建筑教学实践

——北京751地块三维城市结构设计

multiplayer design studio

[芬] 卡斯·欧斯特豪斯　托马斯·亚斯凯维茨　编

冯瀚　张愚　译

中国建筑工业出版社

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Foreword
前言

798艺术区位于北京东北部。这里以前是个电子器件工厂，该区西部最近已发展成一个充斥着画廊、展示、餐厅和创意办公的活跃区域。它是自下而上形成的。与世界上其他后工业地段相似，一个个艺术家发现了这些令人激动的废弃空间，并将其改造出新的使用功能。这最终使798变成了城市最时尚的区域之一，充满了生机和活力。目前，798艺术区正在启动进一步开发，吸引更多的用户和功能。该区西部已成功改造，东部仍然在等待新生。

798艺术区需要进一步扩大。它需要为新的功能和使用者提供新的空间。它要成为北京城市景观的主要焦点之一。然而，如果认为一个自上而下的设计，就能满足正在成长的798社区的所有需要，那就错了。该区域的扩建必须是弹性、多样和不受约束的，而且必须成为这个惊人地段的地标。

作为对此需要的回应，Kas Oosterhuis教授和Hyperbody共同提出了一个想法，来为798区域的东部进行分布式的设计——751工厂。这个概念是要建立一个大尺度、多功能、三维的城市结构，作为自下而上、分布式设计过程的结果。通过把该区域划分为更小的、相互依赖的项目，分配给自治、但同时又密切合作的设计者，从而获得自下而上开发的本质。一方面，他们都应拥有其所需的设计自由，另一方面，其设计过程作为群体行为应当是个游戏，遵循相同而明确的规则设置。

The 798 art district is located in the northeast part of Beijing. Formerly an electronics factory, its western part has recently developed into a vibrant district, full of galleries, exhibition spaces, cafes and creative offices. It has emerged from a bottom-up process. Like in many other post-industrial areas all over the world, individual artists found exciting, unused spaces and adapted them for new functions. This eventually turned the 798 into one of the most hip zones of the city. Already full with life and activities, the 798 art district is bound to develop further and to attract many more new users and functions. The western part of the area has already been successfully transformed. The eastern part still awaits to be re-filled with life.

The 798 district needs to grow further. It needs new spaces for new functions and for new people. It needs to become one of the main focal points in the cityscape of Beijing. Nevertheless, it would be a mistake to assume that one, top-down design can provide an answer to fulfil all needs of the growing 798 community. The expansion of this area has to be flexible, diverse and unconstrained and it has to become a landmark icon for this amazing site.

As an answer to this demand professor Kas Oosterhuis together with the Hyperbody came up with an idea of making a distributed design for the eastern part of the 798 district - the 751 factory. The concept was to create a large scale, multifunctional, three dimensional urban structure, which would be conceived as a result of a bottom-up and distributed design process. The bottom-up nature of the development can be achieved by dividing the area into smaller, interdependent projects, assigned to autonomous but at the same time closely cooperating designers. On one hand all of them should have all the design freedom they may need, on the other hand their design process as agroup should be a game in which they all follow the same, clear set of rules.
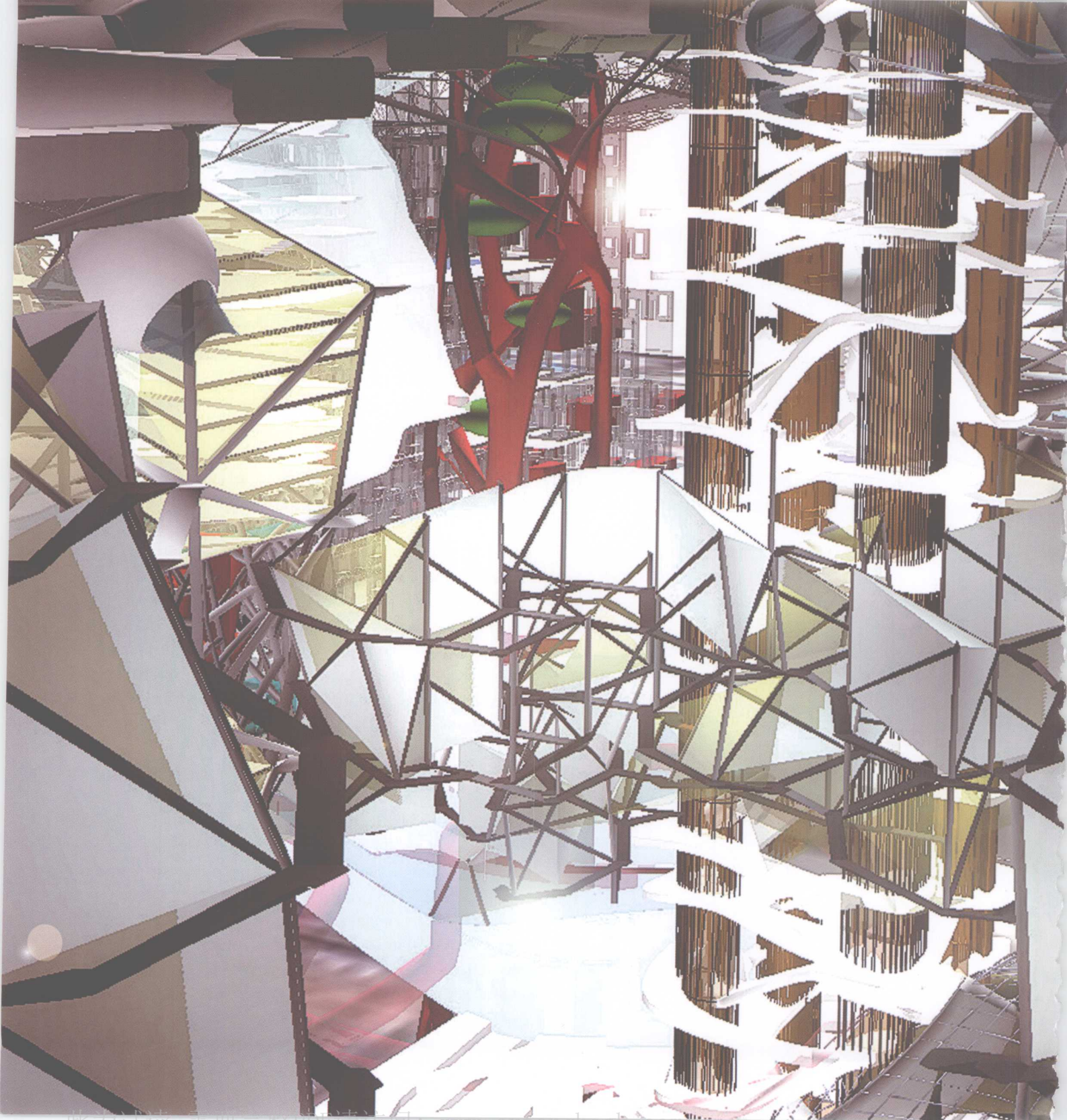
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751项目规划设计是以一个明确概念和有限的几条强制规则为基础的多用户设计游戏。多用户设计的目标在于有效增强小组设计者之间的合作。这种目标一旦达成，那么设计过程将会自下而上地控制，促成总平面的多样统一。

蜂群思维

首要任务是要找到一个概念，以促成多样统一的发展。一个人或持单一思想的小组设计整个城市是极端有问题的，城市多样统一的概念则可潜在地避免这种情况。单一思想导致环境精神品质低劣的例子在过去太多了。人们对于单一思想控制的规划很反感："过于雷同"、单调、视觉贫乏。身处此种城市景观中的居民在精神上缺乏足够的社会和形象刺激。而个体思维的松散组织也不会让城市正常运转。这种城市无异于独立设计、彼此毫无联系的孤岛群。避免这种单一思想的可能方法与它的作用一样简单。总平面应当由相互联系的思维来设计和实施。设计者的思维必须相互联系。相互联系意味着个人努力必须基于他们所共享的东西，但并非决定其使用功能。可以想象，各个用户通过互联网相连，从而形成一个社区、一个群集。在这样一个互联网社区中相互联系着的人们，从属于群集成员，而该技术并不决定其使用功能。互联网技术将这些用户一起带入一个蜂群，这充分描绘了这种可避免单一思维的坚决状态：蜂群思维。

The 751 masterplan is based on an explicit concept and a limited number of strong rules for a multiplayer design game. The aim of multiplayer design is to improve the effectivity of collaborations between a group of designers. Once the effectivity has been improved the design process will be bottom-up controlled as to facilitate the multiple identity of the master plan.

Hive mind

The first task is to find a concept which facilitates the evolution of a multiple identity. The concept of multiple identity for a city potentially solves the extremely problematic condition of one single person or one single-minded group designing a complete city. There are too many examples from the past that single-mindedness causes emotionally poor environments. The users will experience a single-minded masterplan as boring, "more of the same", monotonous, visually underdeveloped. The inhabitants in such a single-minded cityscape are emotionally deprived from sufficient social and formal stimuli. A loose group of individual minds would not be able to make the city work. That city would be no better then an archipelago without any relations between the individually designed islands. The possible solution

总体框架

　　在设计小组开始设计像城市那样错综复杂的东西之前，他们必须展开这种蜂群思维。理论上说，这能够产生于自下而上的过程，确切来说需要很长时间。我们不能强求进化本身的速度，在时间上没有可能的捷径。我们不得不首先建立起总体框架。我们必须设定这个设计游戏的规则。所有规则的设定形成了初始状态，蜂群就居于其中。初始状态可以与互联网相比较。它是所有用户都必须遵循并用来建立彼此联系的规则，他们将用这些规则来游戏。游戏者若违反规则，则会与蜂群断开联系，正如互联网用户如果不使用正确的软件或不遵循网络供应商的指导，就将与网络断开连接一样。接入网络就意味着要接受连接系统的内在规则。要记住，这些都不是关于使用功能的，而只是设备技术。是否使用这些技术在此语境下是不相关的。与此类似，谁被授权参与该总体规划设计的游戏也不在751项目，或者其他任何此种项目范围之内。

总体框架的规则

　　总体框架意在用最少规则产生尽可能强的效用，这是效用的本质。所谓效用是一种必要状态，能够进行透明的多用户游戏设计过程，并产生尽可能有意义的复杂性。复杂并非繁杂，繁杂是无休止违反规则的结果，而复杂来自于简单的规则。总体框架形成于一个盘旋于751基地上空的工作空间，它是一个具有假定形状和尺寸的巨型球体，该球体形成了总体框架的边界状态。边界状态是自上而下决定的，设计者们要将其接受为"既成事实"。边界状态决定了后续设计过程在几何位置上从何处开始与结束。该球体细分为23个三维地块，精致地相互交织，形成了一个三维智力游戏。每个设计者只在其中一个小地块上展开设计。各设计者分别接受作为既成事实的各三维地块，正如在城市肌理中他们也将接受一个二维的城市街区一样。但是现在他们有着更多的相邻地块，不像在城市平面上那样只有两个或四个相邻地块，而是可能有高达10个地块与其相连。设计者的给定任务只是与其直接相连的地块沟通。设计者被明确告知不用建立整个球体的概念。规则要求他们只需与相邻地块沟通，就像群集中的鸟儿一样。这就是他们将如何建立蜂群思维的过程。蜂群思维没有针对整体形状和尺度的线索。任何单独的互联网用户都不会知道互联网究竟是如何延伸出去的。用户只对其同类个体感兴趣，并通过网络技术与他们交换数据。群集中的鸟儿在同类个体之间相互沟通，而在751总体框架中，设计者也是在同类个体之间相互沟通。当数据流出一个地块时，751项目总体规划的设计者，即TU　Delft

Hyperbody的硕士生们，必须通知其相邻地块。有数据进入自己的地块时，他们也将被相邻地块告知，就是这些。数据被限制为结构力、水流和电流、人流和车流。此外，各种需求功能的数量也给这些设计学生规定了如居住、办公、商业和停车的面积。最后一条规则是，其地块最多只能有25%的地方用于建造房屋。这就意味着这个体量巨大的三维球体在城市结构上将会是多孔渗透的。

to avoid single-mindedness is just as simple as it is effective. The masterplan should be designed and executed by connected minds instead. The minds of the designers must be connected. Being connected means that the individual efforts must be based on something they share, but without determining the content. Think of individual users, connected via the Internet forming a community, a swarm. The subjects which are communicated in such an Internet community are subject to the members of the swarm, the technology does not determine the content. The technology of the Internet brings these users together in a hive, describing adequately the mandatory condition for avoiding single-mindedness: the hive mind.

The Master Frame

Before the groups of designers may start on the effort of designing something complex and intricate as a city they must develop that hive mind. Theoretically this could arise from a bottom-up process, but this would literally take ages. We can not evolve evolution faster then evolution itself. There is no by-pass possible through time. We have to construct the Master Frame first. We must set the rules of the design game. The complete set of rules forms the Initial Condition, where the hive lives in. The Initial Condition can be compared with the Internet. It is a set of rules which all users obey and use to build their connections. In much the same sense the Master Frame is defined through a set of rules which the designers of the Master Plan will obey, they will play by these rules. Violating the rules will simply disconnect the players from the hive, just like the Internet users will be disconnected if [s]he does not use the proper software or obeys the instructions as set by their providers to get access to the Internet. Getting access means accepting the rules which underlay the connectivity system. And remember this is not about content, it is only facilitary technology. The question whether or not to pay is in this context not relevant. Similar to the question who will be authorised to access the Master Planning design game is outside the scope of the 751 project. This typically concerns a pre-selection process preceding the 751 project, or any other project in this respect.

Rules of the Master Frame

The Master Frame has been defined as to give the minimum amount of rules with the strongest possible effect. This is the essence of effectivity. Being effective is a necessary condition to be able to embark on a transparent multiplayer design process resulting in the highest possible meaningful complexity. Complexity rather then complicatedness. While complicatedness is the result of an endless series of exceptions, complexity arises from simple rules. The Master Frame is formed within the boundaries of a working space with the hypothetical shape and dimensions of a giant sphere, hovering above the 751 site. The sphere forms the boundary condition of the Master Frame. The boundary condition is a top-down decided fact which the designers will accept as a "fait accompli". The boundary condition decides where the subsequent design process begins and ends geometrically. The sphere is subdivided in 24 3d plots, delicately interwoven as to form a 3d puzzle of plots. Each designer will develop the design of only one such a plot. The 3d plots are a given fact and accepted by the individual designers, just in the same way as they would accept a 2d plot city block in the city fabric. But now they have more neighbours. Not only two or four as in the 3d city plan, but up to 10 neighbours may connect to their plots. The task the designers are given is to communicate with their immediate neighbours only. The designers are explicitly asked not to have a concept on the whole sphere. The rule is that they will communicate with their immediate neighbours only, just like the birds in a swarm. This is how they will develop the hive mind. The hive mind has no clue to the shape or dimensions of the whole. No single Internet user knows how extended the Internet really is. The user is only interested in their peers, with whom they exchange data through the technology of the net. Birds in a swarm communicate peer to peer, and in the 751 Master Frame the designers communicate peer to peer. The designers of the Master Plan, in the 751 project the Master students of Hyperbody at the TU Delft, must inform each other about the data flowing out of their plots. They will be informed by their neighbours of the data coming into their plot, and that's all. The data are confined in terms of structural forces, water and electricity flow, and people / car movements. Furthermore

自下而上的总体规划

在接受了总体框架规则后，这些规划师们开始了他们的设计工作，设计游戏启动了。在此过程中，学生们可以与相邻地块进行土地交易，只要用地总建筑面积和整个球体的总建筑面积得到满足。球体总建筑面积是一个需要满足的总体参数，它只决定于总体框架的变化，而不是任何一个规划师。使用功能不能忽视，总居住量和其他使用功能必须保持不变。23个学生将发展各自的设计主题，这些主题可能非常不同，但又相互联系。这一观念完全显示了总体框架概念的力量。这些联系在一些明确规则的基础上一旦建立，逐渐展开的复杂性过程就开始了。视觉多样性和不同景致逐步展现，并仍保持着相互联系。如果没有这些规则的设置，而是接受各参与者不同的设计态度，那么将导致巨大的冲突。各地块设计者的唯一职责就是根据其自己的设计标准来开发用地，他们始终保持与紧邻地块联系，并交流数据的变化。数据交换是通过一个内在的数据库结构来组织的，它记录了所有数据的变化。设计者们是在此过程中体验工作，而不仅仅是谈论此过程。

在进化中工作

于正在进行的过程中工作，这是由不断变化的动态数据库支配的，就像在进化中工作。这一观念对基于规则的设计来说非常重要。规则一直在执行，永不停息，就像进化本身也是一个不可停止的过程。不论你是否喜欢，你的生命都在进化中展开。就像在751设计游戏中的设计者们一样，人们对于进化可进行外在观察。我们深陷在内部，但这不是问题。相反，在进化中生活，意味着接受和执行生命游戏的规则，这让我们兴奋，因为这表明我们在世间的存在确实很重要。生命只不过是游戏者之间的述行交互。生命包括产品的连续设计和生产，通过产品生命的进化，生命得到扩展。我们这些设计师为产品生命的进化提供帮助。我们移动物质，我们移动数据。人是物质形式和其他形式的数据的传输者。人是数据的递送者，包装、运动、再拆包。不要出错，这是一个人可能期望的生命最深刻的意义。进化之所以成为进化，因为它在实时进行，每个最小的时间单位都完成了数十亿次的离散步骤。生命，就像751中的设计过程，是一个运转过程，一个复杂的运转着的细胞自动机，组成细胞自动机的每个单元基本上都有一个实时执行的简单规则。751项目的学生设计者就是进化的操作者，他们操作着生命游戏的规则，进而操作了751设计游戏。通过玩这个设计游戏，他们实时表现为群集的可靠成员，导演了总平面的进化，他们共同形成了751的蜂群思维。

* Kas Oosterhuis，交互建筑学教授，TU Delft建筑系Hyper-body负责人，并开设鹿特丹ONL [Oosterhuis_Lénárd]设计事务所。

the student-designers are given a numeric program of demands with number of m2 for residential, offices, commercial areas and parking. In addition to that the last rule is that a maximum of 25% of their plot may be built-up. Meaning that the large volume of the 3d sphere will be quite porous in its urban structure.

Bottom-up Master Plan

Having accepted the rules of the Master Frame the Master Planners start their design work. The design game unfolds. In this process the students are allowed to trade m2 with their neighbours, as long as their plot GFA and the sphere GFA is respected. The sphere GFA is a global parameter to be respected, and only subject to change by the Master Framer, not by any of the Master Planners. They will never be allowed to skip content, the total mass of residential and other programmatic content must remain constant. The 24 students will develop their own design themes, they may be very different. Very different but connected. This notion describes properly the power of the concept of the Master Frame. Once the connections are established on the basis of some explicit rules, the process of unfolding complexity starts. Visual diversity, different views unfold yet stay connected. If we would not have these rules set and accepted by the players the difference in the design attitudes would lead to enormous conflicts. Not here since this is something they simply not talk about. It is the sole responsibility of the plot designer to develop their plot according to their own design standards, as long as they stay connected and communicate the changes in data with their immediate neighbours, all the time, in real time. The exchange of data is organized in an underlying database structure which accounts all changes in the data. The designers experience working inside a process, rather than talking about a process.

Working inside evolution

Working inside the ongoing process, which is administrated by the dynamic database of ever changing data, feels like working inside evolution. This notion is crucial for rule-based design. Rules are always running, they never stop. Like evolution itself is a process which is unstoppable. Whether you like it or not, your life unfolds inside evolution. Like the designers in the 751 design game, people have exterior view on evolution. We are trapped inside, but this is not a problem. On the contrary living inside evolution, which means accepting and executing the rules of the game of life, provides us with the excitement that our presence in the Universe does matter. Life is nothing more then the performative interaction between its players. Life includes the continuous design and production of products. Life is augmented with the evolution of product life. We designers assist in the evolution of product life. We move matter, we move data. I would not hesitate to see this as the meaning of the evolution of people in the Universe and hence in their bi-directional relation to products. People are transporters of matter and other forms of data. People are carriers of data, packing, moving and unpacking data. Don't get it wrong, this is the deepest meaning of life one could possible hope for. Evolution is evolution since it evolves in real time, taking billions of discrete steps per the smallest time unit. Life, as is the design process inside 751, is a running process, a complex set of running cellular automata, while each of the constituting cellular automata basically is a simple rule, executed in real time. The student-designers of the 751 project are such operators on evolution, operating on the rules of the game of life, and hence on the design game of 751. Playing the design game they evolve the Master Plan, behaving in real time as reliable members of the swarm. Together they form the hive mind of 751.

* Kas Oosterhuis, professor Interactive Architecture, is the director of Hyperbody at Faculty of Architecture, TU Delft and runs the design office ONL [Oosterhuis_Lénárd] in Rotterdam.
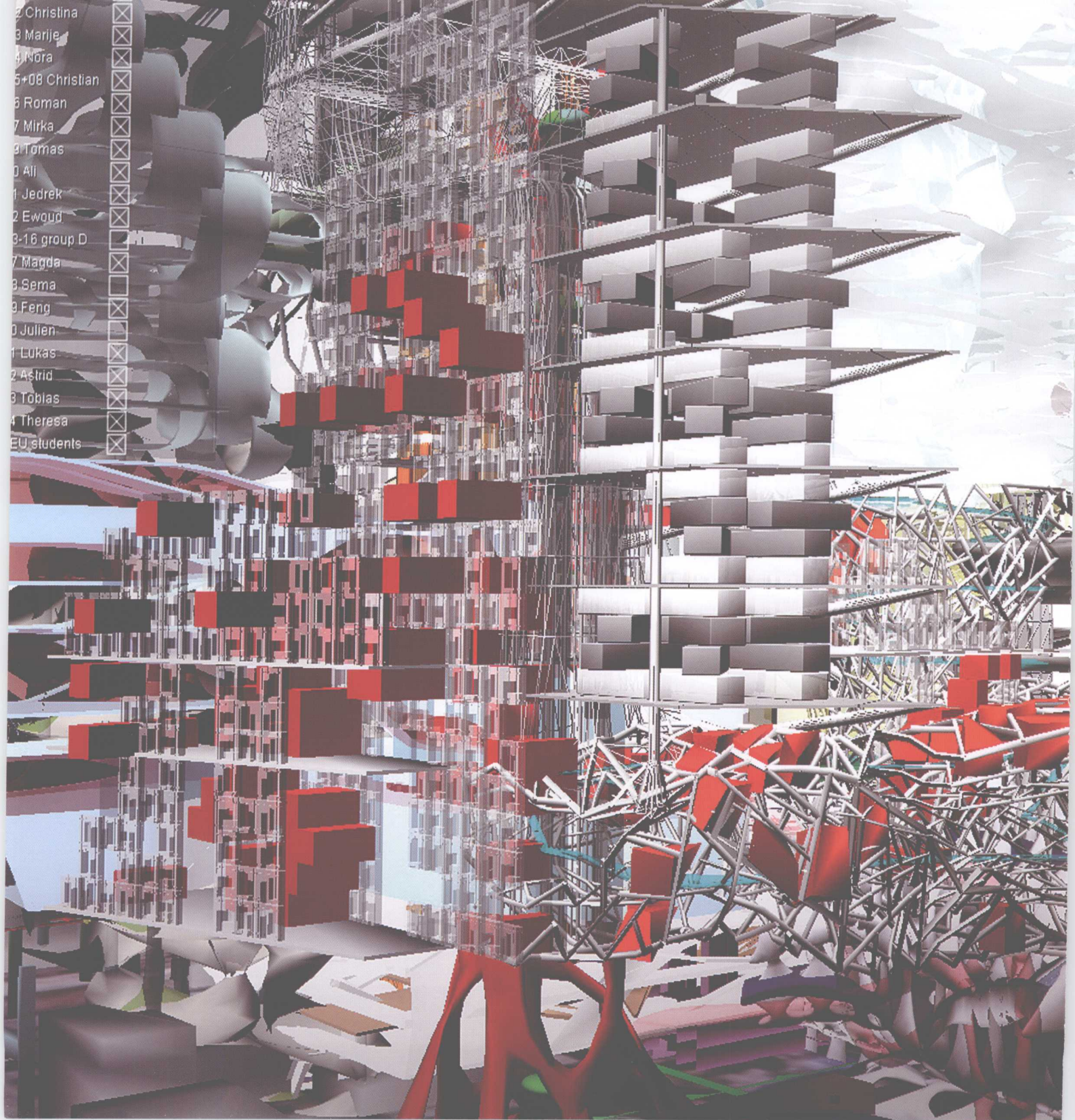
Multiplayer Design
多人设计
Tomasz Jaskiewicz

设计建筑是一种游戏。在这项游戏中我们遵循规则。那些规则当中许多已经为我们预先确定了，余下的则由我们自己开始这项设计游戏时来确定。我们通过达到我们的目标来赢得这场游戏，我们也和其他人一起参与这场游戏。如果我们的目标相冲突，我们则相互竞争。如果我们的目标相一致，我们合作。

由代尔伏特理工大学的Kas Oosterhuis 教授和Hyperbody* 工作室组织的751合作设计课程的目标是设计一个大胆的、丰富的和多样化的三维城市结构。课程始于2006年9月，包含23位来自全球的学生。在这开始以前，我们已经决定设计的基地是一个包含800万m³容积的三维虚拟球体。

整个学期的目标是形成一个包含真实城市环境复杂性的设计模型，这一模型能够随外界参数进化为不同状态。为了达到这一点，球体被分为23个内部的区域。每一区域分给一位参与的学生。整个虚拟建造选址于北京751工厂的中心，部分位于地下，占地面积是不大的20000m²，高出地面120m。751工厂剩下的面积分为5个部分，由来自南京东南大学的董卫、张倩、杜蓉老师指导的5位学生设计。他们的工作平行于代尔伏特理工大学设计小组的进程。他们的设计是产生于二维的设计观点。整个设计过程也有来自北京清华大学，由徐卫国教授指导的学生组成的小组的参与。这一小组使用先进技术和理论以变量的方式捕捉整个项目的地方特色。

Designing architecture is a game. In this game we follow rules. Many of those rules are predefined for us, the rest we set ourselves upon starting the game of designing. We can win this game by reaching our goals and we play the game always together with other people. If our goals are conflicting, we compete. If our goals are complimentary, we collaborate.

The goal of the 751 multiplayer design studio organized by prof. Kas Oosterhuis and Hyperbody* at TU Delft was to design a daring, rich and diverse three dimensional urban structure. The studio started in September 2006 with 23 students coming from all around the globe. Before it had begun, we have decided that the group will get as a design site a three dimensional virtual sphere containing 8 million cubic meters of volume.

The objective set for the entire semester was to produce a design model that would have the complexity of a real urban environment and which would potentially be able to evolve into many variants conditioned by external parameters. To achieve this, the sphere has been divided into 23 interlocking zones. Each of those zones has been assigned to one of the participating students. This whole virtual construct has been then placed in the centre of the 751 factory in Beijing. Partly submerged underground, it would stand on a small base of 20 000 m² and raise 120m above the ground level. The rest of the 751 area has been divided into five parts and became subject to designs of five students from the collaborating South-East University of Nanjing guided by prof. Dong Wei, Zhang Qian and Du Rong. Their work proceeded in parallel to the progress of the TU Delft design studio. Yet, their designs were conceived from a more conventional, two dimensional design perspective. The whole
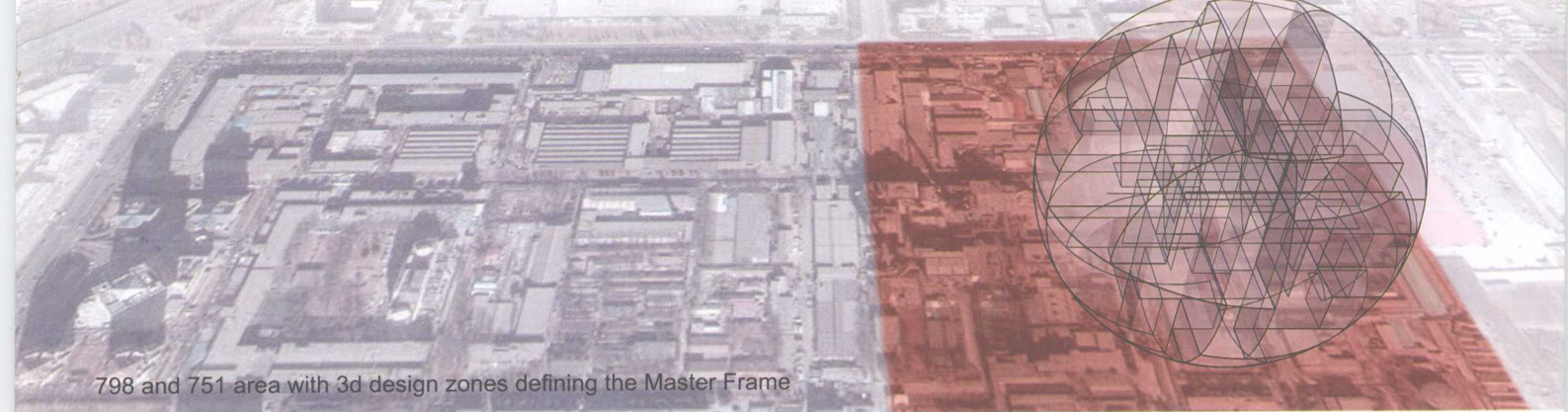
the hive mind swarming through Beijing

代尔伏特理工大学的学生由Kas Oosterhuis教授指导。设计指导Tomasz Jaskiewicz、Gijs Joosen 和 Marthijn Pool与技术指导Gerrie Hobbelman、Bige Tuncer 和 Guus Westgeest一起更近距离地指导学生。整个学期举行了一系列额外的研讨，受邀的讲师包括Jeroen Coenders、Jerome Decock、Lukas Feireiss、Ulrika Karlsson、Chris Speed 和 Patrick Teuffel。学生们通过Bert Bongers的演讲和多媒体演示以及Hans Hubers（Hyperbody的教学负责人）指导的研究与设计课程，拓宽了他们的知识与技能，鼓励每一位学生具有创造力和革新能力。他们被允许发展甚至是最疯狂的概念，只要他们的设计遵循以下的总平面设计原则：

1.功能性的内容是一项100万m³的混合使用的建设范围。

2.包含在800万m³的一个虚拟球体内，75%的部分是开放空间，让阳光能够进入这一大的城市体当中。

3.位置需要处于751场地的中心。

4.一个三维的迷团分为许多连锁的部分，学生们每人分得其中一块。

5.每一个这样的三维区域仅同和它相邻的部分交互和对话。

6.这一三维谜团当中的每一部分对应一种功能（居住、办公、商业、文化、教育、休闲）。

7.每一区域管理它们自己的数据输入、数据处理、数据的输出以及通过一个动态的数据库和它们邻近的局域进行数据交流。

8.每一区域具备自我支撑的结构体系并且同相邻部分进行结构数据的交换。

9.球体必须产生与其消费相一致的能量。

设置那些规则的主要逻辑源于群体行为的想法。正如 Kas Oosterhuis教授定义的那样，在一个群当中，每一部分仅同其相邻部分交流。群的整体形状并不是由其中的任一要素制定的，当中没有领导，群的要素也不需要了解整体。群的结果是一个来自内部自发的，双向互动的组成要素以及严密的外部条件的平衡。在751规划中，学生是自发交流的成员，教师则进行自上而下的控制。

根据整体规划划分的三维基地意味着所有设计者之间必然是内部关联的。一些部分不得不由其他部分支撑，另外一些部分需要为那些同外部环境隔离开的部分提供进入的通道。所有部分需要一起工作来处理阳光的射入、人、水、能量和废物循环以及其他问题。

798 and 751 area with 3d design zones defining the Master Frame

design process has been also followed by a group of students led by prof. Xu Weiguo from the Tsinghua University in Beijing. That group used advanced techniques and theories to capture in a parametric way the genius loci of the entire project.

The group of TU Delft students has been supervised by prof. Kas Oosterhuis. The design tutors Tomasz Jaskiewicz, Gijs Joosen and Marthijn Pool closely guided the students together with technical study tutors Gerrie Hobbelman, Bige Tuncer and Guus Westgeest. Throughout the semester a series of exclusive workshops was given by guest lecturers including Jeroen Coenders, Jerome Decock, Lukas Feireiss, Ulrika Karlsson, Chris Speed and Patrick Teuffel. Students could also broaden their knowledge and skills in the Literature and Media course taught by Bert Bongers and Research and Design course led by Hans Hubers who also coordinates the Hyperbody education. Each of the students was encouraged to be creative and innovative; they were all allowed to develop even the craziest concepts as long as their projects obeyed the following design rules of the master plan:

1. Functional program is a mixed use development of 1.000.000m³ of built-up area
2. It is contained in a virtual sphere of 8000000m³, leaving 75% open space for bringing light into the large urban body
3. Location will be right in the heart of the 751 site
4. Students are provided with a 3d puzzle of as many interlocking parts as there are students.
5. Each of such 3d zones communicates and negotiates only with its immediate neighbours.
6. Each piece of the 3d puzzle has a specific program of

requirements [housing, offices, commercial, cultural, educational, leisure]
7. Each zone administrates their data input, data processing and data output and communicates the parameters in a dynamic database with their immediate neighbours
8. Each zone has to structurally support itself and communicates data of structural loads with their immediate neighbours
9. The sphere must produce as much energy as it consumes
The main logic behind setting up those rules was formed based on the idea of swarm behaviour. As prof. Kas Oosterhuis defines it, in a swarm each of its parts exclusively communicates with its direct neighbours. The global shape of the swarm is not imposed by any of these swarming members. There is no leader and elements of the swarm don't need to have an awareness of the whole. The outcome of the swarm is a balanced result of emergent bi-directional interactions between its acting members and of top-down external conditions. In the 751 master plan student designers were the bottom-up communicating swarm members and the tutors represented the top-down control.

Three-dimensional plot distribution according to the master planning scheme meant that all designs had to be interrelated. Some projects had to be structurally supported by other ones; some other had to provide access to those that were separated from the external environment. All projects had to work together to manage sunlight access, people, water, energy and waste circulation and many other problems.

In this setup students could not design without consideration to how designs of their neighbours were unfolding. Every

在这样的设定当中，学生们如果不考虑相邻部分的设计进展则无法完成设计。每一个特定的设计决策可能潜在地、直接地或者间接地影响接下来的设计决策，不仅是特定的设计者的，甚至是整个设计组的决策。在设计过程中，学生们认识到在这样的条件下预设的和固定的设计方法变得十分无效。周围情况迫使他们以弹性的和参数化的方式进行思考工作，因此，当它们的环境不断变化的时候，设计能够实时改变。参数化的设计规则的原理或许很容易，假设设计者能够很快地使用数字化时代带给我们的所有技术。

然而，这对那些具有传统的教育背景，缺乏需要的技术技能的人仍然比较困难。因此学生们学习了介绍参数化三维生成设计以及利用Virtools Dev以产生实时三维互动设计的课程。他们分为三个技术学习小组，以帮助他们解决在设计任务当中必将碰到的技术困难。其中一个小组负责组织所有进行的设计之间的数据交换；第二个小组负责所有设计方案的结构可行性；第三个小组研究生态问题，主要关注能量循环和确保整个球当中的能量消耗和生产相平衡。

数据交换小组面临的压力最大，因为他们负责发展23个设计者之间信息交换的手段。这需要立刻在设计过程中得到采用。为了这一目的，学生与他们的技术和设计教师发展了一个数据库的原型以储存和交换设计数据和交互式的三维工具，以确定信息能够在球体内部得到交换。这些交换的信息可以是结构负荷、运输和其他方面定义的数据。

不断交换的数据已经作为实时的参数被共同采纳。每一设计基地预先设定了边界，这意味着影响了每一方案的周围的所有信息也与表面的位置有关。结构荷载能够表达为锚固在表面的三维向量。人流和车流将只是一个表面的正或负值。这一信息能够在数据库中容易地建立并且立即被把它作为方案参数的使用者提取。而且，在这一框架中，更多的数据可以容易地添加。

设计系统、技术和方法与设计进程同时发展。因为这点，设计方案并不是到了设计的最后阶段才拼接为一个整体。每人都在等待那一刻，我们所有人都感到惊讶，当我们最终体验这一所有方案组成的虚拟模型当中的三维城市，所有的设计者形成一个庞大的复合结构。然而，另一方面，每一位学生设计者作为一个独立的设计概念都有绝对的唯一性。它们当中的一些

表达为定义清晰、固定的建筑空间。其他一些根据居住者的需求而弹性变化。许多方案是由大量细胞元素组成，同时其他一些只是一个单一形体，在一个表皮之下包含了所有内部空间。它们同其他部分一起填充了整个球体。

这本书的主要部分是收集了那些方案的摘要。那些工作可以看成不同设计和想法的集合。然而，更本质地，它可以被看作未来城市的新图像。一座三维城市，可以与我们的生活互动，能够包含大量的新技术。这一切将以我们以前从未想象过的方式展开。

* Hyperbody是代尔伏特理工大学Kas Oosterhuis教授指导的研究所。Hyperbody的目标是研究互动建筑以及发展其实际应用。

particular design decision could potentially, directly or indirectly, influence all following design decisions, not only of the particular designer, but of the entire team. During the design process students have realised themselves that under such conditions designing in a pre-defined, fixed way becomes very inefficient. The circumstances have forced them to think and work flexibly and parametrically, so that projects could be changed instantly while their surroundings were continuously evolving.

Parametric design may be easy in its principle, assuming that designers can swiftly use all technologies that the digital era has brought to us. However, it might have still been difficult for those with a traditional, top-down educational background and lack of needed technical skills. Therefore students were given introductory courses to Bentley Generative Components for parametric 3d form designing and Virtools Dev to create programs that generate real-time 3d interaction. They were also split into three technical study groups to help them with particular technical difficulties which they were bound to encounter in their assignment. One of the groups was responsible for organising the data exchange between all evolving designs. The second group was taking care of structural feasibility of all projects and the third group has been researching ecological issues, mostly focused on energy circulation and made sure that the global energy consumption and production of all projects together would be balanced.

The biggest pressure has been put on the data exchange group, as they were the ones responsible for developing means of exchanging information between the 23 designs. It needed to be immediately applied in the design process. For this purpose students together with their technical and design tutors developed a database prototype for storing and exchanging design data and an interactive 3d tool to locate points on which the information could be exchanged within the sphere. This exchanged information was related to structural loads, transportation and other, custom defined data. The continuously exchanged data had been acting as instant parameters for mutual adaptation. Each design plot had predefined boundaries. This meant that all information potentially affecting the neighbours of each of the

projects was also related to a position on that surface. Structural loads could be expressed as three dimensional vectors anchored on that surface. Flow of people or cars would just be a positive or negative value on that surface. This information could be easily structured in a database and immediately accessed by parties that were using it as parameters of their projects. Moreover, in such framework, more parameters could easily be added.

The design system, techniques and methods were being developed in parallel to the design process. For this, it was not until the very last phase of the design process that projects could be assembled into one whole and the total outcome might have been verified. Everyone was waiting for that moment and we were all astonished when we were ultimately able to navigate through the three dimensional city in the virtual model assembled out of all projects. All designs were forming one, enormous complex structure. However, on the other hand, each of the student designs has been absolutely unique as a standalone concept. Some of them were embodying well defined, fixed architectural spaces. Other ones were flexibly responding to demands of their inhabitants. Many of them consisted of a high number of cellular elements, while others were just singular bodies embodying all inner spaces under one skin. They all filled up the volume of the sphere with respect to each other.

Main part of this book is the collection of summaries of those projects. That work can be considered as a collection of diverse designs and ideas, yet more essentially; it has to be seen as a new vision for the city of the future. A city that would grow in three dimensions, which would interact with our lives and which would embody numerous new technologies. All this in ways that we could have never imagined before.

* Hyperbody is a group at Delft University of Technology directed by prof. Kas Oosterhuis. The aim of Hyperbody is to study interactivity in architecture and to develop its practical applications.