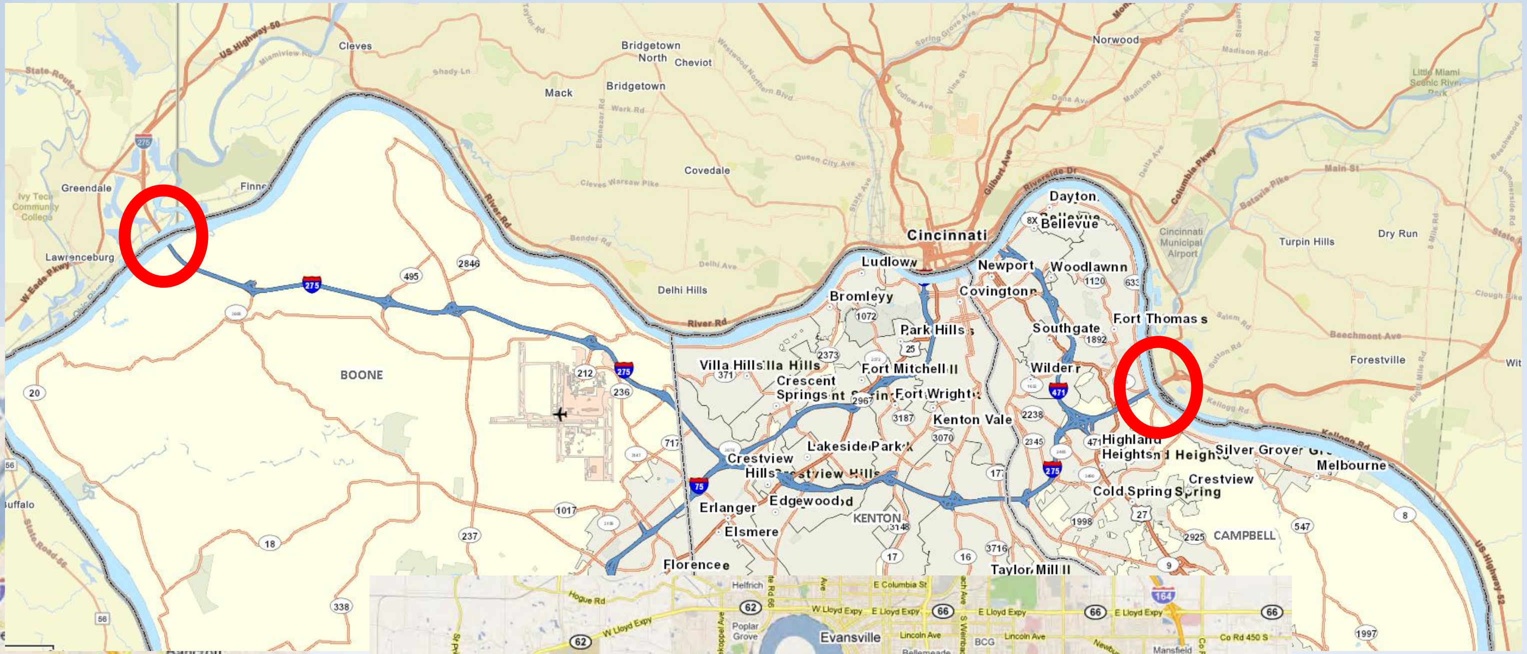
KYTC NDE Evaluation and Remediation Plans for T-1 Steel Members

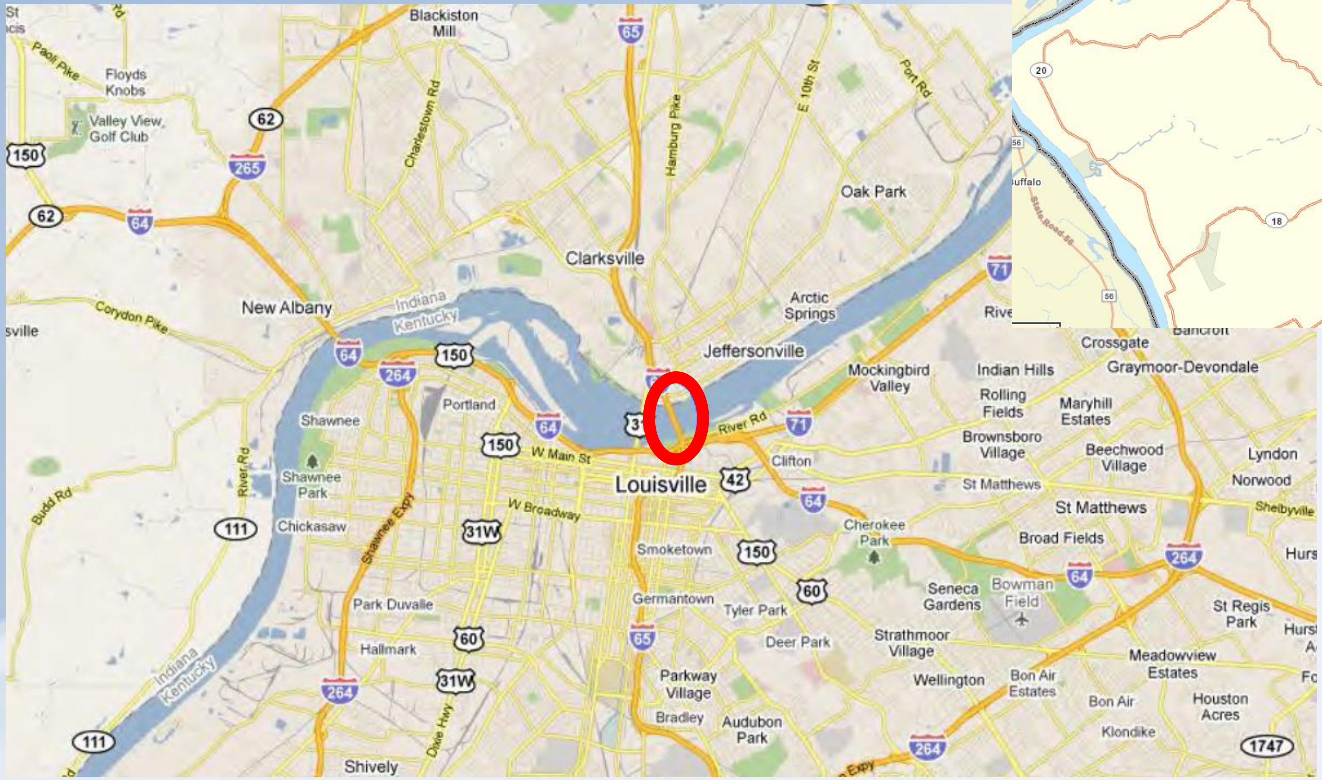
James Edmunds and Jason Stith

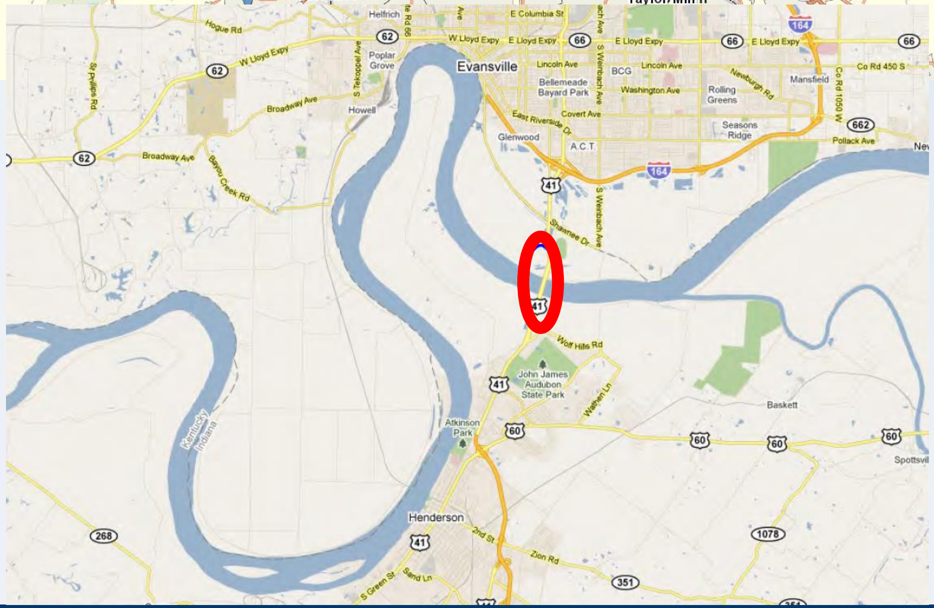
Timeline

- 12/13/2021 – Memo
- **03/08/2022 – KYTC Advertisement**
- 10/17/2022 – Weld Identification begins Kennedy
- 03/14/2023 – Carrol Cropper
- 04/11/2023 – Combs Hehl
- 07/17/2023 – Luther Draffen
- 11/12/2023 –Henderson NDT Complete

KYTC's T-1


Cleves
Bridgetown North
Cheviot
Mack
Bridgetown
Covedale
Norwood
Greendale
Lawrenceburg
Cincinnati
Dayton
Bellevue
Ludlow
Newport
Woodlawn
Bromley
Covington
Delhi Hills
Park Hills
Fort Thomas
Southgate
BOONE
Villa Hills
Fort Mitchell
Crescent Springs
Fort Wright
Wilder
Kenton Vale
Lakeside Park
Highland Heights
Crestview Hills
Silver Grove
Melbourne
Erlanger
Edgewood
Crestview
Cold Spring
Elsmere
KENTON
CAMPBELL
Florence
Taylor Mill
Forestville
Turpin Hills
Dry Run


Blackiston Mill
Floyds Knobs
Valley View Golf Club
Oak Park
Clarksville
New Albany
Arctic Springs
Jeffersonville
Indiana
Kentucky
Shawnee
Portland
W Main St
Louisville
Clifton
Mockingbird Valley
Indian Hills
Rolling Fields
Maryhill Estates
Crossgate
Graymoor-Devondale
Brownsboro Village
Beechwood Village
Lyndon
Norwood
St Matthews
Shawnee Park
Chickasaw
W Broadway
Smoketown
Cherokee Park
Broad Fields
Seneca Gardens
Bowman Field
Park Duvalle
Germantown
Tyler Park
Deer Park
Strathmoor Village
St Regis Park
Hallmark
Parkway Village
Wellington
Bon Air Estates
Meadowview Estates
Bon Air
Houston Acres
Bradley
Audubon Park
Klondike
Shively


Evansville
Howell
Glenwood
Rolling Greens
Seasons Ridge
John James Audubon State Park
Atkinson Park
Baskett
Henderson
Spottsville

Timeline

- 12/13/2021 – Memo
- 03/08/2022 – KYTC Advertisement
- **10/17/2022 – Weld Identification begins Kennedy**
- 03/14/2023 – Carrol Cropper
- 04/11/2023 – Combs Hehl
- 07/17/2023 – Luther Draffen
- 11/12/2023 –Henderson NDT Complete

NDT – Ultrasonic Testing

Timeline

- 12/13/2021 – Memo
- 03/08/2022 – KYTC Advertisement
- 10/17/2022 – Weld Identification begins Kennedy
- 03/14/2023 – Carrol Cropper
- 04/11/2023 – Combs Hehl
- 07/17/2023 – Luther Draffen
- **11/12/2023 –Henderson NDT Complete**

Findings

Bridge Name	T-1 Butt Welds	Rejectable Indications
I-65 (JFK Bridge)	696	44
I-24 WB & EB	32	1
I-275 WB & EB (Combs Hehl)	343	20
I-275 (Carroll Cropper)	600	101
US 41 SB (Henderson)	547	51

Timeline

- **01/25/2024 – Construction Letting of Kennedy**
- 03/26/2024 – Re-Let Kennedy
- 03/29/2024 – Report Submittal to FHWA
- 03/28/2024 – Sign PCA
- 05/13/2024 – Awarded the Kennedy
- 05/23/2024 – Construction Letting of Carrol Cropper

Timeline

- 01/25/2024 – Construction Letting of Kennedy
- 03/26/2024 – Re-Let Kennedy
- **03/29/2024 – Report Submittal to FHWA**
- 03/28/2024 – Signed PCA
- 05/13/2024 – Awarded the Kennedy
- 05/23/2024 – Construction Letting of Carrol Cropper
- September – Proposed Combs-Hehl letting

Timeline

- 01/25/2024 – Construction Letting of Kennedy
- 03/26/2024 – Re-Let Kennedy
- 03/29/2024 – Report Submittal to FHWA
- **03/28/2024 – Signed PCA**
- 05/13/2024 – Awarded the Kennedy
- 05/23/2024 – Construction Letting of Carrol Cropper
- September – Proposed Combs-Hehl letting

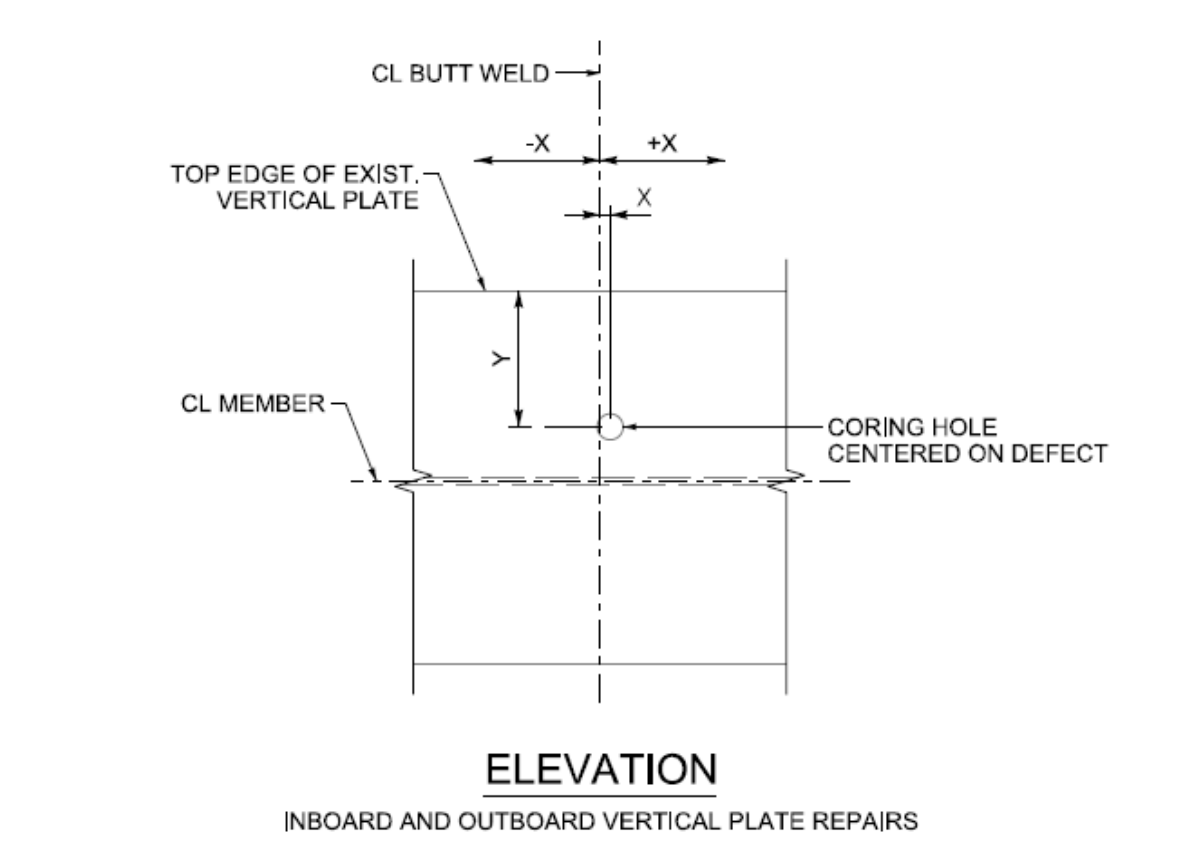
Timeline

- 01/25/2024 – Construction Letting of Kennedy
- 03/26/2024 – Re-Let Kennedy
- 03/29/2024 – Report Submittal to FHWA
- 03/28/2024 – Sign PCA
- **05/13/2024 – Awarded the Kennedy**
- 05/23/2024 – Construction Letting of Carrol Cropper
- September – Proposed Combs-Hehl letting

Findings

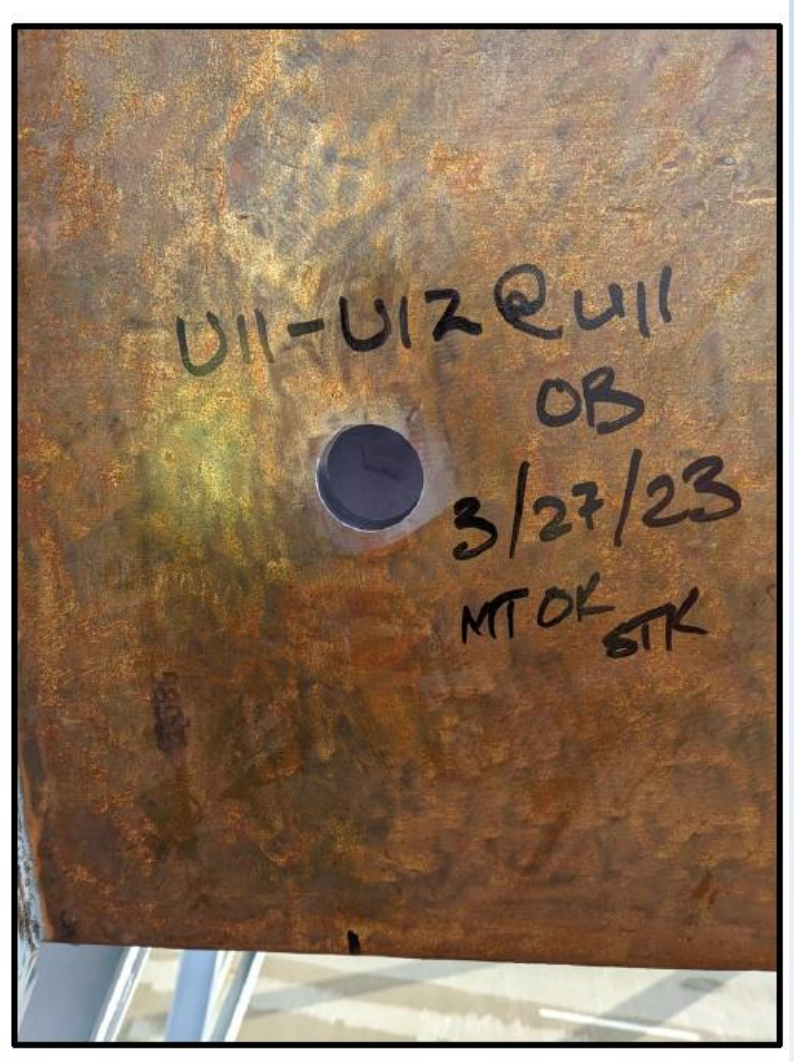
Bridge Name	T-1 Butt Welds	Rejectable Indications
I-65 (JFK Bridge)	696	44
I-24 WB & EB	32	1
I-275 WB & EB (Combs Hehl)	343	20
I-275 (Carroll Cropper)	600	101
US 41 SB (Henderson)	547	51

Remediation



ELEVATION

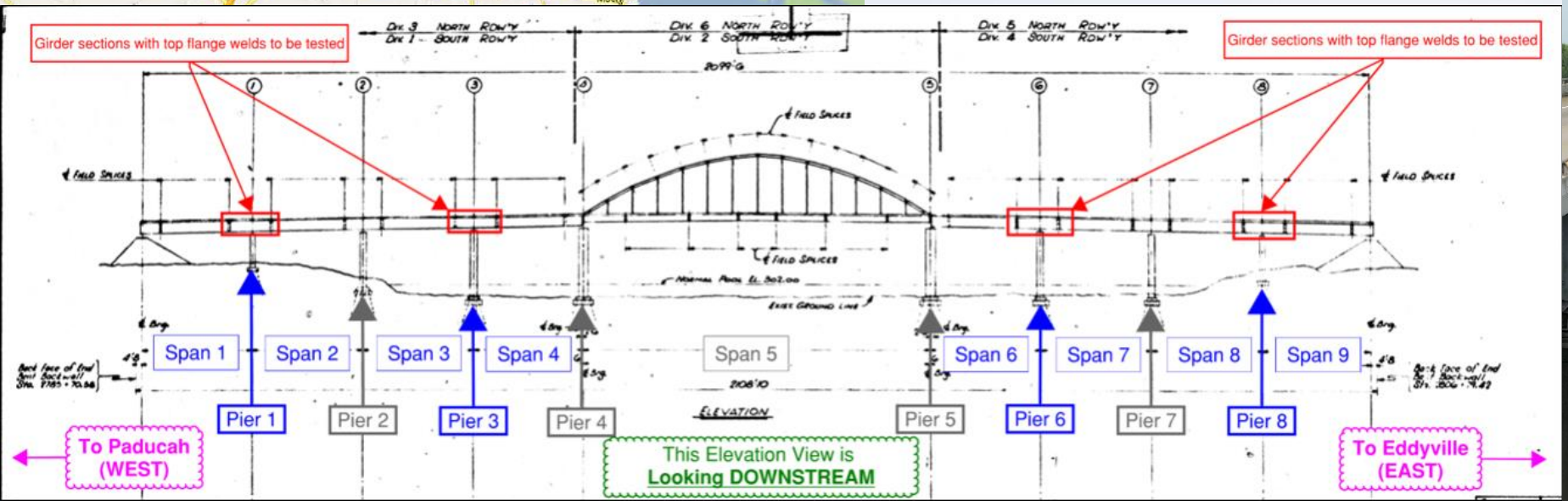
INBOARD AND OUTBOARD VERTICAL PLATE REPAIRS



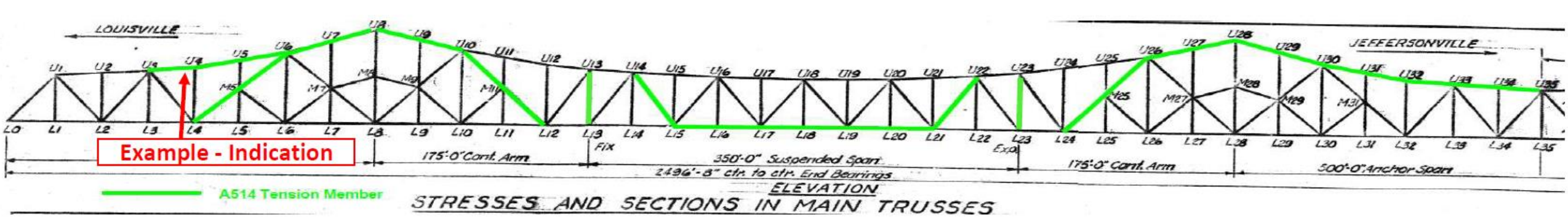
Design Criteria

- What do you design for?
  - Member Capacity?
  - Demands?: LRFD, LFD, ASD
  - Load Rating?: LRFR, LFR, ASR,
    - What trucks?: HL-93, H-20, Legal, EV, Permit
- Axial vs. Flexural Member

Luther Draffen Bridge



JFK Memorial Bridge



Tension Capacity

- **Yield on Gross Section**

$$P_r = \phi_y P_{ny} = \phi_y F_y A_g \qquad \text{(EQ. 6.8.2.1-1)}$$

$$P_r = 0.95\ (\mathbf{100\ ksi})\ A_g = \mathbf{95\ ksi \times A_g}$$

- **Fracture on Net Section**

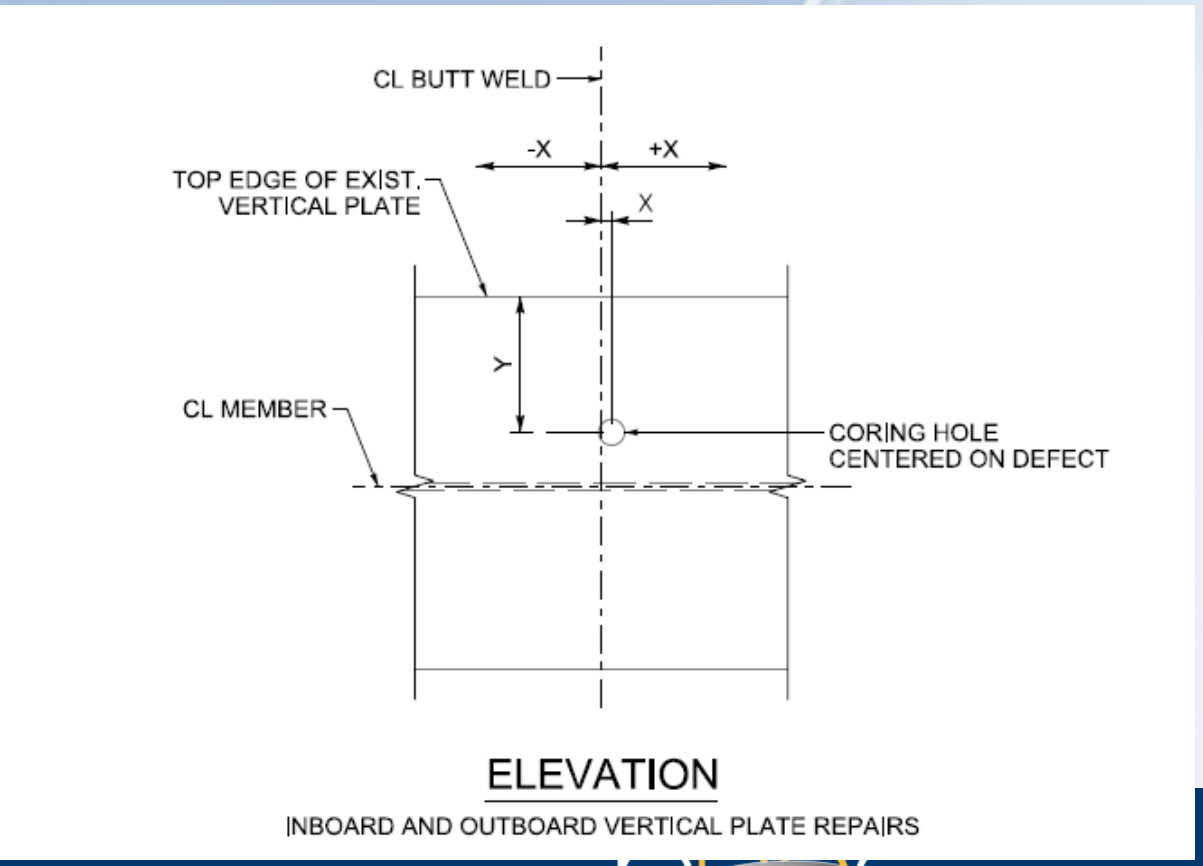
$$P_r = \phi_u P_{nu} = \phi_u F_u A_n R_p U \qquad \text{(EQ. 6.8.2.1-2)}$$

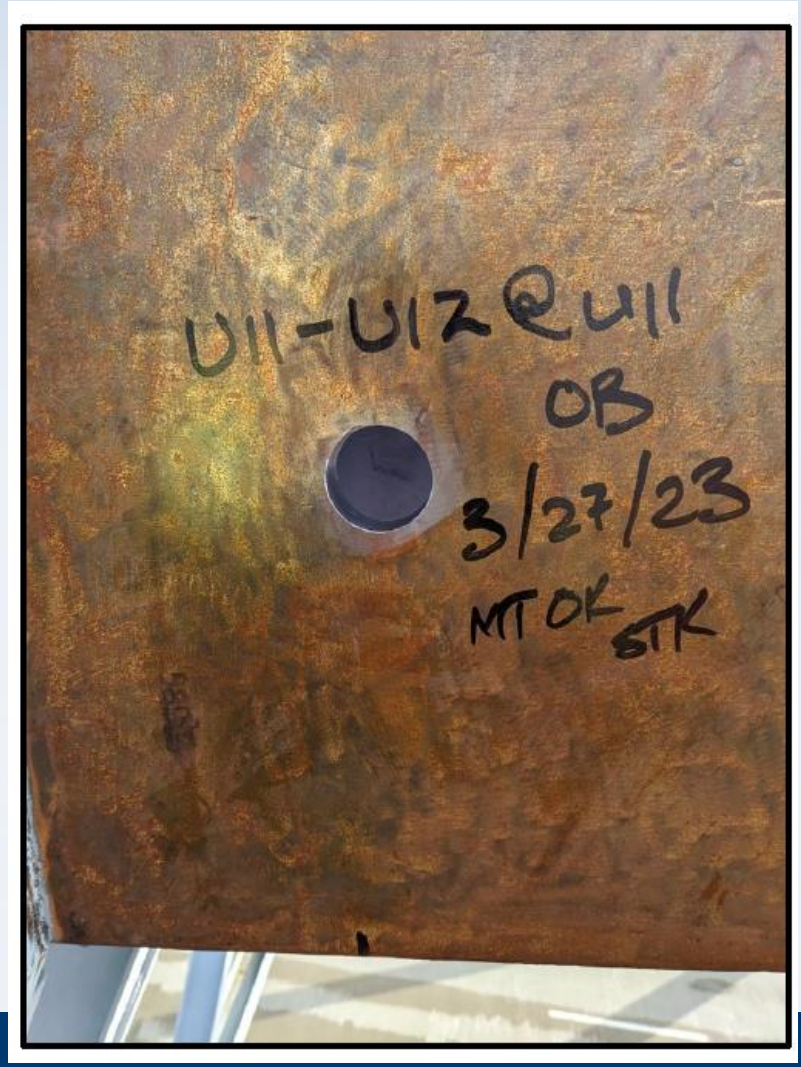
$$P_r = 0.8\ (\mathbf{115\ ksi})\ A_n R_p U = \mathbf{92\ ksi \times A_n}\ R_p U$$

=> Any hole reduces the capacity

Remediation

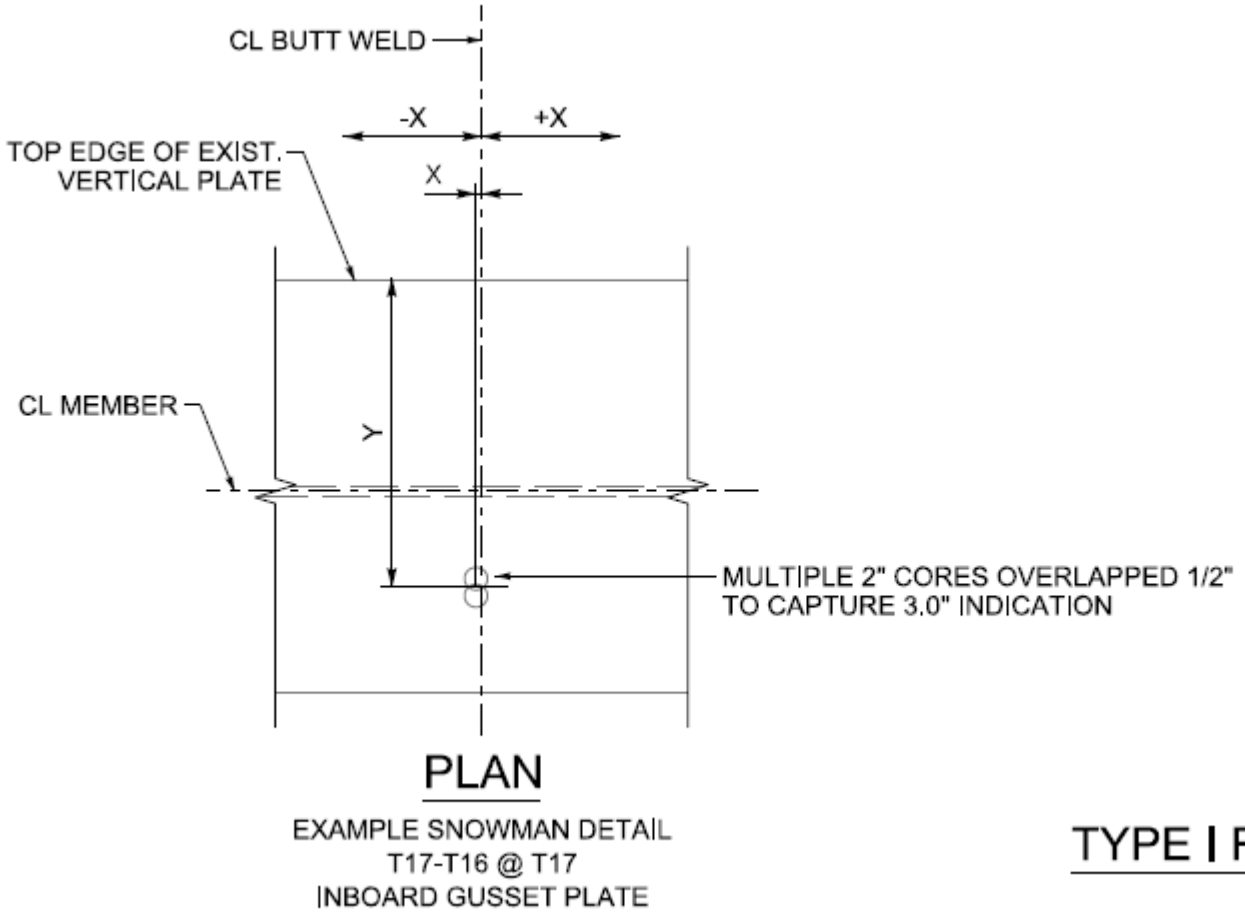
- Coring: 10% Rule





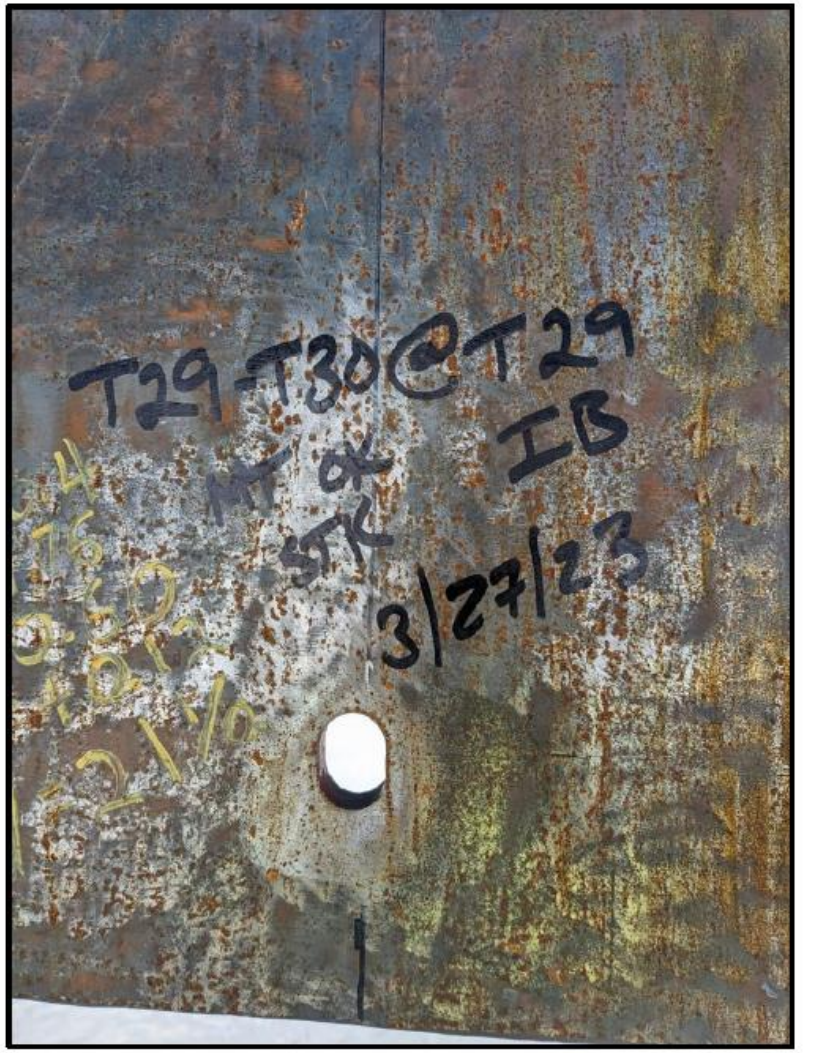
Remediation

- “Snowman”



PLAN

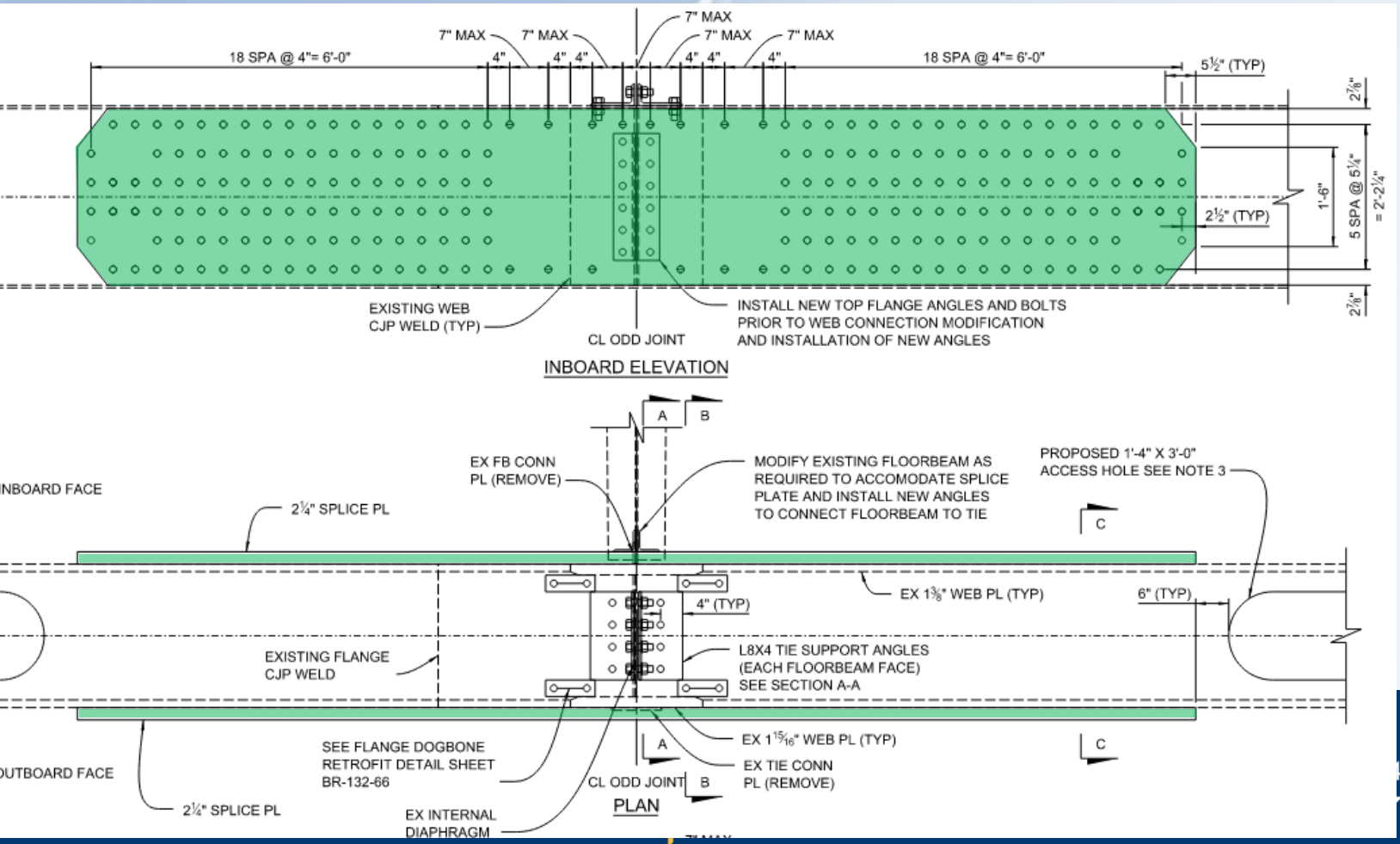
EXAMPLE SNOWMAN DETAIL
T17-T16 @ T17
INBOARD GUSSET PLATE



TYPE I REPAIRS

Remediation

- Plating



Bolted Splice

- AASHTO 6.13.6.1.1 – Tension Members
  - Average of Demand and Capacity or,
  - 75% of Capacity

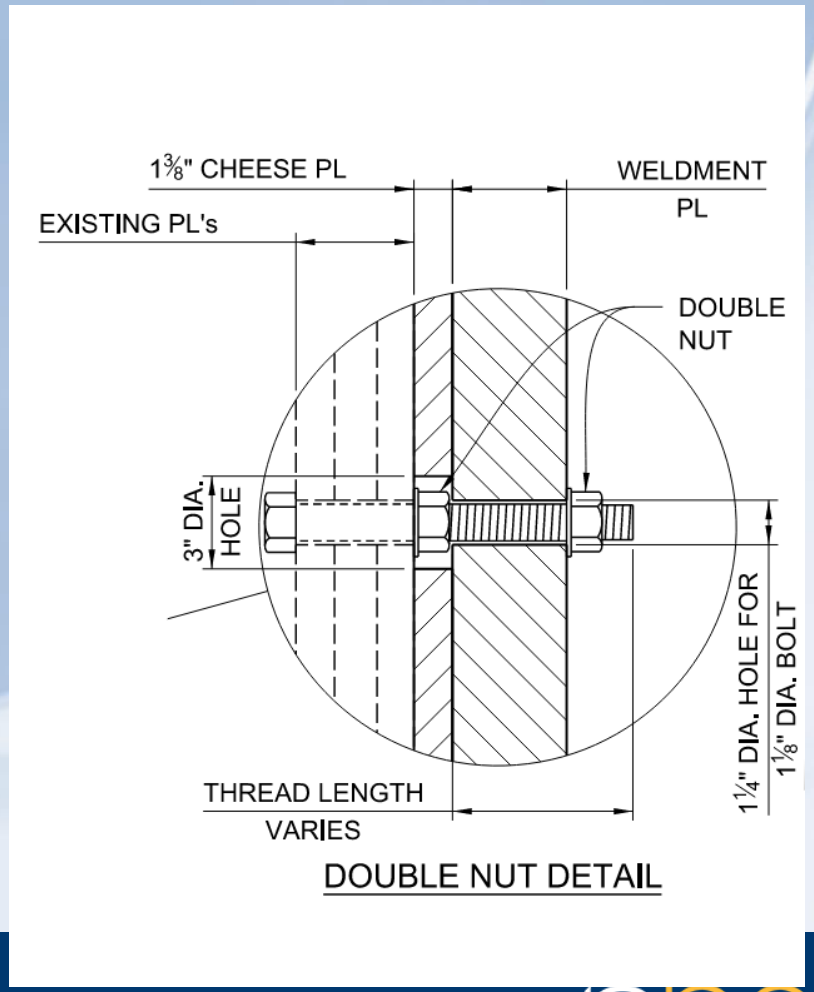
- AASHTO 6.13.6.1.3 – Flexural Members
  - Capacity of Flange
  - Web Shear Capacity

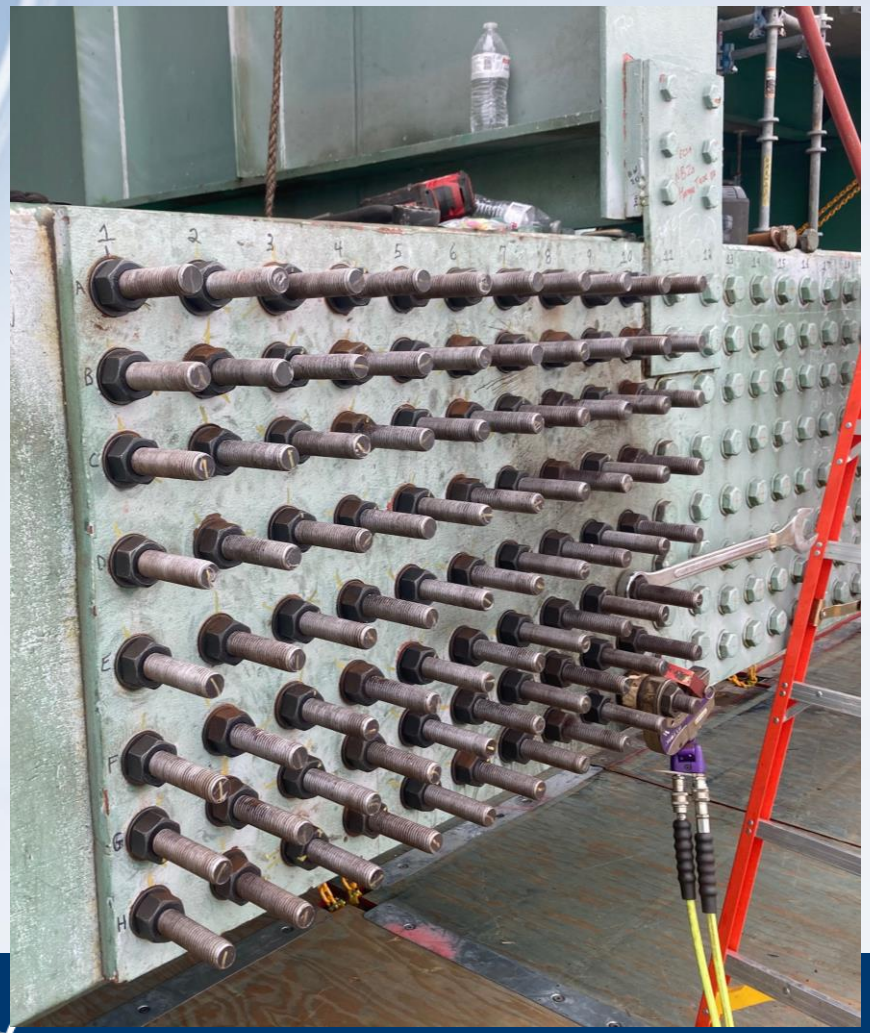
Bolted Splice

- AASHTO 6.13.6.1.1 – Tension Members
  - Average of Demand and Capacity or,
  - 75% of Capacity

- Capacity - (EQ. 6.8.2.1-1 or 2)
- Demand – LRFD Strength I

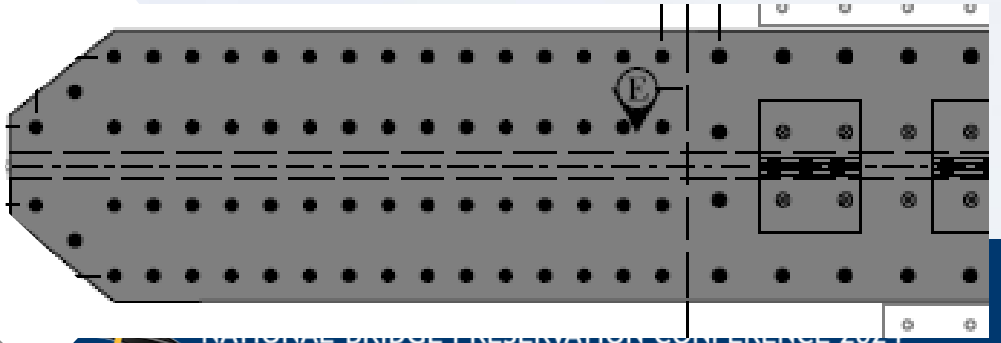
Cheese Plate & Double Nut





Remediation

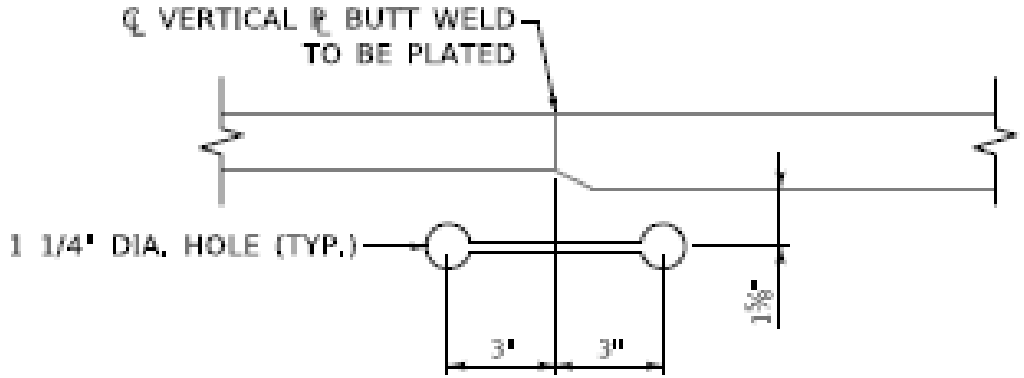
- Plating
- LRFD Design
  - Bolt shear – accounting for fill plates
  - Fracture of splice plate
- Bolt Taper



Remediation

- Dogbone

GENERAL NOTES



DOG-BONE RETROFIT DETAIL

INSTALL AT EACH BUTT WELD AT EACH LOCATION AS SPECIFIED IN THE PLANS

DOG-BONE RETROFIT PROCEDURE:
1. DRILL 1 1/4" DIA. HOLE IN HORIZONTAL PLATE.
2. WITH A CUTTING WHEEL OR PORTABLE PLASMA USE HOLES AS A START/STOP POINT FOR CUTTING SLOT PARALLEL TO VERTICAL PLATE.

Bolted Splice

- AASHTO 6.13.6.1.3 – Flexural Members
  - Capacity of Flange
  - Web Shear Capacity

- Design for load rating > 1.0
- All legal loads at operating level
  - $(1.25DC + 1.5DW + 1.35(LL+IM)) < 0.85*\phi R_n$

Design Criteria

- What do you design for?
  - Member Capacity: Can not get 100% of original capacity
  - Demands: **LRFD**, LFD, ASD
  - Load Rating: **LRFR**, LFR, ASR,
    - What trucks: HL-93, H-20, **Legal, EV**, Permit
- Axial vs. Flexural Member

FS ≈ 2.0

0.9 DL + (LL+IM)
1.8DL+2.0(LL+IM)
1.25DL+1.75(LL+IM)

Questions

- James Edmunds

  James.Edmunds@ky.gov

- Jason Stith

  Jason.Stith@mbakerintl.com