Center Stage

By Dennis R. Tow, P.E. and Corey S. Schrauben, P.E.

Cost-effective and functionally efficient, the new Arena at Gwinnett Center opened to rave reviews.

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To meet the needs of one of the fastest-growing counties in the nation, suburban Gwinnett County, northeast of Atlanta, expanded its Gwinnett Civic and Cultural Center with the construction of the 13,000-seat Arena at Gwinnett Center. In order for the facility manager to maximize the county's return-on-investment, it was essential to create a functionally efficient building that could be booked frequently. Architect Rosser International and structural engineer Walter P. Moore and Associates met the challenge with an innovative steel roof design.

Roof Design

To accommodate show and event configurations, an arena roof must support show-rigging loads weighing thousands of pounds in numerous locations, and must be convenient for rigging crews. In that regard, an economical arena roof design is one that not only makes efficient use of material and labor during construction, but is also efficient in the use of labor during its service life.

With those objectives, the engineers and architects collaborated to create a new standard for functional efficiency in long-span arena roof design. One of the first steps was to move all of the HVAC service to the perimeter of the arena's seating bowl, eliminating mechanical ductwork within the long-span roof area.

Without the encumbrance of ductwork, the only components under the roof deck were structure, smoke evacuation equipment, and electrical fixtures and conduit. Rosser's overall form for the arena accommodated the smoke evacuation in two "gills" that projected above the main roof at approximately the third-points of the arena.

Since the arena was situated so that its main entrance was at its northern end, the gills were configured to run across the east-west width of the roof, with louvers on their southern face. To gain structural depth at the roof's mid-span without sacrificing additional perimeter wall and cladding height, the roof's profile follows a cylindrical shape and is arched in the east-west direction. The top of the gills follow a tighter radius, intersecting the main roof at either end of the main span. The curve of the main roof extends over the concourse areas out to the perimeter of the building.

Roof Structure

Although various schemes were considered during structural schematics, including a mix of composite and tied-arch framing systems, structural steel was the obvious choice for the long-span roof structure. The less obvious decision was which particular framing scheme would be best suited.

Designers chose to use the gills in the roof as primary framing elements. A "super-truss" spanning the 247′ width of the arena was located at each gill, with its upper chord inside the gill above the main roof elevation. Since the super-trusses would be the first elements erected, 6′-wide boxed trusses were selected to minimize the need for temporary erection stability bracing or additional cranes during construction. The super-trusses consist of two planes of W14 web and chord members, with maximum weights of 82 lb per ft in the webs and 211 lb per ft in the chords. The bottom chord is at a constant elevation of 71′ above the event floor, while the top chord follows the curve of the gill above. This results in a structural depth varying between 12′ and 31′. Since the depth of the super-trusses exceeded normal shipping sizes, all connections are bolted so that the truss could be assembled in the field. However, all other elements of the roof framing were shop-assembled and field-spliced where necessary to speed erection.

The super-trusses support three bays of 14 parallel-chord roof trusses spanning in the north-south direction, with the far southern and northern ends of the outer bays of roof trusses bearing on wide-flange girders at the perimeter of the arena seating bowl. The roof trusses consist of WT9 top chords and W12 bottom chords, with double-angle web members. The top-chord elevations are determined by the curve of the roof, while the bottom chord of the 10 centermost trusses in each bay is set at a constant elevation of 81′. As a result, the lines of the roof trusses vary in depth from 9′ to 12′.

The trusses also vary in length from 66′ at the corners to 124′ at the center. The longer trusses have a bolted field splice near mid-span. Otherwise, all truss panel connections are welded. Using a deeper tee section allowed more room for landing the welds for the web members, avoiding the laborious groove welding and grinding normally required for stem-plate extensions at several panel points.

W8 roof beams span the 15′ distance between roof trusses. The beams are cambered to match the gentle curve of the roof. Perforated, 2″-thick acoustical steel roof deck is rolled the "easy way" in the field and bears on the roof beams.

Above: The super-trusses exceeded normal shipping sizes. As a result, all connections are bolted so the truss could be assembled in the field. They vary in depth from 12' to 31'. Photo courtesy of Holder Construction

Below: The roof trusses consist of WT9 top chords and W12 bottom chords, with double-angle web members. Photo courtesy of Rosser International.

Rigging Grid

The use of wide-flange sections for the bottom chord of the roof trusses was based on the design team's desire to have the show/event rigging grid at the highest possible elevation, while still maintaining as little vertical conditioned space within the arena as possible. It made sense to have the truss bottom-chord elements serve double duty as rigging-grid beams. Likewise, W12 rigging-grid beams spanning east-west between the roof trusses also provide bottom-chord bracing for net-uplift conditions during a design wind storm.

The rigging grid is configured such that the central area above the event floor is capable of supporting 5,000-lb-maximum point loads, with additional surrounding areas capable of supporting 2,000-lb loads. A system of safety tie-off lines runs along the trusses for easy attachment of personnel fall-arrest systems. The result is a 15′ square grid of wide-flange beams 80′ above the floor, encompassing nearly an acre with a total rigging-load capacity of 120,000 lb.

One of the design goals was to provide the flexibility to convert the facility into an intimate theater setting. Using house-dividing curtains and wing curtains, the northern end of the arena can be configured into a 3,000-seat theater. Immediately adjacent to the northern super-truss is a flyloft for the 2,000-sq-ft theatrical stage, which resulted in a live-load demand of 200,000 lb, including capacity for future upgrades and additional rigging lines.

By stretching the roof-deck span to match the grid spacing, and having the rigging grid built into the roof structure, the design team was able to save steel tonnage. More importantly, this design resulted in a savings in the number of pieces to be detailed, fabricated, shipped, and erected. Even with the robust rigging capacities, the roof design is efficient as it clear-spans an area measuring 247′ by 365′ with a total steel weight of only 18 lb per sq. ft. Similar-sized arena roofs are typically upwards of 24 lb per sq. ft, including rigging grid framing.

Proven Performer

Due to the capabilities and adaptability of its high-performance roof structure, the Arena can host on consecutive nights an arena football game, a major rock concert, a hockey game, and a Shakespearean play. During its first full weekend in operation, the Arena hosted four different events, including two separate touring concerts and an Arena Football League game within a span of 48 hours.

The arena has already made an impact on the Atlanta market. It serves as the new home for the Arena League's Georgia Force and the East Coast Hockey League's Gwinnett Gladiators, and hosts numerous concerts. Yet despite all the action on the field, floor, ice, or stage, some of slickest moves and fastest turns occur up in the roof after the show is over and the house lights come up. ★

Dennis R. Tow, P.E., senior associate with Walter P. Moore in Atlanta, served as structural project manager and Engineer-of-Record for the Arena at Gwinnett Center. Corey S. Schrauben, P.E., is an associate at Walter P. Moore and served as project structural engineer.

Owner
Gwinnett County, Georgia

Structural Engineer
Walter P. Moore, Atlanta (AISC Professional member)

Architect
Rosser International, Atlanta

Facility Manager/Developer
SMG, Philadelphia

Contractor
Holder Construction, Atlanta

Steel Fabricator
SteelFab, Inc. of Alabama, Roanoke, AL (AISC member)

Steel Erector
Williams Erection Company, Inc., Smyrna, GA (AISC member)

Steel Detailer
Hutchins & Assoc., Inc., Clemmons, NC (NISD member and AISC Member)

Steel Deck Supplier
Consolidated Systems, Inc., Columbia, SC (AISC member)

Engineering Software
SAP2000 NonLinear

Detailing Software
Tekla Xsteel