Vertical Densification: The Architecture of the Structural System of the BBVA Tower Mexico City

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Location Plan.

位置平面图
The Towers act as a gateway between the edge of the Downtown City and Chapultepec Park.

塔楼如同市区与查普尔特佩克公园之间的门户
Creating a Human Scale to the Building and Integration of the Park into the Building.

Concept Sketches.
The Tower is organised into Vertical Communities, separated by the ‘Sky Gardens’.

Direct Access is provided between the Office Levels (Orange) and the Gardens, with views across Parque De Chapultepec opposite.
Car parking is provided at the base of the tower and in the Annexe Building next door (Blue).
Integrating the Park into the Building.

Each ‘Vertical Community’ is a group of 9 Office Levels, each sharing an elevated garden.

Spiral Stair Access to the gardens with views across the Park and City.

Gardens generate a focal point for social interaction, providing a comfortable working environment.

将公园昇华引入建筑内

Integrating the Park into the Building.
Vertical Communities separated by the ‘Sky Gardens’.

垂直社区以‘空中花园’区隔
Colour: Creates Vertical Communities, legibility, way-finding. Mexican Design Culture.
Building Block Components.
Ground Floor Plan.
Typical Office Level Plan.

- 53 Levels in total.
- 235m Total Height
- Access to Heliport at top.
- 78,800m² Office Space
- Between 1,500 + 2,000m²/floor
- 4,500 Employees
- 2,800 Parking Spaces
- 6 Levels of Parking above ground, in Tower and Annex.
- 7 Levels of Parking below Tower and Annex.
Typical Office Level – Lower Zone of Tower
With Garden – With Cantilevered Meeting Room.

Typical Office Level with Garden Plan.
General Plan of Level 12 – Sky Lobby/Auditorium/Staff Dining Hall.

Communal Areas: Sky Lobby, Auditorium + Dining Hall.

Dining Hall Terraces + Sky Lobby Garden.
Internal Perspective of ‘Sky Lobby’ within Tower: Diagonal Central Core, External Service Core.
Staff Dining Hall + External Terraces over the Annex Car Park, accessed from ‘Sky Lobby’.
Auditorium (Levels 12 - 13) located above Car Park Ramps, accessed from ‘Sky Lobby’.

讲堂 (12-13层) 位于车道上方，由空中门厅进出
External Service Core with Goods Lifts + Bathroom Pods, providing human scale and views out.
Eccentrically Braced Seismic Mega-Frame: lateral stability, flexible floor planning + economical.

External frame permits a ‘Soft’ Central Core between Level 11 + 50, over Car Park.

Structural System becomes strong Architectural Expression.
 Sophisticated Structural Analysis.

A combination of 3 Approaches to Seismic Analysis:

1- Mexican Code Requirements.
2- International Code Requirements.
3- Performance Based Seismic Design.

Typical Performance Objectives were:

1- Demonstrate Elastic Performance during Service-Level Earthquakes.
2- Verify Strength and Deflection Demand for Code Level Earthquakes.
3- Demonstrate Life-Safety Performance at Maximum Considered Earthquake.

- Analysis enabled a reduction in column design forces by over 33%.
- Saving of 1000T of Steel.
- Estimated Saving of $6-8 Million to Client.
The top intersection (Node) of the intermittent diagonal Mega-Bracing found on the 2 shorter sides.

The contours demonstrate the concentration of plastic strain within the ‘link’ webs.

A detailed non-linear analysis model. This ‘deformable link’ protects the rest of the system from damage during an earthquake.

The top intersection (Node) of the 3-storey diagonal Mega-Bracing, found on the 4 long sides.

地震保险设置

The Seismic Fuse.
Mega-Beam, Bracing and Floor Plate Beam Connection to the Mega-Column.

Structural Performance Analysis Model of the bracing connection to the Mega-Column.

Connections between Steel plates/elements use ‘Critical Demand Welds’.

CAD Model and photo of the typical Mega-Brace and floor beam connection node with the vertical 1.6x1.6m Mega-Columns.
Below Ground Structure: Structural ‘Shoes’, 50m Deep Piles and Top Down Construction

Each Mega-Column and bottom Brace rests on a Braced Steel ‘Shoe’ Foundation, embedded within the Retaining Wall and tied together by a Capping Beam.

Mega-Frame at ground floor allows a flexible and open transition zone between street and Entrance Lobby.

Braced Steel ‘Shoe’ Foundation embedded in Retaining Wall.

地下结构：结构‘鞋履’，50米深基桩与逆打施工法
Typical Floor Plate Connection to external Mega-Column: Co-ordinated with the Facades.

- 3 Hour Intumescent Paint applied externally (visible) and spray applied cementitious fire protection within the cladding line (non-visible).

- Horizontal tapered steel “Crocodile Clamp” plates connect floor plate beams to Mega-Columns.

- Facades are internally notched in corners.
3 Hour Intumescent Fire Protection on all Exposed Primary Structural Elements.

The majority is hand-applied over a mesh onto the steel and sanded down. Space was left for the area to be welded on site, with the final paint stitched in.

Paint thickness varies according to thickness / massivity of Steel plates.
Seismic Pop-Out Panels surrounding all 4 sides of each Bridge Connection to Tower.
Each Façade is designed independently to respond to the Annual Solar Path in Mexico City.
Part cut-away perspective showing layering of fully glazed panels, Mega-Structure and cleaning + maintenance zone, with externally suspended shading system.

The Building achieved a LEED Gold rating through its environmental strategies.

Typical Office Section: Shading prevents sun from entering Building whilst still allowing daylight to enter and views out.

All 'Celosia' connections to building are highly articulated to Movement in the event of wind loads and earthquakes.

Shading : External Suspended 3-Storey high Diagrid of Alu Frame + Perforated Panels.
General Façade Elevations: showing % of Shading Density required on each face.

- SW 70-75%
- NW 40-45%
- NE 45-50%
- SE 60-65%
Facade – “Celosia” - Perforated Aluminium Panels with Density Variation by Orientation.
External Suspended 3-Storey High Diagrid System directly reflects the Mega-Frame Modulation.
Celosia 遮阳系统提供不同透明度与光线穿透性：往内与往外的视觉感受

Transparency and Lightness of “Celosía” Shading System: Internal and External Views.