



eBEAM140: Precision Beam Calculations, Simplified for Short Span Steel Bridges

IBC
June 15, 2026

Michael Barker, PE
University of Wyoming
Short Span Steel Bridge Alliance



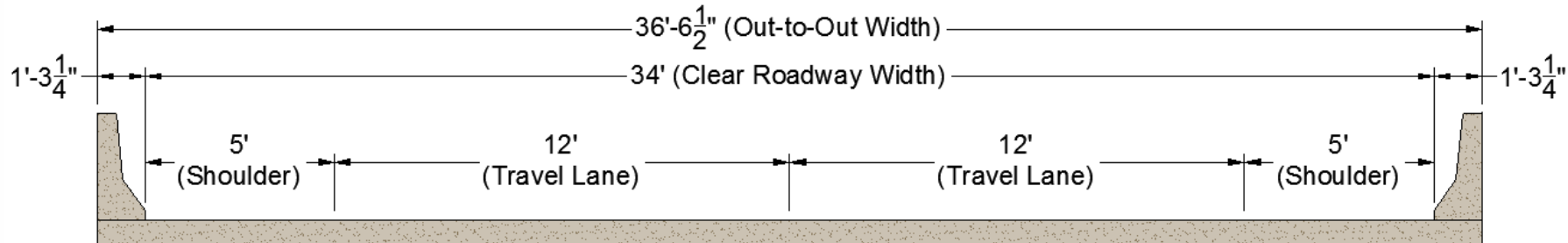
Steel Bridge Design

Design Two-Lane, Simple Span Bridge



Bridge Need and Basic Information

- Decided by Owner/Engineer:
 - 80 ft Simple Span Composite – Steel Girders
 - Two 12 ft Travel Lanes, ADT = 5600 one direction
 - 34 ft Roadway Width
 - Jersey Barriers (1 ft – 3 ¼ in wide)



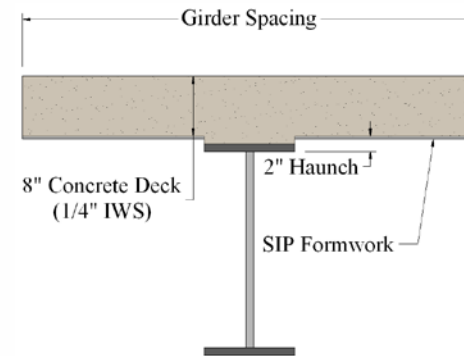
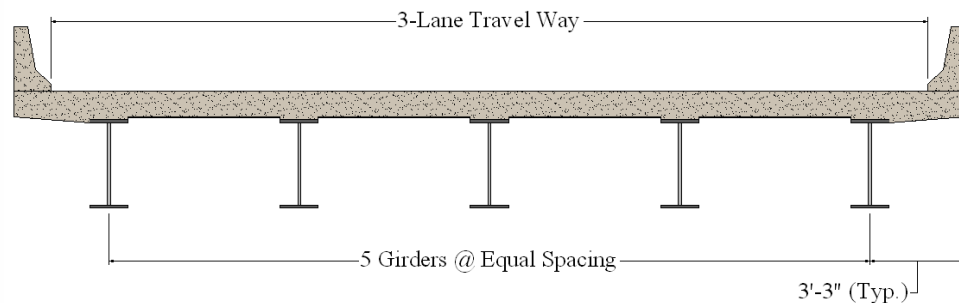
Need a Design for the Bridge SuperStructure

eSPAN140 - Standard Designs Short Span Bridges

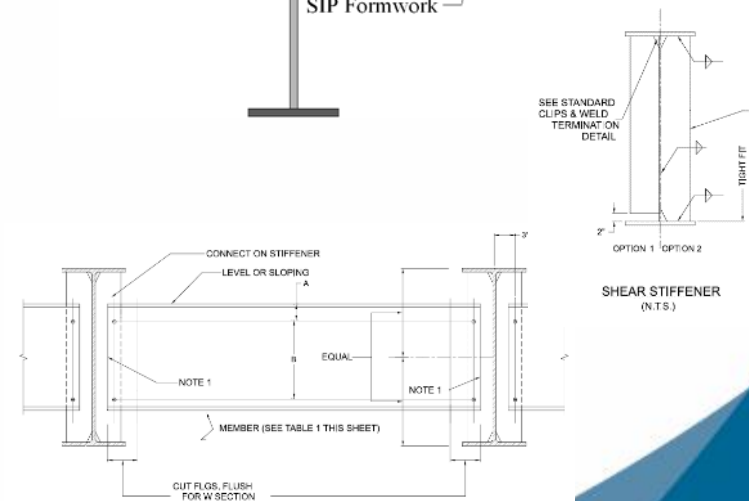
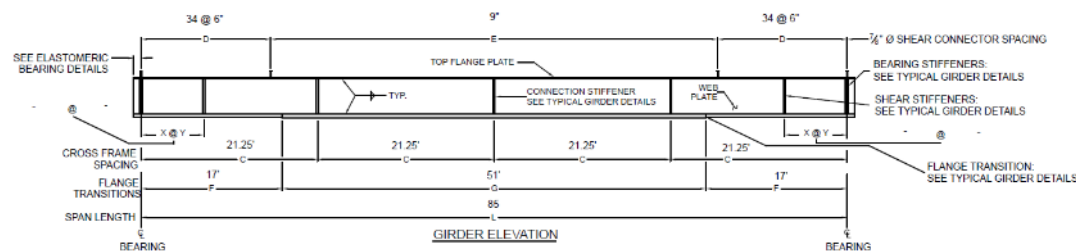
Span lengths 20 ft to 140 ft (in 5 ft increments)

Four girder spacing: 6'-0", 7'-6", 9'-0" and 10'-6",

For each of these increments: Steel girders, Shear stud & stiffener layouts, Welding and fabrication details, Elastomeric bearings, and Concrete deck design



COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 4 GIRDERS AT 8' 10" GIRDER SPACING, HOMOGENEOUS



eSPAN140 Preliminary Design

Solution Type*	Bridge Span Length								Skew Angle	Overhang Width
	0'	20'	40'	60'	80'	100'	120'	140'		
Rolled Beam (40' to 100')**									+/- 20 degrees	3'3" or less
Homogeneous Plate Girder (60' to 140')**									+/- 20 degrees	3'3" or less
Press Brake Tub Girders (0' to 80')									+/- 20 degrees	3'3" or less
Buried Bridges (all)***									+/- 35 degrees****	N/A

* For bridges outside of this range, standard designs will not appear in your solutions book.

** Standard designs for rolled beam and plate girder solutions are rounded in five (5) foot increments.

*** Depending on project requirements this solution will require multiple spans.

**** Can be greater if site geometry allows.

eSPAN140 Preliminary Design

Project Name*
Example 80 ft Simple Span Bridge

Project Status*
Informational Only

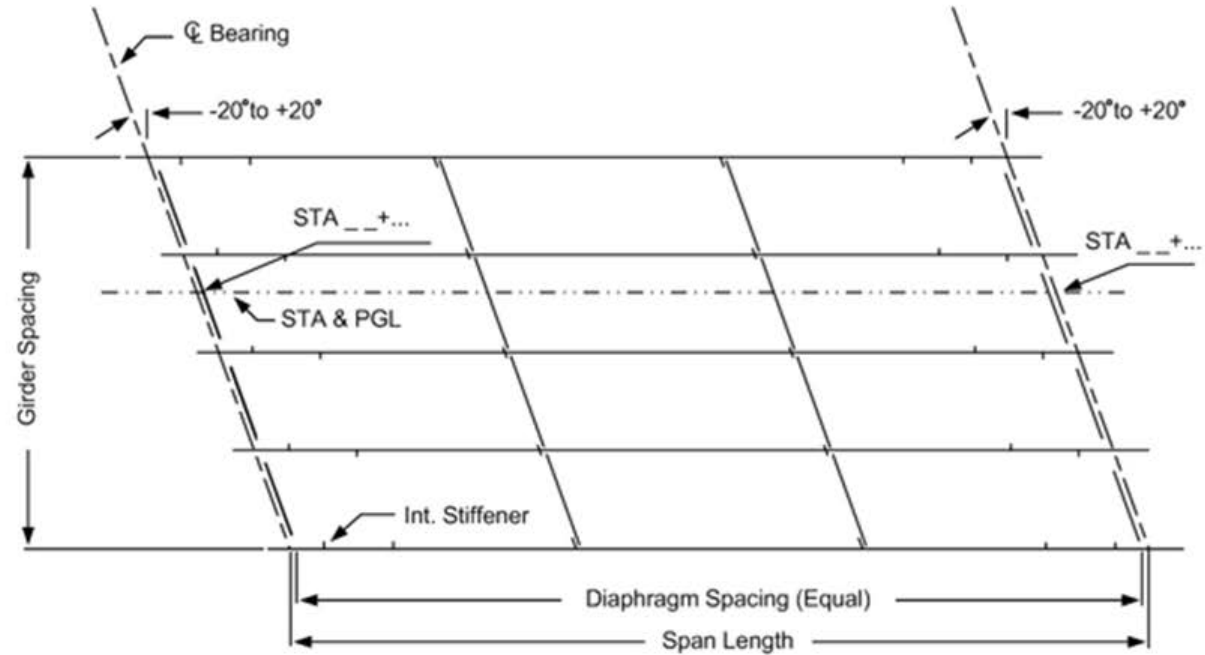
City/County*
Laramie

State/Province* ⓘ
Wyoming

Roadway Name
E 800 South

Bridge Span Length* ⓘ
80 Feet 0 Inches

Next > [Return to Projects](#)



eSPAN140 Preliminary Design

of Striped Traffic Lanes*

Roadway Width*

Feet Inches

Individual Parapet Width*

Feet Inches

Individual Deck Overhang Width*

Feet Inches

Pedestrian Access?

Skew Angle

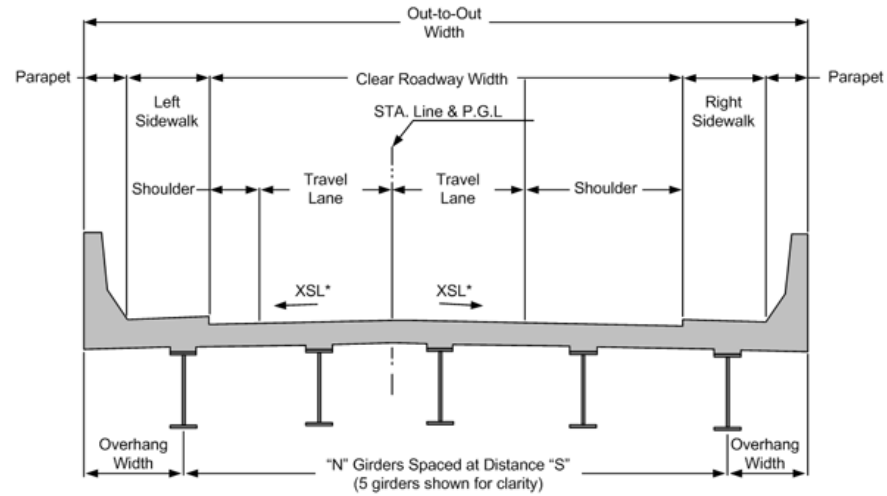
Degrees

Average Daily Traffic

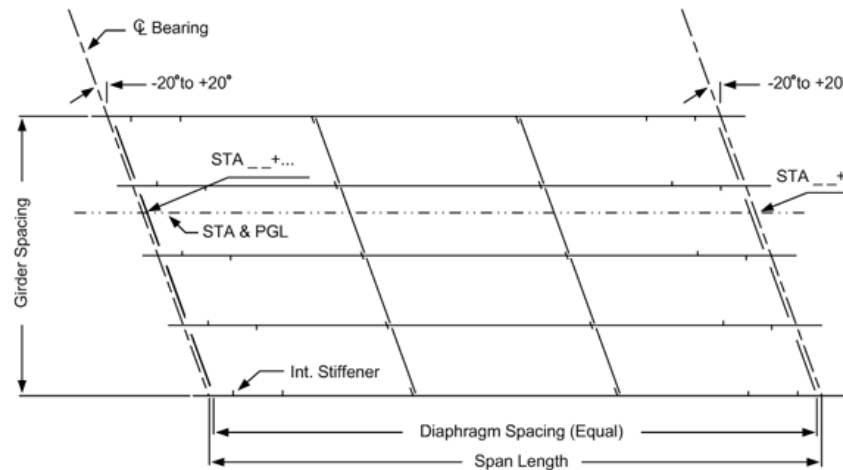
Design Speed

[< Back](#) [Next >](#) [Return to Projects](#)

* Required



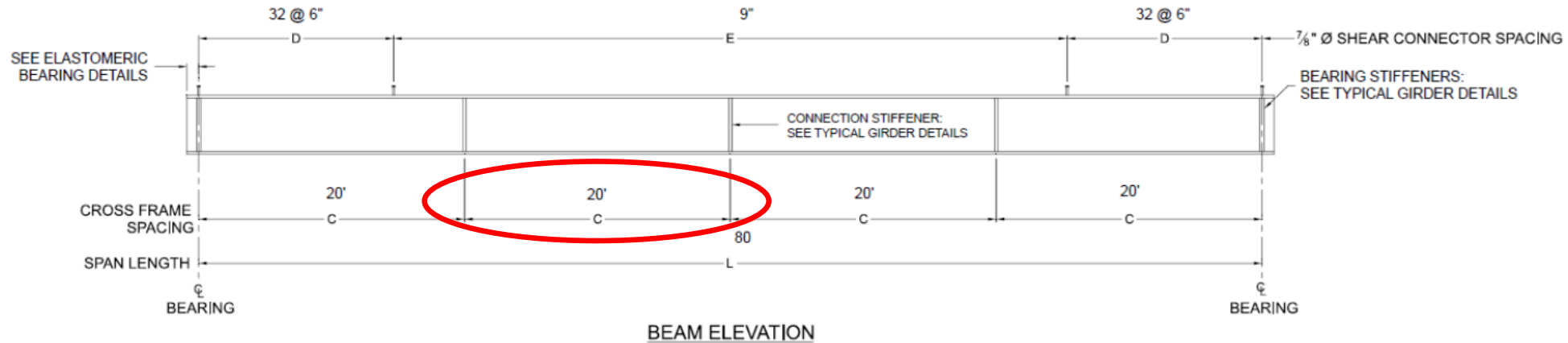
Cross-section of Bridge



Rolled Beam Recommendation

COMPOSITE ROLLED BEAM WITH PARTIALLY STIFFENED WEB - 4 GIRDERS AT 10' 6" GIRDER SPACING, LIGHTEST WEIGHT

The selected rolled beam section is based on the widest (10'-6") girder spacing used in the development of the standards. The steel industry generally recommends the use of the widest girder spacing possible to reduce the potential number of girder lines for optimum economy.



SPAN (L) - ft	ROLLED BEAM	DIAPHRAGM SPACING (C)	SHEAR CONNECTOR MAX. SPACING		WEIGHT
			D	E	
80	W36x210	20'	32 @ 6"	9"	16,800 lbs

STEEL D.L. CAMBER - in					TOTAL D.L. CAMBER - in				
1	2	3	4	5	1	2	3	4	5
0.178"	0.337"	0.461"	0.540"	0.567"	1.255"	2.375"	3.250"	3.807"	3.997"

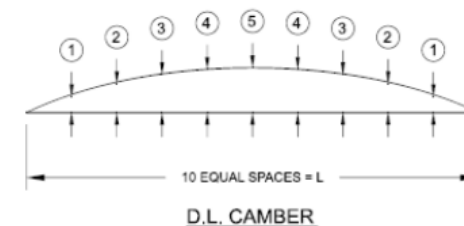
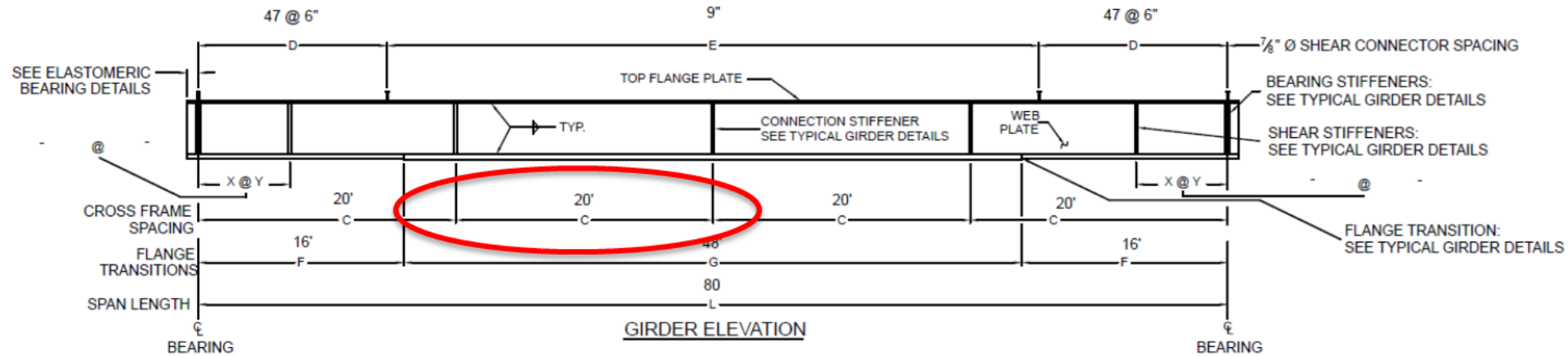


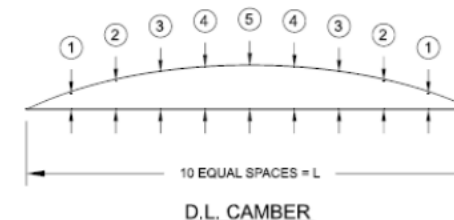
Plate Girder Recommendation

COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 4 GIRDERS AT 10' 6" GIRDER SPACING, HOMOGENEOUS

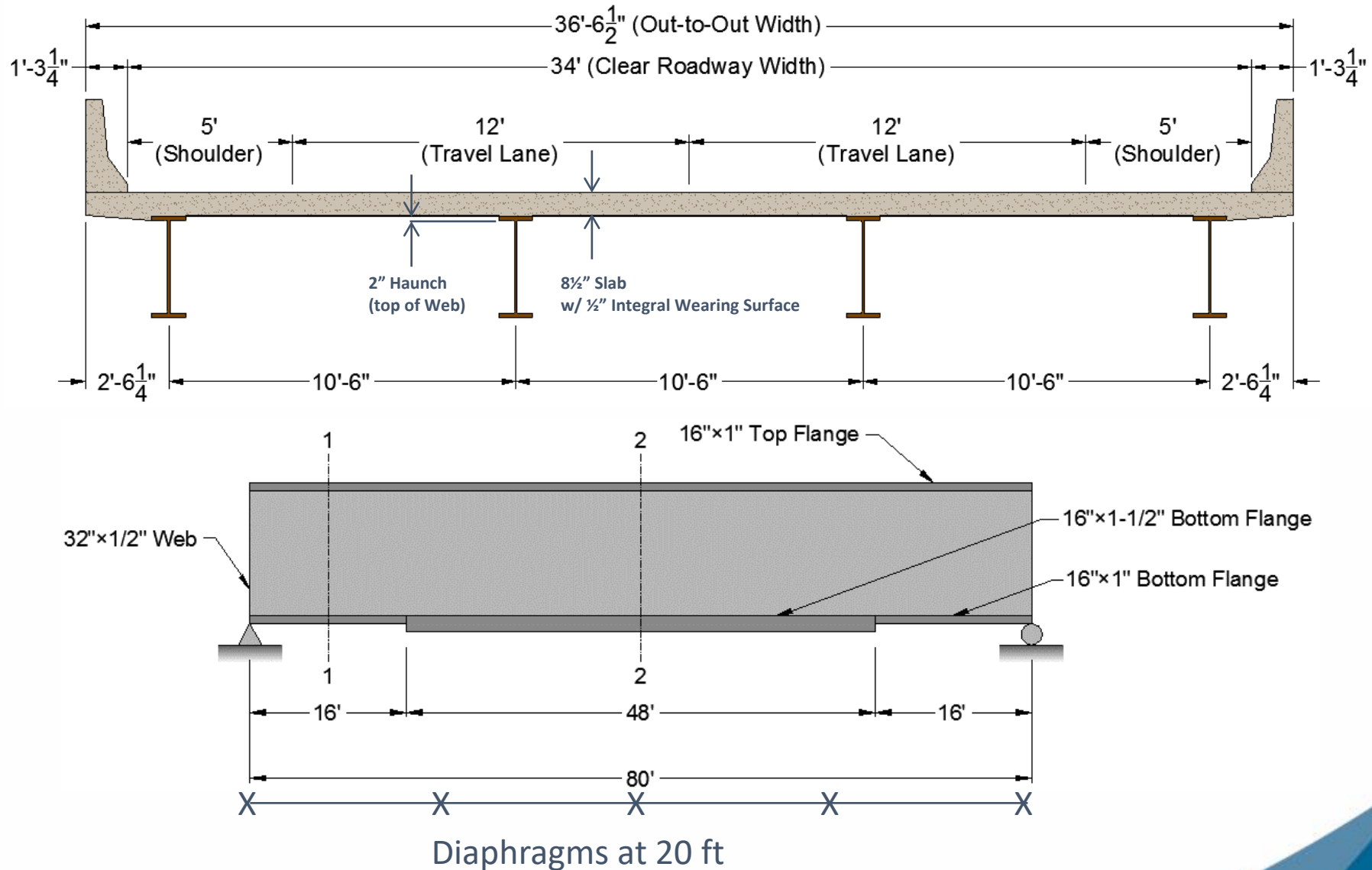


SPAN (L) - ft	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - ft	SHEAR STIFFENERS		SHEAR CONNECTOR MAX. SPACING		INDIVIDUAL GIRDER WEIGHT
	TOP FLANGE - in	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in		X (NO. REQ'd)	Y - ft. (SPACING)	D	E	
		PLATE - in	LENGTH - Ft	PLATE - in	LENGTH - Ft							
80	16 x 1"	16 x 1"	16'	16 x 1 1/2"	48'	32 x 1/2"	20'	-	-	47 @ 6"	9"	14,373 lbs

STEEL D.L. CAMBER - in					TOTAL D.L. CAMBER - in				
1	2	3	4	5	1	2	3	4	5
0.178"	0.334"	0.454"	0.530"	0.557"	1.397"	2.618"	3.554"	4.149"	4.355"



Preliminary Design for Plate Girder Bridge



eSPAN140 Summary

Composite Rolled Beam and Plate Girder Designs
1000's of Designs Performed
Has Worked Well

What's Next?

Update to AASHTO 10th Edition
Adding NonComposite Bridges
Including Additional Solution Options
Release TBD



NEW Short Span Steel Bridge Alliance eBEAM140

Noncomposite and Composite Simple-Span Rolled-Section Steel Bridge Design



Excel Based Rolled Beam Design Software Version 1.0 - Beta

<https://www.shortspansteelbridges.org/ebeam140/>

eBEAM140 Disclaimer: This document has been prepared in accordance with information available to the American Iron and Steel Institute (AISI) and its Short Span Steel Bridge Alliance (SSSBA) program, at the time of preparation. While it is believed to reasonably reflect the present state of knowledge as to the subject, it has not been prepared for conventional use as an engineering or construction document and should not be used or relied upon for any specific application without competent professional examination and verification of its accuracy, suitability, and applicability by a licensed engineer, architect or other professional. AISI and the SSSBA disclaim any liability arising from information provided by others or from the unauthorized use of the information contained in this document, and do not accept any obligation to issue supplements or corrections in the event of errors being discovered or advances being made in the techniques discussed in the document.

Start With Demonstration

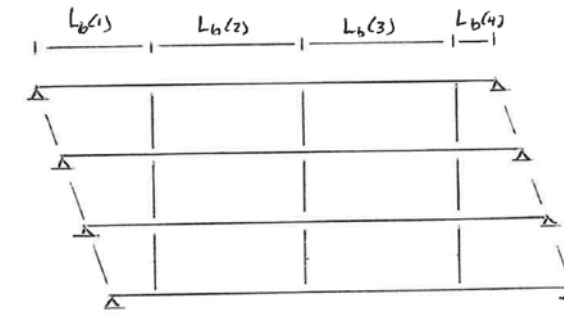
NonComposite Bridge

- 52 ft Length
- Two 12 ft Lanes
- 6 Girders at 5'-6" Spacing
- Overhang 1' - 3"
- Barriers 1' - 0" (50 lb/ft - 50% on Exterior Girder)
- Roadway Width = 28 ft (4 ft of shoulder)
- Bridge Width 30 ft
- Diaphragm (Centerline) at 26 ft
- Unbraced
- Corrugated Metal Deck & Gravel (80 psf)
- No Additional DC1 or DC2 Loading
- No Wearing Surface
- No Construction Load (No Lateral Flange)
- Misc Steel of 5%
- 50 ksi Steel, L/D limit 30, Min d = 12
- L/800 Deflection Limit
- Compression Flange not Braced
- Use AASHTO Appendix A6
- 75 Year Design Life & $ADTT_{SL} = 200$
 - Fatigue II - Finite Life
- No User Defined Vehicle

Design Software

Excel Based Rolled Beam Design Software

- NonComposite & Composite Design
- 33, 36, 50, 65 or 70 ksi Steel
- Bridge Layout
- Diaphragm Variable Along Span
- Any Decking: Wood, Grid, CMD, Noncomposite Concrete, Composite Concrete
- Vehicular Loading: AASHTO HL93 & User Defined Vehicle (i.e., U-80)



SERVICE II near Centerline												
DC1 (ft-k)	108.4	5x=209.0	in*3									
DC2 (ft-k)	7.8	5x=209.0	in*3									
DW (ft-k)	35.5	5x=209.0	in*3									
M (ft-k) Lf=1.75	574.5	5x=209.0	in*3									
Shear Stress	58.0											
Serv II Allow	40.0											
SERVICE II PR	0.961											
LIVE LOAD DEFLECTION (x=4470 in*4)												
LL Defl (in)	0.60	1+7929										
Allowable (in)	0.75	1+8000										
DEFLECTION PR	0.861											
FATIGUE Cat C at Critical Brace												
Fat Moment (ft-k) Lf=0.8	226.7	5Fat=316.1	in*3									
Fat Stress (ksi)	6.88											
Fat Allow (ksi)	9.30											
FATIGUE PR	0.740											
STRENGTH V/S SHEAR at Support												
DC1 (k)	13.5											
DC2 (k)	0.6											
DW (k)	2.8											
HL93 LL+M (k) Lf=1.75	56.3											
Vu (k)	120.5											
Vn (k)	447.0											
SHEAR PR	0.270											
Strength Design Uses AASHTO Appendix A6 STRENGTH V/S												
	Lf=1.75											
	Ma (ft-k)	Cb	Mn (ft-k)	Perf Ratio								
1	20	161.7	7.5	34.1	562.9	1247.7	1.36	1284.0	0.972			
2	10	168.4	7.8225	35.5	574.1	1278.3	1.00	1301.0	0.982			
3	20	161.7	7.5	34.1	563.1	1248.0	1.36	1284.6	0.972			
Strength Design Uses AASHTO Appendix A6 CONSTRUCTION												
	Lf=1.35*50											
	Ld (ft)	Mconstr (ft-k)	Mint (ft-k)	AF	Aff (ksi)	Perf Ratio	fba+Aff (ksi)	Perf Ratio	Sum VBAff (ks)	Fnc (ksi)	Perf Ratio	
1	20	389.2	10.8	1.3	11.7	0.39	27.3	0.47	19.5	51.5	0.38	
2	10	405.4	3.8	1.0	3.3	0.11	28.6	0.34	17.4	51.2	0.33	
3	20	389.2	10.8	1.3	11.7	0.39	27.3	0.47	19.5	51.6	0.38	
DEAD LOAD DEFLECTIONS												
	Distance (ft)	0	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	L
1x (in**4) = 4470.0	DC1 (in)	0.000	0.184	0.347	0.475	0.557	0.585	0.557	0.475	0.347	0.184	0.000
1x (in**4) = 4470.0	DC2 (in)	0.000	0.009	0.036	0.022	0.026	0.027	0.026	0.022	0.036	0.009	0.000
1x (in**4) = 4470.0	DW (in)	0.000	0.039	0.073	0.100	0.117	0.123	0.117	0.100	0.073	0.039	0.000
	Total (in)	0.00	0.23	0.44	0.60	0.70	0.73	0.70	0.60	0.44	0.23	0.00
NOMINAL ABUTMENT REACTIONS												
DC1 (k)	119.5	At Centerline										
DC2 (k)	2.5	At Centerline										
DW (k)	15.6	At Centerline										
Single Lane LL+M (k)	112.7	At 20.00 From Centerline										
Two Lane LL+M (k)	167.8	At 15.00 From Centerline										
Three Lane LL+M (k)	239.4	At 10.00 From Centerline										
Four Lane LL+M (k)	244.1	At 5.00 From Centerline										
Nominal Moments on Girder												
	Length Along Span (ft)	0	10	20	30	40	50	60				
	Moment (ft-k)	0	100	200	300	400	500	600				
	DC1											
	DC2											
	DW											
	HL93 LL+M											
	Fatigue-M											
ONLY IF COMPOSITE												
0.875 (in) SHEAR STUD SPACING												
	Minimum Spacing (in)	5.25										
	10.0-10.0 ft	10.0-20.0 ft	20.0-30.0 ft	30.0-40.0 ft	40.0-50.0 ft							
	Singles Pitch (in)	7.17	8.55	9.24	8.55	7.17						
	Doubles Pitch (in)	14.35	17.09	18.48	17.09	14.35						
	Triples Pitch (in)	21.52	25.64	27.72	25.64	21.52						
	Strength Minimum Number of Studs	56										
	Fatigue Singles Estimated Number of Studs	75.5267789										
	Fatigue Doubles Estimated Number of Studs	76.5267789										
	Fatigue Triples Estimated Number of Studs	77.5267789										
Minimum Transverse Spacing (in) 3.5												
	d (in)	28.8										
	lf (in) =	10.5										
Minimum Transverse Spacing OK												
Minimum Transverse Spacing OK												
Shear Connector Pitch (in)												
	Distance Along Span (ft)	0.00	10.00	20.00	30.00	40.00	50.00	60.00				
	Pitch (in)	7.17	8.55	9.24	8.55	7.17						
	Single Required											
	Single Layout											
	Double Required											
	Double Layout											
	Triple Required											
	Triple Layout											

Design Software

Excel Based Rolled Beam Design Software

- Diaphragm Variable Along Span: up to 7 Unbraced Lengths: Skewed Bridges
 - Compression Flange Bracing During Construction
 - Compression Flange Bracing for Final State
- Any Decking: Wood, Grid, CMD, Noncomposite Concrete, Composite Concrete
 - For Composite: $f'c$, full depth or SIP, haunch, sacrificial surface, shear connector design
 - Additional Dead Load (DC1 – Overhang, Utilities, etc)
 - Variable Bridge Railing
 - Steel Beams Individually Considered in Dead Load
- Wearing Surface
- Additional Dead Load (DC2 – Utilities, etc)

Design Software

Excel Based Rolled Beam Design Software

- Vehicular Loading
 - AASHTO HL93 truck, Tandem and Lane
 - User Defined Vehicle (i.e., U-80)
 - User Live Load Factor (Strength II)
 - Optional Lane Load
 - Single or Multi-Lane Distribution
 - User Impact Factor
- Live Load Distribution Factors
 - Moment & Shear (Based on Decking)
 - Lever Rule if Necessary
 - Single & Multi-Lane
 - Rigid Rotational Analysis
 - User Input LLDF

Design Software

Excel Based Rolled Beam Design Software

- Limit L/D Ratio
- Minimum Depth (diaphragms)
- Maximum Depth (approaches/clearance)
- Option on W40/44
- User Defined Deflection Limit
- Add % Steel for Miscellaneous
- Applies AASHTO 6.10.8 (conservative) or Appendix A6 (optimal) - **AASHTO 10**
- Calculated C_b for Each Unbraced Length - **AASHTO 10**
 - User defined C_b

Design Software

Excel Based Rolled Beam Design Software

- Fatigue I or Fatigue II Based on $ADTT_{SL}$ – AASHTO 10
 - Variable Design Life
- Performs Dead, Construction & Live Load Analysis for Each Unbraced Length
- Strength I/II & Constructability Design for Each Unbraced Length
- Service II Near Centerline (Maximum Moment)
- Fatigue at Critical Diaphragm Location (Detail C')
- Strength & Fatigue Shear Stud Design for Composite – AASHTO 10

Design Software

Excel Based Non-Composite Rolled Beam Design Software

- Determines all W Shapes that Meet Strength I/II, Service II & Construction Performance Ratios
- Corresponding Fatigue Performance Ratio
- Corresponding Deflection Performance Ratio

Lightest 10 Sections (see to the right for additional information)						
Str I, Serv II, Constr	Fatigue	Deflection	L/D	Defl	Mn/My	Weight (tons)
W36X135	W36X135	W36X135	17.5	L/1049	0.78	21.1
W33X141	W33X141	W33X141	18.7	L/1002	0.82	22.0
W27X146	W27X146		22.8	L/761	1.03	22.8
W30X148	W30X148	W30X148	20.3	L/898	0.82	23.1
W40X149	W40X149	W40X149	16.3	L/1317	0.74	23.2
W36X150	W36X150	W36X150	17.4	L/1215	0.84	23.4
W33X152	W33X152	W33X152	18.6	L/1097	0.86	23.7
W36X160	W36X160	W36X160	17.3	L/1312	0.87	25.0
W27X161	W27X161	W27X161	22.6	L/848	1.05	25.1
W24X162	W24X162		25.0	L/695	1.07	25.3

Design Software

Excel Based Rolled Beam Design Software

- Allows User to Investigate Alternatives to
 - Diaphragm Spacing
 - Lightest Weight Solution
 - Other Readily Available Sections

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)	LIST OF ALL W SHAPES RANKED FROM STRENGTH I, SERVICE II & CONSTRUCTION						
W36X135						135	Top 20 That Meet Min Depth, Max Depth & W40 & W44 Limits						
NonComposite							Shape	Strength I/II	Service II	Construction	Fatigue	Deflection	Overall
OVERALL PERFORMANCE FOR W36X135								PR	PR	PR	PR	PR	PR
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	W36X135	0.99	0.73	0.16	0.60	0.76	0.99	
PR	PR	PR	PR	PR	PR	W33X141	0.92	0.71	0.15	0.58	0.80	0.92	
0.993	0.727	0.161	0.599	0.763	0.993	W27X146	0.79	0.77	0.14	0.62	1.05	1.05	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to L/1049	Strength I/II	W30X148	0.95	0.73	0.16	0.58	0.89	0.95	
1		1				W40X149	0.90	0.62	0.15	0.51	0.61	0.90	
PERFORMANCE BY UNBRACED LENGTH FOR W36X135							W36X150	0.81	0.64	0.13	0.52	0.66	0.81
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb	W33X152	0.81	0.66	0.14	0.53	0.73	0.81	
1	26	0 - 26 ft	PR	0.778	1.255	W36X160	0.73	0.59	0.12	0.48	0.61	0.73	
2	26	26 - 52 ft	0.993	0.778	1.256	W27X161	0.71	0.70	0.13	0.55	0.94	0.94	
						W24X162	0.77	0.78	0.14	0.60	1.15	1.15	
						W40X167	0.70	0.54	0.12	0.43	0.51	0.70	
						W33X169	0.69	0.59	0.12	0.46	0.64	0.69	
						W36X170	0.66	0.56	0.11	0.44	0.57	0.66	
						W30X173	0.59	0.60	0.11	0.47	0.72	0.72	
						W24X176	0.70	0.72	0.13	0.54	1.05	1.05	
						W27X178	0.63	0.64	0.12	0.50	0.85	0.85	
						W36X182	0.61	0.52	0.11	0.41	0.53	0.61	
						W40X183	0.59	0.48	0.10	0.38	0.45	0.59	
						W30X191	0.53	0.54	0.10	0.42	0.65	0.65	
						W24X192	0.63	0.66	0.12	0.50	0.95	0.95	

Design Software

Excel Based Rolled Beam Design Software

- Design Summary
 - All Superstructure Design Results Specific to Limit States, Unbraced Lengths, etc.
 - Dead Load Deflections for Camber
 - Abutment Reaction Cases for Multi-Lane
 - If Composite: Strength and Fatigue Stud Design



W44	SERVICE II near Centerline	
	DC1 (ft-k)	183.1 Sx=439.0 in ³
	DC2 (ft-k)	8.5 Sx=439.0 in ³
	DW (ft-k)	0.0 Sx=439.0 in ³
	HL93 LL+IM (ft-k)	670.5 Sx=439.0 in ³
	Serv II Stress	29.1
Lane	Serv II Allow	40.0
	SERVICE II PR	0.727
	LIVE LOAD DEFLECTION	Ix=7800 in ⁴
	LL Defl (in)	0.60 = L/1049
	Allowable (in)	0.78 = L/800
	DEFLECTION PR	0.763
	FATIGUE Cat C' at Critical Brace	
	Fat Moment (ft-k) LLF = 0.8	265.8 Sfat=458.6 in ³
	Fat Stress (ksi)	5.57
	Fat Allow (ksi)	9.30
	FATIGUE PR	0.599
	STRENGTH I/II SHEAR at Support	
	DC1 (k)	14.1
	DC2 (k)	0.7
	DW (k)	0.0
	HL93 LL+IM (k) LLF = 1.75	60.6
	Vu (k)	124.5
	Vn (k)	591.9
	SHEAR PR	0.210

Strength Design Uses AASHTO Appendix A6	STRENGTH I/II		LLF = 1.75				Mu (ft-k)	Cb	Mn (ft-k)	Perf Ratio	
	Lb (ft)	DC1 (ft-k)	DC2 (ft-k)	DW (ft-k)	HL93 LL+IM (ft-k)						STRENGTH I/II MAX PR
	1	26	183.1	8.45	0.0	670.4	1412.6	1.26	1422.9	0.993	0.993
	2	26	183.1	8.45	0.0	670.5	1412.9	1.26	1423.3	0.993	0.993

Strength Design Uses AASHTO Appendix A6	CONSTRUCTION		<0.60Fy				RpcFy=1.16*50					
	Lb (ft)	Mconstr (ft-k)	Mlat (ft-k)	AF	Affl (ksi)	Perf Ratio	fbu+Affl (ksi)	Perf Ratio	bu+1/3Affl (ks)	Fnc (ksi)	Perf Ratio	CONSTRUCTION MAX PR
	1	26	228.9	0.0	1.0	0.0	0.00	6.3	0.13	6.3	38.9	0.16
	2	26	228.9	0.0	1.0	0.0	0.00	6.3	0.13	6.3	38.9	0.16

NOMINAL ABUTMENT REACTIONS			
	DC1 (k)	84.5	At Centerline
	DC2 (k)	2.6	At Centerline
	DW (k)	0.0	At Centerline
	Single Lane LL+IM (k)	114.3	At 9.00 From Centerline
	Two Lane LL+IM (k)	190.4	At 4.00 From Centerline

Modify Demonstration

NonComposite Bridge

- 52 ft Length
- Two 12 ft Lanes
- 6 Girders at 5'-6" Spacing
- Overhang 1' - 3"
- Barriers 1' - 0" (50 lb/ft - 50% on Exterior Girder)
- Roadway Width = 28 ft (4 ft of shoulder)
- Bridge Width 30 ft
- Diaphragm (Centerline) at 26 ft
- Unbraced
- Corrugated Metal Deck & Gravel (80 psf)
- No Additional DC1 or DC2 Loading
- No Wearing Surface
- No Construction Load (No Lateral Flange)
- Misc Steel of 5%
- 50 ksi Steel, L/D limit 30, Min d = 12
- L/800 Deflection Limit
- Compression Flange not Braced
- Use AASHTO Appendix A6
- 75 Year Design Life & $ADTT_{SL} = 200$
 - Fatigue II - Finite Life
- No User Defined Vehicle

Demonstration: 52 ft Span, CMD/Gravel, 6 Girders @ 5.5 ft

NonComposite Bridge: W36 x 135

- What if add additional diaphragm: $L_b = 19, 14, 19$ ft

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)
W36X135	NonComposite					135
OVERALL PERFORMANCE FOR W36X135						
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	
PR	PR	PR	PR	PR	PR	
0.993	0.727	0.161	0.599	0.763	0.993	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Strength I/II	
1		1		L/1049		
PERFORMANCE BY UNBRACED LENGTH FOR W36X135						
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb	
1	26	0 - 26 ft	0.993	0.778	1.255	
2	26	26 - 52 ft	0.993	0.778	1.256	

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)
W33X118	NonComposite					118
OVERALL PERFORMANCE FOR W33X118						
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	
PR	PR	PR	PR	PR	PR	
0.981	0.883	0.155	0.703	1.009	1.009	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Deflection	
2		2		L/793		
PERFORMANCE BY UNBRACED LENGTH FOR W33X118						
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb	
1	19	0 - 19 ft	0.781	1.139	1.391	
2	14	19 - 33 ft	0.981	0.957	1.005	
3	19	33 - 52 ft	0.781	1.140	1.392	

**W33x118 – 5400 lbs Girder Steel Saved
But Additional Diaphragm
And Deflection = L/793**

Demonstration: 52 ft Span, CMD/Gravel, 6 Girders @ 5.5 ft

NonComposite Bridge: W36 x 135

- What if compression flange braced: $L_b = 0$ Corrugated Metal Decking

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)
W36X135	NonComposite					135
OVERALL PERFORMANCE FOR W36X135						
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	
PR	PR	PR	PR	PR	PR	
0.993	0.727	0.161	0.599	0.763	0.993	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Strength I/II	
1		1		L/1049		
PERFORMANCE BY UNBRACED LENGTH FOR W36X135						
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb	
1	26	0 - 26 ft	0.993	0.778	1.255	
2	26	26 - 52 ft	0.993	0.778	1.256	

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)
W30X116	NonComposite					116
OVERALL PERFORMANCE FOR W30X116						
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	
PR	PR	PR	PR	PR	PR	
0.892	0.963	0.161	0.788	1.207	1.207	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Deflection	
2		1		L/663		
PERFORMANCE BY UNBRACED LENGTH FOR W30X116						
Compression Flange Laterally Braced for Final State			Strength I/II			
Inbraced Length	Unbraced Length (ft)	Lb Range	PR	Mn/My	Cb	
1	26	0 - 26 ft	0.892	1.149	1.255	
2	26	26 - 52 ft	0.892	1.149	1.256	

**W30x116 – 6000 lbs Girder Steel Saved
But Deflection = L/663**

Demonstration: 52 ft Span, CMD/Gravel, 6 Girders @ 5.5 ft

NonComposite Bridge: W36 x 135

- What if Logging Truck User Vehicle: 160 kips, 5 Axles

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)
W36X135						135
NonComposite						
OVERALL PERFORMANCE FOR W36X135						
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	
PR	PR	PR	PR	PR	PR	
0.993	0.727	0.161	0.599	0.763	0.993	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Strength I/II	
1		1		L/1049		
PERFORMANCE BY UNBRACED LENGTH FOR W36X135						
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb	
1	26	0 - 26 ft	0.993	0.778	1.255	
2	26	26 - 52 ft	0.993	0.778	1.256	

ENTER W SECTION FOR MORE INFORMATION						Weight (lb/ft)
W36X150						150
NonComposite						
OVERALL PERFORMANCE FOR W36X150						
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	
PR	PR	PR	PR	PR	PR	
0.937	0.736	0.134	0.516	0.658	0.937	
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Strength I/II	
1		1		L/1215		
PERFORMANCE BY UNBRACED LENGTH FOR W36X150						
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb	
1	26	0 - 26 ft	0.937	0.837	1.255	
2	26	26 - 52 ft	0.937	0.837	1.256	

Strength II: LLF = 1.35, No Lane Load, Single Lane, Unbraced W36x150

Strength II: LLF = 1.35, No Lane Load, Single Lane, Braced W33x130

Another Demonstration

Composite Bridge

- 62 ft Length
- Two 12 ft Lanes
- 4 Girders at 9'-0" Spacing
- Overhang 2' - 0"
- Barriers 1' - 6" (250 lb/ft - 50% on Exterior Girder)
- Roadway Width = 28 ft (4 ft of shoulder)
- Bridge Width 31 ft
- Diaphragms at 21 ft & 41 ft
- 8" Structural Deck, ½" Sacrificial, 2" Haunch
- 2" Stay-in-Place Forms (15 psf)
- 7/8" Shear Studs; $f'_c = 4000$ psi
- Additional DC1 Loading = 40 lb/ft
 - 100% on Girder
- 25 lb/ft² Wearing Surface
- Construction Load ($w = 275$ lb/ft & $p = 3000$ lb)
- Misc Steel of 5%
- 50 ksi Steel, L/D limit 30, Min $d = 12$
- L/800 Deflection Limit
- Compression Flange not Braced - Construction
- Use AASHTO Appendix A6
- 75 Year Design Life & $ADTT_{SL} = 1000$
 - Fatigue I - Infinite Life
- No User Defined Vehicle

Demonstration: 62 ft Span, 8" Deck w/SIP, 4 Girders @ 9 ft

Composite Bridge

Lightest 10 Sections (see to the right for additional information)						
Str I, Serv II, Constr	Fatigue	Deflection	L/D	Defl	Mn/My	Weight (tons)
W36X135	W36X135	W36X135	20.9	L/1295	1.88	16.7
W33X141	W33X141	W33X141	22.3	L/1204	1.78	17.5
W27X146			27.2	L/927	1.66	18.1
W40X149	W40X149	W40X149	19.5	L/1553	1.82	18.5
W36X150	W36X150	W36X150	20.7	L/1421	1.78	18.6
W33X152	W33X152	W33X152	22.2	L/1281	1.75	18.8
W36X160	W36X160	W36X160	20.7	L/1491	1.74	19.8
W27X161	W27X161	W27X161	27.0	L/998	1.62	20.0
W24X162			29.8	L/846	1.64	20.1
W40X167	W40X167	W40X167	19.3	L/1726	1.72	20.7

ENTER W SECTION FOR MORE INFORMATION					Weight (lb/ft)
W36X135	Composite				135
OVERALL PERFORMANCE FOR W36X135					
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall
PR	PR	PR	PR	PR	PR
0.793	0.876	0.947	0.961	0.618	0.961
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Fatigue
2		2		L/1295	
PERFORMANCE BY UNBRACED LENGTH FOR W36X135					
Inbraced Length	Unbraced Length (ft)	Lb Range	Strength I/II	Mn/My	Cb
1	21	0 - 21 ft	0.721	1.883	1.425
2	20	21 - 41 ft	0.793	1.883	1.009
3	21	41 - 62 ft	0.721	1.883	1.425

Demonstration: 62 ft Span, 8" Deck w/SIP, 4 Girders @ 9 ft

Composite Bridge

W36X135	Composite			Consider W40 & W44 Beams? Yes	Minimum Depth Beam W12			
Overall PR = 0.961 - Fatigue				L/D Limited to 25	Maximum Depth Beam W44	SERVICE II near Centerline		
Yield Strength (ksi)	50					DC1 (ft-k)	492.3 Sx=439.0 in^3	
Bridge Length (ft)	62		Bridge Width (ft)	31.00		DC2 (ft-k)	60.1 S3n=600.0 in^3	
Girder Spacing (ft)	9		Roadway Width (ft)	28.00		DW (ft-k)	84.1 S3n=600.0 in^3	
Number of Girders	4	Shoulders (ft) each side - Double for One Sided		2.00		HL93 LL+IM (ft-k)	1093.4 Sn=675.0 in^3	
Overhang (22.2% of Girder Spacing) (ft)	2	2 Striped Lanes and 2 Design Lanes						
Barrier Width (ft)	1.5				Lateral Distribution Factors	Serv II Stress	41.6	
Barrier Load on Girder (lb/ft)	125	8 in Structural Deck with 2 in SIP Forms			Single Lane/Multi-Lane	Serv II Allow	47.5	
DC Deck Only Loading (psf)	106.25		Deck f'c (psi)	4000	Moment LLDf = 0.660, 0.767	SERVICE II PR	0.876	
Wearing Surface (psf)	25	Haunch from Top of Web (in)		2	Fatigue LLDf = 0.550			
Additional DC1 Load on Girder (lb/ft)	40		Nominal Girder DC1 (lb/ft)	1024.6	Shear LLDf = 0.720, 0.884	LIVE LOAD DEFLECTION	In=21650.2 in^4	
Additional DC2 Load on Bridge (lb/ft)	0		Nominal Girder DC2 (lb/ft)	125.0		LL Defl (in)	0.57 = L/1295	
			Nominal Girder DW (lb/ft)	175.0		Allowable (in)	0.93 = L/800	
AT OVERHANG FOR LATERAL FLANGE BENDING	0					DEFLECTION PR	0.618	
Construction w (lb/ft)	275	AASHTO HL93 Loading and						
Construction p (lb)	3000	No User Defined Vehicle				FATIGUE Cat C' at Critical Brace		
1/2 of Deck Overhang Weight (lb/ft)	108.75					Fat Moment (ft-k) LLF = 1.75	380.0 Sfat=692.0 in^3	
ADDITIONAL VERTICAL BENDING ON GIRDERS						Fat Stress (ksi)	11.53	
Exterior - Construction p (lb)	3000					Fat Allow (ksi)	12.00	
Exterior - Construction w (lb/ft)	275					FATIGUE PR	0.961	
% Misc Stl for Diaphragms, etc	5%					STRENGTH I/II SHEAR at Support		
						DC1 (k)	31.8	
DEFLECTION LIMIT (x for Deflection Limit in L/x)	800					DC2 (k)	3.9	
						DW (k)	5.4	
Fatigue Design Life (yrs)	75			179298.4375		HL93 LL+IM (k) LLF = 1.75	89.4	
Fatigue ADTTSL	1000	Fatigue I Controls						
						Vu (k)	209.2	
						Vn (k)	591.9	
						SHEAR PR	0.353	

Demonstration: 62 ft Span, 8" Deck w/SIP, 4 Girders @ 9 ft

Composite Bridge

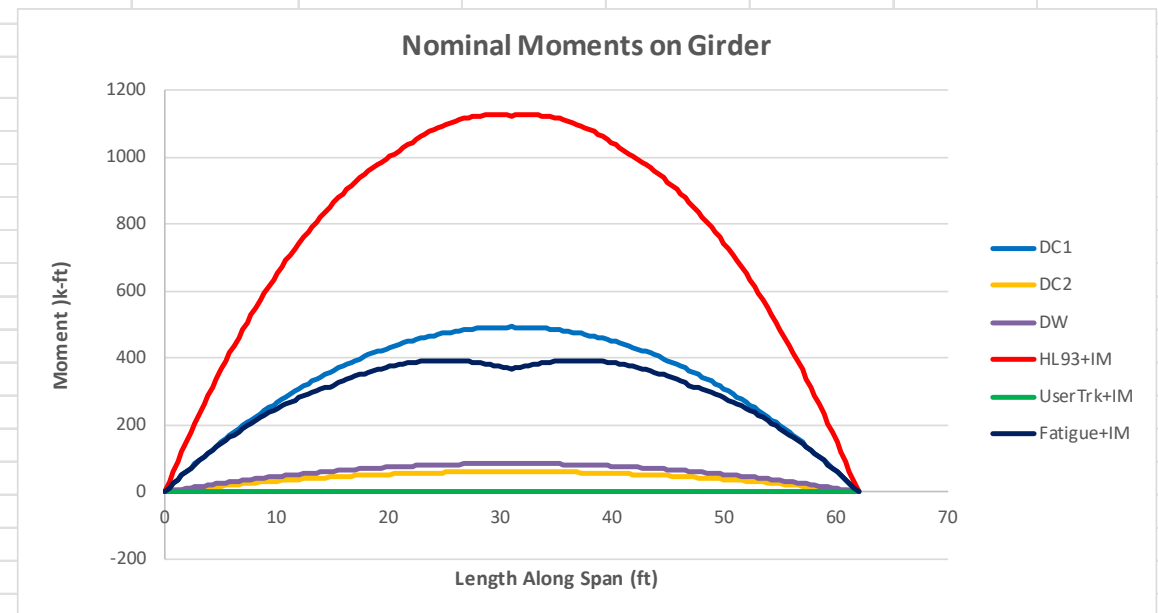
		STRENGTH I/II		Compression Flange Laterally Braced for F LLF = 1.75										
		Lb (ft)	DC1 (ft-k)	DC2 (ft-k)	DW (ft-k)	HL93 LL+IM (ft-k)		Mu (ft-k)	Cb	Mn (ft-k)	Perf Ratio			
	1	21	441.1	53.8125	75.3	1000.4		2482.4	1.42	3444.0	0.721			STRENGTH I/II MAX PR
	2	20	492.3	60.0625	84.1	1093.4		2730.1	1.01	3444.0	0.793			0.793
	3	21	441.1	53.8125	75.3	1000.7		2482.8	1.43	3444.0	0.721			
Strength Design Uses AASHTO Appendix A6 CONSTRUCTION														
		Lb (ft)	Mconstr (ft-k)	Mlat (ft-k)	AF	Affl (ksi)	<0.60Fy Perf Ratio	f _{bu} +Affl (ksi)	R _{pc} F _y =1.16*50 Perf Ratio	φ _u +1/3Affl (ks)	F _{nc} (ksi)	Perf Ratio		
	1	21	791.4	21.6	1.4	18.6	0.62	40.2	0.80	27.8	55.9	0.50		CONSTRUCTION MAX PR
	2	20	883.3	19.9	1.8	23.2	0.77	47.4	0.95	31.9	40.9	0.78		0.947
	3	21	791.4	21.6	1.4	18.6	0.62	40.2	0.80	27.8	55.9	0.50		
DEAD LOAD DEFLECTIONS (Max Loaded Girder)			0	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	L	
		Distance (ft)	0	6.2	12.4	18.6	24.8	31	37.2	43.4	49.6	55.8	62	
		I _x (in ⁴) = 7800.0	DC1 (in)	0.000	0.473	0.894	1.224	1.434	1.506	1.434	1.224	0.894	0.473	0.000
		I _{3n} (in ⁴) = 15409.5	DC2 (in)	0.000	0.029	0.055	0.076	0.089	0.093	0.089	0.076	0.055	0.029	0.000
		I _{3n} (in ⁴) = 15409.5	DW (in)	0.000	0.041	0.077	0.106	0.124	0.130	0.124	0.106	0.077	0.041	0.000
			Total (in)	0.00	0.54	1.03	1.41	1.65	1.73	1.65	1.41	1.03	0.54	0.00

Demonstration: 62 ft Span, 8" Deck w/SIP, 4 Girders @ 9 ft

Composite Bridge

NOMINAL ABUTMENT REACTIONS

DC1 (k)	123.3	At Centerline
DC2 (k)	15.5	At Centerline
DW (k)	21.7	At Centerline
Single Lane LL+IM (k)	121.4	At 9.00 From Centerline
Two Lane LL+IM (k)	202.4	At 4.00 From Centerline



Demonstration: 62 ft Span, 8" Deck w/SIP, 4 Girders @ 9 ft

Composite Bridge – Shear Studs

ONLY IF COMPOSITE

0.875 (in) SHEAR STUDE SPACING

	Minimum Spacing (in) 3.5					Maximum Spacing (in) 48
	0 - 12.4 ft	12.4 - 24.8 ft	24.8 - 37.2 ft	37.2 - 49.6 ft	49.6 - 62.0 ft	
Singles Pitch (in)	4.23	5.03	6.03	5.03	4.23	
Doubles Pitch (in)	8.47	10.05	12.06	10.05	8.47	
Triples Pitch (in)	12.70	15.08	18.08	15.08	12.70	
Strength Minimum Number of Studs	127					
Fatigue Singles Estimated Number of Studs	155.172541					
Fatigue Doubles Estimated Number of Studs	156.172541					
Fatigue Triples Estimated Number of Studs	157.172541					

Maximum Spacing (in) 48

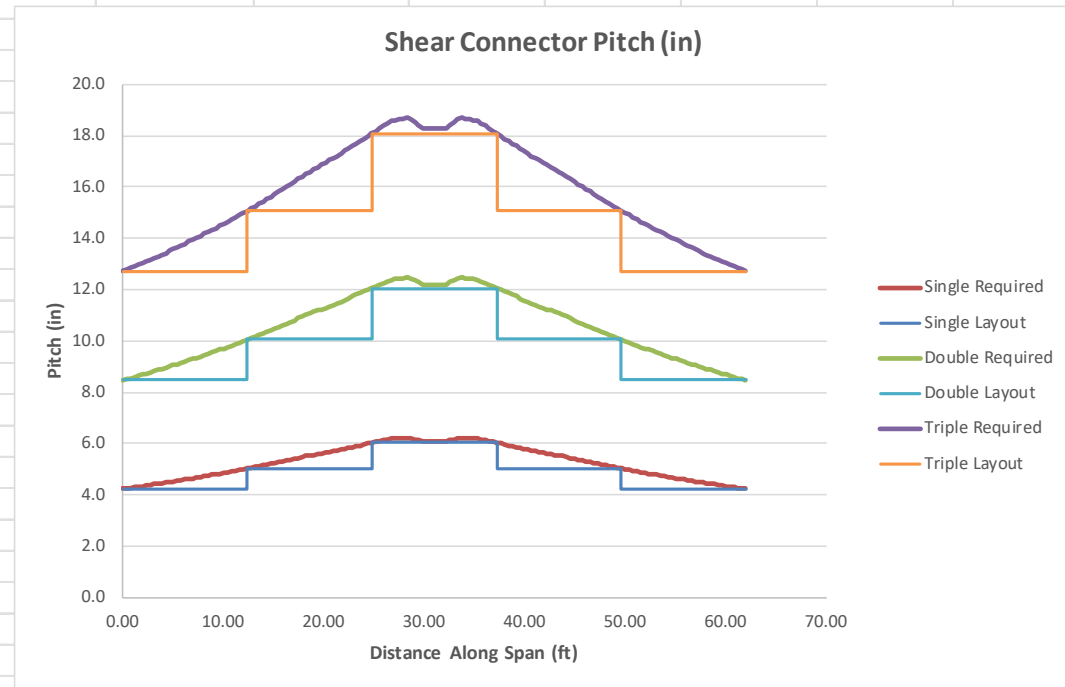
Minimum Transverse Spacing (in) 3.5

d (in) = 35.6

bf (in) = 12

Doubles Transverse Spacing

Triples Transverse Spacing



eBEAM140 Summary

Rolled Shape Bridge Design: Composite & NonComposite

- User Manual & Examples
- Released on www.ShortSpanSteelBridges.org September 2025

<https://www.shortspansteelbridges.org/ebeam140/>

Plate Girder Bridge Design in 2026

ePLATE140 Design Software - 2026

Excel Based Plate Girder Design Software

- Allows User to Investigate Alternatives to
 - Diaphragm Spacing
 - Lightest Weight Solution
 - Other Readily Available Flanges & Webs

Target L/D:

Target L/D – 2”

Target L/D

Target L/D + 2”

Target L/D + 4”

Target L/D + 6”

5 different Web Depths

5100 possible design combinations User Specified Solution

ENTER SECTION FOR MORE INFORMATION						LIST OF GIRDERS RANKED FROM STRENGTH I, SERVICE II & CONSTRUCTION										
bfc	tfc	D	tw	bft	tft	Weight (lb/ft)	Total Wt (tons)	Shape	Strength I/II	Service II	Construction	Fatigue	Deflection	Overall	Total Wt (tons)	
13.00	0.750	38.00	0.500	17.00	0.750	141	22.6									
OVERALL PERFORMANCE FOR TF:13 x 0.75 Web:38 x 0.5 BF:17 x 0.75																
Strength I/II	Service II	Construction	Fatigue	Deflection	Overall											
PR	PR	PR	PR	PR	PR											
0.917	0.973	0.933	0.703	0.807	0.973											
In Lb #	At Centerline	In Lb #	At Critical Brace	At Centerline Equal to	Service II											
3		2		L/992												
PERFORMANCE BY UNBRACED LENGTH FOR TF:13 x 0.75 Web:38 x 0.5 BF:17 x 0.75																
Compression Flange Laterally Braced for Final State			Strength I/II													
Unbraced Length	Unbraced Length (ft)	Lb Range	PR	Mn/My	Cb											
1	20	0 - 20 ft	0.703	1.995	1.509											
2	20	20 - 40 ft	0.917	1.995	1.052											
3	20	40 - 60 ft	0.917	1.995	1.052											
4	20	60 - 80 ft	0.703	1.995	1.509											
								bfc>=D/6 OK								
								bfc/2tfc<=12 OK								
								D/tw<=150 OK								
								2Dcp/tw<=lrw OK								
								lyc/lyt>=0.3 OK								
								Meets Reqrments for A6?								
								Yes								
								Construction Uses A6								
								TF:13 x 0.75 Web:38 x 0.5 BF:17 x 0.75	0.92	0.97	0.93	0.70	0.81	0.97	22.6	
								TF:13 x 0.75 Web:38 x 0.5 BF:13 x 1	0.91	0.97	0.93	0.69	0.80	0.97	22.7	
								TF:14 x 0.75 Web:36 x 0.5 BF:18 x 0.75	0.95	0.99	0.87	0.72	0.87	0.99	22.9	
								TF:13 x 0.75 Web:38 x 0.5 BF:18 x 0.75	0.89	0.94	0.93	0.68	0.78	0.94	23.0	
								TF:14 x 0.75 Web:38 x 0.5 BF:17 x 0.75	0.92	0.97	0.81	0.70	0.81	0.97	23.0	
								TF:14 x 0.75 Web:34 x 0.5 BF:15 x 1	0.97	0.99	0.93	0.71	0.91	0.99	23.1	
								TF:14 x 0.75 Web:36 x 0.5 BF:14 x 1	0.94	0.97	0.86	0.70	0.85	0.97	23.1	
								TF:15 x 0.75 Web:36 x 0.5 BF:18 x 0.75	0.95	0.99	0.78	0.72	0.87	0.99	23.3	
								TF:13 x 0.75 Web:38 x 0.5 BF:14 x 1	0.88	0.92	0.92	0.66	0.76	0.92	23.3	
								TF:14 x 0.75 Web:38 x 0.5 BF:18 x 0.75	0.89	0.94	0.81	0.68	0.78	0.94	23.4	
								TF:15 x 0.75 Web:38 x 0.5 BF:17 x 0.75	0.92	0.97	0.73	0.70	0.81	0.97	23.4	
								TF:15 x 0.75 Web:34 x 0.5 BF:15 x 1	0.97	0.99	0.83	0.71	0.91	0.99	23.5	
								TF:14 x 0.75 Web:34 x 0.5 BF:16 x 1	0.94	0.94	0.93	0.68	0.87	0.94	23.7	
								TF:12 x 1 Web:36 x 0.5 BF:18 x 0.75	0.95	0.99	0.88	0.72	0.87	0.99	23.7	
								TF:14 x 0.75 Web:36 x 0.5 BF:15 x 1	0.91	0.93	0.86	0.67	0.81	0.93	23.7	
								TF:16 x 0.75 Web:36 x 0.5 BF:18 x 0.75	0.96	0.99	0.72	0.72	0.87	0.99	23.7	
								TF:14 x 0.75 Web:38 x 0.5 BF:14 x 1	0.88	0.92	0.80	0.66	0.76	0.92	23.7	

ePLATE140 Plans

Plate Girder Bridge Design: Composite & NonComposite

AASHTO 10th Edition

Develop Users Manual & Examples

Industry Review

Release Sept 2026



Resource Tools for Simple Span Steel Bridge Design

The logo for eSPAN140 features a grey curved line above the text. The text 'eSPAN140' is in a bold, sans-serif font, with the 'e' in green and the rest in black. A small 'TM' trademark symbol is at the end.

eSPAN140™

Composite

Preliminary Rolled Shape and Plate Girder

The logo for eBEAM140 features a grey curved line above the text. The text 'eBEAM140' is in a bold, sans-serif font, with the 'e' in green and the rest in black.

eBEAM140

Composite & NonComposite

Optimized Rolled Shape

Composite & NonComposite

The logo for ePLATE140 features a grey curved line above the text. The text 'ePLATE140' is in a bold, sans-serif font, with the 'e' in green and the rest in black.

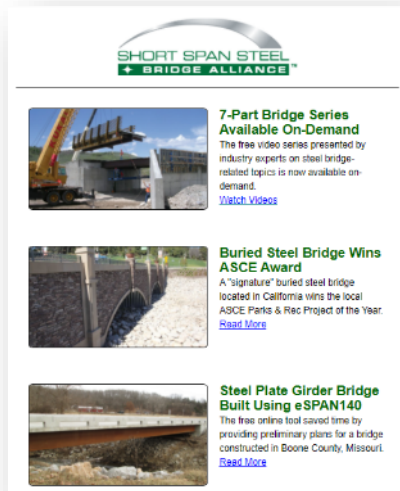
ePLATE140

Optimized Plate Girder

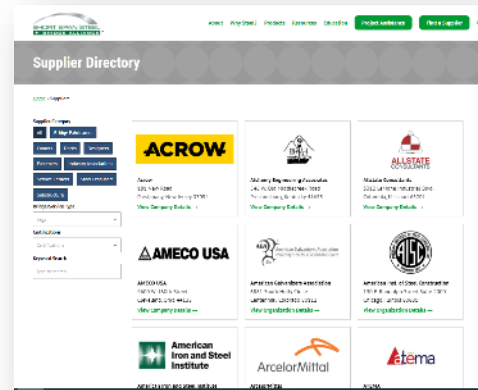
Free on www.ShortSpanSteelBridges.org

5 Ways to Keep Learning About Steel Bridges

1. Subscribe to the Weekly Newsletter



2. Find a Supplier



3. Design a Bridge in 5-Minutes



4. Receive Free Project Assistance



5. Schedule a Workshop/Webinar



www.ShortSpanSteelBridges.org

Questions? Dan Snyder, Director, SSSBA, dsnyder@steel.org, (301) 367-6179



Website: ShortSpanSteelBridges.org

Twitter: [@ShortSpanSteel](https://twitter.com/ShortSpanSteel)

Facebook: [Short Span Steel Bridge Alliance](https://www.facebook.com/ShortSpanSteelBridgeAlliance)