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FROM ABSTRACTION TO MIMESIS: READING URBAN FORM TROUGH UNDERGROUND CITY REPRESENTATION

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ABSTRACT

Urban morphology has traditionally relied on two-dimensional representational frameworks, relegating the underground to a technical domain rather than recognising it as a formative component of urban form. This paper addresses this gap by examining how representation contributes to the understanding of urban form within a three-dimensional conception of urban space.

Building on Muminovic's (2019) process of abstraction, the study adopts a qualitative comparative analysis of five representational regimes, interpreted as epistemic devices that actively construct knowledge by isolating specific morphological properties such as relations, networks, layers, and volumes.

The analysis demonstrates that no single representational mode can fully capture urban thickness. Instead, a three-dimensional understanding of the city emerges from the coordinated use of multiple representational strategies, reframing the underground as a legible and designable dimension of urban morphology.

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Introduction

Although the city is a three-dimensional object, urban knowledge and planning practices have mainly developed through a two-dimensional understanding of space. Despite being structurally integral to the city, the underground dimension remains poorly defined due to its inaccessibility to direct perception. As a result, what lies beneath the ground is often treated as a technical domain rather than a component of the urban form, highlighting the need for a knowledge process capable of contextualising the subterranean realm within the overall morphology of the city.

In 1933, Eduard Utudjian introduced underground urbanism. This discipline fits into the functionalist thinking of the modern city and proposes the use of the subterranean realm for activities considered unsuitable for the surface. The main objective was to lighten and organise the urban fabric, increasingly congested by traffic, through the principle of '*zooning de couple*', which assigns a specific function to each level of depth (Parisi, 2015).

However, this rational vision was accompanied by widespread mistrust of underground spaces, often associated with the underworld. Moreover, in the early days of the underground railway, many passengers felt treated like cargo. The cramped conditions and difficulty in identifying stations led to discomfort and feelings of claustrophobia (Bobrick, 1981).

A greater understanding of underground space was only achieved several decades after the opening of London's first underground line, thanks to Henry Beck's map called '*The Diagram*', which made it possible to find one's way around underground. The map described space through geometric figures, associating specific symbols with stations and routes. By generalising space, it made the underground network easier to read and navigate. The final result was not a faithful representation of reality but an interpretation of its form (Gerland, 1994).

The process of understanding urban form is described by Muminovic (2019) in the article '*Place as Assemblage*'. According to the author, understanding an object requires a phase of abstraction, consisting of an initial reading of its form, a subsequent analysis, and an interpretative proposal synthesised through representation (Figure 1). Only through this process of generalisation and abstraction it is possible to contextualise (Aureli, 2015).

Urban form, understood as the result of relationships and forces shaping the built environment, arises from the tension between what is real and what is imagined (Alexander, 1967). Therefore, when reality is difficult to interpret, representation becomes a fundamental tool for constructing knowledge, giv-

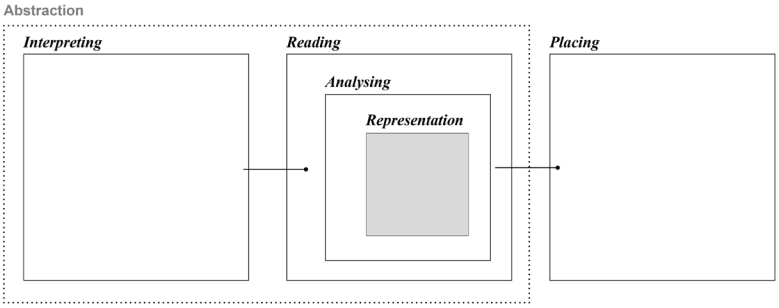

Figure 1. Process of Understanding Urban Form. Graphic based on Muminovic, M. (2019), pp. 74.

ing form to what would otherwise remain elusive (Giaccaria, 2019).

Every representation involves a selection and a specific point of view (Muminovic, 2019). In this regard, Aureli (2005) introduces the diagram as an intermediate tool between thought and reality. The diagram combines an objective dimension, related to the collection and organisation of data, with a subjective dimension shaped by the designer's interpretative choices. The diagrammatic process works in two stages (Figure 2): one of production, which includes the collection, processing and synthesis of information, and one of reception, based on the reading, interpretation and discussion of the content (AMO/OMA, 2025).

The article examines the role of representation in the process of defining the shape of the underground city. Through a non-chronological approach, the study examines representational methods that have contributed to the understanding of subterranean urban morphology, highlighting them as central tools for contextualising reality. In this sense, representation is not only a descriptive device, but a critical one through which the underground realm can be conceptualised, interpreted and integrated into a three-dimensional understanding of urban space.

Methodology

This research adopts a qualitative comparative analysis to investigate how the underground dimension of the city has been progressively understood and conceptualised through different modes of representation.

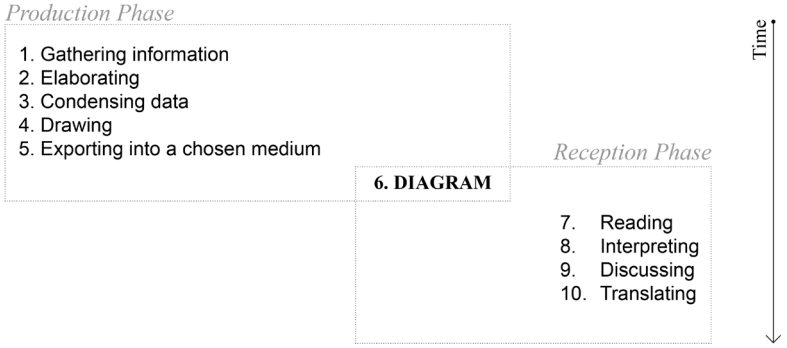

Figure 2. Life of a Diagram. Graphic based on AMO/OMA (2025), pp. 126.

The study builds on the process of abstraction described by Muminovic (2019), according to which understanding form requires a sequence of reading, analysis, and interpretative synthesis. Rather than following a chronological reconstruction, this approach adopts a cognitive framework that evaluates representations by their capacity to produce knowledge about underground urban morphology.

The materials analysed include drawings, diagrams, maps, plans, and three-dimensional prototypes produced in different historical and disciplinary contexts, such as theoretical models, cartographic documents, design proposals, and analytical representations of underground space. These examples function as typologies rather than exhaustive case studies. Their selection is based on three criteria:

1. *Morphological relevance*, defined as the ability to describe spatial depth, stratification, or subterranean relationships.
2. *Representational intentionality*, referring to the explicit attempt to conceptualise underground space rather than merely depict surface conditions.
3. *Cognitive significance*, understood as the capacity to introduce new levels of abstraction or spatial articulation. Through these criteria, the research identifies emblematic examples that support a comparative reading of how underground urban form has been made intelligible.

The *methodological process* is organised into two sequential and interrelated phases. The comparative phase consists of the systematic analysis of different representational methods used to describe underground urban space, evaluated through qualitative parameters such as degree of abstraction and mimesis, treatment of spatial depth and stratification, use of symbols, geometry, and scale, and the relationship between surface and subsurface elements.

The *synthetic phase* interprets the results of the comparative analysis by organising these representational modes into a cognitive continuum structured from abstract to mimetic forms. Rather than proposing a linear historical evolution, this continuum highlights how each representational regime corresponds to a specific level of knowledge of underground urban morphology (Figure 3).

The transition from abstraction to mimesis reflects a process of progressive knowledge acquisition. Relational diagrams emerge where direct knowledge is limited; geometric diagrams introduce logic and measurement; hybrid representations combine technical accuracy with speculative intent; simplified geographical representations operate through selection

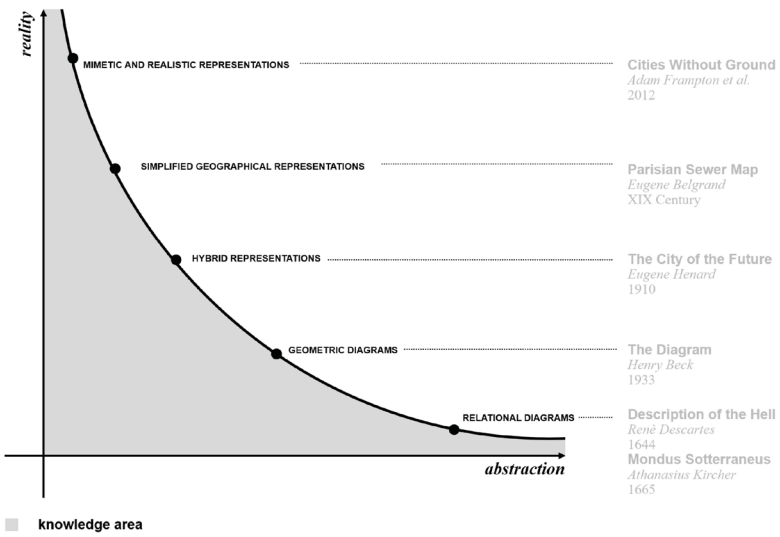

Figure 3. The Area of Knowledge.

and layering; and mimetic and realistic representations aim at maximum correspondence with reality, requiring extensive data collection and contextualisation. Across this trajectory, increasing representational realism corresponds to increasing data availability and organisation, although even the most mimetic representations remain interpretative constructs.

Through this methodology, representation is understood not as a descriptive outcome but as an active analytical tool that transforms the underground from an invisible condition into a legible and designable urban field. By comparing and synthesising different representational regimes, the research provides a framework for reading subterranean morphology as an integral component of the three-dimensional city.

The Comparative Phase

Representing the three-dimensionality of the city requires engaging with the limits of visibility and, consequently, with the limits of urban knowledge. From a morphological perspective, representation operates as a process of abstraction, translating spatial phenomena into structured forms of understanding (Aureli, 2015). In this research, abstraction is understood not as a reduction of reality, but as a cognitive operation through which urban thickness, largely inaccessible to direct perception, is rendered legible.

The selected examples are examined not as historical curiosities, but as operative devices that contribute distinct morphological insights into the three-dimensional structure of the city. It is essential to recognise that each representational tool is shaped by the historical and technical conditions in which it was produced. Objectivity, therefore, is not assumed as an absolute value, but is understood in relation to available data, analytical aims, and representational conventions.

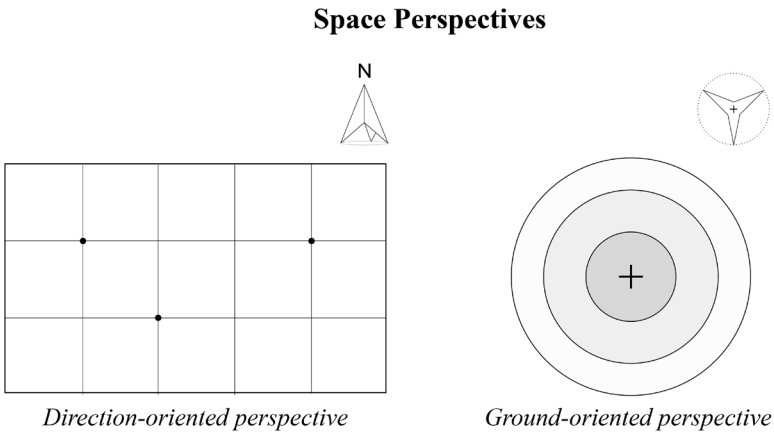

Figure 4. Difference between direction-orientated perspective and ground-oriented perspective. Graphic based on Aït-Touati, F., Arènes, A., Grègoire, A. (2022), pp. 34.

Relational Diagram

The first level of understanding emerges through relational abstraction. At this stage, the city is analysed by breaking its complexity into elementary components and relationships. Representation supports this analytical process by simplifying spatial phenomena into relational structures, allowing form to be understood independently of precise measurements or physical accuracy (Alexander, 1967; Allen, 1998).

While spatial analysis often privileges direction, a three-dimensional reading of the city requires renewed attention to the ground as a key dimension of complexity and depth (Aït-Touati, 2022) (Figure 4). The first underground representations were related to understanding the Earth's interior, such as Descartes' layered model titled *Über die Erde* (1644) and Kircher's *Mundus Subterraneus* (1665), which exemplify this approach.

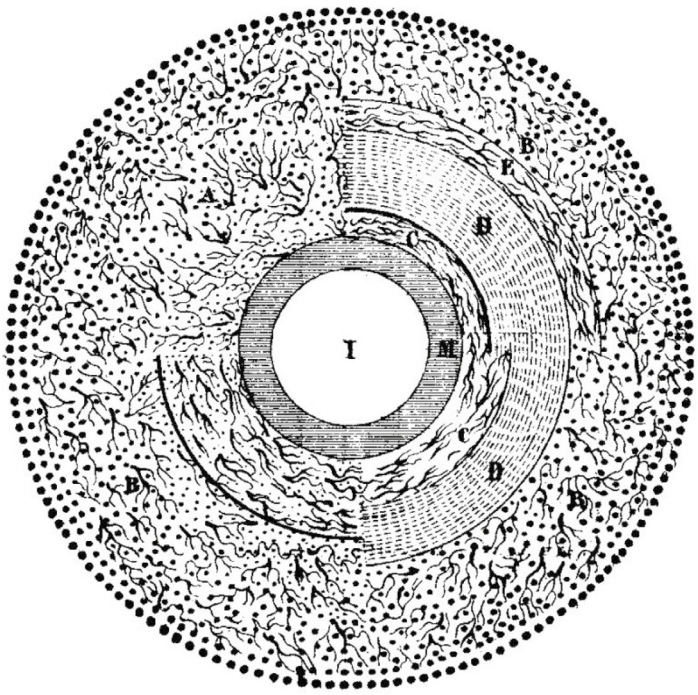

Figure 5. Renè Descartes, Über die Erde, map, 1644, Principia Philosophie.

In René Descartes' representation (Figure 5), the Earth is described as having a hot, molten core that has gradually cooled over time. He articulated a vision of the Earth comprising distinct layers: a dense interior, water, air, and finally, the surface layer.

Building on this foundational idea in 1665, Athanasius Kircher published *Il Mondus Sotterraneus* (Figure 6), which provided a detailed anatomical description and illustration of the Earth's strata. His work emphasised the elements of water, air, and fire, drawing inspiration from his travels around Italy. These investigations were informed by direct observations of volcanic phenomena, particularly at Mount Vesuvius.

Although speculative, these diagrams introduce a crucial morphological intuition. Urban thickness is first made thinkable as a stratified condition before it can be spatialised. At this level, abstraction translates thickness into form by organising relationships, not dimensions.

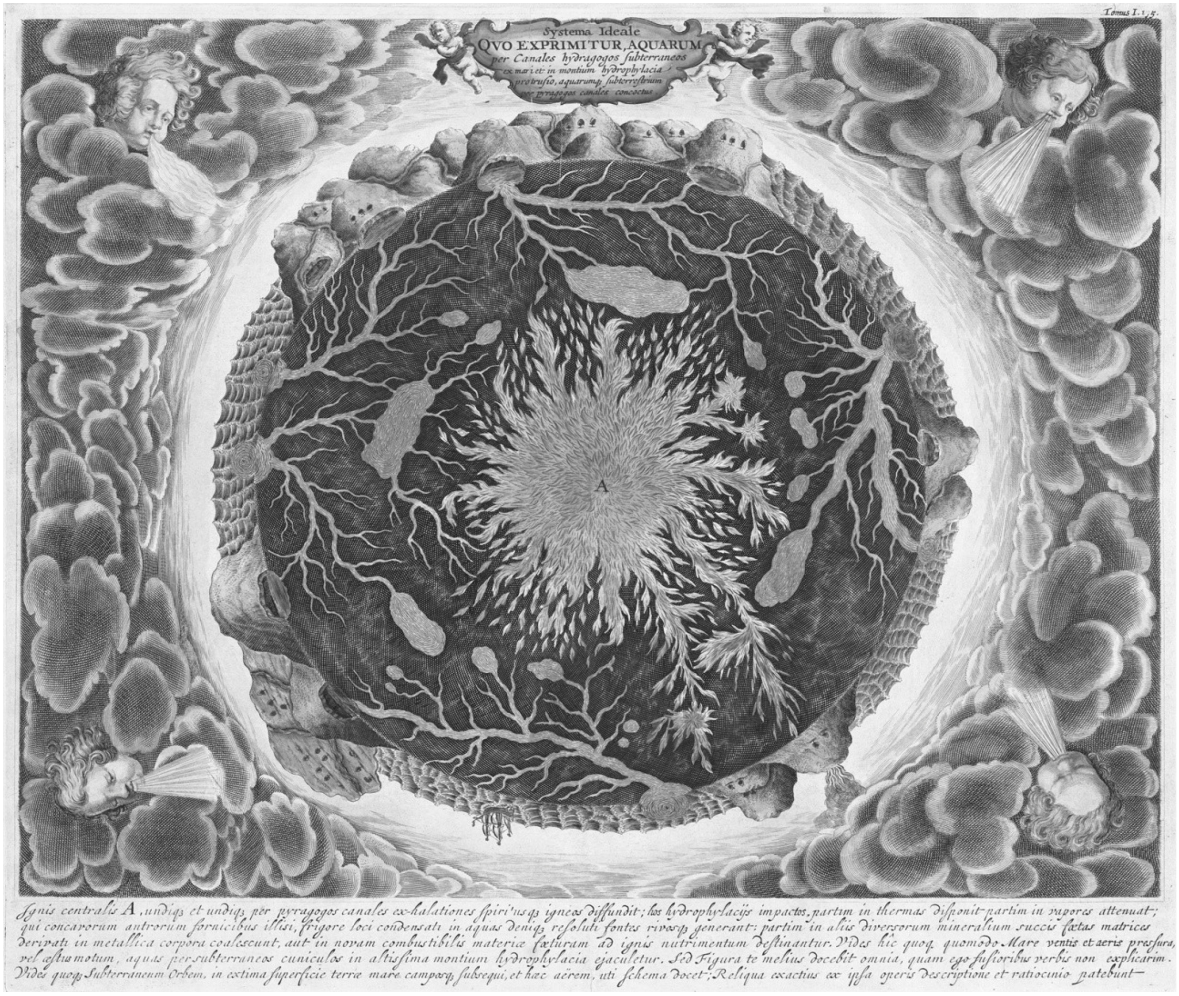

Figure 6. Athanasius Kircher, Systema ideale quo exprimitur, aquarum per canales hydragogos subterraneos ex mari et in montium hydrophylacia protrusio, aquarumq[ue] subterrestrium per pyragogos canales concoctus, maps/atlases, 1665, Mundus Subterraneus.

Geometric Diagram

The second representational regime introduces geometry and logic as structuring devices. Here, analysis focuses on meas-

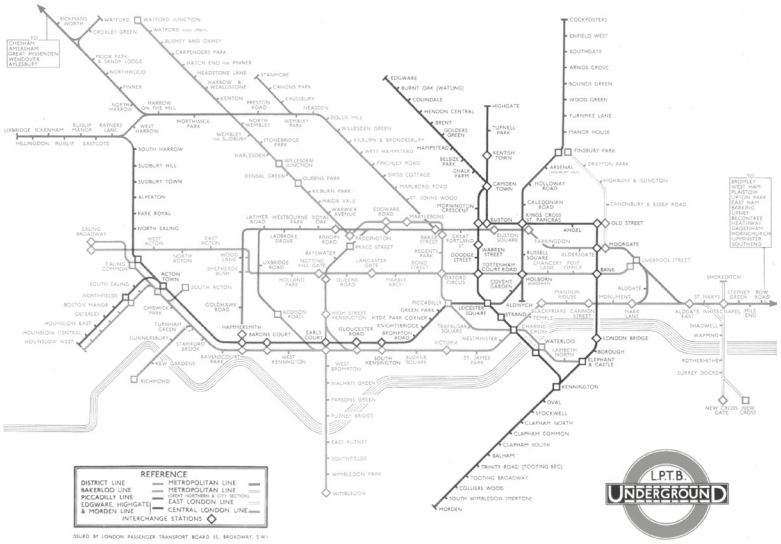

Figure 7. Hanry Beck, Map Of London's Underground Railways, map printed by Waterlow & Sons, 1933, London Transport Museum (TfL).

urable relationships (distance, hierarchy, accessibility) that are abstracted through topology and syntax (Hillier et al., 1988). Representation follows as a geometric system that organises these relations into a coherent structure (Knoesper, 2002).

Henry Beck's 1933 map (Figure 7), called '*The Diagram*' and designed for the underground line of London, exemplifies this syntactical connection between spaces. By replacing geographic accuracy with topological consistency, *The Diagram* renders the underground infrastructure of London as a coherent morphological system (Garland, 1994). Beck's map functions as a syntax model, where individual elements seek to establish relationships with one another. Its legacy lies not in its aesthetic clarity but in its morphological power to translate the invisible urban infrastructure into a coherent, navigable system: a complex set of elements in relation to one another (Alexander et al., 2015).

Morphologically, this regime introduces a second insight: thickness is understood as a networked system, where depth is structured through connectivity rather than physical distance.

Hybrid Representations

Hybrid representations combine analytical rigour with speculative intent. They translate what Muminovic (2019) defines as *place-as-assemblage*, integrating existing conditions with projected transformations. In this stage, abstraction operates by aligning multiple layers (functional, spatial, and infrastructural) within a single representational framework.

Eugène Hénard's multilayered sections of Paris (1910) exemplify this approach, published in '*The Cities of the Future*'. His drawings represented the underground as a vertically organized structure, serving as the foundation for the principles described in Webster's 1914 publication '*Subterranean Street*

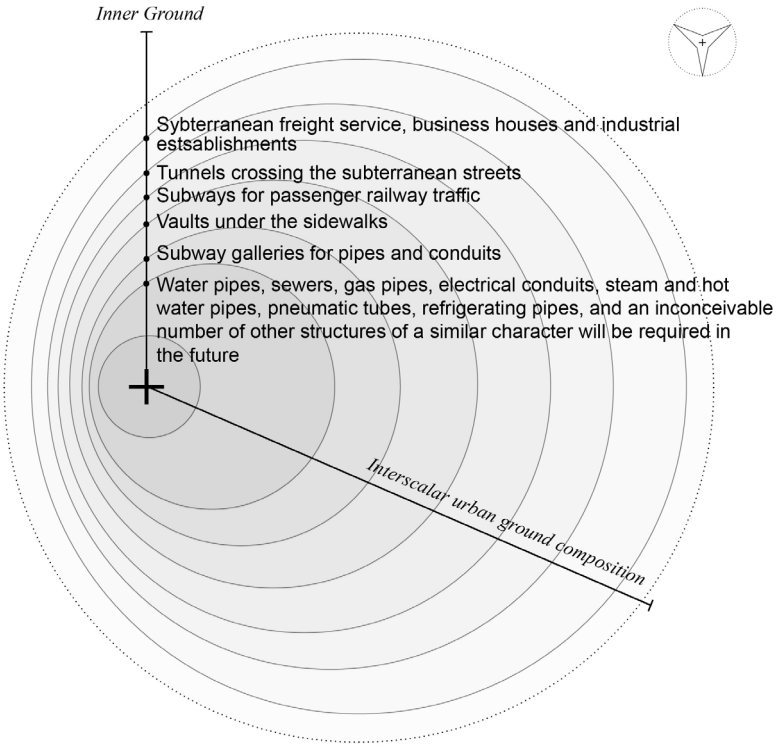

Figure 8. Webster's Vertical City Organisation. Graphic based on Aït-Touati, F., Arènes, A., Grègoire, A. (2022), pp. 70-71.

Planning' (Figure 8). In this system, circulation, services, and public life are distributed across depth (Admiraal et al., 2018).

This regime articulates urban thickness as a vertical assemblage of interacting layers. Representation no longer isolates relations or networks, but integrates multiple strata into a single spatial construct, anticipating the volumetric understanding of the city.

Simplified Geographical Representations

Giovanni Battista Nolli's *Nuova Topografia di Roma* (1748) marks the conceptual origin of a representational logic based on analytical layering. Through the opposition of black and white, figure and ground, public and private, Nolli establishes a language of urban comprehension grounded in the separation of conditions rather than in their synthesis (Trancik, 1990). This approach transforms planimetry into a tool for abstraction: each figure-ground relation corresponds to a conceptual layer through which the urban form can be examined (Rowe et al. 1978).

This method finds a technical parallel in the Parisian sewer network map of Eugène Belgrand (Figure 9), which visualised the underground as an autonomous infrastructural layer (Gandy, 1999). From an underground perspective, the layered plan inaugurates a new cognitive stage in urban conceptualisation. By stratifying the city into autonomous components, it makes the internal anatomy of urban form visible. The layer becomes an operative tool that anticipates the volumetric comprehension of the metropolis: a step toward

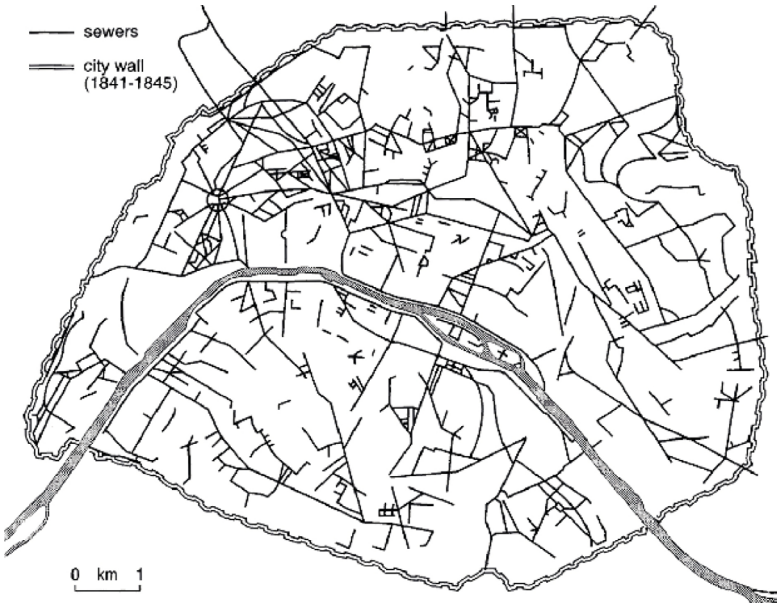

Figure 9. Eugène Belgrand, Paris sewers built between 1856 and 1878, 1887, Les travaux souterrains de Paris V: les e´gouts et les vidanges.

understanding the city as a three-dimensional construct, composed of interacting but still separately analysed systems. This framework prepares the ground for the synthesis of spatial depth and urban complexity (Gandy, 1999).

Morphologically, this regime contributes a further insight: thickness is translated into form through analytical layering, allowing spatial depth to be understood as a composition of interacting but distinguishable systems. Representation here operates as an intermediate step toward volumetric synthesis.

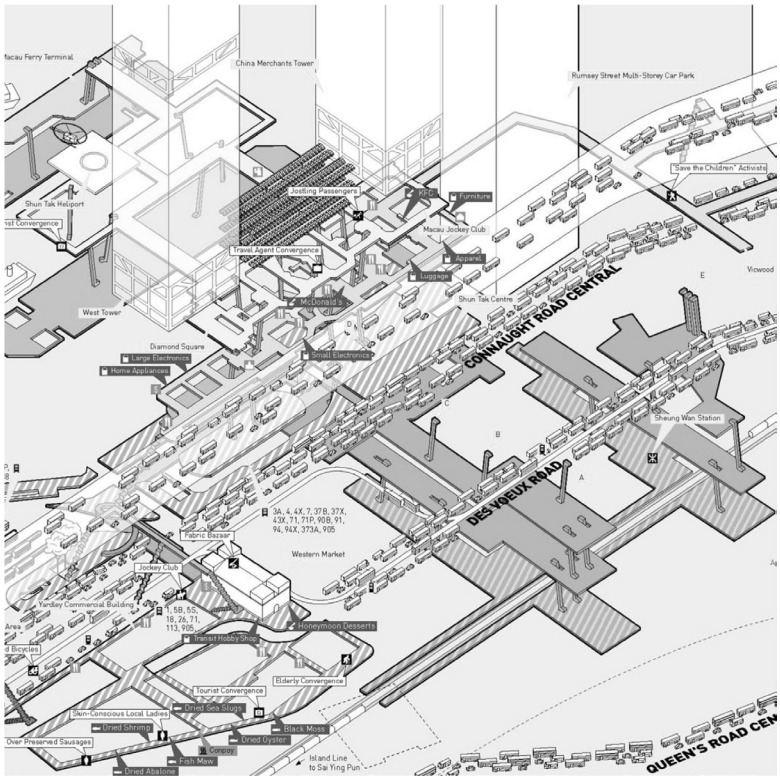

Figure 10. Adam Frampton, Clara Wong, Jonathan D. Solomon, Central, digital model, 2012, Cities Without Ground. A Hong Kong Guidebook. Graphic reworking by the author (black and white, detail), used for critical analysis purposes.

Mimetic and Realistic Representations

The final representational regime seeks maximum correspondence with spatial reality. Mimetic models integrate large quantities of data to construct three-dimensional representations of the urban environment, but despite their apparent realism, these models remain interpretative reconstructions rather than neutral reproductions (Batty, 2019).

In *Cities Without Ground* (2012) (Figure 10), the axonometric representation of Hong Kong depicts the city as a continuous three-dimensional field of movement and infrastructure. Here, the distinction between surface and subsurface collapses into a single volumetric system (Frampton et al., 2012).

Morphologically, this regime translates thickness into form through spatial continuity, integrating the underground into everyday urban life and enabling it to be addressed as a fully designable field.

The Synthetic Phase

Viewing the city from an underground perspective shows how different representational regimes generate distinct ways of understanding the city as a three-dimensional object. Rather than forming a linear or historical sequence, these regimes define a continuous cognitive gradient: a movement from interpretation to spatial placement, in which abstraction operates as the mechanism that translates underground thickness into urban form.

Following Muminovic's (2019) framework, this process unfolds through a recurring sequence of interpreting, reading, and placing. Interpretation corresponds to the initial abstraction of spatial conditions; reading involves analytical operations that organise and structure these conditions; placing translates this structured knowledge into spatial form. Representation operates here as an intermediate step between abstract reasoning and morphological understanding (Figure 11).

Each representational mode analysed in the comparative phase constructs a specific layer of knowledge about the un-

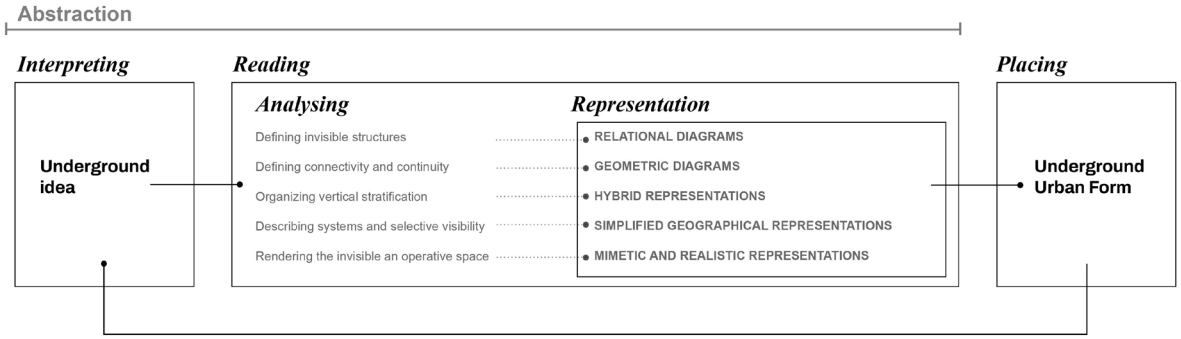

Figure 11. Process of Understanding Urban Form through Representation.

Representation Phases

Phase	*Key Characteristics*	*Cognitive Object*
Relational Diagrams	Matrix of relations, forces, and dependences, non-spatial abstraction	Make invisible structure legible
Geometrical Diagrams	Mathematical/topological logic; geometric simplification.	Define and organize complexity
Hybrid Representations	Layered visions, vertical sections, continuitu between gound and underground.	Reveal the city as a continuous organism
Simplified Geographical Representations	Thematic layers, selective information.	Rationalise the invisible into measurable systems
Mimetic Realistic Models	3D and parametric simulations.	Turn abstraction into operational spatial form

Figure 12. Representational Phases of Underground Visualization.

derground city (Figure 12). While still interpretative, these models transform abstraction into operational spatial form, enabling the underground to be addressed as a designable urban field.

The synthesis of these representational regimes produces three main results. First, underground urban form emerges not as a pre-existing object, but as a construct progressively stabilised through representation. Second, each representational regime isolates a specific morphological property (relations, networks, layers, or volumes) demonstrating that no single mode is sufficient to describe urban thickness in its entirety. Third, the transition from abstraction to mimesis does not eliminate interpretation but reconfigures it, shifting from conceptual ordering to spatial integration. Together, these results show that a three-dimensional understanding of the city depends on the coordinated use of multiple representational strategies.

Conclusion

This research set out to investigate how representation contributes to the understanding of the underground city as a formative component of urban morphology. By analysing a range of representational regimes through the lens of abstraction and mimesis, the study demonstrates that underground urban form does not pre-exist its representations but is progressively constructed and stabilised through them.

The comparative analysis shows that each representational regime produces a partial but specific morphological insight. While each mode enhances understanding, none is sufficient on its own. Urban thickness can only be grasped through the coordinated use of multiple representational strategies.

From an urban morphology perspective, this finding has two main implications. First, it challenges the persistent sep-

aration between surface and subsurface in urban analysis, showing that this divide is not ontological but representational. Second, it reframes representation as an operative tool that does not merely describe underground space but actively enables its integration into morphological reasoning and design processes.

The study suggests that future research should focus on developing representational tools capable of synthesising relational, layered, and volumetric knowledge within a single framework. Such tools could support more integrated approaches to urban analysis, planning, and design, allowing the underground to be addressed not as a residual technical domain but as a generative dimension of the three-dimensional city.

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