

PROACTIVE MAINTENANCE TODAY, FEWER HEADACHES TOMORROW

A CASE STUDY OF THE BERKS COUNTY PARKING GARAGE MAINTENANCE PROGRAM

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Many owners and consultants know that proactive maintenance on their facilities can help to dramatically reduce the headaches associated with the costs, time, and maintenance issues that will result from putting off maintenance for too



Fig. 1: Berks County Services Center office building with underground parking structure

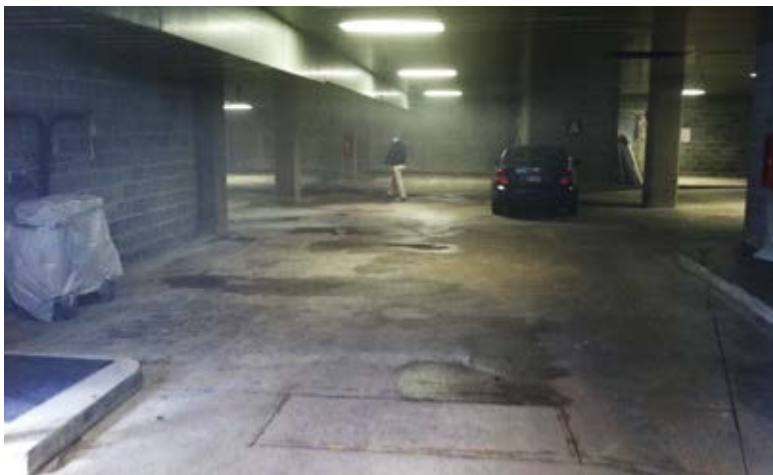


Fig. 2: Underground parking structure

long. However, as is the case in many situations in life, sometimes what seems so simple is easier said than done. Time slips away, money and resources get allocated to other needs, and suddenly you find yourself 10 to 20 years down the road and realize that the certain steps that should have been taken were not, and now the situation is more serious than it needed to be.

The county of Berks, PA, recently faced a similar situation. The county recognized the critical need to evaluate their 20+ year-old parking structure, which had deteriorated over the years due to lack of proper attention. The initial construction of this facility faced many upfront administrative and technical challenges, resulting in a final product that was below industry standards for new construction. Furthermore, as with many parking structures of this age, a comprehensive repair and maintenance program was not in place since construction. This combination is a recipe for disaster, as the condition of the facility declined at a more rapid rate than is anticipated for a parking facility. As a result, the county retained a parking expert familiar with new construction and restoration of parking structures to evaluate the facility.

On top of the issues already facing the project (the initial construction issues coupled with the years of little attention and repair), the structure in question is fairly complex in itself. The Berks County Services Center is a 16-level office building built in the early 1990s, featuring four levels of underground parking (Fig. 1 and 2). Housed within the parking area are segregated parking areas for police booking as well as judges' parking. Additionally, the parking structure consists of filigree construction that incorporates a snow-melting system at the main entrance.

In spring 2011, the county's facility and maintenance personnel quickly realized that the parking garage, which serves as the foundation of the entire facility, was on a fast track to disaster without a comprehensive repair and maintenance program. They set out to undertake a large restoration project to repair the issues seen throughout the garage and

restore the facility to a quality condition. The county recognized the many restoration needs required throughout the garage, and they allocated the appropriate funds to sufficiently restore the facility, as well as took steps to appoint new personnel to manage and maintain their facility. This new step toward the proactive asset management of the facility showed a renewed commitment from the top down to restore the condition of the garage and transform the facility into a more attractive, safe, and welcoming facility for employees and visitors of the courthouse.

Extensive investigative testing revealed that significant structural improvements would be necessary to address the root cause of the garage deterioration. Specifically, core (Fig. 3) and field testing confirmed the following key issues:

1. Chloride levels in the concrete were high. The need to minimize future penetration of chlorides was a necessity to the longevity of the structure. Using non-chloride-containing deicing chemicals such as sodium acetate or calcium magnesium acetate will ameliorate the situation. However, preventing chlorides from penetrating the concrete's surface with a traffic deck coating provides fail-safe (and superior) protection.
2. Petrographic (microscopic examination of concrete) results indicated microcracking in the upper 1 in. (25 mm) of the concrete surface. Microcracking provides channels for chlorides to reach reinforcing and accelerate corrosion. Providing an elastomeric traffic deck coating will bridge these microcracks and prevent chlorides from penetrating the concrete surface.
3. Cover meter (a device designed to locate embedded metallic items in concrete [Fig. 4]) readings and test pits (Fig. 5) confirmed that structural reinforcement was not properly installed, resulting in overstress of beams and excessive deflection. The need for supplemental structural reinforcement was deemed necessary to support the structure properly and avoid overstress of structural members.

Excessive cracking of concrete surfaces led to the accelerated deterioration of embedded structural reinforcement, and ultimately excessive deflection and spalling of the concrete. The surface cracking created direct pathways for salts/chlorides to reach embedded reinforcement. To holistically repair the parking garage and ensure that the repairs would stand the test of time, it would be necessary to prevent salts/chlorides from further penetrating concrete surfaces.

One of the larger issues discovered during the initial site visit was the excessive cracking at the midspan of numerous filigree beams. The subsequent investigative work was critical to properly assess the cause(s) of these excessive cracks. Cover



Fig. 3: Concrete cores for investigative testing

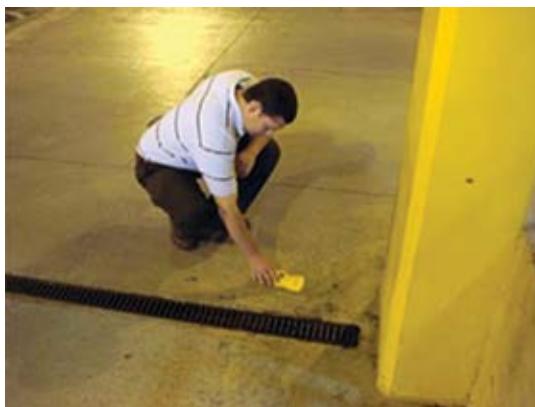


Fig. 4: Cover meter reading near column



Fig. 5: Investigative test pit near column

meter readings and test pit excavations revealed that the top reinforcement at the beam supports was installed lower than designed, and in some cases, nearly 3 in. (75 mm) lower than designed. This condition reduced the beam's moment capacity at the supports, causing overstress to the beams at midspan. Refer to Fig. 6 for a visual aid to depict this phenomenon.

To address this condition, it was determined that additional top reinforcement would be necessary to supplement the beam's ability to transfer the required moment. Various options were explored; however, it was determined that near-surface-mounted carbon-fiber reinforcing would provide

the most economical solution to supplement each beam's moment capacity.

While construction issues were apparent in the initial parking garage construction, a major factor leading to the ongoing issues in this garage was the lack of proactive maintenance for many years. As a result, an important component of the project involved reviewing various options with the county to determine the most cost-effective long-term maintenance plan to address salt/chloride penetration into concrete surfaces.

Ultimately, the county decided to follow the recommendation to install a traffic deck coating on

the entire supported floor slab surface to prevent future chloride penetration (Fig. 7). While initial costs would be higher with the application of a traffic deck coating (as compared to a traditional silane sealer application), the long-term costs would be significantly less considering the slab replacement and/or demolition that would eventually be necessary for the sealer option or continued apathy.

The repair program also addressed long overdue life safety, structural, durability, and aesthetic improvements. Some of the existing conditions requiring repair included deteriorated concrete, trench drain repair, cracked piping, exposed electrical conduit, and flaking paint at sprinkler piping. The county understood that these repairs would improve aesthetics and the patron experience (make their employees happier), while minimizing their own personal liability (improved structure and reduced potential for slip-and-fall). What's more, the implementation of these repairs would put money back in the county's pockets in the long run.

Once the necessary repair items and estimated costs were determined, the next consideration was phasing for the implementation of the repairs. To offset some of the higher initial costs, the project included the development and implementation of a repair program over several years with minimal impact on day-to-day use of the facility. However, the county opted to go with the higher initial costs and implement the gamut of repairs in one shot.

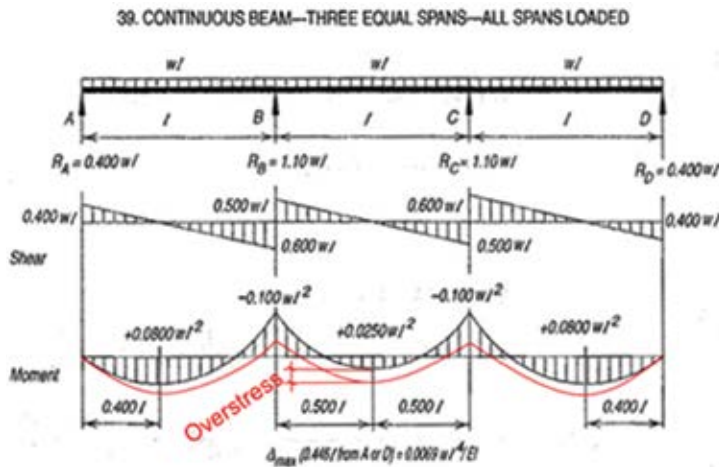


Fig. 6: Table 3-23, AISC Steel Construction Manual Thirteenth Edition, 2006

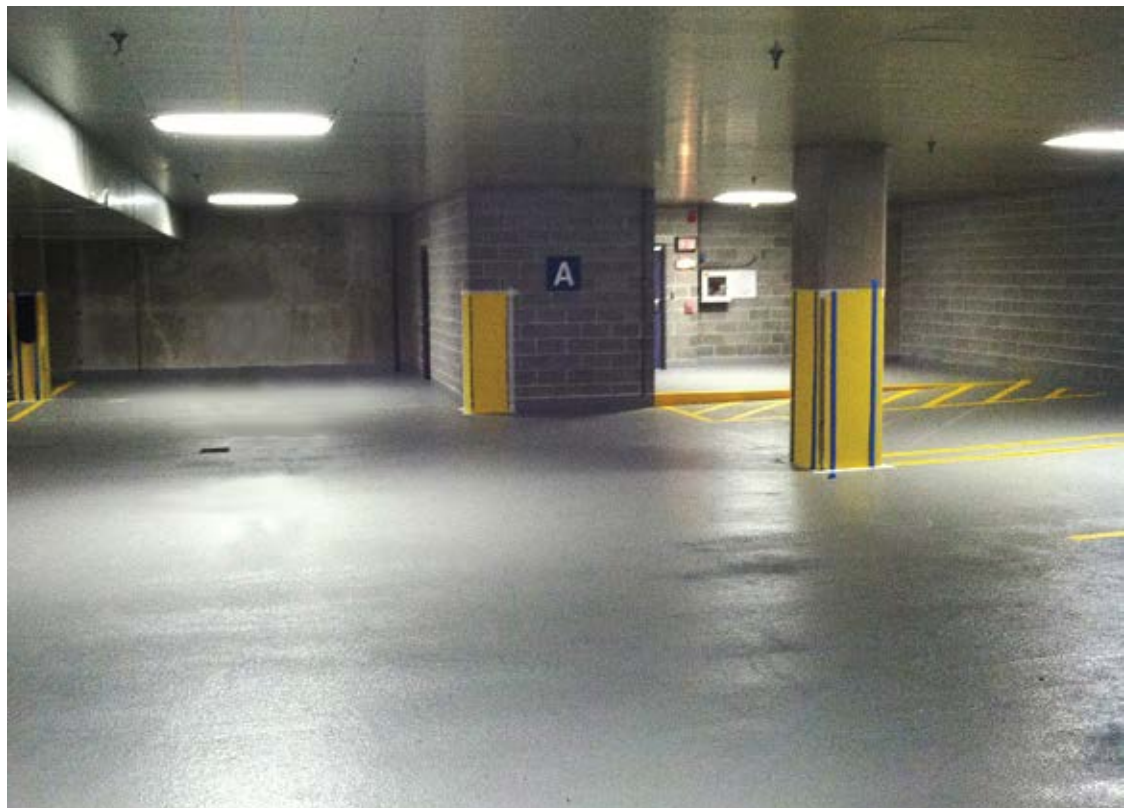


Fig. 7: Traffic deck coating on supported slab

This resulted in a more seamless repair operation, while minimizing potential headaches created by a phased repair program over several years. Further, a single repair approach ultimately resulted in cost savings due to a single mobilization versus several.

One drawback to implementing the repairs all at once was that the county would need to temporarily relocate the parking within the facility to complete the repairs. This amounted to approximately 330 spaces serving employees and visitors. Fortunately, the county was able to secure parking for their employees at a reasonable rate from the adjacent parking authority.

With all of the pieces in play, the county was able to complete the necessary repairs in fall 2012. The county performed a 1-year review of the implemented repairs in fall 2013 and the findings were positive. Only minor additional repairs were needed, as was to be expected with a routine and preventive maintenance program. The county has further implemented these minor additional repairs and has taken the necessary steps to stay on top of the required ongoing maintenance of the parking facility.

The proactive approach has worked well for the county in recent years, as they have experienced

first-hand the headaches that come along with deferred maintenance. As a result, they are seeing the benefits from happier visitors and employees, lower annual repair cost, and a more attractive facility overall.

Recently, the county also undertook a major façade renovation project for their 16-story office building. Currently, the county is undergoing a major renovation of the plaza area above the parking garage just outside of the office footprint. Repairs will likely be completed in summer 2014.



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