

PROJECT SPOTLIGHT

EWB uses precast concrete for bridge in Honduras

On February 19, 2011, volunteers from the Chicagoland Professional Chapter of Engineers Without Borders (EWB-USA CPC) traveled to Central America to construct a bridge in an impoverished mountain community in Canchias, Honduras.

The Canchias Agricultural Bridge Project, EWB-USA CPC's third bridge-building project in Central America, will culminate in a single-lane vehicle bridge over the Yure River. The bridge will allow the residents of Canchias and nearby Las Delicias safe, year-round access to the land that they farm on the north side of the river, which frequently becomes impassable due to flash floods.

During the project's design phase, the team generated several bridge options and created computer models to determine optimal design characteristics, given the environmental constraints and construction challenges in the region. Initial hydraulic models for multiple-pier bridges encountered substantial scour, which led the team away from standard bridge designs. To avoid these scour issues, a 108-ft-long (33.0 m), 8-cell concrete box-culvert design was selected.

The design included mass-concreted stone abutments, a continuously reinforced concrete bottom slab with upstream and downstream cutoff walls sunk into the riverbed, cast-in-place concrete vertical pier walls, precast concrete deck panels, and a concrete top slab flanked with low-level curbs. The bridge will allow for a 2 ft (0.6 m) minimum freeboard above the 100-year storm water level



Workers with Engineers Without Borders remove the precast concrete panels from the casting bed to be stored nearby for use in a bridge in Canchias, Honduras. Courtesy of Andy Kuby of AES Due Diligence.

as well as the ability to be overtopped should debris block the cell openings. The design team also selected a wide, stable river location to maximize riverbank stability.

A continuous concrete deck slab will tie the precast concrete deck system to the abutments and all pier wall units. Due to frequent seismic activity in the area, the reinforced connections from the substructure units to the cast-in-place deck topping are located along the center core area of each support, a configuration that provides some longitudinal rotational capacity without detachment.

“By precasting the deck, we were able to increase our quality control in the bridge’s most critical element as well as minimize erection time in the river.” Scott Eshleman, EWB project lead

A total of 56 deck panels and 16 curb panels were cast on site by EWB. Each panel was designed for a 12 ft (3.7 m) clear span. The bridge will comprise eight spans, with nine precast concrete elements per span.

“By precasting the deck, we were able to increase our quality control in the bridge’s most critical element as well as minimize erection time in the river,” says project lead Scott Eshleman, who has served on PCI’s Bridge Committee for the past 14 years. “We believe this will be the first EWB-USA bridge project with precast concrete deck panels. The panels were all match cast in span-by-span casting beds for tight fit-up.”

In addition to improving quality and speed, the use of precast concrete reduced the project’s environmental impact.

“Due to recent deforestation laws, the cost of lumber for shoring to facilitate traditional cast-in-place deck construction was high and the cutting of timber to use for a temporary purpose was not environmentally responsible. Therefore, precast concrete deck panels became the construction method of choice,” Eshleman says.

With erection of the bridge under way, EWB volunteers face unusual challenges with limited equipment in the remote location.

“Erecting the panels in place is tricky without a crane,” Eshleman says. “Therefore, we will be using a backhoe with ropes for guiding the panels in place.”



The precast concrete lifting system is tested for use in the construction of an Engineers Without Borders bridge in Canchias, Honduras. Courtesy of Dale Thomas of CH2MHill.



These precast concrete casting beds were used to produce match-cast deck panels for a bridge under construction by Engineers Without Borders in Canchias, Honduras. Courtesy of Dale Thomas of CH2MHill.

Eshleman says the bridge, facilitating access to fertile farm land, will raise the region’s nutritional levels and economic stability for generations to come. Additional benefits include improved access to a planned tilapia farm and the ability to increase production of fresh milk and fish to be served at local schools.

The \$98,000 project budget covers the purchase of all materials, rental of equipment, hiring of local skilled labor, and much of the in-country costs of the EWB-USA CPC volunteers. In all, the project will use more than 60 U.S. volunteers and more than 60 volunteers from Canchias and Las Delicias. The bridge is scheduled to be completed within an 11-week time frame, with volunteers working through early May 2011.

—Rory Cleveland



Tindall Corp. provided the precast concrete insulated sandwich wall panels for the new Duke Lemur Center in Durham, N.C. Courtesy of JWest Productions.

Precast concrete choice for LEED-certified lemur housing facility

Two new state-of-the-art facilities housing 140 diurnal lemurs at the Duke Lemur Center (DLC), a refuge owned by Duke University for the world's largest collection of lemurs outside their native Madagascar, feature a sustainable design with a wall construction system composed of 44-ft-long \times 10-ft-tall (13 m \times 3 m) precast concrete insulated sandwich panels produced by Tindall Corp.

"To update and expand our facilities, we wanted an attractive, sustainable design that would be flexible, functional, and efficient, both for cleaning and for shifting animals from one part of the buildings to another when they're sick or being used for observational research," says DLC director Anne Yoder.

After exploring the viability of a number of different building materials, the DLC and architecture firm Lord,

Aeck & Sargent (LA&S) chose precast concrete to most effectively meet their design goals for the new facilities.

"Discussions with the center about designing for maximum flexibility led to the ideal housing concept of groups of five interconnected modules, each with an interior and exterior component. This model is repeated four times to create 20 housing modules in each self-sustaining wing," says LA&S senior associate Lauren Dunn Rockart, who served as project manager and designer. "The repetitive nature of the modules naturally pointed to a prefabricated structure."

"The precast concrete panels and roof planks ultimately chosen provided the best balance between prefabrication, customization, and sanitization," Rockart says. "The buildings have to be washable outside as well as inside, so we chose concrete insulated sandwich panels as the wall construction system. Coated with epoxy paint on the interior and a concrete sealer on the exterior, they are easily cleaned."

In addition to their functionality, the precast concrete wall panels allowed for creativity in fostering a comfortable environment for the lemurs.

For example, Rockart says, “glass blocks have been randomly inserted to bring into the buildings lots of dappled natural light that mimics light filtering through trees in a forest.”

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One building houses 60 lemurs allowed to range freely, when weather permits, in the DLC’s fenced, 69-acre (28-hectare), Forest Stewardship Council–certified Duke Forest. The other houses 80 lemurs that for physical, behavioral, or social reasons have limited free-ranging capacity. This building is also designed with an eye to facilitating research.

“The buildings have made a great difference to our functionality and have improved life for the lemurs and the staff,” Yoder says.

Designed by LA&S as part of a \$10.4 million project, the buildings feature a number of sustainable attributes, including low-volatile organic compound paint sealants; an energy-efficient heating, ventilating, and air-conditioning system; and sensor-controlled lights in areas designed for human occupation. Both buildings have received LEED silver certification from the U.S. Green Building Council.

—Rory Cleveland

Liquid Wall pushes envelope design

A prototype of The Liquid Wall, a new building enclosure system incorporating innovative and sustainable precast concrete materials and design, was constructed and installed in the double-height front window of the Center for Architecture in New York, N.Y., as part of the Innovate: Integrate exhibition held from October 6, 2010, to January 15, 2011.

The Liquid Wall is a unitized curtain wall with a structure cast in fiber-reinforced ultra-high-performance concrete. It combines economical, custom-designed mass

production with long-lasting, upgradable facade components.

For the exhibition, Coreslab Structures produced eight panels cast in Lafarge North America’s Ductal concrete, which allows for improved natural daylighting and ventilation, direct integration with building mechanical systems, and 100% material recyclability.

The panels used precast concrete elements as a frame for window wall panels. The ultra-high-strength (20,000 psi [140,000 kPa]) concrete was used for the 1.5 in. × 6 in. (38 mm × 150 mm) concrete frame, which replaced the extruded aluminum shapes of traditional curtain walls.

The Liquid Wall’s name reflects both its fabrication by casting and its accommodation of liquids flowing through the facade panel.

“There is a passive solar collector panel in the wall into which liquid is actually flowing to recover heat from the sunlight on the building,” says the wall’s designer, Peter Arbour of RFR Consulting Engineers.

The solar energy captured by this spandrel cassette assembly can be transmitted to the building’s interior for use as radiant heat, domestic hot water, air dehumidification, or inverse condensation cooling.

The Liquid Wall was designed for architectural versatility as well as functional performance.

“Facades are the most public aspect of building design, and the mounting demands made of the contemporary building enclosure call for both aesthetic and technically performative solutions,” Arbour says. “All facades must insulate without thermal bridging, they must provide water and air seals and secondary drainage channels, they must resist the vertical spread of fire, they must be constructed efficiently at an industrial scale, and they must operate reliably without excessive maintenance costs or systemic failure. The Liquid Wall is a system that elegantly achieves all of this.”

A video demonstrating production of the prototype can be viewed at www.vimeo.com/15635281.

—Rory Cleveland