MERIT AWARD

$100M OR GREATER

Dallas Convention Center 2002 Expansion

DALLAS, TX

Plans for the 2002 expansion of the Dallas Convention was would make the updated 290′-by-600′ building the largest column-free convention center in the country. The functional criteria established for the space included a flat ceiling 40′ above the convention center floor. The ceiling was designed to be flat in order to attach banners, lights, and other convention function props, and the module of the ceiling grid was designed to center over the electrical outlet boxes in the floor at 30′ by 30′. The goal was for the interior ceiling structure to match the existing convention center ceiling structure while providing column-free space.

These criteria required locating the long-span structure above the roof grid and spanning 190′. The basic roof structure could then remain the same. The only difference was that the roof would be supported by a structure above in lieu of columns. Trusses that span 60′ to 120′ were spaced at 30′ on center. These trusses have a maximum

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GENERAL CONTRACTOR
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FABRICATOR AND DETAILER
North Texas Steel Company (AISC member), Ft. Worth, TX

CURVED PIPE MANUFACTURER
Bendtec (AISC member), Duluth, MN

ENGINEERING SOFTWARE
SAP 2000, RAM Structural System

JUROR COMMENTS:

The use of large scale pipe (48″) for primary structure is excellent.

depth of 14′ for shipping purposes. The bottom chord is horizontal, and the top chord sloped to create the drainage for the roof structure. Bracing trusses 14′-0″ deep were situated in the transverse direction at 30′ on center, creating a 30′-by-30′ main truss grid. Shallow 30′-span bar joists were centered in each grid to reduce the metal deck span to 15′- 0″.

Seven concepts for spanning the 390′ dimension and supporting the 14′-0″ deep trusses were value engineered. Two systems were developed far enough to obtain a cost estimate from the construction manager. The two final systems were a cable-suspended system and the double-pipe parabolic arch concept, which ultimately was selected as the most economical solution.

The two double-pipe parabolic arches are supported on 5′-by-5′ concrete columns that are spaced 60′-0″ apart. The pipes also curve in the horizontal plane and lean against each other at mid span. The top chord is a bent 48″-diameter pipe with wall thicknesses that vary from $^{5}/_{8}$″ to $1^{1}/_{2}$″. The thrust of each double arch is taken by the top chord of a 14′-0″ truss centered on the concrete column support at each end. The top and bottom chords of the tension-tie trusses are 12″-diameter pipes.

In order to transfer the thrust of the parabolic arch to the tension-tie trusses, a 60″-diameter steel pressure-vessel connection was developed. The round ball configuration allowed every member intersecting at the single point to have a plane perpendicular to the member for a connection.

To facilitate erection of the pipe sculptures after the finished ceiling was in place, temporary tie rods and turnbuckles were installed and careful attention to detailing of the connection points was required. A sequence of erection and tensioning of the tensegrity system was implemented to allow removal of the temporary tie rods and installation of the completed pipe sculptures. The tensegrity system has successfully integrated the structural system into a unique artistic and architectural expression. ★

Big Bends

The entire roof-truss support system for the Dallas Convention Center was fabricated and delivered to the job site by BendTec, Inc., a pipe fabricator located in Duluth, MN that specializes in the fabrication of HSS trusses. BendTec's scope included the sizing of connections, detailing, bending of the arches, fabrication of the trusswork and delivery to the job site.

The four arches were bent from 48" OD API 5lX52 pipe using BendTec's induction pipe bending process. Pipe wall thickness varied from 0.625" to 1.5". Since the arches were parabolic, not circular, special measures were taken to guarantee the correct shape. The induction bending process utilized an electric induction coil to heat a narrow band around the pipe to a predetermined, controlled bending temperature. As the pipe was pushed through the machine at a controlled rate, a hinged arm clamped to the pipe caused it to bend. Bendtec utilized specially qualified bending procedures to control essential bending machine parameters and guarantee that required mechanical properties were maintained throughout the bend. After bending, Bendtec installed the gusset plates for the truss hangers and preassembled the arch structures in the shop to ensure correct field fit-up. Each arch was shipped to the field in nine segments ranging from 30' to 50' in length.

The arches were anchored to the north and south end trusses, supported by a total of only three columns (one on the south end truss at mid span, and two on the north end truss). The complex intersections at the corners of the end trusses where five to six members intersect were simplified by using 5'-diameter spheres constructed from hemispherical heads welded together by the SAW process. The spheres varied in thickness from 2" to 3".

The south end truss was fabricated from 30" OD by 2"-thick API 5lX52 pipe and weighs 186,300 lb. After fabrication, this truss was split into two pieces and truck-shipped from Duluth, MN to Dallas, TX. The lighter north end truss was fabricated from 30" OD by ½" API 5lX52 pipe and was also shipped by truck in two pieces.

The side trusses, which connect to the north and south end trusses, were fabricated from 24" API 5lX52 pipe with wall thicknesses ranging from ½" to 1.25". Each truss was furnished in nine shop-fabricated segments, 14'-6" wide by 30' to 58' long.

BendTec detailed the entire project in-house, developing 140 (24" by 36") drawings. Because the arches were slanted towards the center of the truss assembly, the horizontal cross braces presented special challenges to both detailing and fit-up. By accurately drawing the entire truss assembly on CAD, these connections could be isolated and patterns made for coping the cross braces to intersect the arches.

The project involved furnishing of 1,200 tons of architecturally exposed steel for the two truss assemblies. ★