Going in Circles

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Thoughtful steel details complement timber framing in this visitors' center in Winchendon, Mass.

SKILLFUL DETAILING PROVIDED THE STRAIGHTFORWARD AESTHETIC ELEMENTS OF THE ADMINISTRATION AND VISITORS' CENTER AT VETERANS' MEMORIAL CEMETERY IN WINCHENDON, MASS. This detailing allowed the connection of steel and timber to serve as an integral part of the structural and architectural themes.

Structural System

The $2.5 million administration and visitors' center is organized around a central entrance and exhibit hall with a high, pitched roof and wood deck ceiling. The ceiling is supported by exposed, sloped reverse V-shaped glued laminated (glulam) girders with tension rods at the base of the girders, which in effect create a king-post truss. The tension rods effectively absorb the tension induced at the top of the supporting columns.

Wood stud walls, constructed at the sides of the entrance and exhibit hall, act as shear walls and serve as part of the structure's lateral load resisting system. Within the side shear walls, 6" × 6" wood columns occur at each support point for the glulam girders or trusses. Support for the trusses is provided by exposed 6" square steel HSS columns as the roof structure continues outside as an entry porch. The columns are enclosed by 16"-wide masonry brick piers at the datum elevation.

Two symmetrical, curved wings consisting of offices and support facilities open from a curved single-loaded corridor in the central entrance and exhibit hall. The wings are lower in height than the central entrance area. Here the structure—consisting of 3½"-diameter steel columns with a spacing of 6'-4" along the exterior front and rear walls of the building—supports wood girders, which in turn support the 2'-0" on center wood trusses that span 22'-4" between the front and rear curved walls.

The enclosed chapel is constructed with a similar pattern. With a high ceiling and large, full-height glass windows at both the front entrance and rear elevation, the rhythmic line of exposed sloped glulam roof girders, or trusses, is visible from both ends of the building. Adjacent support spaces on both sides of the chapel are lower in height with roofing framed with conventional wood framing.

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Circular gussets provide a clean, uniform appearance.

The administration building and visitors' center is connected to the entry façade of the chapel with an unenclosed walkway. An asymmetric, cantilevered sloped roof is supported by single columns at one edge of the walkway to avoid congestion from foot traffic. Six-inch square HSS columns with eccentric footings and cantilevered steel beams were used to form the one-sided cantilevered T shape of the roof structure. Columns were designed as cantilevers, resisting moments caused by the eccentricity. Anchor bolts were designed for the moments acting at the base of the columns. Foundations were also designed in an eccentric shape for the same purpose.

Detailing for Aesthetics

Connection of the sloped 5" × 15" glulam girders to the steel and columns was made by a pre-engineered detail. This detail was comprised of twin circular steel plates welded to a vertical HSS 6 × 6.

The two plates were through-bolted through glulam girders, and the vertical steel tube was welded to the top of the steel column. In the case of the wood column, the steel tube was inserted at the top portion of the column and through-bolted for stability.

The circular shape of the connection plates provided adequate space for installation of the through-bolts. This helped avoid the usual congestion that occurs in wood connections where small steel gusset plates are used. A pair of horizontal steel plates with a vertical end plate was welded to the circular plates, creating a vertical surface for attachment of tie rods at the top elevation of the columns.

Vertical members were attached to the tie rod at mid-span. A single circular plate, with horizontal and vertical ears was welded there. The tie rods from the center of the sloped roof and the vertical members from the roof's ridge were attached to the circular plates. Turnbuckles were installed on each end of the center circular gusset to tighten the tie rods.

A similar pattern was used for the gussets in the covered walkway area. A 7" × 5" horizontal steel HSS was welded to the top of a 6" square HSS column that cantilevered on one side. A sloped 5" × 8" glulam is supported by a 2½"-diameter steel pipe column at the top and rests at the edge of the 7" × 5" cantilever beam to form the shape of the sloped roof girder. Two-inch by 8" planks with ¾" plywood topping spanning between girders form the walkway's roof structure.

The connection at the top of the columns follows the same pattern as the administration building. Circular double gussets hold the 7" × 5" horizontal steel HSS beam and the inclined 2½" diameter steel round HSS member.

Focus on Gussets

Circular gussets were feasible and advantageous for several reasons. A gusset that followed the horizontal vertical and sloped geometrical lines in the exposed ceiling structural members would not have yielded a desirable view. In comparison, the circular gusset's various lines, without sharp corners, provided a pleasant view.

Due to the large dimensions of the glulam wood girders, a large gusset plate also provided adequate space between thru-bolts, which engaged the whole section of the wood girders in resisting the applied forces.

The gusset connecting the three major elements of the roof structure—namely the steel connection of the column, the sloped girder, and the horizontal tie rod—repeated throughout the three buildings, which made the solution economically feasible.

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