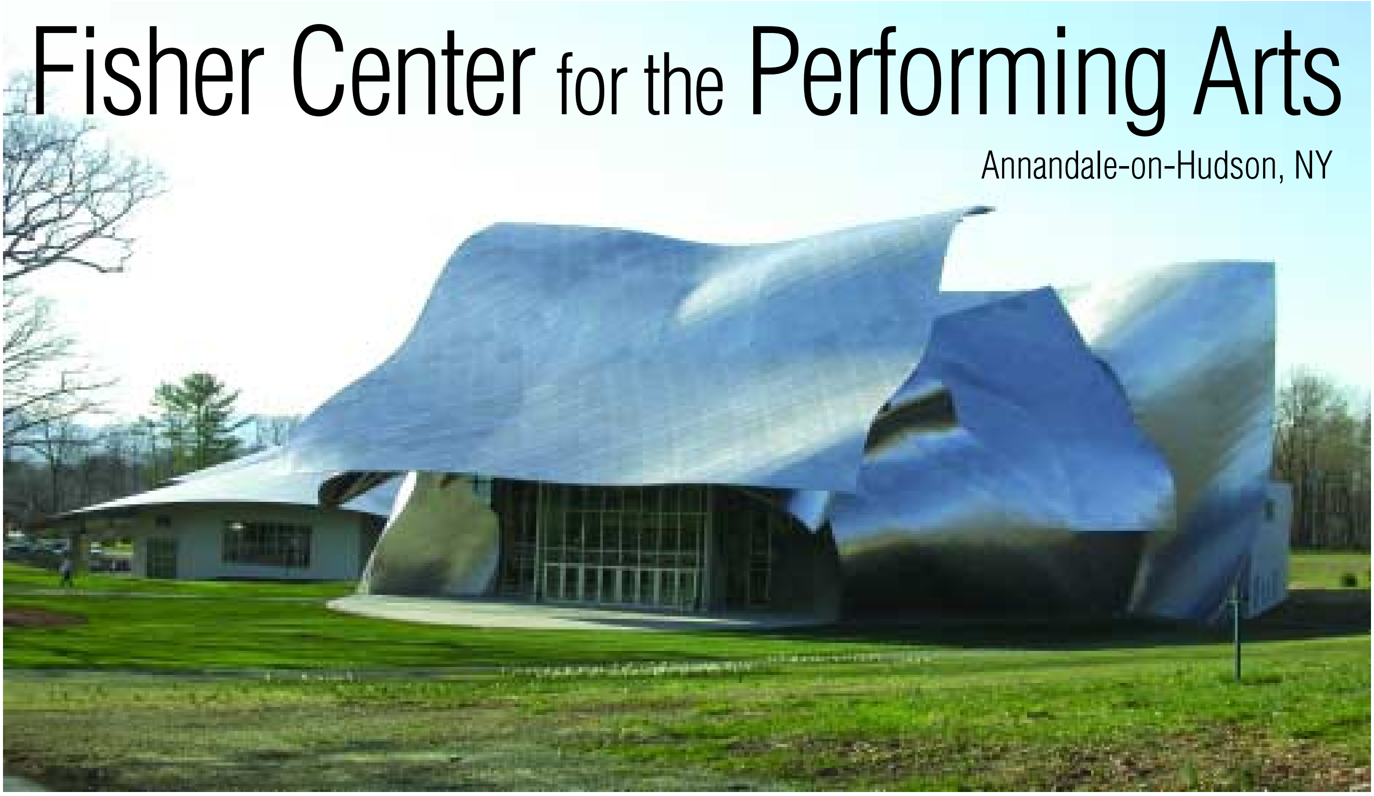
Fisher Center for the Performing Arts

Annandale-on-Hudson, NY



The $62-million Richard B. Fisher Center for the Performing Arts houses the campus's opera, dance, and orchestral productions as well as the school's theatrical teaching facilities. The 64,000 sq. ft complex comprises two distinct buildings that are linked by public assembly spaces and back-of-house infrastructure.

The design solution sought to satisfy the project's structural, aesthetic and programmatic requirements, and the final design is a harmonious blend of three distinct building technologies. To satisfy the acoustic requirements of the theatrical spaces, cast-in-place reinforced concrete was chosen for the main performance hall, and solidly grouted reinforced concrete masonry for the teaching facility. However, to meet the design's challenging long-span and aesthetic requirements, structural steel was used at roofs, at areas interconnecting the theaters and at other sculpted exterior surfaces. The complex coordination of these three structures demanded a variety of expertise and fastidious attention to detail.

The Fisher Center is notable for its innovative use of steel. The enclosure elements are the singular and most obvious steel element within the design. Soaring to heights of up to 100′ and cantilevering out to dramatic piercing knife-edge corners, steel was an ideal choice as it met both the aesthetic and structural requirements of the flowing Frank Gehry design. CATIA, an advanced three-dimensional modeling software, was used to define, dimension and coordinate the design and construction of this sculptural masterpiece. Three-dimensional modeling was an integral part of the design process from concept, to system interference checking, to shop drawings, and facilitated a seamless construction process.

Juror Comment

"Nicely executed design, detailing and erection to solve a complex shaped building."

The building's primary support steel is composed of rhythmic two-dimensional planar curved steel members, which are braced by web-like trusses of

Architect
Gehry Partners, LLP, Los Angeles

Structural Engineer
DeSimone Consulting Engineers, P.L.L.C., New York City

General Contractor
Daniel O'Connell's Sons, Holyoke, MA

Steel Fabricators
Berkshire Bridge & Iron Co., Inc., Dalton, MA (AISC member)

Columbia Wire & Iron Works, Portland, OR (AISC member)

Steel Detailer
Angle Detailing, Inc., Wilsonville, OR (AISC member)

Engineering Software
RISA-3D, ETABS, SAFE

straight, universally oriented diagonal elements. While there are now several completed Gehry projects featuring this type of undulating metal roof surface, the performing arts center is the first design to expose the supporting structural framework at the building's interior.

In addition to exposing the structure, interior finishes were deleted, leaving the ribbing of the metal panels exposed. To finish the surface, industrial stainless steel shingles were field applied to shop-built light-gage metal panels that clip to the structural steel elements. This skin met the design's industrial aesthetic requirements, and also met the design's cost and functional needs, providing both an economical finish grade solution and a functional external thermal and moisture envelope. At the more expansive volumes, the structural frame supporting the panels used an efficient truss work of steel members. The primary wide-flange shapes were curved to meet the undulating surface.

The lobby and front entrance sidewalls also feature exposed, custom-built steel shapes. These wide flange shapes were built-up from high strength structural plate, which had been CNC (computer numerically controlled) produced from computer data generated in CATIA. Thus, the resulting elements match and meet the shapes exactly. After the web CNC is cut, the flanges were CNC-bent on the weak axis (adjusting the curvature along each inch of length), and the resulting shapes were then assembled on a large setting bed and machine-welded at the interfaces. Many of the shapes were long and irregular, requiring that splices be made for trucking purposes. The bolted splices were all assembled in the shop to insure the tolerances of the bolt fit-up as well as continuity of the desired curvature.

The process of erecting the 60′- to 90′-long curved ribs was simplified by a few key design decisions. First, it was determined that the curved vertical elements would not act as columns. Placing load on a buckled shape substantially increases lateral deflection and member size, and necessitates fire-protecting the steel for the first 20′, all of which would destroy the building's aesthetic lines. Cantilevering the roof steel from the cast-in-place walls allowed the design to avoid these difficulties. It also enabled the ribs to be thinned down. With the weight of the metal panels resting on the foundation walls and leaning against the diaphragm of the main roof through slotted connections that accommodate deflection, the ribs only needed to support their own weight.

At the Sosnoff Theater there are six different rib clusters that function together as a single braced unit. There are approximately 1000 brace-member connections, each with a unique vertical and horizontal angle. Setting the ribs individually would have required a complex and cumbersome system of temporary guying. To save time and cost, the permanent bracing was installed concurrently with each pair of ribs. To further simplify the process, a singular unique brace connection was designed to satisfy all details. The cut-to-length horizontal and diagonal steel angle braces span between ribs, pivoting on the single end hole to achieve the required spatial angle at the connection. The members are secured by male and female-ended D-shaped gusset plates above and below, and each has the ability to rotate independently to receive single-bolted diagonal members at different and unique angles. The design allowed for two adjacent ribs to be set with the bracing pivoted into place in a matter of minutes.

While the building's steel structure excels aesthetically and technologically, the process also proved cost and time effective. Change orders traditionally play a very important part within any design process, and are a direct reflection of the quality of the design documents. In the case of the Fisher Center, the design documents not only included the customary plans and specifications, but also the three-dimensional CATIA models. The fully coordinated CATIA models, which specifically addressed the building's steel components, made it possible for the construction team to better understand the building prior to construction commencement, resulting in substantial change-order savings. The clarity they provided enabled change orders to be held to a minimum, totaling only 1.3% of the contract value, a result which would be desirable for any project, let alone one with the theatrical and architectural complexity of the Fisher Center. ★

Read more about the Fisher Center for Performing Arts in the January 2004 issue of Modern Steel Construction *at www.modernsteel.com.*