INTRODUCTION

A team of design professionals and structural engineers were retained to renovate US Cellular Field in Chicago, Illinois. US Cellular Field is a major league baseball stadium and home of the Chicago White Sox. The structure is a three concourse (or tiered) structure that has seats for approximately 45,000 people including 84 luxury suites located on the middle club level. The stadium was originally built in 1991 for $120 million dollars.

The purpose of the renovation was to bring a friendly retro style feeling to the ballpark using structurally exposed elements. The renovation was completed in 2005 at a cost of approximately $70 million dollars. The major points of the renovation included the following:

- Relocation of both bullpens.
- Addition of 600 club level seats.
- Renovation of the batters eye section.
- Integrate new brick and signage along the concourse areas.
- Removal of a portion of the upper deck seating area, and addition of a canopy.

BULL PEN RELOCATION

The first phase in the re-construction project was to re-locate the pull pens. Bull Pens are a grassy location adjacent to the playing field where a pitcher warms up prior to his entrance into the game. The original design of the bullpens for each team were constructed in the outfield, oriented perpendicular to the outfield wall. The renovation project relocated the bullpens parallel to the outfield wall. This enabled the pitchers who within the bull pen to see the game. The new area was constructed using cast-in-place reinforced concrete walls. The old location of the bullpen was then in-filled with precast seating. The subsequent in-fill precast framing enabled almost 800 new seats to be added adjacent to the playing field. This new configuration provided a benefit to both the pitchers and the fans. Refer to figure 1 below for a picture of the new left field bullpen area.
The second phase of the re-configuration called for the addition of 600 club level seats. These seats are usually located at the second level of a baseball stadium, and in this ballpark, they cantilever off the front of the main second level framing. The additional of club level seating posed a unique challenge, in that there was not sufficient capacity to cantilever structure further out from the second level framing. In order to add additional premium seats above the first level, the solution was to hang three rows of seats from the upper level framing. Steel hangers were attached to the underside of the upper deck overhang, and simple beams were attached from the hangers back to the existing club level concrete beams. This added 600 more club seats which supply some of the best views of the playing field.

**Batter’s Eye Re-Configuration**

The batters eye is an outfield seating location directly in line with the pitcher's mound and home plate. This space is usually blocked off from seating to enable the batter to have a clear view of a pitch as it is coming towards him. The existing batters eye (composed of metal deck on steel framing, refer to Figure 2) was replaced with a terraced landscape. Above the landscaping, the designers developed support structure for exposed steel shops, concessions, bathrooms, and a food court style seating area (refer to Figure 3).
CONCOURSE UPGRADE

The exposed concrete on all three concourse levels was covered with brick attached back to existing precast using chemical embeds. New painted steel signs and kiosks were added in a similar fashion to give the walking areas a friendly retro feel.

UPPER DECK CANOPY

The largest phase of the renovation (approximately $35 million) was the construction of a new upper deck canopy (refer to Figure 4). The new upper deck canopy was envisioned to provide for a “friendlier” and “retro” feel to the ballpark, provide additional weather protection to fans seated on the upper deck, and provide for an upper concourse that is more enclosed and sheltered from the frequent wind and rain in Chicago. In keeping with the vision of a retro ballpark, exposed structural steel trusses were the obvious selection. This decision also helped to minimize the dead loads that would be added to the existing structure. The existing structure at the upper deck consists of cast-in-place concrete rakers on radial lines along the curve of the stadium. These rakers, which are supported on 2 cast-in-place concrete columns, cantilever beyond those columns both toward and away from the playing field and support the precast concrete seating risers. The entire building is divided into 8 individual sections separated by 7 expansion joints.
The new upper deck canopy is supported on 2 lines of new steel columns, which are offset in plan (refer to Figure 5). The offset of the 2 lines of new columns was required in order to locate the front canopy column within the aisle between seating sections (located halfway between rakers) to minimize obstructed sight lines and interference with existing seating. The back steel column is supported off the back face of the existing back concrete column, while the front column is positioned approximately midway between the 2 existing concrete column lines. Since the front column is offset in plan relative to the back column, a new steel transfer girder spanning between rakers was required below the seating risers to support the front column. In order to provide the support point for the back canopy column, the cantilever portion of the existing raker at the outside of the building was removed nearly flush with the column, along with the top 8 seating rows of the upper deck. The removal of the 2’ wide raker cantilever was accomplished by the demolition crew with 4’ diameter steel circular saws temporarily mounted to the concrete (refer to Figure 6).
The new canopy is supported off the 2 new column lines by a series of trusses parallel (radial) and perpendicular (tangential) to the existing concrete rakers. The radial trusses, which cantilever 22'-6" beyond the new front column line and 7'-6" beyond the new back column line, occur in plan at the location of the new front column and are supported at the back by a truss spanning tangentially between the new back columns (refer to
Figure 7). There are 2 additional sets of tangential trusses connecting the front and back ends of each radial truss which not only form an architectural fascia for the canopy, but also ensure deflection compatibility within the system. Four new light towers, which were supported primarily on the front column line, were installed above the canopy. Lastly, the entire outside face of the upper concourse was enclosed with a translucent wall panel system.

FIGURE 7
STRUCTURAL SECTION OF THE NEW UPPER DECK CANOPY

The system of offset columns created a challenge to the lateral load resisting system of the canopy, particularly in the sections with the light towers. Lateral loads are resisted in part by frame action of the radial trusses and cantilever action of the new back canopy column. These lateral load paths are tied together using the diaphragm action of the steel roof deck, strengthened with the addition of diagonal diaphragm bracing angles just below the roof deck. Additionally, a system of bracing members below the seating risers stabilizes and provides a load path for lateral loads at the base of the front canopy column (see Figure 8).
The expansion joints in the building also provided a unique challenge to the design of the new upper deck canopy. Because the original building did not have double columns at the expansion joint, slide bearings were strategically located to limit load transfer between adjacent sections of the structure to vertical loading only. In many places, the vertical loads were both positive and negative (uplift) and required complex connection details (see Figure 9).
This phase of the renovation helped create a more welcoming seating area in the upper deck, which was known for being exceptionally steep and uncomfortable. By enclosing the highest seats in the ballpark with a large canopy and translucent back wall, spectators could enjoy a retro style atmosphere at the ball game.

**SUMMARY**

The re-configuration of US Cellular field into a retro style modern ballpark was successful in bringing more people, and larger overall attendance to the Chicago White Sox Organization. By re-locating the bullpens, adding outfield seats, adding club level seats, adding shops and a restaurant at the batters eye, and the addition of an exposed steel upper deck canopy has created the look of a first class ball park. The majority of the work was completed in time for the 2003 Major League Baseball All-Star Game. In addition, the re-configuration of US Cellular Field were showcased at the 2005 World Series.

**REFERENCES**