Bigelow Chapel


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The Bigelow Chapel, located on the campus of United Theological Seminary, New Brighton, Minnesota, is an award-winning example of architecture as art that speaks of spirituality to an ecumenical religious community. The signature elements in the 5,300-square-foot chapel, including glass walls, column-free spaces and cantilevered roof, were made possible by the engineers at HGA Architects and Engineers.

"In order to create the lightness, warmth and intimacy that the architects desired, our team had to look beyond everyday engineering applications and find unconventional uses for conventional technology that would realize their intentions," says Tony Staeger, PE, project Structural Engineer, HGA. Most notably, the engineering team's innovative structural-engineering solutions for the chapel, the bell tower and the narthex roof supported the architects' vision.

Chapel

To create the chapel's 2,200-square-foot, column-free sanctuary, the engineers designed steel roof purlins that taper from 24-inches deep at the support end on the east masonry wall to 8-inches deep above the glass wall on the west side; the beams are connected at the deep supporting end to two roof girders (12 feet apart) that span the 57-foot width of the chapel.

The outermost girder is a tapered, welded-steel Vierendeel truss, designed so the top chord supports the main roof over the chapel and the bottom chord supports a lower roof above the processional corridor. The Vierendeel truss is free of diagonal members, thus allowing the east wall's clerestory windows to be placed within the plane of the truss. To accommodate the architecture, the interior girder is a custom steel plate girder 32 inches deep, with girder flanges not exceeding 9-inches in width. The flanges of the roof purlins were joined to the interior plate girder by moment connections so the purlins act as propped cantilevers.

With approximately three-quarters of the roof load on the east wall (substantially reducing the load on the west glass wall), the engineers intersected stainless-steel mullions (each comprised of four, 1-inch-square steel bars) with stainless-steel plates to create structural, loading-bearing columns on the steel-and-glass wall and at its glass-fin intersections.

Bell Tower

For the bell tower, the architects envisioned two slender 40-foot-high walls with 2 feet of clear space between them. The engineers created two, 9-inch-thick cast-in-place concrete slabs that narrow to 6 inches at the top, to accommodate the 4-foot-square panels of precast-concrete, Travertine-style veneer. The veneer was stacked without mortar to enhance the look of actual stone.

To stabilize the walls, a series of 5-inch-diameter steel pipes were placed horizontally between the towers at heights of 9 and 29 feet. Like the floors of a multistory building, the pipes — in concert with the walls — act as rigid frames. The upper pipes also became the support structure for the bell tower's chimes.

Fact Sheet

Start Date: *Summer 2002*

Completion Date: *August 2004*

Budget: *$3,000,000*

Campus: *10.5 acres*

Arranged in a 'U', the campus includes a library, classrooms, residence hall,café, bookstore and a faculty / administration building.

Bigelow Chapel is located on the eastern edge of the campus adjacent to the classroom building.

Project Dimensions:
5,300 square feet

Sanctuary (2,200 square feet of worship space with seating for up to 220), Processional, Narthex Bell Tower, Support Area (Public Restrooms, Chaplain's Office, and Mechanical Room)

Landscaping:
The Laura Shannon meditation garden features a musclewood tree surrounded by flagstones

Narthex Roof

To repeat the slender forms of the sanctuary wall's glass fins and the bell towers, the engineers constructed a thin, cantilevered roof off the back of the narthex. The roof consists of a 14-foot cantilever joined to a 15-foot backspan by two short 2 ½-inch stainless-steel pipe posts secured to the lower roof, which is flush with the building entrance. The pipes are secured deep enough between the two roofs to not interfere with what appears to be a 29-foot-long cantilever (which is what the architects' originally specified). A concrete shear wall supports the backspan and stabilizes the entire roof system.

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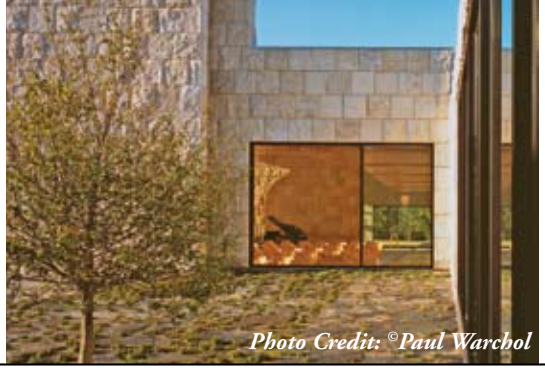
For decking, the engineers used a ¼-inch steel plate custom detailed at the top to connect with the roof beam, and secured with closely spaced, pre-drilled plug welds. In this way, the steel plate also stabilizes lateral loads, and its innovative moment connections provide the required continuity between backspan and cantilever sections.

Through these innovations, new ideas were brought to life through existing technology, the HGA engineers created the appearance of gravity-bearing glass walls, slender freestanding towers and a cantilevered roof. In the process, the engineers elevated, rather than compromised, the architects' vision for Bigelow Chapel.▪



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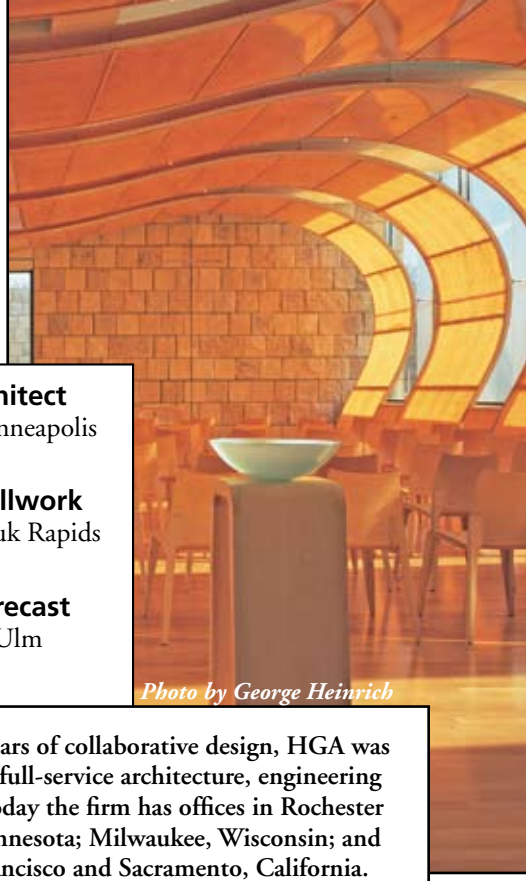

Photo by George Heinrich

Bigelow Chapel Team

Owner
United Theological Seminary, United Church of Christ

Project Architect
HGA

Structural Engineer
HGA

Mechanical Engineer
HGA

Electrical Engineer
HGA

Lighting Designer
Michael DiBlasi, Schuler Shook
Minneapolis, Minnesota

Contractor
M.A. Mortenson Company
Minneapolis, Minnesota

Landscape Architect
Coen + Partners, Minneapolis
Minnesota

Architectural Millwork
Wilke Sanderson, Sauk Rapids
Minnesota

Architectural Precast
Artstone, New Ulm
Minnesota

Celebrating over 50 years of collaborative design, HGA was founded in 1953 as a full-service architecture, engineering and planning firm. Today the firm has offices in Rochester and Minneapolis, Minnesota; Milwaukee, Wisconsin; and Los Angeles, San Francisco and Sacramento, California. For more information, visit *www.hga.com*.