Bridge Maintenance and Repair with Ultra-High Performance Concrete (UHPC)

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2019 Northeast Bridge Preservation Partnership Meeting | Burlington VT
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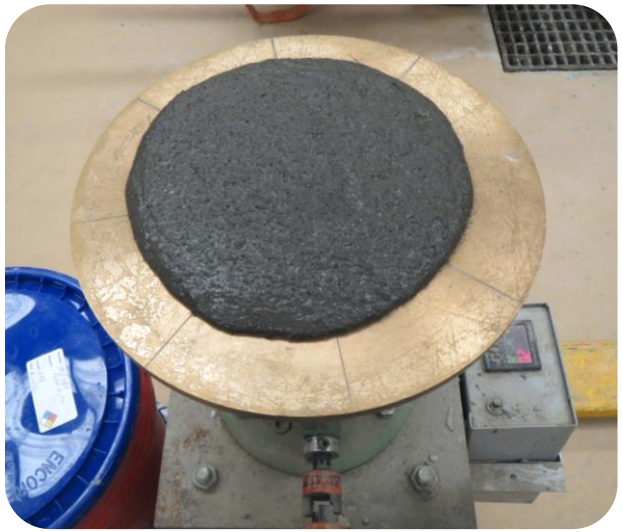
Structural Concrete Research Program
Turner-Fairbank Highway Research Center



U.S. Department of Transportation
Federal Highway Administration

What is Ultra-High Performance Concrete?

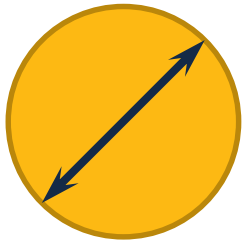


What is Ultra-High Performance Concrete?

Tensile Strength ≈ 300 ksi

Fiber Length ≈ 0.5”

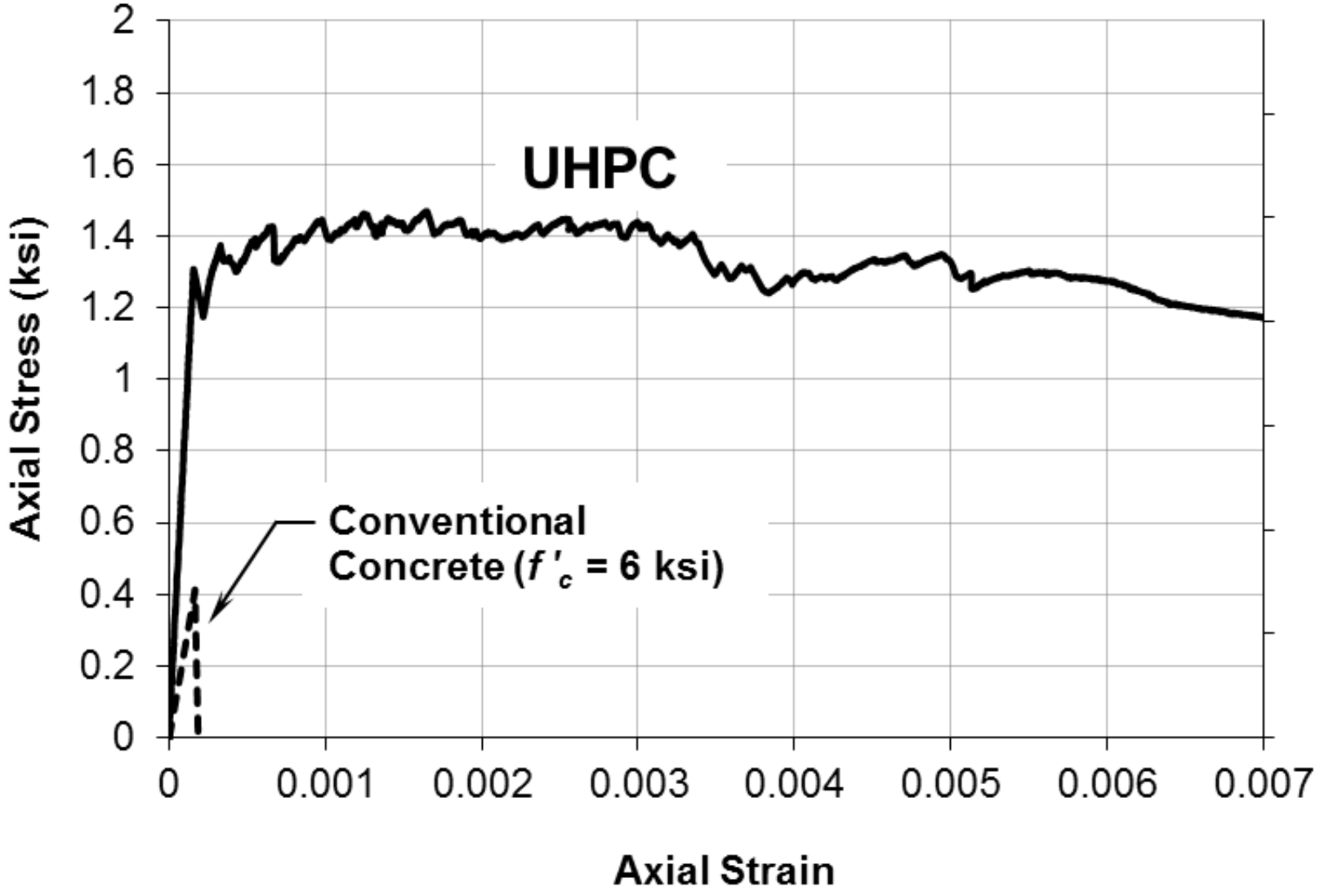
Fiber Diameter ≈ 0.01”

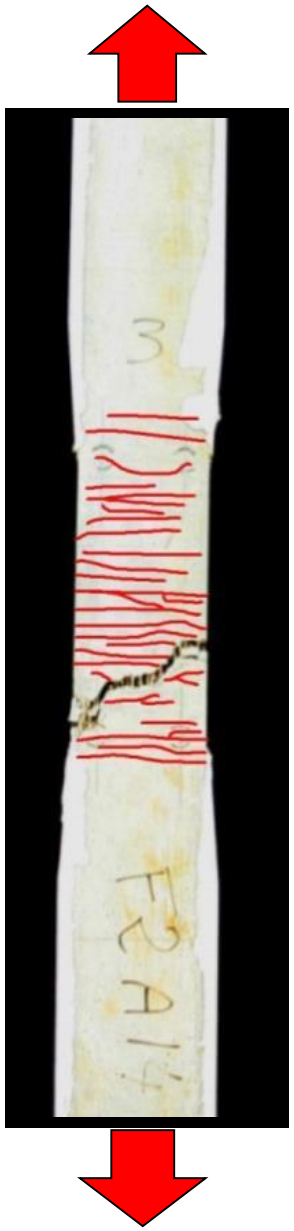


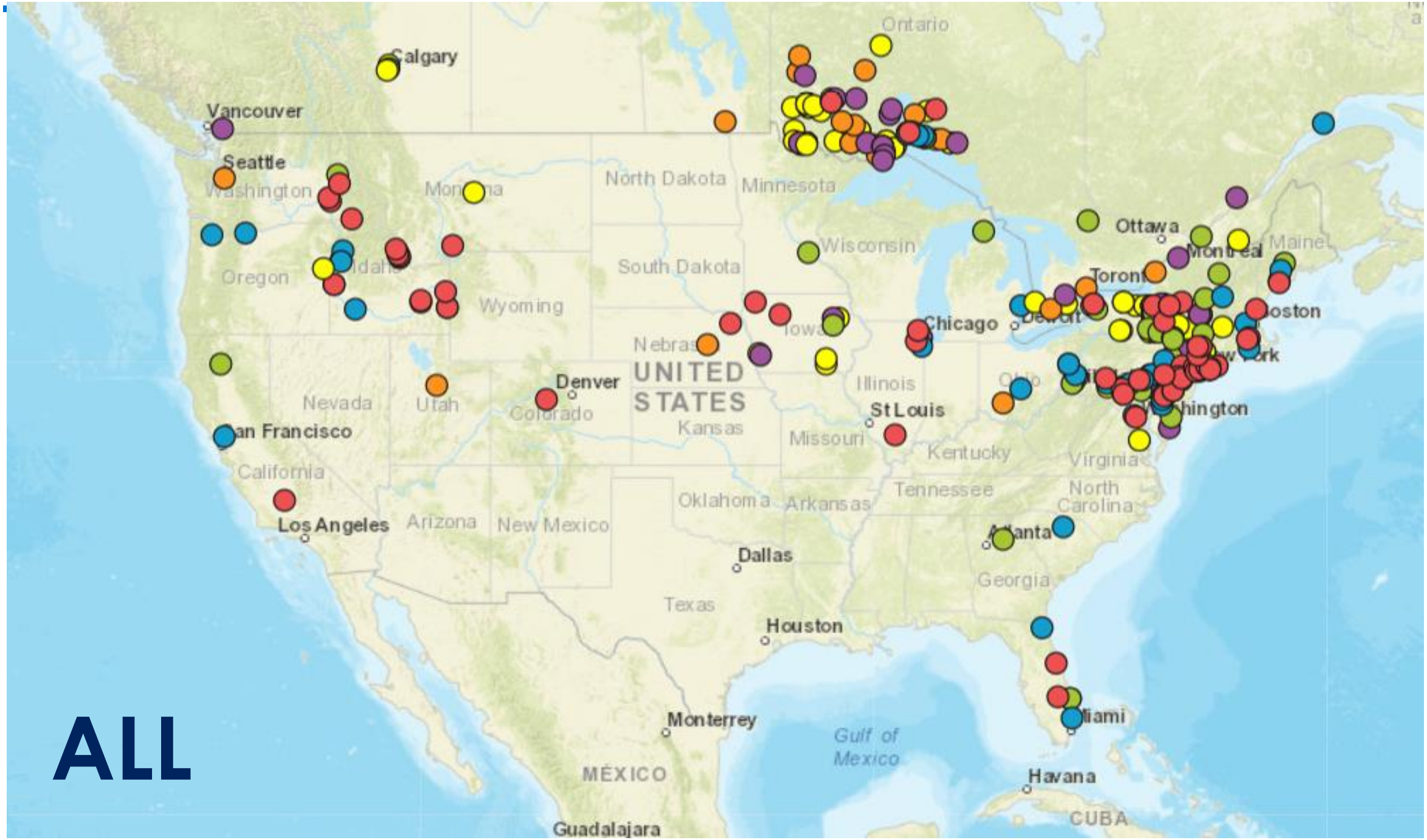
General Properties

- High Compressive Strength (> 21,000 psi)
- High Tensile Strength (> 720 psi)
- Low permeability (10x *Less* Permeable than HPC)
- Resistant to freeze-thaw damage (RDM > 95%)
- Highly resistant to abrasion
- Exceptional bond to existing concrete
- Exceptional bond to rebar
- Self consolidating

UHPC Tensile Behavior



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Dallas
Georgia
Texas
Houston
Miami
Monterrey
Gulf of
Mexico
MÉXICO
Havana
CUBA
Guadalajara


Ontario
Calgary
Vancouver
Seattle
Washington
Montana
North Dakota
Minnesota
Wisconsin
Ottawa
Montreal
Maine
Oregon
Idaho
South Dakota
Toronto
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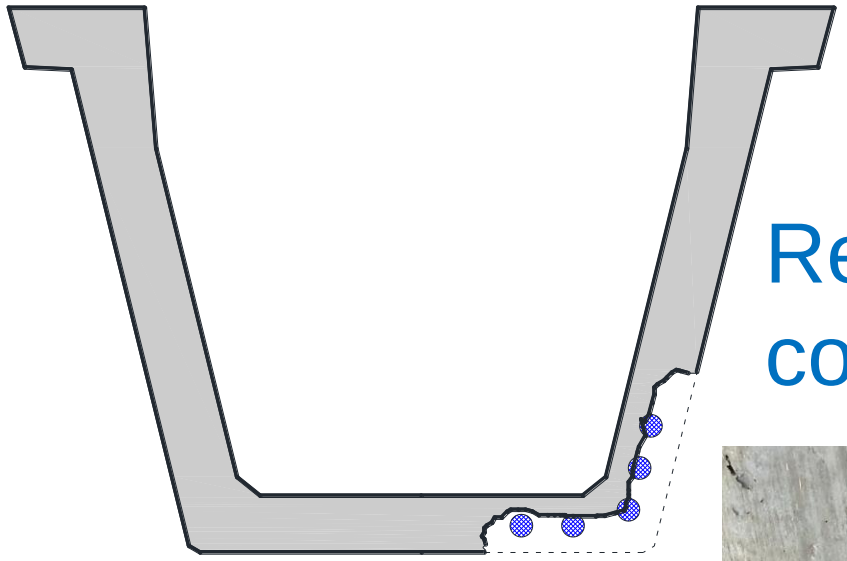
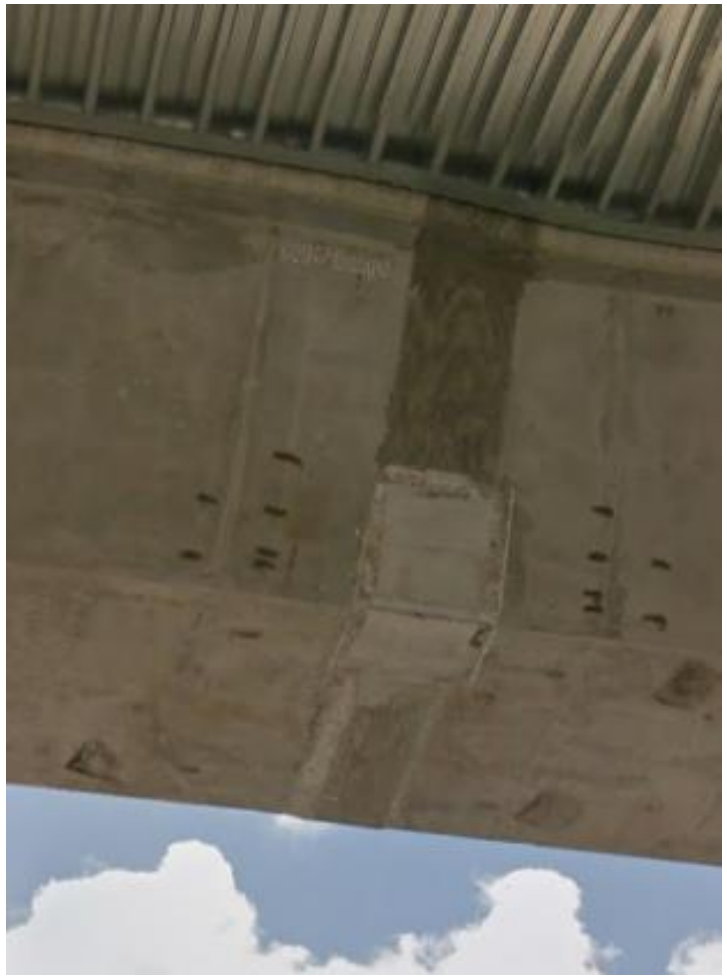
REPAIR

Concrete Girder Repair

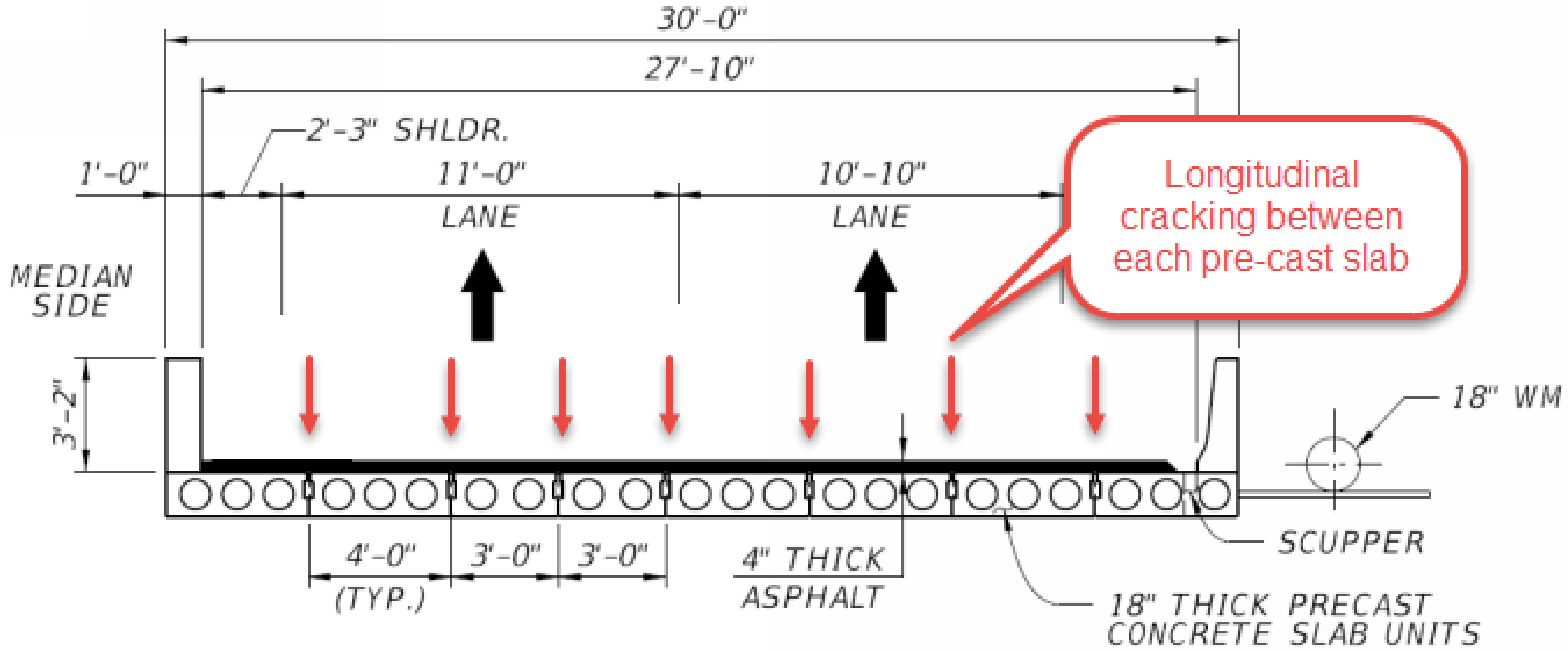


Region of poor consolidation

Repaired with UHPC



Connection Repair Between Slab Beams



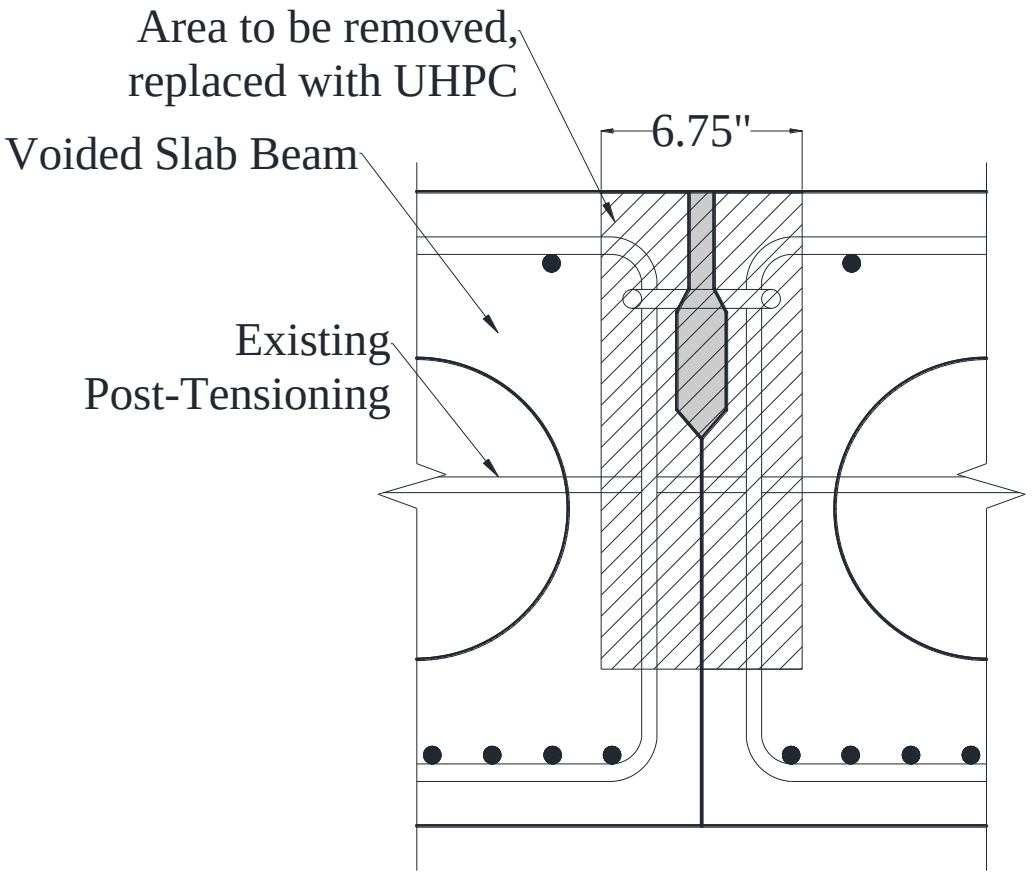
SR-714/Martin Downs Blvd Bridges at Danforth Creek – Palm City, FL

Source: Florida Department of Transportation (2017)

Connection Repair Between Slab Beams

Reflective Cracking in Asphalt

Planned Removal of Deteriorated Connections



Source: Florida Department of Transportation (2017)

Connection Repair Between Slab Beams

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UHPC Overlays for Bridge Decks

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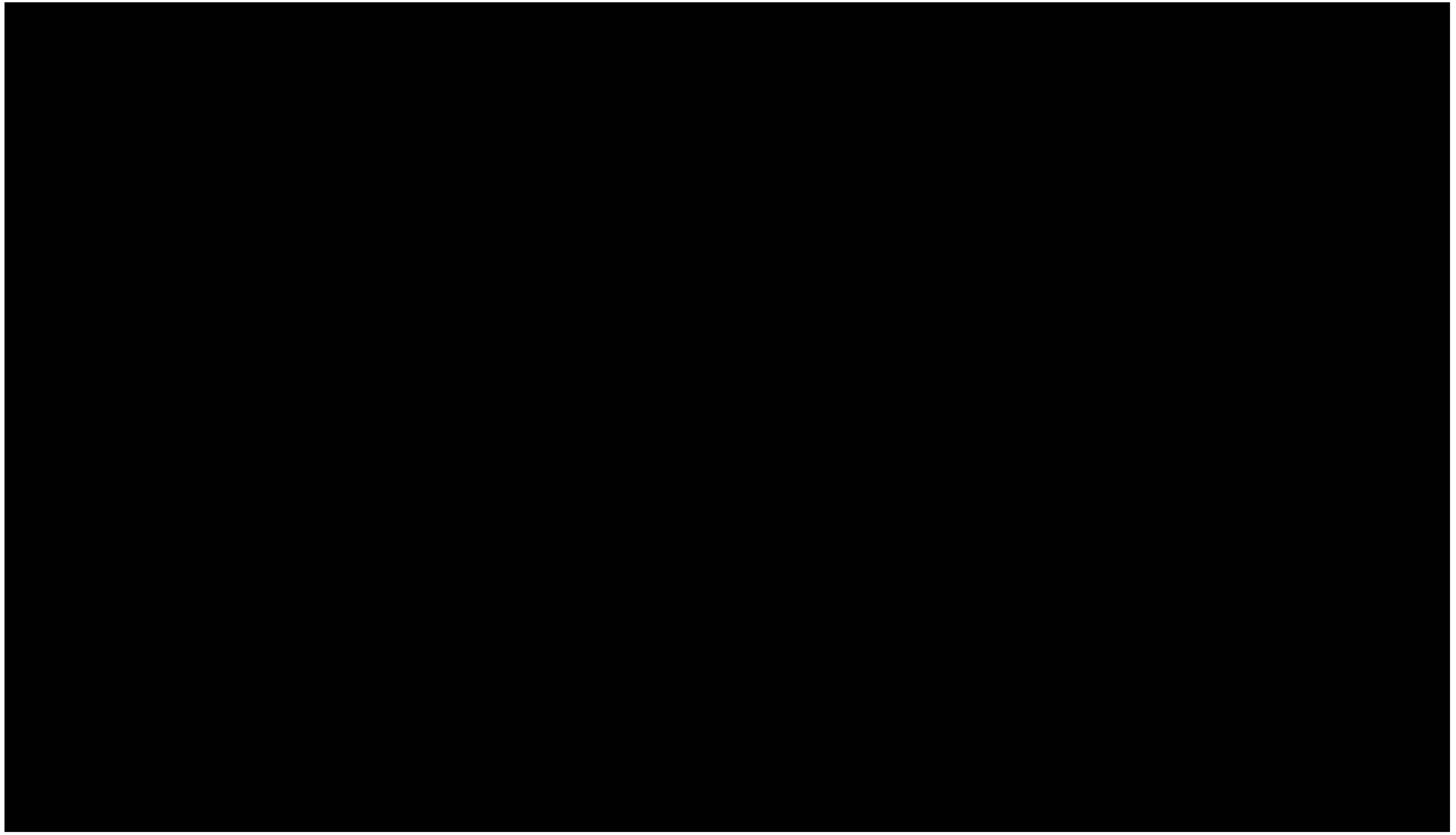
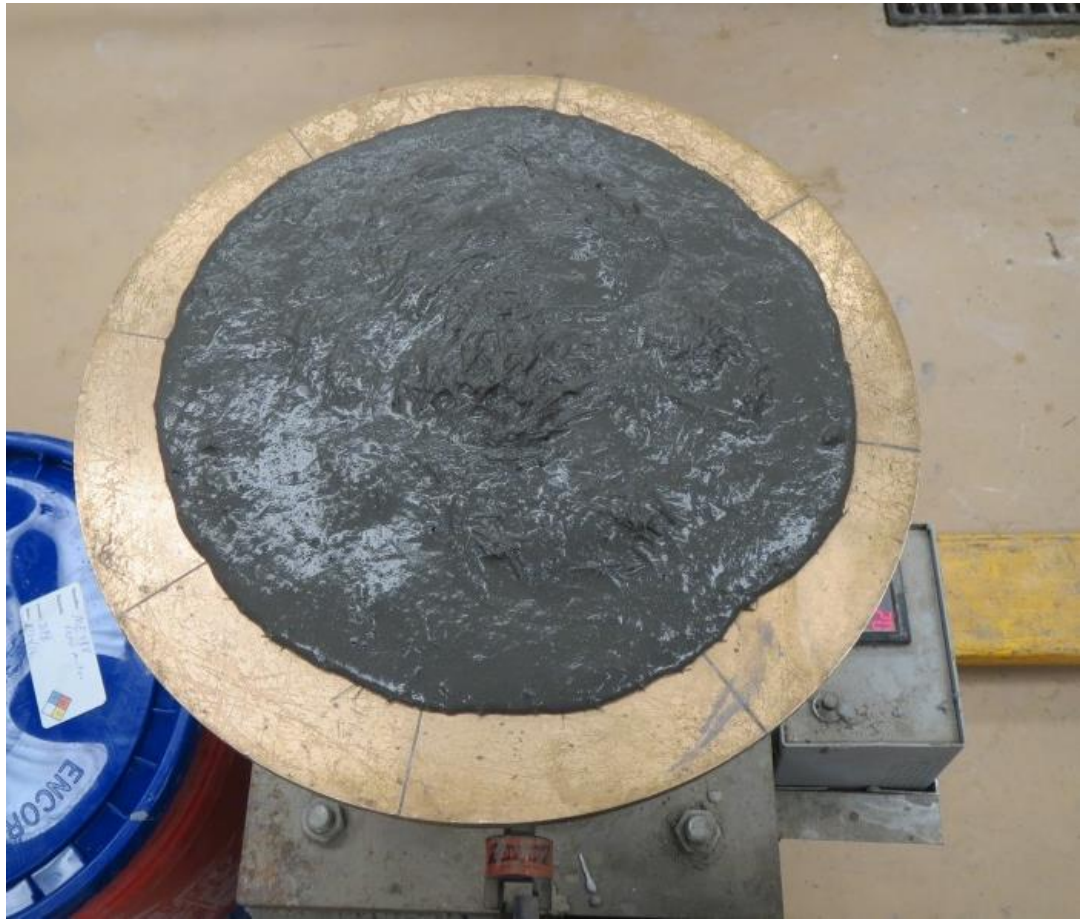
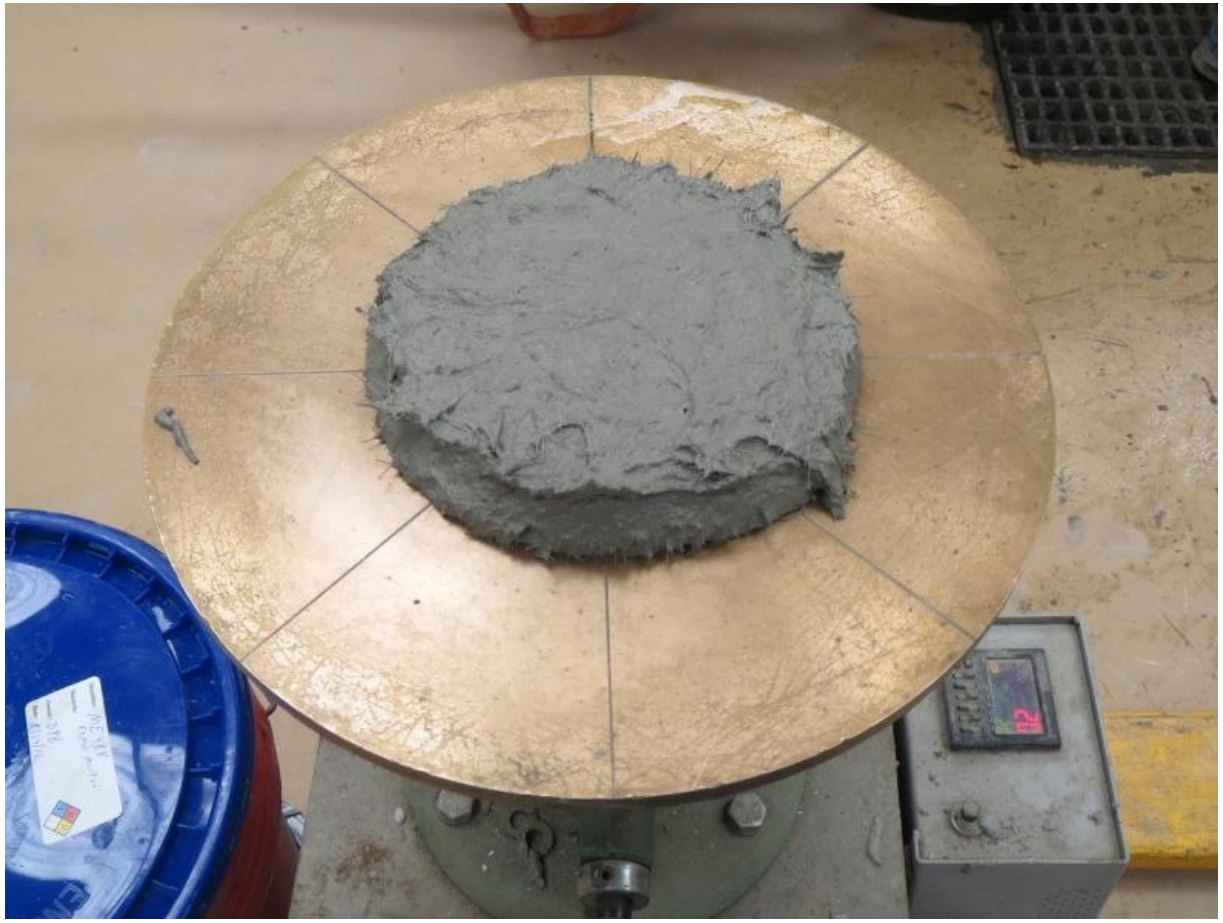


UHPC Overlays for Bridge Decks



Normal UHPC

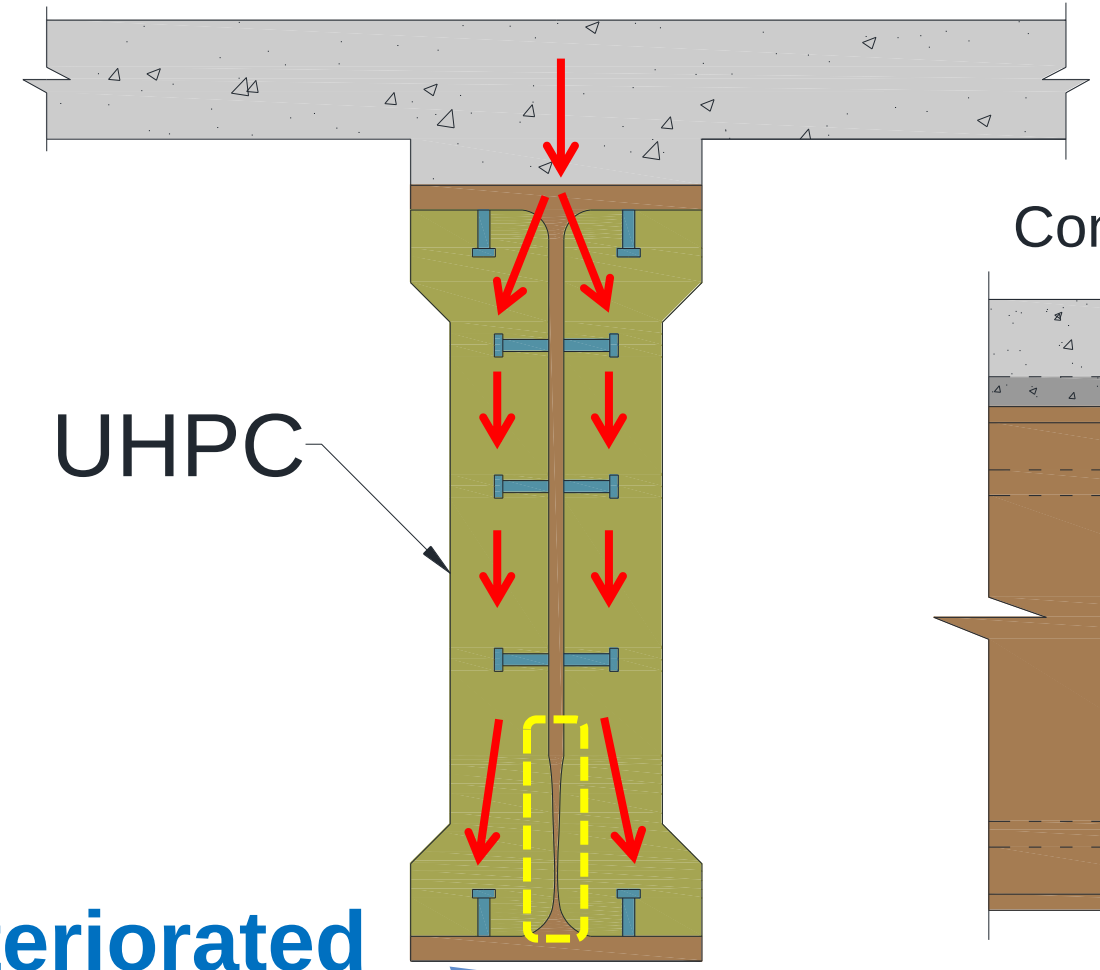


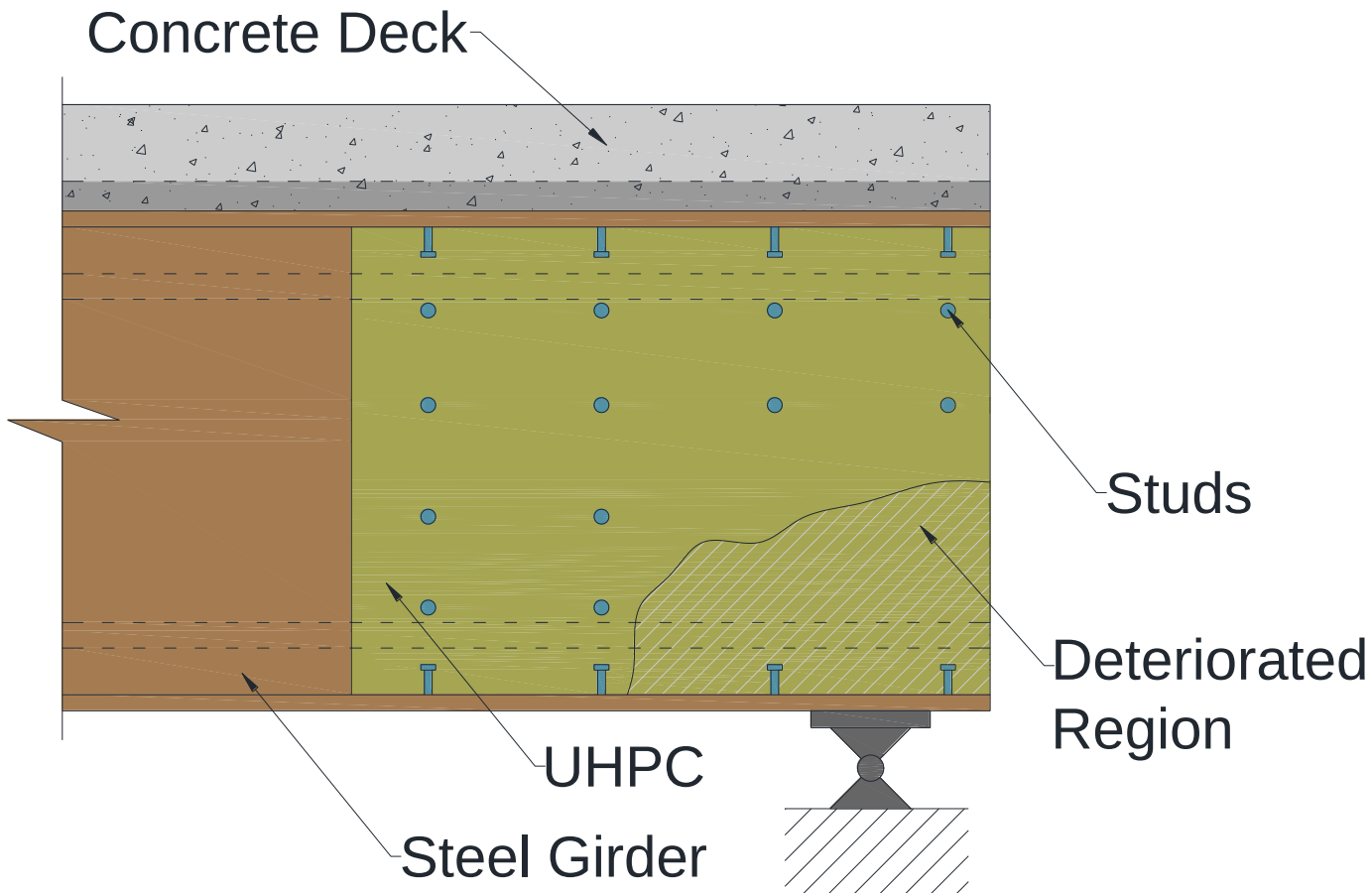
Overlay UHPC

UHPC for Steel Girder Rehabilitation

Leaky or unsealed expansion joints…

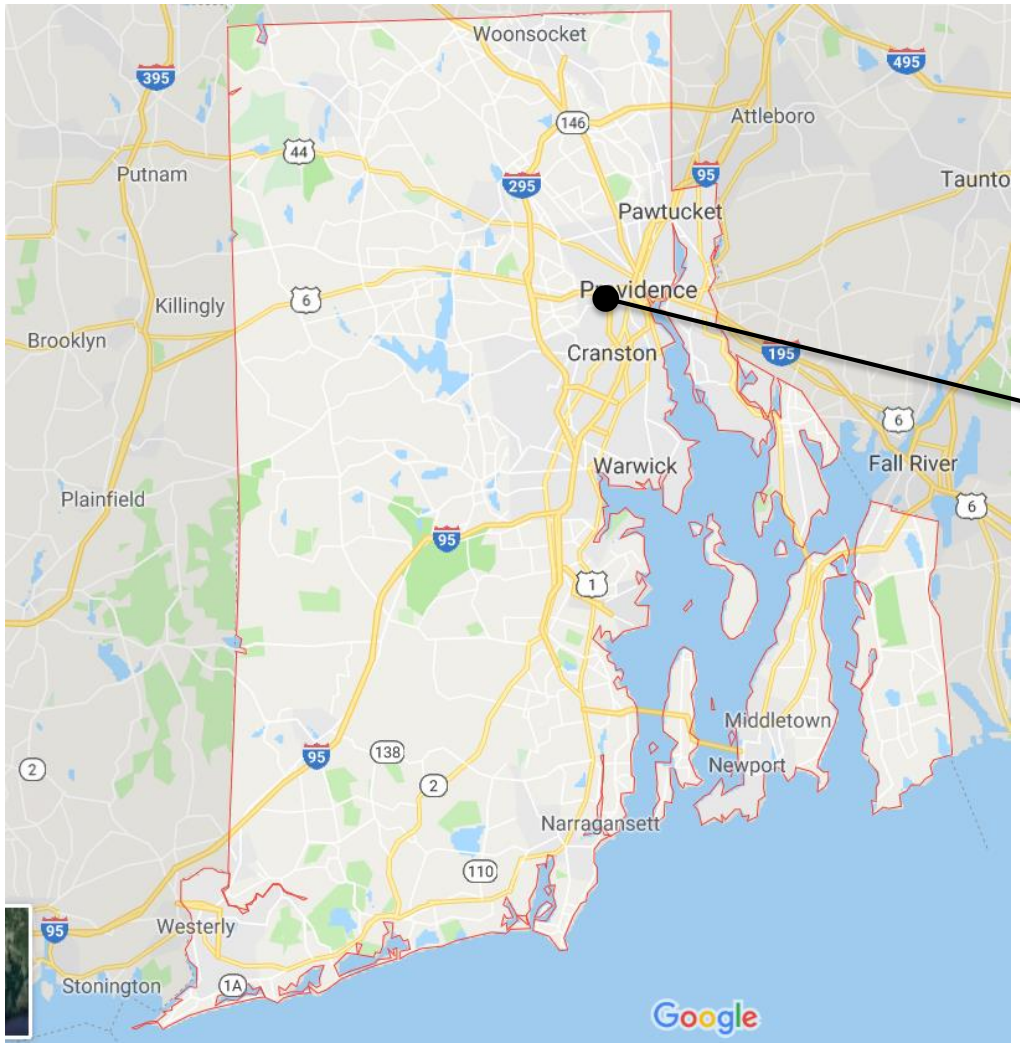
UHPC for Steel Girder Rehabilitation

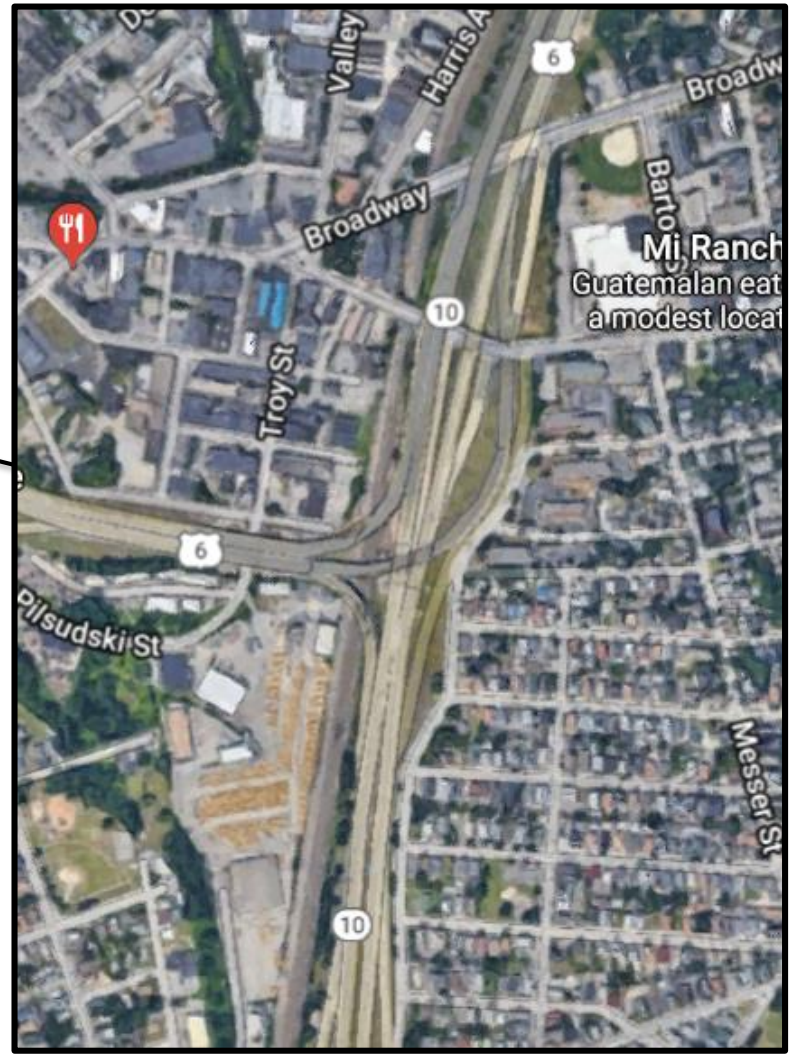




Strengthening of Deteriorated Beam Ends

First Deployment: Route 6/10 Interchange, Providence, RI





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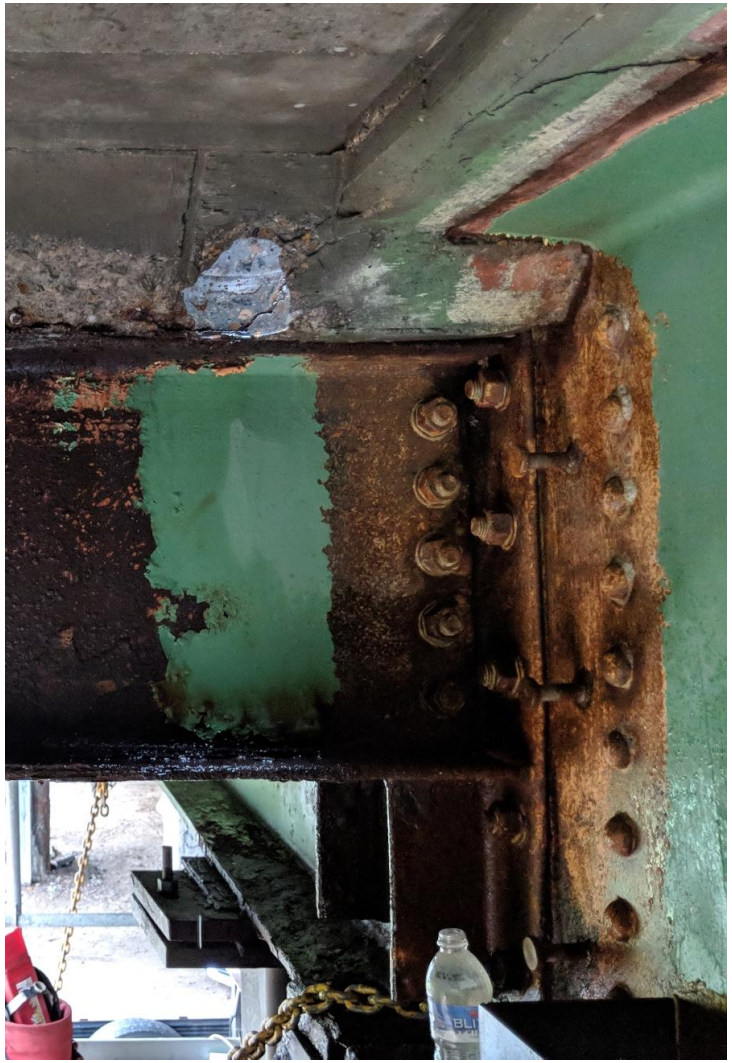
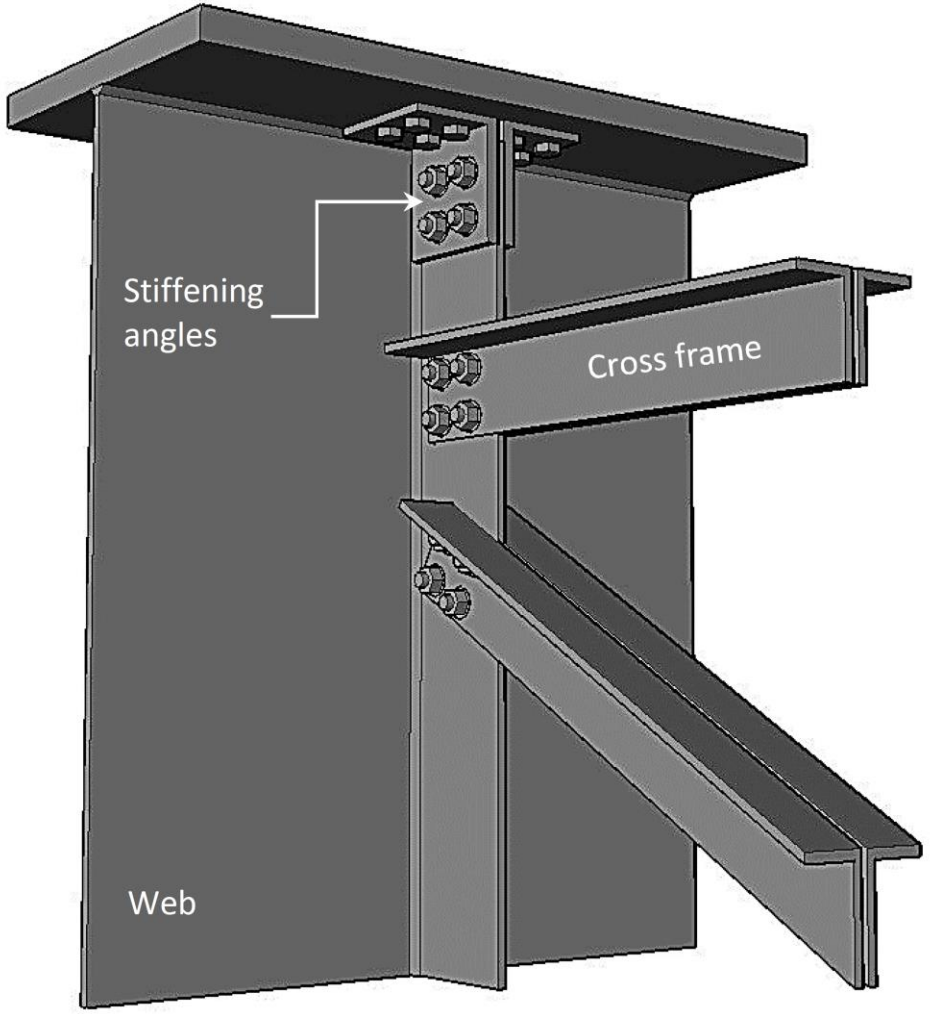


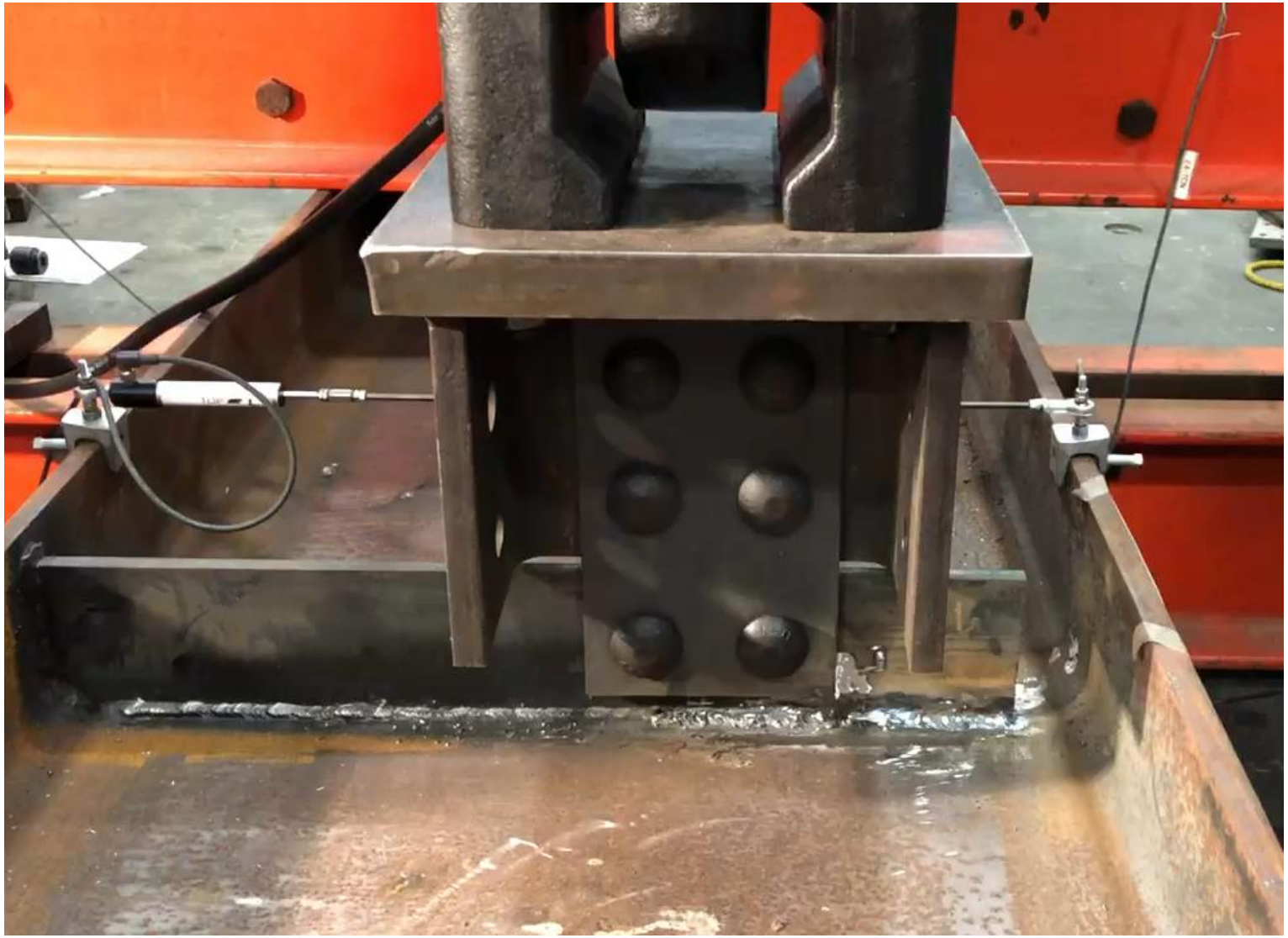
Web-Gap Fatigue Crack Repair

Distortion Induced Cracking



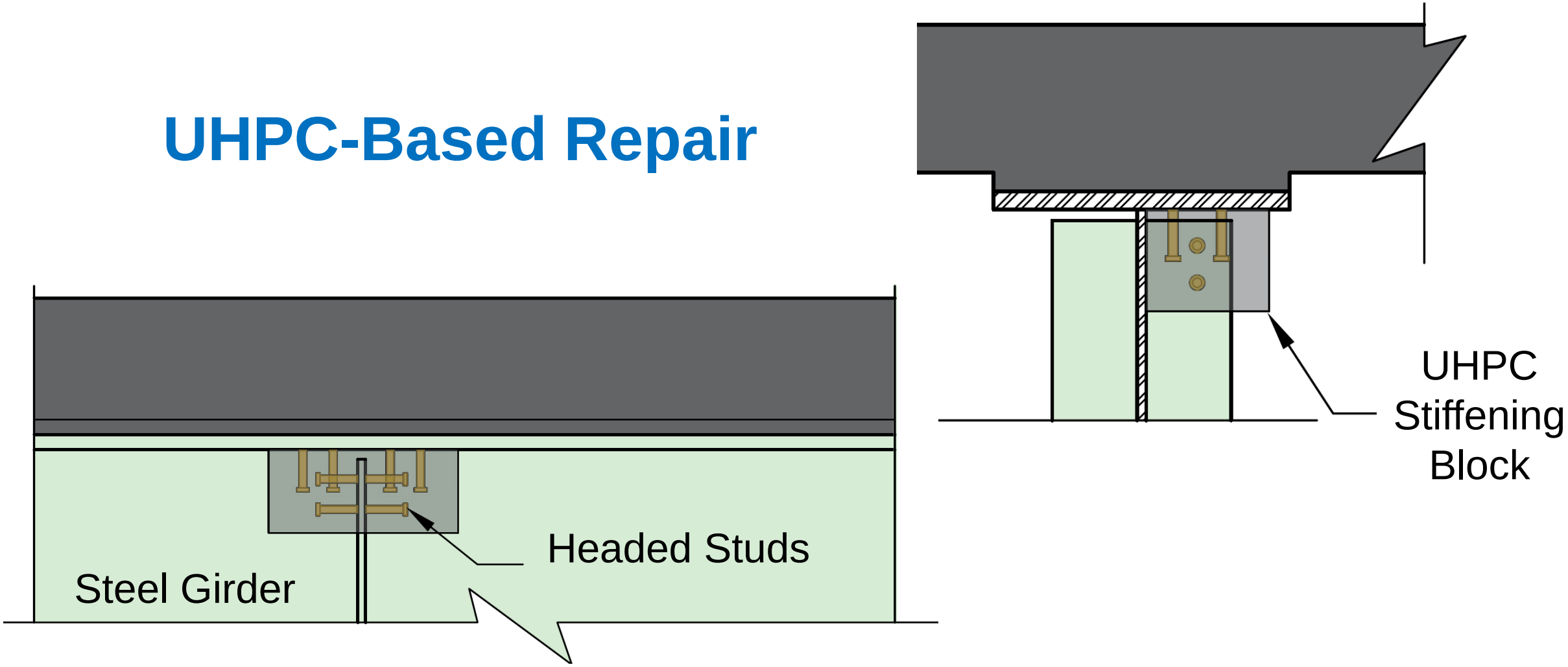
Conventional Repair

Web-Gap Fatigue Crack Repair



Web-Gap Fatigue Crack Repair

UHPC-Based Repair



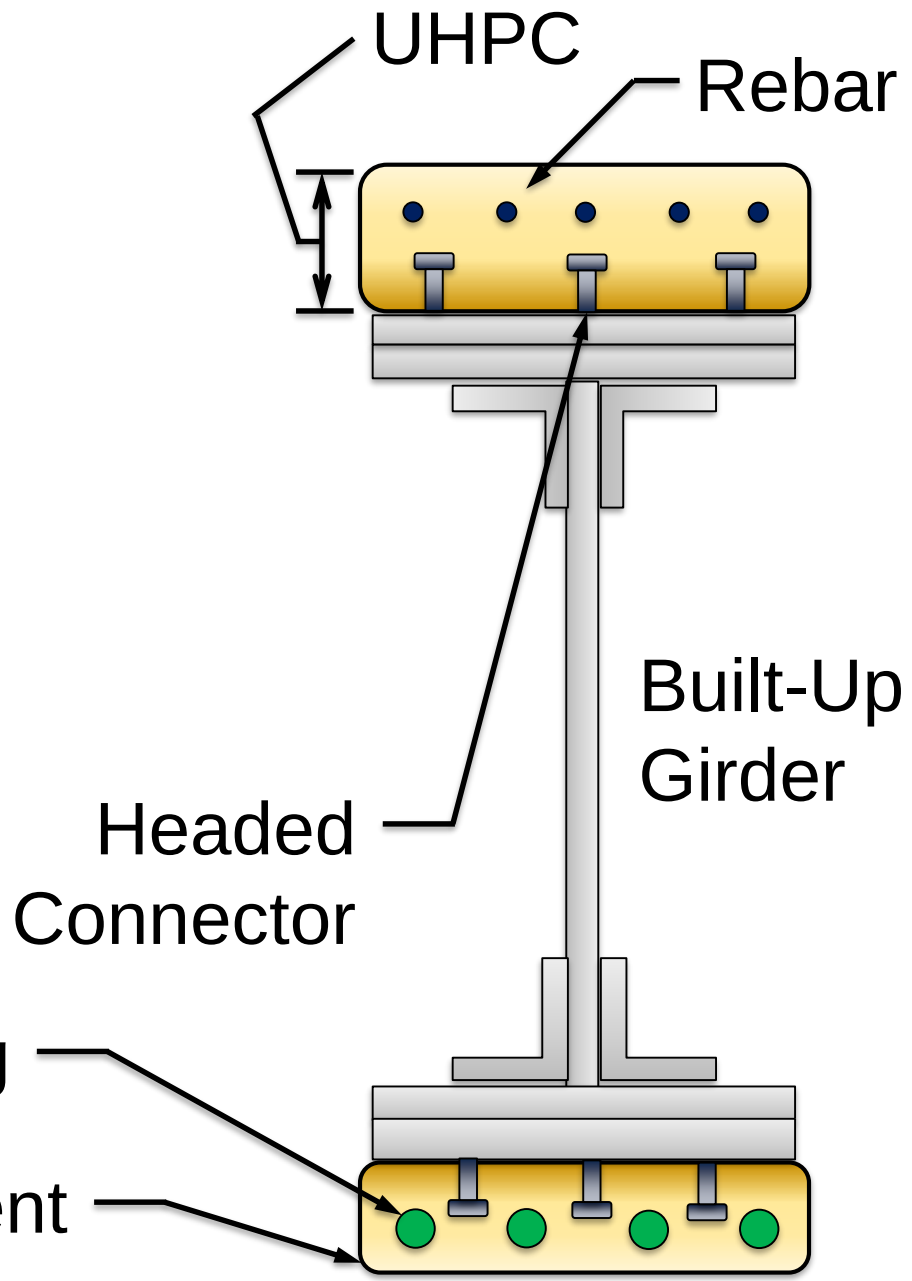
Strengthening of Riveted Thru-Girders

Early 1900s Riveted Steel Bridge Structures

A Potential Solution

UHPC Topping + Bonded Post-Tensioning

- Capacity Increase
- Live + Dead Load Stress Reduction
- Complete Composite Action
- Enhanced Structural Efficiency
- Impact Protection



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