All–precast concrete design gives Stanford student housing traditional campus look

When Stanford University in Palo Alto, Calif., needed new housing for graduate students, the decision was made to build four graduate housing buildings, each 10 stories high with wings varying from 6 to 8 stories. The buildings, called the Escondido Village Graduate Residences, feature a total of 665 two-bedroom apartments, 517 premium studios, and 292 junior studio apartments plus common spaces.

To meet the university's requirements, the designers had to align their vision with several aesthetic and structural requirements. For one, the buildings had to conform to campus standards for unit size, dimensions, and layout. In addition, they had to mimic the traditional architecture of the campus. Furthermore, they had to use durable, cost-effective, and easy-to-maintain materials. Finally, the buildings needed to be built while school was in session to accommodate the next round of graduate students that would be arriving. For these reasons, the architect opted for precast concrete. Clark Pacific of West Sacramento, Calif., was selected for the job.

To meet the strict seismic design requirements, the team had to address several challenges. One related to design. "The biggest challenge here related to vertical irregularities between different wings specific to seismic," says Loehl O'Brien, project executive for Clark Pacific. A seismic joint was aesthetically not achievable at this area of the building, and a structurally coupled wing created a large drag force across dissimilar sections of the building. "To overcome this issue, we cast oversized ribs with PT ducts and anchors and field post-tensioned the structure," he says.

In terms of production, floor flatness on a pretopped panel directly accepting flooring was a challenge. To meet a high finish level, the lightweight concrete ribbed panels were cast inverted with the top face cast on the deck. "Custom back tubs forming the ribs engaged the panel and flipped the panel to an upright configuration at the form," O'Brien says.

Transportation also required some innovative solutions. "Aesthetics such as bullnoses and cornices drove the panelized moment frames to panel weights past standard shipping capabilities," he says. In previous projects, the answer had been to use nine-axle trailers and 45-degree easels that required live load/unload and were difficult to maneuver around the site. For this project, Clark Pacific designed and built custom tri-axle trailers to allow the panels to ship as permit loads and in a vertical orientation for simplified picking.

In terms of erection, the key was optimizing the flow across the structure. The typical flow was to erect the vertical panels, grout the vertical panels, prestock the structure with materials for the interior, erect the horizontal pretopped panels, and concrete the pretopped connections. "This flow crossed a single structure in less than two weeks per level," O'Brien says, "however, the buildings were not equal sizes, so time varied."

—William Atkinson

The Escondido Village Graduate Residences at Stanford University in Palo Alto, Calif., comprise four graduate housing buildings. A creative solution was used to replace the seismic joints and maintain the campus's traditional architecture look. Courtesy of Bernard Andre.

The new Academy Museum of Motion Pictures in Los Angeles, Calif., includes a 60,000 ft² (5600 m²) spherical glass and concrete structure to house a 1000-seat theater. It originally was planned as a cast-in-place concrete shell but was converted to precast concrete. Courtesy of Willis Construction Inc.

The jointing on the sphere that makes up the new Academy Museum of Motion Pictures in Los Angeles, Calif., has parallel slices east/west and north/south like an egg slicer, which causes the shapes of the panels to become more skewed the farther they get from the sphere midline. Courtesy of Willis Construction Inc.

Precast concrete panels create a spherical theater for new museum

The new Academy Museum of Motion Pictures in Los Angeles, Calif., was created to celebrate the art and science of movies. The project involved the exterior restoration and interior gut renovation of a 240,000 ft² (22,300 m²) historic landmark structure.

The project also included a 60,000 ft² (5600 m²) spherical glass and concrete structure to house a 1000-seat theater.

A 150 ft (46 m) diameter glass and precast concrete sphere that appears to float above the ground, the theater offers a counterbalance to the more sedate renovated historic structure. The sphere originally was planned as a cast-in-place concrete shell, but as the design evolved, it became clear that cast-in-place concrete would not be a viable solution. For one thing, the spherical formwork would have been prohibitively expensive for carpenters to fabricate and assemble on-site.

As a result, precast concrete was chosen to allow for a better and more cost-effective quality finish and tighter tolerances and geometric control to ensure a perfect sphere. Precast concrete also allowed for a large, column-free space, providing unobstructed sightlines for the theater in the round, as well as providing the physical mass necessary for acoustic isolation of the high-performance theater.

Willis Construction of San Juan Bautista, Calif., was the precaster. Precast concrete panels were also used as permanent formwork to support the structural concrete during placement operations. This meant that the precast concrete architectural spandrels had to be installed on a temporary steel structure before the dome could be built. Extensive supports and birdcage scaffolding held the structure in place until the final piece of glass was installed.

The project presented other challenges for Willis. "The shape of the museum theater is a sphere cut by intersecting planes," says Mark Hildebrand, chief engineer for Willis. "The jointing on the sphere has parallel east-west and north-south slices, like an egg slicer." This causes the shapes of the panels to become more skewed the farther they get from the sphere midline. The egg-slicer design also required that each panel have side returns that were parallel with the east-west and north-south directions. This meant that each panel would need to have its side bulkheads skewed at a slightly different angle for each form change. "To accurately set the form parameters with a curved radius panel in two directions with sloping bulkheads was very challenging," he says.

Installation also posed some challenges. According to Hildebrand, conventional precast concrete panels are typically installed, locked off, and welded in place from control lines established on the built structure. "One of the innovative features of this project is to use the precast panels as permanent formwork to support the structural concrete during placement operations," he says. In other words, the architectural finish was installed before the structure was built. This required erecting a temporary steel structure upon which to erect the precast concrete panels.

The location and accuracy of the placement of each panel was crucial for creating the spherical shape. With no structure reference to place panels, an alternative method was required. "The solution was to tag the four exterior corners of each panel that corresponded to specific coordinates of the project's global coordinate system," Hildebrand says. "The panels were then set and aligned with positions verified by the surveyor."

—William Atkinson