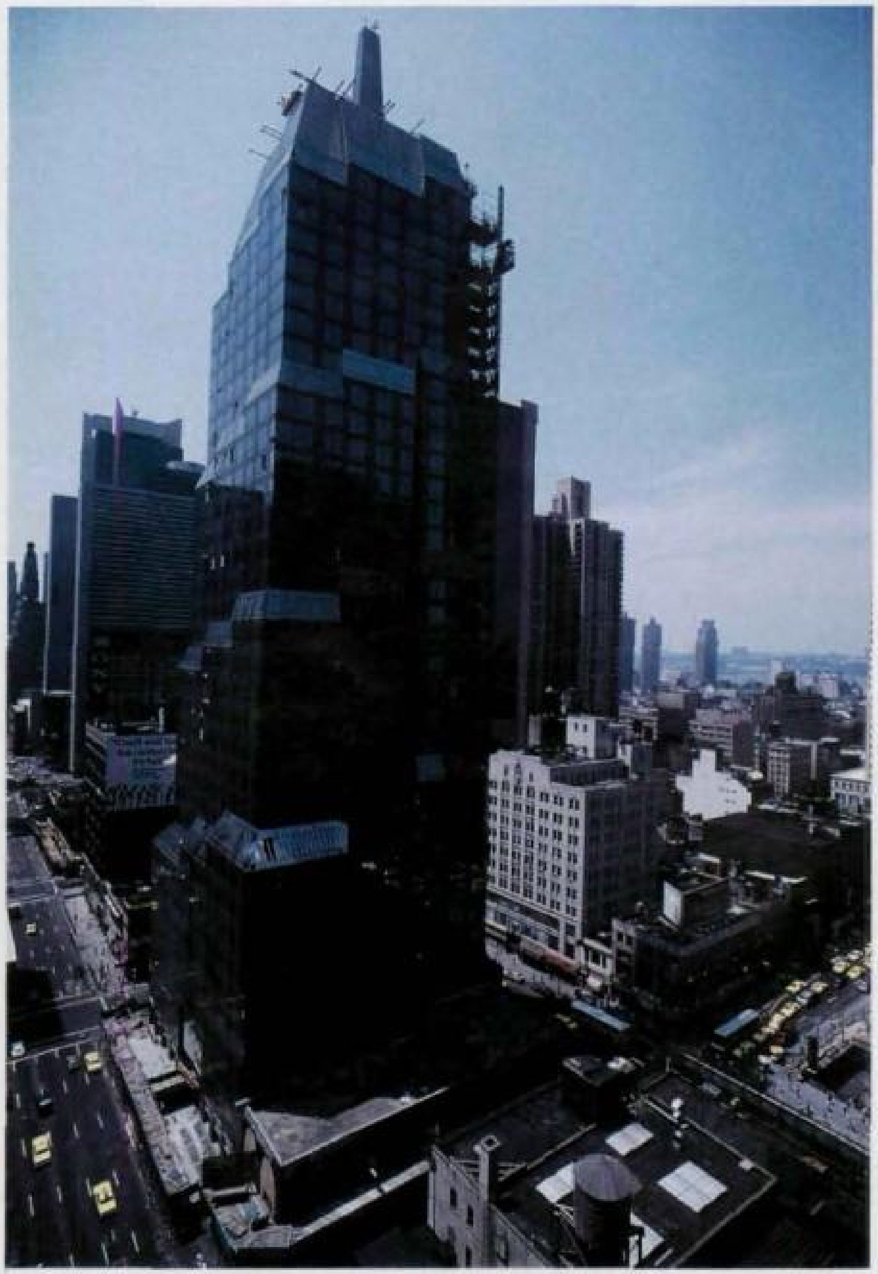
Reinterpreting An Ancient Form

A unique design that met N.Y.C. codes and a need for column-free space required 84 column transfers



The progressively stepped levels of 750 Seventh Ave. in New York City create a unique architectural image. Above photo by Michel Legrand; right photo by Nathaniel Lieberman (718/797-0707)

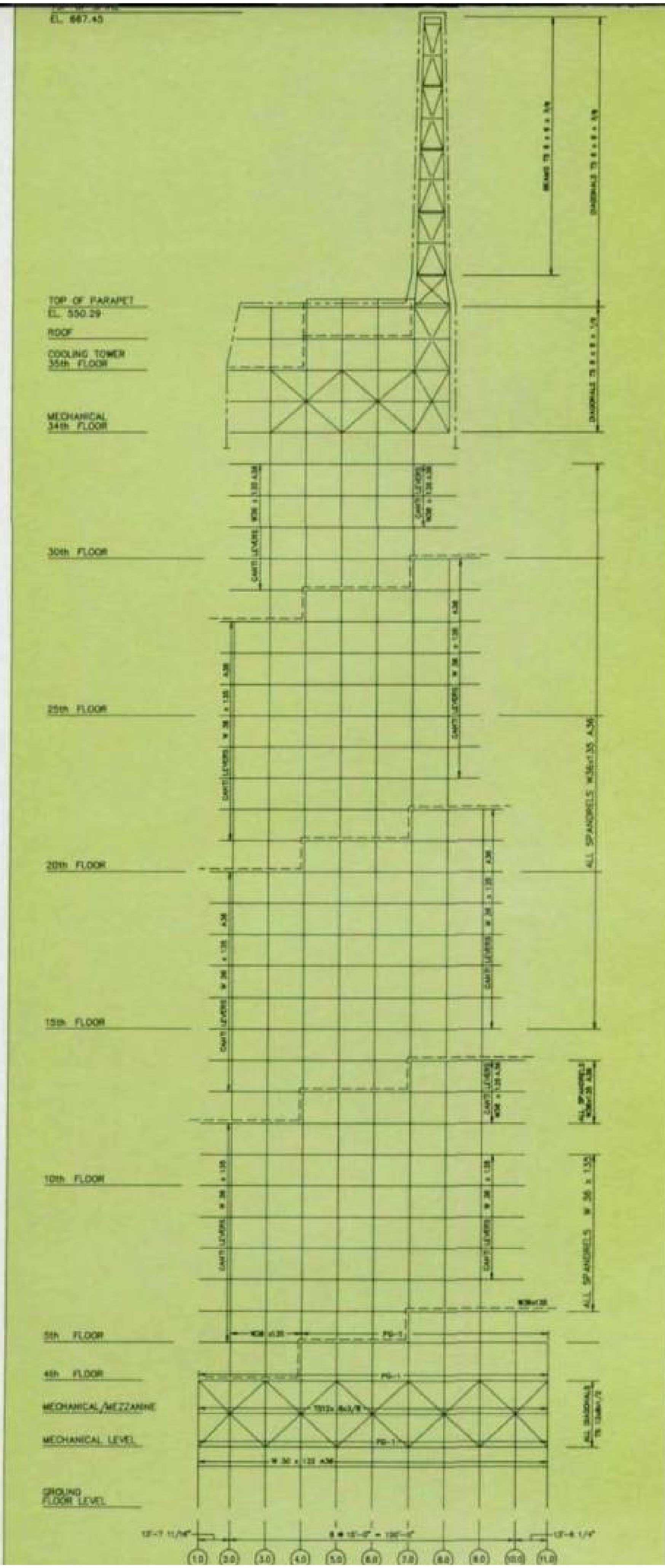
If Postmodernism was successful by drawing on Classical references, then the soon-to-be-complete 750 Seventh Ave. building in New York City should be extremely well received. In order to satisfy zoning demands for setbacks, architect Kevin Roche John Dinkeloo & Associates, Hamden, CT, reached all the way back to ancient Mesopotamia for their latest design.

The new 35-story tower is based on the ziggurat, an ancient building form used in constructing temple towers. In form, it narrows as it increases in height, and is marked by spiraling outside staircases or ramps. In the modern New York version, the glass-clad tower gradually steps back along three sides, creating the illusion of giant steps ascending the structure's face.

"The building was creatively sculpted in order to meet a number of design criteria resulting from the New York City building code," explained John G. Shmerykowsky, P.E., partner with Weiskopf & Pickworth, New York, the project's structural engineer. "The site is bordered by three streets, and the building code requires setbacks on all streets. To add visual interest, the architect made these stepping setbacks spiraling around the building, and he designed them as slopes." The spiraling form creates a more dynamic image than a static shape of stacked, diminishing boxes.

84 Column Transfers

However, while visually fascinating, the unusual design creates numerous structural headaches.



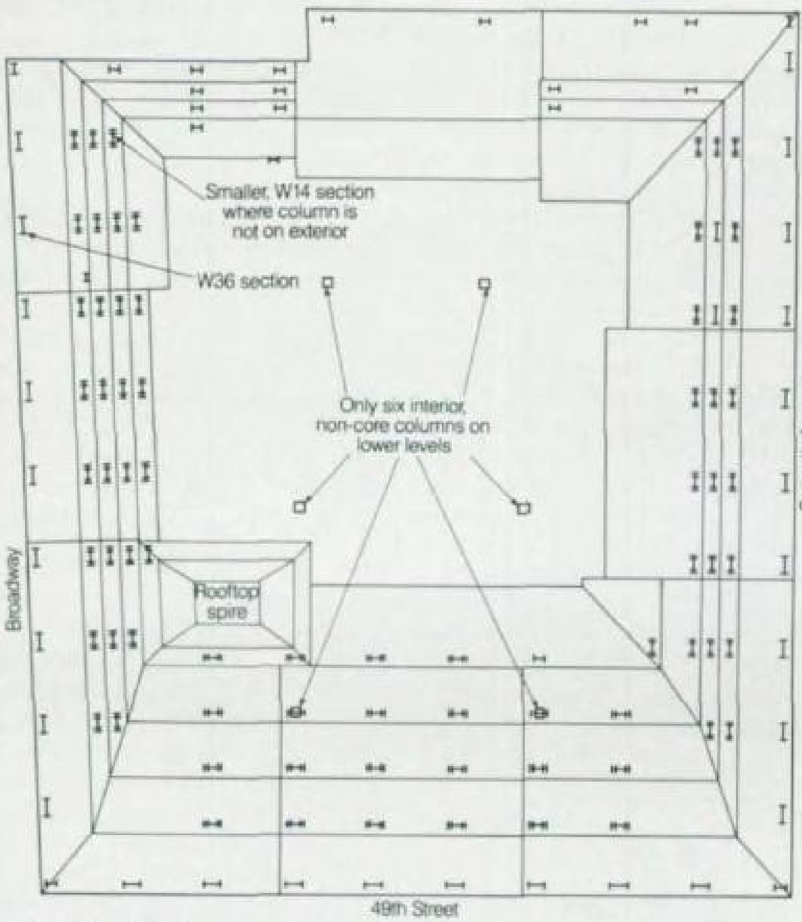
On the lower levels the setbacks are as large as 10', but become progressively smaller, reaching 3'-6" at the upper level. Adding to the complication was the owner's desire for column-free space. "We couldn't carry the column straight down because of the need for column-free space, and we couldn't have sloping columns because the setbacks are at a different location on each floor," Shmerykowsky explained. Had sloped columns been used, very large, unbalanced horizontal forces would have been introduced, especially at the lower floors.

"The only way to satisfy the architectural design and the owners requirements was to use transfer girders," he stated. Project developer was Solomon Equities, Inc., New York.

While three or four or even six or seven transfer girders are not uncommon, 750 Seventh Ave. may have set a record for a building of its size by having 84 column transfers on 26 perimeter columns. Some of the columns are offset as many as four times. Because the column-transfer girders are typically restricted to 42" in depth to fit within the ceiling construction, at the lower levels they have flanges up to 4" thick. "The transfer girders had to be within the depth of the ceiling, which was typically 4' from finish floor to finish ceiling," Shmerykowsky said. "Any ductwork had to pass through the girders." Weiskopf & Pickworth use an in-house program to design for beam penetrations.

Large Wind Loads

"What complicated the structural design is that wind tunnel testing indicated much larger overturning forces than New York City code requires," Shmerykowsky said. "We had to use the exterior of the building as a wind system, so we designed the structure almost as a 'telescoping tube' and the girders get heavier at the bottom." The telescoping tube that Shmerykowsky describes is the overall structure, not the use of



Column layout for 750 Seventh Avenue

The combined floor plan of 750 Seventh Ave. in New York shows the location of both the interior and exterior columns and a composite view of the setbacks. (Construction photo by Michel Legrand.)

hollow structural sections. In plan, Shmerykowsky's tube is similar to an old sailor's telescope. As each section of the "telescope" resists the wind load, it transfers the load to the larger section below.

The column spacing is 15' on center on the exterior. The closely spaced columns on the exterior combine with the spandrel beams to create a tube system, he explained. The braced core system helps transfer wind shear at the setbacks from one section to another. To further complicate the wind system, the architectural design did not allow corner columns. This led to a modified tube system with cantilevers at each corner, according to Shmerykowsky.

While the exterior columns are W36 sections, behind the sloping curtain wall—where the setbacks occur—the columns become W14 sections. For that one floor, at each setback, the column is at the interior. "We had to reduce the size of the column, so a W14 section had to be married to a W36 section," Shmerykowsky explained. "This is also where the braced core picks up wind shear, and it helped that the setbacks step up so that only two or three columns are transferred on each side of the floor."

Although there was a considerable penalty in steel tonnage due to column transfers, the structural engineers economized the use of steel through efficient design of long span composite beams with high strength, 40 ksi composite metal deck. The beams were typically spaced 15' on center. This spacing and spans up to 48' made it possible to take the maximum advantage of the live load reduction allowed by New York City Code and minimized the number of steel pieces.

Great care was needed during construction to accommodate the sloped walls, said Thomas McCloskey, project manager with Tishman Construction Corp. of New York, the project's construction manager. "The sloped portions were more difficult to erect, and they were more difficult to seal," he said. The glass is structurally glazed and a lot of attention was paid to the caulking used to make the structure watertight.

Structural Glazing

The building's curtainwall is a combined glass and aluminum system and is one of the first uses of structural glazing in New York City. In structural glazing, the glass curtainwall is not mechanically fastened or retained with a mullion. Instead, it is held in place with a silicon adhesive bead, which doubles as a wind and water barrier. Even tenants in offices without the sloping sections will have dramatic views due to 10'wide, 10'-high, floor-to-ceiling windows. The windows are separated by opaque grey glass bands that closely shadow the location and dimensions of the structure's exterior columns. The horizontal bands are 3' deep and equal the depth of the floor-ceiling sandwich, while the vertical bands are 5' wide and slightly wider than the 36"-wide columns that are spaced 15' on center along the building perimeter.

The setbacks also created a difficult erection problem. The contractor and steel erector had to carefully monitor the design and construction of the transfer girders, McCloskey explained. "If they were off by an inch, it would create a problem at the transfer point," he said. Coordination was further hampered by the site dimensions. Because the surrounding streets are not at right angles to each other, it was more difficult for the surveyors to ascertain whether or not the columns were correctly located. Also, the large number of column transfers resulted in a lot more welded connections than is typical in a structure of this size.

Steel erector on the project for the superstructure was AISC-member American Steel Erectors, Inc., South Plainfield, PA., and steel fabricator was AISC-member PDM Inc., Pittsburgh. Below-grade steel fabricator was AISC-member Bethlehem Contracting Co., Bath, PA, and erector was Expressway Industries, New York. The project used 7,450 tons of steel.

Additional bracing was provided on the third story mechanical floor. Because there were no office windows that would be affected, the engineer designed full-story transfer trusses.

Most of the exterior columns and girders were wind controlled and are A36 steel. All of the interior steel—the girders, beams, and interior columns—are A572 Grade 50.

The unusual design resulted in a different framing plan for each floor. At the base of the building, floor size is 22,000 sq. ft., but it is only 10,000 sq. ft. at the top floor. As a result, and because the setbacks are in different locations at each floor, more than 2,000 structural detail drawings were needed—about twice the usual number for a 35-story building.

Difficult Steel Erection

The design—as well as the tight sight—also complicated the steel erection. "The site is bordered on three sides by Broadway, 7th Avenue, and 49th St., and Broadway and 49th St. are both bus thoroughfares," McCloskey said. As a result, the streets couldn't be blocked off during construction. To build the cribbing and foundation walls a base was erected on the site. "We brought the crane in over the weekend and only shut a street for one day." That crane was used during the erection of the first few floors. On the 7th Avenue side a climbing tower crane was placed on the sixth floor setback, while on the Broadway side, a climbing tower crane was located on the ninth floor setback.

The tight site also made unloading difficult. "We were restricted to one lane of 7th Avenue and the sidewalk of 49th Street," McCloskey noted.

A final complication was the purely decorative 125'-tall spire on the roof of the building. "It was tall and skinny and there was no place to work," McCloskey explained. As a result, it was difficult to ensure that the spire and the cladding material matched perfectly. To erect the spire above the southwest corner of the roof, the tower crane needed to climb about 50' above the roof level. □