HL23

Unique Geometry Grows Wider as it Goes Up

By Stephen V. DeSimone, P.E., LEED AP and Ahmed M. Osman, P.E.

DeSimone Consulting Engineers was an Outstanding Award winner for the HL 23 project in the 2011 NCSEA Annual Excellence in Structural Engineering Awards Program (Category – New Buildings $10M to $30M).

Developed by one of Manhattan's most progressive developers, Alf Naman, HL23 is a 14 floor condominium tower that responds to a unique and challenging site directly adjacent to the High Line at 23rd street in New York's West Chelsea Arts district. Partially impacted by a spur from the elevated tracks that make up the High Line superstructure, the site is 40 x 99 feet at the ground floor. The site and the developer demanded a specific response from the design team, yielding a solution that is a merger between given parameters and architectural ambition. For the team, the most important question was how to expand the possible built floor area, given the impact of the High Line on the site and the restricted zoning envelope. The project architect, Neil Denari responded to the unique site restrictions by reversing the architectural setback for which New York is famous. HL23 rises up from a small footprint adjacent to the High Line and actually grows wider so that portions of the tower lean out over the park itself. This allowed the developer to maximize the amount of floor area built, and resulted in a dramatic sloping of both the South and East façades.

In New York City, demand for new luxury residential product continues to be strong. The favored method of construction for most residential buildings is cast-in-place, reinforced concrete slab. However, due to the unique geometry of the building and the desire for large column free spaces, steel was the economical and efficient material of choice. Floor beams are composite and, in order to maximize ceiling height, the intermediate beams were eliminated in favor of implementing shored slab construction. Deep, long span composite metal deck of 6 inches was used and shored until the concrete achieved the desired strength. At the upper floors, the maximum beam/girder span is over 30 feet creating dramatic units.

The building slopes east from bottom to top, creating a large, cantilever over the Highline Railway. This cantilever was achieved by utilizing a diagonally braced perimeter frame. The columns on the west side of the structure are in net tension under gravity loading. The columns are anchored into a 3-footmat foundation system, and further stabilized by (12) – 1⅜-inch diameter, double corrosion protected high-strength steel anchors to rock.

In addition to the bending moments due to gravity loads, many of the steel floor beams resist axial loads created by the outward sloping steel columns of the diagonally braced perimeter system. As an added level of redundancy, steel reinforcement bars were placed inside the concrete slab and mechanically spliced at specific locations to hold the columns back and drag the horizontal forces back to the main lateral resisting system. In some cases, where it was difficult to achieve a direct load path, (2) – 1½-inch steel tension rods inside a 2-inch PVC sleeve were anchored from the outward sloping column to the main lateral resisting system and cast within the slab thickness.

The building's main lateral force resisting system is a steel plate shear wall (SPSW) system. While the system has never been used in New York City, it proved to be both structurally effective and economical. The east-west dimension of the building at the base is less than 25 feet wide, and any reduction in structural dimension was beneficial to the floor layouts. Using ⅜-inch thick plates, instead of wide flange diagonal brace members, freed up an extra foot of useable floor area between the columns that made up the ends of the brace frame. In addition, the SPSW system is considerably more stiff then a braced frame. The added stiffness and strength was critical for this building given the demands created by the gravity and lateral overturning forces. A SPSW system typically takes longer to erect than a conventional braced frame. DeSimone worked with TG Nickel and Associates (General Contractor) and Breton Steel (Fabricator) to develop a system of prefabricated shear wall panels, with integral columns and beams. The perimeter of the plate was continuously welded on three sides in the shop. The prefabricated panels were shipped to the site and spliced in the field. This process ultimately saved a considerable amount of time and reduced the construction time over what would have been expected for a conventional braced frame.

The second component of the lateral system is comprised of diagonally braced brace frames located on each of the building elevations. In addition to lateral loads, the perimeter braced frames are part of the gravity system as well. The braced exoskeleton members are 8-inch diameter double-extra strong pipes at the North, South and part of the East façade; HSS 10x5 tubes on the West façade and 6 x 4 back-to-back angles on the remainder of the East façade. DeSimone and project architect, Neil Denari, incorporated the pipe elements into the building architecture and exposed them on the façade and in the residences. The detailing of these elements was heavily scrutinized. In addition to standard AESS (Architecturally Exposed Structural Steel) specifications, the nodes of the system have been designed with an exposed single 1½-inch diameter pin connection. The final building aesthetic embraces the pipe and the connection details both on the façade and in the interior of the units.

The HL23 project is a testament to the versatility of steel and showcases the ability of the Owner, Architect, Structural Engineer, and Contractors to work together to achieve inventive solutions to the challenges of a difficult and unique site.▪

Stephen V. DeSimone, P.E., LEED AP is the President and the Chief Executive Officer at DeSimone Consulting Engineers. He served as Principal in Charge for HL23. He can be reached at ***stephen.desimone@de-simone.com****.*

Ahmed M. Osman, P.E. is an Associate at DeSimone Consulting Engineers. He served as Project Manager for HL23. He can be reached at ***ahmed.osman@de-simone.com****.*