Keeping the

The Pulse Bar at the Atlanta Marriott Marquis.

Benjamin Lipford

New space requirements call for a repurposed lobby and ballroom areas in an Atlanta hotel.

Party Going

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A RECENT HOTEL RENOVATION in Atlanta not only repurposed a significant amount of the interior, it also saved large portions of the building from demolition. This $138,000,000, 302,740-sq.-ft renovation of the Marriott Marquis Hotel presented a number of structural challenges in several areas of the building.

Ballrooms

The most significant portion of the retrofit was the addition of a new roof above the existing atrium level, which in turn became the floor of the new Atrium Ballroom. The new roof is supported by long-span structural steel trusses spanning from 90 ft to 135 ft (WT18 top and bottom chords, double angles for diagonals). The trusses are supported by concrete corbels attached to the existing shear wall structures, using reinforcing steel that was dowelled with epoxy.

For a second ballroom, the Marquis Ballroom, the existing 34,260-sq.-ft. roof structure was converted into the floor for the Atrium Ballroom directly above. With spans of up to 97 ft, 6 in., significant alterations to the trusses were required to satisfy the load capacity and stringent vibration criteria dictated by the new occupancy, as well as limited structural depth due to architectural desires and highly variable steel elevations in the existing secondary framing (see Fig. 1 for a structural cross section of both ballrooms).

Initial 2D models (created with RAM Advanse and several custom applications) and hand calculations determined that the dynamic behavior of the ballroom floor was unacceptable, with computed accelerations in excess of four times the allowable values. Due to the complexity of this problem, a full 3D dynamic model of the structure was made using SAP.

During the structural optimization process, one strengthening concept that was developed was to engage vertically offset the concrete and steel elements to act in composite action. To achieve this Uzun and Case used concrete stem walls, shear studs, and shear friction rebar to engage steel trusses with two different layers of concrete stabs and some vertically offset steel beams.

Extensive benchmark studies were performed to calibrate the structural behavior of the composite system, which lead to a finite element model suitable for static and short-term dynamic analysis. Shear deformations were included to increase the accuracy, and the finite element model yielded deflections deviating less than 0.5% from theoretical results, using the transformed moment of inertia method.

For final static code checks, a staged construction analysis was performed. Non-composite stresses from the construction phase and composite states after completion were superimposed and compared to load carrying capacities of the modified composite ballroom floor trusses. The final solution used WT×325 members with overall lengths ranging from 40 to 60 ft to reinforce the bottom chords of the existing trusses. The top chords were modified to engage the existing and new floors slabs in creating composite action for added rigidity and strength. The welds for the WT shapes were designed for the shear flow along the interface with the existing truss bottom chord (see Fig. 2).

The conversion of the existing roof structure into a composite floor system was accomplished by using a new reinforced concrete slab over structural foam infill divided by a grid of supporting short reinforced concrete walls, which transmitted forces between slab and truss layers using new welded shear head connectors on the top chords of existing trusses. Transverse vibrations were controlled by introducing knee braces at the secondary beams. The new concrete floor slab had a thickness between 5 in. and 8 in. and balanced the simultaneous gain in stiffness and undesirable increase in mass. The resulting non-homogeneous mass and stiffness distribution, bridging the voids between the existing floor truss structure and new slab, was modeled in the dynamic 3D model.

For the spatially defined activity zones on the new ballroom floor, loading conditions for the "dancing" and "concert" scenarios were generated from available spectral representations. The structural response was computed and evaluated in the time domain by means of direct integration, and the response was validated in the frequency domain using spectral analysis methods. The calculated accelerations were mapped over the entire floor system for each loading condition under consideration. Computed acceleration peaks for the modified floor system were within the intervals recommended in AISC Design Guide 11 *Floor Vibrations Due to Human Activity*.

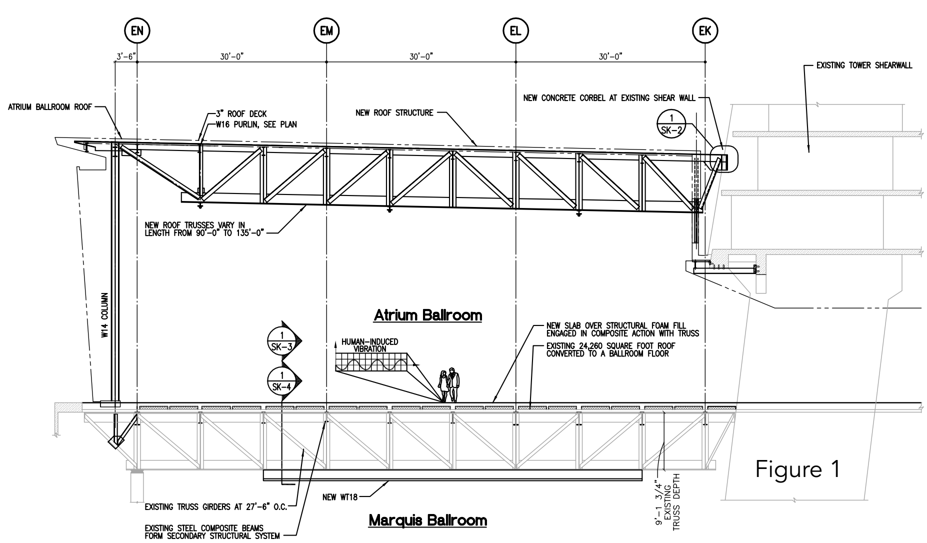
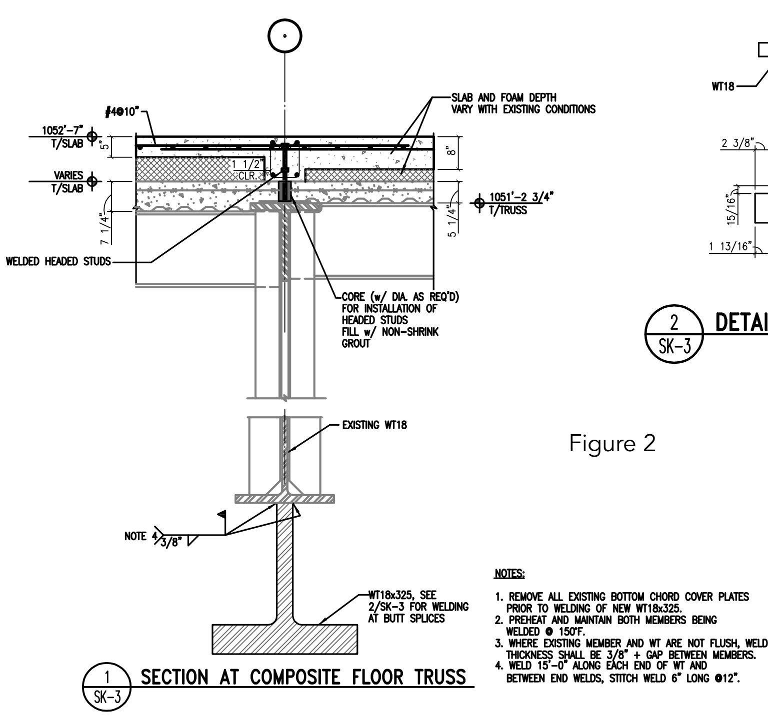


Figure 1



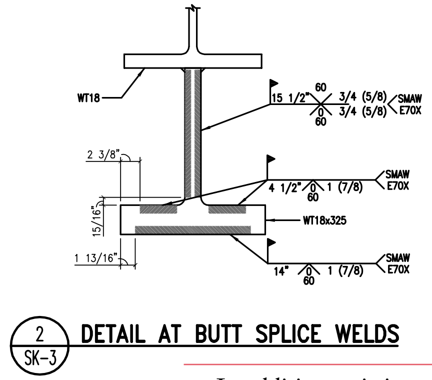


Figure 2

The renovation includes two ballrooms, one on top of the other.

Roof trusses for the Atrium Ballroom.

In addition, existing structures that were above the new floor elevation—concrete columns, stairs and trellis structures—were cut down. Concrete infill slabs on metal deck and steel beams bolted into the existing concrete were used to fill the openings.

Lobby

In the lobby area, a new 45-ft-tall steel and acrylic paneled bar—the Pulse Bar—was added, consisting of curved 8-in. hollow structural sections and rod bracing supported on four HSS columns. Holes were drilled in the existing concrete floor, and the new columns were connected to the floor by steel collars and post-installed anchors.

Also in the lobby area, the existing escalator was expanded to service more floors; openings were cut into the existing concrete floor to make room for the new escalators. The loss of continuity in several cut beams necessitated the addition of steel beams to support the concrete floor. These varied between W12 and W24, more due to the geometry of the space rather than strength. One escalator opening required the removal of an existing concrete tension tie that resisted the "scissor" forces caused by the building's shear walls. The existing tension tie system was replaced by a pre-tensioned, high-strength steel rod system placed below the floor before the existing tie's removal.

Besides escalators, several new stairs also had to be installed in the hotel to satisfy increased building code egress requirements. Floor openings were cut into the existing structure, sometimes to three levels down, requiring the reinforcement of existing steel beams and the creation of new framing using a combination of steel beams and cover plates. The project used approximately 1,025 tons of structural steel in all.

Thanks to some creative reconfiguration work, the Marriott Marquis' prime gathering areas enjoy enhanced use and life, all while keeping one of Atlanta's major hotel and convention destinations intact. MSC

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