MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ARCHITECTURE / BUILDING SCIENCE PROGRAM

BS 536
STUDIES ON TALL BUILDINGS: DESIGN CONSIDERATIONS
Spring 2016-2017

Case Study: **MahaNakhon Tower**
by
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Submitted to: Assoc.Prof.Dr. Mehmet Halis Günel
Assist.Prof.Dr. Bekir Özer Ay

Figure 1: MahaNakhon Tower

Figure 1: facebook.com/MahaNakhonBKK/photos/a.258315734240051.63654.257503217654636/1177805848998697/?type=3&theater (accessed 13.03. 2017)

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Submitted to: Günel, Ay – Spring 2017

MahaNakhon Tower

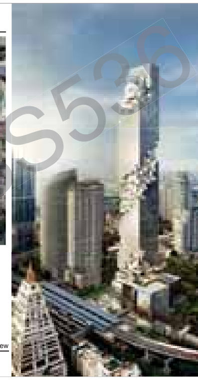
Official Name: MahaNakhon [1]
Other Names: The Ritz Carlton Residences & Edition Hotel [1]
Status: Completed [1]
Location: Bangkok, Thailand [1]
Building Function: residential / hotel [1]
Structural Material: Concrete [1]
Developer: Pace Development Corporation Plc. [1]
Architecture: Office for Metropolitan Architecture [1]
Structural Design: Bouygues Thai Ltd [1]
Global – National – City Ranking: 77 –1 –1(by April 2017) [1]
Height to Tip/Architectural: 314.2 m / 1031 ft [1]
Height Occupied: 299 m / 981 ft [1]
Floors Above Ground: 75 [1]
Floors Below Ground: 1 [1]
# of Elevators: 22 [1]
# of Apartments: 209 [1]
# of Hotel Rooms: 154 [1]
# of Parking Spaces: 899 [1]
Structural System: Outrigged Frame System [2]
Aspect Ratio: 8

Figure 2: MahaNakhon Tower

[1] n.a. The Skyscraper Center. n.d. https://skyscrapercenter.com/building/mahanakhon/8725 (accessed 13.03.2017)
[2] Structural system classification according to the lecture BS 536 in METU
Figure 2: facebook.com/MahaNakhonBKK/photos/a.258315734240051.63654.257503217654636/642592822479005/?type=3&theater (accessed 13.03.2017)

SITE

Figure 3: Site challenges



The site is famous for office towers and has a lot of embassies. At the time in 2008, it was maybe a little bit a poor second area to succumb with or see armed areas. There hadn't been a lot of development going on. However,when the fight was secured there were a number of new developments about to take places a well. The most challenges site issue was the BTS Station, which is in front of the tower [3].

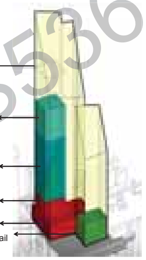
Figure 4: MahaNakhon site view

[3] Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference
Figure 3: Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference
Figure 4: archdaily.com/30025/mahanakhon-ole-scheeren-oma (02.05.2017)

ARCHITECTURAL PROGRAM

The architectural program includes:

Hotel branded residences
+
Luxury hotel
+
Lifestyle retail mall
+
Viewing deck & bar
+
Public Square



If Mahanakhon tower had been a fairly traditional tower, it would not have been very tall. At the right sight figure the yellow shows the designing envelope, and the massing diagram is inside it. So, the tower could have been 271 m in height. That means tall, but not super tall [3].

Figure 5: Height / Program

[3] Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference
Figure 5: Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference

SITE

Bangkok skyline had so many unusual shaped building, so the tower should have unique by not being unique shape like an absolutely standard block. All the surrounding buildings were odd, because of that Beck wanted to do very very simple [3].

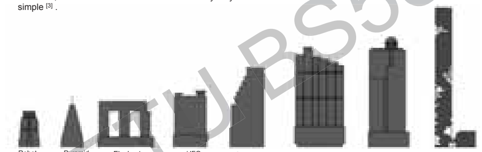


Figure 6: Bangkok Skyline & Form Solution: Unique by not being unique

[3] Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference
Figure 6: Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference

DESIGN STAGE

The significant problem was the height of tower.
Becks' team deconstruct the form of tower by pixelation.
Pixelation supplied:

- Increased height
- Unique residence layouts
- Connection to the street
- Organic form
- Mix of indoor/outdoor space.

Due to the pixelation:

- all residences are diffrent to the others
- one floor plate differs from another floor plate
- Each unit, sitting pixelated section, is unique[3].

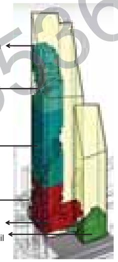


Figure 7: Height solution: pixelation

[3] Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference
Figure 7: Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference

DESIGN STAGE

Figure 8: Pixel scale variations

The form of pixelation tested for:

- supplying optimum mix between organized and disorganized areas
- creating sufficient outdoor space for each layout[3].

[3] Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference
Figure 8: Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference

ARCHITECTURAL PROGRAM

Figure 9: MahaNakhon ground view rendering

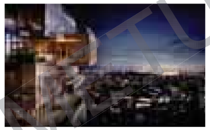


Figure 10: MahaNakhon terrace rendering

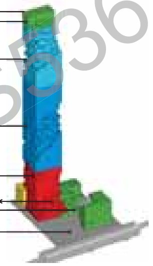


Figure 11: Last design of Multiple Function Integration

Figure 9: MahaNakhon ground view rendering of the indoor and outdoor terraces (source Pace Development Corporation. pacedev.com. accessed 13.03.2017)
Figure 10: MahaNakhon terrace rendering (source Pace Development Corporation. pacedev.com. accessed 13.03.2017)
Figure 11: Beck, K. MahaNakhon Tailand's Tallest Tower, CTBUH 2016 China Conference

STRUCTURAL ELEMENTS – MAT FOUNDATION

Mat foundation
+
Core walls
+
Columns
+
Outriggers
+
Belts
+
Floor Slabs

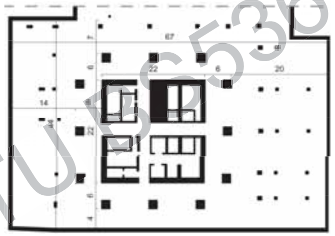


Figure 13: Mat foundation (**drawn by Gizemnur Talas**)
(Dimensions are in meters)

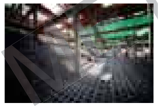


Figure 12: The structure of foundation and basement

Figure 12: MahaNakhon, facebook.com (accessed 25.05.2017)
Figure 13: Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference

STRUCTURAL ELEMENTS – CORE

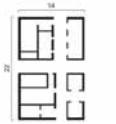


Figure 14a: Core dimensions
14m x 22m from Level 52 to the top
(drawn by Gizemnur Talas)

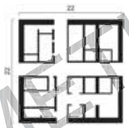


Figure 14b: Core dimensions
22m x 22m from B1 to Level 20
(drawn by Gizemnur Talas)

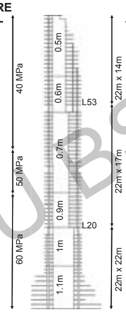


Figure 15: Outer core walls thickness
(drawn by Gizemnur Talas)

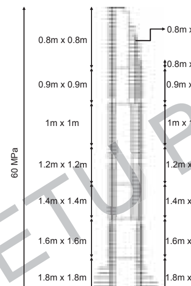
Outer core wall thicknesses are: [4]

- 1.1m at basement 1 to Level 8
- 1m at level 9 to 19
- 0.9m at level 20 to 29
- 0.7m at level 30 to 51
- 0.6m at level 52 to 59
- 0.5m at level 60 to 73

Figure 14c: Core dimensions
17m x 22m from Level 21 to Level 52
(drawn by Gizemnur Talas)

[4] Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference
Figure 14: Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference
Figure 15: Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference

STRUCTURAL ELEMENTS - COLUMNS



Column dimensions: [4]

- 1.8m x 1.8m at basement 1 to level 7
- 1.6m x 1.6m at level 8 to 19
- 1.4m x 1.4m m at level 20 to 29
- 1.2m x 1.2m at level 30 to 39
- 1m x 1m at level 40 to 50
- 0.9m x 0.9m at level 51 to 59
- 0.8m x 0.8m at level 60 to 73

Figure 16: Column dimensions
(drawn by Gizemnur Talas)

[4] Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference
Figure 16: Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference

STRUCTURAL ELEMENTS – OUTRIGGERS & BELTS

Outriggers are made of double floor height (8m) reinforced concrete walls to stabilize the tower globally and locally.
The levels of outriggers and belts:

- Level 51 - Level 52
- Level 35 – Level 36
- Level 19 – Level 20

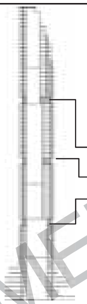


Figure 17: Section
(drawn by Gizemnur Talas)

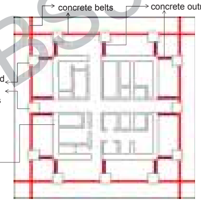


Figure 18: Outrigger application at Level 19-20
(drawn by Gizemnur Talas)

Figure 17, 18: Chanvaivit, K. MahaNakhon Tower and the Use of CTBUH Seismic Guidelines. CTBUH 2014 Shanghai Conference

STRUCTURAL ELEMENTS – OUTRIGGERS & BELTS

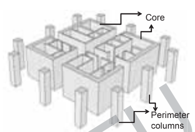


Figure 19a: Level 19-20 columns and core walls
(drawn by Gizemnur Talas)

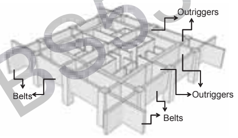


Figure 19b: Level 19-20 with outriggers and belts
(drawn by Gizemnur Talas)

Figure 19: Chanvaivit, K. MahaNakhon Tower and the Use of CTBUH Seismic Guidelines. CTBUH 2014 Shanghai Conference

STRUCTURAL ELEMENTS – FLOOR SLABS

Figure 20a: Unpixelled floor plan of typical hotel floor
(Dimensions are in meters)
drawn by Gizemnur Talas

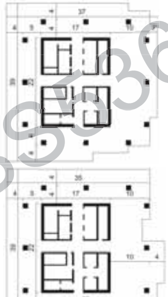


Figure 20b: Level 35 plan (above) - Level 34 plan (below)
(Dimensions are in meters)
drawn by Gizemnur Talas

Figure 20a: Chanvaivit, K. The structural Design and Construction of the MahaNakhon Tower, CTBUH 2015 New York Conference
Figure 20b: cbre.co.th/en/Property/Detail/Buy/Condominium/Bangkok/Silom-Sathon/The-Ritz-Carlton-Residences-Bangkok (accessed 07.06 2017)

STRUCTURAL ELEMENTS – FLOOR SLABS

Pixel effect causes challenging floor plate design and build, because: [5]

- 30% of the slabs in cantilever
- Pixel areas

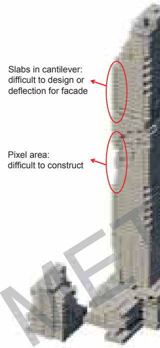


Figure 21: Isometric view

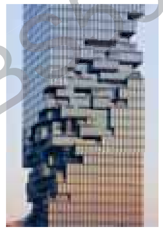


Figure 22: The pixelation of MahaNakhon

[5] Chanvaivit, K. MahaNakhon Tower and the Use of CTBUH Seismic Guidelines. CTBUH 2014 Shanghai Conference
Figure 21: skyscrapercity.com/showthread.php?t=889888&page=24 (accessed 27.03.2017)
Figure 22: dezeen.com/2017/05/24/ole-scheeren-pixelated-mahanakhon-tower-photography-hufton-crow-architecture-skyscrapers-bangkok-thailand/ (accessed 02.05.2017)

STRUCTURAL ELEMENTS – FLOOR SLABS

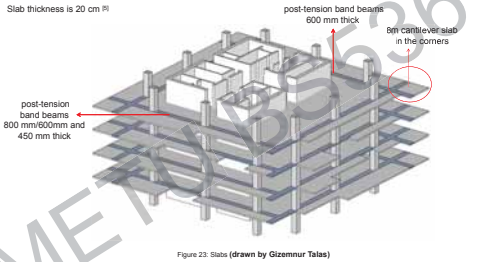


Figure 23: Slabs **(drawn by Gizemnur Talas)**

Figure 23: Chanvaivit, K. MahaNakhon Tower and the Use of CTBUH Seismic Guidelines. CTBUH 2014 Shanghai Conference
[5] Chanvaivit, K. MahaNakhon Tower and the Use of CTBUH Seismic Guidelines. CTBUH 2014 Shanghai Conference

STRUCTURAL ELEMENTS

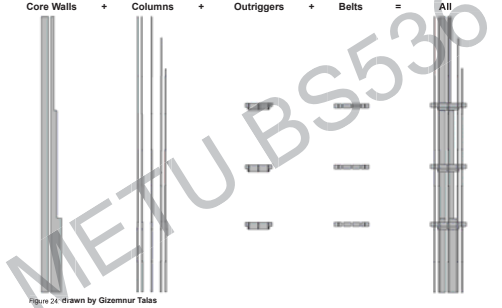


Figure 24: **drawn by Gizemnur Talas**

STRUCTURAL ELEMENTS

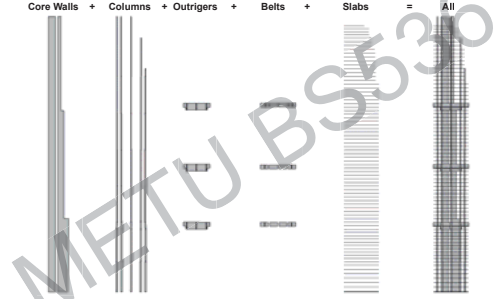


Figure 25: **drawn by Gizemnur Talas**

PS: Slabs dimensions may not be fitted to the towers' orijinal slabs

CONSTRUCTION PHOTOS

Figure 26: at10th floor

Figure 28: at 19 th floor

Figure 27: at 40 th floor

Figure 29: at43rd floor

Figure 26, 27, 28, 29: facebook.com/MahaNakhonBKK/photos/ (accessed 25.05.2017)

CONSTRUCTION PHOTOS

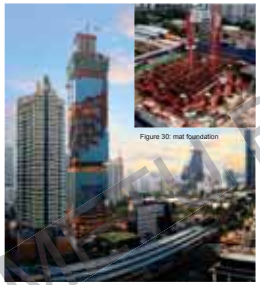


Figure 31: Construction photo

Figure 30: mat foundation

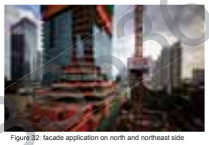


Figure 32: facade application on north and northeast side

Figure 33: Figure 29: Construction photo

Figure 30, 31, 32, 33: MahaNakhon, facebook.com (accessed 25.05.2017)

List of figures:

List of Cited References:

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