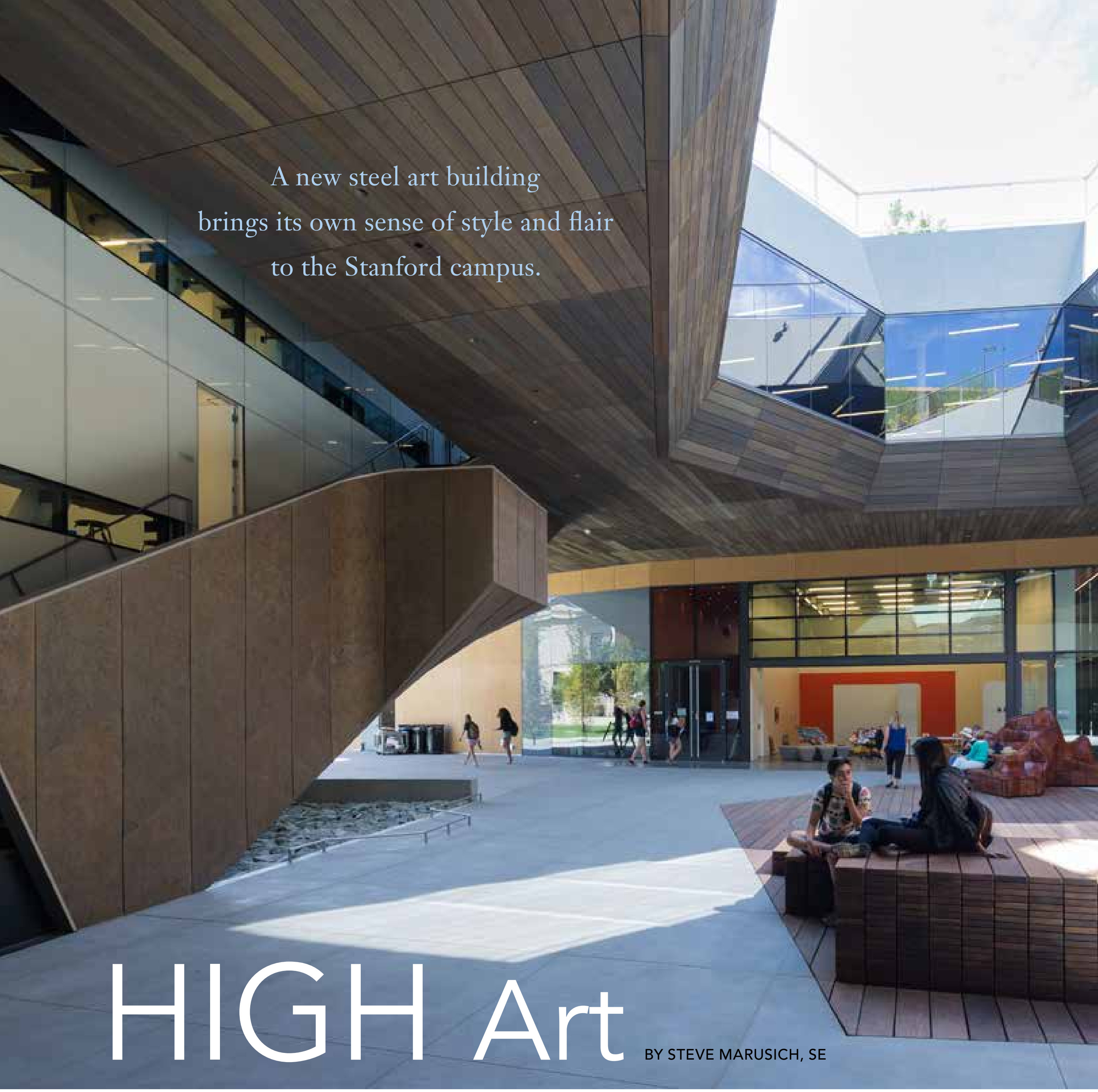


A new steel art building brings its own sense of style and flair to the Stanford campus.

HIGH Art

BY STEVE MARUSICH, SE

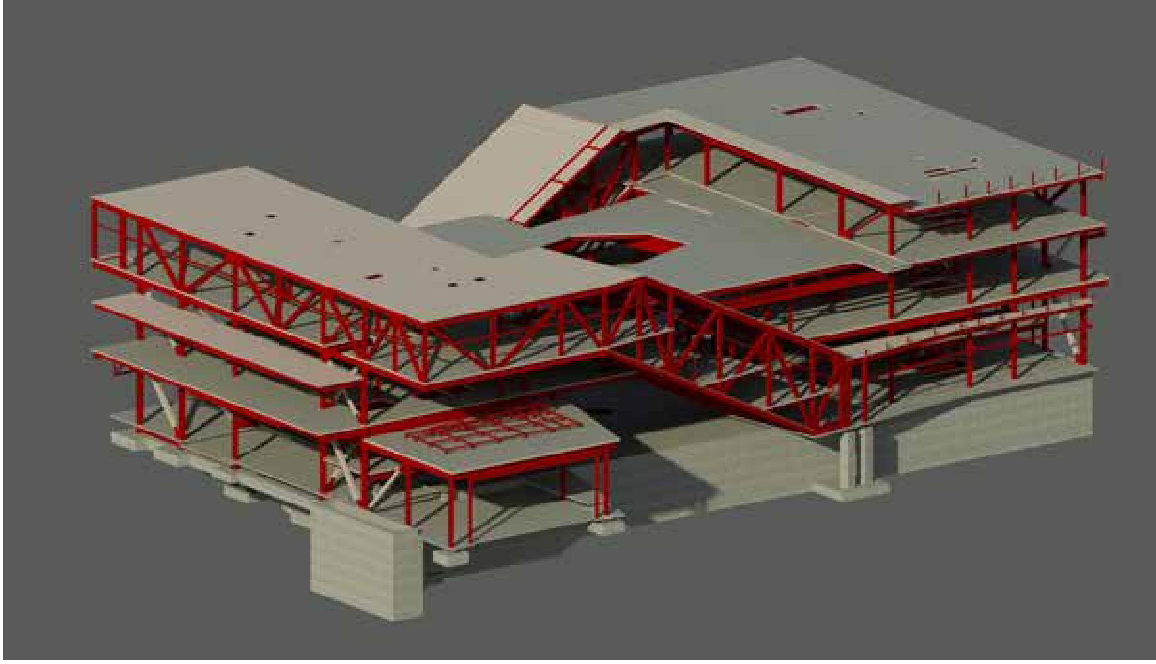
STANFORD UNIVERSITY'S NEWEST BUILDING bucks the trend of the campus' California Mission style and red tiles roofs.

Home to the school's art and art history department, the four-story, 96,000-sq.-ft steel-framed McMurtry Building brings a modernist touch to the campus' more traditional overall aesthetic and serves as an interdisciplinary hub for the arts that promotes collaboration among students and faculty. Two opposing diagonal strands traverse the building providing terraced space for each department, including art studios, workshops, editing rooms, screening rooms, faculty offices and exhibition space. The strands interconnect at the second-floor library and roof garden to encourage cross-department interaction. This layout presented many structural challenges, both gravity and seismic, that required innovative design approaches.

Floating Diagonal Strands

The main structural components are two diagonal strands that interconnect the roof with the ground floor. Story-deep structural steel wide-flange trusses were selected as the most cost-effective means of achieving the approximately 175-ft spans while maintaining the greatest design flexibility and openness. The tops of the strands are supported by perpendicular cantilevered diagonal trusses at the third floor to provide the illusion that the strands are floating. To conform to the overall building geometry, the trusses are kinked at the roof level 26° vertically

Iwan Baan, Courtesy Diller Scofidio + Renfro



◄ The interior courtyard.

▲ A 3D structural model of the building, which uses 1,100 tons of steel.

▼ Framing view from the courtyard, including an interior strand truss.

and 10° horizontally. This necessitated special details to ensure the stability and constructability of the trusses.

The trusses were stick-built in the field as they were too large to transport pre-assembled from the shop. A system of temporary steel shores, up to three stories tall, was used to support the truss construction, and these shores also allowed field adjustment to maintain vertical alignment of the truss chords. Pre-elevation of the strand trusses and perpendicular cantilevered trusses was also used to economize the overall design and offset any deflection of the truss under the full weight of the structure. Surveying performed during construction confirmed the truss deflections closely matched the predicted values.

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▲ The 96,000-sq.-ft building from above.

➤ Cantilever framing.

▼ A wide-flange joint connection at a strand truss.

Since the strand trusses span multiple levels, they tend to act as lateral braces. It was determined that seismic demands would far exceed the available capacity of the trusses, potentially creating an unsafe condition. To relieve these seismic forces, the bottoms of the strand trusses were supported by pin assemblies at the second floor and terminate just above ground floor, allowing the bottom to freely rotate around the pin assembly. The pin detail required careful coordination with the steel fabricator and erector to ensure constructability for tolerances and weld access.

The overall strand truss configuration concentrates seismic drift demands into the first story, which are typically distributed throughout the height of the building. Controlling the lateral movement of the first story was critical to the design, and buckling restrained braced frames (BRBFs) were added throughout the floor plate to add stiffness and absorb earthquake energy. To demonstrate that the structure exceeded code requirements and Stanford's performance objectives, the building model was subjected to a series of earthquake simulations of various mag-

▲ One of the strand trusses. The pin assembly is visible at the top-right of the truss.

▼ The oculus and rooftop garden.

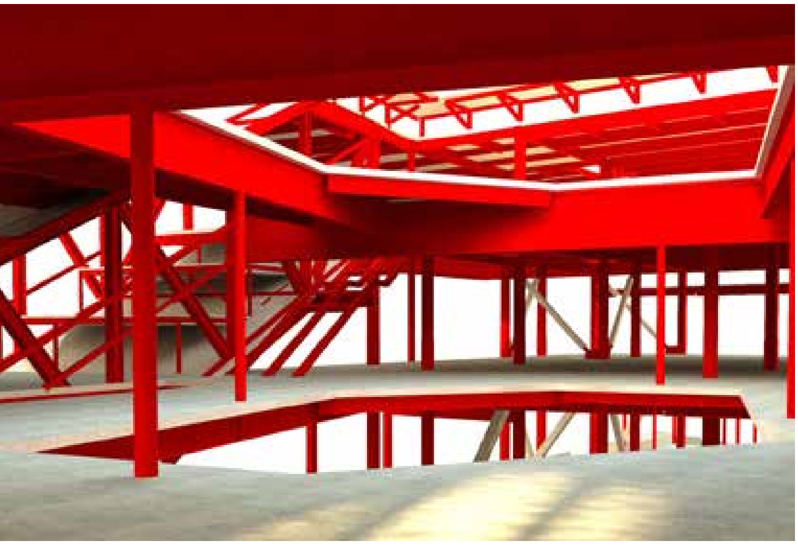
Iwan Baan, Courtesy Diller Scofidio + Renfro

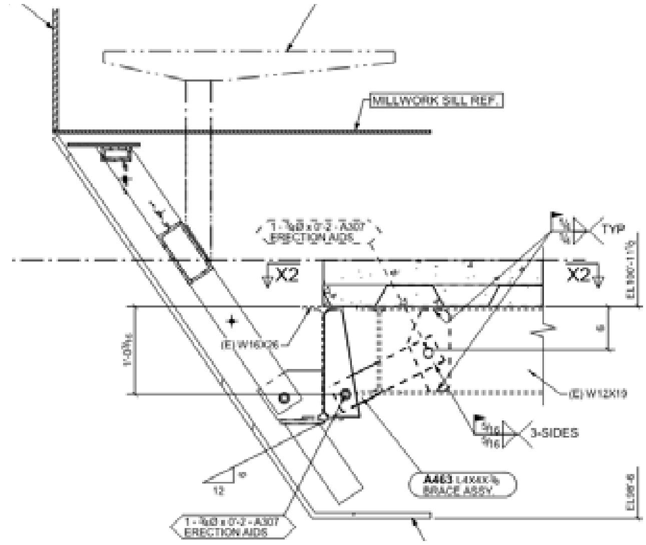
nitudes. This advanced nonlinear analysis confirmed that the truss system would behave in a predictable and reliable fashion. In addition, the trusses and braces are architecturally exposed throughout building to provide a sense of scale and give a glimpse at the structural bones of the building, while also highlighting the versatility, strength and beauty of structural steel.

Roof Garden and Oculus

A rooftop garden provides quiet places for students and faculty to interact. The landscape design uses a series of curved concrete planters, filled with native bushes and shrubs as well as large trees, to define distinct areas. Cantilevered hardwood seats are integrated into most of the planter walls, and free-standing benches also provide additional seating and serve as pedestrian barriers. The hardwood benches are comprised of stacked wood planks that are vertically post-tensioned together to reduce shrinkage effects from the wood's high initial moisture content and exterior exposure.

At the center of the building, and rooftop garden, is a large oculus that visually connects the various levels and conveys





A structural model and detail of the oculus.

natural light to the second-floor library and ground-floor exhibition space. Openness and flexibility was critical for the exhibition space, thus necessitating a column-free area, and steel plate girders were used to span the 75 ft between strands at the roof level with the second-floor library hung from below. A complex grillage of secondary steel was also provided around the oculus to support the exterior cladding components. In addition, custom millwork is located around much of the oculus to provide seating and study areas and is integrated with the secondary steel for the cladding to provide a seamless look.

The McMurtry Building, with its modern flair, contrasts its more traditional neighboring structures yet fits in with them thanks to its complementary façade and similar vertical scale. Its exposed steel framing, thoughtful engineering and sharp angles give a bold new touch to one of the world's most prestigious institutions of higher learning and make it an appropriate and worthy addition to the Stanford campus.

Owner
Stanford University

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Design Architect
Diller Scofidio + Renfro, New York

Executive Architect
Bora Architects, Portland, Ore.

Structural Engineer
Forell/Elsesser Engineers, Inc., San Francisco

Steel Fabricators
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