AASHTOWare Bridge Design Training

Weld Design and Weld Fatigue Analysis (BrD 6.5)

Topics Covered

- Flange to web weld LRFD Design
- Flange to web weld LRFD Design Review
- Weld Fatigue Analysis

Part 1: Weld Design/Design Review

Using BID1 in the sample bridge database, the step by step process of fillet weld design at flange-web junction of a scheduled based plate girder is described below.

Weld Design & Design Review Steps

Step 1- Open BID1:

Open Bridge Design (BrD) 6.5 and then open TrainingBridge1 (BID1)

Bridge Design - [Bridge Workspace - TrainingBridge1]	
🜇 File Edit View Bridge Substructure Window Help	
🖪 🛍 🗞	
RESU 🏭 🕄 ALL NXT 🔛 🎦 🕕 📉	
Preliminary 🔽 🖄 🏞 🖾 🗩 🖬 🖉 🗟 🎠	Ę.
🖆 💷 🗏 🖩 🖉 🗟 🎸 🦮 🗠 🎘 🔁 🗎 🗉	9

Figure 1

Step 2- Open Weld Definitions:

Expand the "Simple Span Structure" under SUPERSTRUCTURE DEFINITIONS and then expand Connectors. Open Weld Definitions.



Figure 2

Step 3- Define Weld:

For weld *design* of top flange – web fillet weld:

Leave the "Weld size" field blank to be designed as per LRFD article 6.13.3.2.4 (Weld Design). After entering all the fields shown below, click on the "Copy Values from Library..." button to populate the "Electrode Strength" of the weld fields. Click "OK" to save the data.

🕰 Stri	icture l	Definition Connectors - Weld	Defin	ition				
	Name:	Weld Def Top	l	Description:	Fillet weld for 1	f op fla	ange to web	weld
			Type Fi Bi	llet weld utt weld				
		Wel	d size		in			
		LFD/ASD fatigue stress cat	egory	Fatigue Cate	gory A	*		
		LRFD fatigue stress ca	tegory	Fatigue Cate	egory A	*		
		Electrode classific	cation	E70 (SI)		*		
		Electrode Strength ASD ultimate tensile stren	ngth =	71.794	ksi			
		LFD ultimate tensile strer	ngth =	71.794	ksi			
		LRFD ultimate tensile strer	ngth =	71.794	ksi			
			Cop from	oy Values h Library	OK		Apply	Cancel

Figure 3

For weld *design review* of bottom flange – web fillet weld:

Open Weld Definitions again (repeat step 2) and repeat Step 3 to define "Weld Def. Bottom". Indicate a value in the Weld Size field for it to undergo design review as per LRFD article 6.13.3.2.4. Click "Ok" to save the definition.

🗛 Structure	Definition Connectors - Wel	d Defin	ition				
Name:	Weld Def Bottom]	Description:	Fillet weld for Bo	ttom flange to web	o weld	
		Type Fi Bi	llet weld utt weld				
	W	eld size	0.35	in			
	LFD/ASD fatigue stress c	ategory	Fatigue Cate	egory A 💦 💊	×		
	LRFD fatigue stress c	ategory	Fatigue Cate	egory A 💦 💊	~		
	Electrode classi	fication	E70 (SI)	1	~		
	Electrode Strength ASD ultimate tensile stre	ength =	71.794	ksi			
	LFD ultimate tensile stre	ength =	71.794	ksi			
	LRFD ultimate tensile stre	ength =	71.794	ksi			
Copy Values from Library OK Apply Cancel							

Figure 4

The Connectors->Weld Definitions->"Weld Def. Top" & "Weld Def. Bottom" as defined should reflect on the "Simple Span Structure" tree as shown below.



Figure 5

Step 4- Navigate to girder profile:

Navigate to MEMBERS and expand it. Expand "G1" and then expand MEMBER ALTERNATIVES. Expand "Plate Girder" as shown below and open Girder Profile.





Step 5- Allocate flange - web weld definition:

For Top Flange the "*Weld*" field select "Weld Def. Top" from the dropdown as shown below. This will design the top flange-web fillet weld for the range of the top flange plate indicated below.

Ту	pe: Pla	ate Girder									
V	Veb	Top Flange	Bottom FI	ange							
		1							1		_
	Begir Widtł (in)) End) Width (in)	Thickness (in)	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld	Weld at Right	
	22.000	0 22.0000	1.2500	1 🚩	0.00	161.00	161.00	Grade 5 💌	Weld Def Top 🛛 💙	None 🗹	

Figure 7

Repeat the same process for the bottom flange as shown below

Тур	e: Plate	e Girder									
W	/eb To	op Flange	Bottom Fl	ange							
	Begin Width (in)	End Width (in)	Thickness (in)	Sup Num	port ber	Start Distance (ft)	Length (ft)	End Distance (ft)	Material	Weld	Weld at Right
	22.0000	22.0000	1.2500	1	~	0.00	36.67	36.67	Grade 5 ⊻	Weld Def Bottom 🛛 🗡	None⊻
	22.0000	22.0000	2.0000	1	~	36.67	87.67	124.33	Grade 5 ⊻	Weld Def Bottom 👱 🚩	None ⊻
	22.0000	22.0000	1.2500	1	~	124.33	36.67	161.00	Grade 5 💌	Weld Def Bottom	None⊻

Figure 8

Please note that the same definition can be used for both the top and bottom flange to web welds provided that both the weld definitions are either undergoing design or design review. Similarly different weld definitions can also be used for different ranges of top and bottom flange plates.

Click "OK" to save the details of allocation.

Step 6- Define Analysis Settings:

Click on View Analysis Settings button

🔓 💵 🖩 🖉 🗟 が 🐂 凹 🖄 み 🗎 🗎 🖻	
---------------------------	--

Figure 9

Click on Open Template and select "HL 93 Design Review" as shown below and click Open:

Open Template			
Templates HL 33 Design Review HS 20 Rating LRFR Design Load Rating LRFR Legal Load Rating	Description HL 93 Design Review HS 20 Rating LRFR Design Load Rating LRFR Legal Load Rating	Analysis Design-Review Rating Rating Rating	Owner Public/Priv Public Public Public Public
Delete			Open Cancel



The Analysis Settings window should be seen as below. Click OK to save the settings.

Analysis Settings				
Design Review Rating	Desig	n Method: LR	IFD	
Analysis Type:				
Line Girder 🗸 🗸				
Lane/Impact Loading Type:				
As Requested 💉	Apply Preference	ce Setting: No	ne	•
Vekieles D. L. C. T. D. L.C.				
Traffic Direction				
Both directions	Refre	esh Temp	orary Vehicles	Advanced
Vehicle Selection:	V	ehicle Summar,	y:	
🖃 Vehicles	Add to Desian	😑 Design Vel	hicles	
Alternate Military Loading		Uesigr HL	-93 (US)	
HL-93 (SI)	>>>	Permit	Loads	
HL-93 (US)		😑 Fatigue	e Loads	
HS 20 (SI)	Remove	LR	FD Fatigue Truck	(US)
HS 20-44	from			
- LBED Fatigue Truck (US)	Analysis			
Agency				
- User Defined				
Temporary	×			
Heset Ulear Open Template	Save Template	OK	Apply	Cancel

Figure 11

Step 7- Analyze G1 – Plate Girder:

Right click on "Plate Girder" and Select Analyze.





Step 8- View Spec Check for LRFD article 6.13.3.2.4

After the analysis gets completed click on the button "View Spec Check" to open the Specification check window (with the "Plate Girder" highlighted as shown above).



Figure 13

Navigate to Superstructure Component->Stage 3->Plate Girder-> Span 1 – 64.4 ft. (this is a representative point for demonstration; you can navigate to any other spec check point you wish to check).

Open article 6.13.3.2.4 Fillet Welded Connections as shown below:

🗆 🦳 Superstructure Component	Constitution Defenses	Unit Chata	Thu: Const	Den est Cell
Stage 1	B 4 0 0 4 Denire Difference	Limic State	niex, pense	Pass/Fail
Garden 2	1.3.2.1 Design Philosophy - Limit State - General for 5.0 c.0.5.2.1 (c. b. C. L.)		N/A	General Comp.
Stage 2	Z.5.2.6.2 Uniteria for Deflection		N/A	Passed
Date Grder	4.6.2.7.1 I-Sections - Lateral Wind Load Distribution in Multibeam Bridges		N/A	General Comp.
Span 1 - 0.00 ft	S.4.2.6 Modulus of Rupture		NJA	General Comp.
Span 1 - 13 66 ft	6.10.1.1.10 btresses for bections in Positive Hexure		N/A	General Comp.
Span 1 - 16 10 ft	6.10.1.10.1 Hybrid Factor, Rh		N/A	General Comp.
- 5pan 1 - 10.1010.	6.10.1.10.2 Web Load-Shedding Factor, Rb		N/A	General Comp.
	6.10.1.6 Flange Stress and Member Bending Moments		N/A	Passed
	6.10.1.7 Minimum Negative Flexure Concrete Deck Reinforcement		N/A	Passed
Den 1 49.20 ft	6.10.1.9.1 Webs without Longitudinal Stiffeners		N/A	General Comp.
	6.10.11.1.2 Transverse Stiffeners - Projecting Width		N/A	Passed
	6.10.11.1.3 Transverse Stiffeners - Moment of Inertia		N/A	Passed
gpan 1 - 64.40 rt.	6.10.2 Cross-Section Proportion Limits		N/A	Passed
Span 1 - 67.56 ft.	6.10.4.2.2 Flexure		N/A	Passed
span 1 - 80.50 ft.	NA 6.10.5.3 Special Fatigue Requirement for Webs		N/A	Not Applicable
Span 1 - 80.98 ft.	6.10.6.2.2 Composite Sections in Positive Flexure		N/A	General Comp.
	6.10.6.2.3 Composite Sections in Negative Flexure and Noncomposite Sections		N/A	General Comp.
Span 1 - 96.60 ft.	NA 6.10.7.1.1 General		N/A	Not Applicable
- Span 1 - 107.81 H.	NA 6.10.7.1.2 Nominal Flexural Resistance		N/A	Not Applicable
- Span 1 - 112.70 ft.	×6.10.7.2.1 General		N/A	Failed
- Den 1 - 121.23 ft.	6.10.7.2.2 Nominal Flexural Resistance		N/A	General Comp.
	6.10.7.3 Flexural Resistance - Ductility Requirement		N/A	Passed
	NA 6.10.8.1.1 Discretely Braced Flanges in Compression		N/A	Not Applicable
	NA 6.10.8.1.2 Discretely Braced Flanges in Tension		N/A	Not Applicable
	NA 6.10.8.1.3 Continuously Braced Flanges in Tension or Compression		N/A	Not Applicable
	6.10.8.2.1 General		N/A	General Comp.
	6.10.8.2.2 Local Buckling Resistance		N/A	General Comp.
	6.10.8.2.3 Lateral Torsional Buckling Resistance		N/A	General Comp.
	6.10.8.2.3.Cb Lateral Torsional Buckling Resistance - Cb Calculation		N/A	General Comp.
	6.10.8.2.3.rt Lateral Torsional Buckling Resistance - rt and Lp Calculation		N/A	General Comp.
	6.10.8.3 Tension-Flange Flexural Resistance		N/A	General Comp.
	✓ 6.10.9 Shear Resistance		N/A	Passed
	6.10.9.1 Shear Resistance - General		N/A	General Comp.
	× 6.10 General Elexural Results		N/A	Failed
	6.13.3.2.4 Filet Welded Connections		NA	Passed
	6.6.1.2.2 Design Criteria		NIA	Passed
	APPD6.1 Plastic Moment		NA	General Comp.
	APPD6.2 Vield Moment		N/A	General Comp.
	APPD6 3 1 In the Flastic Range (Dr.)		N/A	General Comp
	ADDD6 3 2 Denth of the Web in Compression at Plastic Moment		NIA	General Comp
	Steal Elastic Section Dronastian		NIA	General Comp.
	Dices clasur, perupti internes		NVM	deneral comp.

Figure 14

Weld details for top and bottom flange to web welds are provided as below. Note that the Top flange weld size is not visible since it has been designed and shown below.

```
Top flange to web weld

-----

Fexx = 71.7937 (ksi)

Phie2 = 0.8000

Bottom Flange to Web Weld

-----

Fexx = 71.7937 (ksi)

Phie2 = 0.8000

Weld size = 0.3500 (in)
```

Figure 15

The weld resistances for the top and the bottom flange are shown below:

```
SUMMARY:

Weld Metal Resistance (top flange):

Rr = 0.6*Phie2*Fexx = 34.4610 (ksi) (6.13.3.2.4b-1)

Weld Metal Resistance (bottom flange):

Rr = 0.6*Phie2*Fexx = 34.4610 (ksi) (6.13.3.2.4b-1)
```

Figure 16

Fillet-weld *design* for the top flange to web:

Design Step 1: Allowable weld size was determined as per the strength criteria as shown in the tables below. Please note that thickness and size have the same meaning here.

De service et		-1	v (tota)	.)				
Requirea	weld thi	.ckness =	Rr * Sqrt	(2)				
Fectored	load com	nutation	for weld a	lesion (ton	flenge).			
raccorca	IOGG COM	pacación	ror werd (icorgn (cop	ridige).			
Limit	Flex							
State	Туре	VDL St	age 1 vDI	, Stage 1 N	/DL Stage 2	vDL Stage 2		
		(ki	p) (H	ip/in)	(kip)	(kip/in)		
STR-I	Pos		 37.22	0.42	11.73	0.15		
STR-I	Pos		26.80	0.30	6.54	0.09		
STR-I	Pos		37.22	0.42	11.73	0.15		
STR-I	Pos		26.80	0.30	6.54	0.09		
STR-III	Pos		37.22	0.42	11.73	0.15		
STR-III	Pos		26.80	0.30	6.54	0.09		
STR-III	Pos		37.22	0.42	11.73	0.15		
STR-III	Pos		26.80	0.30	6.54	0.09		
STR-V	Pos		37.22	0.42	11.73	0.15		
STR-V	Pos		26.80	0.30	6.54	0.09		
STR-V	Pos		37.22	0.42	11.73	0.15		
STR-V	Pos		26.80	0.30	6.54	0.09		
Limit	Flex	Load				Required Weld	Desim	
State	Type	Combo	WLI.	wI.I.	vtotal	Size(Strength)	Ratio	Code
20400	.15-		(kip)	(kip/in)	(kip/in)	(in)		
STR-I	Pos	1	124.24	1.7	L 2.29	0.0469	1.00	Pass
STR-I	Pos	1	72.29	9 1.00	1.38	0.0284	1.00	Pass
STR-I	Pos	2	101.61	. 1.40	1.97	0.0405	1.00	Pass
STR-I	Pos	2	59.99	0.8	3 1.22	0.0249	1.00	Pass
STR-III	Pos	1	0.00) 0.00	0.57	0.0117	1.00	Pass
STR-III	Pos	1	0.00	0.00	0.39	0.0079	1.00	Pass
STR-III	Pos	2	0.00	0.00	0.57	0.0117	1.00	Pass
STR-III	Pos	2	0.00	0.00	J 0.39	0.0079	1.00	Pass
STR-V	Pos	1	95.84	1.32	2 1.90	0.0389	1.00	Pass
STR-V	Pos	1	55.77	0.7	/ 1.16	0.0237	1.00	Pass
STR-V	Pos	2	78.39	1.08	3 1.65	0.0339	1.00	Pass
STR-V	Pos	2	46.28	3 0.64	4 1.03	0.0210	1.00	Pass

Figure 17

Design Step 2: The weld size was optimized using article 6.13.3.4 as shown below to provide the final designed weld size for the top flange to web weld.

Designed top flange fillet weld size: -------Article 6.13.3.4 Maximum fillet weld size allowed = 0.4375 (in) Minimum fillet weld size allowed = 0.3125 (in) Design fillet weld size at the top flange = 0.3125 (in)

Figure 18

Fillet -weld design review for the bottom flange to web:

Design Review Step 1: Bottom flange weld size (which was provided) was reviewed as per article 6.13.3.4 (allowable weld size) as shown below:

```
Bottom Flange Weld:

------

Throat(eff) = 0.2475 (in)

Area(eff) = 0.4950(in^2/in)

Weld Resistance = Rr*A(eff)

Weld Resistance = 17.0573(kip/in)

Article 6.13.3.4:

Maximum weld size allowed = 0.4375 (in) Pass

Minimum weld size allowed = 0.3125 (in) Pass
```

Figure 19

Design Review Step 2: Bottom flange weld size specification check was performed

•			-					
Limit State	Flex Type	VDL St	age 1 vDL	Stage 1	VDL Stage 2	vDL Stage 2		
		(KI	р) (кі	.p/10)	(KID)	(KID/III)		
STR-I	Pos		37.22	0.49	11.73	0.13		
STR-I	Pos		26.80	0.35	6.54	0.07		
STR-I	Pos		37.22	0.49	11.73	0.13		
STR-I	Pos		26.80	0.35	6.54	0.07		
STR-III	Pos		37.22	0.49	11.73	0.13		
STR-III	Pos		26.80	0.35	6.54	0.07		
STR-III	Pos		37.22	0.49	11.73	0.13		
STR-III	Pos		26.80	0.35	6.54	0.07		
STR-V	Pos		37.22	0.49	11.73	0.13		
STR-V	Pos		26.80	0.35	6.54	0.07		
STR-V	Pos		37.22	0.49	11.73	0.13		
STR-V	Pos		26.80	0.35	6.54	0.07		
Limit	Flex	Load				Required Weld	Design	
State	Type	Combo	VLL	VLL	vtotal	Size(Strength)	Ratio	Code
			(kip)	(kip/in)) (kip/in)	(in)		
STR-I	Pos	1	124.24	1.3	32 1.94	0.0399	8.77	Pass
STR-I	Pos	1	72.29	0.1	77 1.20	0.0245	14.26	Pass
STR-I	Pos	2	101.61	1.0	08 1.70	0.0350	10.01	Pass
STR-I	Pos	2	59.99	0.0	54 1.07	0.0219	16.01	Pass
STR-III	Pos	1	0.00	0.0	0.62	0.0128	27.37	Pass
STR-III	Pos	1	0.00	0.0	0.43 0.43	0.0088	39.93	Pass
STR-III	Pos	2	0.00	0.0	0.62	0.0128	27.37	Pass
STR-III	Pos	2	0.00	0.0	0.43 0.43	0.0088	39.93	Pass
STR-V	Pos	1	95.84	1.0	02 1.64	0.0337	10.38	Pass
STR-V	Pos	1	55.77	0.	59 1.02	0.0209	16.72	Pass
STR-V	Pos	2	78.39	0.0	33 1.46	0.0299	11.71	Pass
STR-V	Pos	2	46.28	0.4	49 0.92	0.0189	18.55	Pass

Specification Check for bottom flange-web weld:

Figure 20

For article 6.13.3.2.4 to pass, weld design (top flange) and weld design review (bottom flange) should both "Pass".

Close the bridge BID1 without saving it.

Part 2: Weld Fatigue Analysis

Table 1: Weld Fatigue Analysis Detail

Fatigue Detail	Conditions for Generation	Fatigue Category
Web to flange	Detail automatically generated at	Category based on the 'LRFD
weld	every analysis point for plate girders.	fatigue stress category' defined on the 'Structure Definition Connectors – Weld definition' window. Otherwise, determined from the Specification.
Plate girder flange	Detail automatically generated at	Schedule based beams:
groove welded butt	every analysis point where condition	Category based on the 'LRFD
splices	exists.	fatigue stress category' defined on the 'Structure Definition Connectors – Weld Definition' window. Otherwise, determined from the Specification.
	Analysis point at transition is	Cross Section based beams:
	generated if user picks 'Generate at	Determined from the
	section change points'.	Specification since the user
		cannot assign a weld definition.
Bearing stiffener	Analysis point generated at	Category based on the 'LRFD
weld to top/bottom	every bearing stiffener location	fatigue stress category' defined
flange	at an offset distance from the	on the 'Structure Definition
	C.L. of bearing specified by the	Connectors – weid Definition
	Leastion' window if user picked	window.
	'Generate at stiffeners'	
	• Detail only generated if 'Top' or	
	'Bottom' flange welds are	
	defined on the 'Bearing Stiffener	
	Definition' window	
Bearing stiffener	Analysis point generated at	Category based on the 'LRFD
weld to web	every bearing stiffener location	fatigue stress category' defined

	at an offset distance from the c.l.	on the 'Structure Definition
	of bearing specified by the user	Connectors – Weld Definition'
	on the 'Bearing Stiffener	window. Otherwise, determined
	Location' window if user picked	from the Specification.
	'Generate at stiffeners'	
	• Detail automatically generated at	
	every analysis point where	
	stiffener exists	
Transverse	Analysis point generated at	Category based on the 'LRFD
stiffener weld to	every stiffener location defined	fatigue stress category' defined
top/bottom flange	on the 'Stiffener Ranges' window	on the 'Structure Definition
	if user picked "Generate at	Connectors – Weld Definition'
	stiffeners'	window.
	• Detail only generated if the 'Top'	
	or 'Bottom' flange welds are	
	defined on the 'Transverse	
	Stiffener Definition'	
	Detail not generated at the	
	respective flanges if the 'Top	
	Gap' or 'Bottom Gap' user input	
	on the 'Transverse Stiffener	
	Definition' window is greater	
	than zero	
Transverse	Analysis point generated at	Category based on the 'LRFD
stiffener weld to	every stiffener location if user	fatique stress category' defined
web	picked "Generate at stiffeners'	on the 'Structure Definition
	Detail automatically generated at	Connectors – Weld Definition'
	every analysis point where	window. Otherwise, determined
	stiffener exists	from the Specification.
	• Distance to the fatigue detail	
	from the top or bottom of web is	
	based on the user input 'Top	
	Gap' and /or 'Bottom Gap' on the	
	'Transverse Stiffener Definition'	
	window. If the values are left	
	blank, the distance is considered	
	to be 0.0	

Shear stud weld to	• Detail automatically generated	d at Determined from the
top flange	every analysis point where sh	ear Specification.
	connectors exist	
	• Detail is only generated if	fa
	defined shear connector is us	ed.
	The detail will not be genera	ited
	for ranges where "Composite	" is
	chosen as the Connector ID	
Longitudinal	• Analysis point generated at	the • Category at the start and
Stiffeners	start and end of the stiffene	er if end of the stiffener is
	user picked 'Generate	at determined from the
	stiffeners'	Specification
	• Detail automatically generated	d at • Category based on the
	every analysis point where	e a 'LRFD fatigue stress
	plate longitudinal stiffener exis	sts category' defined on the
		'Structure Definition
		Connectors – Weld
		Definition'
		window. Otherwise,
		determined from the
		Specification
Welded cover	Analysis point at start and end	d of Category based on the 'LRFD
plates	cover plate is generated if u	ser fatigue stress category' defined
	picks 'Generate at sec	tion on the 'Structure Definition
	change points'	Connectors – Weld Definition'
	• Start and end cover plate de	etail window. Otherwise, determined
	automatically generated at ev	rery from the Specification.
	analysis point where a wel	ded
	cover plate starts or ends	
	• Cover plate side weld de	etail
	automatically generated at ev	rery
	analysis point that contains	s a
	welded cover plate	

The above table provides the list of location stating when and where the weld fatigue analysis is carried out.

The fatigue analysis of flange butt welds and welded cover plates at the start/end can be obtained by editing the Member Alternative Name->Control Options->LRFD->Point of Interest-> "Generate at section change points" as shown below.

Member Alternative: Plate Girder	
Description Specs Factors Engine Import Control	Options
LRFD	LRFR
🛅 Points of Interest	🛅 Poir
Generate at tenth points	
Generate at section change points	
Generate at user-defined points	
Generate at stiffeners	

Figure 21

A new Control Option "Generate at Stiffeners" under Point of Interest has been added for v6.5 to generate the analysis point at the locations of transverse, bearing and at the start and at the end point of longitudinal stiffeners.

Member Alternative: Plate Girder	
Description Specs Factors Engine Import C	ontrol Options
LRFD	LRFR
Points of Interest	🛅 Po
Generate at tenth points	
 Generate at section change points Generate at user defined points 	
Generate at stiffeners	Ľ



Open BID1 and define a weld definition as defined in page 3 of this document. Assign the LRFD Fatigue Category as "Fatigue Category C". Open the transverse stiffener definition (Stiffener) and assign the weld definition as shown below.

	Transverse Stiffener Definition	
Stiffener Definitions Transverse Stiffener	Name: Stiffener Stiffener Type Image: Single Plate Thickness 0.7500 Material Grade 50W Welds Trage Weld Def Welds None Bottsm Weld Def	Top Gap: in 6.0000 in Bottom Gap: in
2 Sided Dia Conn PL		OK Apply Cancel

Figure 23

Before running the LRFD design review of a Member G1, Member Alternative: Plate Girder, make sure that you have the Control Options selected for "Generate at Stiffeners"

After the LRFD design review, Spec check at Stage 3->Plate Girder->Span 1 – 16.08 ft., article 6.6.1.2.2 Design Criteria. This is a location of transverse stiffener.

As shown below, the article shows the fatigue analysis for transverse stiffener to web weld (fatigue category from specification), for transverse stiffener to flange weld (fatigue category defined) and flange to web weld (fatigue category from specification).

	ADTT(SL) Stress													
Detail	Cat.	75 year T6.6.1.2.3-2	Max M LL+I (kip-in)	Min M LL+I (kip-in)	Limit State	Dist from Bottom (in)	DL (ksi)	+LL (ksi)	-LL (ksi)	A*10^8 ((ksi^-3))	(F)TH (ksi)	(F)n (ksi)	f (ksi)	Fn/f Code
TranStiffFlgWeld	C'	745	1211.05	0.00	FAT-I	70.25	-11.88	-0.72	0.00***					
TranStiffFlgWeld	C'	745	1211.05	0.00	FAT-I	1.25	13.48	4.93	0.00	44.00	12.00	12.00	4.93	2.44 PASS
TranStiffWebWeld	C'	745	1211.05	0.00	FAT-I	70.25	-11.88	-0.72	0.00***					
TranStiffWebWeld	С'	745	1211.05	0.00	FAT-I	1.25	13.48	4.93	0.00	44.00	12.00	12.00	4.93	2.44 PASS
TopFlgWebWeld	В	860	1211.05	0.00	FAT-I	70.25	-11.88	-0.72	0.00***					
BotFlgWebWeld	в	860	1211.05	0.00	FAT-I	1.25	13.48	4.93	0.00	120.00	16.00	16.00	4.93	3.25 PASS

Figure 24

Close the BID1 and open BID2

Define a bearing stiffener to flange weld with LRFD fatigue category C'. Assign the weld definition to the top and the bottom flange as shown below

lame: Stiffen	er 1	in	≯ k + k 0.7500 in	
Plate Thickness	0.7500 in	0.7500 in		
Material	Grade 50W	■		
Welds		5.7500 in		
Тар	Weld Def	0.7500 in		
Wab Rattan	None Weld Def	×		
		in	≯₭ ≯₭ 0.7500_in	



For Cross Sections -> Section2, add a top cover plate as shown below

1	Name:	Section	on 2			Туре:	Buil	tup Sec	tion			
	Dimen	sions	Top Cover Plates	Bottom Co	over P	lates Slab	T	launch]			
	Att ©	achme) Weld) Bolte	nt led d/Riveted									
				Re Po	ative) sition	Material		Width (in)	Thickness (in)	Side Weld	End Weld	
					1	Grade 50VV	~	5.000	0.5000	None 👔	🗹 None 📘	-

Figure 26

Define a plate longitudinal stiffener as shown below

ſ	Transverse Stiffener Ranges	ongitudinal S	Stiffener Ranges										
0	💽 Plate i 🔿 Angle												
	Width	Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Y	Measured From		Width (in)	Thickness (in)	Material	Weld	
	Thickness 🛧 👘 🕺	1 💌	10.00	50.0000	60.00	20.000	Top Flange (in)	~	5.0000	0.5000	Grade 50W 👱	None 🛛 💉	4
	Weld												

Figure 27

Before running the LRFD design review of Interior Member, Member Alternative: Built-up Alt, make sure that you have the Control Options selected for "Generate at Stiffeners" and "Generate at section change points".

After the LRFD design review, Spec check for article 6.6.1.2.2 Design Criteria.

Spec check at Stage 3->Built-up Alt->Span 1 63 ft. (left)

This shows the fatigue analysis of flange and web groove weld and shear connector welds to the top flange as shown below. All the fatigue categories are from specification.

		ADTT(SL)					Stress						
Detail	Cat.	75 year T6.6.1.2.3-2	Max M LL+I (kip-in)	Min M Limit LL+I State (kip-in)	Dist from Bottom (in)	DL (ksi)	+LL (ksi)	-LL (ksi)	A*10^8 ((ksi^-3))	(F)TH (ksi)	(F)n (ksi)	f (ksi)	Fn/f Code
FlgWeldAtRight	в	860	423.56	-297.63 FAT-I	37.63	-0.80	-0.29	4.62	120.00	16.00	16.00	4.92	3.25 PASS
FlgWeldAtRight	В	860	423.56	-297.63 FAT-I	0.00	1.09	6.13	-5.57	120.00	16.00	16.00	11.70	1.37 PASS
WebWeldAtRight	в	860	423.56	-297.63 FAT-I	36.88	-0.76	-0.16	4.42	120.00	16.00	16.00	4.59	3.49 PASS
WebWeldAtRight	В	860	423.56	-297.63 FAT-I	0.88	1.05	5.98	-5.33	120.00	16.00	16.00	11.31	1.41 PASS
ShearConnector	С	1290	423.56	-297.63 FAT-I	37.63	-0.80	-0.29	4.62	44.00	10.00	10.00	4.92	2.03 PASS

Figure 28

Speck check at Stage 3->Built-up Alt->Span 1 89.5 ft. (left)

This shows the fatigue analysis of bearing stiffener top and bottom flange (fatigue category defined) and the web weld (fatigue category from spec).

		ADTT(SL)				Stress									
Detail	Cat.	75 year T6.6.1.2.3-2	Max M LL+I (kip-in)	Min M Lim LL+I Sta (kip-in)	it Dist from te Bottom (in)	DL (ksi)	+LL (ksi)	-LL (ksi)	A*10^8 ((ksi^-3))	(F)TH (ksi)	(F)n (ksi)	f (ksi)	Fn/f	Code	
BrgStiffFlgWeld	C'	496 +	0.00	-422.82 FAT	-I 37.50	23.77*	0.00	3.59	44.00	12.00	12.00	3.59	3.34	PASS	
BrgStiffFlgWeld	C'	496 +	0.00	-422.82 FAT	-I 1.50	-21.48*	0.00	-4.50***							
BrgStiffWebWeld	C '	496 +	0.00	-422.82 FAT	-I 36.75	22.83*	0.00	3.42	44.00	12.00	12.00	3.42	3.51	PASS	
BrgStiffWebWeld	C'	496 +	0.00	-422.82 FAT	-I 2.25	-20.54*	0.00	-4.33***							

Figure 29

Speck check at Stage 3->Built-up Alt->Span 1 90 ft. (left)

This shows the fatigue analysis of cover plate side weld to the top flange (fatigue category from specification).

	ADTT(SL)		Stress												
		75 year	Max M	Min M	Limit	Dist from									
Detail	Cat.	T6.6.1.2.3-2	LL+I	LL+I	State	Bottom	DL	+LL	-LL	A*10^8	(F) TH	(F)n	f	Fn/f	Code
			(kip-in)	(kip-in)		(in)	(ksi)	(ksi)	(ksi)	((ksi^-3))	(ksi)	(ksi)	(ksi)		
CouplFlgSideWeld	в	573 ±	0 00	_425 18	RAT_T	38 50	25 62*	0 00	3 83	120.00	16.00	16 00	3 83	A 1'	7 DASS

Figure 30

Speck check at Stage 3->Built-up Alt->Span 2 27 ft. (left)

This shows the fatigue analysis of cover plate end weld to the top flange (fatigue category from specification).

		ADTT(SL)						Stress							
Detail	Cat.	75 year T6.6.1.2.3-2	Max M LL+I (kip-in)	Min M LL+I (kip-in)	Limit State	Dist from Bottom (in)	DL (ksi)	+LL (ksi)	-LL (ksi)	A*10^8 ((ksi^-3))	(F)TH (ksi)	(F)n (ksi)	f (ksi)	Fn/f	Code
CovPlFlgEndWeld	E'	6485	211.36	-148.3	9 FAT-II	38.50	-0.47	-0.23	1.34	3.90	2.60	2.03	1.57	1.2	9 PASS

Figure 31

Speck check at Stage 3->Built-up Alt->Span 1 10 ft. (right).

This shows the fatigue analysis of the start of the longitudinal stiffener (fatigue category from specification).

		ADTT(SL)						Stress							
		75 year	Max M	Min M	Limit	Dist from									
Detail	Cat.	T6.6.1.2.3-2	LL+I	LL+I	State	Bottom	DL	+LL	-LL	A*10^8	(F) TH	(F)n	f	Fn/f	Code
			(kip-in)	(kip-in)		(in)	(ksi)	(ksi)	(ksi)	((ksi^-3))	(ksi)	(ksi)	(ksi)		
LongStiffWebWeld	Е	3530	152.43	-22.73	FAT-II	16.88	1.27	1.17	-0.17	11.00	4.50	2.87	1.34	2.14	4 PASS

Figure 32

Speck check at Stage 3->Built-up Alt->Span 1 60 ft. (left).

This shows the fatigue analysis of the end of the longitudinal stiffener (fatigue category from specification).

		ADTT(SL)						Stress							
		75 year	Max M	Min M	Limit	Dist from									
Detail	Cat.	T6.6.1.2.3-2	LL+I	LL+I	State	Bottom	DL	+LL	- L L	A*10^8	(F) TH	(F)n	f	Fn/f	Code
			(kip-in)	(kip-in)		(in)	(ksi)	(ksi)	(ksi)	((ksi^-3))	(ksi)	(ksi)	(ksi)		
LongStiffWebWeld	Е	3530	229.36	-139.75	5 FAT-II	16.88	0.62	1.76	-1.07	11.00	4.50	2.87	2.83	1.03	L PASS

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