Surge Protection

BY MARK MCVAY AND TONY NIXON, P.E.

Anticipating surging enrollments, the University of California, San Diego's new Pepper Canyon Hall balances current needs with future flexibility.

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THE UNIVERSITY OF CALIFORNIA, SAN DIEGO (UCSD) WILL EXPERIENCE A PROJECTED 50% SURGE IN ENROLLMENT OVER THE NEXT DECADE—AN INCREASE OF MORE THAN 10,000 STUDENTS. To meet the needs of the ever-increasing student population, a new campus building had to be designed and constructed quickly.

The building had to balance short-term requirements against long-term development goals. Flexibility was also critical after years of costly retrofits for other UCSD campus buildings that had been designed for special uses. The design team responded to these needs with Pepper Canyon Hall—a steel-framed structure that incorporates two lecture halls, three large classrooms, computer labs, and a series of temporary spaces including academic quarters, office space, and space for a public arts program.

Structural steel provided the physical and logistical framework for the project's design and construction, which was completed in 18 months. No other system could be designed, fabricated, and erected as quickly while meeting California's stringent seismic standards. Steel building materials were also readily available and relatively inexpensive compared to other structural materials when design was initiated in 2002.

Pepper Canyon Hall is a simple and adaptable structure consisting of a steel braced frame with a concrete-filled metal deck as the gravity system. A special concentric braced frame provides the lateral system, which was designed before the other bid packages to jump-start construction. This system offered maximum interior clear spans and very few interior columns. With the prospect of few modifications to the braced frame during construction, the project team was confident in proceeding with the interior and exterior design while the steel package was bid and erected.

The steel frame provides a 45' clear span for each wing of the U-shaped building. The typical beam size for the 45' span is W21×50. Typical girder sizes range from W21×44 for the shorter 20' spans to W27×84 for the 40' spans. Typical gravity column sizes range from W12×45 to W12×96, while the frame column sizes are W12×120 and W12×170. The beam-to-girder and beam-to-column connections are standard single shear tab with a single row of bolts.

The structural design ties the primary and lateral structural systems together with only six interior columns on the upper floors. There are very few interior columns, which will allow for easy reconfiguration of the space as the university's needs change. Interior walls and building systems can be reconfigured

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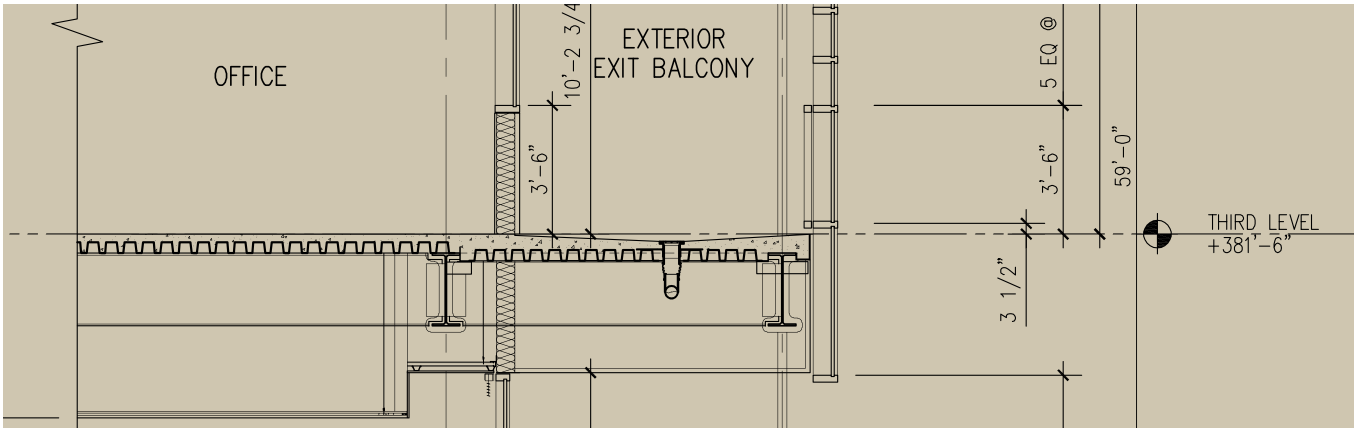

Steel framing easily accommodated the slab depressions required for exterior walkway drainage.

within the frame as needed. This straightforward structural system circumvented unnecessary costs and complications and allowed space for more flexibility in the HVAC, plumbing, and electrical systems—for both the initial build-out and future modifications of the structure.

An upper-level walkway bridge and switchback stair connect the second through fourth floors. A large central column supports the bridge from below, with smaller exposed HSS columns supporting the upper levels. The switchback stair also features a central-column design. By minimizing the number of columns, the ground-level courtyard has a more open feel than it would have had with a more conventional column arrangement.

The seismic lateral force resisting system was designed and detailed using AISC's *Seismic Provisions* and is comprised of Special Concentrically Braced Frames (SCBF). The brace members were square HSS that attached to wide-flange beams and columns.

The design of the SCBF assumes that the brace will buckle under large compression loads. If traditional chevron (inverted "V") braces would have been used, the beam above the brace would have had to have been designed for the large unbalanced load due to the different forces in the tension and compression braces. This force would have resulted in a beam with approximately twice the weight of a traditional beam.

To resolve this condition, the engineers used a two-story "X" brace system. The first floor had a traditional chevron brace and the second floor had an inverted chevron brace. This allows the load to transfer directly through the braces and eliminates the need for the larger beam and corresponding beam connections. This system is shown in the AISC *Seismic Provisions* as a recommended configuration. [An in-depth discussion related to AISC's 2005 *Seismic Provisions* appears on pages 47-54 of this month's issue.]

The design of the braced frame seismic lateral force resisting system minimized the number and locations of braces while maintaining a robust design. The use of structural steel and metal deck allowed for localized depressions at the pedestrian bridge and restroom areas by lowering isolated sections of deck without affecting the surrounding structure.

Exposed steel was kept to a minimum because of the corrosive marine air on the Pacific coastal campus. Pairs of HSS columns along the edges of the pedestrian bridge and walkway are the only instances of exposed steel in the building. These elements were galvanized by the fabricator and coated with field-applied intumescent paint (A/D Fire Protection Systems' A/D Basecoat and A/D Firefilm II). A marine epoxy coating was used for the miscellaneous non-structural steel elements.

Spray-applied Monokote Type MK6/HY fire protection, manufactured by WR Grace, was used for the primary steel structure, and sprinklers were installed in enclosed areas.

The design team accelerated the construction process by designing the details of the mechanical, electrical, and plumbing systems after the steel frame was erected. These systems were placed below beams or in the "building cores," framed by the lateral bracing elements.

The design team's experience with temporary academic facilities had taught them the value of structural systems that have minimal detailing and that are simple to erect. The primary steel frame, concentric brace frame, and concrete-filled metal deck were completed quickly and easily by using standard, repetitive elements with standard bolted connection detailing. Columns for the braced frames came to the site with connection plates and beam stubs already welded in place to minimize field welding. The frames were then assembled on the ground and erected in one piece. The site was tight, but the construction team was able to field-splice columns on the ground and erect them in three weeks at full-height using a nearby courtyard for the crane and an adjacent fire lane as staging space.

In 2005, SmithGroup architects received a citation award for the structure's design from the American Institute of Architects' (AIA) Los Angeles chapter.

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