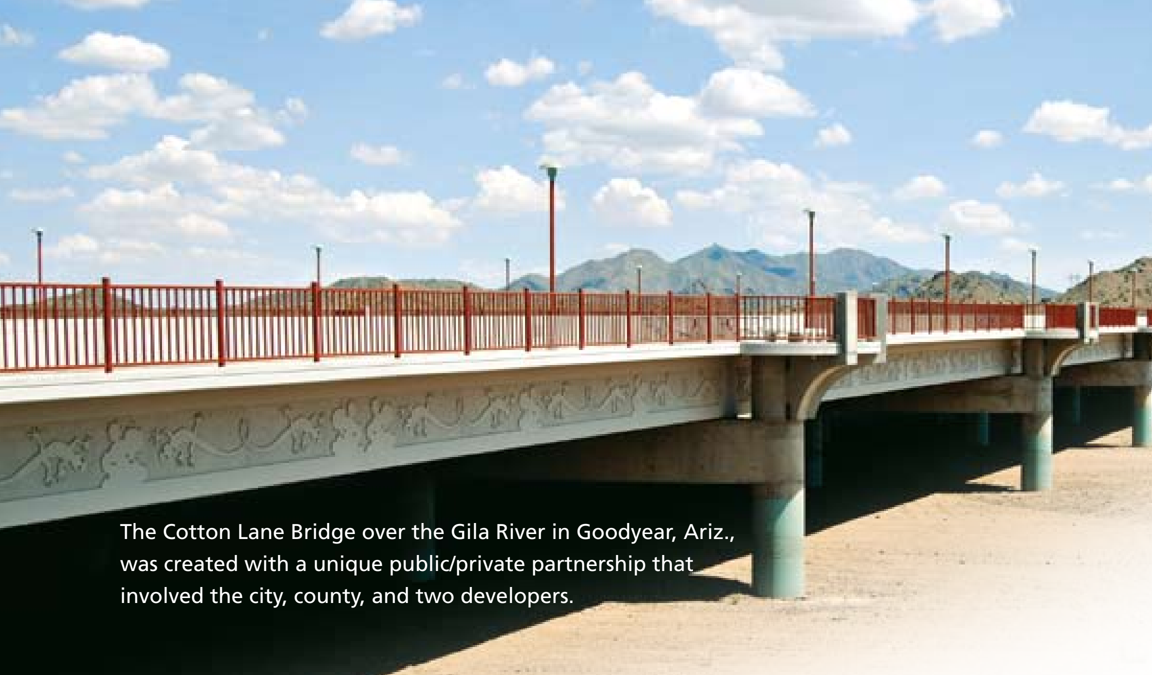


The Cotton Lane Bridge over the Gila River in Goodyear, Ariz., was created with a unique public/private partnership that involved the city, county, and two developers.

Exterior girders had textural decorations reflecting the desert environment cast into them with the use of formliners.

PUBLIC/PRIVATE PARTNERSHIP SUCCEEDS

by David Lawson, Michael Baker Jr. Inc.

Combination of local government and developers produces decorative, cost-efficient bridge design

Bridge designs often must meet the concerns of a variety of participants, and finding innovative ways to ensure all needs are met becomes even more acute as more private organizations join with public entities to fund bridge designs. That proved to be the case for the Cotton Lane Bridge over the Gila River in Goodyear, Ariz., where the Maricopa County Department of Transportation (MCDOT), as the lead agency, joined forces with the City of Goodyear (COGY) and two local developers. The resulting precast concrete design met everyone's needs and produced a strikingly attractive structure that met a reasonable budget and was produced on schedule.

As the city experienced strong growth, COGY and MCDOT officials recognized the need to alleviate traffic congestion in a region that was expanding with housing developments. They also wanted to provide an additional bridge crossing over the Gila River to improve the regional transportation system.

In achieving these goals, the various stakeholders had specific priorities. MCDOT, which transferred ownership to COGY upon completion, wanted to ensure the project was constructed quickly to support the local development and to improve the regional transportation network, setting a one-year construction schedule. The two contributing developers (Sonterra Partners and Estrella Mountain Ranch) emphasized the need for an attractive design to draw potential buyers to the development while remaining within budget. Meanwhile, the Flood Control District of Maricopa County (FCDMC) wanted to ensure the new crossing preserved the area's rich environmental resources and unique river wildlife.

Meeting these needs was complicated by the requirement that the structure optimize the modest construction budget. To achieve this, Michael Baker Jr., serving as the prime consultant, worked with COGY, MCDOT, FCDMC, and the developers through a

profile

COTTON LANE BRIDGE / GOODYEAR, ARIZONA

LEAD AGENCY: Maricopa County Department of Transportation

ENGINEER: Michael Baker Jr. Inc., Phoenix, Ariz.

CONSTRUCTION MANAGER: Tristar Engineering & Management Inc., Chandler, Ariz.

GEOTECHNICAL INVESTIGATION: Ricker Atkinson McBee Mormann & Associates, Tempe, Ariz.

AWARDS: *Best Bridge With Spans Between 75 and 150 Feet, Co-Winner, Precast/Prestressed Concrete Institute's Design Awards 2008; Top 20 Project, Southwest Contractor magazine, 2008; 2008 Honor Award, Arizona chapter of the American Council of Engineering Companies.*

Construction Management at Risk (CMAR) partnership.

COGY, MCDOT, and the developers were all financial participants in the bridge and corresponding roadway's cost. Kiewit Western Co. was selected early in the design process to serve as the construction manager and advisor during design. It also served as general contractor. The CMAR format allowed Baker and the entire design team to evaluate alternatives quickly during design with more accurate estimation of construction cost, constructability, and construction time.

The final design consisted of a 17-span bridge using 12 lines of AASHTO Type VI-modified girders per span. Each span is approximately 121 ft 6 in., resulting in a 2067-ft-long bridge. All interior girders are modified to a 6-in.-thick web as a result of moving the side forms closer together. This

The substructure consisted of cast-in-place drilled shafts, piers, and bent caps.

The precaster, who was brought onto the project early due to the use of a Construction Management at Risk contracting method, supplied 204 Type VI-modified AASHTO girders in 17 spans, each approximately 122 ft long, to create the 2067-ft-long bridge.

provides a 26-in.-wide bottom flange and 40-in.-wide top flange. Interior girders are spaced at 9 ft 5 in. centers.

The fascia girders were modified to accommodate an aesthetic formliner that imparted textures that are overlain by two-dimensional illustrations of geckos. This pattern has a maximum ¾ in. relief, 3 ft 6 in. tall by the full length of the girder. To achieve the flat face to apply the pattern, both top and bottom flanges on the exterior face of the girder were blocked off during casting, creating a "C" or channel shaped girder. In addition, the web was increased to 14 in. thick by adding 6 in. to the outside face. The resulting top flange is 2 ft 7 in.

Alcoves with benches were created along the bridge's length to invite pedestrians to linger and enjoy the scenery, while two bat lodgings were created beneath the bridge to accommodate up to 8000 bats. The alcoves along the bridge are each supported by two precast concrete corbels, which served as falsework during construction, reducing project cost and construction time.

Stakeholder Input and Environmental Assessment

In addition to the four funding groups, many other stakeholders were involved in the design and construction of the project. These stakeholders included local schools, a number of city, county, state, and federal governmental agencies, irrigation districts, railroad, utilities, local residents, and business owners.

With these inputs, designers analyzed several bridge-design alternatives relative to hydraulics, on-site and off-site hydrology, sediment transport, cost, environmental options, and drainage-infrastructure impacts to the Gila River corridor and floodplain.

Drainage design included a review of the Gila River hydraulic and sediment-transport modeling report, and the design and modeling of various alternatives in compliance with the requirements. The alternatives consisted of a longer bridge without floodplain impact and a shorter bridge with improvements to the floodplain. The selected alternative was the shorter bridge with corresponding improvements to the floodplain.

Permitting presented several challenges, since the Gila River is among the jurisdictional waters of the United States, requiring various permits. This effort led to the largest Section 404 permit in Arizona's history.

17-SPAN PRECAST, PRESTRESSED CONCRETE AASHTO I-GIRDER BRIDGE / CITY OF GOODYEAR, OWNER

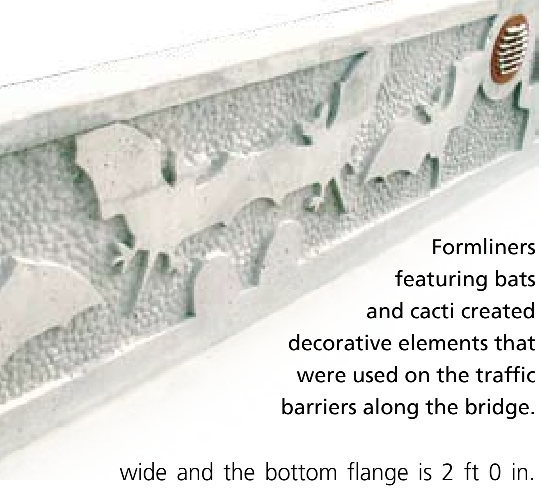
LANDSCAPE ARCHITECT: Corral Dybas Group Inc., Phoenix, Ariz.

PRIME CONTRACTOR: Kiewit Western Company, Phoenix, Ariz.

PRECASTER: Tpac—A Division of Kiewit Western Co., Phoenix, Ariz., a PCI-certified producer

BRIDGE DESCRIPTION: 2067-ft-long bridge featuring 17 spans of AASHTO Type VI-modified precast, prestressed concrete girders, including exterior girders with decorative designs created with form liners; precast concrete corbels supporting circular pedestrian alcoves; and cast-in-place substructure and deck

BRIDGE CONSTRUCTION COST: $27 million



Formliners featuring bats and cacti created decorative elements that were used on the traffic barriers along the bridge.

wide and the bottom flange is 2 ft 0 in. wide. This modified edge girder contains fifty-three 0.6-in.-diameter strands—41 straight and 12 harped. The specified concrete strength was 6500 psi at 28 days and 5200 psi at release. More details of design of the horizontally asymmetric exterior girders may be found in a paper by the author.[1]

The 8-in.-thick deck has an out-to-out width of 114 ft 9½ in. with a 16-ft-wide striped median and provides, in each direction, a 6-ft-wide outside sidewalk protected by a traffic barrier to the inside and pedestrian railing to the outside, a 5-ft 5-in.-wide bicycle lane, and three 12-ft-wide traffic lanes (two striped now and one in the future). Beneath the deck, the bridge carries a 24-in.-diameter reclaimed water line, two 30-in.-diameter water lines, and a large utility bank (12 conduit lines).

Thirty-two circular pedestrian alcoves, placed on both sides of the bridge at each pier location, invite pedestrians to linger and enjoy the scenery. Each alcove is supported by two precast concrete corbels, which were designed to serve as the falsework during construction, reducing project cost and construction time.

In an effort to achieve cost savings without compromising any of the stakeholders' interests, the team utilized creative cost saving strategies. Precast concrete was used where possible to minimize construction time, cost, and adverse impact to the environment. Additionally, a static drilled shaft load test utilizing the Osterberg load cell was performed during early design. Due to the higher reliability of the soil response obtained through the use of this load test, a reduced safety factor, as permitted by the AASHTO LRFD specifications was permitted in design. Savings in the foundation cost far outweighed the cost of the load test and resulted in net savings of more than $1 million to the project.

The bridge's substructure, including columns and bent caps, is cast-in-place concrete. Each column is founded on a single, 72-in.-diameter drilled shaft approximately 105 ft deep.

The Cotton Lane Bridge was a project of firsts and extremes, but the innovative design approach chosen and solutions incorporated into the project exceeded the needs of the owner and client. The design exemplifies environmentally responsive and responsible engineering achieved through continual collaboration of all project stakeholders. The versatility of precast concrete produced a cost-efficient and aesthetically unique bridge that pleased everyone involved.

From forging a creative public/private funding partnership to using unique aesthetics and the CMAR process, the solutions created for this project can serve as a prototype for future bridge-engineering challenges in achieving the collective goals of context sensitivity, project streamlining, and cost efficiency.

References

1. Lawson, David J., and G. P. Wollmann, 2007, "Advanced Aesthetic Embedment in Prestressed Girder," Proceedings of the PCI-FHWA National Bridge Conference, October 22-24, Phoenix, Ariz., 10 pp.
2. Lawson, David J., Ed Corral, and Larry N. Sullivan, 2007, "Cotton Lane Gila River Bridge—Integration of Environment and Infrastructure," Proceedings of the PCI-FHWA National Bridge Conference, October 22-24, Phoenix, Ariz., 11 pp.

David Lawson is a structural engineer with Michael Baker Jr. Inc. in Phoenix, Ariz.

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Sustainability and Aesthetic Impact

The Construction Management at Risk (CMAR) process allowed local precasters to add their valuable input to the design process, contributing to the development of effective precast concrete alternatives. This ensured that critical construction elements were not overlooked and that the most efficient solutions to each challenge were discussed, refined, and implemented.

Creating a Natural Design[2]

Recognizing that this bridge would forever change the natural environment of this portion of the Gila River, the Maricopa County Department of Transportation inspired the team to frame its conceptual design around the question, "How would nature build this?" The answer produced numerous design elements to support the natural environment and wildlife at the construction site while also meeting goals for incorporating sustainable design wherever possible.

The bridge features a low-profile vertical curve, allowing the minimized-arch shape to blend visually with the backdrop of the Estrella Mountains. Sustainability measures also were incorporated into the precast concrete components in a variety of ways. Precasting the components minimized construction waste, and concrete remaining after casting was recycled for use with other ongoing projects. The precast concrete components were cast in nearby Phoenix, minimizing transportation costs. Precast products incorporated Type F fly ash in the concrete mixture, reducing the amount of Portland cement.

Amenities Enhance Design

Inspired by the weathered desert surroundings, the design features exterior girders that used custom form liners to create textures that are overlain by two-dimensional illustrations of geckos. The columns used construction techniques to create fossil-like patterns of prehistoric creatures and plants on their sides. Incorporating the aesthetics directly onto the fascia girders decreased construction time by eliminating the need to hang aesthetic-patterned panels after girder placement. Bats and cacti also were cast onto the back of the traffic barrier to further enhance the desert-themed aesthetics and visual connection to the environment.

To support the wildlife of the river ecosystem, designers created enclosed lodgings to sustain the bat populations living near the river. Baker worked closely with the Arizona Game & Fish Department to incorporate two appropriate bat lodgings on the underside of the bridge, each of which can accommodate up to 4000 bats. Additionally, to minimize pollution caused by excess illumination and comply with the city's "dark sky" requirements, designers created shortened light poles with low-intensity lighting.

photo courtesy of PCI and Mid-States Concrete Industries

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