Top Ten: Bridges of Excellence

Winning projects in the Portland Cement Association's Tenth Biennial Bridge Awards Competition

Ten winners have been named in Portland Cement Association's (PCA) Tenth Biennial Bridge Awards Competition. The competition, instituted in 1988, recognizes excellence in design and construction of concrete bridges.

This year's winning projects:

- Guadalupe County I-40 Overpass Bridges, Guadalupe County, NM
- Elk Avenue/Doe River Bridge Rehabilitation, Elizabethtown, TN
- Moose Creek Bridge, Timmins, Ontario, Canada
- Perry Street Bridge, Napoleon, OH
- Brady Street Bridge, Milwaukee, WI
- University Avenue Arched Pier Bridge over I-74, Peoria, IL
- Four Bears Bridge, New Town, ND
- Noyo River Bridge, Fort Bragg, CA
- County Road 453 over Battleground Creek Bridge, Coupland, TX
- Wapello County Mars Hill Bridge, Wapello County, IA

Guadalupe County I-40 Overpass Bridges, Guadalupe County, NM. Photo courtesy of New Mexico Department of Transportation

Elk Avenue/Doe River Bridge Rehabilitation, Elizabethtown, TN. Photo courtesy of Tennessee Department of Transportation

The 2006 program attracted 79 entries from Canada and the United States, covering a variety of structure types and construction methods. All structures were completed between June 2004 and March 2006. The winners were recognized at the American Concrete Institute's Fall Convention in Denver.

Winning projects were selected based on creativity, functionality, and economy by a jury of three prominent bridge professionals: Daniel Dorgan, State Bridge Engineer, Minnesota Department of Transportation; Mary Lou Ralls, Ralls Newman, LLC, Austin, TX; and Louis Triandafilou, High Performance Structural Materials Specialist, FHWA Resource Center, Baltimore, MD.

The next installment of the bridge awards is scheduled for 2008. Specifics about each winner follow:

GUADALUPE COUNTY I-40 OVERPASS BRIDGES. These routine highway overpass structures have a unique role—they help welcome visitors to Guadalupe County and to New Mexico. As such, aesthetics were a priority through the planning and construction process of the three two-span continuous precast, prestressed concrete bridges. Southwestern-style artwork was incorporated into the MSE walls, wingwalls,

Moose Creek Bridge, Timmins, Ontario, Canada. Photo courtesy of Ministry of Transportation, Ontario/Stantec Ltd./Precon Inc.

piers, and barrier rail.

To minimize fill requirements and to maintain the necessary under clearance, four 54-in. U-beams were selected in lieu of five 63-in. beams for the typical span of 105 ft, 8 in. Judicious use of high strength, high performance concrete, prestressing strands in the top flanges of the beams, spread footings, and semi-integral abutments resulted in economical, durable, and pleasing structures.

Elk Avenue/Doe River Bridge Rehabilitation. In 1926, Elizabethton, TN, proudly cut the ribbons to open a newly constructed bridge over the Doe River. By the late 1990s, the bridge began to suffer the effects of age and was selected for replacement. However, during discussions, there was a strong desire to have the bridge rehabilitated and the designers and the department of transportation agreed.

The scope of work included partial and full deck repairs, removal of portions of the arch ribs under shored conditions, replacement of rib reinforcement in areas near the crown of each span, epoxy injection of various shear cracks and delamination cracks, replacement of spindle rail components and concrete lamp posts, and the addition of a reinforced concrete deck overlay.

Moose Creek Bridge. This first fully prefabricated integral abutment bridge in North America utilized six 47-in. deep pretopped precast, prestressed I-beams on 8-ft centers spanning 72 ft. The beams were pretopped with an 8-ft wide and 9.5-in. thick deck. The adjacent decked beams were joined together with a 16-in. wide cast-in-place concrete closure joint with interlocking looped reinforcing bars. The deck was gradually thickened from 9.5 in. at midspan to 11.5 in. at the prefabricated abutments to account for beam camber. One of the key considerations in the design was to limit the sizes and weights of the various prefabricated units for ease of shipping and handling.

Perry Street Bridge. The challenge was not just to replace an existing 700-ft long seven-span filled-arch concrete bridge in one year, but to do it at the same location and without disturbing the bottom of the river. The solution was to use as much precast concrete as possible. The designers used several latest developments to their advantage: variable depth precast modules, spliced-girder technology, pretopped decked girders, biaxial post-tensioning, and drilling new 60-in. diameter shafts through existing piers. The existing roadway was closed to traffic on February 1, 2005, and the new bridge was open to traffic on October 29, 2005.

Brady Street Bridge. The Brady Street Pedestrian Bridge serves the twin purpose of functionality and architectural expression while enhancing the beauty of the natural surroundings. It is a cast-in-place post-tensioned concrete box section bridge. The varying superstructure thickness is at its minimum of 1 ft 9 in.

Perry Street Bridge, Napoleon, OH. Photo courtesy of HNTB Corporation

Brady Street Bridge, Milwaukee, WI. Photo courtesy of Bloom Consultants, LLC

University Avenue Arched Pier Bridge over I-74, Peoria, IL. Photo courtesy of Alfred Benesch & Company

at the middle of the center span producing a span-to-depth ratio of 71. To reduce the bulk, triangular spandrel openings were provided on either side of the center pier. The owner's requirement for minimum maintenance was addressed by using high performance concrete and eliminating deck joints through the use of integral abutments. The integral abutments were also effectively used to address the uplift caused by a large center-span-to-end-span ratio.

UNIVERSITY AVENUE ARCHED PIER BRIDGE OVER I-74. Using a precast concrete tied arch pier to span the Dry Run Creek flume and support the bridge in a two-span configuration proved an exceptional alternative in a situation where a conventional structure was not possible. The aesthetic elements of the bridge were of paramount significance in the design. The decorative concrete bridge bollards were precast and shipped to the site for installation as needed. A limestone form liner was used on the walls of the vaulted abutments to create a "hand laid stone" appearance. The parapets were built with a smooth form liner using self-consolidating concrete.

FOUR BEARS BRIDGE. The 4,500-ft long bridge is North Dakota's first concrete segmental bridge and the only crossing of the 150-mile long man-made Lake Sakakawea. The precast segmental bridge with typical spans of 316 ft was erected using the balanced cantilever method. The design had to accommodate severe ice loading and frequent high wind conditions, yet allow for economical construction in the deep lake. A "lost form" precast concrete cofferdam with sloping faces was developed to reduce the impact of ice forces while simplifying pile driving operation. The cofferdam also served as a lost form for the cast-in-place concrete pile cap foundation for the pier.

Several design features addressed the need for durability and minimum maintenance for this important bridge, including: high performance concrete, longitudinal and transverse post-tensioning of the deck, elimination of deck blockouts for tendon anchorages, continuous jointless deck, and 3/4-in. integral concrete wearing surface. The context sensitive design recognized the local Native American culture and history with tribal symbols on the box girder web walls and pedestrian walkway.

NOYO RIVER BRIDGE. All of the challenges faced by the designers of this bridge can be attributed to just one cause: site constraints. However, these very limitations were responsible for the unique design features and the resulting picturesque bridge structure. The three-span four-lane cast-in-place concrete post-tensioned box girder bridge is 874 ft long with a main span of 327 ft. Structural challenges included staged construction since the new bridge alignment was the same as the old one, mass concrete application, and high seismicity with soil liquefaction. The builders also need to be sensitive to environmental issues that included the protection of marine life, Native American concerns, dominant fishing industry issues, and impact on area tourism. But the public's main concern was the aesthetics—the view of the harbor through the bridge and the view of the jetty below the bridge had to be preserved.

Four Bears Bridge, New Town, ND. Photo courtesy of FIGG, Engineer of Record for the Four Bears Bridge

Noyo River Bridge, Fort Bragg, CA. Photo courtesy of State of California Department of Transportation

County Road 453 over Battleground Creek Bridge. Speed of construction was the main driver for the design of this modest 60-ft single-span bridge. Additionally, channel hydraulics limited the structure depth to only 2 ft. Engineers at TXDOT focused on three strategies: minimize cast-in-place concrete, minimize the number of beams, and use simple beam connections. Building on the existing standard precast, prestressed slab beams, a new beam shape was developed—7-ft 6-in. wide by 23-in. deep T-beam with 1-ft overhang of the 8-in. thick flange. The side-by-side T-beams were connected to each other along the longitudinal V-shaped joint by welding a 1-in. diameter connector rod to steel plates embedded in flanges of the beams. A conventional bridge at this site would have taken six months to build; the new T-beam bridge took only six weeks.

County Road 453 over Battleground Creek Bridge, Coupland, TX. Photo courtesy of Texas Department of Transportation

Wapello County Mars Hill Bridge. Although a simple, single-span bridge with a three-beam cross section, this bridge is a significant step toward "The Bridge of the Future"—utilizing 110-ft of ultra high performance concrete (UHPC) girders that do not have any rebar for shear stirrups. It was built with Ductal® (www.ductal.com), a UHPC that offers a unique combination of superior properties including ductility, durability, aesthetic flexibility, and strength—compressive strength up to 30,000 psi. With optimized girder crosssections, UHPC bridges can have low lifecycle costs due to efficient design, faster construction due to lighter members, and longer life from superior durability. GE

Wapello County Mars Hill Bridge, Wapello County, IA. Photo courtesy of Rich Sanders/GPA