

Renovating a Chicago Landmark

by Michael Cotter

Soldier Field in Chicago, IL, is home to the Chicago Bears of the National Football League. Located in downtown Chicago, on the shore of Lake Michigan, the stadium is “Dedicated to the Men and Women of the Armed Services.” At Soldier Field on January 21, 2002, at 12:01 a.m., following the Bears’ final game of the season the previous day, contractors began a \$606 million, 20-month renovation and upgrade of this historic facility.



View of the stripped structure from the east



Looking north—demolition complete on the west side

The classic Soldier Field structure consisted of colonnades creating a “horseshoe” formation connecting the four-story wings to the north on the east and west sides. Built in 1924, the structure was literally falling apart. The foundation, underside of the seating bowl, and the walkways were crumbling.

Demolition started at the south end of the stadium and moved in phases toward the north end. As demolition was concluding on the north, structural steel erection was starting on the south end. Asbestos was used in the original construction, further complicating matters. In addition, the ancient stadium, at one time, had a firing range in its basement. In this area, both lead and asbestos had to be removed. This process had begun in September 2001 between the games of the last season.

NRS, Inc., was awarded the restoration contract to repair the concrete using a number of techniques including caulking, tuck pointing, and hand-patching of vertical and overhead surfaces. It became clear very quickly, however, that these techniques were not going to provide the quality of repairs necessary while meeting the ambitious project schedule.

The author received an emergency telephone call from project management requesting a “shotcrete solution.” A mock-up was required to demonstrate this solution. On a Saturday in May 2002, the mockup was shot on a vertical column with vertical bars and horizontal ring steel. A test panel was also shot. This work was done at field level using a prepackaged shotcrete material manufactured in the U.S. Two products were tested, one with and one without fiber. This mock-up was done with all decision-makers present, including construction managers, architects, structural engineers, and restoration managers.

Things Change

Called in on an emergency basis, the shotcrete solution was approved and applied. The original quantities were under 1000 ft² (93 m²)—but after completion were over 30,000 ft² (2787 m²). One problem with concrete restoration projects is that the initial repair survey tends to be inaccurate. Often times, visual inspection by untrained eyes and the time of year the concrete was sounded (that is, a frozen surface) only compounds the problem. There also have been cases of low estimates for budgetary considerations. In the Chicago area, the deterioration of the east face of a structure is often further advanced because it is subject to additional freezing-and-thawing cycles, and Soldier



Original mock-up preparation



Finished column mock-up

Field was no exception. In this case, the city of Chicago Building Commission refused to issue a repair permit without a current, updated survey. Once the stadium was stripped, and after a 2-month delay, it was necessary to sound all concrete surfaces.

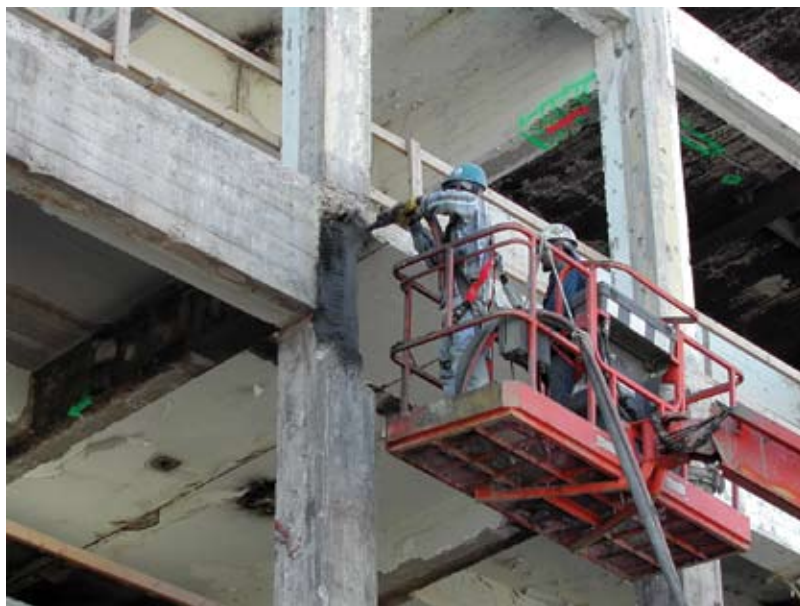
Because the mockup was successful, shotcrete was chosen as the correct method of repair. The restoration of the 78-year-old structure was scheduled to begin after the demolition of the original seating bowl, which had been completed months earlier.

The work specification consisted of removing unsound, delaminated concrete. If the reinforcing bar was exposed more than 50%, it was necessary to chip behind it and blast the bar clean. It was not necessary to saw-cut the edges. The areas to be repaired, including the columns, undersides, fascia, beam pockets, overhead in the mezzanine areas, and crawl spaces, were sounded and marked by engineers.

The debate about saw-cutting versus feather-edging is ongoing. One school of thought believes that a chipped edge leads to a higher quality repair than saw-cutting. A saw cut will leave a highly polished edge/surface that takes extra attention because material has a tendency to pull away and not bond as well.

Shotcrete equipment consisted of Allentown 3 in. (76 mm) swing tube pumps reduced to 1.5 in. (38 mm) with mixers and water meters. Once the project started, 2 months behind schedule, the challenge was to stay ahead of the trades following steel erection, precast, plumbing, heating, painting, and fireproofing. To keep the project within its original construction schedule, it was necessary to add additional crews and equipment to work double shifts.

Demolition and two shotcrete operations labored by day, while sandblasting and surface preparation were accomplished at night. Along with the ever-present clean-up, the arguments over space were semi-satisfied by doing the dusty, dirty work at



Applying shotcrete to a column



Finishing shotcrete on mezzanine underside



Shooting an edge—second lift

Shotcrete Repair Checklist

| | | Acceptable | Unacceptable |
|-----|--|------------|--------------|
| 1. | Verify questionable concrete to be demolished with engineer? | | |
| 2. | Following planned phasing/sequencing of work? | | |
| 3. | Undercut reinforcing bar when exposed 50%? | | |
| 4. | Sandblast reinforcing bar? | | |
| 5. | Coat reinforcing bar? | | |
| 6. | All loose reinforcing bar tied properly? | | |
| 7. | Holes for epoxied bar correct depth, spacing, and blown out? | | |
| 8. | Concrete free of oil, grease, and other contaminants? | | |
| 9. | Ambient/water/substrate temperature OK? | | |
| 10. | Shoot test panel, label, and sketch areas where panel applies? | | |
| 11. | Saturate surface dry conditions? | | |
| 12. | Apply curing compound? Burlap blankets at midpoints if applicable? | | |
| 13. | Prior to second application sandblast curing compound off? | | |
| 14. | Pressure blast surface prior to second application? | | |
| 15. | Apply curing compound to final surfaces? | | |
| 16. | Winterization of pumps/meters with antifreeze before end of shift? | | |

night. The shotcrete nozzlemen charged ahead to leave a sound structure for the other trades to hang their work. The placement consisted of high-velocity wet-mix shotcrete with fiber, not to be confused with low-velocity sprayed mortar, which is air-placed concrete. Work by other trades could not begin until the shotcreting was complete.

A few words of caution on prepackaged products: first, keep track of the batch numbers, delivery tickets, and areas that are applied with such batches. Next, variance at the water meter and/or pump pressure will forewarn you of possible problematic material; remember, things change quickly when using truckloads of material.

Communication is always critical and even more so when working on accelerated schedules. The author uses a Hazard Analysis and Shotcrete Repair Checklist. While it may seem like extra paperwork and wasted time, using these tools were important in providing the quality of repair desired while maintaining a safe work environment. All work was completed with a perfect safety record. Employees were made aware of the challenges presented by this project and worked as a team to complete the project. Three ACI-certified nozzlemen were part of the project. All work was supervised by ACI-certified nozzlemen.

The Soldier Field Renovation project presented many unique challenges. The contractors proved they were up to the task as evidenced by the recognition as the Special Project of the Year from the International Concrete Repair Institute. The “shotcrete solution” was a critical element in this award-winning effort.

Michael Cotter is a former member of the Gunitite Contractor’s Association, Charter Member and Treasurer of the American Shotcrete Association, and an ACI-certified nozzleman. He attended Western Illinois University and is involved in the shotcrete industry, both wet- and dry-mix processes. Cotter was instrumental in helping develop the use of hydrodemolition for overhead and vertical locations in the early 1980s. Cotter is a consultant currently promoting shotcrete in the rail and road transportation arenas. His motto is “There is enough concrete to repair without the need to do it over.” Cotter can be reached at mpccotter@aol.com.