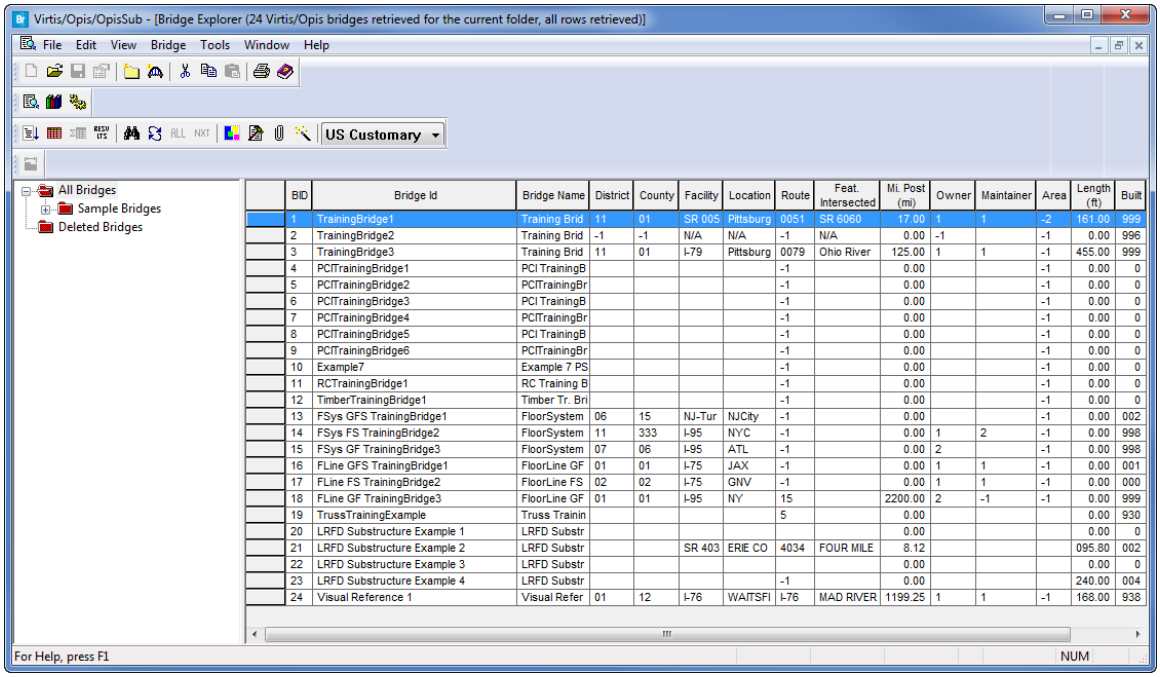
AASHTOWare Bridge Rating Training - (BrR 6.4)

Field Verified Wearing Surface Thickness

Topics Covered

- Field verified wearing surface thickness for LRFR analysis.

Note: *Field measured wearing surface thickness is used only in the LRFR analysis. LFD and ASD analysis do not use this feature.*



	BID	Bridge Id	Bridge Name	District	County	Facility	Location	Route	Feat. Intersected	Mi. Post (mi)	Owner	Maintainer	Area	Length (ft)	Built
	1	TrainingBridge1	Training Brid	11	01	SR 005	Pittsburg	0051	SR 6060	17.00	1	1	-2	161.00	999
	2	TrainingBridge2	Training Brid	-1	-1	N/A	N/A	-1	N/A	0.00	-1		-1	0.00	996
	3	TrainingBridge3	Training Brid	11	01	I-79	Pittsburg	0079	Ohio River	125.00	1	1	-1	455.00	999
	4	PCITrainingBridge1	PCI TrainingB					-1		0.00			-1	0.00	0
	5	PCITrainingBridge2	PCITrainingBr					-1		0.00			-1	0.00	0
	6	PCITrainingBridge3	PCI TrainingB					-1		0.00			-1	0.00	0
	7	PCITrainingBridge4	PCITrainingBr					-1		0.00			-1	0.00	0
	8	PCITrainingBridge5	PCI TrainingB					-1		0.00			-1	0.00	0
	9	PCITrainingBridge6	PCITrainingBr					-1		0.00			-1	0.00	0
	10	Example7	Example 7 PS					-1		0.00			-1	0.00	0
	11	RCTrainingBridge1	RC Training B					-1		0.00			-1	0.00	0
	12	TimberTrainingBridge1	Timber Tr. Bri					-1		0.00			-1	0.00	0
	13	FSys GFS TrainingBridge1	FloorSystem	06	15	NJ-Tur	NJCity	-1		0.00			-1	0.00	002
	14	FSys FS TrainingBridge2	FloorSystem	11	333	I-95	NYC	-1		0.00	1	2	-1	0.00	998
	15	FSys GF TrainingBridge3	FloorSystem	07	06	I-95	ATL	-1		0.00	2		-1	0.00	998
	16	FLine GFS TrainingBridge1	FloorLine GF	01	01	I-75	JAX	-1		0.00	1	1	-1	0.00	001
	17	FLine FS TrainingBridge2	FloorLine FS	02	02	I-75	GNV	-1		0.00	1	1	-1	0.00	000
	18	FLine GF TrainingBridge3	FloorLine GF	01	01	I-95	NY	15		2200.00	2	-1	-1	0.00	999
	19	TrussTrainingExample	Truss Trainin					5		0.00				0.00	930
	20	LRFD Substructure Example 1	LRFD Substr							0.00				0.00	0
	21	LRFD Substructure Example 2	LRFD Substr			SR 403	ERIE CO	4034	FOUR MILE	8.12				095.80	002
	22	LRFD Substructure Example 3	LRFD Substr							0.00				0.00	0
	23	LRFD Substructure Example 4	LRFD Substr					-1		0.00				240.00	004
	24	Visual Reference 1	Visual Refer	01	12	I-76	WAITSFI	I-76	MAD RIVER	1199.25	1	1	-1	168.00	938

Fig 1. Bridge Explorer

From the Bridge Explorer (Fig 1) select TrainingBridge1 (BID 1) and double click (or right click and select open) to open it.

Once Bridge Workspace tree shows up, expand “Simple Span Structure” under “SUPERSTRUCTURE DEFINITIONS” in the tree by clicking on “+” . Then expand “MEMBERS” and select “G2”. Expand “G2” and select “Plate Girder (E) (C)” under “MEMBER ALTERNATIVES”. Expand “Plate Girder (E) (C)” by clicking on the “+”. Then the Bridge Workspace tree will be as shown in Fig 2.

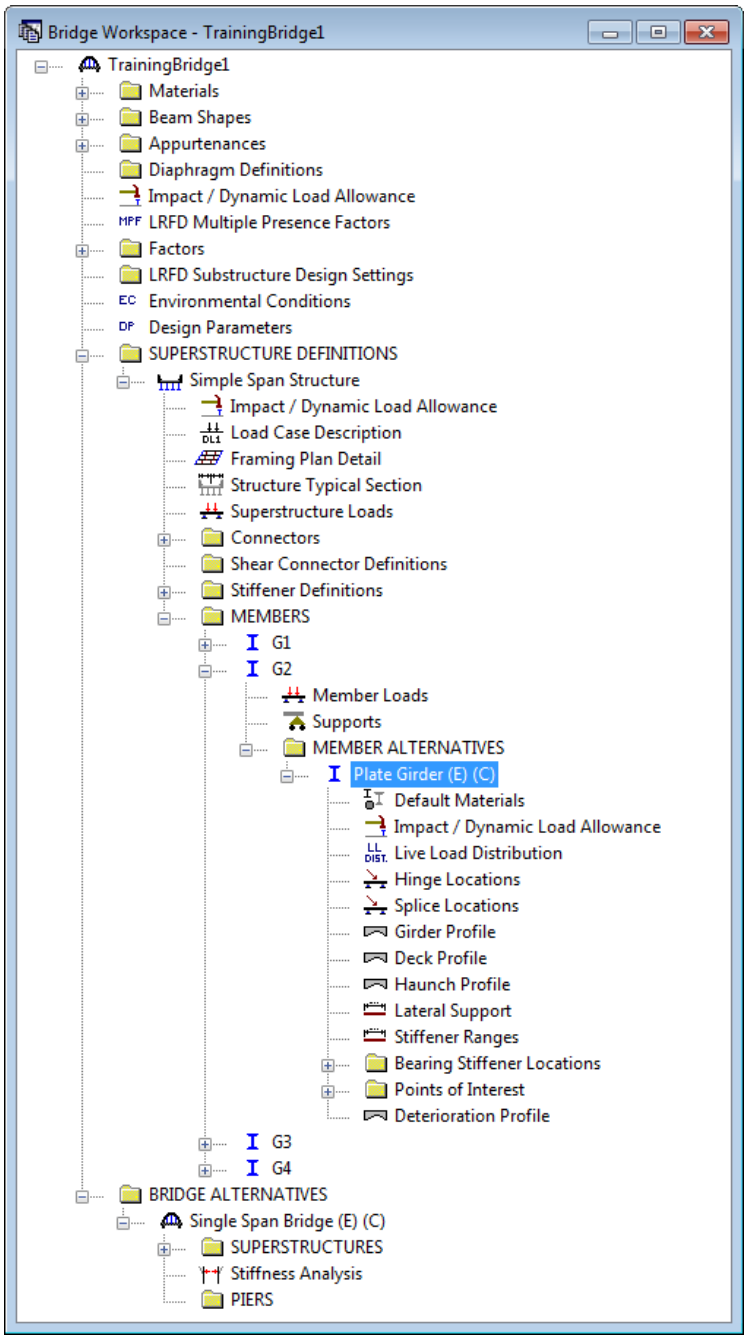


Fig 2. Bridge Workspace Tree - G2 - Girder Member Alternative

After selecting the member alternative “Plate Girder (E) (C)”, go to toolbar and click on the “View Analysis Setting” button (Fig 3).

Fig 3. View Analysis Setting Button

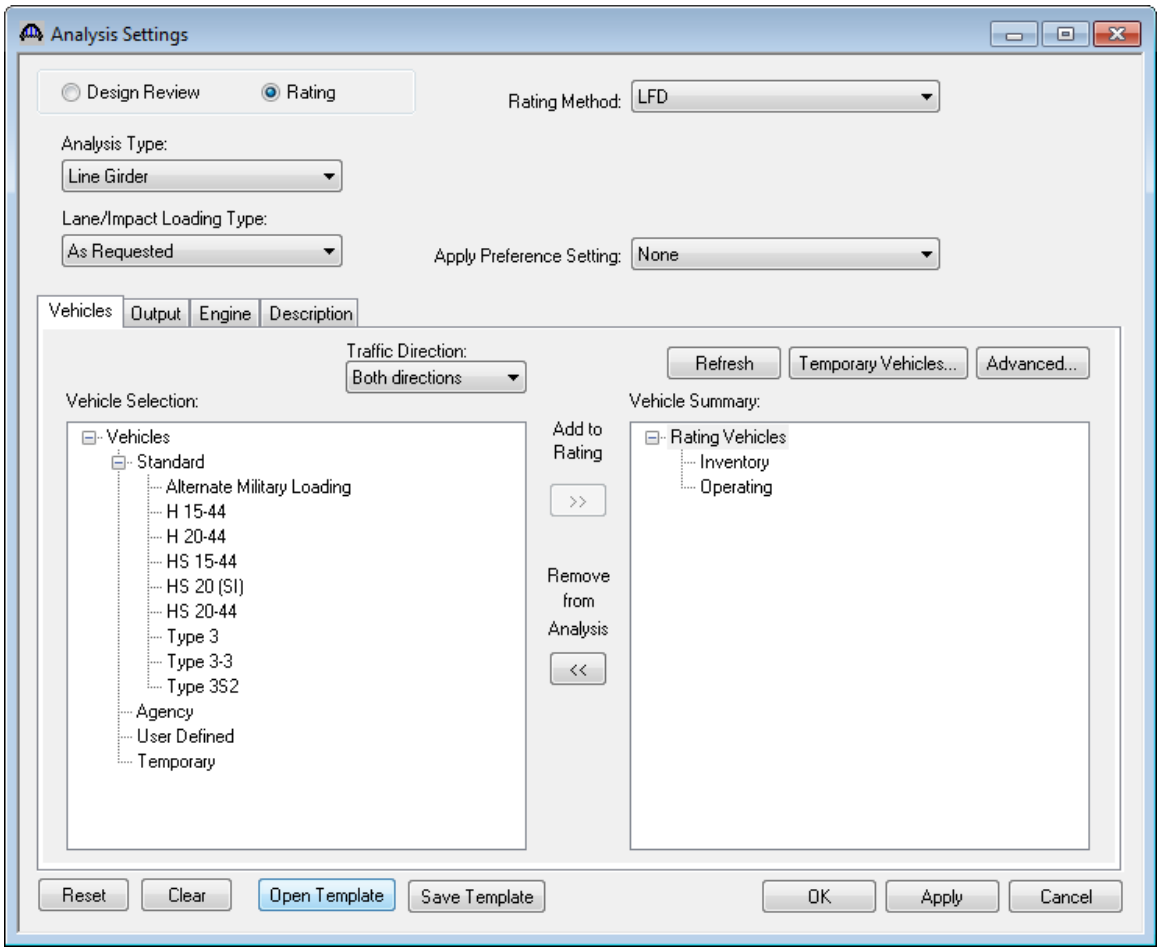


Fig 4. Analysis Settings Window

Once "Analysis Setting" button is clicked "Analysis Settings" window will pop up (Fig 4). Click on "Open Template" button to open Template Library (Fig 5). Select LRFR Design Load Rating Template from Template Library. Click on "Open" button to apply it to Analysis Settings (Fig 6).

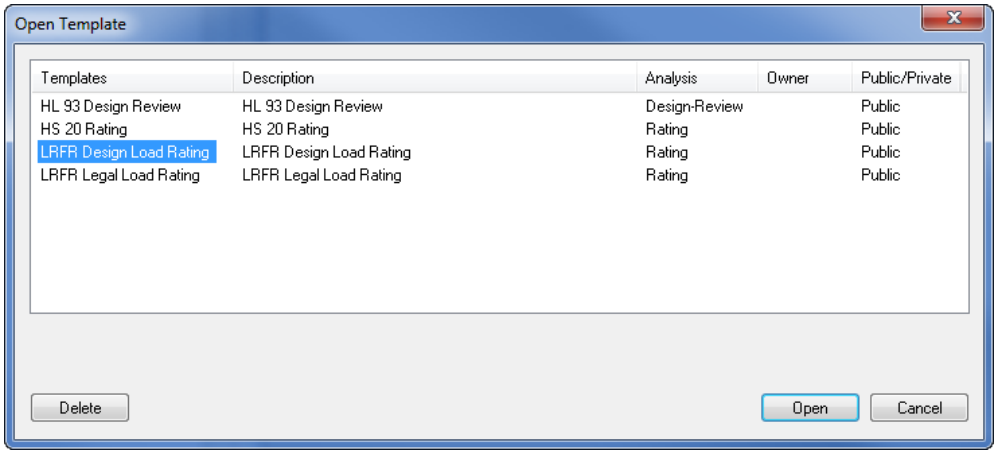


Fig 5. Open Template Window

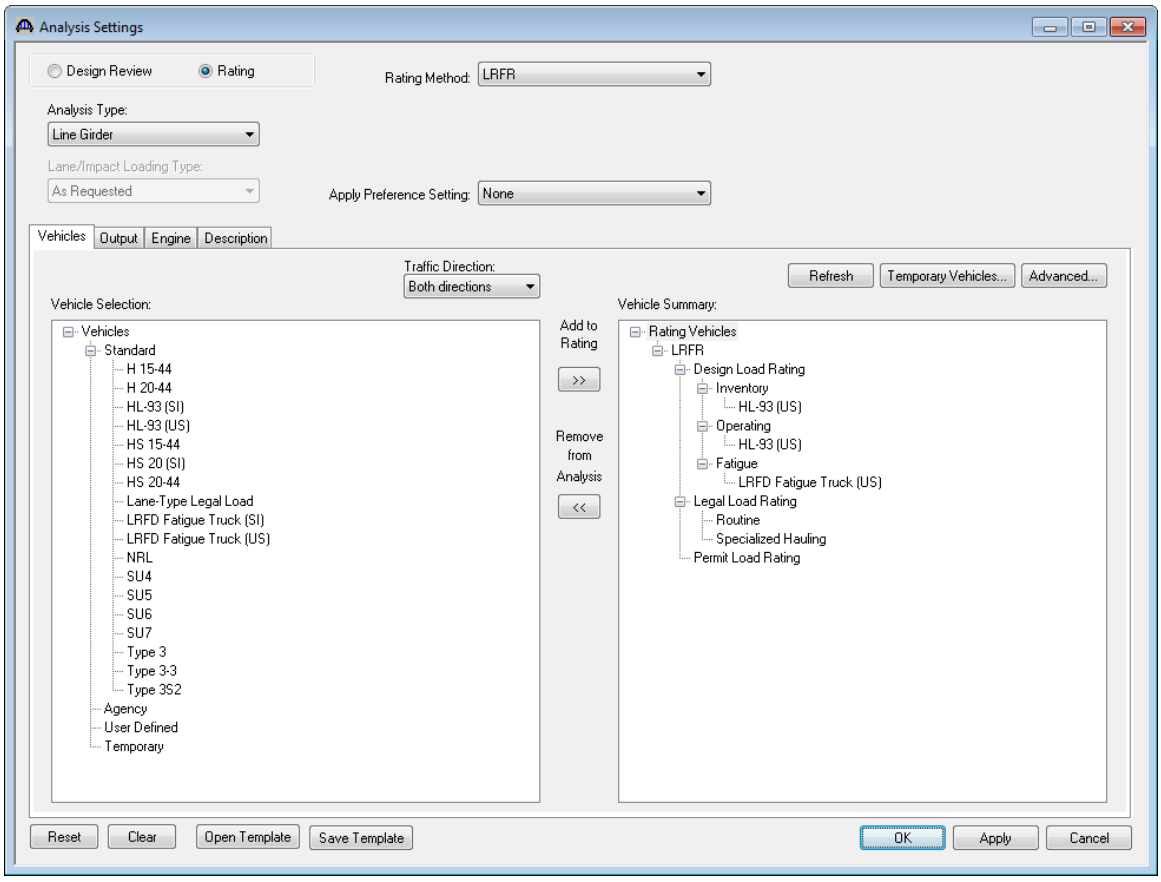


Fig 6. Analysis Settings Window – With rating vehicles selected

Click on "OK" button to save and close the Analysis Settings window. Go to toolbar and click on "Analyze" button (Fig 7) to run the analysis.

Fig 7. Analyze Button

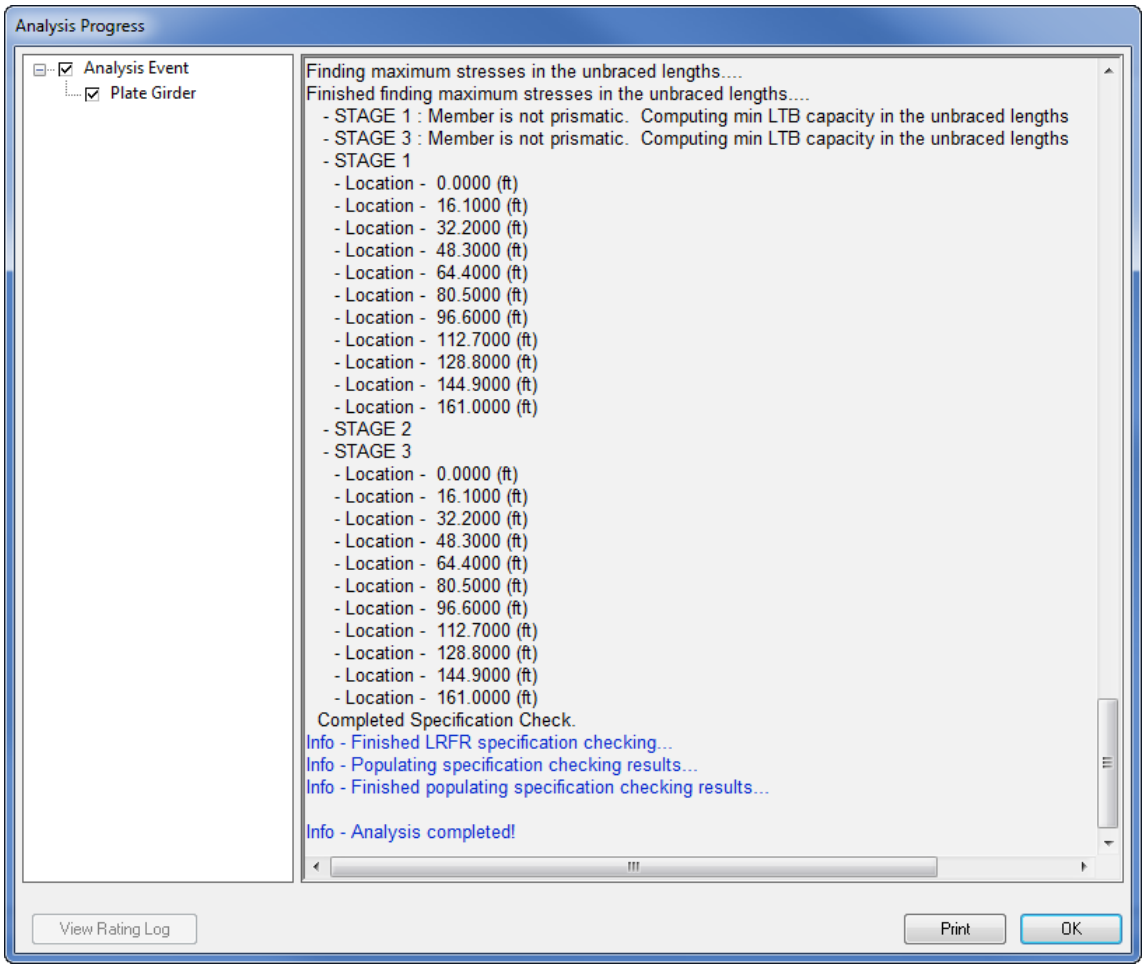


Fig 8. Analysis Progress Window

Once "Analyze" button is clicked, "Analysis Progress" window (Fig. 8) pops up. After analysis is completed click on "OK" button to close Analysis Progress window. Select the member alternative "Plate Girder (E)(C)" for G2. Click on "View Analysis Report" button (Fig. 9) to open Analysis Results window.

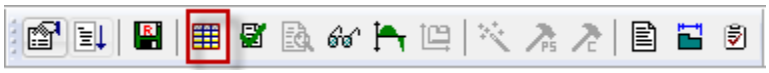


Fig 9. View Analysis Report Button

On Analysis Results window select Display Format as “Single rating level per row” to display analysis results as shown in Fig 10.

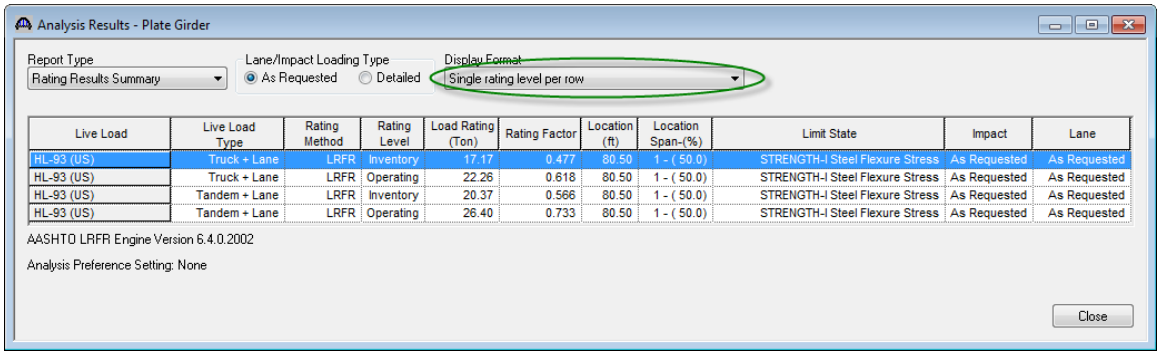


Fig 10. Analysis Results Window

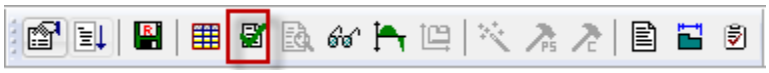


Fig 11. View Spec Check Button

Now go to toolbar, select and click on “View Spec Check” button (Fig 11). Spec Check Summary window will pop up. On Spec Check Summary window (Fig 12) expand “Stage 3” on left of the window. Select and click on ‘Span 1 – 80.50ft” (midpoint of the span1). This displays a list of articles checked for this location. Select and open article “6A.4.2.1 General Load Rating Equation – Steel Flexure Stress” by double clicking on it.

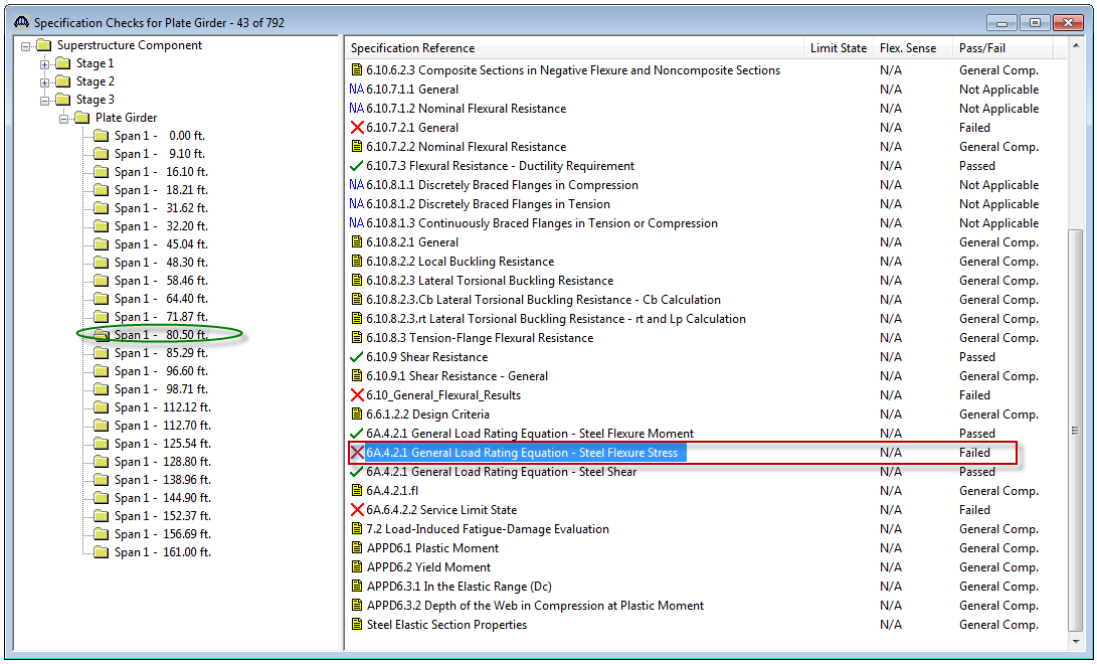


Fig 12. Spec Check Summary Window

This would open the spec check detail computation of the article. In this spec check details as shown in Fig 13, Load Factors DW-WS is considered as 1.50 according to MBE Table 6A.4.2.2 -1.

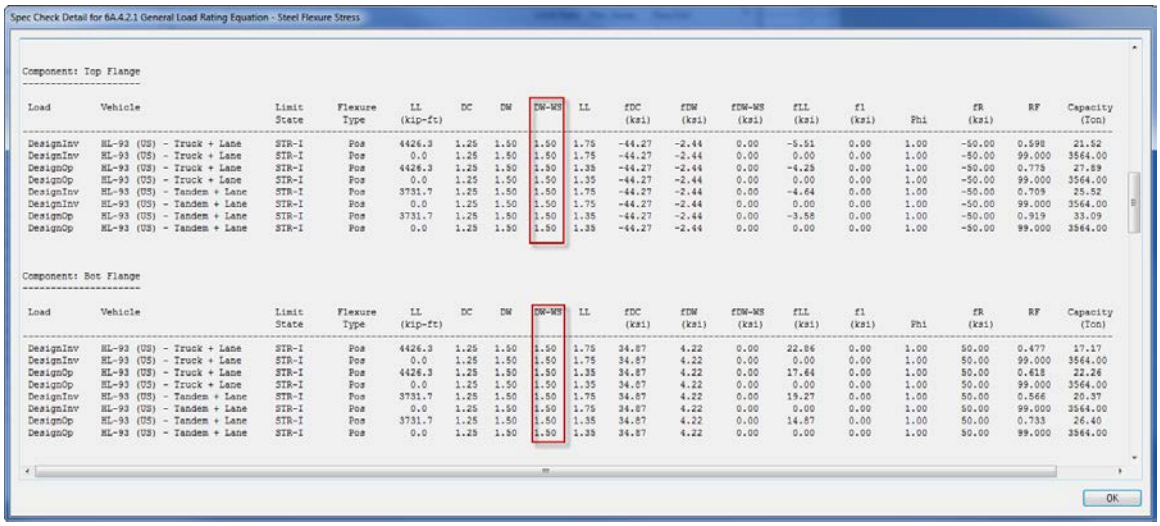


Fig 13. Speck check details of Article 6A.4.2.1 Steel Flexure Stress

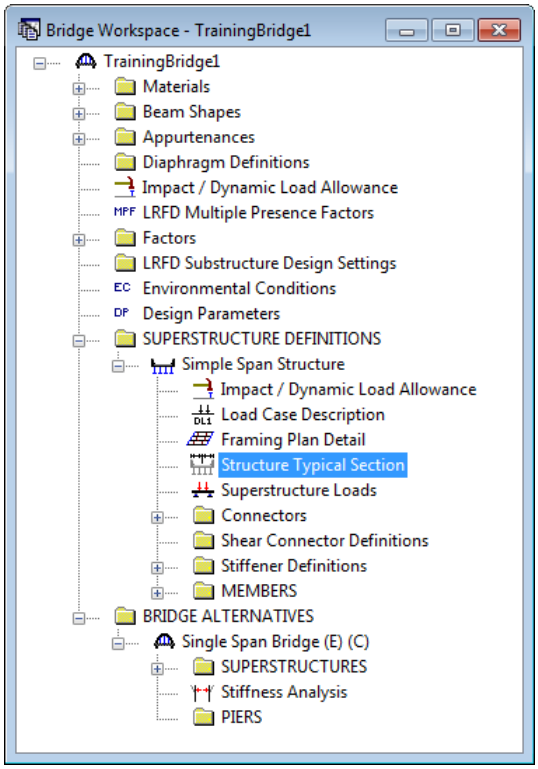


Fig 14. Bridge Workspace Tree for Training Bridge 1

Now go back to Bridge Workspace tree and select "Structure Typical Section" (Fig 14) under "SUPERSTRUCTURE DEFINITIONS". Double click to open on it to open Structure Typical Section window. On Structure Typical Section window go to Wearing Surface tab (Fig 15).

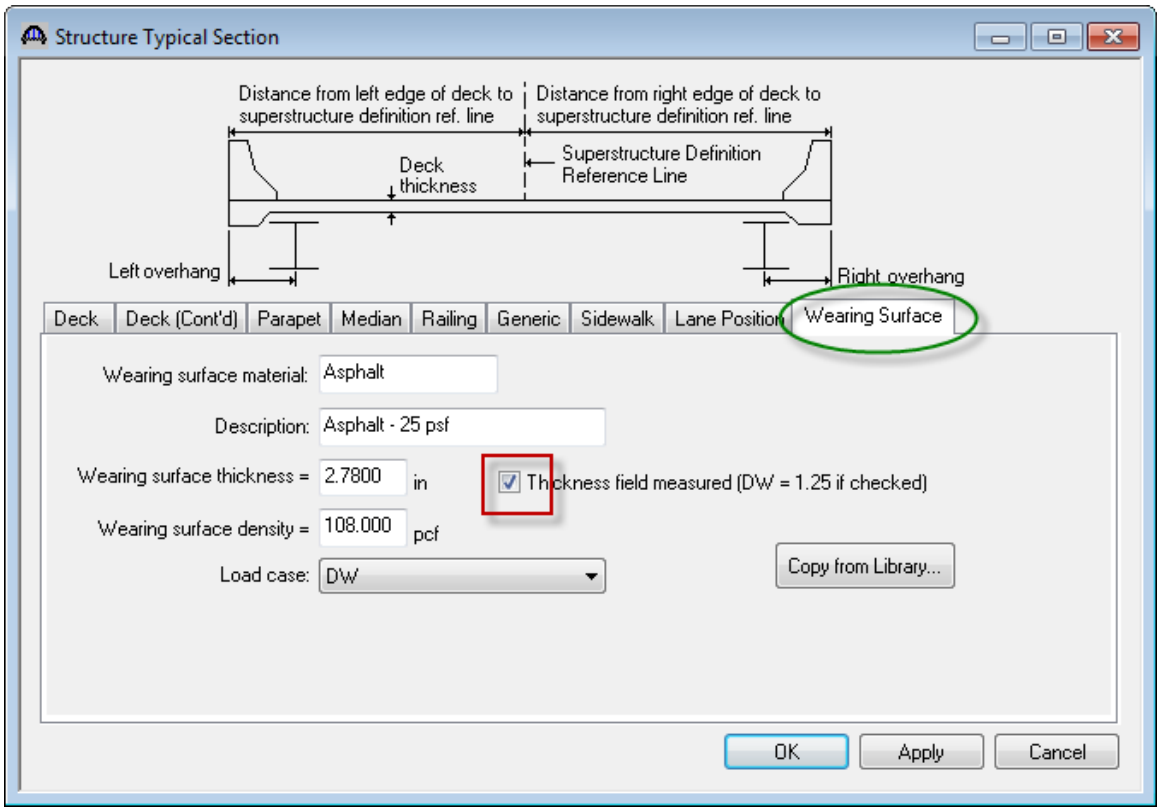
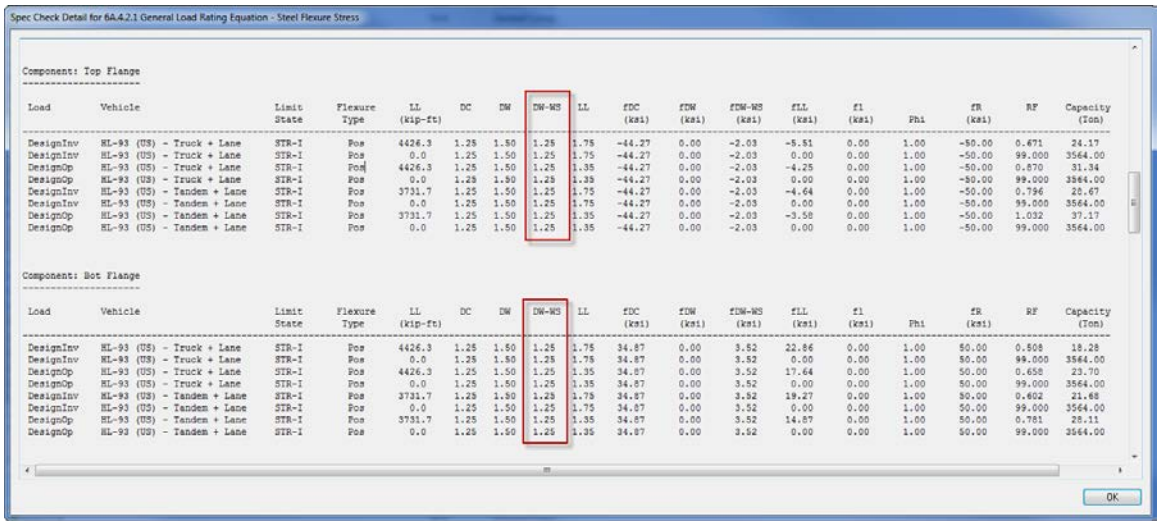


Fig 15. Structure Typical Section Window - Wearing Surface Tab

On Wearing Surface tab select field measured wearing surface thickness by checking the check box for "Thickness field Measured" (Fig 15). Click on "OK" button to save and close the Structure Typical Section window. Now re run the analysis by clicking the "Analyze" button (Fig 8).

After analysis is completed click on "OK" button to close Analysis Progress Window (Fig. 9). Now open Spec Check Summary window (Fig 13) by clicking on the View Spec check button (Fig 12).

Select and open spec article "6A. 4.2. 1 General Load Rating Equation – Steel Flexure Stress" (Fig 16). In this article Load factors for DW-WS is now taken as 1.25 according to MBE Table 6A.4.2.2 -1 foot note point 3 (Fig 17).



Spec Check Detail for 6A.4.2.1 General Load Rating Equation - Steel Flexure Stress

Component: Top Flange

Load	Vehicle	Limit State	Flexure Type	LL (kip-ft)	DC	DW	DW-WS	LL	fDC (ksi)	fDW (ksi)	fDW-WS (ksi)	fLL (ksi)	fl (ksi)	Phi	fR (ksi)	RF	Capacity (Ton)
DesignInv	HL-93 (US) - Truck + Lane	STR-I	Pos	4426.3	1.25	1.50	1.25	1.75	-44.27	0.00	-2.03	-5.51	0.00	1.00	-50.00	0.671	24.17
DesignInv	HL-93 (US) - Truck + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.75	-44.27	0.00	-2.03	0.00	0.00	1.00	-50.00	99.000	3564.00
DesignOp	HL-93 (US) - Truck + Lane	STR-I	Pos	4426.3	1.25	1.50	1.25	1.35	-44.27	0.00	-2.03	-4.25	0.00	1.00	-50.00	0.870	31.34
DesignOp	HL-93 (US) - Truck + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.35	-44.27	0.00	-2.03	0.00	0.00	1.00	-50.00	99.000	3564.00
DesignInv	HL-93 (US) - Tandem + Lane	STR-I	Pos	3731.7	1.25	1.50	1.25	1.75	-44.27	0.00	-2.03	-4.64	0.00	1.00	-50.00	0.796	28.67
DesignInv	HL-93 (US) - Tandem + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.75	-44.27	0.00	-2.03	0.00	0.00	1.00	-50.00	99.000	3564.00
DesignOp	HL-93 (US) - Tandem + Lane	STR-I	Pos	3731.7	1.25	1.50	1.25	1.35	-44.27	0.00	-2.03	-3.58	0.00	1.00	-50.00	1.032	37.17
DesignOp	HL-93 (US) - Tandem + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.35	-44.27	0.00	-2.03	0.00	0.00	1.00	-50.00	99.000	3564.00

Component: Bot Flange

Load	Vehicle	Limit State	Flexure Type	LL (kip-ft)	DC	DW	DW-WS	LL	fDC (ksi)	fDW (ksi)	fDW-WS (ksi)	fLL (ksi)	fl (ksi)	Phi	fR (ksi)	RF	Capacity (Ton)
DesignInv	HL-93 (US) - Truck + Lane	STR-I	Pos	4426.3	1.25	1.50	1.25	1.75	34.87	0.00	3.52	22.86	0.00	1.00	50.00	0.508	18.28
DesignInv	HL-93 (US) - Truck + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.75	34.87	0.00	3.52	0.00	0.00	1.00	50.00	99.000	3564.00
DesignOp	HL-93 (US) - Truck + Lane	STR-I	Pos	4426.3	1.25	1.50	1.25	1.35	34.87	0.00	3.52	17.64	0.00	1.00	50.00	0.658	23.70
DesignOp	HL-93 (US) - Truck + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.35	34.87	0.00	3.52	0.00	0.00	1.00	50.00	99.000	3564.00
DesignInv	HL-93 (US) - Tandem + Lane	STR-I	Pos	3731.7	1.25	1.50	1.25	1.75	34.87	0.00	3.52	19.27	0.00	1.00	50.00	0.602	21.68
DesignInv	HL-93 (US) - Tandem + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.75	34.87	0.00	3.52	0.00	0.00	1.00	50.00	99.000	3564.00
DesignOp	HL-93 (US) - Tandem + Lane	STR-I	Pos	3731.7	1.25	1.50	1.25	1.35	34.87	0.00	3.52	14.87	0.00	1.00	50.00	0.781	28.11
DesignOp	HL-93 (US) - Tandem + Lane	STR-I	Pos	0.0	1.25	1.50	1.25	1.35	34.87	0.00	3.52	0.00	0.00	1.00	50.00	99.000	3564.00

OK

Fig 16. Speck check details of Article 6A.4.2.1 Steel Flexure Stress

6A.4.2.2—Limit States

Strength is the primary limit state for load rating; service and fatigue limit states are selectively applied in accordance with the provisions of this Manual. Applicable limit states are summarized in Table 6A.4.2.2-1.

C6A.4.2.2

Service limit states that are relevant to load rating are discussed under the articles on resistance of structures (see Articles 6A.5, 6A.6, and 6A.7).

Table 6A.4.2.2-1—Limit States and Load Factors for Load Rating

Bridge Type	Limit State*	Dead Load γ_{DC}	Dead Load γ_{DW}	Design Load: Inventory γ_{LL}	Design Load: Operating γ_{LL}	Legal Load γ_{LL}	Permit Load γ_{LL}
Steel	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1
	Service II	1.00	1.00	1.30	1.00	1.30	1.00
	Fatigue	0.00	0.00	0.75	—	—	—
Reinforced Concrete	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1
	Service I	1.00	1.00	—	—	—	1.00
Prestressed Concrete	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1
	Service III	1.00	1.00	0.80	—	1.00	—
	Service I	1.00	1.00	—	—	—	1.00
Wood	Strength I	1.25	1.50	1.75	1.35	Tables 6A.4.4.2.3a-1 and 6A.4.4.2.3b-1	—
	Strength II	1.25	1.50	—	—	—	Table 6A.4.5.4.2a-1

* Defined in the *AASHTO LRFD Bridge Design Specifications*.

Notes:

- Shaded cells of the table indicate optional checks.
- Service I is used to check the 0.9 F_y stress limit in reinforcing steel.
- Load factor for *DW* at the strength limit state may be taken as 1.25 where thickness has been field measured.
- Fatigue limit state is checked using the LRFD fatigue truck (see Article 6A.6.4.1).

Fig 17. MBE Table 6A.4.2.2 -1.