

East House Underground Garage Rehabilitation

Washington, DC

Submitted by Restoration East, LLC

The East House Underground Garage was constructed in late 1969 to provide parking for 700 congressional representatives, staffers, and visitors. The below-grade garage has an 87,500 ft² (8130 m²) footprint spanning an entire city block and consists of six parking decks in a split-level layout. The garage is crowned with a street-level terrace consisting of vast lawns; planters; stone; exposed aggregate sidewalks; architectural springhouses; and a fountain providing a public park setting for Capitol Hill staffers, residents, and visitors. The roof of the structure is a precursor to the green roofs of today but with conventional 3 ft (0.9 m) deep soil beds below the planting areas.

By modern standards, where buildings are light and flexible, this robust structure is distinctive for its load capacity. The perimeter is constructed of freestanding, buttressed retaining walls rising out of a matt slab. The elevated parking decks are dense, 10 in. (254 mm) deep slabs supported by corbels at the perimeter foundation walls and interior structural steel columns encased in concrete with shear heads in drop panels. The lowest level is a 6 in. (152 mm) concrete slab on gravel over the matt foundation. There are slab expansion joints traversing the structure with additional joints where the elevated decks, including the terrace superstructure, intersect the earth retaining walls. Longitudinal corbels provide a slide-bearing support at the

perimeter. Stairs, shafts, and plenums were incorporated into the cast-in-place design.

INVESTIGATION

The structure suffered from prolonged and significant water intrusion due to the failing subterranean waterproofing scheme. The owner invested in an exterior waterproofing system repair prior to the award of the interior rehabilitation; however, the leakage had caused significant damage to the perimeter walls, stairs, and supported floors. Originally, the interior face of the walls had received an ironite coating; this had been compromised by water intrusion from the park above.

The owner engaged an architectural and engineering firm to perform a comprehensive condition investigation of the parking garage to determine the extent and causes of the concrete deterioration. The investigation integrated nondestructive chain drag surveying to locate voids with destructive coring to determine chloride ion content and the compressive strengths of the structural concrete. The existing conditions survey also incorporated a mechanical evaluation, electrical assessment, fire protection consideration, and plumbing efficiency evaluation.

The investigation revealed that the deterioration of the concrete slabs and walls was a combined result of the following:



Deteriorated soffit areas identified for repair



Hydrodemolition of deteriorated floor area

2012 Award of Excellence

- Chloride ion levels above the threshold limit for corrosion to a depth of 5 in. (127 mm) below the top plane of the elevated concrete slabs;
- Leakage of the plaza level through the perimeter waterproofing system, causing extensive deterioration to the foundation wall concrete corbel that supports the slab termination;
- Poor material cover over much of the reinforcing steel;
- Active leaking slab cracks, construction joints, and expansion joints;
- Poor slope and lack of drainage on the elevated garage surfaces; and
- Lack of sealer or membrane protection of the garage slabs.

DESIGN AND CONSTRUCTION

A design firm was employed to prepare specifications and design documents for the structural reha-



Prepared repair area with steel replacements



Deteriorated corbel area



Installed steel support angles

bilitation, as well as a complete renovation of peripheral building implements encompassing life safety systems—mechanical, electrical, and plumbing systems and all of the finishes. The contractor was awarded the contract under a best-value procurement. The completed garage repair scope of work included:

- 172,000 ft² (15,980 m²) of wall-to-wall hydro-demolition of the top 5 in. (127 mm) of the elevated slabs with the incorporation of a graded concrete overlay to provide superior drainage to a revitalized storm sewer design;
- 41,000 ft² (3809 m²) of full-depth, 10 to 12 in. (254 to 305 mm) thick slab repairs;
- Repair and modification of the foundation wall corbels that bear the elevated slab perimeters;
- Abatement of asbestos and removal of lead paint;
- Replacement and augmentation of 42 tons (38.1 metric tons) of slab reinforcing steel;
- Concrete repair of walls, columns, curbs, and ventilation shafts;
- Complete evaluation and revitalization of below-grade drains;
- Rehabilitation of the five stairways providing egress to the facility, incorporating concrete repairs, load-transfer improvement, application of membrane, the installation of modern hand railings, and paint finishes;
- Application of traffic-bearing membrane on elevated slabs;
- Replacement of all structural slab expansion joints;
- Installation of a cement-based waterproofing system on the vertical below-grade perimeter walls in the garage and shafts;
- Removal and replacement of the vertical shaft roofing and waterproofing systems;
- Repair and sealing of historic masonry in the shafts and stairwells;
- Removal and replacement of the perimeter seals;
- Improvement of the existing vehicular guardrail system;
- Re-stripping, traffic marking, and curb paint;
- Installation of updated way-finding signage;
- Preparation and painting of walls, columns, ceiling, railings, and sprinkler piping;
- Removal and replacement of the mechanical systems, including the steam system, exhaust fans, and plumbing;
- Refinishing of the historic aluminum overhead garage entrance doors;
- Replacement or revamp of the pedestrian doors and hardware;
- Renovation of interior finishes in the parking garage management/security office;
- Upgrade and reconfiguration of the entire electrical infrastructure, lighting, and power;
- Removal and replacement of the existing fire sprinkler system; and
- Amplification of the fire alarm system.

CHALLENGES

The project team faced numerous challenges during the construction process, including:

1. **A demanding construction schedule**—As this parking garage provides parking for U.S. members of Congress and staffers, it could only be closed for a limited time. The garage was scheduled for complete closure for 1 year—January 8, 2011, to December 31, 2011. Liquidated damages were set at \$15,000 per calendar day. The contractor received the release for construction in December 2010.
2. **Repair of the corbel supports**—The original design for the corbel repair included spot removal of deteriorated areas of the corbel and slab edge. Demolition revealed that proper thermal movement was inhibited and the structure had not been erected per the original design. Uneven slide-bearing surfaces created a restriction, which amplified deterioration with mechanical friction. Additionally, the slab edge was poured short in some areas, providing less than 2 in. (50 mm) of bearing contact with the haunch, which was inadequate for the spans and loads present. Further complicating this portion of the restoration, the corbel and slab edges were on the critical path. Supplementary shoring was shipped in so loading could be transferred down each level to grade. Therefore, complex sequencing was developed to ensure that the large amount of slab repairs could commence and continue while the supporting structure was being restored. After review by the engineer, a revised detail was implemented. The concrete corbels were completely removed and large galvanized steel angles with a slip-bearing surface were bolted to the foundation walls. This provided a faster repair and additional bearing length and allowed for compensation of the existing conditions.
3. **Secure environment**—Given the proximity of the project to the Capitol, the U.S. Capitol Police oversaw the security on this project. All workers were required to go through background checks and were badged for the project. Additionally, all deliveries and vehicles that required access to and around the site had to go through the security screenings at an off-site location and again at the garage prior to entering the facility.
4. **Noise constraints**—Residential neighborhoods and congressional offices surround this garage. The noise levels were monitored throughout the project and the selection of the use of hydro-demolition greatly reduced the overall noise in the surrounding areas. Additionally, the speed of the hydrodemolition allowed for quicker completion of the demolition work as opposed to conventional pneumatic hammer demolition.

5. **Increased scope**—As the demolition work progressed, the true extent of the damage to the facility became evident and exposed a number of unacceptable existing conditions that had to be addressed within the original project schedule.

PROJECT SUCCESS

Even given all of the challenges faced, all of the work for this project was completed ahead of schedule and under the owner's budget. The use of hydro-demolition enabled the contractor to complete all of the concrete removal and repair work within 6 months.

Originally, the project was designed to meet the U.S. Green Building Council (USGBC) LEED Silver guidelines. Ultimately, the team was able to work together to obtain a Gold certification. The project is the only parking garage rehabilitation to obtain a LEED Gold rating from the USGBC. Additionally, this project received a first-place Sustainability Award from the American Society of Civil Engineers, National Capitol Section.



Completed parking garage interior

East House Underground Garage

OWNER
Architect of the Capitol
Washington, DC

PROJECT ENGINEER/DESIGNER
URS Corporation
Washington, DC

REPAIR CONTRACTOR
Restoration East, LLC
Baltimore, MD

MATERIAL SUPPLIERS/MANUFACTURERS
Advanced Polymer Technology
Harmony, PA
Aquafin, Inc.
Elkton, MD