

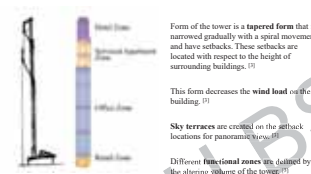
Guangzhou CTF Finance Center

Official Name of the Building: Guangzhou CTF Finance Center^[1]
Architectural Design: Kohn Pedersen Fox Associates^[1]
Architect of Record: Guangzhou Design Institute; Leigh & Orange^[1]
Structural Engineering: ARUP^[1]
Location: Guangzhou, China^[1]
Proposed in: 2009^[1]
Construction: 2010 – 2016^[1]
Structural System: Outriggered Frame System^[1]
Status: Completed^[1]
Function: hotel / residential / office^[1]
Material: Composite^[1]
Cladding Material: Terracotta^[1]
Height to Tip: 530 m^[1]
Height to Architecture: 520 m^[1]
Occupancy Height: 396.5 m^[1]
Number of Floors: 111^[1]
Aspect Ratio: 8.5
Global Ranking by Height: #7 (as of time June 2017)^[1]
Top Elevator Speed: 72 km/h (the fastest in the world)^[1]



[1] <http://skyscraper.com/building/guangzhou-ctf-finance-center/>
[2] <http://www.ctfchina.com/>
[3] <http://www.ctfchina.com/>
[4] <http://www.ctfchina.com/>
[5] <http://www.ctfchina.com/>

DESIGN CONCEPTS



In master plan, CTF Finance Center building and International Finance Center building create an impression of a gate towards the Guangzhou city.
CTF Finance Center is known as East Tower.
International Finance Center is known as West Tower.



[1] Huo, J., Liu, G., Li, H., Yu, D. M. (2014). A new skyline vision: CTF tower in Guangzhou and Tianjin, CTBUH 2014 Shanghai Conference Proceedings.
Figure 2b Retrieved from: <http://www.ctfchina.com/>
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2004 Guangzhou International Finance Center was proposed. Two identical towers were planned to be built on two side of the green alley.
2009 Guangzhou CTF Finance Center was proposed. Instead of building the same tower, a new tower was proposed. It would be 530 m height which is 92 m taller than the previous design. The tallest building was Taipei 101 (508 m)^[1]
2010 Guangzhou International Finance Center was finished. It was the 10th tallest building in the world.^[1]
2016 Guangzhou CTF Finance Center was finished. It was the 5th tallest building in the world.^[1]
2017 June Guangzhou CTF Finance Center is 2nd tallest building in the world.^[1]

Figure 3: Guangzhou International Finance Center and Guangzhou CTF Finance Center

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AERODYNAMIC FORM EVALUATION OF THE BUILDING

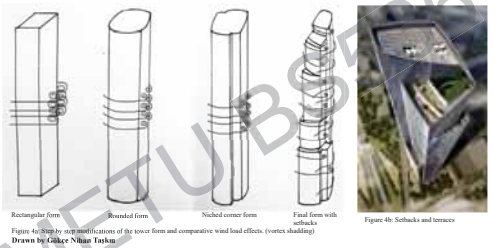


Figure 4b: CTBUH 2014 Shanghai Conference - Wang by David Hu, "A New Skyline Vision" (2014)
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STRUCTURAL SYSTEM



Figure 5a: Section of tower
Figure 5b: Structural elements of different layers
Drawn by Gökçe Nihan Taşkın

PLAN LAYOUT

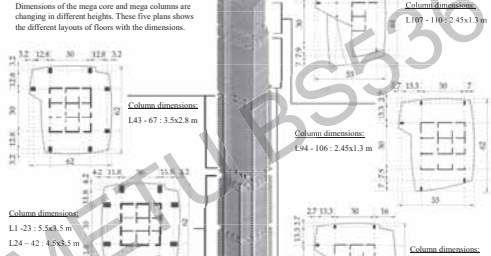


Figure 6: Plan layout with dimensions
Drawn by Gökçe Nihan Taşkın
Figure 6c: CTBUH 2014 China Conference - "Finance China" Efficiency in steel-wood hybrid" (2016)

MEGA CORE AND MEGA COLUMNS

There are eight mega columns around the mega core.^[1]
Mega core and mega columns have composite sections. C80 concrete is used.^[1]
Largest wall thickness of core is 150 cm^[1]. Largest column size is 3.5 x 3.5 m.
Initially structural design was prepared by using C60 concrete. Then it was changed to C80 concrete. This table shows the core wall thickness in mm for both case according to the levels.^[1]

Levels	Outer Core Wall Thickness - C60	Outer Core Wall Thickness - C80
L 23-32	6 m	1.5 m
L 1-22	1.7 m	1.5 m
L 7-14	1.8 m	1.5 m
L 1-6	1.8 m	1.5 m

Levels	Column Dimensions
L 1 - 23	3.5 x 3.5 m
L 24 - 42	4.5 x 3.5 m
L 43 - 67	3.5 x 2.8 m
L 68 - 93	2.6 x 1.8 m
L 94 - 110	2.45 x 1.3 m

Figure 7a: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7c: Column dimension chart

Figure 7b: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7c: Column dimension chart
Figure 7d: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7e: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7f: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7g: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7h: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7i: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7j: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7k: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7l: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7m: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7n: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7o: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7p: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7q: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7r: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7s: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7t: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7u: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7v: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7w: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7x: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7y: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın
Figure 7z: Analytical view of mega core and mega columns
Drawn by Gökçe Nihan Taşkın

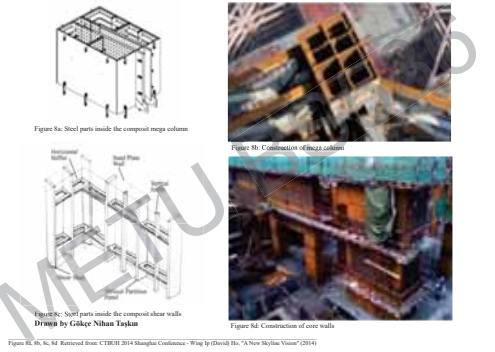


Figure 8a, 8b, 8c, 8d Retrieved from: <http://www.ctfchina.com/>

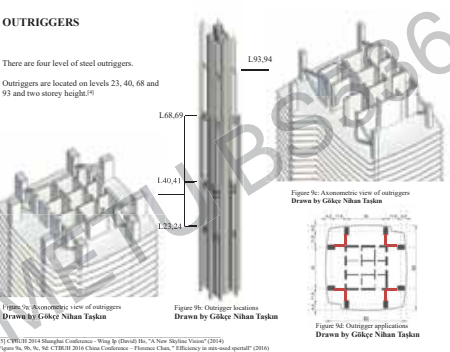


Figure 9a, 9b, 9c, 9d Retrieved from: <http://www.ctfchina.com/>

OUTRIGGER LOCATIONS

Stafford, Smith and Salim (1981) formalized optimum outrigger locations based on equality of core deflection and outrigger deflection. They set equations for two outriggers and generalized the equation for three or more outriggers.^[1]
In that equation, they defined "non-dimensional relative stiffness parameter" (w) value to analyze optimum outrigger locations.^[1]
Using w parameter, Smith and Coall (1991) creates graphics to show optimum locations for outriggers and drift reduction and moment reduction efficiency of outrigger system.^[1]

$$W = \frac{EI_c}{2EI_o} \frac{1}{12(1 + \frac{EI_o}{EI_c})}$$

Figure 10a: Graph of optimum outrigger locations
Figure 10b: Graph of moment reduction efficiency
Figure 10c: Graph of drift reduction efficiency

Figure 10a, 10b, 10c Retrieved from: <http://www.ctfchina.com/>

Following table shows the real values and optimum values according to the graph:

Real Case	Optimal Case
0.21	0.2
0.39	0.44
0.64	0.64
0.90	0.82

For the 1st and 4th outrigger are located on optimum levels.
3rd outrigger is located on a slightly different location due to setback on that level.^[1]
Graphs also show that moment reduction efficiency of the outriggers is 82% and drift reduction efficiency of the outriggers is 98%.^[1]

Figure 11: Outrigger locations
Drawn by Gökçe Nihan Taşkın

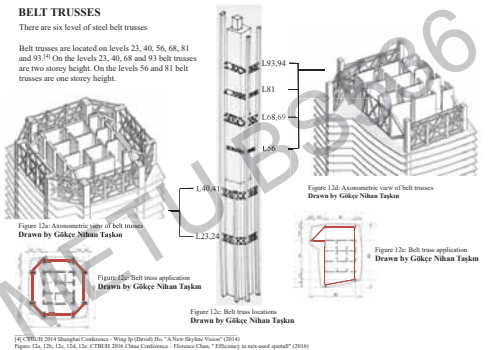


Figure 12a, 12b, 12c Retrieved from: <http://www.ctfchina.com/>

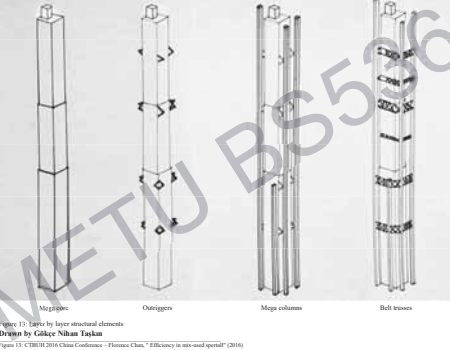


Figure 13 Retrieved from: <http://www.ctfchina.com/>



Figure 14 Retrieved from: <http://www.ctfchina.com/>



Figure 15 Retrieved from: <http://www.ctfchina.com/>

REFERENCES

- [1] <http://skyscrapercenter.com/building/guangzhou-of-finance-centre/176>
- [2] Ghali M.H., Igari E., (2014) Tall buildings: Structural Systems and Aerodynamic Form, Taylor and Francis / Routledge.
- [3] Ho W. J., Fu C.Y., Lo H., Yu D. M., (2014). A new skyline vision: CTF towers in Guangzhou and Tianjin, CTBUH
- [4] CTBUH Interactive Data System <http://skyscrapercenter.com/compendium/>
- [5] CTBUH 2014 Shanghai Conference - Wang Fu (David) Ho, "A New Skyline Vision" (2014)
- [6] SMITH B. S., COULL A. (1991) Tall building structures: analysis and design, Wiley, New York, USA.
- Figure 1 Retrieved From: <http://skyscrapercenter.com/building/guangzhou-of-finance-centre/176>
- Figure 2a Retrieved From: CTBUH 2014 Shanghai Conference - Wang Fu (David) Ho, "A New Skyline Vision" (2014)
- Figure 2b Retrieved From: <https://skyscrapercenter.com/skyscraper/176>
- Figure 2c Retrieved From: http://img.mediacorp.com/news/2011/12/27/news11122711902_001.jpg
- Figure 3 Retrieved From: http://election.nytimes.com/post/guangzhou_guangdong_china/88781.html
- Figure 4a: CTBUH 2014 Shanghai Conference - Wang Fu (David) Ho, "A New Skyline Vision" (2014)
- Figure 4b Retrieved From: <http://2016.ctbuh.org/guangzhou-of-finance-centre/>
- Figure 5a Retrieved from: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 5b: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 6: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 7a: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 7b Retrieved from: Ho W.J., Fu C.Y., Lo H., Yu D. M., (2014). A new skyline vision: CTF towers in Guangzhou and Tianjin, CTBUH 2014 Shanghai Conference Proceedings
- Figure 7c Retrieved from: CTBUH 2014 Shanghai Conference - Wang Fu (David) Ho, "A New Skyline Vision" (2014)
- Figure 8a, 8b, 8c, 8d Retrieved from: CTBUH 2014 Shanghai Conference - Wang Fu (David) Ho, "A New Skyline Vision" (2014)
- Figure 9a, 9b, 9c, 9d: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 10a, 10b Retrieved From: SMITH B. S., COULL A. (1991) Tall building structures: analysis and design, Wiley, New York, U.S.
- Figure 11: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 12a, 12b, 12c, 12d, 12e: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 13: CTBUH 2016 China Conference - Florence Chan, "Efficiency in mixed-use special" (2016)
- Figure 14: Retrieved from: <http://skyscrapercenter.com/building/guangzhou-of-finance-centre/176>
- Figure 15: Retrieved from: <http://skyscrapercenter.com/building/guangzhou-of-finance-centre/176>