

BUILDING TALL

If you have space and don't need to go mega tall - the simplest stable structure is a wide base and narrow top like the Great Pyramids or even the Eiffel Tower.



However, if you want to build a very tall skyscraper there are many engineering challenges...



CHALLENGES IN SKYSCRAPER DESIGN

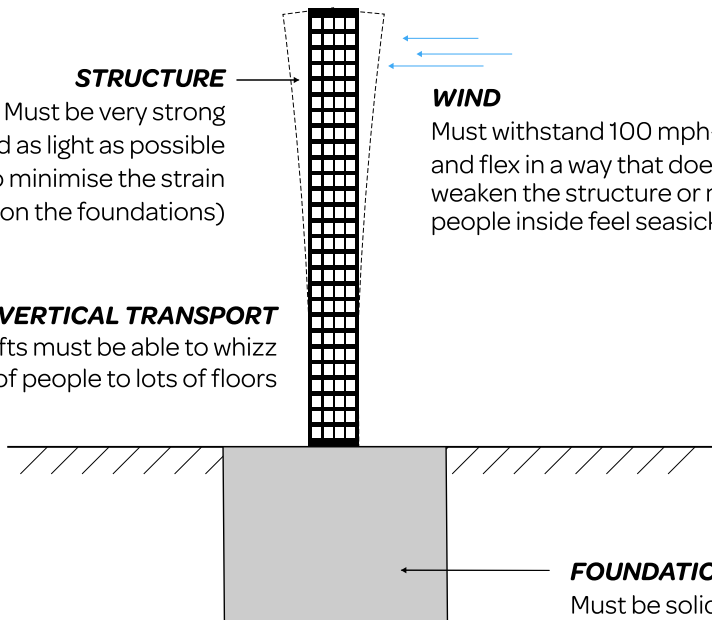
STRUCTURE
Must be very strong and as light as possible (to minimise the strain on the foundations)

WIND
Must withstand 100 mph+ winds and flex in a way that doesn't weaken the structure or make people inside feel seasick!

VERTICAL TRANSPORT
Lifts must be able to whizz lots of people to lots of floors

SAFETY
It must be possible to evacuate inhabitants quickly in the event of a fire

FOUNDATIONS
Must be solid and able to spread the huge forces created by the building over a larger area

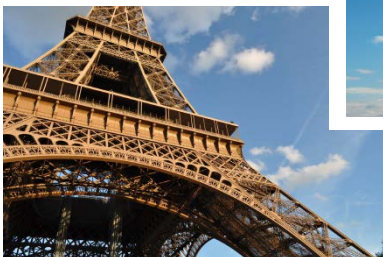


STRUCTURES

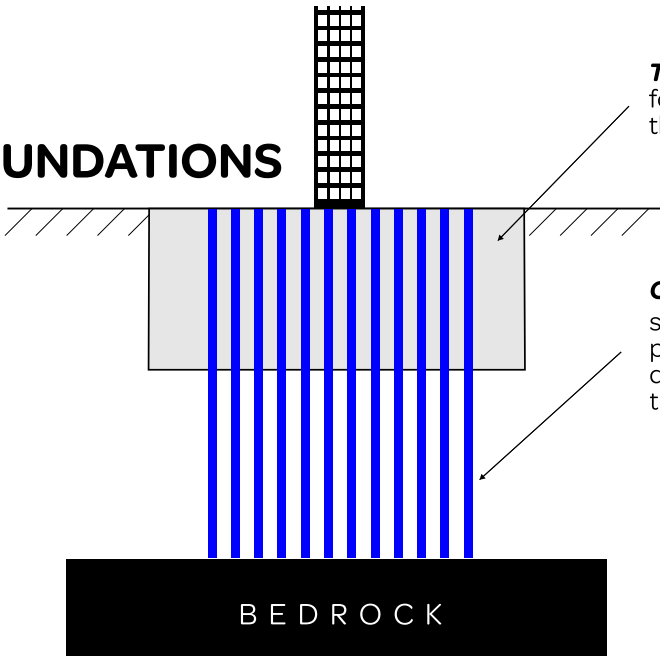
Triangles are used extensively in structures because they add strength & rigidity, bearing heavy loads without deforming.

They can be seen clearly in the Eiffel Tower, radio masts & tall cranes.

Skyscrapers are traditionally steel and concrete, but more modern materials such as carbon fibre are starting to be used.



FOUNDATIONS

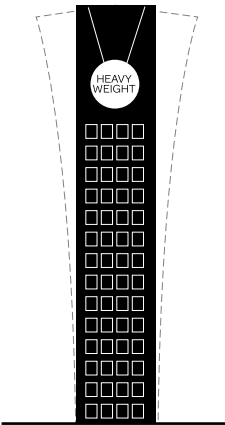


TO SPREAD THE LOAD
foundations are far wider than the skyscrapers they support

ON SOFT GROUND
sometimes many concrete pilings (columns) are pounded down through the ground until they reach bedrock

CONCRETE IS UP TO 5x STRONGER
...than it used to be as it's chemically more advanced. It often uses additives from industrial by-products, such as fly ash, slag from steel mills and microsilica left over from silicon manufacturing

WIND!



The force of wind makes skyscrapers flex/sway. A way to counter this is to utilise dampers, most commonly **Mass Dampers**. These are large weights suspended inside the top of the building. They both **reduce the amount of flex** and also **slow the acceleration**, so inhabitants do not feel the sway and don't suffer the side effects like motion sickness 🍏



WORLD'S LARGEST TUNED MASS DAMPER:

... is in the Taipei 101 skyscraper in Taiwan its BIG... a 5.5m diameter, 660 tonne steel sphere suspended by 8 cables
It's open for public viewing between the 88th and 92nd floors.

The **shape of the building** is also crucial to reduce the effects of wind.

Air pushing against the surface of a tall tower **creates vortices** that can shake and vibrate buildings.

Skyscraper designers want to "**confuse the wind**" to prevent damaging vortices forming.

Facades often have **rounded, chamfered or notched corners** to help break up the wind

The twisted sides of the Shanghai Tower help to reduce the swaying effects caused by the wind

