

Rehabilitation of Wheaton Center Apartments

WHEATON, ILLINOIS

SUBMITTED BY KLEIN AND HOFFMAN, INC.

Wheaton Center Apartments is a complex of six buildings and three parking garages built in the mid 1970s. Due to severe deterioration and structural issues, the owner undertook a major \$19 million rehabilitation to revitalize the complex. The Tower 2 Exterior Façade Repair Program represents the centerpiece of the rehabilitation which also included the major rehabilitation of three (3) parking garages and the unique repair and lifting of Building 6.

Tower 2 is a conventionally reinforced concrete flat plate structure rising 20 stories with sawtooth textured exterior columns/walls and 380 semi-circular cantilevered balconies with sliding glass doors. Each cantilevered balcony is wrapped with a partial height concrete knee wall and a steel railing atop. There are 228 apartments for a total of 243,000 ft² (22,575 m²).

Building 6 is a three-story residential apartment building with one-level of below grade parking. The wood framed residential levels are supported by a conventionally reinforced concrete podium which encloses the parking garage. The podium is made up of a 7 in (178 mm) concrete slab with drop panels supported by interior concrete columns and perimeter foundation walls.

Problems that Prompted the Repair

Tower 2 exhibited extensive signs of advanced concrete deterioration throughout the façades, including spalled concrete, exposed and corroded reinforcement, cracking, and significant honeycombing in the sawtooth flutes (Fig. 1). The cantilevered balconies also exhibited severe signs of distress, as many were improperly pitched and collected water (Fig. 2).

The most common causes for these deficiencies were: misplaced reinforcing; poor quality concrete; poor drainage; presence of chlorides in the concrete; and the formation of cracks that provide paths for moisture to reach the embedded reinforcing steel. Continued deterioration of the reinforcing steel



Fig. 1



Fig. 2

coupled with inadequate maintenance resulted in the vast extent of repairs needed and diminished structural capacity of the balconies.

Extensive delamination and corroded top side reinforcing at most of the apartment interiors was also identified. Shoring was previously installed in 2009 at numerous balconies to support the most severely deteriorated slabs and balconies.

To accommodate the owner's needs for the concrete repair work to be completed in one construction season, an aggressive and cost-effective Work Plan was developed.

At the Building 6 center tier, the first floor structural slab had deflected over 5 in (127 mm) which resulted in cracking of the slab, large cracks in

finishes (tile, drywall, etc.) and very perceivable slope within several apartment units and the main corridor. The cause of the deflection was determined to be a combination of poor construction and inadequate design of the structural slab. To compound this issue, embedded PVC drain lines were leaking which resulted in significant spalling and delamination of the top and bottom of the concrete slabs. Through a thorough site investigation along with a detailed structural analysis using design modeling software, it was determined that the slab was continuing to deflect (Fig. 3) even after temporary stabilization measures were completed several years ago. Several of the apartments were vacated due to the situation. Given the above issues, demolition of the entire apartment structure was considered.

Unique Project Challenges

Engineering Issues

Tower 2

- Anticipation of the structural challenges within the bid documents by providing necessary structural information for bidders to account for temporary bracing and shoring of the columns and balconies (Fig. 4);
- Analysis of severely deteriorated columns and walls at the 7th floor for phased full depth concrete column repairs to prevent the need for full building height shoring;
- Correcting balcony drainage issues by consideration of pitch and long term creep for newly formed balconies; and
- Developing field investigation, repair quantity estimates, and bid/construction documents in an aggressive three-week timeframe.

Building 6

- If the building was able to be salvaged, could the slab be lifted and supported permanently; and
- Providing the Contractor with jacking and concrete repair sequencing guidelines to assure the jacking would not affect the adjacent concrete repairs.

Contractor Issues

Tower 2

- Sequencing construction which would allow tenants to move in during the construction at completed floors;
- Coordinating as many as 100 workers simultaneously;

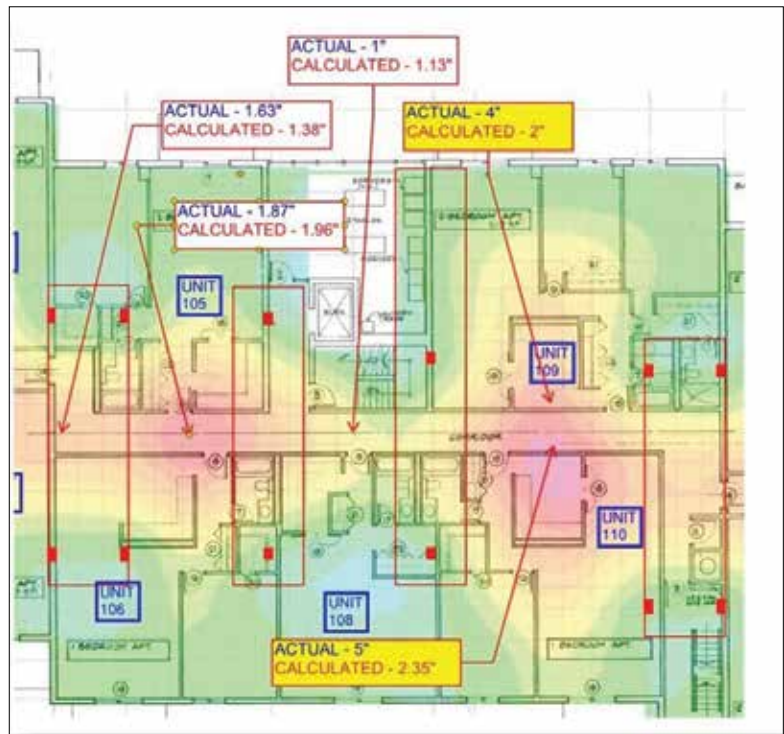


Fig. 3



Fig. 4

- Delivering ready-mix concrete vertically 20 stories for balcony and floor placements;
- Matching the aesthetics for the exterior sawtooth column/wall rebuilds;
- Ensuring safety by minimizing overhead work near adjacent workers; and
- Strictly maintaining the project schedule.

Building 6

- Designing a temporary jacking system to lift the slab to an acceptable level; and

- Completing the work in coordination with the interior contractor prior to the scheduled tenant move in.

Owner Issues

Tower 2

- Removing all tenants from the building to allow the contractor both interior and exterior access to perform repairs;
- Minimizing loss in rental income during the project as each month the building is unoccupied, approximately \$400,000 is lost in rental revenue;
- Coordinating the interior unit remodeling work in conjunction with the exterior façade work; and
- Allowing for tenants to move in at upper floors that have been completed while still allowing the contractor access to elevators and interior work areas.

Building 6

- Remove all tenants from the building to allow the Contractor to jack the building up and perform concrete repairs.

Restoration Program

Tower 2

Upon commencement of the façade rehabilitation project, the owner vacated all 228 rental apartments to provide uninhibited access to the interior of the building. Pipe-frame scaffolding was also erected around the entire exterior of the building to allow the work to be performed in a top-down manner. Approximately 5 floors of scaffolding contained working decks due to the weight limit of the pipe-scaffolding.

Repairs began at the upper five floors of the building and proceeded downward. Once one floor was completed, the deck was moved down to a lower floor where repairs would then continue. This method allowed for the upper floors to be completed first, providing the owner with units that could be rented as the work continued on lower floors.

Extensive concrete repairs were required at both the exterior and interior portions of the building, with some slab repairs extending as far as 20 ft (6 m) into the interior of units. 91 full balconies were replaced due to the extent of deterioration (Fig. 5). The typical replacement balcony required approximately 6 cy (4.6 m³) of ready-mix concrete and a team of over 15 to transport, place, and finish the concrete.



Fig. 5

Given the irregularity in size and pattern of the sawtooth texture, custom wood inserts/formwork were made for each repair location. Ready-mix concrete was delivered to the upper floor repair locations via crane and hydraulic lifts (Fig. 6).



Fig. 6

Significant repair was required at the corner of the building due to ongoing cracking and water infiltration. To reduce the possibility of new cracks forming at the exterior surface of these repair locations, a vertical control joint was routed into each building corner repair, providing a weak plane for cracking to occur. The routed joint was then filled with sealant, covered with a trowel applied compound, and painted over to provide a seamless visual appearance at each building corner.

The completed project included 7,000 ft² (650 m²) of column/wall repairs; 4,000 ft² (372 m²) of concrete slab repairs, with large portions extending

into the unit interiors; 9,500 galvanic anodes installed to provide passive cathodic protection to mitigate the “halo-effect” where reinforcing extended into parent concrete; 30,000 ft² (2787 m²) of pedestrian coatings were applied to the balconies, and exterior concrete surfaces were coated 100% with an acrylic coating (Fig. 7). New aluminum sliding glass doors were installed and detailed to prevent moisture penetration. An epoxy-based overlay system was installed at balconies with ponding water to improve drainage.



Fig. 7

slabs were anticipated for removal, which created two story unbraced columns, the LDP provided lateral loads and bracing locations for stability of the building as well as a more accurate scope of work for the prospective bidding contractors.

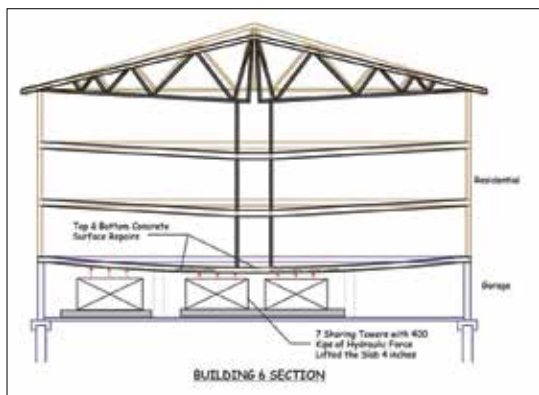


Fig. 8

Building 6

The 7 in (178 mm) thick slab was hydraulically lifted 4 in (102 mm) with seven heavy-duty shoring towers and 21 unified hydraulic jacks (Fig. 8) that induced 400,000 pound-force (1,779,290 Newton). Shoring towers were supported on an 8 in (204 mm) thick reinforced pad which floated on the asphalt pavement. The structural engineer was on site during the lifting process to observe and improvise as necessary.

Over 20,000 lbs (9072 kg) of steel framing was installed to the underside of the slab after being lifted. 100 core holes were drilled above the beams where through bolts were installed to create composite action between the steel and existing concrete slab for stiffness.

After shoring was released, the slab deflected 1 in (25 mm) for a final total deflection of 3 in (76 mm) which was within acceptable design guidelines. Topside concrete slab repairs in the bathrooms and bottom side shotcrete repairs were completed after the shoring was released.

Use of the ACI 562¹ Concrete Repair Code

Per ACI 562, the licensed design professional (LDP) is to determine where shoring or bracing is necessary to maintain global and individual member capacity and stability. At locations where entire

References

1. ACI Committee 562, “Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings and Commentary (ACI 562-13),” American Concrete Institute, Farmington Hills, MI, 2013, 59 pp.

Wheaton Center Apartments

OWNER

Draper and Kramer

Chicago, IL

PROJECT ENGINEER/DESIGNER

Klein and Hoffman, Inc.

Chicago, IL

REPAIR CONTRACTOR

Berglund Construction

Chicago, IL

MATERIALS SUPPLIERS/
MANUFACTURERS

Sherwin-Williams

Schaumburg, IL

J.E. Tomes & Associates

Blue Island, IL