Release Note

Release Date : September 2020

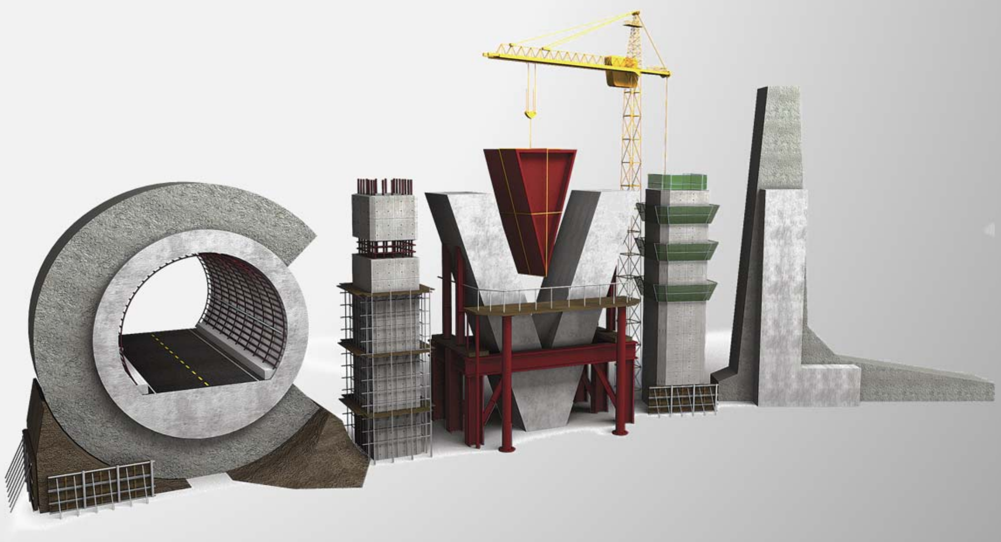
Product Ver. : Civil 2020 (v3.2)

DESIGN OF CIVIL STRUCTURES

Integrated Solution System for Bridge and Civil Engineering

Enhancements

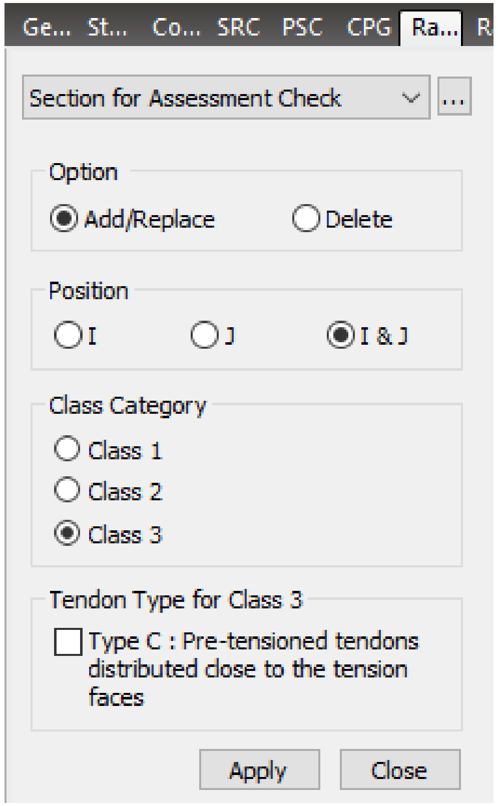
1. Improvement of Bridge Assessment to CS 454: Crack Width of External/Unbonded Prestressing
2. Improvement of Bridge Assessment to CS 454: Torsional Reserve Factor Results
3. Improvement of Prestressed Girder Design to BS 5400: Longitudinal Shear
4. AASHTO LRFD 8th Design Standard – Steel Section
5. Warping Normal Stress for Steel Composite Section Design to AASHTO LRFD
6. Bug fix list



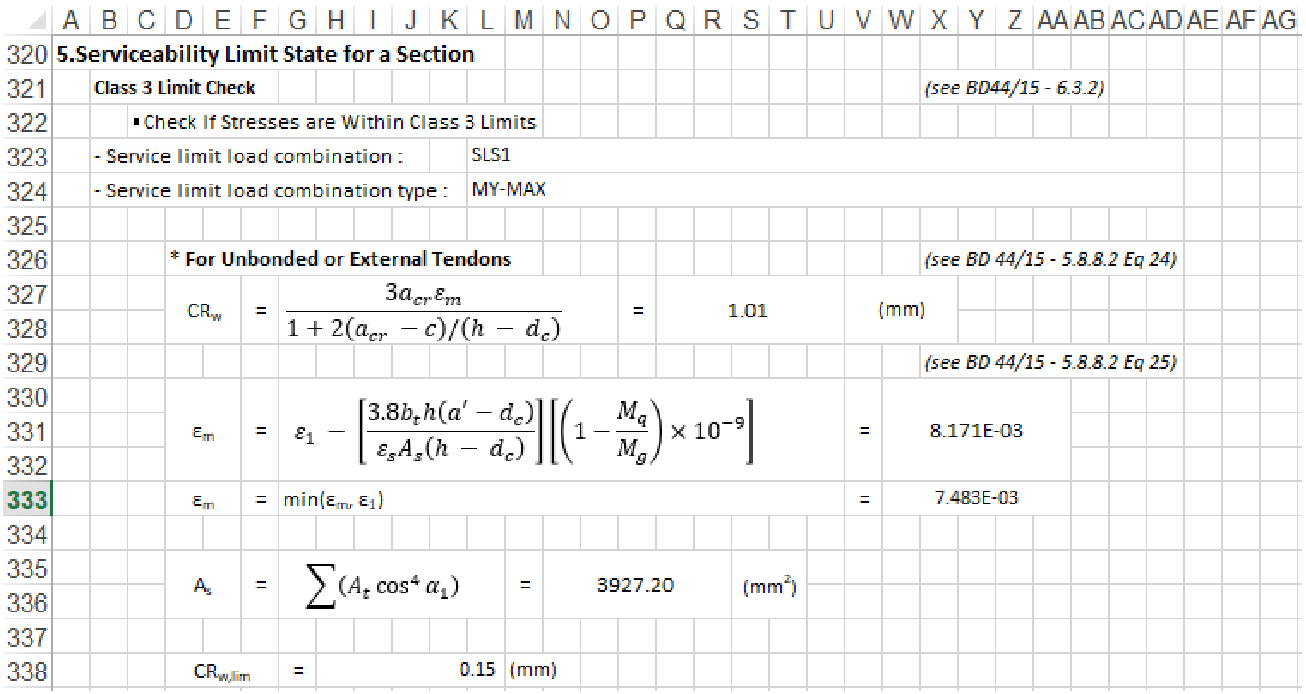
1. Improvement of Bridge Assessment to CS 454: Crack Width of External/Unbonded Prestressing

- For the crack width calculation, prestressed structures containing external and/or unbonded prestressing must be treated as reinforced concrete sections in which the axial force and moment due to prestress is considered as an applied load. Axial force was not taken into account in the previous version. Now, crack width is calculated considering axial force as well as moment.

- ***Rating > Bridge Rating Design > CS 454/19***



Class Category



Crack width calculation report

2. Improvement of Bridge Assessment to CS 454: Torsional Reserve Factor Results

- The method to determine Adequacy factor for torsion is improved as shown below.

- ***Rating > Bridge Rating Design > CS 454/19***

Element	Part	Rating Case	vt (kN/m²)	vtmin (kN/m²)	v (kN/m²)	vtu (kN/m²)	y1 (m)	vtu(y1/550) (kN/m²)	T (kN·m)	Tu (kN·m)	A	Check
1	I[1]	ULS_Mxx(Max)	665.4657	473.4272	-2866.011	6480.0000	4.8355	-	7080.6312	9477.6888	1.338	OK
1	I[1]	ULS_Mxx(Min)	665.4657	473.4272	-2866.011	6480.0000	4.8355	-	-7080.631	9477.6888	1.338	OK
1	I[1]	ULS_Myy(Max)	43.8766	473.4272	-	-	4.8355	-	-	-	10.79	OK
1	I[1]	ULS_Myy(Min)	0.0047	473.4272	-	-	4.8355	-	-	-	1015	OK
1	I[1]	ULS_Mzz(Max)	559.3364	473.4272	-2869.134	6480.0000	4.8355	-	5951.4037	9477.6888	1.592	OK
1	I[1]	ULS_Mzz(Min)	559.3367	473.4272	-2869.133	6480.0000	4.8355	-	-5951.406	9477.6888	1.592	OK
1	J[2]	ULS_Fxx(Max)	190.4501	473.4272	-	-	4.8355	-	-	-	2.485	OK
1	J[2]	ULS_Fxx(Min)	0.0047	473.4272	-	-	4.8355	-	-	-	1014	OK
1	J[2]	ULS_Fyy(Max)	217.6501	473.4272	-	-	4.8355	-	-	-	2.175	OK
1	J[2]	ULS_Fyy(Min)	221.8854	473.4272	-	-	4.8355	-	-	-	2.133	OK
1	J[2]	ULS_Fzz(Max)	1.3240	473.4272	-	-	4.8355	-	-	-	357.5	OK
1	J[2]	ULS_Fzz(Min)	248.9830	473.4272	-	-	4.8355	-	-	-	1.901	OK
1	J[2]	ULS_Mxx(Max)	623.2512	473.4272	-2147.980	6480.0000	4.8355	-	6631.4638	9477.6888	1.429	OK
1	J[2]	ULS_Mxx(Min)	623.2512	473.4272	-2259.093	6480.0000	4.8355	-	-6631.463	9477.6888	1.429	OK
1	J[2]	ULS_Myy(Max)	190.4501	473.4272	-	-	4.8355	-	-	-	2.485	OK
1	J[2]	ULS_Myy(Min)	0.0047	473.4272	-	-	4.8355	-	-	-	1014	OK
1	J[2]	ULS_Mzz(Max)	614.1632	473.4272	-2122.454	6480.0000	4.8355	-	6534.7661	9477.6888	1.450	OK
1	J[2]	ULS_Mzz(Min)	615.2203	473.4272	-2278.913	6480.0000	4.8355	-	-6546.014	9477.6888		
2	I[2]	ULS_Fxx(Max)	206.8457	473.4272	-	-	4.8355	-	-	-		
2	I[2]	ULS_Fxx(Min)	1.3264	473.4272	-	-	4.8355	-	-	-		
2	I[2]	ULS_Fyy(Max)	217.6500	473.4272	-	-	4.8355	-	-	-		

Torsion Reserve Factors

Torsion Reserve Factor Table

Adequacy Factor, A

If $v_t \leq v_{tmin}$,

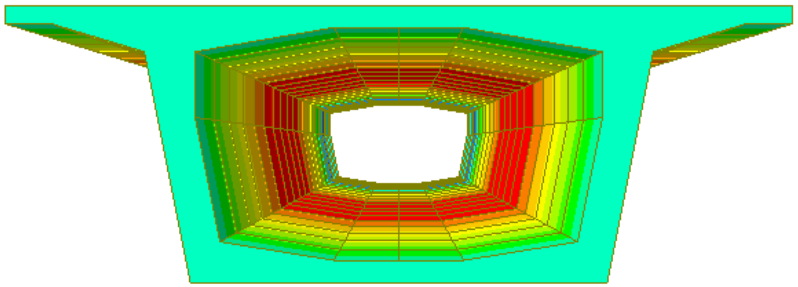
$$A = v_{tmin}/v_t$$

If $v_t > v_{tmin}$,

$$A_1 = v_{tu}/(v + v_t)$$

$$A_2 = T_u/T$$

$$A = \min(A_1, A_2)$$

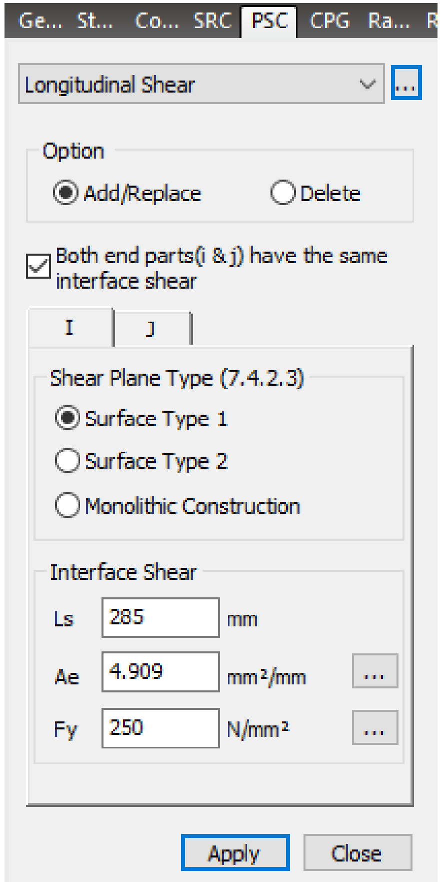


Prestressed Box Girder

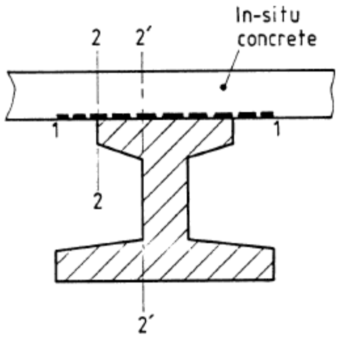
3. Improvement of Prestressed Girder Design to BS 5400: Longitudinal Shear

- Longitudinal shear force per unit length of a composite member is calculated at the interface of the precast unit and the in situ concrete.

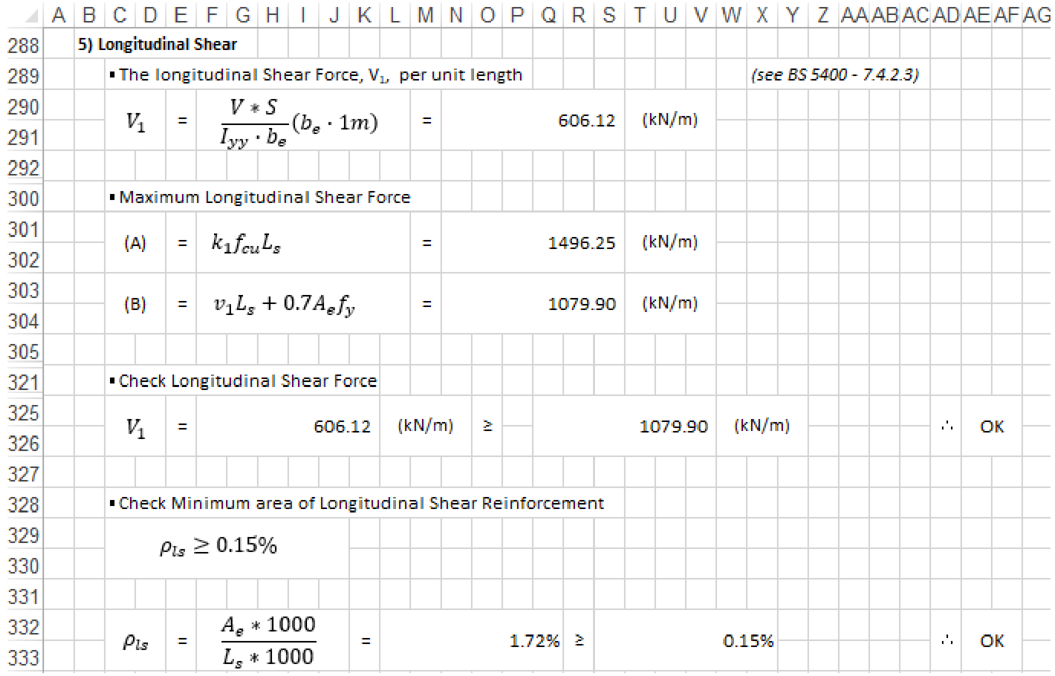
- ***PSC > Design Parameter > BS 5400***



Longitudinal Shear Parameter



Potential shear plane	Longitudinal shear check
1-1	Supported
2-2	Not supported
2'-2'	Not supported



5) Longitudinal Shear

- The longitudinal Shear Force, V_1, per unit length (see BS 5400 - 7.4.2.3)

$$V_1 = \frac{V * S}{I_{yy} \cdot b_e}(b_e \cdot 1m) = 606.12 \text{ (kN/m)}$$

- Maximum Longitudinal Shear Force

(A) $= k_1 f_{cu} L_s$ = 1496.25 (kN/m)

(B) $= v_1 L_s + 0.7 A_e f_y$ = 1079.90 (kN/m)

- Check Longitudinal Shear Force

V_1 = 606.12 (kN/m) ≥ 1079.90 (kN/m) ∴ OK

- Check Minimum area of Longitudinal Shear Reinforcement

$\rho_{ls} \geq 0.15\%$

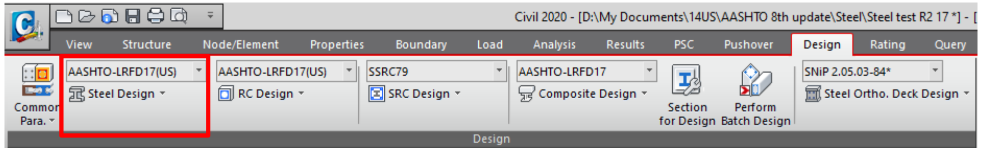
$$\rho_{ls} = \frac{A_e * 1000}{L_s * 1000} = 1.72\% \geq 0.15\%$$ ∴ OK

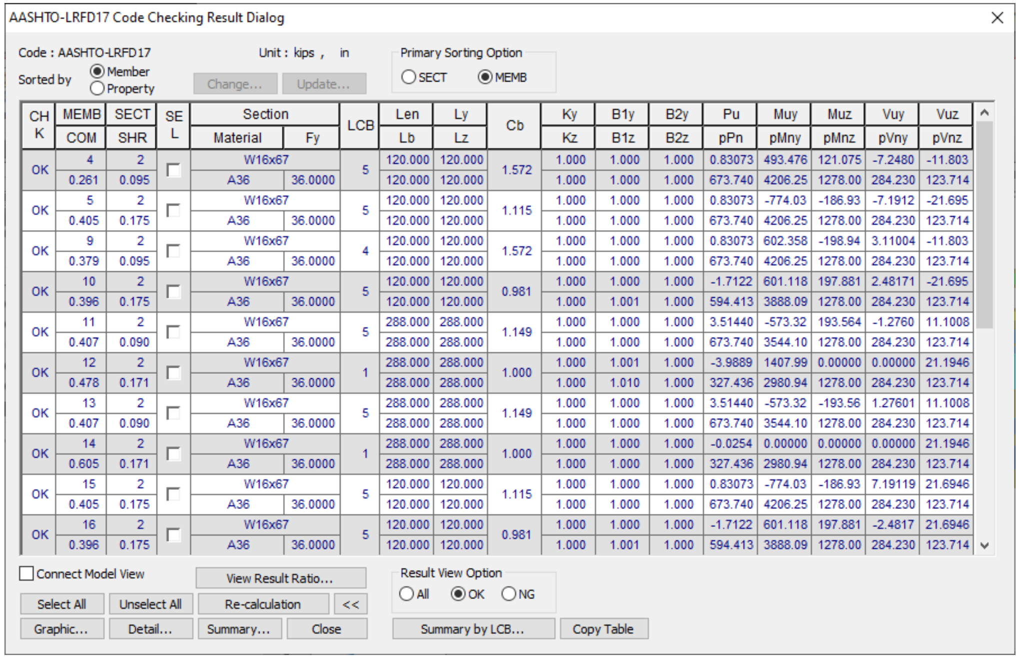
Longitudinal Shear Check Report

4. AASHTO LRFD 8th Design Standard – Steel Section

- New AASHTO LRFD design standard can be applied to steel design. New type of report is provided.
- Steel Section (H or I section, box section (HSS), circular pipe (HSS), T or double angle, channel, single angle, rectangular bar, solid round)

▪ *Design > Steel Design > AASHTO - LRFD 17*





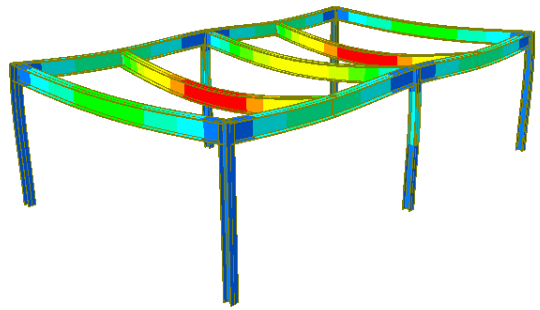
CHK	MEMB / COM	SECT / SHR	SEL	Section / Material	Fy	LCB	Len / Lb	Ly / Lz	Cb	Ky / Kz	B1y / B1z	B2y / B2z	Pu / pPn	Muy / pMny	Muz / pMnz	Vuy / pVny	Vuz / pVnz
OK	4	2	☐	W16x67		5	120.000	120.000	1.572	1.000	1.000	1.000	0.83073	493.476	121.075	-7.2480	-11.803
	0.261	0.095		A36	36.0000		120.000	120.000		1.000	1.000	1.000	673.740	4206.25	1278.00	284.230	123.714
OK	5	2	☐	W16x67		5	120.000	120.000	1.115	1.000	1.000	1.000	0.83073	-774.03	-186.93	-7.1912	-21.695
	0.405	0.175		A36	36.0000		120.000	120.000		1.000	1.000	1.000	673.740	4206.25	1278.00	284.230	123.714
OK	9	2	☐	W16x67		4	120.000	120.000	1.572	1.000	1.000	1.000	0.83073	602.358	-198.94	3.11004	-11.803
	0.379	0.095		A36	36.0000		120.000	120.000		1.000	1.000	1.000	673.740	4206.25	1278.00	284.230	123.714
OK	10	2	☐	W16x67		5	120.000	120.000	0.981	1.000	1.000	1.000	-1.7122	601.118	197.881	2.48171	-21.695
	0.396	0.175		A36	36.0000		120.000	120.000		1.000	1.001	1.000	594.413	3888.09	1278.00	284.230	123.714
OK	11	2	☐	W16x67		5	288.000	288.000	1.149	1.000	1.000	1.000	3.51440	-573.32	193.564	-1.2760	11.1008
	0.407	0.090		A36	36.0000		288.000	288.000		1.000	1.000	1.000	673.740	3544.10	1278.00	284.230	123.714
OK	12	2	☐	W16x67		1	288.000	288.000	1.000	1.000	1.001	1.000	-3.9889	1407.99	0.00000	0.00000	21.1946
	0.478	0.171		A36	36.0000		288.000	288.000		1.000	1.010	1.000	327.436	2980.94	1278.00	284.230	123.714
OK	13	2	☐	W16x67		5	288.000	288.000	1.149	1.000	1.000	1.000	3.51440	-573.32	-193.56	1.27601	11.1008
	0.407	0.090		A36	36.0000		288.000	288.000		1.000	1.000	1.000	673.740	3544.10	1278.00	284.230	123.714
OK	14	2	☐	W16x67		1	288.000	288.000	1.000	1.000	1.000	1.000	-0.0254	0.00000	0.00000	0.00000	21.1946
	0.605	0.171		A36	36.0000		288.000	288.000		1.000	1.000	1.000	327.436	2980.94	1278.00	284.230	123.714
OK	15	2	☐	W16x67		5	120.000	120.000	1.115	1.000	1.000	1.000	0.83073	-774.03	-186.93	7.19119	21.6946
	0.405	0.175		A36	36.0000		120.000	120.000		1.000	1.000	1.000	673.740	4206.25	1278.00	284.230	123.714
OK	16	2	☐	W16x67		5	120.000	120.000	0.981	1.000	1.000	1.000	-1.7122	601.118	197.881	-2.4817	21.6946
	0.396	0.175		A36	36.0000		120.000	120.000		1.000	1.001	1.000	594.413	3888.09	1278.00	284.230	123.714

Design Result Table

▪ Member Design Detail Report AASHTO-LRFD 2017

1. Member Information

- Member : 4



2. Material

(1) Material Name : A36
(2) F_y : 36.00ksi
(3) E_s : 29,000ksi

3. Length

(1) L_y : 10.00ft
(2) L_z : 10.00ft
(3) L_b : 10.00ft
(4) K_y : 1.000
(5) K_z : 1.000

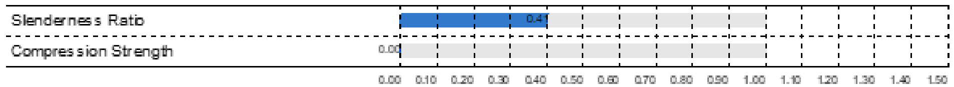
4. Section

(1) Shape : W16x67 (Rolled)
(2) Section Property

A_s	A_{sy}	A_{sz}	Y_{bar}	Z_{bar}
19.70in²	11.34in²	6.450in²	5.117in	8.165in
S_y	S_z	Z_y	Z_z	J
117in³	23.20in³	130in³	35.50in³	2.390in⁴
r_y	r_z	I_y	I_z	I_{yz}
6.960in	2.460in	954in³	119in³	0.000in⁴

5. Check Axial Strength

Category	Value	Criteria	Ratio	Note
Slenderness Ratio	48.78	120	0.407	
Compression Strength (kip)	0.710	594	0.00120	



Word Format Design Report

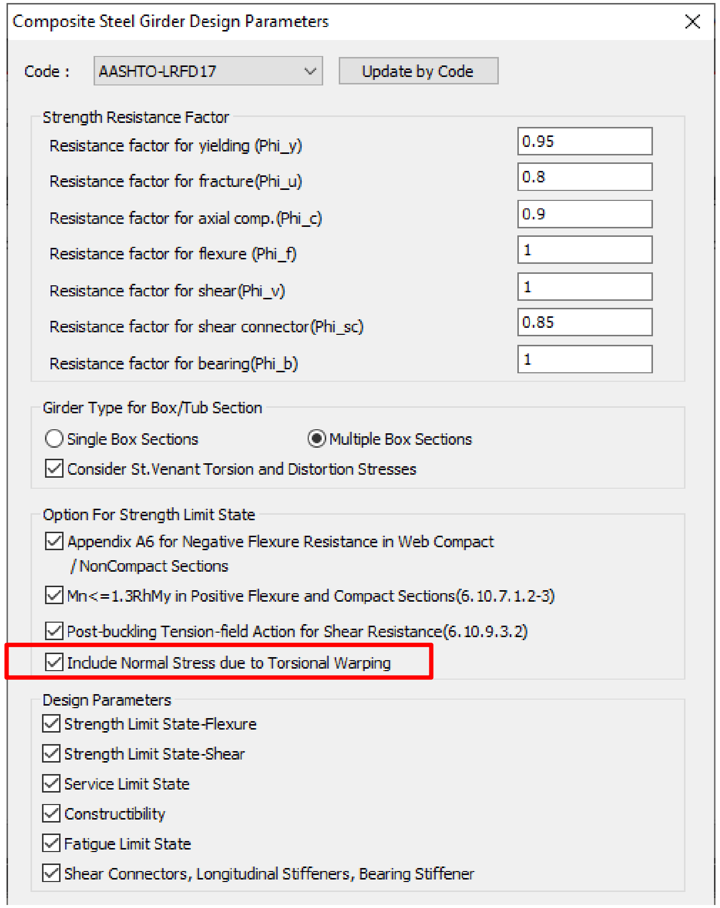
5. Warping Normal Stress for Steel Composite Section Design to AASHTO LRFD

- Normal stress due to restrained warping can be introduced in the design of steel composite section to AASHTO LRFD 17.
- 7th dof option from the Section dialog box and warping normal stress option from the Design Parameter dialog box should be checked on.

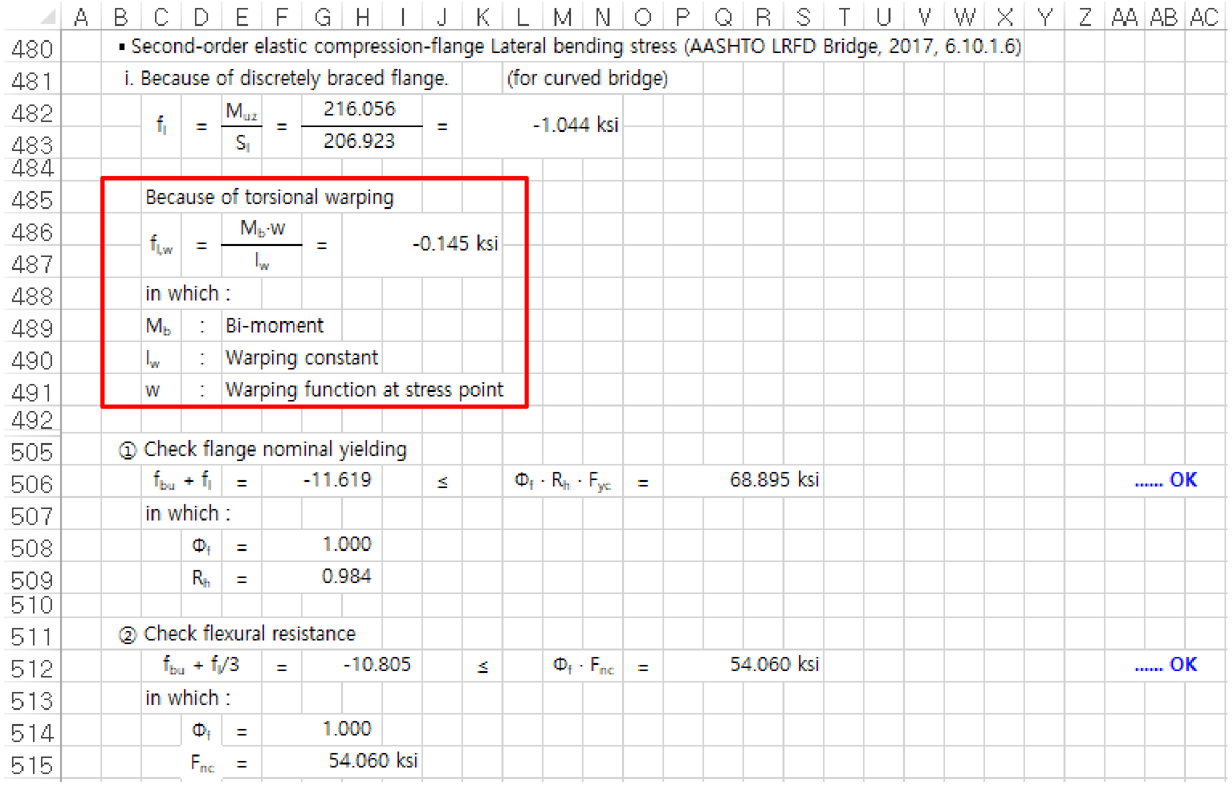
▪ ***Design > Composite Design > AASHTO LRFD 17***

$$\sigma_{xx} = \frac{N}{A} + \frac{M_y}{I_y} z - \frac{M_z}{I_z} y + \frac{B}{C_w} \Psi$$

B: Bi-moment
Ψ: Warping function
C_w: Warping constant



Composite Steel Girder Design Parameter



Design Report

6. Bug fix list

1. [Tendon re-tension] For the re-tension of tendon, relaxation losses are incorrectly calculated. When one tendon among multiple cables in a beam is re-tensioned, stresses in the other tendons are displayed as zero in the Tendon Loss table.

2. While using the standard vehicle from AS5100.2- Heavy Load Platform (Both HLP320 PR HLP400), program gives this error: "ERROR IN READ MODEL DATA : R_MOVE_AUST"

3. Analysis stopped with the error message below when the model included 7 dof of composite section, nonlinear point spring support and moving load analysis.

[WARNING] DISK SPACE IS NOT SUFFICIENT OR FILE ACCESS IS NOT ALLOWED BY ANTIVIRUS.
PLEASE, CHECK DISK SPACE OR ANTIVIRUS PROGRAM OPTIONS

ERRORS ENCOUNTERED. MIDAS JOB TERMINATED. REFER TO .OUT FILE
----

4. Analysis stopped while moving load optimization was performed for the BD 37/01.

5. [Moving Load Analysis to Eurocode]

- Tracer Results were not matching with moving load analysis results. This was happening when there were two moving load cases with railway vehicles, one with Dynamic Allowance Factor and another without Dynamic Allowance Factor.

- Incorrect centrifugal forces from moving load tracer for the LM 71 train load. This was happening when the lanes were defined with the 'Lane Element' method.

6. Bug fix list

6. Analysis stopped with the following error message when point spring supports were used in the construction stage Non-linear analysis. This was happening when some components of point spring supports were fixed.

Spring Element Property is not Proper.

7. [Moving load analysis to CS 454]

- While performing moving load optimization with ALL Model 1, the uniformly distributed load was not applied in the remaining area. Even in this release, the moving load optimization function does not take into account the remaining area for UDL which needs to be defined separately by the user.
- When performing moving load optimization, the Moving Load Tracer crashed when trying to view the results for two different load cases at the time of the second load case.
- When performing moving load optimization for the combined ALL Model 2 and SV 196, SV 196 was not applied when the lane width was smaller than 2.65 m which corresponded to vehicle width.
- The difference in the results between Moving Load Tracer and converted static loads for the combined ALL Model 2 and HB: This was happening when HB load was defined using user-defined vehicle and the unit of HB was other than 30.

8. [Moving load analysis to Polish code] When there were more than one moving load case for optimization, the results of the second moving load case were wrong.

9. [Beam Section Temperature] The analysis results were wrong when Beam Section Temperature load was applied to Composite PSC section (Composite-I, Composite-T, Composite-PSC).

6. Bug fix list

10. [Inelastic time history analysis]

- Initial axial force of PM Multi-Curve hinge was not properly saved and thus the associated hinge reached failure status unexpectedly.

- Time history analysis was running very slow. The analysis was stuck at 13% and not moving ahead.

11. [GSD]

- The area of rebars shown on the corner of bottom-right side was incorrect for a huge section.
- Yield moment at axial force = 0 was shown as zero when hinge property was imported from midas GSD. This was happening when moment-curvature calculation was not converged for a very large size of section.

12. [Steel Composite Girder Design to Eurocode] When trying to define longitudinal stiffeners for the composite-general section, the program gives the following error message.

Can't Find DgnBaseManager.dgne