October 28-29, 2025
Orlando, FL

TRANSPORTATION SYMPOSIUM

SR 115, Arlington Expressway, Jacksonville, Florida Over Red Bay Branch Bridge Repair, Bridge No. 720136 – Lessons Learned

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Transportation Symposium Website
SCAN ME

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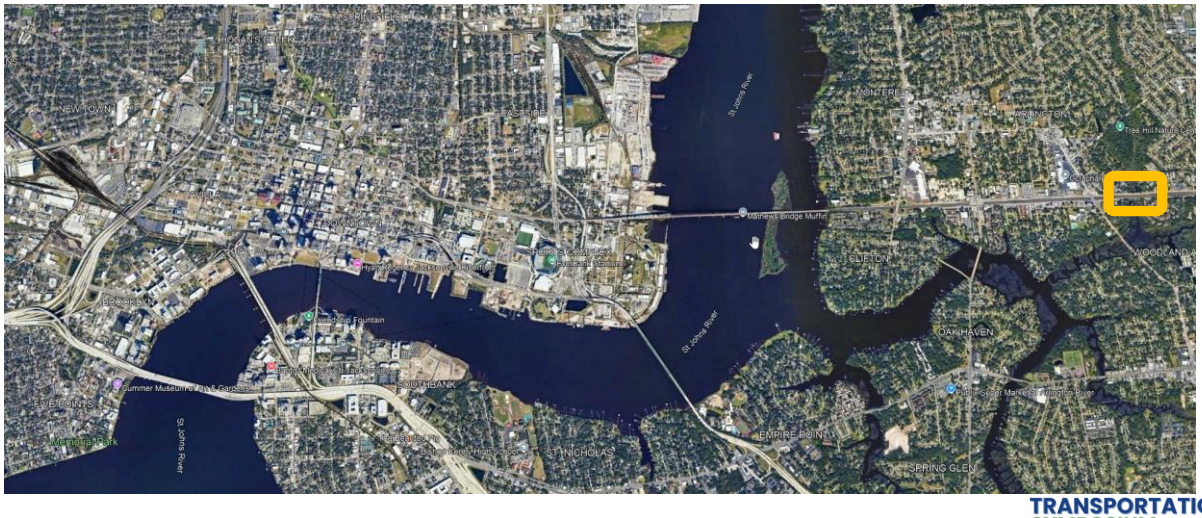
Project Background



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Project Background

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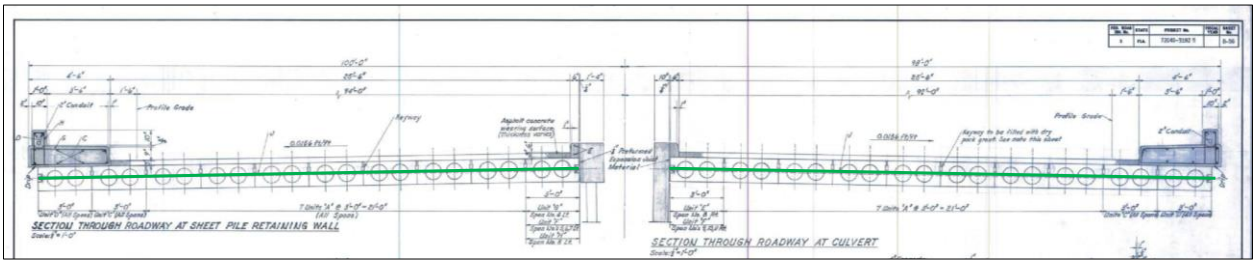
Project Background



Construction 1960
FDOT began maintenance 1970-1972
Slabs tied together by post tension bar
Distress indicated separation of the slabs

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Key Lessons

- Select appropriate repair
- Early coordination
- Education

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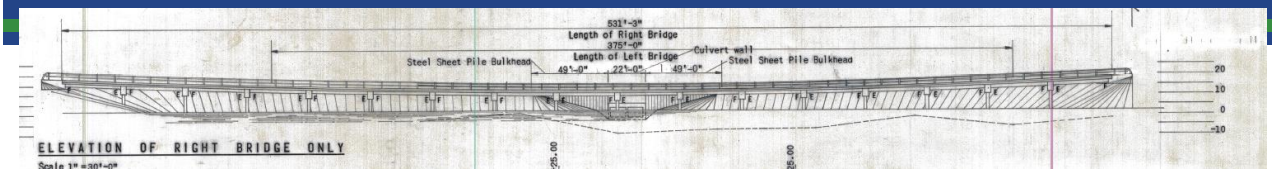

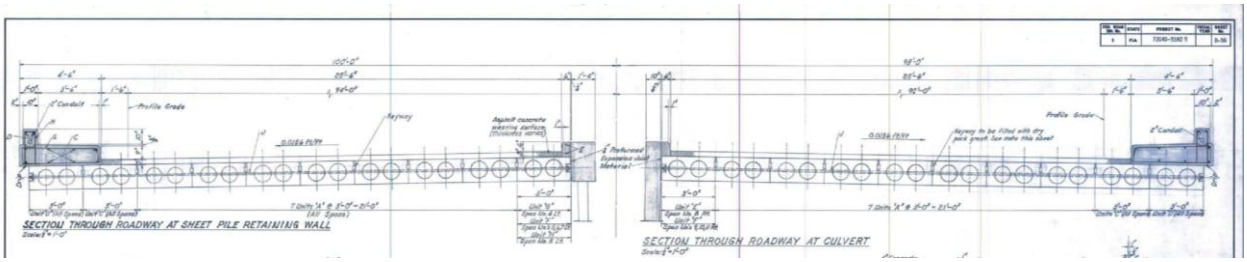

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☐ FUNCTIONALLY OBSOLETE ☐ STRUCTURALLY DEFICIENT

TYPE OF INSPECTION: Regular NBI

DATE FIELD INSPECTION WAS PERFORMED: ABOVE WATER: 12/29/2015 UNDERWATER: N/A

SMART FLAGS: None

OVERALL NBI RATINGS:

DECK: 7 Good
SUPERSTRUCTURE: 7 Good
SUBSTRUCTURE: 6 Satisfactory
PERF. RATING: Good

CHANNEL: 7 Minor Damage
CULVERT: N N/A (NBI)
SUFF. RATING: 91.9
HEALTH INDEX: 80.16

2015

Bridge# 720136
(North Bridge)

☐ FUNCTIONALLY OBSOLETE ☐ STRUCTURALLY DEFICIENT

TYPE OF INSPECTION: Regular NBI

DATE FIELD INSPECTION WAS PERFORMED: ABOVE WATER: 12/12/2017 UNDERWATER: N/A

OVERALL NBI RATINGS:

DECK: 7 Good
SUPERSTRUCTURE: 5 Fair
SUBSTRUCTURE: 6 Satisfactory
PERF. RATING: 3 - Fair

CHANNEL: 7 Minor Damage
CULVERT: N N/A (NBI)
SUFF. RATING: 91.9
HEALTH INDEX: 99.58

2017

☐ FUNCTIONALLY OBSOLETE ☒ STRUCTURALLY DEFICIENT

TYPE OF INSPECTION: Regular NBI

DATE FIELD INSPECTION WAS PERFORMED: ABOVE WATER: 12/5/2019 UNDERWATER: N/A

OVERALL NBI RATINGS:

DECK: 4 Poor
SUPERSTRUCTURE: 4 Poor
SUBSTRUCTURE: 6 Satisfactory
PERF. RATING: Poor

CHANNEL: 7 Minor Damage
CULVERT: N N/A (NBI)
SUFF. RATING: 47.8
HEALTH INDEX: 94.66

2019

The NBI rating for Superstructure was lowered from a "5" to a "4" due to new guidance for rating sonovoid slabs.
The NBI rating for Deck was lowered from a "7" to a "4" due to new guidance for rating sonovoid slabs.
The District Structures Maintenance Engineer was notified as well as the District Bridge Engineering Section.

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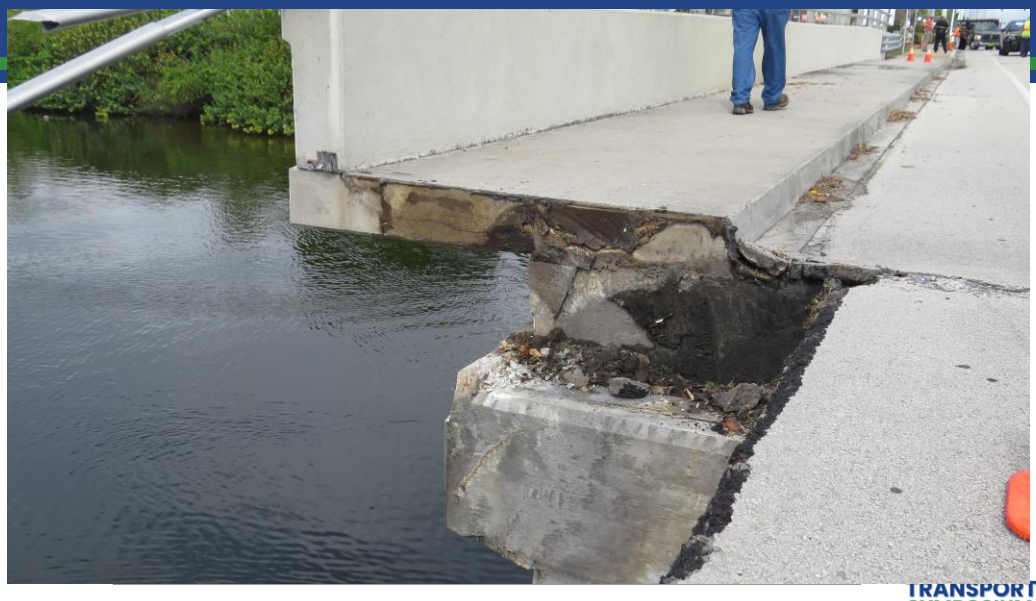

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PHOTO 10 – ELEMENT 8099/510
VIEW OF UP TO MODERATE SIZE LONGITUDINAL CRACKS
IN ASPHALT WEARING SURFACE

Bridge# 720136

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☐ FUNCTIONALLY OBSOLETE ☐ STRUCTURALLY DEFICIENT

TYPE OF INSPECTION: Regular NBI
DATE FIELD INSPECTION WAS PERFORMED: ABOVE WATER: 12/30/2015 UNDERWATER: N/A

SMART FLAGS: None

OVERALL NBI RATINGS:
DECK: 7 Good
SUPERSTRUCTURE: 7 Good
SUBSTRUCTURE: 6 Satisfactory
PERF. RATING: Good
CHANNEL: 7 Minor Damage
CULVERT: N N/A (NBI)
SUFF. RATING: 92.9
HEALTH INDEX: 81.35

2015

☐ FUNCTIONALLY OBSOLETE ☐ STRUCTURALLY DEFICIENT

TYPE OF INSPECTION: Regular NBI
DATE FIELD INSPECTION WAS PERFORMED: ABOVE WATER: 12/13/2017 UNDERWATER: N/A

OVERALL NBI RATINGS:

DECK: 5 Fair
SUPERSTRUCTURE: 7 Good
SUBSTRUCTURE: 6 Satisfactory
PERF. RATING: 3 - Fair
CHANNEL: 7 Minor Damage
CULVERT: N N/A (NBI)
SUFF. RATING: 92.9
HEALTH INDEX: 98.72

2017

☐ FUNCTIONALLY OBSOLETE ☒ STRUCTURALLY DEFICIENT

TYPE OF INSPECTION: Regular NBI
DATE FIELD INSPECTION WAS PERFORMED: ABOVE WATER: 12/5/2019 UNDERWATER: N/A

OVERALL NBI RATINGS:

DECK: 4 Poor
SUPERSTRUCTURE: 4 Poor
SUBSTRUCTURE: 6 Satisfactory
PERF. RATING: Poor
CHANNEL: 7 Minor Damage
CULVERT: N N/A (NBI)
SUFF. RATING: 62.9
HEALTH INDEX: 87.91

2019

The NBI rating for Deck was dropped from a "5" to a "4" during this inspection per recommendations from the Central Office regarding sonovoid slab units.
The NBI rating for Superstructure was dropped from a "7" to a "4" during this inspection per recommendations from the Central Office regarding sonovoid slab units. The District Structures Maintenance Engineer was notified as well as the District Bridge Engineering Section.

Bridge# 720148
(South Bridge)

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PHOTO 10 – ELEMENT 8099/510
TYPICAL VIEW OF UP TO WIDE SIZE LONGITUDINAL CRACKS IN ASPHALT SURFACE OVER SLAB UNIT JOINTS AT RANDOM LOCATIONS

Bridge# 720148

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PHOTO 3 – ELEMENT 8099 (W/O)
TYPICAL VIEW OF TRANSVERSE POST TENSIONING BARS WITH SURFACE CORROSION

PHOTO 6 – ELEMENT 8099
TYPICAL VIEW OF EFFLORESCENCE AND CORROSION BLEEDOUT EMITTING FROM LONGITUDINAL JOINT BETWEEN SLAB UNITS

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BRIDGE MAINTENANCE AND REPAIR HANDBOOK

Florida Department of Transportation
Office of Maintenance
1-866-374-3368 Phone
1-850-410-5511 Fax

BRIDGE MAINTENANCE & REPAIR HANDBOOK

2. Transverse cracks may also be caused by flexure of the deck or lack of cover on the reinforcement.
3. Longitudinal cracks are common over the joints between prestresses, precast adjacent concrete box beams or sonovoid slab units. The cracks are caused by non-uniform bending action of the beams under traffic. Longitudinal cracks also occur over the longitudinal beams of other bridge types when the beam spacing is large and the deck bends over the beams.
4. Random, map or alligator cracking results at locations where excessive shrinkage occurs in fresh concrete due to rapid evaporation, or they result due to factors such as aggregate-cement reaction.
5. Foundation settlement can cause a twisting force on a concrete deck that generally results in a diagonal cracking pattern.
6. Thermal expansion caused by a high temperature combined with debris filled expansion joints can cause deck cracking, or spalling, near expansion joints.

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BRIDGE MAINTENANCE & REPAIR HANDBOOK

4.5 CONCRETE BEAM & GIRDER REPAIR

4.5.1 Crack Repair

A. Epoxy Injection

1. Clean the cracks by air or brush.
2. Install the ports along the crack and seal all the other cracks with epoxy.
3. After the sealing is cured, begin pumping epoxy into the first port that is normally the lowest port.
4. Continue pumping until epoxy flows from a second port.
5. Seal the first port and begin pumping at the second port.
6. Repeat steps 3, 4 and 5 until all ports are full.
7. Remove ports and surface seal after epoxy has cured.

B. Penetrant Sealer

1. The concrete surfaces shall be prepared for sealing by using high pressure (6,000 psi nozzle pressure) water blasting to remove all traces of dirt, grime, mineral deposits and all other deleterious material.
2. Apply the penetrant sealer in accordance with the specification and the manufacturer's recommendation.

C. Drypacking

Drypack can be used for filling narrow slots cut for the repair of dormant cracks. Repair the crack by hand placement of a low water content mortar followed by tamping or ramming of the mortar into place. The use of drypack is not recommended for "active" cracks.

1. Before a crack can be repaired by drypacking, the portion adjacent to the surface should be widened to a slot about 1 inch wide and 1 inch deep using a power-driven sawtooth bit. The slot should be undercut so that the base width is slightly greater that the surface width.
2. Clean the slot thoroughly.
3. Apply a bond coat, consisting of cement slurry or equal quantities of cement and fine sand, mixed with water to a fluid paste consistency.

None of the repair procedures given in the Bridge Maintenance and Repair Handbook address the underlying issue of differential beam deflections

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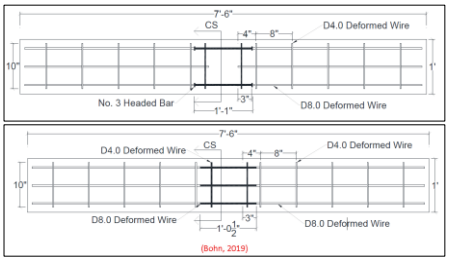
UHPC / Latex Modified / Fiber-reinforced Grout

What are our options?

- Demolition procedure
- Joint filler types
- Reinforcement type
- Continuous vs. Discrete Repair



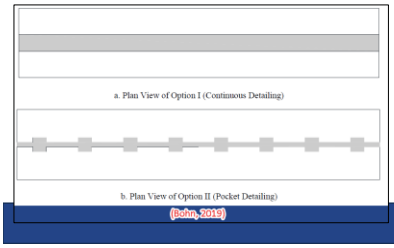


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Table 4.2 Rating of Double-Tee Bridge Longitudinal Joint Rehabilitation Alternatives

Alt. No.	Alt. Name	Filler Material	Reinforcement Type	Const. Risk Rating	Durability Rating	Perform. Rating	Inspect. Rating	Cost Rating	Overall Rating
1	**CUH**	**UHPC**	**Headed-Bar**	**0, -1, 0**	**2, 1, 1**	**2, 1, 1**	**0, 0, 0**	**-2**	**5**
2	**CUW**	**UHPC**	**Wire-Mesh**	**0, 0, 0**	**2, 0, 1**	**2, -1, 1**	**0, 0, 0**	**-2**	**3**
3	CNH	NSG	Headed-Bar	0, -1, 0	-1, 1, 1	0, 1, 1	0, 0, 0	0	2
4	CNW	NSG	Wire-Mesh	0, 0, 0	-1, 0, 1	0, -1, 1	0, 0, 0	0	0
5	CMH	MAP	Headed-Bar	0, -1, 0	-1, 1, 1	1, 1, 1	0, 0, 0	-2	1
6	CMW	MAP	Wire-Mesh	0, 0, 0	-1, 0, 1	1, -1, 1	0, 0, 0	-2	-1
7	**CLH**	**LMC**	**Headed-Bar**	**0, -1, 0**	**2, 1, 1**	**2, 1, 1**	**0, 0, 0**	**-2**	**5**
8	**CLW**	**LMC**	**Wire-Mesh**	**0, 0, 0**	**2, 0, 1**	**2, -1, 1**	**0, 0, 0**	**-2**	**3**
9	CFH	FRG	Headed-Bar	-1, -1, 0	1, 1, 1	1, 1, 1	0, 0, 0	-1	3
10	CFW	FRG	Wire-mesh	-1, 0, 0	1, 0, 1	1, -1, 1	0, 0, 0	-1	1
11	DUH	UHPC	Headed-Bar	0, -1, -1	2, 1, -1	2, 1, -2	0, 0, 0	-2	-1
12	DUR	UHPC	Rebar	0, 0, -1	2, 0, -1	2, -1, -2	0, 0, 0	-2	-3
13	DNH	NSG	Headed-Bar	0, -1, -1	-1, 1, -1	0, 1, -2	0, 0, 0	0	-4
14	DNR	NSG	Rebar	0, 0, -1	-1, 0, -1	0, -1, -2	0, 0, 0	0	-6
15	DMH	MAP	Headed-Bar	0, -1, -1	-1, 1, -1	1, 1, -2	0, 0, 0	-2	-5
16	DMR	MAP	Rebar	0, 0, -1	-1, 0, -1	1, -1, -2	0, 0, 0	-2	-7
17	DLH	LMC	Headed-Bar	0, -1, -1	2, 1, -1	2, 1, -2	0, 0, 0	-2	-1
18	DLR	LMC	Rebar	0, 0, -1	2, 0, -1	2, -1, -2	0, 0, 0	-2	-3
19	DFH	FRG	Headed-Bar	-1, -1, -1	1, 1, -1	1, 1, -2	0, 0, 0	-1	-3
20	DFW	FRG	Rebar	1, 0, -1	1, 0, -1	1, -1, -2	0, 0, 0	-1	-5

Notes: The rehabilitation alternative names consist of letters referring to:
C – Continuous Joint Rehabilitation, D – Dowel Bar Retrofit, U – Ultra-High Performance Concrete, L – Latex Modified Concrete, F – Fiber Reinforced Grout, N – Non-Shrink Grout, M – Magnesium Ammonium Phosphate Grout, H – Headed Bar, W – Wire Mesh, R-Rebar.

(Bohn) 2019

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Table 25.3.1-1 Joint Type

Joint Type [material used]	Applications	Width of Joint
Match-Cast Joints [two-face epoxy]	Adjoining members are post-tensioned together	zero
	Adjoining substructure members are connected with grouted reinforcing sleeve couplers at a horizontal joint[1]	
Pseudo Match-Cast Joints[2] [two-face epoxy]	Adjoining members are post-tensioned together	zero
	One of the elements is precast and the other is cast-in-place	
	Adjoining substructure members are connected with grouted reinforcing sleeve couplers at a horizontal joint[1]	
Non-Match-Cast Grouted Joints (excluding beam build-ups between beam and precast deck panels) [non-shrink grout]	Adjoining members are not post-tensioned together	Varies depending on element tolerances ½-inch minimum
	Members are joined with grouted reinforcing sleeve couplers	
	Element to element tolerances within ±½-inch	
Closure Pours Adjoining members are post-tensioned together [Concrete]	Where dimensional variability of adjoining ducts is high or where jack access is required	2'-0" minimum
	Where duct coupling is required and dimensional variability of adjoining ducts is relatively low and jack access is not required	1'-6" minimum
Closure Pours Adjoining members are not post-tensioned together [Concrete][3]	Members are joined with reinforcing bar extensions (Lap Splices)	As required to develop reinforcing 2'-0" minimum
Closure Pours Adjoining members are not post-tensioned together [Ultra High Performance Concrete (UHPC)[5]]	Members are joined with reinforcing bar extensions	As required to develop reinforcing 6-inches minimum[5]

1. ***LRFD*** 5.12.5.4.2 requirements for minimum stress across epoxy joints are intended to control geometry for segmental applications and may be waived for this application.
2. See Section 25.4.3.5 for Pseudo Match-Cast Epoxy example.
3. Concrete mixes with shrinkage reducing admixtures.
4. Prepare specification requirements to prevent sole-sourcing a proprietary product.
5. ***LRFD*** 5.12.2.3.3e requirement for a minimum pour width is waived for UHPC.

Figure 25.3.3-4 Headed Bars and Hooks Closure Pour

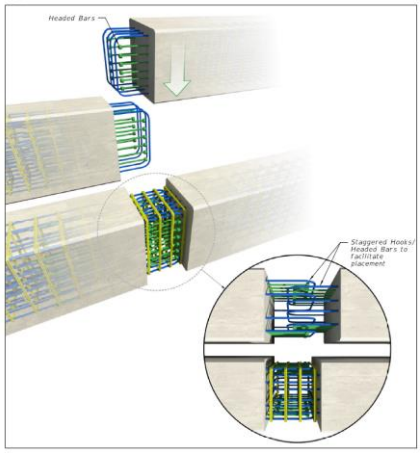
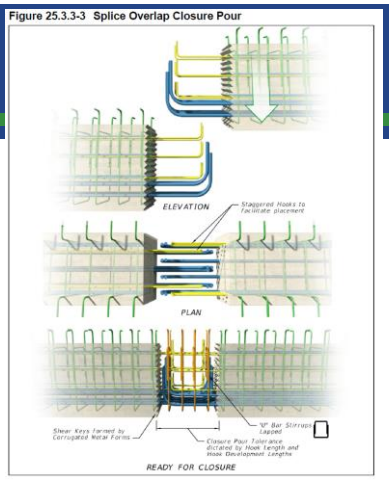


Figure 25.3.3-3 Splice Overlap Closure Pour



5.12.2.3.3e—Cast-in-Place Closure Joints

Concrete in the closure joint should have strength comparable to that of the precast components. The width of the longitudinal joint shall be large enough to accommodate development of reinforcement in the joint, but in no case shall the width of the joint be less than 12.0 in.

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FDOT Structures Detailing Manual

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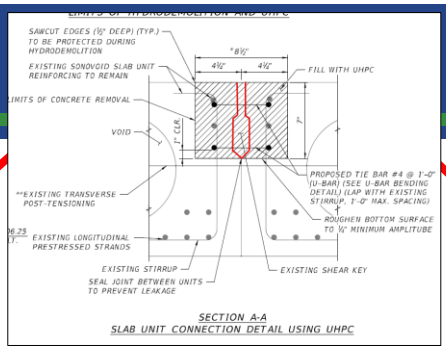

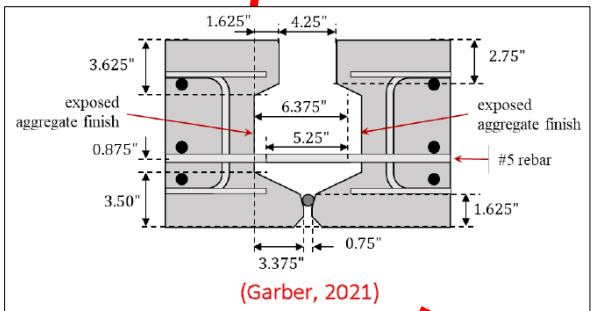

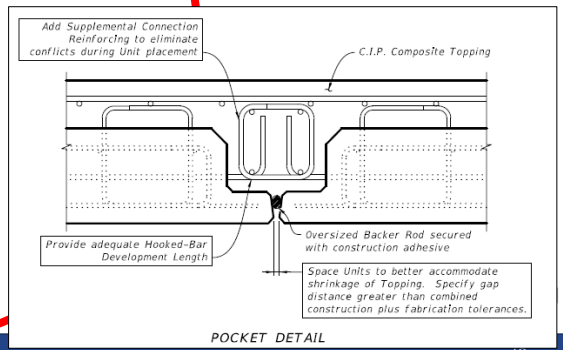

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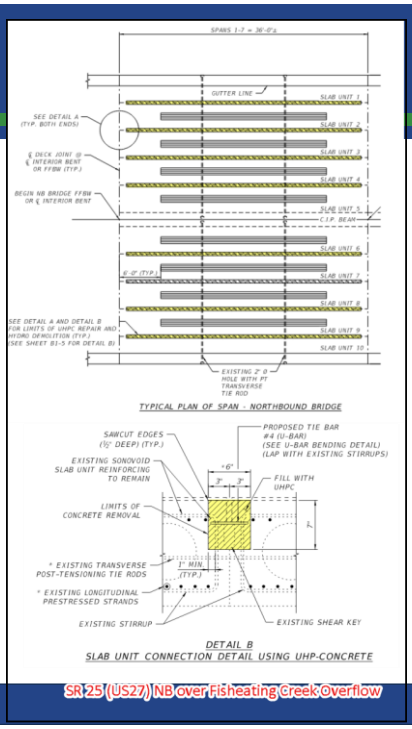

SR 25 (US27) NB over Fisheating Creek Overflow

- I-10 over CR268A Approach Slab Replacement
- I-10 over Flat Creek Approach Slab Replacement
- I-95 over CR5A - Precast Deck Panel Replacement
- I-95/JT Butler Interchange Bridge U-Beam Repair
- SR 115/Arlington Expy over Red Bar Branch
- SR25(US27) NB over Fisheating Creek
- SR 714/Danforth Creek - Sonovoid Rehab
- SR 924/NW 119th St over Rio Vista Canal
- SR 994/Quail Roost Dr over Canal C-102
- US1 over Little Duck Key Channel
- US441 over Taylor Creek - Span 12 Replacement
- US41 over Sunset Waterway Link-Slab
- CR339/Waccasassa River Pile Demonstration

Closure pours or Longitudinal Joint Repair

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References:

FDOT Bridge Maintenance & Repair Handbook (2019)

FDOT Structures Manual (2025)

Review and Structural Investigation of Cracked Bridge Decks (Shahawy, 2001)

Rehabilitation of Longitudinal Joints in Double-Tee Girder Bridges (Bohn, 2019)

Bridge Maintenance Reference Manual (FHWA, 2015)

Florida Slab Beam Bridge with UHPC Joint connections (Garber, 2021)

https://www.fdot.gov/structures/innovation/uhpc.shtm

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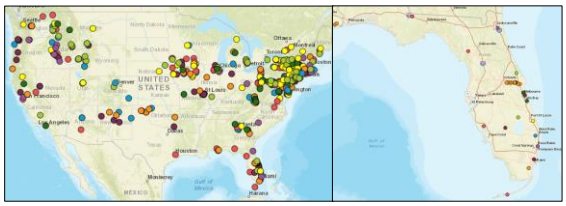
History of UHPC

- 1980s designed by the US Army Corps of Engineers to harden military structures
- 1997 First use of UHPC in North America was the Sherbrooke Pedestrian Bridge in Quebec
- 2000 (+/-) UHPC becomes commercially available
- 2006 First use in United States was on the Mars Hill Bridge
- 2016 FDOT utilizes UHPC for sonovoid repair (SR714/Martin Downs Blvd over Danforth Ck)
- 2020 FDOT installs first UHPC H-pile (County Road 339 Waccasassa River)
- **2024 Largest use of UHPC in FDOT to date (Arlington Expressway)**

Sherbrooke Pedestrian Bridge, Quebec (Perry)

Mars Hill Bridge (FHWA)



Current UHPC projects in United States and Florida (as of October 2025)

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What is UHPC?

No industry-wide standard definition exists

- Generally, UHPC can be defined as a material that far exceeds the capabilities of conventional concretes.
  - Very low w/b ratio (< 0.2)
  - Low to extremely low permeability
  - High compressive and tensile strengths
  - Sustained post cracking tensile resistance

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UHPC Materials

- UHPC is commonly prepackaged, proprietary material, however, careful selection and testing of materials does permit “locally sourced” UHPCs.

- Cement – most commonly Type I/II
- Supplementary Cementitious Materials (commonly silica based)
- Fine sand
- Fiber reinforcement – traditionally metallic, however, non-metallic also utilized
- Admixtures
- Water – ice may also be specified

- Particle packing to achieve discontinuous pore structure

- Properties of UHPC products vary greatly from producer-to-producer and by specified use

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FDOT UHPC Plastic Properties Testing

- Temperature – ASTM C1064

- Flow Spread – ASTM C1437 (**as modified by ASTM C1856**)
  Working Time – elapsed time when flow drops below 7”
  Fiber segregation can also be visually verified

- Density – ASTM C138

- Time of Set – ASTM C191 (**as modified by ASTM C1856**)

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FDOT UHPC Hardened Properties Testing

FDOT required values at 28 days

- Compressive strength – ASTM C39 (as modified by ASTM C1856) ≥17,500 psi
  Note: C1856 specifies grinding cylinder ends
- Flexural Strength (first peak)– ASTM C1609 (as modified by ASTM C1856) ≥1,200 PSI
  Effective cracking strength – AASHTO T397 ≥1,000 PSI
  Crack localization strength – AASHTO T397 ≥1,000 PSI
  Crack Localization Strain – AASHTO T397 ≥ 0.0035
- Length Change of Hardened Concrete – ASTM C157 (as modified by ASTM C1856) ≤800 micro-strain
- Tensile strength and relative toughness of cylinders by Double-Punch (Barcelona Test) – FM 5-516 – Informational only at this time




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FDOT UHPC Durability requirements

FDOT required values at 28 days

- Chloride Content – FM 5-516 ≤ 0.40 lb/yd^3
  Note: FDOT has specified that chloride samples shall be taken prior to addition of fibers. Composite density utilized.
- Chloride ion permeability – AASHTO T259 (0.5-inch depth) <0.1 lb/yd^3
- Scaling Resistance – ASTM C672 Y< 3
- Freeze-Thaw resistance - AASHTO T 161/ASTM C666A (600 cycles) Relative Dynamic Modulus of Elasticity ≥ 95%
- Alkali-Silica Reaction - ASTM C1567 Innocuous

Note: Test methods/requirements subject to change as new research and specifications develop

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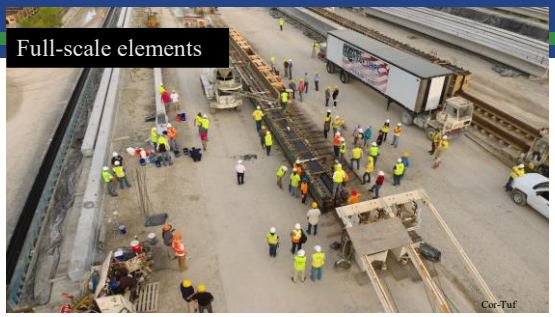
UHPC Applications



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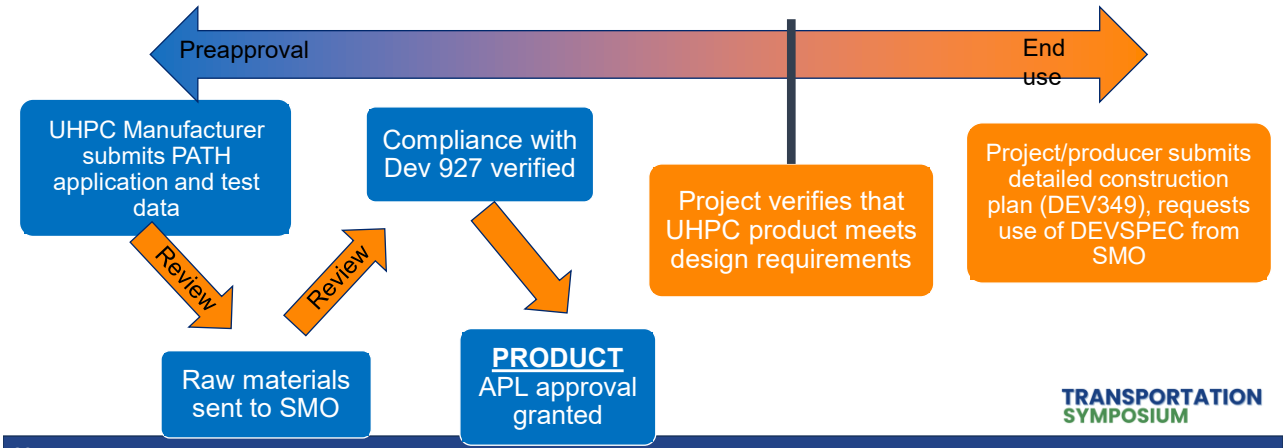
FDOT UHPC Approval

FDOT is utilizing the Approved Products List (APL)/PATH program to preapprove UHPC as individual PRODUCTS by the producer.



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Key Lessons

Select Appropriate Repair

Early Coordination

Education

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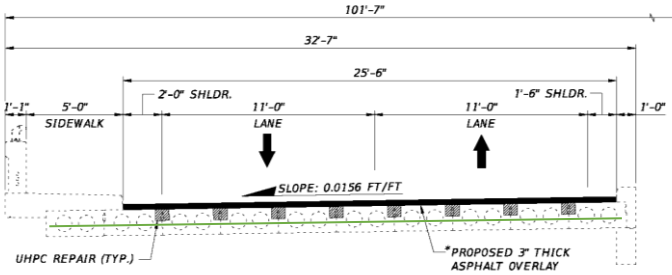
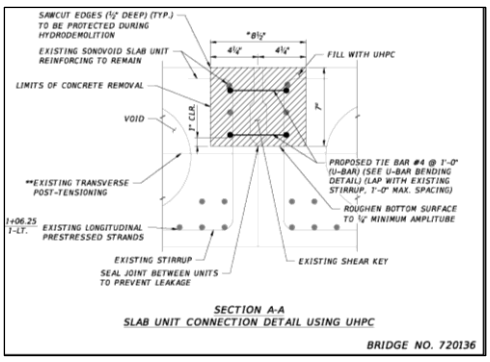
Selecting Appropriate Repair



BRIDGE NO. 720136 TYPICAL SECTION - PROPOSED



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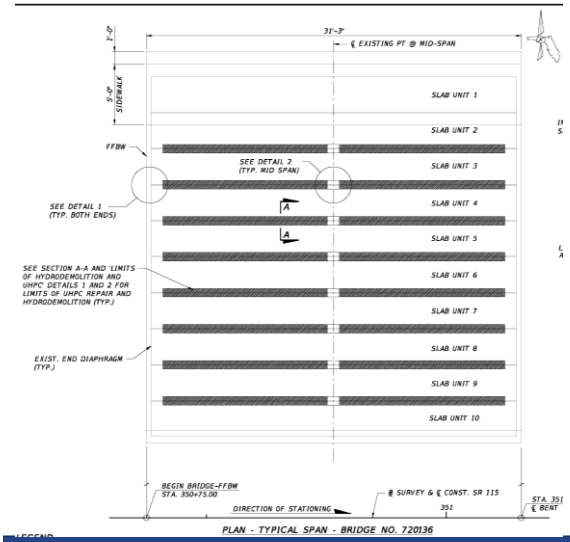
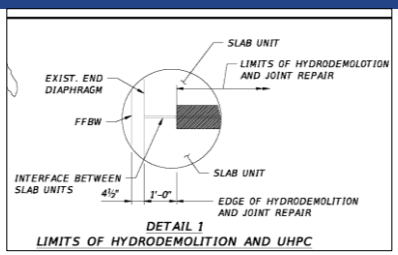
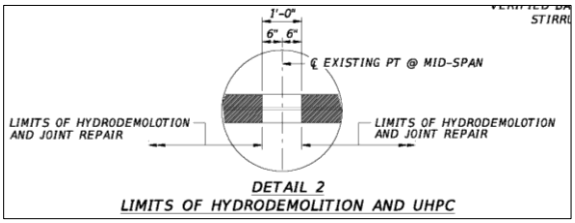
Selecting Appropriate Repair







TRANSPORTATION SYMPOSIUM

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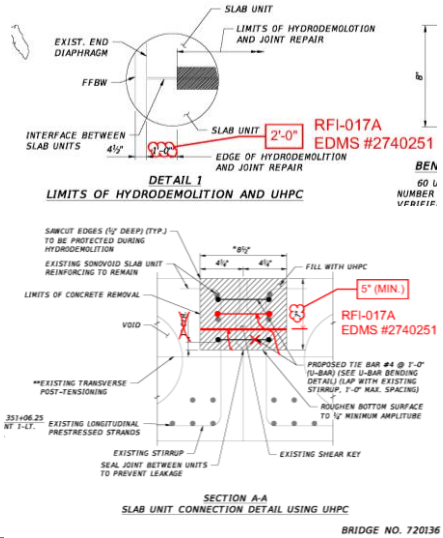
Selecting Appropriate Repair



TRANSPORTATION SYMPOSIUM

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Early Coordination

- State Materials Office
  - Developmental Specifications
    - https://www.fdot.gov/programmanagement/otherfdotlinks/developmental/default.shtm

Dev349UHPC - Ultra-High-Performance Concrete Dev927UHPC - Prepackaged Ultra-High-Performance Concrete	**Must Be Used Together** Allows the use of Ultra-High-Performance Concrete.	Oliver Chung	N/A

TRANSPORTATION SYMPOSIUM

Early Coordination

- 349-3.3 – Manufacturer Technical Rep
- 349-4 – Construction work plan
- 349-6 Mockup

TRANSPORTATION SYMPOSIUM

Early Coordination

- 349-3.3 – Manufacturer Technical Rep

TRANSPORTATION SYMPOSIUM

Early Coordination

ceEntek
Next Generation UHPC 2.0™

UHPC FIELD CAST CLOSURE POURS

CONSTRUCTION PLACEMENT & QA/QC PLAN

Project: FL T2934 SR 115 (Arlington Expressway) over Red Bay Branch Bridge Repair
Contractor: Superior Construction
Date : June 29, 2023

Photo: UHPC Connections for Precast Elements with Plywood Covers

Introduction

The following outlines the procedures and equipment to be used for the production of field cast UHPC closure pours, casting, and construction for the project FL T2934 SR 115 (Arlington Expressway) over Red Bay Branch Bridge Repair by Superior Construction, using ceEntek's Next Generation ce2005F-G™ UHPC 2.0™ mix, under the guidance of ceEntek's technicians.

This Construction Placement & QA/QC Plan covers the means and methods associated with the UHPC connection on this project. This submission is for review and acceptance by the owner &/or owner's representative prior to placing UHPC.

Raw Materials

ceEntek will supply UHPC prebland (ce2005F-G™) in bulk-bags, the CNF paste and admixtures in pails, and the steel fibers in paper bags. One bulk-bag will batch 0.65 cubic yards of UHPC.

Equipment

Mixers

ceEntek will provide 2- Model 30 mixers, each with a mixing capacity of 0.65 cubic yard batch size for the batching.

Confidential

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- 349-4 – Construction work plan

TRANSPORTATION SYMPOSIUM

Early Coordination

- 349-6 Mockup

TRANSPORTATION SYMPOSIUM

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Early Coordination

- Technical Special Provision Library
  - https://www.fdot.gov/programmanagement/otherfdotlinks/technical-special-provision-library/tsp-library
- Section T401
  - It is a DRAFT
  - EOR needs to ***MODIFY TO FIT THE PROJECT***
  - EOR holds *FULL RESPONSIBILITY*

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Early Coordination

- Use requires Structures Design review.
- Technically meets Category 2 criteria.
- APL product: https://path.fdot.gov/ProductTypes/Index/750

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Education

- UHPC limited use
- Test procedures
- Labs have limited experience

TRANSPORTATION SYMPOSIUM

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Summary

- Chose the right repair material
  - UHPC is one of many tools available
  - Not a one size fits all
- Early Coordination
  - Developmental Specification
  - APL product
- Education
  - UHPC limited use in Florida
  - Technical Specifications
  - Many testing labs lack experience

TRANSPORTATION SYMPOSIUM

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Safety Message

When the gates are down, don't go around
Think train

Freight and passenger trains travel at different speeds
Double tracks – possibly two trains different directions
Stopping distance loaded freight almost one mile

TRANSPORTATION SYMPOSIUM

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Contact Us

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  - Zachary.Behring@dot.state.fl.us
  - 850-414-4780

TRANSPORTATION SYMPOSIUM

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