IA-92 OVER LITTLE SILVER CREEK
ACCELERATED BRIDGE CONSTRUCTION PROJECT
MEETING OBJECTIVES

• Share preliminary construction details (60% plans)
• Solicit feedback from Association of General Contractors
• Solidify design concept for final plan development
PROJECT OBJECTIVES

• Safe Project
  • During construction
  • In service

• Successful Project
  • Completed on time, according to plan, and within budget
  • Positive experience for Owner, User and Contractor

• Accelerated Construction Schedule
  • 21 day critical road closure

• Modular Construction
  • Build on Iowa’s experience with this specific construction concept
  • Apply concept to a more challenging site
DEMONSTRATION PROJECT – FALL 2012

US-6 over Keg Creek
Modular Construction with Accelerated Schedule
US6 at Keg Creek
Council Bluffs, Iowa
CURRENT PROJECT – FALL 2015

IA-92 over Little Silver Creek
Modular Construction with Accelerated Schedule
LITTLE SILVER CREEK (vs. KEG CREEK)

• More Complex Geometry
  • Vertical Curvature
  • Skew

• Pile Bent Foundations
  • 100% of Substructure to be completed during critical closure

• Integral Abutments & Pier Diaphragms
  • Revised abutment and pier connection details

• More Conventional Cast-in-Place Concrete
  • Abut. backwalls, wings, diaphragms, transverse deck closures, barrier

• Lengthened Construction Schedule
  • 21-days for current project vs. 14-days for Keg Creek
PROJECT SITE
SITE & EXISTING STRUCTURE

• Site
  • IA-92 over Little Silver Creek
  • Treynor, IA (15 miles east of Council Bluffs)
  • Silty clay soils, bedrock not encountered during drilling (> 100’)
  • Sag vertical curve road alignment
  • Channel is skewed relative to roadway (20°)

• Existing Structure
  • Constructed in 1953
  • 150’ x 28’ Continuous Concrete Girder Bridge
  • 3-span, frame piers, timber piling
Existing 150’-0 x 28’ Continuous Conc. Girder Bridge
WATERWAY OPENING, SPAN 2, LOOKING UPSTREAM
2/4/10

Looking North
UPSTREAM CHANNEL FROM PIER 1
2/4/10
Looking North
Looking South

DOWNSTREAM CHANNEL FROM MID SPAN 2
2/4/10
EXISTING SITE
GRADED CHANNEL
TEMPORARY CAUSEWAY
CONSTRUCTED BRIDGE
CONSTRUCTABILITY DISCUSSION

--- SITE ---

• Grade and Skew
  • Will complicate several aspects of construction
  • Final module geometry not conducive to plant fabrication

• Site Access
  • Steep, degraded channel
  • Temporary causeway will require borrow fill

• Staging Yard
  • Limited DOT Right-of-Way
  • Contractor to arrange Temporary Easement as required
MODULAR DECKED BEAM UNITS
MODULAR DECKED BEAMS

• 2-Beam Modular Units
  • Patterned after US-6 over Keg Creek
  • W40 x 149 rolled steel beams
  • 4’-6 beam spacing, 7’-0 typical deck width
  • 8” high-performance deck, plus additional ¼” sacrificial thickness
  • Stainless steel deck reinforcing
  • ± 100,000 lbs. pick weight (M90 module)
MODULAR DECKED BEAMS

Six-module cross section

10” joint between modules

Discontinuous steel diaphragms
MODULAR DECKED BEAMS

18-module deck
Beam ends project from modular deck for lifting and securing to other modules.
MODULE X-RAY PLAN VIEW
ALTERNATE SITE CASTING

• Construction of modules at precasting plant will be difficult
• Anticipated construction approach includes Alt. Site Casting
  • Construct superstructure off-alignment at nearby site (TBD by Contractor)
  • Temporary falsework to mimic final bearing seat elevations
  • Block-out deck joint locations to allow for use of conventional paving machine
ALTERNATE SITE CASTING

Profile grade scale exaggerated 5X (grade change across bridge ± 5.5')
EXAMPLE ALTERNATE SITE MODULE CONSTRUCTION
EXAMPLE ALTERNATE SITE MODULE CONSTRUCTION
EXAMPLE TEMPORARY FALSEWORK
EXAMPLE TEMPORARY FALSEWORK
JOINT INTERFACE PREPARATION

• Careful joint preparation is critical to performance and durability of superstructure

• Preferred approach – Exposed Aggregate Finish
  • May be required in contract documents
  • Coat joint surface forms with form retarder
  • Remove joint forms after concrete set and pressure wash to expose aggregate (wash off concrete paste)

• Alternate approach – Sandblasted Finish
  • Not as desirable as Exposed Aggregate Finish, but allows more scheduling flexibility for form removal
  • Stainless steel deck reinforcing accommodates this approach
VIEW OF JOINT INTERFACE SURFACE
VIEW OF JOINT INTERFACE SURFACE
EXPOSED AGGREGATE FINISH

(PHOTO COURTESY OF BEN GRAYBEAL, FHWA)
CONSTRUCTABILITY DISCUSSION
--- MODULAR DECKED BEAM UNITS ---

• Casting
  • Alternate site TBD by Contractor
  • Temporary falsework design by Contractor

• Joint Interface Preparation
  • Formed blockouts
  • Formwork removal concerns for Exposed Aggregate Finish??

• Transport & Handling
  • Temporary causeway and working platform within channel
  • Crane placement and capacity need to be considered

• Placement
  • Bearing elevations, deck elevations and reinforcing locations are unique to each module
PILE BENT PIERS
PILE BENT PIERS

• **Long Pile Lengths**
  • ± 120’ (splices required)

• **Large Pile Section**
  • HP16x141
  • Welders for pile splices require special DOT certification

• **Piles Oriented for Strong-Axis Bending**
  • Rotated 90° compared to typical detail

• **Pile Cap: Precast vs. Cast-in-Place**
  • Contractor preference??
  • ± 125,000 lbs. pick weight (precast cap)

• **Pile Encasement**
  • Assumed non-structural; may be constructed outside of critical closure
PILE BENT PIER (C.I.P. CAP)

Conventional construction; forms and reinforcing cage preassembled and dropped into place, concrete maturity after 24-36 hrs.

Pile encasement is non-structural for design; may be constructed after critical road closure.
PILE BENT PIER (C.I.P. CAP)
PILE BENT PIER (PRECAST CAP)

Lifting loops (± 125,000 lbs. pick weight)

CMP pile pockets
PILE BENT PIER (PRECAST CAP)
CONSTRUCTABILITY DISCUSSION

--- PILE BENT PIERS ---

• Pile Driving
  • Hammer selection for larger pile size
  • Splices will be time consuming, require certified personnel
  • Accurate pile placement will be critical for precast cap option

• Pier Cap Construction
  • Do contractors prefer cast-in-place or precast cap??
  • Piles rotated 90°; implications on how cap / cap forms are supported??

• Construction Bracing
  • Increased unbraced length and eccentric loads during construction; temporary bracing options??

• Pile Encasement
  • Multiple forms required if constructed during critical closure
INTEGRAL ABUTMENTS
INTEGRAL ABUTMENTS

• Prebored Holes
  • 10’ deep at each abutment pile

• Long Pile Lengths
  • ± 120’ (splices required)

• Abutment Footing: Precast vs.
  • Cast-in-Place
    • Contractor preference??
    • ± 95,000 lbs. pick weight (precast footing)
    • Mechanical splicers connect footing to C.I.P. backwall

• Cast-in-Place Backwall and Wings
  • Plan details intended to simplify formwork to accommodate C.I.P. construction

Integral Abutment with Precast Cap
INTEGRAL ABUT. (PRECAST/C.I.P.)

± 95,000 lbs. pick weight

CMP pile pockets (omit for C.I.P. option)
INTEGRAL ABUT. (PRECAST/C.I.P.)

Abutment backwall monolithic with end of deck

Mechanical splicers connect footing and backwall
INTEGRAL ABUTMENT X-RAY VIEW (PRECAST CAP)
BEAM-ON-PILE FRAMING (OPTIONAL)

• Any Contractor interest in pursuing this option??

• Detail successfully used in other states
  • Preferred detail in SD and IN for steel superstructures
  • This detail has been used in SD to set beam pairs

• Construction Details
  • Requires more piles, but potentially shorter driven length
  • Eliminates footing construction from critical path
  • Requires considerable accuracy during pile placement
  • Requires accurate trimming/grinding of piles
  • Requires field welding
  • Various details available for beam seats and pile bracing
INTEGRAL ABUT. (BEAM-ON-PILE)

Requires more piles than Precast/CIP option, but shorter lengths

Pile bracing between modules
INTEGRAL ABUT. (BEAM-ON-PILE)

Abutment, wings and deck closure poured together
EXAMPLE BEAM-ON-PILE FRAMING
INTEGRAL ABUTMENT X-RAY VIEW (BEAM-ON-PILE)
SOUTH DAKOTA DETAIL: BEAM-ON-PILE

(PHOTO COURTESY OF STEVE JOHNSON, SD DOT)
SOUTH DAKOTA DETAIL: BEAM-ON-PILE

(PHOTO COURTESY OF STEVE JOHNSON, SD DOT)
CONSTRUCTABILITY DISCUSSION

--- INTEGRAL ABUTMENTS ---

• Pile Driving
  • Splices will be time consuming, require certified personnel
  • Accurate pile placement will be critical for precast cap and beam-on-pile options

• Footing Construction
  • Which abutment construction approach is preferred by contractors??

• Cast-in-Place Backwall and Wings
  • Schedule concerns related to forming, placing and curing C.I.P. components??

• Construction Bracing
  • Increased unbraced length and eccentric loads during construction; temporary bracing options??
SUPERSTRUCTURE ASSEMBLY
CAST-IN-PLACE TRANSVERSE JOINTS

CAST-IN-PLACE TRANSVERSE JOINT CLOSURES

- Wider closure moves joint to lower stress region of deck
- Allows for simpler reinforcing details
- Reduces the complexity and quantity of U.H.P.C. placement
- Requires additional forming and concrete placement effort
ULTRA-HIGH-PERFORMANCE CONCRETE
(± 20 YDS. REQUIRED)

• Material Advantages
  – Better strength and durability compared to conventional concrete
  – Reduced development lengths for narrower joints

• Design Considerations
  – High flowability complicates forming and placement
  – Overfill and grinding required
  – On-site test pour will be required
  – Contractor will be required to coordinate with manufacturer and follow recommended procedures

Example Deck Joint Configurations

Version of this detail used for design
MODULAR SUPERSTRUCTURE

Deck end section cast integrally with abutment diaphragm

Staggered bar lap for transverse joints
MODULAR SUPERSTRUCTURE

Wide transverse deck closure integral with pier diaphragms

Compression block assembly
TRANSVERSE JOINT OVER PIER
LONGITUDINAL JOINT
LONGITUDINAL JOINT BOTTOM AND SIDE FORMS
U.H.P.C. FILLED LONGITUDINAL JOINT
FORMED CHIMNEY AT HIGH END LONGIT. JOINT
U.H.P.C. SURCHARGE AT CHIMNEY
PIER BEARING DETAILS

- Beams to be supported on tapered, laminated neoprene pads
- Steel compression block assembly anchored between beam ends
  - Provides load path for compressive forces
  - Snug-fit between beam bottom flanges
  - Limited shimming will be permissible

**Monolithic diaphragm encases module ends**

**Slotted holes and shim packs facilitate constructability and field adjustment**

**Snug-fit acceptable for compression detail**
SNUG-FIT COMPRESSION BLOCK AT PIER
DECK GRINDING

• **Contract shall require diamond grinding of deck**
  • Smooth overfilled U.H.P.C. joints
  • Make minor corrections to grade profile (as required)
  • Provide smooth, uniform riding surface

• **Select proper grinding equipment for use with U.H.P.C.**
  • U.H.P.C. overfill and grind procedure commonly used by NY DOT
CONSTRUCTABILITY DISCUSSION
--- SUPERSTRUCTURE ASSEMBLY ---

• Cast-in-Place Transverse Joints
  • Schedule impacts related to forming and placing C.I.P. joint closures??

• U.H.P.C. Longitudinal Joints
  • Complexities associated with use of specialized material??
  • Forming considerations??

• Bearing Details
  • Fit-up and construction tolerance considerations??

• Deck Grinding
  • Schedule impacts??
  • Equipment selection consideration??
SCHEDULE
CONSTRUCTION SCHEDULE

21-DAY ROAD CLOSURE

• Pre-closure activities:
  • Prefabricate superstructure modules
  • Prefabricate substructure caps/footings (optional)

• During closure:
  • Demolition
  • Grading and Revetment
  • Substructure Construction
  • Superstructure Construction
  • Approach Construction

• Post-closure activities (permissible single-lane closures as required):
  • Shoulder Construction
  • Guardrail
  • Finish Grading and Seeding
  • Miscellaneous Non-Structural Construction Activities
PROPOSED CONST. PHASING

PHASE I
- Close existing bridge to traffic

PHASE II
- Demolish existing bridge
- Install pilings
- Install abutment & pier beam seats

PHASE III
- Install decked beam modules

PHASE IV
- Construct abutments
- Construct monolithic deck closure at piers

PHASE V
- Construct longitudinal deck closures
- Construct barrier rail
- Construct approaches (not shown)

PHASE VI
- Open new bridge to traffic

CONSTRUCTION PHASING DIAGRAM
## PROPOSED SCHEDULE

### 21 Day ABC Timeline

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Legend:
- Black square: Activity is in progress
- White square: Activity is not in progress

**Notes:**
- **CLOSE IA 92** and **OPEN IA 92** are end activities indicating the start and end of the project.
CONSTRUCTABILITY DISCUSSION

--- SCHEDULE ---

- DEMOLITION & GRADING – 4 DAYS
- PIERS – 7 DAYS
- ABUTMENT SEAT – 5 DAYS
- MODULE PLACEMENT – 3 DAYS
- TRANSVERSE CLOSURES – 3 DAYS
- UHPC JOINTS – 1 DAY
- APPROACHES – 3 DAYS
- BARRIER RAIL – 2 DAYS
- DECK GRINDING/GROOVING – 2 DAYS
CLOSING COMMENTS

- Current design plan status about 60% complete
- Plan development scheduled for completion October 2014
- Project letting scheduled for December 2014
- Anticipated critical closure late Summer / Fall 2015

WE APPRECIATE ANY FEEDBACK TO HELP MAKE THIS A BETTER PROJECT!!
ACKNOWLEDGEMENTS

• Design Team:
  • Dean Bierwagen
  • Mike Nop
  • Curtis Carter
  • John Neiderhiser

• Detailing / Modeling:
  • Paul Sodahl
  • Kimball Olson

• With Thanks To:
  • Iowa Association of General Contractors
  • Federal Highway Administration
  • South Dakota, Indiana and New York State DOT’s
  • Iowa State University
  • US-6 over Keg Creek Design Team
QUESTIONS??

THANK YOU FOR YOUR TIME!!