

Iowa Ultra-High Performance Concrete Use History and Lessons Learned

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Extended Abstract

Iowa Department of Transportation (DOT) has piloted various Ultra-High Performance Concrete (UHPC) technologies over the years starting with the first use of UHPC in the United States to construct a UHPC pretensioned prestressed concrete bulb-tee beam in 2006 for a bridge project in Wapello County to a recently awarded contract to construct a UHPC two-course bridge deck in Cass County in the 2023 construction season. The UHPC two-course deck will consist of a conventional 7 ¾” Portland Cement Concrete (PCC) bridge deck capped with a 1 ¼” UHPC overlay prior to the bridge being opened to traffic. Since the first use of UHPC in Iowa, the Iowa DOT has piloted additional UHPC technologies including:

- UHPC deck level connections for Accelerated Bridge Construction (ABC).
- Pretensioned prestressed UHPC piling for bridge deep foundations.
- UHPC bridge deck overlays for bridge preservation.
- UHPC post-lateral slide connections for ABC.
- UHPC beam end repair.

This presentation will give an overview of the history of implementation of unique and notable UHPC projects in Iowa and discuss lessons learned in the execution of these projects.

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Many UHPC projects have been completed in Iowa including some that are first use of the UHPC technology nationally and some that are local pilots of the UHPC technology to test the technology, gain experience and confidence in their use before implementing more broadly.

Table 1 – Notable Iowa UHPC Projects lists a variety of UHPC projects that are noteworthy pilot projects or that have special and significant characteristics.

Year of Construction	Project Name	UHPC Technology	Location	Bridge Owner
2006	Mars Hill Bridge over Little Soap Creek	UHPC Beam	Wapello County	Wapello County
2008	136th Street at Jakway Park over Buffalo Creek	UHPC Beam (Pi Girder)	Buchanan County	Buchanan County
2011	Dahlonga Road over Little Cedar Creek	UHPC Waffle Deck	Wapello County	Wapello County
2011	US 6 over Keg Creek	UHPC Deck Level Connections (ABC)	Pottawattamie County	Iowa DOT
2012	US 20 over US 71	UPHC Precast Piling	Sac County	Iowa DOT
2015	IA 92 over Little Silver Creek	UHPC Deck Level Connections (ABC)	Pottawattamie County	Iowa DOT
2015	Deacon Ave. over Small Stream	UHPC Beam (K-UHPC)	Buchanan County	Buchanan County
2016	LaPorte Road over Mud Creek	UHPC Bridge Deck Overlay	Buchanan County	Buchanan County
2018	US 18 over Floyd River (Sheldon, IA)	UHPC Bridge Deck Overlay	Sioux County	Iowa DOT
2018	IA 3 over Branch 19 of DD No. 53	UHPC Box-beam Deck Level Connections (ABC)	Pocahontas County	Iowa DOT
2019	IA 1 over Camp Creek	UHPC Connection Post Lateral Slide (ABC)	Washington County	Iowa DOT
2020	EB IA 163 over Walnut Creek	UHPC Bridge Deck Overlay	Jasper County	Iowa DOT
2020	IA 1 over Old Mans Creek	UHPC Connection Post Lateral Slide (ABC)	Washington County	Iowa DOT
2021	IA 92 over Muchakinock Creek	UHPC Connection Post Lateral Slide (ABC)	Mahaska County	Iowa DOT
2023*	NB IA 926 over 7th Street & CNRR	UHPC Beam End Repair	Webster County	Iowa DOT
2023*	IA 92 over Seven Mile Creek	UHPC Two Course Deck	Cass County	Iowa DOT

*Projects are let and awarded – construction is anticipated in the 2023 construction season.

Table 1 – Notable Iowa UHPC Projects

The list of notable Iowa UHPC Projects is not a comprehensive list of all UHPC projects carried out in Iowa but instead is a select list of projects that were first pilots of a UHPC technology or projects where there was an incremental improvement in the use of UHPC. Lessons learned have accumulated and been carried forward to subsequent projects. Key case study projects with selected lessons learned and features to highlight are as follows:

Mars Hill Bridge over Little Soap Creek - 2006

- First use of UHPC in the United States.
- Structural design specifications are needed to optimize PPC beam design.

US 6 over Keg Creek - 2011

- Iowa pilot of UHPC deck level connections for prefabricated modular superstructure units.

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- The need for watertight joint forming and capping of joints on cross-slopes was highlighted.
- Design specifications for UHPC non-contact lap splices needed to reduce joint congestion and constructability issues.

US 18 over Floyd River (Sheldon, IA) - 2018

- Iowa pilot of UHPC bridge deck overlay on the primary system.
- The overlay should be placed monolithically instead of in lifts.
- Staged construction joint reinforcing is not needed and instead use a roughened joint between the construction stages.
- The overlay should not be placed in unfavorable weather conditions and revisions to the controls in the specification were needed.

IA 1 over Camp Creek - 2019

- Iowa pilot of a UHPC connection post lateral slide (ABC).
- Improve joint detailing and configuration on the inside face of the abutment and end diaphragm.
- Cast UHPC connection from rear face only. UHPC consolidated adequately and front face casting blockouts conflicted with the preferred superstructure jacking locations.

NB IA 926 over 7th Street and CNRR – 2023*

- Iowa pilot of UHPC beam end repair.
- Includes a comparison of traditional proprietary UHPC options, non-proprietary UHPC and high-early strength concrete for beam end repair.

IA 92 over Seven Mile Creek – 2023*

- Iowa pilot of UHPC two-course deck.
- Investigate surface preparation (roughening) options beside hydrodemolition.