General information

Location: Hong Kong, China
# General information

## BANK OF CHINA

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architect</td>
<td>I. M. Pei</td>
</tr>
<tr>
<td>Structural engineer</td>
<td>Leslie Robertson</td>
</tr>
<tr>
<td>Height from street to roof</td>
<td>1028ft (367.4 m)</td>
</tr>
<tr>
<td>Number of stories</td>
<td>70 stories</td>
</tr>
<tr>
<td>Number of levels below ground</td>
<td>4 stories</td>
</tr>
<tr>
<td>Space area</td>
<td>1.4 million square feet</td>
</tr>
<tr>
<td>Ground floor area</td>
<td>29,000 square feet</td>
</tr>
<tr>
<td>The highest floor area</td>
<td>7,265 square feet</td>
</tr>
<tr>
<td>Building use</td>
<td>Office</td>
</tr>
<tr>
<td>Building cost</td>
<td>$150 million</td>
</tr>
<tr>
<td><strong>General information</strong></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Frame</strong></td>
<td>Super frame, truss</td>
</tr>
<tr>
<td><strong>Frame material</strong></td>
<td>Steel, concrete</td>
</tr>
<tr>
<td><strong>Basic wind velocity</strong></td>
<td>143mph</td>
</tr>
<tr>
<td><strong>Type of structure</strong></td>
<td>Cross-braced space truss</td>
</tr>
<tr>
<td><strong>Foundation conditions</strong></td>
<td>Square granite clad base (170 feet in length)</td>
</tr>
<tr>
<td><strong>Footing type</strong></td>
<td>poured in place, caisson</td>
</tr>
<tr>
<td><strong>Ground floor column size</strong></td>
<td>14’ × 26’</td>
</tr>
<tr>
<td><strong>Column material</strong></td>
<td>composite concrete and steel</td>
</tr>
<tr>
<td><strong>Floor slabs</strong></td>
<td>4” thick</td>
</tr>
</tbody>
</table>
General information

Building height comparison
Inspired by bamboo, symbolic of strength, vitality, growth and enterprise.
General information

Awards

2002 "Excellent" Award of Hong Kong Building Environmental Assessment Method

1999 Ten Best Architecture in Hong Kong, HKIA

1992 Marble Architectural Award

1991 AIA Reynolds Memorial Award

1989 Award for Engineering Excellence, ACEC

1989 Certificate of Engineering Excellence, NYACE, etc.
Plans

Square plan

four prism towers rise to different levels: 25th, 38th, 51th, 70th

The 25th floor: the fifth column, exterior
Plans

Square plan

four prism towers rise to different levels: 25th, 38th, 51th, 70th

The 25th floor: the fifth column, exterior
The shape of the envelope changes dramatically

Maintaining the purity of the geometry was the challenge around which the very structural feasibility of the project turned.

Structure design concept:

a series of triangles as a super frame.
Facade

X's vs. diamond's

refuge floor

change the form
Facade

• “Form and decoration were not enough. The building must be structurally logical and elegant.”

------ Pei
The over-all result of the façade’s handling is a crisp surface that appears tightly drawn across the faceted faces of the building.
Joints:

A critical joint at which the vertical, horizontal, and diagonal members of the steel frame all come together.

This joint is not a welded connection, nor is it all steel.

A block of reinforced concrete that envelopes all the columns, stiffening trusses, beams, and cross-braces.
• Hong Kong is in a typhoon zone. With wind loads twice that for New York City, and equal to four times the earthquake load for San Francisco.
Trusses used in lateral force system
The wind speed in Hong Kong can reach as high as **143mph**.
Multiframe 3D with Lateral load applied

Bending moment

Shear force

Lateral load: wind load analysis
Lateral load: wind load analysis

Axial load

Deflection
The additional downward force from the transfer increases the effective stance of the building to resist lateral loads.
Lateral load: Planar trusses

- Transfer truss that wrap around every 13th story as the horizontal bracing were concealed, thus the horizontal expression was removed.

- Create planar trusses in structural steel with the frames of but two different geometries.

- In the corners of the towers, we knitted the columns of the planar frames into space-trusses – all within a reinforced concrete column.

A: Vertical trusses
B: Planar trusses
Columns:

The shape causes **eccentric load**.

Off-center loads would cause excessive stresses in columns.

The solution is that using **uniform shear force mechanism** that could counteract and eliminate the bending.

The system is outstanding of its economy of material.
Only a small portion of the loads carried to the service cores in the lower floors flows directly to the foundations.
The vertical force are transferred through braces, columns, space trusses, transverse truss and diaphragms.
Vertical load

Space Truss:
Allows for the vast majority of the gravitational load to be supported at the exterior. By doing so, this eliminated about half of the dead load that there usually is in tall buildings (less steel was needed).

The center column, rising from the 25th floor, bears the gravitational load and resists the overturning moment.
Hong Kong:
It is located on the sedimentary rocks and volcanic rocks.

Superficial Deposits:
Beach sand, intertidal mud and sand, and estuarine mud, clayey silt and sand
Alluvial sand, silt gravel and colluviums.

Due to its location, it was designed for twice the live load that is required in the United States for this type of building.
Foundation construction

The foundation was poured in place, and it is set on several caissons. These caissons were then surrounded by concrete diaphragming walls. Around the vaults, the concrete surrounding the steel plate is three feet thick, so this type of support system for the base is carried up to the fourth floor (Wilson, p.3)
Construction process

- man on spandrel
- man lassoing girder
- men on hanging beam
BOOKS:

STRUCTURAL SYSTEMS FOR TALL BUILDINGS

STEEL, CONCRETE, & COMPOSITE DESIGN OF TALL BUILDINGS, 2nd Edition

I. M. PEI
   Aileen Reid, Bison Group, 1995

ARTICLES:

SCALING NEW HEIGHT, Architectural Record, Jan. 1991 Vol.179


THE BANK OF CHINA, Dr. Larry Bank and Tom Ringelstetter, the University of Wisconsin–Madison, December 2, 2004
Bibliography

Web Sites:

http://www.bre.polyu.edu.hk/school/WebCompetition05/WDC_2005/47/27.swf


http://www.allaboutskyscrapers.com/sp.bank_of_china.htm

http://www.allaboutskyscrapers.com/sp.bank_of_china.htm


http://www.pcfandp.com/a/p/8220/s.html
Bibliography

Web Sites:

http://architectural-world.blogspot.com/2008/05/bank-of-china-tower.html

http://skyscraperpage.com/cities/?buildingID=13

http://books.google.com/books?id=F56YNToJ08wC&pg=PA280&lpg=PA280&dq=bank+of+china+tower+column&source=web&ots=vmRQNvSpzx&sig=aUhMs99s9cvnkq5IGkp2PkJlO6s&hl=en&sa=X&oi=book_result&resnum=7&ct=result#PPA289,M1
Thank you.