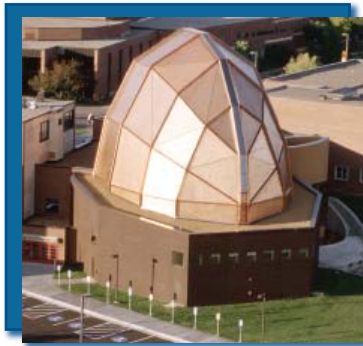


# Award Winners

## Weber Music Hall

*Weber Music Hall was presented an Outstanding Project Award (New Buildings under \$10 Million) in the NCSEA 2004 Excellence in Structural Engineering Awards program.*



“It sounds better,” is encouragement the UMD Director of Orchestras usually offers the musicians as they refine their craft. This praise, however, was directed not toward the brass section, but the steel sections 80 feet overhead at the Weber Music Hall on the Duluth campus of the University of Minnesota.

Completed in 2002, the state-of-the-art auditorium fulfilled the University’s request for flexibility and adequate performance space. Stretching the roof upward and displacing mechanical equipment rooms to the side and below grade achieved the required interior volume and functional utility within a small footprint.

Architect of record, SJA (Duluth, MN), teamed with design architect Cesar Pelli & Associates and acoustic consultant Jaffe Holden Acoustics, Inc. to fulfill the program needs. Meyer, Borgman and Johnson, Inc. (MBJ), with offices in Minneapolis and Duluth, MN, was structural engineer of record for the \$9.2 million facility.

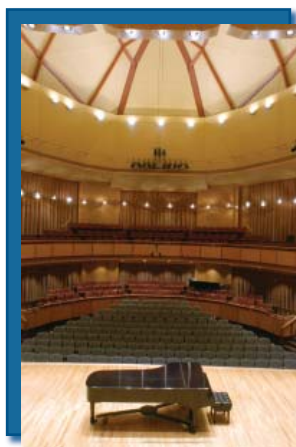
MBJ engineers evaluated several structural solutions in response to the tight site and to the various challenges posed by the architects. A steel frame was ultimately selected for the “dome” and cast-in-place concrete with reinforced masonry for the balance of the structure. Initially working from hand-drawn schematic sketches, MBJ collaborated with the architects to develop a digital model of the complex dome. Selected structural members were exposed on the interior to create ribs and horizontal connecting elements on the ceiling. Visual distractions (including some structural members and building systems) were concealed within the structure between finishes.

Following creation of the initial digital model, several design iterations resulted in a coherent structural strategy to satisfy the acoustic and architectural requirements of the program while simplifying the structure. In its final design, the dome was broken into facets whose boundaries were expressed by wide-flange and HSS sections. Most facets also contained hidden structural members to brace the panel and support the steel roof deck. A system of plywood, insulation, waterproof

membrane and copper shingles formed the exterior skin of the “dome.” The complex surface required nearly all structural members support roof deck. Design challenges included the multi-member structural connections at nodes and the need to maintain surface work-points for the different trades to attach systems and finishes.

The digital model was imported into a three-dimensional STAAD file and analyzed for numerous load cases. MBJ designed all connections and provided construction details using simple connections that were easily adapted to the varying slopes and unusual member intersections. Connection design anticipated the need for a flexible erection sequence that provided greater safety during construction. The simplification of connections also took advantage of the member organization created by the structural engineers.

MBJ established work points for all defining members of a surface. These surface work points were given numbers and their coordinates scheduled on the drawings. Structural members were given numbers corresponding to their location relative to the work points and identified by member type within a schedule. All member and surface work point numbers complemented each other and provided a logical reference to the building grid.



The suspended orchestra canopy (acoustic cloud) is constructed from HSS sections and supports lighting and future equipment. The angular surfaces of the cloud enhance the acoustic performance of the hall and bring a sense of intimacy to the overhead volume. The cloud is suspended by tensioned wire rope braces, fulfilling the architect’s request that the cloud “float.” Oriented along the main axis of the hall, a continuous two-foot wide skylight brings in daylight and creates a dramatic, beacon-like effect at night.

Following award of the construction contract to Oscar J. Boldt Construction Company (Cloquet, MN), the digital model was shared with steel detailers Dowco Consultants Ltd. (Burnaby, B.C. Canada). Dowco generated three-dimensional images of connections that could be further modified by the design team to accommodate aesthetic and functional concerns before the structure was erected. Shop drawings were created from the model and supplied to the steel fabricator, Northshore

Steel (Two Harbors, MN) for fabrication. The general contractor erected 120 tons of structural steel in approximately three months with minimal fit-up problems related to the steel frame.

The selection of a structural steel dome allowed a complex shape to be constructed logically and efficiently. Weber Music Hall blends the creative expertise of engineers and architects with that of UMD’s musicians for the benefit of all who visit this world-class music performance facility. ■

