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### A topological design tool

Alexandrescu, Maria; Forgaci, Claudiu; Ionescu, Ioana

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## URBAN SCAFFOLDING: A TOPOLOGICAL DESIGN TOOL

/MARIA ALEXANDRESCU, CLAUDIU FORGACI, AND ANCA IOANA IONESCU

Delft University of Technology

*anca.ionescu@gmail.com; claudiuforgaci@gmail.com; m5alexandrescu@gmail.com*

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### ABSTRACT

Landscape architecture, landscape urbanism, and urbanism provide a number of tools, methods, and techniques for the design of the built and unbuilt urban landscape. The interplay of these techniques is left up to the designers, and the resulting range of projects associated with the terms is broad and inconsistent. This paper proposes Urban Scaffolding as a way to reconfigure existing practices into a flexible, scalable, repeatable, and compact design mechanism that simultaneously discovers and intervenes in a territory. The method was developed through design projects that focused on reconnecting the urban and natural landscape by means of topological strategies. Two of these projects will be used as examples in this paper.

In this paper Urban Scaffolding is introduced both in terms of what it is, and what it can do. As a conceptual tool, it abstracts key relationships between a landscape's scales, and prepares the ground for subsequent interventions. As a method, it uses the structural potentials of the existing landscape (i.e. water lines, ecological corridors) and urban fabric (i.e. road network, desired paths) to guide the development of territory by coupling social-ecological systems into a framework for development. As a topological device, the scaffolding consists of three components representing three types of connections—enforcers, gatherers, and explorers—capable of adapting to the particularities of each site. With this configuration, the scaffolding seeks to establish inter-scalar relations that facilitate access to local and remote resources, thus guiding rather than prescribing urban development. The method uses three non-metric scales: (1) the territorial scale (scale of context), defined by the watershed and the major urban activities connected to it; (2) the scale of the scaffolding (scale of focus), which identifies the strategic structure; and (3) the project scale (scale of detail).

Urban scaffolding puts forward a number of principles that prepare the ground for subsequent interventions that make use of existing landscape potentials. These principles guide the operations of the three components, actuate their coming together with the existing structural potentials of a landscape, and thus determine what the scaffolding can do:

1. Provide access to geomorphology and natural features;
2. Encourage heterogeneity and coexistence;
3. Unfold, encourage, and build upon existing processes and structures;
4. Embrace emergent, self-organized processes.

The paper is structured in two main sections. In the first section, two design projects, both competition entries, illustrate the use of the method: ‘342.914 km of scaffolding’, a strategy for the reintegration of Bucharest’s River Colentina; and ‘Three faces of Vernon’, a project in which the scaffolding is built on an inter-scalar topology. In both projects, water is the structure that is being connected to the surrounding urban fabric. The second section introduces the method, the tool and its components, with reference to the two projects described previously. In the conclusion, we present a reflection on urban scaffolding as a method for design its potential for in other spatial configurations.

## INTRODUCTION TO URBAN SCAFFOLDING

Accepting that the city, is constantly changing and that its development cannot be precisely determined is a prerequisite for the well functioning of spatial interventions in the urban environment. The current paper departs from this observation and acknowledges the fact that the spatial configuration of the city is the sedimentation of a complex system of social and ecological relationships that presents a great challenge for the planning and design of the urban landscape.

In response to these challenges, Urban Scaffolding is a topological device that identifies and abstracts key relations and structural components as an interface between the urban and natural landscapes, preparing the ground for subsequent design interventions. Such a framework simultaneously discovers and intervenes in a territory while remaining responsive to its specificities.

In the two main sections of the paper, Urban Scaffolding is introduced both in terms of what it can do (as a design tool), and what it is (as a method). The first section presents two design projects carried out by the authors, during which urban scaffolding has been developed. The second section proposes urban scaffolding as a topological design tool by describing its generic characteristics and key components, the scalar framework in which it operates, and its adaptability. The paper ends with a discussion of the advantages and challenges of urban scaffolding as a method, outlining a set of recommendations for its future development.

## TWO PROJECTS

In this section, two design projects—both international competition entries<sup>1</sup>—illustrate the development and use of Urban Scaffolding. Even though located in very different contexts—Bucharest (Romania), and Vernon (France)—, both projects try to respond to the same fundamental challenges of social-ecological integration and adaptable design in the urban landscape while remaining responsive to an evolving and changing context. In addition, the river as a primary natural infrastructure is present in both projects—Colentina in Bucharest and Seine in Vernon.

### PROJECT 1 - 342,914KM OF SCAFFOLDING

‘342,914km of scaffolding’ is a competition entry for the strategic reintegration of Colentina River’s pearl of lakes crossing the North of Bucharest (Figure 1).



FIGURE 1

Colentina river was transformed into a series of lakes in a large scale sanitizing operation carried out in the 1930s, intended to be used for recreation and sports. Today, it is a complex structure that consists of a topography shaped by the river and a complex web of planned and spontaneous urbanization interspersed with green spaces. These green spaces range from formal parks attracting visitors from throughout the city, to temporary spontaneous nature areas facilitated by abandoned properties. At the larger territorial scale, the lakes are a heterogeneous band spanning the length of the city with the hidden potential to form an ecological backbone for structuring the future growth of Bucharest.

As a site for intervention, the Colentina chain of lakes presents a double problematic: on one hand, its specificity, and value lies with the heterogeneity facilitated by its peripheral status, while on the other, these very same qualities disconnect it from the rest of the urban fabric. For instance, rather than trying to stop sprawl and uncontrolled urbanization processes, the strategy works with their dynamics, adapts to them, and slows them down in a three-phased process.

The proposed strategic module is composed by three elements, which target the lakes in a flexible but precise way (Figure 2): an inner ring that places the module at the lakeshore, an outer ring that links important elements from the surrounding urban fabric, and a series of radial links connecting the inner and outer ring. Together, these three components establish a deep connection between the lakes and the city, uncovering the existing potentials of the site, and re-organizing them into a set of prescriptions and simulations.

The module applied on each lake acts as a scaffold that identifies existing functions, elements, infrastructures in the urban fabric of the periphery, while physically linking the lakes together with a continuous, publicly accessible slow mobility network. In the case of Colentina, the flexibility of the module allows it to respond at three scales: (1) the scale of the lake, (2) the scale of the Colentina chain of lakes, and (3) the scale of the entire metropolitan landscape. The repetition of

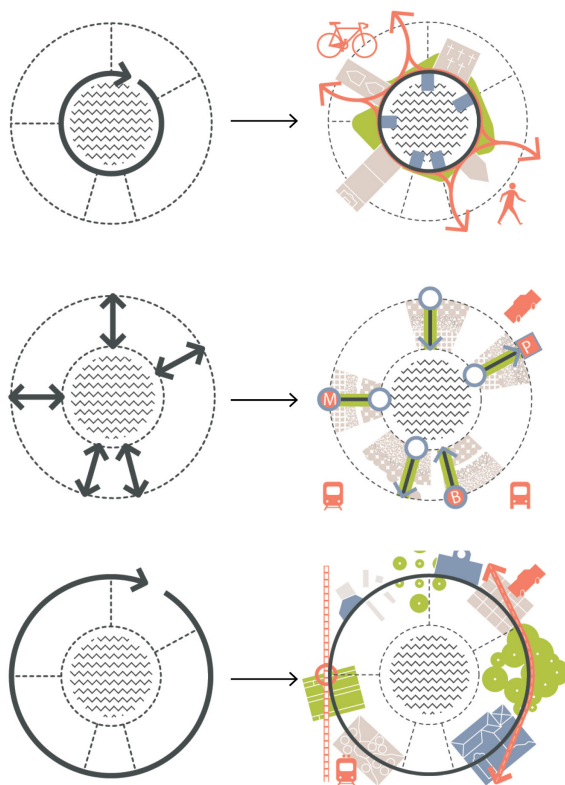


FIGURE 2

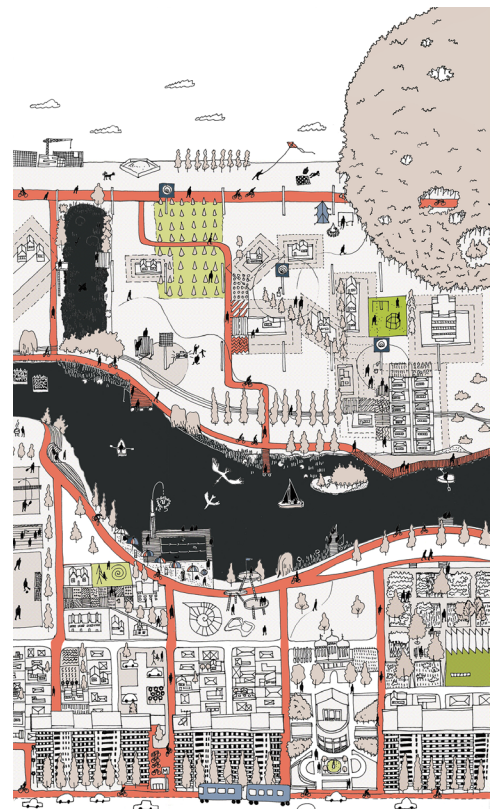


FIGURE 4

the module across the city results in a scaffolding adapted to the heterogeneities of the periphery and can responsively mitigate any further interventions in a location-specific way. Once the scaffolding is set in place, the design interventions can be implemented as a series of prescriptions and simulations based on the uses, elements, possibilities and potentials uncovered in the initial application of the designed module. The method allows for these interventions to be generated and implemented by a variety of actors while maintaining overall cohesion.

The prescriptions for the Colentina lakes involve the structuring of residential growth, the reactivation of unused and former industrial spaces through temporary programmes, the cleaning of the lake water through a set of environmental protection policies, the implementation of reed-based filtering mechanisms, and the reinstatement of the lakes in the leisure and ecological networks of the city. The periphery, as envisioned above, is a garden of the city, in which forests, orchards and fields coexist with residences, leisure and public spaces (Figure 3).

#### PROJECT 2 – THREE FACES OF VERNON

Vernon is a thoroughfare, a town where one passes when travelling along the Seine or towards Giverny. At the same time, confined by the prospect of the valley, the perpendicular orientation of the city across topography is less territorial. Contrary to the frequent misconception that sees in-betweenness, confinement by topography, or rigidity of historical fabric as weaknesses, a new vision for Vernon needs to articulate these three qualities as the three ‘faces’ of the city’s identity. ‘Three faces of Vernon’ is a project that builds on three main qualities of the city of Vernon: in-betweenness (the valley as a morphological structuring element at regional scale), perpendicularity (a new transversal topology at the valley’s scale), and permeability (a sponge-like socio-spatial network at the scale of the urban fabric). Here the scaffolding uses these three hidden qualities as a basis to develop its three relational components.

‘In-between Vernon’ (Figure 4) is a social and spatial strategy that articulates scales, from the territory defined by the Seine down to the scale of local public space and services of the inner town. Vernon has a configuration of parallel spatial units developed along major infrastructural lines on the SE-NW direction: the Seine, the rail line, the major road line, the two ridges of the valley, the forests marking the plateaus, and the highway lines beyond the forests. “In-between Vernon” understands the type and speed of these parallel structures crossing the town and it creates possibilities for transforming the city into a destination.

‘Perpendicular Vernon’ (Figure 5 and 6) is a new topology meant to rebind the two banks of Seine from the railway station area, through the morphology of the urban fabric, and to its topography and natural surroundings. In conjunction with “in-between Vernon”, it slows down the flows crossing the town and places it on the map as a destination. The more strong the perpendiculars are, the more likely Vernon will become a place to visit. The designed links are mainly based on existing connections that may be supported in later phases of implementation by new links.

‘Permeable Vernon’ is a framework of spatial interventions in sites of opportunity in the city center. The sites can be divided in three large clusters, according to their role in the proposed topology: riverside areas; areas of and around the train station; and sites of the inner city meant to enforce the proposed transversal relations between the Seine and the train station. The train station and the shores of the Seine are priority structures, whereas the inner-town sites vary in priorities, depending on their position on the proposed topology.

In this project, the scaffolding takes a more orthogonal configuration, moulding itself to the contours of the valley, while the main focus is on enabling and scaffolding relations between scales (Figure 7). The outermost components take on the role of explorers, and seek out the relation between the transversal topology and the valley’s topography in order to connect to the larger territorial scale. The innermost component closely follows the river and acts as enforcer of public

features and amenities. Last, the transversal links, acting as gatherers, uncover the potential of a middle scale and connect the other two components, discovering and activating the different faces or potential perspectives of the same territory.

In the case of Vernon, the scaffolding manifests as a spatial structure, which couples speeds. It is anchored to the high speed rail and vehicular link to nearby towns, while the riverside gains a new slow mobility routing that provides both amenities and access to the river. Within this middle scale of the valley, the transversal links not only connect the other two scales but are selected to enforce and increase the porosity of the urban fabric too. The city's streets then become a porous series of spaces that emerges within the scaffolding's confines. Within this, key areas are discovered and highlighted for their role as key connectors, providing strategic sites for subsequent interventions such as spatial improvements, (re)insertion of programmes, etc.

### TOWARDS A THEORY OF URBAN SCAFFOLDING

In response to the complexity of urban dynamics, there has been a growing concern for more flexible design approaches, such as frameworks, adaptive planning, scenarios, or even rule-based or parametric urban design. The Strategy of Two Networks of Tjallingii (2005, 2015), the works of Bernardo Secchi and Paola Vigano (e.g. Vigano, 2016), and Branzi's models for 'weak urbanisation' (Branzi in Mostafavi, 2013) are a few examples of such approaches. Urban scaffolding

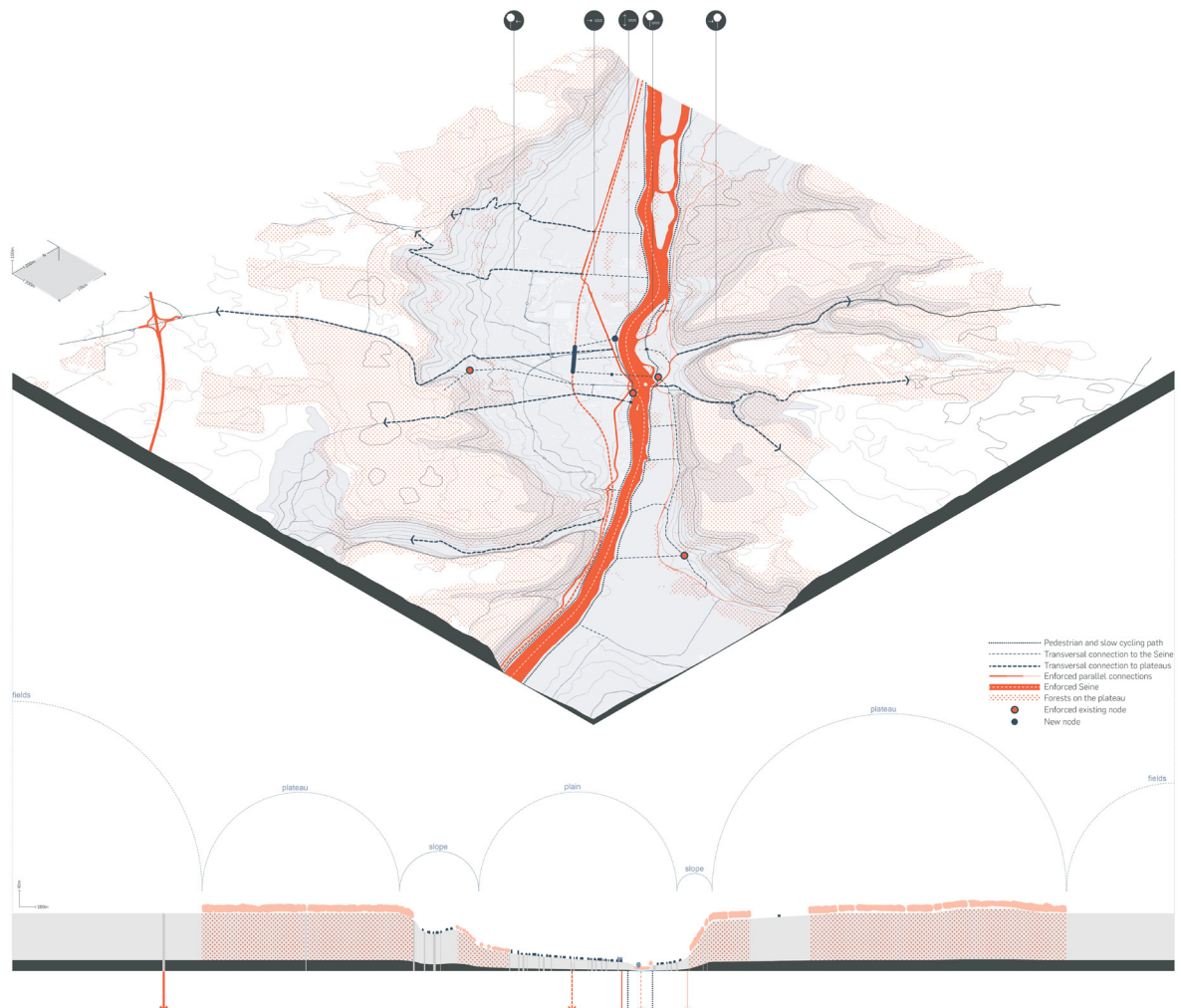


FIGURE 4

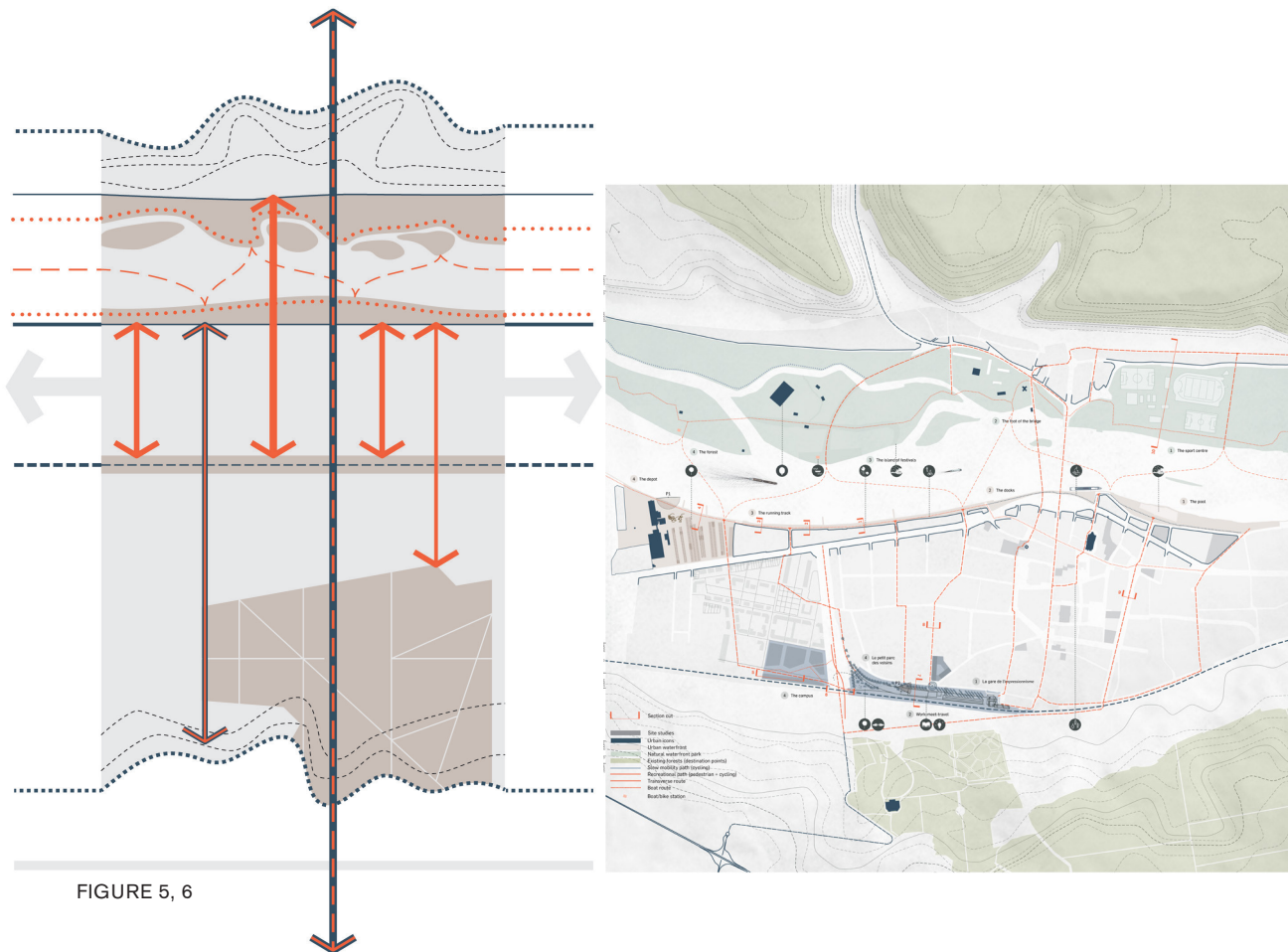


FIGURE 5, 6

shares with these approaches that it is an abstract, relationship making-mechanism that structures growth rather than prescribed form. What urban scaffolding brings to the existing repertoire is a method, as described in the two projects above, which explores and builds strategies upon the existing field of processes and structures by means of a flexible and highly adaptable topological scaffolding.

While developing these strategies, we've noticed the emergence of a method and a number of potential results that we feel this method can achieve. First, it provides access to geomorphology, which means that the river and its valley are accessible to both the neighbour and the city dweller and that the city is part of and can benefit from larger landscape structures. Second, this method encourages further heterogeneity and coexistence. The making of a relational scaffold for future development allows for the existing context to preserve its specificities and further evolve its processes.

This ongoing method (1) works with existing structures; (2) acts as a topological tool; and (3) it establishes relations between scales. In general, the urban scaffolding mediates between contrasting or contradictory patterns of growth, making it a flexible framework guiding the integrated development of the urban and natural landscape.

#### (1) THE USE OF EXISTING STRUCTURES

Scaffolding, as interpreted in this paper, is not a closed mechanism. Rather, it is an open system in which the components and the links are predefined, while the ways of combining is endless. At the same time, a scaffold requires something to attach to. It is a support structure that is never independent of that which it supports, but always close to a complex organism, providing strategic, enabling links. Through these links, the organism's functions are supported and streamlined, opening up new possibilities.

For Urban Scaffolding, this complex organism is the sum of key processes and structures identified in the urban landscape. In order to provide a site specific and adaptive response to an existing context, Urban Scaffolding first discovers the territory by identifying existing programmes, uses, functions and potentials. By using existing structures, a field of possibilities is uncovered, revealing the base structures upon which the scaffold can be constructed. In this field of possibilities, strategic selection is key in preparing the ground for future design interventions. Careful study of morphology uncovers patterns that contain a wide breadth of information on the emergence of the site. These patterns are natural (for example, geomorphology), man-made (urban morphology), or often both (for example, desired paths), and occur as the sedimentation of processes at multiple scales.

Through the scaffolding module, the designer is then able to intervene in this field of possibilities by choosing which existing processes and structures to reinforce and by revealing new relations between the elements identified in the field. Through its relational qualities, the scaffolding is able to uncover these relations without pre-assumptions on their form or format. Furthermore, the relational aspect of urban scaffolding allows a strategic design to embrace emergent and self-organized processes, while still providing an overall cohesion.

(2) TOPOLOGICAL CHARACTERISTICS

Urban Scaffolding proposes a topological device that has three components with three distinct functions: (1) enforcers; (2) gatherers; and (3) explorers. These components work together to uncover the field of possibilities in an existing context and to identify potentials based on certain criteria determined by each components' function (Figure. 1). Through this process, the scaffolding sets in place these potentials with a set of relations that guide and encourage their future growth and unfolding.

The topological character of urban scaffolding allows for various spatial configurations of the same system of relations, site-specific flexibility, adaptability to ever-changing conditions, and the capacity to approach a site at multiple scales at once. As shown in Table 1, the two projects use the three components in different ways, while maintaining the same topological characteristics inherited from the scaffolding.

The topological components of Urban Scaffolding	Project 1: 342,914km of scaffolding	Project 2: Three faces of Vernon
Enforcer	Inner ring	Waterside promenade
Explorer	Outer ring	Regional infrastructure parallel to the valley
Gatherer	Radial connector	Paths perpendicular to the valley

Table 1: The topological components of Urban Scaffolding

(3) SCALE

Urban scaffolding is a multi-scalar approach, in the sense that, when applied, it addresses multiple systems on different scales. While discovering the territory at multiple scales, the components of the scaffolding uncover and establish relations between scales, mapping out a network of resonances within a territory that can then be activated through subsequent design interventions.

Urban scaffolding uses a three-level hierarchy of spatial-temporal scales<sup>2</sup>: the territorial scale (scale of context), defined by the watershed and the major urban activities connected to it; the scale of the scaffolding (scale of focus) identifies the strategic structure; the project scale (scale of detail)



explains the components of the scaffolding. Table 2 shows how these three scales have been applied in the two projects.

The scales of Urban	Project 1: 342,914km of scaffolding	Project 2: Three faces of Vernon
Territorial scale	The metropolitan landscape of Bucharest	The Paris-Le Havre corridor along the Seine
Scaffolding scale	The pearl of lakes crossing the city of Bucharest	The valley and its transversal occupation by the city of Vernon
Project scale	The lake and lakeside urban and natural areas	The pores of potential sites for development in the urban fabric and the riverside promenade

Table 2: The scales of Urban Scaffolding

### FLEXIBILITY AND NEGOTIATION

Urban scaffolding proposes a rule-based topology, meaning that it can evolve through time as long as the relations between components follow a predefined set of rules. This rule-based approach raises several challenges: future spatial configurations cannot be foreseen, the time required for the development to a desired state is difficult to determine, and there is inevitably conflicting and contradicting development that must be negotiated.

To mitigate these challenges, Urban Scaffolding negotiates between fixed and flexible elements with all three strategic components. This means that the scaffolding is not prescriptive or fixed to the existing components of the landscape, but it allows for unforeseen relations to emerge in a field of site potentials. The scaffolding determines types of relations constructing a framework for the negotiation of conflicting interests. By operating at multiple scales, the scaffolding ensures that no single element monopolizes a certain scale, and allows for the middle scenario to emerge.

### DISCUSSION AND CONCLUSION

How does Urban Scaffolding fit into the arsenal of design tools and methods used in urbanism, landscape urbanism, and landscape architecture? Throughout this paper, we set out to present the first steps in the development of Urban Scaffolding, a tool and method which tries to improve the designer's response to site specificity and to the growing complexity of the urban environment. We did so by describing the two design projects in which the origins and emergence of the tool may be found and by extracting from these projects the general principles and characteristics of the tool. The two projects are very different in the way they determine the spatial configuration of the scalar framework of the scaffolding (Tables 1 and 2 offer a brief comparison in this sense), but also very similar in the way they approach the integration between the urban and natural landscape. In its parts, Urban Scaffolding is by no means novel, but the way it is configured and put together makes it a promising tool for flexible, adaptable, and multi-scalar design.

Urban Scaffolding has three key qualities that make it a promising design tool. First, as it is a topological device, it is highly flexible and, therefore, adaptable to the specificities of each site upon which it is applied. Second, as a framework rather than a fixed solution, it provides a way to dealing with complexity, that is, with the uncertainty of future spatial-temporal dynamics. Last but not least, its three components constantly negotiate between natural and urban systems, between fixed and flexible parts of the urban environment, between short- and long-term goals, between ecological balance and socio-economic well-being.

Still, urban scaffolding as a tool and as a method needs further development. As a tool, it has to be tested and refined further in design projects and in conjunction with other existing design tools. As a method, and eventually as a full-fledged theory, it needs to be further substantiated with evidence from design research and it has to be placed into a wider context of theories that propose design frameworks. In this sense, it is important to highlight that the fundamental principles

of scaffolding allow the free combining of existing or new design tools, while the fundamental principles of the scaffolding are consistent and consistently being refined. Urban scaffolding is a continually evolving project tested through design.

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#### ENDNOTES

1. The first project is the winning entry of the competition organized in the Le:Notre International Landscape Forum that took place in Bucharest in 2015. The second project is an entry to the biannual European architecture and urbanism competition European in 2015.
2. Turner and Gardner (2015) refer to a three levels in a hierarchy: an upper level that constrains, a level of focus, and a level of components required to explain the level of focus.

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