THE BASICS OF
STEEL BRIDGE DESIGN WORKSHOP

Basics of Bolted Field Splice Design

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Smarter.
Stronger.
Steel.

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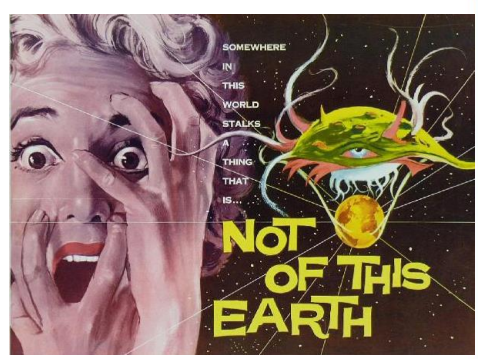
Importance of Good Design

Field Splice
600 Bolts in Web
42 Bolts each Flange
Total 684 bolts



Fabrication: 684 x $20 = $13,680
Erection: 684 x 10 min = 114 field hours each splice

Corman, Roger. (Director). (1957). Not of This Earth [Motion Picture]. United States: Allied Artists.

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Basics of Bolted Field Splice Design

LRFD Specification - Comparison

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LRFD Specification - Comparison

Shear Resistance – AASHTO 6.13.2.7

- Initial Length Reduction
  - Changed from 0.8 to 0.9.
  - Long Joint from 50 to 38 in.
- Bolts with threads excluded from the shear plane:
  - $\mathbf{R_n = 0.56\ A_bF_{ub}N_s}$ (old value 0.48).
- Bolts with threads in the shear plane: (web bolts)
  - $\mathbf{R_n = 0.45\ A_bF_{ub}N_s}$ (old value 0.38).
- Nominal shear resistance in lap tension connections longer than 38 in. taken as 0.83 times the values above.

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LRFD Specification - Comparison

Slip Resistance – AASHTO 6.13.2.8

Class	Typical Surface	7th Edition	8th Edition
A	Mill Scale	0.33	0.30
B	Zinc Rich Paint, Metalized* and Blasted	0.50	0.50
C	Galvanized**	0.33	0.30
D	Organic Zinc Rich	-	0.45

* Unsealed metalized zinc or 85/15 zinc aluminum ($t_{coating}$ ≤ 16 mils). Sealed metalized coatings are not included – must be qualified by test.
** Do not wire brush the surface.

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LRFD Specification - Comparison

Hole Size – AASHTO 6.13.2.4.2

- Maximum hole size in Table 6.13.2.4.2-1 for bolts greater than or equal to 1″ in diameter is increased to the nominal diameter of the bolt plus 1/8″.
- Eliminates need to field ream holes to fit large-diameter hot forged bolts.

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LRFD Specification - Comparison

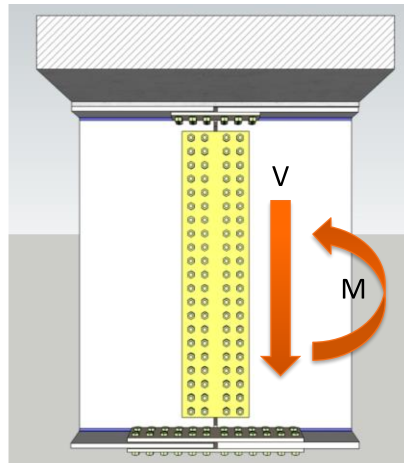
Removed 75 percent and average rules in AASHTO LRFD Article 6.13.1.

Develop the full flange capacity.

- Is it enough to carry factored moment?
- If so… you are done.

Develop the full shear capacity of the web.

- Assign the balance of the moment to the web force.



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LRFD Specification - Overview

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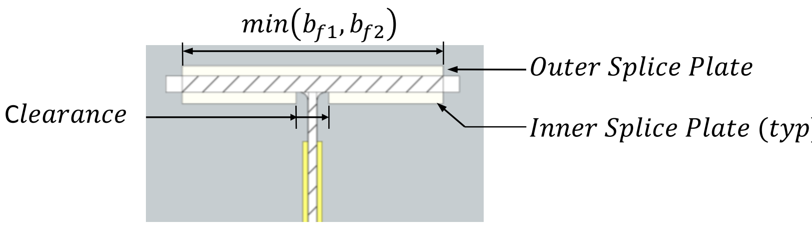
Design Procedure - Overview

Flange Splice Plate Sizing - Width



Girder Section at Splice

Outer Width: $b_{outer} = min(b_{f1}, b_{f2})$

Clearance: $clearance \geq max(t_{w1}, t_{w2}) + 2\left[weld\ size + \frac{1}{8}\right]$

Inner Width: $b_{inner} = \dfrac{b_f - clearance}{2}$

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Design Procedure - Overview

Flange Splice Plate Sizing - Thickness

Thickness: $t_{splice} \geq \left(\frac{t_f}{2}\right) + \frac{1}{16}$

10% Rule: $0.90 b_{outer} t_{outer} \leq 2 b_{inner} t_{inner} \leq 1.1 b_{outer}\ t_{outer}$

$$b_{inner} = \frac{b_f - clearance}{2}$$

$$0.90 t_{outer} \leq \left|1 - \frac{clearance}{b_f}\right| t_{inner} \leq 1.1 t_{outer}$$

$$\therefore Solve\ for\ \ t_{inner}$$

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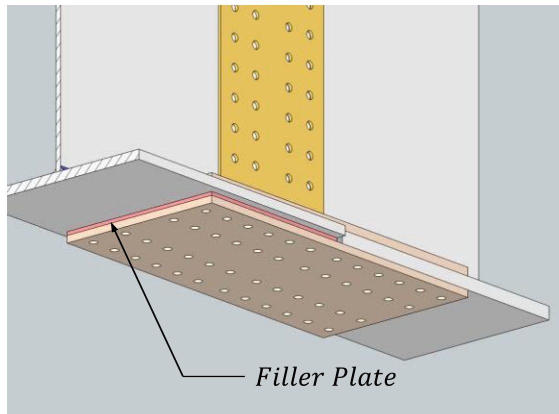
Design Procedure - Overview

Flange Splice Plate Sizing – Filler

- Typical where adjoining plates at the point of splice are different.
- Thickness is difference in thickness of adjoining flange or web plates.
- Reduction factor is applied to bolt shear resistance if filler is ¼" or greater.



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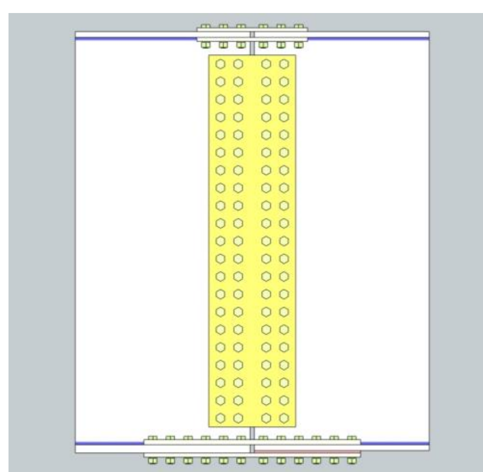
Design Procedure - Overview

Web Splice Plate Sizing

- Symmetrically with plates on each side of web
- Splice plates must extend nearly the full web depth
- No filler plates needed if difference in web thickness is less than 1/16 inch.
- See AASHTO 6.13.6.1.3c



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Design Procedure - Overview

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

Design Flange Connection to Develop the Smallest Design Yield Resistance of the Connected Flanges.

Design Yield Resistance: $P_{fy} = F_{yf} A_e$ 6.13.6.1.3b-1

Effective Flange Area: $A_e = \left(\frac{\phi_u F_u}{\phi_y F_{yf}}\right) A_n \leq A_g$ 6.13.6.1.3b-2

Where: ϕ_u= 0.80 resistance factor for fracture of tension members.
ϕ_y= 0.95 resistance factor for yielding of tension members.
A_n = net area of the flange.
A_g = gross area of the flange.
F_{yf} = yield strength of the flange (Table 6.4.1-1).
F_u = tensile strength of the flange (Table 6.4.1-1).

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Design Procedure - Overview

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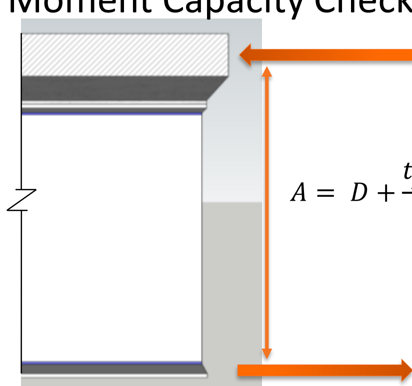
Positive Flange Moment Capacity Check



$$A = D + \frac{t_{ft}}{2} + t_{haunch} + \frac{t_s}{2}$$

$$P_{fy}(bottom) = F_{yf} A_e$$

Moment Resistance:
P_{fy} for the Bottom Flange x Moment Arm to Mid - Depth of Deck
= (F_{yf} x A_e) x A

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Design Procedure - Overview

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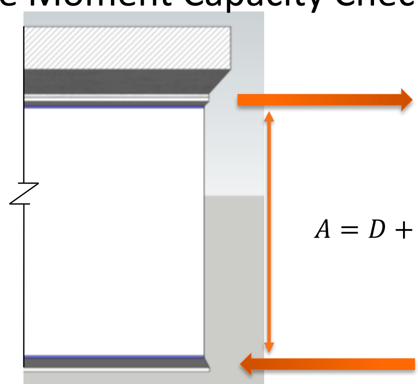
Negative Flange Moment Capacity Check



$$P_{fy}(top) = F_{yf}A_e$$

$$A = D + \frac{t_{ft}}{2} + \frac{t_{fc}}{2}$$

$$P_{fy}(bottom) = F_{yf}A_e$$

Moment Resistance:
Smallest Value of P_{fy} x Distance Between Flange Centroids
= (F_{yf} x A_e) x A

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Design Procedure - Overview

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Flange Splice Bolts

Minimum Number of Bolts: $N_{min} = \frac{P_{fy}}{R_r R}$

Where: P_{fy} = Design yield resistance of the flange.
R_r = Factored shear resistance of the bolts.
R = Reduction factor due to the presence of any filler plates.

Nominal Shear Resistance (Excluded): $R_n = 0.56 A_b F_{ub} N_s$ 6.13.2.7-1

Factored Shear Resistance: $R_r = \phi_s R_n$

Where: A_b = Area of the bolt corresponding to the nominal diameter.
F_{ub} = Minimum tensile strength of the bolt specified (6.4.3.1.1).
N_s = Number of shear planes per bolt (Ns = 2).
ϕ_s = Resistance factor for shear of bolt (0.80).

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Design Procedure - Overview

Design Web Connection to Develop the Smallest Factored Shear Resistance of the Connected Web.

Factored Shear Resistance of Web: $V_r = \phi_v V_n$

Where: ϕ_v= Resistance factor for shear (1.0).
V_n = Nominal shear resistance of the web (6.10.9 or 6.11.9).

Design Procedure - Overview

If Moment From Flanges is Not Sufficient to Resist Factored Design Moment, Calculate Additional Moment to be Provided by the Web.

Web Design Force = Vector sum of smallest factored shear and horizontal force.

$$R = \sqrt{(V_r)^2 + (H_w)^2} = \sqrt{(\phi_v V_n)^2 + (H_w)^2}$$

Where: V_r = Smaller factored shear resistance.
H_w = Horizontal force in the web

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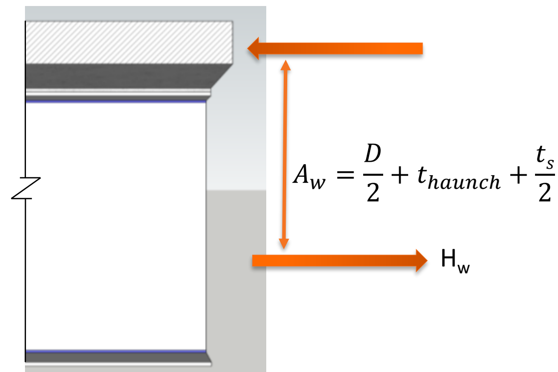
Design Procedure - Overview

Horizontal Web Force

- Composite Section in Positive Bending



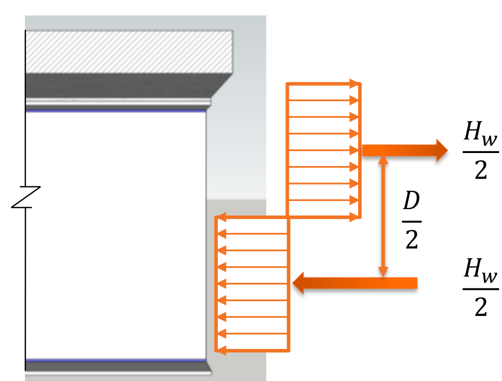
Horizontal Force (H_w)

$$H_w = \frac{Web\ Moment}{A_w}$$

Design Procedure - Overview

Horizontal Web Force

- Composite Section in Negative Bending
- Non-Composite Section



Horizontal Force (H_w)

$$H_w = \frac{Web\ Moment}{D/4}$$

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Design Procedure - Overview

Web Splice Bolts

Minimum Number of Bolts: $N_{min} = \frac{Web\ Design\ Force}{R_r}$

Nominal Shear Resistance (Included): $R_n = 0.45 A_b F_{ub} N_S$ 6.13.2.7-1

Factored Shear Resistance: $R_r = \phi_s R_n$

Where: $Web\ Design\ Force$ = V_r or R.
R_r = Factored shear resistance of the bolts.
ϕ_s = Resistance factor for shear of bolt (0.80).

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Design Procedure - Overview

Anticipated Effect

- Slight increase in flange splice bolts.
- Significant decrease in web splice bolts.
- Overall simplification in the design procedure.
- Easier interpretation of the provisions.
- Faster and more efficient design of field splices
- More consistent and cost-effective designs.

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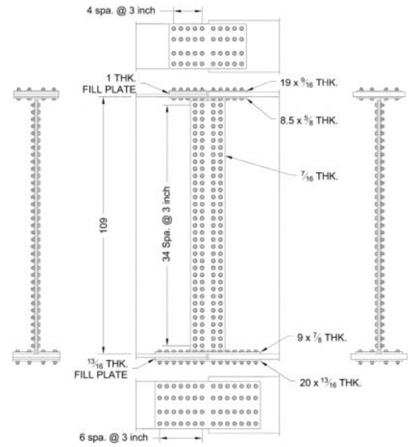
Design Procedure - Overview

	7th Edition	8th Edition
Top Flange	24	20
Web	102	70
Bottom Flange	28	28
Total – Per Side	154	118



Bolts Saved: 72x$20= $1,440
Labor Saved: 72x10 min= 12 field hours each splice

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Basics of Bolted Field Splice Design

Case Study Bridge - Background

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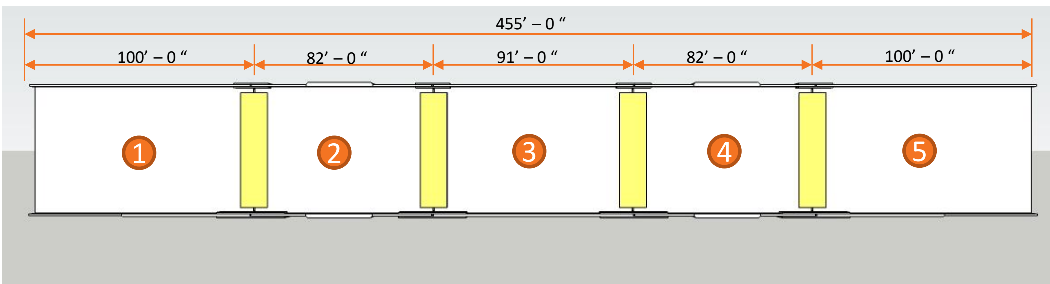
Bolted Field Splice – Case Study Bridge

Five Field Sections



Tip – Field sections should take into consideration common fabrication weight and length capabilities along with shipping and construction limitations. Reference AASHTO/NSBA Steel Bridge Collaboration "G12.1 Guidelines to Design for Constructability".

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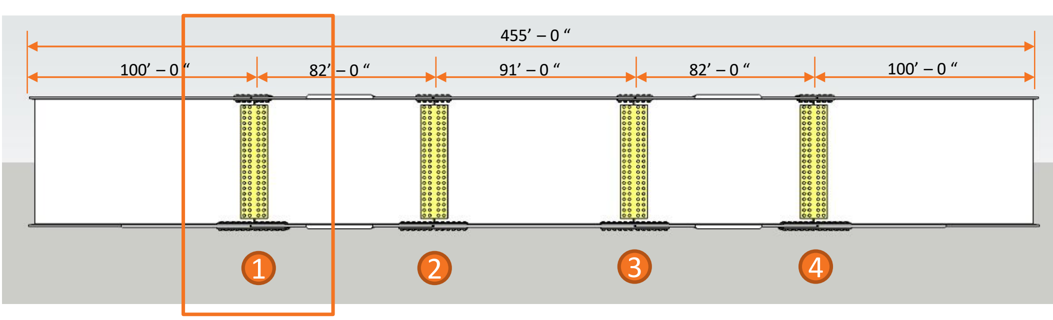
Bolted Field Splice – Case Study Bridge

Four Bolted Field Splices



Tip – Marking field splices as "optional" gives fabricators the discretion of fabricating and shipping less pieces to the field.

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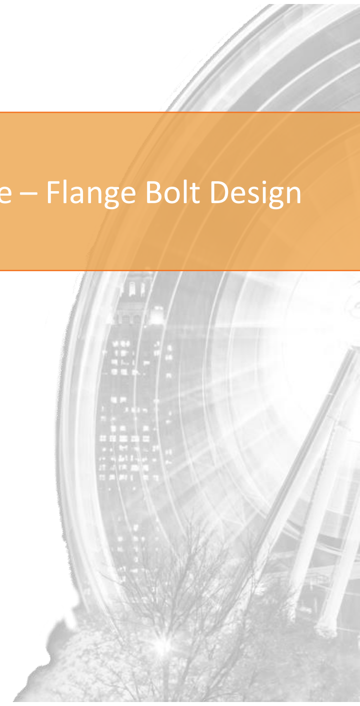
Basics of Bolted Field Splice Design

Case Study Bridge – Flange Bolt Design



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Bolted Field Splice – Case Study Bridge (Flanges)

Material	Grade 50W
Thickness (in)	1
Width (in)	16

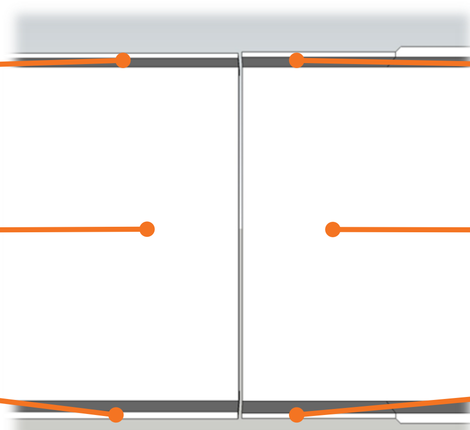
Material	HPS Grade 70W
Thickness (in)	1
Width (in)	18

Material	Grade 50W
Thickness (in)	1/2
Depth (in)	69

Material	Grade 50W
Thickness (in)	9/16
Depth (in)	69

Material	Grade 50W
Thickness (in)	1 3/8
Width (in)	18

Material	HPS Grade 70W
Thickness (in)	1
Width (in)	20



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Bolted Field Splice – Flange Splice Design

Unfactored Design Moments

Load Case	Moment (kip-ft)
Non-composite Dead Load (DC_1)	248.00
Superimposed Composite Dead Load (DC_2)	50.00
Future Wearing Surface (DW)	52.00
Positive Live Load plus Impact ($LL^+ + I$)	2,469.00
Negative Live Load plus Impact ($LL^- + I$)	-1,754.00
Deck Casting	1,300.00

Bolted Field Splice – Flange Splice Design

Factored Moments

Load Case	Moment (kip-ft)
Deck Casting	1,820.00
Strength I - Positive	4,771.25
Strength I - Negative	-2,767.50
Service II - Positive	3,559.70
Service II - Negative	-1,930.20

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Bolted Field Splice – Flange Splice Design

Bolts: F3125 Grade A325

Diameter (in)	7/8
Area (sq-in)	0.6013
P_t (kip)	39
Standard Hole Diameter (in)	15/16
Minimum Edge and End Distance (in)	1 1/8

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Bolted Field Splice – Flange Splice Design

Splice Plates – Top Flange

	Inner	Outer
Splice Plate Material	Grade 50W	
Splice Plate Thickness (in)	11/16	5/8
Splice Plate Width (in)	7	16
Total A_{gross} (sq-in)	9.62	10.00
% Difference Ag Inner/Outer Area	3.82%	
Shear Planes per Bolt (N_s)	2	

Tip – Where the areas of the inside and outside flange splice plates do not differ by more than 10 percent, the connections may then be proportioned for the total flange design force assuming double shear.

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Bolted Field Splice – Flange Splice Design

Flange Design Yield Resistance – Top Flange

Design Yield Resistance: $P_{fy} = F_{yf} A_e$ 6.13.6.1.3b-1

Effective Flange Area: $A_e = \left(\frac{\phi_u F_u}{\phi_y F_{yf}}\right) A_n \leq A_g$ 6.13.6.1.3b-2

$$A_e = \left(\frac{0.80(70.0)}{0.95(50.0)}\right)\left[16 - 4\left({}^{15}/_{16}\right)\right](1.0) = 14.41\ in^2$$

$A_g = [16.0(1.0)] = 16.0\ in^2$ $\therefore A_e = 14.41\ in^2$

P_{fy} = 50.0(14.41) = 720.50 kips

Tip – Left side of the splice has the smaller design yield resistance (i.e., the top flange on the left side has a smaller area and lower yield strength).

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Bolted Field Splice – Flange Splice Design

Number of Bolts Required (Strength) – Top Flange

Nominal Shear Resistance (Excluded): $R_n = 0.56 A_b F_{ub} N_S$ 6.13.2.7-1

Factored Shear Resistance: $R_r = \phi_s R_n$

Bolts Required: N = ${}^{P_{fy}}/_{R_r}$

$R_n = 0.56(0.6013)(120)(2) =$ 80.81 kip

$R_r = 0.80(80.81) = 64.65\ kip$

N = ${}^{720.5}/_{64.65} = 11.14$

$\therefore$ *Use 4 Rows with 3 Bolts Per Row Per Side*

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

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Bolted Field Splice – Flange Splice Design

Splice Plates – Bottom Flange

	Inner	Outer
Splice Plate Material	Grade 50W	
Splice Plate Thickness (in)	7/8	3/4
Splice Plate Width (in)	8	18
Total A_{gross} (sq-in)	14.00	13.50
% Difference Ag Inner/Outer Area	3.64%	
Shear Planes per Bolt (N_s)	2	

Tip – The width of the outside splice plate should be at least as wide as the width of the narrowest flange at the splice.

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Bolted Field Splice – Flange Splice Design

Flange Design Yield Resistance – Bottom Flange

Left Side $A_e = \left(\frac{0.80(70.0)}{0.95(50.0)}\right)\left[18 - 4\left({}^{15}/_{16}\right)\right](1.375) = 23.10\ in^2$

$A_g = [18.0(1.375)] = 24.75\ in^2$ $\therefore A_e = 23.10\ in^2$

P_{fy} = 50.0(23.10) = 1,155.00 kips

Right Side $A_e = \left(\frac{0.80(85.0)}{0.95(70.0)}\right)\left[20 - 4\left({}^{15}/_{16}\right)\right](1.0) = 16.61\ in^2$

$A_g = [20.0(1.0)] = 20.00\ in^2$ $\therefore A_e = 16.61\ in^2$

P_{fy} = 70.0(16.61) = 1,162.70 kips

Tip – Filler plates are typical where adjoining plates at the point of splice are different. A reduction factor is applied to the bolt shear resistance where filler is ¼ in or greater (6.13.6.1.4).

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Bolted Field Splice – Flange Splice Design

Filler Plate Reduction – Bottom Flange

$$Filler\ Thickness = (69.0 + 1.0 + 1.375) - (69.0 + 1.0 + 1.0) = 0.375\ in$$

Filler Plate Reduction Factor: $R_f = \left[\dfrac{(1+\gamma)}{(1+2\gamma)}\right]$ 6.13.6.1.4-1

$$\gamma = {A_f}/{A_p} = {18.0\ (0.375)}/{(20.0(1.0))} = 0.338$$

$$R_f = \left[\frac{(1+0.338)}{(1+2(0.338))}\right] = 0.798$$

Tip – Adjacent girders are web centered, so the filler plate is the difference in height. If the girders were aligned differently, inner and outer filler plates may be necessary.

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Bolted Field Splice – Flange Splice Design

Number of Bolts Required (Strength) – Bottom Flange

$$R_n = 0.56(0.6013)(120)(2) = 80.81\ \text{kip}$$

$$R_r = 0.80(80.81) = 64.65\ kip$$

$$R_f = 0.798$$

$$N = \frac{P_{fy}}{R_f(R_r)} = \frac{1155.00}{0.798(64.65)} = 22.39$$

$$\therefore Use\ 4\ Rows\ with\ 6\ Bolts\ Per\ Row\ Per\ Side$$

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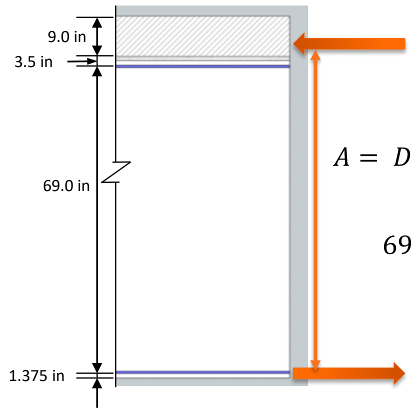
Bolted Field Splice – Flange Splice Design

Moment Resistance - Positive



$$A = D + \frac{t_{ft}}{2} + t_{haunch} + \frac{t_s}{2}$$

$$69.00 + \frac{1.375}{2} + 3.5 + \frac{9.0}{2} = 77.69\ in$$

$$P_{fy}(bottom) = 1{,}155\ kips$$

M_{flange} = P_{fy} (A/12) > |Strength I - Positive (kip-ft)|
1,155(77.69/12) = 7,477 kip-ft > |4,771 kip-ft|

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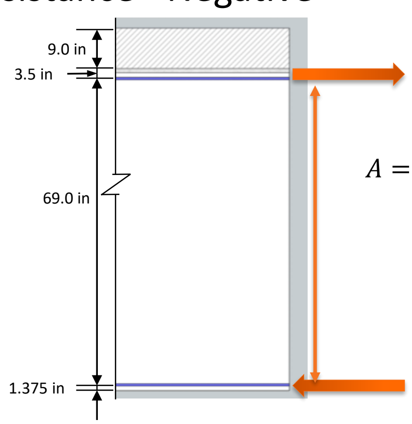
Bolted Field Splice – Flange Splice Design

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

Moment Resistance - Negative



$$P_{fy}(top) = 720.50\ kips$$

$$A = D + \frac{t_{ft}}{2} + \frac{t_{fc}}{2}$$

$$69.00 + \frac{1.0}{2} + \frac{1.375}{2} = 70.19\ in$$

$$P_{fy}(bottom) = 1{,}155.00\ kips$$

M_{flange} = P_{fy} (A/12) > |Strength I - Negative (kip-ft)|
720(70.19/12) = 4,211 kip-ft > |-2,767 kip feet|

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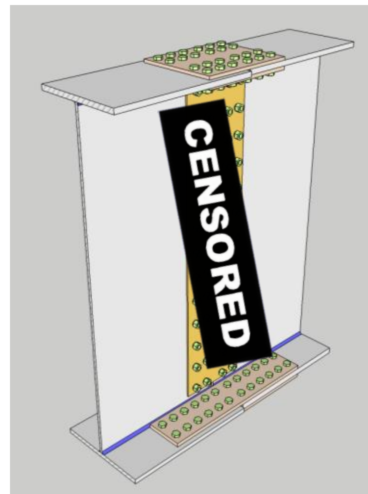
Bolted Field Splice – Flange Splice Design

Summary

Flange	Bolt Rows (Per Side)	Total Bolts (Per Side)
Top	4	12
Bottom	4	24

Additional Considerations

- Factored Yield Resistance - Tension
- Net Section to Gross Section Check - Tension
- Net Section Fracture Resistance - Tension
- Block Shear Rupture Resistance – Splice Plates
- Block Shear Rupture Resistance – Girder
- Bearing Resistance Check
- Slip Resistance
- Entering and Tightening Clearances



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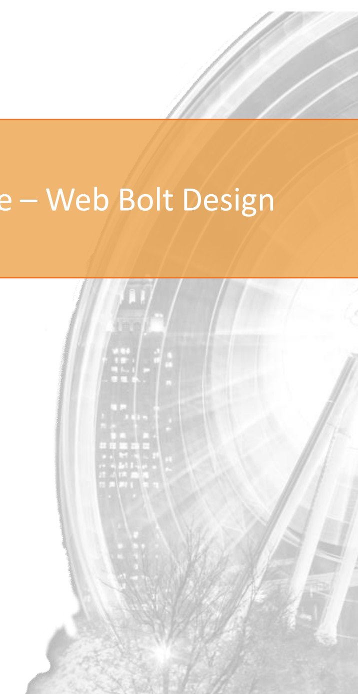
Basics of Bolted Field Splice Design

Case Study Bridge – Web Bolt Design



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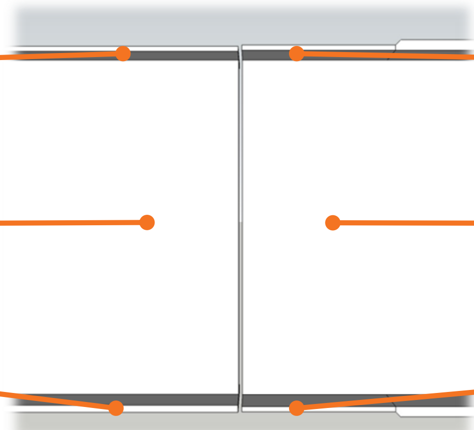
Bolted Field Splice – Case Study Bridge (Web)

Material	Grade 50W
Thickness (in)	1
Width (in)	16

Material	HPS Grade 70W
Thickness (in)	1
Width (in)	18

Material	Grade 50W
Thickness (in)	1/2
Depth (in)	69

Material	Grade 50W
Thickness (in)	9/16
Depth (in)	69



Material	Grade 50W
Thickness (in)	1 3/8
Width (in)	18

Material	HPS Grade 70W
Thickness (in)	1
Width (in)	20

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THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

Bolted Field Splice – Web Splice Design

Unfactored Design Shears

Load Case	Shear (kip)
Non-composite Dead Load (DC_1)	-82.00
Superimposed Composite Dead Load (DC_2)	-12.00
Future Wearing Surface (DW)	-11.00
Positive Live Load plus Impact (LL^+ + I)	19.00
Negative Live Load plus Impact (LL^- + I)	-112.00
Deck Casting	-82.00

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Bolted Field Splice – Web Splice Design

Factored Shears

Load Case	Shear (kip)
Deck Casting	-114.80
Service II - Positive	-80.30
Service II - Negative	-250.60

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Bolted Field Splice – Web Splice Design

Bolts: F3125 Grade A325

Diameter (in)	7/8
Area (sq-in)	0.6013
P_t (kip)	39
Standard Hole Diameter (in)	15/16
Minimum Edge and End Distance (in)	1 1/8

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Bolted Field Splice – Web Splice Design

Number of Bolts Required (Strength)

Factored Shear Resistance: $V_r = \phi_v V_n$

Web Depth: 69 in
Left Web Thickness: 1/2 in
A_{gross} = 34.50 sq-in
E = 29,000 ksi
F_y = 50 ksi
Transverse-stiffener spacing: 17' – 3"

$$V_r = 1.0(468) = \boxed{468\ kips}$$

0.00

$$R = \sqrt{(V_r)^2 + (H_w)^2} = 468\ kips$$

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

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Design Procedure - Web Splice Design

Number of Bolts Required (Strength)

Nominal Shear Resistance (Included): $R_n = 0.45 A_b F_{ub} N_s$ 6.13.2.7-1

Factored Shear Resistance: $R_r = \phi_s R_n$

Bolts Required: $N = V_r / R_r$

Are we done?

$R_n = 0.45(0.6013)(120)(2) =$ 64.94 kip

$R_r = 0.80(64.94) = 51.95\ kip$

$$N = \frac{V_r}{R_r} = \frac{468}{51.95} = 9.00$$

$\therefore$ *Use 2 Rows with 5 Bolts Per Row Per Side*

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

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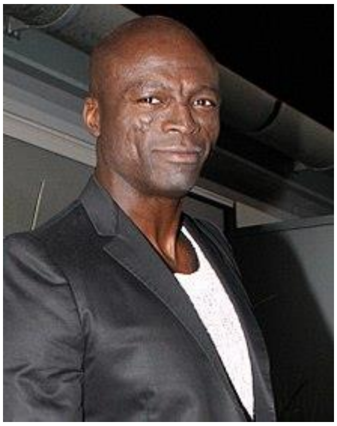
Bolted Field Splice – Web Splice Design

Number of Bolts Required (Seal)



Rinaldi, Eva. (Photographer). (2012). Seal at the The Voice Judges, Celebrities Dine At Bondi Icebergs Dining Room and Bar, Sydney, Australia [Photograph]. Retrieved April 28, 2020, from http://www.flickr.com/photos/evarinaldiphotography/7170014610/.
Turner, Neal. (Photographer). (2011). Sea Lions [Photograph]. Retrieved April 28, 2020, from https://www.flickr.com/photos/neilt/5407955495/.

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

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Bolted Field Splice – Web Splice Design

Number of Bolts Required (Seal)

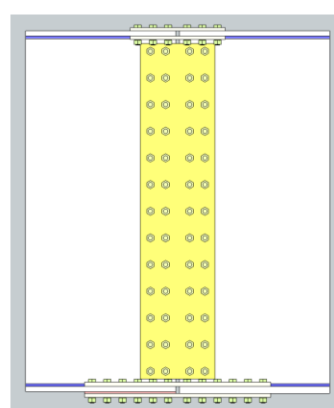
$s \leq 4.0 + 4t \leq 7.00\ in$ 6.13.2.6.2

$$t_{splice} \geq \left(\frac{t_w}{2}\right) + \frac{1}{16} = \frac{1}{2}\left[\frac{1}{2}\right] + \frac{1}{16} = \frac{5}{16}\ in$$

$$s_{max} \leq 4.0 + 4\left[\frac{5}{16}\right] = 5.25\ in$$

$$N_{min} = 1 + \left[\frac{69 - 2(3)}{5.25}\right] = 13\ (per\ row)$$

$\therefore\ Use\ 2\ Rows\ with\ 13\ Bolts\ Per\ Row\ Per\ Side$



Web Splice - Final

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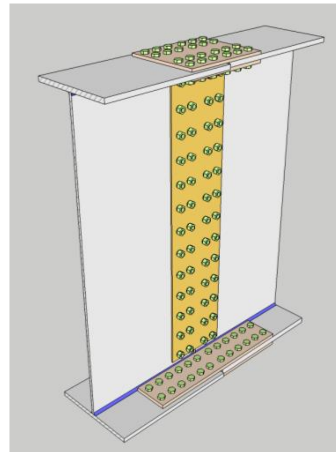
Bolted Field Splice – Web Splice Design

Summary

Bolt Rows (Per Side)	Total Bolts (Per Side)
2	26

Additional Considerations

- Factored Shear Yielding Resistance
- Factored Shear Rupture Resistance
- Block Shear Rupture Resistance - Splice Plates
- Bearing Resistance
- Slip Resistance
- Entering and Tightening Clearances



Splice - Final

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

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Basics of Bolted Field Splice Design

Designer Resources for Bolted Splices

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Designer Resources – Excel Spreadsheet

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

NSBA Bolted Splice Designer - Plate Girder

NOTICE: DO NOT MODIFY THIS SHEET

Web Calculations

Load Combinations - Factored Shear

	Shear (kip)						
	Noncomposite Dead Load (DC1)	Superimposed Composite Dead Load (DC2)	Future Wearing Surface (DW)	Positive Live Load plus Impact (LL+ + I)	Negative Live Load plus Impact (LL- + I)	Deck Casting	
Load Combination	-82.00	-12.00	-11.00	19.00	-112.00	-82.00	Factored Shear (kip)
Deck Casting	0.00	0.00	0.00	0.00	0.00	1.40	-114.80
Service II - Positive	1.00	1.00	1.00	1.30	0.00	0.00	-80.30
Service II - Negative	1.00	1.00	1.00	0.00	1.30	0.00	-250.60

Bolt Factored Shear Resistance

Location	Bolt Type	Bolt Area (sq-in)	K_h	ϕ_s	F_u (ksi)	P_t (kip)	R_r - Single Shear (kip)	R
Web	A325 - Included	0.6013	Standard	0.80	120	39.00	25.98	

Bolt Nominal Slip Resistance

Faying Surface Class (K_s)	Hole Size Factor (K_h)	P_t (kip)	Slip Capacity - Double (kip)
0.50	1.00	39.00	39.00

Flange Design Results

Flange Moment Resistance Check Results

	H_w (kip)	Controlling
Positive	DNA	
Negative	DNA	

EULA | Input | Figures | Design Result Summary | Design Check Summary | Flange Splice Design | **Web Splice Design**

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Designer Resources – Excel Spreadsheet

THE BASICS OF STEEL BRIDGE DESIGN WORKSHOP

New Feature - Results Override

Miscellaneous Properties

Splice Plate Hole Method	Drilled - Full Size
Transverse Stiffener Spacing (d_o) (ft)	17.2500
Alignment Mode	Web Center

Bolt Count Overrides

	Count Override Status	Bolt Count - Calculated	Bolt Count - User Specified	Valid Override
Top Flange Bolt Count Override	User Specified	12	12	OK
Web Bolt Count Override	Spreadsheet Calculated	26		DNA
Bottom Flange Bolt Count Override	Spreadsheet Calculated	24		DNA

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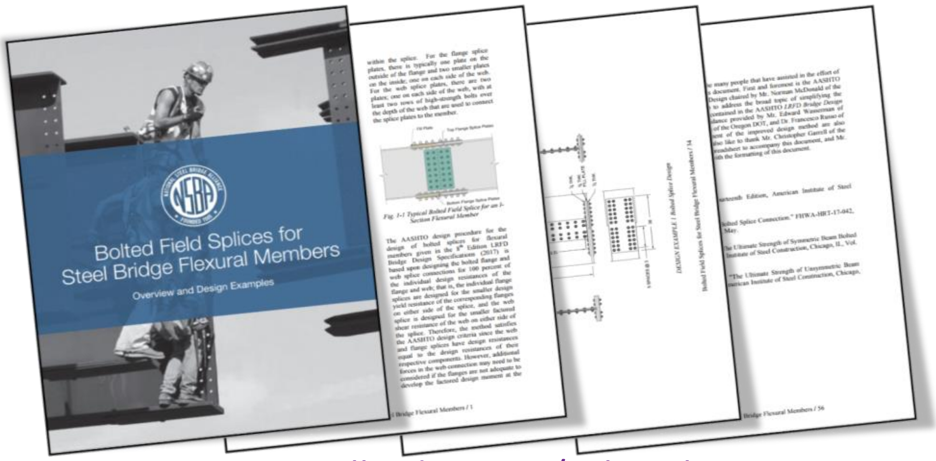
Designer Resources – Design Guide



www.steelbridges.org/nsbasplice

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