INDOT Structures Conference

Preliminary Steel Bridge Selection and Design

February 16, 2016

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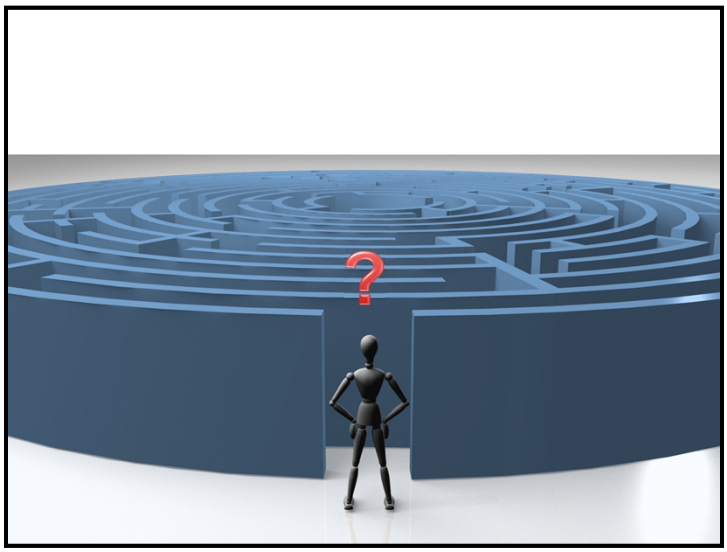

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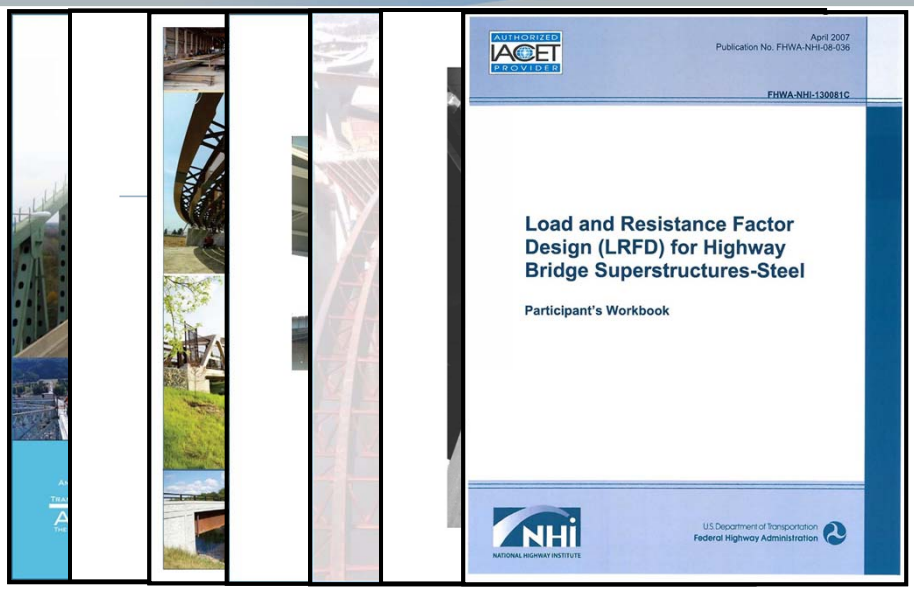
Where do I start?



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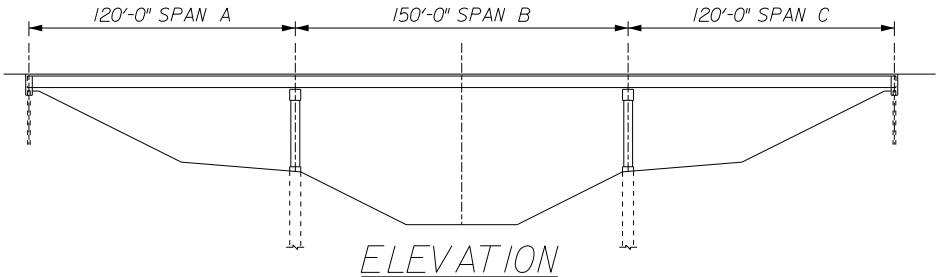
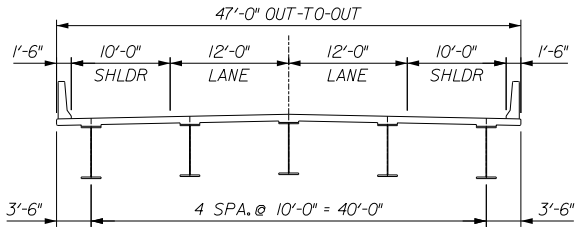
Sample Bridge



ELEVATION



TYPICAL SECTION

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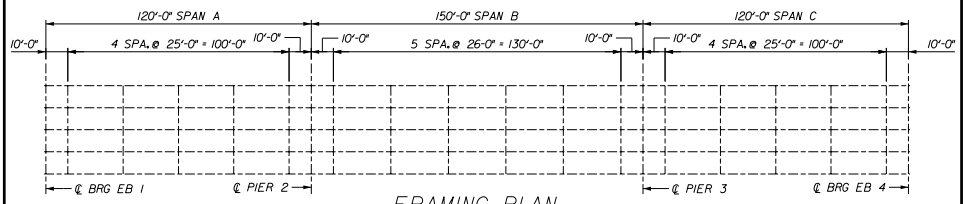
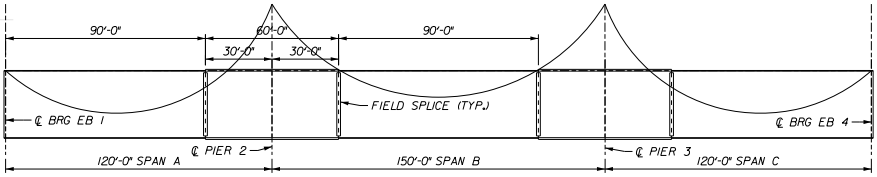
Framing Plan & Field Splice Locations



FRAMING PLAN

Intermediate Diaphragm Spacing:
IDM 407-5.03(01) & AASHTO 6.7.4

Limit field sections to 125 feet maximum
(Up to 150 feet or more for spans approaching 300 feet)



GIRDER ELEVATION

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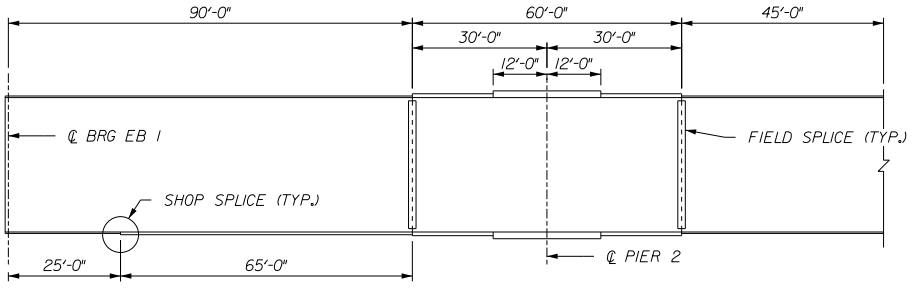
Shop Splice Locations



HALF GIRDER ELEVATION

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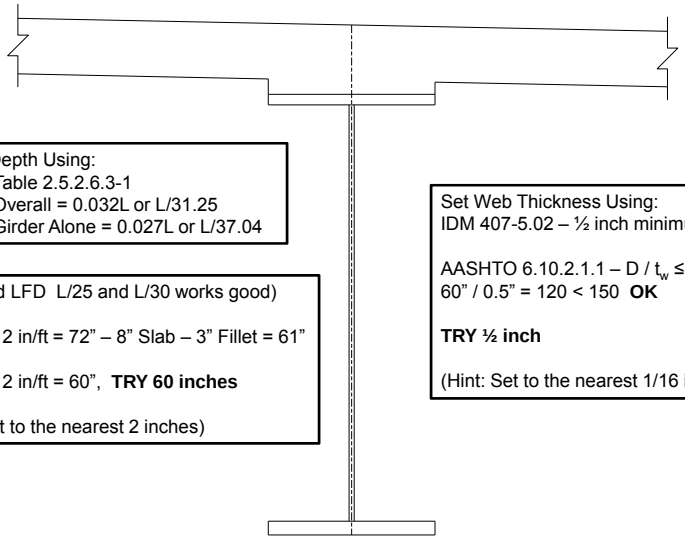
Preliminary Sizing of Girder - Web



Set Web Depth Using:
AASHTO Table 2.5.2.6.3-1
Minimum Overall = 0.032L or L/31.25
Minimum Girder Alone = 0.027L or L/37.04

(Hint 1: Old LFD L/25 and L/30 works good)

150'/25 x 12 in/ft = 72" – 8" Slab – 3" Fillet = 61"

150'/30 x 12 in/ft = 60", **TRY 60 inches**

(Hint 2: Set to the nearest 2 inches)

Set Web Thickness Using:
IDM 407-5.02 – ½ inch minimum

AASHTO 6.10.2.1.1 – $D / t_w \leq 150$
60" / 0.5" = 120 < 150 **OK**

TRY ½ inch

(Hint: Set to the nearest 1/16 inch)

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Preliminary Sizing of Girder - Web

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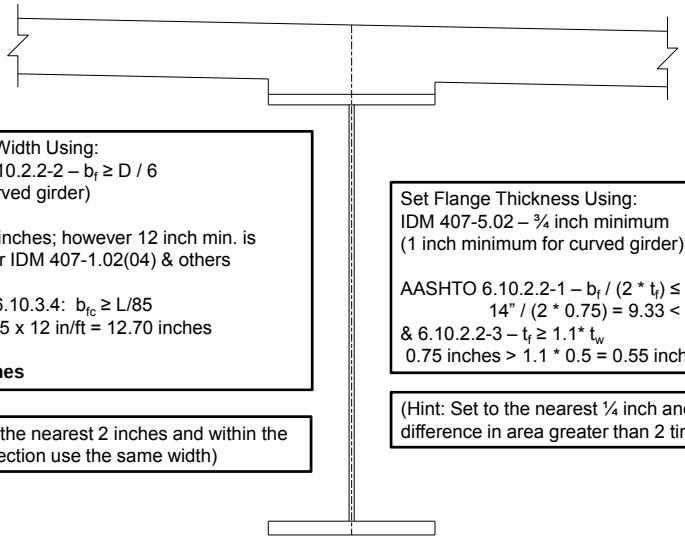
Preliminary Sizing of Girder - Flanges



Set Flange Width Using:
AASHTO 6.10.2.2-2 – $b_f \geq D / 6$
(D / 4 for curved girder)

60" / 6 = 10 inches; however 12 inch min. is preferred per IDM 407-1.02(04) & others

AASHTO C6.10.3.4: $b_{fc} \geq L/85$
90' / 85 x 12 in/ft = 12.70 inches

TRY 14 inches

(Hint: Set to the nearest 2 inches and within the same field section use the same width)

Set Flange Thickness Using:
IDM 407-5.02 – ¾ inch minimum
(1 inch minimum for curved girder)

AASHTO 6.10.2.2-1 – $b_f / (2 * t_f) \leq 12$
14" / (2 * 0.75) = 9.33 < 12 **OK**
& 6.10.2.2-3 – $t_f \geq 1.1 * t_w$
0.75 inches > 1.1 * 0.5 = 0.55 inches **OK**

(Hint: Set to the nearest ¼ inch and do not use a difference in area greater than 2 times)

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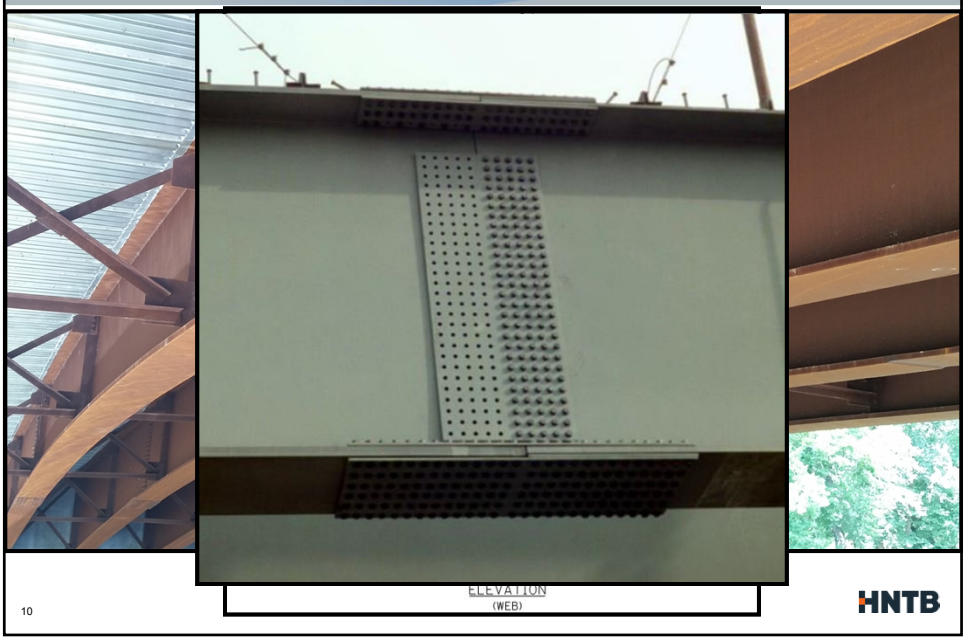
Preliminary Sizing of Girder - Flanges



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Preliminary Girder Sizing – Bearing Stiffeners

Set Bearing Stiffener Width:
Place near narrowest flange width and round down to nearest ¼ inch

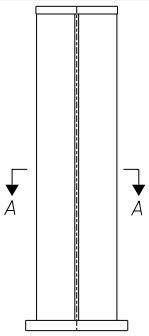
Set Bearing Stiffener Thickness Using:
IDM 407-5.02 – ½ inch minimum

AASHTO 6.10.11.2.2 –
$b_t \leq 0.48 * t_p * \sqrt{(E / F_{ys})}$

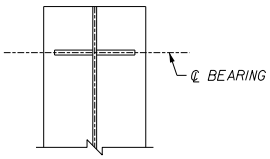
6.75 inches < 0.48 * 0.5 inch * √ (29,000 / 50) = 5.78 inches
NG!

TRY 0.625 inches or 5/8 inch, OK

(Hint: Set to the nearest 1/8 inch)



BEARING STIFFENER DETAIL



SECTION A-A

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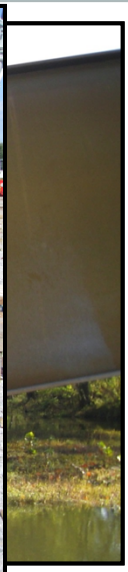
Preliminary Girder Sizing – Bearing Stiffeners



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Preliminary Girder Sizing – Transverse Stiffeners

Set Transverse Stiffener/Connection Plate Width:

IDM 407-5.03(03) – Not less than 5 inches

AASHTO 6.10.11.1.2-1
$b_t \geq 2.0 + D / 30$
5 inches > 2.0 + 60" / 30 = 4 inches **OK**

(Hint: Use the minimum preliminarily and set to the nearest ¼ inch)

Set Transverse Stiffener/Connection Plate Thickness:

IDM 407-5.02 – ½ inch minimum

AASHTO 6.10.11.1.2-2
$16 * t_p \geq b_t \geq b_f / 4$
16 * 0.5 = 8 inches ≥ 5 inches ≥ 14" / 4 = 3.5 inches **OK**

(Hint: Set to the nearest 1/8 inch)

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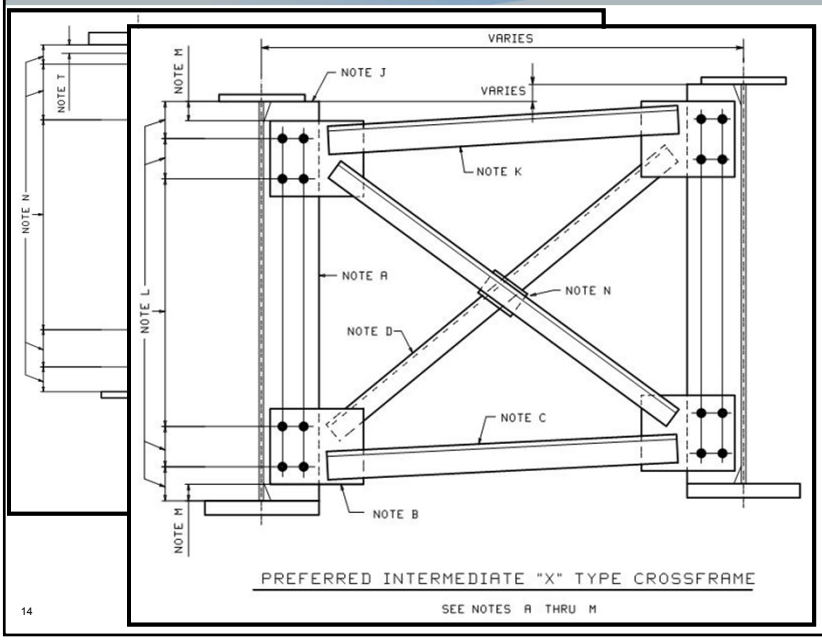
Preliminary Girder Sizing – Intermediate Diaphragms



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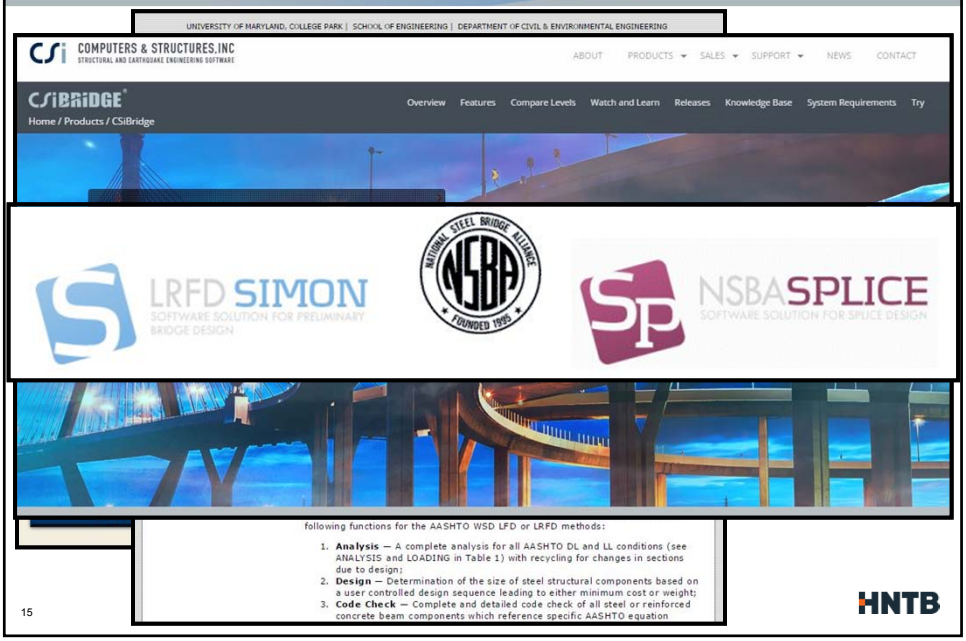
Next Steps



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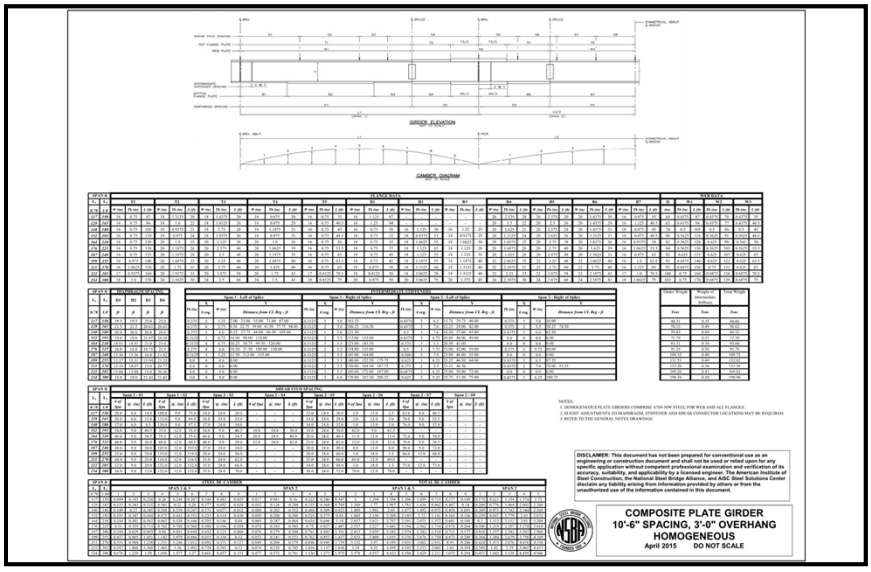
Compare to NSBA Continuous Span Standards



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Preliminary Constructability Check

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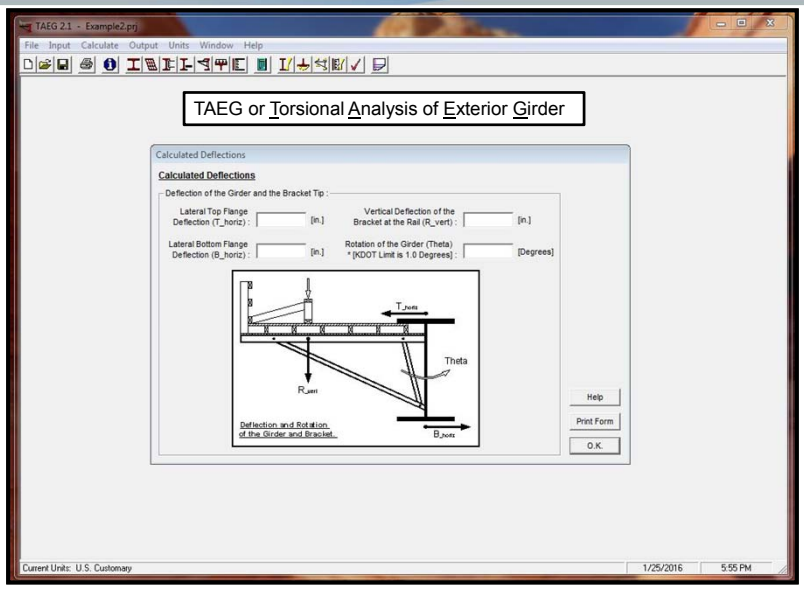
Preliminary Constructability Check



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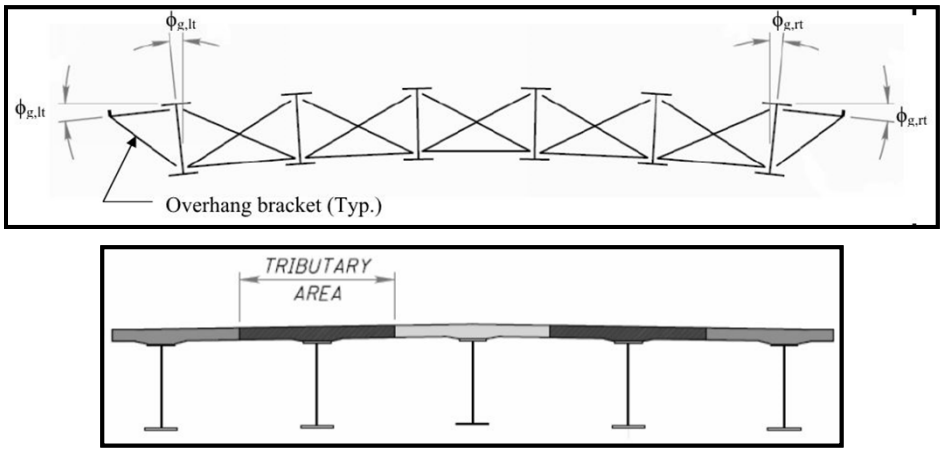
Preliminary Constructability Check

Global Superstructure Distortion



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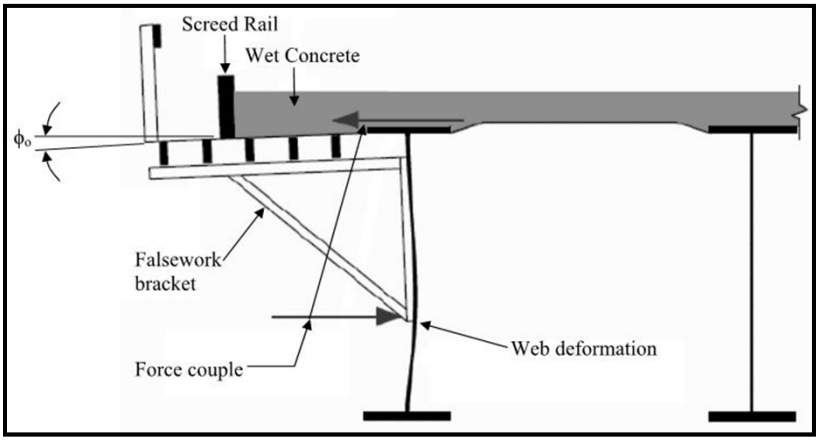
Preliminary Constructability Check

Oil Canning



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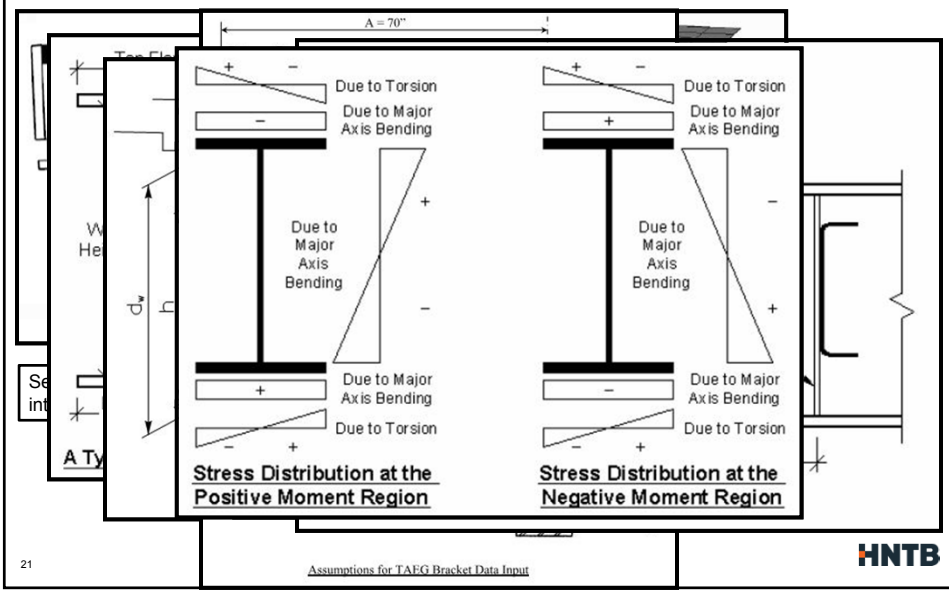
Preliminary Constructability Check

Girder Warping – Perform TAEG Analysis



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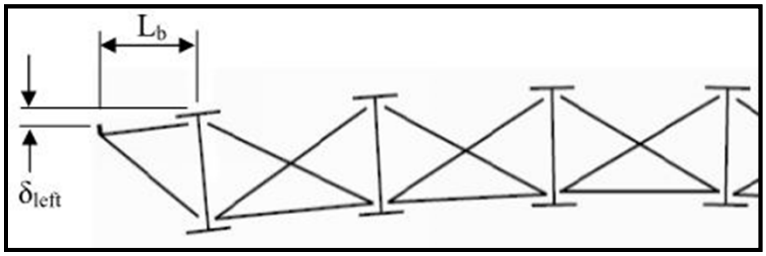
Preliminary Constructability Check

Combined Effect of Rotation and Loss of Deck Thickness from:
Global Superstructure Distortion + Oil Canning + Girder Warping



Industry standard limits this to 0.50 inches maximum

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Steel design doesn't have to be challenging

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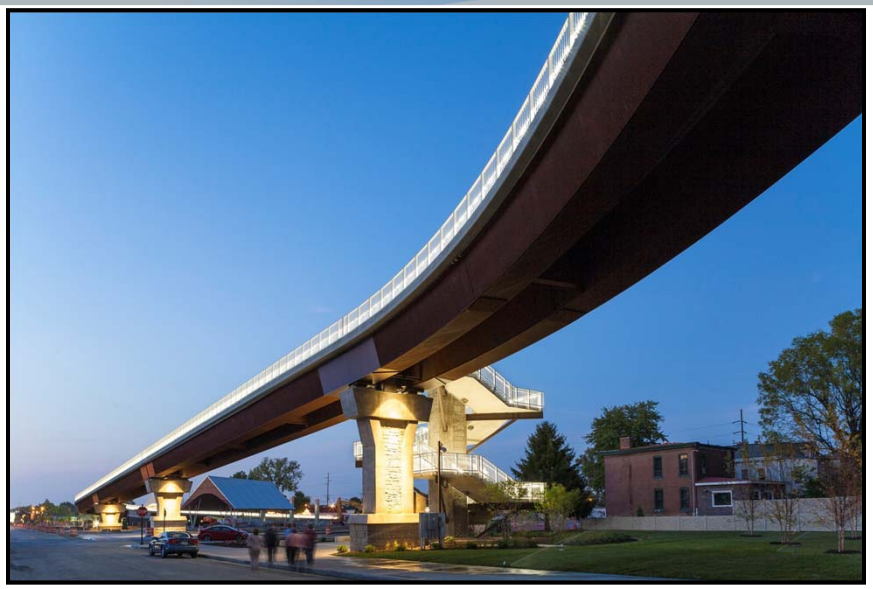
QUESTIONS?



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