

BUCHANAN HOUSE PARKING STRUCTURE: REPAIR AND INSTALLATION OF POST-TENSIONING TENDONS

BY RICK HECKEL

Parking is a premium amenity for those living in urban areas. Located in the Crystal City neighborhood of Arlington, VA, the Buchanan House offers residents of the 200-unit luxury apartment complex nearly 600 parking spaces in a below-grade, three-story parking garage. In addition to the luxury residential units, the facility features restaurants and other retail shops on the street level, which results in additional parking needs. The consulting engineer for the project recognized that the post-tensioned concrete structure had begun to experience degradation from water infiltration. Additionally, the use of deicing salts had caused corrosion of the existing button-head post-tensioning system.

A button-head post-tensioning system consists of 0.25 in. (6 mm) wires that are typically assembled in bundles of four to 12 wires per tendon. During

original installation, these bundled wires are fed through a stressing block or anchor. A “button” is then pressed on the end of the wire, which acts as an anchor for the wire during stressing. The stressing block comprises two plates; each plate has holes that correspond with the number of wires to be stressed. The wires are pushed through the holes in the plates. On the opposite side from which they are running, buttons are then pressed on the wires. To stress the wires, a ram is dropped between the plates and they are forced apart. Then, two additional plates are installed between the stressing plates to maintain the required elongation. After this part of the installation, the jack is removed. One of the challenges with this system is that all the wires have to be the exact same length for the system to work properly.



Stressing of post-tensioning cables

REPAIR STRATEGY

A repair contractor who has a strong reputation with this type of repair was contacted by the consulting engineer to work on the project. The repair contractor worked with the post-tension system supplier to select a repair strategy that would require less labor and would be more cost-effective than a complete system replacement. With the goal of restoring the parking garage's structure and improving its appearance, the repair contractor began the project by removing the damaged and delaminated concrete. This was necessary to thoroughly assess the condition of the existing button-head post-tensioning system components.

The parking structure's concrete slab itself was reinforced by a two-way button-head post-tension system. In most cases, repairs were required for most of the four to 12 wires contained in the tendon bundles. Some tendons had numerous breaks along their length that required multiple repairs. Also, there was the unknown of potential damage to the tendons in other locations not yet exposed. The engineer had to determine the forces to stress the tendons, based on these situations that would work through the project. One discovery during the project was a tower crane opening on two floors, which resulted in tendons being pushed out of profile to wrap around the tower crane opening. Additionally, some of the tendons were anchored on the perimeter of the tower crane opening; and in these areas, corrosion had occurred. To repair this area, the concrete infill where the tower crane opening had been located was completely removed. Reinforcement was added and the correct profile was then established for the tendons.

REPAIR CONSTRUCTION

Overall, the repair contractor repaired 387 button-head post-tensioning tendons. To accomplish this, the repair contractor used a proprietary system from the post-tension system supplier that allowed the team to incorporate new monostrand post-tensioning materials without having to replace sections with a completely new button-head system.

This was a unique project because the repair contractor used monostrand and button-head post-tensioning together to regain the forces in the structure. By using the monostrand post-tensioning repair system, the team was able to reduce costs by requiring less labor on the project and decreasing the amount of concrete demolition needed to make the repairs. In addition to the post-tensioning repair, the repair contractor also performed partial and full-depth concrete repair, as well as soffit, wall, column, and beam repairs.

In addition, a corrosion-inhibiting coating was applied to 300,000 ft² (27,870 m²) of the parking garage in two passes and a urethane coating system was



Full-depth hole for new drain installation

installed to 211,000 ft² (19,602 m²). These coatings will increase the service life of the structure.

Safety was also considered at every phase of the project. During application of the coatings, full-face protection masks were used by the crew because the worked occurred in an enclosed area and the high PH level in the material could cause eye injury.

The repair contractor also installed new handrails on the ramps to meet Americans with Disabilities Act (ADA) requirements. To improve the appearance of the garage, the entire structure was painted, including the painting of new parking stripes and directional indicators.

PROJECT CHALLENGES

The project was completed in six dual phases. Each phase was completed sequentially and consisted of demolition, repair, and new concrete pours to fill the repaired areas of the slab. At the end of Phase Six, the repair contractor went back to the Phase One section and applied the corrosion-inhibiting coating and urethane coating system. Then, the repair contractor continued with the coating applications for the remaining phases. This allowed for the project schedule to move more efficiently and allowed for enough time for the concrete to cure prior to the coating application, painting, and other finishing segments of the project.

Dust control was one of the major challenges for this project. The space was completely enclosed, and all exhaust fans were located on one side of the garage. To combat this, the repair contractor created tunnels to draft the dust out of the work area. Again, safety was paramount on this project.

Additionally, because the retail shops were still open and the residential portion of the building was still occupied, the garage remained open during



Installed base coat



Installing coating detail on column

repairs. As a result, the repair contractor had to ensure proper signage was available to direct both vehicular and pedestrian traffic. Only one of the two exits was equipped with a pay station for those who do not have keycard access. During the repairs, a new pay site was established to ensure the retail shop patrons without a keycard could exit the garage. Phasing and scheduling was also crucial on this project, as several other trades were involved. Coordination between the different trades was critical to ensure that everyone maintained their schedules and that there was no downtime between any of the six dual phases of the project.

Work began on this project in December 2006 and was completed in May 2008. Both the owner and visitors to the garage have commented on the visual appeal of the garage and are pleased with the outcome. The project demonstrates how new technology can be used to repair existing specialty reinforcing systems to provide for a long-term and more cost-effective solution for the structure's owner.

Buchanan House Parking Structure

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