ARCADIS Design & Consultancy for natural and built assets

ACCELERATED BRIDGE CONSTRUCTION – LATERAL BRIDGE SLIDE

ODOT Pilot Project: I-75 over US 6

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CEAO 2016 Ohio Bridge Conference

August 19, 2016

Agenda

- Introduction to Project
- Prepare for Design
- Design Approach
- Construction
- Lessons Learned

Introduction to Project

A Unique Project for Ohio DOT

Why did ODOT choose ABC?

- Looking for different construction methods
- Very concerned with driver delay and inconvenience
- Work-zone safety for drivers and workers
- Improved construction quality

Introduction to Project

Accelerated Bridge Construction – Structural Elements

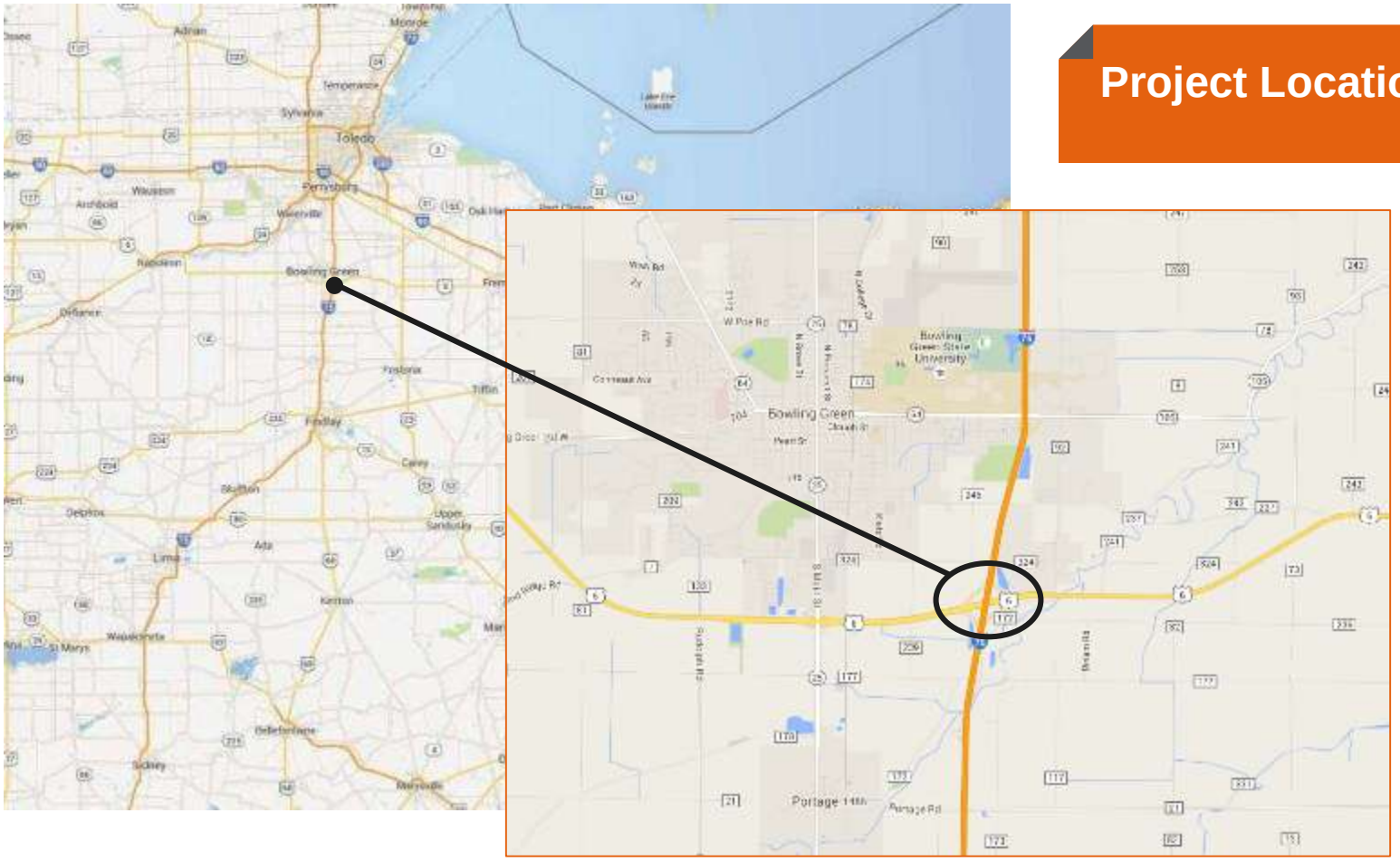
Prefabricated Elements

- Deck Panels
- Beam Elements
- Pier Elements
- Abutment & Wall Elements
- Others: Approach Slabs, Parapets, etc.

Structural Placement Methods

- Self-Propelled Modular Transporters (SPMT)
- Slide-in Bridge Construction
- Longitudinal Launching

Introduction to Project



Introduction to Project

Why this location?

- For pilot project, plenty of room to construct within an interchange
- ODOT District 2 not afraid to try something new and innovative
- Bridge needed replaced and widened for 3rd lane project

Introduction to Project

Existing Twin Structures

- 4-Span Rolled Steel Beam and Concrete Deck
- Spill-through Stub Abutments on H-piles
- Cap and Column Piers on Spread Footings

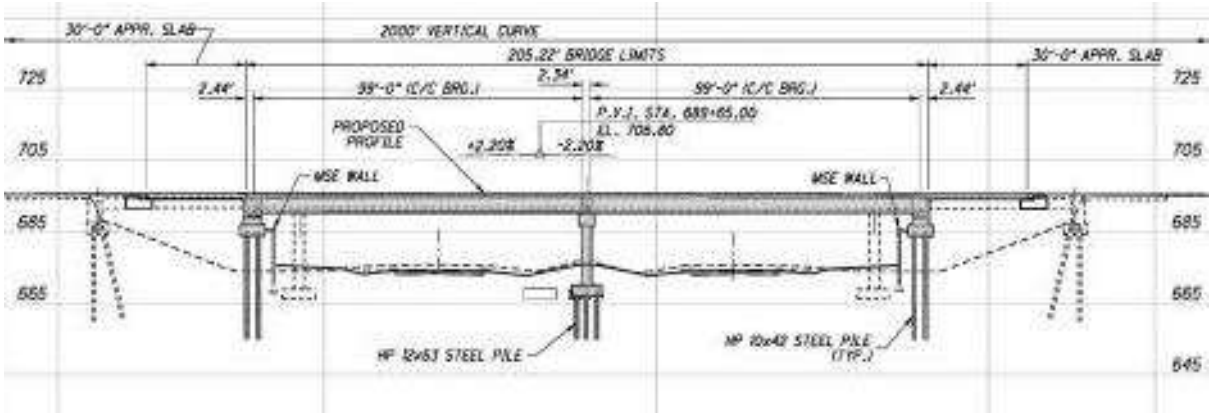
Introduction to Project

Introduction to Project

Introduction to Project

Proposed Twin Structures

- 2-Span Precast, Prestressed Concrete I-Beam and Concrete Deck
- Stub Abutments on H-piles behind Mechanically Stabilized Earth (MSE) Wall
- Cap and Column Pier on H-piles



Prepare for Design

First design utilizing Lateral Bridge Slide

Need to do our homework

Research

- How are other states doing ABC

How to slide

- Push, Pull
- Teflon, rollers, etc.

Resources

- FWHA
- Webinars
- Workshops

Prepare for Design

Research

Similar projects in other states:

- Iowa DOT SR 92 over stream
  - 120’ single span precast I-beams
  - Slid on PTFE (Teflon) coated bearings
- Utah DOT I-80 over Echo Dam Road
  - 78’ single span precast I-beams
  - Slid on PTFE bearings
  - Superstructure supported on temporary steel bents
  - Approach slab moved with superstructure

Prepare for Design

How to slide

Push or Pull?

- Both have been completed successfully
- Affects plan details
- Design assumed contractor would push
- Slide on Teflon coated elastomeric bearings

Prepare for Design

Resources

FHWA

- Accelerated Construction website
  - www.fhwa.dot.gov/bridge/abc/
  - Website devoted to Slide-in Bridge Construction
    - www.fhwa.dot.gov/construction/sibc/
  - Manuals, Specifications, etc.

Webinars

- FHWA
- Florida International University
- Colorado DOT

Prepare for Design

Workshops

Utah DOT: I-84 over Echo Frontage Road

- Single span precast box beams & no approach slab
- Pulled using 2 cranes simultaneously
- Slid on PTFE coated elastomeric bearings

New York DOT: I-84 over Dingle Ridge Road

- Single span precast double tee beams & approach slab
- Pushed with hydraulic ram with steel guide rail
- Slid on PTFE coated elastomeric bearings

Prepare for Design

Workshop: Utah DOT I-84 over Echo Frontage Road

Prepare for Design

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Prepare for Design

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Prepare for Design

Utah DOT: I-84 over Echo Frontage Road

Lessons Learned:

- Sliding on PTFE coated bearings was effective
  - Bearings are very “slippery”
  - Kinetic friction much less than static friction
- Pulling with cranes was not effective
  - Tension in cables difficult to control
  - Bridge tended to “rack” and was difficult to control

Prepare for Design

Workshop: NY DOT I-84 over Dingle Ridge Road

Prepare for Design

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Prepare for Design

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Prepare for Design

Workshop: NY DOT I-84 over Dingle Ridge Road

Prepare for Design

New York DOT: I-84 over Dingle Ridge Road

Lessons Learned:

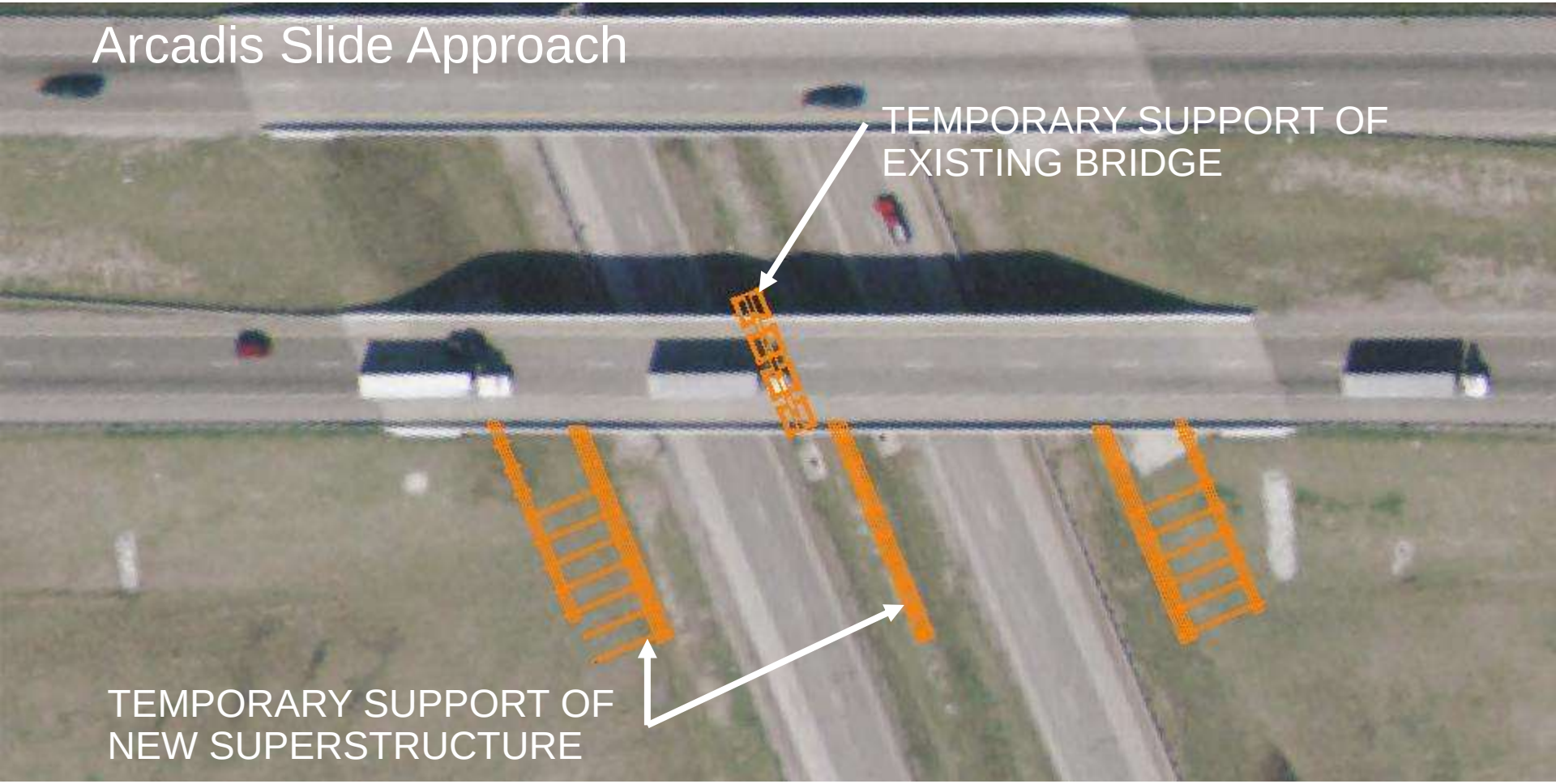
- Sliding on PTFE coated bearings was effective
  - Rain during move increased coefficient of friction
  - Measure movements during slide to control racking
- Pushing with hydraulic ram was effective
- Construction of temporary supports was most time consuming portion of construction

Design Approach

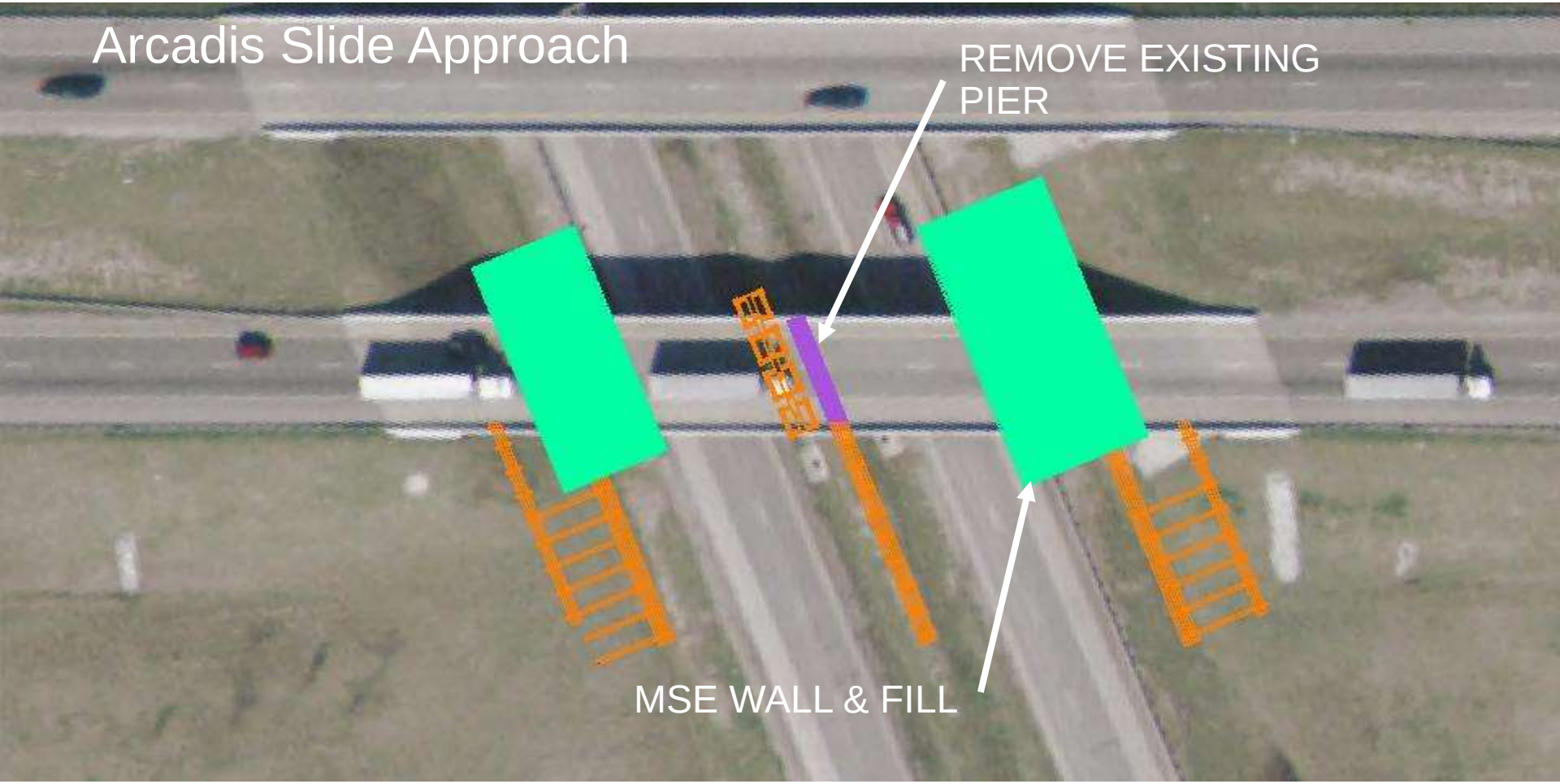
- Arcadis Approach to Slide-in
- Abutment
- Pier
- Superstructure
- Temporary Support
- Slide

Design Approach

Arcadis Slide Approach



Design Approach



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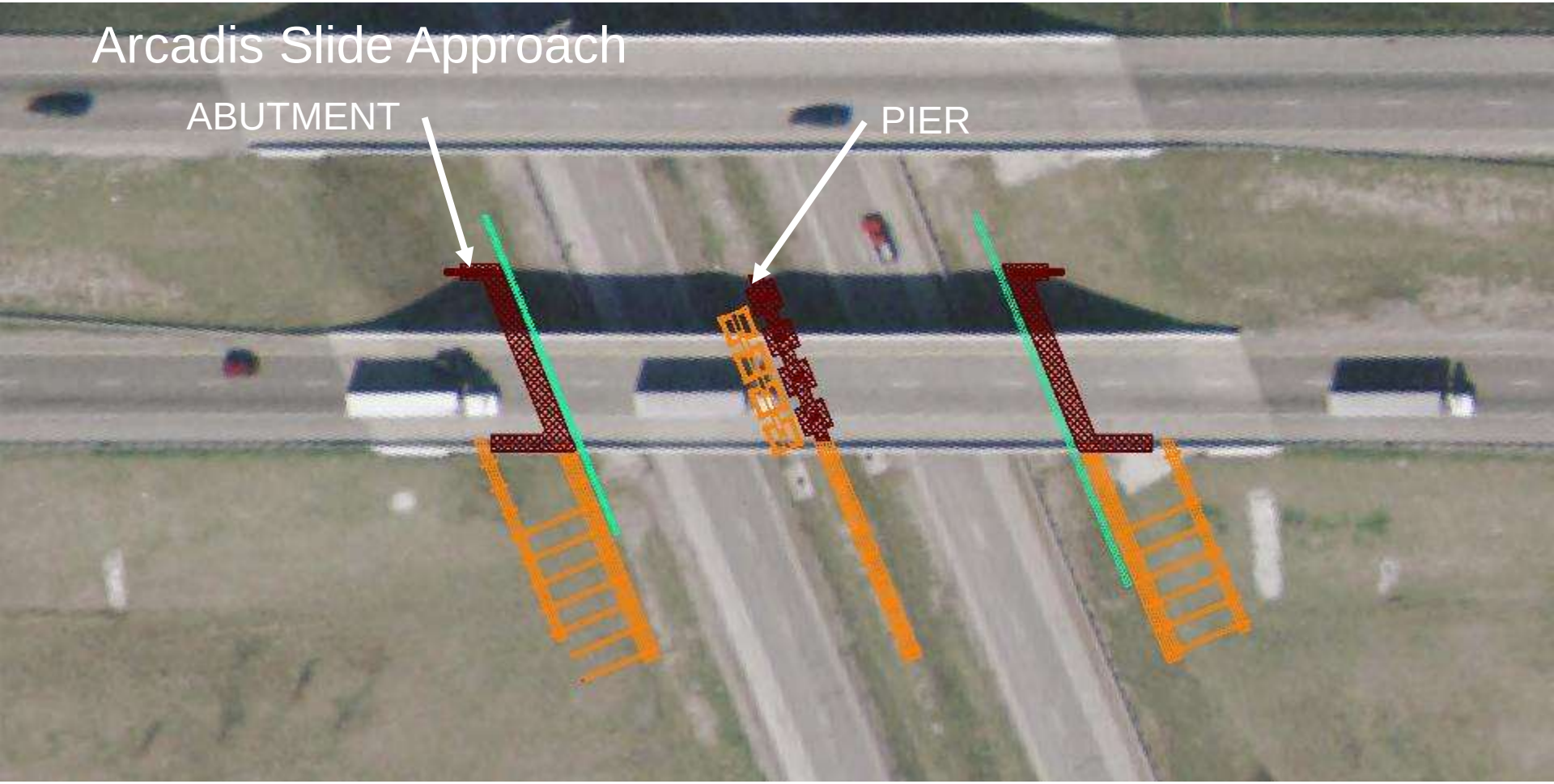
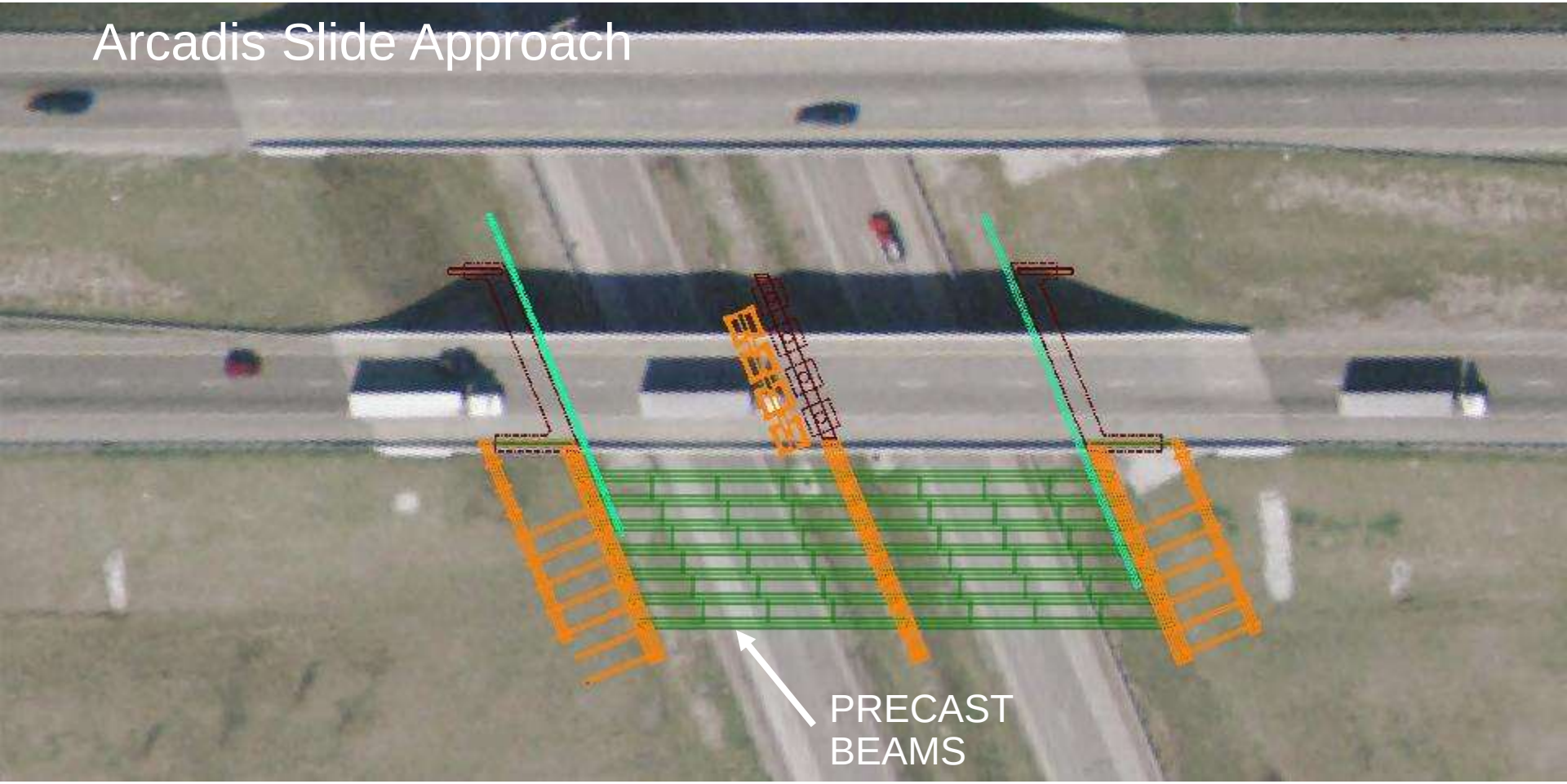


Design Approach

Arcadis Slide Approach



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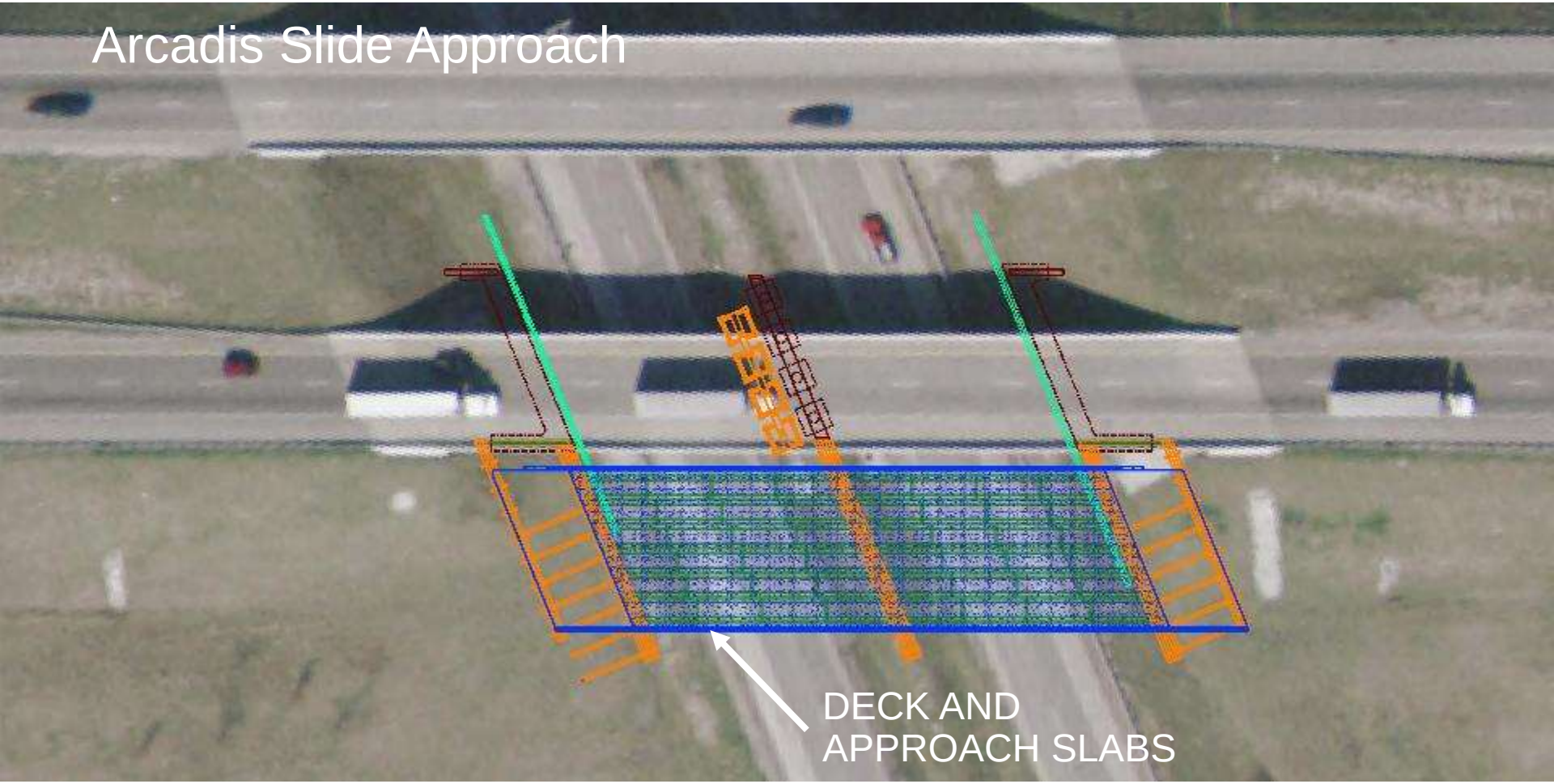

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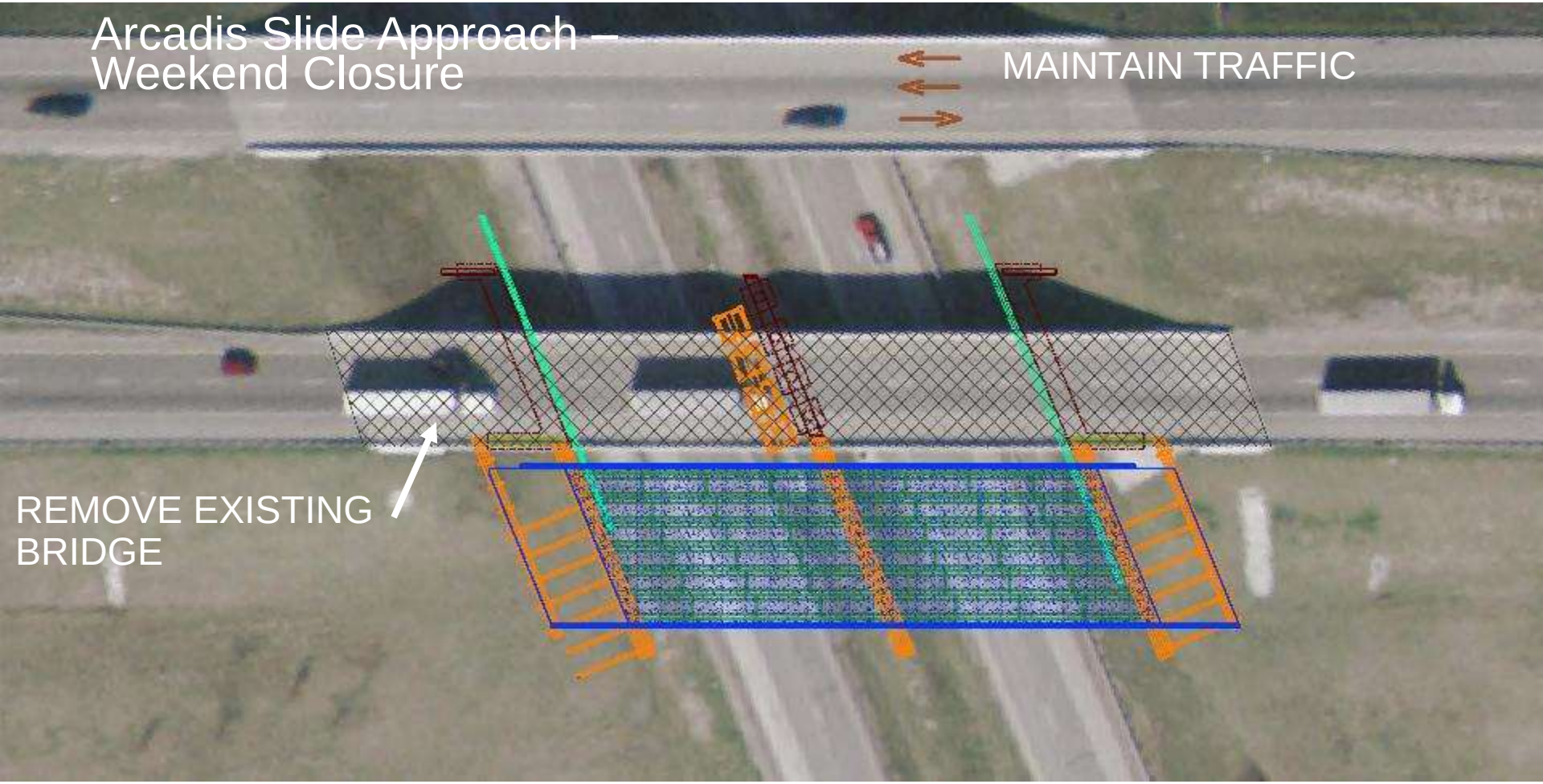

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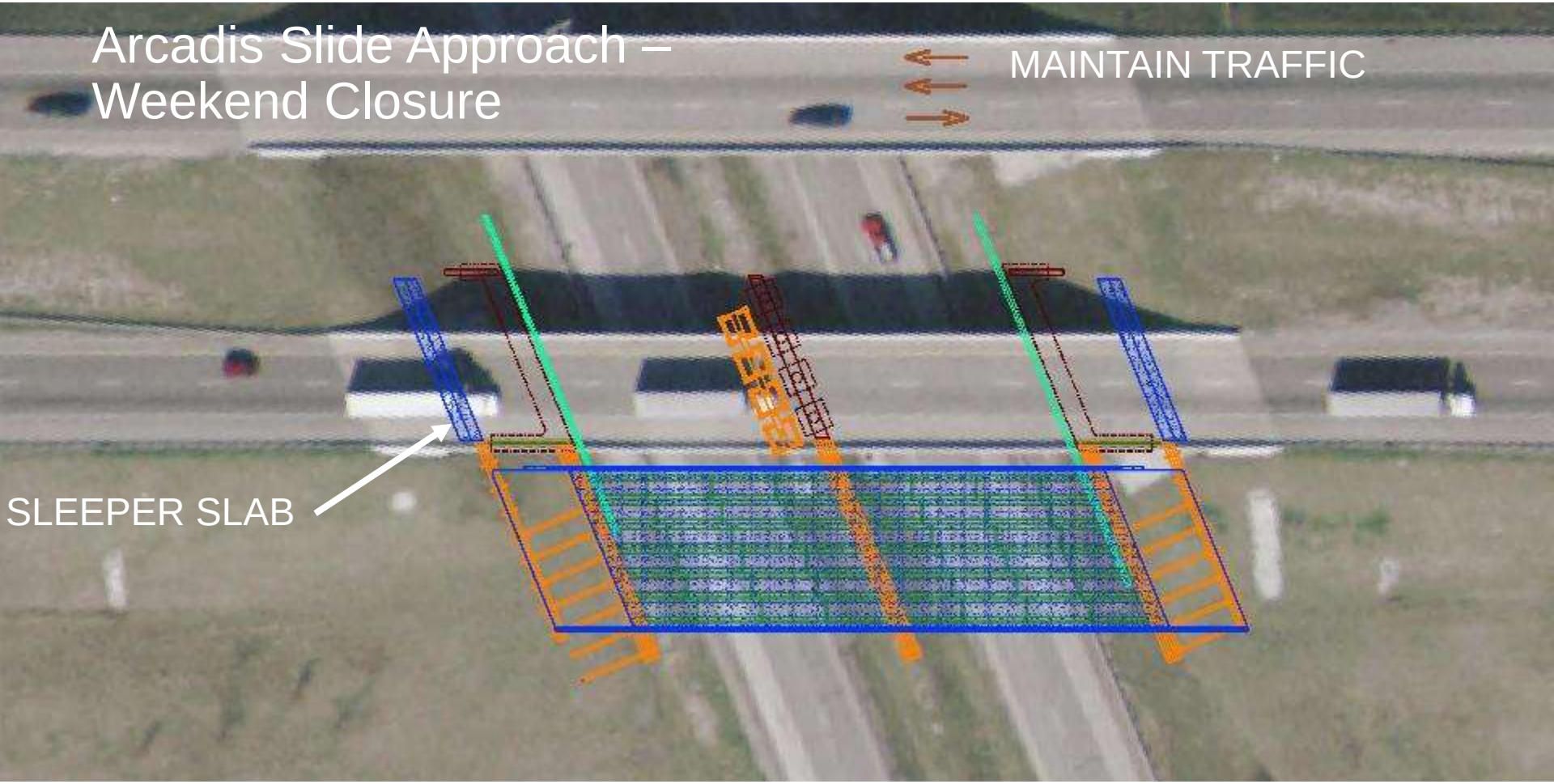

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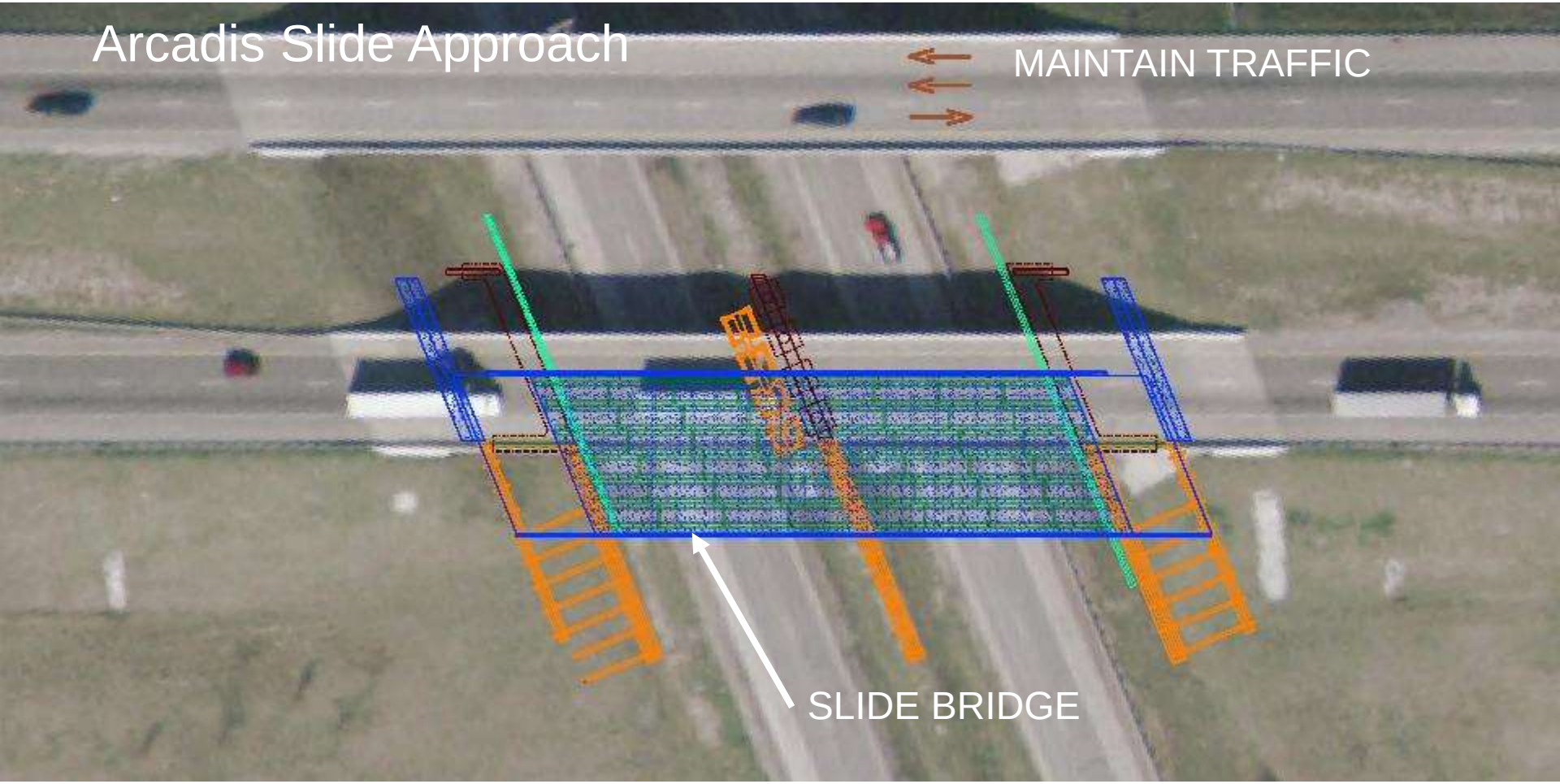

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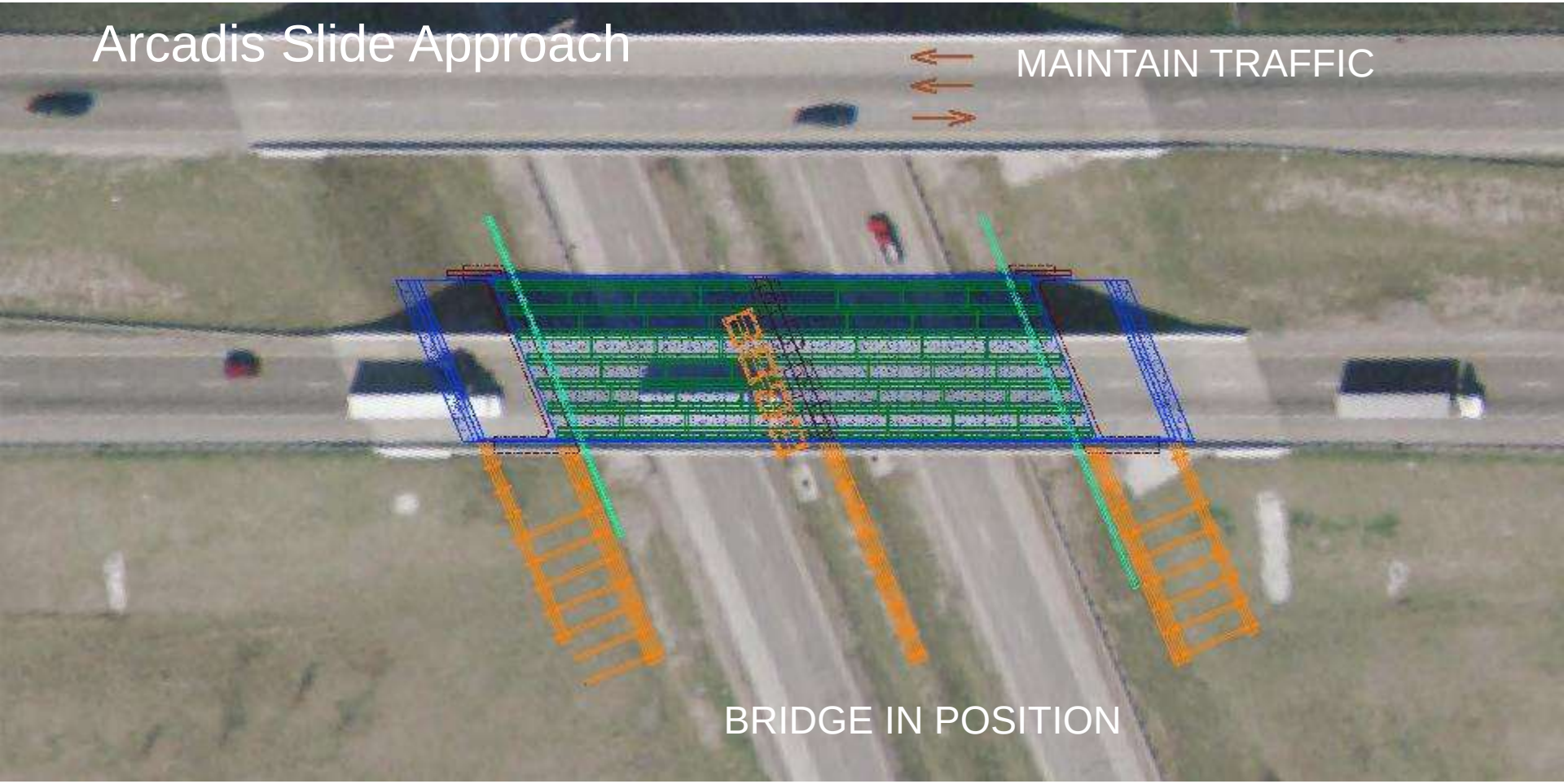

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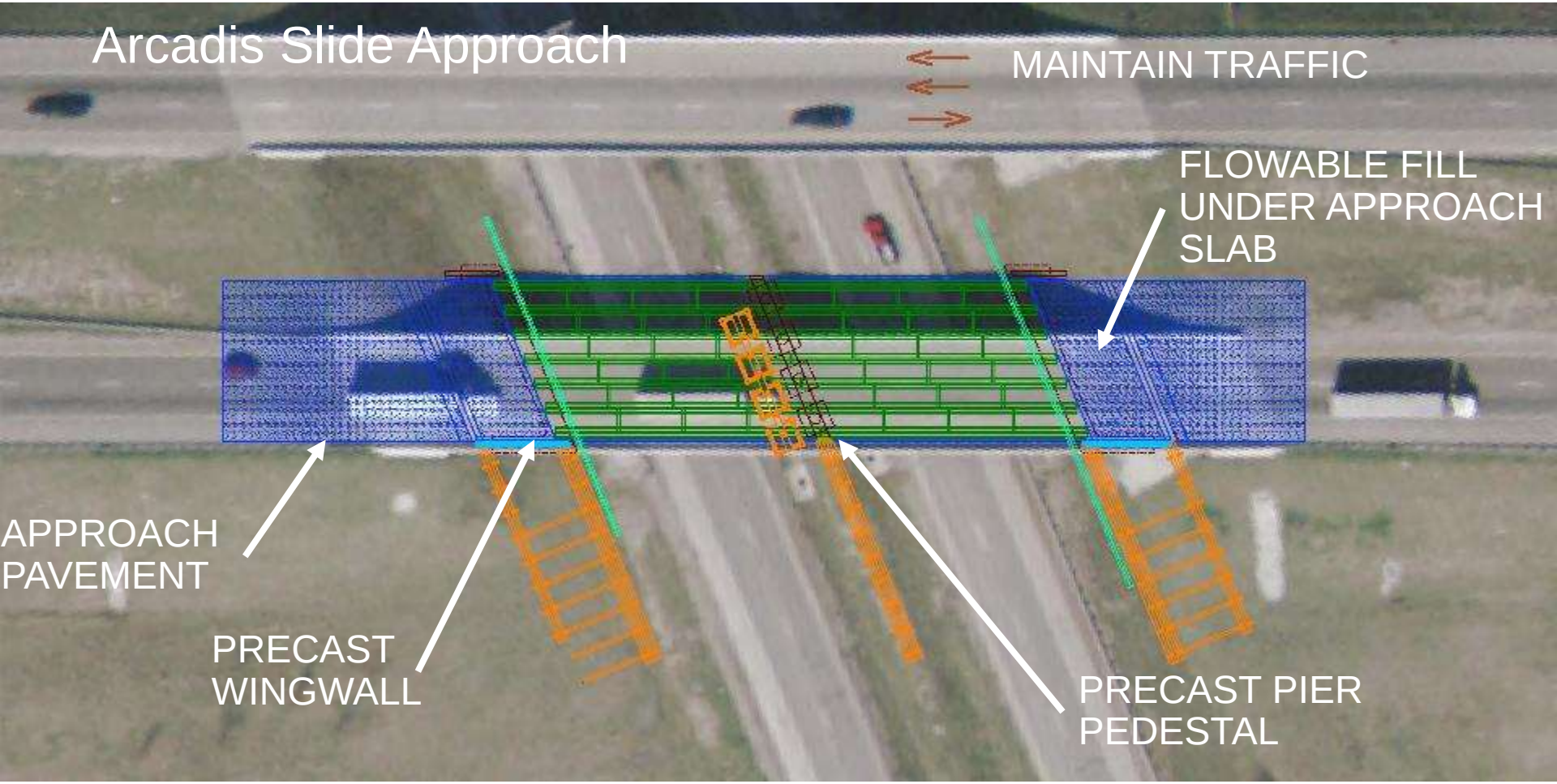
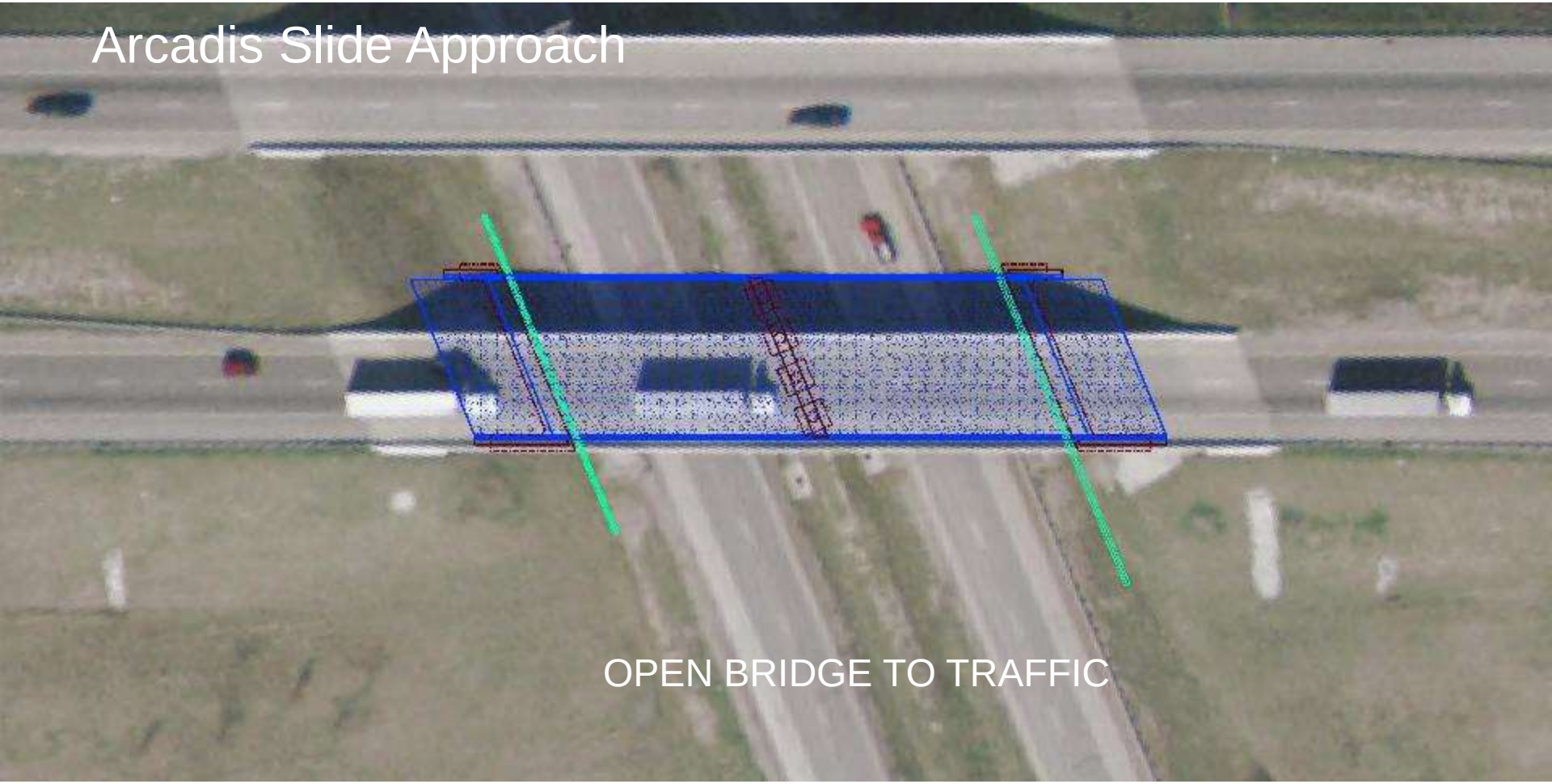


Design Approach



Design Approach

Abutment

Location

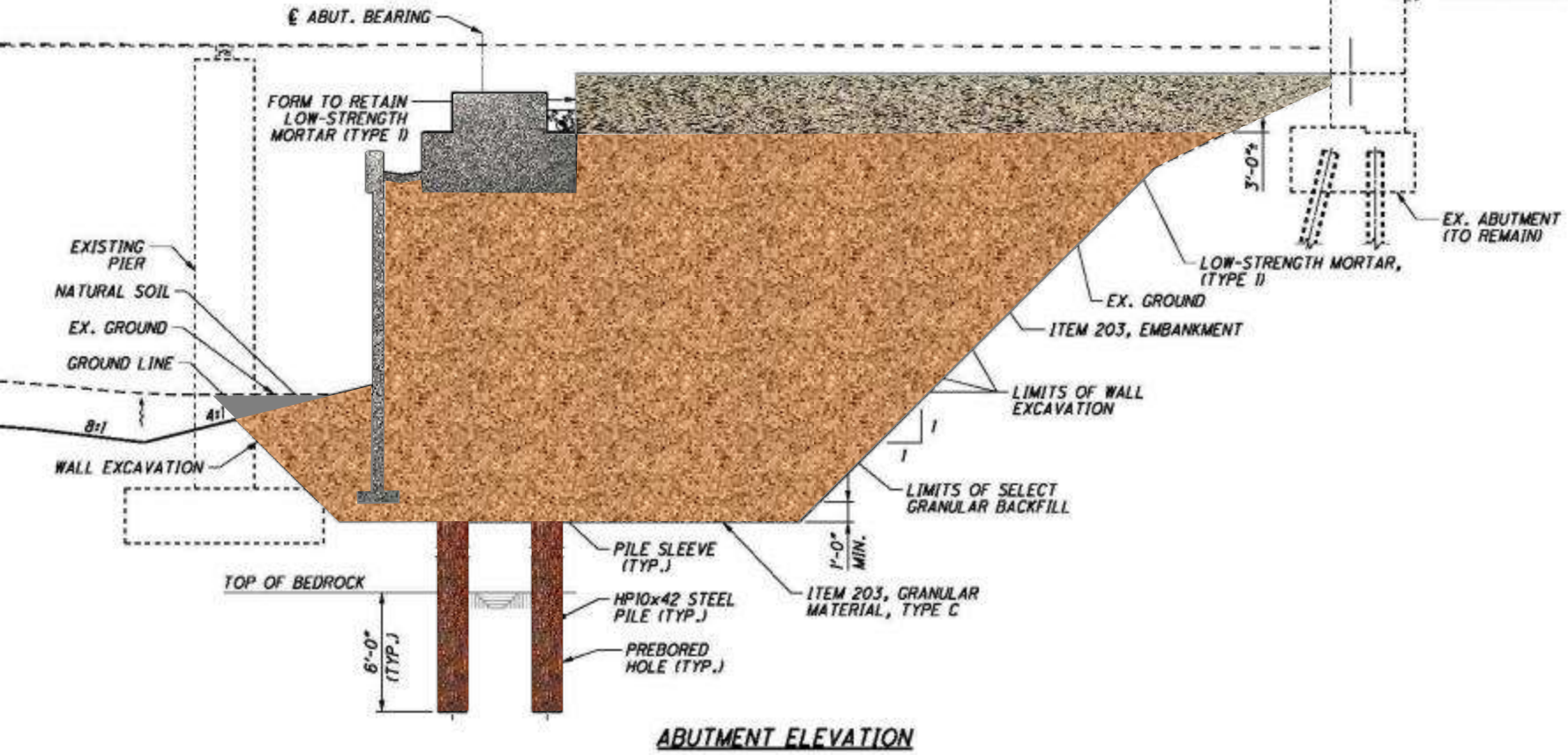
- Under existing bridge
- Placed between existing pier and abutment

Seismic Pedestal

- Usually placed between beams on abutment seat
- Since bridge slides over abutment, use wingwall to resist
- Precast wingwall installed after slide

Design Approach

Abutment



Design Approach

Pier

Pier Location

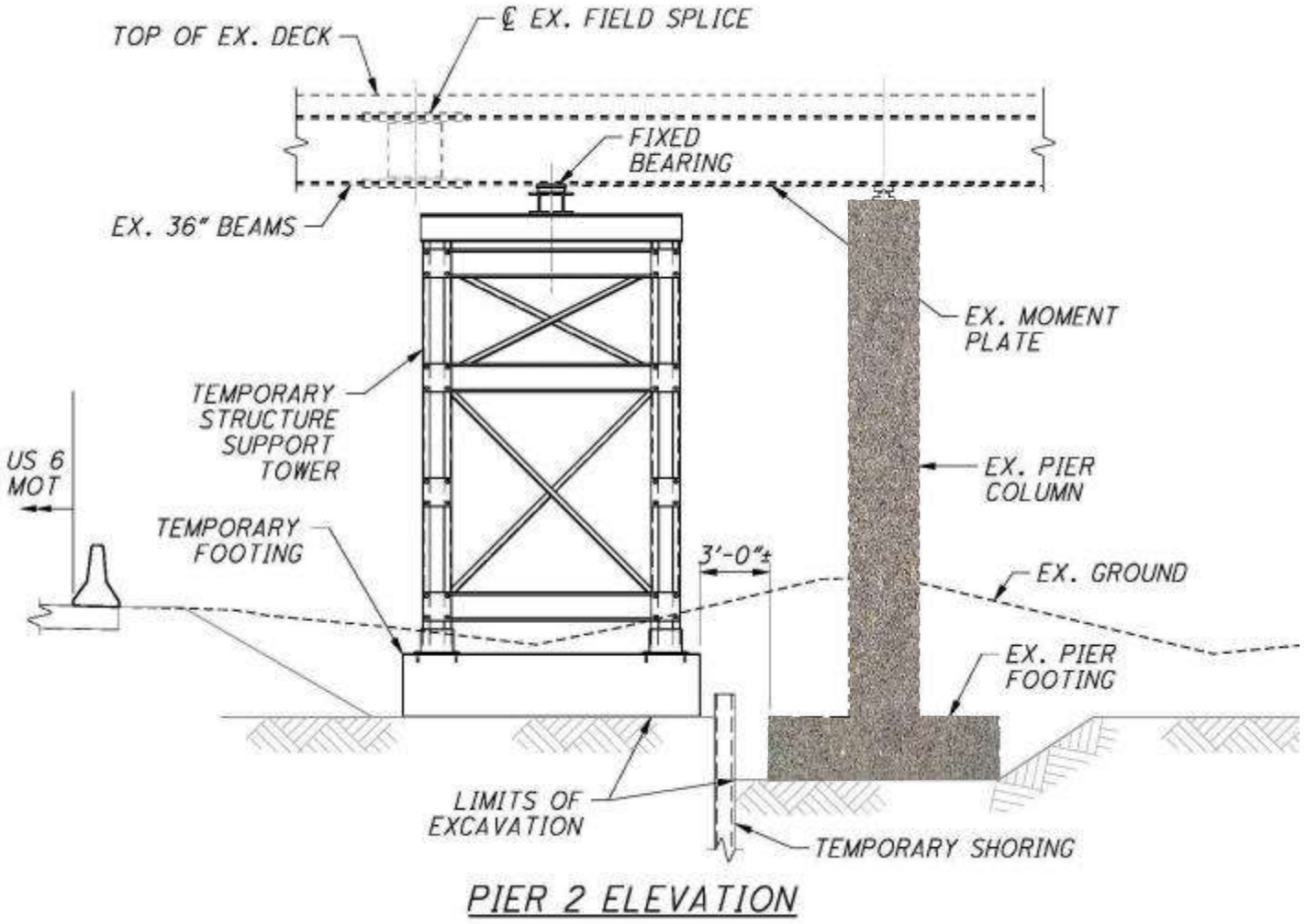
- Temporary support of existing required to build new pier
- Existing bridge now has new span arrangement – required load rating
- Bridge OK for short term

Seismic Pedestal

- Usually placed between beams on pier
- Since bridge slides over pier, pedestal on outside of pier
- Precast pedestal installed after slide

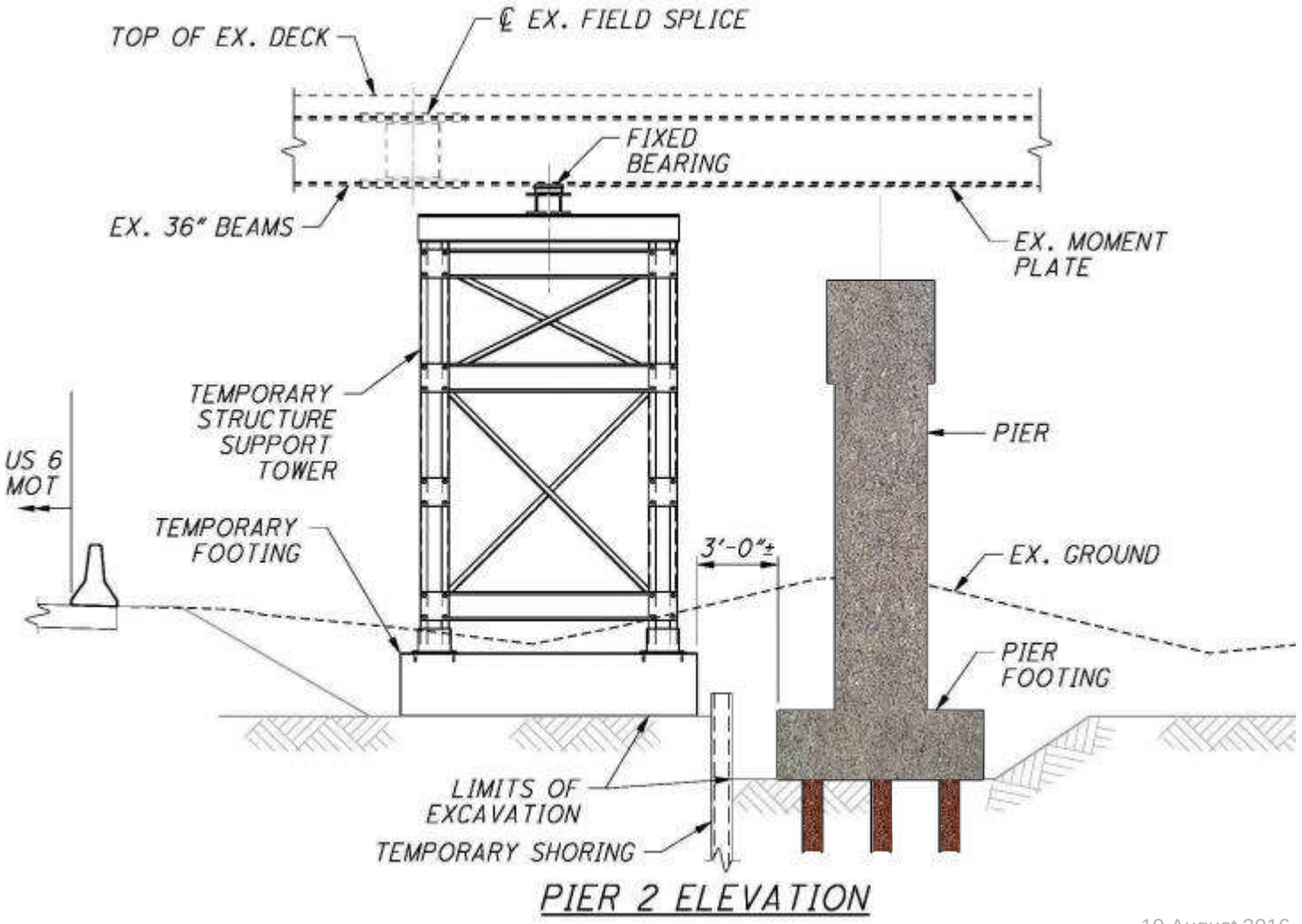
Design Approach

Pier



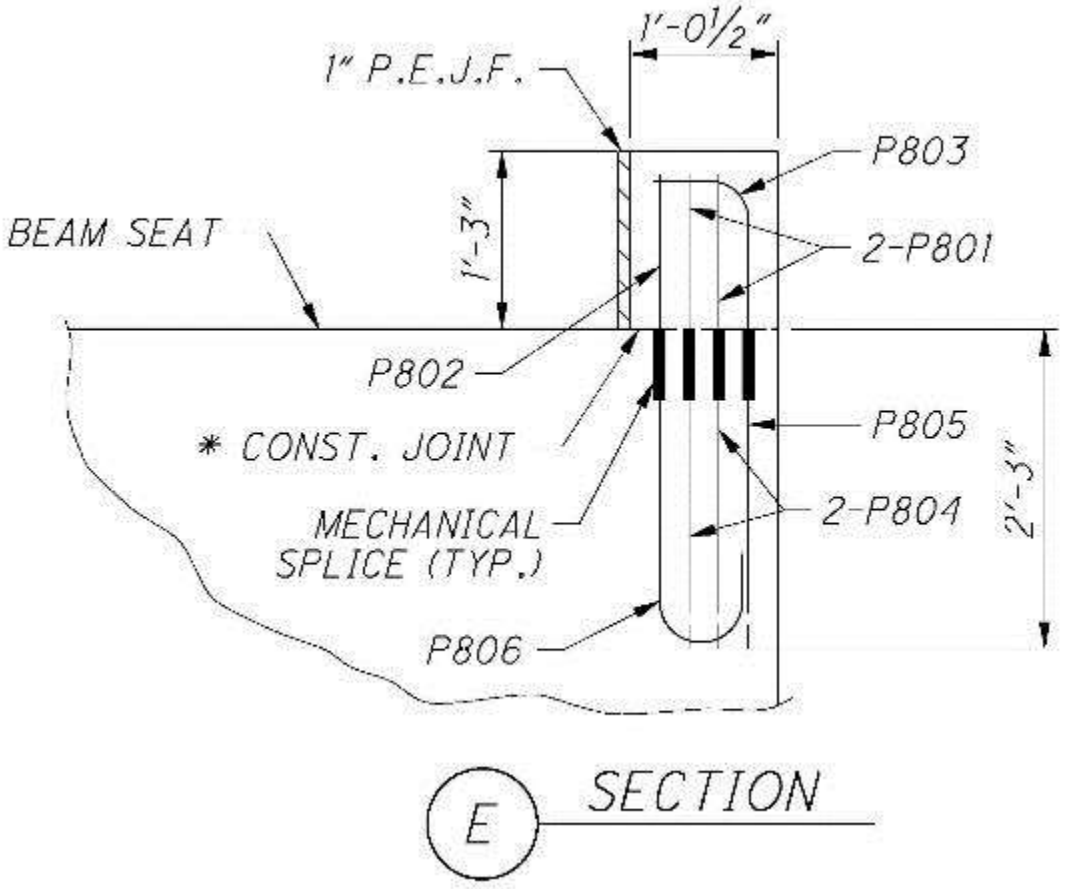
Design Approach

Pier



Design Approach

Pier



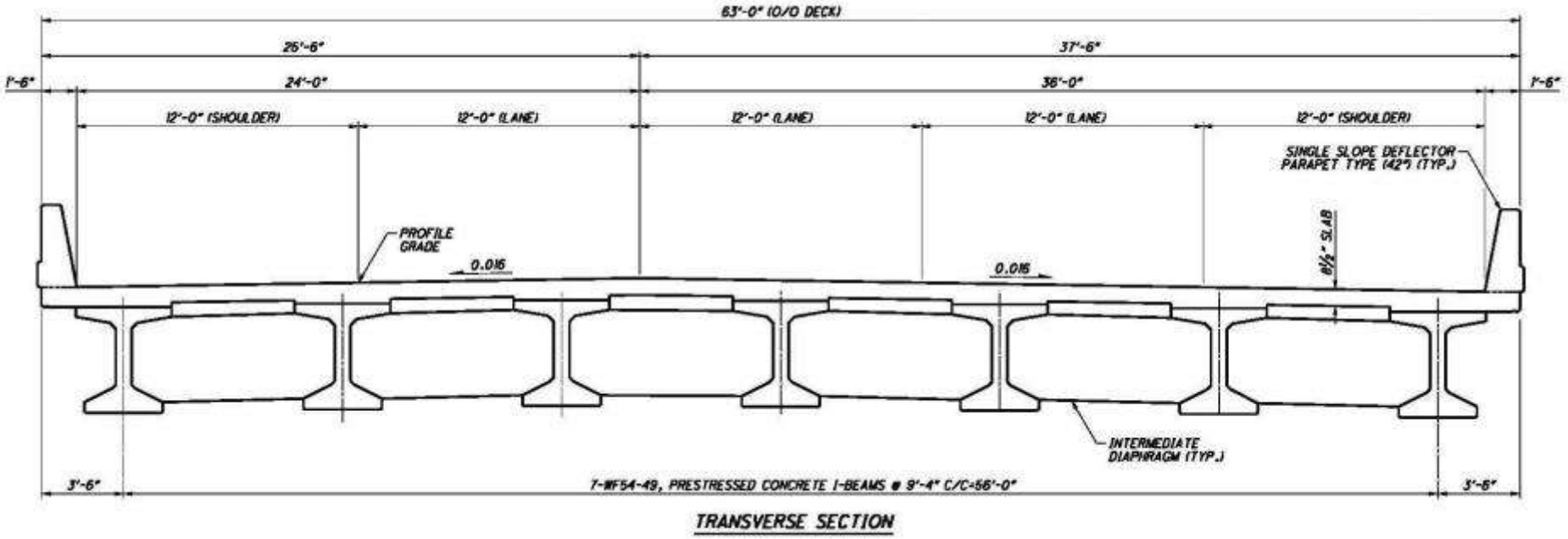
Design Approach

Superstructure

- End diaphragms modified to allow for sliding
  - Stainless steel detailed at bottom of end diaphragms for sliding
  - Details modified at side of diaphragm to allow for pushing
- Approach slabs modified to move with superstructure

Design Approach

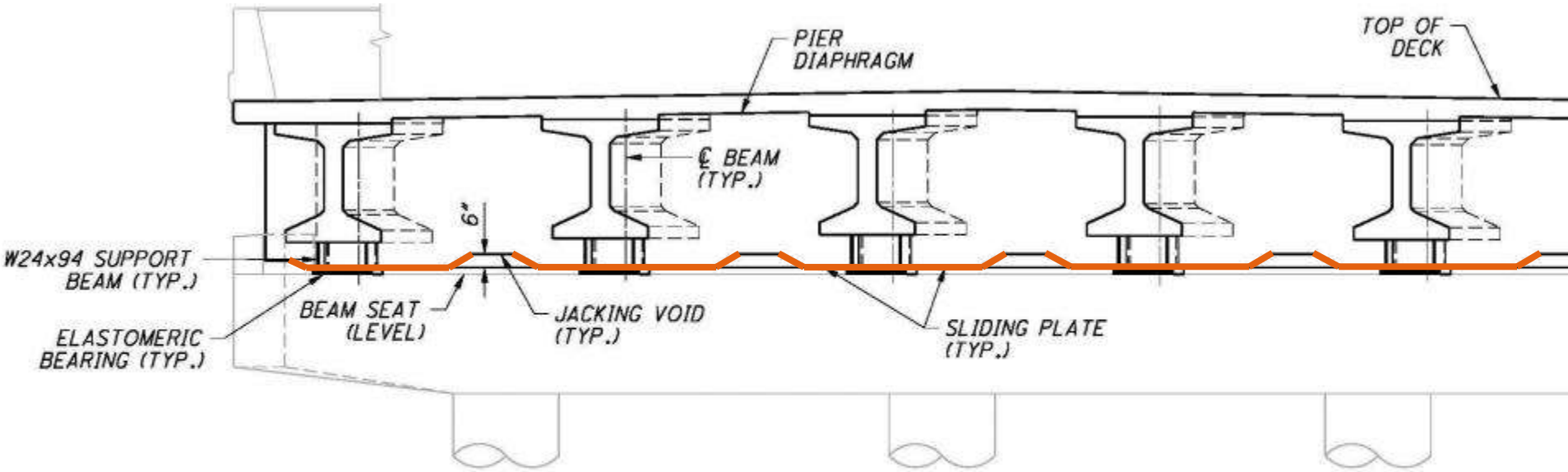
Superstructure



TRANSVERSE SECTION

Design Approach

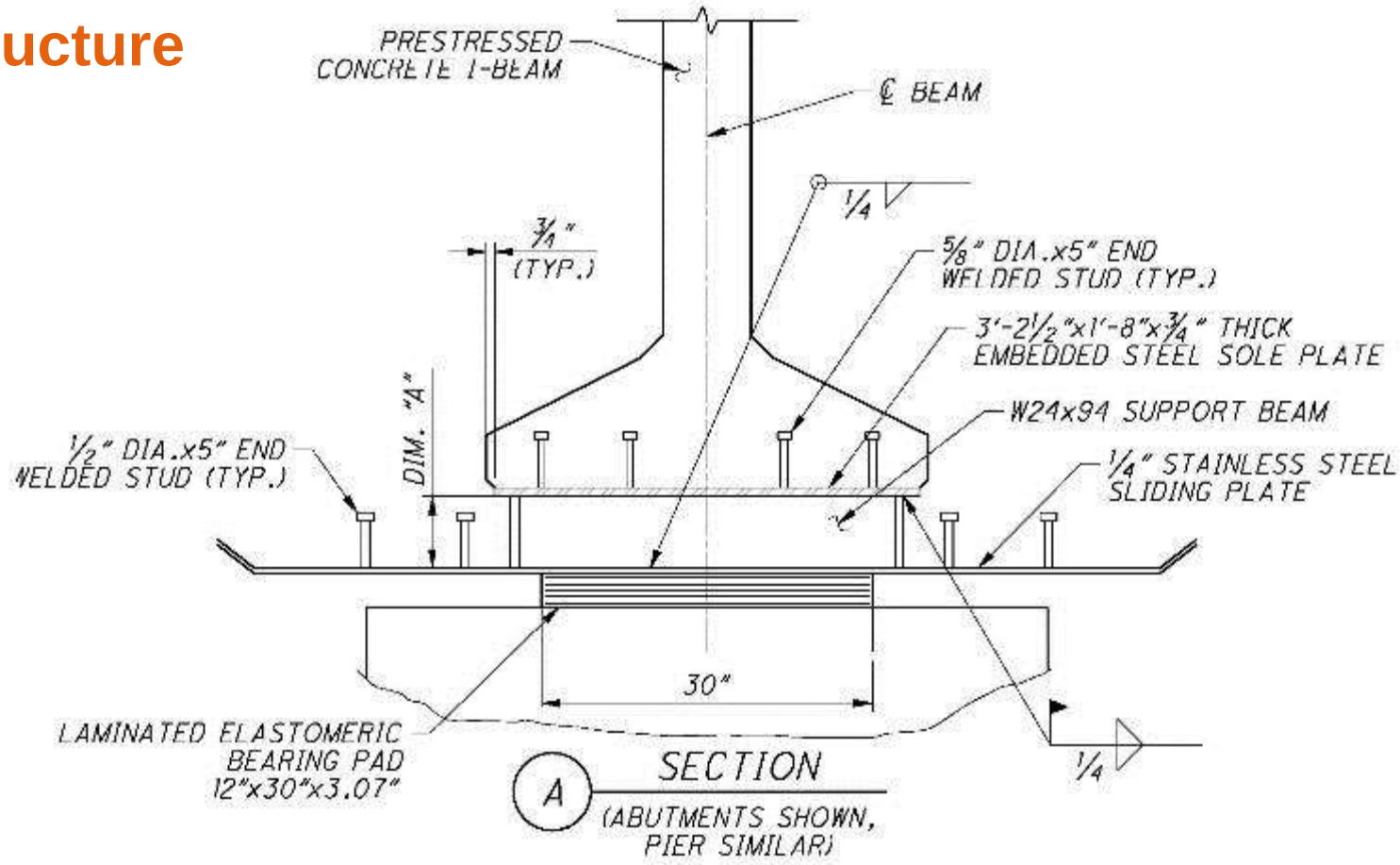
Superstructure



DIAPHRAGM ELEVATION

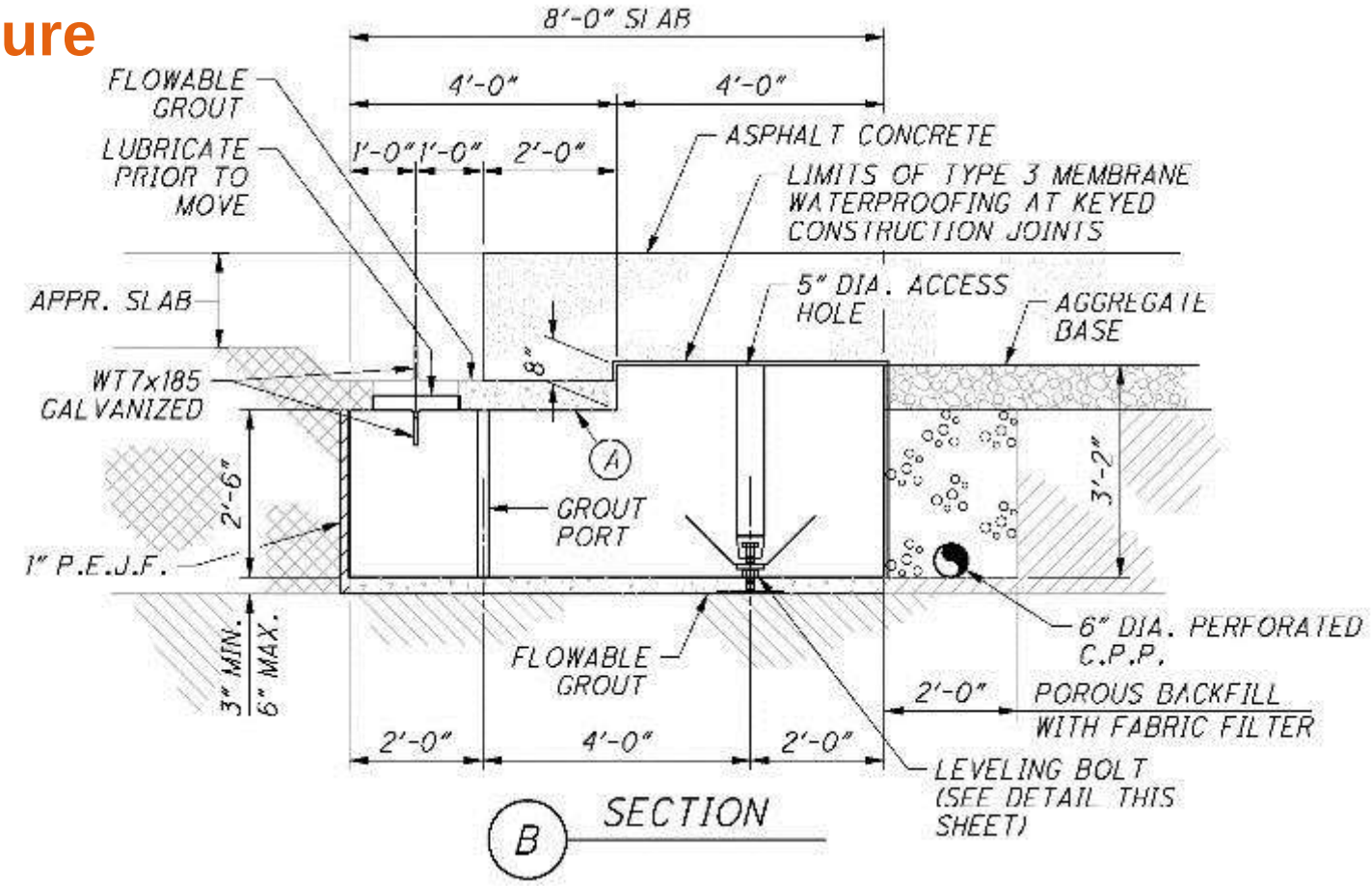
Design Approach

Superstructure



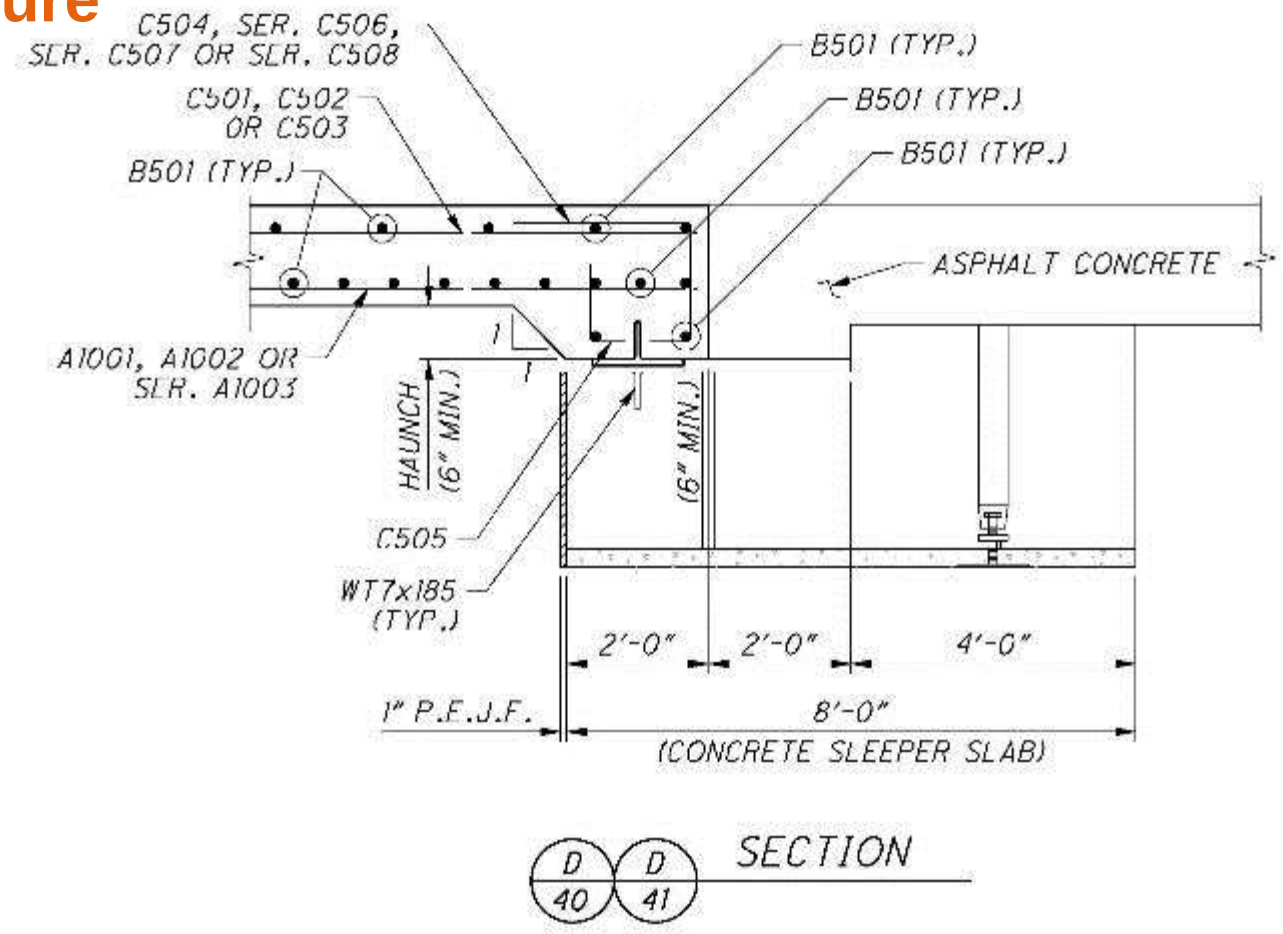
Design Approach

Superstructure



Design Approach

Superstructure



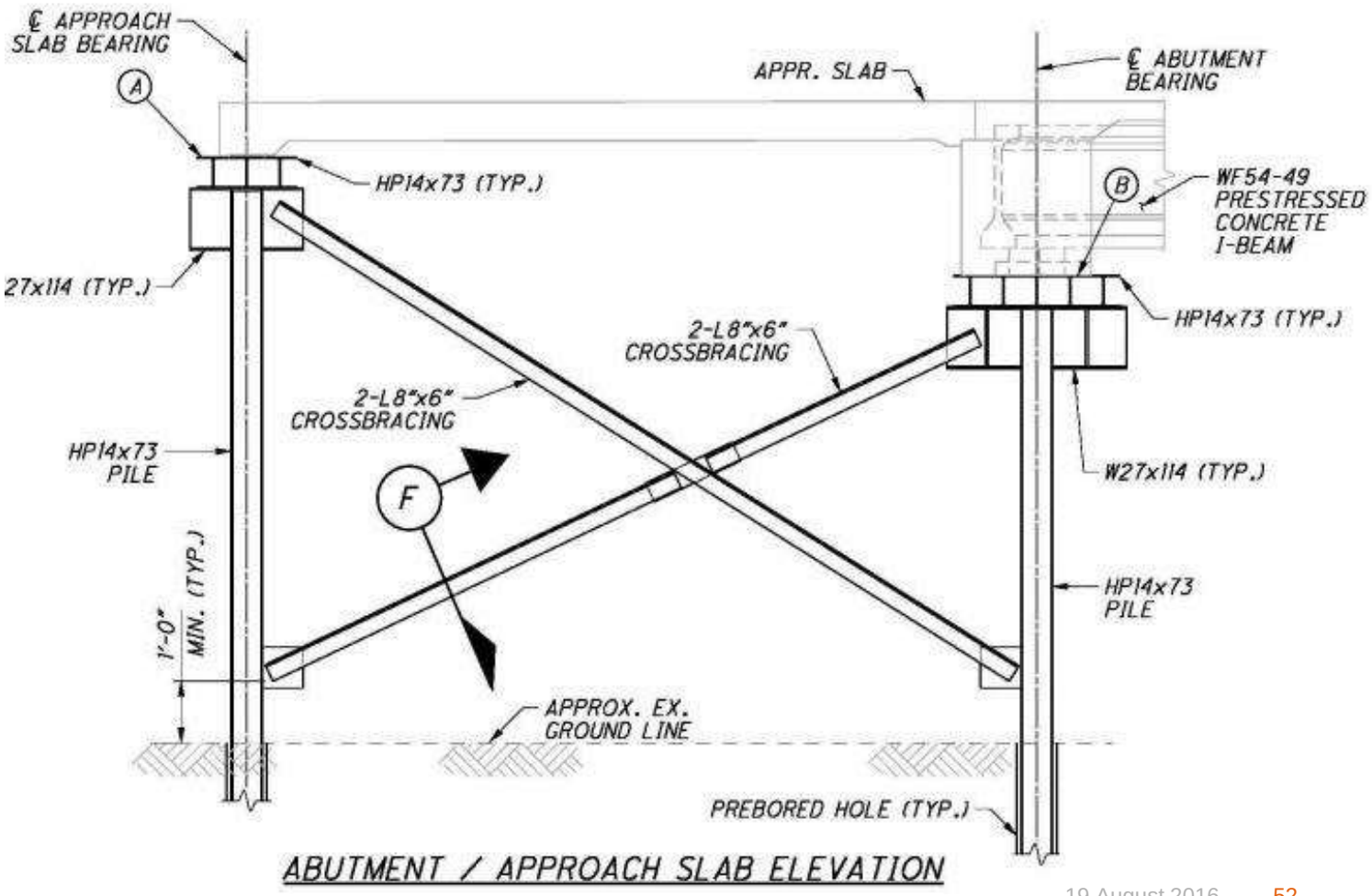
Design Approach

Slide

- How to move – contractor restricted to slide method
- Arcadis assumed pushing on temporary elastomeric bearings
- Temporary supports were designed and could be used by contractor
- Contractor allowed to modify slide details in plan

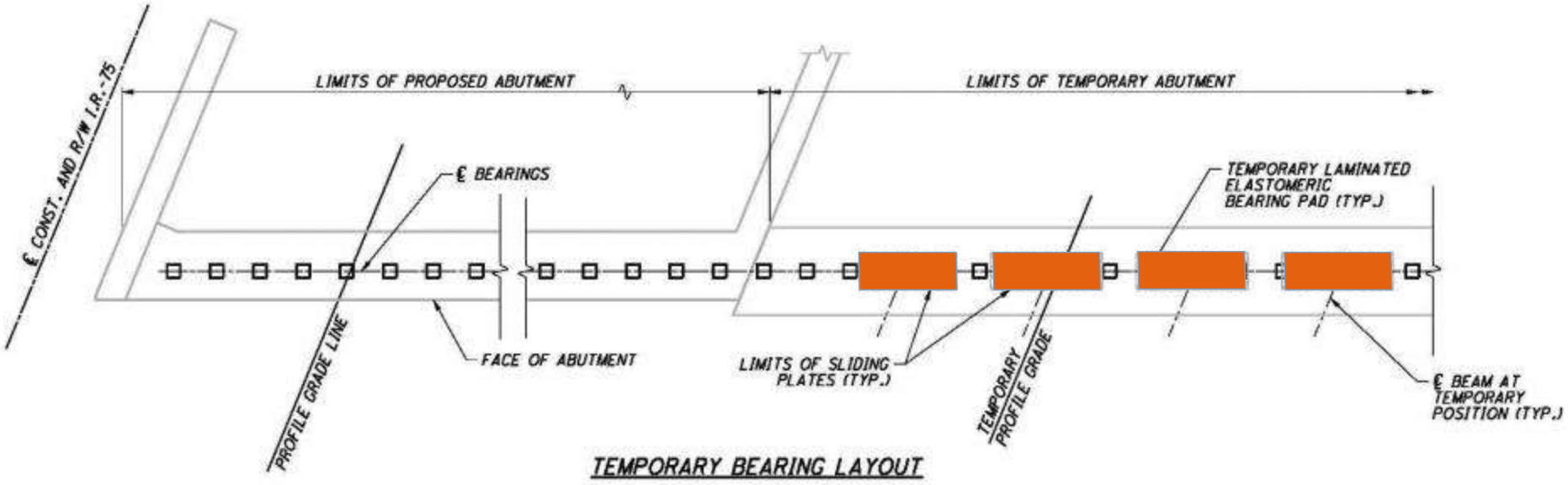
Design Approach

Slide

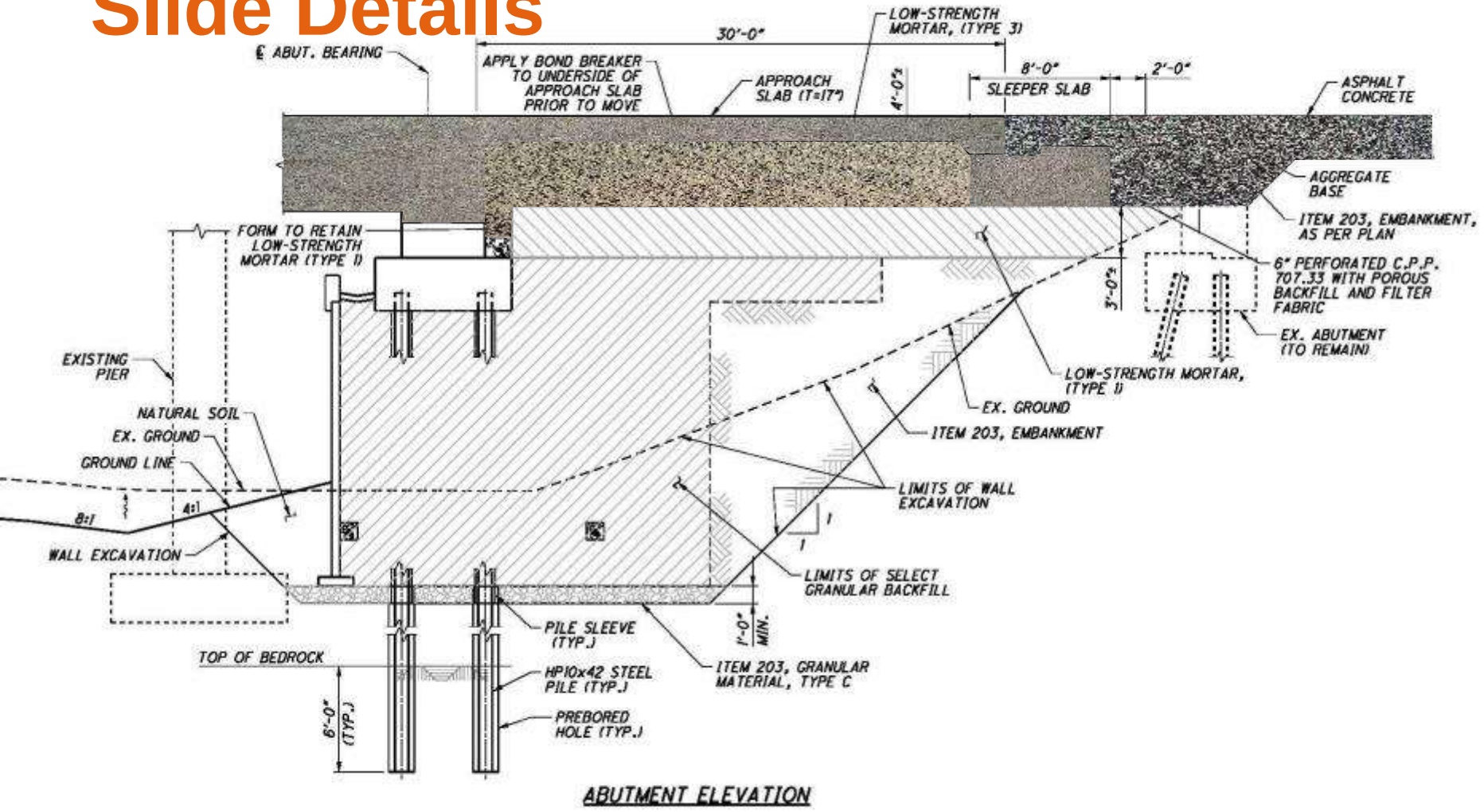


Design Approach

Slide



Slide Details



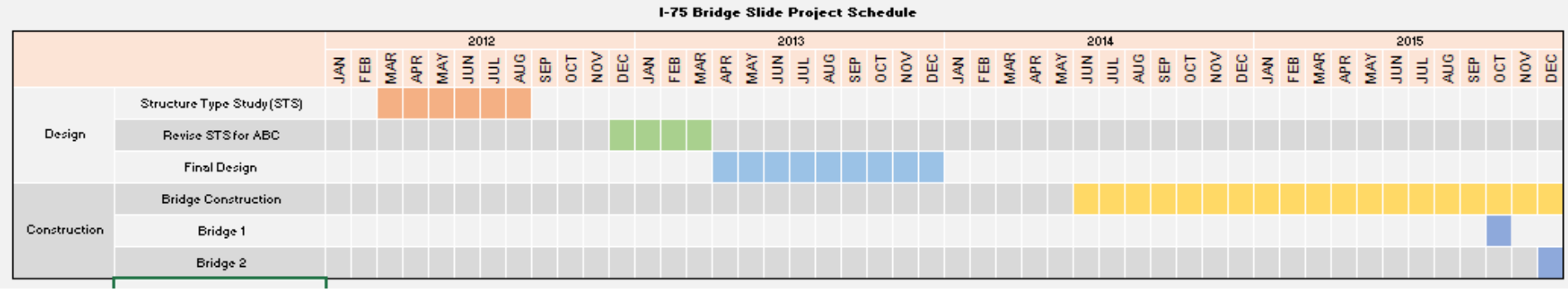
ABUTMENT ELEVATION

Construction

- Schedule
- Maintenance of Traffic (Weekend)
- Contractor Changes
- Bridge Construction
- Cost

Construction

Schedule - Overall



Design Approach

Schedule – Bridge Slide

- 59 Hours
  - Set up MOT
  - Demolish existing structure
  - Slide new bridge into position
  - Place 304 & asphalt up to new bridge
  - Install guardrail and pavement markings
  - Open new bridge to traffic

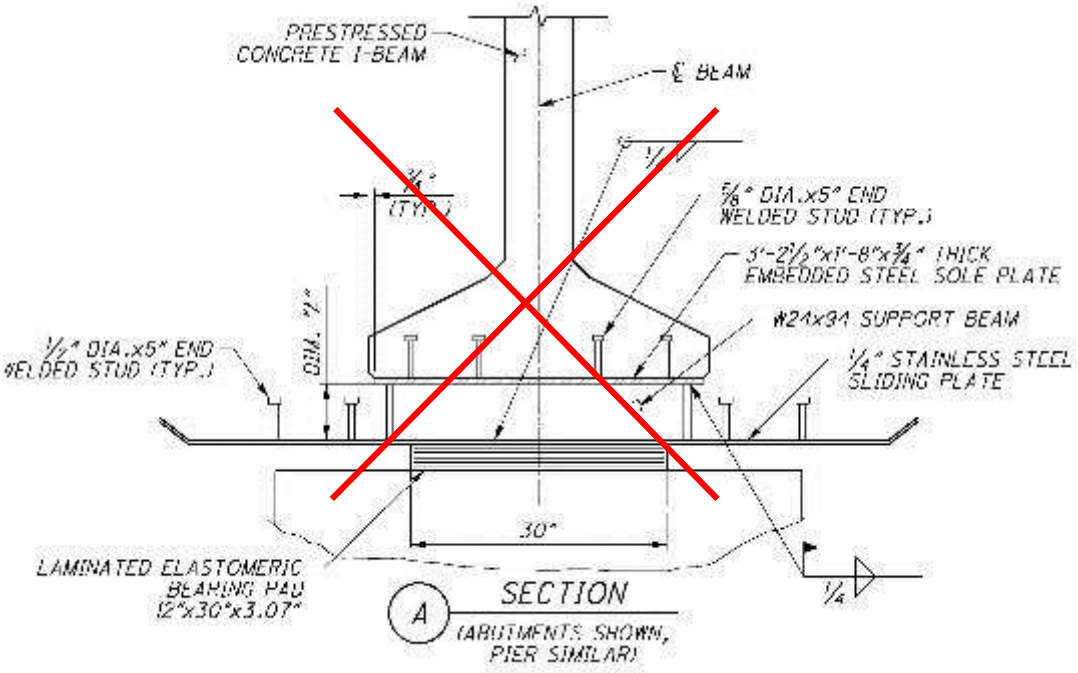
Construction

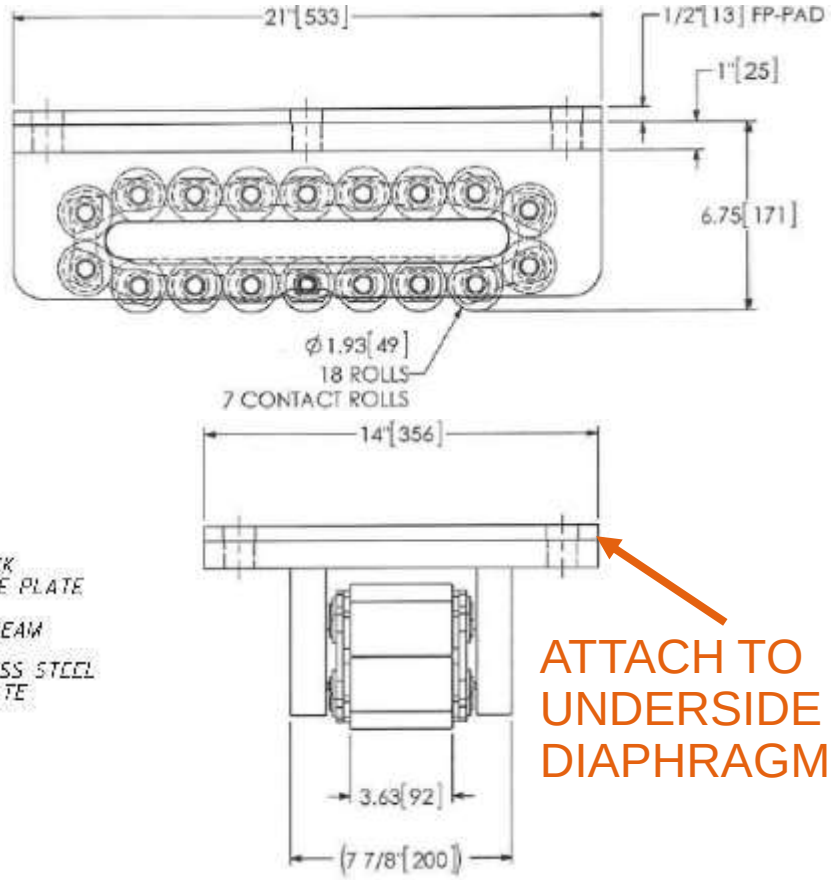
Contractor Changes

- Temporary supports modified
- Pulled not pushed
- Bridge slide used rollers in lieu of Teflon bearings

Construction

Contractor Changes



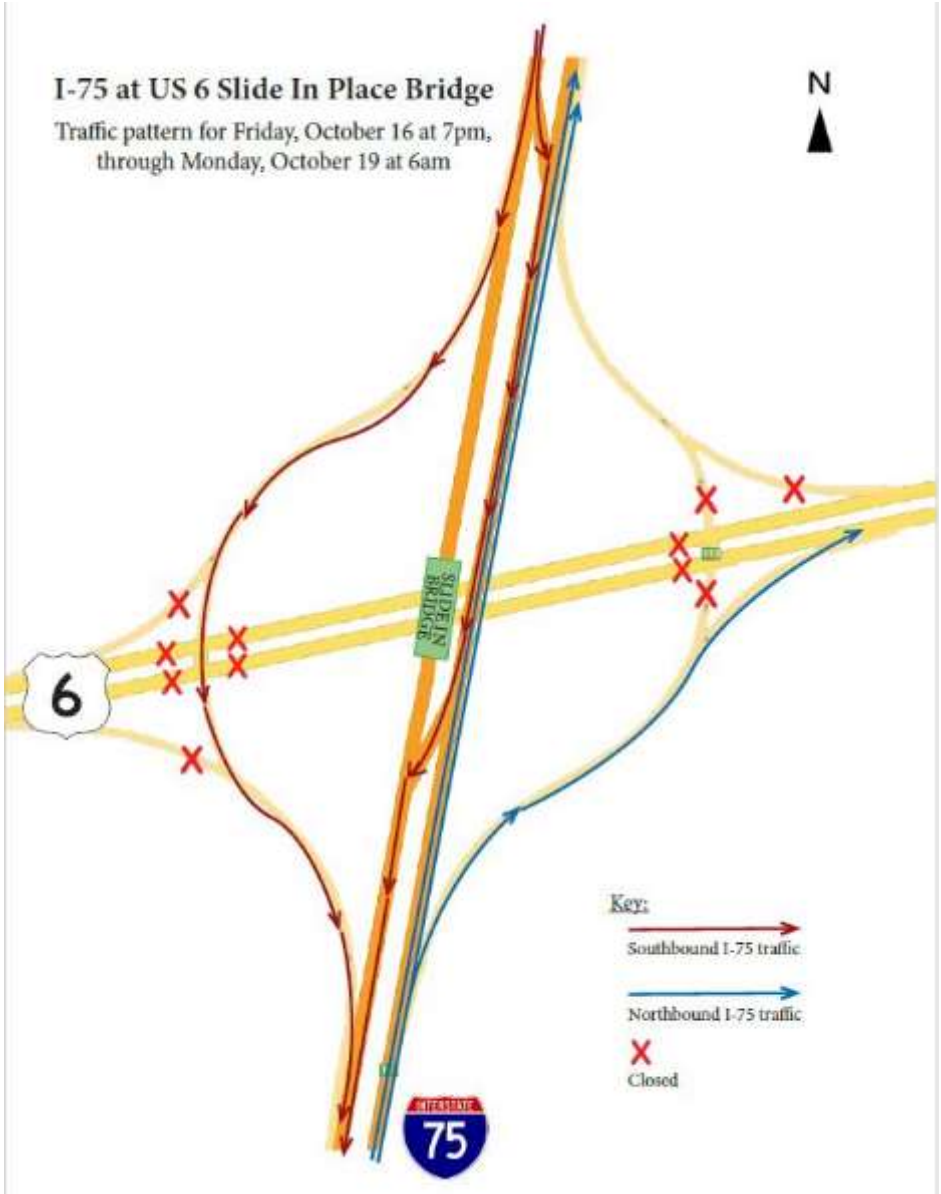


ATTACH TO UNDERSIDE OF DIAPHRAGM

Hillman Rollers

Construction

Maintenance of Traffic (Weekend)



Construction

Abutment

Construction

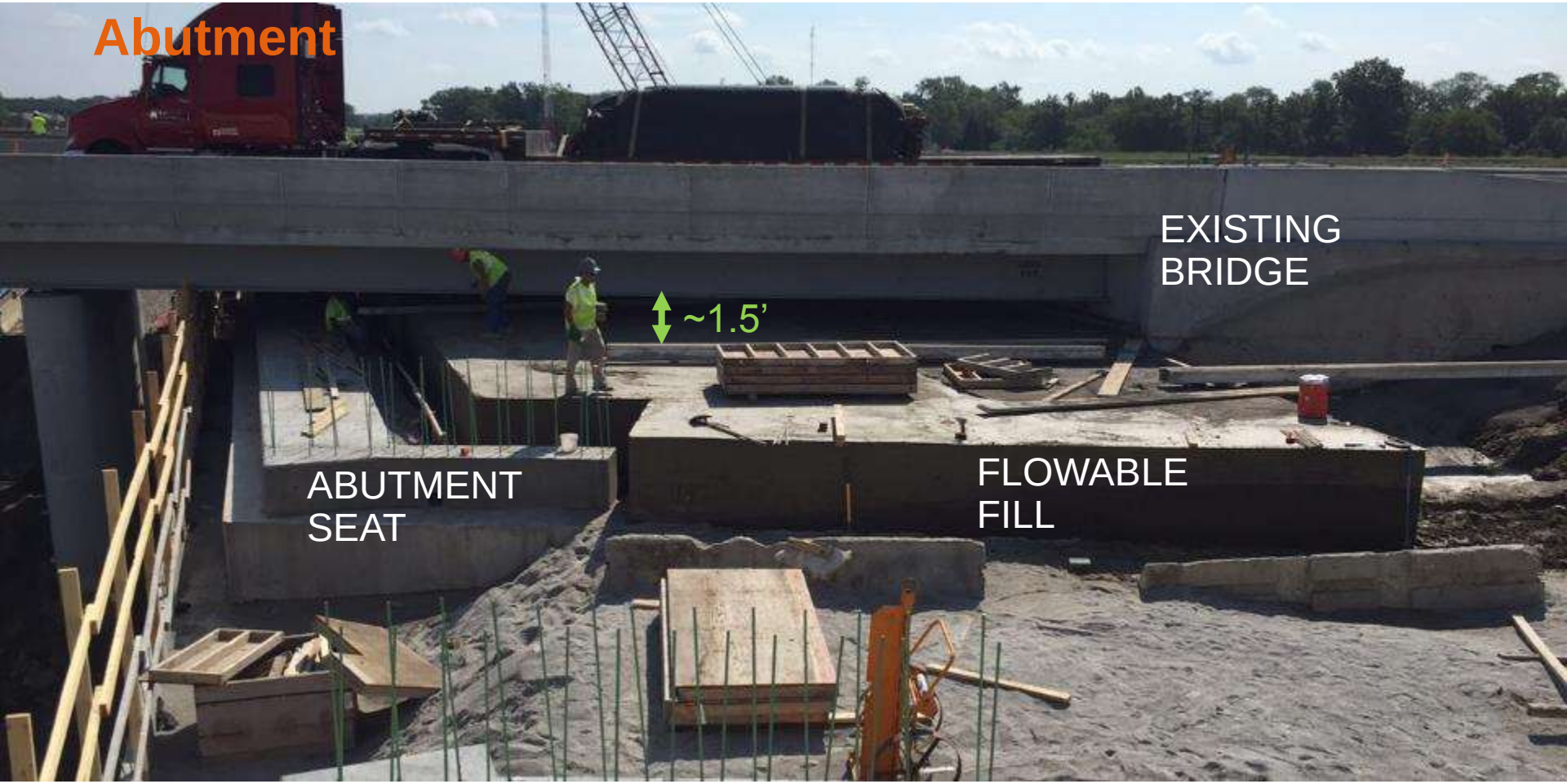
Abutment

Construction

Abutment

Construction

Abutment



Construction

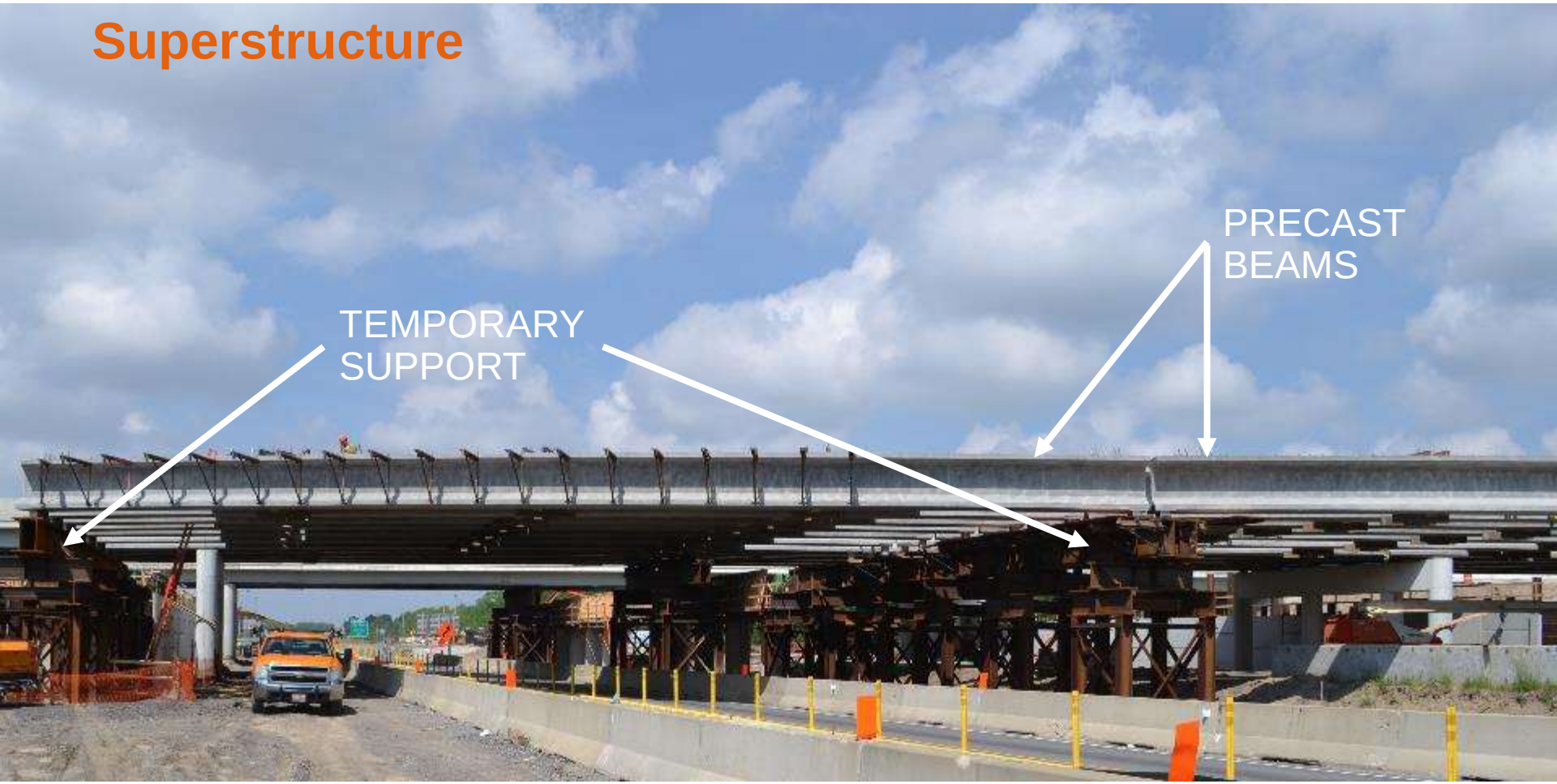
Pier

Construction

Pier

Construction

Superstructure



Construction

Superstructure

Construction

Superstructure

Construction

Temporary Support

Construction

Temporary Support

Construction

Temporary Support

Construction

Divert Traffic & Begin Demolition

Construction

Demolition

Construction

Construction

Slide Details

Construction

Slide Details

Construction

Slide Details

Construction

Slide Details

SQUARED OFF ABUTMENT SEAT

STEEL BRACKET

JACK TO PULL SUPERSTRUCTURE

Construction

Slide Details

Construction

Slide Details

Construction

Cost

- Total cost for twin I-75 Bridges: $7,790,879
- Cost for sliding both bridges: $2,000,000 (25.7%)

Lessons Learned

- Benefits of ABC
  - Enhanced safety for motorist and workers
  - Improved construction quality
    - No phased joints
    - Workers not distracted by traffic
  - Minimal disruption to public (weekend only)

Lessons Learned

- Meeting with Arcadis, ODOT Office of Structural Engineering, ODOT District 2, FHWA & Kokosing
  - Biggest cost driver: building on temporary falsework
  - Size limit for slide: mostly dependent on size of bridge being removed
    - Demolition time is critical during closure
  - Weekend timeframe is appropriate for work to be completed
  - Large crane required to move precast elements
    - Keep weights under 20,000 lbs
  - Consider fast set concrete in lieu of precast elements

Questions

Contact Information

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