In the Club

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One Las Vegas nightclub becomes another thanks to an intricate structural addition and reconfiguration project.

WHEN AN OLD NIGHTCLUB closes and a new one opens in its place, there are often reminders of the former venue. Not so with the Hakkasan Night Club at the MGM Grand Hotel and Casino in Las Vegas.

The new restaurant and club, located in the former Studio 54 space, is a complete transformation. The framing system is part new steel and part overhaul of an existing steel truss dome. The new six-story structure is located on the southwest corner of the existing casino and extends partially into the dome (which is not a true dome shape and would more appropriately be described as an eight-sided pyramid, with eight large raker trusses supporting six stepped octagonal "rings" of trusses). Like the new steel (totaling 1,190 tons), the steel for the original dome was fabricated and erected by Schuff Steel as part of the original MGM Grand construction project in the early 1990s.

The function of the new structure required that some of the steel of the trusses be removed and the trusses retrofitted for their new configurations. The top chords of the trusses being altered were in compression and during construction had to be supported not only vertically for gravity loads but also laterally for buckling in compression.

Another challenge was MGM's desire for the majority of the existing casino and lounge space located under the dome to remain open and active throughout the new construction. This required the design, fabrication and erection of a nearly 80-ft-tall, 200-ft-long indoor "temporary" steel wall to keep construction activities completely separate from hotel and casino guests, as well as keep the outdoor elements from affecting the inside of the hotel during the period of demolition of existing portions of walls, façade and roof areas needed to facilitate truss shoring and reinforcing. Further adding complexity was the fact that a portion of the new club and structure was to extend over and tie into the existing Rain Forest Café, which MGM also required to remain open for as much of the construction as possible. This required demolition of portions of the café and retrofitting of existing columns to support the new higher loads, new truss supports, and dance floor areas being added above.

Demolition and Shoring

Prior to construction of the main steel, the existing framing in the southwest corner of the building had to be demolished and parts of the roof had to be shored before being cut back. Coordination was required between McCarthy Builders, Schuff Steel, Lochsa Engineering and Hassett Engineering to ensure that existing steel was removed in the correct sequence to allow for new steel to be installed and also that any essential shoring was in place before vital steel removal. The first three stages of construction saw the removal of most of the existing steel between the pedestrian walkways at Las Vegas Blvd. and Tropicana Ave. up to the

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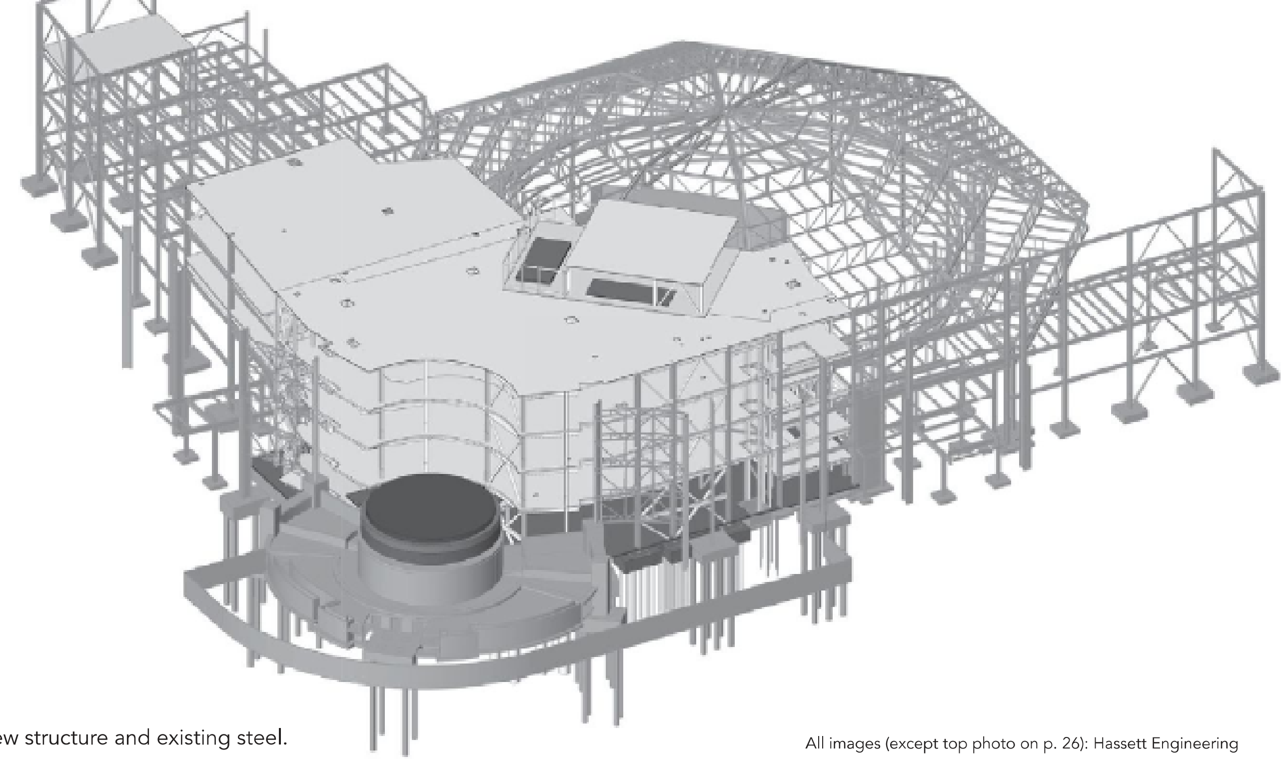

▲ New structure and existing steel.

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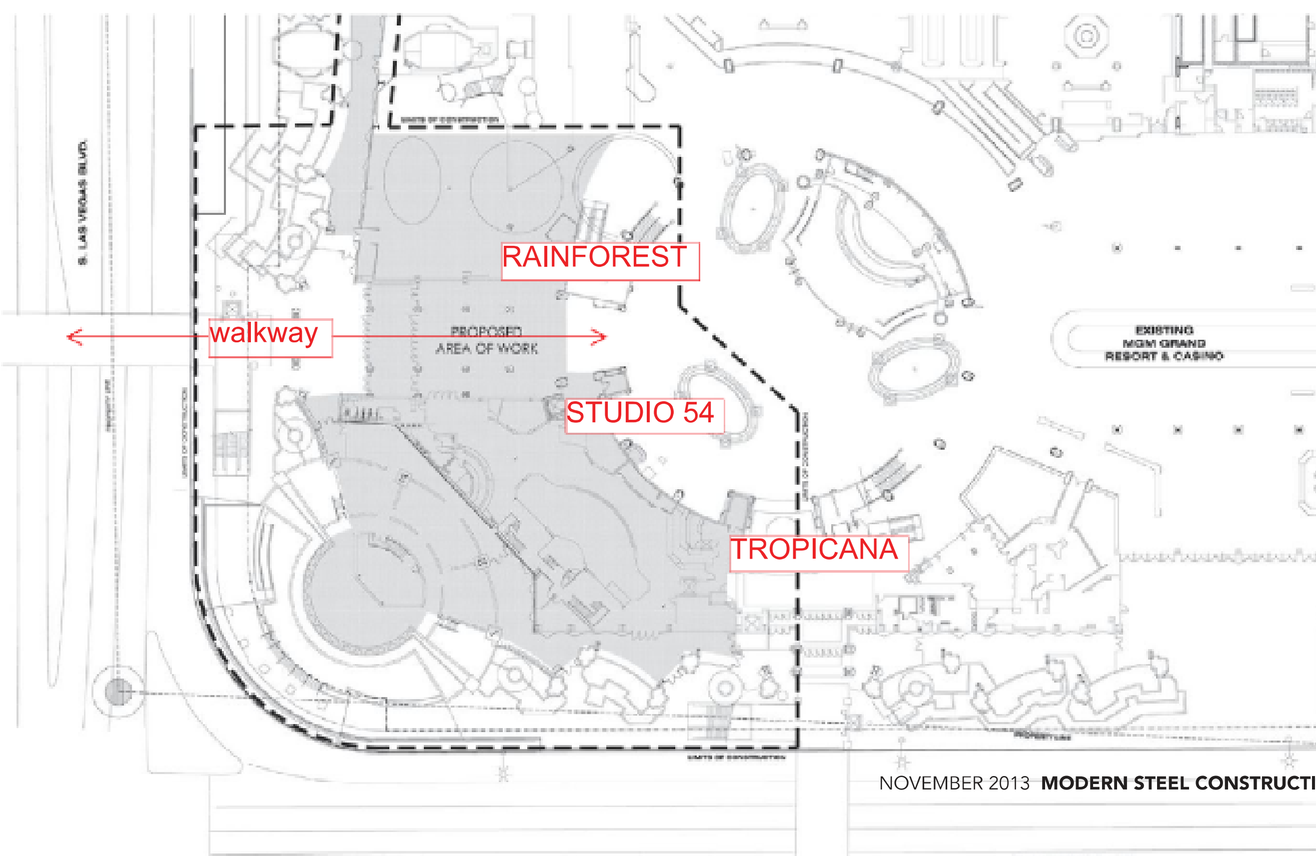
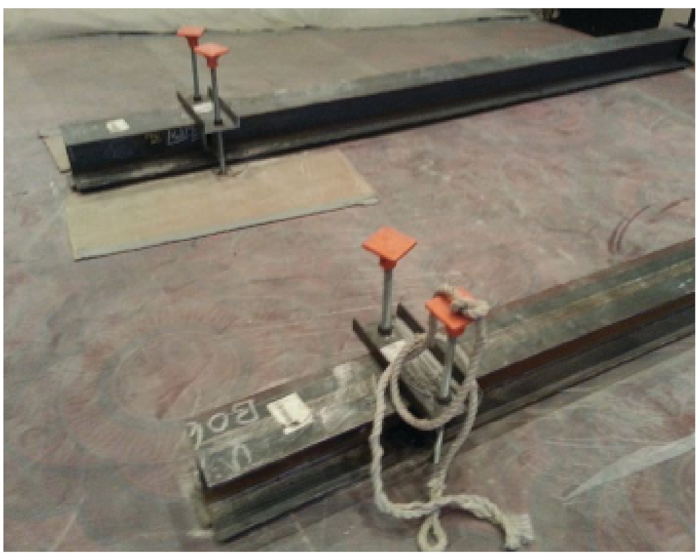
southwest side of the dome. In general, the perimeter wall framing was to remain in the final structure.

In order to cut back the roof, a shoring system was developed to support the roof beams on the steel-framed slab-on-metal-deck walkway that extends from Las Vegas Blvd. all the way into the dome. The first set of shoring used temporary HSS4×4 posts on a W8 spreader. The tops of the posts were field welded to the bottom flanges of the roof beams and W16 beams were field welded between the webs of the roof beams to prevent the bottom chords from buckling out of plane. The existing columns and beams were removed and the roof beams were cut back to allow erection of the new elevator tower.

The second set of roof shoring was on the sloped part of the walkway and used HSS4×4 posts to support six roof beams that were to be cut off and attached to new steel. Four of the shoring posts landed directly above a walkway beam and therefore did not require a spreader. However, two of the roof beams needed to be supported out over the edge of the walkway and two cantilever W8 spreader beams were added to be able to place the posts in the desired location.

▼ Areas of work.





▲ New steel being incorporated into the existing frame.

◄ Hold-downs for the cantilever spreader beams.

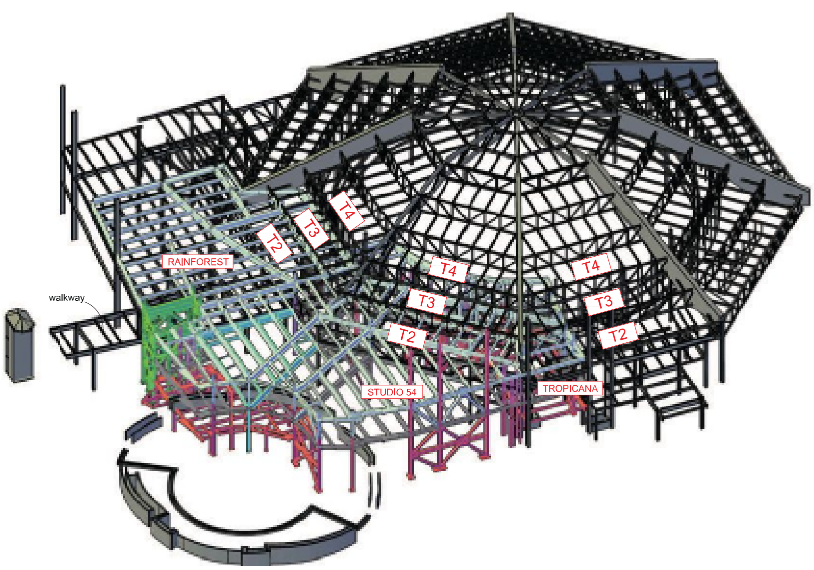
The structure of the walkway itself was not to be changed; therefore a custom connection was developed to handle the uplift load in the back-span of the cantilever spreader beams. Holes were drilled through the slab-on-deck and anchor rods were inserted with C-shapes top-and-bottom to tie the spreader to the beam below the slab. The shores were removed after the cut-off roof beams were connected to the new incoming steel.

Truss Alteration

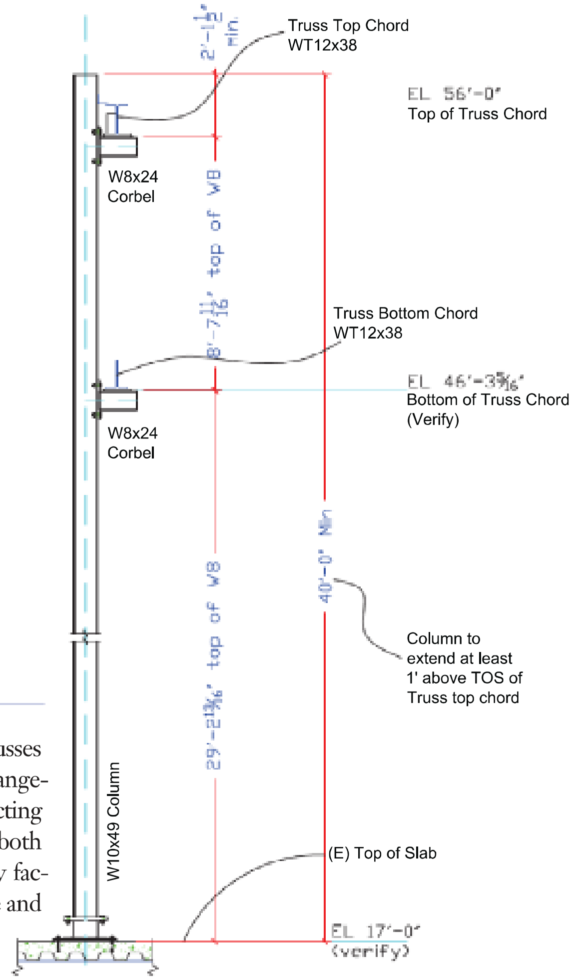
Nine trusses were altered during the erection of the new structure, three in each main area of erection. The complex and asymmetrical intermingling of the new and existing steel caused each new truss configuration and step-by-step retrofit scheme to be different. Lochsa provided the required shoring loads and the general steps to be taken to allow for new levels of steel to come in while maintaining the structural stability of the dome, and Hassett worked out more detailed procedures by coordinating closely with Schuff project managers and field superintendents.

To further complicate the erection, there were eight plate girders that were too heavy for the tower crane to set as a single piece. Splice locations were determined by Schuff and shoring had to be designed and located so that framing below was available to handle the heavy loading.

Each truss had stages of demolition and retrofit that occurred concurrently with the erection of new beams and columns. Since many of the trusses called for the diagonal members to be removed, shoring columns were designed to support the top chords using short cantilever beam stubs with bolted end plates; the typical shoring column consisted of two W8×35



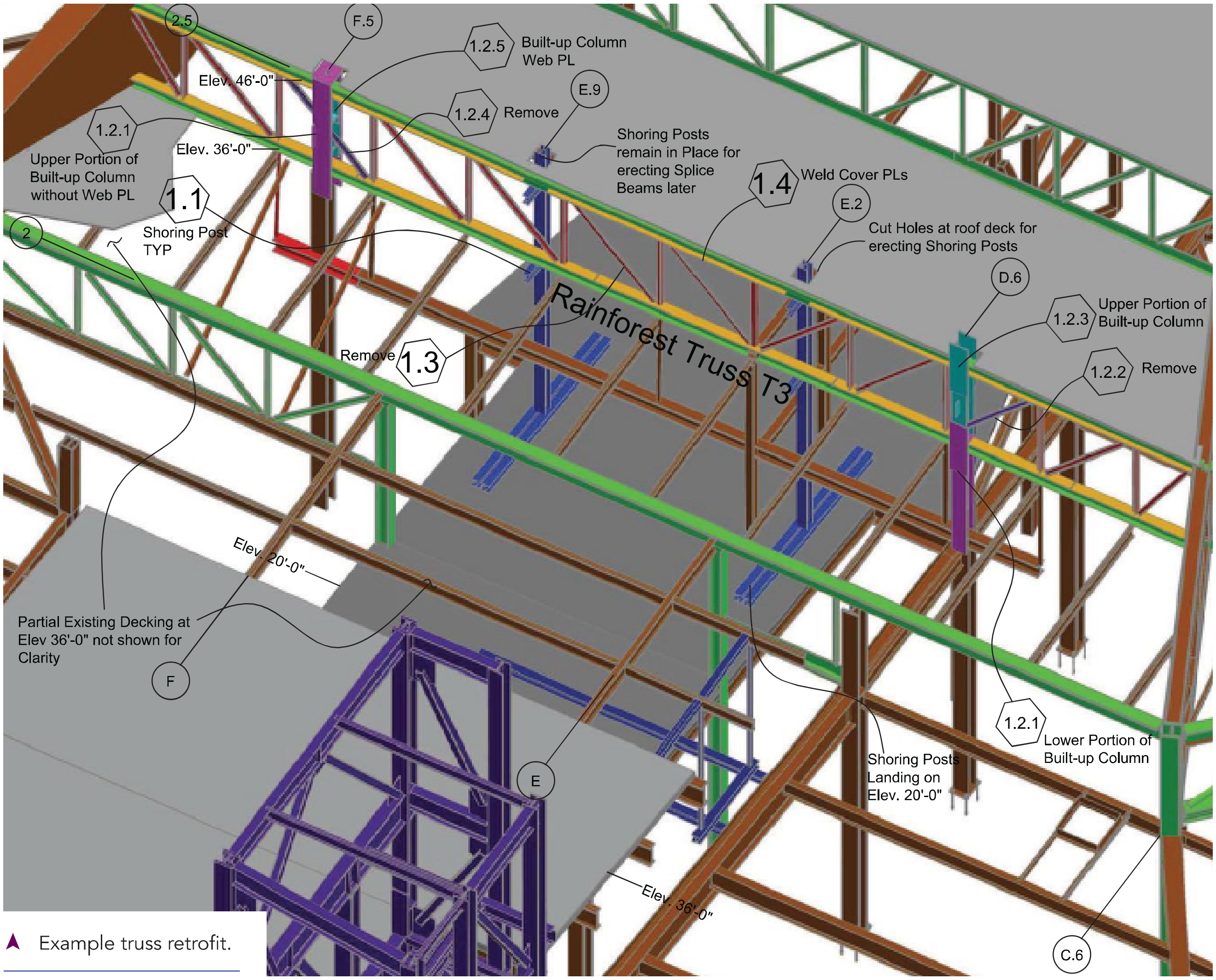
◄ New steel up to Level 4 and original steel (gray).



▲ An example truss top chord with two shoring posts.

➤ Example of truss chord shoring (side view).

spreader beams supporting a W10×49 column with W8×24 cantilevers. The trusses consisted of WT12 chords with double-angle web members. The outrigger arrangement allowed new steel to be installed in the plane of the truss without conflicting with the temporary shoring column, and also allowed for one shore to support both top and bottom chords concurrently. The shoring locations depended on many factors: the length of the truss, the location of new and existing steel, the magnitude and location of the dead and live loads and the supporting structure below the truss.



Example truss retrofit.

The erection procedure for one of the trusses is shown in the example truss retrofit above. The two shoring columns, shown in blue, were erected on the existing walkway and connected to the top and bottom chords of the truss. The built-up portion of the new column on the right (shown in light purple) was installed and connected to the bottom chord, then the built-up portion of the new column on the left was installed and connected to the top and bottom chords; the web plate was left out for the existing truss diagonal. Then the two truss diagonals at each column were removed and the erection of the built-up portions of the columns was completed (see the light-blue pieces).

The remaining truss diagonals were removed and the cover plates (shown in yellow) were welded to the top and bottom chords to allow for the increased span length of the chords. The existing roof beams provided lateral stability of the top chord for buckling in compression. In this particular example, one of the cantilever beam stubs also acted as a support for the erection of a spliced girder that was part of the Level 4 incoming steel.

The load path was followed from the truss chords through the shores into the supporting platform below. At any given truss, shore axial loads were considered and used to analyze the supporting structure below. Where required, temporary spreader beams were used under the shores to ensure that the supporting structure would not be damaged, whether it was the existing or new steel.

The erection of the Hakkasan Restaurant and Night Club, which took place between July and December 2012, presented many challenges for the design team due to its strict demolition and erection sequencing constraints. However, the retrofitting of the nine trusses, each with its own final configuration and in its unique location, was the most challenging part of the erection engineering. Removing pieces of a self-supporting dome without affecting its integrity required very detailed and complex installation that could not have been achieved without the successful coordination of the entire project team. But it was achieved, and the club opened on time in April, a complete transformation from the former space but with the same energy and glitz that defines the MGM Grand and the Las Vegas Strip in general. MSC

Owner
MGM Grand, Las Vegas

General Contractor
McCarthy Builders, Las Vegas

Architect
YWS Architects, Las Vegas

Structural Engineer
Lochsa Engineering, Las Vegas
Hassett Engineering, Castro Valley, Calif. (Shoring and Erection Stability)

Steel Team

Fabricator and Erector
Schuff Steel, Phoenix (AISC Member/AISC Advanced Certified Steel Erector)

Detailer
Dowco Consultants Ltd., Surrey, British Columbia, Canada (AISC Member)