Efficient and Integrated Design of Modern Steel Highway Bridges

Francesco M Russo, PhD, PE

Russo Structural Services

Frank.Russo@RussoStructural.com

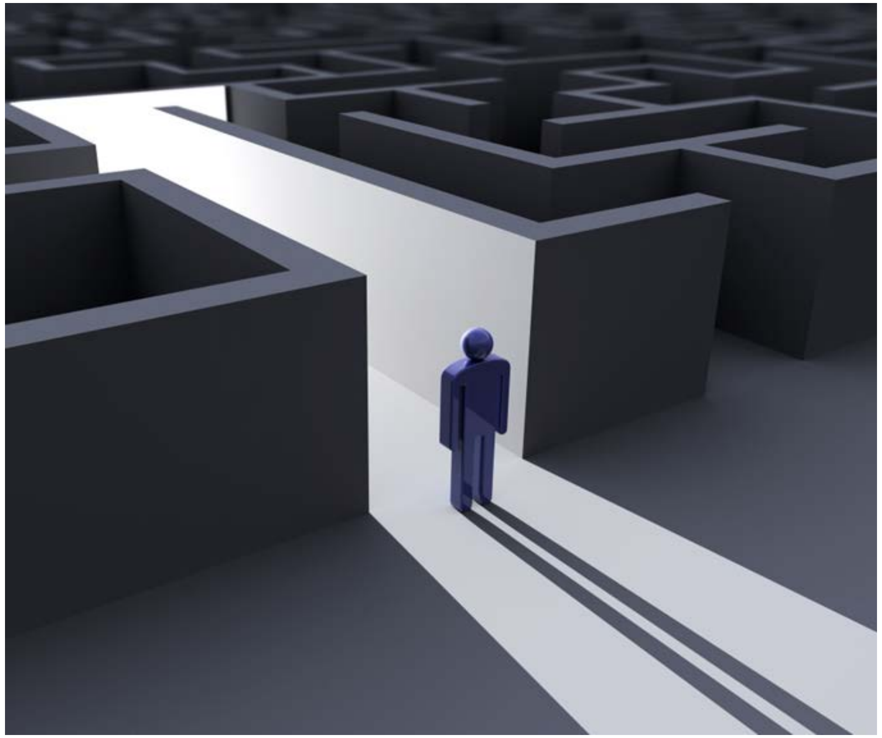
Presentation Outline

- Part 1 – Fundamental concepts for steel bridge layout

- Part 2 – Standard Plans review
  - An overview of the NSBA Standard Plans

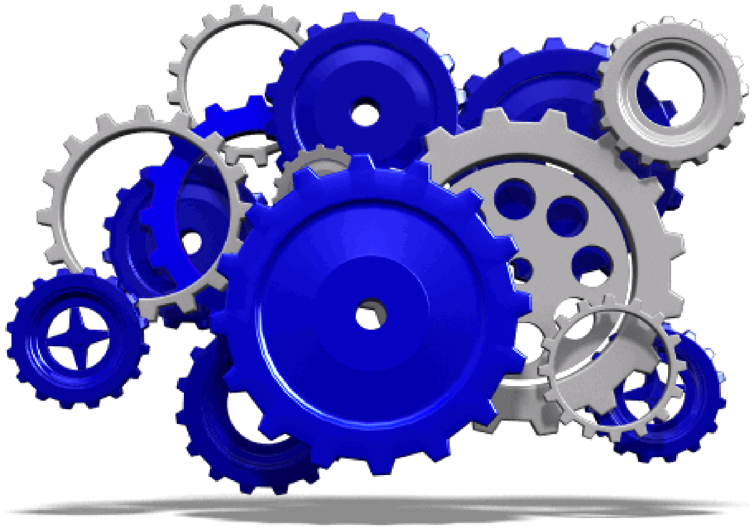
You Want to Design a Steel Bridge? What is required?

- Span arrangement
- Beam spacing and overhang
- Bracing type and spacing
- Flange and web sizing
- Stiffeners, splices, shear connectors, etc.
- Other new and “fun” checks
  - Wind on the erected steel
  - LRFD 10th edition stability requirements



RUSSO STRUCTURAL SERVICES

What is Bridge Design ?



Bridge design is a unique combination of

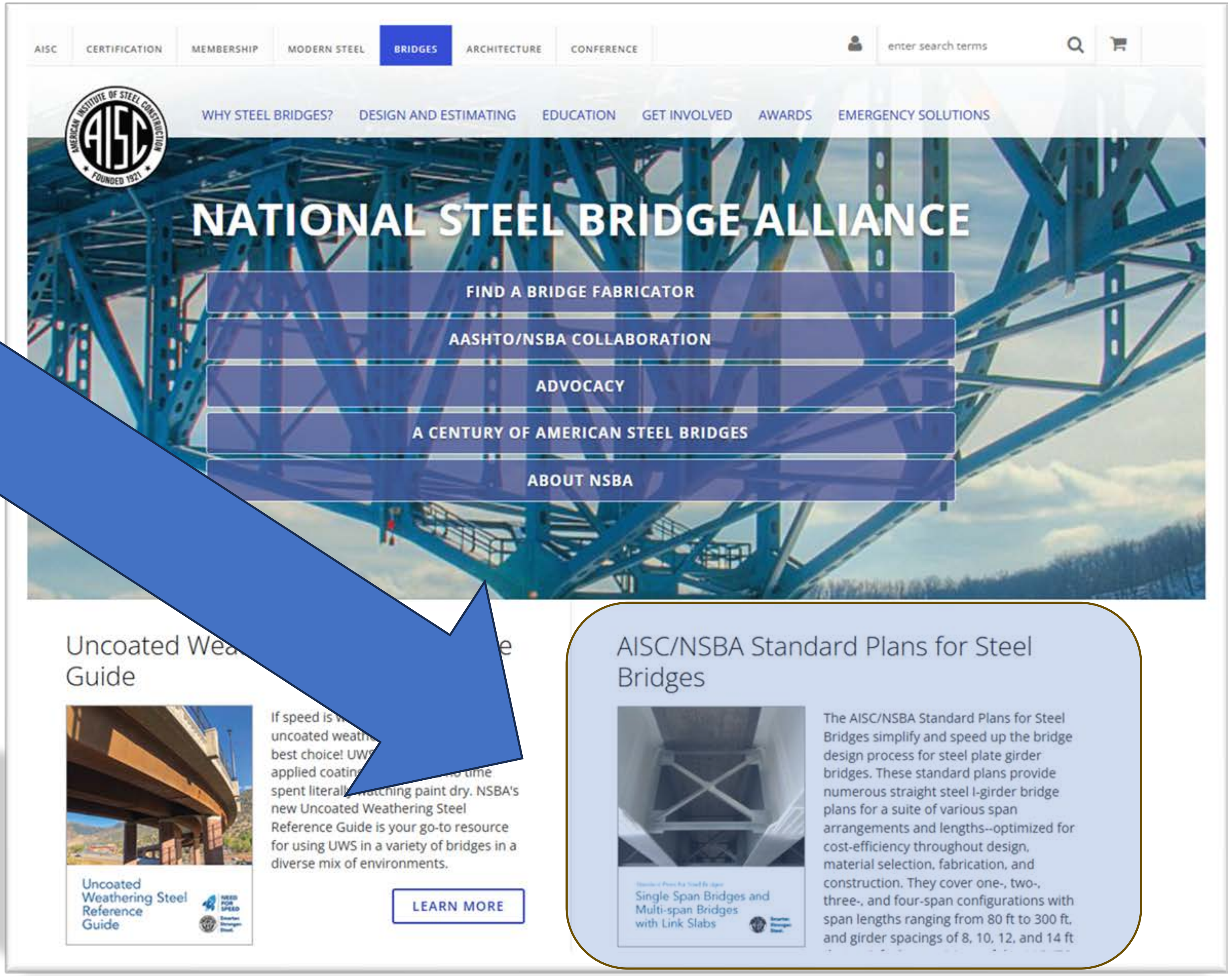
- ***Shall / Must***
  - AASHTO
- ***Should***
  - AASHTO Commentary
- ***It would be good if …***
  - NSBA Collaboration Documents
- ***I wish you would …***
  - other guidance, fabricator and erector preferences
- ***Don't you dare …***
  - avoid this at all costs

There are many good answers, my goal is help you avoid the bad ones

RUSSO STRUCTURAL SERVICES

Let's Begin at the End

https://www.aisc.org/nsba



RUSSO STRUCTURAL SERVICES

Bridge Layout and Planning

RUSSO
STRUCTURAL SERVICES

Span Layout for Continuous Spans

- For multi-span bridges, continuous spans are generally preferred
- A balanced span arrangement is also preferred
  - Peak positive and negative moments nearly equal in all spans

Balanced Span Arrangement

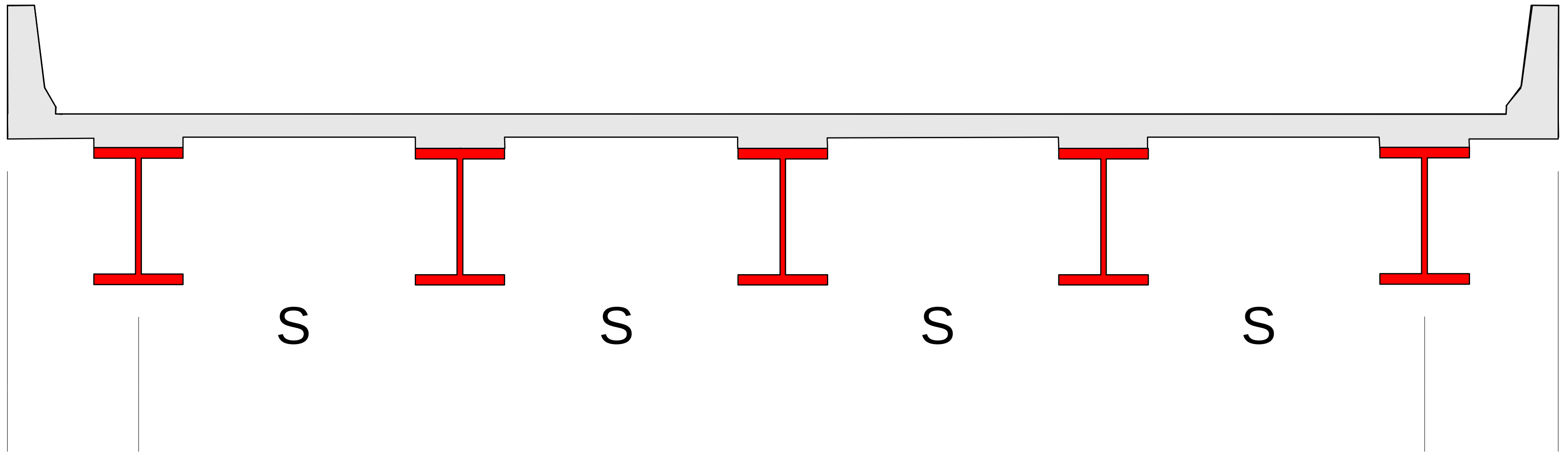
- End spans 75% - 82% of center span

It would be good if …

RUSSO STRUCTURAL SERVICES

Spacing & Overhangs

- Goal – relative balance of total forces among the beams



0.28 S
TO
0.35 S

It would be good if ...

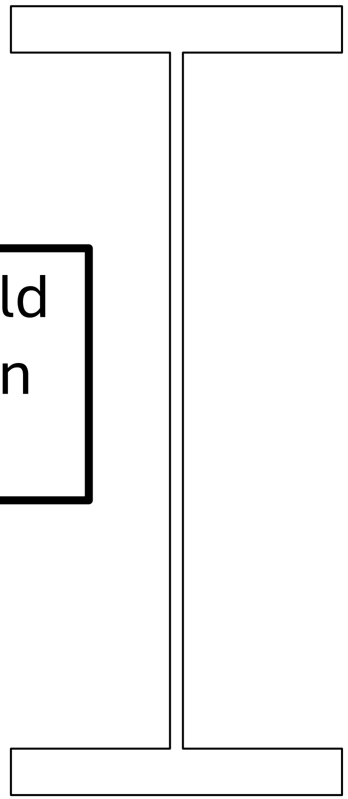
0.28 S
TO
0.35 S

Depth to Span Ratio
Bare Girder (LRFD 2.5.2.6.3)

- Suggested minimum depth of I-beam portion only

0.033L (L/30)	Simple Spans
0.027L (80% * L/30)	Continuous Spans

Must or should depending on your owner



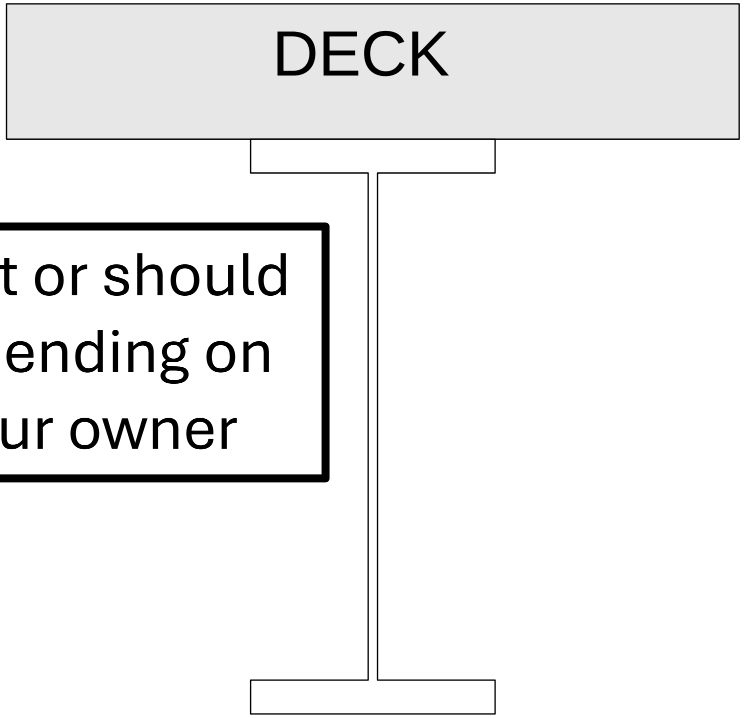
L= Total span length

RUSSO STRUCTURAL SERVICES

Depth to Span Ratio
Composite Section (LRFD 2.5.2.6.3)

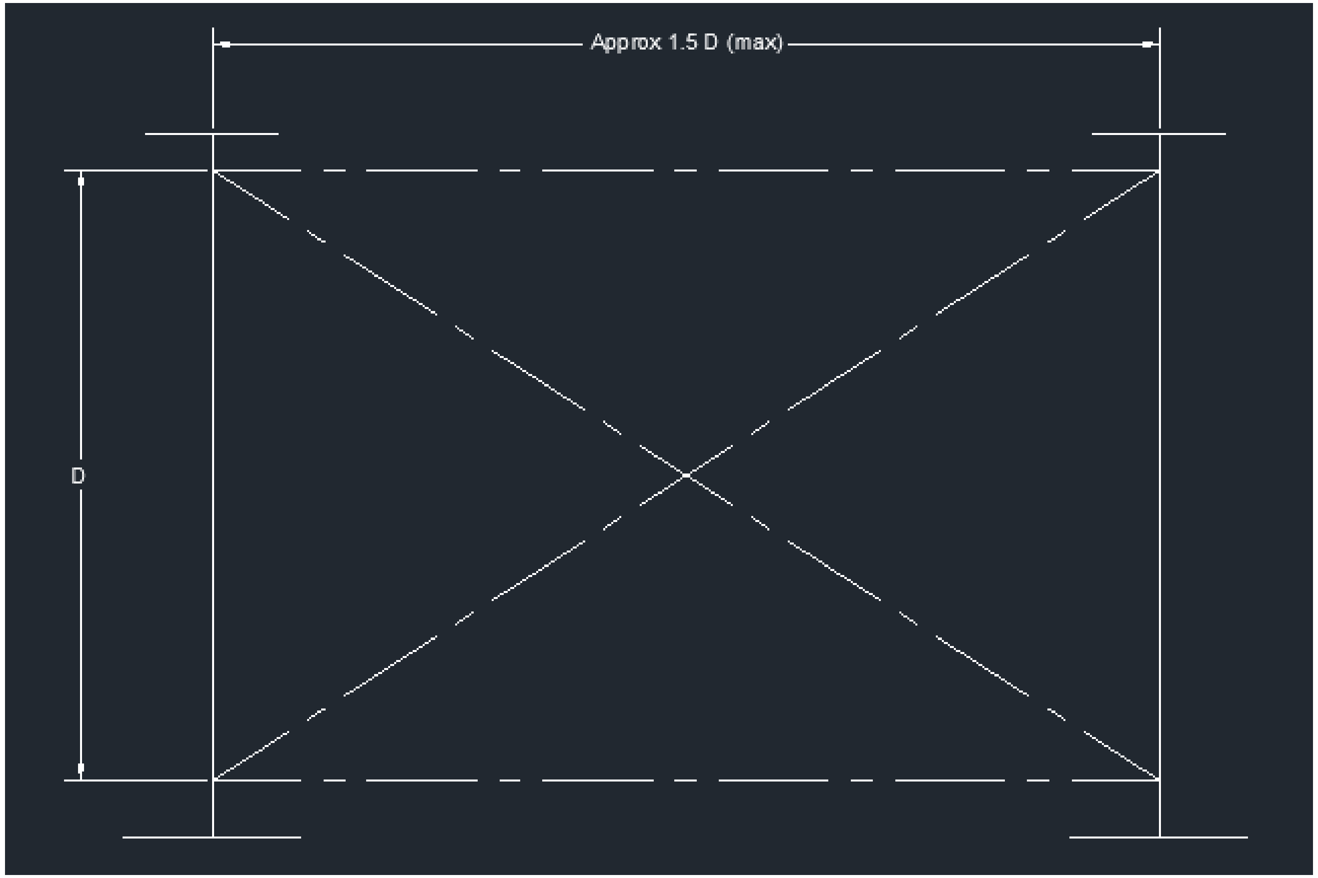
- Suggested minimum depth of composite I-beam

- 0.040L (L/25) Simple Spans
- 0.032L (80% * L/25) Continuous Spans

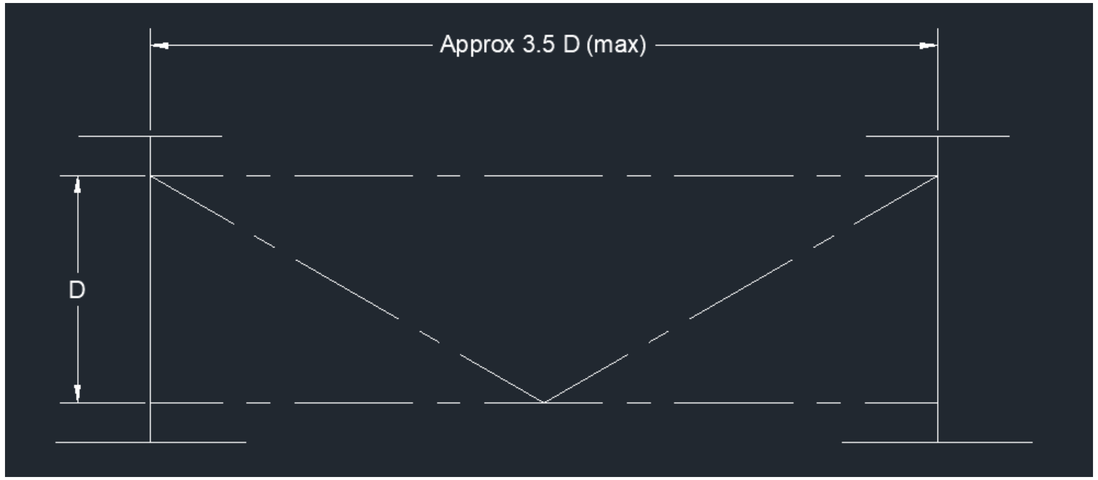


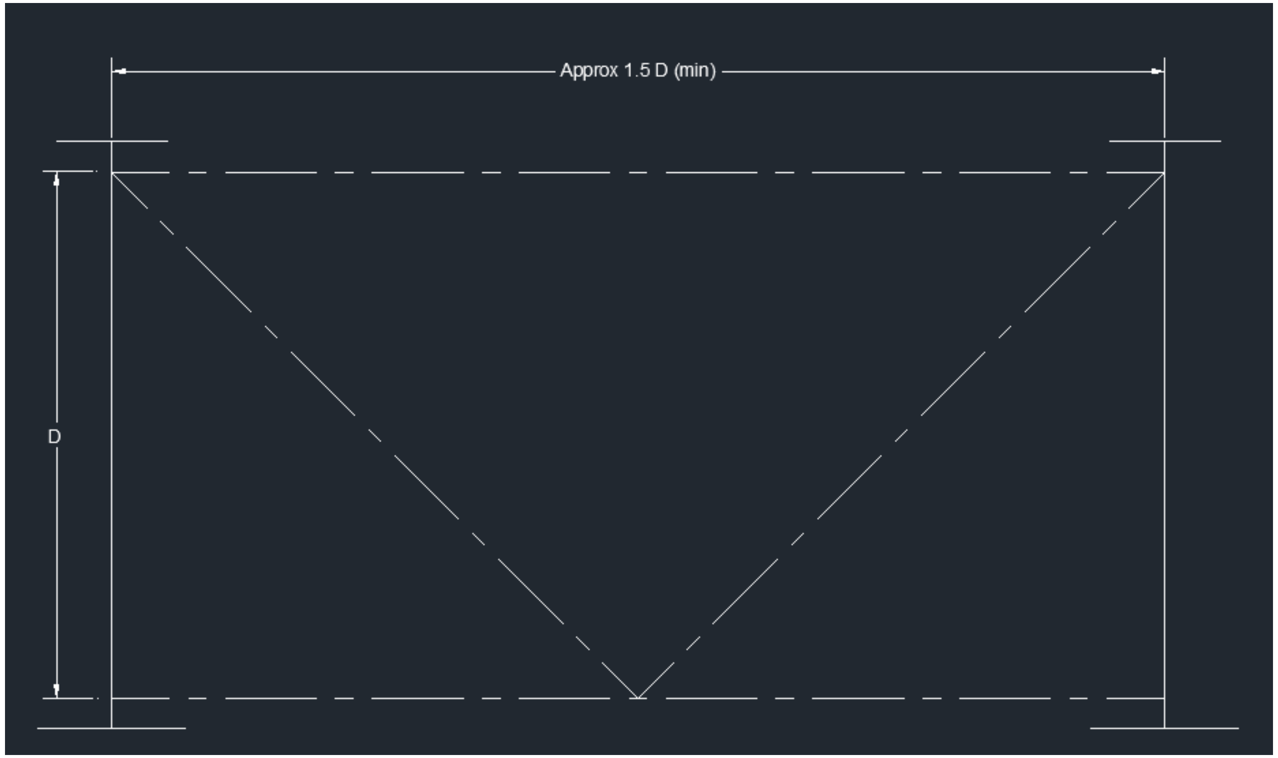
Must or should depending on your owner

When to Use an X-Frame, S/D ≈ 1.5 max.



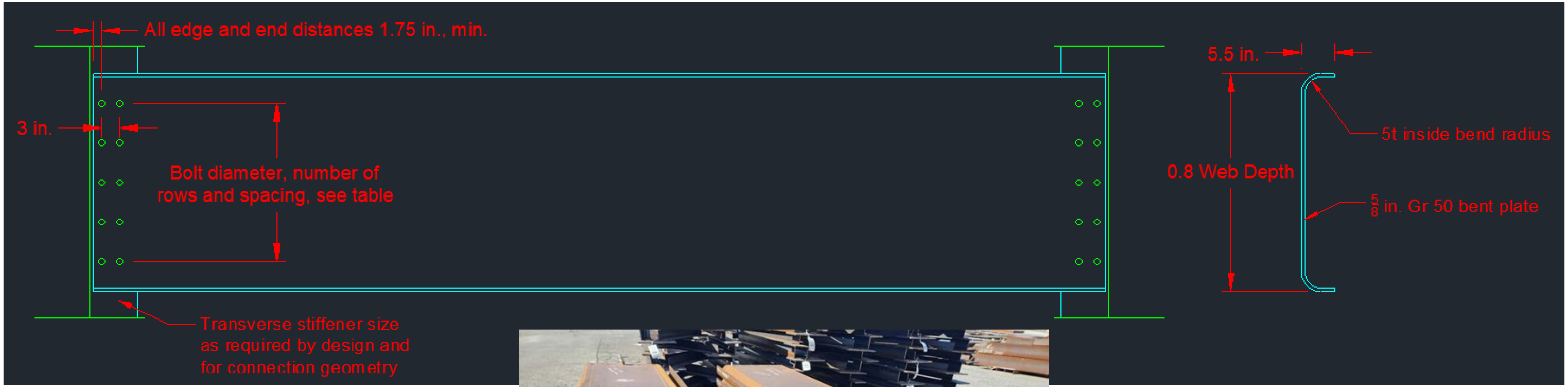
When to Use a K-Frame, S/D ≈ 1.5 – 3.5





RUSSO STRUCTURAL SERVICES

When to use a Solid Diaphragm, S/D > ≈ 3.5



RUSSO
STRUCTURAL SERVICES

Other Considerations…

- Torsion / deck overhang loading
- Wind on the erected steel
- Stability of partly erected steel

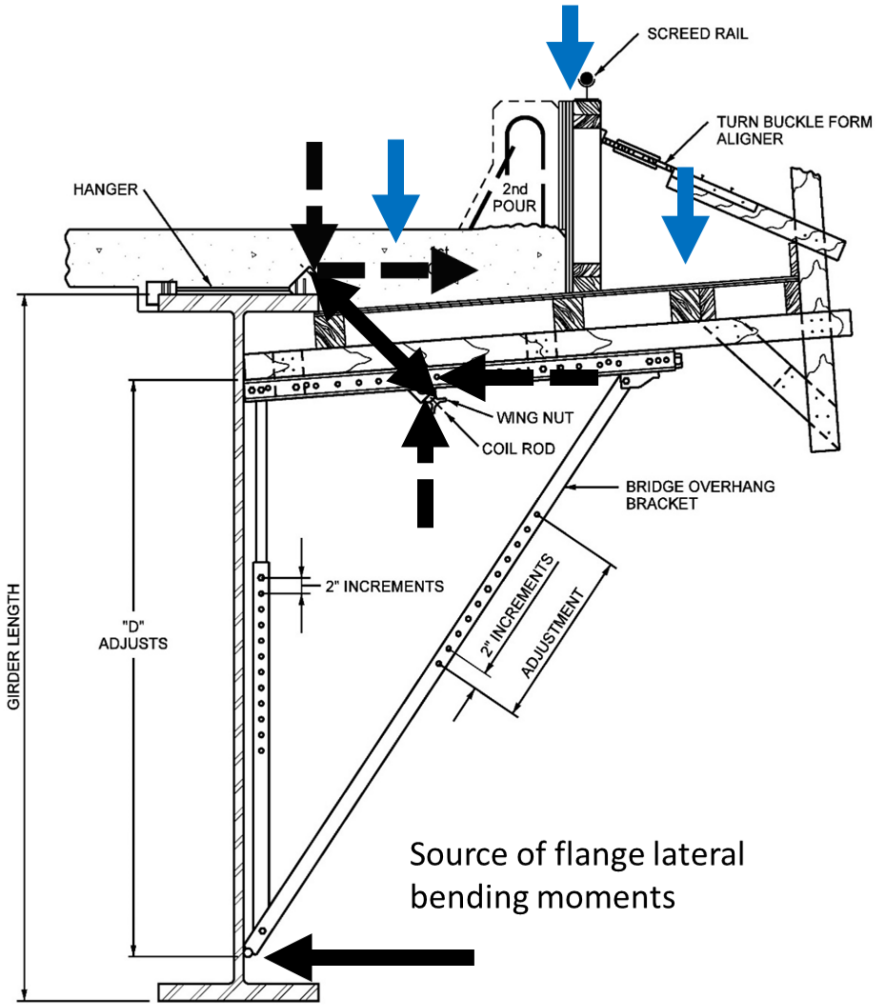
RUSSO STRUCTURAL SERVICES

Deck Overhang Loading

- Significant Effects for Exterior Beams

$$f_{bu} + f_{\ell} \leq \phi_f R_h F_{yc},$$

$$f_{bu} + \frac{1}{3} f_{\ell} \leq \phi_f F_{nc},$$



Source of flange lateral bending moments

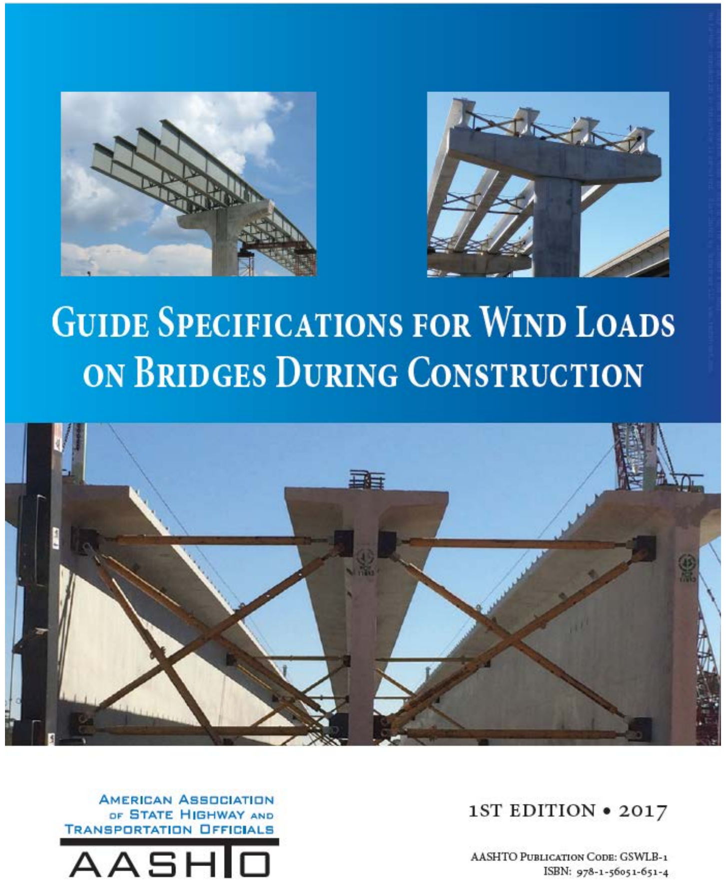
RUSSO STRUCTURAL SERVICES

So Where Are We ?

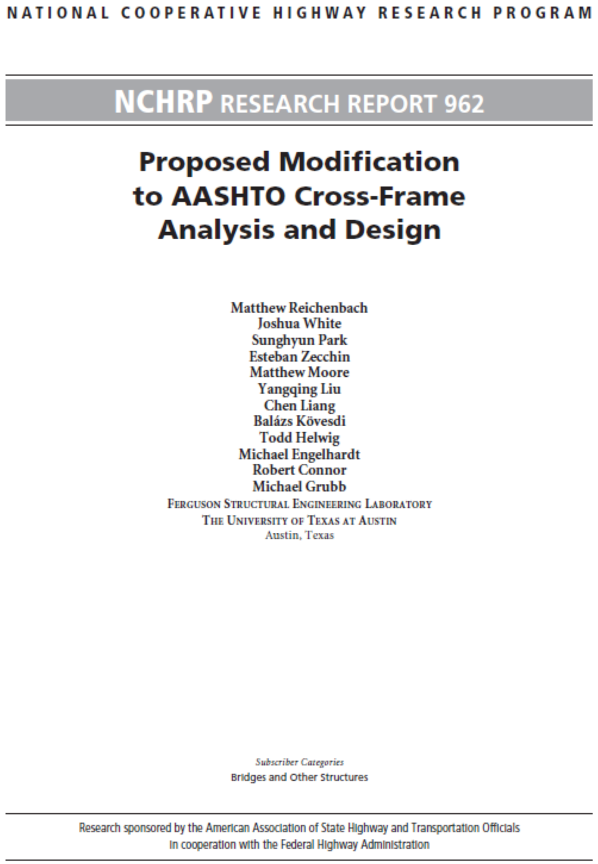
- We have a “good design”
  - Practical and simple layout
    - We chose a rational layout of spans
    - Beam spacing and overhangs make sense
    - We chose a reasonable girder depth
    - Practical bracing layout was provided
    - **All of this can be designed with a line girder, LRFD SIMON**
- Are we done?

Some Other Things to Consider / New Requirements

Wind Loads During Construction



Stability Bracing Requirements


NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP RESEARCH REPORT 962

Proposed Modification to AASHTO Cross-Frame Analysis and Design

Matthew Reichenbach
Joshua White
Sunghyun Park
Esteban Zecchin
Matthew Moore
Yangqing Liu
Chen Liang
Balázs Kövesdi
Todd Helwig
Michael Engelhardt
Robert Connor
Michael Grubb
FERGUSON STRUCTURAL ENGINEERING LABORATORY
THE UNIVERSITY OF TEXAS AT AUSTIN
Austin, Texas

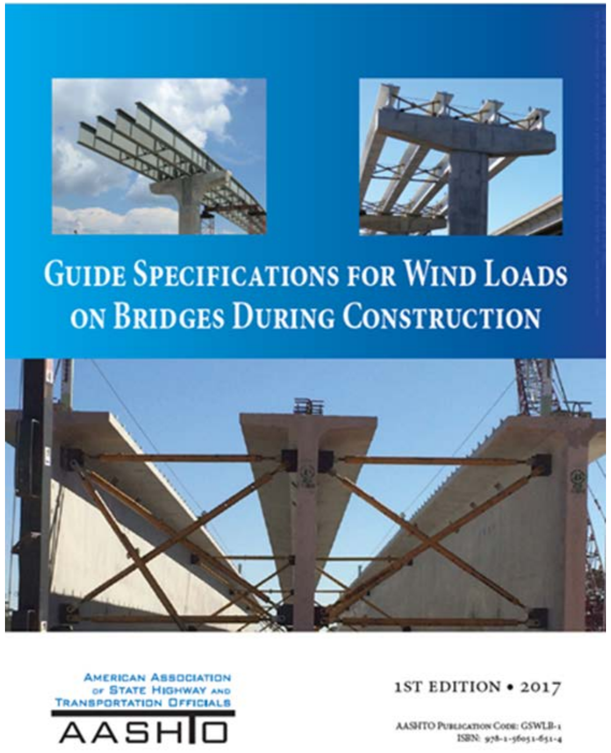
Subscriber Categories
Bridges and Other Structures

Research sponsored by the American Association of State Highway and Transportation Officials in cooperation with the Federal Highway Administration

RUSSO STRUCTURAL SERVICES

AASHTO Wind Loads During Construction

Strength Loads

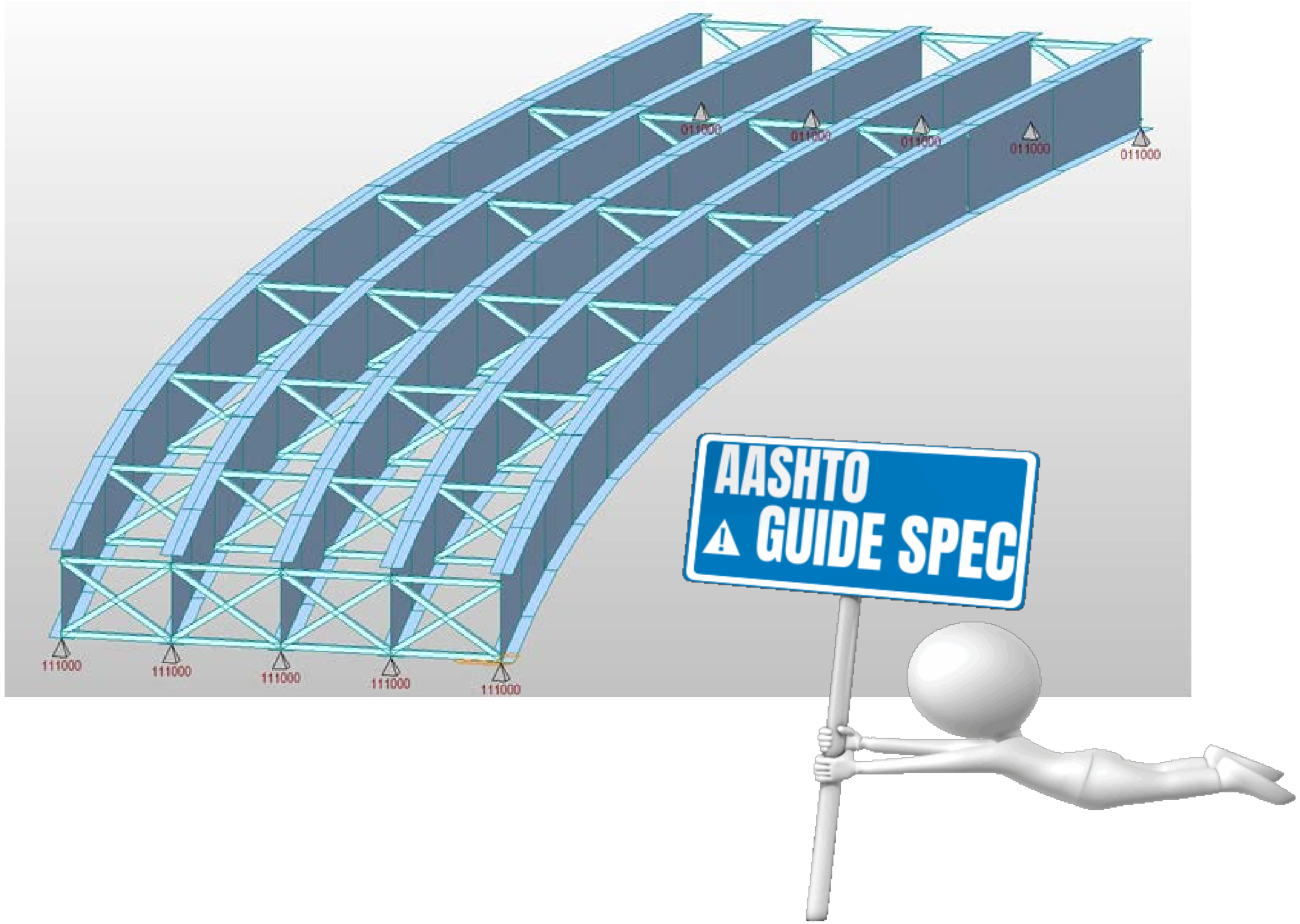


Service

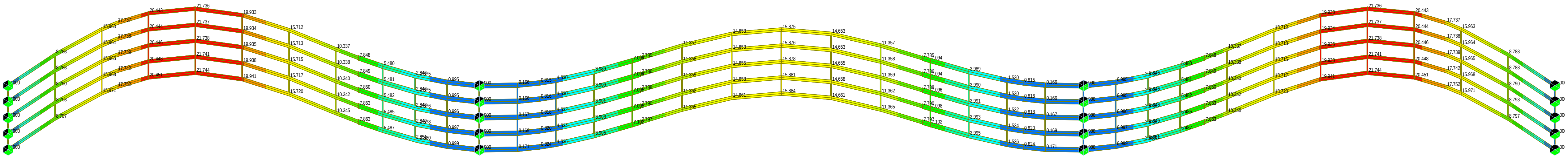
RUSSO STRUCTURAL SERVICES

Wind Load Behavior – Single Spans

- Wind loas applied to the open framing cause lateral deflection, and flange lateral bending stresses
- These must be checked as part of girder strength / stress analysis
- Deflections “might be” a concern



Lateral Behavior of Continuous Spans



- Deflection and stresses in continuous spans are dependent on many factors.

- A grillage or even a single line girder should be used to estimate the deflections and flange lateral bending stresses.

RUSSO
STRUCTURAL SERVICES

AASHTO 10th Edition Stability Bracing Requirements

RUSSO STRUCTURAL SERVICES

Requirements for Bracing Systems

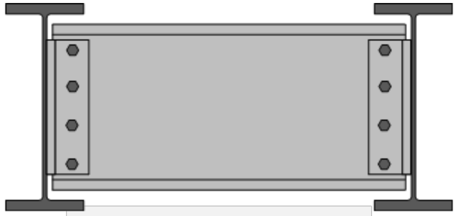
- Effective bracing must satisfy both **strength** and **stiffness** to have a safe system.
- Provisions outlined in the following slides allow engineers to verify the adequacy of the bracing.

RUSSO STRUCTURAL SERVICES

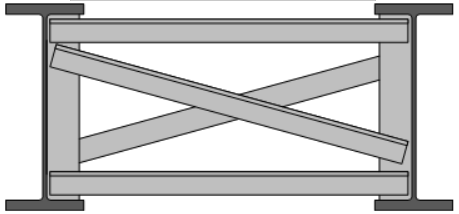
Torsional Bracing of Beams

- The fundamental concept with torsional bracing is:
  - The beam or girder is fully braced at a location if twist is prevented.
  - Stiffness requirement

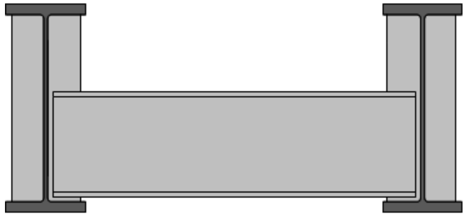
$$(\beta_T)_{act} \geq (\beta_T)_{req}$$



Diaphragms



Cross-Frames



Through-Girders

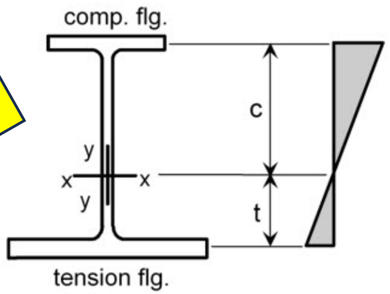
RUSSO STRUCTURAL SERVICES

New AASHTO 10th Edition Stability Bracing Requirements, 6.7.4.2.2

Minimum Stiffness Requirements

$$(\beta_T)_{req} = \frac{2.4L}{\phi_{sb} nEI_{yeff}} \left(\frac{M_u}{C_b}\right)^2$$

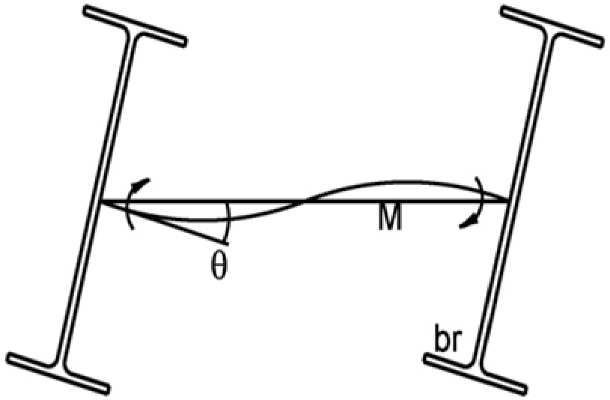
- L = Span length
- n = Num of braces in the span, excluding end braces
- M_u = factored deck casting moment
- I_{yeff}



Minimum Strength Requirements

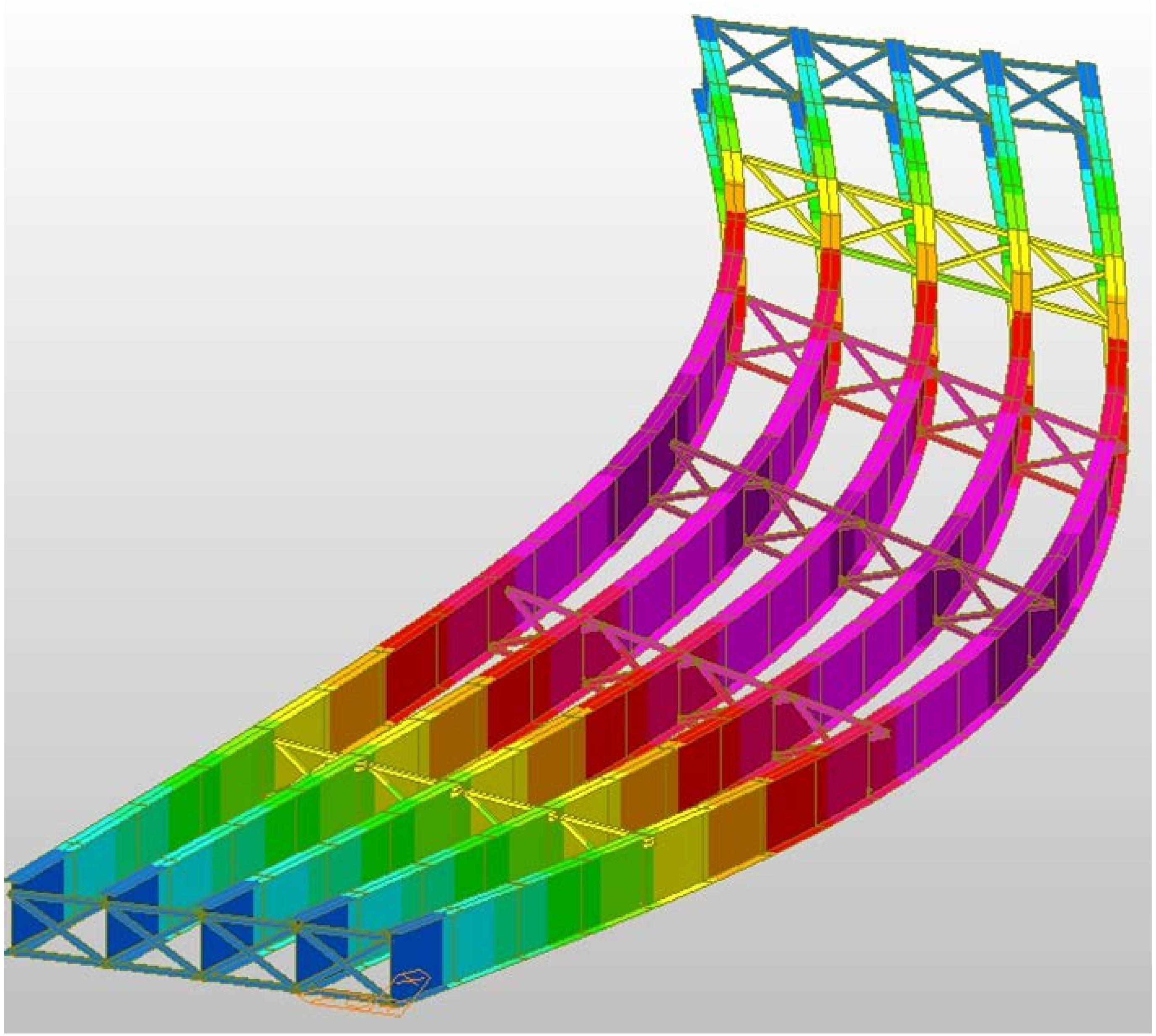
$$M_{br} = \frac{2.4L}{nEI_{yeff}} \left(\frac{M_u}{C_b}\right)^2 \left(\frac{L_b}{500h_o}\right)$$

- L_b = brace spacing
- h_o = distance between flange centroids



System Buckling Illustrated

- Girders are “just fine”
- Cross-frames carry all the “usual loads”
- Yet the entire system fails by buckling as a more-or-less rigid body rolling and displacing laterally



RUSSO STRUCTURAL SERVICES

Provided Bracing Stiffness

- Actual torsional bracing stiffness of the entire system:

$$(\beta_T)_{act} = \frac{1}{\left(\frac{1}{\beta_{br}} + \frac{1}{\beta_{sec}} + \frac{1}{\beta_g}\right)}$$

Springs in series

$$k_{total} = \frac{1}{\frac{1}{k1} + \frac{1}{k2} + \frac{1}{k3}}$$

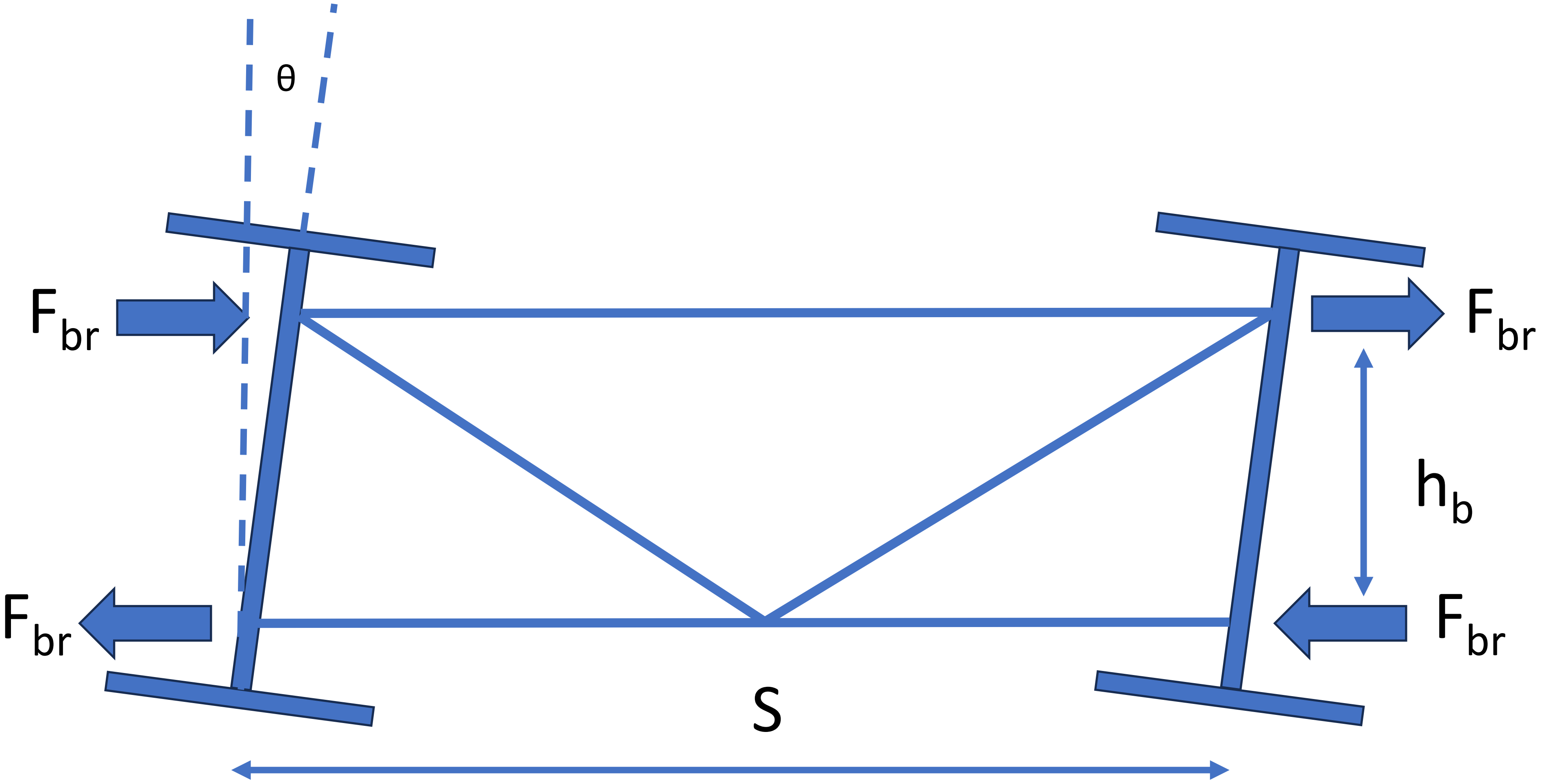
$\boldsymbol{\beta_{T\,act}}$ = Total system stiffness, where

$\boldsymbol{\beta_{br}}$ = Stiffness of cross-frame or diaphragm
$\boldsymbol{\beta_{sec}}$ = Cross-sectional stiffness (web and connection plate)
$\boldsymbol{\beta_{g}}$ = In-plane stiffness of the girder system

RUSSO STRUCTURAL SERVICES

Cross-Frames & Diaphragms Stiffness Model

$$(\beta_T)_{act} = \frac{1}{\left(\frac{\mathbf{1}}{\boldsymbol{\beta_{br}}} + \frac{1}{\beta_{sec}} + \frac{1}{\beta_g}\right)}$$



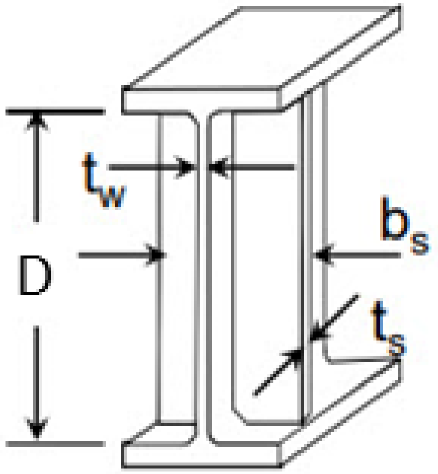
Stiffness of a Cross-Frame, β_{br}

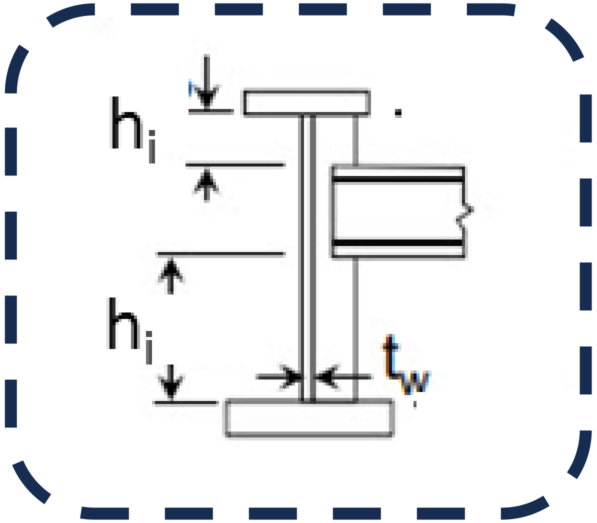
RUSSO
STRUCTURAL SERVICES

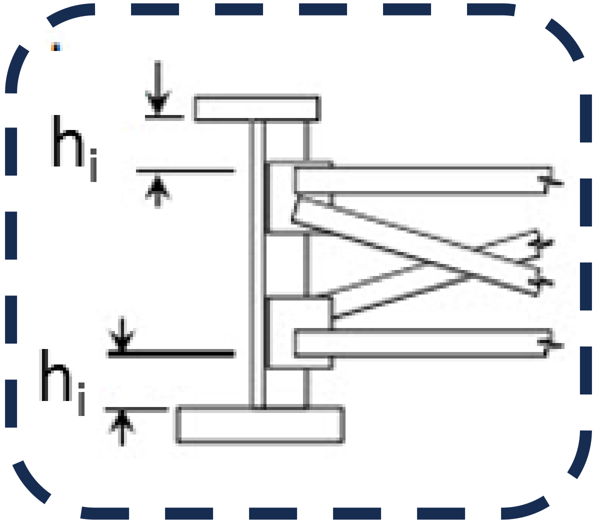
Cross-Sectional Stiffness, β_{sec}

$$(\beta_T)_{act} = \frac{1}{\left(\frac{1}{\beta_{br}} + \frac{1}{\boldsymbol{\beta_{sec}}} + \frac{1}{\beta_g}\right)}$$

- If the cross-section can distort at the point of bracing, the flexible portions of the web must be considered.
- For diaphragms or cross-frames at least 0.8 web depth, this can be ignored
  - Recall, AASHTO requires a cross-frame brace for a plate girder to be 75% of the web height.
    - **Recommendation – For plate girders, just meet the 80% rule**



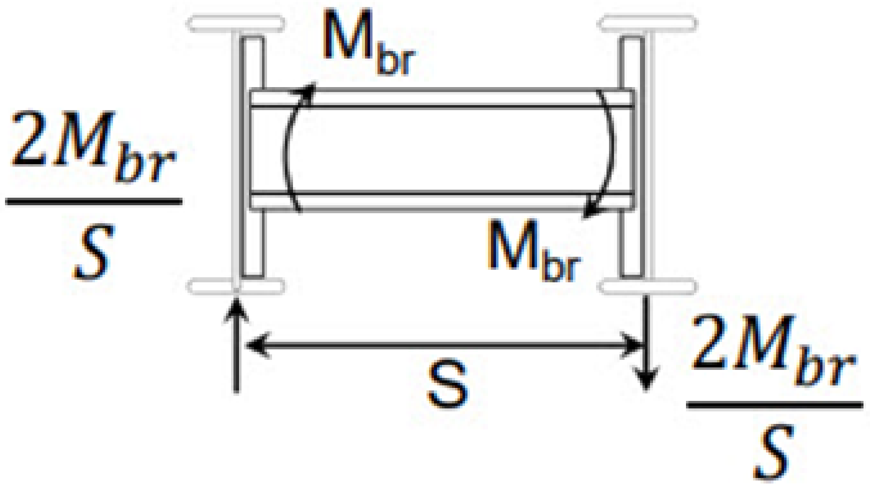


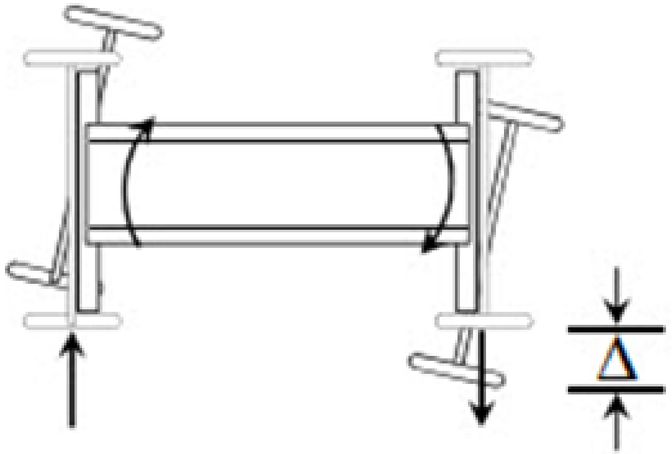


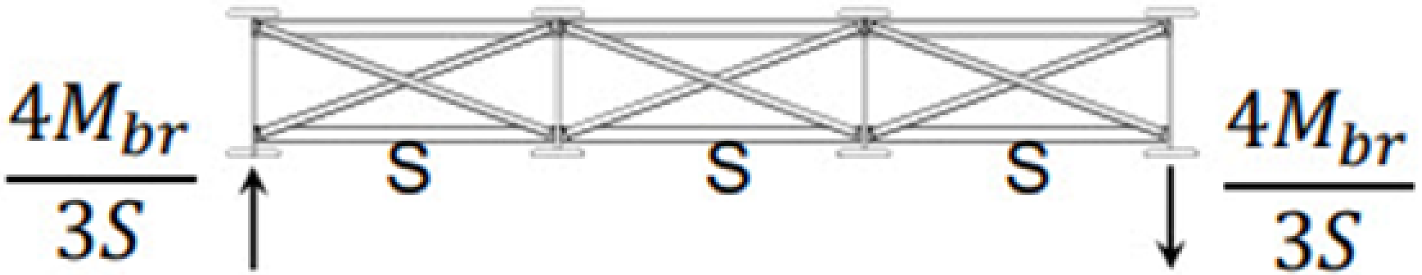
RUSSO STRUCTURAL SERVICES

In-Plane Girder Stiffness, β_g

$$(\beta_T)_{act} = \frac{1}{\left(\frac{1}{\beta_{br}} + \frac{1}{\beta_{sec}} + \frac{\mathbf{1}}{\boldsymbol{\beta_g}}\right)}$$







Summary of New Stiffness Requirements

$$(\beta_T)_{act} = \frac{1}{\left(\frac{1}{\beta_{br}} + \frac{1}{\beta_{sec}} + \frac{1}{\beta_g}\right)} \geq (\beta_T)_{req} = \frac{2.4L}{\phi_{sb} n E I_{yeff}} \left(\frac{M_u}{C_b}\right)^2$$

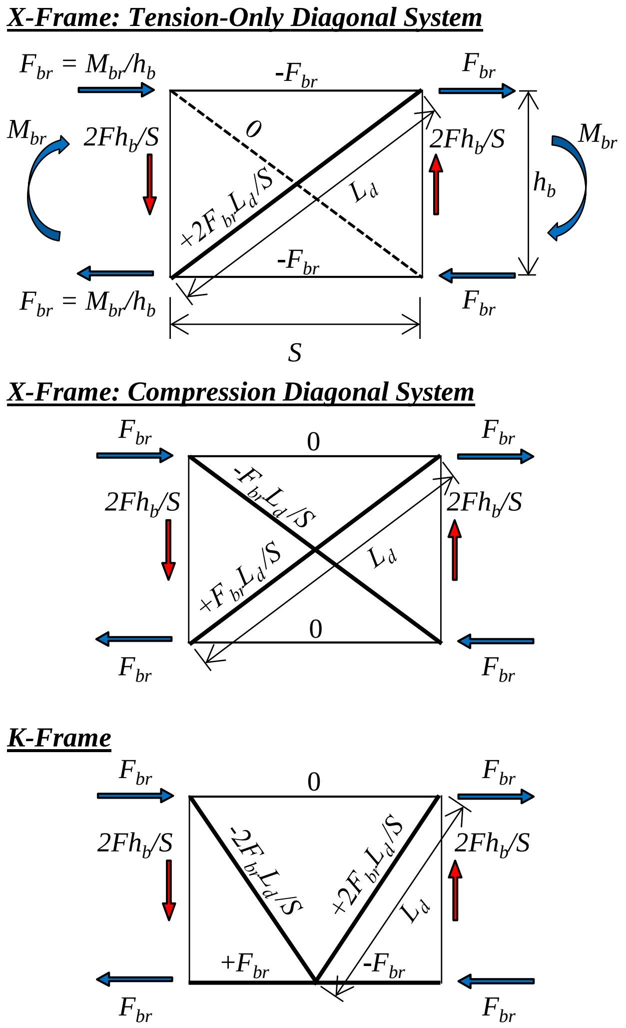
- This is an interactive / iterative problem
  - Flange proportions (b/t) directly influences I_{yeff}
  - Number of braces, n, influences the required stiffness of each brace
  - β_{br} is related to girder web height, spacing, and stiffness of bracing elements
  - β_{sec} can be commonly ignored
  - β_g is related to I_{xx} of the girder

RUSSO STRUCTURAL SERVICES

Summary of New Strength Requirements

$$M_{br} = \frac{2.4L}{nEI_{yeff}}\left(\frac{M_u}{C_b}\right)^2\left(\frac{L_b}{500h_o}\right)$$

$$= \quad K * \theta$$



What if it Doesn't Work?

- A few suggestions
  - If it doesn't work, and it's close…
    - Wider / thinner flange if possible to increase I_{yeff}
    - Deepen the girder to increase I_{xx}
    - Add a line or two of bracing, to increase "n" in the stability equations
  - If it's "way off"
    - Add top flange level lateral bracing for one or two bays at the end of the span
    - Which end(s)
      - The discontinuous ends
    - And then remember to check the wind loads that will now accumulate at the braced end

RUSSO STRUCTURAL SERVICES

Standard Design and Plans for Modern Steel Highway Bridges

What is this project about? What are the deliverables?

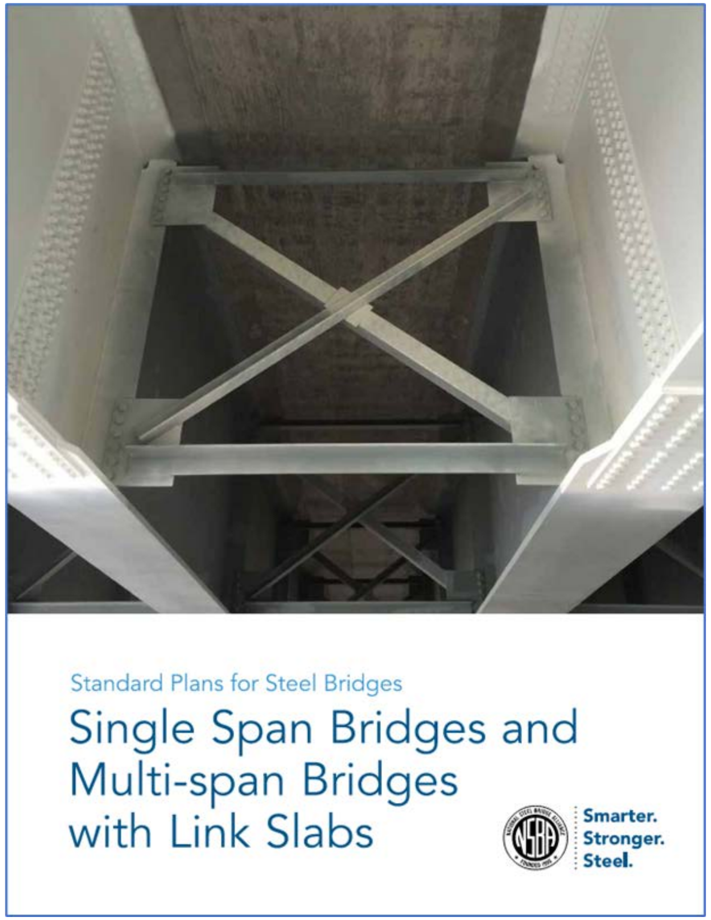
RUSSO
STRUCTURAL SERVICES

Project Team

- Russo Structural Services
  - Prime consultant
  - Lead Designer
- Genesis Structures
  - Constructability advisors
  - CAD / drawing preparation
- M A Grubb & Associates
  - Independent design review and quality control
  - AASHTO code compliance

Standard Designs for Straight I-Girder Bridges

- **Single Span Bridges (8, 10, 12, 14 ft spacing):**
    - 80 – 300 ft (10 ft increments)
    - Cross-frame & Diaphragm Details
    - Lateral Bracing Details
    - Bolted Field Splices
    - Deck Details
    - Link Slab Details
    - 39 sheets



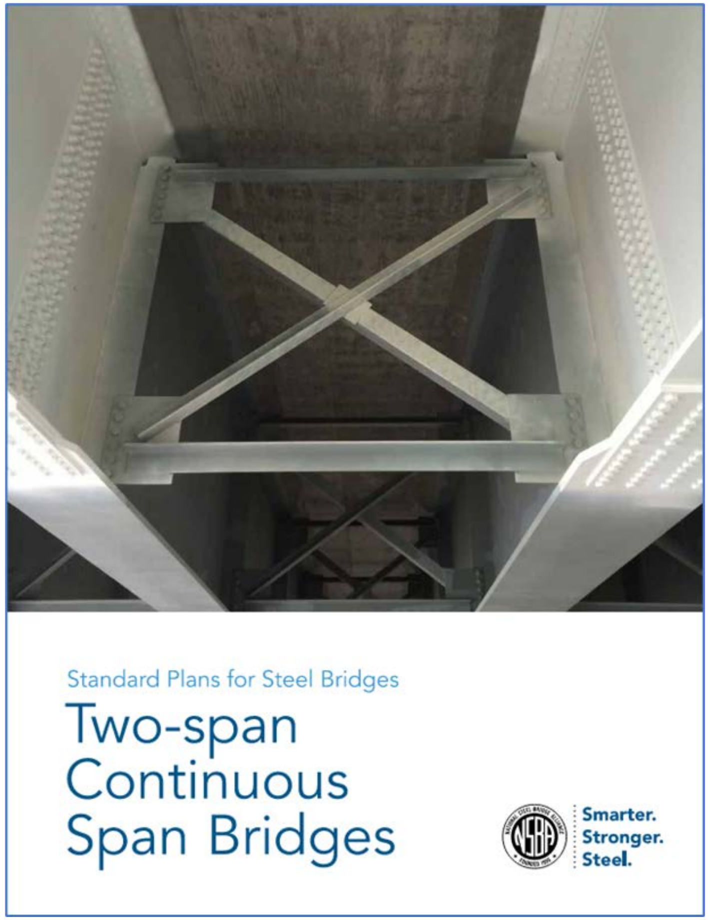
RUSSO
STRUCTURAL SERVICES

Standard Designs for Straight I-Girder Bridges

- **2-Span Continuous Bridges (8, 10, 12, 14 ft spacing):**

  - Equal Spans, 100 – 250 ft (15 ft increments)
  - Deck Pouring Sequence
  - Cross-frame & Diaphragm Details
  - Lateral Bracing Details
  - Bolted Field Splices
  - Deck Details

  - 28 sheets



RUSSO STRUCTURAL SERVICES

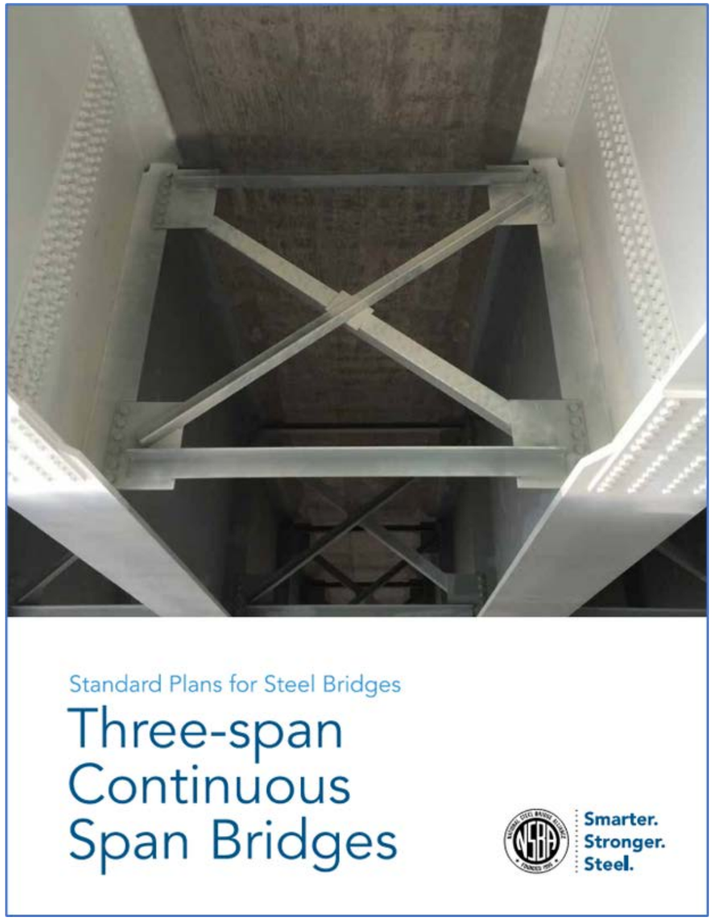
Standard Designs for Straight I-Girder Bridges

- **3-Span Continuous Bridges (8, 10, 12, 14 ft spacing):**

  - Center spans, 150 – 300 ft (15 ft increments)
  - End span = 78% of center span
  - Deck Pouring Sequence
  - Cross-frame & Diaphragm Details
  - Bolted Field Splices
  - Deck Details

  - 33 sheets

Span, ft. End-Int.-End
117-150-117
129-165-129
141-180-141
153-195-153
164-210-164
176-225-176
188-240-188
199-255-199
211-270-211
223-285-223
234-300-234



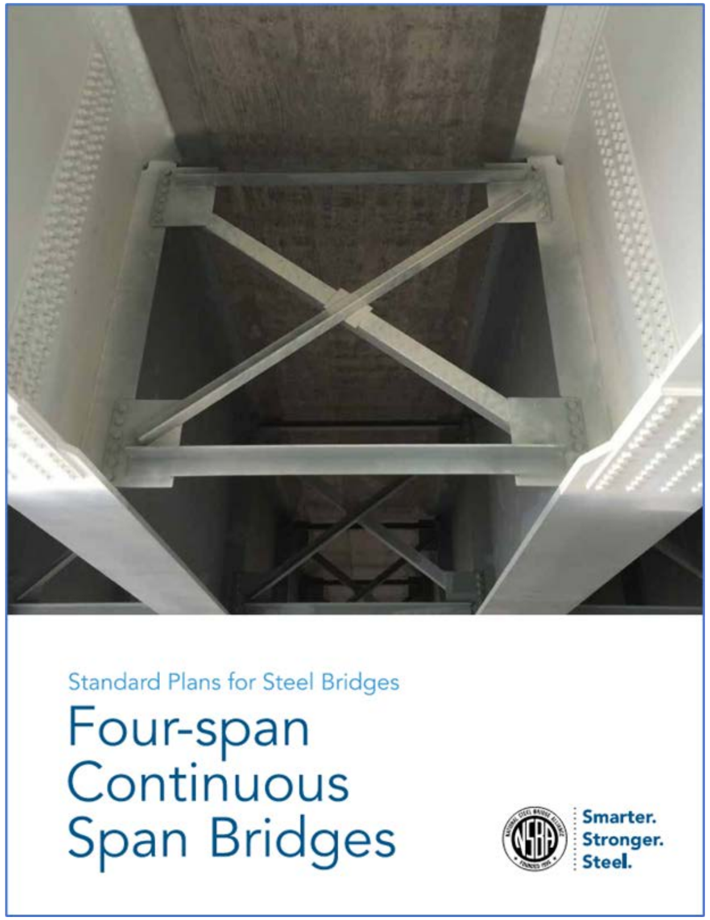
RUSSO
STRUCTURAL SERVICES

Standard Designs for Straight I-Girder Bridges

- **<u>4-Span Continuous Bridges (8, 10, 12, 14 ft spacing):</u>**
  - Two center spans = 150 – 300 ft (15 ft increments)
  - End span = 78% of center span
  - Deck Pouring Sequence
  - Cross-frame & Diaphragm Details
  - Bolted Field Splices
  - Deck Details

  - 33 sheets

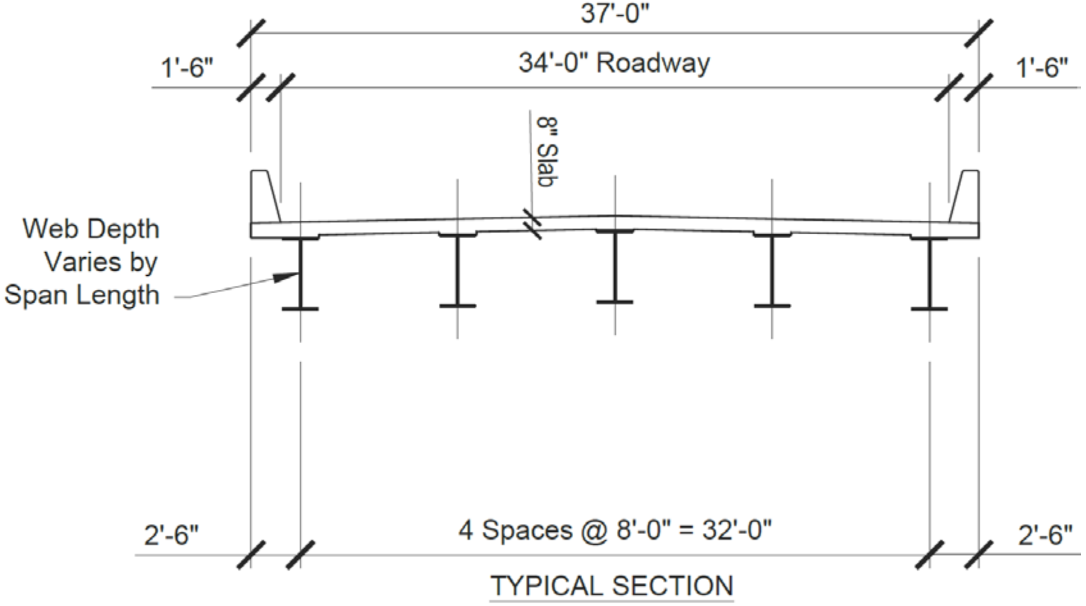
Span, ft. End-Interior
117-150
129-165
141-180
153-195
164-210
176-225
188-240
199-255
211-270
223-285
234-300



RUSSO
STRUCTURAL SERVICES

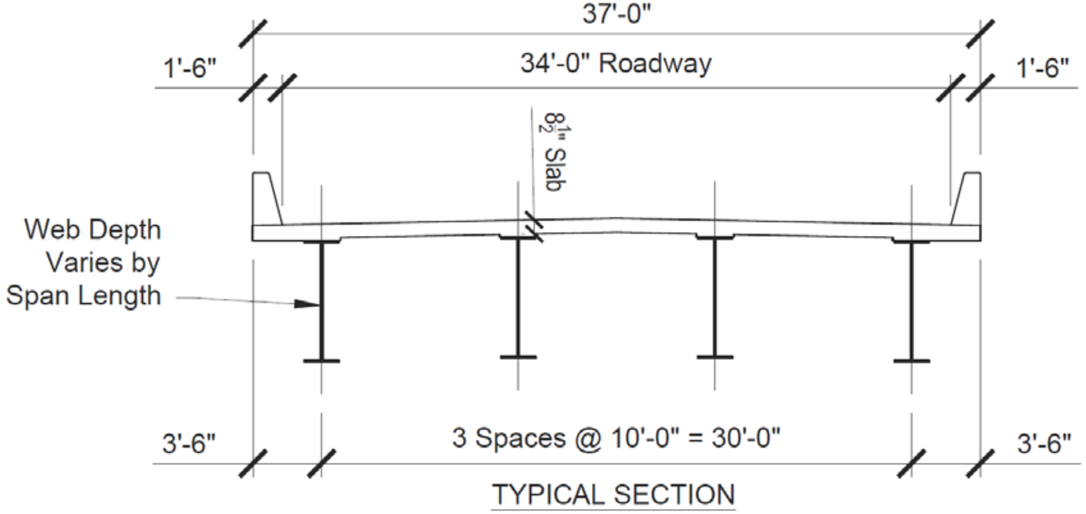
Final Cross-Sections

8 ft beam spacing



0.31S

10 ft beam spacing

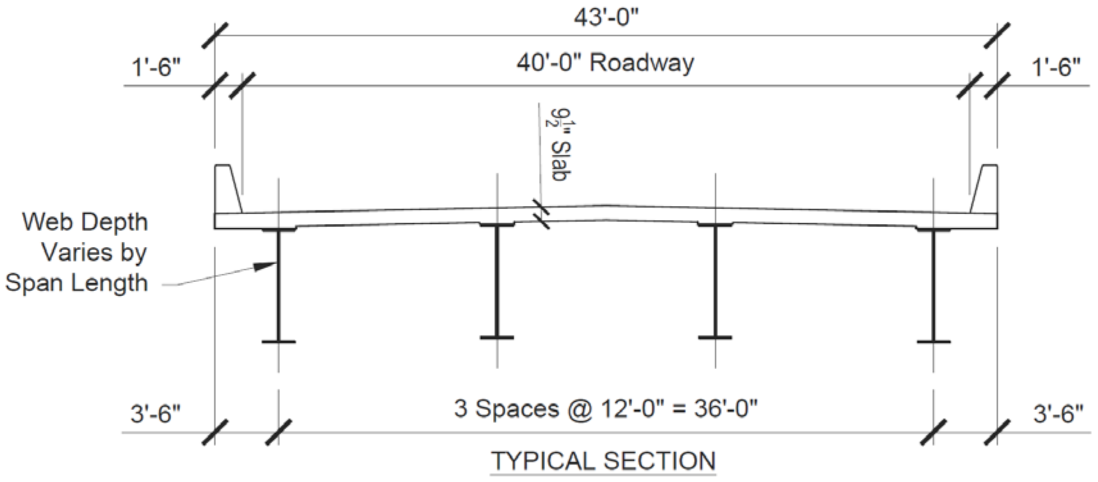


0.35S

RUSSO STRUCTURAL SERVICES

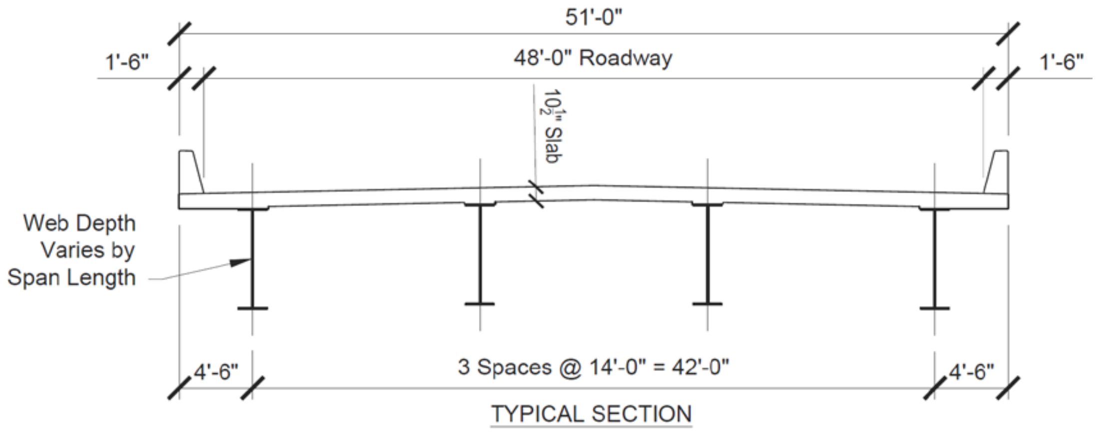
Final Cross-Sections

12 ft beam spacing



0.29S

14 ft beam spacing



0.32S

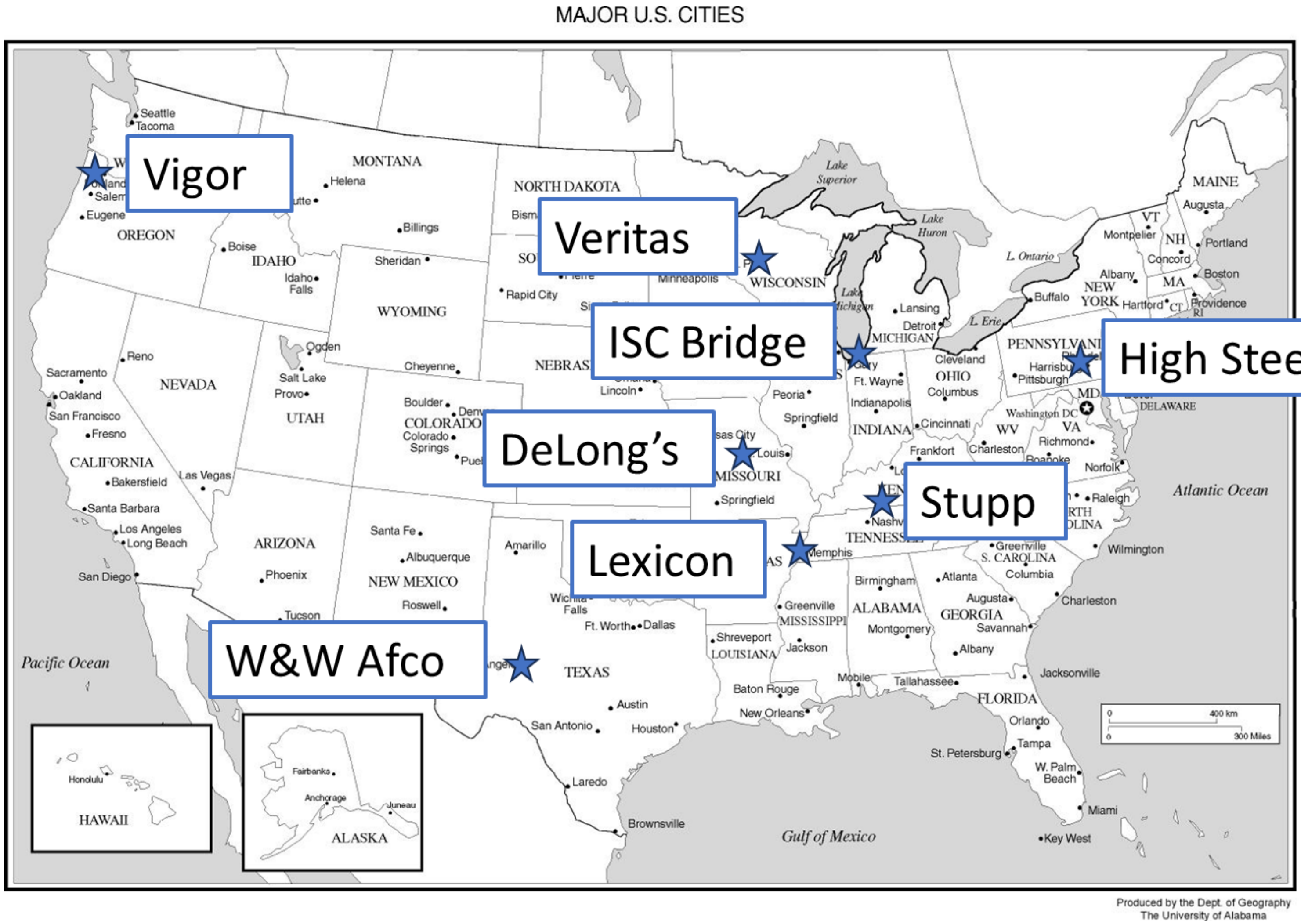
RUSSO STRUCTURAL SERVICES

Fabricator Outreach and Preliminary Studies

What important questions were asked and answered to develop the standards?

RUSSO
STRUCTURAL SERVICES

Fabricator Outreach



RUSSO
STRUCTURAL SERVICES

Efficient Plate Sizing

- Design direction
  - Flanges in any width are acceptable
  - Use as few thicknesses as possible
    - Flanges in 1/4” thickness increments, 1” minimum
    - Webs in 1/8” increments, ½” minimum
    - Flange thickness 3” maximum preferred (or switch to HPS 70W)

RUSSO
STRUCTURAL SERVICES

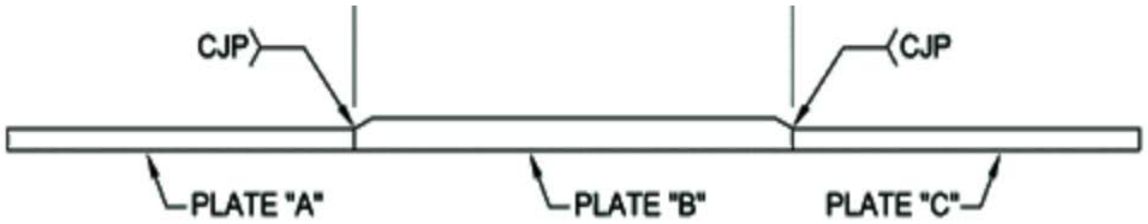
Cost Effectiveness of HPS 70W and Gr 50W

- Use Gr 50W until about 3” thick
- An “over 3” flange” has a cost premium even in Gr 50W so HPS 70W can be used to offset this premium and save weight
- Go wider to stay under 3” when possible

RUSSO STRUCTURAL SERVICES

How Many Unique Plate Sizes?

- 2 webs and 6 unique flanges seem reasonable
- The fewer the better, and at least 10T minimum for any thickness



Multiply weight savings/inch × flange width (length of butt weld)							
Thinner Plate at Splice (inches)	Thicker Plate at Splice (inches)						
	1.0	1.5	2.0	2.5	3.0	3.5	4.0
1.0	70	70	70	—	—	—	—
1.5	—	80	80	80	80	—	—
2.0	—	—	90	90	90	70	70
2.5	—	—	—	100	100	80	80
3.0	—	—	—	—	110	90	90
3.5	—	—	—	—	—	110	110
4.0	—	—	—	—	—	—	130

Notes:

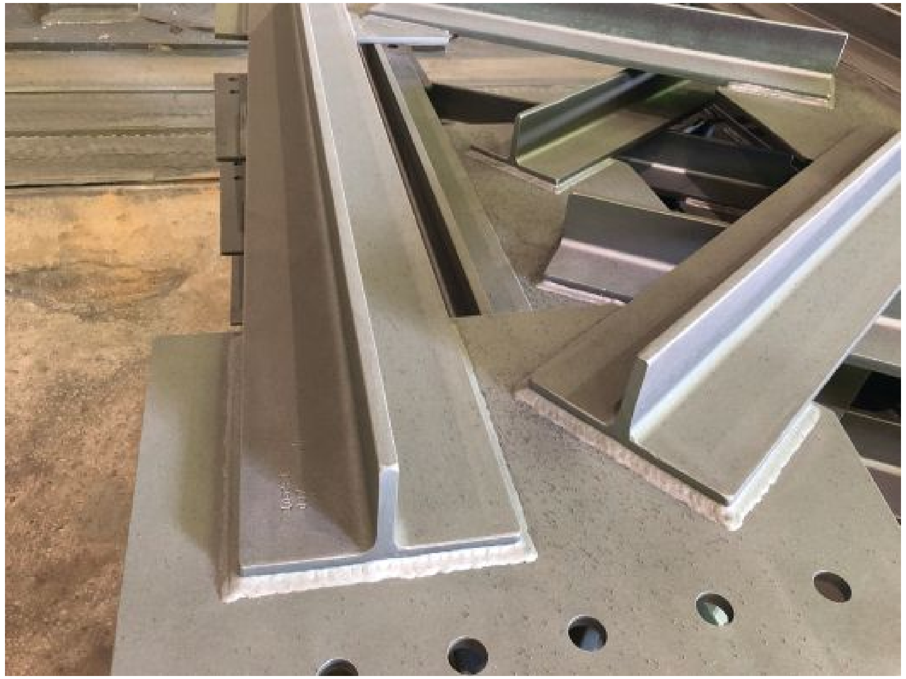
- Source: compiled from various Fabricators, November 2001.

Preferred Field Section Lengths

- Length
  - 120 ft – no problems
  - 130 – 140 generally not a problem
  - Some fabricators have access challenges even getting out of their own plants and on the roads > 150 ft
  - **Decision – maximum field section, 140 ft long**
- Depth
  - Girders under 10 ft deep – no problem for anyone
  - Girders under 12 ft deep definitely preferred
  - **Decision – Maximum web depth, 11 ft**
- Weight
  - **Decision – 50T field section limit – influences the longest spans only and drove the decision to switch to HPS 70W in some cases**

RUSSO STRUCTURAL SERVICES

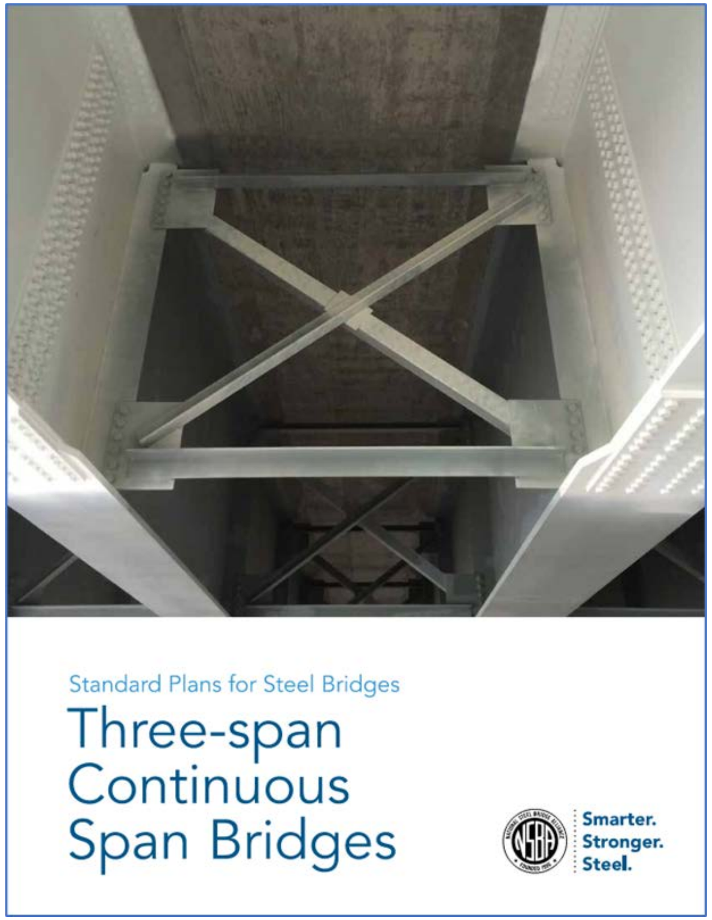
Cost Effective Diaphragms and Cross-Frames

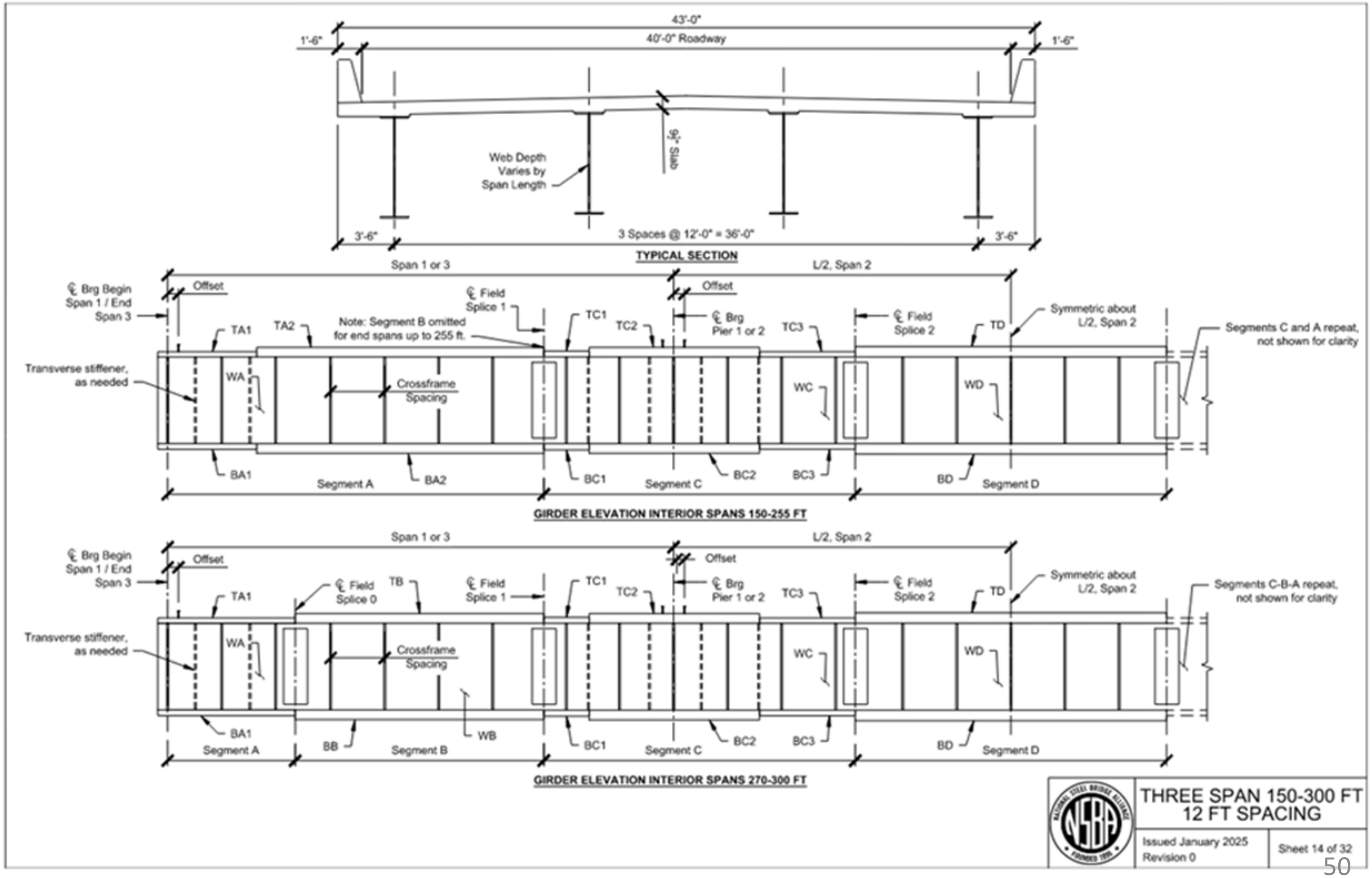


Presentation of Selected Portions of the Standards

RUSSO STRUCTURAL SERVICES

Walk-thru of the Standard Plans
3-Span continuous, 12 ft spacing



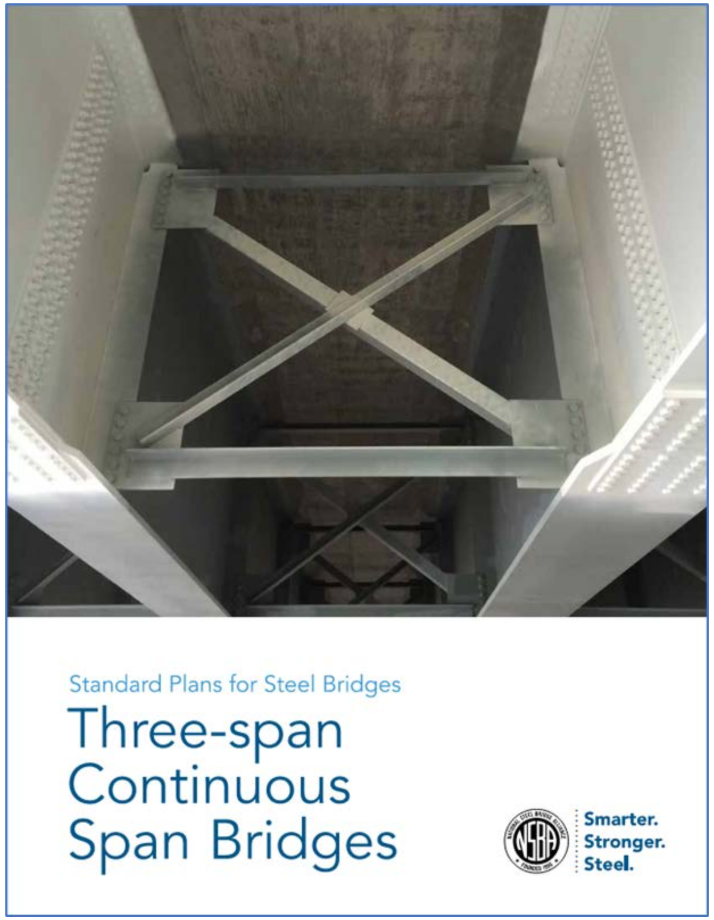


RUSSO STRUCTURAL SERVICES

Scope of Work Reminder

- **3-Span Continuous Bridges (8, 10, 12, 14 ft spacing):**
  - Center spans, 150 – 300 ft (15 ft increments)
  - End span = 78% of center span
  - Deck Pouring Sequence
  - Cross-frame & Diaphragm Details
  - Bolted Field Splices
  - Deck Details
  - 33 sheets

Span, ft. End-Int.-End
117-150-117
129-165-129
141-180-141
153-195-153
164-210-164
176-225-176
188-240-188
199-255-199
211-270-211
223-285-223
234-300-234



RUSSO STRUCTURAL SERVICES

GENERAL NOTES:

Specifications:

AASHTO LRFD Bridge Design Spe

AASHTO Guide Specifications for W
Construction, 1st Edition.

Materials:

Girder Webs and Flanges

ASTM A709 Gr 50W or Gr HPS 70V

Gr HPS 70W flanges are noted with

Stiffeners

A709 Gr 50W

Intermediate transverse shear stiffe
Stiffener sizes shown as required by

Lateral Bracing and Diaphragm / Crossframe M

ASTM A709 Gr 50W

Concrete Deck

f'_c = 4 ksi

Reinforcing Steel

F_y = 60 ksi

Bolts

ASTM F3125 Grade A325, diamete

Dead load assumptions:

For DC1

Slab thickness as shown in plans
Overhang thickness = slab thickness + 4 in.
Concrete haunch weight, 50 plf per beam
Stay-in-place form allowance, 15 psf
Miscellaneous steel weight:
- 8 ft girder spacing - 30 plf
- 10 ft girder spacing - 30 plf
- 12 ft girder spacing - 30 plf
- 14 ft girder spacing - 45 plf

Total DC1 loads shown on this sheet are computed with the above assumptions and assuming equal loading to all beams in the cross-section.

For DC2

Assumed single slope TL5 railing
600 plf divided to two beams

For DW

2 in. asphalt at 140 pcf

nge lateral bending moments from
shing machine. Flange lateral bending
on the **Fascia Beam Design Criteria**

, see **General Design Criteria** sheet.

GENERAL NOTES

Issued January 2025
Revision 0

Sheet 2 of 32

RUSSO
STRUCTURAL SERVICES

Design Assumptions and Criteria, Continuous Span Bridges:

1. Girder Design
   - a. All designs performed using NSBA LRFD SIMON.
   - b. Interior and exterior beams were designed. In LRFD SIMON, the "BOTH" option is used for the LL distribution factors. This results in a single beam designed for the governing shear and moment distribution factors for an interior and exterior beam. The composite slab effective width is based on an exterior beam.
   - c. Live load distribution follows AASHTO LRFD 4.6.2.2 for all beam spacings and span lengths. Designs where the AASHTO distribution factor equations are used beyond the range of applicability are noted in the design tables.
   - d. A skew of 20 degrees from normal is assumed for all designs.
   - e. Live load deflection satisfies AASHTO LRFD 2.5.2.6.2 Criteria for Deflection for vehicular bridges, L/800.
   - f. Girder depth satisfies AASHTO LRFD 2.5.2.6.3 Optional Criteria for Span-to-Depth Ratios.
   - g. Fatigue design based on Category C for shear studs welded to top flanges and Category C' for welded transverse stiffeners, $ADTT_{SL}$ = 1,000 vehicles per day and a 75-year design life.
   - h. Maximum segment length, 140 feet.
   - i. Cross-Frame members are designed as secondary members.
   - j. Cross-Frame members are designed for tension / compression loading.
   - k. Cross-frame member stiffness is based on 0.65AE stiffness reduction factor for eccentrically loaded angles, AASHTO LRFD C4.6.3.3.4.
   - l. Diaphragms and cross-frames are designed for combined stability-induced loads along with simultaneous deck casting forces. The finishing machine is assumed to be centered at a brace point location.

Design Assumptions and Criteria, Continuous Span Bridges:
1. Girder Design
a. All designs performed using NSBA LRFD SIMON.
b. Interior and exterior beams were designed. In LRFD SIMON, the "BOTH" option is used for the LL distribution factors. This results in a single beam designed for the governing shear and moment distribution factors for an interior and exterior beam. The composite slab effective width is based on an exterior beam.
c. Live load distribution follows AASHTO LRFD 4.6.2.2 for all beam spacings and span lengths. Designs where the AASHTO distribution factor equations are used beyond the range of applicability are noted in the design tables.
d. A skew of 20 degrees from normal is assumed for all designs.
e. Live load deflection satisfies AASHTO LRFD 2.5.2.6.2 Criteria for Deflection for vehicular bridges, L/800.
f. Girder depth satisfies AASHTO LRFD 2.5.2.6.3 Optional Criteria for Span-to-Depth Ratios.

3. Wind Load Design
   - a. Lateral deflection and flange lateral bending stresses due to wind on the fully erected steel framing were evaluated. Lateral bracing is not required for the design conditions assumed in 3.1 and 3.2, below. Other conditions may require bracing for wind load deflection or stress.

3.1 Service Design Criteria
   - a. Lateral deflections due to wind loads on the fully erected steel satisfy the Span / 150 requirement established by PennDOT BD-620M. All references to BD-620M are to the April 29, 2016 edition.
   - b. For this deflection check, a 32 psf assumed pressure is applied to fascia beams only for a superstructure height = 30 ft. For other superstructure heights, refer to PennDOT BD-620M.

GENERAL DESIGN CRITERIA

Issued January 2025
Revision 0

Sheet 3 of 32

RUSSO
STRUCTURAL SERVICES

Design Assumptions and Criteria, Continuous Span Bridges:

1. Girder Design
   a. All designs performed using NSBA LRFD SIMON.
   b. Interior and exterior beams were designed. In LRFD SIMON, the "BOTH" option is used for the LL distribution factors. This results in a single beam designed for the governing shear and moment distribution factors for an

3. Wind Load Design
   a. Lateral deflection and flange lateral bending stresses due to wind on the fully erected steel framing were evaluated. Lateral bracing is not required for the design conditions assumed in 3.1 and 3.2, below. Other conditions may require bracing for wind load deflection or stress.

3. Wind Load Design

   a. Lateral deflection and flange lateral bending stresses due to wind on the fully erected steel framing were evaluated. Lateral bracing is not required for the design conditions assumed in 3.1 and 3.2, below. Other conditions may require bracing for wind load deflection or stress.

3.1 Service Design Criteria

   a. Lateral deflections due to wind loads on the fully erected steel satisfy the Span / 150 requirement established by PennDOT BD-620M. All references to BD-620M are to the April 29, 2016 edition.
   b. For this deflection check, a 32 psf assumed pressure is applied to fascia beams only for a superstructure height = 30 ft. For other superstructure heights, refer to PennDOT BD-620M.

3.2 Strength Design Criteria

Girder flange lateral bending is checked for strength as follows:

   a. Maximum wind load positve and negative moment regions were checked. Check other plate transitions in final design.
   b. Fascia beam checked for global bending of the span and local bending between cross-frames.
   c. Wind loads on erected steel determined from the *AASHTO Guide Specification for Wind Loads on Bridges During Construction, 2017.*

      Inactive wind condition, V = 115 mph. Superstructure height, 30 ft

      Superstructure construction duration 6 weeks - 1 year, R = 0.73

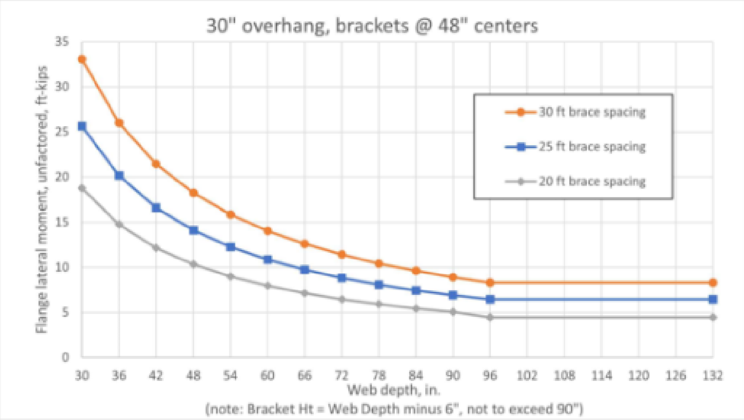
      K_z = 1.0, C_d = 2.2 for fascia beam, per AASHTO Guide Specifications for other beams.

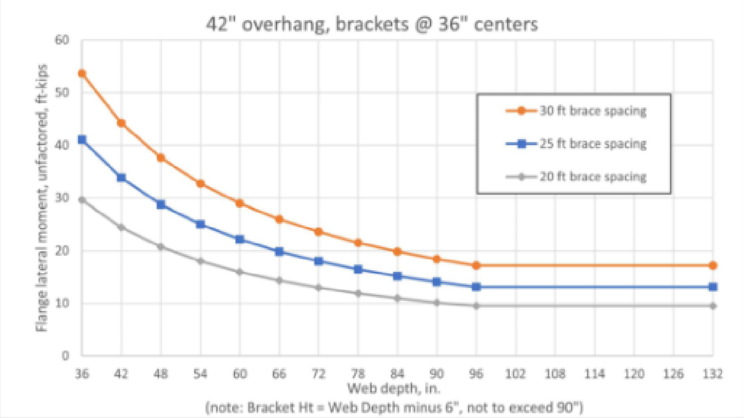
RUSSO STRUCTURAL SERVICES

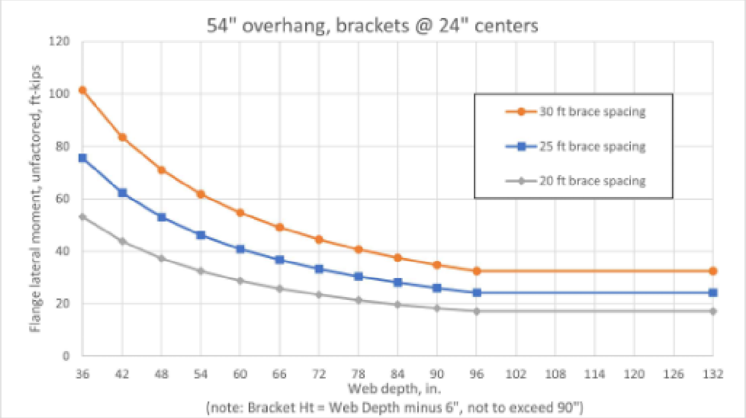
GENERAL DESIGN CRITERIA

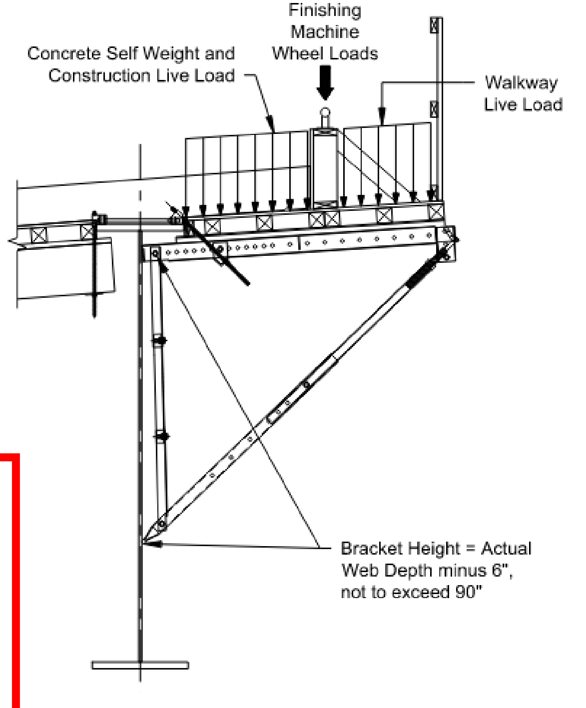
Issued January 2025
Revision 0

Sheet 3 of 32

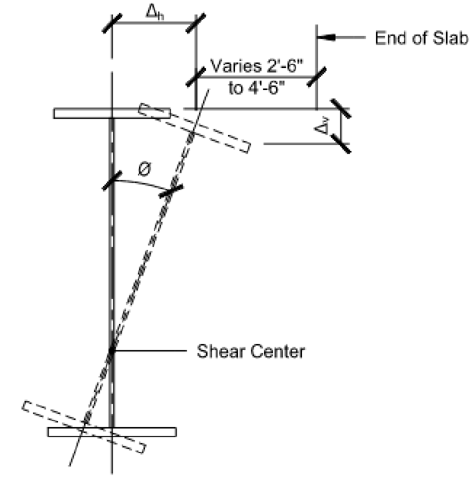








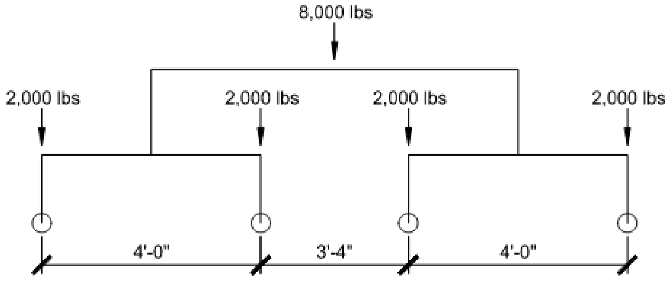
TYPICAL SECTION



GIRDER ROTATION DIAGRAM

Fascia Beam Design Criteria:

1. Finishing machine wheel load, 4 @ 2000 pounds. Loads shown are representative of finishing machines used for bridge widths and types shown on these plans.
2. Concrete density, 160 pcf, to account for formwork weight allowance.
3. Construction live load on deck, 50 psf.
4. Walkway live load, 50 psf. Assumed walkway width, 2 ft.
5. Overhang slab thickness equals nominal slab thickness + 4 in. assuming slab is flush to underside of top flange and an assumed 4 in. haunch.
6. Finishing machine is assumed to be midway between cross-frames for lateral bending moment calculations.
   a. Factored load combination: AASHTO LRFD 3.4.2, 1.25 DC + 1.5 LL
   b. An equivalent service bending moment is computed for LRFD SIMON input. LRFD SIMON uses a 1.4 factor on all lateral bending moments. Moments shown on the accompanying graphs are unfactored and are a total weighted average of the dead and live load lateral flange bending moments.
7. Bracket spacing assumed as follows. Bracket spacing is based on limiting capacities of common commercially available hangers and brackets. Assumed safe working load of 6,000 lbs. per hanger. Assumed safe working load of 3,750 lbs. per diagonal.
   a. 30 in. overhangs, 48 in. bracket spacing.
   b. 42 in. overhang, 36 in. bracket spacing.
   c. 54 in. overhang, 24 in. bracket spacing.
8. Girder service load rotations, Ø, are limited to 1 degree.
9. Lateral deflection at the top of web, Δ_h, limited to 0.25 in. Vertical deflection of the edge of slab, Δ_v, limited to 0.5 in. Both limits checked for maximum finishing machine loading and are instantaneous values.



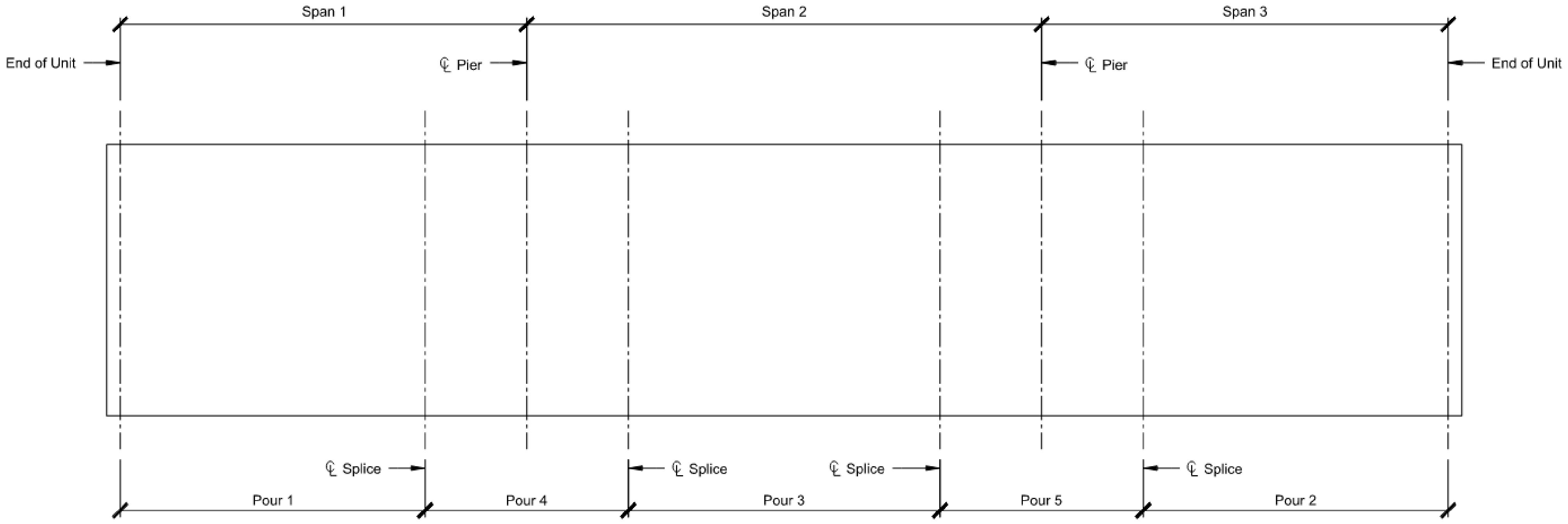
ASSUMED FINISHING MACHINE

FASCIA BEAM DESIGN CRITERIA

Issued January 2025
Revision 0

Sheet 4 of 32

RUSSO STRUCTURAL SERVICES



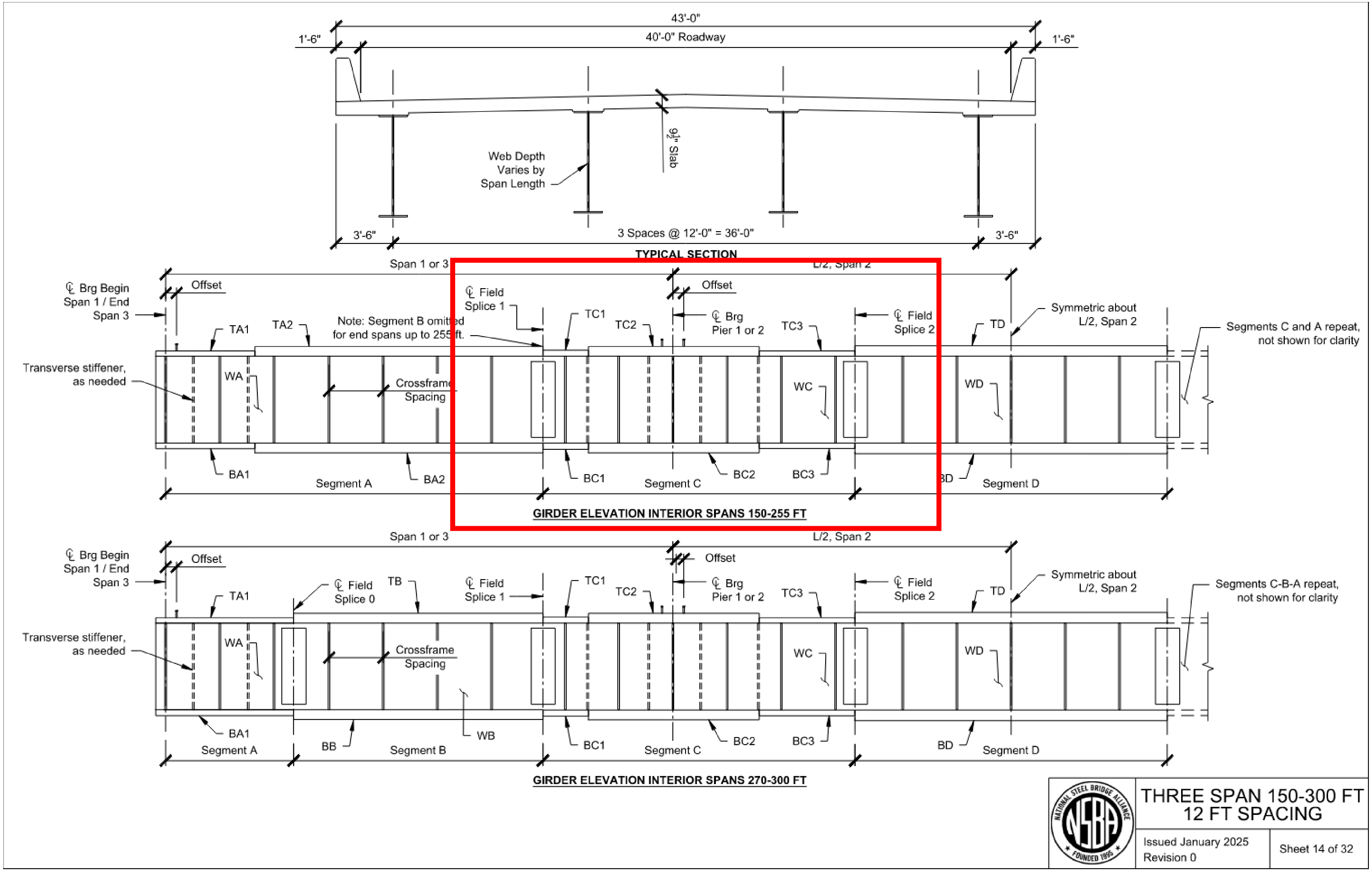
3-SPAN UNIT DECK POURING SEQUENCE

DECK POURING NOTES

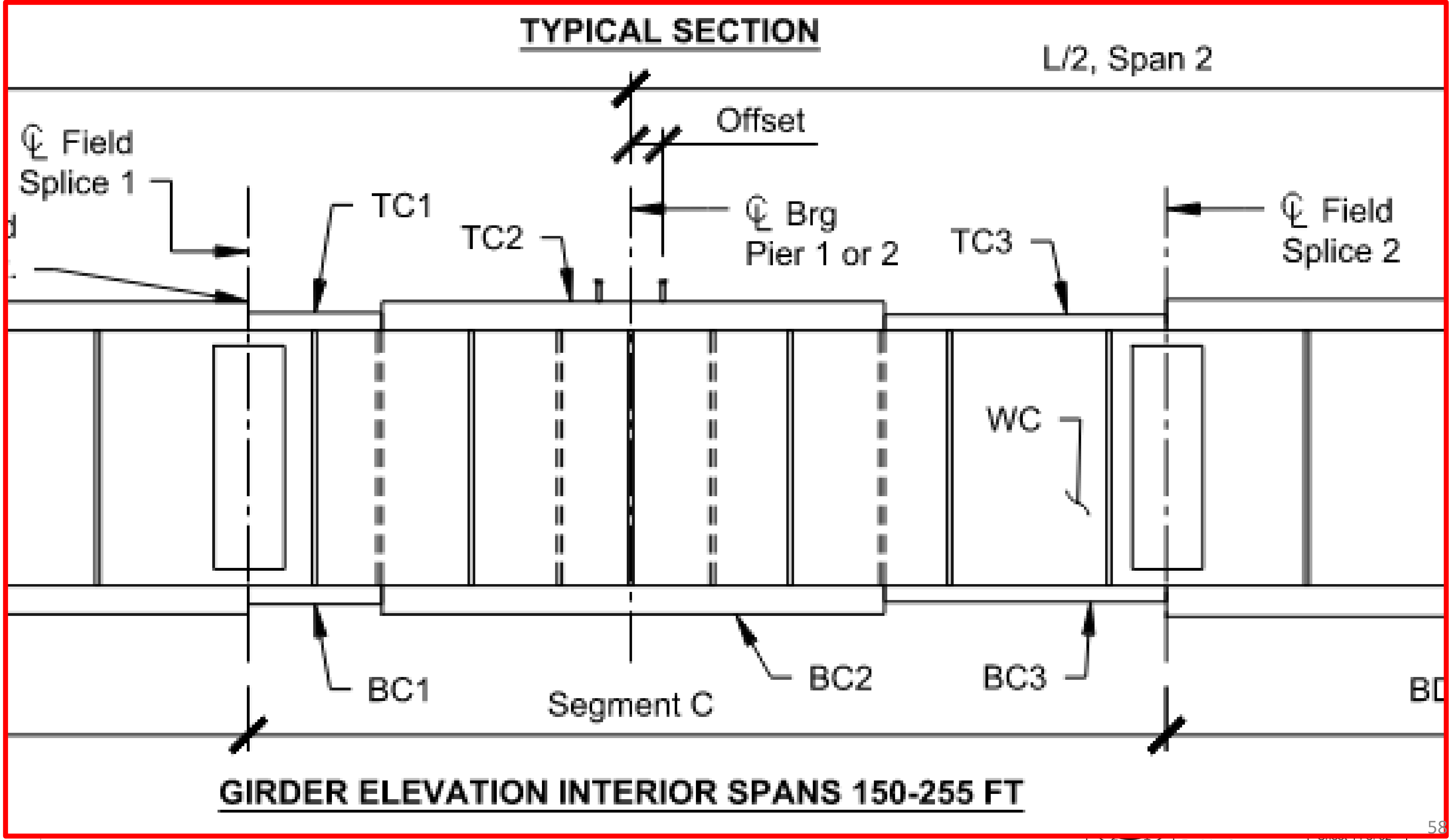
1. The deck pouring sequence shown is the basis of design.
2. The beams are designed for local and lateral-torsional buckling limits for the specified pour sequence and additionally for the global stability and cross-frame requirements of AASHTO LRFD 10th edition Article 6.7.4.2.2.
3. For the 3-span unit, the critical checks for deck casting positive and negative bending in noncomposite sections occur during Pour 2 and 5.
4. The provisions of AASHTO LRFD 6.7.4.2.2 do not account for the stiffening influence of any previously cast and composite deck sections and are conservative for other than Pour 1.
5. Uplift is prevented in all cases.

Note: An alternate pouring sequence with the deck cast continuously end-to-end is also permitted. All girder designs in these standards satisfy stress, strength, uplift, and stability requirements for the alternate pouring sequence.

DECK POURING SEQUENCE	
Issued January 2025 Revision 0	Sheet 5 of 32



RUSSO
STRUCTURAL SERVICES



TYPICAL SECTION
L/2, Span 2
Offset
℄ Field Splice 1
TC1
TC2
℄ Brg Pier 1 or 2
TC3
℄ Field Splice 2
WC
BC1
Segment C
BC2
BC3
GIRDER ELEVATION INTERIOR SPANS 150-255 FT
Revision 0

Span, ft. End-Int.-End	SEGMENT A					SEGMENT B (as needed)		
	WA (in. x in. x ft.)	TA1 (in. x in. x ft.)	TA2 (in. x in. x ft.)	BA1 (in. x in. x ft.)	BA2 (in. x in. x ft.)	WB (in. x in. x ft.)	TB (in. x in. x ft.)	BB (in. x in. x ft.)
117-150-117	54 x 0.625 x 79	---	16 x 1 x 79	---	22 x 1.5 x 79	---	---	---
129-165-129	62 x 0.625 x 89	---	16 x 1 x 89	---	22 x 1.5 x 89	---	---	---
141-180-141	66 x 0.625 x 98	---	18 x 1 x 98	22 x 1.25 x 49	22 x 1.5 x 49	---	---	---
153-195-153	74 x 0.625 x 106	---	18 x 1 x 106	24 x 1 x 65	24 x 1.25 x 41	---	---	---
164-210-164	78 x 0.625 x 113	---	18 x 1 x 113	24 x 1 x 57	24 x 1.25 x 56	---	---	---
176-225-176	82 x 0.75 x 122	18 x 1 x 61	18 x 1.25 x 61	22 x 1 x 61	22 x 1.5 x 61	---	---	---
188-240-188	88 x 0.75 x 130	---	20 x 1 x 130	24 x 1 x 70	24 x 1.25 x 60	---	---	---
199-255-199	94 x 0.75 x 138	---	20 x 1 x 138	24 x 1 x 84	24 x 1.25 x 54	---	---	---
211-270-211	98 x 0.75 x 51	20 x 1 x 51	---	24 x 1 x 51	---	98 x 0.75 x 100	20 x 1.25 x 100	24 x 1.25 x 100
223-285-223	102 x 0.75 x 51	22 x 1 x 51	---	24 x 1 x 51	---	102 x 0.75 x 110	22 x 1.25 x 110	24 x 1.25 x 110
234-300-234	108 x 0.75 x 54	24 x 1 x 54	---	24 x 1.25 x 54	---	108 x 0.75 x 120	24 x 1.25 x 120	24 x 1.25 x 120

Span, ft. End-Int.-End	SEGMENT C						SEGMENT D			Additional Footnotes
	WC (in. x in. x ft.)	TC1 (in. x in. x ft.)	TC2 (in. x in. x ft.)	TC3 (in. x in. x ft.)	BC1 (in. x in. x ft.)	BC2 (in. x in. x ft.)	BC3 (in. x in. x ft.)	WD (in. x in. x ft.)	TD (in. x in. x ft.)	BD (in. x in. x ft.)	
117-150-117	54 x 0.625 x 76	22 x 1 x 24	22 x 1.75 x 28	22 x 1 x 24	22 x 1.25 x 24	22 x 2.25 x 28	22 x 1.25 x 24	54 x 0.625 x 74	16 x 1 x 74	22 x 1.25 x 74	---
129-165-129	62 x 0.625 x 80	22 x 1 x 25	22 x 2 x 30	22 x 1 x 25	22 x 1.25 x 25	22 x 2.25 x 30	22 x 1.25 x 25	62 x 0.625 x 85	16 x 1 x 85	22 x 1.25 x 85	---
141-180-141	66 x 0.625 x 86	22 x 1 x 27	22 x 2 x 32	22 x 1 x 27	24 x 1.25 x 27	24 x 2.25 x 32	24 x 1.25 x 27	66 x 0.625 x 94	16 x 1 x 94	22 x 1.25 x 94	---
153-195-153	74 x 0.625 x 94	24 x 1 x 28	24 x 2 x 38	24 x 1 x 28	24 x 1.25 x 28	24 x 2.5 x 38	24 x 1.25 x 28	74 x 0.625 x 101	18 x 1 x 101	24 x 1 x 101	---
164-210-164	78 x 0.625 x 102	24 x 1.25 x 25	24 x 2.5 x 47	24 x 1.25 x 30	24 x 1.25 x 25	24 x 2.5 x 47	24 x 1.25 x 30	78 x 0.625 x 108	18 x 1 x 108	22 x 1.25 x 108	---
176-225-176	82 x 0.75 x 108	24 x 1.25 x 32	24 x 2.5 x 44	24 x 1.25 x 32	24 x 1.5 x 32	24 x 2.75 x 44	24 x 1.5 x 32	82 x 0.75 x 117	18 x 1 x 117	22 x 1.25 x 117	---
188-240-188	88 x 0.75 x 116	26 x 1.25 x 34	26 x 2.5 x 53	26 x 1.25 x 29	26 x 1.5 x 34	26 x 2.75 x 53	26 x 1.5 x 29	88 x 0.75 x 124	20 x 1 x 124	20 x 1.25 x 124	---
199-255-199	94 x 0.75 x 122	26 x 1.5 x 35	26 x 2.75 x 52	26 x 1.5 x 35	26 x 1.5 x 35	26 x 2.75 x 52	26 x 1.5 x 35	94 x 0.75 x 133	20 x 1 x 133	24 x 1 x 133	a
211-270-211	98 x 0.75 x 125	26 x 1.5 x 30	26 x 3 x 60	26 x 1.5 x 35	26 x 1.75 x 30	26 x 3 x 60	26 x 1.75 x 35	98 x 0.75 x 140	20 x 1 x 140	24 x 1 x 140	a
223-285-223	102 x 0.75 x 135	30 x 1.25 x 31	30 x 2.5 x 57	30 x 1.25 x 47	30 x 1.5 x 31	30 x 2.75 x 57	30 x 1.5 x 47	102 x 0.75 x 139	22 x 1 x 139	22 x 1.25 x 139	a
234-300-234	108 x 0.75 x 140	28 x 1.5 x 25	28 x 3 x 65	28 x 1.5 x 50	30 x 1.5 x 25	30 x 3 x 65	30 x 1.5 x 50	108 x 0.75 x 140	22 x 1 x 140	24 x 1 x 140	a

Note: All plates are A709 Gr 50W.

Footnotes:
a. AASHTO distribution factor equations were used with girder stiffness and / or span length exceeding AASHTO limits. Check with refined analysis.

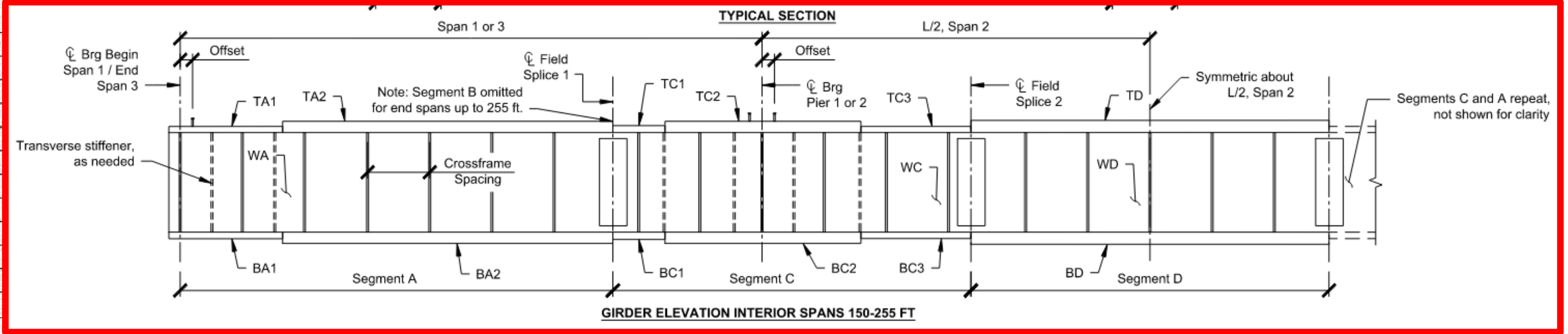
RUSSO STRUCTURAL SERVICES

NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995

THREE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 15 of 32



Span, ft. End-Int.-End	SEGMENT A					SEGMENT B (as needed)		
	WA (in. x in. x ft.)	TA1 (in. x in. x ft.)	TA2 (in. x in. x ft.)	BA1 (in. x in. x ft.)	BA2 (in. x in. x ft.)	WB (in. x in. x ft.)	TB (in. x in. x ft.)	BB (in. x in. x ft.)
117-150-117	54 x 0.625 x 79	---	16 x 1 x 79	---	22 x 1.5 x 79	---	---	---
129-165-129	62 x 0.625 x 89	---	16 x 1 x 89	---	22 x 1.5 x 89	---	---	---
141-180-141	66 x 0.625 x 98	---	18 x 1 x 98	22 x 1.25 x 49	22 x 1.5 x 49	---	---	---
153-195-153	74 x 0.625 x 106	---	18 x 1 x 106	24 x 1 x 65	24 x 1.25 x 41	---	---	---
164-210-164	78 x 0.625 x 113	---	18 x 1 x 113	24 x 1 x 57	24 x 1.25 x 56	---	---	---
176-225-176	82 x 0.75 x 122	18 x 1 x 61	18 x 1.25 x 61	22 x 1 x 61	22 x 1.5 x 61	---	---	---
188-240-188	88 x 0.75 x 130	---	20 x 1 x 130	24 x 1 x 70	24 x 1.25 x 60	---	---	---
199-255-199	94 x 0.75 x 138	---	20 x 1 x 138	24 x 1 x 84	24 x 1.25 x 54	---	---	---
211-270-211	98 x 0.75 x 51	20 x 1 x 51	---	24 x 1 x 51	---	98 x 0.75 x 100	20 x 1.25 x 100	24 x 1.25 x 100
223-285-223	102 x 0.75 x 51	22 x 1 x 51	---	24 x 1 x 51	---	102 x 0.75 x 110	22 x 1.25 x 110	24 x 1.25 x 110
234-300-234	108 x 0.75 x 54	24 x 1 x 54	---	24 x 1.25 x 54	---	108 x 0.75 x 120	24 x 1.25 x 120	24 x 1.25 x 120

Revision 0

RUSSO STRUCTURAL SERVICES

Span, ft. End-Int.-End	Transverse Stiffener Size and Location, Distance From End support, Each Span				Bearing Stiffeners, End		Bearing Stiffeners, Piers	
	Width in.	Thickness in.	Span 1 Location, ft.	Span 2 Location, ft.	Width in.	Thickness in.	Width in.	Thickness in.
117-150-117	---	---	---	---	7.25	0.75	10.25	1
129-165-129	5.5	0.5	113.5	15.5, 149.5	7.25	0.75	10.25	1
141-180-141	6	0.5	108, 124.5	16.5, 33, 147, 163.5	8.25	0.75	10.25	1
153-195-153	6	0.5	116, 134.5	18.5, 37, 158, 176.5	8.25	0.75	11.25	1

DEAD AND LIVE LOAD REACTIONS

Span, ft. End-Int.-End	End Reaction				Pier 1 & 2 Reaction			
	DC kips	DW kips	Truck kips	Lane kips	DC kips	DW kips	Truck kips	Lane kips
117-150-117	88	10	100	40	322	36	173	106
129-165-129	98	11	101	44	358	40	177	117
141-180-141	107	12	101	48	393	43	181	128
153-195-153	116	13	102	52	432	47	184	139

TRANSVERSE AND BEARING STIFFENERS

Span, ft. End-Int.-End	Transverse Stiffener Size and Location, Distance From End support, Each Span				Bearing Stiffeners, End		Bearing Stiffeners, Piers	
	Width in.	Thickness in.	Span 1 Location, ft.	Span 2 Location, ft.	Width in.	Thickness in.	Width in.	Thickness in.
117-150-117	---	---	---	---	7.25	0.75	10.25	1
129-165-129	5.5	0.5	113.5	15.5, 149.5	7.25	0.75	10.25	1
141-180-141	6	0.5	108, 124.5	16.5, 33, 147, 163.5	8.25	0.75	10.25	1
153-195-153	6	0.5	116, 134.5	18.5, 37, 158, 176.5	8.25	0.75	11.25	1
164-210-164	7	0.5	9.75, 125, 144.5	19.5, 39, 171, 190.5	8.25	0.75	11.25	1
176-225-176	6	0.5	155.5	20.5, 204.5	8	0.75	11	1
188-240-188	6.5	0.5	166	22, 218	9	0.875	12	1.125
199-255-199	6.5	0.5	152, 175.5	23.5, 47, 208, 231.5	9	0.875	12	1.125
211-270-211	7.25	0.5	162, 186.5	24.5, 49, 221, 245.5	9	0.875	12	1.125
223-285-223	8	0.625	12.75, 172, 197.5	25.5, 51, 234, 259.5	10	0.875	14	1.25
234-300-234	9	0.625	13.5, 147, 174, 180, 207	27, 54, 246, 273	11	1	13	1.125

Span, ft. End-Int.-End	End Span	Interior Span	Type
117-150-117	4 @ 20.5 + 2 @ 17.5 = 117	2 @ 17.5 + 3 @ 26.66 + 2 @ 17.5 = 150	K-Frame
129-165-129	4 @ 23 + 2 @ 18.5 = 129	2 @ 18.5 + 4 @ 22.75 + 2 @ 18.5 = 165	K-Frame
141-180-141	4 @ 25.25 + 2 @ 20 = 141	2 @ 20 + 4 @ 25 + 2 @ 20 = 180	K-Frame
153-195-153	5 @ 22 + 2 @ 21.5 = 153	2 @ 21.5 + 4 @ 27.25 + 2 @ 21.5 = 195	K-Frame
164-210-164	5 @ 23 + 3 @ 16.33 = 164	3 @ 16.25 + 5 @ 22.5 + 3 @ 16.25 = 210	K-Frame
176-225-176	5 @ 25 + 3 @ 17 = 176	3 @ 16.66 + 5 @ 25 + 3 @ 16.66 = 225	K-Frame
188-240-188	5 @ 26.5 + 3 @ 18.5 = 188	3 @ 17.91 + 5 @ 26.5 + 3 @ 17.91 = 240	K-Frame
199-255-199	6 @ 23.5 + 3 @ 19.33 = 199	3 @ 18.75 + 5 @ 28.5 + 3 @ 18.75 = 255	K-Frame
211-270-211	6 @ 24.67 + 3 @ 21 = 211	3 @ 21 + 6 @ 24 + 3 @ 21 = 270	K-Frame
223-285-223	6 @ 26.5 + 3 @ 21.33 = 223	4 @ 17.5 + 6 @ 24.16 + 4 @ 17.5 = 285	K-Frame
234-300-234	8 @ 23.25 + 3 @ 16 = 234	4 @ 19 + 6 @ 24.66 + 4 @ 19 = 300	K-Frame

bearings, stiffeners, shear studs, bracing, or any other allowances.

RUSSO STRUCTURAL SERVICES

THREE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 16 of 32

TRANSVERSE AND BEARING STIFFENERS								
Span, ft. End-Int.-End	Transverse Stiffener Size and Location, Distance From End support, Each Span				Bearing Stiffeners, End		Bearing Stiffeners, Piers	
	Width in.	Thickness in.	Span 1 Location, ft.	Span 2 Location, ft.	Width in.	Thickness in.	Width in.	Thickness in.
117-150-117	---	---	---	---	7.25	0.75	10.25	1
129-165-129	5.5	0.5	113.5	15.5, 149.5	7.25	0.75	10.25	1
141-180-141	6	0.5	108, 124.5	16.5, 33, 147, 163.5	8.25	0.75	10.25	1
153-195-153	6	0.5	116, 134.5	18.5, 37, 158, 176.5	8.25	0.75	11.25	1

DEAD AND LIVE LOAD REACTIONS								
Span, ft. End-Int.-End	End Reaction				Pier 1 & 2 Reaction			
	DC kips	DW kips	Truck kips	Lane kips	DC kips	DW kips	Truck kips	Lane kips
117-150-117	88	10	100	40	322	36	173	106
129-165-129	98	11	101	44	358	40	177	117
141-180-141	107	12	101	48	393	43	181	128
153-195-153	116	13	102	52	432	47	184	139

SHEAR STUD LAYOUT																					
Span, ft. End-Int.-End	Studs per row	Span 1										Span 2									
		Offset in.	Group 1			Group 2			Group 3			Offset in.	Group 1			Group 2			Group 3		
			Spaces	Pitch in.	Length ft.	Spaces	Pitch in.	Length ft.	Spaces	Pitch in.	Length ft.		Spaces	Pitch in.	Length ft.	Spaces	Pitch in.	Length ft.	Spaces	Pitch in.	Length ft.
117-150-117	4	0	27	8	18	90	12	90	3	36	9	0	15	24	30	90	12	90	15	24	30
129-165-129	4	0	13	6	6.5	91	12	91	10	36	30	0	13	30	32.5	100	12	100	13	30	32.5
141-180-141	4	0	14	6	7	99	12	99	11	36	33	0	14	30	35	110	12	110	14	30	35
153-195-153	4	0	115	12	115	7	42	24.5	3	48	12	0	13	36	39	117	12	117	13	36	39
164-210-164	4	0	123	12	123	10	48	40	---	---	---	0	12	42	42	126	12	126	12	42	42
176-225-176	4	0	132	12	132	10	48	40	---	---	---	6	11	48	44	136	12	136	11	48	44
188-240-188	4	0	19	12	19	92	16	122.67	11	48	44	0	12	48	48	144	12	144	12	48	48
199-255-199	4	0	30	12	30	80	18	120	12	48	48	30	12	48	48	154	12	154	12	48	48
211-270-211	4	0	32	12	32	85	18	127.5	12	48	48	6	13	48	52	109	18	163.5	13	48	52
223-285-223	4	0	23	12	23	97	18	145.5	13	48	52	12	14	48	56	114	18	171	14	48	56
234-300-234	4	0	12	12	12	102	18	153	17	48	68	36	14	48	56	121	18	181.5	14	48	56

129-165-129	4 @ 23 + 2 @ 18.5 = 129	2 @ 18.5 + 4 @ 22.75 + 2 @ 18.5 = 165	K-Frame
141-180-141	4 @ 25.25 + 2 @ 20 = 141	2 @ 20 + 4 @ 25 + 2 @ 20 = 180	K-Frame
153-195-153	5 @ 22 + 2 @ 21.5 = 153	2 @ 21.5 + 4 @ 27.25 + 2 @ 21.5 = 195	K-Frame
164-210-164	5 @ 23 + 3 @ 16.33 = 164	3 @ 16.25 + 5 @ 22.5 + 3 @ 16.25 = 210	K-Frame
176-225-176	5 @ 25 + 3 @ 17 = 176	3 @ 16.66 + 5 @ 25 + 3 @ 16.66 = 225	K-Frame
188-240-188	5 @ 26.5 + 3 @ 18.5 = 188	3 @ 17.91 + 5 @ 26.5 + 3 @ 17.91 = 240	K-Frame
199-255-199	6 @ 23.5 + 3 @ 19.33 = 199	3 @ 18.75 + 5 @ 28.5 + 3 @ 18.75 = 255	K-Frame
211-270-211	6 @ 24.67 + 3 @ 21 = 211	3 @ 21 + 6 @ 24 + 3 @ 21 = 270	K-Frame
223-285-223	6 @ 26.5 + 3 @ 21.33 = 223	4 @ 17.5 + 6 @ 24.16 + 4 @ 17.5 = 285	K-Frame
234-300-234	8 @ 23.25 + 3 @ 16 = 234	4 @ 19 + 6 @ 24.66 + 4 @ 19 = 300	K-Frame

RUSSO STRUCTURAL SERVICES

NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995

THREE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 16 of 32

TRANSVERSE AND BEARING STIFFENERS								
Span, ft. End-Int.-End	Transverse Stiffener Size and Location, Distance From End support, Each Span				Bearing Stiffeners, End		Bearing Stiffeners, Piers	
	Width in.	Thickness in.	Span 1 Location, ft.	Span 2 Location, ft.	Width in.	Thickness in.	Width in.	Thickness in.

DEAD AND LIVE LOAD REACTIONS								
Span, ft. End-Int.-End	End Reaction				Pier 1 & 2 Reaction			
	DC kips	DW kips	Truck kips	Lane kips	DC kips	DW kips	Truck kips	Lane kips

CROSS-FRAME SPACING			
Span, ft. End-Int.-End	End Span	Interior Span	Type
117-150-117	4 @ 20.5 + 2 @ 17.5 = 117	2 @ 17.5 + 3 @ 26.66 + 2 @ 17.5 = 150	K-Frame
129-165-129	4 @ 23 + 2 @ 18.5 = 129	2 @ 18.5 + 4 @ 22.75 + 2 @ 18.5 = 165	K-Frame
141-180-141	4 @ 25.25 + 2 @ 20 = 141	2 @ 20 + 4 @ 25 + 2 @ 20 = 180	K-Frame
153-195-153	5 @ 22 + 2 @ 21.5 = 153	2 @ 21.5 + 4 @ 27.25 + 2 @ 21.5 = 195	K-Frame
164-210-164	5 @ 23 + 3 @ 16.33 = 164	3 @ 16.25 + 5 @ 22.5 + 3 @ 16.25 = 210	K-Frame
176-225-176	5 @ 25 + 3 @ 17 = 176	3 @ 16.66 + 5 @ 25 + 3 @ 16.66 = 225	K-Frame
188-240-188	5 @ 26.5 + 3 @ 18.5 = 188	3 @ 17.91 + 5 @ 26.5 + 3 @ 17.91 = 240	K-Frame
199-255-199	6 @ 23.5 + 3 @ 19.33 = 199	3 @ 18.75 + 5 @ 28.5 + 3 @ 18.75 = 255	K-Frame
211-270-211	6 @ 24.67 + 3 @ 21 = 211	3 @ 21 + 6 @ 24 + 3 @ 21 = 270	K-Frame
223-285-223	6 @ 26.5 + 3 @ 21.33 = 223	4 @ 17.5 + 6 @ 24.16 + 4 @ 17.5 = 285	K-Frame
234-300-234	8 @ 23.25 + 3 @ 16 = 234	4 @ 19 + 6 @ 24.66 + 4 @ 19 = 300	K-Frame

188-240-188	5 @ 26.5 + 3 @ 18.5 = 188	3 @ 17.91 + 5 @ 26.5 + 3 @ 17.91 = 240	K-Frame
199-255-199	6 @ 23.5 + 3 @ 19.33 = 199	3 @ 18.75 + 5 @ 28.5 + 3 @ 18.75 = 255	K-Frame
211-270-211	6 @ 24.67 + 3 @ 21 = 211	3 @ 21 + 6 @ 24 + 3 @ 21 = 270	K-Frame
223-285-223	6 @ 26.5 + 3 @ 21.33 = 223	4 @ 17.5 + 6 @ 24.16 + 4 @ 17.5 = 285	K-Frame
234-300-234	8 @ 23.25 + 3 @ 16 = 234	4 @ 19 + 6 @ 24.66 + 4 @ 19 = 300	K-Frame

THREE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 16 of 32

DEAD AND LIVE LOAD REACTIONS

Span, ft. End-Int.-End	End Reaction				Pier 1 & 2 Reaction			
	DC kips	DW kips	Truck kips	Lane kips	DC kips	DW kips	Truck kips	Lane kips
117-150-117	88	10	100	40	322	36	173	106
129-165-129	98	11	101	44	358	40	177	117
141-180-141	107	12	101	48	393	43	181	128
153-195-153	116	13	102	52	432	47	184	139
164-210-164	123	14	102	55	472	51	186	149
176-225-176	136	15	103	59	517	54	187	159
188-240-188	145	16	103	63	561	58	188	171
199-255-199	154	17	103	66	601	62	189	181
211-270-211	165	18	103	70	646	65	190	192
223-285-223	178	19	104	74	684	69	190	202
234-300-234	187	20	104	78	731	73	191	213

Note: Truck and lane reactions include distribution factors, skew correction, and impact on the truck loading.

THREE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 16 of 32

RUSSO
STRUCTURAL SERVICES

GIRDER WEIGHT

Span, ft. End-Int.-End	Segment A tons	Segment B tons	Segment C tons	Segment D tons	Total tons
117-150-117	11.12	---	12.60	9.73	57.17
129-165-129	13.29	---	14.26	11.89	66.98
141-180-141	14.92	---	16.15	13.55	75.70
153-195-153	16.33	---	19.52	15.16	86.88
164-210-164	18.02	---	23.67	17.32	100.70
176-225-176	22.68	---	27.92	21.30	122.49
188-240-188	24.94	---	33.00	23.42	139.30
199-255-199	27.43	---	36.57	25.91	153.93
211-270-211	10.20	21.86	40.90	27.99	173.91
223-285-223	10.63	25.08	43.79	29.80	188.80
234-300-234	12.40	28.79	49.64	30.25	211.91

Note: Girder weight is total weight of web and flanges only measured between CL brg at each end. Does not include girder extension at end bearings, stiffeners, shear studs, bracing, or any other allowances.

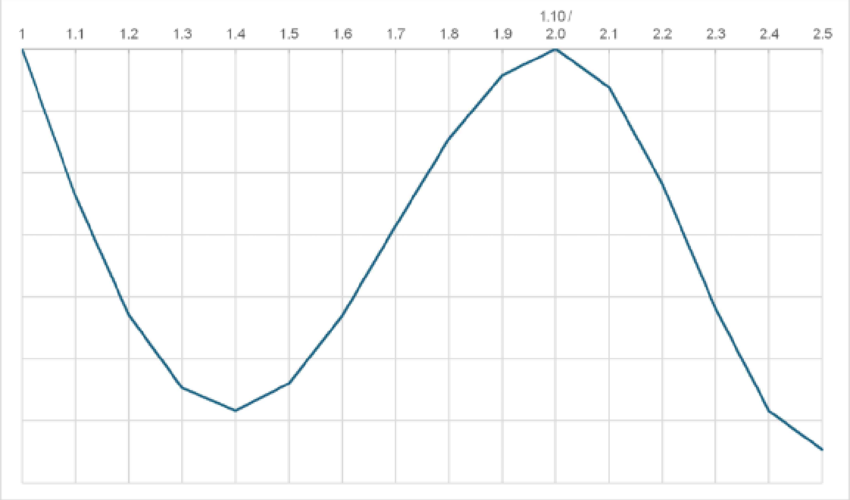
...EE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 16 of 32

RUSSO
STRUCTURAL SERVICES

DEAD LOAD DEFLECTIONS, SPAN 1 AND L/2 SPAN 2 SHOWN, SYMMETRIC																	
Span, ft. End-Int.-End	Span Tenth Points and Deflections, in. Span 1											Span Tenth Points and Deflections, in. Span 2					
	1.0	**1.1**	**12**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**1.10**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**
117-150-117 ft. span - steel only, in.	0.00	0.13	0.24	0.31	0.34	0.32	0.26	0.18	0.09	0.03	0.00	0.00	0.04	0.14	0.27	0.36	0.39
slab, in.	0.00	0.69	1.26	1.63	1.76	1.65	1.33	0.88	0.42	0.10	0.00	0.00	0.28	0.93	1.67	2.23	2.44
barrier rails, in.	0.00	0.06	0.12	0.15	0.16	0.15	0.13	0.08	0.04	0.01	0.00	0.00	0.03	0.11	0.18	0.24	0.26
117-150-117 ft. span - total, in.	**0.00**	**0.88**	**1.52**	**2.10**	**2.27**	**2.12**	**1.72**	**1.15**	**0.56**	**0.14**	**0.00**	**0.00**	**0.35**	**1.17**	**2.12**	**2.83**	**3.09**
129-165-129 ft. span - steel only, in.	0.00	0.15	0.28	0.36	0.39	0.37	0.31	0.21	0.11	0.03	0.00	0.00	0.04	0.16	0.30	0.40	0.44
slab, in.	0.00	0.75	1.37	1.78	1.92	1.80	1.45	0.96	0.46	0.12	0.00	0.00	0.28	0.96	1.75	2.35	2.57
barrier rails, in.	0.00	0.07	0.13	0.17	0.19	0.18	0.14	0.10	0.05	0.01	0.00	0.00	0.04	0.12	0.20	0.26	0.29
129-165-129 ft. span - total, in.	**0.00**	**0.98**	**1.79**	**2.31**	**2.50**	**2.34**	**1.90**	**1.27**	**0.62**	**0.16**	**0.00**	**0.00**	**0.36**	**1.23**	**2.24**	**3.01**	**3.29**
141-180-141 ft. span - steel only, in.	0.00	0.19	0.35	0.46	0.49	0.46	0.38	0.26	0.13	0.04	0.00	0.00	0.05	0.20	0.37	0.50	0.55
slab, in.	0.00	0.93	1.59	2.18	2.33	2.18	1.75	1.16	0.56	0.14	0.00	0.00	0.34	1.16	2.11	2.84	3.11
barrier rails, in.	0.00	0.09	0.17	0.22	0.24	0.22	0.18	0.12	0.06	0.01	0.00	0.00	0.04	0.14	0.24	0.32	0.34
141-180-141 ft. span - total, in.	**0.00**	**1.21**	**2.21**	**2.85**	**3.07**	**2.86**	**2.31**	**1.54**	**0.76**	**0.19**	**0.00**	**0.00**	**0.43**	**1.49**	**2.72**	**3.66**	**4.00**
153-195-153 ft. span - steel only, in.	0.00	0.22	0.40	0.51	0.55	0.52	0.42	0.29	0.15	0.04	0.00	0.00	0.05	0.21	0.40	0.54	0.60
slab, in.	0.00	1.05	1.92	2.48	2.66	2.47	1.98	1.32	0.65	0.18	0.00	0.00	0.29	1.10	2.07	2.81	3.09
barrier rails, in.	0.00	0.11	0.20	0.26	0.28	0.26	0.21	0.14	0.07	0.02	0.00	0.00	0.04	0.14	0.25	0.34	0.37
153-195-153 ft. span - total, in.	**0.00**	**1.38**	**2.52**	**3.25**	**3.49**	**3.25**	**2.62**	**1.75**	**0.87**	**0.24**	**0.00**	**0.00**	**0.39**	**1.45**	**2.72**	**3.69**	**4.05**
164-210-164 ft. span - steel only, in.	0.00	0.25	0.46	0.59	0.64	0.60	0.49	0.33	0.18	0.06	0.00	0.00	0.05	0.22	0.43	0.59	0.65
slab, in.	0.00	1.18	2.15	2.75	2.94	2.73	2.20	1.48	0.76	0.24	0.00	0.00	0.27	1.05	2.05	2.83	3.13
barrier rails, in.	0.00	0.13	0.23	0.30	0.32	0.30	0.24	0.16	0.08	0.02	0.00	0.00	0.05	0.15	0.28	0.37	0.40
164-210-164 ft. span - total, in.	**0.00**	**1.56**	**2.34**	**3.64**	**3.90**	**3.63**	**2.92**	**1.97**	**1.02**	**0.32**	**0.00**	**0.00**	**0.37**	**1.42**	**2.75**	**3.79**	**4.18**
176-225-176 ft. span - steel only, in.	0.00	0.33	0.59	0.76	0.81	0.75	0.61	0.42	0.21	0.06	0.00	0.00	0.08	0.31	0.59	0.81	0.89
slab, in.	0.00	1.30	2.35	2.99	3.15	2.90	2.31	1.53	0.75	0.20	0.00	0.00	0.38	1.37	2.56	3.48	3.82
barrier rails, in.	0.00	0.15	0.27	0.34	0.36	0.34	0.27	0.18	0.09	0.02	0.00	0.00	0.06	0.18	0.33	0.44	0.48
176-225-176 ft. span - total, in.	**0.00**	**1.77**	**3.21**	**4.08**	**4.31**	**3.99**	**3.20**	**2.13**	**1.05**	**0.29**	**0.00**	**0.00**	**0.52**	**1.87**	**3.48**	**4.72**	**5.19**
188-240-188 ft. span - steel only, in.	0.00	0.36	0.55	0.83	0.89	0.83	0.66	0.44	0.22	0.06	0.00	0.00	0.11	0.35	0.64	0.88	0.96
slab, in.	0.00	1.41	2.56	3.28	3.50	3.23	2.57	1.69	0.83	0.22	0.00	0.00	0.39	1.31	2.46	3.38	3.73
barrier rails, in.	0.00	0.16	0.29	0.38	0.41	0.38	0.30	0.20	0.10	0.02	0.00	0.00	0.06	0.19	0.34	0.46	0.50
188-240-188 ft. span - total, in.	**0.00**	**1.92**	**3.50**	**4.49**	**4.79**	**4.43**	**3.53**	**2.33**	**1.14**	**0.30**	**0.00**	**0.00**	**0.56**	**1.85**	**3.45**	**4.72**	**5.19**
199-255-199 ft. span - steel only, in.	0.00	0.40	0.73	0.94	1.01	0.93	0.75	0.50	0.25	0.07	0.00	0.00	0.11	0.37	0.69	0.95	1.04
slab, in.	0.00	1.50	2.73	3.51	3.74	3.44	2.73	1.79	0.87	0.23	0.00	0.00	0.42	1.41	2.64	3.64	4.02
barrier rails, in.	0.00	0.18	0.32	0.41	0.44	0.41	0.33	0.22	0.11	0.03	0.00	0.00	0.07	0.21	0.38	0.51	0.56
199-255-199 ft. span - total, in.	**0.00**	**2.08**	**3.78**	**4.86**	**5.18**	**4.78**	**3.80**	**2.51**	**1.23**	**0.33**	**0.00**	**0.00**	**0.60**	**1.99**	**3.71**	**5.10**	**5.62**
211-270-211 ft. span - steel only, in.	0.00	0.46	0.83	1.07	1.15	1.07	0.87	0.58	0.30	0.09	0.00	0.00	0.11	0.40	0.75	1.04	1.15
slab, in.	0.00	1.57	2.84	3.61	3.83	3.53	2.79	1.81	0.86	0.21	0.00	0.00	0.50	1.60	2.99	4.11	4.53
barrier rails, in.	0.00	0.19	0.35	0.45	0.48	0.44	0.36	0.23	0.11	0.03	0.00	0.00	0.08	0.24	0.42	0.57	0.62
211-270-211 ft. span - total, in.	**0.00**	**2.23**	**4.02**	**5.12**	**5.46**	**5.04**	**4.01**	**2.63**	**1.27**	**0.33**	**0.00**	**0.00**	**0.69**	**2.24**	**4.17**	**5.72**	**6.31**
223-285-223 ft. span - steel only, in.	0.00	0.54	0.98	1.25	1.35	1.26	1.02	0.69	0.36	0.11	0.00	0.00	0.13	0.51	0.97	1.33	1.47
slab, in.	0.00	1.80	3.25	4.14	4.42	4.10	3.28	2.18	1.07	0.30	0.00	0.00	0.49	1.83	3.46	4.74	5.21
barrier rails, in.	0.00	0.22	0.41	0.52	0.56	0.52	0.42	0.28	0.14	0.04	0.00	0.00	0.08	0.26	0.47	0.64	0.70
223-285-223 ft. span - total, in.	**0.00**	**2.56**	**4.53**	**5.91**	**6.33**	**5.89**	**4.73**	**3.15**	**1.57**	**0.44**	**0.00**	**0.00**	**0.70**	**2.60**	**4.90**	**6.70**	**7.38**
234-300-234 ft. span - steel only, in.	0.00	0.57	1.04	1.33	1.44	1.34	1.08	0.73	0.37	0.11	0.00	0.00	0.13	0.51	0.99	1.37	1.52
slab, in.	0.00	1.75	3.17	4.05	4.32	3.98	3.14	2.04	0.96	0.23	0.00	0.00	0.57	1.93	3.63	4.98	5.49
barrier rails, in.	0.00	0.22	0.41	0.53	0.57	0.53	0.42	0.28	0.13	0.03	0.00	0.00	0.09	0.28	0.51	0.69	0.75
234-300-234 ft. span - total, in.	**0.00**	**2.54**	**4.51**	**5.91**	**6.32**	**5.85**	**4.65**	**3.04**	**1.46**	**0.37**	**0.00**	**0.00**	**0.79**	**2.72**	**5.13**	**7.04**	**7.76**



DEFLECTION VERSUS SPAN TENTH POINT, SYMMETRIC ABOUT L/2 SPAN 2

All Girders

Deflection Assumptions

"Steel Only" = self weight of girders

"Slab" = deflection due to user-input non composite uniform dead load (slab, haunch, allowance for bracing)

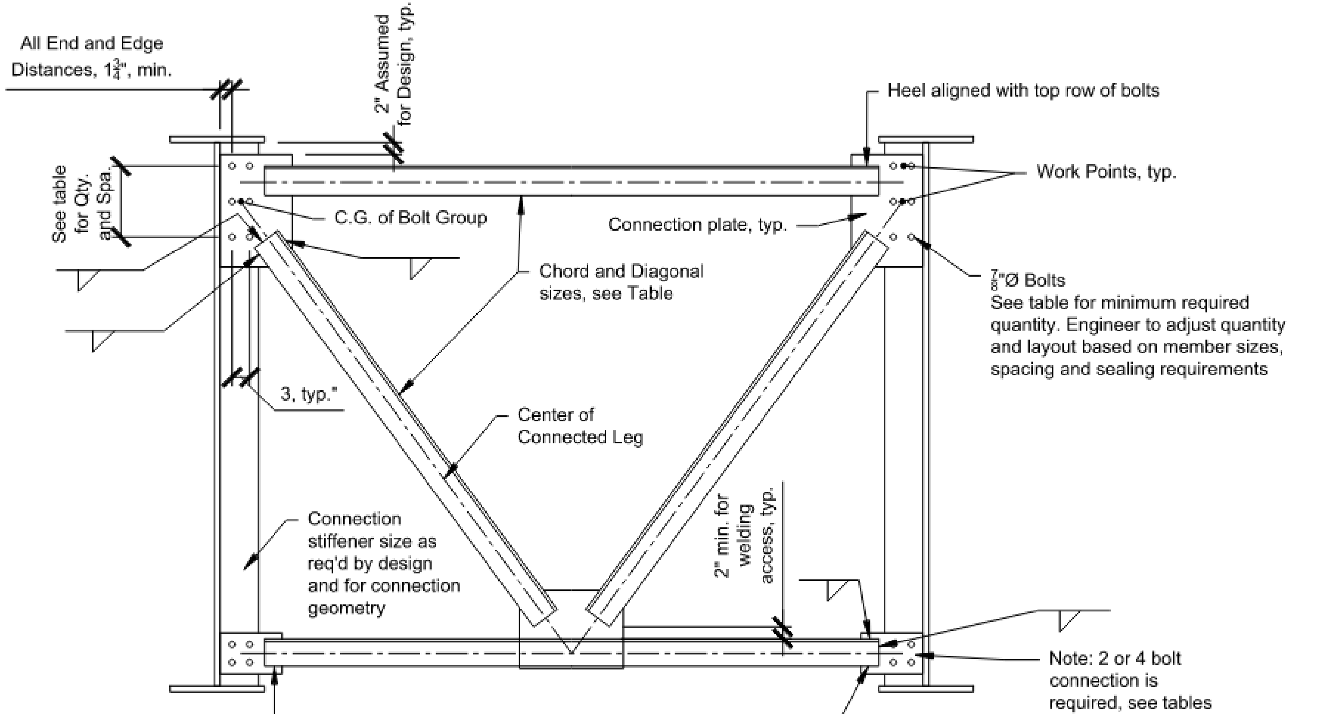
"Barrier Rails" = deflection due to barrier rail loading distributed evenly to exterior and first interior girder.

RUSSO STRUCTURAL SERVICES

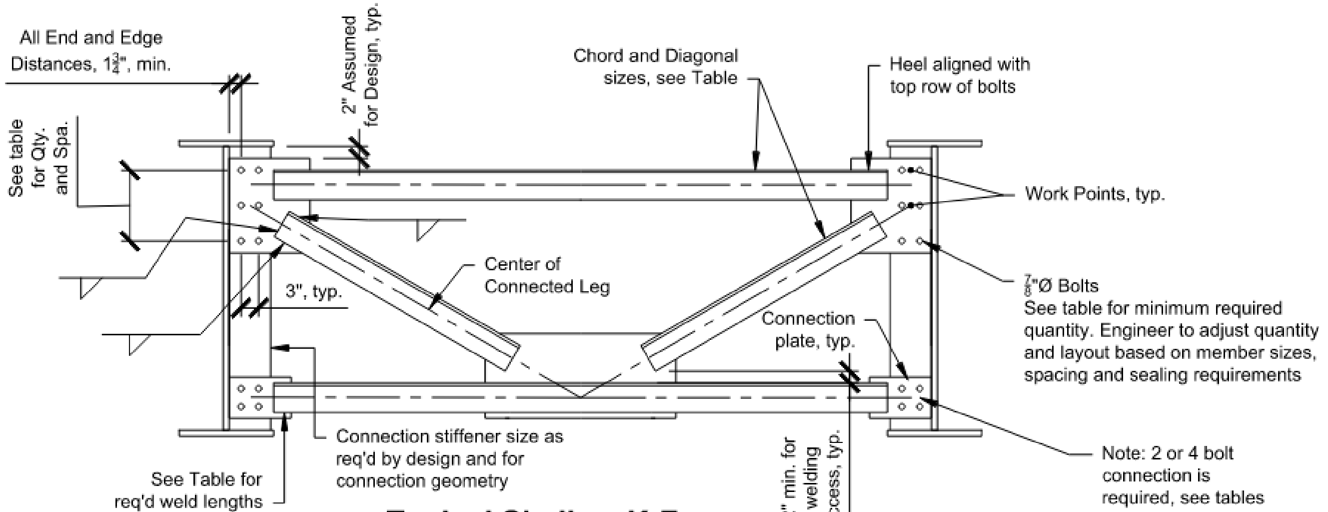
THREE SPAN 150-300 FT
12 FT SPACING

Issued January 2025
Revision 0

Sheet 17 of 32



Typical Deep K-Frame



Typical Shallow K-Frame

CROSS-FRAME DETAILS

Beam Spacing, ft.	Span, ft. End-Int.-End	Type	Chord	Diagonal
8	117-150-117 through 164-210-164	K-Frame	L5X5X3/8	L5X5X3/8
	176-225-176 through 234-300-234	X-Frame	L5X5X3/8	L6x6x3/8
10	117-150-117 through 199-255-199	K-Frame	L5X5X3/8	L5X5X3/8
	211-270-211 through 234-300-234	X-Frame	L5X5X3/8	L6X6X3/8
12	All spans	K-Frame	L6X6X3/8	L5X5X3/8
14	141-180-141 through 234-300-234	K-Frame	L8X6X1/2	L5X5X3/8

CROSS-FRAME WELD DETAILS

Angle Size	Toe Length	Heel Length
L5x5x3/8	2 in. min. See notes regarding toe weld length	4 in.
L6x6x3/8		4 in.
L8x6x1/2		4

CROSS-FRAME BOLTED CONNECTION DETAILS

Beam Spacing, ft.	Type	Top Connection		Bottom Connection	
		Total Num Bolts	Vertical Spacing	Total Num Bolts	Vertical Spacing
8	K-Frame	6	6 in.	2	3 in.
	X-Frame	6	6 in.	6	6 in.
10	K-Frame	6	6 in.	2	3 in.
	X-Frame	6	6 in.	6	6 in.
12	K-Frame	6	6 in.	2	3 in.
14	K-Frame	8	4.75	4	4.75

Notes:
1. For general notes, see **Cross-Frame & Diaphragm Details 1**.

RUSSO STRUCTURAL SERVICES

NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995

CROSS-FRAME & DIAPHRAGM DETAILS 2

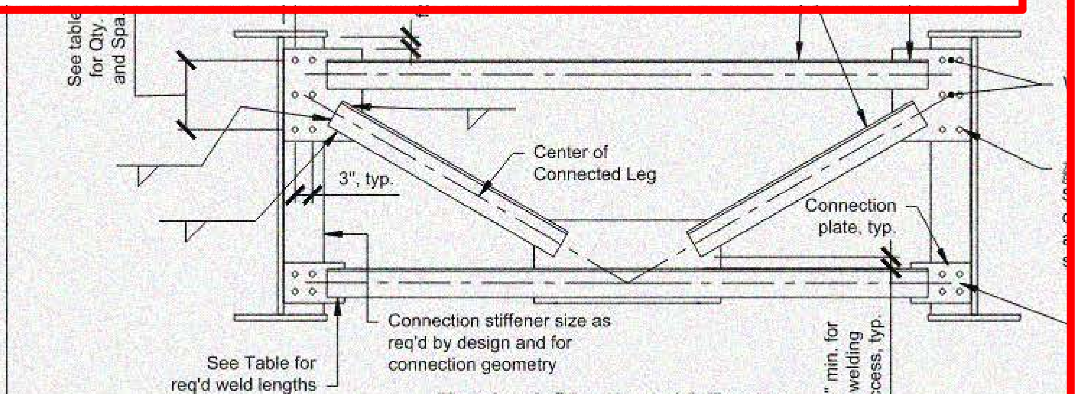
Issued January 2025
Revision 0

Sheet 23 of 32

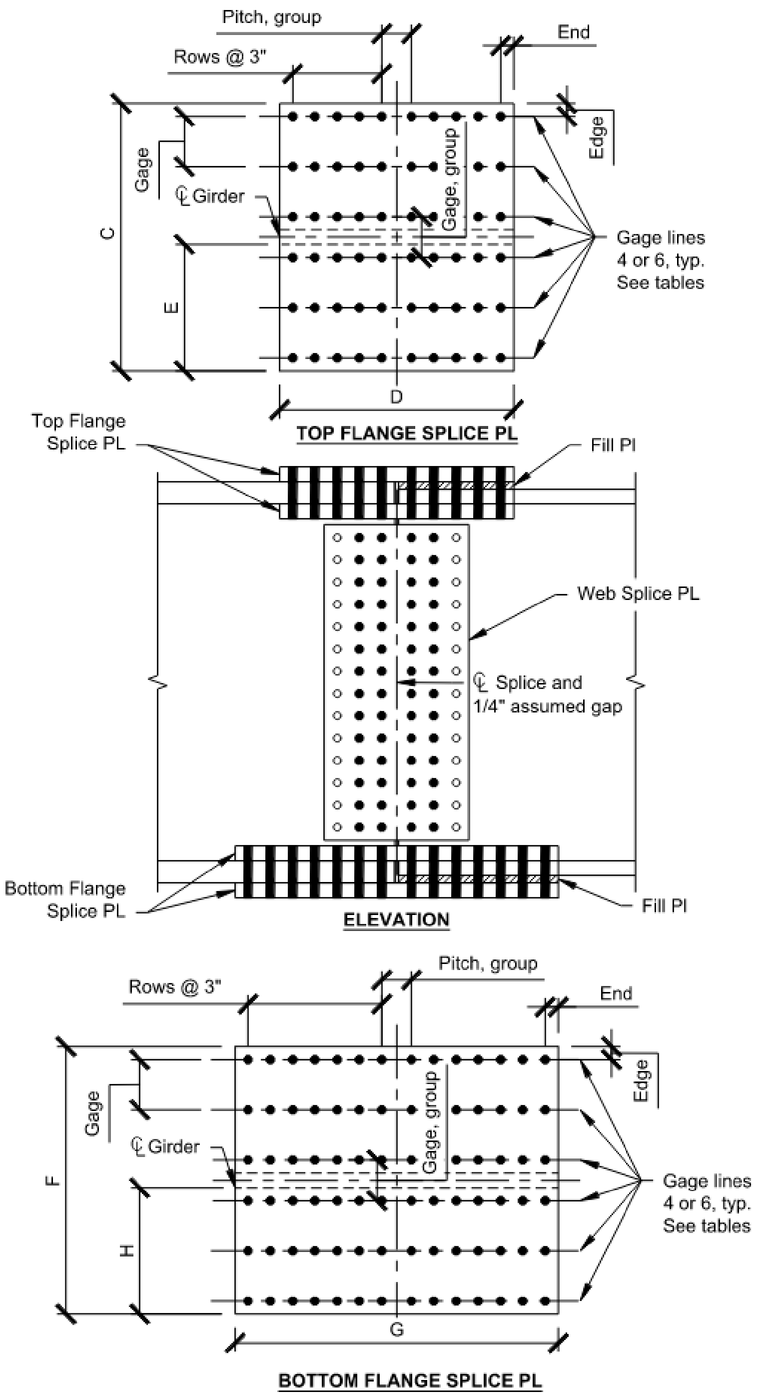
CROSS-FRAME DETAILS				
Beam Spacing, ft.	Span, ft. End-Int.-End	Type	Chord	Diagonal
8	117-150-117 through 164-210-164	K-Frame	L5X5X3/8	L5X5X3/8
	176-225-176 through 234-300-234	X-Frame	L5X5X3/8	L6x6x3/8
10	117-150-117 through 199-255-199	K-Frame	L5X5X3/8	L5X5X3/8
	211-270-211 through 234-300-234	X-Frame	L5X5X3/8	L6X6X3/8
12	All spans	K-Frame	L6X6X3/8	L5X5X3/8
14	141-180-141 through 234-300-234	K-Frame	L8X6X1/2	L5X5X3/8

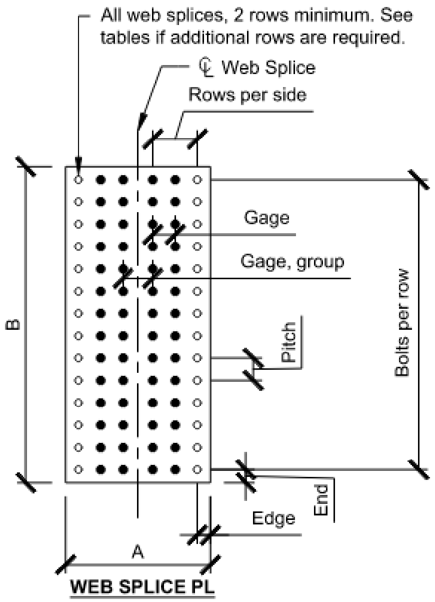
CROSS-FRAME WELD DETAILS		
Angle Size	Toe Length	Heel Length
L5x5x3/8	2 in. min. See notes regarding toe weld length	4 in.
L6x6x3/8		4 in.
L8x6x1/2		4

CROSS-FRAME BOLTED CONNECTION DETAILS					
Beam Spacing, ft.	Type	Top Connection		Bottom Connection	
		Total Num Bolts	Vertical Spacing	Total Num Bolts	Vertical Spacing
8	K-Frame	6	6 in.	2	3 in.
	X-Frame	6	6 in.	6	6 in.
10	K-Frame	6	6 in.	2	3 in.
	X-Frame	6	6 in.	6	6 in.
12	K-Frame	6	6 in.	2	3 in.
14	K-Frame	8	4.75	4	4.75



Typical Shallow K-Frame





NOTES:

All bolted field splices designed using NSBA Splice Version 03_15. Design assumptions listed below. For bolt quantity and plate dimensions, see Sheets **Bolted Field Splice Dimensions 1 - 4**.

1. Bolts F3125 Grade A325, Type 3 weathering, 1 in. diameter in 1.125 in. diameter holes. All plates A709 Grade 50W.
2. Threads excluded from flange shear planes. Threads included in web shear planes.
3. Class B surface condition for slip resistance.
4. For continuous spans in which "Splice 0" is used to control the field section lengths, a large moment must be carried by the web (AASHTO LRFD 6.13.6.1.3c). If the combined tension due to the bottom flange force plus the web force, H_w, exceeds the compression capacity of the slab, these splices are designed as noncomposite and noted in the design tables.
5. Top and bottom flange bolt group dimension, "Gage, Group" exceeds the 7 in. maximum spacing for sealing for some splices (AASHTO LRFD 6.13.2.6.2). This is due to girder tension flange net section requirements at the splice, the choice of 1 in. diameter bolts, and enforced symmetry requirements for the inner flange splice plates. The engineer may choose to accept the proposed designs, or redesign the splice. Solutions could include using asymmetric inner plates, staggered bolts, or smaller diameter fasteners. If additional and smaller diameter bolts are used to decrease the "Gage, Group" dimension, check the net section. See AASHTO LRFD 6.10.1.8.

BOLTED FIELD SPLICE LAYOUT	
Issued January 2025 Revision 0	Sheet 25 of 32

Spacing-Span	Web Splice Plates				Top Flange Plates, Outer				Top Flange Plates, Inner, 2 req'd.			Bottom Flange Plates, Outer				Bottom Flange Plates, Inner, 2 req'd.			Web Bolts					Top Flange Bolts					Bottom Flange Bolts					Composite Note
	Width, A	Length, B	Thk.	Edge / End Distance	Width, C	Length, D	Thk.	Edge / End Distance	Width, E	Length, D	Thk.	Width, F	Length, G	Thk.	Edge / End Distance	Width, H	Length, G	Thk.	Bolts per Row	Rows per Side	Pitch	Gage	Gage, group	Num Rows Ea Side	Pitch, group	Gage Lines	Gage	Gage, group	Num Rows Ea Side	Pitch, group	Gage Lines	Gage	Gage, group	
12-117-150 Splice 1	12.25	49	0.5	1.5 / 1.5	16	18.25	0.625	1.5 / 1.5	7	18.25	0.625	22	30.25	0.75	1.5 / 1.5	10	30.25	0.75	9	2	5.75	3	3.25	3	3.25	4	4	5	5	3.25	4	7	5	Composite
12-117-150 Splice 2	12.25	49	0.5	1.5 / 1.5	16	18.25	0.625	1.5 / 1.5	7	18.25	0.625	22	30.25	0.75	1.5 / 1.5	10	30.25	0.75	9	2	5.75	3	3.25	3	3.25	4	4	5	5	3.25	4	7	5	Composite
12-129-165 Splice 1	12.25	56.75	0.5	1.5 / 1.5	16	18.25	0.625	1.5 / 1.5	7	18.25	0.625	22	30.25	0.75	1.5 / 1.5	10	30.25	0.75	11	2	5.375	3	3.25	3	3.25	4	4	5	5	3.25	4	7	5	Composite
12-129-165 Splice 2	12.25	56.75	0.5	1.5 / 1.5	16	18.25	0.625	1.5 / 1.5	7	18.25	0.625	22	24.25	0.75	1.5 / 1.5	10	24.25	0.75	11	2	5.375	3	3.25	3	3.25	4	4	5	4	3.25	4	7	5	Composite
12-141-180 Splice 1	12.25	60.5	0.5	1.5 / 1.5	18	18.25	0.625	1.5 / 1.5	8	18.25	0.625	22	30.25	0.875	1.5 / 1.5	10	30.25	0.875	11	2	5.75	3	3.25	3	3.25	4	5	5	5	3.25	4	7	5	Composite
12-141-180 Splice 2	12.25	60.5	0.5	1.5 / 1.5	16	18.25	0.625	1.5 / 1.5	7	18.25	0.625	22	24.25	0.875	1.5 / 1.5	10	24.25	0.875	11	2	5.75	3	3.25	3	3.25	4	4	5	4	3.25	4	7	5	Composite
12-153-195 Splice 1	12.25	69	0.5	1.5 / 1.5	18	18.25	0.625	1.5 / 1.5	8	18.25	0.625	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	13	2	5.5	3	3.25	3	3.25	4	5	5	3	3.25	6	4	5	Composite
12-153-195 Splice 2	12.25	69	0.5	1.5 / 1.5	18	18.25	0.625	1.5 / 1.5	8	18.25	0.625	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	13	2	5.5	3	3.25	3	3.25	4	5	5	3	3.25	6	4	5	Composite
12-164-210 Splice 1	12.25	72	0.5	1.5 / 1.5	18	18.25	0.625	1.5 / 1.5	8	18.25	0.625	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	13	2	5.75	3	3.25	3	3.25	4	5	5	3	3.25	6	4	5	Composite
12-164-210 Splice 2	12.25	72	0.5	1.5 / 1.5	18	18.25	0.625	1.5 / 1.5	8	18.25	0.625	22	18.25	0.875	1.5 / 1.5	10	18.25	0.875	13	2	5.75	3	3.25	3	3.25	4	5	5	3	3.25	6	3.5	5	Composite
12-176-225 Splice 1	12.25	76.125	0.5	1.5 / 1.5	18	24.25	0.75	1.5 / 1.5	8	24.25	0.75	22	18.25	1	1.5 / 1.5	10	18.25	1	14	2	5.625	3	3.25	4	3.25	4	5	5	3	3.25	6	3.5	5	Composite
12-176-225 Splice 2	12.25	76.125	0.5	1.5 / 1.5	18	18.25	0.75	1.5 / 1.5	8	18.25	0.75	22	18.25	0.875	1.5 / 1.5	10	18.25	0.875	14	2	5.625	3	3.25	3	3.25	4	5	5	3	3.25	6	3.5	5	Composite
12-188-240 Splice 1	12.25	81.75	0.5	1.5 / 1.5	20	24.25	0.75	1.5 / 1.5	9	24.25	0.75	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	15	2	5.625	3	3.25	4	3.25	4	6	5	3	3.25	6	4	5	Composite
12-188-240 Splice 2	12.25	81.75	0.5	1.5 / 1.5	20	24.25	0.75	1.5 / 1.5	9	24.25	0.75	20	18.25	0.75	1.5 / 1.5	9	18.25	0.75	15	2	5.625	3	3.25	4	3.25	4	6	5	3	3.25	6	3	5	Composite
12-199-255 Splice 1	12.25	89.25	0.5	1.5 / 1.5	20	24.25	0.625	1.5 / 1.5	9	24.25	0.625	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	16	2	5.75	3	3.25	4	3.25	4	6	5	3	3.25	6	4	5	Composite
12-199-255 Splice 2	12.25	89.25	0.5	1.5 / 1.5	20	24.25	0.625	1.5 / 1.5	9	24.25	0.625	24	18.25	0.625	1.5 / 1.5	11	18.25	0.625	16	2	5.75	3	3.25	4	3.25	4	6	5	3	3.25	6	4	5	Composite
12-211-270 Splice 0	12.25	93	0.5	1.5 / 1.5	20	24.25	0.75	1.5 / 1.5	8	24.25	0.75	24	30.25	0.75	1.5 / 1.5	10	30.25	0.75	17	2	5.625	3	3.25	4	3.25	4	5	7	5	3.25	4	7	7	Composite
12-211-270 Splice 1	12.25	93	0.5	1.5 / 1.5	20	30.25	0.75	1.5 / 1.5	9	30.25	0.75	24	24.25	0.75	1.5 / 1.5	11	24.25	0.75	17	2	5.625	3	3.25	5	3.25	4	6	5	4	3.25	6	4	5	Composite
12-211-270 Splice 2	12.25	93	0.5	1.5 / 1.5	20	24.25	0.75	1.5 / 1.5	9	24.25	0.75	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	17	2	5.625	3	3.25	4	3.25	4	6	5	3	3.25	6	4	5	Composite
12-223-285 Splice 0	12.25	95.25	0.5	1.5 / 1.5	22	30.25	0.75	1.5 / 1.5	9	30.25	0.75	24	30.25	0.75	1.5 / 1.5	10	30.25	0.75	19	2	5.125	3	3.25	5	3.25	4	6	7	5	3.25	4	7	7	Composite
12-223-285 Splice 1	12.25	97	0.5	1.5 / 1.5	22	24.25	0.75	1.5 / 1.5	10	24.25	0.75	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	17	2	5.875	3	3.25	4	3.25	4	7	5	3	3.25	6	4	5	Composite
12-223-285 Splice 2	12.25	97	0.5	1.5 / 1.5	22	24.25	0.75	1.5 / 1.5	10	24.25	0.75	22	30.25	0.75	1.5 / 1.5	10	30.25	0.75	17	2	5.875	3	3.25	4	3.25	4	7	5	5	3.25	4	7	5	Composite
12-234-300 Splice 0	12.25	102.875	0.5	1.5 / 1.5	24	30.25	0.75	1.5 / 1.5	10	30.25	0.75	24	30.25	0.875	1.5 / 1.5	10	30.25	0.875	18	2	5.875	3	3.25	5	3.25	4	7	7	5	3.25	4	7	7	Composite
12-234-300 Splice 1	12.25	102.875	0.5	1.5 / 1.5	24	18.25	0.75	1.5 / 1.5	11	18.25	0.75	24	18.25	0.875	1.5 / 1.5	11	18.25	0.875	18	2	5.875	3	3.25	3	3.25	6	4	5	3	3.25	6	4	5	Composite
12-234-300 Splice 2	12.25	102.875	0.5	1.5 / 1.5	22	18.25	0.75	1.5 / 1.5	10	18.25	0.75	24	18.25	0.875	1.5 / 1.5	11	18.25	0.875	18	2	5.875	3	3.25	3	3.25	6	3.5	5	3	3.25	6	4	5	Composite

12 FT SPACING - 3 SPAN

NOTES:

1. All dimensions / spacing shown in tables in inch units.

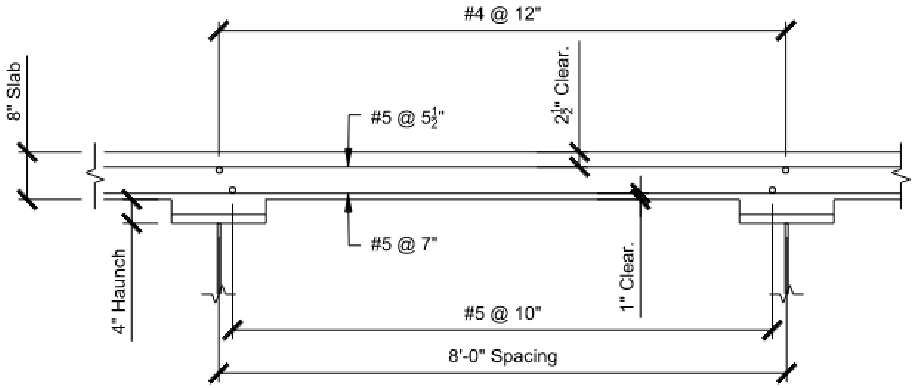
RUSSO STRUCTURAL SERVICES

NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995

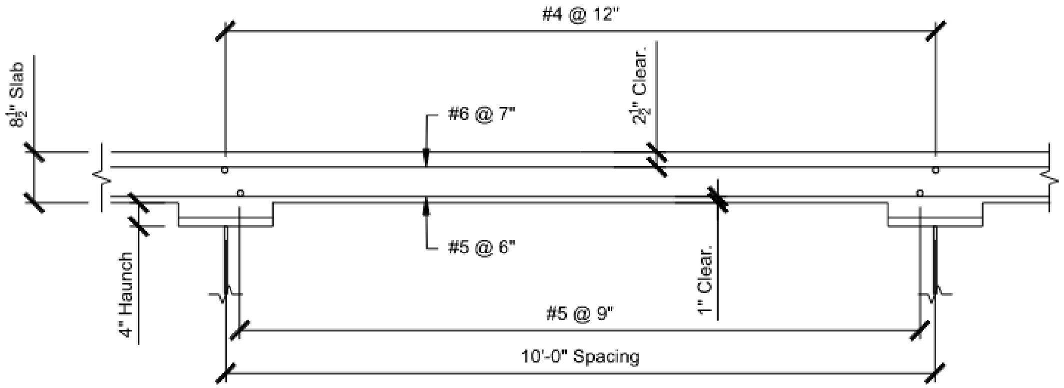
BOLTED FIELD SPLICE DIMENSIONS 3

Issued January 2025
Revision 0

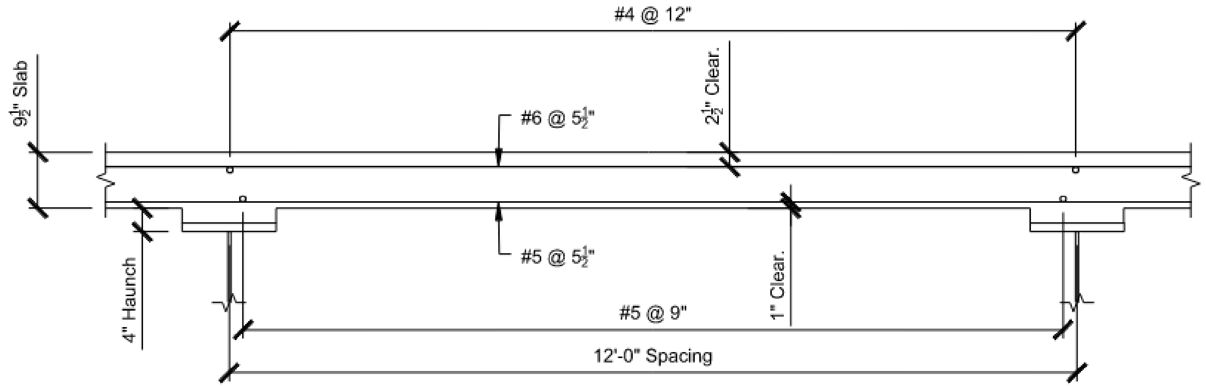
Sheet 28 of 32



8 FT SPACING



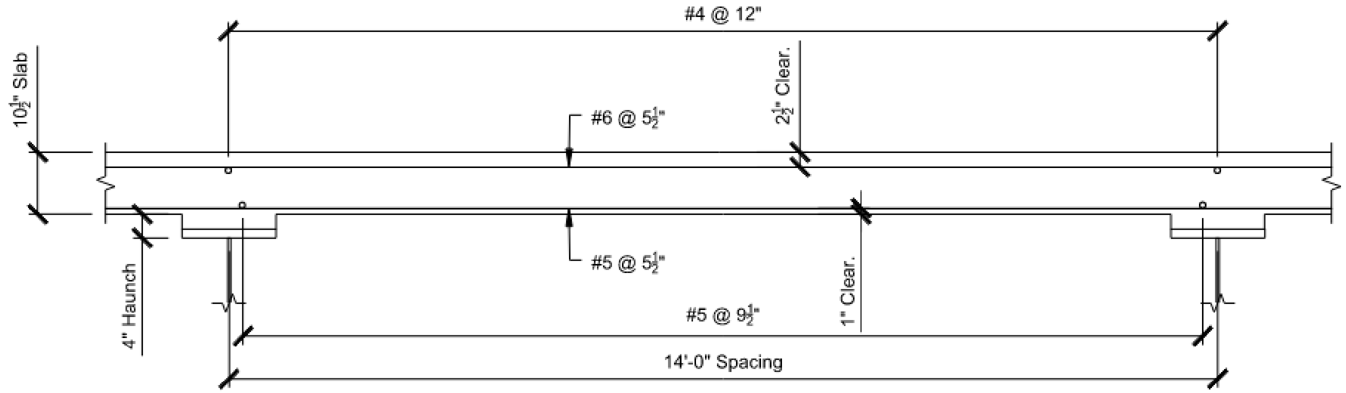
10 FT SPACING



12 FT SPACING

DECK DESIGN NOTES

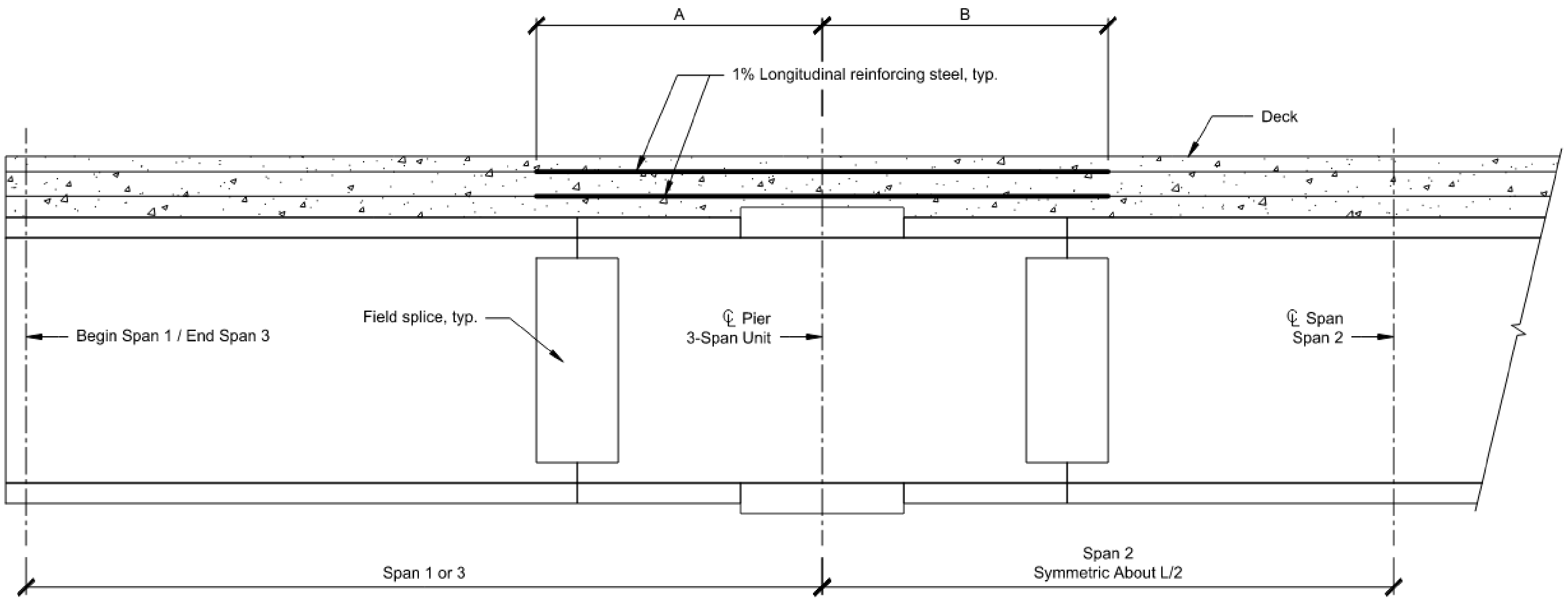
1. Deck details are representative of slab designs for the beam spacings used in these plans.
2. The gross thickness shown is used for weight calculations. Structural capacity assumes a 1/2 in. loss in deck thickness due to wear.
3. The details on this sheet are for positive moment regions of the span and represent an acceptable transverse and longitudinal reinforcing steel design complying with AASHTO LRFD 9.7.3.
4. The slab thickness, cover, bar sizes and spacing are based on decks designed using the AASHTO equivalent strip method.



14 FT SPACING

RUSSO STRUCTURAL SERVICES

DECK DETAILS Simple Spans and Positive Moment Region of Continuous Spans	
Issued January 2025 Revision 0	Sheet 30 of 32



LONGITUDINAL REINFORCING STEEL TERMINATION LIMITS

Notes:

1. Dimension "A" defines the limit of required one percent longitudinal reinforcing steel extending from Pier 1 or 2 into either Span 1 or 3.
2. Dimension "B" defines the limit of required one percent longitudinal reinforcing steel extending from Pier 1 or 2 into Span 2.
3. Dimension "A" and "B" are at a minimum the distance to each field splice or as required by Note (4) below.
4. Longitudinal reinforcing steel is designed to meet the requirements of Service II Limit State, AASHTO LRFD 6.10.1.7 in the completed bridge only.The cutoff locations are approximate and are to be refined in final design.
5. Designer to determine if the factored deck casting and construction loads require this reinforcing steel to be extended.
6. For beam design, the longitudinal reinforcing steel was assumed to be exactly one percent and meeting the preferred two-thirds top mat placement. Sample reinforcing patterns for the positive and negative moment region longitudinal reinforcing steel are provided in the Deck Details, Sheet 30 and 31.

1% Longitudinal Steel, Distances A and B, ft. Versus Beam Spacing, ft.				
Span, ft.	8 ft.	10 ft.	12 ft.	14 ft.
End-Int.-End	Length A, B	Length A, B	Length A, B	Length A, B
117-150-117	43 38	38 38	38 38	38 38
129-165-129	49 42	40 40	40 40	40 40
141-180-141	53 45	47 43	43 43	43 43
153-195-153	58 52	54 47	47 47	47 47
164-210-164	61 56	59 51	59 51	56 51
176-225-176	67 61	61 54	59 54	61 54
188-240-188	71 64	70 62	69 58	67 58
199-255-199	73 69	74 67	73 65	72 61
211-270-211	78 70	81 66	78 72	78 67
223-285-223	82 79	83 77	82 73	73 73
234-300-234	86 80	86 80	86 80	78 80

RUSSO STRUCTURAL SERVICES

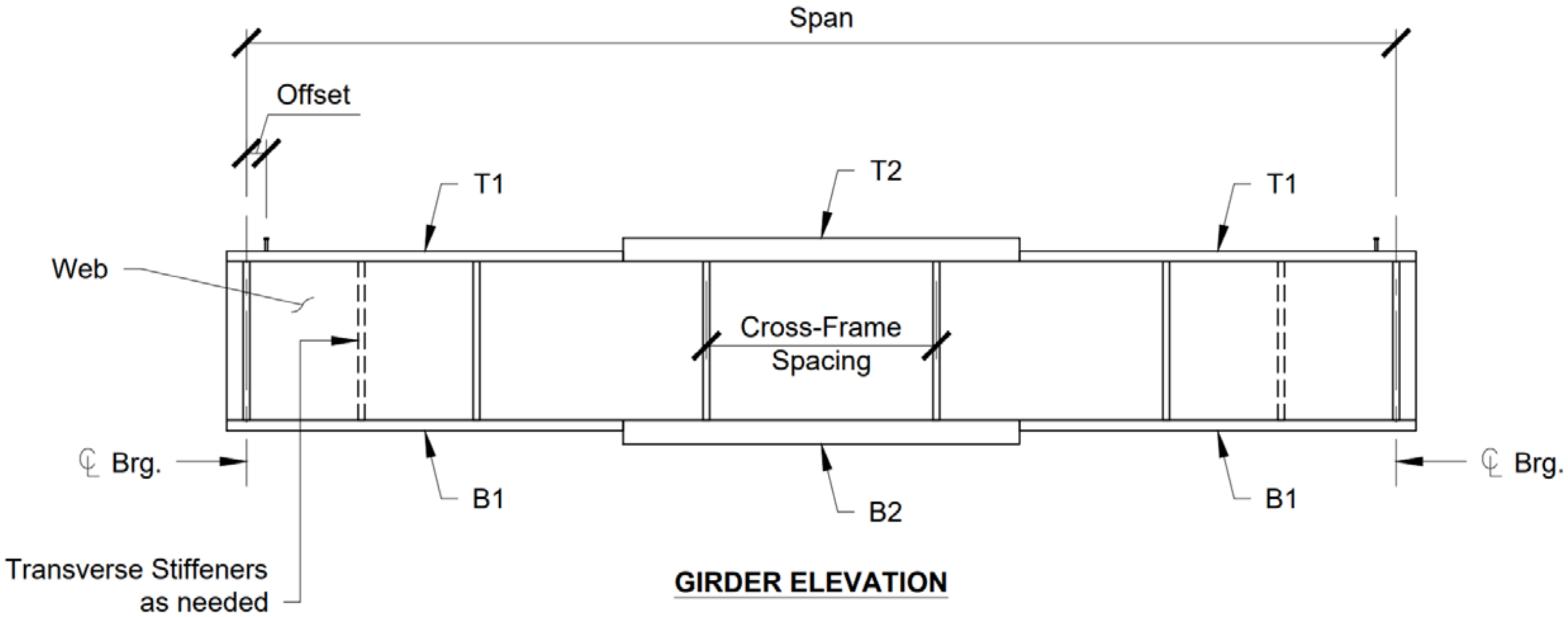
NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995

DECK DETAILS
LONGITUDINAL REINFORCING STEEL TERMINATION, 3-SPAN UNITS

Issued January 2025
Revision 0

Sheet 32 of 32

Special Topic: Multi-Span Bridges with Simple Spans and Link Slabs



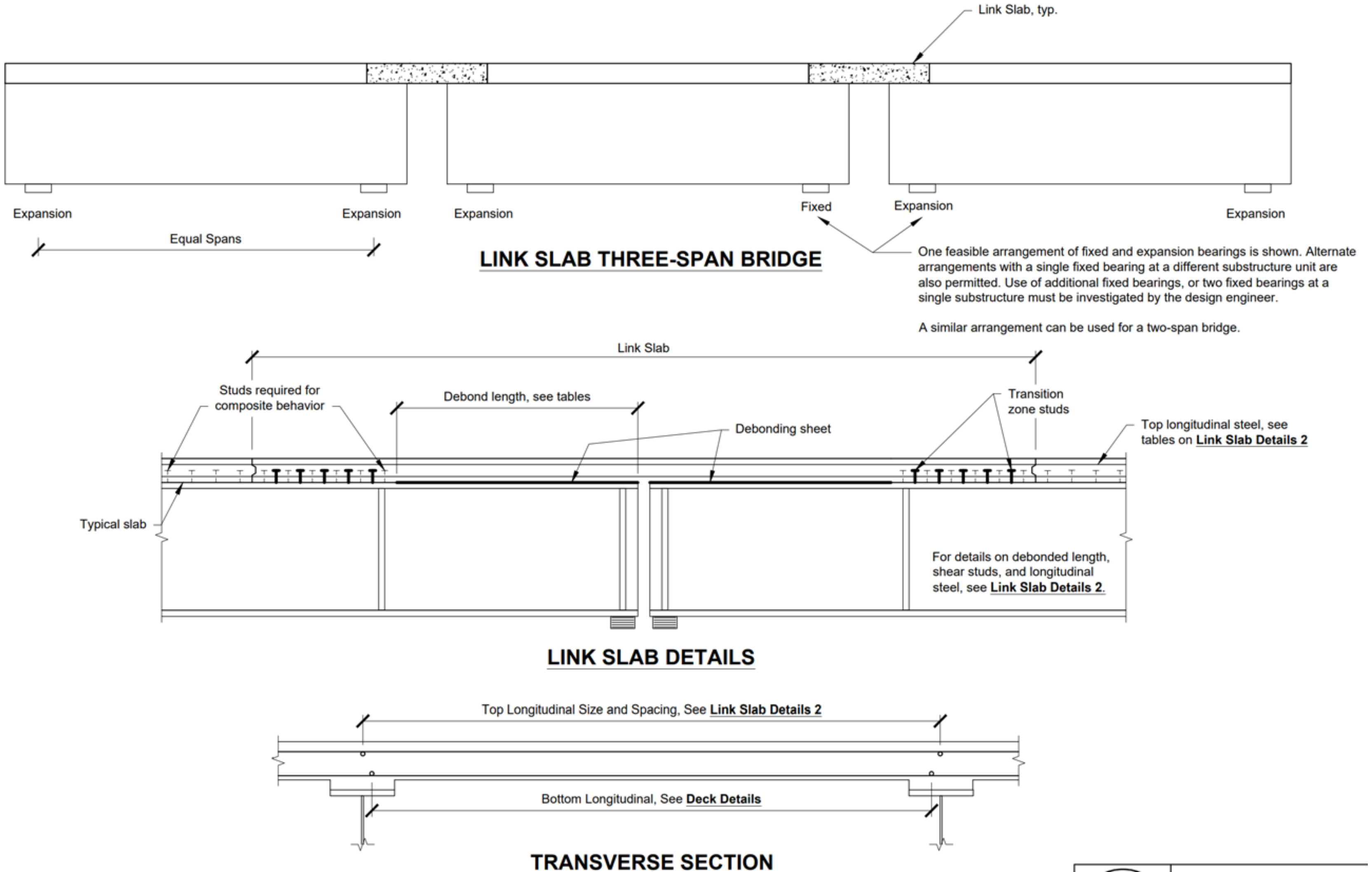
Standard Plans for Steel Bridges

Single Span Bridges and Multi-span Bridges with Link Slabs

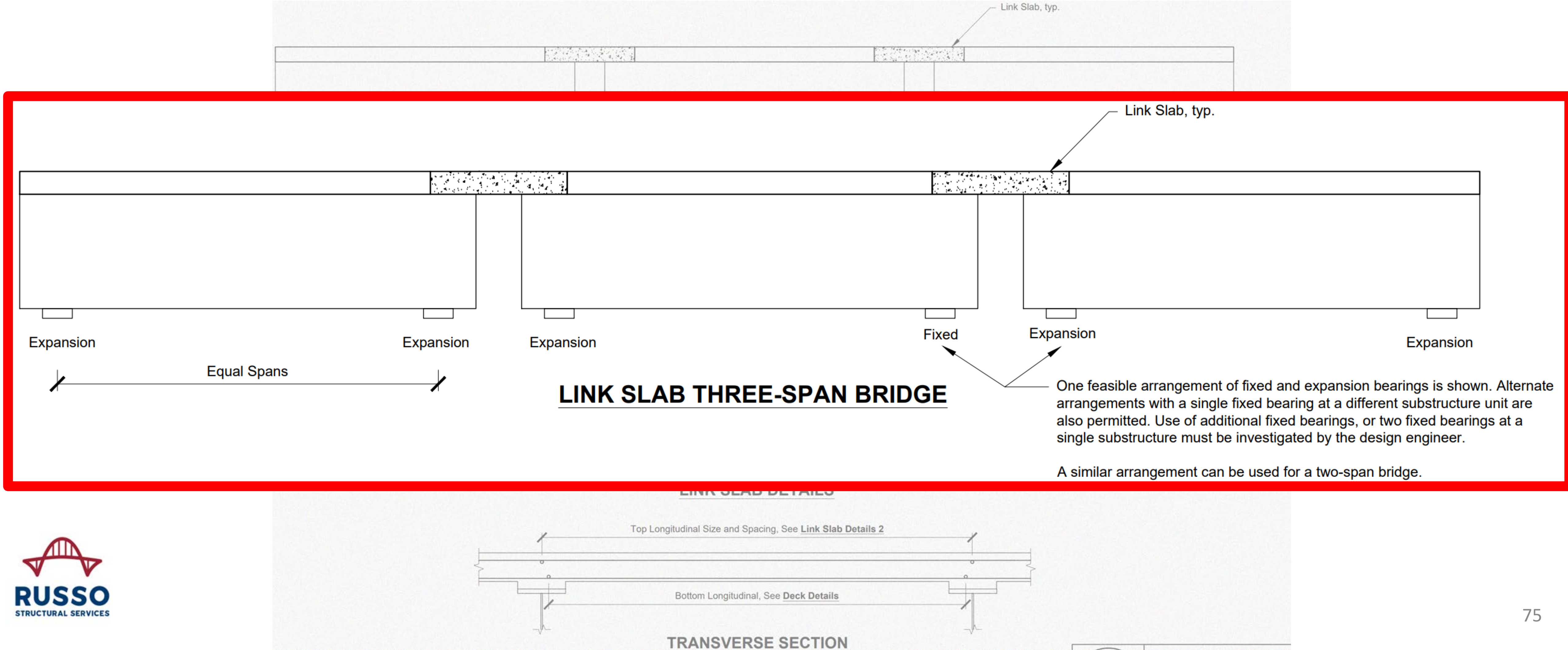
Smarter. Stronger. Steel.

RUSSO STRUCTURAL SERVICES

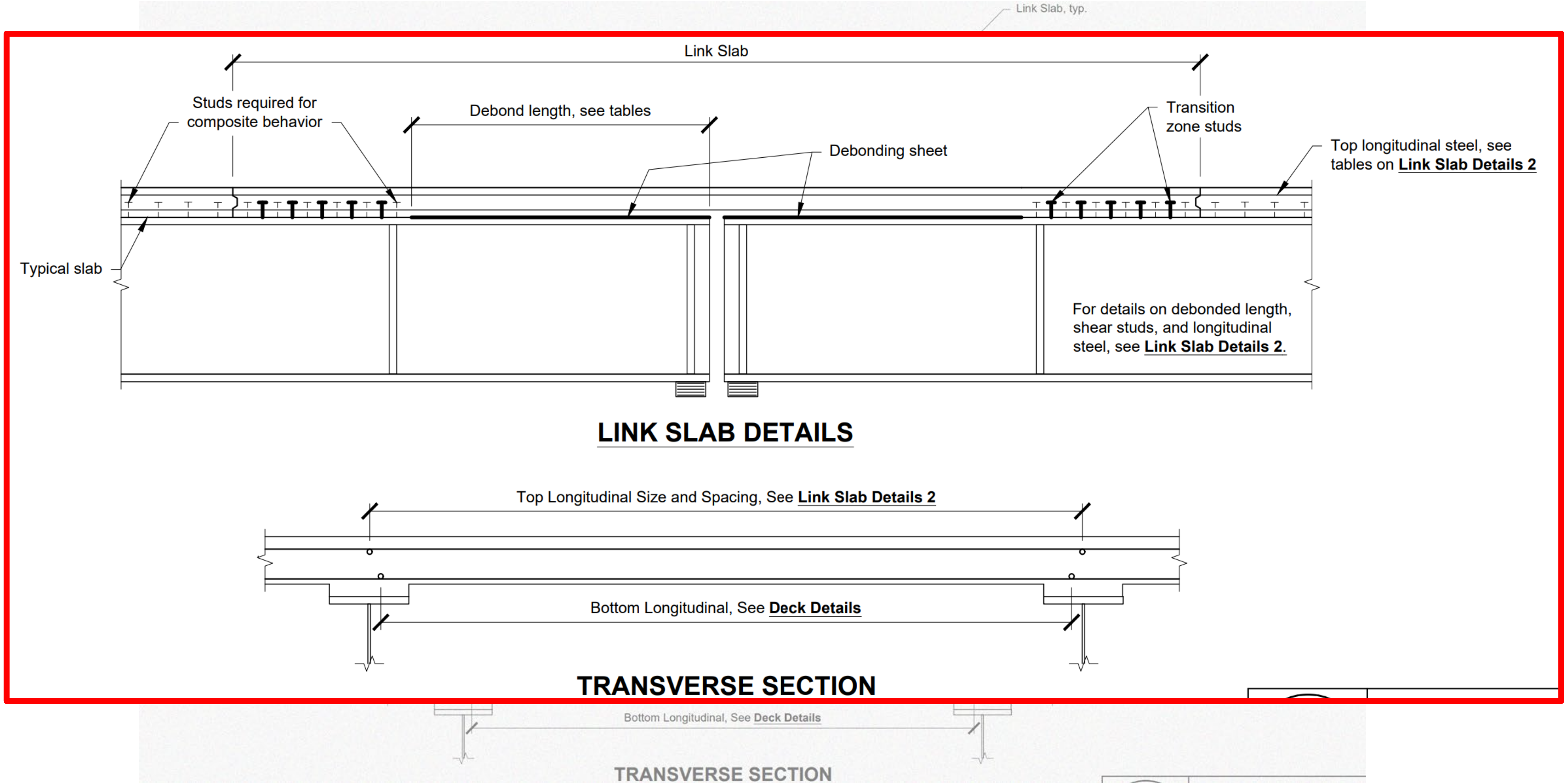
Link Slab Details



Link Slab Details



Link Slab Details



RUSSO STRUCTURAL SERVICES

Link Slab Details

		Span, Ft							
Spacing, Ft	Notes	80	90	100	110	120	130	140	150
8	Top longitudinal bar quantity, size, spacing, in.	2 - #6 @ 5 in.	2 - #6 @ 6 in.	2 - #6 @ 6.5 in.	2 - #6 @ 6.5 in.	2 - #6 @ 6.5 in.	2 - #6 @ 7 in.	2 - #6 @ 7.5 in.	2 - #6 @ 8 in.
	Debond length, each span, Ft	4	4.5	5	5.5	6	6.5	7	7.5
	Transition zone studs, additional rows required	8	7	7	7	4	4	4	4
10	Top longitudinal bar quantity, size, spacing, in.	2 - #6 @ 6 in.	2 - #6 @ 6.5 in.	2 - #6 @ 6.5 in.	2 - #6 @ 6.5 in.	2 - #6 @ 6.5 in.	2 - #6 @ 7.5 in.	2 - #6 @ 7.5 in.	2 - #6 @ 8.5 in.
	Debond length, each span, Ft	4	4.5	5	5.5	6	6.5	7	7.5
	Transition zone studs, additional rows required	9	8	8	8	5	4	4	4

RUSSO STRUCTURAL SERVICES

Conclusions

- Modern, cost-effective, and comprehensive standard plans have been developed
- Simple spans from 80 – 300 ft and continuous spans as long as 300 ft are included
- Four unique beam spacings are covered
- Design of the final beams is performed / checked using NSBA LRFD SIMON
- Extensive checking of stability during deck casting, stresses from overhang brackets, and stresses / deflections under wind load are considered
- Many additional design elements are fully designed and detailed including splices, cross-frames, lateral bracing, and shear connectors
- Designs are “near final” and require only the adaptation to specific site requirements that may differ from the standard plans.

RUSSO
STRUCTURAL SERVICES

Assessment Question 1

- The Standard Plans can be used for

A. Simple and continuous span bridges
B. Beams spacing of 8, 10, 12, 14 ft
C. Simple span bridges converted to continuous units with link slabs
D. All of the above

RUSSO
STRUCTURAL SERVICES

Assessment Question 2

- True or False

A continuous steel bridge of three or or more spans is most economical when all spans are equal

RUSSO
STRUCTURAL SERVICES

Assessment Question 3

- True or False

For an economical steel bridge, engineers should strive to achieve the lightest weight even when that means adding frequent flange plate transitions and transverse stiffeners to thin webs

RUSSO
STRUCTURAL SERVICES

Thank You

FRANCESCO M RUSSO, PHD, PE

FOUNDER & PRINCIPAL

215.266.5623

Frank.Russo@RussoStructural.com

www.RussoStructural.com

RUSSO
STRUCTURAL SERVICES