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8. Texas Commerce Tower, Houston (Texas, USA)

Owner/Developer: *Gerald D. Hines Interests, Texas Commerce Bank, Houston*

Architect: *I. M. Pei & Partners, New York 3D/International, Houston*

Engineer: *Structural Engineers CBM Engineers, Houston Mechanical Engineers I. A. Naman & Associates, Inc., Houston*

Contractor: *Turner Constr. Co. of Texas, Houston*

Works Durations: *42 months*

Service Year: *1981*

Rising to a height of 276 m the 75 story Texas Commerce Tower (Fig. 1) in United Energy Plaza, Houston is the tallest composite building in the world and the tallest building outside Chicago and New York.

The Structure

The 75 story building measures 49 m square in plan with one corner having a large chamfer at a 45 degree angle to create a fifth side that is 26 m column free span of steel girders and dual-pane glass (Fig. 2).

The exterior structure of the building is a "composite" system. The exterior columns are placed at 3 m on center on all sides except the front face of 26 m. The exterior columns are constructed using steel erection column and cast in place concrete. The cast in place spandrel is 1.2 m deep. The interior columns and floor framing are all structural steel.

The exterior composite system, called a "ruptured tube", is the main element that is used to carry the wind loads for the structure. Since the exterior tube is ruptured at 26 m front face, the "healing" of the rupture is done by continuing lateral load resisting elements toward the core of the building. A concrete shear wall is placed next to the front row of elevators and the connection between the interior shear wall and the exterior tube is a very stiff steel link beam in the floor. The secondary stiffness element is the steel girder that spans 26 m and ties the two

Fig. 1 Houston sky line

triangular concrete front piers together. The composite system was selected to obtain the advantages of the construction speed of the steel frame and economics of a concrete structure. The concrete columns and the spandrels in the system also have an inherent stiffness important in high-rise buildings. These also provide basic back-up for the granite cladding on the exterior face of the building. The column width and the spandrel depth have been adjusted so that the glazing of exterior face can be done without intermediate mullion.

The 72,637 m^3 of cast in place concrete for columns and spandrels required 8500 tons of reinforcing steel and ranged in strength from 52 MPa at ground level to 21 MPa at the top.

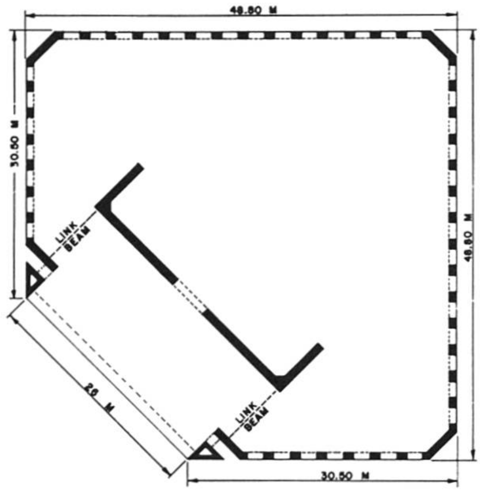

Fig. 2 Primary structural structural system

Foundation

Texas Commerce Tower is the sixth tallest structure in the world. Unlike the five taller buildings which are supported on rigid rock, this tower is the tallest building in the world supported on soil.

The tower is supported on 66 m^2 mat (Fig. 3) with one corner out at 45 degree angle to match the footprint of the tower. The 3 m thick with concrete strength of 41 MPa required approximately 1700 tons of reinforcement.

The bottom of the mat is founded on a very stiff clay at the elevation of 19 m below the street level and 6 m below the water table.

Construction

The temporary retention system for 19 m deep excavation concrete cast in place soldier piles with two and four levels of pre-stressed tie backs. A continuously operating dewatering system of jet eductor wells spaced at about 5 m on center was provided all around the block to have a dry operating level for the basement.

The 3 m thick with 11,622 m^3 of concrete was poured in two pours approximately equal in quantity. Because of the physical constraints in constructing such a mat foundation, the placement of the mat was done during weekend and at night between

Fig. 3 Mat foundation

6 p.m. on Saturday and Sunday morning. The mat concrete was placed at a peak rate of 612 m^3 per hour.

The connection of the perimeter composite concrete frame was performed by utilizing a custom-built jump form system and pumping the concrete to record heights. The contractor maintained 3 day time cycles per floor to build 72 floors in 11 months. The bare steel frame (Fig. 4) was allowed to proceed 12 floors ahead of exterior concrete frame. The steel frame, during construction was stabilized by temporary steel bracings which was moved along with the steel frame as the construction proceeded. The tower is due for completion for full occupancy around October, 1982.

(P. V. Banavalkar)

Fig. 4 Construction