THE RENOVATION OF THE COTTON BOWL, PHASE IB

BY MARK LEMAY

Located in the National Historic Landmark District known as Fair Park in Dallas, TX, the first portion of The Cotton Bowl was constructed in 1930. Originally, the 46,200-seat stadium was known as Fair Park Stadium, and, at the time, was the largest stadium in the southern U.S.

The original ("lower") bowl was constructed on grade, with a grassy berm surrounding the stadium. It is thought that the original construction consisted of wood treads and risers, supported on concrete raker beams. At some point, the lower bowl was reconstructed in concrete cast on grade, possibly in 1936, when Fair Park Stadium was incorporated into the Texas Centennial Exposition as the centerpiece for the celebration of Texas' first 100 years. That same year, Fair Park Stadium was officially renamed the Cotton Bowl.

In 1948 and 1949, major expansions extended the lower level of seating by 17 rows, added plank-formed cast-in-place concrete upper decks on each side, new cast-in-place concrete pedestrian ramps, lower- and upper-level covered concourses, and a new press box. This brought the total capacity of the Cotton Bowl to 72,000.

Corroded reinforcing steel resulted in spalling of the concrete—a significant hazard to patrons below

In 2006, as part of a unique and cooperative effort with the City of Dallas, the State Fair of Texas pledged $20 million to fund the first phase of a renovation of the Cotton Bowl. This phase included the removal and replacement of the seating, concrete repairs and waterproofing, a new scoreboard and video replay screen, and the design of the improvements scheduled for Phase II (to be funded by the City of Dallas). The concrete repair and waterproofing portions of the work began immediately upon completion of the Cotton Bowl Classic football game on January 1, 2007, and were completed in time for the opening of the State Fair of Texas and the "Red River Rivalry" game between Texas and Oklahoma in the fall of 2007.

CONDITION ASSESSMENT AND EVALUATION METHODS

The first step of the repair process included a complete condition assessment of the concrete surfaces. Years of moisture intrusion, coupled with a failure to provide adequate funding for maintenance and repair, had taken its toll on the oldest sections of the Cotton Bowl—the original lower bowl Cracks, spalls, and inadequate repairs were visible in virtually every section of the stadium. In addition, severely eroded steps in aisle ways and unevenness across expansion joints in the seating areas posed potential trip hazards for patrons. Unsealed expansion joints allowed water to penetrate into critical service areas such as concession stands, food storage areas, and restrooms. Spalling concrete from elevated structures could come loose and fall on unsuspecting patrons at any time.

The engineer's condition assessment team methodically walked each row in every section of the stadium, sounding all of the concrete surfaces. A motorized manlift was used to survey the undersides of the structure. Nineteen core samples of the existing concrete were taken at random locations throughout the stadium. Petrographic analysis and air content testing performed on three of the sample cores revealed significant carbonation of the concrete surface, microcracking, and an inadequate air void system in the oldest sections of concrete at the Lower Bowl. The testing lab deemed the durability of the concrete surface to be poor.

Fortunately, the newer, structured sections of the Cotton Bowl that were added in 1948 and 1949 were in somewhat better condition. Isolated honeycombs and overhead sections of spalling concrete caused by corrosion of embedded reinforcing steel, however, were significant hazards in need of proper repair. Ponding water, cracks, and unsealed expansion joints were significant contributors to the deterioration of the structure.

REPAIR SYSTEMS SPECIFIED

The potential for excessive moisture vapor emission prevented the protection of the 49 rows of seating cast on grade at the original lower bowl by means of a membrane-forming deck coating system. The engineer determined that resurfacing the treads and risers using a trowel-applied, breathable, polymer-modified repair mortar containing an integral corrosion inhibitor provided the best means of protection for these concrete surfaces. The elevated portions of the concrete structure would be repaired, and then protected using a waterproof deck coating system. Expansion joints in the seating areas would receive two layers of protection, while the expansion joints at the ramps would be outfitted with a traffic-grade system, due to the extensive use of motorized vehicles.

Floor plans and reflected ceiling plans were developed to show the approximate locations of the areas of concrete to be repaired, along with repair quantities for each seating section. Photographs were incorporated into the plans to help identify typical and specific problem areas.

Estimated repair quantities were established to create a level playing field for bidding contractors. Each bidder was asked to provide unit prices on a bidding schedule that listed the predetermined quantities.

All removal geometry, surface preparation, application methods, measurement, and testing were specified to be in accordance with ICRI Technical Guidelines. The scope of work and material specifications included the following:

1. Horizontal repair of concrete less than 1 in. (25 mm) in depth, cementitious overlay at the lower bowl, and overhead repairs:
   - Prepackaged, polymer-modified repair mortar, minimum 1-day strength of 2000 psi (13.8 MPa)
   - Hand-applied
2. Horizontal repair of concrete less than 1 in (25 mm) in depth:
   - Prepackaged, rapid-cure repair mortar extended with aggregate, minimum 1-day strength of 3500 psi (24.1 MPa)
   - Formed and poured
3. Repair of cracks in concrete:
   - Two-component, low-viscosity epoxy injection resin
   - Cracks sealed and ported
   - Epoxy resin pressure-injected into cracks
4. Pedestrian traffic deck coating system:
   - Mechanical surface preparation
   - Rout, seal, and apply detail coat over cracks and joints
   - 25 mil base coat and one 15 mil topcoat at seating areas
   - 25 mil base coat and two 15 mil topcoats at ramps and concourses
   - Broadcast aggregate for slip-resistant texture
5. Expansion joint system at seating areas:
   - Remove existing metal nosings and repair concrete
   - Overlay concrete on low side of joint to eliminate tripping hazard
   - Impregnated, precompressed foam sealant
   - Two-component, polyurethane joint sealant
6. Expansion joint system at ramps and concourses:
   - Repair concrete at existing blockouts
   - Thermoplastic, traffic-grade, preformed rubber joint seal anchored into blockout using elastomeric concrete
7. Wall coating:
   - Water-dispersed, acrylic, protective anti-carbonation coating at vomitory walls; columns; and front, rear, and side walls of upper deck level, colors to match Fair Park standards
8. Quality assurance:
   - Post-placement, visual inspection
   - Sounding of repairs and overlay
   - In-place adhesion testing of the cementitious overlay material to the substrate in accordance with ICRI Technical Guideline No. 210.4-2009 (formerly No. 03739)
   - Sixty tests on horizontal surfaces, 24 on vertical surfaces

HISTORICAL CONSIDERATIONS

The Fair Park National Historic Landmark District is home to the largest collection of Art Deco-style buildings in the U.S. All work performed at Fair Park must undergo a rigorous review by Dallas' Landmark Commission, and must conform to the Secretary of the Interior's Standards for Rehabilitation. It was the desire of the commission to differentiate the original, lower bowl construction from the 1948-1949 additions. For this reason, the color selection for the pedestrian traffic deck coating system was designed to contrast with the concrete color of the polymer-modified overlay applied to the lower 49 rows of the stadium. In doing so, the commission also had the opportunity to use colors that adorn the exterior facades of many other of Fair Park's Art Deco-style buildings.

Concrete repair work commenced even before all seating had been removed

Sounding of concrete at underside of upper deck prior to installation of repair mortar

PROJECT INSTALLATION

The method of identifying repair quantities on the bid form significantly reduced the time required to bid the project, eliminated the quantity variable from the pricing equation, and proved to be extremely beneficial in comparing and evaluating the price portion of the proposals.

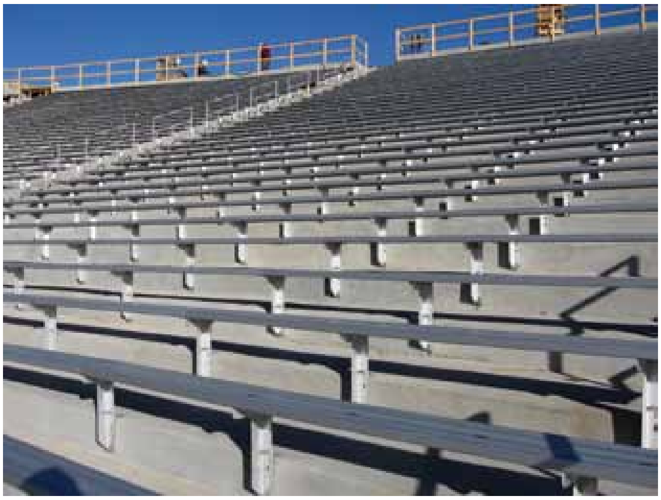
Removal of the existing seating began on January 2, 2007. During the course of the work, quantities of the unit price repair items were documented on a daily basis by the repair contractor and verified by the construction manager and the engineer. Reports of repair quantities were summarized and provided to the owner at bimonthly project coordination meetings. Because of this ongoing documentation process, monthly pay applications from the contractor were easily verified. At the end of the project, adjustments were made to the estimated bid quantities to accurately compensate the contractor for the actual quantities of repair materials installed.

Visual inspections and random soundings of the repairs were made during the entire course of the project to ensure that the owner would be provided with a quality installation. In addition, in-place pulloff tests, performed in accordance with ICRI Technical Guideline No. 210.4, tracked and documented the quality of the cementitious overlay installation. Test locations and results were documented on a spreadsheet and reviewed at the bimonthly project coordination meetings.

MAJOR CHALLENGES AND UNFORESEEN CONDITIONS

Major project challenges included careful planning and coordination of the seating and repair contractors' operations to maximize efficiency and phasing of the work in an extremely tight construction schedule. Under the upper decks, the repair sequence included:

Concourse beam before and after repair



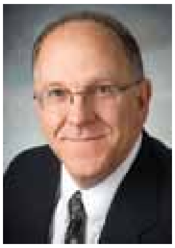
All unsound concrete was removed and new aluminum bench seating was attached to repaired concrete at original lower bowl

- Remove existing seats and protruding anchors
- Repair concrete surfaces on the lower level
- Repair concrete surfaces on the undersides of the upper decks
- Installation of anchors for new seating
- Installation of expansion joint systems
- Installation of pedestrian traffic deck coating system
- Installation of new seating

Detailed preplanning of this orchestrated effort paid significant dividends by avoiding potentially disastrous delays.

By completing a thorough condition assessment, the engineer significantly reduced the number of unforeseen conditions encountered during the course of the work. At three locations in the lower bowl, however, the existing concrete was found to be so severely deteriorated that repair was deemed unfeasible. At these locations, it was determined that the concrete had to be removed and replaced with new, high-early-strength concrete.

After all the work is completed, the long-overdue repairs will provide the necessary protection for this focal point of Fair Park for many years to come!



***Mark LeMay**, AIA, LEED AP, is an Associate and Senior Project Manager with Jaster-Quintanilla Dallas, LLP (JQ), in its Fort Worth office, and is head of JQ's Condition Assessment Group. The four-office firm of JQ provides structural and civil engineering, surveying, and condition assessment services throughout Texas. A graduate of the University of Notre Dame, LeMay has been a licensed architect in the State of Texas since 1982. He has more than 30 years of experience in historic renovation and restoration, concrete and masonry repair, specialty waterproofing, and structural strengthening projects. LeMay has served on the Board of Directors of ICRI's North Texas Chapter for 5 years, including his current position as Immediate Past President. In addition, he is a voting member of the ICRI Chapters Committee, and an active member on ICRI Committee 710-A, Horizontal Waterproofing of Traffic Surfaces.*

Cotton Bowl Renovation, Phase IB

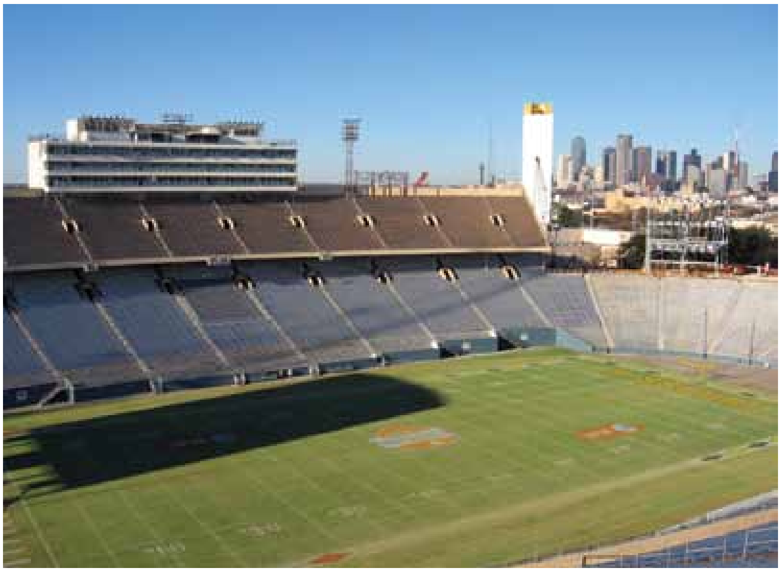
OWNER
City of Dallas
Department of Parks and Recreation
Dallas, Texas

PROJECT ENGINEER/DESIGNER
Jaster-Quintanilla, Dallas, LLP
Dallas, Texas

REPAIR CONTRACTOR
L.S. Decker, Inc.
Houston, Texas

MATERIAL SUPPLIERS
Sika Corporation
Lyndhurst, New Jersey

LymTal International, Inc.
Lake Orion, Michigan



Early morning view of the completed project