

## **Kinects** Seattle, Washington

Kinects is a state-of-the-art tower located in the Denny Triangle, one of downtown Seattle's fastest growing neighborhoods. The 550,000 square foot project includes 356 apartments, upscale retail, and four levels of parking above grade, with four additional levels below. Three sides of this 41-story tower taper gently outward as the building rises. As a result, Level 39 is approximately 50% larger than Level 8, creating more rentable square footage at the top of the building where views are best and rents highest. Construction started in early 2015 and finished in 2017. The project achieved LEED Silver certification for its sustainable materials and advanced design.

Kinects signature structural system includes:

**High-Strength Concrete and Reinforcing Bar** Kinects utilized high strength concrete and high strength reinforcing bar to improve structural performance and enhance constructability. A concrete strength of 12,000 psi was specified for tower columns up to Level 8 to reduce the column sizes, allow fewer and smaller columns, and increase the leasable floor area. This also allowed sizes to be kept constant nearly full height, which maximized formwork productivity. Further, Grade 80 reinforcement was used for all tie steel in columns and shear wall boundary elements, as well as in shear wall coupling beams. Grade 80 was also used in the mat foundation for all flexural reinforcement. This synergistic use of high strength concrete and high strength rebar reduced the overall steel tonnage, minimized rebar congestion, and reduced field labor.

**Performance-Based Seismic Design** Through a peer review process, the Structural Engineer used nonlinear analysis and performance-based design to develop a seismic system consisting of a single core extending from the foundation to the roof. This proved ultraefficient, both in terms of material usage and spatial requirements. Seven pairs of earthquake ground motions specific to the site were used to analyze the building performance in a major seismic event. Compression-only concrete struts were utilized in the non-linear analysis model to approximate soil / structure interaction below the core, and enable an accurate assessment of soil effects on the tower.

**Sloping Tower Columns and Efficient Post-Tensioned Slab Design** Kinects slopes gently outward on three sides, resulting in increased floor area at upper levels of the building where views are best and rents highest. To achieve this design, ten columns on the expanding sides were slanted approximately six inches per level. A consistent reinforcing layout was maintained by cantilevering the slab twelve feet at each floor and increasing the interior back-span as the floor plates grew. This helped keep slab bending moments reasonable, while facilitating a repeatable reinforcing layout with only minor variations in rebar and tendon layout above Level 8.

The floor system consists of 8" thick two-way post-tensioned slabs, with five 18" deep outriggers extending 8'-0" from the sloping columns. The outriggers helped extend the slab cantilevers to twelve feet at the perimeter. The optimized slab design eliminated additional internal columns, which resulted in open and spacious interior layouts, and maximum floor to ceiling heights.

Post-tensioned slabs were used at all levels, including the subterranean parking. Shotcrete perimeter basement walls were constructed after stressing of the subterranean slabs, while tower construction continued. The delay between basement slab and wall construction allowed unrestrained slab shortening, resulting in a nearly crack free subterranean garage.