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Key Construction Technologies
结构施工关键技术

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This chapter introduces the key technologies for the structural construction of the Ping An Finance Center from six perspectives regarding the deep foundation pit, large diameter piles, massive concrete mat, climbing formwork of core wall and mega column, large-tonnage luffing crane, and ultra-high concrete pumping. To date, the deep foundation pit, large diameter piles and massive concrete mat have been completed, while the climbing formwork of core wall and mega column, large-tonnage luffing crane, and ultra-high concrete pumping are still under construction.

本文将从深基坑、超大直径桩、大体积混凝土底板、核心筒和巨柱爬模、大吨位动臂塔吊、超高混凝土泵送六个方面介绍结构工程施工关键技术。深基坑、超大直径桩、大体积混凝土底板已经完成，核心筒和巨柱爬模、大吨位动臂塔吊、超高混凝土泵送正在实施过程中。

Overview of Structural Design

Deep Foundation Pit

The foundation pit work of this project was confronted with serious challenges through the complicated surrounding environment. On the north side of the foundation pit runs Metro Line 1. The airshaft is less than 2 meters away from the nearest edge of the foundation pit and only 10 meters from the entrance and exit of the metro. The deepest level is -33.5 meters and the earthwork volume is 520,000 m^3.

Pile Foundation

The Piles are very difficult to construct, piles of this size are not common in China nor are they common abroad. The maximum pile diameter is 8 meters and the hole caliber is 9.5 meters, the pile, which settled into micro-weathered granite is no less 0.5 meters. The single pile's bearing capacity characteristic value is 800,000 kN.

Mass Concrete Mat

Basement mat is an extremely thick and massive concrete mat, its concrete strength grade is C40 and thickness is 4.5 meters and maximum single continuous seamless pouring volume is 30,000 m^3.

Tower

The lateral bracing system utilizes a stiff RC core wall + composite RC mega columns + outrigger truss + peripheral belt truss + giant inclined support + corner giant V-shape support, shown in Figure 6.16. The core wall's maximum size is 33 m × 33 m, which is divided into 9 internal cylinders. The concrete strength grade is C60. The maximum thickness of the external walls is 1.5 meters and the interior wall is up to 0.8 meters. The concrete strength grade of the mega columns is C70 and C60, the maximum cross-section is 6.525 m × 3.2 m. In general, mega columns converge inward and have multiple variable cross-sections. There are 7 sets of peripheral belt truss, with the maximum weight of a single truss is 374t, maximum span is 29.5 meters and maximum height is 13.9 meters. There are 4 sets of outrigger truss. The giant inclined support is installed along 4 façades between mega columns and runs from the first floor (-1.45 m) to the top of the tower (529.37 m). The V-shape support is located at the corner

平安金融中心工程概况

结构设计概览

深基坑

复杂的周边环境给本工程基坑施工带来了严峻挑战。基坑北侧为正在运营的地铁1号线，其通风竖井距离基坑边缘最近处不足2m，距地铁出入口仅有10m。最深处-33.5m，土方量为52万m^3。

桩基础

桩基施工难度非常大，桩的尺寸国内外罕见。最大桩径8m，开孔直径9.5m，桩端入微风化花岗岩不小于0.5m，单桩承载力特征值800,000KN。

大体积混凝土底板

基础底板属超厚大体积混凝土底板，混凝土强度等级为C40，厚度为4.5m，最大单体连续无缝浇筑体积30,000m^3。

塔楼

抗侧力采用劲性钢筋混凝土核心筒+劲性钢筋混凝土巨型柱+外伸臂桁架+周边带状桁架+巨型斜撑+角部巨型V撑体系，见图6.16。核心筒最大尺寸为33m×33m，分为9个内筒，混凝土强度等级为C60，外墙厚度最大1.5m，内墙厚度最大为0.8m。巨型柱混凝土强度等级C70、C60，最大截面达6.525m×3.2m。总体上，巨柱由下至上内收且多次变截面。周边带状桁架共7道，单榀最大重量为374t，最大跨度

Figure 6.14. Workers welding the support structure. (Source: Ping An)
图6.14. 工人焊接平安金融中心的支撑结构 (来源: 平安)

of the mega column of the tower and runs from the first floor (-1.45 m) to the top of the tower (548.07 m).

29.5m，最大高度13.9m。伸臂桁架共设置4道。巨型斜撑设置在塔楼四个立面巨型柱之间，从首层-1.45m标高处贯穿至塔楼顶部529.37m。V撑在主塔楼巨柱角部之间设置，从首层-1.45m贯穿至塔楼顶部548.07m。

Key Construction Technology of the Structure

Deep Foundation Pit

Design of Foundation Pit

The foundation pit support structure uses slope protection piles with a double-ring concrete support (see Figure 6.17). The core wall of main tower passes through the large ring. Eight mega columns pass through eight large preset holes in the first layer's support, so that the temporary internal support of the foundation pit is independent from the construction procedure of the formal structure. Meanwhile, taking the load requirements of different parts into account, the concrete cover slab is installed to the first support to greatly improve the structural construction schedule.

New Technology and Technique

To accelerate construction, two Bauer BG25C rotary drilling rigs are transferred to smoothly install the upright column and slope protection pile into the rock of the foundation pit. Use reinforcement cage

结构关键施工技术

深基坑

基坑设计

基坑支护采用支护桩+混凝土双圆环内支撑，见图6.17。主塔楼核心筒穿过大圆环，8根巨柱穿过首道支撑上预设的八个大洞，从而使得基坑临时内支撑与正式结构施工在工序上脱开。同时，考虑了不同区域的荷载要求，在首道支撑设置封板，极大促进了后期结构施工进度。

新工艺和新技术

为加快工程进度，抽调2台宝峨BG25C旋挖钻机，顺利完成基坑工程入岩立柱桩和护坡桩的施工。采用钢筋笼分段吊装工艺。通过引进加锁母型套筒连接形式，显著缩短了连接钢筋笼的时间。

超大直径桩

超大直径桩总计24条，其中桩径为8.0m的巨型桩8条，桩径为5.7m的巨型桩16条。

桩孔开挖

分节开挖，分节支护。挖土由人工从各个分段自上而下逐段用镐和锹进行，遇坚硬土及风化基岩用风镐辅助破碎。弃土装入吊桶内，由提升设备提升到孔口。

桩钢筋绑扎

由于桩径大，主筋数量多而密集，主筋单根重量大，箍筋直径大，数量多，桩体钢筋结构复杂，单个钢筋笼直径跨度大，钢筋笼安装困难。对AZH1巨型桩纵筋直接从坑顶预留洞口吊入孔内，箍筋先吊至坑底，再人工放入孔内；对AZH2巨型桩内圈钢筋笼采取坑顶预先制作，分段吊至坑底后再吊入孔内。

Figure 6.15. The building under construction. (Source: Ping An)
图6.15. 施工中的平安金融中心 (来源: 平安)

桩混凝土

适量掺配矿渣粉与粉煤灰，降低水泥用量，严格控制原材料拌制温度，降低混凝土入模温度。混凝土浇筑温度不超过30℃。采用蓄水养护法养护30天。对混凝土块体内外温差和降温速度进行监测。

大体积混凝土底板

配合比设计 – 正交试验

正交法是一种评估哪些因素以及这些因素水平是如何影响混凝土性能的试验方法。选用水泥品种、水胶比、胶凝材料用量和粉煤灰掺量等4个参数作为正交设计试验的影响因素，水胶比、胶凝材料用量和粉煤灰掺量各设定4个水平，水泥品种设定2个水平。由深圳市两家混凝土搅拌站平行进行试验。

足尺模拟 – 试验方法

试块尺寸为4.5 m × 4.5 m ×4.5 m，混凝土强度等级为C40。在施工现场搭设8 m ×8 m的密闭保温棚，模拟深圳地区夏季的平

sectional hoisting technology. The sleeves are coupled with locknuts to remarkably reduce the connection time of RC cages.

Oversized Diameter Pile

There are 24 oversized diameter piles in total, including 8 giant piles with king-pile diameter of 8.0 meters and 16 giant piles with pile diameter of 5.7 meters.

Excavation of Pile Hole

Excavation and support should be conducted in sections. With a pickaxe and a shovel, workers may complete the excavation work from top to bottom in each section. The hard soil and weathered bedrock encountered during the excavation should be crushed via air pick. The excavation sequence in the hole should be hoisted to the porthole through the hoisting equipment.

Rebar Installation of RC Pile

Installation of rebar cages is extremely difficult due to the large pile diameter, high quantity of crowded longitudinal rebar, single rebar's high weight, large stirrup diameter, high quantity of stirrups, the

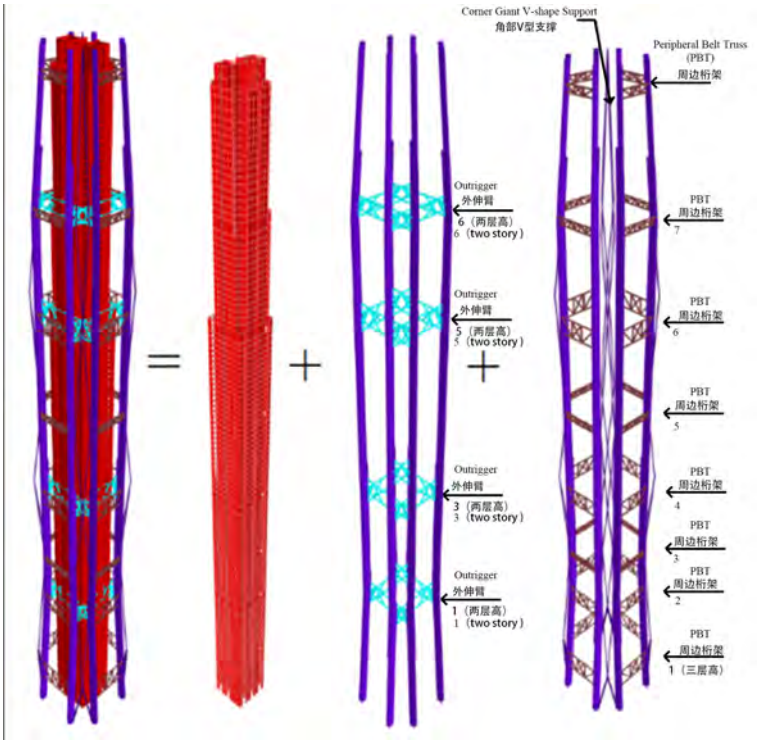

Figure 6.16. Tower Structural System. (Source: Yuqi Zhou)
图6.16. 塔楼结构体系 (来源: 周予启)

complicated structure of RC pile, and single rebar cage's large diameter. The longitudinal bar for the AZH1 giant pile should be directly hoisted into the hole from the preformed hole on the roof of pit. The stirrups should first be put in the bottom of pit and then placed into the hole manually; the inner ring RC cage of AZH2 giant pile should be manufactured on top of the pit and then hoisted into the bottom of the pit section by section.

Pile Concrete

The right amount of slag and coal ash should be blended to reduce the cement content, strictly controlling the mixing temperature of raw materials, and reducing the casting temperature of concrete. The concrete pouring temperature should be no more than 30 °C. The concrete pile should be cured for 30 days through the water conservation method. Monitor the temperature difference of interior and exterior concrete blocks and cooling rate.

Massive Concrete Mat

Mix Ratio Design – Orthogonal test

Orthogonal test is a method used to evaluate different factors and their level of impact on concrete function. Use four parameters: the cement type, water-cementitious material ratio, the amount of cementitious materials and fly ash content as impact factors of orthogonal test. While the water-cementitious material ratio, the amount of cementitious materials and fly ash content will have four levels respectively, and the cement type has two levels. The test was conducted by two concrete batching plants in Shenzhen.

Full-Scale Simulation – Test method

The test block size is 4.5 m × 4.5 m × 4.5 m and the concrete strength grade is C40. An airtight insulation shed of 8 m × 8 m is erected on the construction site and simulates the average temperature in summer of Shenzhen. Test physical and mechanical properties of concrete. The temperature and strain sensors should be embedded in the concrete block.

Figure 6.17. Double ring internal support system for foundation pit. (Source: Ping An)
图6.17. 基坑双圆环内支撑系统 (来源: 平安)

均气温。检测混凝土的各项物理力学性能。在混凝土试块内预埋温度和应变传感器。

温度监测与模拟

监测结果表明，在混凝土入模温度为24℃时，实际结构内部的最高温度为65℃，绝对温升为41℃。根据混凝土的绝热温升和试块的边界条件，进行了混凝土试块的温度场模拟。

应变监测与模拟

监测结果表明，各点60d的拉应变最大值小于200微应变，混凝土的开裂风险比较小。

抗压强度

混凝土强度试块分三批养护，即标准养护、同条件养护、温度匹配养护。混凝土在这三种养护条件下的60d强度均达到了C40混凝土的要求。

浇筑

塔楼4.5m厚大底板混凝土总方量3万m3，90小时浇筑完成。按照大体积混凝土施工形式为一次连续斜面分层推移式浇筑。场内在大圆环北侧共设置3个溜槽+多个次溜槽+2个地泵下灰口，见图6.18。混凝土浇筑时，每个溜槽周边设置停靠区，行驶路线与停靠部位均在允许荷载区域内。

测温和养护

底板共设置5个测温点，每个测温点上下设置3个温度传感器。采用MCU微波自动远程监测系统，可自动定时测量采集数据、自动数据存储，也可人工实时采集。测温结果表

Figure 6.18. Chute for mat concrete pour. (Source: Yuqi Zhou)
图6.18. 底板上的混凝土浇筑溜槽 (来源: 周予启)

Temperature Monitoring and Simulation
The monitoring result shows that, in case that the casting temperature of concrete is 24 °C, the actual maximum temperature inside the structure is 65 °C, and the absolute temperature rise is 41 °C. The temperature field simulation of the concrete block is conducted in accordance with the adiabatic temperature rise of concrete and boundary conditions of the test block.

Strain Monitoring and Simulation
The monitoring result shows that, if maximum strain value of each point 60d is less than 200 micro-strain, the cracking risk of concrete is relatively small.

Compression Strength
The maintenance for concrete strength blocks should be divided into three types, such as standard curing, equal condition curing, and temperature matching curing. The 60-day compression strength of the concrete attains to the C40 under the three curing conditions mentioned above.

Pouring
The 4.5 m-thick massive concrete mat of the tower is 30000 m^3 in volume and should be poured for 90 hours. The massive concrete should be poured once on a continuous slope in a segmented and propelled way. There are three chutes, multiple sub-chutes, and two pumps on the north end of the large circle in the construction site (see Figure 6.18). Upon pouring, the parking area should be set around each chute. The parking site and route should be within the allowable load area.

Temperature Measuring and Curing
There are five temperature monitoring points in the base mat. Three temperature sensors are installed on the upper and lower sections of each temperature measuring point. We set the MCU microwave automatic remote monitoring system to automatically and regularly measure and collect data and to store data. Real-time data also can be collected manually. The results show that maximum temperature of the internal plate does not exceed 65 °C.
The thick mat was cured with water conservation during the early period and with thin film and hessian cloth at a latter period. If the moisture curing lasts more than 14d, the insulation layer should be removed layer by layer. If the maximum temperature difference of concrete surface temperature and ambient temperature is less than 20 °C, all insulation layers should be removed.

Climbing Formwork Of Core Wall
Main performance indicator
The formwork height is 13.8 meters. The distance to wall ranges from 0.1m to 0.3m. The rated load of the hydraulic cylinder is 120 kN, its rated pressure is 25MPa, cylinder stroke is 400 mm,

明，底板内部最高温度未超过65℃。
厚底板采用前期蓄水养护，后期采用薄膜+麻袋片养护。保湿养护持续时间超过14d，保温覆盖层的拆除分层逐步进行。当混凝土养护的表面温度与环境最大温差小于20℃时，需全部拆除保温层。

核心筒爬模
主要性能指标
架体高度13.8m。离墙距离0.1m-0.3m。液压油缸额定荷载120kN，额定压力25MPa，油缸行程400mm，伸出速度约400mm/min，提升步距300mm。泵站功率22KW。爬升速度10分钟/米 (见图6.19) 。

机位设计
共布置108个机位，其中外墙单侧液压爬模机位40个，内筒使用双侧液压爬模机位共34个。其中外侧架体最大承受跨度为4.05m，内侧爬模架体最大支撑跨度为3.25m。

平台设计
核心筒外爬模设5层平台，从上往下为上平台、模板操作平台、主平台、液压控制平台和吊平台。核心筒内爬模设4层平台，从上至下为上平台、主平台、液压控制平台和吊平台。核心筒外爬模主平台设计最大活荷载3KN/m^2。核心筒内爬模上平台设计最大活荷载5KN/m^2。

如何解决墙厚变化 墙厚变化小于150mm时
通过单侧液压爬模自身斜爬功能解决。墙厚变化超过150mm时，在附墙挂座与墙体之间加设垫块使架体正常爬升。爬架在爬升时要使导轨倾斜一个角度向上爬，爬架最大倾角可达5度。

extending speed is about 400 mm/min, and the hoist step pitch is 300 mm. The pump power is 22 kW. The lifting speed is 10 min/m (see Figure 6.19).

Design of Machine Position

There are 108 machine positions in total, among which the outer wall has 40 unilateral hydraulic climbing formwork machine positions; the inner cylinder has 34 bilateral hydraulic climbing formwork machine positions, of which, the maximum span of outer formwork is 4.05 meters and that of inner formwork is 3.25 meters.

Platform Design

The external climbing formwork of the core wall has a five-layer platform, there is an upper platform, templates operating platform, main platform, hydraulic control platform, and crane platform arranged from top to bottom. The internal climbing formwork of the core wall has a four- layer platform. There is an upper platform, main platform, hydraulic control platform, and crane platform arranged from top to bottom. Maximum live load of the main platform of climbing formwork outside the core wall is 3 kN/m^2. Maximum live load of upper platform of climbing formwork inside the core wall is 5 kN/m^2.

How to solve the wall thickness variation

If the wall thickness variation is less than 150mm

The variation can be addressed through the oblique climbing function of the unilateral hydraulic climbing formwork. If the wall thickness variation exceeds 150mm, the pad should be attached between the wall-mounted seat and the wall so that the formwork can normally climb up. When the formwork is climbing up, the guide rail should provide an angle, with maximum dip angle of formwork attaining five degrees.

How to deal with overhanging steel corbel obstructing climbing formwork

If the overhanging steel corbel is less than 600 mm, the turn-plate platform should be used. Open the turning-plate at the beginning of climbing, and then close it after climbing; if the overhanging steel corbel is

Figure 6.19. Climbing formwork system for core walls. (Source: Ruohui Sun)
图6.19. 核心筒爬模体系 (来源: 孙若晖)

Figure 6.20. Climbing system for mega column. (Source: Ruohui Sun)
图6.20. 巨柱爬模 (来源: 孙若晖)

more than 600 mm, the beam of platform at overhanging steel corbel should be made into the detachable unit. When climbing, the platform beams which are obstructing should be removed temporarily and then connected until the climbing position is above the steel corbel.

Safety Shield

To meet the impact resistance, endurance, and lighting requirements of outer shield, the outer shield uses the perforated steel plate, with the thickness of the color steel plate being 0.75 mm and the diameter of the hole being 5 mm.

Climbing Formwork of Mega Column

Formwork selection for mega column

The hydraulic self-climbing form system, which has an external hoisting function, is used outside the mega column. Because of obstruction from the horizontal structure of composite slabs, the interior side of mega columns cannot use self-climbing formwork, conventional formwork are used here (see Figure 6.20).

The Climbing Formwork Conforms to Variable Cross-Sections

Each mega column is arranged with five climbing formwork positions in the beginning. Due to the changing structure of mega columns, each platform layer of the climbing formwork should be designed to be retractable. There are a few exceptions that changed cross-section that require re-mounting the formwork, others only require adjusting the platform length of the formwork. Climbing formwork on the 19th floor should reduce a climbing formwork position and should be reinstalled on the 55th floor.

Stability of cantilevered part of upper climbing formwork

The design height of the column climbing formwork is 17.5 meters; the free end of the upper formwork reaches 11 meters. To ensure construction safety, during the climbing formwork construction, the highest ends of upper formwork should be connected with the fittings and steel pegs. One end of the fitting should be fixed with steel pegs and the other end should be

如何解决爬模遇到外伸钢牛腿

当牛腿外伸长度小于600mm时，只需将平台板做成翻板式，在爬升时将翻板掀开，爬升过后盖好即可; 当牛腿外伸长度大于600mm时，将牛腿外伸处的平台横梁做成可拆卸的单元，在爬升时将发生冲突的平台横梁临时拆除，待爬升超过牛腿处再进行连接。

安全防护屏

为满足外围护的抗冲击性、耐用性和采光要求，外围护选用带孔钢板，钢板厚度为0.75mm，孔直径5mm。

巨柱爬模

巨柱模板选型

巨柱外侧采用了具有外围导向提升功能的液压自爬升模板系统。由于组合楼板水平结构阻挡，巨柱内侧模板无法采用自爬升模板，采用常规的支模方法进行施工，见图6.20。

爬模如何适应巨柱变截面

每个巨柱起初布置5个爬模机位，由于巨柱结构不断变化，将爬模各层平台设计为可伸缩式以满足施工需要。除个别突变截面需要重新安装架体外，其它仅需将爬模平台长度进行适当调整即可。爬模需

provided with the trolley to roll on the upper formwork of the guide track, so as to ensure the safe ascension of the climbing formwork.

Large-Tonnage Boom Crane

Selection of Crane Model

Through the analysis of the relationship of the steel structure weight, location and lifting capacity and lifting radius of the crane, four large inner-climbed boom cranes are selected, among which No.1 and 2 cranes are M1280D and No. 3 and 4 cranes is ZSL2700, with a maximum lifting load of 100t. The special custom parameters include: the rope capacity reaching up to 1,100 meters, the total tower height increased up to 64 meters.

Layout of Tower Crane

Four tower cranes are attached to the outer side of structural wall of the core. According to the layout plan, the tower has fewer standard sections, lower requirements for concrete strength of core wall, and it is not affected by substantial variation in the outer shape of the structure. It also will not affect outer curtain wall construction or require secondary displacement. So the tower cranes have many obvious advantages (see Figure 6.21).

How to Deal with the Gradual Thinning of the External Walls of the Core Wall

The external wall becomes thinner from the bottom to top, and its thickness varies from 1500 mm to 500 mm. The positioning device with multiple bolt holes is specially designed.

Tower Crane Climbing

Climb once every 20-22 m, for a total of 27 times. The climb order of the tower crane goes No.3, No.-2, No.-4, and No.-1. The main processes of tower climbing include: removing the support beam of the lower part of tower crane, installing the support beam of upper part of tower crane, and tower crane climbing.

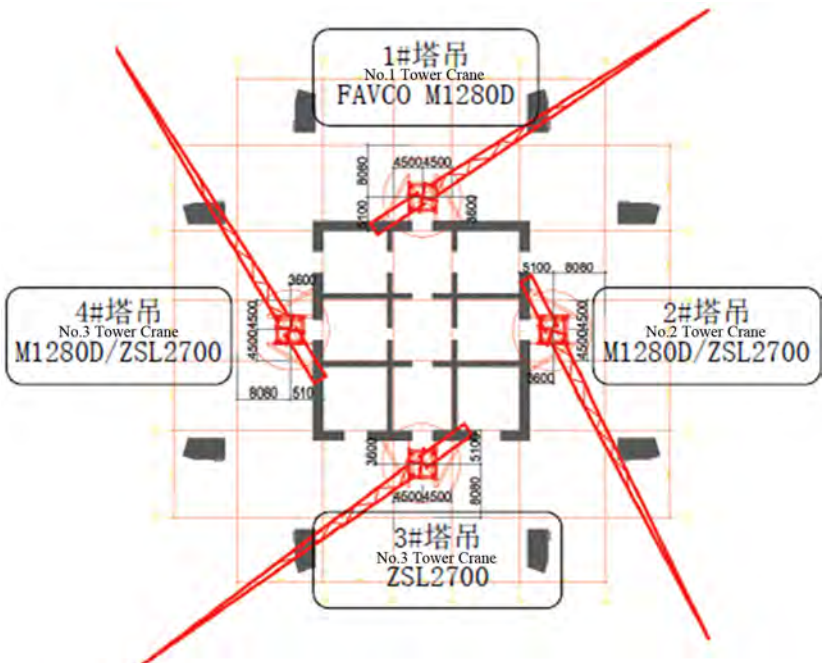

Figure 6.21. Layout for luffing tower cranes. (Source: Yuqi Zhou)
图6.21. 动臂塔吊位置示意图 (来源: 周予启)

在19层减少一个爬模机位，同时在55层重新安装。

爬模上架体悬挑部分稳定性

巨柱爬模设计高度为17.5m，上架体自由端达到11m。为确保施工安全，爬模施工工况时上支架的最上端利用拉结件与钢骨栓钉拉结，爬模爬升工况时时拉结件一端固定钢管栓钉上，一端设置滚轮在上架体导轨上滚动，保证爬模安全爬升。

大吨位动臂塔吊

塔吊选型

通过分析钢结构构件重量、位置与塔吊起重能力、起重半径的关系，选用4台内爬式大型动臂塔吊，其中1#、2#塔吊为M1280D，3#、4#塔吊为ZSL2700，最大起重量均为100t。特殊定制参数: 容绳量增加至1100m，塔身总高度增加至64m。

塔吊布置

将四台塔吊附着于核心筒结构墙体外侧。该布置方案塔身标准节数量较少，对核心筒混凝土强度要求较低，不受建筑外形大幅度变化的影响，不影响外幕墙施工，无需二次移位，优势明显 (见图6.21) 。

如何解决核心筒外墙逐渐变薄问题

核心筒外墙厚度自下而上变薄，由1500mm 逐步减至500mm。为此专门设计了一种带有多个螺栓孔的定位装置。

塔吊爬升

每隔20-22m爬升一次，共计爬升27次。塔吊爬升顺序为3#-2#-4#-1#。爬升主要工序为塔吊下部支撑梁拆除→塔吊上部支撑梁安装→塔吊爬升。

超高混凝土泵送

混凝土最大泵送高度C70 (400m) 、C60 (554.45m) 、C35 (585.58m) 。

超高压混凝土输送泵

泵送高度越高，管道布设越长，管道摩擦阻力及混凝土自重压力越大。混凝土强度等级越高，其粘度越大，粘滞阻力越大。通过理论计算和以往超高层泵送经验数据复核，考虑30%的泵送能力储备，本工程选用三一重工 HBT90CH-2150D 超高压泵。

泵管选型、布置和固定

选用直径150mm、壁厚12mm泵管。泵管内径越大，其对混凝土的阻力越小。为平衡垂直管道内混凝土的自重，水平管道长

Ultra-High Concrete Pumping

The maximum pumping height of the concrete: C70 (400 m), C60 (554.45 m) and C35 (585.58 m).

High Pressure Concrete Pump

The higher the pumping height is, the longer the pipeline is. Thus, the pipe's frictional resistance and pressure due to self weight are higher. The higher concrete strength and the greater viscosity result in viscous resistance. Based on the theoretical calculations and review of previous pumping empirical data of high-rise construction, taking 30% of pumping capacity reserves into account, the project selects HBT90CH-2150D super pressure pump manufactured by SANY.

Selection, Layout and Fixation of Pump Pipe

Use the pump pipe with the diameter of 150mm and the wall thickness is 12mm. The larger the inner diameter of pump pipe is, the smaller its resistance to concrete is. To balance the concrete weight inside the vertical pipe, the length of horizontal pipe should be 1/5 – 1/4 of the main building. At 3 m ~ 5 m of initial segment of horizontal

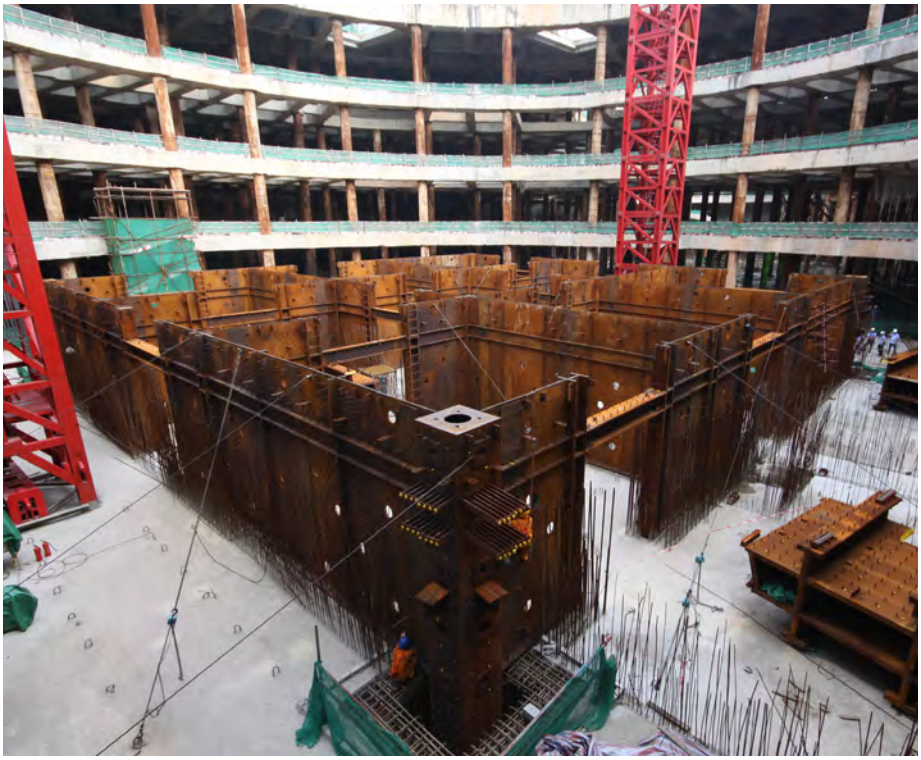

Figure 6.22. Core formwork at the base of the tower. (Source: Ping An)
图6.22. 塔楼底部的核心筒模架 (来源: 平安)

Figure 6.23. Climbing cranes enables uninterrupted construction capabilities. (Source: Ping An)
图6.23. 爬升式塔吊让不间断施工成为可能 (来源: 平安)

Figure 6.24. The highly skilled and dedicated workers have been key in making a safe, productive work environment. (Source: Ping An)
图6.24. 技艺精湛、专注投入的建筑工人是保证平安金融中心施工安全和效率的关键 (来源: 平安)

pipe and vertical pipe should be installed with a set of stop valves respectively, to ensure and impede the flow of concrete. The vertical pipe should be installed with a buffer bend.

Mass Concrete Cracks Control of Mega Columns and Core Wall

Select poly-carboxylate water reducer made from the parent metal which is imported from Germany; every cubic meter of concrete should be mixed with 90kg of flake ice to reduce the concrete casting temperature and adiabatic temperature rise; ensure the 48-hour curing after the pouring is completed; after the removal of template, use the high-pressure pump preheat spray technology for curing.

度为建筑主体高度的1/5~1/4。在水平管起始段3m~5m处和垂直管起始段各安装一套截止阀，可实现混凝土流动的通、断。在垂直管道部分设置缓冲弯。

巨柱和核心筒墙大体积混凝土裂缝控制

选用聚羧酸系减水剂，由德国进口母材复配而成; 每立方米混凝土内掺冰屑90kg，降低混凝土入模温度以及绝热温升; 浇筑完成后确保带模养护48小时; 拆模后采用高压泵预热喷雾技术养护。