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*AASHTOWare BrD/BrR 6.8*

***Feature Tutorial***

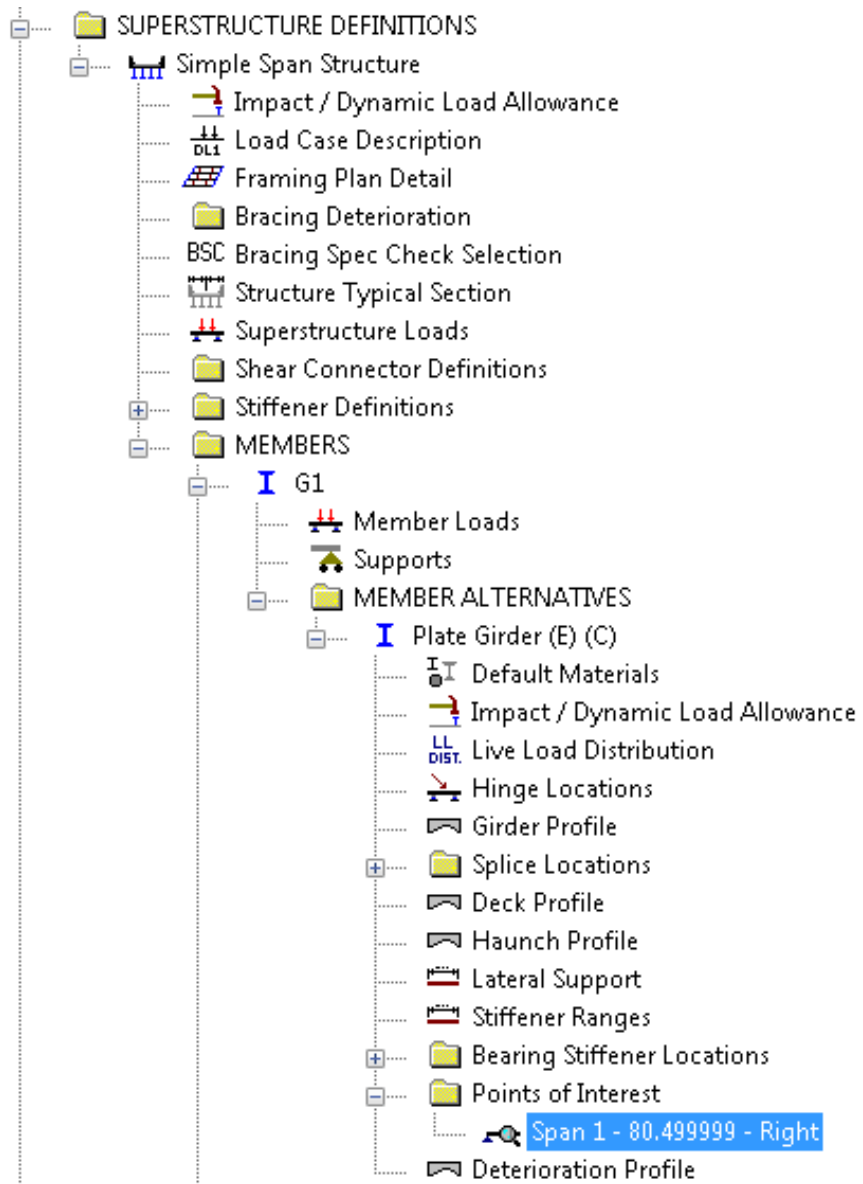
*Capacity Override at Points of Interest*

## Topics Covered

- Capacity Override LRFR
- Capacity Override LRFD

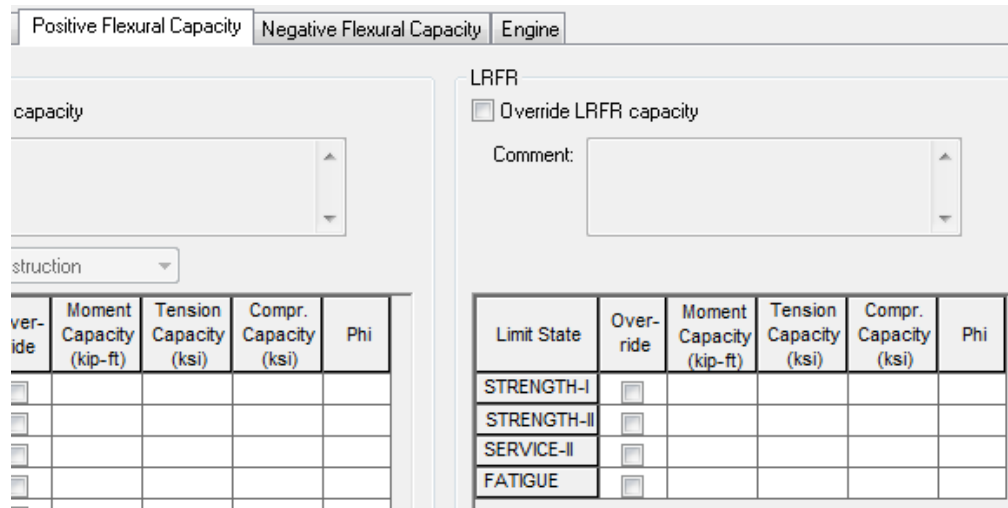
## Capacity Override LR

Open BID1 in BrDR and navigate to SUPERSTRUCTURE DEFINITIONS->Simple Span Structure->Members->G1->Member Alternative->Plate Girder-> Point of Interests->Span 1 80.5.



## Capacity Override

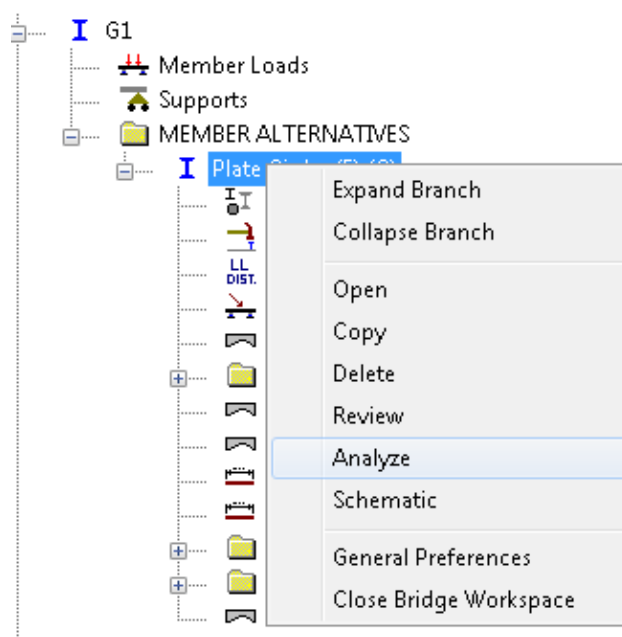
As seen from the window below, the option for “Override LRFR capacity” for “Positive Flexural Capacity” is not checked. Hence, the beam capacities at 80.5 ft will be computed by the AASHTO LRFR Engine.



Open “View Analysis Settings” and choose “LRFR Design Load Rating” template for analysis.



Right click on “Plate Girder” and Select Analyze.



## Capacity Override

After the LRFR analysis is completed open “View Spec Check” and navigate to Stage 3->Plate Girder->Span 1 80.5 ft. -> Article 6.10.7.2.1.

Specification Checks for Plate Girder - 44 of 822

Specification Reference	Limit State	Flex. Sense	Pass/Fa
5.4.2.6 Modulus of Rupture		N/A	General
5.4.2.8 Concrete Density Modification Factor		N/A	General
6.10.1.1.1b Stresses for Sections in Positive Flexure		N/A	General
6.10.1.10.1 Hybrid Factor, Rh		N/A	General
6.10.1.10.2 Web Load-Shedding Factor, Rb		N/A	General
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
6.10.1.9.1 Webs without Longitudinal Reinforcement			
6.10.11.1.2 Transverse Stiffness			
6.10.11.1.3 Transverse Stiffness			
6.10.2 Cross-Section Proportioning			
6.10.4.2.2 Flexure			
6.10.6.2.2 Composite Sections			
6.10.6.2.3 Composite Sections			
6.10.7.1.1 General			
6.10.7.1.2 Nominal Flexural Resistance			
6.10.7.2.1 General			
6.10.7.2.2 Nominal Flexural Resistance			
6.10.7.3 Flexural Resistance - Design			
6.10.8.1.1 Discretely Braced Flanges			
6.10.8.1.2 Discretely Braced Flanges			
6.10.8.1.3 Continuously Braced Flanges			
6.10.8.2.1 General			
6.10.8.2.2 Local Buckling Resistance			
6.10.8.2.3 Lateral Torsional Buckling			
6.10.8.2.3.Cb Lateral Torsional Buckling			
6.10.8.2.3.rt Lateral Torsional Buckling			
6.10.8.3 Tension-Flange Flexural Resistance		N/A	General
6.10.9 Shear Resistance		N/A	Passed
6.10.9.1 Shear Resistance - General		N/A	General
6.10_General_Flexural_Results		N/A	Failed

Spec Check Detail for 6.10.7.2.1 General

6 Steel Structures  
 6.10 I-Section Flexural Members  
 6.10.7 Flexural Resistance-Composite Sections in Positive Flexure  
 6.10.7.2 Noncompact Sections  
 6.10.7.2.1 General  
 (AASHTO LRFD Bridge Design Specifications, Seventh Edition - 2014, ...)

Steel Plate - At Location = 80.5000 (ft) - Left Stage 3

INPUT:  
 phif = 1.000  
 Section Type: Composite  
 Compact: Yes  
 Allow Plastic Analysis Control Option: No  
 Allow Moment Redistribution Control Option: No  
 Moment Redistribution Qualified: No, redistribution did not occur.

```

fc = stress in the slab
f'c = 4.5000 (ksi)
Stress = fbu
Resist = phif * Fnc
Design Ratio = Resist/Stress

Note: If the capacity has been overridden, the Resistance is computed as override phi*override capacity.
Otherwise the Resistance is computed as per the Specification.
  
```

--- Compression Flange ---

Limit State	Load Comb	Flexure Type	Component	--- Override ---							Stress (ksi)	Resist (ksi)	Design Ratio	Status
				fbu (ksi)	frd (ksi)	Fnc (ksi)	Phi	Fnc (ksi)	Stress (ksi)	Resist (ksi)				
STR-I	1, DesInv	Pos	Top Flange	-48.00	0.00	50.00				-48.00	-50.00	1.042	Pass	
STR-I	1, DesInv	Pos	Top Flange	-41.35	0.00	50.00				-41.35	-50.00	1.209	Pass	
STR-I	1, DesOp	Pos	Top Flange	-46.48	0.00	50.00				-46.48	-50.00	1.076	Pass	
STR-I	1, DesOp	Pos	Top Flange	-41.35	0.00	50.00				-41.35	-50.00	1.209	Pass	
STR-I	2, DesInv	Pos	Top Flange	-46.95	0.00	50.00				-46.95	-50.00	1.065	Pass	
STR-I	2, DesInv	Pos	Top Flange	-41.35	0.00	50.00				-41.35	-50.00	1.209	Pass	
STR-I	2, DesOp	Pos	Top Flange	-45.67	0.00	50.00				-45.67	-50.00	1.095	Pass	
STR-I	2, DesOp	Pos	Top Flange	-41.35	0.00	50.00				-41.35	-50.00	1.209	Pass	

```

Stress = fbu + fl/3
Resist = phif * Fnt
Design Ratio = Resist/Stress
  
```

--- Tension Flange ---

Limit State	Load Comb	Flexure Type	Component	--- Override ---							Stress (ksi)	Resist (ksi)	Design Ratio	Status
				fbu (ksi)	fl (ksi)	frd (ksi)	Fnt (ksi)	Phi	Fnt (ksi)	Stress (ksi)				
STR-I	1, DesInv	Pos	Bot Flange	62.68	0.00	0.00	50.00			62.68	50.00	0.798	Fail	
STR-I	1, DesInv	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass	
STR-I	1, DesOp	Pos	Bot Flange	56.38	0.00	0.00	50.00			56.38	50.00	0.887	Fail	
STR-I	1, DesOp	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass	
STR-I	2, DesInv	Pos	Bot Flange	58.35	0.00	0.00	50.00			58.35	50.00	0.857	Fail	
STR-I	2, DesInv	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass	
STR-I	2, DesOp	Pos	Bot Flange	53.04	0.00	0.00	50.00			53.04	50.00	0.943	Fail	
STR-I	2, DesOp	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass	

## Capacity Override

The resistance factor “ $\phi$ ” value is 1.0 as shown above.

The above two figures show the resistances for the compression and the tension flange at location 80.5 ft as per  $F_{nc}$  and  $F_{nt}$  respectively which were computed.

Close the article and the View Spec Check window. Again navigate to SUPERSTRUCTURE DEFINITIONS->Simple Span Structure->Members->G1->Member Alternative->Plate Girder-> Point of Interests->Span 1 80.5.

Check the “Override LRFR capacity” for “Positive Flexural Capacity” and input the values as shown below.

The screenshot shows the 'Positive Flexural Capacity' tab selected. In the 'LRFR' section, the checkbox 'Override LRFR capacity' is checked. Below it is a 'Comment' field. A table displays the override values for various limit states:

Limit State	Over-ride	Moment Capacity (kip-ft)	Tension Capacity (ksi)	Compr. Capacity (ksi)	Phi
STRENGTH-I	<input checked="" type="checkbox"/>		100.000	90.000	0.600
STRENGTH-II	<input type="checkbox"/>				
SERVICE-II	<input type="checkbox"/>				
FATIGUE	<input type="checkbox"/>				

Click Ok to save the data and right click on “Plate Girder” and select Analyze.

After the LRFR analysis is completed open “View Spec Check” and navigate to Stage 3->Plate Girder->Span 1 80.5 ft. -> Article 6.10.7.2.1.

The “ $\phi$ ” value remains the same as above but it has been overridden for a specific limit state case (mentioned in the POI 80.5 ft. window) as can be seen from the figures below. The “Resist” field reflects the implementation of the capacity override.

```

--- Compression Flange ---
fc = stress in the slab
f'c = 4.5000 (ksi)
Stress = fbu
Resist =  $\phi$  * Fnc
Design Ratio = Resist/Stress

```

Note: If the capacity has been overridden, the Resistance is computed as  $\phi$ \*override capacity. Otherwise the Resistance is computed as per the Specification.

Limit State	Load Comb	Flexure Type	Component	fbu (ksi)	frd (ksi)	Fnc (ksi)	--- Override ---		Stress (ksi)	Resist (ksi)	Design Ratio	Status
							Phi	Fnc (ksi)				
STR-I	1, DesInv	Pos	Top Flange	-48.00	0.00	50.00	0.60	90.00	-48.00	-54.00	1.125	Pass
STR-I	1, DesInv	Pos	Top Flange	-41.35	0.00	50.00	0.60	90.00	-41.35	-54.00	1.306	Pass
STR-I	1, DesOp	Pos	Top Flange	-46.48	0.00	50.00	0.60	90.00	-46.48	-54.00	1.162	Pass
STR-I	1, DesOp	Pos	Top Flange	-41.35	0.00	50.00	0.60	90.00	-41.35	-54.00	1.306	Pass
STR-I	2, DesInv	Pos	Top Flange	-46.95	0.00	50.00	0.60	90.00	-46.95	-54.00	1.150	Pass
STR-I	2, DesInv	Pos	Top Flange	-41.35	0.00	50.00	0.60	90.00	-41.35	-54.00	1.306	Pass
STR-I	2, DesOp	Pos	Top Flange	-45.67	0.00	50.00	0.60	90.00	-45.67	-54.00	1.182	Pass
STR-I	2, DesOp	Pos	Top Flange	-41.35	0.00	50.00	0.60	90.00	-41.35	-54.00	1.306	Pass

## Capacity Override

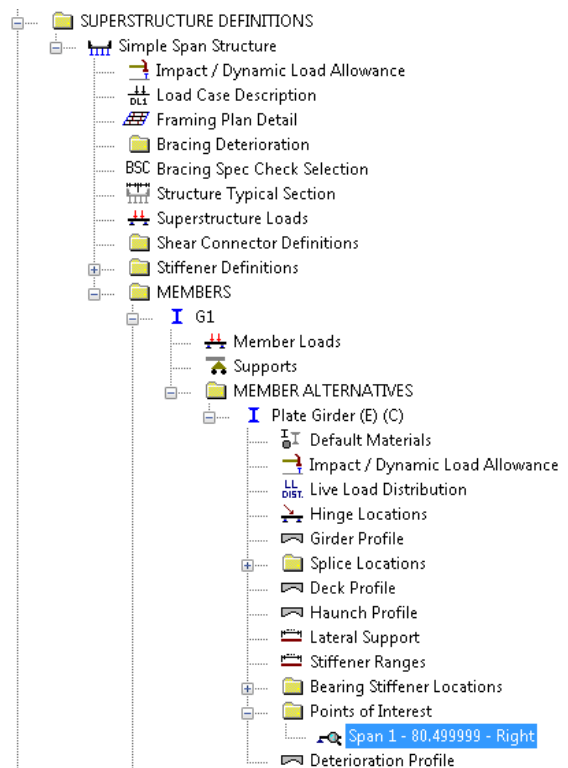
--- Tension Flange ---

Stress =  $f_{bu} + f_l/3$   
 Resist =  $\phi_{if} * F_{nt}$   
 Design Ratio = Resist/Stress

Limit State	Load Comb	Flexure Type	Component	--- Override ---							Stress (ksi)	Resist (ksi)	Design Ratio	Status
				f <sub>bu</sub> (ksi)	f <sub>l</sub> (ksi)	f <sub>rd</sub> (ksi)	F <sub>nt</sub> (ksi)	Phi	F <sub>nt</sub> (ksi)					
STR-I	1, DesInv	Pos	Bot Flange	62.68	0.00	0.00	50.00	0.60	100.00	62.68	60.00	0.957	Fail	
STR-I	1, DesInv	Pos	Bot Flange	35.10	0.00	0.00	50.00	0.60	100.00	35.10	60.00	1.710	Pass	
STR-I	1, DesOp	Pos	Bot Flange	56.38	0.00	0.00	50.00	0.60	100.00	56.38	60.00	1.064	Pass	
STR-I	1, DesOp	Pos	Bot Flange	35.10	0.00	0.00	50.00	0.60	100.00	35.10	60.00	1.710	Pass	
STR-I	2, DesInv	Pos	Bot Flange	58.35	0.00	0.00	50.00	0.60	100.00	58.35	60.00	1.028	Pass	
STR-I	2, DesInv	Pos	Bot Flange	35.10	0.00	0.00	50.00	0.60	100.00	35.10	60.00	1.710	Pass	
STR-I	2, DesOp	Pos	Bot Flange	53.04	0.00	0.00	50.00	0.60	100.00	53.04	60.00	1.131	Pass	
STR-I	2, DesOp	Pos	Bot Flange	35.10	0.00	0.00	50.00	0.60	100.00	35.10	60.00	1.710	Pass	

## Capacity Override LRFD

Open BID1 in BrD and navigate to SUPERSTRUCTURE DEFINITIONS->Simple Span Structure->Members->G1->Member Alternative->Plate Girder-> Point of Interests->Span 1 80.5.



As seen from the window below, the option for “Override LRFD capacity” for “Positive Flexural Capacity” is not checked. Hence, the beam capacities at 80.5 ft will be computed by the AASHTO LRFD Engine.

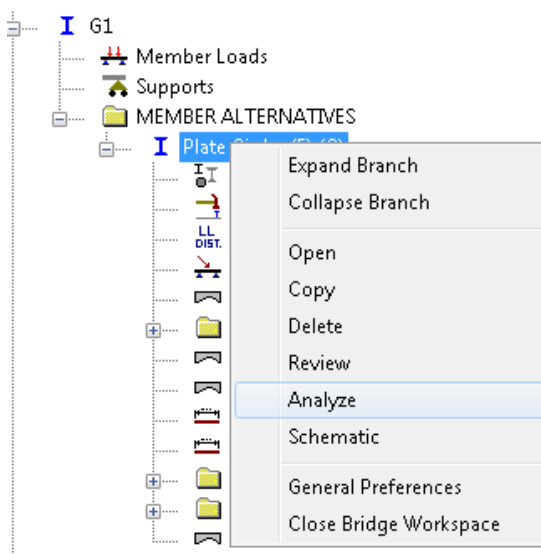
## Capacity Override

Limit State	Over-ride	Moment Capacity (kip-ft)	Tension Capacity (ksi)	Compr. Capacity (ksi)	Phi
STRENGTH-I	<input type="checkbox"/>				
STRENGTH-II	<input type="checkbox"/>				
STRENGTH-III	<input type="checkbox"/>				
STRENGTH-I	<input type="checkbox"/>				

Open “View Analysis Settings” and choose “HL 93 Design Review” template for LRFD analysis.

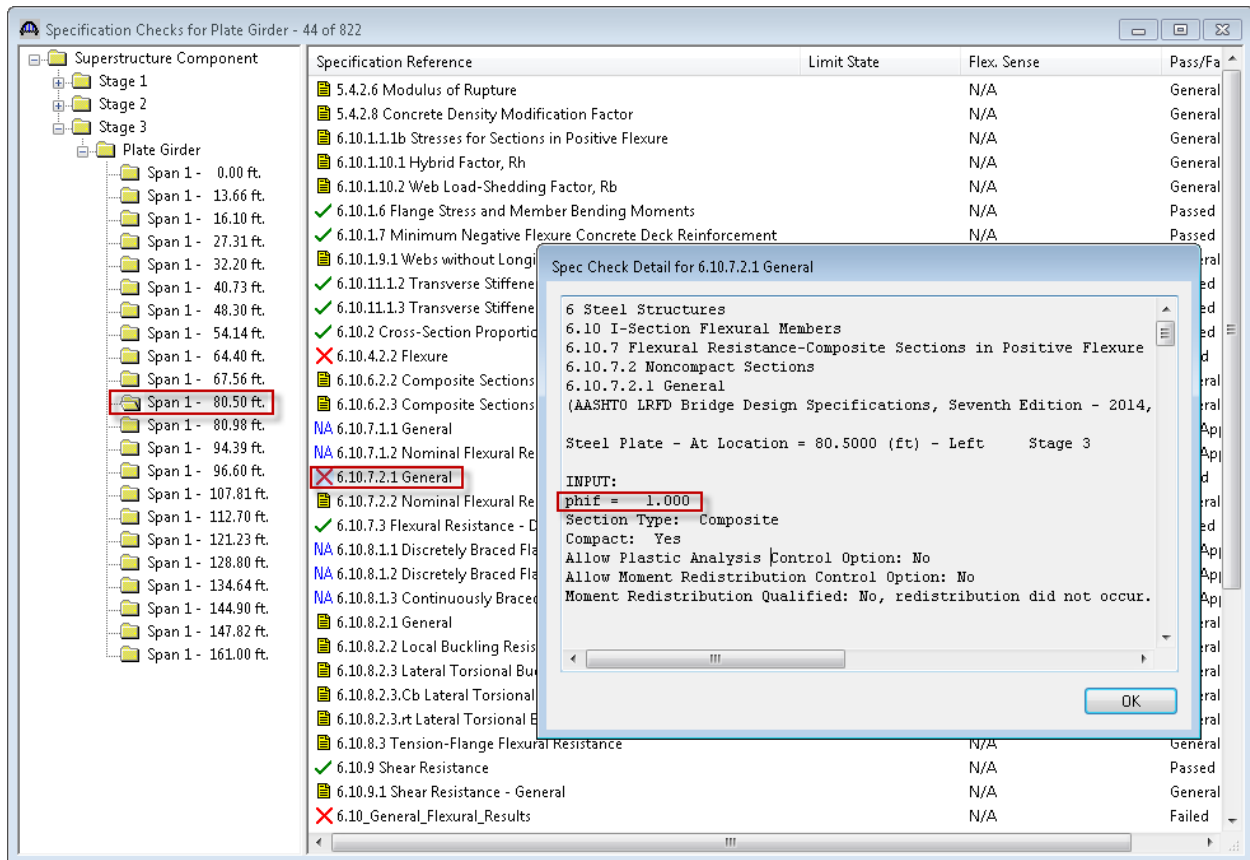


Right click on “Plate Girder” and Select Analyze.



After the LRFD analysis is completed open “View Spec Check” and navigate to Stage 3->Plate Girder->Span 1 80.5 ft. -> Article 6.10.7.2.1.

# Capacity Override



```

--- Compression Flange ---
fc = stress in the slab
f'c = 4.5000 (ksi)
Stress = fbu
Resist = phiif * Fnc
Design Ratio = Resist/Stress

Note: If the capacity has been overridden, the Resistance is computed as override phi*override capacity.
Otherwise the Resistance is computed as per the Specification.
  
```

Limit State	Load Comb	Flexure Type	Component	fbu (ksi)	frd (ksi)	Fnc (ksi)	--- Override ---			Status
							Phi	Fnc (ksi)	Stress (ksi)	
STR-I	1	Pos	Top Flange	-48.00	0.00	50.00				Pass
STR-I	1	Pos	Top Flange	-29.07	0.00	50.00				Pass
STR-I	2	Pos	Top Flange	-46.95	0.00	50.00				Pass
STR-I	2	Pos	Top Flange	-29.07	0.00	50.00				Pass
STR-III	1	Pos	Top Flange	-41.35	0.00	50.00				Pass
STR-III	1	Pos	Top Flange	-29.07	0.00	50.00				Pass
STR-III	2	Pos	Top Flange	-41.35	0.00	50.00				Pass
STR-III	2	Pos	Top Flange	-29.07	0.00	50.00				Pass
STR-V	1	Pos	Top Flange	-46.48	0.00	50.00				Pass
STR-V	1	Pos	Top Flange	-29.07	0.00	50.00				Pass
STR-V	2	Pos	Top Flange	-45.67	0.00	50.00				Pass
STR-V	2	Pos	Top Flange	-29.07	0.00	50.00				Pass



## Capacity Override

--- Tension Flange ---

Stress =  $f_{bu} + f_l/3$   
 Resist =  $\phi_{if} * F_{nt}$   
 Design Ratio = Resist/Stress

Limit State	Load Comb	Flexure Type	Component	f <sub>bu</sub> (ksi)	f <sub>l</sub> (ksi)	f <sub>rd</sub> (ksi)	F <sub>nt</sub> (ksi)	--- Override ---		Stress (ksi)	Resist (ksi)	Design Ratio	Status
								Phi	F <sub>nt</sub> (ksi)				
STR-I	1	Pos	Bot Flange	62.68	0.00	0.00	50.00			62.68	50.00	0.798	Fail
STR-I	1	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-I	2	Pos	Bot Flange	58.35	0.00	0.00	50.00			58.35	50.00	0.857	Fail
STR-I	2	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-III	1	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass
STR-III	1	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-III	2	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass
STR-III	2	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-V	1	Pos	Bot Flange	56.38	0.00	0.00	50.00			56.38	50.00	0.887	Fail
STR-V	1	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-V	2	Pos	Bot Flange	53.04	0.00	0.00	50.00			53.04	50.00	0.943	Fail
STR-V	2	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass

The resistance factor “ $\phi_{if}$ ” value is 1.0 as shown above.

The above two figures show the resistances for the compression and the tension flange at location 80.5 ft. as per  $F_{nc}$  and  $F_{nt}$  respectively which were computed.

Close the article and the View Spec Check window. Again navigate to SUPERSTRUCTURE DEFINITIONS->Simple Span Structure->Members->G1->Member Alternative->Plate Girder-> Point of Interests->Span 1 80.5.

Check the “Override LRFD capacity” for “Positive Flexural Capacity” and input the values as shown below. The Stage field indicates that during which stage of design, the capacity values have to be overridden.

Shear Capacity | **Positive Flexural Capacity** | Negative Flexural

LRFD

Override LRFD capacity

Comment:

Stage: Final

Limit State	Over-ride	Moment Capacity (kip-ft)	Tension Capacity (ksi)	Compr. Capacity (ksi)	Phi
STRENGTH-I	<input checked="" type="checkbox"/>		120	90.000	0.600
STRENGTH-II	<input type="checkbox"/>				
STRENGTH-III	<input type="checkbox"/>				

Click Ok to save the data and right click on “Plate Girder” and select Analyze.

After the LRFD analysis is completed open “View Spec Check” and navigate to Stage 3->Plate Girder->Span 1 80.5 ft. -> Article 6.10.7.2.1.

## Capacity Override

The “ $\phi$ ” value remains the same as above but it has been overridden for specific limit state case (mentioned in the POI 80.5 ft. window) as can be seen from the figures below. The “Resist” field reflects the implementation of the capacity override

```

--- Compression Flange ---
fc      = stress in the slab
f'c     = 4.5000 (ksi)
Stress  = fbu
Resist  =  $\phi$  * Fnc
Design Ratio = Resist/Stress

Note: If the capacity has been overridden, the Resistance is computed as  $\phi$ *override capacity.
Otherwise the Resistance is computed as per the Specification.

```

Limit State	Load Comb	Flexure Type	Component	--- Override ---							Design Ratio	Status
				fbu (ksi)	frd (ksi)	Fnc (ksi)	Phi	Fnc (ksi)	Stress (ksi)	Resist (ksi)		
STR-I	1	Pos	Top Flange	-48.00	0.00	50.00	0.60	90.00	-48.00	-54.00	1.125	Pass
STR-I	1	Pos	Top Flange	-29.07	0.00	50.00	0.60	90.00	-29.07	-54.00	1.857	Pass
STR-I	2	Pos	Top Flange	-46.95	0.00	50.00	0.60	90.00	-46.95	-54.00	1.150	Pass
STR-I	2	Pos	Top Flange	-29.07	0.00	50.00	0.60	90.00	-29.07	-54.00	1.857	Pass
STR-III	1	Pos	Top Flange	-41.35	0.00	50.00			-41.35	-50.00	1.209	Pass
STR-III	1	Pos	Top Flange	-29.07	0.00	50.00			-29.07	-50.00	1.720	Pass
STR-III	2	Pos	Top Flange	-41.35	0.00	50.00			-41.35	-50.00	1.209	Pass
STR-III	2	Pos	Top Flange	-29.07	0.00	50.00			-29.07	-50.00	1.720	Pass
STR-V	1	Pos	Top Flange	-46.48	0.00	50.00			-46.48	-50.00	1.076	Pass
STR-V	1	Pos	Top Flange	-29.07	0.00	50.00			-29.07	-50.00	1.720	Pass
STR-V	2	Pos	Top Flange	-45.67	0.00	50.00			-45.67	-50.00	1.095	Pass
STR-V	2	Pos	Top Flange	-29.07	0.00	50.00			-29.07	-50.00	1.720	Pass

```

--- Tension Flange ---
Stress = fbu + fl/3
Resist =  $\phi$  * Fnt
Design Ratio = Resist/Stress

```

Limit State	Load Comb	Flexure Type	Component	--- Override ---							Design Ratio	Status	
				fbu (ksi)	fl (ksi)	frd (ksi)	Fnt (ksi)	Phi	Fnt (ksi)	Stress (ksi)			Resist (ksi)
STR-I	1	Pos	Bot Flange	62.68	0.00	0.00	50.00	0.60	120.00	62.68	72.00	1.149	Pass
STR-I	1	Pos	Bot Flange	24.06	0.00	0.00	50.00	0.60	120.00	24.06	72.00	2.992	Pass
STR-I	2	Pos	Bot Flange	58.35	0.00	0.00	50.00	0.60	120.00	58.35	72.00	1.234	Pass
STR-I	2	Pos	Bot Flange	24.06	0.00	0.00	50.00	0.60	120.00	24.06	72.00	2.992	Pass
STR-III	1	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass
STR-III	1	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-III	2	Pos	Bot Flange	35.10	0.00	0.00	50.00			35.10	50.00	1.425	Pass
STR-III	2	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-V	1	Pos	Bot Flange	56.38	0.00	0.00	50.00			56.38	50.00	0.887	Fail
STR-V	1	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass
STR-V	2	Pos	Bot Flange	53.04	0.00	0.00	50.00			53.04	50.00	0.943	Fail
STR-V	2	Pos	Bot Flange	24.06	0.00	0.00	50.00			24.06	50.00	2.078	Pass