UHPC

Michigan Bridge Conference

March 22, 2017

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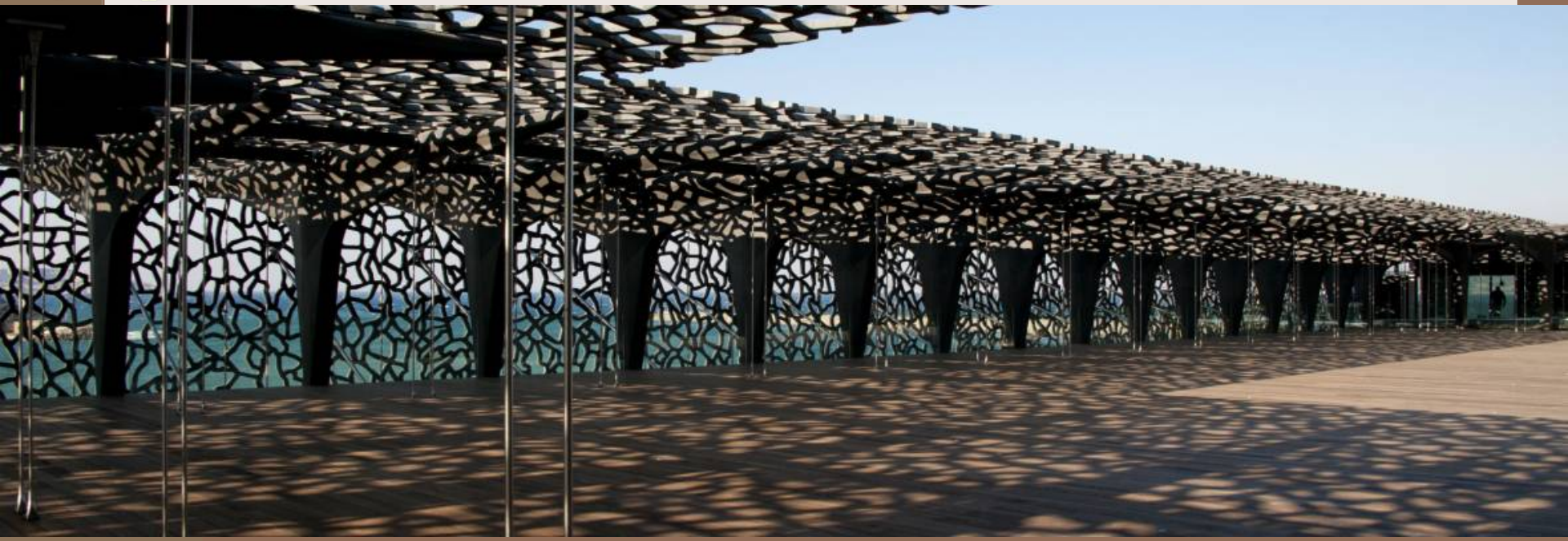
Michigan Department of Transportation

What is UHPC?

It’s pretty!



It’s efficient

It’s pretty efficient!

Why UHPC?

- High compressive strength
- High durability
- Low permeability
- Fibers (removal mild reinforcement)
- High bond strength
- After curing it is stable and has minimal creep and shrinkage
- More efficient sections
- Self leveling

Typical Properties

- Compressive strength = 18-33 ksi
- Flexural strength = 2.2-7 ksi
- Tensile strength = 1.1-1.6 ksi
- Modulus of elasticity = 6,000 to 8,000 ksi

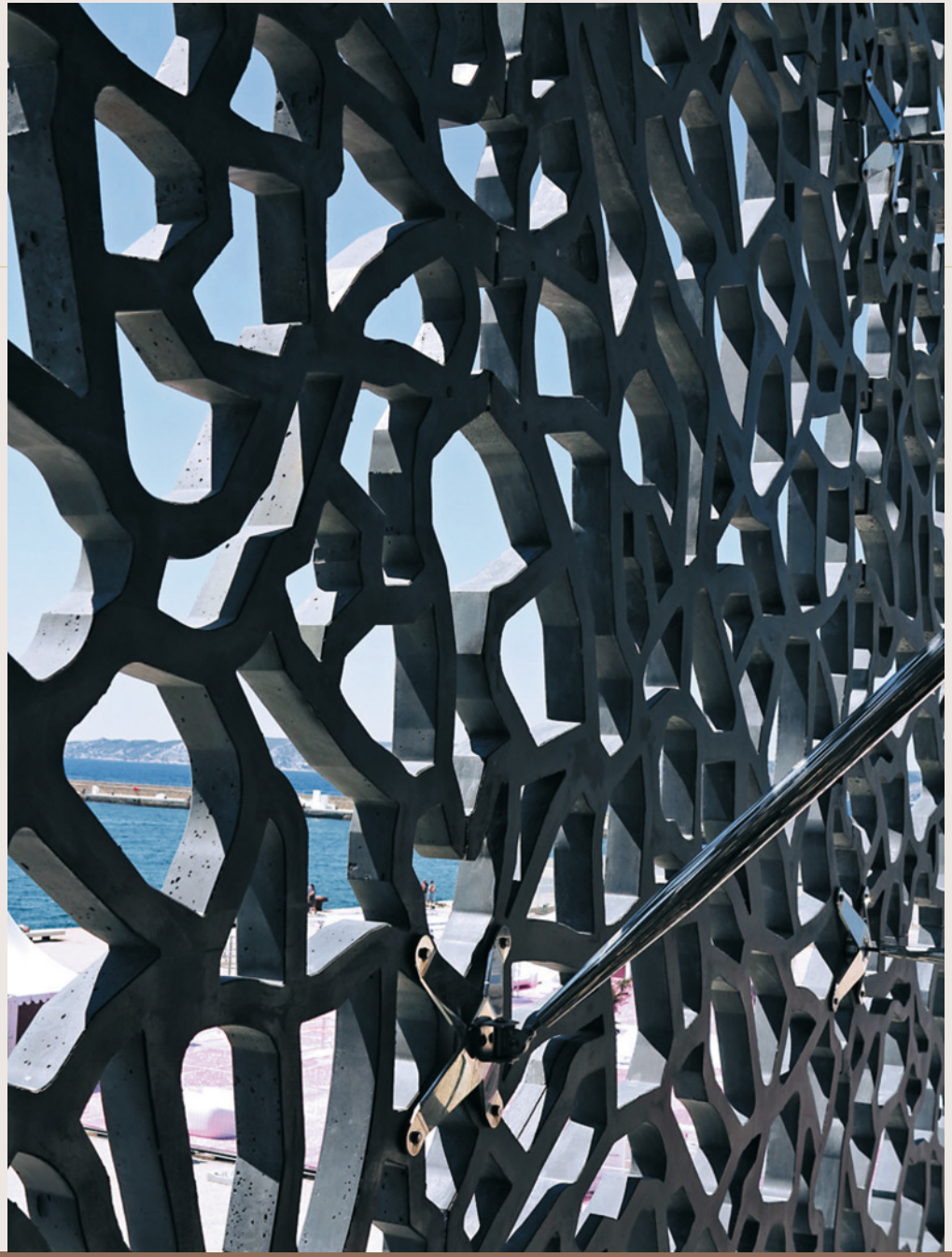
What is UHPC made of?

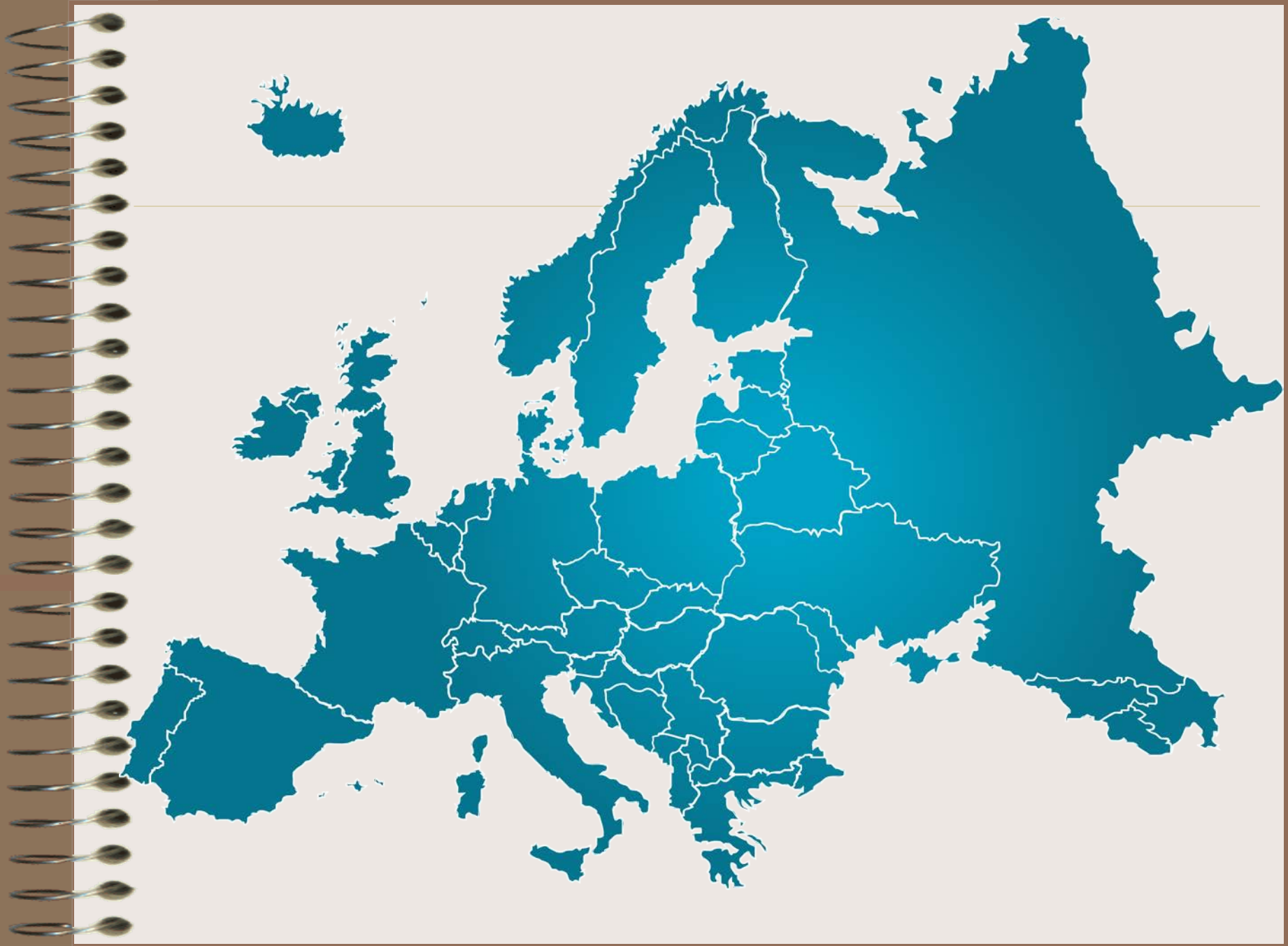
- Cementitious materials: Portland cement, silica fume, cement, slag cement
- Aggregate: fine sand, silica powder, ground quartz
- Reinforcement: fibers (metallic and non-metallic)
- Placeability and hydration provided with water and superplasticizer
- Largest aggregate (fine sand 0.024 inches)
- Steel Fibers (0.008 inches x 0.5 inches)
- W/C ratio 0.15-0.25

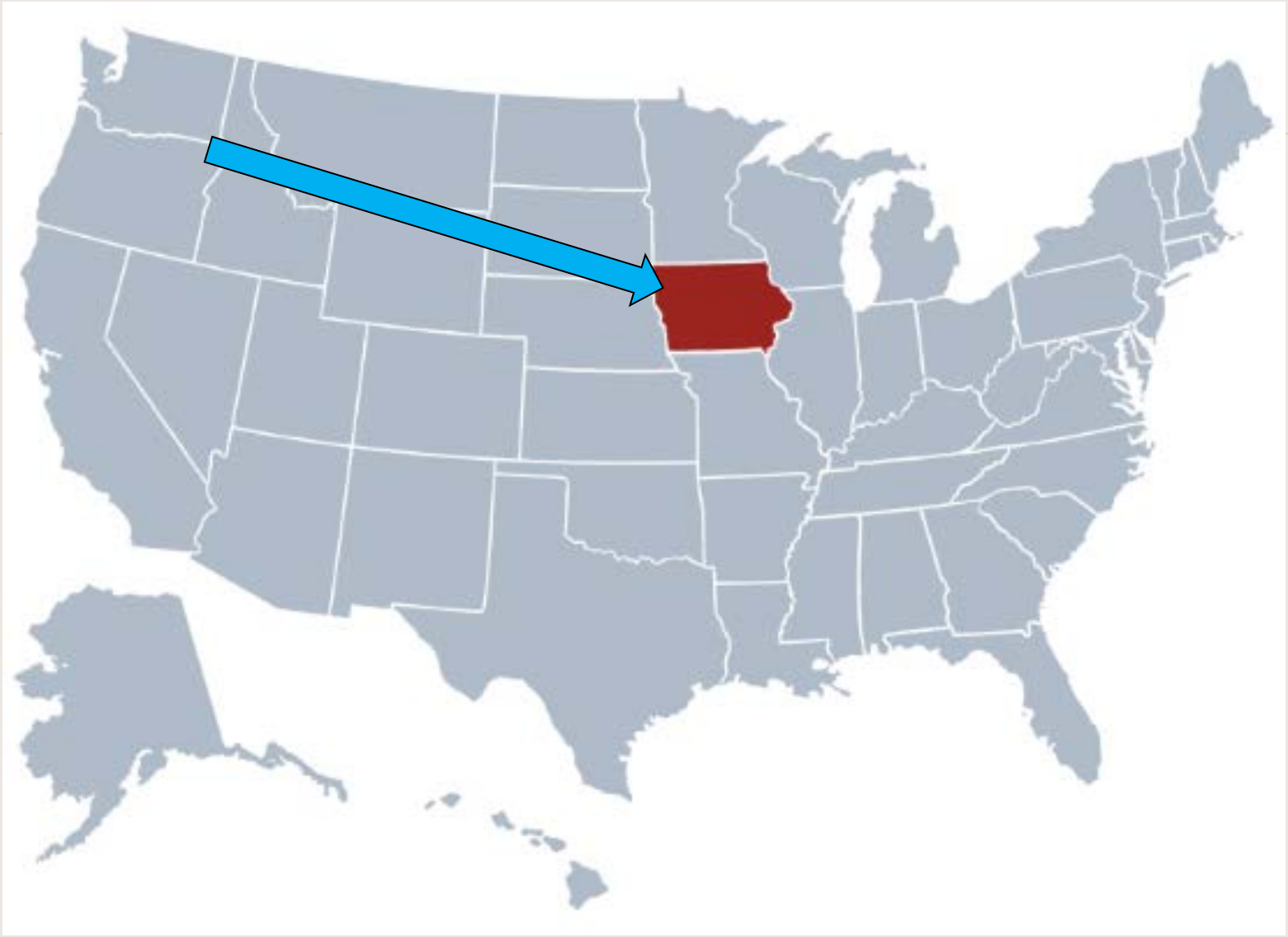
Sample Mix Design

- Portland Cement: 1200 lbs/yd^3
- Silica Fume: 390 lbs/yd^3
- Fine Sand: 1720 lbs/yd^3
- Ground Quartz: 355 lbs/yd^3
- Superplasticizer: 51 lbs/yd^3
- Water: 218 lbs/yd^3
- Steel Fibers: 263 lbs/yd^3

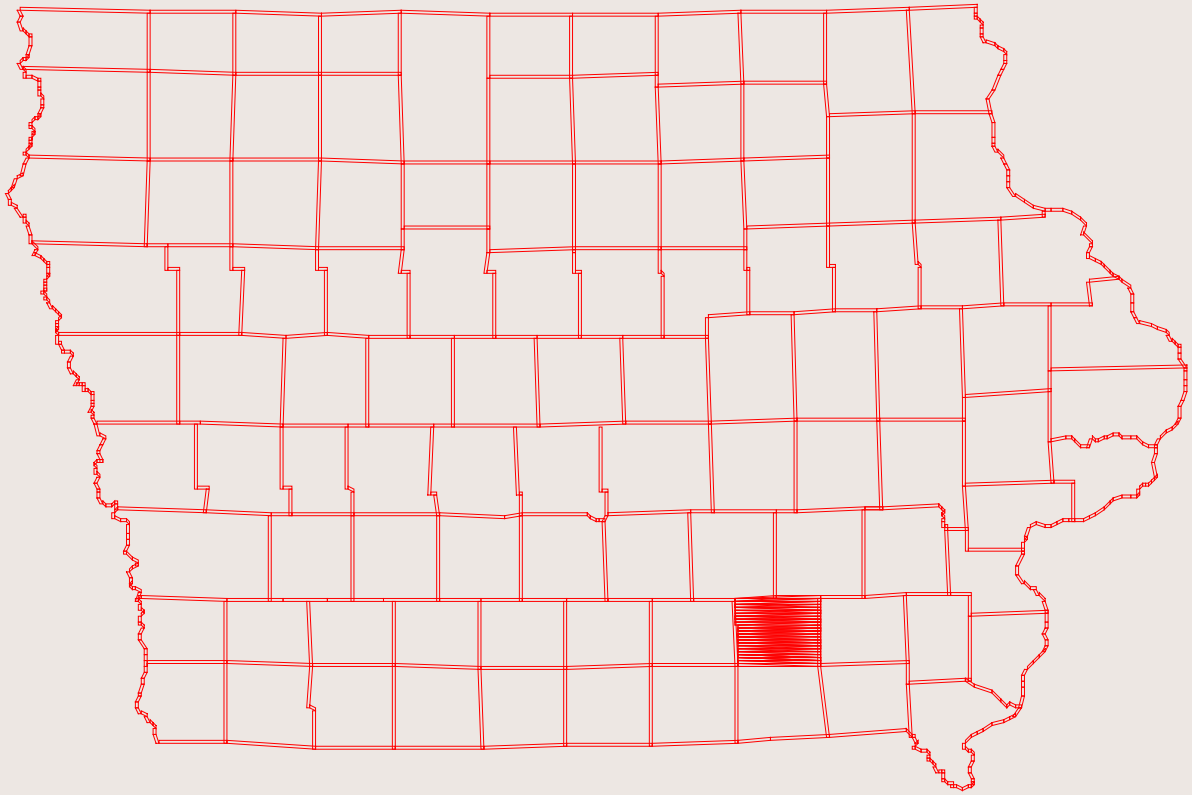
UHPC Experiences







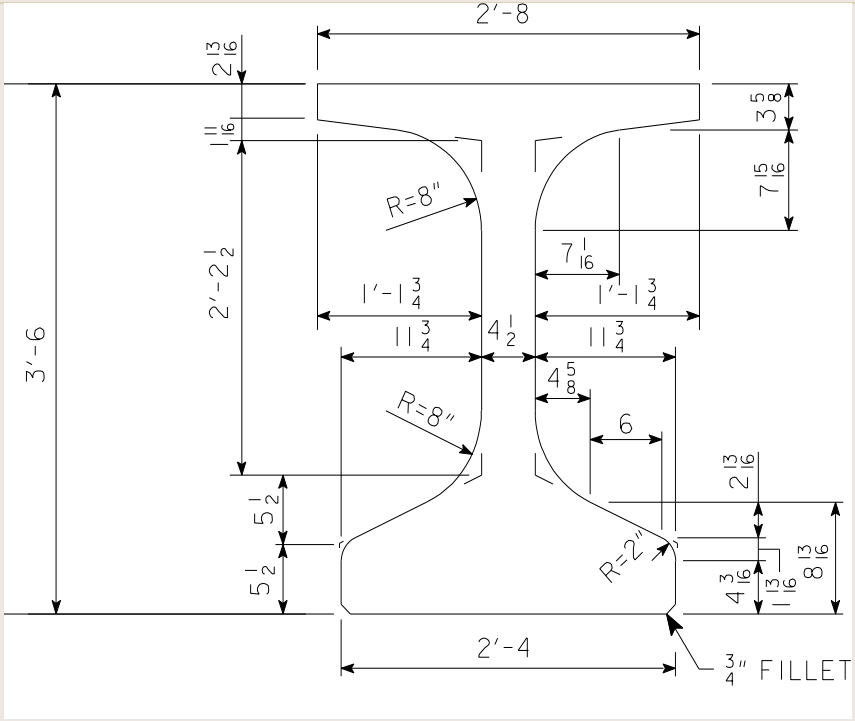
Project Location, Wapello Co., Iowa

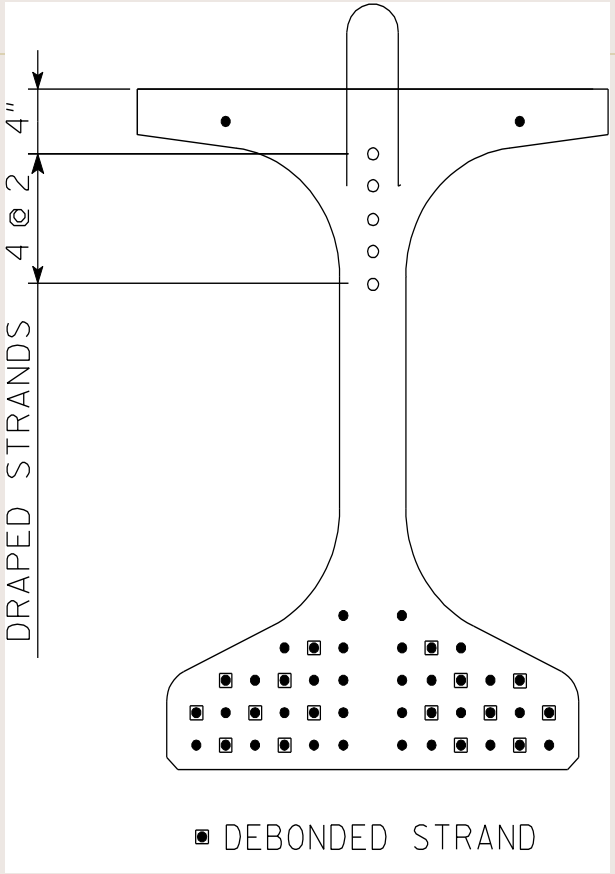


Mars Hill Bridge

- 110 ft single span
- 3 beam cross section
- Modified Iowa bulb-tee
- Integral abutments
- 8 inch cast-in-place deck
- Open style concrete rail.

Summary of Section





Sec reduced 1” top, 2” bottom, 2” web

A = 512.3 in^2, yb = 18.72 in, I = 123,654 in^4

UHPC 14.6yd^3

49 – 0.6” Dia. strands

5 draped, 16 debonded, 72.6% GUTS

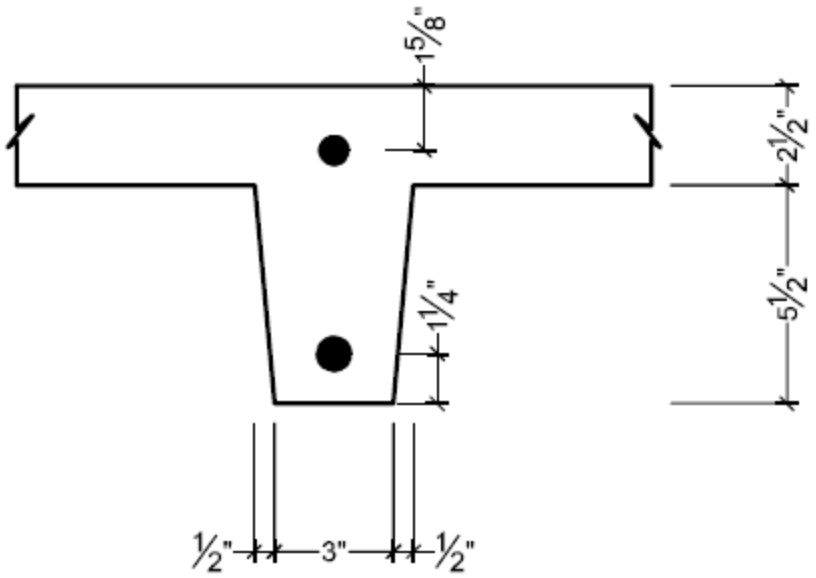
110’ Girder Casting

Completed Structure

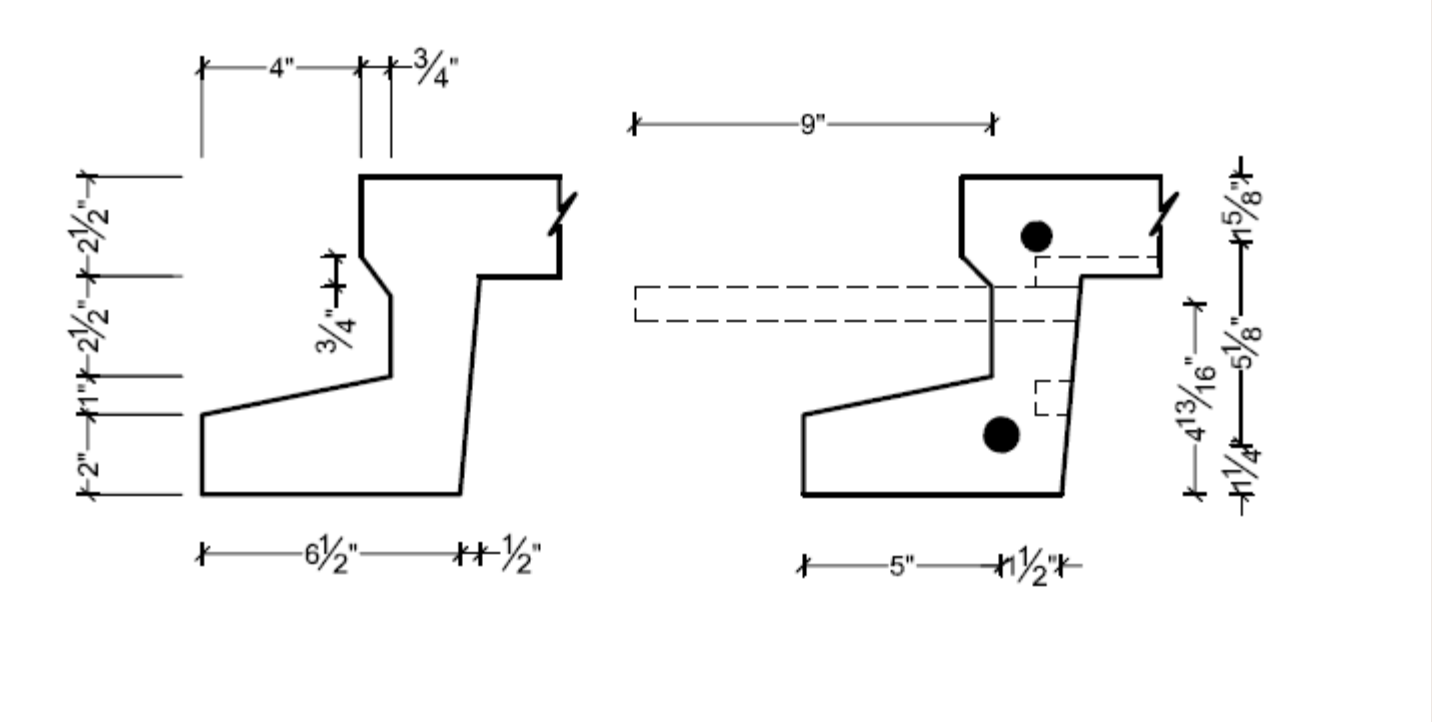
Little Cedar Creek Bridge A.K.A. Waffle Slab Project

- Developed jointly by Coreslab, Iowa State University, Wapello Co, and Iowa DOT
- Proposed system builds on prior work by FHWA and others
- Panels fabricated by Coreslab, Omaha
- 8 in. panels cast up side down
- For texture, form liners were used for production panels.
- Joints were field-cast with UHPC

Typical Web Detail



Typical Transverse Joint Detail



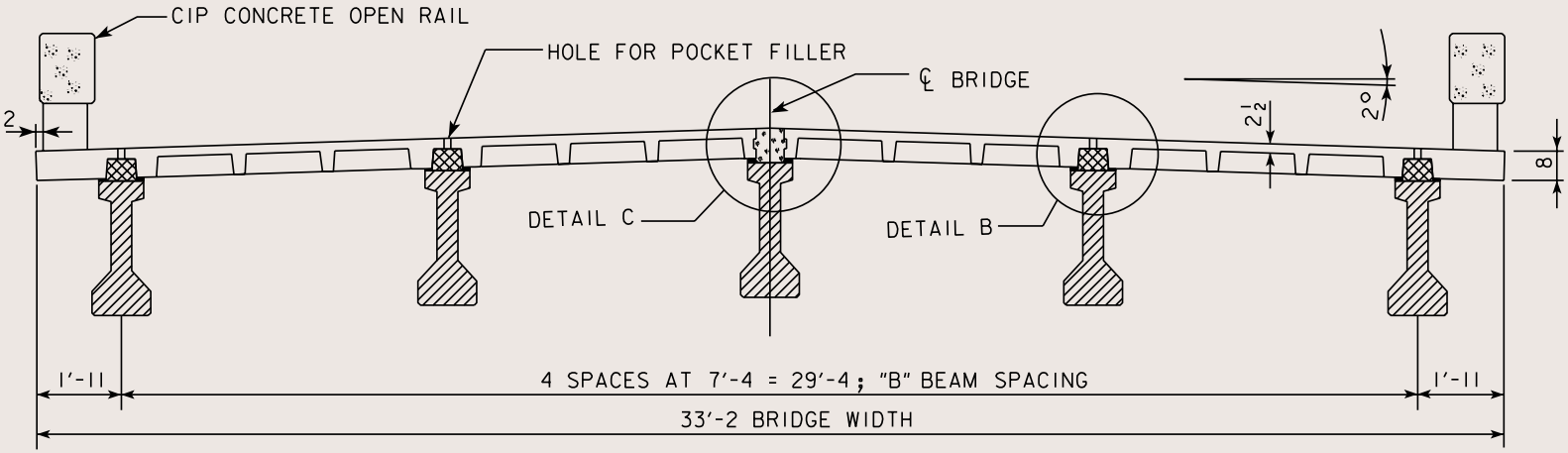
Waffle Slab Production Panel

- Individual panels 8’-0 x 16’-2 ¾ tied at the centerline of roadway
- #6 reinforcing bars top and bot at rib spacing
- Total 14 precast panels for project
- Stainless steel reinforcing in field joints
- Field casting of joints using UHPC


Styrofoam
Styrofoam


DOW
Styrofoam
Square Edge Insulation

Bridge Deck Cross Section



SECTION THRU PANELS

Panel Placement

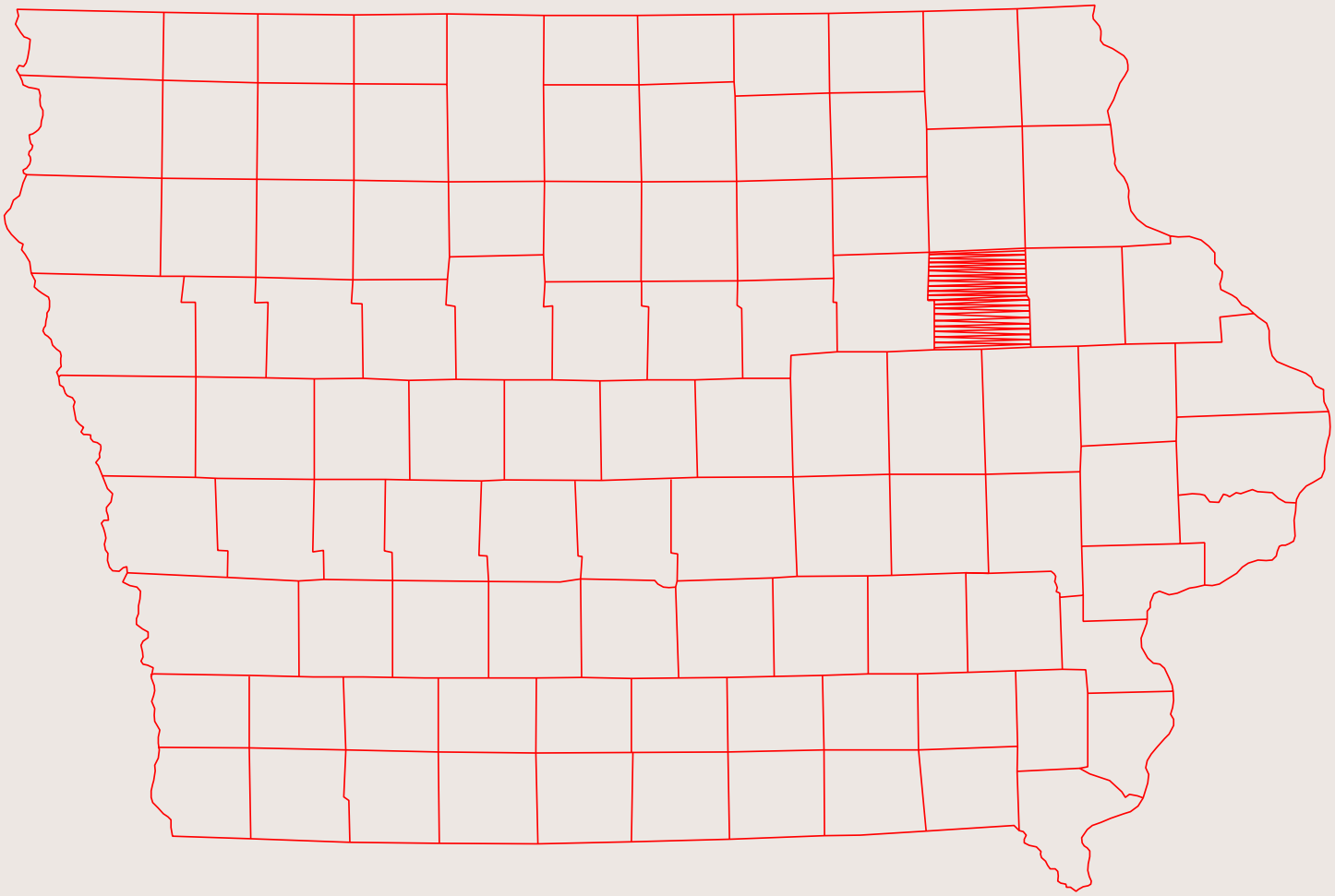
Joint Casting


EVIL


11/21/2011 14:18


11/21/2011 14:20

Project Location, Buchanan Co., Iowa



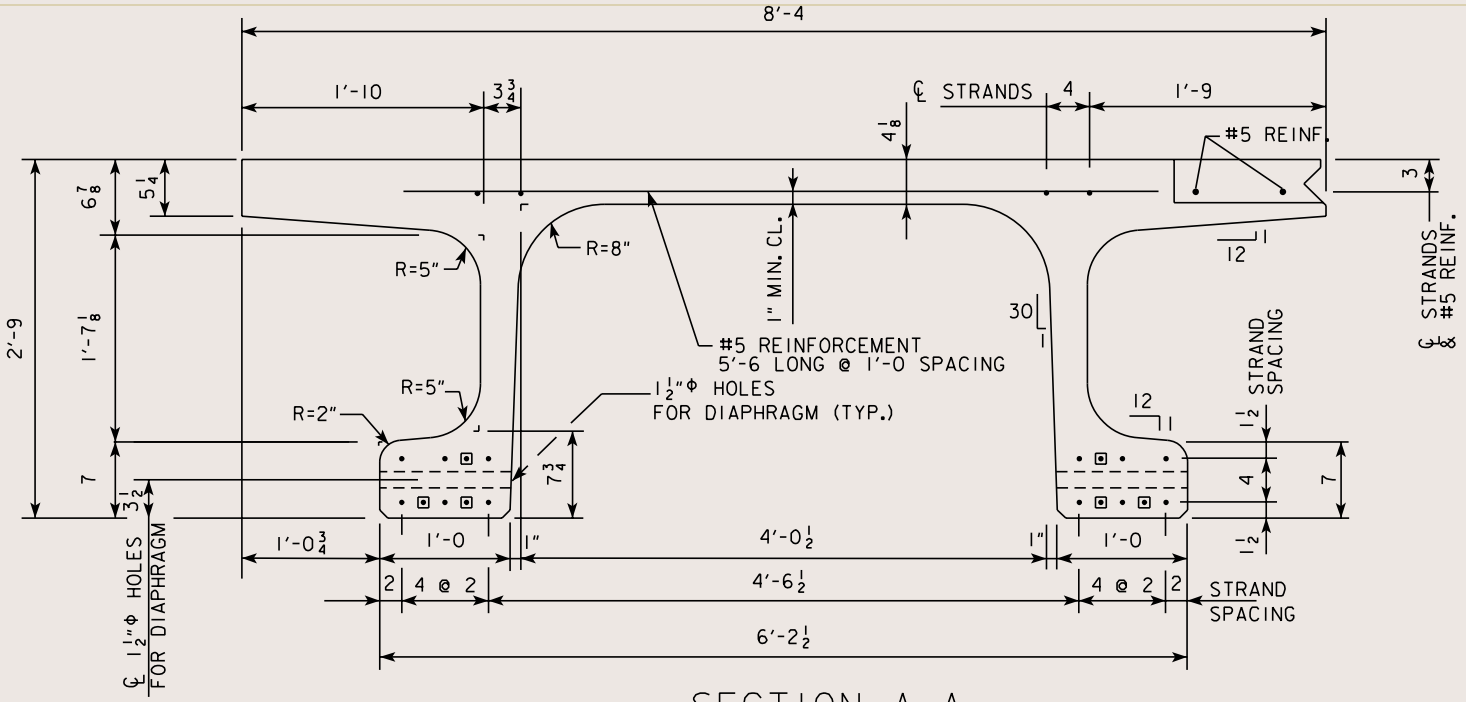
Jakway Park Bridge

- 3 spans
- End spans CIP concrete slab (30’-7” ea)
- Center span 3 PI girders (51’-2”)

PI Girder

- Developed by MIT/FHWA
- Optimized section
- No Mild Steel
- Integral Deck
- Tested by FHWA and revised due to problems with transverse capacity.

Final Section New detail



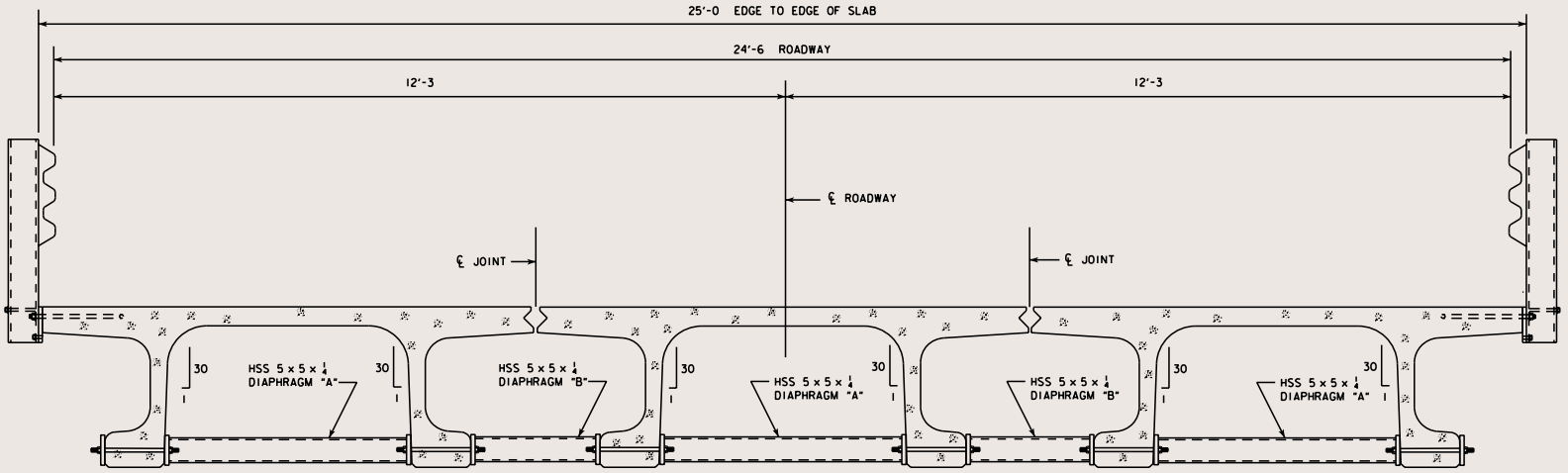
SECTION A-A

BOTTOM STRAND DEBONDING	
SYMBOL	DEBONDED LENGTH FROM EACH END OF BEAM
⊡	3'-0

A = 860.8 in^2
yb = 22.5 in
I = 105,730 in^4
wt/ft = 0.932 k/ft

SECTION PROPERTIES

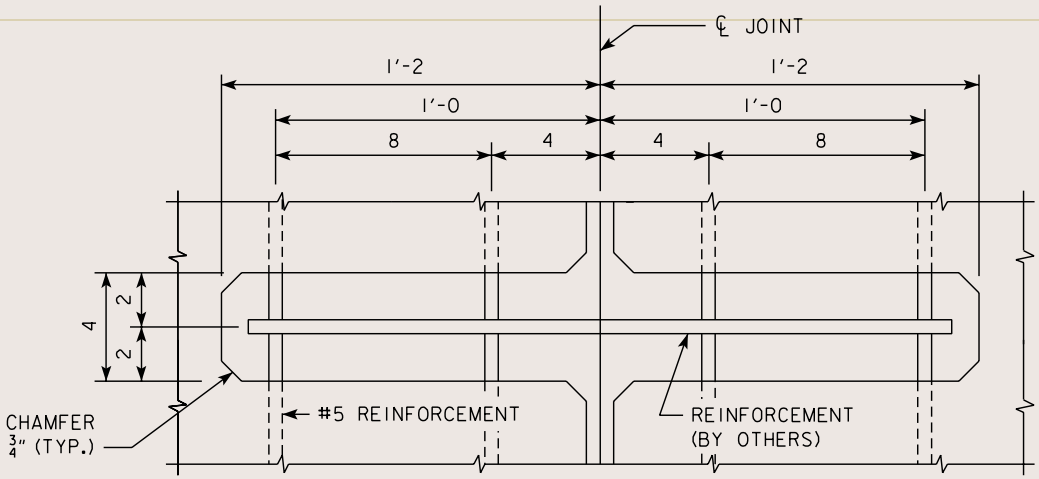
PI cross-section



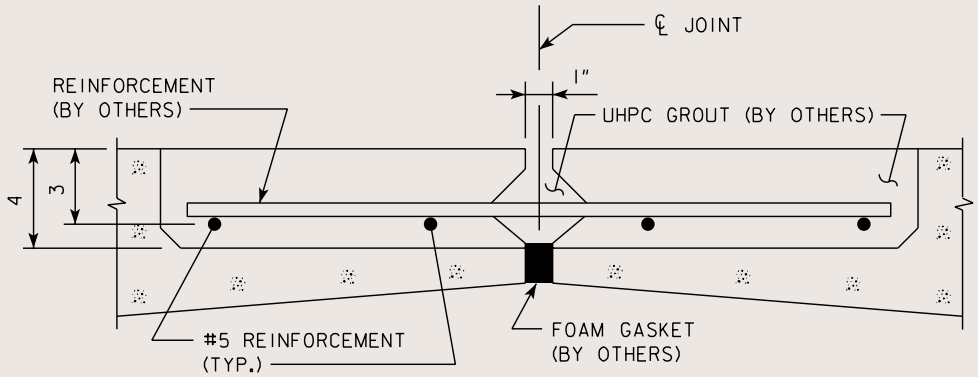
Girder Placement

Grouting of Pockets

Final Section New detail



PLAN VIEW SHOWING DOWEL POCKETS



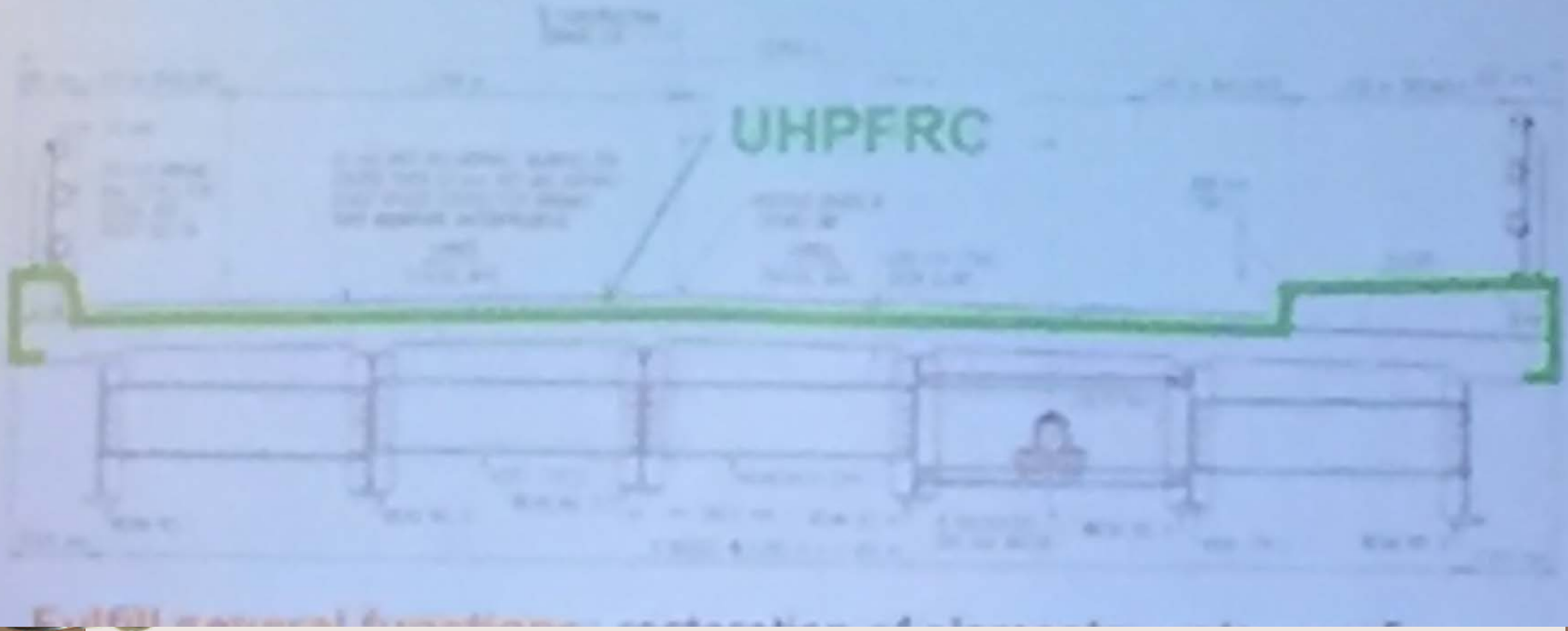
TYPICAL LONGITUDINAL SECTION
THRU JOINT DETAIL AT POCKET LOCATIONS

Mud Creek Bridge
UHPC Overlay

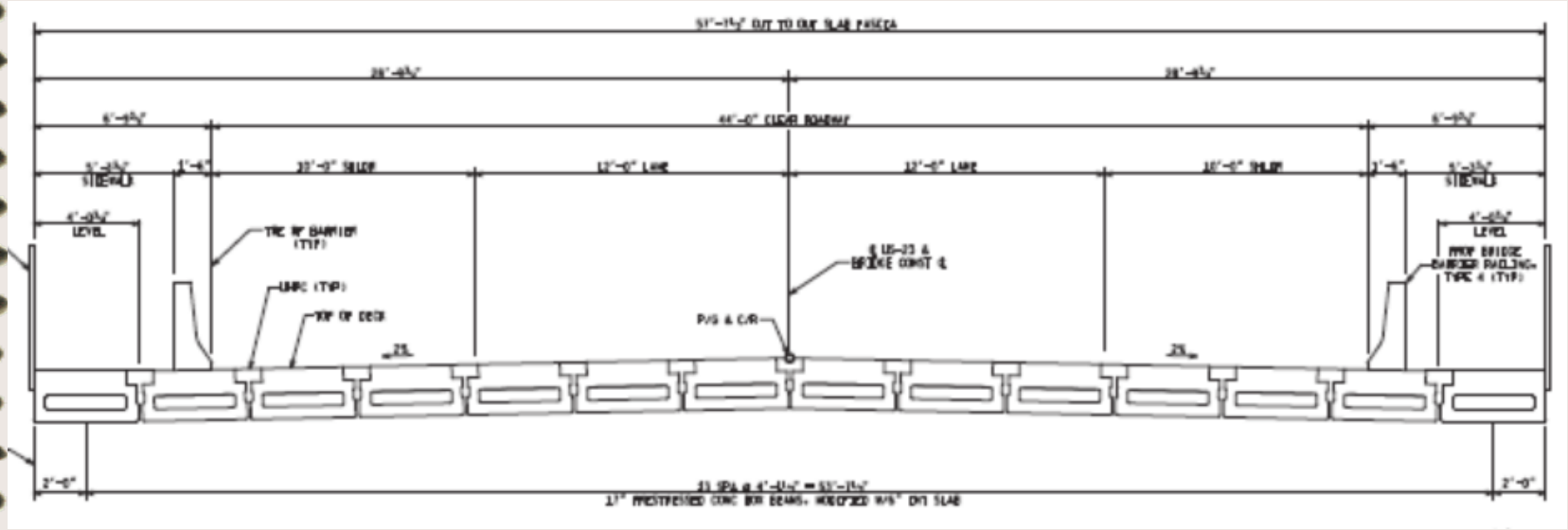
- Existing deck was ground
- Mesh was placed over the piers
- 1.5” UHPC overlay placed with vibrating screed
- Covered with plastic for curing
- After curing the surface was ground again and ultimately grooved to obtain desired texture

Lausanne, Switzerland by Walo Construction

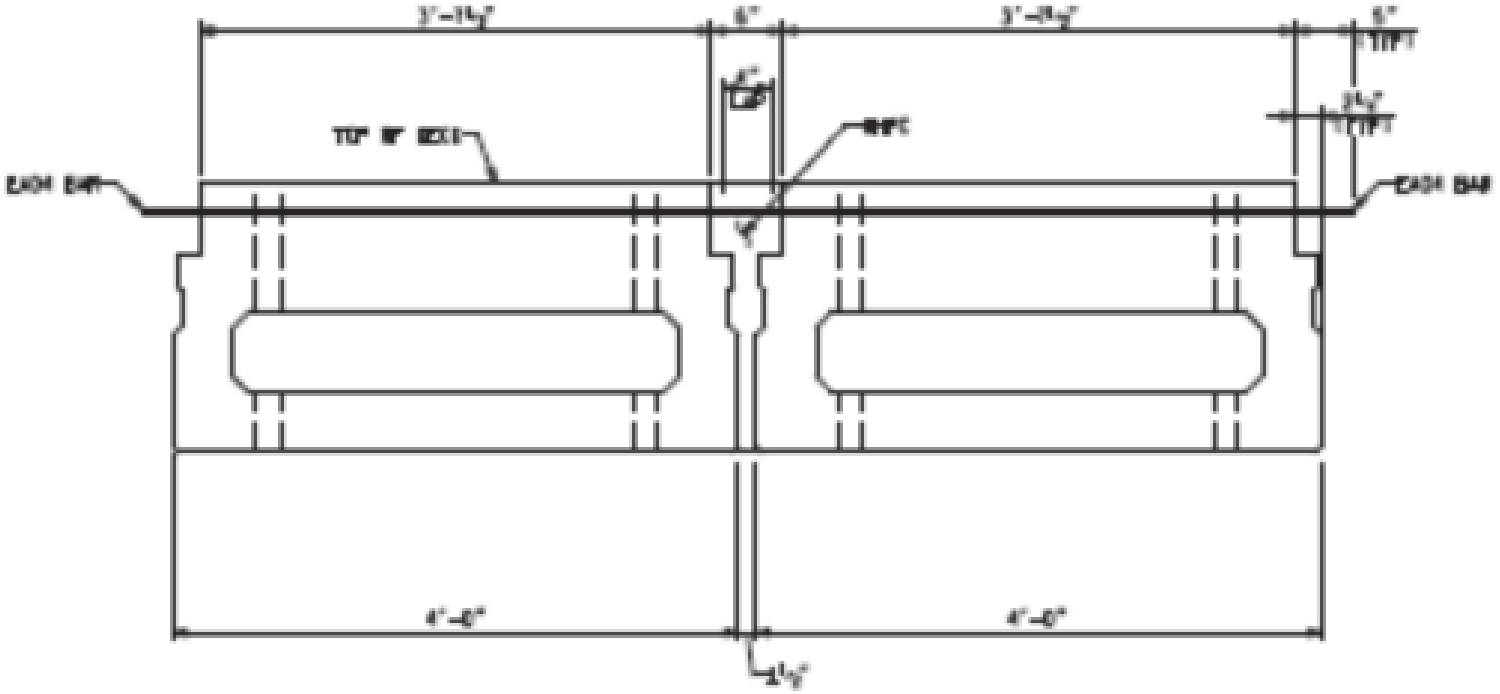
2: Repair and retrofit is not sufficient ! Reinforced concrete needs to be improved !



US-23 over the Little Black River Cheboygan, MI



Decked Adjacent (Side by Side) Box Beams




THINK
SAFETY


LeDuc's Creekside
MOTEL
TEMPUR-PEDIC BEDS


HAMMERSMITH
MAXIMUM BATCH CAPACITY
STERLING


MOTEL

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