本文引用格式 / PLEASE CITE THIS ARTICLE AS

Li, J., Dong, H., & Jiang, J. (2020). Prototyping in the Design of Built Landscapes. Landscape Architecture Frontiers, 8(4), 90-103. https://doi.org/10.15302/J-LAF-1-030018

原型思维在广义建成景观中的设计应用

PROTOTYPING IN THE DESIGN OF BUILT LANDSCAPES

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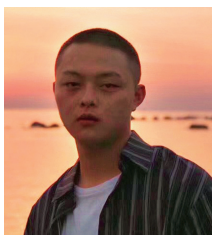

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https://doi.org/10.15302/J-LAF-1-030018　收稿时间 RECEIVED DATE / 2020-05-30　中图分类号 / TU986　文献标识码 / B

摘要

“原型”起源于“本质主义”——认为万物均拥有其客观存在的本质，人们可以对典型现象进行抽象、描述并揭示该事物的本质。在建筑学发展过程中，由于本质主义无法描述形态变体的差异性，因而产生了类型学的概念。类型学强调对建筑形式进行变化和组合，形成与历史、文化或环境具有内在联系的新的空间形式。而在景观领域，面对复杂多变的设计对象，自类型学衍化而来的原型概念由于包含时间维度而被更广泛应用。可以说，原型思维是一种空间秩序的描述及测试，从提取特征、确定形式、测试模拟，到最终引入实体空间，形成了“抽象 – 衍化 – 测试 – 结果”的设计方法。在景观都市主义语境下，设计者首先必须了解场地的特定文脉，了解过去和未来及使用人群的设计语言，而后进行原型推演，并将时间性纳入考虑。本文主要探讨了原型概念的演化过程，并进一步讨论原型思维在广义建成景观设计过程的三个阶段——研究设计对象、推敲设计策略及测试最优策略——中起到的作用。

关键词

原型思维；建成景观；切片；情境分析；模拟

ABSTRACT

The concept of “prototype” originated from "essentialism"—the theory holds that everything is found in its own pure realm that can be typically abstracted, described, and represented. In the development of Architecture, essentialism fails to describe the differences between formal variations, and then Typology was born which manifests the new spatial forms that are embedded within the historical, cultural, and environmental contexts through the changes and combinations of architecture. Prototype, stemming from Typology, highlights the qualities of the time dimension and has been broadly used in the field of landscape architecture to address the objects that are often complex and chaotic. Prototyping is to profile and test the spatial order and characterized by a process of “extraction–deduction–test–outcome”: through the scenario analysis upon understanding and perception of the site, the design extracts the elements, deduces the forms, tests the simulations, iterates the strategies, and finally realizes the outcome physically. In the discourse of Landscape Urbanism, designers must understand the specific material language of the site, the design language of the site’s history (past and future), and the design language of the human activities proposed, while considering the changes over time. This article primarily reviews the evolution of the concept of prototype, and discusses its role in benefiting the design of built landscapes, ranging from the design investigation to the conceiving and testing of design strategies.

KEYWORDS

Prototyping; Built Landscape; Site Section; Scenario Analysis; Simulation

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EDITED AND TRANSLATED BY　Tina TIAN

1 引言

“原型”（prototype）概念最初起源于社会哲学，而后在建筑学、城市规划、景观设计学等领域的语境中逐渐发展演变，经历了从“本质形式”（form）到“类型”（type）再到“原型”的认知过程。

早在希腊古典时期，柏拉图提出了基于形而上学的形式理论，认为任何的实体都有具有其永恒不变的本质形式[1]。在古典哲学比喻《洞穴之喻》中，柏拉图认为形式是构成可感知世界的基础[2]。文艺复兴时期，建筑师菲拉雷特提出建筑的本质表现为一个坡屋顶及其4根支撑立柱；而后，建筑理论家马克—安托万·洛吉耶在《建筑随笔》中呼吁建筑应当摒弃装饰，返璞归真[3]。

18世纪末，第一次工业革命推动了生产力的发展，促使建筑师提出更高效的设计方法。法国新古典主义建筑师让—尼古拉—路易·迪朗成为现代主义以来基于类型学（Typology）进行设计的开创者。他在《古代与现代各类建筑汇编》一书中倡导使用类型学将古典主义建筑语言进行分类，利用轴线和网格来布局模块单元演化建筑形式，从而使类型学成为一种简单的模式化生产工具，并满足新时代对建筑标准的需求[4]。直至勒·柯布西耶提出“多米诺”体系，引入空间、结构、功能等要素，才终于使类型学走出了形而上的秩序性探讨[5]。自此，类型学成为一种设计方法：通过基于建筑单体的变化和组合，形成与历史、文化或环境相融合的建筑空间形式。

推动类型学研究在城市规划中进一步发展的重要人物是阿尔多·罗西，他在《城市建筑》一书中提出：“城市自身就是一个建筑体”[6]。罗西认为城市是各种类型的构筑物的集合，具有普遍性和集体特征，并批评当时的功能主义在研究城市空间时忽略了它在时间影响下的品质与特性变化[7]。此时，人们已开始将时间概念引入设计过程。与相对静态的类型学方法相比，“原型”设计方法将时间维度纳入讨论，即包含了原始模型或参照对象在不同时间维度下的各个状态[4]。景观语境中更多运用的是“原型思维”（prototyping）概念，即在理解和认知场地的基础上进行情境分析，提出策略，并修正策略。由于广义下的建成景观是人类主观能动性改造自然的产物，具有动态性和复杂性[8]，原

1 Introduction

Initiatively proposed in Social Philosophy, the concept of “prototype” has gradually adopted and developed in the fields of Architecture, Urban Planning, Landscape Architecture, etc., having been cognized through an evolution from “form” and “type.”

As early as in the Ancient Age of Greek, Plato put forward his metaphysical view, the Theory of Forms, which believed that the things being defined are to be found in an eternal, unchanging, and ontologically pure realm[1]. Plato’s *Allegory of the Cave* notes that knowledge is gained primarily by coming to know the Form[2]. In the age of Renaissance, architect Filarete exemplified the essence of architecture as four columns and a pitched roof on top of it; In his *Essai sur l’Architecture* (*An Essay on Architecture*), architectural theorist Marc-Antoine Laugier believed that architectural conceptions should be “unnecessarily decorative in nature”[3].

At the end of the 18th century, the first industrial revolution propelled the advances in productivity which spurred architects to conceive new design methods for higher efficiency. Among modern designers, French neoclassical architect Jean-Nicolas-Louis Durand is considered the pioneer who practiced the ideas of Typology. In the book *Recueil et Parallèle des Édifices de Tout Genre*, he advocated classifying the language of classical architecture with typological concepts, using axes and grids to handle the composition, where “a simple enough method of coping with the programs and the new building requirements demanded by a new society” was offered[4]. It was not until the ideas of the Dom-ino System proposed by Le Corbusier that exceeds the “objective view of the autonomous rules of architecture”[5] by introducing the concepts of space, structure, function, etc. Typology has been employed as a design method: through the changes and combinations of building units, an architectural spatial form that is intrinsically embedded within the historical, cultural, and environmental contexts is shaped.

Aldo Rossi is key to push forward typological research in the field of urban planning. In his book *The Architecture of the City*, Rossi regarded the city itself as an artifact[6]. He also emphasized that the city is as a totality where “all urban artifacts and the city are a collective,” and criticized that the naïve functionalism ignores the quality and uniqueness developed in time[7]. In this process, the concept of time has begun to be introduced into the design process. Compared with the design methods in Typology that examine “frozen mechanisms,” those in Prototype amplify the varying status of the dimension of time what a form or an object has[4]. In landscape architecture, prototyping is used to generate

型思维成为了景观设计师“否定过去和展望未来的方式”[4]。原型的作用也已超出对空间的主观改编：设计者首先必须了解场地的特定文脉，了解过去和未来及使用人群的设计语言，而后进行原型推演[9]。总之，景观设计语境下的原型思维可以帮助设计者做出更合理且具有适应性的决策。

2 空间设计原型起源：对自然的模仿和再造

目前大多数关于空间设计原型的研究主要集中在建筑和城市空间，然而，最初的空间设计原型很可能源于自然景观。罗西提出，建筑和城市类型学首先建立在自然“初型”（archetype）的基础上[9]。在《城市建筑》中，他认为城市“是由建筑和一切人类改造自然形成的产物构成的”[6]。建筑师约瑟佩·米利齐亚指出，“尽管现实中的建筑缺乏自然的模型，但在人类建造他的第一所房屋时，它已经具备了另一种源自自然劳动的属性”[10]。

古罗马建筑师维特鲁威在《建筑十书》中想象了史前人类受到自然启发而主动搭建庇护所的过程[11]。他指出这些房子正是对自然的模仿：有些是用树枝扎成棚架，有些是在山上挖洞，有些则模仿燕子的巢穴和栖息地，将树枝的房屋交织在一起并用泥土或粘土覆盖。通过观察和改善彼此的庇护所，他们很快开始建造更好的屋子。因此，那些天生喜欢模仿的人，为自己的发明感到自豪，也通过先前的方法获得了日常经验，从而在建造的品质方面相互竞争”[11]。维特鲁威的描述中暗含的信息是：建筑起源于自然，即从混沌和不断变化[9]的自然语言中找到规律，提取为人类所用的部分，来满足人类生存的需要。随着时间推移，一种共享的空间设计原型语言慢慢地扎根于人类的精神世界中。安东尼·维德勒在《类型思想》一文中引用了法国建筑师里巴

scenario analyses upon the understanding and perception of the site, and to propose strategies that can be altered accordingly. Broadly defined, the built landscape is the product of human transformation on the nature which contains the “dynamic multiplicity of urban process”[8]. For landscape designers, prototype “becomes a way of denying the past, as well as a way of looking at the future”[4]. The role of the prototype has also gone beyond the subjective adaptation of the space: designers must first “understand the specific material language of the site, the design language of the site’s history (past and future), and the design language of the human activities proposed”[9]. In short, prototyping, in landscape design, can help designers make more reasonable and adaptive decisions.

2 The Initial Prototype of Spatial Design: The Imitation and Reconstruction of Nature

At present, most of the research on the prototypes of spatial design mainly focuses on architecture and urban spaces. However, the initial prototype of spatial design likely stemmed from natural landscapes. Rossi suggested that “building and urban typology rests on a foundation of natural archetypes”[9]. In *The Architecture of the City*, Rossi argued that the city “is constituted of its architecture and of all those works that constitute the true means of transforming nature”[6]. Architect Giuseppe Milizia defined that “although architecture in reality lacks a model in nature, it has another model derived from man’s natural labor in constructing his first house”[10].

In *De Architectura*, the ancient Roman architect Marcus Vitruvius Pollio imagined that prehistoric humans built shelters which were learnt from the nature[3]. He described that “some by making arbors with the boughs of trees, some by excavating caves in the mountains, and others in imitation of the nests and habitations of swallows, by making dwellings of twigs interwoven and covered with mud or clay. From observation of and improvement on each other’s expedients for sheltering themselves, they soon began to provide a better species of huts. It was thus that men, who are by nature of an imitative and docile turn of mind, and proud of their own inventions, gaining daily experience also by what had been previously executed, vied with each other in their progress towards perfection in building”[11]. This implies that architecture originates from the nature by extracting the laws of nature—the impressive landscape of chaos, and a state of constant change[9]—to meet the needs for human survival. As time goes by, a shared prototype language of spatial design has taken root in the spiritual world of human beings. In The Idea of Type, Anthony Vidler adopted the definitions of

1. “圃”和“囿”是中国最早的景观空间原型

1. In China, "Pu" (圃) and "You" (囿) are the earliest landscape prototypes.

特·狄·夏姆斯特在概述类型历史时对“类型”和“初型”的定义：“类型”反映了人类为了满足自身使用或愉悦需求而进行的改造自然的首次尝试；而画家从自然中有理有据地选择出那些既能激发又能指引其想象力的可感知对象，则称之为“初型”。[12][13]

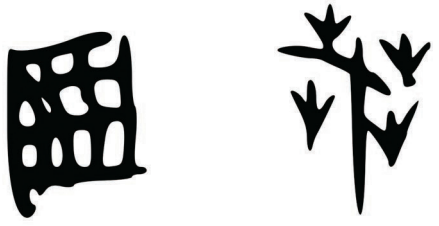
据此，本文认为，空间设计原型的提出并非完全是人类对自然要素的直接提取，而是源于人类的主观能动性，是利用自然规律并反作用于自然的改造行为。这些空间设计原型的提出最初聚焦于生产功能，在漫长的演化中逐步衍生为一系列空间美学体验；而且建筑和城市的原型也建立于自然原型之上。也就是说，在封闭建筑内或开放空间中，我们的空间体验不存在本质的区别。

人类最早期形成景观空间原型之一是空地。居住在森林中的史前人类在清理森林的过程中产生了空间体验的对比：森林是郁闭的、昏暗的、神秘的，而采伐后的空地则是开阔、明亮的、焦灼的[9]。这种对于空间体验的对比作为一种经验扎根于人类的意识中；直到现在，设计师在建筑或景观中编排连续空间序列时，还是会通过控制明暗、开闭等手法来影响观者的空间认知和情绪。

在西方海洋文明语境中，典型的景观空间原型包括生产性的果园，以及贸易和交往所需要的公共空间，如剧场、台地等[9]。相比之下，“圃”和“囿”是中国最早的景观空间原型——前者指栽种蔬菜的地方，即菜圃；后者最初指稻田，后指饲养禽兽的地方——圃、囿的甲骨文文字就表示出古人成行成畦栽植稻米果蔬的形象（图1），是最早对建成景观的一种原型呈现。

3 原型思维在设计过程中的作用

运用类型学方法的设计过程可以说是将空间对象的要素（即该空间对象的形式结构的基础元素）引入场地，使之在适应性处理后达到精确状态的一种方式[4]。能够体现该过程的一个典型案例是意大利乌尔



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“type” and “archetype” proposed by French architect Rebart de Chamoust in his overview on Typology history: The word type reflects “the first attempts of man to master nature, render it propitious to his needs, suitable to his uses, and favorable to his pleasures; The perceptible objects that the Artist chooses with justness and reasoning from nature in order to light and fix at the same time the fires of his imagination, I call archetypes.”[12][13]

On these grounds, this article holds that human’s extraction of the prototype of the spatial design is not merely a simple selection of natural elements, but a utilization to meet human needs that transforms the nature by imitating the nature. Initially developed for productive uses, such prototypes have manifested a series of spatial aesthetic experience and evolved into the prototypes for architecture and the city. In other words, essentially there is no difference between people’s experience in enclosed buildings and open spaces.

One of the earliest landscape prototypes is the clearing, which dramatically shaped the spatial experience of prehistoric human beings: the forest is gloomy, shady, and inviting, and the clearing is alternatively brilliant, exposed, and scorching[9]. Such a contrast is rooted in human consciousness as an experience. Up to now, the choreography of brightness and darkness as well as opening and enclosure in continuous spatial sequences is still used in architectural and landscape design.

In the Western marine civilization, typical landscape prototypes include production places (e.g., orchards), and trading or commercial public spaces (e.g., theaters, terraces)[9]. In China, “Pu” (圃) and “You” (囿) are the earliest landscape prototypes. The former refers to vegetable gardens and the latter initially refers to rice paddy fields and then animal farms—the oracle inscriptions of Pu and You express the image of the ancients planting rice, fruits, and vegetables in rows and plots (Fig. 1), profiling the earliest prototypes of built landscapes.

3 Prototyping in Design Process

The design process employing typological methods is a way of bringing the elements of a typology (the formal structure of a given spatial object), through adaptive interventions, “into the precise state that characterizes the single work”[4]. A typical example of such a process is the Collegio del Colle project in Italy (Fig. 2), where the architect Giancarlo De Carlo attempted to integrate the shape of the structure with the contours of the hill: a series of “boxes” (the building) was perfectly configurated in accordance to the terrain, as the orchestration of spatial experience. Like the Dom-ino System which became a design paradigm of modernist architecture, Carlo, rather than simply

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2. 意大利乌尔比诺学生公寓平面图及实景照片

2. The plan and photo of Collegio del Colle project in Italy

比诺学生公寓（图2）。建筑师吉卡洛·德·卡洛尝试将建筑的形状与山丘的形态相互渗透："方盒子"被巧妙地排布在山体之上，适应等高线和微地形变化，使建筑与场地形成了一组空间合奏。正如"多米诺"体系所奠定的现代主义建筑设计范式，卡洛并不是将建筑单体进行单纯的组合，而是通过类型学的设计方法来创造空间变化[5]。

在狭义景观的范畴，传统设计过程往往通过类型的组合或变体来适应场地，并构成新的空间。这是一种感性的、微观的设计技巧。如今，景观的概念已不再仅限于狭义的公园等绿地，而是广义下人类活动改造自然的产物，即建成景观。詹姆斯·科纳在《流动的土地》一文中指出，景观都市主义认为景观首先是动态的过程，受到城市化进程、资本积累、放松管制、全球化、环境保护的影响而不断变化[8]。在面对具有复杂时间性和动态性的设计对象时，需要运用源自类型学的、具有时间维度的原型概念：原型不是静止或永恒的；原型可以被认为是设计随着场地条件的变化而发生转变时记录下的瞬时影像。因而，原型思维也是一种动态设计方法：在理解和认知场地的基础上进行情境分析、提取场地特征、确定设计形式、测试模拟、修正策略，

combining individual structures together, exercised typological design methods to create changes of space[5].

In the narrow sense of the landscape, traditional design processes often adapt to the site through typological combination or variation to constitute new spaces, representing a sensitive micro-scale technique. Today, landscape no longer simply refers to green spaces such as parks; it has been broadly defined as the products of human's transformation of the nature, i.e. built landscapes. James Corner pointed out in the article Terra Fluxus that landscape urbanism processes over time, and the processes of urbanization are shaped by urban relationships such as capital accumulation, deregulation, globalization, and environmental protection[8]. In landscape design, the understanding of complicated objects in time and dynamism necessitates using the concept of prototype that contains typological ideas to examine how things work in space and time. Rather than being unchanging or eternal, prototype can be considered a series of instantaneous images of the design changes when the changes of the site occur. Therefore, prototyping is also a dynamic design method which is characterized by a process of "extraction-deduction-test-outcome": through the scenario analysis upon understanding and perception of the site, the design extracts the elements, deduces the forms, tests the simulations, iterates the strategies, and finally realizes the outcome physically. At the same time, in the discourse of modern landscape, designers need to observe the world from a more rational and macro perspective, with the advancement of

再最终引入实体空间，构成了“抽象—衍化—测试—结果”的设计过程。同时，在现代广义的景观范畴下，设计师需要以更为理性、宏观的角度去观察世界，理解景观与人类文化、社会、经济、政治等因素之间的联系[8]。本文将通过场地切片、情境分析和模拟三个途径来讨论现代广义景观设计下的原型思维应用。

3.1 场地切片——利用原型思维研究设计对象

场地切片是一种从研究场地中提取、简化或抽象推演空间原型，以对建成景观进行研究归纳的手段。在研究建成景观（包括一切受到人类干预的自然景观）时，尤其是在面对后现代复杂的“拼贴城市”的过程中，选择有代表性的地块进行场地切片研究，将有助于指导更合理的空间设计。

在此方面的代表性研究是斯蒂芬·M·韦勒的《大都市地区的建筑景观：国际类型学》[14]。韦勒利用卫星地图研究了建筑—景观—街道格局，依此提炼出全球24个大都市区的建成景观原型（图3）。这些建成景观的场地切片通常为1km^{2}以上，场地使用者具有固定的使用习惯——原型的形态反过来也影响了居民行为和空间使用模式。韦勒同

3 斯蒂芬·M·韦勒对全球24个大都市区的建成景观原型进行了提炼（来源：参考文献[14]）

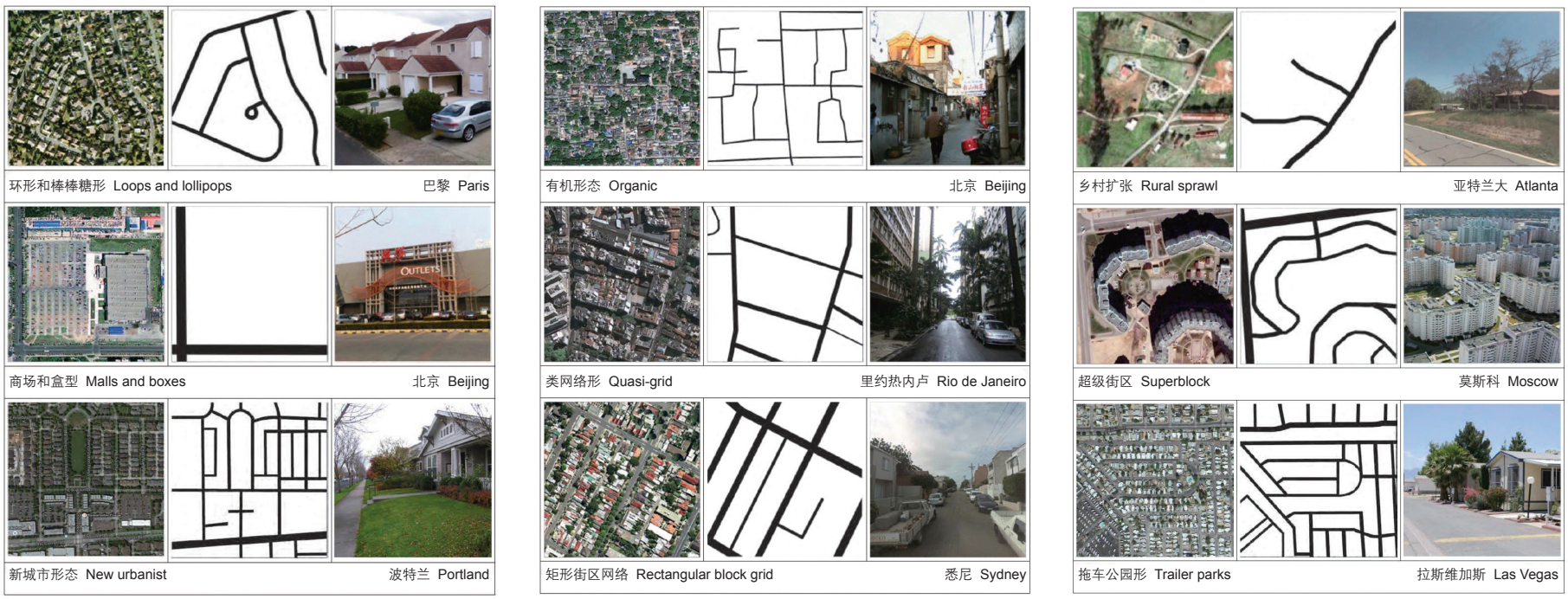
3. Stephen M. Wheeler studied 24 metropolitan regions across the world to extract the prototypes of built landscapes (Source: Ref. [14])

“more socially just, politically emancipatory, and ecologically sane mix(es) of the spatio-temporal production process”[8]. This article demonstrates the application of prototyping in landscape design in the forms of site section, scenario analysis, and simulation.

3.1 Site Section—Prototyping as Site Investigation

The site section is an approach to extract, simplify, or abstractly deduce spatial prototypes from the given sites for the investigation and induction of built landscapes. When studying built landscapes (including all natural landscapes under human interventions), particularly the post-modern complex “collage cities,” selecting representative site sections would help generate more reasonable design schemes.

Typically, in the Built Landscapes of Metropolitan Regions: An International Typology[14], Stephen M. Wheeler used satellite maps to study the architecture-landscape-street pattern of 24 metropolitan regions across the world to extract the prototypes of built landscapes (Fig. 3). Most of the site sections covered an area of 1 km^2 or larger and the sites had been shaped by the observed usage patterns—which had been shaped by the typology of the prototypes in turn. Wheeler also analyzed the formation and historical backgrounds of each prototype. This typology of built landscape forms can help decision-makers and



3

时分析了不同原型的形成原因和历史背景。这种建成空间类型学能够帮助决策者和公众理解复杂的城市街区或更大规模的土地利用，并指导设计师解读某种建成空间类型背后的政治、经济和文化因素，从而促进在宜居性和可持续性方面的反思与创新。在此基础上，韦勒归纳了全球大都市区的27种建成景观基本类型，并指出目前由传统邻里构成的有机城市类型仅占全球多数大都市地区的一小部分，剩下的绝大部分为郊区和郊区形式的其他区域[14]。

从城市建成景观的角度而言，城市蔓延是发达国家和发展中国家的城市所共同面临的当代问题。在中国，该问题主要表现为因农业用地空置及城市建设用地扩张而导致的城市无序发展。本文以城镇化问题尤为突出的云南省宜良县为例，在空间划分层面采用类型学研究方法，将宜良县按照人口密度分为城市、郊区、乡村三个圈层，并最大程度地利用城郊的可种植界面，分别对三个圈层提出连续性生产景观设计原型，旨在在缓解城市环境问题的同时引导城市合理增长。在城市圈和郊区圈区域，根据人口密度，将现有的城市聚落组团进行切片研究和分类，得到9种空间切片（超高层住宅、超级街区、板楼、旧城、商业空间、开放空间、工业区、山地，以及郊区），并在每种空间切片的基础上探讨增加生产性景观界面的可能性。针对具有改造潜力的城市界面（如公共建筑的屋顶、高层或老城住房的双坡屋顶），提出了一系列弹性的改造策略与设计原型（图4，5）。

3.2 情境分析——利用原型思维推敲设计策略

如上文所述，原型思维和原型设计方法使得设计师可以适应微妙的场地要素变化和时间变化的要求，甚至对可能出现的条件变化做出假想和预判。这可称为情境分析，即通过设立不同情景，预测对象可能出现的情况或产生的后果。

在全球气候变化的影响下，斯堪的纳维亚半岛的西部沿海地区普遍存在冻土融化问题。尤其在挪威，封冻的土地在春季提早消融，阻碍了当地的萨米人和鹿群的回迁路线。[15]相关研究资料显示，冻土融化

the public understand the land use of complex urban blocks or in larger-scale cases, and help designers interpret the political, economic, and cultural threads of a certain type of built spaces, to promote the reflection and innovation in livability and sustainability. Through such case studies, Wheeler found that 27 basic types of built landscape made up metropolitan regions worldwide; neighborhood-scale urban types of tightly knit organic patterns now "make up a small fraction of most metropolitan areas, while suburbs and suburban forms comprise the vast majority of the land area"[14].

In terms of urban built landscapes, urban sprawl is a contemporary problem faced by cities in both developed and developing countries. In China, there is a contrast between the vacancy of agricultural land and the expansion of urban construction land, leading to disordered urban development. In the case study on the urbanization in Yiliang County of Yunnan Province, the authors adopt typological research methods to restructure the spaces of the county into three types—urban, suburban, and rural—according to the population density. The proposal maximally leverages the plantable land in the suburban areas with the designed prototypes that support continuous productive urban landscapes to each type of space. This can not only alleviate urban environmental problems but also bring the possibility to spur a smart urban growth. In the urban and suburban areas, the proposal extracts 9 types of site sections of the existing urban clusters with consideration of population density: incremental, superblock, apartment block, organic, commercial, open space, industrial, mountainous, and suburban. Flexible transformation strategies and design prototypes for each site section that would increase productive landscape interfaces (such as the roofs of public buildings, and the pitched roofs of high-rises or the housing buildings in the old town) are then developed (Fig. 4, 5).

4. 连续性生产景观：城乡结构及空间原型
5. 连续性生产景观：城市界面改造设计原型

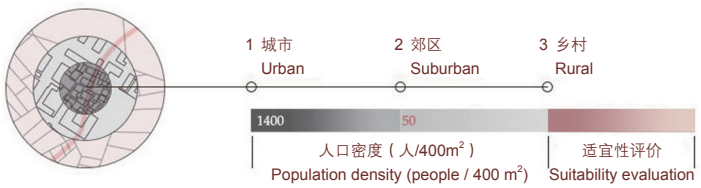
4. Continuous productive urban landscapes: the urban-rural structure and spatial prototypes
5. Continuous productive urban landscapes: design prototypes of urban interface regeneration

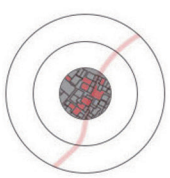
3.2 Scenario Analysis—Prototyping for Design Strategies

As mentioned above, prototyping and prototype design methods enable designers to be sensitive to the subtle alterations of the elements within the site, as well as time changes, and to prepare responding strategies upon the predictions of possible changes. This is the approach of scenario analysis, which allows designers to simulate various possibilities and the corresponding consequences.

Under the impact of global climate change, the problem of permafrost thawing is increasingly observed in the western coastal areas of Scandinavia, especially for the Saami people in Norway where snows melt earlier in the springtime and reindeer heading becomes more difficult as the ice is weak,

什么是连续性生产城市景观设计?
What is Continuous Productive Urban Landscape (CPUL)?





1 城市圈 Urban cycle

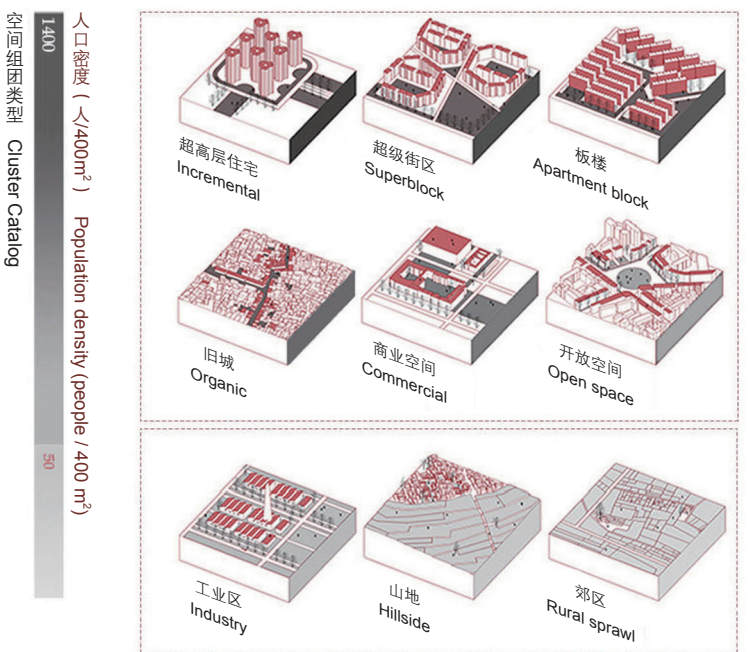
城市圈层中的连续性生产景观界面的人口密度较高，可利用屋顶、墙体、绿地等界面来生产食物
Characterized by high population density, CPULs in urban cycle use various interfaces like rooftop, wall, and green space to produce food

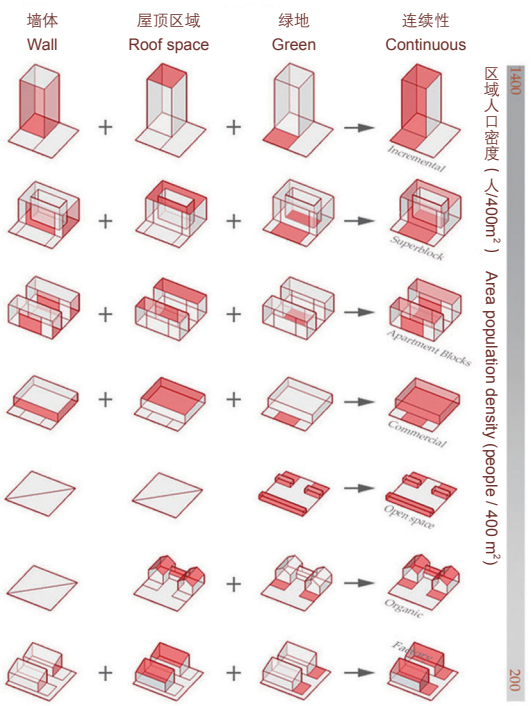
2 郊区圈 Suburban cycle

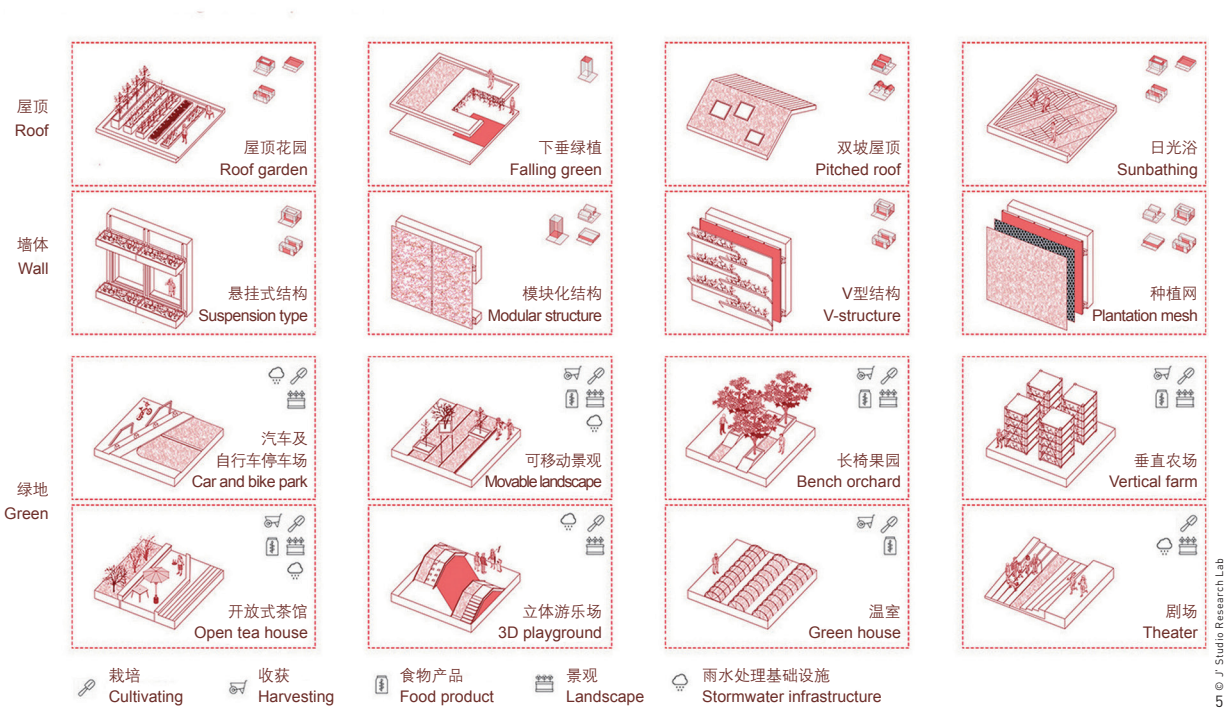
由于郊区圈层的人口密度低，其连续性生产景观会利用工厂附属绿地等闲置土地建设低维护的农业园区
Given a low population density, CPULs in suburban cycle use spare land like green space of factories to construct agriculture park of low-maintenance

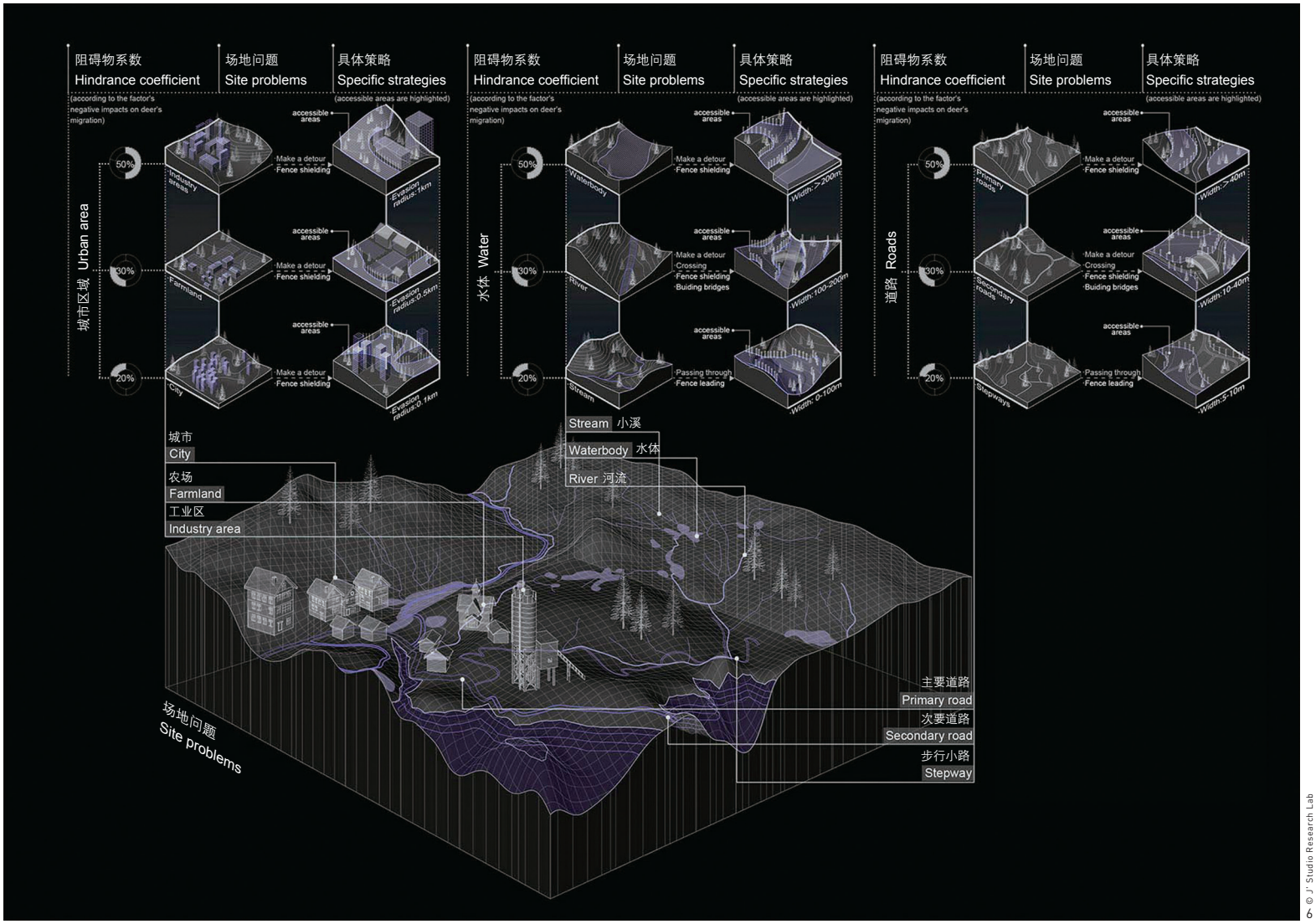
3 乡村圈 Rural cycle

在乡村圈层中，通过加权计算（对当前场地类型、可达性和水安全性进行评价和打分）来确定连续性生产景观土地的选址
In this cycle, CPULs land is selected by weighted calculation: current field type, accessibility, and water security are evaluated and scored









6. 应对气候变暖的驯鹿迁徙廊道设计

6. Reindeer migration corridor design in response to climate change

最严重的区域集中在密林区，高大林木在雪地上投射阴影，吸收大量的热量。科学家利用卫星图比较了被鹿群啃食和未啃食的地块，发现被啃食的苔原或灌木丛能够反射更多的太阳光，其效果足以减慢冻土的融化[16]。因此，笔者通过运用情境分析方法设计了一条迁徙路线，在保障驯鹿的可通过性与安全性（主要包括对驯鹿迁徙途中可能遇到的阻碍物进行归类分级，并提出不同的穿行策略）的同时，通过引导鹿群啃食植被来缓解冻土融化问题（图6）。

making the herders have to navigate the migration differently.[15] Relevant research reveals that the most heavily thawed frozen soil is largely distributed in dense forests, where the shadow of tall trees on the snow absorbs more heat. By using satellite images to compare with the grazed and un-grazed snow-covered sites, scientists found that grazed tundra or bushes can have a higher solar reflectance that is enough to offset the heat absorbed, which can greatly help slow the melting of frozen soils[16]. Through scenario analysis, the authors planned a new migration route that can ensure the passing and safety of the reindeers—primarily by classifying the possible obstacles on the route and arranging alternative route if necessary, and alleviating the permafrost thawing by leading the reindeers to the targeted vegetation areas (Fig. 6).

① 关于该课程的更新信息，请访问建筑联盟学院网站。

① For more information about this program, please visit the website of the Architectural Association School of Architecture.

3.3 模拟——利用原型思维测试最优设计策略

在建成景观中，设计师面对的环境是不断变化的。如今，计算机技术的发展使得设计师可以对场地环境的各个要素（风、光照、水文、沉积物等）进行模拟，最大程度接近场地的真实条件变化。其中，模拟推导设计原型的设计方法论在全球前沿院校的景观课程中受到了广泛关注。

英国建筑联盟学院开展的景观都市主义研究生项目强调将自然过程和城市发展整合为可持续的人工生态方式，对景观过程进行大量的模拟研究，并以此指导设计。①以2015年的“重塑海岸”项目为例，设计者从尼罗河三角洲沿海地区达米埃塔海岬鱼塘里使用的装置中获取了设计原型：使用泥沙围栏和泥沙幕布进行不同方向的空间围合，可以减慢泥沙的运动，改变沉积物的偏转和积累方向。同时，养鱼作业中形成的构筑物本身就有利于泥沙的沉积，这反过来又能有利于当地居民扩大生产。[17]

计算机技术支持设计者在迭代模拟运行时实时做出决策。当沉积物到达与潟湖边缘土地相接的高度时，设计者根据他们规划的引导角度设置了更多的泥沙截取装置，这些岛屿起到了控制和形成额外潟湖的作用。这一过程的不断重复不仅形成了一系列堆叠的潟湖，也为当地沿海居民提供了新的生存环境（图7）。

此外，以模拟验证原型设计过程的还有由克里斯托弗·吉鲁特教授指导的苏黎世联邦理工学院的景观设计课程——机器人自动化建造的景观。该课程将计算机模拟设计方法论与机械臂实验相结合，要求学生随着时间的推移开发创新的河道地形原型，以确保河流在这种动态景观中的长期平衡。[18][19]

J’ Studio景观研究工作室同样将模拟作为测试设计原型，从而指导设计的重要手段。模拟方法包括计算机模拟和物理实验模拟；模拟对象涵盖水文、城市扩张、流体、泥沙、群聚、风环境、太阳辐射等。例如，位于佛得角共和国福戈岛的“岩浆引流——火山灾害下的农业景观”项目通过使用流体模拟，指导策略生成、原型选择，以及最终

3.3 Simulation—Prototyping for Optimizing Design Strategy

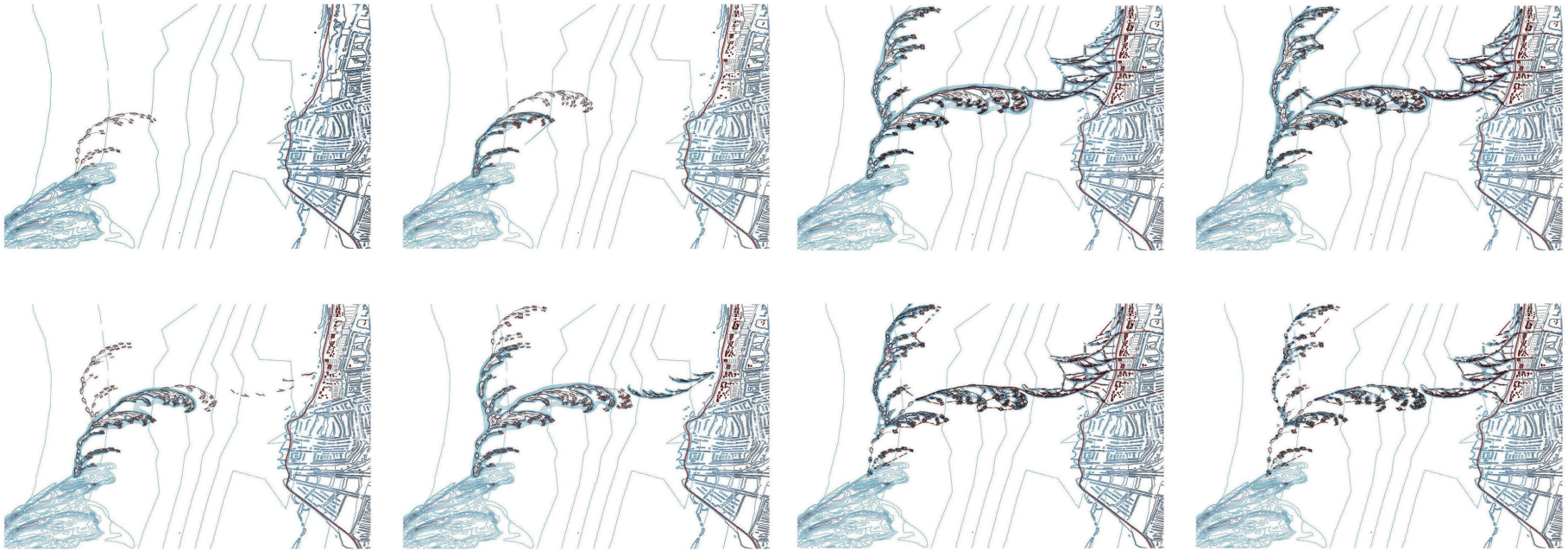
The environment of the built landscape is constantly changing. Nowadays, the advance of computer technology allows designers to simulate various site elements (wind, light, hydrology, sediment, etc.), as close as possible to the authenticity. The methodology that deduces design prototypes through simulation has been widely employed in landscape courses of leading colleges in the world.

The AA Landscape Urbanism (AALU) is a research graduate program in the Architectural Association School of Architecture. This program offers a way in which it allows the integration of natural processes and urban development into a sustainable artificial ecology and contextualizes the practice through stimulations of landscape processes.① Taking the Littoral Negotiations project in 2015 as an example, the AALU designers extracted a design prototype from a fishery device in the Damietta Spit, a coastal area of the Nile Delta. Techniques such as silt fences and silt curtains are used to slow sediment movement and for deflection and accumulation. The fish farmers themselves have an incentive to deploy this technique given that it has the capacity to accumulate land, which in turn allows them to expand their production.[17]

Computer technology supported the designers making real-time decisions during the iterative simulations. When the spit reached the point at which it touched the land forming a lagoon, the designers inserted more islands as sediment interception devices arranged in a designed angle, which serve to control and provoke the formation of an additional lagoon, offering implications upon the lives of the people who live in the Damietta Spit (Fig. 7).

Another program that verifies the prototyping design process through simulations is the Robotic Landscapes at ETH Zürich, led by Professor Christophe Girot. This program introduces an experimental robotic arm into the computer simulation, and requires students to develop innovative river typology that changes over time, to ensure the long-term dynamism of the river landscape.[18][19]

J’ Studio Research Lab also uses simulation as a primary means to test prototypes to optimize the design. The simulations employed include computational simulation and physical simulation, and the application ranges from hydrology, urban expansion, flux, sediment, clusters to the wind,and solar radiation. For example, in the project “Lava Diversion—Structure Strategy for Volcanic Hazards and Barren Land” in Fogo, Cape Verde, flux simulation was used for developing design strategies, selecting prototypes,



设计的形成（图8，9）。该项目旨在利用引流装置将火山灾害转化为机遇：火山喷发是一种自然灾害，但是它同时也是一种潜在资源——火山灰是良好的农业肥料。设计者通过调查场地的地质条件、村落分布、岩浆的喷发及流动情况等，在结合流体模拟的基础上提出了引流装置的设计原型，以在火山喷发时将岩浆引流至人烟稀少、土壤贫瘠的地方。同时，项目利用火山喷发后的风化物质改善当地土壤肥力，促进岛屿农业和旅游业的发展，以及岛民生活条件的改善。

4 讨论与结论

在人类主观能动性改造自然的过程中，空间设计原型作为一种经验始终贯穿于人的意识中，其在设计领域中发挥的作用也不断演变——原型思维既是一种研究方法，也是一种设计和验证的手段。

自20世纪80年代末以来，景观都市主义理论在查尔斯·瓦尔德海姆、理查德·韦勒、科纳、莫森·莫斯塔法维等人的推动下逐渐完善，建成景观的历史背景、复杂性及时间性都被纳入设计师的考虑范

and forming the final schemes (Fig. 8, 9). The project aims to turn volcanic disasters into opportunities with designed drainage devices. A volcanic eruption is a natural disaster but it can also bring a potential resource: the volcanic ash is good fertilizer for plants. By investigating the geological conditions of the site, the distribution of villages, and the eruption and the flow of lava, the designers proposed design prototypes of the drainage devices through the flux simulation—Lava can be diverted to the sparsely populated and barren areas when the volcanic eruption occurs. At the same time, the project uses the volcanic ash to improve the fertility of the island, promoting the agriculture and tourism development of the island and improving the living standards of the locals.

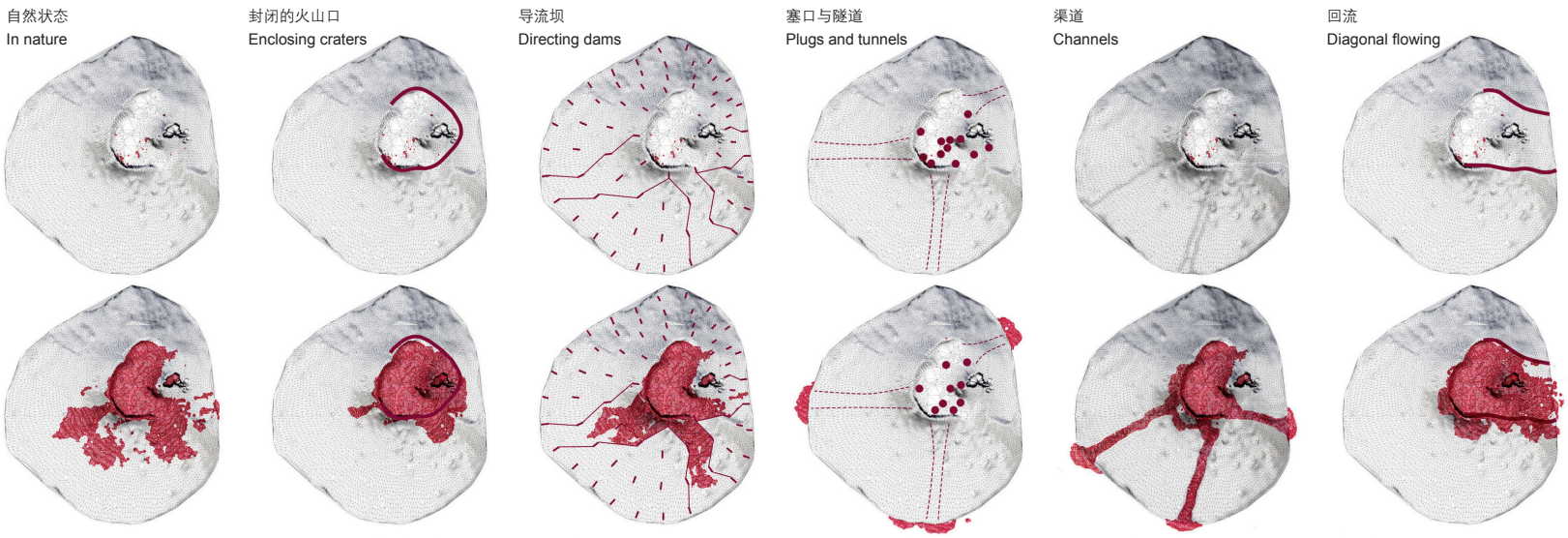
7. 鱼塘与潟湖的地形演化
8. 岩浆引流设计策略：通过物理实验进行火山喷发模拟

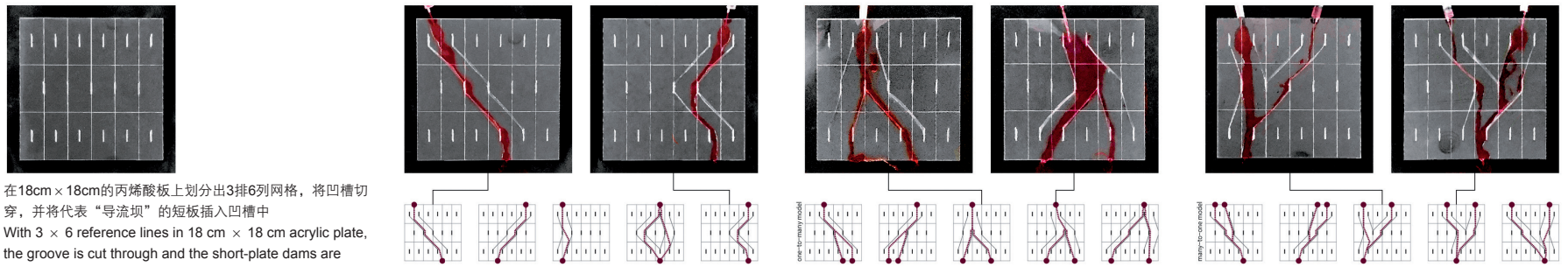
7. Topographical intersection evolution of the fishery area and the lagoon
8. Lava diversion strategy: simulation of eruption with physical experiments

4 Discussion and Conclusion

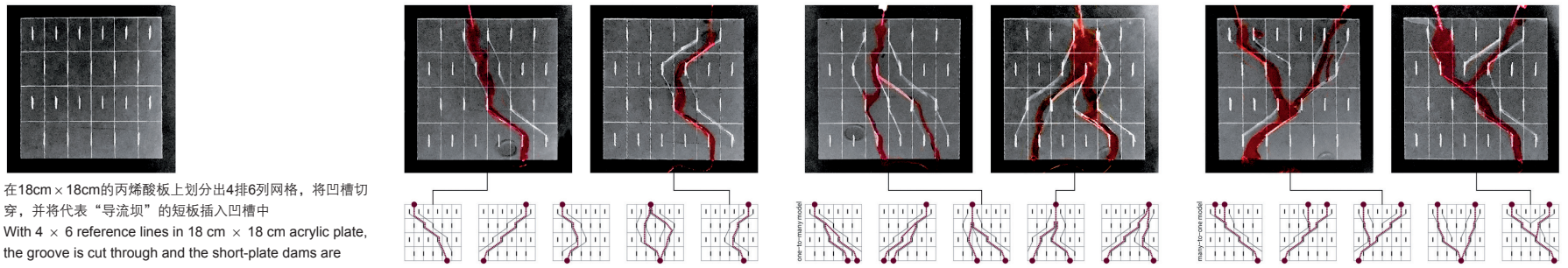
The process of transforming the nature manifests human's use of prototypes of spatial design as a conscious experience, and the role of these prototypes in the field of design is continuously evolving: Prototyping is not only a research method but also a means of design and a way of testing design ideas.

Since the end of the 1980s, the theory of Landscape Urbanism has seen an improvement with the efforts by scholars—including Charles Waldheim, Richard Weller, Corner, and Mohsen Mostafavi—and the historical background, the complexity, and the dimension of time of the built landscape

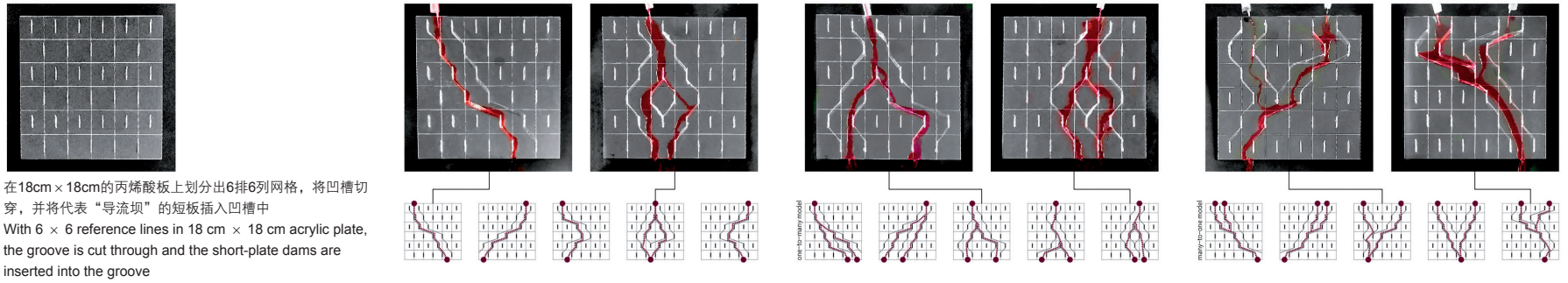




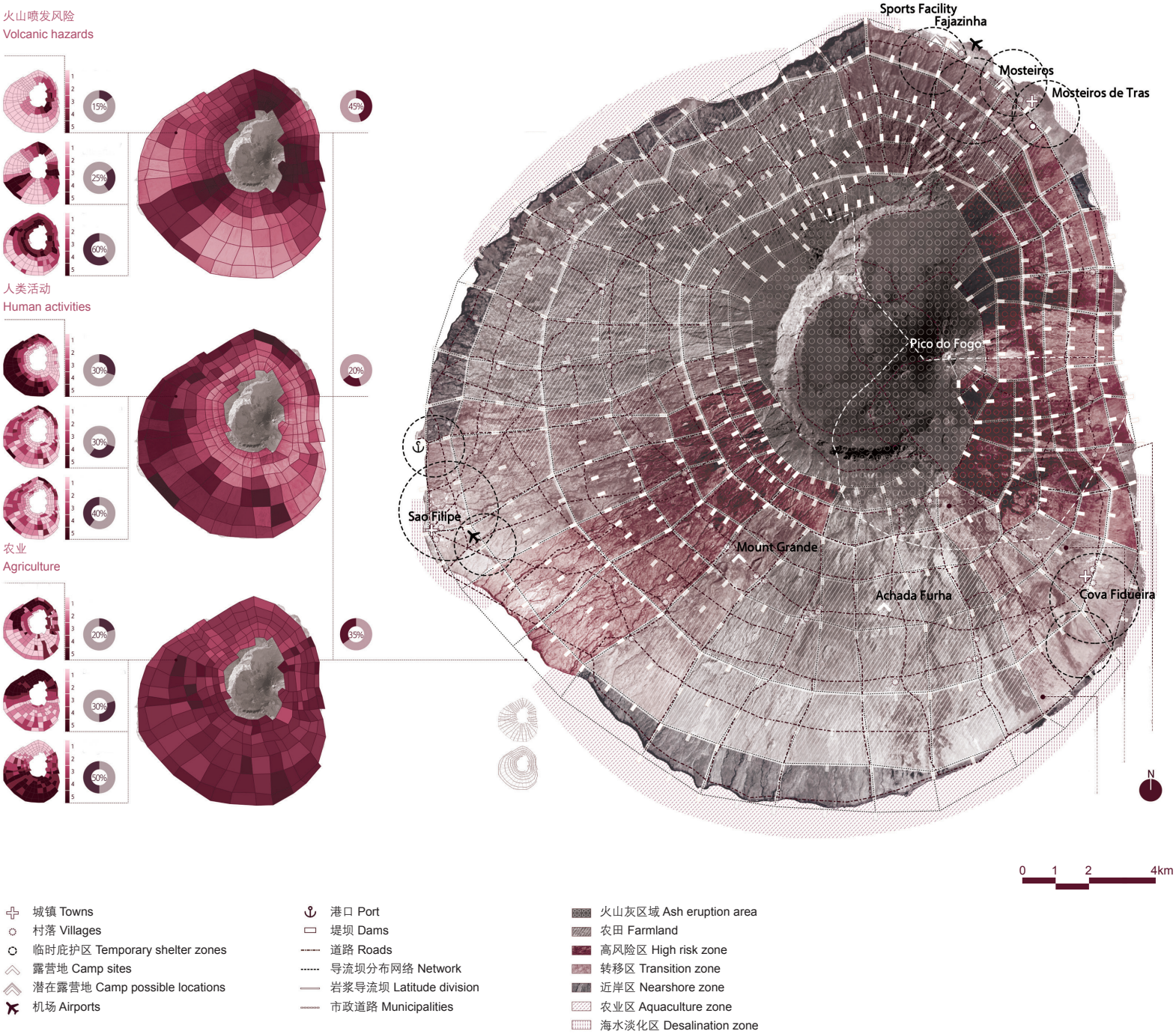
在18cm × 18cm的丙烯酸板上划分出3排6列网格，将凹槽切穿，并将代表“导流坝”的短板插入凹槽中
With 3 × 6 reference lines in 18 cm × 18 cm acrylic plate, the groove is cut through and the short-plate dams are inserted into the groove



在18cm × 18cm的丙烯酸板上划分出4排6列网格，将凹槽切穿，并将代表“导流坝”的短板插入凹槽中
With 4 × 6 reference lines in 18 cm × 18 cm acrylic plate, the groove is cut through and the short-plate dams are inserted into the groove



在18cm × 18cm的丙烯酸板上划分出6排6列网格，将凹槽切穿，并将代表“导流坝”的短板插入凹槽中
With 6 × 6 reference lines in 18 cm × 18 cm acrylic plate, the groove is cut through and the short-plate dams are inserted into the groove



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畴。设计师可以利用场地切片的方法，从研究场地中提取、简化或抽象推演空间原型，对建成景观的历史背景进行研究归纳；通过情境分析，设计师可以对可能出现的条件变化做出假想和预判，从而提出应对情境的设计原型；在时间景观的语境下，使用计算机技术对场地所

are all underscored in the design process. Designers can use the approaches of site section to extract, simplify, or abstractly deduce the prototypes of spatial design, as a way of investigating the historical background of the given site; Through scenario analysis, designers can make predictions on possible changes of site situations to conceive the design prototype accordingly; Highlighting that landscapes process over time, computer

9. 岩浆引流设计策略：设计方案评估

9. Lava diversion strategy: evaluation of plan

处环境要素进行模拟，使设计师能够根据实时变化及时调整原型的组合或变体。

与此同时，原型思维也存在一定的局限性。例如，虽然原型思维在抽象—衍化—测试—结果的过程中作为一种预判设计方法是可行的，但在现实条件中，这种强调过程的设计方法忽略了设计受到的政治和社会层面的制约[20]。再比如，由于景观设计师面临的设计对象（如城市、自然）都属于混沌系统，具有不确定性和不可预知性[21]，任何初始条件的细微差异都有可能导致原型设计从理论到应用过程中出现偏差[22]。

但是，总的来说，得益于在生成设计策略与推敲设计方案时的优势，越来越多的景观实践和研究将原型思维纳入其方法论中。这不仅是由于现代景观的动态性和复杂性，更突显了跨学科合作的必要性。事实上，原型思维不仅是设计师理解场地、深入设计和验证结果的工具，更可作为一种简单有效的沟通方法，帮助公众、政府部门、开发商等不同群体理解设计师所做的干预。相信在未来，原型思维会帮助景观设计师制定出更具有实践意义和创新性的解决方案。**LAF**

technology supports designers to simulate the alternations of environmental elements of the site, during which real-time adjustments and iterations on the prototypes, be it combinations or variants, can be made.

Meanwhile, the limitations of prototyping cannot be denied. For example, although prototyping is applicable in the process of extraction-deduction-test-outcome, as a prediction means, in reality "the idea of process is limiting today because it works against the agency of design as a political and social project"[20]. For another example, in landscape design, the objects are often chaotic systems, such as cities and the nature, which are characterized by uncertainty and unpredictability[21], and any subtle or sensitive dependence on initial conditions would lead to a disparity in the formation process of a prototype or in its application in design practice[22].

However, in general, prototyping has benefited the development of design strategies and design schemes, and more and more landscape practices and studies demonstrate the working integration of prototyping with methodology. This not only results from the dynamics and complexity of the modern landscape but also comes to prominence of interdisciplinary collaboration. In fact, besides being a tool for designers to comprehend the site, improve proposals, and test outcomes, prototyping can also help with designers' communication with the public, the government, developers, etc., who can better understand the design interventions simply and effectively. In the future, prototyping will witness a broader application in landscape design practice as impulses to innovative solutions. **LAF**

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