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# IL 115 OVER GAR CREEK ACCELERATED BRIDGE REPLACEMENT

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# AGENDA

- ❖ Project Overview and Need
- ❖ Design and Special Provisions
- ❖ Construction Engineering
- ❖ Lessons Learned



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# Project Overview and Need

# Bridge Background

- ❖ IL 115 south and west of Kankakee over Gar Creek
- ❖ Single span precast box beam bridge built in 1976 replacing an older bridge built in 1923
- ❖ Inventory rating of 9 tons and operating rating of 26 tons
- ❖ Emergency repairs performed in 2011 to replace a failed box beam
- ❖ ADT of approximately 2,500

# New Gar Creek Bridge

- ❖ 82 feet back to back of abutment to miss existing abutment and piles
- ❖ Wide flange beam superstructure using a semi-integral abutment
- ❖ Proposed state route detour of over 30 miles
- ❖ Using local roads shortened detour but required \$903,000 in improvements
- ❖ Estimated cost for replacement was \$847,000 in 2014 dollars

# Accelerated Bridge Construction (ABC)

- ❖ IDOT through FHWA obtained Accelerated Innovation Development funds to test ABC techniques
- ❖ Objectives were to:
  - ❖ Demonstrate whether or not ABC techniques could reduce construction time
  - ❖ Measure the actual time to build bridge under ABC
  - ❖ Determine if ABC techniques could be carried out by a contractor of modest means with average skill and staffing



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# Design and Special Provisions

# Design

- ❖ Maximize precast elements to speed construction
  - ❖ Semi-integral abutment design which allowed the abutment to be set independent of the bridge backwall
  - ❖ Precast abutments and wingwalls with pockets to receive driven piles
  - ❖ Precast approach and sleeper slabs with typical IDOT details
  - ❖ Design only looked at final stresses and not construction loads including pick points



# Design

- ❖ Provided a suggested approach to lateral slide in as part of the design documents
  - ❖ Based on IowaDOT ABC bridge projects
  - ❖ Envisioned new bridge built on temporary falsework adjacent to the existing bridge that would be strand jacked into place using Hillman Rollers and guide channels
  - ❖ Detailed a temporary support bent and guideway system
  - ❖ Detailed a jacking procedure to swap out roller for permanent bearings
  - ❖ Envisioned a 72 hour closure for the work

# Special Provisions

- ❖ Lateral Slide-in Bridge Superstructure as a special pay item
  - ❖ Ensured that bidders understood the importance of the work
  - ❖ Mandated contractor SE be prequalified in Advanced Typical Bridges and Railroad Bridges since that is where ABC techniques are most often used
  - ❖ Required conformance with IDOT GBSP 67 for Structural Assessment of Contractor's Means and Methods for all aspects of the work
  - ❖ Detailed list of submittal relative to the bridge translation
  - ❖ Specified QA/QC procedures to be followed during the work

# Special Provisions

- ❖ Test move of the bridge required prior to actual move to test concepts
- ❖ Proposed construction procedure to provide guidance to the contractor
- ❖ Requirements for detailed geometric control during translation including vertical, horizontal and skew measurements
- ❖ Tolerances for final placement of the bridge in permanent position
- ❖ Post translation inspection to ensure no cracking or other construction induced distress

# Bidding

- ❖ Normal IDOT bid procedures used
- ❖ Five bidders with a range of \$1.34 to \$1.68 million
- ❖ Lateral Slide-In Bridge Superstructure pay item ranged from \$150K to \$332k
- ❖ Low bid was Tobey Construction & Cartage, a typical small to medium size contractor that does extensive work for IDOT



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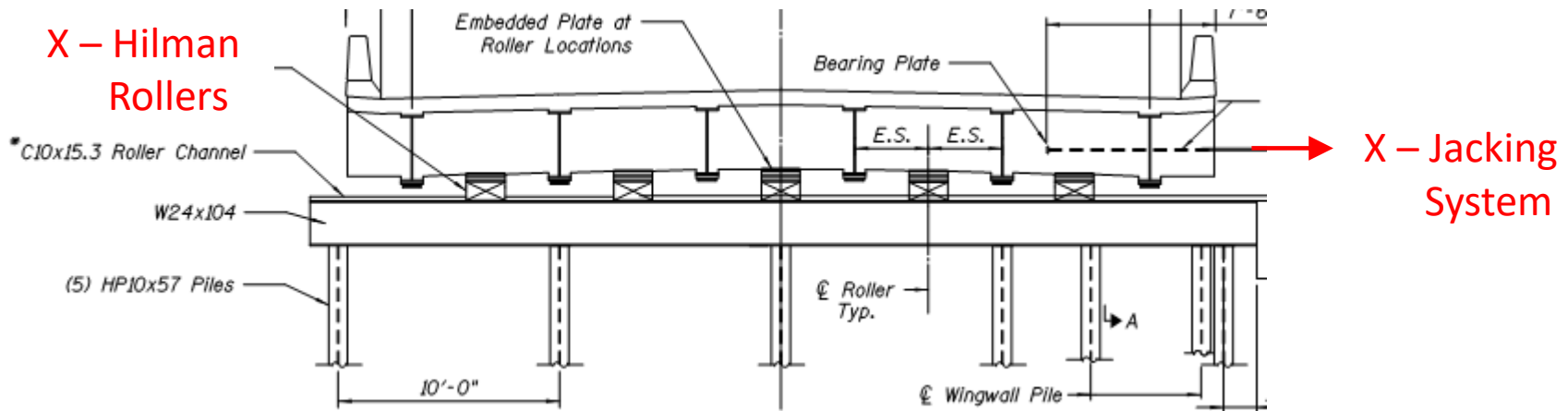
# Construction Engineering

# Contractor's Means & Methods

- ❖ WHKS & Co. retained by Tobey's
- ❖ S.E. services for contractor's means & methods
- ❖ Road closure on-site representation: structural issues
- ❖ Required by project specifications

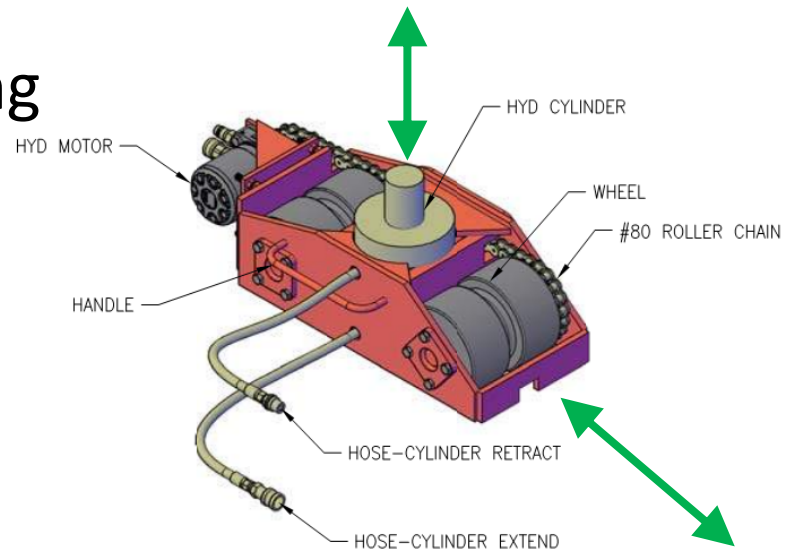


# Lateral Slide Concept Revisions

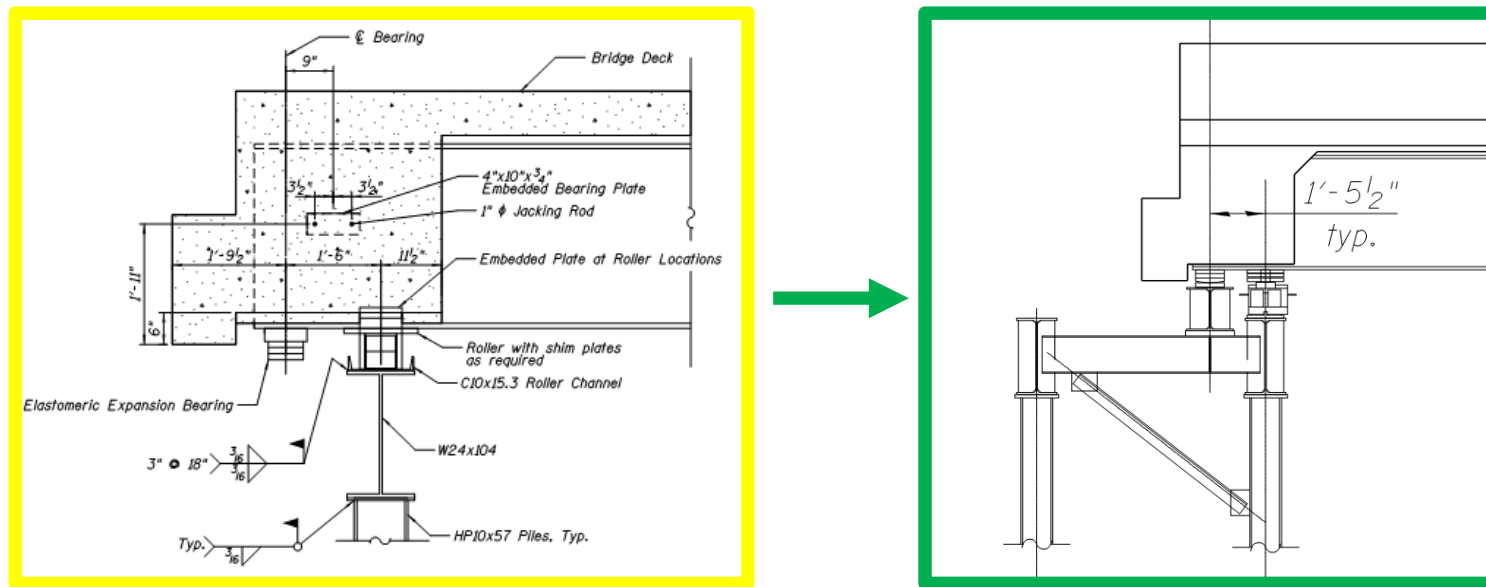


❖ Use Barnhart Crane & Rigging Co. hydraulic powered roller w/ integral hydraulic jack

❖ Placed under each beam



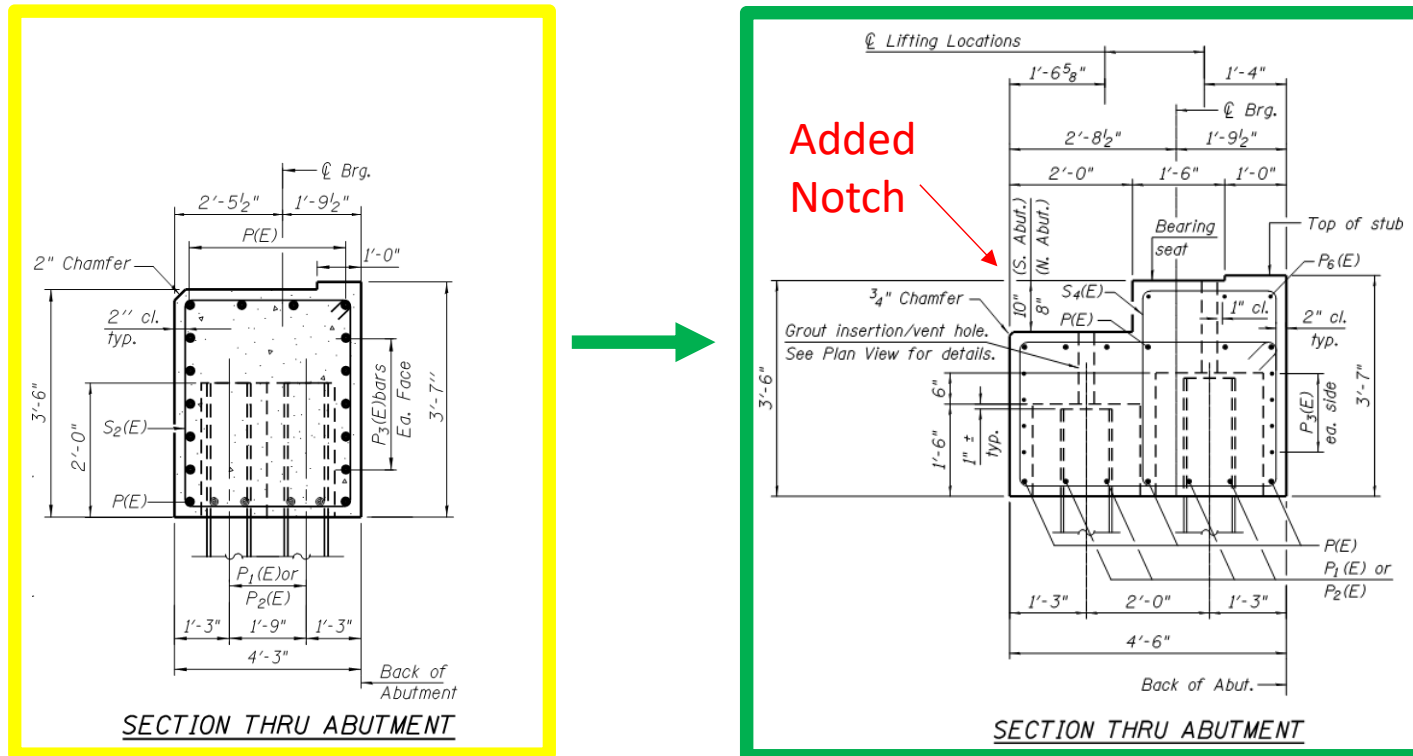
# Lateral Slide Concept Revisions



- ❖ Used 2 rows of piles w/ each temp. bent
- ❖ Approx. 10' loose sand → increased lat. stiffness
- ❖ Increased support points for bearings, formwork, and roller system

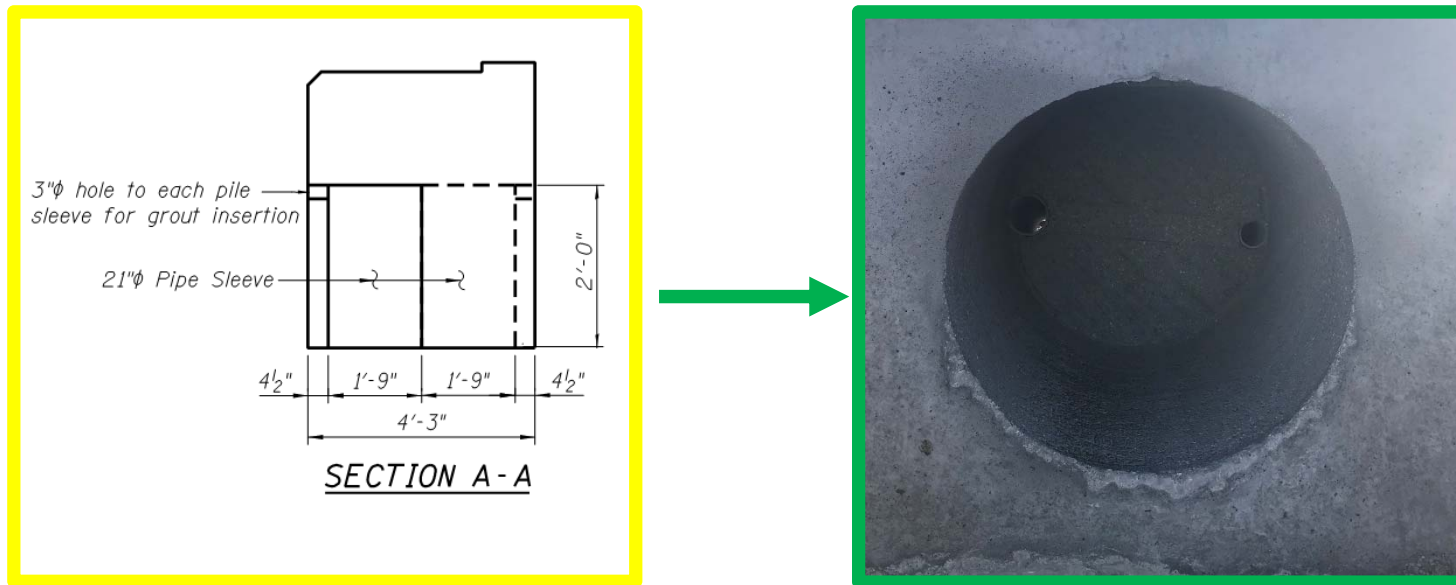


# Lateral Slide Concept Revisions



- ❖ Provided shelf / notch in front of abut. for rollers
- ❖ Adjusted front pile row location to center under rollers

# Lateral Slide Concept Revisions



- ❖ Moved 3" dia. pile sleeve grout tube to top of cap
- ❖ Included 2" dia. vent tube

# Existing Structure Demolition



# Temporary Bent & Superstructure Construction



# Abutment Construction

- ❖ 13-HP 10x42 each abut
- ❖ Driven  $\approx$  15' through loose sand to rock
- ❖ Abuts  $\approx$  80' apart  $\rightarrow$  only one driving rig used for safety reasons



# Abutment Construction



- ❖ WHKS – handling design for  $\approx 80$  kip abut. cap
- ❖ Fine aggregate bedding to seal base of pile sleeve

# Abutment Construction



❖ Only 3” tolerance for the pile sleeves – tight fit!!

# Abutment Construction

- ❖ 2 piles needed trimmed
- ❖ Exact reasons unknown - suspected of shifting during driving
- ❖ With tight tolerances, problems were anticipated
- ❖ Contingency plans evaluated during design





# Abutment Construction



- ❖ Vertical geometry control – abutment elev's must match already constructed temp. bents for rollers
- ❖ 4 piles at each abut precisely cut to match the top of pile sleeve – all other piles rough cut 1 in. short.

# Abutment Construction

❖ Grout pumped into top of the pile pipe sleeves



# Abutment Construction

- ❖ Spec's req'd 3500 psi grout strength
- ❖ Tobey's evaluated many sack mixes requiring manual mixing
- ❖ Sack mixes = time, consistency, & strength problems
- ❖ IDOT allowed use of PP-5 mix → onsite mobile mixer
- ❖ With a learning curve →  $\approx \frac{1}{2}$  hour to grout an abut.
- ❖ PP-5 strengths: 3700 psi at 4 hours, 5400 psi at 5.5 hours
- ❖ *Due to material loss, insufficient grout quantity for 2 abut's resulting in  $\approx 4$  hour delay!!*



# Lateral Slide



❖ Hydraulic powered rollers & control center



# Lateral Slide

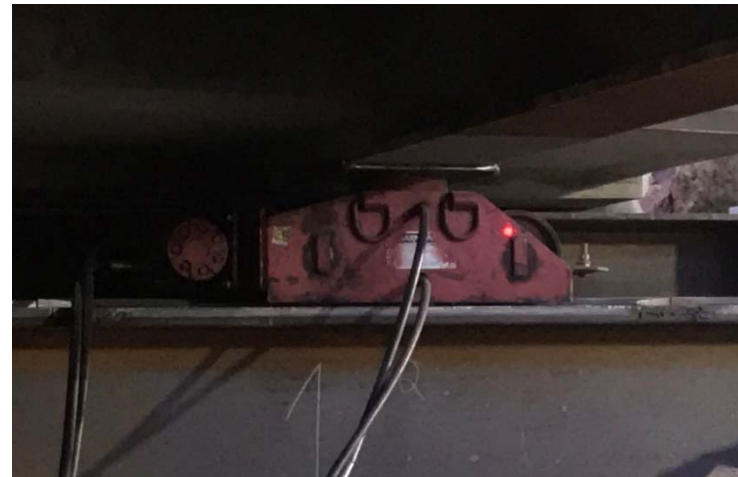
- ❖ Roller track and guide rod



# Lateral Slide

## ❖ Geometry control

- Lasers mounted to rollers



# Lateral Slide

- ❖ Geometry control – total station equip. & prisms adhered to bridge parapets



# Lateral Slide

❖ Let the move begin!!!





# Lateral Slide



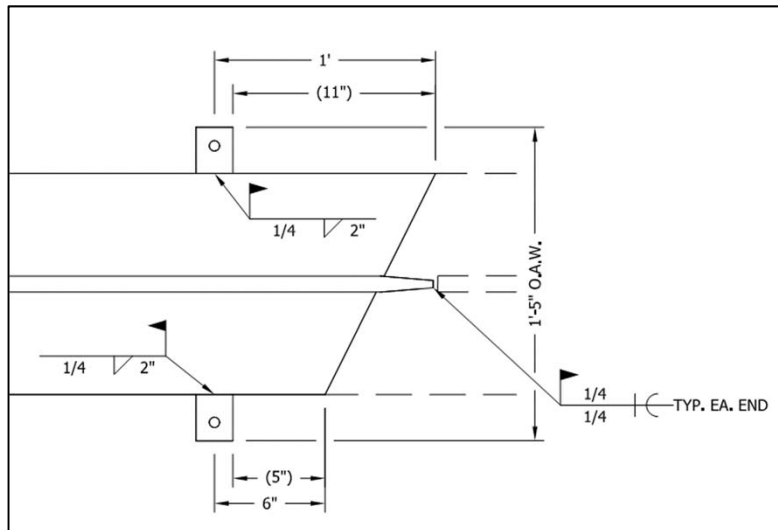
# Lateral Slide

Rolled right along for first 15 ft and then.....



# Lateral Slide

- ❖ Subcontractor omitted field welds = guide rods bending/rollers binding
- ❖ Rollers had to be repositioned, field weld added



# Lateral Slide



# Lateral Slide



# Lateral Slide



# Lateral Slide

- ❖ 2 hours to complete slide w/ 1 hour delay
- ❖ Slide completed at hour 40 / 72 hour closure



# Lateral Slide



- ❖ 3/6 fixed bearings misaligned  $\approx$  1.5 inches
- ❖ Cut anchor bolts to shift bottom plates & lower structure
- ❖ Welded stub plate retrofit w/ anchor bolts in CIP block



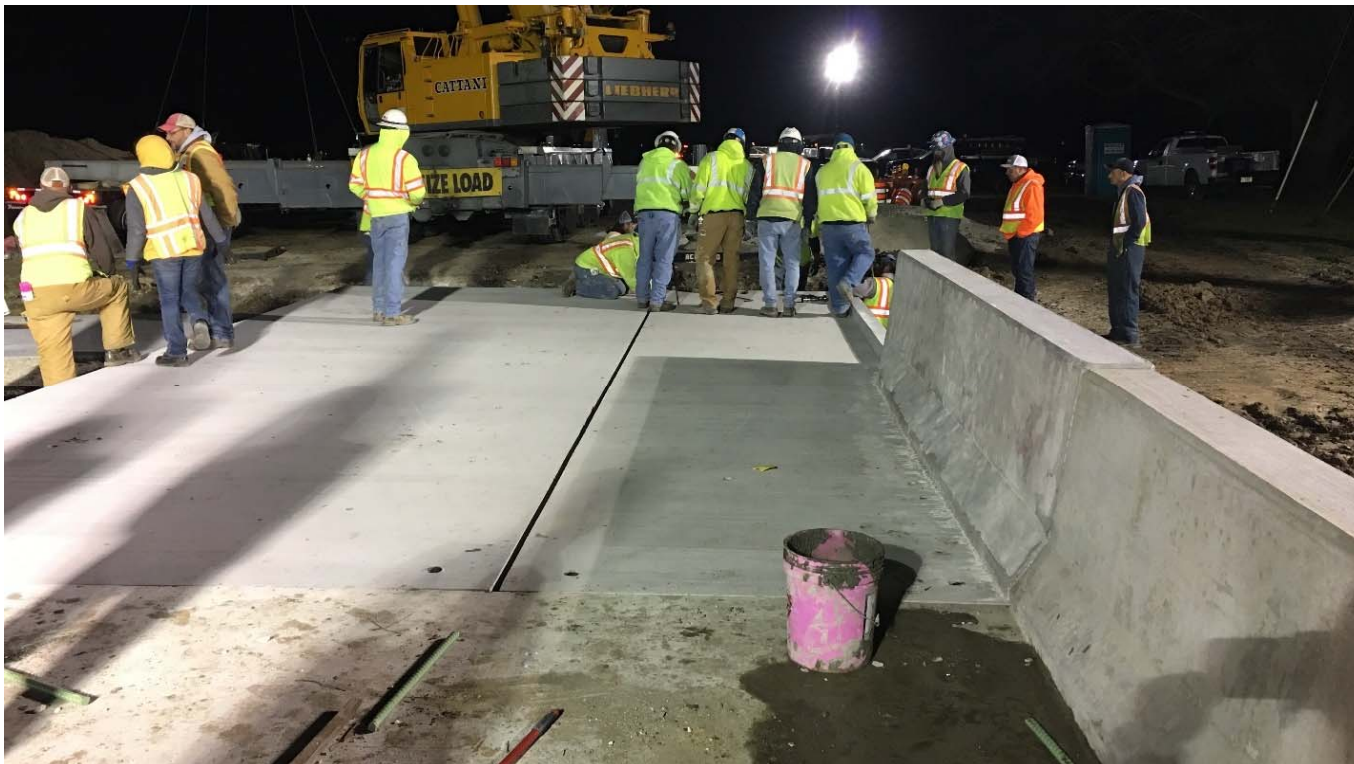
# Bridge Approach Slabs

❖ Precast Footings – 1' x 10' x 38' (60 kips)



# Bridge Approach Slabs

- ❖ Precast 12' wide driving lanes (68 kips)
- ❖ Precast 6' shoulders w/ parapet (50 kips)
- ❖ Approaches completed at hour 54 / 72 hour closure



# Paving & Guardrail





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# Lessons Learned

# Lessons Learned

- ❖ A reasonably competent contractor of modest mean with a well qualified construction engineer can complete the replacement of a single span bridge within 72 hours and probably as short as 48 to 56 hours
- ❖ The cost premium for the ABC techniques is offset by user costs and detours

# Lessons Learned

- ❖ Provide more details during design including determining pick points and other handling details
- ❖ Self-guided hydraulic roller and jacks is superior to strand jacking
- ❖ Include extra material such as piles and grout to mitigate delays associated with time lost obtaining materials required for construction
- ❖ Require dedicated staff to oversee the work and anticipate problems before they happen

# Lesson Learned

- ❖ Design the substructure to be more robust to anticipate problems with mislocated piles or piles that are fouled during driving
- ❖ Accurate layout is essential. Total station survey and translation of shop and field erection information to permanent work is essential for accuracy.
- ❖ Grouting of pockets in precast can be problematic. IDOT PP-5 mix with latex provides good bonding but can be difficult to use when crews are not familiar with the material.

# Lessons Learned

- ❖ Look to modify standard details such as paved shoulder to shorten construction
- ❖ Contractor engineer needs to be responsible for all aspects of the work in the field including evaluating crane placements and capacities.
- ❖ Add a suggested schedule to the plans so that the contractor understands the objectives and commitment of staff and equipment



# Lessons Learned

- ❖ Consider incentivizing the contractor with A+B type payments
  - ❖ Ensures that there is a shared risk for the work
  - ❖ Rewards contractors that approach the project with innovative ideas to shorten duration
  - ❖ Keeps focus on the shortest duration for the work to be successfully completed



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Questions?