

*Construction Management 2019
9th International CM Day
5th Global CM Contest*

PERSPECTIVE ON HIGHRISE BUILDINGS

Wang Shaofeng

Chairman, China State Construction Overseas Development Ltd.



中國建築

1

Brief Introduction about CSCEC



中國建築

The world **largest** construction & investment conglomerate



No.23 in 2018



Global Contractor
No.1 in 2018



Rating "A"

BRIEF INTRODUCTION ABOUT CSCEC



中國建築

Company	Buildings
CSCEC Group of Companies	21
Arabian Construction Company	6
Shanghai Construction Group	6
AECOM	4
Brookfield Multiplex	4
Samsung C&T Corporation	4
Hong Kong Construction (Holdings) Limited	3
Kumagai Gumi	3
Saudi Bin Laden Group	3
Turner Construction Company	3
Arabtec	2
Besix	2
Dubai Civil Engineering	2
Guangzhou Municipal Construction Group JV	2
Lend Lease	2

2

Distribution Trend of Highrise Buildings



中國建築

DISTRIBUTION TREND OF HIGH-RISE BUILDING AROUND THE WORLD

1. The Inevitability of Highrise Building Development

The Marketing Characteristic of the Land in the City

- ◆ The land cost reach to certain level
- ◆ The land in important area is scarce

The Development Stage of Urbanization

- ◆ Primary Stage: Urbanization < 30%
- ◆ Accelerating Stage: Urbanization 30%--65%
- ◆ Late Stage: Urbanization > 65%

The Highrise Building is inevitable based on the Urbanization Development. In more and more developing countries along the One Belt One Road, when their Urbanization come to certain stage, the Highrise Building will be coming definitely.

DISTRIBUTION TREND OF HIGH-RISE BUILDING AROUND THE WORLD

More than 80% built super high-rise buildings locate in Asia

More than 90% super high-rise buildings under construction locate in Asia

The data above indicated that the distribution of high-rise building generally has close connection with the urbanization process of the region. Most Asian countries, including China, are in fast development phase of urbanization, and subsequently, more high-rise even super high-rise buildings spring up nowadays

Along with the end of urbanization in developed country, the market of super high-rise buildings are transferring to developing countries, for example, In countries along the Belt and Road, including Southeast Asia, Middle East, North and East Africa and so on, as the largest contractor of China, CSCEC had taken active part in the construction of high-rise buildings in various countries and regions with great honor

DISTRIBUTION TREND OF HIGH-RISE BUILDING AROUND THE WORLD

Dream Tower
168m

CBE Tower
206m

ASTAKA Twin Tower
275m

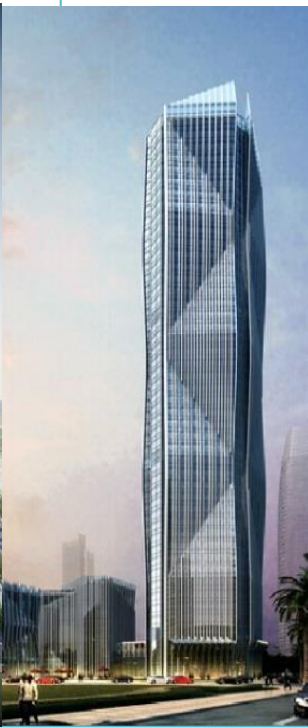
Sundi Center
208m

Indonesia 1
303m

Iconic Tower
386m

Exchange 106
452m

Signature Tower
638m



Jeju, Korea

Addis, Ethiopia

Johor, Malaysia

Auckland, N. Z.

Jakarta, Indonesia

Cairo, Egypt

KL, Malaysia

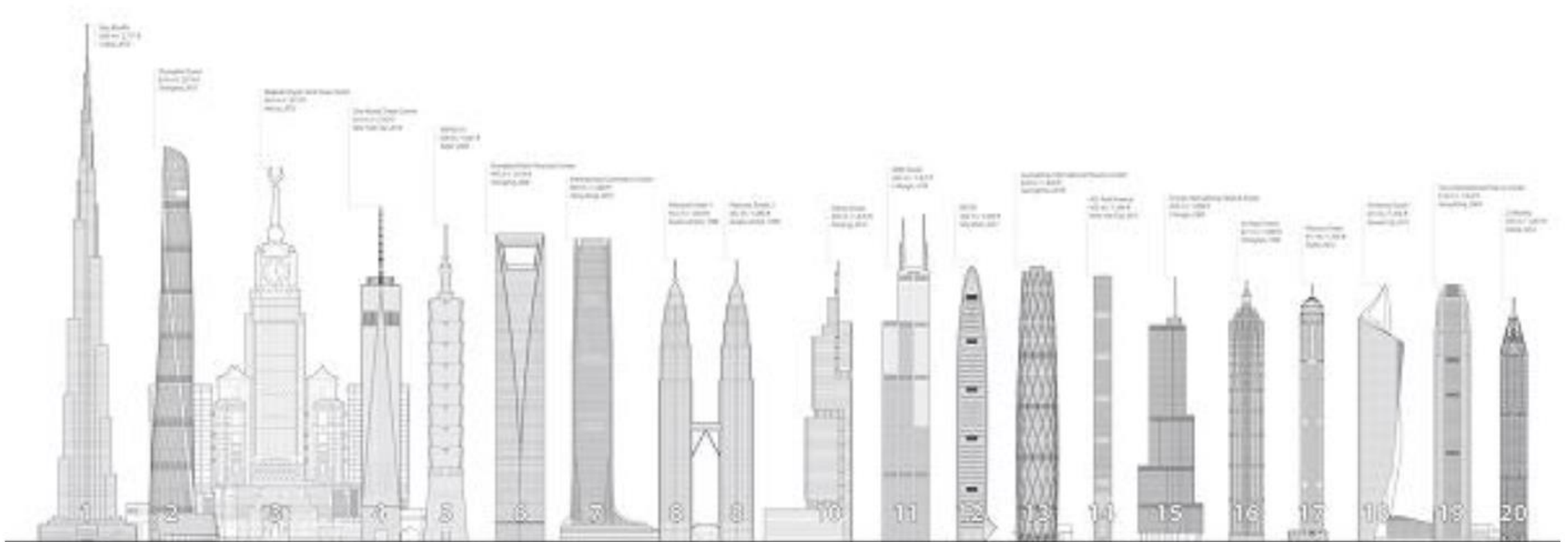
Jakarta, Indonesia

Tallest Buildings in certain region/country, which are executed and to be executed by CSCEC

DISTRIBUTION TREND OF HIGH-RISE BUILDING AROUND THE WORLD

2. The Super Highrise Building is quite effective to promote city reputation

To make the city more open and enhance the city management



Source: Council on Tall Building and Urban Habitat, 2016

DISTRIBUTION TREND OF HIGH-RISE BUILDING AROUND THE WORLD

3. Based on the Super Highrise Building, CBD will be created. This can push the infrastructure and region development.

Above model has been verified in many practical case



- The Empire State Building has pushed the creation of Manhattan Financial Area.



- The Twin Tower in KL has pushed creation of the CBD of KL.



- The Shanghai World Financial Center has pushed the creation of Lujiazui CBD.

- The Hong Kong China Bank Building has pushed the creation of Financial Area.



- The Shard Tower has pushed the development of London South.



3

How to Build Highrise Buildings



中國建築



中建掌握千米级超高层建筑施工核心技术 |

Know how - to Build Skyscraper Stand Up to 1000 M

1、智能化超高层建筑施工集成平台 Intellectualized Integrated Construction Platform

2、超高层垂直运输体系 Vertical transportation system for Super High-rise Building

3、超高层混凝土泵运送 Concrete Formula & Pumping Methodology for Super High-rise Building

4、超高层钢结构施工技术 Structural Steel Fabrication & Construction for Super High-rise Building

5、超高层机电设备安装 MEP System Construction Methodology for Super High-rise Building

6、超深基坑施工技术 Construction Methodology for Extreme Deep Foundation Pit

7、千米建筑幕墙和装饰技术 Façade & Finishes Work for Super High-rise Building

8、磁力缓降安全逃生装置及试验研究 Research on Emergency Escape & Egress system

9、超高层建筑BIM技术应用研究 BIM Application on Super High-rise Building

1 Foundation Construction – Deep Pile



Goldin Finance 117

City: Tian Jing, China Floor: 3B+117

GFA: 847,000 m² Height: 597 m

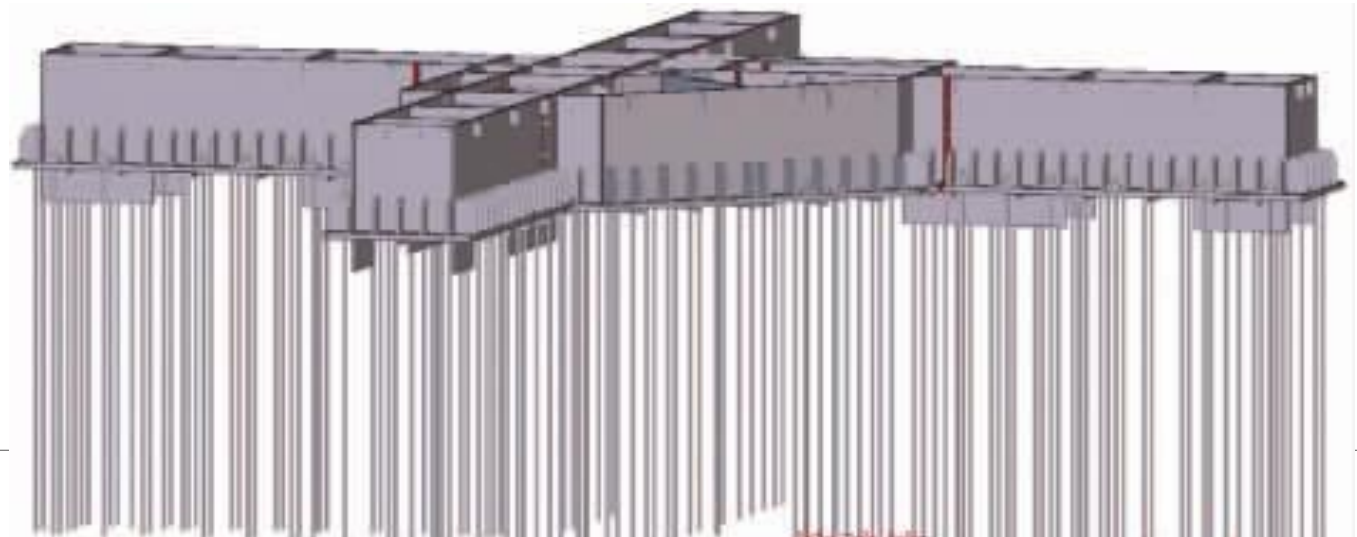
Pile design

Length: 100m

Concrete: C 55

Diameter: 1 m

Load capacity: 42,000KN



1 Foundation Construction – Deep Pile



Key Technology

- Bentonite mix
- Drill verticality control
- Long cage manufacture and connection
- Self-compacting deep water concreting
- Post grouting

Achievement

- ✓ Verticality < 1/300
- ✓ Capacity > 42,000kN

1 Foundation Construction – Composite Pit Support



Ping An Financial Center

City: Sheng Zhen, China

Floor: 5B+118

GFA: 461,000 m²

Height : 600 m

Foundation Size

Area: 18,000 m²

Deep: 29.8~33.8 m

Perimeter: 550 m

1 Foundation Construction – Composite Pit Support



Distance to:

Building : 20 m

Power line: 3.8m

Metro Line: 3.0m

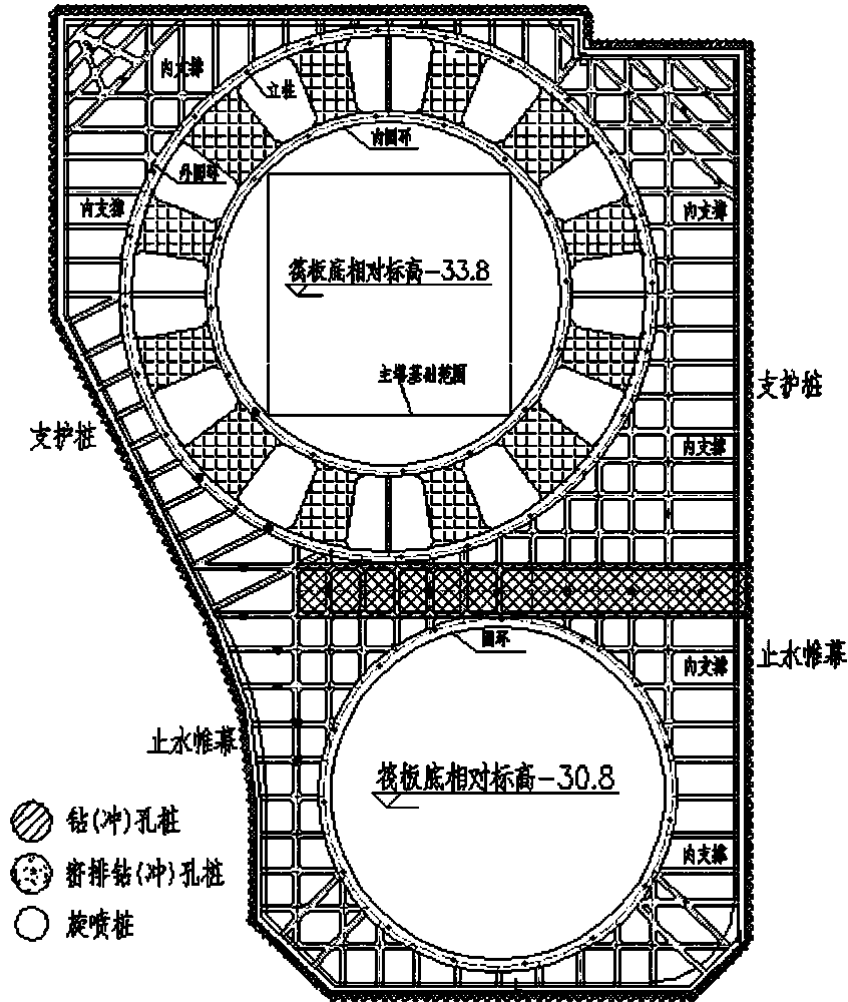
Earth work:

55,000 m³

Settlement Requirement:

< 20 mm

1 Foundation Construction – Composite Pit Support



Key Technology

- Row pile
- Inner support system
- High pressure rotary jet pile
- Permeation grouting (sleeved pile)
- Spray slurry slope protection

Achievement

- ✓ Horizontal deformation < 12mm
- ✓ Vertical settlement < 11mm
- ✓ $K < 0.086 \text{ cm/24h}$

1 Foundation Construction – Smart Monitoring System

Smart Foundation Monitoring System



Sensor



DAQ



Wireless
Transmission



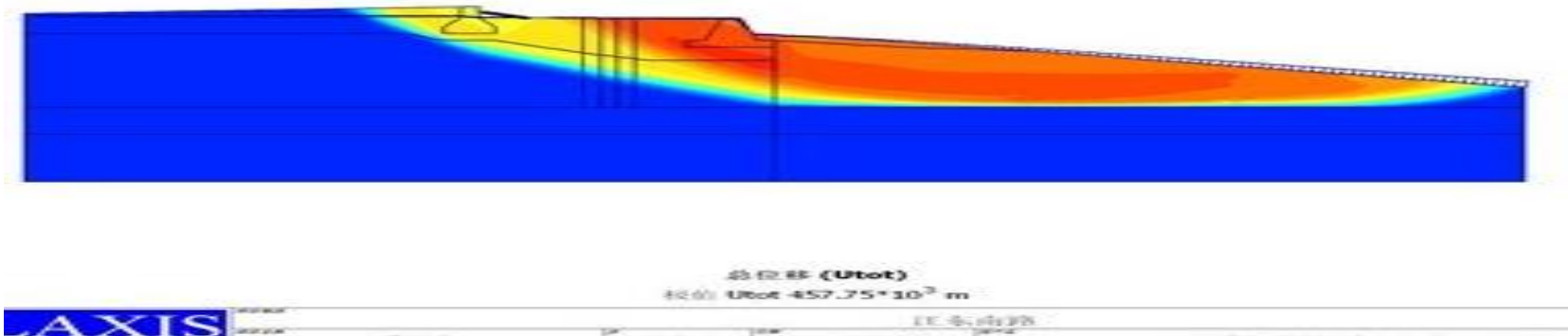
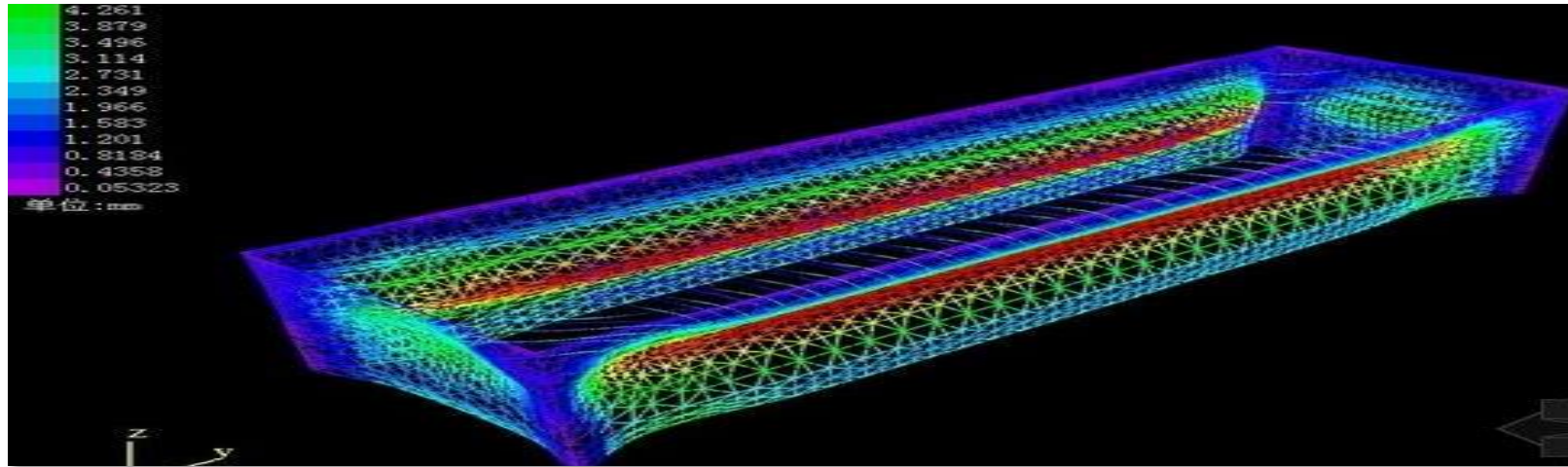
Cloud
Platforms



Monitoring
Terminal

- Dynamic Date Collecting
- Real time Analyzing
- User friendly Interface

1 Foundation Construction – Smart Monitoring System



2 Concrete Structure Construction – Mass Concrete



Signature Tower

City: Kuala Lumpur, Malaysia

Floor: 6B+93

GFA: 380,000 m²

Height : 452 m

Foundation Size

Area: 4,600 m²

Thickness: 4.2 m

Concrete Volume: 19,000 m³

2 Concrete Structure Construction – Mass Concrete



Iconic Tower

City: New Capital, Egypt

Floor: 2B+79

GFA: 241,000 m²

Height : 386 m

Foundation Size

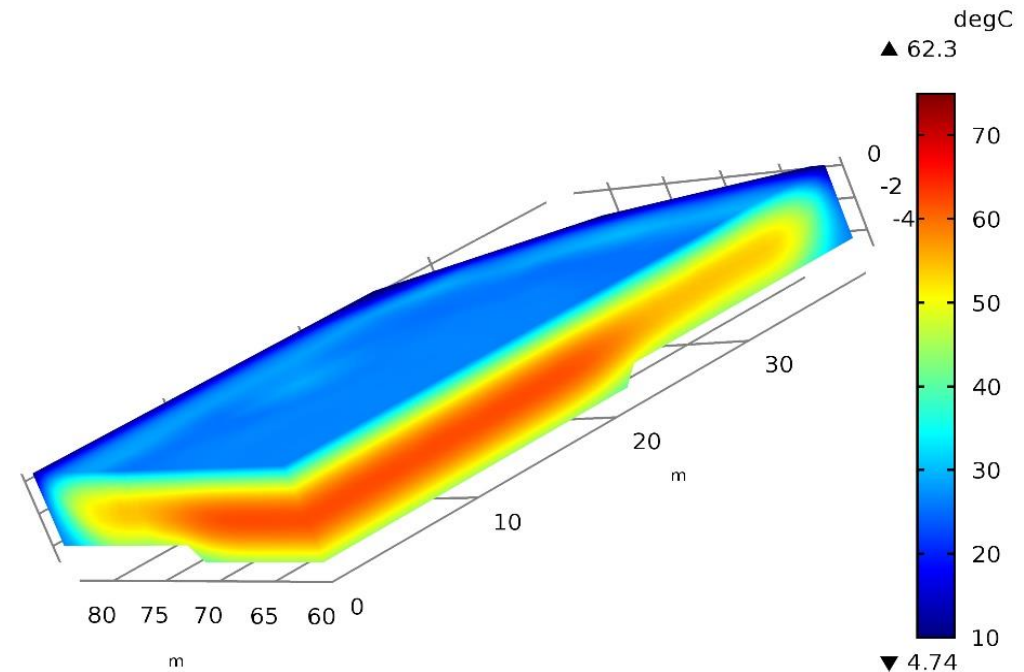
Area: 3,700 m²

Thickness: 5 m

Concrete Volume: 18,500 m³

2 Concrete Structure Construction – Mass Concrete

The key point of mass concrete construction is to control temperature gradient, the gradient of inner and surface temperature and the gradient of daily descending. By control the gradient, it can control the crack efficiently

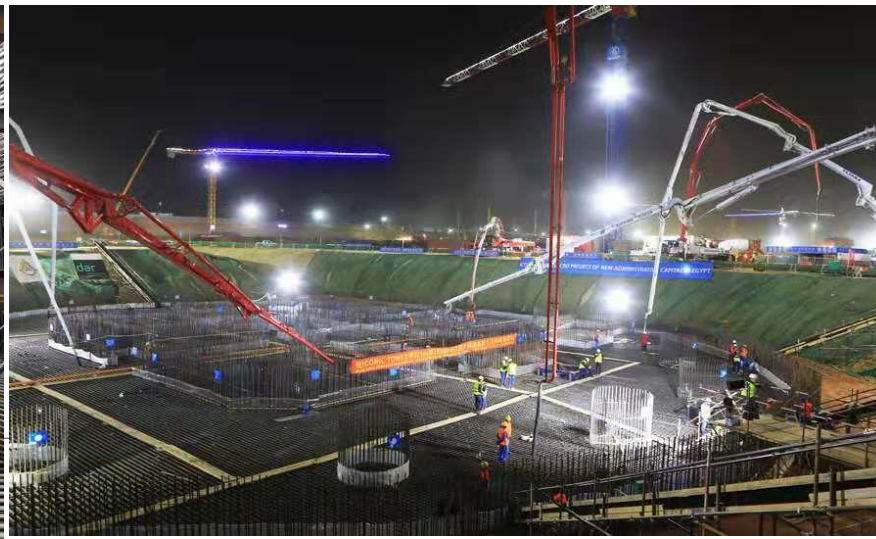


2 Concrete Structure Construction – Mass Concrete



Key Technology

- Mix Design
- Cast Progress
- Pouring method
- Workability



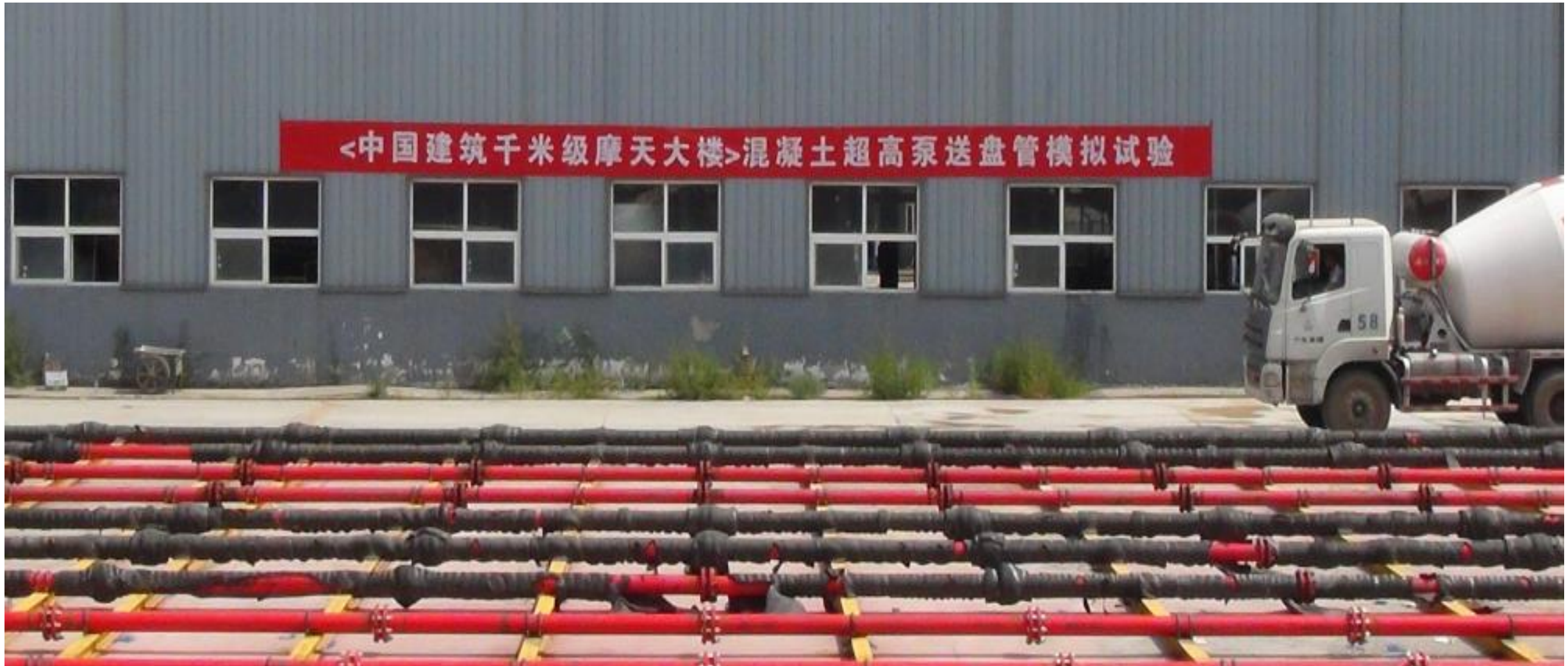
2 Concrete Structure Construction – Super High Pumping of Concrete

Highest Concrete Casting Record



2 Concrete Structure Construction – Super High Pumping of Concrete

Simulation of 1000m High Concrete Pumping



3 Steel Structure Construction – Multi-chamber Steel Column



CITIC Tower

City: Beijing, China

Floor: 7B+108

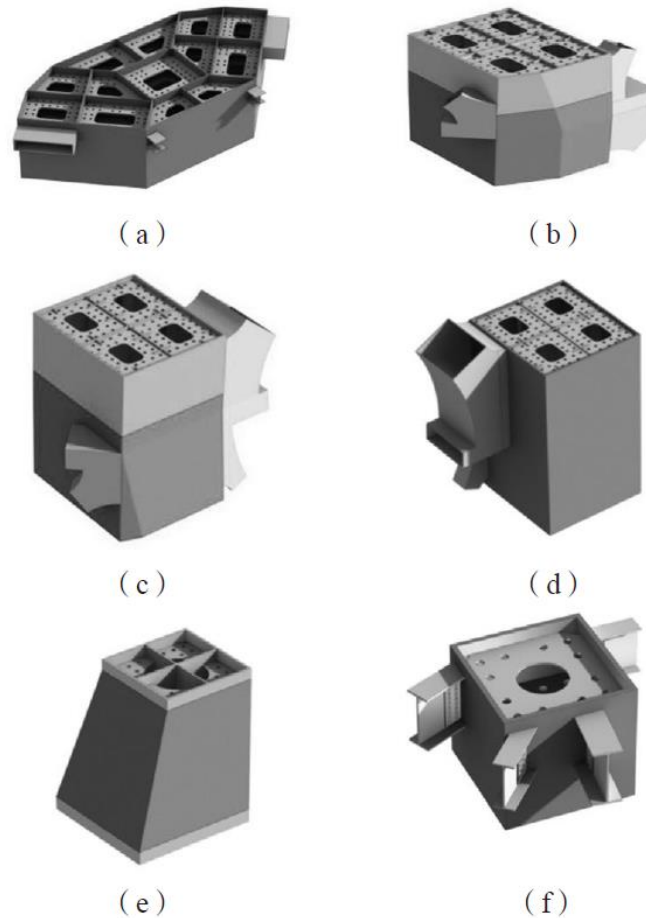
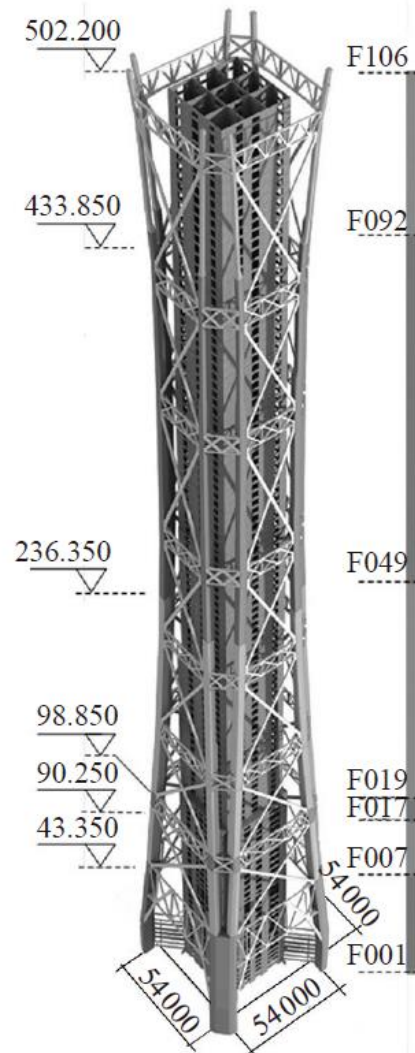
GFA: 43,7000 m²

Height : 528 m

Steel Tonnage: 50,000 T

Giant Columns: 6 types

3 Steel Structure Construction – Multi-chamber Steel Column



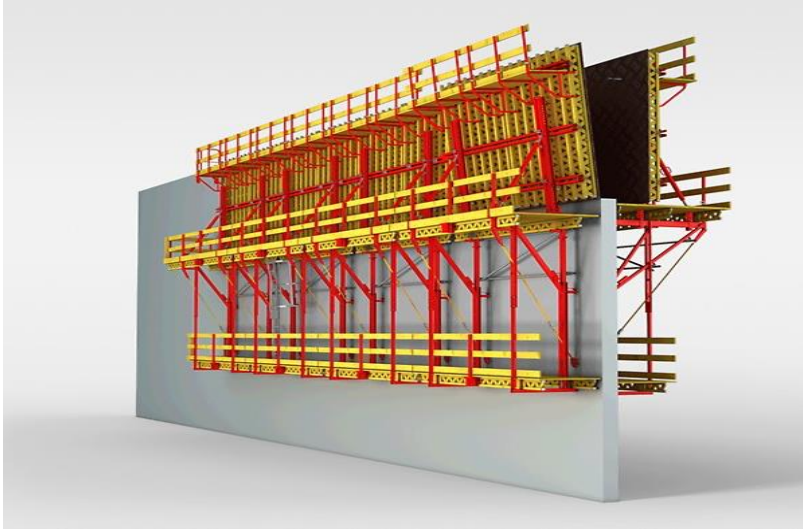
Key Technology

- Segment
- Pre-assembling
- Installation
- Welding

3 Steel Structure Construction – Multi-chamber Steel Column



4 Working Platform – Platform v1.0



Platform v1.0

Self –climbing Formwork

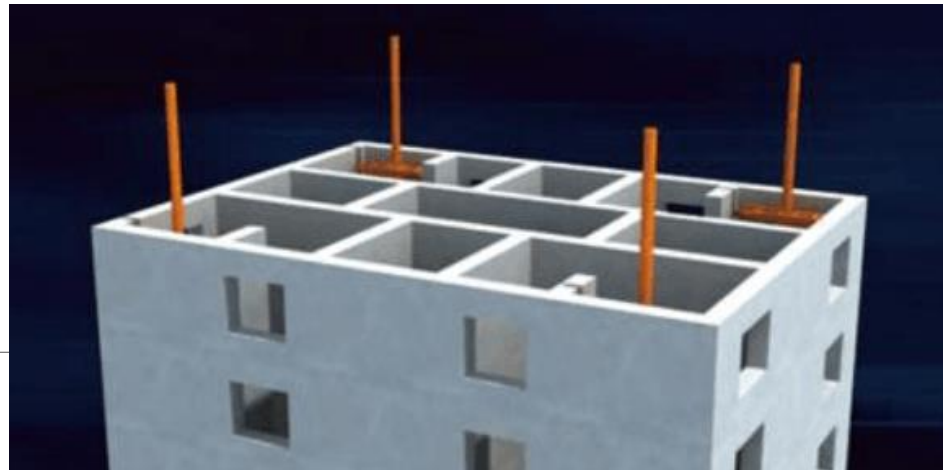
Climbing formwork is lack of bearing capacity, CSCEC develop the low point jacking working platform, the single support can bear about 400 Tons construction load, improve the workability and safety.

4 Working Platform – Platform v1.0



Key Technology

- Low Point Jacking
- Less supporting point
- Long climbing distance



4 Working Platform – Platform v2.0



Key Technology

- High Bearing Capacity
- Integrate Platform
- Recyclable

4 Working Platform – Platform v3.0



Greenland Tower

City: Wuhan, China

Floor : 6B+126

GFA: 303,275 m²

Height: 636 m

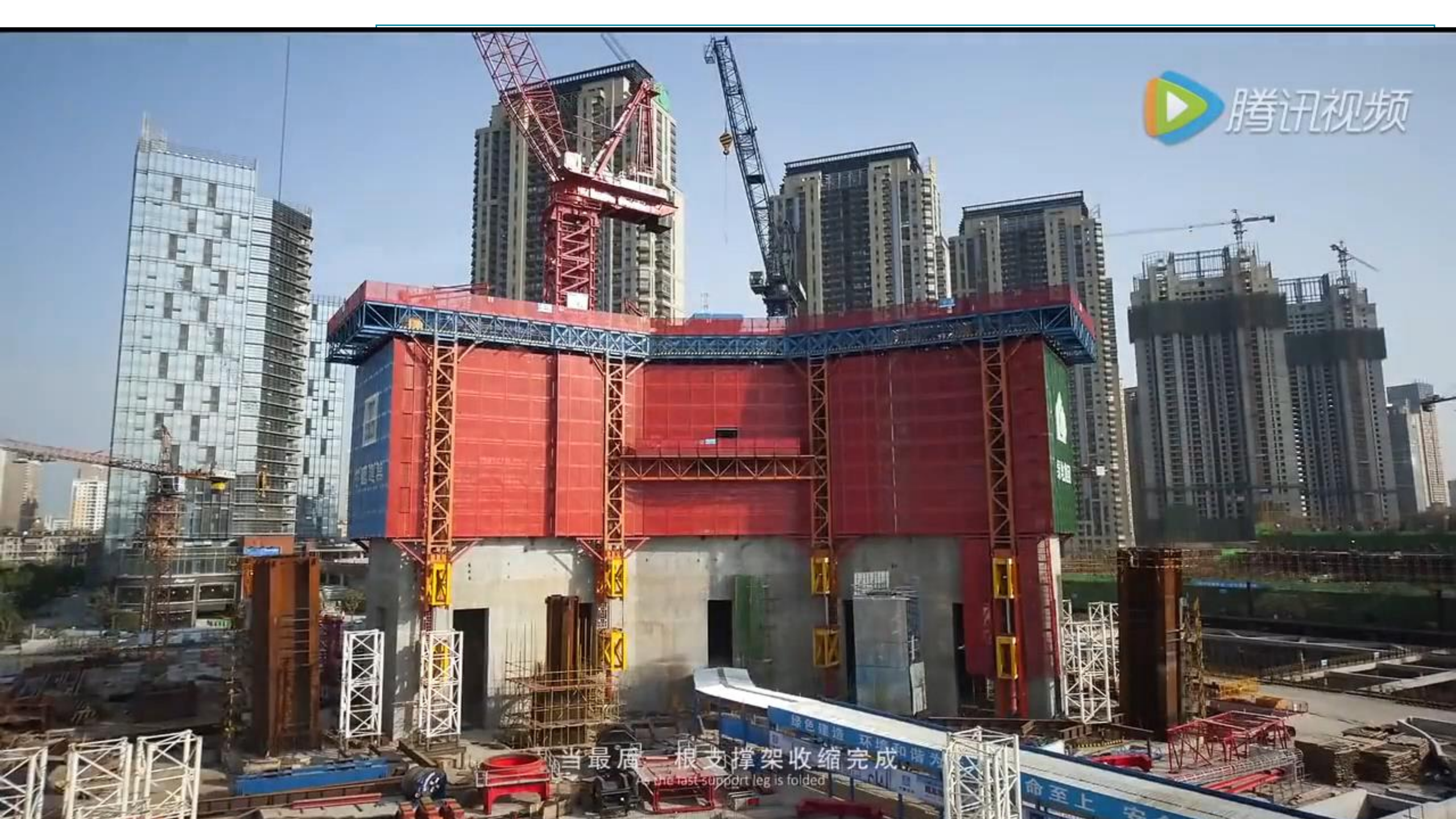


4 Working Platform – Platform v3.0



Key Technology

- Micro-Pivot Lifting
- High Loading Capacity
- Smart Control System



当最后一根支撑架收缩完成

the last support leg is folded

命至上 安全

5 Vertical Transportation – Single-Tower Multi-Cage Elevator



Key Technology

- Isolated conductor rail Power Supply
- Rail switching system
- Centralized dispatch control system
- 3 Level of safety mechanism

5 Vertical Transportation – Rotary Tower Crane



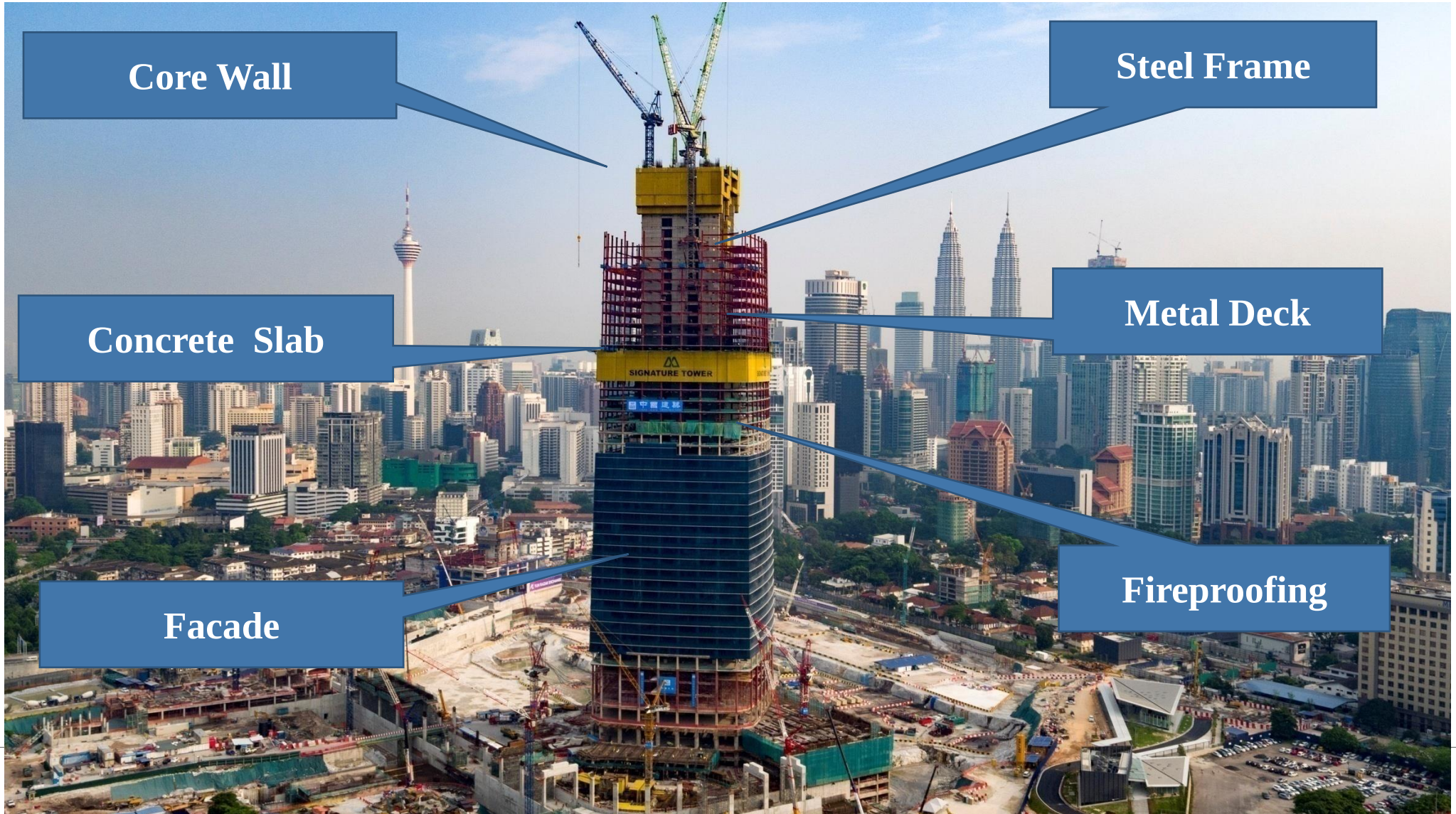
Key Technology

- Base Structure
- Rotate system
- Anti-Clash control system
- Balancing

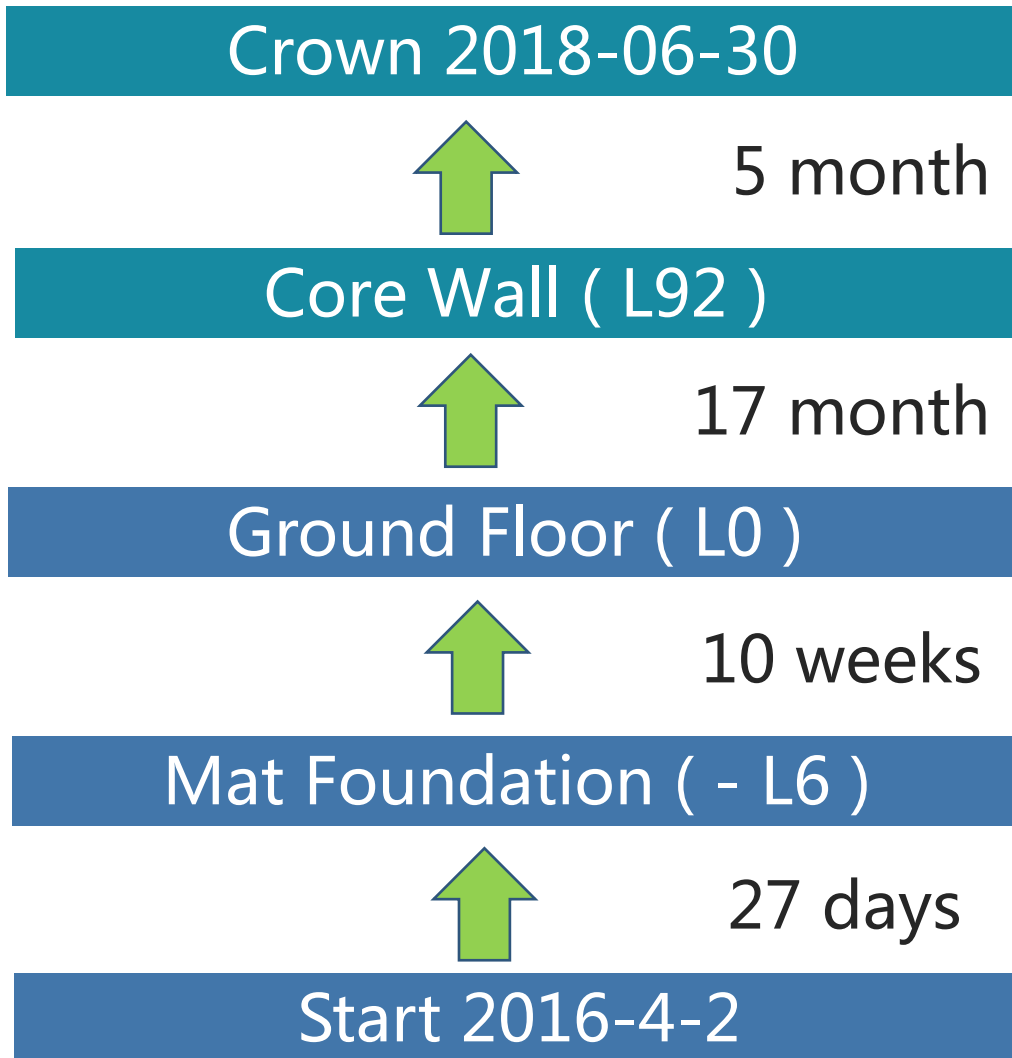
5 Vertical Transportation – Magnetic Sliding Escaping System



6 Construction Management – Compact Overlapping Management



6 Construction Management – Compact Overlapping Management



Commencement 2016-4-2





Mat Foundation (- L6) 2016-4-29



Ground Floor (L0) 2016-7-21

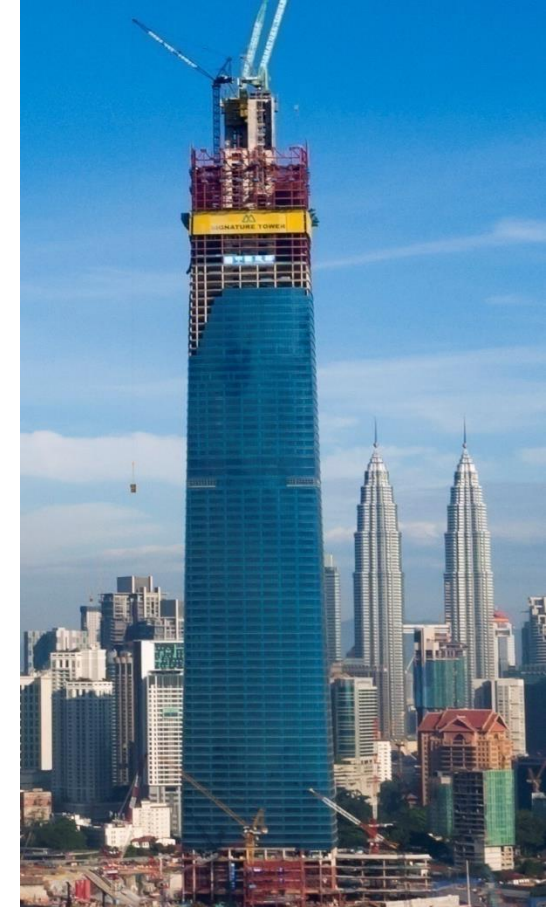


Core Wall (L92) 2017-12-20



Crown 2018-06-30

6 Construction Management – Compact Overlapping Management



Comparison of Core Wall Topping Out

6 Construction Management – Compact Overlapping Management

Construction Duration (400m ~ 500m Completed Buildings)

	Topping Out	Completion
Signature Tower	26 month	3 years
Average Durations for 17 Others	40 month	5-6 years

LAST PIONTS : *HOW TO DEVELOP THE SUPER HIGH-RISE BUILDINGS MORE REASONABLE*

■ *Problems in super high-rise buildings*

1. High construction cost and maintenance cost, low economic rationality
2. Large overall energy consumption and high carbon emissions;
3. Impact on the urban environment;
4. Poor living experience with overpopulation, etc.

■ *Principles for the development of super high-rise buildings*

1. Super high-rise buildings need to be better integrated with the environment to prevent building super high-rises for the purpose of building super high-rises.
2. The infrastructure and supporting facilities of super high-rise infrastructure needs to be improved, avoiding building super high-rises with incomplete supporting facilities.
3. The business portfolio of super high-rise buildings needs to comply with market demand, and the development stages of different countries and cities determine the development direction of the business.
4. Construction of super high-rise buildings shall follow the principles of science and moderation, avoiding one-sided pursuit of height
5. Focus on planning and evaluation of the entire life cycle of super high-rise buildings to prevent construction and operational risks

Driven by social, environmental, commercial, and operational needs, and fully considering the various issues of the building life cycle, super high-rise buildings will truly play well their role in driving the economy, enhance city competitiveness, and create better living space for human beings.