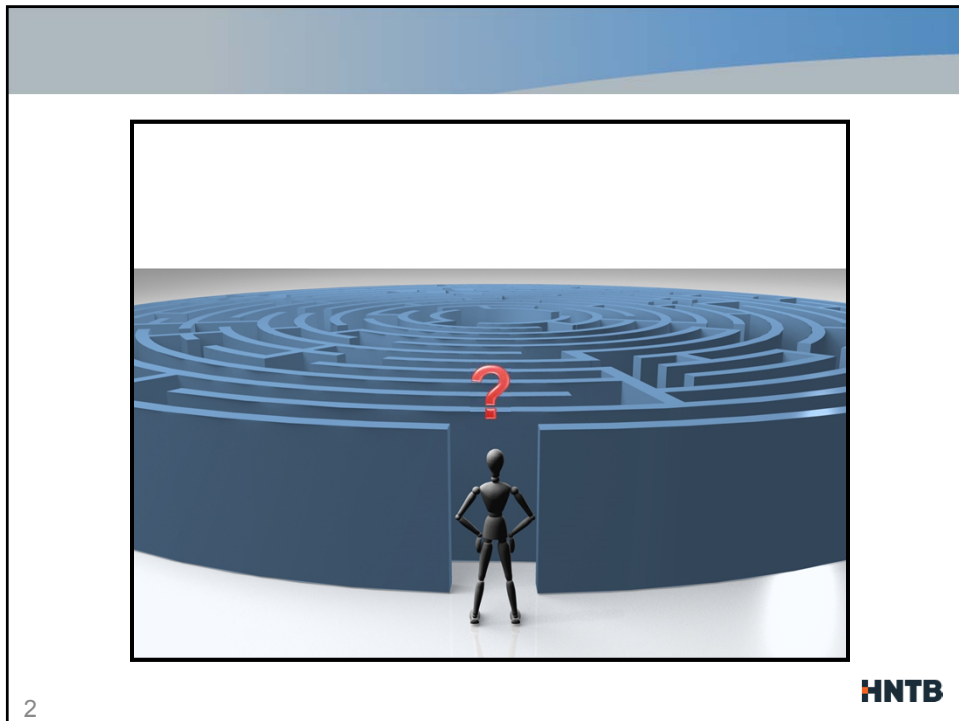


INDOT Structures Conference
Preliminary Steel Bridge Selection
and Design

February 16, 2016

HNTB

This slide features a white background with a blue and grey curved graphic on the left side. The title is centered, with an orange square to the left of the main title. The date is centered below the title, and the HNTB logo is in the bottom right corner.



HNTB

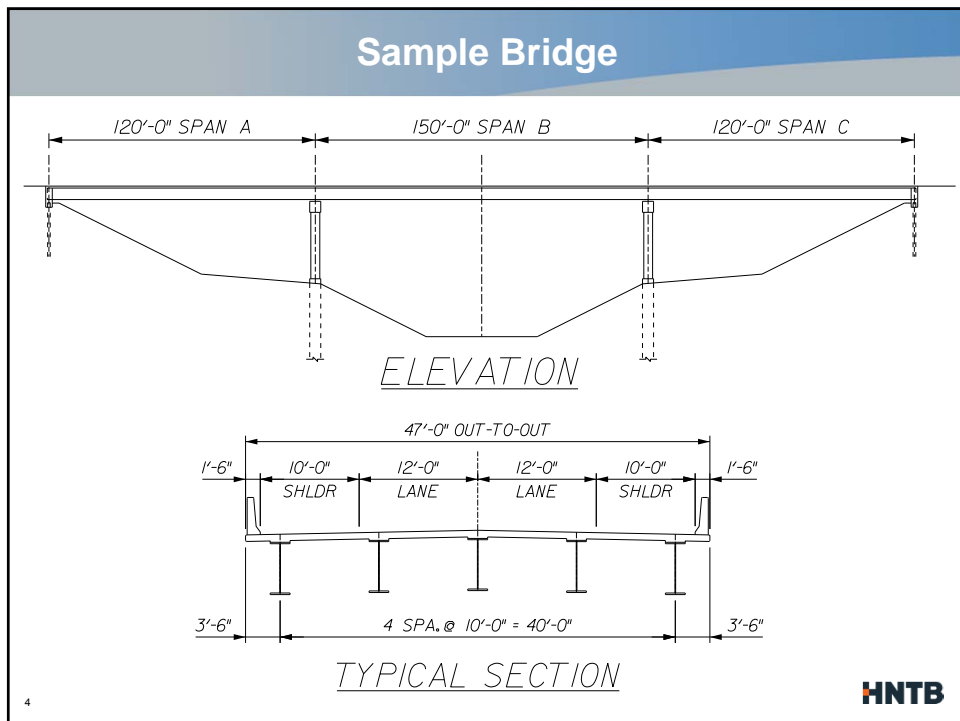
2

This slide contains a 3D illustration of a blue maze. A small, grey, humanoid figure stands at the entrance of the maze, looking at a large red question mark. The maze is set on a white surface against a light blue background. The HNTB logo is in the bottom right corner, and the number '2' is in the bottom left corner.

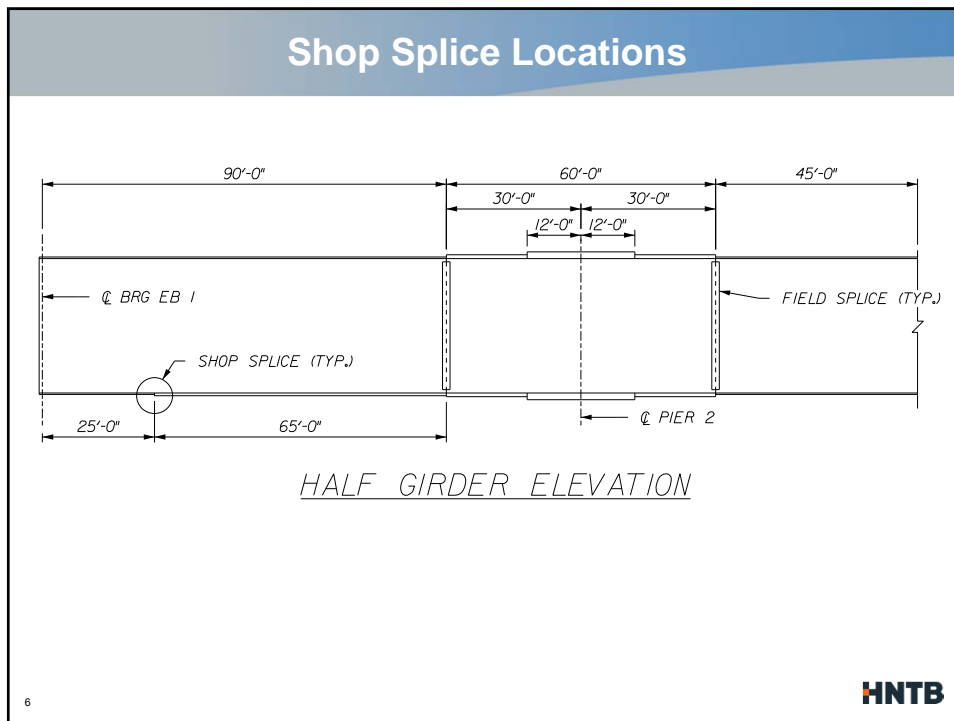
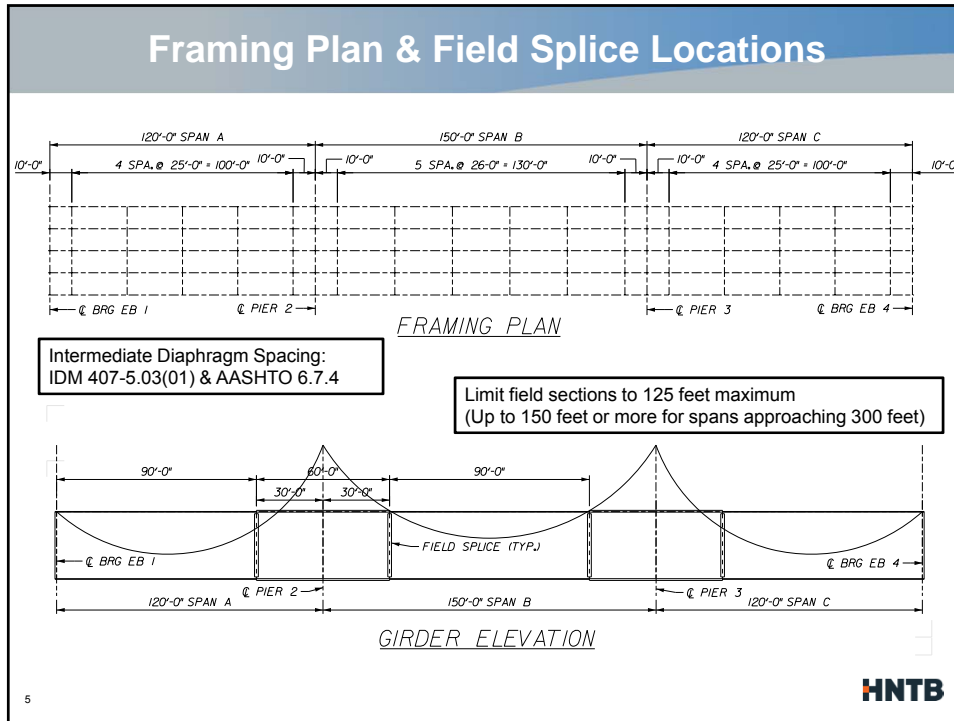
Where do I start?

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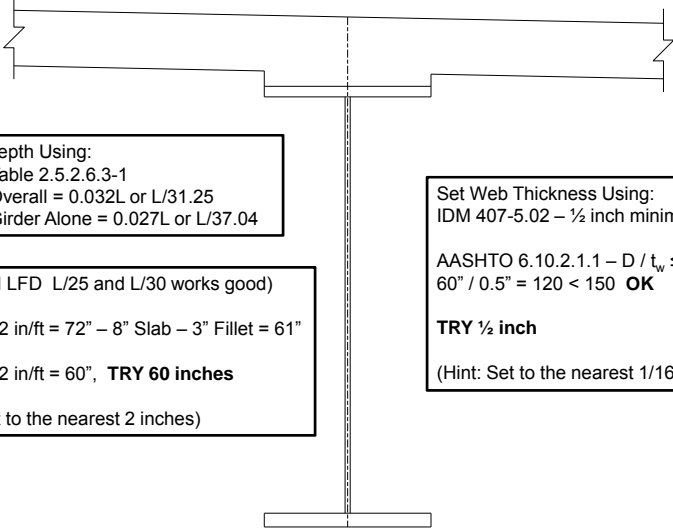
3



4



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)

$150'/25 \times 12 \text{ in/ft} = 72'' - 8'' \text{ Slab} - 3'' \text{ Fillet} = 61''$

$150'/30 \times 12 \text{ in/ft} = 60''$, **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)

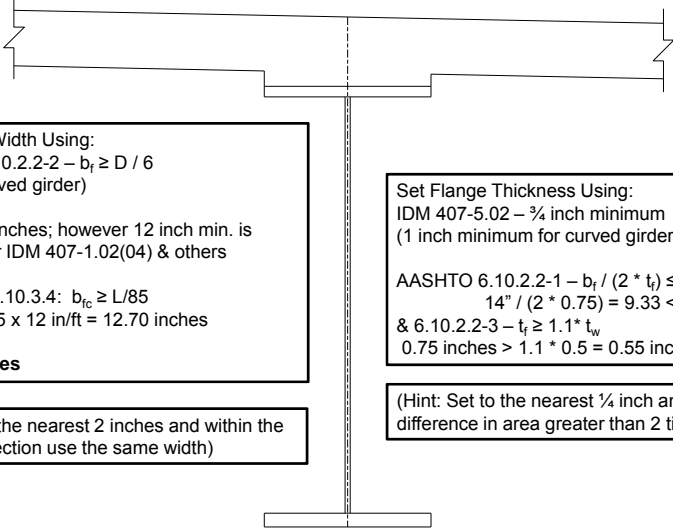
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Preliminary Sizing of Girder - Web



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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: $b_{fc} \geq L/85$
 $90' / 85 \times 12 \text{ in/ft} = 12.70$ inches


TRY 14 inches

Set Flange Thickness Using:
 IDM 407-5.02 – $\frac{1}{4}$ 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 – $t_f \geq 1.1 * t_w$
 $0.75 \text{ inches} > 1.1 * 0.5 = 0.55 \text{ inches}$ **OK**


(Hint: Set to the nearest $\frac{1}{4}$ inch and do not use a difference in area greater than 2 times)



Preliminary Sizing of Girder - Flanges



ELEVATION
(WEB)



Preliminary Girder Sizing – Bearing Stiffeners

Set Bearing Stiffener Width:
Place near narrowest flange width and round down to nearest 1/4 inch

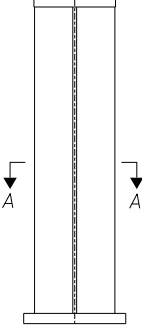
Set Bearing Stiffener Thickness Using:
IDM 407-5.02 – 1/2 inch minimum

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

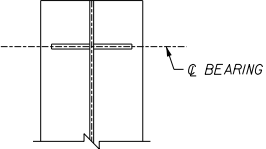
6.75 inches < $0.48 * 0.5 \text{ inch} * \sqrt{29,000 / 50} = 5.78 \text{ inches}$
NG!

TRY 0.625 inches or 5/8 inch, OK


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



BEARING STIFFENER DETAIL



SECTION A-A



11

Preliminary Girder Sizing – Bearing Stiffeners





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 1/4 inch)

Set Transverse Stiffener/Connection Plate Thickness:

IDM 407-5.02 – 1/2 inch minimum

AASHTO 6.10.11.1.2-2

$$16 * t_p \geq b_t \geq b_t / 4$$

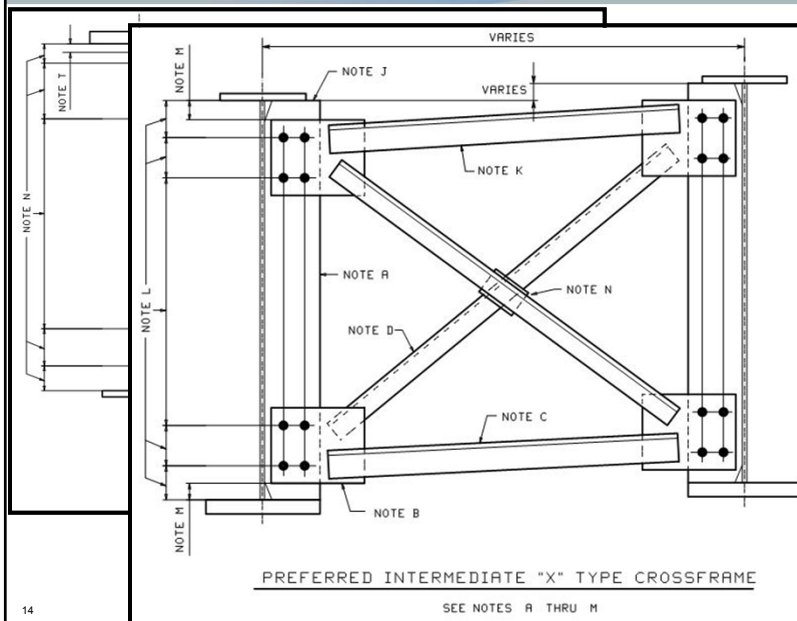
$16 * 0.5 = 8$ inches ≥ 5 inches $\geq 14" / 4 = 3.5$ inches **OK**

(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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following functions for the AASHTO WSD LFD or LFRD methods:

1. **Analysis** – A complete analysis for all AASHTO DL and LL conditions (see ANALYSIS and LOADING in Table 1) with recycling for changes in sections due to design;
2. **Design** – Determination of the size of steel structural components based on a user controlled design sequence leading to either minimum cost or weight;
3. **Code Check** – Complete and detailed code check of all steel or reinforced concrete beam components which reference specific AASHTO equation

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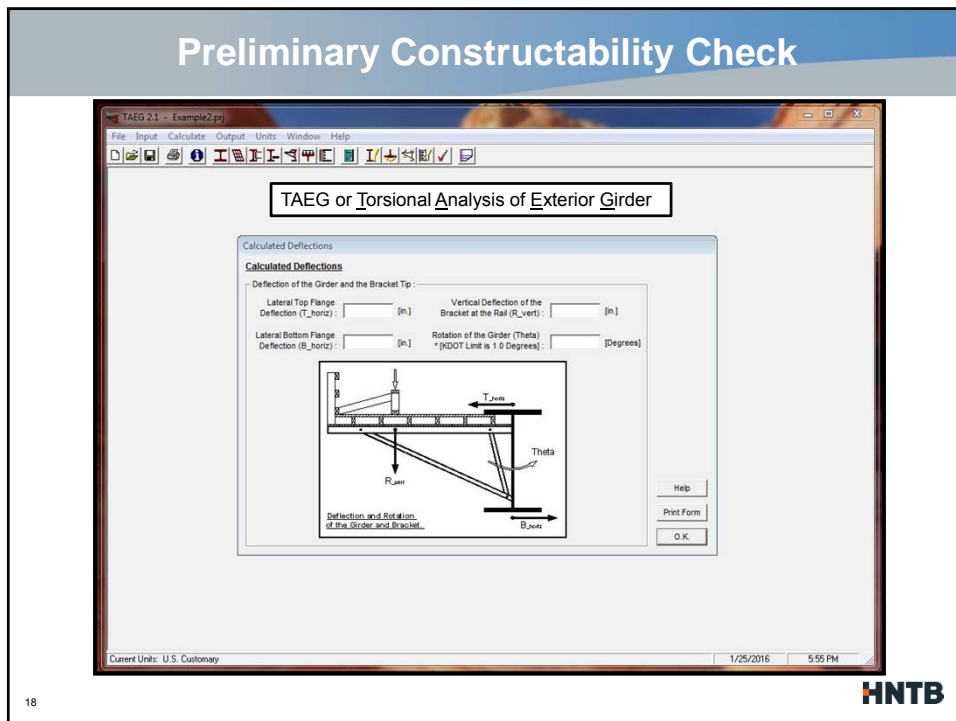
Compare to NSBA Continuous Span Standards

SECTION 1 - BRIDGE SPAN												SECTION 2 - BRIDGE SPAN											
Span	1	2	3	4	5	6	7	8	9	10	11	Span	12	13	14	15	16	17	18	19	20	21	
Length	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Width	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
Depth	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
Area	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	
Weight	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	115200	

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COMPOSITE PLATE GIRDER
10'-6" SPACING, 3'-0" OVERHANG
HOMOGENEOUS
April 2015 DO NOT SCALE

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Preliminary Constructability Check

Global Superstructure Distortion

The diagram illustrates global superstructure distortion on a truss bridge. It shows a side view of the bridge with several spans supported by piers. At the ends of the bridge, there are overhang brackets. The diagram is labeled with $\phi_{g,lt}$ at the left end and $\phi_{g,rt}$ at the right end, indicating global distortions. A central section is labeled "TRIBUTARY AREA". Below the bridge, a cross-section of the deck is shown with a shaded area representing the tributary area. The HNTB logo is in the bottom right corner.

Overhang bracket (Typ.)

TRIBUTARY AREA

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Preliminary Constructability Check

Oil Canning

The diagram illustrates oil canning, a common issue in steel bridge construction. It shows a cross-section of a bridge deck being poured with wet concrete. A screed rail is used to level the concrete. A falsework bracket is attached to the steel web of the girder. A force couple is applied to the bracket. The diagram shows the resulting web deformation, which is a common cause of oil canning. The angle of the force couple is labeled ϕ_o . The HNTB logo is in the bottom right corner.

Screed Rail

Wet Concrete

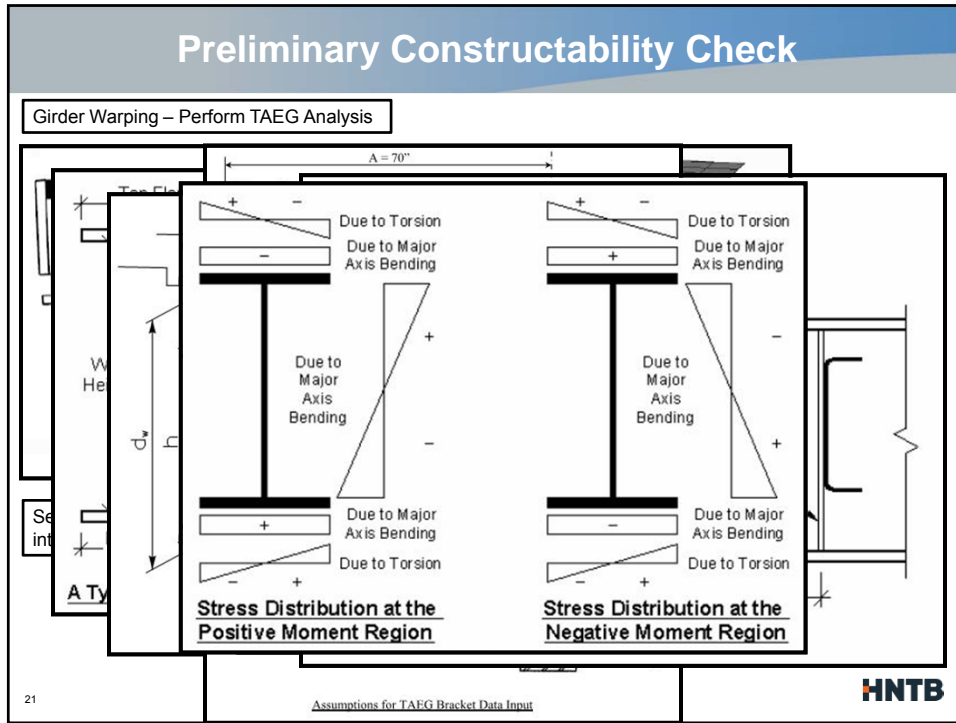
Falsework bracket

Force couple

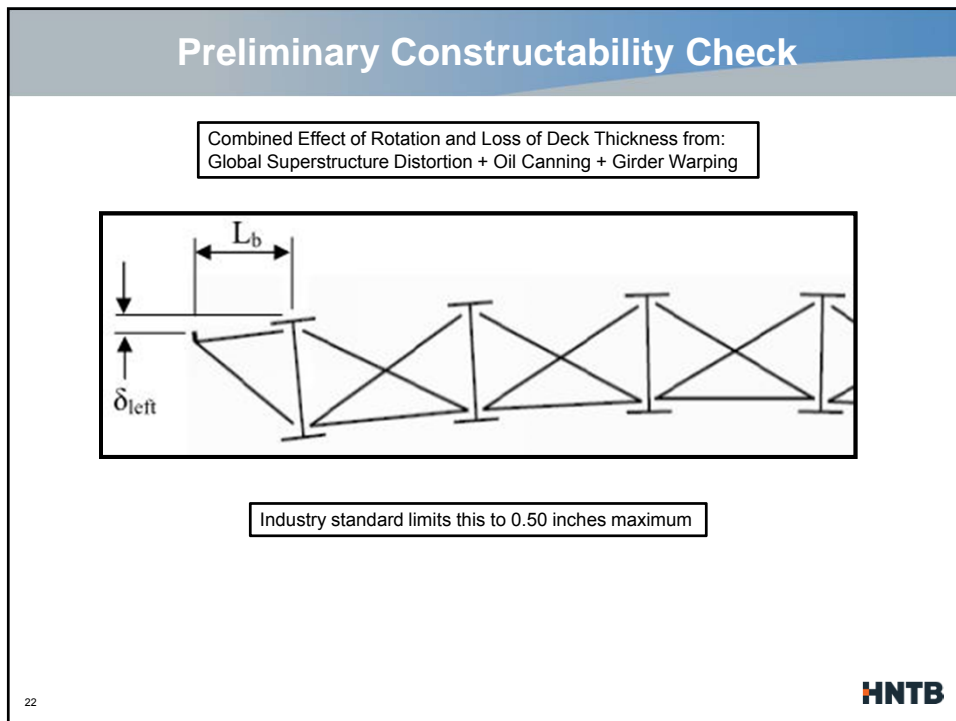
Web deformation

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22

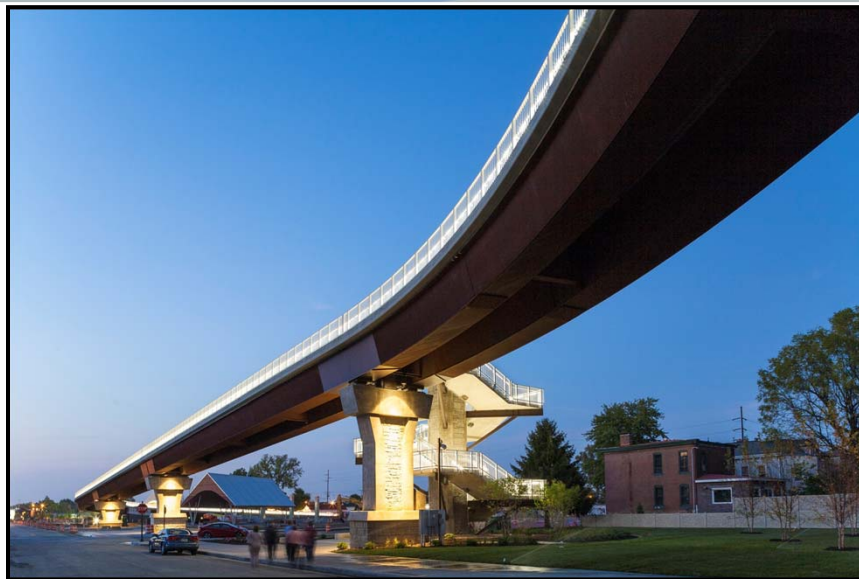
Steel design doesn't have to be challenging



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QUESTIONS?



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