300 MADISON AVENUE

Steel Enables Timely Security and Style in Midtown

All building design is based on the practical and poetic use of space, but 300 Madison Avenue, a sleek recent addition to the office towers of midtown at 42nd Street, owes many of its creative features to time. Practically speaking, a rapid construction schedule, combined with new post-9/11 security requirements for this Grand Central Station neighbor, resulted in an all-steel structural solution so distinctive it required a variance to the New York City building code. Speaking more poetically, the designer's reflection on atmospheric cycles and daily routines resulted in an imaginative curtain wall facade of eye-catching stainless-steel spandrel panels and fins.

Drawings were out to bid and foundation excavations were already well underway for the 40-story, 1.2 million-square-foot skyscraper in the Fall of 2001 when the events of September 11 temporarily sent construction crews downtown and designers back to the drawing board. "We wanted to harden the building beyond the requirements of typical loading," says Skidmore, Owings & Merrill (SOM) Associate Angelo Anzano, senior technical coordinator on the project along with senior designer John Durschinger. A study by project structural engineers Gilsanz Murray Steficek (GMS) was commissioned to consider progressive collapse caused by the weakening of individual members and identify ways in which the original design could be modified to resist it. Two alternatives—a reinforced concrete core and a more conventional braced steel core—were developed to the bidding stage. Says Anzano, "We had originally designed a concrete core and steel perimeter frame. We went back and changed the design to a steel core." Among other reasons, an all-steel solution enabled already-fabricated steel columns and beams to be reinforced on-site. Says Anzano, "It helped keep us on schedule. We'd already started fabricating the steel and connections, but we managed to do a lot of welded plate reinforcing in the field, not the factory."

OPPOSITE The beginning of the structural steel core

Speed was of the essence. Despite the new design and construction considerations, the move-in date arranged between prospective tenant CIBC and developer Brookfield Financial Properties was fixed and could not change. Much of the work of four years would have to be done in about two and a half. "This was a creative and fast-track job," says GMS project manager Karl Chen. Time efficiency suggested a steel solution. Bypassing the formwork and other phases required for a concrete core meant, says Chen, "No temporary structural members, and just one trade already on the site instead of two or more contractors."

In an era with frequent turnover between tenants and with technology requiring and enabling frequent reconfiguration of office space, change over time was also an essential consideration. "The clients wanted to invest in providing more flexibility over the life of the building," comments Anzano, "as things change, a [concrete] core means you have to cut through and then reinforce 18 inches of concrete and rebar and re-distribute all kinds of dead loads and lateral forces," in order to accommodate new circulation, ductwork, or other building systems. Instead, 300 Madison's steel-framed core provides 30 feet of clearance between many structural members for adjustments, renovations, and innovations over time.

Creating such a core at low cost and high speed required structural and even legal innovations. 300 Madison is the first skyscraper in New York to use ASTM A992 Grade 65 steel in all its columns and bracing members, rather than the conventional 50 ksi steel. "This grade is normally used for special applications, like tunnels," says Chen, "Since it's a relatively new use of the material, there were no provisions for it in the city building code," and UBC 1991 seismic requirements proscribed the use of 65 ksi steel for lateral force resistance. GMS received a NYC Department of Buildings variance to allow use of the material for all columns and for two distinctive belt trusses: a 48-foot-deep chevron-braced perimeter truss at the mechanical floors nine through 11, and a similar 27-foot-deep truss at the 36th floor combined with a lateral truss connecting to the top of the steel core. A dual-layer cage lattice of No. 6 rebar on six-inch centers reinforces the four adjacent concrete floor plates, providing another link between the perimeter and core frames. The higher-strength steel enables the belt trusses to replace more conventional and space-wasting outrigger core-to-perimeter trusses or large-scale perimeter cross-bracing. The result is a sturdy but unusually lightweight structure. Despite "hardening," its weight per square foot in steel tonnage compares favorably to similar building types and loading applications. The substitution of 65 ksi for 50 ksi members, such as a 14W176 65 ksi member for its 14W233 50 ksi equivalent as for a typical 1,698 kip capacity column, resulted in an average weight-to-linear foot savings of 135-pounds-per-foot over the entire structure and an average steel material savings of 24 percent. Says Chen, "you can build faster, reduce waste, and simplify transportation by truck and crane."

OPPOSITE TOP The steel core offers as much as 30 feet of clearance between structural members.

OPPOSITE BOTTOM LEFT, RIGHT Bypassing formwork and other phases required for a concrete core allowed a fast-track erection.

OPPOSITE A belt truss was used to support the tower above and hang the structure below.

The mechanical floor belt truss also enabled an ingenious adaptation to a surprising design challenge. Local storefront zoning suggested that the primary lobby entrance be at the tower's northeast corner. Yet an atrium that accommodates an 18-foot grade change across the site would be interrupted at exactly this point by a column supporting the corner of the tower's shaft above. "Even after design development, the architects decided this column still bothered them. We determined that we could remove the column by using the belt truss to both support the loads above and hang the structure below, basically reversing the load, as opposed to transfer girders or a skewed column that might have been required with a conventional outrigger system," Chen observes. "We got that for free, structurally." To re-balance the building's vertical loading, the equivalent column at the opposite southwest corner was cut, although it was left in place for consistency. "The joke," says Anzano, "is that someday somebody will pull down the sheetrock around that one column and find out it doesn't go to the ceiling."

But if some of the steel ingenuity is buried deep within 300 Madison, much of the artistry in steel is right on the surface. The facade of the tower features a unique system of 1/2-inch-thick, 4-foot-tall orbital-finished type 304 stainless steel vertical fins on 10-inch centers. The fins run the length of a pattern of 12-inch-wide mirror-finish stainless steel plates aligned to spandrel panels and windows. The depth of each fin varies from 2 inches to 10 inches across the entire width of the building's facades, creating a reflective syncopation and visual flicker that continually changes with weather, natural light conditions, and the angle of a pedestrian's view. "People looking up from their routine see something different every time," comments Anzano. In both substance and surface, practically and poetically, 300 Madison's creativity in steel produced a building that, as Anzano puts it, "engages change over time." ■

300 MADISON AVENUE

Owner **Brookfield Properties Corportation** *New York, NY*
Architect **Skidmore, Owings & Merrill LLP** *New York, NY*
Engineer **Gilsanz, Murray, Steficek LLP** *New York, NY*
General Contractor **Turner Construction** *New York, NY*
Structural Steel Fabricator **Canron Corp.** *New York, NY*
Structural Steel Erectors
Cornell and Company *Woodbury, NJ*
Canron Corp. *New York, NY*
Miscellaneous Steel Fabricators and Erectors
Empire City Iron Works *Long Island City, NY*
Post Road Iron Works *Greenwich, CT*
Metal Deck Erector **Solera Construction, Inc.** *New York, NY*