

TIANJIN CTF FINANCE CENTRE



<sup>11</sup> <https://skyscrapercenter.com/building/tianjin-ctf-finance-centre/310>

Case Study: **Tianjin CTF Finance Centre** by Beste Fakioglu  
Submitted to: Günel, Ay – Fall 2016



<sup>11</sup> CTBUH, among completed, stacked and architectural topologies.  
<sup>12</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH

Official Name: Tianjin CTF Finance Centre  
Other Name: Tianjin Chow Tai Binhai Centre  
Location: China, Tianjin  
Use: Hotel/ Serviced Apartments/ Office  
Architectural Height: 530m <sup>11</sup>  
Occupied Height: 439.5 m <sup>11</sup>  
Ranking: 7th tallest in the world, 5th tallest in China <sup>11</sup>  
Aspect Ratio: 7.20  
Structural Material: Composite <sup>11</sup>  
Floors above ground: 97 <sup>11</sup>  
Construction: 2013-2018 (under construction) <sup>11</sup>  
Architect: Skidmore, Owings and Merrill, Ronald Lu & Partners, ECAD  
Structural Engineer: Skidmore, Owings and Merrill, Leslie E. Robertson Associates  
Structural System: Framed Tube System  
Perimeter Frame <sup>11</sup>



<sup>11</sup> Top view rendering of the Tianjin CTF Finance Centre, 2016, ECAD  
<sup>12</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH

ARCHITECTURAL DESIGN

- Retail podium <sup>11</sup>
  - The 530-meter-tall skyscraper: offices, 300 service apartments, and a five-star, 350-room hotel <sup>11</sup>
  - The gently curving glass skin conceals eight sloping columns. <sup>11</sup>
  - Strategically placed, multi-story wind vents combined with the tower's aerodynamic shape reduce vortex shedding, which in turn dramatically minimizes wind forces. <sup>11</sup>
- Total gross floor area: 389,900 m<sup>2</sup>. <sup>11</sup>



<sup>11</sup> SOM  
<sup>12</sup> CTBUH

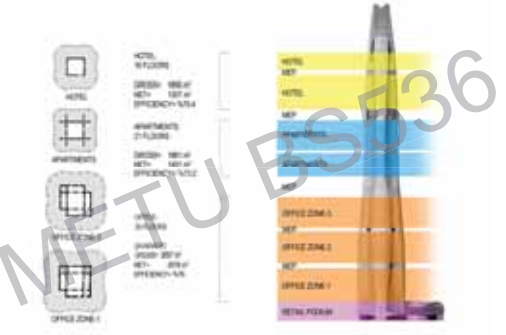
A carved-out city block in a low-rise neighbourhood. <sup>11</sup>



<sup>11</sup> From Icon to Community: The Reshaping of the Mega Tower in the city context, 2016, CTBUH  
<sup>12</sup> <https://skyscrapercenter.com/building/tianjin-ctf-finance-centre/310>

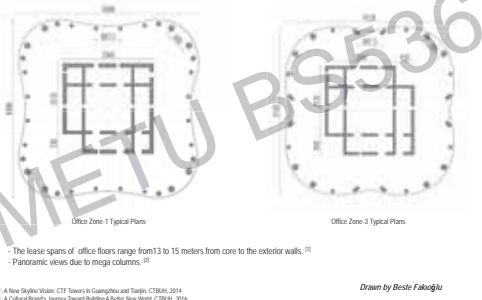


<sup>11</sup> A New Skyline Vision: CTF Towers in Guangzhou and Tianjin, CTBUH, 2014  
<sup>12</sup> <http://www.skyscrapercenter.com/building/tianjin-ctf-finance-centre/310>



Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH

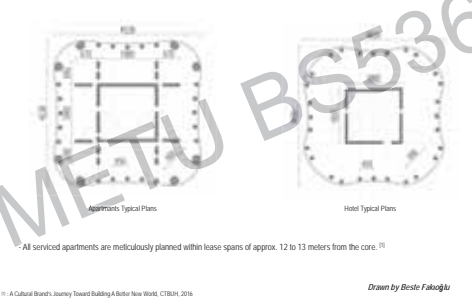
STRUCTURAL PLANS- 1



<sup>11</sup> A New Skyline Vision: CTF Towers in Guangzhou and Tianjin, CTBUH, 2014  
<sup>12</sup> A Cultural Branch: Journey Toward Building A Better New World, CTBUH, 2016

Drawn by Beste Fakioglu

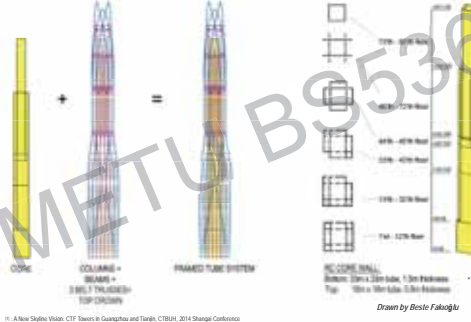
STRUCTURAL PLANS- 2



<sup>11</sup> A Cultural Branch: Journey Toward Building A Better New World, CTBUH, 2016

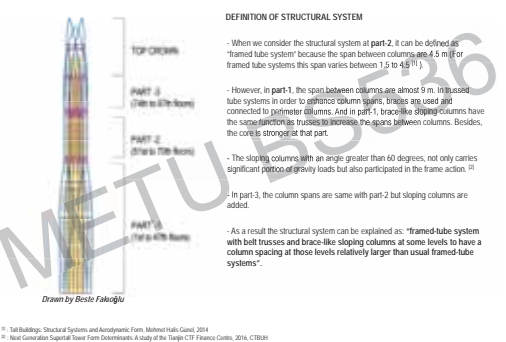
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STRUCTURAL SYSTEM



<sup>11</sup> A New Skyline Vision: CTF Towers in Guangzhou and Tianjin, CTBUH, 2014 Shanghai Conference

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<sup>11</sup> Tall Buildings: Structural Systems and Aerodynamic Form, Mehmet Halis Günel, 2014  
<sup>12</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH

DEFINITION OF STRUCTURAL SYSTEM

- When we consider the structural system at part-2, it can be defined as "framed tube system" because the span between columns are 4.5 m for framed tube systems this span varies between 1.5 to 4.8m <sup>11</sup>
- However, in part-1, the span between columns are almost 9 m. In trussed tube systems in order to enhance column spans, bracing are used and connected to perimeter columns. And in part-1, however sloping columns have the same function as trusses to increase the spans between columns. Besides, the core is stronger at that part.
- The sloping columns with an angle greater than 60 degrees, not only carries significant portion of gravity loads but also participated in the frame action. <sup>11</sup>
- In part-3, the column spans are same with part-2 but sloping columns are added.
- As a result the structural system can be explained as: "framed-tube system with belt trusses and brace-like sloping columns at some levels to have a column spacing at those levels relatively larger than usual framed-tube systems".

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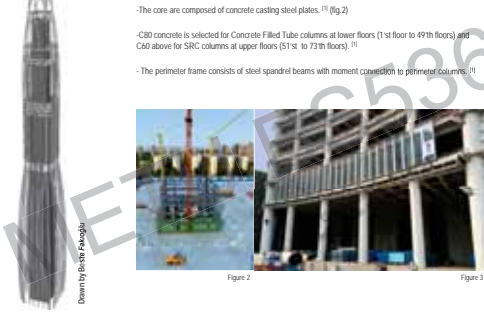
COLUMNS



- The curved sloping columns geometry is developed for optimal configuration. <sup>11</sup>
- The upper work points transfer a portion of the corner column load to the sloping column so tension in the sloping column and the required amount of steel is decreased. <sup>11</sup>
- The intersection of the sloping columns spread across multiple floors which minimizes axial forces in perimeter beams. <sup>11</sup>
- The reduced number of columns allowed more dramatic suites at the top zone of the hotel. <sup>11</sup>

Images are borrowed from: Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre  
<sup>11</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH

DETAILS OF THE STRUCTURAL SYSTEM

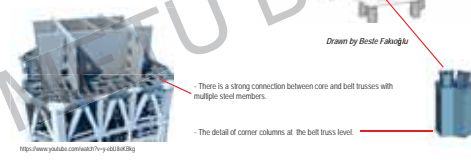


- The core is composed of concrete casting steel plates. <sup>11</sup> (Fig.2)
- C80 concrete is selected for Concrete Filled Tube columns at lower floors (1st floor to 49th floors) and C60 above for SRC columns at upper floors (51st to 73th floors). <sup>11</sup>
- The perimeter frame consists of steel spandrel beams with moment connection to perimeter columns. <sup>11</sup>

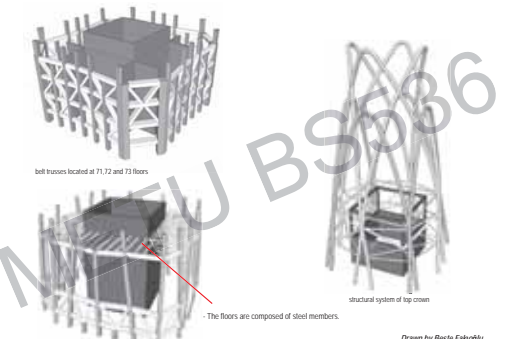
<sup>11</sup> A New Skyline Vision: CTF Towers in Guangzhou and Tianjin, CTBUH, 2014  
<sup>12</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre

ELIMINATION OF OUTRIGGERS

- Elimination of outriggers was a major factor in reducing quantities, costs and erection time. <sup>11</sup>
- Outriggers greatly increase the stiffness of the structure, but since they have limited ductility, they also increase the seismic loads. <sup>11</sup>
- Outriggers also reduce the area available for mechanical equipment, which reduces the overall architectural efficiency of the building. <sup>11</sup>



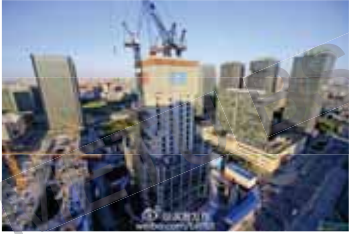
<sup>11</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH



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#### CONSTRUCTION PHOTOGRAPHS



Images are retrieved from: <http://www.skyscrapercity.com/>

#### CONSTRUCTION PHOTOGRAPH OF THE FACADE



<sup>[1]</sup> <http://www.skyscrapercity.com/>  
<sup>[2]</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre  
<sup>[3]</sup> A Cultural Brand's Journey Toward Building A Better New World, CTBUH, 2016



The Wind Engineering of the CTF Tianjin Finance Centre, ICWE, 2015



<sup>[1]</sup> Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH

#### WIND ENGINEERING

- Wind tunnel tests were conducted in the schematic design stage to determine optimal shaping of the tower. <sup>[1]</sup>
- The goal: reducing wind forces to equal or below seismic loads so wind wouldn't control the design. <sup>[1]</sup>
- Final crown configuration: high cladding porosity and open top of the crown leads to reducing wind loads in entire tower. <sup>[1]</sup>
- Curved corners and tapering shape dramatically reduce wind loads. <sup>[1]</sup>
- The building's aerodynamic shape greatly reduces this vortex shedding by "confusing the wind". <sup>[1]</sup>

#### WIND ENGINEERING

- In response to strong winds, multi-story wind vents are placed at strategic intervals.
- These multi-story wind vents together with aerodynamic shape of the tower dramatically reduce wind loads by cutting vortex shedding.



SOM and China: Evolving Skyscraper Design Amid Rapid Urban Growth, CTBUH, 2016

#### REFERENCES:

- SOM and China: Evolving Skyscraper Design Amid Rapid Urban Growth, CTBUH, 2016
- Next Generation Supertall Tower Form Determinants: A study of the Tianjin CTF Finance Centre, 2016, CTBUH
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- From Icon to Community: The Implications of the Mega Tower in the City context, 2016, CTBUH
- <http://www.som.com/>
- <http://www.ctbuh.org/>
- <http://www.theurblist.com/>
- <https://www.youtube.com/watch?v=y-ebU8k8Big>
- <http://www.globalrealestateexperts.com/wp-content/uploads/2015/09/Tianjin-CTF-Finance-Centre.jpg>
- <http://www.skyscrapercity.com/>
- <https://skyscrapercenter.com/building/tianjin-ctf-finance-centre/310>

#### BUILDING FACADE

- The curvilinear facade is parametrically modeled to optimize panel sizes and facade curvature. <sup>[1]</sup>
- There are 24 910 window units in the tower. By using BIM parametric optimization only 339 unique panels are obtained. <sup>[1]</sup>



<sup>[1]</sup> <http://www.globalrealestateexperts.com/wp-content/uploads/2015/09/Tianjin-CTF-Finance-Centre.jpg>  
<sup>[2]</sup> A New Skyline Vision: CTF Towers in Guangzhou and Tianjin, Conference presentations, Shanghai, 2014