Project Spotlight

Low-income housing goes green in New Jersey

The Kent Avenue Apartments in Pennsville, N.J., might seem like a standard low-income residence for people who are 55 or older or have disabilities, but this complex conceals a myriad of sustainable features that add to its affordability.

In 2005, Omega II Corp. took on the Kent Avenue Apartments as an affordable-housing project in order to provide Council on Affordable Housing (COAH) credits for Pennsville Township in New Jersey. Omega II contracted with Nitterhouse Concrete Products Inc. of Chambersburg, Pa., to produce and erect the precast concrete products. Nitterhouse had completed the drafting and engineering and 49% of the precast concrete component production before it was notified to stop production because of a delay in funding.

Ron Rukenstein, general contractor, and John Bibeau, president of Tri-County Real Estate Maintenance Co., then partnered to take over the construction of the apartments. For them, the biggest challenge of this project was to make the building sustainable and still keep it affordable.

During a visit to the Nitterhouse plant, Bibeau intended to tell Nitterhouse that the new funding would not allow for precast concrete to be used due to cost constraints. During his visit, however, Bibeau changed his mind, and in July 2006 the original contract was accepted. Bibeau was impressed with the energy efficiency achieved with an all–precast concrete structure.

Highly durable, long-lasting precast concrete building systems return greater savings than other construction materials because of reduced floor-to-floor heights, reduced site time, rapid installation, and longer life spans.

Nitterhouse continued to produce 39,237 ft^2 (3645 m^2) of 12-in.-thick (300 mm) insulated exterior wall panels, 16,693 ft^2 (1550 m^2) of 7-in.-thick (175 mm) interior wall panels, 85,652 ft^2 (7960 m^2) of 8-in.-thick (200 mm) precast concrete hollow-core units, and 34 precast concrete stair units with landings.

Erection of the precast concrete components only took 37 days from start to finish. Even an unexpected fire that broke out during the installation of the roofing did not stop construction progress because precast concrete is inherently fire resistant and was not damaged.

The use of precast concrete also played an important role in supporting the building's 61,000 lb (270 kN) rooftop solar-panel collection system. According to Goff Sun Power, the company that built the system, the 462 solar panels that were installed will, in the products' life span, produce 2,764,375 kW-hr of electricity.

The Kent Avenue Apartments in Pennsville, N.J., disprove the assumption that standard-looking, low-cost materials need to be used when building affordable housing. Building green, which actually costs less in the long run, qualified the owner to receive tax credits. Courtesy of Nitterhouse Concrete Products Inc.

Because of the combined energy efficiencies achieved, the owner was able to eliminate 101 gas meters and include heat, hot water, cable TV, and trash removal in the rental cost.

The project included several other sustainable features. The concrete contains recycled aggregates, construction debris was recycled, there was storm-water absorption on-site, and paints and sealants low in volatile organic compounds were used, among many other sustainable features.

The future savings and tax credits far exceed the small additional premium for precast concrete and can yield big payoffs in lower energy costs, minimal maintenance, a better environment for residents, and a longer building life cycle.

New Jersey is only one state that currently gives low-income-housing developers who incorporate sustainable elements extra points on their applications to win allotments of the federal tax credit.

—Source: Nitterhouse Concrete Products Inc.

California bicycle bridge easy on environment

Precast, prestressed concrete played a prominent role in the building of the world's longest stress-ribbon bridge in 2009 in San Diego, Calif. Built in an environmentally sensitive area, the structure comprises three 330 ft (100 m) spans for an overall length of 990 ft (300 m).

Altogether, 87 precast concrete panels (29 in each span) were used in the deck. The deck panels were post-tensioned to ensure continuity in the spans, close the transverse joints, and give the bridge its required stiffness for live loads.

Officially named the David Kreitzer Lake Hodges Bicycle Pedestrian Bridge, the structure is situated in San Dieguito River Park. The bridge provides a vital link to the Coast to Crest Trail, eliminates a 9 mi (15 km) detour, and furnishes a safe route for bicycle commuters who otherwise would ride on the shoulder of the busy and dangerous interstate freeway.

The major design challenge was to build a bridge for cyclists and pedestrians over an environmentally protected lake approximately 1000 ft (300 m) across. The structure could not be massive; it had to have a light and airy look. It also had to be free of vibration.

T. Y. Lin International was the engineer of record for the project and was responsible for the design and construction of the bridge. Assisting the engineer was Safdie Rabines Architects, which provided general aesthetic guidance. The engineering firm performed concept studies, detailed structural design, and resident engineering during construction.

The stress ribbon bridge with a precast, prestressed concrete deck is a type of suspension bridge with cables embedded in an ultra-thin concrete deck. The cables follow a catenary path, and as they interact with the concrete deck a complex nonlinear behavior develops, which affects long-term stresses and deformations. The design required fairly complex analytical methods to evaluate the nonlinear behavior of the cable system and the time-dependent effects from concrete creep and shrinkage as well as to stage construction analysis to evaluate the locked-in stresses as the bridge was constructed.

Only six stress-ribbon bridges exist in North America, with fewer than 50 worldwide.

No falsework was needed during construction of the bridge, which has a typical width of 14 ft (4.3 m) and a total deck area of 14,460 ft^2 (1343 m^2). All of the 87 panels are 14 ft wide, 10 ft long, and 16 in. thick (4.3 m, 3.0 m, and 406 mm), resulting in an astonishing depth-to-span ratio of 1 to 248.

Once the precast concrete panels were in place and the closure pours were filled with concrete, the entire length of the bridge was post-tensioned by a second set of prestressing tendons. The completed bridge features widened decks (or belvederes) over the two intermediate pier supports on the lake and includes benches for prime viewing spots with informative displays of the lake.

The need for a flexible abutment at the south end of the bridge added some complexity to the structure that is not normally encountered with stress-ribbon bridges. While the bridge utilizes a fixed abutment that is anchored into rock at the north shore of the lake, the south abutment is founded on a deep layer of alluvium. This made rock anchors impractical and four cast-in drilled-hole piles were used instead. The pile heads are fixed into the thick pile cap and undergo double bending as they resist the large thrust from the bearing and prestressing cables. Overturning of the pile system causes the rear piles to unload as they are pulled toward the lake.

The precast concrete manufacturer was U.S. Concrete Inc., and the precast specialty engineer was Angelo Kolokithas.

Extensive coordination was required among the general contractor, Caltrans, the City of San Diego, and San Dieguito River Park, all of which had jurisdiction over various portions of the project. Construction of the bridge was only allowed during the winter months due to restrictions imposed by nearby breeding habitats for endangered species. Therefore, construction was split into three phases. Precast concrete erection took place during the final phase of construction, starting in November 2008 and ending a year later.

This pedestrian bridge was a cowinner of the Nonhighway Bridge category in the 2009 PCI Design Awards Program.

The total cost of the bridge project was $10.5 million.

—George Nasser

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As the longest stress-ribbon bridge in the world, the precast concrete David Kreitzer Lake Hodges Bicycle Pedestrian Bridge in San Diego, Calif., spans an environmentally protected lake. Courtesy of Mark Defeo.