LINCOLN SQUARE EXPANSION

BELLEVUE, WA

Authorized reprint from: December 2015 issue of the PTI Journal

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Bellevue, Washington State's second-largest city, continues to blossom into a vibrant, world-class community. The much-anticipated Lincoln Square Expansion (LSE) is the newest addition to Kemper Development Company's Bellevue Collection, which consists of separate mixed-use complexes of office, residential, hotel, retail, and convention space. When construction is completed in 2017, LSE will expand the Bellevue skyline with two 450 ft (137 m) towers, a five-level podium, and six levels of subterranean parking, totaling 2.6 million ft^2 (241,540 m^2).

The 41-story hotel/residential tower will feature a W Bellevue with 245 guestrooms in the lower 14 levels and upscale rental residences in the upper levels. The 31-story office tower will feature Class-A premiere office space with views of the city, water, and mountains. Both towers will sit atop a podium featuring retail shops and chef-inspired restaurants. The subterranean parking, which will be connected to additional parking garages at The Bellevue Collection via tunnels, will add over 2200 parking spaces on six levels.

The hotel/residential tower is a cast-in-place concrete structure with a mix of one-way and two-way post-tensioned slabs. The office tower and podium are framed in structural steel. Concrete shear walls resist seismic loads for both towers and the retail podium. The subterranean parking structure features one-way post-tensioned slabs with wide-shallow post-tensioned beams to achieve ultra-long floor spans and user-friendly parking.

LSE is an excellent example of how innovative structural design can respond to demanding architectural programs and still meet cost and schedule targets. The architectural design called for large, open space with minimal columns, in spite of four different structures and five different uses. The structural design of the hotel/residential tower and subterranean parking for Lincoln Square Expansion used post-tensioned concrete to provide an innovative solution to a complex architectural program.

LONG, EXPANSIVE FLOOR SPANS

Long-span beams created column-free internal spaces and a flexible parking layout while reducing substructure cost. Instead of the typical practice of using short-span framing at the parking levels beneath a high-rise building, a system of one-way slabs and wide-shallow beams with post-tensioning was used in the subterranean parking to modulate with tower columns above, creating column-free bays of 30 x 50 ft (9 x 15 m) throughout the six-level subterranean garage and 30 ft (9 m) spans at the hotel/residential tower above. This provided open and spacious parking by eliminating many interior columns that would have otherwise been required, and allowed use of standardized formwork throughout the garage.

SUBTERRANEAN POST-TENSIONED SLAB SHRINKAGE CONTROL

The subterranean parking structure was constructed prior to the perimeter basement walls. Post-tensioned parking slabs were allowed to cure and shorten prior to construction of the walls, which were shotcreted against the shoring system after completion of all six subterranean levels. To control shrinkage and elastic shortening, 3 ft (0.9 m) wide closure strips were incorporated into the slab design throughout the garage. The use of post-tensioned slabs below grade created a system which will remain nearly crack-free. It also reduced the floor-to-floor height with thinner slabs and shallower beams, resulting in lighter foundations and reduced excavation depth.

REDUCED GRAVITY LOADS AND SEISMIC MASS

Post-tensioned flat-plate construction resulted in thinner concrete slabs and less dead load/mass, which decreased lateral forces under seismic ground shaking. This also reduced slab reinforcing quantities, facilitated faster construction, and cut down on labor.

HOLLOW STRUCTURAL SECTION DEFLECTION COLUMNS

CKC incorporated two-way post-tensioned slabs and hollow structural sections (HSS) as deflection columns in the hotel/residential tower, creating 14 ft (4.3 m) long hybrid cantilevers on both the north and south ends of the hotel using only 8 in. (200 mm) thick PT slabs. This hybrid system allowed stripping of formwork prior to installation of the HSS columns. Further, cantilevered outrigger beams

were incorporated into the hotel/residential tower slab design to lengthen slab cantilevers and preclude the need for additional columns.

HIDDEN UTILITIES

Water supply and most building utilities were placed in the post-tensioned slabs. This eliminated the need for dropped ceilings in the units, thereby maximizing floor-to-ceiling heights.

STEEL FIBER-REINFORCED CONCRETE

For the seismic system, performance-based design (PBD) provided a means to implement the use of steel fiber-reinforced concrete (SFRC) in shear wall coupling beams, which included 341 of 392 coupling beams in the hotel/residential tower and office tower. The use of SFRC eliminated all diagonal reinforcing bars—the bars that create extreme buildability challenges in conventionally reinforced coupling beams—and significantly reduced the quantities of remaining reinforcing bar. The result was a simple and buildable system that eased reinforcing bar congestion, facilitated faster construction, and reduced steel tonnage.

SLOPED COLUMNS

To eliminate transfer beams, CKC incorporated sloped columns in the hotel/residential tower as the building transitions from the parking structure through the retail podium and into the hotel.

COLUMN CONCRETE PLACEMENT AT SLAB

In the hotel/residential tower and parking levels below, an innovative detail allowing column concrete to be placed continuously through the slab eliminated the need for concrete puddling around the columns. "Stayform" was wrapped around the column ties to restrain slab concrete. The column concrete was then placed in the column core, providing the continuity of strength required. Shear-friction reinforcement was added through the joint to supplement the connection strength.

Owner: Kemper Development Company, Bellevue, WA
Structural Engineer: Cary Kopczynski & Company (CKC), Bellevue, WA
Architect: HKS Architects, Dallas, TX/Sclater Architects, Seattle, WA
Contractor: GLY Construction, Bellevue, WA
PT Supplier: Central Steel/Harris Rebar, Tacoma, WA