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S t u d e n t s

数字建构 学生建筑设计作品

(Im)material Processes

New Digital Techniques for Architecture

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前言

本书为“数字建构：2008年国际青年建筑师及学生作品展”学生建筑设计作品集。“数字建构”建筑展试图为26所世界一流的建筑学院提供一个展示的窗口，着重展示新数字技术的创新应用。该展览的另一部分为青年建筑师作品展，展出57个极具潜力的建筑师事务所的作品。作为本书的系列，还有青年建筑师作品集。

“数字建构”指在建筑生产过程使用物质或非物质的数字技术进行建筑设计及教学。非物质数字技术包括创造性地使用脚本、编程和参数化模型软件；物质数字技术包括创造性地使用数字建造技术，例如：数控切削、3D打印和激光切割。

这次展览由清华大学建筑学院主办，并作为第三届中国国际建筑艺术双年展的一部分；双年展由罗丽博士领导。展览开幕的同时还将举办由清华大学建筑学院主办、全国建筑院系建筑数字技术教学指导委员会组织的建筑设计及教学研讨会。

主办者感谢国家自然科学基金给予的支持；感谢798时态空间提供展场便利，感谢Autodesk（中国）公司为会议提供赞助。

最后，主办者感谢所有帮助布展和编写本书的人员，在此特别感谢宋刚、劳拉·费拉雷多、李晔国、陈寅、尹志伟、孟姝均、肖燕、姜赛双和魏娜所作出的贡献。

尼尔·林奇
徐卫国

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Preface

This catalogue covers the works on display in the '(Im)material Processes: New Digital Techniques for Architecture' exhibition of students work . The intention is to offer a showcase of 26 of the leading schools of architecture in the world, with a particular emphasis on the innovative use of new digital techniques. This work is part of a larger exhibition on the same theme, which includes work from some of the most talented architects in the world.

(Im)material Processes refers to the use of both immaterial and material digital techniques in architectural production. Immaterial digital techniques include the innovative use of scripting, programming and parametric modeling softwares. Material digital techniques on the other hand include the innovative use of digital fabrication technologies such as CNC milling, 3D printing and laser cutting.

This exhibition is organized by Tsinghua University School of Architecture and is taking place as part of the Architecture Biennial Beijing 2008 .The opening of the exhibition coincides with a conference on digital design hosted by Tsinghua University School of Architecture and organized by the Architectural Digital Techniques Education Committee of the NSBAE of China.

The organizers are grateful to NSFC of China for their support of the exhibition, to the directors of 798 Space for permitting the exhibition to take place, and to Autodesk (China) for sponsoring the conference.

Finally the organizers are grateful to all who have contributed to staging this exhibition and preparing this catalogue. In particular they would like to thank Song Gang, Laura Ferrarello, Li Yeguo, Chen Yin, Yin Zhiwei, Meng Shujun, Xiao Yan, Jiang Saishuang and Wei Na for their invaluable contribution in helping to design and compile this catalogue.

Neil Leach
Xu Weiguo

新唯物主义

北京的天际线在最近几个月发生了改变，新的建筑物已经涌现。其中的一些，如OMA设计的中央电视台总部大楼、赫尔佐格和德梅隆设计的“鸟巢”奥林匹克体育场，以及PTW事务所设计的“水立方”奥林匹克水上中心，属于这个世界最惊艳的奇迹。这三个建筑不单为我们的展览提供了一个引人注目的背景，同时也是建筑感性转变的一个证据，这个转变支持了这本书中很多作品的创作。

这表明统治后现代主义建筑文化的旧有体系正让位给新的设计方法。这也许在对结构和装饰的态度上表现最明显。由罗伯特·文丘里、斯科特·布朗和斯蒂文·艾泽诺尔，在他们开创性的著作《向拉斯韦加斯学习》中倡导的对“装饰的外壳”的强调，尽管已影响建筑创作数十年，但最终衰落[1]。我们见证的是一种新的表达：结构已不再是服务于装饰和隐藏在表皮以下，立面也不再被玻璃幕墙的逻辑统治；取而代之的是结构被表现在外并作为一种装饰形式。这并不是说结构凌驾于装饰，而是结构与装饰之间的关系得到了重新定义，结构装饰化，而装饰则结构化。结构和装饰相辅相成。

这背后显然存在一个潜在的结构性能趣味。诸如“性能”这样的时髦词汇已经开始出现，对结构效率的关注在特定的激进建筑师群体的作品中扮演越来越重要的角色，这本书中就有很多这样的例子。同时，历史上一些对结构性能有很准确认识的建筑师，如高迪、奥托和奈维尔，被重新审视并成为评论的焦点。更有甚者，一些像塞西尔·巴尔蒙德那样被德兰达尊称为“材料哲学家”的当代杰出结构工程师，已经成为被人崇拜的偶像。

与对结构性能的兴趣并行的是一个日益增长的对环

New Materialism

The skyline of Beijing has been transformed in recent months. A new generation of buildings has emerged. Some of them – such as the new CCTV headquarters building designed by OMA, the ‘Bird’s Nest’ Olympic stadium by Herzog & de Meuron, and the ‘Water Cube’ Olympic Aquatics Centre by PTW Architects - are among the most startlingly novel to be found anywhere in the world. These three buildings do not only provide a striking backdrop to this exhibition. They also seem to provide evidence of a shift in architectural sensibilities that underpins much of the work in the catalogue.

It as though the old parameters that governed post-modern architectural culture are giving way to a fresh approach to design. This is most evident, perhaps, in attitudes towards structure and ornamentation. The emphasis on the ‘decorated shed’ which Venturi, Scott-Brown and Izenour had championed so much in their seminal book, Learning from Las Vegas, and which gripped architectural production for several decades, is – it would seem – finally on the wane.[1] What we are witnessing instead is a new expressivity where structure is no longer subordinated to ornament and hidden beneath the surface, and the façade is no longer dominated by the logic of curtain walling. Instead structure is being expressed on the outside and treated as a form of ornamentation. This is not to say that structure is being privileged over ornament. Rather the relationship between structure and ornamentation is being reconfigured so that structure has become ornamental, and ornament structural. Structure and ornament feed into and inform one another.

Behind this there is clearly an underlying interest in structural performance. Buzz-words such as ‘performativity’ have begun to appear, as concerns for structural efficiency play an ever greater role in the work of a certain group of progressive architects, many of them featured in this catalogue. Meanwhile architects from the past who had an acute awareness of structural performance – figures such as Antonio Gaudi, Frei Otto and Pier Luigi Nervi – have been revisited, and have become the focus of critical re-evaluation. Meanwhile certain leading contemporary structural engineers, such as Cecil Balmond – ‘material philosophers’, as Manuel DeLanda has called them - have begun to assume a certain cult status.

Paralleling this interest in structural performance is an increasing interest in environmental performance. Just as intelligent structures can reduce the amount of materials used, so too intelligent environmental design can reduce the amount of energy consumed. Both interests are ultimately part of the same logic of performativity – the urge to use materials efficiently and minimise waste. As such they cannot be dismissed as the latest fad in an architectural culture all too wrapped up in the latest fashions, but should also be seen to be operating within an ethical dimension in addressing concerns about sustainability.

This concern for performance has led to an increasing interest in materials and their behaviour. This refers both to the use of new materials – such as the ETFE used for pneumatic panels on the ‘Water Cube’ – but also to the intelligent use of more traditional materials – such as the steel structure of the ‘Bird’s Nest’.[2] Para-

批判的“图解”

解释性图解

“图解”的概念由来以久，可以说与建筑学本身一样古老；然而“图解”在过去，只是一种解释性或分析性的工具，通常用来表示某种几何关系，进行形式研究，解释事物之间某种内在的关系，或者展现建筑师的设计灵感。西方建筑理论史的奠基人维特鲁威提出的“维特鲁威人”就是对他所建立的建筑形式标准的图解，之后又有希·罗·宾根、弗·迪·乔奇奥、温·斯卡莫奇以及达·芬奇等人均绘制过维特鲁威人，试图表达建筑、人体、世界之间的几何关系[1]。柯布西耶在1915年绘制的“多米诺住宅”是一个具有划时代意义的建筑图解，他以多米诺命名，意味着这是一栋像骨牌一样标准化的房屋。在这里柯布将建筑抽象还原到由梁、柱、板以及垂直交通组成的基本结构，这一结构可批量生产，其形式随着建筑类型的需要可进行修改。这个图解直接反映了柯布“住宅机器”的概念，是“机器美学”的具体体现[2]。现代主义的功能关系泡泡图是典型的抽象分析性图解。基于“形式服从功能”的信条，建筑设计首先要分析功能组成及其相互之间的联系，功能泡泡图正是对建筑功能组成及其关系的图解，它简单化地表达了功能及流线的关系，并作为建筑形式发展的抽象基础。在泡泡图中，人的动态活动要求被片面地表示为静止的功能体块，建筑中各种活动之间的复杂联系被表示为简单的流线，其结果导致现代建筑僵化、生硬、缺少人性。

生成性图解

埃森曼开发了“图解”的生成性用途，把建筑作为一个事件不断展开，时间在这里具有了积累、绵延的特

The Critical Diagram

Explanatory Diagrams

The concept of the diagram is as old as architecture itself, dating back thousands of years. In the past, the diagram was understood only as an explanatory or analytical tool in the study of form. It was used to visualize certain relationships in geometry, to illustrate the inherent connections between objects and events and to explain the intentions of architects.

The first diagram was proposed by Vitruvius. He introduced the prototype of Vitruvian Man as a standard diagram for architectural forms. This spawned a series of reinterpretations - from Hildegard von Bingen to Francesco di Giorgio, Vincenzo Scamozzi and Leonardo Da Vinci - using the model of Vitruvian Man to express the geometrical relationships between architecture, the human body and the world.[1]

In his design of the Domino House in 1915, Le Corbusier established another landmark in the history of the architectural diagram. He named it ‘domino’ to convey an idea of a standardized structure made up of basic units, just like dominos. In the Domino House, architecture is reduced to basic units, which combine beam, column, flat surface and vertical circulation and can be mass produced, the forms varying according to the building type. The diagram directly reflects Le Corbusier’s concept of the house as ‘a machine for living’ and manifests the beauty of the machine.[2]

In modernism,the bubble diagram is used in functional analysis as a typical abstract diagram. Under the belief that ‘form follows function’, architectural design always starts from analyzing the composition of functions and the interrelationship between them, based on the bubble diagram. It simplifies the relationships between functions and flows, and serves as an abstract base for the eventual architectural form. In the bubble diagram, however, dynamic activities are reduced to static functions. Any complex interactions between the different activities in a building are represented by over-simplified flows. As a consequence, modern architecture tends to be somewhat rigid, stiff and mechanical.

Generative Diagrams

It is Peter Eisenman who expands the use of the ‘diagram’ into form generation. He sees architecture as an ongoing event, where time acquires the features of accumulation and extension, and form becomes an aggregation of movements. In his working method Eisenman first applies certain methods or rules to a primitive form or initial concept, then tunes these to create a series of forms and finally generate a design.[3]

From his series of house designs onwards, Eisenman uses the diagram to develop most of his designs. In House No 2, Eisenman selects a 9-point grid as the primitive form, employing operations such as rotation and doubling to capture the multiple configurations of column and wall, which determine the overall spaces. House No 6 is also derived from a 9-point grid, although the underlying concept comes from film-making. The final design ends up as a series of traces left by the prototype in particular times and spaces. Relying on a form

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法国巴黎玛莱柯建筑学院

两个重要的问题从对目前建筑实践的观察中凸现出来。第一，建筑理念和建筑模型交流的全球化，此现象可以通过地区、文化、环境、政治和功能需求得以弥补；第二，使用复杂数字技术的专业技术和项目开发工具的引入。上述数字化和全球化的背景对建筑学教育构成了重大的挑战。我们致力于以开放和实验的方式，理解世界主要城市经历的城市环境的转变。我们坚信对“密度形式”和中国环境中城市建筑形态发生的反思具有广泛意义，它们应当构成建筑学院的前瞻性研究。环境正在改变；私人融资部门正在承担日益重要的职责；建筑项目在过程和参与者问题上日趋复杂。我们观察到新的非典型城市的境况是：原有的活动地点、基础设施和服务区、不连续或被废弃的区域极度令人讨厌或未经规划就使用等。这些新状况表明经典“城市构成”原则和由队列和同质性主导的城镇规划布局已经变得陈旧落伍，并鼓励我们探索更灵活和开放的方式。中国城市和乡镇面临的重要的环境和城市转变以及因环境恶化所面临的危险已经导致我们反思西方城市特有的新现象。

布鲁诺·J·胡伯特

Paris Malaquais, France

Two key aspects stand out from the observation of current architectural practices: firstly, the globalisation of the exchange of ideas and architectural models, a phenomenon counterbalanced by local, cultural, environmental, political and functional requirements; secondly, the introduction of expertise and project development tools using sophisticated digital technologies. Taking this digitized and globalised context into account constitutes a major challenge in architectural education. In an open and experimental approach, we are devoted to understanding the transformation undergone by the urban environments of major cities. We believe that reflections on the ‘forms of density’ and on the morphogenesis of urban fabric in the Chinese context can be generalised and that they should constitute prospective research within architectural schools. The environment is changing; the private financing sector is taking on an increasingly important role; the architectural project is becoming more complex in its procedures and number of players involved. We observe that new and atypical urban situations: former activity sites, infrastructure and service zones, areas of discontinuities or abandoned areas, places with high levels of nuisances or with unplanned usages, etc. These new situations demonstrate the obsolescence of classical rules of ‘urban composition’ and town planning layouts governed by alignment and homogeneity, and encourage the exploration of more flexible and open approaches. The important environmental and urban mutations with which Chinese towns and cities are confronted and the perils that they face in terms of degradation of the environment have led us, in return, to reflect on the new phenomena that characterise our western cities.

Bruno Hubert

本研究使用模型和计算机化的GDL（几何描述语言）脚本，在将地块划分为宽度相等的带状区域的基础上，对指定地块进行总体密度的研究。借用录音的寓意，上述条状区域具有不同的垂直或水平“行为”。这些不同的行为反映出不同的用途：技术设施、居住空间、办公室等。本项目调查了高碑店地区，该地区具有带状系统——或者更确切地讲——具有等截面被占用的“管道”。这些系统具有向南的立面，符合中国的规范，并且根据不同的功能程序、环境或可居住性，在三个方向上改变路线。

This approach using models and computerised GDL (geometric description language) scripts involves a search for overall density on the assigned plot of land, based on a division into strips of constant width. Using the metaphor of sound recordings, these strips have different vertical or horizontal ‘behaviours’. These ‘behaviours’ reflect the different uses: technical facilities, living spaces, offices, etc. The project invests the Gao Bei Dian site with a system of strips – or, to be more precise - occupied ‘tubes’ of constant section. They have south-facing facades, which meet Chinese regulations, and change course and move out of line in three dimensions, depending on their functional programmes, context or even habitability.


Strip Behaviour

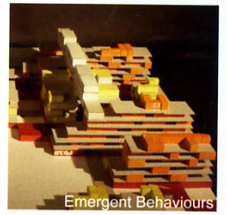
该学生的研究包括理解领会地块的大小及其边界，从而确定进入所需的密度，但需要采取灵活和连续的方式。考虑到景观，导致了设计基于广受认可的中国式景观寓意：花园、梯田、山脉和山谷。使用几何描述语言编程，本项目以蛇形蜿蜒盘旋的方式适应并进行自身变形，最终赋予未经建造的空间上述特色。我们运用了厚度变化的建筑剖面原则，由此实现了建筑项目设计的多样化：住宅单元、办公室、文化设施和停车场等。

The student’s approach consisted in apprehending the size of the plot of land and its limits so as to install the required density, but in a flexible and continuous manner. Taking the landscape into account led to working on the basis of well-recognised metaphors of the Chinese landscape: gardens, terraced cultivation, mountains and valleys. Using GDL programming, this proposal adapts and deforms itself in the manner of a snake, constituting meanders which characterise in their turn the non-constructed spaces. The principle of building sections of variable thickness is employed, thereby enabling a wide variety in the architectural programming: housing units, offices, cultural facilities or car parks.


Section and Meanders

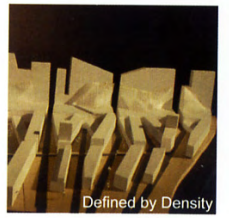
该学生的方案直接质疑北京的城市发展策略：遵循经济逻辑消除现有建筑物并提高地表的密度，这一策略对该场地先前存在的活动和居民构成损害。本项目以激进的方式构想建造层面的“连续”建造方式，以使人们或特定人群根据自身的需求，在遵循基本程序的同时，越来越多地投资于这个地块。上述策略基于有机的、自我控制的城市发展的假设提出。本项目通过增加交叉式模块框架、借助不断演进的项目逐渐增加居民而实现。

The student’s strategy directly questions the urban development of Peking, which increases ground density while eradicating the existing fabric in an economic logic that is developing to the detriment of pre-existing activities on the site and its inhabitants. The project conceives, in a radical manner, the ‘successive’ construction of built layers enabling persons or groups of persons to invest the site progressively, according to their needs and while complying with basic ground rules. The strategy is based on the hypothesis of an organic and self-controlled urban development. The project is built up through the addition of intersecting modular frames, progressively colonised by the inhabitants with programmes that are in constant evolution.


Emergent Behaviours

该学生对密度、拥挤度和建筑设计之间的关系进行了研究。使用几何描述语言编程，生成可能的形态。数字化的研究方式构成了表面适当且大小不同的建筑物，在功能上可满足未来可见的一系列活动。储藏区、车库、商业或体育设施采用低层高密度建筑，办公和居住建筑布置在可自然采光及花园处。在东面，可变密度和程序确立的“带状区域”原则，沿西—东走向延伸，与低密度建筑形成鲜明对比，形成屹立在环路上复杂的设施，并被办公大厦衬托出来。

The student carried out research on the relations between density, thickness and architectural programme using GDL programming to generate a morphology of potentiality. The digitised approach thus organises appropriate surfaces and differentially sized buildings as a function of the future envisaged activities: storage areas, car parks, commercial or sporting facilities in the case of low, thick buildings; offices and housing units in the case of thinner topologies requiring natural light or gardens. To the east, a principle of built up ‘strips’ of variable density and programme, which evolve along a west-east orientation, contrasts with a very thick building, forming a complex of facilities that stands right against the ring road and is surmounted by office towers.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