THE CONSTRUCTION OF PING AN FINANCE CENTRE
HEIGHT

SPEED

SAFETY
THE PING AN FINANCE CENTRE HAS BEEN RISING AT THE RATE OF 1M² PER DAY.

32,000 M³ OF CONCRETE FOR THE MAT SLAB WAS POURED WITHIN 72 HOURS. THIS VOLUME OF CONCRETE IS EQUIVALENT TO 416,750 TERRACOTTA WARRIORS.

1 M² OF CURTAIN WALL IS INSTALLED EVERY 4 MINUTES.
March 2010
Excavation started

October 2010
-29.5m bottom level of mat slab

December 2011
The construction of the mat slab was completed

May 2012
Lifting of steel structure started
December 2012
60 meters above ground

December 2013
300 meters above ground

December 2014
Structural top out @ 555.5m

December, 2016
Completion

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Key technologies for design and construction of ultra-deep foundation pits in Ping An Finance Centre

1. Challenges
2. Technical measures

- Designed as a support system with double-ring internal support
- Applied numerical simulation to evaluate surrounding environment deformation
- Applied calculation model to study pile-soil interface during soil removal
Key technologies for design and construction of ultra-deep foundation pits in Ping An Finance Centre

2. Technical measures

- North side - bored pile + waterproof curtain + 5 reinforced concrete internal support
- Large surface - bored pile + waterproof curtain + 4 reinforced concrete internal support + 2 anchors
Key technologies for design and construction of ultra-deep foundation pits in Ping An Finance Centre

- March 2010: Construction of lateral support for foundation pit
- May 2010: Construction of first layer of lateral support
- September 2010: Completion of construction of the third layer of lateral support
- December 2010: Foundation pit was dug
- March 2011: Piling construction began
- October 2011: Construction of pile raft
- January 2012: Pile raft was completed
- June 2012: Core wall SPSW installation started
Key technologies for design and construction of ultra-deep foundation pits in Ping An Finance Center

3. End up with

10% Reduced the construction period by nearly 10%
2.5mm Lateral deformation
Key technologies for the construction of rock-socketed end-bearing piles with large diameter and hand digging

1. Challenges

- Diameter up to 8.0m
- The longest pile length is 35m

The construction technology of hand digging and blasting of rock-socketed end-bearing piles were the only solution
Key technologies for the construction of rock-socketed end-bearing piles with large diameter and hand digging

2. Technical measures

1. Bedrock fissure grouting and water stoppage and advanced small duct grouting
2. Advanced mini pile
3. Blasting technology for rock formation below moderately weathered situation

construction process

- Design of bedrock fissure grouting sealing scheme
- Bedrock fissure grouting construction
- Pile positioning and locking
- Pile hole excavation
- Pile hole safety protection measures construction
- Retaining wall rebar binding
- Retaining wall formwork support
- Blasting of rock formation below moderately weathered situation
- Pile body reinforcement cage construction and installation
- Pile core mass concrete pouring
- Pile concrete temperature monitoring
Key technologies for the construction of rock-socketed end-bearing piles with large diameter and hand digging

3. End up with

1. Expanded the fissure grout waterproofing and reinforcement of high-strength granite rock
2. Formed a comprehensive construction of end-bearing piles with large diameter and hand digging holes
3. Developed a smooth controlled blasting pile in coarse-grained granite
4. Method for calculating the bearing capacity of large-diameter enlarged rock-socketed piles based on the interface characteristics of rock piles and the rock quality indexes
## 1. Technical measures

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total slab area</td>
<td>About 6800 m²</td>
</tr>
<tr>
<td>Octagon unilateral span</td>
<td>85 m</td>
</tr>
<tr>
<td>Volume of concrete</td>
<td>32000 m³</td>
</tr>
<tr>
<td>Thickness</td>
<td>4.5 m</td>
</tr>
<tr>
<td>C40/S12, slump requirement</td>
<td>180±20 mm</td>
</tr>
<tr>
<td>Time</td>
<td>72 Hours continuous pouring</td>
</tr>
</tbody>
</table>

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Continuous, seamless mat slab foundation construction technology

1. Technical measures

- Reliability
- Crack resistance
- Intensity
- Durability

Full-scale model tests and numerical simulation for mix proportion

Technological process:
- Other project implementation experience
- Actual situation of the location of the project
- Mass concrete mix design
- Construction preparation
- Continuous casting of concrete
- Temperature measurement and maintenance

- Orthogonal test confirmed ratio
- Internal temperature rise calculation and simulation
- Expert argumentation
- Match ratio confirmation
- Site management planning
- Material preparation
- Work force preparation
- Construction machinery preparation
- Surveying and setting out
- Set up chute, fix pump
- Mass concrete continuous pouring
- Concrete curing
- Concrete temperature measurement
- Concrete sampling test

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Continuous, seamless mat slab foundation construction technology

1. Technical measures

(1) Selection of raw materials
(2) Concrete mix design and full-scale model test
(3) Seamless continuous casting of mass concrete slab
Max Temperature: 62.5 C
2. End up with

1. Developed "High performance concrete mix design - simulated construction, temperature and stress distribution calculation - continuous seamless rapid concreting" technology

2. Developed high-performance concrete formulation technology for large-volume foundation slab

3. Method for high-precision simulation and analysis of engineering structures using full-scale model tests and finite element calculations

4. Studied the application of the chute technology and the inclined layered pouring method in the rapid construction of mass concrete
1. Challenges

- The core wall structure is complex and varies
- "Major frame-core wall-outrigger truss" lateral resistance system
2. Technical measures

(1) Formwork design

- Formwork fixing layout plan
- Formwork inside core wall
- Formwork outside core wall

600-meter supertall concrete structure hydraulic climbing formwork system
2. Technical measures

(2) Formwork construction

Accumulative adduction of 1000mm on the outside of the external wall, the maximum change of 300mm, the internal wall accumulative adduction of 400mm, the maximum change of 200mm.

Diagonal climbing super-heavy body construction
2. Technical measures

(3) Formwork monitoring

600-meter supertall concrete structure hydraulic climbing formwork system

Climbing formwork inner tower model

Climbing formwork outer trigger model
3. End up with

The core wall averages 4 days per floor

2.5 days per floor at the fastest speed

600-meter supertall concrete structure hydraulic climbing formwork system
1. Challenges

- The carbon equivalent of the cast steel is Ceq=0.401%.
- Harder to weld
2. Technical measures

(1) Welding procedure qualification for welding specimens of 75mm thick G20Mn5 cast steel
(2) 1:1 simulation welding test for 200mm thick steel castings

1/3 weld welding: One-time continuous welding
2/3 weld welding: Flaw detection
3/3 weld welding: Test summary
2. Technical measures

(3) Technical disclosure and process control

Welding sequence and arc starting method

Field welding method

Welding process parameters

<table>
<thead>
<tr>
<th></th>
<th>底层</th>
<th>中间层</th>
<th>盖面层</th>
</tr>
</thead>
<tbody>
<tr>
<td>气体流量（L/min）</td>
<td>40-50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>电流（A）</td>
<td>255-300</td>
<td>300-340</td>
<td>286-320</td>
</tr>
<tr>
<td>电压（V）</td>
<td>37-40</td>
<td>40-42</td>
<td>39-41</td>
</tr>
<tr>
<td>焊接速度（cm/min）</td>
<td>40-45</td>
<td>40-45</td>
<td>40-45</td>
</tr>
</tbody>
</table>

Preheating before welding

Inter-layer temperature control

Heat preservation after welding
3. End up with

One-time completion of thickness of **220mm**

Total weld length **7.5m**

One-time pass rate **100%**

Post-weld appearance
Comprehensive application technology of cloud platform in super high-rise building construction management

- CAD\BIM drawings flow, sharing in large quantities
- Created conditions for the formation of a large database
- Provide strong hardware support and guarantee for deepening design work, BIM technology development and application, and information integration management work
- Lay the foundation for the deep application of BIM big database
Construction technology of combining large-diameter pipeline automatic welding and “top-down installation method”

- The “flip method” is to feed and weld at the bottom fixed floor. After completion, it is lifted to the floor as a whole.

- Reduce the movement of construction materials, machine tools to reduce the flow of people and provide guarantees for safe construction.
End up with

Transportation time for pipes reduced

Flexibility on the installation location

Construction technology of combining large-diameter pipeline automatic welding and “top-down installation method”
Simulation of large scale equipment hoisting and transportation

- Combine text and animation with virtual simulation and BIM
- Make it easy to find program risk factors and demonstrate their feasibility
Simulation of large scale equipment hoisting and transportation

Tower Plate Heat Exchanger Hoisting Scheme

- Plate heat exchanger entering hoisting cage
- Plate heat exchanger entering floor
- First direction adjustment in floor
- Second direction adjustment in floor
Simulation of large scale equipment hoisting and transportation
Safety Management in PAFC

- Safety management from developer

- Safety management from main contractor
Safety management from developer

- Set requirements in the contract, e.g. require to create good safety manufacture condition
- Promote safety management system and technical innovation
- Award and penalty (Prize and fine)
- Quarterly safety assessment
- Daily, monthly, quarterly safety inspection
- Stipulate personal safety conduct
- Site workers training and education, e.g. highlight to apply code for the personal protection products and facilities

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Payment for safety measures

- depends upon work done on safety measures rather than project progress
- one-way in, one-way out
Delegation of safety responsibility

With the signing of the responsibility breakdown statement, the responsibility is broken down to people, effectively improving management effectiveness.
Safety Management in PAFC

Research topics in risk control in high-rise buildings
Safety management from main contractor
Safety management from main contractor

Safety culture
ZERO casualty
THANK YOU
• 2554 days = 2009.12.3 – 2016.11.30
• ELS between 2009.12.3 – 2011.1.29 (-10% = -40d)
• Sub-structure between 2011.
• Super-structure between
5 Working Surfaces

• 1st: Structural steelwork inside core-wall (核心筒钢结构施工),
• 2nd: Reinforced concrete inside core-wall (核心筒混凝土结构),
• 3rd: Structural steelwork outside core-wall (外框钢结构施工),
• 4th: Composite structure outside core-wall (外框组合楼板施工),
• 5th: Construction of mega columns (巨柱混凝土施工)。

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• 32,000 m³ concrete in 72 hrs., 7.4 m³/min., 3 nos. sliding channels (100 m³/hr/sliding channel) + concrete pumps (3.2 万方混凝土，90 小时，6 方/分钟，3 条溜槽 天、地泵)
• 25-30m by blasting
• Concrete strength at 42d rather 28d (完善了大体积混凝土浇筑施工控温防裂 - 混凝土42天强度)
• All-direction-and-angle protection (全方位就近防护)
Safety management from main contractor

Access door monitoring by CCTV