Long-span steel trusses were the winning structural solution for a high school sports facility in El Paso with a transparent, wide-open design.

Clear Winner

BY MICHAEL STUBBS, SE, PE, ADAM SANCHEZ, AND ISAAC HARDER

SCHOOL EXPANSIONS are typically driven by overcrowding and the need for more academic space.

But for Bel Air High School in El Paso, Texas, a recent expansion was completed to address the school's desperate need for additional space to accommodate its successful basketball, volleyball, wrestling, and dance programs.

The problem was where to put it. The school was out of space for new facilities, having built out its entire parcel of land between four bordering roads, including a state highway.

The solution came in the form of a 98,000-sq.-ft, two-story replacement gymnasium on the site of the existing, smaller gym. The intent, according to David Alvidrez of Alvidrez Architecture, was to create "a facility that celebrates sports in a visible, connected manner to the community," with transparency as the foremost design goal.

And the new gym is certainly transparent. The lower level of the 40-ft-tall building starts approximately 12 ft below the existing grade and houses the primary competition court with bleachers,

Bel Air High School's recent expansion provides additional space to accommodate its successful basketball, volleyball, wrestling, and dance programs.

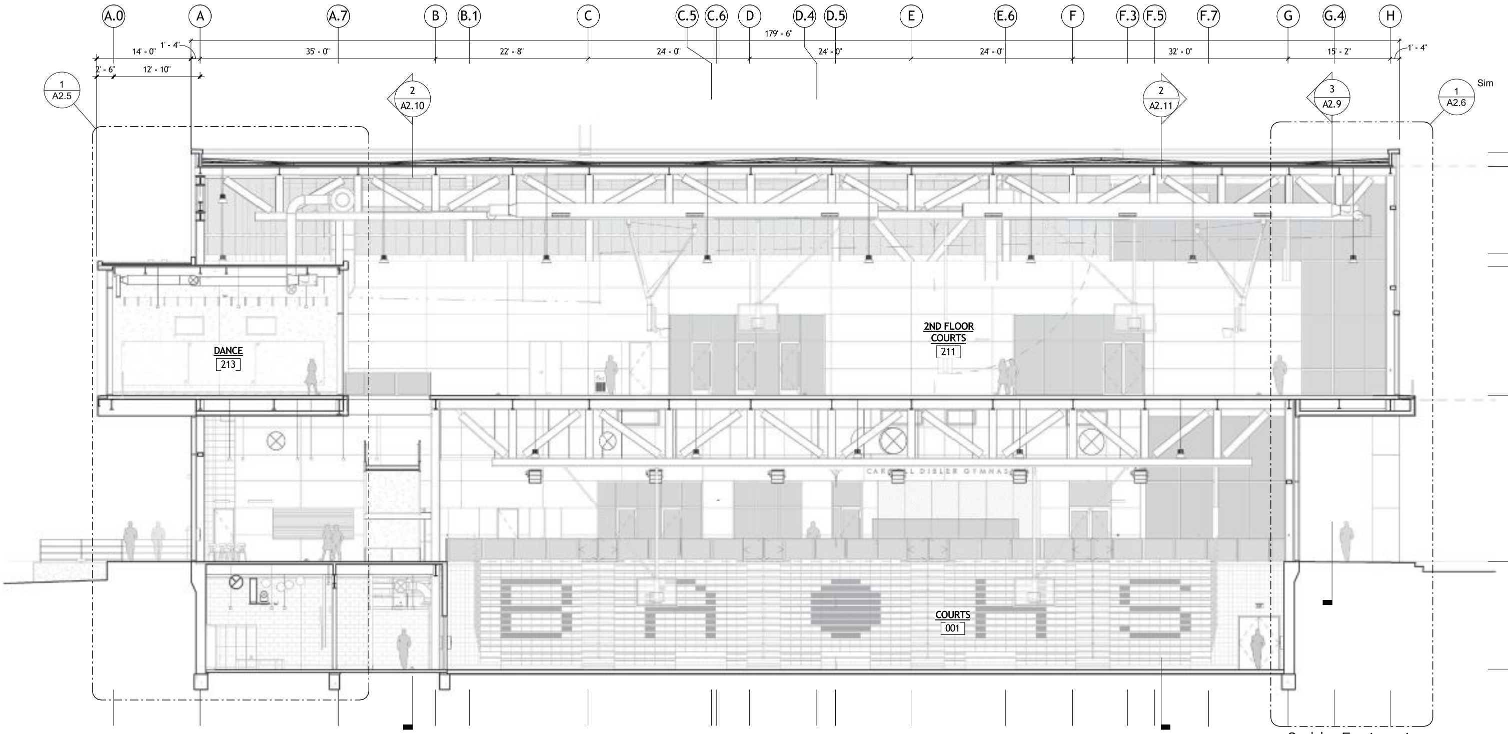
Manny Madole Photography

locker rooms, coaching staff offices, and storage space. And at grade level, it is wrapped with floor-to-ceiling windows, providing viewing and walking areas on three sides, along with lobby, concession, and restroom spaces. The upper level supports practice courts, a dance studio, and gymnastics and wrestling practice areas.

From an architectural standpoint, the challenge was taking spaces allocated to different sports with different needs and getting them to coexist in the facility while also optimizing circulation. The intent was to create multiple large, column-free, high-bay spaces that could accommodate both athletes and spectators. Structural engineer Stubbs Engineering rose to the challenge with a framing plan driven by exposed long-span structural steel

Michael Stubbs (**mstubbs@stubbseng.com**) is president and **Adam Sanchez** and **Isaac Harder** are engineering interns, all with Stubbs Engineering, Inc., in El Paso.

Be sure to check out Stubbs' session "Strategies for Managing Projects with Delegated Design," which was presented as part of NASCC: The Virtual Steel Conference: **aisc.org/2020nascconline**.



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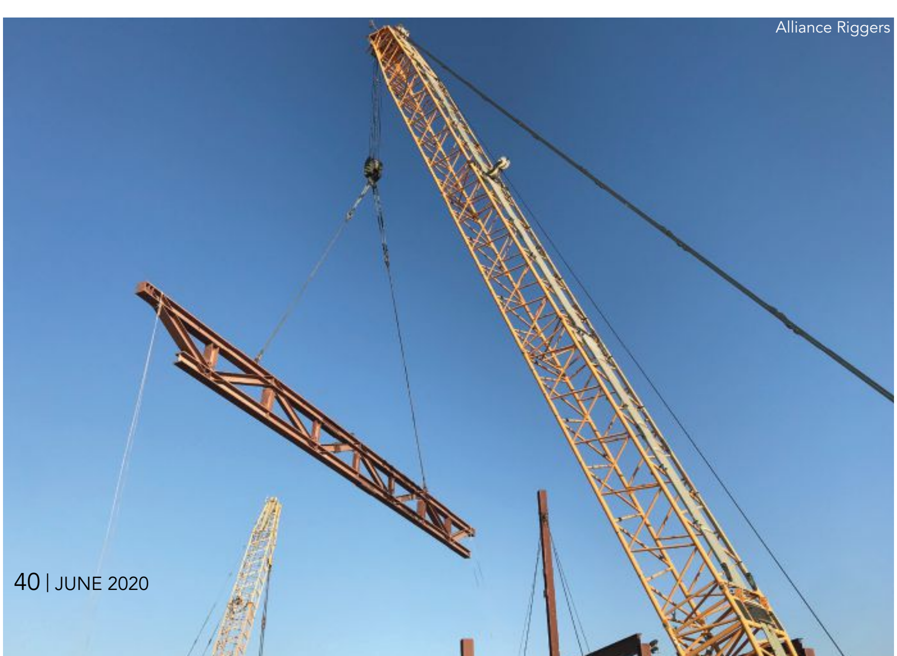
above: The lower level of the 40-ft-tall building starts approximately 20 ft below the existing grade.

left: The facility is supported by 127- and 177-ft-long trusses.

trusses and a "stacked" approach as opposed to a sprawling layout. The second-floor trusses, which are 9 ft, 11 in. deep, span approximately 127 ft and are composed of W14×342s for the top chords, W14×311s for the bottom chords, and predominantly W14×90s for the web members. Due to the building's athletic program and the need to prevent movement in the suspended lights and scoreboards, vibration in the trusses was of great concern during design. To address damping, the team designed a floor system comprising 4 in. of concrete over a 3-in. metal deck. While this system helped with vibration, it also created deflection concerns, so camber design for the trusses also became a critical part of the analysis.

The roof was also framed with long-span trusses—even longer than the main-floor trusses, at 177 ft—that are 7 ft, 10 in. deep and use W14×257s for the top chords, W14×233s for the bottom chords, and W14×90s for the web members. For both economical and aesthetic reasons, the roof slopes were kept very shallow, highlighting the need for detailed deflection and camber design for these trusses as well.



Alliance Riggers

Lifting a long-span truss into place.

The trusses were shipped on special dunnage (manufactured specifically for this project) in 32 escort loads from Houston to El Paso.

El Paso is in a region of moderate seismic risk, and the new gym was classified as a Seismic Design Category C. In response, the building incorporates a lateral system comprised of a combination of cast-in-place shear walls and steel braced frames. Despite the moderate seismic loads that needed to be designed for, the structural design team decided to use a Response Modification Factor (R) of 3, allowing maximum flexibility when designing the exposed braced frame connections to meet the architectural intent. The design team was able to get the braced frames to work within the code provisions for a structural steel system not specifically designed for seismic and as such, no supplemental damping products were needed. The braced frame connections consisted of gusset plates with bolted angle connections to the brace flanges and bolted plates to the brace webs. To accommodate the necessary long column-free spaces, the braced frames and shear walls were located at the perimeter of the building. Like the trusses, the braced frames were also left exposed.


Stubbs Engineering


Banes Construction

right: For both economical and aesthetic reasons, the roof slopes were kept very shallow.

below: Steel braced frames at the perimeter.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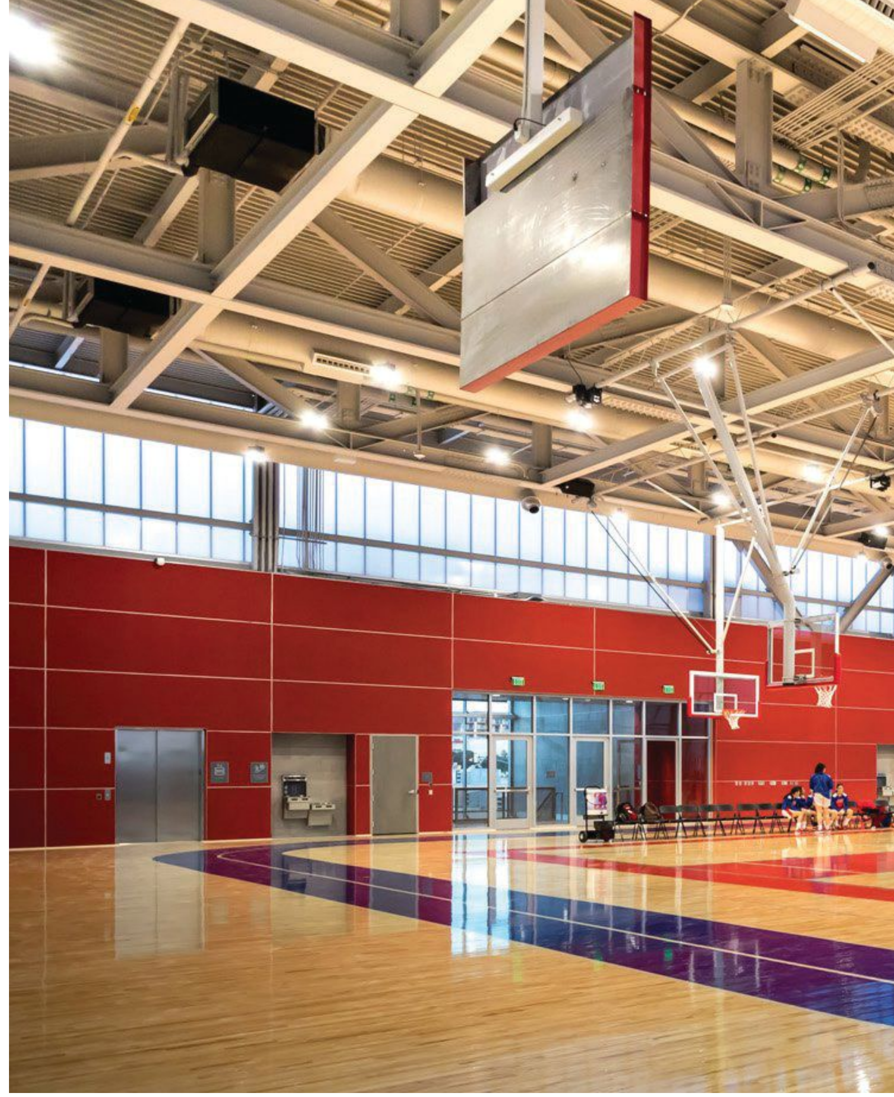
The building is wrapped with floor-to-ceiling windows, providing viewing and walking areas on three sides.



Of course, trusses of such a large scale created fabrication challenges. Weighing approximately 27 tons each, the trusses exceeded project fabricator Basden Steel's crane capacity, so the shop developed custom jacking systems to maneuver each one. Basden also test-assembled each truss at its Houston plant prior to shipping to verify fit-up and camber. The trusses were shipped on special dunnage manufactured for this project in 32 escort loads from Houston to El Paso. In addition, the truss web connections were welded to the chord members with stiffener plates in the chords, and the design team created bolted splice connections for the chords to facilitate shipment of the trusses.

When it came to erection, there was limited ability to connect to the primary lateral system. The floor and roof decks were also difficult to place do to their size and weight and were therefore not always in place while steel was being erected. Additional piers were placed around the site with W14 columns embedded in them to act as tie-off points for bracing cables. Where adding piers was not feasible, 17.5-ton concrete deadman anchors were used. The bracing cables were attached to trusses prior to installing hoisting cables to serve as both temporary lateral bracing and to brace against lateral-torsional buckling until the deck could be installed. The erection plan also included post shores to act as temporary lateral braces until the diaphragm could be fully connected to the brace frames and shear walls. The trusses—six at the lower level, six at the main level, and one at the roof—were erected in pairs, resulting in several unique bracing/rigging configurations throughout the erection phase.

The finished structure is a necessary, efficient, and attractive addition to Bel Air High School. Thanks to its stacked nature, it makes the most of limited available space on campus. And thanks to its long-span steel trusses, it makes the most of the space inside the building, providing a high-performing venue for the school's high-performing teams. ■

Owner
Ysleta Independent School District, El Paso

General Contractor
Banes General Contractors, Inc., El Paso

Architect
Alvidrez Architecture, Inc., El Paso

Structural Engineer
Stubbs Engineering, Inc., El Paso

Steel Team

Fabricator
Basden Steel Corporation, Brookshire, Texas (AISC Certified Fabricator)

Erector
Alliance Riggers and Constructors, Ltd., El Paso (AISC Associate; AISC Certified Erector)

Detailer
Steelweb, Inc., Coral Springs, Fla. (AISC Detailer)

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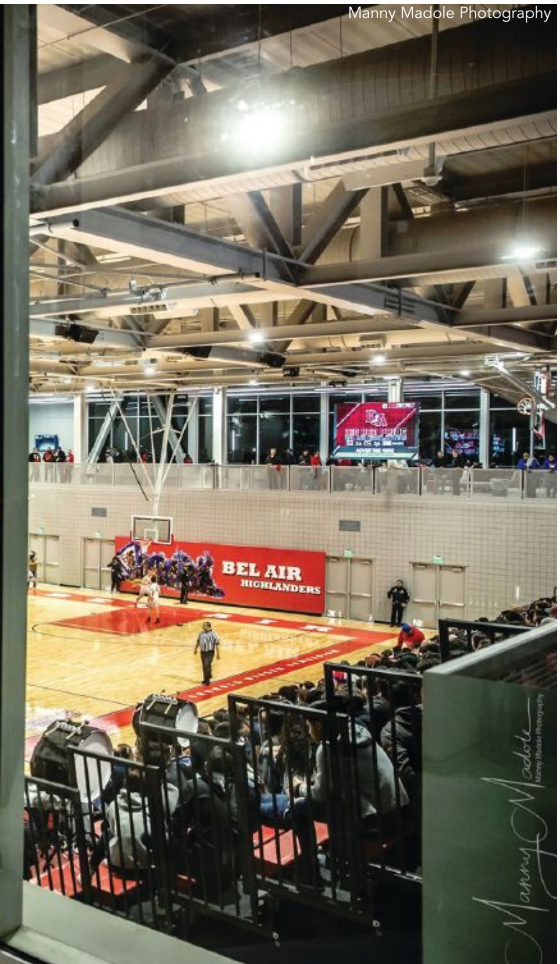

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Alliance Riggers

above and below: The trusses exceeded project fabricator Basden Steel's crane capacity of 27 tons, so the shop developed custom jacking systems to maneuver each truss.

Basden Steel