

Historic stadiums, such as the University of Illinois' Memorial Stadium, are undergoing renovation work to keep the seats full and the fans happy.

Photos by Brad Feinknopf, courtesy of HNTB

Built in 1923 and expanded over the years, the stadium's most recent renovation was completed in time for the 2008 football season.

Exposed trusswork in the concourse complements the brick cladding and imagery of former Illini football greats.

Big Draw

BY ROBERT HYLAND, P.E., AND JEFF ADAMS, P.E.

THERE'S NO DOUBT that Big 10 alumni and students are passionate about their athletic teams. Football is a particularly big draw at most Big 10 schools, and many of the conference's stadiums are beloved icons for the universities and surrounding communities. Many of them are also almost a century old and in need of renovation.

The University of Illinois' Memorial Stadium in Champaign is one such stadium. Built in 1923, the structure had simply become outdated. The restroom and concession facilities appeared crowded, the press box didn't have the technology and space found in more modern venues, and the stadium lacked the hospitality facilities for top-flight viewing and entertainment. In short, the stadium was showing its age.

As such, the university embarked on a project to make improvements to Memorial Stadium so it could better compete with other Big 10 schools. These involved providing student-athletes with state-of-the-art facilities and adding a high-end club level for recruiting and entertaining and add revenue-generating luxury

suites. The renovation was completed in time for the Illini football team's first home game of the 2008 season, and the \$120 million project used about 3,300 tons of steel in all to make it happen.

Architectural Tradition

Memorial Stadium is a unique example of an architectural stadium within collegiate athletics. Built in a classical revival style, the stadium was designed as a memorial dedicated to the 189 students and alumni of the University of Illinois who died in World War I. A set of colonnades run the length of the east and west façades. Two hundred columns complete the colonnades, and 189 of the columns are inscribed with the name of an Illini soldier who died in the war. Intricate carved stone panels on the exterior of the facility commemorate the war and pay tribute to the athletic games.

To honor this rich architectural tradition, the existing building elevations, colonnades, great halls, ramp towers, and all



A night game at newly renovated stadium.



The renovation project kept the stadium's historic façade intact, including the signature columns.

historic details needed to remain intact during the renovation. All new renovation work planned for the west and east sides of the stadium had to occur within the historic façades.

Working within those confines, HNTB Architecture, Inc., joining forces with associate architect Isaksen Glerum Wachter, LLC, developed a plan that included:

- Increased restroom and concession capacities
- A new 1,200-seat outdoor club and 200-seat indoor club
- 45 climate-controlled suites
- Enhanced functionality of press and game-day operations
- An expanded concourse with new secured entry portals
- Addition of a mechanical mezzanine on the west side of the stadium

A Tight Construction Plan

A short construction deadline required the engineers, architects, and construction team to develop a unique scheduling plan. Work on the west side of the stadium began in early 2007 and the east side broke ground in the spring of 2008. Again, all work had to be completed in time for the first home football game, on Sept. 6.

To meet this tight schedule, the west stadium project, where the bulk of the construction occurred, was divided into thirds. Before the 2007 season began, about two-thirds of right and left wing structures were constructed to match the height of the existing building. Although construction wasn't completed on these wings, the structure had to meet IBC 2000 load requirements so that spectators and members of the media could pass through those areas while heading to their seats in the lower bowl and to the press box in the center.

At the end of the 2007 season, selective demolition and construction immediately began on the center section of the west sta-

dium. At the same time, crews worked on completing the erection of the structural steel on the left and right wing structures. Interior work began in the wings while the center section was being erected. The center structure reached its maximum height in the months following and work began on its interior. This "divide-and-conquer" planning enabled the construction team to meet the relatively short schedule while still enabling the 2007 Illinois football season to go on without interruption.

Building from the Inside Out

The architectural and engineering team considered structural steel, precast, and cast-in-place systems to complete the renovation. Structural steel was selected because of the complexity of the design, the height of the proposed structure, the speed of construction, and to match the structural framing of the existing stadium—which was also structural steel.

While the material properties of the 1920s-era steel are different from the steel of today, testing showed that the more than 80-year-old existing structure had no deterioration and was strong enough to withstand new construction, including modern welding; in the 1920s, riveting was the standard way to connect steel parts.

The primary challenge of marrying the old 1920s-era steel construction with the new steel structure was the confines in which we had to build. In most stadium renovations where you are adding suites and additional levels, you build from the outside. This stadium is unique in that we had to build from the inside, adding to the existing structure while being vigilant to not tear it apart or compromise the existing façade.

The project plan called for the interior of the west stadium structure to be removed while shoring and bracing the remaining structure until the new interior structure could be completed. To

prevent damage to the historic façade and colonnades, the existing structure had to be shored, jacked, selectively demolished, re-jacked, and supported while minimizing any movement. The solution was to provide shoring columns and beams to support the existing trusses. The existing trusses were supported on a new transfer truss. Foundations were designed to support the shoring columns and temporary loads.

Because the new foundations would experience small settlements and the support trusses would be subjected to deflection under load, the existing trusses were jacked up and continuously monitored. The historical masonry façade and other brittle elements also were monitored during the process to verify they were not damaged.

Marrying Two Different Structural Grids

Project plans created a second challenge of transferring from a structural grid—defined by the regular spacing of the suites, press area, and club spaces that splayed with the curve of the façade—to the existing grid of the lower bleachers and historic façade. The lower half of the building matched the orthogonal grid of the existing building, whereas the new suites followed a radial grid. This caused the columns to not be in line with each other, so transfer girders and trusses were designed to provide a load path for the columns. As a result, no single column continued directly from the roof to the foundation.

The main structural support system for the existing structure was a series of transfer trusses. The new design required the existing trusses to be cut in half while they were still supporting the upper half of the building. Where existing trusses were cut, an 8-ft-deep perpendicular transfer truss constructed of 12-in.-wide-flange sections was erected to support the existing trusses. Transfer from the 14-ft to 16-ft grid spacing of the existing stadium to the 30-ft grid of the upper levels occurred two levels up using a 40-in.-deep beam. Approximately 30 ft east of the west transfer truss, another 15-ft-deep transfer truss was built to support the lower bleacher framing and the upper suite, club, and press framing, while matching the existing column grid below.

In addition to the transfer trusses and

members, the floor system used was typically a concrete slab on composite metal deck and steel-beam framing. Depending on the span and load, the typical floor framing ranged from 12-in.- to 30-in.-wide-flange beams. Heavy 40-in.-deep girders as large as 297 lb per linear foot were used to support cantilevers at the suite, club, and press seating areas.

A Landmark Stadium

Because of the inside-out renovation that took place and due to its national significance to the development of recreation in America, Memorial Stadium is eligible for both the National Register and National Historic Landmark listing, the latter of which is the highest national distinction available to historic structures.

From the 2008 season forward, the Fighting Illini football tradition will continue from a stadium that maintains its historical integrity on the outside while providing a state-of-the-art experience for players and fans on the inside. **MSC**

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Construction Manager

Hunt Construction, Indianapolis

West Stadium General Contractor

Williams Brothers, Peoria, Ill.

Structural Analysis Software

RISA3D, RISAFloor

Steel Detailing Software

StruCAD

Memorial Stadium: A Timeline

Nov. 3, 1923: First game played in Memorial Stadium.

1967: Installed press box atop the west balcony; constructed Ray Eliot Varsity Room, a training table, and trophy display area at the southeast corner of the stadium.

1972: \$1 million stadium renovation, which included the addition of aluminum seating.

1974: Installed the first artificial turf field and a new lighting system.

1977: Renovated the varsity locker rooms and training facilities.

1985: \$7 million renovation, which featured new artificial turf and expanded football headquarters in the northeast corner of the stadium. Also in 1985, an air-tight vacuum dome completely covering the field—commonly known as “The Bubble”—was inflated for the first time. The Bubble allowed for practice during the winter months.

1989: Replaced a portion of the AstroTurf field after vandals burned a 40-yard swath in the middle of the field.

1991-1992: \$18 million renovation project included replacing all the concrete bleachers in both upper decks, as well as the top 25 rows of the main stands. The stadium’s electrical and drainage systems were brought to code, and new restroom facilities were installed in the corner towers and great halls.

1994: Added new color matrix scoreboard to the north end zone.

2000: Replaced The Bubble with the Irwin Indoor Practice Facility.

2001: Replaced AstroTurf with AstroPlay, an artificial surface featuring a grass-like, non-abrasive, polyethylene fiber matrix filled with special rubber granules.

2002: While Soldier Field was under renovation, the Chicago Bears played all of their 2002 home games in the friendly confines of Memorial Stadium. In anticipation of the Bears’ arrival, locker rooms and meeting rooms were expanded, and a new sports medicine facility was built on the building’s first floor. In addition, a new video-replay scoreboard was installed in the north end zone. (For an article on Soldier Field’s own structural renovation/expansion, see “Field Goals” in the 7/04 issue of MSC, available at www.modernsteel.com.)

2007: Added a 5,200-seat bowl to the north end of the stadium.

2008: Renovation project completed in time for first home game of 2008 season.