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Advantages of Early Design Consultant and Contractor Coordination

设计方与承包商于项目初期合作的益处

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The Ping An Finance Center required a tremendous effort to coordinate design/engineering and construction trades. This began very early in the design process and will continue beyond the completion of construction. From contract administration, to extensive use of BIM software, to incorporation of international standards in project management methodologies, the deployment of people and planning was just as impressive an undertaking as the daily dance of steelworkers high above the ground. This chapter summarizes some of the main steps that were taken to ensure a smooth and efficient construction sequence.

建造平安金融中心要求建筑设计、工程设计和施工三方的高度协调。这一点在设计初期就显现出来了，并将延续到竣工以后。从合同管理到BIM软件的广泛运用，再到项目管理方法中关于不同国际标准的协调，人员的调度和计划的部署就像每天架设钢结构的工人在高空中舞蹈一样精彩。本节总结了为保证施工进程的顺利和高效而采取的一些主要步骤。

Basic Planning

Planning Concept

PAFC is designed to utilize a massive space in the metropolis. It will become the landmark building in the Futian District's CBD. The western side of the PAFC will accommodate a straight north-south pathway for pedestrians, along with café shops to enhance the environment.

Basement Traffic Planning

It is anticipated that tourists and shoppers could directly enter PAFC through CoCo Park or an underground shopping mall. Also, tourists could enter the main PAFC lobby from Fu Hua Road, MTR mall or the MTR station. The subway is not only convenient for tourists, but it also saves time for the pedestrians navigating on the street level throughout densely populated areas. The PAFC basement is connected to the basements of four other street zones. This will substantially enhance the efficacy of all services around the district. Trucks could make use of the multi-purpose driveway from the vehicular ramp to connect to other zones from the PAFC basement.

Main Street Traffic Management

The Shenzhen Metro lines 1 and 3 transfer stops are located at the northwestern side of the PAFC lot. The Shenzhen Metro line 1 platform is located at the northern side of the PAFC lot. There is a pathway connecting the Shenzhen Metro station and PAFC to allow passengers a direct entrance (see Figure 6.25).

The Guangzhou-Shenzhen Railway Station is located at the northeast side of the PAFC lot. Its platform connects to Shenzhen Metro line 1, so that passengers could directly enter PAFC.

There are some entrances of the main centers in the northeast and northwest corners of the PAFC lot. There is also a pedestrian walkway adjacent to the eastern end of the PAFC lot.

Pedestrian Bridge Planning

There is a link bridge over Fu Hua 3rd Road which provides an alternative access between the north and south tower.

基础规划

规划概念

平安金融中心被设计成一个巨大的都市共享空间，并将成为福田区中心商务区的地标建筑。中心的西侧将布置一条南北向的步行通道，两侧分布着许多咖啡店来增强环境氛围。

地下交通空间规划

规划希望游人能够直接通过可可公园和大型地下商场进入到金融中心。同时游人也可以从福华路MRT商场以及MRT站直接进入中心的主要大堂。地下空间不光对游人方便，而且为行人节省了穿越人群密集街道的时间。另外，金融中心的地下空间还与另外的四个街区相连。这将极大地提高整个街区的服务效率。火车可以通过多功能机动车道从金融中心的坡道进入到其他区域。

主要街道的交通管理

深圳地铁1号线和3号线的换乘中心坐落在金融中心地块的西北角。1号线的站在中心的北侧，并且直接与中心相连(见图6.25)。

广深港火车站坐落在金融中心地块的东北角。它不仅与地铁1号线相连，也能直接进入金融中心。

交通与流线 | 公共交通 Traffic & Circulation | Public Transportation



Figure 6.25. Traffic management plan (Source: Ping An)
图6.25. 平安金融中心附近的交通路线图 (来源: 平安)

Design Inputs

With reference to the basic design parameters of the project as listed in Table 6.2, the following practical factors were fully taken into consideration during the preliminary design and design development stages.

Sub-Structure Design

The PAFC's subsurface design includes the design of excavation and lateral support, selection of construction method, e.g. bottom-up construction and top-down construction, consideration of utility and traffic diversion, selection of the main tower structures, consideration of basement and podium independent from the construction method, in order to ensure that the construction of the main tower was not on a critical path.

Super-Structure Design

The design of the superstructure incorporated numerous elements to ensure a smooth, efficient and green result. The team first had to ascertain Ping An's requirements on building height, structural form and layout planning.

在金融中心地块的东北和西北角有几条主要城市支路进入这个区域，同时人行通道也与中心的东侧相邻。

步行桥的规划

在福华三路上提供了一个连接北塔和南塔的天桥。

更多设计信息

如表6.2所示建筑的基本设计指标，这些因素在初步设计和设计深化过程中都得到了关注。

底层结构设计

底层结构设计包括基坑侧面支撑和建造方法的选择，例如：是采取自下而上建设还是自上而下的建设，考虑功能分区和交通分区，主楼的结构选择，考虑地下建筑和群楼建筑与主楼的独立建设等。

上层建筑的设计

平安公司要求的建筑高度，结构形式和平面布局、建筑顺序，如：核心筒要快于巨柱，巨柱要快于结构钢梁，结构钢梁要快于楼面。高性能混凝土的使用，如：高易和性使其提高效率和质量，尤其是300米以上高度的混凝土。高强预应力钢筋的使用使建筑的总用钢梁减少（见图6.26）。同样，高强预应力钢筋的使用使建筑自重降低。

电梯、立面和幕墙的简化和标准化结构设计使爬升系统速度提高。

增强建筑设备的交通流线。

建筑设备的安装

根据建设分期设计独立的消防系统。

为了达到施工过程中物料的高效提升，提供了独立的上人电梯，货梯，塔吊和观测电梯。建立施工进度里程碑。

Description 名称	Design parameters 设计指标
Construction site area 建筑用地面积	18,931.74m ²
GFA 建筑面积	459,525m ²
Building height/stories 建筑高度	660m/115 stories 660米/115层
Basement depth/stories 地下建筑	30m/5 stories 30米/5层
Podium height/stories 群楼建筑	52m/8 stories 52米/8层
Site coverage 建筑退线	65% Eastern boundary: 6m offset 东边界: 后退6米 Southern boundary: 10m offset 南边界: 后退10米 Western boundary: 6m offset 西边界: 后退6米 Northern boundary: 3m offset 北边界: 后退3米

Table 6.2. Basic design parameters.
表6.2.基本设计指标

Next, the construction sequence was determined, beginning with the core wall before the megacolumns, megacolumns before structural steel beams, and steel beams ahead of composite decking. The team resolved to use high-performance concrete, for its high workability and to increase efficiency and quality, especially when poured at altitudes of 300 meters or more above grade. High-strength steel reinforcement bars were adopted, thus reducing the total amount of steel reinforcement bars. Similarly, high-strength structural steel was adopted, thus reducing the total amount of structural steel (see Figure 6.26). Both of these moves resulted in a reduction of the ultimate load exerted on the structure.

The design of the structure adjacent to elevators, façades and curtain walls was simplified and standardized, so that the efficiency of climbing systems could be increased.

In addition, the structure was optimized so as to support MEP systems.

MEP installation

The installation of the MEP system undertook the several approaches and considerations. Considering that the building would be occupied in phases, an independent fire engineering system was designed as per the phasing plan.

Vertical transportation components, including passenger, material, shuttle, and observation elevators were installed early, in order to achieve high efficiency in material hoisting during the construction stage.

A system of markers was set up, both for the construction schedule and for testing and commissioning of MEP equipment.

During the preparation of construction drawings, accommodations for hoisting large-sized MEP equipment and instruments were taken into full consideration.

BIM Application

The deployment of BIM greatly aided the successful execution of the project. It was made more useful by the team's approach to BIM, which included modeling combined service drawings (CSD) and combined builder work drawings (CBWD) and optimizing these; checking the encroachment of structural elements against MEP, and MEP components against each other, to minimize duplicate handling; quantifying building materials, facilitating visual information exchange, and surrendering the completed BIM model to the operation and maintenance team.

建立检测和预定所有设备的里程碑。

在施工图阶段充分考虑大型工程设备的管理。

BIM的使用

对设备图纸和施工图纸进行建模。通过应用BIM系统检查结构与设备的冲突以及设备与设备之间的冲突。优化设备和施工图;建筑材料的量化;视觉信息的交换;将完整的BIM系统已交给建筑的运营和维护者。

“绿色”建筑

为了实现绿色建筑的构想,设计团队做了一下努力。

- 自2009年2月起,建筑施工按照美国LEED标准保证绿色设计,绿色施工和绿色实施,并获得了金牌证书。
- 为达到LEED的标准,评估师做出了一系列对幕墙,能耗,保温,水可持续性等问题针对深圳区位和气候的分析。
- 基于建筑表现的评估建立建筑耗能模拟,使建筑与ASHRAE / IESNA标准相比节能18.25%。
- 通过水的循环利用,使用水量降低30%。提供了1000辆自行车停车位。为电能汽车提供充电装置。
- 使用至少50%的由森林保护局认证的木材。

50%的屋顶绿化,屋面材料具有较强的反太阳辐射系数。使用T5灯泡,建筑外墙安装日光敏感器,办公区域安装触发器。冰储存系统在低峰期储存能量。雨水收集系统提供灌溉,给水和清洁用水。使用800公里内的本地材料。

使用低挥发性产品。重复利用建筑材料。提供用户手册。

近期,“绿色设计”在中国得到强调。从2013年8月20日起,所有新建筑都要达到“1星”或者“铜牌认证”。

非常幸运,本项目会远超这些目标。

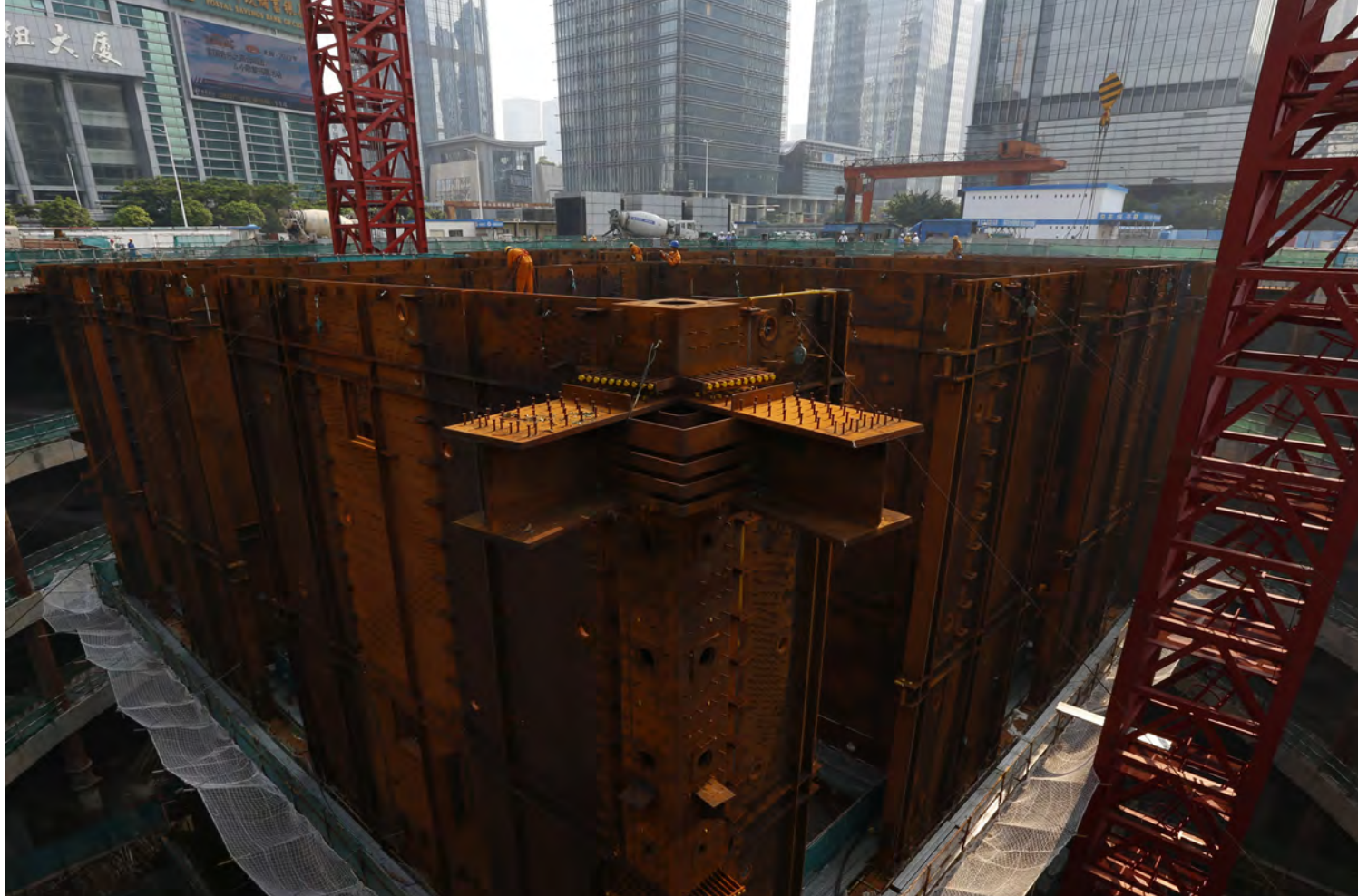


Figure 6.26. The high-strength structural steel used in the construction (Source: Ping An)
图6.26. 平安金融中心中应用的高强度结构钢 (来源: 平安)

“Green” Building

To achieve a green building within desired parameters, the team undertook the following steps.

- From the outset of design in February 2009, the team applied and executed USGBC LEED construction standards to ensure “green design, green construction, and green application” over the project. PAFC aims to achieve a LEED Gold certification.
- In order to satisfy LEED Gold requirements, the project LEED consultant carried out a series of technical analyses including: curtain wall analysis, energy consumption simulations, ice storage system analysis, water resource sustainability analysis, and others, with ample consideration of the location and climate in Shenzhen.
- The consultant also conducted building performance assessments to simulate building energy consumption, in order to save energy up to 18.25% by comparing the ASHRAE / IESNA criteria.
- Further assessments reduced water consumption by 30% through recycling, provided over 1000 parking spaces for bicycles, and provided electric chargers for private electric cars.
- Used at least 50% Forest Stewardship Council-certified wooden products

In the interest of controlling energy consumption, the design team committed to covering 50% of the roof area with plants and other roofing materials that have a high solar reflective index; specified T5 lamps, installed daylight sensors along external walls and installed office areas with light sensors; utilized ice-storage systems to store energy during non-peak hours; collected rainwater for irrigation, general water supply and cleaning; specified local materials, defined as being sourced from within an 800-kilometer radius.

In further support of sustainable goals, the team specified the use of interior finish products with low Volatile Organic Compound (VOC) content, the re-use of building materials, and provided tenant handbooks.

Recently, “green design” has been enforced in China. In Shenzhen, starting from August 20th, 2013, all new buildings were required to be designed to meet “1-Star” or “Bronze medal” requirements.

Fortunately, this project will be well ahead of that goal.

招标采购

为了在控制成本和预算的同时获得达标的质量，平安中心在现有合同框架的基础上引进了国际先进的项目管理方法，并结合国际先进的工程项目管理模式，建立了完善的合同架构体系。合同分为顾问类和工程类，工程类合同采用总承包模式。专业工程和重要设备/材料以指定分包及指定供应的形式由业主和总包共同招标确定，明确中标单位、合同价格、技术规格要求、工作界面和管理要求，加强建设方对分包单位选择的管控。

为了充分考虑市场有效性，业主对总包商的监督是通过监管所有的分包商和供货商的报价，资质证书，分工协议来实现的。总包商和分包商以及供应商都相互签署协议。因此协调工作就转移到了建筑商身上，责任和风险也由建筑商来承担。

根据2011年中华人民共和国招标投标法，投标人，监理方以及各个级别的承包商，材料商，设备商，尤其是总承包商的资质和声誉必须通过资格预审。

施工管理

施工管理包括合同监管和场地管理 (见图 6.27)。

合同监管

在前面提到的招标管理中，所有的分包商



Figure 6.27. Site management team (Source: Ping An)
图6.27. 平安金融中心施工现场管理 (来源: 平安)

Procurement

In order to achieve appropriate costs and budgets, project completion, and acceptable quality standards, PAFC was based on a “current contract” format, which takes into consideration international advanced project management methodologies to establish a unique contracting system. Contracts were divided into two types: engineering and consultancy. The engineering contracts included a main contractor, specialized contractors and nominated suppliers.

With full consideration of market effectiveness, the supervision between the main contractors and sub-contractors, all nominated sub-contractors and nominated suppliers were co-determined by the client and main contractors with prices, technical specifications, demarcation, and requirements on specified by management. The contract was signed between the main contractor and sub-contractors, or contractors and suppliers. Hence, work coordination, responsibilities and risks could be shifted to contractors.

In accordance with the 2011 Tendering and Bidding Law of the People’s Republic of China (translated), pre-qualification must be carried out prior to tendering on consultants, supervising engineers, all types and levels of contractors, material suppliers, MEP equipment suppliers, and especially the main contractors, to ensure that a reputable team is assembled before contract execution.

Construction Management

Construction management includes contract administration and site management (see Figure 6.27).

Contract administration

As stated in the procurement above, all sub-contractor contracts were under the main contract. There were two main contractors; one was to construct the main structure, and one was to install MEP. In this article, both are generally referred to as “main contractors.” The main contractors’ responsibilities were to take the lead in site safety, quality control and assurance, construction program and progress, and coordination between their sub-contractors. The main contractors were responsible for certifying the work that was done by their sub-contractors, in addition to the settlement of payments.

The contractor team introduced some of the following innovations and improvements. In order to improve the efficiency of transportation and installation, the welding gap between horizontal and vertical steel elements and the rational division of each component had been optimized during the design development stage. In order to speed up the construction of partition walls, rational planning and division of light-gauge steel wall joists were introduced

都是与总包商签署合同的。因此这里有两个主要的承包商，一个是负责建筑结构施工的，另一个是负责设备安装的。在本文中，总体上讲这两个都被称为总包商。总包商全面负责项目的场地安全，质量监控，施工进度和分包商的协调与管理。另外，总包商还负责施工验收和费用支付。

在深化设计阶段，优化钢构件横竖焊缝设置，合理设置构件分段加工，以便提高运输和安装效率。合理规划、分区使用轻钢龙骨墙体，减轻主体结构负荷，减少湿作业，减轻垂直运输压力，加快隔墙施工进度。结合结构设计方案，选择优质高效的核心筒爬模体系，以便调高爬模拆装及更换效率，加快进度，提高混凝土质量。通过合同手段或经济措施，充分调动、激励总包单位的项目协调管理潜力，化解或减少总包与分包单位之间的冲突。严格筛选材料、设备供应商，定期抽查、抽检混凝土、钢筋、钢材等主要原材料，确保保质保量供货。从制度上、技术上、现场管理和人员意识等方面，加强安全管控，杜绝重大安全事故。制定符合企业特征和项目需求的管理制度和数据网络平台，提高日常管理效率。

场地管理

在场地管理方面一下内容被充分的考虑。加强场地安全管理；加强质量管理；加强各层分包商之间的联系；塔吊的位置；场地的规划；优化横竖构建焊接节点；合理使用轻质石膏板来减轻结构重量，减少湿作业，减少湿作业，减轻垂直运输压力，加快隔墙施工进度。

to reduce structural load, wet work and vertical transportation requirements. In order to speed up the construction of the central core, climbing framework systems were introduced in conjunction with the structural design. Contract control and economic incentives were used to encourage and promote coordination between sub-contractors, in addition to avoiding conflicts. To ensure careful selection of materials; MEP suppliers regularly inspected concrete, steel bars and steel products to ensure quality and quantity of supply. The contractor team avoided significant safety hazards through systematic technical, site and staff management. It was also the contractors' duty to provide appropriate management systems and databases for the company and project, and to improve the efficiency of daily management.

Site Management

Regarding site management, the following factors were fully taken into consideration during the construction stage: Execution of site safety measures, execution of quality control and assurance, cooperation with all levels of contractors, crane location, planning of the site layout, optimization of vertical and horizontal welding joints for steel structures, and stipulating the reasonable use of gypsum boards to reduce loading on structures, to reduce working on wet operations, to eliminate loading on hoisted materials, and to reduce the construction schedule.

Completion and Inspection

Client Requirements

To meet the high demands of the project, the team divided inspections of practical completion into lower and upper zones so that installation of the lower zone could be commenced earlier.

Supervising Engineer Roles

This was aided by the presence of a supervising engineer, who finalized the handover standards and client requirements as soon as possible so as to prepare the as-built drawings, witnessed all checks and inspections, collected all necessary documents for archiving as early as possible, and Liaised with governmental departments regarding statutory inspections.

Operation

The property management company, a subsidiary of Ping An Group, joined the design and planning process as early as possible so that inputs from the property management company could be considered during the construction stage; there is a clear understanding of the final statutory inspections that will be facilitated in the handover; and so that operational training to potential operators is provided.

竣工验收

客户要求

底层和上层建筑分期验收，这样可以使底层的安装工程提前开始。

监管工程师职责

将客户提出的标准和要求迅速转换成施工图纸；所有的质量检查都要莅临现场；及时进行文件归档；积极与政府部门对接相关法律法规的检查。

运营接管

平安下属的物业管理公司在最早的时机进入项目，这样可以达到：物业管理公司的需求可以在施工阶段得以考虑。了解最终合法验收和协助建筑移交工作，为未来的运营者提供培训。

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