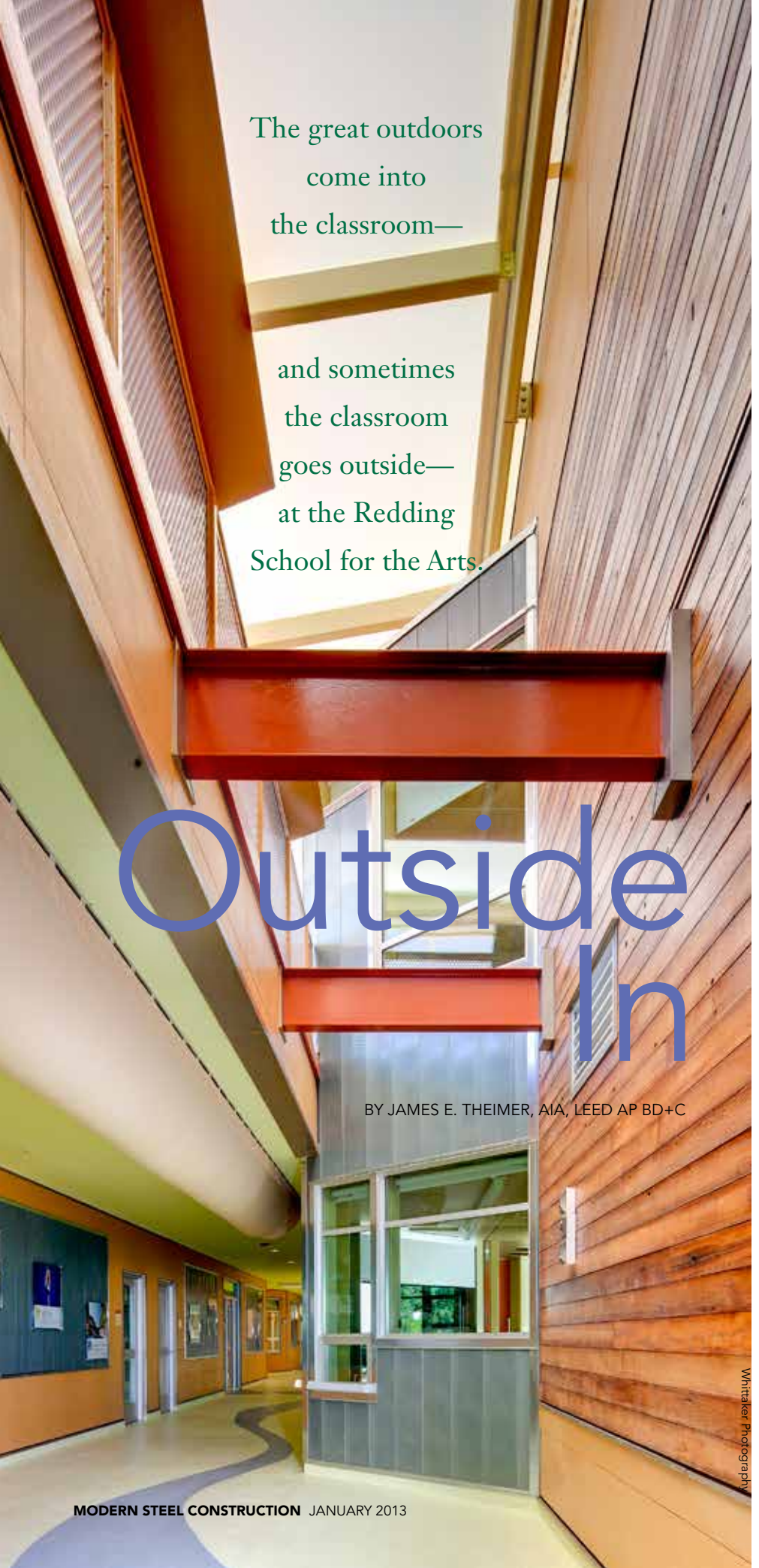

The great outdoors come into the classroom—

and sometimes the classroom goes outside—at the Redding School for the Arts.

Outside In

BY JAMES E. THEIMER, AIA, LEED AP BD+C

OPERATING ONE SCHOOL—with a capacity of more than 500 students—out of two separate campuses isn't an ideal situation.

But it was long the reality for the Redding School of the Arts in the northern California community of Redding.

By the autumn of 2007, despite the best efforts of the school to raise funds for a unified campus, prospects appeared dim.

Then, unexpectedly, a locally based philanthropic foundation stepped forward with an offer to provide both land and the funds to design and construct a new ultra-green school.

Once an agreement was reached to move forward, Trilogy, the architect, approached the funder (the McConnell Foundation), school administrators, parents and general contractor with this question: "What is the single most important characteristic to you for this new school to possess?"

This was not about figuring out how many classrooms were needed or how large the music rooms needed to be, but rather about the very core of what the school wanted to accomplish with its design.

One answer in particular resonated with the designers: "Integrate indoors with outdoors."

Thus began design on a new campus for this 77,000-sq.-ft K-8 public charter school for the visual and performing arts, with the goal that when complete it would serve as both an environmental model for other schools and an inspiring learning environment for its own students. Looking to break away from traditional design patterns, the design team conceived of a school where more than half of the learning space would actually be located outdoors.

Of course, northern California weather isn't always conducive to holding class outside, but even in times of inclement weather the school's large glazing areas—especially on the north side—help bring the outdoors inside. And steel framing helps facilitate this. Trilogy and Kibler & Kibler, the structural engineer, chose a system of interior structural steel braced frames—not only to help maximize daylighting but

◀ Exposed structural materials are the norm at the new Redding School of the Arts in northern California.

Whittaker Photography

Trilogy Architecture

also because such a framing system was well-suited to the building's complex geometry; steel was also deemed the most cost-effective solution for both the vertical and lateral systems.

Creating a footprint for maximum daylight also provided an opportunity to alter the traditional rectangular classroom shape into multi-purpose spaces, allowing for arrangements conducive to teaching large groups as well as break-out areas for smaller groups or individuals. Exposed interior structural columns and braces are accented in bright colors and provide a lesson on how buildings are structurally supported.

The braced frames for the school were typically constructed with HSS5×5×$\frac{5}{16}$ columns, W16×26 floor and roof beams and HSS4×4×¼ braces. The braces were designed as X-bracing to reduce the buckling length so the brace size could be minimized. This significantly reduced the requirements for the brace connections, as their design was based on the tensile strength of the bracing. When possible, based on the frame size that could be readily transported to the site, the frames were completely fabricated in the shop.

The building has a total of 40 different roof planes and more than 140 structural corners, and required 102 braced frames (83 different geometries). Portions of the second-floor exterior walkways are covered with fabric tensioned-membrane roof supported by exposed HSS beams. The connections for these beams were designed so they could be fabricated and erected with the main structure while allowing adequate access to install the exterior wall finishes and the roof membrane at later dates. Additional complications included a seismic separation joint between the three wings that was offset between the floor framing and roof framing levels, a 40-ft-tall tower, two levels of amphitheater seating, rammed earth walls at the three stage areas and a variety of sloped second-level floors.

▲▼ The new school brings together more than 500 students, initially at two separate campuses, into a state-of-the-art facility that connects the indoors with the outdoors.

Kibler & Kibler

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Whittaker Photography

▲▼ The outdoor amphitheater, surrounded on all sides by the school. A 3D modeling approach allowed the lighting designer to conduct shading studies for the roof over the theater. This roof, supported by W27×84 beams, cantilevers approximately 20 ft.

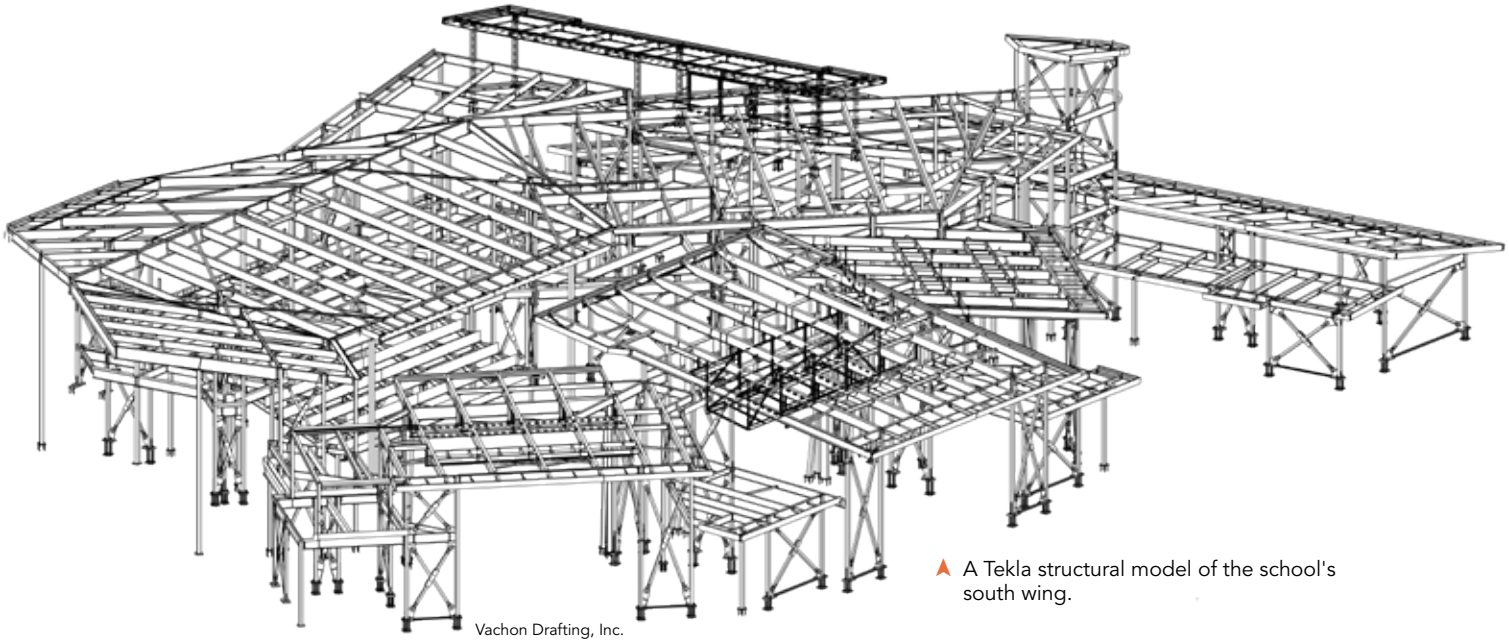
Kibler & Kibler

Head Start

One of the most pressing restrictions of the project, as with many projects, was a tight schedule. With the cooperation of owner McConnell Foundation and general contractor Gifford Construction, shop drawings were begun even before final structural design was complete and before the steel fabricator/erector had been selected. The building was designed as three structurally distinct wings, each seismically separated from the others, and the shop drawings were completed in three phases corresponding to the wings. This "head start" on shop drawings was crucial in allowing the project to move forward in a timely manner. As with the shop drawings, the fabrication and erection of the structural steel was phased, allowing for other trades to begin work earlier in the project. In addition, many of the two-story braced frames for the lateral system were shop fabricated, which reduced the field fit-up, welding and special inspections of the frames.

ArchiCAD software was used to model the structural elements in 3D and provided a continual verification of the design as necessary structural revisions were made throughout the design process. The 3D modeling approach also allowed the lighting designer to conduct shading studies for the roof over the central outdoor theater. This roof, supported by W27×84 beams, cantilevers approximately 20 ft and extends over the adjacent wing.

The building has an unorthodox shape, meaning that there would be very limited repetition among the structural members. This precluded the use of concrete, where the unique formwork required for each and every portion of the building would have been cost-prohibitive; open-web steel joists were considered but also rejected due to the same concern over the number of unique



Vachon Drafting, Inc.

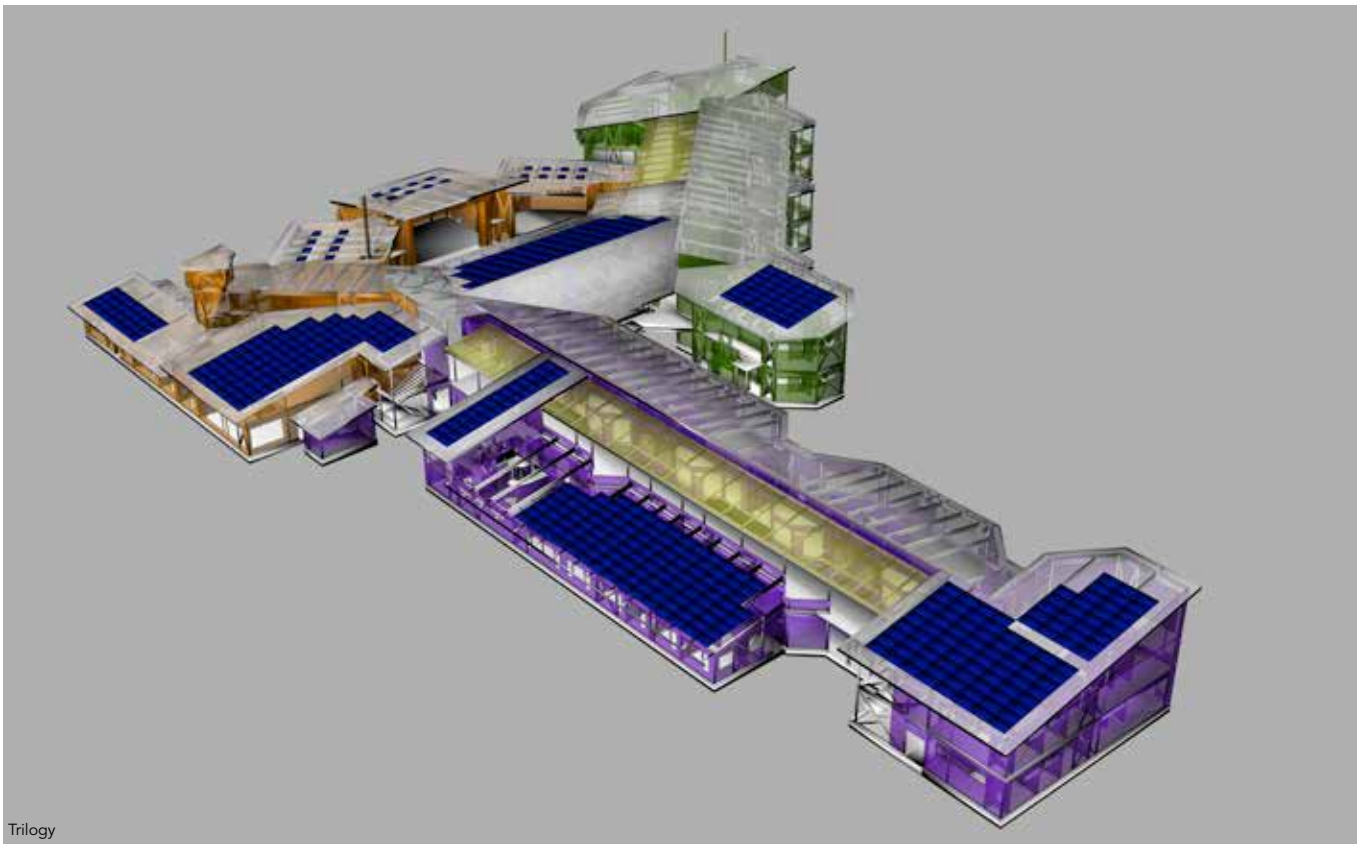
A Tekla structural model of the school's south wing.

elements required. In the end, cross-braced hollow structural section (HSS) frames using conventional wide-flange horizontal beams with HSS columns proved to be the most economical structural system and also provided an additional advantage when it came to connections. By using cross-braced HSS frames, the effective lengths of the bracing members were reduced, which allowed the connections in the special concentric braced frames to be designed for 36% less load than if standard braces had been chosen. Also, the member sizes, welds and foundations were significantly less than if a moment frame system had been chosen. The building uses 664 tons of sturctural steel in all.

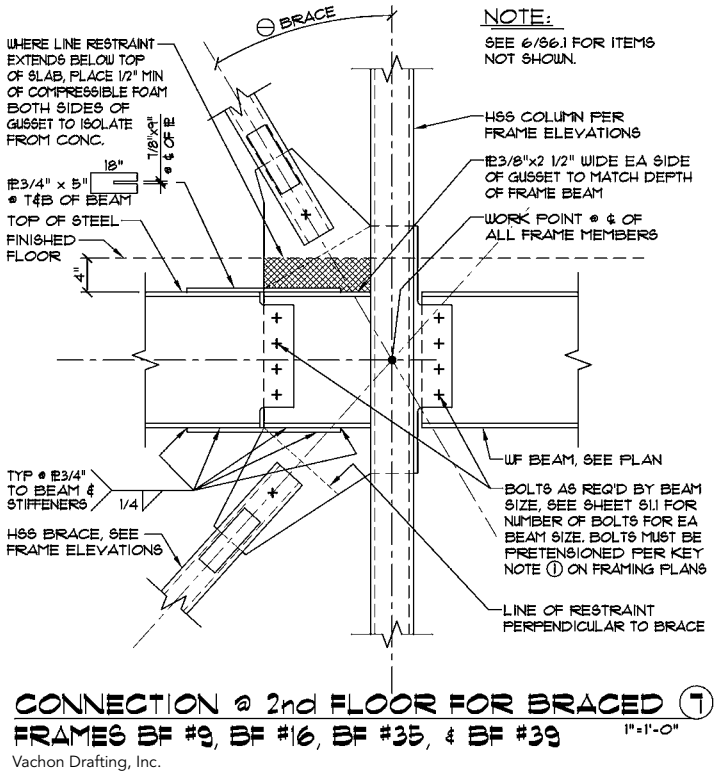
Another goal of the structural team was to allow the other design disciplines maximum flexibility in their design. With the project team working toward LEED Platinum status, Trilogy and the building systems team would need to be granted maximum flexibility in designing their systems—without the structural system providing unnecessary constraints. To facilitate this, the structural system was minimized at the building's exterior, giving the team much more room to work with for the placement of windows and shading devices in the façade. In addition, using HSS columns (moslty HSS5×5) allowed for a less intrusive design, and the relatively thin floor and roof beams (mainly W16s at the floor and W14s at the roof) allow maximum daylighting on both floors.

Whittaker Photography

Maximizing daylighting in the classrooms was a major goal for the project.



Trilogy



Vachon Drafting, Inc.

▲ A Rhino 3D model of the K-8 school.

◀ A connection drawing of second-floor braced frames.

Near Zero

The school was designed to be a model for future public buildings by placing energy and budget responsibility ahead of the popular notion of net-zero energy, and the school generates about 70% of the energy it uses thanks to photovoltaics; plans to increase efficiency for the second year of operation (the school opened in the fall of 2011) are being instituted, with the expectation that the energy gap can be reduced even further.

The green efforts have been recognized. In May, Redding School of the Arts became the first completely new school campus to receive Platinum certification under the 2009 LEED for Schools standards. It also won a 2012 Design Excellence Award for Educational Facilities from the American Institute of Architects. The school is a living, learning laboratory that blurs the line between the inside environment and the great outdoors. MSC

Owner

The McConnell Foundation, Redding, Calif.

Architect

Trilogy Architecture • Urban Design • Research, Redding

Structural Engineer

Kibler & Kibler Architecture and Engineering, Redding

General Contractor

Gifford Construction, Redding