


ABC Innovative Projects

Jakway Park Bridge					
Location	136 th Street over the east branch of Buffalo Creek in northeast Buchanan County				
State	Iowa				
Owner	Buchanan County				
Year ABC Built	2008				
State ID #	9008248179				
NBI #	083671				
Coordinates	Latitude: 42.58790812		Longitude: -91.73069963		
Contact Person	Brian P. Keierleber, P.E. County Engineer Buchanan County, Iowa Phone: 319-334-6031 Email: engineer@co.buchanan.ia.us				
Mobility Impact Time	ABC: 52 days		Conventional: 15-20 additional days		
Impact Category	<i>Tier 1</i>	<i>Tier 2</i>	<i>Tier 3</i>	Tier 4	<i>Tier 5</i>
				X	
Primary Driver(s)	<ul style="list-style-type: none"> • improved site constructability • improved material quality and product durability • reduced life-cycle cost 				
Description	<ul style="list-style-type: none"> • 115.33-ft long and 24.75-ft wide three-span ultra-high-performance concrete (UHPC) pi-girder bridge (30.58 ft – 51.17 ft – 30.58 ft) [pi-girder in center span only] • Rural location • Average Daily Traffic count: 30 (2005) • Traffic management alternative, if constructed conventionally: extended use of 5-mile detour <p>Existing Bridge: The existing single-span pony truss bridge was 64-ft long and 16-ft wide with timber substructure. It had two 8-ft-wide traffic lanes and two 3-ft-wide shoulders. Built in 1900, the bridge was destroyed in a flood and required replacement.</p> <p>Replacement Bridge: The replacement bridge has two 12-ft-wide traffic lanes and two 3-ft-wide shoulders. The middle span's cross-section consists of three 8.33-ft-wide 2.75-ft-deep adjacent pretensioned UHPC pi-girders with 3-inch-wide tapered webs spaced at 4.42 ft. The deck is 4.13 inches thick between webs and tapered from 6.88 inches to 5.25 inches outside the webs at the deck edge. The bridge is the first highway bridge built with the UHPC pi-girder concept, the first North American highway bridge to incorporate batching of UHPC in a ready-mix truck, and the second North American highway bridge built with UHPC girders.</p> <p>Construction Methods: The 50-ft-long simple-span pi-girders were fabricated in three separate pours on three separate weeks in September 2008 at a plant in Canada. Ready-mix trucks were used to batch the UHPC mix to reduce costs. The required compressive strength after steam curing was 21,500 psi, and the final average compressive strength approached 30,000</p>				

	<p>psi.</p> <p>While the pi-girders were being fabricated, the contractor graded the bridge site and constructed the conventional cast-in-place integral abutments on steel H-piles and cast-in-place pier caps on steel H-piles encased in concrete. The pi-girders were trucked to the site and erected on plain neoprene bearing seats in mid-October 2008, approximately one month after the last pi-girder was fabricated. They were tied together transversely with No. 8 reinforcement bars in grouted pockets at 18-inch spacing and with steel diaphragms across the bottom of the flanges at quarter points. The contractor encased the pi-girder ends in cast-in-place diaphragms with 3,500 psi concrete compressive strength. The two reinforced concrete slab end spans were constructed conventionally. No deck surface preparation was done other than a tack coat. The contractor applied a 3/8-inch asphalt chip seal to provide texture. Because the project was so late in the year the chip seal was placed in the spring of 2009. Construction monitoring allowed assessment of structural performance.</p> <p>The contract required the bridge to be closed a maximum of 53 calendar days. The bridge was re-opened in 52 days.</p> <p>The Iowa DOT standard specifications were used on the project. No incentives or disincentives were included in the contract.</p> <p>Stakeholder Feedback: This bridge was the first project in Buchanan County to use UHPC. The County learned much about the use of UHPC, e.g., how best to cure UHPC since it cures differently than conventional concrete.</p> <p>The purpose for the project was to optimize the use of UHPC in precast bridge girders. The project engaged a novel superstructure design referred to as a pi-girder, designed to carry HL 93 loads over an 87 ft span. Numerous hurdles existed, and solutions were implemented to overcome the issues. Practical concerns with the ability of precast concrete fabricators to efficiently construct UHPC components within their normal operations were addressed through the use of ready-mix trucks to mix and transport the concrete to the forms.</p> <p>Another very positive aspect is UHPC's impervious nature and self-consolidating properties. However, this prevented placing a texture on the UHPC and raised concerns about whether a surface texture could be bonded to it. The County placed an asphalt chip seal on the deck as a friction surface and it appears to be performing well; the County expects epoxy friction surfaces to work well also.</p> <p>The rate of mechanical property development of the UHPC is an aspect that would benefit from additional investigation. UHPC tends to display an hours-long dwell time prior to the initiation of any mechanical property development. As such, precasting operations must be scheduled appropriately to allow for casting, curing, demolding, and stressing operations.</p> <p>FHWA developed an executive summary of the research project which developed and performed full-scale structural testing on the 2nd generation pi-girder. See "Other Related Information" for TechBrief link.</p>
<p>High Performance Materials</p>	<ul style="list-style-type: none"> • Ultra-high-performance concrete (UHPC) pi-girders

Photos Additional photos				
Project Planning	<i>Decision-Making Tools</i> <ul style="list-style-type: none"> 	<i>Site Procurement</i> <ul style="list-style-type: none"> 	Procurement <ul style="list-style-type: none"> Design-bid-build 	Contracting <ul style="list-style-type: none"> Full lane closure
Geotechnical Solutions	<i>Foundations & Walls</i> <ul style="list-style-type: none"> 		<i>Rapid Embankment</i> <ul style="list-style-type: none"> 	
Structural Solutions	Prefabricated Bridge Elements & Systems			<i>Construction</i>
	Elements <ul style="list-style-type: none"> Other decked beam elements: pi-girders 	Systems <ul style="list-style-type: none"> 	Miscellaneous <ul style="list-style-type: none"> CIP reinforced concrete closure joints Grouted keys Asphalt chip seal, no membrane Steel diaphragms 	<ul style="list-style-type: none">
Costs	<p>The low bid was \$ 288,000 of which \$199,000 was funded by IBRC for the UHPC portion. There were two bidders. The UHPC pi-girders were provided to the contractor at an additional cost of \$314,000. The cost per sq ft of bridge was \$224 compared to \$100 per sq ft for conventional construction in this region in 2008. The County expects the UHPC material costs will drop over time and the economics will be more comparable.</p> <p>The IBRC award included allowances for monitoring, design, and testing costs and was supplemented by additional money from the Iowa Highway Research Board. The overall cost was somewhat complicated since only one span was UHPC, along with the fact that the girders were purchased directly from the producer and were not included in the construction contract.</p> <p>The project received federal (SAFETEA-LU and IBRC) and local funding.</p>			
Funding	<i>Federal only</i>	<i>State only</i>	<i>Federal and State</i>	Other See "Costs"
Incentive Program (\$)	<i>Highways for LIFE</i>	IBRC \$700,000	<i>SHRP2</i>	Other \$80,000 – Iowa Hwy. Research Board
Contract Plans	Complete Set: Contract Plans (link to pdf)		ABC *:	
Specifications	Complete Set: Standard Specifications [http://www.iowadot.gov/specifications/index.htm]		ABC *:	
Bid Tabs	Bid Tabs (link to pdf) Contract Schedule of Prices (link to pdf)			
Schedule	Engineer's: Not available.	Actual: Not available.		
Other Related Information	Iowa DOT IBRC/IBRD Website [http://www.iowadot.gov/bridge/ibrcibrd_research.htm]			

	<p>Iowa DOT Research News, April 2011 (link to pdf)</p> <p>“Design of Buchanan County, Iowa, Bridge using Ultra-High Performance Concrete and Pi-Girder Cross Section,” 2010 PCI National Bridge Conference Proceedings (link to pdf)</p> <p>“FHWA, Iowa Optimize Pi Girder,” PCI ASPIRE, Winter 2010 (link to pdf)</p> <p>“Structural Behavior of a 2nd Generation UHPC Pi-Girder,” FHWA TechBrief, October 2009 [http://www.fhwa.dot.gov/publications/research/infrastructure/structures/09069/]</p> <p>Iowa DOT Bridge Standards Website [http://www.iowadot.gov/bridge/v8ebrgstd.htm]</p>
Photo Credits	Buchanan County; Iowa Department of Transportation

* Specific to the ABC used in the project.