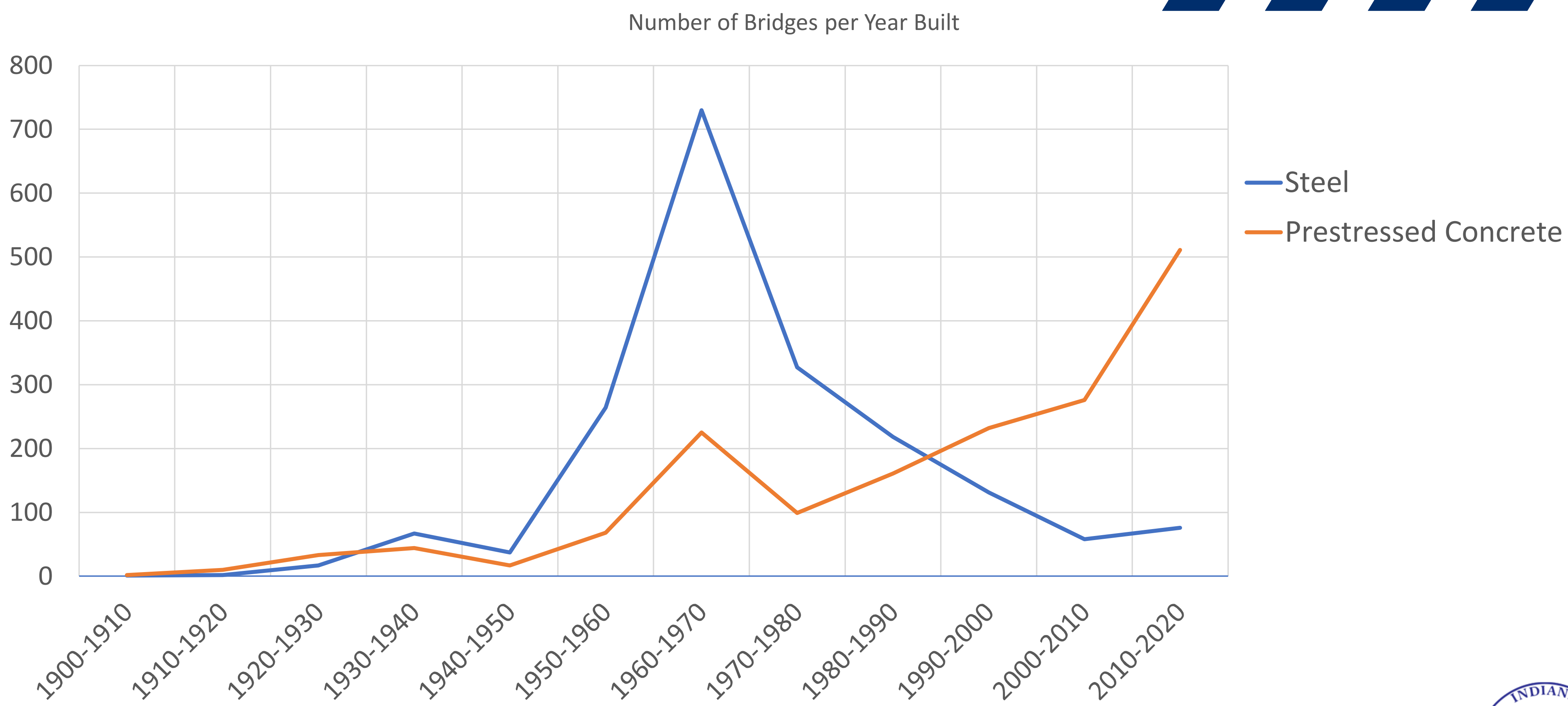
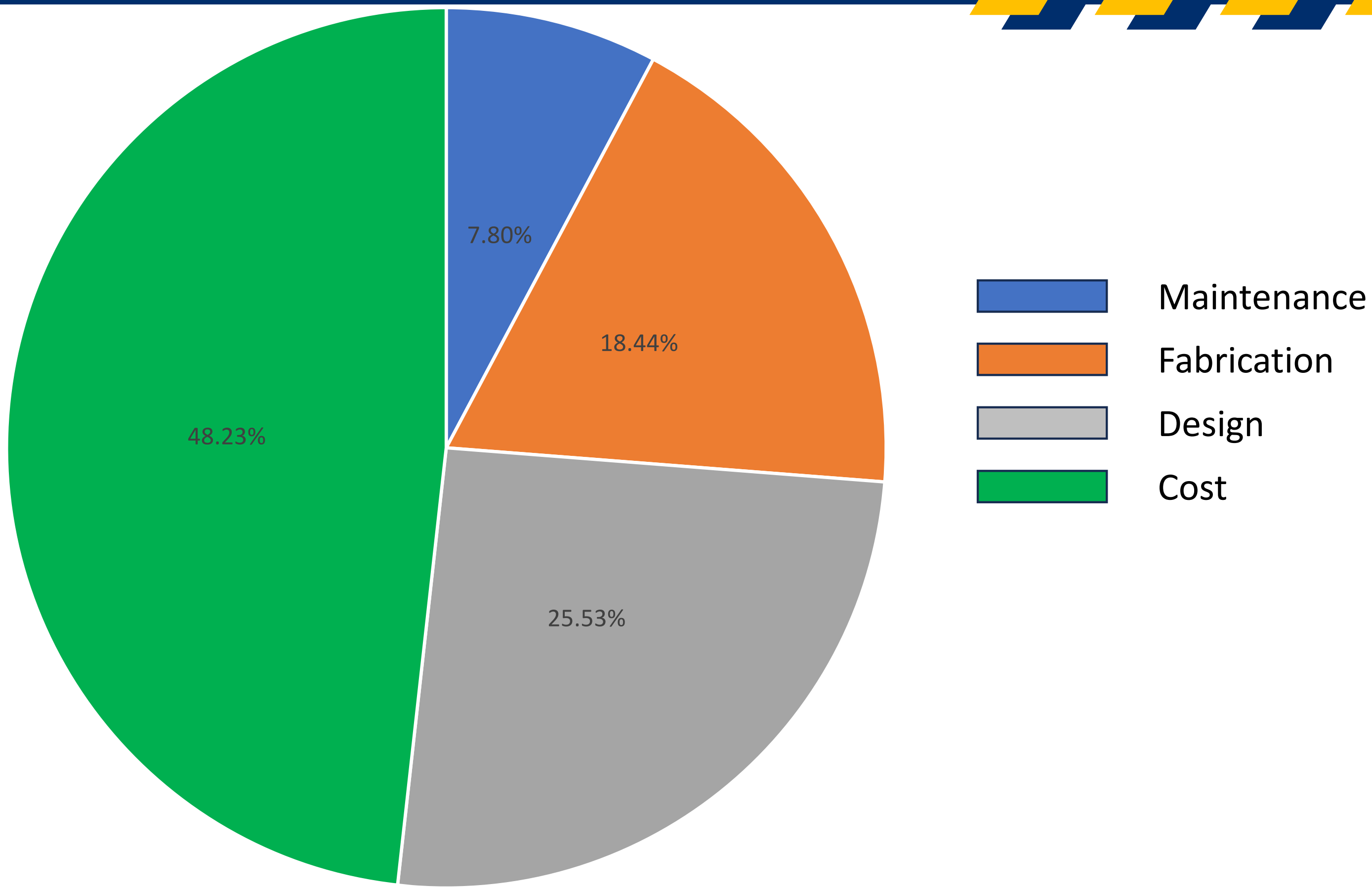
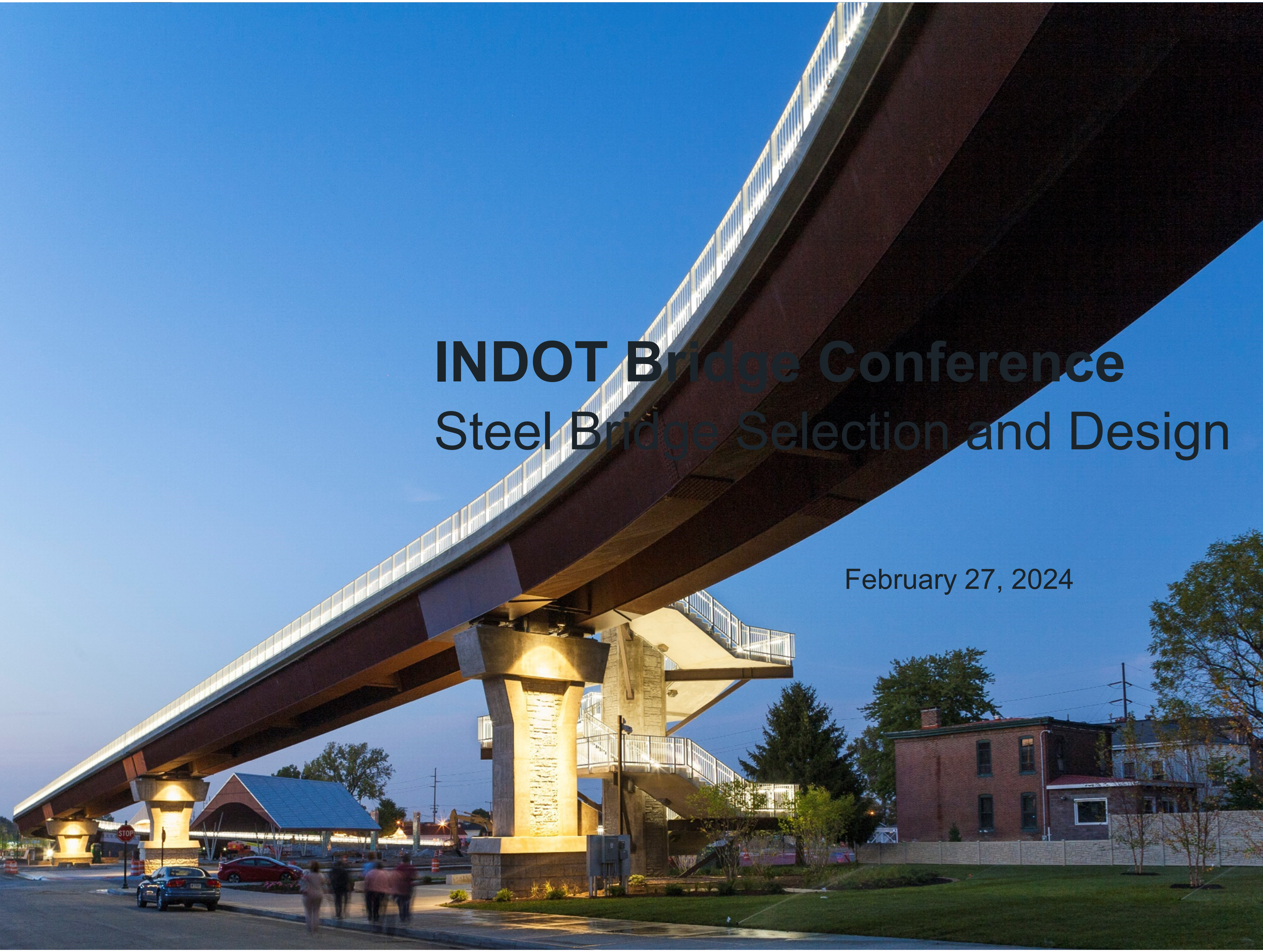
Steel

Steel vs. Concrete



Steel Challenges





INDOT Bridge Conference

Steel Bridge Selection and Design

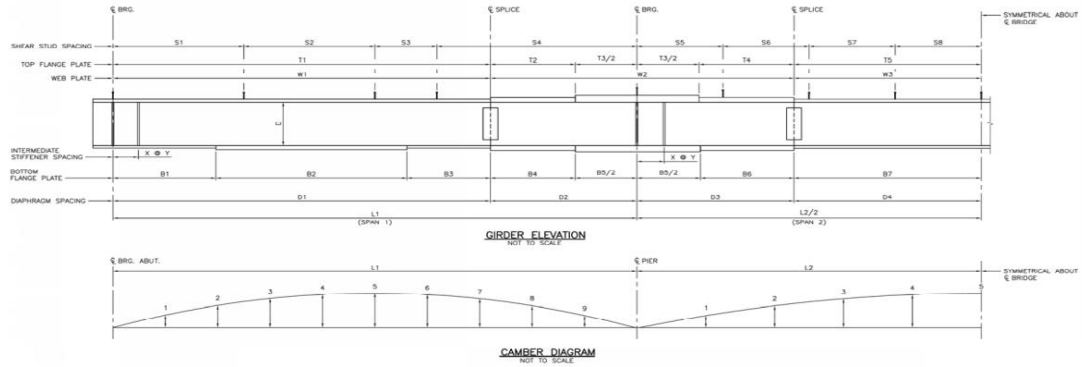
February 27, 2024

AGENDA

- Navigating Steel Design
- Steel Bridge Options
- Factors to Consider
- Sample Bridge Preliminary Design
- Understanding the Misunderstood

Navigating Steel Design

NSBA Continuous Span Standards



FLANGE DATA

L1 (SPAN ft)	L2	T1 W (in)	T1 Th (in)	T1 L (ft)	T2 W (in)	T2 Th (in)	T2 L (ft)	T3 W (in)	T3 Th (in)	T3 L (ft)	T4 W (in)	T4 Th (in)	T4 L (ft)	T5 W (in)	T5 Th (in)	T5 L (ft)	B1 W (in)	B1 Th (in)	B1 L (ft)
0.78	1.0																		
117	150	16	0.75	87	18	1.3125	20	18	1.4375	20	18	0.875	30	16	0.75	35	16	1.125	87
129	165	16	0.75	94	18	1.0	22	18	1.8125	26	18	0.875	29	16	0.75	40.5	16	1.25	94
140	180	16	0.75	105	18	0.9375	21	18	1.75	28	18	1.1875	31	16	0.75	45	16	0.75	30
152	195	16	0.75	110	18	0.875	24	18	1.9375	36	18	0.875	31	16	0.75	48.5	18	0.75	32
164	210	16	0.75	120	20	1.0	25	20	2.125	38	20	1.0	36	16	0.75	50	18	0.75	35
176	225	16	0.75	130	20	1.1875	26	20	2.375	40	20	1.0625	39	16	0.75	53.5	18	0.75	37
187	240	16	0.75	135	20	1.1875	28	20	2.5	48	20	1.1875	31	16	0.75	65	18	0.75	45
199	255	16	0.875	140	20	1.6875	35	20	3.25	48	20	1.6875	40	16	0.75	63.5	18	0.75	45
211	270	16	1.0625	150	20	1.75	31	20	3.75	60	20	1.625	40	16	0.75	65	18	0.875	50
222	285	17	0.9375	160	20	1.9375	33	20	3.875	58	20	1.75	43	17	0.8125	70.5	18	0.8125	50
234	300	18	1.0	170	24	1.5625	30	24	3.5	68	24	1.5	41	18	0.8125	75	20	0.875	50

L1 (SPAN ft)	L2	B2 W (in)	B2 Th (in)	B2 L (ft)	B3 W (in)	B3 Th (in)	B3 L (ft)	B4 W (in)	B4 Th (in)	B4 L (ft)	B5 W (in)	B5 Th (in)	B5 L (ft)	B6 W (in)	B6 Th (in)	B6 L (ft)	B7 W (in)	B7 Th (in)	B7 L (ft)	WEB DATA D (in)	W1 Th (in)	W1 L (ft)	W2 Th (in)	W2 L (ft)	W3 Th (in)	W3 L (ft)
0.78	1.0																									
117	150	-	-	-	-	-	-	20	2.125	20	20	2.375	20	20	1.4375	30	16	0.875	35	64	0.4375	87	0.4375	70	0.4375	35
129	165	-	-	-	-	-	-	20	1.5	22	20	2.5	26	20	1.4375	29	16	1.125	40.5	65	0.4375	94	0.4375	77	0.4375	40.5
140	180	16	1.125	50	16	1.25	25	20	1.625	21	20	2.375	28	20	1.4375	31	18	0.875	45	74	0.5	105	0.5	80	0.5	45
152	195	18	0.9375	53	18	0.9375	25	20	1.3125	24	20	2.625	36	20	1.3125	31	18	0.875	48.5	80	0.5625	110	0.5625	91	0.5625	48.5
164	210	18	1.0625	55	18	1.0625	30	20	1.4375	25	20	2.75	38	20	1.4375	36	16	0.9375	50	82	0.5625	120	0.625	99	0.563	50
176	225	18	1.125	65	18	1.125	28	20	1.6875	26	20	2.75	40	20	1.625	39	16	1.0625	53.5	84	0.5625	130	0.5625	105	0.5625	53.5
187	240	18	1.125	55	18	1.125	35	20	1.625	28	20	2.875	48	20	1.5625	31	16	0.875	65	92	0.625	135	0.625	107	0.625	65
199	255	18	1.1875	55	18	1.1875	40	22	2.0625	35	22	3.25	48	22	2.0625	40	16	1.0	63.5	93	0.6875	140	0.625	123	0.625	63.5
211	270	18	1.3125	60	18	1.3125	40	22	2.1875	31	22	3.75	60	22	1.75	40	16	1.125	65	93	0.6875	150	0.75	131	0.625	65
222	285	18	1.0625	70	18	1.3125	40	22	2.25	33	22	3.875	58	22	2.1875	43	17	1.0	70.5	100	0.75	160	0.6875	134	0.6875	70.5
234	300	20	1.0625	75	20	1.375	45	24	2.1875	30	24	3.875	68	24	2.1875	41	18	1.0625	75	103	0.75	170	0.6875	139	0.6875	75

DIAPHRAGM SPACING / INTERMEDIATE STIFFENERS / WEIGHTS

L1 (SPAN ft)	L2	D1 (ft)	D2 (ft)	D3 (ft)	D4 (ft)	Span 1 - Left of Splice Th (in)	X # req.	W (in)	Y Distance from CL Brg - ft	Span 1 - Right of Splice Th (in)	X # req.	W (in)	Y Distance from CL Brg - ft	Span 2 - Left of Splice Th (in)	X # req.	W (in)	Y Distance from CL Brg - ft	Span 2 - Right of Splice Th (in)	X # req.	W (in)	Y Distance from CL Brg - ft	Girder Weight (Tons)	Weight of Intermediate Stiffener (Tons)	Total Weight (Tons)
0.78	1.0																							
117	150	19.5	19.5	25.0	25.0	0.375	5	5.25	7.00 23.00 55.00 71.00 87.00	0.3125	1	5.0	103.25	0.4375	3	6.5	13.75 29.75 40.00	0.375	1	5.0	56.00	44.31	0.35	44.66
129	165	21.5	21.5	20.63	20.63	0.375	6	5.75	6.50 22.75 39.00 61.50 77.75 94.00	0.3125	2	5.0	100.25 116.50	0.4375	3	7.0	12.25 28.00 42.00	0.375	2	5.5	58.25 74.50	50.13	0.49	50.62
140	180	20.0	20.0	20.0	20.0	0.375	5	6.0	9.25 27.75 68.00 86.50 105.00	0.3125	1	5.0	121.50	0.5	3	7.0	18.50 37.00 45.00	0.4375	1	6.0	63.50	59.83	0.48	60.31
152	195	19.0	19.0	21.67	24.38	0.3125	3	4.75	10.00 90.00 110.00	0.3125	2	5.5	112.00 132.00	0.4375	3	6.75	20.00 40.00 49.00	0.0	0	0.0	0.00	71.79	0.31	72.10
164	210	14.91	14.91	21.0	21.0	0.3125	4	4.75	10.25 30.75 99.50 120.00	0.3125	2	5.5	123.00 143.50	0.375	2	5.5	20.50 41.00	0.0	0	0.0	0.00	83.31	0.30	83.60
176	225	16.0	16.0	18.75	22.5	0.375	4	6.0	10.50 31.50 109.00 130.00	0.3125	2	5.5	134.00 155.00	0.5	3	7.75	21.00 42.00 59.00	0.375	1	5.75	80.00	91.25	0.54	91.79
187	240	13.36	13.36	16.0	21.82	0.3125	3	5.25	11.50 112.00 135.00	0.3125	2	5.5	141.00 164.00	0.500	3	7.5	23.00 46.00 55.00	0.0	0	0.0	0.00	108.32	0.40	108.72
199	255	13.27	15.31	15.94	21.25	0.0	0	0.0	0.00	0.3125	3	5.5	140.00 152.50 175.75	0.625	3	8.25	23.25 46.50 64.00	0.4375	1	6.5	87.25	131.53	0.49	132.02
211	270	13.19	14.07	15.0	20.77	0.0	0	0.0	0.00	0.3125	3	5.5	150.00 164.50 187.75	0.375	2	5.5	23.25 46.50	0.4375	2	7.0	70.00 93.25	153.20	0.36	153.56
222	285	13.06	13.88	15.0	20.36	0.0	0	0.0	0.00	0.3125	3	5.5	160.00 172.00 197.00	0.6875	3	8.25	25.00 50.00 72.00	0.0	0	0.0	0.00	169.20	0.43	169.62
234	300	18.0	18.0	21.43	21.43	0.0	0	0.0	0.00	0.3125	3	6.0	170.00 182.50 208.25	0.625	3	9.25	25.75 51.50 75.00	0.4375	1	6.25	100.75	190.38	0.58	190.96

SHEAR STUD SPACING

L1 (SPAN ft)	L2	Span 1 - S1 # of Spa	@ (in)	L (ft)	Span 1 - S2 # of Spa	@ (in)	L (ft)	Span 1 - S3 # of Spa	@ (in)	L (ft)	Span 1 - S4 # of Spa	@ (in)	L (ft)	Span 2 - S5 # of Spa	@ (in)	L (ft)	Span 2 - S6 # of Spa	@ (in)	L (ft)	Span 2 - S7 # of Spa	@ (in)	L (ft)	Span 2 - S8 # of Spa	@ (in)	L (ft)
0.78	1.0																								
117	150	28.0	6.0	14.0	100.0	9.0	75.0	14.0	24.0	28.0	-	-	-	13.0	24.0	26.0	2.0	15.0	2.5	62.0	9.0	46.5	-	-	-
129	165	26.0	6.0	13.0	112.0	9.0	84.0	16.0	24.0	32.0	-	-	-	14.0	24.0	28.0	2.0	12.0	2.0	70.0	9.0	52.5	-	-	-
140	180	17.0	6.0	8.5	130.0	9.0	97.5	17.0	24.0	34.0	-	-	-	16.0	24.0	32.0	1.0	12.0	1.0	76.0	9.0	57.0	-	-	-
152	195	54.0	9.0	40.5	35.0	12.0	35.0	54.0	9.0	40.5	18.0	24.0	36.0	18.0	24.0	36.0	82.0	9.0	61.5	-	-	-	-	-	-
164	210	46.0	9.0	34.5	55.0	12.0	55.0	46.0	9.0	34.5	20.0	24.0	40.0	20.0	24.0	40.0	11.0	12.0	11.0	72.0	9.0	54.0	-	-	-
176	225	48.0	9.0	36.0	68.0	12.0	68.0	40.0	9.0	30.0	21.0	24.0	42.0	21.0	24.0	42.0	12.0	12.0	12.0	78.0	9.0	58.5	-	-	-
187	240	40.0	9.0	30.0	103.0	12.0	103.0	27.0	24.0	54.0	-	-	-	20.0	24.0	40.0	8.0	12.0	8.0	96.0	9.0	72.0	-	-	-
199	255	32.0	9.0	24.0	119.0	12.0	119.0	28.0	24.0	56.0	-	-	-	30.0	24.0	60.0	1.0	18.0	1.5	66.0	12.0	66.0	-	-	-
211	270	44.0	9.0	33.0	116.0	12.0	116.0	31.0	24.0	62.0	-	-	-	33.0	24.0	66.0	69.0	12.0	69.0	-	-	-	-	-	-
222	285	32.0	9.0	24.0	132.0	12.0	132.0	33.0	24.0	66.0	-	-	-	34.0	24.0	68.0	1.0	18.0	1.5	73.0	12.0	73.0	-	-	-
234	300	16.0	9.0	12.0	152.0	12.0	152.0	35.0	24.0	70.0	-	-	-	36.0	24.0	72.0	78.0	12.0	78.0	-	-	-	-	-	-

STEEL DL CAMBER / TOTAL DL CAMBER

L1 (SPAN ft)	L2	Steel DL Span 1 & 3: 1	2	3	4	5	6	7	8	9	Steel DL Span 2: 1	2	3	4	5	Total DL Span 1 & 3: 1	2	3	4	5	6	7	8	9	Total DL Span 2: 1	2	3	4	5
0.78	1.00																												
117	150	0.099	0.183	0.238	0.26	0.248	0.207	0.146	0.082	0.029	0.017	0.081	0.16	0.222	0.246	0.547	1	1.294	1.396	1.306	1.059	0.719	0.377	0.109	0.175	0.621	1.154	1.574	1.73
129	165	0.133	0.243	0.315	0.341	0.32	0.26	0.177	0.092	0.028	0.032	0.128	0.244	0.335	0.368	0.749	1.369	1.77	1.907	1.781	1.436	0.962	0.487	0.14	0.208	0.776	1.464	2.005	2.206
140	180	0.149	0.27	0.345	0.368	0.339	0.267	0.171	0.077	0.012	0.068	0.202	0.352	0.468	0.509	0.823	1.489	1.901	2.03	1.877	1.492	0.973	0.458	0.095	0.309	0.973	1.742	2.344	2.568
152	195	0.191	0.347	0.444	0.475	0.442	0.353	0.233	0.114	0.030	0.059	0.208	0.386	0.524	0.575	0.93	1.685	2.156	2.309	2.145	1.72	1.141	0.565	0.156	0.259	0.947	1.779	2.43	2.672
164	210	0.244	0.441	0.563	0.602	0.558	0.446	0.295	0.146	0.04	0.069	0.247	0.464	0.634	0.696	1.14	2.057	2.621	2.797	2.591	2.071	1.372	0.681	0.188	0.3	1.112	2.112	2.91	3.208
176	225	0.31	0.559	0.713	0.762	0.708	0.568	0.380	0.194	0.058	0.074	0.285	0.543	0.75	0.827	1.407	2.537	3.227	3.443	3.194	2.562	1.714	0.878	0.264	0.306	1.219	2.357	3.274	3.618
187	240	0.348	0.629	0.803	0.86	0.801	0.644	0.432	0.221	0.066	0.076	0.279	0.544	0.761	0.843	1.341	2.413	3.059	3.242	2.974	2.342	1.514	0.721	0.177	0.418	1.357	2.542	3.503	3.866
199	255	0.437	0.805	1.051	1.142	1.079	0.886	0.615	0.338	0.12	0.033	0.241	0.523	0.762	0.853	1.437	2.633	3.409	3.655	3.376	2.676	1.754	0.873	0.249	0.364	1.384	2.679	3.758	4.169
211	270	0.531	0.964	1.238	1.331	1.246	1.012	0.692	0.371	0.127	0.049	0.268	0.579	0.846	0.945	1.739	3.132	3.97	4.199	3.835	3.002	1.931	0.93	0.246	0.424	1.473	2.876	4.076	4.538
222	285	0.587	1.066	1.368	1.465	1.36	1.092	0.738	0.391	0.13	0.074	0.339	0.703	1.016	1.137	1.848	3.34	4.25	4.499	4.105	3.213	2.085	1.03	0.294	0.389	1.42	2.79	3.965	4.417
234	300	0.676	1.229	1.58	1.696	1.577	1.27	0.861	0.457	0.153	0.077	0.372	0.781	1.136	1.273	1.979	3.578	4.557	4.822	4.394	3.429	2.211	1.072	0.294	0.453	1.602	3.128	4.438	4.946

NOTES:
1. HOMOGENEOUS PLATE GIRDERS COMPRISE A709-50W STEEL FOR WEB AND ALL FLANGES.
2. SLIGHT ADJUSTMENTS TO DIAPHRAGM, STIFFENER AND SHEAR CONNECTOR LOCATIONS MAY BE REQUIRED.
3. REFER TO THE GENERAL NOTES DRAWINGS.

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

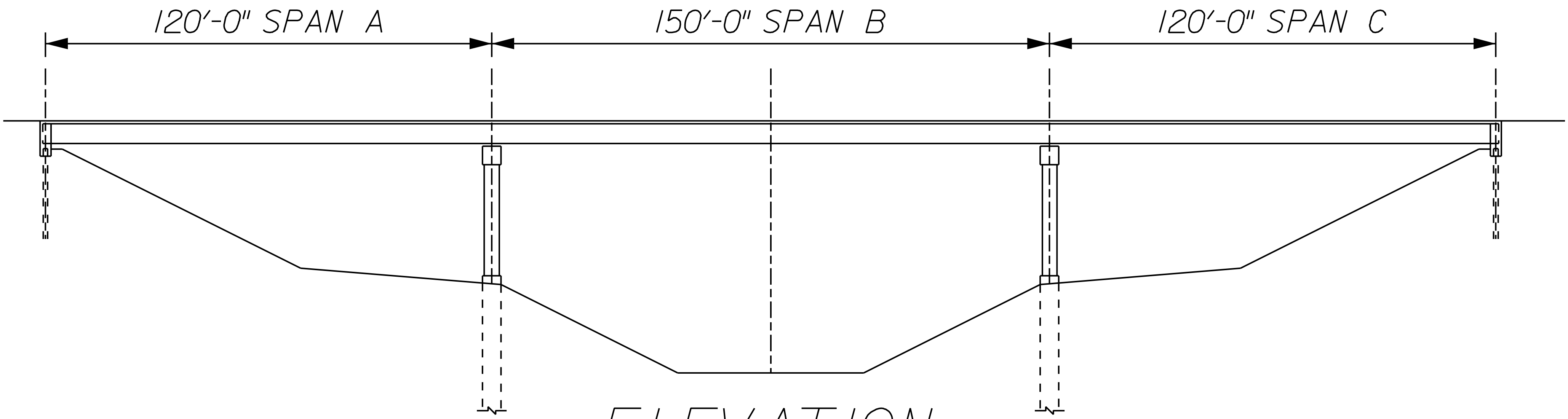
HNTB

Factors to Consider

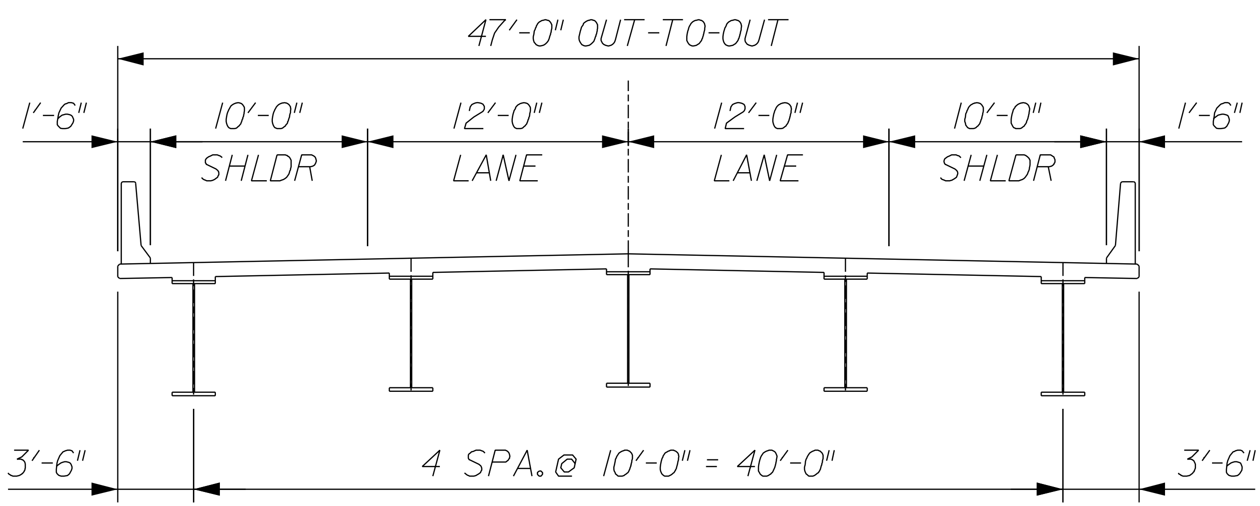
- Span Configuration
  - Simple Waterway or Grade Separation
  - Long Waterway or System Interchange Flyover Ramp
- Design
  - Beam/Girder Lines
  - Substructure Dimensions, Reinforcing, & Foundations
- Profile & Right of Way
- Life Cycle
  - Painted
  - Weathering, Galvanized or Metallized

HNTB

Sample Bridge

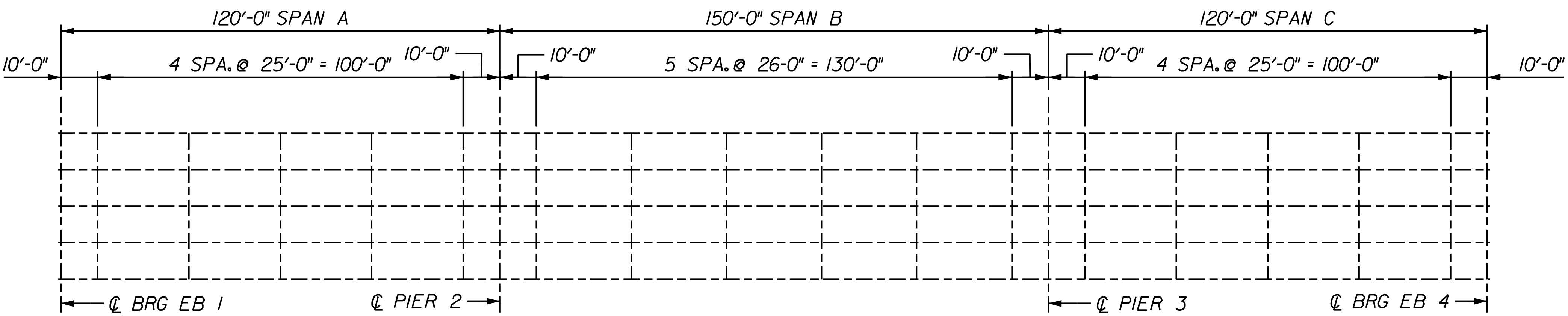


ELEVATION



TYPICAL SECTION

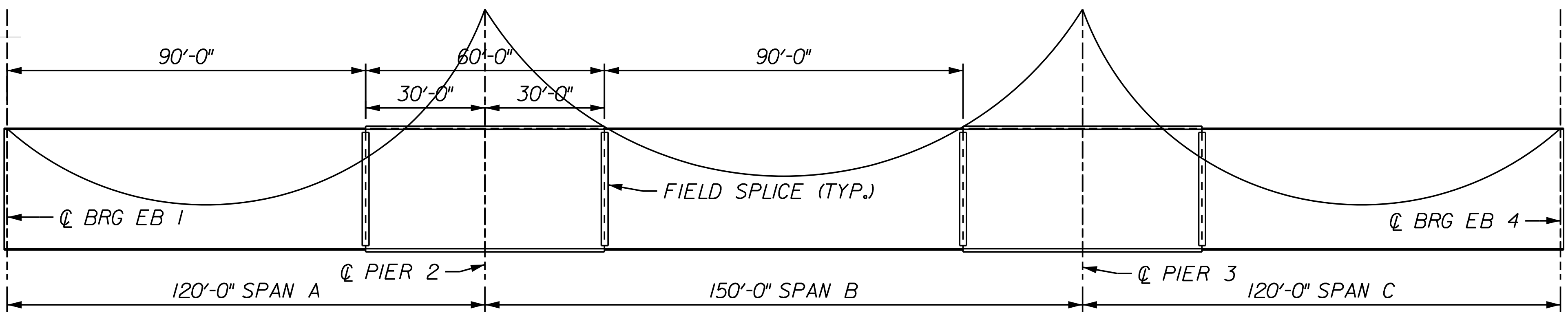
Framing Plan & Field Splice Locations



FRAMING PLAN

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

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



GIRDER ELEVATION

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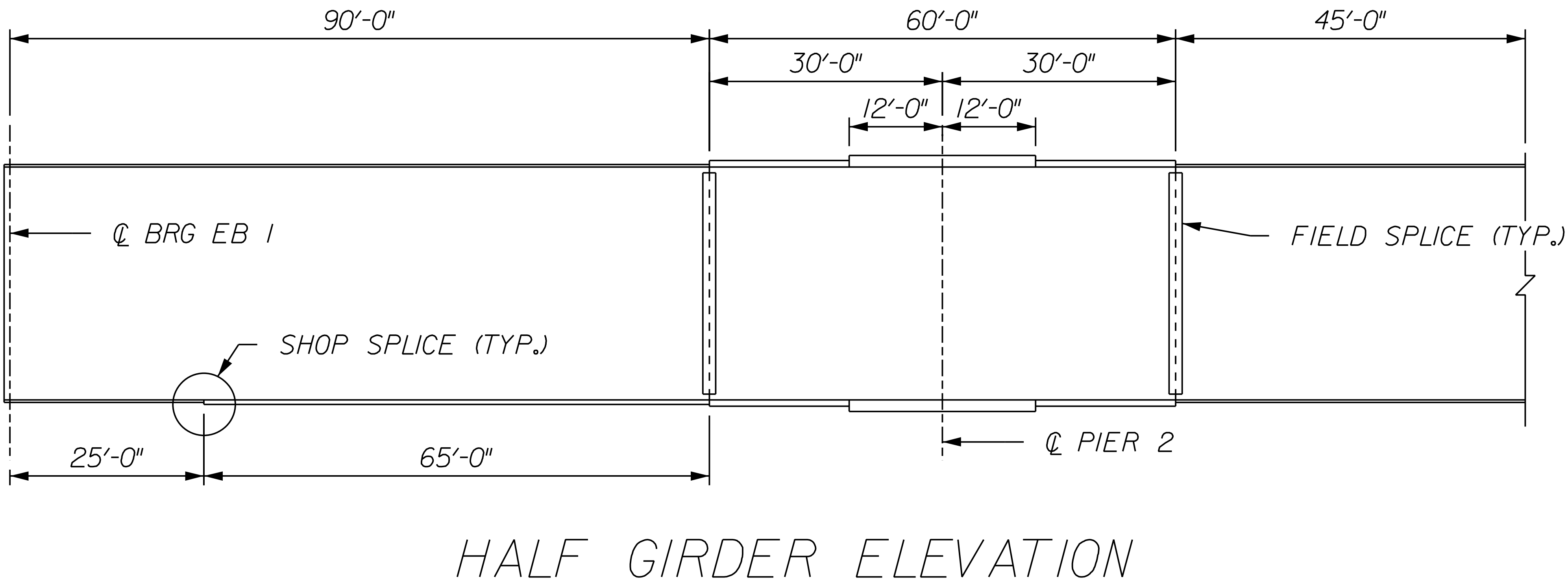
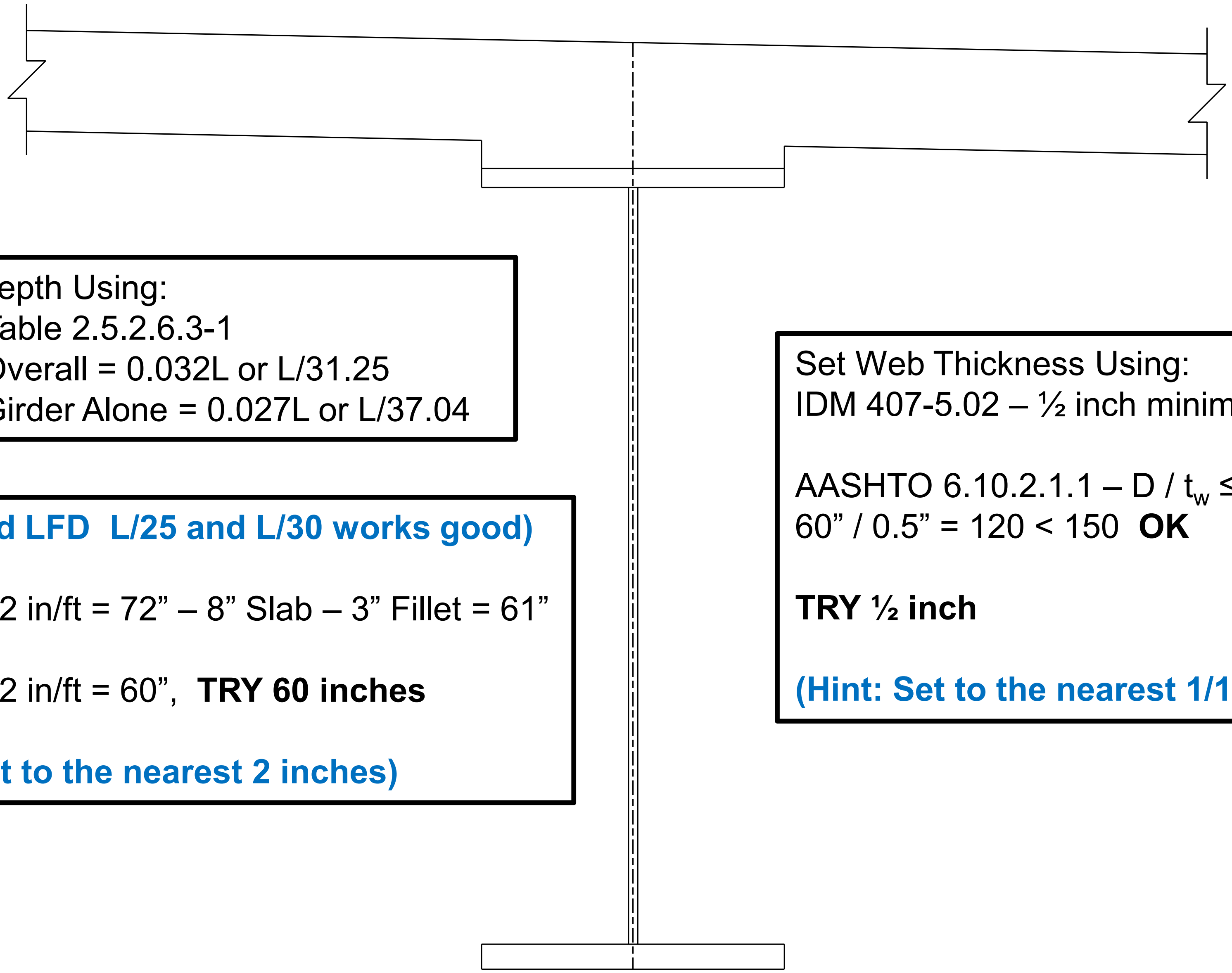
Shop Splice & Flange Transition Locations



Preliminary Sizing of Girder - Web



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

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

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

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

(Hint 2: Set to the nearest 2 inches)

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

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

TRY ½ inch

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

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Preliminary Sizing of Girder - Web

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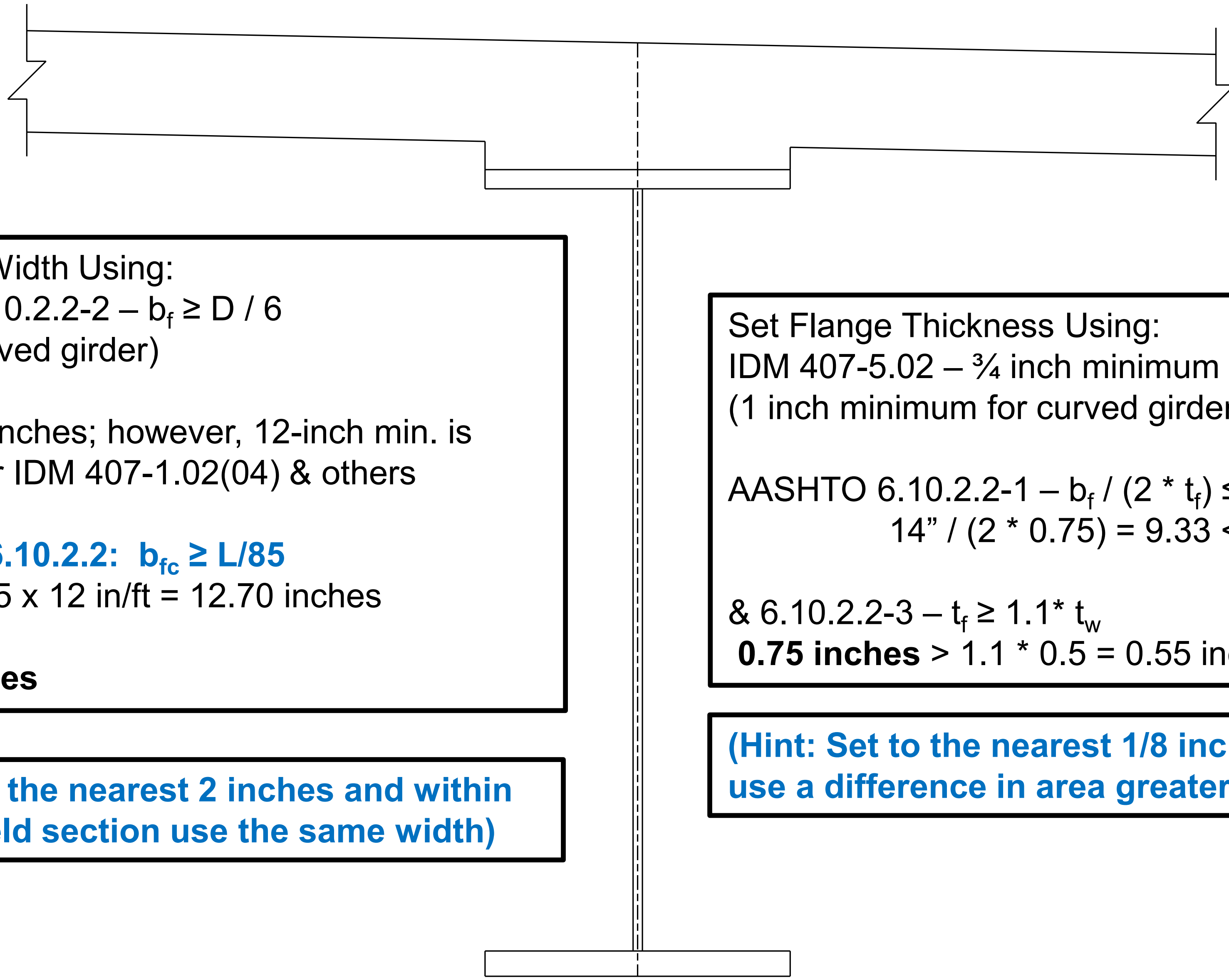
Preliminary Sizing of Girder - Flanges



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

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

AASHTO C6.10.2.2: $b_{fc} \geq L/85$
90’ / 85 x 12 in/ft = 12.70 inches

TRY 14 inches

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

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

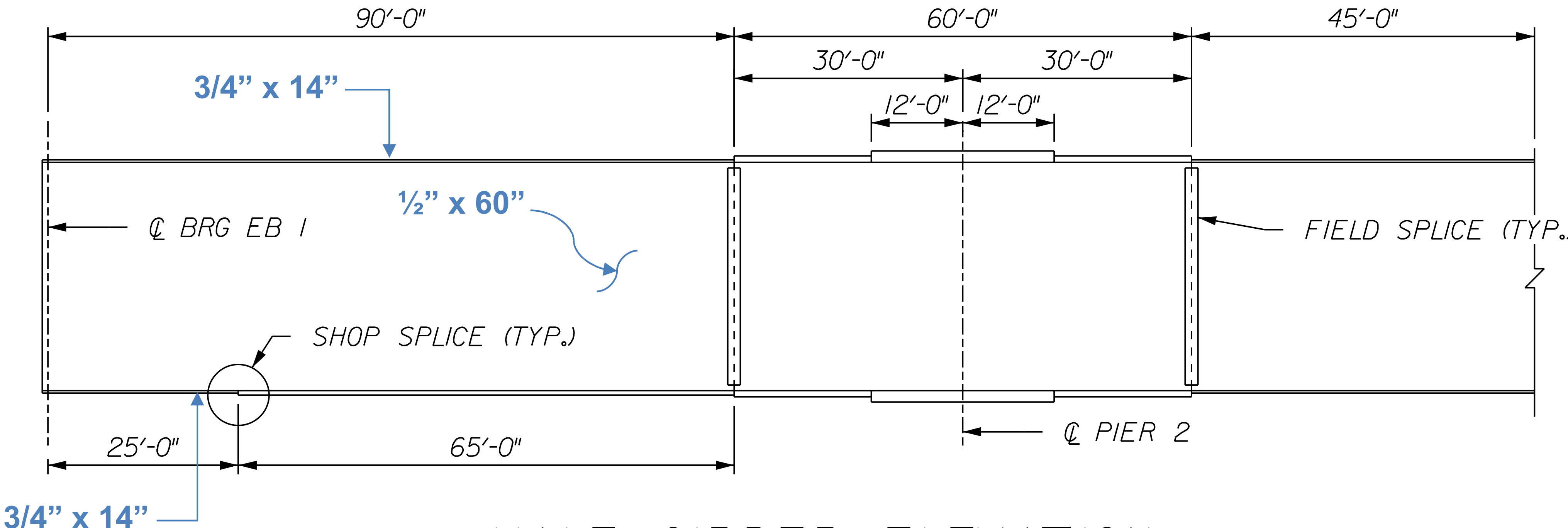
AASHTO 6.10.2.2-1 – $b_f / (2 * t_f) \leq 12$
14” / (2 * 0.75) = 9.33 < 12 **OK**

& 6.10.2.2-3 – $t_f \geq 1.1 * t_w$
0.75 inches > 1.1 * 0.5 = 0.55 inches **OK**

(Hint: Set to the nearest 1/8 inch and do not use a difference in area greater than 2 times)

HNTB

Minimum Plate Sizes



HALF GIRDER ELEVATION

Preliminary Girder Sizing – Bearing Stiffeners

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

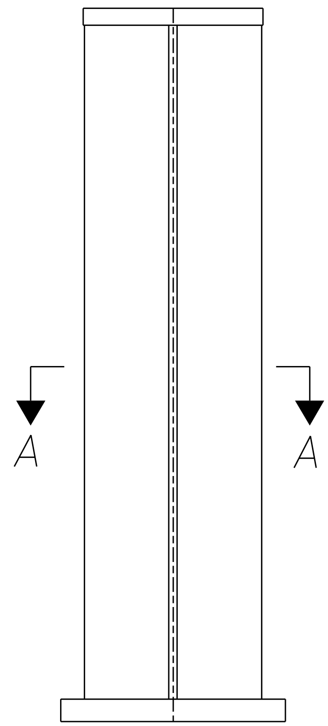
Set Bearing Stiffener Thickness Using:
IDM 407-5.02 – ½ inch minimum

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

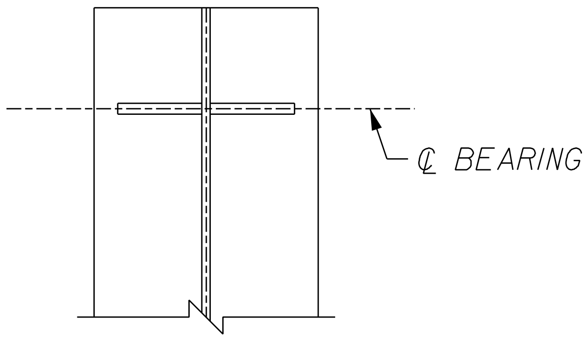
7 inches / 0.48 * √ (29,000 / 50) = 0.606 inches

TRY 0.625 inches or 5/8 inch, OK

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



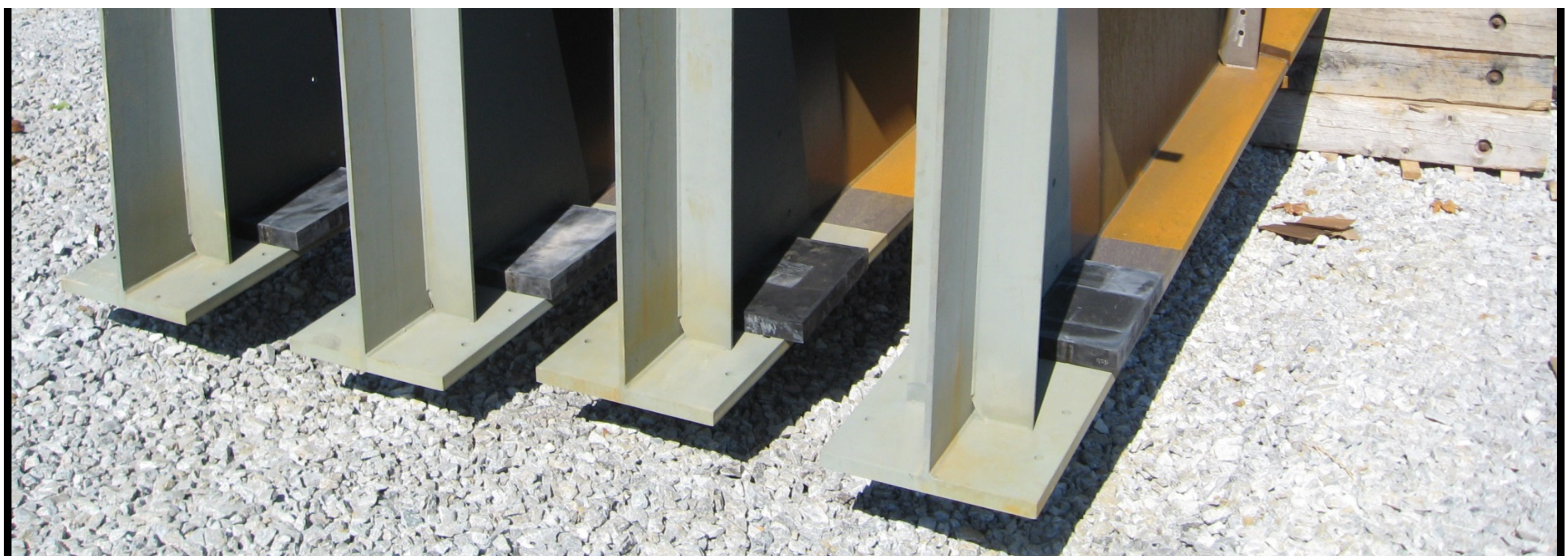
BEARING STIFFENER DETAIL



SECTION A-A

Preliminary Girder Sizing – Bearing Stiffeners

BEAM ENDS AND BEARING STIFFENERS SHALL BE FABRICATED SUCH THAT THEY ARE VERTICAL UNDER FULL DEAD LOAD.



HNTB

Preliminary Girder Sizing – Transverse Stiffeners

Set Transverse Stiffener/Connection Plate Width:

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

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

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

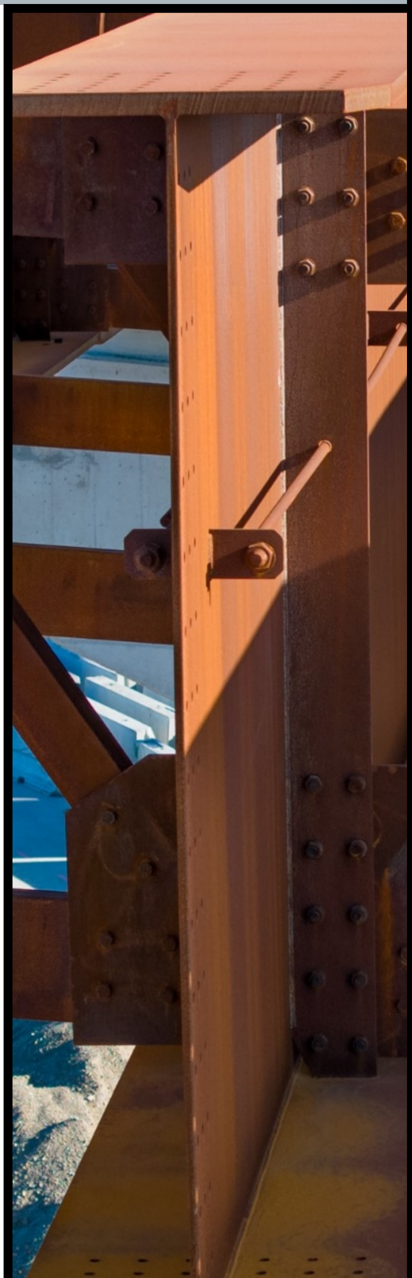
Set Transverse Stiffener/Connection Plate Thickness:

IDM 407-5.02 – ½ inch minimum

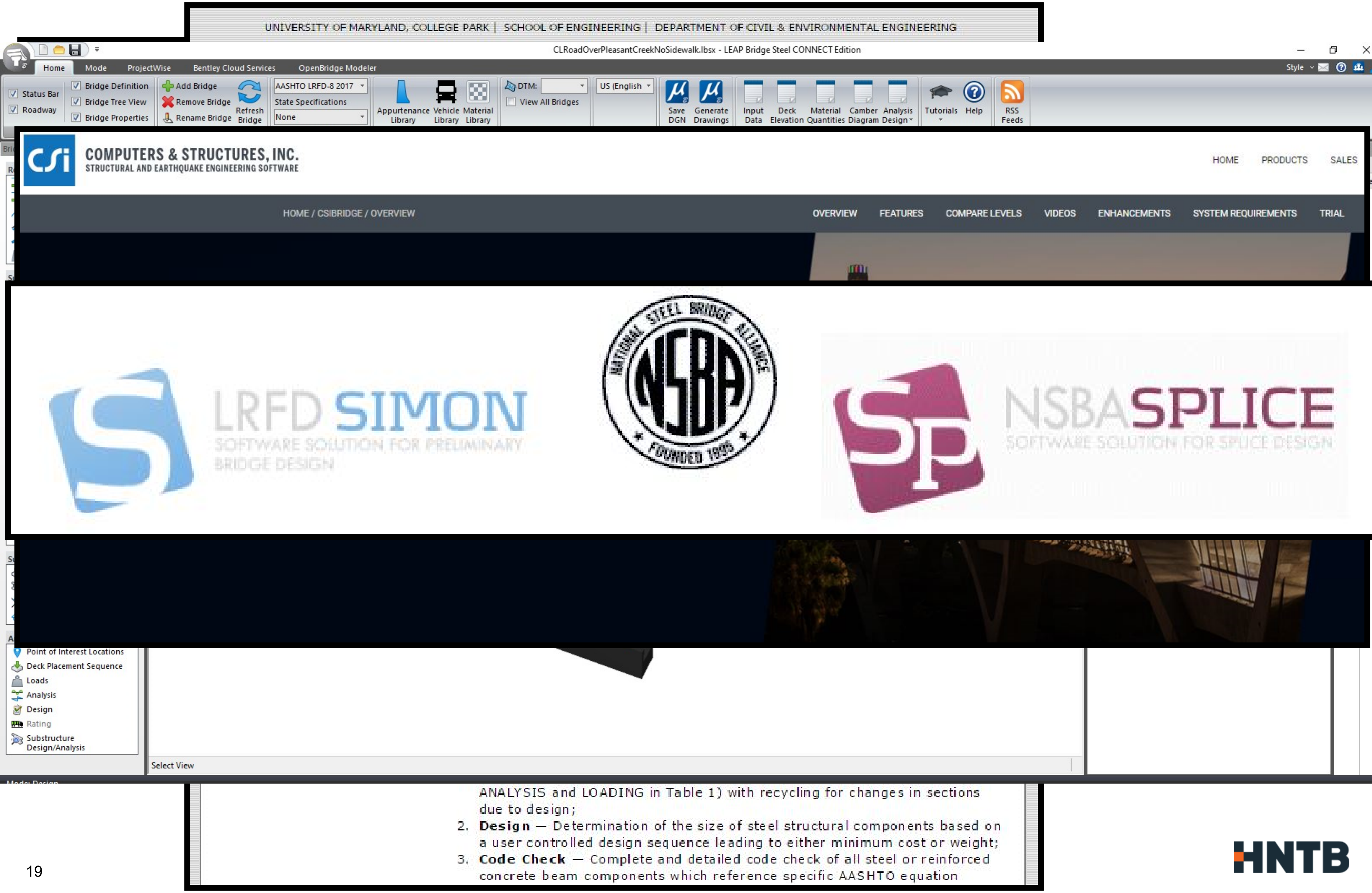
AASHTO 6.10.11.1.2-2
$16 * t_p \geq b_t \geq b_f / 4$
16 * **1/2** = 8 inches ≥ 5 inches ≥ 14" / 4 = 3.5 inches **OK**

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

Preliminary Girder Sizing – Intermediate Diaphragms

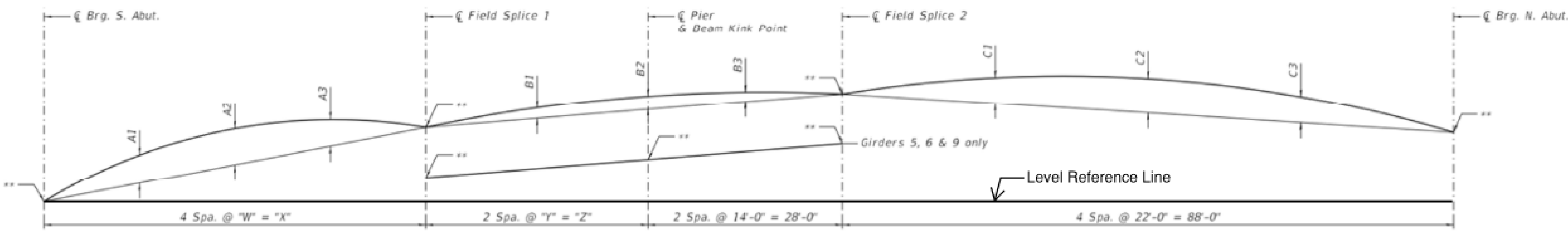


Next Steps



HNTB

Understanding the Misunderstood



CAMBER DIAGRAM - GIRDERS 5 THRU 9

** Top of Web Elevations

CAMBER DIMENSIONS
GIRDERS 5 THRU 9

Girder	A1	A2	A3	B1	B2	B3	C1	C2	C3	"W"	"X"	"Y"	"Z"
5	1 1/4"	1 7/8"	1 3/8"	0"	0"	0"	3 7/8"	5 1/8"	3 5/8"	13'-9 1/16"	55'-0 1/8"	±16'-1/16"	32'-0 1/16"
6	1 1/4"	1 7/8"	1 3/8"	0"	0"	0"	3 7/8"	5 1/8"	3 5/8"	13'-9 5/16"	55'-0 3/8"	16'-0 5/16"	32'-0 3/8"
7	1 1/4"	1 7/8"	1 3/8"	1/2"	3/4"	1/2"	3 7/8"	5 1/8"	3 5/8"	±13'-9 5/8"	55'-1 1/16"	±16'-0 7/16"	32'-0 13/16"
8	1 1/2"	2"	1 1/2"	1/2"	3/4"	1/2"	3 7/8"	5 1/4"	3 5/8"	±13'-9 5/8"	55'-2 5/16"	16'-0 1/2"	32'-1 1/2"
9	1 3/8"	2 1/8"	1 5/8"	0"	0"	0"	4"	5 1/4"	3 3/4"	13'-10"	55'-4"	±16'-1 3/16"	32'-2 5/16"

TOP OF WEB ELEVATIONS *

Girder	℄ Brg. S. Abut.	℄ Splice 1	℄ Pier	℄ Splice 2	℄ Brg. N. Abut.
1	701.55	702.51	702.84	703.13	702.53
2	701.68	702.65	702.98	703.27	702.67
3	701.81	702.80	703.13	703.41	702.82
4	701.94	702.94	703.27	703.56	702.97
5	701.94	702.88	703.20	703.49	702.90
6	701.73	702.72	703.05	703.34	702.75
7	701.53	702.56	702.96	703.20	702.61
8	701.33	702.45	702.86	703.10	702.51
9	701.42	702.57	702.91	703.21	702.62

* For fabrication only

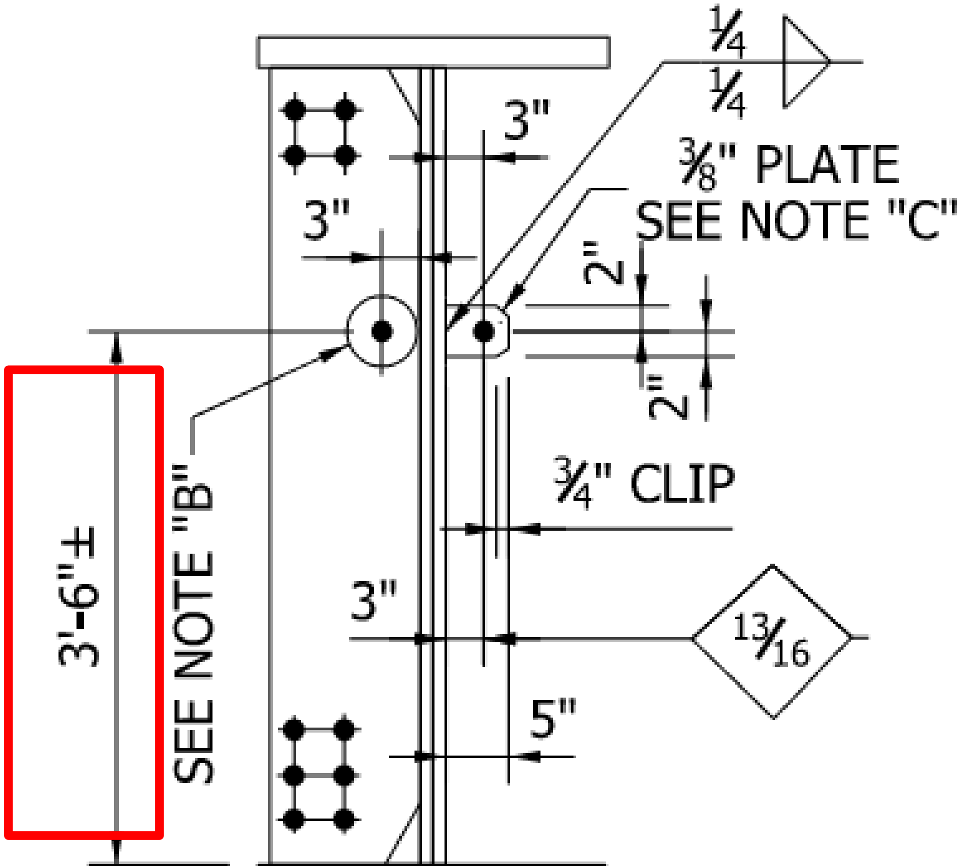
BLOCKING DIAGRAM

NO LOAD CAMBER AND REAMING DIAGRAM

(SKETCH SHOWN FOR CREST VERTICAL CURVE)

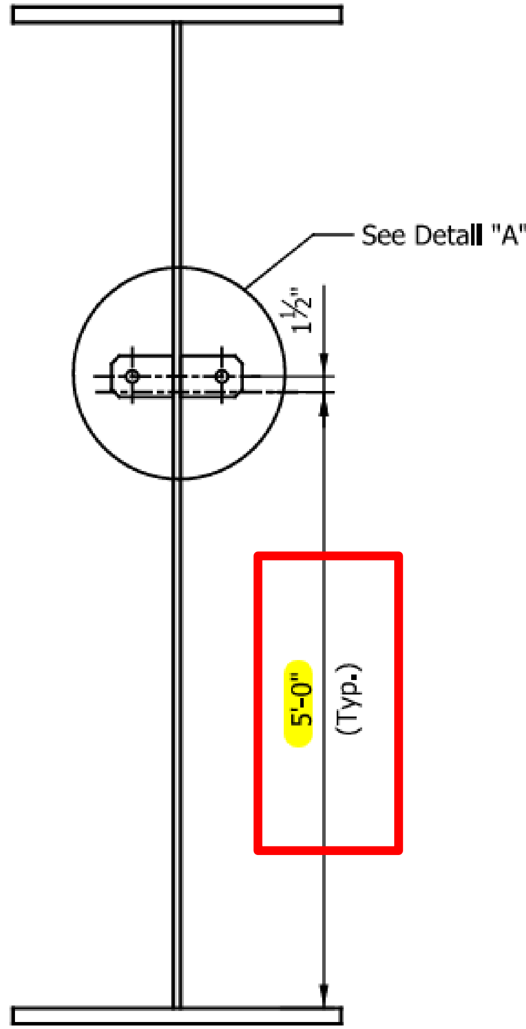
HNTB

Understanding the Misunderstood



SECTION

IDM Figure 407-1D

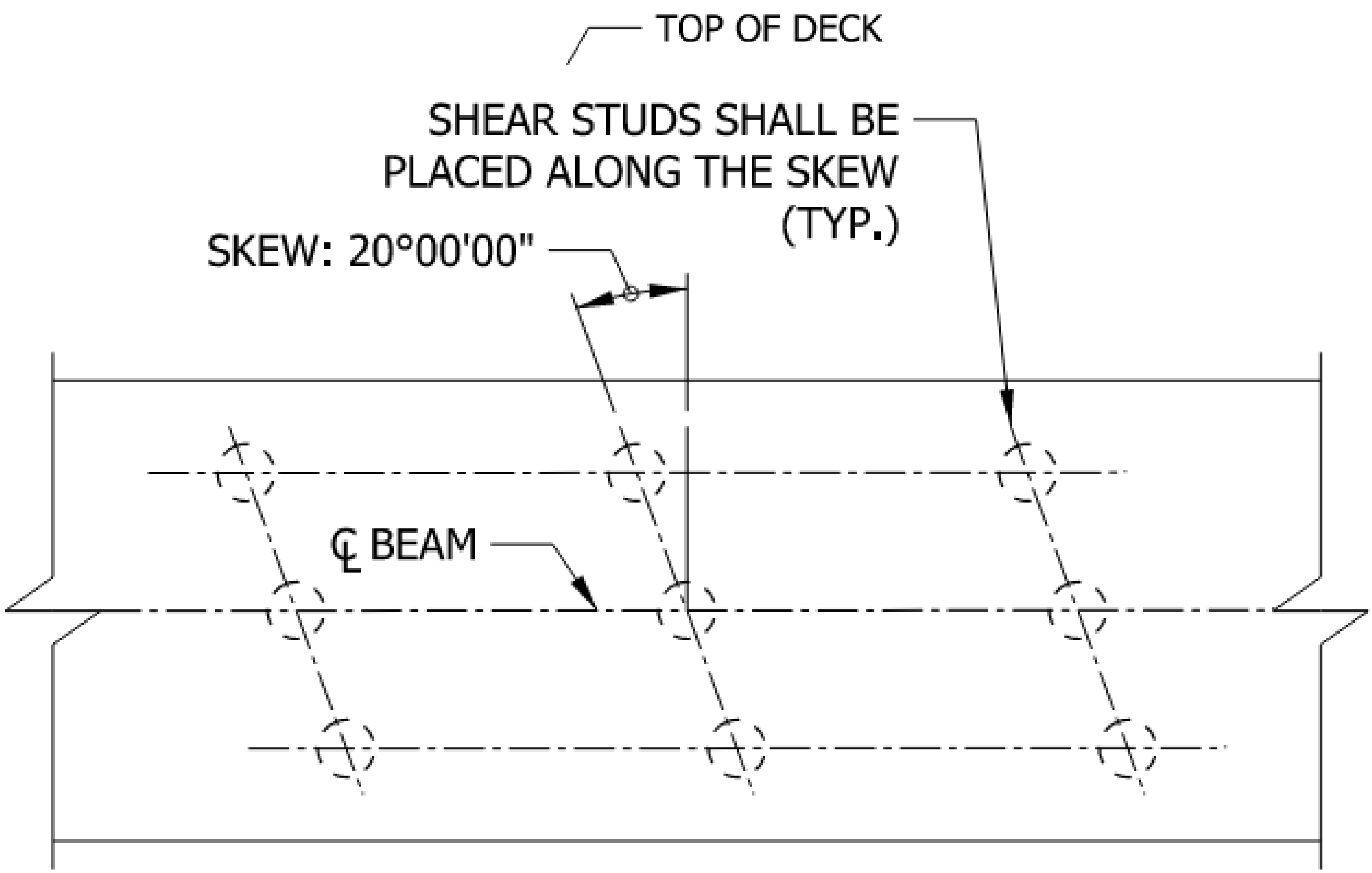


SECTION A-A

Handrail to Run the Length of the Girder and May Be Discontinuous at splice locations. Interior Girder Elevation Shown, Handrail Only on Inside Face of Exterior Girders

HNTB

Understanding the Misunderstood

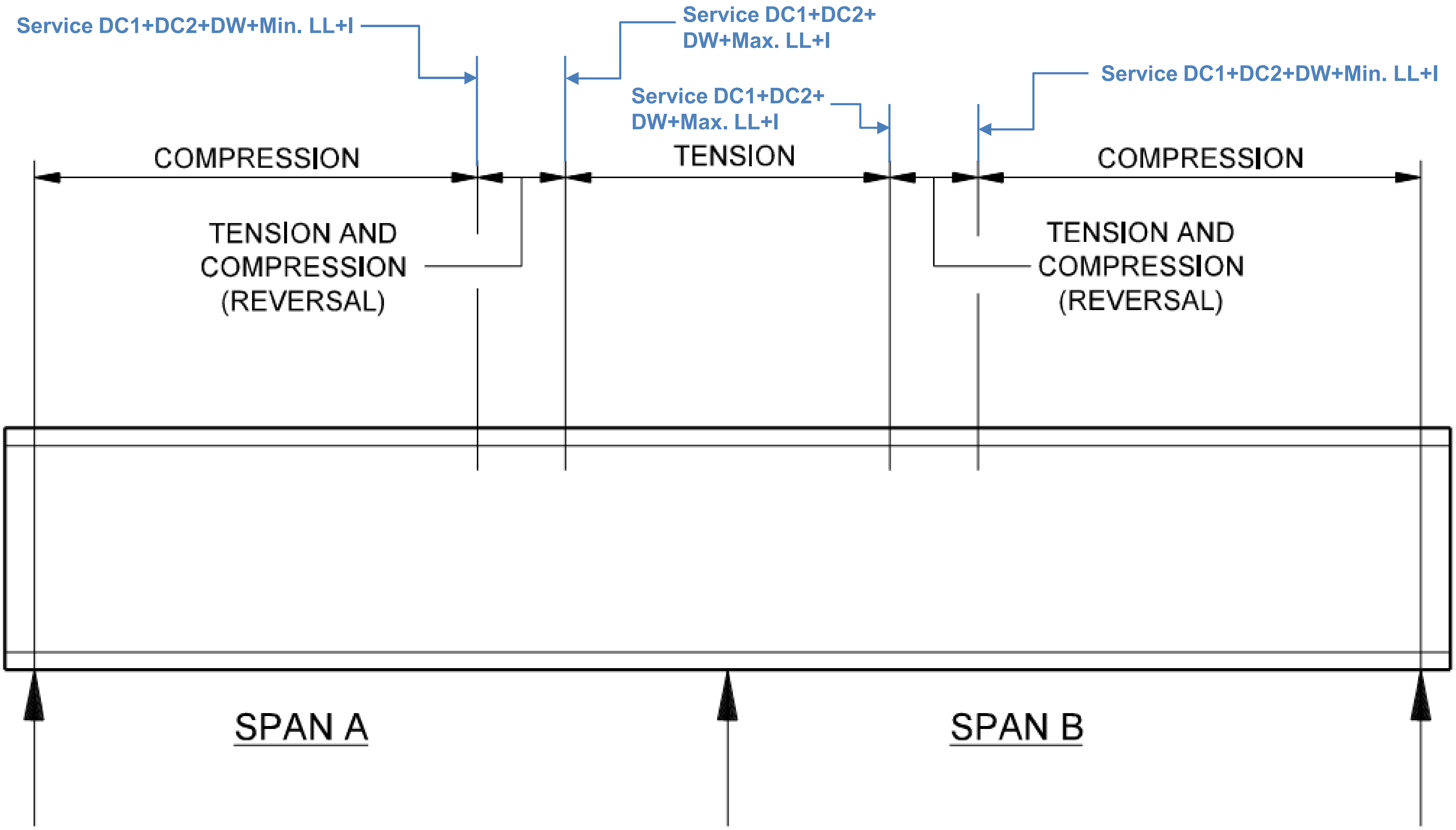


TYPICAL SHEAR CONNECTOR PLAN

SCALE: 1½" = 1'-0"

3. CONTRACTOR SHALL USE TALLER WELDED SHEAR STUDS AS NECESSARY TO MAINTAIN 2" MIN. EMBEDMENT INTO THE SLAB.

Understanding the Misunderstood



HNTB

Steel Design Doesn't Have to be Challenging

QUESTIONS?

STRUCTURAL STEEL
A FABRICATORS PERSPECTIVE

Speaker:
Justin Cowan P.E.
Business Development Manager
Wabash Steel Company, LLC

WABASH

AISC CERTIFIED FABRICATOR & ERECTOR

LET'S TALK STRUCTURAL STEEL

- *What is Structural Steel?*
- *Where does Structural Steel come from?*
- *How is Structural Steel made?*
- *Why Steel?*
- *How much does Structural Steel cost?*
- *Who can help?*

WHAT IS STRUCTURAL STEEL?

STRUCTURAL STEEL (BRIDGES)

It depends!

Rolled Beam

Kinked Plate Girder

Tied-Arch

Railroad Thru-Girder

Bascule

Plate Girder

Cantilever

Curved Tub Girder

Built-Up Press-Brake Tub Girder

Arch

Truss

Kinked Beam

Thru-Girder

Cable-Stay

Pedestrian

Curved Plate Girder

Press Brake Formed Tub Girder

Welded Plate Tub Girder

You get the point!

WABASH

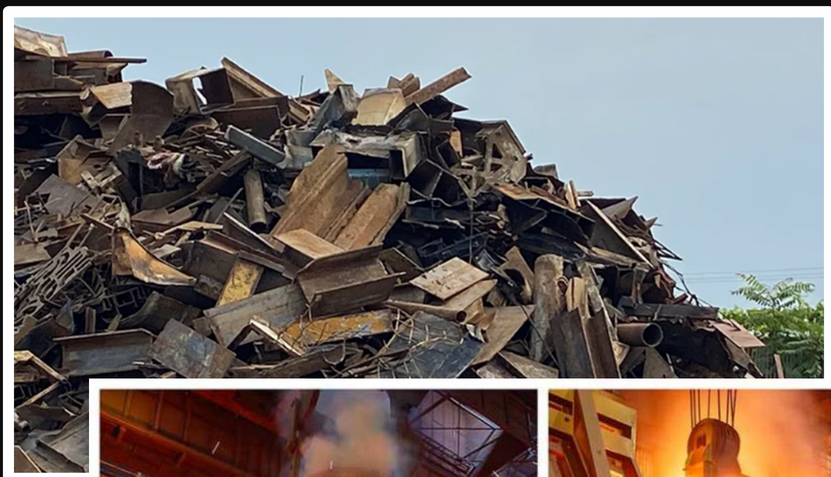
WABASH

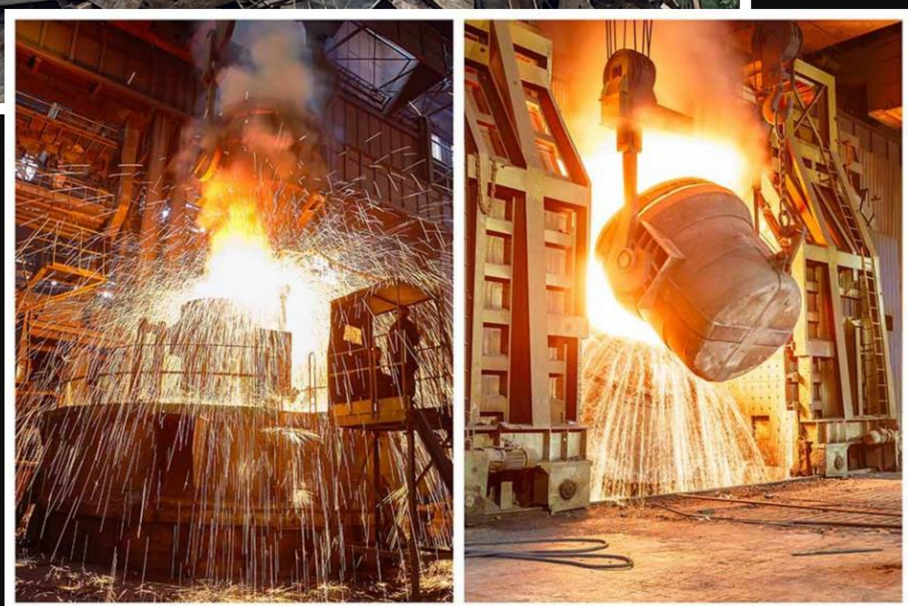
WABASH

WABASH

WHERE?

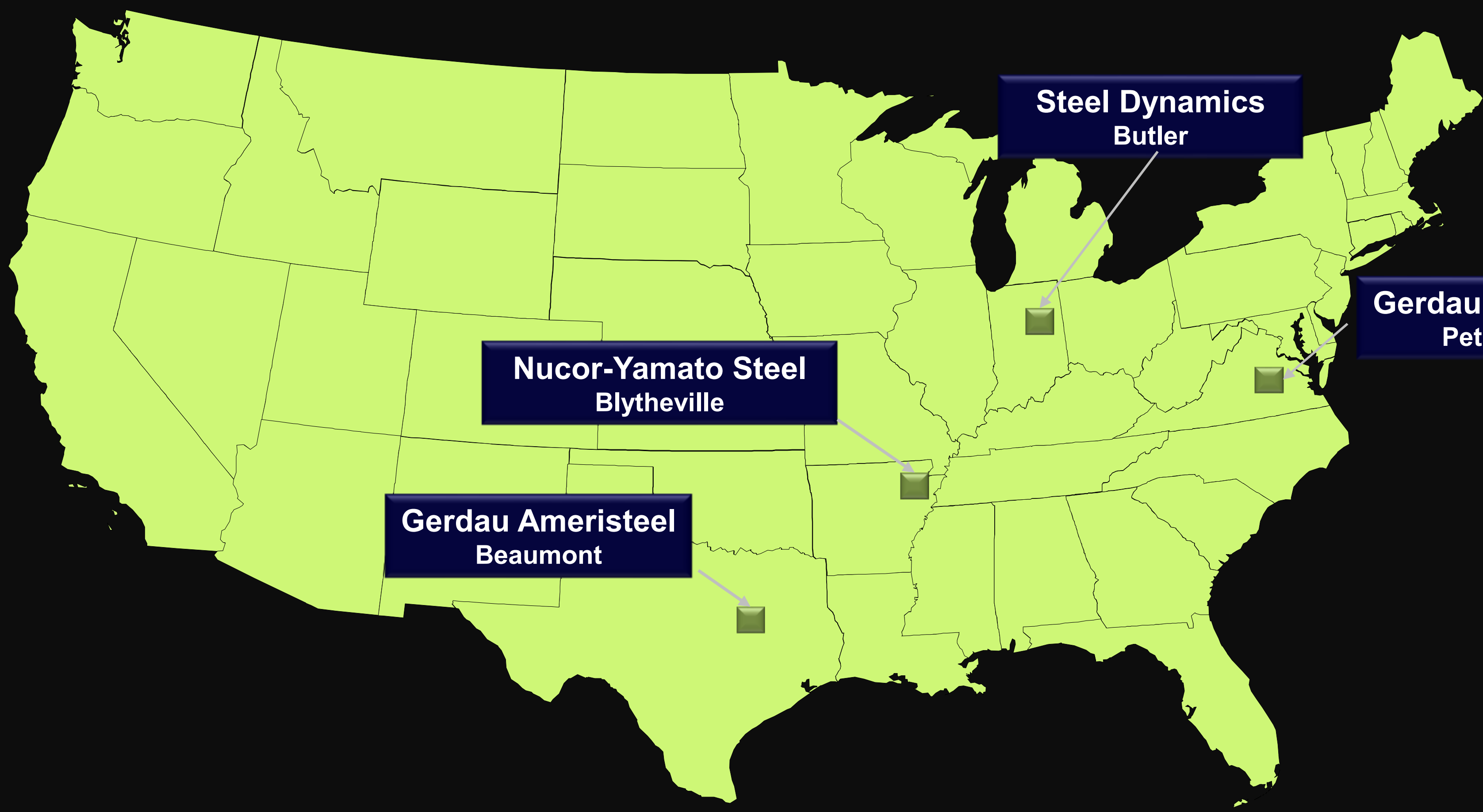
WHERE IT ALL BEGINS – STEEL MILLS





STEEL MILLS – Structural Plate

STEEL MILLS – Structural Shape



FABRICATORS IN THE AREA

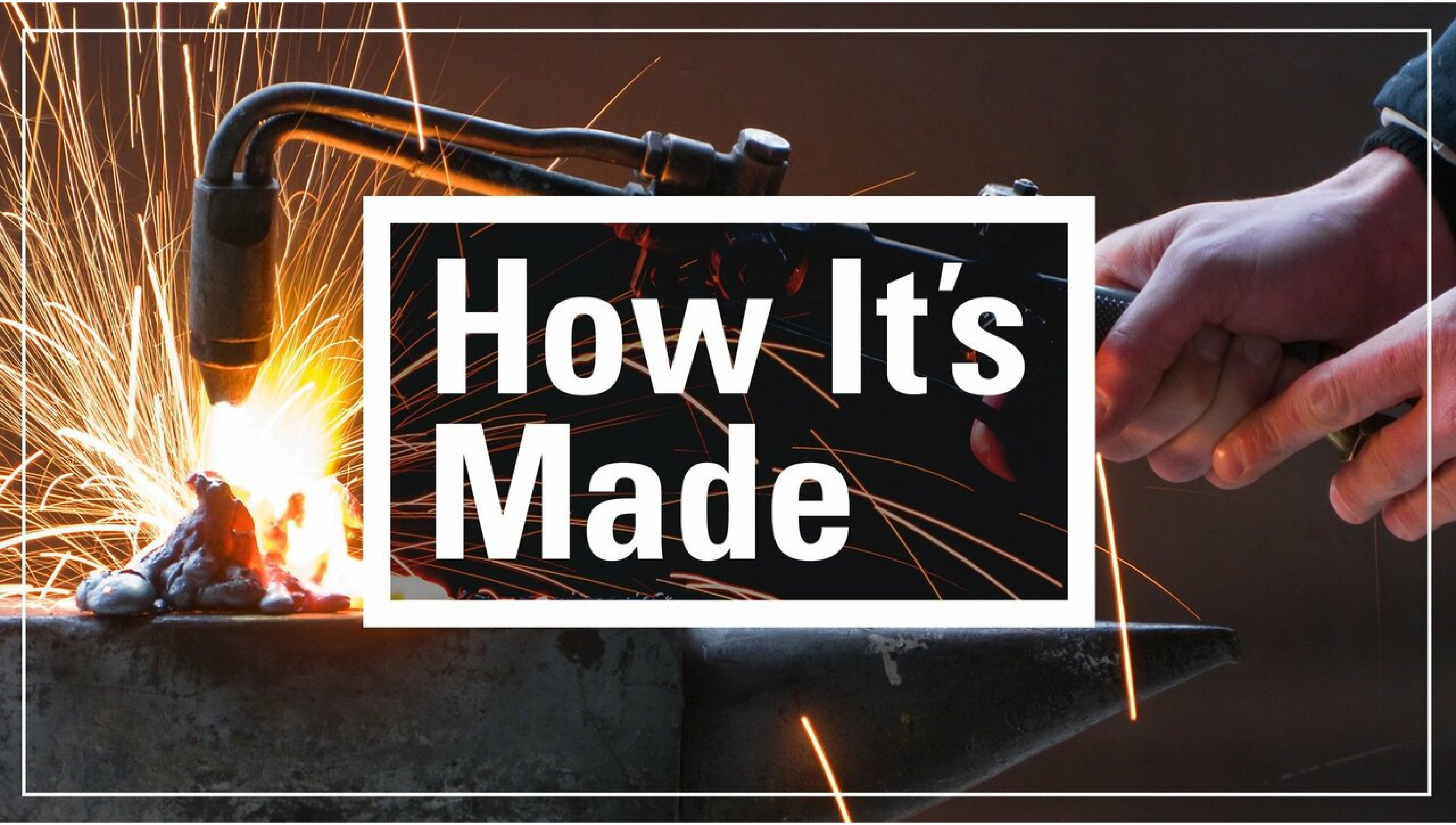
Located in Indiana

Indiana Steel & Engineering Corporation
Industrial Steel Construction, Inc.
Munster Steel Company, Inc.
Wabash Steel Company, LLC

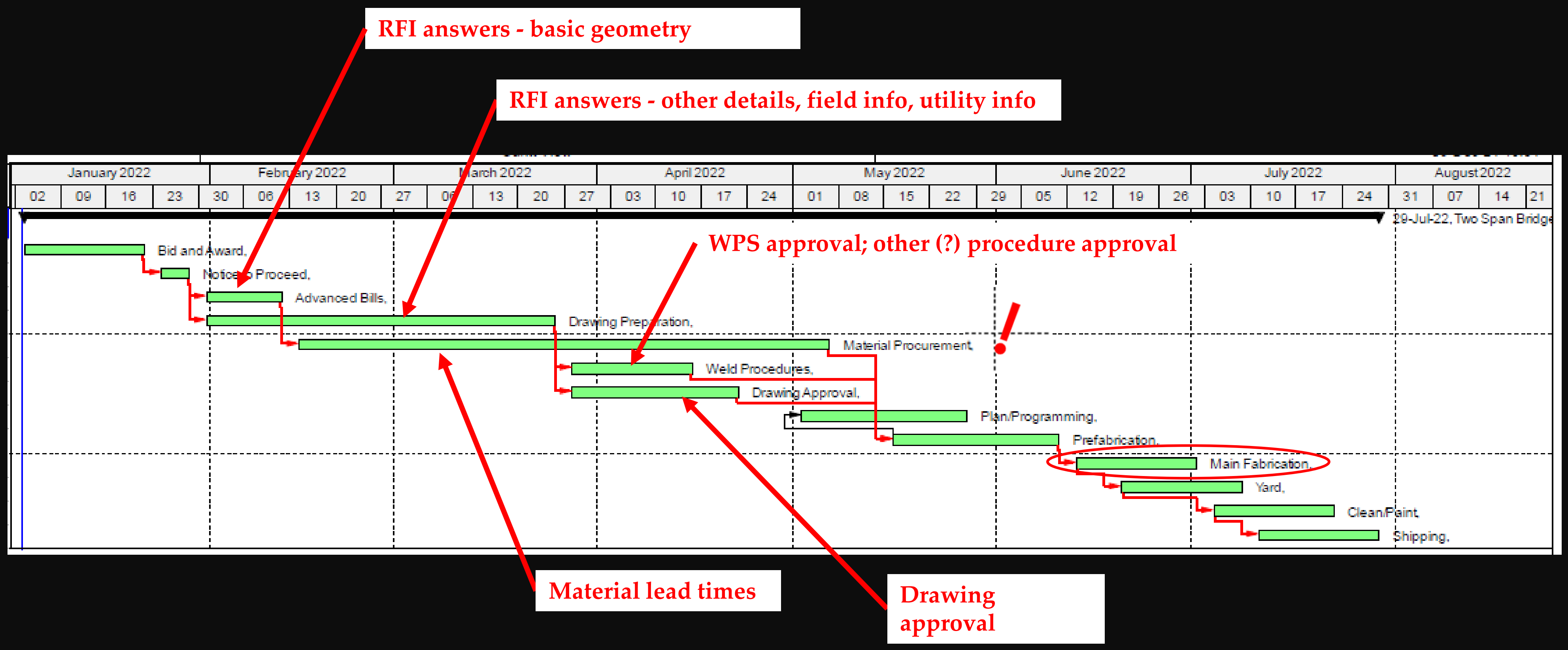
Nearby that Service Indiana

Delong's , Inc.
High Steel Structures, Inc.
Kard Welding, Inc.
Stupp Bridge Company
Veritas Steel
W&W/AFCO Steel
Others....

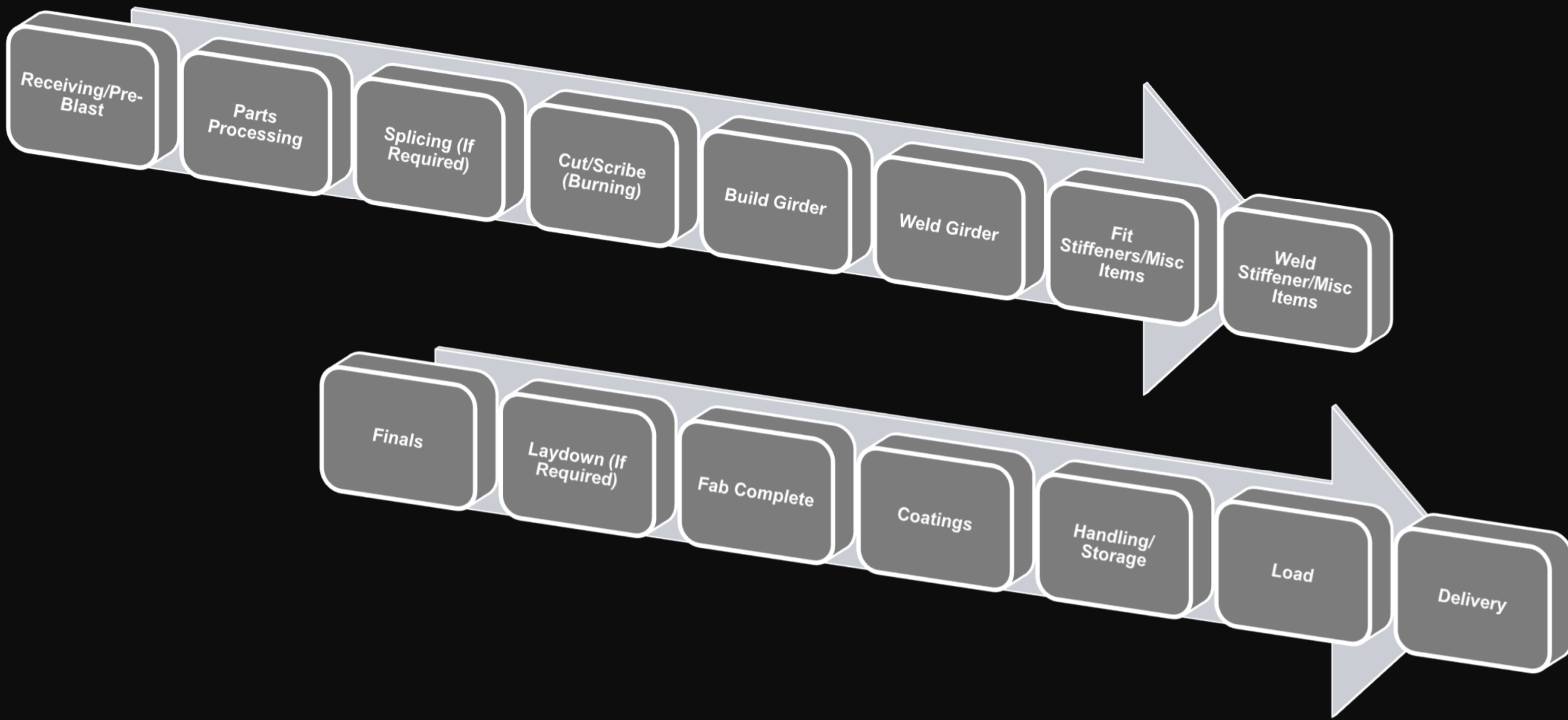
https://www.aisc.org/nsba/get-involved/certified-bridge-members/


How It's
Made

PROJECT LIFE CYCLE (NTP TO DELIVERY)



FABRICATION - PLATE GIRDER EXAMPLE



RECEIVING

Media Blast Raw Material Immediately Prior to Fabrication

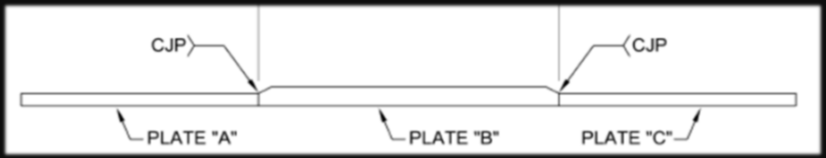
PRE-BLAST

PARTS PROCESSING – Misc Parts

- Plasma & CNC programming is used to process many miscellaneous parts within a Bridge project
- Stiffeners, splice plates, gusset plates, XF parts, etc.

PARTS PROCESSING – Misc Parts

- *Most commonly butt welds which are required where girder lengths exceed mill rolling limits*
- *Also required when thicknesses vary along the girder*
- *CJP Weld is used and subjected to NDT*



SPLICING (AS REQUIRED)

- ***Occasionally required due to Girder Shape***

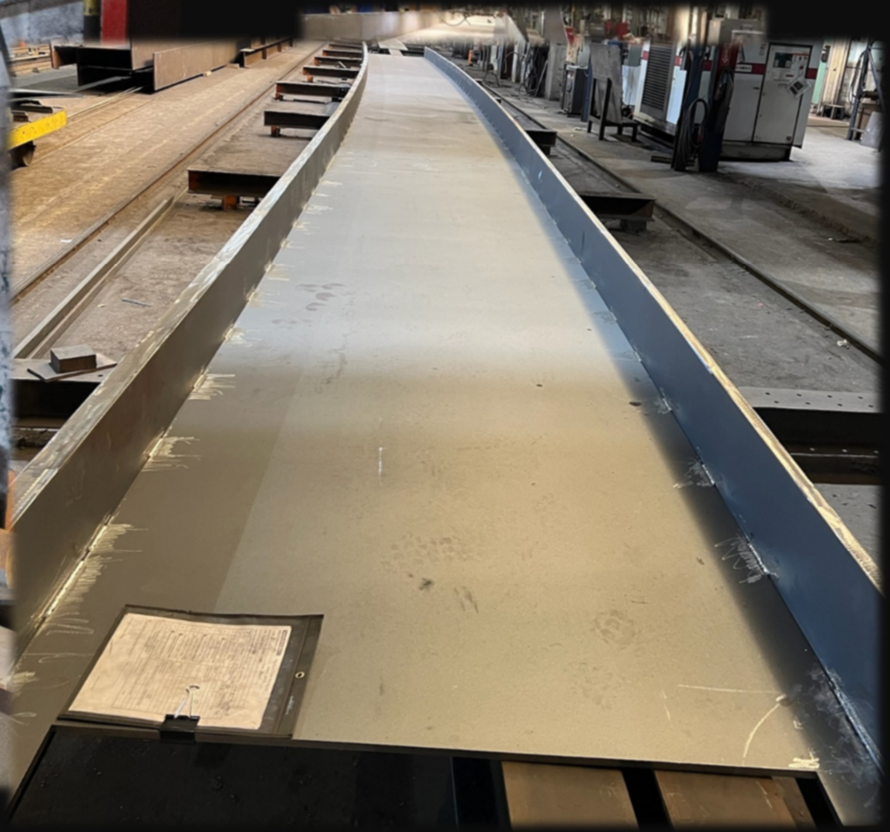
SPLICING (AS REQUIRED)

- *Plasma Cut Webs with Required Design Camber*

CUT/SCRIBE (BURNING) - Webs

- Cut Flanges with Oxy-Fuel Torches

CUT/SCRIBE (BURNING) - Flanges

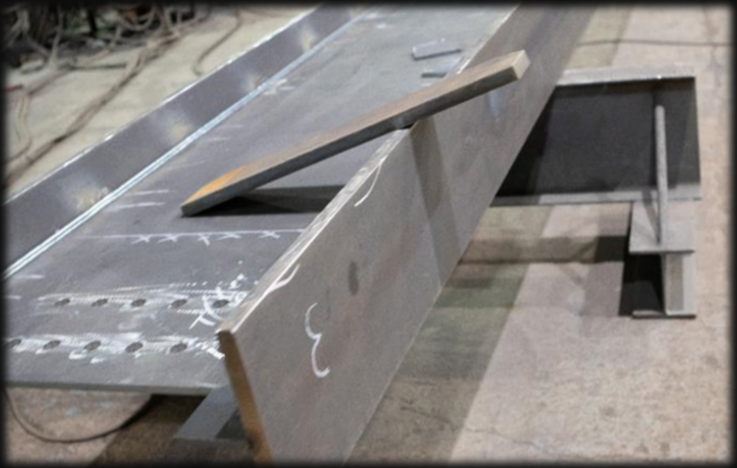


- ***Properly position the Web & Flanges and tack weld in place to create the Girder shape***
- ***Not only are the Web & Flange pieces heavy, but they are also flexible. It is only after the girder is assembled that some rigidity is attained.***

BUILD GIRDER

➢ *After girder is assembled, they are welded together with Submerged Arc Welding (SAW)*

WELD GIRDER



- Stiffeners are placed at their appropriate position and tacked into place.
- Certain fit conditions (tight fit or mill to bear) will be accomplished at this stage

FIT STIFFENER/MISC ITEMS

- ***After all stiffeners are in place, the required design welds are performed.***

WELD STIFFENER/MISC ITEMS

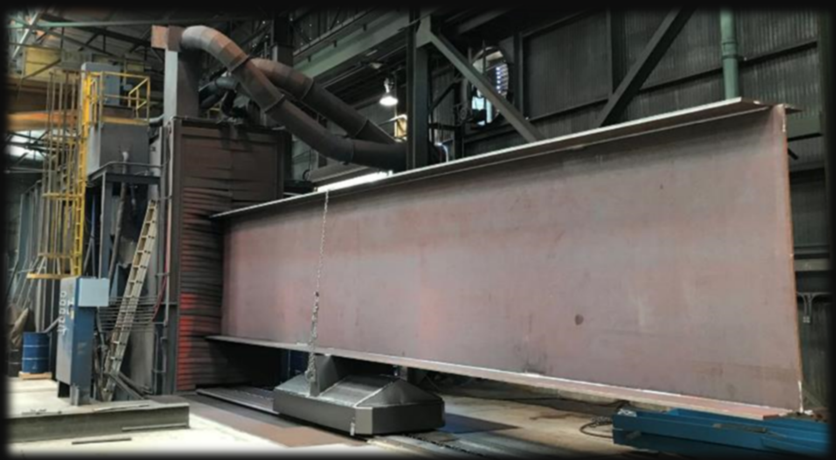
- ***After stiffeners have been welded, any ancillary pieces are added to the girder. Girder ends are trimmed to final geometry.***
- ***Often includes holes in webs for connections for abutment reinforcing and fabrication associated with bearing connections.***
- ***Taller girders may have handrail installed.***
- ***Once all fabrication and NDT is completed, a final geometry check is performed. Commonly includes Camber/Sweep checks***

FINALS

- ***Laydown is one method used to ensure proper fit of field splices. (Methods vary by fabricator's equipment)***

LAYDOWN (AS REQUIRED)

- *After fabrication is completed, steel superstructure will receive surface preparation.*
- *Blast cleaning is most commonly utilized, but grinding is used where appropriate*
- *Surface preparation parameters are dependent on final coating*



FAB COMPLETE

- *INDOT projects most commonly require shop applied primer coat.*
- *Some Owner's request entire paint system to be applied in the fabrication shop with field applied touch-up procedure.*
- *Coatings may also include Galvanization or Metalizing.*

Note: Most fabricators prefer to minimize painting efforts, so Weathering Steel (UWS) is strongly encouraged and traditionally most cost effective for the owner

COATINGS (AS REQUIRED)

HANDLING/STORAGE

LOADING & DELIVERY

WHY STRUCTURAL STEEL?

Resilience

100-year steel bridges have been built for over 100 years. Many notable, historic, and revered bridges have been built with steel: Golden Gate Bridge, Eads Bridge, and the Brooklyn Bridge to name a few. With appropriate maintenance, these 100-year bridges have proven their resiliency to harsh environmental conditions and extreme events. Steel bridges of today are built with steel materials, coatings, and fabrication techniques that have the potential to be even more resilient than bridges built 100 years ago.

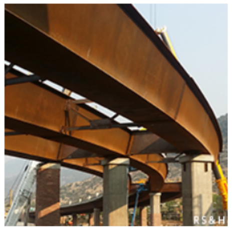
In-Service Inspectability

Steel bridges can be visually inspected, as all major load-carrying components are easily accessible by bridge inspectors to efficiently evaluate their in-service condition. Main-load carrying components are not hidden from the bridge inspector's eyes, and typically do not require costly specialized equipment or non-destructive testing methods to determine their condition. Bridge inspectors are able to touch the main load-carrying components and obtain physical measurements of any possible deterioration, providing evaluators the data necessary to appropriately load rate the structure.

Accelerated Construction Schedule

Fabricated off-site with geometrically controlled equipment, structural steel has the advantage of being ready to erect as soon as it reaches the bridge site. Reinforcement and formwork installation is not required. Structural steel erection is not limited to a specific temperature range. Structural steel is often lighter than other materials for the same span, resulting in smaller or fewer erection cranes. The use of structural steel for a bridge project accelerates construction and reduces on-site labor requirements and overall project costs.

Complex Geometries



Steel girders and other bridge components can meet the challenges for numerous complex geometrical configurations, from the simple to the complex. Steel bridges have the advantage of being able to handle tight curves, large skews, variable width decks, single-point urban interchanges, as well as entrance and exit ramp bifurcations that are a necessity within limited owner right-of-way spaces.

Unmatched Span-to-Depth Ratio

The recommended minimum depth for a continuous steel girder is 33% shallower than the recommendation for precast concrete. Combine these shallower girders with the fact that steel can span crossings well over 500 feet, and you have enormous benefits--in the form of lower initial construction costs now and lower maintenance and inspection costs in the future.

Reduced Waste and Pollution

On average, structural steel produced in the U.S. contains at least 93% recycled content, and 100% of a structural steel frame can be recycled into new steel products. Steel's high strength-to-weight ratio coupled with a low carbon footprint-1.16 tons of CO_2 per ton of fabricated hot-rolled steel-results in an overall reduction of the embodied carbon of a typical structure compared to other framing materials. Simply stated, waste and environmental impacts are minimized when steel is used.

https://www.aisc.org/nsba/why-steel-bridges/

Reliability and Redundancy

Steel bridges achieve reliability through redundant design and construction practices. Effective and efficient redundancy can be achieved through system or member-level mechanisms using engineered damage tolerances that can be coupled with the inspection interval of the bridge. Additionally, exposed tension elements of in-service steel bridges improve the probability of damage detection during routine visual inspections, further increasing safety and reliability.

Lightweight Superstructure

Superstructures for steel bridges are generally lighter than other building materials which typically result in smaller and less costly foundations. Also, lighter superstructures typically result in reduced seismic forces which can be a major advantage in high seismic regions.

Future Modification and Adaptability

Structural steel bridge components can be strengthened and adapted if the need arises in the future to address increased live loadings, new live loadings, roadway widenings, or other changes in configuration. Other materials do not have the same adaptability and oftentimes require replacement for new loadings or changes in configuration.

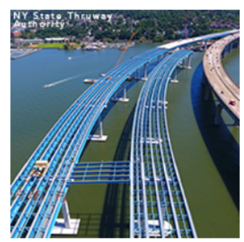
Maintainability and Repairability

When necessary, steel bridges can be efficiently repaired and remain in service, and not require complete replacement. Components can be strengthened with additional steel, or components can be removed and replaced without removing the bridge permanently from service. Impacts and damage from over height vehicles below the bridge are often easily corrected with well-documented heat-straightening techniques. Maintenance, repairs, and rehabilitation of a steel bridge can often occur with all or a portion of traffic maintained on the structure, while extending the in-service usefulness of the existing bridge.

Workhorse Bridges

Steel bridges offer owners opportunities in the short span, typical overpass, workhorse bridge market as well. Steel bridges can provide a cost-effective solution for short spans, utilizing standard rolled sections or standard plate girders, as well as modern coating systems. When a quick replacement is necessary for a shorter span, steel offers the ability to be modular in construction, and rolled sections can be made readily available.

Quality and Predictability



Off-site fabrication allows for controlled conditions, ensuring a higher quality product configured to precise tolerances. While all bridges experience some type of movement, a structural steel bridge behaves in a predictable manner to provide comfort to the traveling public.

Railroad and Transit Applications

Steel bridges are well suited for railroad and transit applications due to the high strength and stiffness that steel can provide as deck girder, through-girder, or truss type bridges. Steel's high strength to weight ratio is ideal for supporting rail live loads which are nearly five times as heavy as traditional highway live loads. The stiffness characteristics provided by steel bridges can be exploited to meet the more stringent live load deflection and operational requirements of rail and transit loading.

Long-Lasting and Durable

Stiffness, strength in both tension and compression, and the ability to bend without cracking or breaking are inherent advantages of structural steel. Compared to all other materials, structural steel has the greatest ability to maintain strength and integrity during extreme events. Steel bridges are not subject to shrinkage or creep under load over time. Even in corrosive environments, applied coatings protect structural steel and add longevity to the bridge. A durable and nonporous material, steel provides value and a significant return on investment.

https://www.aisc.org/nsba/why-steel-bridges/

HOW MUCH DOES STRUCTURAL STEEL COST?

What did the audience think?

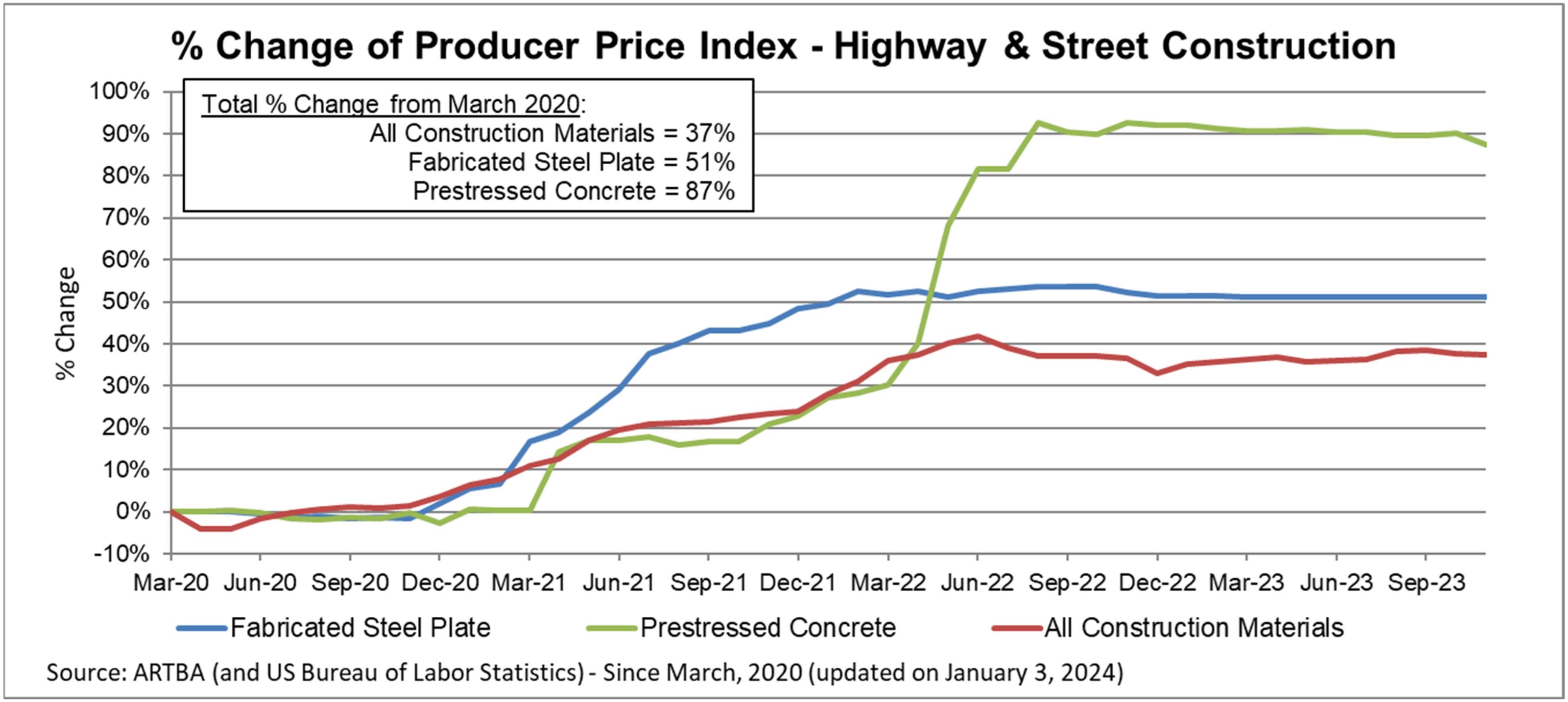
11. In your experience, how does 2023 steel pricing compare to 2022 steel pricing?

More Details

Higher	166
Lower	22
Minimal Change	72

Fabricator Pricing for Furnish Only of similar scope indicated Minimal or Lower

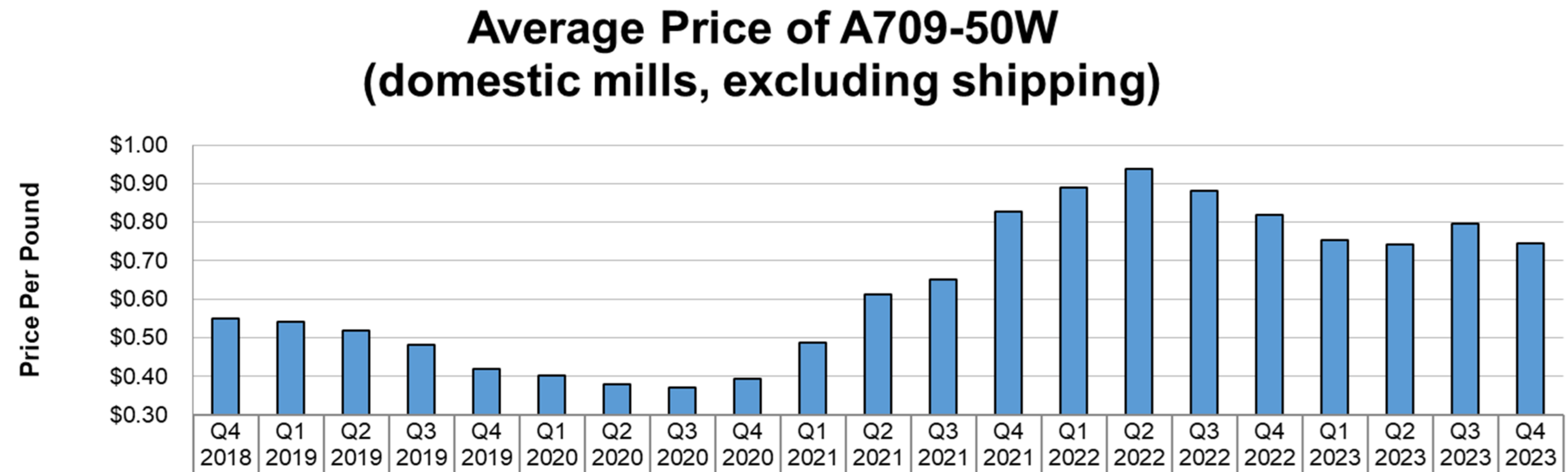
Historical Fabricated Steel Costs



Also available at artba.org/economics/materials-dashboard/

Average Mill Price of A709-50W

Ex) Size 1 ½ in. thick x 96 in. wide x 636 in. long



	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Q1 2023	Q2 2023	Q3 2023	Q4 2023
Cost Per Pound	$0.55	$0.54	$0.52	$0.48	$0.42	$0.40	$0.38	$0.37	$0.39	$0.49	$0.61	$0.65	$0.83	$0.89	$0.94	$0.88	$0.82	$0.75	$0.74	$0.79	$0.74

Raw material pricing presented in this chart is a small snapshot of a limited time and is not representative of long term historical and future trends.

General Cost Guidelines

- *Total cost to owner – General Breakdown (Approx.)*
  - *Raw material - 33%*
  - *Fabrication Labor - 33%*
  - *Erection & construction - 33% (Verify w/ contractors)*
- *Saving material (designing for least weight). Pay attention because some methods of weight reduction can result in a greater fabrication labor cost.*
- *Reduce labor to improve cost and lead times.*
- *Designers should talk with bridge fabricators about their design before finalizing it. (the devil is in the details)*
- *Don't overcomplicate it*

Not All Structural Steel is Created Equal

When in doubt, talk to a Fabricator!

WABASH

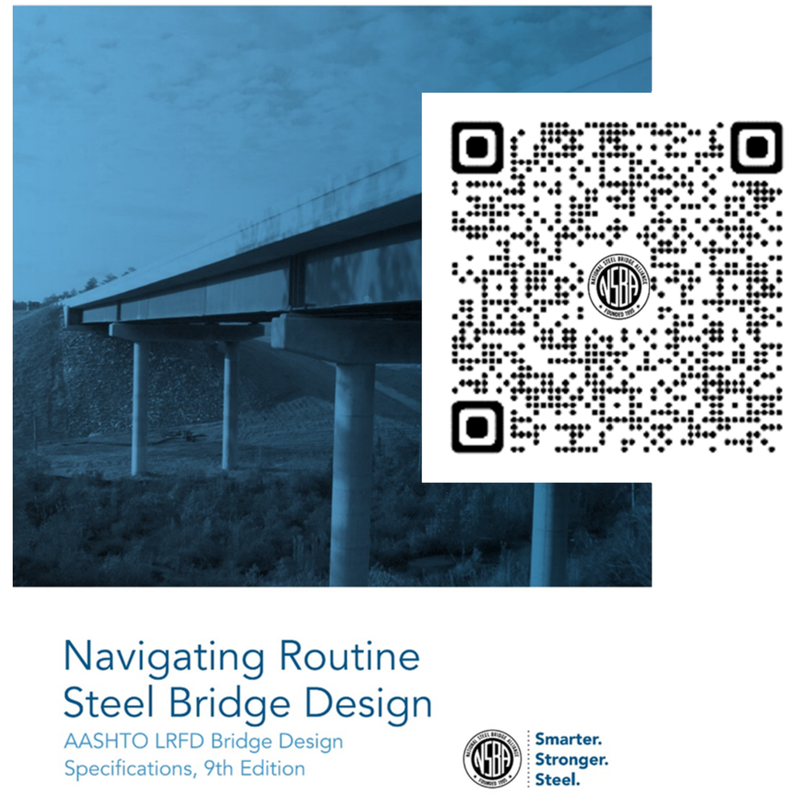
WHO CAN HELP?


NATIONAL STEEL BRIDGE ALLIANCE
NSBA
FOUNDED 1995
Smarter.
Stronger.
Steel.
https://www.aisc.org/nsba/

AISC's Need For Speed Initiative

Guide to Navigating Routine Steel Bridge Design - Completed

- **Motivation:**
  - AASHTO Bridge Design Specification has, become overly complicated.
  - Design and checking of routine steel I-girder bridges has become more difficult, time-consuming and error prone.
- **Objective:**
  - Develop a tool for engineers to make steel bridge design an easier and simpler task than designing.

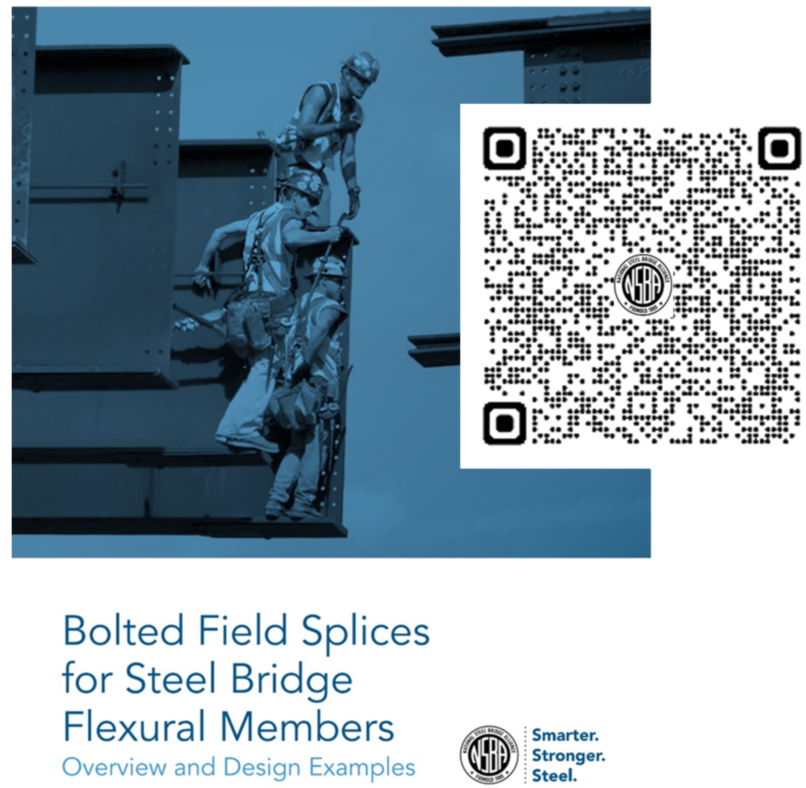


aisc.org/streamlineddesign

AISC's Need For Speed Initiative

Bolted Field Splice for Flexural Members - Completed

- **Motivation:**
  - Completely new design procedure introduced in 8th Edition Bridge Design Specification.
  - Designers found previous method vexing.
  - Resulted in overdesigned splices.
- **Objective:**
  - Develop reference guide that describes new design procedure in detail and provide easy to follow examples.
  - Allows designer to quickly analyze various bolted splice connections to determine the most efficient bolt quantity and configuration.



aisc.org/nsba-splice

AISC's Need For Speed Initiative

Lean-on Bracing Reference Guide - Completed

- **Motivation:**
  - Cross-frames are one of the costliest elements in a steel bridge on a per-pound basis.
  - Lean-on reduces the number and complexity of cross-frames.
  - Significantly impact speed of fabrication, speed of erection, and overall bridge cost.
- **Objective:**
  - Develop reference guide for implementing in routine bridge designs with confidence and with minimal computational effort.

Lean-on Bracing Reference Guide

NEED FOR SPEED

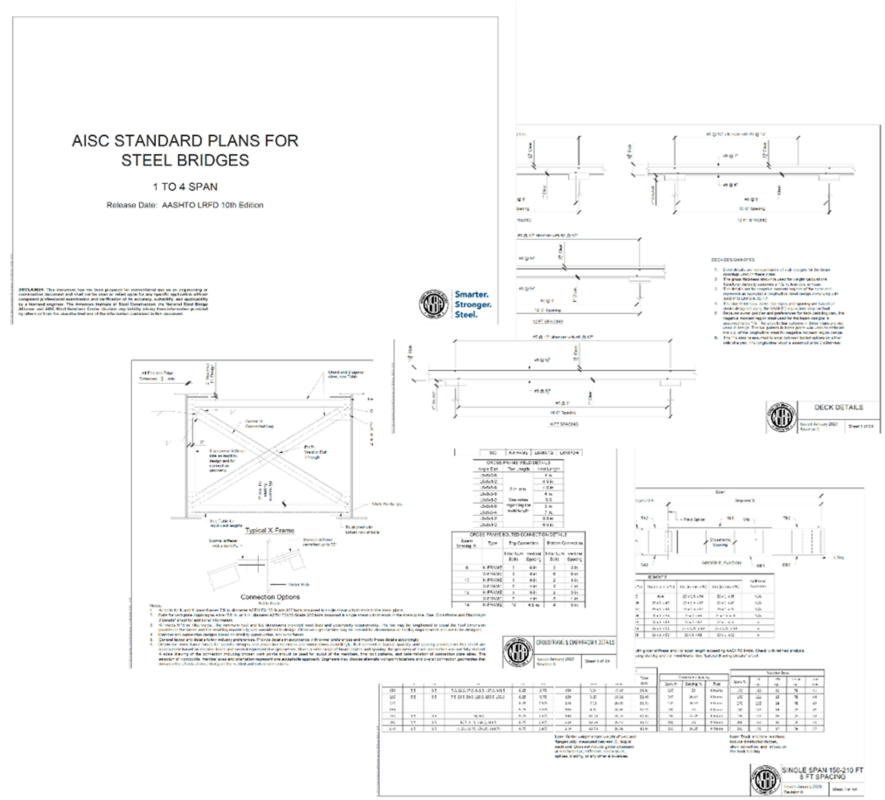
Smarter. Stronger. Steel.

aisc.org/leanonbracing

AISC's Need For Speed Initiative

Standard Designs for Straight I-Girder Bridges – In Progress

- **Motivation:**
  - Steel provides great flexibility in design.
  - Engineers are routinely confronted with repetitive design decisions regarding material thickness and sizes for the routine steel I-girder bridges.
- **Objective:**
  - Develop designs for 1, 2, 3, and 4 span arrangements.
  - Optimize and standardize web, flange, stiffener, and field splice plate sizes from typical mill plate widths and thicknesses.
  - Provide cost-efficient diaphragm and cross-frame standards.



AISC’s Need For Speed Initiative

Achieving Speed in Steel Bridge Fabrication - Completed

- **Motivation:**
  - Simplifying design, detailing and fabrication.
  - Delays can stem from ambiguity regarding roles and responsibilities.
- **Objective:**
  - Develop guide to streamline steel bridge projects that represents best practices.
  - Clearly outline roles and responsibilities of stakeholders.
  - Minimize misunderstandings on the project.

Accelerated Steel
Achieving Speed in Steel Bridge Fabrication

NEED FOR SPEED

Smarter. Stronger. Steel.

aisc.org/fasterbridgefab

AISC's Need For Speed Initiative

Guide to the use of Uncoated Weathering Steel - Completed

- **Motivation:**
  - Uncoated Weathering Steel (UWS) is a durable material providing cost-effective solutions.
  - UWS requires no further painting or protection, resulting in faster fabrication and installation.
- **Objective:**
  - Develop reference guide compiling all current research, resources and best practices.
  - Provide recommendations for design, detailing and maintenance of UWS bridges.

aisc.org/uwsguide

SHORT SPAN STEEL

BRIDGE ALLIANCE ™

https://www.shortspansteelbridges.org/

Short span steel bridge design standards

[HTTP://WWW.ESPAN140.COM/](http://www.espan140.com/)

FREE ONLINE DESIGN TOOL FOR SHORT SPAN STEEL BRIDGES

UTILIZES STANDARD SHORT SPAN STEEL BRIDGE DESIGNS

Standards for Short Span Steel Bridge Designs

Goals:
- Economically competitive
- Expedite & economize the design process
- Simple repetitive details & member sizes.

Bridge Design Parameters:
- Span lengths: 40 feet to 140 feet (5-foot increments)
- Girder spacing: 6 feet, 7.5 feet, 9 feet and 10.5 feet
- Homogeneous & Hybrid plate girders with limited plate sizes
- Limited Depth & Lightest Weight Rolled Beam Sections
- Selective cross-frame placement/design (AASHTO/NSBA)

Primary value is use as an estimating tool!

- Now have the ability to produce a valid steel bridge design in minutes
- Obtain a cost estimate from a fabricator within a day
- Can directly compete with concrete alternate
- Design can then be further optimized

eSPAN140

One-stop shop for customized steel bridge and culvert solutions!

eSPAN140 provides:

Standard designs and details for short span steel crossings
- Rolled Beam and Plate Girders
- Corrugated Steel Pipe and Structural Plate

Manufacturers' Steel Solutions (SSSBA Partners)

Coatings Solutions

Industry Contacts
- Contacts can provide budget estimates and pricing information

Free and easy to use!!!
http://www.espan140.com/

Step 1.
Create a User's Account

Step 2.
Input Your Specific Project Details

Step 3.
View Your Instant Customized Solutions Boo

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Fabricators