Parking Structures Category

Detroit Metropolitan Airport Blue Deck Parking Structure Restoration

Romulus, Michigan
Submitted by Carl Walker, Inc.

Detroit Metropolitan Airport Blue Deck Parking Structure

The Blue Deck Parking Structure provides parking for approximately 5500 cars at the Detroit Metropolitan Wayne County Airport. It was constructed in two phases: the six-story East Deck in 1992 and the four-story West Deck/Flyover in 1993. The East Deck had its own internal traffic flow and ramping system. The West Deck/Flyover has speed access lanes, providing parking to all four supported levels and the six levels of the East Deck.

In 2006, restoration commenced on the West Deck rooftop with the installation of a special concrete overlay. In 2008, the remaining lower levels and stair towers were repaired and a complete new signage system installed.

The project included 170,000 ft^2 (15,793.5 m^2) of bonded concrete overlay and 190,000 ft^2 (17,651.5 m^2) of deck coating membrane.

PROBLEMS THAT PROMPTED REPAIR

The structure received nominal maintenance during its first decade of service; by early 2000, it was exhibiting aggressive surface deterioration on the roof level and localized damage at other interior parking levels. Floor surface spalling, freezing-and-thawing damage, joint sealant failure, and precast connectors failure were evident at numerous locations.

The deck surface experienced significant failure of connectors, causing movement of double-tee elements throughout the structure. Original connectors experienced problems associated with original construction methods, tolerances, and welding procedures and operationally with exposure to abnormal snowplow loads.

INSPECTION AND EVALUATION

The investigation included review of the original contract documents combined with a field survey that consisted of the following:

- Conducting visual observations and nondestructive chain-dragged testing;
- Performing materials sampling (core extractions and testing);
- Obtaining measurements of joint widths and related conditions;
- Recording areas of surface ponding and related distress; and
- Obtaining relevant information on drainage systems.

An evaluation of information and data obtained indicated that certain construction deficiencies, combined with the lack of effective maintenance and the use of aggressive snow removal practices, was contributing to premature deterioration of the deck, especially the roof level. Other serviceability and long-term maintenance issues were identified for both immediate repair and follow-up maintenance action.

REPAIR PROJECT

Two separate repair protection systems were designated for use on this structure. The first was a latex modified concrete overlay used in conjunction with supplemental mesh reinforcing and stitch (reinforcing) rods; the second was a vehicular deck coating system again combined with supplemental stitch rods. Structural repairs to the concrete tees,

both localized along expansion joints and targeted around drains, were completed before the overlay and deck coating were installed. Additional shear transfer beams were also installed (beneath roof level expansion joints) to replace original devices.

This project was on a fast track. Numerous planning meetings were held with airport staff to coordinate all work and lay out a critical path. The phasing and staging of the restoration work allowed for continuous operation of the parking structure.

The restoration was completed in three phases: West Deck rooftop in 2006, East Deck roof in 2007, and the lower parking levels in 2008. Zones were identified throughout the structure capturing 750 cars per zone and allowing 4750 available spaces throughout the restoration program. This involved capturing areas on the roof and on corresponding spaces directly below the work site so debris did not fall in an occupied area.

A new terminal was scheduled to open in the fall of 2008. The initial restoration of the West Deck focused on those areas that would be impacted most heavily by the new terminal and ground transportation construction activities.

A schedule was established that permitted the completion of all major repair work on the rooftop in advance of construction start-up for the Transportation Center and adjacent parking structure. By sequencing the roof-top repairs, the West Deck restoration did not conflict with the new terminal and new parking deck construction activities.

Scheduling of the project was provided on a double-shift basis, proving to be more cost efficient and productive. Only at isolated locations was work done either off shift, after hours, or on weekends.

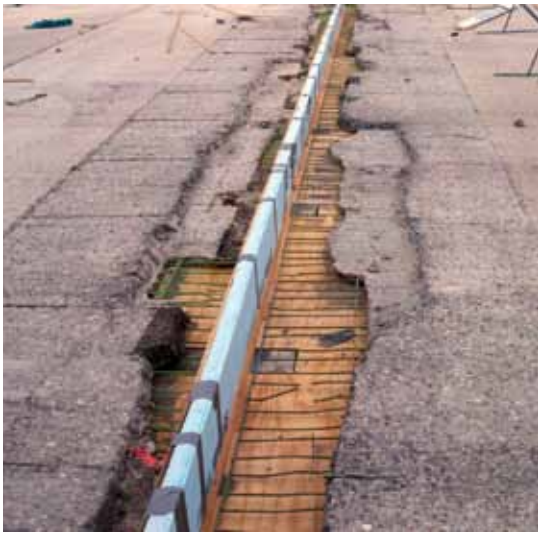
Rigorous methods, including a 6 ft (1.8 m) high chain link fence, were installed around all work sites with gates, chains, and locks to prevent pedestrian and vehicular movement into construction zones.

Special steps were taken during surface grinding to limit dust migration by using fogging and to minimize dust spread by using tarps or limiting sandblasting operations. Water jetting was used as a supplement to sandblasting, either for the removal operation or for the final surface preparation.

OVERLAY INSTALLATION PROCEDURES

Latex-modified concrete was used because of its excellent durability and long-term excellent bond characteristics. The 6000 yd^3 (4587.3 m^3) required a site concrete batching operation. The overlay was installed in strips perpendicular to the tee flanges to provide maximum grade control and improved drainage throughout the roof structure. This resulted in a pond-free parking and walking surface. New joints were tooled into the fresh overlay directly above existing flange joints for subsequent sealant installation.

Significant failure of connectors causing movement of double-tee elements throughout the structure



Structural repairs to the concrete tees were completed before the overlay and deck coating were installed

Special steps were taken during surface grinding to minimize dust spread by using tarps

Supplemental reinforcing, in the form of stitch rods along with additional mesh reinforcing, was used to provide extra strength at those locations where the original connectors could not be repaired. New combined drains were reconfigured and installed to promote better drainage.

The flange-to-flange connector failures were restored by monolithic bonding of the new overlay with a wire mesh-reinforcing layer. Shear-wall rooftop connectors were reinforced during the

Roof deck with reinforcement in place and overlay to be installed

Car fire on the roof of the repaired structure in November 2006

overlay process. Offending drains in the immediate vicinity of shear walls were relocated to permit better drainage and avoid future deterioration. The deck was essentially leak free following construction due to 100% replacement of the original joints sealant system.

REPAIR PROCESS EXECUTION

Debris removal was performed off peak traffic to minimize congestion. Cranes removed rooftop debris to the lower level without interfering with normal operations.

Intensive preplanning with airport staff minimized contractor reconstruction interference with pedestrian movement and normal facility operations. Concrete was hoisted to the roof with cranes to avoid movement of materials through the deck. This proved highly effective at reducing any conflict between construction and operation activities.

Widespread failures of existing connectors required reconstitution and supplanting them with additional reinforcing. The design detailing integrated these procedures with overlay installation. Drain basin reconstitution, which involved strengthening the concrete around the drain, was also performed. Special supplemental reinforcing reconnected shear walls to the structural tee system.

Low volatile organic compound (VOC) deck coatings were installed around the stair towers. In no instances were fumes or odors a problem during construction. On the rooftop, large areas of vehicular deck coating were installed where structural damage was minimal. At designated rooftop locations with isolated connector failure, latex concrete overlays were used after stitch rod installation, mesh reinforcing, and the repair of the original connectors.

The design focused on performing necessary refitting of original connectors and the addition of supplemental reinforcing steel in several key locations throughout the structure for capacity improvements. A latex-modified concrete overlay was used on the West Deck and portions of the East Deck to provide added surface protection and reduce the incidence of future deterioration. Where lesser degrees of damage were encountered, a vehicular deck coating system was used.

Existing stair tower features were upgraded with mesh grill work along handrails and new caulking to correct isolated leaking. Stairwell glass enclosures also required panel refitting and major recaulking to restore the weather-tight envelope. In addition, several trial areas of new light fixtures were installed and monitored prior to implementing a structure-wide lighting upgrade. Finally, additional parking stalls to meet current codes were provided to accommodate handicapped parking needs.

UNFORESEEN CONDITIONS

There were a greater number of basic connector failures throughout the deck than expected. The overrun on the simple flange-to-flange connectors were offset by an underun on a much costlier connector repair.

The roof downspout repairs also proved to be more extensive than originally anticipated, but they were still within a manageable number.

Of special interest was the car fire on the roof of the repaired structure in November 2006. The overlay design limited flame spread in the structure and limited damage to the total structure to less than $10,000.

The use of a latex-modified concrete overlay was instrumental in maintaining project costs. The nature and extent of damage or impairment with flange-to-flange connectors, shear-wall connectors, drain basins leaking, expansion joint shear transfer devices, and drainage gradient issues necessitated use of an effective macrosystem, as opposed to a piecemeal approach. The original estimated budget was $6,100,000, and the final project cost was $5,900,000.

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