AWARD OF EXCELLENCE

PARKING STRUCTURES CATEGORY

The Phoenician Resort—Post Tension Garage Repair

SCOTTSDALE, AZ

SUBMITTED BY TADJER-COHEN-EDELSON ASSOCIATES, INC.

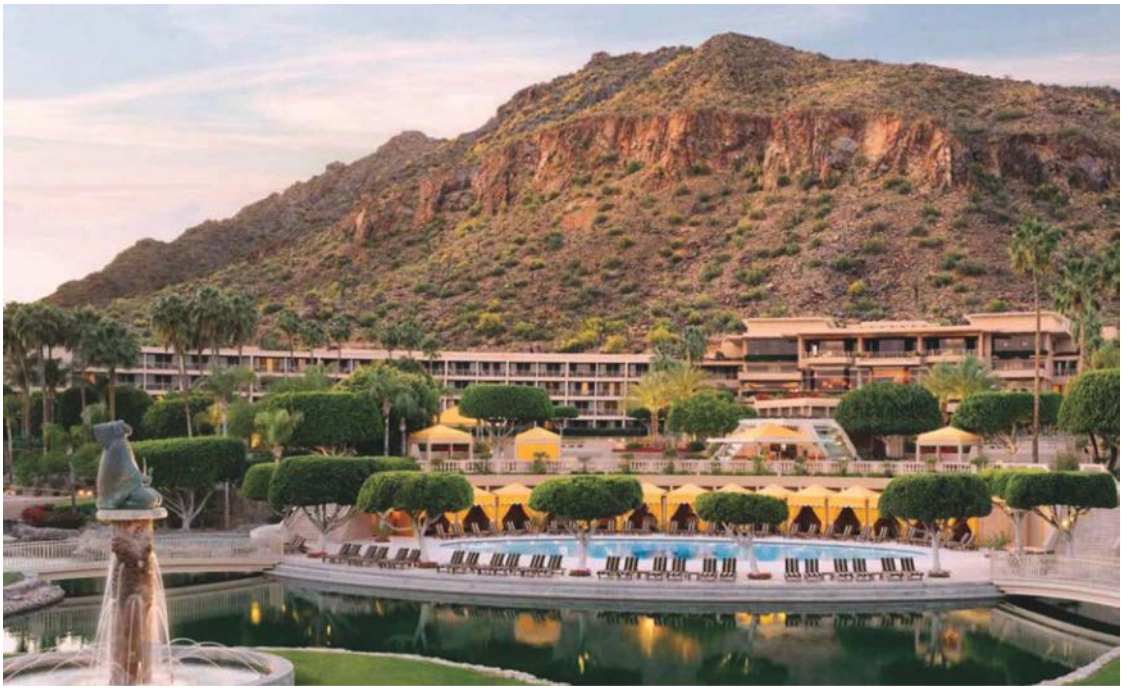

Fig. 1: Phoenician Resort

PROPERTY OVERVIEW

The Phoenician Resort is a luxury resort located in Scottsdale, Arizona. The property is situated on 250 acres (101 hectares) at the base of Camelback Mountain (Fig. 1). The resort was opened in 1988 and is approximately 30 years old. The property contains 643 guest rooms, 11 restaurants, 9 swimming pools, spa facility, 16 tennis courts and a 27-hole golf course. In plan, the main hotel consists of two large curved structures with a connecting segment near the midpoint and low-level ballrooms between the buildings. The hotel is oriented facing in the southwest direction with the nearby Camelback Mountain on the north side. The main hotel buildings are primarily conventionally reinforced concrete structures supported on a foundation containing a combination of grade beams, pilasters, spread footings, foundation walls, and columns and walls bearing directly on bedrock.

GARAGE STRUCTURE

A single-level subgrade parking garage is located below the hotel with the south side of the garage extending beyond the main hotel structure (Fig. 2). The segment that extends in front of the main building has an elevated post-tension concrete slab above the parking level with approximately 6 ft (1.8 m) of soil, landscaping and event space concrete pads above the buried slab. The post-tension slab is 15 in (381 mm) thick, approximately 62.5 ft (19 m) wide and runs the length of the crescent shaped building—approximately 900 ft (274 m). The post-tension cables are 0.5 in (12.7 mm) diameter, monolithic, unbonded cables consisting of seven (7) wire strands wrapped in plastic sheathing. The center segment below the restaurant extends almost to the nearby swimming pools. On the south end of the garage, the post-tension slab is supported on a 10 in (254 mm) wide reinforced concrete foundation wall that extends to the bedrock below the garage. On the north end, the post-tension slab is supported by concrete beams and columns along the expansion joint.

EXISTING CONDITIONS

Prolonged water migration into the subgrade garage caused deterioration of post-tension components and conventionally reinforced concrete beams, columns and foundation walls in the structure. While the desert

climate in the Scottsdale area generates low annual rainfall, the landscaping irrigation system deposits water above the garage on a regular basis. Leakage occurred along the south end of the structure where the stressing end of the post-tension slab bears on the foundation wall. Leakage also occurred along the expansion joint prompting the hotel staff to install a network of collecting pans and drain lines below the garage ceiling to alleviate water stains on cars and dripping water on hotel guests below. The garage started experiencing ruptured post-tension tendons and large cracks on the bottom surface of the slab in recent years.

CONDITION SURVEY

The structural issues prompted an engineering condition survey to evaluate the subgrade garage structure with findings used to develop a repair program. The survey included visual examination of the entire garage structure with exploratory openings within the overburden above the garage in order to ascertain the condition of the concealed structural and water resisting components. An exploration pit at the south end of the garage exposed a portion of the stressing end of the post-tension slab and top of the foundation wall. At this location, the existing surface-adhered "peel and stick" cold-applied sheet membrane was debonded and beyond its useful service life. The membrane conditions allowed water to reach and corrode the stressing anchors. Water also traveled within the protective sheathing causing corrosion and subsequent rupture of the post-tension tendons that was observed in the garage below (Fig. 3).

An exploration pit at the north end of the garage exposed the expansion joint. The same type of sheet membrane was revealed, exhibiting similar conditions. Spalling concrete was observed on the large concrete beams and columns directly below this leaking expansion joint.

REPAIR PROGRAM

A repair program was developed to address garage leakage and restore structural components to their intended original integrity. The most concerning aspect was determining the extent of deterioration that had already occurred to concealed post-tension components. Assessing the entire slab edge and stressing anchors could not take place without removing 6 ft (1.8 m) of overburden and existing waterproofing for the entire length of the structure. The original structural drawings were reviewed to understand the layout and quantity of tendons. The repair program required ongoing evaluation and repair determination during the construction phase, which was scheduled for summer of 2017 to coincide with the replacement of the swimming pools and spa facility at the hotel. The repair program consist of three main components: stressing end repairs, expansion joint repairs, and concrete repairs to members within the garage.

Stressing End Repairs

The project included removal of overburden to expose the stressing end of the slab and foundation wall (Fig. 4). The existing debonded sheet membrane and grout pockets were removed for engineer assessment of the stressing anchors, and components were repaired accordingly (Fig. 5). Corroded anchors required slab openings, locking off the existing tendon, replacement of the anchor, splicing

Fig. 2: Overhead view of subgrade garage

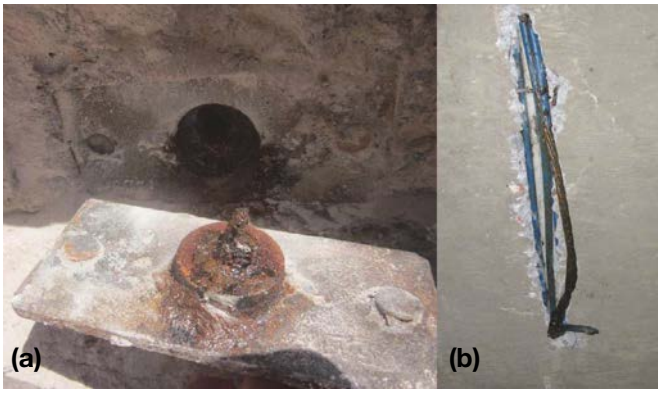

Fig. 3: (a) Corroded post-tension anchor, and (b) Ruptured tendon

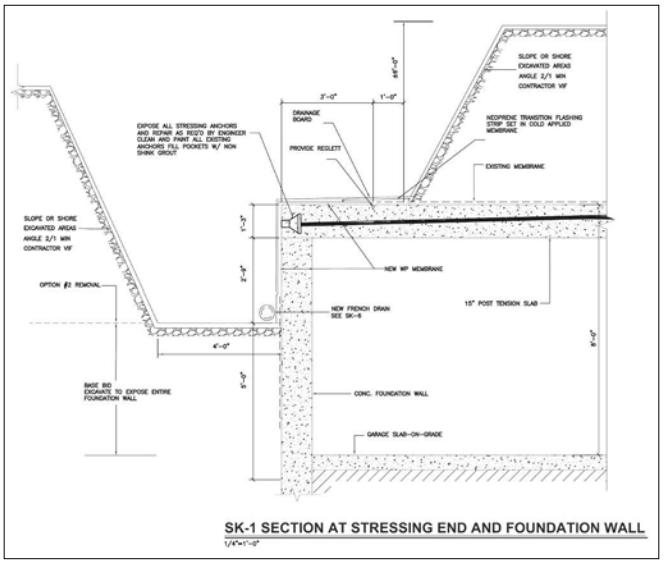

Fig. 4: Section detail at stressing end and foundation wall (repair drawing)

Fig. 5: Post-tension repairs in progress (stressing end)

Fig. 6: New membrane and flashing along the expansion joint and building wall

Fig. 7: Foam blocks and backfilling in progress after completion of waterproofing repairs along the expansion joint

Fig. 8: Completion of repairs with new landscaping in front of the hotel building

to the existing tendon, placing concrete, stressing, and placing new non-shrink grout at the stressing pockets prior to installing new hot applied reinforced membrane on the slab and foundation wall. By the end of the project, over 1,000 stressing anchors were exposed, evaluated and 364 repairs required. Due to the reconstruction of the adjacent swimming pools and spa facility, space to excavate and store soil was limited. In addition, storing soil above the garage utilizing shoring was not feasible due to the hotel using the garage for parking. Therefore, the excavation and repairs had to be performed in four consecutive phases.

Expansion Joint Repairs

This component included removal of overburden to expose the expansion joint and dead end of the slab adjacent to the main hotel building. The existing membrane and joint seals were removed for engineer assessment of the slab and identification of required repairs. A new sloped concrete topping and drainage system were installed to reduce water on the expansion joint. The drainage system included drain pipe cleanouts in the drain piping below the slab and extensions above the drains to allow regular maintenance and clearing at the landscaped area.

The waterproofing repairs included new expansion joint seals and looped flashing sheets over the joint, and hot applied reinforced waterproofing membrane and counter flashings at the slab and building wall (Fig. 6). Upon completion of waterproofing repairs, a drainage layer, expanded polystyrene (foam) blocks, and a 2.5 ft (0.8 m) layer of soil were placed over the slab (Fig. 7). The foam blocks were used to reduce the load on the structure and provide easier access to the expansion joint for future serviceability.

PROJECT CHALLENGES

Various challenges were addressed during the repair project and included restraints from site conditions, strict schedule requirements for completion within a four-month period, the magnitude of repairs, scope complexity, and unforeseen conditions. The completed project is shown in Figure 8. ■

The Phoenician Resort—Post Tension Garage Repair

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