

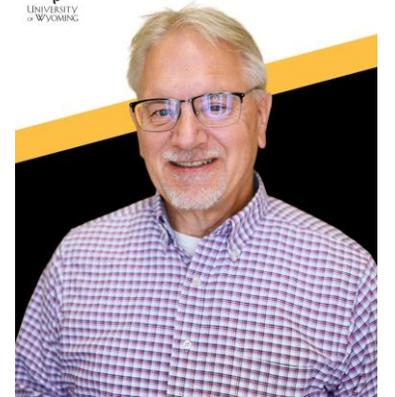


UNIVERSITY of WYOMING

Economical Design & Accelerated Prefabricated Options for Short-Span Steel Bridges

Minnesota Local Technical Assistance Program
January 14, 2026

Dr. Michael G. Barker, PE
University of Wyoming &
SSSBA, Director of Education



Today's Session

Design Resources for Short Span Steel Bridges

eSPAN140 & eBEAM140 Design Software

Prefabricated Steel Bridge Systems and Accelerated Bridge Construction

Case Studies and Alliance Members

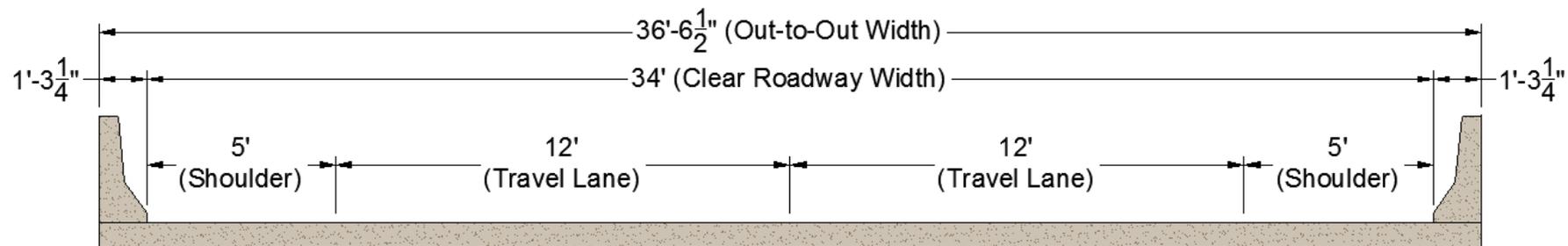
Traditional Fabricated Steel Bridges

Design Superstructure for Two-Lane, 80 ft 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)



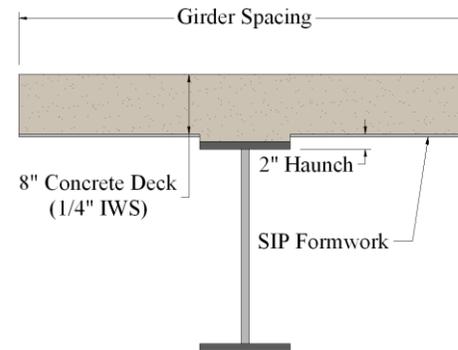
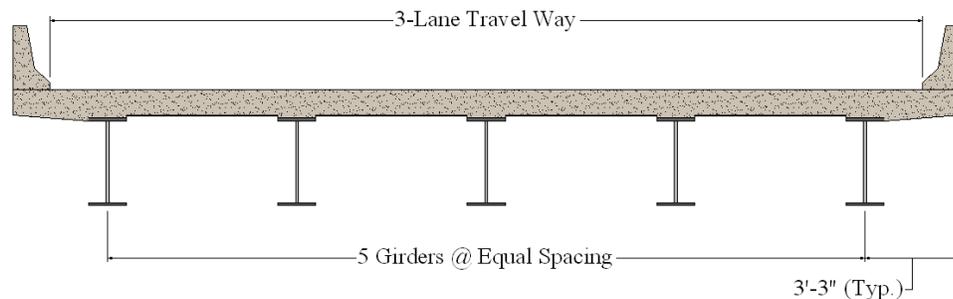
Need an Initial Design for the Bridge SuperStructure

eSPAN140 - Standard Designs for Short Span Steel Bridges - www.ShortSpanSteelBridges.org

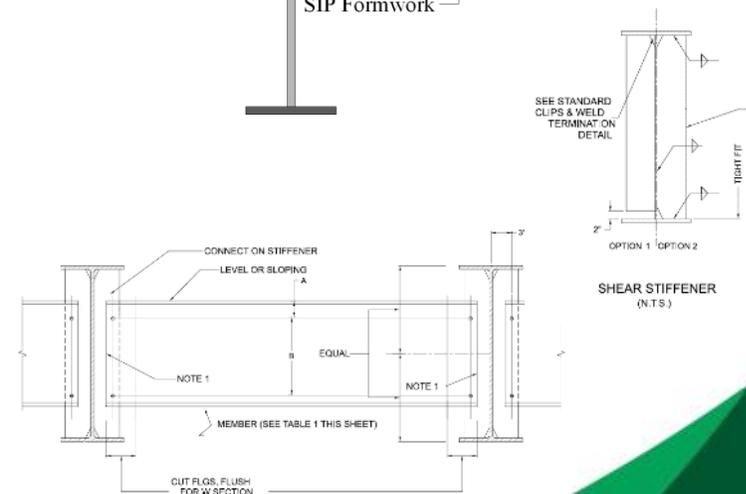
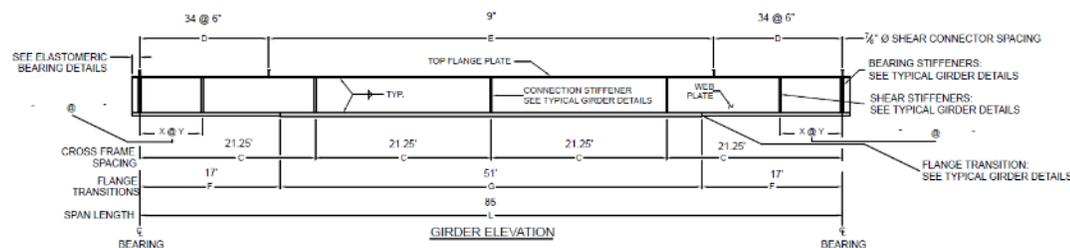
Span lengths 20 ft to 140 ft (in 5 ft increments)

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.

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

eSPAN140 Preliminary Design

Project Name*
 Example 80 ft Simple Span Bridge

Project Status*
 Informational Only

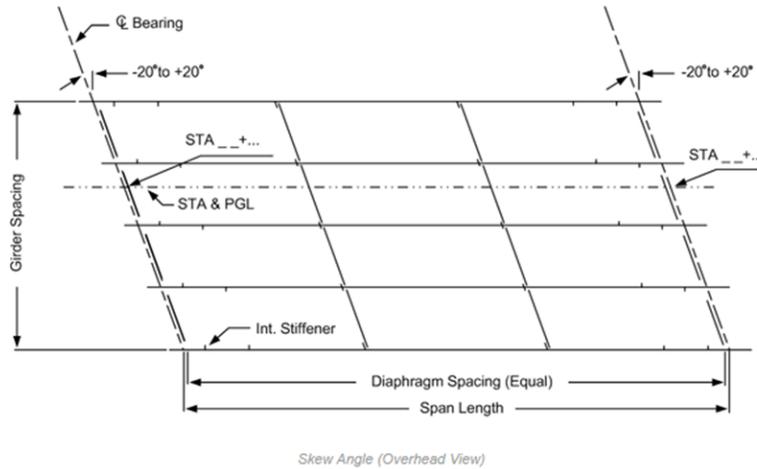
City/County*
 Laramie

State/Province*
 Wyoming

Roadway Name
 E 800 South

Bridge Span Length*
 80 Feet 0 Inches

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of Striped Traffic Lanes*
 2

Roadway Width*
 34 Feet 0 Inches

Individual Parapet Width*
 1 Foot 3.25 Inches

Individual Deck Overhang Width*
 2 Feet 6.25 Inches

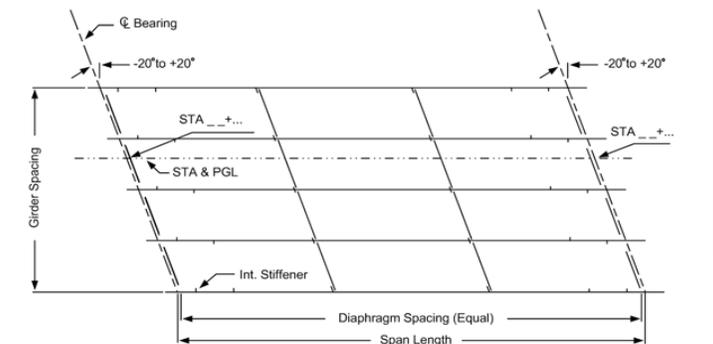
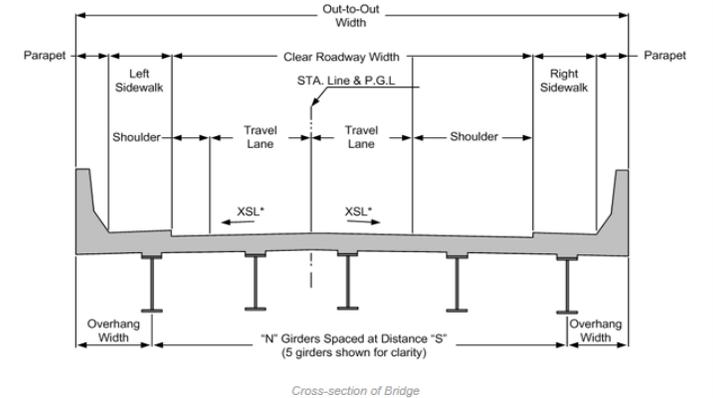
Pedestrian Access?

Skew Angle
 0 Degrees

Average Daily Traffic
 Over 2,000

Design Speed
 46+ mph

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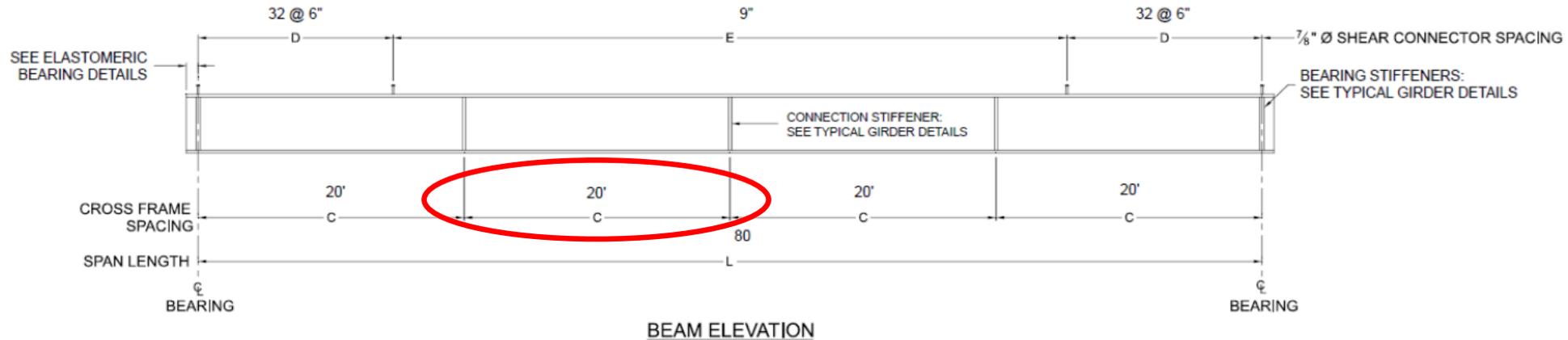


* Required

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) ft	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"

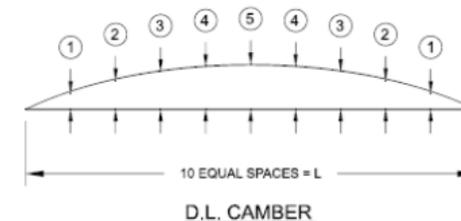
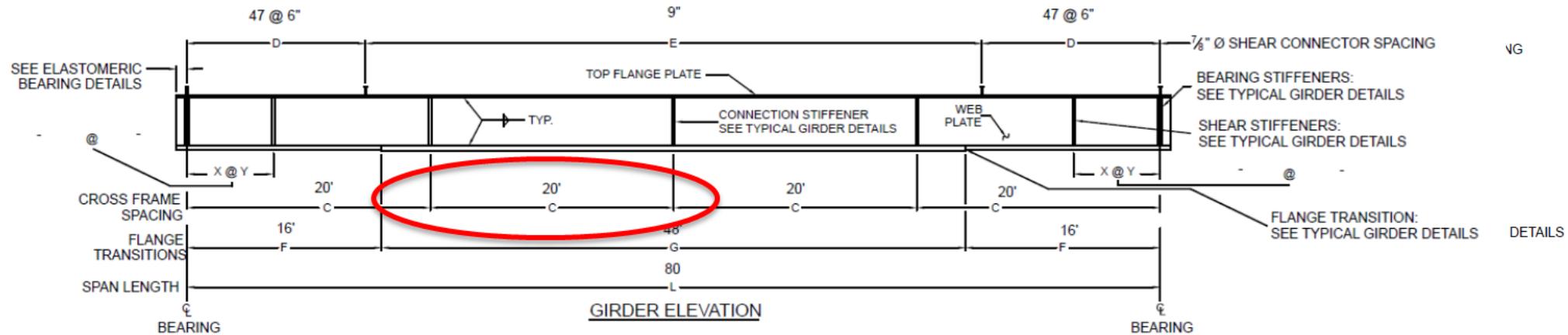


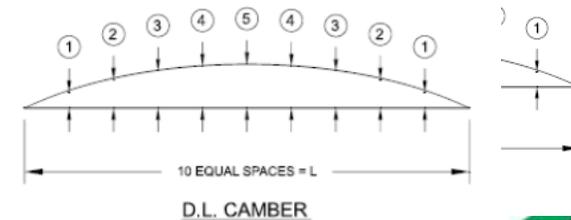
Plate Girder Recommendation

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

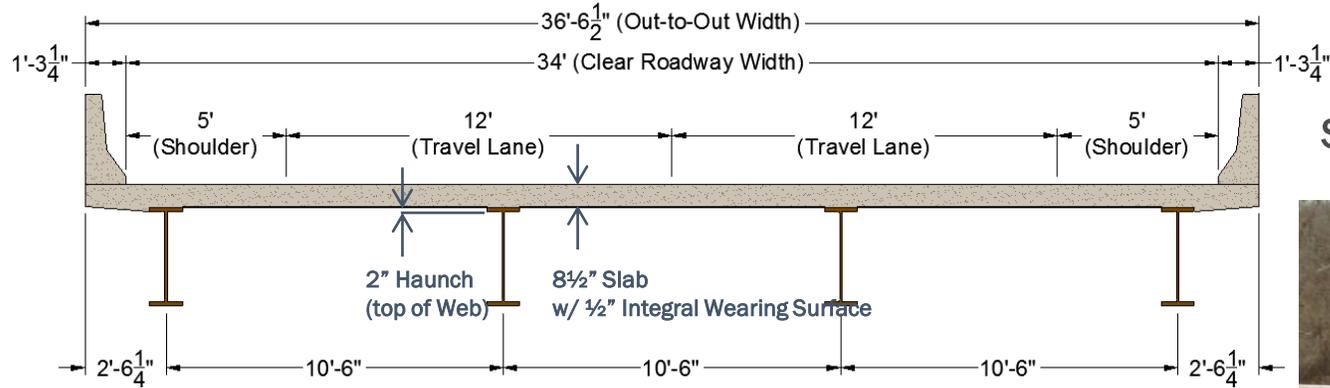


SPAN (L) - ft	PLATE GIRDER SIZE						DIAPHRAGM SPACING (C) - ft	SHEAR STIFFENERS		SHEAR CONNECTOR MAX. SPACING		INDIVIDUAL GIRDER WEIGHT	GIRDER WEIGHT
	TOP FLANGE - in	BOTTOM FLANGE (F)		BOTTOM FLANGE (G)		WEB PLATE - in		X (NO. REQ'd)	Y - ft. (SPACING)	D	E		
		PLATE - in	LENGTH - Ft	PLATE - in	LENGTH - 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	lbs

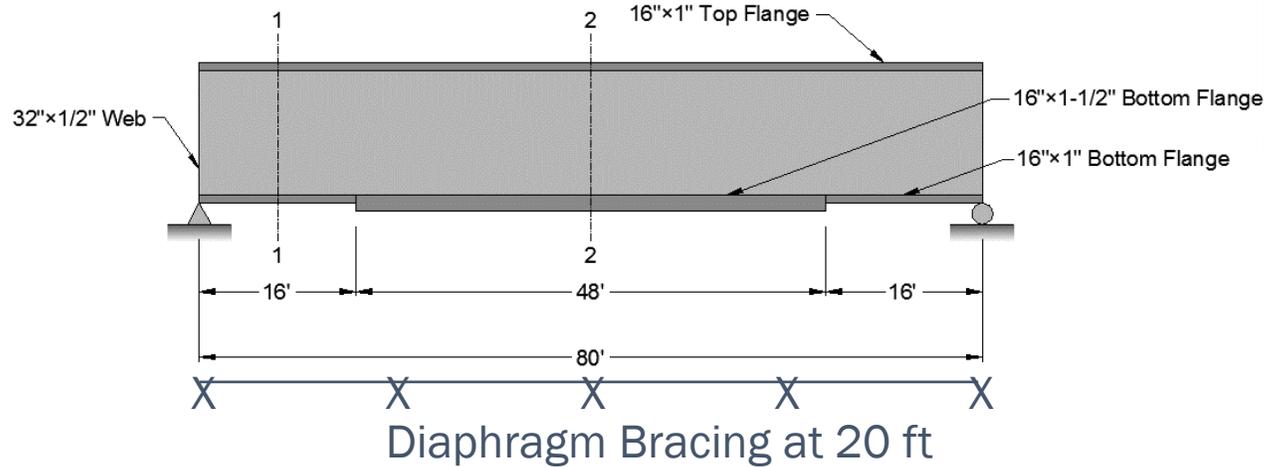
STEEL D.L. CAMBER - in					TOTAL D.L. CAMBER - in				
1	2	3	4	5	1	2	3	4	5
0.178"	0.334"	0.454"	0.530"	0.557"	1.397"	2.618"	3.554"	4.149"	4.355"



Design for Homogeneous Plate Girder Bridge



Superstructure Design for Two-Lane, 80 ft Simple Span Bridge



NEW Short Span Steel Bridge Alliance eBEAM140

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



Excel Based Rolled Beam Design Software

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

Version 1.0 - Beta

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

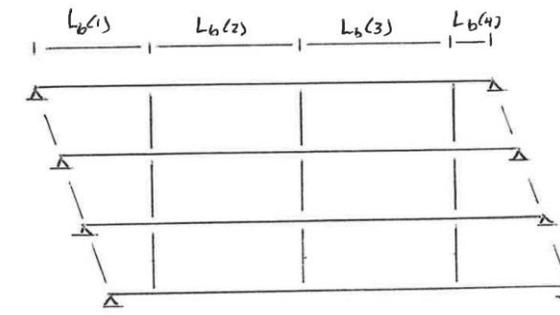
NonComposite Bridge

- 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) LFL = 1.75	574.5	5x-209.0	in ³								
Shear II Stress	58.5										
Serv II Allow	40.0										
SERVICE II PR	0.951										
LIVE LOAD DEFLECTION											
LL Deflt (in)	0.65	1+709									
Allowable (in)	0.75	1+800									
DEFLECTION PR	0.861										
FATIGUE CR C at Critical Brace											
Fat Moment (ft-k) LFL = 0.8	226.7	5x4-316.1	in ³								
Fat Stress (ksi)	6.88										
Fat Allow (ksi)	9.30										
FATIGUE PR	0.740										
STRENGTH U/S SHEAR at Support											
DC1 (k)	13.5										
DC2 (k)	0.6										
DW (k)	2.8										
HL93 LL+M (k) LFL = 1.75	56.3										
Vu (k)	120.5										
Vn (k)	447.0										
SHEAR PR	0.270										
Strength Design Uses AASHTO Appendix A6 STRENGTH U/S											
LLF = 1.75											
Lb (ft)	DC1 (ft-k)	DC2 (ft-k)	DW (ft-k)	HL93 LL+M (ft-k)	Mu (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	7.8125	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	1284.0	0.972		
Strength Design Uses AASHTO Appendix A6 CONSTRUCTION											
Lb (ft)	Mconstr (ft-k)	Mlat (ft-k)	AF	Atf (ksi)	Perf Ratio	f _{bu} +Atf (ksi)	Perf Ratio	f _u +V _u /Atf (ksi)	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	19.6	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
I _x (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
I _x (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
I _x (in ⁴) = 4470.0	DW (in)	0.000	0.039	0.079	0.100	0.117	0.117	0.117	0.100	0.079	0.039
Total (in)	0.000	0.233	0.464	0.60	0.70	0.79	0.79	0.60	0.444	0.233	0.000
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)	113.7	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											
Moment (ft-k)											
Length Along Span (ft)											
ONLY IF COMPOSITE											
0.875 (in) SHEAR STUD SPACING	Minimum Spacing (in) 5.25										
0 - 10.0 ft	10.0 - 20.0 ft	20.0 - 30.0 ft	30.0 - 40.0 ft	40.0 - 50.0 ft	Maximum Spacing (in) 48						
Singles Pitch (in)	7.17	8.55	9.24	8.55	7.17						
Doubles Pitch (in)	54.96	17.09	18.48	17.09	24.35						
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	75.52657289										
Fatigue Doubles Estimated Number of Studs	76.52657289										
Fatigue Triples Estimated Number of Studs	77.52657289										
Shear Connector Pitch (in)											
Pitch (in)											
Distance Along Span (ft)											
SHEAR PR											
0.00	10.00	20.00	30.00	40.00	50.00	60.00					
STRENGTH U/S MAX PR											
0.982											
CONSTRUCTION MAX PR											
0.472											

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	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	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	0.993	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 in⁴	
	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	Lb (ft)	DC1 (ft-k)	DC2 (ft-k)	DW (ft-k)	LLF = 1.75	HL93 LL+IM (ft-k)	Mu (ft-k)	Cb	Mn (ft-k)	Perf Ratio	
	1	26	183.1	8.45	0.0		670.4	1412.6	1.26	1422.9	0.993	STRENGTH I/II MAX PR
	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	Lb (ft)	Mconstr (ft-k)	Mlat (ft-k)	AF	Affl (ksi)	Perf Ratio	f _{bu} +Affl (ksi)	Perf Ratio	f _{bu} +1/3Affl (ksi)	Fnc (ksi)	Perf Ratio	
	1	26	228.9	0.0	1.0	0.0	0.00	6.3	0.13	6.3	38.9	0.16	CONSTRUCTION MAX PR
	2	26	228.9	0.0	1.0	0.0	0.00	6.3	0.13	6.3	38.9	0.16	0.161

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
(W33x130 Meets All)**

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
 (W33x130 Meets All)

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									
Yield Strength (ksi)	50				L/D Limited to 25	Maximum Depth Beam W44		SERVICE II near Centerline	
Bridge Length (ft)	62		Bridge Width (ft)	31.00				DC1 (ft-k)	492.3 Sx=439.0 in ³
Girder Spacing (ft)	9		Roadway Width (ft)	28.00				DC2 (ft-k)	60.1 S3n=600.0 in ³
Number of Girders	4	Shoulders (ft) each side - Double for One Sided		2.00				DW (ft-k)	84.1 S3n=600.0 in ³
Overhang (22.2% of Girder Spacing) (ft)	2	2 Striped Lanes and 2 Design Lanes						HL93 LL+IM (ft-k)	1093.4 Sn=675.0 in ³
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	
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

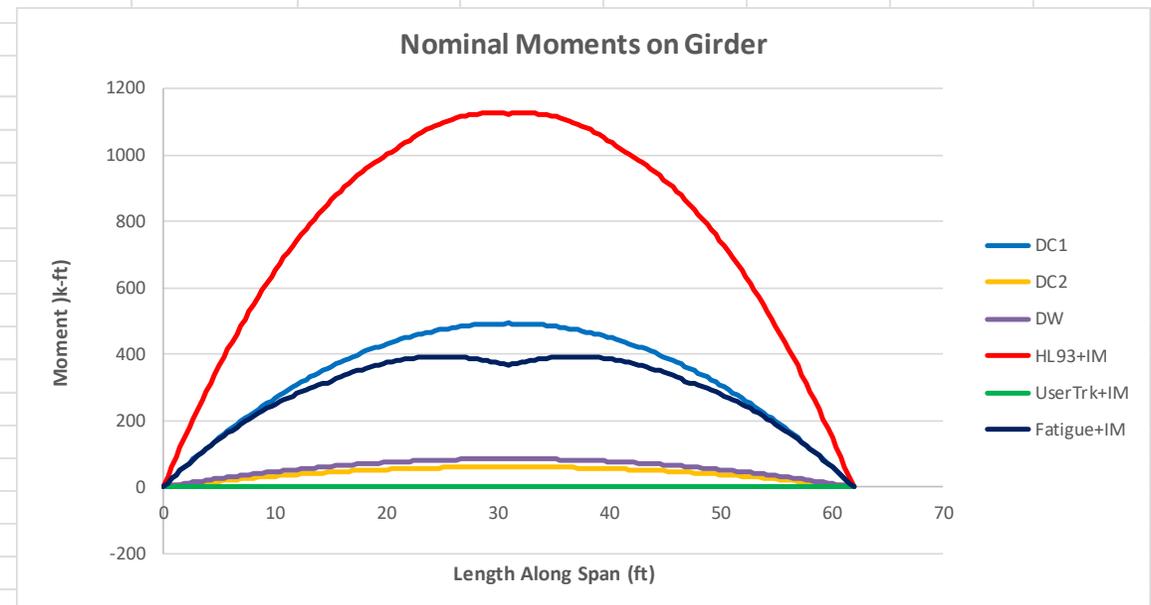
		STRENGTH I/II		Compression Flange Laterally Braced for F			LLF = 1.75							
		Lb (ft)	DC1 (ft-k)	DC2 (ft-k)	DW (ft-k)	HL93 LL+IM (ft-k)		Mu (ft-k)	Cb	Mn (ft-k)	Perf Ratio			
	1	21	441.1	53.8125	75.3	1000.4		2482.4	1.42	3444.0	0.721			STRENGTH I/II MAX PR
	2	20	492.3	60.0625	84.1	1093.4		2730.1	1.01	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)	Perf Ratio	f _{bu} +Affl (ksi)	Perf Ratio	f _{bu} +1/3Affl (ks)	Fnc (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



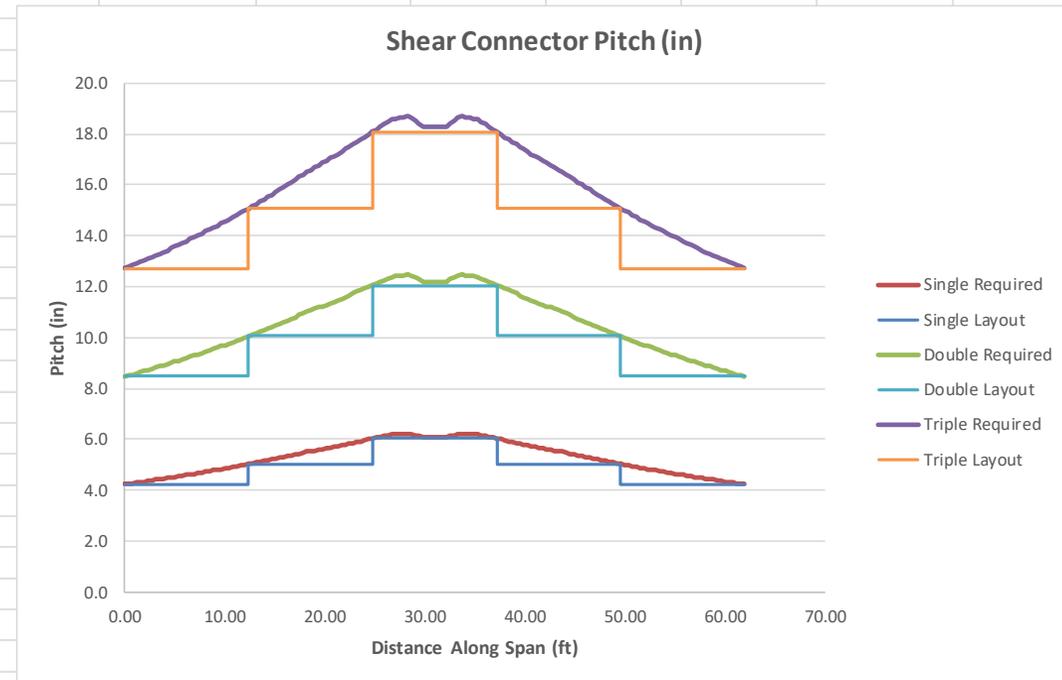
Demonstration: 62 ft Span, 8" Deck w/SIP, 4 Girders @ 9 ft

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					



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

Composite Bridge: W36 x 135

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

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						
Compression Flange Laterally Braced for Final State			Strength I/II			
Inbraced Length	Unbraced Length (ft)	Lb Range	PR	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	

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	
0.822	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						
Compression Flange Laterally Braced for Final State			Strength I/II			
Inbraced Length	Unbraced Length (ft)	Lb Range	PR	Mn/My	Cb	
1	21	0 - 21 ft	0.753	1.883	1.425	
2	20	21 - 41 ft	0.822	1.883	1.009	
3	21	41 - 62 ft	0.753	1.883	1.425	

Strength II: LLF = 1.35, No Lane Load, Single Lane W36x135

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

**SHORT SPAN STEEL
+ BRIDGE ALLIANCE**

AGA American Galvanizers Association
Protecting Steel for a Sustainable Future
Zn

Building Better Bridges in 2025

 AIA Approved Continuing Education	Feb 19, 1 pm ET	Steel vs Concrete Life Cycle Performance and Costs
 ENGINEERING RCEP	April 23, 1 pm ET	Unlocking the Potential of Buried Steel Structures
	Sept 10, 1 pm ET	Next-Gen Steel Bridge Design Tools for Smarter Solutions
	Dec 10, 1 pm ET	Simple for Dead, Continuous for Live Designs for Optimal Performance 

www.steel.org

SOON Short Span Steel Bridge Alliance ePLATE140

Noncomposite and Composite Simple-Span Plate-Girder Steel Bridge Design

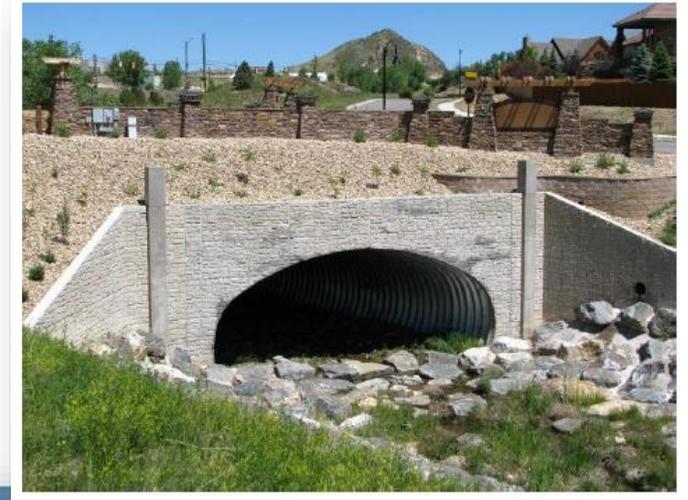


Excel Based Rolled Beam Design Software
Version 1.0 - Beta

eBEAM140 Disclaimer: This document has been prepared in accordance with information available to the American Iron and Steel Institute Short Span Steel Bridge Alliance (SSSBA) program, at the time of preparation. It is believed to reasonably reflect the present state of knowledge and should not be used or relied upon for any specific design without professional examination and verification of its accuracy, by a licensed engineer, architect or other professional. AISI and SSSBA assume no 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 provide supplements or corrections in the event of errors being discovered or advances being made in the techniques discussed in the document.

SIMILAR

Prefabricated Bridges - Manufacturer Solutions



The Most Common - Modular Beam

Shop Fabricated Quality

Shipped as Modules

Lifted into Place

Gravel Surface, Cast-in-Place Deck or Pre-Decked with Closure Joint

Prefabricated Bridges

Accelerated Bridge Construction

County Built

The 5 C's

Cost

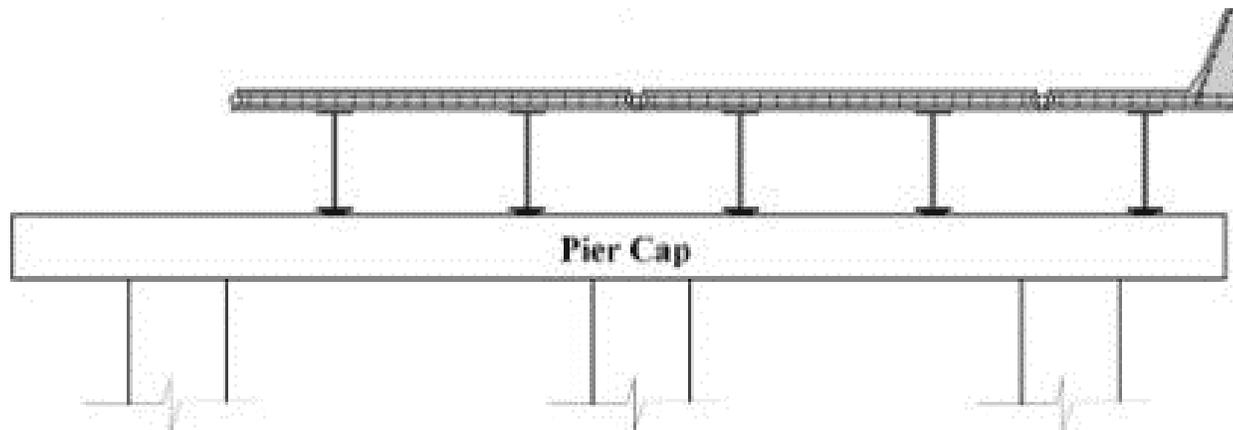
Convenience

Construction (ABC)

County Built

Carbon Footprint

Look at Two Examples



Other types of Prefabricated
Bridges include:

Buried Steel Bridges – Culverts

Buried Steel Bridges - Arch

Trusses

Pre-Fabricated Modular Beam – County Crew Built

Seltice-Warner Bridge, White Road, Whitman County, WA

Fabricator: BigR/Contech Engineered Solutions
Contractor: Whitman County Crew
Design Engineer: Mark Storey, County Engineer



Existing Structure – 30 ft Span, 20 ft Wide

Wood with Wood Piles & Wood Backwalls
Wood Deterioration & Susceptibility to Scour

Replacement Structure Requirements

Increase Hydraulic opening – 30 ft Channel
Raise Clearance for 100 yr Flood
Gravel Roadway
Piles with Alluvium Soils / Scouring



Pre-Fabricated Modular Beam

Bridge Structure

35 ft Span x 28 ft Wide

2-Girder Modules / 3 Modules

Shipped on One Truck

Fully-Assembled

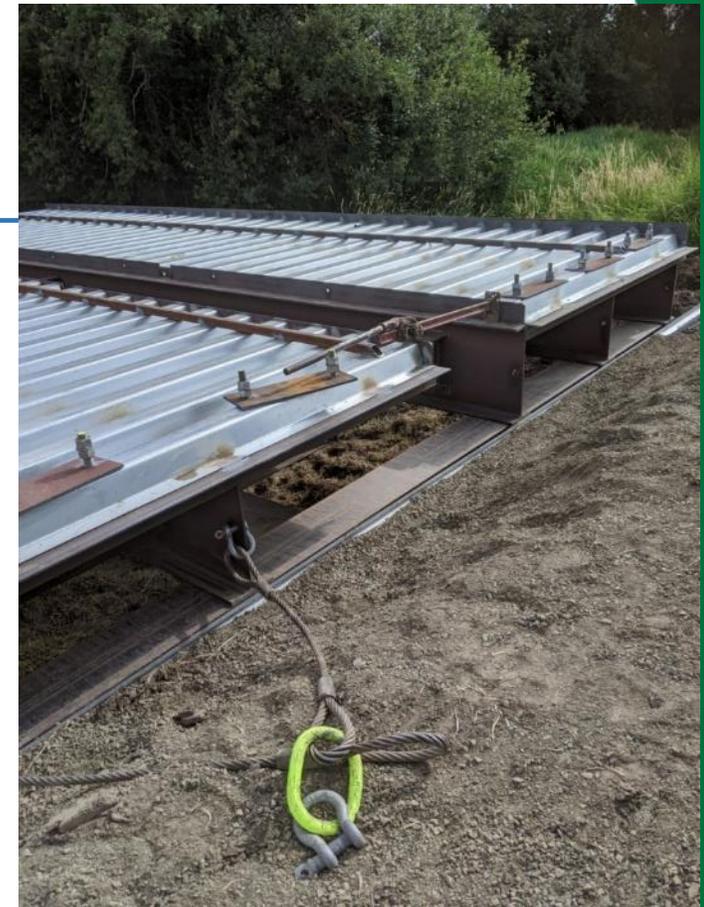
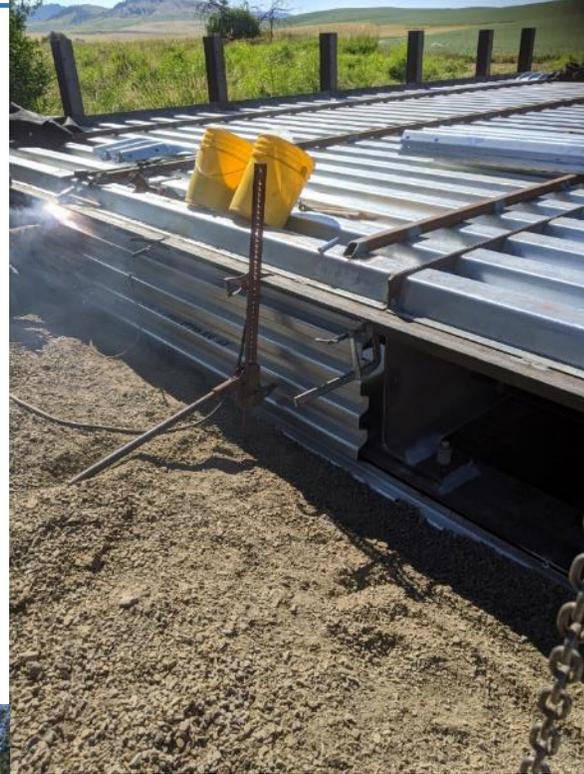
CSD & Gravel

Simple Connections



Pre-Fabricated Modular Beam

SuperStructure Erection



Pre-Fabricated Modular Beam

Timing

Excavation, Stream Restoration &
Bridge Installation ~ 4 Weeks

Costs

Steel Superstructure	\$ 59,000
Labor & Equipment	\$ 70,000
Pile Foundations	\$ 20,000
Permitting	\$ 10,000
Total	\$159,000

\$ 162.25 / ft²

Concrete Superstructure Alternative \$ 82,000



Pre-Fabricated Modular Beam – Contractor Built

Brookfield 100 Road, Hancock Forest Management, Cathlamet, WA

Fabricator: BigR/Contech Engineered Solutions

Contractor: Quality Excavation

Design Engineer: Pacific Forest Resources



Existing Structure – 36” Pipe

Barrier to fish movement

Restricts 6+ feet of natural stream width

Inundated by Columbia River tidal influence zone

Replacement Structure Requirements

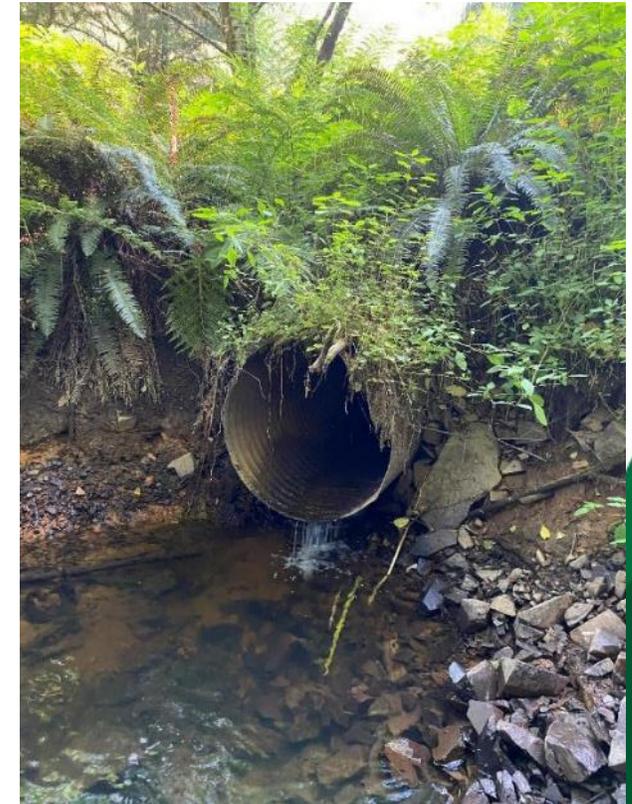
Increase Hydraulic opening

Needed 55 – 60 ft span

Poor soil bearing capacities

Large equipment difficult in forest setting

Special logging U-80 Vehicle



Pre-Fabricated Modular Beam

Structure Considerations

Poor Soils on Right End

Steel-Bin Abutment

Vertical Abutment Allowed 50 ft Span

Light Superstructure

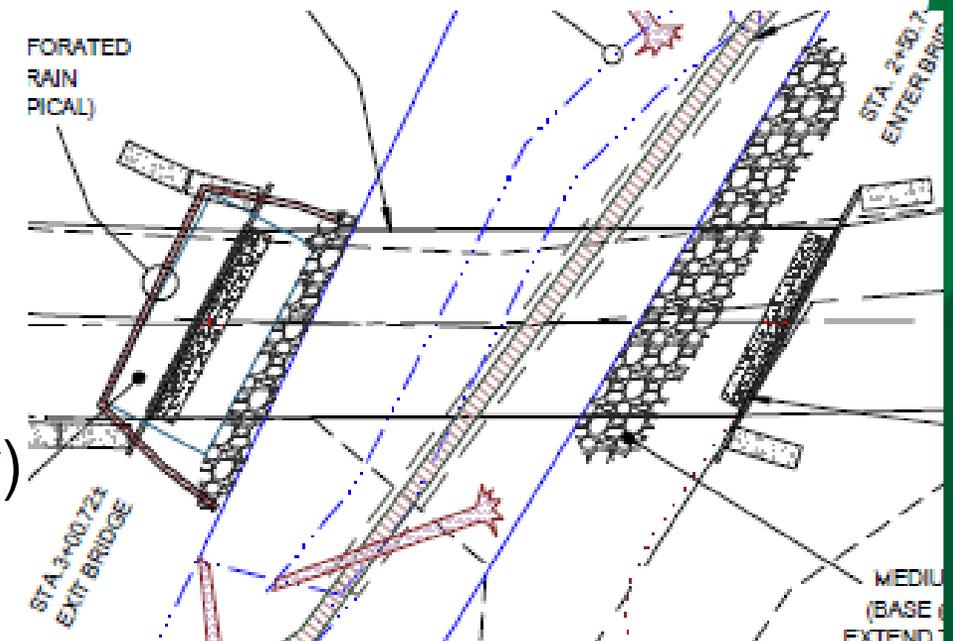
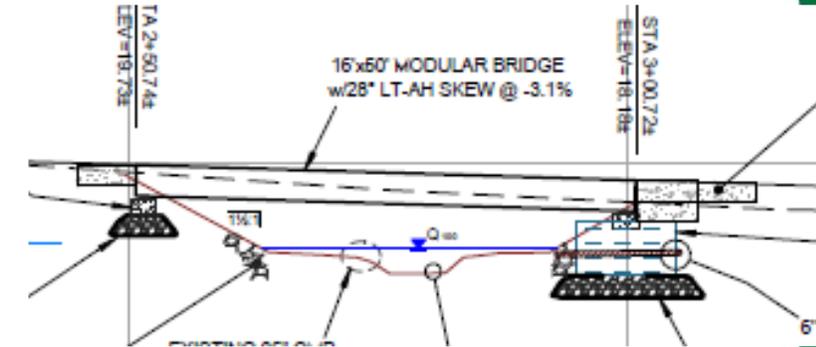
Gravel Roadway for Forest Service

Control of Debris into Creek

Erection Equipment

Two Excavators (~15 kip capacity)

Modular Superstructure



Pre-Fabricated Modular Beam

Substructure Considerations

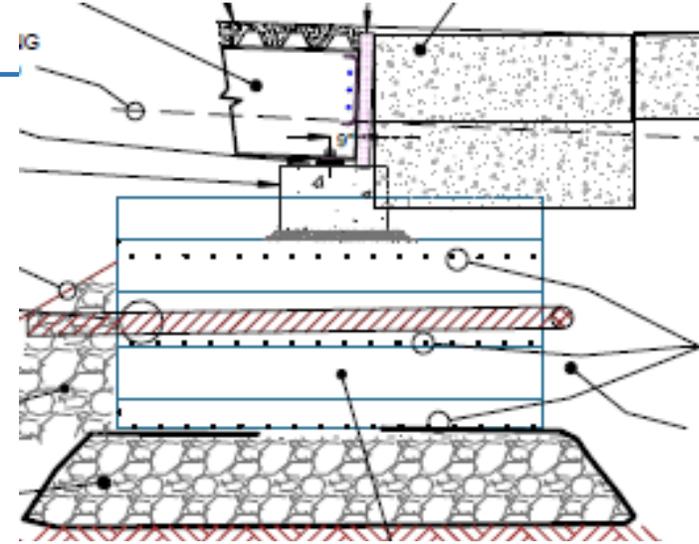
Poor Soils on Right End
Equipment – Piles Difficult

Steel-Bin Box Abutment

10 ft x 20 ft x 6 ft Bin
Geogrid Layers at 16"
Precast Sill
Rip-Rap Protection

Left Abutment Better Material

Precast Sill
Rip-Rap Protection



Pre-Fabricated Modular Beam

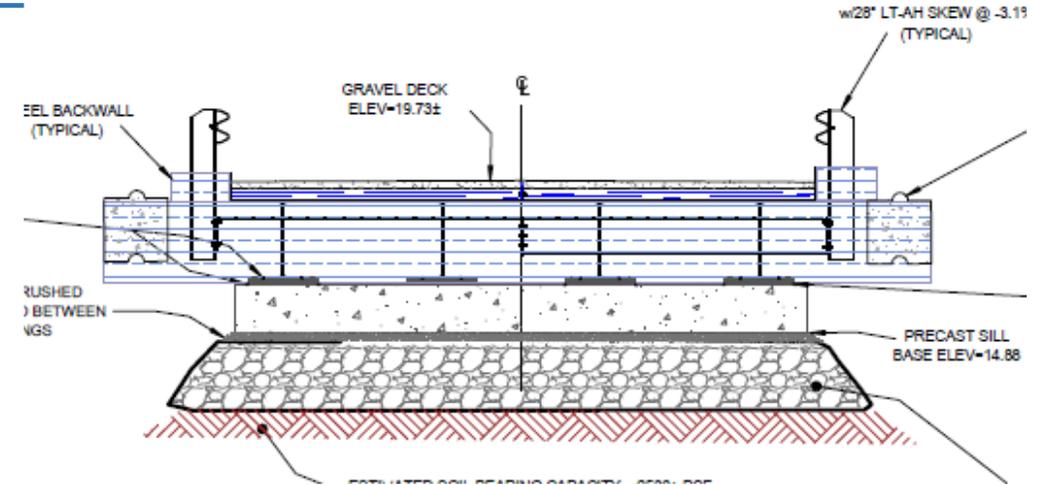
Substructure Construction



Pre-Fabricated Modular Beam

Superstructure Considerations

- Abutment Capacity
- Equipment Capacity
- Handling
- Convenience



BigR/Contech Modular Bridge

- 2-Girder Modules
- Fully-Assembled
- 19.5 kip each
- CSD and Dams
- Simple Connections



Pre-Fabricated Modular Beam

Superstructure Erection



Pre-Fabricated Modular Beam

Timing

Excavation, Stream Restoration &
Bridge Installation – 2 Weeks

Costs

Bridge, Sills, & Steel-Bin	\$ 68,500
Labor (Prevailing Wage)	\$ 77,500
Engr, PM, Survey, Misc	\$ 17,000
Total	\$163,000

\$ 203.75/ft²



Case Studies Modular Beams



Minneapolis, MN

Sevier River Bridge. Axtell, UT

Fabricator: Wheeler Bridge
Contractor: Gerber Construction

75 ft long, 28 ft wide Modular Rolled Beam



Schoepps Valley Road, Waumandee, WI

Fabricator: Wheeler
Contractor: JF Brennan

Three-Simple-Span (3 x 48 ft) with 24 ft Roadway
Emergency Replacement During Winter Months



Performance of Today's Short Span Steel Bridges

Cost Effective

- Simple & Practical Details
- Lighter Equipment
- Smaller Abutments



Speed of Construction

- Accelerated Bridge Construction
- Modular Construction

Longevity - 100+ yrs

- Durable Materials
- Corrosion Protection Systems
- Integral Abutments & Jointless Decks



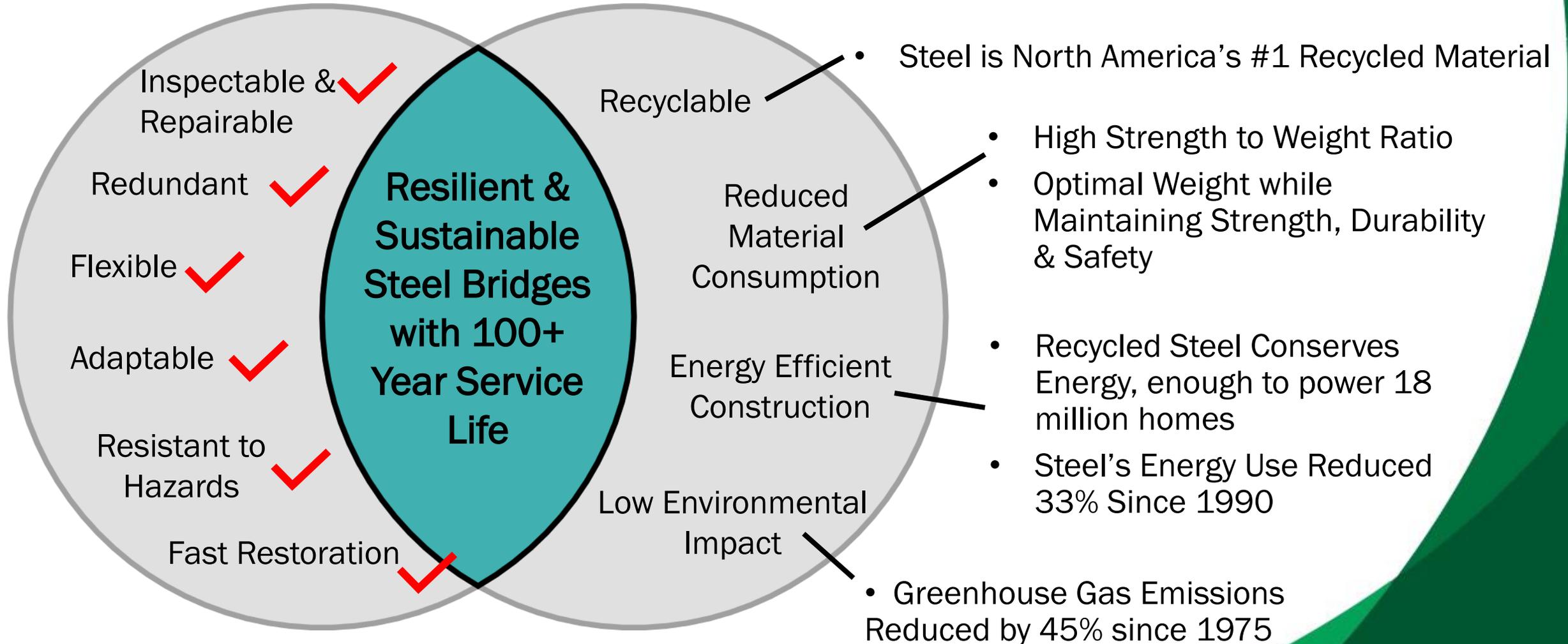
Resilient & Sustainable

www.ShortSpanSteelBridges.org

Resiliency & Sustainability

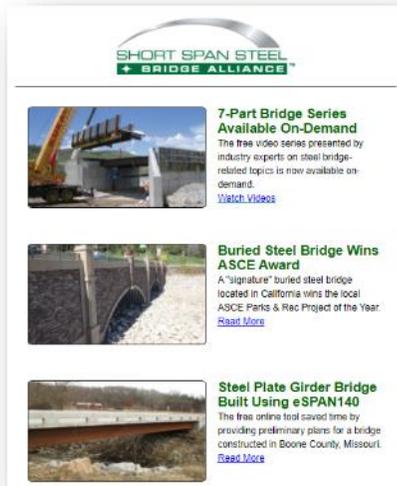
Resiliency

Sustainability

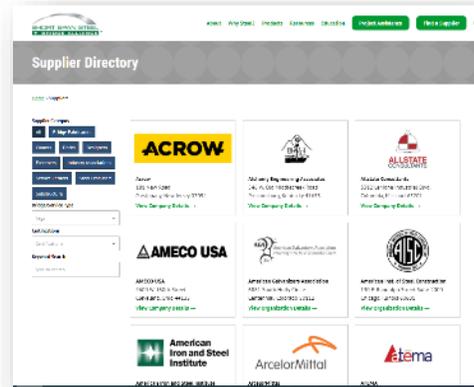


5 Ways to Keep Learning About Steel Bridges

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

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