

## Lacon Truss Bridge Rehabilitation



Presented by: Chad Hodel, P.E., S.E.

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## Structure Description

### ► Lacon, IL

- ❖ Units 1 & 3: 4-span continuous WF - 270 ft each
- ❖ Unit 2: 3-span continuous through-truss - 1,026 ft



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## Structure Description

- ❖ 2 Lanes IL 17 - 26 ft 3 in. face-to-face curb
- ❖ 1939 - Original Construction
- ❖ 1970 & 1974 - Repair Contracts
- ❖ 1990 - Major Rehabilitation (inc. new deck)
- ❖ 2019 - WHKS Contracted → Extend Service Life 20 to 25 Years



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### Bridge Condition

- ▶ AASHTO HS-20 Load Rating (2019)
  - ❖ Inventory Rating Factor = 0.65
  - ❖ Operating Rating Factor = 1.09

- ▶ Bridge Deck Condition Rating
  - ❖ 2020 = '6' (Satisfactory)
  - ❖ 2022 = '6' (Satisfactory)
  - ❖ Transverse cracks = 8 ft spacing
  - ❖ 200 sq. ft spalls/delaminations



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### Bridge Condition

- ▶ Superstructure Condition Rating
  - ❖ 2020 = '5' (Fair)
  - ❖ 2022 = '4' (Poor)
  - ❖ Approach span webs - 77% section loss
  - ❖ Truss span floor beams - 20% section loss
  - ❖ Truss span stringers - 12% section loss



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### Bridge Condition

- ▶ Substructure Condition Rating
  - ❖ 2020 - Deck CR = '5' (Fair) (Satisfactory)
  - ❖ 2022 - Deck CR = '4' (Poor)
  - ❖ Heavy spalling - exposed reinforcement
  - ❖ Loss of bearing
  - ❖ Cracked and separated steel encasement



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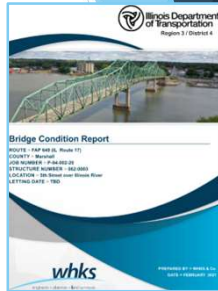
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### Bridge Condition Report Recommendations

- ▶ Scarify, repair, & overlay deck with a Microsilica Concrete Overlay
- ▶ Replace all expansion joints and relief joints
- ▶ Repair/strengthen deteriorated members of truss & floor system
- ▶ Repair caps, columns, crash walls of all 10 piers
- ▶ Repair pier protection system at piers 5 and 6



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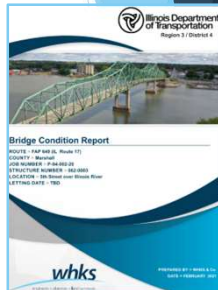
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### Bridge Condition Report Recommendations

- ▶ Clean and paint the superstructure
  - ❖ Truss Spans - Splash zone (12 ft above deck) and entire floor system below the deck
  - ❖ Approach Spans - Fascia beams & 5 ft of all beam ends at joints



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### Bridge Deck Overlay Evaluation

- ▶ Thin Polymer Overlay
  - ❖ Condition Rating = '6' → good option!
  - ❖ 3/8 inch thick → lightweight option
  - ❖ Requires partial depth slab repairs
  - ❖ 12 - 15 year lifespan → replacement likely within 25 years



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## Bridge Deck Overlay Evaluation

### ► Hard Concrete Overlay

- ❖ 2.25 inch overlay with 0.75 inch scarification → 1.75 inch increase in deck thickness
- ❖ Dead load increase??? (IRF=0.65, ORF=1.09)
- ❖ Hydro-scarification → X-partial depth slab repairs
- ❖ 20 - 25 year lifespan



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## Load Rating Report

- Effects of concrete overlay weight
- Approach span beams
- Truss members, gusset plates, floor beams, and stringer
- Determine needed repairs / strengthening
  - ❖ AASHTO HS-20 IRF  $\geq 0.9$
  - ❖ AASHTO HS-20 ORF  $\geq 1.0$
  - ❖ IL Rating Vehicles ORF  $\geq 1.0$



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## Bridge Deck Overlay



- Latex Concrete Overlay - difficulty placing on grades > 3%
- Microsilica Concrete Overlay chosen
- Scarification and overlay - 4,600 square yards

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### Bridge Deck Overlay



1/4 inch mechanical scarification + 1/2 inch hydro-scarification

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### Bridge Deck Overlay



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### Bridge Deck Overlay



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### Bridge Deck Overlay



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### Bridge Deck Overlay



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### Bridge Deck Overlay



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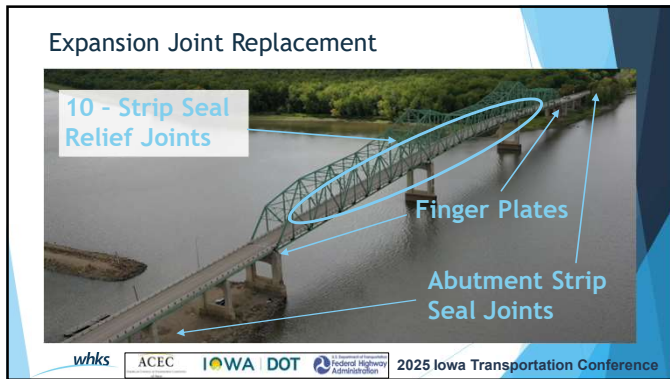
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### Expansion Joint Replacement



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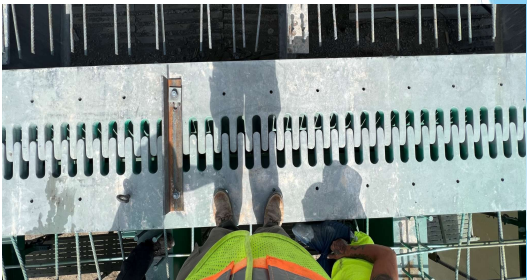
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### Expansion Joint Replacement



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### Structural Steel Repair

- Structural Steel Removal - 25,000 Pounds
- Furnish & Erect Structural Steel - 50,500 Pounds
- Structural Steel Repairs - 21,000 Pounds
- Temporary Shoring

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### Structural Steel Repair - Floor Beam End Repair



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### Structural Steel Repair - Floor Beam End Replacement



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### Structural Steel Repair - Floor Beam End Replacement



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### Structural Steel Repair - Temporary Shoring



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### Structural Steel Repair - Temporary Shoring



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### Structural Steel Repair



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### Piers 5 and 6 Repairs



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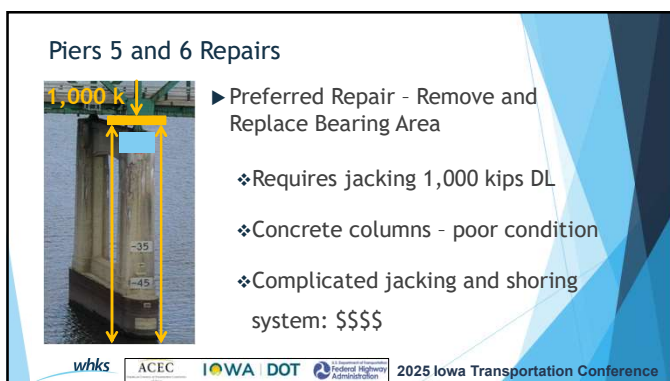
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Piers 5 and 6 Repairs



Concrete directly under the bearing generally sound

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Piers 5 and 6 Repairs

- Preserve/strengthen the core - jacket top 7 ft



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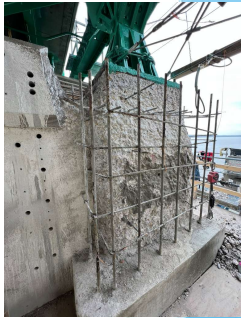
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Piers 5 and 6 Repairs

- Preserve/strengthen the core - jacket top 7 ft
- Remove unsound exterior concrete



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### Piers 5 and 6 Repairs

- ▶ Preserve/strengthen the core - jacket top 7 ft
- ▶ Remove unsound exterior concrete
- ▶ Add supplemental reinforcement



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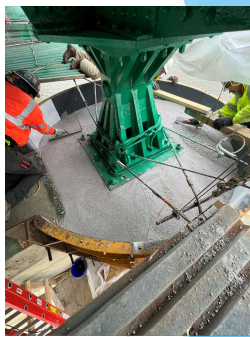
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### Piers 5 and 6 Repairs

- ▶ Preserve/strengthen the core - jacket top 7 ft
- ▶ Remove unsound exterior concrete
- ▶ Add supplemental reinforcement
- ▶ Use MMA Polymer Concrete



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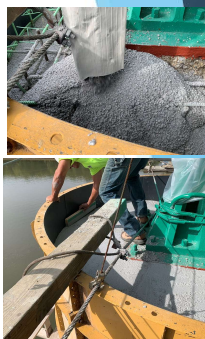
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### Piers 5 and 6 Repairs

- ▶ Methyl Methacrylate (MMA) Concrete  
- resin based rapid-setting material  
(Transpo T-17 used for project)
- ▶  $f'_c$ : 8 ksi /  $f_t$ : 1 ksi
- ▶ Resin based - minimal shrinkage
- ▶ Strong chemical bond/adhesion
- ▶ Impermeable
- ▶ \$\$\$ < UHPC



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### Piers 5 and 6 Repairs

- ▶ PT Strands
- ▶ 6 - 0.6" diameter strands
- ▶ Stressed to 47.5 kips
- ▶ Active confinement
- ▶ Anchorage



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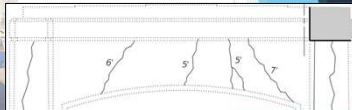
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### Piers 1-4 & 7-10



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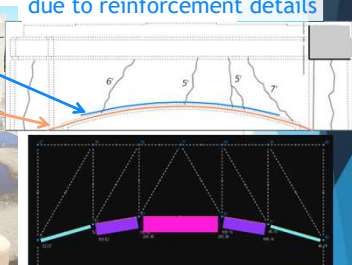
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### Piers 1-4 & 7-10

Concerns that cracks may be due to reinforcement details



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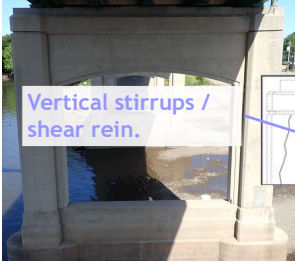
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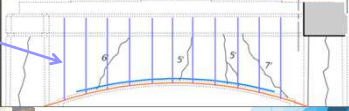


Piers 1-4 & 7-10



Vertical stirrups / shear rein.

Concerns that cracks may not be intersected by shear rein.



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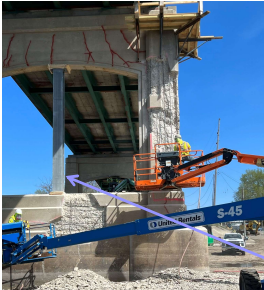
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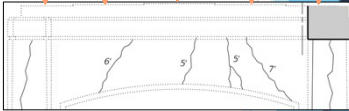
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Piers 1-4 & 7-10



2023 DL  
1990 DL  
1939 DL



Steel support columns added

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Structural Repair of Concrete



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### Structural Repair of Concrete



Many locations -  
repairs limited to  
one face of one  
column at a time  
at a pier

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### Structural Repair of Concrete



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### Structural Repair of Concrete



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# Structural Repair of Concrete

- Shotcrete



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# Structural Repair of Concrete

- Shotcrete



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# Structural Repair of Concrete

- Shotcrete



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### Pier Protection Cell Repairs



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### Pier Protection Cell Repairs

- Existing plans: ice protection plates

No horizontal reinforcement present



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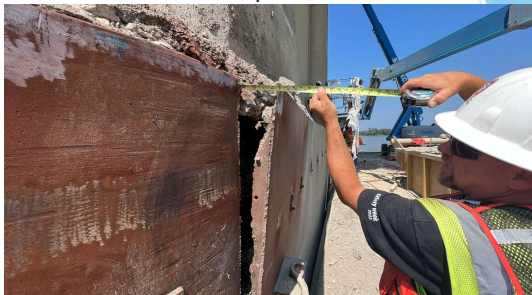
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### Pier Protection Cell Repairs



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### Pier Protection Cell Repairs



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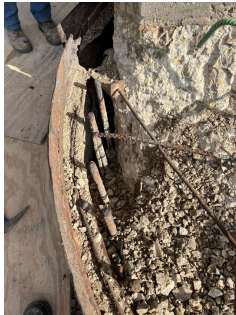
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### Pier Protection Cell Repairs



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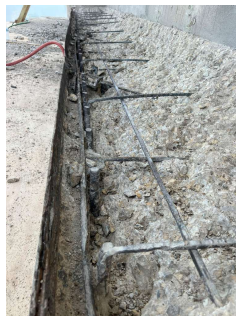
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### Pier Protection Cell Repairs



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### Pier Protection Cell Repairs



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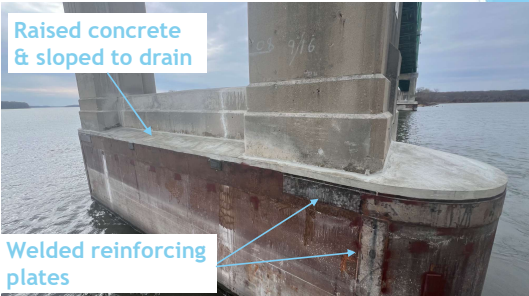
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### Pier Protection Cell Repairs



Raised concrete & sloped to drain

Welded reinforcing plates

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### Contract Data

- ▶ November 2022 Letting
- ▶ Low bid \$10,100,000
- ▶ White Construction (William Charles)
- ▶ Road closure April 1, 2023 - November 3, 2023
- ▶ Liquidated damages - \$15,000 / day



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## Contract Data

- ▶ November 2022 Letting
- ▶ \*Road closure April 1, 2023 - November 3, 2023
- ▶ \*Liquidated damages - \$15,000 / day

*\*Significant Phase III involvement for construction issues*



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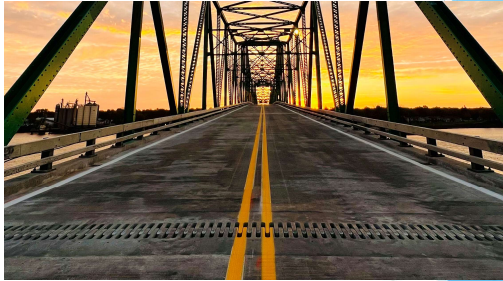
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## Questions???



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