

# 2021 Geotechnical Conference Bridge Engineering Overview

Mahmoud Hailat, PE & Donald Shaw, PE

Bridge Engineering

INDOT

February 24, 2021

# Outline

---

- 2020 Bridge Engineering Overview
- Bridge Engineering Policy Update
- Lesson Learned: Design and Construction cases
- Research Involvement
- Sherman Minton Bridge



# Overview of 2020 Presentation

---

2020 Presentation: What Bridge Engineers Like to See in a Geotechnical Report

Link To 2020 Presentation

<https://www.in.gov/indot/2804.htm>

- Soil Boring: locate as close you could to the bridge supports
- Wall Pier on Single row of piles adjacent to spill through fill where Soft Soil is encountered → Concern lateral movement.
- Soil Borings for MSE wall & Cross-over, Include recommendations in the geotechnical report for undercut.
- Foundation Lateral Loading where Soft/ Weak soil is encountered.
- Cofferdams stability adjacent to spill through Fill when soft soil is encountered.

# 2020 Bridge Engineering Overview

---

- 411 in house Project Review, 872 Total
- 53 In-House Design Submittals, 597 New Load Ratings
- Major Project Involvement: I-69, North Split, Sherman Minton Bridge, & other specialty projects
- Continued to provide support to design and construction community
- Continued to work with Geotechnical office on Foundation Design and construction support
- Updated several policy items
- Beginning 2021 Delivered Promiles for OSOW vehicles.
- OSOW permitting, 2020 processed:
  - 15,055 Permits for Trucks <200,000 lbs
  - 1,336 permits for Trucks > 200,000 lbs

# Policy Update

- Rehabilitation Projects Naming Convention, similar to new design

## INDOT | BRIDGE DESIGN AIDS

BDA 100-03 | JANUARY 11, 2021

### Bridge Preservation Projects Submittals

	Previous Submittal	New Submittal Name
• BrInsp	Bridge Inspection Report	Stage 1
• BRFPS	Preliminary Plans	Stage 2
• BRPPS	Final Plans	Stage 3

- Not an official policy, provide Guidance to Designer
- Location:

<https://www.in.gov/dot/div/contracts/standards/bridges/BDA.htm>

# Policy Update - Design Methodology

	Work Type and Design Methodology				
Original Design Methodology	Deck Replacement	Bridge Widening, Reusing Existing Beams	Bridge Widening, Full Superstructure Replacement	Superstructure Replacement	Bridge Replacement
ASD or LFD	All Elements: LFD <sup>1, 2</sup>	All Elements: LFD <sup>1</sup>	Superstructure: LRFD Substructure: LFD <sup>1</sup>	Superstructure: LRFD Substructure: LFD <sup>1</sup>	Superstructure: LRFD Substructure: LRFD
LRFD	All Elements: LRFD	All Elements: LRFD	All Elements: LRFD	All Elements: LRFD	All Elements: LRFD

Notes:

<sup>1</sup> LFD in accordance with the AASHTO *Bridge Specifications for Highway Bridges, 17<sup>th</sup> Edition*.

<sup>2</sup> LRFD design methodology is acceptable.

## BRIDGE DESIGN METHODOLOGY BY WORK TYPE

Figure 412-3A

# Policy Update - Design Methodology

---

- Three design methods used in the design:
  - ASD
  - LFD
  - LRFD for bridge with geotechnical request made after January 1<sup>st</sup>, 2008 (Memo 08-01, 03/18/12008)
- Existing structures designed with ASD → Sometimes overstressed when checked with LFD
- Or existing Structures designed with LFD → Sometimes overstressed when checked with LRFD

# Policy Update – Design Methodology/ Loading

---

- Rehabilitation Projects:

- Adding more load when widened or replaced superstructure
- Expansion Connection between superstructure and substructure changed to Fixed Connection → in this case Substructure Attracts more loads/ lateral
- Lateral Loads eventually transferred to the foundation
- Cause structural and geotechnical challenge for rehab projects.



# Policy Update - Design Methodology

---

- When checked with different design method:
  - Apply appropriate Strength reduction factor and Load factors
  - If original design with ASD → Remove safety factor and apply appropriate strength reduction factor.
- Things to Consider when Bridge is overstressed:
  - Can we live with slightly  $< 2.0$  SF ?
  - What is the acceptable % overstress?
  - What is bridge condition?
  - Type of Piles?



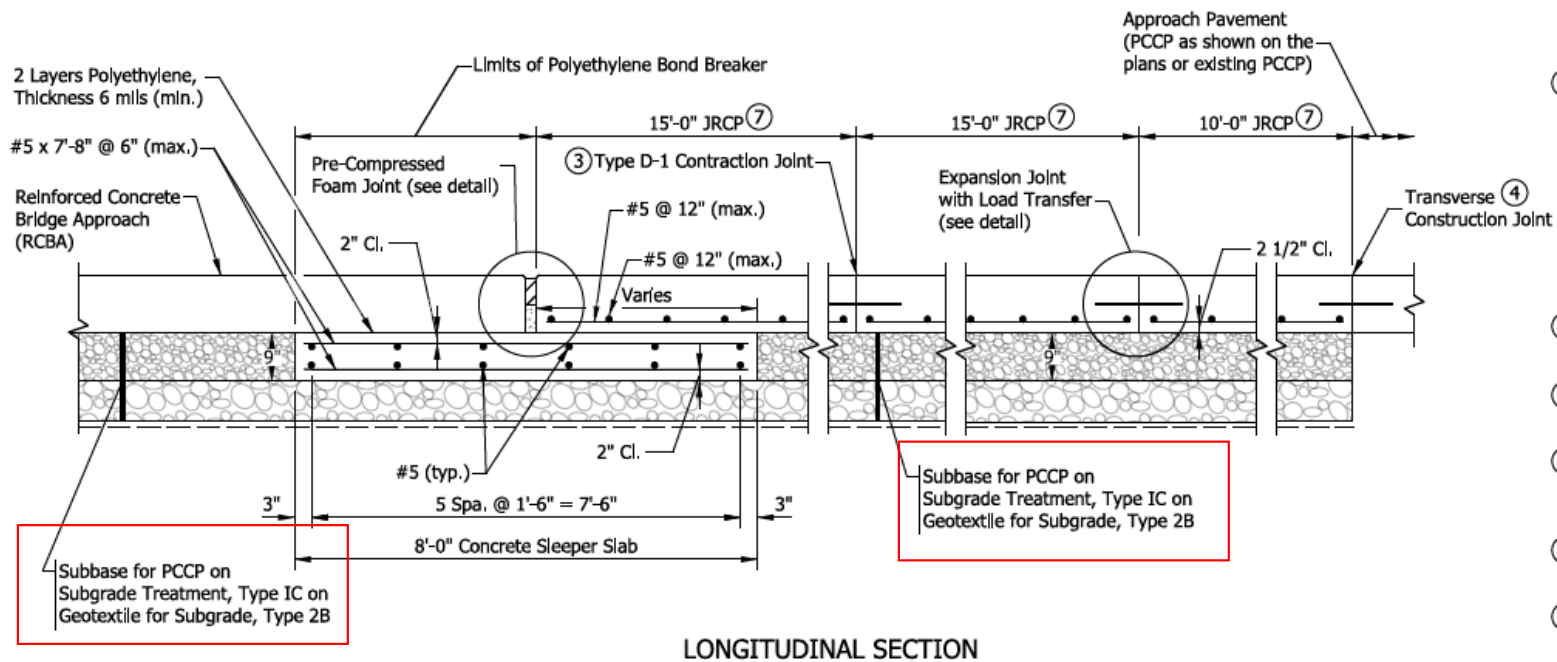
# Policy Update - Design Methodology

---

- Part of INDOT's Structure Committee, subcommittees were formed to evaluation samples of existing bridges utilizing different design methods.
- LRFD Loads are heavier than LFD or ASD loads.
- What is the acceptable LRFD % overstress?
- Currently Case by Case: We recommend to contact bridge Engineering And Geotechnical office

# Policy Update - Subgrade Treatment

- New Terminal Joint – RCBA
- Detail Standard Drawing E 503-BATJ-



# Subgrade Treatment

---

- Pavement Reconstruction – Bridge Approaches
- Where high moisture content/ soft soil is encountered
- Include recommendations for Foundation Soil Modification/ Improvement.
- Helps the designer to determine if additional subgrade quantities are required
- Avoid change orders.



# Policy Update – MSE Wall @ Bridge

- New Memo 21-02, MSE Wall Checklist is recently Issued.
- Pile Sleeve ?
- Alternative Solution for Downdrag?
- Bridge Lateral Load → What is distance between back of MSE wall and Pile/ Pile Sleeve ??

**NOTE:**

Coarse aggregate and 6" end-bent drain pipe are not required to be specified separately for an end bent placed behind an MSE Wall.

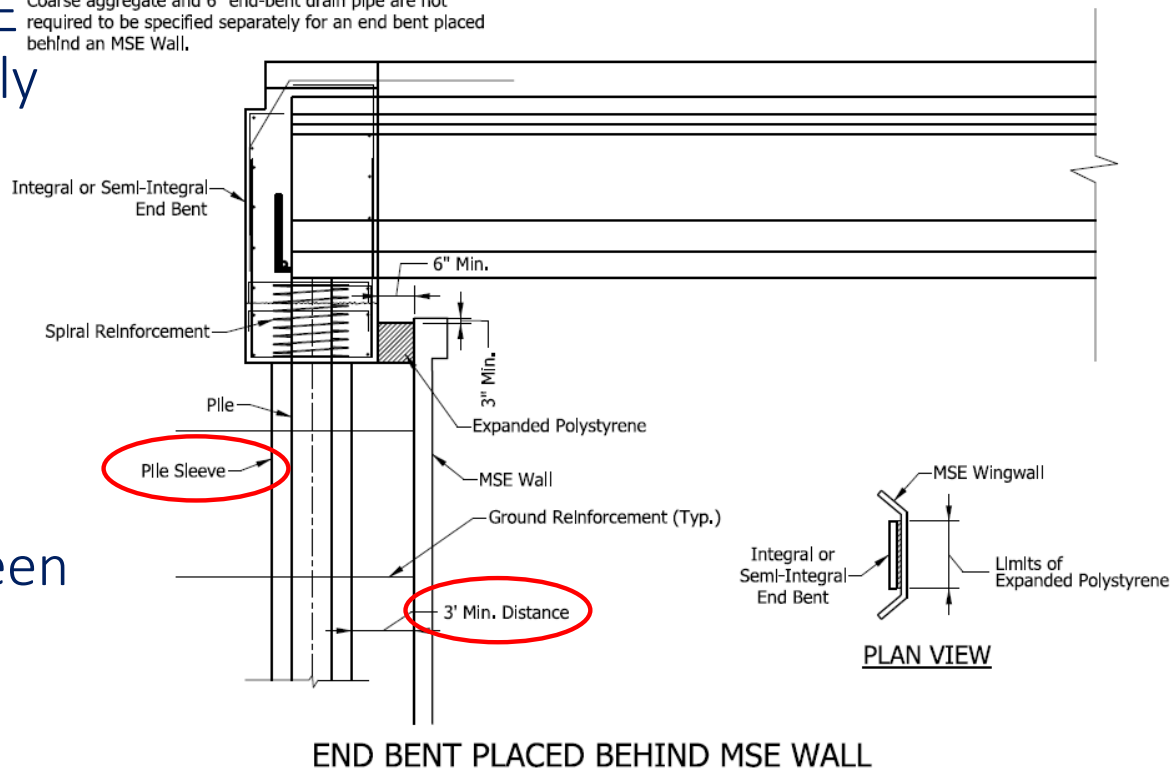
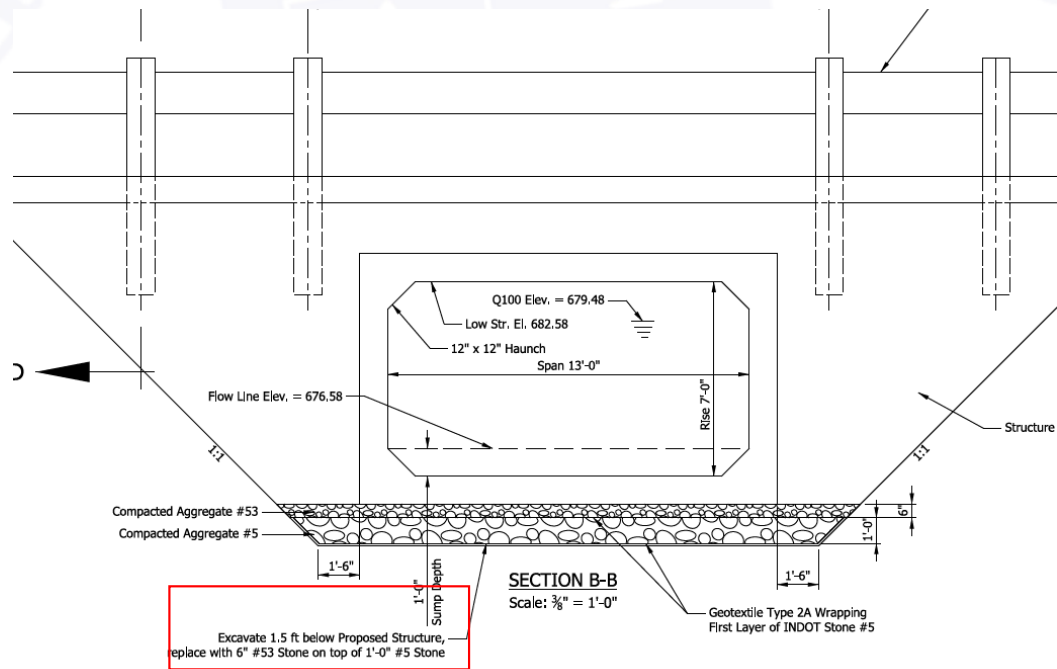


Figure 409-2G  
(Sheet 1 of 2)

# Precast Culverts



Foundation improvement shall consist of excavating all unsuitable soils down to a maximum depth of 18-inches. A geotextile in accordance with INDOT Standard Specification 918.02(b), Type 2A shall be placed at the base of

# Tilted Pier – Construction Case

- Piles driven off about 6"
- Pier Intentionally Tilted to correct seat elevation location, ~7" out of plumb.
- Analysis was completed: Geotechnical and structural → Pier and piles were found structurally sufficient.
- Better solution: Pier Cap widening



# Scour Countermeasure

- Cofferdam filled with Concrete as scour countermeasure
- Additional load on foundation

Current policy

- Current Practice is to use Riprap
- Scour Critical Determination process → Hydraulics Division + Bridge Engineering + EOR





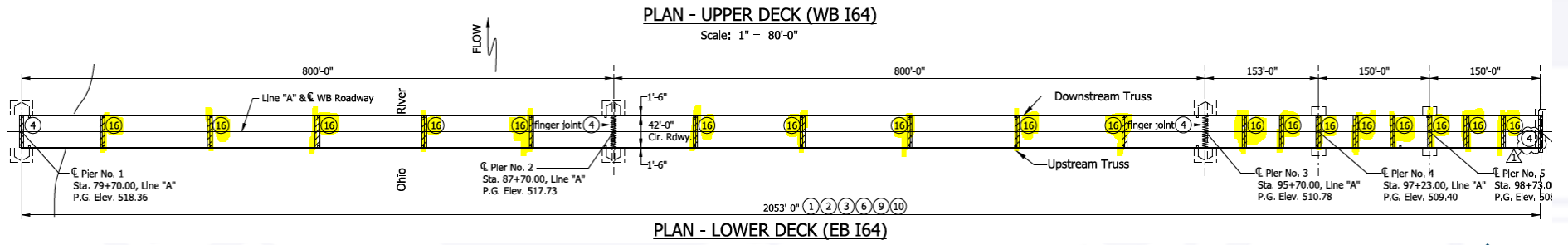
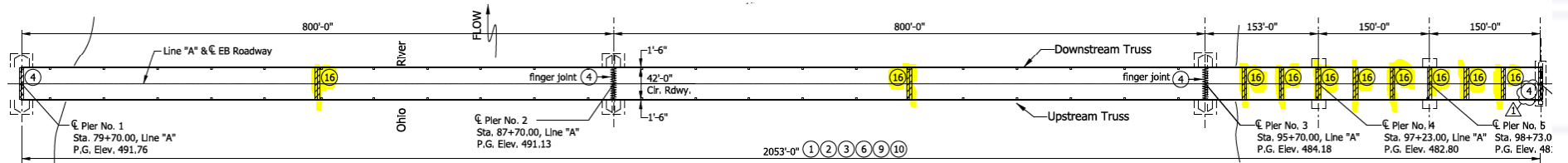
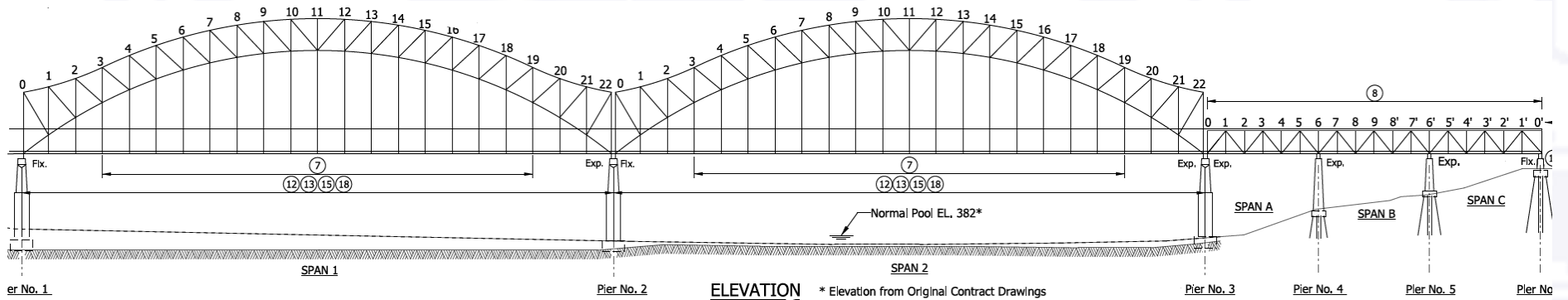
# Research

---

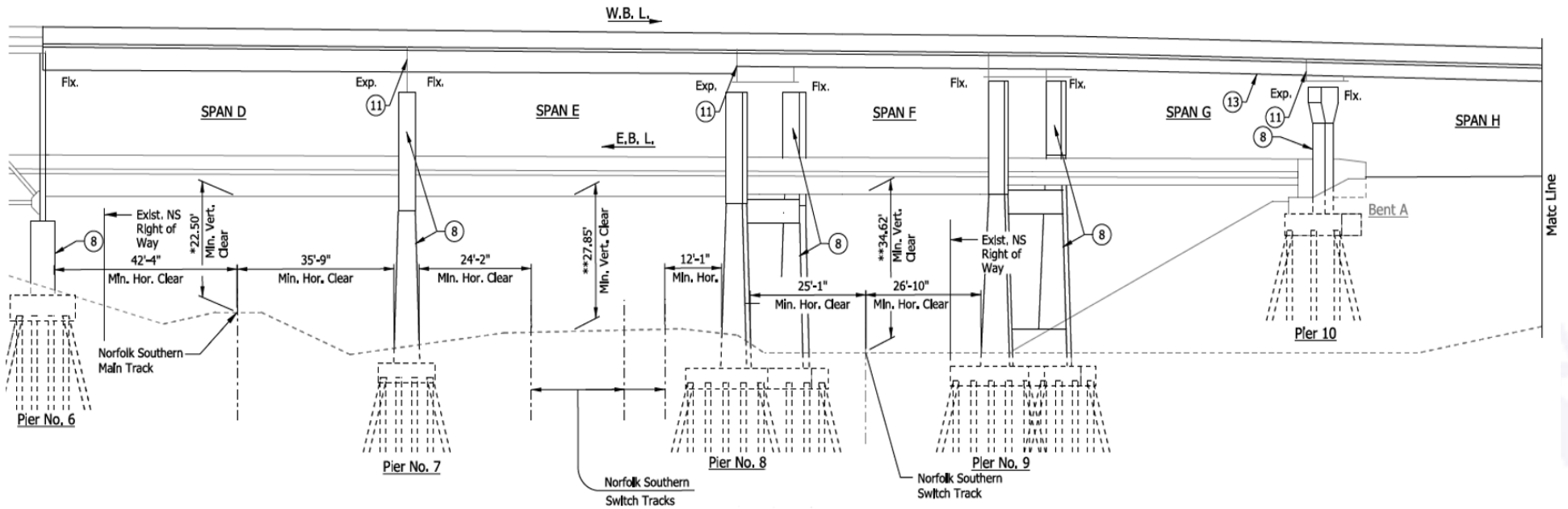
- Current Research, Geotechnical office + Bridge Engineering:
  - Reuse of Existing Foundations:
    - to address: Condition assessment, load capacity, design methodology, and Remaining Service Life of the bridge.
  - Pile Stability Analysis in Soft Soils:
    - Guidance on Foundation Design Assumptions with Respect to Loose/ Soft soil Effect on Pile Lateral Capacity and Stability



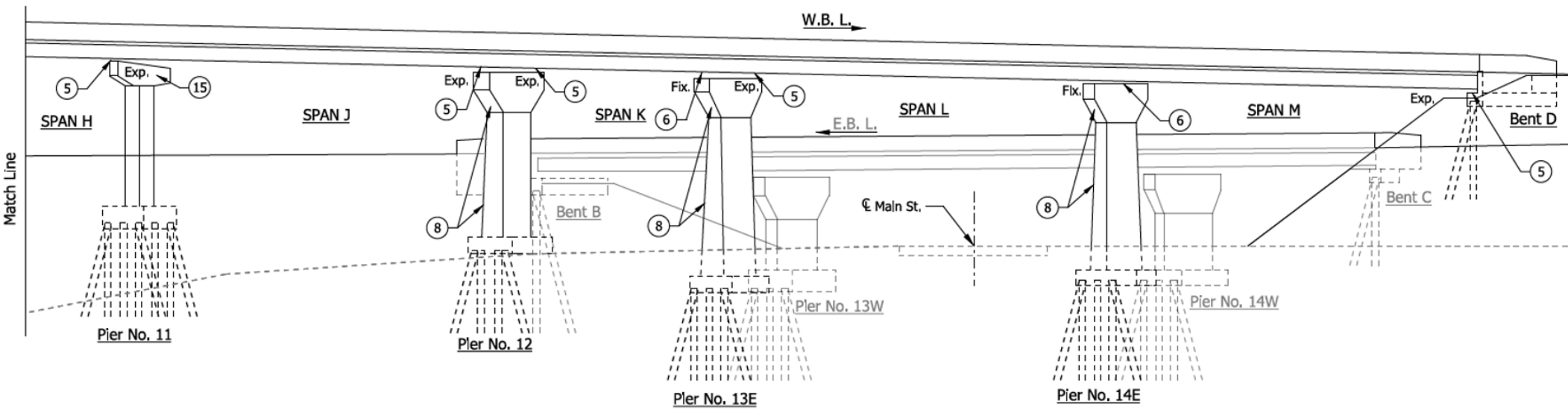
# Sherman Minton Bridge



# Sherman Minton Bridge



# Sherman Minton Bridge



Thank you  
Questions?

