**PID 124818**

**Harrison Rd. Over I-70 Bridge Repairs**

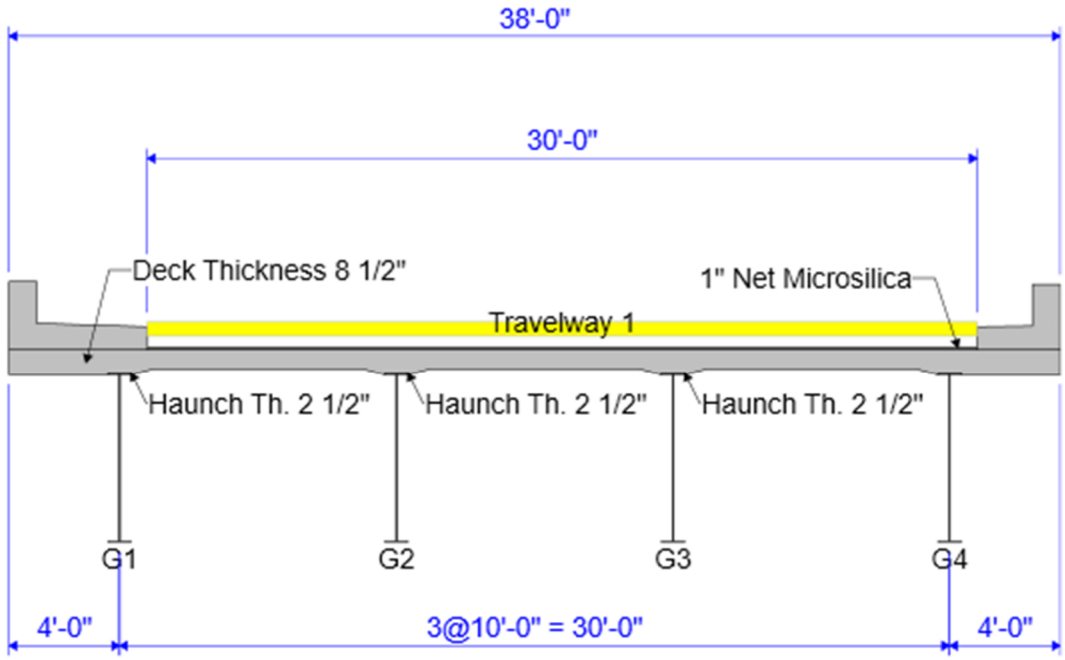
**Cracked Bottom Flange Splice Design**

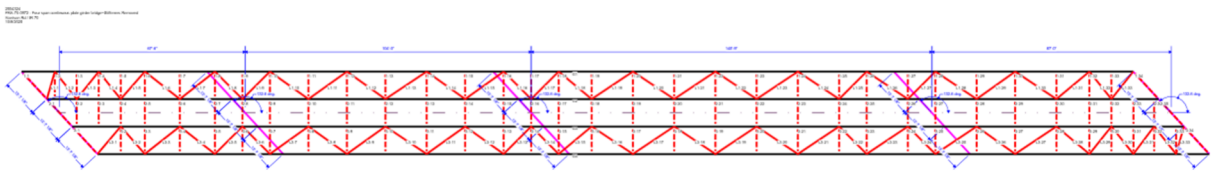
**Billy Hernandez PE 88345**

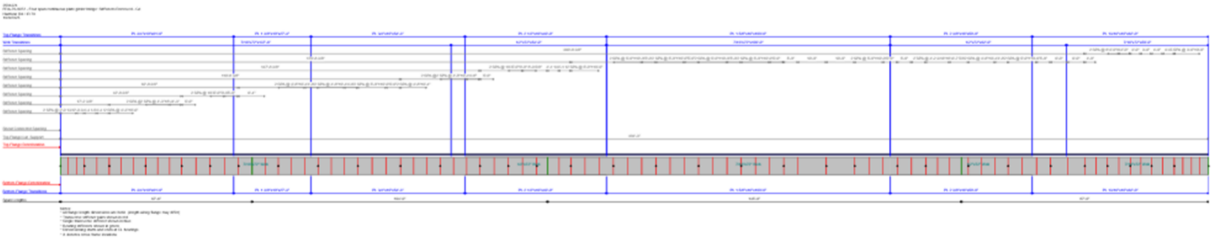
## Design Forces:

Analysis completed using a BrDR model:

2504324
FRA-70-0972 - Four span continuous plate girder bridge~Stiffeners Removed
Harrison Rd / IR 70
10/8/2025





Splice 1 DL:

| WEB PLATES | Height | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Main | 70.000 | 14.500 | 0.375 | 2 | 0.220 |
| Filler(s) | | | | 0 | 0.000 |
| | | | sub total weight | | 0.220 Kips |

Height/Length/Width entries are to be in inches

| TOP FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 35.500 | 10.000 | 0.438 | 1 | 0.045 |
| Flange Plates | 35.500 | 4.000 | 0.500 | 2 | 0.041 |
| Cover Filler | 17.750 | 10.000 | 0.625 | 1 | 0.032 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.118 Kips |

| Input | |
|---|---|
| Fixed | |
| Computed | |
| Total Wt | |

| BOTTOM FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 35.500 | 10.000 | 0.438 | 1 | 0.045 |
| Flange Plates | 35.500 | 4.000 | 0.500 | 2 | 0.041 |
| Cover Filler | 17.750 | 10.000 | 0.625 | 1 | 0.032 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.118 Kips |

| BOLTS | |
|---|---|
| Diameter (in) | 1.000 |
| Wt/Bolt (lbs)* | 1.50 |
| Number | 120 |
| sub total weight | 0.180 Kips |

*Typical weight/bolt values (heavy hex, 2 washers, one nut):
1" diameter use 1.5 lbs each
7/8" diameter use 1.1 lbs each

OR compute your own at:
http://www.portlandbolt.com/technical/tools/bolt-weight-calculator/

TOTAL SPLICE WEIGHT = 0.637 Kips

Splice 2 DL:

| WEB PLATES | Height | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Main | 70.000 | 14.500 | 0.375 | 2 | 0.220 |
| Filler(s) | | | | 0 | 0.000 |
| | | | sub total weight | | 0.220 Kips |

Height/Length/Width entries are to be in inches

| TOP FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 42.500 | 16.000 | 0.688 | 1 | 0.135 |
| Flange Plates | 42.500 | 7.000 | 0.750 | 2 | 0.129 |
| Cover Filler | 21.250 | 16.000 | 0.875 | 1 | 0.086 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.350 Kips |

| Input | |
|---|---|
| Fixed | |
| Computed | |
| Total Wt | |

| BOTTOM FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 42.500 | 16.000 | 0.688 | 1 | 0.135 |
| Flange Plates | 42.500 | 7.000 | 0.750 | 2 | 0.129 |
| Cover Filler | 21.250 | 16.000 | 0.875 | 1 | 0.086 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.350 Kips |

| BOLTS | |
|---|---|
| Diameter (in) | 1.000 |
| Wt/Bolt (lbs)* | 1.50 |
| Number | 176 |
| sub total weight | 0.264 Kips |

*Typical weight/bolt values (heavy hex, 2 washers, one nut):
1" diameter use 1.5 lbs each
7/8" diameter use 1.1 lbs each

OR compute your own at:
http://www.portlandbolt.com/technical/tools/bolt-weight-calculator/

TOTAL SPLICE WEIGHT = 1.185 Kips

Splice 3 DL:

| WEB PLATES | Height | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Main | 70.000 | 14.500 | 0.375 | 2 | 0.220 |
| Filler(s) | | | | 0 | 0.000 |
| | | | sub total weight | | 0.220 Kips |

Height/Length/Width entries are to be in inches

| TOP FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 42.500 | 16.000 | 0.688 | 1 | 0.135 |
| Flange Plates | 42.500 | 7.000 | 0.750 | 2 | 0.129 |
| Cover Filler | 21.250 | 16.000 | 0.750 | 1 | 0.074 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.338 Kips |

| | |
|---|---|
| Input | |
| Fixed | |
| Computed | |
| Total Wt | |

| BOTTOM FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 42.500 | 16.000 | 0.688 | 1 | 0.135 |
| Flange Plates | 42.500 | 7.000 | 0.750 | 2 | 0.129 |
| Cover Filler | 21.250 | 16.000 | 0.750 | 1 | 0.074 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.338 Kips |

| BOLTS | |
|---|---|
| Diameter (in) | 1.000 |
| Wt/Bolt (lbs)* | 1.50 |
| Number | 176 |
| sub total weight | 0.264 Kips |

*Typical weight/bolt values (heavy hex, 2 washers, one nut):
1" diameter use 1.5 lbs each
7/8" diameter use 1.1 lbs each

OR compute your own at:
http://www.portlandbolt.com/technical/tools/bolt-weight-calculator/

TOTAL SPLICE WEIGHT = 1.161 Kips

Splice 4 DL:

| WEB PLATES | Height | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Main | 70.000 | 14.500 | 0.375 | 2 | 0.220 |
| Filler(s) | | | | 0 | 0.000 |
| | | | sub total weight | | 0.220 Kips |

Height/Length/Width entries are to be in inches

| TOP FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 35.500 | 10.000 | 0.438 | 1 | 0.045 |
| Flange Plates | 35.500 | 4.000 | 0.500 | 2 | 0.041 |
| Cover Filler | | | | 1 | 0.000 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.086 Kips |

Input
Fixed
Computed
Total Wt

| BOTTOM FLANGE | Length | Width | Thickness | Number | Weight (Kips) |
|---|---|---|---|---|---|
| Cover Plate | 35.500 | 10.000 | 0.438 | 1 | 0.045 |
| Flange Plates | 35.500 | 4.000 | 0.500 | 2 | 0.041 |
| Cover Filler | | | | 1 | 0.000 |
| Flange Filler(s) | | | | 2 | 0.000 |
| | | | sub total weight | | 0.086 Kips |

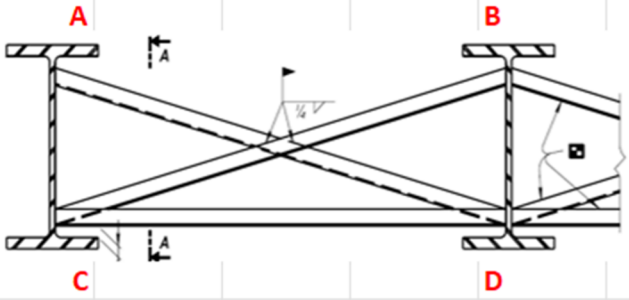
| BOLTS | |
|---|---|
| Diameter (in) | 1.000 |
| Wt/Bolt (lbs)* | 1.50 |
| Number | 120 |
| sub total weight | 0.180 Kips |

*Typical weight/bolt values (heavy hex, 2 washers, one nut):
1" diameter use 1.5 lbs each
7/8" diameter use 1.1 lbs each

OR compute your own at:
http://www.portlandbolt.com/technical/tools/bolt-weight-calculator/

TOTAL SPLICE WEIGHT = 0.572 Kips

Intermediate Diaphragms DL:




Comments:

Weight of Steel = 490 lb/ft^3

| Member Shape | | | | | |
|---|---|---|---|---|---|
| a (in) | x | b (in) | x | t (in) | Section Weight per FT (lbs) |
| 3 | x | 3 | x | 0.3125 | 6.0479 |

| Girder Properties | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spacing between Girders (ft) (CD) | Depth of Girder (in) | Web Thickness | Top Flange Thickness (in) | Bottom Flange Thickness (in) | Distance from Top of Web (in) | Distance from Bottom of Web (in) | Calculated Length of AD and CB (in) | Calculated Length of CD (in) |
| 10 | 72 | 0.4375 | 2.5 | 2.5 | 0 | 6 | 134.224 | 119.563 |

| Total Weight of Diaphram Without AB | |
|---|---|
| lbs | kips |
| 195.6 | 0.1956 |

| Total Weight of Diaphram With AB | |
|---|---|
| lbs | kips |
| 255.8 | 0.2558 |

Additional Dead Load due to bracing was applied as point loads with half of each brace applied at the connection point.

$$Py := \left( \frac{\sqrt[2]{S_1^{\,2} + 10^2}}{2} + \frac{\sqrt[2]{S_2^{\,2} + 10^2}}{2} \right) \cdot 20 + 19.14$$

20 is the nominal weight of the ST shape

19.14 is the weight of the connection plate at each bracing location

S1=Spacing to the previous cross frame

S2=Spacing to the next cross frame

| Horizontal connection Plate for Bracing | | | | | |
|---|---|---|---|---|---|
| | | Width | Thickness | Length | Weight |
| 490 | lb/cf | 9 | 0.5 | 15 | 19.14063 |

| G1 | XFrame1 | XFrame2 | Distance | Px | Py | M | Description |
|---|---|---|---|---|---|---|---|
| 1 | 2.8562 | 8 | 12.0578 | | 0.251 | | Bracing + Attachment Plate |
| 2 | 8 | 8 | 28.0578 | | 0.275 | | Bracing + Attachment Plate |
| 3 | 8 | 8.75 | 44.8078 | | 0.314 | | Bracing + Attachment Plate |
| 4 | 12.75 | 12.75 | 70.3078 | | 0.323 | | Bracing + Attachment Plate |
| 5 | 10 | 10 | 90.3078 | | 0.333 | | Bracing + Attachment Plate |
| 6 | 14 | 14 | 118.3078 | | 0.363 | | Bracing + Attachment Plate |
| 7 | 14 | 15 | 147.3078 | | 0.371 | | Bracing + Attachment Plate |
| 8 | 14 | 14 | 175.3078 | | 0.333 | | Bracing + Attachment Plate |
| 9 | 10 | 10 | 195.3078 | | 0.317 | | Bracing + Attachment Plate |
| 10 | 12 | 15 | 222.3078 | | 0.380 | | Bracing + Attachment Plate |
| 11 | 15 | 15 | 252.3078 | | 0.380 | | Bracing + Attachment Plate |
| 12 | 15 | 15 | 282.3078 | | 0.380 | | Bracing + Attachment Plate |
| 13 | 15 | 10 | 307.3078 | | 0.341 | | Bracing + Attachment Plate |
| 14 | 15 | 10 | 332.3078 | | 0.341 | | Bracing + Attachment Plate |
| 15 | 15 | 14 | 361.3078 | | 0.371 | | Bracing + Attachment Plate |
| 16 | 15 | 12 | 388.3078 | | 0.303 | | Bracing + Attachment Plate |
| 17 | 8 | 7.9422 | 404.25 | | 0.247 | | Bracing + Attachment Plate |
| 18 | | | 88.25 | | 0.637 | | Field Splice 1 |
| 19 | | | 192.25 | | 1.185 | | Field Splice 2 |
| 20 | | | 292.25 | | 1.161 | | Field Splice 3 |
| 21 | | | 354.25 | | 0.572 | | Field Splice 4 |

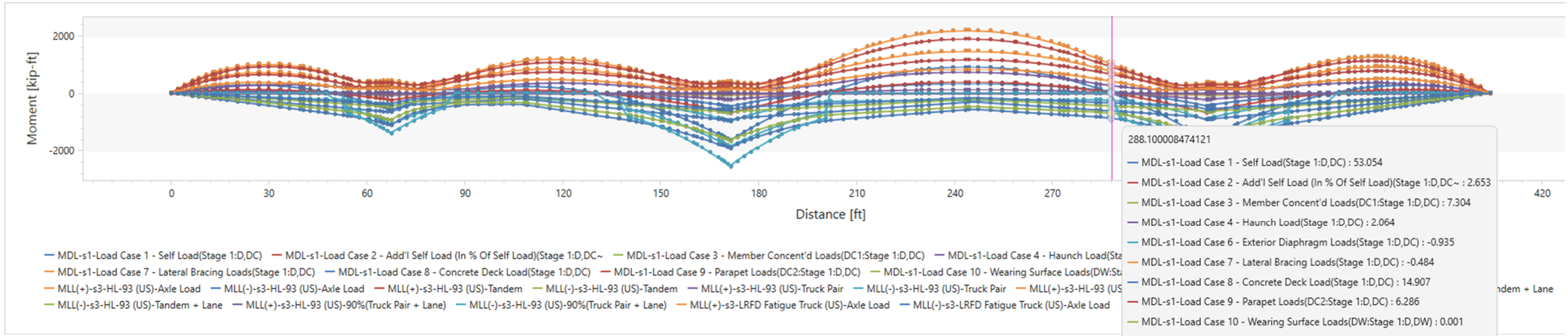
| G2 | XFrame1 | XFrame2 | Distance | Px | Py | M | Description |
|---|---|---|---|---|---|---|---|
| 1 | | | 0 | | 0.123 | | Bracing + Attachment Plate |
| 2 | 2.8562 | 8 | 10.8562 | | 0.275 | | Bracing + Attachment Plate |
| 3 | 8 | 8 | 26.8562 | | 0.280 | | Bracing + Attachment Plate |
| 4 | 8.75 | 12.75 | 48.3562 | | 0.343 | | Bracing + Attachment Plate |
| 5 | 12.75 | 10 | 71.1062 | | 0.302 | | Bracing + Attachment Plate |
| 6 | 10 | 14 | 95.1062 | | 0.363 | | Bracing + Attachment Plate |
| 7 | 14 | 14 | 123.1062 | | 0.371 | | Bracing + Attachment Plate |
| 8 | 15 | 14 | 152.1062 | | 0.363 | | Bracing + Attachment Plate |
| 9 | 14 | 10 | 176.1062 | | 0.302 | | Bracing + Attachment Plate |
| 10 | 10 | 12 | 198.1062 | | 0.356 | | Bracing + Attachment Plate |
| 11 | 15 | 15 | 228.1062 | | 0.380 | | Bracing + Attachment Plate |
| 12 | 15 | 15 | 258.1062 | | 0.380 | | Bracing + Attachment Plate |
| 13 | 15 | 15 | 288.1062 | | 0.341 | | Bracing + Attachment Plate |
| 14 | 10 | 15 | 313.1062 | | 0.341 | | Bracing + Attachment Plate |
| 15 | 10 | 15 | 338.1062 | | 0.371 | | Bracing + Attachment Plate |
| 16 | 14 | 15 | 367.1062 | | 0.356 | | Bracing + Attachment Plate |
| 17 | 12 | 8 | 387.1062 | | 0.247 | | Bracing + Attachment Plate |
| 18 | | | 88.25 | | 0.637 | | Field Splice 1 |
| 19 | | | 192.25 | | 1.185 | | Field Splice 2 |
| 20 | | | 292.25 | | 1.161 | | Field Splice 3 |
| 21 | | | 354.25 | | 0.572 | | Field Splice 4 |

| G3 | XFrame1 | XFrame2 | Distance | Px | Py | M | Description |
|---|---|---|---|---|---|---|---|
| 1 | 8.453 | 8.75 | 17.6546 | | 0.283 | | Bracing + Attachment Plate |
| 2 | 8.75 | 12.75 | 39.1546 | | 0.343 | | Bracing + Attachment Plate |
| 3 | 12.75 | 10 | 61.9046 | | 0.302 | | Bracing + Attachment Plate |
| 4 | 10 | 14 | 85.9046 | | 0.363 | | Bracing + Attachment Plate |
| 5 | 14 | 14 | 113.9046 | | 0.371 | | Bracing + Attachment Plate |
| 6 | 15 | 14 | 142.9046 | | 0.363 | | Bracing + Attachment Plate |
| 7 | 14 | 10 | 166.9046 | | 0.302 | | Bracing + Attachment Plate |
| 8 | 10 | 12 | 188.9046 | | 0.356 | | Bracing + Attachment Plate |
| 9 | 15 | 15 | 218.9046 | | 0.380 | | Bracing + Attachment Plate |
| 10 | 15 | 15 | 248.9046 | | 0.380 | | Bracing + Attachment Plate |
| 11 | 15 | 15 | 278.9046 | | 0.341 | | Bracing + Attachment Plate |
| 12 | 10 | 15 | 303.9046 | | 0.341 | | Bracing + Attachment Plate |
| 13 | 10 | 15 | 328.9046 | | 0.371 | | Bracing + Attachment Plate |
| 14 | 14 | 15 | 357.9046 | | 0.356 | | Bracing + Attachment Plate |
| 15 | 12 | 8 | 377.9046 | | 0.275 | | Bracing + Attachment Plate |
| 16 | 8 | 7.5 | 393.4046 | | 0.272 | | Bracing + Attachment Plate |
| 17 | 8 | 2.8454 | 404.25 | | 0.223 | | Bracing + Attachment Plate |
| 18 | | | 88.25 | | 0.637 | | Field Splice 1 |
| 19 | | | 192.25 | | 1.185 | | Field Splice 2 |
| 20 | | | 292.25 | | 1.161 | | Field Splice 3 |
| 21 | | | 354.25 | | 0.572 | | Field Splice 4 |

| G4 | XFrame1 | XFrame2 | Distance | Px | Py | M | Description |
|---|---|---|---|---|---|---|---|
| 1 | | | 0 | | 0.150 | | Bracing + Attachment Plate |
| 2 | 8.453 | 8.75 | 17.203 | | 0.314 | | Bracing + Attachment Plate |
| 3 | 12.75 | 12.75 | 42.703 | | 0.323 | | Bracing + Attachment Plate |
| 4 | 10 | 10 | 62.703 | | 0.333 | | Bracing + Attachment Plate |
| 5 | 14 | 14 | 90.703 | | 0.363 | | Bracing + Attachment Plate |
| 6 | 14 | 15 | 119.703 | | 0.371 | | Bracing + Attachment Plate |
| 7 | 14 | 14 | 147.703 | | 0.333 | | Bracing + Attachment Plate |
| 8 | 10 | 10 | 167.703 | | 0.317 | | Bracing + Attachment Plate |
| 9 | 12 | 15 | 194.703 | | 0.380 | | Bracing + Attachment Plate |
| 10 | 15 | 15 | 224.703 | | 0.380 | | Bracing + Attachment Plate |
| 11 | 15 | 15 | 254.703 | | 0.380 | | Bracing + Attachment Plate |
| 12 | 15 | 10 | 279.703 | | 0.341 | | Bracing + Attachment Plate |
| 13 | 15 | 10 | 304.703 | | 0.341 | | Bracing + Attachment Plate |
| 14 | 15 | 14 | 333.703 | | 0.371 | | Bracing + Attachment Plate |
| 15 | 15 | 12 | 360.703 | | 0.303 | | Bracing + Attachment Plate |
| 16 | 8 | 8 | 376.703 | | 0.272 | | Bracing + Attachment Plate |
| 17 | 7.5 | 8 | 392.203 | | 0.247 | | Bracing + Attachment Plate |
| 18 | | | 88.25 | | 0.637 | | Field Splice 1 |
| 19 | | | 192.25 | | 1.185 | | Field Splice 2 |
| 20 | | | 292.25 | | 1.161 | | Field Splice 3 |
| 21 | | | 354.25 | | 0.572 | | Field Splice 4 |

BrDR Analysis Output: The location of the crack was estimated to be 116.6 ft from Pier 2, row highlighted in gray below:

Moment results:

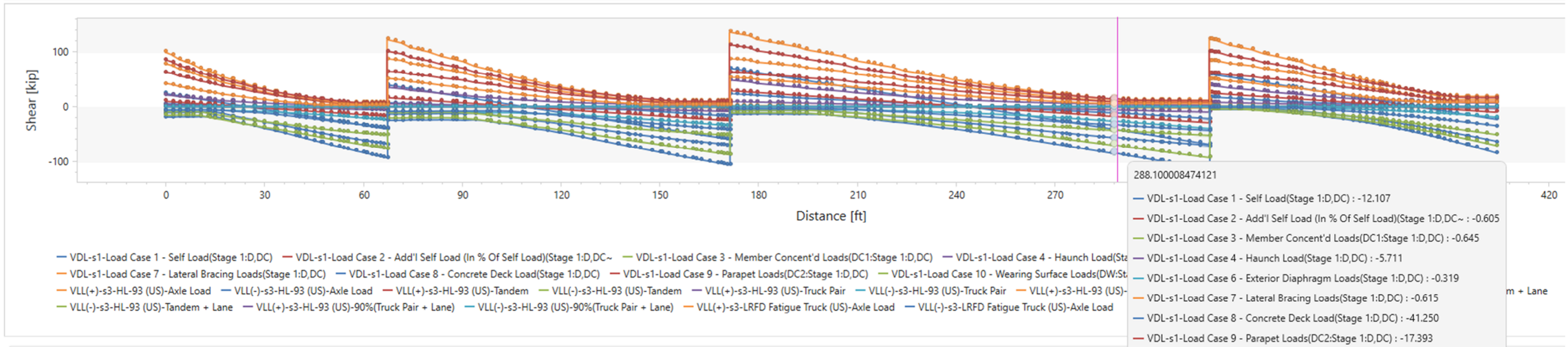



- Moment
  - Dead Load
  - Live Load
  - Design Ratio
- Shear
  - Dead Load
  - Live Load
  - Design Ratio
- Axial
  - Dead Load
  - Live Load
- Torsion
  - Dead Load
  - Live Load
- Deflection
  - Dead Load
  - Live Load

| Span | Location | Distance | MDL-s1-Load Case 1 - Self Load(Stage 1:D,DC) | MDL-s1-Load Case 2 - Add'l Self Load (In % Of Self Load)(Stage 1:D,DC~ | MDL-s1-Load Case 3 - Member Concent'd Loads(DC1:Stage 1:D,DC) | MDL-s1-Load Case 4 - Haunch Load(Stage 1:D,DC) | MDL-s1-Load Case 6 - Exterior Diaphragm Loads(Stage 1:D,DC) | MDL-s1-Load Case 7 - Lateral Bracing Loads(Stage 1:D,DC) | MDL-s1-Load Case 8 Concrete Deck (Stage 1:D,D | -)-s3- (US)- ne |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 75.70 | 247.2 | 316.02 | 15.80 | 20.15 | 126.75 | 5.94 | 11.64 | 9 | -254.53 |
| 3 | 79.45 | 250.95 | 311.70 | 15.59 | 20.40 | 124.54 | 5.87 | 11.88 | 8 | -252.24 |
| 3 | 83.20 | 254.7 | 303.38 | 15.17 | 20.64 | 120.47 | 5.79 | 12.13 | 8 | -249.95 |
| 3 | 86.95 | 258.45 | 291.07 | 14.55 | 19.47 | 114.53 | 5.33 | 11.01 | 8 | -247.66 |
| 3 | 87.45 | 258.95 | 289.14 | 14.46 | 19.31 | 113.60 | 5.27 | 10.87 | 8 | -247.36 |
| 3 | 90.70 | 262.2 | 274.76 | 13.74 | 18.29 | 106.73 | 4.88 | 9.90 | 7 | -245.37 |
| 3 | 94.45 | 265.95 | 254.45 | 12.72 | 17.11 | 97.07 | 4.42 | 8.79 | 7 | -243.08 |
| 3 | 98.20 | 269.7 | 230.15 | 11.51 | 15.94 | 85.55 | 3.97 | 7.68 | 6 | -240.79 |
| 3 | 100.70 | 272.2 | 211.73 | 10.59 | 15.15 | 76.84 | 3.42 | 6.94 | 5 | -239.27 |
| 3 | 102.03 | 273.53 | 201.27 | 10.06 | 14.74 | 71.90 | 3.13 | 6.55 | 5 | -238.46 |
| 3 | 103.20 | 274.7 | 191.54 | 9.58 | 14.37 | 67.30 | 2.87 | 6.20 | 4 | -237.74 |
| 3 | 105.70 | 277.2 | 169.56 | 8.48 | 13.59 | 56.93 | 2.31 | 5.45 | 4 | -236.22 |
| 3 | 108.20 | 279.7 | 145.82 | 7.29 | 12.80 | 45.73 | 1.76 | 4.71 | 3 | -234.69 |
| 3 | 111.95 | 283.45 | 106.87 | 5.34 | 10.35 | 27.38 | 0.56 | 2.39 | 1 | -232.40 |
| 3 | 113.20 | 284.7 | 92.99 | 4.65 | 9.53 | 20.85 | 0.16 | 1.62 | 150.62 | 63.51 | 0.01 | 311.81 | -234.79 |
| 3 | 115.70 | 287.2 | 63.92 | 3.20 | 7.89 | 7.17 | -0.65 | 0.07 | 51.82 | 21.85 | 0.01 | 274.47 | -247.70 |
| 3 | 116.60 | 288.1 | 53.05 | 2.65 | 7.30 | 2.06 | -0.94 | -0.48 | 14.91 | 6.29 | 0.00 | 261.72 | -253.71 |
| 3 | 119.45 | 290.95 | 17.36 | 0.87 | 5.46 | -14.77 | -1.85 | -2.24 | -106.67 | -44.98 | -0.01 | 220.93 | -273.91 |

| | MLL(+)-s3-HL-93 (US)-Axle Load | MLL(-)-s3-HL-93 (US)-Axle Load | MLL(+)-s3-HL-93 (US)-Tandem | MLL(-)-s3-HL-93 (US)-Tandem | MLL(+)-s3-HL-93 (US)-Truck Pair | MLL(-)-s3-HL-93 (US)-Truck Pair | MLL(+)-s3-HL-93 (US)-Truck + Lane | MLL(-)-s3-HL-93 (US)-Truck + Lane | MLL(+)-s3-HL-93 (US)-Tandem + Lane | MLL(-)-s3-HL-93 (US)-Tandem + Lane | MLL(+)-s3-HL-93 (US)-90%(Truck Pair + Lane) | MLL(-)-s3-HL-93 (US)-90%(Truck Pair + Lane) | MLL(+)-s3-LRFD Fatigue Truck (US)-Axle Load | MLL(-)-s3-LRFD Fatigue Truck (US)-Axle Load |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47.70 | 807.42 | -622.39 | 677.20 | -457.30 | 0.00 | 0.00 | 1,081.90 | -870.09 | 951.68 | -705.00 | 0.00 | 0.00 | 434.46 | -349.21 |
| 53.71 | 780.64 | -629.17 | 658.56 | -462.28 | 0.00 | 0.00 | 1,042.35 | -882.88 | 920.27 | -716.00 | 0.00 | 0.00 | 417.39 | -353.01 |
| 73.91 | 683.57 | -641.46 | 589.45 | -471.31 | 0.00 | -708.26 | 904.50 | -915.37 | 810.38 | -745.22 | 0.00 | -883.95 | 356.98 | -359.91 |

Shear results:




- Moment
  - Dead Load
  - Live Load
  - Design Ratio
- Shear
  - Dead Load
  - Live Load
  - Design Ratio
- Axial
  - Dead Load
  - Live Load
- Torsion
  - Dead Load
  - Live Load
- Deflection
  - Dead Load
  - Live Load

| Span | Location | Distance | VDL-s1-Load Case 1 - Self Load(Stage 1:D,DC) | VDL-s1-Load Case 2 - Add'l Self Load (In % Of Self Load)(Stage 1:D,DC~ | VDL-s1-Load Case 3 - Member Concent'd Loads(DC1:Stage 1:D,DC) | VDL-s1-Load Case 4 - Haunch Load(Stage 1:D,DC) | VDL-s1-Load Case 6 - Exterior Diaphragm Loads(Stage 1:D,DC) | VDL-s1-Load Case 7 - Lateral Bracing Loads(Stage 1:D,DC) | VDL-s1-Load Case 8 Concrete Deck (Stage 1:D,D | | | | )-s3- (US)- ne |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 75.70 | 247.2 | -0.62 | -0.03 | 0.07 | -0.34 | -0.02 | 0.06 | | | | | -12.81 |
| 3 | 79.45 | 250.95 | -1.69 | -0.08 | 0.07 | -0.84 | -0.02 | 0.06 | | | | | -13.84 |
| 3 | 83.20 | 254.7 | -2.75 | -0.14 | -0.31 | -1.33 | -0.12 | -0.30 | | | | | -14.93 |
| 3 | 86.95 | 258.45 | -3.82 | -0.19 | -0.31 | -1.83 | -0.12 | -0.30 | | | | | -16.08 |
| 3 | 87.45 | 258.95 | -3.96 | -0.20 | -0.31 | -1.90 | -0.12 | -0.30 | | | | | -16.24 |
| 3 | 90.70 | 262.2 | -4.88 | -0.24 | -0.31 | -2.33 | -0.12 | -0.30 | | | | | -17.29 |
| 3 | 94.45 | 265.95 | -5.95 | -0.30 | -0.31 | -2.82 | -0.12 | -0.30 | | | | | -18.55 |
| 3 | 98.20 | 269.7 | -7.01 | -0.35 | -0.31 | -3.32 | -0.22 | -0.30 | | | | | -19.88 |
| 3 | 100.70 | 272.2 | -7.72 | -0.39 | -0.31 | -3.65 | -0.22 | -0.30 | | | | | -20.79 |
| 3 | 102.03 | 273.53 | -8.10 | -0.40 | -0.31 | -3.83 | -0.22 | -0.30 | | | | | -21.28 |
| 3 | 103.20 | 274.7 | -8.43 | -0.42 | -0.31 | -3.98 | -0.22 | -0.30 | | | | | -21.72 |
| 3 | 105.70 | 277.2 | -9.14 | -0.46 | -0.31 | -4.31 | -0.22 | -0.30 | | | | | -22.69 |
| 3 | 108.20 | 279.7 | -9.85 | -0.49 | -0.65 | -4.64 | -0.32 | -0.62 | | | | | -23.67 |
| 3 | 111.95 | 283.45 | -10.92 | -0.55 | -0.65 | -5.14 | -0.32 | -0.62 | | | | | -25.19 |
| 3 | 113.20 | 284.7 | -11.27 | -0.56 | -0.65 | -5.31 | -0.32 | -0.62 | | | | | -25.71 |
| 3 | 115.70 | 287.2 | -11.99 | -0.60 | -0.65 | -5.64 | -0.32 | -0.62 | | | | | -26.76 |
| 3 | 116.60 | 288.1 | -12.11 | -0.61 | -0.64 | -5.71 | -0.32 | -0.61 | -41.25 | -17.39 | -0.00 | 4.82 | -26.58 |
| 3 | 119.45 | 290.95 | -12.92 | -0.65 | -0.64 | -6.09 | -0.32 | -0.61 | -43.98 | -18.54 | -0.00 | 4.61 | -28.16 |

| | VLL(+)-s3-HL-93 (US)-Axle Load | VLL(-)-s3-HL-93 (US)-Axle Load | VLL(+)-s3-HL-93 (US)-Tandem | VLL(-)-s3-HL-93 (US)-Tandem | VLL(+)-s3-HL-93 (US)-Truck Pair | VLL(-)-s3-HL-93 (US)-Truck Pair | VLL(+)-s3-HL-93 (US)-Truck + Lane | VLL(-)-s3-HL-93 (US)-Truck + Lane | VLL(+)-s3-HL-93 (US)-Tandem + Lane | VLL(-)-s3-HL-93 (US)-Tandem + Lane | VLL(+)-s3-HL-93 (US)-90%(Truck Pair + Lane) | VLL(-)-s3-HL-93 (US)-90%(Truck Pair + Lane) | VLL(+)-s3-LRFD Fatigue Truck (US)-Axle Load | VLL(-)-s3-LRFD Fatigue Truck (US)-Axle Load |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.76 | 8.69 | -58.40 | 8.34 | -43.43 | -0.00 | -0.00 | 13.65 | -85.16 | 13.30 | -70.19 | -0.00 | -0.00 | 4.91 | -34.37 |
| 26.58 | 9.99 | -57.26 | 9.48 | -42.54 | -0.00 | -0.00 | 14.81 | -83.84 | 14.30 | -69.12 | -0.00 | -0.00 | 4.92 | -33.16 |
| 28.16 | 8.35 | -59.93 | 7.34 | -44.46 | -0.00 | -0.00 | 12.96 | -88.09 | 11.95 | -72.62 | -0.00 | -0.00 | 4.81 | -35.40 |
| 28.72 | 8.35 | -60.63 | 6.89 | -44.92 | -0.00 | -0.00 | 12.86 | -89.36 | 11.41 | -73.64 | -0.00 | -0.00 | 4.81 | -35.88 |

Dead load effects were summed:

Moment:

MDL=84.84Kip-ft

VDL=-78.64 Kip

Live load combinations that induced the largest effects were chosen.

Moment:

Non-Composite DL: 84.84 Kip-ft

LL (MLL(+)-s3- HL-93 (US)- Truck + Lane): 1042.35 Kip-Ft

LL(MLL(-)-s3- HL-93 (US)- Truck + Lane):-882.88 Kip-Ft

Shear:

Non-Composite DL: -79.12 Kip

LL (VLL(+)-s3- HL-93 (US)- Truck + Lane): 14.81 Kip

LL(VLL(-)-s3- HL-93 (US)- Truck + Lane): -83.84 Kip

**Bottom Flange Splice Design at Cracked Section**

The splice design was completed using the NSBASplice_PlateGirder_v3_16 spreadsheet, loads input as explained above:

- Results:

## Bolts Arrangement

| | Bolt Rows (Per Side) | Total Bolts (Per Side) | Design Basis |
|---|---|---|---|
| Bottom Flange | 4 | 16 | Spreadsheet Calculated |

## Splice Plate Dimensions

| | Thickness (in) | Width (in) | Length (in) |
|---|---|---|---|
| Bottom Flange - Inner (Each) | 1 | 7 1/4 | 29 |
| Bottom Flange - Outer | 11/16 | 16 | |

| | Gage - Bolts (in) | Edge Distance (in) | Pitch - Bolts (in) | End Distance (in) | Gage - Bolt Groups (in) | Pitch - Bolt Groups (in) |
|---|---|---|---|---|---|---|
| Bottom Flange | 3 3/4 | 1 3/4 | 3 1/2 | 2 | 5 | 4 |

No filler plates are necessary.

The resulting shear planes per bolt of 1 had to be used. The limited clearance under the bridge prohibits increasing outer plate thickness.

Spreadsheet is included in this folder. Input is shown in

The existing splice was also verified using the proposed plate thicknesses and materials and capacity was adequate. That spreadsheet is also attached.

**Input shown in next two pages:**

# NSBA Bolted Splice Designer - Plate Girder

Cell Fill Color
- User Input Field
- Spreadsheet Status Field
- Spreadsheet Calculated Field

## Design Input

### Unfactored Loads - Splice Centerline

| | Moment (kip-ft) | Shear (kip) |
|---|---|---|
| Noncomposite Dead Load ($DC_1$) | 84.84 | -78.64 |
| Superimposed Composite Dead Load ($DC_2$) | 0.00 | 0.00 |
| Future Wearing Surface (DW) | 0.00 | 0.00 |
| Positive Live Load plus Impact ($LL^+ + I$) | 1042.35 | 14.81 |
| Negative Live Load plus Impact ($LL^- + I$) | -882.88 | -83.84 |
| Deck Casting | 0.00 | 0.00 |

### Girder Properties

| | Left | Right |
|---|---|---|
| Top Flange Material | Grade 36 | Grade 36 |
| Top Flange Thickness (in) | 1 5/8 | 1 5/8 |
| Top Flange Width (in) | 16 | 16 |
| Longitudinal Stiffener | No | No |
| Transverse Stiffener Spacing ($d_o$) (ft) | 3 17/48 | 1 31/48 |
| Transverse Stiffener Status | Stiffened | Stiffened |
| Web Material | Grade 36 | Grade 36 |
| Web Thickness (in) | 7/16 | 1 7/16 |
| Web Depth (in) | 72 | |
| Bottom Flange Material | Grade 36 | Grade 36 |
| Bottom Flange Thickness (in) | 1 5/8 | 1 5/8 |
| Bottom Flange Width (in) | 16 | 16 |

### Bolt Properties

| | | |
|---|---|---|
| Bolt Type | A325 | |
| Bolt Diameter (in) | 1 | |
| Web Threads | Included | |
| Flange Threads | Excluded | |
| Surface Condition Factor ($K_s$) | A | |
| Hole Size Factor ($K_h$) | Standard | |
| Top Flange Rows | 4 | OK |
| Web Rows | 4 | OK |
| Bottom Flange Rows | 4 | OK |

### Concrete Deck Properties

| | | |
|---|---|---|
| Composite | Non-Composite | |
| Thickness (in) | 8 1/2 | |
| Effective Width (in) | | OK |
| Concrete Strength (ksi) | | OK |

### Spacing and Clearance Values

| | | |
|---|---|---|
| Bolt Spacing (in) | 3 1/2 | OK |
| Edge Distance - Flange (in) | 1 3/4 | OK |
| End Distance - Flange (in) | 2 | OK |
| Edge Distance - Web (in) | | Use Minimum Edge Distance |
| End Distance - Web (in) | | Use Minimum Edge Distance |

## Haunch Properties

| | Left | Right |
|---|---|---|
| Haunch (in) | 2 1/2 | 2 1/2 |
| Haunch Status | OK | |

## Splice Plate Properties

| | Inner | Outer |
|---|---|---|
| Top Flange Splice Plate Material | | |
| Top Flange Splice Plate Thickness (in) | | |
| Top Flange Splice Plate Width (in) | 7 1/4 | 16 |
| Total Agross (sq-in) | 0.0000 | 0.0000 |
| % Difference Ag Inner/Outer Area | 0.00% | |
| Shear Planes per Bolt ($N_s$) | 2 | |

| | |
|---|---|
| Web Splice Plate Material | |
| Web Splice Plate Thickness (in) | |

| | Inner | Outer |
|---|---|---|
| Bottom Flange Splice Plate Material | Grade 50 | |
| Bottom Flange Splice Plate Thickness (in) | 1 | 11/16 |
| Bottom Flange Splice Plate Width (in) | 7 1/4 | 16 |
| Total Agross (sq-in) | 14.5000 | 11.0000 |
| % Difference $A_g$ Inner/Outer Area | 27.45% | |
| Shear Planes per Bolt ($N_s$) | 1 | |

| | | |
|---|---|---|
| Web Weld Size (in) | | |
| Web Weld Clearance (in) | | |
| Web Gap (in) | | |
| Entering & Tightening Clearance (in) | | Use Minimum Clearence |

## Miscellaneous Properties

| | |
|---|---|
| Splice Plate Hole Method | Drilled - Full Size |
| Alignment Mode | Web Center |

## Bolt Count Overrides

| | Count Override Status | Bolt Count - Calculated | Bolt Count - User Specified | Valid Override |
|---|---|---|---|---|
| Top Flange Bolt Count Override | Spreadsheet Calculated | 12 | | DNA |
| Web Bolt Count Override | Spreadsheet Calculated | #DIV/0! | | DNA |
| Bottom Flange Bolt Count Override | Spreadsheet Calculated | 16 | | DNA |

## Status - Error Count

| | |
|---|---|
| Design Status - Flange | 0 |
| Bolt Layout Status - Flange | 1 |
| Design Status - Web | 0 |
| Bolt Layout Status -Web | 2 |
| Slab Strength Status | 0 |

**Bolt spacing between existing splice and splice through flange crack (sealing bolt spacing):**

Per AASHTO 6.13.2.6:

6.13.2.6.1 Minimum spacing shall be no less than three times the diameter of the bolt

Minimum spacing = 3*1”=3”

6.13.2.6.2 Maximum spacing for sealing bolts

Single line sealing spacing= s<=(4.0+4.0t)<=7

s<=4.0+4.0*11/16<=7

s<=6.75<=7

Second line of fasteners uniformly staggered at gauge less than 1.5+4.0t

g=1.5+4.0t=4.25

s<=4.0+4.0t-(3.0g/4)<=7.0

s<=3.56

t= thickness of the thinner outside plate or shape (in)

g=gauge between bolts

Due to field verification of distance between flange crack and beam splice location, bolts between these two structural splices will not be staggered and a maximum spacing of 6.75” will be specified

Results:

Sealing spacing should be a minimum of 3” and a maximum of 6.75”

**Minimum Stiffener Thickness for Temporary Shoring (Intermediate stiffener acting as bearing stiffener)**

$bt := 4.5$ (stiffener width)

$Fys := 36000$ (web steel)

$Fyn := 50000$ (new specified steel strength)

$tp := \frac{7}{16} = 0.438$

$Es := 29000000$

$En := 29750000$

$tw := \frac{7}{16}$

$\phi b := 1.00$

$0.48 \cdot tp \cdot \sqrt[2]{\frac{En}{Fyn}} = 5.122$

$tchk := \frac{bt}{\left(0.48 \cdot \sqrt[2]{\frac{En}{Fyn}}\right)} = 0.384$

$tp > tchk = 1$

$bbrg := bt - 1 = 3.5$

$Apn := 2 \cdot bbrg \cdot tp = 3.063$

$Br := \phi b \cdot Apn \cdot Fyn = 1.531 \cdot 10^5$

lbs Calculated using 50ksi for new stiffener

$RFactored := 1.25 \cdot 102000 = 1.275 \cdot 10^5$

$$Br > RFactored = 1$$

lbs

$$9 \cdot tw = 3.938$$

$$\phi c := 0.9$$

$$kl := 0.75 \cdot 72 = 54$$

$$Is := \frac{\left( \left( tp \cdot (bt \cdot 2 + tw)^3 \right) + \left( (9 \cdot tw \cdot 2 - tp) \cdot \left( \frac{tp}{2} \right)^3 \right) \right)}{12} = 30.652$$

$$As := \left( tp \cdot (bt \cdot 2 + tw) \right) + \left( (9 \cdot tw \cdot 2 - tp) \cdot \left( \frac{tp}{2} \right) \right) = 5.756$$

$$rs := \sqrt[2]{\frac{Is}{As}} = 2.308$$

$$\lambda := \left( \frac{kl}{rs \cdot \pi} \right)^2 \cdot \frac{Fyn}{En} = 0.093$$

More conservative using 50ksi

$$Pn := 0.66^{\lambda} \cdot Fys \cdot As = 1.993 \cdot 10^5$$

lbs More conservative using 36 ksi

$$RFactored < Pn = 1$$

The stiffener retrofit plates for bearing must be at least 7/16”x4.5”, A ½” thick stiffener will be specified for ease of procurement.