

PRECAST PARKING GARAGES

MAINTENANCE & REPAIR: PART 1

Project Introduction

Precast concrete parking structures are often built for their cost savings and expedited construction schedule, as compared to cast-in-place construction. Structural elements of precast parking structures are fabricated in a manufacturing plant under controlled conditions and are shipped to the construction site where they are assembled to form the parking structure. The factory controlled conditions allow for higher quality concrete compared to concrete cast on site. Despite the several advantages over cast-in-place concrete parking structures, precast parking structures must be maintained on a stricter basis to avoid accelerated deterioration and safety issues.

Flexural elements of a precast structure, typically beams, girders and spandrel panels, are reinforced with steel tendons that are prestressed prior to the placement of concrete. Coupled with the cured concrete, the internal forces from the prestressing help to counteract dead and service loads, depending on the design. This allows for lighter elements and longer spans versus conventionally reinforced elements. Most precast parking structures consist of prestressed double-tee beams, inverted-tee girders and spandrel panels, all supported by conventionally reinforced concrete columns or precast corbeled panels. Embedded steel plates welded to one-another during the assembly process tie together each of the elements to allow the structure to work as a system. Coatings and sealants help to protect these embedded steel elements and stop water from reaching the levels below.



WATER LEAKAGE THROUGH FAILED SEALANT JOINT

Like all parking structures, the structural elements of precast garages are susceptible to the deleterious effects of deicing salts. Inadequate maintenance of the coatings and sealants allows the chloride-laden water to reach the embedded steel elements which exacerbates deterioration. Coatings and sealants used at precast parking structures are typically urethane-based. Urethanes generally have a service life of 5-8 years, depending on maintenance, exposure and use. Coatings have a similar service life, except for paints used at the embedded steel which may last 10 years or longer depending on the type and quality of application.



CORROSION RELATED SPALL AT SHEAR CONNECTION



FAILED SEALANT JOINT EXPOSING A SHEAR CONNECTION

Proliferation of deterioration due to deferred maintenance often results in much higher repair costs and shut-down of the structure. It is best to perform routine walk-throughs and maintenance on precast structures on a monthly basis. Walk-throughs should incorporate the following:

- Inspection of the structural members for any cracking or spalling of the concrete
- Examination for any corrosion based staining of embedded steel
- Inspection of coatings and sealants for any debonding, damage or other distress
- Inspection of expansion joints for debonding, damage or other distress
- Review of all drains for proper functioning
- Review of the levels beneath the top deck for water leakage following inclement weather

Routine maintenance should include twice-annual power-washing of the deck surfaces and localized repair of failed sealant joints. It is recommended to avoid use of deicing salts; however if deicing salts are necessary, use of magnesium-based salts is recommended to lessen the damaging effects. Use of rubber-tipped snow plows is also recommended to avoid damage to the precast elements. This includes ensuring the structure is not overloaded by large vehicles or machinery for which the structure may not have been designed to support. Professional assessment of the parking structure by a Professional Engineer is recommended every 5 years, unless the structure has been neglected or repaired previously where a shorter time-frame of 2-3 years between assessments is recommended.



CORROSION RELATED SPALL AT A SHEAR CONNECTION



FAILED CONCRETE AT A DOUBLE-TEE FLANGE CORNER

Precast parking garages are an economical solution to cast-in-place concrete or steel construction; however with the cost and schedule benefits during original construction comes the requirement for a higher frequency and attentiveness of maintenance. Lack of regular and thorough maintenance is a major safety issue that can result in personal or property damage. As structural engineering consultants, TCE has been involved in the assessment and repair of numerous precast parking structures for many years. Our services ensure a proper, long-lasting repair in a cost effective manner.

In the next segment of this series, we will outline the methodologies used in repairing precast concrete parking structures and provide some examples of completed projects.



FAILED HEADER MATERIAL AND COATING AT AN EXPANSION JOINT



SPALLED CONCRETE AT A DOUBLE-TEE BEAM BEARING LOCATION

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