

CITIGROUP

LIC 2

Security Concerns, Shifting Client Demands Met with Steel





PREVIOUS LIC 2's elegantly placid facade hides a complex structure designed to handle the anticipated loads of a significant addition.

ABOVE Stub outs on the phasing wall await the steel of phase 2.

In 2005, when Mayor Michael Bloomberg tossed the first shovelful of dirt at Citigroup's Long Island City 2 (LIC 2)'s groundbreaking, he praised the project as a catalyst for the economic development of the area. At that time 18 tower cranes dotted the neighborhood and today there are even more, as the first phase of Citigroup's new corporate satellite nears completion: a 16-story, 500,000-square-foot tower of sloping and curving glass that seems to embody the optimism of the Mayor's words in its daring form and potential size. As in many construction projects, the real cause for celebration is that it gets successfully completed under the pressure of tight deadlines and design changes en route—challenges that the selection of steel for the structural frame gave the designers the flexibility they needed to address not only design changes but exceed New York City building codes in terms of safety and security, and prepare the structure for a second phase that will add 36 more stories and 900,000 square feet.

Despite the seeming effortless speed with which the first phase of LIC 2 has risen on the Queens skyline, design work got off to a stuttering start. In the summer of 2003, architects Kohn Pedersen Fox and engineers WSP Cantor Seinuk started working on a plan for the two-phase development. Then, shortly after the team began design, Citigroup put the project on hold for a year for internal reasons. On its return, the team was able to complete schematic design before another roadblock appeared that put the project on hold for three more months. Part of the reason for the second delay was that authorities had found an Al Qaeda-owned laptop listing Citigroup as a prime target. When the project resurfaced Citigroup, uncertain about the need for both phases, instructed the designers to continue only with the 16-story podium portion of the project and asked them to incorporate heightened security measures into the project. Despite these changes the original design schedule was not altered, meaning the team had to find a way to make up the three idle months in order to deliver the building on schedule.

To make up some of the lost time, Cantor Seinuk turned to technology. It used Pro Steel software in designing the structural system, and it was able to convince Citigroup to contract a steel detailer who would create a three-dimensional detailing model using Tekla's X-steel package, resulting in far fewer conflicts. "The nature of the program meant that all the connections had to be worked out or else the model wouldn't resolve itself," notes Andrew Cleary, a Senior Associate Principal at KPF and Job Captain on LIC 2. "So, once handed the deliverable, the contractor could start producing piece drawings rather than having to do calculations and design the entire system. A lot less coordination was required during the construction process, ultimately saving a lot of time and money."

In spite of Citigroup's uncertainty about the second phase, the team still needed to design for its possibility. "Phase two had to be finished to the point where the steel for it could be sized and configured," said Cleary. "Progressing into the design for phase one, none of the phase two steel could be moved or made larger. At the same time, we couldn't move steel columns around in phase one because it was tied to something in phase two." In order to accommodate the potential tower addition, certain of phase one's members were designed to accept phase two's loads. The designers placed W24 columns that extend four feet above phase



ABOVE TOP TO BOTTOM In spite of frequent stops and starts, the speed of a steel erection kept the project on schedule.

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one's roof, or stub-ups, to which the phase two columns will eventually connect. The team also designed the building's west face as a phasing wall with stub outs to accept phase two's framing.

In addition to being able to handle the gravity and lateral loads of a tower addition, the phase one structure had to address the heightened security concerns. While the design team could not reveal exactly what this entailed, they did say that the structure had to be upsized to handle the additional load of concrete masonry units used to harden the egress stairs.

But even with this upsizing LIC 2 delivers all of the benefits associated with steel structures, including long spans for open plan spaces. Two bays—one of 25 feet and one of 41 feet—span from the core to the perimeter with one interior column line. The beams here range from W14x22s spanning 25 feet with no camber to W21x44s spanning 42 feet with 1¼-inch camber. The girders, typically W24x84s with 1¼-inch camber, were raised three inches, allowing the building's ductwork to fit in the ceiling zone without beam penetrations. Steel shear studs tie the 5 ½-inch composite slabs of the floor system directly into the framing members.

LIC 2's north facade steps back 25 feet on the seventh floor and 16 feet on the 12th to fit within the zoning envelope. On the 12th floor the facade steps back to the tower columns, but on the seventh floor W40x149 gird-

ABOVE A W44x262 girder on each floor created 85 by 80 feet of column free space all the way up the building.

The result is 85 feet by 80 feet of column-free space on each floor going up the whole podium. You're never going to get that with concrete.



ABOVE With the exception of the welded perimeter moment frames, all of the connections were bolted

ers 41 feet in length with 2-by-14-inch cover plates on the bottom flange transfer the shifted load.

Three components make up the lateral system. The first is bracing within the core, both concentric and eccentric. The second is a perimeter moment frame consisting of W24 columns and W36 beams. The third is an outrigger truss system with trusses located on the 15th floor and on the proposed 36th floor. Four outrigger trusses are currently located in phase one on the 15th floor. In the proposed phase two portion of the building, there will be two outrigger trusses added on the 15th floor for a total of six and six on the 36th floor.

The engineers designated ASTM A992 steel for all of the wide flange members, ASTM A572 Grade 50 for the plates, and A00 GR B for the HSS members. With the exception of a permanent moment frame, which was welded, the connections are bolted, with the size of the connection driving the size of the bolt: A325 bolts are used for shared connections and mostly A490 bolts are used on the lateral system. Overall, 5,000 tons of steel was used in the project.

But there was one more hurdle to challenge the designers in their effort to stay on schedule, one for which the properties of structural steel were admirably suited: During the middle of design development Citigroup told the team that the building needed to house its Global Training Center, meaning that a 300-person auditorium would have to be incorporated in the design of the second floor. This entailed removing an interior column to achieve the open space desired. Different options for carrying the gravity load from the third floor column were investigated, but ultimately the team decided that the column should be removed throughout the full height of the building. To accomplish this significant change, the designers added an 83-foot long, W44x262 girder on each floor to span the longer distance. "We created a really long girder which you're only going to be able to do with steel," says Allen Thompson of Cantor Seinuk. "The result is 85 feet by 80 feet of column-free space on each floor going up the whole podium. You're never going to get that with concrete." ■

CITIGROUP LIC 2

Owner: **Citigroup** *New York, NY*
Developer: **Tishman Speyer** *New York, NY*
Architect: **Kohn Pederson Fox** *New York, NY*
Structural Engineer: **WSP Cantor Seinuk** *New York, NY*
Mechanical Engineer: **Cosentini Associates** *New York, NY*
General Contractor: **Turner Construction** *New York, NY*
Structural Steel Fabricators: **Owen Steel** *Columbia, SC*
Structural Steel Erectors: **A. J. McNulty & Co. Inc.** *Maspeth, NY*
Miscellaneous Steel Fabricators and Erectors: **Kraman Iron Works, Inc.** *New York, NY*; **FMB** *Harrison, NJ*
Architectural Metal Fabricators and Erectors: **American Architectural** *Bensalem, PA*; **Allied Bronze LLC** *Long Island City, NY*
Ornamental Metal Fabricators and Erectors: **American Architectural** *Bensalem, PA*; **Allied Bronze LLC** *Long Island City, NY*
Curtain Wall Fabricator: **Permasteelisa Cladding Technologies** *Windsor, CT*
Curtain Wall Erector: **Tower Installation LLC** *Windsor, CT*
Metal Deck Erector: **A.C. Associates** *Lyndhurst, NJ*