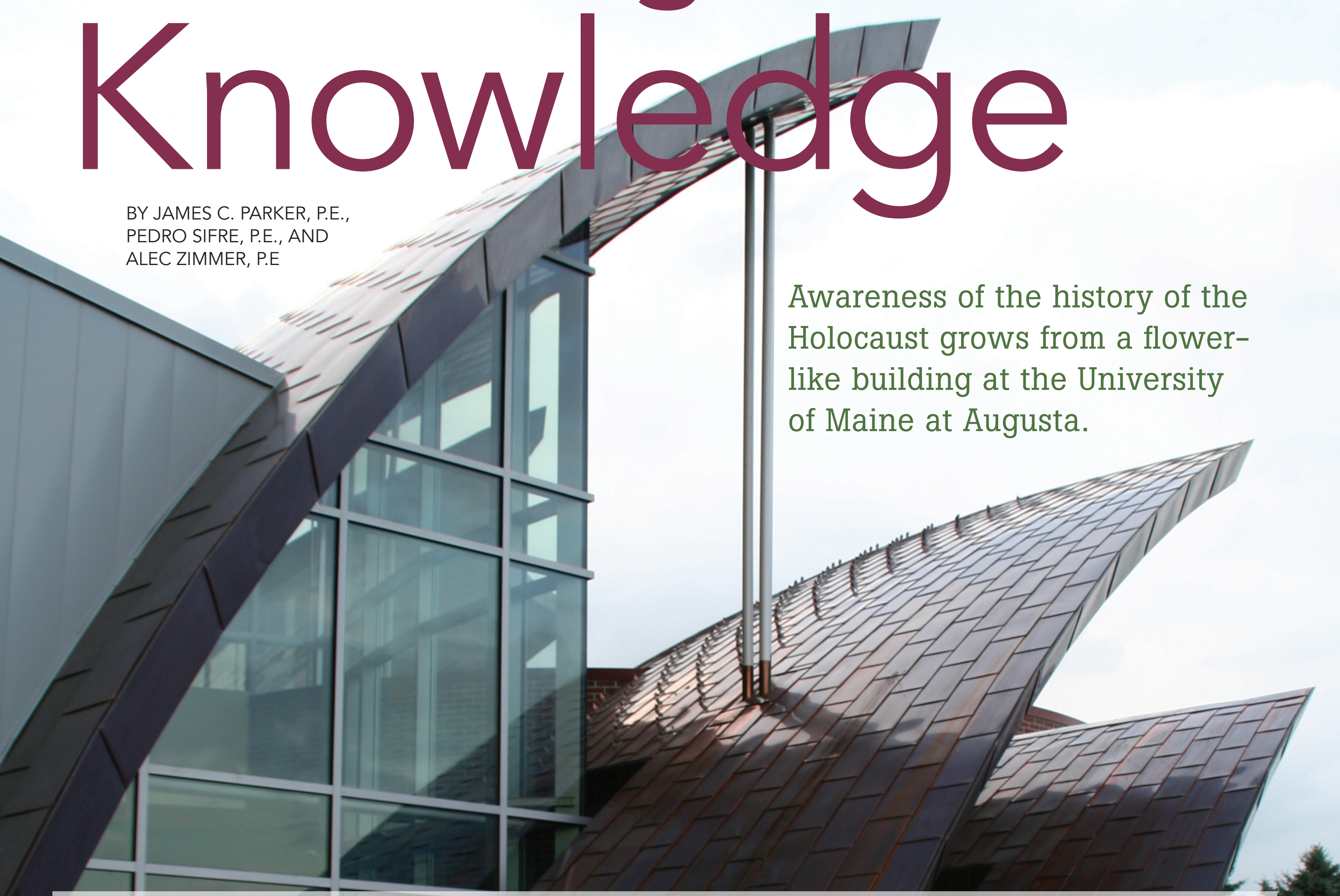
Blossoming Knowledge

BY JAMES C. PARKER, P.E.,
PEDRO SIFRE, P.E., AND
ALEC ZIMMER, P.E

Awareness of the history of the Holocaust grows from a flower-like building at the University of Maine at Augusta.



IN 1984, A SEMINAR AT BOWDOIN COLLEGE in Brunswick, Maine called "Teaching about the Nazi Holocaust in Maine Schools" inspired a number of participants to found the Holocaust and Human Rights Center (HHRC) of Maine the following year. Since its founding, this organization has developed a lending library of materials on the Holocaust and human rights issues, and it regularly sponsors multi-day seminars for students and educators on these themes.

In 2004, the HHRC, looking for a permanent home, sponsored an international competition to design a new building on the campus of the University of Maine at Augusta (UMA); the competition drew more than 200 entries. Boston-based architecture firm Shepley Bulfinch Richardson and Abbott (Shepley Bulfinch), with the assistance of structural engineering firm Simpson Gumpertz and Heger's (SGH) Waltham, Mass. office, prepared the winning entry for the design competition.

The result is the Michael Klahr Center (MKC). Named in honor of a Maine resident who survived the Holocaust, the Center is a 6,300-sq.-ft, one-story building that houses classroom space, administrative offices for the HHRC, and a soaring atrium that can be used for temporary exhibits and functions. The centerpiece is a permanent exhibit space that tells the stories of Holocaust survivors from Maine through their own words in an audio-visual presentation. The MKC is situated on a low hill at the southeastern edge of the UMA campus along Jewett Road and is linked to the Bennett D. Katz Library, helping to enclose an existing academic quadrangle.

A Symbol of Preservation

Shepley Bulfinch's massing for the MKC is a visual metaphor for the HHRC's mission to educate visitors about the Holocaust and other human rights abuses. Like a seed that preserves and perpetuates a flower, the cylindrical permanent exhibit space at the center of the structure is dedicated to preserving the stories of Holocaust survivors for future generations. Four light-filled, flower-like petals spring from the ground around that central focal point, reminding visitors of the rebirth of human rights, freedom, and democracy after the long, hard winter of World War II. Bundled pipe columns that support the petals extend the floral metaphor by evoking stamens. As visitors leave the permanent exhibit space, they pass beneath and through the light-filled petals into the classrooms and meeting rooms on the north side of the building. The ground to the south of the structure slopes down, following natural grades into a space that will, some day, become a landscaped amphitheater.

The petals are clad in copper panel shingles.

photo by SGH/Alec Zimmer

While the building's gross floor area is relatively small, the design was not without its challenges. The steeply graded amphitheater to the south of the structure necessitated that the footings for the cylindrical permanent exhibit space be well below the footings of the petals and the classroom spaces. Dropping these footings to stay below the 5-ft frost protection depth at the lowest point of the amphitheater brought the footings close to an existing 30-in.-diameter storm drain that bisected the site. In several areas, the foundation walls had to be designed to bridge the storm drain.

The classroom areas on the north side of the building are conventionally framed with structural steel wide-flange non-composite beams and columns with 3-in. roof deck. The lateral load resisting system consists of structural steel concentrically braced frames not specifically detailed for seismic resistance (R = 3) with hollow structural section (HSS) brace members. The gravity framing was designed using RAM Steel. In addition to the lateral loads imposed by wind and seismic forces, the lateral load resisting system also resists forces from the two largest petal structures. Although these petals extend to the ground and are supported by columns, the flat roof above the classrooms provides additional out-of-plane restraint for the petals, and these restraining forces were combined with the wind and seismic forces for the brace design. The petal structures, in turn, provide nominal in-plane frame action to the building.

The roof of the cylindrical permanent exhibit space consists of 3-in. roof deck and non-composite structural steel wide-flange beams framing to load-bearing concrete masonry unit (CMU) walls. This structural steel framing also supports two of the bundled pipe columns and part of one of the petals. The smallest of the petals attaches to steel wide-flange columns embedded within the CMU wall of the exhibit space.

Steel Petals

Because the HHRC built the MKC on a total budget of only $2.8 million, structural steel proved essential to realizing the architect's vision for the building. Although the sculptural forms of the petals were well-suited to cast-in-place concrete, the expense of the curved formwork and the construction schedule demanded a different structural system. The design team also considered using glue-laminated wood beams to create the petals, but the architect's requirement that the petals not exceed 12 in. in thickness (including cladding) precluded this system. In response to the sculptural demands of the petal architecture, SGH developed a structural system consisting of a grid of HSS sections using curved HSS8x8s as the ribs along "meridians" of the spherical petal sections and straight HSS4x4s along "parallels of latitude" of the petals. The HSS grids, moment connected in-plane and strategically braced in certain bays, provide the petal structures with shell membrane action. Selecting steel for the petals allowed for portions of the petals to be shop fabricated, speeding construction considerably. The petals bear partially on painted architecturally exposed structural steel (AESS) bundled columns consisting of three 3-in.-diameter pipe sections that diverge as they rise to meet the petals. SGH modeled the petal structures with RISA 3D based on 3D geometry provided by the architect. To check the demands and capacities of the petal rib and parallel elements, SGH developed a post-processor in Excel to compare the member capacities and demands.

The fact that the architect agreed to base the petal shapes on spherical shell geometry proved beneficial in design, fabrication, and construction. Shepley Bulfinch used Bentley Architecture building information modeling (BIM) software to produce a 3D model of the building. The BIM model helped the design team determine the

SGH/Alec Zimmer

View of the south façade of the Michael Klahr Center, showing all four petals.

SBRA/Harold Hon

The structural steel frame above the classrooms on the north side of the building is erected and temporarily braces Petal 2 as it cantilevers over the permanent exhibit space.

SBRA/Harold Hon

View from the lobby of the architecturally exposed structural steel that supports the curtain wall; outside the glass, the two smaller petals frame to steel columns embedded in the masonry wall at left.

complex geometry of how the petals relate to the other portions of the building. It was particularly useful in assessing how the openings in the petals relate to the structure. For each petal, the geometry was clearly defined using spherical coordinates originating from a geometric center defined in relation to the building grids. The structure and all of the finishes were defined by varying radii. For each petal, the HSS meridians are bent following a radius with a constant curvature. The reduced dimensions of the straight segment latitude sections allowed them to remain within the spherical structural envelope. This decision reduced the cost of bending the shell steel by half.

SGH also developed a system of wood-framed box beams consisting of 2x4s and plywood that span between the ribs of the petals. These box beams, spaced at 2 ft on center along the ribs, provided a convenient way for the contractor to sheath the petals in plywood and install the standing seam copper roofing panels.

Independent Entrance

The connector to the adjacent Katz Library is the new main entrance to both buildings. The connector's structure is laterally independent of both the library and the MKC. The roof of the structure is framed with 3-in. roof deck supported on tapered structural steel wide-flange sections and HSS columns. Lateral load resistance is provided by moment-frame action between the columns and the roof beams. All the steel in the connector is AESS.

Constructed in 1974, the Katz Library is a load-bearing CMU wall building with an open-web joist roof. The portion of the building immediately adjacent to the connector structure formerly housed a lobby, restrooms, audio-visual equipment storage, periodical storage, and the circulation desk. The renovation plans called for this space to be entirely reprogrammed to make way for a new lobby, circulation desk, and access to the MKC. The plans included removing a major interior load-bearing CMU partition and creating a new door opening in the exterior load-bearing CMU wall at the connector. SGH reviewed the original contract documents for the building and investigated the condition of the existing structure, then determined that the seats of the existing roof joists were not adequately braced to prevent sliding. To remove one of the bearing walls, installation of a new structural steel beam was required. The new beam is supported at one end by a steel new HSS column and at the other end by an existing steel column that needed to be reinforced to support the additional load. MSC

James C. Parker is a senior principal with Simpson Gumpertz and Heger's Los Angeles office. Pedro Sifre is a principal and Alec Zimmer is a senior project manager, both with SGH's Waltham, Mass. office.

Owner
Holocaust and Human Rights Center of Maine, Augusta, Maine

Architect
Shepley Bulfinch Richardson and Abbott, Boston

Structural Engineer
Simpson Gumpertz and Heger, Inc., Waltham, Mass.

General Contractor
Wright-Ryan Construction, Inc., Portland, Maine

Software
RAM Structural System, RISA 3D