

Economics Planning of Super Tall Buildings in Asia Pacific Cities

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Introduction

- Large in scale, complex in nature and more expensive in construction.
- No previous study on super tall buildings.
- Examine the **economics planning** of super tall office buildings in Asia Pacific cities.

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Research Method

- Tall buildings - in the range of 30 to 50 stories
- Super tall buildings - in excess of 50 stories
- **Case studies** of the Asia Pacific's 10 tallest buildings.
- Represent the world's 15 tallest buildings.
- The tallest buildings in its cities.
- **Landmark** buildings designed by renowned consultants.

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Sample Cases

Building Cases	City	Height	Floors	Year
1. Taipei 101 Tower	Taipei	509 m	101	2004
2. Petronas Tower 1	Kuala Lumpur	452 m	88	1998
3. Petronas Tower 2	Kuala Lumpur	452 m	88	1998
4. Jin Mao Tower	Shanghai	421m	88	1998
5. International Finance Centre	Hong Kong	415 m	88	2003
6. CITIC Plaza	Guangzhou	391 m	80	1997
7. Shun Hing Square	Shenzhen	384 m	69	1996
8. Central Plaza	Hong Kong	374 m	78	1992
9. Bank of China Tower	Hong Kong	367 m	70	1990
10. The Center	Hong Kong	346 m	73	1998

Asia Pacific's 10 Tallest Buildings

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Plan Shape of Building

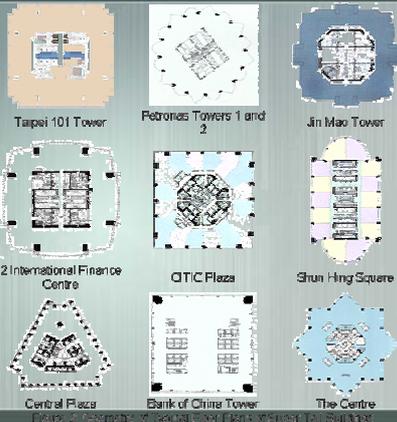


Figure 2.1 Forming a special and unique shape for building

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Size of Floor Plate Lettable to Gross Floor Area Ratio

- The lettable to gross floor area ratio depends on the size of **floor plate** in relation to its **service core**.
- It was found that
 - The site areas are large and floor plate design is not constrained by its maximum site coverage.
 - The floor plate is large, ranging from approximately 2,100m² to 2,800m².
 - All can achieve a high lettable to gross floor area ratio of about 80%.

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Wall to Floor Area Ratio

Size of Floor Plates

- External wall is a cost significant element.
- It was found that
 - The average wall to floor area ratio is 0.34.
 - Jin Mao Tower has the lowest wall to floor area ratio of 0.30.
 - Petronas Towers have the highest wall to floor area ratio of 0.40.
 - If Petronas Towers are excluded, the average wall to floor area ratio will become 0.33.

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Lease Span

- Lease span is the clear distance from the building core to the external wall. It was found that
 - The common lease span is 12m, ranging from 9.80m to 13.89m.
 - Bank of China has the longest lease span of 17m at its lower floors.
- It is desirable to have as few columns as possible within the lease span area. It was found that
 - except Central Plaza, all buildings have no columns.
 - In Central Plaza there is only one column at the middle.

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Floor Height

- The floor height consists of two aspects; floor-to-floor height and floor-to-ceiling height.
- It was found that the floor-to-ceiling height ranges from 2.60m to 2.80m.
- Raised floor is provided in some buildings and increases the floor-to-floor height.
- It was found that the common floor-to-floor height is 4.0m, ranging from 3.73m to 4.20m.

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Structural Floor Systems

Floor Height

- Structural floor system can have an impact on the overall floor height.
- It was found that
 - Traditional concrete flooring system in CITIC Plaza and Central Plaza.
 - Steel flange beam with composite metal deck and concrete flooring system in remaining buildings.
 - **No** direct relation between structural floor systems and its overall floor height.

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Building Form

- Large podium floors at lower levels to accommodate commercial functions.
 - **Setback** in main tower to accommodate different functions.
 - No much variance of window size and proportion due to different floor-to-floor heights.
- A single structural system and a single construction material.

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Building Form

- Tapering has a significant improvement in the overall building structural behaviours to wind force.
- It was found that many buildings have a slightly tapered building shape at its top floors.



Taipei 101



Petronas Towers



Jin Mao Tower



2 International Finance Centre



Central Plaza

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Service Core Design

- The size of service core should be reduced to an acceptable minimum.
- It was found that
 - **Central core** approach in all buildings, except Bank of China Tower.
 - Central core as a **structural element** to provide stability.
 - Its **internal layout** is changed.



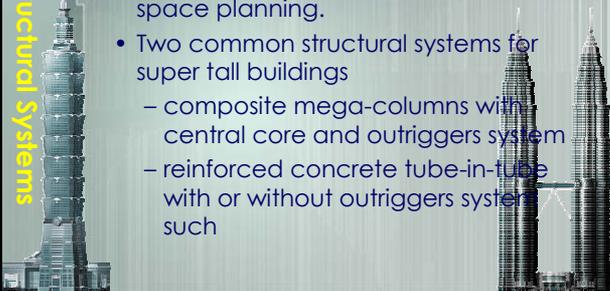
Service Core Construction

- The core material can be built from steel or concrete.
- Structural steel and drywall construction is less common.
- **High-strength concrete** to reduce the thickness of service core walls.
- Service core construction on the critical path programme.
- By using slip-form or jump-form techniques, a 3 to 4-day cycle is achievable for core wall construction.
- This speed is similar to steel construction.

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Structural Systems

- The structural system has a great impact not only on exterior aesthetics of a building, but also on its interior space planning.
- Two common structural systems for super tall buildings
 - composite mega-columns with central core and outriggers system
 - reinforced concrete tube-in-tube with or without outriggers systems such



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Structural Materials

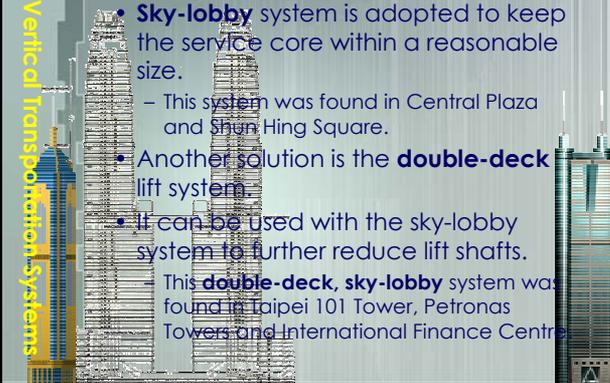
- There are limited supply of quality structural steel and experienced contractors in steel fabrication.
- Steel construction is more expensive than reinforced concrete.
- Very high-strength concrete (over 100MPa) can be produced with no difficult from materials available from local market.



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Vertical Transportation Systems

- **Sky-lobby** system is adopted to keep the service core within a reasonable size.
 - This system was found in Central Plaza and Sun Hing Square.
- Another solution is the **double-deck** lift system.
 - It can be used with the sky-lobby system to further reduce lift shafts.
 - This **double-deck, sky-lobby** system was found in Taipei 101 Tower, Petronas Towers and International Finance Centre.



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Conclusions

- The structural system is the most important criterion for super tall buildings.
- With sufficient site area, the building can be designed to have a larger floor plate, and a longer lease span.
- Square or similar plan is the most common geometry in super tall buildings.
- Central core approach is commonly used in super tall buildings.



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