Design Foresight

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A new office high-rise paves the way toward revitalizing Queens and creating a new business district for New York.

Zoning setback requirements influenced the architect's design of a sloping east façade (right in picture) and a curved south façade.

LONG ISLAND CITY IN QUEENS IS BEING TOUTED AS NEW YORK CITY'S NEWEST CENTRAL BUSINESS DISTRICT. Certainly helping the cause is the recent addition of Long Island City 2 (LIC2), a $290 million, 16-story, 528,000-sq.-ft structure with an unusual architectural massing. The building is anticipated to be the primary catalyst in revamping the business and residential economies of Queens.

Owned by Citigroup, LIC2 is part of the company's relocation plan to move many back-office and support functions outside of Lower Manhattan. It will be the national headquarters for Citibank's credit card division and branch banking business.

LIC2's geometry was driven by tight site constraints and zoning regulations relative to sky exposure. To maximize office space, the building footprint stays as large as possible for as high as possible, and then the façades step inward accordingly. In combination with the required setbacks, the architect chose a sloping east elevation and a curved south elevation.

As Citigroup anticipated the possible need for more space at the same location, LIC2 is designed to accept a "phase 2" addition to the current building. The addition would complete the podium level and add a tower topping out at 36 floors. The tower would be supported by the podium portions of both phases.

Framing System

The building's floor system is typically composed of 5½-in. slabs—2½ in. of concrete on top of 3-in. metal deck. Steel framing is designed compositely with slab via the use of steel shear studs. The distance from the core to the perimeter is typically 64 ft on the north side and on the south side up to the seventh floor. Above this point the core-to-perimeter distance is typically 40 ft on the north side and 48 ft on the south side.

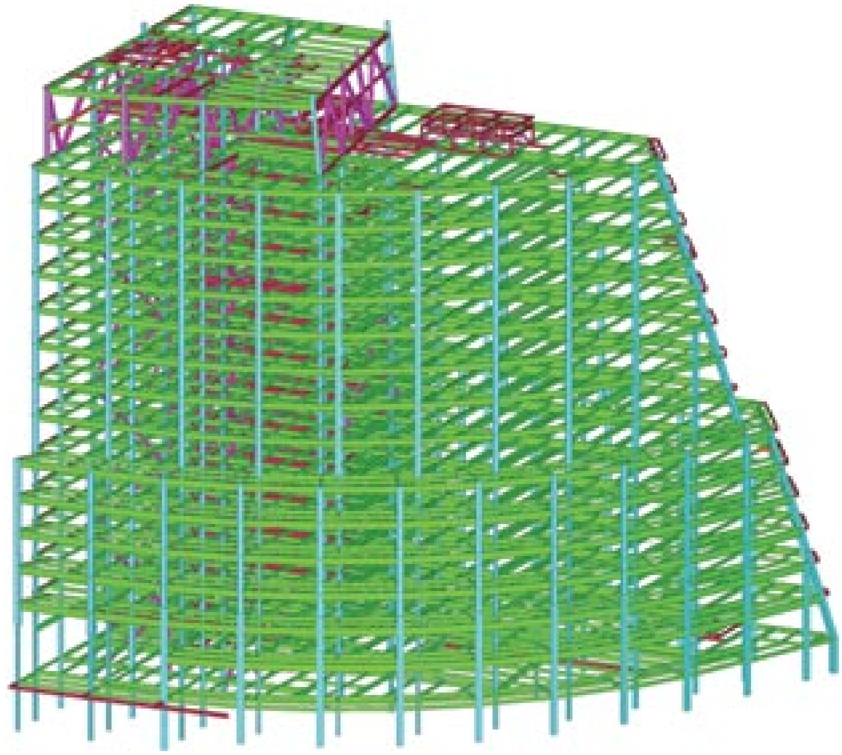
The span from the core to the perimeter is divided into two bays with one interior column line. Typical beam spans are 25 ft on the interior bay and 41 ft on the exterior bay, and typical filler beams range from W14×22s spanning 25 ft with no camber to W21×44s spanning 42 ft with 1¼-in. camber. Girders are typically W24×84s with 1¼-in. camber, and girders over 21 in. in depth were raised 3 in., allowing the ductwork to fit in the ceiling zone without beam penetrations.

Because of the setbacks required for sky exposure, the north façade steps back 25 ft 10 in. on the seventh floor and 16 ft 2in. on the 12th floor. On the 12th floor the façade steps back to the tower columns, but on the seventh floor, transfer girders—41-ft-long W40×149s with 2-in. by 14-in. cover plates on the bottom flange—were required.

The lateral system is composed of three components. The first is steel bracing within the core consisting of concentric and eccentric bracing. 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 16th floor and the proposed future 36th floor. Four of the outrigger trusses are currently located in phase 1 on the 15th floor. In the proposed phase 2 portion of the building there are six outrigger trusses on the 15th floor and six on 36th floor.

Phased Construction

In order to properly design phase 1, phase 2 was designed to a "design development plus" level. The "plus" meant that the core configuration had to be 100% designed in order to properly lay out the phase 2 bracing. Without exact phase 2 bracing, reliable phase 2 forces acting on phase 1 could not have been developed.



Above: 3D X-steel model of the framing for Phase 1, looking primarily at the south façade. Transfer trusses (pink) at the top (15th floor) prepare the project for the construction of a future office tower.

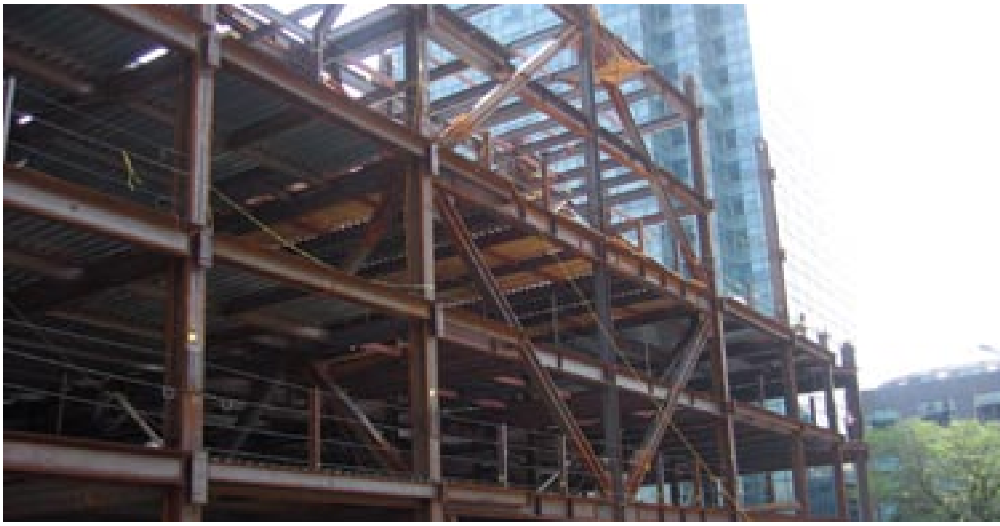
Below: Transfer trusses transition the columns from the future office tower to the columns of the podium structure.

The east façade of the tower is skewed and sloping, while the south façade is curved. The columns in these tower façades are at 30 ft on center and do not align with the podium below. In order to support the east façade, four columns in the podium were adjusted to fall in line with the intersection line of the tower's east façade and the 15th floor. From the 15th to the 16th floor (a double-height mechanical floor), a sloping transfer truss was designed to transfer the six tower columns to four podium columns. The south façade required sloping three columns, the most dramatic of which sloped 6 ft horizontally over 27 ft 4 in. vertically. The sloping columns were accommodated within the outrigger trusses. The outrigger and southern tower columns within the podium were located on a straight line drawn from the southern tower columns to the core columns from which the outriggers emanate. The floor plans allowed for column location flexibility in the east-west direction.

Auditorium

During the design phase, the owner chose to add an auditorium on the second floor of the phase 1 building. To create a column-free auditorium, one interior column had to be removed. Different options for carrying the gravity load from the third-floor column were investigated. One option included adding a transfer truss on the third floor, but the truss decreased headroom to an unacceptable level. The selected option included the removal of the column throughout the full height of the building. To accomplish this, an 83-ft long, W44×262 girder was added on each floor to span the longer distance. The benefit of this scheme was the 80-ft by 83-ft column-free zone created on each floor.

The W44 girders were each fabricated with a 2¼-in. camber. Although concerns were expressed about "ponding" at the center of the spans and about the accuracy of the camber, survey results after the concrete pour showed that the specified camber resulted in a level slab of uniform thickness.



Structural stub-outs on the west side of the structure await the construction of phase 2 of the podium.

Foundations

Long Island City is founded on glacial sediment over bedrock. As a consequence of the thickness of the sediment varying significantly from east to west across the site, the foundations under the new and future phases are different. In fact, phase 1 is supported on three different types of foundations. Spread footings on 3 tons per sq. ft soil support the lower podium columns. Due to their higher loads, the tower columns are supported on spread footings bearing on 40 tons per sq. ft rock or 120-ton piles, depending on the rock depth.

Coordination

The developer authorized the creation of a three-dimensional detailing model (using Tekla's X-steel package) in order to get a head start on the steel shop drawing process, and steel detailers were subcontracted during the design phase in order to develop the model. Three primary benefits resulted from this effort. First, time was saved in the fabrication schedule, because a fully developed X-steel model was already available upon award of the steel contract. Second, the bid phase period was shortened, since the steel bidders were provided with the model. Third, the data that the detailer needed to create the model were incorporated into the design drawings, resulting in minimal RFIs during construction. MSC

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Software
ETABS
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