Architects

数字建构

青年建筑师作品

(Im)material Processes

New Digital Techniques for Architecture

[英]尼尔·林奇
Neil Leach

徐卫国 编
Xu Weiguo [eds.]

中国建筑工业出版社
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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”建筑师作品集。“数字建构”建筑展试图为57个极具潜力的建筑事务所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学生建筑作品展，展示26所国际著名建筑院校的学生作品。作为本书的系列，同时出版的还有学生建筑设计作品集。

“数字建构”指在建筑生产过程中使用物质或非物质的数字技术进行建筑设计及建造。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

Preface

This catalogue covers the works on display in the '(Im)material Processes: New Digital Techniques for Architecture' exhibition of architect's work . The intention is to offer a showcase of some of the most talented architects 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 leading schools of architecture 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 third 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

非物质化过程

代码，似乎是无处不在。我们开始明白自然环境中的许多事物都基于以规则为基础的行为，从鱼群和鸟群涌现的集群智慧，到雪花、蕨类植物、海贝和斑马皮肤的复杂图案，概莫能外。甚至人的身体也不例外。人类基因组成正在被科学家绘制和测序，以展现人类生命本身的遗传蓝图。

在此背景下，建筑师开始在设计工作室探索类似的法则也就不足为奇。这些代码的重要性在于开启了通过数字手段生成建模系统的可能性，以及利用数字技术的潜力催生新的结构的可能性。一群不断成长的年轻建筑师正在使用“脚本”技术（数字代码的处理操作）生成极具创新性的建筑环境。新一代建筑正在被创造出来，它使世人认识到计算机的潜力不仅仅是作为一种先进的绘图和渲染工具，而且是具有强大潜力的设计生成工具。

我们正在见证由计算机算法所引发的一种新鲜的和高度创新的建筑形式语汇的创造，从细胞聚集的增殖逻辑，到贯穿场环境变化着的分布式系统的自适应、参数行为。同样，我们也在目睹数字运算地位的变化，即从一个被边缘化的实验领域转变为建筑信息产品中心的角色。现在，有影响的建筑事务所几乎没有不参与到先进的数字建模实践中的；而此前，数字建模仅局限于先锋派的实验范围。

在当今世界许多主要的建筑事务所里，我们能够发现一种新兴的文化：事务所的研究部门致力于探索上述新工具在建筑设计生成方面的潜力。在2006年北京国际建筑艺术双年展以“涌现”为特色的展览中，由奥雅纳公司的AGU和福斯特公司的SMG所肇始的开发研究，现在已经普及到主流建筑事务所。许多国际领先的商业事务

Immaterial Processes

Code, it would seem, is everywhere. We are beginning to understand that much of our natural environment is based on rule-based behaviours, from the emergent swarm intelligence of flocks of birds and schools of fish, to the complex patterns of snow flakes, ferns, sea shells and zebra skins. And nothing escapes. Not even the human body. The human genome is being mapped out and sequenced by scientists to provide a genetic blueprint of human life itself.

In this context, it is hardly surprising that architects are now beginning to explore similar principles in the design studio. The apparent primacy of these codes opens up the possibility of modelling systems through digital means, and with it the potential of using digital technologies to breed structures. An ever-growing group of young architects is using the technique of 'scripting' – the manipulation of digital code – to produce radically innovative architectural environments. A new generation of structures is being created, that recognizes the potential of the computer not just as a sophisticated drafting and rendering tool, but also as a potentially powerful tool in the generation of designs themselves.

We are witnessing the creation of a fresh and highly innovative vocabulary of architectural forms, generated by the algorithmic potential of the computer – from the proliferating logic of cellular aggregation, to the adaptive, parametric behaviour of distributive systems mutating across a field condition. So too, we are witnessing a shift in the status of digital operations from a marginalized domain of experimentation to a central role in the production of architectural information. Few significant architectural offices can afford not to engage with advanced digital modelling, which was once limited to the province of the avant-garde.

Within many of the leading architectural offices in the world we can find an emerging culture of research units dedicated to exploring the potential of these new tools in the generation of architectural designs. What began with the development of the Advanced Geometry Unit at Arup and the Specialist Modelling Group at Foster and Partners, featured in the 'Emerging Talents, Emerging Technologies' exhibition at the Architecture Biennial Beijing 2006, has spread to mainstream architectural offices. Many leading international commercial practices, such as Skidmore Owings and Merrill, Kohn Petersen Fox and Aedas, have such units within their offices. Even relatively conservative practices, such as Allies and Morrison, have begun to explore this avenue. Meanwhile CODE, the digital research unit within Zaha Hadid Architects, has taken on an increasingly prominent role in the office. Radical changes are taking place in architectural production.

Many of these offices depend on talented students graduating from some of the most progressive architectural schools in the world – such as we see included in this exhibition – graduates who have been introduced to new parametric modelling software programmes, like Digital Project or Generative Components, and who have learnt scripting and other programming skills. What is surprising, however, is that these skills are not yet being taught universally in mainstream schools of architecture. Lars Hesselgren recently confided in me that Kohn Petersen

所，如：SOM、KPF和AEDAS，在其事务所内都设有这样的研究部门。即使是相对保守的事务所，如：阿莱斯和莫里森事务所，也已经开始探索这种方法。与此同时，扎哈.哈迪德事务所的数字化研究部门CODE，已经逐步在公司内部扮演越来越重要的角色。建筑生产正在发生根本的变革。

上述许多事务所依赖于从世界上一些最激进的建筑学院毕业的有才能的学生，正如我们在本展览中所看到的一样，这些研究生在学校里接触到了DP和GC这类新的参数建模软件程序，学会了脚本和编程技巧。然而，令人惊讶的是，上述技巧和知识并没有在主流建筑学院被普遍教授。拉尔斯.何塞尔格伦最近在我面前透露，KPF根本无法找到足够精通上述新技术的毕业生填补工作人员空缺。就此看来，建筑实践在某种意义上领先于建筑学教育。毫无疑问，这只是暂时现象，可以肯定，过不了多长时间，建筑教育就会对此作出回应。但是，它仍然是2008年建筑生产现状的一个鲜明的特征。

在北京的环境中，反映上述建筑文化新发展的最明显的例证之一就是,盖里科技公司作为顾问参与了由赫尔佐格和德梅隆设计的“鸟巢”奥林匹克体育场的建造。盖里科技公司起源于寻找合适的数字工具来描述和构建盖里事务所设计的复杂形式的需求。不久前，盖里科技公司开发了DP，这是一个最初为航空制造业而开发的软件CATIA的新版本，并在建筑建造的协调与合理组织方面开展了咨询业务。盖里科技公司在使用一套极为精密的数字工具解决“鸟巢”复杂的构造问题方面所提供的服务被证明是无可估量的。当然，一个世界领先的建筑事务所的子公司，以顾问的身份和另一个世界领先的建筑事务所合作，这足以引人注目。但同样引人注目的是，计算机中的非物质世界已被证明在解决建筑的物质世界构造问题方面是如此不可或缺。

当计算机首次被引入建筑学教育，新一代的数字设计师在上个世纪90年代中期应运而生。他们最初只是将为别的行业而开发的软件引入建筑领域，生成出如斯坦.艾伦所提出的“由流体建模技术催生的新的可塑性”。哥伦比亚大学建筑规划与保护学院正是最初率先使用这些工具的学院之一。最初涌现出的是一系列新鲜、撩人的构型，这些构型是在计算机屏幕的非物质世界里生成的，但并不一定容易建造。这毫不奇怪的引起了较传统的批评者们一定程度的抵制，他们认为——在我看来是正确的——建筑不应该基于计算机程序的算法，而应基于真实材料的建构能力。当然，读读弗兰普顿的《建构文化研究》一书，就有可能将其作为对这个基于屏幕设计的幻境般的新世界的批评参考[1]。数字的“非物质”世界和建造的“物质”世界之间存在明显的对立。

然而，世纪之交，数字与建造的对立已经开始消融，越来越多的建筑师和工程师开始使用计算机的“非物质”逻辑去解决实际建造的“物质”问题。举例来说，克里斯·威廉姆斯在为由福斯特事务所所设计的伦敦大英博物馆庭院顶棚提出结构解决方案时，已经不仅用算法，并且使用一个叫“动态松弛”的数字技术，去消除结构中的矢量力。而克里斯蒂娜·希亚则编写了一个叫EIFFORM的程序，作为一个随机、非单调的模拟退火形式，其能够生成具备结构完整性的三角形形式。正如我在《数字建构学》一书中所指出的那样：“数字（技术）和建构对立的旧观念已开始崩溃，数字技术正在越来越多的用于为建构服务。一门新兴的关于数字的筑造学——数字建构学已经开始形成。”[2]

脚本本身的潜力远远超越其所产生的创新形式。这一新的实践并非扩展了后现代透视造型，而是对于该领域的批评。随着对于可持续性和效率的日益关注，根据环境、结构、经济以及其他方面性能优化的需要，界定了一个新的建筑伦理境域的可能性。事实上，一般而言，数字世界的真正的潜力肯定在于能够利用模拟测试性能。在模拟世界中，测试一个建筑性能的唯一手段就是把建筑物给建起来。当然，可以进行一些计算，也可以根据建筑结构或环境方面的性能潜力进行一些估算。同时还存在通过模拟技术检测模型的可能性。例如，缩尺模型可放置在风洞中测试，以评价其空气动力学性能。同样，日影仪可以被用来依据太阳的入射角测试建筑的状态。

然而，在数字世界中，检测设计的可能性远远超过那些模拟世界的可能性。我们现在正目睹众多数字工具的发展，它使这类测试比以前更容易实现。这样一来，对一个建筑物结构或环境性能信息的收集，就不需要征

Fox simply cannot find enough graduates proficient in these new techniques to staff their offices. In this respect, architectural practice is - in some senses - ahead of architectural education. This is, no doubt, a temporary situation. It will not be long, surely, before architectural education has registered this and responded accordingly. And yet it remains a clearly identifiable characteristic of the state of architectural production in 2008.

In the context of Beijing, one of the clearest examples of this new development in architectural culture has been the involvement of Gehry Technologies as consultants in the construction of the 'Bird's Nest' Olympic stadium designed by Herzog & de Meuron. Gehry Technologies has its origins in the need to find suitable digital tools to describe and construct the complex forms being generated in the office of Gehry Partners. It was not long before Gehry Technologies had developed Digital Project, its own version of Catia, a software originally created for the aeronautical engineering industry, and had set up its own consultancy business in the coordination and logistics of building construction. The services of Gehry Technologies proved invaluable in resolving the complex constructional problems of the 'Bird's Nest' using a new set of highly sophisticated digital tools. It is of course remarkable enough that a subsidiary company of one of the world's leading architectural firms is collaborating in a consultancy capacity with another of the world's leading architectural firms. But it is remarkable too that the immaterial world of the computer has proved so indispensable in resolving tectonic problems of the material world of construction.

When the computer was first introduced in architectural education, a new generation of digital designers had formed by the mid 1990s, importing software programmes originally developed for other industries into an architectural arena to generate, as Stan Allen notes, a 'new plasticity enabled by fluid modelling techniques'. Columbia GSAPP was one of the first schools of architecture to pioneer the use of these tools. What emerged was a set of fresh and voluptuous - but not necessarily easy to construct - forms generated in the immaterial world of the computer screen. Not surprisingly, this prompted a certain amount of resistance from more traditional commentators, who recognised – correctly, in my opinion - that architecture is based not on the algorithmic potential of a computer programme, but on the tectonic capacities of actual materials. Indeed it is possible to read Kenneth Frampton's book, *Studies in Tectonic Culture*, as a critique of this new world of Maya based on screen designing[1]. There was a clear opposition between the 'immaterial' world of the digital and the 'material' world of tectonics.

By the turn of the millennium, however, this opposition between the digital and the tectonic had begun to dissolve, as increasingly architects and engineers were using the immaterial logic of the computer to solve material problems of actual construction. Chris Williams, for example, had used not only algorithms but also Dynamic Relaxation Technique, a digital technique for smoothing out vectorial forces in a structure, for his structural solution to the glazed canopy over the British Museum courtyard in London, designed by Foster and Partners, and Kristina Shea had written her eifFORM programme as a stochastic, non-monotonic form of simulated annealing that could generate triangulated forms with a structural integrity. As noted in *Digital Tectonics*, 'the old opposition between the digital and the tectonic has begun to collapse, and the digital is beginning to be used increasingly in the service of the tectonic. A new tectonics of the digital — a digital tectonics — has begun to emerge.'[2].

The potential of scripting itself lies beyond questions of generating innovative form. For what this new practice offers is not so much an extension to postmodern scenographic form-making, but a critique of that realm. With increasing concerns for sustainability and efficiency, the need to optimize performance in terms of environment structural, economic and other concerns, demarcates a

询那些领域专家的意见。结果是产生了一批新的混合型专业人士，他们打破了传统的学科分界。这并不是说专家就可以被取代，事实上由于建筑业正日益变得精专；相反，而是已经存在利用新的数字技术深入理解不同学科领域的可能性。

通过脚本，建筑测试的潜力能够被更多地向前推进，因为数字工具不仅可以用来建立模型和测试性能，而且还可以按照一定的性能标准生成建筑。换言之，一旦一个基于性能的逻辑能被写入脚本，结果便已经被优化。于是就没有必要去测试该脚本所生成的对象。因而，这就是脚本的逻辑——一个更加关注过程而非表现，更加关注性能而非外表的逻辑。于是，我们或许会说，不是形式，而是“形成”——建筑物作为数字景观、信息景观，是通过对性能的考虑而产生的构型。

有一些人认为脚本的使用违背了设计的逻辑；这是放弃对一个领域的控制。事实上，脚本的显著作用之一，是它有效的“设计”了设计过程。“设计”在此意味着质疑了建筑师“签名”的权威性。建筑师的权威被损害；建筑师的签名遭到质疑。但是，这已被某些人视为一个积极的进步。卡尔·初称赞这是一个世纪之交超越那些主导建筑话语权的签名建筑师的进步。

同样有些人可能会认为，计算机的优势将破坏设计中想像力的作用。然而，也有人认为，想像力的作用并没有被减少，仅仅是转移到不同的方面。正如建筑师的角色从过去自上而下的造物主——将形式强加给世界——转变为自下而上的过程控制者，想像力的使用已经越来越多地转向上述过程的创造性应用。事实上，假如看到本书中一系列丰富多样的设计，就不难发现，在那些依赖上述新的数字过程而产生的设计作品中，仍然体现了非常多的想像力。

无独有偶，也会有一些人带着疑惑观看本书中的作品。他们会将这些作品看成是一个抛弃过去并对未来寄予不加批判的信仰的运动的一部分。他们会说，也许我们应该回归到过去的形式，例如，在当代中国正确的建筑做法是，在城市中心区设计许多座宝塔。然而这样做只会把中国城市变成迪斯尼主题公园。正如福柯曾经指出的那样，不可能“回归”过去。对于任何这样的回归而言，都只是在新的文化框架中再重复陈旧的东西。这不是说我们应当摒弃过去的形式。事实上，当代中国一个最大的悲剧是过去的形式——比如那些传统的胡同住宅——被促进经济发展的狂潮涤荡一空。同样，这也不是说要摒弃传统概念本身。更确切地说，是要意识到传统要有生命力，并且对所处时代的文化、经济和社会条件作出回应。

传统从来不是静止不变的。它由一个矢量力动态场组成，永远吸纳来自外部的新鲜动力。传统是不断变异的，但它是通过重复得以巩固。每一个传统都从零开始，而单一事件在没有被再三重复之前不可能成为传统。从这个意义上讲，我们应该意识到，我们在这二年一次的系列展览的第三次展览中所目睹的一切，也许本身就是建立了传统——一个鲜活的、动态的传统。威尼斯双年展也是开始于历史的某一刻。它逐步将自己呈现在世界文化日程表之中，已成为展示不断发展的艺术领域的最重要的展览之一。我们或许可以预期北京双年展产生类似的重大影响。

事实上，本展览所关注的既不是未来，也的确不是过去。更确切地说，提供一个现时的快照，记录建筑设计领域某种能量刚刚迸发的时刻。尽管如此，本展览为我们呈上了一个多种建筑技巧和处置方式的潘朵拉之盒。现在，这个盒子已经打开，似乎盒中的东西开始像病毒一样在建筑生产领域广为传播。从这个意义上说，本展览或许是一个对未来的预言——建筑实践真实未来的脚本。

尼尔·林奇

new ethical horizon of possibilities. Indeed the real potential of the digital world in general is, surely, to use simulation to test performance. In an analogue world almost the only means to test the performance of a building is to build it. Calculations can be done, of course, and some estimation of the potential of a building in terms of its structural or environmental performance can be made. Also the possibility exists of testing models through analogue techniques, For example, scale models can be tested in a wind tunnel to evaluate aerodynamic performance. Equally a heliodome can be used to test the behaviour of the building in terms of the angle of incidence of the sun.

However, the possibilities of testing a design in a digital world far exceed those of the analogue world. We are now witnessing the development of numerous digital tools that make such testing far more accessible than before. Thus information on the structural or environmental performance of a building can be gathered without the need to consult specialist experts in those fields. What this is engendering is a new hybrid professional, who is breaking down traditional disciplinary boundaries. This is not to say that the position of the specialist expert is being eroded, because the building industry as such is becoming increasingly specialised, but rather that the possibilities now exist for enhanced understanding of different fields through new digital technologies.

With scripting this potential for testing can be pushed even further, as digital tools can be used not only to model and test performance, but also to generate buildings according to certain performance criteria. In other words, once a performative logic has been written into a script, the results are already optimized. There is no need to test what is generated by that script. This, then, is the logic of scripting, a logic whose potential is to focus more on process than representation, more on performance than appearance. We might speak, then, not of forms as such, but 'formations' - formations informed by performative considerations, buildings as datascapes, landscapes of information.

There will be those who argue that the use of scripting goes against the logic of design. It is to relinquish control in an arena that traditionally has depended upon the total control of the hand of the architect. Indeed one of the obvious effects of scripting is that it effectively 'de-signs' the design process. To 'de-sign' here means to question the authority of the architect's 'sign' or 'signature'. The authority of the architect is undermined. The signature of the architect is called into question. But this has been seen by certain people as a positive move. Karl Chu celebrates this as a move beyond the signature architects who dominated architectural discourse at the turn of the millennium.

Equally some might argue that the privileging of the computer undermines the role of the imagination in design. In defence, however, it could be argued that the role of the imagination has not been diminished, but simply displaced into a different arena. Just as the architect has shifted in roles from the top-down demiurgic figure of the past – imposing form on the world – to the controller of processes in a more bottom-up fashion, so too the deployment of the imagination has shifted increasingly into the inventive use of these processes. Indeed, given the rich and varied array of designs in this catalogue, it is clear that imagination is still very much at work in works that rely upon these new digital processes.

Likewise there will be those who view the works in this catalogue with suspicion. They will see them as part of a movement that forsakes the past, and places uncritical faith in the future. They will argue perhaps that we should return to the forms of the past, and that the correct way to build in contemporary China is, for example, to design pagodas in city centres. Yet to do so would merely be to turn Chinese cities into Disneyfied theme parks. There can be no 'return' to the past, as Michel Foucault once noted. For any such attempted return merely reinscri-

[1] [美]肯尼斯·弗兰姆普敦. 建构文化研究：论19世纪和20世纪建筑中的建造诗学. 剑桥：麻省理工学院出版社，1996
[2] [英]尼尔·林奇，戴维·特恩布尔，克莱斯·威廉姆斯著. 数字建构. 齐彻斯特：威利出版公司，2003：4

bes the old within the cultural framework of the new. This is not to say that we should abandon the forms of the past. Indeed one of the great tragedies of contemporary China is that those forms – such as the traditional hutong dwellings – are being swept away in a craze of redevelopment. Nor is it to abandon the notion of tradition itself. Rather it is to recognise that tradition has to be alive and to respond to the cultural, economic and social conditions of its time.

Tradition is never static. It is constituted by a dynamic field of vectorial forces, forever registering fresh im pulses from outside. Tradition is constantly mutating, but it is consolidated through repetition. Each tradition starts from point zero, in that a single event cannot become a tradition until it is repeated. In this sense, we should recognise that what we are witnessing in this third in a series of Biennial exhibitions is itself perhaps the establishment of a tradition – a live and dynamic tradition. The Venice Biennale itself started at one moment in history. Gradually it has instantiated itself within the cultural calendar of the world to become one of the most significant forums for presenting the ever-developing fields of artistic expression. Perhaps the Beijing Biennial is destined for similar greatness.

In fact the concern of this exhibition is neither for the future nor indeed the past. Rather it is to offer a snapshot of the present, and to record a certain fresh burst of energy in architectural design. Nonetheless this exhibition offers us a Pandora's box of architectural tricks and treats, and one, which, now unleashed, seems set to spread like a virus across the full range of architectural production. In this sense, this exhibition is perhaps a presage of the future – the scripting of the very future of architectural practice.

Neil Leach

[1] Kenneth Frampton, *Studies in Tectonic Culture* : The Poetics of Construction in Nineteenth and Twentieth Century Architecture, Camb., MA: MIT Press, 1996.
[2] Neil Leach, David Turnbull and Chris Williams (eds.), *Digital Tectonics*, Chichester: Wiley, 2003, p. 4.

数字建构

本书的中文名为“数字建构”，具有明确的两层含义：使用数字技术在电脑中生成建筑形体，以及借助于数控设备进行建筑构件的生产及建筑的建造。前者的关键词是“生成”，而后者的关键词是“建造”，两者均离不开数字技术。这两层含义也正对应了本书的英文名称“非物质和物质”。在计算机中生成设计属于数字技术的非物质性的使用，而在实际中构件的生产及建筑的建造则是数字技术的物质性使用。这本书之所以中英文书名不同，是因为我与尼尔先生均试图用各自语言中最恰当的词汇表达同一内容，即“运用数字技术进行形体的生成及形体的建造”，在书中收录的作品也均属于这类建筑设计。在《数字建构——学生建筑设计作品》中，我的主题文章着重阐述了形式生成的核心问题——“图解概念”，在这本书中，将主要阐述形体的数字建造问题。

从迄今为止发现的原始人类聚居地遗址来看，无论是法国靠近尼斯的泰拉阿马塔的旧石器时代遗址，德国北部的阿伦斯堡—荷尔斯泰因的旧石器时代人类冬季及夏季住地遗址[1]，还是中国北京周口店“北京人”遗址，这些遗址的形状都是不带棱角的向心性形状，考古学家经过推断赋予这些遗址的上部形体也几乎都是不规则的连续形状，这种形状是原始人类以“火”为中心的生活行为要求的结果；同时它也最本能地反映了人类对居所的最理想形态的企求。但是，从人类发展历史来看，生产力的发展水平远远低于人类对理想居所形态不断发展的要求，居所的形状只能屈从于生产力水平的限制，通常被建成在相应技术条件下可能的形状，比如，屋顶做成僵硬的坡顶，或者做成为了排水而带缓坡的平顶，墙体做成垂直的并带有转角的围护墙。实际上，人类从本能上试图避开这些生硬的形式带来的侵犯性，比如中国风水理念就讲究避开屋脊或横梁而睡，室内避免出现墙体阳角等，这是因为人类长期面对这些突兀的形状，身体及心理健康会受到严重损害。

人类无时不在寻求与生活行为及环境条件相适应的理想居所形态，就像原始人类居所那样。今天信息技术的发展不

Digital Constructing

Digital constructing can be understood to operate at two levels. The first level refers to the generation of architectural forms using digital technologies. Beyond this, digital constructing can also refer to the production of building modules and the construction of buildings with the aid of CNC (Computer Numerically Controlled) technologies. The key word for the former is 'generating' and for the latter 'construction'. The two layers echo what is implied by the term '(im)material' in the English title of the catalogue. The generation of designs through software programmes belongs to the 'immaterial' use of digital technologies, while the manufacture of components and the construction of buildings belong to the 'material' application of digital technologies. Our catalogue has two seemingly different titles for two different languages. The idea behind this is that Neil Leach and I tried to find out the most appropriate words in our respective languages to express the same meaning - the utilization of digital technologies to generate and construct forms. All works collected in this catalogue reflect this common theme. In the other volume – the catalogue of students' works - I emphasized the concept of the 'diagram', a core issue for form generation. In this volume – the catalogue of architects' works -I will mainly discuss digital fabrication.

From the ancient remains of human settlements up until now - be they the Paleolithic sites of Terra Amata by Nizza in France, or Paleolithic sites of winter and summer residences in northern Germany[1], or ancient Chinese sites - all these remains display the same concentric pattern with organic shaped chambers. Archaeologists infer that the structures are uniformly made in an irregular and continuous form, in response to a lifestyle centered around the hearth. The form also expresses ancient people's most intuitive quest for an ideal form of living. However, from the origins of human development, mastery of techniques of construction has often lagged well behind aspirations for an ideal living space. As a result, limitations in construction techniques has often constrained the form, which could only be built in the way that technical conditions would allow. For instance, buildings could only be covered with a sloping roof or with a flat roof with a gentle fall for drainage. Invariably the wall would be constructed as a vertical slab set at right angles. Actually these rigid forms are somewhat antithetical to unconscious human aspirations. Fengshui, the traditional belief system prevailing in China, tells us that the roof ridge and beam should be parried in a sleeping area and that the interior space should contains no sharp angles on the assumption that such bizarre forms would have a negative impact on the occupants both physically and psychologically.

Like the ancients, modern man continues his quest for an ideal living space that suits his behavior and environment. The rise of information technology will help not only to search out these forms and their underlying relationship with human dynamic behaviour but also to realize them. Obviously, the nature of such ideal forms is determined by the complex, dynamic activities of human beings themselves. They are also subjected to multiple environmental factors. The forms must therefore be complex and irregular.

In the history of architecture such forms have been designed by a handful of architects. Spanish architect Antonio Gaudi found architectural forms in the organic forms described by Ernst Haeckel in his research into the forms of natural plants and animals[2]. Togo Murano, a Japanese architect and a follower of Gaudi, focused on soft forms to express the beauty of human nature. Another example would be the American architect Bruce Goff, who pursues an organic architectural language of continuous external surfaces and interior spaces based on geometric transformations and sculptural forms[3]. One of his followers, Bart Prince, also takes the organic shape of animals as a prototype for his architectural designs[4]. All these works are characterized by continuous external surfaces and interior spaces, irregularity and complexity. How