Overlapping Realms. Extending Figure-Ground theory to the Subterranean City.

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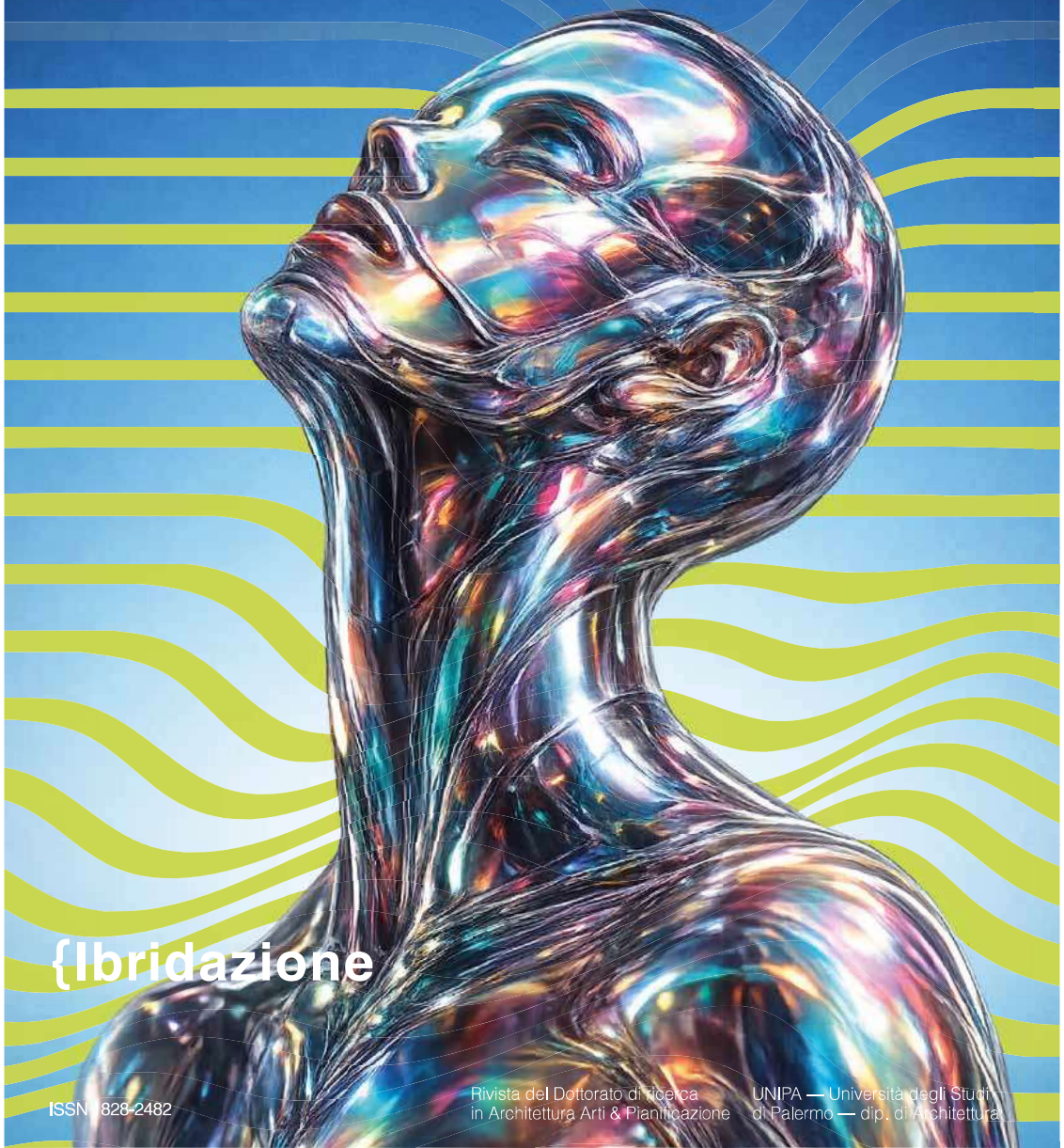

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In copertina
Hybrid Thinking
elaborazione grafica di
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D'ARCH DIPARTIMENTO DI ARCHITETTURA UNIPA
DAAP DOTTORATO DI RICERCA IN ARCHITETTURA, ARTI E PIANIFICAZIONE DIPARTIMENTO DI ARCHITETTURA DI PALERMO

La Rivista

In folio è la rivista scientifica di Architettura, Design, Urbanistica, Storia e Tecnologia che dal 1994 viene pubblicata grazie all'impegno dei dottori e dei dottorandi di ricerca del Dipartimento di Architettura (D'ARCH) dell'Università di Palermo (UNIPA). La rivista, che si propone come spazio di dialogo e di incontro rivolto soprattutto ai giovani ricercatori, è stata inserita dall'ANVUR all'interno dell'elenco delle riviste scientifiche dell'Area 08 con il codice ISSN 1828-2482. Ogni numero della rivista è organizzato in cinque sezioni di cui la prima è dedicata al tema selezionato dalla redazione della rivista, mentre le altre sezioni sono dedicate all'attività di ricerca in senso più ampio. Tutti i contributi della sezione tematica sono sottoposti a un processo di *double-blind peer review.*

Per questo numero il tema selezionato è:
Ibridazione

L'ibridazione, intesa come integrazione e fusione di elementi provenienti da contesti diversi, ha assunto un'importanza crescente in molteplici ambiti, dalle scienze naturali, urbane e sociali alla cultura e alla tecnologia. Questo processo, spesso visto come una forma di trasformazione o contaminazione, dà origine a nuove forme, idee e pratiche, mettendo in discussione le definizioni tradizionali e favorendo la nascita di modelli innovativi di interazione tra sistemi talvolta considerati apparentemente distinti.
I modelli ibridi puntano alla sperimentazione di strategie e metodologie capaci di arricchire e ampliare il complesso delle relazioni sociali, economiche e culturali. Questi processi si realizzano attraverso «…la contaminazione, l'innesto, la stratificazione di espressioni e attività eterogenee, persino incoerenti, capaci di generare insiemi abitati inediti, talvolta imprevisti, sensibili e ricchi di senso.» [Caudo G., Hetman J., Metta A., 2017, 6] L'ibridazione diventa dunque una lente privilegiata attraverso cui interpretare e affrontare le trasformazioni del nostro tempo, poiché consente di superare i confini disciplinari e di sperimentare nuove modalità di interazione. Questo processo può assumere forme differenti: in alcuni casi, genera risultati definiti e stabili nel tempo; in altri, si manifesta come un fenomeno in continua evoluzione, capace di adattarsi a contesti in fase di cambiamento e a esigenze sempre più diversificate. In un'epoca caratterizzata da cambiamenti rapidi e interconnessioni sempre più complesse, l'ibridazione si rivela un paradigma essenziale per affrontare le sfide contemporanee. Superando rigidi compartimenti disciplinari, essa favorisce il dialogo tra ambiti diversi, stimolando l'innovazione e la creazione di nuovi modelli di pensiero e azione. La capacità di adattarsi ed evolvere attraverso contaminazioni e sinergie rappresenta un'opportunità fondamentale per sviluppare soluzioni sostenibili, resilienti e inclusive. Guardare al futuro con una prospettiva ibrida significa dunque accogliere la complessità e valorizzare la diversità come motore di trasformazione e crescita.

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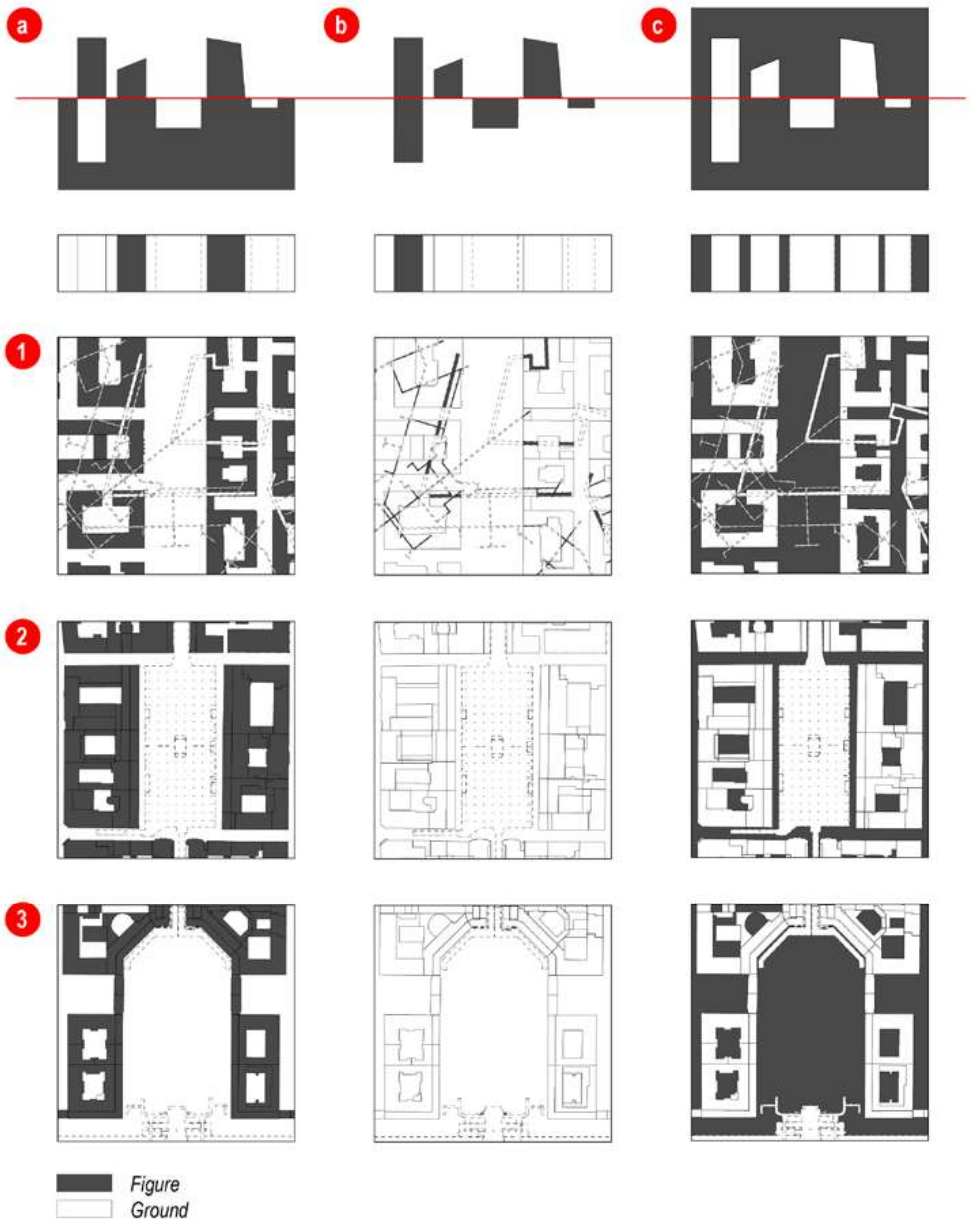
Indice



Application of the models to the case studies (image by the authors).

Overlapping Realms
Extending Figure-Ground theory to the Subterranean City

Caterina Juric
Jowita Aleksandra Tabak

This paper extends Figure–Ground theory into the subterranean realm by proposing a series of models for vertical interpretation, while demonstrating the limitations of the traditional, predominantly horizontal understanding of urban form. Through theoretical inquiry and practical application, the paper proposes and examines three models, ultimately identifying the most clear and coherent approach - one that shifts the conventional focus of urban design from solids to voids and presents the city as a volumetric continuum, thereby highlighting latent natural potentials for urban regeneration.

Keywords: *Vertical city, Model, Voids, Essence of the city, Figure-ground.*

Introduction

Cities' ground is usually perceived mainly as a bidimensional entity. On the flat surface, buildings are laid out, and the patchwork of streets, squares, and green areas overlaps the tessellation of property boundaries. However, the layering of the urban ground, although hidden mainly from ordinary perception, is an integral part of urban design, not only in technical terms (geological, infrastructural and so on), but also in morphological ones. The construction and the transformation of the city is always closely connected with the subterranean structure of the ground: the buildings are never just laid down on the ground, as they dig new underground volumes, that provide space for essential functions; the streets are never just bidimensional ribbons of asphalt, as they usually host under their surfaces a thick bundle of underground services, like sewage and freshwater piping, district heating and data networks; the subway systems are not just limited to the isolated spaces of the stations, as they carve long tunnels through the city, whose layouts must deal with all the other subterranean presences. This topic becomes increasingly important as cities develop and their morphological layout and the density of the networks increase.
A central concern in contemporary cities and their design is the balance between built and unbuilt, between solids and voids, to create spaces of collective meaning [Schrijver, 2006]. The urban spaces – voids - are the ones that shape urban life and define the city's livability [Granata, 2021]. Therefore, in a context where the city cannot be considered bidimensional anymore, understanding the morphology of its underlying layers is essential for urban spatial design.
In "*Place as Assemblage*," Muminovic [2019] examines how the city's morphology is understood. The examination begins with the interpretation, which is the initial perspective adopted when encountering something for the first time. Following this, the reading phase with analysis begins, formulating the representation and culminating in the placement moment, where a complete understanding of the object is achieved [Muminovic, 2019]. The article focuses on the transitional phase between analysis and placement, suggesting representation – drawing, which becomes the zone of altered reality [Rossi, 1982] as a key means to grasp and re-elaborate the city's morphology [Fig. 1].
Building upon *Figure–Ground* theory and extending its application to the underground domain, the study proposes hybrid technique to reevaluate the interpretation of solids and voids in contemporary vertical city. The aim

is to enhance understanding of urban form, city's vertical morphology, and highlight the potential for future transformations.
The article is organized into two parts. The first, theoretical section distinguishes between the above-ground and subterranean city, examining how these two realms interact through the relationship between solids and voids. The introduction of underground elements gives rise to a *groundline paradox*. As one moves from the surface to below ground, the conventional relationship between solid structures and empty spaces is inverted. This condition adds complexity to the three-dimensional representation of the city. This section presents the three representational models and illustrating how overlapping layers from above and below ground are translated from section into plan.
The second part applies the proposed theoretical models to three selected areas in Turin - Piazza San Carlo, Giardino Sambuy, and Porta Nuova Station. In each case, the relationship between solid structures and empty spaces is examined through the application of models, revealing distinct interpretive insights. This comparative analysis identifies the model that is most effective for understanding the city's three-dimensional structure.

Theoretical framework

Trancik [1986] delineates three key theories of urban spatial design: *Figure–Ground, Linkage,* and *Place*.
Figure–Ground theory presents urban morphology by focusing on the relationship between solids and voids, positioning them in relation to the essence and background of urban elements. This theory is also the most used mode of urban representation in contemporary urban spatial design. Given that, *Figure–Ground* theory is adopted in the article as the primary framework for examining the three-dimensional morphology of the city and the interactions among its multiple layers. By emphasizing the reciprocal relationship between solids and voids, the theory foregrounds urban morphology as a dynamic system of evolving relations and interconnections. Founded on contrasts between opposites and articulated through both conceptual and graphical means, *Figure–Ground* theory analyzes and represents the city through the conceptualization of the *Figure* - its essence - traditionally embodied by built elements rendered in black and examines their relationship to the voids depicted in white as *Ground* [Rowe et al., 1978].
While open spaces have historically been understood as *Ground*, contemporary studies and projects increasingly conceptualize them as Figures, thereby foregrounding the problem of the void - one that can no longer be interpreted singularly or unambiguously.

Horizontal city

Beginning with theoretical and historical studies within *Figure-Ground* theory, the distinction was made between what is built (object) and what is not (space), referred to as solid and void, positioning them as *Figure* and *Ground*, respectively. These definitions aimed to emphasize the materiality of the area, with a direct impact on its spatial configuration: solid refers to any volumetric, independent element, clearly distinguishable from the void, which is considered its absence or lack [Thuer et al., 2023]. This represents a classical, horizontally oriented depiction of the city, commonly referred to as the *Schwarzplan*, which in contemporary urban spatial design has become the most prevalent mode of urban representation: a morphological depiction of the city in black and white that distinguishes built structures from empty spaces [Hebbert, 2016].

Vertical city

Considering the city beyond a two-dimension perspective reveals certain difficulty in understanding the notion of the void. In the underground dimension, the solid–void relationship is neither as binary nor as visually distinct as it is above ground. Here, the soil itself is conceived as a solid, depicted in black, and only through architectural intervention, voids are created as excavated spaces which become accessible and usable. In this context, the void is not merely the open space between structures, but rather a constructed absence within the mass.
Within this spatial logic, the soil functions as the solid (*Ground*), and the built structures becomes the voids (*Figures*), thereby reversing the typical *Figure–Ground* relationship observed above ground. However, when considering both above- and below-ground realms together, difficulties persist in achieving a coherent understanding. The transition point - the shift from below- to above-ground - connects two distinct urban realities and is defined by the ground line.

Models

The conceptual framework of the three models, initially developed from a sectional perspective, is transposed into a plan, offering a new interpretation of urban space. Consider a schematic vertical section representing an above-ground square and the parking structures below. This section is analysed through *Figure–Ground theory*, interpreted and represented in three different ways - models. Each model investigates the solid–void relationship from a vertical urban perspective. The sections are then translated into plan through superposition. Importantly, an element is represented as *Figure* (shown in black) in the plan only where the *Figure* overlaps in both the above- and below-ground realms. Consequently, the plan depicts the *Figure* exclusively at points of coincidence between the two vertical layers.

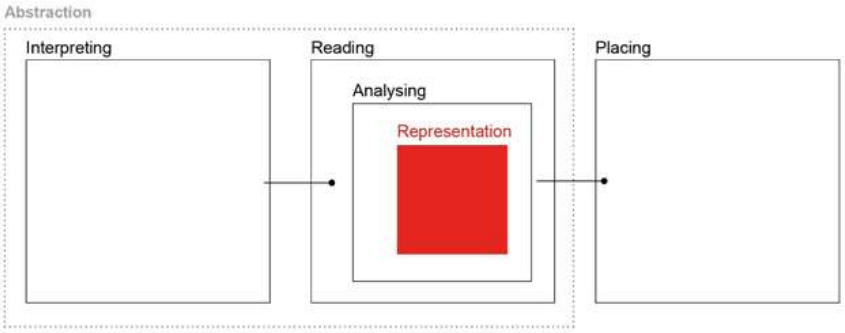


Fig. 1. Genealogy of Urban Form Understanding. Graphic based on Muminovic, M. (2019), (image by the authors).

A key graphic element in the plan representation is the differentiation between surface and underground construction through line type: continuous lines denote structures above ground, while dotted lines indicate those below. This distinction preserves the legibility of vertical stratification within a unified framework, allowing the viewer to decode the depth and condition of each architectural element. Rather than flattening the reading of urban form, this layered coding introduces a calibrated syntax that retains spatial continuity and ontological difference.

Model a

In the first model, the *Figures* (rendered in black) are the solid elements - the buildings above ground - while the square, the void between them, is the *Ground* (rendered in white). Below the surface, however, this relationship is reversed: the solid element, the unexcavated soil, becomes the *Figure*, while the built structures, depicted in white as the voids, constitute the *Ground*. The result is an inversion of what is *Figure* and *Ground* (solid and void), going from above to below the surface. This perspective hinges on a clear demarcation of the groundline, which separates the above-ground solids and voids from their subterranean counterparts. The model is then hybridized into the plan, where a *Figure* is defined only when it overlaps both above and below the surface. In such cases, the defined area is rendered in black as *Figure* [Fig.2 a].

Model b

In the second interpretation, the above-ground and underground built elements are depicted as *Figures*, rendered in black, unified by their structural presence. The space and soil around and between them are represented as a continuous void - the *Ground* in white colour. This perspective emphasizes the constructed elements as solids while considering the voids as a homogeneous, undifferentiated Ground. In this model, when translated into the plan, the *Figures* correspond exclusively to constructed areas only when they overlap in both the above- and below-ground realms.
This interpretation reduces the emphasis on the transition between the surface and the underground, defining a singular three-dimensional urban space. Moreover, the corresponding plan emphasizes the areas, which are built both above and below the ground and presenting them as *Figures* [Fig. 2 b].

Model c

The third interpretation considers the soil and space as the *Figures* (rendered in black), while the built structures, both above and below ground, are treated as *Ground* (depicted in white). Human-made constructions are no longer differentiated by their position relative to the surface but are unified across layers. This interpretation emphasizes the empty spaces of the city - the areas that are not constructed. In the plan, the unbuilt areas, both above and below ground, are considered *Figures*. They are depicted in black only where the area is empty of construction within the layers. The built elements above and below the surface are rendered in white as *Ground*, while the surrounding voids are depicted as *Figures* in black [Fig. 2 c].

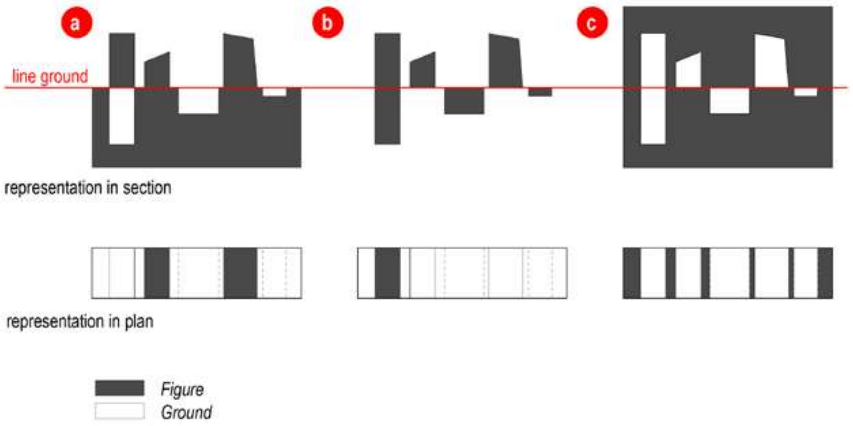


Fig. 2. Experiments with Figure-Ground theory: three models in sections and plans (image by the authors).

Fig. 3. Figure-Ground plan of Turin: case studies, (image by the authors).

Practical application

The models explored in the previous chapter reveals a paradoxical relationship between the solid and void elements of the city, rooted in the dynamic interplay between above ground and underground spaces. In a vertical city, spatial relationships are not confined to the surface but extend, involving a continuous negotiation between surface and subsurface realms.
In the first model (Model a), above ground, voids appear as open spaces outlined by solid built forms. Below ground, these roles are reversed: voids become habitable excavations carved from the earth's mass. What is solid on the surface becomes void beneath, and vice versa. This inversion destabilizes the binary classification of solids and voids, revealing transitional spaces that blur clear spatial definitions. On the other hand, the second model (Model b) focuses on the built structures, but not representing their masses. It does not distinguish between superficial and underlying elements, resulting in an undefined urban space where all layers overlap without a clear order. Finally, the third model (Model c) reflects a contemporary perspective, dividing space into what is anthropized and what is not. The result is a space shaped by constructions, with emptiness assuming a fundamental importance.

Application: City of Turin
Turin is historically recognised as Italy's most important company town. Its socio-economic configuration underwent profound transformation in the second half of the twentieth century. Since the 1990s, in the wake of a prolonged industrial crisis affecting its principal factories, Turin has experienced sustained urban contraction, resulting in approximately 10 million square metres of abandonment and emptyness [Vassallo, 2022].
Today, Turin constitutes a paradigmatic example of a post-industrial, shrinking city. Confronted with intersecting demographic, economic, and ecological challenges, the city is compelled to articulate a new strategic vision for its future development. This search requires an analysis and comprehensive understanding of the city's spatial structures, especially empty ones.
The article presents the application of the theoretical models to the Turin's urban spaces within the *Mandorla Barocca,* the historic Baroque core of Turin. For the analysis, there were selected three areas in Turin: Corso Vinzaglio with the underground tunnels [Fig.3 (1)]; Piazza San Carlo with its underground parking facility [Fig.3 (2)]; Piazza Carlo Felice with Giardino Sambuy and the entrance to Porta Nuova station [Fig.3 (3)].
In the first case study - Corso Vinzaglio and its tunnel system - three analytical models are employed to investigate different morphological relationships between above- and below-ground structures. Model a closely resembles the conventional figure-ground representation of above-ground buildings. The only additional layer of information consists of dashed lines indicating subterranean structures. Where tunnels pass beneath buildings, voids appear within the black mass, signifying the excavated underground terrain. In Model b, however, the plan becomes largely illegible from a morphological standpoint. Spatial relationships are difficult to discern, as only elements that exist simultaneously above and below ground are rendered in black. As a result, the tunnels - located beneath the buildings - are the only clearly visible elements, while the overall configuration of the built environment is obscured. Model c, by contrast, allows for an immediate comprehension of spaces free from construction. This representation reveals a spatial continuum extending both above and below ground that remains non-anthropized. Consequently, model c most clearly articulates the vertical morphology of the site, making explicit the relationship between built form and unbuilt space.
A comparable condition emerges in the second case study, Piazza San Carlo. Here, too, the first representation lacks clear articulation of subterranean structures. Although underground elements are indicated by dashed lines, the relationship between solids and voids below ground remains unclear. In the second model, this relationship disappears entirely: both above- and below-ground structures are represented only through white outlines, resulting in a loss of morphological legibility. The third model, however, effectively highlights the empty, unstructured spaces enclosed by the buildings, thereby restoring a clear reading of spatial morphology.
The third case study, Piazza Carlo Felice, exhibits similar characteristics. The model once again approximates a traditional figure–ground plan, supplemented by dashed lines indicating underground structures. Nevertheless, this representation alone does not allow for a precise understanding of the actual location or extent of the subterranean spaces. In Model b, the near absence of black elements renders the drawing difficult to interpret. Model c, in contrast, clearly delineates the empty spaces in relation to the built fabric, offering the most legible and comprehensive morphological reading of the site.

Discussion and Limitations

As cities evolve into layered systems, conventional paradigms reveal the insufficiency in articulating the volumetric nature of cities. The comparative analysis of the three models across the case study areas in Turin reveals the limitations of Figure-Ground theory when applied to the vertical city. Transitioning from a planar to a stratified, three-dimensional understanding of urban form necessitates reconfiguring frameworks.
The proposed Model c emerges as the most coherent and operative approach within this context. The method conceptualizes the soil as a *Figure,* treating built structures - above or below ground - as *Ground* resulting from anthropic subtraction.
The inversion is a conceptual repositioning, not solely a graphical convention. By presenting the unstructured areas as *Figures* and the built ones as *Ground*, the city's

non-anthropized areas gain an immediate understanding, highlighting the natural potential for urban transformation. The voids (soil and open space) within and around built areas are no longer viewed as mere background for architectural and urban projects, but as the essence and primary focus for the development of the city toward an ecologically and collectively oriented future. Through this model, the city is represented as a volumetric entity where the surface and the subsurface are hybridized in a unique bidimensional map. In this context, the soil results in a *Figure*, highlighting that anthropized spaces have the most significant potential and value for the ecological transition. The consequence is a representation of empty spaces extending from *caelo* usque ad *centrum,* and therefore with the potential for transformation.

Nevertheless, the model introduces an important epistemological paradox. While the Model c unifies spatial understanding across vertical layers, it risks obscuring the symbolic, and functional specificities of surface and subterranean environments. The erasure of the groundline as a perceptual threshold may diminish the dialectic between upper and lower realms, potentially flattening their relational tension. Thus, while the method excels in visualizing the mass of unbuilt space and revealing the city's volumetric articulation, it may fail to account for the typological differences embedded in various urban strata without the use of complementary analytical tools.

Nevertheless, the proposed model, which hybridizes the above- and below-ground realms into a single bidimensional map of the city, reveals and emphasizes spaces that are critical to the future of urban environments. This interpretive tool can be applied to cities worldwide, offering new perspectives and alternative readings of morphological maps. It functions both as a means of understanding and as a powerful instrument for re-conceptualizing future urban development. By positioning non-anthropized urban spaces as Figures - fundamental urban elements - urban design can refocus its attention on their preservation and actively seek to identify and expand such spaces, particularly in response to the urgent need to reduce ecological impacts.

Conclusions

The proposed Model c should not be understood only as a representational technique, but as a critical device capable of revealing the urban fabric's hybrid, stratified, and performative condition. It enables a reconceptualization of the soil as more than a neutral datum: it becomes a site of natural and ecological potential, from which the contemporary project can be reimagined and directed into future ecologies.

The emphasis on unbuilt rather than built areas enables the dissolution of the traditional hierarchy between surface and subsoil, a hierarchy that persists in the first, traditional model (Model a). While it maintains a fixed and rigid boundary at the groundline, the second model approach risks homogenizing all constructed masses. In contrast, the third model (Model c) re-establishes a meaningful contrast between transformed and untransformed matter. The contrast, in turn, highlights the latent urban potential of unexcavated terrain—understood here as the city's most significant spatial and projective resource.

The presented method and models enable the identification and hybridization of the above- and below-ground domains. The city is no longer perceived as a layered sequence of autonomous planes, but as a continuous and dynamic system. Spatial agencies across vertical layers are revealed to be interdependent, and the built forms rise above the surface and are carved beneath it. The soil and open space become a generative field, a focus for the urban spatial design. By representing the built environment as Ground and the terrain as Figure, their interdependence is made explicit: urban structures are read as cavities within a dense material continuum. This inversion reframes the design narrative, repositioning the soil and open space not as background but as an active subject in urban formation.

Through this tool, new forms of urban representation can generate critical insights for future urban development by refocusing attention on non-anthropized areas, which - particularly in the context of ecological crises - must be increasingly re-evaluated and reinterpreted. Areas, both above and below ground, where no built structures are present, constitute a potential for urban ecological transformation. Voids function as grounds of possibilities: areas for water management and mitigation, the reduction of urban heat island effects, and the support of ecological systems. By repositioning such spaces at the center of urban interpretation - and, consequently, of urban design - their value and significance can be fundamentally redefined.

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