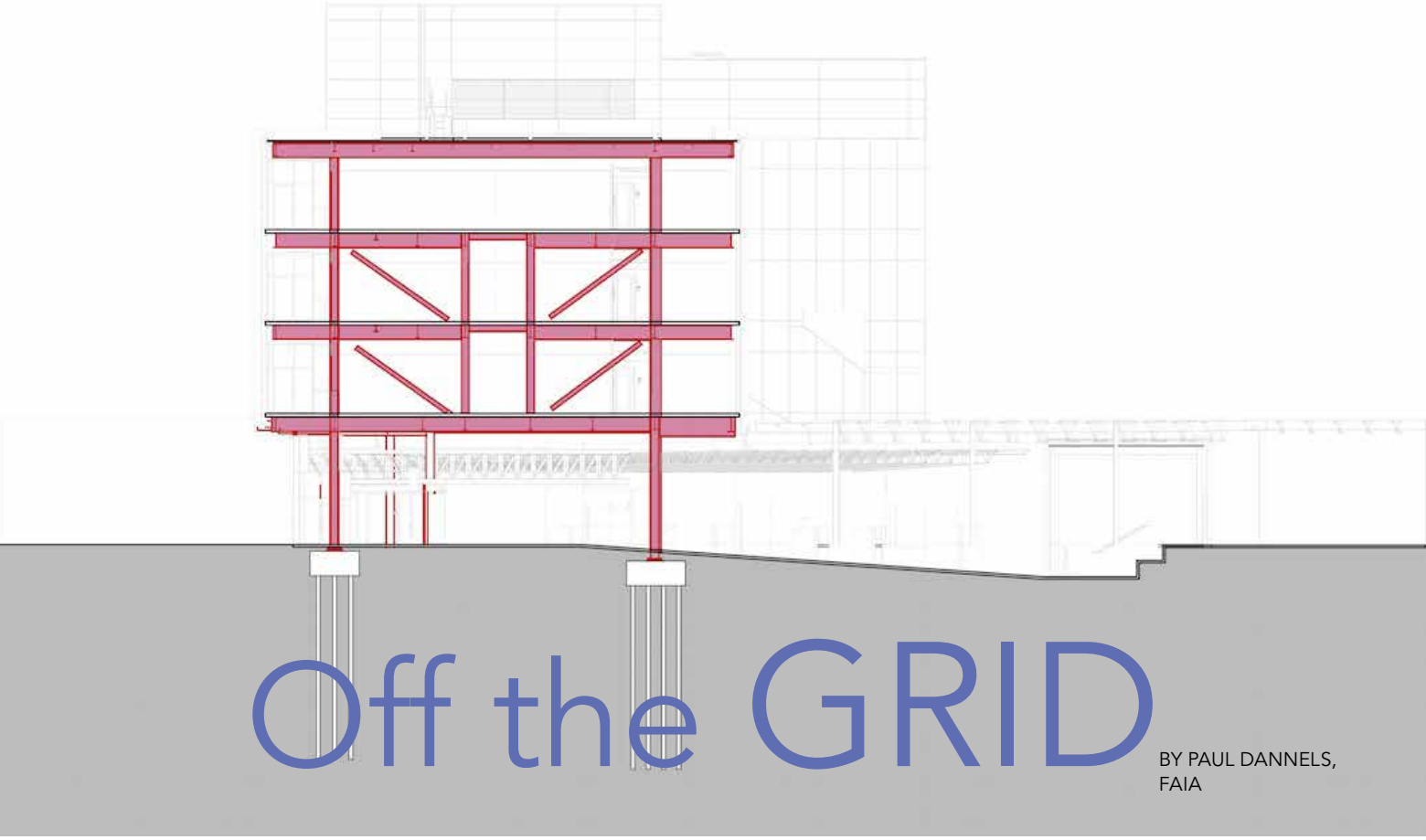
A vertical addition to a university building is offset from the below building by 31° in order to meet site requirements.



Off the GRID

BY PAUL DANNELS, FAIA

IT HAD TO BE DIAGONAL.

That was the determination after many months of deliberation about positioning a new academic building in relation to an existing building at Michigan State University.

The new classroom and office building that would replace the school's Morrill Hall, which was demolished, had been considered in numerous locations and orientations. The final decision, though, was that in order to meet all of the programmatic and site requirements, the new building needed to rise three stories directly above the existing Wells Hall building—not aligned on the original building's grid, but rather sprawled diagonally across it.

Set at a 31° angle to its immediate surroundings, the 88,000-sq.-ft addition includes three stories and a mechanical penthouse above existing classrooms. It provides a new home for the College of Arts and Letters and allows the university's language programs to be brought together in a common facility that includes classrooms, offices, language labs, a two-story atrium, a new auditorium, a coffee shop and a green roof. It's a technologically advanced learning facility designed to be a comfortable place of interaction between students and faculty.

Planned Eccentricities

The design team took on the challenge with one disclaimer: Though the building would be oriented as desired, constructed on time and on budget and built to preserve functional existing ground-floor classrooms, the design team would propose a regular structural grid and the university would accept the plan's eccentricities that the regular grid imposed. Thus began a complicated geometric exercise of overlaying potential structural grids diagonally across existing auditorium-type classrooms, many with demanding requirements for unobstructed views to the classroom podium. Numerous bay sizes and lateral systems were considered, then tweaked and shifted to leave columns in strategically acceptable locations.

Ultimately, 17 column locations on a surprisingly regular grid were proposed for surgically precise insertion into the floor plan of the existing building: four outside the building and 13 inside, with four columns inside auditoriums. The column grid was chosen to minimize impact on the classrooms, with an emphasis on preserving seating, maintaining lines of view and honoring circulation requirements. Once these priorities

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▲▼ The new vertical expansion to Michigan State's Wells Hall added 88,000 sq. ft of space in three stories—at a 31° angle to the existing building directly beneath it.

◄ A cross section of the framing for the new structure...

► ...which penetrates the existing building below.

Paul Dannels (**paul@sdistructures.com**) is a principal with SDI-Structures and a faculty member in the school of architecture at the University of Detroit Mercy. He was a 2013 IDEAS^2 Awards juror.

were addressed, columns landed in locations of minimal functional impact, though one column appears in a corridor (and was painted bright green to match the color scheme of the area).

In order to minimize the number of columns, a central spine of 49-ft bays was established at the ground floor. Above, the wide bay spacing is spanned by two-story-tall steel trusses with bottom chords that cantilever 9 ft in one direction and 14 ft in the other direction to add additional floor space in the above stories. As the trusses were installed in the air, temporary shoring and bracing was used to hold the cantilever in the proper position until the field welding could be completed.

HSS members terminated by welded T-sections serve as diagonal truss webs. At the connections to floor members, which are W-shapes that serve as truss chords, web ends are bolted with tension-control bolts to exposed gusset plates at the column bases. At the top end of the diagonals, connections are concealed above finished ceilings and the webs are welded to gussets to provide for field adjustment. The vertical truss elements act as building columns as well and are sized to carry significant truss forces without web stiffeners. The use of the two-story-tall trusses allowed lighter, shallower floor members at levels two, three and four, and the trusses were left architecturally exposed and are prominently visible throughout the building. The bolted floor connections become a natural part of the building's aesthetic and at locations where the webs penetrate the finished ceiling, careful drywall and wood detailing allows the members to gracefully pass through the ceiling plane. The two-story trusses also provide stiffness to the upper stories of the building and serve as part of the structure's transverse lateral system. Ground-floor wide-flange mo-


Paul Dannels

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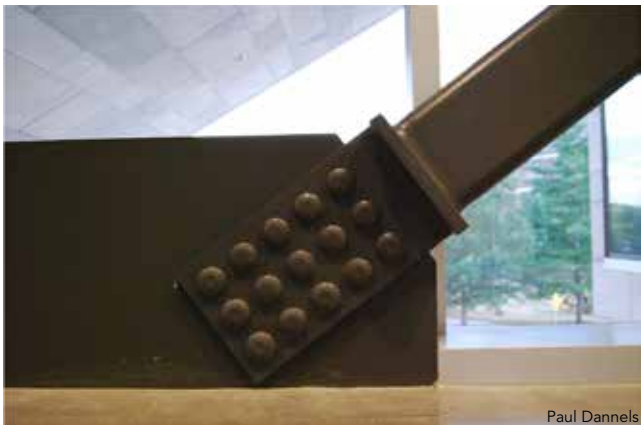
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▲ At the connections to floor members, web ends are bolted with tension-control bolts to exposed gusset plates at the column bases.

▼ The new addition's orientation relative to the below, existing building.

ment columns complete the transverse lateral system to the ground, and the longitudinal lateral system is also a steel moment frame that acts along the column's weak axis. The new columns thread precisely through the existing building's roof structure to carefully selected locations in order to balance a variety of competing concerns. These selected locations minimize disruption to the function of existing spaces, provide uniformity to the new column grid and allow efficient placement of new foundations. Since the existing walls were left in place, anchor rod installation was more difficult than with new construction as the sight lines were obstructed from one column to the next.

The new columns bear on pile caps that gather together groupings of micro-piles. More than 200 steel-encased micro-piles were installed to depths of up to 100 ft, most of them installed from within the tight confines of the existing building. In some cases the piles caps were set in basement areas, working with limited overhead clearance. In other cases pile caps were set just below existing foundation bearing elevations to serve as underpinning for existing bearing walls. The micro-piles resolve both gravity and lateral forces. In order to install the micro-piles, all first-floor auditorium furnishings and finishes were meticulously removed prior to the new foundation work and stored for future reinstallation after the columns had been positioned and the slab re-poured. Based upon the relatively heavy loads, several columns were upsized to eliminate column web doublers and stiffeners in an effort to reduce cost.

Columns were precisely inserted into the floor plan of the existing building: four outside and 13 inside, with four columns inside auditoriums. In one case, an interior column was painted bright green to match the color scheme of the surrounding area of the building.

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Building on a college campus meant limited laydown area, which mandated small sequences and frequent steel delivery that was coordinated on a truck-by-truck basis. The work was done over the summer and a single semester during which no classes were scheduled in the areas impacted by construction. Once the second-floor steel deck had been installed and poured, construction was far enough along that work could proceed safely above while students attended classes below.

The new building now stands as a state-of-the-art learning space that has gathered together previously dispersed programs in an inviting and new common setting. Having missed only one semester of use, the first-floor auditoriums function just as before—with a few new columns tucked away here and there. ■

Owner
Michigan Sate University, East Lansing, Mich.

Design Architect
Hamilton Anderson Associates, Detroit

Architect of Record
Integrated Design Solutions, Troy, Mich.

Structural Engineer
SDI-Structures, Ann Arbor, Mich.

Construction Manager
Barton Malow, Southfield, Mich.

Steel Fabricator and Detailer
Steel Supply and Engineering, Grand Rapids, Mich. (AISC Member/Certified)