Presentation Outline

• Iowa UHPC Use Timeline
• Case Study – US 18 over Floyd River
• Case Study – EB IA 163 over Walnut Creek
• Future use of UHPC
• Bridge Preservation Resources
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

Deployment of UHPC in Iowa
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

UHPC Use in Iowa Timeline (Year of Construction)

2006
- Mars Hill Bridge over Little Soap Creek
  - Wapello County
  - UHPC Beam (Bulb-Tee)
  - LaFarge Ductal

2008
- 136th Street at Jakway Park over Buffalo Creek
  - Buchanan County
  - UHPC Beam (Pi Girder)

2011
- US 6 over Keg Creek
  - Iowa DOT
  - UHPC Deck level connections (ABC)

2012
- US 20 over US 71
  - Iowa DOT
  - UHPC Pile

2011
- Dahlonega Road over Little Cedar Creek
  - Wapello County
  - UHPC Waffle Deck Panels with UHPC joint
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

UHPC Use in Iowa Timeline (Year of Construction)

2015
- Deacon Avenue over Small Stream
  Buchanan County
  UHPC Beam (Pi Girder)
  K-UHPC

2016
- LaPorte Road over Mud Creek
  Buchanan County
  UHPC Bridge Deck Overlay

2018
- US 18 over Floyd River in Sheldon
  Iowa DOT
  UHPC Bridge Deck Overlay

- IA 92 over Little Silver Creek
  Iowa DOT
  UHPC Deck level connections (ABC)

- IA 3 over Branch 19 of DD No. 53
  Iowa DOT
  UHPC Deck level connections between box beams (ABC)
  GRS-IBS
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

UHPC Use in Iowa Timeline (Year of Construction)

2019
IA 1 over Camp Creek
Iowa DOT
UHPC connection post lateral slide (ABC)

2020
IA 1 over Old Mans Creek
Iowa DOT
UHPC connection post lateral slide (ABC)
Cor-Tuf UHPC
IA 1 over Old Womans Creek
Iowa DOT
UHPC connection post lateral slide (ABC)

2022 (anticipated)
NB IA 926 over 7th Street & CNRR in Fort Dodge
Iowa DOT
UHPC concrete beam end repair
Non-proprietary

2023 (anticipated)
IA 92 over Seven Mile Creek
Iowa DOT
UHPC two course deck

2020
EB IA 163 over Walnut Creek
Iowa DOT
UHPC Bridge Deck Overlay

2021
IA 92 over Muchakinock Creek
Iowa DOT
UHPC connection post lateral slide (ABC)
Steelike UHPC

Non-proprietary UHPC Mix Design

A. Mixture Ingredients.

The non-proprietary UHPC mixture shall be made in accordance with the following ratios, proportions, and material specifications:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Cement</th>
<th>Sand</th>
<th>Masonry Sand</th>
<th>Silica Fume</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Ratio (for 1.0 ft³)</td>
<td>0.425</td>
<td>0.226</td>
<td>0.200</td>
<td>0.060</td>
<td>0.089</td>
</tr>
<tr>
<td>Proportion (lb/yd³)</td>
<td>1500</td>
<td>790</td>
<td>710</td>
<td>210</td>
<td>320</td>
</tr>
</tbody>
</table>

1. **Cement**: Type I/II portland cement meeting the requirements of Section 4101 of the Standard Specifications.

2. **Sand**: Meeting the requirements of Section 4110 of the Standard Specifications with a specific gravity of (at least) 2.65. It shall be sieved such that the portion with 100% passing the No. 30 sieve is obtained to be used as sand required for the mixture.

3. **Masonry Sand**: Meeting the requirements of Section 4110 of the Standard Specifications with 100% passing the No. 30 sieve.

4. **Silica Fume**: Meeting the requirements of AASHTO M307 with a high purity (i.e., silica content ≥ 94%).

5. **Water**: Meeting the requirements of Section 4102 of the Standard Specifications.

6. **High-Range Water Reducer (HRWR)**: It shall be in accordance with Section 4103 of the Standard Specifications and Materials I.M. 403. The HRWR content shall be determined based on the trial batch to reach the desired flow, i.e., with a spread diameter of 8 to 12 inches. An HRWR-to-cement ratio of 0.05 (45.0 pounds per cubic yard) can be used as a starting point.

7. **Steel Fiber**: Straight 0.008 inch diameter by 0.5 inch long steel fibers with a smooth surface meeting the requirements of ASTM A820 shall be incorporated into the mixture design. The steel fibers shall have a minimum tensile strength of 285 ksi. The steel fiber dosage is 2.0% by volume (263 pounds per cubic yard).
3. Testing shall be performed by the Contractor and approved by the Engineer. The required testing is summarized in the following table. The table contains the test methods, minimum acceptance criteria, and expected frequencies. Tests may be performed at a more frequent intervals than described below, at the discretion of the Engineer.

<table>
<thead>
<tr>
<th>Description</th>
<th>Test Method</th>
<th>Acceptance Criteria</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow and Visual Stability</td>
<td>ASTM C1856</td>
<td>8 inches (Minimum); 12 inches (Maximum); No bleed; water; Consistent fiber distribution</td>
<td>One per batch</td>
</tr>
<tr>
<td>Compressive Strength*</td>
<td>ASTM C1856 (3x6 inch cylinders)</td>
<td>≥ 9 ksi (at 7 days); ≥ 11 ksi (at 14 days); ≥ 12.5 ksi (at 28 days) (150 psi/sec loading rate)</td>
<td>7 day, 14 day**, and 28 day</td>
</tr>
<tr>
<td>Rapid Chloride Ion Penetrability***</td>
<td>ASTM C1856 (4x8 inch cylinders)</td>
<td>≤ 300 coulombs</td>
<td>28 day (two per job)</td>
</tr>
</tbody>
</table>

* Each set shall contain at least three samples and all test sets shall be cured similar to that of the field work.
** 14 day compressive test shall be used for acceptance.
*** The samples shall be collected at the time of the flow test before the addition of steel fibers.
Case Study – US 18 over Floyd River
Case Study – US 18 over Floyd River

- US 18 over Floyd River
- FHWA No. 48351
- 205’-6 x 44’ Three Span PPCB Bridge
- Constructed: 1992

- Project Letting: 7/18/2017
- Prime Contractor: Cramer & Associates
- Sub Contractor: WALO IA, LLC
Case Study – US 18 over Floyd River
Case Study – US 18 over Floyd River

Figure 1: Stage 1 Construction Staging

Figure 3: Two Layer Section

Figure 4: First Layer Reinforcement
Case Study – US 18 over Floyd River
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

Case Study – US 18 over Floyd River
Case Study – US 18 over Floyd River

1. Limit mix placement temperature to 80°F (specification allowed 90°F).

2. Eliminate staged construction joints as much as possible.

3. Eliminate joint reinforcement.

4. Eliminate two course UHPC application.

5. Improve method of achieving a saturated surface-dry (SSD) condition on the bridge deck.
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

Case Study – EB IA 163 over Walnut Creek
Case Study – EB IA 163 over Walnut Creek

- IA 163 (EB) over Walnut Creek
- FHWA No. 30811
- 95’-0 x 44’ Single Span PPCB Bridge
- Constructed: 1974

- Project Letting: 11/19/2019
- Prime Contractor: Jasper Construction Services, Inc.
- Sub Contractor: UHPC Solutions North America
Case Study – EB IA 163 over Walnut Creek

REPAIR AND OVERLAY DEFINITION

NOTE:
THE 2'-0" CLASS "A" REPAIR AREA SHOWN AT BRIDGE ENDS SHALL
BE REMOVED TO A MINIMUM DEPTH 1 INCH BELOW THE EXISTING
TOP MAT OF REINFORCING. THE EXISTING BRIDGE DECK REINFORCING
BARS SHALL BE CAREFULLY EXPOSED AND INCORPORATED INTO THE
NEW CONSTRUCTION WORK.
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

Case Study – EB IA 163 over Walnut Creek
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

Case Study – EB IA 163 over Walnut Creek
Case Study – EB IA 163 over Walnut Creek

1. Improve method of achieving a saturated surface-dry (SSD) condition on the bridge deck.

2. Address contractor concerns regarding grinding and grooving UHPC.
Future of UHPC

1. UHPC Beams pretensioned prestressed
2. UHPC Precast waffle deck
3. UHPC for ABC connections
   • Deck level connections
   • Post lateral slide connections
4. UHPC Piling pretensioned prestressed
5. UHPC Bridge deck overlay for preservation
6. UHPC Beam end repair
   • Steel
   • Concrete
7. UHPC Bridge deck overlay for service life
8. UHPC Link slab (future)
State Perspective: UHPC for Bridge Preservation, Repair & Other Initiatives

AASHTO Publications

Guide to Preservation of Highway Bridge Decks, 1st Ed. – Balloted and Passed AASHTO COBS July 2021