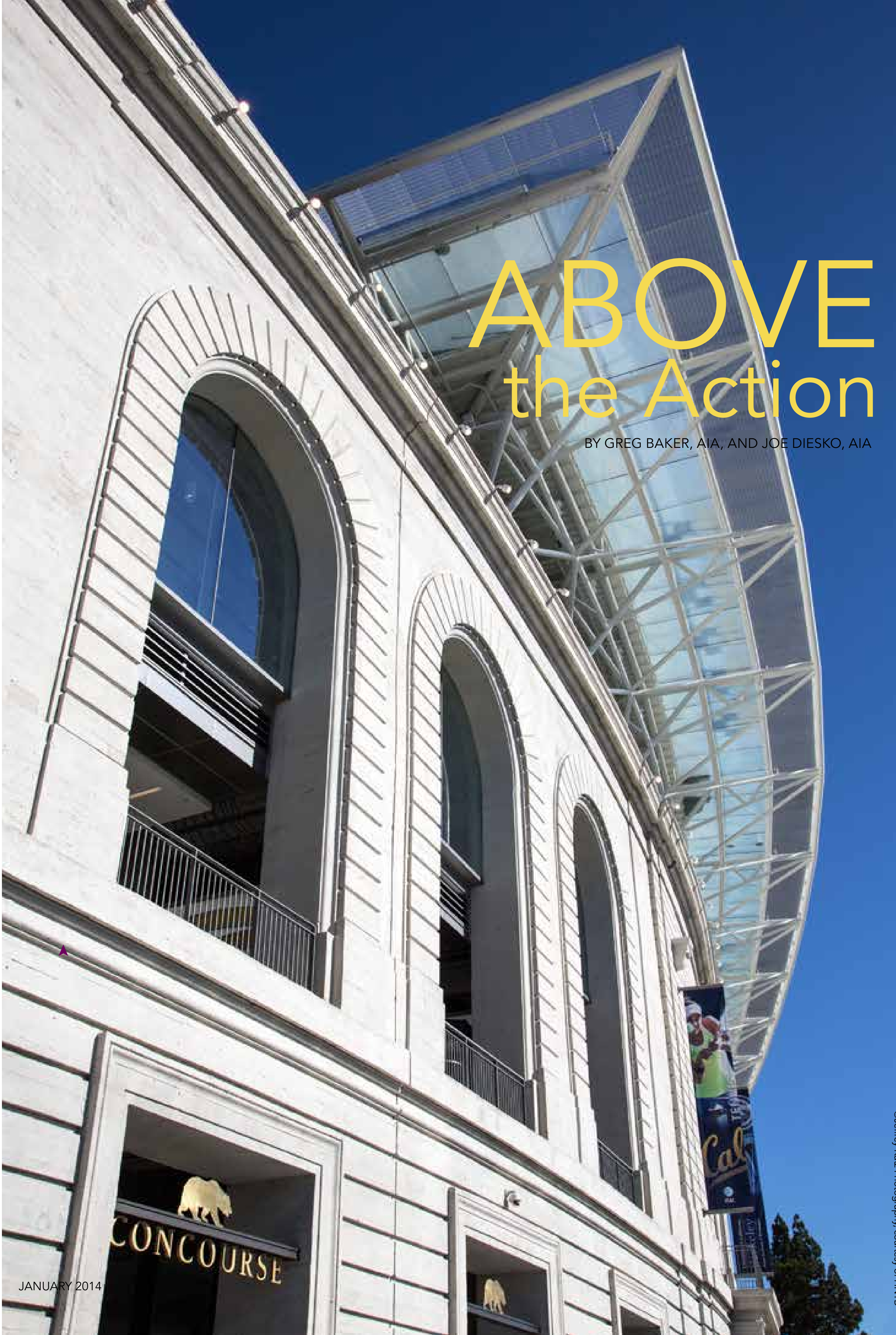
ABOVE the Action

BY GREG BAKER, AIA, AND JOE DIESKO, AIA



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Floating over Cal Berkeley's Memorial Stadium, a sleek, new press box complements the structure's historic Beaux Arts façade.

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IT'S TYPICAL TO SEE a blimp hovering over a football stadium on game day. A hovering press box? Not so much.

But the new press box at the University of California Berkeley's (Cal) Memorial Stadium, home of the Golden Bears football team, appears to do just that.

The modern, two-story structure is 437 ft long, including a 387-ft-long main box truss and two end-span cantilevers of 25 ft each. On game days, it is filled with up to 1,700 sports reporters, coaches, university officials, alumni and donors, providing outstanding views of not only the playing field and stadium but also the San Francisco Bay Area.

Sidelined for Renovations

Built in 1923 as a memorial to California's fallen heroes of World War I, Memorial Stadium sits on a fault line that is creeping a little more than a millimeter per year.

"The Hayward Fault is a strike-slip fault," says Bob Milano Jr., assistant athletic director for the university. "One side of the plate moves slowly north and the other side moves slowly south. It was slowly ripping the stadium in half."

▲ The new press box uses 1,350 tons of structural steel.

Besides slow movement along the fault, seismic activity of a more catastrophic scale was also a problem. By 1998, the university had assigned a "poor" rating to the stadium in a self-performed, campus-wide seismic safety study. With a 62% chance of a 6.7-magnitude or higher earthquake occurring sometime in the next three decades, university officials knew something had to be done.

Cal hired HNTB Corporation in association with Studios Architecture of San Francisco to create and implement a master plan for renovating the historic stadium and surrounding area. HNTB was confident it could provide the university with a facility on top of the fault that would be just as safe as building a new stadium adjacent to the fault. As a result, the university broke ground in December 2010 on the $474 million project. There were three major components to the renovation:

- **Seismic renovation.** The original façade was maintained and shored in place while the demolition of the old non-ductile concrete seating bowl occurred. The façade was eventually connected

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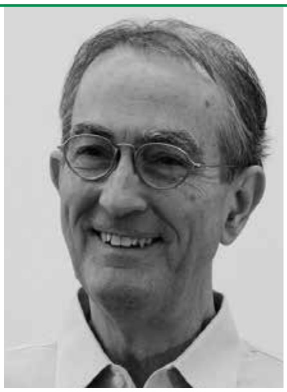


◄ Modern atop classic.

The cantilevered glass deck is obscured to block street views of the balconies.

Truss framing for the press box. Inset: connections at truss corner.

to a new concrete seating bowl structure meeting current seismic code requirements. The stadium was divided and retrofitted into seven separate structures, two of which straddle the active Hayward Fault. Per Forell/Elsesser's design, the renovation allows the stadium to accommodate 2 ft of vertical movement and 6 ft of horizontal movement along the fault in the event of an earthquake that statistically would only occur every 1,200 years. The retrofitted structure provides a modern seismic-code-designed building that is well-equipped for ground shaking in the event of a surface fault rupture directly beneath the structure.

- **Historic preservation.** Memorial Stadium's inclusion in the U.S. National Register of Historic Places made preservation of the stadium's façade and seating bowl a key requirement. To achieve this, two-thirds of the stadium's interior was gutted and replaced while the historic façade was preserved through an extensive temporary bracing system.
- **Facility upgrades.** The early 20th century stadium was updated for the 21st century with improvements that include a public plaza at the stadium's entrance and a state-of-the-art 145,000-sq.-ft athletic training center for the football team and 12 other collegiate sports.

First of its Kind

The stadium's previous "permanent" press box served the media's needs until 2001. At that time, the press box was determined to be extremely vulnerable to a seismic event and was torn down. A temporary one was built with the understanding that a new, permanent press box would eventually be included as part of a stadium upgrade.

"Essentially, the university was asking us to make the new press box very much a part of the game day experience but not a part of the physical stadium," says Fernando Vazquez, HNTB project designer for the renovation and seismic retrofit.

The interplay play of steel with glass was a design goal from day one. Structural and aesthetic qualities inherent to steel—modernity, flexibility and the ability to create a lightweight appearance—made it right for the project, and thus it incorporates 1,350 tons of structural steel.

"Any other material wouldn't have made sense," noted Vazquez. "The design wanted to be steel and so it was."

The first level of the press box, which is curved to mirror the existing stadium wall below, houses the print, radio and TV media functions in 10,200 sq. ft of space. This level is framed with fully welded wide-flange trusses. Two primary trusses span longitudinally between the supporting core walls and columns with a maximum span of 100 ft. Perpendicular to these trusses are two-bay transverse trusses at each gridline that cantilever the press box and club seating 14 ft toward the field from the main trusses (which themselves cantilever 15 ft past the cores). In addition there are horizontal trusses at each floor level of the press box to brace the structure to the main core walls and resist lateral seismic loads. This series of trusses support the steel-and-glass-enclosed premium club space on the second floor. This 24,000-sq.-ft club level cantilevers in four directions off the 3D truss, offering outdoor seating on one side and balconies on the other three sides.

The 25-ft cantilevered balcony on the back and at each end of the press box is supported by a space truss comprised of 6-in. and 10-in. round HSS. This balcony truss system, which includes

Courtesy of HNTB

The modern two-story structure is 375 ft long.

seismic and out-of-plane bracing, has several multimember joint connections with some joints connecting up to eight members. The cantilevered glass deck is obscured to block street views of the balconies, giving club members an added element of exclusivity as well as a dramatic 180° view of the Bay Area, including the San Francisco skyline and the Golden Gate Bridge.

"The new press box is a design-driven concept," says Vazquez. "It is not modeled after any existing structure. While many of the design elements are common in architecture, this may be the first time they have been combined in such a manner."

The idea to "float" the press box sprang from an initial brainstorm when Vazquez presented a sketch with the press box "flying" over the stadium. This drawing led to the overall concept of using the bare minimum number of supports, which indeed produces the effect of a floating structure.

The design also altered the more traditional approach to press boxes. Modern news media and event operations require significant space as evidenced by other stadium press boxes, which are typically three and four stories tall. Adding that many stories to Memorial Stadium would have made the structure disproportionate in size to the stadium bowl and therefore overly conspicuous.

"With the help of steel, Cal's press box avoids this by compressing and then stretching the program to produce a longer, flatter design that reduces the structure's height, mass and weight," Vazquez explains. "Further, the long, horizontal design has almost no vertical lines, leaving the traditional archways of the Beaux Arts stadium unbroken."

At the same time, the design permits a compelling juxtaposition between the stadium's classic style with the light, contemporary press box. Had designers attempted to mimic the stadium's Beaux Arts look with the press box, notes Milano, the two structures most likely would have competed against each other.

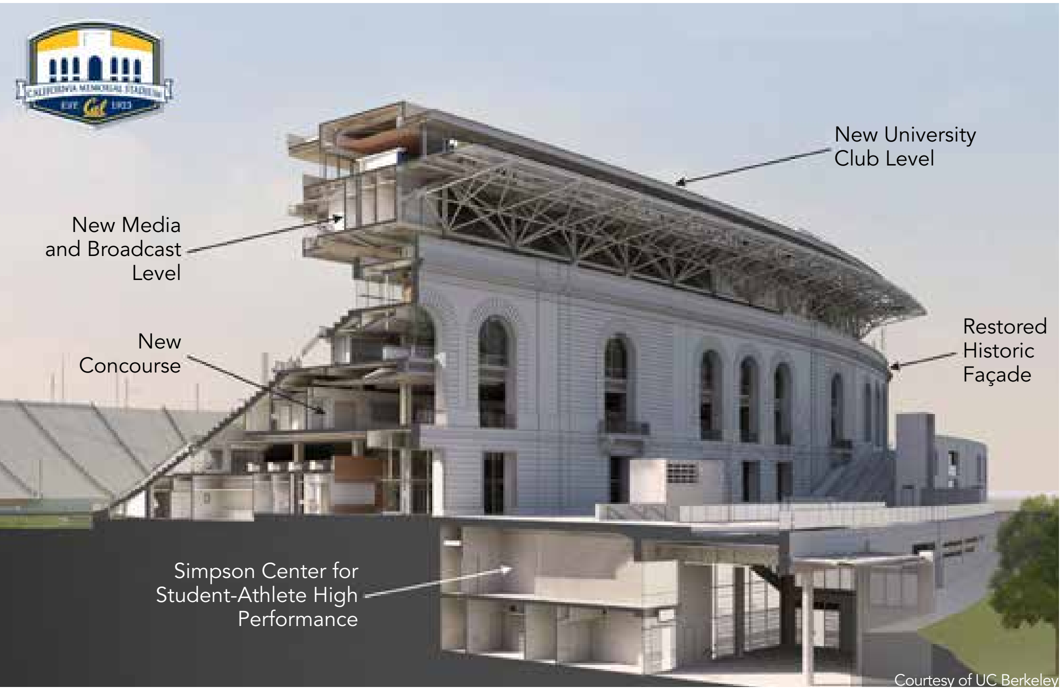
"The university's forward-thinking perspective welcomed the modern structure concept," he says. "The historic community was very much in favor of not copying the past."

Seismic Integrity

While aesthetic considerations were open to debate, seismic considerations were not. The press box is supported by four 15-ft-tall W14×398 pivoting steel columns (with 6-in.-diameter high-strength steel pins sandwiched by five 100-ksi steel gusset plates, top and bottom) and four concrete cores that penetrate all levels of the stadium. Each core measures 18 ft by 24 ft and contains an elevator and staircase that provide access to the press box. This design separates the seating bowl and press box structures, allowing them to move independently in the event of seismic activity.

Sixteen fluid viscous dampers (one on each side of each core) act as shock absorbers, buffering movement between the two structures and tempering accelerations in the press box. (These dampers, manufactured by Taylor Devices, have a +/-5-in. stroke and a 440-kip force capacity.) Vertical post-tensioning in all of the cores allows them to rock by providing a restoring force and a constant compression force to maintain elasticity. The combination of the vertical post-tensioning and fluid viscous dampers allows the two structures to work together to resist strong ground motions.

If the core wall system were to rock, the large drift angle of the cores would cause large bending and shear forces in the press box above. To alleviate these forces and economize the design, the press



A diagram of Memorial Stadium's renovation work and new elements.

Working on the HSS of the cantilevered balcony.

box is supported on steel pins at the center of each of the four cores. These innovative pins allow the press box to pivot on the cores during an earthquake and minimize damage to the steel structure. Each 7-in.-diameter high-strength steel pin is sandwiched by five 100-ksi steel gusset plates. The entire press box structure is supported on 16 of these high-strength pin assemblies (eight 6-in. assemblies at the center columns and eight 7-in. ones at the concrete cores).

"The cores are the only exits from the press box," explains Rene Vignos, structural engineer of record with Forell/Elsesser Engineers, Inc. "They had to be able to emerge from an earthquake with minimal, controlled damage to allow people to safely exit the structure. Thanks to the steel pins, rocking towers and dampers, they will. This type of rocking system is an innovation in the seismic design world that enabled this floating press box to be built right next to the active Hayward Fault."

Assembled on the 50-Yard-Line

Due to the complex nature of the site and surrounding neighborhood, there was limited space on which to erect and construct the press box. Steel allowed the structural framing to be assembled and welded at mid-field (since the entire stadium was being renovated), disassembled into five parts and then lifted into place.

One of the largest crawler cranes in the country, a 750-ton Liebherr LR1750 with a 253-ft boom and a 65-ft rolling counterweight extension, plucked up each of the five pieces and hoisted them into place a top the cores. Carefully selected splice locations were predetermined to ensure each of the five segments would be within the crane's capacity for weight and reach. Each of the segments exceeded 75% of the crane's capacity and were therefore considered critical lifts. The two largest lifts of the five segments were both 165 tons at a 160-ft reach, which used more than 98% of the crane's capacity. The crane used 900 tons of counterweight to pull off the lift.

Meet the Press

The new press box and renovated Memorial Stadium, which now seats close to 63,000, opened in time for the Golden Bears' 2012 campaign. While the designers no doubt appreciate whatever positive recognition the architecture and structural system garner, perhaps the most rewarding recognition is that of the people who spend the most time there: the press.

"The features of Memorial Stadium's new press box have definitely impressed the media," says Herb Benenson, Assistant Athletic Director—Athletic Communications with Cal. "From the broadcast booth and the main press writing sections to the clear sight lines, the modern environment meets all of the media's needs and helps them to do their jobs better." ■

The Memorial Stadium project is one of AISC's 2013 IDEAS² Award winners. See the May 2013 issue for more.

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The University of California at Berkeley, Calif.

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STUDIOS Architecture, San Francisco

Structural Engineer
Forell/Elsesser Engineers, Inc., San Francisco

General Contractor
Webcor Builders, San Francisco

Steel Erection Engineering Consultant
Hassett Engineering, Inc., Castro Valley, Calif.

Steel Team

Fabricator and Erector
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