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# Urban Mega-Structure – Vertical Landscape of Hangzhou Civic Center

## 都市巨构——杭州市民中心的垂直景观设计实践



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### Abstract

Based on the design practice of Hangzhou civic center, the paper defines the "Urban Mega-structure", a new typology for the urban high-rise known as super high-rise block, as well as describes strategies in vertical-scape design. By analyzing Hangzhou civic center's concepts in morphology scale, systematic organization, fire protection systems, and structure design, the paper elaborates on the challenges and opportunities in transferring "Mega-structure" from design to practice. Finally, the paper summarizes the ecological strategies of Hangzhou civic center for day-lighting, water recycling, natural ventilation and landscape integration which provides an effective way for the performance of "Urban Mega-structure".

**Keywords: Urban Mega-Structure, Vertical-Scape, New Paradigm**

### 摘要

本文通过杭州市民中心实践项目，定义并介绍了“都市巨构”这一建筑类型，同时阐述它在城市垂直向空间设计的方法策略。接着文章通过分析杭州市民中心在形态学、系统组织、建筑消防、结构设计的创新，进一步阐明了“都市巨构”建筑类型从设计到实践面临的挑战与机遇。最后，文章归纳了杭州市民中心在采光、水循环、自然通风、景观设计等可持续发展策略方面的研究与实践，为“都市巨构”降低能源消耗提供了有效的途径。

**关键词: 都市巨构, 垂直景观, 新类型**

### Urban Mega-Structure

Hangzhou is famous for its cultural and natural scene of world's heritage status. The West Lake, surrounded by mountains and horizontally scattered old towns, is the soul of the city.

As a typical case of China's urban explosion, the mega Civic Center is chosen as the "Motivator" to stimulate the development of Qianjiang New City, which is located alongside Qiantang River and a few miles away from the West Lake (see Figure 1). The ten-year procedure of designing and construction has aroused numerous disputations and discussions which reflected the most complicated operations of China's modern architecture (see Figure 2).

The project stood out from 69 proposals in the international competition. It defines Hangzhou Civic Center as Heart of Hangzhou (see Figure 3), and breaks down the leitmotif into three concepts. Firstly, a strategy of "Urban Void" was applied, against the global metropolitan background. As the West Lake is to the old town, so is the human scale-oriented garden to the public at the core of the architectural complex (see Figure 4). Secondly, it employs the strategy of Cluster High-Rise. It is supposed to be a landmark of the city not only

### 都市巨构

杭州是中国最具生活品质的城市，以融合丰富的人文与自然景观著称。优美平缓的山峦与水平展开的老城以西湖为中心各居一边，构成杭州独特的城市精神。

作为中国当代城市剧烈扩张的典型案例，当杭州脱离西湖而沿1000米宽度的钱塘江两岸展开新城格局时(图1)，决定选择市民中心这一都市巨构作为带动新城的“启动器”，这是特定阶段的中国城市扩展策略。而围绕其中的争论与博弈，贯穿在项目十年多的设计与建造历程中，反映出复杂而现实的中国当代建筑图景(图2)。

这个设计方案从69个国际竞标方案中脱颖而出，它将市民中心定义为杭州的“城市之心”(图3)。主旨分为三个层面，首先，相悖于全球城市化的大背景，市民中心采用了“虚空”的策略。如同西湖是杭州的中心，市民中心坚持以一个开放式的花园作为群簇建筑的核心。(图4)其次，市民中心策略性地坚持了群簇形态的构成。它作为一个具有里程碑式的建筑物，不仅体现在高度上，而且在于创造一种新的城市空间类型。受到杭州周围群山意象启发，市民中心旨在构筑成为独特的城市景观并成为能在全市范围内高度辨识的地标性建筑(图5)。再次，由于其在新城的核心地位，市民中心需塑造未来城市CBD地块的



Figure 1. Context Plan of Hangzhou Civic Center (Source: Linxue Li)  
图1. 杭州市民中心区位图 (来源: 李麟学)



Figure 2. Site of Hangzhou Civic Center (Source: Linxue Li)  
图2. 杭州市民中心地址 (来源: 李麟学)

in terms of height but also of new urban space typology. Inspired by the overall mountain imagery, it was designed to constitute part of the unique urban landscape and be recognizable from all viewpoints within the city (see Figure 5). Thirdly, it must comply with a predictable morphology concept of the whole future CBD area because of its key role in the new city. The architects successfully persuade the client to substitute a high-rise of 300 meters with the lower cluster which adds some operational control to the subsequent high-rise and commercial development (see Figure 6).

For the overall layout, Hangzhou Civic Center has a mega block structure composed of six 100-meter high-rises and four podium buildings. Located on the city axis with the West Lake to the north and Qiantang River to the south, it covers a 400m by 400m block. The high-rises are connected at the height of 85m by the sky-bridges. It is a mega project of 580000 square meter floor area. The project consists of complex and changeable functions, including administrative and commercial offices, a conference center, a civil library, a youth activity center, an urban planning exposition hall, an administrative and civic service center, and also some synthesis service facilities such as restaurants, gymnasiums, supermarkets, parking lots and huge facility rooms (see Figure 7). The different parts of the architecture are connected on the basement floor by an 8-meter wide corridor, which also leads to the metro and periphery blocks.

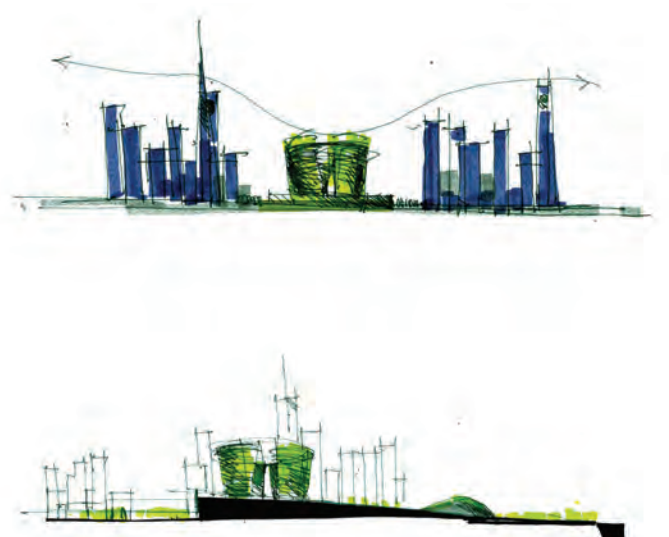


Figure 3. Concept Sketch of Hangzhou Civic Center (Source: Linxue Li)  
图3. 杭州市民中心概念草图 (来源: 李麟学)



Figure 4. Court View of Hangzhou Civic Center (Source: Linxue Li)  
图4. 杭州市民中心庭院透视 (来源: 李麟学)

建筑形态控制法则。建筑师最终说服业主摒弃单纯强化“物体”形象的300米超高层建筑，而以群簇建筑与周边CBD地块的超高层楼群共同塑造未来整体城市形态 (图6)。

从整体布局上看，杭州市民中心由六幢100米高层与四组裙楼组成街区建筑巨构，它在400米见方的超级街区上展开，矗立在北眺西湖、南瞰钱塘江的宏伟都市轴线上，高层建筑在90米高空连为一体，总建筑面积达到58万平方米。项目具有极为复杂的和不断变动中的功能构成，其中包括近万人的办公空间、会议中心、城市图书馆、城市青少年活动中心、城市规划展示馆、政府集中办事中心与市民服务中心，以及餐厅-运动-超市-停车库与大型设备机房等综合服务设施 (图7)。建筑在地下一层通过8米宽度的走廊形成全天候联系，并与城市地铁和周边城市地块直接贯通。



Figure 5. Overall Close Southeast View of Hangzhou Civic Center (Source: Linxue Li)  
图5. 杭州市民中心东南角透视 (来源: 李麟学)

### New Paradigms of High-Rise

As a mega complex, Hangzhou Civic Center has been confronted with great challenges in terms of urban topology and systematic organization. The project has four major innovations.

Firstly, it has exemplified a new topology for urban high-rise, known as “super high-rise block”. The inspiration comes from the idea of Mega structure of Banham and the human-centered spirit of Pantheon in Rome. It’s a mega-structure open to the city with an active interaction between the high-rise and the podium. It is a new topology of the hybrid architecture including various functions, infrastructures, and public spaces. Consequently, Hangzhou Civic Center has become the dominating element at the core of CBD. Moreover, there is a continuity of urban space from the urban balcony above the river, in the distance of 2 kilometers, to the Civic Center.

Secondly, it has a systematic organization for the complicated functions, spaces, circulations, and landscapes. The functions are organized efficiently and systematically according to the logic of open and close principle in order to ensure the needs of the administrative office and the public activities. It contains three hierarchies for the circulation of vehicles, namely, outside, middle, and inner round roads. A continuous public space is carefully designed to ensure an excellent experience of the pedestrians strolling along the corridor (see Figure 8) underground that connects all the parts of the complex, the corridor of podium, the different sink gardens and the elevator for tourists to the overpasses, etc. The three-dimensional landscape is enhanced by the sink garden, the green slopes, and the roof gardens.

Thirdly, it is about the innovation of the unique office space topology. Taking the demands of the client into consideration, the architects came up with the concept of ecological Combi-office, which originated in northern Europe. The center of the typical floor has the potential of an open organization for public service. On the other hand, the office space shows great flexibility in incorporating small transparent offices. Owing to the cluster of high-rises, every part of office has a good view of the central roof garden, the outside garden, and the river. Buildings of the cluster were connected by overpasses at the height of 85 meters. The combination of the high-rise with natural elements is rather unique.

Fourthly, the architects endeavored to collaborate with outstanding corporations and organizations in the architectural industry of contemporary China. The architects work together with the worker testing the double façade (see Figure 9) in a mega project, and meet the challenge of fabrication for the unit of curtain walls. Finally, the architects have a unit 3.3 meters in height and 1.4 meters in width, and it almost reaches the limit of fabrication (see Figure 10) in China. As for the entrance hall and the skin of podium, the architects use the single cable suspension curtain wall, which performs extremely well in transparency.



Figure 6. Diagram of Hangzhou Civic Center (Source: Linxue Li)  
图6. 杭州市民中心图解 (来源: 李麟学)

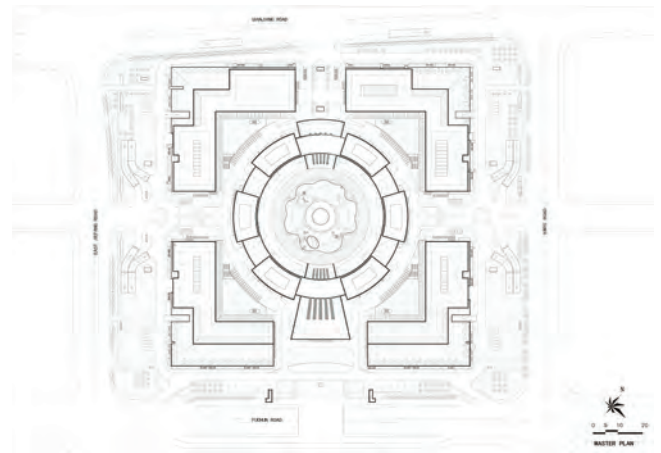


Figure 7. Master Plan of Hangzhou Civic Center (Source: Linxue Li)  
图7. 杭州市民中心总平面图 (来源: 李麟学)



Figure 8. Corridor View of Hangzhou Civic Center (Source: Linxue Li)  
图8. 杭州市民中心走廊透视 (来源: 李麟学)



Figure 9. Façade Detail of Hangzhou Civic Center (Source: Linxue Li)  
图9. 杭州市民中心幕墙细部一 (来源: 李麟学)



Figure 10. Façade Detail 2 of Hangzhou Civic Center (Source: Linxue Li)  
图10. 杭州市民中心幕墙细部二 (来源: 李麟学)

## Sustainable Strategies

As an urban complex of high-rise, Hangzhou Civic Center is also a cluster with enormous energy consumption. To cut down future daily operating costs, it has been designed to be a model of green public buildings in Hangzhou. The whole strategy is based on the passive approaches and an integration of advanced green technologies. Through the simulations of wind, solar and energy, there is an intense combination of the architectural form and the environmental elements.

Emphasizing energy saving, the design aiming at sustainable development takes measures to reserve natural resources such as energy and water, uses renewable energy sources and products, and makes efforts to improve indoor air quality. Moreover, the overall consideration of different architectural elements and technologies in different phases of the project is required. The buildings are equipped with both high-tech energy saving systems and passive systems to minimize energy consumption. There are four main sustainable strategies employed in Hangzhou Civic Center.

Firstly, the project has constructed the sustainable design that pays the utmost attention to the passive strategies. The architects tried to compact

## 高层建筑新类型

作为巨构建筑, 杭州市民中心面临着都市形态与系统组织的双重挑战, 该项目有四个创新之处。

第一, 它代表了一种新的城市建筑类型, 即“超级高层集群”。这一灵感来源于班汉姆的巨构结构以及罗马万神庙的人本精神。它在高层与裙房之间构筑起一个活跃的向城市开放的平台, 同时也代表着一种混合功能、基础设施与公共空间的新建筑类型。因此, 杭州市民中心成功成为主导新城CBD发展的核心元素, 与此同时, 公共空间从约2公里外出挑在钱塘江上的“城市阳台”开始, 一直延伸到市民中心的“虚空”花园。

第二, 市民中心对复杂的功能、空间、交通与景观有着系统的组织。依据开放与封闭原则系统有效地组织功能分区, 以满足政府办公与公共活动对于空间的需求。在交通组织上, 建筑师设计了外、中、内三个层次的环形车道以满足交通流量。他们同时精心设计了一条连续的公共连廊以确保行人沿着走廊漫步的美妙体验(图8)。这条连廊连接着裙房, 下沉花园以及通向天桥的电梯等部分。而对作为公共空间的三维花园的组织, 则通过下沉广场, 绿色草坡以及屋顶花园得以体现。

第三, 它是对创新型办公空间的实践。综合业主要求, 设计师提出了交流式办公, 这种模式源于欧洲, 标准层的中心可设置一个开放式的公共服务区。另一方面, 这种办公模式强调小型的私密性办公空间, 并展现出极强灵活性。由于群簇建筑的缘故, 每一处办公空间都可极佳地观赏到中心花园、外部景观与钱塘江的角落。这些办公空间所在的高楼均由一个离地85米的天桥相连。这种高层与自然巧妙的结合, 浑然天成, 独一无二。

第四, 设计者努力与当代中国建筑业最杰出的公司合作, 他们与工人一起测试市民中心的双层幕墙系统(图9), 并挑战制造单元幕墙的最大尺寸。最终, 他们设计了高3.3米, 宽1.4米的单元双层幕墙, 这几乎是目前国内已知的最大尺寸(图10)。同时, 在入口大厅与裙房的表面, 设计师使用单悬索幕墙并达到了极致的透明效果。

## 生态策略

作为城市高层建筑集群, 杭州市民中心同时也是能量消耗极大的集群。为了减少未来的日常运营成本, 它被设计成为杭州绿色公共建筑的典范。整体策略基于被动式的手法以及先进绿色技术的集成, 通过对风、太阳能和能量的模拟, 以达到建筑形式和环境元素的高度整合。

设计强调节能, 针对可持续发展的目标采取措施来储备能源和水等自然资源, 并使用可再生能源和产品, 以努力改善室内空气质量。除此之外, 在项目各周期对不同建筑元素和技术的整体考量也十分必要。建筑同时配备了高技术节能系统及被动式系统来减少能源消耗。这其中主要有四个可持续策略。

第一, 项目将可持续设计构建在对被动式策略的充分关注上。建筑师试图将其集约放置在城市中心的高密度结构中。为了减少建筑集群的体量, 有250,000平方米的面积被布置于地下, 其上覆盖高效节能的草坡。项目合理整合不同功能以同时实现功能之间的独立性和相关性。充足的自然光照得益于办公板楼恰当的进深, 在实现最低外表面积的同时, 又保证了优良的热舒适性。对于裙房部分, 下沉花园使得地下空间得到良好的自然采光和通风。

第二, 项目引入生态微环境的模拟系统, 以期建立基于生态概念的可持续建筑。通过模拟技术及对综合体内风、热、和光照等环境影响因素的测验, 建筑师不断重塑建筑集群来创建环境友好的建筑。不同于单方面追求高科技技术, 该设计同时做到了高效和创新。

it into a high density structure in the urban center. In order to reduce the volume of the cluster, there's 250,000 square meter underground floor area, with grass slope covering which is efficient in energy saving. Different functions are reasonably integrated to achieve both independence and relevance. The natural light is perfect, owing to the proper depth of the office slab which at the same time provides minimum surface area to ensure excellent thermal performance. For the podium, the sink gardens enable natural ventilation and lighting in the underground space.

Secondly, it has introduced a stimulation system of the eco-micro environment to establish a sustainable architecture based on the green concepts. With the technology of simulating and testing environmental impacts of wind, heat and light of the complex; the architects keep reshaping the building cluster to create an environment friendly architecture. Instead of unilaterally pursuing high-technologies, the design is efficient as well as innovative.

Thirdly, it has applied the latest double façade and natural ventilation in public buildings in the Yangtze River Delta region. Considering the local conditions of climate and the traditional needs of natural ventilation in transition seasons, the architects worked together with the engineers on the testing of thermal performance and the construction details of the double skins in six towers. The electric sun shelter is used in the space between inner and outer skin. Meanwhile, it is also an integration of pure architectural aesthetics, green materials, structure supporting, and thermal performance, which consumes hard work.

Fourthly, different green technologies employed in this project are supposed to coordinate with each other well but not simply add up. There are two central underground energy stations close to the center to guarantee the shortest distance of pipes. An underground circulating water-heat-pump system is used to meet the different air conditioning requirements of four rooms. A big intermediate water system is used to recycle wastewater and falling rain along the green slopes that is collected for recycling. The design also uses solar street lights for outdoor illumination and solar lights for the parking.

### Systematic Challenges

The design and the construction of Hangzhou Civic Center have been confronted with great systematic challenges including technical problems in architectural design and the breakthrough of many current building codes, new structural innovation and even operational strategies.

1. It's the strategy for the definition of the morphology scale and materials. The scale of the cluster of six towers often arouses disputation among the architects. Finally, it was decided that the cluster would have an outer diameter of 195 meters, an internal diameter of 142 meters, and the height of 109 meters. The architects had to make an experiment with balloons (see Figure 11) to show the proper scale of the towers to the client and the public because it's the first high-rise in the CBD and the architects had no reference. The scale is decided according to the scales of the river, the urban axis, and the imagination of the future urban skyline (see Figure 12) against the metropolitan background. Another challenge of scale is the human scale-orienting space and experience. Hangzhou is very famous for its exquisite lifestyle with prolific natural products such as tea, bamboo, silk and other seasonal treats. For example, the rising shape of the roof of the towers echoes the transparent image of the main buildings, and the surface of the main buildings, which is slightly convex and along with

第三. 项目在长江三角洲地区应用了最新的双层幕墙和自然通风技术。考虑到当地的气候条件和过渡季节对自然通风的传统需求, 建筑师和工程师一起合作测试六个塔楼的热舒适性能和研究双层幕墙的构造细节, 在内部和外部表皮之间应用电动太阳遮阳系统。与此同时, 这也是在大量实验研究工作的基础上实现的纯粹建筑美学、绿色材料、结构支持以及热舒适性能的集成与整合。

第四, 在这个项目中应用的各个绿色技术相互协调、共同运转而不仅仅是简单的叠加。在地下靠近中心的区域设置有两个核心能量站点来确保管线之间的最短距离。应用地下水热泵循环系统来满足四个房间的不同空调需求。一个沿着绿色斜坡的大型中水系统回收废水以及收集的雨水作为循环使用。设计还利用太阳能路灯来作为室外照明以及停车场照明。

### 系统性的挑战

杭州市中心的设计和建造一直面临着巨大的系统性挑战, 包括解决建筑设计中的技术难题, 突破现有的建筑规范, 发展全新的结构体系, 甚至创新运作的策略。

1. 第一个挑战是确定建筑的形态、尺度以及材料。六个塔楼集群的规模在建筑师们一次次的争议后, 其尺寸被最终确定为外直径195米、内直径142米, 高109米。由于杭州市



Figure 11. Experiment with Balloons (Source: Linxue Li)  
图11. 气球实验 (来源: 李麟学)



Figure 12. Hangzhou Civic Center in Context of the City's Skyline (Source: Linxue Li)  
图12. 杭州市民中心城市天际线 (来源: 李麟学)



Figure 13. Structural Detail of Hangzhou Civic Center (Source: Linxue Li)  
图13. 杭州市民中心结构细部 (来源: 李麟学)

round viewpoints, exerts a rich light and shade effect. All the important materials would not be selected until the definite objects had been confirmed in the construction site.

2. It's the strategy to realize high flexibility of functions. Hangzhou Civic Center has very complicated and mutative functions and the architects have to construct a flexible and general space allowing for possible modifications in the future. The architects use the cores of service space in the plan of the buildings, and try to organize equipment circulation within the limit of the cores of service space. Meanwhile, the architects always focused on the idea of a continuous space open to the public, especially considering the difficulty of transforming the closed government administration space in to an open one.
3. There are issues of fire protection performance and public security. A study of fire protection performance has been conducted involving smoke control and evacuation to ensure the fire evacuation safety of the central conference center. The overpasses among the six towers can play a practical role in a public security emergency. It's also a potential new direction for the safety of high-rises after the 911 terrorist attacks in New York.
4. It's the challenge of the structure (see Figure 13) and the construction of the overpasses. The six overpasses connecting the six towers have made a great challenge to the engineers and the construction site. The biggest one has a span of about 72 meters. They were fabricated on the ground and elevated to the height of 85 meters. The architects controlled the whole process precisely through the inductors on the steel frame and the computers. There are two big steel sliding bearings in the towers for each overpass.
5. It's the integration of separate particular designs. For a mega project as Hangzhou Civic Center, it needs strong control and coordination of separate designs including interior, landscape, curtain wall, lighting, and sign system etc. The architects tried to construct the outline as well as the coordination process with the architects responsible for each particular design. For example, the architects coordinate with the lighting engineer about the choice of inner lighting for the towers' outer surface and the reflecting lighting for the inner surface in order to reinforce the void space of the cluster.

## Conclusion

From the perspective of architectural history, there are two major streams of thoughts in the development of urban architecture. One is the mega-structure, and the other is skyscraper. On the one hand, the mega-structure reflects the "bigger" building impulse, "Mega-structure: organizing a large scale, huge, complex block [1]". On the other hand, the skyscraper is concentrates on the exploration of "a sky boundary[2]". But the architects believe that there will be another possible typology for the future urban architecture that combines the mega-structure and the skyscraper and the construction of a vertical-scape. Historically speaking, the architects believe that Hangzhou Civic Center can be considered as a definition and experiment of this new paradigm: the fusion of architecture and landscape in the vertical dimension based on the local urban context.

## References (参考书目):

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民中心是钱江新城CBD区第一座高楼，周边没有其它建筑体量可供参考，为了更好地向甲方和公众展示塔楼的适宜尺度，建筑师创造性利用气球做了一个“高度模拟”实验(图11)。建筑的外观尺度既要呼应钱塘江的恢弘气势，又要避免城市景观轴上的过高体量，同时还要在大都市背景上塑造未来城市的天际线(图12)。另外一个尺度定位的难点是把握人性化尺度，基于人的体验和空间感知。在现象学意义上，杭州是一个“感知导向”的城市，它之所以闻名天下，离不开其精致的文化方式和多样的自然物产，茶之香，竹之幽，丝之滑，四季之变化，都是自然予人的触动。而在建筑细部的处理中，同样关注人在其中的感觉和材料的技术体现。例如，塔楼屋顶升腾的姿态呼应着建筑主体的透明形象，主体表面微微凸起的曲线以及圆形的视点，营造出丰富的光影效果。所有重要材料的选择都要等到施工现场的实样确认后才最终确定。

2. 第二个挑战则是要实现功能的高度灵活性。杭州市民中心有着十分复杂多变的功能，建筑师需要建造一个灵活的通用空间来容纳日后灵活变化的可能。于是，建筑师在设计中使用了一些服务性的核心空间，并试图将设备循环系统组织在这些核心服务空间的范围内。与此同时，建筑师也一直致力于打造一个对公众开放的连续空间，当然这里要特别考虑到把传统封闭的办公管理空间转变成一个开放空间的困难性。
3. 防火性能和公共安全也是不容小觑的问题。为确保中央会议中心的消防疏散安全，进行了几项包括防排烟和疏散在内的建筑防火性能研究。六座塔楼之间的立交桥也能够在公共安全应急中发挥实际作用。该设计还为继纽约911恐怖袭击之后的高层安全提供了一条充满潜力的新思路。
4. 来自结构的挑战(图13)和“空中连廊”的施工。用六段“空中连廊”连接六座塔楼给工程师和现场施工带来了巨大的难题。其中最大的一个跨度达到72米。这些立交桥先在地面上完成装配，然后再吊至85米的高空。建筑师通过计算机协同和安装在钢框架上的感应器来全程控制精确施工，并在塔楼上为每一段天桥配置了两个大型钢制的滑动轴承。
5. 整合几个独立的设计体系。像杭州市民中心这类巨构项目，它需要强有力地控制和协调各个独立的系统，包括室内、景观、幕墙、照明、和标识系统等。建筑师在努力构建整体性的同时，还要负责协调每个独立工种的设计进程。比如，为了强化塔楼围合的“虚空”空间，建筑师要与照明工程师一同实验，并选择适合形态表现的室内光源以及相应的内表面反射光形式。

## 结论

从建筑历史的角度来看，城市建筑的发展涌现过两个重要的潮流。一个是巨构，另一个是摩天楼。一方面，巨构反映了把建筑“做大”的冲动，“巨构：一个大尺度、巨大而复杂街区的组织”[1]。另一方面，摩天楼则集中于“天空边界”的探索[2]。然而，建筑师相信，未来城市建筑中还会有另外一种类型的可能，它将巨构、摩天楼和垂直景观的建构整合在一起。用历史的观点看，建筑师认为杭州市民中心就是上述新形式的一个定义和尝试：它是基于地方都市文脉的建筑与景观在垂直维度上的创造性融合。