UDOT's Experience with UHPC

Carmen Swanwick, SE
UDOT Chief Structural Engineer

Eric Wells
Granite Construction, Area Manager

Presentation Outline

- Project Overview
- Design Phase Decisions
- Lessons Learned
  - Owner Perspective
  - Contractor Perspective

Project Overview

- Highways for LIFE funding
- Project description

Project Overview

- Why UHPC?
  - Construction
    - Eliminate the need for post-tensioning
    - Reduce specialized construction equipment and labor
  - Quality
    - Reduce joint size
    - Improve durability and continuity
    - Extend life expectancy
  - Construction schedule
    - Reduce on-site construction time

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Project Overview

Project Overview

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Design Phase Decisions

- Specification requirements
- Construction phasing impacts

Design Phase Decisions

Specification

- UHPC mix
- Field demonstration
- Quality control and acceptance testing
- Installation plan
- Measurement and payment

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Design Phase Decisions

Specification – UHPC Mix

PART 2 PRODUCTS

2.1 UHPC

A. Use UHPC produced with "Ductal®" concrete materials manufactured by Lafarge North America (Provider). Obtain all UHPC components from this Provider.

B. UHPC mix requirements:
1. Use Ductal® JS 1000 Concrete with the proportions of premix, water, super plasticizer liquid, and steel fibers based on the approved working drawings and Provider's recommendations.
2. Refer to the requirements in Table 1.

Table 1

UHPC		
Property	**Test Method**	**Requirement**
Minimum Compressive Strength	AASHTO T 22	
A-Heat-Treated*		≥ 25 ksi
B-Not Heat-Treated		≥ 20 ksi @ 28 days
C-Not Heat-Treated		≥ 14 ksi @ 4 days
Split Cylinder Cracking Strength	ASTM C 496	≥ 800 psi @ 28 days

Design Phase Decisions

Specification – Field Demonstration

Design Phase Decisions

Specification – Quality Control and Acceptance Testing

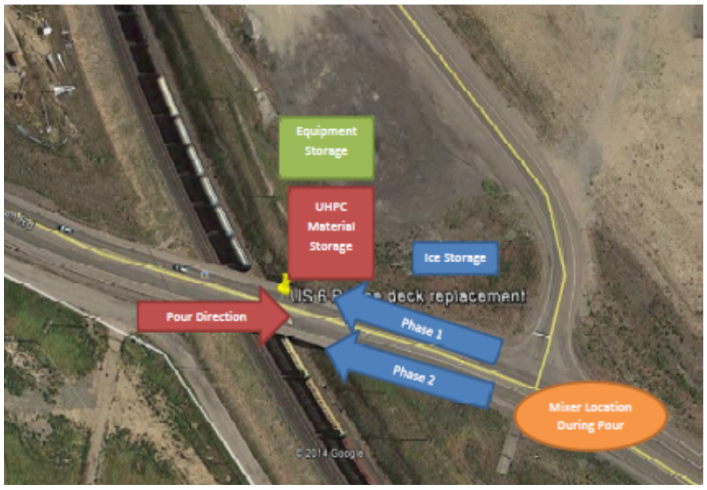
Design Phase Decisions

Specification – Installation Plan

- Sequence of UHPC placement (pour layout drawings)
- On-site staging plan
- Bulkhead forming plan
- Underside of joint forming plan
- Camber strip forming plan

Design Phase Decisions

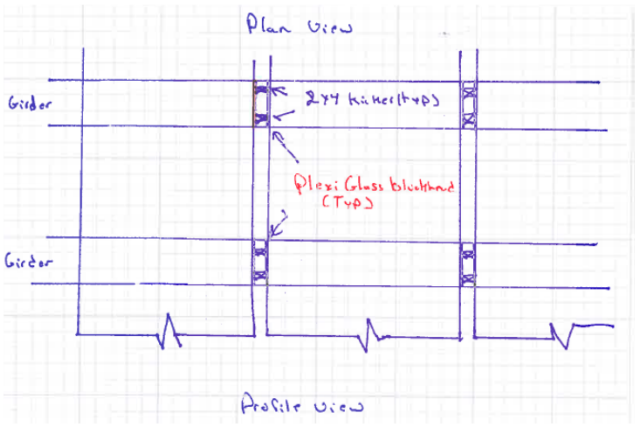
Specification – Submittals



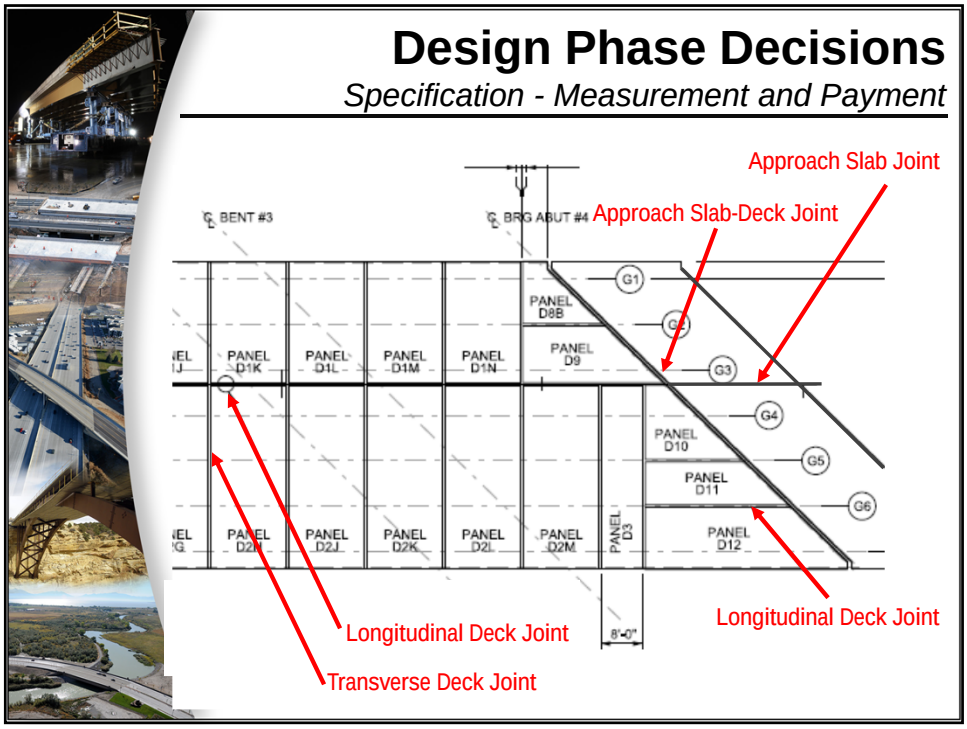
ON-SITE STAGING PLAN

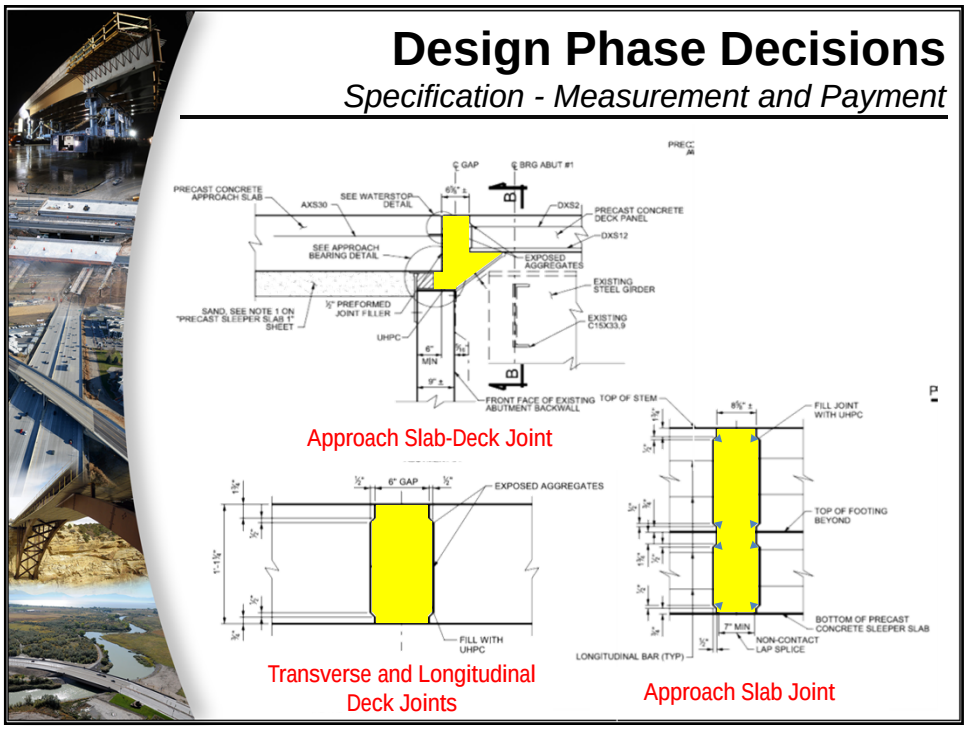
Design Phase Decisions

Specification – Submittals



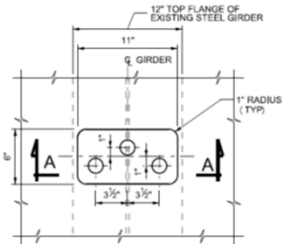
BULKHEAD FORMING PLAN


Design Phase Decisions
Specification - Measurement and Payment
Approach Slab Joint
Approach Slab-Deck Joint
℄ BENT #3
℄ BRG ABUT #4
PANEL D8B
PANEL D9
PANEL D1K
PANEL D1L
PANEL D1M
PANEL D1N
PANEL D10
PANEL D11
PANEL D12
PANEL D2J
PANEL D2K
PANEL D2L
PANEL D2M
PANEL D3
G1
G2
G3
G4
G5
G6
8'-0"
Longitudinal Deck Joint
Longitudinal Deck Joint
Transverse Deck Joint

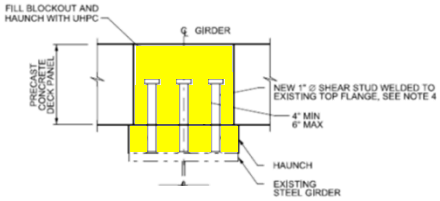

Design Phase Decisions
Specification - Measurement and Payment
PRECAST CONCRETE APPROACH SLAB
AXS30
SEE WATERSTOP DETAIL
SEE APPROACH BEARING DETAIL
SAND, SEE NOTE 1 ON "PRECAST SLEEPER SLAB 1" SHEET
½" PREFORMED JOINT FILLER
UHPC
℄ GAP
℄ BRG ABUT #1
DXS2
DXS12
PRECAST CONCRETE DECK PANEL
EXPOSED AGGREGATES
EXISTING STEEL GIRDER
EXISTING C15X33.9
FRONT FACE OF EXISTING ABUTMENT BACKWALL
TOP OF STEM
Approach Slab-Deck Joint
6" GAP
EXPOSED AGGREGATES
FILL WITH UHPC
Transverse and Longitudinal Deck Joints
FILL JOINT WITH UHPC
TOP OF FOOTING BEYOND
BOTTOM OF PRECAST CONCRETE SLEEPER SLAB
NON-CONTACT LAP SPLICE
LONGITUDINAL BAR (TYP)
Approach Slab Joint

Design Phase Decisions

Specification - Measurement and Payment



Shear Blockout Detail

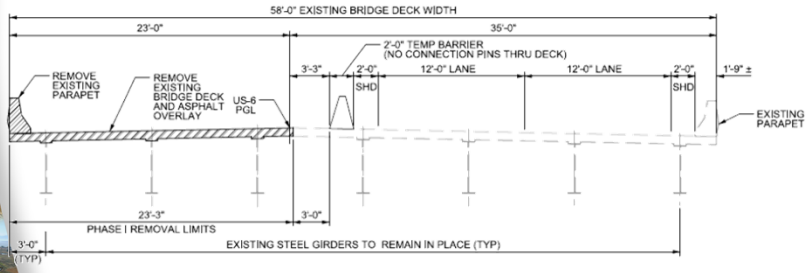


Girder Haunch

Design Phase Decisions

Construction Staging

- Maintenance of traffic limitations
- Differential deflection
- Longitudinal closure joint



PHASE I-A

Lessons Learned

Owner Perspective

- Develop performance based mix design with owner-performed testing and acceptance
- Require field demonstration
- Simplify joint details at abutments
- Consider locations to block off pours
- Size longitudinal closure joint for build up of construction tolerances
- Evaluate differential deflection

Lessons Learned

Contractor Perspective - JS100 – Mix Design

- Typically provided in 3000 lb super sacs - yields ~ 0.66 cy per bag
- Adjust mix using 50 lb bags if needed
- Use ice or ice/water when above 70°
- Stay organized when weighing and mixing UHPC
- Have all materials prepped before mixing

JS1000 - Grey Premix

JS 1000	kg's per m^3	lbs per yd^3	kg's per 50 lb bag	lbs per 50 lb bag
Premix	2195	3700	22.7	50
Water	140	236.0	1.447	3.189
Premia 150	30	50.6	0.310	0.683
Steel Fiber (2%)	156	262.9	1.612	3.554
Thermal Treatment	No			
		Volume -	0.0103 Cubic meters/bag	0.365 Cubic feet/bag

Lessons Learned

Contractor Perspective - Placement

- Equipment needs
  - 300 KW generator to power mixers
  - Minimum 3 georgia buggies
  - Reach forklift
- Manpower
  - 16 people for operation/1.5 cy per hour (includes man power to cover the joints)

Lessons Learned

Contractor Perspective - Placement

- Leaks
- Block off location for pours
- Phasing of pours and cold joints

Lessons Learned

Contractor Perspective - Placement

- Weather/wind
- Consider use of PT and UHPC
- Consider use of standard grout in haunch and blockouts

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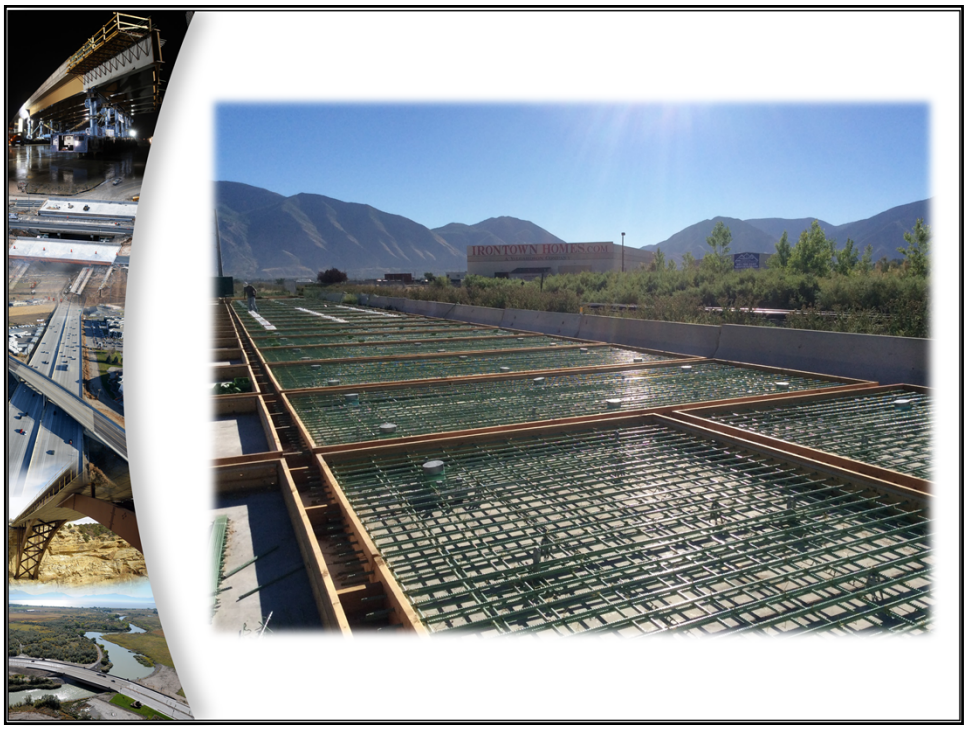
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Thank you

Questions?