MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ARCHITECTURE / BUILDING SCIENCE PROGRAM

BS 536
STUDIES ON TALL BUILDINGS: DESIGN CONSIDERATIONS
Fall 2011-2012

Case Study: **Jin Mao Tower**
by
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Submitted to: Günel, Tanyer, Ilgın – Fall 2011

JIN MAO TOWER

•Official Name :	Jin Mao Building (1)
•Former Name:	Jin Mao Tower (1)
•Location :	Shanghai ,China (1)
•Use :	hotel / office (1)
•Architectural Height :	420.5 meter (1-2)
•Occupied Height :	348.4 meter (1-2)
•Floors Above Ground :	88 (1-2)
•Construction :	1994 – 1999 (1-2)
•Structural Material :	composite (1-2)
• # of elevators :	130 (2)
•Building cost :	$540,000,000 (2)
•Design Architect:	Adrian Smith, Skidmore Owings & Merril LLP (SOM)
•Structural Engineer:	SOM
•MEP Engineer :	SOM
•Main Contractor :	Shanghai Jin Mao Contractor

www.ctbuh.org
1: www.ctbuh.org
2: wwmmporis.com

www.skyscraperpage.com

STRUCTURAL SYSTEM

- Taranath: Mega Frames With Super Columns
- Smith&Coull: Outrigger Braced System
- Oral Büyüköztürk: Core and Outrigger System
- Günel &Ilgın: Outriggered Frame System

Challenges for the design

- Soil conditions are very poor.
- Typhoon and strong extratropical wind conditions exist.
- Moderate earthquakes are possible.

www.ctbuh.com
Adrian Smith, 2007
Smithgill.com

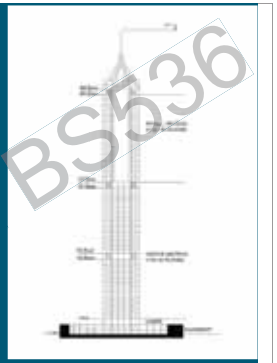
- Regional architectural and cultural traditions as main design motives
- The building is designed around by the number of eight.
  - _88 floors
  - _octagonal core
  - _8 main super-frame columns
  - _8 sided exterior at the top
- The pagoda is another inspirational subject.
- Attempt to reinterpreting the pagoda in a contemporary idiom and with contemporary technology.
- The biaxial symmetry of its forms allows to views from all directions.
- Its gently stepping and undulating form ascends in a rthymic way increasing the sense of height. This also acts as a wind damper to diffuse the lateral loads on the mass.

wanderingvegans.wordpress.com

a freehand sketch of Jin Mao Tower near Shanghai World Financial Center

jordanmechner.com

- The Jin Mao Tower is a mixed-use building that includes a five star hotel, office spaces, parking, and retail uses.
- Tower composes of
  a main tower,
  a podium,
  a basement.
- 123,000 m2 office space
- 82,000 m2 hotel area
- Totally 205,000 m2 gross framed area



Sarkisian, .Mathias, Long, Mazeika, Gordon, Chakar, 2006

Drawn by Derya DİNÇEL

- Integration of inovative structural systems and construction methods while respecting the architectural design intent.
- A kind of greek cross configuration with incorporated composite design having
  - _ a reinforced concrete core
  - _ steel outriggers
  - _ composite exterior mega columns
- The central core houses the primary building service functions,including elevators, mechanical fan rooms for HVAC services, and washrooms.

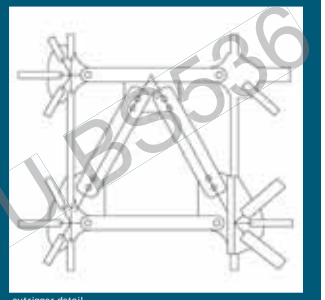
Dwell, 2002
Adrian Smith ,2007

- 3 structural steel outriger trusses interconnect the concrete core and the composite mega columns at two-storey tall levels
  - _24-26 floors
  - _51-53 floors
  - _85-87 floors (the 3 dimensional structural steel cap truss system)
- The cap truss system which frames the top of the building between Level 87 and the spire , is used to
  - span over the open core,
  - support the gravity load of heavy mechanical spaces,
  - engage the structural steel spire,
  - resist lateral loads above the top of the central core wall / composite mega column system.

cap truss system
Adrian Smith,2007

Adrian Smith,2007
Sarkisian, .Mathias, Long, Mazeika, Gordon, Chakar, 2006

- After all the wind tunel and seismicity tests special considerations were given to the outrigger trusses and their connections.
- In all design cases, these structural steel trusses were designed to remain elastic.



outrigger detail

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Sarkisian, .Mathias, Long, Mazeika, Gordon, Chakar, 2006

Adrian Smith,2007

- In addition to resisting lateral loads , the core wall , composite mega-columns and structural steel columns carry gravity loads.
- Composite structural steel wide-flanged beams and built-up trusses are used to frame typical floors
- The floor framing elements are typically spaced at 4.5 m on center with a composite metal deck slab (75 mm metal deck topped with 80 mm of normal weight concrete) framing between the steel members.

Adrian Smith ,2007
Sarkisian ,Mathias, Long, Mazeika, Gordon, Chakar, 2006

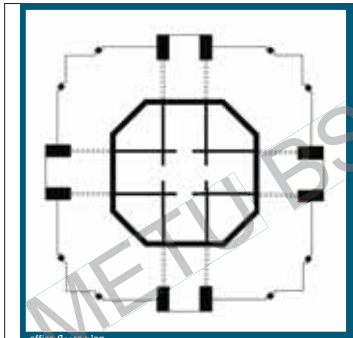
Advanced structural engineering concepts were used in design

- Open ended structural steel piles extending 82 m deep below grade
- Four meter thick reinforced concrete mat is used as an interface between the superstructure and the piles.
- A one meter slurry wall extends 36 m deep around the perimeter of the site acts as a permanent water cut off wall

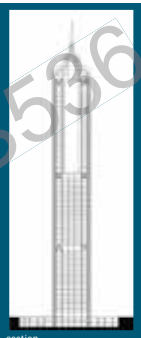
Sarkisian, .Mathias, Long, Mazeika, Gordon, Chakar, 2006

Dwell, 2002

Dwell ,2002



office floors plan



section

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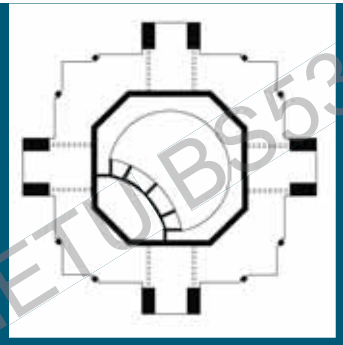

hotel floors plan

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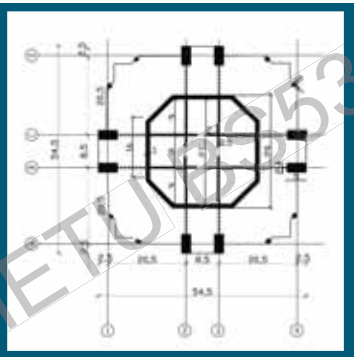

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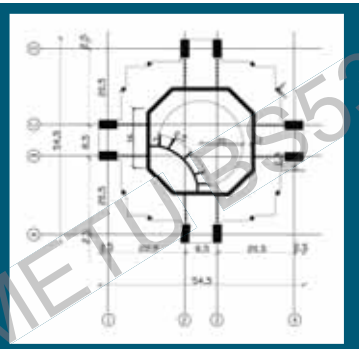

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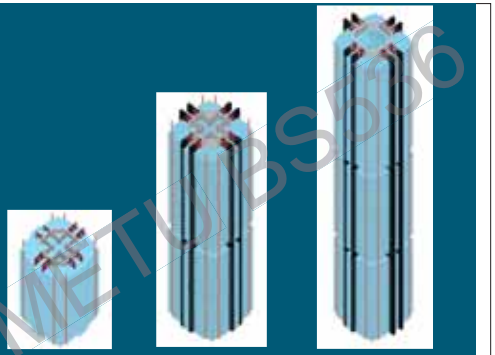

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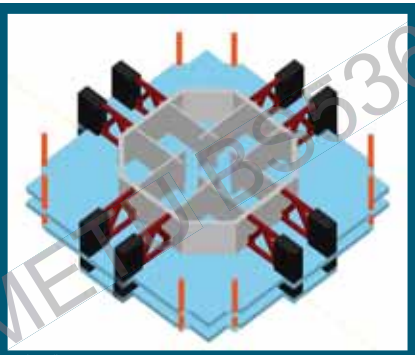

outrigger floor

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