Euclidean space. However, Gideon’s shift of the core of architectural theory research to the construction of space and time was very enlightening at the time and no lightweight. He pointed out that space was aim to describe the transferring process from physical images of the space to the emotional realm. It showed the reality of the spiritual confrontation between human beings and nature (Giedion, 1986). Obviously, Schulz absorbed the view from Gideon also noticed his lack in philosophy, furthermore, conducted a pioneering discussion on the philosophical significance of architectural space, focusing on existentialism, structuralism, and phenomenology and the display of its existence and the expression “meaning” of architectural symbols, which deeply concerned by many phenomenologists.

Architecture is a phenomenon of human self-recognition in time and space. Thus, architectural existence is understood as a meaningful and symbolic form derived from nature, humans, and spirit, integrated with others into the history of the meaning of existence (Norberg-Schulz, 2005). In this way, architecture naturally becomes the reality of the combined human history with the present and enables people to restore the phenomenon essence displayed by architectures from the historical relics. Inspired by philosophers such as

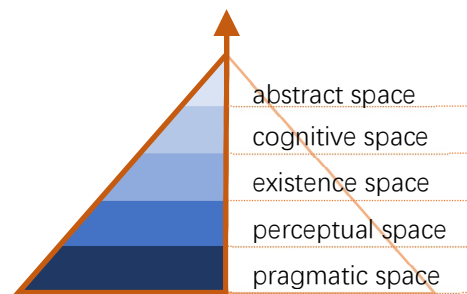


Fig. 1-6 five space schemes described by Jean Piaget

Heidegger, a group of architectural theorists, such as Schulz and Kevin Lynch, have tried to use “a sense of direction” and “a sense of identity” to build connective meaning to space and time according to the description of people’s space experience, and claimed that the foundation of architecture and urban space is to provide the shaping and protection of human spiritual space (Feng, 2013). The theoretical exploration of the integration of people and place in the field of built environment coincides with the humanistic reflection initiated by Tuan Yifu in the field of human geography. In addition, the discussion on the combination of human existence, space, and place with city, architecture, and built environment by a large number of architectural scholars has laid a research foundation for revealing the essence of architecture and achieved an era response to the spiritual call of human-centered existence and spatial significance.

(2) Poetics and ethics The poetics here is not the one proposed by Antoninades, but the one, based on the architectural language, attempts to gain the liberation of architecture between abstraction and reality through the ideological description of archetypes (Guo, 2011). As early as 1957, Gaston Bachelard stated that architecture was the poetics of dwelling, and space was the dwelling space of people’s consciousness rather than a container for accommodation (Bachelard, 2009). Besides, he defined human consciousness as the cognitive subject of architecture to realize the aim of design and construction. The cold elements, such as cold air, winter, ice, and snow, described in his book *The Poetics of Space*, profoundly influenced the architects’ spatial image of home. Otherwise, Bachelard used transsubjectivity of the figure in that book to discuss the internal origin of architectural forms. His repeated advocacy of spatial poetics attempted to project himself to the interior and center of the matter, and intended to the source and meaning of spatial experience. Furthermore, the inquiry to the “internal vision” actually was a widespread discussion of a cognitive psychological structure named “echo” in Europe at that time, through which people can feel a kind of simple resonance and emotional reflection beyond psychoanalysis and psychoanalysis. Even if without any substance as a medium, the viewer can feel a natural experience and use poetics to express the creation of existence. In exploring the relationship between architectural meaning and poetics, the famous architectural historian Joseph Rykwert (2006) took the meaning as the core content in his many studies. In his book *On Adam’s House in Paradise*, he stated that modern people took the source as an excuse to rethink the architectural essence and put forward a reverse spiritual appeal to the “rational” architectural thinking that prevailed in Europe at that time, emphasizing that the meaning of architecture lies in the communication between people and the place rather than being restricted to the material. Moreover, Rykwert made the architectural vision return to “Humanology” with attention to ethics and poetics from deeply trapped in the trend of “Le Corbusier’s New Five Points”. Under the influence of Husserl, Heidegger, and Merleau-Ponty’s thoughts, Dalibor Vesely mixed Hans-Georg Gadamer’s thoughts opened up a new situation for the development and application of phenomenology and hermeneutics in architectural poetics and ethics. He proposed that architectural poetics was not based on dreams or improvisations but could only appear with time in the vast synthesis (Vesely, 2004, p. 389), which required architects to see the living world from the current world to construct the architectural meaning in daily experience.

The theory of humanist architecture initiated by Vesely and Rykwert influenced many scholars and architects, especially the “Essex School” (Feng, 2013). In 1972, Daniel Libeskind discovered that in the reproduction of the fictional reality in the life-world, people could obtain the continuity of meaning and open the inherent historical dimension of the architecture to unmask its meaning. In the following half a century, their ideas inspired the entire pedigree of architectural theoretical research, including Alberto Perez-

Gomez, David Leatherbarrow, Mohsen Mostafavi, Peter Carl (Bedford, n.d.). Among them, Perez-Gomez had researched architectural representation since 1987 and interpreted the materialized copy of architecture as a kind of mechanical emptiness, and the actual architectural representation should be a poetic translation rather than an ordinary copy (Pérez-Gómez, & Pelletier, 2008). In 2008, he even indicated that “the people’s psychological needs for architecture were far more complex than technology and material. The essence of architecture was not a house relying on the form or function sense but people’s desire to dwelling and emotional satisfaction. Therefore, ethics and poetics were vital for exploring the spiritual meaning of architecture and the return to the architectural originary” (Pérez-Gómez, 2008). Karsten Harries, whom Heidegger also influenced, also sincerely agreed with this view.

Additionally, in the development of architectural theory and design practice, the Asian architect Kazunari Sakamoto has been trying to express ethics in the poetic architectural space, emphasizing that simple daily experience is the premise of understanding the intention of the built environment and life-world. In his creation view, poetics contrasts the bizarre reality of life with the arising social desires. He proposed that people could only get a sense of themselves by trying to close to daily life, and the meaning of architecture only when regarded as a part of people’s bodies (Guo, 2011, p.9). So, ethics reads the people’s demand for the feeling of their body’s existence.

(3) Presence and embodiment Scottish philosopher Thomas Carlyle English architect A.W. N. Pugin respectively predicted the spiritual and cultural emptiness and dissatisfaction in the second half of the 19th century. The unprecedented high technology and material life cannot respond to what architecture is. John Ruskin, whom Pugin significantly impacted, brought the spirit of architectural skepticism to the extreme. In his book *Stone of Venice*, he discussed the influence of social culture and human economic conditions on architecture. Obviously, Kenneth Frampton is also a fan of Ruskin’s architectural ethics. In his book *Towards a Critical Regionalism*, he talks about modernization sweeping the earth like an apocalypse; although it has wholly overcome the twists and turns of the local civilization, the architecture cannot return to the original. In *Study in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, Frampton once again explored the meaning of the human body. In this book, through the description of the auditory and tactile experience, he concluded that people must feel immersive to perceive existence. This architectural view has a solid conceptual color of empathy based on the human’s psychological and emotional cognition of the world, and therefore also embodies a physical and emotional, even conceptual and ideological standpoint. It is the empathizing formal perception and material expression that makes Frampton advocate that design should include the meaning of the basic perceptual level, which people have ignored for quite a long time, and then architects could realize the series of the perception of construction, place, and individual (Frampton, 2007). The importance of the body in architectural experience has been directly linked to the essence of architecture from the experience description of architectural space. In addition, both Steen Eiler and Charles Willard Moore have clearly emphasized the importance of the concept of the body and the experience in the cognitive process of the built environment in their works, foreshadowing the proposal of the architectural philosophy concept of body presence. Meanwhile, Juhani Pallasmaa, a friend of Frampton’s, in *Collision and Impact: Written Notes on Pallasmaa’s Architecture*, criticizes the blind abandonment of tradition when talking about the architectural presence and states that the purpose of architecture is not to understand but to put the embodied into the architectural phenomenon. Furthermore, he affirmed that architectural works obtained the reality of existence through the creator’s imagination at the beginning

of design, and the embodiment was the ultimate goal of architecture creation (Pallasmaa, 2014). This view has been fully reflected in his book *The Eye of the Skin*, which deliberately emphasizes that body perception is an embodied process of comprehensive architectural experience by constructing “tactile architecture”. The expression in the book draws heavily on the poetic philosophies from Merleau-Ponty and Bachelard on architectural space. Moreover, in the second chapter, he puts forward the concept of “figure of the movement”, combining, measuring, and shaping to make body and place to separate architecture from other art forms. Pallasmaa has published more than a hundred articles on the architectural originary, and his remarkable research results have attracted Stephen Holl’s attention and gained his response. In fact, Holl’s early experimental house was the practice of Heidegger’s existentialist phenomenology, and he completed the relevant theoretical work *Anchor* in the late 1980s. However, Holl’s design thought took another turn after being influenced by Merleau-Ponty’s theory of phenomenology of perception. In the Japanese magazine, A+U’s unique issue, *The Problem of Perception: Phenomenology of Architecture*, Perez-Gomez, Pallasmaa, and Holl jointly discussed the relationship between human body perception, experience, and architectural cognition. Since then, Hall had more and more phenomenological thoughts on body and perception in architectural theory and design (Pallasmaa, 2012, p. v). In 2000, he published *Parallax*, which marked his later poetic experience of architectural creation.

In addition, Marco Frascari was impacted by both semiotics and phenomenology, and his studies involved the body, the senses, and memory. In *Thinking Architecture* and *Architecture Atmosphere*, Peter Zumthor also launched a series of discussions on the mutual structuring relationship between human perception and architectural cognition. He emphasized that the body’s memory was the starting point for people to experience architecture, and the breath and touch were more likely to trigger the previous association of presence (Zumthor, 2010, p.32). Architects, concerned with architectural philosophy and architectural poetry, generally agree that architecture should perceive reality from the perspective of the human body and thus establish the mental projection between human and architectural elements.

Norberg-Schulz, influenced by Heidegger’s phenomenological theory, still lacked the understanding and speculation of deeper philosophical thinking. Though he put forward the architectural originary laid on people’s existence experience and could construct the space by extracting existence space elements, the “existence” was essentially different from the “existence” from Heidegger: the former analyzed the experience itself for present existence, but ignored the experience and imagination in the presence of the role of cognitive structure; however, the latter’s “existence” was based on the existence and presence of human beings, considered as the precondition of presence. The way of human existence in architecture should start from architectural experience and manifest in architectural sites. When confronted with the loss of architectural spirit under the authority of rationalist discourse, architectural scholars and practitioners in the field of ethics and poetics, derived from Heidegger’s concept of “human poetically dwelling”, emphasize that architecture should respond to the expression of humanity and emotion in addition to its function. However, many architects euphemistically adopt the metaphor in practice, making the information conveyed by them too obscure. The lack of readability directly leads to the audience’s confusion and makes it challenging to reverberate and means that the spiritual appeal that the architect wants to convey also fails. In this regard, Rykwert once suggested that the basis for decoding the “metaphor” in architecture should be the face-to-face interaction between people and architecture, that is, the symbol of human nature. Foreign scholars’ and architects’ discussion of the meaning and purpose of architecture has gradually shifted from theory to practice. Space and place have become

the main issues of the object study in architectural philosophy and focused on the architectural existence from poetics, ethics, embodiment, and presence.

Foreign countries have not taken the philosophical theory category of cold region architecture as an independent subject to study. In addition, most cold regions in foreign countries are economically developed port cities, and the problems presented in the architectural design are quite different from those in China. Besides, Northern European countries such as the Netherlands have always been the creative frontier of post-modern culture and artistic trends. As a result, many excellent architectural works have emerged and developed into regional architectural landscapes with their unique styles.

1.2.2 Domestic research status

(1) Phenomenology and architecture Since the 1960s, Chinese architectural theorists have absorbed Western philosophy to rebuild the local architectural theoretical framework. Especially after borrowing deconstruction and post-structuralism ontology, cultural philosophy and cultural theory have become the core ideas of the development of the architectural theory (Peng et al., 2009, p.8). In the mid-1980s, phenomenology was gradually introduced into the field of architecture research in China, and after that, it was paid attention to by the Chinese philosophy circle and developed its related theoretical research. In 1992, *Introduction to Architectural Phenomenology* was edited and published by Ji Tienan, including four parts: “*Theory*”, “*Place*”, “*Architecture*”, and “*Environment*”, with the excerpted papers of the first Architecture and Phenomenology Seminar in Taipei (Ji, 1992, p.18). Many philosophical articles from phenomenological scholars, including Husserl, Heidegger, Merleau-Ponty, have been translated and published in “*Theory*”. The rest of the sections correspond to papers in different application fields of phenomenology, such as Tuan Yifu, Thomas Thiis-Evensen, Zhu Wenyi. This collection is an early classic of China’s phenomenology and includes the study of architecture and phenomenology. Affected by this, architectural phenomenology temporarily became a frontier hotspot of Chinese architectural theory research in the late 1990s, providing a new methodology for analyzing the origin of architecture at that time. At the Phenomenology and Architecture Seminar” held in Suzhou in 2008, the architectural theorists and philosophers who participated in the meeting delivered relevant keynote speeches and articles on Heidegger’s architectural thought, focusing on the ontology of architecture, regarding the meaning of construction as the fundamental way of human existence. At that time, the reflection on architectural experience has become the essence of architectural phenomenology. At the beginning of the 21st century, domestic research on architecture and phenomenology was mainly according to the theoretical works of foreign architects and philosophers (see Figure 1-7), which led to related discussions. Wang Tan, Yin Peitong, Shi Zhiming, Sun Zhouxing, Shen Kening, Wang Junyang, Fang Hai, and others became the first group of scholars who made architecture and phenomenology mutually constructed and gained a more pioneering understanding through international exchanges and cooperation. In the development of architectural theory in China, architectural phenomenology is a method both to explain architectural behavior and enlighten design. At the beginning of phenomenology entered the study of architectural theory, Heidegger’s existentialism and Schulz’s architectural phenomenology provided the theoretical cornerstones. After the 21st century, Merleau-Ponty’s perceptual phenomenology collided with architecture and provided the current theoretical development direction around the body--space. Later, there was a gradual increase in the study of phenomenology-related architectural theorists, such as Chen Jieping on Holl, Liu Dongyang on Zumthor, He Weiling on John Hejduk. At the same time, the application of phenomenology in China’s architectural practice is also gradually improved, such as

works from Liu Jiakun, Wang Shu, and other architects.

(2) Ontology and art Since the 1930s, the western architectural theory has gradually turned from the “ism” debate to the interpretation of architecture ontology and its artistry, and then this trend of thought spread to China. It has become a top priority of putting the artistry of architecture in the intended purpose to realize the premise of comprehensive and essential cognition of architecture (Du, 2003). In the early 1990s, Zheng Guangfu published a series of articles entitled *Architecture is the Misconception of Aesthetics*, which triggered a debate on architecture, aesthetics, and art (Chen, 2000). In 1999, Professor Zheng added a great deal of architectural philosophy in his book *Revolution in Architecture*. In the article *Ontology of Intrinsically Generated -- Rationality and Emotion in Architecture* (Part I), Bu Zhengwei concluded that as the container of life, architecture was not only composed of material but also forged by spirit. Therefore, the originary and nature of architecture are essential cornerstones to construct the bridge of modern architectural theory” (Bu, 1996). For architecture, the ontological discussion on the mutual dissociation of reason and sensibility, material and spirit, has become the most complex philosophical topic in the Chinese architecture field since the 20th century. As Academician Qi Kang (2012, p. 106-107) said, “architectural theory should include the study and discussion on the ‘ontology’ of architecture. Moreover, there is a common ontological consciousness in human architectural activities.”

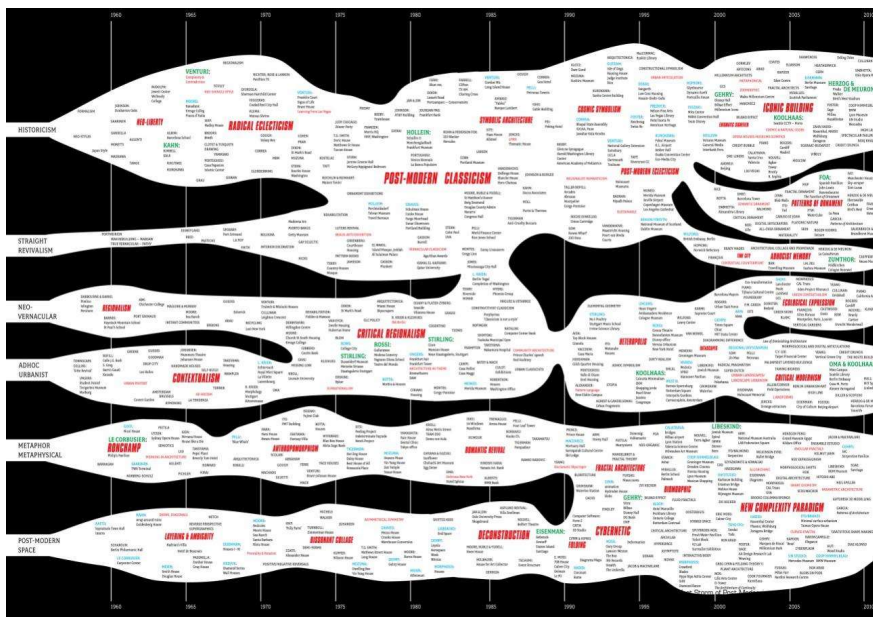


Fig. 1-7 The diagrams of Late, Neo, and Postmodernism (Jencks, 2015)

In China, there are four tendencies on the relationship between architecture and art: (1) architecture is art; (2) architecture is a practical art; (3) architecture is both science and art; and (4) architecture is not art (Chen, 2000). As far as architectural ontology is concerned, the essence of architecture cannot be away from artistic reality. From Liang Sicheng’s “art synthesis theory” to Wu Liangyong’s “science and art are equal” to Dai Nianci and Qi Kang’s “architecture is the combination of technology and art”, they all express that architectural science and art are closely related and promote each other. To understand the architectural originary in China, theorists cannot do without the ontology analysis of architectural artistry, but its development is not continuous. Since the founding of the People’s Republic of China, many Western architectural technologies and trends of thought have flooded into, instead of experiencing the natural process of technology and

art stimulating each other, and realized the division and rule of art and technology. In today's rapid development of science and technology, Chinese humanities are relatively lacking, and the architectural discipline is also facing the same problem. While blindly pursuing higher, faster, and more robust, it is necessary to integrate artistic ontology into the existing technical ontology to realize the cognition of the existing system structure of the architectural theory. As a draft of phenomenological discussion, the essence of image consciousness is that it originates from comments on artworks and structural discussions expressed in painting, with many works centered on the discussion on art ontology and originary. Professor Wang Yuechuan's *Art Ontology*, Professor Cheng Zhongying's *Ontology and Explanatory Aesthetics, Literature, and Art*, and Professor Yan Zhaozhu's *The Foundation of Philosophy and Aesthetics*, published in the past five years, all emphasize the subject-object relationship between people and art. The tremendous significance of art lies in its thematic impact on people, so the search for the origin of art cannot be divorced from human a priori and feelings. Theories of art and architecture in China have flourished over the past two decades. Art theorists turned their attention to the essential core of art. As one of the eight major categories of art, architecture, with Western thoughts, presents a shift from the original thinking about material and form to the original contemplation of architecture.

In China, the research on cold region architecture mainly concentrates in the Northeast. The research team led by Professor Mei Hongyuan from Harbin Institute of Technology has deeply engaged in this field for many years. In the past 20 years, they have created more than 100 pieces of cold region architecture works, published 51 master's theses and 19 doctoral theses. In the book *Cold Region Architecture*, Professor Mei Hongyuan described the difficulties and challenges faced in the cold region and put forward the originary of "three characteristics" for relevant design to return to the originary of creation (Schild, 1986). However, it has not been found that works directly involve image consciousness in cold region architecture theory. The concept of the fragment appeared in the papers of the philosophy work, which primarily focused on the application of macroscopic philosophy to prove the experience cognitive relationship between people and architecture lacking in analysis on the current consciousness structure of the understanding image in the background of phenomenology or relevant cognitive procedure of the architecture, which is the disjunction between theory and practice.

1.3 Research purpose and research significance

1.3.1 Research purpose

(1) Supplement of the existing theoretical framework of cold region architecture

Half of Chinese land is located in the cold region and has special economic conditions and social and cultural backgrounds. With the turn of technological innovation on scientific research in the construction industry, most of the theoretical research on the design of cold region architecture focuses on the technology and the corresponding design strategies to protect the buildings or people from the cold climate. However, technology can never answer architectural questions in isolation or replace meaning and poetry (see Figure 1-8). On the one hand, China has developed the theory of architectural cognition for more than thirty years. However, there is no relevant deep analysis or thoughts for the particular situation of cold region architecture. The practice of architecture in the cold region presents the parallel situation of technology and art without organic interweaving. Even though part of the research involves more or less, it fails to answer the core issue of "what cold region architecture is".

On the other hand, although some architectural practice projects stand in the cold region, it is difficult to say that they are "rooted" there, and the occurrence of this

phenomenon also presents a vague and challenging attitude. In the turbulent flow of excessive technology, the concern and inquiry to the originary of cold region architecture are gradually disappearing. However, it should not be lost or ignored that the embodiment and body-centered in cold region architecture. This paper proposes that the originary deconstruction of cold region architecture is a meditation on the “what design is” and “why design is” after the blind following with data and practice.

(2) Call to the humanism thinking of cold region architectural view What should be vigilant is that hidden in the theory of technological omnipotence behind the technological trend of thought. The current society faces a profound cultural transformation: visual symbols have become the dominant ideology over linguistic symbols, and images have replaced language as the cultural subject, the coming “world image era” predicted by Heidegger and other philosophers in the 1830s. Meanwhile, during the nearly 40 years of architectural manufacturing, the visual carnival has brought about the image crisis, and aesthetic generalization flooded into mass trends. From the aesthetic blindness, we can get a glimpse of the impetuous view of architecture at present, and the gravity of the void of architectural spirit caused by the absence of the original is also becoming increasingly severe. Fortunately, a group of architects have woken up from the annihilation of images and tried to reconstruct the meaning of architecture by going back to the originary and facing the relationship between people and place as the core issue in architectural theory and design. In the long run, such a narrow interpretation of architecture will invisibly weaken people’s appeal to the sense of being in the world. Losing one’s sense of place can leave one spiritually unsettled. The habitual technological dependence will eliminate geographical and time isolation, but at the same time, people will lose the enormous morphological database reserved by difference and the opportunity of harmonious development inspired by difference.

Architecture is the reality of human existence and carries the social and historical concepts of times. The reflection and introspection on the originary of cold region architecture is never a whim cultural phenomenon but a theme that should run through in the study. Architecture is the mirror of human self-examination; all reflection at any time is necessary and should be parallel with practice. This study starts from the view that architecture is a condensed ideology and then deconstructs the formation process of cold region consciousness through the appearance of cold region architecture to put forward the return to humanism to understand the world.

1.3.2 Research significance

1.3.2.1 Theoretical significance

(1) Fuller to consciousness construction of cold region architecture from method layer Hegel (1979, p.28) claimed that “architecture was one of the earliest arts” at the beginning of *Aesthetics*. Nowadays, the acquisition of the artistry of architecture has been inevitably affected by image culture: image has become the start of the recognition and deconstruction of architecture. It is the required method to understand the deep meaning of architectural images in the cold region and the vital link to analyze the generation of consciousness of architectural images in the cold region. Exploring and revealing the image consciousness structure generated during experiencing cold region architecture is the critical method to understand the deep meaning of its image and a vital link to analyze the generation of the image consciousness of the architecture in the cold region. It provides a relatively complete basic structure and logic for this study that both the philosophical theory of image consciousness and the method of its application in art appreciation analysis. The application of image consciousness to analyze the originary of cold region architecture could make this research obtain the profound relationship

between architecture and people in a specific place from the era and society's stance and transfer the spiritual meaning of construction.

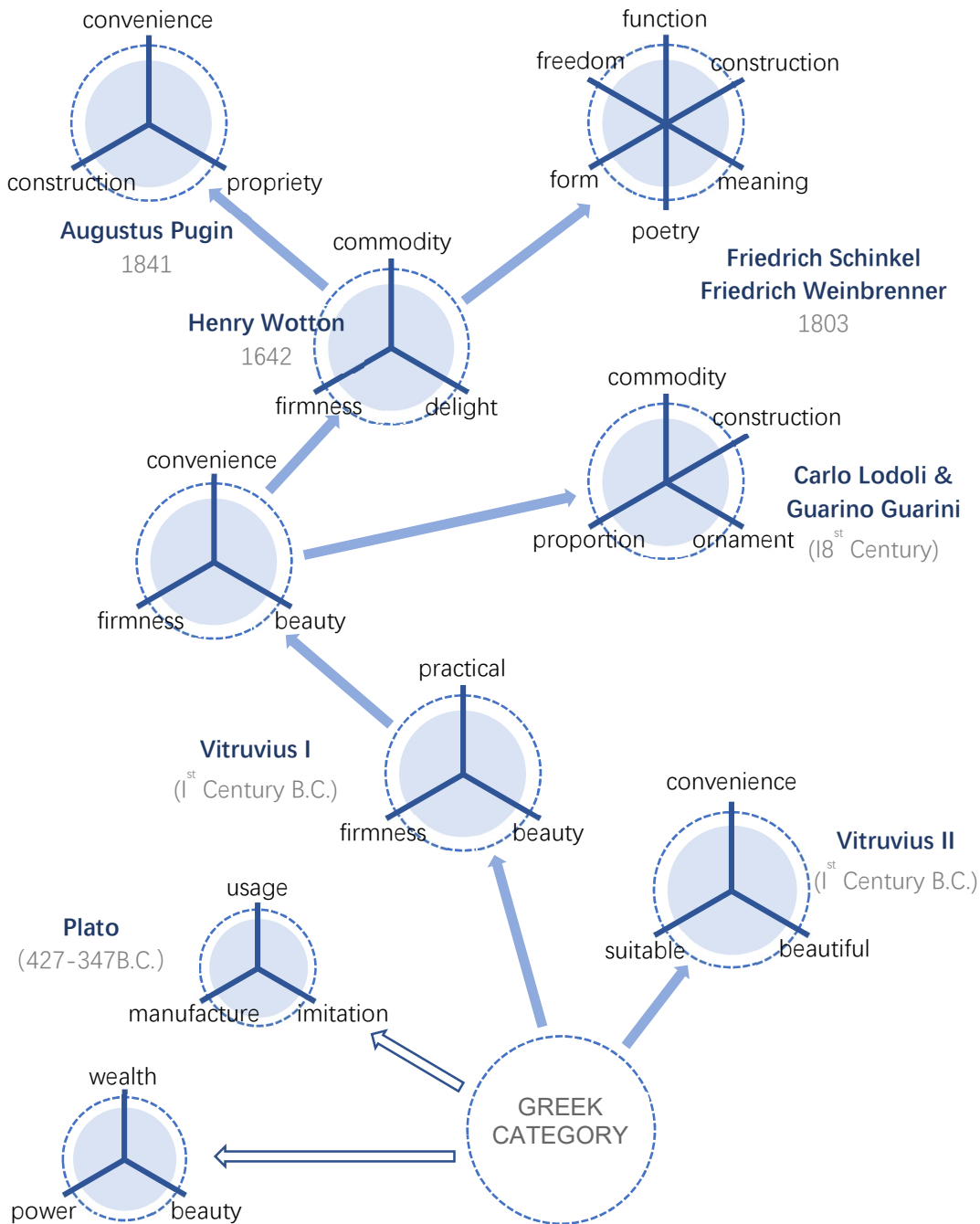


Fig. 1-8 The change of architectural research (Capon, 2016)

(2) Analysis of the construction culture of cold region architecture from framework layer As a carrier of cold region culture, the architecture there reflects the characteristics of the time from different aspects, so it is a critical way to deeply understand the architectural phenomenon in the cold region to investigate contemporary architecture from the perspective of social and cultural background. Thus, for example, all the “visual correction” in Greek classical architectural aesthetics, Adolf Loos’s “decoration is evil” in modernism, and Mies’s “less is more” all start from the attention to architectural images and turn to the consciousness culture behind it. As a result, the

analysis of consciousness of cold region architecture is a profound exploration of the cultural phenomenon, which enables the thinking on the cold region architecture expanded and extended in the fields of philosophy, sociology, aesthetics, comparative art, semiotics, communication, and other fields.

(3) Support for the thinking of cold region architecture from theoretical layer

Faced with the image bubble caused by an aesthetic generalization and elite culture depression, architects should consider the design development and innovation mode of cold region architecture from the interior. It is a kind of thinking that does not encourage a blind return to history but attempts to interpret the ontology in cold region architecture based on epistemology. However, now the mass trends and mainstream consciousness almost determine the final form of architectural expression and, at the same time, diminish the individual value orientation of architects. Therefore, the originary deconstruction of cold region architecture from the philosophical perspective has an extensive significance: neither ignore the times to return to the tradition blindly nor drift to cater to be the present, try to put cold region architecture in a wide theoretical dimension and think the originary with the architecture and region as anchors. Moreover, it should also clear that the development of architectural design in China's cold region needs to continue to expand the theoretical space and perspective to obtain the basis for the balanced pattern of complex material needs and spiritual needs and to provide specific assistance and inspiration for the exploration of "Chinese style" and "cold region style" in the context of globalization.

1.3.2.2 Practical significance

(1) Provide a narrative framework for the creation In the traditional architectural design, there is often a relatively vague thinking process: from the abstract needs to the evolution of concrete architectural form. This step grasped by "inspiration" has caused different architects to propose completely different design schemes under the same task. This study explores the cognitive procedure of cold region architecture from image to consciousness, achieves matter anchor and echo structure of constructive cognition in the cold region from explicit material, space, and place, and supplies a narrative structure and logic for views' understanding, which could be the reverse reference for architectural creation. The operation on the material level in the cold region architecture design process turns to the narrative operation on forming the viewer's consciousness. In such a framework, the single "thing" is replaced by "thingness", which can effectively avoid the trap of a fixed stylized image in architectural creation.

(2) Propose a people-place perspective for design The meaning of architecture is to unfold the relationship between people and place. Cold region architecture aims to reflect the view of the environment and survival of residents in the cold region. Therefore, the originary deconstruction of cold region architecture discusses the interactive relationship between the residents and the place and provides a people-place perspective for architectural design, which is an original method. In the cold region, architecture is the reality of people's thinking and consciousness of the environment, and it is the concrete phenomenon that the environment is internalized in the body and projected to the outside world. Therefore, the practice of cold region architecture presented under such a creation basis starts from the subjectivity of the architectural viewer and realizes the real regionalism, rather than drawing from the subjective imagination of the architect.

With the development of science and technology and the rapid development of computer image technology, people's consciousness is increasingly affected by appearance. In daily life, the spatial-temporal "interval" channel of "image" has opened to the public, and "image consciousness", as a change of thinking mode, has exerted an

enormous influence on contemporary architectural design (Mei, 2012). China's cold region architecture theory and practice, impacted by environmental factors and aesthetic trends for a long time, shows an irrational development of adapting to cold and following fashion on one side. In the name of innovation, the design method, accompanied by dazzling interdisciplinary theories, has made the cold region architectural design move from one kind of limitation to another. The birth of the trend of thought itself does not have anything to blame, but it is worth pondering that the fashion blind followers subsequently generated. This study aims to deconstruct the ontological structure of architectural consciousness through epistemological interpretation to sort out the architectural physical appearance to the internal consciousness construction of the subject's body and propose a way of thinking about the theory and practice of cold-field architecture.

1.4 Research overview

1.4.1 Concept

(1) Image consciousness It refers to the consciousness associated with images with essence to “analyze the meaning of the image, by asking the meaning of the image to reflect on the subject, that is, the process and the way the viewer views the image and the experience of existence” (Xiao, 2011). Husserl first proposed in Text No. 1 of 1904/1905, aiming to establish a cognitive structure related to artistic works and perception, also known as the phenomenology of image consciousness. In Husserl's philosophical system, image consciousness is one of the theories of Husserl's early exploration stage of phenomenology. The research objects include vision, touch, hearing, and text, and in a broad sense, all representative objects are called “images” by Husserl. The theoretical support of image consciousness includes triple objects, triple “*auffassung*”, and the triple structure emphasizing the structure of consciousness. Furthermore, as an epistemological method, image consciousness explains how to respond to the image theme by examining the meaning of image perception. It is a theory of the intentional formation of consciousness with three dimensions: objectivity, subjectivity, and subject-object combination. As a method introduced in this research, image consciousness is much more than the narrowly defined and theoretical concepts put forward by Husserl. Instead, it takes Husserl's image consciousness as a blueprint and puts the question of “image meaning” on the phenomenon. In the general background of academic development, through combing its evolutionary context, seeking anchor points that are more compatible with the original cognitive structure of cold region architecture to establish an explanatory nature from its images to the consciousness structure.

(2) Cold region architecture The international definition of the cold region is a region with significant winter environmental characteristics with another name winter city. Cold region architecture is a building in the cold region with significant winter climate characteristics. Furthermore, the cold region ranges according to an average January temperature below 0°C and above 45°N. The research scope of this study focuses on areas with significant winter environmental characteristics, which refers to the temperature is lower than 0°C for an extended period in the year with the ground covered with snow and the water frozen. China's corresponding cold regions include Heilongjiang, Liaoning, Jilin, Beijing, Inner Mongolia, Xinjiang, Gansu, Ningxia, Qinghai, Tibet, and other provinces and municipalities (Leng, 2009, p. 4).

(3) Originary The Greek word “*arche*”, formerly translated as “the first base”, defined by early Greek philosophers as the basis of all things in the world, is the first sign of the ontology and then gradually approaches the discussion of being (Yu, 2012, p. 20; Heidegger, 2018, p. 1). The research object of this study is the originary of cold region

architecture, which means the inquiry about how architecture exists and what architecture is in the cold region.

1.4.2 Content

(1) Cognitive structure of cold region architecture Building the cognitive structure system of cold region architecture by integrating Husserl's cognitive construction of image consciousness and phenomenology of image consciousness to provide an adequate phenomenological basis for understanding experience and object of cold region architecture consciousness (Ni, 2001), and a corresponding theoretical basis for the originary deconstruction of cold region architecture.

(2) Deconstruct cognition of cold region architecture The discussion on the originary of cold region architecture reflects the ontology of architecture, which needs an answer from epistemology. By introducing the cognitive structure path in the phenomenology of image consciousness in the epistemology, the cognition of cold region architecture could be deconstructed from the object perspective, the subject perspective, and constructed corresponding cognitive structures to obtain the originary deconstruction.

(3) Reconstruct cognition of cold region architecture The reconstructive cognition is the reverse procedure of the deconstructive cognition of cold region architecture that attempts to reconstruct the cognitive object, cognitive body, and cognitive carrier from the consciousness of cold region architecture to grasp the architectural ideology and essentially refers to the thinking process for design.

1.4.3 Method

This article adopts the epistemological methods and theories of the phenomenology of image consciousness to deconstruct the originary of cold region architecture. According to the characteristics of the subject, the relevant research methods as follows:

(1) Phenomenological description As the core method of this research, it mainly revolves around the essential restoration, intentionality, and phenomenological reflection. The essential restoration uses associated changes to reveal the invariable or essential connotation of a particular phenomenon. The intentionality theory takes consciousness as the main content of phenomenology, constructs structure through the generation of intentional behavior of consciousness, and then clarifies the procedure phenomena internalized into consciousness and externalized projection from its construction. In this study, the intuitive reflection and restoration of phenomenological essence and the structure of meaning correspond to the originary deconstruction and reconstruction of the cold region architecture: the restoration, as "deconstruction", withdraws from the natural attitude and enters the subject level of the transcendental self from the daily life world; as a "reconstruction", meaning structure refers to returning from consciousness to the life-world, as it manifesting itself in consciousness. From the view of most scholars, the phenomenological method is a description method rather than an explanation one. However, unlike quantitative research (see Table 1-1), phenomenology emphasizes exploring the construction process of things by describing and analyzing the world with consciousness as the medium.

Table 1-1 Comparison of phenomenological and quantitative studies (Xu, 2008, p.21)

	Phenomenological research	Quantitative research
Method	Descriptive method	Experimental method Investigation method
Aim	Distinguish	Causal analysis
Methodology	Reflection	Calculation Quantification

Degree of cognition	Go deep into the things	Limited to the outside of things
Cognitive basis	Experience Feeling Intuition	Data
Comprehensiveness	Comprehensive survey	Partial, fragmented analysis

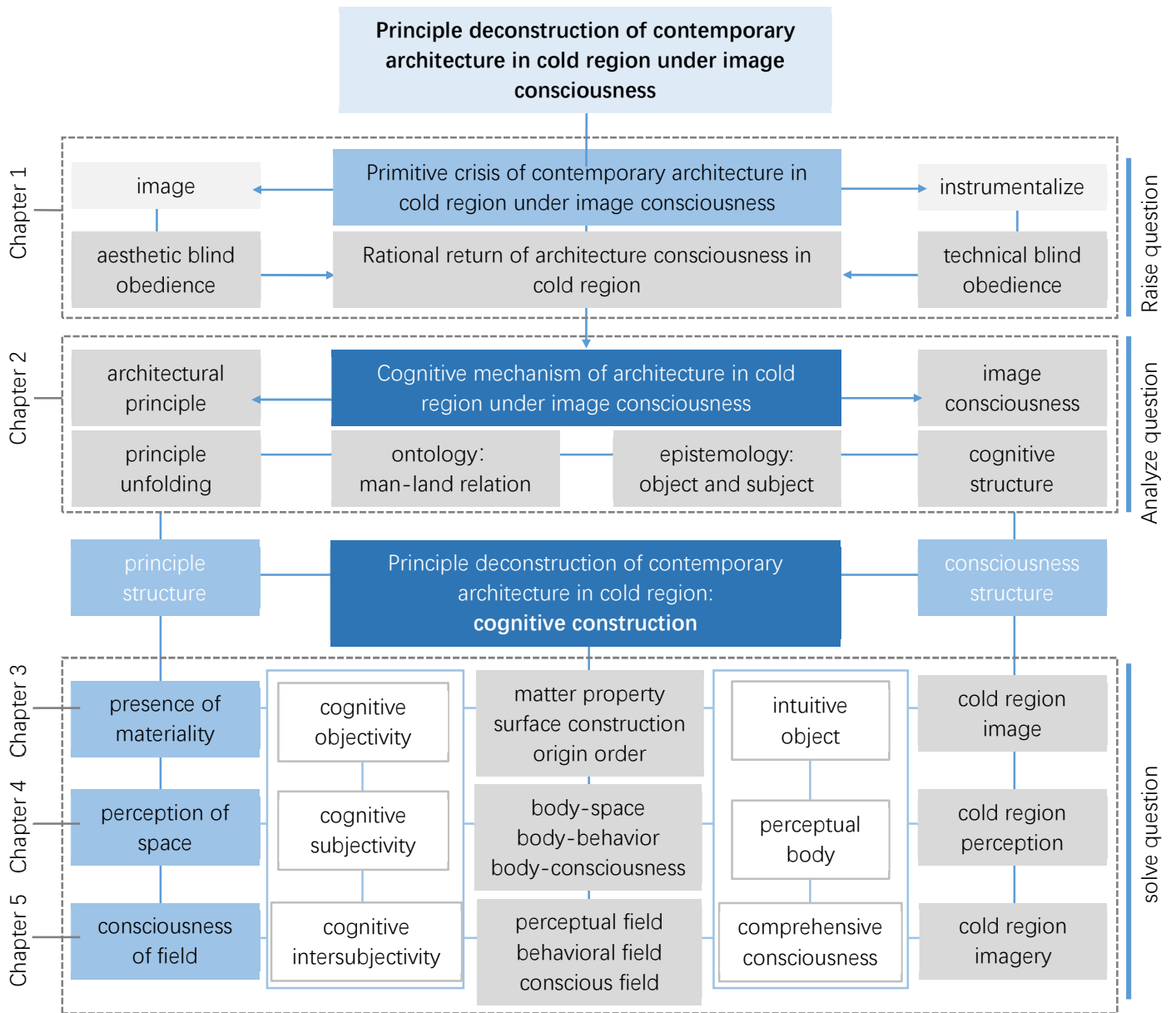
(2) History method It is one of the most widely used research methods in this study to explore the interweaving and mutual promotion of architectural thoughts and philosophical changes. Guided by the timeline, it can combine different stages, such as generation, development, evolution, and termination. Moreover, through comparison, induction, and other means to seek the nature of things, the law of development, and other research conclusions.

(3) Semantic analysis It takes words as the unit, regards the process of language generation as the process of social construction, and obtains the location and the shift of the language in social cognitive structure by exploring the analysis on the meaning and construction among words. This research clarifies the research concept and scope by the discrimination, including the relationship between ordinary and archetype, image and imagination, and matter and material, and the structures relation, covering image and consciousness in image consciousness, and cold region and architecture in cold region architecture.

(4) Case study It is to combine the in-depth sampling of the phenomenon of a specific event, process, and activity to obtain a detailed understanding of the unique and general, quantifiable and qualifiable, representative and original characteristics of things. There are three types of case studies involved in this research: (a) intrinsic case study: to conduct an in-depth discussion of a particular case for essential research; (b) instrumental case study: to obtain deep insights on a specific problem by decision-oriented study; and (c) collective case study: to summarize brief symbolic impression through a series of character studies. The above three types are all to effectively illustrate and understand the occurrence or existence of a phenomenon.

(5) Hermeneutics method It is the interpretation of the author's inner world and related personnel. This method requires the ability to interpret the purpose and meaning of text hiding. Phenomenology is the reverse process of hermeneutics. This thesis introduces some scholars' works, opinions, and narrative texts to restore them to the current interpretation of experience and speculation.

1.4.4 Framework



CHAPTER TWO

ANALYSIS OF THE ORIGINARY OF CONTEMPORARY ARCHITECTURE UNDER IMAGE CONSCIOUSNESS

2.1 Speculation of the originary of contemporary architecture

The research on the architectural purpose belongs to science, and the discussion of the architectural meaning belongs to philosophy. All the problems that the architecture reveals present the dual structure of science and philosophy. However, on the one hand, what needs to be considered urgently in current architecture is how to coordinate the nearly unlimited construction capacity with the limited natural endurance, that is, how to use architecture to adjust the people's lifestyle and replace human management with object management. On the other hand, it is how to deal with the so-called counter-mainstream values of people, society, and life to respond to questions about value and meaning. These thoughts are not the "reappearance of resistance" to resist for the sake of resistance, but the almost "compulsive" deconstructive reflection to achieve the "landing" of the inner order. This flow has led to contemporary research on cold region architecture, showing an almost paranoid focus on technology and a blindly flattened decomposition of cold region culture. The fragmented analysis did not make the outline of the cold building clearer and brought new problems: the purpose became the coat of the wrapping technology abuse, and the form occupied the meaning. The human spirit had nowhere to dwell. Glenn Murcutt once proposed that the meaning of contemporary architecture has been emptied by style and doctrine, should re-grow from the culture in itself, its environmental and social factors (Drew, 2000) to reflect a comprehensive inter-relationship between people and the built environment. Architecture presents a way of people's being in the world.

2.1.1 Development research on the architectural originary

2.1.1.1 Basic connotation of architectural originary

The originary, beginning with the Miletus school, was used by early Greek philosophers to describe the most basic unit that makes up everything. The Greek word is "*arche*," and the translation is beginning and basis. The study of "originary" is called the forerunner of ontology, and it is gradually approaching the discussion of "being", which is to attribute the existence of the world to specific material, spiritual entity, or particular abstract order. In Parmenides's theory, the originary is the only constant; in Aristotle's thought, the originary explores the relationship between essence and phenomenon, universal and specific, general and individual; in Descartes's research, the originary is the metaphysics whose object is the entity or ontology. In the following 17th to 18th century, transcendental philosophy and idealism joined the criticism and supplement of ontology or originary. Finally, in modern Western philosophy, after experiencing opposition from positivism, analytic philosophy, and philosophy of science to any metaphysics and ontology, Husserl, Heidegger, and Nicolai Hartmann have tried to use super-sensor and super-rational intuition to establish the ontology of existentialism.

The ontology after Hegel affirmed that ontology should be around "being" in general. According to it, the originary of architecture is "what architecture is", a comprehensive abstract description of the ultimate goal, not the origin of architecture as a factor or experience, but the origin of its meaning. Heidegger proposed that "architecture is a way that people being on the earth"; Norberg-Schulz believes that "architecture exists because of human's existence"; in Gideon's exposition, "architecture is the embodiment of differences in human ideology". The architectural scholar answers this question to support the meaning and purpose of design, while for philosophers, architecture, as an objective world entity, is a reality of the "existence" practice of the philosophical concept. The originary of cold region architecture from a philosophical perspective can be reactivated by "answer-back", and finally realize the separation of specific architectural forms to think about the essence of human Dasein in the time dimension.

Meanwhile, it is worth noting that the three different concepts, architectural originary, archetypes, and theories, always appear at the same time when discussing any one of them. As the spirit of architecture, the architectural originary is to explore what architecture is and earlier than the construction. As the body of architecture, the architectural archetype and theory are to discover how to construct architecture condensed or corroborated by extensive architectural practice, metaphysics. The former has intentional meaning for the latter one, and they are internally mutually supportive and isomorphic. Therefore, to strengthen the concept of architectural originary in the cold region, the relevant archetype and theory are added to the discussion.

2.1.1.2 Concomitant relationship between architectural originary and archetype

Architectural archetype concludes a general layout and the structural technology, aiming to realize the architectural originary characterized by unconditionality and non-decoration (Wang, 1998). The architectural movement of each era usually begins with the archetype discussion triggered by the temporal speculation on originary. In 1753, March-Antoine Laugier (n.d.) proposed in *An Essay on Architecture* (see Figure 2-1) that architectural thinking should start from the most primitive thatched hut, instead of laying out every column with strict rules. It is the first time to face the philosophical nature of the architectural originary, advocating the use of theory to guide design and claiming that there should not be only one idea that guides the generation of archetypes. The foundational significance of this book in architectural theory makes Laugier rated as “the first real architectural philosopher of the present age” by the later generations. Moreover, a particularly famous sketch in the book interprets the architectural originary and archetype (see Figure 2-2): behind the goddess of architecture are scattered Ioni stigmas, and the structure, made of tree trunks, stands at the direction of her finger. As if she is explaining the most primitive structural archetype to the little angel on the side. The image implies that the architectural form can only be generated after the understanding of architecture. The archetype is not an abstract summary after numerous architectural practices but rather is the essential feature of a general building that precedes construction. It is necessary to think more deeply about the architectural archetype to uncover the originary concealed in it. For example, in the illustration, the wood used to build the architectural archetype is directly taken from the forest where the construction lies, reflecting people’s on-site transformation of the environment. From the architectural originary to the archetype, the process is to realize the material dependence of the architectural spirit from abstract to concrete. It is a necessary process of architectural design and determines the diversity of architecture from the source. Nevertheless, even if Laugier has opened up the architectural originary -archetype pattern to the world, most architects still confuse the two concepts or take an existing archetype as the first standard and carry out designs.

In 1914, Le Corbusier proposed the Domino system based on the load-bearing system of the frame structure, which replaced the original architectural space organization mode based on the load-bearing wall structure system, so that architects could divide the interior space more freely and flexibly and realize the connection and flow of space and the organic integration of interior and exterior space. On this basis, he put forward “Five Points of New Architecture” in *Towards New Architecture* in 1926. Since then, a new archetype, the grid structure, has emerged. After inspired by the new five points, Ludwig Mies Van der Rohe proposed the construction priority theory around glass and steel. Thus, the *international style* was born as the archetype of the *high-tech*. Then a new round of cultural panic set in with Mies’s followers copying the giant glass boxes worldwide. Architecture is not a container of space, and it cannot move to a place and integrate into

its culture without regard to the background at will. Although the *New Five Points*, as an architectural archetype, obtains a classic position for its flexibility and high industrialization in the development history of architectural design, there is strong opposition because of the speculative shackles brought by it in the next wave of post-modern architecture. The development of architectural theory and practice in the following fifty years was nothing more than to oppose the old archetypes and to set up new ones, constantly cycling from destroying the old idols to shaping the new ones. From Le Corbusier to Mies to Zaha Hadid, people have become accustomed to generalize about an era, a phenomenon, or a discipline, including architecture, with the most straightforward possible label. However, due to the neglect of initial architectural intention, the essential thing of architecture is rudely stripped away during the abstracting of the concrete image into consciousness. The images of times replaced the spirit of times, and the architectural originary was dissolved invisibly in a rush to shape the archetype.



Fig. 2-1 *Essay on Architecture* (n.d.) written by Marc-Antoine Laugier



Fig. 2-2 The sketch of the architectural archetype from Marc-Antoine Laugier (Eisen, C.-D.-J., 1755)

The architectural originary is different from the archetype; it must be “shapeless”. Even though the purposiveness of the architectural originary makes people quickly think of the slogan: “Form follows Function” in modernism, its one-sidedness fails to respond to the multiple spiritual construction needs of contemporary people for dwelling and habitation. The deconstruction of the architectural archetype is necessarily comprehensive and complex and eventually returns to the originary. In his later years, Le Corbusier avoided talking about the archetype creation mode that he had been familiar with for many years and began to design with different forms, functions, and spirits, showing a thinking trend like retrospection of the architectural originary. The ancient Greek scientist Heraclitus famously said, “you cannot walk into the same river twice”, meaning that the river is flowing ceaselessly and that each time you step into the river, new water must flow under your feet that is not the same water that once flowed there. If the river is the architectural originary, then stepping into the river becomes the archetype. “People walked down a river but did not walk down the same river, and people existed but did not exist.” The interpretation of architectural archetypes must rely on a deep understanding of the originary. If the archetype is not a fixed, concrete form, the architectural originary is a series of comprehensive descriptions wrapped in external conditions, containing the possible flow direction of the archetype.

2.1.1.3 Driving relationship between architectural originary and theory

Liang Sicheng once pointed out that architecture originated from demand, was subject to nature, had no intention of form and system, and did not care about faction. The structural system and the form faction were all caused by the material environment. Ancient primitive architecture, all produced in its environment, first hole embryo, rough with scale, then grow, turn to increase complexity. The construction of architecture must be affected by geography, climate, products, materials, customs and culture, ideological system, politics, economy, and more by the current culture, art, technology, and scientific and technological levels. Therefore, architecture is closely related to the development of national culture (Liang, 1998, p. 11). Lin Huiyin also considered *Elementary Architecture* as the most crucial course for studying architecture because architecture students can understand the architectural originary and think about architectural design from that originary. The architectural originary is the beginning of architecture and the starting point of understanding architectural design. By exploring the architectural originary, people can understand architecture to apply the abstract information learned to the actual operation.

As early as in ancient Greece, Aristotle's system of philosophy linked people and buildings through "harmonious number and order" and claimed, "when the scale of the building is in harmony with the human body, the building is beautiful". The architectural originary reflects the spirit of harmony between man and the world, and architectural design reflects this harmony through correlative numbers. Vitruvius, the Roman architect, inherited ancient Greek ideas, designed from the human needs, put forward the design originary of "firm, practical and beautiful", and completed the classic *Ten Books on Architecture*. During the long medieval period, social and political structures have undergone tremendous changes, and principal cognition has gradually changed from the subject of consciousness to the subject of spirit. People believed that human beings are born with humanity and divinity, which attributes to the essence of humanity. Thus, understanding the architectural originary jumps from practical use to the transcendental place of restoration. In the Renaissance, Alberti's *Architectural Theory* was based on "human aesthetics" and put forward the "use, sturdiness, and beautiful" design originary. However, since the primary purpose of the Renaissance movement was to challenge theology with natural science, his architectural route of praising the body did not get substantial development and soon became a simple mechanical imitation and replication of architectural images. The inquiring design of the body and nature evolved into the monotonous repetition and expansion of the form and structure. Baroque, Rococo, and other design trends rise one after another, directed urban structure, architectural form, spatial scale, material movement to an extreme, once again deviating from the coordinate centered with "human being" (Meng, 2003).

The realization of architecture requires it to become a reality, not illusory like the picture in the frame, the play on the stage, or the image on the screen. It is about the actual living person and the present being. As an artificial order, if architecture has to be revealed, then the principal consideration is bound to become an essential link in the realization process. The American poet Ezra Pound once warned his readers: "too far from the dance, the music will wither; too far from music, poetry will wither." Dance, music, and poetry share the exact origin, which makes them bind and achieve each other, and the same with architecture. An architecture will lose its usefulness if it strays too far from its origin. The architectural originary is the starting point of design theory, which provides the direction and source power of its development. A deep understanding of the architectural originary can promote the design theory and the interactive relations among them.

2.1.2 Unfold the originary of cold region architecture

In existentialist phenomenology, Heidegger regarded the thingness of things as the originary and believed that the relevant explanation of things ran through the whole process of western thought. Moreover, he deconstructed the originary of the object from three layers of thingness: (1) intuitional thingness, such as grass, wood, gold, stone; (2) instrumentality, immaterial spatial distribution presented by functions; (3) artistry, enlightenment from the convergence of the above factors (Chen, 2019, p. 223-249). The thingness of cold region architecture, corresponding to the above structure, could be material, space, and field. First of all, the material presents intuitional thingness in cold region architecture. The self-explanatory and thingness will not change due to the architecture, and people's understanding of its properties or materials will not shift according to the difference of its form or position. Secondly, space is the carrier of the cold region architecture as an instrument, and its function implies the living way in the cold region. The instrumentality needs to be perceived and discovered in the specific architectural scene and has significant deviation in the eyes of different viewers. Finally, the artistry of cold region architecture dwells in its place. The artistry of architecture is not innate, which could be possible to obtain by used and experienced. The thingness structure of cold region architecture lays the foundation and deepens the dependence of the cognitive subject layer by layer (see Figure 2-3). This layered analysis is helpful to understand the "other factors" in the architecture by breaking down each layer. It is worth noting that the layered structure of thingness cannot be treated separately from each other. Different thingness layer provides different perspectives and integrated with blurred boundaries. In addition, the thingness is unique in the cold region architecture. For example, to cold region architecture, ice and snow present the intuitional thingness from the material layer, such as white, implying that buildings have a heating function from the space layer; combine with the environment to cognize the artistry from the field layer. It is an architectural cognition of the cold region life to unfold the originary of cold region architecture with compound structure with multiple syntheses of reality and fiction, dynamic and static, materiality and spirituality.

2.1.2.1 Presence of material

Material is a fundamental problem in architecture because it belongs to nature (Zhou, 2005). In constructing architectural consciousness in the cold region, materials provide people the most direct channel to connect with the world and trigger synaesthesia. As the cognitive object, the materials in the originary of cold region architecture can be deconstructed as (1) cognitive mode of material attribute: experience and association; (2) organizational model of material impedance: construction and order; (3) understanding way of material in place: culture and inheritance. On the one hand, for viewers, the material is the foundation for the architectural existence in the cold region and provides the basis for its cognition. On the other hand, for the designer, the material is used to imitate the daily cold life and connect the existence parallel to itself. The two visions lie in connecting the material experience before with the in-field imagination forming the present introverted projection, which is a discovery method to self-being. In the current picture reading era, the material has become the first presence image of architecture. According to individual experience, understanding material does not require a professional background in structural mechanics, history, or aesthetics and can be unconscious. It is an intuitive thingness that can trigger pure phenomena and is the precondition of architectural spiritual images in the cold region.

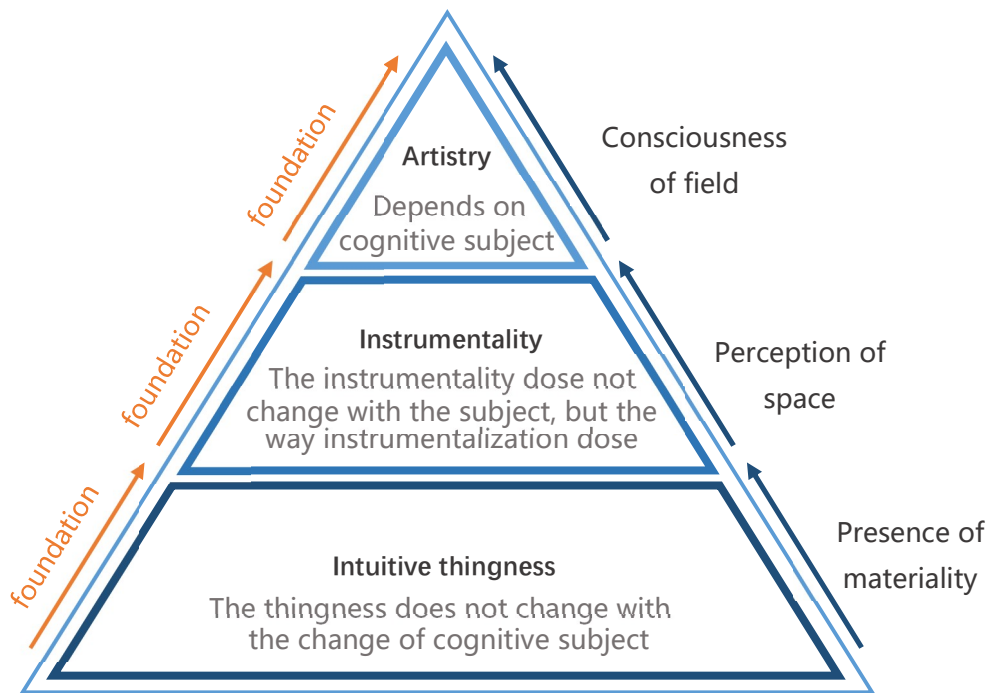


Fig. 2-3 The thingness of architecture as a thing from three layers

The presence of material is vital in studying modern architectural theory because of its fundamental role in the cognition of the architectural originary. From Gottfried Semper's exploration of the decoration originary in *The Four Elements of Architecture* to Loos's *The Principle of Ornament* and Leatherbarrow's *Surface Architecture*, the material is always the primary attribute of architecture archetype and design theory. However, most of the significant researches focus on the image composition for aesthetic purpose or the construction method for the spatial purpose. The time dimension of its existence is always ignored, let alone the structural phase of materials presented in the cognition of architectural originary. The material is not static, with clear marks left by time. The presence of material accompanies an architecture from birth to the dead, enabling the viewer to gain a direct building experience and lay a foundation for the consciousness, making the association gain a sense of time. However, this embodied cognition is always regarded as the adjunct of material attributes.

Today, when vision dominates the consciousness, the most direct way to unfold the originary of cold region architecture to be restrained by images is the material because the material first provides intuitive images for shallow reading. Moreover, research on material presence primarily focuses on presenting experience-association and construction-culture into the cognitive structure of architecture in the form of slices through layer-analysis materials (Shi, 2008, p. 11-24). Therefore, achieving an anti-apparent and structural material presence is a study task on originary deconstruction of the cold region architecture. In the cold region, due to the particular climate, ice and snow are added to layer-analysis of material to integrate a visual image for demand: to increase the dimension of color, temperature, and time to make the material own the geographical character (see Figure 2-4, 2-5). In addition, the viewer's perception of the material will also produce compound synesthesia. Architectural materials present a comprehensive image of the natural properties, artificial construction techniques, and the process by time and the environment.



Fig. 2-4 The logs covered by snow, Swedish, Lapland. (Hearne et al., n.d.)



Fig.2-5 The facade covered by snow, Swedish, Lapland (Hearne et al., n.d.)

2.1.2.2 Perception of space

The Italian architectural theorist Bruno Zevi made it clear for the first time that the architectural subject perceived was space in his book *Architectural Space: How to Appreciate Architecture* published in 1934: people move and perceive in the building from a continuous of viewpoints. In other words, it is this kind of human activity that creates the fourth dimension of space and gives it a complete reality (Zevi, 1985, p. 11). Walter Netsch puts forward in his famous architectural viewpoint “*field theory*”: the key to organizing architectural space is not to develop architectural schemas based on geometry, whose description of architectural space can only play the role of “modification”. In the process of architectural cognition, space is reconstructed by the viewer through physical behavior, escaping from the limitation of physical definition. The purpose of space is to carry the viewer’s body, and the originary of space includes physical space and body space. The birth of space is most closely related to body perception: physical space is the realistic assumption of the body, and body space is the reality of the body’s existence. In addition, the generation of body space in most cases does not require the actual interaction between body and space but is more based on the synaesthesia of body experience to make people have the spatial perception for the place where they are. Therefore, spatial perception implies the relationship between the viewer and the environment and, mentally, shows the reality of confrontation between human beings and the environment.

The space view of the originary of cold region architecture integrates the related perception of cold climate and intention, which needs to mobilize the body to complete the experience. For example, it is depressed that the feeling only the cold wind in the wilderness space perception; it is lonely that the perception of silent space is covered by falling snow (see Figure 2-6); it is non-oriented that the experience of a bright and clean space covered by ice (see Figure 2-7). In the unfolding of architectural space in cold areas, it is often necessary to take the cold climate as the background and the viewer as the main body to discuss a series of bodies feeling aroused and abstract, precipitate, and synthesize them. Cold determines the perceived temperature and hardness of architectural space in the cold region, provides intentional content for the architectural experience of the viewer, and thus enables the architectural space to imitate the life in the cold region constructed by the body. The space experience has become a process for the viewer to reproduce and recall the experience of the cold region. Combining with the prior experience and making all perception, feeling, and spirit present, it becomes the instrumentality display of the originary of cold region architecture here and now.



Fig. 2-6 The snowy morning in Paris
(Langmade, n.d.).



Fig.2-7 The snowy morning in a rural area (Foged,
2011)

2.1.2.3 Spirit of place

After years of phenomenological research on the nature of architecture, Schulz made the following summary: “architecture provides a foothold of existence for people; the aim is to explore the spiritual rather than the practical aspects of architecture” (Norberg-Schulz, 2010, p. 3). The scale of practicality and feature of the architecture is a part of some “comprehensive system”. The influence of the environment on people means that the purpose of architecture goes beyond the definition given by early functionalism. So, the slogan that “architecture is an exact science” is obviously untenable. The will of human beings creates the world, and human beings build an order with self-rules. The purpose of the order cannot stand solely on the material, but the spiritual needs lead to such rules, and its realization depends on the material. People need symbolic things so that the “situation” can obtain the carrier to truly reflect the existence and realize the emotional communication between different individuals on the spot at the same time. People cannot try to explain the whole world only from a foothold obtained by scientific understanding. The architectural place makes the abstract concept of existence “concretization” and restores the spiritual pursuit of architecture, which is the basic need of human nature.

The spirit of place is the top of the pyramid of consciousness based on the materialized world. It is also the architectural originary: the relationship of human presence. The philosophical nature of architectural theory research is self-evident. Otherwise, buildings with only pragmatism should stand on the path of purified science. While solidifying material, the architectural place also solidifies the interaction and consciousness between people and the built environment and the dual “identity” of the object environment and the subject body. As for the place spirit of cold region architecture, Heidegger tried to interpret the formation of cold consciousness with Georg Trakl’s *Winter Night*, in which the life elements and situations, such as snow, window lattice, houses, trees, threshold, bread, and wine, are full of outward natural images and inward humanity. The essential characteristics of existence appear through the mutual support of the general and local phenomena in the place. Here, concretization means to make generally visible something integrated into a vivid, detailed, and full of situation. The scientific path in architecture is to continuously purify and instrumentalize everyday phenomena, thus achieving a “perfect” rule independent of the living world. Therefore, it needs to move in the opposite direction to scientific thought for understanding the spirit of place in the originary of cold region architecture. When science leaves “existing things”, the spirit can lead people to return to concrete things and unravel the profound meaning of the life-world. The overemphasis on the instrumental nature of contemporary architecture in the cold region undoubtedly accelerates the multi-layer unfolding and synthesis of the thingness of

architecture, resulting in the fading and disappearance of the perception of spatial experience. Therefore, the significance of the existence of architecture in the cold region as a “thing” masked by the prevailing utilitarian dialogue applied to the space research.

2.2 Cognitive theory and method of image consciousness

Phenomenology is a discipline that pursues self-evidence and thoroughness, originates from the speculations between the individual and the common, in other words, the correlation between the phenomenon and the essence. In Husserl’s phenomenology, the discussion of consciousness runs through the whole process, and all of his theories are finally for deconstructing consciousness. Ni Liangkang (2007, p. 88) once summarized the position and function of consciousness in Husserl’s phenomenology and said, “the life of consciousness is the inevitable starting point of philosophy because it is the basis of constructing all practical meanings”. Husserl’s phenomenology of image consciousness emphasizes that the root of “consciousness” is intentionality, which indicates that the “mode of consciousness” is the intentional relationship between objects. As the first visual object in the cognitive system, “image” is the beginning of the cognitive construction. Image consciousness reflects the immediacy of image, which is an intentional behavior of individuals in the cognitive procedure by presenting an actual object and laying a foundation for consciousness in an image. It is logically dependent and belongs to the proposition of ontology. The discussion of consciousness is to grasp the essence and to preserve and manifest it by suspending the “natural attitude”. Then phenomenology of image consciousness mediates on constructing the intention associated with images, meditating on how to own the world and the meaning of the world presented, and principal study of receiving consciousness starting from images.

In this study, the discussion on the originary of cold region architecture is anchored in the ontology. As an epistemological theory and method, the phenomenology of image consciousness is to explain and grasp the architectural phenomenon in the cold region to be studied and establish the cognitive structure of the architectural originary by analyzing its relevant intentions.

2.2.1 Image consciousness as epistemology

2.2.1.1 Consciousness and image consciousness

Consciousness is regarded as a representation of objects in philosophy, divided into perception and apperception. The meaning of consciousness is more inclined to intentional experience, with three definitions: (1) at the apparent level, as the synthesis of all the objective phenomena of the experiencing self, forms a unified psychological experience interweaving through body internalization; (2) at the construction level, is an internal perception of one's own psychological experience, which makes all perceptions and experiences build and perfect inside the body; (3) in the aspect of intention, which is also the most core feature of consciousness, Husserl thinks consciousness is the general term of all “psychological behavior” or “intentional experience”. As for the definition of consciousness, Husserl made it clear that the research scope of consciousness is the external experience of concrete phenomena and then internalized into the internal experience of self-abstract phenomena to realize the overall grasp of the content and meaning of consciousness. The study of consciousness deconstructs the conscious experience, including planned activities and intentional behaviors with directional meaning. Planned activities require prior experience and memory as the foundation, called “intention-related items”, while subsequent conscious behaviors are immediate phenomena. Intention-related items need the consciousness content of the intention and actual item, composed of the material and the planned activity. The basic meaning of

planned activity is the action of thought, which can be regarded as the activation function of conscious behavior (see Figure 2-8). When the materials of intention-related items come from non-intentional senses such as smell, hearing, touch, intentionality, then planned activities and behaviors are superimposed. In the discussion of image consciousness, the related items of intention anchored to the image and the viewing as an intentional act are no longer pure. The object to be watched is not perceived ontologically but grasped in its particular hierarchical structure by picturing the ideograph (Heidegger, 2009, p. 111-112). To analyze the hierarchical structure for the grasping process is to realize the cognition of the originary with the phenomenological method of image consciousness.

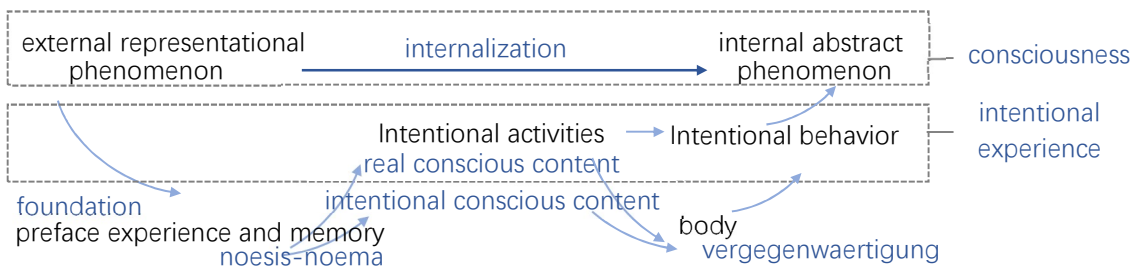


Fig. 2-8 The content of consciousness

Image consciousness is the consciousness related to images, whose research focuses on the structure of consciousness generated when viewing images to reveal the deep meaning of images, which is one of the foundational theories of phenomenology. Husserl put forward the concept of image consciousness in the early stage of his phenomenology research, and the related theoretical research also presents a change with the continuous development of phenomenology. The theory and method of image consciousness discussed in this study, for deconstruction, is not a wholly narrow sense of image consciousness but draws on the part of Derrida's deconstruction thought. Conscious behavior mediated by images includes the immediateness of images and the absent context of phenomena.

2.2.1.2 Structure of image consciousness

Husserl pointed out that the construction of image consciousness contains three kinds of objects. The first is the visual object, also known as the physical object or physical thing, such as the color block on the portrait, the paper of the painting, the clay used for the clay sculpture. The second is the image object, namely the display object displayed in the present, such as the colorful and lifelike sunflowers in the oil painting. The third is the image subject, namely the displayed real object, which is the object of purpose and goal depicted in the second object. Husserl believes that the image object has a corresponding relationship with the first kind of object image, which is called the spiritual image. For example, Van Gogh meant the natural sunflower in the objective world in Sunflower (see Figure 2-9), which Husserl also marked as the actual matter. Therefore, the first object of the physical thing is an intuitive output, while the second object of a mental image needs to be based on the first object and awakened, while the third subject, as a practical matter, does not necessarily appear in the construction of image consciousness, but only appears as an "addition". Spiritual images, awakened by the physical thing, can represent the image subject (Ni, 2001). This complete image consciousness experience is composed of the three objects and the corresponding three apprehensions, none of which is dispensable, but there are differences in the degree of presentation in different image consciousness

processes. These three kinds of apprehensions are essentially three kinds of planned activities, which correspond to three types of form: the physical thing corresponding to perception apprehensions, the image object corresponding to perceived imagination apprehensions, and the image subject corresponding to the imagination apprehensions. In perception apprehensions, the physical thing is natural perceptual objects, as physical support in the process of image consciousness. As a matrix in the structure of image consciousness, the physical thing triggers and awakens other images.

Secondly, the apprehension of the image object is the perceived imagination apprehension based on the perceived image of the figure, lack of the natural characteristics of the apprehension of the physical thing, so it is not directly perceived as existence but appears as a perception of the imagined image. The above apprehension is different from perception apprehension and leaves the pure intuition of presence into a



Fig. 2-9 *Sunflower* from van Gogh and natural sunflower (Gogh, 1889)(Vbalehl, n.d.)

kind of representation that needs to imagine the immediacy of absence. This kind of apprehension is based on perception and then causing variation of planned activity. Therefore, Husserl called the image object the spiritual image, and it is the apprehension of the image object that makes the image consciousness meaning. Finally, the apprehension of the image subject is divided into imagination apprehensions because the image subject is the real thing corresponding to the image consciousness. However, the viewer has no direct perception of it in the experience of image consciousness (see Figure 2-10). Therefore, the image subject does not have independent meaning and what may appear is just a memory because once the apprehension of the image subject is fully revealed, the image consciousness will not exist (Husserl, 2006, p. 31). Therefore, the image subject can be regarded as the reconstructive imagination, which will not show itself in the image consciousness, but is not entirely non-presence. It is embodied in the representation of a similar image between the physical thing and the image object.

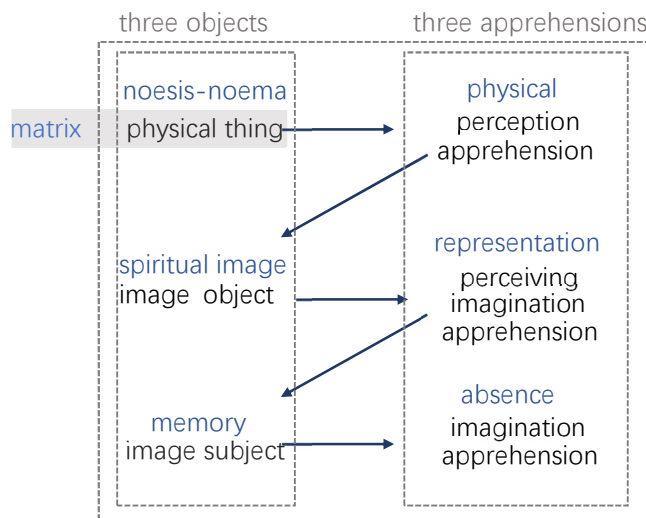


Fig.2-10 The structure of image consciousness

In constructing image consciousness, three objects and the corresponding three

apprehensions do not appear in a definite order. The physical thing and the image object have the same apprehension content, but the apprehension of the physical image and the spiritual image can neither present simultaneously nor appear separately from each other and may appear alternately. Based on the intuitive perception of the physical thing, the image subject further imagines the acquired image object and repeatedly resonates with the other two objects through imitating images. In the actual conscious experience of the image, the viewer's attention will switch among the apprehensions of the three objects at will but cannot focus on only one. Because no image object can be built on its own, there will be no image subject, image object, not to mention full image consciousness (Husserl, 2006, p. 31). That is also the relationship between the construction of self of transcending subjectivity and the world's construction that Derrida pays attention to in deconstruction. In other words, originary deconstruction is genetic, not an absolute static structure.

2.2.1.3 Characteristics of image consciousness

By combining the three objects and three apprehensions of image consciousness above, it is clear that image consciousness is structural, making the essence of image consciousness experience repetition based on similarity, with specific intention characteristics. In the process of repetition, the viewer recreates the original object in the perceptual activity, which is manifested in two forms, that is, in the occurrence of image consciousness and the subsequent repetitions. The first kind of repetition refers to the imitated image between the image object and the image subject in the image consciousness, for the meaning of imitation. Among them, the imitated image is a functional characteristic for apprehensions as an imaginative activity. The occurrence of imitating relies on the similarity and the internal correlation of the objects. Then, the objects are connected with reality through similarity (Geng, 2009, p. 39). By imitating the image, the apprehensions of the image object and the image object are interwoven together internally. The second kind of repetition refers to associating the three objects after image consciousness experience, which is the reproduction of memory.

At the same time, image consciousness, in addition to those mentioned above inherent structural and caused by intentional repetition, the “conflict” presented in its object construction is also an essential factor to complete image consciousness implying the reflection of the image consciousness. Husserl interpreted it as “the conflict, between the appeared content and the content needed by experience, is the basis of image consciousness, whose logic is indirect rather than purely sensory” (Husserl, 2006, p. 31). The conflicts in image consciousness can be divided into three kinds : (1) the conflict between the physical thing and the viewer’s perceived object in the apprehension of physical thing; (2) the conflict between the presentation of the image object and the perception of the presence in the apprehension of the image object; and (3) the conflict between the image object and the image subject. The first kind of conflict occurs between the real thing and the physical image, which is essentially the conflict between the content of the substantive consciousness and the content of the intentional consciousness in the related items of the intention. The first kind of conflict occurs between the real thing and the physical image, which is essentially the conflict between the content of the substantive consciousness and the content of the intentional consciousness in the related items of the intention. For example, in most buildings, it is impossible to repeat the material’s natural appearance. However, this contradiction does not affect the viewer’s image consciousness experience and can even lead the subsequent intentional activity to the viewer’s preference according to the individual’s prior understanding. The second kind of conflict occurs between the presentational image and the physical image of the object, which is essentially the conflict between the ideal world and the perceived world. The viewer

establishes the presentational image's world by presenting the physical image in image consciousness because the look natural is the most uncomplicated information to operate. However, the world built by physical images cannot be completely unified with the objective external world, so images are just images, not authentic. It is like drawing the three-dimensional space on flat paper. The three-dimensional space cannot be genuinely copied to the two-dimensional medium, but the viewer can get a spatial sense from the painting through image consciousness, even if the space depicted contradicts the space experience in the real world. The third kind of conflict is inevitable and occurs between the image subject and the perception of reality. Because the essence of the image subject is imagination, which, compared with reality, can produce an imitated connection or even the substitution of information, but it cannot be equal to reality. From this perspective, the acquisition of the image subject also has significant individual differences.

2.2.2 Cognitive theory of image consciousness

2.2.2.1 Paradigm development of cognitive science

Cognitive science is the continuation of philosophical epistemology and has been expanded by some emerging empiricism problems, whose main paradigms including computationalism, symbolism, representationalism, and cognitivism. Each paradigm has its specific corresponding cognitive philosophy thought. However, all of its essences are the most appropriate understanding of human cognitive or intelligent activities, which regard them as the representational structures in the mind and the computation that operates on these structures (He, 2013, p. 18). The cognitive core of computationalism is “the essence of cognition is computational”. The cognitive core of symbolism is that “knowledge is a series of information and cognition is the logical system of information”. The cognitive core of representationism is that “the cognitive process is the internalization of ideas”. The cognitive core of cognitivism is that “cognition needs non-mechanical discovery”. With the development of modern science, the traditional cognitive science paradigm represented by computationalism has been widely recognized. However, it should also be noted that although the computational-representational understanding of the mind is the most successful paradigm of theoretical and practical exploration to date, it does not apply to all fields. With the deepening of the study of world phenomena, more and more problems are exposed in the cognitive paradigm of science-hermeneutics, which locates the basis point of hermeneutics on the independent in-itself world, such as the inability to simulate the most superficial biological intelligence and fully explain the biological origins of cognition. Psychologists who closely linked concepts to intuitive perception, philosophers influenced by Husserl and Heidegger, and roboticists dissatisfied with the traditional approach to artificial intelligence began to charge that the traditional cognitive science paradigm limited thinking to computational processes occurring in the mind. It ignores the close interaction between the human body and the built environment on thinking (He, 2013, p. 18). Phenomenon experts believe that simplified or economic originary are helpless to explore the deeper structure of phenomenon. The correct way should be in a spirit of tolerance to expand the scope of direct experience of people, to help overcome the theoretical crisis of science, which raises the natural control and reduces their understandability, it cannot reach the completed cognition. Phenomenology can restore the connections among things that people care deeply about by returning intuitive phenomena to their essence.

2.2.2.2 Phenomenology as a research paradigm of contemporary embodied cognitive science

People divide themselves into consciousness and body for a long time, and the binary

relation gives birth to consciousness philosophy and body philosophy. Descartes first puts forward the concept of consciousness philosophy, but the thought can be secretly and tortuously traced back to Plato. In essence, both of them set mind, consciousness, and body against each other: consciousness is the decisive element of human beings, while the body is nothing but an obstacle to mental and conscious activities. Only getting rid of the body can free-thinking be achieved (Wang, M. 2006, p. 3-5). The blind debasing of the body is due to its temporality and limitation, which is opposed to the immortality of consciousness, making it an invisible obstacle to the stripping away of appearances and pursuing all phenomena. The censure of the body, on the other hand, is the praise of the soul and the gods. Finally, the transcendental world becomes the end of the mind. Even though natural reality rose since the late Middle Ages and the contradiction between theology and nature shook the cornerstone of ancient philosophy, the body was only a tool of consciousness without absolute freedom when science flogged the spirit. The separation of body and mind occupies a central position in the traditional philosophy of Descartes and forms the concept of universal rational subject in architectural metaphor (Crary, 1992, p. 7). From the artistic reproduction of the body and nature to the exquisite proportion, and finally, to functionalism, “reason” has become the actual manifestation of the philosophical view in Renaissance (see Figure 2-11 and 2-12).

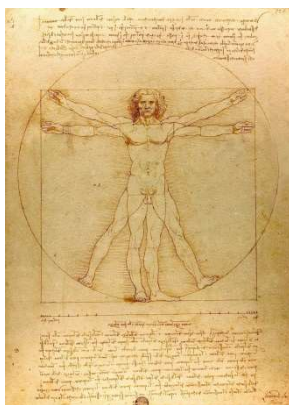


Fig. 2-11 Da Vinci's Vitruvian scale man
(Vinci, 1490)

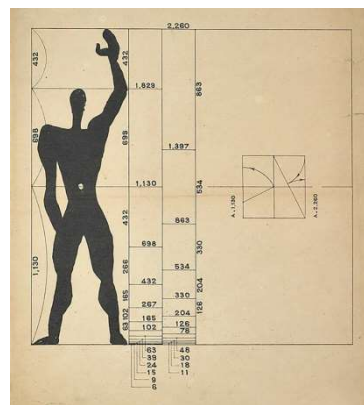


Fig. 2-12 Scale man in *Le Module* (Corbusier,
1956)

Descartes could not get out of the ontology frame of mind-body dualism and looked around between the body and the mind but unable to extricate himself. Nevertheless, it is absurd to construct the human mind and body into unity by conceiving the difference between them. Husserl's phenomenology tries to pull the ontology back to the cognitive paradigm from the outside to the inside, advocating that “all cognition starts from the phenomenon” and “seeing intuitively”. The theory has been continuously developed and supplemented by its followers, directly and indirectly influencing and producing various philosophical theories and phenomenological originary and methodological systems in ontological research in the western humanities. The early phenomenological movement mainly carried out a transcendental reduction analysis on the intentional structure and studied the self at different levels and the constitutive use of the transcendental self, respectively, with reflection as the fundamental method. Husserl's student, Heidegger, changed the direction of phenomenological research in the late 1920s, and the new trend of thought of “being” came to the stage and lasted until the 1950s. Heidegger believed that although reflective consciousness is essential, it should first study the more basic structure of conscious experience and put forward the ontological structure of “pre-reflection”, “pre-understanding”, and “pre-logic”, the structure of being. Under the

influence of Heidegger, Merleau-Ponty led phenomenology to ontology. He emphasized that cognizing an object should return to itself. The human body is the subject of all cognition, which is permanently embedded in the environment and cannot be separated from the world. Thus, phenomenology in epistemology realized the reappearance of the body, which had been neglected in traditional philosophy, and dominated the philosophical trend of thought in the whole 20th century. Contemporary phenomenological studies synthesize ideas and methods from different periods (see Table 2-1).

The cognitive structure of phenomenology reveals that the essential difference between man and machine is the body, not the reason or the soul. The gap between machine and human is that the machine cannot possess the human body, so it cannot truly possess the rationality and consciousness in human cognition. At the same time, phenomenology holds that higher, deterministic, logical, and conceptual intelligence must be derived from lower, indefinite, illogical, and non-conceptual physical ability. That is known as ontological cognitive construction. According to the above, two crucial cognitions can be used by cognitive science: the background theory of perception and the body theory. As for the former, Dreyfus argues that the pivotal part of human perception is uncertainty, “there is a basic figure-ground phenomenon, which is essential to any perception: it is some uncertain background that gives the definite thing a uniform, bounded appearance and influences the definite thing’s appearance in our experience” (Dreyfus et al., 1992). In Merleau-Ponty’s words, something in perception is always in the midst of other things, always part of the “field”.

Regarding the latter, the body pattern recognition, provided by the body theory, is a fundamental skill of human cognition and refers to describing, recognizing, classifying, and interpreting various forms of information representing things or phenomena. Consciousness is the field that spreads out from the body’s internal perception to the outside. Since the body projects the internalized meaning into the environment around it, transmits it to other materialized subjects (Merleau-Ponty, 2001, p. 255), and makes perception possible.

In contemporary phenomenological cognitive science, the research paradigm shifts from non-embodied to embodied, emphasizing the consciousness with the syncretism of body and mind and body as the subject, stating that the perception is formed by the body receiving the information of the external world. The cognitive context based on the ontology is constructed to clarify the ontology through the internalization of the presence. This study discusses the originary of contemporary cold region architecture belonging to ontology, an inquiry into the cognitive significance and consciousness construction of specific architectural phenomena. Phenomenology of image consciousness provides the direction and vision for this question from the perspective of cognitive science by its principle and methods of epistemology.

Table 2-1 Three historical stages of phenomenological development

1900-1930	Husserl period phenomenology	Husserl Phenomenology of consciousness	First period “Descriptive Phenomenology” restores the essential structure of experience from unique personal experience
			Second period The question of reality exists regardless of the “Pure Phenomenology” that focuses on consciousness itself
			Third period “Transcendental Phenomenology” from the subject’s unique field of vision to

			the world of life with transcendental consciousness
		Max Scheler	Phenomenological description of emotion and value structure in consciousness
		Göttingen and Munich Group	Use the phenomenological description to explore essential issues such as ontology, ethics, aesthetics, law, psychology, natural philosophy, etc.
1930-1950	Ontological phenomenology period	Heidegger Existential phenomenology	The ontological structure of Dasein is the logic behind the experience of consciousness, used to understand the possibilities and conditions of consciousness and the transcendental self. It is also called the phenomenology of hermeneutics.
		Merleau-Ponty Perceptual phenomenology	Consciousness structure is the fundamental problem of philosophy. A priori perceptual world restored by phenomenology is the original relationship between man and the world.
1950-1970	Phenomenology in the period of comprehensive research		The study of phenomenology worldwide. Comparative studies with analytical philosophy, pragmatism, structuralism, psychoanalysis, hermeneutics, and Western Marxism have been further strengthened. Phenomenology is widely used in history, sociology, linguistics, religion, psychopathology, and literary theory.

2.2.2.3 Image consciousness in phenomenology

The logical starting point of Husserl's phenomenology is the phenomenological reduction based on the intuitionistic nature, and the phenomenological reduction is to reduce the empirical nature to the intuitive nature and the fact to the possibility. Restoration is to obtain the characteristics of objects constructed in consciousness through precise and subtle conscious analysis, the judgment of representational behavior, and logical behavior. Image consciousness belongs to the behavior of representation, both for intuitive (perception, imagination) and unintuitive (Ni, 2001): this cognition must be received by specific intuitive material to present, and not by the intuitive perception can represent the most original consciousness, the necessary intuitive materials have to be a present back to make the cognitive structure of originary completed. In addition to the secondary consciousness proposed by Husserl in *Logical Investigations*, image consciousness also has a broad sense of primary consciousness. Heidegger inherited part of Husserl's viewpoint of the phenomenology of consciousness and put forward the phenomenology of existence on this basis by replacing intuitive materials with sensory materials. As a result, images become a kind of sensory object, emphasizing that sensory experience comes from different parts of the body. In Heidegger's phenomenology, the subject to the material has already emerged, and the originary view holds that the "end" of consciousness is existence, and the subjective structure of existence is the logic behind consciousness and experience. "People realize the relationship between the body and the place and then recognize existence through the sensory stimulation of the body movement in the place". In Heidegger's view, the architecture should be constructed according to the characteristics of places and users, shaped by referring to the natural terrain and human landforms, with the purpose of dwelling rather than abstract objects (Sharr, 2017). Merleau-Ponty inherited Husserl's theory of consciousness and was influenced by Heidegger at the same time, pointing out that the structure of consciousness is the essence

of the originary unfolding and the body is the subject of all consciousness, both physical and mental, indivisible. That makes the cognitive relationship between the world and human beings ambiguous and ambiguous. Thus, the mind-body dualism has been completely overturned, and the body-centered cognitive mode provides the systematic thinking guidance of the integration of body and mind. Furthermore, Merleau-Ponty referred to all the body's sensations as perception and proposed the phenomenology of perception. Thus, all cognitive objects, including images, no longer exist independently but are entirely connected with the body.

In the process of phenomenological development, image consciousness presents the following characteristics: (1) image as intuitive material, and the body is the subject to its perception; (2) the body moves in the situation and can obtain continuous and changing perceptual consciousness; (3) the body always exists in the "field", and consciousness is the receiving channel of such existence; (4) consciousness is intentional and structural, and intuitive images are not always the source of ontology structure.

2.2.3 Cognitive method of image consciousness

2.2.3.1 Embodied image perception

In Husserl's phenomenology of image consciousness, the most crucial part is the apprehension of three kinds of objects: the conscious behavior of multiple objects. However, the cognitive method with pure subject-object view ignores the body and implies that the body is attached to the transcendental consciousness so that the cognitive description does not entirely break out of the traditional philosophy. However, Husserl has answered the contradiction of the separation of body and mind in his phenomenology. Furthermore, he proposed that the formation of consciousness was the internalization process of the intuitive image and the outpost of the discussion on the subtle relationship between consciousness and body. Merleau-Ponty inherited Husserl's academic thought, made clear the body as the subject of consciousness, and put forward three main functions of the body as a structural model in the process of consciousness construction: (1) make the dynamic processing of images; (2) supply the activity pattern (3) connect proprioception and perception (He, 2013, p. 18). Firstly, vision can be divided into visual proprioception and visual kinesthesia. In general, the image is regarded as static and directly received by the visual ontology, but the image itself contains a lot of body information, such as the viewer's height, the distance between the actual item, and the interaction with the environment. Especially when discussing architectural images, architecture needs presence bodies for intuition without fixed viewers on the sidelines like paintings in frames. Following the constantly moving body, the perspective of the visual image and the object of image consciousness multiple changes. Secondly, body movement is the output of the intentional behavior of the body after acquiring the intention-related items, which has two schemata: innate instinct and acquired learning. These schemas will be reinforced or transferred according to unconscious repetition and conscious practice, and then the planned activity will change. At this point, the information of proprioceptive perception will change with the variation of the body schema. So, the schematic approach becomes the basis of image consciousness. Finally, the body's proprioception is modular, and there is a transformation mechanism of the information between modules. Just as Gideon believed that vision was an extension of touch, Pallasmaa said that gazing at the white wall in the distance was a touch. The information of the optical module and the tactile module form association about the presence. The body is the container and the matrix of its occurrence. It is worth mentioning that this transformation requires experience and memory as the premise. That is to say, people without cold experience cannot get the cold experience brought by ice

and snow images.

The cold body is the precondition to the cognitive structure of the originary of cold region architecture under image consciousness. When all architectural image materials are added with a cold conscious body, the structure of consciousness and consciousness field will undergo corresponding transfer from ontological perception, behavioral schema, and module interaction. Without a substantial body, transcendental and recollection are out of the question. The viewers without cold consciousness are not the cognitive subjects with regional attributes in this study and do not serve as the central perspective of this research.

2.2.3.2 Structuration image cognition

Structuration is one of the main features of originary cognition in Husserl's phenomenology. It is also an essential method of phenomenological deconstruction, especially in image consciousness, which indicates that cognition has a clear path. (1) Firstly, establish the hierarchy of objects: the objects in image consciousness are the "materials" in the image's intention experience. In the method of image consciousness, the association structure among objects constructs the framework to acquire consciousness. (2) Secondly, establish the relationship of meanings: establishing the structure is also the combing of the internal logic of the originary of objects, which is the embodiment of understanding the structure from the object's perspective. (3) Finally, sort out the direction of consciousness: compared with the relationship between the physical and image objects. The appearance of the image object is not pure, which may be accompanied by the image subject. As Husserl said, "Rather, there are two apprehensions intertwined together" (Husserl, 2006, p. 27), but there are no two manifestations. Precisely, one manifestation has two functions. In this sense, the meaning of the image subject and the image object is linked, interwoven, dependent, and implied. For this reason, Husserl called the apprehension of the image subject "the reappearance consciousness of the unmanifested among the manifested". In this way, the consciousness of the image subject can be distinguished from the non-image, that is, pure reconstructive reproduction.

In the construction process of architectural consciousness in the cold region, there is "presenting, representing, imagining and visualizing" based on image object (Husserl, 2006, p. 30). Although the image is a general reference to intuitive materials, especially with apparent elasticity in the architectural experience of the viewer, the formation of consciousness is following the salient structure. Therefore, by sorting out the consciousness structure from the architecture image in the cold region, the accessibility of the value and meaning that the architecture delivers could be judged.

2.2.3.3 Present image repetition

As a method to discover the originary of things, the phenomenology of image consciousness is more a repetition of presenting intention based on experience. First of all, it needs to establish the subject and field under image consciousness cognition. Although the viewer's attention begins with the physical thing presenting in the presence, the viewer's consciousness can shift to the absent association or even imagination through the constructed cognitive structure. The acquired image subject will not be the pure thought of the original physical thing. Since entering the image consciousness, the viewer acquiesces to an image field based on perception, or perceived field. There is a central subject in each field. As the subject of both image consciousness and image field, the viewer faces the image by imagination and defines the perceived material as the object based on the transcendental structure. Therefore, when exploring the originary structure through image consciousness, only the framework, method, and intention of

consciousness can be obtained. However, it is difficult to draw specific conclusions because the repetition is not the real physical world, which essentially reflects different levels of consciousness of the field.

In addition, the flow of consciousness between the subject and the field is also the center of image repetition. In modern philosophy, Descartes introduced the originary of self-consciousness into the ontology for the first time and proposed, “I think; therefore, I am”. “I think” is the way that the first image relates to “I”, the object and the subject; that is, the “thinking” as the object forms the self-consciousness of “I am”. The forms of “am” are varied, and the “think” generated is individual and different. Johann Friedrich Herbart perfected and emphasized the interdependence of subject and object based on Descartes’s theory and declared that “perception is a way of being”. In the research on the originary cognition of cold region architecture with image subject as the goal, if feeling, imagination, will, and emotion are stripped away, perception, life activity, and behavior mode as material are abandoned, there is nothing but nihilism. As the origin of people’s cognition of the world, the body is closely linked with subjectivity and intentionality in originary construction based on image consciousness, and it is the anchor point for constructing the three objects and their apprehension structure. People should not take the attitude of mount but should take the body as the starting point to construct the whole consciousness cognitive logic.

2.3 Application of image consciousness on construction the originary of cold region architecture

In the phase of cold region architecture, “cold” refers to a climatic feature or physical sensation. In China, the cold region means the region with a heating period of more than four months a year. Due to different geographical locations and historical evolution, many types of “cold culture” have been formed in China’s cold region. Among them, the cold culture in Northeast China is particularly famous for its rough, primitive, unrestrained, and heroic impression. The cold, not only in the environment but also with humanism and spirit, jointly constitute the core and extension of cold region architecture in China, which is the key to distinguishing the architecture in the cold region from that in other regions. Therefore, during the originary deconstruction of cold region architecture, the cold image and consciousness are the important anchor points to inspire the viewers to recognize the cold region architecture. Meanwhile, the image and consciousness are also the theoretical foundation of image consciousness as the reduction of cognitive construction. Therefore, image consciousness can decompose and reconstruct the originary cognition of cold region architecture organically from intention experience.

2.3.1 Relationship between the cognition of architectural originary and image consciousness image consciousness

2.3.2.1 Dialectical relationship between image and architectural exposition

Expansively, the “image” in traditional cognition reappears the actual thing, not a copy but an imitation, and is fixed as an artistic truth (see Figure 2-13), and endows it with the meaning of human nature. Obviously, there is no need nor ability for this kind of “naturalism” to realize an authentic reproduction of natural things. However, Gadamer (1991, p. 24) still thinks that this art form seeks the ontological function: “it communicates the gap between ideal and reality, and reflects Baumgarten’s aesthetic definition of “ars pulchre cogitandi”, namely the skill of good thinking”. Even modern art does not express itself in that objective form. Therefore, in the history of western architecture, the similarity between images and nature, things, and reality form the basis of architectural artistry. In the image of Oriental architecture, the form of similarity is

composed of both shape and spirit. The similarity in form is only the basis, and architectural images must enable the viewer to identify the object and subject. Otherwise, the artistry of architecture cannot be constructed with each other. Although postmodern architecture extended along with the infinite similarity between the construction image and the real when Marcel Duchamp displays toilet as artworks, abstract art comes out in strange and obscure attitude to the life-world, the original similarity relationship suddenly lost its explanatory power, presents another ambiguity to against experience (see Figure 2-14). Beyond the appearance or features of the objects in the existing life experience, it subverts the image of traditional symbols, thus arousing viewers' reflection on the similarity between architecture and images and even experience. Therefore, the abstract spirit, one of the characteristics of contemporary architecture, expresses "completely non-reproducing art, or the art that transforms the displayed or observed forms into patterns. The viewer usually does not think of their origin but interprets them as some independent relations" (Lucie-Smith, 2005). Therefore, the dialectical relationship between the image and the architectural manifestation emphasizes revealing the artworks from reality. No matter the similar representation or the dissimilar non-representation, they all need to move from the concrete experience to the abstract experience, implying the perspective of subjectivity



Fig.2-13 Holly creeper on Corinthian Order (n.d.)



Fig.2-14 Chiat/Day building (n.d.)

The dialectical relationship between image and architecture comes from the process of architecture being perceived. Unlike artworks, architecture requires absolute presence rather than looking on. When there is no need for image subject-like association, architecture and images are similar, and human cognitive subjects construct this similarity. The material needs to show and express itself; space needs to extend its existing "stored" content, and the place needs to bring together all materials and space. It is difficult for the viewer to obtain the intention experience or even the spiritual dwelling in many architectures. Nevertheless, other ones are intended to fulfill their ideological value as artworks. At this point, the image becomes an explicit slice of the architecture, and the entire situation and originary of the architecture "stretch" between the infinite slices.

2.3.2.2 Similarity relationship between image and architectural entity

As a thinking tool of architectural design, image is reflected in the leading position of mathematics and geometric rules in western architecture, which makes it equipped with the theoretical basis of "science", which can be seen in the works of Alberti, Palladio, and Vignola. Moreover, the development of mathematical beauty in architecture has never been separated from the field of artistic practice. From the Renaissance to the end of the 18th century, architecture has always been a branch of the paradigm image, whether it is the rational beauty related to the digital rhythm or the dominant reflecting the essence of

the universe itself, sharing the way that human beings understand the world with the main image world. Image is the circulation of architectural expression. As Ruskin said, “architects are all metaphysicians”, image, as an actual item covered outside the building, rises to the abstract of “learning” through its “formal” entity.

At the end of the 18th century, faith and reason were gradually separated from real life due to the development of science and technology. At the beginning of the 19th century, mathematics in architecture was utterly reduced to a simple form and tool, and science became the judgment criterion for everything (Feng, 2013, p.22). The idea of mechanism also spread to the field of painting. The mid-nineteenth century British Archigram put forward the thought of both mechanical aesthetics and structural aesthetics, from modernist lay particular stress on the first generation of mechanical aesthetics emphasizes the logical process, mechanical equipment, technology and structure, the modernist aesthetic concept of the second generation plant is more pay attention to the form of motility (liquid), and emphasizes the extrasensory concept, which form is lighter and more flexible than the first generation mechanical aesthetics, and the style tends to be an outer skeleton effect. From Fernand Légar (see Figure 2-15) to the Centre Pompidou (see Figure 2-16), from Van Gogh to Zaha Hadid, schools of thought continue to travel in different fields, showing three characteristics: (1) the transformation of artistic thought first appeared in the field of painting, because painting is easier to be presented and can be independently interpreted by everyone, and then become an idea to influence architecture. (2) Architecture, as an objective three-dimensional existence, can be understood by transcendental translation into two-dimensional or multidimensional dimensions according to the cognitive subject. At the same time, although painting is a two-dimensional work, it can be supplemented by three-dimensional visual effects and multidimensional consciousness experience. (3) Both painting and architecture reflect a specific humanism experience and meaning detached from its own object value. Thus, the image has become a presentation tool of architectural expression, which makes architecture and image reflect on one: image has a self-evident role in promoting the appearance of architecture, and the artistic conception association of architecture is all derived from image-like imagination association, switching, and integration between the present and non-present, intuitionism and observation.



Fig.2-15 Three Women with the bouquet
(Légar, 1922)



Fig.2-16 Centre Pompidou, 1977 (Kranendonk,
n.d.)

In the contemporary art world, the pursuit of “feeling” is often overtly, but it is always hidden in architecture. In fact, architects in the design process are also pursuing “feeling” and following “feeling”, but because “feeling” is always labeled as “irrational”, even if it is used, it is not respected because there are very few theories to support the origin of feelings. In modern ontology, people realize that “feeling” cannot exist entirely “absolutely freely”, and it needs to be established based on human nature, choose the relationship between “here” and “there”, and build all noumenon on the understanding of

human nature at “here” level. In this way, it can be deciphered that the cognitive structure of the vast majority of artificial works, including architecture. In *Problems of Art: Ten Philosophical Lectures*, Susanne K.Langer put forward that “all art is a form of perception created to express human emotions”. It points out the correlation between subject and object, an essential purpose, and representation in art, and follows the argument that “the structure of art is similar to the structure of life, and the artwork is a form of life”. Image has thus become a reflective tool of architectural abstraction. In contemporary times, as artworks, including daily-life products, it is a process of continuous self-imitation and self-cognition, which implies the necessity and inevitability of the evolution of people's thoughts. The historical change of the ontology cognition of architecture as artwork and product is also in line with this significant context. Its originary deconstruction is bound to require the transformation from the low-dimensional materiality of representation to the multi-dimensional divinity of life to answer the self-cognition of people in the time dimension.

2.3.2.3 Associated relationship between image and architectural contents

The image could be understood from the “graph” and the “feature”. The “graph” refers to the broad visual content, the physical conditions presented by the entity. In Husserl's image consciousness, the meaning of “feature” is closer to the word “imagination” or a pure mental image, also defined as fantasy in Husserl's writings. Different contexts involve different objects, and the objects of imagination are also different. It may refer to an image of a substance, or it may imply an image derived from an image but not from the construction of the thing itself. Under the concept of consciousness, the image construction is not a kind of objective representation familiar to people but refers to a structure with a multi-layer structure. So complex perceptions of things can be built from images.

In Husserl's lecture entitled *Imagination and Image Consciousness*, he elaborated on the complex structure of image consciousness: “when comparing the construction of image representation with that of mere perception representation, the former is far more complex than the latter. The meanings which seem to be superimposed on each other are actually different in nature. However, it will expose the bias intention along with the attention preference when it runs through the image consciousness”. For architecture, different from films, paintings, and other artwork, the image acquisition is based on the visual perception of materials, and the architecture experience should be based on the eternal “here”. Nonetheless, the architectural artificiality is implied by the off-site processing of materials, which can only be obtained by the viewer's imagination of the off-site images based on “here” intuitive images. From this perspective, all architectural materials are symbolic representations of the architectural originary because they all need to “look back” to obtain both the construction and productivity of the application origin of materials and further “look back” to their original originary. At this time, the cognitive process of architecture can be constructed like the structure of image consciousness, and architectural originary is naturally embedded in this constructing.

2.3.2 Originary deconstruction of cold region architecture under image consciousness

2.3.2.1 Cognitive object

Since Descartes, people have realized that the image on the retina is an interception of information rather than perception itself, so it is impossible to obtain the will of the actual object through the pure image. Robin Evans once said, “the matrix of architecture does not exist in materialized objects, but only in the consciousness of the brain” (Evans, 2000,

p. 358). The existence of architecture is cognized by its form. Before the construction is not completed, the design drawing is the form of architectural cognition; after the completed construction, the architectural image is the form of architectural cognition, but the starting point of consciousness, the image, cannot reach the other side of it. The formation of architectural consciousness in the cold region needs to experience the cognitive structure. Under the image consciousness, the cognitive object is constantly changing in the structure, and the relevant cognitive intention behavior is constantly in flux.

First of all, as intuitive images, architectural materials are first received by the viewer in the form of intention-related items, and the grasp of their nature has become the primary perception paradigm. Color, shape, texture, and other image elements are acquired in the first time, and then the viewer can deduce the properties of the material, whether it is stone or wood, the touch of the material, smooth or fuzzy, the authenticity of the material, processed or unprocessed. Based on this, the perceptual information foundation of the building material with the implication is obtained. In addition, the experience and cognition of ice, snow, and other natural elements are naturally prepositioned in the images of architectural materials in cold regions. Since then, a focus on whiteness and transparency is added to color elements; an awareness of sharpness and continuity is added to shape elements; a touch of roughness or smoothness is added to texture elements have been added. Thus, the viewer can connect directly with the cold environment through architectural images (see Figure 2-17, 2-18).



Fig. 2-17 China Wood Sculpture Museum (MAD, n.d.)

Fig. 2-18 Harbin Opera House (MAD, n.d.)

Secondly, as a perceptual image object, architectural space embodies architectural instrumentality and carries specific architectural activities. Since the beginning of Modernism, architectural problems have focused on the way to grasp the architectural space. With the development of the body-space theory, people's understanding of space has already free from the original physical space description by drawings, and space is no longer regarded as a purely objective reality that can be independent of the cognitive subject. Starting from the instrumentality level, if the construction of architectural space ignores the user's body space, its significance will be lost instantly. In the image consciousness of cold region architectural space, the deconstruction construction should always be around people as the cognitive subject; furthermore, the body is the primordium of spatial cognition: It is the body that suggests space scale, gives the overall structure of the space, defines the spatial position, direction, and a dynamics mechanism. In the cognitive construction of architectural space, the body is the cognition subject and the medium, making original pure architectural space constantly enriched to become apprehensions of the image object in the representationally perceptual imagination. Therefore, the body and spatial consciousness are mutually corroborated and cannot be separated, are characterized by contingencies, uncertainties, and openness. The spatial

perception of cold region architecture is full of perceptual grasp starting from and penetrating the skin. Space is known and understood according to the change of three dimensions and temperature following time. Thus, the perceptive layers are enriched and connected by the body's behavior in the space (see Figure 2-19).



a) Stage of forests, Jilin (Su, n.d.)



b) Town Hall, Saynatsalo (Chard, 2014)

Fig. 2-19 The consciousness of the cold region is strengthened by the body moving in the space

Finally, as the imagination of the image subject, the architectural place is the sublimation of the intuitive thingness and instrumentality, the carrier of the architectural spirit and artistry. However, the intuitive thingness and instrumentality cannot convey the truth of the cognitive construction of architecture, which needs their active participation. The architectural place is based on the former two, so that the architectural being becomes unusual and contains, changes the way people understand the world, and helps people's behavior, cognition, evaluation, and horizons. Heidegger believed that all cognition revolved around the central field; Schulz believes that the architectural spirit can only be realized in the architectural place; Zumthor called the architectural place spirit the atmosphere of architecture, which contains architectural quality. Therefore, the absent image subject of cold region architecture needs to be apprehended during the exploring process of the embedded subject centrality and structuration (see Figure 2-20).



a) Office Building of the ADRI of HIT



b) Visitor Center in Bakkagerdi, Iceland (Lud, 2019)

Fig. 2-20 The architectural field is the synthesis of material, space, and environment

2.3.2.2 Object structure

According to the above, the cold region architecture, as a cognitive object, could be deconstructed from the three layers of thingness under image consciousness: (1) the physical properties, such as material, fabric, craft; (2) the instrumental both orientation and function, as the body-space structure; (3) the form and meaning of art, as to be perceived, to be opened, and to be realized. This multi-fractal-like structure enables different objects to appear in different cognitive subdivision structures simultaneously so that different structures are related to each other but cannot be replaced entirely by each

other. It should be noted that the third layer of both the subdivision structure and the main structure, namely, the image subject as an artistic manifestation, is present, hidden, or absent completed as the case may be. The corresponding relationship between the architectural thingness unfolding and cognitive construction can be integrated into the object structure of the principle cognition of architecture under image consciousness (see Figure 2-21). Among them, the architectural material corresponds to the physical thingness, which is objective self-evident and can be intuitively perceived by viewers, belonging to common apprehension. The architectural space corresponds to the image object, which is presented under perception with intersubjectivity and can be received only through the body structure of representation by viewers, belonging to apprehensions of perceptual imagination. The architectural place corresponds to the image subject, which does not always appear under any circumstances. Even if without a deep understanding of architectural place, the formation of complete architectural consciousness will not be affected. The architectural consciousness based on the reception of the material and space has the present intention of absence and presence.

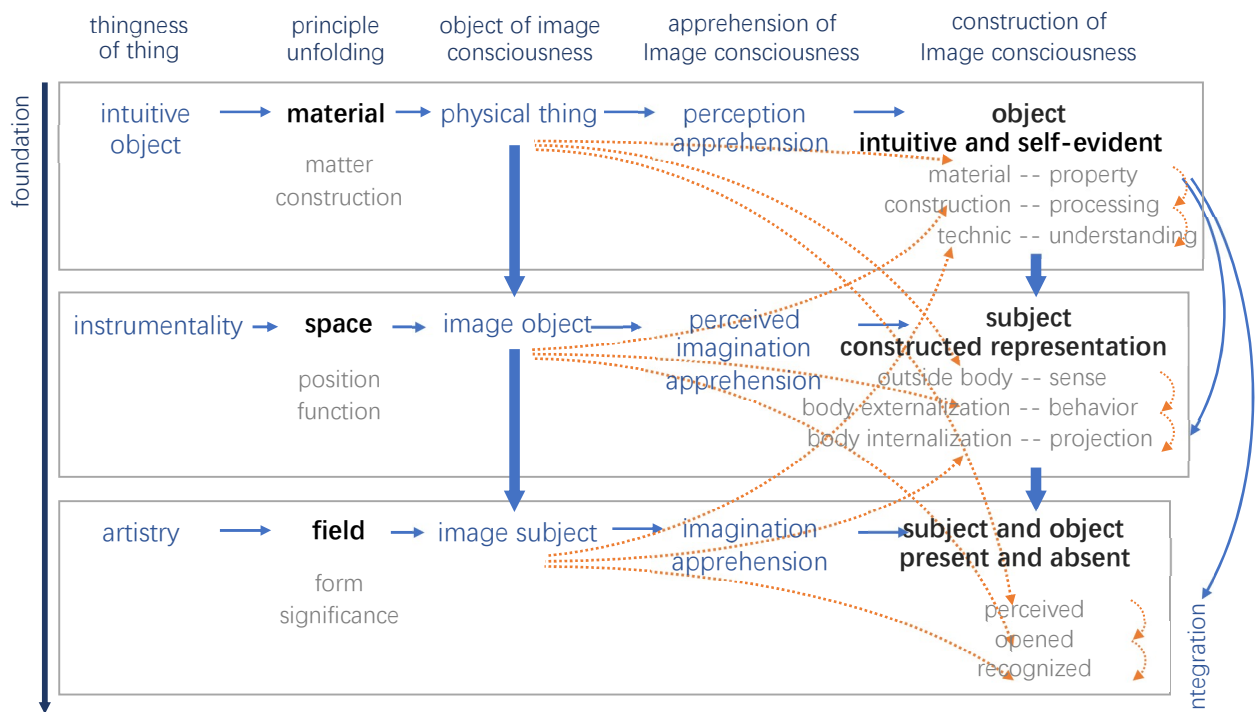


Fig. 2-21 The schematic diagram of architectural cognitive object structure

As for the audience’s “leaping” neglect of the architectural visualization in the cognitive structure, their understanding of the cold region image presents an unthinking binary mapping. In the originary deconstruction of cold region architecture, material, as an intuitive thing, is an intent-related item of cold experience, laying a foundation for the ontological construction of cold consciousness. The intentional activities and behaviors triggered by it have even formed a perceptual apprehension paradigm over the years. This kind of experiential conscious subjectivity is not only received in the first layer of the originary structure of cold region architecture, but all the processed objects, which have been free from their original natural state, enter into an entirely traditional cognitive system. That is the shaping process of the local culture of techniques. As an instrumentality of the architecture, space is where the cold behavior occurs, which needs to be built on the present body. Both heating or shelter from the cold is all architectural representations based on the body’s demands. If the cognition of cold region architecture

stops at an instrument, then there is no essential difference between architecture and many other tools or objects in daily life. It cannot be called architecture ever, but building. It is the place spirit, as the image subject, that makes the cold region architecture acquire the meaningful core separated from its form so that people's architectural consciousness can break away from the architecture and extend to the broader world in the cold region.

The above interpretation construction of cold region architecture only completes its originary deconstruction from the object level of operation. However, architectural existence relies on the human being as the subject. That makes the architecture unfolded and responded uniquely, which only happens in the architectural place. The unfolding, perhaps, is just the moment when people look at the architecture. People are integrated with the architecture from the outside world, obtain a sense of actual existence, and interact with the built environment. At the same time, the cold region architecture presents a meaning that only exists in its situation, which is the characteristics projection of the cold region to the architecture and has nothing to do with the meaning of the architecture itself. Whatever its significance, this trait can make the cold region architecture unable to escape from its situation and avoid being purely conceptualized. It is the key to distinguish the architecture in the cold region from the one in other regions. That is the most critical perspective to explore the originary of cold region architecture in this study.

2.3.2.3 Relationship among apprehensions

In the material world, objects exist in a particular form. The architectural originary study depends on its existence as an object being unfolded by the life-world as the subject. The object's form and the subject's intuition form an apprehensive relationship of mutual verification: with the subject's "intuition", the object's "form" obtains the reason for self-elaboration and expression. With the reality of "form", the "intuition" has the judgment of intentionality behavior and thus has the basis to know and distinguish the object from the surrounding world ideologically. The importance of "form" in visual art lies in that people interpret the profound connotation behind the form mainly through visual senses. Clive Bell, a representative of the British formalist aesthetician, believes that the essence of art is "meaningful form". The "form" here refers to the relationship and order in both the lines and colors of artwork arranged and combined in a certain way (Wang & Zhang, 2007). The goal of the "form" is to provoke emotion to realize the other side of the form, the meaning. William J. Mitchell gave a relatively straightforward definition of the "form": "The form of an architecture is its internal material structure" (Mitchell, 1995, p. 17). The material structure is not the physical structure that makes the building, but the structure of the intrinsic construction of architecture: from the subdivision structure's single property of the single component to the overall structure composited layer by layer.

On the other hand, as a member of visual art, architecture also needs to pay attention to the most critical content in visual art, form, which is the only basis and reasonable explanation for the existence of any visual art (Wang, 1995, p. 17), and also one of the fundamental problems of architecture. In the contemporary era when a visual pursuit is prevalent, although the visual form is the final presentation of the architectural externalization, mixed with a variety of concrete factors, that is not the expression of personal consciousness and emotion like pure art, people's fanaticism for the visual form of architecture often overrides the architectural originary. The most straightforward logic of pursuing the formal beauty of architecture starts when the viewer's eyes contact the building, thus triggering spiritual resonance (Albertazzi et al., 2010, p. 91). At the same time, people's expectation for an experience beyond the transcendental also surges in the undercurrent, turning a blind eye to the habitual perceptual content. This kind of interest in the strange, abrupt, exaggerated, weird, and other wonders indicates that the

understanding of architecture has shifted from the functional stage to the visualized intention possibility. When people begin to seek the motivation under the form and the consciousness above the form and try to construct a more complete and transparent form-background structure, the expectation for the cognitive ontology structure of architecture is also increasing day by day.

In the cognitive structure of the cold region architectural originary, the objective form of various layers, as the thingness, is the only reality to grasp exactly by viewers. In addition, the architecture unifies the whole of external presentation and internal space through forms, making it possible to obtain the cold region architectural originary layer by layer through the object from architectural materials to architectural place. During the consciousness construction, the conditions of the cold region, as the actual cold region environment and experience, become the premise of viewers' intentional activities, so that the conditions of the cold region and architecture constantly influence each other in different stages, with viewers as the subject, extending the cold consciousness in the architectural experience.

2.3.3 Originary reconstruction of cold region architecture under image consciousness

2.3.3.1 Visual synthesis of architectural presentation

The current post-modernism culture is a global social culture with an economic model as its origin. In this cultural wave characterized by "consumption", with the innovation and popularization of electronic mass media such as film, TV, multimedia, and network, the culture centered on "language" has changed to the visual culture centered on "image and video". Visual culture has influenced every aspect of society, and "image narrative" has gradually become the most direct and intuitive way of information transmission and expression in this era. Life is surrounded by images, simulations, fantasies, copies, and reproductions. With aesthetic and sociological meanings, the architecture is inevitably involved in the current trend and shows a visual turn under the influence. The expression of architectural creation is classified as a kind of copy and paste based on images, tossed in the mechanization process. This operation on the form implies a superficial understanding of architecture. It needs to penetrate the apparent to extend consciousness to the whole architecture for a truly more bottomless interception. It is also a new issue for the visual communication of contemporary architecture: in the structural extension of image consciousness of architecture, how to build an inclusive relationship between the visual, as the cornerstone of consciousness, and both external architectural imagery and intention-related items.

Most of the understanding of architecture starts from the external image. Its core is to realize reflection around the viewer's cognition of the environment, rather than the self-reliance, autonomy, and self-consistency of architecture. This turn of values makes the architecture free from the Mechanistic Materialism of the industrial revolution. Along with the questioning and subversion to the classical scientific system from fuzzy theory, chaos theory, and dissipative structure theory that appeared in the second half of the 20th century, the theory and practice of architecture have shown a free and pluralistic situation, and the flow of ideas has been constantly split, transferred and replaced. In this context, architectural consciousness can only rely on the images received to appreciate the current architectural connotation and significance. Once the image consciousness is extended, the architecture understanding will change from the original single image consumption to the image narrative.

In the ontology structure of cold region architecture consciousness, architectural materials, as the first intuitive object and foundation of the whole construction

consciousness, do not occur only at the material layer, the basement of space and field. As a result, visually integrated throughout the consciousness constructing, and the apprehensions of the three objects unable to completely fragmented, which relationship must be blended and the object's identity is constantly transformed. Starting from the people's long-distance viewing, the people shorten the distance between the body as the subject and the architectural as the object, making the information of the architectural image constant changing and more affluent and completing image-based perception based on transcendental synaesthesia in the process of the formation of architectural cognition. In *Poetics of Space*, a man is described staggering in the cold snow. He suddenly sees the light in the distance and imagines the warmth of the house. It means that the body in a cold environment will topology a series of warm images according to colors. In fact, the temperature and space of the environment do not change. The imagery association through the image is also a part of the visual synthesis, which has self-evident significance.

As early as the stage of Gestalt Psychology, people have regarded "schema" as a cognition structure to indicate the interaction between individuals and their environment to imply the existence of the parallel space of physical and psychological. As the most basic concrete media, architectural images are the basis of physical and psychological space for forming architectural consciousness. At the same time, Piaget once pointed out that people's "spatial consciousness" is based on the schema of operation and based on experience. For people in cold regions, images and visions of the long winter form the general cognitive basis of architectural consciousness in this environment, but specific to other places. It is stable and unconscious of the "schema" accumulated under the mapping relations deployed by long-term environmental factors and social and cultural conditions. Although the subject will realize constant revision in the long practice through the corresponding relationship of new experience to the schema, the consciousness of architecture is also dynamic.

2.3.3.2 "I think" experience in architectural situation

The originary cognition of architecture, inspired by Merleau-Ponty's phenomenology of perception, returns to people's perception and experience of place, space, and environment in daily life. In contrast to perception, experience is an absent memory composed of life segments in the virtual environment, constantly accumulated and updated by the present perception. So phenomenology of intuitive architecture integrates with the constantly changing instant feeling and associative memory. The architectural situation in people's consciousness is not a pure thingness presentation, but more abstract artistic acceptance and resonance on instrumentality, which is the empathy caused by the viewer's projection of the architectural appearance outside to the inside of the body. In Descartes' epistemological philosophy, he believes that subject consciousness is the center of the cognitive world. As the subject, the viewer perceives architecture, which exists because of "I think". All perceptions to the other are where "I think" is located. Without "I", "I think" will cease to exist, and architecture will be out of the question. Therefore, the architectural situation is the experience and restoration object of "I think", with its uniqueness. But at the same time, the uniqueness of all individuals ultimately constitutes the universality of the group. Descartes believes that architectural experience is absolute obedience and profound immersion for the viewer. When the subject gets perceptual existence, image consciousness becomes mutual evidence of the place where "I think" and architecture. The experience and "I think" form a mapping relationship, and consciousness experiences in the architectural situation of "I think". Just as Heidegger pointed out, "The philosophy people discussing should be related to ourselves, and touching the things deep in our nature" (Li, 2011, p. 26). Therefore, "I think" architecture

should reflect on the existence of the relationship between architecture and “I”, which aims at the integration of feeling, thinking, and behavior. According to the above, the abstract architectural originary can be revealed from the architecture entity through the emotional communication experience between the viewer and the building to reflect on the viewer’s feeling and the thinking world.

In the “I think” cold region architecture, all experiences are multidimensional syntheses. As the subject of experiential activities, the body has the schema of both deconstruction unity and the self-similar perceptual structure, and the endpoint of perception contains the extension of the local climate experience. It is not to achieve regionalism to discuss the architecture in cold places here as Anthony Earl of Shaftesbury put it directly and powerfully in his *Characteristics of Men, Manners, Opinions, Times* (Levin, 1993). The unique beauty of the region is widely accepted. Trying to abandon the part of national chauvinism in the article, the meaning of the sense of region is the source of people’s recognition and the beginning of “I think” when they feel sincere praise. Pallasmaa also proposed in *Geometry of Sentiment* that the acquisition of the architectural situation should be traced back to the experience of the environment. The essence of experience is the environmental extension of people’s vision, touch, smell, hearing, and stepping into the building, gradually acquiring the materials, space, and features of the architecture, and further projecting the transcendental to form “I think”. In this way, the architectural feature structure is solid, multidimensional, and complete. At the same time, in the creation of cold region architecture, architects integrate “I think” into the situation: Le Corbusier and Richard Meyer tended to express the architectural form visually (although there is a strong tendency of tactile wandering in the later period). Erich Mendelsohn and Hans Charon preferred incorporating muscle force and touch into their designs to demonstrate architectural plasticity (see Figure 2-22, 2-23). Aalto’s architecture is based on a complete understanding of the materialized human environment and the many instinctive responses hidden in the human subconscious.



Fig. 2-22 Einstein Tower designed by Mendelsohn (Rahmstorf, 2001)



Fig. 2-23 The switching of stair railing designed by Mendelsohn (Axelrad, 2013)

2.3.3.3 Emotional description in architectural spirit

Architecture provides a physical vehicle for different events and situations. The connection between people and architecture is based on encountering activities and experiences in the material carrier. The viewer approaches and faces the architecture, creating a connection based on the body structure, and realizing to initiates and guides the subject taking image-consciousness activity in the space. However, for the architectural entity object and the carrier of physical performance, more of it expresses

its loaded thoughts. The thoughts here or emotions come from the architect and the architecture itself.

In the cognition of the cold region architectural originary, the cold sensation is a critical way to obtain the sense of belonging in the cold region because the perception is never isolated. The cold description is closely associated with warmth and heat, accumulating physical experience in a series of blows, rain, snow, and sunshine. The understanding of cold will enhance the feeling of the interior of the building where people are located. The cold is not limited to numerical value as the physical temperature. The complete sense of cold is based on emotion and develops into thought. Like the cognitive terroir structure of the human spirit advocated by Herde (see Figure 2-24), cold arises from the objective environment but does not serve it. Its existence needs to be justified by the presence of the body. People's need for warmth in the cold is derived from the instinctive need for survival, and the pursuit of warmth-related intentions is also a way to explore their existence. In architectural design, the association of warmth is often accompanied by comparison: rough materials, cold colors, dark light, and shadow. This comparison is difficult for the viewer to obtain in the same space and at the same time. It is the recall of memories that enables the viewer to obtain the inner identity of the place. Instead of providing a space to block the external physical environment, the architecture aims to build a way for people to connect with the cold outside. This kind of practice with the meaning of Human Geography is reflected in the architectural design of the non-cold region to integrate the natural environment with the artificial environment. Different representation operations are to strengthen people's cognition of the natural environment. The architecture in the cold region is like a barrier, not to cut off, but to explore and deepen the meaning of belonging.

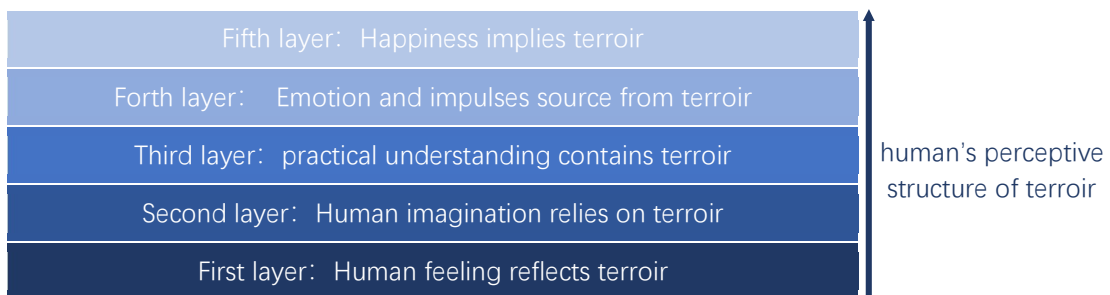


Fig. 2-24 Human spirit terroir structure promoted by Herder

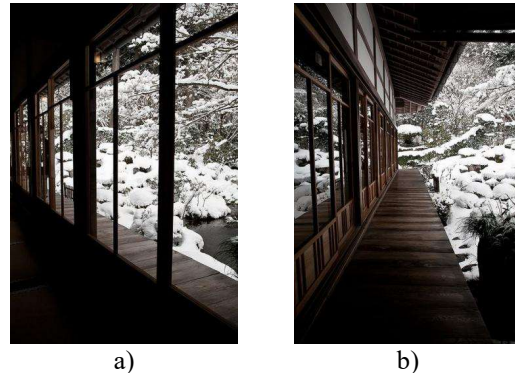
Refusing to be in the cold is out of the instinct of survival, which should only belong to the first and second levels of terroir structure summarized by Herde, which is the intuitive perception of the physical level. However, it is evident that people, as the main body of architecture behavior in a cold region, can reach a higher level of cold perception, especially those who have extensive living experience in cold areas. This kind of embodiment is just like a dialectical view of the ethical relationship between the construction and influence of people and the environment. Even if the cold is a part of the terroir and separated from the people's outer skin, it cannot be rejected from the inner experience. Moreover, the exterior wall of the architecture is just like a layer of people's skin to perceive. This understanding of cold is very similar to the relationship between the environment and people in Japanese Zen Buddhism. Only in the environment can people obtain inner peace and achieve natural silence. The "happiness is also indigenous", as the fifth level in perceptual terroir structure, is highly reflected in the temple architecture of Japan. Even in the mountains and forests with distinct seasons (see Figure 2-25), Ohara Sanyuyuan in Kyoto retains a walking space under the eaves. People do not refuse to experience their inner happiness in the "transition space" between the building

and the environment in the cold winter. By comparing the indoor and outdoor in the same season and location, the design emphasizes the natural environment is more “light” and “pure” rather than standing out the indoor brightness and warmth as some architectural designs in cold areas. This contrast and emphasis are essential to reflect the association between the cold natural environment and the indoor artificial environment and the “non-refusal” environmental view in the cold region to realize a genuinely high level of human perception.

2.4 Summary

Cognition of architecture is not a single composition of images or simple logical accumulation of materials but the establishment of multiple perception channels by individuals from the whole human cognition of the world. Multiple perceptions are constantly stimulated and extended to construct a complete individual world view. The reception of an architectural entity is by no means the purpose or endpoint of architecture cognition. As the communicative “skin” between people and the outside building, architecture’s significance connects the

individual body’s external and internal worlds. In the cold region architecture, the cold region is not only the pre-background for the architecture to be recognized, but also the place juxtaposed with the architecture, making different realities meet in the space so that the individual can obtain the actual “body” in the world, rather than being trapped in a self-shaped, limitless visual constructing. The cognitive paradigm based on image consciousness provides a cognitive path for the originary deconstruction of cold region architecture with cold as the cognitive background, making it possible to construct its principal structure. At the same time, the cold region architecture, as a thing, has the general thingness structure: intuitive thingness, instrumentality, and artistry corresponding to the material intuition, spatial perception, and place spirit of the building, which is unfolded in the cold region as the background of the cognition, which consciousness can be decomposing in the cognitive structure of the cold region architecture.



a) b)
Fig. 2-25 Indoor and outdoor in the exact location of Ohara Sanzen-in Temple’s winter in Kyoto (@T’s Photo, n.d.)

CHAPTER THREE

PRESENCE OF MATERIALITY IN COLD REGION ARCHITECTURE UNDER IMAGE PERCEPTION

3.1 Materiality as the presence of matter image

For people, the subject in architectural cognition, architecture construction does not follow a mechanical structure. If the cold region architecture could be regarded as a thing, it must be unfolded according to the thingness of the thing. This process of unfolding is the procedure of the experience of viewers. People cannot mechanically unfold a cold region architecture from a completely objective perspective. If meaning and value are removed, architecture cannot become work. If the “factors of things”, intuitive images, are ignored, the experience will not be possible (Merleau-Ponty, 2001, p. 255). Of course, the factor to successful architecture as work, besides the intuitive image, is more “other factors” to be received by people. Moreover, the “factor of things” triggers the “other factor” and combines with this “other factor” (Feng, 2013, p.31). In the cognition of cold region architecture, material, as the direct and intuitive object of people’s expectation for architecture, should not be reduced to the viewer’s perception, nor understood or described solely based on something the material extended in people’s perception different from its thingness. The representation of materials should be based on the “thing” in realism. The existence of the “thing” should rely on the “representation”, understanding of the image (Bergson, 2013, p. 194). Then, the basic originary of the material itself and its “appearance” and “presentation” in the cold region should be the first topic to discuss the cold region architectural materials.

3.1.1 Nature of material

3.1.1.1 Multiple natures of material

Material nature does not refer to the unique property of a given material but is abstracted from a class of common characteristics, “which makes things for things” (Heidegger, 2010, p. 8). People receive the differences between materials through nature. Since the birth of architecture, it is this material nature that has attracted Vitruvius to Alberti to Laugier, to Gropius, Wright, Le Corbusier, Steven Holl, Zumthor, and the other modernist masters, who put the discussion of materials at the center of theory and practice whenever there is a transition like architectural reconstruction. In architecture, the pure physical property of materials, as an intuitive element, is the architectural skin and the physical condition for the construction, divided into nature as the surface-decoration outside and the load-bearing inside.

(1) Surface-decoration Texture is a non-abstract, intuitive material nature, defined by the perception of roughness obtained when people’s skin comes in contact with the material. Surface-decoration has an apparent structure: after the primary color and scale are determined, the binary correspondence between texture and qualitative sense is also integrated into material nature. In daily architectural cognition, wood, stone, glass, metal can be directly judged by color, texture, reflection, and other apparent material factors, whose identity will not be blurred by the mixed situation in architectural images. Moreover, even if it is ignored that the priori as architectural components or the collage of two-dimensional images or a pure surface-decoration as material image present, the material nature still can be revealed. After getting rid of the “rules” of architectural elements, the abstract aesthetic meaning of the material nature would be discovered. Many architectural designs realize the independent abstract beauty of surface decoration by removing or destroying the transcendental consciousness of architectural elements. Once the appearance of the material corresponds to the building elements, the precise decoration of the architectural components will be formed. That makes the material a subtle difference between wooden columns and wooden window lattices. Architectural components add purpose to their materials, and architectural elements enable materials to acquire the attributes of the component’s category. When faced with being limited by

components and elements, the acceptance of architectural material nature will give way to the main body being composed and classified.

(2) load-bearing Material is the entity of the architecture. Load-bearing is a way for materials to prove their existence, and people are used to establishing a binary correspondence between materials and their load-bearing capabilities. If the load-bearing capacity of the material is fundamental to the architecture, then the following decorative function is only an accessory. That stimulated the emergence of the idea of the dual unity of material nature. However, at the same time, the architects tried to divide the architecture into the structural part and the decorative part, and this fuzzy multi-binary correspondence directly resulted in the complexity of the architecture. Dominique Perrault claims that there are two kinds of beauty in architecture (see Figure 3-1): one is objective beauty, which depends on the expression of architecture, the precision of construction techniques, the overall scale of space; The other is subjective beauty, which is the evaluation that people receive based on individual experiences, such as the space between the proportion of the relationship between materials, as well as the shape of the silhouette and the trend and appearance of the architecture. From the perspective of materials, the former is mainly derived from the load-bearing nature of materials, while the latter reflects the decorative nature of materials.

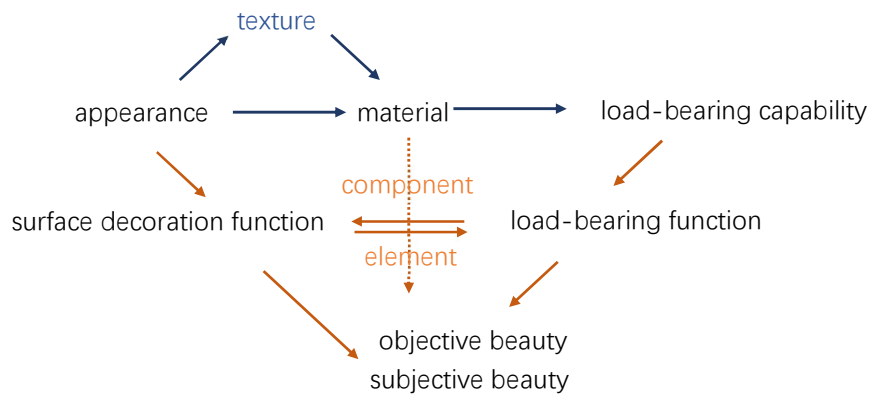


Fig.3-1 The multiple dualities of the nature of material

3.1.1.2 Multiple manifestations of material

(1) Natural manifestation The natural manifestation of materials is the authentic reproduction of the properties of architectural materials, and it has been the pursuit of many architects in design for a long time. Both the visual appearance of decorative surfaces and the structural appearance following the stress law is based on understanding and selecting materials. All the speculations about the nature of appearance and structure are preconditions for the cognition of architectural materials. Furthermore, the relationship between the architectural materials and the environmental materials they are placed in is also a discussion element to realize their natural manifestation. The relationship between architectural materials and the materials in their environment is also the context for realizing natural manifestation. For example, fair-faced concrete architecture respects the load-bearing nature of the material, but in the natural environment, its surface-decoration function is not the general environmental dialogue that people often expect. However, those glass houses deep in the forest (see Figure 3-2) can hardly be imagined as a residence or small museum on the Little Khingan Mountains in Northeast China (see Figure 3-3), where the dense dark brown pine forests are hardly comparable to the broad-leaved fields in Illinois. The way that Farnsworth House advocates getting close to nature is obviously very difficult to achieve in the cold region

of China. Mies used glass, the main melody of the building material language in the 1960s, to make architecture a transparent medium to reconcile the cognitive relationship between people and the environment. This view of nature is direct but limited to the architecture owner, while for the ordinary viewer, this perception through the architecture and the environment is too personal. The hut of the keeper of the Little Khingan Mountains adopts local materials and integrates with the natural environment to reflect the transitional relationship between the natural environment and the indoor artificial environment. The former applies the “perspective,” and the transparency of glass means the perception of a series of different spatial positions simultaneously (Rowe & Slutzky, 2007). The latter is the material utilization based on the perspective of construction. The natural manifestation of the material essence is a literal visual translation of the architectural imagery and the cognitive cornerstone of the next layer of architectural image consciousness.



Fig. 3-2 The Farnsworth House in Winter (n.d.)



Fig. 3-3 The Chalet in Lesser Hinggan (Zen, n.d.)

(2) Artificial manifestation There is a significant dialectical relationship between the natural manifestation of materials and the artificial manifestation in architecture. First of all, Vitruvius proposed in the *Ten Books on Architecture* that the nature of the materials that appear in the architecture comes from artificial because the original materials are difficult to be directly used in the construction, even the primitive cave dwellings have transformed the mountain. Although it cannot be called a natural building, it shows the difficulty of people to achieve “natural” habitation. Secondly, all building materials come from the natural environment. Therefore, it is indispensable for artificial processing in construction to realize the artificially manufactured building. Thirdly, the cognition of the natural manifestation of the material is the preconditions of the artificial manifestation. Titus Lucretius Carus defined materials’ primary attributes and secondary attributes in *The Nature of Things*, and “the nature of things” he advocated emphasized that the essence of natural materials must be appeared by artificial processing. For example, the natural condition of the wood, such as woodcutting time, growing place, and seasonal climate, are all classified through artificial comparison, which realizes the cognitive framework of wood as a material. Therefore, it should be recognized that materials all have “artificial” creation components. In architectural design, such creation becomes a reflection of the designer’s self-consciousness based on the degree of concession or application to the natural properties of materials. For example, the wood is taken from natural and vertical trees. The architect makes it appear non-straight and reverse curved effects through the processing technology, which architectural image presented will not be completely unified with the general properties. At the same time, the same sort of materials varies significantly in different regions. The natural primitiveness of materials reflects the in-place relationship of materials. Meanwhile, its processing mode reflects

the local craft and aesthetic tendency and reveals the dialectical relationship between residents' environment and self-cognition (see Figure 3-4). The presentation of the material itself can constitute complete cognitive imagery of the cold region architecture.

(3) Experimental manifestation Perrault believes that objective beauty is the most basic in the process of architecture being understood by viewers, and subjective beauty only depends on individual habits, so all intuitive observations are of particular significance. In his research, he tried to establish the corresponding relationship between all senses by separating the viewer's integrated perceptual experience. It is found that there is an equivalent relationship between the structure of intuitive perception and the structure of everyday public experience. Then the breakthrough of the so-called equivalence relationship, or the "misplaced" association of the material image generated by the fixed equivalence relationship, is the experimental manifestation of the material. That is the true meaning of Perrault's natural beauty. In recent years, architects have begun to expand the correspondence between existing materials' natural and artificial properties. For example, the heavy stone was polished to obtain the translucent properties (see Figure 3-5); Or by laminating one material to obtain a surface image of another material. One of the purposes of material expression is to cause abnormal perception. Therefore, by designing the directional generation of material images, the viewer can get the final perception through information collection, precipitation, and synthesis in receiving material images.



Fig. 3-4 The hardened wood façade was adopted in Saint Benedict Chape (Lin, 2017)



a)



b)

Fig. 3-5 A translucent stone facade was adopted in Deutsche Bundesbank (Bitter, n.d.)

3.1.2 Apparent properties and perceptual experience

3.1.2.1 Establishment of apparent properties

The surface properties of materials are people's physical descriptions based on the senses. This description is never abstract, and all aspects of the nature of the material must have "property" to be recognized or perceived (Shi, 2008, p. 30). Traditional classification usually focuses on the primary and secondary properties of materials (Hays, 1988). The cognition of the primary property primarily relies on the scientific development of perceptual intention downwards. It proposes new performance viewpoints and concepts from a known angle or derives a functional relationship between appearance and content from a brand-new perspective. The secondary property is those elements that are uncertain and vary depending on the environment and processing conditions, such as the relationship between woodiness and soil, landform, light, humidity, and harvesting season. At this time, all defined words to describe the decisive status of the apparent properties will face failure, and it is the occasional characteristics that reconstruct the contours of the material and make its different features. The constant and long-lasting primary property and the secondary property, which have a regulating effect on the environment, have stimulated new thinking about the influence of materials on architecture.

In cold region architecture, even if the same material is used, different "property"

changes with self-organization will be triggered under the mediation of different geomorphology, environment, spatial form, and other factors. Moreover, the architectural space has become a carrier for transforming the judging mechanism, and the subject is the viewer. Therefore, the phenomenon shows that the secondary property of architectural space is critical, and the view of architectural materials from the cold environment is fundamental. A regional material translation, just as the secondary property dimension presentation of wood materials in winter cold region architecture (see Figure 3-6), differs from tropical buildings (see Figure 3-7). The non-natural modern materials, such as fair-faced concrete, without secondary properties for linking their inability to perceive their origin, lose the original foundation making the architectural space appear no sense of place belonging (see Figure 3-8). Therefore, establishing the apparent properties needs to restore the material to its original appearance and take the locality as the starting base of properties.



Fig. 3-6 Wood Duck, Canada (Jérôme, 2016)



Fig. 3-7 Punta Sayulita Treehouse, Brazil (Petr, n.d.).



Fig. 3-8 No-environment building leads to placeless (Minh T., n.d.).

3.1.2.2 Accumulation of perceptual experience

In architectural design, architects constantly waver between showing and concealing the quality of materials. As Sullivan said, the true architect is a poet, but he uses no words but architectural materials. However, when space becomes the carrier of material expression, it is applying material based on attributes. No matter primary or secondary properties belong to the apparent properties, they constitute the first attribute of the material space. With the architectural dialogue with the ground, the second attribute of the architectural space is achieved by the human-oriented judgment. That is the proof, rooted in the material level, for architectural isogenicity. Back to architectural space, as a kind of artificial product, the fundamental condition of its existence is the existence of people. The second spatial attribute is the accumulation of people's perceptual experiences based on different external causes. Such as the spatial material in the snowy night and the hot sand day; the spatial material in the cold wind and the warm tropical sunlight; the first attribute has not changed, but the second attribute that people pay more attention to has changed completely. If only the natural environmental factors, the functional relationship between material properties and environmental factors are likely to show a simple linear. Once the humanism factor is added, the second spatial attribute of the material becomes a fundamental factor in understanding the architecture.

Meanwhile, material emotions also tend to resist and follow. In winter cities, ice, snow, and cold wind are natural climatic phenomena and the main body of winter life of residents in cold areas. In addition to the negative "resistance" emotions such as snow removal and clearing snow, the cold culture also gave birth to unique ice and snow activities. It is not limited to sports based on ice, snow cover, or the interface, but with

snow and ice as a companion in various forms to express the love of snow and ice and cold cities, which is an emotion derived from the accumulation of emotional experience of the snow, the cold environment, and the material. It is no need to demonstrate that there is an aesthetic structure in the appreciation of artworks. The understanding level and result of abstract things depend on the individual's perceptual experience, which can only achieve internal high-level resonance and consistency.

3.1.2.3 Autonomy of conscious images

Autonomy is a philosophical concept that Kant defines as “ought implies can”. The rationality of the individual must be based on the freedom of choice of consciousness because consciousness is also the fundamental attribute and way to distinguish man from machine. The in-itself primary property of the material generates the secondary property of autonomy in its interaction with the environment and people. The second property of the material is indirectly created by possibilities of the environment, which provide an opportunity of consciousness autonomy from the image. Leatherbarrow's series of works all show the recent shift of attention to the secondary properties of materials, especially in *Architecture Oriented Otherwise*, applied the philosophical concepts and methods in *Otherwise Than Being or Beyond Essence*, and the relationship between city, architecture and material discussed and proved by using architectural cases. That also reflects a common focus from contemporary architecture scholars on the “sensibility” or even “sensuality” of materials. The American painter Robert Rauschenberg once summed up his view of art life to Leatherbarrow: “Art and life are inseparable, and anyone who tries to separate them will lose everything”. Moreover, Rauschenberg spent his life trying to bridge the cognitive gap between life and art. This difference and connection, obviously, also exists between architecture and art. According to Leatherbarrow, architectural design has more to do with people's dwelling spirit, while architectural structure enables functional shelter (Leatherbarrow, 2008, p. 21). Therefore, the study of perceptual association with material images is a way to connect life with the ontology of architectural art.

Obviously, the architectural materials are almost processed. So long as they leave the original state, they will lose their true purity. The consciousness regression of materials starts with the primary property caused by the material image and then through the environmental association of the secondary property. Finally, the primary property and the secondary property are integrated to form the material's apparent property contour and synthesize the first attribute of the space constituted. As the subject of material cognition, people complete the autonomous unfolding of material cognitive structure from image to consciousness. The so-called unfolding indicates that the material is understood in the space with the same structure as the aesthetic process of art. When discussing and examining the material view in the space, people need a humanistic standpoint. The pure objectivity of materialists is inappropriate. To sum up, the fundamental and invariable properties of materials have been invalidated in the architectural space, and it is obviously not appropriate to the only talk about the primary properties of materials. Multiple secondary properties should be combined to examine the whole architecture.

This point above has been discussed and practiced since the Renaissance and intensely explored in Nordic cities, whose view of architectural material is the all-around expansion of the environment without blindly follow technologies and materials of postmodern architecture.

3.1.3 Matter re-enchantment and perceptual atmosphere

3.1.3.1 Image and non-image of material

Jean Nouvel introduced the concept of “non-image” in a speech he gave at the 1988 Jerusalem Architecture Symposium, arguing that people “desperately want human beings, like magicians, to be able to create anything that suddenly appears or suddenly disappears at will; Can also teleport or self-propel more quickly to any illuminated position” (Leatherbarrow, 2008, p. 78). To confirm or at least support this view, Nouvel echoed Paul Virilio’s observation about contemporary technology: “Speed and technology remove the barriers between man and nature, between our world and the universe”. In support of these comments on technology and place have been references to the transparency work of James Turrell and Nouvel’s recent work in Paris: the Cartier Foundation for Contemporary Art (1991-1994) and the Centre for Arab Studies (1981-1987) (see Figures 3-9, 3-10). In all these works, there is a sharp, almost erasure reduction. It eliminates the separation between the “world” in which people live and the nature created by traditional architecture. That is because “people want there to be nothing between heaven and us... We want a state of material does not exist, to be able to put us in this place and the non-artificial world”. Leatherbarrow understood that what Nouvel wanted to express here was nature, but by no means pure nature. What Nouvel advocated was that we should not give up the connection with nature even in the city. As an artificial material processing, the new images formed by the city have been isolated from nature. “Glass, the most invisible of materials, will be the key to re-establishing the connection between architecture and nature and urban life, just as the world-nature connection is achieved through the urban world” (Leatherbarrow, 2008, p. 55). Nouvel’s “non-image” or “no image” criticizes the fragmented architecture-city image secularized without foundation, losing growth vitality.



Fig. 3-9 Cartier Foundation Building (Boegly, 2013).



Fig. 3-10 Institut du Monde Arabe (Enrique Jan + Jean Nouvel + Architecture-Studio, n.d.)

3.1.3.2 Space and atmosphere of material

In the same year that Nouvel made the above comments, Peter Zumthor presented his view on the relationship between architecture and its environment. In stark contrast to Nouvel’s “non-image”, Zumthor, writing of his Vals Baths in Switzerland, explained: “The building takes the form of a large stone object covered with grass embedded deep in and within the mountains (see Figure 3-11-a). I try to give an architectural interpretation to this series of words... Guiding our design and giving it shape step by step.” In the built environment, people rely on materials to obtain rich perceptions. In its fully manifested material, it seems that the architectural space is formed by hollowing out pre-existing objects; Zumthor did not seek a light building, but a heavy one that was solid, heavy, and thick (see Figure 3-11-b). Nouvel’s works proposed the pure passage between the interior of the architecture and its environment. In contrast, Zumthor’s works simulated the pure connection with no difference between interior and exterior: the substantial space and

state, rather than the “trajectivity” described by Virilio and Nouvel.

For architecture, the search for atmosphere begins with material theory, going back to Weser Renaissance architecture. The great Italian architect Andrea Palladio advocated unadorned architecture, which is deeply rooted in the environment and landscape, and constructed from local materials. Based on this perspective, Zumthor put forward the “combination” and “inlay” that naturalize the building materials in the natural environment. It is not difficult to find that this way of material cognition is bottom-up with a historical dimension, atmosphere, and “spatial nature”. When a specific tree in front of the viewer, its own growth time is added to any perception process. On the contrary, clean metal is brutal to create a sense of time, so the architect used metal rust to express the historical dimension supplied by the material (see Figure 3-12). Thus, the material exists as the statement of time with a charming atmosphere. At the same time, when the emotion of things has the dimension of time, the sense of space emerges.



a)



b)

Fig. 3-11 The Therme Baths Vals (Ceriani, n.d.).



Fig. 3-12 Berlin Jewish Museum (Ziehe, n.d.).

3.1.3.3 Perception and consciousness of material

In *Ten Books on Architecture*, Vitruvius proposed the potential similarity between different materials, but then from Perrault to Laugier to Caesariano to Piranesi, no one made the same evaluation (Shi, 2008, p. 11-24). If, as Laugier pointed out, emphasizing the similarity of materials is to encourage imitation between materials, then why not let the material represent itself. The reason why the material can become itself is not only related to the

superficial image but also related to more internal properties, which cannot be obtained through external imitation. Moreover, the architect also selects materials and constructs the building according to the uniqueness of the materials. The material form should be consistent with its unique properties, thus forming a coherent architectural consciousness. The primary property constitutes the first feature of the material perception structure, which is the foundation and benchmark extending to the second feature. When the external environment material imitating, the internal structure of the material’s properties will be confused in the material cognition. If the external environmental characteristics are positively promoted with the factors of the primary property, the material perception is more based on the return of the mechanical characteristics of the material’s first attribute. Submissive perception stimulates extended thinking of the material itself because there is no contradiction between the appearance of the primary property and the manifestation of the secondary property. For example, when Vitruvius insisted on making the stone appear like a tree trunk, it was evident that trees could directly express trees. However, the external factor of the secondary property, the carrier, made the material obtain characteristics inconsistent with the primary property. The primary property of a material is its origin. The process of establishing secondary properties of the material is

the people as the subject, recognizing the self's reappearance. In material cognition, the transformation from objectivity to subjectivity is realized from perception to consciousness, and the process and purpose of people's cognition of the world through materials are also completed. "Things are not transmitted by sense, sensation, or perception; We face things directly, we can only understand the limitations of our knowledge and cognition from the secondary aspects" (Merleau-Ponty, 2001, p. 255).

For the image perception of materials, it is necessary first to establish people as the perception subject. Like Wittgenstein's "Architecture of the Author", he emphasizes not the individual's applied reconstruction of space, but the necessity of the individual, as the subject of feeling, trying to describe the space and realize the reproduction of space. Without the subject, there is no description, and the space cannot be reproduced. The space that cannot be reproduced is the space without a subject, just a combination of a pile of materials. In the description, the selection of material in space has the originary of binary correspondence but without an absolute rule of selection result. So the individual factor is the primary issue in material cognition. It is a prerequisite for discussing material that recognizes individual choice and representation based on personal experience.

3.2 Surface as the construction of imagination

3.2.1 Concept of enclosure and definition of surface

3.2.1.1 Combination and staggering of material

In Zumthor's view, limited, untreated raw materials such as stone, wood, and concrete offer the opportunity to inject astonishing power into their architectural expression. He wanted to reveal "the eclectic meaning of these materials without any cultural overtones" and to allow "the materials to echo and flourish in the architecture (World Great Architects Editorial Department, 2006)". Many architects like to stimulate the viewer's deep reading of architecture through the combination of materials, such as the Vals spa, which simulates nature through various materials and dissolves the building in the natural environment. Of course, it is also worth discussing the proponents of mono-materials, architects like Tadao Ando, who have their own "obsession" with a single material. Through the above discussion, it can be concluded that the reading of materials will extend to the association of the secondary property through the surface reading of the primary property. The architecture material will trigger the "readers" to continuously collect, sort out, and recreate the architectural information. The architectural consciousness is to gradually establish a clear outline in acquiring a series of information with structure. When architectural images are composed of a single non-natural material, the void of natural association causes indirect association when they are read. As Tadao Ando used to apply concrete in his works, his "readers" would perceive the color of concrete as gray stone or white marble; The rough touch can be reminiscent of the natural unfinished, and the smooth one will have a sense of alienation of metal. The reception of its manifestation is based on the viewer's priori to other natural materials with the primary property. Therefore, when the material loses the primary property, there is no natural "link", the architecture is shaped like the manual mold of the designer, and the viewer will immediately focus on the next cognitive level of consciousness construction, space. With such materials, the understanding of architectural space will become pure and concentrated.

(1) Transparent overprint Gyorgy Kepes, in *Visual Language*, defines transparency as "the simultaneous perception of different spatial positions". The transparency mentioned here obviously starts from the "visual passability" of the primary property of the material and sightline through the first material to see the second material. The image of the second material obtained at this point is different from the image

intuitively received but superimposed a series of properties and characteristics from the first material. Kepes adopts the transparency of literal reality described by Gideon and also proposes the transparency of phenomenon. For example, even if has a clear, digitization degrees Celsius to calibrate temperature, people still used to rely on the outside through the window to obtain visual images to produce experience feelings with that of the binary climate information, on the cognitive more specific and direct, such as how thick is the snow on the ground outside, the wind, can feel the temperature changes. At this point, the transparent overprint formed by both the glass window and the material image outside is true transparency. Furthermore, through the glass window, the indoor space and the outdoor space are connected by experience. The viewer will place his body in the cold environment outside the window through the image association. The priori will be integrated into the image and the present consciousness, which is the transparency of the phenomenon. Just like the constructivist Moholy-Nagy (see Figure 3-13) and the cubist Leger's ambiguous spatial changes in the vertical superimposition of images (see Figure 3 -14).



Fig.3-13 Am7(26), Moholy-Nagy (1926)

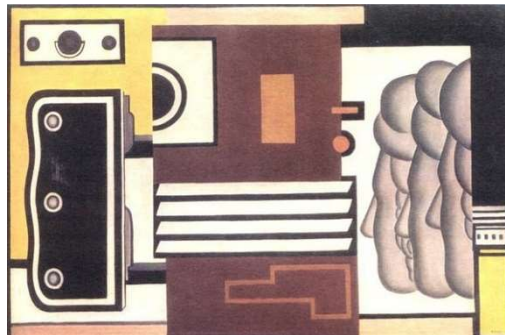


Fig.3-14 Three Faces, Fernand Léger (1926)

In addition, the discourse of transparency can transition from the primary property to the secondary property. When different buildings overlap in one's field of vision, nobody would think that the building lacks in form, even if the occluded building without "visual penetration" property. In image perception, the perceptual association enables the viewer to complete the blocked architectural image in consciousness construction. Even if the results are not accurate, the establishment of Gestalt is conducive to the extension of the following architectural consciousness. Therefore, when an impenetrable transparent overprint occurs to the architectural image, the viewer will constantly adjust his position to obtain the overprint to establish a more completed architectural impression with a changing architectural image. The obtained transparency is based on phenomenological cognition, and all the construction of architectural consciousness is like peering through "glass" with the sightline from one space to another to establish the "figure - background" cognitive connection. In the winter of cold regions, the climate provides the material properties of the "background" of the architectural images, such as the vast sky, the surrounding monotony covered by snow, and even the mud of melting snow. Architecture more or less obtains the effect of overprint under the environment as the background, and space obtains the layered structure in overprinting, which is the mechanism of perceiving images and gaining consciousness beyond intuitive materials.

(2) Memory association According to Plato, all cognition is based on experience. Memory is a database of individuals, and association is similar to data matching for judging the world. Therefore, memory is the individual's cognitive channel to the world, and associating is the process of channel establishment. For example, the cold perception can be associated with the snow image, and association results are

different for people with different memories of snow. An accurate cold perception binary correspondence cannot be established by snow image alone, but the corresponding establishing mechanism is consistent. Colin Rowe stated he could “feel the implicit passion of concrete through the glass curtain” (Rowe & Slutzky, 2007). Obviously, this kind of memory association cannot be directly shared and obtained. All the associations are based on individual experience and can only analyze the mechanism without drawing a clear conclusion.

In 1948, Henry-Russell Hitchcock discussed the connection between modern painting and architecture in *Painting Toward Architecture* and proposed that association based on multiple materials was the primary theoretical and practical development mode at present. This view can be found in a variety of artistic movements throughout the 20th century. When a viewer integrates different material images in one frame, various materials no longer exist independently but are associated with each other. The material perception of cold region architecture is mainly derived from the association of various materials, the most characteristic of which is based on the memorable experience of coldness. The covering or comparison of the materials on the exterior surface of the building by snow makes the architectural image consciousness in winter different from that in summer. It is the visual association of the environmental materials in the cold region that lays the foundation for the whole consciousness structure of the cold region architecture.

3.2.1.2 Experience and overload of material

“I am convinced that a good building must be able to appeal to the trajectory of people’s lives, thereby gaining a special richness.” This Zumthor’s passage implies that the architecture material itself should be capable of bearing such imprints rather than relying solely on geometric or spatial forms. Of course, if the material cannot participate in the construction of experience, the relevant experience will not occur, and the secondary property of the material will not be able to get feedback beyond the primary property. At the beginning of the design, it is inevitable for the architect to construct the viewer’s “life trajectory” in the future through his own experience. So, the expected trajectory may occur, or it may not be easy to identify with or perceive. For material perception, no particular technology or professional knowledge is required (Leatherbarrow, 2008, p. 78), which is the general knowledge among individuals and creates the first consensus of image perception for the space enclosed by materials.

Complex architectural images can be moving enough and change the viewer’s trajectory, but it is pretty limited for the progressive improvement of life. At least for architects who are more concerned with the primary properties of materials, the necessity of complex forms is open to question. In 1908, Loos criticized the city image with intense decoration, suggesting that the house be “dedecoration”. In 1924, Le Corbusier published his famous critique of French decorationism: “The chairs express too much desire.” Tadao Ando said that in his works, he tried to use as few materials as possible, simple forms, in order to express the maximum emotion. Abandon all redundant elements is to make space genuinely realize the ultimate actual performance of human existence. In fact, the excessive material images form information selection overload in the understanding of architectural space, which makes it difficult for the viewers to experience the actual space. Purity does not mean superficiality; Overloading is challenging to achieve abstract profundity. If the understanding of materials is mainly based on binary correspondence, it is obviously hard to clarify many elements in architectural originary. In cold regions, the architecture carries most of the people’s life trajectories. There is a phenomenon that material overload overwhelms the initially true life, and the consciousness of architecture is only anchored at the material level without expanding to a deeper one. The former

makes the viewer get lost in information chaos, while the latter is difficult to arouse the viewer's resonance to the cold perception.

3.2.1.3 Transcendence and penetration of material

Material cannot exist independently, and there is no cognition gained through memory without experience. As the matrix to obtain material consciousness, the primary property is by no means the whole of material consciousness. In architecture materials and the primary property mentioned above, there is also a secondary property in the time dimension. Material images will “evolve” together with the overall architecture image over time, allowing viewers to obtain a more vivid perception. On the other hand, the processing will be reflected in the material images. All the processes are hidden in various image imprints, which have apparent directivity of consciousness in the cognitive structure for the directional experience. For example, in Saint Benedict Chapel (see Figure 3-15), Zumthor adopted local shingles and the traditional firing process, in which color changes with the water content in the air, making the building color transition from reddish-brown to gray and white throughout the year. The overall shape creates a rough and determined tactile image. In addition, the architectural details contain a large number of curves and warp to build a close intimacy.

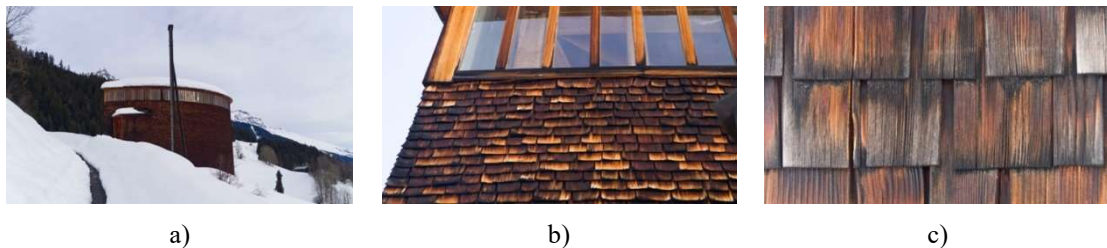


Fig. 3-15 Saint Benedict Chapel, Sumvitg, 1988 (Jiumenhutong, 2018)

3.2.2 4-dimension compounds and surface flow

3.2.2.1 Dynamic perception of material

In cold regions, the perception of building materials is based on a significant flow in architecture consciousness formation. Although people generally do not accept that dynamic blurriness and lack of focus are typical visual perceptual systems. Vision is the primary source of information for constructing people's daily perception world (Merleau-Ponty, 2001, p. 255). However, the single frame of images captured at each instant is only a fraction of the information surrounding it. First, the information obtained is limited by the Angle. Secondly, under the influence of the habit of focusing the brain, only the object in focus is relatively straightforward, and a large number of images outside the focus are blurred. Just because of this, the depth of the object in the space can be revealed. The so-called surreal realistic painting school uses the originary of multiple exposures to make multiple focal points in the same picture. This “defect”, in which materials are displayed unequally in architectural images, helps people establish spatial order and makes the images have the dynamic meaning of direction in the transfer and transformation of the path. Even though an object's existence does not depend on the subject's acquisition, the object cannot become self-evident if it is not acquired. In other words, acquisition is defined as being perceived by the subject. The information acquired must be subjective, and people think that the objective world is a complete projection of subjective feelings.

It can be said that the image of the world obtained by people through vision is not a single image, nor can it be genuinely felt independently of other information. Consciousness must be placed in a continuous, malleable cognitive structure, and the

individual's perception is constantly fused and reconstructed through memory. That is also how visual perception transforms into expressive tactile entities, rather than a single retinal image like a snapshot lens. Ultimately, it is an experiential, tactile understanding of the world that enables people to establish and sustain the existence, permanence, and continuity of the experience; As Merleau-Ponty put it, "We share our embodied existence". People can regard self-consciousness and world consciousness as one of the sensory systems. In Rudolf Steiner's philosophy, the four components of human beings include self-consciousness, which corresponds to the pure state of matter in Goethe's natural philosophy. As a result, perception is a necessary channel and must be placed in the continuous dynamic display of "background – figure" in material cognition. At the same time, recent neurological studies show that color is perceived more than shape, and shape precedes motion, with a difference of 60 to 80 milliseconds between color and motion. In the winter architectural experience, people first see some colors, confirm the properties of the objects being observed through their shapes, and finally, their dynamics (see Figure 3-16). Therefore, the perception of building materials is sequential, continuous, and can be said to be dynamic.



Fig.3-16 Skigard Hytte Cabin, 2019 (Damonte & Benavides, 2019)

3.2.2.2 Consciousness construction of material

Gestalt theory establishes opinions and related tendencies for the expression of material images. However, this argument helps people understand relationships of properties that have definite shapes and devise a series of adjectives to describe them, such as simplicity, similarity, and compactness. The theory deliberately avoids the forms and elements Gestalt cannot explain, which does not explain why all images need to be understood through this theory as a graphic-psychological cognitive model. Freud has observed that, for the conscious mind, the formal experiences born out of the lower level thoughts, such as dreams, visions, hallucinations, have no fixed and captured forms, are full of mixed images, associations, and memories, and are always indescribable compared with other experiences. Nevertheless, this seemingly untrained and unrepeatably process of consciousness contains rich artistic expression and creative insight. Constantin Brancusi described the profound need for art to evoke "the shock of life" and "a sense of breath".

In Anton Ehrenzweig's research, he distinguished apparent vision from the subconscious, believing that what the former presents often focused on the figure, reflecting the separation, different from the early unconscious, full of continuity and seriality (Ehrenzweig, 1969). Experiments with subliminal vision have demonstrated its excellent efficiency in scanning the entire field, for example, by being able to understand the highly brief exposures of subliminal images that are intentionally invisible. This ability is shrewdly used in architectural metaphors and other forms of psychological regulation. Ehrenzweig convincingly identified the priority of unconscious perception and thinking in the creative process. He went so far as to argue that all creative activities

in people's minds, including architectural design and architectural consciousness, involved a "temporary paralysis" of some superficial functions. Not each stage in the consciousness structure requires the apperception of all senses, and sometimes even more focused on a particular perception to achieve a relatively concentrated and pure sense. The indescribable elements of artistic language are the addition of multiple art forms and the source and essence of artistic language. Ehrenzweig believed that "Non-gestalt vision", namely the visual mode that appeared outside the rules of Gestalt vision, was crucial, and the use of hierarchical perception ability for simultaneous and parallel images means that normal focusing perception must be suppressed (see Figure 3-17). According to Henri Bergson, "all creative thinking begins with a state of fluid vision comparable to intuition. And then, rational insight emerged" (Ehrenzweig, 1969, p. 35). Ehrenzweig concluded that "All artistic perception has an element of non-gestalt", and "Non-gestalt fusion vision is an artistic way of observing the world" (James, 1890, p. 36).

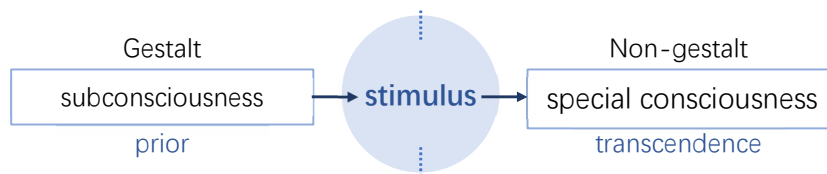


Fig. 3-17 The layers of construction of material consciousness

The establishment of the subconscious is not only the judgment formation of the subjective world but also the existing foundation of the objective world. For example, Richard Fuller, a famous American engineer, explained his extraordinary ability to read as scanning. The pages he saw were meaningless grey surfaces that contained no detailed information before his subconscious discovered any new information. This point of view effectively explains that in China's cold cities, a large number of repetitive residential buildings are challenging to trigger people's emotional impact on the cold environment because even if the form is changed, such a gesture has been retained in the subconsciousness of residents in cold regions and cannot create a new perception. Therefore, the level of material consciousness depends on whether the apparent architectural image deviates from the viewer's subconscious agreement on the established content.

3.2.2.3 Atmosphere generation of material

Zumthor once thought that the reception of architectural atmosphere burst out when entering the architectural space. The atmosphere was the symbiont of the material image. Eighty years ago, John Dewey, an American philosopher, spoke eloquently of an encounter with the atmosphere of a church, which produced a dizzying array of expressive but unordered architectural images. He was greeted by sudden opulence and the wisps of cigarettes in the dim light as his stepping into the church, together with colorful mosaics and powerful beam-columns, merges into an overall impression that cannot be separated each other. The architectural atmosphere is more compelling than a static painting because the viewer comes to the atmosphere and is immersed in it. This timely experience is full of sensibility and subconsciousness. In the primary collection of visual information, the material information obtained is scattered, connected in series by changing the focus sequence. Unless there is a significant position or mark, the order between the materials is difficult to be received following some deliberate guidance. In the whole construction of architectural consciousness, the things that the viewer focuses on first, even if the architect attentively designs the focus direction, cannot guarantee that the expectation will be presented entirely in the viewer's consciousness unfolding. The perceived material is

open and indeterminate, and these intuitionistic pure attributes are all perceptual objects in the structure of image consciousness. By comparing the perceptual object with experience and memory, people get that the image content in front is the “representation” symbols with objective meanings such as snow, ice, trees, and windows. Then associations following the representation may arise: snow has the imagery of deformation after stress, ice has the imagery of melting after heating, wood has the imagery of carving processing. The association projects the material images in front of us beyond the space being in but does not depart from the human body perception. These association perceptions are the origin of the architectural atmosphere.

The atmosphere of materials in the construction of cold region architecture consciousness should naturally include the harmony of snow and ice as background materials so that all architecture materials have a dialogue with them. Then a comprehensive impression of the cold region and architecture there can be obtained. In this process, there is no point in discussing the whole order of the material discovery because individuals will freely construct all the elements in the consciousness construction and automatically find the focal point of balance to form the overall image theme.

3.2.3 Time-space and behavior experience

3.2.3.1 Material superimposition: light

The natural place seems to be a manifestation of eternal order and can be self-centered “anun-*dfursichsein*”. Light is a unique material in nature and covers the building with a specific skin. As for a translucent property, its description mostly feels the body’s expansion with nature as the background. However, due to the characteristics of the locality, the perception of light can vary greatly. In cold cities, light is a vivid, dynamic and poetic element as the condition of the atmosphere changes continuously. Like the flat surfaces divided into small spaces, the light retains a local and accessible value in the Netherlands. The landscape of northern France, on the other hand, unfolds and expands into the sky, becoming a vast stage and providing sunlight with a continuous and changing quality. The experience of the “light world” inspired the illuminated walls in Gothic churches and the Impressionist paintings of Monet. The solid and warm sun permeates the space, triggering the plastic quality of the natural shape and the “thing”.

In winter, the light environment and being able to judge the position of things, material, contour, and bring a sense of the region. In the perceptual activity of architecture, light introduces the relationship between natural place and artificial place, which enriches the levels of image perception. When people perceive buildings, light is the condition to discover the architecture materials. At the same time, people can experience the light in the architectural image separated from the architecture. Thus, light has become an extraordinary layer in the image materials of architecture cognition, with vital timeliness and temperature, bringing people natural associations.

3.2.3.2 Duration of motion: time

(1) Process generation Bergson proposed that the body, by its position in the world at each moment, indicates the parts and aspects of the material that people can grasp: perception accurately measures the virtual actions people take on things. The viewer gets a series of images about time through the existing material images, such as worn wood or rusted metal. A series of material images of the process can be associated through the instantaneous image of material people obtained, in which time also becomes concretized. That is time stored through material images and the presentation of sensuous and physical natures in addition to its materiality. Due to time, architectural materials are no longer

self-centered but constantly interact and exchange with the surrounding environment, reflecting the actual existence.

The contemporary public culture moves towards the alienation of the relationship between human beings and reality, the indifference of the senses, and the exhaustion of passion. Painting and sculpture seem to have lost their sensuality; Instead of creating intimate perceptions, contemporary works of art often express the abandonment of sensual curiosity and pleasure (Pallasmaa, 2012, p.38). The cold image is ossified into a single temperature, and the cold region architecture is being mass-designed as an insulated incubator. People are forced to live in a time-lost and unreal world.

(2) Layer analysis The weakening of entity perception makes the current standardized construction more boring. With the continuous enhancement of experience, the vision can penetrate the surface of natural materials, such as stone, brick, and wood. The non-static exploration of materiality images affirms the entity. The general presentation of natural material is frozen when processing is completed, but the material image is self-evident for its history, including its age, origin, and experience; all the information continues in the image-time. However, today the deeply machined building materials are trying to present a single image to the life-world. Different materials show various transparency along with changing times. The definition of transparency does not come from measuring the amount of light penetration but from the hierarchical perception of time. Synthetic artificial materials do not have a temporal dimension, so it is hard to build deep localization associations with any nature factor. The contrast between artificial and non-artificial images is hidden behind the temporal background of the terroir.

Transparency has become one of the central themes of contemporary art and architecture. It creates a sense of thickness in the space as well as subtle variations in movement and light. As a result, most architectural materialization thinking focuses on the expression of “void” and “solid” that leads to varied spaces, places, and meaningful experiences. When the change of material transparency is obtained in the continuous overlapping images, the timeliness of the image will be dissipated, thus having a destructive spiritual effect on the time experience of the material in the environment. People have a spiritual need to recognize that they live in a river of time; Experience is the way to store time. If the flat transparency of technical materials domesticates the residence, the time experience in architectural space will disappear. The contemporary cold region architecture loses its localization expression and is essentially unable to accommodate endless time, making people’s settlement an instant eternity.

3.2.3.3 Integration of perception: embodiment

Embodiment is the multidimensional reality of images generated by perception and the structural consistency of materials from the local to the whole. More importantly, the embodiment enables time and space to have the same structure in materials and achieve unity (Ji, 1992, p.18). Heidegger put forward a question about the universality of architecture: facing the same material, what determines the architecture to be made and what determines it to be inhabited. He then gave many examples of “staying” and “stopping” and proposed a series of perceptual terms: safe, guarding, above the earth, free. The superposition of this series of perceptions forms an image of the dwelling place and the house. This process is embodiment. Understanding “being” exists in almost every event in the world, and embodiment has the purpose of superimposing image consciousness from seemingly different sources. Like how people determine the entity’s existence of architectural materials, it is necessary to connect the tactile image, color image, material image, background image in all the architecture environments according to time. The ultimate goal of understanding architectural materials is to understand the originary of

architecture. The building materials make the whole cognitive structure of the building superimposed into a more extensive system.

In a cold environment, what affects the perception of the material is the superimposed image of each layer: the touching sense of the wood under cold wind; The color of the iron frame under the warm winter sun; The faded bricks hidden in a field of snow. The embodiment of cognition image is incomplete without the environment, or it is impossible to achieve the real embodied. In addition to wind, light, and snow, a cold environment must include all the contents formed by the cold terroir, including cold behaviors, cold customs, and cold other habits. Italian architect studio NOA Network Architecture has designed Hotel Torfana by Badia Vally (see Figure 3-18) at the foot of a snow-capped mountain. The architect developed the undulating outline of the snow mountain in the environment into the form of the building, responding to the winding of the ski track in the local ski resort with continuous curved corridors, hoping to reflect the interaction between people and nature inside the building. The building's contour line echoes with the mountain in the background, making people think about the relationship between people and the environment at the graphic level.



a)



b)

Fig. 3-18 Hotel Torfana in winter (Filz, 2016)

3.3 Place as the origin of order representation

3.3.1 Classical order and humanistic rationality

3.3.1.1 Original perception of material

Louis Kahn once asked, with religious devotion, “what does a brick want to be?” Pallasmaa argued that “all material has its own will to speak its own language”. Heidegger believed that because of the stone as a material, there was the later stone axe, “the better the material is, the more suitable it will disappear in the existence of the instrumentality without resistance”. That implies the origin of manufactured products is often associated with the properties of natural materials, so with time, the independent properties of materials have been ignored due to their instrumental appearance. Just like in the construction of architectural consciousness, materials are paid attention to as the entity of architecture. The inquiry of the architectural originary naturally refers to the material primary and secondary properties: the primary property is the natural physical property, and the secondary property is the physical property presented through processing. For example, people will not confuse the lofty mountains with the temples of Athens, but they can feel the connection between them: from the point of view of the material, they are all derived from stone, one is a mountain from original nature without artificial “intervention”; One is a temple as an “artificial” spirit carrier. “It is the stone that makes temple opens the world of works, together constitutes a series of shared qualities:

persistence, bearing and eternity. The temple establishes a world that does not make materials disappear but makes them appear” (Heidegger, 2004, p. 32). If there is no stone to build a temple, people, as the subject, will also have limited and stagnant cognition of the stone. Of course, as a tool, people’s perception and association of mountains are also enriched during the construction (see Figure 3-19 and 3-20).

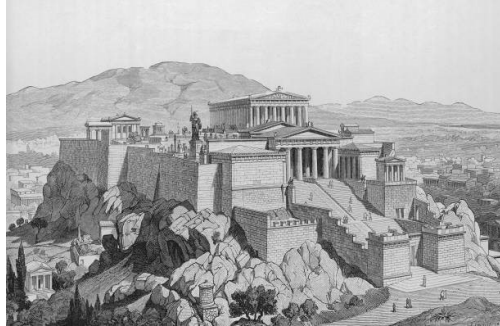


Fig. 3-19 Athen Acropolis (Mayes, 1906)



Fig. 3-20 The Parthenon in Athen (Baldwin, 2019)

In the Cold Region Research Center of Harbin Institute of Technology (see Figure 3-21), stone has been restored to its original natural form. The stone and steel bars hidden in concrete are relieved by mimicking the reduction of the concrete, but they are still confined to the metal frame. The architect’s attitude towards materials does not stem from an attempt to return to their original roots or from the philosophical inquiry. After the superposition of materials, it is an experimental attitude, obtaining multiple orders between materials and the environment employing contemplation, rather than a deep artificial processing method, which ensures the long-term retention of such precious physical properties in objects. Obviously, the original self-evident is an illusion, and the viewer cannot define the other without his own experience. Obviously, the original self-evidence of the material is an illusion, and the viewer cannot define the material without his own experience, like the mountains and the Parthenon, like the intervention in the formation of concrete in the Cold Region Research Center. If it is clear that all materials are “derived” from the subject’s mapping of its physical attributes, then the view and materials are inseparable concepts (see Figure 3-22). In perception, the acquisition of images by the viewer is based on individual selection, which is local, cultural, transcendental, and present. In the consciousness construction of cold region architecture, more attention is often paid to such a primitive beauty, implying the worship of nature. The original culture is rooted in the cold region architecture, which is limited to the cold region extending the features of the environment as the center, and the original quality can more effectively connect people with the architecture locally.

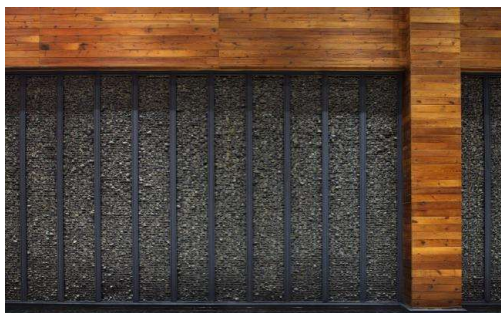


Fig. 3-21 Cold Region Architecture Research Center

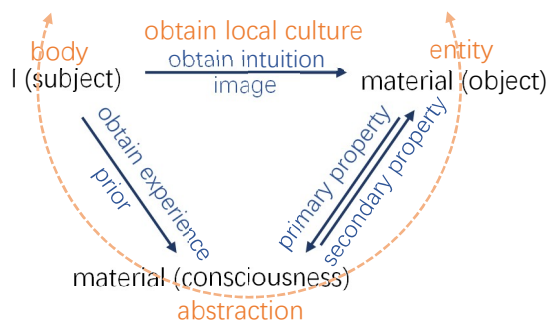


Fig. 3-22 The relationship between observer and material

3.3.1.2 Following association of material

When “looking at” the material, the viewer will get all material properties through association based on the current material image and all the body’s sensory experience before. This way of reading materials makes each presented image information based on a priori hidden deep in the body consciousness of the individual, which is the associative “background” of the material image created subjectively by the viewer. For example, in the perceptual acquisition of architecture materials in cold regions, when faced with the translucent material image information, people can obtain the association of ice, followed by the visual features of reflective, refractive, smooth surface, and transparent edge as complex and smooth perceptual attributes. According to the previous discussion, image information is received sequentially. The confirmation of the seemingly intuitive material needs first to see the color and texture, then define the shape and dynamic, obtain the confirmation of the material through the integration with a priori, and then trigger the association around the material. This following association has already begun with the acquisition of color.

Moreover, the architecture consciousness is uninterrupted. It can only be said that certain information shows the difference in strength and weakness at different time points in the process. So, the association of materials is complex, composite, and temporal. For example, when an image of ice appears on a building in a cold region, it also contains a unique natural appearance in winter, closely related to melting, evaporation, and condensation, enriching the visual information of the original explicit and direct architectural image. Combined with the related coldness association, it will bring people the perceptual imagery of coldness, desolation, and alienation. However, on the other hand, it provides a warm, vibrant, intimate emotional experience when the reverse association occurs.

3.3.1.3 Memory metaphor of material

Since Plato, countless philosophers have used the architect as a metaphor to point out that all artificial activities can be regarded as the construction process and that the seeming pursuit of natural generation actually implies the production of confrontation with generation. Nietzsche is even more direct in pointing out that rational aspirations, thought to have originated in Greece, are based on irrational choices (Dong, 2001). In the chapter of *Architectural Will* in his book *Architecture as Metaphor*, Kojin Karatani (2010, p. 3) questioned the “covering” of the original western thought: If the purpose of architecture is to serve other functions besides the actual use of the body, obviously metaphor should be one of them, also a part of the architectural originary. “When I embark on a design, I often find myself immersed in the forgotten memories of the past,” said Zumthor in *A Way of Looking at Thing*, describing his state at the beginning of a design. If an architect’s control over a building is to construct the physical body of work with form and content, creating a primary emotion with strong appeal is characteristic, which is concerned with things and understanding, and in a nutshell, with a kind of reality as opposed to purely fun composition and creativity. Material is the starting point of the viewer’s consciousness of architecture, but the starting point of design does not for architects. Architects use poetic memory metaphors in the materials and hide them in the combination of materials to evoke the viewer’s associations. Therefore, the process of architectural design begins with poetic associations and ends with material echoes. As for the viewer as the subject, the process of forming the architectural consciousness is the opposite. They first get the actual material and then evoke the metaphor similar to the architect’s inspiration in their memory through association. People who have not touched snow can hardly learn from general experience that snow can be soft and hard. The shared memory of material is the

key to achieve the architect's preset metaphor for viewers. Material is the carrier of the architect's memory, and the perceived material resonates with the preset memory of the architect. Viewers find their vague retention in metaphors. It also suggests that "the house itself is not poetic. At most, it may have a wonderful quality that allows people to understand things in a way that they have never understood before, at some moment". Thus, it can be clarified that the metaphorical mechanism of the material. Moreover, suppose metaphor is regarded as material nature. In that case, it belongs to the category of Heidegger's artistic nature, and its reception needs the pure material nature and instrumental nature as the foundation to realize the echo of consciousness.

3.3.2 Sensory experience and reality rationality

3.3.2.1 Decorative critique of material

Loos's "decoration is evil" draws a chasm between the material and the architecture. Many people regard it as a declaration against all decorations. This kind of out of context is a fallacy of understanding. In Gottfried Semper's *Style in the Technical and Tectonic Arts*, he said: "As an artwork, it is not necessary to submit to the property of materials, let alone try to explain and extend the meaning of material property with the artwork. Instead, it is necessary to make materials submit to artwork and form a harmonious whole". However, that seems to be at odds with the firm view of materials: "materials and the relevant production form the intersection point between human's inner desire and the external objective world". The dual construction of the practical spirit of things exists in architectural problems, which Semper recognizes, but each kind of speech stands in different angles to clarify the problem itself. The actual material obviously cannot determine all the architectural will, but the carrier of spirit is the material and the way it is constructed. If the rational hierarchical phenomenological approaches were adopted, Semper would not be labeled as a "materialist", and Riegl would not attack him. As a matter of fact, in Semper's and Riegl's works, whether it is the face decoration of "materialism" or the spirit of "artistic will", the conceptual connotation is constantly changing in the discussion. In the current world landscape of numerous architectural images, it is evident that it is impossible to find a material that has no decorative function in the real sense. Even the white has its own emotions that it wants to express, so the veneer of the material can be regarded as a common phenomenon. The primary property of material accompanies spirit, and through its own experience, it has a secondary property. As long as the subject exists in the image consciousness, the elements in any system can hardly be absent because the absence of description itself is also a description.

From the perspective of cold region architecture, material decoration mainly involves two directions: camouflage and conflict. Camouflage is an artificial representation of materials designed to match the natural environment (see Figure 3-23); Conflict is more like the opposite of the environment (see Figure 3-24). Thus, the cognition of architecture materials is more of a manifestation of the difference of intention, which plays a decorative role, but it is not independent of the existence of the architecture-environment spirit. Such decorative expression and manifestation in context are essential elements and links in the construction of architectural consciousness in the cold region.

3.3.2.2 Properties resistance of material

Architecture is not a carrier or symbol of other things but needs to reflect its functionality and possibilities. In the current carnival society of non-essential things, architecture can provoke a revolt, resisting useless form or meaning with its linguistic structure. The materials, as architectural morphemes, should not be a stylized label because it is unique to the environment and locality of each architecture. For example, in the architecture of

cold areas, wood is always accepted as warm imagery derived from nature, but in non-cold areas, wood will make the viewer associate the artificial field with the natural environment and feel a kind of coolness close to nature. When people acquire materials images in perceiving architecture, they can obtain the association of warmth or coolness, which is not the primary property of materials. People would lose the possibility of consciousness association to the material image if they broke away from the environment-culture.



Fig. 3-23 Forrest Cabin, Canada (Thibodeau, 2019).



Fig. 3-24 Forrest Cabin, America (Kundig, 2005)

Under this motivation, there has been a rebellious reflection on the physical properties of materials in cold region architecture in recent years. People begin to try the experimental primary property confrontation for the material presented so that people get a complete overturning feeling in the image consciousness. For example, the primary property of building materials is heavy, and then the secondary property would be processed into light; The primary property is frivolous, and then the secondary property would be into dignified; The primary property is approachable, and then the secondary property would be processed into alienated. In essence, the presentation of material resistance is an attempt to arouse profound thinking on originary cognition of materials to force the viewer to get rid of the original unconscious reading of architectural materials but to face up to the construction process of architectural consciousness and pay attention to the hidden background meaning of environment-culture.

3.3.3 Cultural environment and behavior pattern

3.3.3.1 Traditional sense of material

The application of materials has been studied since the birth of architecture. Since architecture is based on the need for construction, it must include all scales of materials, from macro to micro, which should express the nature of material consciousness. Steven Holl believes that materials always play a crucial role in the “perceive atmosphere”. The traditional view of materials primarily focuses on the material selection based on the physical properties that are conducive to or conform to the construction requirements. The role of materials is mainly focused on the entity that constitutes the existence of the architecture. This logic runs from the economy, practicality, and aesthetics as the core architectural originary concluded in *Ten Books on Architecture* to Loos’s inquiry of the decorative quality of materials, who objected to the visual style of materials in the grandiose Baroque and Rococo buildings and criticized too many layers of facial decorative materials but cover up the significance of the existence of the architecture itself. Ignoring the meaning of Luce for the moment, however, without the prescriptive mechanical support that contributes to the existence of architecture, the significance of materials to architecture will be divided into two systems in the process of cognition: the central construction part and the decorative part. The history of architecture materials is

often mentioned from primitive stone and wood to later sintering brick, and then to artificial materials, concrete and steel reflect building construction technology development. People have been accustomed to the traditional classification and discussion according to the material. In *Meaning of Materials*, Wright ruled out multiple uses of materials, or, conversely, different materials in the same form and surface. According to his autobiography, his disagreement with his teacher, Louis Henri Sullivan, began when the latter indiscriminately used bricks, wood, iron, clay, and other materials to make distinctive decorations (Venturi, 1991, p. 24). For Wright, “a design that works for one material does not work for another” (Wright, 1943, p. 148). He also criticized Eero Saarinen’s use of curved and continuous brick walls in the facade, undermining the traditional sense of regularity and rigidity of brick as a building material. It has to be admitted that the judgment of the artistry of materials should include the traditional consciousness of material construction and its property. When the presentation of deviating materials deviates from traditional consciousness, it will lead to a differentiated consciousness experience. For example, in China’s cold cities, due to the cold temperature in winter, the low transparency of the fabric of building materials is presented. When different from traditional material images appear, people’s architectural experience will show unpredictability and diversity.

3.3.3.2 Anti-experiential application of material

The emotional metaphor of materials has been crucial in the research field since the end of the 19th century, but obviously, this critical “ability” of materials did not start from the end of the 19th century. Materials have long been known to create a psychological effect. The focus on materials has shifted from functional exploration to spiritual construction, reflecting that when people are chasing the trend of technological innovation, they also hope for the simultaneous expansion of the spirit. Besides the apparent existence of the world, the exploration of the perceptual consciousness of apparent development has been one of the essential topics of architectural theory since the 19th century. And then, material applications have gone beyond the application and understanding of pure opposition for the sake of opposition. It can also stimulate people’s spirit, feeling, and desire, so matter and phenomenon can transcend the narrative framework of empiricism and rationalism and spread outward. Thus, it began to appear the concept of using materials as the source to reapply their properties to construct the world and reflect the world. Because the cornerstone of world epistemology is also existential epistemology, all artificial actions are designed to respond to humanist needs. As a result, materials have gained new recognition in architecture, and materials have become one of the essential creative approaches of architecture.

The material construction thinking from perception is critical in architectural consciousness breaking through traditional experience, which reception requires finding a new balance in an echoing or dissonant way. The use of glass (see Figure 3-25) in the facade of Chanel flagship store in Amsterdam, designed by Dutch firm MVRDV in 2016, breaks through the traditional material consciousness: transparent glass bricks replace the original red brick of the building, and the facade becomes crystal clear, accepting the maximum natural light. In this project, glass is transformed from a lighting function into an enclosure, and the bold use of glass in the “Crystal Palace” is a breakthrough. This anti-experiential material application enables people to obtain a glass that is not fragile and stone that is not heavy (see Figure 3-26), which has a refreshing effect in practice. People’s conscious judgment is always based on the precipitation and synthesis of past experiences. Transparency is often associated with fragility and lightness, by which the translucent interface created makes it easier for the building to achieve harmony between

inside and outside space.



Fig. 3-25 Nonfragile glass, Amsterdam (Scagliola & Brakkee, 2016).



Fig. 3-26 Nonheavy stone, Chemnitz (Bitter, n.d.).



The anti-empiricism of the material breaks narrow empiricism of the past; it is a renewal of cognition, which is the progress source of consciousness. In the intention experience of snow as a material, the texture of the snow is soft, and most of it is snow that can leave footprints (see Figure 3-27). In Harbin's annual ice and snow festival, workers used rammed snow bricks to construct snow and ice buildings, whose hardness and density are pretty impressive (see Figure 3-28). Experience is always used to describe relative phases on the axis of time. Experience is not an absolute creation but a state to be opened and already opened so that people can constantly stimulate different intentions and images in the experience of materials and the process of architectural cognition.

3.4 Summary

This chapter takes the cognitive structure of image-consciousness as the paradigm and puts forward the cognitive structure presented by the architecture materials in the cold region around the cognitive object. As the intuitive layer of architectural consciousness structure, architecture materials are the first layer in the ordinary cognitive structure of cold region architecture, laying the foundation for the overall construction. This chapter expands the cognitive structure layer by layer from three progressive levels: material perception of intuitive physical thingness, surface construction of instrumentality, and order origin of artistry. It follows the triple structure of image-consciousness at each level and focuses on the intuitive - image, instrumentality - interface, and artistry - texture of the cold region, respectively. In constructing the cognitive structure of architecture materials in the cold region, it is discussed that the comprehensive influence in the development of consciousness construction in the cold region.



Fig. 3-27 The printed snow ground Snow-covered pavement with footprints (n.d.)



Fig. 3-28 Workers polish a snow sculpture ahead of the 31st Harbin International Ice and Snow Festival in the northern city of Harbin (Reuters, 2015)

CHAPTER FOUR

PERCEPTION OF SPACE IN COLD REGION ARCHITECTURE UNDER BODY IMAGE

4.1 Body-space for cold environment

4.1.1 Perception of space

Merleau-Ponty proposed the concept of “body schema” to discuss and emphasize how the body generates and expresses its meaning in movement, and revealed that the body schema is a dynamic self-organizing movement schema in the two-way movement of “body--world”. Through this movement schema, the body can express the meaning constituted through body movement in the world. Since such expression is ultimately inseparable from the relationship between body and position in the movement, Merleau-Ponty referred to the movement’s meaning of position to the body and the constraint mechanism as “topology of expression” (Liu, 2015).

Perceptual space includes people’s depth perception and orientation perception, which is the “embodied” place of architectural space. When people make comments on a space, they often use perceptual description, which contains the body internalization mechanism of external body information. The embodied space is subjective and perceptual, built on the relatively objective representation materials, and based on the “five senses” and “piori”. Although Merleau-Ponty’s phenomenology of perception centers on “perception”, which is one of the most core concepts in this theory, it has never given a unified and exact concept of perception. The reason is that affirmation means stipulation, stipulation indicates limitation, and limitation implies negation (Feng, 2013, p.55). Although many concepts are ambiguous, discrimination and description with negative expressions are effective ways to prevent empiricism and rationalism. In the cold environment, the human body and limbs can feel the cold, which diffuses inside the body, thus establishing the connection between the body and space (Baek, 2016). The perception of the body is vague and difficult to count, but the tendency can be described to discuss and sort out the mechanism of architecture consciousness in the cold region.

4.1.1.1 Stimulus and association

Empiricism holds that perception has the feature of directness; although its definition is very vague, it provides a possibility to solve the stimulus-association consciousness construction mode. In the perception, people often have a sense of temperature to colors, even though the colors themselves have no temperature. Thus, the temperature is perceived as the result of experience. For example, when people see white color, they will associate it with snow. However, people without visual experience of snow cannot immediately establish such stimulus-association structure, let alone the subsequent temperature association of snow. Another example is that when different people describe white, the object generated in their brain is not absolutely the same, and the color described by them also has different intervals. Perception is derived from a subjective experience, and the perceived color has apparent traces of personal experience. The structure of individual consciousness determines the associative extension generated for a particular stimulus, so color and the individual cannot be separated (Baek, 2016). People first associate colors with the embodiment in perceiving colors and then distance them to establish the pure perception in the ideal. Nevertheless, in fact, there is nothing in pure perception. Without impersonating an object or relevant background, people cannot confirm its existence. This paradox reveals the stimulus-association perceptual model (Larger, 1989, p. 4), whose results have individual differences and openness. Instead, empiricists reduced the perceptibility of color to an object property and believed that perception is accomplished through a series of stimuli with an order in biological senses. However, this argument cannot explain everything that happens in the world of everyday life. In the classic Muller Lyer Illusion (see Figure 4-1), people cannot get the actual length relationship of the two segments through stimulus-association, as people always

try to find the dynamic elements in the static snow. The pre-structure of consciousness is not fully incorporated into the system of consideration by empiricists so that the expected results of stimulus association are not always met in their experiments. The stimulus is not embedded in its overall cognitive structure. In the perceptual mode, the stimulus-association schema exists, but the contextual perceptual structure should also be discussed. Like whether something can be a visual stimulus, people also need to look at the environment in which something is; if it fits in with the background, it cannot be perceived.

This pursuit of stimulus association is also quietly popular with the development of technology in architecture. The cognitive model with vision as the core ignores the retention of history and environment as the background. In architecture, the viewer is just the recipient of stimulation. The architect wants the viewer to follow the preset stimulus-association pattern and then develop directional imagination. However, the perceptual structure of this stimulus cannot be separated from the regional cultural context in the construction of architectural consciousness. Architectural space is not simply the embodiment of body extension and demands but also should bear the influence of place and place.

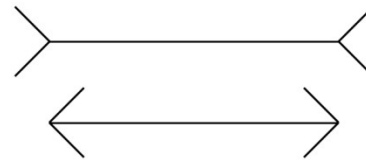


Fig. 4-1 The two lines are in equal length, but the former appears much longer than the latter

4.1.1.2 Attention and judgment

In constant discussion, the empirical perceptual model was soon declared invalid. However, the attention-judgment perceptual model proposed by rationalists does not avoid repeating the mistake of empiricism's neglecting the background. Rationalism holds that in perceiving things, the first thing is to place a preset structure on things, and this unique placing is like "attention". For example, when people describe space, they will call this space circular or square, which means that people need to place the circle or square on this space in advance and coincide with space to seek to reveal the current perceived object structure with the result that has been retained and widely recognized. Under rationalism, people can only rely on the existing cognitive structural model to seek a reliable explanation of the new object.

Thus, people can judge whether the object conforms to the preconceived idea based on the existing structure. Judgments are usually introduced as missing from perception to achieve rationality in perception (Merleau-Ponty, 2001, p. 58). Just as people do not have access to the whole picture of things, it does not affect people's understanding and acquiescence of the general state of things. Even if the viewer can only see three faces of a cube simultaneously, almost no one will suspect that the cube has three other faces because people make "judgments" based on the existing structure. However, it is difficult for people to produce new perceptions somehow, and then perceptions disappear. Existing structures and impressions are always subject to transcendence and cannot be attributed through a single "judgment". This attention-judgment mode of perception ignores the developmental possibility of perception, and the actual perception here becomes a variation of attention or judgment, sliding to the edge of the existing cognitive structure. Therefore, the rationalist approach cannot explain and develop the world of consciousness.

The concept of architectural consciousness under rationalism hides the root of the scientific crisis: Architects who only focus on pure things believe that the rationality of materials, structure, and construction is sufficient to respond to the demands of perception but are unable and unwilling to face the problems of value and meaning (Spiegelberg,

2012, p. iii). This arrogance of technical rationality permeates the spatial construction of contemporary cold region architecture. Nevertheless, the “destination” of cold region architecture is not to create a perfect “black box” because the creation of space itself has no real meaning. As an artificial response to the natural climate, the core of space response should be the response itself, instead of using rational thinking to replace perceptual experience. If the inherent meaning of the architectural space in the cold region is to carry people’s sense of security, then it must contain an essential sense of residential intimacy. This kind of emotional progression obviously cannot be obtained from the existing rationalist structure.

4.1.1.3 Perception and consciousness

Both empiricism and rationalism provide a preset perspective of the world, ignoring the extensibility and suddenness of human body perception. This way of thinking has also spread in the field of architecture through computational design in contemporary times.

Without the actual participation of people, the concept of space would not hold. For the consciousness structure that does not intuitively participate in the construction of perception, it cannot express the position and development of objects in the structure in perception (Merleau-Ponty, 2001, p. 51). Therefore, the construction of perception must return to the body and make the body and space simultaneously return to the ground and the life-world through perception. The figure-background structure implies an integral relationship between the cognitive space and its environment, which cannot be separated from each other. For space, the environment provides the possibility and direction of associative extension, and people can evoke special memories in the environment to strengthen the understanding of the space. In addition, the body behavior makes the space and the environment acquire an actual connection. That is not to negate the meaning of judgment or stimulus but to state that the construction of perception is not purely empiricism or rationalism or the superposition of the two. Perception has the originary quality and is only not parasitic on some existing schema. Stimulus and judgment during perception are symbolic representational associative schema, which is a kind of picture that can quickly and profoundly obtain related information, but not the whole one.

It is not difficult to find that the body cannot be ignored in the perceptual structure. All architectural spaces need to be grasped at both the body level and the object level. Thus, “body-figure-background” constitutes a more complete and broad perceptual mode, that is, the concept of the “perceptual field” proposed in the perceptual phenomenology. It enables people to clarify their position and meaning in perception; moreover, it also provides a channel to reflect on themselves through the object of perception.

The revelation of perceptual structure has direct enlightening significance for understanding the construction of body perception in cold region architecture. The perceptual structure of cold region architecture can be constructed only by placing people in the “architecture-cold region”. In cognition, the perceptual feeling of the body in the cold region environment should be placed in the cognitive process of cold region architecture. The experience of cold region environment and the perceptual information of cold are the structural basis of cold region architecture consciousness. The priori is not about all the previous priors about architecture provided by memory or association, but about “architecture-cold” and “body-cold”. That is an irreducible perception system of cold region architecture, reflecting the proper relationship between the viewer and cold region architecture, and is the premise of architectural significance and value.

4.1.2 Aperception of body

4.1.2.1 Visual synthesis

Normal vision requires visual synthesis of both eyes. Physiological and psychological studies have found that people have two independent monocular visual images for a nearby visual object when the eyes are focused on the infinite distance. When people turn their gaze to the nearby visual object, people see the two one-eyed images gradually coming together and finally blending into a single binocular visual object (see Figure 4-2). In the architectural vision, people are concerned about widely understanding and applying the visual synthesis of both eyes and the visual unity achieved in this process.

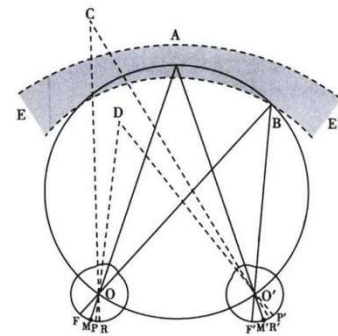


Fig. 4-2 The horopter circle (Li, 2019, p. 3)

Empiricists try to explain the visual fusion of two monocular figures without the visual synthesis of the body. They attempted to understand vision as some “third-person process” occurring in the innate apparatus of the optic nervous system using a “stimulus-response” causal model. In this case, an external object preexisting in the objective world every time sends a unique visual stimulus to the nervous system. The eyes are merely mediators that receive this definite visual stimulus. According to the causality law of “stimulus-response”, the visual center can realize the fusion of two monocular images through the objective third-person process. In response to this empirical understanding, Merleau-Ponty retorted that “the existence of a certain visual center alone is not enough to explain a single object, because sometimes diplopia also occurs, just as the existence of two retinas is not enough to explain a single object, because diplopia is not a constant phenomenon” (Merleau-Ponty, 2001, p. 255). In other words, the rare phenomenon of diplopia shows that visual synthesis can produce both a single object and two different monocular images. That shows that visual synthesis is not a strictly causal third-person process. In architectural space, this kind of monocular visual difference in binocular synthesis generates depth perception, making the concept of depth addition to distance added to the description of spatial attributes. The ability of this kind of synthesis is acquired from early childhood.

However, the empiricists were not deterred by the phenomenon of double vision. They also cite the “divergence” and “convergence” of the two eyes to explain the double vision. The difference between diplopia and a single object poses a fatal refutation to the empirical model of causal explanation. As long as empiricists insist on a stimulus-response causal model to explain the vision, the constancy and certainty of causality do not allow them to explain both diplopia and a single visual object. In short, to explain the visual fusion mechanism of two monocular images, in any case, it needs the active participation of the body, which will involve the comprehensive activities of the body. In space, the body needs to obtain the depth of the space through the vision to determine its relative position with space and then through movement to receive different sensory materials. The depth of the object is constantly changing, and this change is not uniform or linear. For example, in approaching a building, the observer will find that the perspective relationship of the building is getting larger and larger. Therefore, it is difficult for the visual focus to remain unchanged at different observation points of the movement path. Some spaces and landscapes will “suddenly appear” in front of people’s eyes.

4.1.2.2 Intellectual synthesis

After the subject receives the information of sensory perception, it will undergo intellectual synthesis. In Kant's Critical Intellectualism, intellectual synthesis is the action taken by a transcendental epistemological subject or pure conscious subject when confronted with phenomena or multifaceted conceptions of perception. When this transcendental subject synthesizes intellectually, it endures the pure concepts or categories of understanding to these phenomena by connecting "some apperception or mental activity", thus constructing an identical cognitive object and thinking of all these phenomena as various phenomena this object. For Kant, therefore, synthesis is the intellectual activity in which the understanding, employing concepts or categories, ties together the manifold representations of perceptual intuition to form a unified consciousness or cognitive, intellectual activity. Kant called it "intellectual synthesis" or "transcendental synthesis" because this purely intellectual synthesis activity is logical rather than physical, innate rather than empirical.

In terms of the consciousness construction of cold region architecture in this study, the intellectual synthesis discussed has the following main characteristics: (1) the viewer who implements the intellectual synthesis has specific cognition and experience of coldness and cold region climate; (2) The intellectual synthesis does not occur in the memory-association based on the coldness material, but in the present being; (3) The meaning operation mechanism of intellectual synthesis is a one-way meaning-making mechanism from intellectual concept to perceptual intuition and from transcendental form to experiential content; (4) The intellectual synthesis is completed as soon as the subject realizes or recognizes the object, which is a kind of non-temporal synthesis; (5) The intellectual synthesis is a kind of objective synthesis, which results in a wholly constituted and thoughtful, conceptual object. Thus, it achieves a fundamental, conceptual, and formal unity, and it tries to unify the cold region architecture with the cold-body ultimately.

4.1.2.3 Perceptual synthesis

The visual synthesis of two monocular images cannot be an intellectual synthesis with the above characteristics but a "perceptual synthesis". Perceptual synthesis is a kind of non-objectivism activity; it results in leading to a never-constructed object, which can only be perceived but not thought about; it achieves a unity of presumption, intention, or pre-logic, which is an open unity that is always in an incomplete and uncertain state and takes place in the horizon of visual experience.

Starting from the difference or diversity of senses, the empiricists conceive the vision or touch as the simple acceptance or possession of specific sensory properties to the perceived object, thus separating the body's various senses. Therefore, it cannot be transformed into a perceived object with unity in color, hearing, and touch. Thus, empiricists interpret the unity of perceived objects in terms of separating the senses from each other.

The rationalist starts from the unity of senses and understands this unity as belonging to a primordium of pure consciousness. They put the unity and difference of senses at different levels: the unity is innate and necessary, while the difference is experiential, acquired, and accidental. If a feeling is not about something, then it cannot be regarded as a feeling. In order to ensure the unity of cognitive objects and the objectivity or absolute certainty of cognition, the senses should be priori open to a single primordium consciousness, and through it, obtain the unity of primordium and necessity. On the contrary, it is only when, in reflective analysis, one returns to a specific experiential activity of knowledge that one distinguishes between a contingent matter and a necessary unity. However, this material is only an idealistic factor, not a separate component in the

whole activity of cognition. Thus, in analyzing the necessary structure of cognition, intellectualism speaks only of consciousness and not of the senses.

Nevertheless, once intellectualists assumed this abstract unity, they can no longer account for the variety of substantial differences between different senses. The senses are left with the abstract function of supplying the same primal consciousness with sensory materials. In the end, vision is only responsible for presenting unstructured, formless, and meaningless visual materials to consciousness. It is consciousness that judges, not the senses that see. Thus, there are no senses, only consciousness. The intellectualist reduces differences of senses to an absolute unity. The difficulty they face is how to explain, from this abstract unity, the tangible differences and rich multiplicity of the senses and sensory experiences.

In cognition of cold region architectural space, the degree of cognition of the cold region environment is closely related to the degree of understanding of architectural space. Everything from sight to touch requires consciousness to give meaning and to provide the following body behavior. Therefore, this study is different from complete rationalism or empiricism but adopts a situation between the two, believing that sensory materials and perceptual consciousness are inseparable. Especially for the consciousness construction of cold region architecture, which is unfolded around the coldness, its apperception way makes the perceptual process continuous, structured, and diversified.

4.1.3 Embodiment of space

4.1.3.1 Phenomenal body and perceptual world

The body subject is the whole philosophical dimension of the phenomenology of perception and the entrance to constructing the ontology of intersubjectivity. Merleau-Ponty initially “saw the hope of this new philosophy in the body” (Merleau-Ponty, 1962). For the body can be both subject and object, being purely between subject and object (Merleau-Ponty, 1962, p. 35), Merleau-Ponty proposed “phenomenal body” and “actual body”, trying to construct multiple structures about the body, corresponding to the thingness of things. Among them, the “phenomenal body” is the “living body” that blends spirituality with materiality (Merleau-Ponty, 2005, p. 235); There is no pure nature materialized by empiricism, and no pure consciousness conceptualized by rationalism. In this body, consciousness and nature constitute figures and backgrounds in each other’s perceptual construction. Nature situationalizes consciousness and consciousness spiritualizes nature. In the “phenomenal body”, body and mind could be integrated, subject and object could be blended.

“Phenomenal body” is relative to the objective “actual body”. In *The Structure of Behavior*, Merleau-Ponty put forward that the “phenomenal body” would turn into the condition of the phenomenon. Instead of deliberately ignoring the “actual body”, it needed to return the perceptual ability to the body. The “phenomenal body” is the body of perception, so it has the characteristics of perception: structure and development. The “phenomenal body” has no fixed shape or boundary. It changes as perception unfolds and can shrink to the smallest size or expand to the entire world. So it is only within a particular perceptual construction that the scope of the phenomenal body can be determined. The boundary between the phenomenal body and the world is never straightforward and finally integrates with the world, becoming a kind of intersubjectivity. According to this theory, in the perceptual construction of subject-body to object-thing, the “actual body” develops the “phenomenal body” layer by layer (see Figure 4-3). In the embodied process of objectification, what is first received as a tangible object corresponds to the compounding - chemical body, which is the actual composition of the human body; Secondly, the subject-body will project its biological and vital body characteristics to the

object so that the object and the body will have the life connection and match a position in the living environment. Finally, the subject's consciousness leaves the object-thing and returns to the transcendent body being, and the cognition of the thing becomes the experience of constructing the present body. The body at this time is the body of the phenomenon, is the body that people cannot touch. It can be found that people's unique local habits may all come from the phenomenal body rather than the actual body. In the discussion of body and the perceptual world in cold region architecture, more people should turn their vision to the phenomenal body rather than the actual body, but at the same time, the actual body is needed to lay the foundation for the construction of the phenomenal body.

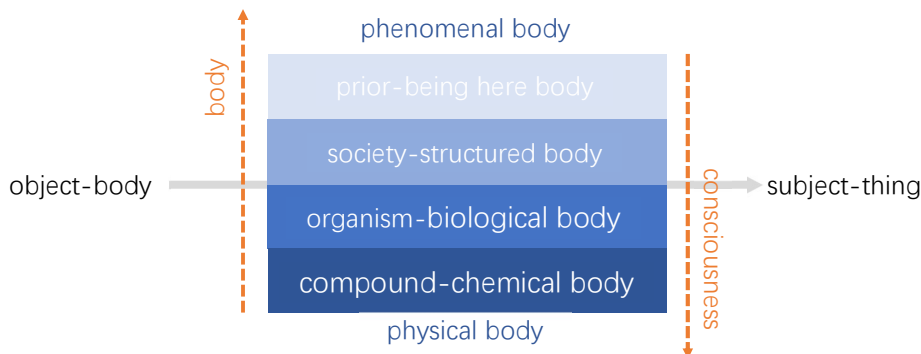


Fig.4-3 The relationship among object, subject, and intersubjectivity

4.1.3.2 Flesh body and conscious world

People cannot divide the body into the spiritual mind and material object. It is clear from the above discussion that there is a deep cycle in the body that Merleau-Ponty calls flesh (*la chair*). That makes the world inhabited by the body acquire another meaning: the “flesh body” in the “deep” is the possible ontological guarantee of the relationship between body and mind, and it is the inevitable result of the body's ontology, showing that Merleau-Ponty has realized that the body is not a final concept and cannot be used as a subject. It needs to be explained itself, and only the “flesh body” can be used as the final concept. “The flesh body is the final concept”. The body is only the witness of the flesh body, and the body-consciousness is only a part of the relationship between subject and object. If the body-consciousness is integrated, the subject and object must also be blended. The flesh body is not an empirical fact but an ontological representation of consciousness. The concept of the flesh body can be understood in two ways: (1) extending from the body to the flesh body of the world; (2) Reflect inward from the body to the flesh body. However, what the two have access to is the same because the viewer's body and the world of the viewer's consciousness result from the operation of the same flesh body. The phenomenal body can keep expanding and fully release the intersubjectivity thought contained in itself. The relationship between the body and the world has the exact nature of the relationship between consciousness and the body. While the body is shaping the world, it is also being shaped by the world. Because of the homogeneity of the body and the world, the flesh body can break through the actual body's limitations and become the phenomenal body, thus eliminating the boundary between the body and the world.

If space also has its own actual space and embodied phenomenal space, is there also a flesh space? According to the definition of the flesh body, space-consciousness represents the spatial flesh body. The meaning of space is just like the dwelling proposed by Hölderlin. The flesh body of space is the noumenal dwelling in the depth of actual space, which is expanded into the phenomenon space by people as the subject, and it is the artistic representation of the spatial artwork as the object. In the conscious world of cold

region architecture, space needs to expand the cold habitation into a phenomenon. Moreover, the acquisition of this kind of phenomenal space must represent the phenomenal body, which is a symbolic representation of the phenomenal body and is integrated. Thus, people can get a multi-structure of body and space to explain the generating relationship of the originary construction of space in cold region architecture.

4.1.3.3 Metaphorical body and symbolic world

In the perceptual world, the body is the unspoken third item in the figure - background, while in the symbolic world, the figure - background composed of speech and language seems to need nobody. However, when the body subject is re-applied to the symbolic world, language can have meanings just as the body can have perceptions and behaviors. Therefore, in *On the Phenomenology of Language*, Merleau-Ponty called the signifier “quasi body”. In this way, the body subject is introduced into the symbolic representation world metaphorically. Architecture is derived from the body and evolved from the proportion of the body and limbs (Kruft, 2005, P. 29). Therefore, architecture naturally becomes a symbol of the human body: the height ratio of the column base to the column body refers to the relationship between the length of human feet and the height; Gender becomes a metaphor for the Greek column: the Doric Order is for the male body, while the Ionic Order is for the female; The three-section pattern in traditional architecture also comes from the “three heights and five stands” on the human face. Architectural space is like the human body, which has a direct dialogue with nature and is also the shell of the spiritual shell to realize the dialogue for the natural dialogue. When the body wanders in the architectural “body”, it is the process of the physical flesh body reshaping the nihilistic no-flesh body, and at the same time, the actual body expands into the phenomenal body. At this time, the subject’s metaphor is not limited to the mere imitation of body proportion but is more derived from the perception of the flesh body. Just like in a cold environment, besides directly feeling the cold with the skin, people have the opportunity to present the cold with architectural space. Therefore, it can be said that the architectural space in the cold region is a copy of residents’ daily life in the cold region. Furthermore, its form will also trigger people’s visual synesthesia of the cold and become a unique symbol of the representative body: the gathered shape is the representation of the body curl of the buildings in the cold region when people resist the cold environment; The building in a cold region with small window corresponds to the people’s wrapping their clothes to reduce heat loss; The heavy decorative facade is the representation of people’s clothing in the cold wind (see Fig. 4-4, 4-5). At the same time, the symbols of coldness in different cold cities are not consistent, and the metaphor of the body is never limited to the actual body and the imagery body. However, it is worth noting that this kind of reception of metaphor for architecture in the cold region should be based on natural and profound life experience in the cold region; otherwise, it is impossible to realize the essence of metaphor accurately.

4.2 Body behavior for cold experience

4.2.1 Displacement of body

4.2.1.1 Perception and measurement

The concept of the body has never been alone. Ever since Merleau-Ponty put forward the phenomenological methodology of “radical reflection”, the research on the body has never avoided physiology and psychology. By giving up the presupposition that physiology and psychology impose on the objective body through the so-called research results, it can be rediscovered that the viewer’s initial perceptual experience of the existing body. At the same time, in order to avoid making a judgment in advance, people,

as subjects, should understand objective thinking strictly from their own view. Only by suspending the current objective thinking and looking at the predicament it is in can people obtain the above vision change. Therefore, it is more objective to measure architectural space with the body because the origin of objective is intuitive perception.



Fig. 4-4 The tram makes its way through the snow down towards Slussen (n.d.), Stockholm



Fig. 4-5 A woman struggles against wind and drifting snow in Stockholm (2012)

When the viewer begins to use the body to measure the architectural space, two conditions are required: (1) the re-understanding of the body (the difference in body cognition determines the different levels of understanding of the architectural space); (2) the deterministic cognitive grasp of the body as the subject of spatial cognition. That is to say, the relationship between body and space is no longer “body in space”, but “body and space belong to each other” and are constructed interactively (Liu, 2015), which contains multiple presentations different from objective space (see Figure 4-6). First, space is marked by body parts: the reach of the hands and the measured distance of the feet; Secondly, the body gives a projection of spatial position and direction. Thirdly, the body provides spatial “point-vision” and “figure-background” structures so that information is presented unevenly and contains ambiguity all the time. Fourth, the body endows the space with a specific dynamic mechanism, and the spatial distribution displayed by the body is constantly changing with the change of movement and purpose. Finally, the body makes space contain a unique spatial consciousness. As an intermediary, the body enriches the originally pure space and blends with a specific body consciousness (Merleau-Ponty, 2001, p. 255). Thus, the body becomes the foundation of the cognition of objective space, and the result of cognition inevitably connects the body and space and supports each other. The resulting space embodies the body’s habits, contingencies, uncertainty, openness, and body-like structure. At the same time, each part of the space contains a unique interpretation of the world by the body.

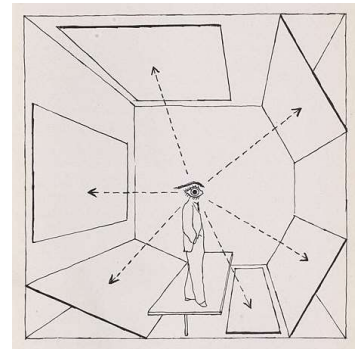


Fig. 4-6 The body-space system (Bayer, 1940)

In cold winter areas, architectural experiencers need to move from the outdoor space, get close to the building, and enter inside to obtain a complete architectural sensory experience. On the path of architectural experience, all the viewer’s perception before each position is the antecedent experience of constructing the present one. Especially in the exterior space of the building, all the sensory experiences that are stimulated together lay the foundation for the cognition and cold environment’s emotion. Based on that, the body puts forward the experience intention of protecting and keeping it away from the cold to the building.

4.2.1.2 Stasis and movement

In spatial perception, stasis is used to describe a perceptual property. However, as the experience happens, the activity already emerges even though there does not seem to be anything moving. Stasis in the consciousness construction is more like an extension of a waiting state. The stasis here is the static of the intuitiveness of the object's state, but the corresponding instrumentality of the object's state must be moving. Here, the body consciousness is united with time and space through "movement". In the ontological cognitive structure of cold region architecture, the static state is like numerous points, while the movement is like the duration between points during the body's movement in the architectural space. The appeal of architectural space brought by stillness is more like "a breath shock to life through a sudden moment" (Shanes, 1989, p. 67), which comes from the instantaneous inspiration of cold region images. Movement is a more continuous and coherent physical behavior, reflecting the order in the non-special and extensive world of cold life.

Stasis and movement cannot be separated. Only the stasis of the object's state gives people space for consciousness to meditate. Stasis and movement disappear under the definition of objective thinking (Merleau-Ponty, 2001, p. 343). In the cold region architectural space, the extraordinary natural climatic conditions provide the viewers with unique stillness in moving and movement in stasis. The former refers to image materials in the cold region that have not been updated under the behavior and activities. For example, heavy snow in winter can cover all colors, creating a static environment. Even if the vision is in a state of motion, it cannot flow like image changes. In such a situation, loneliness is most likely to occur, where the consciousness of time is stretched, wandering in the "blank" space, and the purpose gradually becomes blurred after losing the reference of the environment. The latter refers to that in the cognition of cold region architectural space, people, as the subject, have a stop during the movement. People themselves show static characteristics, but the image materials of the environment are moving. Such as waiting in the winter night, people often stand in front of the window to observe the surrounding situation. In the construction of consciousness, people constantly try to find the meeting point of expectation in the surrounding picture, and they will inevitably lead to loneliness after they cannot establish a connection after consciousness wandering. Although cold fetters the behavior of flesh bodies, it makes the behavior of consciousness more accessible. Starting from the body, the perceptual ontology construction of cold region architectural space makes space view changed radically. The world is no longer a European geometric interpretation of the completely homogenous rigid frame; perception and environment space of the object cannot be strictly separated; properties of the object will change following its position moving in the environment space. The environmental space and the people who are the perceptual subjects in it cannot be strictly separated because these perceptions need to be obtained through the connection between spaces and the human bodies and presented from limited perspectives. The architectural experience in the cold region caused by behavior as a kind of sensory mode connects numerous sensory experiences through the continuous displacement of the human body to form a continuous and comprehensive spatial perception full of cold region intention. The stasis and movement speculation is closely connected with the cold environment, which is the unique embodiment of the cold consciousness.

4.2.1.3 Experience and memory

People unconsciously place the body within a three-dimensional boundary that encloses the whole body, separating them from the world and, at the same time, creating a transition between them and the world. In *Body, Memory, and Architecture*, Kent Bloom points out

that the boundary between the body and the world is unstable, reflecting the psychological effects of force through release or retraction. It is like a virtual envelope that encloses the uncertain, dynamic correction of consciousness for the force (Bloomer et al., 2008, p. 42). Seymour Fisher's work on the psychological forces of boundaries found that people who are more sensitive to force tend to be more likely to distort boundaries, allowing them to experience their environment more vividly. Through the extension of the body, the envelope of the boundary is constantly changing. The characteristics of "penetration" and "barrier" are accompanied by the biological nature and innate way of the cognitive world to establish a layered model according to the body's physical relationship and emotional relationship between the body and the body outside the world. For example, the body's skin can accept tactile sensations; Muscle contraction is the result of nerve stress to external conditions; The brain's "look" can give people internal feedback about their intentions. The human body has a mental coordinate to internalize the information outside the body into the consciousness needed to deconstruct the outside world inside the body.

The spatial experience forms the perceptual world of the individual inside the body and generates many meanings, through which people constantly deconstruct and reconstruct themselves and the world. By recognizing the body as a channel of information about an individual's perception world, people can better understand the perceptual experience of the body. When the body is acquiring consciousness for the purpose, it often replays, recreates, and expands the present characteristics based on the basic sense of position and touch. It is a kind of activity that people call "recreation" but is often neglected by designers during architectural design. The weakening of body experience impairs people's memory about who they are. That is also why most residents in China's cold region who are protected by air conditioning and heating all around the year are not adapted to the cold areas any longer. Their perceptual and adjustment ability are both regressing. The average viewer's experience in cold region architecture is very different from that of architects, most of whose architectural consciousness is formed by body apperception and transcendental judgment. The sense of form and experience that the architect "designs" will not necessarily be perceived by the viewer. Like the ideas of empathy that were sharply refuted in the 19th century, especially the idea of "empathy" by Theodor Lipps. He proposed that beauty depends on the extent to which the viewer could perceive personal identity in the activities of another person or object.

Just as one person who has lived in a cold place describes to another the joys of living in a cold environment, the other person can imitate it entirely but does not get the same insight. The experience gained by the individual cannot come from the words of others but can only rely on the body self to gradually form the individual, the inner world experience: The touch of a cold wind; Contractions of muscles caused by feeling cold; The sense of vastness when the ground is covered with snow and ice. The cold environment has the dual structure of physiology and psychology for the body. For the viewer's body to be placed in a cold environment, what is needed is the foundation of cold consciousness and the "node" that can call for cold feedback to stimulate cold memories. In the Oslo Waterfront Apartment by the famous Nordic architecture firm A-Lab, many architectural nodes are invoked to cold body experience (see Figure 4-7). This successful organization of elements is also closely related to the Norwegian background of the firm. An outdoor terrace is designed on the roof of the towers, which is particularly important for the closed office space in winter. The exterior of the building is clad in textured white and grey stone, while the platform is clad in warm wood. The complex "shell" of the building, the platform, is like a transparent interface to the exterior of the interior space. In winter, the trees on the platform will be removed, leaving only a thin layer of snow; Even in summer, the pool is filled with fine sand to imitate snow, echoing

the typical landscape of the two seasons. Besides, the cold wind of the port to the warm color of the wood grain has been psychologically resolved. This contrast is often used in cold cities because it reflects most physical and psychological needs of people who have lived in cold environments for a long time.

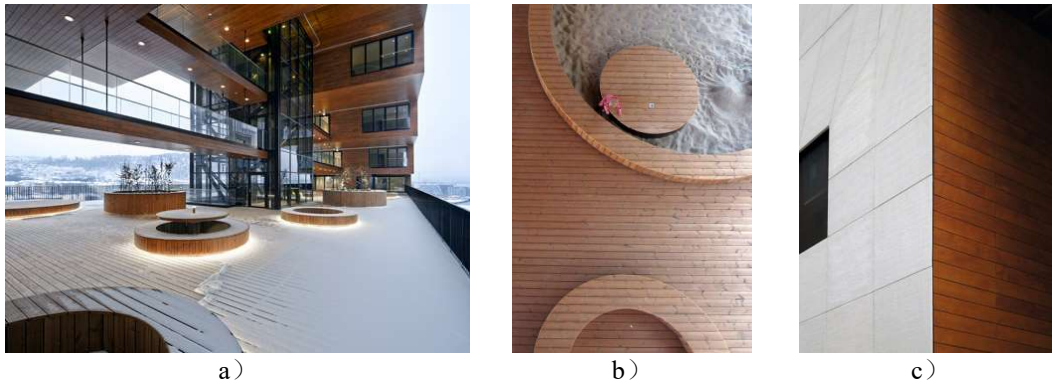


Fig. 4-7 The Water Apartment in Oslo designed by A-Lab (Brodey, 2014)

4.2.2 Structure of behavior

4.2.2.1 Behavior and image

The cognition of architectural space is accomplished through the people's behavior in the space. The body deforms and displaces during its moving and is subjected to ceaseless exchanging forces from the external space. In the movement behavior, the image consciousness of all architecture materials becomes the viewer's intention source in the stage of space consciousness, which is characterized by constant changing zoom with time as the axis. For example, the cognitive information about it is initially vague for a distant building and not enough to judge the accurate material and form. However, as the viewer tries to approach it, the architecture consciousness extends from its initial uncertainty to the exact figure. At the same time, its consciousness of materials is constantly strengthened in the accumulation, making the object image consciousness add dimension and depth in the brain (Figure 4-8). Whether the viewer is aware of this process or not, the human body is constantly in dialogue with the cognition of the architectural space. In the cognitive activities of cold region architecture, body behavior plays a decisive role in the generation of space. The body behavior stimulated by the cold environment determines the cognitive extension of architectural space, which has apparent density and directivity. Density refers to the richness of the position oriented by behavior under image consciousness. The space that is not conducive to stopping tends to have a low image density. Directionality is the direction of behavior based on body apperception. At this time, the spatial cognitive structure of cold region architecture is constructed by a series of image consciousness through continuous precipitation, abstraction, and synthesis.

When the body acquires images in spatial cognition through behavior, it separates itself from the space, and the body behavior becomes the symbol of the image. When attention is focused on the material, all the senses are concentrating on it. The resulting image consciousness has significant centrality and realism, and vice versa. Therefore, in the movement, the viewer constantly changes the state in the space through body behavior and understands the role of various forces so that the material images are continuously highlighted. Here, the state is not a geometrical concept but a synthesis with all the kinesthetic derivatives of the muscle, extending from the external state to the internal body. Zumthor once mentioned in his *Thinking Architecture* that when he was designing,

he would indulge himself in walking optionally in the remembered images, allowing himself to be drawn freely by emotions so that the images evoked could be associated with the architecture pursued. Obviously, for Zumthor, the body behaviors in space closely follow the thoughts caused by the images obtained at the moment, and the images and behaviors affect mutual motivation. At this point, the images reverberate internally in consciousness repeatedly, and the muscles react externally by acting to “match” the consciousness extension among images. Just as Heidegger summed up the task of the image to describe and reflect the whole existence of objects and the behavior and discovery, the image features appear. In the cognition of cold region architectural space, image-based body behavior has become the primary way for architects to guide viewers to discover space. The individualization and uncertainty of such behavior have strengthened the realization level of architectural cognition.

In the house Tanigawa designed by Kazuo Shinohara in 1974, space is set in a logged forest, which blends into the surrounding cold environment, forming a small mountain top and responding to a series of undulations on the site (see Figure 4-9). The architect tried to create a series of “non-level” to trigger the viewer’s continuous movement in the space to obtain different image experiences to resist the prevailing residential intention of the “living machine” at that time. People seem to be part of the snow mountain together with the building space, in an unstable state that is about to slip at any time. The interior wood frame stands against the exterior dead wood as if standing and rooted in the snow together. Kazuo Shinohara wrote in his notes in 1976 that he hoped to strengthen people’s sense of instability in the cold environment through the encounter of two different spaces representing the natural topographic drop (Editorial Committee of Kazuo Shinohara’s Collection. 2013, p. 133). Due to the revelation meaning that such behavior and images constantly meet and inspire each other, Tanigawa’s residence has turned into a playground for primary school students by the owner. When asked whether the non-standard behaviors caused by such non-horizontal body instability would affect living, the house owner said: “Architecture should reflect the spirit as well as living, and comfort is the enemy of the spirit” (Fujioka, 2017, p. 65).

The environment in the cold region is a synthesis of natural features in winter. The space cognition of cold region architecture is projected and developed in the body with other material images as a perception image. Eyes follow muscle movements; Both behaviors and images cannot exist independently in constructing body-behavior-space structures. People’s inner perception records individual behavior-images bring introspective awareness. In this structure, the material image is the beginning of consciousness, and the cold environment lays the foundation for the image consciousness and thus stimulates the viewer’s behavior in the architectural space.

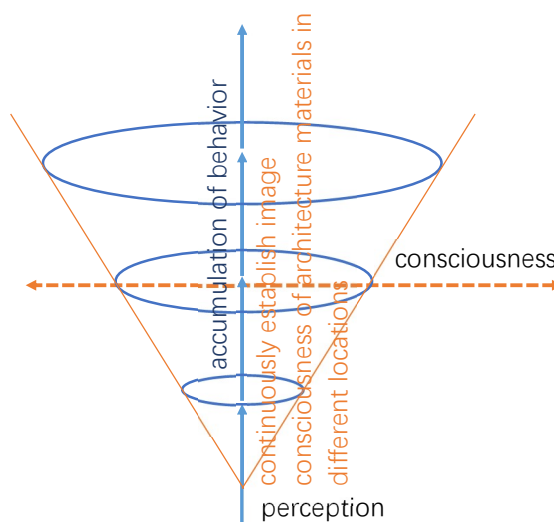


Fig. 4-8 The construction relationship between behavior and image

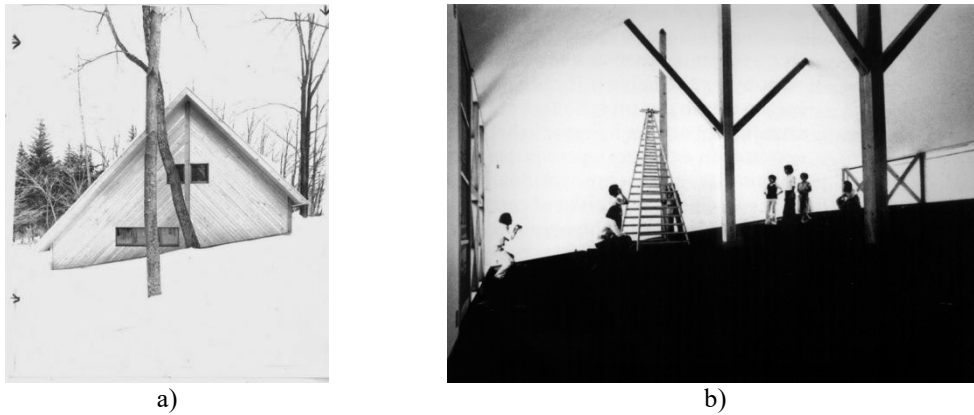


Fig. 4-9 Tanikawa House (1974)

4.2.2.2 Behavior and consciousness

All architectural space experiences are an underlying behavioral stimulus (real or imagined) at work. A building itself is a stimulus of behavior, a stage for movement and sympathy. That starts with the ever-present relationship between space and body, which is an interaction experienced from early childhood: the game creates a close relationship between the body and space by constantly changing the dimensions of the body's extension, the rhythm of the movement, and the movement force. This ebb and flow, weightlessness and excess weight, rhythm and wave from the body, is inherent and uniform in body behavior and synchronizes with consciousness. Before the actual occurrence of the external action, bodies have already produced the pre-consciousness in the heart of all upcoming actions rehearsed. In this case, all behaviors need the outer consciousness material provided to the senses in advance to obtain the sensory material of intentionality. According to the internal consciousness, individuals will acquire the consciousness of architectural space according to the behavior and state of the body at the moment, capture the material of the intention behavior at the next moment, and then complete the following external perception intention behavior. In the cold environment, the body-behavior external and internal perception representation and winter landscape images form consciousness, which lays the foundation for the cognition of architectural space and thus forms people's daily behavior in the cold region.

Cold consciousness connects the understanding, internalization, and outward projection of exterior architecture materials in the cold environment. In the cognition of architectural space in the cold region, a starting point of image material can be determined temporarily, and the generation of behavioral space can be understood with the construction relation of consciousness. For example, in the project of the Villas Winterberg, the building is attached to the whole ski resort activity, and the image material is obtained from the moving body, and the dynamic force of the architectural space is always opposite to the direction of motion (see Figure 4-10). If space serves as a call to movement, the irregular rhythm between the body's motion and sight-line and polyline roof suggest the conflicting different consciousness of the behavior and the image, which causes the architectural space to stand out in the environment.

Images can stimulate the most common external perception and form external perception consciousness. At this time, the ongoing conscious behavior is also conscious and becomes the internal perceptual behavior, providing the pre-conscious behavior of a body. The cognition of architectural space in the cold region can be traced back to the level of consciousness. Here, the conflict of consciousness is the basis of the typical structure of image consciousness. As the external environment, the cold environment itself contains the preconditions of the conflict of righteousness for the internal

environment of architectural space. Through the operation of the image level, we are creating the consciousness of architectural space to create the conflict of righteousness.



Fig. 4-10 Villas Winterberg (Rost, 2017)

4.2.2.3 Behavior and association

By observing the body in space, it can be found that the geometric description and abstraction of the body's positioning and behavior soon take on an associative meaning. Rudolf von Laban once used "positive", "vertical", and "horizontal" planes to describe motion, providing a three-dimensional structure very similar to the body coordinates of the body-intention theory: the body will use its guidance system to move from one place to another (Laban, 1974). Kenneth Ewart Boulding pointed out in his book *The Image* that "Image is the dependency of behavior, and 'Image' is established in the whole experience of each person". Li Daozeng agrees with this view and explains in *Introduction to Environmental Behavior* that space comprises a series of points in the road network connected to form the road. Due to the positioning of the body in space, all roads extend the sense of direction and distance corresponding to personal feelings and further differentiate "intimacy" and "alienation", and "orientation" and "deviation" (Li, 1998, p. 68). These feelings also change through body behavior, while spatial consciousness becomes more complex and organic as the road grid expands (see Figure 4-11). The internalized consciousness will generate behavioral intention through accumulation, precipitation, and abstraction, and the occurrence of intention is the key to the link between body and behavior.

From the perspective of perception, through moving on the snow, people can feel the thickness, temperature, and density of the snow and directly get the experience of walking in the snow. These experiences are integrated into the associated image consciousness and indirectly get the image of the snow. That explains why, even with plenty of images and descriptions, it is difficult to understand something if no object interacts with it. Therefore, even seeing and experiencing snow cannot take the living experience in a cold area because occasional behavior is an independent generalization of unique feelings, while continuous behavior will make consciousness rooted deeper and broader. The human mind has a typical gestalt. If the first identification needs to be based on some experience, then the subsequent behavioral intention is a straightforward and unspoken feeling. Kevin Lynch believes that the viewer and the environment have the characteristics of mutual construction, and in the process, the environmental intention based on their adaptability to the environment is generated. This kind of intention follows the viewer's own spatial will, adding the subjective description of the space by oneself and endowing it with meaning, while the environment only provides objective distinction and connection. In Lynch's statement, most people's body pattern understands the image to intention as the process and result of cognition of things, but the structure of obtaining the image and understanding the intention is always ignored in some contexts. Boulding's

theory has already answered that behavior is the basis of realizing the framework of in-situ consciousness, and it is also the way to acquire images and develop them into intentions. However, Lynch, whom Boulding inspired, apparently did not take this important point into account.

In 1965, Karl Polany proposed that the “map of the mind” could only be obtained through behavior. Behavior is not only the basis of acquiring image material but also the constructive element of intention. In the project Stage of Forest, the changes of color, texture, material, and light in the space transition suggest that people move from a cold and monotonous world to a warm and colorful place (see Figure 4-12-a). As the body behavior is perceived, the image is internalized into consciousness, laying the foundation for the behavioral intention. At the same time, the body behavior of rising from the horizon in rotation supplies the viewer with an intentional feeling of a wider new world (see Figure 4-12-b).

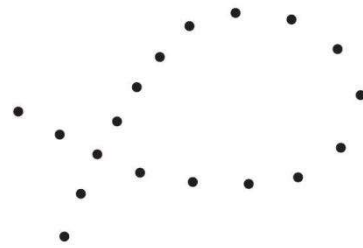


Fig. 4-11 Black dots are grouped according to elementary grouping laws like vicinity, shape similarity, the similarity of color, and good continuation. These dots form a loop-like curve and not a closed curve plus two small remaining curves: This illustrates the global gestalt originary of *articulazione senza resti*. (Desolneux et al., 2000, p. 3)



a) The stair is regarded as undertaking dimensional development intention



b) The view platform serves as a vast landscape framework

Fig. 4-12 Stage of Forest, Songhua Lake (Su. n.d.)

Leaving aside the overall consciousness of cold region architecture, the images in the field of view naturally follow the body-behavior changing. When this change is reinforced by architectural means in combination with the cold environment, the consciousness generated by the image at the last moment becomes the intention to understand the image at the next moment and provides subliminal behavior. When the intention association caused by the behavior is shown again by the viewer’s behavior, it is formed a rich and continuous experience of the consciousness structure. Moreover, the association of muscle memory is included in the intention. The overall image of the architectural space in the cold region is enriched by combining the dimension of time.

4.2.3 Reappearance of experience

4.2.3.1 Intuitiveness of presence

The perception of behavior is always related to the experience of being present. Once the viewer exists as a subject experiencing the world, the perception will always present the behavior schema to the subject. Once the behavior occurs, the behavior object is assumed to be authentic at every point in the behavior’s trajectory, even if it is not. So, when people talk about behavior, they already have behavioral objects (Merleau-Ponty, 2001, p. 245).

That is to say, behavioral experience does not need to be strictly investigated whether it is accurate or not, and behavior and behavioral objects have a high degree of identity derived from experience and presence. At the same time, behavior creates a kind of intuition: people have to construct the present intuitively with the information of the behavior. In the experience of cold region architecture, it is not easy to accurately describe the space in one moment. Because in this way, space becomes a landscape painting, which only stays at the level of the image material. Nevertheless, this experience is not pure or isolated because it cannot be independent of the whole cognitive system, and its structure must affect the image, consciousness, and association associated with body behavior. The image consciousness is now, together with the image of the present moment, an experience of this point. That is behavior without a definite motion. Therefore, even in the understanding of interior space of architecture in a cold region, people will also superposition the image of the outdoor environment and integrate it into the consciousness of being here.

In the spatial cognition of cold region architecture, looking at body behavior is mainly manifested as the collage of multiple images in a single spatial picture. The integration of all independent image consciousness can effectively stimulate a broader and richer experience of behavioral intention. Thus, an illusion of “behavior object” can be shaped by the continuous images switching in the architectural space. For example, in the design of Harbin Zhongchuang Bookstore (see Figure 4-13-a), the architects believe that the snow in winter symbolizes the abundant water resources that will return to the earth after melting. Taking the forest of Xiaoxingan Mountains as the imagery (see Fig. 4-13-b), the architect set up an ample space with a variety of images of different consciousness, such as simple wood and steel with a sense of strength; The friendly small size space and the shocking giant space create a “magical and powerful atmosphere” with the contrast and rich contemporary experience.

The architectural space cannot present all the images of people, but this does not affect the body’s ability to present all the memories and associations and break the original space-time isolation in a single space experience. That is also done in the actual process of spatial cognition. People’s consciousness of the architectural space in a cold region is condensed in the present experience.

4.2.3.2 Transcendence of perception

Gottfried Wilhelm Leibniz believes that the view of architecture can be extended to the direction of architecture from any point of view. Although different viewers’ perspectives and visions are different, it does not affect that people are experiencing the same object. However, the existing architecture is not one of these manifestations and cannot be seen in its entirety from anywhere. People need a viewless limit that can never be constructed, which contains all perspectives. Therefore, it can be found that the viewer’s perceptual experience of architectural space implies two undoubted concealments: (1) The image of architectural space requires the viewer to obtain it from a particular perspective, but this image is not the whole of architectural space, so what the viewer sees is only perceptual information based on perspective. (2) Viewers can obtain the image information of the architectural space from different perspectives. Although the information is different, the architectural space is the same, so the architectural space does not depend on the viewer’s perspective. There is a remarkable paradox structure in the perceptive architectural space of perspective. Perception must begin at a certain point of view, but the perception formed is not limited to the view from somewhere. Husserl believes that human perception has transcendence and can diverge and supplement the acquired experience according to the current perspective, but this kind of supplement and three-dimensional cognition is based

on a prior. In the perception of cold region architectural space, even if viewers “see” from a specific space, consciousness will subconsciously supplement the experience of other spaces and perspectives to fill the consciousness of the whole architectural space, such as the indoor perspective to supplement the outdoor experience.



a)



b)

Fig.4-13 M.I. bookstore in Harbin (Kano, 2018) and melting snow-ice in Xiaoxingan Mountain (Ruowuqishi, 2013)

In the image presentation of cold region architectural space, viewers reproduce their experience of viewing the architectural space outside the window through the images of the cold region environment and form relevant conscious intentions (see Figure 4-14, 4-15), which makes the images and experiences inside and outside the architectural space overlap from the same perspective. That is the originary of perspective transcendence that applies the experience of perceptual space. Here, it is more evident for the role of architecture as a medium between people and the environment. Therefore, many architectural spaces strengthen the difference of experience superposition by contrasting indoor and outdoor image materials, thus highlighting the originary of cold region architecture in perception.

The architectural consciousness formed by the viewer in the perception of architectural space in the cold region must be one-sided and multi-dimensional, which is derived from the consciousness itself needs to be enriched. For example, in an experiment described by Rasmussen in *Experiencing Architecture*, people may perceive a room as warm and comfortable with a warm color change or carpet and curtains, even though the temperature does not change (Rasmussen, 2003). From the experience of architectural space in a cold environment, people can indeed reach a certain consensus derived from the transcendental perceptual contrast provided by the reflections of the physical body. Thus, different experiences are blended based on the body-behavior structure of cold region architecture, which further influences the behavior-perception inside the architectural space. That also explains why warm colors and rough materials are often used in architectural spaces in cold regions.



Fig. 4-14 Water Tower Renovation, Shenyang (Sun, & Chun, 2012)



Fig. 4-15 La pointe, Ottawa (Jérôme & Lebrun, 2018).

4.2.3.3 Intentionality of coldness

(1) Apparent cold Through the imagery resonance in the perceptual construction of cold region architectural space, people can receive the architect's perceptual experience and attitude towards the cold region climate: accepted or opposed. Speaking at Winter Cities Shake-Up 2015, Patrick Coleman of the Winter Cities Institute pointed out that based on research in Canada, the attitude of urban residents in cold areas towards winter is not as "sad" as non-cold area residents imagine (see Table 4-1). Therefore, architects living in non-cold areas often focus on obtaining cold intention from visual image representation in the architectural design of cold regions and respond to the cold environment with a concrete presentation of ice and snow (see Figure 4-16, 4-17). Regions with more experience in cold environments tend to use warmer, softer materials as exterior surfaces to create the impression of cold. One is the direct giving of the environment as an element, and the other emphasizes dwelling in the environment. Therefore, the viewer will experience familiarity and strangeness by representing different architectural design works in the cold region. Of course, this also suggests that the cold climate embodies externalization and internalization as the two ideas during symbolization.



Fig. 4-16 The design of Harbin International Airport was inspired by snowflake (MAD, n.d.)



Fig. 4-17 The design of Harbin Opera House was inspired by snowy mountains (MAD, n.d.).

(2) Metaphorical cold The perception of the cold environment is multi-dimensional and remarkably structural. The metaphorical coldness is a different experience of the cold environment beyond the external coldness. Besides the direct experience of the cold environment, people can also realize the response to the cold through the desire to dwell in the cold region. The door handle is a handshake between people and the building. The door handle is a handshake between people and the building. At the moment of contact, people can feel the heat leaving from their skin and then generate the association of the cold environment. Staring at the distant wall is a kind of gentle caress that can make people feel cold and unfamiliar or warm and cordial through the smooth or rough line of sight. Of course, in addition to the "skin of the eye", strength, image imitation, imagination can bring the viewer metaphors about the cold environment, a physical constant rooted in every detail and never limited to the thermometer. Therefore, the experience of dwelling in the cold region presented in the cold region architectural space, such as warm colors, rough interfaces, and native materials (see Figure 4-18), often arouse the audience's resonance about living from the metaphorical or symbolic perspective.

Table 4-1 How people feel about winter (2015)

80% of respondents expressed a positive attitude towards winter		
male (82%) female (78%)		
positive attitude rates of	21-34	79%
different ages towards	35-44	72%

winter	45-54	97%
	55-64	73%
	65-74	33% (respondents 3)
	75+	87% (respondents 8)
positive reason	like winter activity	47%
	like snow	18%
	like seasonal variation	12.5%
	like winter visit	12%
	like winter	12%
negative reason	do not like cold	36%
	difficulty in travel	15%
	do not like snow	15%
	inconvenient to clear snow	10%
	do not like winter activity	10%
	too long winter	10%
	too much snow	10%



a) The overall look



b) The step covered by sackcloth



c) The wooden handle

Fig. 4-18 The warm red house in white snow, Helsinki (Vappula, 2017)

(3) Impressional cold Architecture, “as the way of human being’s existence on the earth” (Heidegger, 2005, p. 154), shows and imitates people’s daily life-world and is the extension of human reality. The cold environment endows the people living there with a unique way of life, and architecture is the symbol. Moreover, people also understand the cold region through the experience of architecture, forming the mutual construction between people and architecture in the cold region environment. The cold perception, the cold landscape, and the cold culture are all the construction contexts of the architecture perception provided by the cold region. The existence of cold must be based on being perceived by the body. “Feeling cold” is an intentional experience that connects subjective feeling and objective temperature. Ice and snow are the unique natural landscapes of cold cities in winter, making all materials, shapes, and contours attached with a layer of color with temperature and trigger perceptual association. The cold environment and life also give birth to the unique cold culture. For example, the “cold culture” in Northeast China is characterized by rough, primitive, unrestrained, and heroic (see Figure 4-19). As the perceived sense originates in the body, the cold begins with the skin, abstracts as consciousness, and finally extends through the skin to the emotion. The English poet Wystan Hugh Auden said in his poem *Rimbaud* that “cold makes a poet”, suggesting that the visual stretch of snow mountains and the tactile chill of winter wind, cold places are capable of injecting spiritual force into people and giving rise to a way of looking at things based on local plots. Besides, the cold environment will also bring people a different understanding of architecture. “Winter makes the house get extended” (Wilson, 2014). Because only in the cold, warmth could be perceived; warmth cannot survive in summer, people who have long lived in the cold know the meaning of warmth better. The use of wood as the building surface material gives people a warm and intimate memory extension; The heavy form of the space provides a sense of security and stability while standing in the cold wind. In northeast China, except for psychological meaning, color

also has the imagery of natural culture: black can be the black soil in the cold region or a dense mountain forest or a cold river in the depths of winter; White can be white clouds in the pure sky or the snow-covered hills on the ground or the winter of the whole city. The spatial images of white, black, and wood in the architectural space in the cold region are composed to imitate the image of “White Mountain and Black Water” (Figure 4-20) to evoke the resonant memory of local culture.



Fig. 4-19 Shanshui painting with the topic of snow and ice by Yu Zhixue (n.d.)



Fig. 4-20 White mountain and black water in Greater Khingan (n.d.)

4.3 Internalized space based on cold region culture

4.3.1 Order for being-in-itself

4.3.1.1 Instrument for settlement

Residence, as human behavior, makes people have the self-proof of their own existence. In Heidegger's opinion, it is the residence that makes architecture have the meaning of being here. For existence to exist, existence must be instrumental (Heidegger, 2005, p. 154). The instrumentality makes the users around the existing thing, forming an interactive world, and here, the instrument and the user mutually construct the relationship between each other in the world. At the same time, the instrument also prompts some users to change their behavior. Architecture is one of those instruments, both to make people settle and to make people understand settlement. In cold region culture, the instrumentality of architecture meets the basic needs of carrying activities and provides feedback to the natural environment. Architectural space in the cold region should reflect residents' living experience in the cold region on the architectural level. The cold region architectural representation can be condensed into a kind of cold region culture. For example, cuoluozi is a typical traditional residential form of the Ewenki, Hezhen, and Oroqen people in northeast China (see Figure 4-21). The material is taken from the northeast forest where the ethnic group lives: the birch wood in the four seasons and the mountain closure period of half a year, which creates the living mode and architectural style with typical ethnic characteristics. A simple A-shaped wooden frame, made by a birch tree to support the structure, is placed on the animal hide and grass roof as the envelope structure. In the natural environment, it is entirely built on the spot or anywhere (Zhang, 2004), and the oblique wall formed can be conducive to the drainage of snow. This kind of primitive ideology based on the cold region reflects the interaction of the region, landform, and environment to integrate an image of life, and in this interaction, it formed its aesthetic system called Aoluguya. Perennially white snow and grey tree trunks create unique architectural imagery as an instrument. In contrast, northern European architecture in cold regions advocates integrating nature into architectural life and putting architecture into nature instead of decorating. Just as Ralph Erskine designed the facade as a storage space for wood in winter (see Figure 4-22), the exterior walls are constantly changing as the wood is used for heating and replenishment, reflecting the nature acting on the people's life. Sverre Fehn once concluded that Nordic counties' cold

culture was “living in nature”, so architecture as an instrument should reflect the following of nature.



Fig. 4-21 The birch bark “cuoluozhi”, Heilongjiang (Yu, 2015)



Fig. 4-22 The box, Ekerö (Lindman, 2018)

4.3.1.2 Value from heart

People’s first grasp of architecture and the world is derived from their house, and then their understanding of the world is continuously strengthened through the other architecture. The house is the original universe of people (Zumthor, P. 2010, p. 13). At the same time, the house implies how people establish the cognitive structure of architecture - the world: people’s cognition of the world is based on the inside house and extends outwards. The meaning of the house and the value of people’s hearts are bred with each other, which have remarkable unity and complexity. As a “corner of the world”, the house has almost all its particular values in itself. In its scattered and wholesome image, imagination enriches the value of the house. Moreover, people are used to concentrating all kinds of images around the house to understand the mapping better when constructing the cognitive way of the architecture - the world. In the memory of all the architectural spaces that had been sheltered, people all imagined the living space. That is an attempt to summarize a specific essence from the heart and project protected, centripetal spatial image characteristics and unique values.

To answer this question in cold region architecture, people should regard the house space as the instrument for settling down and apply the use and imagination to it. In the cold region architectural consciousness, the core meaning of house space is not energy-saving or thermal comfort, nor what kind of appearance it has. People should try to describe it beyond the intuitive thingness and instrumentality, whether this perceptual description is destined to be subjective. However, it is more important is to grasp the main, reliable, and direct emergence of happiness in the cold environment and discover the abstracted culture, precipitated and integrated by all phenomena on the path to realization. This kind of architecture-world cognitive structure originated from the heart makes people put forward the sense of security, the sense of dialogue, and attachment to the place based on the instinct for the cold region architecture. Establishing the self-architecture-world cognition can help people deeply understand how to root themselves in “a corner of the world” and in the world.

In life rooted in the cold region, the inner value is people’s emotion towards the cold region and the value identification. Whether receptive or resistant to the cold environment, beloved or hostile to the cold life, identified or fuzzy to the cold culture, will be reflected in the house and other architecture to realize the inner value of the world cognitive construction.

4.3.1.3 Intentionality of reference

As the carrier of living behavior, architecture is full of contradictions from the perspective of world image. To sum up, what architecture cares about is not based on theory, technology, or function but the life-world (Pallasmaa, 2014, p. 28). Architecture can produce a series of images, which can evoke the experience and think of a particular life form. Stanford Anderson once wrote of The Villa Savoye: “Architecture creates a world, while determining nothing, can influence and change our thoughts and actions”. This world is distinguished from the real one, and it is derived and stimulated into the spiritual space by the space generated by people’s body behavior in architecture. People use it as a perceptual reference of intention to understand the originary of behavior-space. This architecture-world cognitive structure is bound to be limited because people can only refer to their reference, to their intention. The world of omniscience cannot be received, only the world of experience-spirit. Therefore, it is doomed that people’s cognition of architecture can only be built on a limited dimension, and the spiritual space that can be expanded through reflection is also minimal. “We can only understand those things that conform to our unique living conditions, and the architectural space provides us with the most important vision of experience and understanding.”

The cold region architectural space gives the residents a unique cultural and spiritual space and provides the reference and intention to explain the material world. This understanding causes people in different regions to have different consciousness of the same thing and forms the experience perspective. Therefore, the cognition of the cold region architectural space implies understanding all the past spaces, which serves as the reference of the intention and is integrated into the individual’s spiritual cognition of the whole architectural space and the internalized culture of the cold region.

4.3.2 Order for being-for-itself

4.3.2.1 Functional formal metaphor

In his book *Modern Architecture Since 1900*, the architectural historian William Curtis deals with the myth of functionalism in a chapter. He claimed that: “Even those requirements that people have well defined may end up with different solutions; A priori image related to the final appearance of the architecture enters our design process at a specific time. Function, therefore, can only be added to the form and space of the architecture through a stylistic screen. In this case, function, as a symbolic form of style, in many references, especially means the idea of function” (Curtis, 1983, p. 180). With the post-modernism movement, the architectural myth of functionalism has been broken, and people have to face the problem of architectural signified and signifier again. Architectural spaces and images are neither able nor willing to indulge in the “forms follow functions” monism in a narrow sense. Returning to the order of architecture itself has become an essential basis for building itself.

The inner meaning of architecture refers to two levels: from an artistic point of view, it provides a metaphorical response, and at the same time, it should also meet the actual needs of function, structure, execution, and economy. In the 1920s and 1930s, purely functionalist originary were developed in post-war European countries with great success. However, the fact has proved that such large-scale mechanized industrial products are not a symbol of human progress or the direction of social development (Shen, 2009, p. 3). Only when people genuinely acknowledge the profound metaphorical nature of functionalism can its style matrix be entirely accepted. Leonardo Benevolo, a famous historian of modern architecture, once described it this way: “Since the modern movement has been reduced to a system of formal rules, it is argued that the current unease stems from the narrow and schematic nature of these rules. They believe that the solution lies

in changing the direction of the form and reducing the emphasis on technology in order to return to a more human, warmer, freer architecture” (Wang & Guo, 2019).

The discussion of architectural function is not to deny the dominant role of function in the architectural space in the cold region or to seek an imposed separation of form and function. Functionalism has always been in a vague state. The primitive crisis of cold region architecture at present is not so much the crisis of architecture itself, but rather the fact that architecture takes the initiative to carry too much on itself. The complexity and variability of modern life clearly cannot be underestimated in the design and understanding of architecture. However, as architecture itself, it is necessary to consider whether fixed order can place function, form, and aesthetics in the framework with a clear relationship. People need to have a backward understanding of the concept of architectural function, that is, standing behind the function to understand what the function covers. In cold region architecture, the demand for function implies a more emphatic response to the environment that goes beyond the general architectural function. This response is not the layering relationship of general function composition but is rooted in the foundation of architecture and the natural combination of the inner aesthetic logic and functionalism around the cold region. Only in this way can people have the opportunity to synchronize the consciousness construction and the physical space construction of cold region architecture.

4.3.2.2 Body memory of behavior

Memories are spatialized experiences that conform to environmental conditions. These memories connect places and events so that people’s cognition of living space is not a bunch of simple two-dimensional patterns, but a series of alive, multi-sensory spaces, and people continuously express their significance and importance through habits. When the viewer perceiving the architectural space, he does not attempt to seek the aesthetic feeling and desire to get pleasure from it at the beginning. Even so, people have always been able to capture spatial images and recall them through body behavior. Some recollection fragments, when recalled, possess the property of immediacy and must appear as images expressing meaning. However, there is no denying that both the memory itself and the act of evoking it are full of meaning. As a result, people will collect familiar or unusual images, which enlarge and consolidate the realm of the viewer’s memory and, ultimately, strengthen the sense of self. People’s very few memories have some genuine purposes; they serve social and psychological functions. Wallace Stevens said, “I am all that is around me”. Another poet, Noel Arnaud, declared, “My space is where I am.” Both poets’ succinct, formulaic narratives emphasize the interwoven nature of the world and the self and the objectified foundations of memory and identity.

Space is a part of the architecture, but it can achieve independent and individual spatial memory and memory space due to different transcendental behavior modes, and behavior modes, becoming a part of architectural consciousness. In the cold region, the cold environment is a particular anchor point for people’s behavior memory, making the architectural consciousness linked with time: for example, in winter, the people’s collar should stand up before going outside to keep out the cold wind far as possible; In order to avoid the impact of cold snow on vision, people have to take lower their heads and slightly open their eyes. The environment provides the basis and condition of unifying the body behavior, and the consciousness is represented in the architectural space, forming a staggered association and memory. Behavioral memory is always based on environmental experience and the main cognitive structure in the consciousness construction of cold region architecture.

4.3.2.3 Spiritual power of abstraction

In his novel *The Notebooks of Malte Laurids Brigge*, Rainer Maria Rilke movingly describes a distant memory of family and self, which generated when the protagonist was a child, recorded fragments and scattered descriptions of a building. The review of rooms and corridors was not continuous or complete, but the impression generated by the description was retained profoundly and became the consciousness of the whole building. “As if house pictures in my head, falling from an infinite height and crashing in front of me” (Rilke, 2019, p. 12-36). Architecture is more than just a visual game of superficial pleasure. Architecture is an art of ideas that embodies certain enduring and even eternal values and ideals (Zhu, 2018, p. 9).

In the form of use or remains, architectural space records the story of human destiny, which can be real or imagined. Ruins stimulate people to reconstruct those lost life scenes in their imagination and abstract a memorable and touching emotional power through its erosive power, forcing viewers to recall and associate. In Medieval and Renaissance illustrations and paintings, architecture images often appear as just a corner of a wall or a window. However, even these isolated fragments are enough to evoke the experience of an entire architectural space. That also explains the representative power and extension of the part in the whole cognitive structure. The part implies that in cognition, the viewer needs to “suspend” the concept of the whole, from which he can obtain the spiritual power to be transmitted by the whole architecture. Some architects, such as Zumthor, Alva Aalto, and Tadao Ando, are adept at using fragments of architecture to convey emotions. Especially under the background of natural forces, people’s reflection on the environment and themselves are more likely to obtain abstract emotions of subordination or separation, compact or lightness, or conflict, firmness, and fragility. In cold and snowy winter, the vagueness of nature and the solitude covering all sounds will make time and color fade away in the architecture image, and the spatial power of architecture is abstracted, making the viewer feel as if he is in and out of everything to look on the world (see Figure 4-23 and 4-24).

4.3.3 Order for being

4.3.3.1 Trigger of cold behavior

All body behavior generation has a specific mechanism, and the environment is like a trigger, which is the key to trigger and forms the cold behavior selection relationship. In cold areas in winter, the viewer needs to move from the outdoor space of the courtyard to the architecture. Through observation, it is determined that the direction of movement and the object for further observation. Furthermore, by constantly adjusting the perspective, the continuously changing visual field and architecture materials can lay the foundation and trigger the intentional behavior. As the viewer moves through the surface image of the building and into the interior space, the external environmental conditions change. The emotional and psychological mechanisms triggered by viewing the cold outside are different from those triggered by the warm inside. Starting to enter the scope of the building, it becomes the next stage of cold behavior from seeing and entering. The walking system changes, there are private channels, and the sequence of plants with windshield function and the building path appears, all of which become hints for entering the control range of the building. This kind of suggestive language triggers the movement to rush, creating the urge to “speed up”.



Fig. 4-23 The Therme Vals, Graubunden (Ceriani, n.d.).



Fig. 4-24 Church on the water, Yufutsu (Yoshio, 1988)

Pallasmaa has an experiential insight into the touch design of cold cities: “The handrail of the building is the first intimate handshake between people and the building (Pallasmaa, 2014, p. 4)” (See Figure 4-25). The trigger of people’s cold behavior is the extended release of the five senses in the architectural experience. The cold environment makes for an impressive architectural experience that puts the body and mind in a more sensitive information reception than the comfortable environment among the triggers of behavior including physiological and cultural, collective and individual, conscious and unconscious, analytical and impulsive, psychological and physical, spiritual and expressive (Pallasmaa, 2014, p. 13). The sense of architectural space originates from the process of experiencing architecture. The sound of the occasional drop of water falling into the dark and damp basement creates a sense of space derived from the sense of hearing. It is the measurement of the vertical distance brought by the drop of water and the horizontal echo formed by the impact of the backwardness and the ground, which brings the scale of two dimensions of space. Of course, the supplemental information comes from the gestalt guesses of the empirical scenario. Alternatively, imagine the aroma of baked bread wafting through the street in cold winter. The smell itself is just a combination of chemical components. Its heat is insignificant compared with the street environment, but it can bring warmth to people, indicating the direction and distance of the space. The spatial sense originates from entity spaces with diversity, which can be created more vividly through abstract behavior.

The basic cognition of behavior in the cold region should start from a broader perspective, to bring about the perception of spatial diversity (Pallasmaa, 2014, p. 14), and face up to the intention of architectural spatial behavior in the cold region proposed by perception “trigger”. In turn, it is aroused that more abundant and associative images of the cold region are.



Fig. 4-25 The Handle, Alpine Cabin (Scott & Scott Architects, 2019)

4.3.3.2 Trigger of cold scenes

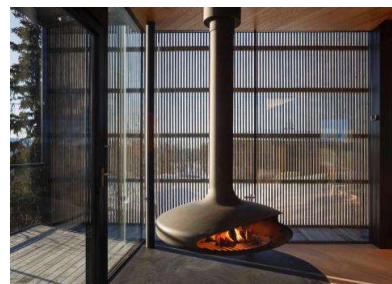
In the architectural space of the cold region, there are unique “scenes” that appear to adapt to the cold climate, which is mainly reflected in the connection between indoor and outdoor. The transformation of the environment becomes the origin of the primary architectural behavior and space. Louis Kahn argued that returning the mind to its origins would reveal the beauty of human behavior in its infancy. Because all the spirit and creativity are concentrated in origin, people can find a constant source of inspiration in exploring the origin problem. Architecture is an “artifact” condensed by various demands of people’s daily life, and its spatial presentation results from the architectural viewers’ behavior. British behaviorist psychologist Daniel Berlyne first proposed that there should

be a two-way consciousness of arousal theory of human behavior in space. His research found that people feel stimulation to space, which gradually decreased as the number of stimulation repetitions and events increased. People perceive the shape, size, distance, direction, and other information of things through the body's movement in the space and full spatial consciousness through the reference of objects in the formed behavior field. Behaviors make the perception of architecture a state of change, enrich the experience through continuous spatial images, and stimulate new movements. Like the doorknob that Pallasmaa mentioned so many times, the unique design of a handshake itself was the formation of a cold situation. Even if the viewer does not open the door or use the handle, there is still a conscious resonance. When the priori is rich enough, experience is not the only way to gain interaction and perception. When consciousness becomes a priori, it is not necessary to collect all the conditions for it aroused. The transcendental has a remarkable distinction and the definite vicissitude trend in the different times. The formation of the corresponding cold-adapted scene should also have the context of times. Due to historical reasons, people living in cold areas in China have suffered from the baptism of technological revolution before the tradition of dialogue with cold has been formed and have not developed precise self-cultural characteristics. That is significantly different from any active cold city in the world now. Coldness is quantified without emotion, making architects and viewers gradually lose the ability to describe and express cold according to an instinctive rejection.

In image consciousness, image perception is formed by the dual structure of people and the environment. For example, people in cold conditions are accustomed to seeking warmth in the field of vision, fighting against the cold, or ensuring their own "survival". However, it is unnecessary to be in an environment opposite to the cold to resist the cold. Sometimes, people can get a psychological sense of warmth just by depicting the scene of the part of the building (see Figure 4-26).



a) The Entrance of the Cabin



b) The Interior Stove

Fig. 4-26 Cabin Kvitjell, Norway (Hughes & Goodwin, 2016).

4.3.3.3 Trigger of cold consciousness

Constructivism holds that the perceptual image is formed by memory traces of previous experience and added to the sense of presence rather than from the innate rules of composition in the brain. Moving in the cold, thus people gain the cold consciousness, creates a series of cold behaviors. There have been two disputes over how behavior is stimulated for a long time: (1) One is the "stimulus-response" theory, which reflects that people find their way through constant unconscious temptation and correction of mistakes in the category of behavioral psychology. At this time, behaviors in space are regarded as the understanding of spatial sequence obtained after learning from past experiences. (2) The second one is that individuals find out their spatial position according to an environmental intention contour and then get the direction and distance to the destination, rather than the programmed trial-and-error mode. That is the embodiment of the concept of "map in mind" mentioned above, that is, space and destination are extended into a

network with topological relations, and people only need to master the relative position relations of points to points, namely, the relationship of sequence, inside and outside, direction, continuous and discontinuous like general situation, while geometric distance is not necessary. If the behavioral system is mapped to pathfinding theory, people can similarly identify themselves. That way, there must be a consistency between the actions of the present self and those of others in distant lands, no matter how much complexity is crossed.

Each place has its local behavior. Part of it comes from culture, and part of it comes from the climate. Lewin called it the Field Theory, and the geographer Kirk Bryan described it as a model of the environment with three interrelated models (see Figure 4-27). In the internalized space of cold region culture, the phenomenon environment refers to the objective, cold region world itself. Other parts can be externalized into behaviors, then internalized into body space and expanded into context and individuals. Therefore, architecture itself is a kind of individual's environment; that is to say, cold region architecture can be understood as people's internalized understanding based on the objective phenomenon in the cold region and through externalized behavior. Only when the architects understand these localized behaviors to adapt to the cold region culture can they design the presentation of the cold region consciousness beyond the material level, thus triggering the cold region residents' consciousness.

4.4 Summary

This chapter puts forward the cognitive structure of cold region architectural space around the cognitive subject with the paradigm of body-schema cognition. Bodies are channels through which people interact with the outside world and where external information is internalized and integrated. It is the body that is constantly receiving all the sensory information that is connected to the external environment. Because of the body, architecture acquires the generation and meaning of its space. This part expands the cognitive structure of cold region architectural space layer by layer from three decreasing levels: perceptual space of intuitive thingness, behavioral space of instrument, and spiritual space of artworks. In addition, it follows the triple structure of image-consciousness at each level; furthermore, it deeply constructs the spatial cognitive structure of cold region architecture and considers the mutual construction relation of the body to built environment consciousness.

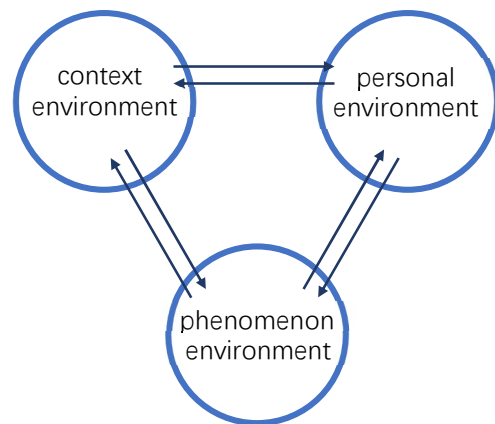


Fig. 4-27 The interrelationship between three types of environment

CHAPTER FIVE

CONSCIOUSNESS OF FIELD IN COLD REGION ARCHITECTURE UNDER ONTOLOGY BEING

5.1 Priori of perceptual field to describe cold region phenomenon

5.1.1 Foundation to perception of cold

In his book *The Concept of Dwelling: On the Way to Figurative Architecture*, Norberg-Schulz proposed that being able to settle down in the sense of “quality” was the essential condition of human existence. Poet Friedrich Hölderlin claimed that dwelling was the primary feature of human’s “being here” and found poetry from it, which he believed was essential to understand dwelling. Heidegger believed that when people chose a place, they chose how they exist in the world (Shen, 2016). The human’s existence needs to construct an intimate relationship with the environment to connect the self and the environment. Then people can get a sense of identity from the environment to obtain proof of self-existence. Besides, people discover themselves through the recognition of the environment during their settlement. Here, the relationship between people and the world is determined, as is the way of being in the world. Initially, people who settled in cold regions described the world they settled in as “cold” and “frozen”. It is the cold climate that distinguishes “this place” from “that place”, “being here” from “being there”. The construction field in the cold region is full of cold perceptual priori and provides the settlers with the condition and the consciousness of “being here”. It is the cold that lays the foundation of the cognitive structure of the cold region residents, thus perceiving the external world and constantly constructing their inner world.

5.1.1.1 Structure

(1) Centralized field In the cognition of the architectural field, architecture is often the center of the field (Shen, 2016). The “center” conveys a spirit of beginning, origin, and introversion. In distinguishing between ordered and chaotic spaces, familiarity and similarity provide a specific anchor point of empirical relevance, according to which people can establish the consciousness of living in the center of the world. The centralization is of profound significance for primitive people to understand the world and usually a practical and universal method. It is a way of constructing the universal view of the place to use “centers” and “edges” to organize the environment and the radiating sense of direction in space (see Figure 5-1). Starting from the subject, recognizing the body’s position is the premise of cognition. All feelings and experiences start from “I”; the rest place’s value decreases according to the distance from the center. Therefore, the architectural field is viewed from individuals, as the center, to the group with architecture as the matrix. This tendency stems from the conscious self in the human mind, which constructs the environment and the universe centrally and gives an order to the world instinctively. On the other hand, from the perspective of philosophy, the centralization of the architectural field can be divided into “intersubjectivity center” and “phenomenology center”: “intersubjectivity center” of architectural field refers to the overall consistency formed by the connections between individuals in the architectural field; the “phenomenological center” of the architectural field is owned by the individual alone. Each person is located in the center of his own “phenomenological world”, and this center is the environmental element of “Dasein”(being here) proposed by Heidegger. When the environment is single, or there are few references, the self-centered construction mode of architectural field consciousness is more able to trigger the structural resonance of the perceptual field to receive “I am here”. Here, the center of intersubjectivity and phenomenology can be understood as two sides of the same perceptual field. For example, people have been constructing a “central” mutual cognition with their homes since they were born. The center of consciousness field is not the geometric center but where the muscles move and produce mental consciousness. By completing various activities in the house, the body constructs the intersubjectivity

centered on it in all furniture and space and forms the distinction between self and others; and the cognition of the architectural field presents radial progression. Making the architecture obtain a similar central position in the field is a perception imitation of the body so that the perceptual field also obtains a body structure similar to that of the perceptual body. If the most basic and peripheral levels are “cold”, then the most core should be “warm”, which is the ideal dwelling place of human beings, the deification, and the highest level that the spirit tries to reach. The architectural noumenon in the architectural field is the center of its consciousness and the reality of human beings in the world, which makes the core meaning of space exposed and retained on the ontological level. On the contrary, the destruction of the central relationship between architecture and the construction field will cause people to be confused about the place out of focus, and it is challenging to construct a complete and transparent perceptual field.

(2) Stratified world Mircea Eliade tried to point out that the meaning and the center belonged together, and the center existed in the field at different levels. The development of people’s daily lives is closely connected with the center of the place, where essential activities often occur. For example, the sculpture forms a center of arrival and pause in the landscape, a natural landscape sign or a “knot,” as defined by Kevin Lynch. In addition, people’s experience of the center is generally associated with the vertical axis, which connects the sky and the earth, and paths and axes are necessary supplements. So architecture is a way of making it an accomplished fact that people are alive. Architectural forms, spaces, and typologies can all do that. When architectural field structure and perceptual field structure fit, people will not feel strange after arriving at a new architectural field but think they are in an explained perceptual field. It is also possible to experience that the living place can continue to extend outwards, break through the tangible material boundary, and merge into the feeling of “being here” in the architectural field.

Meanwhile, this cognitive relationship has the feature of stratification. In many traditional societies, people believe that the world or universe consists of three levels: heaven, the earth, and the underground, and communication is accomplished through the pillar or sacred tree of the universe. Thus, the cosmic pillar standing at the center of the universe and the living space constitute the “cosmic system”. The people of Siberia and Central Asia think that the house is a miniature universe. The smoke from the top hole of the tent, which, as the archetype of residing, symbolizes the sky shape, flies out to the North Star. So the hole stands for the sacred tree through the world of heaven, earth, and underground. Bachelard stated that going to heaven is poetic and should be undertaken by the poet in modern society. In fact, in the material world, the significance of the architectural field is to arouse the viewer’s spirituality, feeling, and imagination by carrying such activities to construct a “heaven and earth” architectural space in the consciousness so that people can live poetically. Therefore, in the cold region architectural field, the poetic reception of the ontological structure needs to start from the image presentation of intuitive materials. The cold imagery of the outer layer is connected with the centered dwelling through the stratified consciousness so that the architecture entity can inspire people and then trigger the association and imagination perpendicular to the architectural field. That is also the way for architecture, as the perception object, to have

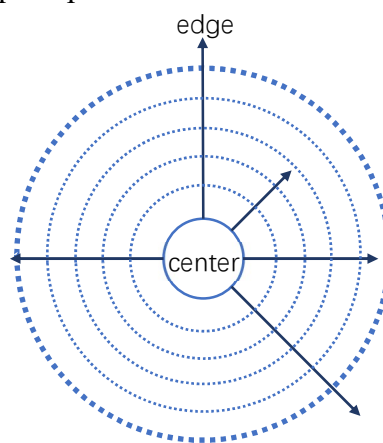


Fig.5-1 The place view constructed by “center” and “edge”

resonance in the cognitive structure of the human being as the perception subject.

5.1.1.2 Material

The ontology image of the architecture is built on the organic construction of different materials, of which various properties are integrated, forming the material field. In the perception, facing numerous possible combinations of material properties, the viewer never needs to comb deliberately to avoid confusion in understanding because people have become accustomed to the perception-filled world revealed by their senses and daily life experience (Merleau-Ponty, 2019, p. 3). The synthesis of perception in all material fields is not only based on priori but also partly experiential. First of all, although the properties of materials can be presented separately, it is undeniable that when they are constructed together, the synthesis of materials will bring a unique perceptual experience even if the materials themselves do not change. In addition, viewers will seek a similar point of understanding when receiving different material properties according to the present conditions. For example, a building often needs different materials, naturally producing textural synaesthesia due to materials acting as the architectural elements. To be sure, if the material is too different, the material synaesthesia will not react; putting too similar materials together will also destroy them. The same kind of material, different processing methods, different amounts of material, different lighting conditions will occur more. Zumthor once wrote an experience of material field in his text and continuously described and compared different materials and spatial perception. All his narration on materials understanding showed that the vividness of materials needs to be reflected in the material field. Without fair-faced concrete, it is hard to imagine Zumthor's description of pine as "without problems" in the environment; it is impossible to counteract the sense of scale and color of concrete without sufficient volume of ebony (Zumthor, P. 2010, p. 25). Therefore, in architectural perception, sensory information is constantly stacked and integrated with the material field. Then through stimulation, comparison, and judgment, a kind of inter-subject consciousness is formed, making it possible for different types of material entities to merge in a shared context. In the cognition of the cold region architectural originary, all materials need to be integrated with cold perception to interpret and understand "being here". Otherwise, the cognitive process of cold region architecture will reflect the lack of background in the ontology structure, making it difficult for people's spiritual feelings to reach the essence of presence.

From the point of view of the material field, since the 1930s, a new generation of Nordic architects represented by Erik Gunnar Asplund, Arne Jacobsen, and Alvar Aalto simultaneously broke away from the simplified functionalism aesthetics and turned to the multi-level, multi-sensory architectural thinking and design from the local materials. Whether the dark blue ceiling of the Skandia Cinema as a metaphor for the Swedish sky (see Figure 5-2), or the overlapping arrangement of porches and Nordic trees in a woodland cemetery (see Figure 5-3), or the SAS Royal The cotton and linen interiors used in the hotel to soften the smooth lines of the severe cold climate of Copenhagen (see Figure 5-4) all reflect the architects' mobilizing the sensory system in the material field. This sensory materiality and tradition evokes a beneficial experience of the continuity of nature and time in Northern Europe and realizes an implicit emotional association based on the environment. During this period, the materials presented in the cognitive structure of image consciousness are constantly spliced, transformed, abstracted, and fused to form a composite architectural space in the cold region. The "seams" on all the paths metaphorically represent the transfer of time and consciousness in the cold region, just like the comma in a sentence, making the meaning of the sentence complete and more layered. The viewer's emotion and experience will also change accordingly. Thus, the

material field in the cold region architecture is released at different levels and coupled in multiple dimensions.

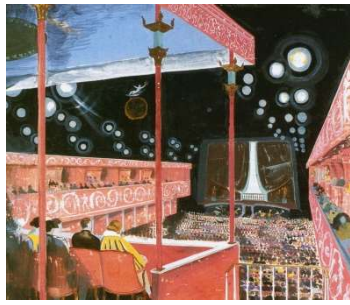


Fig. 5-2 The cinema drawing by Asplund (1922)



Fig. 5-3 Resurrection Chapel (Kesäläinen, 2019)



Fig. 5-4 The SAS House, 606 Room, designed by Jacobsen (Sheridan & Jacobsen, 2011)

5.1.1.3 Temperature

When describing an architectural field with temperature, it does not refer to the physical association of temperature brought by a single material, but a “generalization” given to the body by integrating all perceptions and “processing” through the consciousness structure. This generalization begins in the skin and then penetrates it, which the body perceives as a goal and a unified consciousness within the body with other sensations. In the cold region architectural field, the experience of temperature can genuinely connect the body to the invisible “being here”, which becomes the matrix for all cognition of architecture in the cold region. Japanese philosopher Watsuji Tetsurō has concluded: “The cold of Western Europe is not so much shrinking as enliven, inspiring the power of man to overcome the cold and subdue nature. After the cold biting wind, there is the joy of the sun; The next day, the sunshine and the snowmelt happen under the eaves after a few feet of snow. It is an ensemble of humidity, sunshine, and cold that cannot be played by cold alone. The symbols of winter in Western Europe have manufactured things. It is winter that brings people to their feet (Watsuji, 2006, p. 11-15)”.

Different areas of the construction field in winter have a distinct temperature experience. Taking Harbin as an example, winter is long, and the average physical temperature in January reaches minus 20°C. The cold atmosphere in winter is significantly different from that in Quebec, with similar climatic conditions (Figure 5-5). Cold as a climatic condition put forward a series of settlement conditions different from non-cold areas, such as low-temperature climate, natural climate snowfall, river surface ice. At the same time, it also extends the different experiences of cold area residents to the temperature. For example, when people walk through the snow, they can predict whether a distant architectural field is warm through the material and light. When entering a space, people will judge the temperature of the atmosphere based on a range of sensory materials; Even in the same building with heating conditions, different interior spaces will give people a different “sense of temperature”. At the same time, this experience also implies a wealth of background information based on region, nationality, and country. Temperature is an imagery of the architectural field, which is about what people experience. It is never a purely physical measure but a comprehensive perception. At this point, the skin, as the largest organ of the human body, is autonomously coordinated with other senses, and the temperature information obtained from the architectural field is finally projected into a kind of consciousness associated with the cold experience inside the body.



a) Winter Street View in Harbin



b) Winter Street View in Quebec (The Restless (n.d.))

Fig.5-5 The significant differences in cold region atmosphere

In a cold region architectural field, the architecture is placed in a natural environment with significant periodic changes, whether on the artificial or natural levels. Therefore, coldness has become the key to the consciousness of architecture. As a descriptive tendency of temperature perception, the body is maximized to be connected with the architectural field through tactics. The material consciousness and the architectural field image have a centripetal tendency, which is the body's internal needs deviating from cold and warm. The material perception inside the architectural field will be lost without the background correlation of cold (see Figure 5-6). That is to say, if there is no cold image, then the meaning of warmth will also be weakened. Therefore, the temperature experience of a building in a cold area must include the perception of cold and warmth. Without this kind of contrast and judgment, the architecture will lose at least one dimension of perception. At the same time, the "body" displacement of the temperature experience premise, without which the experience is both eternal and instantaneous, unable to form an absolute consciousness.

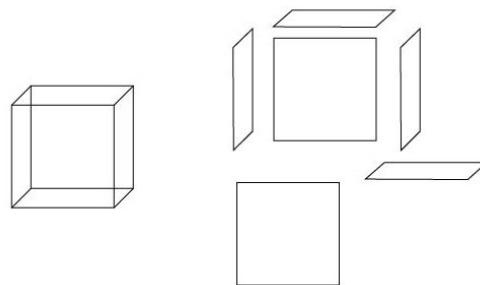


Fig. 5-6 Volume and Space relationships. If the sidewalls of a volume are scattered in different directions, spatial patterns or spatial relations originate.

5.1.2 Association to experience of cold

5.1.2.1 Perception

It is challenging to plan an accurate experiment in discussing the generation mechanism of architectural field consciousness because the experiment is characterized by operability and repeatability. However, in the architectural field, people's reception is both universally divergent and uniquely concentrated. Even if people try to recognize the architecture itself alone, all the perceptions before entering the architectural field will affect people's consciousness of being here and now. Therefore, the description of the architectural field is always full of uncertainty and openness. In *Towards a New Architecture*, Le Corbusier tried to construct the architectural cognitive process from the material image to the consciousness presence through the description, starting from a wall that "impressively extends to the sky". Corbusier claimed that he had already grasped the

intention of architecture here. All things in the architectural field express themselves without a word, relying only on their form and those specious relations with other things and forms. Such perceptual description of the architectural field seems to have nothing to do with the practicality of architecture. However, it is the most authentic architectural language, which is the originary of architecture, establishing a relationship that can arouse the viewer's emotion (Malaps, 1977, p. 107; Corbusier, 2015, p. 149). It can be seen from this that when facing the perception problem of the architectural field, people should first recognize the existence and importance of perception. All unutterable emotions can be perceived, and even if they can be spoken, language cannot replicate them completely. The current claim that architecture is merely a material and geometric object created by focusing on some vision has become the past (Pallasmaa, 2014, p. 207). In fact, this abandoned picture and the pursuit of clear images do not respond to the ephemeral, obscure emotional origin.

People are born with the ability to instantly recognize the intrinsic nature of a place, which is similar to the automatic reading, and grasp an object's nature and characteristics as in the biological world with an enlarged background. A specific space or place is an image, a spirit, or a biological experience alone, which is associated with itself after perceiving the image—for example, seeing snow, as if the viewer perceives the cold outside. Here perception does not need to be a complete and thorough experience, as it can be judged by evoking memories in the body. On the other hand, perception is a one-sided description of this reality and the processing of what people perceive: internalized mapping according to images to achieve embodied understanding. At the moment, the snow on the retina is no longer the actual snow in front of us, but a kind of information processed, which may be pieced together by some experiences and has the effect of montage (see Figure 5-7). It is derived from individual experience and is the mobilization and reconstruction of its information base. People indeed possess an incredible ability of integration, though that is often not recognized at all or reclassified into the domain of extraordinary intelligence and value. Because of a cultural bias that only values logic and reason in the human mental world, unfortunately, people often reject this comprehensive ability. Freud made this revolutionary discovery more than a century ago, but even today, people continue to seriously underestimate the whole unconscious world and the process of representation in the current cultural behavior of architecture (Pallasmaa, 2014, p. 209).

The contemporary world is full of various disturbances; the commercialization and rapid pace of the world have drowned the originary order. Technology cannot make people grow up simultaneously as production efficiency and people's perceptual ability declines in the dazzling deformity of perception. When they cannot feel connected to the built environment, they will lose the pleasure of having real-world experiences. On the other hand, the architectural field can inspire and transform daily being. By changing the material feeling in the architectural field into subjective perception and objective existence, architecture has become more thoroughly involved in the people's direct perception construction than any other art form (Holl, 1994). Therefore, the perception of architectural materials in the cold region must be realized through perception to construct viewers' external experience. The essence of the perceptual field formed is that the consciousness of architecture materials in the cold region participates in the projection of the internal association of the viewer's perception on the spot so that the perception of the cold region and the perception of



Fig. 5-7 Montage was initially used to mean construction or assembly (n.d)

materials constantly compound and overlap, presenting a semi-ordered state. This experience and synaesthesia simultaneously stimulate internal and external perception, raise consciousness and express a series of meanings about the cold region architecture, and respond to the duality of site characteristics and environment.

5.1.2.2 Atmosphere

Atmosphere refers to the overall perception and feeling of a specific environment, a social situation, and the impression with emotion. The nature or feature of spiritual background and experience is suspended between the perceived object and the expressive object (Pallasmaa, 2014, p. 204). Zumthor believes that the essence of architecture is the atmosphere, which significance lies in the realizing resonance of design expression through the representation of atmosphere in the viewer's mind. As a form of experience, Atmosphere has immediacy, derived from the instinct to generalize the character of a place. In an architectural field, the viewer usually first understands its atmosphere, then perceiving the objective reality such as materials and space, and then corresponding the perceived structure with the materials. At this point, the experience of nature is hard to have a fixed on the one-to-one mapping of material received, and atmosphere and expression shared are complicated, but this does not affect the seemingly void atmosphere that has been formed in the viewer's mind with an emotional view, and the imagery does not change over time (Merleau-Ponty, 2001, p. 245). People daily looked out of the window, for example, by the sky's color, the clouds' shape, and the light's intensity, to construct an image (see Figure 5-8) for determining the weather and outside atmosphere. Besides, more people's mood will be influenced, even though any material entities that are not indoor, including air. The ability to experience an atmosphere and the materials used to construct it changes over time. Dewey further discusses the consciousness from a preliminary understanding of the temporal wholeness to a thorough understanding of the detailed investigation: "In every subject, all thoughts are thus derived from an unanalyzed totality. If an object under study is reasonably familiar to us, then we are immediately aware of the relevant differences, whereas the mere quality of detail cannot be preserved in our memory to be recalled at any time" (Dewey, 1910, p. 188). It can be seen that atmosphere is the positioning and generalization of the whole space, which is rooted in the evolutionary process of human beings. People identify different place-atmosphere with the help of their emotional sensitivity. New biological psychology and ecological psychology have proved that this cognitive model originates from the relationship between instinct and transcendence in human behavior and cognition.

The atmosphere is abstract and invisible. Meanwhile, it is concrete, which can evoke the internal consciousness of the body and project a specific description of the emotion to the entity in the architectural field. The atmosphere that religious architecture wants to convey is mysterious and wondrous, while the atmosphere that residential architecture wants to convey is poetic and warm. The architectural atmosphere closely matches the activities and construction purposes of architecture. So, the atmosphere of regional architecture is born with regional characteristics. In cold-region architectural fields, ice and snow cover all materials and color and blurs the outline of the architecture. As a result, the cold is always closely related to silence and loneliness. The cold atmosphere always

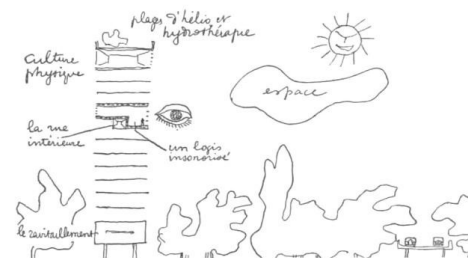


Fig. 5-8 A man stands on his floor before a wall of glass, facing the sun, space, and verdure. His eye sees these things (Corbusier, 1964, p. 113).

emphasizes the quiet environment by specific architectural elements, including applying warm indoor lights (see Figure 5-9) and low saturation color (see figure 5-10). In contrast, the depictions of tropical architectural fields mainly focus on the multiple calls and dominance of the environment to the senses and then abstract them into the tropical concept with a romantic imagination and the vivid beauty of the sensory quality (Veronica, 2019) (see Figure 5-11). The atmosphere is the anchor point for the viewer to be immersed in the contrast synaesthesia between individual and the environment to seek self-consciousness. It is the place of feeling, between tranquility and induction, which triggers an environment of walking and a state of mind for the viewer.



Fig. 5-9 Undergraduate residence at MIT (Holl, 2003, p. 532)



Fig. 5-10 Valley Villas, Changbai Mountain (Xia, 2017).



Fig. 5-11 Andra Matin home, south Jakarta (BluPrint Editorial, 2019, p. 19)

5.1.2.3 Imagination

Imagination is the innate ability to understand an overarching range of perceptions and atmospheres, akin to imagining a series of emotionally charged associations based on an entire novel when reading. It is worth noting that these imaginary spaces are not just abstract, thin spatial feel or atmosphere. They are filled and like dreams, not just pictures, but complete spaces, embodying people's imagination to experience life. In her recent book *Dreaming from Books*, Elaine Scarry discusses the process of literary imagination and the vividness it brings: In order to attain a "sense of life" in the material world, language art must seek to mimic its "persistence" and, more importantly, its "giving" quality. The "instructive" feature of language art certainly satisfies its mimetic requirement of "giving". The Czech writer Bohumil Hrabal once said of the concrete manifestation of the literary imagination: "When I read, I do not just read. I chew a beautiful sentence like a fruit or a sip of wine until thoughts dissolve into my body like alcohol, into my brain and heart, and run to every vein's end". Compared with literature, in the construction of architectural consciousness, imagination also elicits deeper materiality, senses of both seriousness and reality, rather than a purely nihilistic atmosphere of entertainment or fantasy. As Constantin Brâncuși put forward, "Art (sculpture) must be able to bring viewers a violent and sudden impact of life and the feeling of breath". The description is suitable for the architecture, as was also compared with text, this kind of present material synaesthesia strengthened people's experience of the life-world because, in the architectural field, materials connected to the natural viewer body through a variety of sensory experiences, and even become a part of them so that the imaginary part is also from the sense of activated and strengthened reality. Therefore, life exists both in the physical world and in the spiritual world and constantly merges and stimulates each other in the two worlds.

Meanwhile, imagination as a skill determines the depth of people's understanding of the architectural field. Those experienced and remembered actions become the material for imagination, which, together with the retained images in mind, synthesize a series of feelings that seem to have been truly experienced and develop into an expanded reality. Brain science research shows that perception and imagination both occur in the same place in the brain, and there is a close relationship between the two, but even the absence of perception can trigger imagination, and even the absence of seeing snow does not stop people from imagining snow. Imagination is not created automatically by the senses and needs external stimulation and the basis point of imagination. All imagination has intentionality. In addition, people's psychological behavior is endowed with a complete sense of intention. For example, people can create a cold environment or cold landscape in their imagination, including buildings in the snow, the state of pedestrians in the snow, and the environmental atmosphere in the snow. There is no doubt that in this process, the sense of unity dominates the arrangement of details. Different cognitive abilities of the architectural field lead to the difference in planning power from abstract outline to concrete detail in imagination. This originary also reflects people's cognitive structure and image mode.

Gaston Bachelard argued that the most crucial significance of the home is that it harbors daydreams and is one of the tremendous forces that integrates human thoughts, memories, and imaginations. Here, home is not a defined living space in a narrow sense but a living place in a broader sense. Imagination has a deep correlation with the place and is an essential part of the complete cognitive structure. Just as not all structures of image consciousness have an image subject, not all architectural fields can inspire imagination. The imagination in the cold region architectural field superimposes the mapping of the cold region consciousness. If there is no corresponding imaginary structure in the architectural entities, it is difficult for people to realize the intimate natural feeling of being here. In most cases in cold areas of China, people only imagine the construction activities but ignore the cold region consciousness, disintegrating local identity.

5.1.3 Recipency and synesthesia of cold

5.1.3.1 Comprehension

Architectural problems can never be identified by themselves, nor can they be identified solely by others. If it is just the self-solving of the architecture itself, it must not be easy. Because architecture has not always existed, nor has it always remained the same. Obviously, the understanding of architecture should be placed on a broader scale. Understanding a building is actually to construct the architecture consciousness, rather than actually to construct. The viewer needs to establish a concept of the architecture and a set of perceptions about it. Since the collapse of dualism in the last century, systematics has been widely recognized and accepted in the formation of architectural consciousness. With the development of times, the number and types of buildings have diversified and expanded with significant complexity and the burst of multiple consciousnesses of the image world. As for the topic of understanding architecture, Lynch put forward in *The Image of The City* that architecture should be identified by its identity, which is simply the distinctive characteristics of architecture, space, or city, and the characteristics that enable people to distinguish and remember. It is identified that the experience of anything must be related to the surrounding environment, sequence, and previous experience (Lynch, 2001, p. 1). It is not difficult to find that the formation of the viewer's architecture consciousness seeks self-clarity in architecture discrimination. As an artificial product, architecture is a directional prop that provides a lifestyle to be constantly transformed with the change of its own needs. Therefore, it is necessary to refer to all the materials in

the field of architecture, including the viewer's priori.

The local-specificity of cold regions is reflected in the particular climate and periodicity of plants: (1) the different temperatures of the four seasons; (2) the appearance of alternate rainy and snow seasons; (3) the periodic growth of coniferous and broad-leaved trees. The impression of the place is the premise for viewers to form the architectural consciousness, the basis for positioning "me" and "architecture", and the dwelling's foundation. Like architecture, place formation is entitative but directed to consciousness because the field is the association of architectural consciousness and the individual's personalized imagination of architectural and environmental elements. Just as someone who has lived in a cold region for many years can immediately identify which ground is more likely to fall, individual experiences are unconsciously incorporated into conscious associations. It is the viewer himself who defines the architectural field. In the expression of architectural design, architects are used to passing on their own experience of self-awareness in order to achieve viewers' discrimination. Alvar Aalto always tries to show the appearance of the lush trees in his design. According to his local consciousness, the lush trees are the imagery of the architectural field in Finland, making viewers feel the reappearance of cold region life. In the Saynatsalo Town Hall (see Figure 5-12, 5-13), located in a Finland forest, Aalto was described as too sentimental to be practical (Lefavre & Tzonis, 2007, p. 52). for his unabashedly expressed feelings towards the new town, he sought to create a sense of belonging and community. The particular layout directly responds to the local natural landscape, giving the building a special effect, closely connected with nature with humanized and multi-relational accesses, and adopt undecorated masonry, logs, and leather. The architect incorporates too much of his own intentional experience of the architectural field to achieve self-evident results. On a visit to the project, architect Mark Toddy wrote: "Built-in a tall Finnish pine forest, the building confidently establishes a sense of permanence of weight, never removed from nature, but simply rooted in the place." (Toddy, 2012)



Fig. 5-12 Alvar Aalto was always trying to describe Finland's wooded in the scheme (Chard, 2014)



Fig. 5-13 The design of the entrance is influenced by multiple, humanity and adaptability (Chard, 2014)

5.1.3.2 Interaction

Interaction is used to describe a contradictory standpoint from which modern art derives its essence. In the image consciousness of architecture, interaction clarifies the cognitive method. In this way, the architectural image does not belong to the traditional or stylistic domain, although it may include either or both. Further, the interaction can be traced back to details and imprints that identify any architectural tradition without the need for typological imitation. In addition, the interaction is enough to retain the potential for stylistic development and point to classical features when appropriate. According to Le Corbusier, what is presented in the architectural field includes everything that an architect can perceive as an ordinary individual: the experience of the light, nature, and

environment and contains the individual's unique thinking and aesthetic interest. That makes the cognition of the architectural field reject the silence of architecture or the silent architecture. Architecture needs to be woven together with the local elements to become a part of the place where people dwell. It is neither all nor separated from it. Thus, the emotions of the viewers are continuously exchanged in the place experience. Therefore, the place is the convergence of synesthesia between different people and the iteration of one person's different consciousness at various time points. Substances of different spaces and times realize synesthesia through the viewer's body and consciousness. Here, the interaction of all the individuals in the place makes the image no longer consist of many isolated "it" (objects), but innumerable interrelated "me" (subjects). In the environment as the background, seemingly different ideologies realize "unity" in "me". Therefore, the architectural consciousness condensed in the architectural field is also viewers' consciousness.

5.1.3.3 Poetry

Poetry is the emergence of imagery in consciousness. As the direct product of mind, soul, and human, it is grasped by the viewer in reality (Bachelard, 2009, p.3). Poetry is scattered in all aspects of the life-world, allowing people to go deep into themselves being and thus produce the echo's diversity from the unity of being. In the echo, poetry becomes the projection of people's self and realizes the transfer of being. Although echoes occur in the poetry of all fields of architectural phenomenology, the discussion always revolves around some single image that strikes directly at the soul. In the construction of cold region architectural consciousness, the architectural field is like a poet, hoping to inspire the participants to wake up the echoes of the place through its crooning to shake every corner of the life-world. Therefore, the architectural field in the cold region is located at the architectural originary and meditation starting point. If the significance of architecture is to carry people's activities, then the significance of its field is to provoke people's meditation and transcend all psychology and psychoanalysis through echo to make people feel surging poetic power in their hearts. Because of the echo, one can feel the emotional resonance and the poetry of the projection. However, the image touches the deep heart before it touches the surface, which the viewer can genuinely realize in an everyday experience. Through the perception of the architectural field, people form a poetic self inside the body.

In the cold perceptual field, perception starts when the object triggers the sensory experience and abstracts it into a dotted moment. Then, through the viewer's own will, the material consciousness information that cannot be self-verified or otherwise verified is reconstructed. The process is created for the echo of the viewer himself, which Heidegger meant by poetry: a dynamic behavior rooted in the individual's perception of the built environment. Moreover, when people form their architectural field consciousness, the shared commonness is formed according to the shared environment, which is the resonance matrix. At the same time, after the formation of unified field consciousness, the abstract conscious impression will be internalized into the psychological image, becoming the cognitive background. That is the predictable and consistent scope in the mutual influence of various material entities, a common culture, and essential biological characteristics. In the blending of the architectural field, all materials achieve a habitat in the natural environment, thus achieving a here and now architecture, which Hawkes calls poetry based on the environmental tradition (Hawkes, 2008, p. 80). Therefore, the architectural field finds a practical use for the site and reflects the culture here and now by the inhabitant's poetical dwelling. Mumford says: "An architectural field is an echoing place that you can touch". Perceiving architecture in it is

a way of inspiring people to find a connection in the world today. For example, the Snowy Country Villa in Whistler Valley takes the boulder commonly seen on the hillside of the site as the imagery anchor (see Figure 5-14), and the independent and solitary perceptual image of the building becomes a poetic response to the place (see Figure 5-15), seeking to create the place and becoming a harmony part of the place. This poetry unquestionably points to the construction and dwelling of the individual's flesh body and links with the related construction activities throughout history. The present construction can be in dialogue with the creativity and mystery of the whole world.



Fig. 5-14 The stone lying on the Whistler valley in southwest British Columbia is the original image for the site to the architects. (Dow, 2013)



Fig. 5-15 The country villa's form originates from the echo of the site's place and image. (Dow, 2013)

5.2 Structure of behavioral field to deconstruct cold region perception

5.2.1 Structure of behavior

Behavior is subjective, marks the eternal struggle between man and nature and society. Therefore, as a means of opening, behavior is the manifestation of opening and provides the means of shifting horizons. All cognition is opened by perception within those horizons (Merleau-Ponty, 2001, p. 240). In this part, the behavior analysis begins with the internal grasp of the behavior through the characteristic phenomenon under the naive consciousness. It then explores the direction, intention, and specific meaning of the behavior, to realize the transformation of the behavior as image consciousness to another type of reality. Finally, the behavioral structure of the cold region architectural field will be unfolded from these three aspects, which correspond to position, form, and impression.

5.2.1.1 Position

It should not be said that the body is in space, nor in time. The body of the viewer resides in space and events (Merleau-Ponty, 2001, p. 185). Through the body, the viewer establishes his position in the place, and at the same time, he confirms the reality of his presence through perceptual positioning. All the body behaviors that are motivated in the place are fed back into the individual's body schema. People initially understood the "body schema" as the generalization of the body experience, giving an interpretation and a meaning to the present internality and proprioception. The body schema should provide the viewer with the position's change of other parts when a body's specific part moves. The position of each local stimulus in the whole body, and the sum of the movements completed by a complex movement at each moment (Merleau-Ponty, 2001, p. 136) That is the subjectivity of the behavior, revealing the inseparable relationship between the viewer and the behavior, and the behavior itself is a physical event restored by the body. The field presents the embodiment of intention and the extension of consciousness in body behavior. Both Koffka's and Helmholtz's experiments have demonstrated the loop closure relationship between visual images and body positioning in the field. As the basis of cognition, consciousness is also the foundation of behavior: people cannot experience

each point in the field but can only transform through the information of other points and then realize the phenomenon explained point by point. The behavior at each point of this phenomenon occurs following the requirements of the whole consciousness (Merleau-Ponty, 2005, p. 179). Therefore, when studying the behavioral structure of the cold region architectural field, the starting point should be a positioning rather than a repeated study of the viewer's path. That not only avoids the occurrence of a vague sense of space but also deviates from the rules of the behavioral field. Of course, the structure cannot summarize all the behaviors in the cold region architectural field, and it is necessary to discuss the significance of contrast and transparency, which will be discussed in the latter part of this study.

Thus, the formation of the consciousness of the cold region architectural field is accompanied by the behavior field's expansion. The viewer's cognitive structure will continue to iterate along with the body behavior, then forming the process of experiencing architecture and the continuous perception-imagine-consciousness structure of the architectural field. Zumthor has described the interior of Thermal Bath Vals as introducing people into a series of spatial sequences that move from place to place, opening and closing before one's eyes (see Figure 5-16). The section sketch records his concern about space extending over time and reflects his thinking on space positioning from the viewer's perspective: windmill rules and zipper rules, the former ensures the interlocking between spaces and positioning, and the latter ensures the mainline of space-positioning structure. It can be seen that there are two anchor points positioned on the cognitive structure of architecture in space: one is experiencing, and the other is association. In addition, taking a shower is a process of purifying the body and mind and perceptual and spiritual consciousness. This cognitive sequence guides the experience process from the dark and psychedelic indoor space to the open and clear outdoor space. From the indoor warmth and dense atmosphere to the outdoor sky and snow mountains, the viewer acquires a new positioning of the physical body and obtains a new positioning of the flesh body in the world. All the experiences and associations are not instantaneous but slowly unfold along the time axis with the people's positioning and transfer, looking for new forms and then removing some appearances to realize the thinking back to the architectural originary.

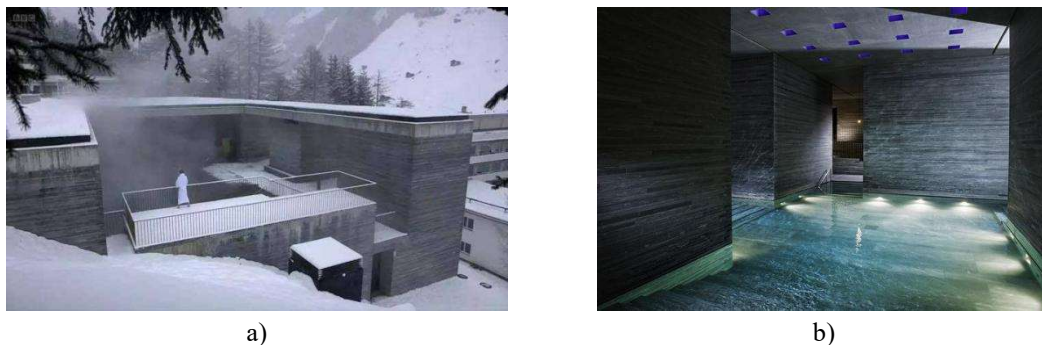


Fig. 5-16 The winter Thermal Bath Vals (FG+SG, n.d.).

5.2.1.2 Form

Just as the Piéron scheme was rejected: the color value of a given stimulus depends not only on the overall color structure but also on its spatial structure (Merleau-Ponty, 2005, p. 130). The concept of integration and coordination can be used to determine some fixed construction, with which some local activities become interdependent, so the associative consciousness is received by the unconscious as “automatisme” (Merleau-Ponty, 2005, p. 135). With the initiation of the body's positioning in space, automaticity becomes apparent. Coordination connects the elements to each other and forms a whole through

their union, which has its regularity. As long as the environment gives some essential “stimulus” elements, viewers will supplement almost all the images according to the cognitive structure. In the perceptual process of color, material, and spatial position, the result is temporary because the form is stimulated and constructed temporarily at the moment of perception. Thus, the architectural field has a positive and appropriate reality that is not a simple consequence of sense organs or substrates (Berndt et al., 1968, p. 51). The formation of behavior structure is an undecomposable unity, not a simple synthesis of various partial processes. The behavioral field of perceptual architecture does not depend solely on the stimulus architectural elements but also depends on the individual’s prior consciousness structure. Therefore, it is not the real world that directly constitutes the perceived world (Merleau-Ponty, 2005, p. 138). Thus, the structure of behavior can be divided into three forms based on the emergent themes that are finally realized: “chaotic form”, “changeable form”, and “symbolic form”.

(1) Chaotic form Behaviors always need to be confined to the natural environment and constantly accept the hints of various situations. Even the scene of an unexpected encounter, the viewer will package it together with other plots to understand and regard it as a prescribed presentation. Chaotic form means that behavior is often tied to some abstract aspect of the situation but is occasionally subject to a specific plot with a stimulating purpose. For example, for people living in cold areas, for a survival instinct, one of his physiological structures of the adjustment tendency of there is to resist the cold. A sudden blizzard, temperature drop, or over the summer season like snow as a stimulus, based on cognitive strengthening behavior will make the person produces cold weather. The instinct of human-animal nature triggers this sense of refusal to the cold climate. When the environment is stimulated towards a colder climate, people will have a sense of stress. When there is a sudden environmental transition in the architectural field, such as an outdoor space sandwiched between two spaces, people will make different psychological expectations and behavioral rehearsals for going from inside to outside.

(2) Changeable form Once people observe in the behavior history that signals that are not determined by the type of instinctual equipment appear, it can be inferred that these behaviors are based on the structure of the materials in which they are relatively independent and realized. The behaviors that fall into the former category contain references to relationships. However, they are still limited to certain situational materials.

(3) Symbolic form In animal behavior, symbols always remain as signals and never become symbols. The use of the symbol requires that it cease to be a time or an omen to become the characteristic theme of some activity that expresses it. This type of activity has been learned in certain exercise habits.

5.2.1.3 Impression

Behavior can be divided into the overall response to the stimulus and the local monotone movement in the behavior field structure. Therefore, when people try to recall the image of a specific architecture or retrieve relevant consciousness, the contour of the architectural field with the scene will be formed in their brain, and this contour is the synthesis of perspectives formed by the substitution, overlap, and verification of different viewpoints of behaviors in the field. Part of the information is a more stereoscopic image mutually corroborated by multiple perspectives; the other part of the information with fewer perspectives can be reflected by other things’ images obeying the whole architectural field. According to the behavior structure, the result is naturally produced, thus constituting the “impression” of the architectural field in people’s minds. In the modernist movement, this impression, once regarded as the second stage of modern architecture, was briefly understood as regionalism, which gives architecture and places

uniqueness (Norberg-Schulz, 2010, p. 192). Therefore, the architectural design began to focus on the relationship between the building and the surrounding environment, and this kind of careful “layout” also conforms to the viewer’s grasp of the architectural ideology. The straightforward regionalism conveyed by the Finland Pavilion at the 1939 New York World Expo and MIT’s student dormitory is just like Wright’s declaration that architecture “desires reality”, resonates in the architectural world. However, this superficial re-impression of impression only starts from concept and takes impression as an already mature material text, which is realized by collecting many architectural image materials, obviously, has moved too far from impression structure.

Chapel de la Ronchamp, designed by Le Corbusier (see Figure 5-17), returns to the architectural field of the viewer’s architectural consciousness and leads it to a description of the behavioral field full of impressions: “a very absorbed, silent and contemplative ship”. This description abandons the traditional image materials of brick, form, light, and shadow but spans the structure of image and association and directly supplies the synthesis of consciousness. Vincent Scully described it as a meaningful center of truth and a “rallying force” (1961, P. 45). When architects begin to construct behavioral fields in the way of impression, it is the ultimate moment to combine the design consciousness with the architectural consciousness of the viewer. Louis Kahn once asked what architecture was and said his view of architecture: “I want to wrap ruins around a building”. In Kahn’s opinion, the architectural consciousness cannot be separated from the architectural field, and the two cannot be separated. People’s experience in the architectural field becomes the material of each other’s architectural consciousness. People produced social interconnection in the rooms, buildings, streets, and cities. The impressions of different fields are various and reflect each other: they can be places of the spiritual atmosphere, a social room, the consensus of the room, and a collection of places.

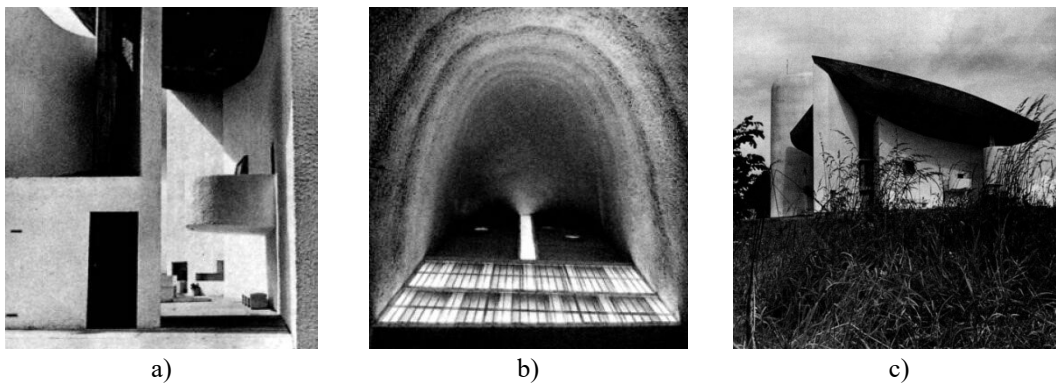


Fig. 5-17 Interior and Exterior of Ronchamp Chapel (Hervé, 2013)

Architectural consciousness is produced during the establishment of the architectural field. The impression will not only include the perception brought by the viewer in the actual behavior of the entire building and the site, but also the impression brought by the architectural behavior itself, such as the area where the building is located, people in cities, countries, social environment, economic status, history will all be included as part of the behavioral impression. For example, in Harbin, a typical cold city in China, some “European-style buildings” exist as a form of replicating history. On the one hand, they become the required features of urban development, and on the other hand, they also hinder the renewal of the urban appearance. However, in European countries with a long history and similar latitude and climate conditions, there are also new “replicas” of buildings, but they are not obtrusive. The construction of architectural consciousness is also a part of people’s systematic cognition of the world, which cannot exist in isolation.

Therefore, even in cold cities, the field impression formed by people is entirely different, becoming the whole of multiple perspectives and the part of a few perspectives in the structure. The architectural impression, which has been too isolated in the past architectural behavior, has opened up the modernist architectural movement. Cold region architecture may also need a “movement” to help architects see the status quo of inner isolation within the surface connection.

5.2.2 Organization of behavior

5.2.2.1 Order

According to reflexology, “geographic environment” and “behavioral environment” are not precisely synonymous. In the hierarchy of the behavioral organization system, the various effective relationships of each hierarchy stipulate a kind of nature: a way of transforming stimulation inherent in it (Koffka, 2010, p. 28). Therefore, not all the organism’s actions are above the entity, but the unique reality of the structure (Merleau-Ponty, 2005, p. 197). When people try to understand some behavior, the understanding is not a solid explanation, and science cannot always help people interpret all phenomena. Koffka once said: “Explanation and understanding are not different ways of treating people’s objects. They are not the same thing at all. It means that causality is not a simple order of facts that can be recorded in memory, but an understandable connection”. In the behavior of the cold region architectural field, the view can be understood as: the essence of behavior has a complex organization with diversified motivation, rather than forming a binary trigger mechanism corresponding to the environmental conditions in the cold region. The entire behavioral field system does not seem to be coherent, but the fact that it cannot be contained by science does not mean that it cannot be perceived (see Figure 5-18). This research does not want to discuss the philosophical issues co-existing between psychology and realism but to understand an abstract world about the real essence behind the physical world of cold architecture by using cognitive methods from images to consciousness.



Fig. 5-18 Complex organization of essential problems (Sartre, 2007, p. 531)

The order in the spatial organization of the behavior field means that the system in which the behavior takes place is like the “black box” pattern in the ontology. With the foundation of behavior and its ultimate effect, architects are expected to provide a more appropriate architectural entity to meet the viewer’s behavioral needs for space so that the duration of the viewer’s thoughts in time and the echo of consciousness can be lengthened. After all, there is an opportunity to give up the philosophy of substantive concepts only in the realm of pure form. With the harmonization of phenomena in the universe, the influence of previous and contemporaneous phenomena on a given phenomenon diminishes proportionately with distance. The discussion on physical behavior is not limited to the level of architectural cognition of the architectural field. For the viewer, the architecture cognition is completed with experience and guided under the presence stimulus, which will bring about the possible deviation of cognitive behavior and presupposition. Sociologist Willam Whyte was one of the first people to discuss the impact of behavioral order on space. He proposed a more “triangular” plan: suggesting that urban planners use the layout of objects and buildings in open public places to encourage people to get closer physically and further stimulate contact with each other through walking. Whyte’s colleagues later tried this idea out in the basement of Rockefeller Center in New York in 1975: Instead of intimidating spikes as planned,

benches were placed next to the purple tree, thus changing people's usage habits in Rockefeller Center. By changing the order of physical behavior in the space, the logic of people's behavior is changed, thereby changing people's architectural cognition of the Rockefeller Center. Norwegian architecture firm Snøhetta introduced granite benches to New York's Times Square, turning a once-clogged street into a place for walking breaks. Architectural consciousness is the field formed in the viewer's consciousness, which has a significant relationship with the order of behavior, which is based on an underlying state of conscious arousal.

In the cold region architecture field forming, viewers seek the way and order of interaction with the architecture in the established natural context to achieve a balanced relationship between themselves and the environment. This cognitive way of architectural field is consistent with what Zumthor said in *A Way of Looking at Things*: finally, architecture needs to settle down in the life-world in an authentic way, which is a way for architecture to proclaim its existence. Thus, the behavioral experience of architecture is more like exploring the undiscovered sounds in the real world.

5.2.2.2 Horizon

All the activities in the architectural field cannot be separated from the behavior and the architectural image obtained at the behavior point. The conscious association generated by the image promotes the following behavior, and all the images collected on the behavior that can trigger the architectural consciousness constitute the field's horizon, which is the interaction of architecture materials (Zumthor, P. 2010, p. 13). Aldo van Eyck believes that the horizon of an architectural field is acquired based on the experience perception of the body. The architectural field is not an abstract concept but a "place for the occasion", a collection with image consciousness, which emphasizes the potential of time and opportunity as an "occasion" (Architectural Institute of Japan, 2012, p. 111). The image field is the beginning of everything, and the horizon of "seeing" comes from the behavioral structure of "anticipation brought by everyday experience". The behavioral field stimulates the consciousness field, in which the image field with the behavioral field as the reference frame constitutes the horizon. The viewer's experience passes through different fields, constantly iterating out the "non-functional" relationship between the architectural field and people's world. Due to the behavioral field, space has a superimposed horizon on the time axis.

The viewer's horizon in the architectural field overlaps the predicted images rather than a single image material. People often have this experience: "being here" in the architectural field is a kind of anticipation, which, together with the surrounding things, constitutes a world owned by people. Although the perception of it is gained through experience, many basic structures exist in the priori and constitute the stimuli for understanding the environment and place (Norberg-Schulz, 2013, p. 70). Therefore, this kind of compound experience enables people to realize the "perceptual origin", not the physical law of things, but their actual appearance. Norberg-Schulz's writings as dean of the School of Architecture at the University of Oslo were filled with calls for the horizon experience in places and the unity of mind. The horizon in the behavioral field, like all other modes of existence, is not a static prototype but an open and unbound "mirror image" of "identical" and "different" in people's fields. In focusing on the natural climate, Schulz believes that the unity of its environment is the basis for a "life-world" through architecture. As a result, the unity of the architectural landscape is tangible, and the natural places exhibit understandable Gestalt characteristics. During a tour of Philip Johnson's Glass House, Frampton said: "An architectural work is not just a project, but an architect's horizon of the architectural field. What you see and touch is the architect's answer to the

question ‘what is architecture?’” The natural environment of the Glass House does not change, but the horizon of the behavioral field overlaps with the broader scope of the place and the images of other times and space, and then the architectural image and field gain multiple regenerations. Frampton has visited the Glass House several times, including in winter, when the site is covered with snow and the snow “presses” down all the landscape in the environment (see Figure 5-19-a). In summer, however, the architectural field is entirely different: the glass boxes disappear in the rich natural landscape (see figure 5-19-b). Due to natural conditions, cold region architecture can have a richer horizon about time and space due to the seasonal change. Architectural images and architectural behavior fields are constantly contrastive synesthesia.



Fig. 5-19 The Glass House designed by Philip Johnson (Coder, 2015; Perez, 2010)

5.2.2.3 Activity

The perception of “thinking” and the construction of people’s connection with the world are through the viewer’s unconscious activities. These activities are the embodied expression of the senses, thoughts, and emotions, are the origin of all art and creation. Salman Rushdie once pointed out that the most blurred and flexible boundary between the natural world and the individual lied in the experience of the artist and the viewer. That is to say, the honest “dialogue” between all artists’ works and viewers’ perceptions is based on behavioral experience. Therefore, artists’ creative activity needs to imitate the dual perspectives: one focuses on the world, and the other focuses on the individual. Architecture is not just a shelter for bodies; it is also the skyline for people’s minds and consciousness.

People’s daily behavior contains many activities, including those carried out in the subconscious, and not all of them can be isolated and given corresponding theoretical explanations, just as the tacit knowledge is hidden in the familiar environment and behavior. For the analysis of activities, people can explore the generative structure of the behavior but cannot answer all the activities that trigger the behavior. For example, when the viewer stays in front of a stone wall, the level of behavior is to see the stone wall and then trigger the stay. However, after seeing the stone wall, the architectural association caused by the perception image, the collection of architectural consciousness acquired, and the behavioral structure of staying are all the viewer’s behavioral field activities. Activities are rich and comprehensive and must be based on the architectural field because the stone wall cannot be separated from the place to show independently or be understood by the viewer, so the stay cannot be separated from the whole architectural field. Places without context do not exist. Therefore, in cold region cities, viewers with different cold region consciousness cannot trigger the same activities in the face of the same architectural places, but they may produce the same behaviors. At this time, the realization of the dual tasks in architectural design, which is constructing “real world” and

“independent self”, has been transformed to arouse the cold region’s resonance. It makes people with limited knowledge of the cold region open up the “curiosity” of the cold region as the background and triggers the reconstruction of cold region architectural consciousness, which involves seeking self-identity and discovering a new self in the world.

When discussing spatial organization, the relationship between activity and field is vague because the viewer himself establishes the field, and the basis for the establishment is not limited to the place where the building is located. In image consciousness construction, space begins to be organized in one’s mind from the moment of image acquisition. This process is a manifestation of cognitive activities. The viewer can enrich consciousness through a small number of materials to complete cognition with individual experience. It is undeniable that, due to the difference in practical information, even for the same viewers, there will be at least systemically rich differences in architectural consciousness obtained through indirect information and the space establishment of body presence. During the cold winter, the lake on the site where the Butterfly House is located is frozen, and the thick snow covers it, which supports the whole building (see Figure 5-20). The owner of the hut, Mary Kalantzis, described: “I wake up every day, and it looks like it is flying in the sky from some perspectives.” As for the outdoor environment, the “context” of the hut “looks fuzzy, like cedar walls”. The Butterfly Hut’s designer Jeffery Poss poetically describes it as “a winter cabin that sits on top of the snow rather than floating, protecting the tranquility of the place but still teeming with life.” In the cognition of cold region architecture, the activities in space are full of association and dynamic and sometimes hidden and unclear. They are people’s annotations on the built environment and architectural space and can even stimulate the behaviors in specific places. The spatial organization mode endowed by the cold environment contains the deconstruction of warmth, an essential activity-oriented element for the architectural field’s cognition, and a crucial clue for developing the behavioral structure.



Fig. 5-20 The Butterfly Roof Meditation Hut (Kalantzis-Cope, n.d.)

5.2.3 Stretching of field

5.2.3.1 Geography

In the traditional cognitive system, geography is “the objective geographical knowledge within the geographical region”. While for humanist geographers, geography is “the geographical sense of the objective geographical knowledge of the geographical region”. The positioning of architectural images in the objective world means that they must have their geographical information and corresponding geographical knowledge. Human behavior makes architectural images present with geographical markers. The integrated architectural consciousness depends on individual subjective evaluation, which shows the inevitability and necessity (Tuan, 2001). Geographical sense requires viewers to actively mobilize their senses based on perceptual experience and then obtain a comparative

cognition. In doing so, an intuitive sense of boundaries is created in response to the environment. Geographical sense has remarkable fluidity and changes with the continuous inter-construction of humans and the environment. Although geographical sense has prominent “human nature” characteristics, different viewers’ emotional responses to the same area are random, but any response is rational. Therefore, viewers’ architectural fields are different, the reception of consciousness is continuously extended with the change of behavior, and the geographical sense is constantly enriched.

The sense of geography is the thinking that people’s senses produce meaning to the environment, reflecting the actual relationship and contextual inline between objects at the place level. Tuan Yifu defined geographical sense as a broad term, which can be discussed from two aspects: spatial sense and place sense. The concept of “space” of humanistic geography is constructed from the “subjective geography” emphasized in “existential-phenomenological geography”, is named after the word “existential space”. Space is the primary originary of human existence. As long as people exist on the earth and have activities on the surface, there will be space based on the body. The basic structure of this space is determined by distance and relationship (Ji, 1992, p.334). As the body’s position changes in space, the consciousness of the corresponding point and other points transfer accordingly so that the viewer can obtain a sense of space in the evolvment of consciousness synthesis. In addition, when the viewer interacts with the built environment, various forms of emotional connections and loyalty of both attitude and behavior are generated to a specific place, which is called the sense of place. Bradley Jorgensen and other scholars proposed that the dimension of place sense includes place attachment, place dependence, and place identity. Moreover, people cannot talk about the sense of place and space without the element of time. Therefore, the historical sense of time is part of the “broad sense of geography”.

In any case, the sense of geography, as a rational sensibility, describes the consciousness of the interaction between people and the environment, which an individual’s architectural field will cover. The sense of geography is not narrow regionalism, but it can support the acquisition of architectural regionality. Carnizeno once expressed emotion on the topic of architectural regionality. He believes that people always try to study only those differentiated content in the current extensive discussion and show regional architectural theories in an irreconcilable and opposite posture. Nevertheless, in fact, the architecture of every place should present the possibility of participating in its environment, which is a balanced and harmonious appearance. The difference of geographical knowledge in different regions will lead to a different sense of geography, but the similarity of the formation structure of geographical sense comes from people’s standard cognitive mode. The difference in the geographical sense between cold region architecture and tropical region architecture is superficial and limited in constructing image consciousness. Only under this premise can people explain how they connect the four seasons in series to construct the unified consciousness of the same place.

Consciousness must be defined and flow in complex natural geographic information. Even in summer, the consciousness generation of architecture cannot eliminate the winter landscape impression of its place. This geographical spatiotemporality becomes the perceptual mapping of self, projected in the present behavioral field, making the behaviors have a geographical connection. While geographical information is enriched, it also reflects the need for a “return to things” in people’s cognitive logic. For example, in *Winter Nights*, all the object descriptions imply that the geographic information is the cold winter night without a direct description. However, when readers grasp this information, understanding the cold environment is added to the other objects’ consciousness. Any geographical situation has its particularity and generality, and

internality and externality. The concrete objects are “placed” in the objective geographic information, and the abstract scene is obtained no matter space is constructed or the activity is accomplished. Finally, the consciousness leaves the existing geography of the object and returns to the viewer’s spirit for a sense of identity here.

5.2.3.2 Context

When the architecture is built on the place, the architecture and the place become a system, whether it looks harmonious or not. The architecture will gradually separate itself from the potential background, which is assigned during the design process, and then more and more fit into the actual place, together constitute the system context allocated by its value system (Pallasmaa, 1965). At this time, architecture separates from the construction project, with an independent appearance and posture into the place, become a part of it. Pallasmaa explains that the relationship between architectural form and “being experienced” is not fixed: in the eyes of architects, architectural form is more like a visual game, but the process and angle of experience are entirely different. People always mistakenly believe that understanding architecture is to feel its form instead of exploring the more profound and original symbol or meaning behind it, which is the “truth” that the architecture wants to express. Architects use the form to express architecture, but architecture is perceived because the form is in the context. When the form is removed from the context, its meaning disappears. The field, formed by the architectural form and context, gives the viewer an overall understanding of the architectural system. All human consciousness in the world is derived from passive sensory perception and active embodied existence.

Traditional society’s cognition is stored in the senses, not in words or stones, but emotions in the lines and the construction. Trying to dismember the architecture is like picking a text out of great work. Without complete context information and narrative framework, people can only catch bits and pieces of common sense. From the perspective of architecture generation, it is the concrete form of people’s stimulation of the environmental context and feeling. From the perspective of architectural cognition, it is a process for the viewer to perceive architectural images and form cognition. The architectural form needs to be internalized and then projected to the environmental context. When a new building is built on an empty site, it can be said that the original field is “destroyed,” and the inherent context relationship is disintegrated. However, the site is reorganized and becomes the background of the subsequent “invasion” and the new building. Moreover, the physical site is only a part of the context because the building site as a system also contains the viewer. Then the context of architectural consciousness should be the people’s daily life, which affects the dynamic streamline of the viewer’s evaluation of the architecture to obtain architectural images to influence the logic of comprehensive consciousness. Levinas (1997, p. 4) wrote in *Being Elsewhere*: “There are often transparent things in life. We see fish in the water through water, and we see indoor furnishings through the glass. However, how can no fish realize that there is water, and how can the tranquility of the indoor furnishings recognize the existence of glass”. The existence of cognition often needs the context as another auxiliary to explain the object, and at the same time, the viewer can understand a variety of things. The context makes the viewer’s object clearer and closer to the object itself.

5.2.3.3 Memory

In the cognition of architecture, people keep talking with the field, trying to separate architectural elements from many images, and then integrate them into a systematic architectural field through body behavior, thus endowing them with the significance and

meaning of architecture. Peter Eisenman states that in cities, memory begins when history ends (Rossi, 1982, p. 11). Zumthor believes that memory contains the most profound architectural experience known, which is a rich source for architects trying to explore architectural atmosphere and image in their work. Pallasmaa claims that people measure the world by the body, and memory is the body's refuge, which contains all the experience of the body's interrelation with the world. People decompose their self-consciousness into the built environment and then reconstruct and synthesize a complete self according to the environment. The being present mapping of architectural consciousness is the memory of the viewer's body.

Memory does not record specific times. People cannot repeat the time and space that no longer exist, but people can imagine and reflect on it. Therefore, the initial memory is stagnant, frozen in the place where it happened, then becomes the memory. Memories are also eternal because they cannot be changed. When memory is extracted as information from people's ideas, the longer the time from this moment, the more profound the repercussions. In the formation process of architectural consciousness, from the collection of images to the association and then to the backtracking of consciousness, there is no avoiding the interaction with memory. Shen Kening points out in *Phenomenology of Architecture* that architectural experience is composed of experiences and faces that interact with memory. Husserl puts forward that in memory, the past is transformed into behavior instead of the thought kept in mind and brain by separation from the body, and memory becomes a vivid and active element in the activities needed to complete a particular character. Thus, memory has become an expectation in people's subconscious in the countless echo of the generation of architectural consciousness and significantly correlates with time consciousness. The memory that becomes the past expects to become the future, which becomes the present in the association of architectural being-here consciousness. Thus, both memory and consciousness are marked. John Dewey once summarized that architecture affects the future and records and transmits the past. So the originary is given the anchor of time, and time is also positioned by the originary. It is given memory and expectation of the present moment. Time thus becomes a concrete concept, summed up by memory and exists in the stream of consciousness. The most "ultimate" purpose of architectural consciousness is to recognize architecture from multiple memories and expectations, thus solidifying time.

In Eisenman's architectural world, architecture is also a part of the human body world. Humans have the inherent ability to remember and imagine fields. Memory and expectation cannot be separated and constantly interact with perception in the field. The memory of the field and the environment is always inseparable from individual perception and the body. Eisenman regards the eternity of architecture as overcoming the existence of architecture: because of eternity, memory and expectation coincide with it on the timeline, and the visualization of time creates countless presence. After history, people open their own experiences; only then can they have the actual memory. For the memory of cold region architecture, viewers combine the cold memories of many times and places to form a rich cold experience and a more spatial and embodied cognition of the cold. From this point on, people's description of cold region architecture is no longer limited to abstract and general. However, it will instead describe the thickness of snow, travel difficulties, the degree of darkness of the sky, and other details to realize the comparison between memories and expectations and lay a foundation for cold region architectural consciousness.

5.3 Association of conscious field to extend cold region consciousness

5.3.1 Foundation of behavior

Behavior can be regarded as a result of the environment in which it has its roots and final effects (Merleau-Ponty, 2005). The form of behavior is the modeled presentation of the body's response to external environmental stimuli. Here, the cold region architecture becomes an event, and the behavior is bound to be mediated by various representations and consciousness, so that life and spirit can be understood as moving from one actual plane to another. Consciousness becomes the mode condition to supplement the uncertain and inadequate material elements. Viewers take behavior as the stimulus mode in the cold region (see Figure 5-21), by constantly adjusting and changing the body as the subject, putting the body as the object into the architectural field to be experienced, making the body behavior as the thematic experience and extending the imagery of the cold region. In this part, the foundation of behavior will be deconstructed from the three levels of life-world, internalized experience, and consciousness space.

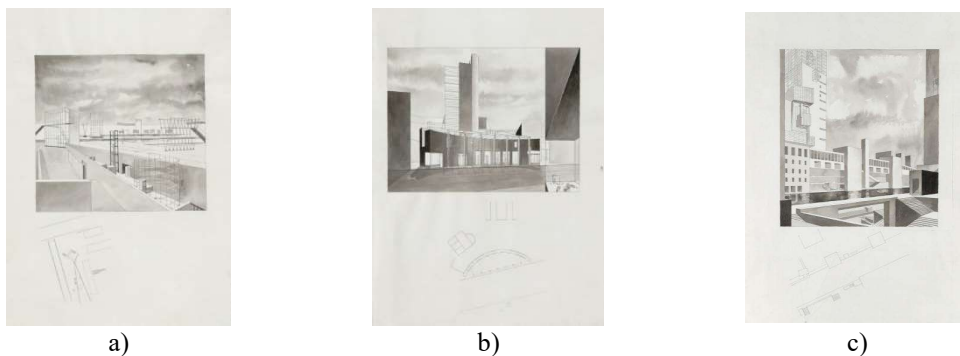


Fig.5-21 Examples from the Milan Porta Vittoria project (Holl, 1986) demonstrate a process of urban design utilizing a series of partial-view perspectives drawn a priori and cast backward into plan fragments. These fragments were later assembled into a “whole” urban plan, according to a concept of centrifugal movement from heavy to light in reverse of the sprawl tendency of the current city

5.3.1.1 Life-world

The life-world, in pre-science, is concrete, rational, and intuitive. Its situational and relative truth put forward the necessity of the subjective first-person perspective in the process of image consciousness (Zahavi, 2007, p. 137). The objects in the life-world are characterized by relative, approximate and angular giving, seeking the knowledge of how the world is in the interaction between people's embodiment nature and the world's practicality. Heidegger used to project the life-world into the “Schwarzwald” and proposed that architecture allows heaven, earth, man, and God to enter the state of integration (Peng et al., 2009, p.134). The architectural archetype is a reaffirmation of concerns about environmental ethics. It is believed that the architecture needs to present a self-sufficient strength in design, which is integrated and inclusive of culture, landscape, and materials. In *The Crisis of Architecture and Modern Science*, Perez-Gomez proposed that the excessive attention to instrumentality represents the modern “Barrenness Era” dominated by technological rationality and consumer culture. However, people cannot see things without seeing people in their understanding of the life-world, and the world-as-lived is the first source of meaning (Wang, 1997). In France, in the late 1950s, a “Situation International” had emerged that emphasized the constructed situation of an accidental, generative, communicative, and emotional ambiance of everyday life-world. Both *Architecture of a Situation* and *Place and Non-Place* detail that people's world cognition is based on the description of the situation in their daily life. Architecture should be based on people's characteristics to achieve feedback to “life situations”, and the

establishment of life itself depends on the foundation of the environment. Guy Debord once put forward that the city's goal was to create various new "situation" fields, and life could not be understood without considerate feelings and smooth description. As he described in *Landscape Society*: "Situation is a life state with a high degree of freedom, fluidity and communication context. The life-world should not be represented as landscape or tool; it is the expression of the emptiness of the spiritual world" (Debord, 2017, p. 1-41). If people want to explore the originary of architecture, they need to start from the actual life-world so that the consciousness they get is full of life experience. Consciousness and meaning thus acquired are not eternal or holistic but subjective, temporary, transitory, and ambiguous. Therefore, under this framework, there must be variables caused by behaviors in the consciousness field cognition of cold region architectural originary. Thus constituted, the cognitive framework is also fluid, but it must reflect the cold region life and form a life-world in the cold region. It is here that a profound understanding of the life-world becomes the foundation of behavior, which breaks the life-world down into fragments and contingents, and relates to small parts of the environment, on which consciousness can only drift.

5.3.1.2 Inner experience

Inner experience provides a space for material accumulation and presents itself in spatial behavior as a carrier for the deduction of "scene" (Chen, 2011, p. 82). Inner experience cannot derive its originary from a dogma (a moral attitude), from a science (knowledge can be neither its end nor its origin), or from a search for a state of fullness (an experimental, aesthetic attitude). It cannot have any other concern or aim than itself (Bataille, 2016, p. 13). The inner experience is like a journey to the end of human possibility. The recognition of the occurrence of inner experience is the affirmation of other architectural meanings besides its instrumentality, the key to the spiritual significance of the place, and the only way to explore the originary. Experiences are produced continuously but have been torn to shreds by the time they are described, leading to great uneasiness about their existence or not. Inner experience reveals the complexity of the relationship between body and behavior on the ground. Behavior cannot have the stability and eternity that the place can have because of the material entity, but it does not entirely lose the constraint of the place occupied by the object. The viewer's body shapes the behavior, and the inner experience brought by the behavior reveals the multiple existences of the viewer. Through the cognition of self-existence, the behavior is also constantly changing so that the cognition finally approaches reality infinitely. In this ontological fit between body and place, the subject's inner experience directly relates to the shaping of the behavioral field.

In the cold region architectural field, the cold condition will trigger a series of viewer's activities, forming the inner behavioral experience. The inner experience returns to the outer environment as cold consciousness and synthesizes into comparative, experiential basic knowledge. The direct correlation between behavior and experience is the embodiment of the environment, and the cold region becomes a kind of the viewer's body consciousness. In cold region architectural design, the behavior in the architectural field is stimulated to guide the extension of cold region consciousness outside the building to the interior to realize the continuous construction of consciousness field. The environment becomes the spatial cognition's cornerstone and constructs the context together with the body, rather than being physically blocked by a cold door. As cold region and body occur, the consciousness interaction, induced by the cold body perceived, is obtained through hands to direct embodiment. The door of the building has become the communication interface for the built environment and body. People's experience of pushing the door is

both about architecture and the environment. The generated perception starts from the skin and finally penetrates it, is internalized for the environmental cognition, and finally is projected to the environment from the inside, abstracted as a series of conscious summarization of the cold place, and completes the internal situational experience. Many Nordic architects pay attention to the design of doors and doorknobs (see Figure 5-22), reflecting their views that the intermediary of architecture is the environment as the source object.

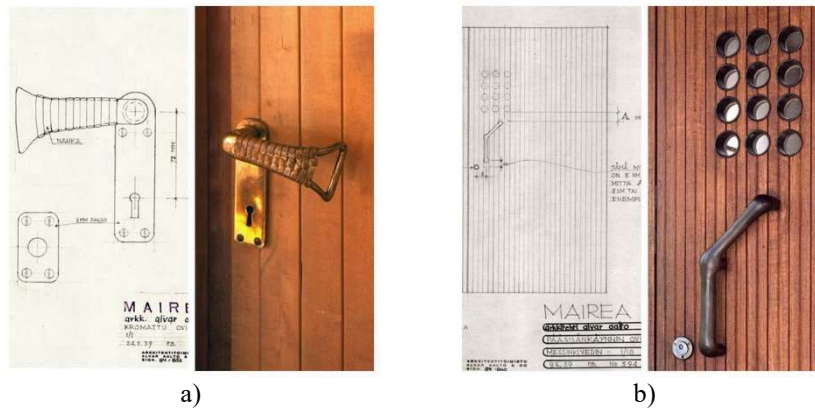


Fig.5-22 The design for the door handle of Villa Mairea (Aalto, n.d.).

5.3.1.3 Spatial consciousness

Space is the innate attribute of the body, and the body is the most primitive space that people can perceive. The spatiality of the behavioral field must be constructed concerning body-space structure. According to Heidegger, this position is embedded, and the establishment of this position is related to the human body mechanism first, which is both the starting position of behavior and the animal nature based on which the behavior is based. At the same time, space can be understood as the record of the viewer's behavior ability and behavior track, which is the trend between "object and place" or the phenomenon of being excluded. Then space can be obtained through the sense of geography in the architectural field, that is, the experience of the object's relative position and the place. Therefore, the architectural field's space can be regarded as the connection or separation of the distance between objects, which starts from the body and behavior as the experiencing way. The essence of spatial consciousness is the body's experiential synthesis of stimulus feedback and behavior. As the core of architectural originary, the built environment has an irresistible power to form architectural consciousness. Colin Wilson once explained: "As if I was being manipulated by some subconscious code, which I could not translate into words. It directed my central nervous system and my imagination. At the same time, the vivid spatial experience disrupts the meaning of this suggestion, which seems to be the same thing. The code has such a direct, dynamic effect on us because it is so familiar to us. It is the first language we learned, and it predates the existence of writing. Through art, we can recall its existence, and art is the key to bringing it back to life" (Wilson, 2014). People can understand the atmosphere of a space entity from the perspective of biological survival or fully grasp the existence value of the atmosphere of the whole situation. The instinct derived from animal nature calls for the continuous development of human cognition of nature. Space is actually a transition created by people from their skin to the natural environment to realize the progressive progress from the body to nature, from "me" to "the world", which is both a barrier and a connection. From the senses to the cold region, compared with other regional environments, the viewer needs to go through the obstacles of temperature, humidity,

wind resistance; needs to think about gaps in heat, vegetation, color; needs to realize the poetic state of safety, warmth, dwelling. Establishing the space consciousness of the cold region architectural field is the body's flow from the external environment to the body and back to the external environment by decomposing the cold region through behavior. The existence of the architecture should be suspended first, and then the actual "being here", and the environment should be actively established.

5.3.2 Unfolding of synesthesia

5.3.2.1 Constructing body

If people admit that space is the essence of architecture, then the forming essence is actually constructing "body". The construction is divided into two processes, as Pallasmaa said: the entitative body construction and the mental body construction. He stated: "The body is not just a material object; It is enriched with past and future, memories and dreams (Pallasmaa, 2014)". By stretching the body, the viewer interacts with the environment perceptively. While experiencing the space, the viewer also places his flesh body in the architectural field. Since ancient Greece, it has been customary to use the human body when describing the scale of architecture, and the number as the measurement is the result of the embodied architecture (see Figure 5-23). As most people who hold the viewpoint of architectural phenomenology say, space is an abstract concept, while "my space" is concrete (Shen, 2016, p.128). Space and the body are constructed during the experience of the viewer's presence. The interaction of the body in the architectural field determines the degree and level of the viewer's cognition of the architecture. So, the viewer's flesh body becomes a cognitive result of architectural consciousness. If the form of architectural existence is considered objective, even if this objectivity is obtained subjectively, then the body combines the subjectivity and objectivity of the architectural field. The being of architecture and its field is achieved through subjective judgment after perception. At the same time of judgment, the viewer gets the internalized perception of the body, such as soft, hard, cold, and warm. The consciousness field is constructed and follows the body to shuttle, move and transmute repeatedly. The architecture consciousness is obtained through the architectural field, which cannot be entirely and purely independent. The architectural consciousness will change after leaving the architectural field. Therefore, the body consciousness and the architectural field co-own the body, not only because some particular behavior can co-own the whole to get complete, even this kind of integrity must be included in the architectural field. Architecture and field are now an essential part of the body's conscious construction. So, the complete body schema construction is that both the body's entity and the body's spirit are jointly constructed as a whole. This structure is achieved "being here" by the presence of the body, but it is deeply influenced by experience, and this experience is the integration of all parts of the body: past limb experience can evoke a vision, and the same visual experience can influence the body behavior feedback. Therefore, the body schema is not a direct superposition process of the various perceptions in the field "experience", and there is no "global consciousness" of the body (Merleau-Ponty, 2001, p. 137)—the body's spatiality results from the positioning of the body entity in the architectural field. The spatiality of the body's "situation" is a series of spaces associated with body perception. The architectural image consciousness is simultaneously constructed in the architectural field and a part of the body's construction.

Meanwhile, space and time are unified in the body. The unity among senses and the unity of perception-behavior suggest that the unity is not limited to what is actually and incidentally combined in the viewer's experience. The poet Noel Arnaud declared: "My space is where I am" (Bachelard, 2009). The sensory world's systemic experience embeds itself into the body's overall consciousness. The viewer's body consciousness construction in the cold region must contain the characteristics of the cold region and the relevant memories. Architecture, place, and body, the three objective objects, can only be unified in constructing consciousness when they are objectively integrated and related. The architectural field and the bodies are the basis and result of mutual construction.

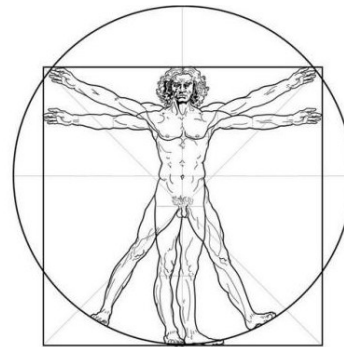


Fig.5-23 The Vitruvian Man (Ocean, n.d.)

5.3.2.2 Differing time

Husserl believes that objective time should be suspended in constructing image consciousness and turned to the time experienced or experienced. People's way of consciousness has a typical time extension; that is, the coagulation of consciousness is not limited to the content that is realized at a particular moment but has a continuity: consciousness contains more things than what is given at the moment (Zahavi, 2007, p. 137). When the viewer perceives the current image, he inevitably perceives what no longer exists or what will happen. The absence perception is not purely imaginary because the information varies in time dimensions, increasing the width of presence. The present image is not just momentary information but multiple moments. Time is malleable to a certain extent in the process of image consciousness, and the essence may change in the extension (see Figure 5-24). According to this, the structure of architecture image consciousness can be understood from three stages in time. First, as a material that only points to architecture, the image is the viewer's primal impression and an abstraction of the behavior that cannot be manifested alone. Subsequently, it is accompanied by retention, and its intention is provided to the viewer's consciousness of the nascent stage of the object. At the same time, it is also accompanied by protention and begins to follow the present image or behavioral information into uncertain intentions. Husserl argues that this is an expectation of the time that will occur, and it is based on the empirical fact of the part. It should be noted that protention and retention are not past or future stages but are always at the same time as the primal impression. Each display stage of consciousness includes primal impression (A), retention (B), and protention(C), and the structural correlates of this tri-in-one immersion center are the current stage(O2), past stage (O1), and future stage (O3) of the object (Zahavi, 2007, p. 137).

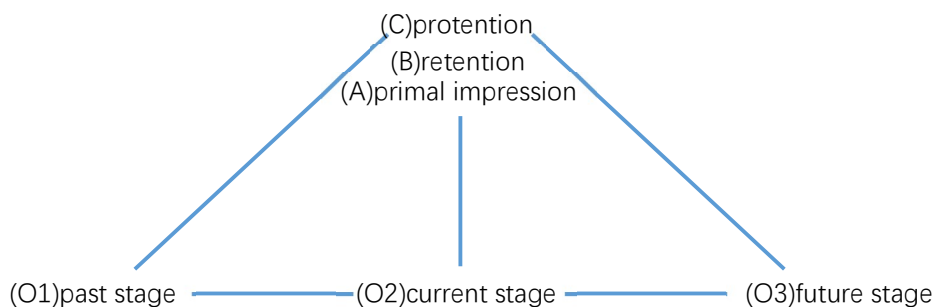


Fig 5-24 The relationship between object and primal impression-retention-protention in different temporal stages

Therefore, when people experience the current architectural images in the cold region, they are taken as the primal impression, followed by the subsequent image given in the architectural image as the primal impression. The retention retains the architectural image as the primal impression, and when the new architectural image is presented with the change of behavior, it replaces the previous architectural image in the original intention. Although the primal impression (A) and retention (B) coincide, the realization is that things are different. Husserl puts forward that people's perception of these objects is itself constituted by temporality. People's experience is also the unity of time through birth, continuance, extinction, and continuous and uninterrupted differentiation. Each present moment is retained like retention, which has a limited impact on the future. For those closely connected architectural images, spaces, and fields, the construction of consciousness tends to have a higher degree of correlation due to clear intentions.

5.3.2.3 Flowing perception

The formation of architectural consciousness depends entirely on the body's experience. When the body enters an architectural field, the architectural field also enters the body. The first body refers to the entity, and the second body is the thought. Therefore, experience is the communication and integration between object and representation object. Whether the object of architectural consciousness is an environment, a building, or a room, the viewer's description of it will always be inseparable from the overall perception, impression, and emotion. The presentation of such "encounter" has a unified and coherent character. That is the "commonality", "coloring", or "feeling" of the experience situation. People's judgment of all the details of architectural consciousness is unified under the general background of perception, and this spiritual consistency is suspended between the perceived object and the appearance (Pallasmaa, 2014, p. 205). Perception enables people's consciousness of the architectural field to shuttle back and forth in the body and spirit and continue to rise. Consciousness is a stream of experience, so various and different perceptions are experienced by "I", so these different experiences imply the consciousness structure of "me", and it is this consciousness structure that belongs to "me" that unifies these different perceptual experiences.

When the body in the architectural field is confirmed, the viewer will have a broad sense of encirclement. This instantaneous atmosphere perceiving is a specific way of perception, which is the unconscious and scattered peripheral. These "things" do not exist in the real world; they are merely some features of the human sensory organs. Therefore, when people systematically describe an architectural field, the logic is often processed with the piecemeal experience. People's consciousness of the architectural field is to continuously integrate the world of these fragments into relatively complete information and combine with the experience to achieve the creative fusion and interpretation of those natural and separate perceptions. In the process of perceptual experience, there is a shift from visual to non-visual imagination. The flesh body is in the place, but the body's spirit is pulled away from the whole site. It is to experience the emotions of the architecture and the place, such as loneliness, warmth, and softness, just like the landscape paintings of Cezanne and Monet (see Figure 5-25 and 5-26), as well as the numerous architectures and fields floating among countless viewers. Even creative activities call for an unfocused and undifferentiated subconscious visual mode, an integrated tactile experience. The object of creative behavior not only needs to withstand the exploration of eyes and touch, but it must also be able to turn inward and be recognized himself and his living experience. In the deep mind, focused vision is blocked; Thoughts wander with absent-minded eyes. Instead of indulging in the contemplation of external logical problems, the artist experiences body, existential, and atmospheric experiences. Therefore, when the viewer

forms an absolute architectural consciousness in the building, the architectural image has become one of many pieces of information and is not a decisive element active in the whole perceptual flow.

Architecture is a body-centered art, full of complexity and contradiction of human nature. As a place, the house, like the body, gathers memories with emotional characteristics, not just data or images. This kind of perception obtained by the viewer's experience must be the reappearance of memories. Charles Moore has discussed the relationship between experience and memory in the process of perception profoundly. He believed that people inject their inner world into the morals, people, places, and events felt by the outer world in their lives and associate these events with emotions (Bloomer et al., 2008, p. 48). Thus, besides the structure experienced by the flow, the perceptual flow of the cold region architectural field also has a powerful rhythm.



Fig.5-25 Cézanne (1879), Melting Snow at Fontainebleau



Fig.5-26 Monet (1867), Magpie

5.3.3 Reproduction of imagination

5.3.3.1 Perceptual reflection

To remove the cover of the unity of the architecture consciousness, viewers need to reflect on the property of the architecture, which seems to be independent into a signification affective, which connects the property to the emotional meaning of all other senses. Just as the room's color can create an emotional atmosphere that makes the objects inside sad or bright, gloomy or uplifting, the mood also affects the sound and tactile images that appear in the visual image of the architecture. Human experience confers specific emotional meanings on properties, so once a property is put back into human experience, it can relate to other seemingly unrelated properties in reflection (Merleau-Ponty, 2019, p. 3). Its essence reflects the spatial nature of the body and explains why so much experience is meaningless apart from perception. Therefore, once this perceptual path is accepted, the perceived nature of each architectural image leads to other sensory properties. Perception does not point directly to the next stage of consciousness like the nodes in the cognitive structure but instead presents a kind of reflection to obtain the overall grasp of this stage of architectural consciousness.

In the perception of the cold region architecture field, the result must include the viewer's consciousness of the environment and architecture as the background to clarify the overall grasp of the cold region's boundary and outline at this time and place. Therefore, the perception of body space implies a reflection on the spatiality of the situation. In the first stage of perception, the viewer directly receives the information through the active and passive reception of the senses. In the second stage, the reflection is to throw the directly received information back to the gradually expanding background to obtain the basic outline of the current viewer object. As the result of the stage, the description of the cold region architecture contains seemingly direct information, but it is

challenging to eliminate the reflection based on the context. Nevertheless, this cognitive method of comparing new things with experience and analogy is a general way for people to grasp the current architecture quickly. From now on, the current cognition of cold region architecture must imply the relevant experience of the cold region environment and the reception of architecture. Then, from the present image subject has taken another step.

5.3.3.2 Intention of behavior

There is a direct equivalence between the positioning of the behavior field and consciousness itself as the behavior body. The connection between people and architecture is an encounter experience in the behavioral field. People approach and face the architecture to produce physical connection (Shen, 2016, p.96). The experience enriches behaviors, but they tend to be closer to the place of action. To the viewer, it is still a field that can interact with each other, which is created by human consciousness. Only when the behavior is fed back can the field stimulate the individual's consciousness to form the field. Depending on the location, the response to the behavior will be different. When a particular character is a feedback to an external thing, each phenomenon or activity triggers the "take place" of the event. The field forming is the goal or focus of experience and the starting point of association that enables the viewer to realize his positioning and grasp the environment with his body. This grasp is the result of the behavior's continuous discovery of the architectural field. Due to the place complexity, the scope of the architectural field will be gradually enriched with the behavior. A field will contain several small fields, and the behavior will agitate and influence each other in different built environments. Thus, the consciousness field of architecture forms a constantly flowing relationship under the "shuttle" of behavior. Norberg-Schultz once pointed out that to understand a structured environment, one needs to rely on a relatively stable place that does not move. However, the image world is constantly changing, so it cannot form a stable behavior-consciousness schema relationship.

In the cold region architectural field, the intention of behavior is more reflected by the comprehensive influence of experience. For example, in the winter of cold cities in north China, besides low temperature, the climate features are accompanied by heavy snow and ice on the water surface. The experience of both short-term and long-term participants in the ice influenced people's judgments of the time and distance to enter a building on the ice, as well as body posture. Thus, it helps people define the hidden security framework in behavior, the behavioral framework and establish the scope and time path to ensure the critical distance between themselves and the external environment.

5.3.3.3 Persistence of imagery

Imagery is an image with intention, which is constantly superimposed in the construction of consciousness, making the experience obtain the extension of the present. "The past is not because it is a fact of the past, instead of its value today. It is this point that makes a person most aware of his position in the long river of time and his own time.". Empiricist philosophers consider a subject that perceives and tries to describe what is happening: various sensations are the state or way of the subject's existence. There are fundamental psychological things, and the subject with sensation ability is the place of these psychological things. Philosophers describe this feeling basis as the persistence of human consciousness. Being is spatially and temporally obvious, and time is neither an external object nor an internal experience. People constantly construct and iterate their self-consciousness in time to quickly extract the past image in the face of the present, make their behaviors of the present intentional, and then obtain imagery. Here, the structure of

individual consciousness becomes a cognitive paradigm, enabling information to constantly interact, thereby triggering a series of continuous, internal, and external coexisting behaviors.

Being is defined to exist, not because things exist here, but because consciousness exists in things, being is discovered, located, and defined. Husserl once said: “When I face a tree and observe it, I form a tree’s thinking, including certain thinking of seeing and certain thinking of the tree. Although in the end, I did not touch the tree, I did not merely confront it, but because in confronting this being of mine, I rediscovered something of the concept of it which I had actively formed”. The architectural field is the subject of people’s consciousness, the perceptual ability of imagination, and the consistent reproduction of the image materials obtained by people as viewers. It is often said that the point of view, in fact, the point of view, does not exist in the construction site, but it is the cause of its formation. Although consciousness cannot be consistent with behavior and exists in the track from one point to another, it is more accurate than behavior to form architectural consciousness for the viewer. Consciousness becomes the medium through which people understand the world. It can walk in different substances, distances, and places without the flesh body, even travel through time to extract experiential scenes. Consciousness wraps itself outside the flesh body to connect the individual with the world. Just as inhabitants in the cold region can evoke the consciousness of the snow in summer and describe an experience of ice and snow, also stand on the snow to see an ice building’s texture and smoothness. The imagery of a cold place is reinforced as it is repeatedly evoked because the perceived coldness always makes people feel natural. However, if the viewer does not construct himself through the cold appearance, the absolute cold consciousness cannot be formed. Human judgment is completed by consciousness, which is the structure in the spiritual construction of the body. Over time, a certain kind of consciousness will fade, but the consciousness is still in that space. The cold is not elsewhere; it is in the memory of the bones and muscles of cold-region residents and abstracted into imagery that recurs again and again.

5.4 Summary

This chapter takes the cognitive structure of image-consciousness as the paradigm and puts forward the cognitive structure of the place spirit of cold region architecture which revolves around the cognition of subject and object. In the process of architectural consciousness, architecture is the object of consciousness, and the viewer is the subject of consciousness. Thus, the architectural field realizes the mutual integration of the subject and the object of consciousness, which is the synthesis of the ontology consciousness structure of cold region architecture. The part expands the cognitive structure of architectural places in cold regions layer by layer from three progressive levels. The tripartite structure of image-consciousness is followed at each level, focusing on the intuitive thingness–phenomenon, instrumentality–perception, and artwork–imagery of the cold region. In constructing the cognitive structure of the architectural field in the cold region, it is discussed that the consciousness flow function of the place leading to the development of the cold region architectural consciousness.

PART II

ANALYSIS OF THE BUILT ENVIRONMENT: PUBLIC SPACE SCALE

CHAPTER ONE

INTRODUCTION

1.1 Background

1.1.1 Role of street furniture in public space

Street furniture refers to the objects and facilities located in urban public spaces that provide various services and functions. It is one of the most critical elements of the city construction that contributes to citizens and their city life. There are so many different sorts of street furniture coming out in our daily life, which supplying convenience for us every day, such as benches, cabins, station-stops, in determining the quality of an urban environment and life, and in representing a city image.

As an artificial production, street furniture presents contemporary people's needs in public life and fills in the gaps between human-being and the living environment; street furniture is like a medium to connect them and open up someone's psyche to experience space more fully. Street furniture acts as a set of tools or sets of elements that heighten and reveal. In a word, the street furniture can invite both mental and physical participation when pedestrians encounter it in the open air. The number of street furniture is increasing as the necessity of street furniture is known by the public to enhance the opportunities to gain the benefits, which creates the settings for resting, eating, socializing, and meeting. That can be especially important for the elderly, people with limited mobility, and families with small children. We believe that the right furniture thoughtfully and appropriately placed can attract people to outdoor spaces and add to their enjoyment once they get there. Getting people outdoors is the challenge. Helping them feel welcome, comfortable, and engaged is the goal.

Meanwhile, the role of street furniture has been emphasized in developed parts of the world since its early stages, usually with the step of urbanism, but is just beginning to gain in importance in other places. In most developed European countries, such as Italy, the street furniture has the closest contact and interaction with humans, making many accounts of people's city life quality. Moreover, people have realized that street furniture is an essential element of landscape and will directly affect the experience in public space, which has been the primary mission of the development of European cities for many years.

Street furniture, as a landscape, could promote the quality of city public space from the aesthetic layer, which enhances the opportunities for citizens to reap joviality from the environment. Recently, more and more street furniture is free from the stereotype of public facilities in volume production, which characteristics present the new local and individual trends to identify the places it was sited. People could judge the square orientation through the shape, color, material, and other street furniture elements. Some street furniture builds a vivacious atmosphere to attract more young people to participate in the space (see Figure 1-1); some create peace through the shape, material, environment to imply quiet to enjoy the atmosphere (see Figure 1-2).

As a service station, street furniture could apply convenience with citizens, material help (e.g., drinkable water), and invent people to the whole society information network to interact between users and street furniture. People usually call this new generation of street furniture smart street furniture.

According to the above, the role street furniture plays in our daily lives is more important, which has become a primary response indicator to evaluate the public environment and life convenience, from two parallel aspects, function and form, both contributing to the degree of national development.



Fig. 1-1 Paprocany Lake Shore Redevelopment designed by RS+. © Tomasz Zakrzewski



Fig. 1-2 Kung yu's studio designed by Seksan Design. © Seksan Design

1.1.2 Trend of city life studies

Like the weather, life is difficult to predict. Nonetheless, meteorologists have developed methods enabling them to predict the weather, and over the years, their methods have become so refined that they can make forecasts with greater accuracy and reach. Therefore, it is necessary to focus on how life unfolds in city space. However, the people's behavior and the reaction could not be accurately predicted; this study could supply first-hand information to get closer to people's minds.

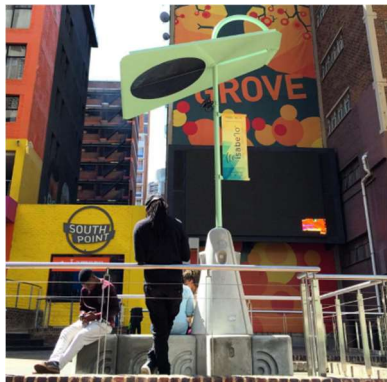


Fig.1-3 The cast concrete Isabelo Smart Bench, which launched officially, aims to breach the digital divide in African cities by providing a space enabled with free Wi-Fi. © Annelize Nel



Fig.1-4 The i-City by SPEECH Tchoban &Kuznetsov is gaining attention for its unique and innovative design concept. The Russian pavilion showcased as the Venice Architecture Biennale covers its interior façade with millions of QR codes. © Patricial Parinejad

A good city plan ensures good interaction between public space and public life, which was once disregarded by designers, becoming a mainstream research field to current urban design and general context to nearly each landscape problem, widely discussed. This meaningful tendency is donated by fast urbanization. The happiness from the city life of citizens could not follow up on the step of city construction in quite a long time. People had to stop building the city aimlessly and turn to the city life they want to embrace. Then the better life turned to be the goal of all design activities for cities.

In the early 1960s, critical voices began to remark that something was very wrong in many of the new districts being built, in record numbers, during this period of rapid urban growth. Something was missing, something that difficult to define but was expressed in concepts. Life between buildings had been forgotten, pushed aside by cars, large-scale

thinking, and overly rationalized, specialized processes (Gehl & Svarre, 2013). Public life and public space were historically treated as a cohesive unit. The changes in public space on scale, function, layout alter public life, driven by increasing public life requirements from people living in cities. So, the research on city life study is a way to know people's real needs in daily life. Meanwhile, public life study has become a primary method to evaluate the urban plan design. As we know, the depth of urbanization has been accelerating faster and faster since 70 years ago, and the discussion on the quality of city life never stops. On the one hand, some urban public space plans cannot match people's behavior patterns. On the other hand, the people's behavior pattern is changing, but the city public space keeps still forming the time it constructed. Thus, the mission of city life study should be long and continuous to provide design considerations for urban planning and design.

The environmental design pioneers of the 1960s took the basic steps needed to understand better the ephemeral concept of public life and its interaction with public space and buildings. Furthermore, the time is the concept of the city becoming apparent, so most of the research was to study existing, and as a rule pre-industrial, cities and public space to gain basic knowledge about how we use and get around in cities. In the following 30 years, several books were published on city life description, and some basic study methods for city life research got considerable development during this time. From about the year 2000, it increasingly became taken for granted in architecture and urban planning practice that working with life in cities was crucial. However, much bitter experience had shown that vibrant city life does not happen by itself. That is particularly noticeable in cities that are highly developed economically because apart from commuters, people are no longer on the street by necessity to work, sell trinkets, do errands, and so on (Gehl, 2013)(see Figure 1-5). Therefore, it is necessary to add manual intervention to city public spaces through design and planning to enhance the vitality of city life.

Series of basic rules and factors on the relationship between public space and public life have been concluded through the efforts of generations of scholars and designers and applied in design practice. This solution is not to recreate pre-modern cities but to develop modern tools that can be applied analytically to ally cities' lives and spaces.

1.1.3 *Sm²art* project

Smart is a research project by the Italian Ministry of Research Education and University aimed to design new generation street furniture, in which digital technologies are integrated. The research project partnership sees the collaboration between research partners and private enterprises in street furniture design and production and intelligent technologies. Two Italian cities endorsed the research project: Torino, supported by Politecnico di Torino, and Milano, supported by Politecnico di Milano. All the partners are coordinated by Telecom Italia, the Italian leading telecommunication company.

The research project is built on two pillars:

- The creation of a series of smart and sensitive objects and street furniture, scattered on the city;
- The development of a platform to manage them and provide services, information, inbound and outbound data from/to the citizens and from/to the public administration.

The *Sm²art* solutions are meant to renew the public space, also aggregating existing functions and generating an "offer" of wellbeing, which, in turn, stimulates a further "demand" for increasing the efficiency of urban services (Savio et al., 2017).

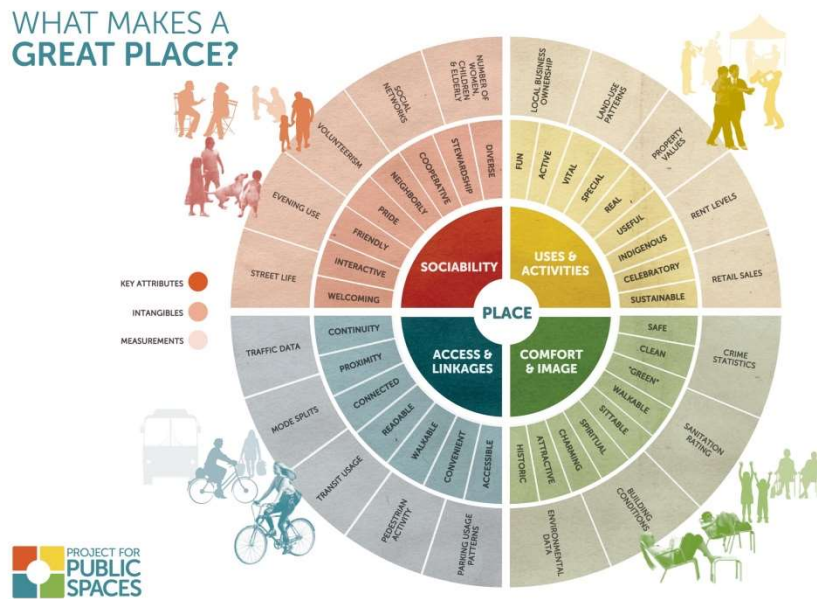


Fig. 1-5 What makes a great place? Street furniture can contribute many of the intangibles supporting all of the key attributes. The project for Public Space is renowned for its insistence upon use as the critical measure of success and for its programming and advocacy designed to increase public use of outdoor spaces. “In evaluating thousands of public spaces around the world, Project for Public Space (PPS, n.d.) has found that successful ones have four key qualities: they are accessible; people are engaged in activities there; the space is comfortable and has a good image; and finally, it is a sociable place: one where people meet each other and take people when they come to visit.”
 Credit: copyright 2002 Project for Public Spaces

Sm²art integrates the design of innovative furniture and the design of an ICT platform, aiming at:

- Optimizing existing networks (public transport, bike sharing, water supply, etc.), currently not integrated, by gathering them into a multi-purpose hub where street furniture can be installed;
- Deliver innovative services, widely accessible and available to all citizens, with social inclusion and urban security issues, are crucial;
- Evolve through an open approach to offer simple on-demand services.
- Provide the city with “tangible” and “intangible” tools to better meet current and future citizens’ needs;
- Reduct the “digital divide” with increased accessibility of computer services offered in Public Administrations.

The project service network concept comes from the traditional telephone box: small urban furniture scattered all over the cities in a network, beneficial to the citizens to communicate. *Sm²art* urban services have been developed on a square meter, the original telephone box dimension, replaced by significant smartphone diffusion. The concept at the base of the research project was investigating citizens’ actual needs that could lead to a new “telephone box network” service: a small urban smart furniture scalable system, increasing citizens’ urban well-being, through the implementation of public services efficiency, accessibility, and functionality (Savio, 2017) (see Figure 1-6).

The project was founded on an open structure: many possible urban furniture and intelligent technologies in the shortlist. In other words, the design of the services supplied by *Sm²art* was left as an “open issue”. The research partners define the service design through a participative process involving the public administration (the municipalities of

Turin and Milan) as the project's other partners.

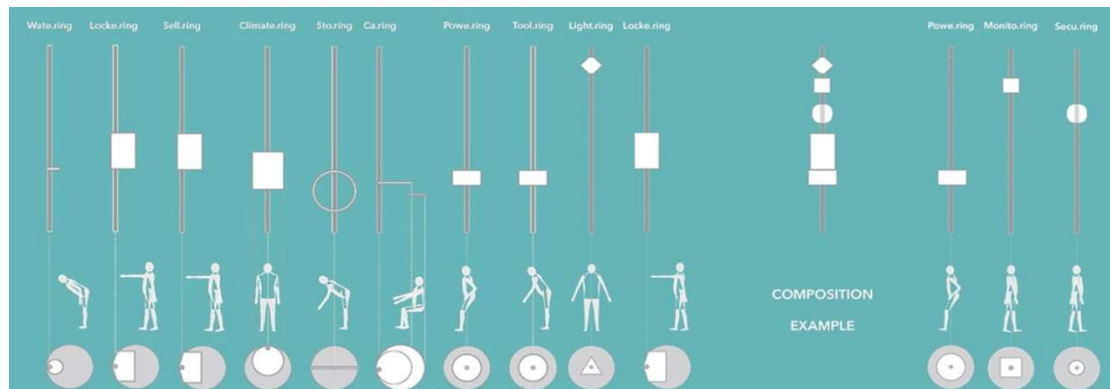


Fig. 1-6 *Sm²art* flexible “Abacus”. It results from a workshop with the topic *Street Furniture Function Design* organized by the *Sm²art* project (Savio et al., 2017).

1.2 Research problem

Regarding the importance and functions of street furniture, different parties need to understand the importance, functions, design, and plan criteria of street furniture to create quality street furniture, hence a quality urban environment and urban life. As a result, a comprehensive study of street furniture design and plan is required.

Different studies on street furniture design focusing on material, shape, and function have been done in the past decades. However, comprehensive studies on the placement are rarely found. The studies tend to be sketchy or specific to some areas. For many studies, street furniture is just briefly mentioned in an urban landscape design study, in which the functions and design principles of street furniture are not described and explained sufficiently. Some principles are listed without in-depth discussions. Without clear explanations and examples, designers are prevented from achieving the principles. For some studies, street furniture is intensively investigated in one specific area. Thus, the principles and concerns of the street furniture plan are dispersed with little discussion in different studies. For example, some design guidelines focus on the technical aspect of street furniture. Some focus on the aesthetic aspect of street furniture by recording street furniture designs in different places. The coordination between different design principles is ignored in these studies. It creates difficulties for designers and those in related professions to understand the equal importance of different principles and integration. They may create street furniture by only focusing on one area without considering different aspects as a whole.

These general or dispersed studies limit different parties from understanding street furniture design completely and cause misinterpretation of the importance, functions, and design criteria of street furniture, which also fails to illustrate the importance of every principle and the mutual and multiple effects in their operation. As a result, street furniture may be designed without a balanced concern for different aspects and coordination of different principles. It thus brings negative impacts to the urban environment and urban life.

1.3 Research aims and research objects

This study aims to comprehensively investigate the influence factors of street furniture plans, that is, to establish a series of plan principles considered from different perspectives. By discussing the plan principles, the reasons for, and the correlations between them, this study aims to provide a proper understanding of nature, importance, functions, and plan principles of street furniture. This study also aims to provide a comprehensive reference

to street furniture plan which can be flexibly applied to various situations. The research objectives are as follows to achieve these aims:

- To investigate, integrate, and reorganize the principles of relevant street furniture planning studies.
- To investigate, apply, and extend the principles of urban life study into the principles of street furniture planning (Given that street furniture is part of the urban landscape).
- To implement, evaluate, and consolidate the principles of street furniture plan, and based on this core knowledge, to suggest new principles through different case studies.

1.4 Research scope

This study investigates different studies of street furniture design to establish broad principles. It includes the general concepts and design principles of street furniture design from different perspectives. Also, considering that street furniture is part of the urban landscape, this study includes investigating the urban landscape, including general concepts, design theories, and general design principles. Thus, knowledge of the urban landscape is directly applied and extended in establishing the principles of street furniture design in this study.

According to the existing studies, the considerations of street furniture design generally include three main aspects: function, environment, and meaning. However, various in-depth studies have been done on the functional aspect, whereas few studies have been done on the environmental and symbolic aspects of street furniture design. In this study, more attention is given to the environmental and symbolic aspects. In other words, more humanistic approaches are included in these discussions. Additionally, this study investigates the integration of different principles, that is, how different principles together create quality street furniture.

This study includes different case studies and design projects for discussion and analysis. In addition, they include observations of street furniture design in different places such as the United States, Japan, China. Also, Turin's study of street furniture design is comparatively intense through different observations, and the collaborative streetscape and street furniture design projects carried out with relevant Turin government departments.

1.5 Research significance

1.5.1 Street furniture layer

Citizens get together in the piazza to attend public life. In the middle Ages, the piazza is usually the center of a city or residential area while the core of daily life. People exchanged information in personal and public scope, traded in open-air markets, involved in the celebration. The government published official news in the square. The piazza was the most social place for citizens. It is no doubt that the piazza promotes the quality of public life. Nevertheless, some situations have changed during the past 20 years: privatization of modern life more profound. People no longer need to get the latest news from the square. The gathering in the piazza is not necessary anymore. The central government's policies and the supermarket discount information would appear in your family mailbox or Gmail. Most residents no longer buy food at open-air markets or pump water from public wells. Public events could occur at home, which had to go on in the square, such as water, electricity, news, mails, and computer work, which can be operated just at a personal table without moving a step. The new-generation information Client and the development of life-step guided by the new technologies are destroying our public life by substitution. There is no apparent reason for people to stay in public spaces to do activities. If we want to restore the vitality of urban life, we have to face the fact that the

dependability of the citizens to public life is declining firstly. Then new strategies should be designed for meeting the needs of today's people living in the city to realize more active participation in public space. It will be a beginning for citizens to live in a humanized city.

It is vital to design elements with attraction to the pedestrian in public space when staying in public space is not an essential activity in people's lives, nor is the leading social way to stimulate people's desire to stay in public space the scene (see Figure 1-7). As an artificial installation, street furniture is on the mission to inspire potential public activities through the functions supplied (see Figure 1-8). The gap needed to be filled in by the update of street furniture is between the hitching post and the bike rack from a functional perspective. It is more to motivate people's imagination and provide people with convenient conditions for taking them in public space to add the possibility of interaction between human-being and the environment (Main & Hannah, 2010, p. vii-xii).

- The street furniture itself may be conceived as art.
- Sometimes the aesthetic of the furniture defines the character of the space.
- Communities may find the success of a place in its pride engenders or cultural heritage expression.
- Special features such as fountains or sculptures can make spaces successful.
- The ability of a space to conjure or enable experiences such as hearing the sounds of wind or water or watching the play of light is an essential measure of success.
- The ability to manage and maintain a space can determine (or undermine) success.
- The extent to which a space supports multiple constituencies and allows people to work and play together can be critical to its success.

All that said, our focus is not on the outdoor space itself but on what is in the space. Street furniture is vital to the way people respond to outdoor space to the duration and quality of their experience there. It has numerous roles.

- In its type and arrangement, street furniture can communicate social messages. By enabling community activity and group interaction, it expresses support for civil society. Moreover, providing opportunities for underserved populations, such as the elderly and disabled, signals a commitment to inclusiveness. In its style, furniture may embody and convey historical connections to a specific time or event or the architectural heritage.
- Street furniture also plays a vital role in public open spaces. It could add to the square usefulness by supporting multiple options for activities, both active and passive.
- Street furniture could help people rest, meet, and wait by punctuating their routes to divide a long distance into segments.
- Some street furniture could supply safety to people and their property, such as barriers, bollards, and bike racks.
- Street furniture could be very effective in creating visual order, providing space definition, delineating functional areas, and providing orientation.



Fig. 1-7 Street furniture supplies opportunities to social life.



Fig. 1-8 The function of street furniture could be extended.

1.5.2 People life layer

Public life studies can serve as an essential tool for improving urban spaces by qualifying to have more people-friendly cities. In order to encourage people to linger in the public space, something is needed to persuade them to stay. People look for rich views and “anchor points” that attract them in their surroundings, whether they are physically (sitting, leaning) or mentally (standing nearby and watching). The activity taken by people is the essential question. However, life is unpredictable, complex, and ephemeral; no one could plan how life might play out in cities. However, it is not impossible to pre-program the interaction between public life and space in detail, but targeted studies can provide a basic understanding of what works and what does not and thus suggest suitable solutions.

Even if some behavioral pattern rules in some places, the scope of behavior shared is limited. Such as the official staff from a particular company will obey the same rest schedule, you will find that streams of people appearing in the company’s placement in a series of specific times. Thus, the behavioral pattern has a secure connection with the location. Furthermore, the behavior of office staff is distinguished from the student studying in the university (This point will be discussed in Chapter 5).

Street furniture, such as a landscape element, should be studied in the context of users and using the built environment to gain effective design strategies. Only by fully understanding the existing factors within the project area and influencing humans’ usage of public space can the corresponding effective solutions be targeted. People will stop in public spaces with suitable conditions both in site and environment to enjoy pleasure from the open city space and choose a particular activity; thus, the citizen could enjoy city life.

1.6 Research contribution

1.6.1 Theoretical layer

The people living in the city are the essence of the city rather than the manufactured concrete forest. Each artifact is used to serve both citizens and public city life. The artifact, including the city, cannot exist without people’s activities. The street furniture, as an artifact, not only plays the role of supplying service for people but also takes responsibility to inspire vitality of city public life. The research on new generation street furniture with the usage context aims to simulate citizens to come back to public space to enjoy better city life to improve the quality of daily experience the time that the private space is gaining increasing attention, to make the city become an actual city for people instead of the place people living.

The research on the theory of urban space started over 100 years ago and has achieved remarkable progress during the past decades. Meanwhile, people have realized that the

interaction between people and space is the key to a flourishing city. Many new concepts such as urban design and city landscape have become the critical anchors along the trace of city public life study. By contrast, street furniture is obscure, classified as landscape by some scholars, as urban facilities in some research. The former research tends to describe its aesthetic characteristic, and the latter focuses on functionality. Street furniture can supply people with special detailed services and general daily functions and participate in public activities. On the other side, street furniture is more than a public facility because of its aesthetic significance. In some cases, people do not have to use street furniture, which can promote the quality of public space by giving citizens visual pleasure and generating interest among passing-by pedestrians (see Figure.1-9, 1-10).

This research strategy starts from the street furniture usage environment to build the relationship among people activities and conditions of open space to find needs of citizens in the outdoor. From this perspective, it is not completed view only to research street furniture in function or landscape. Instead, this research tries to solve the design problem from the city public life through the needs studies layer, which is possible to explore the topic and bring theoretical implications for relevant studies.



Fig.1-9 New Wi-Fi stations in Paris (Ribon, 2012), where people can sit down to use their laptops or access local information via a large screen designed by French designer Mathieu Lehanneur



Fig.1-10 A new central meeting point, supplying seating, shade, and place to communicate, is organized by a 12-meter tree and some benches in a slatted canopy designed by Samuel Wilkinson Studio (2009)

1.6.2 Practice layer

This research is closely related to the *Sm²art* project, established on the data taken from many field studies in Turin, especially in Alessandria Largo, where to place the new smart street furniture prototype. Meanwhile, several open spaces with similar scales and functions are investigated to compare and analyze public behavior and its impact. The targeted research would be a supplement to the current result of the *Sm²art* project. The perspective promoted in this part that street furniture is more like architecture than production, of which both placement and direction can affect the usage. It is necessary to advise the researchers and designers of street furniture from a broader version to think to project to achieve the new generation of street furniture more flexible, adaptable, and sustainable, hoping the series of guidelines proposed could bring certain enlightenment to the future relevant design work. After all, updating street furniture will never stop, following closely to the development of society and people's requirements.

This study provides an overall picture and complete understanding of street furniture design. It is a platform aimed at supplementing preliminary studies and linking dispersed specific studies. Rather than create brand new principles, this study presents comprehensive principles of street furniture plan by applying and extending the design

principles of an urban landscape and reorganizing and integrating the design principles which are not studied sufficiently by relevant studies. Different from other individual studies, this research also discusses the coordination between different principles, with examples.

This study is a reference tool for street furniture design that provides full disclosure of design principles, which introduces the functions, importance, and different design principles of street furniture and helps readers understand and know about street furniture design. Further studies and investigation on specific principles can be done regarding this or other relevant street furniture studies.

According to the above, this study raises the following significance and value for different parties, including policymakers in planning relevant strategies of urban design, development, and renewal, designers in creating the urban landscape and street furniture, and the public in using and appreciating street furniture, and also participating in designing street furniture.

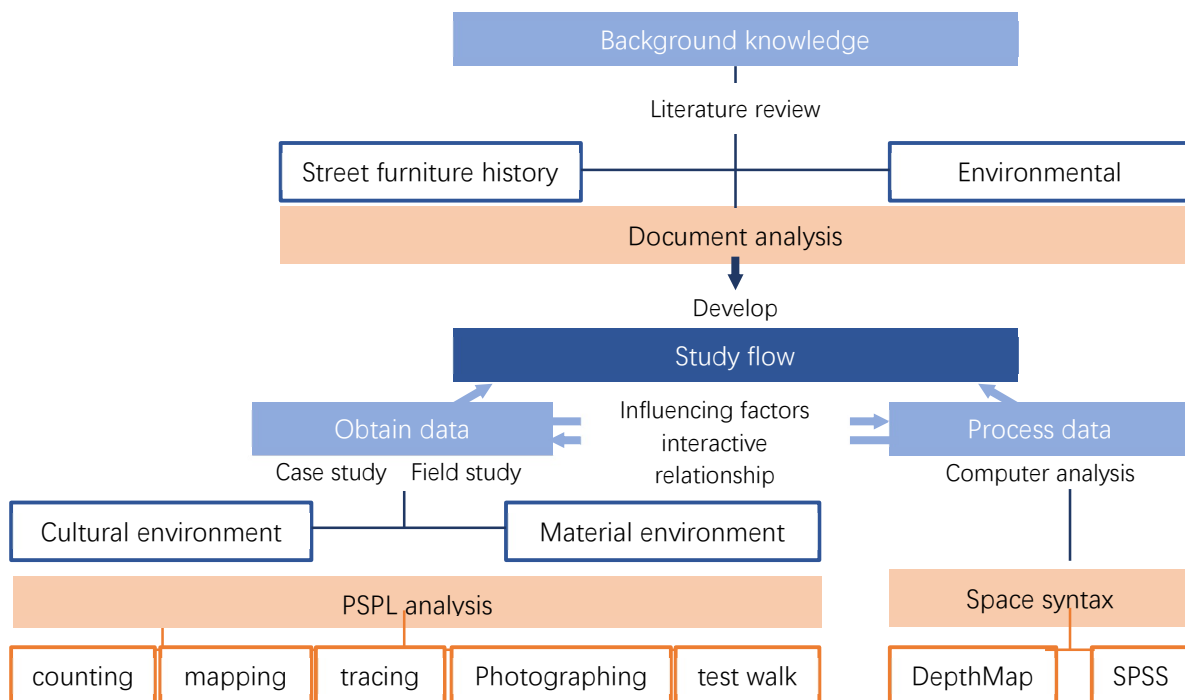
- A comprehensive reference of street furniture design is needed to create quality street furniture, hence a quality urban environment and urban life.
- To direct different parties to understand or re-understand the importance, functions, and design principles of street furniture.
- To rectify and reinforce concepts on the nature of street furniture: street furniture is part of the urban landscape and a complex system that includes a wide range of concerns.

To further investigate street furniture design and further studies of some specific areas based on this study.

1.7 Research overall

1.7.1 Framework

The figure presents the framework of this research.



1.7.2 Content

Chapter 1 provides an overall picture that introduces the background, an overview of the research problems, research aims and objectives, scope, significance, and contribution.

Chapter 2 is a literature review of relevant studies of street furniture design. It includes general concepts and design principles of street furniture. In addition, research problems, that is, imperfect and not covered areas of street furniture design by existing studies, are addressed in this chapter. Also, the knowledge, including the design principles of street furniture studied in this chapter, are integrated and reorganized toward establishing the principles of street furniture design in this study.

According to the research directions addressed in Chapter 2, this study aims to establish broad principles of street furniture design. The research methodology to achieve the aims of this study is discussed in Chapter 3. The research methods applied in this study include the application and extension of principles of urban landscape design, the integration and reorganization of principles of street furniture design of relevant studies, case studies, and collaborative street furniture design projects.

This study investigates relevant knowledge on the urban landscape to have a more in-depth and all-around investigation of street furniture design. Chapter 4 is the study of the urban landscape, including general concepts, the development of design theories, and general design principles of the urban landscapes. This chapter further discusses the urban landscape studied in this chapter, which is applied and extended to establish the principles of street furniture design in this study.

Following the study of street furniture and the urban landscape, through the application and extension of the principles of urban landscape design and the integration and reorganization of the principles of street furniture design of other relevant studies, a rudimentary series of principles of street furniture design is established. The principle is then implemented, evaluated, and consolidated; these new principles are suggested through the case in different places, including the United States, Japan, and China, and collaborative streetscape and street furniture design projects in Turin's urban renewal districts.

The principles of street furniture design are finally presented and discussed with a model in Chapter 5. Based on the "people-oriented" premise, the model comprises three main principles: function, unity, and identity. The chapter discusses the importance, reasons, and details of the premise, principles, and sub-principles and the correlations between them, using case studies and collaborative design projects.

The model of principles of street furniture design is created to be flexibly applied in different situations. Using Turin as an example, this chapter discusses how street furniture is designed according to its location by implementing the principles of street furniture design and how street furniture design can be improved by comparing real situations and theoretical principles. Through the comparisons, the limitations of street furniture design in the given areas are addressed. The reasons behind and possible solutions to the limitations are then suggested. After establishing the principles, Chapter 6 concludes and analyses how the design principles can be implemented in designing street furniture in real situations.

Chapter 7 concludes the study by summarizing the main ideas in this study. It also readdresses the main aim of this study, which is to direct different parties to re-understand street furniture design and points out the difference between theory and reality. Finally, further research, which can be conducted based on this study, is suggested.

1.8 Summary

The period dominated by functionalistic architecture and city planning has passed

decades. It is necessary to probe into the new generation street furniture design from its used context, environment, and behavior. After all, without context, no discussion on function can be started, which is the core problem of *Sm²art*. This research aims to ask for concern for people who live in particular public spaces; it is urgent to understand subtle qualities related to meetings of people in the public spaces throughout the process of smart street furniture design. As a part of city public life, street furniture plays a vital role in helping the communication between the individual and the whole city, including social events, other people living in the city, and the built environment.

CHAPTER TWO

LITERATURE REVIEW: STREET FURNITURE AND BEHAVIOR PATTERN

2.1 Introduction

Street furniture is an “everyday product” of city life. Notwithstanding, the thoughtfulness of street furniture is always insufficient. From the review of related researches, it is not difficult to see that apart from the specific professions involved, the public usually has no idea of “street furniture”, its functions, contribution, and importance in the urban environment and urban life. Moreover, some related professions are not knowledgeable enough about street furniture design. All individuals in the urban setting, including the government, professionals, and the public, need to understand street furniture as an urban life product essential to achieve a better urban environment and urban life. In the meantime, public space life plays a crucial role in building the sustainable, socially equal, and livable cities of tomorrow. It is intensely concerned today with the sustainable development of our fast-urbanizing society and finding ways to improve our city life more socially cohesive, environmentally friendly, and economically competitive (Varna, 2014). Moreover, as a critical component of city life, street furniture is used in the context of public space. However, the connection between them is always folded in many pieces of research.

A review of related studies of street furniture planning and design is conducted. This chapter is fundamental for this study. It includes the general concepts of street furniture: the definition; history and development, function, nature, and characteristics; and classification and scope, and overview of the design principles of street furniture. Through the review, analysis, and organization of the related studies, this chapter aims to achieve the following goals:

- To have a complete sorting and review of street furniture design studies.
- To obtain a basic concept and knowledge of street furniture by helping understand street furniture intensively from different perspectives.
- To figure out the possible research direction for this study from the areas which have not been covered in related studies.

2.2 Street furniture studies

2.2.1 Definitions

The concept of “street furniture” was developed in Europe in the 1960s. In English, it is called “street furniture”, also known as “urban furniture”. It is generally defined as “the private or public facilities and equipment in urban public space which provide certain services or functions to the public” (Yang, 2005, p.15). A similar concept in German is “Straßenanlage” (street facilities). In French, it is “Mobilier urbain” (urban furniture) or urban environmental facilities (Bao et al., 2006a; Wang & Wang, 2006; Yang, 2005). Thus, street furniture is considered as one type of urban element. Today, the term “street furniture” is generally accepted by academics, professionals, and the public (Yang, 2005). It is used in various related studies and also in this thesis.

Carmona, in 1985 (Yang, 2005) stated that street furniture refers to all public facilities and equipment located at the edges of road and pavement, as well as on the road or elsewhere. In addition, Eckbo (2001) stated that street furniture includes “all of the non-moving elements introduced into street and highway corridors as an adjunct to the basic surface paving and utility structures and enclosing building, fences or wall” (p.3).

Yang stated that the term “street” is an adjective and may mislead. Street furniture may be misunderstood as the objects and pieces of equipment only installed on the streets. He elaborated on the definition of street furniture according to the five urban elements analyzed in Lynch’s 1960 study. The five types of urban element (Lynch, 1960) include (a) path — channels: streets, walkways, transit lines, canals, and railroads, among others; (b) Edges — linear elements: shores, railroad cuts, edges of the development, and walls,

among others; (c) Districts — medium-to-large sections of the city; (d) Nodes — points: primarily junctions, places of a break in transportation, a crossing or convergence of paths, moments of shift from one structure to another; and (e) Landmarks — another type of point reference: building, sign, store, or mountain, among others (p.48).

Yang pointed out that those objects and equipment installed in locations — the city elements (a to d) above are defined as street furniture. Street furniture provides a high level of “imageability” and hence becomes part of the public image by its appearance, location, and accessibility. Yang further claimed that to a certain degree, street furniture could act as landmarks. For example, many fountains in Turin have different figures as landmarks and public images to people with high “imageability” (see Figure 2-1, 2-2).



Fig. 2-1 Turin's tores, which you will see in the city squares, streets, and gardens around Turin, symbolize the city itself



Fig. 2-2 The fountain and statues in Solferino Square are a famous landmark in Turin.

More intense definitions of the terms and their scopes are conducted in various studies. “Urban facilities” or “urban environmental facilities” are standard defined with an enormous scope. Besides street furniture, it includes more extensive scale facilities, for example, bridges, water towers, television towers and station entrances (which are considered as architecture in some studies), and to a certain degree, also street, subways, and squares (which are considered as other urban elements apart from street furniture in the urban landscape) (Yu, 2003). On the other hand, facilities like public toilets, newspaper kiosks, telephone booths, and bus stops, among others, may be considered as street furniture; this varies with the scale of the facilities and the perspective of the studies. Therefore, it is not easy to define the related terms accurately. On the other hand, the urban landscape is a total concept; according to this, street furniture, other urban elements share common design principles, and their scope can be adjusted within the location and needs of the studies or projects under consideration.

Bao et al. (2006a) and Wang & Wang (2006) provided an alternative view to interpret street furniture. “Street furniture is the relative concept of interior furniture” (Bao et al., 2006, p.8). In other words, it is the relative concept of the interior environment (interior design) and the exterior environment (urban environmental design or urban landscape design). Interior design, in residences, is the spatial arrangement of enclosure elements and then the setting up of furniture and facilities. They contribute to a comfortable and convenient living environment and reflect the owner’s personality and lifestyle. When people shift from the interior environment to the exterior environment, their basic needs remain constant despite different interior and exterior factors. Therefore, some furniture used in the interior is also required in the exterior and becomes street furniture. It is not possible to place interior furniture directly in the exterior environment. The furniture in the exterior environment (street furniture) should be designed and installed in coordination with the different factors of the exterior urban environment, such as climate and safety, among others. In this regard, the sofa, telephone, and clock in the interior

become the bench, telephone booth, and the clock tower (probably as a landmark). However, the exterior is much more complicated than the interior. There are more critical requirements for street furniture which go beyond considering them as “hardware” only.

With due regard to the definition (including the items and locations) of street furniture, it is evident that the users of street furniture are the public. The term “everyone” includes both locates (residents) and non-locals (visitors) who possibly appear in the places, as mentioned in the preceding discussion, to make use of street furniture. On the other hand, in terms of ownership and maintenance, the government plays its part in most street furniture while some private sectors or companies take responsibility only for a particular amount or kind of street furniture in a city. Therefore, it depends on the nature, functions, and locations of street furniture. For example, the government owns street furniture on the streets and public parks, while the shopping mall owner may operate those in the open area in front of a shopping mall.

2.2.2 History and development

2.2.2.1 Development of history

Although street furniture was first defined in the 1960s, street furniture itself is not a modern invention. Instead, it appeared with the coming of the city (Bao et al., 2006a).

Street furniture existed since the formation of the city; it was practical and functional at the early stage: the indication or the separation on the ground (e.g., bollards), seats, public fountains (providing potable water), notice boards, public toilets. Later, there were street lights, commercial notices, decorations, newspaper kiosks, street nameplates. Much later, there were rubbish bins, telephone booths, traffic signs, bus stops. (Bao et al., 2006a, p.8).

Few studies have touched on the history of street furniture. Thus, it is not easy to investigate a detailed and complete history of street furniture. Wang and Wang (2006), Yang (2005), and Yu (2003) claim that it is difficult to discuss the history of street furniture for two reasons. Firstly, the history of street furniture is closely linked to urban design (or urban landscape design). Therefore, the history of urban design cannot be ignored when investigating the history of street furniture. However, large-scale items and considerations like architecture, planning, engineering (constructions), gardening always emphasize urban design. Therefore, street furniture becomes an accessory in urban design, and its history is not the mainstream of record and discussion. Secondly, although different studies classify street furniture, street furniture is an open and changing system with complicated elements and rapid development. That causes difficulties in definitively defining its scope and hence examining its history systematically and comprehensively.

By reviewing the studies (Mukoda, 1990; Wang & Wang, 2006; Warren, 1978; Yang, 2005; Yu, 2003) which describe some history of street furniture, a fitting history and development of street furniture are organized. As street furniture has existed since the formation of the city, it can already be found in ancient Greek and Roman cities. In ancient Greek cities, street furniture already appeared in different public places (e.g., arenas, plazas, and podiums). In ancient Rome, urban design and street furniture design developed into a complete system. Street furniture includes elevated water channels, pavements, street lights, flower beds, and a signage system. Later design of Roman cities took another direction and reflected Rome’s ambitions to extend it and achieve world domination. Streets were planned tidily, and urban axes were emphasized. Street furniture like triumphal arches, fountains, pools, and steles was designed to become significant

landmarks in the city.

Paris has been recognized as the best representative of urban design since the 18th century. The geometric royal garden, radial street system, star-shaped plaza, and classical architecture, with coordination and arrangement of street furniture, including triumphal arches, street lights, monuments, and fountains, represented a sense of unity.

Street furniture considerably developed and changed in the late 19th century. “The nineteenth century saw a flood of street furniture. Urban life developed at such a speed that is required not only more street furniture than had previously been needed but new street furniture” (Warren, 1978, p.10). The industrial revolution from the late 19th century had to change the world. Hence, it led to the rapid urbanization process, increasing urban design and street furniture requirements. It also brought new technology (e.g., machines) and new materials (e.g., metal, glass, and concrete), first applied in street furniture design. As part of the urban landscape, street furniture and the different urban design concepts considerably changed in terms of design, scale, quantity. Also, new types of street furniture were inspired and created in this new era.

Since entering the second half of the 20th century, urban design and street furniture had already developed to a particular state under a functional and technological approach; urban design, including street furniture, was evaluated spiritually and methodologically. As a result, various schools of urban design developed. On the one hand, there are different requirements today because of new information based on industrial and technological developments. However, on the other hand, the industry, technology, and urban landscape developments have seriously destroyed the natural environment and humanism, regionalism. Therefore, street furniture needs a new direction for the development, one that coordinates different needs and concerns.

Today, street furniture is still undergoing development and evolution. It is also gaining increasing attention from the public and developing and permeating into more expansive areas. As stated (Wang & Wang, 2006; Yang, 2005; Yu, 2003), it is evident that the history of street furniture is in line with urban design. Street furniture indeed is part of the urban landscape. Therefore, to have an in-depth study of street furniture design, including its history and development, intensive research of urban landscape design is essential.

2.2.2.2 New-generation street furniture

With the development of technology, the human lifestyle changes a lot. The new generation of street furniture presents two main design directions: (a) looks more like a landscape or streetscape, partial to aesthetic with the primary function, to organize the activities through form, color, material. (see Figure 2-3, 2-4), Moreover, (b) is used as an innovative integrated service station to support modern people’s behavior to supply convenience such as internet, electricity, information. As a result, the traditional category by functions is no longer accurate: the new-generation street furniture is multi-function in both usage and aesthetics. “Street furniture is not only for practical use but also an element of visual pleasure vital to street scenery; Street furniture shows the beauty of design” (Mukoda, 1990, p.130). Bao et al. (2006a), Wang & Wang (2006), and Yu (2003) pointed out that the functions of street furniture cannot be considered individually and separately.



Fig. 2-3 The outdoor furniture invites people to take part in a landscape painting. We cannot call this furniture seating (Eheim, 2006)

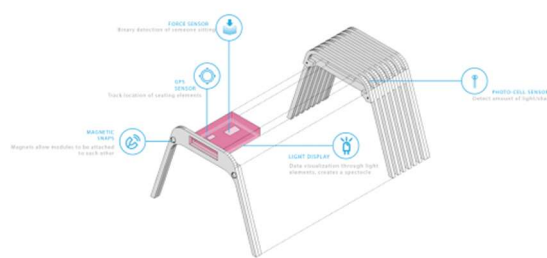


Fig. 2-4 A concrete sculpture to memory his grandmother designed by hung-yin yen. The seating function enhances the memorial. © hung-yin yen

In recent years, designers focus on smart street furniture to match the needs of new city life, aiming to offer a unique technology solution. Cities are creating next-generation infrastructure by linking them to public carriers or city networks. The new connections are hard to categorize as existing ones, facilitating new services and benefits to citizens and visitors, such as Wi-Fi, mobile charging, interactive city maps, and real-time city information and alerts. In addition, cities can gather air quality, traffic, and noise data from sensors on smart street furniture to manage city dynamics better and boost neighborhood safety. Some research institutes, such as Civic Data Design Lab (see Figure 2-5), engage in a long-term study on city life through the data collected from the new innovative furniture, depending on sensors and machine learning technology. That makes the outdoor facilities not only take part in city life also in city research. The database on people's behavior patterns is built by the sensors and monitors installed on street furniture, and then the data would make an immense contribution to the next-step society development strategy. The smart city should be embodied in smart data sharing and not just in smart services supplies.



a)



b)



Fig. 2-5 In 2017, the Civic Data Design Lab developed the BenchMark project to see how “smart” furniture might augment urban design methodologies for measuring public life. Underlying the experiment was a desire to provide an alternative to the current model of private-sector actors shaping the augmentation of urban space with “smart” technologies (Gehl Institute, 2018)

Smart street furniture helps cities establish a digital public way, which bridges the technology divide across neighborhoods, empowering citizens and enabling greater citizen-to-business and citizen-to-city interaction. In addition, smart street furniture helps form the technology foundation of a smart city. Over time, cities can add applications to the platform to achieve more excellent connectivity and link systems, allowing electric, gas, water, and wastewater utilities to harmonize with other transportation, public health,

and emergency response systems. When operations are integrated, communities become environmentally and economically sustainable and convey a higher quality of life to residents. Many countries and districts have launched innovative outdoor furniture to promote the quality of city life and create a new interaction model between the city environment and the public to degrade the whole society. The characteristics of new-generation street furniture are multi-functional, unitary, and digital (see Table 2-1). What is more, the city life study has been unprecedentedly developed due to the furniture equipped with sensors.

Table 2-1 New generation smart street furniture design worldwide

Appearance	Time	Country	Description	Characteristics/ Function
	2006	Scotland	The new smart street furniture has dual operational viewing screens. In addition to having a screen, they generate a Wi-Fi service and provide all the Public Data Web multiple content services, plus video email and VOIP/SKYPE Free-phone telephony. An on-screen avatar helps you figure things out and can also read messages to you. At night, the umbrella top is illuminated.	light, information screen, free telephone, free Wi-Fi
	2011	Massachusetts	MIT Soft Roker is a solar-powered charging station and simple relaxing rocking chair created by a team of MIT students. Through parametric design software, they have managed to adjust the panels to the angle of the sun.	light, seat, solar energy
	2012	Paris	The shelter features a green roof covered in foliage reminiscent of a garden placed on top of tree trunks. Swivel seating is provided for citizens, made of concrete with mini tables, and equipped with plugs for laptop use. A large touch screen gives updated signage for tourists and visitors.	light, seat, table, information screen, green roof
	2014	New York	City Charge gives users who are on the go a place to sit and relax while their devices charge. Powered entirely by solar energy, it features six charging cables that can accommodate most smartphones and tablets. The design is round, easy to move, and has a communal table that encourages social interaction.	table, charge, mobile, solar energy

	2015 South Africa	<p>The first of its kind in South Africa, the Isabelo Smart Bench allowing users to sit down, charge their phone in the provided USB points, and connect to Wi-Fi for free – once you have completed a quick online survey. It is also wholly solar-powered.</p>	<p>light, seat, charge, Wi-Fi, solar energy</p>
	2015 Saint Paul	<p>The design is a solution for a shelter with a small footprint that may be better suited to these constrained sites. Metro transit is also interested in exploring design solutions to integrate solar power generation. Bringing sustainable energy sources to shelters in a cost-efficient manner can advance Metro Transit's ability to provide light, lit advertising panels, real-time information, and even heat at these shelters.</p>	<p>light, solar energy, seat, table, information screen, shelter</p>

The proposal of new-generation street furniture implies the development direction of human society: more integrated, more multi-system synergistic, and more detailed. The research and development procedure of new outdoor furniture is the redefinition of city life and people's behavior pattern.

2.2.2.3 Model of new smart street furniture

According to the above, the new street furniture should be a complex functional system with flexible and extensive considerations. According to this, smart street furniture can be analyzed through the following aspects (see Figure 2-6).

- Service supplement: The functions include a modern lifestyle such as gas stations, charge stations, and temporary lockers besides traditional outdoor furniture. The new street furniture model should match the needs of new city operation rules from the functional layer.

In the modern world, the built environmental protection is the object that human-being needs to face. So, both solar energy and greening have become a functional form equipped on the new street furniture.

- Data collection: The most remarkable feature of modern society development is that data is applied widely in many fields. The measure and collection of data are two parallel pillars of data application—the data collection forms database to further design and research. Meantime, the data monitoring could supply proof of people's behavior patterns.
- Information interaction: The essence of public life is interaction. In ancient times, people get-together to share the latest news happened around. When cities form, citizens take public spaces to participate in social life to connect the individual to collectivity, which is an essential information interaction procedure — the new interaction style now is a digital connection.

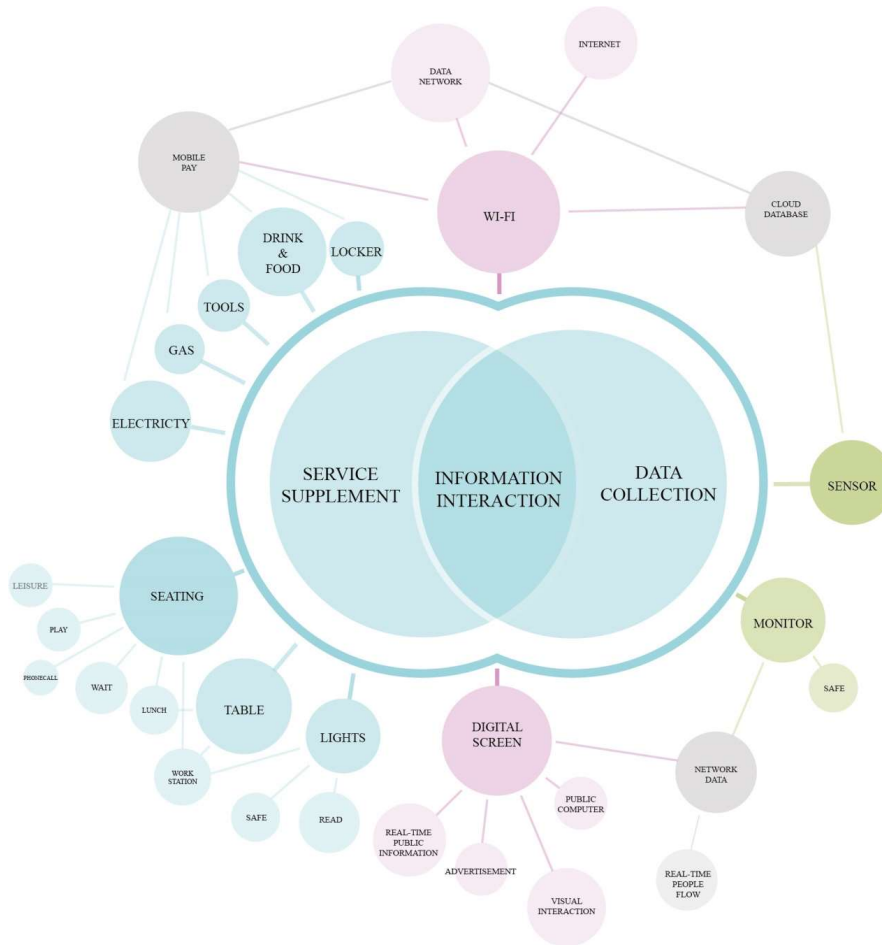


Fig.2-6 New street furniture functional diagram

2.2.3 Placement of street furniture studies

When streets enhance the urban environment and meet the needs of pedestrians, they make a city livable and beautiful. Appealing, well-maintained, safe, and accessible public streets are a common theme and a necessary ingredient for positive urban experiences in all significant cities worldwide. Streets, when they are well-proportioned and designed, become public outdoor rooms. They are places for people to gather, meet, stroll, sit in cafes and window-shop. They are the locations where connections are made among residents and visitors.

As the city works to improve the design and character of the urban environment, it must look carefully at all of the components that result in good street design. For example, unobstructed and ample pedestrian space, high quality and durable materials, safe and accessible sidewalks, and well-designed and thoughtfully placed street furniture contribute to successful streets.

From the early 21st century, street furniture was studied worldwide as an essential landscape or streetscape element, and the local government published the relevant design guidelines to manage and regularize both the design and plan (see Table 2-2). High-quality street furniture aims to improve the looking character of urban streets; more significant, the impact of that is more meaningful to the development of public life. Moreover, as one of the most important public facilities to inspire citizens to join the social life, street furniture is the key to booming city spatial design.

Table 2-2 Street furniture design guidelines worldwide

Name	Time	City/Country	Content
<i>City Plan Directions for Vancouver</i>	1997	Vancouver	What is a city plan; a version for Vancouver; city of neighborhoods; the sense of community; healthy economy- healthy environment; a vibrant central area; making city plan happen; the city in the region
<i>Manual for Streets</i>	2007	Whales	Introduction; streets in context; the design process- from policy to implementation; layout and connectivity; quality places; street users' needs; street geometry; parking; traffic signs and markings; street furniture and street lighting; materials, adoption, and maintenance
<i>Minneapolis Coordinated Street Furniture Program Guidelines Report</i>	2007	Minneapolis	Overview; program components; process
<i>Street and Site Plan Design Standards</i>	2007	Chicago	Introduction; functional street classification; street design elements; street cross-section components; other street design elements
<i>City of Ottawa Integrated Street Furniture Policy and Design Guidelines</i>	2009	Ottawa	Introduction; context; the process and scope of the ISFP; core design principles; Ottawa's right (roads, sidewalks, and boulevards)
<i>Co-ordinated Street Furniture Urban Design Guidelines</i>	2009	York	Introduction; design vision/objectives; street furniture; heritage/special character areas; transit stop site design; conclusion
<i>Streetscape Design Guidelines</i>	2010	Brighton	Street furniture; signs & road markings; surfaces
<i>Better Street Plan</i>	2011	San Francisco	Introduction; context; goals and policies: the plan to better streets; approach: designing great streetscapes; guide: street designs; guide: streetscape elements; implementation
<i>City of Hamilton Co-ordinated Street furniture Guidelines</i>	2011	Massachusetts	Pedestrian zones; street furniture selection and placement criteria
<i>Street Furniture & Sidewalk Patio Design Guidelines</i>	2011	Owen	Introduction; sidewalk patio standards; street furniture standards
<i>Vibrant Streets: Toronto's Coordinated Street Furniture Program Design and Policy Guidelines</i>	2012	Toronto	Introduction; background and context; objectives of the coordinated street furniture program; process: public consultation, outreach, and best practices; scope of the program – a catalyst for Improving the public realm; design guidelines; placement guidelines; street furniture and advertising
<i>Urban Design and Landscape Guidelines</i>	2012	Thunder Bay	Introduction; urban design vision and guiding principles; performance standards: public realm; performance standards: general building and site design; performance standards: land use specific; implementation recommendations
<i>Urban Design Manual- Part A: Street furniture and Park Furniture Guideline</i>	2013	Ballarat	Aims, current issues, recommended guidelines, street and park furniture area mapping; and grouping the various furniture items into "furniture Suites" relate to the appropriate locations section of the datasheets.
<i>Sustainable Streets: 2013 and Beyond</i>	2013	New York	Safety; mobility, world-class streets; infrastructure; resiliency
<i>Main Street Urban Design Guidelines</i>	2013	Cambridge	Introduction; study area overview; streetscape master plan for the main street; urban design guidelines

<i>Street Furniture Guidelines</i>	2014	Maidstone	Simple general guidelines on street furniture.
<i>Boston Compete Streets Guidelines: Sidewalks: Street Furniture</i>	2014	Boston	Seating; bollards, trash compactors, and recycling bins; bicycle parking; bicycle racks
<i>Street Design Guidelines for Greater Mumbai</i>	2014	Mumbai	Introduction; non-motorized transport strategy; street design guideline; street design templates
<i>Street Amenities in the Road Corridor Guidelines</i>	2015	Auckland	Guideline's definitions; guideline statement; background; purpose and scope; guidelines; approval process; monitoring and review; related guidelines
<i>Edmonton Main Streets Guideline: Edmonton Main Street Design Tool KIT</i>	2016	Edmonton	Adjacent lands guidelines; frontage zone guidelines; pedestrian through zone guidelines; furnishing zone guidelines; ancillary zone guidelines; traveled way guidelines; operation & maintenance guidelines; renewal & funding
<i>Urban Street Design Guideline for Pune</i>	2016	Pune	Introduction; street typology; street elements; safety elements; multi-utility zones; universal accessibility and barrier-free design element; intersection; USDG reference templates; street design process
<i>Citywide Design Guidelines manual: Streetscape Design Guidelines</i>	2017	Antioch	Introduction; design objectives; street materials and furnishings; traffic calming; navigational sign system; public art; utilities
<i>Urban Design Guidelines for Victoria: Objects in the Public Realm</i>	2017	Victoria	Principles for objects in the public realm; street and park furniture; trees and planting; barriers and fences; lighting; signs and way-finding; small public building and structure

Based on the public consultations, relevant experiences, and research, many criteria were developed for a new program that puts the needs of pedestrians first. The criteria call for new street furniture elements to provide exceptional design, universal accessibility, safety, quality maintenance, pedestrian-oriented placement, and sustainable components. In addition, revenues from selective advertising could finance the program and return a benefit to the city for the privilege of occupying the public realm.

From the preceding, people know that cities' guidelines are primarily for single-functional street furniture, and both are designing and planning as a landscape or streetscape. The situation does not entirely match with the new multi-functional smart street furniture. Moreover, the guideline of design and plan is disjointed with people behavior pattern which is changing all the time. Therefore, a large number of further studies are needed for a long-term and sustainable plan. The simple guideline is not able to solve all the problems. The methods are more required.

2.3 Street furniture usage context studies

2.3.1 City public life studies

2.3.1.1 Definition

Public life studies are critical to our understanding of how public life space functions. Through careful and systematic observation, we can understand that public spaces serve the needs of people. These needs include dimensions of comfort, safety, and ease of mobility for pedestrians. Studies include counting pedestrians and cyclists and inventory of stationary activities and behaviors.

The findings of studies can inform strategies to change the public realm and help us understand the impacts of changes. Gathering data on pedestrians at regular intervals

provides necessary tests for how a public space performs for the people who use it, giving everyone a good idea of where to focus future efforts. For cities that have never counted people, the first pedestrian counts are the most important because these counts establish a baseline for future comparison.

Typical public life study phases (see Figure 2-7) include the initial study design, the training and scheduling of individuals for data collection, the aggregation and validation of completed data, and the data analysis and visualization for final reports. The data gathered from studies provide insight into when, where, and why people use public spaces. Understanding this basic information can lead to ideas about how space can function better to support a lively atmosphere and improve the quality of the space.

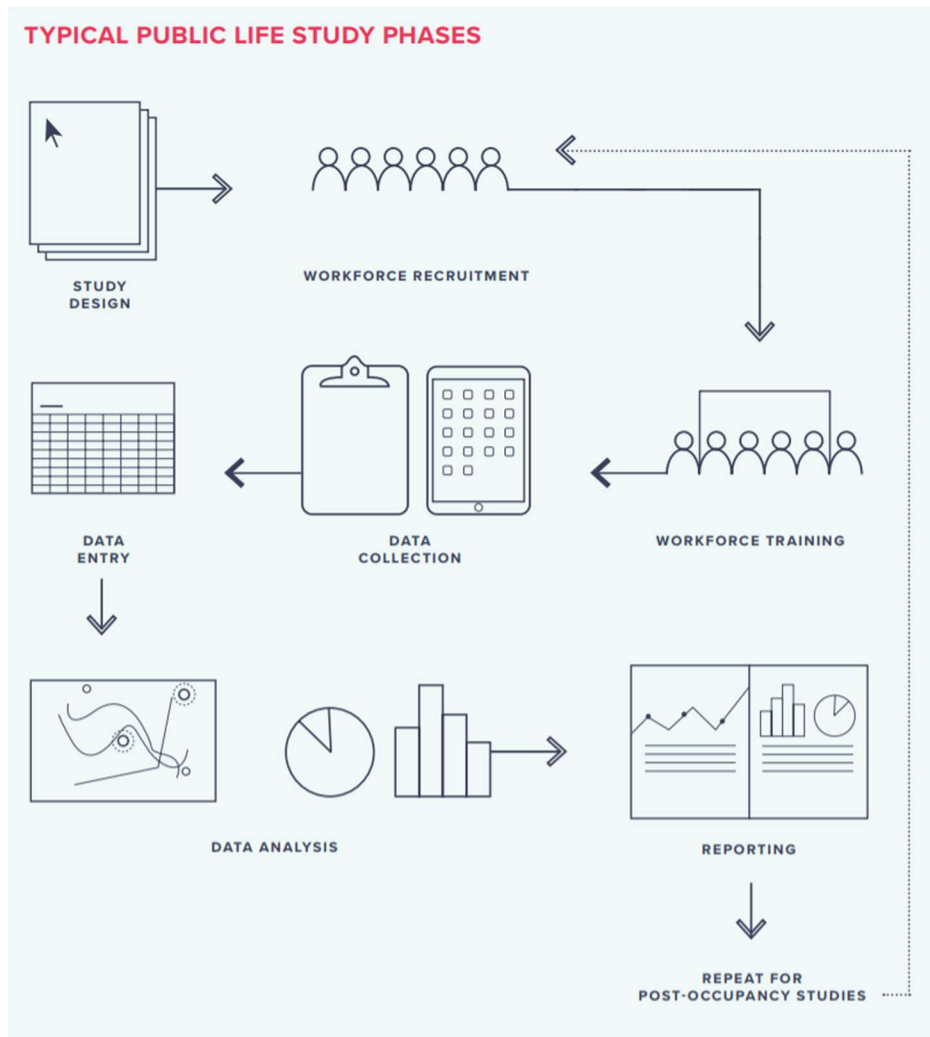


Fig.2-7 Typical public life study phases (San Francisco Planning Department, 2018)

Public life studies provide assessments of pedestrian life and the quality of public spaces. In addition, these studies collect data regarding pedestrian activity and capture pedestrian satisfaction with streets and plazas.

2.3.1.2 History and development

The foundations for the current view on public space were laid in the late 1950s and early 1960s, when two famous studies, Jane Jacobs's *The Death and Life of Great American Cities* (1961) and William H. Whyte's *Securing Open Space for Urban America: Conservation Easements* (1959) were published. In the following decade, during the

1970s, three critical philosophical writings appeared: two on the nature of space and place, Lefebvre's *The Social Production of Space* in 1974 and Edward Relph's *Place and Placelessness* in 1976, along with a meditation on the nature of public life and society, Richard Sennett's *The Falls of the Public Man* (1977). Alongside other efforts, these helped create a shift in the perceptions and understandings of urban public space, leading to the 1970s to be often quoted as a turning point in reconsidering the importance of public space in the urban landscape

Later on, in the 1980s, two essential writings enriched the field of public space research, Lyn Lofland's *The Public Realm* (1998) and William H. Whyte's *The Social Life of Small Urban Spaces* (1980), where he presented the results of his previous 1960s work on the "Street Life Project". During the same decade, other disciplines brought essential contributions to the field; the edited collection *The Public Face of Architecture*, edited by Nathan Glazer and Mark Lilla, published in 1987 was followed by the 1989 English translation of the breakthrough analysis of the public sphere concept by Habermas in *The Structural Transformation of the Public Sphere*. The 1990s and the 2000s have witnessed rapid development in the public space literature from different research fields and focusing on different aspects. One of the chief reasons for this increased interest in public space was the deindustrialization of many important cities, seeking to reinvent themselves and placing a concentrated effort to create new public places at the center of their regeneration.

In parallel with increasing the production of new and "regenerated" public places, the quotes above suggest another critical reason for the recent increase in public space research – a growing concern with their quality. Thus, it seems that something is changing, like urban public places around the world. However, this change has been mainly described as a negative phenomenon. Later on, in 2001, Tridib Banerjee rhetorically asks, "What is the future of public space?" and identifies three principal trends that together represent fundamental shifts in the way public life and public space are conceptualized and in the privatization and "commodification" of public goods on the background of the connection to the fast increasing phenomenon of globalization. Thirdly, he argues that the radical, rapid change in information and communication technology public space (Banerjee, 2001).

Continues regeneration of the street furniture is the epitome of changing of public space. The human society operates in a complete framework. All design activities have resulted from a series of specific reasons to satisfy people's ever-developing needs. So, it is crucial to take deep research on city public life and then better understand the new requirement for street furniture design and plan.

2.3.1.3 Methods on city public life studies

With the development of theory, the studies on city public life obtain great blooms in many dimensions. The accessibility and usage evaluation of open public space (OPS) are directly essential indexes to measure a successful city design and plan. The public open space, recognized as the leading site for urban residents to carry out activities, communication, and recreation, is a natural element to connect different life scenes. In recent years, the research on city public life never stops. The quality of city life is one of the most critical study topics in contemporary society. Scholars have developed many methods to research the relevant themes, such as ration method, covering method, cost method, opportunity accumulation method, space syntax method, PSPL. Different methods focus on different emphases.

(1) Space syntax (SS) The analysis on city space is all for practical design problems, and the early connected studies are primarily based on discussions on geometric forms,

lacking a systematic approach; thus, that self-consistency problem cannot be solved. Space syntax, developed by Professor Bill Hillier and his research team from UCL (University College London) in the 1970s, focuses on the solution to the visualization of city space indexes by explaining the connection between people and the public space they take activities in by data. Space syntax quantizes the spatial structure, starting with the research on the organizational relationship of urban space to reflect human society and urban economic development. Hillier states that the urban street network has a systematic influence on the distribution pattern of people's behavior. In other words, the imbalanced city planning structure plays an essential role in the accessibilities of different places and other impacts on the urban residents' situation. From this perspective, space becomes an inner characteristic of people's behavior patterns, which could be researched by analyzing factors of public space. Space syntax makes the connection between people's behavior patterns and activity space visual. The impact of space on people is not through a single space itself but the whole structure of the relevant spaces. In a word, space syntax is not a method or software, more like a kind of theory to understand the relationship between humans and space (see Figure 2-8).

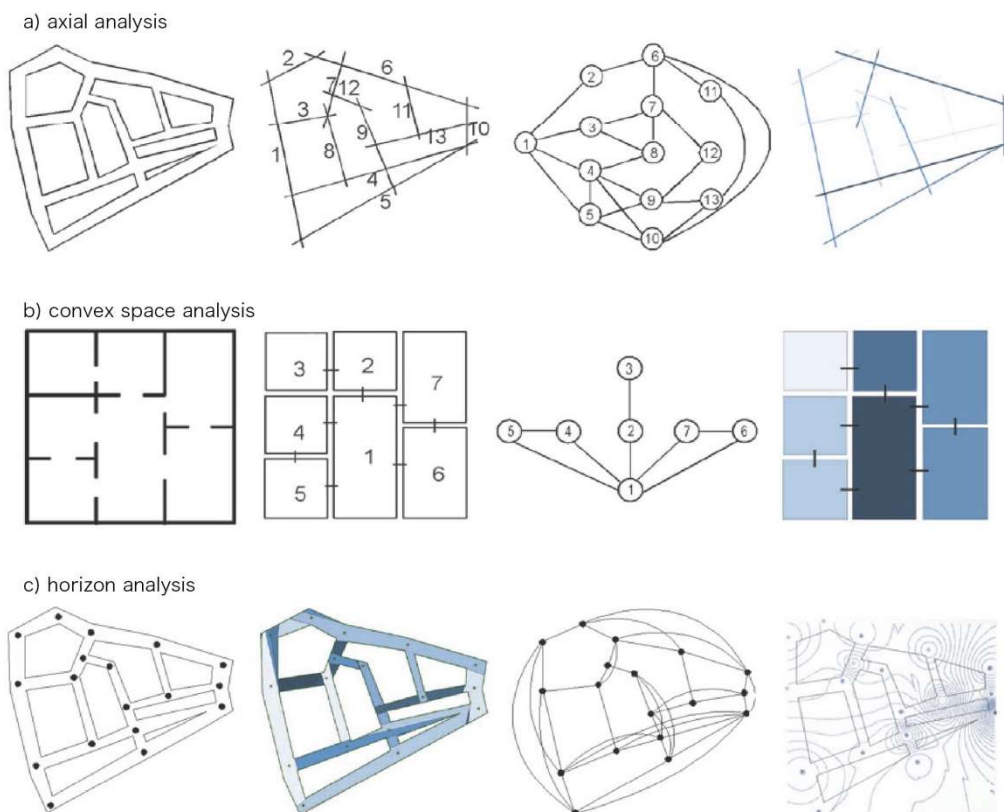


Fig. 2-8 Connections among spaces analysis with space syntax (Zhang, 2010)

(2) Public space & public life (PSPL) survey Public Space & Public Life (PSPL) survey is the primary method for Jan Gehl's research of the relationship between public space and public life as well as usage. It aims to find and understand people's activities and behavior patterns in the public domain. Its results are presented by quantitative and qualitative analysis to provide supports for urban public spaces construction and remodel that create a high quality of public space for citizens' use. Unlike POE (Post Occupancy Evaluation), taking buildings as the research object with people used for the core, PSPL is a survey method to investigate and evaluate the quality of people's activities in public space. Its object is multiple-scale urban public spaces, and the core problem is that people

in the cities and the activities they take in the open space aim to research the relationship between the residents and places through citizens' activities. Through nearly 50 years of continuous improvement, PSPL has become a primary method to study city plans and people's behavior patterns. Better yet, Gehl's researches in recent years have involved relevant studies on new street furniture, with sensors and monitors, to get further data in people behavior pattern.

- Counting is a widely used tool in public life studies. In principle, everything can be counted, which provides numbers for making comparisons before and after, between different geographic areas, or over time.
- Mapping, activities, people, places for staying, and much more can be plotted in, drawn as symbols on a plan of an area being studied to mark the number and type of activities and where they take place. That is also called behavioral mapping.
- Tracing means people's movements inside or crossing a limited space can be studied by drawing his moving lines on a plan map.
- Tracking, in order to observe people's movements over a large area or for a longer time, observers can discreetly follow people without their knowing it or follow someone who knows and agrees to be followed and observed, is also called shadowing.
- Photographing is an essential part of public life studies to document situations where urban life and form either interact or fail to interact after taking initiatives.

(3) 2-step floating catchment area method (2SFCA) The 2-step floating catchment area method (2SFCA), which is essentially a particular case of the gravity model, as a basic gravity model, extends many methods, such as KD2SFCA, E2SFCA, and 3SFCA. However, FCA has drawn sharp criticism because it does not consider distance decay with the same given region; it still is one most essential tools to evaluate the accessibility of public space in cities. Its principle is based on opportunities accumulation and developed from both cost method and coverage method. Opportunities accumulation means people could get the summation of resources of POS in a specific period and distance, which is widely applied.

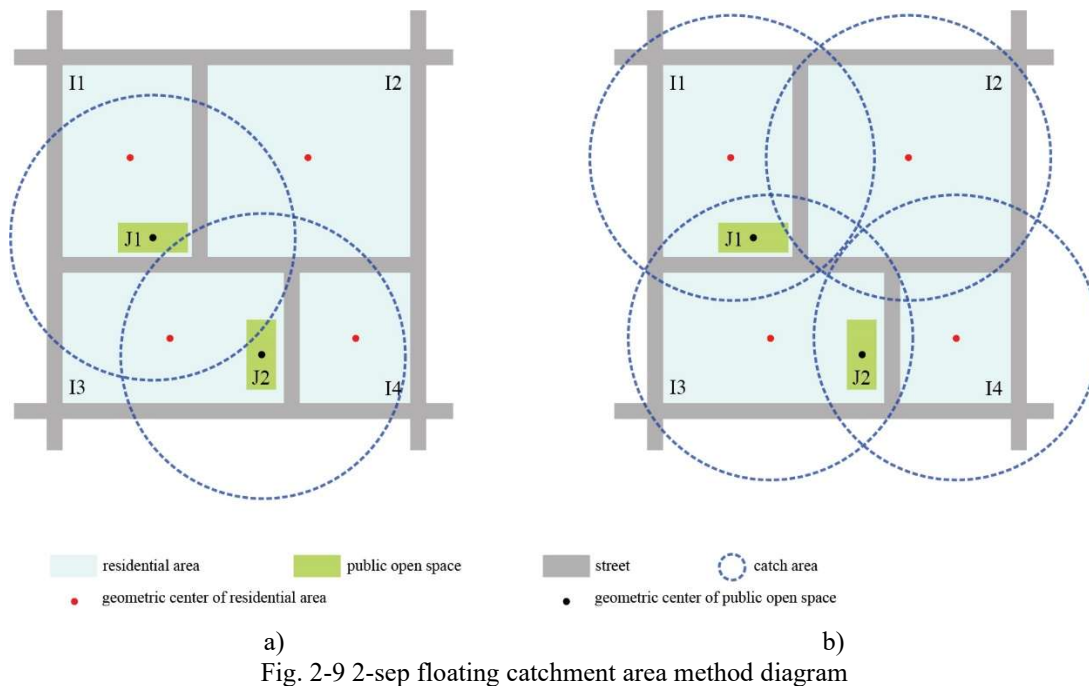
The application of 2SFCA needs to complete the following two calculation procedures:

- Public open space service capability value = Public open space area / The total population accessible

As shown in Figure 2-9 (a), the catchment area of public open space J1 includes the geometric centers of residential areas I1 and I3. The residential field in the catchment area represents where public open space can serve. So, the service capability of J1 equals to area of J1 divides the sum of the population of both I1 and I3. The service capability of J2 could be found in the same way.

- Move the search area to each residential land; identify the accessible open public space in the search area of each settlement, and calculate the sum of the service capability value of public open space, which is the accessibility of the residential area to open public space;
- Accessibility means the sum of service capability value of public open space.

Figure 2-9 (b) shows that the catchment area of residential area J3 includes the geometric centers of public open space, J1, and J2. Therefore, the accessibility of J3 equals the sum of service capability of both J1 and J2 calculated in the last step. Furthermore, the accessibilities of I1, I2, and I3 could be got in the same way. In conclusion, the accessibility of residential area I3 is highest in the four areas, and that of I2 is 0.



The limitation of 2SFAC lies in lacking thought on the residents living far away from the specific public open space but needing to take activities there. In the recent studies, scholars fixed 2SFAC, focusing the disadvantage through dividing the original catchment area into different parametric areas to building the quantized relationship between usage distance and accessibility. Up to now, accessibility is still the most important index to evaluate a public open space.

2.3.2 People environment-behavior studies (EBS)

2.3.2.1 Definition

Sound design for the city ensures good interaction between public space and public life. However, while the designer deals with space or the work, people's behavior has often been forgotten. The main reason for this situation is that life is ephemeral and metaphysical, which is difficult to describe and quantize—public life constantly changes in a day, week, or month and over the year. In addition, design, gender, age, financial resources, culture, and many other factors determine how we use or do not use public space. People behavioral pattern study aims to research on the interaction between overt human action and the environment, with the basic theory of psychology, some methods and concepts to human activity happened in the city and the buildings, and the reaction to the environment, then to help the urban planning and architecture design, in order to improve the quality of citizen life.

2.3.1.2 History and development

As a part of psychology, environment behavior studies (EBS) started in the early 1960s and have not progressed since their inception, which owes dissatisfaction with the lack of knowledge about how people and environments interact. Such knowledge seemed essential for design; without that, the design was more like a prediction groundless since no outcome could be reliably foretold. However, the EBS was ignored by designers for quite a long time because the evaluation could not be detailed rather than described, and some opinions were obtained that EBS was just for explaining and checking the behavioral pattern through the experience, which could not satisfy the need of design, facing the future. 1930, Hannes Meyer tried to offer a cultural history course on

environmental psychology to behavior in Bauhaus. Nevertheless, the process of agreement between behavior and design had not been smooth. The turning point appeared 30 years later; the development of environmental psychology worldwide culminated in the 1970s. The journal *Environment and Behavior* has been published in the United States since 1969. The Environment Design and Research Academy (EDRA) firstly published annual meeting records in 1970, 10 textbooks, six readings, and 30 monographs were published from 1973 to 1978; “environmental psychology” was added to the Wolman encyclopedia; The American psychological association for children founded the 34th branch, “the population and environmental psychology”, whose journal was *Population and Environment*. In addition, the International Association of Applied Psychology (IAAP) founded the branch “environmental psychology” and “international association people-environment studies” (IAPS). In the early 1970s, some scholars, such as Canter and Honikman from the UK, Kuller from northern Europe, began to developed research work in this area, and some successful experience was obtained. Furthermore, regular academic conferences were organized in Europe in 1976 and 1977. 1978, Kominski, a German scholar, reviewed the research on this field in Germany. In Asia, an academic seminar on “human behavior” was held in Tokyo in 1978, which attracted many scholars from both Japan and United States, and many works in English and German were translated into Japanese for publication (Li, 1998, p. 1-11; Gehl, 2011, p. 9).

2.3.2.3 Characteristics of public behavior studies

Environment-Behavior Studies (EBS) aims to research interaction between humans and the built environment. In the interactive process, people are changing the built environment, and in turn, their activities will be affected by the built environment. Therefore, EBS is a science concerned with the relationship between human beings and the environment, including research and practice to improve the quality of environmental design to utilize and promote this process. Under this definition, two goals of EBS are as follows:

- It is to understand the interaction between people and the built environment.
- It is to Use the knowledge to solve complex environmental problems.

Two types of people played a role in the founding of EBS, together with the Environmental Design Research Association (EDRA) and Environment and Behavior, which marked the first steps in its institutionalization. However, the domain of study is most usefully defined in terms of what I call the three basic questions of EBS (Rapoport, 2008):

- What bio-social, psychological, and cultural characteristics of human beings (as members of species, various groupings, or as individuals) influence, and design should influence which characteristics of the built environment?
- What effects do which aspects of which environments have on which group of people, under what sets of conditions, and why?
- What is the mechanism of these two-way interactions between people and the built environment?

This domain covers an extensive range of phenomena, the study of which involves many disciplines. As a result, EBS has been multidisciplinary from the beginning. Also, new domains and disciplines have become relevant, but EBS has, by and large, neglected and ignored such developments and stayed with the original fields – psychology, sociology, anthropology, and human geography, with the first two consistently dominant.

2.3.3 Street furniture with city public space study

The main steam transforms the focus from the city plan to the urban plan in recent years. The difference is not just a change in word, which illustrates that society begins to pay much more attention to daily life – interaction between citizens and site. Especially in highly urbanized areas, the quality of public space activity, with the speeding up of work steps and development of personal space privatization, is on the declining. In most situations, street furniture is thought of as an object designed to increase comfort in public spaces while creating a solid identity and perception of quality. However, the research and design task is always regarded as cumbersome, and the design result usually depends directly on the, often limited, time and resources invested (Pincin, 2013).

This kind of disassociated approach had the disadvantage of offering a particular and often limited vision. In contrast to this spontaneous and often clumsy management of the new, uncontrolled growth of agglomerations across France, cities were still weighed down by Haussmann's imposing 19th-century legacy¹. This legacy included iconic street furniture that was and still is universally loved: the Morris Columns built in 1842 by architect Gabriel Davioud, the Wallace fountains carrying the name of their sponsor and designer that have been providing the city with water since 1872, and not forgetting the emblematic metro entrances designed by Guimard in 1900.

In the 19th century, the industrial revolution considerably changed the face of French cities. It became vital to find a way to organize urban spaces, which gave rise to modern urban planning. The development of Barcelona by the Catalan engineer Ildefons Cerdà I Sunyer in 1860 marked the city's transformation from an old city to an industrial one. Like Haussmann, Cerdà drew on new sanitation theories, as well as integrating communication and transport networks. Urban furniture was used to decorate public spaces while also offering passersby a multitude of services.

In 1889, the Austrian architect and historian Camillo Sitte claimed to have laid the foundations of artistic urban planning in "City Planning According to Artistic Principles". He analyzed ancient cities to find a balance between empty spaces and buildings on a human scale. He advocated using curves and perspective to stage public life and enhance the relationship between individuals and institutions. These reflections did not extent to street objects but set contours of a design approach favoring harmonious proportions.

The British urban planner Ebenezer expressed his vision of the ideal city based on a community model joining the city and the countryside in "Tomorrow: A Peaceful Path to Real Reform", 1898. The invention of the "garden city" was, according to its creator, "an original combination of different proportions" capable of housing a new society (see Figure 2-10).

In the 20th century, sensitive and decorative approaches to public spaces deriving from Renaissance models were replaced by a functionalist vision of the city. This "machine-city" was practical, efficient, and rational. Progressive urban planners divided space into localized functional areas with green spaces and linked by differentiated traffic lanes. Following "an ideal city" by Tony Garnier, Le Corbusier developed an urban redesign project for Paris in 1925, "Le Plan Voisin". It offered a functionalist vision of the city, which moved away dramatically from the traditionalist vision of the city model. The geometrical design used new building spaces and functions that ensured the population's well-being. Unfortunately, the emptiness left between the monotonous and rectangular buildings stripped of all "superfluous" objects or decorations left little room for the imagination.

¹ The strict construction norms imposed on architects by Baron Georges-Eugène Haussmann, prefect from 1853 – 1870, can be summarized by the ambitious title of the renovation program "Paris embellie, Paris agrandie, Paris assainie." (A more beautiful, bigger and cleaner Paris)

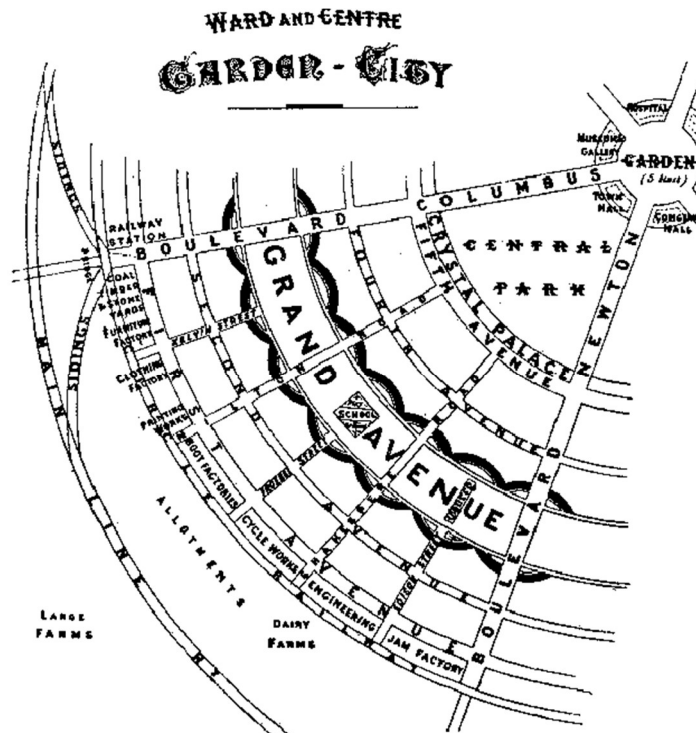


Fig. 2-10 Garden cities, developed by Ebenezer Howard (1902), describe a utopian city where people live harmoniously with nature

Design, and its transversal approach at the meeting point between many disciplines, is interested in urban planning problems. It helps enhance the quality of a city through landscaping, street furniture, harmonizing spaces, different surfaces, directional signage, heritage, and transport. The urban plan is never limited to defining land uses or linking the central exchange and travel axes. It is also about producing spatial compositions and giving recommendations regarding the organization, which consider overall strategies and local constraints. The intervention, needed in the immediate and familiar dimension that users encounter during their everyday wanderings, creates a tangible link between the individual and the city to make them feel safe and belonging. The role of street furniture has changed from a functional facility to an installation that could create a meaningful and harmonious atmosphere in an immediate environment at a very personal level with transforming both aims and methods of the city plan. Within vast public city spaces, their reduced scale establishes a more overall identity and enhances quality.

2.4 Development tendency of street furniture

According to the above, we can know that the future of street furniture reflects and meets people's needs and new thoughts of a city plan. The prediction for new street furniture is another view to design city and city life in the future, as a result, which should be unfolded tight around the development of people behavior patterns. The desire to better anticipate changes in society and their impact on living spaces encourages us to imagine more multi-demand future scenarios, particularly for society moving at an ever-accelerating rate. More buildings would be constructed in cities. More social functions must be installed in limited spaces between buildings. The public space should supply a site to take different activities and take care of citizens' feelings and mental pressure from high-speed daily life. Energy issues, Natural harmonious and socially sustainable development would all impact the street furniture design and plan. The design drives innovation by making these hypotheses into reality.

2.4.1 Flexible

The new generation street furniture should be in a high flexibility. With further urbanization, the area of city open public space is limited and takes more functions. It is impossible of all the function of the street furniture to be in use the whole day, even if high-desired one in crowded areas. On the other hand, it will impact the whole layout if the street furniture covers an exaggerated area, more like a functional landscape opuscul. Therefore, the structure design of new street furniture should be more extensible. For example, the smart street furniture should be designed in a small footprint, one by one meter, in “*Sm²art*” project, could be transformed variously with a limited coverage area, which is much easier to adapt to different spaces for mass production.

On the other hand, the public space could be maximized, and more opportunities are left to the square to take activities. Meanwhile, the folding and unfolding procedure is an interaction between users and public space. Different users define both street furniture and the environment. The flexibility of new generation street furniture brings flexibility to the whole place.

2.4.2 Adaptable

With the depth-development of the commercial process, prefabrication and modularization have become keywords to modern production models. So, new generation street furniture design should ensure the most adaptability to the placement under the precondition of bulk production. Moreover, each installation should match the local built environment. Therefore, the adaptability of new street furniture in the future needs to face enormous challenges.

The other side of the adaptability of new street furniture lies in developing people’s new habits. From the perspective of new people’s behavior patterns, it is more robust and more vital of dependency from citizens to handheld devices, such as smartphones, tablets, and PDSs, now give us highly customized digital experiences. People have been used to this kind of customized service; such phenomenon also occurs in public space, even if the usage of street furniture. Such as more and more new street furniture could supply charging service to the public, which is designed based on the new internet-life mode: the personal smartphone, as a private terminal link, could send or receive information from the worldwide network to complete daily work, social, shopping, entertainment, and payment. Thus, the dependency on the personal mobile terminal is steadily creasing. Therefore, charging and Wi-Fi would become the main functions of future street furniture to adapt to the future city life (see Figure 2-11).

The functions needed are linked closely to the location in the city. For example, translation and map are necessary for the city center and tourist areas; on the contrary, that is redundant in neighborhood leisure square. It will waste public facilities, including street furniture, regardless of differences in requirements of various places in the particular city. As a result, much deeper research on the relationship between placement and requirement is essential in future design and plans for street furniture.

2.4.3 Sustainable

With the influence of urbanization and globalization, global warming, and a growing emphasis on humanism, urban landscape design, including street furniture, faces unprecedented challenges and requirements in the 21st century. By 2050, 70 percent of the world’s population will live in urban areas. Consequently, the cities must evolve to adapt to the new situations: higher density, fewer cars, and taller buildings (Albert, 2017).



Fig. 2-11 ARIA with PowerMe. The Australia Institute of Landscape Architects (AILA), Internet of Things Alliance Australia (IOTAA), and Smart Cities Council Australia New Zealand (SCCANZ) built the street of future at Circular Quay on Alfred Street, in front of Customs House in October 2017. In the Smart and Complete Streets, PowerMe charging tables by Street Furniture Australia were a hit with the owners of thirsty devices, with sometimes three or four phones, tablets, or laptops plugged into the one unit (WE-EF, 2017)

Many scholars supported the point that the role of the street would become outstanding to realize a sustainable society (Jegou, 2013 & Scholl, 2013 & Albert, 2017). As walking is encouraged, the quality and quantity of street furniture will increase in the a-long term, which will matter a lot in the quality of future city life. Meanwhile, more street furniture will be needed and produced in a sustainable context. The generation of future street furniture should not be limited in shape layer, as the saying that design needs to follow requirement, but be extended to both material layer and design layer. The realization of the long-time operation of street furniture should be the main aim in future design.



Fig. 2-12 The aims of new generation street furniture

Therefore, the new street furniture design may be divided into three parts: platform, component, and control system. From the above, the future street furniture should be flexible, adaptable, and sustainable. Furthermore, the function component should be a solution to match the different challenges to satisfy all the trends.

- As the basement of new street furniture, Platform could supply the essential function to construct a complete facility, such as supporting structure, reserved connection, and power source. According to the specific case, the height can become higher. Moreover, components with different functions could be equipped with the platform.
- Component, with various functions, unified the limited forms of connection with the platform, could provide many possibilities and services with users, such as seats, tables, shelter, charging, screen, Wi-Fi, sensors, and so on, and both installed and uninstalled conveniently to further replacement and renovation.
- Control system mainly works for a flexible control method: people should use the app in personal mobile devices to check the available facility they need nearest and interact with the detailed component. For example, people could adjust the height of a specific component or use the app to generate a unique QR code to use the public locker equipped with the platform.
- The mode of this new street furniture is identified platform-component, which intends to the next generation urban facility is composed by a platform for structural and

functional components.

2.5 Research phases and scope

2.5.1 Research phases

According to the above, the design and plan for new street furniture are never independent, that should be synthesized both the users and usage environment, and the design and plan of street furniture could not be separated. So the research direction of this research focuses on two phases of the design and place of new street furniture: when the new mode of street furniture is built, the place and design procedure are identified. First, the expected placement of new street furniture should be picked, and the condition and classification of open spaces would be addressed, of which criteria are divided to analyze whether the built environmental conditions are fit for new street furniture, and the challenges proposed according to the existing problems on the place. Furthermore, the analysis conclusion could be as presupposed conditions to the next step design and plan of new street furniture, involving in the following decision-making process of the new urban facility. Along with the data collected in the open space where has been chosen to site new street furniture, on the behavior pattern of pedestrian belong the place, the designers can decide which functional components are needed by the area, and the layout of the new urban facility.

- The first phase: Classify the preselected area of the placement of new street furniture. The content of the classification includes the indexes of the place background and the potential users. And then, the correspondences between the condition of the area and the need for the street furniture's functional component would be built.
- The second phase: Investigate the people's behavior pattern about the activities taken in the aimed space. The data collected, such as main route, flow direction, activities sorts, average leisure time, the age structure of users, could help us draw a map of the public space usage situation. Moreover, on this basis, people can design the layout of the new street furniture combing with the existing landscape plan of the square.

2.5.2 Research scope

The main research objectives in this thesis are public open spaces, users, and new street furniture, which would be discussed respectively on the research scope in the following part.

2.5.2.1 Public open space (POS)

Urban planners and landscape architects often refer to public open space by the acronym "POS" (In the following part, POS will stand for public open space). Depending on various definitions are adopted, a series of areas could be called POS, such as a public park, a town square, a greenway which is open to the public but runs through farmland or a forest, a public highway, a private road with public access and some bottom floors of the private high building which is open to the public but runs by the manager of the building. All the mentioned areas belong to POS with different service conditions and modes of occupation. Considering the main research problem in this thesis, the placement of street furniture, and the research aims to promote the quality of public city life, some kinds of POS are not going to in the following discussion. In this research, the scope of POS refers to an outdoor space that could supply the area with citizens to go through and take activities, and not covers streets or city central square, the usage of which is strongly influenced by travel season, most of which attract a large number of tourists, with many usage indexes of those unique and special. For the same reason, the scenic square as the central city square would not be on the research list.

2.5.2.2 Users

People are the subject of all the activities that happened in the city. This research focuses on people's cognition; therefore, the role of people in this thesis is prior. The users concern the people taking activities in the POS, which include walking, stopping, and relaxing. The users belonging to the specific POS could not be intermixed with users from other areas. The people's behavior pattern is proper to the location. The critical analysis will come in Chapter 5. The scope of users is confined to the people active in the square, where would lie new street furniture in the plan.

2.5.2.3 New street furniture

The research on new street furniture is complex and involved. In this thesis, the one future mode of new generation street furniture is presupposed in **2.4 Development tendency of street furniture**, which is proposed as per the development of the whole society including technology, environment, and people's need. The future modes should be diversified, not fixed, and alterable. To focus on the behavior-environment, the usage context, the platform-component, on the one hand, is promoted for further research more concentrated on the core problem; on the other hand, the model proposed matches the "*Sm²art*" project. Consequently, the scope of the new street furniture brought up in the later chapters is limited to the platform-component mode. Moreover, the discussion on the design and plan of new urban facilities will be unfolded on the platform-component mode. In the following part, P-C will stand for plat-component mode (see Figure 2-13).

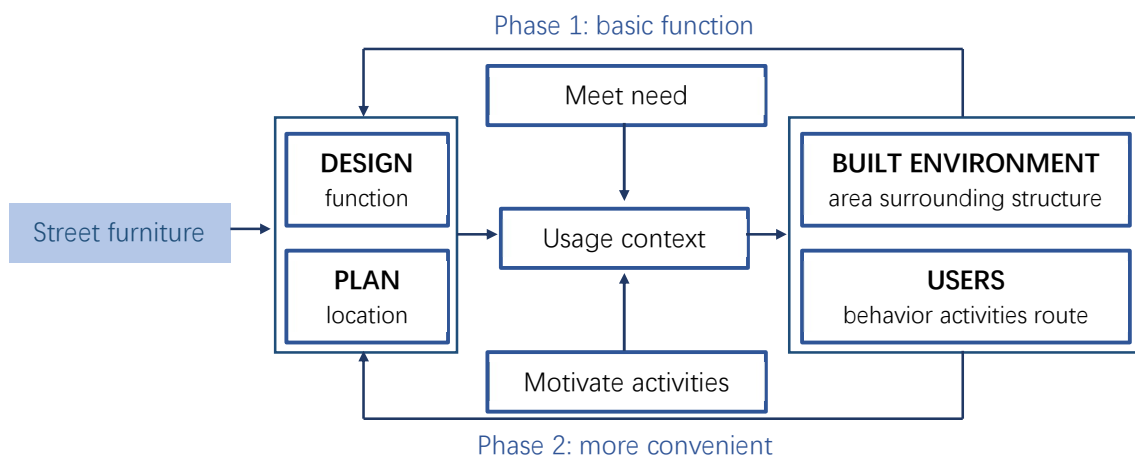


Fig. 2-13 The diagram of relationship among street furniture, environment, and users, the core problems in this research

2.6 Summary

In this chapter, a review of related studies of both street furniture and the usage context was done. The review included (a) the general concept and development history of street furniture; (b) overview of street furniture usage context, including city public life studies, people's environment-behavior studies, and studies on street furniture with city public space. The review provides foundational knowledge of street furniture. It assisted in recognition of the design context from society, development of technology, and people's behavior pattern. It follows that the future of street furniture will be more flexible, adaptable, and sustainable. From the above, the P-C is concluded to describe a possible mode of next-generation urban amenity. It established the foundation for the following phases unfolded.

As studied, though the street furniture becomes fixed at the time of its installation in the area, the impact of people activities in POS is open, complex and extensive in the

environment. In the future, as the world becomes more urbanized, the role of street furniture playing is increasing significance. The agent of growing influence is the need to promote the quality of public life in the city, which is caused by the privatization trend of city life. The research on new street furniture design and plan could not come away from the built environment and people behavior pattern in this perspective. In recent 50 years, the rise of humanization and environmental harmony is the epitome of the turn of design research direction.

Moreover, in essence, the design cannot exist without context. That is to say, the discussion on environment-behavior is the precondition of the design and plan for new street furniture. “Modern environmental facility is a multiple, united and organic idea. Therefore, beginning from the space of human environment, going through the systematic analysis and process and then well handle the relationship between human, environment and the environmental facility as a whole to develop the best and most ideal ‘human-environment system’” (Wang & WANG, n.d.).

All suggested that understanding the environment and people’s behavior is the key to investigating the new street furniture design and plan principles. Therefore, this study of city people patterns will be done in Chapter 4 and Chapter 5.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The study includes several phases of research that are different but significantly linked. Phase-to-phase research was specially planned, and each stage was conducted to provide a foundation and generate information for subsequent stages. Furthermore, different research methods were selected for particular purposes in each stage.

This chapter will start with a research overview describing and explaining the differences among research methods employed in various stages. The methods will subsequently be discussed individually, following their description and explanation.

3.2 Overview

3.2.1 Identifying and confining research direction

This research commenced with a general review of street furniture design through literature review. It serves as a guide for this study and introduces the current situations and knowledge of street furniture. Three main issues are specially addressed in the review:

- The importance of street furniture
- The usage context of street furniture
- The development tendency of new street furniture

The three issues provided reasons for this study and identified the research phase's principles of street furniture.

Concerning research phases, an intensive literature review of street furniture and its context was conducted to obtain an in-depth understanding of the situation and confined and specific issues for investigation. The key issues include the following:

- The usage context decides the functional needs and the placement of street furniture in the future.
- Different concerns and principles are varied in different areas.
- The design and plan of street furniture should be analyzed in the exact place.

This investigation provided solid details, scopes, and areas for the succeeding research stages when suggesting the design-plan principles.

3.2.2 Establishing demand forecasting model

After the initial research stages, this study began to identify missing and previously unknown principles. Various research methods and processes were applied in establishing the design and plan principles.

This study first outlined a rudimentary series of conditions of POS, which could influence the need of citizens living around in daily life, through (a) the data collected during the investigation, (b) application and extension of principles of city life study, and (c) integration and reorganization of principles of street furniture design and plan of relevant studies.

First, it is necessary to recognize that street furniture plays a vital role in city life with other facilities as a part of the urban landscape. Therefore, it should not be analyzed as individual pieces, but rather as elements of the entire public city life, including other elements such as architecture, open spaces, grounds, human, and their activities, while considering the function and meaning of all these elements. Given this condition, the principles of street furniture functional design and placement ought to bond with the POS information where would lie a new amenity, which we could define as the influence factors of the built environment to judge the function the citizens active around need. Without a doubt, during the investigation, people will find some requirements of residents implying existing shortages could not be met through placing an amenity belonging to the inadequate conditions of the POS. Consequently, analysis on the area should be the entrance to new street furniture design and plan.

Second, according to the relevant studies on city public life and EBS, the potential influence factors of the site would be summarized and form a framework. The effects could be illustrated through PSPL, 2SFAC, and SS, such as accessibility, visibility, operability. Moreover, the effects would be listed through a 5-dimension graph to clarify the condition of the preselected square, which could supply an intuitive way to evaluate the needs caused by the urban environment.

3.2.3 Establishing placement forecasting model

As stated in the research above, it is completed that the first phase of design and plan of new street furniture, choosing adaptive functional components. In this part, much more profound and detailed studies would be carried out to promote the placement principles for street furniture.

This part transforms the research perspective from the urban layer to the regional layer; it focuses on the people behavior pattern reflected from activities, such as route, content, time. Through (a) the data collected during the long-term investigation and (b) comparison and correlation analysis, the local behavior pattern could be straightforward.

First, as an urban functional facility, the street furniture takes part in citizens' activities in POS. Therefore, the primary placement should satisfy walkability, visibility, service space required and make people use and arrive more convenient. Second, the layout of street furniture should be itemized and listed with the resident's activities, and the potential relationship should be promoted.

Second, based on the data collection, the analysis would be performed through SPSS to test the correlation between the people's activities and behavior patterns. As an element of the landscape, the plan principles of street furniture should obey the general rules of the whole square layout while adjusting the specific function and people active in the aimed place. At the end of this part of the research, the adjustment guidelines would be summarized.

In this part, correlation analysis is reasonably necessary. Some relationship between the phenomenon and conclusion is on the surface, but some are hard to detect. The analysis principles would be organized and presented in this part. In the meantime, some principles we summarized need data to support is the foundation of the following design guideline.

3.2.4 Case studies in Turin

As stated, this study is built on the *Sm²art* project, which was introduced in Chapter 1. Piazza Alessandria is the preselected POS to place the prototype in the program. A detailed analysis would be taken in this phase following the steps promoted in the former sections. Finally, the relevant conclusion would be presented, and some guidelines would be explicitly promoted to this task.

3.2.5 Finalizing and proposing plan principles

Finally, the model of a complete series of principles of new street furniture plan and design, with examples and demonstrations, was suggested. Examples of street furniture plans from different places and collaborative design projects were documented and utilized for discussion and analysis in explaining the model. In addition, collaborative design projects which demonstrated the implementation of the principles of street furniture plan according to the research of the selected places demonstrated the comparison between theoretical theories and realistic situations in this study. Street furniture plans developed collaboratively were likewise utilized as examples for discussion and analysis.

The research results do not aim to provide an absolute answer in planning street furniture. Instead, based on different stages of research, it seeks to suggest possible concerns and solutions addressing the critical issues under investigation. The research results are expected to “inspire” furniture investigations and discussions to improve the street furniture plan and the quality of city life, and people’s behavior patterns.

3.3 Application and extension of the city public life study

The concepts and research methods of city public life study were reviewed, analyzed, applied, and extended to establish the close bond with the street furniture design and understand that in citizens’ daily lives. The reasons and methods can be explained in the following ways.

The city comprises different elements, including city spatial structure, functional buildings, various people, and street furniture. In this sense, the presentation of urban public life is interaction taken among each other. So, each urban factor needs to be studied, considering others, while being a part of the research context with else at the core. Given that different city constituents have their functions and positions in the social life and influence mechanism, they should be designed following specific criteria and manners within their connection and extending the city public life study. The street furniture in the past researches was always deconstructed into some “designable” elements, and deconstruction methods became the core problem in that exploration. The overall design philosophy is necessary to research the topic on public activities. Even if the central issue of this study is street furniture, the related elements and the interaction would be discussed to fulfill the plan and design principles under the unfolded urban city life as a whole.

Taking street furniture, public open space, and people behavior pattern as the explanation, the relationship between them is shown. Furthermore, different elements are not separated but are instead integrated in similar ways. For street furniture, it is the element located in another urban constituent – public open space. The relationship of urban constituents is directly applied to its different contexts as street furniture is an element in public open space, aside from sharing interactive relationships among the whole city operation process. Therefore, the plan and design principle of new street furniture should be discussed in this backdrop, including what function of the next generation urban facility is adaptable to the placement in the urban area and how they are placed in a more convenient location for daily usage.

This research stage included a review of different urban life studies, including urban plan, urban life, and urban operation. The focuses of reviews in this part included the following:

- Discuss general concepts of the urban planning principles for daily human life. These refer to the definitions, natures and characteristics, classifications, and creation of the urban planning principles for daily human life. The concepts helped in the establishment of street furniture plan principles by understanding the urban landscape as a complex system and recognizing the position, contribution, and importance of street furniture as a part of the urban landscape, as well as the different perspectives and responsibilities of different professions in the urban landscape, including street furniture.
- Summarize the development history of the street furniture and city planning with daily human life. These mainly focus on the interactive relationship among the development of city life, city planning, and the usage pattern of street furniture. With the changeable of urban life with the advance of science and technology, city, urban space, and street furniture are all the consequences of continuous improvement caused by the variational character of people to the built environment.

- Compare various research methods and theories for study city public life. The behavior pattern of people living in the city cannot be discussed apart from the urban environmental condition, of which methods in different periods reflect the citizen's environmental views. In addition, the internal connections among people and the city were discovered.

According to the review mentioned above, the development of design and plan for street furniture was pursued. Moreover, the interrelationship was studied to build up the system of people's behavior-environment. As an element in different layers in the whole system, the street furniture follows the design rules that coincide with the overall structure to locate street furniture better to understand the influence factor of its design and plan.

3.4 Integration and reorganization of the strategy of street furniture plan of relevant studies

The concepts and design principles of the urban plan, which have to satisfy various city elements, are general and convenient with people's daily lives. Through the rearrangement of the urban plan system, the influence relationship among various city elements is reorganized. Moreover, the role street furniture plays in the whole system and the relevant elements are apparent.

3.4.1 Conform to the city operation rules: city spatial configuration

City spatial configuration should be considered in the placement design of street furniture as a component in the city machine. The city comprises a series of organized spaces containing different functions with various scales to guarantee the urban operation from the environmental condition. The rules of urban spatial pattern essentially determine the city transportation, which is the primary stone of the city performance. According to the city configuration theory, we can know that there is a structural hierarchy for the spaces in the city. The development potential of the district can be discovered from the relationship among them.

It is necessary to learn the city spatial configuration to know the influencing mechanism on citywide space structure. From the city layer, the connection between the placement-design of street furniture and the city includes the following (see Figure 3-1):

- The formal elements of the city: From the urban evolution procedure, a city begins with several axes forming the main urban control lines, and then the axial structure to support the city skeleton is generated based on the dominated streets. The spaces among the axial structure form blocks and districts. According to this perspective, spatial configuration supplies a view to discover the city growth operation.
- The function of city spatial configuration: As the research background, the function of configuration pattern is studied to analyze the influence factors for both placement and function design of street furniture, which need to match the local transportation and urban characteristics from the urban spatial view. The axial structure as the street system citywide creates a set of rules to guide both the people flow and traffic flow, and the differences among flows contribute to the characteristics of users in various dominations in a specific city. According to this perspective, spatial configuration supplies a view to discover the city flow operation rules.
- The feature of city spatial configuration: The urban feature embodies urban development step, citizen life pattern, spatial organization order could be inferred from the spatial configuration. The urban space arrangement illustrates the people's behavior pattern in daily life, including activity radius, activity circulation, and activity trend. According to this perspective, spatial configuration supplies a view to discover the city activity operation rules.

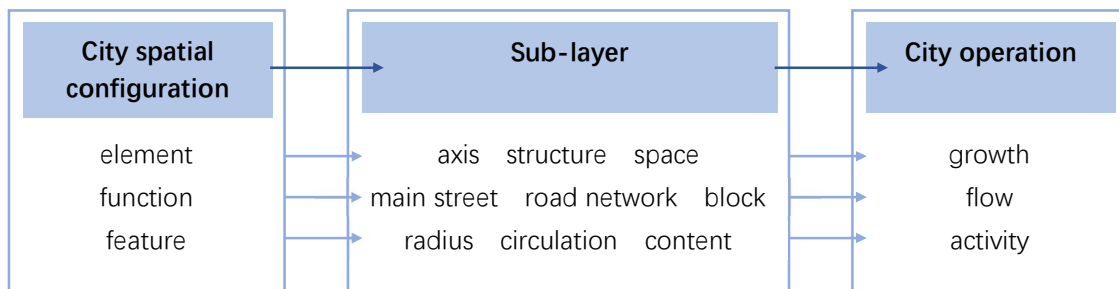


Fig. 3-1 The methodology of city spatial configuration

3.4.2 Integrate people movement customs: walking, staying, and sitting

The people living in the city are the primary users of street furniture. The usage of street furniture is an activity of citizens to respond to the environment when they are in the open public space. It means its occurrence needs a series of certain conditions both from environmental and personal. Consequently, it benefits from studying the activity resident usually takes in the open public space and its related conditions for people to learn its usage. The new street furniture, like a fresh installation to supply specific service with human-being, its use happens when people are moving in the city. The public taking movement includes walking, sitting, and staying; 3 different situations represent distinct procedures in the daily life cycle.

It is necessary to understand the parallel requirement that possibly happened during each activity, and then the relevant environment condition could be discovered (see Figure 3-2).

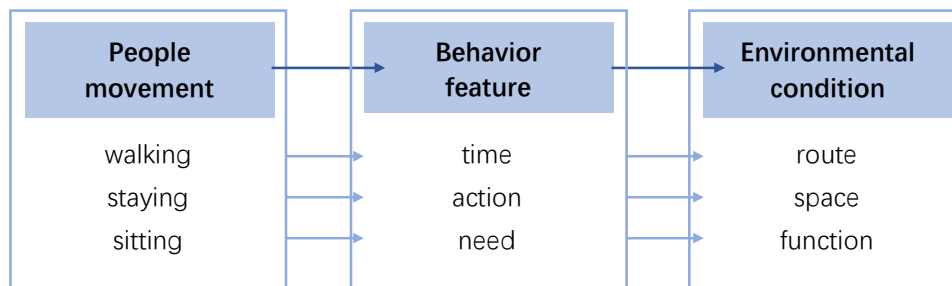


Fig. 3-2 The methodology of people movement customs

- Walking: Most activities that happened in daily residential life need walking to link up with each other and taking most time in their open-air being. Many existing street furniture serves citizens when they walk by, such as street lights, street single, road signs, electronic information boards. The information offered by the urban facility is the primary purpose for the resident. Moreover, people choose the shortest and least-turns (turning angular) route to leave for another place from their locations. The street furniture is aimed to supply this kind of information should follow with the condition of inhabitant' walking.
- Staying: Some accidental conditions make the residents staying on the route. Citizens are used to stopping to take an activity such as answering a phone call, taking a break, waiting for somebody, watching something. The corresponding physical conditions could be researched consequently. Furthermore, street furniture design should follow the relevant situations both in the placement and function.
- Sitting: Taking a seat means an opportunity to spend a longer time on specific movements such as eating a burger, reading a book, watching the children, and so on. The feature of the activity taken suggests both the appropriate environmental condition and behavioral demand. The new generation of street furniture seeks to match

diversifying requirements in daily open public life to inspire people to positively participate in social life and create more chances to enhance communication among citizens. Therefore, both everyday needs and specific requests are integrated into an intelligent facility for various activities during sitting. Furthermore, the placement should be planned according to different activities.

3.4.3 Respect people psychological needs in public: security, intelligibility

The new street furniture is located in the open public space, and people's behavior patterns should follow the laws and theory of environment-behavior, including physical needs and psychological needs. From the psychological perspective, citizens must satisfy security and intelligibility to stay open-air to take activities.

The residential sense of security and the sense of intelligibility for using street furniture should be researched from both the layout of a specific place and the location of the facility in the square (see Figure 3-3):

- Security: The sense of security belongs to basic human needs in an open public space. Before determining some activity in a specific place, people are used to justifying the security of the square and then the placement of street furniture to decide whether to use it.
- Intelligibility. The intelligibility of a specific place is the primary condition to stay a citizen. Low intelligibility makes citizens feel confused in the open public space and lose the opportunity to stay with people. In addition, in a complicated, planned, open place, intelligibility plays a vital role in finding street furniture. In that case, its placement is a part of the layout pattern. Consequently, the location of new street furniture has a close relationship with the whole plan.

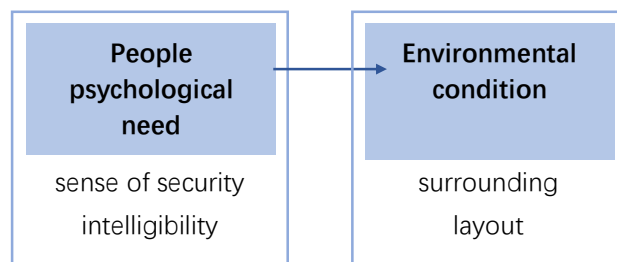


Fig. 3-3 The methodology of people psychological needs

3.5 Case studies

The elementary principles of street furniture design drafted at the previous stage were examined by case studies (and collaborative street furniture design projects, which will be discussed in the next section). The case studies are examples of street furniture design in different places, including local and overseas. Research in Turin was extensive because the original research was based here; research conducted in other places was limited to two to three weeks.

Cases selection is not dependent on the place; instead, researching different places was planned to collect sufficiently different backgrounds of design practice, management, culture, user behaviors. Moreover, each day, areas of varying nature (traditional, tourist, and residential areas.) were selected. In this manner, the principles were thoroughly examined and flexible enough for designing street furniture for different backgrounds, not only for particular places, practices.

Turin within different places was in-field studied. They were selected by striking a balance between the time and financial constraints of the research and the attainment of sufficient research data. Under this condition, each place was selected for research

focusing on specific principles and situations (this will be discussed later). In addition, the selected cases attempted to avoid overlapping with those in existing street furniture studies, which the study intended to use in examining the principles with a new example.

The process and methods of examining the principles are as follows:

- Each main principle and its sub-principles were examined one by one.
- The cases (examples) are varied, and the scale used is based on the principle examined. For example, to examine the principle of “unity”, a set of street furniture including bench, rubbish bin, light, and the environment as a whole is taken as a case. In comparison, to examine the principle of “comfort”, an individual bench could likewise be a case.
- Various methods, including background research, observation, and interviews, were utilized in evaluating the principle.
- For each principle and sub-principle, applying them and not applying them were analyzed, so the value of principles can be evaluated through cases from both sides (applied principles and unapplied principles). As stated, the suggested principles are not expected to apply merely to one specific area. At least three cases of each side (applied-unapplied) were analyzed. It provided sufficient support and guaranteed the breadth and flexibility of the principles. For example, the sub-principle of “arrangement” suggests the rubbish bin should be placed near the bench for users’ convenience. Three different places wherein (a) the two items are put together and (b) are not together were investigated. The result is a clean environment found in the example (a), whereas a rubbish bin nearby (b). The principle was shown to be practical and realistic, and hence consolidated.
- For some cases, design concepts and practice which were not included in the elementary principles were discovered. Those design concepts were examined through different cases by both viewpoints (as stated above) and became listed as design principles (i.e., suggestions for new principles). For example, in Turin, railings are installed on the two sides of the zebra crossing on the pedestrian path to lead people crossing the road within the zebra crossing. The urban policy in Turin regulates it. However, these examples were not found in every city researched in this study. Finally, the sub-principles of “urban policy and regulation” suggest street furniture should be designed and arranged according to its location’s urban policy and regulation.

Details of the evaluation methods follow:

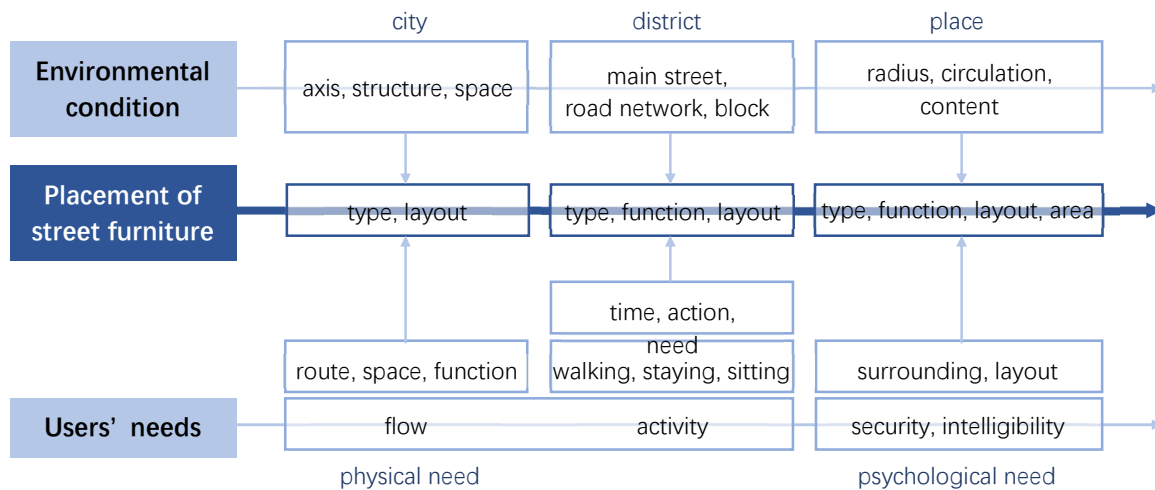
- Background research includes the history, culture, functions, and users of the cities and places (e.g., streets, squares, and parks) where the observed street furniture is located, the functions, design concept, people flow, gender.
- Fundamental analysis includes the calculation of spatial relationships among spaces in multi-scale by software.
- Synergy analysis includes the comparison according to time, group, gender, direction, location, and other relevant factors.

The whole case study flow structure as following Table 3-1 shown:

Table 3-1 The case study flow structure

PHASE/ LAYER	METHOD	PARAMETER	ANALYSIS CONTENT	RESULT
1/ City	T: space syntax SW: DepthMap	integration connectivity	whether the COPS has the opportunity to gather human and traffic flow in urban range	Whether the COPS has the condition to place new street furniture. The higher the connectivity means more chances of NSF to be used
2/ District	T: space syntax SW: DepthMap	integration connectivity	whether the COPS has the opportunity to gather human and traffic flow in the district range	Whether there are differences in the ability to gather people and traffic flow among different COPS in a district
		visibility	visibility of COPS from the main street (the possibility of NSF to be found)	Several streets enclose each COPS, can propose the placement of NSF closer to someone of them
	T: space syntax SW: DepthMap T: PSPL M: counting, tracing	compare the attributes according to spatial configuration and actual pedestrian distribution	Consistent or not. If not, find the reason. The building condition could not be described in the DepthMap, which influence is complicated. People can analyze the phenomenon from different aspects: building function, life circle, permeability mixability of facade	find the reason for the gap formed, and justify whether it is possible to change the intentional placement to site NSF. Or propose a modification scheme to promote the opportunities of people passing by the COPS
3/ Place	T: space syntax SW: DepthMap T: PSPL M: mapping	visibility	the visibility of each point in COPS; get the vision changing through real prominent people to flow moving	find the spot or area in the COPS with a higher visibility
		T: PSPL M: counting, tracing SW: Excel	activity compare the attributes on features	collect data of the local people behavior pattern: activity type, average time, activity favorite, relationship between users' behavior and layout of the place

3.6 Methodology structure



3.7 Summary

This chapter has discussed and analyzed the different research stages of this study and how different research methods were utilized in each stage. The principles of the street furniture plan were initially drafted based on the application and extension of the concept and principles of the urban landscape plan and the integration and reorganization of principles of the street furniture plan of relevant studies. They included the review of urban landscape design, urban planning, open space, street, and different street furniture studies. The elementary principles were subsequently examined and analyzed through the case studies of street furniture plans in Turin's different places and collaborative streetscape and street furniture plans. Principles at this stage were implemented, evaluated, consolidated, and served as a basis on which some new principles were suggested. Eventually, a complete series of principles of street furniture plan was suggested with examples and demonstrations. The principles are not considered as golden rules but as a possible solution based on this study. It will also be a reference for further discussions and investigations.

CHAPTER FOUR

URBANSCAPE

4.1 Introduction

Street furniture is an element of the urban landscape. That means that street furniture should be designed with the urban landscape, including other urban elements, as a whole (Design council, 1976; Eckbo, 2001; Wang & Wang, 2006; Yu, 2003).

Landscape architects who design an environment including benches, chairs, trash boxes, ashtrays, signs equipped on the street must re-examine and design street furniture with an attention to each item and an eye for complete landscape design (Graphic-Sha Publishing, 2001b, p.7).

As part of the urban landscape and being considered in line with the entire urban landscape, the placement of street furniture is extended from that of the urban landscape layout.

What determines the design of street furniture, whether good or bad, is the same design principle as landscape design as long as deciding the quality of space, whether private or public, and designing it by coordinating well (Graphic-Sha Publishing, 2001b, p.7).

Today, so much of what we do with outdoor space is about solving problems such as aging society, the accessibility of public space, improving community vitality, and all remediation. We try to make things whole, shape them to allow people to connect so they will want to pay more attention to the built environment. Street furniture works when it connects people to the landscape and opens up someone's psyche to experience space more fully. Furniture acts as a set of tools or sets of elements that heighten and reveal (Main & Hannah, 1999). In other words, street furniture is a bridge from the personal body to the built environment, from personal feeling to a sense of local identity (see Figure 4-1).

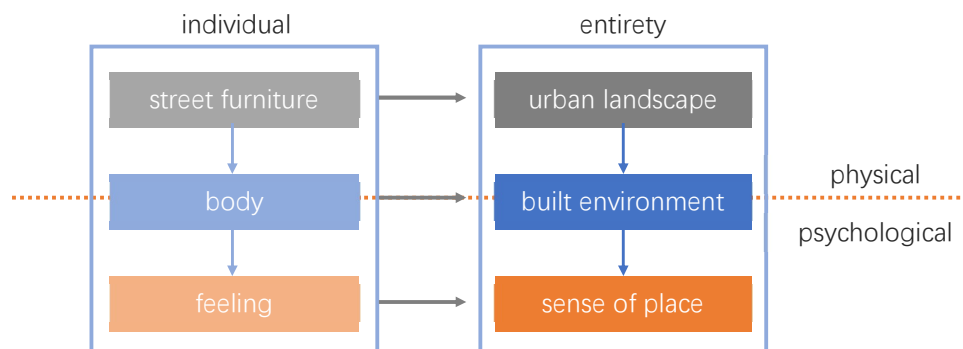


Fig. 4-1 Relationship of street furniture and urban landscape

According to this, and as stated in Chapter 2, to have an in-depth understanding of street furniture and establish comprehensive plan-flow, there is a need to investigate the urban landscape's relevant concepts and study indexes.

This chapter is a study of the urban landscape. Section 4.2 will discuss general concepts including (a) definitions, (b) classifications, (c) nature and characteristics, and (d) creation of the urban landscape. Besides understanding the urban landscape as a vast, complicated system, this part of the study aims to recognize the position, the contribution, and the importance of street furniture as a part of the urban landscape from different urban scales, and also the different perspectives and responsibilities of different professions in it.

Section 4.3 is a review of the development of the design theories of the urban landscape. It will review the design theories of various concerns raised in different periods. The theories will eventually be analyzed and organized into a series of leading design roles of the urban landscape for today and the future in Section 4.4. Studying the development of the urban landscape plan theories is essential to obtain the urban landscape design plan

indexes with all-around concerns for the past, present, and furniture. The plan indexes will become a foundation and will be applied and extended in the plan indexes of street furniture design.

Following the comprehensive urban landscape design investigation, Section 4.5 will focus on another urban landscape element – urban space (open public space), where street furniture is located in the urban landscape. Based on the concept and plan principles of the urban landscape, this part aims to provide more in-depth and specific sources for street furniture plans. Some significant considerations of urban space will be addressed. Also, the importance and functions of the street, the primary source of open public space where street furniture is extensively implemented, will be addressed and investigated for designing street furniture practically and mainly.

Finally, Section 4.6 will summarize the results obtained from this chapter and discuss how the results will be applied and contribute to the street furniture plan and establish its plan flow in the following chapter.

4.2 Urban layer: general concept

4.2.1 Definitions

The urban space (or the urban environment) refers to the visible features, including natural and artificial elements. “Urban spaces are the organic integration of natural landscape and artificial landscape. It is the apparent expression of urban spaces and urban objects” (Wei & Sung, 2005, p.1). More specifically, the urban landscape is created through the perpetual construction of an artificial landscape based on the reconstruction of the natural landscape by humans for reasons of living and human factors such as politics, economy, history, culture, development.

The urban space comprises the natural landscape (natural elements) and artificial landscape (artificial elements). Natural elements are shaped from the natural and geographical environment and include weather, climate, landforms, water, and plants. Artificial elements refer to both urban spaces and urban objects. Urban spaces include squares, parks, streets, and urban objects, which implies architecture, urban facilities, and street furniture. All the above elements are known as tangible elements of the urban landscape (Wei & Sung, 2005). The natural elements are usually reconstructed, reformed, or rearranged in the process of urban landscape creation. So both the natural landscape and artificial landscape have artificial properties, as part of the city, where people live, serves citizens’ daily lives. The natural elements always give and direct the characteristics of a city (Hung, 1999). The natural landscape and artificial landscape, or say, natural elements and artificial elements, are interlocked and integrated to form the urban landscape (Wan, 2007), supply the essential condition to public activities.

All urban landscape elements are arranged by certain principles and compose the whole urban frame (Wan, 2007). In this paper, the urban landscape plan is the research background, which includes (a) urban configuration – the urban spatial structure, (b) urban form – the shape, internal property, (c) urban axis – the means of the spatial arrangement of a series of spaces or a single open public space, and (d) urban volume – the scale of the city, includes the scale of the plane and architecture (modified from Wei & Sung, 2005).

The past urban landscape plan was paid more attention to urban spaces’ graphical order and visual aesthetic. Entering into the 21st century, however, our life scale continued extending in physical scale day by day; our city life was gradually and progressively decaying on a psychological scale. Therefore, the aim of the urban landscape plan has transformed more people-oriented to make the planned suite for residents’ public activities even inspire citizens to spend more time in urban public space to involve in city

life to improve the connection among different individuals in the sense of belonging to the city. However, unfortunately, that induces the city plan to be less connected with honest people-oriented thoughts. As a result, the research on urban landscape plans cannot be departed from a human. The human factors are the intangible elements of the urban landscape, the connotation or meaning of urban landscape, and the connotation or meaning of urban landscape and a city (Rowe & Kotter, 1978; Wei & Sung, 2005, Xu, 2005).

Tangible and intangible elements are closely linked. They are equally important in the urban landscape such that either one cannot be absent. Tangible elements carry the intangible elements, and intangible elements are expressed and presented by the tangible elements. On the other hand, intangible elements are the tangible elements' connotations, and people can recognize and understand the intangible elements through the tangible elements (Wei & Sung, 2005). For example, people use a step to measure the city and describe their urban life. The natural correlate of the spatial configuration is movement (Hiller, 1996). The urban landscape is designed for people using it. So, all the elements in the whole urban frame will be listed and summarized from the user's perspective.

According to Lynch's statement in his book *City Image* (1960), the three levels' recognition and sense of people toward the environment can be explored. The first level is identity. "A workable image requires first the identification of an object, which implies its distinction from other things, its recognition as a separable entity" (Lynch, 1960, p.8). Identity, in this way, can be understood as the style and appearance of the environment and objects with specific features. They refer to positions, forms, scales, colors, proportions of urban objects. Different objects contain different styles and appearances distinguished from one another (see Figure 4-2). The second level is structure. "The image must include the spatial or pattern relation of the object to the observer and other objects" (Lynch, 1960, p.8). Besides different styles and appearances, objects can be recognized by their spatial structure and relation with other objects and observers. The third level is meaning. "The object must have some meaning for the observer, whether practical or emotional" (Lynch, 1960, p. 8). That is the connotation of the environment and objects behind the appearance. Meaning is the sum of intangible elements: history, culture, human behavior, politics, and economy. Based on which the environment and objects are created. There is also spiritual sympathy, cognition, and experience of humans (see Figure 4-3).



Fig. 4-2 Different patterns in fountains in different places in Italy to present the city symbols

4.2.2 Classification

Different classifications of the urban landscape can be researched from three levels: the urban macro-environment, the urban moderate-environment, and the urban micro-environment. The urban macro-environment considers the urban environment as a whole,

including the architectural groupings, road systems, green systems, and water systems. The urban moderate-environment focuses on partial zoning. For example, when the research objects concentrate on only one block, which surrounding environment – the ambient urban spaces should be considered as a study background. Finally, the urban micro-environment refers to the comparatively small-scale environments in different zones in a city, such as squares, green spaces, streets, and water spaces. In other words, the moderate-environment plays a role in linking macro-environment and micro-environment.

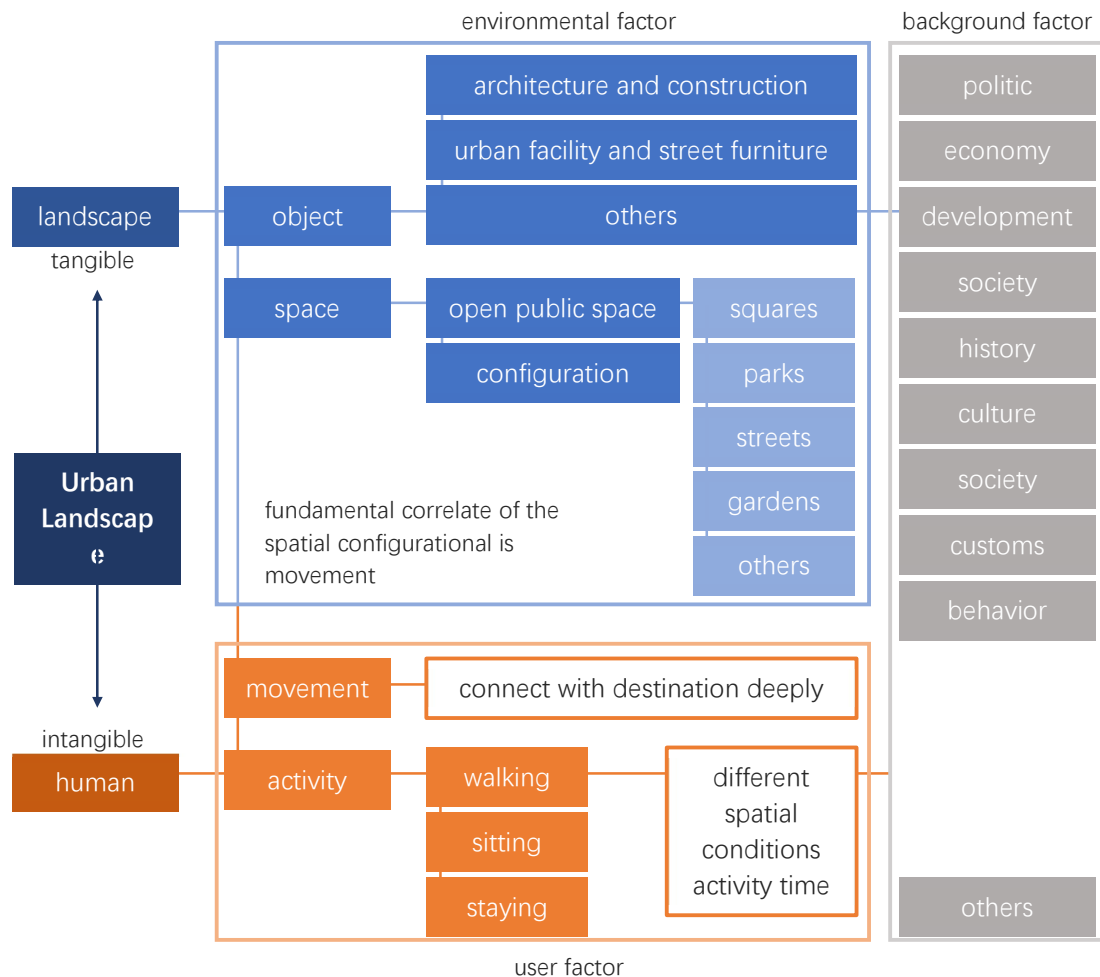


Fig. 4-3 Structure of the urban landscape (modified from Wan, 2007)

There are many methods of classifying the urban landscape beside the above one depending on an urban scale. According to that, a city is an integrated system of nature, economic, social, and cultural; Wei and Sung (2005) also provide three perspectives of classifying the urban landscape: the natural system – plants, grasses, hills, rivers; the economic system - factories, shops; the social system – residential, political office construction, hospitals; the cultural system – historical architecture, libraries, exhibition halls. Lastly, the urban landscape can be classified by function. As an urban facility, street furniture is to supply convenience to citizens daily, matching different environments. The street furniture is located in different types of urban landscapes, and its functions are accordingly elaborate. However, numerous studies to precisely identify and classify different urban landscapes have been conducted in which street furniture is also studied and classified with the classified urban landscape. This paper aims to discuss the placement of new street furniture, not the function or appearance design. So the study

flow will follow with the classification methods on urban scales.

4.2.3 Nature and characteristic

The urbanscape is unity and integrates all environmental, human, tangible, and intangible urban elements, which do not exist individually but are interlocked to form an urban landscape. Every element, including those in small scale or inconspicuous in the urban landscape, is equally significant and cannot be neglected (Hong, 2002; Xiong, 1999; Zhang & Yang, 2000). From the generalized perspective, the urban landscape, including not only still landscape objects but also dynamic human movement, is changing all the time with the residential usage. For this reason, the nature and characteristics of the urban landscape contain two parts: environment and human. Wei and Sung (2005) stated that “the architecture and urban spaces are ‘flowers’, whereas the pavement and street furniture are ‘leaves’. Flowers are important, but without leaves to set off, it is hard to achieve a pleasing result” (p. 4). However, it does not make sense that the beautiful landscape is born to blush unseen.

The urban landscape is complicated (Xu, 2006). Besides abundant landscape elements, the urban landscape is an academic word combined with different professions: urban design, urban planning, architecture, landscape architecture, engineering. Therefore, it illustrates that the urban landscape problem could be solved from many diverse perspectives from another view. Meanwhile, the urban landscape can also be classified into various types by its scale, function, nature, and characteristic. Consequently, the judgment for the urban landscape problem is also complicated. Therefore, it is impossible to form a simple, binary conclusion to the discussion on the urban landscape.

The urbanscape is an endless accumulation and process of creation (Kurokawa, 1991, 2004; Norberg-Schulz; 1971; 1980; Rowe & Koetter, 1978 Saarinen, 1943). Different histories, cultures, needs, trends, and so on in different periods add different characteristics to a city and its urban landscape (Wan, 2007). Thus, the urban landscape is formed and accumulated from the characteristics of different periods, which including various intangible factors: politics, society, history, culture, customs, behavior patterns. At the same time, different seasons, weathers and climates, and other natural phenomena, which could influence human behavioral patterns, forming unique usage traces in the city, furnish the urban landscape with different appearances. Thus, the historical urban fragment will be integrated into new landscape design and maintain past features and characteristics.

The urbanscape is diversified. Diversity is natural to big cities (Jacobs, 1961: p.143). More than 70% world’s population lives in the city. According to jobs, ages, cultures, customs, and aesthetics, plenty of human requirements and activities call for diverse usage and appearance for the urban landscape. The diversification of human beings results in diversifying the urban landscape (Hong, 2002, p. 118). That also contributes to the complexity of the urban landscape. In the research on the urban landscape, the diversification of users and the built environment cannot be ignored. On the other hand, the number of variables should be limited in a particular range as far as possible.

The urbanscape is not only the clear image of physical objects. All the visible is the manifestation of the invisible (Lévi, 1841). Such as the urban landscape represents the city image and plays the carrier of history, culture, economic, aesthetics. It contains deep-seated connotations and meanings, lying in the graphical relationship and colorful patterns, which in regions make cities of differing characteristics (Kurokawa, 1991, 2004; Norberg-Schulz; 1971; 1980; Rowe & Koetter, 1978 Saarinen, 1943).

4.2.4 Creation

The urban landscape is multi-science, multi-perspective, and compositive (Hong, 2002; Wei & Sung, 2005). It is an integrated work by different professions, sciences, theories, and principles and is synthetically formed through urban planning, urban design, architecture, landscape architecture, environmental design, engineering. All subjects function and cooperate consistently. It is impossible to depart any subject from the compositive combination, in which contents and principles of different professions and subjects related to the urban landscape are always overlapped and shared. At the same time, the research scope of the urban landscape is much broader, including an approachable scale than some other professions. Xiong (1999) pointed out that urban landscape design, regardless of what professions, subjects, or sciences are involved, aims to provide a desirable living environment to people; that is, it is people-oriented. One of the most critical issues of the urban landscape is creating a more comfortable living environment for people's daily lives from both physical and psychological layers.

There are significant differences in the nature and responsibility of different professions in urban landscape creation, under the central premise, which includes geographic location and zoning, natural climate and environment, resources and foreground, nature and land use planning, population structure and prediction, historical background, traditions and characteristics of a city, civil facilities system, environmental preservation and green belt system, historical and cultural preservation, land use and functional distribution, spatial structure, and residential environment. (Wan, 2007).

The core issue in this paper is concluded in urban landscape meanwhile close related to urban planning, which is a complicated task and always cross disciplines with other professions, such as marketing, management, economics, with the main reason that it usually focuses on functional, technological, and economic aspects. Though urban design always focuses on the spatial pattern, investigates the spatial structure and environmental features to reflect and complete the characteristics of a city, the principles of urban design should follow the urban planning rules to keep the unity of a city. Urban planning and urban design do not proceed separately, whereas urban design belongs to urban planning. Urban design is part of urban planning, and at the same time, it is relatively isolated in terms of its research process and areas of investigation (Xiong, 1999).

The difference between urban planning and urban design should be taken full advantage of; urban planning starts from complex and objective factors, which are the natural environment, land use, transportation, to achieve continuous growth and development of a city. In contrast, urban design starts from soft and subjective factors, physical, psychological, and behavioral aspects of human beings, to arrange a comfortable and meaningful environment of a city.

The research refers to the procedure of the creation of urban landscape: (a) start from the city master plan; (b) distribute zones for different use and functions by urban planning and urban structure; (c) focus on some zone to organize and arrange the local spatial structure and visible features of a city by urban design; (d) eventually create urban landscape through architectural design (i.e., functions, forms, construction) and environmental design (i.e., squares, parks, streets) under guidelines regarding the needs from both zoning function (i.e., factory zones, residential community, central business district) and people-oriented (i.e., leisure during work, daily social life, business talk.). The purpose is to provide the urban landscape with urban planning and respect the individual buildings and spaces to reflect the local people's behavioral pattern and make the urban a unity. As an urban facility, the street furniture should be sited in the whole urban context to satisfy the behavior rules from the three different layers (see Figure 4-4).

4.3 Urban landscape: review of the development of design theories

The complexity of the urban landscape is in its role today as a composite subject of multi-sciences and multi-perspectives and its dynamical research view according to the users' changing movement in it. People are in motion in the city, interacting with their surroundings all the time. The city builds our life, and we build our city. Both the landscape objects and human behavior patterns compose the integrated physical and social urban landscape.

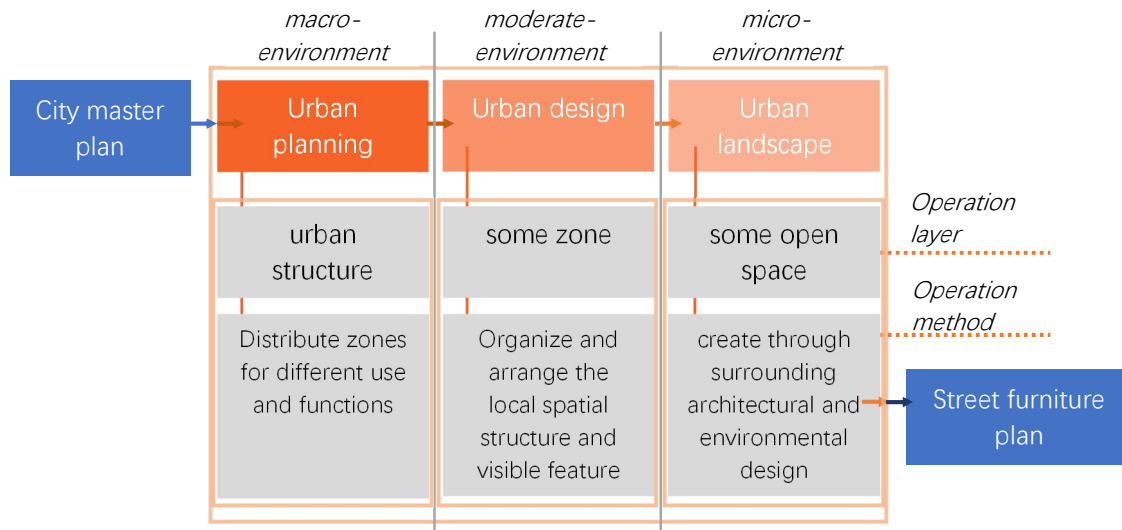


Fig. 4-4 The procedure of the creation of urban landscape

An urbanscape must form a unity; different professions in urbanscape creation are closely related to create a desirable and comfortable urbanscape to fulfill human needs (Wan, 2007).

The urban landscape is widely recognized as a complex phenomenon, rich in uncertainty. It is the unpredictable consequence of the complex interplay involving urban forces (both top-down or bottom-up), urban resources (spatial, social, economic, and infrastructural, as well as political or cognitive), and transformation opportunities (endogenous or exogenous; Concilio & Rizzo, 2016).

Various theories/concepts/principles of urban design were suggested and developed in different periods. The history of research on the urban landscape is a series of studies for interaction between people and their environment. It is common for residents to self-organize in urban spaces with the existing urban landscape. Therefore, most of the theories/concepts/principles of urban design exposed human awareness, needs, and attitude to the environment behind the graphical relationship or color aesthetic. In order to obtain more profound knowledge of the urban landscape and apply them in street furniture plans, this section conducts a review and investigation of the development of urban landscape design theories. According to the historical background, the development can be divided into the five main periods:

- Before the 20th century: the period before the industrial revolution, when the cities were small in scale with slow developmental progress.
- The 20th century 1900s – 1940s: the period under the significant influence of the industrial revolution, when cities were developing and extending expeditiously.
- The 20th century 1950s – 1970s: the period right after World War II, when urban design theories and methods of that time were evaluated from a humanistic approach.
- The 20th century 1980s – 1990s: the period that drew severe destruction of the natural

- environment, when eco-awareness became an issue in urban landscape design.
- The 21st century onwards (today and the coming future): a new era of information and technology, urban landscape design faces unprecedented challenges. It requires broad principles by integrating different urban design theories to deal with the complicated problems that have resulted from urbanization, globalization, destruction of the natural environment.

4.3.1 Before the 20th century

Before the industrial revolution, cities were comparably small in scale with simple functions and a slow development process (Xu, 2007; Zhang & Yang, 2000). Cities of this period were usually designed by architects who acted as both urban planners and artists with an architectural slant. The urban design worked with the idea of “physical determinism” with the principle of “visual order” (Liang & Xiao, 2000). From the ancient period of Greece and Rome to the Middle Ages, religion, politics, and the economy took predominant roles in city design. The church, city hall, and plaza represented the three leading powers and were located in the city center (Wei & Sung, 2005).

The industrial revolution since the 1900s brought significant influence to urban design; in *The Art of Building Cities*, Sitte (1889/1945) figured out the various limitations of capitalist cities. With the aims of functional zoning and efficient development, the design of cities tended to be monotonous and exceedingly regular. Urban space was not effectively utilized; spatial structure lacked a particular order. By investigating cities of the Middle Ages, Sitte restored a humanistic approach and concluded that urban design is not purely technical but also aesthetic. His principle emphasized “visual orders” between architecture, plazas, and streets and that architects should create compatibility between planning and architecture.

4.3.2 The 20th century 1900s-1940s

The industrial revolution began in the late 19th century in Europe. “Industrial Revolution is a turning point of the world city history” (Wei & Sung, 2005, p. 24). The new technology and mechanization of industrialization induced significant productivity increases and expedited transportation development. Considerable numbers of people crowded into cities for employment opportunities provided by different industries with an efficient transportation system. In addition to the rapid and intense construction of commercial buildings, factories, residential blocks, transportation facilities (e.g., harbors, train stations, and roads), and urban facilities, cities changed and expanded significantly. The rapid growth of cities without mature planning caused various urban problems. For example, overcrowded population and transportation, significant poverty, shortage of residential housing, problems of shantytowns, high crime rates, and severe pollution all resulted in social turbulence, arguments, and reformation. The urban design developed different theories to improve the cities.

New City and Suburbanization

To solve the urban problem, some tired of dealing with them by the humanistic approach. The idea of the “garden city” raised by Howard is a representative example (Howard, 1904/2000). The garden city is a new city located away from the original city, built to disperse the concentrated population and solve different problems found in big cities. The garden city integrates city and rural areas, with rural areas occupying most of the city. It aims to provide a desirable living environment that integrates humans and nature. In addition, the garden city implies fair ownership of the land; land investments are prohibited so that people can enjoy a stable land price. The garden city provides different

functions (i.e., political, recreational, residential, industrial, and commercial) and urban facilities with detailed planning, space structure, and arrangement principles. Howard's idea was turned into practice by establishing the first garden city, Letchworth, near London, in 1906. The garden city has dramatically influenced urban development and contributed to new urban movements like the new town or the satellite city, especially after World War II.

Wright brought up the "broad-acre city" in 1932 (Wang, 2001; Xu, 2007). He claimed that cities would be everywhere that dispersed cities-broad-acre city was the tendency. Similar to the garden city, the broad-acre city also integrates city and rural areas. The principal idea of Wright's concept is that inside a broad-acre city, each family has its land, house, and garden. People can access different places conveniently through the complex highway system connecting each family and urban facilities with their vehicles. Wright's idea provided a foundation for a desirable living place in the rural-urban fringes and advanced the suburbanization of the middle class for America and Europe.

Functionalism

For the rapid urbanization caused by industrialization and capitalism, some individuals suggested designing and planning the city by functional, rational, and technical approaches, that is, functionalism. Functionalism, or modernism in urban design, emphasizes the city's economic, social, and cultural aspects and its complex function. The city is seen as a big, rapidly running machine in which different parts operate according to certain principles (Hong, 2002). Functional efficiency, economic growth, and the application of new technology are the focus. Implementation of functionalism achieves efficiency through functional zoning and transportation systems; solves the urban problems like overcrowding and undesirable environments by high rise blocks and vast urban spaces and greenbelts; and upholds the industrial and technological vitality in modern city design (Wang, 2001; Wei & Sung, 2005).

The *Athens Charter* by *Congres International d' Architecture Moderne* (CIAM) (International Congress for Modern Architecture) developed in 1933 represents functionalism (Le Corbusier, 1943/1973). Concentrating on the main idea of the "functional city", the document categorized four main city functions: living, working, recreation, and circulation. After analyzing the problems of each function, it further suggested outlines for modern urban design and planning. Functional zoning and a classified transportation system were the main ideas. The *Athens Charter* also investigated how historic districts and buildings were preserved.

Le Corbusier elaborated on his idea of functional urban design through the model of the "contemporary city for three million inhabitants" (1922/1971) and the "radiant city" (1933/1967). Le Corbusier argued that including Paris, which had been developed since its early years, was unable to coordinate with the economic growth and deal with the urban problems of the modern society. He emphasized functional distribution, the significance of urban space and greenbelt, and suggested that intensive urban renewal should be carried out with the following fundamental principles: (a) City should be planned with functional zoning like the industrial zone, residential zone, political zone, commercial zone; (b) Buildings in the city center should be vertically developed as high rise blocks can achieve lower density among buildings in order to provide sufficient urban space for parks, playgrounds, and greenbelts; (c) Traffic roads should be classified systematically according to function and speed to satisfy different needs and realize efficient transportation; (d) The linear and geometric pattern of urban planning is the means to reflect modern industrial vitality.

It is noteworthy that the idea of functionalism requires large-scale destruction and

reconstruction of a city. Therefore, urban renewal during the 1940s and 1950s and new city agendas provide favorable factors for implementing functionalism. In addition, the aims (i.e., functional efficiency, economic growth, and application of new technology) of functionalism merge with that of modern city development. As a result, functionalism was widely accepted and applied in urban design and planning. Chandigarh in India and Brasilia in Brazil are representative examples of new city development of independent functionalist cities after World War II.

Arturo Soria Mata, another functionalist urban planner, had already raised the idea of the “linear city” in its earlier stage in 1882. Transportation is the core idea that the linear city is constructed based on a complex main transportation path. Different zones and facilities of various uses are placed along the path with rural areas and greenbelts. The highlight of such a plan is that the city can expand the transportation path to become a continuous city (Wang, 2001; Xu, 2007). Tony Garnier suggested an “industrial city” in 1918, in which different types of industries are grouped with transportation systems connected with residential areas to form a city (Wiebenson, 1969).

Organic Order

According to the problems of cities and inspired by Howard’s concept of the garden city, Saarinen (1943) advocated the concept of “organic order”. In his theory, the city is an organism with cells (i.e., different city parts). Different cell characteristics – the expression of different cells as coordinate with one another – form an organic entirety. “The principles of expression and correlation are not independently functioning principles, but rather a daughter – principles of that all – governing mother – principles of ‘organic order’” (Saarinen, 1943, p. 15). Different cells in an organism operate by following the “organic order”. The destruction and mistake of any parts (cells) of the city will destroy the city as a whole or its organic unity. Organic decentralization, for the problems of poorly planned (inorganic) and uncontrolled megalopolises, is not just to set up a new city with the same functions as the urban center, but so selectively decentralize and relocate certain kinds of functions according to the characteristics and problems of the city regarding its organic unity. For example, heavy and light industry and work should be decentralized to the new city and self-contained; administrative and political departments should remain in the city center with their employee population; more green spaces should be introduced with the space left by decentralization. In this manner, urban problems in the center could be solved. Both the living environment of people inside and outside the city center can be improved. Saarinen also emphasized that city design should be able to reflect the nature and meaning of a city. Saarinen’s concept of organic decentralization greatly influenced urban design strategies after World War II.

4.3.3 The 20th century 1950s-1970s

Functionalism, focusing on function and a mechanism for a city redevelopment and renewal, remained the mainstream of urban design after World War II. However, many have argued that functionalism oversimplified both the urban landscape and society. The city is not a machine but rather is more complicated and diversified. Diversification, original structures, and city characteristics were not considered by functionalism; history, culture, customs, psychology, human behavior, and the relationship between humans and the environment were also neglected. “The urban exploration and development in large scale greatly destroy the historical environment, living order, linkage and coordination of different elements in a city” (Hong, 2002, p. 110). Since the 1950s, different theories have developed regarding urban design. They were no longer just focused on the function, technology, and efficiency of a city but examined from various sciences and perspectives

– society, culture, psychology, behavior, ecology – city life. Urban design concepts from this period are known as postmodernism.

Postmodernism started with the disbandment of the CIAM and the establishment of Team 10 in the 1950s. Team 10 revolted against CIAM philosophies and the large-scale destruction and construction by functionalism. They restated that a desirable urban environment involves the unity of the entire landscape with variations in its parts. Team 10 emphasized the importance and investigation of the physical environment. Team 10's members have raised various urban design models, for example, the concepts of stem and web, streets in the sky, and cluster cities (Field, 2001; Liang & Xiao, 2000; Xiong, 1999; Wang, 2001; Vollaard & Heuvel, n.d.; Xu, 2007). In sum, Team 10 advocated the following main urban design concepts:

- Urban design is a continuous and dynamic decision process, and it emphasizes the continuity and linkage of the past, present, and future.
- Sense of place consists of place (space) and occasion (time), essential in urban design for people to experience and obtain meanings in different places.
- Urban Design emphasizes cultural diversity.

Environmental image

Lynch (1960) explored urban design through psychology and raised the “environmental image” concept in his book *The Image of the City*. Through investigation in three American cities – Boston, Jersey City, and Los Angeles, Lynch examined the city image held by its citizens, that is, how people understood and recognized a city through their feelings, experiences, and memories.

According to Lynch, identity, structure, and meaning are the three components of an environmental image. Moreover, a good mental image of an environment contains a high degree of “apparent clarity”, “legibility”, or “visibility,” by which it is easily identified and is easily grouped into an overall pattern. It is defined as “imageability” –

That quality in a physical object gives it a high probability of evoking a strong image in any given observer. It is that shape, color, or arrangement that facilitates the making of vividly identified, powerfully structure, instrumental mental images of the environment (Lynch, 1960, p. 9).

For deeper investigation, the public image refers to the mental image of a city which is not only carried by an individual, but also “by large numbers of city's inhabitants: areas of agreement which might be expected to appear in the interaction of a single physical reality, a common culture, and a basic physiological nature” (p. 7). It implies that an environment or object should contain degrees of imageability to become a public image.

After analysis, Lynch identified five main elements which compose the city image held by citizens. They are (a) Paths – channels: streets, walkways, transit lines, canals, railroads; (b) Edges – linear elements: shores, railroad cuts, edges of the development, walls; (c) Districts – medium-to-large sections of the city. (d) Nodes – points junctions, places of a break in transportation, a crossing or convergence of path, moments of shift from one structure to another; and (e) Landmarks – another type of point reference: building sign, store, or mountain primarily. A landmark is an object and a definite visual focus.

Lynch's study suggested that urban design should have an agreeable arrangement and coordination of the five image elements to compose a solid environmental image to enhance people's sense of security, sense of belonging, and sense of recognition toward a place and create a humanistic living environment. Lynch also identified that history and culture exert comparatively prominent effects in forming a city's image in its inhabitants' minds; regarding this, the preservation of historical information is essential to urban

design. In addition, the city image is judged by the observer's psychological factors (i.e., subjective factor), and the public image of the environment can be utilized in an urban rebuild.

Vitality and diversity

In *The death and life of great American cities* (1961), Jacobs examined urban design from social science. She suggested via a people-oriented urban design that diversity is the nature of cities. Human beings and their lifestyles and activities are diverse. For this reason, the city should be diversified to fulfill human living and needs. "The diversity, of what kind, that is generated by cities rest on the fact that in cities so many people are so close together, and among them contain many different tastes, skills, needs, supplies, and bees in their bonnets" (p. 147). Jacobs opposed the functional urban design, which oversimplified a city without considering its many details. Furthermore, public participation and opinion were both ignored. As a result, cities existed without characteristic vitality, flexibility, and imagination and finally gave rise to different urban problems.

Jacobs suggested the mixed-use of space with sufficient complexity. Based on enormous diversity and the concentration of residents, mixed-use can sustain city safety, public contact, and cross-use. She highly emphasized the importance of the street, the sidewalk – the pedestrian parts of the street that should be diverse and energetic. Besides carrying vehicles and pedestrians, streets serve the primary purposes – safety, contact, and assimilation of children. She suggested that the street, for example, should be small-scale designed according to human-scale and connected with different blocks, ages of buildings, dwellings, and shops to facilitate people contact and activities at different times to ensure safety and create energetic living environments with casual atmospheres.

Like many of its internal parts as possible, the district must serve more than one primary function, preferably more than two. These must ensure people who go outdoors on different schedules and are in the place for different purposes but can use many facilities in common (Jacobs, 1961, p. 150).

She further claimed that "a lively city scene is lively largely by its enormous collection of small elements" (p. 148) and "most blocks must be short; that is, streets and opportunities to turn corners must be frequent" (p. 150).

Space and order

After researching different famous cities in the world, in *Design of Cities* (1974), Bacon concluded that the space and pattern of the city are formed through public participation across daily lives. The activities of each citizen every day contribute to the aesthetics of the city. The responsibility of urban design is to understand the citizens' activities, movements, and experiences and integrate them into urban design. Bacon presented his "simultaneous movement systems". The city/environment/ space experiences of inhabitants are based on their movement and activities in the city. "Movement through space creates a continuity of experiences derived from the nature and form of the space through which the movement occurs" (p. 34).

Nevertheless, the ways of movement are varied depending on identities, movement speed, vision, and the surrounding environment of different people. Every individual has his/her path and experience toward a city. Bacon believed that:

If one can establish a track through space which becomes the actual path of movement of large numbers of people, or participators, and can design the area adjacent to it to produce a continuous flow of harmonic experience as one moves over that track in space, successful designs in cities will be created (p. 34).

In *Urban Space* (1975/1979), Krier analyzed the urban space, including squares and

streets, by topology. He divided the topology of urban space into three main groups: square, circle, and triangle. Based on the three basic topologies, the different urban spaces in a city are reformed and changed by methods like angled, divided, added to, superimposed. Krier's systematic study on the topology of urban space provided a significant reference for designing urban space to satisfy different human needs.

Place and context

Rowe and Koetter (1978) suggested the idea of the "collage city". It suggested that the formation of a city, like a collage, is the accumulation of development and elements from different times. According to this, collage is one method of urban design and can be applied to present the history of a city. Urban designers, familiar with the history, tradition, and development of a place, should be able to select the historical body, parts, and elements that are representative of a place; and subsequently develop, change, or reorganize them with modern elements according to the current needs and standards. In this way, the "collage city" can inherit historical heritage and its characteristics, and at the same time, fulfill the needs of development. The collage city is a demonstration of the concept of "Contextualism", also raised by Rowe. Urban design operates according to the city's contexts, which include a tangible and intangible form. The tangible form includes humans and their activities, where human activities occur, objects, spatial elements like buildings, statues, and street lamps. The intangible form refers to politics, economics, history, culture, custom, behavior, which greatly influence a city's form and development.

Norberg-Schulz had developed the concept of "place" in his studies in 1963, 1971, and 1975 and drew up the term *genius loci* (spirit of place) in 1980 (Norberg-Schulz, 1971, 1980). "Place" is a concrete term for the environment, consisting of natural and artificial elements with meanings behind it. A series of "places" compose a town and a city. In Norberg-Schulz's study, a place comprises "structure" and "spirit". The structure of a place includes "space", and "character" refers to the "atmosphere," and "concrete form," and "substance of the space-defining elements". "Spirit" consists of the place related to the human activities in the place, psychology, history, culture, and geographic factors. The meaning of the place assists people in knowing and understanding the structure and character of a place and hence originates the sense of belonging, sense of recognition, and sense of security. Norberg-Schulz believed that "architecture means to visualize the *genius loci* (spirit of place), and the task of the architect is to create a meaningful place" (p. 5).

The place spirit determines the local structure and character, while the structure and character of a place contain and express the spirit of the place. Norberg-Schulz pointed out that history, culture, and tradition are closely linked to the spirit of the place. In other words, the spirit of the place is formed through historical development. New historical factors may give rise to changes in the structure of the place, but not to the loss of the spirit. Change of spirit is comparably slower than that of structure, and the balance between spirit and structure is an essential issue for urban design. It implies that respect and protection of the spirit of a place are needed. However, it does not mean that everything should remain unchanged or directly duplicated from the old pattern and form. On the contrary, it is necessary to understand the meaning, the spirit of the place and integrate this into modern living by figuring out the relationship between new and old, and finally expressing and presenting them by new methods.

Rowe's and Norberg-Schulz's concepts similarly claim that there are meanings behind an environment and a city. Both suggested preserving meaning given by the human/intangible factors like history, tradition, culture, human behavior, and activities. They also advocated the integration of the new and the old. Context and place are twin

concepts. “Space is physically defined with certain forms. It contains context and becomes a place once it is related to society, history, culture, human activity, and geographical factors” (Wang, 2001, p. 94).

In 1960, Japanese architects (Metabolism Group) raised the concept of “metabolism” for urban design (Metabolism Group), including Kisho Kurokawa, Fumihiko Maki, and Kiyonori Kikutake. Kurokawa subsequently raised the concept of “symbiosis” and developed and examined this for over 40 years until today through his urban design and architectural activities (Kurokawa, 2003/2004; Schmal, Flagge & Visscher, 2005). “Metabolism” and “symbiosis” oppose functionalism and western culture as the sole standard, ideal, and goal by advocating pluralism and diversification of culture. “Metabolism” and “symbiosis” are themes taken from biological and ecological concepts. The Japanese architects claimed that the city acts like an organism and is not static but metabolic. City development is continuously proceeding. During development, new elements are formed and oppose the old elements. It eventually gives the city a new situation. Importantly, metabolism does not mean that the new destroys the old but cooperates with it. Metabolism is a process in which different elements (e.g., culture, value, and objects) of the past, present, and future exist concurrently, meaning they exist in “symbiosis” with one another.

When the position or standards of cultural value are in disagreement, one side does not need to defeat the other or force his value on his opponent. Instead, they can search for common ground, even while remaining in mutual opposition (Kurokawa, 1991, p. 10).

“Symbiosis” is “philosophy” of “both-and” rather than “either-or, a practice of mix and match rather than creation from scratch, an either of inclusion rather than exclusion” (Kurokawa, 1991, p. 6). Kurokawa argued that the symbiosis of advanced technology and regional culture is essential. New technology should be applied according to and coordinating with the regional culture, tradition, customs, climate. In other words, to present the regional culture through applying new technology to guarantee the diversification of culture and legibility of different regions. It implies the traditional culture and reality; past and present; the historical heritages and new constructions.

Kurokawa’s concept of symbiosis is widely contained. “We can apply this (symbiosis) to all aspects of our life, i.e., equally to questions in international politics and multilateral trade relations and current problems of architecture” (Schmal et al., 2005, p. 7). Urban design refers to the symbiosis of nature and human beings; rural and city; different cultures; globalization and regionalization/localization; entirety and parts of the city; Kurokawa (2003/2004) argued that the city is a complicated and open system by which many micro cities – different parts of a city – are integrated as different organisms. Every micro-city has its characteristics and emerges in symbiosis, and forms a city with the diversification of value. He claimed that it is more practical and exciting to use different approaches to create different micro cities for different regional characteristics. The symbiosis of cultures, traditions, and localization tend to be intangible. Hence, urban design, including architecture, urban spaces, and street furniture, is the physical expression of the metabolic process and its symbiosis.

4.3.4 The 20th century 1980s-1990s

Ecological urban design and sustainable development

Since the industrial revolution, the destruction of the natural environment due to the rapid development of human society, urbanization, and industrialization became more and more serious. It gave rise to serial problems such as degeneration of the ecological system, different kinds of pollution, storage of natural resources. The ruin and changes to the natural environment directly harmed human society, the economy, and even the survival

of human beings (Dong & Wang, 1999).

Human activities not only have greatly influenced our natural environment; it has also affected our health and would eventually hinder our economic growth potential in the future. Therefore, if no solution is introduced and we continue with our behavior, there will be grave consequences for our environment, society, and economy (Ng & Chan, 2005, p. 11).

New ethics have emerged regarding urban design and development. The concept of the ecological city and sustainable development has become popular since the 1980s.

The idea of the ecological city occurred in early periods, for example, the Chinese traditional human living environment which encompassing humans and nature (Xiong, 1999; Wei & Sung, 2005); Howard's 1904 shining city (Howard, 1904/2000), Wright's 1932 Broad-acre city (Hong, 2002; Wei & Sung, 2005), and Kurokawa's 1960 philosophy of symbiosis (Kurokawa, 1991, 2003/2004; Schmal et al., 2005). Since 1960, Kurokawa has been advocating a paradigm shift from "the Age of Machine Principle" to "the Age of Life Principle" (Kurokawa, 1991, 2003/2004).

The ecological city is a city designed according to principles of ecology. It emphasizes ecological balance and ecological cycle, which refer to diversification and stability of the ecological system. Urban development should co-exist with the natural environment (Hong, 2003; Wang, 2001; Wei & Sung, 2005). In other words, nature and humans should exist in symbiosis (Kurokawa, 2003/2004). McHarg (1969) emphasized human cooperation and the biological partnership between human beings and nature. He further claimed that "not to impose design arbitrarily, but to use to the fullest the potentialities – and with them, necessarily, the restrictive conditions – that nature offers" (p. vii).

The World Commission on the Environment and Development (WCED) popularized the concept of "sustainable development", defined as "the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs" (Smith, 2005, p. 76). Hurrell and Kingsbury, in 1992, claimed that "sustainable development sought to combine environment and development in such a way that the interdependence of the economy and environment was recognized and allow for both environmental protection and economic growth" (cited in Smith, 2005, p. 79). "When sustainable development is applied to a city, the city can be seen as consisting of three main sectors: the environment, society, and economy. Each sector has different forms of capital or pools of resources" (Ng & Chan, 2005). Liang and Xiao (2000) stated that the ecological environment should be considered equally with economic and social development in which the urban environment should achieve a harmony of the natural and human environment.

The environment consists of our natural surroundings and the embedded resources, and they are fixed and limited in quantitative terms. Within the environment, society exists that is concerned with the population's well-being and includes the economy. The embedded society and economy may expand and grow due to various reasons, such as technological advancement and innovation, but our environment is fixed. As the former two elements are dependent on the latter, it implies that the natural environment, to have a healthy society and economy, must be kept in good shape to survive (Ng & Chan, 2005, p. 17).

Knowledge of ecology is essential for urban designers to create an "ecological city" for sustainable development in which humans, society, and the economic n natural environment can reasonably survive (Liang & Xiao, 2000).

New urbanism

New urbanism was the urban design movement in America that developed in the 1990s.

It was the concept of combining several urban design theories of postmodernism to solve new urban problems and satisfy new urban needs. The experience of suburbanization for a half-century saw numbers of affluent and educated people eager to come back to the cities for modern and civilized lives. At the same time, they wanted to enjoy the traditional village life and nature; this cultivated the idea of new urbanism (Hong, 2002).

New urbanism encompassed postmodernism, which focuses on humanism, localism, and ecological and sustainable development. Traditional Neighborhood Development (TND) by Andres Duany and Elizabeth Plater Zyberk (DPZ) and their Seaside Cities, as well as Transit-Oriented Development (TOD) by Peter Calthorpe, are the representative examples of new urbanism (Hong, 2002; Xiong, 1999). They aim to create a humane, delightful, and comfortable living environment through which the design tends to be human-scaled, traditional, diversified, and natural. There are mixed-use of land for residence, office, retail store, and open space in cities of new urbanism. Different buildings are arranged for high density. Historical heritage, even if it is small in scale, is preserved and redeveloped. New urbanism attaches importance to “walkable”, with complex, pedestrian paths connecting open spaces and urban facilities to encourage people’s contact and neighborhood relationships. Large-scale greenbelts and extensive plantings integrate human beings and nature. Today, new urbanism has become one tendency of contemporary urban design, especially in America.

4.3.5 The 21st century onwards (today and the future)

The 21st century is known as the new era of information. The continuously and rapidly developing technology, transportation system, and internet are increasing and enhancing the contact among people throughout the world. They also accelerate urbanization with the increasing number and scale of cities. Capitalism aggravates the effect of globalization and eliminates many cultural characteristics. The world tends to become a “global city” with no regional differences. On the other hand, the destruction of the natural environment has not been solved but has turned more serious. Such influences have become much more apparent and directly affect humans’ survival (Wang, 2001; Wei & Sung, 2005; Xiong, 1999, Xu, 2006).

Urban design, or urban landscape design, faces significant challenges and increasing requirements in this new age. Different urban design theories, especially those using humanistic approaches, are valuable and extensively advocated regarding current urban problems. Urban landscape design continues to be investigated and developed according to the changing world.

4.3.6 Summary

“Traditional urban design focuses on macro view and the entirety; the modern urban design focuses on micro view and the specifics” (Hong, 2002, p. 175). After a long development period, current urban landscape design is a composite investigation of varied subjects and areas, including social science, politics, economics, psychology, praxeology, ecology, geography—planning, landscape design, architecture. There are advantages and disadvantages to different urban landscape design concepts, and this is why urban landscape design continues to develop through cooperation with different parties.

This section has reviewed the development of urban design theories, contributing to investigating the main concepts of urban landscape design and street furniture design today. The review did not include every single study in the development but instead showed the main flow of stream by which the main concepts of urban landscape design were derived. For the studies (e.g., Alexander, 1977; Gibberd, 1970) which were not included, they were used for some explanations in other parts of this study.

Also, some in-depth details of the studies were not included because they are not suitable for street furniture design and planning, but other areas like urban planning, fu, and The studies were reviewed at a considerable level (showed above), that the main ideas of urban landscape design were obtained. Based on this, the solid details of street furniture design are established by referring to relevant street furniture studies and the author's research (case studies and design projects). The main concepts of urban landscape design derived are organized and discussed in the following sections. (see Table 4-1)

Table 4-1 The review of design theories

Time	Urban planning	Urban design	Urban landscape	Street furniture
before 20 th century	Before the industrial revolution, urbanism was planned by architects and artists. The church, city hall, and plaza represent the three leading powers to grasp the urban structure (by politics).	“physical determinism” with the principle of “visual order”		
20 th century 1900s- 1940s	The industrial revolution began Garden city ---- Howard Broad-acre ---- Wright Athens charter ---- CIAM Radiant city ---- Le Corbusier Industrial city ---- Tony Gamier Organic order ---- Saarinen	functionalism organic order	organic order	functionalism
20 th century 1950s- 1970s	functionalism mechanism sufficient complexity	Urban design is a continuous and dynamic decision process, sense of place, cultural diversity ---- Team 10 vitality and diversity ---- Jacobs The city is based on the inhabitants' movement ---- Bacon Analyze urban space by topology ---- Krier Collage city ---- Rowe & Koetter Metabolism ---- Metabolism group	Functionalism: oversimplified, diversification, the original structures, and city characteristics were not considered by functionalism. Unity ---- Team 10	
20 th century 1980s- 1990s	ecological city sustainable development	ecological sustainable development new urbanism: walkability	Complex systems of pedestrian paths connecting open spaces and urban facilities	
Onwards 21 st century	new era of information global city scale extension			

4.4 Urban landscape: general plan principles

General principles in this study refer to the significant theories suggested in different periods and range of study fields and are widely accepted and applied as the main concepts in urban theoretical development and trend today.

Various concepts and theories of the urban landscape were developed at different periods according to the situation of the times. Today and the incoming future (the 21st century onwards), with the continuous development of cities and technology, the urban landscape will become a more complicated system with numerous considerations. Urban landscape can no longer be planned and designed by only one type of theory but needs a combination of different theories, concepts, and perspectives to meet diverse concerns and requirements. Different theories have specific concerns and merits. They can complement one another and compose a relatively complete theoretical system. (Hong, 2002; Wei & Sung, 2005). As the review above, the procedure of the development of urban theory, including three different scales, urban planning, urban design, and urban landscape, starting from the physical layer: function, went through psychological layer: politic, culture, nation, and then moved towards the combination of physical and psychological needs.

By organizing and integrating the theories and tendencies of urban design reviewed in Section 4.3, and referring to the general principle listed by the composite urban design studies (e.g., Hong, 2002; Wang, 2001; Wei & Sei, 2005; Xu, 2006; Zhang & Yang, 1999), the general principles are revealed according to the situations of today urban landscape and that of the study of urban landscape design, as well as street furniture plan principles and the plan flow for today and the future. Thus, there is no unchangeable phenomenon but eternal methodology.

According to the above, the general plan for today and the plan flow for tomorrow will be discussed and summarized from two perspectives: physical and psychological, from three scale layers: urban planning, urban design, and urban landscape, which correspond to city, district, and local space. It is hard to distinguish physical need from psychological need. All we could say is that some point is closer to material or spirit requirement. This method is to avoid crossing over in points as far as possible.

4.4.1 City layer: deeply study urban spatial structures

In the urban planning field, the urban spaces are not equal to inhabitants to arrive from the day the urban construction is completed. The city is constructed for citizens; citizens are the owners of urban life. However, the urban spatial structure silently influences people living in daily life.

The city comprises a series of spaces with various functions and shapes connected by a robust street system from the urban planning layer. The location of destinations and the combination of streets in the city are vital factors to the movement and activities of citizens' behavior patterns. Therefore, the city planning designer should design a city following the rules and customs of people's behavior. At the same time, we should follow the limits from the existing urban spatial structure to study the people's behavior rules, resulting from the progressive design for city life.

Hiller stated that in his book *Space (2007) is the machine*: “the physical and structure of cities are one of the most important motivations for the residents moving in urban space”. The meaning of the urban spatial structure is complex enough for people to need a hard lesson to analyze and understand. It is a truism to say that how we design cities depends on how we understand them. So, a deeper theoretical understanding of cities is what we need (Hiller, 2007).

Physically, cities are stocked with buildings linked by space and infrastructure. Functionally, they support economic, social, cultural, and environmental processes. (p111)

In the view of the city in this research, that the city as a cluster of spaces is to build a better relationship between human and city, which is an abstract concept to our daily life; on the other hand, connect closer with the smaller study layer – urban design layer – district layer. In addition, the information hidden behind the urban spatial structure is the relationship between existing spaces and the development of urban culture and economy both in history and the future.

Urban spatial structure refers to the application of topological relationships to describe the urban space configuration. The no-geometrical analysis is quite effective in refining the urban spatial structure. On the other hand, the usage of relative relation is more straightforward to the city system and restores the design process of city planning. And then, the geometrical elements in cities, such as distance, angles, and other geographical information, could be overlaid to analyze and understand how the city operates and influences residential life.

There are different levels and ways to develop spatial structures, unfolds as follows:

- It is necessary to deeply study the urban spatial structure for the context of street furniture's placement.
- The complex hierarchical relationship of spaces in a city could be studied through urban configuration.
- It could supply a method to predict the distribution of people moving in the city, which could aid in deciding the quantity and plan of new street furniture on an urban scale.

4.4.2 District layer: unity

Urbanscape should be considered a unity; the urban landscape elements do not exist individually but coordinate with one another and form a whole. Some suggested that the city is an organic entirety in which different organisms and cells cooperate organically and compatibly (Geddes, 1915/2000; Kurokawa, 1991, 2004; Saarinen, 1943). In other words, the city or urban landscape is an organic integration of different elements.

Unity of urban landscape can be achieved in several ways. First is the compatibility of different meanings. The urban landscape consists of urban planning and design, politics, economics, social science, history, geography, demography, and ecology. Balance among different concerns should be developed to achieve a compatible integration with minimum conflict for a continuous, stable urban development (Wei & Sung, 2005). Second, the compatibility of different urban landscape elements needs consideration. "In a city, from the small like statues and signage to the big like roads, squares are a unity of urban landscape" (Wei & Sung, 2005). All urban landscape elements should be considered as a whole to present a compatible visual and aesthetic environment in terms of styles, forms, colors, features, materials (Gibberd, 1970). Piecemeal development, which only emphasizes individual style and style and expression without considering the total environment, should be avoided. Compatibility between the urban landscape and its meaning is essential. "Any form-manifestation in nature is a true expression of the meaning behind this form-manifestation" (Saarinen, 1943, p.11). Different places contain different contexts, spirits, and hence the identity, which may refer to the history, culture, human activities, lifestyle, and behavior (Noreg-Schulz, 1971, 1980; Rowe & Koetter, 1978). Urban elements like architecture, squares, parks, or street furniture should be consistent according to the meanings of their locations and people's needs, appearance, and usage.

There is no contradiction but coordination for the unity of different urban landscapes and the unity of urban landscape and its meanings, as explained in Saarinen's (1943)

principles of expression, correlation, and organic order. He considered the city an organic matter entirely. Therefore, the principles of expression and correlation function coordinately and process towards and maintain the organic order to create a compatible urban landscape.

Unity of urban landscape does not mean monotony of the urban landscape. In other words, the entire urban landscape should be designed coordinately with different variations in details and different areas. Different individual elements of the expression are correlated in that they show compatibility by certain kinds of means. In this sense, individual landscape elements show their expression for different individual needs while coordinating with one another in some ways (e.g., proportions, color tones, and special features) for rhythmic order (organic order) and forming a compatible streetscape (Saarinen, 1943). Every street shows its expression of characteristics related to its residents, businesses while coordinating with other streets in a district until finally, different districts show their expression of regional differences while coordinating with one another, creating a broad sense of image and culture for a whole nation and achieving unity within the entire urban landscape of a city. That is also what Kakogawa's philosophy of symbiosis (1991, 2004) suggested that a city consists of different micro cities; every micro-city contains different characteristics and is organically integrated to form a unity.

4.4.3 District layer: identity and regionalism

The city should have an identity. "Show me your city, and I will tell you what the cultural aims of its population" (Saarinen, 1943, p. ix) are. Every city's self-character is represented in its urban landscape, implying local natural factors and human factors: the former include weather and climate, landform, land nature, waterscape; the latter direct local history, culture, tradition, custom, society, lifestyle, human behavior, and psychology. The characteristics and hence the city's identity, in urban landscapes, are incarnate in city form, spatial arrangement and structure, and the design of urban landscape elements such as architectures, squares, parks, streets, pavement, street furniture. (Hong, 2002; Wei & Sung, 2005; see also Alexander, 1977; Jacobs, 1961; Kurokawa, 1991, 2004; Lynch, 1960, 1981; Norberg-Schulz, 1971, 1980; Rowe & Koetter, 1978; Saarinen, 1943; Sitte, 1945).

Norberg-Schulz's concept of "spirit of place" (1980) identifies implies that meanings of a city or a place is essential to human's psychological and experiential recognition as it helps people to know and understand a place, the nations, and also themselves through a sense of belonging, security, and identification. It implies that public participation is essential as the public has the best knowledge of the place they live and know how to create a suitable living environment for themselves. Some suggested that history and culture exert comparatively prominent effects in forming a city's characteristics and identity (Lynch, 1960; Rowe & Koetter, 1978).

Protecting one's characteristics and identity does not mean keeping everything immutable and frozen; the urban landscape should be flexible toward change. The urban landscape characteristics need preservation with concurrent innovations through certain kinds of adjustments, reformations, and integrations (Kurokawa, 1991, 2004; Norberg-Schulz, 1979; Rowe and Colin, 1978).

4.4.4 Local place layer: people-oriented

The people-oriented principle is the primary principle/core idea of urban landscape design, and it serves as a foundation for other principles. The urban landscape is created for both the physical and psychological needs of human beings. Therefore, a desirable living environment should satisfy different activities and provide psychological commitment

and recognition.

Based on the humanist approach, different urban design methods, especially postmodernism, put people first in their considerations. For example, Sitte's *Visual Order* (1889/1945), Howard's *Garden City* (1904), Saarinen's *Organic Order* (1943), Lynch's *Environmental Image* (1960), Jacob's *Diversity of city* (1961), Kurokawa's symbiosis (1991, 2003/2004), Bacon's *Simultaneous Movement Systems* (1974), Alexander's *Pattern Language* (1977), Rowe and Koetter's *Collage City* (1978), and Norberg-Schulz's spirit of place (1980) (See also Gibberd, 1970; Lang, 2005).

According to Wei & Sung (2005), a people-oriented urban landscape should be (a) comfortable – visual/aesthetic and practical; people feel comfortable when having different activities; (b) recognizable – enough signs for indication, solid spatial structure, appropriate numbers and arrangement of landmarks, pollution-free environment, sense and context of culture; (c) selective – a wide range of open place for different human activities; (d) interactive – people can involve in designing the environment according to their needs; and (e) convenient – people can use different activities and access different places easily.

To create an ideal living environment that can satisfy different human physiological and psychological needs, the participation and opinions of the public are the critical issues on the purpose of the people-oriented design (Bacon, 1974; Jacob, 1961; Lynch, 1960). Wang (2001) describes the development of the concept of public participation in urban design. From ancient times to the present, in many cities, inhabitants – non-designers created their living environment and communities according to their needs and values without the assistance of related professionals. Team 10 first suggested public participation along with others (Jacob, 1961; Rudofsky, 1964). They claimed that it demonstrated the wisdom and ability of the inhabitants to create their places. In addition to other studies, for example, Turner (1963) and Habraken (1965) both suggested the importance of public participation, which can significantly contribute to environmental design to fulfill inhabitants' needs and avoid specific problems.

Public participation refers to the idea that the designers do not design for the public but design with the public. Therefore, communication is essential in the design process. Designers should learn and understand the needs and values of the inhabitants and the context and background of the place from the public, while the inhabitants should learn and understand the techniques and related knowledge of designing an environment from the designers. Regarding to its implementation, it "is to building partnership among the government, private sector and the civil society and opening up the planning process to allow dialogue among all stakeholders" (Ng & Chan, 2005, p. 33).

There are different levels and ways to develop public participation, such as public forums, special public working groups, public visits to development, exhibition, discussion of design concepts, and public interviews. All aim to enhance communication with the public to understand the inhabitants' living, needs, and problems to determine an appropriate design. Also, "dialogue helps generate collective wisdom because various stakeholders can offer different kinds of knowledge (political, social, economic, environmental, and community) and perspectives on urban planning issues" (Ng & Chan, p.33). Urban landscape design can use sciences; urban designers should consider different perspectives, such as social science and history, to design an environment (Wang, 2001).

4.4.5 Local place layer: time and movement

Time is a considerable element in urban landscape design. The urban landscape is not static but dynamic. Fundamentally, various factors, including politics, economy, history, culture, society, and ecology, shape city characteristics are presented in the urban

landscape. The design of the urban landscape simultaneously affects the economic, historical, cultural, ecological development of a city. This mutual effect makes the city and urban landscape continuously develop (Wei & Sung, 2005).

Moreover, the factors are varied in different periods and give different characteristics to the city and urban landscape of different times. All urban landscape elements, for instance, architecture, are designed to represent the characteristics of its people, place, and time, and hence together, they form the entire urban landscape. That is to say, the urban landscape is the accumulation of the development of characteristics of different periods. Also, new characteristics will accede to the urban landscape and advance its development. Because of this, the coordination and compatibility of time are essential to maintain the unity of the urban landscape (Zhang & Yang, 2000).

It is essential to respect and preserve the characteristics of the urban landscape of different times. During urban landscape development, there are always confrontational positions of new and old. It is improper to replace the old with the new total. Old, new, and also the future should exist in symbiosis and coordinate for a new scene and sustainable development (Kurokawa, 1991, 2003/2004; see also Schmal et al., 2005). For a compatible urban landscape, the elements of history, traditional culture, customs, which refer to the spirit of a place, should be respected and preserved. Urban designers should have a comprehensive understanding of the context, meaning, and spirit behind the urban landscape to integrate them with current needs and technology to adapt to modern society. New developments should be carefully designed according to a place's situation and destroy the characteristics and meaning of place, smoothly transitioning from the past (Rowe & Koetter, 1978; Norberg-Schulz, 1971, 1980; Kurokawa, 1991, 2003/2004).

The progressive creation of urban landscape requires flexibility in urban landscape design. Various factors always affect the city and urban landscape development, requiring exhaustive research and appropriate future visions and allowing rooms for the urban landscape to be adjusted and reformed for continuous development.

Cities are not designed by taking pictures of the way they should be twenty years from now. They are created by a decision-making process that goes on continuously, day after day. If people trained as designers are to influence the shape of the city, they need both a strong vision of what ought to happen and the opportunity to be present when the critical decisions are being made (Barnett, 1982, p. 10)

That also implies that there should be a careful plan for urban landscape design with a comprehensive investigation. "Urban landscape design is different from product design, is for one or more generations. Destruction because of design's faults requires a huge expense and causes irreversible loss of nature and culture. For these reasons, cautions design in a must" (Wei & Sung, 2005, p. 276). From the perspective of time, an urban landscape coordinates past, present, and future.

4.4.6 Local place layer: sustainable development

The concept of sustainable development is already a significant consideration of urban development today. Sustainable development aims to maintain the harmony of the environment, society, and economy. Equity is essential for sustainable development; every one of the same generations (intra-generational) and different generations (inter-generational) should access resources and their interests equitably and evenly. The resources should be fairly distributed and preserved for the next generation. Public participation can ensure that different parties' needs, interests, and opinions create an equitable and harmonious situation (Dong & Wang, 1999; Ng & Chan, 2005).

For urban landscapes, practical design and arrangement are essential to maximizing the reduction of waste and inequality. The ecological environment should be respected,

protected, and integrated. For example, urban development should be structured by considering the natural environment (e.g., geographical and ecological features, and diversification and stability of the ecologic system); resource-saving (e.g., 3Rs – reduce, reuse and recycle); pollution reduction (e.g., control on transportation, industry, and material use); protection and preservation (e.g., greenbelt, planting, and parks) and blue space (e.g., river and waterscape); and citizenship education and promotion (Hong, 2002; Wang, 2001; Wei & Sung, 2005).

4.5 Urban landscape: urban space (open public space)

4.5.1 Open public space in urbanscape

The urban landscape comprises urban objects (e.g., architecture and street furniture), urban space, land, people, and their activities in a broad sense. The urban space refers to different open spaces/public spaces in a city with different scopes. In this study, a broader definition is used: urban space (open public space) includes squares, plazas, parks, gardens, greenbelts, streets, natural lands, and other like spaces in front of and between architectures, corner gathering places, sitting areas (Appleyard, 1981; Aubock & Cejka, 1996; De Chiara & Koppelman, 1982; Gibberd, 1970; Goldsteen & Elliot, 1994; Heckscher & Robinson, 1997; Krier, 1979; Liang & Xiao, 2000; Madanipour, 1996; Moughtin, 2003; Shan, Guo & Lu, 2000; Trancik, 1986; and Xiong, 1999). Also, open space and public space in interchangeable. Therefore, urban space is a significant element of the urban landscape and the main content of urban landscape design (Gibberd, 1970; Liang & Xiao, 2000; Xiong, 1999).

Open space or public space is defined as “a place that allowed public gathering, communication, and easy interaction” (Siu, 2001, p. 40). Madanipour (1996) defined public space that “allows all the people to have access to it and the activities within it, which is controlled by the public agency, and which is provided and managed in the public interest” (p. 148). Carr et al. (1992) considered public space as “the common ground where people carry out the functional and ritual activities that bind a community, whether in the normal routines of daily life or periodic festivities” (p. xi). It is emphasized that the street is also the space for public access, human interaction, communication, and activities and is considered an open space (Appleyard, 1981; Goldsteen & Elliot, 1994).

Given the definition, street furniture, as one type of urban object located in urban space, provides various services and functions for human living and activities. That means that street furniture is located in the open space of the urban landscape. Yang developed a similar concept in 2005 that street furniture is located in Lynch’s (1960) city elements, including paths, edges, districts, and nodes. Furthermore, “Street furniture is designed fully committed to the public environment” (Siu, 2004, p. 83). In this sense, street furniture can also be understood as “open space furniture” or “public space furniture”.

Street furniture is essentially required and installed in different open spaces. Based on the extension of the urban landscape design principles, street furniture is designed by considering the open space where it is located. (Carr et al., 1992) suggested the meanings and nature of open space that street furniture design can refer to:

- Responsive: design and manage to serve the needs of their users.
- Democratic: accessibility for all groups and providing freedom of action.
- Meaningful: allowing people to make strong connections between the place, personal lives, and the larger world (p. 99-20).

People are put in the first place in considering open space to provide freedom for human activities and communication. According to Shan, Guo, and Lu (2000), open space is one element of the urban landscape. Therefore, the common principles of open space design extend and follow that of urban landscape design. The principles include human-being

oriented, compatibility, and sustainable development. That is the same story as street furniture design that street furniture is one urban landscape element and shares the design principles of the urban landscape.

For further practice, with extensive coverage, types, and usage of open space, street furniture in different open spaces should be designed according to design purpose, functions, usage, and users' needs and behavior based on its located open spaces. "The designer should survey as many examples as possible to understand how space is adapted to its surroundings and how it serves its function" (Trancik, 1986, p. 96).

4.5.2 Importances and re-emphases of street

The street is the primary source of open space in the urban landscape (Appleyard, 1981' Goldsteen & Elliot, 1994; Jacobs, 1961); hence, it contains high significance for urban landscape and urban life. Therefore, street furniture, which is applied mainly on the street, can directly contribute to the importance and functions of the street. Also, understanding the importance and functions of streets (open space) enhances the understanding of the importance and functions of street furniture and facilities, establishing the design principles of street furniture.

Streets include paths, avenues, highways, ways, routes, roads, boulevards, malls, promenades (Marshall, 2005; Moughtin, 2003; Rubenstein, 1992), defined by various perspectives like traffic function, traffic speed, width, and street length. One discussion concerns the difference between "road" and "path" from the wide range of terms. Moughtin (2003) stated that "defining a street as a road for vehicles is not the same as designing it as a path". A road is the "traffic route designed by an engineer to serve passenger car units (PCUs) per hour; it relegates the street to the level of a sewer, a conduit which facilitates the efficient movement of affluent" (p. 134). For path, Norberg-Schulz (1971) stated that

On the plane, man chooses and creates paths that give his existence space a more particular structure. People's taking possession of the environment always means a departure from where he dwells and a journey along a path that leads him in the direction determined by his purpose and his environment image. The path, therefore, represents a fundamental property of human existence and one of the great original symbols (p. 21).

It is noticed that "path" where places human firstly and emphasizes "walkable", pedestrian, humans' interaction, and communication is taken as the significant meaning of street in many studies (Alexander, 1977; Bacon, 1974; Jacobs, 1961; Krier, 1979; Moughtin, 2003; Norberg-Schulz, 1971).

The importance of street

The importance of the street is realized through its functions in the urban landscape (Lu & Ma, 2000). Understanding the importance and functions of the street, the central open space in the urban landscape, helps to design much appropriate and quality street furniture to serve the public.

Streets are the framework of a city. Firstly, streets are a kind of transportation system. They serve both traffic and pedestrian movement, from place to place, outside and within a city. "It provides a framework for the distribution of land and gives access to individual plots. It has a more pronouncedly functional character than the square" (Krier, 1979, p. 17). Moughtin (2003) stated that street, "as a link it facilitates the movement of people as pedestrians or within vehicles and also the movement of goods to sustain the wider market and some particular uses within the street" (p. 131). Also, the street is the place to locate civil facilities, such as water and electric supply pipes underground. Thus, streets are imaged as the "blood vessel" of a city (Lu & Ma, 2000). In addition, streets connect and

associate different architecture and urban spaces systemically to construct an urban landscape. Moughtin (2003) claimed that “street provides the link between buildings, both within the street, and in the city at large” (p.131). “The street is not buildings frontage but space which dwellings are grouped to form a series of street pictures; alternatively the street is a space that may be expanded into wider spaces such as closes (yards/courts) or square” (Gibberd, 1975, p. 282).

Streets are commonplace for daily activities and communication; everyday life and activities of residents make use of the street. Gutman (1978) pointed out that the street is “a site for casual interaction, including recreation, conversation, and entertainment, as well as its use as a site for ritual observances, such as procession” (p. 250). In addition, pedestrians gain feeling and think through the interaction with and observation of the streetscape, including street furniture (Lu & Ma, 2000; Xiong, 1999).

Street and street patterns are one reflection of a city’s character. The historical context, local culture, tradition, and lifestyle of the place and its residents originate the characteristics and identity of the city. Those characteristics and identity are developed in different periods and become the patterns and features of the street as well as other urban landscape elements (Hong, 2003; Kurokawa, 1991, 2003/2004; Lu & Ma, 2000; Norberg-Schulz, 1971; Rowe & Koetter, 1978; Wei & Sung, 2005). Streetscape and street pattern recognize the historical context, local culture, tradition, lifestyle, and city development. The street “was a ‘small universe’ where the district’s character and the town as a whole were presented in condensed form to the visitor. The street represented a section of life-history that had shaped its details”(Norberg-Schulz, 1971, p. 81). In general, streets reflect the characteristics of a city.

Street presents the image of a city. Jacobs (1961) claimed high importance streets to represent a city. Street and their sidewalks, the main public places of a city, are its most vital organs. Think of a city, and what comes to mind? It is the street. If a city’s streets look attractive, the city looks interesting; if they look dull, the city looks dull (p. 29).

The street is the place where both residents and visitors experience the most a city has to offer. Pedestrians experience everything (architecture, street furniture, people, historical and cultural characteristics) on the street. Therefore, the image presented by the street is the image of a city in people’s minds. In other words, the street is the arena for presenting the urban landscape. “Different from the professions, the public views a city without knowing the city’s characteristics, scale, form, development history. The image of a city they feel is experienced from streets”(Lu & Ma, 2000, p. 8).

The re-emphasis of street

Most “streets” are constructed for vehicle traffic. The original meaning of the street, which allows human contact, interaction, and urban experience, has changed (Hong, 2002; Yang, 2005). Hence the emphasis and importance of streets, including street furniture, were neglected. Street “changes” created different problems, like a feeble human relationship, loss of traditional and characteristic environments, uninteresting urban life, and street experience. Also, silent streets due to low pedestrian traffic gave rise to social problems like criminal behavior (Jacobs, 1961).

Starting from the period when post-modernism urban design developed, its lack of humanism criticized functional urban design. Many argued that streets should be re-emphasized for their importance stated above. Although streets lost their original traditional meaning and function due to the dominance of high-speed vehicles (Le Corbusier, 1933/1967; Trancik, 1968), some still encourage that “street should be for staying in, and not just for moving through, the way they are today” (Alexander, 1977, p. 590-591). Krier (1979) claimed that “the street is unsuitable for the flow of motorized

traffic while remaining appropriate to human circulation and activity” (p. 17). Streets are re-emphasized by placing the importance of people, human contact, communication, interaction, urban life, and experience at their core.

“Walkable” streets and pedestrian precincts are designed and applied in today’s urban landscape (Tolley, 1990). For example, new urbanism focuses on the streets with the slow vehicular flow in residential areas, connecting different daily shops, open spaces, and neighborhoods. Pedestrian precincts are popularly applied in different countries like United States, Europe, and China. They are designed only for pedestrians where vehicular traffic is entirely prohibited except for residents’ and visitors’ movements, activities, and recreation. Pedestrian precincts are divided into two types: permanent in commercial zones with safe, comfortable, convenient shopping environments that consider people first. Details and attractive design of the architecture, facilities, and street furniture satisfy the pedestrians’ physical and psychological needs. Advertisements and lightboxes are standard features in pedestrian precincts (Lu & Ma, 2000; Rubenstein, 1992).

Foreseeing urban development, Hong (2002) observed that a “carfree city” is one of the main future ways for sustainable urban development. “Carfree city” is a place where vehicles are prohibited. People establish the city through the complex pedestrian street system with the assistance of railway systems. Mix zones (e.g., residential and commercial zones) are encouraged in “carfree city”. With significant pedestrian streets and comprehensive connections, the public can quickly access different points for living on foot. The streets are designed following human scale for different users’ needs and express details and aesthetics. It finally enhances the communication and interaction between people and between them and the built environment; it revitalizes the positive characteristics of a city and enriches the urban experience. Most importantly, the city without vehicular traffic commits to environmental protection and sustainable development.

Streets are the primary source and the most significant proportion of open space in urban landscapes and are re-emphasized in today’s urban landscape. Street furniture is applied on different streets to serve different human needs and activities. In other words, streets (and other open spaces) incorporate street furniture to perform and maintain the functions and importance of streets. Therefore, like the street, street furniture is essential. It requires a considerable design to fulfill different human needs and activities, support contact and interaction with one another and the environment, and eventually enhance quality. Based on the design principles extended from urban landscape design, street furniture should be designed practically and mainly according to the functions and importance of different streets and other open spaces.

4.6 Conclusion

Street furniture, an element of the urban landscape, extends and shares the design principles of the urban landscape. This chapter, to facilitate the study of street furniture and establish its design principles, investigated the urban landscape concept. The knowledge and concepts investigated in this chapter will be applied and extended in the following chapter on street furniture placement design.

The general concepts of urban landscape included (a) definitions, (b) classifications, (c) nature and characteristics, and (d) creation of the urban landscape. The urban landscape is a vast and complex system; street furniture is a part of the urban landscape. Different perspectives and responsibilities of different professions in the urban landscape, including street furniture, complicate planning and decision making.

Urban design theories developed an understanding of different parties’ different perspectives and needs in urban landscape design. They were organized and analyzed to

present an overall picture of urban landscape (and street furniture) design today and in the future. They included (a) people-oriented, (b) time and movement, (c) diversity, (d) unity, (e) identity and regionalism, and (f) sustainable development. These design principles are significant sources and will be applied and extended in the design principles of street furniture (a part of the urban landscape) in the following chapter.

This chapter identified urban space (open space/public space), the significant urban landscape where street furniture is primarily implemented. Its functions realized the importance of the street: (a) the framework of a city, (b) the commonplace for daily activities and communication, (c) reflection of a city's character, and (d) representative of the image of a city. Although the original meaning of the street is lost due to rapidly developed transportation, it is re-emphasized in today and future urban landscape through a humanistic perspective. Based on the extension of the design principles of the urban landscape, the investigation of the importance and function of streets provided more in-depth and specific references for street furniture design.

CHAPTER FIVE

STREET FURNITURE PLAN STRATEGY

5.1 Introduction

The planned flow of new street furniture with broad principles is established in this chapter through different research methods from three scales of urban layers.

This chapter will firstly introduce the plan flow. Then, based on the people behavior pattern premise, the plan flow will be studied from three main layers: city layer, district layer, and place layer both in unity and identity, corresponding with city structure field research, district flow field research, and local place activity field research. This chapter will then discuss the importance, reasons, and details of the premise, principles, and sub-principles and their correlations. Finally, the case studies of street furniture plans in different places and collaborative street furniture usage used in examining the principles will be used as examples for discussions and demonstrations.

5.2 Plan flow framework

The principles/rules of new street furniture placement design should not be a list of points or views out of order. Instead, both the plan and design follow the logical flow to compose all the information in a well-organized framework to make all guidelines multiple-layered (see Figure 5-1).

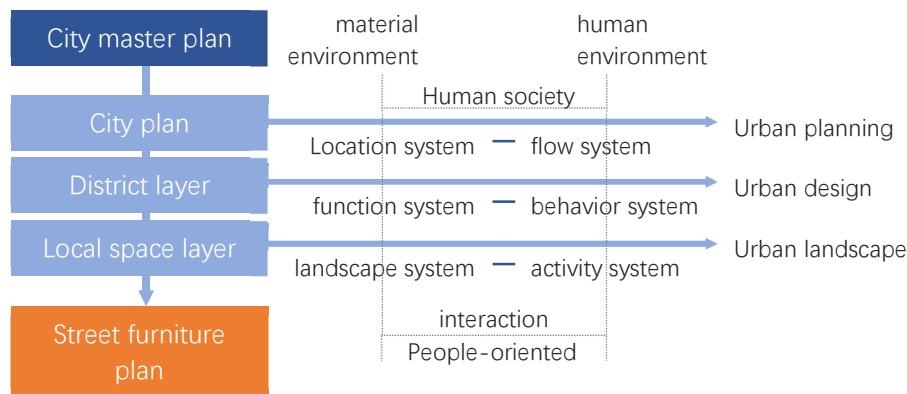


Fig. 5-1 Plan flow framework of street furniture

The premise of street furniture placement design is that it should be “people-behavior-oriented.” It is the core idea of street furniture placement design and as the result of the framework. Based on the premise, the plan flow is unfolded from the three diminishing scale layers: city layer, district layer, and local place layer. The three layers describe the whole procedure of the city plan, following with the workflow from urban planning to urban design, finally to the urban landscape. It implies that the constitutive property of layers in the framework is in a progressive relationship, which guarantees the unity of the whole city.

The premise and the three layers are analyzed according to society’s environment, divided into the material environment and human environment. As discussed before, the main influence factors to people’s behavior pattern in the city are from material conditions, such as spatial structure, building function, the shape of open public space, and cultural conditions, such as local customs and age of residents life cycle. For realizing the plan of new street furniture more people-oriented premise, the consideration from city layer includes (a) location system in material view and (b) flow system in human view. The consideration from the district layer includes (a) function system in material view and (b) behavior system in human-environment. The consideration from the local space layer includes (a) landscape system in material view and (b) activities system in human view. Note that the factors proposed from the perspective of material and factors proposed from

humans go hand in hand. In other words, they are motivated, affected, and corresponded to each other. These principles are equally essential and coordinate and interflow with one another. The fulfillment of one principle can contribute to the achievement of others and vice versa. It will be shown in the following discussions of each principle and sub-principle.

It is important to note that this framework does not list every planning detail of every type of street furniture; it instead presents the plan flow of new street furniture in an existing urban environment. The condition both in material and culture in different cities are diverse. Therefore, it is almost impossible to summarize the rules/principles of placement design of street furniture through a specific list of guidelines. However, the design/plan logic could be found and followed by professional designers. The main issue of this thesis is to put the problem of placement of street furniture into the context of citizen's behavioral patterns in urban life through a series of discussions on people's behavior systems and urban operation mechanisms. Given one specific type/functional street furniture, the designers can arrange the placement through deep study in citizen life following the plan flow to know better about the people activities to find the possible areas to make the new facility play a role for residents and avoid unnecessary resource-wasting. In the planning process, the designer and manager may adjust and select which factors can be applied or emphasized more, and vice versa regarding realistic situations. Also, different types of street furniture may contain various proportions to meet needs in people's daily lives from three layers according to the particular situation. Therefore, implementing these principles should closely consider specific aspects (e.g., locations, functions, and requirements) of street furniture.

5.3 City layer

Cities are the most significant and most complex artifacts that humankind makes (Hiller, 2007). It is reflected in the scale of the city far exceed from the human being. However, on the other hand, it is, therefore, during the slow growth of knowledge of urban development and the even slower timescale of our understanding, designers and planners still pay tireless efforts in a deeper theoretical understanding to make the city better serve residents and guide progress in urban life.

People are standing at a juncture where fundamental questions about the city's future, in which the issue of sustainability has raised. It is widely acknowledged that to make cities sustainable, and people must base decisions about them on a more secure understanding of them from multiple layers and viewpoints. Physically, cities are stocks of buildings linked by space and infrastructure. In effect, they are means-ends systems in which the means are physical and end functional. Functionally, they support economic, social, cultural, and environmental processes (Hiller, 2007).

Meanwhile, places are not local things. They are moments in large-scale things, which we call the city. Places do not make cities. It is the city that makes places. That is why the city layer is discussed firstly to place new street furniture, which cannot be discussed away from the whole urban context.

People can try to unfold the city problem following the evolving procedure of a city: beginning with several axes, accompanied with formed topological structure, then the space generated by enclosed axes, and the scale of the city extended based on the existing network. The function of buildings and people acting in the city obey the city elements above. So, this part will be studied from the axis, topological structure, and visible space (see Figure 5-2).

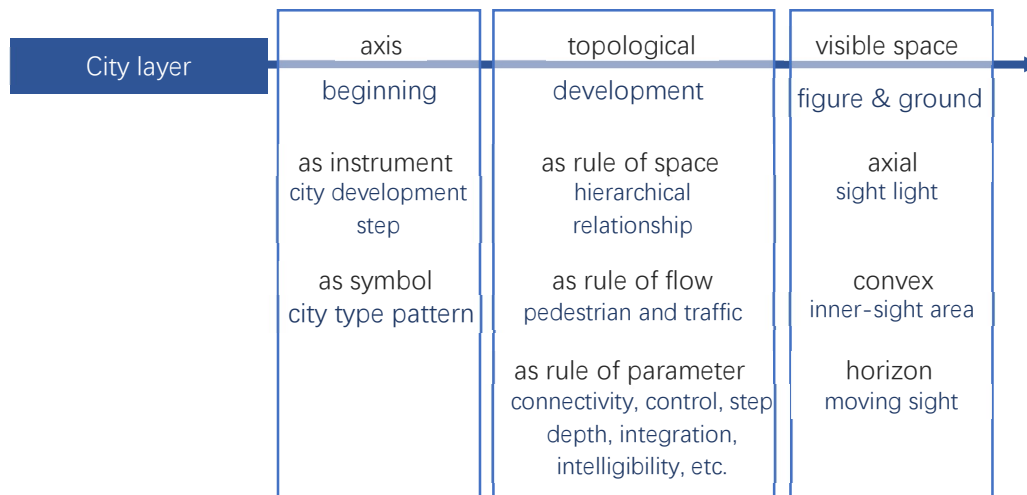


Fig. 5-2 City layer plan flow framework of street furniture: more global analysis for a better understanding of the whole city and to grasp the basic information from 3 aspects for street furniture plan: the accessibility of function, the accessibility of walk, and the accessibility of view.

5.3.1 Axis

5.3.1.1 As an instrument in city analysis

At the beginning of cities, the axis, as the central control element in city planning, crosses as many urban spaces as possible to form the path/ street through a large scale of cities as possible. The axis does not only strengthen the contacts of each place in the urban environment, especially for the center with the margin/edge of the city. In concrete, the axis plays a role in “folding space” – implement topological space in the city: spatially, connecting the furthest places both ends of the street is vital in the urban development process. Heidegger stated the meaning of edge: edges are not where things stop (1971). The edge and the center are twinning concepts, representing the spatial relationship and social relationship, built from urban edge to urban center according to principles of social organization (Zhao, 2017).

The urban axis system, composed of several main axes through the city and sub axes starting from some points on main axes to connect different main axes and sub axes to support the urban planning logic, sets up the multi urban space system and establishes the foundation for city operation and long-term development design trend: should settlements be dense or sparse, nucleated or dispersed, monocentric or polycentric, or a mix of all types. Thus, the hierarchy of the urban space system is determined by the urban axis system.

In common urban space, the most familiar property of the axis is that it usually passes through a series of open public places. That is how cities create a more global awareness of the urban form in the peripatetic observer than is available from the organization of the place. Therefore, people associate this property with the practicalities of understanding cities well enough to move around them effectively. A comprehensive recognized acknowledges hidden in the axis system: axial organization is consistently used to make large-scale links from one place to another than the apparent irregularity of the plan would initially suggest. The “simple” web formed by axes to abstract urban space makes the city planning logic understood by pedestrians to avoid losses in the urban maze. Most geometrical relationship in urban axis system includes verticality and parallel, which help us know better routes in cities and increase the urban intelligibility and order.

In most urban open public places, axes guide both people flow and traffic through a series of spaces and make them could be understood. Experimentally, the feeling of people moving into the city is continuous. The memory of a city formed by coherent

spaces connected by axes is helpful for people to identify the city. In other words, the urban axis system divides up urban space, which is necessarily continuous. Moreover, we could arrange the spaces generated by dividing them differently according to how human beings function. Consider, for example, Figure 5-3-a is the plan of Rome, in which the customary representation with the buildings in black and the space white has been reversed to draw attention to the fact that it is the black structure of space that is our focus of concern. Hillier supplied a possible structure, the fewest and most extended lines that cover the open space of Rome, and therefore form its potential route matrix. It is not difficult to find that urban axes classify the urban spaces into different levels, which implies that the people's daily behavior pattern is influenced by the organization of the urban axis system. The highest connectivity axis supplies the best vision street in urban planning. It is easy for people to locate themselves in cities to improve the sense of belonging, security, and intimacy and identify the urban structure. This kind of logical method of city configuration also is reflected in people's cognitive practice. So, for example, when we read a city map, we are used to finding the nearest main street in the city. This profound architecture underlying the plan creates the pattern of natural movement in the city. Furthermore, of course, this is the key to its logic.

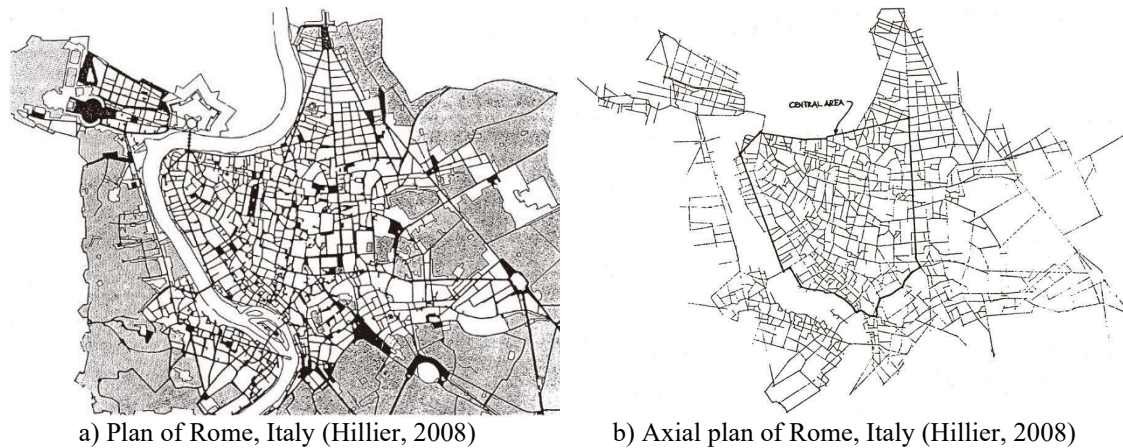


Fig. 5-3 From geographic map to axial map

5.3.1.2 As a symbol in city analysis

As Gestalt psychology stated, the basis of people's understanding of geometry starts with simple symmetric relations, such as circle, square, equilateral triangle. The symmetric urban construction is reflected in the building façade, but also urban planning with the axis.

In some typical urban planning patterns, it is easy to find that symmetric implies a strong sense of spatial order in some typical urban planning patterns. Places and buildings are listed along the central axis to enhance the atmosphere of local space (see Figure 5-4). The axis increases the experience of space and supports the cultural environment of the local place. The place, building, and landscape, including street furniture, all follow the main order defined by the urban axis, which benefits from intensifying the whole environment from all layers in various scales as a unity.

In a more common situation on the city layer, the axis plays a role as a symbol in an urban environment. Most axes are straight and long, and easy to understand. It makes people feel comfortable and safe on the axis with the most visibility. In other words, the axis can attract more residents to take activities there. It is not hard to find that many new planned cities locate the center and most important public space on the central axis in the city. The symbol and instrument function of the axis cannot depart from each other. In

some extreme cases, there is only one central axis in the whole urban planning, such as Las Vegas. Buildings are unfolded along the central axis, which presents absolute control to the city.

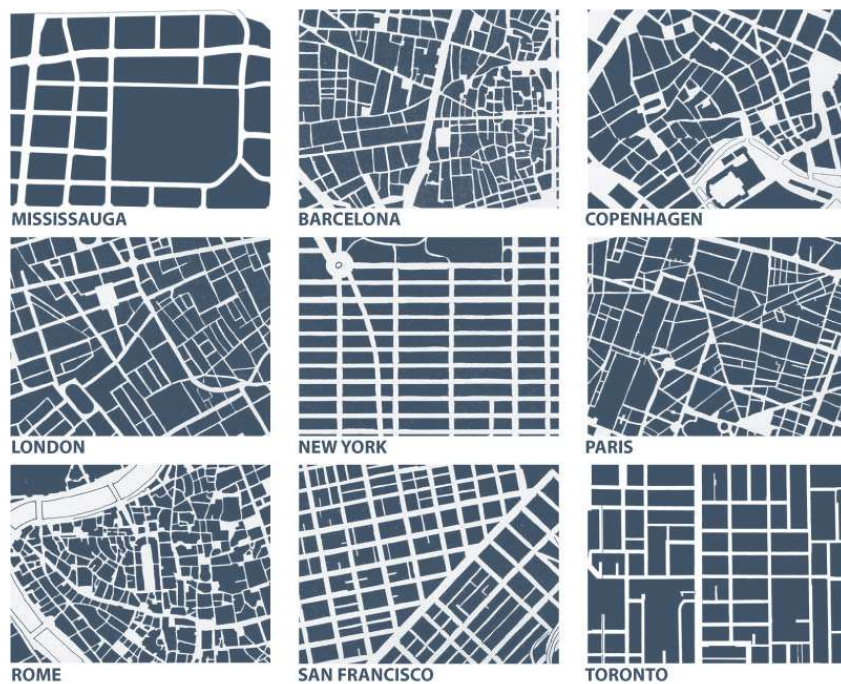


Fig. 5-4 Black-white city pattern (Jacobs, 1961)

5.3.1.3 Summary

Social reproduction, we might say, requires symbolic forms of space, social production instrumental forms of spaces. Both express themselves fundamentally through how the axis is handled. The axis can be a symbol, or it can be an instrument. People can understand the city-forming pattern and human environment through analysis of the urban axis. However, the axis, its primary instrument, the symbolic and ideological role is subordinated – through never eliminated – by the practical dominance.

5.3.2 Topological structure

The space system is an inner-uniformed and inter-related unity within various spatial elements. The people's cognition of space is not limited to some local spatial experience and movement that better understand the space system's intelligibility. As a result, people must learn about the space system as an organic whole – city to research its inner structure. A feeling caused by some local space has an inherent connection with its neighborhood space and the overall city. More importantly, the local space follows with whole spatial structure as a “supply”, which includes information from all aspects of the city, such as function, society, culture. Moreover, the topological structure created by city axes is the primary supply to the space system.

More and more psychological experiments prove that the first thing people perceive is not the superficial part of the graph or its local integrated features. The human visual perception begins with the large-scale topological property (CAS (Chinese Academy of Sciences) official website, 2003). Topological relationship, traced from geometric research, different from usual plane geometry and solid geometry, reckons without the length, scale, area, volume, or other measurements of the relationship between properties and attribute to focus on the knowledge about the position. In the scope of city space, there is the necessity of researching from that perspective. The topological structure in

the city represents a spatial relationship diagram emphasizing the position connection of spatial knots rather than the actual distance among them, especially for the depth of topological relationship and an important measure to quantize the structural relation.

5.3.2.1 As rules of spaces

Gu Chaolin stated in the book *Aggregation and Diffusion: New Theory on City Spatial Structure* that: “the city spatial structure discovers means of expression of both spatial form and interaction among cities from spatial perspective under rational, organized theory. In other words, the spatial dimension is added to describe city based on urban structure.” Thus, city spatial structure measures the relationship among elements in spatial organization, which is interaction with cities.

The city structure acts as an urban skeleton to support the whole city planning. People can find that some places in the city are more accessible to arrive at than others in our daily lives. According to the above, the axes taken from main city streets are convenient for citizens to get together. In addition, many public buildings are located nearby rather than the building’s service some people such as the dwelling, which is usually planned on the back burner in city structure.

The importance and status of city spaces with a similar function, such as city open public space including street, park, square and so on, are different from each even if taking the same role in city daily life, for instance, local park and city center park. The spatial status does not limit function but has a lot to do with the relative location citywide, observably in the spatial liveness. There is a significant relationship between the ability to attract citizens of space and the location of open public space in the whole topological structure. According to both maps of Beijing (see Figure 5-5), it is easy to find that: (a) the topological structure forming by the road network, urban spaces are classified by series of circles, the centric area is the city center; (b) the axial symmetric part of topological structure means the city etiquette square, where is used to hold a national celebration with larger topological structure than that of the neighborhood district, where is a famous walkable shopping center in Beijing with the traditional urban pattern forming by people self-organized activities; and (c) in the small-scale map, the pattern shaped by the topological structure is quite different from each other’s, the reason causing the appearance is the age, the building scale is smaller than the ones constructed in modern time.

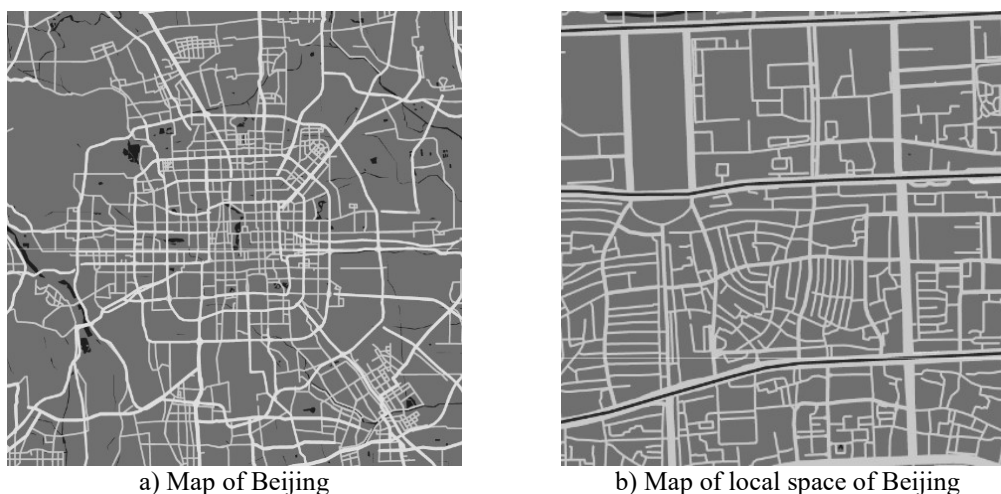


Fig. 5-5 Different scale map of Beijing

According to city topological structure from the view spaces, the research can be discussed globally and locally. The local structure pattern should be analyzed in the

context of the global one. The general urban formation could be studied in the global topological structure, which grades the space integrally. The closer the open public space near to the center of the topological structure is, the higher the hierarchy of the space in the whole city is. Besides, the center's density is much higher than that at the city's edge. From the urban development step, the city generates from the heart area with the longest evolution time. On the other hand, the type of space could be inferred from the pattern of local topological structure, including the function and formative years.

5.3.2.2 As rules of flow

The topological structure plays a crucial role in the human activity organization methods in open public space, reflecting the collective social movement. It is illustrated that people will affect each other when taking activities in open public space by abounding investigation. When the series spaces form a chain shape, the inspiration cannot generate in most spaces. Therefore, people's behavior patterns cannot be concluded through a single space but a larger-scale space. Most people's activities in public space are limited by the spatial structure, as urban topological structure, which influences the distribution of both people flow and traffic flow. In other words, when the city topological structure is completed, the density of flows is confirmed with it accordingly: some axes, more extended and more central than the others, can get together citizens. Pedestrian movement will change with its transformation. The city topological structure is a hierarchy system of axes standing for streets, which deeply lies the city energy distribution.

Consequently, the structure represents the urban transportation system from the entity level. However, there are notable exceptions to this strong positive correlation between the street hierarchy from the municipal perspective and people's density. For example, the higher rank or broader does not mean more users on that street.

Some streets with higher accessibilities than others in the same district can gather more people flow and traffic flow, with more significant potential to being an activity destination. Moreover, others may turn into the passing way between start point and destination. As a consequence, the street configuration implies the rules of people flow. According to the above, the connection between urban material space and people behavior patterns in open public space is built. Hillier wrote in *Space is the machine* that: the primarily associated media in configuration is people's movement in the space from the view of the element to confirm the shape of space, the people flow dominates the urban spatial layout to a great extent; from the view of the spatial form effect, the people flow limited by the organization of city spaces. As the pure spatial configuration, the city road network plays the most vital role in determining it. The people's movement in the city, including pedestrians and cars on the road, is recognized as the essential element to build an open public space. The holistic urban pattern needs to be discussed from the city planning view. The more significant flow on the main streets motivates a smaller stream of people moving on the streets connecting the main ones. Both the people flow and traffic flow overlapping in the city topological structure forming interaction with the accessibility of city space consequently.

In the project Lavazza garden in Turin, in the beginning, the park was only a leisure square for the staff of Lavazza, but two months later, it turned open to the public. The structure of the entire region changed a lot. Consequently, the pedestrian flow and public life for people living nearby alter a lot following, especially in summer (see Figure 5-6). Via Ancona's possible paths to Via Bologna increase due to the disparking of Lavazza garden. According to an in-field study, the number of people on Via Ancona and Via Bologna per 20 minutes enhanced significantly. The density of the local topological

structure has a strong correlation with local citizen’s activities situation. The open public space with a higher density topological structure creates more opportunities to stay people becoming the active square to get together more residents. As a result, the research on the topological structure could reflect the liveness differences among different districts in the whole city and bring more profound thoughts about the distribution of street furniture need from a citywide view.



5.3.2.3 As rules of parameters

In the quantitative research on topological urban structure, a series of parameters, as to form variables, was developed by space syntax based on a topological calculation to describe the whole structural relationships. In urban spatial structure, this analysis is applied to understand the background of operation status of the whole city. The essential variables as following five parameters:

- Connectivity: measures the number of spaces immediately connecting the space of origin (Hillier & Hanson, 1984). In real space, the higher the connectivity value of space is, the better the spatial permeability.
- Control: measures the degree of choice that each space represents for its immediate

neighbors as a space to move there. Each space has a certain number of immediate neighbors. Therefore, each space gives to each of its immediate neighbor's $1/k$ and then summed for each receiving space to give the control values of that space. Spaces with a control value greater than one will have substantial control; those below one will be weak control spaces. A typical example is a city center square connected to many buildings and public districts (see Figure 5-7).

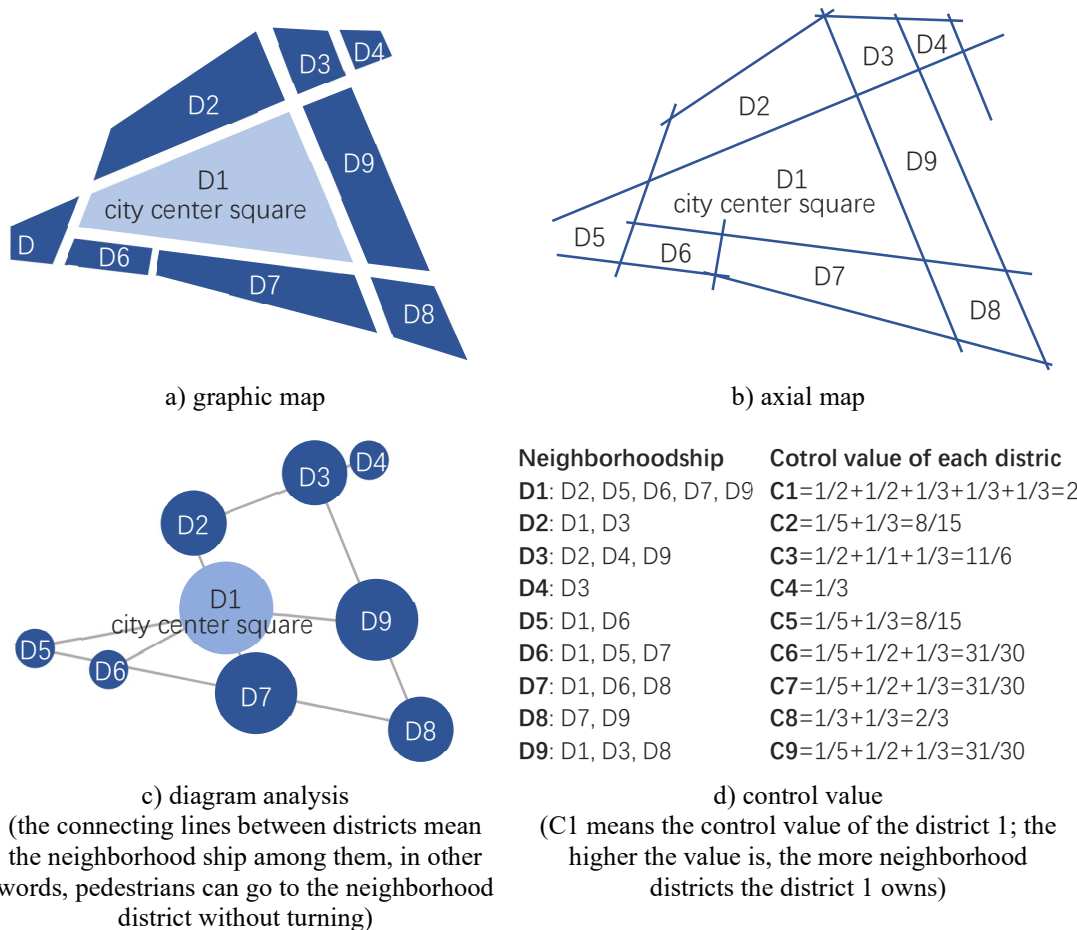


Fig. 5-7 Control value

- Step depth also called point depth in the previous version of DepthMap, follows the shortest path from the selected root line (or segment) to all other lines (or segments) within the system, and the path length records on the line (or segment) (Turner, 2004). Mean depth is calculated by assigning a depth value to each space according to how many spaces it is away from the original space, summing these values and dividing by the number of systems less than one (the original space). The formula is $MD = [(\sum \text{depth} \times n) / (n-1)]$. [n is the number of sum of nodes]. Total depth is defined as the sum of the topological depth from any node to others (Hillier & Hanson, 1984). The formula is $\sum_{j=1}^n d_{ij}$. [d_{ij} represents the shortest distance from node i to node j.]
- Integration is a normalized distance measure from any space of origin to all others in a system. In general, it calculates how close the origin space is to all other spaces and can be seen as the measure of relative asymmetry (or relative depth) (Hillier & Hanson, 1984). The above methods define integration as determined by the quantity of the nodes in the system to a large extent. Therefore, to void the distribution from it, P. Steadman improved the algorithm with relative asymmetry for standardization. The formula is $RA = 2(MD-1) / (n-2)$. [n is the number of sum of nodes]. Integration is the

reciprocal of RA for positively correlated with practical significance. Then, RRA is used to a further standardization for integration and local integration. Global integration is for the convenience of the relationship between a node and other nodes in the whole system, and local integration means the convenience of the relationship between a node and the neighbor nodes with a range of 3 steps to 10 steps called radius-3 integration and radius-10 integration (Zhang, 2004).

- **Intelligibility:** Axial intelligibility indexes the degree to which the number of immediate connections a line has is a reliable guide to the importance of that line in the system as a whole (namely, it is a correlation between axial connectivity and global axial integration). The connectivity mentioned above, control value, and local integration illustrate the local structural character, and global integration is for the global structural character. Intelligibility means the correlation between them. Hillier stated that: we cannot experience spaces immediately or locally, whether in cities or buildings, only during movements to build the whole spatial image part by part, and then guide the invisible spatial structure. As a result, a strong correlation, or “high intelligibility”, implies that the whole can be read from the parts.

The above variables quantitatively describe the relationship among nodes and nodes, the whole structure, and the whole structural characters. In addition, in specific configuration analysis, relevant parameters would be listed for certain issues to illustrate. The analysis based on variables would be applied not only in the city layer but also in the other two layers.

5.3.2.4 Summary

The problem should be solved from the whole city layer to the local landscape design issue. It is vital of the location of specific place planned the new street furniture there. Even if the public space layout is redesigned with the location of the place in a city with a low integration, intelligibility, and connectivity, the experience of urban life there would not be improved. In addition, the analysis of citywide topological structure is for better understanding urban background: the distribution of people flows and traffic density, potential vivid streets, and the validity of open public spaces. That is the cornerstone of the street furniture plan in the city.

5.3.3 Visible space

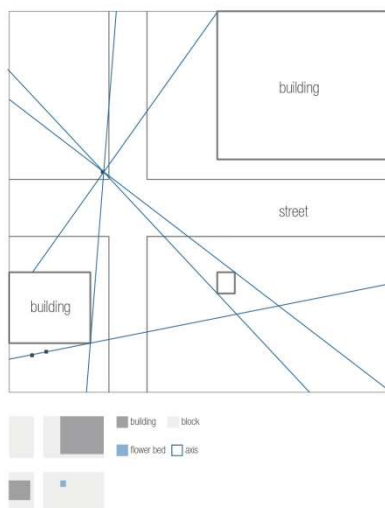
Configuration refers to the relationship among urban spaces, which are about movement and do not seek to express the relations of significant buildings to each other. Socially and culturally speaking, the human cognition on space has never been only some individual spatial properties, but also the complex relationship among spaces, which configure the whole urban layout and urban spatial organization. For example, when people take activities and communicate in open public space, which forms unfixed and full shapes, the background will present a series of characters. In addition, there is apparent linear characteristic during people traveling in the public space, and the communication among citizens needs to see each other. As a result, public activities should happen in a convex space.

Moreover, people are used to watching around from their sitting locations when in observation space. The generated horizon is the naturally largest area limited by both sight and the edge of the place. When talking to the complicated and continuous one, people try to understand the space through moving in it and overlaying the visual areas to build the overall impression of the whole space. This configuration of order and spatial organization is the foundation that we know the society.

5.3.3.1 Axial analysis

It is easy to find that the main street could carry the longest sightline in the built environment. People are used to moving along the sightline, and as a result, the most movement and experience in the city's open public space depends on the sightline. From this perspective, space could be understood as an area scanned by a series of sightline. In this way, the visible space is no longer even, in other sayings, with the same visibility of points in space. Some points are much easier to be seen than others. Consequently, the visible space discussed from axes means analysis by reducing its dimensionality from area to line.

When a pedestrian moves along his sightline, which is stipulated as the furthest visible distance from a point in the space, space could be described by a series of least and most extended sightlines, represented by lines as axes in the space syntax theory. The axis acts for sightline and has profoundly practical significance, where laying the most economical and convenient people moving path in urban space. In addition, the various urban axis system means human's potential movement including going forward, staying, turning. Therefore, the axis has two meanings, sightline, and motion. The street furniture does not supply convenience in urban daily life but also plays the role to inspire residents to involve public activities staying in city open space, and is found and used on their walking path, which is led by the sightline with little influence from other factors. So, the objectivity and feasibility of the structure of the street system could be studied through axial analysis. The spatial configuration turns to the relationship among spatial nodes, which are represented by the axis. Then the analysis diagram could be gotten with the parameter mentioned above in space syntax to analyze the adaptability of organization and function of the street system and confirm whether the usage of street furniture adapts to the particular area (see Figure 5-8).



a) People's sightline in open public space



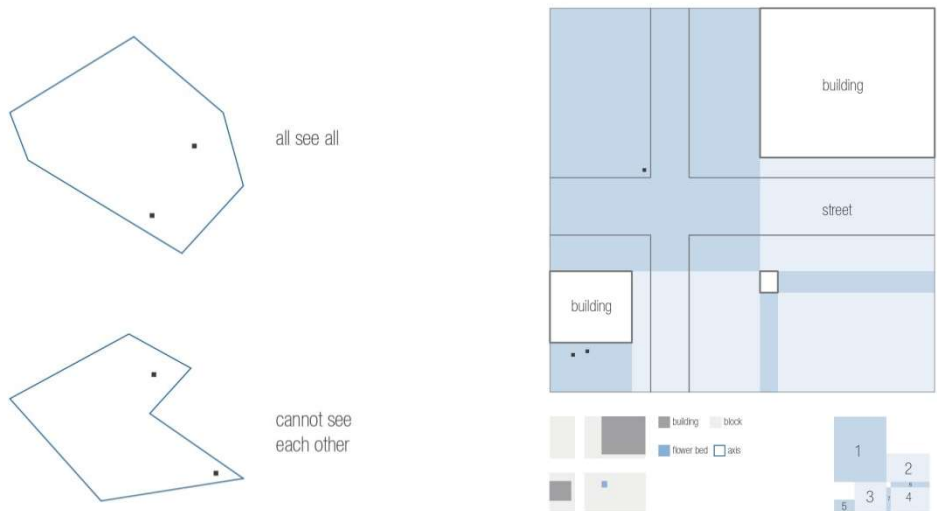
b) The street networks and the open public spaces of Norway (Eriksen, 2018)

Fig. 5-8 Axes as sightlines for visibility analysis in city

5.3.3.2 Convex space analysis

According to the above, people are used to walking follow with their sightline in open public spaces. In this case, a person walking in the city as a point in an area, and the destination, as another point, the visibility between the two points determine the people's movement, which is the primary stone of path-finding theory. The convex space corresponding to the concave space is a mathematical concept with that any two points

could see each other, and the line joining the two points never intersect with the edge of space. The graphical representation of convex space similar to an axial map is closed by the lines between any two points, reflecting social attributes with practical significance. As Figure 5-9 shown, three people are located in the open public place; area 5 is occupied by two people, is a sub-convex space, with a neighboring space separated by a building where the other people are standing. It is easy to find that the sightline and communication among the three people are limited by building in the plan while forming two convex spaces. As a result, there are more potential opportunities to interact with the two people staying in the no.5 convex space, and the status of a single person in no.1 presents the spatial characteristics as rejection, loneliness, and lack of communication. The spatial connotation set comprises the shape, quantity, and relationship of all convex spaces inside the spatial system. In the open public space in the residential area, it is helpful to improve the urban daily life to reasonably arrange and design convex space divided by street furniture to increase the chances of interactivities among present habitats. From the diagram layer in the space syntax analysis, the parameters generated by dividing the space into the several tiniest and largest convex spaces, represented by space nodes, are used to research the relationship.



a) Definition of convex space: any two points in the area could see each other, called all see all. Each angle of the convex is smaller than 180°.

b) Besides the city’s transportation system, the open public space could be divided into a series of convex spaces to show the “all see all” area pedestrians lying.

Fig. 5-9 Convex space plane for visible space analysis

The city’s open public space could be divided into sub-convex spaces, showing that people could grasp sufficient vision information. Obviously, in figure 5-8-b, the method to divide open public space is not unique to generalize the visibility. The more the limitation is, the exacter the “all see all” area is. In daily life, the “all see all” area has close links with abundant factors to public activities such as security, stayability, sense of direction. From that view, city space is composed of a lot of connected convex spaces. The larger the convex is, the more vision information pedestrian can get with a higher sense of security to stay longer.

The sequentiality of space is an essential aspect of the city plan in open public space, linking convex spaces in different sizes. Consequently, people from a smaller convex to a larger one seek an opportunity to a stop with diverse reasons. After pedestrians passed a sequence of small ones, they usually prefer a larger one to take a break. In the design of

the placement of street furniture, the convex it lying implies the possibility to be used.

5.3.3.3 Horizon analysis

People's horizon original a 3D concept is to study the relationship between people's sightlines and behavior patterns on the 2D plane in space syntax. It could be understood as the visible area of people standing in a specific plane and present as an irregular polygon different from convex space. There are recognizable physical edges, and any two points could see each other inside the convex space. However, any two points in horizon space could not see each other, and each point inside it could see an observation point. As Figure 5-10 shown, the green area is the observer's horizon; the sightline is disturbed by the pillar and the wall in the space forming an irregular polygon. The relation between the horizon and convex space could be confirmed by the share of physical edges over horizon edges. The horizon equals the convex space only that the horizon is closed by physical edges. In addition, many social connotations can be studied from horizon analysis, such as the area the observer can see, the edge degree of the observer's location, the distance from the observer to the visual center.

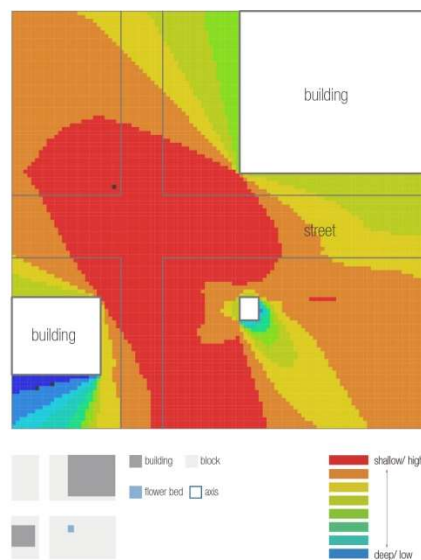


Fig. 5-10 Horizon space plan to describe the area differences of people standing in divers locations in open public space for visibility analysis

The past traditional horizon analysis focuses on the unique visual points, which occupy better horizon strategy locations in spatial structure to supply the best scopes of vision and locate at the street crossing and turning. However, this analysis method has its limitation. In recent years, some relevant scholars proposed a new horizon analysis – horizon limitation analysis, which creates a series of points by subdividing the space into an even network and calculating each point's horizon area. According to the overlapping areas among them, the parameter of each viewpoint in the space could be caught. The analysis is also regarded as horizon integration analysis, unfolded and applied in the latter case study chapter.

5.3.3.4 Summary

In this part, we tried to understand open public space by visual sense. For quantifiable and visible analysis, the city is abstracted into graphs: people as points; street furniture as points; sightline as the line between 2 points. The spatial analysis model could be studied from three space division ways based on space syntax transferring complex space system

to several key nodes, each representing the corresponding divided spatial unit, then to build related diagram from the real spatial relationship among points.

5.3.4 Conclusion

Urban space analysis is the essential study context for this research. It is necessary to deeply understand city-forming elements, their relationship, and the interaction with people taking activities in it. Analysis on sub-layer should follow with the urban operation rules on city layer, which is the headstone to supply the foundation information of the relationship between specific city spaces and the movement for people living there. For quantitative research, the city is generalized into axes and areas enclosed and residents as points. According to this, the relationship between the citizens' movement cloud is measured by mathematic method. In addition, the placement of new street furniture, as a point in the city, could be analyzed quantitatively besides graphically combined with the usage rather than layout pattern.

5.4 District layer

Urban space is composed of a series of subsystems and subunits. In this study, the subunit system refers to urban operation motivation in both competition and collaboration between spatial units or local spatial organizations within a city. Each subsystem has a relatively complete self-organizing ability in daily life. That is, residents can complete all life loops in this area. Meanwhile, the random start is influenced by personal customs and natural forces, such as the function and form of buildings in the region producing the synergistic effect of collective movement, of which the primary mode further dominates the location-selective movement of each subsystem in the space system, thus making the space system go into a spiral cycle of cross-development. Therefore, on the research from the local layer, it is more intuitive to make a complete study of people's behavior patterns in a particular region.

On the other hand, urban space is heterogeneous in many aspects. The non-linearly development of urban space directly determines the complex characteristics of the urban space system. Historically, each urban subsystem ---- district/block, has different properties, all impacted by the citywide analyzed as section 5.3 above. In addition, some specific elements were also studied in this part detailedly.

The core element in the district is the spatial connection relationship from the physical condition. Consequently, the problems on the local layer were analyzed following three aspects (see Figure 5-11): configuration neighborhood, functional neighborhood, and streetscape neighborhood. The previous two belong to the horizontal interface of the city, and the last one belongs to the vertical interface. Meanwhile, this section was studied with dimensionality reduction: the first part, configuration neighborhood, was analyzed from the area; the second part, function neighborhood, was from the line, and the third one, streetscape neighborhood, was studied from the point.

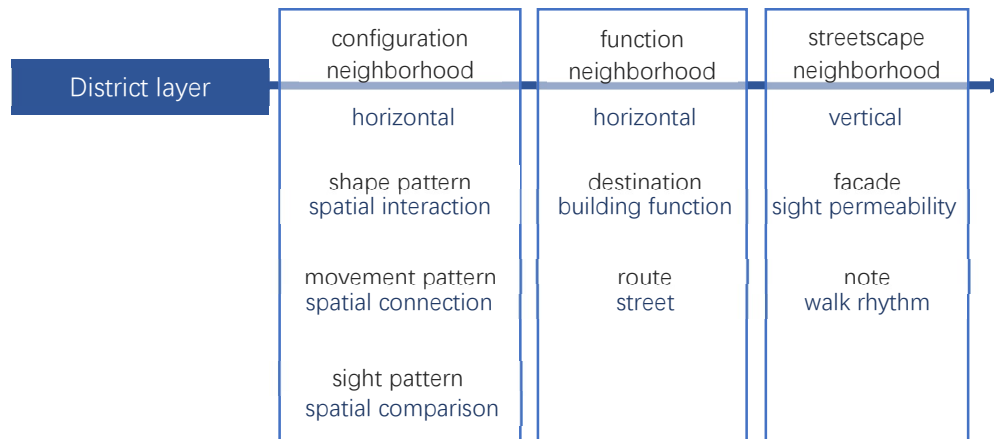


Fig. 5-11 The planning flow framework of street furniture from district layer: more local analysis to better understand the moderate-city and grasp the detailed information from 3 aspects for street furniture plan: the spatial relationship on configuration neighborhood, function neighborhood, and streetscape neighborhood.

5.4.1 Configuration neighborhood

5.4.1.1 Shape pattern

There is a linkage between neighborhood spaces, which can be described graphically in a mathematical way causing by force from the shape itself. According to section 5.3.3.2, the city's open public space could be divided into a series of convex spaces. From the city layer, for a more global view, the shape of space is ignored for a unity conclusion and general understanding of the city. On the contrary, in the smaller scale—district layer, the shape of space plays a vital role in the local movement of people. The shape pattern of the local space system could be studied from the following aspects:

(1) Form

For cognizing the objective things, the built environmental elements are usually simple generalized signs extremely (Wu & Geng, 2018). Most open public spaces can be classified into narrow spaces and expansive spaces. Most streets are narrow ones for passing by, and squares are vast spaces with diverse forms such as circles, regular polygon, and triangles, and people are used to abstract the longest axis of the space moving along with it. When all the axes are in the same length, people will lose the subconscious moving direction resulting in a stop. The symmetry of the vast space helps the resident to confirm the main direction in the district. Figure 5-12 shows the axis pattern abstracted according to forms of open public convex spaces. People understand the spatial sequence through the continuous axis. Some parts forming web and others forming a branch, longer axis means more primary movement direction; the axis of open public space as web states an opener spare that people can get more direction there and owns higher independence and openness, and the open public space with branch end of axis creates a private environment.

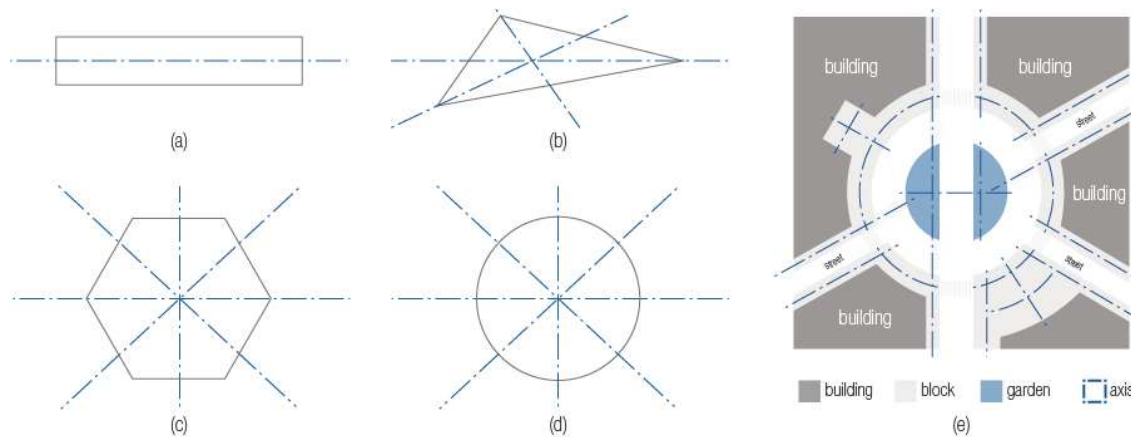


Fig. 5-12 (a), (b), (c), and (d) show the corresponding axis forms, respectively. The city's open public space combines diverse forms shown as (e), the axis pattern illustrates the residential potential movement direction.

(2) Enclosing degree

The degree of enclosure of convex space leads to a significant contribution of the sightline direction when the pedestrian is walking in the open public space because the people's custom on movement is greatly determined by vision. So the movement analysis could be inferred by local degree enclosure of spaces in a particular district. The continuity of sightline can help to find the path in the city. In addition, the citizen is used to move along with the edge of the convex space to get a large sight area as far as possible. In other words, the analysis is for vision possibility, as shown in Figure 5-13. It benefits the pathfinding of the placement of street furniture from the view of sight.

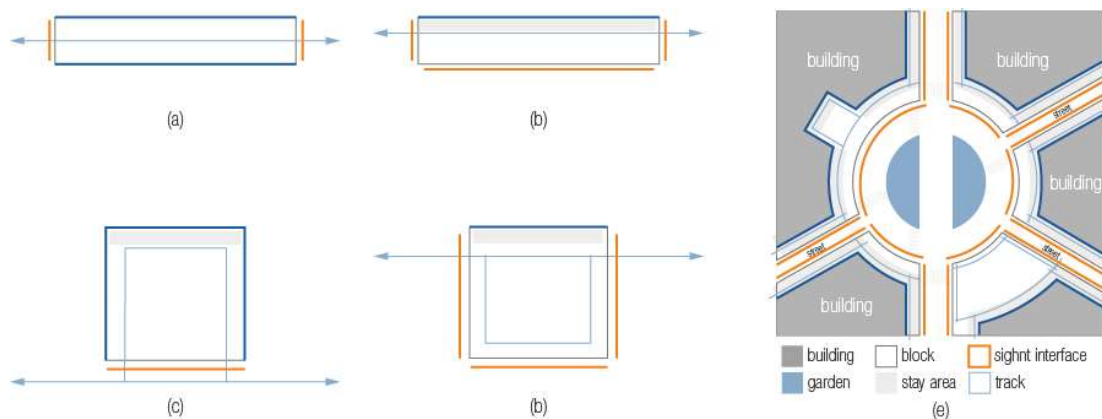


Fig. 5-13 (a), (b), (c), and (d) show the axis corresponding with different enclosing degrees of streets and squares, respectively. The people are used to move along with the edge of convex space, especially the interface for the enclosure, causing divers to stay areas. The city's open public space combines diverse forms shown as (e), the movement track, and the sight interface pattern interacting.

5.4.1.2 Movement patterns

People have different behavioral trajectories in urban space to see what subtle changes in space can bring about spatial attributes and functional changes. In some sense, there are two typical layouts to respect the most common form of urban spatial pattern, which are known as "transferred grid": the open public space closed by neighborhood dwellings with a public entrance, forming regular "grid", which is transferred by two methods:

- Axial transformation. In the regular grid, the sightline and movement trend continually happen to the façade of neighborhood building and have to change the direction;
- Convex transformation. The planner space changes the forms and directions unfold on

the ground forming wide or narrow continuous spaces.

The pedestrian's perception of the district environment evolves along with the altering trend of both axis and convex, which can help change space's understanding. In different spaces, the people's behavioral patterns are quite different from each other. As a result, the discovery of city configuration brings out more profound functional development.

The great significance of the interaction between local-part and global one reflects in the spatial function, which is people's both flow and get-together as an energy activity in the urban network. Hillier stated in *Space is the machine* that: the primary link of spatial configuration is the people moving in the city public space, then to confirm the spatial form: from the view of urban evolving, the citizen's flow significantly dominates the city layout; from the view of spatial form's effect, the citizen's flow dramatically depends on the urban spatial organization and composition, whether for walking people flow or traffic flow, urban network, as pure configuration, is the main factor to determine. Considering the different activity ranges and characters of both the two flows, traffic flow is always studied on the city layer. On the other hand, for the research on the placement of new street furniture, the district layer for people movement walk pattern is necessary for this thesis to understand the urban configuration neighborhood pattern.

In the project Lavazza Garden (first mentioned in section 5.3.2.2), the adjustment is essential to the block configuration rather than the garden's openness. The people flow distribution (see Table 5-1) illustrates the changes in street vitality. At the same time, the integration of the block becomes higher to present the increase of economic activity and people movement implying the high consistency of regional both society and economy—the results of observation accord with the results of the analysis. Even if the neighbor streets own similar functions and locations, the local experiences are pretty different. The openness of the Lavazza garden changes the understanding of the Lavazza block. The garden becomes a place for public activity from a private square.

Meanwhile, it offers more methods to cross the block between Via Bologna and Via Ancona besides Via Pisa and Corso Palermo. As a result, Via Ancona turns into a new neighborhood get-together street. Hillier considered that the differences and similarities between local spaces had roots in historical accumulation of residential perception of urban network forming a holistic cognition and understanding of regional district and then to the movement pattern. In space syntax theory, intelligibility to measure this spatial cognitive attribute is the synergy between the integration and connectivity of nodes in the system: (a) when the value is more than 0.5, the direct proportion between the two variables is more substantial higher relevance. That means people standing in a space with higher integration can get higher visual penetration, and it is much easier for residents to build the whole invisible spatial structure through visible space and then take diverse activities corresponding with the open public space. On the other hand, the sense of place is created by the people's movement. The openness of the Lavazza Garden essentially inspired the people to take activities around for understanding the whole district.

Table 5-1 The change of integration and people number distribution on the streets closing the Lavazza center before and after the Lavazza Garden open to the public.

before/after	Corso Palermo	Via Bologna	Via Ancona	Via Pisa
the number of people per 60min	54/76	120/132	32/76	54/63
integration [HH]R3	4.48183/ 4.49579	3.93375/ 3.96556	3.17032/ 3.19334	3.5915/ 3.61542

* The data was collected in both June and July 2018. The open-air temperatures are the same made nearly no difference to people's activities in the open public space. The range of the integration in the table is the district area for both situations.

It is a space to realize urban functions that the interactive interface between different spatial integrations with different radii, which form a close relationship between a smaller scale of people flow and a larger scale of people flow. Therefore, it is the key to generate local effect (walking through flow) and the way of urban flow to create benefits for local areas. The design method for achieving this goal is to maintain a certain amount of interactive interfaces: between the building entrance and all other spaces in multi-scales; between smaller urban spaces and larger urban spaces; among linear spatial structures with different scales; and especially between the unity and local part.

Designing new street furniture is to design new people activities and improve the citizen movement forming new-generation people's behavior patterns. Therefore, it is necessary to analyze the local movement pattern and the relation with the physical condition pattern to choose the suitable placement of the city service element to promote the quality of daily life.

5.4.1.3 Sight patterns

Hillier and his co-workers applied the cognitive principle of people behavior pattern caused by the visual experience of the space by topological means to describe the spatial configuration more intuitively and visibly, and abstracted the complex relationship among spaces from the whole complicated city system and identified relevant mathematic model for analysis, forming the quantifiable diagram introduced in section 5.3. As a result, the research and application on configuration and urban spatial development have higher readability and expansion on this district layer.

System theory holds that there is a necessary correlation and representation among each system's elements, which synthetically leads to the integrity of the overall system. Camillo Sitte stated that vision, which has the essence of spatial perception, is the basis for all architectural effects: it should also be the basis for solving all the conflicting factors in urban construction. Vision is the main channel of sensory information. Therefore, people's spatial experience of synthetic stone with architecture is mainly accomplished through vision. In particular, the urban space where citizens live is identified by the visual image during people's movement to form cognition of the whole city finally. For example, some researchers compared squares in the city and the convex spaces in different rooms; the "diamond-shaped spatial-visual area (see Figure 5-14)" analysis is also used to study the visible range of people's daily activities, and the visual area of the facade is used to analyze the relationship between critical buildings and urban space.

5.4.1.4 Summary

The analysis on configuration neighborhood from the district layer focuses more on the interaction among neighborhood elements in the system. Most of the research is developing the relationship between space organization and people acting on the city layer. The primary tool is space syntax and to get spatial data through the software DepthMap. When the scale of research objects changes, the analysis result changes too, and the data could be combined with the local investigation to get more local people's behavior patterns with the spatial structure to support a better decision on the placement of new street furniture.

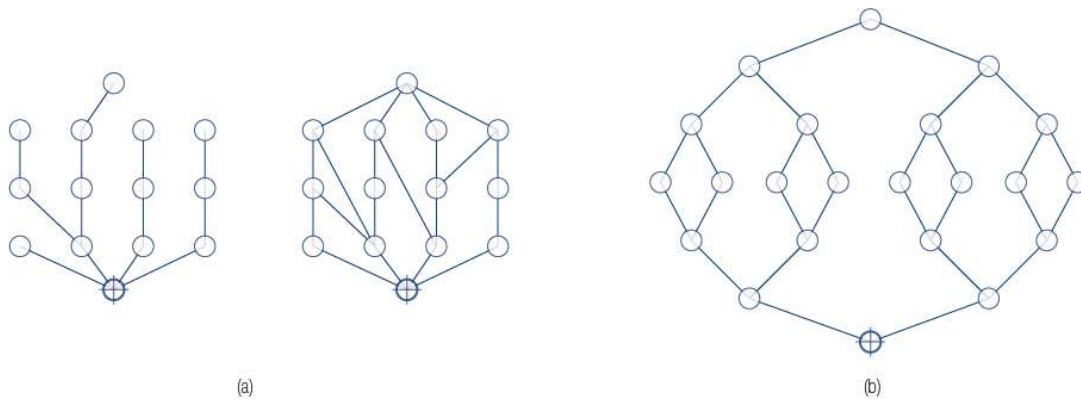


Fig. 5-14 (a) The numbers of both systems are the same, but the topological relationships are different. Consequently, the values of the total depth of the core space are different. Unique space should be created as a standard to avoid the impact caused by the connection relationship and justify the other structure with the same number of spaces. The ideal space should follow with a set of simple rules to be built quickly and after adding any element the remapping of the new structure as each element is entirely the same. (b) The ideal structure is called “diamond-shape topological structure” as a standard configuration method to compare the total depth of different elements in different structures (Mu, 2013).

5.4.2 Function neighborhood

People’s activities in the city’s open public space could be regarded as a series of destinations linked by routes. The destination means the detailed activities citizens complete in their daily life circle (see Figure 5-15). As a consequence, successive activities become “neighborhoods” connected by routes. The design rule of placements of new street furniture will be quite different, corresponding with the usage happening in different phases. It is just like some street furniture was placed on the street, and some were in much opener space with different plan rules and functions. The analysis of function neighborhood is not only for the placement but also for the function chosen.

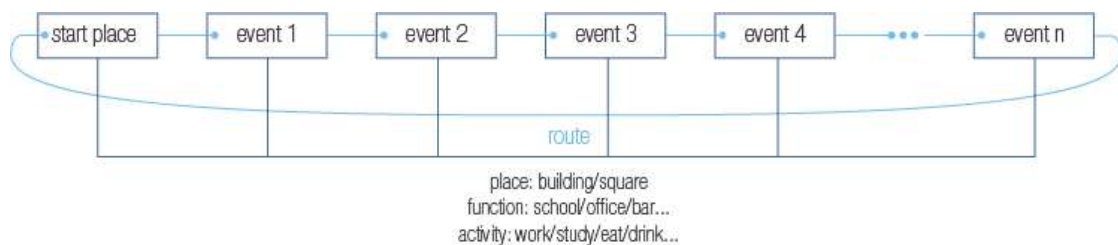


Fig. 5-15 Daily life cycle diagram

5.4.2.1 Destinations

The developed district has a specific ability of self-organization embodied in the function in this district comparatively integrated. Meanwhile, the opportunity of work and study offer possibility that the people living in this area leave here and some people spend their work or school time in this district. Most destinations in certain districts contribute to the people’s inner loop and part-inner loop, consequently forming the local people’s behavior pattern. It is easy to find that. The destination implies the function of each block in the district linked to the user structure and usage customs. From this perspective, the street furniture has the same service reference factors as the neighborhood building with different service scales. Therefore, the analysis of the function of the block is essential condition research for street furniture design and placement. Through the activities of the destinations with various functions supported, the new street furniture potential function and placement could be added to the local citizen’s daily life cycle. Moreover, according to the investigation on the life cycle, the expected usage time of some particular function

of the street furniture could be estimated. From this view, new-generation street furniture could not use a uniform type to meet diverse users' structures in different districts. Therefore, both the function design and placement need to adapt to the particular district to achieve maximum utilization.

5.4.2.2 Routes

The route is to connect two neighborhood activities taken in two destinations. It is easy to find that the route person chosen depends on the activity besides the spatial structure. The route and the life loop have stability with both individual's behavior pattern and spatial pattern. Not all the route is fit for the placement of new street furniture. The design rule should follow the local behavior besides enough area on the street. Sometimes, causing the function demand, the physical environment will be "re-designed" by users. The primary need factor comes first, following the connection situation between the two destinations.

5.4.2.3 Summary


The traditional topological structure analysis abandons the function of the block and ignores the impact of the buildings on the people's movement. On a large scale – citywide, to reach the general relationship between people flow and spatial configuration, the blind on function is necessary. However, on a smaller scale, especially for some well-organized areas in the city, the role of the relevance function of the block is quite essential. Therefore, when deciding on the placement and function of new street furniture on the district layer, any main factor forming the city life should be discussed on potential usage.





5.4.3 Streetscape neighborhood

5.4.3.1 Façade

The human eye is developed primarily for horizontal vision: we seldom look up, although we occasionally look down to see where we are going. However, most of what we take in visually is at eye level and concerning buildings; it is primarily the ground-floor level that catches our eyes. Numerous studies have pointed to edges, the transition between building and public space, as significant for how many and which activities take place (Gehl & Svarre, 2004). Shop/bar facades and activities on the sidewalks lining the shops were studied based on the assumption that there would be more activities in front of ground-floor facades with an open and varied character than closed and monotone. Gehl and his research group selected 100-meter segments along Copenhagen shopping streets to test the theory (see Table 5-2).

Table 5-2 Façade categories (Gehl & Svarre, 2013)

Façade	Corresponding characteristics
	<p>A – active</p> <ul style="list-style-type: none"> Small units, many doors (15-20 doors per 100m) Large variation in function No blind and few passive units Lots of characters in façade relief Primarily vertical façade articulation Good details and materials

	<p>B – friendly Relatively small units (10-14 doors per 100m) Some variation in function Few blind and passive units Façade relief Many details</p>
	<p>C – mixture Large and small units (6-10 doors per 100m) Some blind and passive units Modest façade relief Few details</p>
	<p>D – boring Large units, few doors (2-5 doors per 100m) Almost no variation, uninteresting units Few or no details</p>
	<p>E – inactive Large units, few or no doors (0-2 doors per 100m) No visible variation in function Blind or passive units Uniform facades, no details, nothing to look at</p>

This study showed clearly that façade design could significantly influence the pattern of activities on shopping streets. There was a considerably more significant activity level in front of open facades than in segments with closed facades. People walked slower, turned their heads more frequently. Moreover, although people sometimes stopped to look at the shops, interesting enough, many of their stops were made somewhere besides an active façade: for example, people stopped to tie their shoes, talk on their cell phones, adjust their shopping bags, and so on. Jane Jacobs wrote: “the sight of people attracts still other people”. In total, many activities could be seen before the open façade than in front of closed facades, and the open façade supply more opportunities for pedestrians to stop than the closed ones.

Urban life in some open public spaces did not perform as well as expected. The potential reason causing that on the district layer may be from the façade around. The inactive and dull types cannot stop pedestrians or attract them to turn heads. Therefore, when the street furniture’s placement is chosen on the street, the façade condition should play an essential role in urban facilities. Of course, the attractive condition and degrees should be studied for specific districts, and the stay time could help designers decide which functional component will work there.

5.4.3.2 Nodes

On the route of citizen daily life cycle, there are some specific nodes on the walkway. On the other hand, the walk is an essential element in public life to present local people’s behavior patterns. Meanwhile, the core issue of this research is the usage of street furniture. Consequently, the pedestrian’ walk custom is a vital cycle here. The stop/ stay

is a kind of node break in the route from the dimension of time. According to the investigation, the pedestrians spend a significant amount of their time waiting at the many traffic lights, prioritizing car traffic. When a district construction is completed, the users in this area are confirmed at the same time. The movement in the district is represented by a walk, which indexes the rhythm of people's life to connect the different functions based on the configuration.

The test walks proved to be a reliable political tool to provide better conditions for pedestrian traffic. The observer walks selected important routes, noting waiting times, possible hindrances, and diversions on the way to make test walks. There can be significant differences in walking a distance measured in sightlines and a theoretical idea about how long it takes to walk from A to B and the time it takes to walk that distance. The actual walk can be slowed by having to wait at stoplights or by other hindrances that slow the pedestrian and make the walk frustrating or even unpleasant. Test walks are a good tool for discovering this type of information (see Figure 5-16).

The opportunities to plan new street furniture can be created by a stop and stay. Correspondingly, people would not spend time on another rest immediately after a staying. As a result, the utilization of street benches near a traffic light is not relatively high. Walk test is an investigation for intensely studying local use cases of urban facilities and behavior patterns. The special event in the specific area is the core to make a short staying to use street furniture. Therefore, the placement of street furniture should follow with particular event nodes. At the same time, people will transform their daily life loops to coincide with the changing local events.

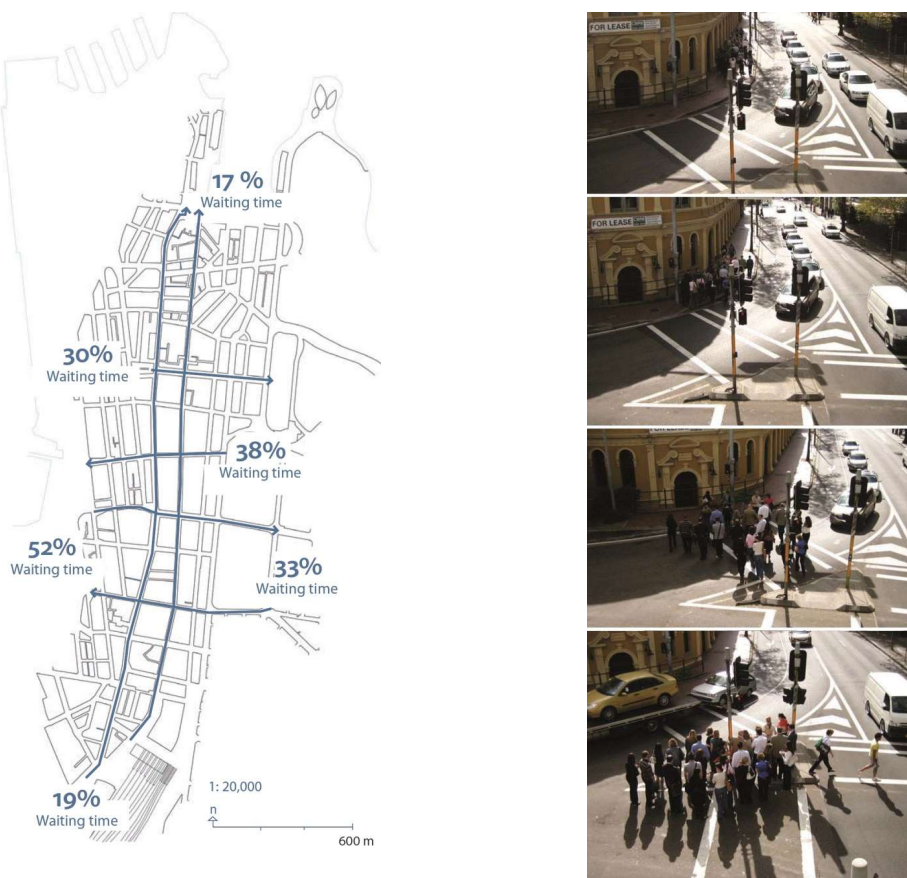


Fig. 5-16 Test walks in Sydney showed that up to 52% of the total walking time was spent waiting at traffic lights (Gehl & Svarre, 2013).

5.4.3.3 Summary

Essentially, the analysis on both façade and node are the supplements for the daily life loop. For the usage of new street furniture, we tried to find as many opportunities as possible to create a stop/stay for pedestrians, especially for the potential users without a clear purpose to have the convenience supplied by street furniture. A stop means longer stay in open public space and more possible to see the new urban facility with the exact placement condition, for example, the standing position far from the specific location 2 visual depth.

5.4.4 Conclusion

The research scale of the district layer is smaller than that of the city layer. Different from the placement decision more on citywide layout according to the global configuration, the placement design on the district layer depends on the functional operation in the location space and how the elements of the district support the local behavioral pattern. Besides seeking better visibility and walkability, the increase of stop to stay people in open public spaces is the primary mission of this research layer. The forming factors of the district are classified road network, block, and node and try to enhance the ignored elements to topological structure.

5.5 Place layer

In most past research, street furniture's placement design focuses on the layout plan of a particular place, such as a square, garden, park, and as an element of landscape to form a unique pattern. However, in the practical layer, the significant differences between street furniture and other landscape elements lie in that the street furniture is not only for ornament or creates a relaxed atmosphere for people but also supplies the same service and convenience in citizens' daily lives promotes it. Furthermore, on account of the main feature of the new-generation street, furniture is polytechnic integrated and multi-function. Therefore, its core issue has made it easier to find and inspire people to use it. Therefore, the study on that topic will trend to more quantifiable to measure and predict its usage and more visible to coincide with the total layout of the open public space.

According to the above, the placement of new street furniture on the place layer needs to follow the design rules as the same as the other landscape elements and discover new guidelines for another side as a product. From this perspective, the street furniture, as a production for daily public service, the user, and the usage environment should be considered. On the place layer, the place means the street, square, park, and other public open places in the city to be located in the new street furniture. Therefore, the site analysis must study better the needs of the local place and the methods for more chances for the new facility will be installed to be used: (a) found, (b) stay, and (c) used.

This part will be unfolded following with the study flow as Figure 5-17. The specific place-aimed placement site should be classified into different open public places to discuss its characteristics. Then to study its existing layout from a more people-oriented perspective such as visibility, walkability; and the activity there should be investigated and summarized to find the specific behavior pattern there and possible opportunities to use the new street furniture; finally, a better placement condition could be learned to support more active public atmosphere.

5.5.1 Types

The open public space in the city could be classified into many different types according to several standards. In this study, the city place was discussed from the city center, residential area, park, and street by the location and function in the whole city system.

Different types of open public spaces represent distinct users' structures and activities. Consequently, it is necessary to talk about the placement of street furniture to affirm the type of potential site for placement.

5.5.1.1 City center

The city center is the city center's geographical center and the economic and cultural center in the city as the symbol of the urban features. Especially in most long-history of cities, the city center evolved from the political center and public activity of ancient time to a place holding distinct, concentrated culture, which supplies the place for business, open-air market, public celebration, ceremony, festival activity, and communication. The users of the city center from all over the city and in other hand attract visitors get-together there. Most public activities in the center cannot be found in any other open public space citywide. The location of this kind of place could be analyzed from the urban axial map. Historically, the city center is usually located in an area with higher connectivity and integration value. Besides, the city center most distributes near the train station and geographic place where the number of public buildings is inseparable from the city-forming procedure from the development step of the city.

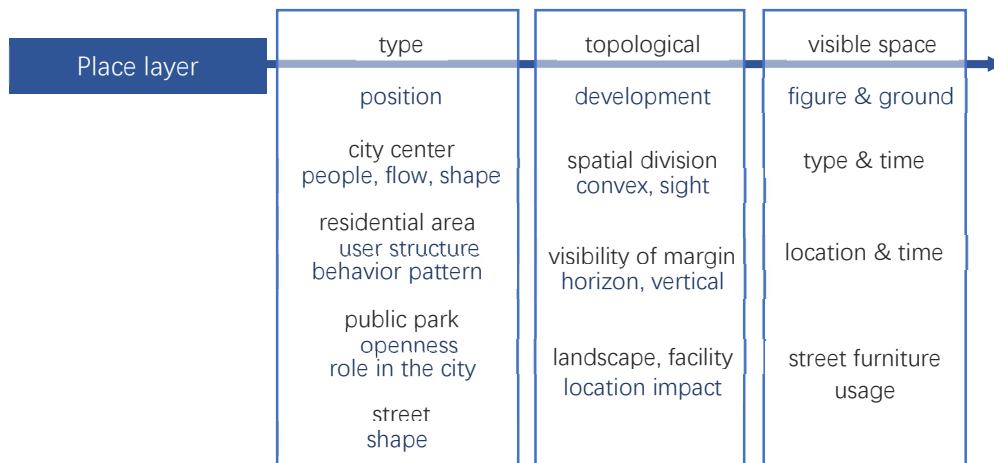


Fig. 5-17 The planning flow framework of street furniture from the place layer: more local analysis for a better understanding of the micro-city and to grasp the detailed information from 3 aspects for street furniture plan: type, layout, and activity

The city center's primary forms of open public spaces include city center square and Commercial Pedestrian Street (see Figure 5-18, 5-19). The comparison between them shows in follow Table 5-3. According to the above, the placement of street furniture there are different: the placement in the city center square should be the margin of the space to guarantee the maximum open area, and the placement in the Pedestrian Street should be chosen in the central axis of the street to keep the commercial interface as continuous as possible. A host of economic activities mean abundant of users with various behavior and aims there. As a result, the function and placement should be considered for more users, including citizens and foreign visitors. That means the design has higher visibility and easy-planning rules and combines with the main flow direction to make it smooth to find the city public facility.



Fig. 5-18 City center square: Piazza San Paolo in Turin (2017, June 3)



Fig. 5-19 Commercial Pedestrian Street: Via Accademia

In the city center, the placement of street furniture has a close connection with the site's shape. However, street furniture playing there is not such essential hinges on the primary function and activity planned. Consequently, its placement is always arranged away from the prominent active area.

Table 5-3 The comparison between city center square and Commercial Pedestrian Street

	<i>City center square</i>	<i>Commercial Pedestrian Street</i>
<i>form</i>	vast space: square, triangle, circle	narrow space: linear rectangle
<i>users</i>	local citizens, foreign visitor	local citizens, foreign visitor
<i>activity</i>	get-together activity: photographing, watching, stopping, celebrating	commercial activity: shopping, watching
<i>flow</i>	center, margin	margin
<i>flowability</i>	low	high
<i>placement of street furniture</i>	margin	center

5.5.1.2 Resident areas

The residential area, also called neighborhood public space, is the most common type of city open public space for the people living around and life cycle pass-by (mentioned in section 5.4.2). Neither of the scale or shapes of this kind of square is certain. It is mainly determined by the local plan of the district layer to supply an area to relax or take leisure, which is the “vacancy” in the urban figure-background relationship. In this kind of place, the regular people's activity is according to the local behavioral pattern, which could be investigated through in-field study. Consequently, the design both of placement and function of street furniture should follow the factors of local usage. That is relatively stable in the residential area relative to the users' structure in the city center, where it is essential to realize highly self-organized in the local area by creating a buffer between 2 routes to relieve the pressure from long-walk.

The primary location of residential areas is usually at the street's end and the crossing as the road's expansion. So, the residential area has the function of passage besides relaxation, and the people flow from distinct directions are not the same. Therefore, the placement of street furniture is closely related to the local residential movement, such as the age of users, the time spent there, customary route, and so on to promote the visibility and walkability of the street furniture; in addition, the function design should also follow with the customs of people living nearby (see Figure 5-20).



a) Piazza Risorgimento in Turin



b) Piazzetta Ludwik in Turin

Fig. 5-20 both (a) and (b) are residential areas nearby in Turin with different locations, scales, functions, and ranges of users. Even if the two sites are close, the usages are distinct from each other. Most of the placement of street furniture is combined with the other elements forming the landscape pattern.

The residential areas could be subdivided continually. For the placement of new street furniture, the study logics of different sub-types are similar. The people's movement could be conferred by researching the local behavioral pattern and the spatial pattern. Moreover, the data would be used to support the design of the new street furniture.

5.5.1.3 Park

The city park is an integral part of the whole city system as an urbanscape and ecosystem to provide leisure, visit, communication, holding the public activity, cultural event and so on with citizens. The primary function of the park is for social life activities rather than passing by. The most city park has clear margin with barrier because it needs to recognize the activities through a limited number of entrances and designed routes to divide spaces. In addition, most parks with a specific theme are to attract people around the whole city with its location possible both in the city center and city margin. As a result, the area of the park is more significant than any other type of open public space in the city and designed more completed: (a) firstly, the entrances should be confirmed depending on the traffic conditions and the location in the whole city; (b) secondly, the space of the park is divided according to with the theme, and then the route network system is planned to connect the serious of spaces; (c) the landscape, predominantly plants, is chosen and arranged as per the geological and hydrological condition; (d) the location of the building is determined covering basic plan form, location of the entrance, height, and other elements.

The street furniture in the park plays an assist role to make the public life there more convenient (according to the accessibility pyramid, it is easy to find that the urban public facility is not the necessary element to whether daily social activities could be taken). Consequently, the plan of street furniture is usually the final step in the design flow of the park. The street furniture needs to satisfy a certain satisfy radius and higher accessibility to enhance the quality of activity taken in the park. The complicated spatial relationship in the large parks could easily cause interruption of the view from street furniture, which accessibility is reduced as a result. The abundant spatial experience in the park stands in sharp relief against the simple layout in the city center place to stay citizens longer to let them get fully relaxed there. So, the core issue of placement of street furniture mainly focuses on the service radius, and high accessibility contains visibility and walkability.



a) Valentino Park in Turin



b) Vento Park in Turin

Fig. 5-21 The two parks in Turin respect two different typical themes in the city: waterfront park and urban pattern park

The city park likes an independent area and functional building without opaque walls in a city configuration. People take plenty of activities to relax, and from this point of view, the street furniture like a “pause” to link two activities – walking along the path is also an activity in the park. Therefore, the placement of street furniture in a park could be designed to reference the life circle (discussed in section 5.4.2) to organize the spaces – activity for people reasonably. As stated in the method above, the usage of street furniture becomes an event, and each element to inspire public activity is flattened in the park to study the potential movement flow.

5.5.1.4 Sidewalk

The sidewalk in the city makes up the transportation system of the city. For people walking in the urban space, the widths of pedestrian streets are different for many reasons. In some city situations, as per the linear shape, the sidewalk is divided into a series of parallel spaces for walking, biking, and sitting, respectively. Even if the methods to divide the space are simple, not single. Figure 5-22 shows that the street benches’ placements are different: (a) is near the street, and (b) is far from the street. The location depends on the sidewalk’s width, the neighboring street’s level in the city, and the sightline’s permeability on the ground floor of the interface between the sidewalk and the building in the block.

On the other side, the street’s conditions should also be considered, such as the active type, the scale, the service area, and the potential shade of the urban facility from the situation on the street. In addition, to talking about sidewalks, a narrow open public space, the security issue is the premise of placement design of street furniture. Consequently, both pedestrian sightlines on the sidewalk and drivers on the street need to be simulated after the designed location of new street furniture is done.



a) Corso Alcide De Gasperi in Turin



b) Via Bologna in Turin

Fig. 5-22 The two streets in Turin respect two different typical themes in the city: near the traffic interface and far from the traffic interface. The different placement schemes depend on the interface between the building and pedestrian streets.

5.5.1.4 Summary

The roles of different types of open public spaces are quite different from each other in the city system. Some distinct layouts of street furniture are brought by scales, shape, functions in the city, locations, openness, and other characteristics. The first step of the decision on the placement of street furniture is to confirm the type of aimed place's belonging. And then, the limited condition for location design for the new urban facility could be analyzed targeted. (a) The main issue for the city center is the study on people flow; (b) the main issue for residential area is the investigation on people behavior patterns; (c) the main issue for the park is the accessibility, including visibility and walkability; and (d) the main issue for the sidewalk is the experience of view.

5.5.2 Layout

To most placement of new street furniture, the aimed place is well-designed on the landscape planning. So, it is necessary to study the existing layout of the open public space, including the physical spaces and located landscape elements from the users' perspective.

Firstly, the spaces perceived by citizens in the place are not as designed as drawing, should be studied from the actual interactive way with people – spatial division. Secondly, caused by the experience of spatial margin is not as the same as the central space, the visibility of margin was researched next. Finally, the location of existing facilities was learned for a new composition relation with new elements.

5.5.2.1 Spatial division

Defensible space theory

As the defensible space theory stated, defensible space is where a user's security needs are satisfied with four factors: domain, natural watch, environment image, and surrounding. The defensibility for a geometric space is not equal, and the sense of security is higher in the area closed by the lines connected to the midpoint of each edge in the polygon than in other areas. Geometrically, the graph could be regarded as a matrix of points. The closer to the center of the viewpoint is, the larger the sight area is. The central area is the square's visual core to an open public space, and the midpoint of each edge is the observation point. As a result, it benefits for a shorter time to make a quick judgment

about a square for more defensibility to locate the entrance to the open public space at the acute angle (see Figure 5-22).

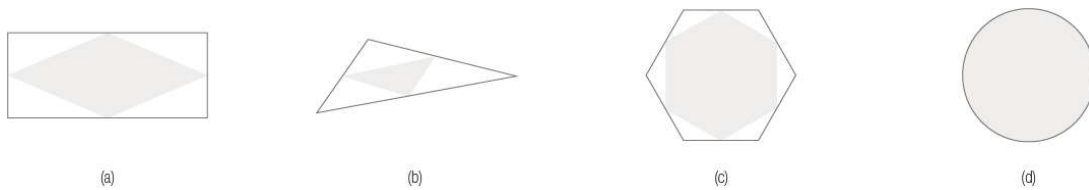
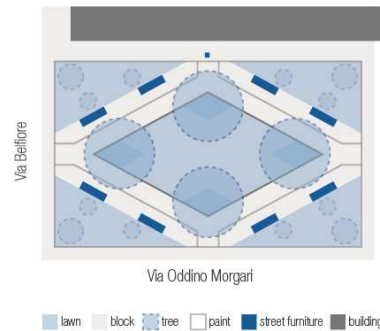
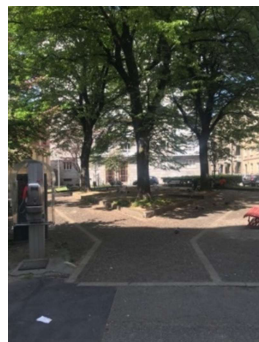


Fig. 5-22 (a), (b), (c), and (d) show four kinds of forms of squares, and the gray area represent higher defensible space formed by the connection of the midpoint of each edge of polygons. It is easy to find that the secure area is the largest in a circle. In other words, the security in a circle is the highest among different forms. The security in the central part of the form is higher than that in the margin area.

The layout design should follow the defensible space rules. Moreover, the actual people's movement will be impacted by the spatial division. Take the case of the Piazza Donatello (see Figure 5-23), where the form is a rectangle, and the layout pattern matches with the defensible space figure (see Figure 5-22-a). The area with low security is planned as a landscape with trees and flowers. Most street furniture is located along with the security margin to keep the sight area as large as possible. The central area is full of trees. That is to say, the highest security part of the piazza is not planned as any space for activity. During the investigation, few people took activities in that area. Furthermore, because of the blocking of sightlines, the total security of Piazza Donatello is low, that many homeless people sleeping on the benches there.



a) The photo was taken at the entrance to Piazza Donatello b) The layout of Piazza Donatello

Fig. 5-23 The layout pattern analysis of Piazza Donatello

Visible area analysis

With the method above that open public space was regarded as a matrix of points, space could be transferred to a series of interlinked points by applying calculus thinking. Moreover, the relationship of spaces becomes the links among points. From the perspective of the relation between the entity and space, visibility turns to spatial segmentation with potential generally. Some space is seen at first glance, and others need a longer time to find. However, this visibility of the law to abstract space must minimize individual differences with more attention paid itself. In section 5.3, the axial map analysis and convex space were introduced for the spatial system also adapts to a single space, where the question of the subjectivity of the method can be solved through in-field study combined with the investigation on local movement investigation record to learn the actual situation of the spatial segmentation in the particular place.

According to the visual segmentation method, the Piazza Risorgimento case was redesigned in 2016 and formed an ample open space in the center of the square, according to the visual segmentation method, divided by the following schemes (see Figure 5-24).

Nevertheless, as the data collected during the in-field study, the detailed spatial division was found by the local pedestrian movement tracing. Moreover, as per the feature of the connection of divided spaces, it is easy to find that the actual division pattern is determined by the users' structure there, where nearly 87% of users are the aging, whose behavioral characteristics of the elderly tend to be more direct, ornamental activities without time limitation in the open air. Therefore, the overlay of spatial geometry could obtain the differences from the design expectation to the actual usage of the open public space and people behavior pattern, then propose the local people need and the proposal to improve local vitality.

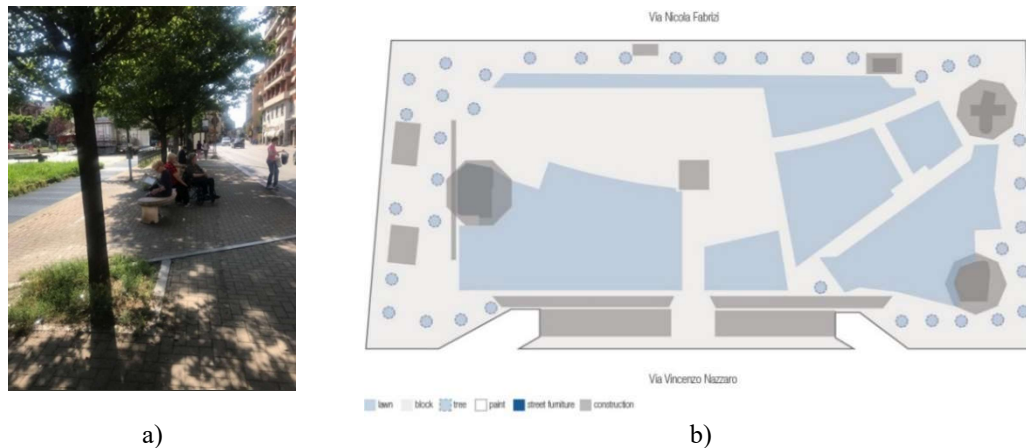


Fig. 5-24 The layout pattern analysis of Piazza Risorgimento

Integration of visual area analysis

A point matrix with a specific density is established to simulate and analyze a spatial relationship than to calculate the sight area for each point in the place. Then, as per the connection among these visual areas, the syntax variable of each point is worked out. This approach is called the integration of visual area analysis (Turner, 1999).

Given the relationship among points, it is not necessary for two observation points in the place with partly overlapping visual areas to see each other. In the integration of visual area analysis, both the observation points in the place are defined as having connectivity when they can see each other (point first movement) and cannot see each other with the overlapping visual area (point second movement). Then the researchers in UCL only called the points in the place have connectivity as they could see each other (point first movement) and generate the corresponding analysis graph to calculate integration and another parameter, finally to variables in space syntax of each point represented for tiny space.

Surface partition and endpoint partition analysis

Motion is closely related to the perception and understanding of space. Frankl (1914) stated that the premise of description form with cognition when moving in the space is to synthesize the local images from different observation points in the building. Cassirer (1955) pointed out that intuition of form was related to motion because motion can be understood as an underlying form and interpreted as the underlying structure. Poincare (1913) illustrated differently from Piaget and Inhelder (1967) that motion allowed us to correlate distinct viewpoints in complex spatial structure and find the operational basis of spatial description through the combination of direct experience and abstract reasoning. On the other hand, Gibson pointed out more specifically from space perception that the

relationship between the visible, the regressive, and the shaded edges observed in the movement makes people understand the spatial structure (Peponis, 1997).

On this basis, Peponis further commented that the spatial information perceived by people moving in the space was generally discontinuous. Therefore, people divided the spatial system into basic units of visual perception according to the discontinuity and then to form an understanding of the spatial boundary through the configuration of these spatial units. Consequently, space division was to find the boundary of these space unities. Peponis thought that the discontinuity of spatial information is caused by the interruption to the spatial boundary, such as the corner of the wall, the turning of the wall, the end of the free-form wall distinguishes the physical boundary into different edges. And then, the basic unit for spatial information is defined by “whether could see the same edge”.

Surface partition measures space division by extending both sides of all relax angles (angles greater than 180 degrees less than 360 degrees). The endpoint of the free-form wall can be recognized as a 360 degrees angle, so it should also be extended. The dividing line is the critical point between visible and invisible on the extended wall surface with the divided subspace called *S space*. The endpoint partition draws the extension lines of all the extendable relax angle connectors beyond surface partition lines. That means the boundary between the visible and invisible edges, where the visible line can be no longer seen as soon as crossing the line or a visible line can be found, forming *E space*, with the characteristic of “obtaining information stably”. In other words, each point in the same *E space* can only see the same edge, precisely that the basic unit of spatial experience is. It is not equal to spaces forming by endpoint partition to obtain visual information from locals. The blue ones can get the least visual information – four edges, and on the other hand, the yellow ones can get the most visual-spatial information – eight edges. Peponis defined the spatial continuity by visibility: if each point in the 2 *E spaces* could see each other, there is a convex space that contains the 2 *E spaces* without interruption by entities, and the 2 *E spaces* are considered to be connected. In this way, the diagram is generated to show the relationship among *E spaces*, then to calculate the following syntax variables. Furthermore, the depth of some *E space* means determining the number of steps needed to visually see the entire space from the *E space* (Figure 5-25).

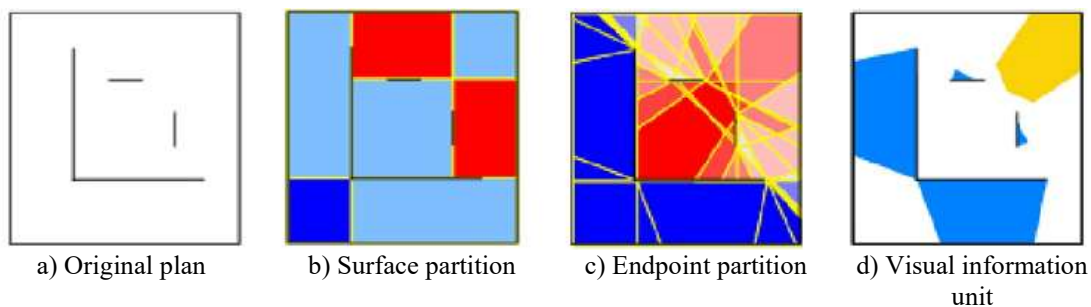


Fig. 5-25 The visual information unit by surface partition and endpoint partition (Modified from Zhang, 2004)

5.5.2.2 Visibility of margin

Analysis from horizon

The boundary of space is the way to define the space and an essential factor to shape the overall perception of space. Psarra from the architecture school of Welsh directly took the spatial boundary as the research object and discussed the visibility differences between different positions of the spatial boundary and the structural relationship among those from the research level of points. Firstly, the boundary divides the space into the same-size grid. Then, each grid is put as a point, according to the visibility between grid (that

is, a grid cannot keep out from inside the space to see another grid), generates relationship diagram, and finally to calculate the syntactic variables of each grid with the size of different shades of colors represent for the values of distinct variables. The lighter the color is, the more space boundaries can be seen.

Figure 5-26 shows the analysis for some H-shape space's boundary to discuss the relationship between the visibility of spatial boundary and the gradually widening of both up and down open gaps. It shows the integration analysis of connectivity in three cases with different shapes respectively at the upper left. It is easy to find that connectivity and integration are generally low near the concave's angle and other closed ones. According to the table on the right, both the mean connectivity and integration points on the boundary gradually decline with the "open gap" becoming wider and wider. It shows the assumption that the boundary is straightened as the x-axis, and the y-axis represents the corresponding connectivity value and integration value of each point on the left below, forming a variation trend chart. It is observed that the change successively decreases from left to right, which also quantitatively indicates that the standard deviation (V-value) of its connectivity gradually declines. In addition, the change in connectivity keeps up with the corresponding change in integration in these three shapes. However, both connectivity and synergy (R-squared) reduce the three situations from the point of value sequentially. It illustrates that the more irregular the spatial boundary is, the more difficult it is for the observer to understand margin configuration.

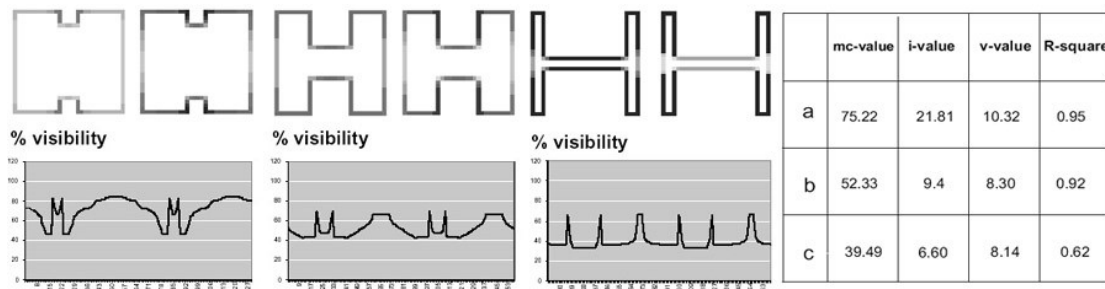


Fig. 5-26 The diagram shows the changes in visibility causing by the transformation of shapes (Psarra, 2003)

This method is to discover the structural relationship of spatial boundary on the layer of points. Consequently, it is more accurate than the integration of visual area analysis able to distinguish the configuration difference of different positions on the same edge to provide a way to understand the boundary of space objectively.

Analysis from facade

The boundary of open public space acts as a barrier to the sidewalk, including the accessibility of walkability and accessibility of sightline, and plays a vital role in the overall spatial perception. For instance, people are used to understanding the space through its geometric such as symmetry. The sight block on the symmetrical axis of the square would make trouble with the intelligibility of the city's open public space. Geometric regular is helpful for residents to infer the logic of spatial organization from interface vertical to the ground. The façade with few standard geometric rules is hard to create a sense of security or stability, affecting people crossing and staying in the space and against street furniture placing in the particular open public space.

5.5.2.3 Landscape facility

The main features in the city's open public space include three roles: ornamental, functional, and municipal. All the landscape elements constitute the whole facility system.

The interaction between each facility and people is diversely reflected in attraction value, barrier effect, and service radius, forming coactions in the space like magnetic field overlaying on the existing physical condition to impact people's behavior patterns.

The research shows an apparent correspondence between the spatial configuration of open public space and activities taken there, especially informal activities. The status of people distribution in the space, seemingly complex and random get-together, could be changed by altering the facility's placement and providing vital guidance for practical design. Sitte stated that the foundation and monuments should be located with low traffic in traditional open public spaces. He supposed that the snow-covered the square of a city with a series of paths beat out through the snow, naturally forming streets, and children would pile snowmen in large open spaces between streets. The open public squares were not paved or even built flat complete with ruts and open ditches in ancient times (Sitte, 1990, 14). As a result, people placed the fountain on the island place to avoid traffic flow. This selection method for placement adequately considered the human behavior pattern.

Azimzadeh (2003) studied the Neuer market in Vienna (see Figure 5-27), where Sitte mentioned many times, by all-line analysis. It is easy to find that the axial structure is clear. The axis with the highest integration (the red line) is roughly along the diagonal of the square connecting the alley at the upper left corner and the other one at the lower right corner. According to Sitte's saying, this seems to be understood as the main route for people crossing the square. As the comparison of graphs shown, the axial structure of the plaza after the construction completed of the fountain is quite similar to the plaza's structure before. In addition, both the locations and directions of lines with the highest integration almost perfect match. In that regard, the people's understanding of spatial layout is a few convenient straight paths and the relationship between these straight lines. The fountain's construction maintains the original spatial layout and enhances its structural characteristics with the importance of the line in highest integration strengthened.

If the fountain's location were moved to the path pedestrian crossing the square, all the axes would change a lot. The lines with high integration are distributed in different directions, and consequently, the structure is not clear enough. If the fountain was placed where it is most unlikely to concentrate people flow and then carry out all-line analysis, it is easy to find that an optional placement of the fountain would cause significant changes in the spatial structure of the whole square. People can intuitively detect this structural change and use it to guide their activities in the city's open public space.

This visible analysis according to place layout could offer a method to check the potential placement of the new street furniture to predict the impact to the people activities in the specific place through rational and accurate research the spatial configuration can be revealed which can only be understood by intuition and the motion structure determined by it.

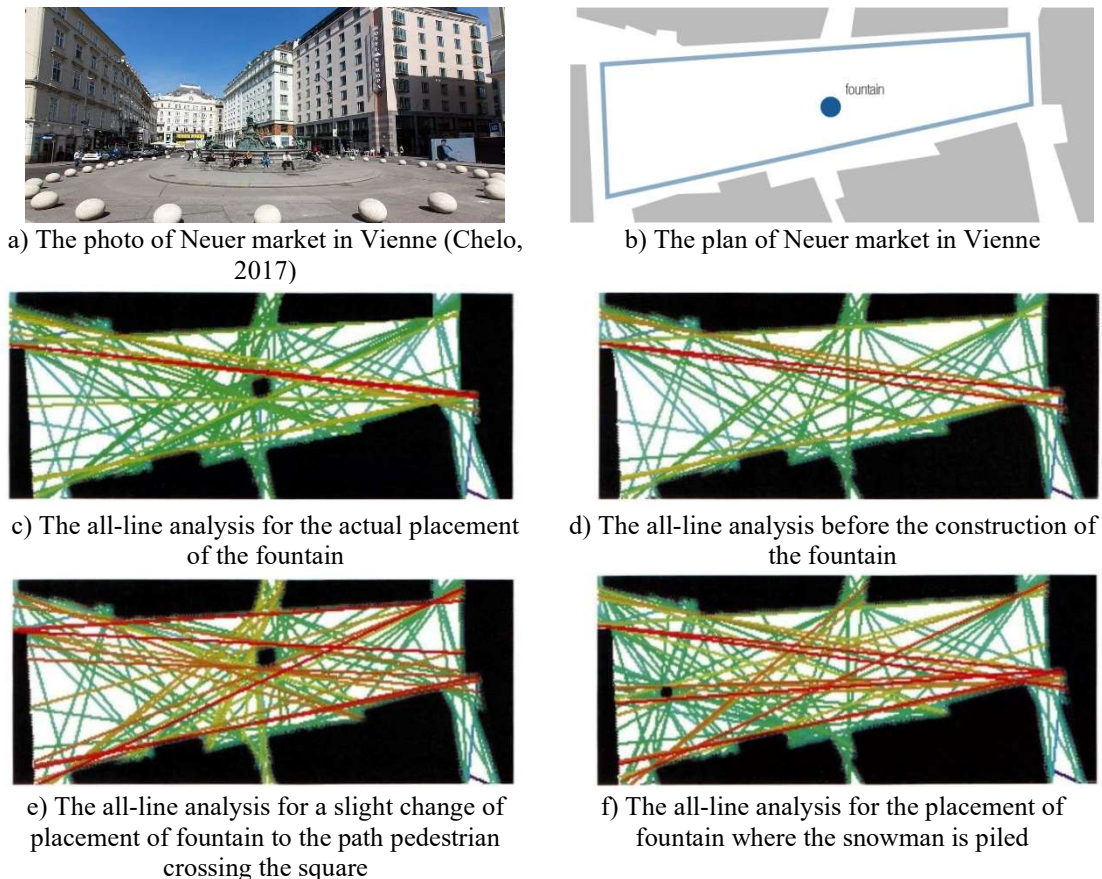


Fig. 5-27 Neuer market in Vienna ((c), (d), (e) and (f) referenced Azimzadeh, 2003)

5.5.2.4 Summary

The most common research layer for the placement of street furniture is the existing layout. In this part, the quantitative and visible analysis methods are developed instead of the general ones to study the relationship between landscape elements and residential behavior. Consequently, the study flow was researched in this part: (a) the space of the specific place could be subdivided to represent different physical and psychological experiences. From the physical level, the place could be recognized from the space and the margin. So, the spatial division methods were discussed to supply comparison among different thoughts; (b) the characteristics of spatial margin quite different from the central space were studied from horizon level and vertical direction, and (c) the relationship between the location of landscape element and the structure of the particular place, and the impact to the people movement.

5.5.3 Activities

The illustration of necessary and optional activities comes from *People on Foot* by Gehl in the architectural journal *Arkitekten* in 1968. It was part of the first extensive study of the correlation between public space and public life.

This early categorization of activities is part of Gehl's essential work to describe life in city spaces. Later, the general categories of necessary and optional activities were described from a historical perspective in *New City Life*. In the 20th century, fewer necessary activities took place in public space. If this illustration of activities had been made in 2012, it would include new activities such as talking on cell phones – while walking, standing, and seated – smoking in public space due to changes in smoking legislation and many types of exercise. Moreover, the type of activities would vary widely from place to place.

The activities imply the local customs of citizens living in the particular city. Furthermore, the activity taken in the open public space is connected with different staying times in the square. The sort of activities means represent the people are used to spend how much time there. The activity investigation is the primary data to study the local behavior pattern (Figure 5-28).

The city's open public space bears the most basic transportation function to link each destination in the life circle (mentioned in section 5.4.2). From the walk point, the stop during the walk becomes one of the most critical foundational conditions for the activity taken on the way. Both the time and duration of stay change with the physical spatial condition altering. When the time of stay turns longer, the residential need for sitting is generated as a result. Moreover, the human activity alters from walk to stand then to sit (see Figure 5-28), which is generalized behavior referring to the stay in an open public space with straightforward activity content, which is also one of the most common behaviors people do in the public life. That is reflected in the fact that even if there is no relative street furniture in the space, people may create conditions to meet the requirement of sitting. The classification of people behavior patterns in open public space is significantly classified according to the region, due to the background of different cultures, histories, economics, and habits in a different region, where includes not only different countries, but also different places within the same city bringing significant gaps in behaviors, time cost, and other properties.

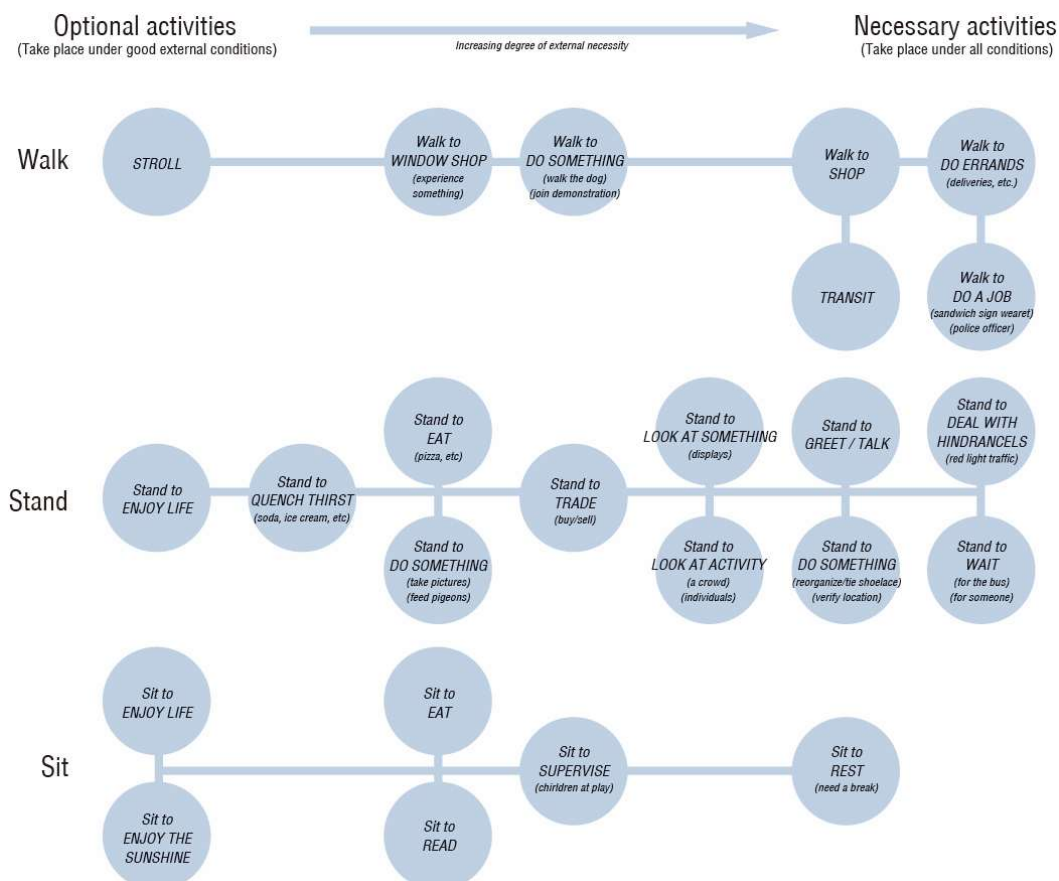


Fig. 5-28 Necessary and optional activities in open public space (Modified from Gehl, 2012)

5.5.3.1 Types and conditions

By remapping Maslow's theory to the activity citizens taking in the open public space, the diagram abstained as shown in Figure 5-29. According to Maslow's hierarchy of needs,

the people’s needs in daily life are classified into physiological, safety needs, love and belonging, esteem, and self-actualization. Combined with elements in the urban space, there are three categories in people’s needs in public space: protection, possibilities, and personal expression from the basic need to high-class mental need with an increasing degree of external necessity.

- *Protection*: physiologically and safely, the activity people taking in the open public space is for protection themselves basically: (a) against traffic and accident; (b) against crime and violence, and (c) against unpleasant climate.
- *Possibility*: belonging and physically, the activity people taking in the open public space is to transport and complete the social life for daily needs. The open place offers the place to prompt the activity happened. The environmental conditions of possible activities for the particular motion are different in facilities and atmosphere.
- *Personal expression*: emotionally, people’s activities in the open public space are for personal expression.

It is hard to identify that some particular activity belongs to someone category. Generally, one activity taken is for many needs in daily life. However, its condition could be understood through different layers than to find the corresponding environmental condition, including the placement and function of new street furniture.

The conditions accompanied by the activities above indicate that people divide the space into different areas according to their demand structure and put forward different usage methods - activities causing by their behavioral pattern. Consequently, the functions, forms, and layouts of street furniture should comply with local people’s activity type and condition.

There three categories in people needs in public space: protection, possibilities and personal expression.

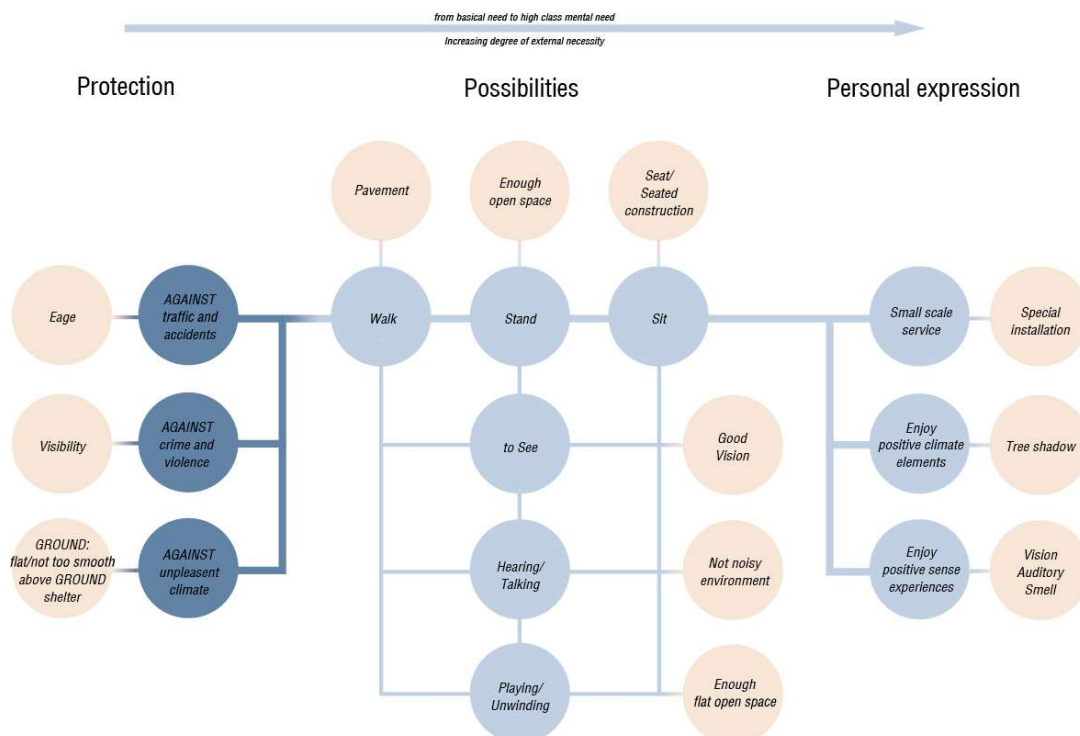


Fig. 5-28 Three categories in people in public space: protection. possibility and personal expression (referenced Gehl, 2012)

5.5.3.2. Location and time

The speed is fluctuant citizens walking in the city open public space at different daily

circles and affected by the place and time the people walk by. (The core issue of this study is the placement of the new street furniture). In common sense, people would accelerate when crossing the street. However, on the other hand, citizens are used to speeding up when passing by the open public space holding a celebration, exhibition, and other public activities. Consequently, the edge of open public space, a significantly more expansive space, is set as a quick-pass way to guarantee different types of activities from interfering. According to the data collected through investigation, average pedestrian speed is higher when walking on the regular sidewalk than in the park and square. It has to do with the different spatial shapes, which has an oppressive and guided effect to people's behavior pattern (discussed in section 5.4.1). Consequently, the faster the movement speed is, the more unfavorable the observation of street furniture is or in the open public space stays. The average speed of pedestrians in different routes in the daily life cycle can be studied by tracing (the method was introduced in section 2.1.3.3), and the area with high stability can be found then compare the conclusion with the analysis by the location of the street furniture and the environmental layout to study the gap between practical situation and design condition. Meanwhile, the layout is helpful for a pedestrian to quickly judge the activity being held there outside the square then to decide whether they want to take part in it.

The study follows four registrations of pedestrians' average speed covering a 100-meter stretch along the walking street in Copenhagen (see Figure 5-30). The entire 1.1 km long street can be walked in 12 minutes, but in practice, speed is influenced by weather, age, mobility, errands, and whether the pedestrian is alone or part of a group. In addition, the walking speed also correlates with temperature.

A representative segment of pedestrians was shadowed through a 100-meter stretch, and their speed registered in seconds per 100 meters. The graph clearly shows the tendency to walk slower in warmer weather. Shown at the bottom is how different people walk faster than people in groups. Individual men walk fastest (record: 48 seconds/100 meters), with teenagers and women slightly slower. Then come people in groups, and just like in any other convoy, they are forced to follow the speed of the slowest participant. A police officer on patrol clocked the slowest time, 137 seconds/100 meters.

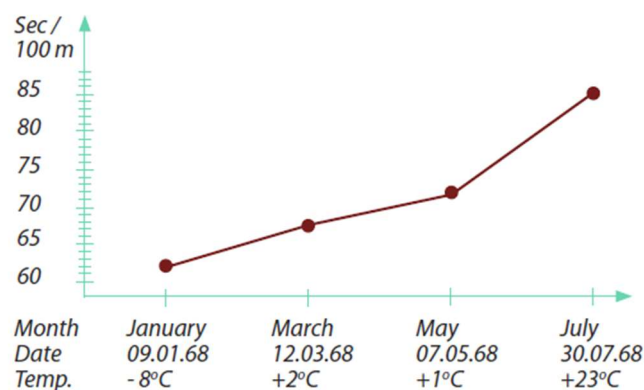


Fig. 5-30 The average speed it took randomly selected pedestrians to cover 100 meters. Four registrations were made on Copenhagen's pedestrian street in January, March, May, and July. (Gehl, 1968)

5.3.3.3 Street furniture usages

The usage of street furniture should be thought to take the layout of the open public space and the users' structure (see Figure 5-31). Therefore, it is necessary to study the local behavior pattern in-field to analyze advantages and disadvantages through the

relationship between existing environmental conditions and the utilization of the new street furniture.

5.5.3.3. Summary

It is the most intuitive expression of the liveness of local social life that the activity people are taking in the public space. It is necessary to understand the types of activities and the matching condition, including time, temperature, and personal behavior, besides the placement of street furniture to improve the quality of public life from the place layer. In other words, the usage of street furniture relates to the built environmental condition and the alterable residential movement according to the physical and psychological conditions. The study of this part should be taken as a premise for the placement plan of street furniture to adapt to the local behavior pattern. On the other hand, the research also plays an essential role in the local function chosen of new-generation street furniture.

5.5.4 Conclusion

The place layer aims to evolve various methods to build a relationship between the landscape environment and the local behavioral pattern. In this way, the potential users of the future street furniture could turn from description to data and be applied in a geometrical relationship for graphical layout design. The usage of street furniture and the related planning factor is quantified by software calculation and in-field investigation. The precise impact relation must be locally observed and analyzed from different aspects such as the time, type, temperature to respect the local people's behavior pattern.

5.6 Conclusion

The procedure of plan street furniture is dynamic, systematic, needs to combine the physical conditions and people's behavior patterns. Most new street furniture placement design focuses on the geometrical relationship of landscape elements in the site, potentially located the new urban facility in the past. With the development of technology and social life, the city's public activity is degenerating, which is the core content to forming an urban relationship. Consequently, the new mission of fresh landscape elements, including new-generation street furniture, inspires citizens to participate in the public event to activate the existing open space. The new smart street furniture plays a role in supplying more opportunities to help people communicate and create besides making daily life more convenient. Its placement decision should be thought from multi-scale layer for the city to higher accessibility including walkability, visibility, and availability – from user-friendly to user-welcome. This part is to supply a research strategy through discussions on the influence factors from city layer, district layer, and place layer to match distinct stages in the whole process of the new street furniture plan. This method is built based on all the new street furniture is recognized as a system. Besides, it is designed and planned to coordinate with other landscape elements to ensure an entire layout of the particular open public space. (a) The city layer research the whole urban configuration from axis analysis, topological structure analysis, and visual space analysis. (b) The district layer tends to study the neighborhood relationship of the local series of spaces from configuration, function, and streetscape. (c) The place layer: more tends to analyze the interaction between local people's behavior patterns and the landscape elements from the type of the place, the layout of the place, and the activity people are taking in the place. Moreover, the study flow with analysis methods and the meaning is unfolded following the sub-layer mentioned above.

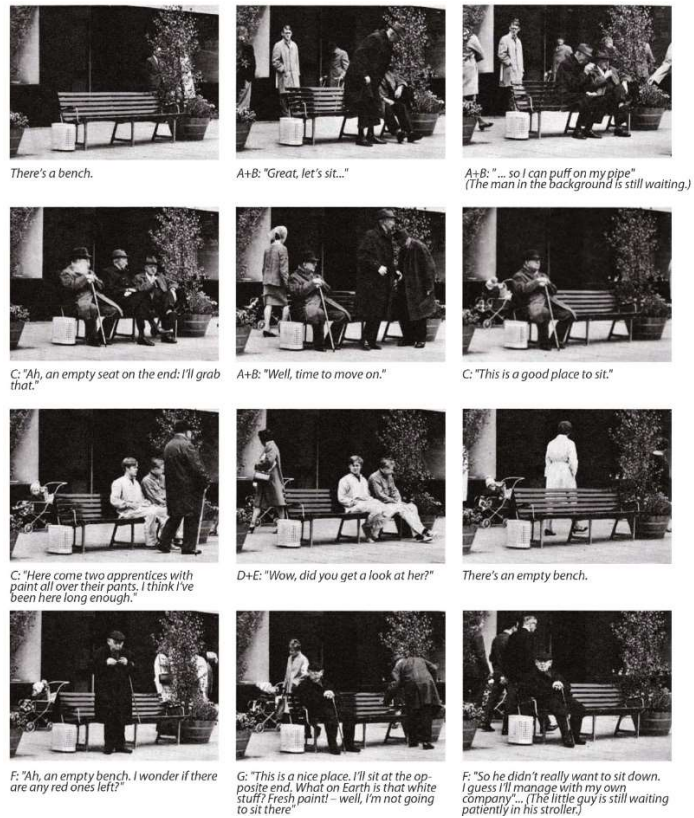


Fig. 5-31 How is a bench used? (Gehl, 1968)

CHAPTER SIX

CASE STUDY IN TURIN

6.1 Introduction

The topic of this thesis is based on *Sm²art*, a research project supported by the Italian Ministry of Research Education and University aimed at designing innovative street furniture integrated with digital technologies. Moreover, the prototype, which the research group proposes at the Polytechnic University of Turin, is located in Largo Alessandria (see Figure 6-1). The feasibility analysis is studied in this chapter by following the plan flow concluded above.



Fig. 6-1 Largo Alessandria in Turin

The planning flow will be unfolded from three layers: city layer, district layer, and local layer (see Table 6-1). Firstly, analyze the conditions of all aspects according to the framework of street furniture plan flow:

- The city layer analyzes the location relationship of the aimed public place in the whole city and confirms the public space type to infer the user structure. The primary functional component of street furniture could be listed.
- The district layer analyzes the traffic relationship, functional relationship, people flow, and horizon relationship. Moreover, according to the above, the condition of placement benefits the accessibility of street furniture could be summarized.
- From the local layer, analyze the layout of the aimed placement and the existing street furniture, through field-study, the relationship between local behavior pattern and the usage of street furniture could be concluded, and then to predict the usage of new street furniture sited there.
- Finally, the list of local plan flow for the new street furniture could be designed (see Table 6-1).

Table 6-1 Planning flow of new street furniture

layer	sub-layer	influence element	method	parameter	algorithm/ theory	meaning
city	economic activity	economic framework	axial division	connectivity	connectivity measures the number of spaces immediately connecting space of origin	The connectivity of axes reflects the possibility of some streets to connect other streets. The whole city's function location and development position could be analyzed by comparing the connectivity and district maps.
		least angle	segment division	street density	$Sd = \frac{tD}{tA}$	The street density means the total distance in the street network to the area ratio in a specific range of urban area to describe the street development level.
		accessibility	axial division	global integration and local integration	$I_n = \frac{m \left\{ \log_2 \left(\frac{m+2}{3} - 1 \right) + 1 \right\}}{(m-1)(\bar{D}-1)}$	The whole city economic activity type could be analyzed through a comparison between global integration and local integration.
	traffic activity	positive walk	axial division	global integration and local integration	$I_n = \frac{m \left\{ \log_2 \left(\frac{m+2}{3} - 1 \right) + 1 \right\}}{(m-1)(\bar{D}-1)}$	By comparing global integration and local integration of the specific open public space, the possibility of the positive walk could be analyzed, which has a close relationship of potential chances of usage of street furniture.
		friendly wayfinding	axial division	connectivity	the synergy between connectivity and local integration	The local intelligibility could be reached through the synergy between connectivity and local integration, which has a close relationship with the ease of understanding and reading the road network and is vital to finding street furniture.
		sense of security	axial division	global integration	$I_n = \frac{m \left\{ \log_2 \left(\frac{m+2}{3} - 1 \right) + 1 \right\}}{(m-1)(\bar{D}-1)}$	The integration of streets determines the people's flow densities. That is because the main entrance to the open public space fits the street with higher integration.
district	configuration	communicability	axial division	people flow interface	the correlation between global axial integration and axial selectivity When $R^2 < 0.5$, they are uncorrelated; $0.7 > R^2 > 0.5$, they are weakly uncorrelated; when $R^2 > 0.7$, they are strongly uncorrelated	The correlation reflects the probability for residents to meet their familiar neighbors. Therefore, the higher correlation means more opportunities to stay people in a particular space.

	intelligibility	axial division	intelligible degree	the correlation between global axial integration and axial connectivity When $R^2 < 0.5$, they are uncorrelated; $0.7 > R^2 > 0.5$, they are weakly uncorrelated; when $R^2 > 0.7$, they are strongly uncorrelated	The correlation illustrates the activities people taking in the public space, and then the intelligibility of surrounding spatial structure can be speculated. The higher the correlation is, the higher the intelligibility of the street structure is.
function	dependency	PSPL	life cycle	classify the usage situation of different city open public spaces according to the function of neighborhood building	The usage of street furniture is close to the function of surrounding buildings. The origin of people flow could be summarized through the classification.
streetscape	façade	PSPL	permeability	draw the permeability of interface of streetscape red means accessibility of body to the public; orange means accessibility of sightline of the public; blue means no accessibility, neither	The mixability means the capacity for being mixed with different permeability of façade of the streetscape. According to an in-field study, the liveness of city open public space is closely related to the mixability rather than the single openness of boundary.
	intersection	PSPL	stay time	investigate the situation of the intersection of streets turning means a possibility to stop to look and stay; crossing means a possibility to stop to watch and wait	The intersection creates chances of people pause during the walk. According to the classification of the intersection of the open public space, the opportunities to use the street furniture could be summarized.
place	facility	convex space	global integration	$I_n = \frac{m \left\{ \log_2 \left(\frac{m+2}{3} - 1 \right) + 1 \right\}}{(m-1)(\bar{D}-1)}$	The value implies the importance of specific street furniture in the local space.
		convex space	mean depth	$\bar{M}I = \frac{M1 + M2 + M3 \dots M_n}{N}$	The value measures the total accessibility of the facility in the local space.
		convex space	standard deviation depth	$\sigma_c = \sqrt{\frac{1}{n} \sum_{k=1}^n (M_k - \bar{M}I)^2}$	The value reflects the statute of distribution and the equity of facilities in the local space from the layout.
layout	intelligibility	axial division	synergetic degree	the correlation between local axial integration and global integration When $R^2 < 0.5$, they are uncorrelated; $0.7 > R^2 > 0.5$, they are weakly uncorrelated; when $R^2 > 0.7$, they are strongly uncorrelated	The degree states multi-core or single-core. Moreover, the street furniture system should follow the pattern to enhance pedestrians' intelligibility.
	sense of security	axial division	local integration	the integration of topological radius-6	The integration measures the accessibility of the path system of the local place. The higher the integration, the higher accessibility is. The location benefits the placement of street furniture to improve comfort.

	staying	segment division	people flow interface	the related parameter of integration	The number reflects the possibility of running into other people.
space	staying	horizon	area	the area from the viewpoint in the whole horizon	The information pedestrian can get. The larger the area is, the higher the visibility of street furniture is.
			freeness	the distance from the viewpoint to the geometric center of the horizon	The distance reflects the distance from the pedestrian's location to the square center. The higher the marginal degree is, the lower the interference degree of activity is.
	accessibility	horizon	sightline depth	the number times the vision changes from some point to aimed local space	The number illustrates times of transforming sightline if the pedestrian walks to local space. The more the times are, the longer the psychological distance to the aimed space pedestrian has.
	communicability	horizon	polymerization	the ratio of visible area to invisible area from the viewpoint on the horizon	The ratio represents the visibility between two points in local space. The lower polymerization could easily cause a blind corner. The communication with the whole space there is low, and street furniture usage could be semi-private status.

6.2 City layer studies

The new-generation smart street furniture communicates the relationship among the people, built environment, and social events. Therefore, the function and placement should follow each urban planning level to meet economic behavior, social custom, and spatial configuration. For the city layer, this section would analyze Turin, the city where Largo Alessandria lies, from the logic index to get the economic activity orientation and the character of the target population on the overall view. First of all, according to the geographic map, the axial map for the whole city was drawn (see Figure 6-2).



Fig. 6-2 Axial map of Turin for analysis

6.2.1 Economic activities

The power for urban daily operation lies in the citizen's periodic and purposeful activity. Both the urban life and spatial relationship reflect the self-organization activity of people living in the city. On account of urban development, the longer the street is, the more easily economic activities get together. In other words, the street, where more cafes, restaurants, stores, tobacco shops, could run more business, is one of the most essential and longest streets in the city. With the aid of the software DepthMap, the analysis of Turin on economic activity will reveal whether the spatial structure of Turin complies with its economic framework, development path, and commercial distribution.

6.2.1.1 Fitting analysis for spatial structure and economic framework

It benefits to justify whether the city planning is led by the government power or residents' self-organization by comparing urban spatial structure and economic framework analysis. The future development of urban design oriented by people living there could be speculated by existing city space patterns and people's behavior patterns, including the function and location of new street furniture in the city machine.

Figure 6-3 shows the connectivity of Turin weight measured by length. The shallower the color is, the higher connectivity is. The red means the highest connectivity streets in the whole city. Moreover, through co-layer with Turin district map (see Figure 6-4), it is easy to find that streets with the highest connectivity are the main street in each district where they lie. And the vivid districts accord with the area in shallower colors. It means that Turin is a city with a development footprint coinciding with the citizens' self-organization activities.

Meanwhile, the history of the extension of the city centered on Quadrilatero district, where the old town locates. The connectivity analysis graph, the reddest line in the northern part of the city, is C.so Orbassano, which color is not organically integrated into the pattern. So, it is a new planned main street with high connectivity but low accessibility; thus, the surrounding color is deep without a smooth transition. Even if the street connectivity is robust, the new town is separated from the old ones. With the conclusion that the spatial structure calculation through DepthMap fits Turin's economic framework, the district type could be summarized in the following part.

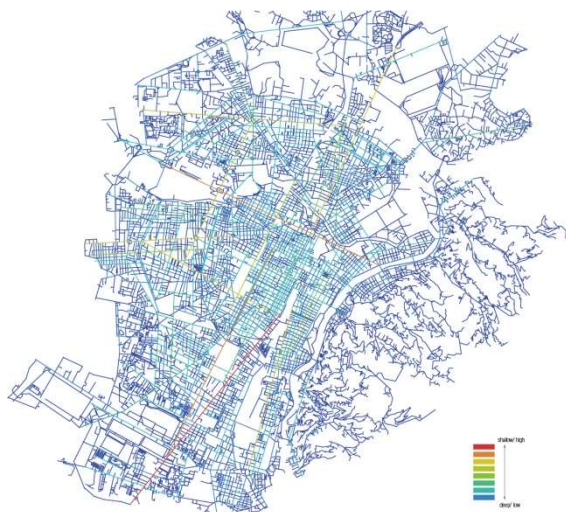


Fig. 6-3 Connectivity analysis weight measured by the length



Fig. 6-4 Turin districts map

6.2.1.2 Development path analysis

The main research subject in this thesis is the urban built environment and the activities people taking there. During the urban spatial development, where residents' behavior patterns are promoted, city configuration conforms to the economic activities pattern from urban history and the transformation process of figure-ground relation.

The segment map, an alternative method that takes the road's centerlines from a pre-drawn transport network simplified and cleans it up to reduce over-articulated curves for removing extraneous road traffic features (Tuner, 2004), is converted from the axial map of Turin and imported into DepthMap to calculate in detail through data of street density and the direction of people flow (street angle). It is further to study people's daily activity in the city and analyze and then understand urban evolution.

People calculate segment analysis with metric type with radius 564, 1000, 2000, and

5000 weighted measures by segment length (see Figure 6-5).

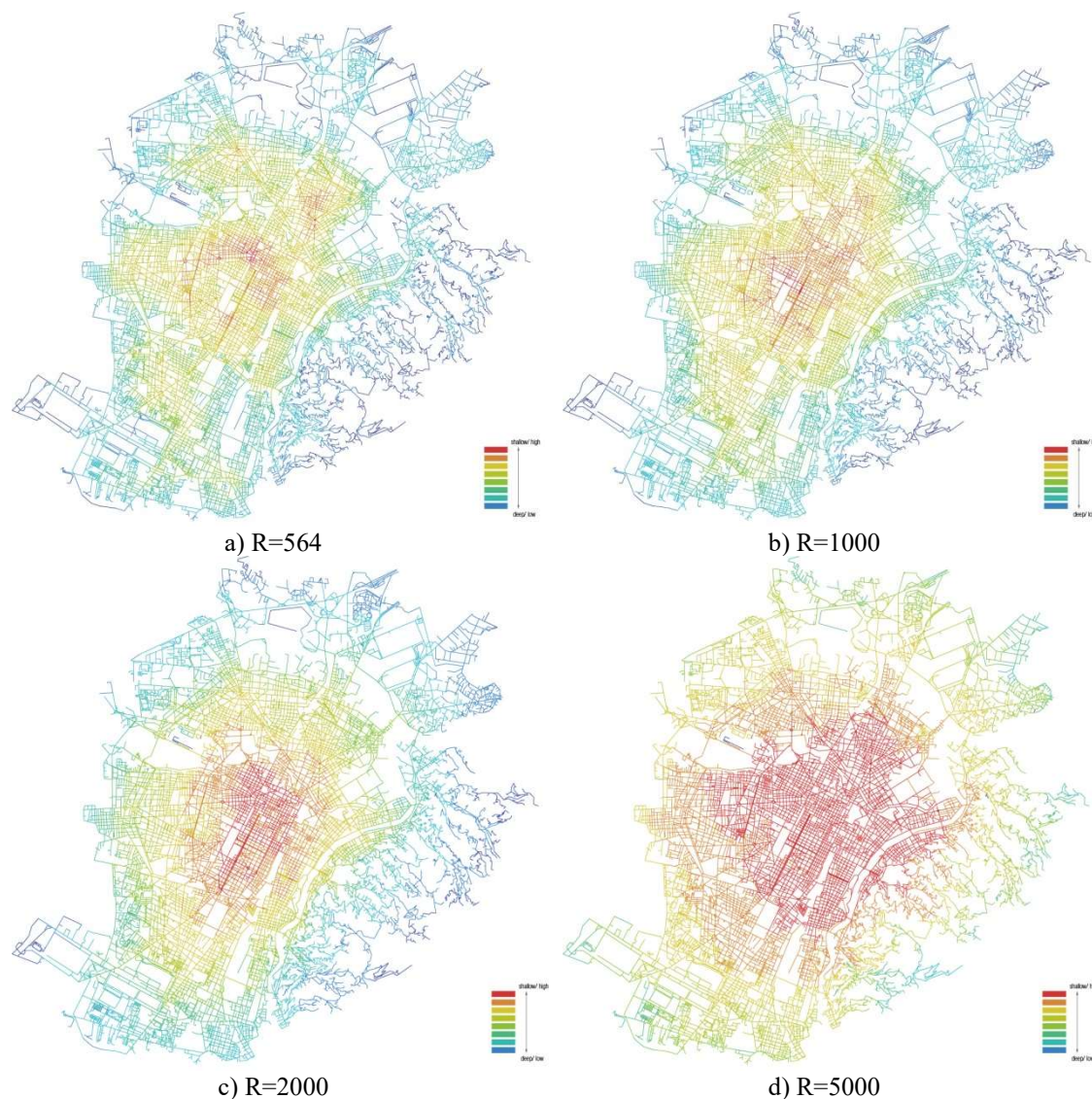


Fig. 6-5 Segment map analysis weighted measures by segment length

The old town with a long history, of which accessibility is limited by transportation, stands out in the high density of the street network, small scale in the district. However, with the development of travel mode and the popularization of bicycles, private cars, and public buses, the new community tends to more extensive scale in block measure, broader and longer road, and sparser road network. Consequently, the course of urban development could be obtained through sifting different densities of the street network.

When the radius is 564m, the matric area is 1 square kilometer, which is the city group for walkability. The higher density states more vivid economic activities there could take. As shown in Figure 6-5-a, we can know that: at the beginning of the city, there are two city centers on both sides of the Dora river; in the following development with some reasons, the two centers began to fuse to a more significant vivid center (see Figure 6-5-b), and obviously, the city center in the southern part to the Dora river played a leading role in this urban movement; radius as 2000m measures people's much freer outdoor activities – 10-minutes-drive or 40-minute-walk, just like Turin today, the mono-core urban plan has developed well, the city center in the northern part to the Dora river has disappeared and higher accessibility extended to the south shoreline of Dora river, the

city spatial structure change completed; and when the urban transportation system is well-developed, and the radius reaches 5000m, most area of Turin lies in the status with homogeneous economic activities in the Future.

6.2.1.3 Commercial area distribution analysis

According to the city's history, the open public space in Turin's old town takes more citywide public activities, such as celebrations, festivals, Easter parades, and get-together watching the football game, belongs to city classification, as the same as the park, both where we call as citywide public space (CPS). On the contrary, some new communities lying in new towns aim to offer convenience for residents only. With the development step of urban evolution, the new town began conversing with the old ones, but the seams are usually not smooth enough. As a consequence, the service object is in low mobility. This kind of open public space could be called a neighborhood public space (NPS). Through in-field study, the security in NPS is higher in neighborhood monitoring effect. In the meantime, the local people's behavior patterns are more stable than in CPS, where the user's structure is floating without rules and more complicated. Therefore, the function and location of the new street furniture could be possibly designed more detailed and corrected to meet the resident's needs and behavior customs. Besides, levels of economic activity could be compared to predict the stability of the local user structure to supply sufficient material for the proposal of new street furniture.

The pleasurable experience for economic activity always follows with the walkability of a specific urban area, which relates to one of the most important indexes of open public space. Therefore, the coming analysis will compare the global integration of whole Turin and local integration with depth radius 3 (see Figure 6-6). If both the global and local integration is low, the accessibility there is low; if the global integration is low, but the local one is high, the place is city commercial primary area or secondary area; and if neither of global and local integration is high, the whole city is in low development.

As shown in Figure 6-6-a, the shallower the color is, the higher the integration is. Red means the street with higher integration than the blue ones. Moreover, there is a positive correlation between integration and accessibility of a particular place (Hillier, 2007; Turner, 2004). The accessibility of the city center and Porta Nuova is higher than in other places. In other words, people will choose the destination with high accessibility, so the global integration graph shows the space where it is easier for citizens from all over Turin to get together. The place with high integration is always CPS. Corresponding to global integration, the R3 means a shorter outdoor trip: someone leaves for someplace across three depths. That can be used to simulate aging people's walk-in open public space. Furthermore, R5 is used for the adult's walk-in open public space. It is easy to find that, some places are friendly and vivid for a local walk movement but not in the city center. The open public space lying in these kinds of places belongs to NPS.

The Figure 6-6-d and 6-6-e are the scatter plots between global integration and local integration. Shown as in Figure 6-6-d, when the integration is high, the ratio between global integration and local integration R3 less than 1; in other words, some walk-friendly open public spaces forming separated from the city center. Those areas fit aging people because the elder completes their most social life during the outdoor walk (Shi, 2018). Furthermore, through analysis on Figure 6-6-e, the shallower area indicts the community fit for adults' walk, and though the overlay the Figure 6-6-b and Figure 6-6-c, people can summarize some areas are adapted to both the elder and adults and some are just welcomed by adults or the senior people. Thus, each part of the whole city connects closely to get a smooth regression line.

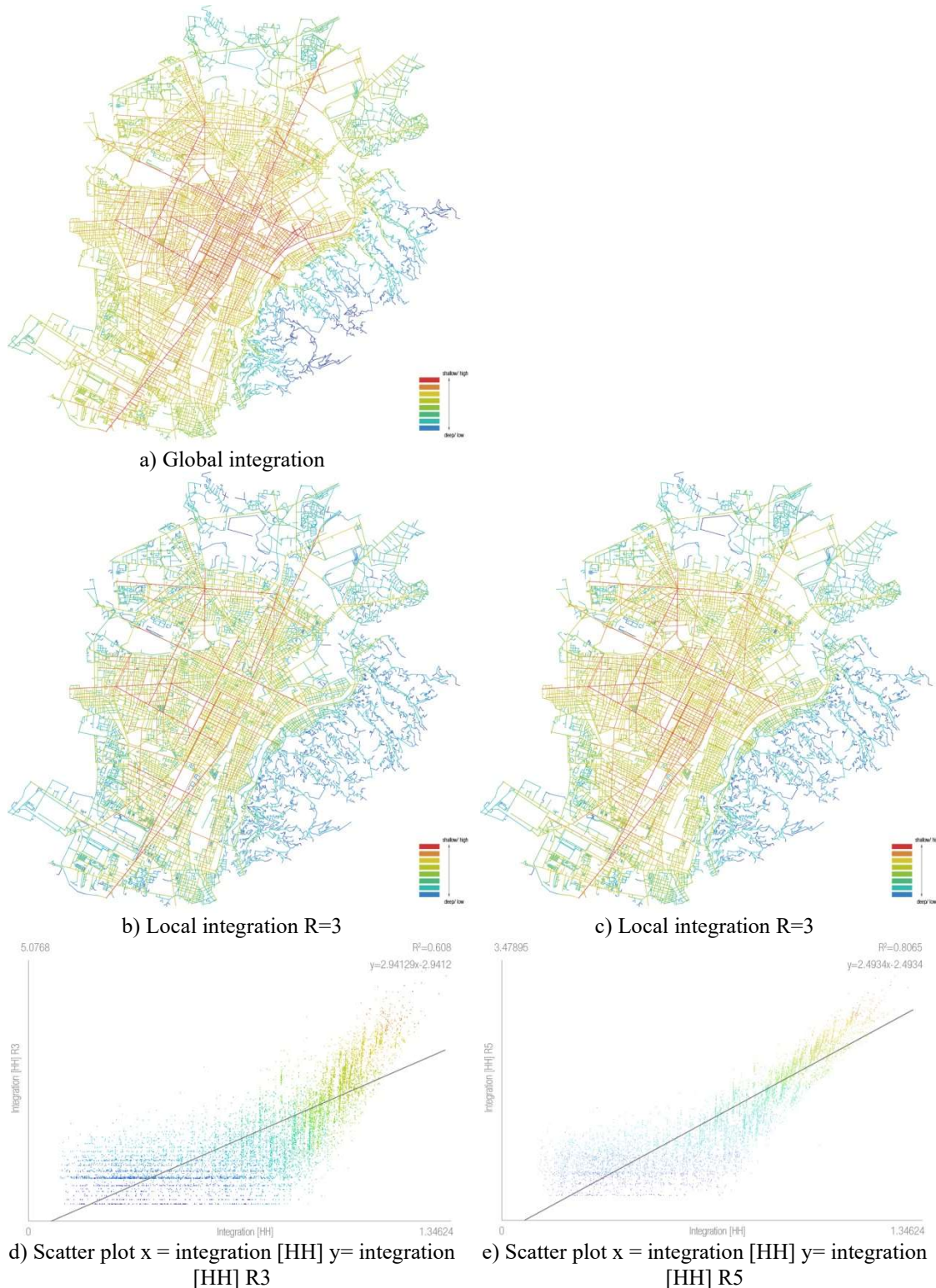


Fig. 6-6 Axial map for integration analysis

According to the integration graph, the leading service subject belonging to aimed open public space could be deduced. Largo Alessandria was taken, for example,

- The area is fit to leave for the bus or car with the integration value is 1.15152 more than the average value of 0.817128;
- The area is friendly for the aging people with the integration value is 3.93375 more than the average value of 1.88378;
- The area is suit for the adult people with the integration value is 2.68369 more than the

- average value of 1.64756;
- There is no remarkable tendency more to by walk or car;
 - The detailed ratio between adult users and aging users was listed in the 6.4 section.

Table 6-1 Attribute properties on integration

	<i>Integration [HH]</i>	<i>Integration [HH] R3</i>	<i>Integration [HH] R5</i>
<i>Average</i>	0.817128	1.88378	1.64756
<i>Selection</i>	1.15152	3.93375	2.68369

6.2.2 Traffic activities

The city's material condition connects with people's social lives with their urban space movement (Hillier, 2007). The road capacity level is not limited by the width of the road but also by its location in the whole city road network and urban transportation system. Based on the analysis of accessibility of areas in Turin, the existing accessibility of aiming open public space was calculated out and some development choice. It is crucial for accessibility analysis with the premise that the new street furniture is confirmed.

6.2.2.1 Positive walk between global and local analysis

Historically, the extension of the urban pattern is a process to continuously inspire people to take activity in open public space, which makes up of both city life and city instead of physical space. It is suitable for urban evolution to positively create dense and diverse open public gathering places to improve social opportunities, promoting positive walk and interaction among people through well-designed spatial layout to double win. Well-design spatial layout means creating a positive relationship among different travel measures: the people flow in the building and on the outdoor road, the local people flow on the secondary street and the overall flow in a large-scale, and the resident flow and the resident flow stranger moving among cities. Dr. Pepoins stated that the city is the interface collection of people flow outdoor on various scales. (Hillier, 2007)

Firstly, an extended area including Largo Alessandria is chosen as Figure 6-7-a to analyze the positive walk of Largo Alessandria, and Figure 6-7-b shows the scatter plot about global integration and local integration with 3 depths as the radius of Turin. The black points measure the axis chosen for analysis of the local walk. The point group forms a regression line with high slop, which intersects with the regression line between global integration and local integration. Consequently, the local integration is higher than the global one and with more characteristics (Hillier, 2007). Therefore, Largo Alessandria lying can supply positive walk opportunities with pedestrians through integration global-local analysis. At meanwhile, the integrations of main streets enclosing Largo Alessandria are above the regression line. That means the street could get together people citywide, not limited in the area. According to the in-field study, Via Bologna's traffic is the busiest in the area, as far as the number of pedestrians. The pre-located open public space – Largo Alessandria owns a well-designed spatial structure, which fits for a positive walk and high accessibility.

However, not everywhere is as friendly as Largo Alessandria to walk or use street furniture. The waste of urban facilities is caused by local layout; in most situations, the reason can be classified as spatial configuration. For example, Giardino di Via Jonio, a small open public place in Turin, has the exact location rather than its layout. It is no doubt that the same conclusion could be got through an in-field study and the amount of data collected during investigations. However, the software could considerably shorten the early stage of the plan of new street furniture city-wide and is convenient for a quick judgment.

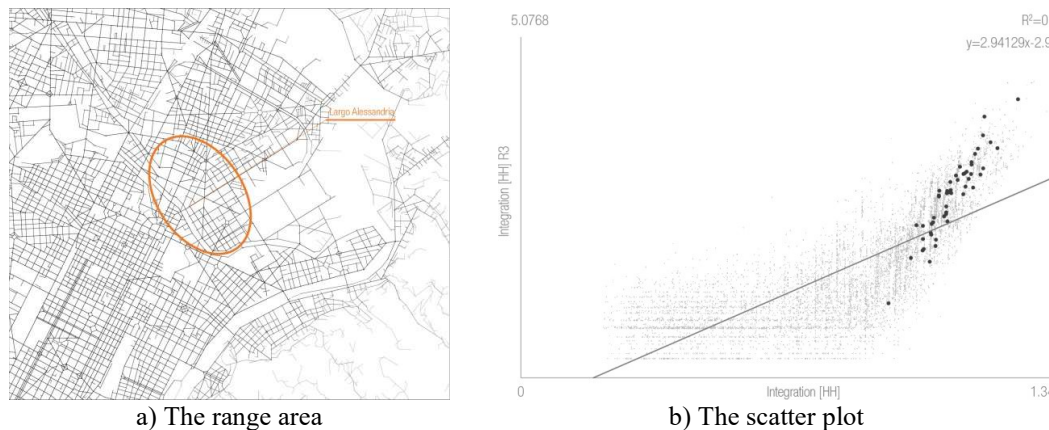


Fig. 6-7 Largo Alessandria area in the global integration of the whole Turin

6.2.2.2 Friendly walk for wayfinding analysis

The new street furniture will be an integrated polytechnic service station and limited distributed the whole citywide. When its placement is made, the users in the area will leave to enjoy the convenience the smart urban facility offers. Based on the above, the intelligibility of the area is vital to help potential users to find the service station in a pre-planned open public space by walking freely in a specific district without confusion or anxiety. The wayfinding on the city layer focuses on predicting the potential problems the new street furniture will meet after installation and avoiding this as far as possible.

The synergy between integration and connectivity could supply intelligibility based on spatial configuration. Higher integration means more opportunities to get together people around the whole range, and the connectivity measures the ability of the street that pedestrians could leave for other streets from the certain one. In outdoor travel, people prefer choosing the most crucial street in the city to locate themselves, creating high integration and connectivity. As a result, the higher synergy is, the higher intelligibility is. In other words, the slope of the regression line is less than 1, which means both high integration and connectivity (Hillier, 1996, Ding & Zhou, 2008).

Based on the connectivity graph of Turin (see Figure 6-8-a), the shallower the color is, the higher the connectivity the street has. The value of connectivity is closely related to the length of the street. That conforms to the law of city development: people began the city usually with a center or the main street. Moreover, from the perspective of the scatter plot, the whole city's intelligibility is low; the reason leading to that is completed and various. People can focus on the area chosen in the last part to discuss the intelligibility of Largo Alessandria. The black point group represents the street in the chosen area. It is easy to find that the regression line angle and the x-axis are far below 45° (see Figure 6-8-b).

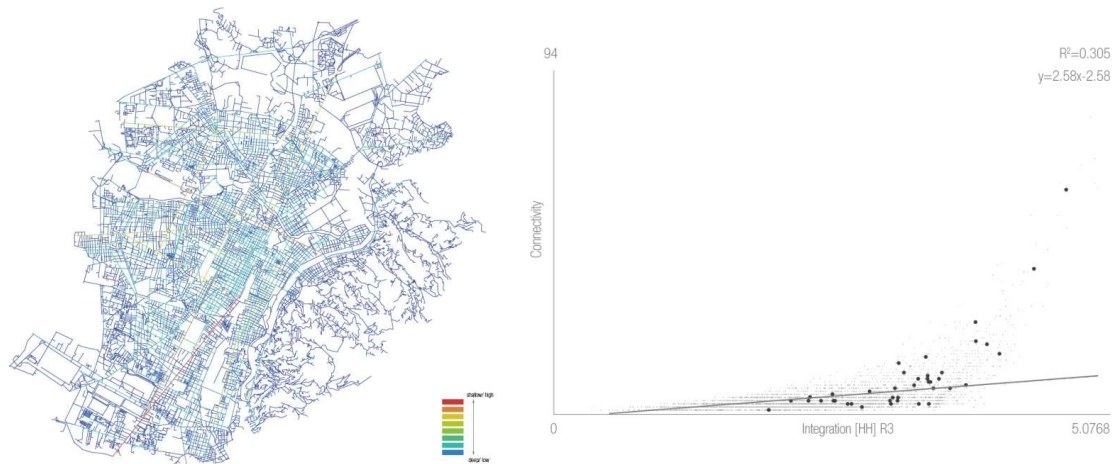
If there is trouble for the pedestrian to understand the environment information, something wrong occurs in the connection and relationship between global and local spatial configuration. As a consequence, the intelligibility of the area is low. The reasons attributed to this result would be discussed further in the next part. Furthermore, the promotion proposal would also be mention in the following.

6.3 District layer studies

6.3.1 Configuration structure

Both deep research and analysis on the configuration structure of the whole district are to grasp the path choices of potential users of the new street furniture and the guidance of spatial environment to the pedestrian's behavior pattern to achieve expected outcomes of the new installation avoid unnecessary waste. The significant advantage of space syntax

is that street system efficiency, which possesses higher reliability and stability. According to the past practice, the reliability of analysis on the streets' accessibility in traffic flow distribution could reach 75% - 80%.



a) The connectivity
b) The scatter plot
Fig. 6-8 The intelligibility of Largo Alessandria area in the context of the whole city

Giulio Cesare, Lungo Dora Firenze, and Corso Regio Parco are chosen to promote the analysis area's boundary to promote the analysis result's relative accuracy. Moreover, the area enclosed is for the district to understand Largo Alessandria. The distribution of city public open space of the specific district was shown in Figure 6-9.



Fig. 6-9 The open public space distribution graph

6.3.1.1 Security

Firstly, according to the regional geographical map based on the street system (see Figure 6-10), the axial map is built to import to UCL DepthMap and generate the global integration map and the corresponding integration table by computing.



Fig. 6-10 Axial map of Largo Alessandria for analysis

Secondly, divide the integration range into ten intervals differentiated by colors. The red lines show the streets with the highest integration values, while the blue ones show the most segregated ones. The results show that there are four streets with higher accessibilities: Corso Giulio Cesare, Corso Palermo, Corso Brescia, and Via Bologna, and the number represent the integration in the district sited Lagro Alessandria (see Figure 6-11). Moreover, the lighter color means a higher permeability, connectivity, security, and more opportunities to get together more people traffic and flow.

Comparing the global integration map (see Figure 6-11) and pedestrian flow distribution (see Figure 6-12) makes it easy to find a positive correlation between the average pedestrian number and the integration relationship among streets. That is due to the location of Largo Alessandria belongs to neighborhood space, most of where the function of buildings is dwelling. The users' structure there is stable from the workplace, school, and residence surrounding. There is no large-scale public people park, plaza, open-air market, or shopping mall. As a result, it is a high fitting for people's behavior patterns and the regional configuration. The reasons causing low fitting can be classified into the following situations:

- Considering the boundary effect, the fitting near the regional boundary may be incorrect.
- The people's behavior pattern is reflected by the functions and density of the buildings in the district, more or less. However, as Hiller (2003) stated, it was not expected that the density of buildings in the area played a leading role in the number of pedestrians unique to a particular street.
- The urban public transportation system will affect the aggregation of people.

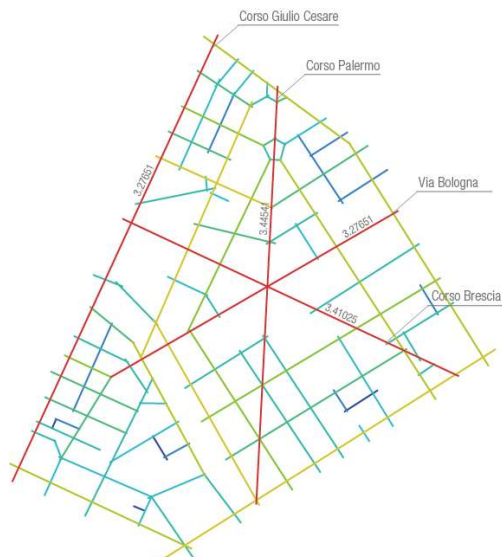


Fig. 6-11 Global integration analysis

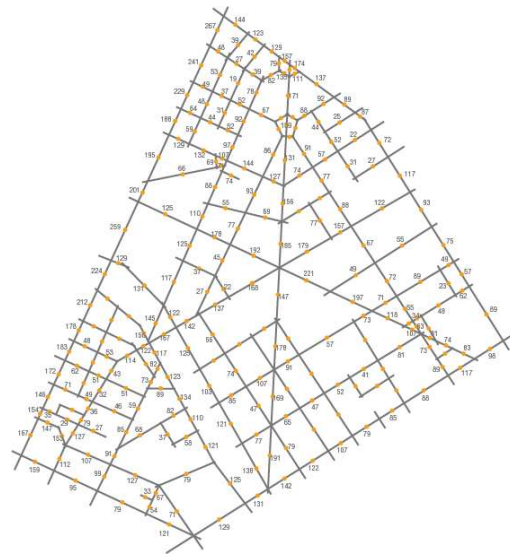


Fig. 6-12 Average pedestrian number per hour in the whole district

6.3.1.2 Communicability

The communicability analysis is represented as *people flow interface* on the district layer. People flow interface measures the relative coefficient between global integration and selectivity, which is called choice betweenness in space syntax. The selectivity implies the times of crossings shortest topological route any two axes except the aimed axis in the district. The more opportunities of being crossed the street have, the higher its selectivity is, and more possibilities of staying the older people. From this perspective, the strategic status of the axis and its selectivity appear to go hand in hand. The neighborhood correlation among pedestrian flow, integration, and selectivity is high in the familiar district. In other words, the axis with high integration has high selectivity. It illustrates that the “gathered effects” lie in global pedestrian flow and local pedestrian flow, closely related to neighborhood familiarity. As a result, Largo Alessandria is located in a typical neighborhood district.

6.3.1.3 Intelligibility

The intelligibility measures the correlation coefficient between global integration and local integration with domain from 0 to 1. The integration reflects the accessibility of spaces. The higher integration is, the higher the accessibility is. Moreover, accessibility is positively correlated with local connectivity. When the relevance is weak, it is shown that a particular space has high connectivity with other spaces with a low integration. That will result in that pedestrians misunderstand the local spatial structure then being lost in its configuration. When the relevance is strong, it is shown that a particular space is perfectly integrated into the global spaces. Thus, it is easy for users to accurately deduce the whole spatial framework when walking in the area, especially for first-coming pedestrians and the elderly.

Both *free movement* and *ideal community* rely on people’s intelligibility, which implies the global accessibility of the space. The higher the global choice and integration are, the higher spatial intelligibility is. On the contrary, the lower value causes distress to your misunderstanding of the environment. Intelligibility measures the relationship between local space and global space. In other words, the intelligibility of global space could be inferred, is a quantitative analysis of pedestrians’ understanding potential spatial configuration, which could be illustrated by linear regression relationship between connectivity and global integration. In the scatter plot, the vertical axis means global axial

connectivity, the horizontal axis represents integration, and the regression line shows the correlation between them. As in Figure 6-13, the spots are centralized in the scatter graph with the value of R^2 is 0.7515. In space syntax theory, the value of R^2 less than 0.5 replies that the vertical axis does not relate to the horizontal axis – the spatial intelligibility is low; the value of R^2 more than 0.5 replies the two factors are relevant – the spatial intelligibility is high; when the value of R^2 more than 0.7, there is a significant correlation between vertical and horizontal axes (Ding & Zhou, 2008).

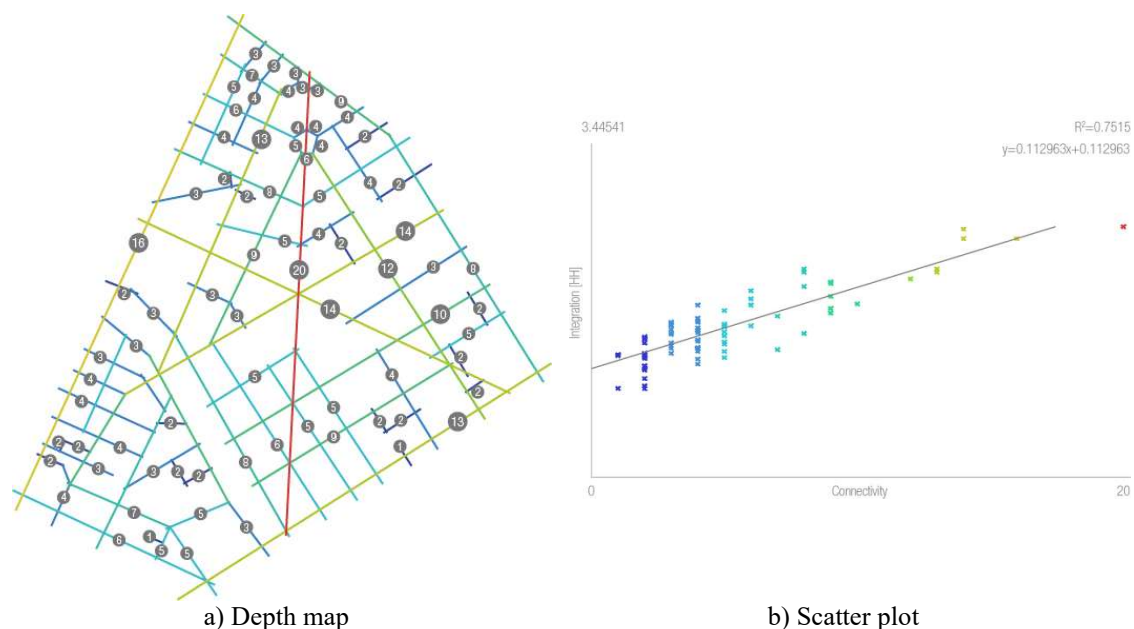


Fig. 6-13 Intelligibility analysis

The higher spatial intelligibility, the higher regularity is, and the resident's cognitive range is more extensive, which benefits the building of a stable *ideal community*. Moreover, to the district with high intelligibility, higher integration, the higher the relevancy of pedestrian movement, where the particular square is, the spatial configuration plays an active guiding role in public activities with negative spaces. Therefore, according to the above, the new street furniture with more popular functions, such as tourism information, mapping, charting, is fit for the location with high intelligibility to serve people.

6.3.2 Functional mapping

Largo Alessandria is a typical neighborhood public space where the relevance between people's behavior patterns and spatial configuration is relatively high. For example, there are six similar open public spaces with street furniture in the area with a 500m radius shown in Figure 6-14. Thus, the actual people flow distribution is closely related to spatial selectivity and impacted deeply by the function system among buildings.

According to the data collected from the investigation, the usage of street furniture, the pedestrian includes residents, workers, and students. The user's structure, usage rate, time, and usage characteristics were recorded (that part will be specified in section 6.4.). Transport flow is to leave for the destination in the district, and the users for work and study has a typical schedule in public activities, such as breakfast time, coffee break, and after office or school. Through the integration analysis above, it is known that the transport flow of Via Bologna is larger than the other street enclosing Largo Alessandria from the perspective of configuration, which coincides with the practical situation.



Fig. 6-14 Six public spaces along with Via Bologna in the range of 250m-radius

6.3.3 Streetscape impacts

6.3.3.1 Façade

According to the above section 5.4.3, the potential opportunity for pedestrian's staying could be inferred from the permeability of the façade of the streetscape. In other words, walking speed would be slow down, and the possibility of usage of street furniture near the interface is high. Therefore, the passing-through could be divided into two sides: body and sightline, which was called the permeability of the façade. Through the investigation, the permeability is shown in Figures 6-15. Red means accessibility of body to the public; orange means accessibility of public sight; and blue means no accessibility.

By comparing the population distribution on the street in the district, the pedestrian's walk is impacted by the permeability. Therefore, it could be summarized that:

- The permeability of the ground floor in outdoor space forms the pattern to describe the relative density.
- According to defensible space construction, the stay of the pedestrian is impacted by the permeability of the ground floor. Therefore, even if the openness of the open public space is high, the possibility of accessibility for taking activities there is low on account of the low-permeability environment.
- The absolute density does not directly relate to the staying.
- The higher the permeability of the street infers more opportunities to stay people.
- In other words, the high permeability, richer pattern for the ground floor means a safer outdoor space, where has more possibilities to be monitored.
- The block is mainly closed by blue line means low permeability and security, which will influence surrounding open public space and fewer people taking activities there.

According to defensible space theory, the usage of public space designed is not limited by the street configuration but also by the ground floor on both accessibility and security (Liu, 2004; Jacobs, 1966; Jeffery, 1971), which could be investigated by the number of windows and door to the public.

The stay of pedestrians makes more chances of the entrance to the public space. As a result, the street furniture placed there could be used more frequently. In contrast, even if

street furniture is well, which location is in fast-pass space, where cannot stop resident, the utilization rate is low, which causes the waste of public resources.



Fig. 6-15 The permeability of the façade of the streetscape in the district

6.3.3.2 Intersection

According to the data collected through the investigation, the intersection. The intersection could be classified into two sorts: the corner of the block, the crossing with a signal lamp. The corner means the direction and the walking speed would change at this kind of intersection, and an unavoidable wait will happen at the pedestrian crossing by the signal light for a while, both of which form the rhythm during people's route. The 78% of pedestrian changes the walking speed of people walking in the district, and nearly 7% pedestrian use the bench in the open space near signal light before and after crossing the street. So the street furniture, placed at the intersection with the signal, is not frequently used even though it offers particular convenience (see Figure 6-16, more relevant images of different public spaces would be listed in the appendix).

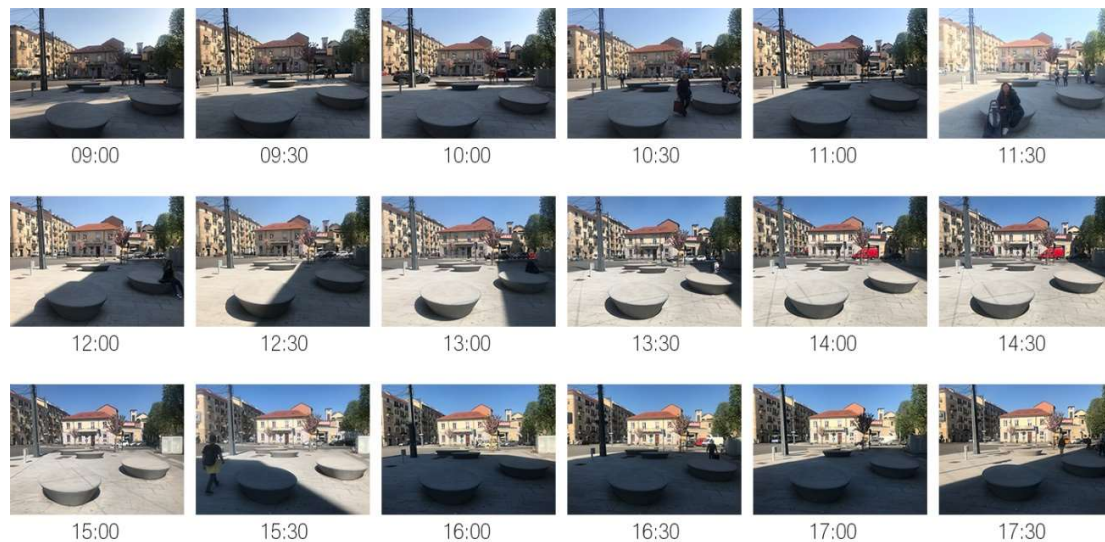


Fig. 6-16 The investigation on the people speed change and usage of street furniture in Largo Brescia

The speed-down at the intersection combined with the expansion of open public space in the corner creates more opportunities for resident's stay and inspires a pause in the pedestrian's route outside. However, the promotion caused by signal lights at the crossing is limited. The increase of pause would be discussed, and the open public space layout in flowing section 6.4 with detailed data through field study.

6.4 Place layer studies

The influence factors of the usage of street furniture from local layer study could be classified by the physical condition and people behavior pattern, which was investigated by PSPL survey (Public Space & Public Life) and analyzed by DepthMap as following. The Largo Alessandria is the aiming research space special for the *Sm²art* project.

The open public space distribution in the district chosen in the last part is shown in Figure 6-9, with the attributes were analyzed through comparison to illustrate how the factors impact the behavior pattern and the usage of street furniture for proposals on the placement of the new smart urban facility. Largo Alessandria was analyzed primarily. Moreover, according to the in-field investigation, two open public spaces were chosen to analyze together: Lavazza garden and Giardino di Via Como (see Figure 6-17).

Largo Alessandria is closed by Via Alessandria and Via Bologna, which general shape is a triangle. The other side of the square is a facade of the building. There are four benches, four short arc walls for sitting, a tree standing in the center of the square in the circle enclosed by four arc walls, and a fountain near the side adjoining Via Bologna.

6.4.1 Space analysis

Most people's activities in open public spaces are induced by vision. Therefore, the sightline plays a critical role in the pathfinding of behavior patterns in the square. The dominant effect of vision is embodied in the feeling caused by the shape of open public space; then, the feeling will affect the spatial experience and influence the behavior and activities. From this perspective, the horizon analysis is more adaptable with small-scale Largo Alessandria than convex analysis.

6.4.1.1 Pausibility

The potential usage of the new street furniture includes three situations: (a) seeking for the street furniture in the local district for some certain functions; (b) passing-by the area where the street furniture lying and inspired to use it; and (c) people notice the new street

furniture when they are taking activities in the open public space and want to have a try and learn about the smart urban facility. Like finding-way in a particular place, the first situation has been discussed from both the city and district levels. The second one depends on the visibility when people walking nearby the new street furniture and could be discussed from two levels: district level – the open public space could be found where is located the new street furniture; local layer – the people can see the street furniture from the entrance to the open public space. Moreover, the last but not the least important one leans on the possibility of whether the potential user could catch the sight of new street furniture. No doubt that the same theory and analysis method could be applied in large-scale and planned complicatedly city square and park.

Visibility at the entrance

People usually justify the activity taking in the open public space by glancing when they pass by the “entrance” to the square or park. Consequently, it is essential to design the visibility of the new street furniture at the entrance. That could inspire residents to discover the new intelligent service station, particularly for the people without pronounced opinion to spend social life.

In Largo Alessandria, there are four entrances to the neighborhood area respectively from Via Bologna and Via Alessandria (A and D), and two openings on the barrier of the square to cross the Via Alessandria (B and C). The visibility from the four entrances is shown in Figure 6-19-a,b,c,d. From entrance C, the most extensive visual area is gotten. Moreover, the smallest visual area can be seen from entrance D. In graph (e), the visual situations from four entrances are complexed by overlaying. The open public space is not even from the perspective of visibility. It is easy to find that the visibility of locations of the four benches is different, which would be discussed detailedly in section 6.4.3. The green zone is the standard visual area from the four entrances. In other words, to guarantee the new street furniture can be seen when a pedestrian enters the specific area, the new street furniture should be placed in the area where it could be seen from all the entrances. For instance, the street furniture is designed to supply or remind citizens of information; the primary consideration should be the visual depth from the entrance.

Visibility of the margin

People are used to pass-by the open public space along the spatial margin. The visibility of different positions of margin is diverse. According to the changeable visibility of the boundary, the possibility of a stay could be found.

In Largo Alessandria, points in the boundary changes with the position are shown by means depths (MD) as Figure 6-20. The position sequence starts from entrance A, ends up at entrance D. The higher the MD is, the higher the point’s visibility. The fluctuant line illustrates that the visibility of the boundary changes unevenly. It is easy to find that segment 2 and segment 4 are lower than other segments. A pedestrian can see areas more extensive and more quickly with high MD, which creates more opportunities to wait, have a phone call, observe. People usually find a position in the open public space with a better vision to stop for activities.

Consequently, the orange segments are more pausable than others. Furthermore, it coincides with the result from the in-field study. The new street furniture can supply a short stay as a stop on the route could be placed on the position on the spatial margin with a lower MD, or the area could be seen from the points, such as charging, check information, and light.

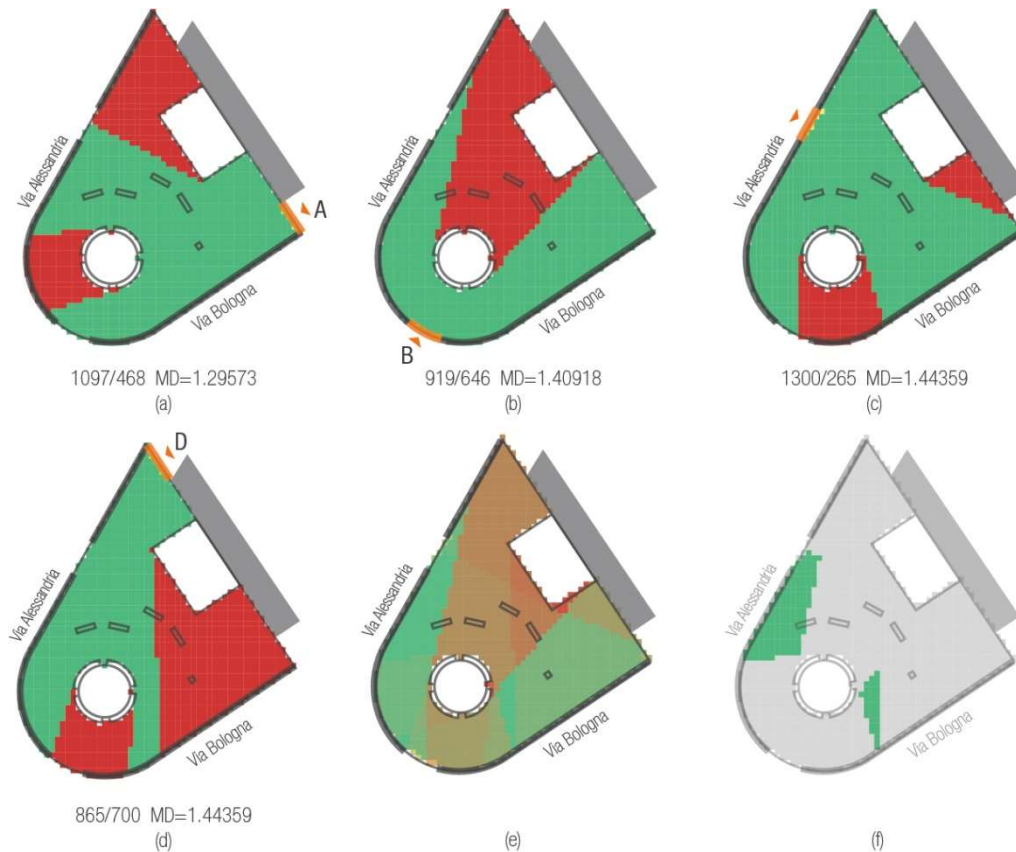
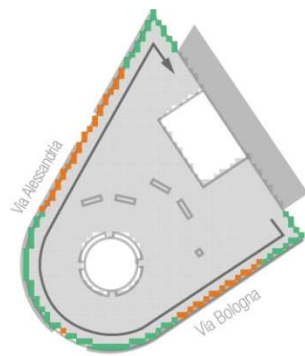
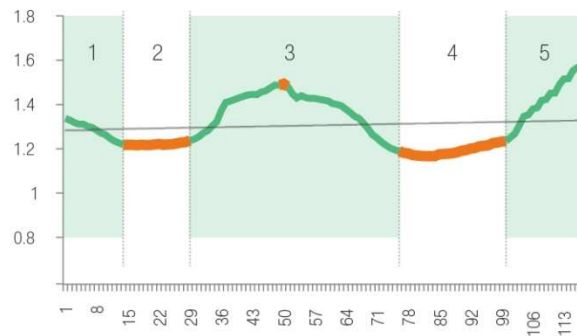


Fig. 6-19 (a), (b), (c), and (d) are shown the visibility step depth of 4 entrances to Largo Alessandria. The green grid means one depth, and the red one means two depths. X/Y: X measures the first depths – the number of green grids; Y measures the second depth – the red grids. (e) illustrates the result of the co-layer of 4 visibility graphs. The greener the area is, the higher visibility is. In (f), the green area means the zone could be seen from all four entrances.



a) The boundary of Largo Alessandria: 117 grids



b) The relationship between mean depth of visibility and position of the boundary

Fig. 6-20 The visibility of spatial boundary of Largo Alessandria. * The MD-position graph is according to the data shown in appendix 2.

In addition, “first glance” is vital for a quick decision during walking by open public space. The visual areas of each point on the boundary are different. The larger the first-glance area is, the more information the pedestrian gets from the point. When people cannot get enough information from the first glance, the user will pass by fast. Potential users will ignore the street furniture there. In Largo Alessandria, the relationship between the number of one depth grids and boundary position is shown in Figures 6-21. The orange segments indicate a more extensive area pedestrians can get from a specific position. It does not entirely express the inverse relationship with the MD. It is necessary to analyze

them respectively to check the visibility of the boundary.

Visibility of the space

It is easy to find that the points in the orange range are easy to control the whole situation of the square, and the lines connected with the points among the two are the shortest ones. In DepthMap, controllability is used to describe the situation of point to grasp the information. The format is that (Turner, 2004):

$$\text{Controllability } (g_1) = \frac{\text{number of elements seen from t/he point } G}{\text{number of elements of 2 visual depth of point } G} \quad 1$$

According to past researches, controllability has a high correlation with the information people get through vision. As the Figure 6-22, in Largo Alessandria, the warmer the area is, the higher the controllability of the point is. The range segments are two edges of the red zone. Coincidentally, the benches existing are located in the red district. The placement of new street furniture in the area with high controllability conducts a long-time staying and activity. Because visual controllability measures visually dominated areas, people are not aware that others observe their activities. In addition, observably, the visibility of points in the open public space is diverse besides the margin. Therefore, it is easy to see people's activities from visually dominant areas without difficulty being seen by observed people (see Figure 6-23).

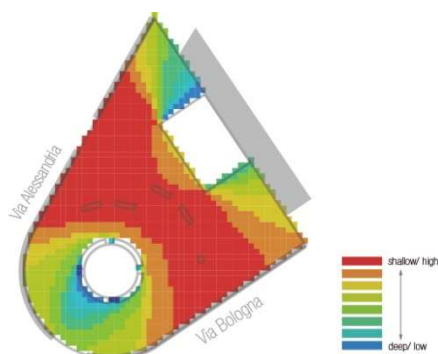


Fig. 6-22 The visual controllability of Largo Alessandria

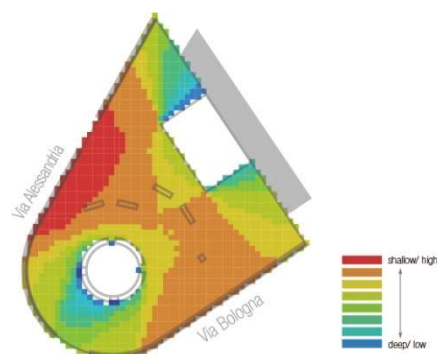


Fig. 6-23 The visual control of Largo Alessandria.

As a result, the street furniture with a monitor and people could stay there to supervise other's activities could be placed in the area with high visual control of Largo Alessandria, such as parents could sit there to watch their children or equipment to collect the information of all the space. Moreover, people will relax in the area with high controllability with low awareness.

The visual integration

The chance people see the new street furniture in a specific place could be measured by visual integration coefficient, which indicates the probability of any two points seeing each other in the space, with value domain is between 0 and 1; and the higher the value is, the greater the probability is, with a shallower and warmer color. That can reflect the rate that residents staying in the square could observe the smart furniture. In the layout design for new street furniture, the different placement forms corresponding to visual integration to describe the usage gap among decisions. In a large-scale open public space, the layout is

¹ "It is possible to predict the street characteristics that attract criminals or how much opportunity they offer to crime?" Nubani and Winerman published a paper to discuss the relationship between the controllability and the criminals happened in the certain area.

complicated, and the new facility could be located in the placement with the value approximates to 1.

6.4.1.2 Accessibility

When there is no clear intention to leave for someplace, including street furniture or street furniture, people are used to estimating the distance from their locations to the place they will arrive to by “look”. Sightline depth could describe the number of times sightline turns from the local position to the specific street furniture. The more times the user’s sightline turns, the longer psychological distance to aimed space the pedestrian has. People can use the attribute to predict the radius of the new street furniture service range. Moreover, if the time is quite many, the local layout of the open public space should be changed. For example, shown in Figure 6-24, Hillier and Hanson quantify the visual accessibility of spaces through the number of turns connecting those spaces (Turner, Doxa, O’Sullivan, & Penn, 2001, p114). The elements with warmer colors mean it can watch other elements in the whole area with fewer turns and much easier to grasp the whole situation than other observation points. In other words, the point in the particular place only pays fewer turns could see the point with high integration. It is easier for the point with high visual integration to attract the sightline from other points. When people stay in Largo Alessandria, the visual accessibility of new street furniture located in the red area is high. On this basis, Duncan J. Watt and Steven H. Strogatz, as two mathematicians, researched the interpersonal relationship. They promoted that the spatial privacy of the element in a specific place could be expressed by the ratio between the second-glance area and first-glance area, named visual clustering coefficient, with the format:

$$\text{Visual Clustering Coefficient} = \frac{K}{k(k-1)}$$

K means the number of grids of 2 visual depths; k means the number of grids of 1 visual depth. The warmer the area is, the higher the visual clustering coefficient’s value and the higher the element’s privacy. The privacy will cause improper behavior or criminal (Figure 6-24). Consequently, to improve the civilization level of Largo Alessandria, the street furniture with light and monitor could be placed in the red area to supervise and prevent uncivilized activities from improving the city’s public life.

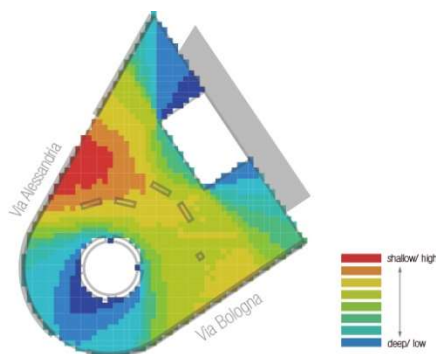


Fig. 6-24 The visual integration[HH] of Largo Alessandria

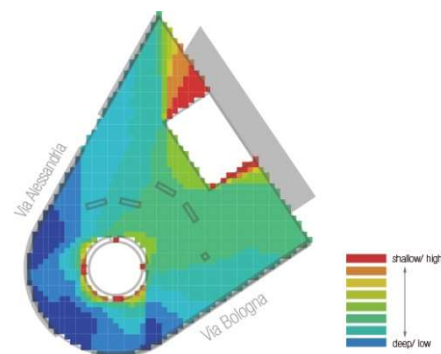


Fig. 6-25 The visual clustering coefficient of Largo Alessandria

6.4.1.3 Communicability

Communication is the most critical function of the city’s open public space. Most people stay in the square to complete their social life. In real life the communicability means people take everyday activity in a specific place. However, communicability represents an ordinary being at the design level, a visual concept to generalize the visibility ratio between two points in the square. The lower polymerization could easily cause a blind

corner. The communication with that whole space is low, and street furniture could be semi-private status.

Some activities are taken in open public space, but the people tend to find a place where others cannot disturb. The street furniture for this situation is suitable for the location with high visual angular depths, which means the total number of turnings to see other points from the observation position when people stay in a particular square. As shown in Figure 6-26, the warmer the area's color is, the higher the angular depth's value is. Compared with the connectivity of Lavazza Garden, higher connectivity means higher accessibility of sightline of the specific position. It is easy to find that the high-accessibility area is not close to the four entrances, which goes against people's understanding of the whole layout and getting information from the first glance.

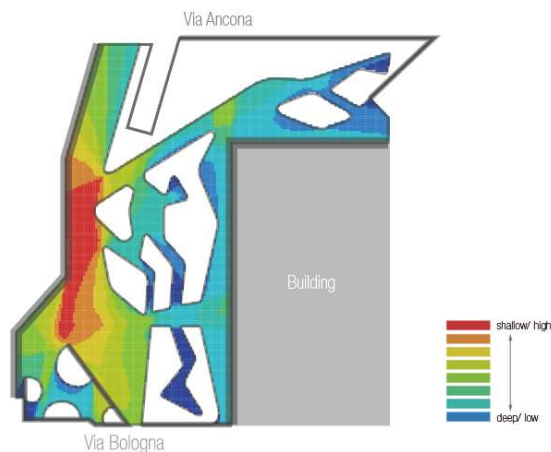


Fig. 6-26 The visual angular depth and connectivity of Lavazza Garden

6.4.2 Layout analysis

6.4.2.1 Intelligibility

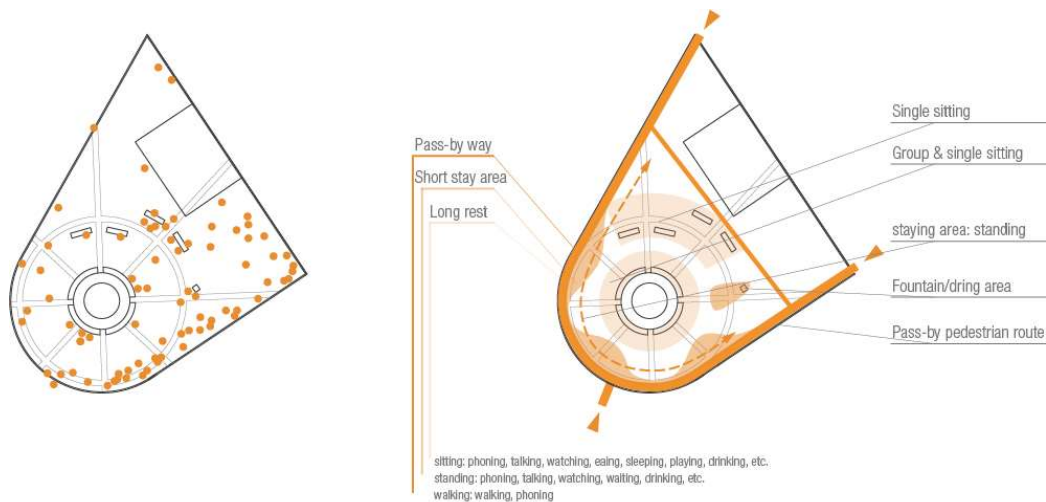
Behavior pattern level

The layout content differs from each other for different open public spaces. As a result, with various locations, the users vary in structure. The intelligibility is to measure the layout of the square, but the evaluation standard is according to pedestrians' behavior patterns for the specific place. For instance, the elderly tend to take activities near green landscapes, causing their fading physical skill (Hu, 2014). Concerning the data collected by investigation in Turin, the most users of neighborhood open public space are aging people. Their majority activity is sitting on the benches for a long time rest, enjoying good weather to talk with others, or watch the environment surrounding them. Moreover, the usage time is distributed throughout the daytime from 8 a.m. to 6 p.m. (summertime). In the meantime, most aging people prefer a broader horizon to increase opportunities to communicate with others, including strangers, to form the central senior social life

In Largo Alessandria, the spatial relationship is easy to understand, and the obstacles of comprehension among different areas mainly focus on the different understandings for specific areas with the same functional street furniture. The function area of Largo Alessandria is shown as follows to describe the abstract intelligibility of users how to use the intelligibility (see Figure 6-27).

From the users' perspective, the simple layout of open public space could be sub-designed by personal behavior patterns. Even if personal customs are quite different from each other, the social behavior presents a convergence of people from a tiny community in a specific group. Pedestrian understands the areas in Largo Alessandria as a centered hierarchy: the outermost layer is transport area for fast pass-by – walking; the intermediate layer is for a short stay – standing; and the core layer is the main area for long-time rest – staying. The layout of street furniture in Largo Alessandria conforms to people's behavior patterns: the longer spend there, the further from the people flow to decrease distribution as far as possible. At the same time, the extended rest area formed coincides with the security area of a geometric square, which is the area by joining the

midpoints of each side (Hillier, 1988), having the most extensive horizon. From this perspective, the new street furniture should be placed in the core area to get more opportunities to stay residents.



a) the people distributed in the square b) the spatial division according to the local behavior pattern
 Fig. 6-27 The functional area to reflect abstract intelligibility to users for Largo Alessandria.

In addition, through the in-field study (Appendix 3), the local usage time pattern (see Table 6-2) and the prominent people flow (see Table 6-3) could be summarized according to the population statistics. Moreover, comparing the actual condition and the conclusion calculated by spatial structure could state the goodness of fit from the physical environment to people’s walk situation. As per the people flow-time pattern, the population from 15:00 to 16:00 is more than that in the other two periods. The two main flow directions are from entrance A and entrance C. During the 3-time domains, there was no pedestrian on the route, none of C to E, C to D, D to C, nor C to C. People were having lunch from 13:00 to 14:00, so fewer residents were passing by Largo Alessandria. Furthermore, in the afternoon, more people arrived at the place to take leisure, and the liveness of Via Bologna increased, which was related to the time (Figure 6-28).

Table 6-2 The portion of the average population from each route crossing Largo Alessandria with time pattern (according to 20 groups data, and each period is 1 hour)

	A	C	B	C	B	A	C	C	B	D	D	D	A	B	C
	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
	C	A	C	B	D	B	E	D	A	A	B	C	A	B	C
13-14:00	18	27	9	1	2	9	0	0	12	13	1	0	5	1	0
15-16:00	54	76	7	5	1	15	0	0	6	4	1	0	6	0	0
17-18:00	52	47	12	5	6	18	0	0	4	0	0	0	2	1	0

According to the investigation on population flow on different routes across Largo Alessandria, which are 15 possibilities, theoretically. It is easy to find that routes A to C and C to A took most people in Largo Alessandria. On the other hand, routes A to A, B to B, and C to C illustrate that some pedestrians take a break in the square and then leave. The origin of the main flow investigated coincides with the conclusion through simulation by space syntax.

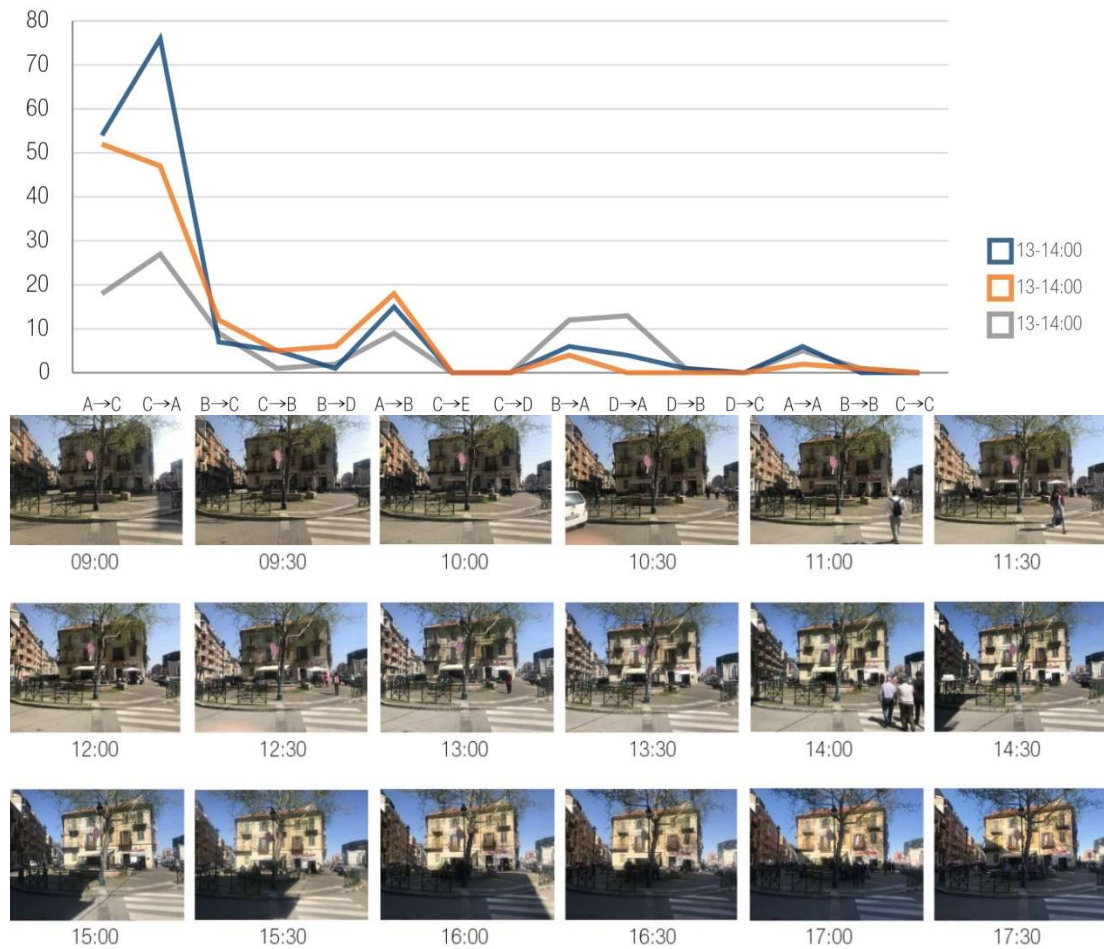


Fig. 6-28 The photos according to the time pattern of Largo Alessandria

Table 6-3 The portion of the average population from each route crossing Largo Alessandria (according to 20 groups data, and each period is 1 hour)

A	C	B	C	B	A	C	C	B	D	D	D	A	B	C
→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
C	A	C	B	D	B	E	D	A	A	B	C	A	B	C
33.1	30.4	5.6	4.28	1.95	10.2	0.13	0.06	3.44	1.85	2.09	0.84	1.66	1.03	0.64
9%	6%	%	%	%	%	%	%	%	%	%	%	%	%	%

Configuration patterns

In large-scale, well-designed open public space, the intelligibility from the perspective of spatial configuration is embodied in the easiness and hardness to find the street furniture, which theory is the same as that from the district level. The synergy between local axial integration and global integration: when $R^2 < 0.5$, the intelligibility is low; when $0.5 < R^2 < 0.7$, the intelligibility is expected; and when $R^2 > 0.7$, the intelligibility is strong, the spatial structure is adaptable to arrange the new street furniture. According to the analysis graph (see Figure 6-29), intelligibility according to the configuration pattern is vital. In other words, the spatial structure of Lavazza Garden benefits for the pedestrian to understand the layout to find and use the new street furniture.

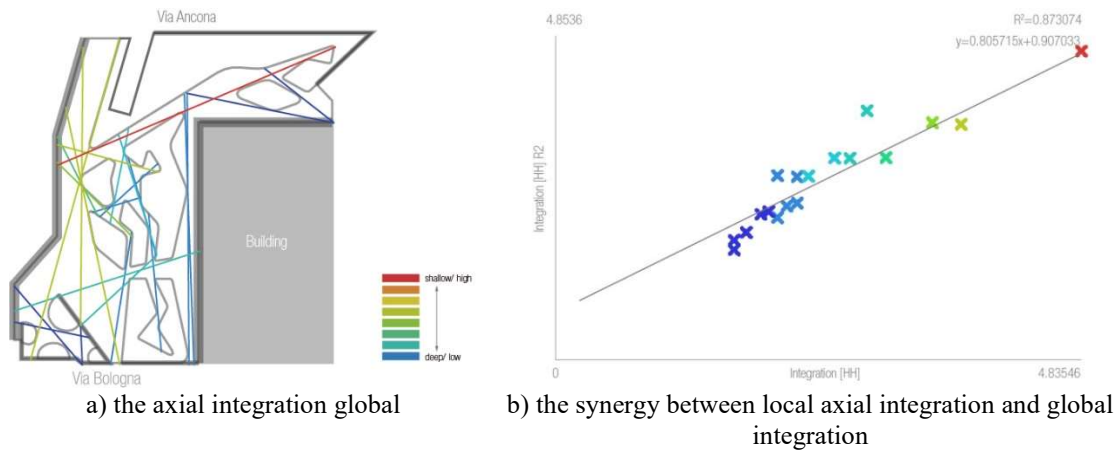


Fig. 6-29 The configuration pattern of Lavazza Garden

Form pattern

Most daily behavior and cognition to environment people living rely on sign-gestalt-expectancy theory. The form of the square layout will also affect the walkability. For example, symmetry is helpful to identify a space, especially to the aging, whose intelligence is decaying day by day. The layout of Piazza Risorgimento is symmetrically shown in the picture, but the entrance to the Piazza is not on the symmetric axis. Moreover, from where you can find the symmetry, the interfaces are hidden by the tree and barrier, which brings down the intelligibility. In Largo Alessandria, the square shape is straightforward, with the block of sightline is limited. Therefore, the intelligibility of the space is high. However, in some other open public spaces with a complex layout, the intelligibility relies on the relativized asymmetry (has been discussed in section 5.5.2). The format for RA of a relevant diamond is as follows:

$$RA \text{ of Diamond} = \frac{n \left\{ \log_2 \left(\frac{n}{3} \right) - 1 \right\} + 1}{\frac{(n-1)(n-2)}{2}}$$

As a result, the RA of Diamond for Lavazza Garden (see Figure 6-30) is 0.19734973, which is more than the axes' RA value. The symmetry of the layout of Lavazza Center is too low for users to understand. Consequently, the layout of Lavazza Garden impairs the placement of new street furniture for people unfamiliar with the spatial organization there or people with low intelligibility, such as children or aging people.

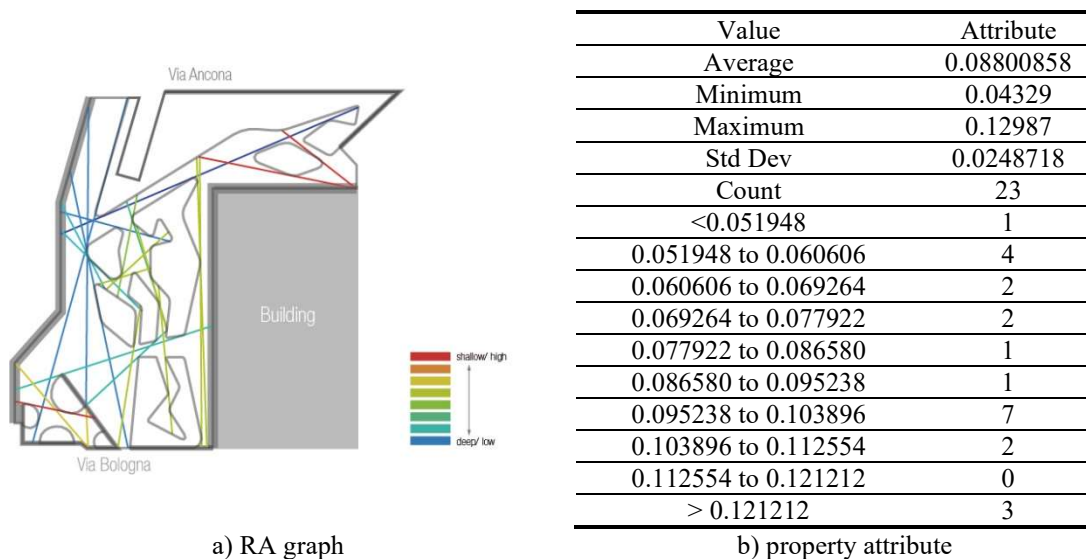


Fig. 6-30 The RA analysis of Lavazza Garden

6.4.2.2 Security

It will take quite a long time for users to enjoy the service and convenience offered by the new type of street furniture. The security of its environment plays a conclusive role in staying pedestrian. Environmental security includes spatial positivity, accessibility, and visibility. Besides the basic shape of the open public space, the sense of security is the overall effect of sightline. As shown in Figure 6-30, the penetrability of sight is quite different from the block situation. The higher the penetrability is, the security of the point in the open public space is.

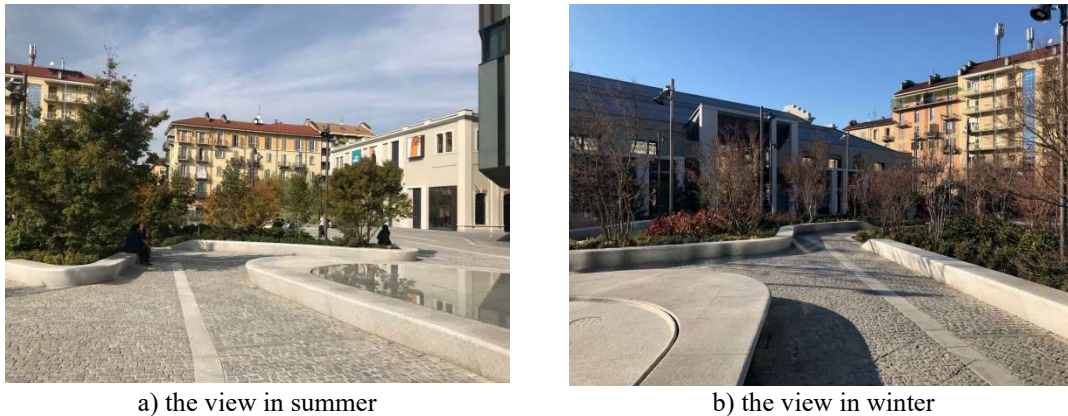


Fig. 6-30 The difference of security recused by the penetrability of sight in Lavazza Garden. In winter, with tree leaves falling, the penetrability of sight changed a lot from it in summer.

6.4.2.3 Pausibility

In in-field study, it easy to find that people will stay longer in public spaces if they run into other people. Higher probability to happen to others benefits for increase chances to spend more time and use street furniture. For example, the bench usage rate is higher near the entrance and open space, with a common saying, as margin space and center space. In reality, if the structure of public space is single-core and straightforward, space with high rate people meet each other can be inferred easily. On the contrary, the stayability for the public space with complex and multi-core layout could be related to integration. The stayability also could represent the openness of space. Some street furniture with specific functions should be placed in the area with low openness, high security, and easy to find. So, the placement of street furniture is based on the overall effect besides the corresponding function and service object.

6.4.3 Facility analysis

6.4.3.1 Usage of existing street furniture

Usage Ratio

Different street furniture has its own usage rules, including function, control range, and used method. Some usage phenomenon is extraordinary and local impact reflecting the local people's behavior patterns, such as life cycle, which is too complicated to weight value for each influence factor or mechanism. However, the possible influence reasons could be speculated and analyzed through the data collected by investigation. For example, the same four benches face both the crossing and the central tree in Largo Alessandria. Nevertheless, the usage rate of each is not the same. According to the in-field study, the number 3 bench is most used, called first chosen, which means when all the benches are available, 95% of people will choose that one. Moreover, the same conclusion could be found through the degree of bending of the sitting board (see Figure 6-31). Different locations of four benches could explain the special usage appearance, but the underlying

reasons behind the location need to be further confirmed.

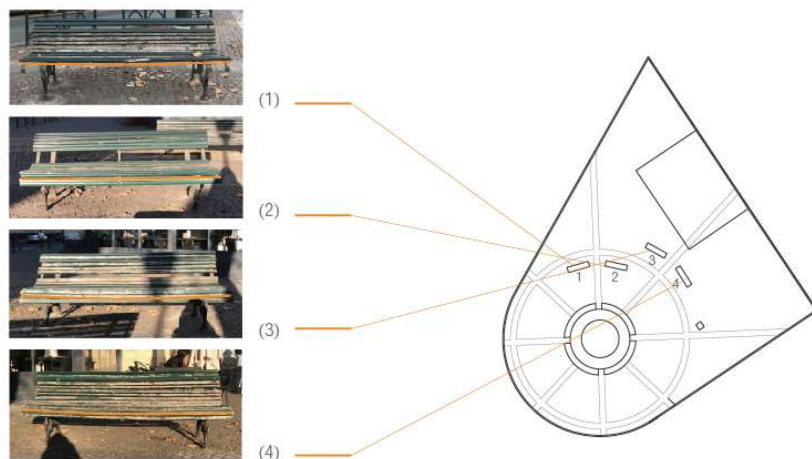


Fig. 6-31 The degree bending of the four same benches in Largo Alessandria

Usage time

The layout of open public space could be analyzed its potential usage chances. The design for the placement of street furniture in a specific place is reflected in more possibilities and longer staying pedestrian in public space. In the meantime, the actual usage time needs to be investigated by observation. The usage pattern of public space could be researched by usage time. Usage time includes utility time and usage status – lonely or group. Largo Alessandria, as the example, shows the usage time of benches in Table 6-4: (observation period is one hour and 20 periods). The people have a short rest for less than 10mins occupied by more than half of the users, and some people sit on the bench for more than 60 minutes to kill time rather than a regular break. Most bench users are alone. During the investigation, some people suddenly began to talk with others sitting nearby for quite a long time.

The usage time of the sitting pedestrian reflects the distribution of the users of Largo Alessandria. People feel security there, and the location is on the many various routes to some other places. So the new street furniture could be designed both in function and placement to attract passing by walkers and people used to kill time there (most of them are aging residents).

Table 6-4 Usage time of the bench in Largo Alessandria

time (min)	(0,5)	,10)	,15)	,20)	,25)	,40)	,35)	,40)	,45)	,50)	,55)	,60)	(60,-
users ratio	34%	19%	8%	9%	2%	6%	6%	0%	2%	0%	0%	2%	13%
alone ratio	67%	50%	25%	40%	100%	3%	100%	0%	100%	0%	0%	100%	63%

Usage manner

The activity taken in open public spaces differs depending on the site’s physical and humanistic condition and surroundings. The activity types have been listed in the last chapter, but many factors will limit usage. The information through different functional street furniture usage statistics could reflect many future new street furniture designs. For example, Largo Alessandria and Lavazza Garden are two neighborhood open public places, but the activity structures differ significantly. Their main entrances are both on Via Bologna, and the accessibilities of the exterior environment are almost the same.

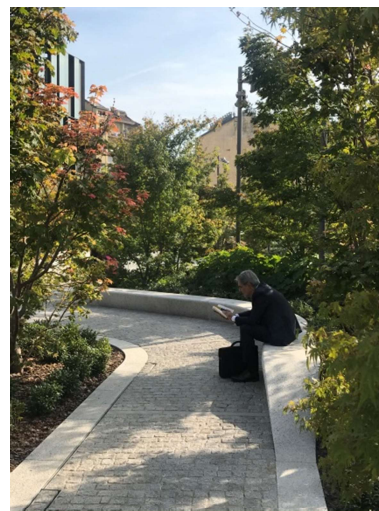
However, the presented user' structures and usage manners are quite different. From the usage pattern, we can find the two places with diverse positions for public life. Lavazza Garden creates a semi-private and space and peaceful atmosphere. That is much freer in Largo Alessandria. So the usage manner gap appears in various activities with the same functional street furniture. The users sitting to read and have lunch in Lavazza Garden is much more than Largo Alessandria's (see Figure 6-32).

Moreover, the resident sleeping on the bench is never observed in Lavazza Garden. In addition, the ratio of female users of Lavazza Garden (63%) is higher than it in Largo Alessandria (49%). Furthermore, comparably, there are fewer parents with infant take activity in Lavazza Garden. Some influence elements hidden behind these appearances could be explored:

- The characteristics of open public space will follow with the surrounding building property. As a result, the structure of users attracted is linked by the whole atmosphere, such as jobs, ages, genders.
- It limits the crossing behavior of the public space that the height difference between the side of the street and the square. Nevertheless, on the other hand, the people will stay longer in the space with a small gap.
- The usage manner of street furniture depends on its function and its surrounding landscape, and the path to its location.



a) The activity is taken in Largo Alessandria



b) The activity is taken in Lavazza Garden

Fig. 6-32 The different usage manner between two neighborhood open public spaces

Some rules could be summarized by a series of phenomenon investigated through observation. In some situations, we can find a convictive explanation for the particular usage. However, the motivation behind the behavior is local for the particular open public space and local users. So the design guideline adapted to one place cannot be applied directly to other places. To better use the new street furniture after its placement, it is necessary to study existing ones to understand both physical and humanistic environments better.

6.4.3.2 Distribution accessibility of new street furniture

The new street furniture, the smart service station will be distributed all over the city in the future, which number should be limited, and the total distribution should be estimated before the installation. According to the above, some new street furniture's placement design conditions have been discussed from the configuration level. For example, a lower psychological depth and a higher integration are better. Besides that, the new street

furniture net should be built to check the heterogeneity of distribution of new street furniture. Through the depth standard deviation, the non-uniformity of spatial configuration could be quantized to measure the service fairness of the facility (Qu, 2012). The formula is:

$$\overline{MI} = \frac{M1 + M2 + M3 \dots M_n}{N}$$

\overline{MI} : presents mean depth of the accessibility of service facility

$M1, M2, M3 \dots M_n$: presents the depth of different locations

$$\sigma_c = \sqrt{\frac{1}{n} \sum_{k=1}^n (M_k - \overline{MI})^2}$$

σ_c : presents depth standard deviation of the accessibility of service facility

n : presents the total number of calculating convex

M_k : presents the depth of the accessibility from convex to service facility

6.5 Conclusion

From city layer

(a) Turin was developed extending along the main street to connect with several important districts with an existing economic framework according to the spatial configuration. (b) The economic center drifted in the past and confirmed in the long term. The aimed square is not in the center. (c) The area is fit to leave for the bus, and the area is friendly for the aging people on foot can be recognized. Consequently, the primary users of Largo Alessandria are the senior. (d) Largo Alessandria is located in a well-designed structural environment. (e) Not all the streets around Largo Alessandria are fit for a walk from the citywide view.

From district layer

(a) The people distribution situation is consistent with spatial configuration rules: Via Bologna, Corso Brescia, Corso Palermo, and Corso Giulio Cesare can attract more people than other streets in the specific district. That means more pedestrians arrive at Largo Alessandria from the Via Bologna. (b) The local intelligibility is not high enough for people who are unfamiliar with the street structure to find ways in this district. As a result, if the search of street furniture located in this district researched relies on an electrical map, it is hard to arrive at the aimed open public space. (c) The usage of street furniture has a close relationship with the function of surrounding buildings. (d) The actual accessibility of open public space mostly depends on the permeability's mixability of the environmental façade. The higher mixability means more opportunities for people to stop taking activities there. Therefore, the possibilities for people staying in the open public space of Largo Alessandria are more than those in other squares in the district. (e) According to the intersection situation classified into turnings and crossings, it is hard for Largo Brescia or Largo Palermo to stay pedestrian to use the street furniture.

From place layer

(a) From comparison among the visual areas according to the first glance from the entrance of the open public space, the common area could be reached by overlay to guarantee the new street furniture would be seen at all the entrances. (b) The street furniture offers information that could be located along with the segments with high mean depth. (c) The street furniture for long-time usage without much distribution should be placed in the zone with high visual controllability. (d) The street furniture with the need

to observe other's activities like a monitor in Largo Alessandria should be installed in the area with high visual control. (e) In the complex designed square, the layout of street furniture could be modified through visual integration. (f) The street furniture with information needs a long time to understand, and with the function to attract the attention of residents taking activities in Largo Alessandria should be located in the area with high visual integration. (g) The street furniture supplying function to meet the needs of people's communication should be placed in the area with high connectivity. (h) The new street furniture should be placed in the corresponding functional area in a specific square. (i) The new street furniture should be placed in an area with high intelligibility. (j) The fundamental symmetry of a particular place could be calculated first to predict the intelligibility of the whole square. (k) The security will change with the alternatively seasonal penetrability of sight. (l) The usage of new street furniture is higher in single-core than it in multi-core. (m) The location of street furniture is closely related to usage ratio, which needs to be investigated before the new placement. (n) The usage time could be studied to learn the local behavior pattern, according to which the function of the new street furniture could be chosen. (o) Some specific usage manners could be summarized by long-time investigation to find the characteristics of the environment of the open public space.

CONCLUSION

In the current design process, the people's cognition and use of the built environment are always ignored. That leads to inhuman design and demand out of thin air only existing in the designer's imagination. Therefore, a cognition pattern should be provided and proposed to be further applied to a specific design project, becomes a link of the thinking flow to improve the design. This research applies qualitative analysis and quantitative analysis to explore and construct the built environment's cognitive process and usage behavior by dividing it into different objects like architecture, open public space, and urban facility through the interaction with people.

First of all, as a human activity, cognition is a process of people's internalization of external information, which has a typical structure. This research introduces the concept of image consciousness with the corresponding consciousness generation mechanism and the figure-background cognitive schema to analyze the construction of architectural consciousness and illustrates it with examples. It is concluded that architectural image can be unfolded according to the general thingness of the thing and then to obtain a triple-layer structure of architectural thingness, which shows that architecture, as a cognitive object, presents different thingness in different cognitive stages. Furthermore, based on this structure, using phenomenological description as the analytical method, cognitive structures with three levels as the three objects, the viewer as the subject, and the built environment as the cognitive background are established. The above together constitute the cognition pattern of architecture. Besides constructing the multi-object cognitive structure of architecture, this research also proposes that reflective cognition patterns can inspire design thinking to integrate people's cognitive structure into the existing design process and make it more people-oriented.

Secondly, the cognition pattern of open public space, as the negative shape of architecture, is discussed and divided into city layer, district layer, and place layer based on the scale in this research. Finally, according to the Space Syntax theory, supplemented by the computer simulation analysis of DepthMap and the in-field survey of PSPL, the people's cognitive patterns and use patterns at various spatial scales are established. It shows that the cognitive object of people's understanding of open public space depends on the cognitive scale layer to obtain various types of urban information for guiding their public spatial behavior, which with the built environment constitute the cognitive schema of figure-background, reflecting how people use the built environment. Furthermore, according to the people's cognitive patterns and use patterns obtained above, the smart street furniture, as a typical urban facility, is analyzed for its placement design. The corresponding design flow is constructed, which provides a specific placement selection strategy for the *Sm²art* research project.

The main findings and contributions in this research were as following:

- Construct the triple structure theory of architectural principle under image consciousness;
- Construct the multi-level and multi-object cognitive structure of the architecture, including the intuition-material structure of the architectural material cognition based on cognitive objectivity, the perception-space structure of architectural space cognition based on cognitive subjectivity, and consciousness-field structure of the architectural field based on cognitive intersubjectivity;
- Propose a reflective paradigm of architecture under image consciousness and reconstructs the cognitive system of architectural consciousness.
- Propose the placement plan system form multi-scale combined with the physical condition and people behavior pattern to impact the built environment.
- Propose a method system to match the placement plan flow to supply a detailed

approach to professional designers and managers to decide on the placement of street furniture.

- Propose the design and plan aim of the new street furniture: adaptable, sustainable, and flexible, and the corresponding intelligent street furniture type: service station composed by the support structure and functional component.
- Explain the method by application for Turin as a case study.

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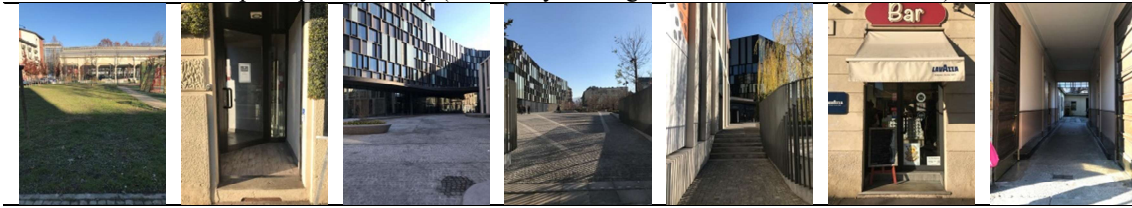
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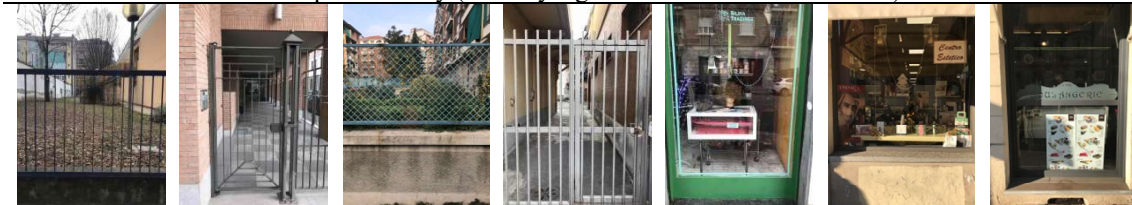
APPENDIX

Appendix 1 The permeability of façade of the streetscape in the district

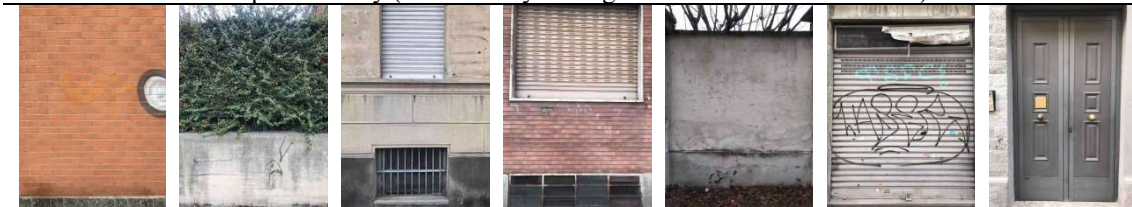
Complete permeability (both body and sightline could cross the facade)



Partial permeability (the only sightline could cross the facade)



No permeability (neither body nor sightline could cross the facade)

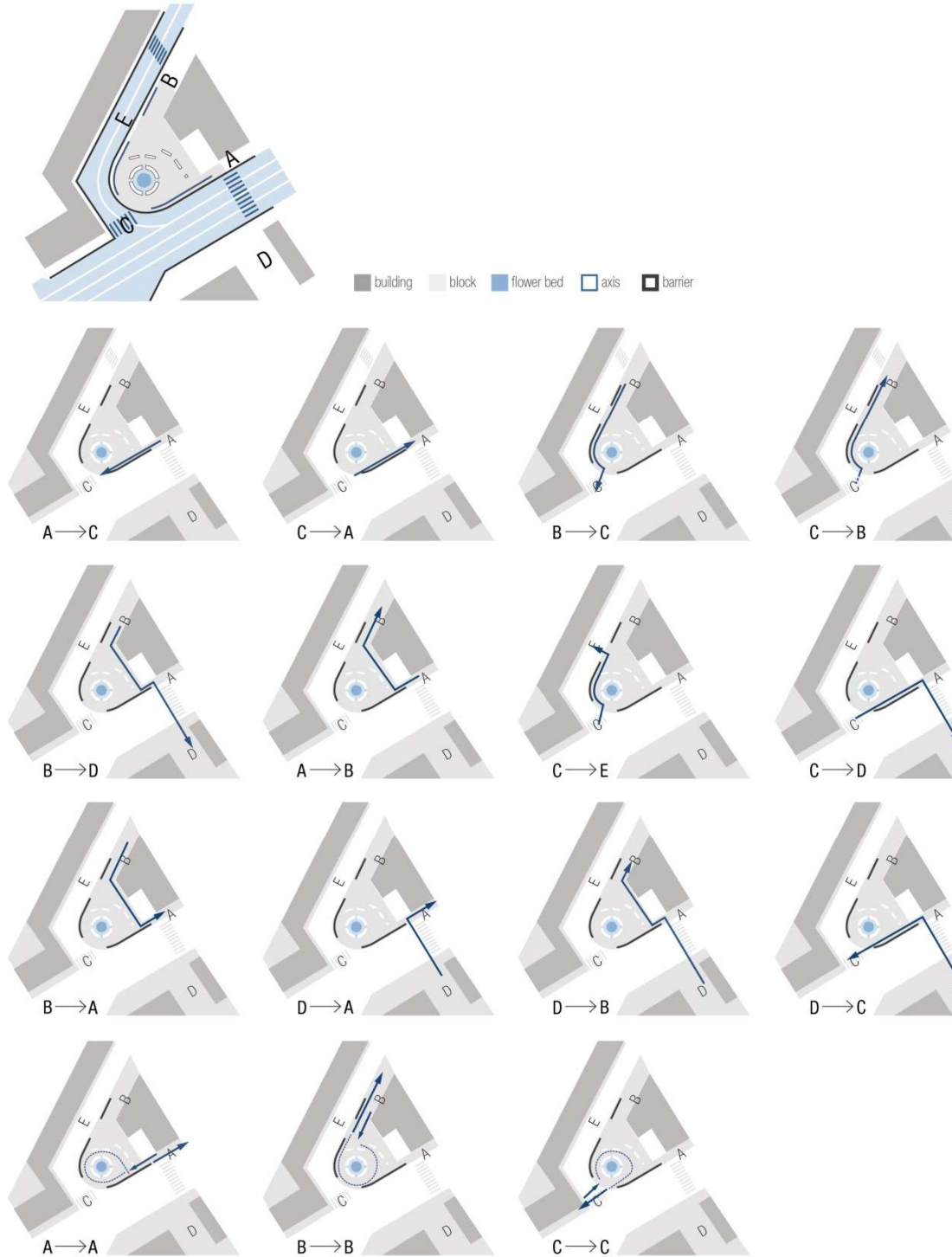


Appendix 2 Attribute Properties of points in the boundary

	MD	1 ST dept h	2 nd dept h	3 rd dept h		MD	1 ST dept h	2 nd dept h	3 rd dept h		MD	1 ST dept h	2 nd dept h	3 rd dept h
1	1.3339	104		4	1.427				79	1.169	130			
	7	3	525	0	02	904	657	7		53	1	267		
2	1.3263	105		4	1.434				80	1.166	130			
	2	5	513	1	67	891	671	6		99	5	263		
3	1.3154	107		4	1.439				81	1.165	130			
	9	2	496	2	77	882	681	5		71	7	261		
4	1.3084	108		4	1.442				82	1.164	130			
	8	3	485	3	32	877	687	4		44	9	259		
5	1.3084	108		4	1.441				83	1.164	130			
	8	3	485	4	68	874	694			44	9	259		
6	1.2982	109		4	1.453				84	1.164	130			
	8	9	469	5	15	856	712			44	9	259		
7	1.2931	110		4	1.458				85	1.173	129			
	8	7	461	6	89	847	721			36	5	273		
8	1.2810	112		4	1.471				86	1.174	129			
	7	6	442	7	64	827	741			63	3	275		
9	1.2676	114		4	1.483				87	1.175	129			
	9	7	421	8	75	808	760			27	2	276		
1	1.2613	115		4	1.483				88	1.177	128			
0	1	7	411	9	75	808	760			18	9	279		
1	1.2453	118		5	1.490				89	1.181	128			
1	8	2	386	0	12	798	770			64	2	286		
1	1.2326	120		5	1.478				90	1.188	127			
2	3	2	366	1	01	817	751			66	1	297		
1	1.2243	121		5	1.444				91	1.191	126			
3	5	5	353	2	87	869	699			2	7	301		
1	1.2154	122		5	1.426				92	1.198	125			
4	2	9	339	3	39	898	670			22	6	312		
1	1.2160	122		5	1.436				93	1.201	125			
5	6	8	340	4	58	882	686			4	1	317		
1	1.2160	122		5	1.428				94	1.207	124			
6	6	8	340	5	3	895	673			78	1	327		
1	1.2135	123		5	1.423				95	1.210	123			
7	1	2	336	6	84	902	666			96	6	332		
1	1.2154	122		5	1.424				96	1.213	123			
8	2	9	339	7	47	901	667			51	2	336		
1	1.2147	123		5	1.420				97	1.223	121			
9	9	0	338	8	65	907	661			07	7	351		
2	1.2147	123		5	1.416				98	1.224	121			
0	9	0	338	9	83	914	653			98	4	354		
2	1.2173	122		6	1.413				99	1.230	120			
1	4	6	342	0	64	919	648			72	5	363		
2	1.2192	122		6	1.400				10	1.231	120			
2	5	3	345	1	89	939	628		0	99	3	365		
2	1.2154	122		6	1.397				10	1.249	117			
3	2	9	339	2	07	945	622		1	2	6	392		
2	1.2173	122		6	1.391				10	1.265	115			
4	4	6	342	3	97	953	614		2	77	0	418		
2	1.2179	122		6	1.375				10	1.305	108			
5	7	5	343	4	4	978	590		3	29	8	480		
2		121		6	1.360	100			10	1.343	102			
6	1.2218	9	349	5	74	1	567		4	53	8	540		
2	1.2249	121		6	1.343	102			10	1.351	101			
7	8	4	354	6	53	8	540		5	18	6	552		

2	1.2275	121			6	1.333	104			10	1.377			
8	3	0	358		7	97	3	525		6	31	975	593	
2	1.2351	119			6	1.312	107			10	1.383			
9	8	8	370		8	3	7	491		7	05	966	602	
3	1.2415	118			6	1.288	111			10	1.415			
0	6	8	380		9	08	5	453		8	55	915	653	
3	1.2523	117			7	1.260	115			10	1.419			
1	9	1	397		0	68	8	410		9	38	909	659	
3	1.2689	114			7	1.246	118			11	1.448			
2	6	5	423		1	02	1	387		0	69	863	705	
3	1.2791	112			7	1.227	121			11	1.448			
3	6	9	439		2	53	0	358		1	69	863	705	
3	1.3014	109			7	1.212	123			11	1.488			
4	7	4	474		3	87	3	335		2	21	801	767	
3	1.3199	106			7	1.201	125			11	1.511			
5	5	5	503		4	4	1	317		3	79	764	804	
3	1.3709				7	1.192	126			11	1.513			
6	4	985	583		5	48	5	303		4	07	762	806	
3	1.4059				7	1.186	127			11	1.548			
7	9	937	624	7	6	11	5	293		5	76	708	858	2
3	1.4117				7	1.179	128			11	1.564			
8	3	929	631	8	7	09	6	282		6	05	684	882	2
3	1.4200				7	1.175	129			11	1.571			
9	19	915	646	7	8	91	1	277		7	7	677	884	7

Appendix 3 The table for in-field study of people flow in Largo Alessandria



nu	A	C	B	C	B	A	C	C	B	D	D	D	A	B	C	t
m	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	o
	C	A	C	B	D	B	E	D	A	A	B	C	A	B	C	t