China ZUN: Shaping the Future Skyline of Beijing

Weiping Shao, Executive Chief Architect, Beijing Institute of Architectural Design
New height for future Beijing——Design realization of China Zun
城市沿革与超高层建筑
City history and super tall high-rise building

北京CBD核心区都市建设计划与中国尊
Beijing CBD core zone urban construction plan and China Zun

中国尊整体设计策略
General design strategy for China Zun

中国尊核心系统设计
China Zun key system design

结语
Conclusion
城市沿革与超高层建筑  //  城市格局

北京有着三千余年的建城史和八百多年的建都史，紫禁城居中的布置方式奠定了几何方正、轴线明晰的城市格局。南北中轴线承载着北京的历史，紫禁城是历史的起点。

Beijing has over three thousand years city history and over eight hundred years capital history. Centered layout of Forbidden City establishes the geometric upright and foursquare city pattern with clear axis. South-north central axis bears Beijing history and Forbidden City is the beginning of the history.
// 城市沿革与超高层建筑  // 城市格局——老北京的胡同
// City history and super tall high-rise building  // Urban pattern, Hutong of old Beijing
Chang’an Avenue, perpendicular to central axis is an east-west axis recording modern city development footprint, and Beijing CBD is located at this axis, within 7 km² taking Guomao Bridge as center. For city history, style and features protection, super high-rise buildings within internal area of Beijing city are limited, and CBD is a historic breakthrough among super high-rise buildings in Beijing.
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北京CBD区域规划建筑总面积近1900万平方米。
CBD核心区周边大部分地块的建设工作已接近完成。作为预留用地的核心区，具有举足轻重的作用和后发优势。

Beijing CBD area planned general construction area is about 19 million m². Construction work for most areas around CBD core area is close to completion. The core area as preserved area has important function and potential advantage.
2010年地方政府决定启动核心区的建设计划，核心区占地约30公顷，规划建筑面积约410万平方米，地上建筑面积约270万平方米，地下建筑面积约140万平方米。

In 2010, local government had decided to start the core area construction plan, and the core area took about 30 Hectares; planning construction area is about 4.1 million m²: above-ground construction area is about 2.70 million m² and underground construction area is about 1.4 million m².
核心区的建设模式是一种开拓性的尝试，在确定了控规条件之后，优先启动的是位于道路和城市开放空间以下的52万平方米建筑面积的城市公共服务基础设施，且核心区地下公共空间项目，其由政府主导，统筹整合环境、交通、市政、防灾等多重城市功能，为各二级地块提供基础设施的标准接口，同时为市民生活提供高品质的城市公园。

Core area construction mode is a pioneering try, and after determining the regulatory planning conditions, preferentially started urban public service infrastructure with 0.52 million m² construction area, under the road and city opening space, that is underground public space of core area, which is led by government, and comprehensively integrated with environment, traffic, municipal, disaster prevention and multiple city functions. It provides each secondary land block with standard interface of infrastructure, as well as provides citizens with high quality city park.
北京CBD核心区都市建设计划与中国尊

Beijing CBD core zone urban construction plan and China Zun

Beijing CBD core zone urban construction plan, pedestrian path at the first floor underground
北京CBD核心区都市建设计划与中国尊

Beijing CBD core zone urban construction plan and China Zun

CBD核心区都市建设计划——地下二层交通环隧

Beijing CBD core zone urban construction plan, traffic loop tunnel at the second floor underground
China Zun is the most important building at central axis for core area, as well as the commanding height at CBD area, and it redefines the city skyline. China Zun takes 1.15 Hectares area; total construction area is 0.437 million m², wherein 0.35 million m² for area on the ground and 87,000 m² for area underground; height reaches 528 m, and there are 108 floors on the ground and 7 floors underground.
北京CBD核心区都市建设计划与中国尊

Design concept: Gift for Huaxia, Zun for China

Tower building model inspiration is from “Zun”, traditional Chinese sacrificial vessel, with waist shape feature.
Tower building on ground is designed with office area, meeting area, and sightseeing area. At the top of tower building, sightseeing platform and multifunction center are set there. Sightseeing platform presents as 360° surrounding the core tube, and sightseeing space height is 15 m, where people can see the Beijing city below.
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中国尊大厦项目的工程建设及未来运营将面临空前的技术、经济、环境、安全等等方面的挑战。

Engineering construction and future operation of China Zun Building will face unprecedented challenges in terms of technology, economy, environment, safety and other aspects.

中国尊大厦项目不再是一般意义的简单建筑，它汇集了一个超级建筑工程的所有难题，我们将中国尊建筑看成一个复杂系统的总和。
China Zun Building project is not only simple building with ordinary meaning, it collects all difficulties for a super building engineering. We will take China Zun as a summation of complex systems.

通过整体设计的手段，以最终项目品质为目标，平衡建筑的各个环节，综合地解决建筑形态、结构安全、交通集散、安全防护、能源供给、运行控制等各个方面。
By integrated design method, aiming at final project quality, balance each technical links of building, and comprehensively solve issues on architectural form, structure safety, traffic distribution, safety protection, energy supply, and operation and control, etc.
超高层的巨构体系就是设计师针对超高层特点创立的全新结构体系。建筑不再是由每一层楼板和立柱叠加而成，其结构首先由跨多个楼层的巨形支柱、腰桁架、斜撑，内核心筒共同组成一个清晰的系统，进而形成体系，维护建筑结构的安全。同样，我们认为建筑的其它子系统也应该有整体的概念。基于此，我们提出了模块化概念。

Super high-rise huge structure system is the totally new structure system created by designer aiming at super high-rise building characteristics. The building is not made by piling each floor slabs and columns. Its structure firstly has a clear system composed by huge columns crossing multiple floors, waist trusses, braces, internal core tubes, all of which will further form a system to maintain the building structure safety. Similarly, we believe other main systems of the building should also have integral concept. Basing on this, we proposed modularization concept.
基于模块划分，在条件允许的情况下，所有系统应按照以上模块划分的原则进行设置。在设计中首先基于模块概念构建关于建筑整体运行的基础性系统，通过基础性系统的建立保证每个模块具有相对独立的运行和安全保障条件，每个模块之间具有可靠的安全分隔，局部的突发事件的处理优先被控制在模块内部解决。

Basing on module division, under the permissible conditions, all systems should be arranged as per the above said module division principle. During design, firstly construct the infrastructure system related to building integral operation, basing on module concept; ensure each module has relative independent operation and safety security conditions by infrastructure system; there is reliable safe separation between each module, partial emergencies treatment priority would be controlled within module for handling.
General design strategy for China Zun  // Design strategy, systematization

Muscular system

Nervous system

Control and regulation technology

Bearing structure

Metabolic system

Supply and emission technology

Thomas Herzog compares Frog physiology system with building sub-systems

The complex characteristics possessed by China Zun are revealed from the diversity of its system composition. During system division, it needs to consider space characteristics, movement characteristics and others of system elements; at the same time, the system should be detailed and perfected along with deepening design, and system division level should have extensible conditions. Different systems have different functions for building operation; the system itself has importance and less importance divisions; the system division method would directly affect the creation of building information model.
For China Zun, combining with essential data in model, relevant database development has been performed, specifically including following four items: collection and arrangement on information already possessed by model; and input and arranging information that model cannot record directly; integrating the above two aspects' information and developing project overall information platform; developing data interface and providing some specialties with test and simulation, and providing overall and detail information for later phase information adjusting.
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中国尊结合模型中的基础数据信息，进行了相关数据库的研发，具体包含以下四项内容：对模型已有信息进行采集和整理；对模型不能直接记录的信息进行录入和整理；对以上两部分信息进行整合，形成项目的全信息平台；开发数据接口，为相关专业测试与模拟、为后续阶段调整相关信息提供全面详实的资料。

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General design strategy for China Zun  Design strategy, data base
// 中国尊整体设计策略  // 设计方式——信息化之几何控制
// General design strategy for China Zun  // Design strategy, geometrical control
// General design strategy for China Zun  // Design strategy, Standardization
城市沿革与超高层建筑
City history and super tall high-rise building

北京CBD核心区都市建设计划与中国尊
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中国尊整体设计策略
General design strategy for China Zun

中国尊核心系统设计
China Zun key system design

结语
Conclusion
// China Zun key system design // Site system, site automobile streamline organization
China Zun key system design // Site system, cargo delivery streamline organization at the second floor underground.
// 中国尊核心系统设计
// China Zun key system design

// 场地系统——市政接驳
// Site system, municipal connection

室外进线标高示意
Z15 tower building adopts the advanced and efficient safe structure system. During design, use the advanced technology to analyze, and use seismic performance-based analysis to realize the aim of no damage after minor earthquake, repairable after medium earthquake, and no collapse after major earthquake. Its structure system has passed the ultra-limit seismic audit.
外框架由巨型柱、巨型斜撑和转换桁架组成。

巨型柱采用目前超高层结构中普遍采用的钢—混凝土组合结构，使其在保证强度的同时有更好的延性。

转换桁架被设计为独立承受上部全部荷载，抗震性能目标为大震不屈服，有力保障了结构的竖向传力途径及转换结构的安全性。

External tube is composed of mega column, large diagonal brace and transfer truss.

Large column adopts steel-concrete combination structure, which is currently used widely in super high-rise structures, thus to ensure the good ductility, and ensure the strength at the same time.

Transfer truss is designed to be able to bear all load of upper part, and the anti-seismic property is no yielding after major earthquake, thus it strongly ensures the vertical force transferring channel and safety of transfer structure.
// China Zun key system design // plan system, second floor of basement
中国尊核心系统设计
China Zun key system design
平面系统——首层
plan system, first floor
中国尊核心系统设计  // plan system, Standard office floor
中国尊核心系统设计
China Zun key system design
平面系统——典型办公层
plan system, Standard office floor
中国尊核心系统设计
平面系统——空中大堂层

// China Zun key system design  // plan system，sky lobby floor
平面系统——设备层
plan system, MEP floor
// China Zun key system design
// plan system, Refuge floor
平面系统——观光层

China Zun key system design  // plan system, Observation floor
101 sets

- 47 lifts for office area
- 18 shuttle lifts for office area
- 3 shuttle lifts for sightseeing
- 1 lift for sightseeing
- 2 VIP shuttle lifts
- 1 VIP shuttle lift
- 6 low area public lifts
- 4 garage lifts
- 1 large goods lift
- 3 high speed service lifts
- 8 sectional service lifts
- 1 lift for low area service
- 4 lifts for underground service
- 2 lifts for club service
中国尊核心系统设计  // Lift system, interchange mode
China Zun key system design  // Lift system, interchange mode
穿梭电梯平均到达目的地时间

F091 空中大堂 85.5秒
F090 空中大堂

F059 空中大堂 71.6秒
F060 空中大堂

F033 空中大堂 56.8秒
F032 空中大堂

F001 首层大堂
B001M 地下夹层

SL低区穿梭电梯
SM中区穿梭电梯
SH高区穿梭电梯

// 中国尊核心系统设计
// China Zun key system design
// 电梯系统——换乘方式
// Lift system, interchange mode
<table>
<thead>
<tr>
<th>序号</th>
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<tr>
<td>F091</td>
<td>空中大堂</td>
<td>电梯系统——换乘方式</td>
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<td>F001</td>
<td>首层大堂</td>
<td>电梯系统——换乘方式</td>
</tr>
<tr>
<td>B001M</td>
<td>地下夹层</td>
<td>电梯系统——换乘方式</td>
</tr>
</tbody>
</table>
// China Zun key system design
// Curtain wall system, Geometrical control
基础控制面被定义为幕墙玻璃外完成面理想位置。幕墙深化设计过程中，幕墙被划分为更为细致的3大部分——入口雨棚、主体、塔冠。基础控制面也被深化为更为细致的幕墙控制面。

Foundation control face is defined as the ideal position for completion face of curtain wall glass. During deepening design procedure of curtain wall, the curtain is divided into more detail 3 parts, they are entrance rain shed, main body, tower crown. Foundation control face is also deepened into more detail curtain wall control face.
// China Zun key system design // Curtain wall system, curtain wall type

- Curtain wall for tower crown sightseeing platform
- Curtain wall for main body of tower building
- Curtain wall at entrance of tower building bottom
// China Zun key system design
// Curtain wall system, curtain wall type for MEP floor
中国尊核心系统设计
China Zun key system design

幕墙系统——擦窗机
Curtain wall system, window cleaning machine
China Zun key system design
Curtain wall system, window cleaning machine
城市尺度

URBAN SCALE
To create a presence in the nighttime skyline, the building lantern and vertical fin lighting will be seen from a distance.

街道尺度

STREET SCALE
To emphasize the form of the building where it is on view and is presented in full form linking the top and base.

行人尺度

PEDESTRIAN SCALE
To bring out the elegance of the building and to match the interior lobby, site, and landscape, day and night, so the sense of the building is cohesive.
// 中国尊核心系统设计  // China Zun key system design
// 室内设计——地下大堂  // Interior design, underground lobby
China Zun key system design

Interior design, lift car
标准办公层采用双层中空玻璃做法，整个塔楼窗墙比为0.44。
Standard office adopts double-hollow glass curtain wall, and the whole tower window-wall ratio is 0.44.
© Council on Tall Buildings and Urban Habitat
### 暖通空调系统全年运行能耗（均折算为耗电量）统计

<table>
<thead>
<tr>
<th>分项</th>
<th>参照建筑</th>
<th>设计建筑</th>
<th>单位</th>
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<td>冷站</td>
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<td>17</td>
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<td>能耗指标</td>
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<td>节能率</td>
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### 暖通空调系统全年能耗费用统计

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<td>冷水二次泵</td>
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<td>空调末端</td>
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<td>1252</td>
<td>万元</td>
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<td></td>
<td></td>
<td>28.7%</td>
</tr>
</tbody>
</table>

注：根据设计窗墙比平均约为0.45，参照建筑的围护结构热工参数采用北京市《公共建筑节能标准》DB11/687-2009 中的限值。
## 全年能耗统计

<table>
<thead>
<tr>
<th>分项</th>
<th>参照建筑</th>
<th>设计建筑</th>
<th>单位</th>
<th>分项节能率</th>
</tr>
</thead>
<tbody>
<tr>
<td>制冷</td>
<td>3779</td>
<td>4039</td>
<td>MWh</td>
<td>-6.9%</td>
</tr>
<tr>
<td>冷却塔</td>
<td>102</td>
<td>87</td>
<td>MWh</td>
<td>14.7%</td>
</tr>
<tr>
<td>风机</td>
<td>2908</td>
<td>2177</td>
<td>MWh</td>
<td>25.1%</td>
</tr>
<tr>
<td>水泵</td>
<td>1325</td>
<td>1097</td>
<td>MWh</td>
<td>17.2%</td>
</tr>
<tr>
<td>外部照明</td>
<td>345</td>
<td>345</td>
<td>MWh</td>
<td></td>
</tr>
<tr>
<td>设备</td>
<td>12689</td>
<td>12689</td>
<td>MWh</td>
<td>-</td>
</tr>
<tr>
<td>室内照明</td>
<td>9768</td>
<td>9002</td>
<td>MWh</td>
<td>7.8%</td>
</tr>
<tr>
<td>采暖（MBtu）</td>
<td>37511</td>
<td>31895</td>
<td>MWh</td>
<td>15.0%</td>
</tr>
<tr>
<td>生活热水（MBtu）</td>
<td>15920</td>
<td>15920</td>
<td>MWh</td>
<td>-</td>
</tr>
</tbody>
</table>

### 参照建筑与设计建筑能耗对比

<table>
<thead>
<tr>
<th>模型</th>
<th>电力能耗（MWh/yr）</th>
<th>市政供热能耗（MBtu/yr）</th>
<th>电能能耗节约（%）</th>
<th>市政供热节约（%）</th>
<th>电费（RMB/yr）</th>
<th>热计量费（RMB/yr）</th>
<th>总能耗费用（RMB/yr）</th>
<th>能耗费用节省（%）</th>
</tr>
</thead>
<tbody>
<tr>
<td>参照建筑</td>
<td>30,916</td>
<td>53,431</td>
<td></td>
<td></td>
<td>33,778,351</td>
<td>3,916,485</td>
<td>37,694,836</td>
<td></td>
</tr>
<tr>
<td>设计建筑</td>
<td>29,434</td>
<td>47,814</td>
<td>4.8</td>
<td>10.5</td>
<td>29,412,198</td>
<td>3,504,792</td>
<td>32,916,990</td>
<td>12.7</td>
</tr>
</tbody>
</table>

注：参照建筑根据ASHRAE90.1-2007附录G性能评估方法规定的流程和参数，在设计建筑模型的基础上修改得到。
城市沿革与超高层建筑  
City history and super tall high-rise building

北京CBD核心区都市建设计划与中国尊  
Beijing CBD core zone urban construction plan and China Zun

中国尊整体设计策略  
General design strategy for China Zun

中国尊核心系统设计  
China Zun key system design

结语  
Conclusion
中国尊大厦项目的建设已全面展开。纵观整个设计流程，基于建筑系统划分的整体设计策略使设计工作受益匪浅。同时，借助于BIM手段，建筑师得以在一个前所未有的层面上对建筑进行掌控，最大限度地保证了建筑的设计质量。China Zun Building project has been fully carried out. Viewing the whole design flow, design work benefits a lot from integral design policy basing on building system division. At the same time, by applying BIM method, architect can control the building on at unprecedented level, and can ensure the design quality of building to the utmost degree.
THANKS!