Achieving High Sustainability

— Craig A. Shutt

Photo courtesy of John Swain.

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The precast concrete aided energy efficiency, provided a cost-effective system, and helped ensure that the center was finished on schedule. Photo courtesy of John Swain.

More projects are aiming high when they apply for LEED certification, and precast concrete is helping to meet those lofty goals

With owners and designers focusing more attention on energy conservation, "green" building, and Leadership in Energy and Environmental Design (LEED) requirements, more projects are not only looking to attain LEED certification but are hoping to achieve silver, gold, or platinum status. A number of those projects are using precast concrete components because of the assistance they provide in reaching that goal.

Achieving the "metallic" LEED ratings can be difficult because some of the credit requirements must be interpreted by the U.S. Green Building Council (USGBC). The owner and designer may determine that their approach achieves the credit requirements, but the USGBC may not reach the same conclusion. When the project goal is a higher LEED certification level, there is little room for error in credit interpretation, and every possible design element must be aligned to add to the total number of credits achieved.

There also is the need to overcome obstacles presented by highly specific programmatic needs in some facilities, such as hospitals or justice

Fact Sheet

Project: *Alameda County Juvenile Justice Center*

Type: *Courthouse and juvenile dormitory*

Location: *San Leandro, Calif.*

Architect of Record: *Hellmuth, Obata+Kassabaum (HOK), San Francisco, Calif.*

Associate Architect: *Beverly Prior Architects, San Francisco*

Engineer: *The KPA Group, Oakland, Calif.*

Construction Manager: *Vanir Construction Management Inc., Sacramento, Calif.*

Design-Build Contractor: *Hensel Phelps Construction Co., San Jose, Calif.*

Owner: *County of Alameda, Calif.*

Precaster (structural components): *Mid-State Precast LP, Corcoran, Calif.*

Precaster (architectural panels): *Willis Construction Co., San Juan Bautista, Calif.*

Project Size: *Three-story building, 379,000 sq ft*

Precast Concrete Components: *800 structural panels of various sizes, 112 architectural panels of various sizes, 260 slabs*

Project Cost: *$176 million*

centers, where function definitely comes first. "The United States Green Building Council's criteria for achieving a LEED-certified building for new-construction projects do not take into account the special operational and construction constraints of a juvenile justice facility," says Beverly Prior, principal in Beverly Prior Architects in San Francisco, California.

Her firm was the associate architect to HOK in the design of the award-winning Alameda County Juvenile Justice Center in San Leandro, California, which features a gold LEED rating and structural and architectural precast concrete panels. The facility was designed to create a more collaborative approach for supporting at-risk juvenile offenders by partnering county agencies with community-based organizations.

More High School than Prison

The plan was to create a building with a softer appearance, resembling a high school rather than a prison. Authorities also wanted to integrate environmentally sustainable architecture to educate visitors about the importance of environmental stewardship and to create a healthier building, Prior explains. The 379,000-sq-ft, $140 million facility features three buildings, including a three-story courthouse; a one-story, 360-bed dormitory; and a two-story support building. A large entry courtyard and an inviting lobby dominate the dormitory, which was designed with sleeping quarters surrounding a common social space and an adjacent outdoor recreation area.

The largest of the three buildings, the 162,000-sq-ft dormitory, was constructed entirely of precast, prestressed concrete structural panels and other components, she explains. The panels used for the exterior walls and interior corridor walls were 7 to 8 ft wide and 26 ft tall, while interior dormitory panels, which were Y-shaped to form individual sleeping rooms, were 16 x 10 ft. These panels supported floor slabs that were 10 ft wide and 22 ft long. It also incorporated 14-in.-thick insulated sandwich wall panels that were 10 x 30 ft.

The courthouse building features architectural precast concrete panels on structural-steel framing. The 27,696-sq-ft building uses a two-tiered panel system, with an upper tier of 11 x 14 ft panels with a smooth gray finish and a lower tier of 11 x 30 ft panels with an integral cream color and smooth finish, except at the 3-ft-tall rusticated base. "The two-tiered system provides an attractive appearance at the main entrance into the complex and creates a rhythm along the buildings' long façades with horizontal banding combined with a series of vertical reveals and inset storefront windows," she explains.

"The use of precast concrete on these buildings contributed an appealing aesthetic and a sense of permanence," Prior says. "It also provided numerous environmental benefits and contributed to several LEED credits." The structural concrete included fly ash, a pre-consumer material that also saved on the use of virgin materials.

"Precast concrete also reduces construction materials and waste by using reusable forms instead of wood formwork and recycling manufacturing waste materials," she adds. "It also uses regional materials and has a lower embodied energy than many other construction materials. Its thermal mass also contributes to higher energy performance, and the minimal VOC emissions create healthier indoor-air quality."

The precast concrete not only offered an affordable system, it also played a vital role in completing the center on "an extraordinarily tight schedule," she stresses. The facility was created in 31 months from design through occupancy. The exterior structural panels were fabricated in eight months and erected in five months, completing the shell that allowed interior trades to begin work earlier.

The facility was designed to maximize daylight and uses solar power for 60% of the building's electricity. It also was designed to outperform building-code requirements for energy and water by more than 40%.

Turning Silver to Gold

The justice center is an indication that government officials at all levels, and for all types of projects, are looking to minimize their environmental impact, both to save long-term maintenance costs and to set a good example for the public. Those were key factors in designing the California Department of Transportation's District 11 Headquarters in San Diego, California. The five-building, $72 million project

The use of precast concrete provided numerous environmental benefits and contributed to several LEED credits.

Photo courtesy of Chi Fang.

The Alameda County Juvenile Justice Center in San Leandro, Calif., which achieved a gold LEED rating, used structural and architectural precast concrete panels to reach a variety of goals.

Fact Sheet

Project: *California Department of Transportation District 11 Headquarters*

Type: *Government office complex*

Location: *San Diego, Calif.*

Designer: *Carrier Johnson Architects, San Diego*

Engineer: *John A. Martin & Associates, Los Angeles, Calif.*

Contractor: *Clark Construction Group, Costa Mesa, Calif.*

Owner: *Department of General Services, State of California, West Sacramento, Calif.*

Precaster: *Clark Pacific, Fontana, Calif.*

Project Size: *Five buildings with 300,000 sq ft plus 815-car parking structure*

Precast Concrete Components: *126 wall panels, 276 spandrel panels, 188 column covers*

Project Cost: *$72 million*

Community, sustainability, and location were the guiding factors for the new California Department of Transportation's District 11 Headquarters in San Diego. The five-building project features precast concrete panels and column covers for the solar grand trellis at the front.

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Precast concrete column covers provide a complementary look for the grand trellis, which is supported by 70-ft-high tubular steel purlins.

features a variety of energy-efficient systems, including a dramatic solar grand trellis that prominently shelters drivers as they arrive and generates electricity for the site.

The project qualified for a silver LEED rating, but the state did not fund application for the rating, so it is not officially rated. State officials recently decided to apply for the rating, however, and are preparing paperwork for submittal. The state also plans to upgrade several existing systems to make them more efficient, thereby qualifying the project for a gold rating.

The project's design focused on "community, sustainability, and location," explains Edward Holakiewicz, project manager for Carrier Johnson Architects in San Diego. Bordered by the historic Old Town district, a railroad right of way, and a freeway exchange, the headquarters offered high visibility and a challenging site. But the designers used both the irregular, restricted site and the requirements for sustainability and security for their inspiration. "From the very beginning, it was clear that the way that the project fit within the context of its neighborhood was going to be our primary concern," says Holakiewicz.

Input from the Old Town community was a key ingredient in making the design work, he adds. "They helped us interpret the design guidelines so that we could give things back to the community, as opposed to just taking things away. One of the benefits for us was that they allowed us room on a couple of building elements to go higher than is normally allowed." This concession was critical, as the site's obstacles, including a small seismic fault, required that some areas be avoided. By building higher, the team could condense the floor plates and provide some landscaping for the site on the avoided spaces.

The buildings' height and positioning paid homage to the surrounding neighborhood, with the elevation closest to Old Town presenting a short, regimented, well-ordered façade. Meanwhile, as the buildings move farther back from the street, the shapes begin to fragment and become more angular. An 815-space parking structure, initially targeted for the front of the site, was placed in the rear so the complex would provide a more welcoming face to visitors.

Precast Panels Clad Buildings

The five buildings, including three primary office buildings and two ancillary structures, were clad with architectural precast concrete panels, covering the buildings in height from two stories along the Old Town side to five stories. The panels, produced by Clark Pacific in Fontana, California, were finished to replicate limestone to integrate the project with the Spanish architectural influence of Old Town.

Interior spaces were designed for departmental flexibility and were organized around central gathering spaces, which serve as access points for conference rooms, support amenities, and vertical circulation. Environment-

friendly aspects include recycled-content carpet, certified-sustainable wood products, and task and indirect lighting modulated by solar orientation. Work areas were located to maximize exposure to natural light and encourage interaction among staff.

Outside, the grand trellis dominates, providing a welcoming and functional focal point. The solar photovoltaic modules were a cost-effective approach to providing shading, as they will pay for themselves and offset other material costs. Clark Pacific was charged with designing and installing the massive precast concrete column system for the structure. The precast concrete columns cover 70-ft-high tubular steel purlins to form a trellis that reduces electric bills for the complex.

The trellis is among a series of design features that contribute to the project's fulfillment of California's Tier 1 and 2 Energy Efficiency and Sustainable Building Measures. The natural thermoplastic properties of concrete were exploited to help reach these goals, Holakiewicz says.

Thermal Mass Exploited

Concrete provides excellent thermal storage of cooler nighttime temperatures that are slowly released during the day, cooling both the building and the enclosed exterior courtyards. During the cooler desert nights, the panels release the accumulated daytime heat, eliminating the need for nighttime heating. The limestone-beige color for the panels also helps meet efficiency needs due to its high albedo and low reflectivity, which creates a soft, pleasing color that eliminates solar glare. "All these benefits contributed to a reduction in heat-island temperatures associated with building environments," he says.

In addition to the environmental benefits and the aid in visually integrating the complex, the use of precast concrete panels also helped to meet the state's requirements that the facility be built to last at least 100 years.

Precast concrete also helped to meet the state directive for ensuring public safety and occupant protection. By creating a hardened, secure building envelope, the reinforced concrete panels resist penetration while absorbing significant amounts of energy in the envelope and redistributing those loads across a broader area.

The building's proximity to a major highway interchange also influenced the specification, as the panels exceeded the sound-barrier requirements set by the state for resisting sound intrusion to office environments. "Extensive sound testing ensured that the building's orientation and use of precast panels reduced ambient sound exposure," says Holakiewicz.

Other environmental features include passive bio-swales that percolate water in the parking areas, an innovative water-recycling system, and a cool roof. "The campus organization, material selection, and resulting

'One of the greatest challenges was engineering the precast wall panels to accommodate all of the openings.'

Fact Sheet

Project: *Harm A. Weber Academic Center, Judson College*

Type: *Classrooms, library, and student activity center*

Location: *Elgin, Ill.*

Designer: *Burnidge Cassell Associates, Elgin, and Short & Associates, London, U.K.*

Engineer: *KJWW Engineering, Naperville, Ill.*

Contractor: *Shales McNutt Construction Co., Elgin*

Owner: *Judson College, Elgin*

Precaster: *Mid-States Concrete Industries, South Beloit, Ill.*

Precast Specialty Engineer: *Losch Engineering Corp., Palatine, Ill.*

Project Size: *88,000 sq ft*

Precast Concrete Components: *8 in. hollow-core slabs with attached insulation*

Project Cost: *$25 million*

A key challenge in designing the precast concrete panels was the number of penetrations required by the ventilation system, which produced a "swiss cheese" look for the components. Photo courtesy of Burnidge Cassell Associates.

The new academic center features three building segments clad with insulated precast concrete panels. Included are the library (square building at top), central academic wing (narrow shape in middle), and space for the Division of Art, Design & Architecture (sloped-roof structures in foreground).

energy benefits represent the finest in community-driven sustainable design," he adds. "The headquarters is a holistic composition of secure and sustainable architecture, building materials, and the people who will experience and enjoy it."

Teaching Tomorrow's Designers

Education administrators also understand the long-term value of incorporating sustainable measures, not just for the community the facility serves but for those who are learning in it as well. Nowhere is that more important than at architectural schools, such as the Harm A. Weber Academic Center (HWAC) at Judson College in Elgin, Illinois. The HWAC houses the library and the Division of Art, Design & Architecture (DADA) at the private Christian liberal-arts school, influencing the students' perspectives and inspiring future designs.

The 88,000-sq-ft, $25 million project was designed to greatly reduce the energy used by a baseline design through the use of natural ventilation and other efficient measures. The four-story building features three sections. The largest section forms a square enclosing the central atrium. The library is on the second and third floors, with architectural studios on the fourth floor. The first floor houses the building's mechanical systems and storage.

The library is joined to a central academic area that comprises the main concourse, art gallery, and lecture room on the main floor, with studios and classrooms are on the other levels. The DADA wing features a long, bar-shaped design that holds offices, a photo studio, a shop, and additional studio space.

To create the design, Burnidge Cassell & Associates (BCA) in Elgin, the architect of record, worked with Short & Associates in London, U.K., a design firm known for its innovative work with energy-efficient ventilation systems. The two design partners worked closely despite the challenge of integrating their work across the Atlantic Ocean. Short's team focused on the overall design while BCA translated the design into construction documents and worked on construction administration and submittal for LEED rating. A gold rating is anticipated.

The building's design relies on the stack effect, drawing air in at the lower level, circulating it up through the floors, and eventually exhausting it through roof vents. This natural-ventilation system is designed to operate primarily in the spring and fall months, while a traditional mechanical system provides heating and cooling in more extreme summer and winter conditions.

The precast concrete load-bearing panels and slabs that make up the structural system for the building played a key role in accomplishing the efficiencies in this ventilation system, explains Nanette D. Andersson, current project manager for BCA.

Insulated Panels Used

The 8-in.-thick solid panels, fabricated by Mid-States Concrete Industries in South Beloit, Illinois, feature 4 in. of insulation on their exterior side, which was finished with an exterior insulation finish in some places and a copper-colored metal panel in others, she explains. "This configuration allowed the panels to act as a large thermal mass, helping to passively regulate the indoor air temperature. They also were more cost efficient than cast-in-place or tilt-up concrete."

The floor/ceiling slabs were used on a 3.5:12 slope for an approximately 30 in. plenum that channels air out through the ventilation turrets at the roof. "One of the greatest challenges was engineering the precast wall panels to accommodate all of the openings required for the unusual ventilation system and large amount of glazing required for effective daylighting," she explains. "The south wall in particular was challenging; we joked that it looked like Swiss cheese."

The other challenge was engineering a solution to allow for the angled panels at the fourth-floor ceiling, which was accomplished with a special bracket. "The installers had to be very skilled to complete this work because the panels had to be handled delicately due to the large voids."

The interior sides of the panels also had to have a high-quality finish because they served as the interior walls of the structure with only a final coat of paint. "The whole building has a rather 'raw materials' aesthetic to it, and the precast panels fit into that aesthetic beautifully."

The result of the unique design and the precast concrete structure is a facility that has garnered high interest. "We had quite a few raised eyebrows during the construction process due to the innovative building techniques," she says. "However, the building's sustainability fits in well with the university's mindset that we are stewards of the earth. As a building meant to house a school of architecture, the daily exposure that the students have to this innovative design will influence their education and future careers." ■

For more information on these or other projects, visit www.pci.org/ascent.

Platinum Precast

Designers continue to push higher on the LEED spectrum, with more projects receiving the ultimate designation: LEED platinum. The first such project in Florida, now under construction, features architectural precast concrete panels as cladding.

The Conservatory at Celebration Place, a six-story, 170,000-sq-ft office condominium, is part of a complex of commercial buildings in Celebration, Florida. "This is the fifth and final project in the complex, and the others also feature precast concrete cladding," explains Robert Stack, project architect with Morris Adjmi Architects in New York. The panels, provided by Gate Precast Co. in Kissimmee, Florida, include an integral coloring and a washed, buff finish to complement the other buildings.

"The precast was not chosen specifically because of the desire for a LEED platinum designation, but it fit in beautifully with those needs," he adds. Precast concrete aids with LEED certification specifically through the use of recycled content, such as fly ash, and in using local materials and being produced locally, he says.

A variety of energy-saving attributes will help achieve the platinum level, including clerestory and atrium windows, photovoltaic lighting in common areas and hot-water heating in washrooms, operable windows and an underfloor fresh-air plenum, nearby public transportation, a green roof, waterless urinals, pervious paving, and gray-water recycling.

The project, which will be one of only 23 platinum buildings in the country, is expected to be completed in 2009.