WHY PLAN FOR PARKING STRUCTURE MAINTENA

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The design of parking structures is extremely complicated in terms of durability, service life, and maintenance, especially when compared to that of an enclosed structure such as an office building. Not only must parking structures be built to withstand the weight of vehicles, but they also need to be able to endure harsh weather extremes, water infiltration, thermal expansion and contraction, dynamic vehicular loading, and depending on the region, de-icing salts, snow plows, and salt mist or rain from the ocean. All of these factors contribute to the deterioration of parking structures at a much faster rate than that of a typical building.

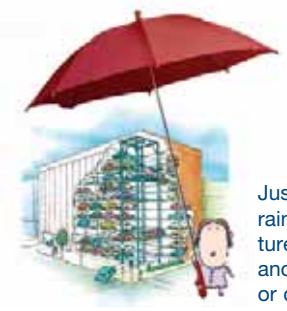
The problems related to parking structure deterioration are serious. A structure that is not properly maintained will result in unfavorable consequences including structural deficiencies, premature concrete deterioration, unsafe conditions for patrons, loss of revenue, and unhappy customers. In addition, today many of the newer parking structures include mixed-use features, and are becoming architectural landmarks in downtown, urban and even university settings. Therefore, the aesthetic concerns which come as a result of parking structure deterioration can significantly damage the perception of the structure, as well as the surrounding area where it is located. Every one of these matters has the potential to disrupt the normal operation of the garage, create a poor impression of the facility, and as a result negatively impact the owner's investment.

Pre-Construction Planning

Effective parking structure maintenance should be implemented early in the design. The type of maintenance that will be required, as well as the frequency it is needed, is influenced by the design of the structure and by the quality of construction. For instance, durability features incorporated during the design and construction of the facility are essential to the long-term maintenance and quality of the facility. These include provisions such as high quality concrete, concrete admixtures, epoxy coated rebar, penetrating silane sealers and elastomeric traffic membranes. Additionally, great attention to drainage design and the methods of concrete placement and curing used during construction are critical to producing durable facilities.

Maintenance Program

The most effective strategy for proactively preventing the many issues that can come as a result of poor parking structure maintenance, as well as to ensure asset preservation, is through the establishment of a comprehensive maintenance program to serve as a guide for successful facility maintenance. Ideally, this program should be developed and implemented from day one of operation, although this is rarely accomplished. However, it is never too late to develop a maintenance program, and the sooner it is in place, the better. The cost of repairs or replacement due to deferred maintenance is much greater than the cost of a developing a proper maintenance program.



Just as we use umbrellas to shield us from rain or UV rays, floor slabs of parking structures are typically protected from chloride and moisture penetration by concrete sealers or coatings.


NCE?

A simple walk through condition appraisal by an experienced parking structure restoration engineer is the first step to determine the state of the structure and the path forward. The engineer will be able to assess concerns associated with the age of the structure, geographic location, structural system, and construction quality. The engineer will provide recommendations based on the findings of the initial walk through condition appraisal, as well as a review of the existing documents, reports, and maintenance records. Depending on the age and condition of the structure, as well as the quantity of existing documents, the engineer's recommendations will likely consist of one or a combination of the following:

- Conduct a more in-depth condition appraisal
- Perform restoration documents for required repairs
- Implementation of a preventive maintenance program

ABOVE: Lack of a maintenance program or deferring maintenance over long periods of time can lead to major structural deficiencies and require costly repairs such as slab replacement.

ABOVE: Structural members that show signs of deterioration such as cracking, corrosion stains, leaking water, leaching, delaminations or spalling should be reviewed by a qualified parking structure restoration engineer.

Typical Types of Deterioration

One of the most important parking structure elements which must constantly be examined for signs of needed maintenance is the structural system. This includes regular inspections of floor slabs, beams, columns, stair and elevator towers, joint systems, bumper walls, and exposed steel. Each of these items must be checked regularly for signs of distress. Some of the most common red flags which are cause for concern and will require attention include:

Cracking – Cracking can be caused by a number of factors including construction-related issues, thermal extremes, structural loads, concrete shrinkage or corrosion.

Corrosion – Corrosion is the deterioration of the metals embedded in the concrete of the parking structure. Corrosion often creates pressure on the concrete, which can lead to cracking, as well as other structural problems. Corrosion is typically caused when deicing salts penetrate concrete and raise the chloride ion content to a threshold that initiates corrosion of the steel reinforcement. Corrosion can also be caused by a process known as carbonation, where carbon dioxide and moisture in the air enter the concrete and reduce the pH of the concrete to a level that initiates corrosion of the steel reinforcement.

Delamination – Concrete delamination often occurs as a result of corrosion of embedded reinforcing. As rust forms, it occupies a greater volume than the steel and creates internal stresses within the concrete. These stresses crack the concrete and create additional avenues for water and salt penetration. Eventually the concrete loosens and delaminates.

Spalling – Spalling of concrete typically occurs as a result of corrosion induced delaminations that break away from the structure. Potholes collect and hold water and salts, which intensifies the deterioration process. Spalling can also be caused by impact, stone popouts, freeze-thaw cycles as well as by extremely high temperatures.

Scaling – Scaling is often seen in structures located in regions which experience cycles of freezing and thawing. When not properly treated, these temperature extremes cause the cement paste on the surface to disintegrate. This can result in creating dents or impressions in the concrete, which can cause tripping hazards, as well as form areas of ponding which will lead to further deterioration.

Leaking – Leaking occurs when cracks or joints within a structure are not properly sealed. This can contribute to many long term problems, as well as drastically speed up the process of deterioration.

Leaching – Leaching is the passage of water through concrete. When this occurs, the cement consituents are dissolved, and can then combine with each other to crystallize on the surface of the concrete. This crystallization, called "efflorescence", can drip onto the vehicles in the structure and cause damage to the vehicle paint and finish.

ABOVE LEFT: Leaking water from poorly maintained plumbing and fire protection systems can cause major structural damage, requiring costly repairs such as beam repair or replacement. ABOVE RIGHT: While pigeons appreciate naturally occurring bird baths, ponding water within parking structures must be corrected as it caused many issues such as accelerated structural deterioration and slip and fall hazards.

Each of these issues has the potential to cause serious problems, which will require expensive solutions. Therefore, it is critical to implement a comprehensive maintenance program from the beginning that concentrates on critical areas.

Critical Issues and Prevention Techniques

The most vulnerable element of a parking structure is typically the concrete floor slab. The floor slab requires the most attention, as it is vulnerable to damage from water, road salts, climate extremes, and wear and tear. The frequency with which the floors will need to be treated will depend on factors including geographic area, concrete quality, the type of concrete sealers or membranes used, the type of corrosion control/prevention measures utilized, and the location within the structure (i.e. high areas of wear and tear including entry/exit lanes, turning bays, and helixes).

Application of a protective sealer or membrane will help to prevent penetration of water absorption, as well as other corrosive elements such as road salts. This is most effective when applied immediately after the concrete has cured. Reapplication of sealers is typically required every 3-5 years, while a membrane can last up to 5-7 years.

Another area which should be regularly examined for needed maintenance is the structure's beams, columns, and bumper walls. These supporting components are susceptible to deterioration caused by water leakage through joints and floor slab cracks, as well as salt water splashed by moving vehicles. In addition, these areas are also vulnerable to vehicle impact, and should be monitored for distress as a result.

Stair and elevator towers can also be at risk due to leaks between the floor slab and the tower. Often poor drainage around the towers will contribute to this. Further, these areas are also vulnerable due to exposure to salt contamination. Often periodic resealing of the concrete surfaces will help to prevent damage.

Every one of these issues has the potential to result in very serious consequences. When one presents itself, it has the ability to result in the development of many more of these problems, creating a chain of problems which become more serious, as well as much more expensive to correct. Each one has the potential to affect the quality, appearance, and even safety of the parking structure. These can drastically change the

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appearance of the structure, creating a negative perception of the garage, and perhaps even the surrounding area. In addition, issues such as water ponding can create slipping hazards, concrete corrosion can result in falling pieces, and the basic structure and strength of the garage can be compromised.

Tasks such as regular concrete sealing, cleaning of drains, proper snow removal and ice control, and even simply making time to regularly clean the structure by picking up trash, sweeping the floors, and pressure washing the parking areas can help to reduce the likelihood, or at least the severity, of developing these problems. This can help to reduce the likelihood of water ponding, as well as reduce the build-up of destructive elements such as road salt and dirt.

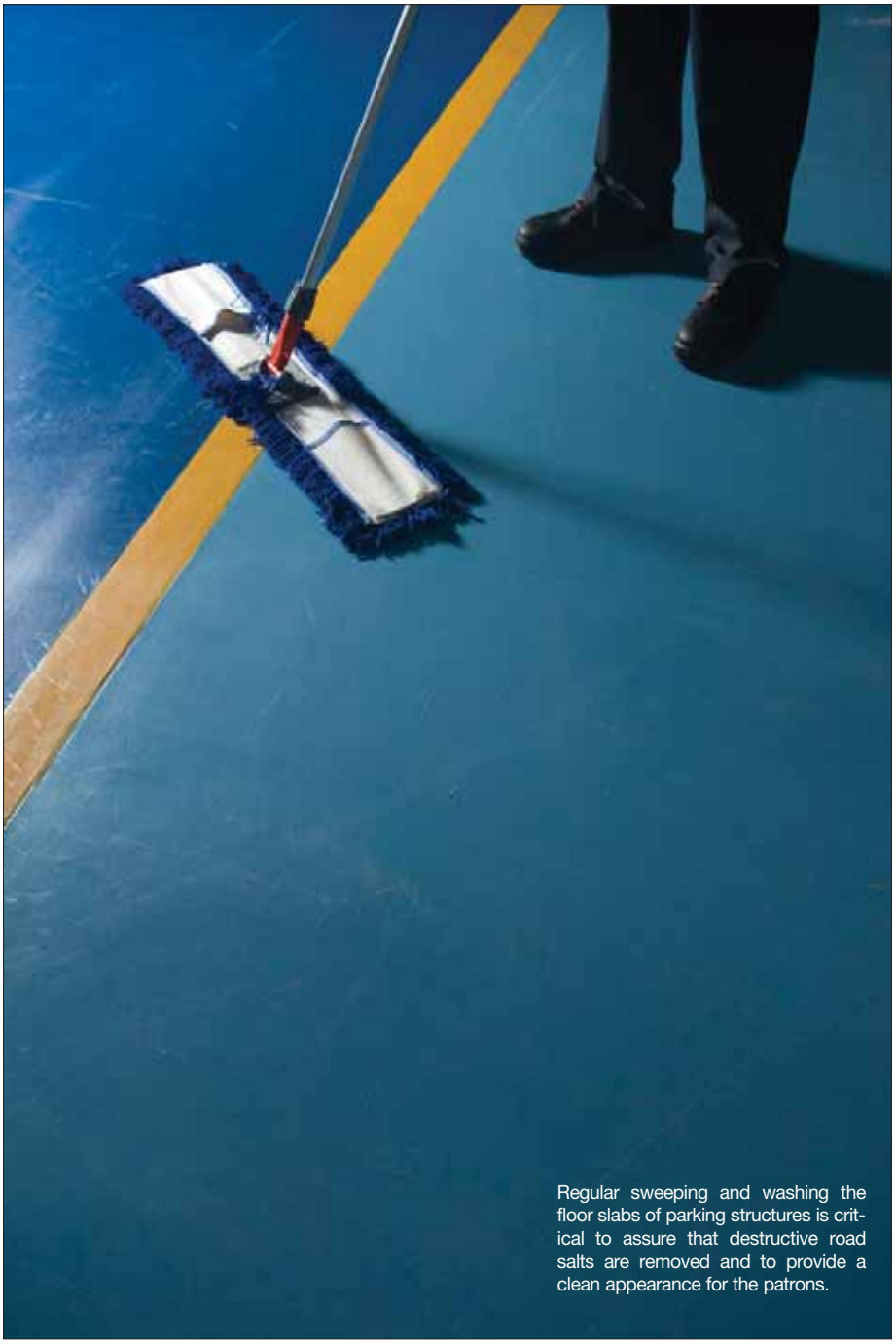
Parking structures are unique facilities, designed to withstand particularly harsh conditions compared to most buildings. Given the unusual challenge of withstanding not only extreme weather conditions, but dynamic loads as well, these structures must be thoroughly maintained. Utilizing strategies to make sure maintenance needs are taken care of early is the best way to not only ensure the quality of the facility, but also to avoid situations where substantial and costly maintenance becomes necessary.

Budgeting for Maintenance Needs

An effective maintenance program is a relatively inexpensive way to proactively approach parking structure issues. The costs associated with correcting the problems that come as a result of poor maintenance, as well as those associated with the potential liability of neglecting these issues, are outstanding compared to the costs of prevention. However, it is still important to appropriately budget for these preventive tasks. Often owners do not budget funds for these tasks from the beginning, which is the reason they may be overlooked.

Another reason that adequate funds are not usually set aside is that it can be difficult to assess the cost of preventive maintenance. Therefore it is a good idea to bring in an experienced restoration specialist to review the structure at the beginning, in order to appropriately budget for the anticipated structure maintenance cost.

To many, maintenance seems like a minor issue compared to the design, operation, and management of a parking facility, but the need to keep the structure in the best condition possible is of equal importance. In addition, as parking structures continue to be incorporated into more active mixed-use environments, designed to be more architecturally pleasing, and often serving as a "gateway", giving patrons a first impression of an area, it increases the need to make sure the facility is of the highest quality and safety, as well as serves as an attractive and inviting place of community. ■



Regular sweeping and washing the floor slabs of parking structures is critical to assure that destructive road salts are removed and to provide a clean appearance for the patrons.

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