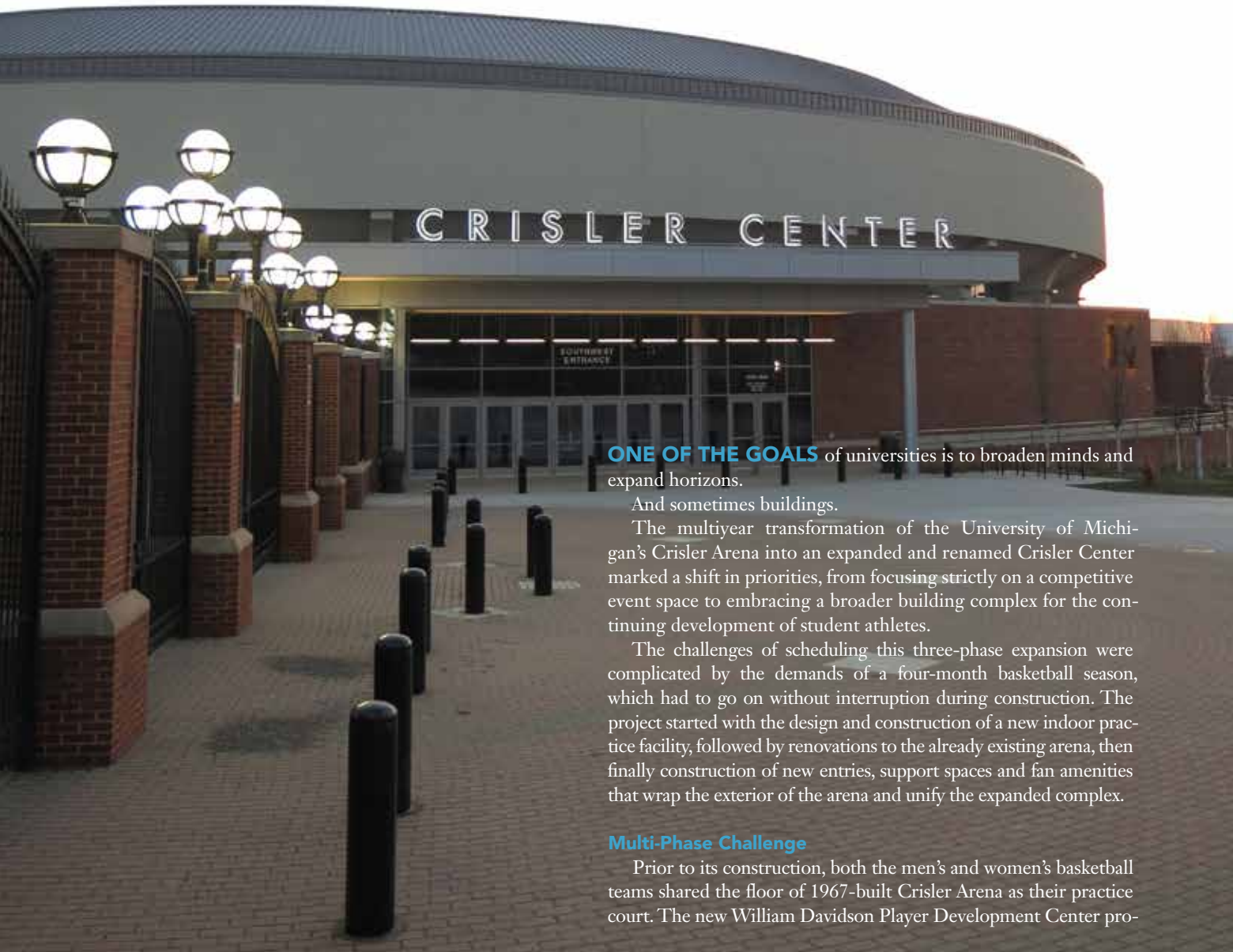
Early steel procurement,
point-cloud modeling and phased detailing
team up for a big win in the speedy expansion of Michigan's basketball arena.

Game Time

BY PAUL DANNELS, FAIA, AND ANDERS SJOGREN, P.E.



ONE OF THE GOALS of universities is to broaden minds and expand horizons.

And sometimes buildings.

The multiyear transformation of the University of Michigan's Crisler Arena into an expanded and renamed Crisler Center marked a shift in priorities, from focusing strictly on a competitive event space to embracing a broader building complex for the continuing development of student athletes.

The challenges of scheduling this three-phase expansion were complicated by the demands of a four-month basketball season, which had to go on without interruption during construction. The project started with the design and construction of a new indoor practice facility, followed by renovations to the already existing arena, then finally construction of new entries, support spaces and fan amenities that wrap the exterior of the arena and unify the expanded complex.

Multi-Phase Challenge

Prior to its construction, both the men's and women's basketball teams shared the floor of 1967-built Crisler Arena as their practice court. The new William Davidson Player Development Center pro-

vides new practice courts for each team, as well as locker rooms and training space within its 57,000 sq. ft. The project also includes tunnels extending below the arena seating that connect the new facilities with the existing arena floor. The design team of TMP Architecture and Sink Combs Dethlefs also envisioned a rooftop courtyard that extends out from the upper concourse of the existing arena.

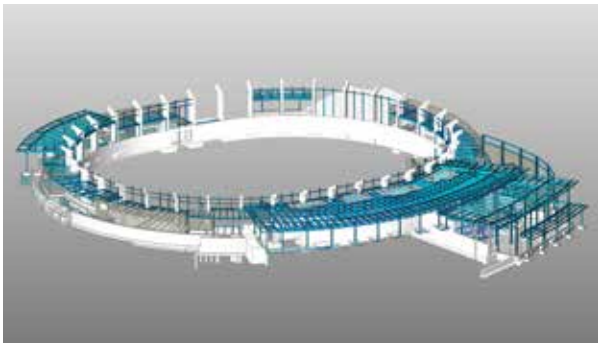
An unusually high water table on the site created a challenge to the design team by requiring that the practice courts fit between the water table below and the existing arena concourse above. In order to support the new courtyard with the shallowest possible clear-span structural system, the structural engineer, SDI-Structures, designed two parallel trusses to subdivide the practice space between courts. The two 10-ft-deep trusses, each 120 ft long, are made up of heavy 14-in. wide-flange sections and provide the stiffness required to control deflection under the weight of the courtyard paver system and associated live loads above. Wide-flange members frame into the trusses and complete the roof framing while providing variable point load capacity to accommodate a range of potential uses for the plaza.

Elsewhere on the project, steel framing provided a flexible and efficient way to quickly construct the geometrically complex roof planes that were dictated by a radial plan and variable field conditions. A glass-enclosed cylindrical entry to the Player Development Center achieves a clean look through use of steel columns and canopy members. Moment connected steel maintained within a single plane provides a shallow and dramatic roof overhang.

Advance Order

The contractor for the arena expansion, Spence Brothers, was the original builder of the arena and was charged with the daunting task of completing 63,000-sq.-ft, $52 million project within ten months of the date when the project was to be awarded to them. In order to help make this possible, the owner procured steel in advance from a mill order supplied by structural engineer SDI-Structures, who was also hired to oversee generation of shop drawings prior to awarding contracts.

Steel erection was planned to begin at the very start of the off-season, in March of 2012, with engagement of Spence occurring only two months earlier. This necessitated that steel shop drawing production begin in December 2011 under the design team's contract. This unconventional process was successfully adopted based on confidence in the BIM capabilities of all of the team partners, and model sharing between platforms and between partners allowed the process to proceed smoothly and efficiently. Structural analysis during design was completed in Fastrak, and structural and architectural modeling was completed in Revit. SDI-Structures then engaged Prism Steel Detailing (AISC member) to generate shop drawings in SDS/2; the 800-ton project was then broken into nine sequences and Prism completed them one by one. The sequences were arranged in a radial plan centered on the existing arena that accommodated movement of the erection crews around the site and also prioritized modeling and fabrication. Some included concourse space only but others included major program spaces. In each case the sequence was released only after a secondary review of the model by SDI-Structures. Both reviews were



▲ A 3D model of the expanded steel framing for the arena.

▼ The project included 63,000 sq. ft of new space.

All images: SDI-Structures

◄ The University of Michigan's Crisler Arena was expanded in time for the 2012-2013 basketball season.

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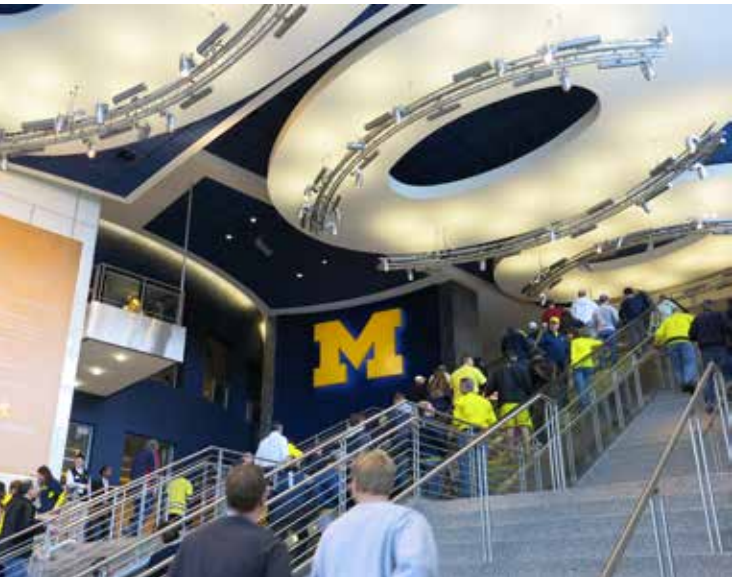
The 800-ton steel framing system was divided into nine sequences.

Crisler Arena was originally constructed in 1967.

10-ft-tall trusses in the practice facility.

Framing for one of the entrances.



Interior, post-renovation.

completed electronically in SDS/2 concurrent with development of the model, and protocols were developed for documenting and tracking reviews to ensure accuracy and accountability.

Entrusting production of the fabrication model to the design team prior to the construction contract turned out to be a time-saver. "There's no way we would be setting steel in March otherwise," said Mike Marenghi, senior project manager for the University of Michigan's Architecture, Engineering and Construction Department.

Andy Greco, a principal with SDI-Structures, agreed. "Ongoing developments in modeling capabilities allow us to completely rethink the ways in which projects are delivered," he said. "As engineer-of-record we can easily and efficiently watch fabrication models develop as part of the design process. It's something we've done on this project and others to provide owners with smoother and faster workflow from design to fabrication and erection."

Critical Dimensions

The team's confidence in its shop drawing production process is further evidenced by the decision to implement the process on projects of such geometric complexity. With the additions forming a ring around the existing building, and with hundreds of distinct connection points, field dimensions were critical. As such, the team relied on a laser-generated point cloud to inform dimensioning and the existing arena exterior was fully defined by the point cloud, then each field connection was modeled to it.

The advanced modeling technologies not only added an extra level of precision but also confidence in the process. "We were surrounding one complex building with another," said Greco. "There would have been plenty of opportunity for finger-pointing if anything with the fit-up had gone wrong, but the team members all had great confidence in one another."

The confidence proved to be well founded as all nine steel sequences were erected on time, setting up the project for successful completion this past September in advance of the Wolverine men's basketball team's campaign toward the 2013 NCAA Championship game. MSC

Owner
The University of Michigan, Ann Arbor

Design Architect
Sink Combs Dethlefs, Denver

Architect of Record
TMP Architecture, Bloomfield Hills, Mich.

Structural Engineer
SDI-Structures, Ann Arbor

General Contractor
Spence Brothers, Saginaw, Mich.