AASHTOWare BrDR 7.5.0 Steel Tutorial Steel Fishbelly Web Examples

STL9 - Steel Fishbelly Web

Topics Covered

- Steel plate girder fishbelly web profiles
- Reverse parabolic
- Reverse circular curve
- Analyze with AASHTO LFR engine

Fishbelly web profiles are either reverse circular or reverse parabolic web profiles. Fishbelly web profiles can be modeled in BrDR for steel plate or built-up girders. This example reviews the input of reverse parabolic and reverse circular web profiles.

Fishbelly Web Profiles

- Only available for steel plate and built-up girders
- Available for both schedule based and cross section based input
- Fishbelly profiles must be either totally parabolic or totally circular. Adjacent parabolic and circular sections are not allowed.
- BrDR LFR engine is the only analysis engine currently available for rating

The following sketch illustrates a reverse circular web profile:



Br	AASH	TOW	'are Bric	lge Design and Rating	l	?	_		\times
BRIDGE EXPLORER BRIDG	FOLDE	R	RATE	TOOLS VIEW	r				
New Open Batch ~	Find Copy	Pa	ste Co To	py Remove Delete From					
впаде		1	wanag	e					
···· 🚖 Favorites Folder			BID	Bridge ID				Bridg	e N
Recent Bridges			1	TrainingBridge1		Trainin	g Bridge	1(LRFD)	1
Hin Sample Bridges			2	TrainingBridge2		Trainin	g Bridge	2(LRFD)	
Deleted Bridges			3	TrainingBridge3		Trainin	g Bridge	3(LRFD)	
j			4	PCITrainingBridge1		PCI Tra	iningBri	dge1(LFR)
			5	PCITrainingBridge2		PCITrai	ningBrid	lge2(LRFI)
			6	PCITrainingBridge3		PCI Tra	iningBri	dge3(LFR)
			7	PCITrainingBridge4		PCITrai	ningBrid	lge4(LRFI))
			8	PCITrainingBridge5		PCI Tra	iningBri	dge5(LFR)
		Ŀ	9	PCITrainingBridge6		PCITrai	ningBrid	lge6(LRF[) -
									-
				Total Bridge Cou	unt:	31			

Using the **Import** option from Bridge Explorer, import the STL9 bridge provided with this tutorial.

Open the Bridge Workspace for **Fishbelly Web Example**. This bridge contains a reverse parabolic and a reverse circular curve web profile example.



Reverse Parabolic

Schematic

Using the **Reverse parabola example**, navigate to **G1**, **Schedule Plate Girder** member alternative, **right click** and select **Schematic** for the member alternative on the Bridge Workspace.

Bridge	- 0
🖮 🗛 Fishbelly Web Example	
🖶 🥟 Components	
📁 Diaphragm Definitions	
📟 📁 Lateral Bracing Definitions	
MPF LRFD Multiple Presence Factors	
Environmental Conditions	
Design Parameters	
🖗 🔚 EUPERSTRUCTURE DEFINITIONS	
🖶 📶 Reverse parabola example	
Impact/Dynamic Load Allowance	
Load Case Description	
🛲 Framing Plan Detail	
Bracing Deterioration	
BSC Bracing Spec Check Selection	
the Superstructure Typical Section	
Shoar Connector Definitions	
Stiffanar Dafinitions	
Member Loads	
Supports	
MEMBER ALTERNATIVES	
└── I Schedule plate girder (E) (C)	
Se Expand Branch	
Q Collanse Branch Allowance	
Open 🖉	
Сору	
📋 Duplicate	
💥 Delete	
Analyze	
😅 Validate Dns	
View Summary Report	
Q View Detailed Report	
🔹 🎰 Schematic	
🗄 🎲 General Preferences	
🛗 📅 📅 🖾 Close Bridge Workspace	

The following shows the **Girder profile** schematic with some additional text shown to describe where the reverse parabolic web profile exists. (The display of stiffeners in the schematic has been turned off.)

Note: The **Parabolic Down** and **Parabolic Up** labels shown below do not show up in BrDR, they have been added to the schematic for this training example only.

rder profile				- 1
🗈 📐 🔍 🕂 🖶 🔂 🖯 50% 🗸 🗸				
3/4"[78 1/2"-163 9/16"]×108"-0"		3/4"[16	13 9/16"-3/4";3/4"[168 T T T	3 1/2"-159 9/16"]x6'-0"
4E/7 0*				
2 SPA.@ 8'-4"=16'-8"i-0"=75'-0" 8'-4" 2 S	PA.@ 8'-4"=16'-8" 8'-4"	2 SPA.@ 8'-4"=16'-8"	8'-4"	2 SPA.@ 8'-4"=16'-8"
H H	- H	- n	14	
		1 1 1		
3/4"Web: [78 1/2'-163 9/16']		3/4"W	لح eb: [163 @/#88########	2"1MBB 1/2"-159 9(16"]
*		*		
		Para	bolic Up	
Parabolic D	own			
Tarabolie D	own			
PL 6"x18"x108"-0"			PL 4"x18"x8"-0	
125'-0"				

Girder Profile

Double click on the Girder Profile node in the Bridge Workspace tree. The input data describing the web profile is shown below:

/eb	Top fl	ange	Bott	om flange								
	Begin depth (in)	Depth	vary	End depth (in)	Thickness (in)	Support number	Start distance (ft)	Length (ft)	End distance (ft)	Material	Weld at right	
>	78.504	None	\sim	78.504	0.75	1 ~	0	10	10	Grade 50W 🗸 🗸	None 🗸 🗸	
	78.504	Para	\sim	163.572	0.75	1 ~	10	108	118	Grade 50W $$	None 🗸	
	163.572	Para	\sim	168.504	0.75	1 ~	118	6	124	Grade 50W $$	None 🗸	
	168.504	None	\sim	168.504	0.75	1 ~	124	2	126	Grade 50W $$	None 🗸	
	168.504	Para	\sim	159.576	0.75	2 ~	1	6	7	Grade 50W $$	None 🗸	
	159.576	Para	\sim	102.504	0.75	2 ~	7	37.5	44.5	Grade 50W $$	None 🗸	
	102.504	None	\sim	102.504	0.75	2 ~	44.5	161	205.5	Grade 50W $$	None 🗸	
	102.504	Para	\sim	159.576	0.75	2 ~	205.5	37.5	243	Grade 50W $$	None 🗸	
	159.576	Para	\sim	168.504	0.75	2 ~	243	6	249	Grade 50W $$	None 🗸	
	168.504	None	\sim	168.504	0.75	2 ~	249	2	251	Grade 50W \lor	None 🗸	
	168.504	Para	\sim	163.572	0.75	3 ~	1	6	7	Grade 50W $$	None 🗸	
	163.572	Para	\sim	78.504	0.75	3 ~	7	108	115	Grade 50W $$	None 🗸	
	78.504	None	\sim	78.504	0.75	3 ~	115	10	125	Grade 50W 🗸	None 🗸	
										New	Duplicate	Delete

Click **OK** to close the window.

Analyze with AASHTO LFR engine

Member Alternative - Specs

Open the **Schedule plate girder** member alternative **Specs** tab and be sure the **AASHTO LFR** Analysis module is selected as the **LFR Analysis method type**. This is the only analysis engine available for fishbelly web profiles.

mb	er alternative: Sch	nedule plate girder					
)es	cription Specs	Factors Engine Ir	nport Control optio	ons			
	Analysis method type	Analysis module	Selection type	Spec version	Factors		
	ASR	AASHTO ASR 🛛 🗸	System Default 🗸 🗸	MBE 3rd 2023i, Std 17th 🖂	N/A	\sim	4
>	LFR	AASHTO LFR 🗸 🗸	System Default \sim	MBE 3rd 2023i, Std 17th 🛛 🗸	2002 AASHTO Std. Specifications	\sim	1
	LRFD	AASHTO LRFD 🗸 🗸	System Default $~~$	LRFD 9th \vee	2020 AASHTO LRFD Specifications	\sim	ſ
	LRFR	~	System Default 🗸 🗸				

Analysis Settings

With the focus on the **G1 Schedule plate girder** member alternative click on the **Analysis Settings** button from the **Analysis** group of the **DESIGN/RATE** in the ribbon.

Bridge Worksp	ace - Fishbelly Web Ex	ample	ANALYSIS	REPORTS	?	_	\times
BRIDGE WORKSPACE	WORKSPACE TOC	LS VIEW	DESIGN/RATE	REPORTING			
Analysis Analyze Analysis	Tabular Specification	Engine Resu	k R				
Analysis Events	Results Check Detai	i Outputs Grap Results	oh Kesults				

In the	Analysis	Settings	window	select the	e HS 20) LFR	Rating t	emplate.

Analysis Settings				_		×
Design review	Rating	Rating method:	LFR		~	
Analysis type: Lane / Impact loading type:	Line Girder ~ As Requested ~	Apply preference setting	g: None		~	
Vehicles Output En Traffic direction: Both di	ngine Description rections ~	Refresh	Temporary vehicles	Advar	nced	
	itary Loading	Add to Ad	44 44 entory erating			
Reset Clear	Open template Save	e template	ОК А	pply	Canc	cel

Click **OK** to apply the data and close the window.

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Bridge Workspace - Fishbelly Web Ex	ample	ANALYSIS	REPORTS	?	_	×
BRIDGE WORKSPACE WORKSPACE TOO	LS VIEW	DESIGN/RATE	REPORTING			
Analysis Settings Analysis Analysis Analysis Analysis Events Analysis Events	Engine Resu Outputs Gra	olts Save Results				

With the focus still on the G1 Schedule plate girder member alternative click on the Analyze button.

Tabular Results

When the analysis rating is finished, click on the **Tabular Results** button from the **Results** group of the **DESIGN/RATE** ribbon. The rating results are shown below.

Bridge Worksp	oace - Fishbelly Web Example	ANALYSIS	REPORTS	?	_	×
BRIDGE WORKSPACE	WORKSPACE TOOLS VIEW	DESIGN/RATE	REPORTING			
a 🖛 🗉	🔲 🖹 🗫 🕻	/ 🖪				
Analysis Analyze Analysis	Tabular Specification Engine Resu	∾ ⊾ _ ults Save				
Settings Events	Results Check Detail Outputs Gra	ph Results				
Analysis	Results					

۵	Analysis Re	sults - Schee	dule plate girder								- 🗆	×
	Print Print											
Rep	ort type:		C Lane/	Impact load	ing type	Display	Format					
Rat	ing Results	Summary	~ 0		d O Detail	ed Single	rating leve	l per row	\sim			
				Astequeste								
	Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane	
	HS 20-44	Axle Load	LFR	Inventory	75.85	2.107	125.00	1 - (100.0)	Service - Steel	As Requested	As Requested	-
	HS 20-44	Axle Load	LFR	Operating	126.67	3.519	125.00	1 - (100.0)	Service - Steel	As Requested	As Requested	
	HS 20-44	Lane	LFR	Inventory	42.50	1.181	125.00	1 - (100.0)	Service - Steel	As Requested	As Requested	
	HS 20-44	Lane	LFR	Operating	70.97	1.971	125.00	1 - (100.0)	Service - Steel	As Requested	As Requested	
												w
AAS	HTO LFR En	gine Versior	7.5.0.3001									
Anal	ysis prefere	nce setting:	None									
											Cle	se

Reverse Parabolic - Cross Section Ranges

This superstructure definition also contains the reverse parabola described as a cross-section plate girder. Open the **Cross Section Ranges** window for the member alt in member **G3** as shown below:



Rating this member alternative gives the same rating results as the schedule based alternative for member G1.

Reverse Circular Curve

A reverse circular curve web profile is included in this bridge as well. Open the **plate girder** member alternative for **G1** in the **Reverse Circular Curve** superstructure definition.



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Schematic

The member alternative schematic is shown below.



Girder Profile

The **Girder Profile** window describing the reverse circular webs is shown below along with the BrDR LFR ratings for an HS20 vehicle.

	Begin depth (in)	Depth vary		End depth (in)	Thickness (in)	Sup	oport nber	Start distance (ft)	Length (ft)	End distance (ft)	Material	Weld at right	
>	80.5	None	\sim	80.5	0.5	1	\sim	0	89.30	89.3073	Grade 50W $$	None 🗸 🗸	1
	80.5	Circular Concave	\sim	100.5	0.5	1	\sim	89.3073	15	104.3073	Grade 50W $\!$	None 🗸 🗸	
	100.5	Circular Convex	\sim	120.5	0.5	1	\sim	104.30	15	119.3073	Grade 50W $\!$	None 🗸 🗸	
	120.5	None	\sim	120.5	0.5	1	\sim	119.30	1.375	120.6823	Grade 50W $\!$	None 🗸 🗸	
	120.5	Circular Convex	\sim	100.5	0.5	2	\sim	0.68751	15	15.68751	Grade 50W $$	None 🗸 🗸	
	100.5	Circular Concave	\sim	80.5	0.5	2	\sim	15.687	15	30.68751	Grade 50W $$	None 🗸 🗸	
	80.5	None	\sim	80.5	0.5	2	\sim	30.687	118.5	149.19791	Grade 50W $\!$	None 🗸	
	80.5	Circular Concave	\sim	100.5	0.5	2	\sim	149.19	15	164.19791	Grade 50W $$	None 🗸	
	100.5	Circular Convex	\sim	120.5	0.5	2	\sim	164.19	15	179.19791	Grade 50W \sim	None 🗸	
	120.5	None	\sim	120.5	0.5	2	\sim	179.19	1.375	180.57291	Grade 50W $$	None 🗸	
	120.5	Circular Convex	\sim	100.5	0.5	3	\sim	0.68751	15	15.68751	Grade 50W $$	None 🗸 🗸	
	100.5	Circular Concave	\sim	80.5	0.5	3	\sim	15.687	15	30.68751	Grade 50W \sim	None 🗸 🗸	
	80.5	None	\sim	80.5	0.5	3	\sim	30.687	118.5	149.19791	Grade 50W 🗸	None 🗸 🗸	
	80.5	Circular Concave	\sim	100.5	0.5	3	\sim	149.19	15	164.19791	Grade 50W 🗸	None 🗸 🗸	
	100.5	Circular Convex	\sim	120.5	0.5	3	\sim	164.19	15	179.19791	Grade 50W $$	None 🗸 🗸	
	120.5	None	\sim	120.5	0.5	3	\sim	179.19	1.375	180.57291	Grade 50W $$	None 🗸	
	120.5	Circular Convex	\sim	100.5	0.5	4	\sim	0.68751	15	15.68751	Grade 50W \sim	None 🗸	
	100.5	Circular Concave	\sim	80.5	0.5	4	\sim	15.687	15	30.68751	Grade 50W $$	None 🗸 🗸	
	80.5	None	\sim	80.5	0.5	4	\sim	30.687	89.30	119.99481	Grade 50W $$	None 🗸 🗸	

Click **OK** to close the window.

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Tabular Results

Run an LFR analysis using the **HS 20 LFR Rating** template as discussed in the previous section. The rating results are shown below.

Analysis Results - plate girder											- 🗆	×
Print Print												
Report type: Display Format												
Rating Results Summary V 🔿 As requested Detailed Single rating level per row V												
Live L	oad	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane	
HS 20)-44	Axle Load	LFR	Inventory	69.35	1.926	299.88	2 - (100.0)	Service - Steel	As Requested	As Requested	-
HS 20)-44	Axle Load	LFR	Operating	115.81	3.217	299.88	2 - (100.0)	Service - Steel	As Requested	As Requested	
HS 20)-44	Lane	LFR	Inventory	26.46	0.735	299.88	2 - (100.0)	Service - Steel	As Requested	As Requested	
HS 20)-44	Lane	LFR	Operating	44.20	1.228	299.88	2 - (100.0)	Service - Steel	As Requested	As Requested	
												w
AASHTO LFR Engine Version 7.5.0.3001												
Analysis preference setting: None												
											Clos	e