From Office-to-Condominium
The Park Monroe

Adaptive Reuse of the 55/65 E. Monroe near Chicago's Millennium Park

Park Monroe from Millennium Park (Courtesy Goettsch Partners, Inc.)

By Terry McDonald, S.E., P.E. and Homa Ghaemi, S.E., P.E.

Often times building owners and developers are not fully aware of the possibilities when considering renovations for their properties. With the help of structural engineers, the reserve strength of the building structure can be utilized for dramatic effects. This was the case with the Park Monroe at 55/65 E. Monroe in Chicago, Illinois. Overlooking downtown Chicago's beautiful Millennium Park, the Park Monroe was renovated from an office building to a mixed-use office and luxury condominium building. Once dubbed a "graceless hulk" by a 2006 Chicago Tribune article titled *Edifice Wrecks*, the building was transformed taking advantage of its location and unobstructed views of Lake Michigan and Millennium Park (*Figure 1*).

Built in 1972, 55/65 E Monroe is made up of 8-to10-inch thick light weight concrete flat slabs supported by 33-inch x 33-inch interior columns and closely spaced 12-inch x 24-inch perimeter columns. The lateral force resisting system consists of several 12- to 16-inch thick shear walls. The lower level of the building houses commercial space and a 9-story, 300,000 square foot parking garage. Above the garage, office levels extend to the roof level. The Park Monroe renovation consisted of converting the top ten office floors to condominium units, which required numerous structural tasks.

Figure 1: Balcony view of Lake Michigan and Millennium Park.

Figure 2: The existing two-story space at the 48th floor where the original cooling tower was placed. This tower and supporting structure were demolished to allow for the new 49th floor.

New 49th Floor Structure

Originally, the south half of the 48th floor was a two-story open space where three large cooling towers were located (*Figure 2*). The cooling towers were removed to make room for an entirely new 49th floor with 10,000 square foot of space for a swimming pool, hot tub, fitness center, and landscaped outdoor terraces. The reserve strength in the existing structure allowed a substantial amount of load to be added without reinforcement. The logistics of transporting construction materials to the top of the occupied high-rise building in the heart of Downtown Chicago were studied by the General Contractor and the design team, and cast-in-place concrete was selected as the preferred material. This decision was driven by the fact that use of structural steel would have necessitated transport via the existing freight elevator. However, the limited size of the elevator would have required numerous splices in 30-foot long steel beams.

The swimming pool which contained about 12,000 gallons of water was framed out with cast in place concrete beams. To make the beam to existing column connection, a concrete haunch with threaded "U" rods and a plate washer was designed (*Figure 3*). To avoid the reliance on epoxy anchorage for the sustained tension of the top steel reinforcing bars into the existing columns the beam was assumed to be simply supported on this haunch.

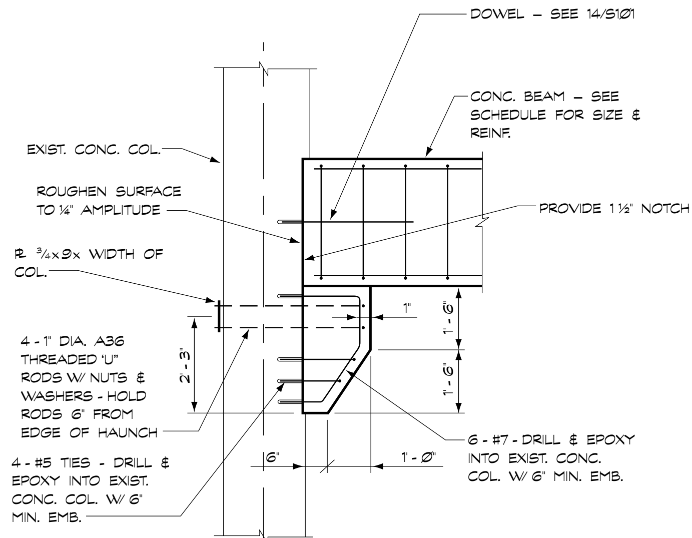

Figure 3: New concrete support beam below new swimming pool. Note the cast haunch and plate washer at back side of existing concrete column.

The outdoor terrace, with up to 3 feet of soil in the landscaped areas, had a combined service load reaction of 250 kips at each slab to existing column connection. To transfer this large load to the existing columns, shear collars were designed which relied on a combination of shear friction and a 1½-inch bearing around the perimeter of the column (*Figure 4, page 28*).

Increasing Floor Capacities for the New Use

In an effort to increase the load carrying capacity of the 10-inch 2-way slabs, 3-inch lightweight structural bonded overlay was utilized. This occurred at several areas: 1) the north end of the 49th floor, where the use changed from office (70 pounds per square foot) to outdoor terrace (100 pounds per square foot); 2) the roof of the 50th floor mechanical level where a portion was upgraded to 100 pounds per square foot for an outdoor terrace; and, 3) the second floor office space (70 pounds per square foot) to the tenant storage room (125 pounds per square foot). In all of the above cases, the structural capacity was increased effectively by taking advantage of the existing bottom steel reinforcement and the additional top steel reinforcement in areas of negative moment. This is not always the case as, often the additional weight of the overlay or floor height restrictions eliminate this approach to increasing capacity. As surface preparation was key to ensure proper bond between the existing 10-inch slab to the new 3-inch structural overlay, construction documents and specifications dictated strict and clear instructions to prepare the surface, based on the guidelines by International Concrete Repair Institute (ICRI). These guidelines include roughening the surface, wetting the substrate to provide a saturated surface dry (SSD) condition at the time of placement, application of a neat sand cement slurry, and proper curing procedures.

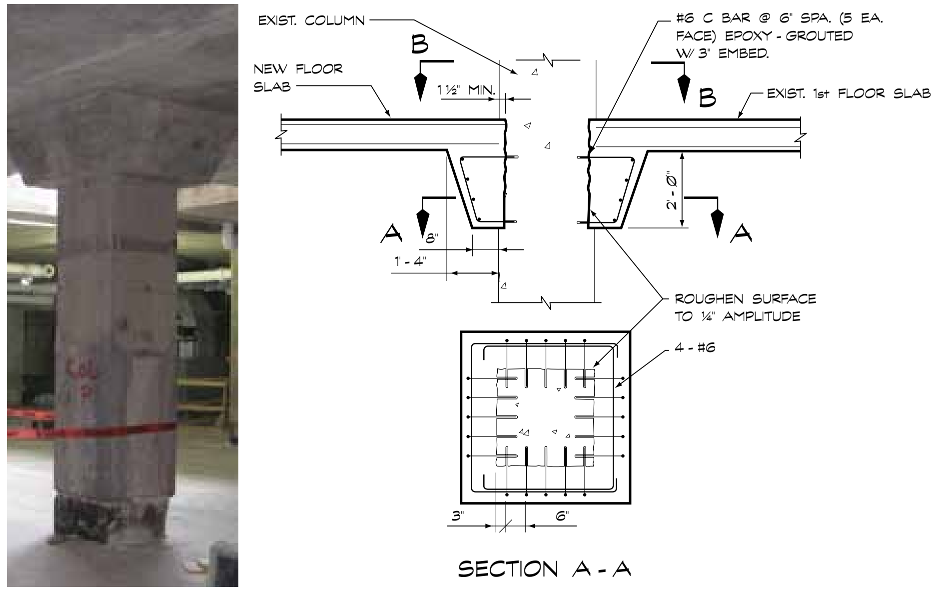

Figure 4: Shear collar connection at new 49th floor slab to existing concrete column interface.

Large Openings in Slabs and Walls

To provide additional outdoor space for the residents, large openings were made in the roof slab at the north half of the 49th floor. The openings, which ranged in size from 19 feet by 9 feet to 19 feet by 17 feet, were strategically placed to avoid column strips. The resulting unbalanced moments at columns increased the punching shear at several locations. To increase the punching shear capacity and to avoid an underside concrete shear collar for aesthetic reasons, u-shaped reinforcing steel was drilled through the slab on all four sides (*Figure 5*). The additional steel pushed the critical shear section away from the column and thus increased the capacity. This analysis was completed similar to shear stud reinforcement in new construction.

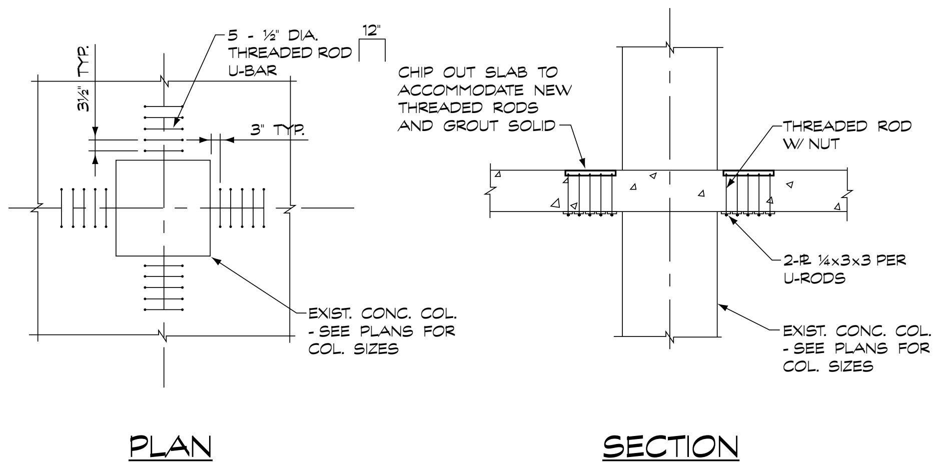

Figure 5: Additional shear reinforcement detail to increase the punching shear capacity due to the unbalanced moment created by new roof openings.

The redesign and upgrade of the mechanical systems necessitated large duct penetrations through the existing 12- to 16-inch thick concrete shear walls. A finite element structural analysis model was developed to evaluate various locations and configuration of new openings in the shear walls, and their effect on the structure's lateral force resisting system. The mechanical engineer was provided with a list of preferred locations by the Structural Engineer of Record for the new openings, which helped accelerate the design and coordination process and minimized the effect of the mechanical upgrades on the structure's lateral system.

One of the major challenges of this project was that it took place while 40 floors of office and retail space below were occupied. All construction materials were lifted by using the freight elevator which limited the length of the steel reinforcement to 12-foot long sections. In addition, the weight limit on the freight elevator resulted in 1,600 round trips for the concrete buggies alone. Needless to say, careful review of the reinforcing steel shop drawings was necessary with the high number of splices.

By employing various methods of strengthening, the architect and developer were given the freedom and versatility to "dream up" significant changes and deliver an exceptionally unique urban living experience. The new residents can truly live by the lake as they take advantage of all that Downtown Chicago business, theater and shopping districts can offer.▪

Acknowledgements

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