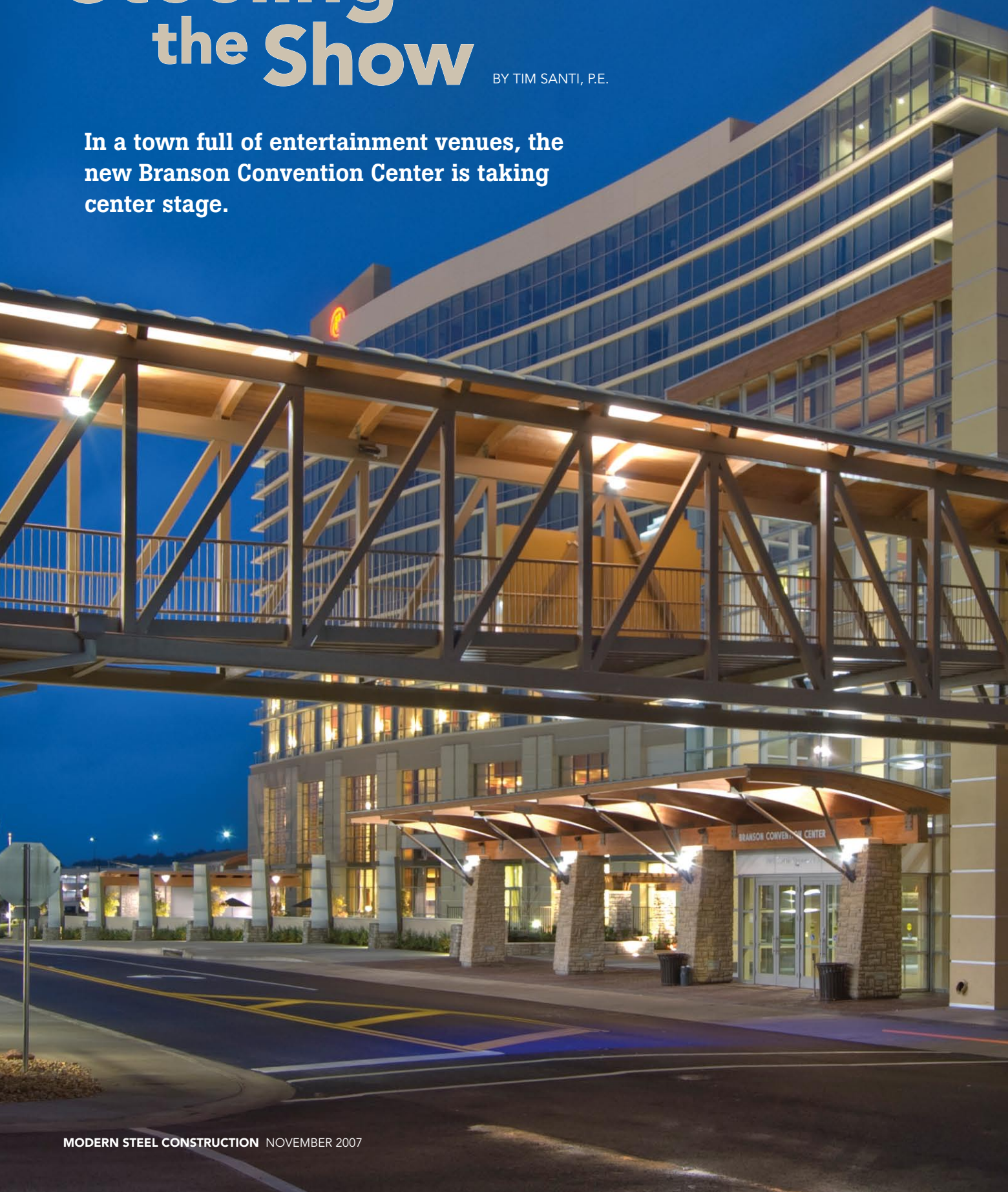
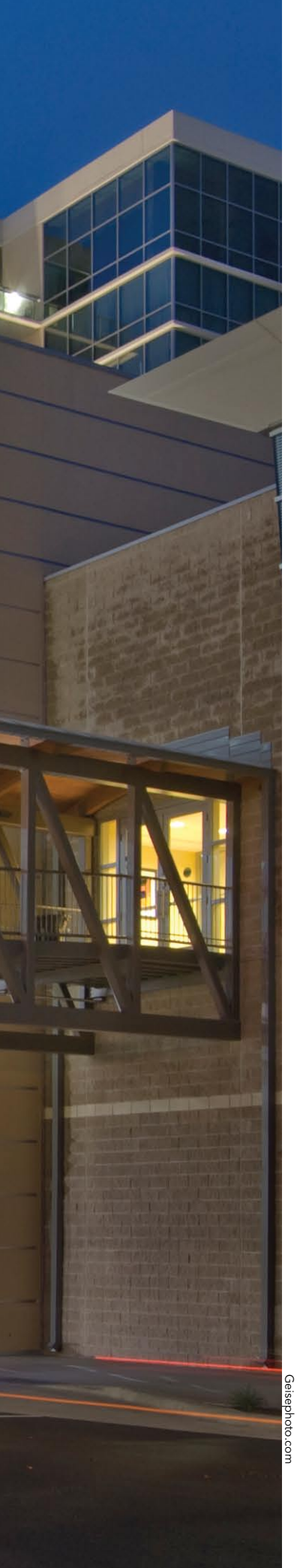
Steeling the Show

BY TIM SANTI, P.E.

In a town full of entertainment venues, the new Branson Convention Center is taking center stage.





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MORE THAN 7 MILLION TOURISTS A YEAR COME TO BRANSON, MO., known by many as the "Live Entertainment Capital of the World." The city boasts having more theater seats than New York City's Broadway District. However, a different type of venue has just opened its doors in this dynamic entertainment destination: The Branson Convention Center, Hilton Branson Convention Center Hotel and Parking Deck. The complex, which opened in August, comprises the latest components of the $420 million Branson Landing mixed-use development, which covers 1.5 miles of Branson's downtown Lake Taneycomo waterfront.

A meeting planner's dream, the new 220,000-sq.-ft convention center includes popular amenities such as a 50,000-sq.-ft exhibit hall, a 23,000-sq.-ft ballroom, and spacious conference and meeting rooms on the upper level. Interconnectivity and flow are vital to a successful mixed-use facility, which was at the forefront of the design team's vision. A dramatic concourse component ties the many amenities together and extends into the adjacent 12-story, 294-room luxury hotel. A 73-ft-long pedestrian bridge connects the convention center and hotel to the 475-car parking deck.

Long spans and cantilevers, knife-edge eave framing, and soaring monumental entrances in the convention center demanded a material with great strength, versatility, and construction economy. Structural steel, essentially unparalleled for such challenges, was the unrivaled choice.

Long-span Efficiency and Economy

Functional requirements of exhibit halls and ballrooms typically restrict column locations to the building perimeters and back-of-house zones, and a convention center in this city—where performance and gathering space is paramount—would be no exception.

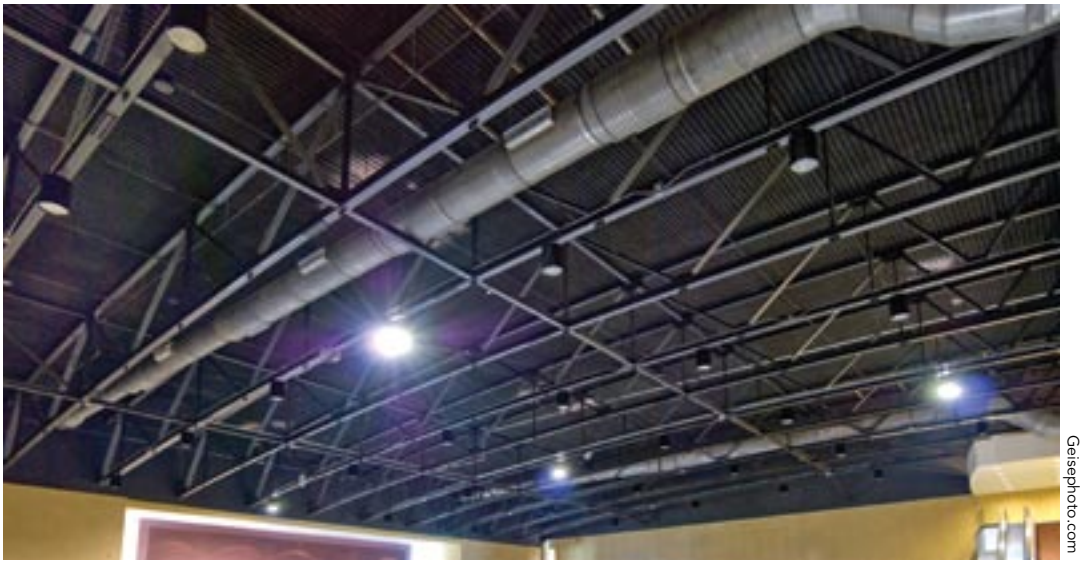
The barrel-vaulted roof over the exhibit hall and ballroom clear span between 156 ft and 165 ft. Twenty-nine structural steel roof trusses are spaced at 15 ft on center across the exhibit hall and ballroom. This truss spacing was selected to maintain the architectural 30-ft module, but more importantly to permit the 3-in.-deep metal roof deck to span truss to truss, thereby precluding the need for additional roof filler beams. Every other truss is supported by a W30 transfer girder to carry the gravity loads to the main 30-ft column grid. Four sets of truss-to-truss bracing are located at quarter points across the space to provide erection and stability bracing. To provide further economy, continuous bottom chord bracing is located only at third points along the truss spans.

Several truss geometries and member shapes and orientations were studied to derive the most economical design. W12 top and bottom chords and double-angle web members yielded the lightest truss weights and are amenable to simple, straightforward connections. The geometry of the double-angle web members were coordinated closely with the architect to align throughout the exhibit hall and ballroom and to provide panel points at rigging locations.

The W12 top and bottom truss chords are curved and parallel to match the shape of the barrel-vaulted roof. Aligning the bottom chord with the curved top chord minimized the truss depth at each section along the span. The shallow truss depths offered two advantages: The maximum clear height below was achieved for the exhibit hall and ballroom usage; and truss components could be shop assembled by keeping the total truss depth below the regional maximum shipping depth of 14 ft. Shop assembly of the truss components shortened erection time by reducing transportation time and costs, reducing the quantity of field connections, and capitalizing on the steel fabricator's shop efficiency in welding and bolting.

Backbones of Steel

The edges of the barrel-vaulted exhibit hall and ballroom roof create a striking appearance as they



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Barrel-vaulted trusses clear span between 156 ft and 165 ft over the exhibit hall and ballroom.

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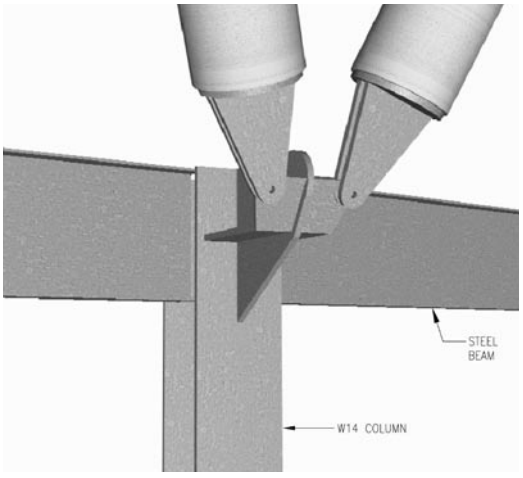
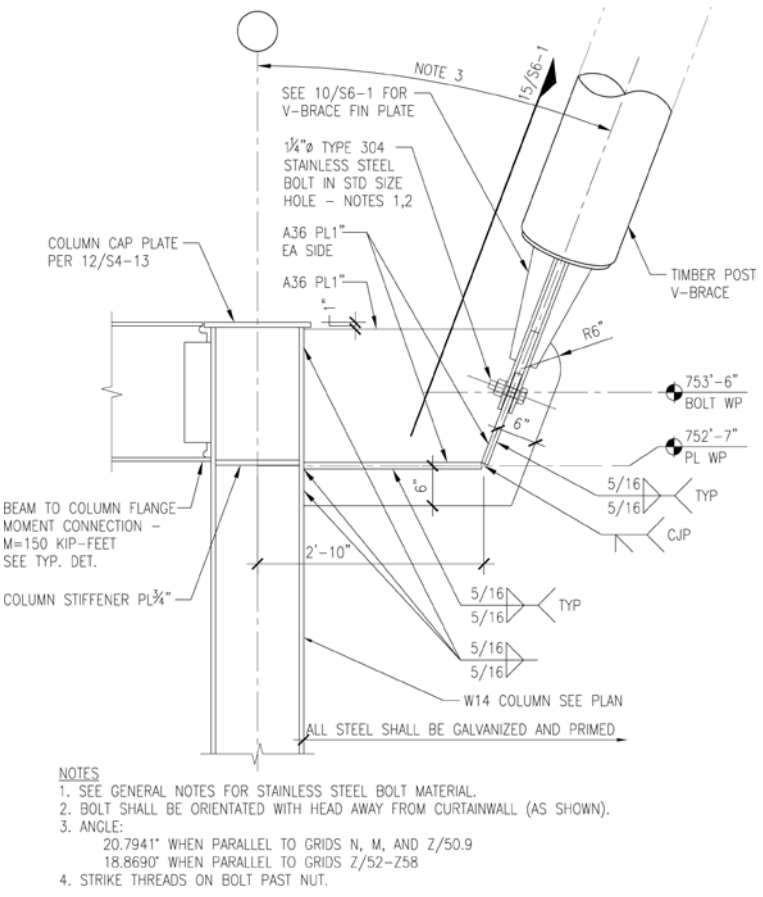
The V-braces punctuate the exterior of the 900-ft-long serpentine concourse.



Perspective view of the timber-to-steel connection at the base of the V-braces.



Relatively simple timber-to-steel connections were carefully detailed.

cantilever several feet beyond the building cladding to a crisp point. The long-span truss top chords cantilever over the supporting columns to suspend the knife edge channel framing assembly.

Four "wing wall" elements, curved in plan to match the shape of the concourse, knife out of the building at various points to communicate entrance and exit locations. The wing walls are tiered, or stepped down, in elevation to ease users from the elevated concourse down to grade as they exit the building. Wide-flange columns interlaced with curved wind girts serve as the backbone of the stepped wing walls in a simple yet effective solution to brace the walls for out-of-plane wind loading.

The monumental south lobby and prefunction entrances required 60-ft-high unbraced steel columns and wind girts for curtain wall support. Back-to-back HSS 10×4 columns are exposed and stitch-welded together with weld locations specified to match the curtain wall horizontal mullions. To complete the impressive prefunction space, steel pipe posts and two ASTM A36 1-in.-diameter rods attach to the top timber chord of queen post roof trusses that are spaced at 15 ft on center overhead.

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Queen post trusses of glu-lam and steel form the ceiling in the prefunction area.

Structural steel also proved to be the only viable material for many of the project's other architectural expressions, including the hotel lobby's grand stair. Uniquely configured, this segmented half-spiral staircase spans around the twisting corner with no supporting columns. The built-up 36-ksi box stair stringers, carefully detailed to support the treads and handrails with minimal obstruction into the lobby space below, won out over concrete stringers due to formwork and placement challenges. The strength and versatility of steel was put to use yet again for support of other various hotel features such as the cantilevered wood-clad canopies, a massive rooftop billboard, and an iconic rooftop "eyebrow."

Mixing Metal and Wood

Steel and timber construction, when well-thought out and carefully planned between architect and engineer, can create a bold and enchanting blend of construction materials. The concourse of the convention center is such a statement, owing to thoughtful design. Serpentine in plan, the focal concourse extends roughly 900 ft along the convention center and hotel. HSS 8×4 posts provide lateral support for the 25-ft-tall curtain wall. Glulam decking is supported on glulam roof beams spaced at 10 ft on center. Twenty-nine sloping V-braces march along the serpentine concourse to support the glulam beams.

The V-braces were erected quickly and easily with an innovative system. Fifteen-in.-diameter timber poles are attached to the structural frame with an exposed adjustable steel tie-rod assembly and built-up steel apex assembly. Simple steel-to-timber connections were vital to maintain an efficient and cost-effective design solution. Each V-brace apex node is "pinned" with one ASTM A304 stainless steel bolt per pole, while each tie rod assembly above is adjustable to accommodate various roof slopes and erection tolerances. The V-brace system shows creativity at its best by fusing two very diverse materials into a unified, warm composite, with neither material overpowering the other.

Gravity and Lateral System

Composite steel framing is used throughout the second level to support the concourse, meeting rooms, and other program areas. Widespread cantilever conditions due to restricted column locations were no problem for the flexibility afforded by steel framing. A combination of wide-flange and double-angle braced frames and moment frames provide lateral resistance to wind and seismic loads induced on the convention center. Strategically located, the various frames provide the most economical means of transferring lateral loads to the foundations.

At a total project cost of $81 million and with 2,100 tons of structural steel, the Branson Convention Center and Hilton Hotel will undoubtedly be a big hit in this city of entertainment. MSC

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Software
SAP2000 v9, ETABS v8, IntelliBeam