2022 ACEC-IA + Iowa DOT + FHWA Iowa Transportation Conference

Iowa DOT Bridges and Structures Bureau Update

Michael Nop

IOWA DOT GETTING YOU THERE

September 28, 2022

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Presentation Outline

- BSB Personnel Updates
- 3D/DD/BIM Efforts
- BDM and Specification Updates
- Bridge Standards
- ABC Lateral Slides
- Deck Cracking
- UHPC Overlays
- UHPC Beam End Repair
- Approach Slab IRI

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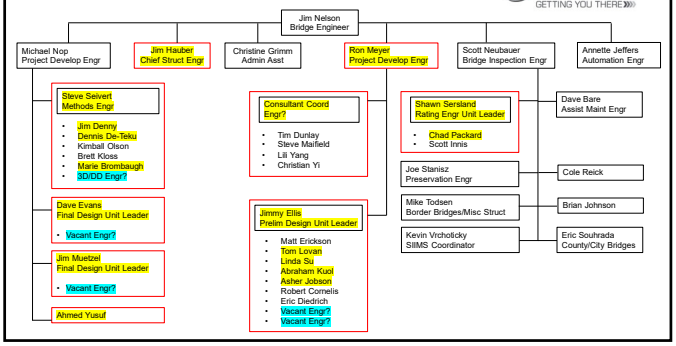


Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

THE DEPARTMENT'S VISION for digital delivery is to enhance our abilities to share information seamlessly across the enterprise, significantly improve asset management, and provide greater value to all users, including construction contractors and suppliers.

OUR MISSION is to enable streamlined data sharing and active collaboration between different Divisions, Bureaus, as well as the public and other external stakeholders.

DIGITAL DELIVERY is a modern process in which 3D models and other files are created and delivered to facilitate construction and incorporate digital information to support maintenance and operations activities and lifecycle asset management.

Benefits
- Improved design quality
- Early identification of potential issues that reduce change orders
- Data visualization allows project teams to optimize construction means, methods, and schedules
- Streamlined data collection that reduces duplication of work
- Ability to access the right information at the right time

Focus Areas
- Data requirements, standards and guidelines
- Data collection and storage
- Workflow efficiency
- Technology implementation
- Workforce development outcomes
- Digital Delivery Lead and Communications

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

The Digital Delivery Initiative will impact the entire Department with respect to planning, design, construction, maintenance and operation activities.

Currently, the primary focus on the project development side of the Bridges and Structures Bureau (BSB) with respect to this initiative is to work towards having the 3D "Model as the Legal Document" (MALD) with an unofficial self-imposed target date of 2027.

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

Some Benefits of MALD

Single source of truth leads to reduced errors in design, construction, and fabrication:
- The model is the sole source of information. Any cut sections are derived directly from the model and are not created independently. Information can be digitally retrieved from the model.
  [Eliminate the bad Re-s which lead to errors such as Re-produce, Re-create, Re-type, Re-entry and only include the good Re-s such as Re-use.]
- 3D, combined with 2D, allows for better visualization and communication of plan intent for all involved parties. [The model provides flexibility to contractors and inspectors since they can view the 3D model as desired and can cut any sections they want to see from the model.]
- Contractors/surveyors can pull staking data directly from the model to reduce construction errors.
- Clash detection is easier to perform with a 3D model. [Conflicts within the bridge details themselves, but also with existing structures and utilities if they can be accurately located.]
- Quantities can be calculated directly and accurately from the model.

There is a caveat here as the BSB tries to determine the best approach to handle our "bread and butter bridges". We prefer not to custom design/detail each bridge, but make use of standards – perhaps standard 3D models.

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

Some Benefits of MALD

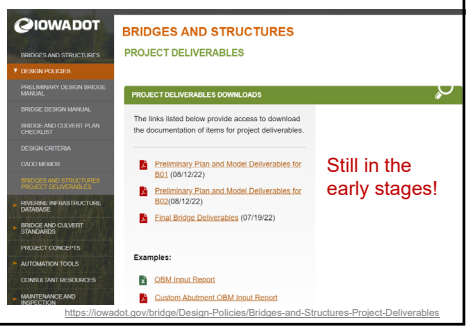
Data exchange with all parties saves time (and reduces errors):

- Industry foundation classes (IFC) is an open file format that will allow seamless data exchange of the model between different softwares which allows parties downstream to build on the model information provided at letting.
- Design and detailing software are becoming more integrated which may cut down on design/detail time and errors.
- Reinforcement bar tables can be generated directly from the model and fed digitally to the fabricator.
- Steel bridge beam information can be digitally accessed and built upon by steel fabricators.

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

Software:

- Bentley Connect
- OpenRoads Designer (ORD)
- OpenBridge Modeler (OBM)
- ProStructures



Still in the early stages!

https://iowadot.gov/bridge/Design-Policies/Bridges-and-Structures-Project-Deliverables

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

BSB BIM – Overcoming a Rocky Start

Current Practice ----

1.) 2D is legal document

2.) Supplement 2D with 3D — 2D is legal document

Future Practice ----

3.) Develop all 2D from 3D — 2D is legal document

4.) Supplement 3D with 2D — 3D is legal document

5.) 3D is legal document -- maybe

Bridge New-Steel Girder
I-80/I-380 Interchange in Johnson County, Iowa,
Special Provisions for Conformity with and Coordination of the Contract Documents
Project Number: IM-080-6(355)239--13-52, Let 07-31-2018
Software: Open Bridge Modeler and ProStructures

Figure 1: Location of Ramp B

BSB is still primarily on #1. Hoping to do more of #2 in the next 2 years and see some contractors make use of 3D supplements for more than just visualization. #3 is the biggest hurdle.

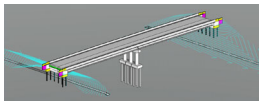
BSB is committed to providing 2D plan sheets and details as long as needed to ensure a smooth transition.

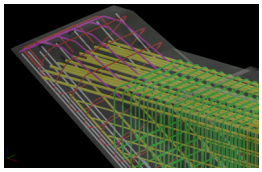
Bridges and Structures Bureau Update

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

Some BIM Challenges

- Software capabilities are limited
- Software constantly changing
- Compatibility between software versions
- IFC is not here (yet)
- Software is complex - training employees
- Developing 3D workflows
- Best practices for 3D models (LOD)
- Incorporating standards
- Role of engineer and technician
- How to check a 3D model – dimensions, elevations, etc.
- Industry buy-in
- Tools for contractors/inspectors
  (and less technical DOT engineering managers)





2022 Iowa DOT Bridge Forum on 3D and Digital Deliverables

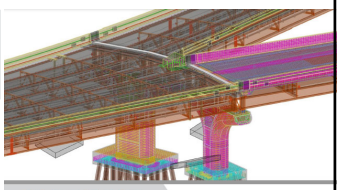
Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

November 1, 2022
8:30 AM to 5:00 PM

Marriott West Des Moines
1250 Jordan Creek Parkway

Planned Forum Topics:
- Digital Delivery National Industry Efforts
- Iowa DOT Digital Delivery Vision
- Utah Bridge Digital Delivery Case Study – Design / Construction / Inspection
- Challenges and Opportunities – Iowa AGC, Iowa ACEC, Fabricators
- Facilitated Panel Discussion – Public Agency / Contractor / Designer

Forum is open to all interested parties (contractors, designers, fabricators) and will be provided free of charge, but capacity is limited. The goal of the forum is to identify transportation industry challenges and opportunities as the Iowa DOT moves towards digital delivery for bridge design and construction, and registration link and additional details will be sent out later this month.



SAVE THE DATE

Bridges and Structures Bureau Update

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

Schedule of Events

8:30 am - 9:30 am Forum Kickoff

Iowa DOT Digital Delivery Roadmap
Charlie Purcell, Deputy Director of Transportation Development Division

National Efforts: Open Data Standards and Model As Legal Document (MALD)
David Unkefer, Senior Construction and Project Management Engineer, US DOT, FHWA

Iowa DOT Bridges and Structures 3D/DD Vision and Efforts
Michael Nop, Bridge Project Development Engineer

9:30 am - 10:30 am Bridge Digital Delivery Case Study - Utah DOT
Cheryl Hersh Simmons, Chief Structural Engineer (Utah DOT)
Scott Fernald, Granite Construction Technology Manager (Contractor)
Kaleb Nelson, Project Engineering Consultants (Inspector)

10:30 am - 11:30 am AGC of Iowa: Challenges and Opportunities
Andy Stone, Project Manager, United Contractors
Dan Cramer, President, Cramer & Associates
Mark Freier, Godbersen-Smith Construction Company

11:30 am - 12:30 pm ACEC-Iowa: Challenges and Opportunities
I-80 over Sugar Creek, Cedar County
Sean Connor, Structural Engineer, HR Green
IA 2 Overflow Bridge and Other Examples
Tony Bower, Senior Structural Engineer and Jamie Wahl, Principal Designer, Stanley Consultants
Various Examples
Grant Schmitz, Bridge Engineer, HDR

12:30 pm - 1:30 pm Lunch

1:30 pm - 2:45 pm Fabricators: Rebar and Steel, Challenges and Opportunities
Rebar Fabrication- Anne Duffield, President, Mid States Rebar and Supply
Steel Fabrication-Brad Dillman, High Steel Structures
Steel Fabrication (Another Perspective)- Adam DeMargel, Stupp Bridge Company

2:45 pm - 3:45 pm Construction Survey and Inspection, Challenges & Opportunities
Construction Survey
Josh Doughan, Vice President, McClure Engineering
Construction Inspection/Digital As-Builts
Curtis Carter, Iowa DOT Senior Structural Engineer
Cedric Wilkinson, Iowa DOT Senior Engineering Technician

3:45 pm - 4:45 pm Facilitated Panel Discussion
Moderator Alexa Mitchell, HDR
Jim Hauber, Chief Structural Engineer, Iowa DOT
Will Sharp, Director of Highways, HDR
Ron Otto, Technical Director, AGC/Iowa
Cheryl Hersh Simmons, Chief Structural Engineer, Utah DOT

4:45 pm - 5:00 pm Closing Comments -
Charlie Purcell, Deputy Director of Transportation Development Division

Registration on ACEC website is Open!
https://www.cec-iowa.org/home

Bridges and Structures Bureau Update

Iowa DOT Strategic Plan (Roadmap) for Digital Delivery

BSB Methods Unit
New BIM Engineer Position – Interviews Complete!

Develop, implement and lead all aspects related to Bridge Information Modeling (BIM) including those aspects related to asset management, multi-dimensional modeling (e.g. 3D) and digital delivery for the Bridges and Structures Bureau (BSB).

- Guide the development and coordination of policies and procedures related to BIM for the BSB.
- Coordinate BIM efforts in the BSB with other DOT Bureaus, consultants, software vendors, contractors, fabricators, federal and local agencies and other parties as needed.
- Coordinate and communicate with the BSB Methods Unit and Automation Engineer to ensure BIM efforts are compatible with the efforts of this group as a whole in relation to design policy and CADD detailing practices.
- Develop expertise in the software required to generate 3D models. Examples of software include Bentley's Microstation Connect, OpenRoads Designer, OpenBridge Designer/Modeler, and ProStructures.
- Evaluate and recommend software purchases related to BIM.
- Develop and implement training documentation, training courses and training videos for customers as needed.
- Actively work to develop ways to increase efficiency and productivity in the design, detailing, modeling and workflow processes. Investigate ways to integrate design and detailing processes.
- Participate in local and national research efforts related to BIM.

Bridges and Structures Bureau Update

BDM August 2022 Update
Working Drawings – CADD Note E65

SHOP DRAWING SUBMITTALS

SHOP DRAWINGS SHALL BE SUBMITTED FOR THE FOLLOWING ITEMS SHOWN IN THE TABLE BELOW. (NOTE ADDITIONAL SHOP DRAWINGS MAY BE REQUIRED IN ACCORDANCE WITH ARTICLE 1105.03 OF THE STANDARD SPECIFICATIONS.)

SUBMITTAL REQUIREMENTS FOR SHOP DRAWINGS SHOULD BE IN ACCORDANCE WITH 1105.03 OF THE STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION OF THE IOWA DEPARTMENT OF TRANSPORTATION.

SHOP DRAWINGS SHALL BE SUBMITTED WITH THE FOLLOWING NAMING CONVENTION:
(Paren)_County_DesignNumber_SubmittalDescription.pdf
Example: (090)_Blackhawk_Design915_DeckDrains.pdf

1	
2	
3	
4	
X	

Old

Certification by an Iowa PE is required for:
- Falsework for slab bridges
- Shoring plans
- Transparent SIP deck forms
- Cofferdams
- Temporary sheet pile
- Steel girder erection plan

Calculations with certification by an Iowa PE may also be required.

WORKING DRAWING AND CALCULATION SUBMITTALS

WORKING DRAWINGS AND CALCULATIONS SHALL BE SUBMITTED FOR THE FOLLOWING ITEMS SHOWN IN THE TABLE BELOW. (NOTE ADDITIONAL WORKING DRAWINGS AND CALCULATIONS MAY BE REQUIRED IN ACCORDANCE WITH ARTICLE 1105.03 OF THE STANDARD SPECIFICATIONS.)

SUBMITTAL REQUIREMENTS FOR WORKING DRAWINGS AND CALCULATIONS SHALL BE IN ACCORDANCE WITH 1105.03 OF THE STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION OF THE IOWA DEPARTMENT OF TRANSPORTATION. THE ABSENCE OF A CERTIFICATION REQUIREMENT FOR A SUBMITTAL DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY TO ATTAIN CERTIFICATION.

CALCULATION SUBMITTALS IN THIS TABLE WHICH ARE ASSOCIATED WITH WORKING DRAWING SUBMITTALS SHALL BE SUBMITTED ON THE SAME DAY. REVIEW TIME FOR CALCULATION SUBMITTALS SHALL BE OF THE SAME DURATION AS AND RUN CONCURRENTLY WITH REVIEW TIME FOR ASSOCIATED WORKING DRAWINGS. THE CALCULATION SUBMITTALS LISTED IN THE TABLE ARE NOT MEANT TO BE AN EXHAUSTIVE LIST AND DO NOT RELIEVE THE CONTRACTOR FROM PROVIDING ADDITIONAL CALCULATION SUBMITTALS IF REQUESTED BY THE ENGINEER.

NO.	WORKING DRAWING DESCRIPTION	WORKING DRAWING FILE NAME CONVENTION FOR SUBMITTAL	CERTIFIED BY IOWA P.E. (YES/NO)
1			
2			
3			
4			
X			

New

NO.	CALCULATION DESCRIPTION	CALCULATION FILE NAME CONVENTION FOR SUBMITTAL	CERTIFIED BY IOWA P.E. (YES/NO)
5			
6			
7			
X			

Bridges and Structures Bureau Update

Specification Update - Concrete Deck Wet Cure

Iowa DOT Standard Specification 2412.03, E to specify a 7-day, instead of the current 4-day, wet cure for concrete bridge decks that are cast using Class C concrete (except for CCS).

3. Apply water to the burlap covering for a period of 4 calendar days for continuous concrete slab bridge decks and 7 calendar days for all other concrete bridge decks. Use a pressure sprinkling system that is effective in keeping the burlap wet during the moist curing period. The system may be interrupted only to replenish the water supply, during periods of natural moisture, or during construction contiguous to the concrete being cured. The Engineer may approve interruptions for periods longer than 4 hours on the basis of the method for keeping the concrete moist.

4. Maintain continuous contact, except as noted above, between all parts of the concrete deck and the burlap during the ~~4 calendar day~~ moist curing period.

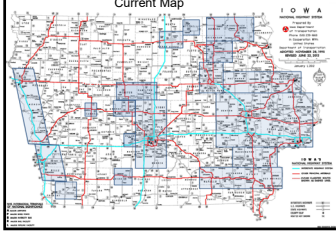
- Likely reduces deck cracking to some degree. Wet cure is just one piece of the puzzle.
- More in line with research recommendations and what most states require. Synthesis 20-05/Topic 47-01 was completed 2/8/2017. 70% of state DOT's cure bridge decks for 7 days or more. Over 20% of state DOT's cure bridge decks for 14 days. "The most effective curing is to keep the concrete continuously wet with a wet cover for at least 7 to 14 days."
- Most state projects use HPC which already requires a 7 day wet cure. From 2015 to2019 – 78% of decks cast on primary system bridges were HPC (106/136). 22% conventional Class C (30/136). Over the years we have been seeing an expansion in HPC availability.
- Class C benefits more from wet curing than HPC due to its higher permeability.

Bridges and Structures Bureau Update

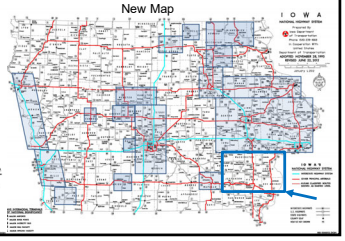
BDM Future Update
HPC Map Changes

Continental Cement Company's Davenport Cement Plant located in Buffalo, IA will discontinue production of Type IT(S20)(L10) cement by the end of 2022. The company is no longer going to produce the IS or IT cements due to lack of a slag source. This affects the availability of HPC-O and HPC mixes.

Current Map



New Map



Bridges and Structures Bureau Update

General Update – Stainless Steel Rebar (SSR) Costs

ECR was substituted for SSR in bridge decks for some interstate interchange bridge projects.

Letting	09/22	07/22	02/22
SSR	$3.95 to $5.76	$4.00 to $4.00	$4.75 to $6.00
ECR	$1.50 to $1.94	$1.60 to $1.85	$1.55 to $1.65
UR	$1.25 to $1.75	$2.20 to $2.30	$1.20 to $1.26

Costs based on new bridges/bridge replacements only.

Bridges and Structures Bureau Update

BDM March 2022 Update
Art 6.3 Drilled Shafts

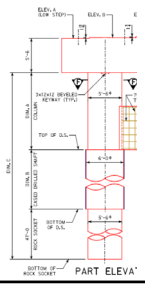
1. Supply at least 18 inches of clearance between the perimeter of the drilled shaft and the closest edge of the existing superstructure, but a minimum clearance of 12 inches is acceptable.
2. Contractors often use temporary casings in the soil at the top of the shaft that are 10 to 15 feet in length and 6 to 12 inches larger in diameter than the nominal shaft dimension at that location. Consider implications due to additional weight, stiffness, downdrag, and hydraulics. [New CADD Note E745]
3. The contractor is responsible for any temporary and permanent casing design. [New CADD Note E748]
4. Include the following rock socket details:
   - Estimated top of competent bedrock elevation
   - Minimum rock socket length in feet
   - Estimated bottom of drilled shaft elevation

Drilled Shaft Repair

SB IA-28 over Racoon River, BRF-028-2(45)--38-77
72" dia drilled shaft with a 66" dia rock socket

Repair Procedure
- 42" diameter core
- Chipping hammer

Similar to repair in "Drilled Shafts: Construction Procedures and Design Methods, NHI Course No. 132014"
https://danbrownandassociates.com/wp-content/uploads/2020/02/GEC10-Drilled-Shaft-Final-10-5-18.pdf



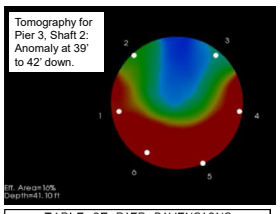


TABLE OF PIER DIMENSIONS

LOCATION	PIER 1	PIER 2	PIER 3
DIM. A	15'-3¼	18'-0¼	13'-8¼
DIM. B	32'-0	30'-0	28'-0
DIM. C	94'-3¼	95'-0¼	88'-8¼

Bridges and Structures Bureau Update

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BDM August 2022 Update
Deck Overlay Projects

1. Eliminated language for Delamtec plots.
2. Included language that decks getting their first overlay will typically include automated acoustic sounding (AAS) plots for Class A/B repairs.
3. If AAS is not available for a first-time overlay, then the District will need to provide a plot of Class A/B repairs based on visual inspection and deck sounding using chain drag/hammer.
4. The decks for second-time overlays are only evaluated after letting once the existing overlay is milled off and the deck can be sounded.
5. Added CADD Note E400 to ensure that exposed epoxy from epoxy injection repair is removed prior to applying the overlay.
6. CADD Std. Sheet 1069 for hydrodemolition has been voided and is replaced by DS-15094.

Bridges and Structures Bureau Update

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Deck Overlay Projects

Two Internal Studies Completed:

1. Investigation of Deck Life Span [Time to First Deck Overlay] for Iowa Bridge Decks with Uncoated Reinforcement from 1970 to 1975
   - Total bridges considered = 405 bridges with uncoated/black rebar in deck
   - 95 bridges have no overlay, 4 bridges have asphalt overlays, 306 bridges have dense low slump concrete overlays
   - Average Expected Life = 36 years+
   - 21 bridges have had a 2nd overlay with an Average 1st Overlay Life = 29 years

2. Investigation of Deck Life Span [Time to First Deck Overlay] for Iowa Bridge Decks with Epoxy-Coated Reinforcement [1976 onward to 2019]
   - Total bridges considered = 1739 bridges with ECR in deck
   - ECR in top mat only = 440 bridges, built in 1976 to 1989, 15 bridges with deck overlay
   - ECR in both mats = 1299 bridges, built in 1987 to 2019, 15 bridges with deck overlay
   - Overlays for various reasons: Two-course decks, Profile Correction, Shallow Rebar, Widened Bridge, Deck Deterioration, Research on Hydro, Epoxy and UHPC Overlays
   - Average Expected Life = Unknown, but certainly 35 years+

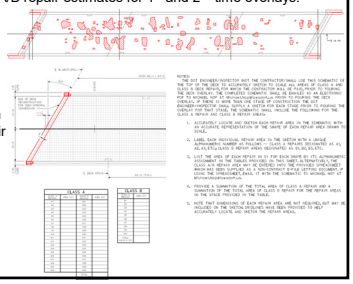
Bridges and Structures Bureau Update

Deck Overlay Projects

Received feedback that Class A/B repairs may be significantly underestimated. Is this anecdotal?

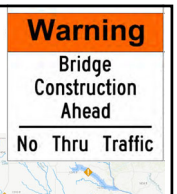
Doing internal studies on the accuracy of Class A/B repair estimates for 1st and 2nd time overlays:

- Initial study – Compare estimated versus as-built data for Class A/B repairs for the 2020 construction season.
  - Study is ongoing
  - Data is limited due to poor records
  - Data not always clear
- Upcoming study – Include schematics in plan set for inspector sketches of Class A/B repair areas to be submitted.
  - 2023 construction season
  - 41 projects
  - Spreadsheet E-file included for entering quantities.



Bridges and Structures Bureau Update

BDM Future Update
Signage for Water Trail and Paddling Routes



This is a list of potential work types that will initiate signing requirements. This is not an all-inclusive list:

1. New structures
2. Replacement structures
3. Bridge widening
4. Superstructure replacements
5. Superstructure strengthening
6. Deck replacements
7. Deck overlays
8. Bridge removal
9. Bridge painting
10. Retrofit rails
11. Bridge repairs – any superstructure or substructure repairs over/in the waterway and within approximately 20 feet of the bank.
12. Revetment

https://iowadnr.maps.arcgis.com/apps/webappviewer/index.html?id=767d75008b0f40ce922138d3c5d7f4f0

Bridges and Structures Bureau Update

Major Updates to Bridge Standards - Ongoing

General updates:

- All standards going to lowercase format with keyword capitalization.
- All standards are being updated for lap and development lengths.
- MASH barrier rail update.
- New deck thickness and deck rebar clearances.

Hope to release in mid-January 2023 and start to incorporate in some projects in the Fall 2023 letting timeframe.

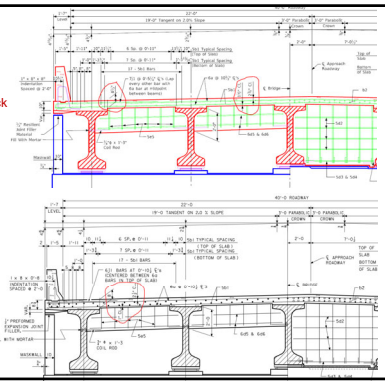
Bridges and Structures Bureau Update

Major Updates to Bridge Standards - Ongoing

New Deck Thickness and Deck Rebar Clearances

Current	Proposed
8.00"→	8.50" deck thickness
0.50"→	0.75" of uppermost deck portion is non-structural
2.50"→	2.75" top rebar clearance
1.00"→	1.50" bottom rebar clearance
8.75"→	10.00" edge of PPCB deck overhang thickness

Proposed Deck



Current Deck

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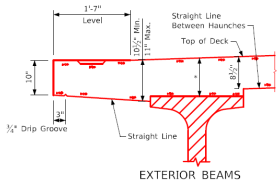
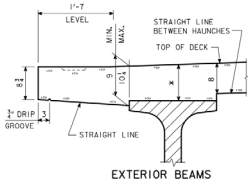
Major Updates to Bridge Standards - Ongoing

Proposed Deck Overhang



Current Deck Overhang



Bridges and Structures Bureau Update

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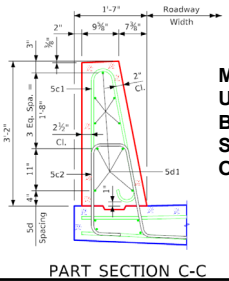
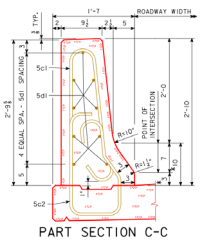
Proposed
38" High MASH TL-4 Single Slope Rail
Area = 3.51 sq ft



Major Updates to Bridge Standards - Ongoing

Current
34" High NCHRP 350 TL-4 F-Shape Rail
Area = 2.84 sq ft



Bridges and Structures Bureau Update

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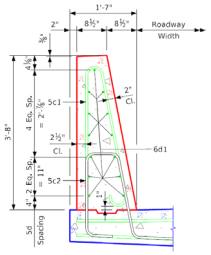
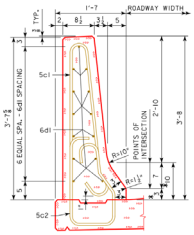
Proposed
44" High MASH TL-5 Single Slope Rail
Area = 3.89 sq ft



PART SECTION C-C

Major Updates to Bridge Standards - Ongoing

Current
44" High NCHRP 350 TL-5 F-Shape Rail
Area = 3.46 sq ft



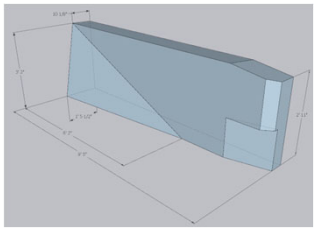
PART SECTION C-C

Bridges and Structures Bureau Update

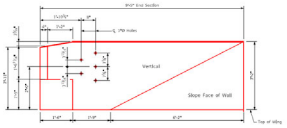
IOWA DOT GETTING YOU THERE

Major Updates to Bridge Standards - Ongoing

MASH barrier rail update



PART PLAN VIEW



PART ELEVATION VIEW

Provide 5 holes formed with 1"Ø plastic conduit. Cost to be included in price of Bid for Concrete Barrier Railing.

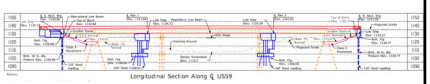
Bridges and Structures Bureau Update

Major Updates to Bridge Standards - Ongoing

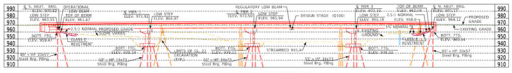
Design 122, Page County
Bridge Replacement-PPCB
BRF-059-1(31)--38-73
IA 59 over East Nishnabotna River
Maint No 7314.2S059
Let 10-18-2022

541'x44' PPCB
25 deg RA Skew
Stub abutments

New Deck Thickness
MASH TL-5 Rail



Longitudinal Section Along ℄ US59



LONGITUDINAL SECTION ALONG ℄ US59

Design 223, Pottawattamie County
Bridge Replacement-PPCB
BRF-059-3(44)--38-78
Location: East Branch West Nishnabotna River
Maint No 7863.1S059
Let 01-18-2023

369'x44' PPCB
30 deg RA Skew
Integral Abutments

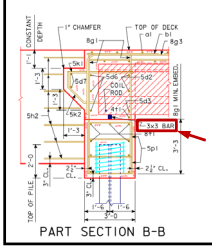
New Deck Thickness
MASH TL-4 Rail

Bridges and Structures Bureau Update

Major Updates to Bridge Standards - Ongoing

PPCB Updates - Completed

Integral Abutment Bearing Options
IM 570,Appendix I

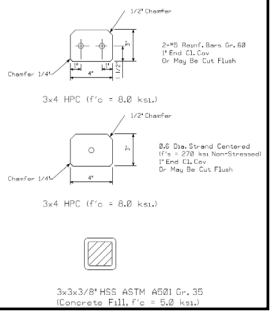


Notes:

The material notes and details for integral abutment bearing bars as shown on this Appendix may be used as an alternate for the 3x3 solid steel bar shown in the plans. Alternates shall be 2'-4 1/2" long. In addition, SAE/AISI 1018 steel will be allowed as a substitute for A36 steel for the 3x3 bar.

The alternates shown may also be used for the 53x7.5 section matching the lengths shown in the plans.

Material requirements:
Concrete for 3x4 bar f'c = 8.0 ksi.
Nonstressed Reinforcing Gr.60 ksi
Prestressing Steel fs = 270 ksi
HSS ASTM A500 Gr.35
HSS Concrete fill f'c = 5.0 ksi



Bridges and Structures Bureau Update

Major Updates to Bridge Standards - Ongoing

PPCB Updates - Ongoing

Tie Downs for Shipping BTD and BTE Beams

Bridges and Structures Bureau Update

Major Updates to Bridge Standards - Ongoing

PPCB Updates - Completed

Beam Design

Redesign Needed

- New lap and development lengths – base everything on ECR so that substitutions can be made.
- Heavier deck, deck overhang and rail.
- Follow AASHTO code on live load distribution factors (for exterior beams).
- More conservative assumptions on span release lengths related to transporting off of bed.
- AASHTO LRFD Bridge Design Specifications, 8th Edition, 2017.
  - Iowa has not yet adopted the 9th edition, 2020
  - The current PPCB standards are based on the 4th edition, 2007
- Software: Bentley's Leap Bridge Concrete (LBC) Connect Edition (CE) V21, Version 21.00.00.24.

Goals

- Maintain our maximum beam lengths for each beam size (A-D, BTB-BTE).
- Maintain our current maximum beam spacings for each beam span length or, at a minimum, be able to use the same number of beam lines for each of our standard bridge cross-sections (e.g. 30', 40' and 44' roadway widths).

Major Updates to Bridge Standards - Ongoing

PPCB Updates - Completed

Beam Design

Anticipated Changes

- Final 28-day concrete strength, f'c, may increase from 9.0 ksi up to 10.5 ksi (if needed).
- Maximum concrete release strength, f'ci, may decrease from 8.0 ksi to 7.5 ksi to limit bed turn-over.
  - Only go to current maximum of 8.0 ksi if necessary.
- Debonded strands will likely be used (in addition to draped/harped strands).
  - Probably single split sheathing tube (rather than double split or rigid sheathing tubes).
  - Develop IM.
- May increase number of draped strands from 6 rows of 12 draped strands to 7 rows of 14 draped strands.

Other Changes

- Camber will be based on ISU research.
- Only single steel channel (or bent plate) intermediate diaphragms will be used.
- Decrease top flange tining to 18" with 8" smooth strips on each side to reduce deck restraint/cracking.
- Change top strand projection from 1'-6" to 1'-2" so strands do not project above top mat in deck.

Major Updates to Bridge Standards - Ongoing

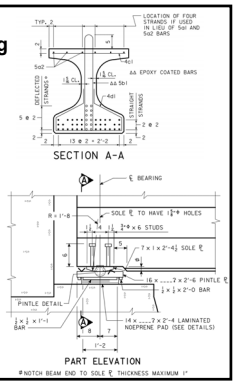
PPCB Updates - Completed

Beam Design

Other Changes

Fabricators want a steel plate to extend to beam end since concrete can pop out due to tight rebar clearance on bottom of beam which requires them to do a repair.

- Use "protection plate" cast in beam with a separate upside down curved sole plate?
- Use thinner curved sole plate welded to a "protection plate" cast in the beam?



ABC Lateral Slides

Completed Projects

Massena, 120'x44' PPCB
Cass County, FHWA 017841, Maint. No. 1563.4S092
IA 92 over Small Stream
BRF-092-2(36)--38-15
Let 04-16-2013

Old Woman's Creek, 135'x44' PPCB
Johnson County, FHWA 031691, Maint. No. 5278.9S001
IA 1 over Old Woman's Creek
BRF-001-5(104)--38-52
Let 12-17-2019

Camp Creek, 120'x44' PPCB
Washington County, FHWA 051661, Maint. No. 9265.1S001
IA 1 over Camp Creek
BRF-001-4(50)--38-92
Let 12-18-2018

Old Man's Creek, 300'x44' RSB
Johnson County, FHWA 031681, Maint. No. 5728.0S001
IA 1 over Old Man's Creek
BRF-001-5(110)--38-52
Let 12-17-2019

ABC Lateral Slides

Completed Projects Continued

Muchakinock Creek, 230'x44' CWPG
Mahaska County, FHWA 034981, Maint. No. 6278.0S092
IA 92 over Muchakinock Creek
BRF-092-7(45)--38-62
Let 12-15-2020

Upcoming Projects

Woodbine, 72.5'x44' PPCB (30 deg skew)
Harrison County, FHWA 027521, Maint. No. 4330.1S030
US 30 over Stream
BRFN-030-1(164)--39-43
Let 09-20-2022

Cooper Creek, 155'x44' PPCB
Appanoose County, FHWA 013931, Maint. No. 0415.2S005
IA 5 over Cooper Creek
BRF-005-1(74)--38-04
Let 12-20-2022

ABC Traditional Construction? 5 weeks?

Prairie Creek, 100'x44' PPCB
Benton County, FHWA 014481, Maint. No. 0608.5S150
IA 150 over Prairie Creek
BRFN-150-2(24)--39-06
Let 01-17-2024

Close road/demolish existing bridge	2 days (maybe 1 day)
Grading	2 days (maybe 1 day)
Drive pile	4 days (maybe 3 days)
Form/pour/cure abutments	6 days (maybe 3 days)
Set beams	1 day
Form deck/place rebar	6 days (maybe 4 days)
Pour deck/cure (*)	11 days
Barrier rail and approaches	4 days (maybe 3 days)
Paving and guardrail	2 days (maybe 1 day)
Total	**38 days (maybe 28 days)**

(*) Wet cure is 7 days by Spec. for Class C and HPC

Full Depth Transverse Deck Cracking Issues

Concrete cracking typically occurs due to restrained volume changes:

- Shrinkage (autogenous, drying, and plastic)
- Temperature change

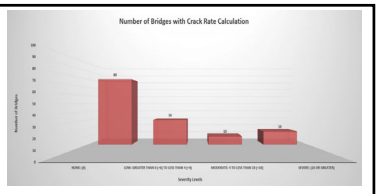
Three general sources that can contribute to or exacerbate cracking:

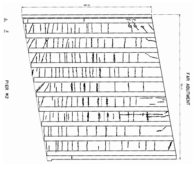
- Concrete Material Properties
  - Cement type and proportion
  - Aggregates
  - Admixtures
  - Slump/water content
  - Air content
- Construction
  - Air temperature and wind speed
  - Vibration
  - Time from pour to finish
  - Curing - application time and total duration
  - Pour sequence (flexural tensile stress)
- Structural Design/Geometry
  - Concrete cover
  - Reinforcing bar size/spacing
  - Girder to deck stiffness and beam spacing
  - End and intermediate restraint at abutments/piers/cross frames
  - Steel versus prestressed
  - Curved versus straight
  - Skew

Full Depth Transverse Deck Cracking

In-House Investigation

- 136 Beam Bridges Constructed between 2015 and 2019 with an Inspection
- 59% of new bridge decks are uncracked
- 41% have some degree of cracking.
- 19% of new bridge decks have moderate to severe cracking.





Deck Crack Rate = 31.7, Severe
Woodbury County
FHWA 700335
Maint. No. 9748.1R029

Deck Cracking
Fiber-Reinforced Concrete for New Decks

- Include use of fiber-reinforcement by Special Provision (SP).
- Separate SP for HPC and non-HPC concrete.
- Purpose of the synthetic fibers (polypropylene) is for controlling plastic shrinkage cracks in concrete (micro fibers) and to provide increased residual flexural strength in the concrete (macro fibers).
- Three manufacturers listed in the SP with an option for alternate submittals meeting the requirements.
- Trial batch and test placement required.
- 2599 bid item is used to track costs.

Deck Cracking
Fiber-Reinforced Concrete for New Decks

Completed Project

HPC Deck
Polk Design No 120 and 419
710'x62' PPCB widened to 84'/86'
Maint. No. 7733.1L&R080
IMX-080-3(209)133--02-77
I-80/I-35 over DSM River
Let 05-21-2019

Fiber was for link slabs only, but was expanded to entire deck to avoid construction joints and allow for continuous pour.

No known construction issues and no cracking to date.

Recently Let Projects

HPC Deck
Polk Design No 125
626'x38' PPCB w/ 10' Sidewalk
Maint. No. 7716.1L028
BRF-028-2(45)--38-77
IA 28 over Raccoon River
Let 12-21-2021

HPC Deck
Johnson Design No 1120
292'x30' PPCB
Maint. No. 5250.6O080
IM-080-7(152)251--13-52
Wapsi Ave over I-80
Let 02-15-2022

Non-HPC Deck
Franklin Design No 122
204'x44' PPCB
Maint. No. 3577.7S065
BRF-065-7(42)--38-35
US 65 over Bailey Creek
Let 02-15-2022

Deck Cracking
Fiber-Reinforced Concrete for New Decks

Future – May expand to all bridge decks in near future depending on cost and performance.

Upcoming Projects

Non-HPC Deck
O'Brien Design No 120
120'x40' PPCB
Maint. No. 7143.6S010
BRF-010-2(033)--39-71
IA 10 over Mud Creek
Let 10-18-2022

Non-HPC Deck
Pottawattamie Design No 223
369'x44' PPCB
Maint. No. 7863.1S059
BRF-059-3(44)--38-78
US 59 over E Br W Nishnabotna R
Let 01-18-2023

Non-HPC Deck
Wayne Design No 123
194'x44' PPCB
Maint. No. 9307.0S065
BRF-065-1(32)--38-93
US 65 over Caleb Creek
Let 02-15-2022

HPC Deck
Polk Design No 323
297'x34' PPCB
Maint. No. 7798.7O035
IM-035-4(246)99--13-77
NE 142nd Ave over I-35
Let 12-20-2022

HPC Deck
Cedar Design No 222/322
264'x72' PPCB
Maint. No. 1669.5L/R080
IM-NHS-080-7(164/108)270--03-16
I-80 WB/EB over Sugar Creek
Let 10-18-2022

HPC Deck
Story Design No 123
292'x40' PPCB w/ 10' Trail
FHWA 701155
NHSX-030-5(277)--3H-85
CR S-14 over US 30
Let 01-18-2023

Bridges and Structures Bureau Update

IOWA DOT

Deck Cracking
Chem-Crete Admixture and Pavix

Upcoming Projects

Appanoose Design No 123
155'x44' PPCB – ABC Lateral Slide
Maint. No. 0415.2S005
BRF-005-1(74)--38-04
IA 5 over Cooper Creek
Let 12-20-2022

Multi-crystalline Intermixed Concrete Enhancer for Improving Concrete Durability and Sustainability

CHEM-CRETE® MCE™ ENHANCER

MCE is an aqueous solution that is mixed into fresh PCC during the batching process resulting in uniform distribution throughout the paste. The material has been shown through extensive laboratory studies and field trials to enhance the hydration of the Portland cement, increase workability, improve strength, reduce capillary porosity, prevent ASR, chloride intrusion and freeze/thaw damage. The improved moisture management, due to the MCE, significantly reduces the tendency for drying shrinkage and plastic shrinkage cracking. A reduction in shrinkage and cracking of up to 91% and numerous other benefits are highlighted in the PRODUCT FEATURES section.

BRIDGE DECK ADMIXTURE NOTES:

THE 261.3 YARDS OF STRUCTURAL CONCRETE FOR THE BRIDGE DECK WILL INCLUDE A "MULTI-CRYSTALLINE INTERMIXED CONCRETE ENHANCER" (CHEM-CRETE MCE OR MCE) ADMIXTURE MANUFACTURED BY INTERNATIONAL CHEM-CRETE (ICC), INC., AT A RATE OF 2% OF THE TOTAL CEMENTITIOUS (BY WEIGHT) OF THE MIX. ADDITIONALLY, ONE-HALF OF THE SURFACE OF THE BRIDGE DECK (HALF THE WIDTH OF THE DECK, FOR THE FULL LENGTH OF THE DECK) WILL BE TREATED WITH A WATER-BASED DUAL-CRYSTALLINE PENETRATING CONCRETE SEALER UNDER THE PRODUCT NAME PAVIX AS MANUFACTURED BY ICC. THE MCE ADMIXTURE AND PAVIX PRODUCT ARE INTENDED TO IMPROVE CONCRETE DURABILITY.

Bridges and Structures Bureau Update

IOWA DOT GETTING YOU THERE

Deck Cracking
Research "Guide to Remediate Bridge Deck Cracking"

- Characterize bridge deck cracks
  - Shallow cracks are up to 1-inch deep, define by width of 5 mils (0.005 inch)
  - Deep cracks go to rebar, define by width of 10 mils
  - Cracks greater than 40 mils should be investigated prior to any treatment
  - Defined crack density (low, moderate, severe, very severe)
- Select optimal crack remediation options
  - Treatments considered: Penetrating Sealers, Flood Coats, ~~HMA Overlays~~, Thin Polymer Overlays, Thick Polymer Overlays
  - Time to 5% damage (trigger repairs) and 20% damage (deck replacement)
  - Service Life Modeling based on Time of Repair Application (0, 2, 5, 10 years)
  - LCCA

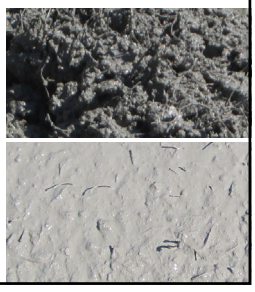
Future: Currently have RFP out for automated deck scanning to detect crack widths and crack density. Consider scanning all new decks one year after construction and do remediation on cracked decks second year after construction.

Bridges and Structures Bureau Update

IOWA DOT GETTING YOU THERE

Deck Cracking
Fiber-Reinforced Concrete for HPC-O Overlays

- Include use of fiber-reinforcement by Special Provision (SP).
- Purpose of the synthetic fibers (polypropylene) is for controlling plastic shrinkage cracks in concrete (micro fibers) and to provide increased residual flexural strength in the concrete (macro fibers).
- Three manufacturers listed in the SP with an option for alternate submittals meeting the requirements.
- Trial batch and test placement required.
- 2599 bid item is used to track costs.



Bridges and Structures Bureau Update

Deck Cracking Fiber-Reinforced Concrete for HPC-O Overlays

Completed Projects

Polk Design No 419
710'x62' PPCB widened to 86'
Maint. No. 7733.1R080
IMX-080-3(209)133--02-77
I-80 EB over DSM River
Let 05-21-2019

Jasper Design No 121
120'x28' CCS
Maint. No. 5014.6S117
BRFN-117-1(28)--39-50
IA 117 over Stream (near Mingo)
Let 11-18-2020

Recently Let Projects

Winneshiek Design No 122
410'x32' Steel Beam
Maint. No. 9651.5S052
BRFN-052-5(45)--39-96
US 52 over Upper Iowa River
Let 01-19-2022

Woodbury Design No 222
207'x24' PPCB
Maint. No. 9739.8O029
IMN-029-6(283)140--0E-97
Co Rd K-25 over I-29
Let 02-15-2022

Pottawattamie Design No 222
110.5'x28' CCS
Maint. No. 7847.2S059
BRFN-059-3(37)--39-78
US 59 over Small Natural Stream
Let 12-21-2021

Louisa Design No 322
80'x44' CCS
Maint. No. 5858.1S092
BRFN-092-9(152)--39-58
IA 92 over Little Indian Creek
Let 01-19-2022

Scott Design No 122
110'x68' CCS
Maint. No. 8291.3S022
BRFN-022-5(34)--39-82
IA 22 over Dodge Creek
Let 02-15-2022

Bridges and Structures Bureau Update

Deck Cracking Fiber-Reinforced Concrete for HPC-O Overlays

Upcoming Projects

Webster Design No 123
130'x44' CCS
Maint. No. 9466.0S007
BRF-007-5(024)--38-94
IA 7 over S Br Lizard Creek
Let 02-21-2023

Webster Design No 222
403'x44' CWG
Maint. No. 9416.7R020
BRF-020-3(177)--38-94
US 20 EB over SR D20 and UPRR
Let 02-21-2023

Cerro Gordo Design No 422
215'x40' PPCB
Maint. No. 1784.5L018
BRF-018-5(151)--38-17
US 18 WB and IA 27 NB over UPRR
Let 12-20-2022

Cerro Gordo Design No 522
170'x40' PPCB
Maint. No. 1783.6R018
BRF-018-5(152)--38-17
US 18 EB over Cerro Gordo Co Trail
Let 12-20-2022

Monona Design No 223
233'x44' PPCB
Maint. No. 6723.7S175
BRF-175-1(079)--38-67
IA 175 over Maple River
Let 02-21-2023

Monona Design No 123
210'x30' CWG
Maint. No. 6711.2S175
BRF-175-1(080)--38-67
IA 175 over DD
Let 02-21-2023

Bridges and Structures Bureau Update

Deck Cracking Fiber-Reinforced Concrete for HPC-O Overlays

Upcoming Projects

Muscatine Design No 123
210'x44' PPCB
Maint. No. 7078.6S006
BRF-006-8(040)--38-70
US 6 over Sugar Creek
Let 01-18-2023

Muscatine Design No 223
169'x30' Cont Conc Voided Slab
Maint. No. 7081.4S006
BRF-006-8(039)--38-70
US 6/IA 38 over IA IS RR
Let 01-18-2023

Jackson Design No 123
90'x32' CCS
Maint. No. 4922.0S064
BRF-064-2(067)--38-49
IA 64 over Small Natural Stream
Let 02-21-2023

Jackson Design No 223
135'x44' PPCB
Maint. No. 4935.3S064
BRF-064-2(066)--38-49
IA 64 over Prairie Creek
Let 02-21-2023

Harrison Design No 322
130'x44' CCS
Maint. No. 4304.5S127
BRF-127-1(026)--38-43
IA 127/183 over Steer Creek
Let 11-15-2022

Future – May expand to all HPC-O bridge deck overlays in near future depending on cost and performance.

Bridges and Structures Bureau Update

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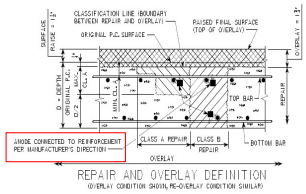
Deck Overlay with Zinc Anodes

Upcoming Projects

HPC-O with fiber
Monona Design No 223
233'x44' PPCB
Maint. No. 6723.7S175
BRF-175-1(079)--38-67
IA 175 over Maple River
Let 02-21-2023



SPECIAL PROVISIONS FOR EMBEDDED GALVANIC ANODES FOR CORROSION PROTECTION FOR A BRIDGE DECK OVERLAY WITH UNCOATED CARBON STEEL REINFORCEMENT

Embedded galvanic anodes are designed and installed to provide localized corrosion protection based on the principles of cathodic protection. When placed at the appropriate spacing along the perimeter of concrete repairs or along the interface between new/existing concrete, the anodes mitigate corrosion and the formation of new corrosion sites at the reinforcing steel in the adjacent existing concrete.

Bridges and Structures Bureau Update

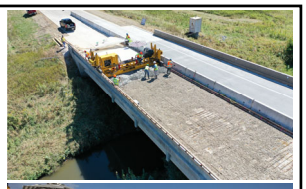
UHPC Deck Overlays

Completed Projects

Mud Creek Bridge
Buchanan County, Brian Keierleber
Constructed in 2016

205.5'x44' PPCB (Bridge built in 1992, 1st overlay)
Sioux County, FHWA 048351, Maint. No. 8441.3S018
US 18 over Floyd River
BRFN-018-1(94)--39-84
Let 07-18-2018

98'x44' PPCB (Bridge built in 1974, 1st overlay)
Jasper County, FHWA 030811, Maint. No. 5015.8R163
IA 163 EB over Walnut Creek
BRFN-163-2(56)--39-50
Let 11-19-2019



Bridges and Structures Bureau Update

UHPC Deck Overlays

Upcoming Projects

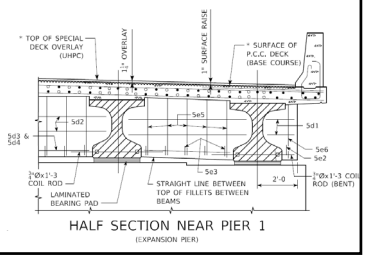
151.33'x44' PPCB (1974 bridge, 1st overlay)
Humboldt County, FHWA 028941, Maint. No. 4683.1S169
US 169 over Trulner Creek
BRF-169-7(047)--38-46
Let 02-21-2023

151.33'x44' PPCB (New Replacement Bridge)
Cass County, FHWA 017821, Maint. No. 1548.6S092
IA 92 over Sevenmile Creek
BRF-092-2(44)--38-15
Let 09-20-2022

- 8-inch thick fiber-reinforced concrete deck
- 14-day wet cure followed by 7-day dry cure
- Hydrodemolition of new deck for surface texture (1/4" depth)
- 1.25" thick UHPC proprietary overlay (2nd course)
- Barrier rail placed before overlay
- Monitored by a Research Team

Future of UHPC Overlays in Iowa

- Continue doing approximately one per year to gain experience and monitor performance.
- Costs likely need to come down before more widespread use.
- Future research and implementation of a non-proprietary UHPC overlay.



Bridges and Structures Bureau Update

UHPC Beam End Repair

Completed Projects

Steel Beam End Encasement with UHPC
County Project - Ringgold County
Rte J23 approx. 5 miles West of Diagonal, Iowa over the Platte River

- Placed in Aug/Sept 2022
- Lafarge Ductal UHPC
- Mixed by local county forces
- ISU monitoring

Upcoming Projects

736.7'x30' PPCB
Webster County, FHWA 052103, Maint. No. 9401.5R926
NB IA 926/Kenyon Rd over CN RR and 7th St. (Fort Dodge)
MB-926-1(506)1--77-94 (PPCB Repair)
Let 07-19-2022 [Work to be done in 2024]

- Repair 18 Beam Ends at 3 Piers
- Use 3 Different Mixes (SPs for all 3 mixes)
  - High Early Strength Concrete
  - Proprietary UHPC
  - Non-proprietary UHPC
- Monitored by ISU Research Team

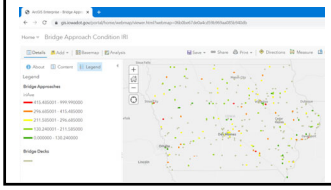
Bridges and Structures Bureau Update

Investigation into Approach Slab IRI

IRI = International Roughness Index (for Pavement Smoothness)

IDOT Standard Specifications

- Section 2316 Pavement Smoothness
- Section 2317 Primary and Interstate Pavement Smoothness
- Section 2428 Smoothness of Bridge Decks and Bridge Deck Overlays
- Section 2529, H Full Depth Finish Patches, Smoothness
- IM 341 Determining Pavement and Bridge Ride Quality



TPM

Pavement Condition Thresholds

	Good	Fair	Poor
IRI (inches/mile)	<95	95-170	>170
Rutting (inches)	<0.20	0.20-0.40	>0.40
Faulting (inches)	<0.10	0.10-0.15	>0.15
Cracking (%)	<5	5-20 (asphalt) 5-15 (JCP) 5-10 (CRCP)	>20 (asphalt) >15 (JCP) >10 (CRCP)
PSR	PSR ≥ 4.0	2.0 ≤ PSR ≤ 4.0	PSR ≤ 2.0

[23 CFR 490.313]

Bridge Approach IRI Map
https://gis.iowadot.gov/portal/home/webmap/viewer.html?webmap=06b0be67de0a4cd59b969aa085b940db

Bridges and Structures Bureau Update

Questions