Tapered Helix Building Shape Requires 84 Column Transfers . . . a Record?

In a plan drawing, the steel frame for 750 Seventh Avenue looks more like abstract art than like the structure of a 35-story office tower. The reason is what may be a record 84 column transfers on 26 perimeter columns.

"Some columns are offset four times, each time generally by either 10′-0″ or 3′-6″. At the lower floors, column-transfer girders have flanges up to 4 inches thick, because they are typically restricted to 42 inches in depth, to fit within the ceiling construction," explained John G. Shmerykowsky of Weiskopf & Pickworth, the structural engineers.

This extraordinary column geometry resulted from the building's unique, helical or corkscrew shape. Architects Kevin Roche John Dinkeloo & Associates were inspired by the ziggurat, a tower that progressively shrinks in cross-section with increasing height and which has outside staircases or ramps. The ziggurat is a very old structural form, dating back to an ancient Mesopotamian temple tower.

Some columns are offset four times, resulting from the building's unique, helical shape.

The choice of this shape was prompted by zoning requirements for setbacks that limit the maximum area of floors to a progressively stepped-back building. This was the basis for early massing studies. The form of a helical tower was chosen because it gives the building a more dynamic feeling than the static one of stacked, diminishing boxes. The per-floor areas decrease from 22,000 sq. ft. at the base to just over 10,000 sq. ft. at the top, 35th floor.

The dramatic helical shape was created by staggering the location of building setbacks, and by using story-high sloped glass in the setbacks.

Even tenants in offices lacking sloped glass will have dramatic views, thanks to 10-ft.-high, floor-to-ceiling windows, each 10 ft. wide. As viewed from outside the building, these large vision panels will be separated by opaque gray glass bands that closely shadow the location and dimensions of the structure's exterior tube frame. The horizontal opaque bands are 3 ft. deep, the depth of the floor-ceiling sandwich; the vertical opaque bands are 5 ft. wide, little more than the width of the 36-inch columns that are spaced on 15 ft. centers along the building perimeter, plus their column covers.

The glass in the aluminum and glass curtainwall will be attached to its frame solely by a continuous bead of adhesive silicone running around all four edges of each piece of glass. That is, the glass is not mechanically retained by the aluminum mullions. The adhesive bead will double as a barrier to wind and water penetration.

John Barker of curtainwall contractor Glassalum Engineering Corp. said this will be one of the city's first buildings glazed solely with structural adhesive. He said the city's pioneer in using only structural adhesive and no mechanical attachment of glass, is the massive black Metropolitan Tower on 57th Street near Carnegie Hall, completed two or three years ago.

At 750 Seventh Avenue, the key structural challenge, of course, was the column transfers at the setbacks. One way to move the exterior columns inward at each offset would have been to slope them. But in many locations, a setback on one side of this building is not matched by a corresponding setback on the opposite side. Had sloped columns been used, explained structural engineers Emmanuel Pisetzner and Mr. Shmerykowsky, partners in Weiskopf & Pickworth, extremely large, unbalanced horizontal forces would have been introduced, especially at lower floors.

Because they do not introduce unbalanced forces, column transfers were chosen instead. But their use led to complicated column connections, whose complexity is increased by the fact that many columns switch from W36 at the exterior of the building, to W14 as they become interior columns at the sloping setbacks. That is, at each column transfer, and for a height of one floor, the column is a W14 section. At the exterior, the same column is a W36 section.

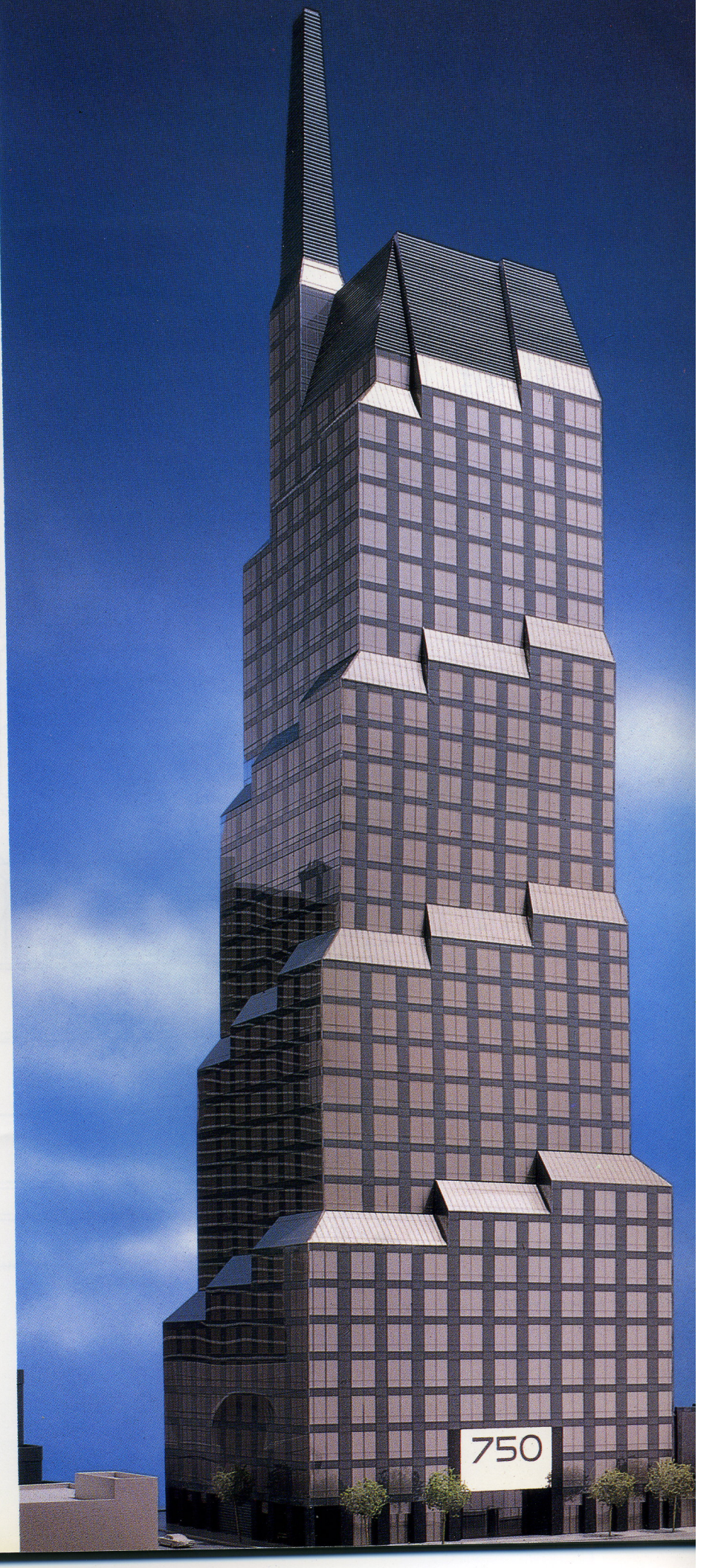
"The design goal was column-free office space. . . Typical spans are 40 ft. to 50 ft."

The result of these structural challenges, according to L.N. Ross, president of L.N. Ross Engineering, one of the firms which detailed the steel, is that "at a single location, some columns were designed for a change in section, a spandrel moment connection, a moment connection to the girder that frames at right angles to the spandrel, and horizontal X-bracing. What challenging conditions structural steel can be designed to handle!"

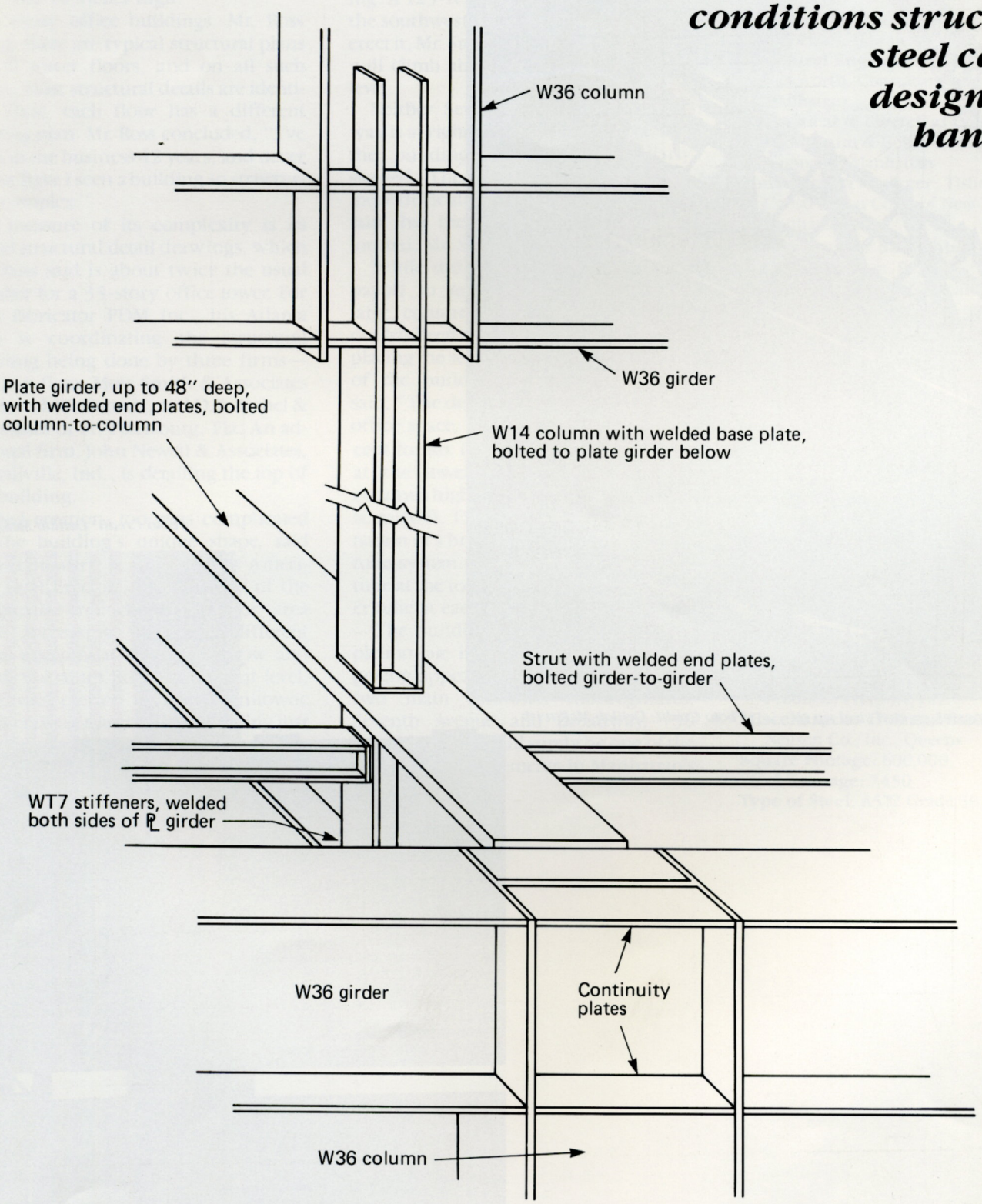
Another complication, Mr. Ross said, was the presence of so many penetrations that some girders looked like "Swiss cheese." Paul Schwer of mechanical engineers Jaros, Baum & Bolles said the "Swiss-cheese" girders are some of the transfer girders at lower floors. Their 42-inch depth takes up all the depth available in the 4-ft.-deep floor-ceiling sandwich, so the HVAC ducts had to be routed through the girders. Especially near the building core, Mr.

750 Seventh Avenue—
photograph of model

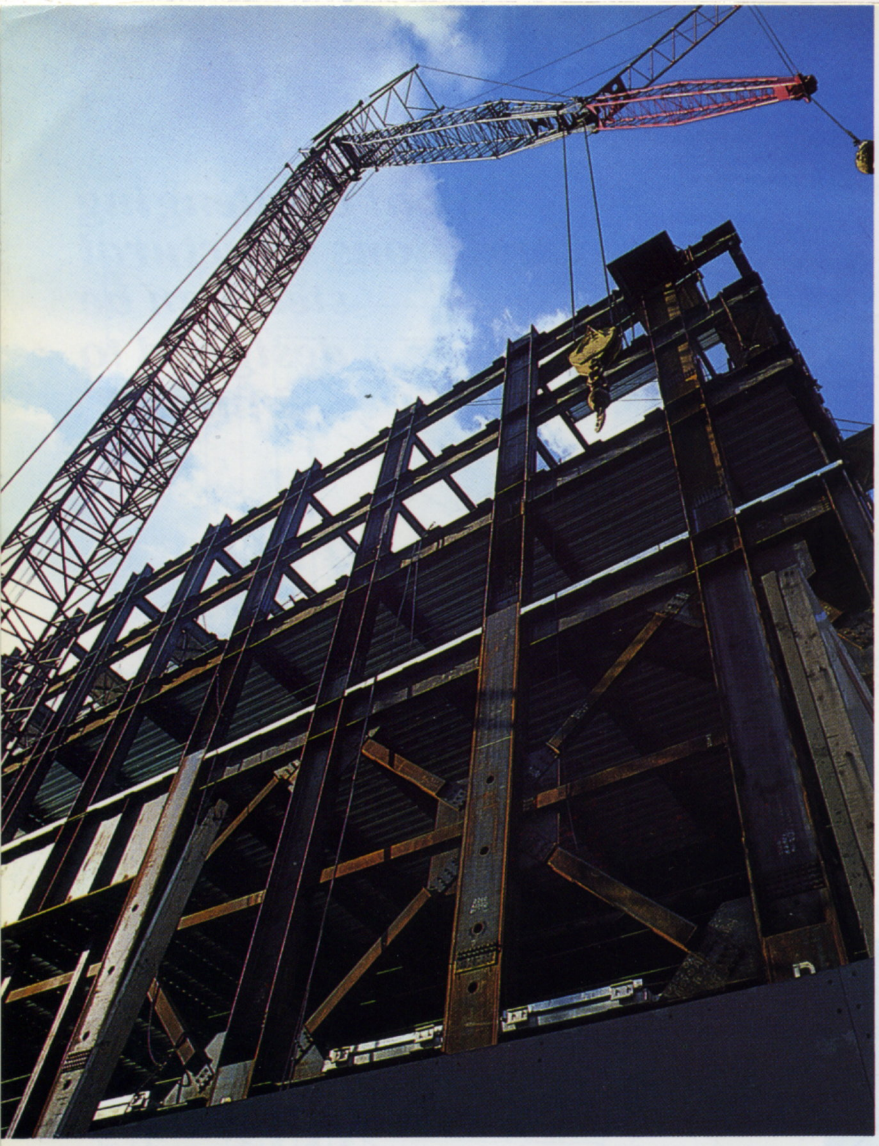
Photo Credit: © 1988 Nathaniel Lieberman



"What challenging conditions structural steel can be designed to handle!"



TYPICAL COLUMN TRANSFER



***Crawler tower cranes** erected steel up to the ninth floor*

Photo Credit: Delilah McKavish

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Schwer said, these conditions meant girder penetrations as large as 60 inches wide and 16 inches high.

In many office buildings, Mr. Ross noted, there are typical structural plans for all tower floors, and on all such floors, most structural details are identical. Here, each floor has a different framing plan. Mr. Ross concluded, "I've been in the business 42 years, and never before have I seen a building so structurally complex."

A measure of its complexity is its 2,000 structural detail drawings, which Mr. Ross said is about twice the usual number for a 35-story office tower. For steel fabricator PDM Inc., his Atlanta firm is coordinating the structural detailing being done by three firms—his own firm, Moss Smith & Associates of Thornhill, Canada, and D.R. Gabel & Associates of St. Petersburg, Fla. An additional firm, John Newell & Associates, Merrillville, Ind., is detailing the top of the building.

Steel erection, too, was complicated by the building's unique shape, said Robert Stewart, Jr., president of American Steel Erectors, Inc. Because of the progressive reductions in floor area with increasing elevation, different crane equipment was used below and above the ninth floor. Below that level, steel was erected by two Manitowoc 4100 crawler tower cranes standing just outside the building perimeter. Two climbing tower cranes, located at the 6th floor and 9th floor setbacks, on opposite sides of the tower, are erecting the remaining steel in the 35-story building. A 125-ft.-high spire will rise above the southwest corner of the roof, and to erect it, Mr. Stewart said, the tower crane will climb about 50 ft. above the roof level.

Neither Seventh Avenue nor Broadway is at right angles to 49th Street, and the building footprint is similarly skewed. The irregular angles made it more difficult for the surveyors to ascertain that the columns were correctly located, Mr. Stewart said.

While the structure is complex, the payoff to tenants will be extremely large, column-free areas. The floor layout has been optimized for tenant use by placing the service core at the north side of the building. Mr. Shmerykowsky said, "The design goal was column-free office space, and this was achieved except for six interior, non-core columns at the lowest floors, and two such columns higher up. Typical spans are 40 ft. to 50 ft. The wind system is a combination of a braced core with a telescopic tube system. The wind resisted by the tube at the top, gets transferred to a larger tube at each setback below."

The building is scheduled for completion late in 1989. Thanks to its imposing appearance and its frontage on two main midtown thoroughfares, Seventh Avenue and Broadway, 750 Seventh Avenue will surely be one of the most dramatic elements in Manhattan's skyline.

750 SEVENTH AVENUE

Developer: Solomon Equities Inc., Manhattan
Architect: Kevin Roche John Dinkeloo & Associates, Hamden, Conn.
Structural Engineer: Weiskopf & Pickworth, Consulting Engineers, Manhattan
Mechanical & Electrical Engineers: Jaros, Baum & Bolles Consulting Engineers, Manhattan
Construction Manager: Tishman Construction Corp. of New York, Manhattan
Superstructure Steel Fabricator: PDM Inc., Pittsburgh, Pa.
Below-grade Steel Fabricator: Bethlehem Contracting Company, Bath, Pa.
Superstructure Steel and Metal Deck Erector: American Steel Erectors, Inc., South Plainfield, N.J.
Below-grade Steel Erector: Expressway Industries, Bronx, N.Y.
Steel Detailers: L.N. Ross Engineering, Atlanta, Ga.; D.R. Gabel & Associates, St. Petersburg, Fla.; Moss Smith & Associates, Thornhill, Canada; and John Newell & Associates Inc., Merrillville, Ind.
Metal Curtainwall Fabricator: Glassalum Engineering Corp., Miami, Fla.
Metal Curtainwall Erector: Diamond Architecturals Inc., Manhattan
Architectural Metal: Melto Metal Products, Freeport, N.Y.
Miscellaneous Iron and Stairs: Adler & Neilson Co., Inc., Queens
Square Footage: 600,000
Steel Tonnage: 7,450
Type of Steel: A572 Grade 50