CASE STUDY

VAN NESS EAST CONDOMINIUM GARAGE AND PLAZA REHABILITATION

The Van Ness East Condominium is a 12-story L-shaped structure that was built in the mid-1960s. The building features a two-level below-grade garage and plaza. The garage and plaza structure is nested inside of the L-shaped condominium structure and was constructed at the fourth, fifth, and sixth (lobby) levels of the residential tower. The plaza is approximately 34,000 ft^2 (3160 m^2) in size and the garage levels below are approximately 38,000 ft^2 (3530 m^2). Expansion joints are provided at the transition between the building structure and the plaza/garage structure at the two elevated levels as well as at the lower level slab-on-ground. The garage and plaza were constructed using conventionally reinforced cast-in-place concrete slabs.

Reports of leaks into the garage levels at various locations—including along the expansion joint—and visible concrete deterioration prompted the initial visit that precipitated the need for a survey of the garage and investigation of the existing waterproofing system at the plaza level.

SURVEY RESULTS

A visual survey of the garage and plaza along with intrusive (destructive) sampling of the plaza surfaces was undertaken. A summary of the significant findings is as follows:

- The plaza deck was intrusively sampled in several locations. It was noted that the driveway areas of the plaza, which had a bituminous asphalt surfacing, used a hot rubberized asphalt waterproofing system. The hardscaped portions of the plaza, which typically had stamped concrete (Baumanite) surfaces, used what appeared to be a flood coat of Type 1 asphalt waterproofing. No drainage board or migratory layer had been installed and entrapped water was encountered in the areas sampled.
- The waterproofing detail at various membrane transitions, such as the numerous slab folds, slab penetrations, the fountains, the expansion joint, and planter area, were in poor condition.
- The existing expansion joint waterproofing between the plaza structure and building was fabricated from a copper sheet using a bellows-

Plaza and landscaping before rehabilitation

Deterioration and staining due to failure of existing expansion joint

type flashing that spanned the opening. Due to years of thermal movement and improper detailing, the joint failed systemically. Severe concrete deterioration of the slab edges along the building-to-garage/plaza transition and severe staining was noted.
- The elevated concrete garage deck and garage and plaza soffits exhibited deteriorated concrete (that is, delaminated, spalled, or cracked) and exposed reinforcing steel.

DESIGN REQUIREMENTS/CHALLENGES

During the initial phase of the design process, it was determined that the best methodology to address the leak issues as well as to expose, evaluate, and repair the structural deterioration was to perform a removal of the plaza overburden down to the structural deck; rehabilitate the concrete structural deck; and then install a monolithic waterproofing system with an enhanced drainage design. As part of the engineer's recommendations, the owner was given the option of restoring the plaza finishes to match the architectural intent of the original design or enhancing the plaza with a new plaza greenscape and hardscape design. The owner elected to enhance the plaza with a new design.

The design architect presented several design concepts and invited the input from the general ownership. Once a concept was selected the design was undertaken. The structural concrete rehabilitation and waterproofing design work was developed simultaneously with the architectural design work. The new plaza design rendered by the architect included significant changes to the plaza live loads in certain locations of the plaza as follows:

- Elimination of existing fountains that were formed within the structural deck, and installation of a fountain at a different location;
- Several planter areas were added; and
- The traffic lane was relocated to travel over areas that were previously designed for hardscaping.

During the design process the owner also expressed a desire to make the plaza accessible to fire trucks. The changes listed previously, coupled with the owner's desire to accommodate fire truck access, prompted the need to perform a detailed structural analysis of the plaza structure to determine the as-built structural capacity of the concrete deck. Due to the lack of a complete structural drawing set, a study using ground-penetrating radar (GPR) was commissioned to determine the existing reinforcement placement, spacing, and size. Selective intrusive sampling was also performed to confirm the GPR findings. The results of the GPR survey revealed deficiencies in existing reinforcement which, in turn, prompted the need for structural upgrades in the form of strengthening using carbon fiber as well as the use of lightweight planting materials, significant restrictions relative to fill depths, as well as the locations of certain architectural features and an overall deck load limitation that precluded fire truck access to the plaza deck.

CONSTRUCTION

A significant portion of the plaza and garage rehabilitation involved repair of the structural concrete elements and the installation of polyurethane-based vehicular traffic-bearing membrane on the elevated parking level as well as a hot rubberized asphalt waterproofing membrane on the plaza deck. The contractor performed the following scope of work:

- A predemolition survey was performed to identify all areas of deteriorated concrete. The contractor removed all of the deteriorated concrete in general conformance with project specifications, ICRI guidelines, and ACI requirements. The exposed reinforcement showed signs of substantial corrosion resulting in locations where the reinforcement had lost more than 25% of its cross-sectional area. Supplemental steel reinforcing was installed at those locations;
- Abrasive blast cleaning (SSPC-10) was performed to remove laitance and to clean and prepare the reinforcing steel. The cleaned reinforcement was then coated with a zinc-rich primer;
- Formwork and shoring was erected. The contractor used ready mix concrete as well as bag mix concrete, depending on the application. The repair patches were wet-cured;

Exposed reinforcement during the predemolition survey and concrete preparation

Existing fountain areas were filled in

A hot-applied rubberized asphalt membrane was installed on the plaza deck

A vehicular traffic-bearing membrane coating was applied to the upper-level garage

A new waterproof expansion joint system was installed between the plaza level and the building

- At the existing fountain and canopy areas where the GPR investigation and subsequent analysis had revealed inadequate structural capacities, new carbon-fiber reinforcement was installed at both negative- and positive-moment locations;
- A high-density, lightweight extruded polystyrene board was used to fill the existing fountain areas and the fountains were capped with a concrete topping slab;
- A vehicular traffic-bearing membrane coating was applied to the upper-level garage. The coating was applied to help reduce the water intrusion into the porous concrete substrate, thereby better protecting the steel reinforcement and extending the serviceable life of the garage;
- A hot-applied rubberized asphalt membrane was installed on the plaza deck. The rubberized membrane included a polyester reinforcing fabric sandwiched between two layers of hot rubber. A perimeter turndown and trench drain was installed in certain areas along the driveway transition to help manage storm-water runoff;
- A new waterproof expansion joint system was installed between the plaza level and the building;
- A new waterproof vehicular traffic-bearing expansion joint system was installed between the upper garage level and the building where appropriate; and
- The entire plaza was water tested for 24 hours to meet the plaza waterproofing manufacturer's warranty requirements. Due to varying elevations, a multi-tiered and phased water test with bulkheads was required to affect the various water tests. The expansion joint at the plaza level was water tested separately for 48 hours to achieve the joint manufacturer's warranty requirements.

DESIGN CHANGES DURING CONSTRUCTION

After the project was bid, the contractor was selected, and construction was underway, the owner elected to make significant architectural changes to the plaza hardscape design, which required additional structural analysis and design work during the construction phase of the project. In addition, new design team members were introduced to the project, including an architectural consultant who proposed several material changes to the hardscape design as well as relocation and redesign of the fountain and a fully redesigned steel canopy structure. A local artist was commissioned separately to create a sculpture and water feature that was to be the centerpiece for the plaza. The structural engineering consulting firm was asked to perform in a unique role as the prime consultant. Their responsibilities included taking on the role of coordinator between the various design team members and managing the flow of information/communication between the owner, the general contractor, and the design team.

CHANGE TO THE FOUNTAIN DESIGN

The new architectural consultant rendered a design that was selected by the owner, which significantly changed the shape, size, and location of the fountain. The design changes to the fountain were made after the installation of the new carbon-fiber reinforcement per the original design. Accordingly, this required a reanalysis of the structural deck for the new load pattern. The analysis determined that additional carbon-fiber reinforcement was required. During the design of the carbon-fiber reinforcement, the contractor modified the sequencing of the plaza waterproofing installation work to allow the carbon-fiber reinforcement application prior to waterproofing the affected area.

CHANGES TO THE CANOPY DESIGN

The original architectural design included some aesthetic modifications to the existing canopy. The new architectural consultant rendered a canopy design that included removal of two of the eight existing columns as well as the widening of the canopy roof. This required significant changes to the existing structural framing of the canopy. After short consideration to modify the existing structural steel framing, it was determined that it was more cost effective to demolish the existing steel framing and furnish and install new steel framing. In addition, the footprint of the new canopy roof increased the column loads which, in turn, required additional carbon-fiber reinforcement. A new structural steel canopy design and carbon-fiber reinforcement layout was developed.

The entire plaza was water tested for 24 hours

A sculpture/water feature was designed, built, and installed in the new fountain

ADDITION OF A SCULPTURE TO THE FOUNTAIN

The owner retained an artist to design and build a sculpture/water feature to be installed in the new fountain. During the design of the fountain sculpture, it was determined that the new sculpture would introduce additional point loads to the structural deck, which also required strengthening. The fountain also required installation of several water supply and drainage openings to accommodate the plumbing work associated with the fountain/sculpture. Further analysis of the plaza structural deck was performed and additional carbon-fiber reinforcement was designed. The carbon-fiber reinforcement strip layout was coordinated with the location of the core holes though the slab for the plumbing installation.

OTHER DESIGN MODIFICATIONS

Due to the structural deck weight restrictions, lightweight fill similar to that used on green roofing projects was used to manage the weight restrictions. The planting schedule offered by the landscape design contractor also was customized to accommodate plants and landscaping materials capable of flourishing in the available fill. A special pervious asphalt mixture design was also used to help accommodate drainage in the paved areas to manage water to the underdeck drainage system.

SUMMARY

The Van Ness East Condominium was a challenging garage/plaza project that required a coordinated effort between various design team members and the contractor to address the owner's aesthetic concerns by updating the early 1960s plaza architecture while restoring the integrity of the structure and the plaza waterproofing. The project involved structural concrete rehabilitation work, structural strengthening, application of hot liquid rubberized asphalt membrane, and polyurethane vehicular traffic membranes. The enhanced appearance of the plaza, coupled with the extended life of the plaza and garage, has contributed to produce a successful project, a satisfied owner, and an increase in the property's value.

Van Ness East Condominium Garage and Plaza Rehabilitation

OWNER
Van Ness East Condominium
Washington, DC

PROJECT ENGINEER
Structural Rehabilitation Group
Rockville, MD

REPAIR CONTRACTOR
Culbertson Company of Virginia
Manassas, VA

MATERIAL SUPPLIERS
Carlisle Coatings and Waterproofing
Wylie, TX

Sika Corporation
Lyndhurst, NJ

Plaza and landscaping after the rehabilitation was complete