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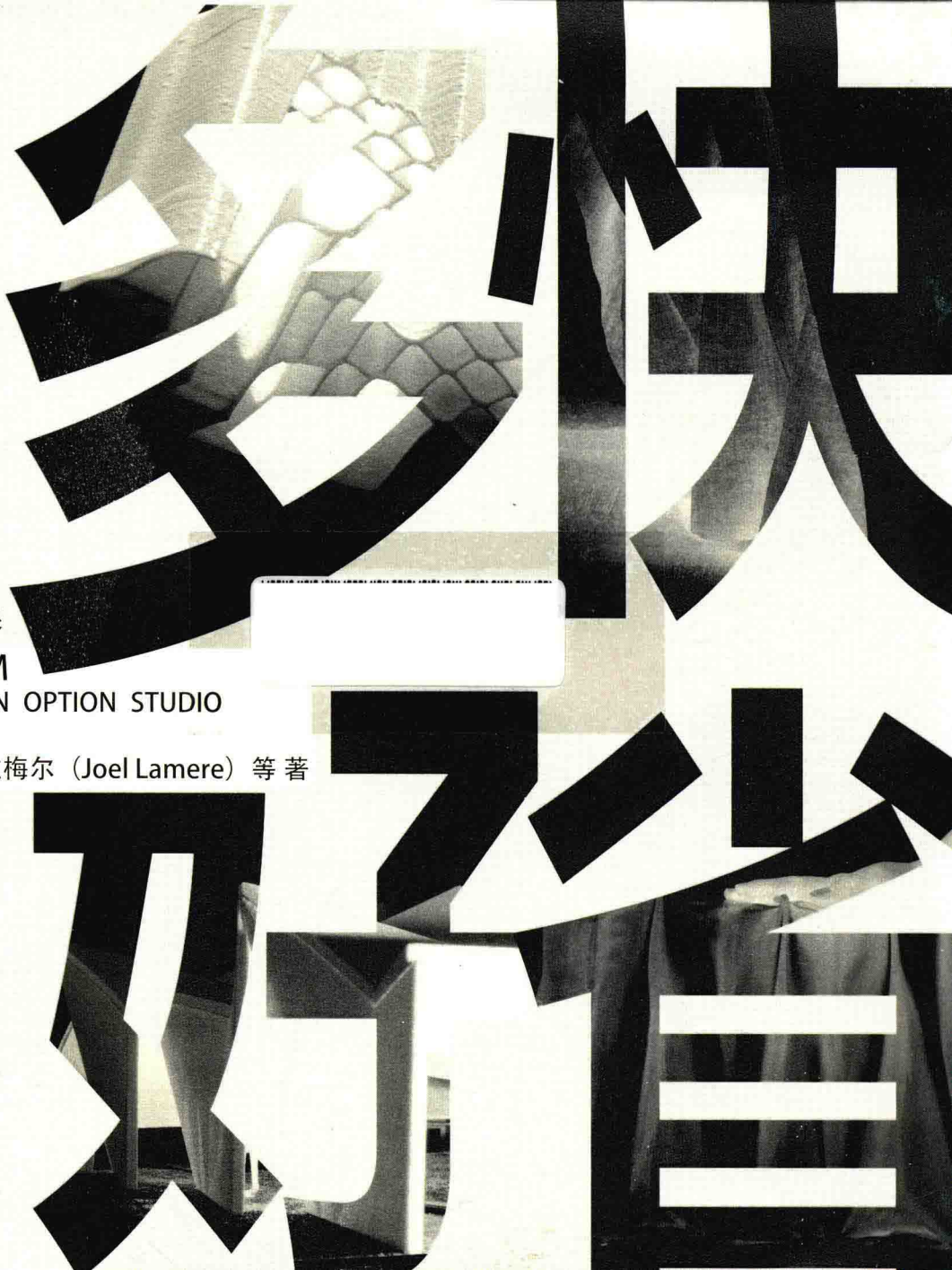

多快好省博物馆

麻省理工学院建筑系研究生设计课

LIGHT,CHEAP,FAST MUSEUM

MIT 4.154 ARCHITECTURAL DESIGN OPTION STUDIO

张永和（Yung Ho Chang） 乔尔·拉梅尔（Joel Lamere）等 著

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前言 PREFACE

“多快好省”

“Light, Cheap and Fast”

张永和

Yung Ho Chang

“多快好省”是中国过去的一个政治口号。如果说“多快省”可以通过政治热情拼出来，“好”在这个过程中又是如何获得的？正因为一个本质上反技术的意识形态是无法保证“好”（或质量）的，最终“多快省”即使做到了也毫无意义。但在今天，如果利用新的科学技术，这个当年似乎不可能的目标就有了实现的可能。技术包括材料、预制、数控等多个方面，在恰当的思想或设计方法下运用，“多快省”和“好”不是绝对不能统一起来的。

在麻省理工学院，我和乔尔·拉梅尔教授2013年春季开设的硕士班高年级设计课以规模扩张迅速的四川安仁建川博物馆聚落为个案，试图寻找在购入收藏和建设场馆之间分配资金这一难题的解决方法。轻型复合材料可能减轻建筑基础、运输等诸方面带来的费用压力，被假设为降低造价的途径之一。预制有加快速度并保证质量的潜力，也是重点研究的课题。此外，课程的内容还涉及相应的结构体系和建造方式的设计、材料的地域性、博物馆建筑类型及机构性质等方面的探讨与探索。教学上强调设计与动手制作并行，学生自己制作材料的实物样品，用大比例模型及足尺的墙身为研究手段推动建筑设计。作为课程作业，学生分组合作完成的三个设计尚未发展到可以直接实施的答案，离真正的“多快好省”也尚有一段距离，但从中依稀可以看到一线效率与质量结合的曙光。

"Greater, faster, better and cheaper" is a political slogan from Chinese history. If quantity, speed and economy can be achieved through political enthusiasm, how could we obtain quality in this process? Because anti-technology ideology is essentially unable to guarantee the quality, the quantity, speed and economy we eventually achieved is meaningless. However, today, we may reach this seemingly impossible goal if we use new science and technology. Technology includes several aspects such as materials, prefabrication, computational control, etc. By using those technologies in appropriate ideas and design methodology, "greater, faster, better and cheaper" could be unified.

At MIT, in the spring of 2013, Professor Joel Lamere and I instructed an advanced graduate architecture design studio and used the rapid-growing Jianchuan Museum Cluster in Anren, Sichuan, as a case, trying to find a solution to balance the allocation of funds between the purchase of museum collections and the construction of museums themselves. Lightweight composite materials could reduce the cost of building foundation, transportation and other aspects as a hypothetic way to cut down the total expense. Prefabrication has the potential to speed up and ensure quality, which is the concentration over this course. In addition, the content of this course also involves the design of relative structure systems and construction processes, as well as the research and exploration of location materials, museum typology and institution organization. Students produced physical samples of materials, using large-scale models and full-scale walls to advance their design. As a design studio, students in teams showed us three different results, which have not yet demonstrated a fully developed answer that could be directly implemented. Even though there is still some distance away from the real "greater, faster, better and cheaper," we could observe the light of dawn from a combination of efficiency and quality.

关于不可能的思考

乔尔·拉梅尔

On Things Impossible Now

Joel Lamere

一个无法解决的问题成为这门设计课议程的核心:传统的公式证明在优质、高速和廉价三者中，只有两者可以同时存在。然而课程在此要求之上，又多加了一个标准：轻质。这让设计课面对的问题更是难上加难。而实际上，想要设计一个能快速建造，既廉价又轻盈的优质博物馆几乎是不可能完成的任务。更准确地说，基于传统和现行建造的材料和科技，人类历史上没有出现过可以符合这些标准的设计先例。

在麻省理工大学的建筑系，尤其是这门设计课，我们欣然接受挑战。我们教育的前提是学生不仅仅简单地继承现成的科技。学生们在了解这些技术之上对其进行推敲、改造甚至误用，最终创造出新的方式、方法，取而代之。简言之，学生们在预测可能的未来。因此当我们向学生们展示一个不可行但是真实存在的问题时，我们正是在挑战他们对常规逐步进行突破。设计课包含了一个更大的野心：学生们需要建造未来，以应对可能出现的更大的难题。

建筑这门学科对所设想的未来可以作出更多贡献，尤其是在新材料、新设计科技和制造过程这些领域。建筑师们可以通过引进新的建筑材料和创造新的电脑设计工具，来开创一片新天地。这些新的建筑可能性都将转而解决全球问题，以及指导我们建造整个物质世界。

此次设计课程的研究从材料调研开始，通过计算机辅助设计和材料的制作来进一步推动，并最终综合起来在大尺度上得以实际应用，来对一系列十分具体的建筑问题进行探讨。我们不但研究了高科技复合材料、常规天然纤维材料、塑料和泡沫，还包括许多其他尚未在常规建造中得到应用的材料。在这个充满大胆假设的设计过程中，上述研究将材料自身作为生产动力，产生了全新的形式策略和结构机遇来探索建筑。

An unsolvable problem lies at the very center of this design studio's agenda. The conventional formulation is that one can only choose two among quality, speed and affordability. Yet for this studio we have added still one more criteria – lightness – promising to completely frustrate student efforts toward finding a singular solution. In fact, it is impossible to design a high-quality museum for delicate objects that is also fast, cheap, and light. Or more precisely, there is no way to design such a museum at this moment in human history, using our current set of conventional technologies and material processes.

At MIT, in our Department of Architecture, and particularly in this studio, we embrace impossible problems. Our pedagogy is based around the premise that our students do not simply inherit the technologies made available to them. Students understand those technologies, tinker with them, hack them, misuse them, and ultimately invent new means and methods to replace them. In short, students project possible futures. So when we present an impossible but real problem to our students, we are challenging them to do more than incrementally update conventions. Our studio embodies the more ambitious premise that students must build the future in which big problems can be solved.

The discipline of architecture has much to contribute to the production of this imagined future, particularly in the realms of new materials, new design technologies and new processes of making. Architects will open a huge new realm of possibilities through expanding the material palette available to architecture and inventing new computational design tools. These new architectural possibilities will in turn address global problems, and guide how our entire physical world is constructed.

This design studio was structured to address these exact lines of architectural inquiry, beginning with material investigation, advancing through computational design and fabrication, and culminating in making at a large scale. We investigated high-tech composites, simple natural fibers, plastics, foams, and many other materials not yet conventionally available in architecture. We were no less adventurous with design process, using advanced computational simulation environments, and an in-studio 3D-Printer as a tool for real testing. These studies revealed new formal agendas and structural opportunities, engaging material as a generative impetus from which to explore architecture.

我们并不想引导这个设计课程单单去解决一个具体的建筑问题，而是想同时打开一扇窗，去观察在构想中更远的未来我们将面临的全球性问题。从表面上看，我们要求学生设计一座博物馆，而实际上，我们抛给他们的是一个不可能完成的任务，是去设计一个系统，来记录在世界历史上一次前所未有、快速前进的文明进程。在这样的速度和规模下，一幢建筑不能单独运作，就像一幢建筑不可能应对全球经济增长、社会发展与环境退化问题。世界上大多数棘手的问题都不是能通过常规的方式得到解决，而是会时进时退，充满了不确定性、愿景和推测。学生都在思索如何设计未来，如何建造，使用什么样的工具和材料，而不仅仅去设计建筑本体。他们即使失败了也在不断测试，提出看似不可行的提案，并在这个过程中创造未来。

We directed this studio not merely to address a specific architectural problem, but also as a window into the larger global issues that our imagined futures will confront. On the surface, we asked students to design a museum. In actuality, we gave them the impossible task of designing an archive for the fastest-growing civilization in the history of the world. A single building cannot work at that speed or scale, just as a single building cannot address the blazing pace of global growth, development and environmental degradation. Most of the intractable problems in the world will require fits and starts, uncertainty, visions and speculation, not incremental problem-solving or conventional resolutions. Rather than designing buildings, these students are speculating on how we will design in the future, how we will build, and what we will use when we do. They are testing to failure, making infeasible proposals, and producing the future in the process.

有关建造的建筑教育

冯菲菲

Hands-on Pedagogy

Feifei Feng

建造是一种设计和思考的方法。在设计过程中，建筑师只能依赖自己的触觉来与其所构想建立感觉上的联系，因此实体建造是最有效、最直接的推敲方法。建造应该具有研究性和前瞻性，能够突破工业规范标准的限制。吴良镛曾经说："我们要从万物中，从各种纷繁的现象中，要根本地从中国国情的主要矛盾中探索问题的解决，寻找我们自己的范式。如果有建筑诺贝尔奖的话，它应授予根植于本土、惠及人类的创造。"中国所缺的是有利于发展社会需求，但又不被经济主导的、高质量的新建构方法。张永和教授在麻省理工的实践设计课，提出了一种教学的新模式，从建造本身去解决问题。在"多快好省"博物馆的项目中，建造观念贯穿了整个设计项目。

The act of building is a way of thinking. During the design process, architects can only establish physical relations imagined through their tactile senses. Therefore, physical building is the most direct deductive means. Building can be experimental, forward-looking, and able to challenge the limits of industrial norms. Mr. Wu Liang Yong once said: "We need to see through the intricacies of the world and discover solutions that lies in the specific conditions of China, finding our own norms. Should there be a Nobel Architecture Prize, it shall be given to designs that originate locally and distribute benefits to mankind." What China lacks is a new building method that is of high quality and conducive to social development, yet not dominated by the economy. Prof. Yung Ho Chang, who taught design studio at MIT, raised a new pedagogical model that resolves the problem through physical building itself. The notion of building runs through the entire "Light, Cheap, Fast Museum" studio.

1. 应对性：为什么叫“多快好省”？这个词是20世纪50年代周恩来和毛泽东提出的建设社会主义的指导思想。这个词成为设计的挑战。我们如何通过新的材料和建造方法，去多快好省地应对中国飞速和大量的建设，避免“潦草城市化”。樊建川先生的收藏代表了中国社会发展特征，比如他喜欢批量收藏与中国大事件有关的物品，小到毛主席像章，大到飞机枪炮、四川地震后的汽车和自行车残骸。

2. 双向性：与其他设计课不同的是，这门课有两个出发点，两条并行的研究路线。一条是材料，一条是建筑类型。根据曾有的实践经验，张老师提出了研究的重点：复合材料以及博物馆。这两条路线互相作用：通过材料寻找新型的博物馆；反过来，通过收藏的性质来影响材料在结构和展示系统的应用。

1. Reactive: Why should it be “greater, faster, better and cheaper”? This concept was raised in the 1950s by Premier Zhou Enlai and Chairman Mao Zedong as the guiding thought of building socialism. This became the challenge for the design studio. How do we respond to fast and large-scale construction in China with new materials and building methods and at the same time avoid “sloppy urbanization”? The collections of Mr. Fan Jianchuan represent such attributes of China’s development. For example, he has acquired a large amount of items related to sensational events, things that can be as small as Mao badges, or as large as airplanes, guns and cannons, wreckage of cars and bikes after the Sichuan Earthquake.

2. Bidirectional: Different from other design classes, this studio had two parallel research directions – one was on material, the other on architectural type. According to his own practical experience, Prof. Chang set the foci of research: compound materials and museums. The two paths became both force and inspiration for each other. New museum types were discovered through attributes of new materials. On the other hand, application of materials in structure and display systems is influenced by specific museum collections.

3. 团队性：两个老师配对，各抒己长。乔尔·拉梅尔教授在建筑几何上很有造诣，主要是从微观上把握材料研究、结构等系统推理。张老师从宏观上引导设计方向和建筑空间。学生被分成三组，通过合作和分工去探索和发现，不强调差异化和个人表现。

4. 研究性：在学术氛围下的实践与行业实践不同的是，它不受现成材料和传统工业造法的约束。实验从建筑最基本的成分开始，也就是从材料出发，甚至小到纤维。三个组分别有特定的研究方向：膨胀塑料、自然纤维复合物与复合折板，然后通过各种试验把这个材料的可能被应用的方法推到极限。这个试验的过程是难以预见的，其中经历了成功和失败，老师鼓励我们不断地试验。这个试验的过程就是对材料认知的过程。

下面通过三个不同的项目实例总结三个未来建造的概念。每个设计团队都有这些特征，在这里重点谈一下每组的特长。

3. Collaborative: The studio stressed teamwork among both professors and students. Prof. Joel Lamere is accomplished in architectural geometry, giving specific guidance on material research and structural systems. Prof. Chang provided insights on integrating design elements and directing architectural quality in a broader perspective. Students were divided into three groups and worked through collaboration instead of expressing personal ego.

4. Experimental: Different from industrial practice, academic research is not restricted by existing materials and established manufacturing methods. The experiment started from the most basic element of architecture, i.e., materials, or fiber to be more specific. The three teams pursued different research topics: expanding materials, natural fiber compound and composite plate. Through different experiments, the teams tried to exhaust the possible applications of one material. The process was hardly predictable. There were numerous failures and occasional successes, and the professors never stopped encouraging new experiments. The experiments provided us the tactile understandings of the materials.

Following are examples of three different projects representing three concepts of future construction. The expertise of each team will be discussed, though they all share these attributes.

1. 模拟建造。设计课很重视模拟实现博物馆的整个建造过程。“可膨胀的博物馆”利用聚丙烯片材薄和柔的特点，提出一个“从平到形”的建造概念。聚丙烯片材经过简易切割，组装成蜂窝结构后压平，作为轻质板材运输。到达现场之后，用脚手架扩张片材单元，填充膨胀塑料，快速定型。单元成型之后，在现场组装。与普通设计课模型制作不同的是，我们通过用真实的材料进行大比例实体建造，用来测试并证明博物馆的可建性。

2. 环保建造。我们在设计中关注快速建造对环境的影响，是否可以用新型的材料和理念来避免建筑垃圾？“可生长的博物馆”从环保材料的角度出发，利用当地自然资源，如麻布、泥草等，通过与本地社团合作，现场制造。这是我们自己模拟建造。墙体会随时间发生变化，成为可生长和消亡的建筑。这种生消系统是针对樊先生时事收藏的一些特点，比如藏品的短暂性和不可预料性，进行灵活并且即兴的建造。这个方案不是传统静态的建筑，而是一个新的有生命的系统。地形的改变不仅为建筑提供材料，并且使每个展厅性格各异，最后展品和建筑可一起回归土地，为下一轮博物馆的生长做准备。

1. Construction stimulation. The studio attached great importance to stimulating the whole building process of a museum. “Expandable Museum” adopted the thinness and softness of polyproline, with the concept of “Flat to Form”. Polyproline was cut and assembled into a beehive, then pressed into a plate to transport to the site. Then the team used a scaffolding to resume the shape of the polyproline and filled the units with inflatable plastic to set the shape. Different from model-making in other design classes, students were encouraged to use real materials and to build prototypes at large scales in order to test the buildability of the actual museum.

2. Sustainable construction. We cared about the influence of our design on the environment. Can we use new materials and concepts to avoid producing architectural trash? “The Museum That Grows and Decays” was designed to be built on-site using local natural resources—like linen, mud and grass—and with local communities. The walls would change as time goes by, and the building may grow or perish. This drew inspiration from Mr. Fan’s collections, e.g., their short life spans, unpredictability, flexibility and randomness. It was not a traditional static building, but a new architectural ecosystem. The change of terrain not only could provide materials for the building but make each exhibition space unique. In the end, the exhibits and the building would return to Mother Earth and be prepared for the next churn of museums.

3. 低技建造。这门课很强调中国劳工在“多快好省”建造中可发挥的作用。“巨跨储藏博物馆”探索了在没有高科技设备和技工的情况下，如何教授本地工人使用简易的工具，依然制造出高性能的纤维泡沫复合板材，快速实现大跨度且有变化的储藏空间。在实际建造过程中，用工厂预制好的铁条，固定在泡沫两旁作切割的轮廓，预埋连接构件，两个工人不费力气就可以手持热线丝切割出高结构性能的直纹曲面，最后包裹纤维织物，涂抹环氧树脂，放入可回收的塑料膜中抽真空，冷凝成型。

在老师和学校的支持下，我们在这门设计课中带着美好的愿景大胆设想、实验、建造。希望建筑教育与实践能够不断接轨，能互相作用以及启发，来解决社会所存在的问题。

3. Low-tech construction. This course emphasized the role that Chinese labor can play in the “Light, Cheap, Fast” construction. “The Storage Museum” explored ways to teach local workers to use simple tools and still be able to build highly functional fiber foam composite plates, forming a spacious and flexible storage area, with the absence of high-tech equipment and skilled labor. During the actual building process, the team used two metal plates on both sides of the foam as cutting profiles and imbedded connectors in the foam. Two workers would cut out the ruled surface using hot wire. The foam would then be packed up in fiber canvas, put on epoxy and put it into recyclable plastic vacuum bags, then condensate for molding.

With the support of the professors and the school, we endeavored to imagine, experiment and build throughout the studio. We hope that academic research and industrial practice can gradually intersect, interact and inspire each other in order to address increasing problems in society.