A small but significant structure provides an inspiring focal point for a large healthcare complex.

Healing LIGHT

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IN 1858, the Sisters of Charity of Leavenworth (SCL) was founded with a special mission to provide service to the poor.

They founded St. Joseph's Hospital in 1873, the first private hospital in the Colorado territory. Over the years, the hospital, located just west of downtown Denver, underwent a series of expansions and renovations—and just last year was replaced by a brand new campus that includes 3.5 acres of open space.

Thin and Light

A highlight of the healthcare complex is the 3,317-sq.-ft freestanding chapel. Despite its relatively small stature, the chapel makes a big visual impact while appearing light and elegant, thanks to its appropriately light and elegant framing system. Using approximately 80 tons of steel, the system uses W24 beams to span 50 ft across the main sanctuary space perpendicular to the roof slope. Roof beams are rotated in section so that the top flange of the beam matches the roof slope, keeping the structure depth as thin as possible and simplifying detailing. At high and low eaves, W8 beams cantilever to minimize the fascia thickness, and the W24 beams that extend out into the rake framing are coped to 8 in. to maintain the same profile.

The entire south face of the chapel is a 62-ft-long by 15-ft-tall structural glass wall with glass fins perpendicular to the wall plane at approximately 5-ft intervals. While these types of systems are typi-

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- The cantilever-supported beam over the south wall.
- The chapel uses approximately 80 tons of structural steel.
- The south glass wall and repurposed stained glass.

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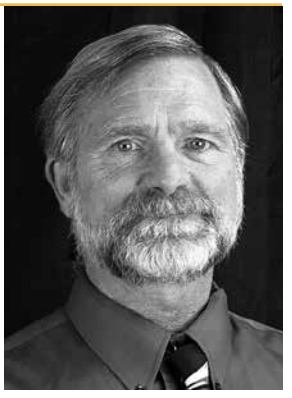
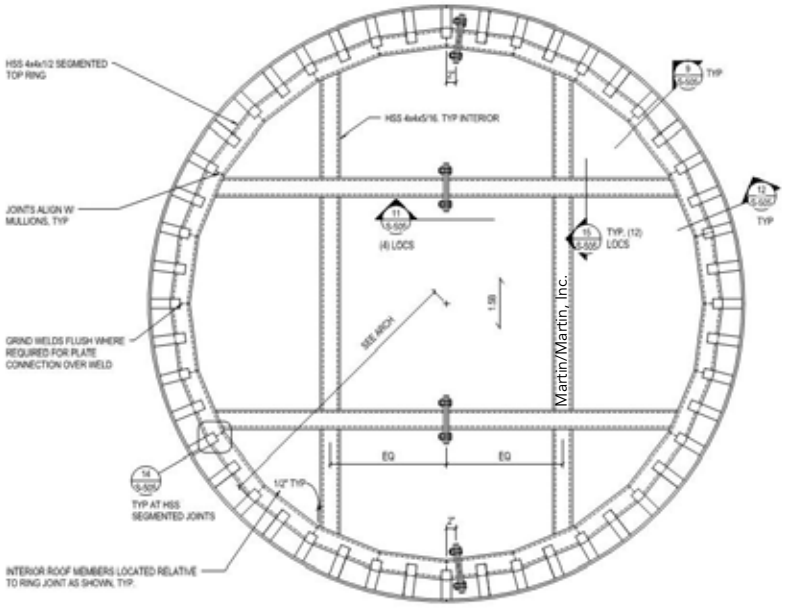
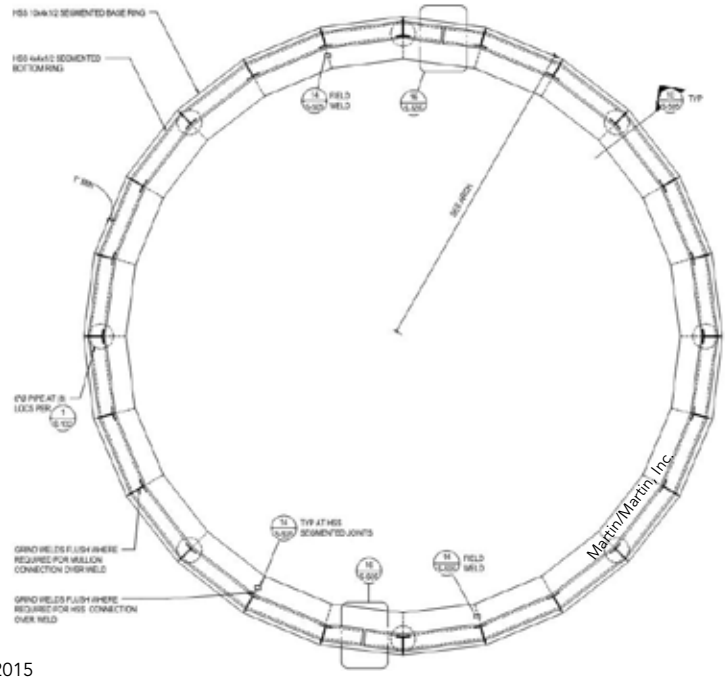




The top ring plan for the skylight.

The stained glass skylight.



The skylight's bottom ring plan.

cally hung from their structural supports, in this case the wall is base-supported in order to minimize the overhead structural depth. Above the glass wall, a W36×135 beam supports the roof and resists out-of-plane loads from the top of the glass wall. The W36 beam is supported at its west end by a column hidden in the wall, and at the east end the W36 is supported by a cantilever extending from the tower frame. The cantilevered support of the W36 edge beam allows the glass wall to be completely uninterrupted by the structure. Despite its base support, the glass wall still imposes deflection criteria on the beam above, and total live load deflections of the W36 beam were limited to 1 in. of vertical movement downward and ½ in. upward. In addition to the live load movements of the beam, structural engineer Martin/Martin specified upward camber for the cantilevered support at the east end.

Steel roof framing is supported by 6-in.-square HSS columns, approximately 27 ft tall, at the north end of the building. The east exterior wall of the building is composed of channel glass spanning horizontally between columns, which are designed to take the vertical and out-of-plane loads from the channel glass in addition to axial loads from the roof. The main roof diaphragm is supported laterally by steel X-braces composed of 3-in. angles and 6-in.-square HSS columns within sections of exterior stone-clad walls. In addition to the braces, some lateral support to the main diaphragm is provided by the tower columns. Two low, flat roof wings are supported laterally by moment frames made with W12 beams and 6-in.-square HSS columns.

Support from Above

The chapel also features a 28-ft-tall stone tower. In addition to serving as an architectural feature, its steel framing also provides gravity and lateral support to the structure. Two 47-ft-tall W18×158 columns comprise the spine of the tower framing, and a second offset frame using 6-in.-square HSS members supports the second tablet of stone. In addition, a W36×135 beam cantilevers 18 ft from the tower to support the W36 beam at the south end of the roof. The design of the tower-cantilever interface included considerations for rotations of the tower and deflection of the cantilever during erection. Tapered shims were specified at the beam-column joint to help the erector maintain tower plumbness, and an X-brace is included in the plane of the tower to provide east-west support to the main roof diaphragm.

For lateral loads perpendicular to the tower, the W18×158 columns cantilever from a 4-ft-thick cast-in-place concrete mat supported by four 24-in.-diameter drilled piers. The design team specified a fabricated stone panel system by TerraCore Panels for the tower cladding rather than traditional stone veneer. Composed of a lightweight composite backing with a thin stone face, these panels are lighter (15 psf) and more flexible than tradi-

Steel roof framing is supported by 6-in.-square HSS columns, approximately 27 ft tall, at the north end of the building.

Channel glass at the east wall.

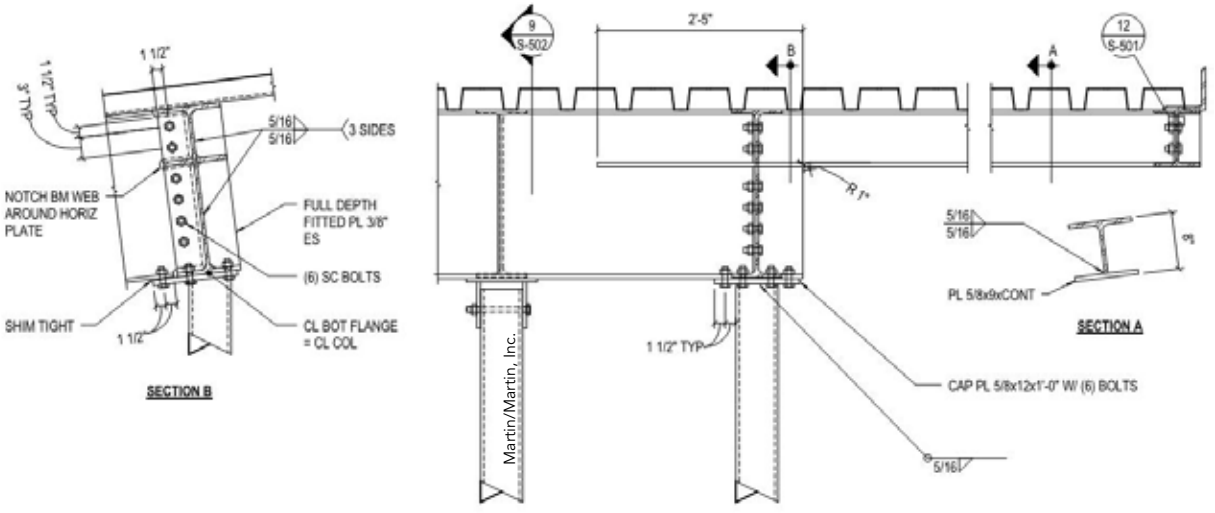
The steel beam depth transition at the east rake.

tional stone, which let the engineers design the steel support structure for higher allowable deflections than traditional stone would have allowed.

Repurposed Art

The chapel in the original hospital housed two remarkable pieces of stained glass art, which were transferred to the new chapel. The first is a series of seven, 4-ft-wide by 14-ft-tall stained glass panels supported in the new chapel structure by a series of C8 channels. The second is a drum-shaped skylight with 24 1-ft-by 6-ft-tall glass panels. A new custom steel drum structure was designed from 4-in. HSS and custom plate T-shapes. New protective glass on the exterior of the drum protects the stained glass from weather, and interior protective glass was added as well. The drum frame, which required extensive welding in difficult-to-access joints as well as heightened distortion control, was shop fabricated in two halves so that it could be customized to the sizes of the existing skylight panels (these were lifted into place and spliced together on-site).

Because hospital construction was already far along when the chapel work started, the steel team, including fabricator Zimkor, had to work within a tight "box" that was already built around the structure; the site was surrounded on three sides by the hospital and a parking garage. Fortunately, the courtyard opens to 20th Avenue, which provided access for material deliveries. In addition, the skylight frame lagged months behind the main framing for the chapel because the design team needed more time to finalize their design to accommodate the stained glass work; this required the erector to mobilize yet again after construction had progressed even further.



◀ Coped roof beams at the east rake.

The skylight and the building itself now serve as beacons of light and color on the new hospital campus, and are helping to usher in a new era for Colorado's first private hospital. ■

Owner
SCL Health

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M.A. Mortenson Company

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H+L/Davis – A Joint Venture (Denver), as the architect in association with
ZGF Architects, LLP (Portland, Ore.), as design consultant

Structural Engineer
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