Tall Structures of the world

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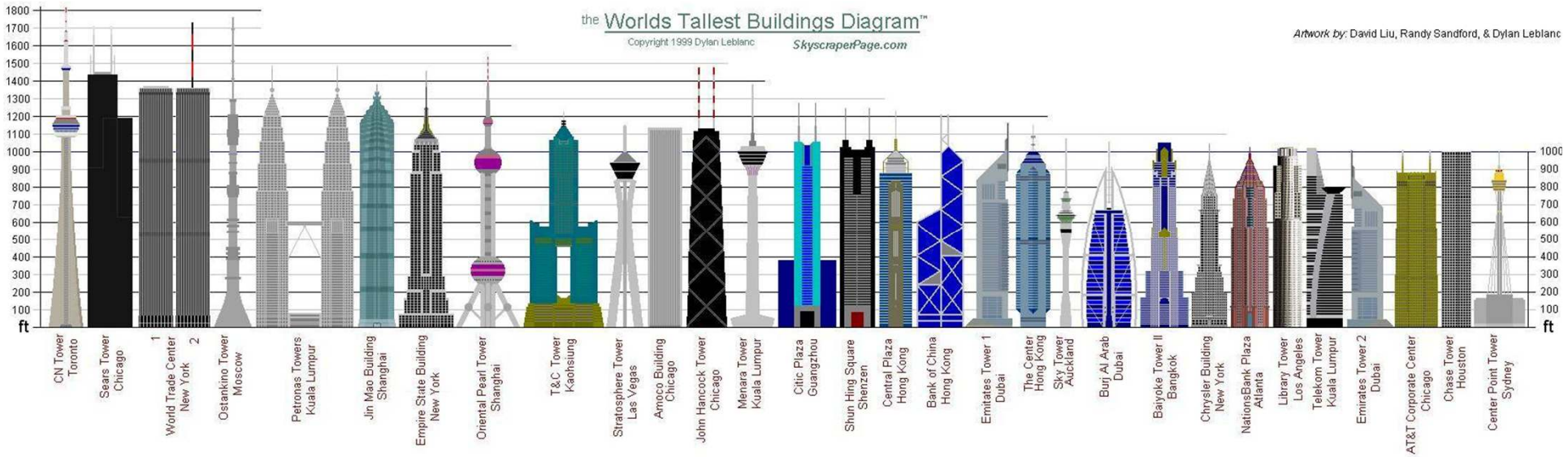
TAIPEI 101


the Worlds Tallest Buildings Diagram™
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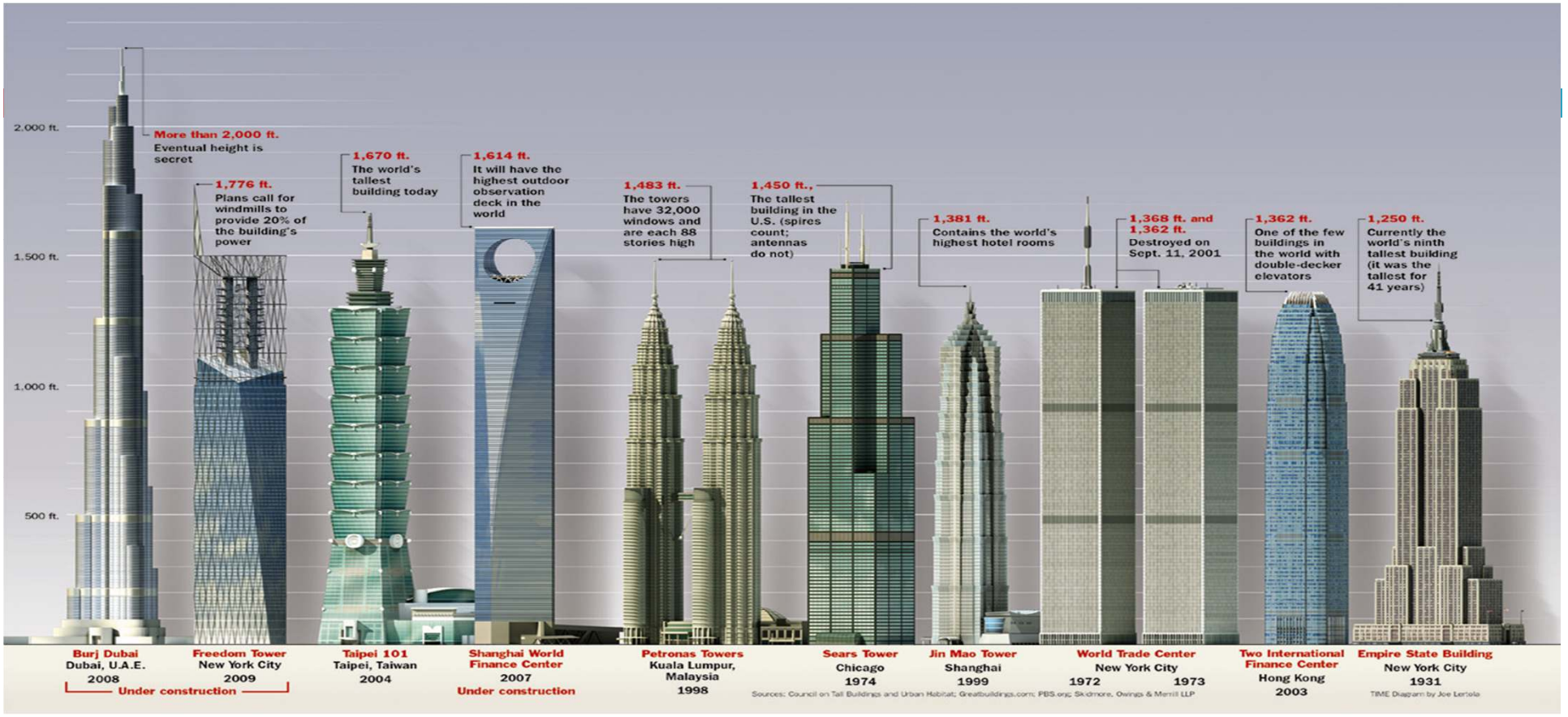
SkyscraperPage.com
Artwork by: David Liu, Randy Sandford, & Dylan Leblanc
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
ft
CN Tower Toronto
Sears Tower Chicago
1 World Trade Center New York
2
Ostankino Tower Moscow
Petronas Towers Kuala Lumpur
Jin Mao Building Shanghai
Empire State Building New York
Oriental Pearl Tower Shanghai
T&C Tower Kaohsiung
Stratosphere Tower Las Vegas
Amoco Building Chicago
John Hancock Tower Chicago
Menara Tower Kuala Lumpur
Citic Plaza Guangzhou
Shun Hing Square Shenzen
Central Plaza Hong Kong
Bank of China Hong Kong
Emirates Tower 1 Dubai
The Center Hong Kong
Sky Tower Auckland
Burj Al Arab Dubai
Baiyoke Tower II Bangkok
Chrysler Building New York
NationsBank Plaza Atlanta
Library Tower Los Angeles
Telekom Tower Kuala Lumpur
Emirates Tower 2 Dubai
AT&T Corporate Center Chicago
Chase Tower Houston
Center Point Tower Sydney


2,000 ft.
1,500 ft.
1,000 ft.
500 ft.
More than 2,000 ft.
Eventual height is secret
1,776 ft.
Plans call for windmills to provide 20% of the building's power
1,670 ft.
The world's tallest building today
1,614 ft.
It will have the highest outdoor observation deck in the world
1,483 ft.
The towers have 32,000 windows and are each 88 stories high
1,450 ft.,
The tallest building in the U.S. (spires count; antennas do not)
1,381 ft.
Contains the world's highest hotel rooms
1,368 ft. and 1,362 ft.
Destroyed on Sept. 11, 2001
1,362 ft.
One of the few buildings in the world with double-decker elevators
1,250 ft.
Currently the world's ninth tallest building (it was the tallest for 41 years)
Burj Dubai
Dubai, U.A.E.
2008
Under construction
Freedom Tower
New York City
2009
Under construction
Taipei 101
Taipei, Taiwan
2004
Shanghai World Finance Center
2007
Under construction
Petronas Towers
Kuala Lumpur, Malaysia
1998
Sears Tower
Chicago
1974
Jin Mao Tower
Shanghai
1999
World Trade Center
New York City
1972
1973
Two International Finance Center
Hong Kong
2003
Empire State Building
New York City
1931
Sources: Council on Tall Buildings and Urban Habitat; Greatbuildings.com; PBS.org; Skidmore, Owings & Merrill LLP
TIME Diagram by Joe Lertola

Taipei 101

- 101-floor landmark skyscraper located in Taipei, Taiwan.

- The building, designed by C.Y. Lee & Partners and constructed by KTRT Joint Venture.

- Taipei 101 is managed by the International division of Urban Retail Properties Corporation based in Chicago USA.

- The name of the building reflects its location in Taipei's 101 business district along with its floor count.

- The original name planned for the building, **Taipei World Financial Center**, derived from that of its owner, **Taipei Financial Center Corporation**

The records held by Taipei 101

- Ground to highest architectural structure (spire): 509.2 metres (1,670.60 ft). Previously held by the Petronas Towers 452 metres (1,483 ft).
- Ground to roof: 449.2 metres (1,473.75 ft). Formerly held by the Sears Tower 442 metres (1,450 ft).
- Fastest ascending elevator speed: 16.83 m/s (60.6 km/h or 37.7 miles/h).

Contd…..

- Ground to highest occupied floor: 439.2 metres (1,440.94 ft). Formerly held by the Sears Tower 412 metres (1,352 ft)

- Largest countdown clock: On display every New Year's Eve.

- However the record for greatest height from ground to pinnacle remained with the Sears Tower in Chicago (USA): 527 metres (1,729 ft).

- On 21-07-2007 Taipei 101 was overtaken in height by the **Burj Dubai in Dubai, UAE**, upon the completion of that building's 141st (Actual 164 floors) floor.

- Taipei 101 retains its title until the Burj Dubai is completed(Expected to be completed in mid -2009)

Construction

- Taipei 101 is designed to withstand the typhoon winds and earthquake tremors common in its area of the Asia-Pacific.

- Planners aimed for a structure that could withstand gale winds of 60 meters per second and the strongest earthquakes likely to occur in a 2,500 year cycle

- The design achieves both strength and flexibility for the tower through the use of high-performance steel construction.
- Thirty-six columns support Taipei 101, including eight "mega-columns”
- Every eight floors, outrigger trusses connect the columns in the building’s core to those on the exterior.

Foundation

- The foundation is reinforced by 380 piles driven 80 meters into the ground, extending as far as 30 meters into the bedrock
- Each pile is 150 cm in diameter and can bear a load of 1100-1450 tons
- The stability of the design became evident during construction when, on 31-03-2002, a 6.8-magnitude earthquake rocked Taipei.

Tuned Mass Dampers

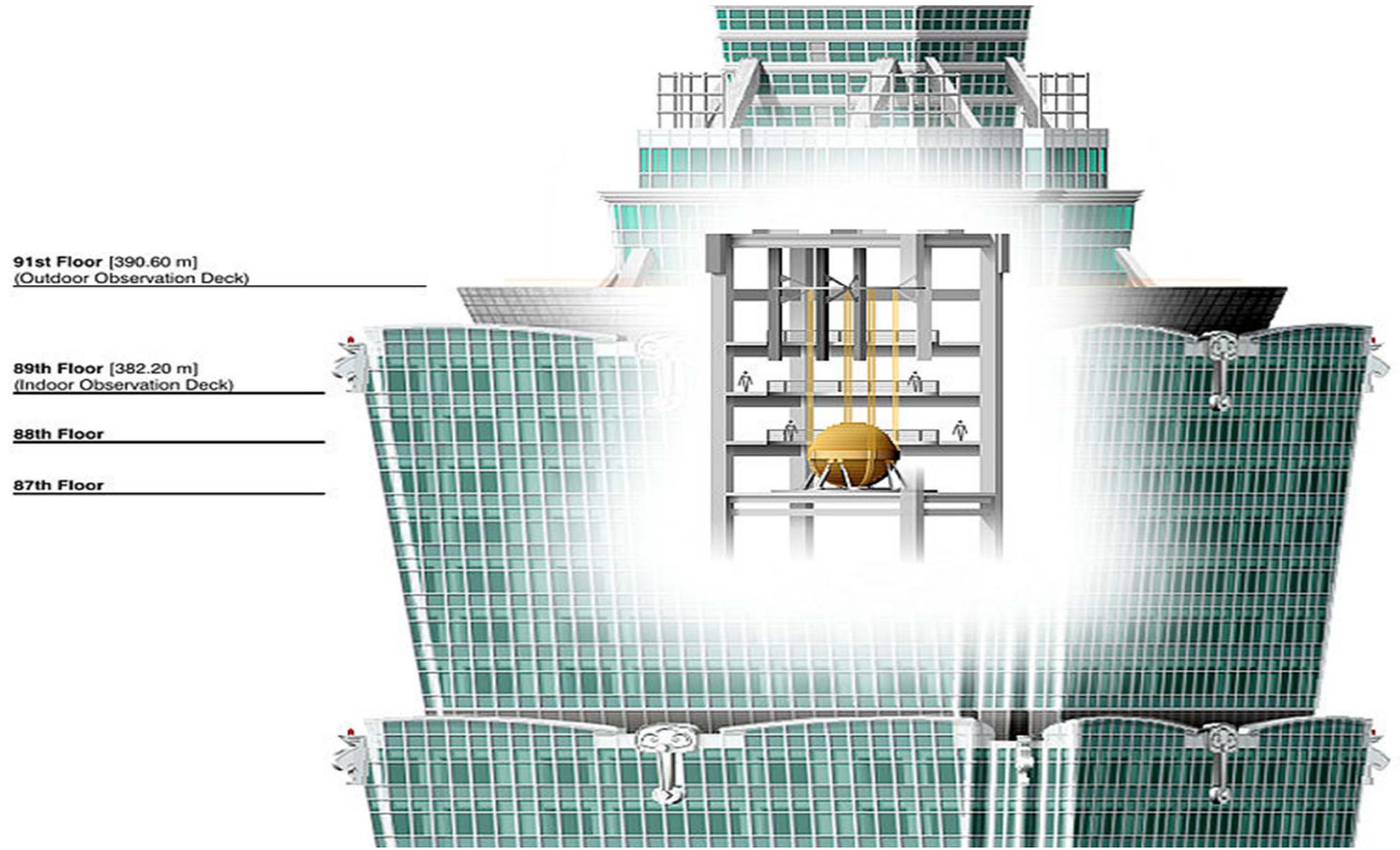
- A tuned mass damper, or harmonic absorber, is a device mounted in structures to prevent discomfort, damage or outright structural failure by vibration

- Typically, the dampers are huge concrete blocks mounted in skyscrapers or other structures to stabilize the structure against violent motion caused by harmonic vibration.

- A 662 metric ton steel pendulum that serves as a tuned mass damper, Suspended from the 92nd to the 88th floor, the pendulum sways to offset movements in the building caused by strong gusts.

- Its sphere, the largest damper sphere in the world, consists of 41 layered steel plates, each with a height of 125 mm being welded together to form a 5.5-meter diameter sphere

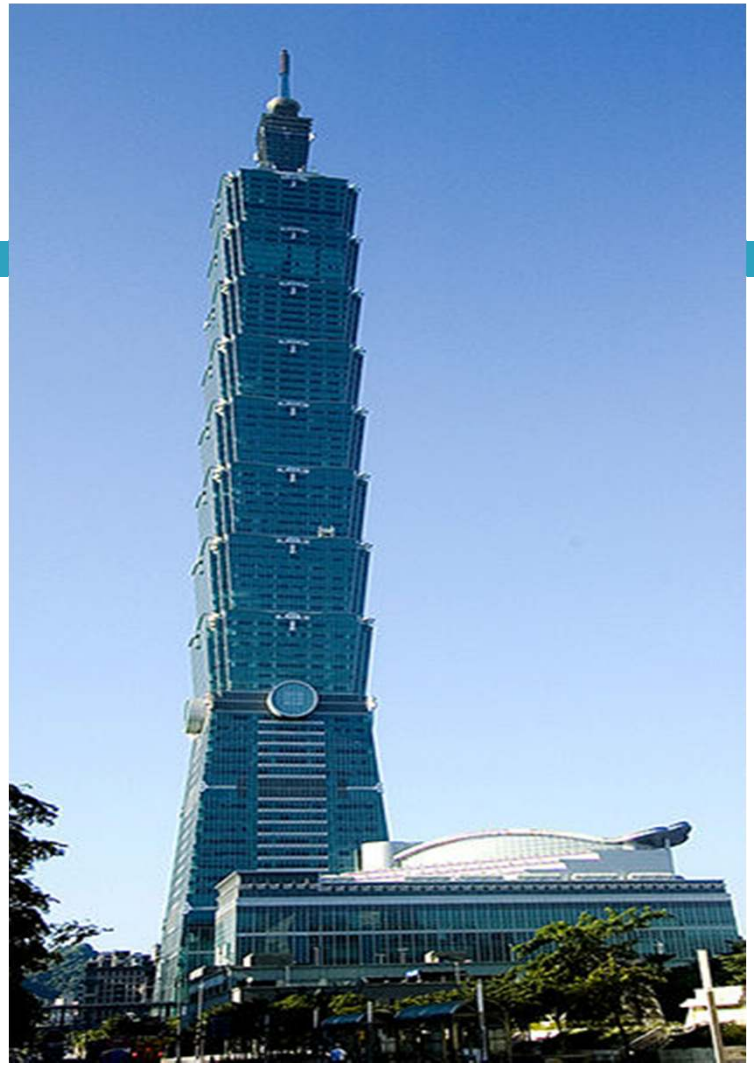
Damper in Taipei 101

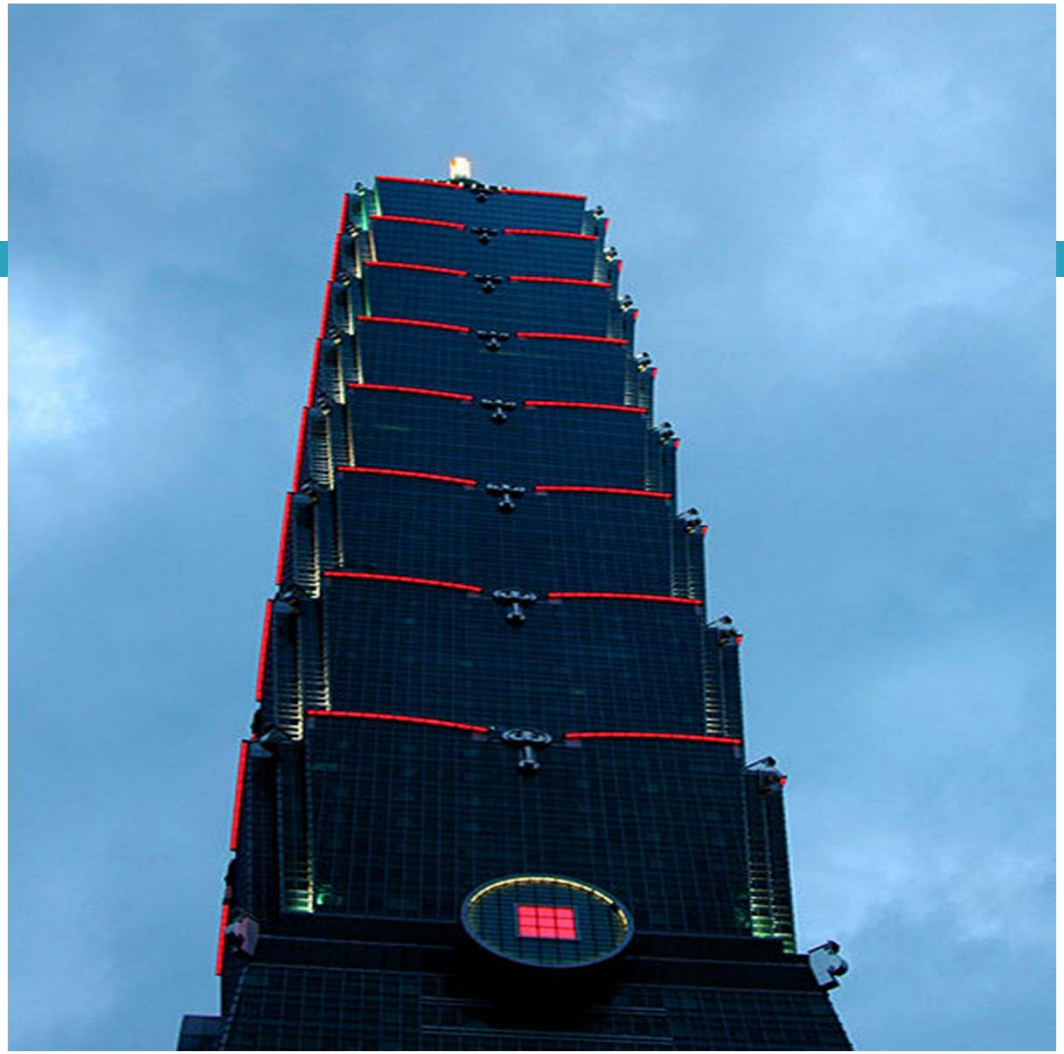

91st Floor [390.60 m]
(Outdoor Observation Deck)
89th Floor [382.20 m]
(Indoor Observation Deck)
88th Floor
87th Floor

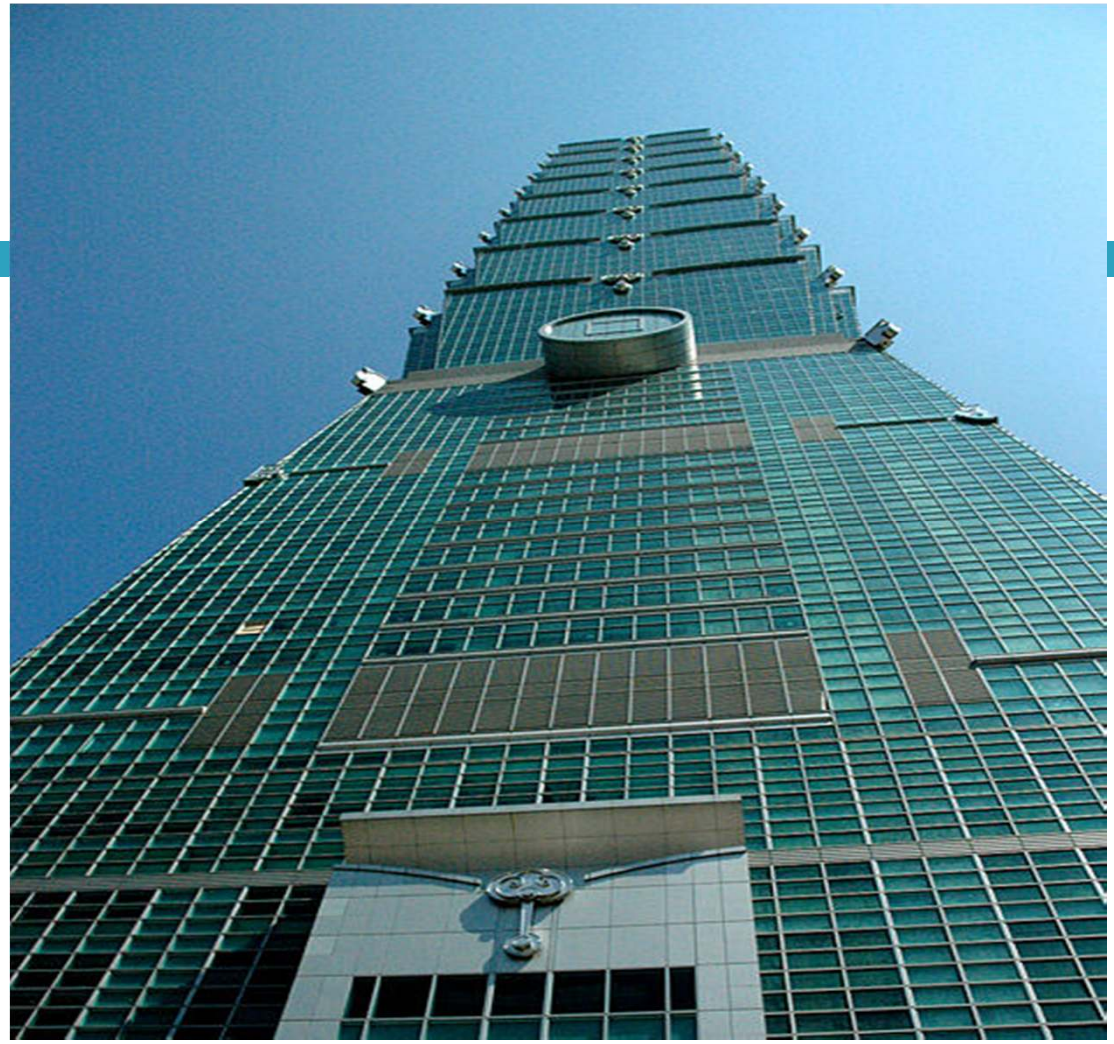
- Another two tuned mass dampers, each weighing 4.5 tons, sit at the tip of the spire

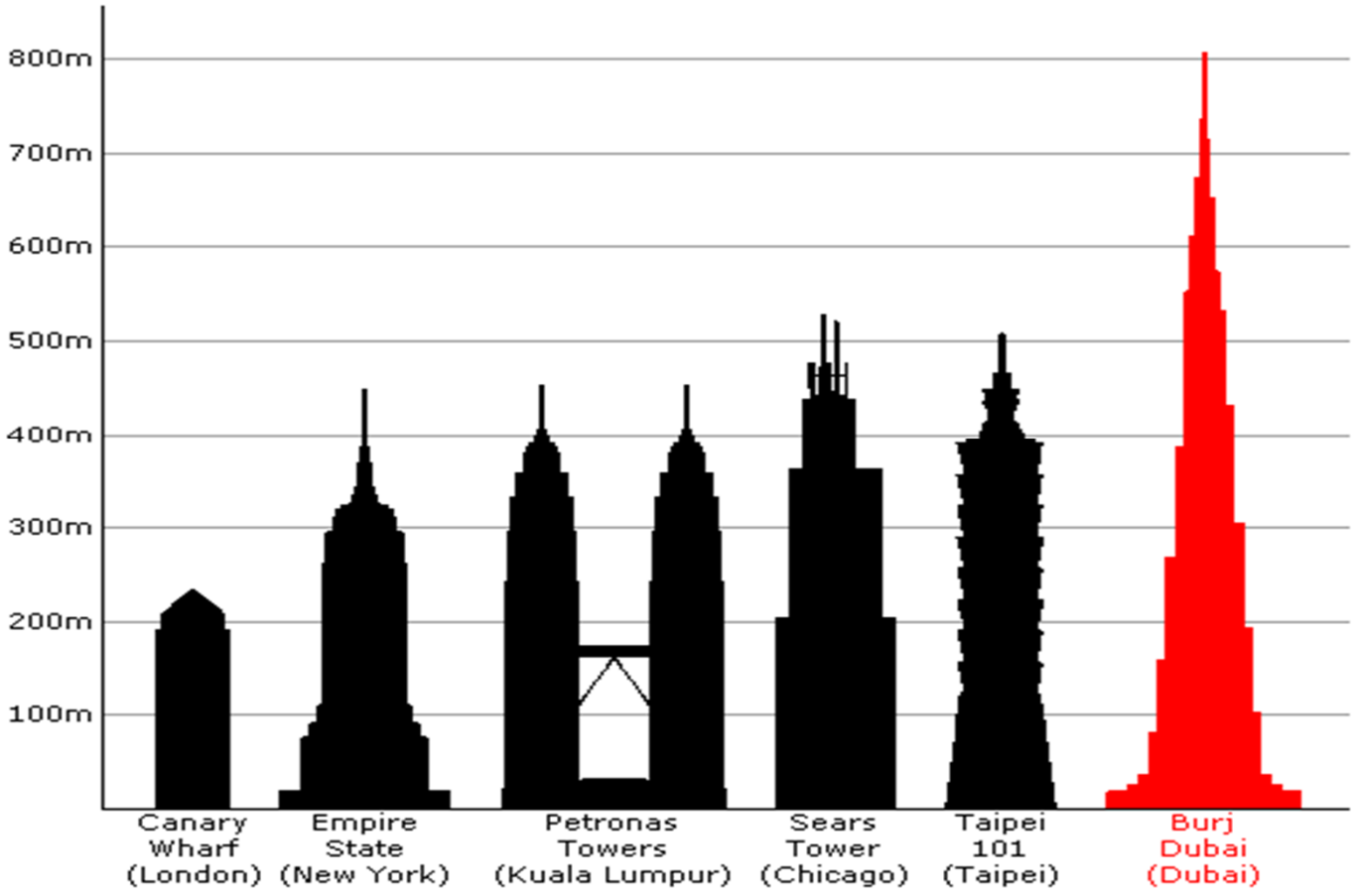
- These prevent cumulative damage to the structure due to strong wind loads

- Taipei 101's characteristic blue-green glass curtain walls are double glazed, offer heat and UV protection, and can sustain impacts of eight tons








800m
700m
600m
500m
400m
300m
200m
100m
Canary Wharf (London)
Empire State (New York)
Petronas Towers (Kuala Lumpur)
Sears Tower (Chicago)
Taipei 101 (Taipei)
Burj Dubai (Dubai)

CHICAGO SPIRE

Chicago Spire

- The **Chicago Spire** is a super tall skyscraper under construction **609.6 m** (Started on June25,2007) in 400 N Lake Shore Drive Chicago, Illinois.
- The building was designed by Spanish architect Santiago Calatrava and is being developed by Garrett Kelleher of Shelbourne Development Group, Inc.

- The Chicago Spire is scheduled to be completed in 2011 with 150 floors.
- The Chicago Spire will incorporate world-class sustainable engineering practices to meet Gold standard of Leadership in Energy and Environmental Design certification.

Design

- Each of the building's 150 stories are rotated exactly 2.44 degrees from the one below for a total 360 degree rotation.
- For supplemental structural support, each floor would be surrounded by cantilevered corners and four concave sides.

- The curved design, may provide two major benefits to the structure of the building.
  - Designs have a tendency of adding to the strength of a structure
  - The curved face of the exterior will minimize wind forces.

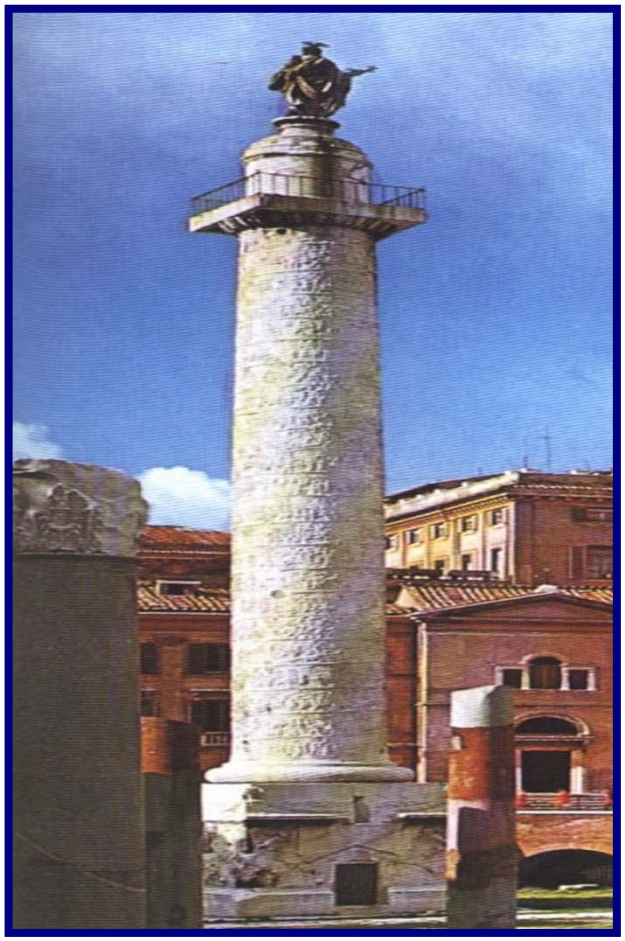
- Although the curved design of the Chicago Spire will not completely negate wind forces, a tapering concrete core and twelve shear walls emanating from it are installed to counteract these forces instead.

Construction progress….

- In preparation for construction, 34 concrete and steel caissons will be drilled 37 m into bedrock underlying the Earth's surface.
- A cofferdam with 31 m diameter and 24 m depth will be installed to create a work environment and will later act as a foundation for the building's core.
- The underground portion of the construction is expected to be completed in the first quarter of 2008.

- Sustainable features include
  - Recycled rainwater, river water used for cooling,
  - Ornithologically-sensitive glass to protect migratory birds,
  - Intelligent building and management systems
  - Waste storage and recycling management, and
  - Monitored outdoor air delivery.

Outstanding Tall Structures of the world



TRAJAN'S COLUMN

Erected in 113 A.D.

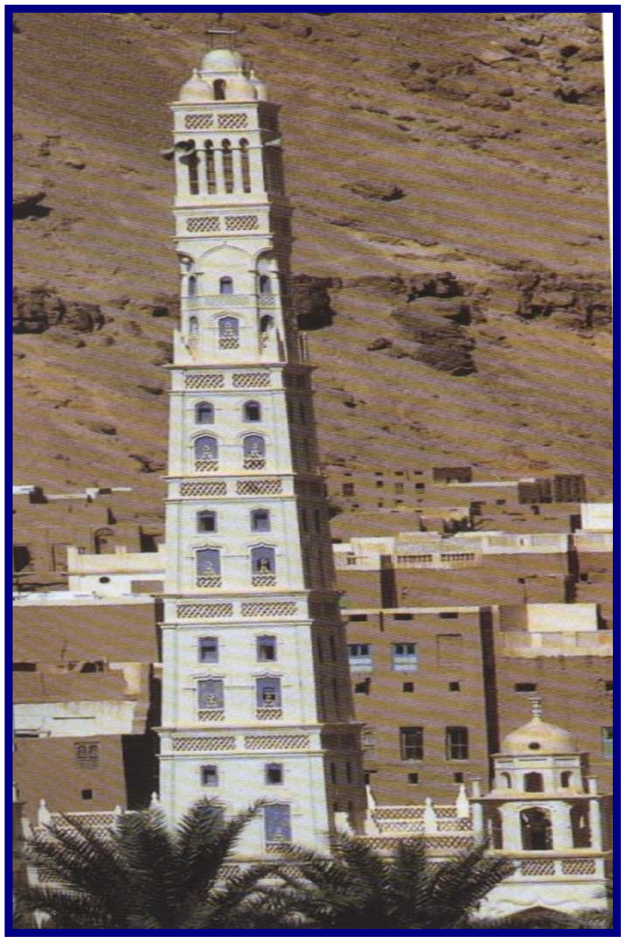
Height : **43 meters**

Constructed to recall
Trajan's victory over Daciens

MARCUS AURELIUS' COLUMN

Location : **Rome**

Erected in 180 A.D.



THE AL-MOHDAR MOSQUE

LOCATION: SOUTH YEMEN

HEIGHT: 50 METERS

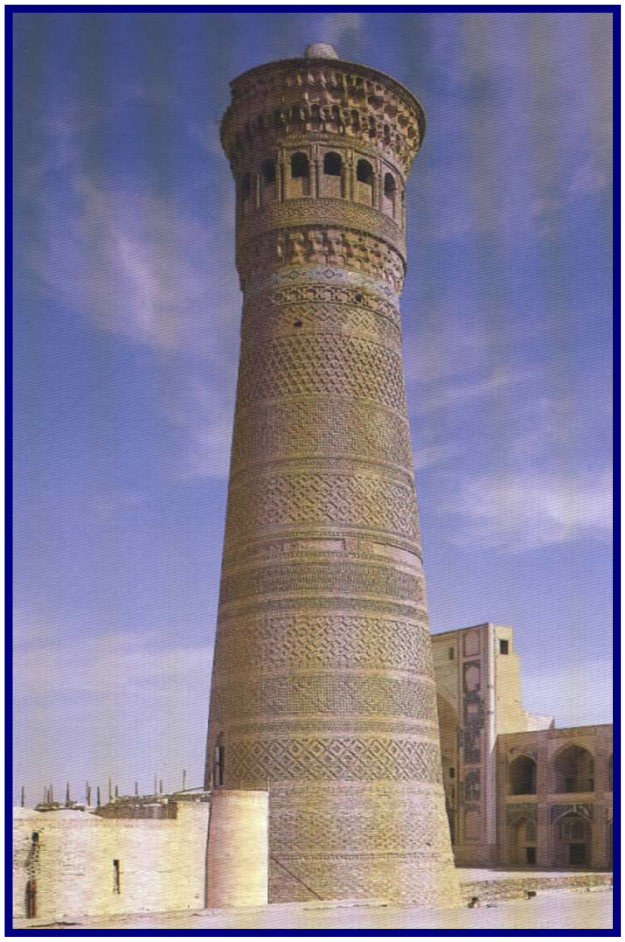
PERIOD : RECENT

MINARET AT GAZNA, IRAQ

ERECTED BY MASUT III

PERIOD 1099

HEIGHT 50 METERS

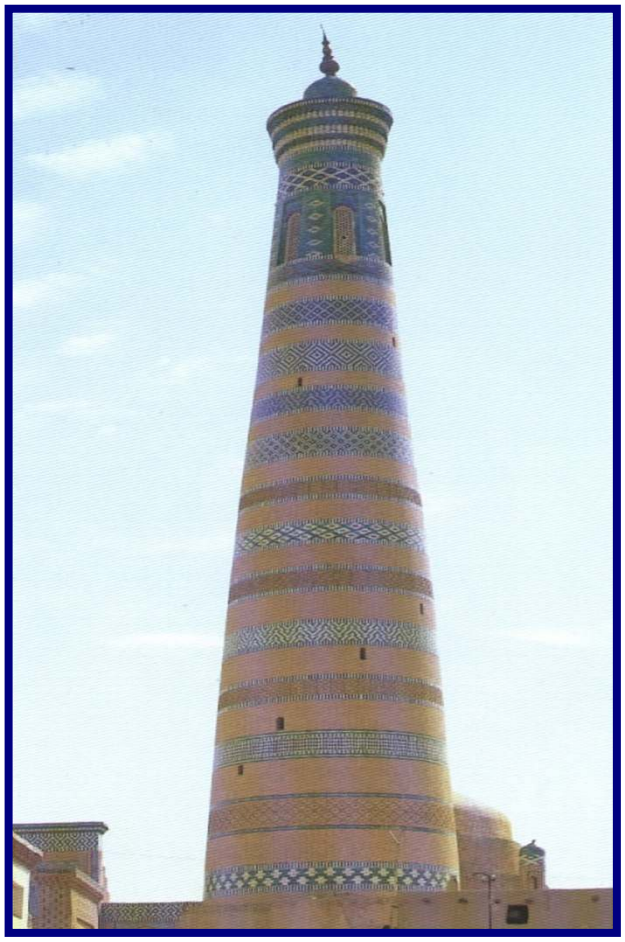


MINARET OF KALIYAN AT BUCHARA, UZBEKISTAN

Erected in 1102 A.D.

Height - 50 meters

Geometric tile patterns is a unique feature

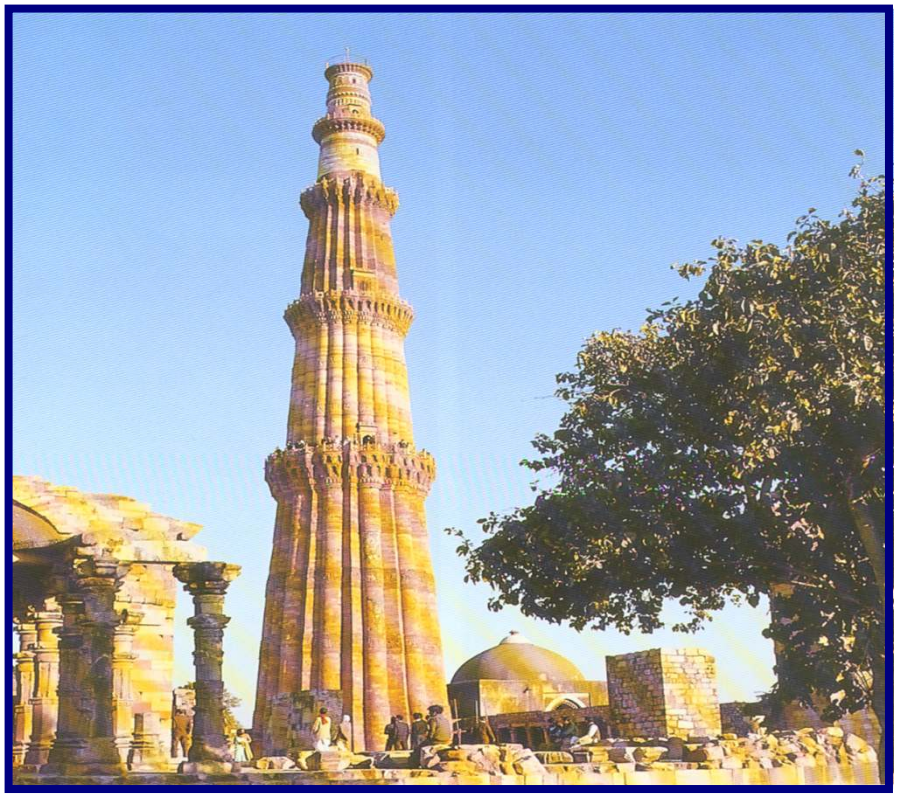


MINARET OF GHOSHA MOSQUE IN CHIWA, UZBEKISTAN

Erected in 1200 A.D.

Height - 50 meters

Tile mosaics is attractive



QUTUB MINAR AT DELHI

Erected in 1199 A.D.

Height - 73 meters
Dia 15 meters at Bottom and 5 meters at Top

STUPA AT BODHGAYA

Renovated in middle ages

Height - 80 meters

BHUWANESHWAR TEMPLE

Erected in 8th Century

Height - 100 meters

Square ground plan with parabolic Contour tower

BRIHADESHWARA TEMPLE GOPURAM AT TANJORE

BRIHADESHWARA TEMPLE GOPURAM AT TANJORE

Height - 63 meters

Has withstood the test of time

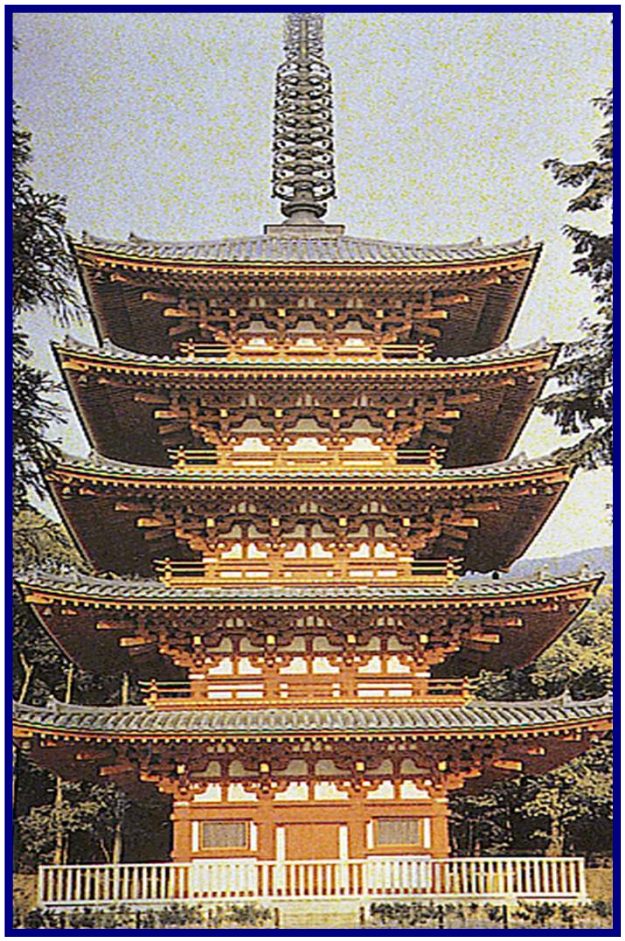
SHWE DAGON PAGODA

A guilt Structure in Rangoon

Height - 91 meters

Renovated in 1372 A.D.

A remark by one of the traveller - "More gold is used in this pagoda than what is in store in Bank of England"



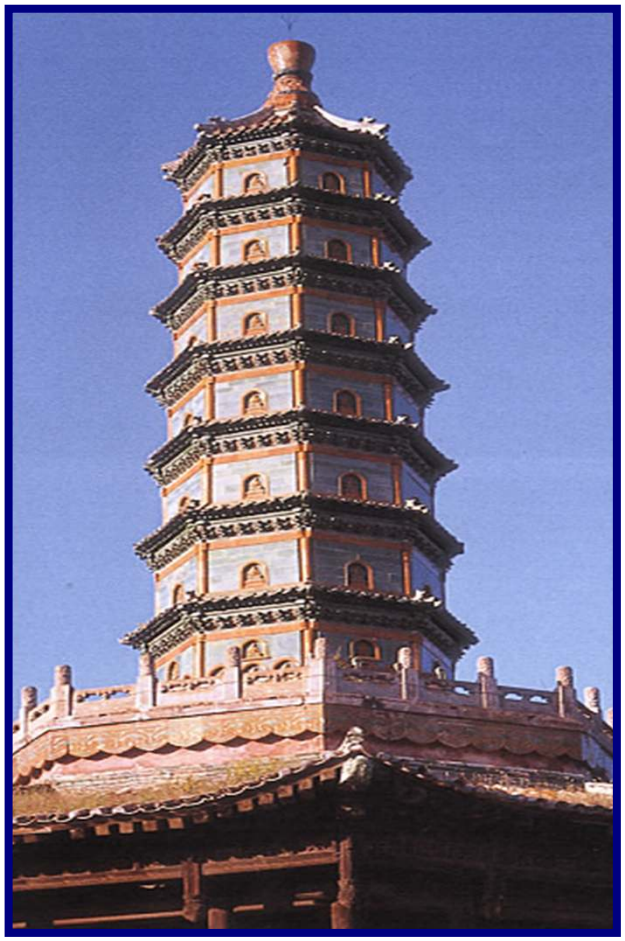
PAGODA IN JAPAN

LOCATION NARA

PERIOD 607 AD

HEIGHT 45 METERS

A FAMOUS SHINTO SHRINE



CHENGDE PAGODA

Set up by Ming Dynasty in China in Peking

Erected in 1368 A.D.

Height - 62 meters

Ceramic tile facade is attractive

A fine piece of Architecture

IRON PAGODA

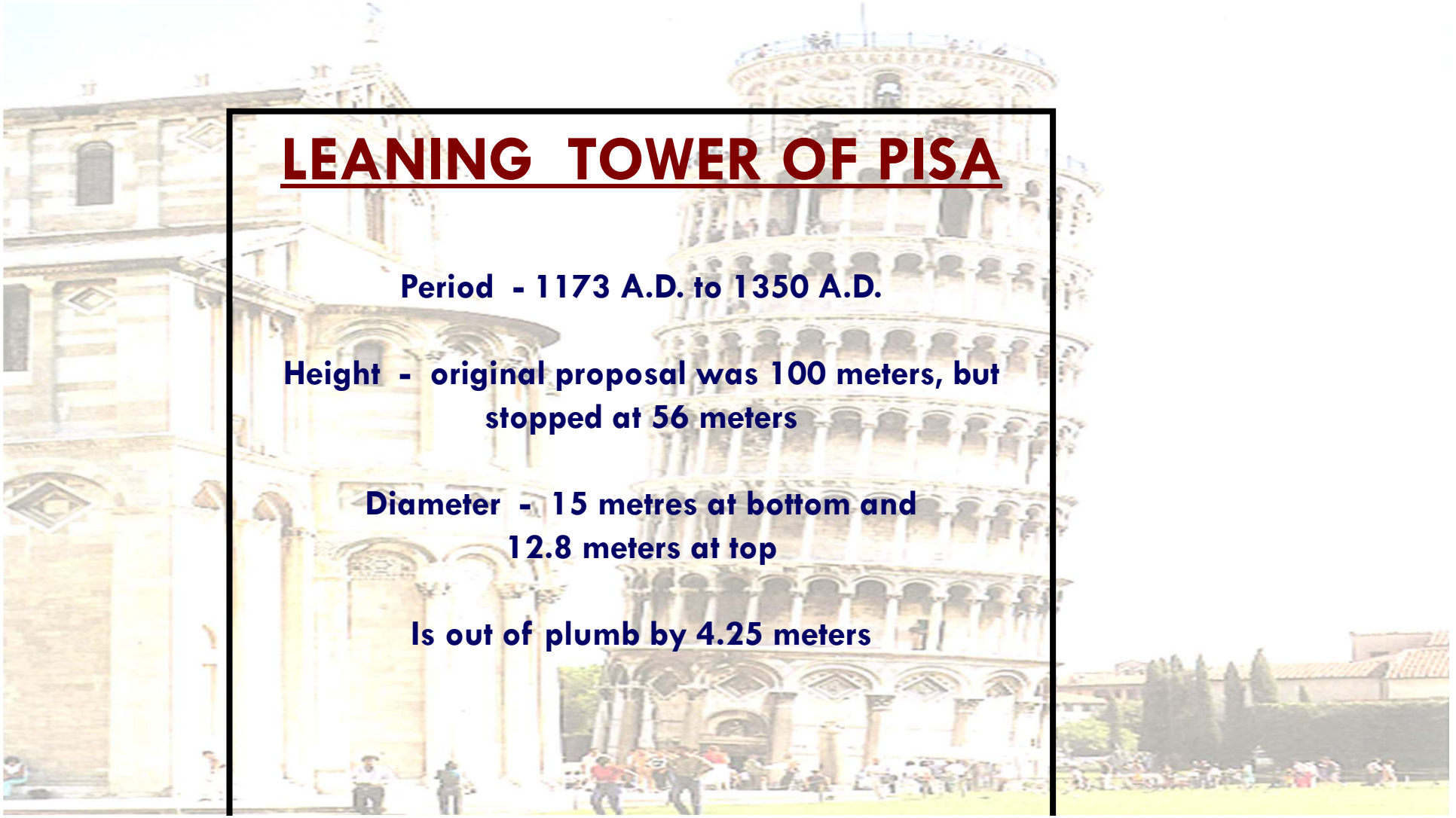
Building at Keifing in China on the Bank of Huang He river

Erected in 1044 A.D.

Height - 55 meters

Iron coloured tiles is the special feature

The outstanding feature of the project is that -"it has withstood 37 severe earthquakes, 18 typhoons and 15 large floors".



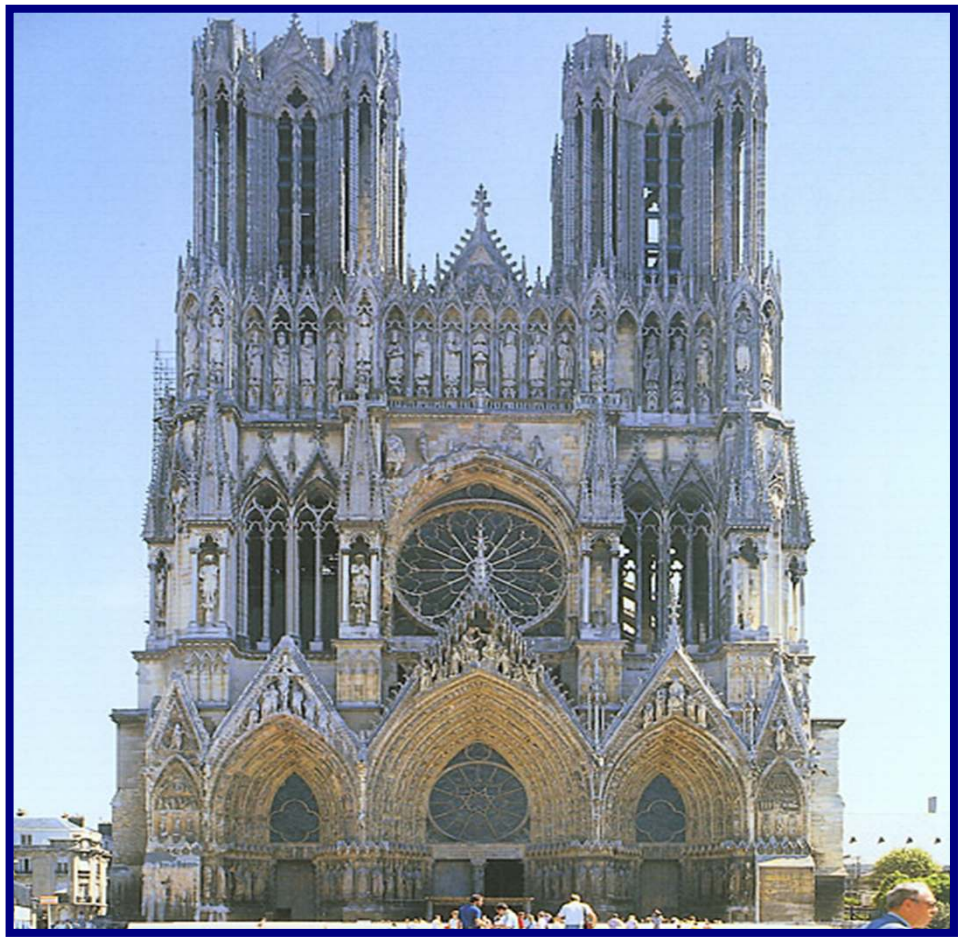
LEANING TOWER OF PISA

Period - 1173 A.D. to 1350 A.D.

Height - original proposal was 100 meters, but stopped at 56 meters

Diameter - 15 metres at bottom and 12.8 meters at top

Is out of plumb by 4.25 meters



NOTRE-DAME OF REIMS

PERIOD 862 AD

RENOVATED IN

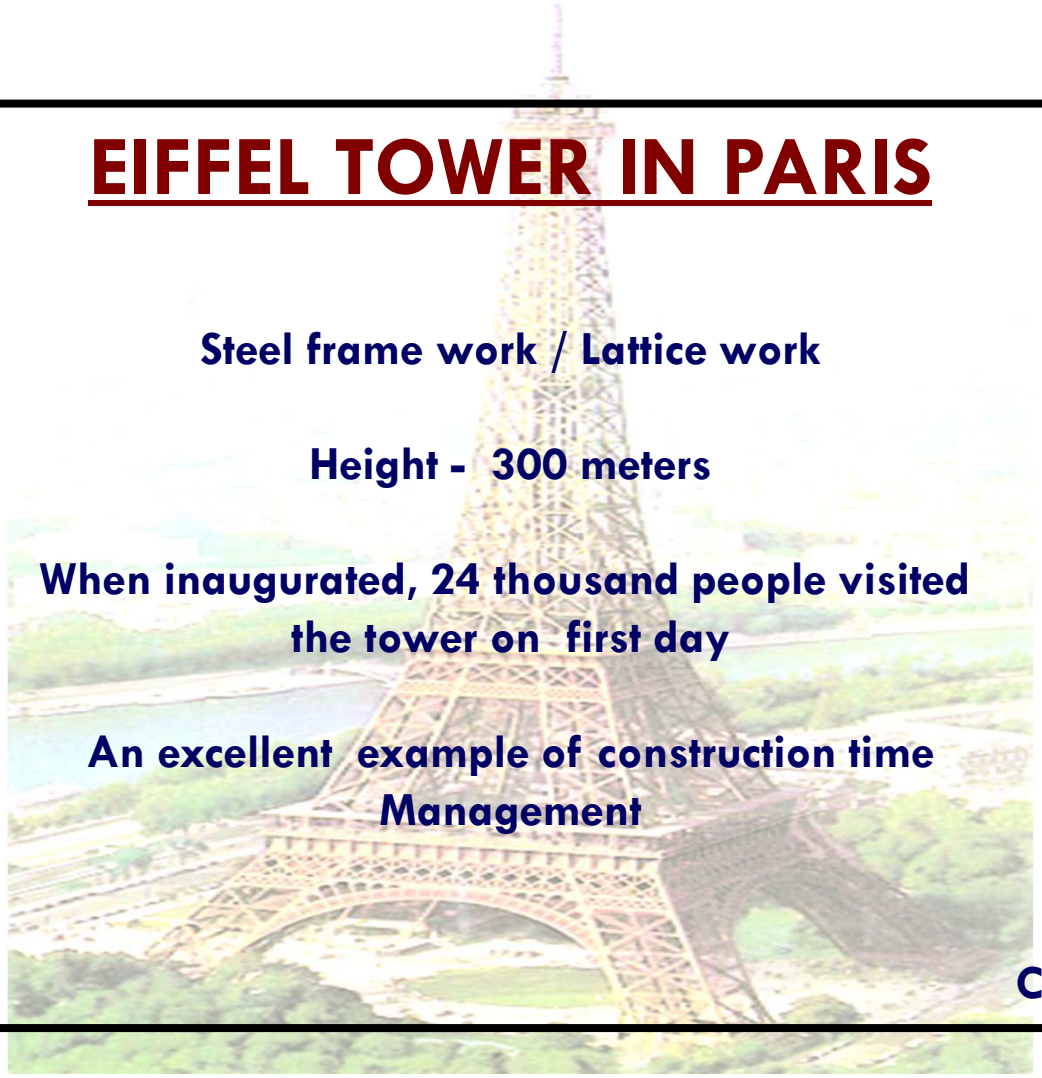
1406 AD

HEIGHT

80 METERS

EIFFEL TOWER IN PARIS

EIFFEL TOWER IN PARIS



Steel frame work / Lattice work

Height - 300 meters

When inaugurated, 24 thousand people visited the tower on first day

An excellent example of construction time Management

Contd..

STUTTGART TOWER

STUTTGART TOWER

Architect / designer - Fritz Leonhardt

Owner - South German Radio Corporation

Period - 1955

Height - 172 meters + steel tower

Diameter - 10.8 meter at bottom and 5 meter at top provided with observation platforms and instrumentation cabins.

Beginning of the era of concrete multipurpose towers

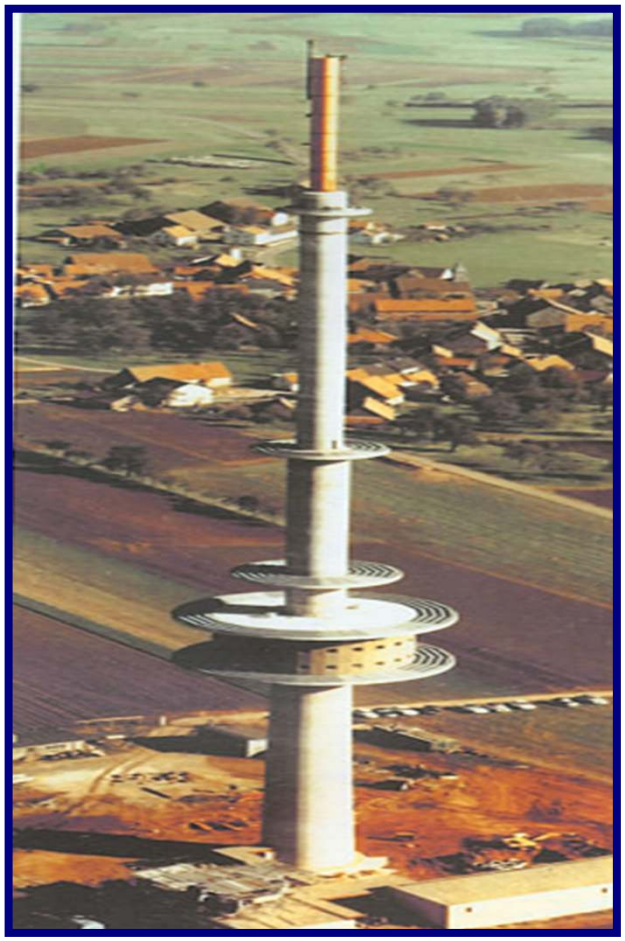
TELE COMMUNICATION TOWER AT NENNSINGEN (GERMANY)

TELECOMMUNICATION TOWER AT WIGGENSBAEB

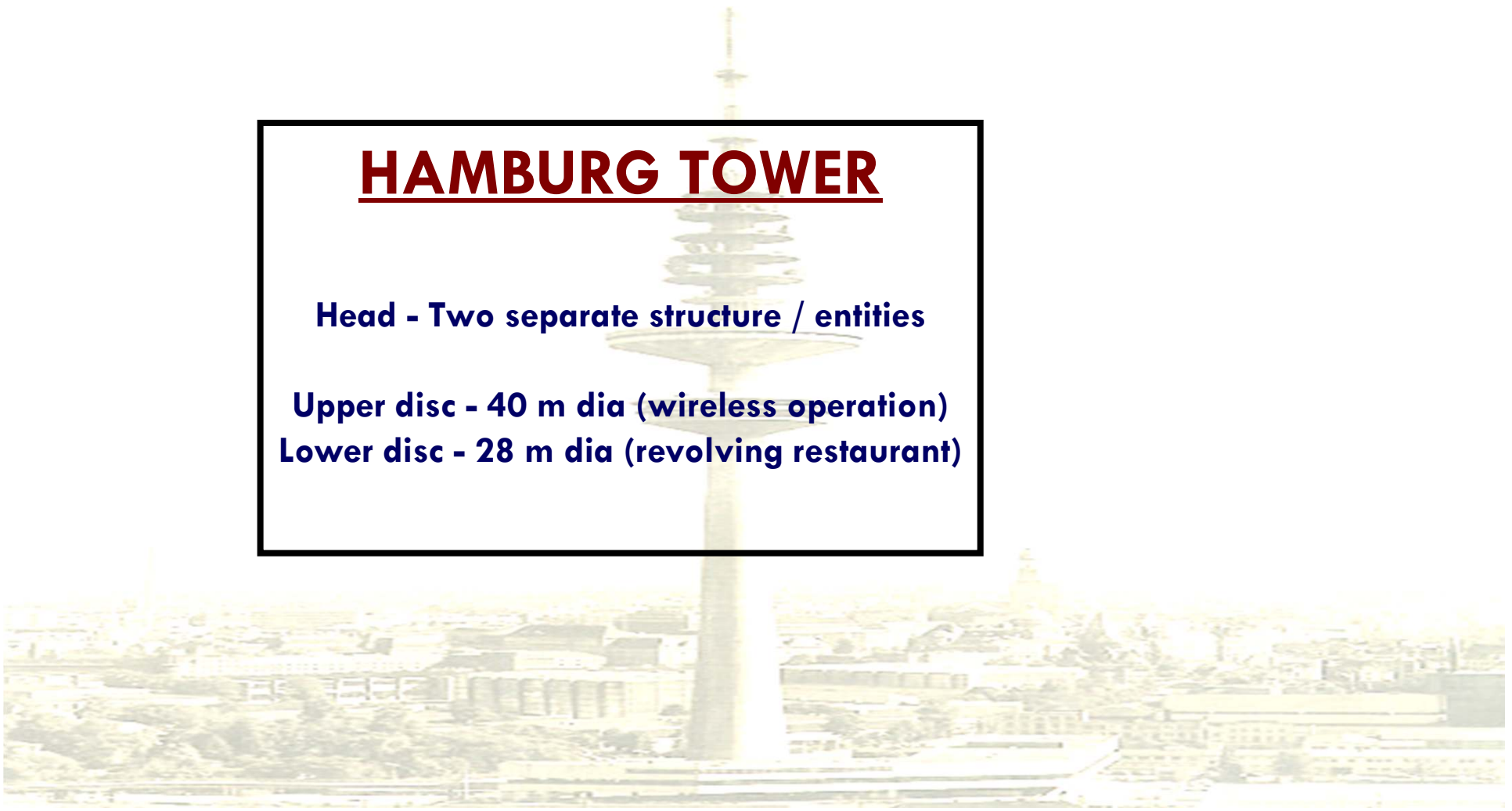
Period - 1958

Height - 200 meters including steel mast

Smaller transmission housing and smaller operation floor are the special features



TELE COMMUNICATION TOWER AT REISENBACH (GERMANY)



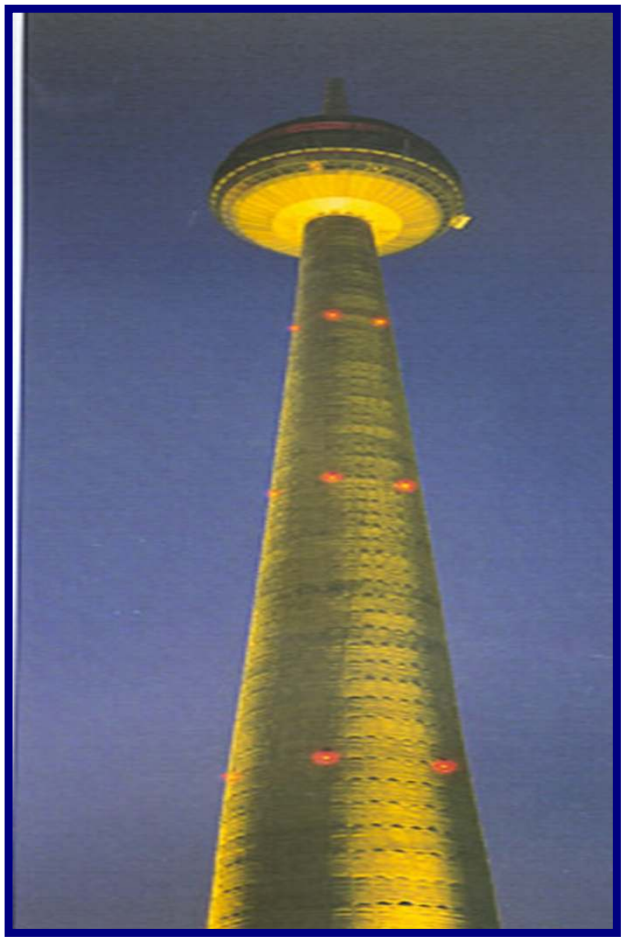
HAMBURG TOWER

Head - Two separate structure / entities

Upper disc - 40 m dia (wireless operation)
Lower disc - 28 m dia (revolving restaurant)

COLOGNE TOWER

[Fitted with a revolving restaurant]



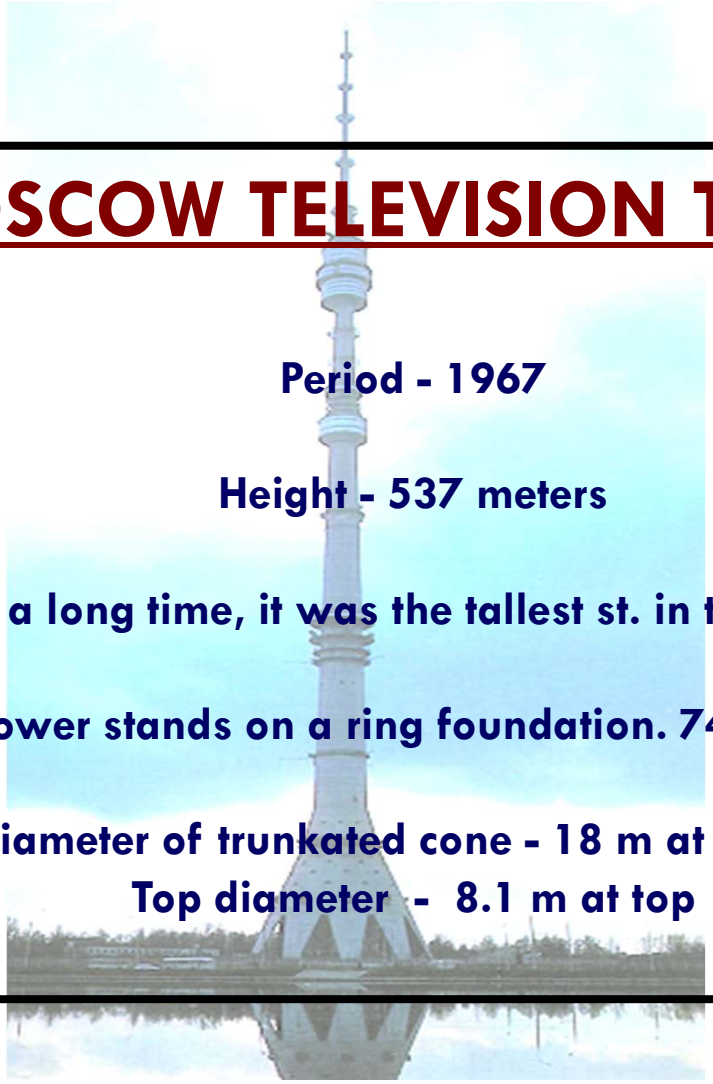
NUREMBERG TOWER BY NIGHT

Height - 310 meters

To resemble Peter Henlein's egg shapedpocket watch

MOSCOW TELEVISION TOWER

MOSCOW TELEVISION TOWER



Period - 1967

Height - 537 meters

For a long time, it was the tallest st. in the World

Tower stands on a ring foundation. 74 m dia

Diameter of trunkated cone - 18 m at bottom
Top diameter - 8.1 m at top

Contd..

MOSCOW TELEVISION TOWER Contd….

Floors used for transmission purpose

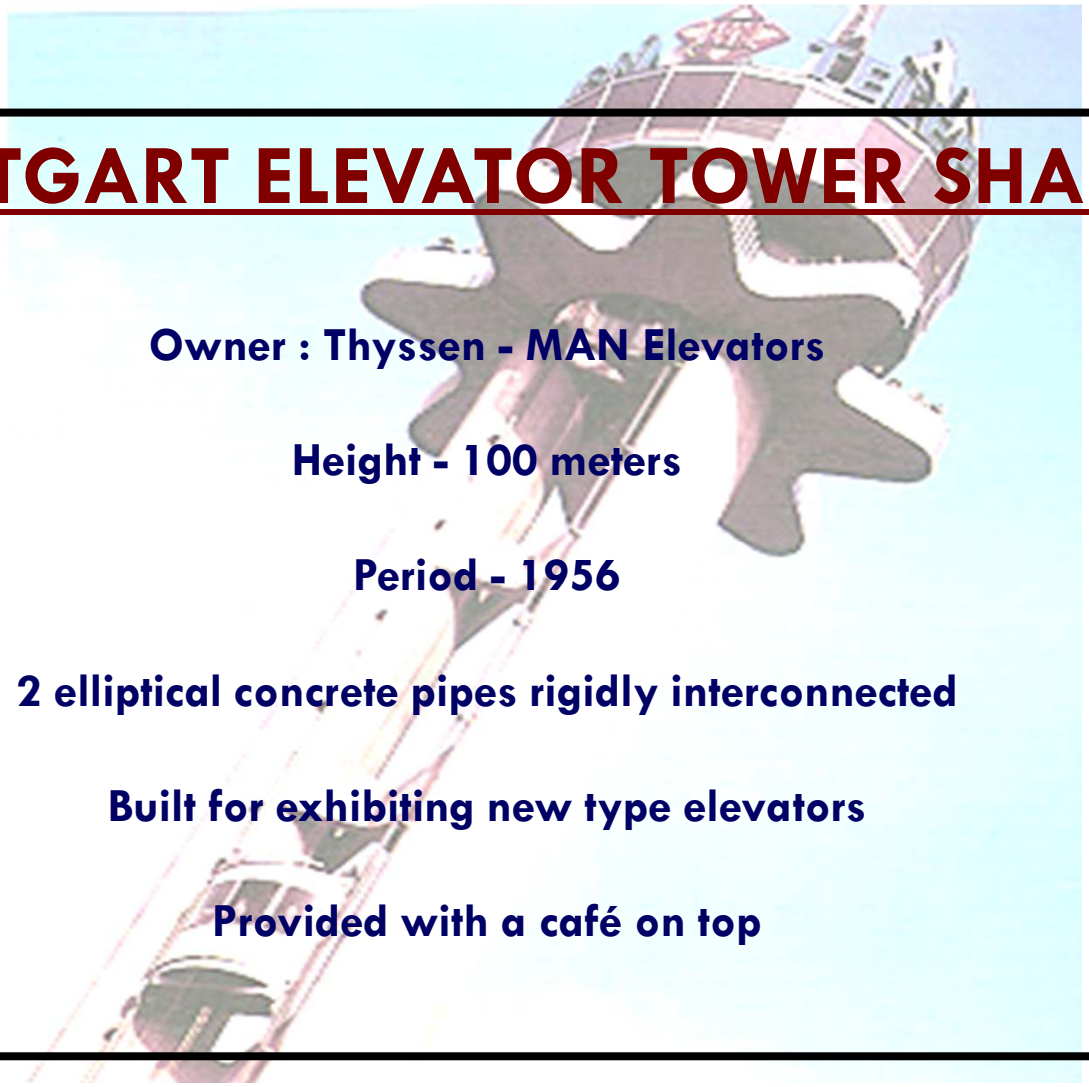
Provided with 8 storey head

Provision of a restaurant

Outward bend due to strong winds
at tip - 3.5 m

STUTTGART ELEVATOR TOWER SHAFT

STUTTGART ELEVATOR TOWER SHAFT



Owner : Thyssen - MAN Elevators

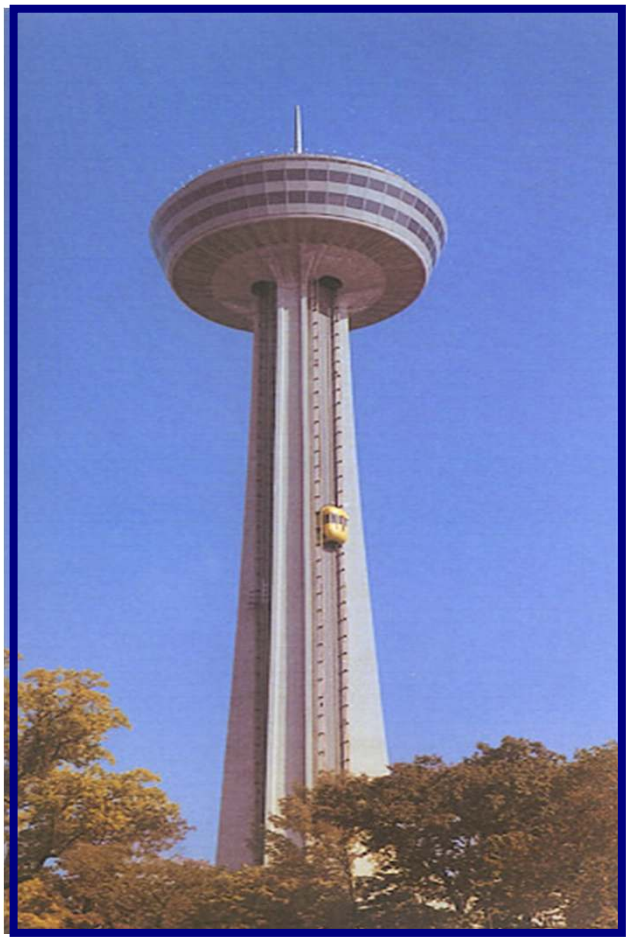
Height - 100 meters

Period - 1956

2 elliptical concrete pipes rigidly interconnected

Built for exhibiting new type elevators

Provided with a café on top



CANADIAN SKYLON TOWER

Height - 160 meters

Built to overview Niagara Falls

The three star shaped ribs in cross section have an elegant curved incline

CN TOWER AT TORONTO

CN TOWER AT TORONTO

Period - 1976

Height upto the tip - 553 meters

Provided with three broad radial ribs (box type) each extending 28 meters outwards

A multipurpose tower

SAUDI ARABIAN TELEVISION TOWER

Period - 1981

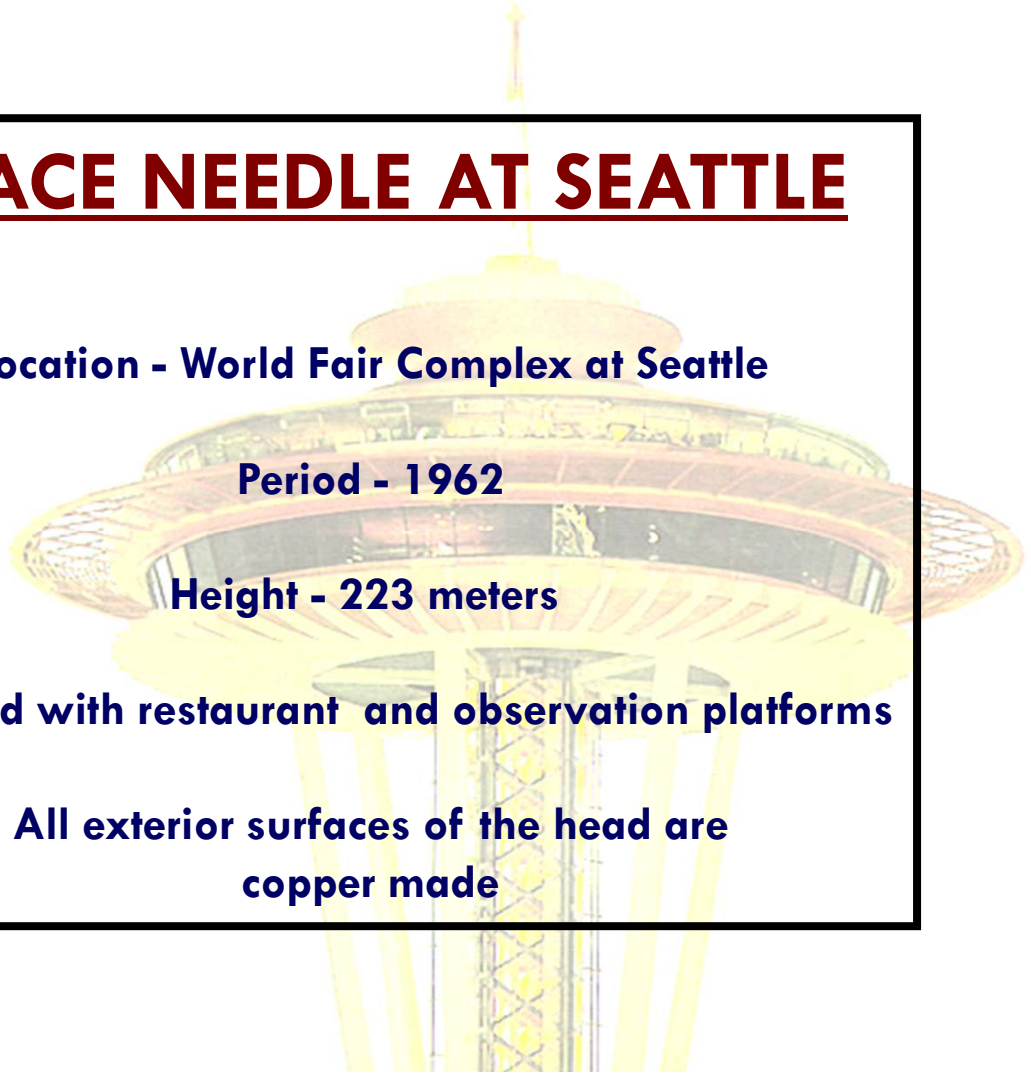
Height - 170 meters

An imaginative fancy tower with emphasis on night illumination

Classic example of Islamic architecture

SPACE NEEDLE AT SEATTLE

SPACE NEEDLE AT SEATTLE



Location - World Fair Complex at Seattle

Period - 1962

Height - 223 meters

Provided with restaurant and observation platforms

All exterior surfaces of the head are copper made

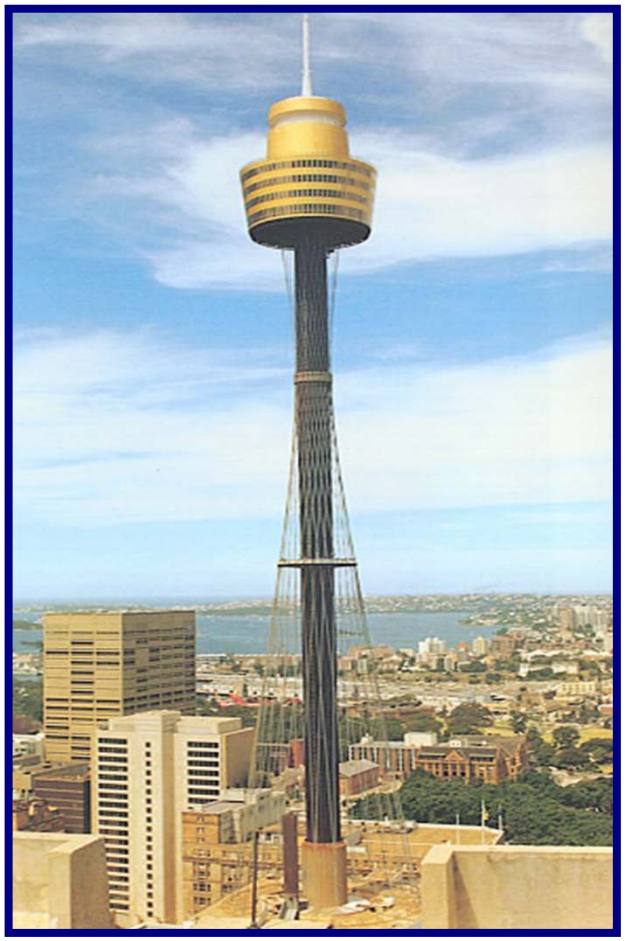
PORT OF KOBE TOWER

Location - Harbour of Kobe, Japan

Height - 100 meters

Shape - Hyperbolic Parabolloid
Material - Thin steel pipes

Elevator shaft out of delicate steel lattice work



SYDNEY CENTRE POINT

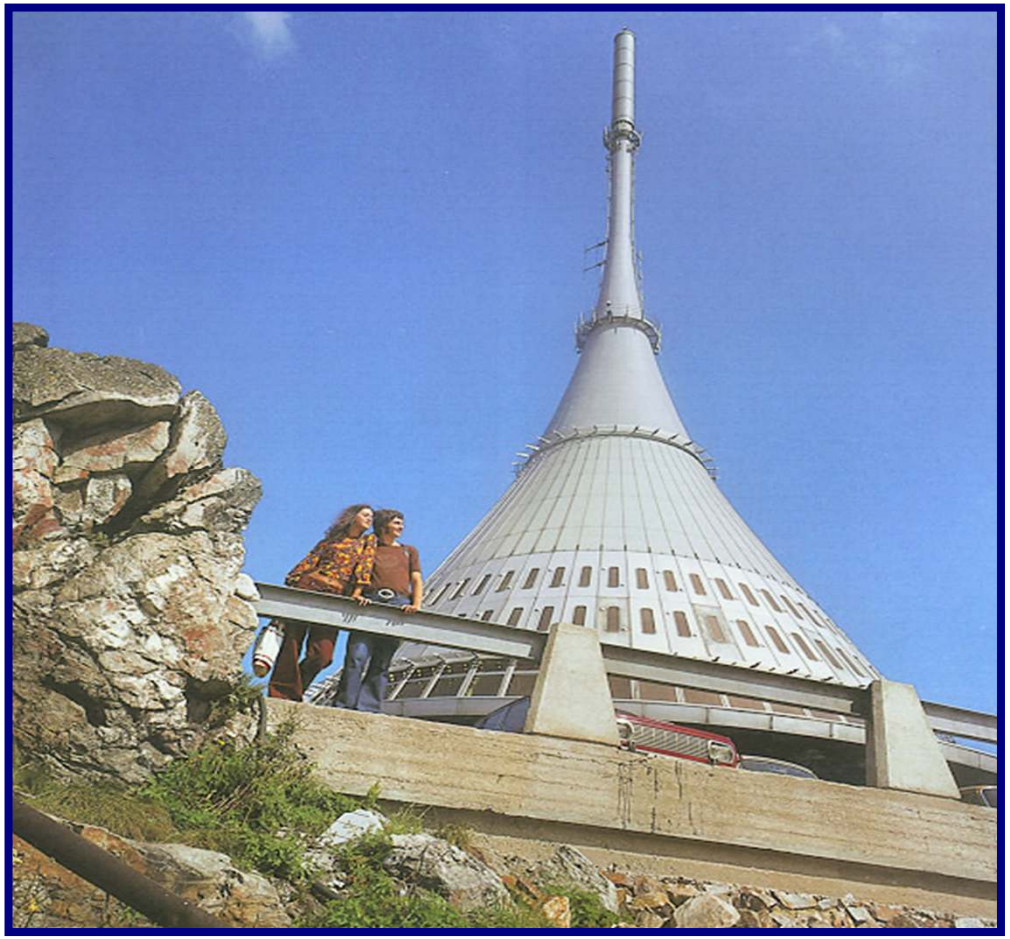
SYDNEY CENTRE POINT

Location - Near Sydney sea coast in Australia

Wind Resistor - Hyper forum

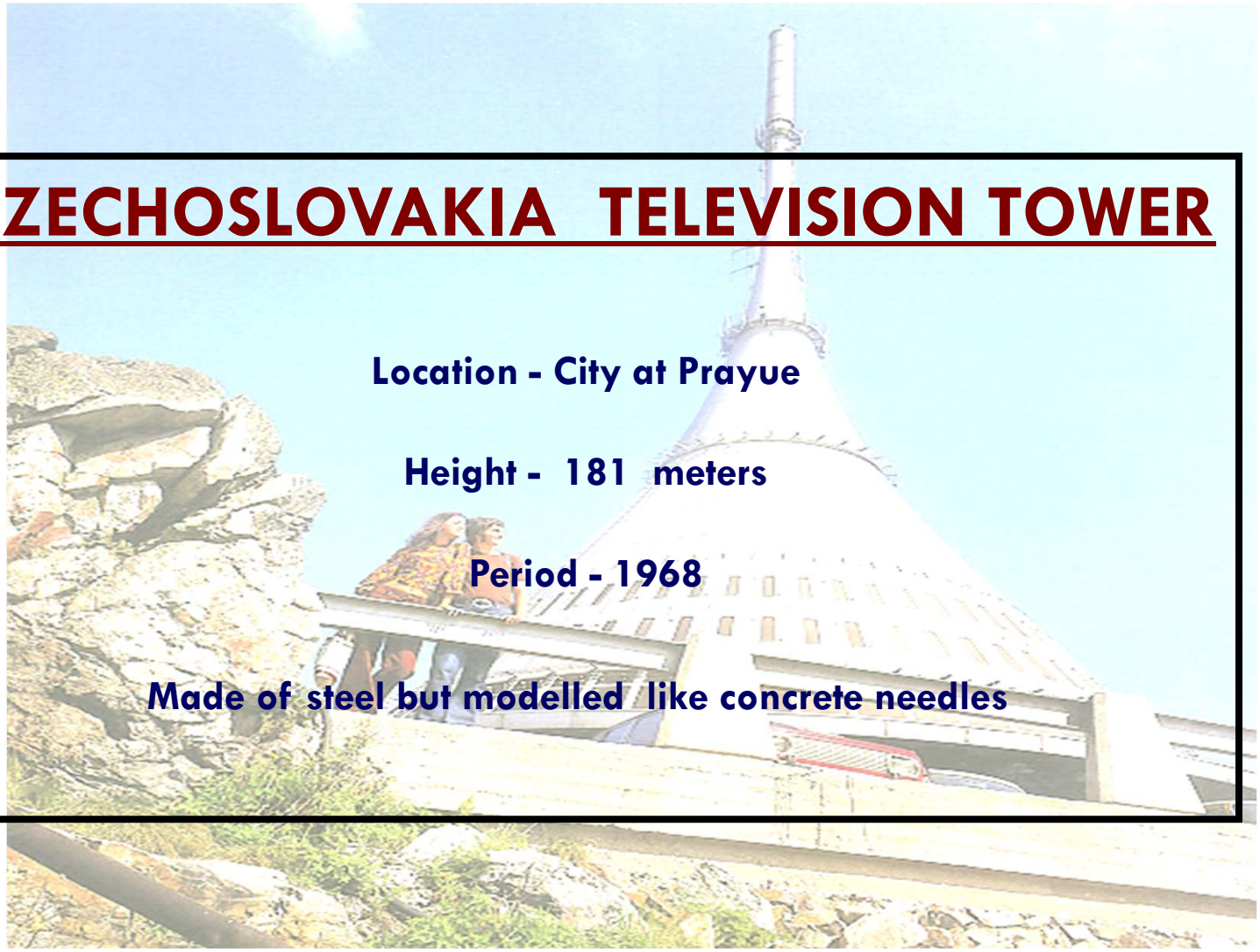
Height - 325 meters

Emerges from a multi-storeyed department store



CZECHOSLOVAKIA TELEVISION TOWER

CZECHOSLOVAKIA TELEVISION TOWER



Location - City at Prayue

Height - 181 meters

Period - 1968

Made of steel but modelled like concrete needles

GUYED MAST AT WARSAW

Type - Rigged mast

Height - 643 meters

Period - 1970

Side length at bottom - 4.8 meters

Number of rigs - 5

Tallest mast in the World

HIGH VOLTAGE MAST AT CADIZ

Height - 150 meters

Cross Arms - 50 meters

Bottom dia - 21 meters

Top dia - 6 meters

To provide high voltage transmission line link between main land of Spain and Island of Cadiz
Span between two towers - 1.5 km

WATER TANK AT MONCHENGLABACH (Germany)

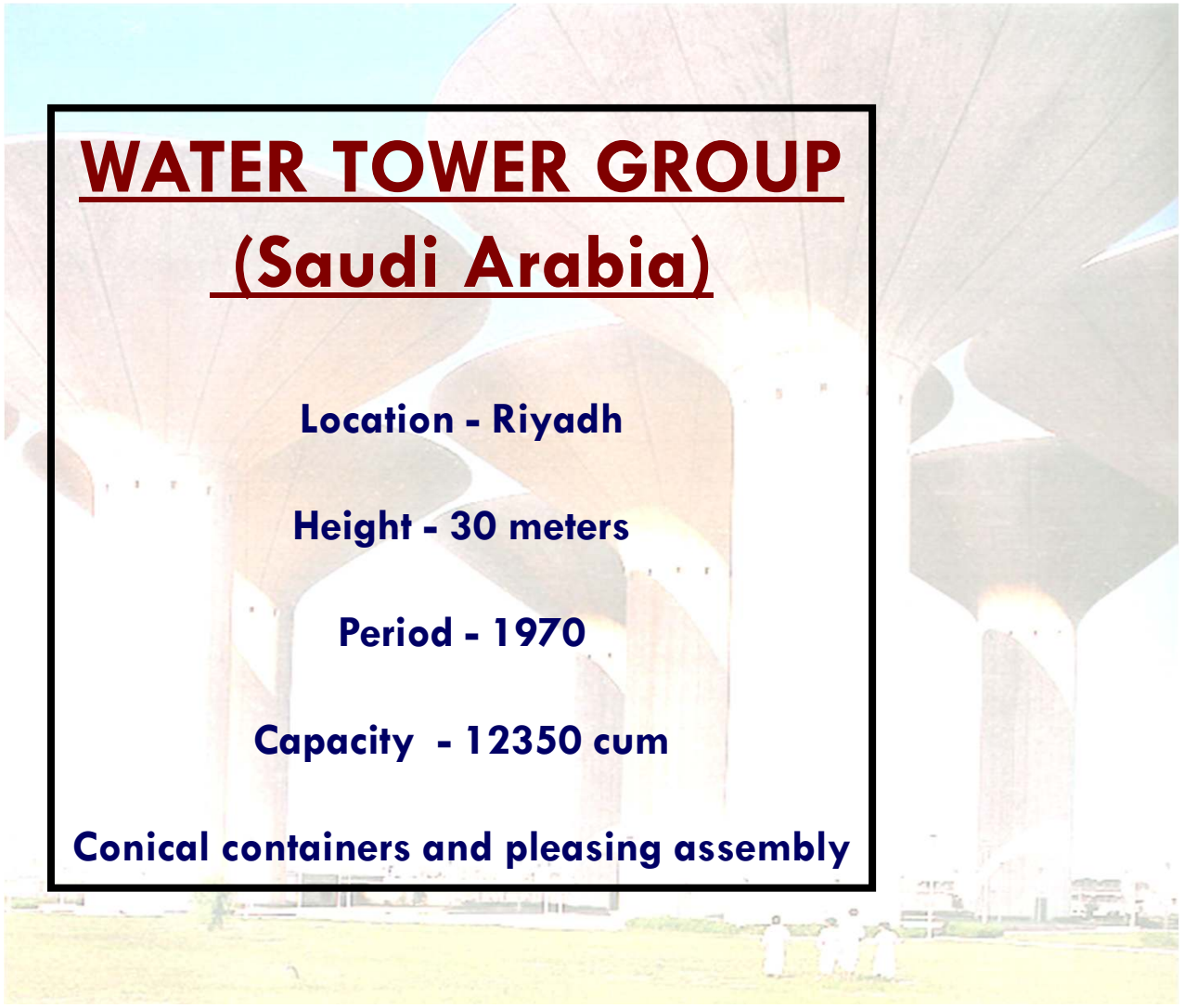
Height - 60 meters

Rich industrial city with poor architectural treasures

Landmark and a monumental structure

Steel container capacity - 2300 cum

WATER TOWER GROUP (Saudi Arabia)



WATER TOWER GROUP
(Saudi Arabia)

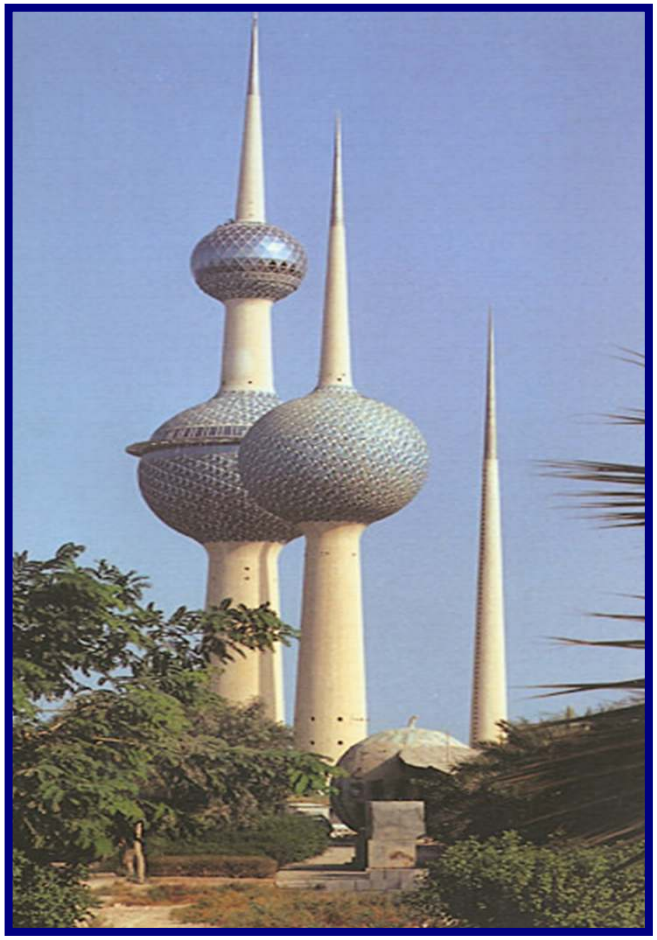
Location - Riyadh

Height - 30 meters

Period - 1970

Capacity - 12350 cum

Conical containers and pleasing assembly



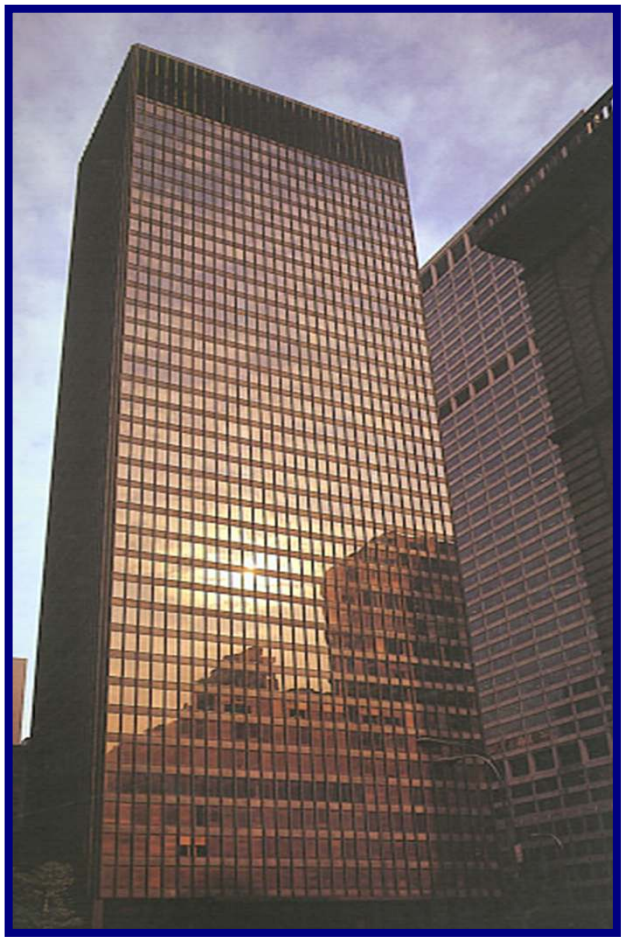
KUWAITI NEEDLE

Height - 180 m, 150m and 120 m

Period - 1970

Capacity - 4500/ 4000 cum

Restaurant and ornamental garden are additional features



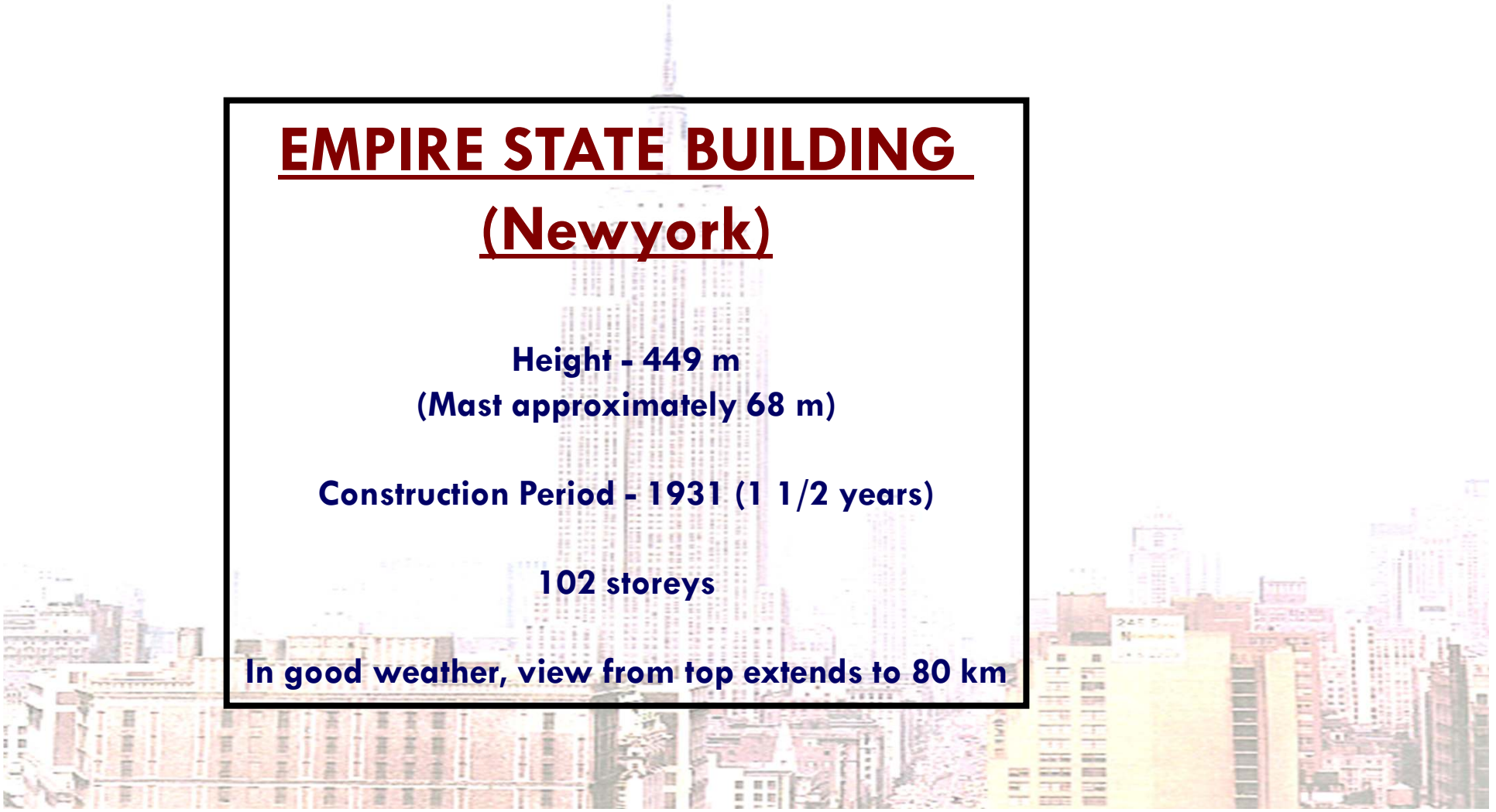
SEAGRAM BUILDING (New York)

Height - 160 m

Period - 1958

38 storeys


EMPIRE STATE
BUILDING
(New York)



EMPIRE STATE BUILDING (Newyork)

Height - 449 m
(Mast approximately 68 m)

Construction Period - 1931 (1 1/2 years)

102 storeys

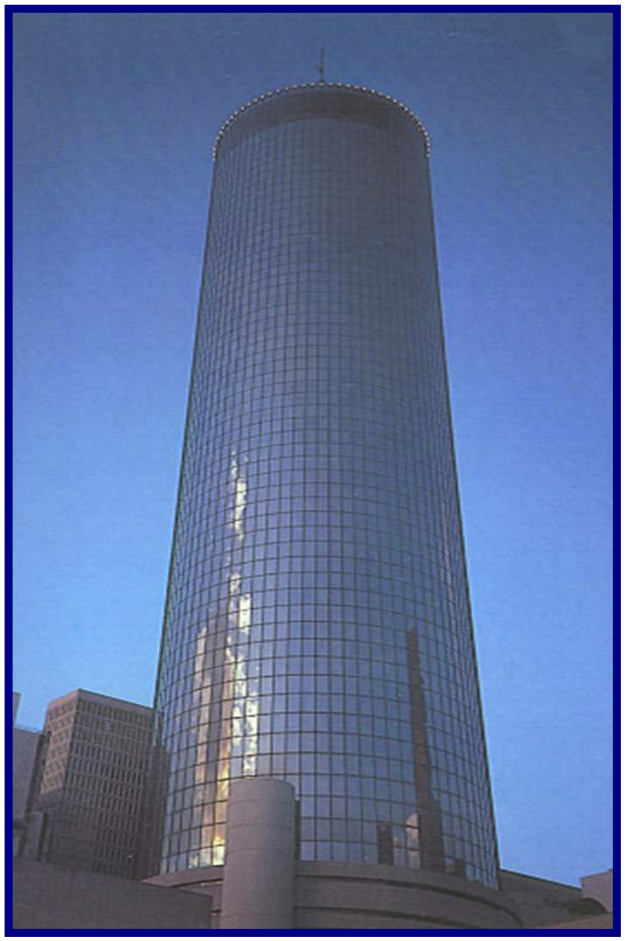
In good weather, view from top extends to 80 km

LAKE POINT TOWER (Chicago)

Height - 196 m

Period - 1968

70 storeys



PEACHTREE CENTER PLAZA (Atlanta)

Height - 230 m

Period - 1975

73 storeys

One of the tallest hotels in the World

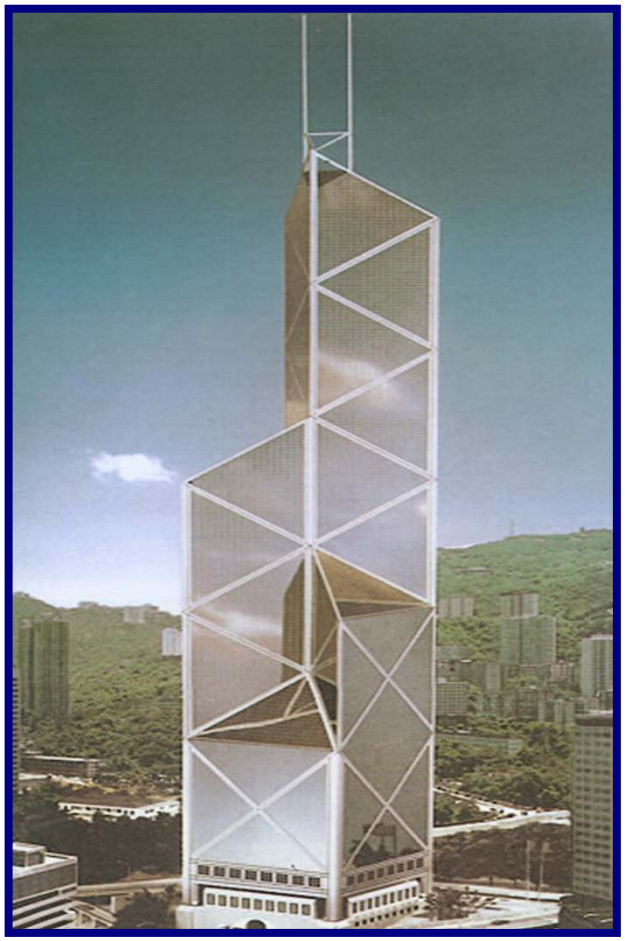
JOHN HANCOCK CENTRE (Chicago)

Height - 343 m

Period - 1969

100 storeys

Slanting of exterior walls and external diagonal members are structural hallmarks



BANK OF CHINA (Hongkong)

Height - 315 m

Period - 1988

Diagonal rigidification is the decisive structural feature

PETRONAS TOWERS (1997)

Reference

- Http://en.wikipedia.org

- Lecture by Dr. C.S. Viswanatha, Chief consulting engineer, Torsteel research foundation in India, Bangalore at summer camp-2005 in IITK.


Thank you