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7. Georgia Pacific Corp. HQ, Atlanta (Georgia, USA)

Owner: *Georgia Pacific Corporation*
Architect: *Skidmore, Owings & Merrill*
Consulting Engineers: *Weidlinger Associates*
Contractor: *J. A. Jones Construction Co./ H. J. Russell*
Construction Dates: *1979-1981*

General Description

The building contains the Corporate Headquarters of the Georgia Pacific which occupies approximately 50% of the total area; the remaining space is available for rental. In addition to the 52 story structural steel office tower, the complex includes a lower ancillary building in steel, containing exhibition space, cafeteria, commercial spaces and a separate parking garage of prestressed concrete structure for 670 cars and a health club. The current construction program is as follows:

Office Tower – 108,480 m^2
Ancillary Building – 17,945 m^2
Garage – 26,415 m^2

Preliminary Studies

The relatively narrow site resulted in a tower which is 38 m wide but rises 222 m above the foundations. The complex space requirements to accommodate the needs of the corporate client and that of commercial rental space, produced an unusual plan and geometry. To arrive at economical structural design, extensive preliminary studies were undertaken by examining alternate materials and framing systems, such as: structural steel, reinforced, pre-stressed concrete and composite steel-concrete construction.

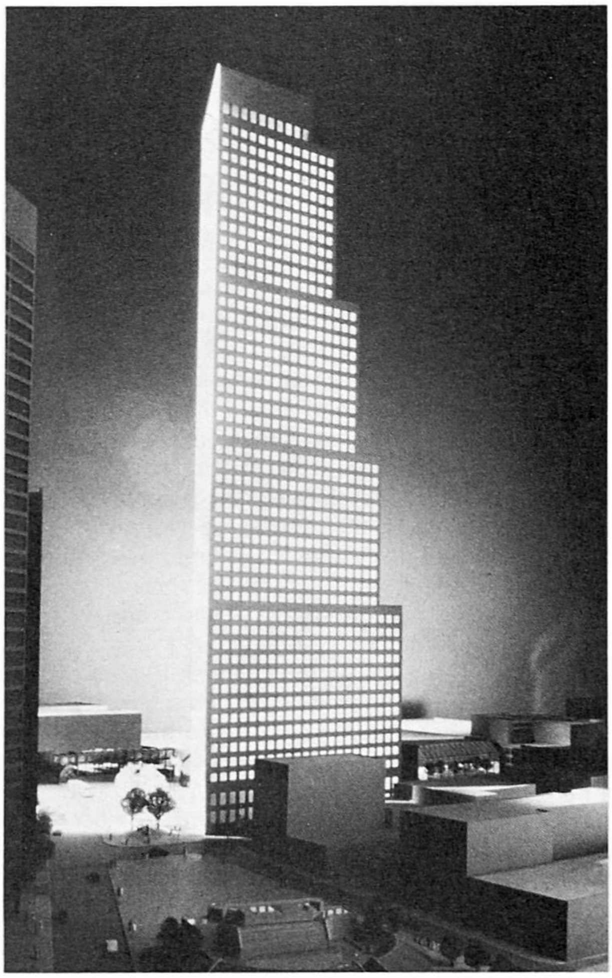

Fig. 1 Tower model

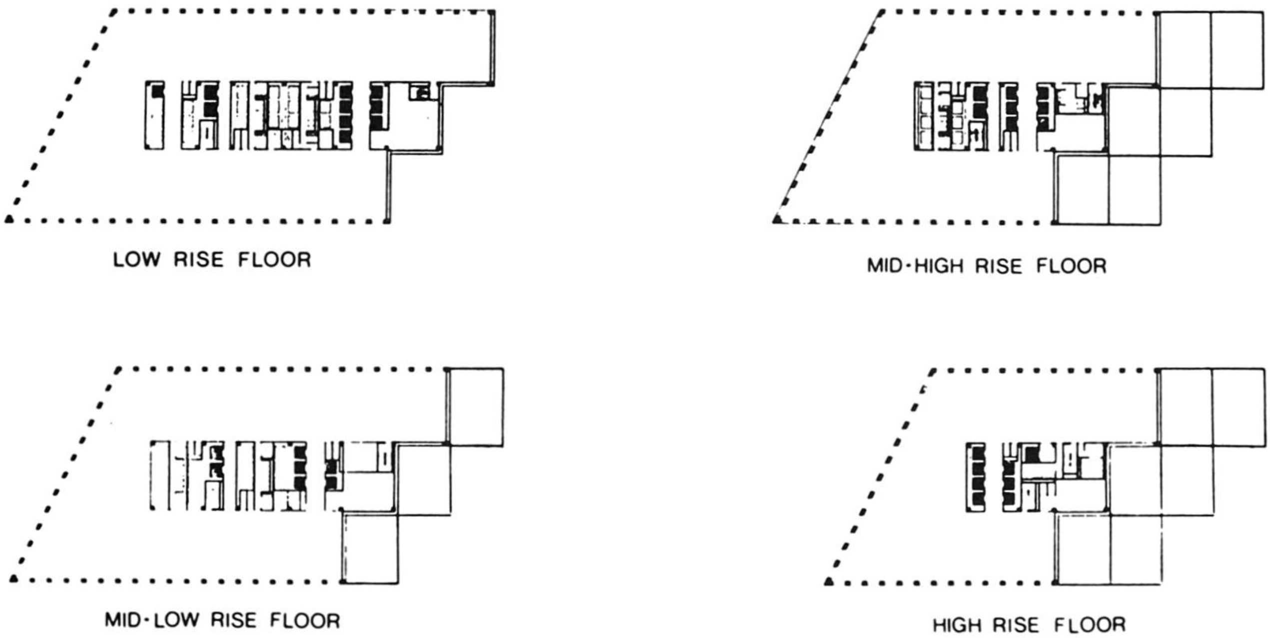

Fig. 2 Tower floors

The choice of the structural steel frame for the final design was based on a number of factors that included first cost, length of the construction cycle, local availability of materials and labor.

Structural Design of the Tower

Before final design of the tower was begun, a series of alternate framing and lateral bracing systems were explored. During this period, the number of floors and the total area to be built were also determined. The design that was finally executed contains 52 floors and one basement. (Fig. 1 & 2)

Foundations: The building is founded on drilled-in piers which penetrate into rock. The over-burden consisted of sandy soil and silt. The foundation design details are affected by the choice of the lateral bracing system, because it has to deal with high localized uplift generated by lateral forces.

Gravity Loads: The floor framing system consists of a composite steel deck supported on composite steel floor beams and girders. The construction depth is 130 cm. including a specially designed ceiling system incorporating lighting, air conditioning ducts, air difusers and acoustic treatment. Exterior columns and deep spandrel girders are fabricated of built-up sections.

To achieve maximum economy, 70% of the structural steel is of A36 steel and the remaining 30% is high strength A572 Gr. 50.

Lateral Bracing System

The complex geometry and the 1 to 6 aspect ratio of the tower required very careful consideration of the wind forces and seismic effects. The solution posed a series of problems to the designer of the tower. Dimensional and planning constraint required that the lateral bracing system be incorporated in the exterior wall of the structure. This exterior "tube", however, is interrupted on the north side of the building by horizontal offsets and vertical setbacks occurring about every 12 floors. To transmit the wind forces over this surface a folded truss system was designed which follows the setbacks and offsets of the exterior wall. The resulting geometry is such that the head-on view of the bracing corresponds to a plane truss which is then folded (Fig. 3) in such a fashion that at the folds transmission of lateral forces is accomplished. In addition ot this external truss, interior vertical trusses with "outriggers" were introduced in the core between elevators that rise to mid height of the structure so that the torsional response of the structure can be "tuned" and adjusted in the design process.

The aerodynamic response of the system was one of the major unknowns in design and it was resolved by construction of an aeroelastic model tested in the Boundary Layer Wind Tunnel Laboratory at the University of Western Ontario.

Fig. 4 Tower under construction

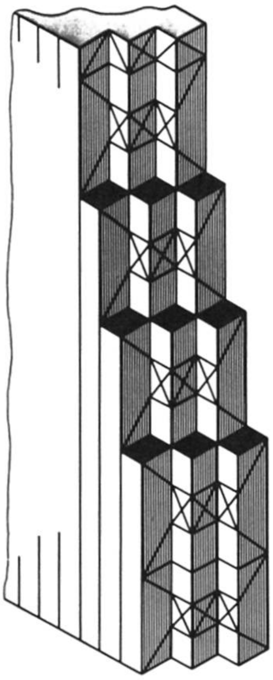

Fig. 3 Lateral bracing system

Construction Procedures

To achieve the required stiffness, main elements of the bracing system operate at about 30% of maximum allowable stress levels, resulting in large individual members, some weighing as much as 11 t each (Fig. 4). Welding was accomplished by using an inner shield process on steel that was preheated by resistance preheating. All full penetration welds are ultrasonically tested, others are inspected by magnetic particle procedures. Bolted connections are checked by follow-on trial torque.

(Paul Weidlinger)