

An aerial photograph of Dubai, United Arab Emirates, showing a dense urban landscape with numerous skyscrapers. The Burj Dubai is the central focus, appearing as a tall, slender tower under construction with a visible steel framework. The city is surrounded by a network of roads and highways, with a large multi-lane highway in the foreground. The sky is overcast with grey clouds, and the overall lighting is somewhat dim, suggesting an overcast day.

BURJ DUBAI

ARCH 631 STRUCTURE CASE STUDY

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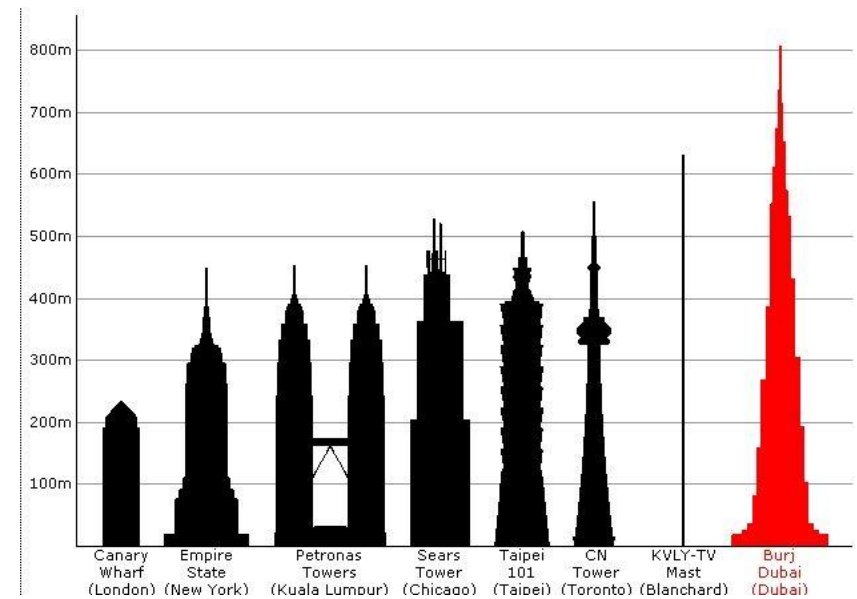
Overview

- **Location:** Arab
- **Construction Date:** 2004.9- 2010.1
- **Architects and Engineers:**
Chicago-based Skidmore, Owings and Merrill (SOM)
- **Designer :** Adrian Smith
- **Main Contractor:** South Korea's Samsung Corporation
- **Project & Construction Manager:**
New York-based Turner International



Overview

- Final height : Over 800 meters (2,625 ft)
- Final number of floors Over: 162 stories
- Built-up area: 5.67 million sq ft
- Weight of empty building 500,000 tones
- Total concrete used: 330,000 cubic m (11.6 million cubic ft)
- Total reinforced steel used 39,000 cubic m
- Total glass used for façade 103,000 sq m (1.1 million sq ft)
- Total stainless steel used for cladding 15,500 sq m (166,800 sqft)
- Total man hours :22 million



General idea

Lateral load resistance

Lateral load resistance is one of the dominant concerns for the design of Burj Dubai, which is ambitiously to be the tallest building in the world.

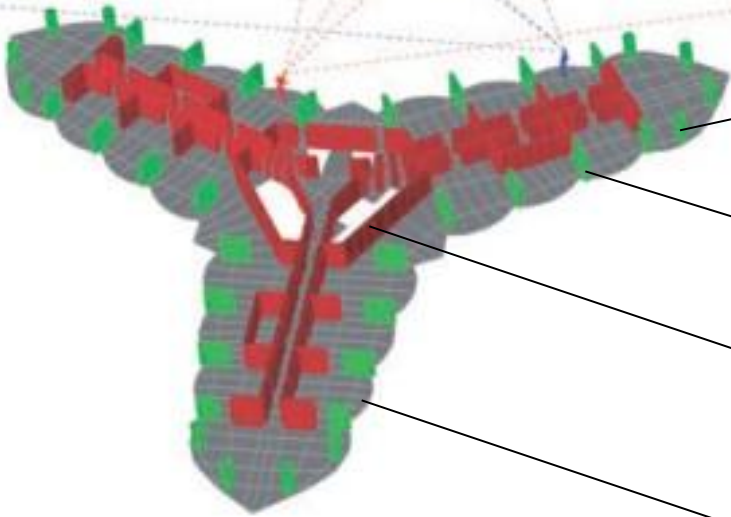
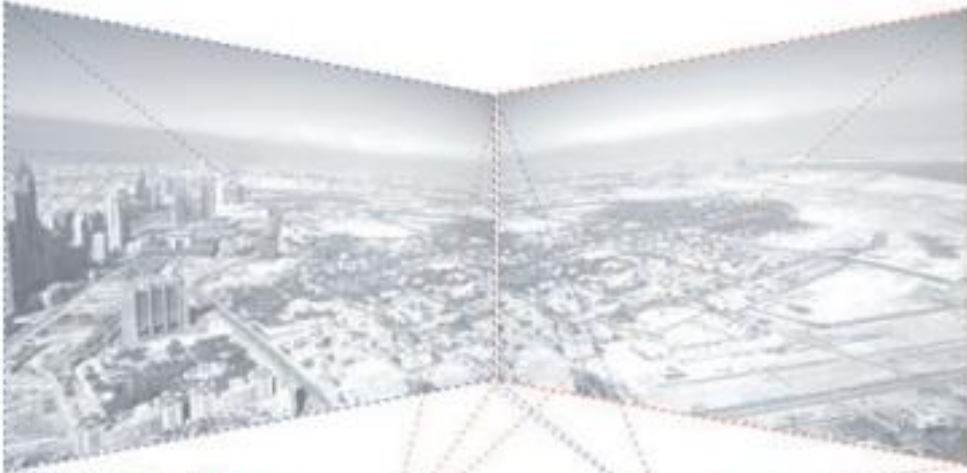
The profile of the Burj Dubai

The profile of the Burj Dubai is shaped by the notion of minimizing wind forces while keeping the simplicity and constructability of the structure.

The project consists of the tower itself, as well as an adjacent podium structure, separate twelve-story office annex and two-story pool annex.



Structure system



concrete nose columns

concrete perimeter columns

concrete core walls

two way slab

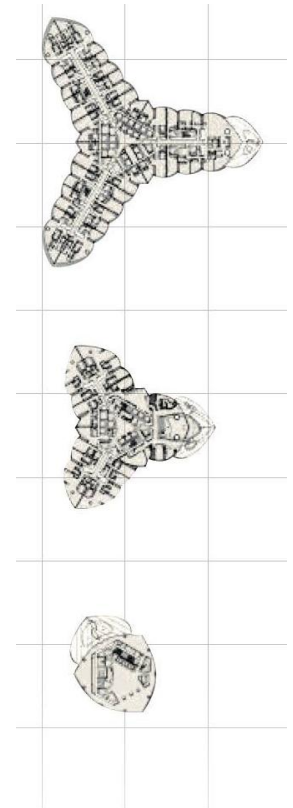
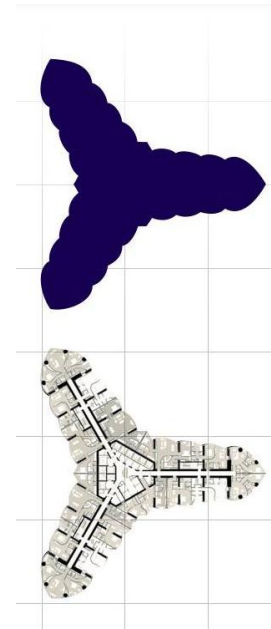
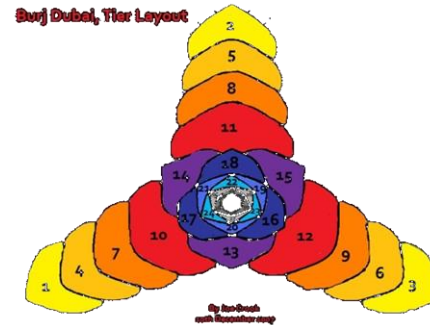
Key features

The design of the plan “buttressed” hexagonal hub

The hub is where the elevators are located and can be regarded as an axis preventing twisting of the structure.

The hub is buttressed by three wings of the structure, at the same time wings brace one another through the connection of the hub.

For the wings of the structure, each of them consists of several tiers; when the structure rises the twenty-six tiers set back generating a spiraling profile of the structure.



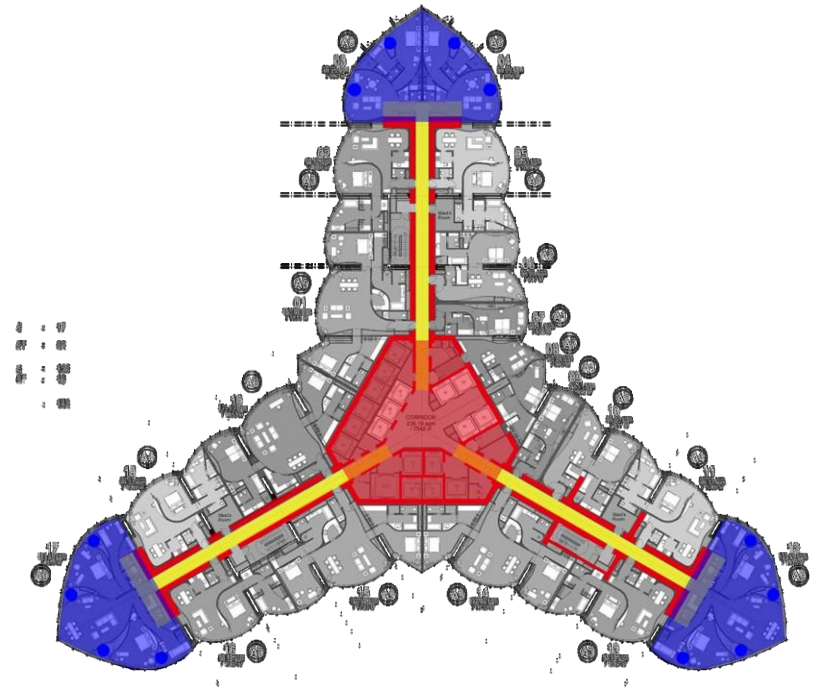
Key features

The structural system

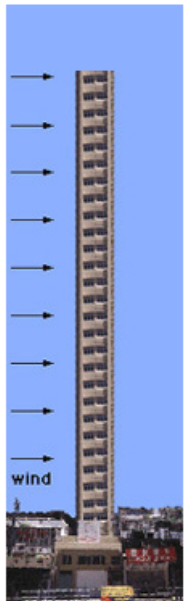
There are corridor walls extending from the hub and terminating in thickened hammerhead walls, which behave similarly to the webs and flanges of a beam to resist the wind shears and moments. There also have some perimeter columns and flat plate floor construction.

All of the vertical concrete is utilized to support both gravity and lateral loads.

The tower is extremely stiff laterally and torsionally.



Key features



Shear
Max. = 21870 N



Moment
Max. = 984150 Nm



Deflection



Vertical design of the structure——**tapered profile**

The overall shape of the structure is slender at the top and wider at the base. Such decision is suitable for resisting the shear and bending moment distributed on the structure: the shear and bending moment accumulate from the top to the bottom. And at the same time, such shape is wise when considering the whole structure as a cantilever beam fixed in the ground, since it has larger size of the internal moment arm and smaller forces in vertical members when providing the same internal resisting moment.

Key features

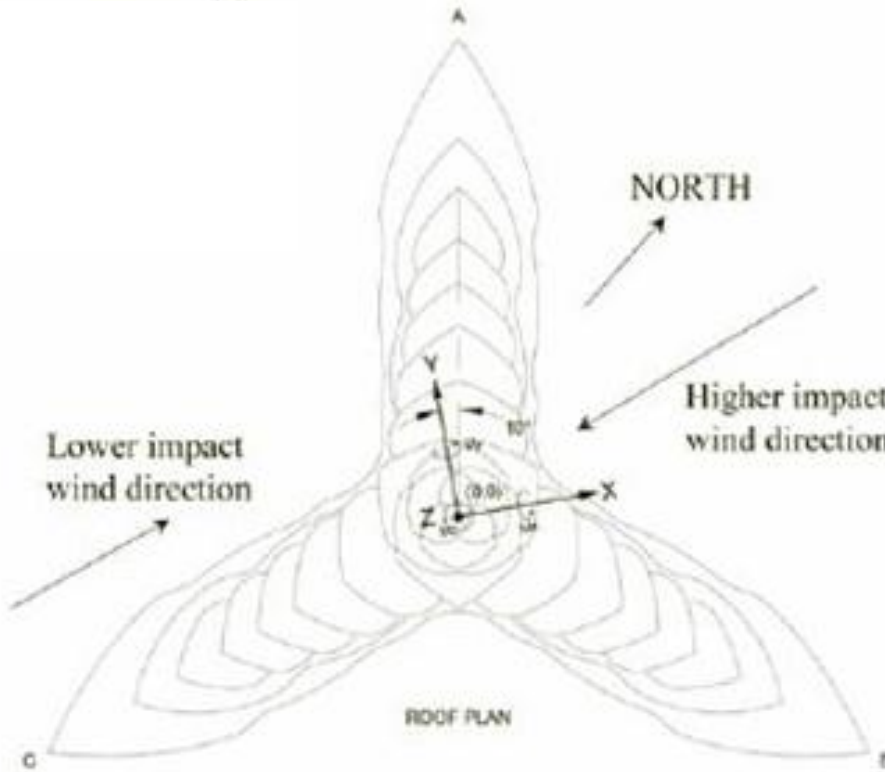
Building material


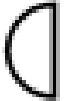






Burj Dubai can be considered as a reinforced-concrete structure, though there is a slender spire made of steel above the first 155 stories. Concrete offers higher stiffness, mass, and damping for controlling building motions and accelerations. Due to the use of concrete, there is no supplemental damping devices are used in this building.

High-performance concrete was utilized for the tower, with wall and column concrete strength ranging from C80 to C60 cube strength.

Additionally, in order to provide increased stiffness to the system, C80 wall and column concrete was specified as a high-modulus concrete. The concrete mix was designed to provide low permeability and high durability.

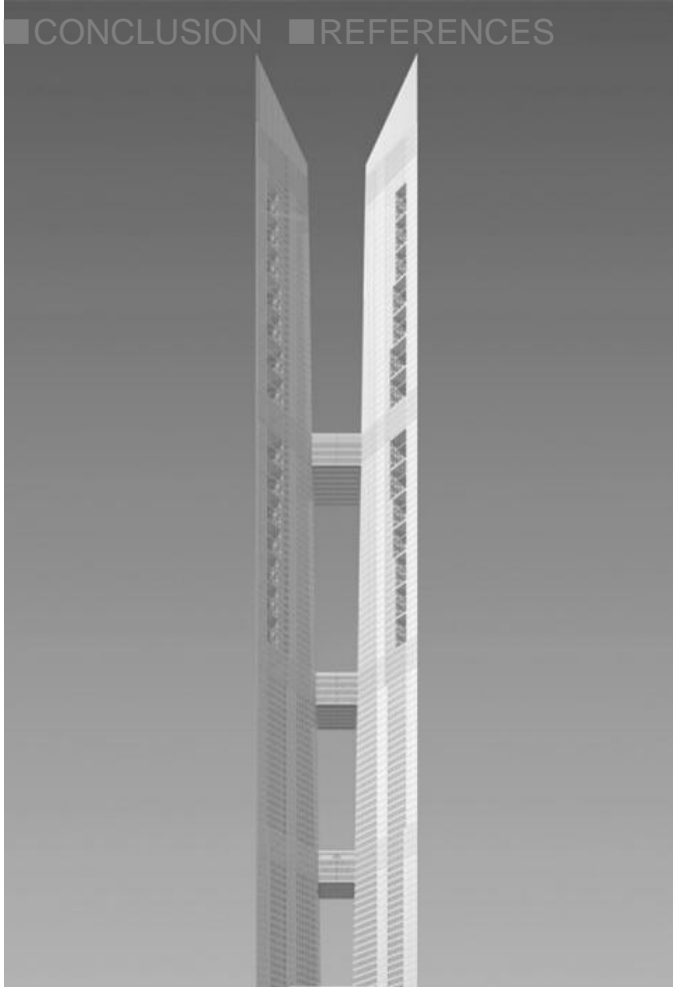
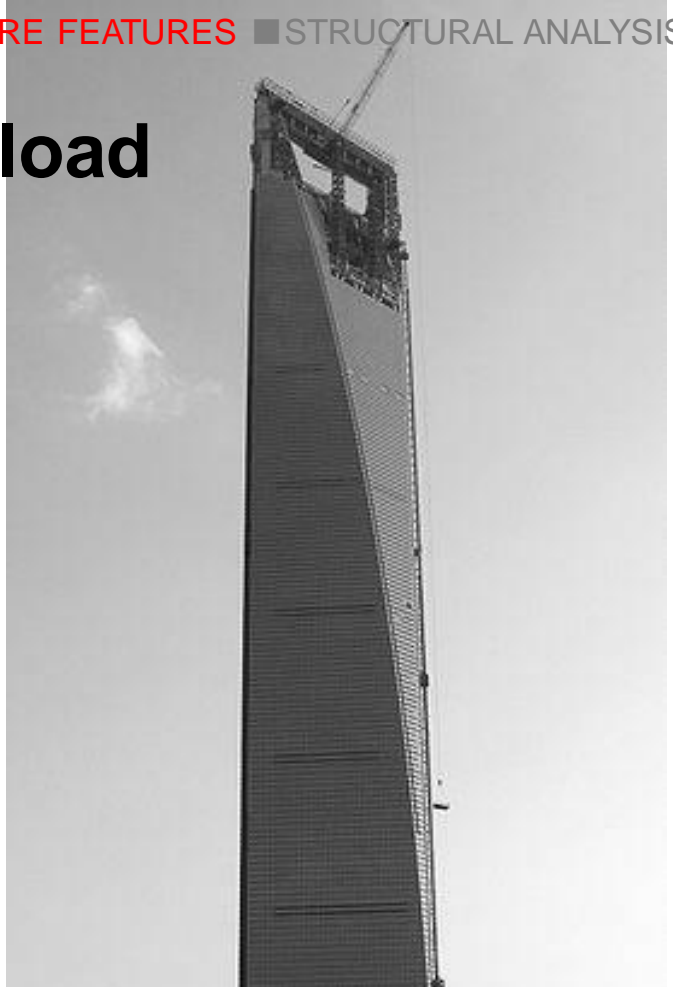
Lateral wind load



| Shape | Drag Coefficient |
|--|------------------|
| Sphere →  | 0.47 |
| Half-sphere →  | 0.42 |
| Cone →  | 0.50 |
| Cube →  | 1.05 |
| Angled Cube →  | 0.80 |
| Long Cylinder →  | 0.82 |
| Short Cylinder →  | 1.15 |
| Streamlined Body →  | 0.04 |

After researching into the prevailing wind direction, the engineers rotate the building 120 degrees toward the major wind direction

Lateral wind load



ROUGH CORNER

OPENINGS

SLOTS

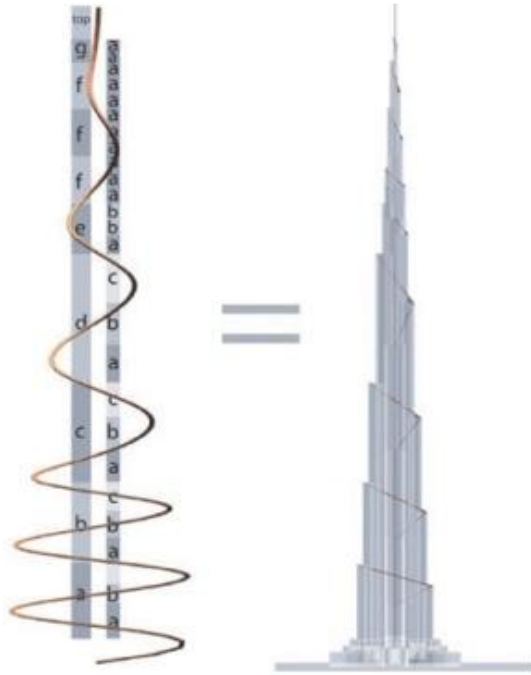
Taipei 101

Shanghai financial center

151 incheon center



Lateral wind load

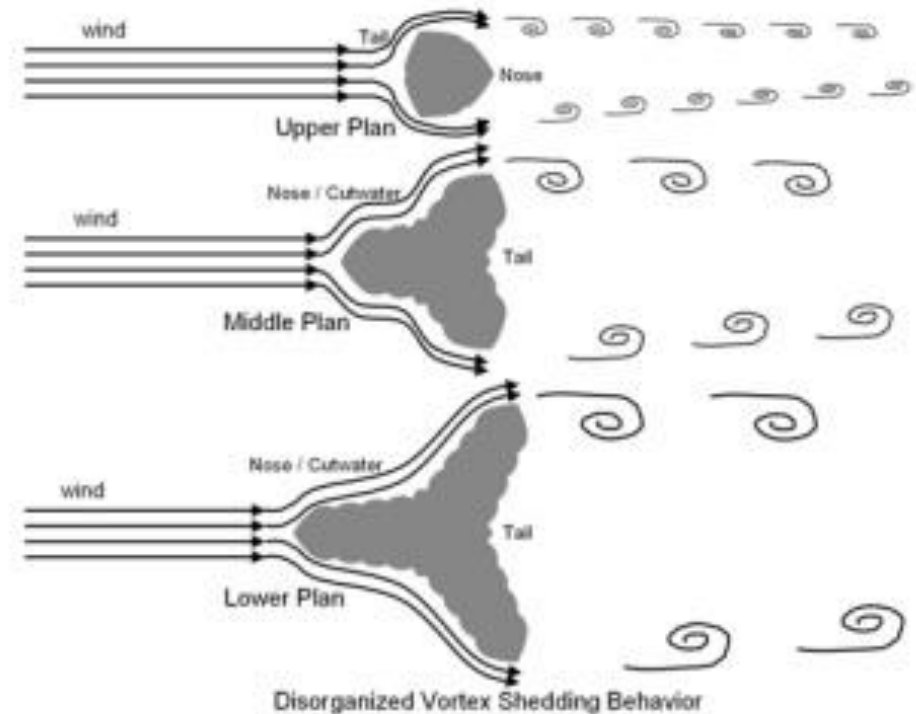


In the top part of burj dubai, the direction of the triangular plan are rotated so that it can minimize loads from prevailing direction



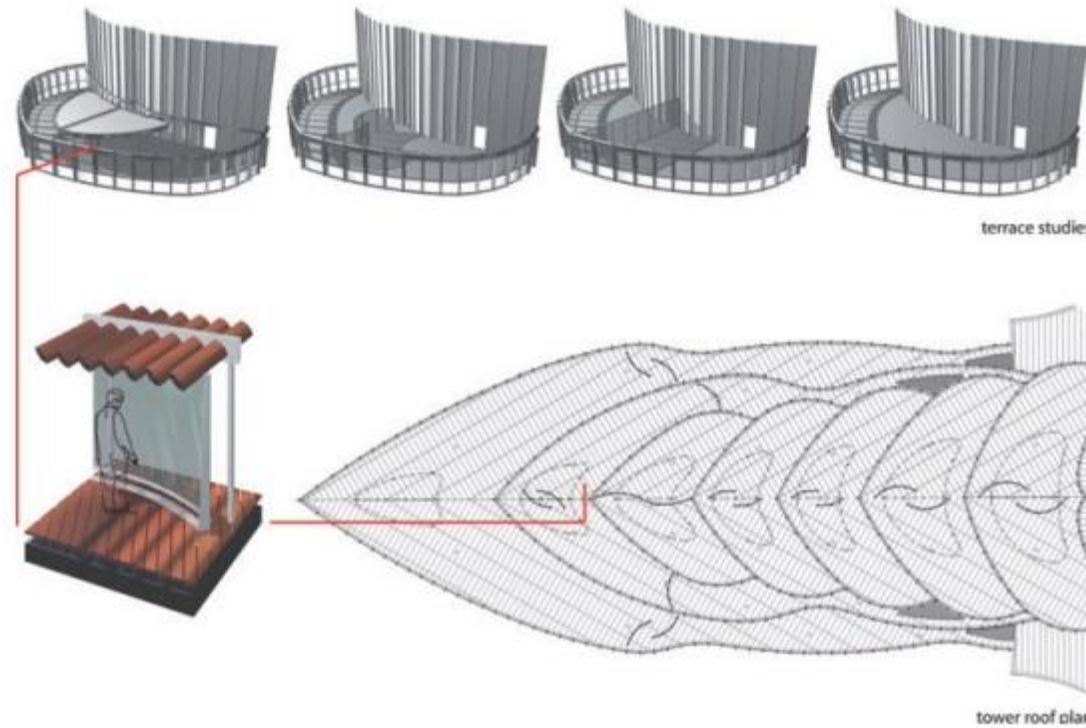
Lateral wind load

The three wings set back in a clockwise sequence with the A wing setting back first. This process resulted in a substantial reduction in wind forces on the tower by “confusing” the wind, by encouraging disorganized vortex shedding over the height of the Tower

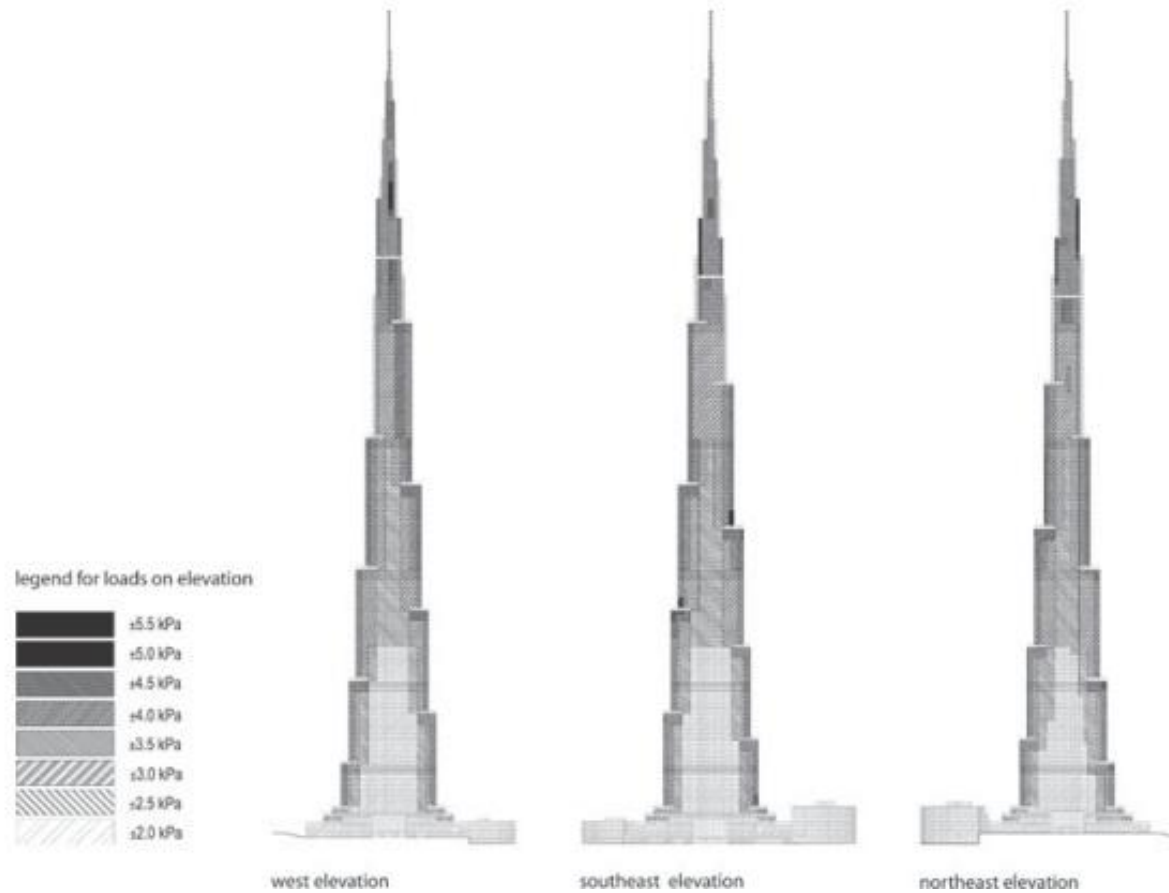


Lateral wind load

In order to reduce the wind speed at upper terrace, each terrace was given a slightly different combination of parapet wall heights, opacity and interior divider screens, the divide screen turned out to function well.

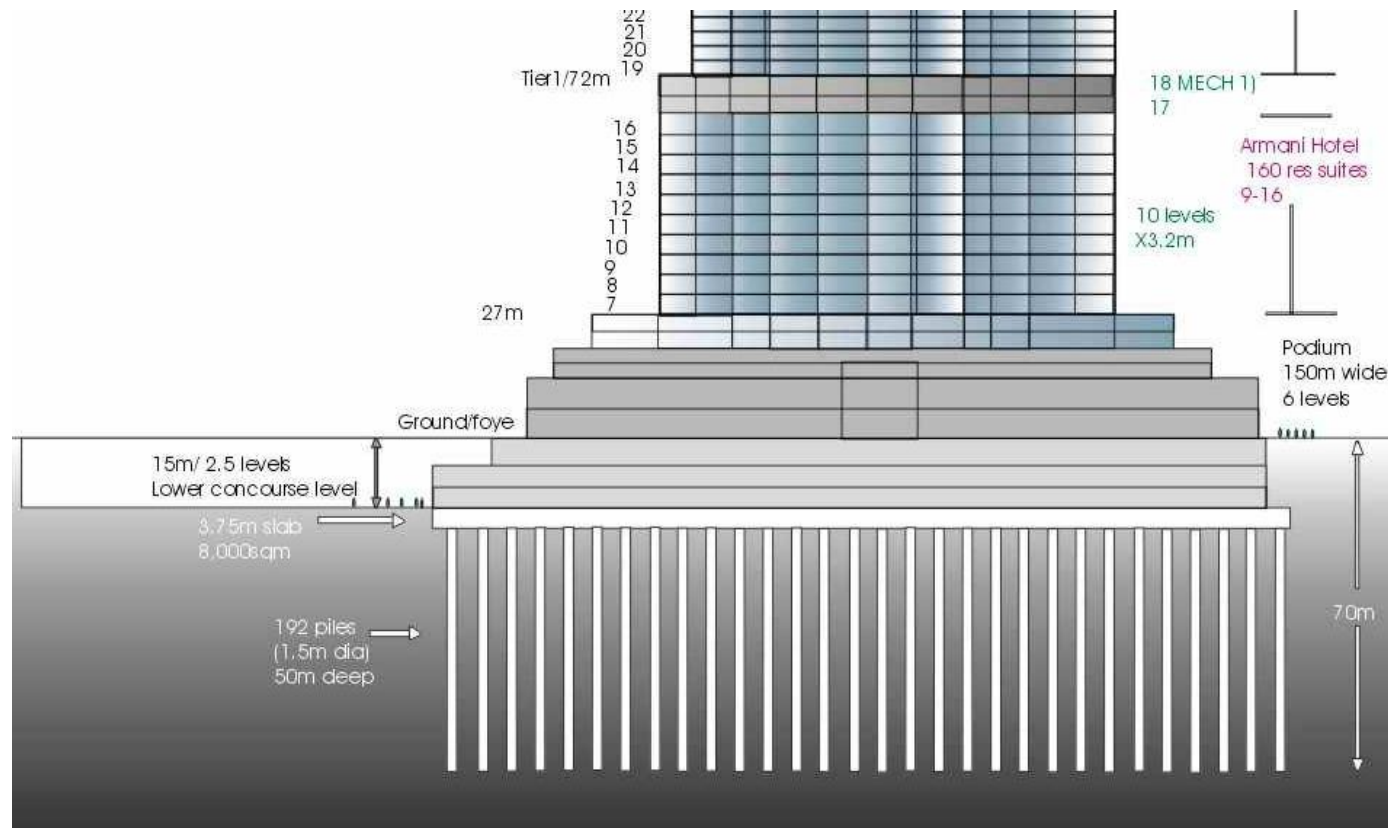


Lateral wind load



Foundation and Soil

The Burj Dubai is founded on a 3.7m thick raft supported on bored piles, 1.5 m in diameter, extending approximately 50m below the base of the raft.

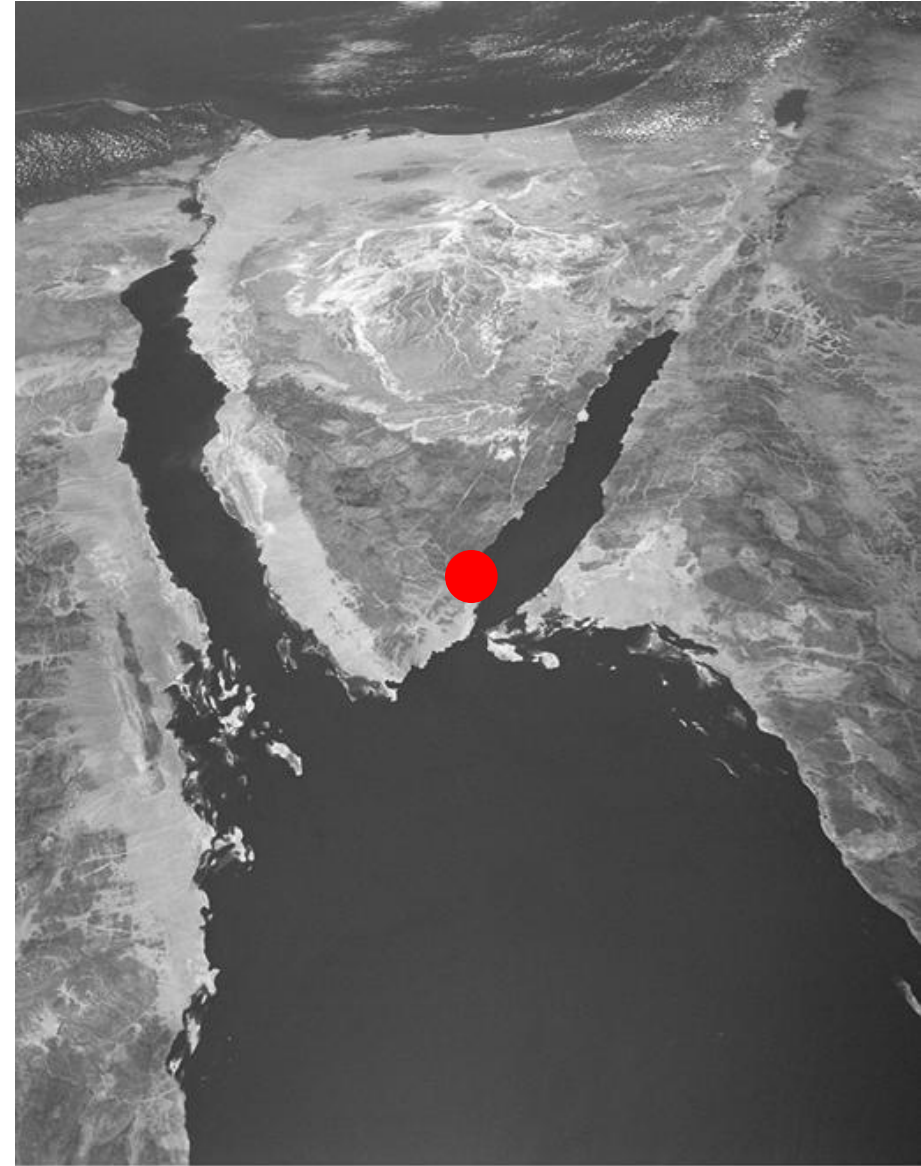


Foundation and Soil

Geology

The geology of the Arabian Gulf area has been substantially influenced by the deposition of marine sediments. The country is generally relatively low-lying, with near-surface geology dominated by deposits of Quaternary to late Pleistocene age, including mobile Aeolian dune sands, evaporate deposits and marine sands.

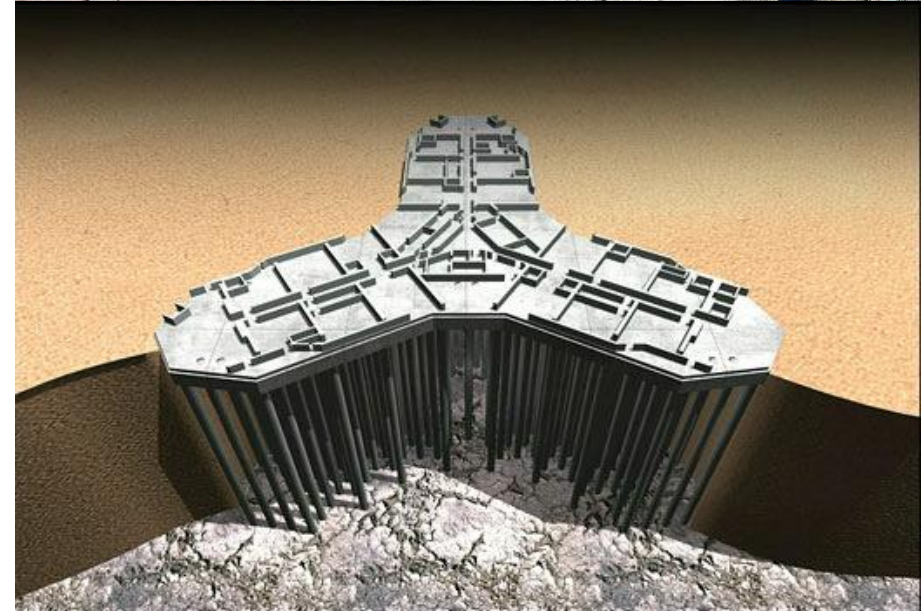
Dubai is situated towards the eastern edge of the geologically stable Arabian Plate and separated from the unstable Iranian Fold Belt to the north by the Arabian Gulf. The site is therefore considered to be located within a seismically active area.



Foundation and Soil

Foundation

The superstructure is supported by a large reinforced concrete mat, which is in turn supported by bored reinforced concrete piles. The design was based on extensive geotechnical and seismic studies. The mat is 3.7 meters thick, and was constructed in four separate pours totaling 12,500 cubic meters of concrete. The 1.5 meter diameter x 47.45 meter long piles represent the largest and longest piles conventionally available in the region. A high density, low permeability concrete was used in the foundations, as well as a cathodic protection system under the mat, to minimize any detrimental effects from corrosive chemicals in local ground water.



Foundation and Soil

Podium

The podium provides a base anchoring the tower to the ground, allowing on grade access from three different sides to three different levels of the building. Fully glazed entry pavilions constructed with a suspended cable-net structure provide separate entries for the Corporate Suites at B1 and Concourse Levels, the Burj Khalifa residences at Ground Level and the Armani Hotel at Level 1.



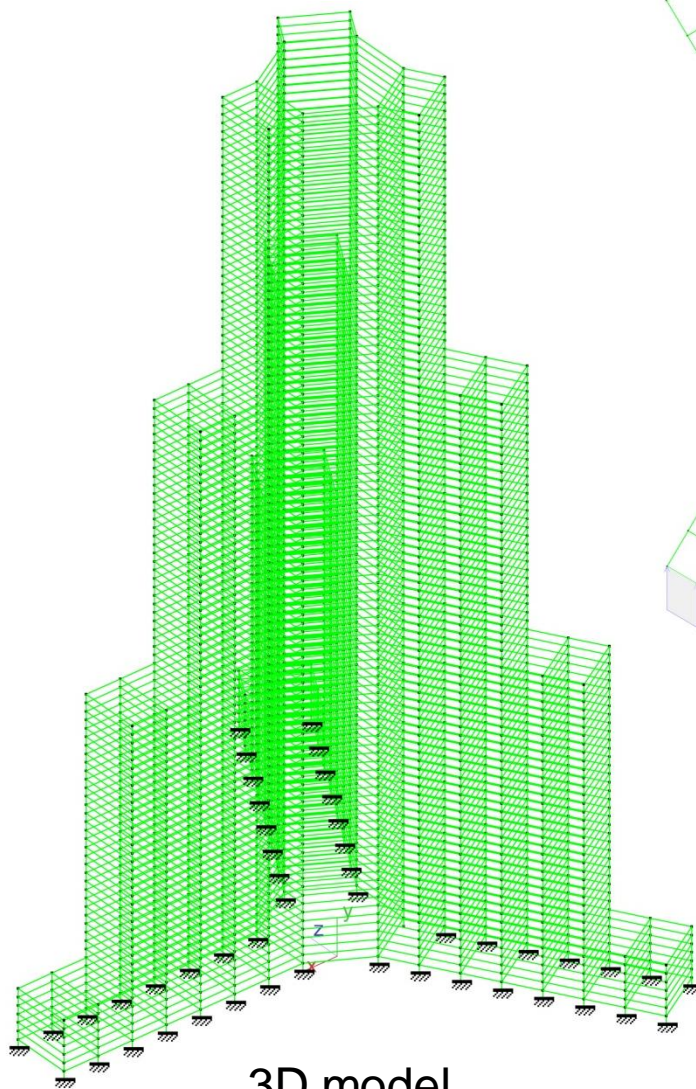


- [Video](#)

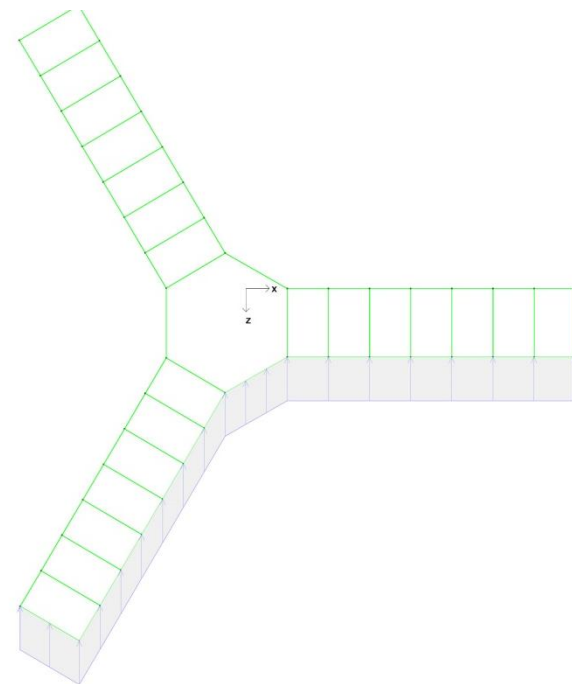
Multiframe model



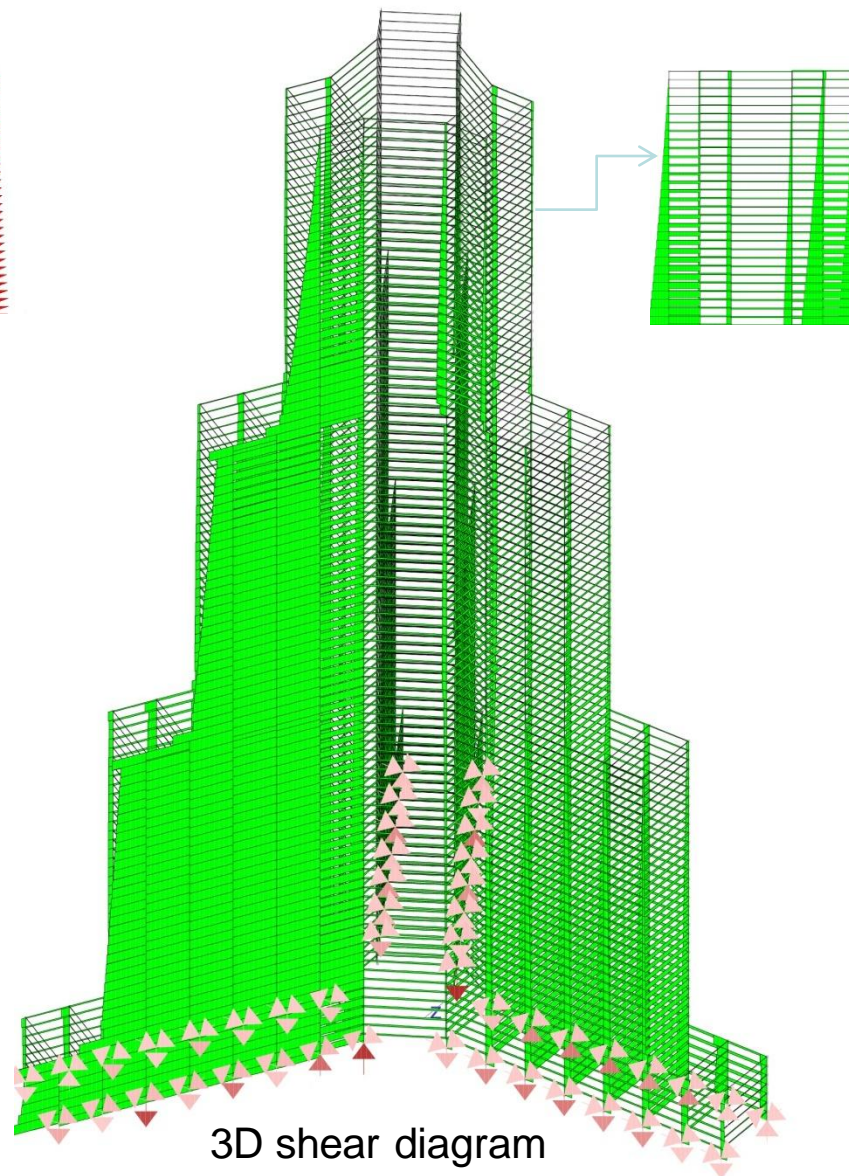
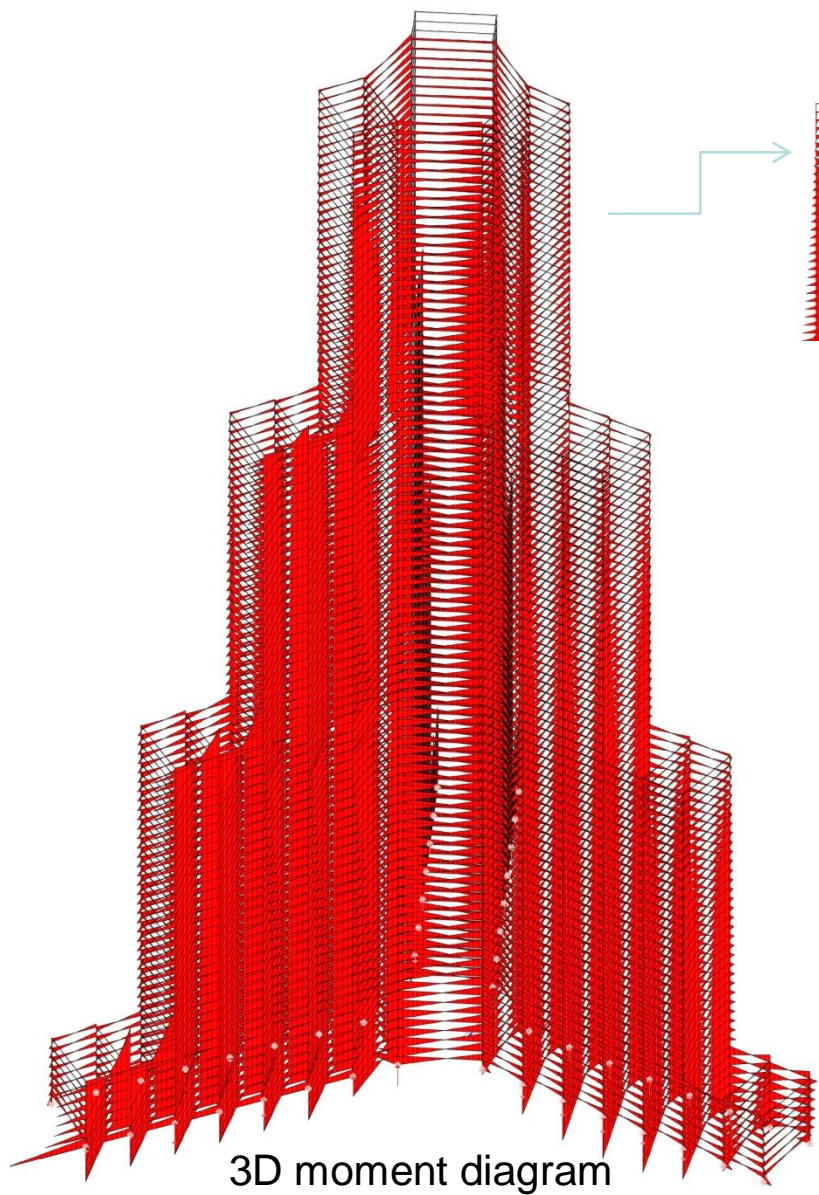
Lateral load

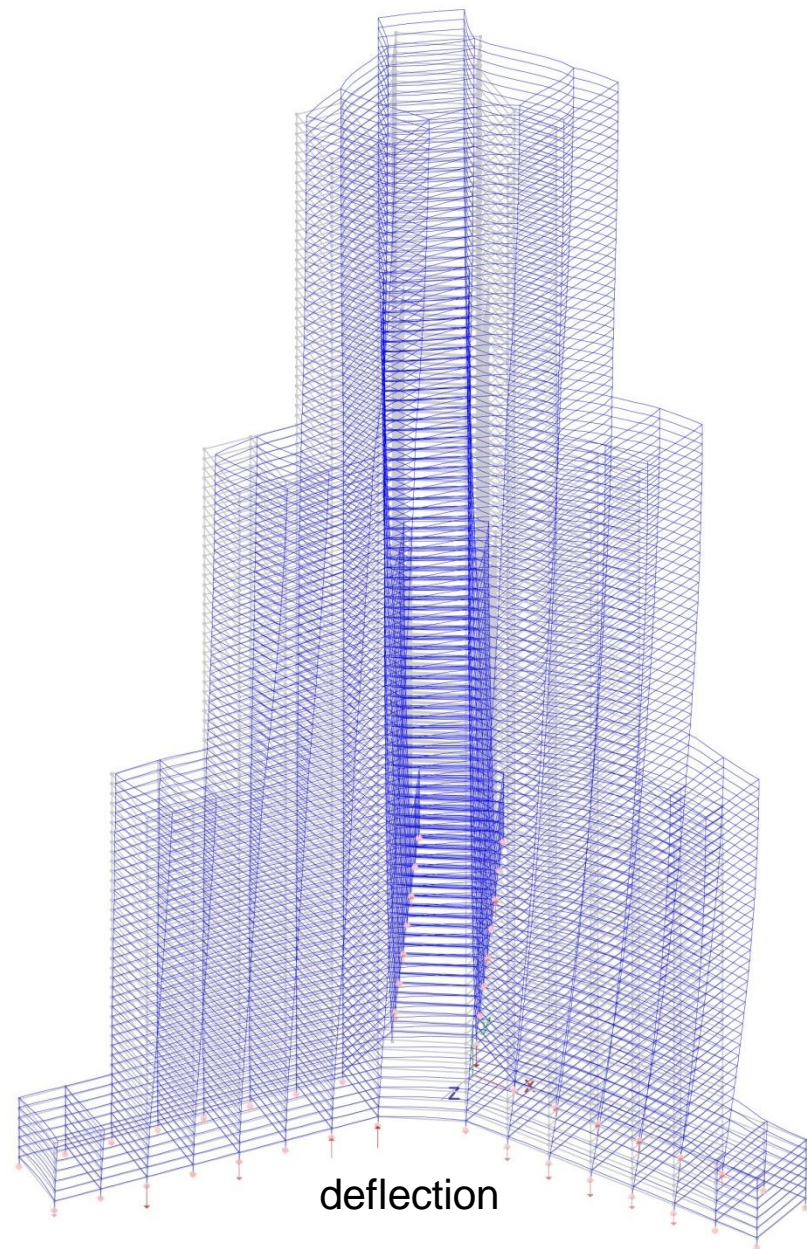
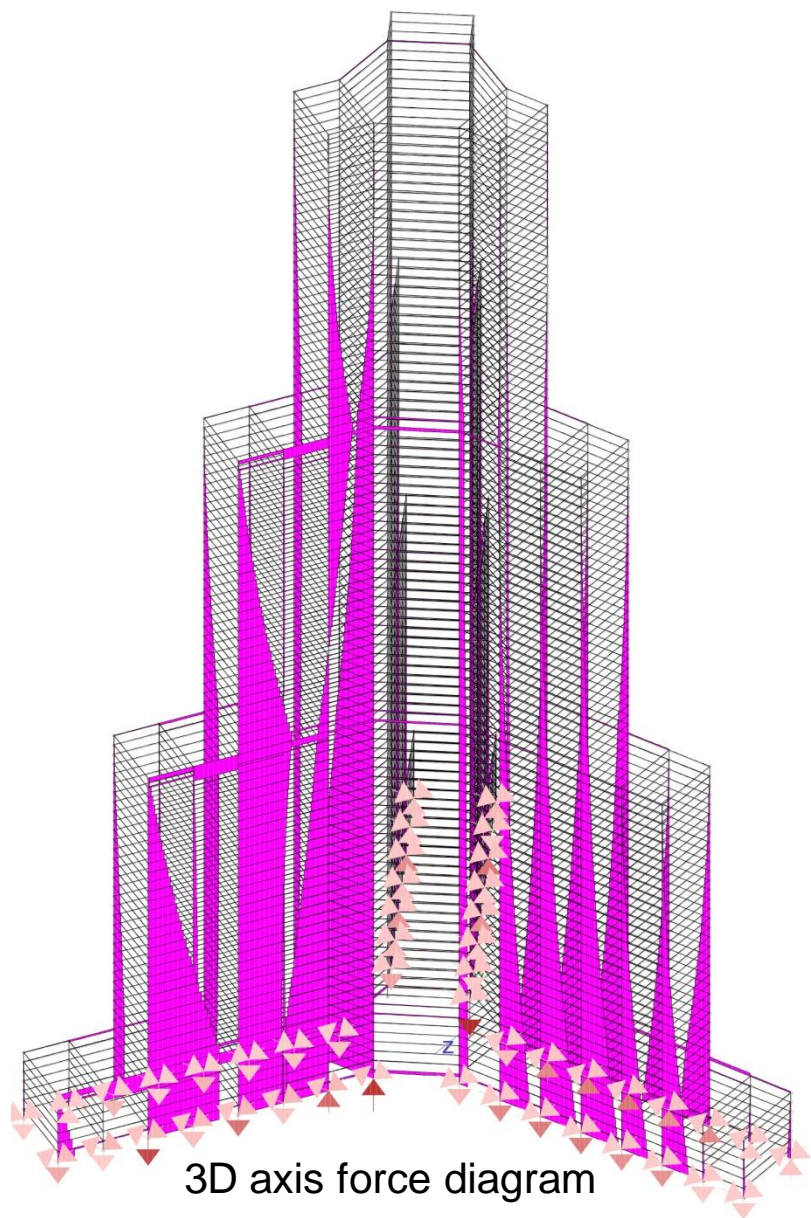


3D model



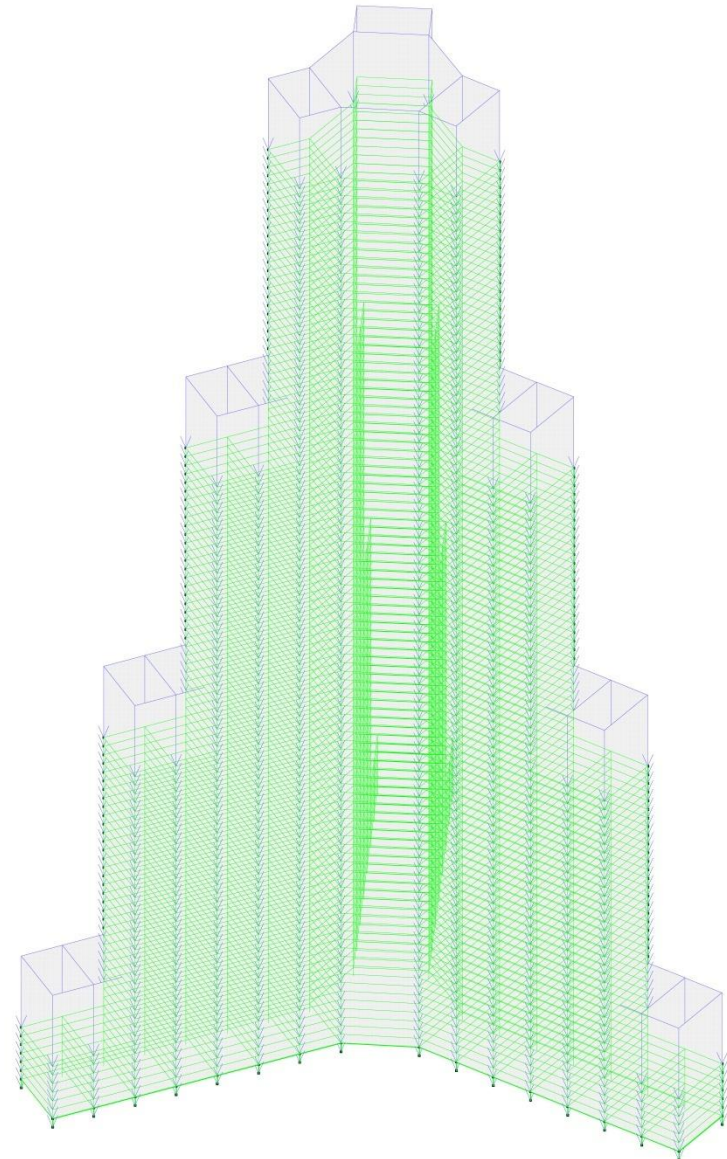
Lateral wind load

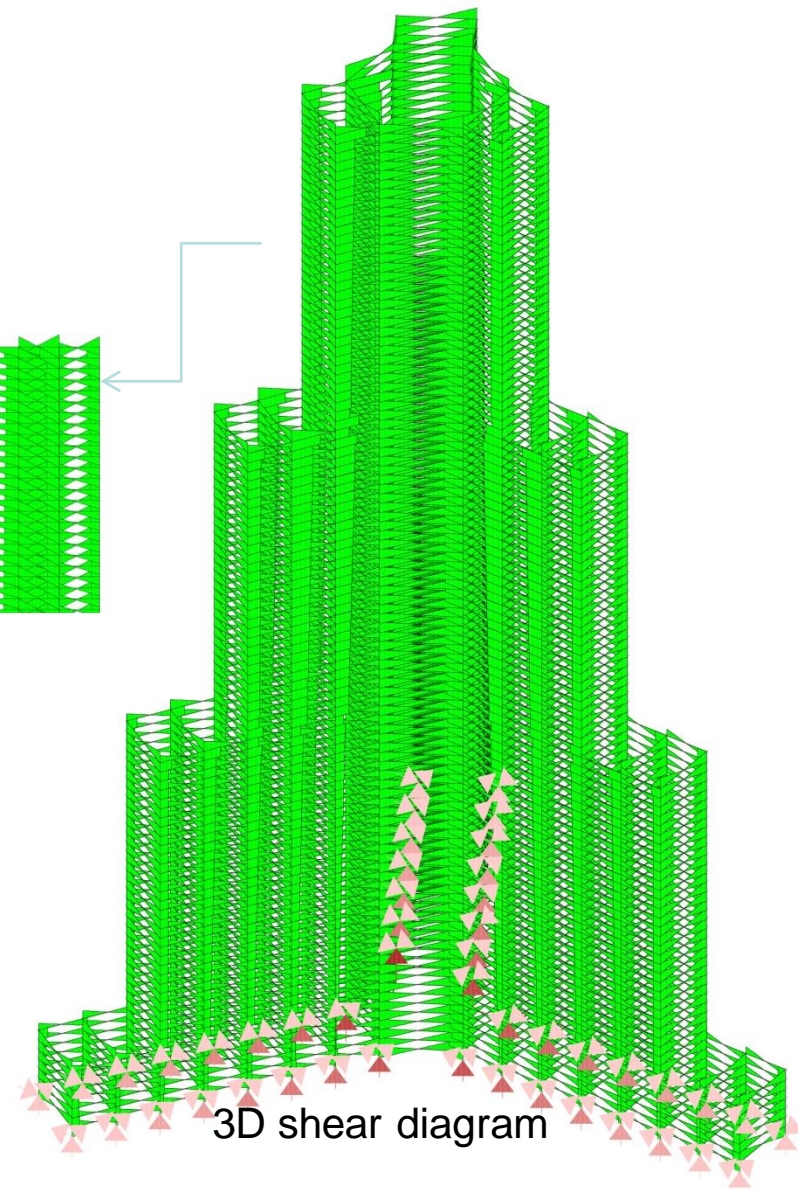
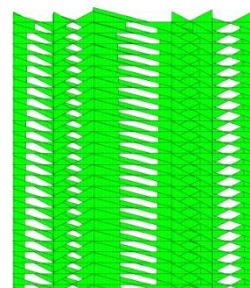
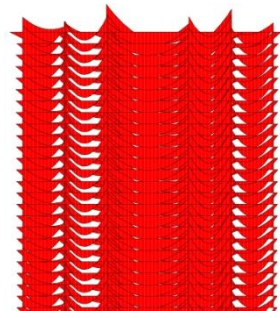
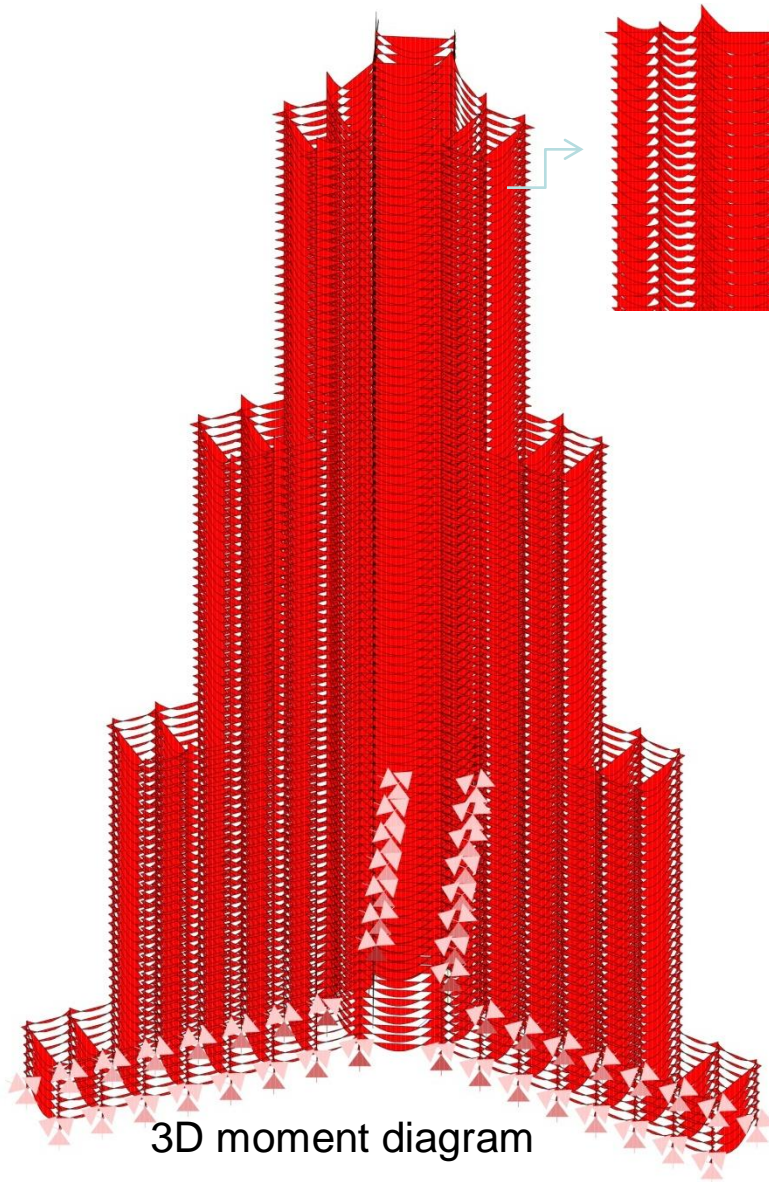


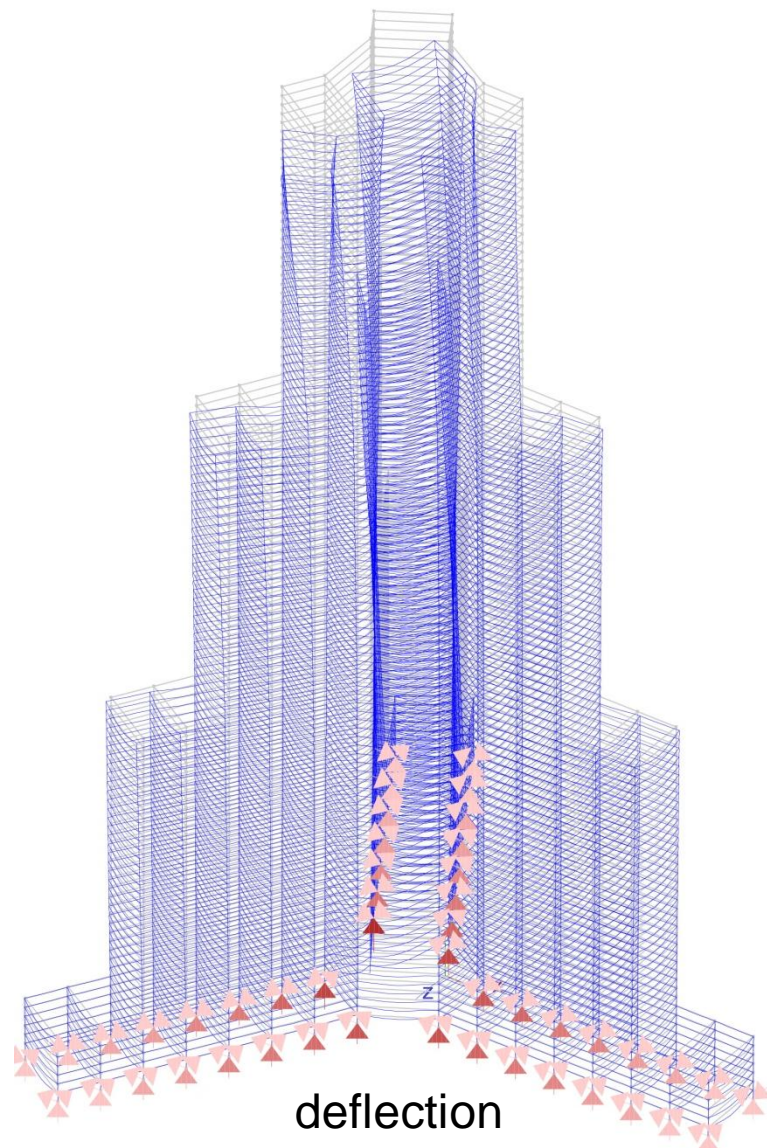
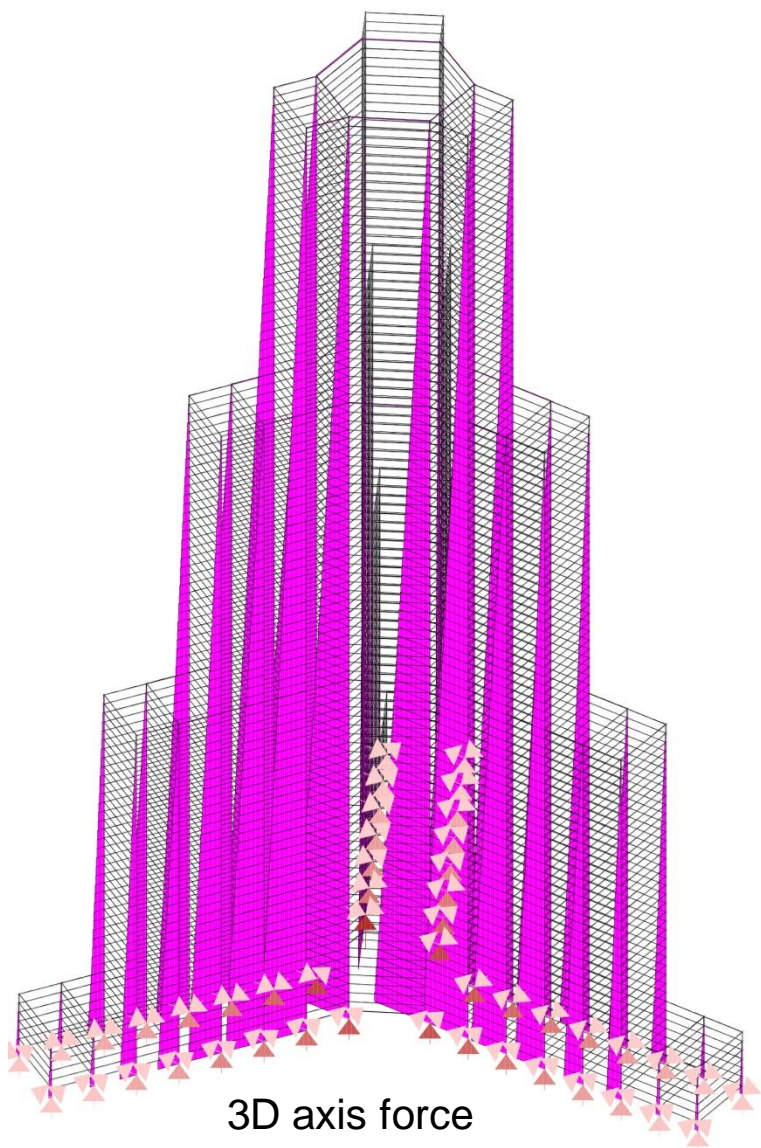


Gravity load

In the lower level, the concrete system (shear wall, column) is the main way to support the gravity load. The wall thicknesses and column sizes were fine-tuned to reduce the effects of creep and shrinkage on the individual elements which compose the structure.







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- <http://okok.org/forum/viewthread.php?tid=202951>
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THANK *You*

IN APPRECIATION OF YOU, AND ALL THAT YOU DO.