ACCELERATED BRIDGE CONSTRUCTION IN IOWA

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Iowa Department of Transportation

Office of Bridges and Structures

Accelerated Road Works for Work Zone Safety and Mobility

June 5-6, 2012 Denver, Colorado

Iowa Department of Transportation

U.S.Department of Transportation
Federal Highway Administration

Outlines

- ABC/PBES Concept, Advantages, & Disadvantages.
- Iowa's ABC Deployment Strategy
- Case Study: Keg Creek Lessons Learned

PBES

- Prefabricated Bridge Elements and Systems (PBES): it is a strategy to accelerate bridge construction that employs prefabricated individual Elements such as beam, deck, abutment footing, pier column, pier cap, etc. Or entire superstructure System that is assembled off-site and moved into place.

Why use ABC?

- To deal with schedule constraints
  - Limited time-window due to special events
  - Emergency replacement due to natural disasters, accidents, or intentional acts
- To minimize impact on local traffic
  - Access to business
  - Commuters
  - Essential services
- To deal with the unavailability of suitable detour

ABC: Benefits

- Reduced public inconvenience
- Improved public perception
- Improved road users and workers safety
- Reduce negative economic impact on local businesses
- Perhaps improve the durability of the structure

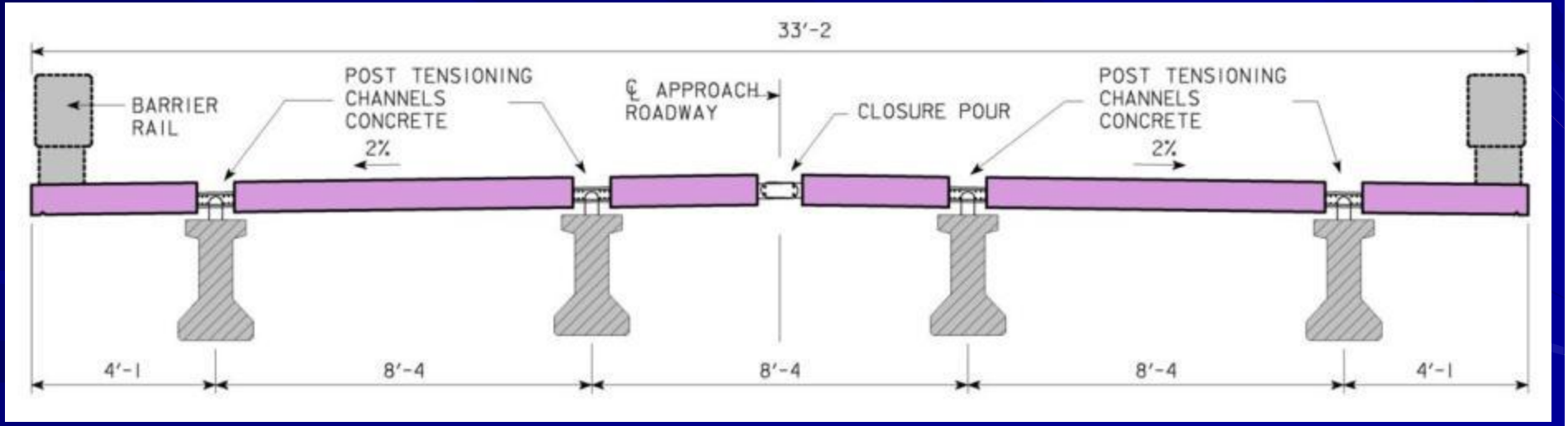
ABC: Disadvantages

- Substantial increase in construction cost: fewer bridge replacements
- Contractors are generally uncomfortable with the PBES concept: higher cost
- Requires the development of new design standards and specifications: higher design cost

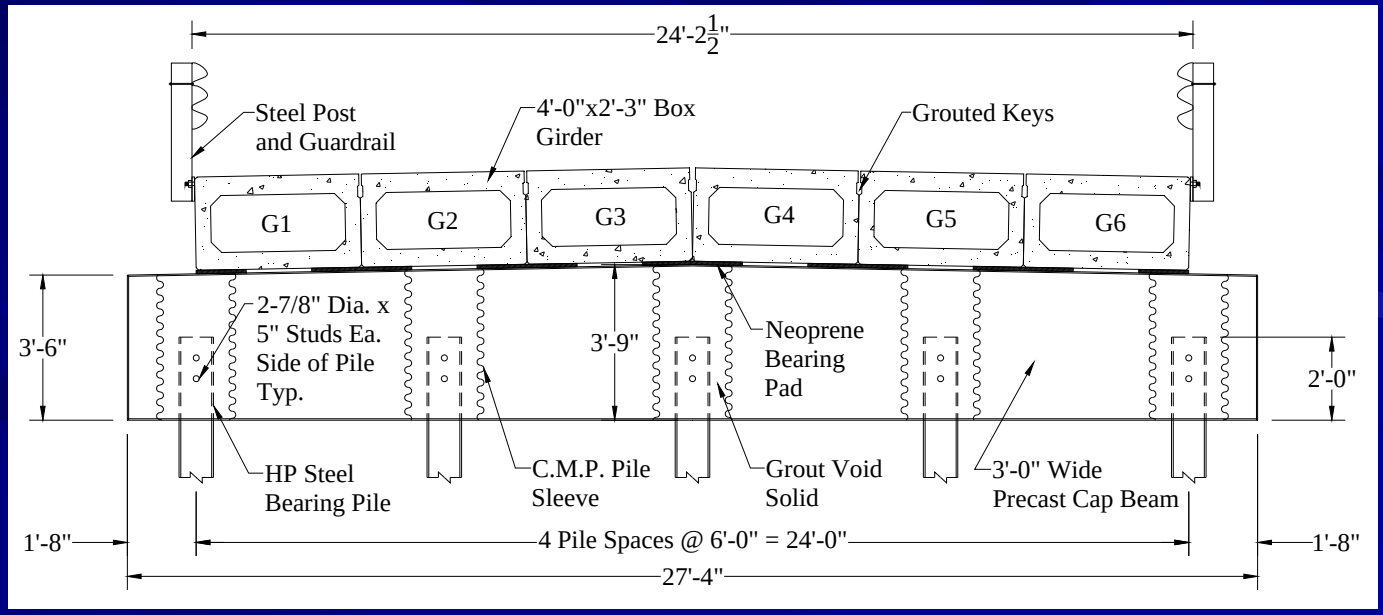
Iowa DOT ABC Deployment Strategy

- Develop skills and design details through demonstration projects (IBRD, HfL, SHRP2, ..)
- Invest in research and include laboratory and field testing to confirm constructability and performance.
- Participate in national pooled fund studies
- Involve local construction industry and hold ABC workshops.
- Develop policies for ABC

Boone County Mackey Bridge



Madison County

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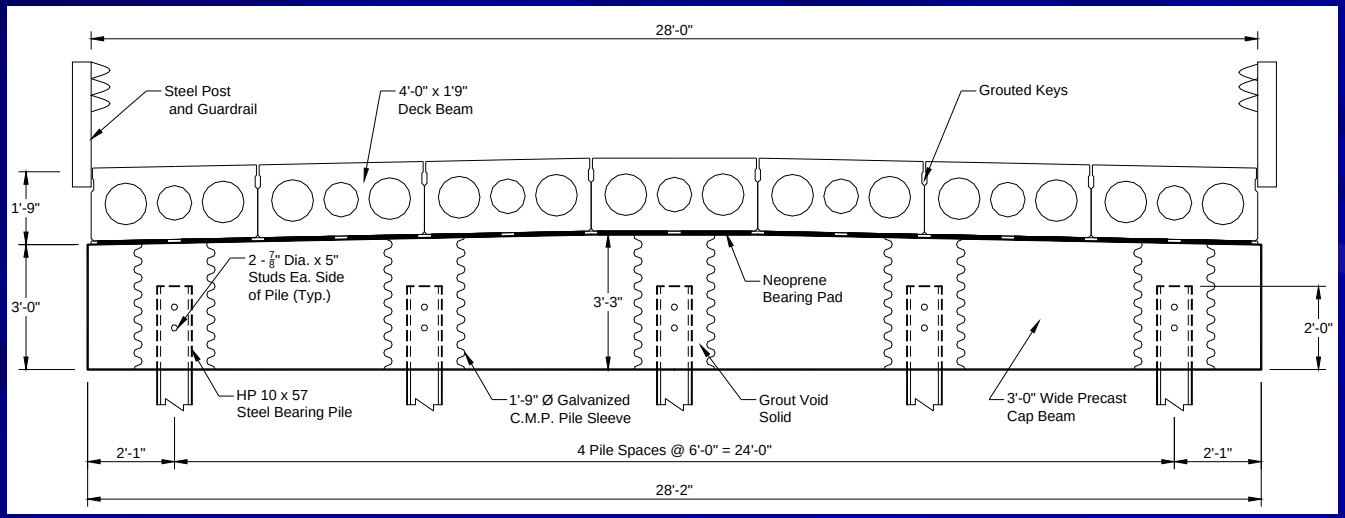
Buena Vista County

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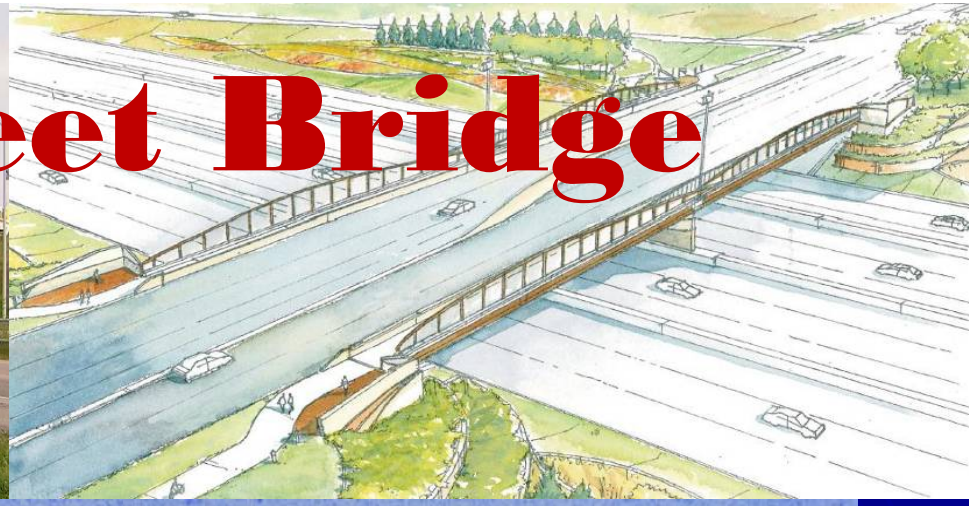
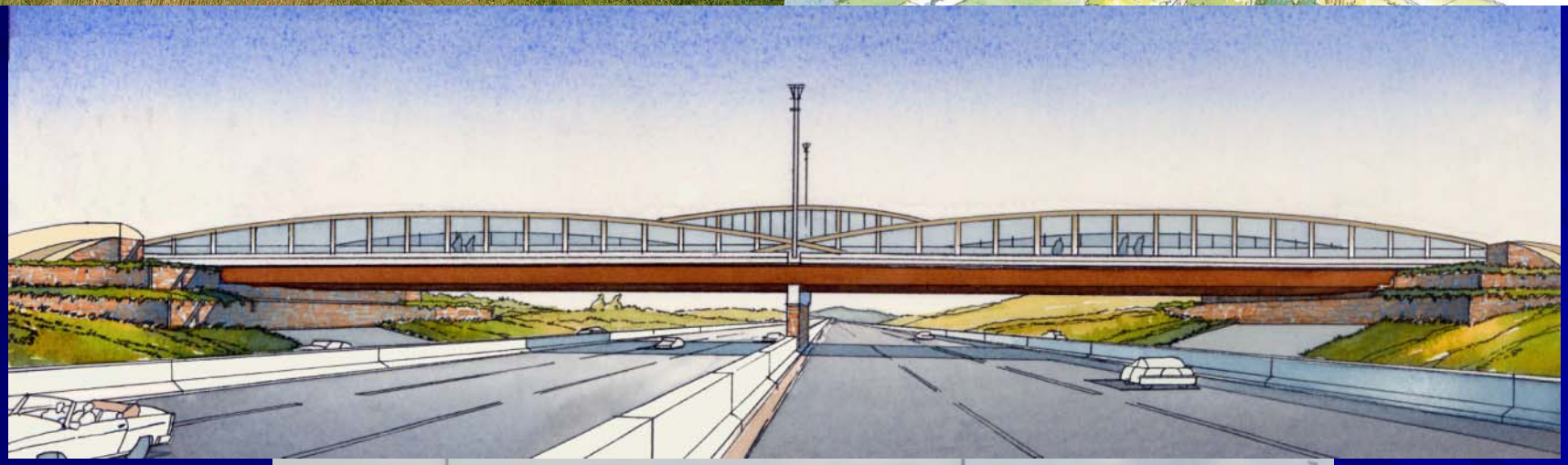
24th Street Bridge





Overview

- Reconstruct the 24th St Interchange over I-80/I-29
- Replace existing structure with a two-span CWPG
- Use staged construction to maintain one-lane traffic in each direction plus a turning lane
- ABC techniques used:
  - Full-Depth Precast Deck Panels
  - High Performance Concrete and Steel
  - Structural Health Monitoring
  - Fully Contained flooded backfill
  - A+B Bidding
  - ITS


NEBRASKA SLINGS


POWER TEAM

Accelerated Bridge Approach Replacement

Iowa Department of Transportation

O'Brien County Project

Bremer County Project


PCI

Iowa DOT ABC Deployment Strategy

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Iowa DOT ABC Deployment Strategy

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ABC Policies

- The policy for ABC implementation is being developed. A target completion date of July 1st.
- Assembled a team of engineers from various disciplines to develop the policy with strong support from top management.
- The policy will utilize decision making tools such as:
  - ABC Rating Score & Flow Chart similar to Utah as a first level filter
  - AHP Decision Making Tool as a second level confirmation and further evaluation of alternatives.

ABC Implementation Barriers

- Funding to offset ABC construction cost – need to identify new revenues or alternative funding
- Resistance from some local contractors to ABC – working with industry to change the climate
- Limited contracting methods – since Design Build (DB) is not allowed in Iowa we are looking at the partial DB option
- Design aids – we are working on ABC design policies, specifications and standard details.
- Limited experience in ABC design – several ABC projects have been identified to attain experience for our engineers.

Case Study: Keg Creek Lessons Learned

Background

- SHRP2 – R04 Research Team needed to demonstrate ABC design concept for typical multi-span stream crossings – a common rural bridge replacement
- Proposed a demonstration project in Iowa
- Successful project may pave the way for developing national ABC standards
- A bridge on US 6 over Keg Creek in Pottawattamie County met the objectives

Project Data

- Design: HNTB (*M. LaVoilette, B. Sivakumar, F. Hubbard, and K. Price*)
- Owner: Iowa DOT (*D. Evans – Design Review, B. Flippin & G. Feazell)*
- Testing: ISU *(M. Rouse, B. Phares, D. Hartwell, D. Wood, and T. Wipf)*
- Contractor: Godbersen-Smith (*K. Triggs & M. Freier)* $2,658,823 (7 bidders from $2.66M to $3.99M)
- Unit cost: $231 per sq.ft. ($124 estimated for conventional)
- Contract period:
  - Phase 1 – Drilled shaft installation (9 working days)
  - Phase 2 – ABC Period (14 calendar days)
  - Phase 3 – Revetment, grading, and flumes (20 working days)
- Incentive/Disincentive on 14 days ABC: $22,000 per day
- ABC approximate start date: 9/19/11 (actual 10/17/11)
- SHRP2 funds: $250,000 (*M. Starnes – Program Officer)*
- HFL funds: $600,000 or 20% (*M. Huie – Program Coordinator)*

EXISTING BRIDGE

180’ x 28’-0 Continuous concrete girder bridge

- Built in 1953
- 3 spans
  53’6”,73’,53’6”
- Moderate sized, typical rural crossing
- Small, meandering stream
- Narrow bridge width on primary road system
- Sufficiency rating 33

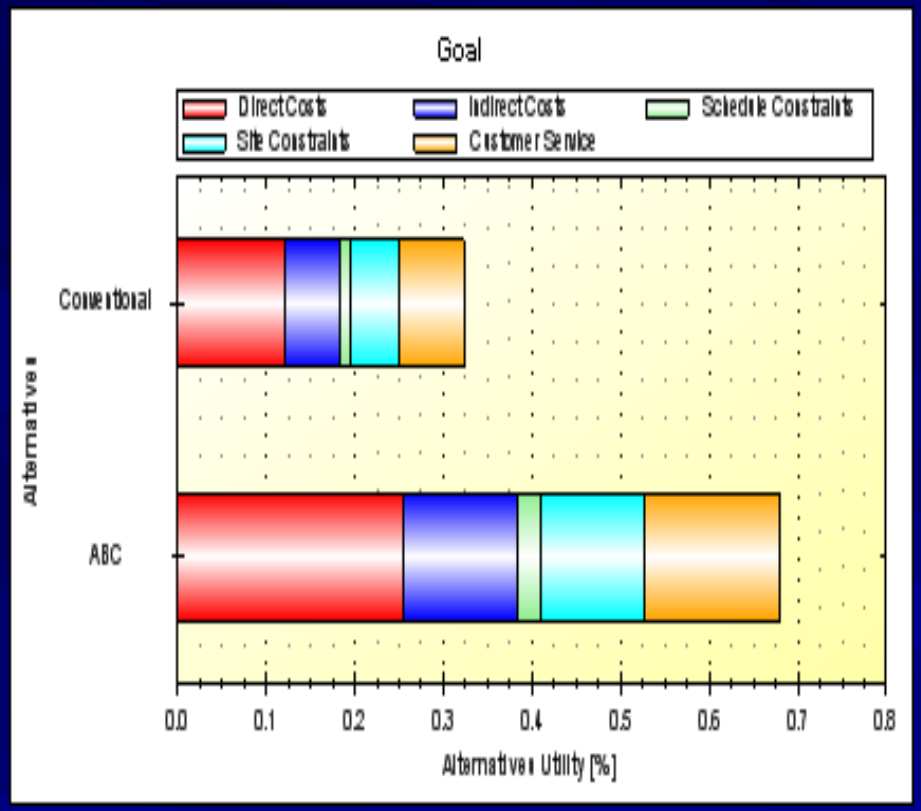
Why Keg Creek?

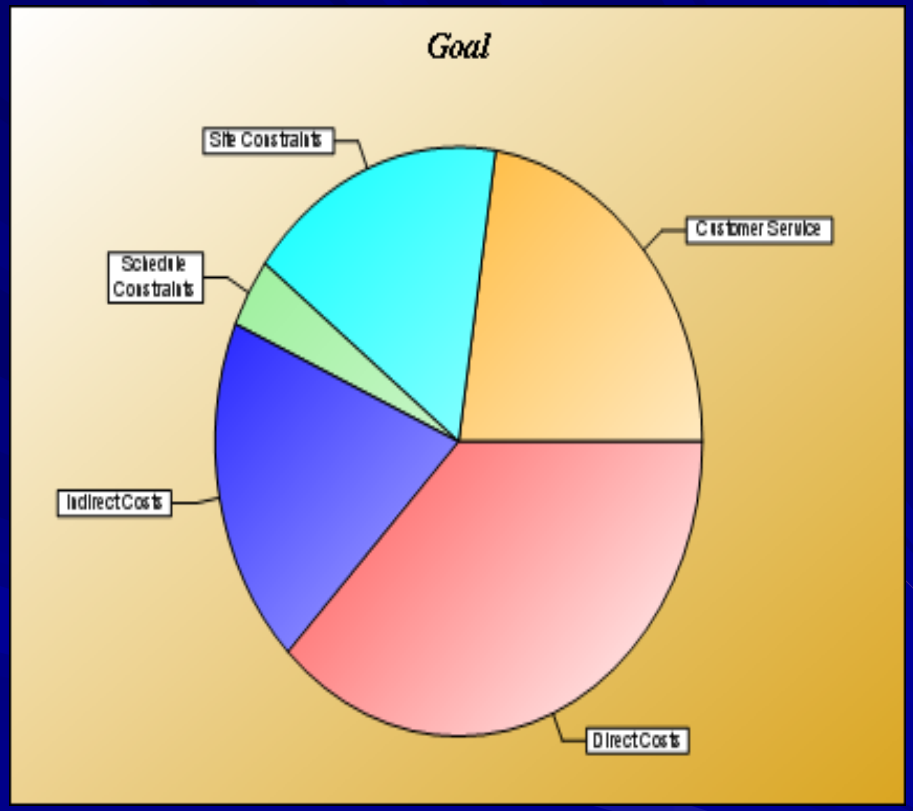
- Typical rural, moderate size stream crossing in Iowa. Indicative of many bridges throughout the mid-west and country. SHRP2 looking to standardize ABC design plans.
- Detour: 22 mile detour less desirable for traveling public over 4 to 6 month period versus 2 week ABC period.
- Schedule: already programmed for 2011 construction.

Why Keg Creek?

- Size of bridge favorable for pilot project in term of cost.
- Low AADT = ideal for demonstration site.
- Narrow existing bridge width allowed for drilled shaft foundation construction prior to bridge closure (outside of ABC).
- Bridge geometry: 0 degree skew and flat grade.

AHP Analysis





- AHP analysis was not used in site selection process but provided confirmation

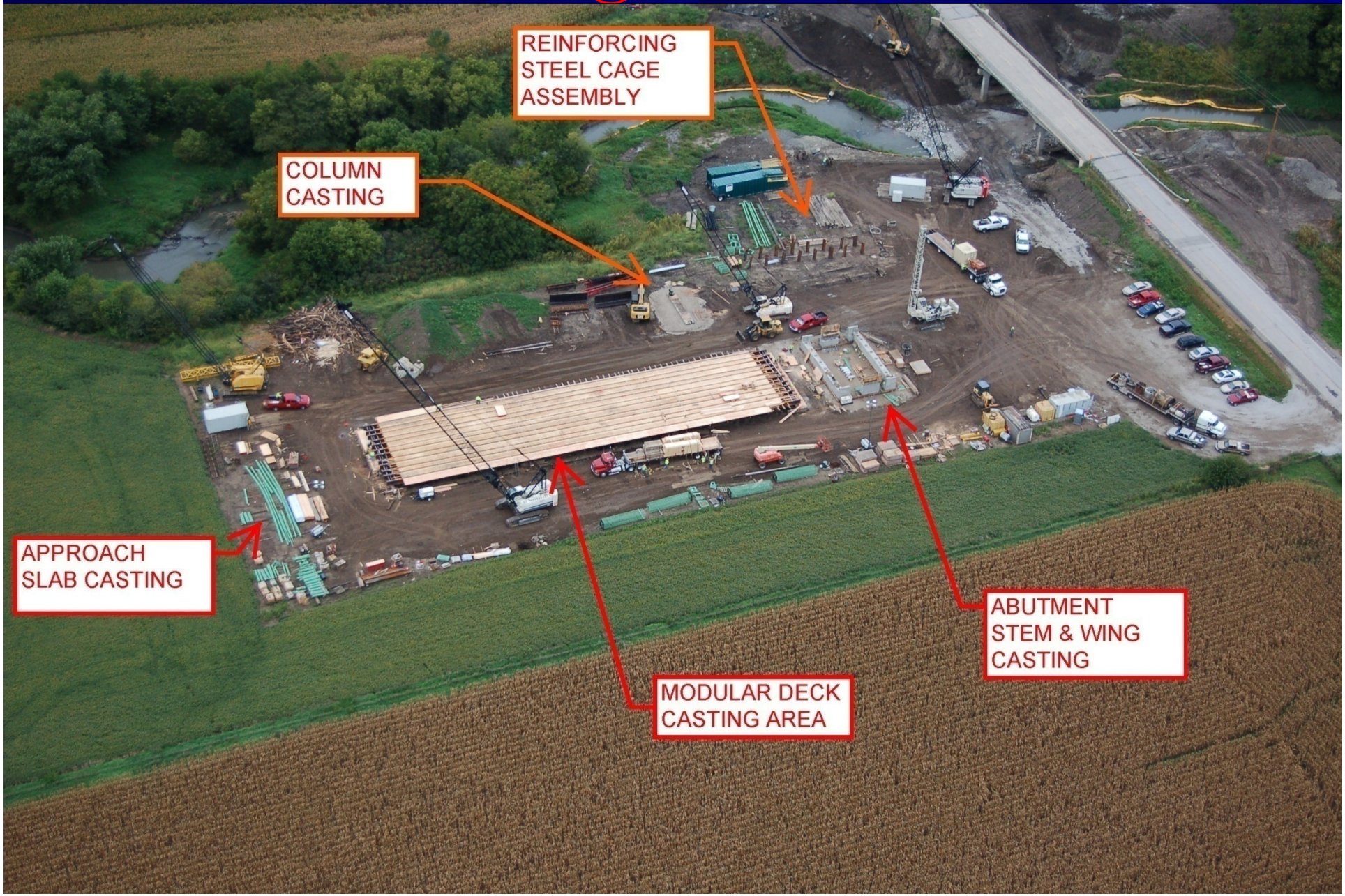
14-Day ABC Timeline

(as proposed by the Contractor)

	14 DAY CLOSURE PERIOD													
	28-Sep	29-Sep	30-Sep	1-Oct	2-Oct	3-Oct	4-Oct	5-Oct	6-Oct	7-Oct	8-Oct	9-Oct	10-Oct	11-Oct
CLOSE HWY 6	■													
BRIDGE DEMOLITION	■	■	■											
DRIVE ABUT. PILING/SET COLUMNS			■	■										
SET ABUT.'S & ABUT. WINGWALLS/POUR SELF LEVELING CONC.					■	■								
SET CAPS						■								
ERECT DECK MODULES							■	■	■					
SET APPROACH/SLEEPER BEAM										■				
POUR UHPC JOINTS											■			
POUR UHPC BARRIER CLOSURE												■		
GRINDING/ACC PAVING													■	■
GUARDRAIL/PAINT/OPEN ROAD														■

Actual ABC period: October 17 – November 1

Iowa Bridge Farm *(Phase 1)*



Precast Substructure Components Casting *(Phase 1)*

Superstructure Modules – Structural Steel Assembly *(Phase 1)*

Superstructure Modules – Deck Forming *(Phase 1)*

Deck Concrete Placement

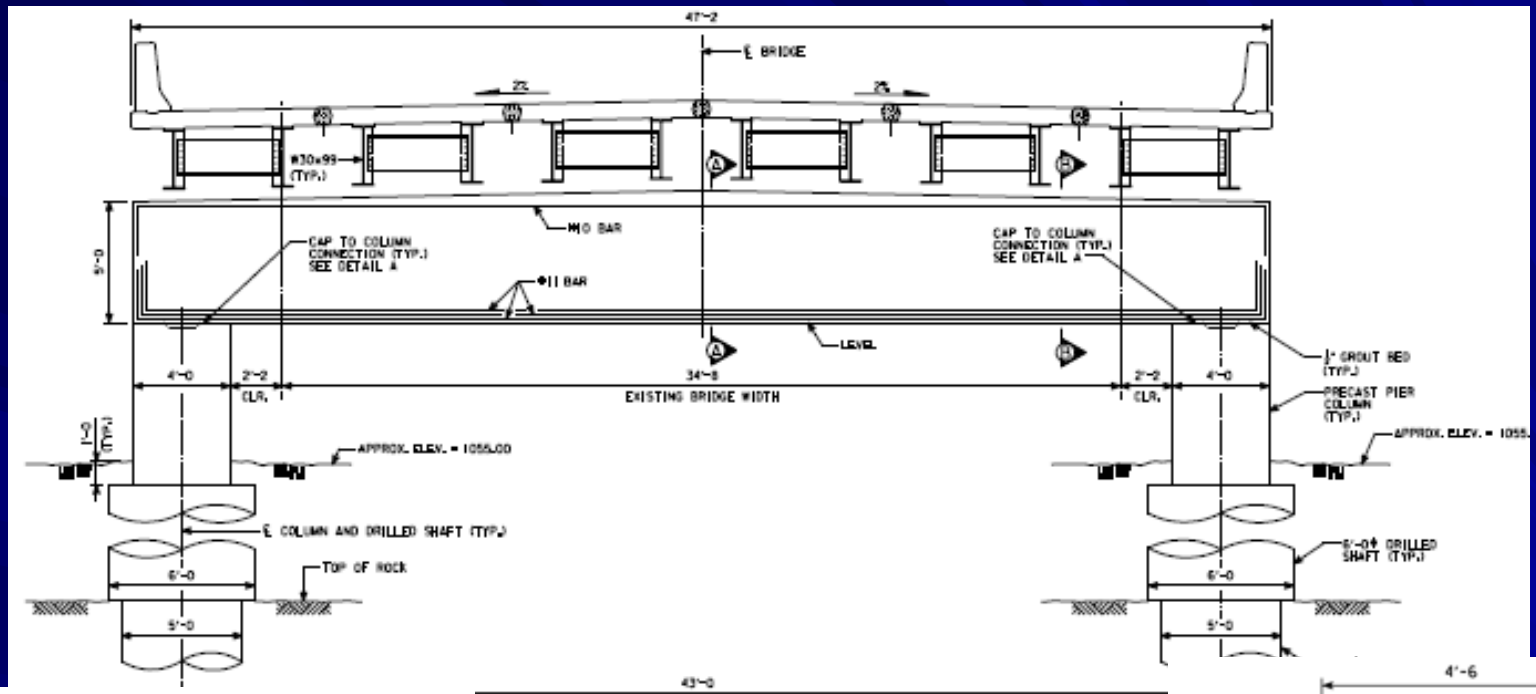
(Phase 1)

Drilled Shaft Construction

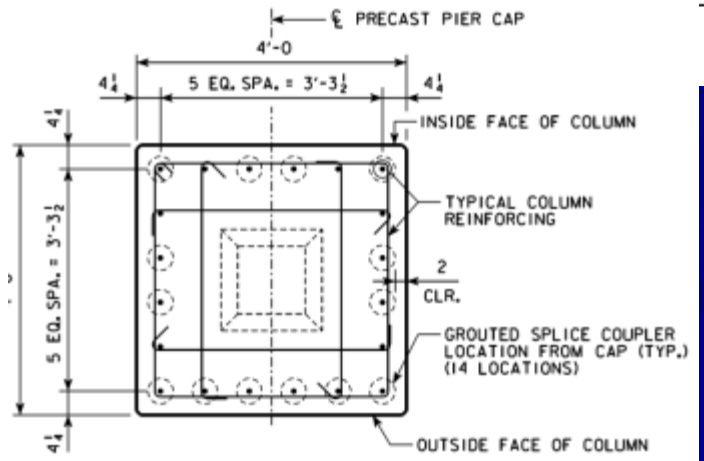
(Phase 1)

Abutment / Wing Erection

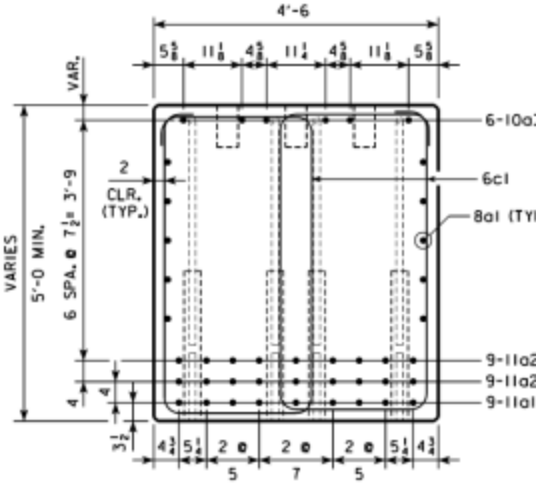
Pier Details



PIER ELEVATION

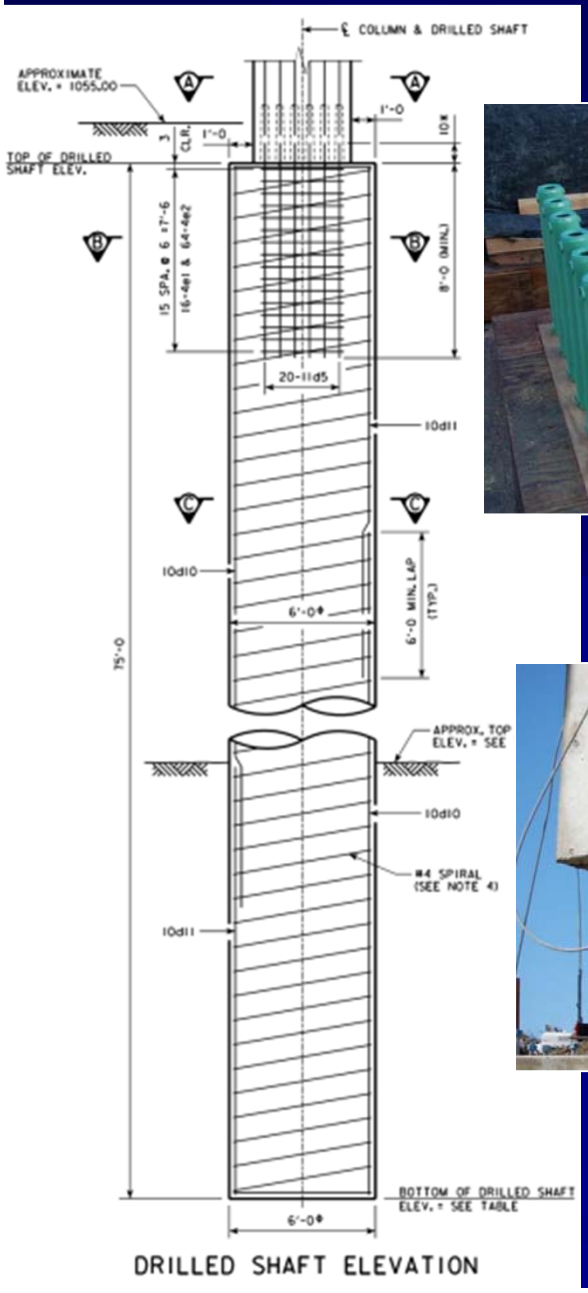


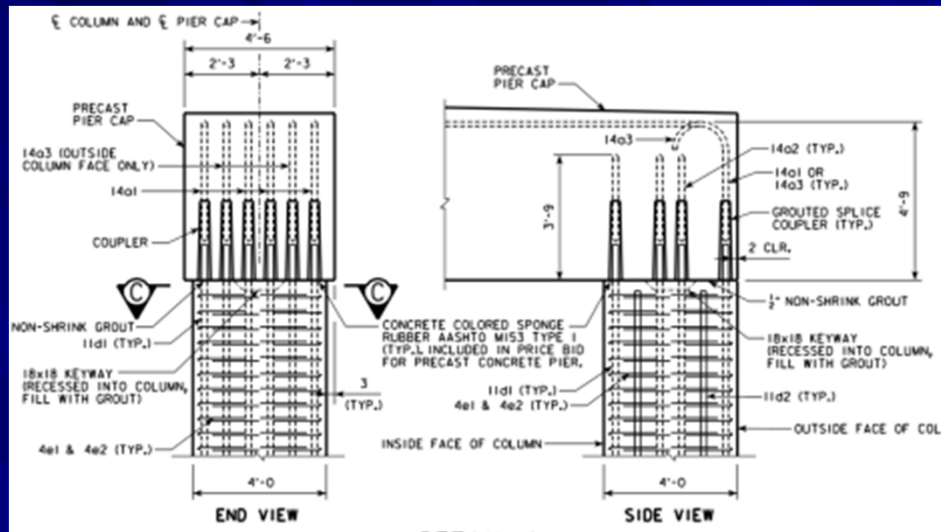
SECTION C-C
PRECAST COLUMN



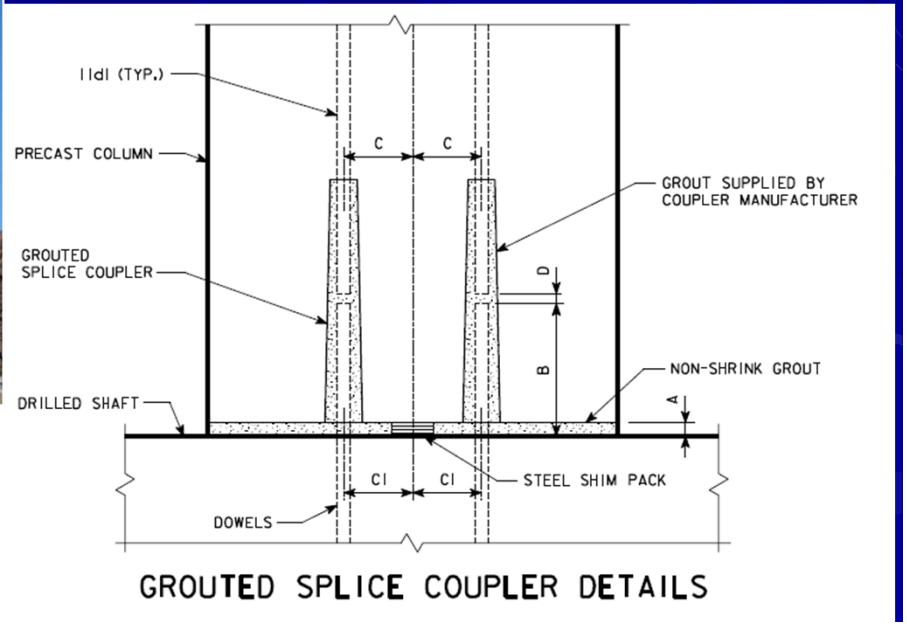
SECTION B-B
PRECAST PIER CAP

Pier Connection Details





DETAIL A
CAP TO COLUMN CONNECTION



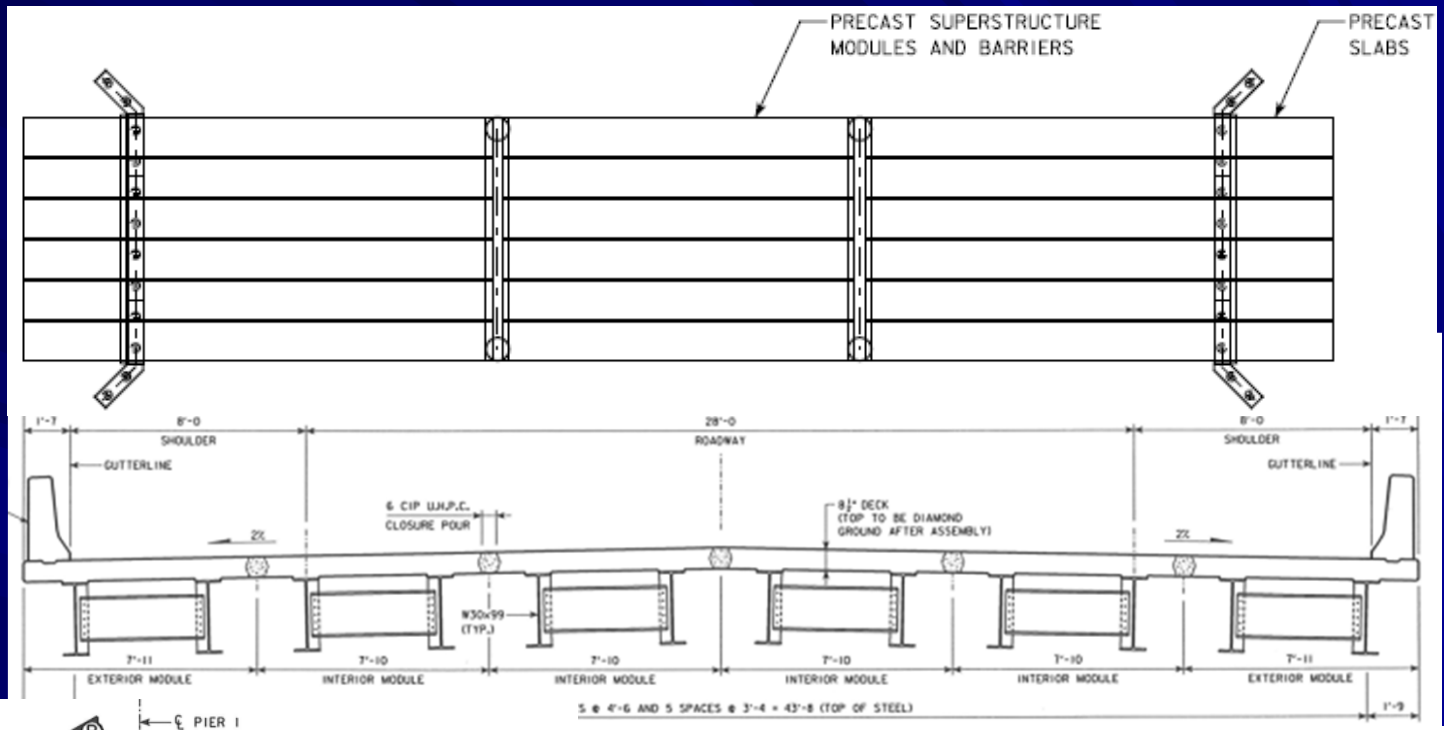
GROUTED SPLICE COUPLER DETAILS

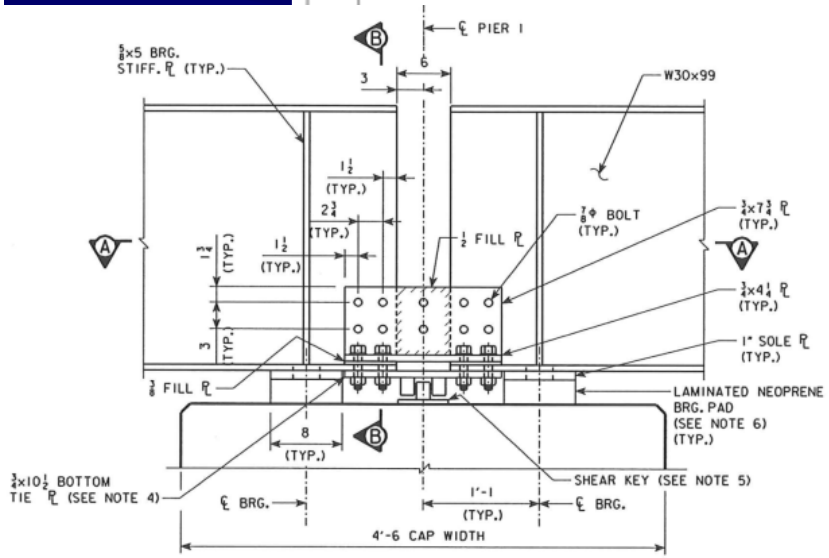
Column Assembly

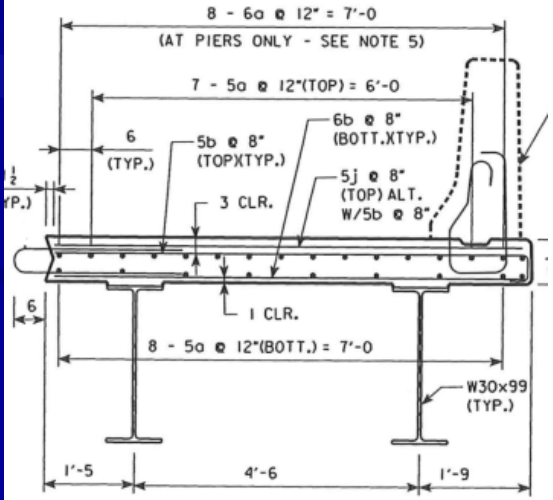
Bedding and Coupler Grouting

Cap Beam Assembly

Modular Superstructure Details



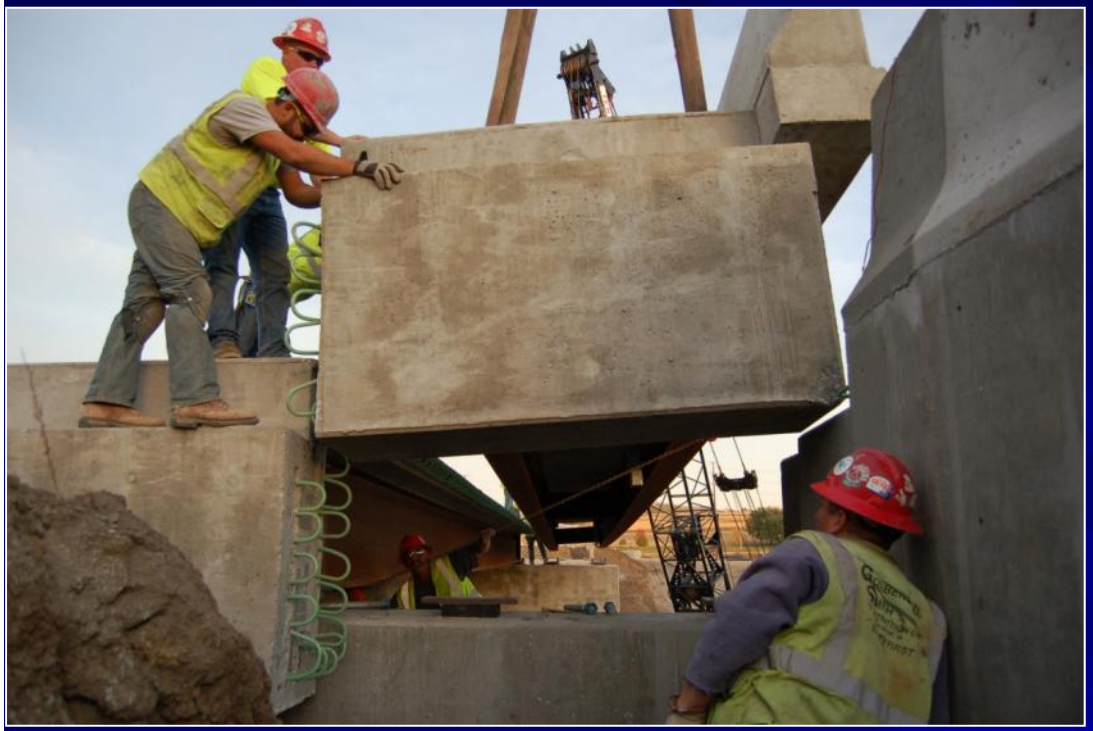




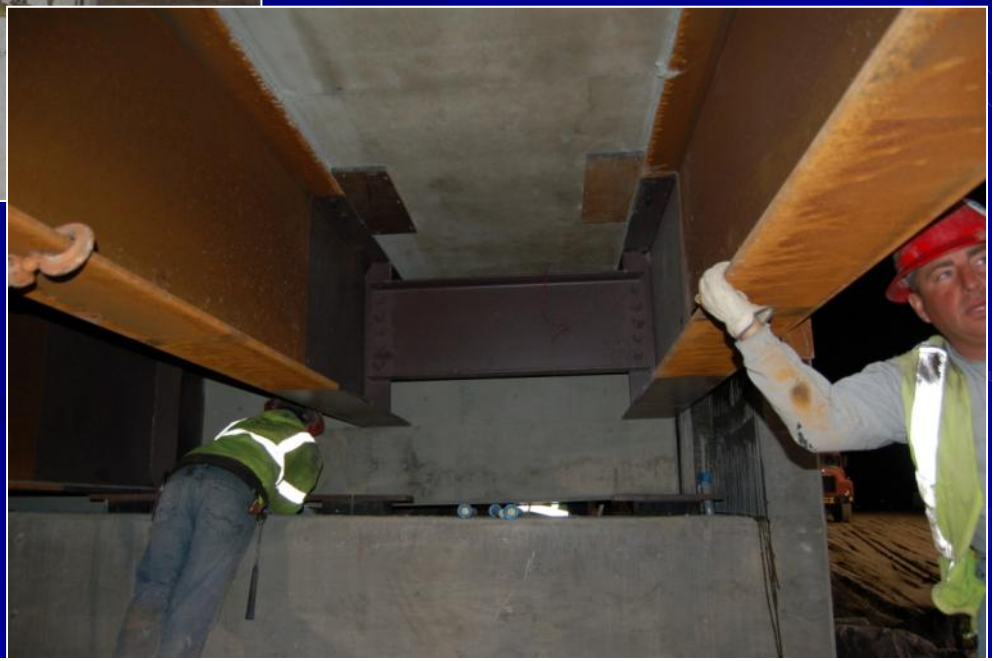
Superstructure Module Transport

Module Assembly

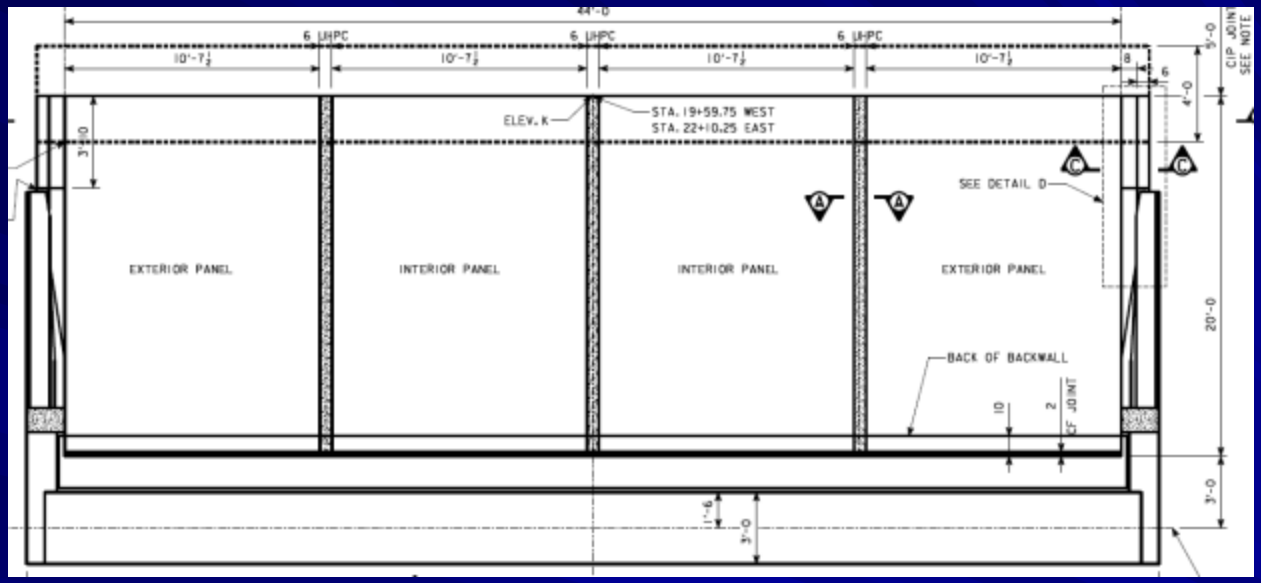
Module Assembly

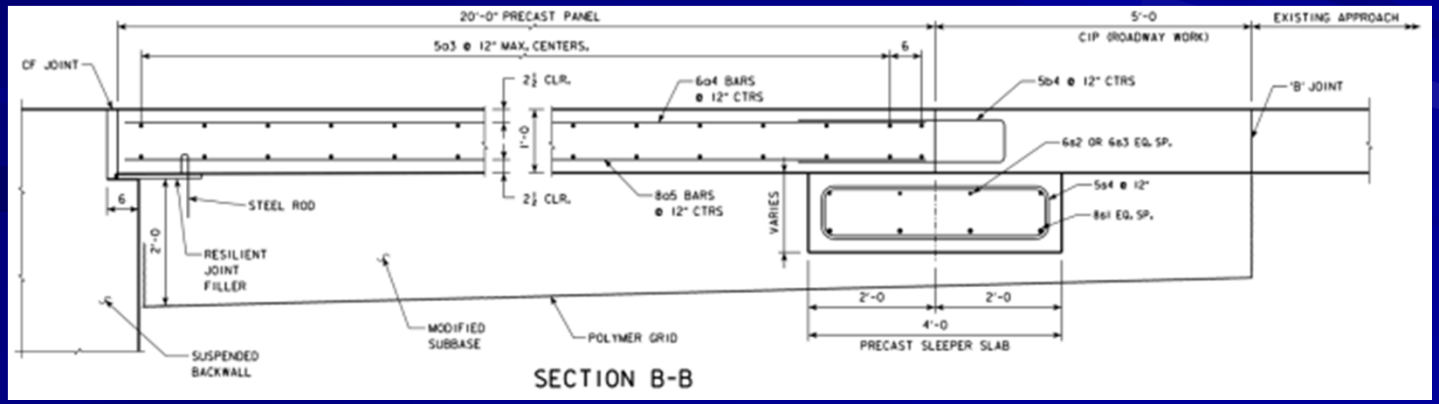


Final Module Placement



Precast Approach Slab Details





Flooded Backfill System

Precast Approach Preparation

Precast Approach Slab Placement

31-37 kips

UHPC Placement

Completed Bridge


October 17, 2011

Conclusions

- ABC design concept was successfully demonstrated but there were some challenges along the way.
- Post construction review identified problem areas, as expected, and provided recommendations for improvements which will be documented in the final report.
- As the result of this project (and other past ABC projects), Iowa DOT gained a better understanding of risks and benefits associated with ABC and is developing ABC policy.

Project Website

http://www.iowadot.gov/us6KegCreek/

Questions?