Bear Heights

Floyd Casey Stadium, home of the Baylor Bears, recently completed a major upgrade to help the Waco, Texas university's football program remain competitive.

R. John Aniol, P.E., S.E. and David A. Platten, P.E.

The Baylor Bears have been playing football at Baylor University in Waco, Texas since 1899. On a campus rich in tradition, Floyd Casey Stadium has stood as a symbol of the university's competitive spirit for the past 51 years and has been the training ground for three generations of NFL stars.

Originally built in 1950, Baylor Stadium was renamed in 1989 for Floyd B. Casey, a longtime supporter and trustee. When the Southwest Conference disbanded in 1994, Baylor was one of four Southwest Conference teams that joined eight Big Eight schools to become the powerful and ultra-competitive Big 12 Conference. As the smallest university in a conference that has produced 16 national football championships, Baylor's athletic facilities faced heightened pressures to modernize and expand, despite relatively limited funding sources.

The renovation added 36 VIP suites for 550 patrons and 400 "Bear Heights" Club seats atop the existing west stadium grandstand and press box. The expansion increased the stadium's capacity to 50,000 seats while also providing a new media-relations area, expanded home/visiting coaches' and radio/television booths, plus a new consolidated game operations room. The $9.4 million, 39,000 sq. ft. skybox addition presented distinct challenges for the structural design team.

PROJECT CHALLENGES

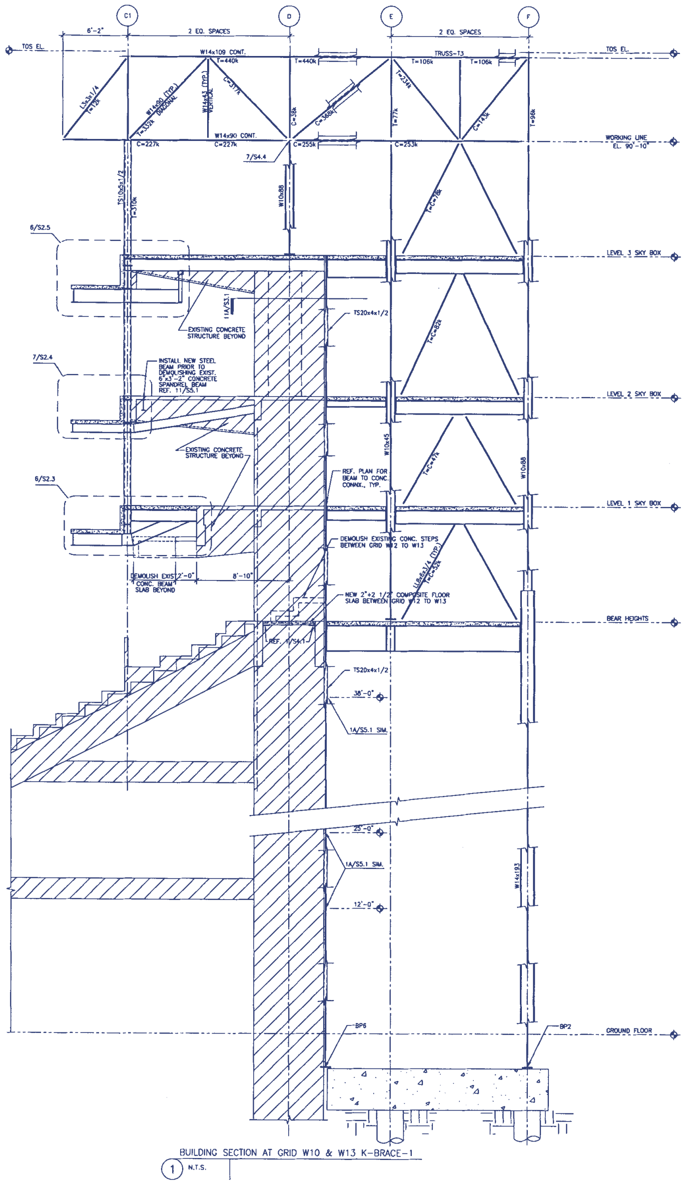
The project's structural challenges were shaped by limitations of the existing structure.

The skybox addition was designed and built around an existing three-level concrete skybox structure that varies in size from 1,300 sq. ft. to 2,600 sq. ft. per level. The architectural design team initially considered demolishing the existing skybox down to the top of the seating bowl elevation. But schedule and budget constraints convinced them to seek a more economical and faster-to-build option that could keep the existing skybox structure in place. Working with Walter P. Moore's structural team, an innovative structural solution accomplished this goal and allowed the project to be completed within budget and within the limited timeframe.

RE-USING EXISTING STRUCTURES

The solution allowed the existing concrete skybox floors to be left in place. New skybox floor framing was hung from ten, 9′-0″ deep, cantilevered vertical steel truss bents, extending the skybox floor area in all four directions. The existing skybox roof was removed to allow attachment of the new steel trusses. Each truss was completely shop-fabricated to simplify and speed erection. The vertical truss bents begin at ground level, rise behind the existing seating bowl, extend 55 feet above the top of bowl rim, and cantilever 23′-0″ out and over the seating bowl below.

The maximum roof height of the extended skybox was restricted to 19 feet above the Level 3 concourse to allow the existing light poles to remain in place and bear at their original location through the new structure. This height restriction limited the depth of the main trusses to nine feet. These trusses cantilever 23 feet with only a 20′-6″ back span. Extension of the skyboxes



Truss Bent 1, used where the existing concrete skybox structure remained.

The truss bents are clearly visible in this construction photo of the Bear Heights level looking southwest.

beyond the stadium footprint outside of the bowl was considered as a structural option to increase the backspan, but the idea was abandoned due to an existing adjacent roadway below. For the main cantilever trusses, Walter P. Moore selected a Warren truss configuration for economy and simplicity. W14 chords and W14 tension/compression diagonals were used to control the deflection and vibration of the cantilevered truss portion of the bent. Extensive three-dimensional structural analyses on the new structure confirmed that drift, overturning, deflections, and vibrations are acceptable.

FOUR COLUMNS

There are two truss bent type. The first type (see figures) is placed where the existing concrete skybox structure remained. These four truss bents, spaced at 30′-6″ on center, each feature four columns. Each column has its own challenging structural story. The field side (front) W10 column bears at Level 3 on existing 2′-0″ by 6′-8″ concrete columns. Because the foundations supporting these existing concrete columns cannot safely handle all the new loads, Walter P. Moore developed a clever solution to transfer the excess loads to new foundations. A second column, consisting of a TS20x4 tube, was placed on the backside of the existing 2′-0″ by 6′-8″ concrete column to support new floor framing loads. These tubes, which are connected to the concrete columns with double angles with vertical slots for bracing, carry the excess vertical loads to new 2′-6″ by 4′-0″ grade beams that cantilever over newly installed foundation piers.

The third column, a W10 wide-flange shape, extends down to the Bear Heights Level where it is supported by a W24 transfer girder, making way for a grade level service drive below. The fourth column, also using W10 and W14 shapes, is located at the backside of the skybox. These columns extend from the roof all the way to new foundations at grade. Chevron angle braces (2-L8x6) carry lateral and sway forces from the roof level down to the existing concrete bowl structure.

Six truss bents of a second type were installed outside the limit of the existing skybox structure at 30′-6″ on center. These bents consist of only three columns. The field side (front) W14 column extends down from the roof truss to a cantilevered 4′-0″ wide by 6″-6″deep grade beam and supporting piers. The W10 full-height middle and back columns, with 2-L8x6 chevron braces, resist the lateral and overturning forces.

HSS 10x5x$^{1}/_{2}$ tube hangers support the new skybox floors. These HSS hangers were set back (5′-4″ to 8′-3″) from the front of the skyboxes to improve fan sightlines from the new boxes.

New skybox, Floyd Casey Stadium. Photo by Lewis Hodnett.

RESTRICTED CLEARANCES

Designers used a shallow floor framing system to accommodate the limited 10′-6″ floor-to-floor height between Levels 1 and 2. The floor framing consists of 2$^{1}/_{2}$″ normal weight concrete on 2″ composite floor deck, spanning over shallow steel composite beams at 8′-0″ on center. The required two-hour floor-assembly fire rating was achieved with spray-on fireproofing. Roof framing consisted of 1$^{1}/_{2}$″ 20-gauge, wide-rib steel roof deck spanning over shallow steel beams at 5′-6″ on center.

Since the 1950 structure did not comply with current ACI concrete shear provisions, several of the existing concrete beams were reinforced with new steel plates to meet the current ACI standard.

MEMORABLE OPENING

Enthusiastic early-season ticket sales by the Bear Boosters encouraged Baylor to increase the area of the new skyboxes by nearly 50 percent during design. This sent the design team scrambling to add three bays to the design without affecting the already compressed schedule. Like many stadium expansion projects, construction was limited to the eight-month off-season between December 1998 and July 1999. To make up for the time lost in reconfiguring the new larger skyboxes, the team issued a phased set of construction documents, including early foundation and steel mill order packages. As a result, the project was completed on time and within the budget. The first game in the expanded stadium was memorable. More than 32,000 fans gathered on September 11, 1999 to cheer as Baylor built a lead over the visiting UNLV Rebels, only to watch in horror as the game slipped away on the last play with a 99-yard fumble return for the winning touchdown.

As for the impact of the skybox expansion on the football team's success, only time will tell. One thing is certain: Baylor Bear fans have plenty to cheer about when it comes to their skybox expansion.

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