

Release Note

Release Date : Oct. 07, 2021

Product Ver. : Civil 2022 (v1.1)



DESIGN OF CIVIL STRUCTURES

Integrated Solution System for Bridge and Civil Engineering

Enhancements

1. UK CS 454 Bridge Assessment for Steel Composite Girder
2. UK High-Speed Train Loads Database for Train Load Generator
3. Train Load Generator Time Forcing Function Improvement
4. AS 5100.5:17 Update for midas GSD
5. Italy NTC 2018 RS function
6. Auto-generation of Beam Section Temperature Loads (AASHTO, Eurocode, Australia)
7. Load Rating LRFR 2019 Update to AASHTO MBE 3rd edition
8. Traffic Load AK, N11 Update to Russia Standard
9. Longitudinal Stiffener Input Measured from Bottom of Steel Composite Girder



1. UK CS 454 Bridge Assessment for Steel Composite Girder

- Steel composite girder assessment to CS 454 and CS 457 has been added.

- **Rating > Steel Bridge > CS 454/20**

Design Manual for Roads and Bridges



Llywodraeth Cymru
Welsh Government



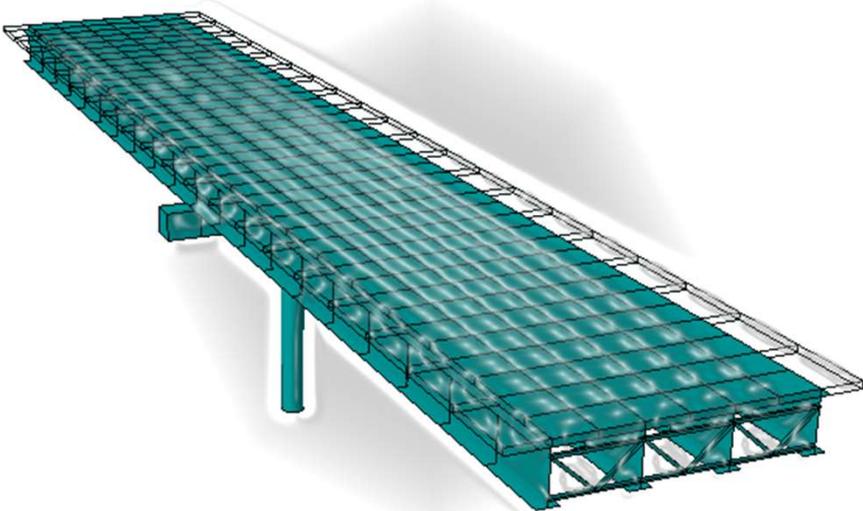
Highway Structures & Bridges
Inspection & Assessment

CS 457

The assessment of composite highway bridges and structures

(formerly BD 61/10)

Revision 1



1. UK CS 454 Bridge Assessment for Steel Composite Girder

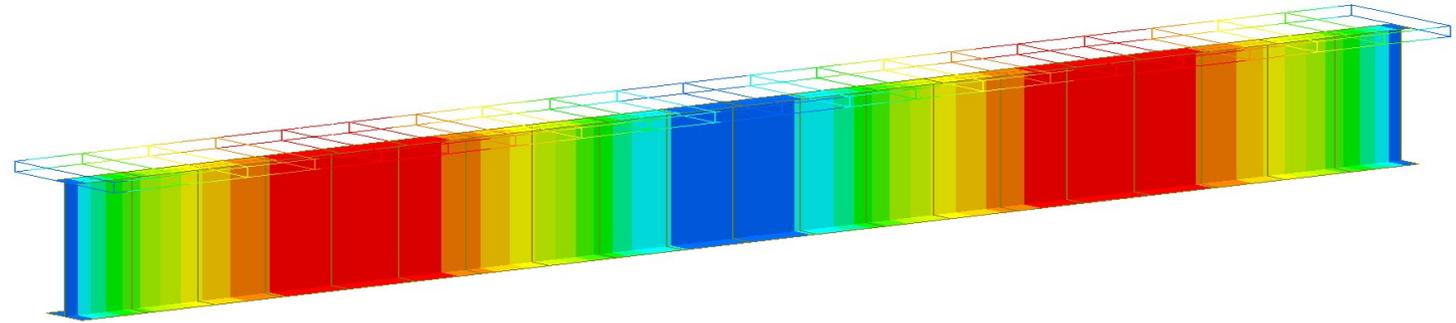
- Level 1 assessment can be performed now for the **steel composite girders** in midas Civil.
- Assessment load combinations can be defined to obtain output for strength & service limit states.

Rating > Steel Bridge > CS 454/20

CS454/20 AASHTO-LRFR1

Steel Bridge PSC Bridge

- Design Code for Assessment...
- Assessment Code Parameters...
- Modify Composite Material...
- Load Combinations for Assessment...
- Longitudinal Reinforcement...
- Transverse Stiffener...
- Web Panel Assignment...
- Shear Connector...
- Laterally Unbraced Length...
- Effective Breadth by Shear Lag...
- Serviceability Parameter...
- Section for Assessment Check...
- Section for Assessment Report...
- Rating Design Tables
- Perform Rating Design
- Rating Report Print...
- Rating Design Result Tables



Assessment Parameter

Condition Factor(Fc)

Material Strength used for Assessment

Characteristic Strength

Worst Credible Strength

User Input

Ultimate Limit State

Flexure

Shear

Flexure & Shear & Torsion for Box Girders with Longitudinal Stiffeners

Longitudinal Shear

Serviceability Limit State

Stress Longitudinal Shear

Detailed Report

Ultimate Limit State

Serviceability Limit State

Define Assessment Case

Load Combination

Name	Limit State	Comb. Type	Description
ULS1	ULS	Comb1	
ULS2	ULS	Comb2	
ULS3	ULS	Comb3	
ULS4	ULS	Comb4	
SLS1	SLS	Comb1	
SLS2	SLS	Comb2	
SLS3	SLS	Comb3	
SLS4	SLS	Comb4	
*			

Static Load Cases and Factors(Gamma_{fl})

Static Load Cases	Factor
Dead Load(CS)	1.0500
SW_conc(CS)	1.1500
SDL_surface(CS)	1.7500
SDL_other(CS)	1.2000
*	

Moving Load Cases and Factors(Gamma_{fl})

Auto MVL Case ULS1(MV)

Other MVL Case

Assessment Input

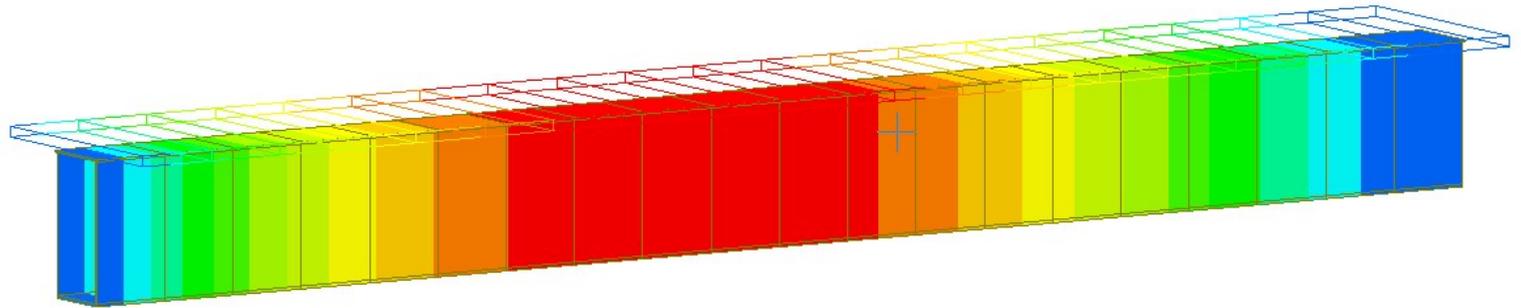
Assessment Parameters

Load Combination for Assessment

1. UK CS 454 Bridge Assessment for Steel Composite Girder

- Assessment can be performed depending on section types such as plate girders and box girders. (Note: Box girder assessment will not be included in this release.)
- Stiffeners in the transverse and longitudinal direction, web panels, shear connectors can be defined.

Rating > Steel Bridge > CS 454/20



Web Panel Assignment

Option
 Add/Replace Delete

Web Panel
 Allow Single Element Panel

Idx	Elem. List
1	1, 2
3	3, 4
5	5, 6
7	7, 8
9	9, 10
11	11, 12
13	13, 14
15	15, 16
17	17, 18
19	19, 20
21	21, 22
23	23, 24
25	25, 26
27	27, 28
29	29, 30
31	31, 32
33	33, 34
35	35, 36
37	37, 38

Apply Close

Web Panel Assignment

Section Manager

Mode: Transverse Stiffener

Target Section & Element: Section : 1, 1-Box

Grid: 0.1 m

Some Stiffeners Data at I & J-end

Transverse Stiffener: Web Tee

Bearing Stiffener: Bearing Flat

Stiffener Type: Tee

Transverse Stiffener: One stiffener Two stiffener

Fv: 355000 kN/m²

Pitch: 3.5 m

H: 0.3061 m

B: 0.3048 m

tw: 0.0118 m

tf: 0.0197 m

Apply Close

Transverse Stiffeners

Section Data

Section ID: 1 Name: Box

Section Type: Steel-Box (T)

Slab: Bc: 5.45, tc: 0.23, Bf: 0.12, Hf: 0.045, Bf3: 0, Hf3: 0

Girder: Hw: 3.09, B1: 1.56, B2: 1.56, B3: 0, Bf: 0.12, Hf: 0.045, Bf3: 0, Hf3: 0

Material: Select Material From

Stiffener Properties: Name: T, Type: Tee

Stiffener Position: Both

N Left: 2, N Right: 2, N Bottom: 0, N Top: 0

C	d (m)	Stiffener									
<input checked="" type="checkbox"/>	1.862	T	<input checked="" type="checkbox"/>	1.862	T	<input checked="" type="checkbox"/>	0.81	T	<input checked="" type="checkbox"/>	0.81	T

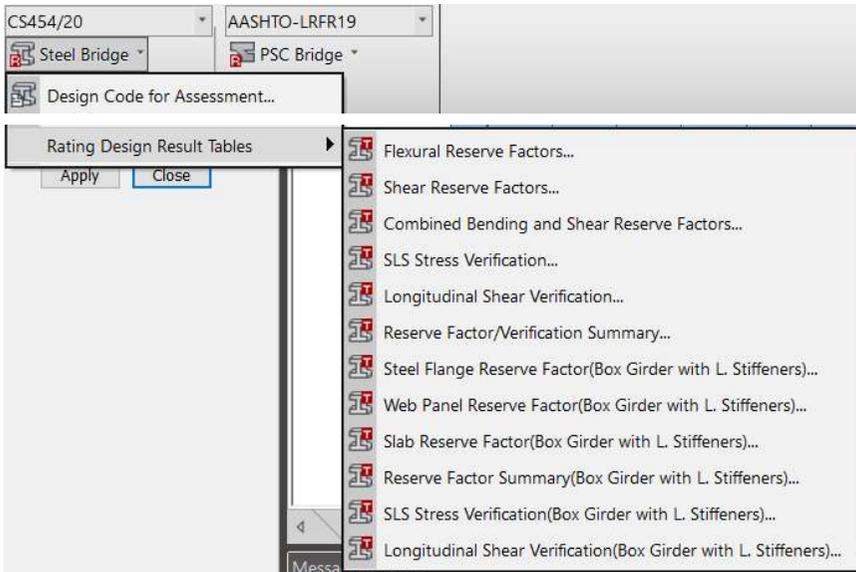
Show Calculation Results... OK Cancel

Longitudinal Stiffeners

1. UK CS 454 Bridge Assessment for Steel Composite Girder

- Assessment results can be viewed in tabular format in midas Civil itself and these can be exported to excel file as well.
- Both summary and detailed report are provided for the bending, shear, combined bending and shear, longitudinal shear checks and service limit state.

Rating > Steel Bridge > CS 454/20



Assessment Result Tables

Element	Part	Rating Case	Comp./Tens.	Sig_yf (N/mm²)	Sig_f_SV (N/mm²)	Tau_SV (N/mm²)	Sig_f_DL (N/mm²)	Tau_DL (N/mm²)	Sig_f_ST (N/mm²)	Tau_ST (N/mm²)	A	Psi	Psi*	Check
10	[10]	ULS1_Fxx(Max)	-	0.0000	0.0000	2078105	0.0000	0.0000	0.0000	0.0000	0.0000	-	-	NG
10	[10]	ULS1_Fyy(Max)	-	7.6313	0.0000	0.0000	6.5929	0.0000	0.0000	0.0000	1000000	1000000	1000000	OK
10	[10]	ULS1_Fyy(Min)	-	7.6313	0.0000	0.0000	6.5929	0.0000	0.0000	0.0000	1000000	1000000	1000000	OK
10	[10]	ULS1_Fzz(Max)	-	7.6313	-28.5044	0.0000	-23.6392	0.0000	-4.7813	0.0000	1000000	1000000	1000000	OK

Element	Part	Section Type	Rating Case	Load Effect	RA* (kN.m)	S* (kN.m)	SD* (kN.m)	SST* (kN.m)	SA* (kN.m)	A	Psi	Psi*	Check
10	J[11]	Compact	ULS1_Fxx(Max)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Fxx(Min)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Fyy(Max)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Fyy(Min)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Fzz(Max)	Negative	7713.604	-2392.26	-393.340	-2754.93	-3148.27	2.4501	-	-	OK
10	J[11]	Compact	ULS1_Fzz(Min)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Mxx(Max)	Negative	7713.604	-1279.73	-393.340	-1664.86	-2068.20	3.7477	-	-	OK
10	J[11]	Compact	ULS1_Mxx(Min)	Negative	7713.604	-1279.73	-393.340	-1664.86	-2068.20	3.7477	-	-	OK
10	J[11]	Compact	ULS1_Myy(Max)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Myy(Min)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Mzz(Max)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK
10	J[11]	Compact	ULS1_Mzz(Min)	Negative	7713.604	0.0000	-393.340	0.0000	-393.340	19.6105	1000000	1000000	OK

Tabular Output in midas Civil

1. Design Condition

Design code	Element	Part(Node)
CS454/20	8	I(8)

2. Assessment factors
The following factors, as in CS 454, have been used to compare results of different configurations and combinations.

Adequacy factor:

$$A = \frac{R_a^*}{S_a^*}$$

Special Vehicle reserve factor ψ :

$$\psi = \frac{R_a^* - (S_D^* + S_{ST}^*)}{S_a^*}$$

3. Flexural Reserve Factors

Assessment Case	Load Effect	R _a * (kN.m)	S* (kN.m)	S _D * (kN.m)	S _{ST} * (kN.m)	S _a * (kN.m)	A	ψ	ψ*	Check
ULS1_Fxx(Max)	Negative	7818.638	0.0000	-393.340	0.0000	-393.340	19.878	-	-	OK
ULS1_Fxx(Min)	Negative	7818.638	0.0000	-393.340	0.0000	-393.340	19.878	-	-	OK

4. Shear Reserve Factors

Assessment Case	R _a * (kN)	S* (kN)	S _D * (kN)	S _{ST} * (kN)	S _a * (kN)	A	ψ	ψ*	Check	
ULS1_Fxx(Max)	-	-	-	-	-	-	-	-	-	OK
ULS1_Fxx(Min)	7720.152	0.0000	201.277	0.0000	201.277	38.356	-	-	-	OK

5. Combined Bending and Shear Reserve Factors

Assessment Case	M _D (kN.m)	M _f (kN.m)	V _D (kN)	V _R (kN)	M _{SV} (kN.m)	V _{SV} (kN)	M _{DL} (kN.m)	V _{DL} (kN)	M _{ST} (kN.m)	V _{ST} (kN)	A	ψ	ψ*	Check
ULS1_Fxx(Max)	6769.383	6769.383	7720.152	7720.152	0.0000	0.0000	-322.941	NG	0.0000	0.0000	0.058	-	-	OK
ULS1_Fxx(Min)	6769.383	6769.383	7720.152	7720.152	0.0000	0.0000	-322.941	NG	0.0000	0.0000	0.058	-	-	OK

Where:
R_a* : the as
S_a* : the as

6. Longitudinal Shear Verification

Assessment Case	q (kN/m)	P _m (kN)	P _a (kN)	q _r (kN/m)	q/q _r	(q/q _r) _{lim}	Check
ULS1_Fzz(Max)	0.032	125.000	82.642	0.248	0.065	1.000	NG
ULS1_Fzz(Min)	-	-	-	-	-	-	-
ULS1_Fyy(Max)	0.032	125.000	82.642	0.248	0.065	1.000	NG
ULS1_Fyy(Min)	0.032	125.000	82.642	0.248	0.065	1.000	NG
ULS1_Fzz(Max)	0.578	125.000	82.642	0.248	1.166	1.000	NG
ULS1_Fzz(Min)	0.255	125.000	82.642	0.248	0.513	1.000	NG
ULS1_Mxx(Max)	0.351	125.000	82.642	0.248	0.708	1.000	NG
ULS1_Mxx(Min)	0.077	125.000	82.642	0.248	0.156	1.000	NG
ULS1_Myy(Max)	0.077	125.000	82.642	0.248	0.155	1.000	NG
ULS1_Myy(Min)	0.162	125.000	82.642	0.248	0.327	1.000	NG
ULS1_Mzz(Max)	0.032	125.000	82.642	0.248	0.065	1.000	NG
ULS1_Mzz(Min)	0.032	125.000	82.642	0.248	0.065	1.000	NG

Excel Report Output

2. UK High-Speed Train Loads Database for Train Load Generator

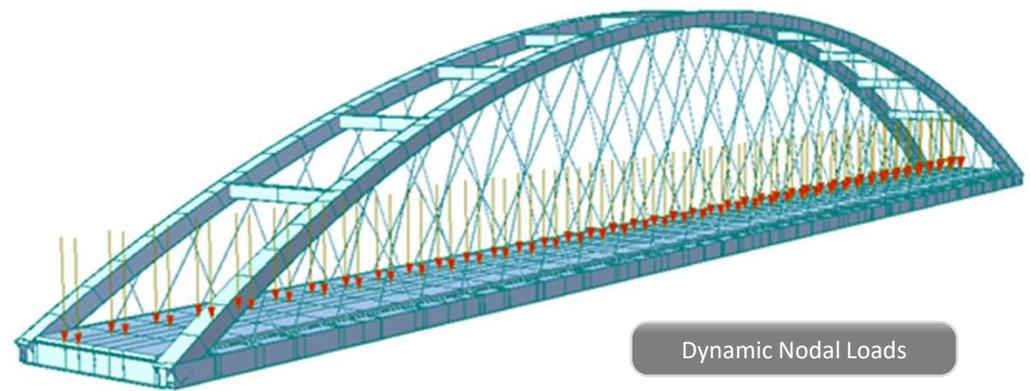
- UK high-speed train loads database are available in the Train Load Generator.
- UK Vehicle data is provided as per the clause of UK HS2.

▪ **Load > Dynamic Loads > Time History Analysis Data > Train Load Generator > Vehicle Code - UK**

No	Length(m)	Force(kN)
1	0,000	177,000
2	2,800	177,000
3	8,200	177,000
4	2,800	177,000
5	4,500	111,000
6	13,140	215,000
7	13,100	209,000
8	13,100	216,000
9	13,100	222,000
10	13,100	222,000
11	13,100	214,000
12	13,100	214,000
13	13,100	222,000
14	13,100	222,000
15	13,100	222,000
16	13,100	228,000
17	13,140	117,000
18	4,500	177,000
19	2,800	177,000
20	8,200	177,000
21	2,800	177,000

Train Load Generator

Vehicle Code & Type

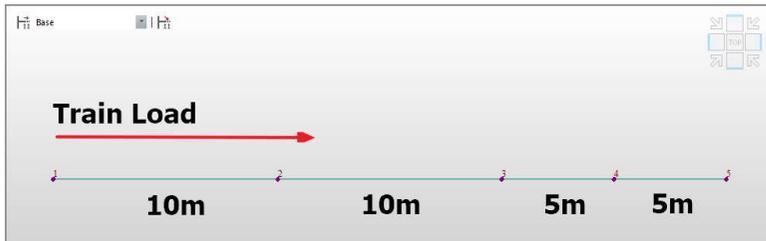


Dynamic Nodal Loads

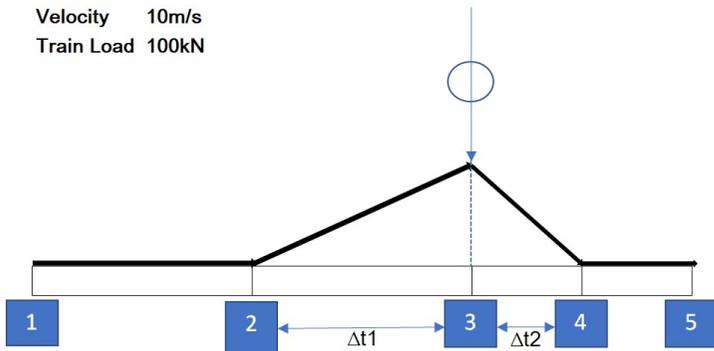
3. Train Load Generator Time Forcing Function Improvement

- Time-history function is improved for the nodes which have different distances between nodes.
- Time-history function is also improved for the first node and the last node of the track.

▪ **Load > Dynamic Loads > Train Load Generator**



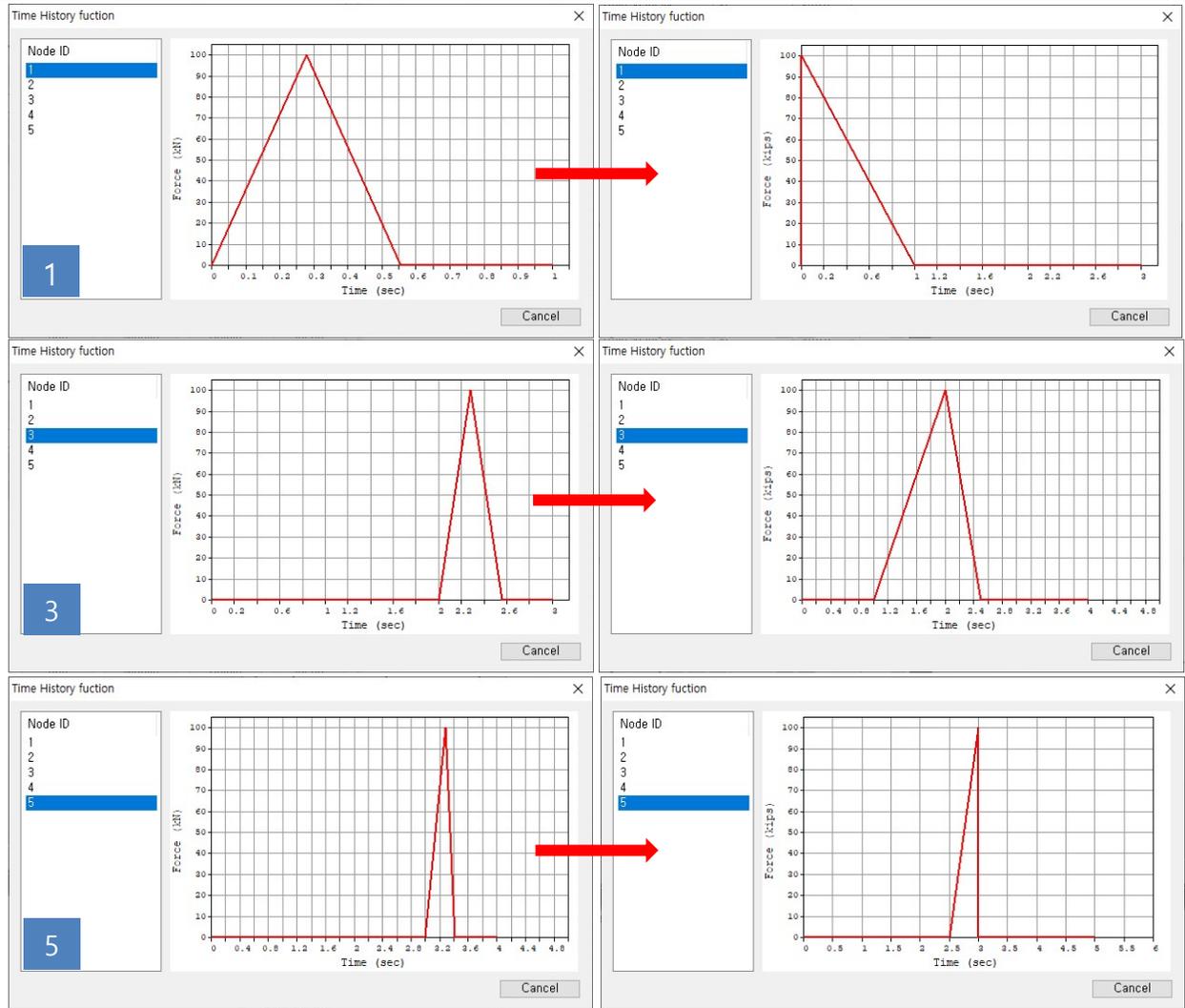
Velocity 10m/s
Train Load 100kN



$$\Delta t1 = (\text{distance between node 2 to 3}) / (\text{velocity})$$

$$\Delta t2 = (\text{distance between node 3 to 4}) / (\text{velocity})$$

Generation of time-history function



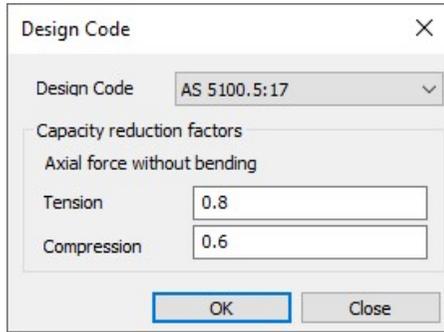
Civil 2021 v1.1

Civil 2022 v1.1

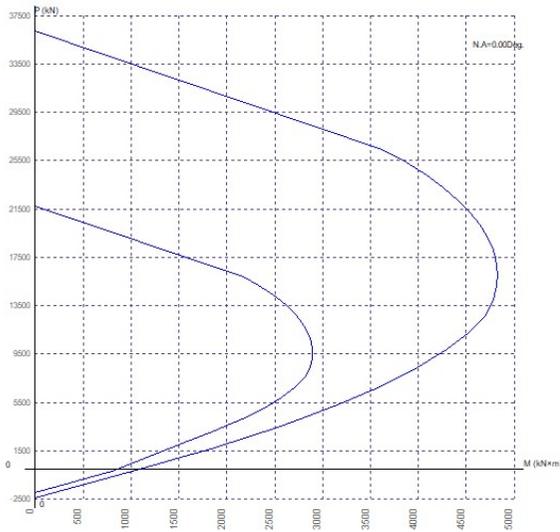
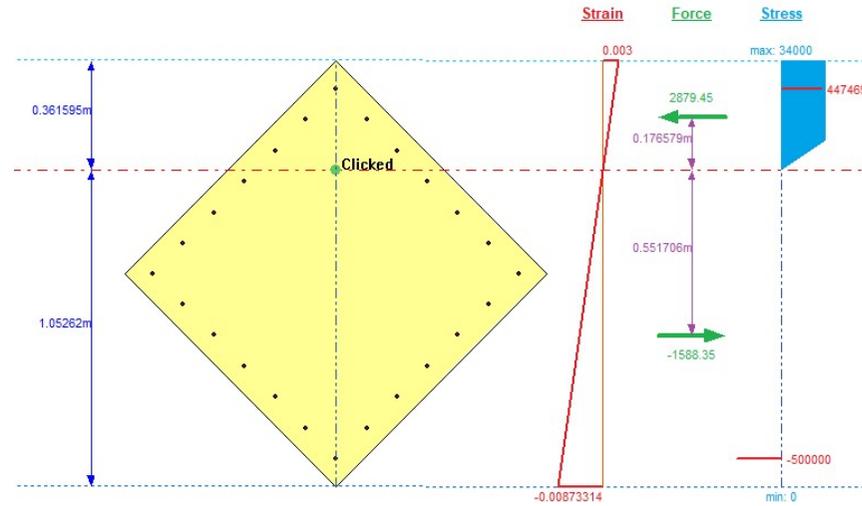
4. AS 5100.5:17 Update for midas GSD

- Factored & unfactored P-M curve, M-M curve and stress contours based on AS 5100.5:17 can now be generated in midas GSD.
- Accurate M-M curve calculations with incremental NA rotation is adopted as it could be used for any section shape. This is preferred over traditional empirical approach in the code.

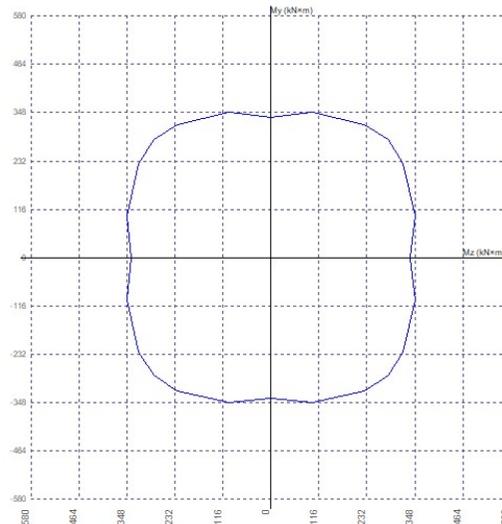
▪ **Load > Temp./Prestress > Tendon Prestress**



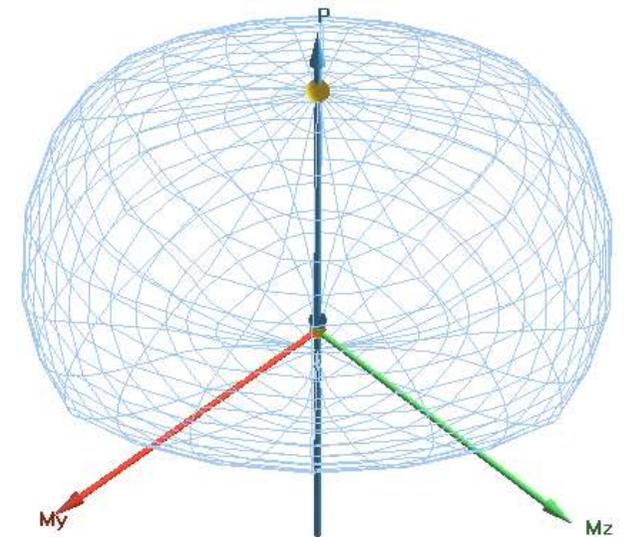
Design Code & Reduction Factors



Factored & Unfactored P-M Curve



M-M Curve using Incremental NA Rotation



5. Response Spectrum Function: Italy NTC 2018

- Response spectrum function as per Italy NTC 2018 has been added.

▪ **Load > Dynamic Loads > RS Functions**

Add/Modify/Show Response Spectrum Functions

Function Name: NTC2018 H-ELASTIC

Import File: **Design Spectrum**

	Period (sec)	Spectral Data (g)
1	0.0000	0.0800
2	0.0250	0.1100
3	0.0500	0.1400
4	0.0750	0.1700
5	0.1000	0.2000
6	0.1250	0.2000
7	0.1500	0.2000
8	0.1750	0.2000
9	0.2000	0.2000
10	0.2250	0.2000
11	0.2500	0.2000
12	0.2750	0.2000
13	0.3000	0.2000
14	0.3250	0.1846

Spectral Data Type: Normalized Accel. Acceleration Velocity Displacement

Scaling: Scale Factor: 1 Maximum Value: 0 g

Gravity: 9,806 m/sec² Damping Ratio: 0,05

Graph Options: X-axis log scale Y-axis log scale

Description: NTC2018 H-ELA: G=A,S=1,00,Tb=0,10,Tc=0,30,Td=1,92,ag=0,08g,Fo=2,5,Tc+=0,30,Damping=5,00

Buttons: OK, Cancel, Apply

Response Spectrum Functions

Generate Design Spectrum

Design Spectrum : NTC2018

Spectrum Type: Horizontal Elastic Spectr

Ground Type: A

Spectrum Parameters: T1 T2 T3 T4 User Defined

Soil Factor (S)	Tb	Tc	Td
1	0,1	0,3	1,92

Maximum Horizontal Acc. (ag): 0,08 g

Amplification Factor (Fo): 2,5

Period of constant Hor. Acc. (Tc*): 0,3

Viscous Damping Ratio (xi): 5 %

Max. Period: 2,5 (Sec)

Buttons: OK, Cancel

Design Spectrum inputs

6. Auto-generation of Beam Section Temperature Loads (AASHTO, Eurocode, Australia)

- Auto definition of the temperature gradient for PSC and Steel composite girders as per AASHTO LRFD 2020.
- Applicable for sections defined from PSC, Composite tab (not applicable for SPC and Value type sections).

▪ Load > Temp/Prestress> Beam Section Temperature > AASHTO LRFD 2020

Beam Section Temperatures

Load Case Name

Load Group Name

Options

Section Type

Apply by Code Provision

Beam Section Temperature

Define Code Provision

Define Code: AASHTO LRFD 2020

Section Type: PSC

Temperature Gradient: Positive Negative

T1: 54 [T] T2: 14 [T]

T3: 5 [T]

A: Auto User: 12 in

OK Cancel

Auto Option as per Code Provision

6. Auto-generation of Beam Section Temperature Loads (AASHTO, Eurocode, Australia)

- Auto definition of the temperature gradient for PSC and Steel composite girders as per Eurocode.
- Applicable for section defined from PSC, Composite tab (not applicable for SPC and Value type sections).

▪ Load > Temp/Prestress > Beam Section Temperature > Eurocode

Beam Section Temperatures

Load Case Name

Load Group Name

Options

Section Type

Apply by Code Provision

Beam Section Temperature

Define Code Provision

Define Code: EUROCODE

Section Type: PSC

Temperature Gradient: Heating

T1: 13 [T] T2: 3 [T]

T3: 2,5 [T]

h1: Auto

h2: Auto

h3: Auto

surfacing depth in metres
(for thin slabs, h₃ is limited by h - h₁ - h₂)

h	ΔT ₁	ΔT ₂	ΔT ₃
m			°C
≤ 0.2	8.5	3.5	0.5
0.4	12.0	3.0	1.5
0.6	13.0	3.0	2.0
≥ 0.8	13.0	3.0	2.5

Auto Option as per Code Provision

6. Auto-generation of Beam Section Temperature Loads (AASHTO, Eurocode, Australia)

- Auto definition of the temperature gradient for PSC and Steel composite girders as per AS 5100.
- Applicable for section defined from PSC, Composite tab (not applicable for SPC and Value type sections).

▪ Load > Temp/Prestress> Beam Section Temperature > AS 5100

Beam Section Temperatures

Load Case Name

Load Group Name

Options

Section Type

Apply by Code Provision

Beam Section Temperature

Define Code Provision

Define Code AS 5100

Section Type PSC

Temperature Gradient Positive

T1 20 [T] T2 5 [T]

h2 200 mm

OK Cancel

Auto Option as per Code Provision

6. Auto-generation of Beam Section Temperature Loads (AASHTO, Eurocode, Australia)

- The AS 5100 standard has different temperature distributions between the shaded area and other area of the top slab of the PSC sections, but in this function, the temperature distribution of other area is applied to the whole area of the top slab.
- It is recommended to use the General Section Type in Beam Section Temperatures to apply the temperature distribution of the shaded area.

Load > Temp/Prestress > Beam Section Temperature > General Type

Tree Menu
Node Element Boundary Mass Load

Beam Section Temperatures

Load Case Name

Load Group Name
Default

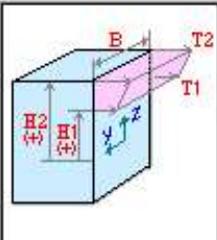
Options
 Add Replace Delete

Section Type
 General PSC/Composite

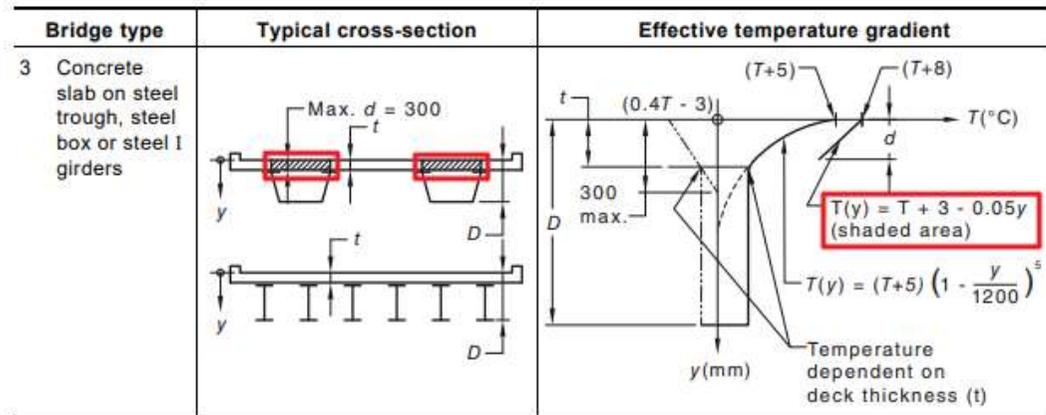
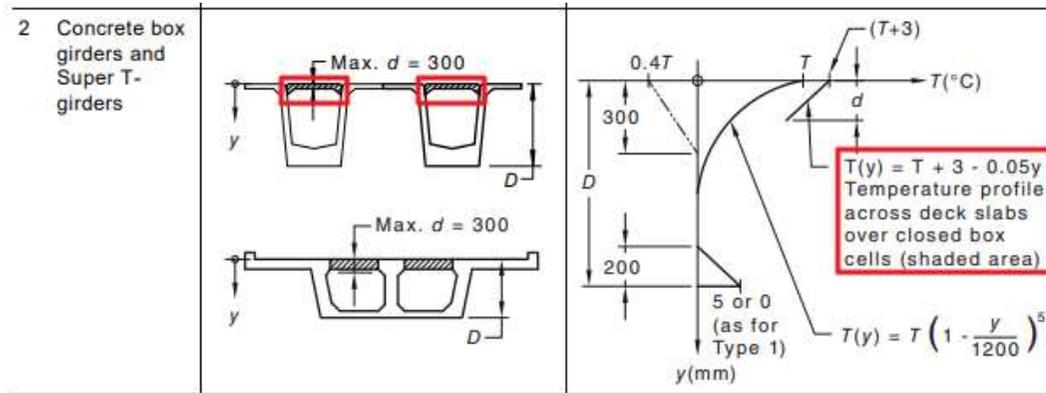
Apply by Code Provision

Direction
 Local-y
 Local-z

Ref. Position
 Centroid
 + End(Top)
 - End(Bot.)



Beam Section Temperature



AS 5100 Standard (PSC/Composite, Steel/Composite)

7. Load Rating LRFR 2019 Update to AASHTO MBE 3rd edition - Steel Composite Girder

- Service, Strength & Fatigue rating are available for steel composite girder based on AASHTO-LRFR19.
- Finite/Infinite life as well as serviceability index could be viewed in the software and the excel report could be referred to for detailed calculations.

Rating > Bridge Rating Design > Steel-Composite Bridge > AASHTO-LRFR19

Steel Bridge Load Rating Parameters

System factor: 1

Strength Limit State

Strength Resistance Factor

Resistance factor for yielding (Phi_y)	0.95
Resistance factor for fracture (Phi_u)	0.8
Resistance factor for axial comp. (Phi_c)	0.9
Resistance factor for flexure (Phi_f)	1
Resistance factor for shear (Phi_v)	1
Resistance factor for shear connector (Phi_sc)	0.85
Resistance factor for bearing (Phi_b)	1

Girder Type for Box/Tub Section

Single Box Sections Multiple Box Sections

Consider St. Venant Torsion and Distortion Stresses

Option For Strength Limit State

Appendix A6 for Negative Flexure Resistance in Web Compact / NonCompact Sections

Mn <= 1.3RnMy in Positive Flexure and Compact Sections(6.10.7.1.2-3)

Post-buckling Tension-field Action for Shear Resistance(6.10.9.3.2)

Service Limit State

Limiting Stresses in Structural Steel

Auto-Calculation User Input

Design Load

Compressive Stress: 0 kN/m²

Tensile Stress: 0 kN/m²

Legal Load / Permit Load

Compressive Stress: 0 kN/m²

Tensile Stress: 0 kN/m²

Fatigue Limit State

Fatigue Life Check

Only infinite fatigue life Infinite and finite fatigue life

Finite Fatigue Life Parameter

Current Age of the Detail, a: 6 Year

Expected Annual Growth Rate of ADTT_SL, g: 0.0075

Average Number of Truck per Day in a Single Lane

(ADTT_SL)limit: 1000 (ADTT_SL)0: 559

Fatigue Serviceability Index

Load Path Factor, G: 0.80 0.90 1.00

Redundancy Factor, R: 0.90 1.00

Important Factor, I: 0.90 0.95 1.00

Application of Diagnostic Test Result

Load Test Measurement: Strain Displacement

Load Rating Parameters – Previous Versions

Steel Bridge Load Rating Parameters

System factor: 1

Strength Limit State

Strength Resistance Factor

Resistance factor for yielding (Phi_y)	0.95
Resistance factor for fracture (Phi_u)	0.8
Resistance factor for axial comp. (Phi_c)	0.9
Resistance factor for flexure (Phi_f)	1
Resistance factor for shear (Phi_v)	1
Resistance factor for shear connector (Phi_sc)	0.85
Resistance factor for bearing (Phi_b)	1

Girder Type for Box/Tub Section

Single Box Sections Multiple Box Sections

Consider St. Venant Torsion and Distortion Stresses

Option For Strength Limit State

Appendix A6 for Negative Flexure Resistance in Web Compact / NonCompact Sections

Mn <= 1.3RnMy in Positive Flexure and Compact Sections(6.10.7.1.2-3)

Post-buckling Tension-field Action for Shear Resistance(6.10.9.3.2)

Service Limit State

Limiting Stresses in Structural Steel

Auto-Calculation User Input

Design Load

Compressive Stress: 0 kN/m²

Tensile Stress: 0 kN/m²

Legal Load / Permit Load

Compressive Stress: 0 kN/m²

Tensile Stress: 0 kN/m²

Fatigue Limit State

Fatigue Life Check

Only infinite fatigue life Infinite and finite fatigue life

Finite Fatigue Life Parameter

Current Age of the Detail, a: 6 Year

Expected Annual Growth Rate of ADTT_SL, g: 0.0075

Average Number of Truck per Day in a Single Lane

(ADTT_SL)limit: 1000 (ADTT_SL)0: 559

Fatigue Serviceability Index

Load Path Factor, G: 0.80 0.90 1.00

Redundancy Factor, R: 0.90 1.00

Important Factor, I: 0.90 0.95 1.00

Application of Diagnostic Test Result

Load Test Measurement: Strain Displacement

Load Rating Parameters – Civil 2022 v1.1

Tree Menu

Gen... Steel Con... SRC PSC CPG

Fatigue Parameter

Option

Add/Replace Delete

Both end parts(i & j) have the same type

I | J

Category: A

(ADTT)SL: 0

n(cycles): 0

Warping Stress Range

Auto Calculation User Input

Top Flange: 0 kN/m²

Bot. Flange: 0 kN/m²

Fatigue Parameters – Previous Versions

Tree Menu

Ge... St... Co... SRC PSC CPG Ra... Ra...

Fatigue Parameter

Option

Add/Replace Delete

Both end parts(i & j) have the same type

I | J

Num. of Lanes, nL: 0

(ADTT)Present: 0

(ADTTSL)Present: 0

n(cycles): 0

Check Position

Top of Top Flange

Bot. of Top Flange

Top of Bot. Flange

Bot. of Bot. Flange

Category: A

Warping Stress Range

Auto Calculation User Input

Top of Top Flange: 0 kN/m²

Bot. of Top Flange: 0 kN/m²

Top of Bot. Flange: 0 kN/m²

Bot. of Bot. Flange: 0 kN/m²

Fatigue Parameters – Civil 2022 v1.1

7. Load Rating LRFR 2019 Update to AASHTO MBE 3rd edition - Steel Composite Girder

- In earlier versions, just the classification whether the detail had infinite fatigue life or finite fatigue life was available.
- In Civil 2022, if the detail has finite fatigue life, then the minimum, evaluation I, evaluation II & mean fatigue life along with serviceability index are provided with detailed calculations.

Rating > Bridge Rating Design > Steel-Composite Bridge > AASHTO-LRFR19

The image displays several overlapping Excel spreadsheet pages from a 'Rating Excel Report'. The sheets are organized into sections for different stages of the LRFR (Load and Resistance Factor Rating) process:

- 4.2 Finite Fatigue Life:** Contains tables for determining fatigue life type and effective stress range (Δf_{eff}) for finite fatigue life. It includes a table with columns for Position, R_s , and values for Top of Top Flange, Bot of Top Flange, Top of Bot Flange, and Bot of Bot Flange.
- 4.2.1 Minimum Life:** Similar to 4.2, but uses R_R and provides values like 1.300.
- 4.2.2 Evaluation 1 Life:** Similar to 4.2, but uses R_R and provides values like 1.900.
- 4.2.3 Evaluation 2 Life:** Similar to 4.2, but uses R_R and provides values like 1.900.
- 4.2.4 Mean Life:** Contains a table for effective stress range (Δf_{eff}) for finite fatigue life with columns for Position, R_s , R_p , Δf (ksi), and $(\Delta f)_{eff}$ (ksi). It also includes formulas for N_1 based on $ADTT_{SL}$ values.
- Calculate Remaining Fatigue Life Y_{REM} :** Contains a table with columns for Position, N_{av} , N_1 , g , and $ADTT_{SL}$ (LIMIT). It includes a formula for Y_{REM} involving g , N_{av} , and N_1 .
- Calculate Modified Remaining Fatigue Life, $Y_{REM, MOD}$:** Contains a table with columns for Position, Y_{REM} (Year), $ADTT_{SL}$ (LIMIT), $ADTT_{SL}$ (LIMIT), and (Y_{MOD}) . It includes a formula for $Y_{REM, MOD}$.
- Determine Total Fatigue Life, Y:** Contains a table with columns for Position, a (year), $Y_{REM, MOD}$ (year), and Y (year).
- Calculate Fatigue Serviceability Index, Q:** Contains a table with columns for Position, Y (year), a (year), N (year), G, R, I, and Q.

Various mathematical formulas are shown throughout the sheets, such as $N_{av} = \frac{R_R A}{(\Delta f_{eff})^3}$ and $(ADTT_{SL})_{FUTURE} = [(ADTT_{SL})_{PRESENT}](1 + g)^{Y_{REM}}$.

Rating Excel Report

7. Load Rating LRFR 2019 Update to AASHTO MBE 3rd edition - PSC Girder

- PSC/PSC Composite girders could now be rated based on AASHTO-LRFR19.
- In earlier versions, legal & permit load rating were combined. In newer version, these have been separated and stress ratio for reinforcement/tendon is now calculated for permit load rating.
- Tendon Primary load case should not be selected for the load combinations. It is automatically taken into account by the program.

Rating > Bridge Rating Design > PSC Bridge > AASHTO-LRFR19

Define Rating Case

Static Load Combination

Service Limit State Strength Limit State

Load Type	max	min	Load Cases
DC	1.00	1.00	*
DW	1.00	1.00	
Temperature	1.00	1.00	
T. Gradient	1.00	1.00	
Secondary	1.00	1.00	
Permanent	1.00	1.00	
User Defined	1.00	1.00	

Live Load Combination

Live Load Factors for Rating

Primary Vehicle: Case(MV) 1

Adjacent Vehicle: Case(MV) 1

Evaluation Live Load Model

Design Live Load Legal Load / Permit Load

Name of Rating Case: []

Description: []

Name	Limit State	Description
Design	Service	
Legal	Service	
Permit	Service	

Load Rating Case –Previous Versions

Define Rating Case

Static Load Combination

Service Limit State Strength Limit State

Load Type	max	min	Load Cases
DC	1.00	1.00	
DW	1.00	1.00	*
Temperature	1.00	1.00	
T. Gradient	1.00	1.00	
Secondary	1.00	1.00	
Permanent	1.00	1.00	
User Defined	1.00	1.00	

Live Load Combination

Live Load Factors for Rating

Primary Vehicle: MVL 1(MV) 1

Adjacent Vehicle: MVL 1(MV) 0

Evaluation Live Load Model

Design Live Load Legal Load Permit Load

Name of Rating Case: Design

Description: []

Name	Limit State	Description
Design	Service	
Legal	Service	
Permit	Service	

Load Rating Case – Civil 2022 v1.1

3.2 Legal Load Rating

1) Rating Factor

Lcom	Comp. / Tens.	Capacity (ksi)	Dead Load Demand (ksi)	Live Load Demand (ksi)	Rating Factor
Legal	Comp.	24.132	4.144	-0.564	35.427
Legal	Tens.	5.171	4.144	1.862	0.552

Where,

$$R.F = \frac{\text{Capacity} - \text{Dead Load Demand}}{\text{Live Load Demand}}$$

• Measure Type: Strain

Lcom	Comp. / Tens.	ϵ_c / Δ_c (in)	ϵ_t
Legal	Comp.	0.000E+00	1
Legal	Tens.	0.000E+00	1

3.3 Permit Load Rating

Stress Ratio (Girder)

Concurrent force type: FX-MIN

Lcom	Cracked / Uncracked	Rebar / Tendon	Allowable Stress (ksi)	Applied Stress (ksi)	Stress Ratio
Permit	Cracked	Tendon	1378.952	527.412	2.615

Where,

$$\text{Stress Ratio} = \frac{\text{Allowable Stress}}{\text{Applied Stress}}$$

in which:

$\epsilon_c (\Delta_c)$: maximum calculated strain (displ)

$K = 1 + K_s \times K_b$

$K_b = \frac{\epsilon_c}{\epsilon_t} - 1$

Calculate moments in excess of cracking moment.

$$M_{dead} + M_{live} - M_{cr} = -381420.87 \text{ kip-ft} \quad \therefore \text{Cracked}$$

Where,

$M_{dead} = -0.199230098 \text{ kip-ft}$

$M_{live} = -0.022951786 \text{ kip-ft}$

$M_{cr} = 43094785195 \text{ kip-ft}$

Section Properties for the cracked section

Neutral axis depth, c = 15.53045483 in

Second moment of inertia, Icr = 572170.8574 in³

Applied stress in the reinforcement or tendon.

- Tendon

Effective prestress = 936.2502549 ksi

Stress due to M_{dead} = -204.4190901 ksi

Stress due to M_{live} = -204.4190901 ksi

Total stress = 527.4120748 ksi

• Where "-" in result table means that live load demand value is close to 0.0

PSC Load Rating Report

8. Traffic Load AK, N11 Update to Russia Standard

- The reliability factor for the UDL of AK vehicle load has changed from 1.15 to 1.25 to the latest amendments to SP 35.13330.2011.

▪ **Load > Moving Load > Vehicle**

Define Standard Vehicular Load
✕

Standard Name
Russia - Road Bridge and Railway Bridge

Vehicular Load Properties
 Vehicular Load Name : AK
 Vehicular Load Type : AK

(Unit : KN)

No	Load(kN)	Spacing(m)
1	10K	1.5
2	10K	end

K:

Fatigue
 Apply same Loaded Length between Bogie and UDL

Dynamic Factor

Auto Calculation - SNIP
 Material Type: RC
 Bridge Type: Road and Town Bridge
 Dynamic Factor (1+Mu): $1+(45-\lambda)/135$

User Input
 Dynamic Factor (1+Mu) for Bogie:
 Dynamic Factor (1+Mu) for UDL:

Load Reliability Factor

Auto Calculation - SNIP
 User Input
 Load Reliability Factor (Gamma f) for Bogie:
 Load Reliability Factor (Gamma f) for UDL:

Lane Factor (s1)

	Lane 1	Lane 2	Lane 3 and more
Bogie	<input type="text" value="1"/>	<input type="text" value="0.6"/>	<input type="text" value="0.3"/>
UDL	<input type="text" value="1"/>	<input type="text" value="0.6"/>	<input type="text" value="0.3"/>

Vehicle Dialog Box

8. Traffic Load AK, N11 Update to Russia Standard

- The axle load of N11 has changed from 14 K (14 x 11 = 154 kN) to 196 kN to the latest amendments to SP 35.13330.2011.
- N11 (2nd Edition) vehicle has been added.

▪ **Load > Moving Load > Vehicle**

Define Standard Vehicular Load
✕

Standard Name
Russia - Road Bridge and Railway Bridge

Vehicular Load Properties

Vehicular Load Name : N11(2nd edition)

Vehicular Load Type : N11(2nd edition)

No	Load(kN)	Spacing(m)
1	196	1.2
2	196	1.2

Consider the Effect of Two Vehicles as well as One Vehicle

Reduction Factor: 0.75

Dynamic Factor

Auto Calculation

Material Type: RC

Bridge Type: Railroad Bridge, Subway, Tram

Dynamic Factor (1+Mu): 1+10/(20+Hambda)

User Input

Dynamic Factor (1+Mu): 1

Load Reliability Factor

Auto Calculation

User Input

Load Reliability Factor (Gamma f): 1.1

Reduction for Limit State 2nd Group 0.8

OK
Cancel
Apply

Vehicle Dialog Box

9. Longitudinal Stiffener Input Measured from Bottom of Steel Composite Girder

- Longitudinal stiffeners can be defined with respect to the bottom of the steel beam. Previously, the distance was measured only from the top surface.
- This would be useful when you add longitudinal stiffeners for the tapered girders.

▪ **Properties > Section Properties > Tapered or Composite**

Section Data

DB/User Tapered

Section ID 1

Name Tapered

Dimension

tf2	35.00	mm
Size-J	Import...	
Hw	2365.00	mm
tw	22.00	mm
B1	600.00	mm
tf1	40.00	mm
B2	1300.00	mm
tf2	35.00	mm

Material

Es/Ec 6.16251 Ds/Dc 3.0792

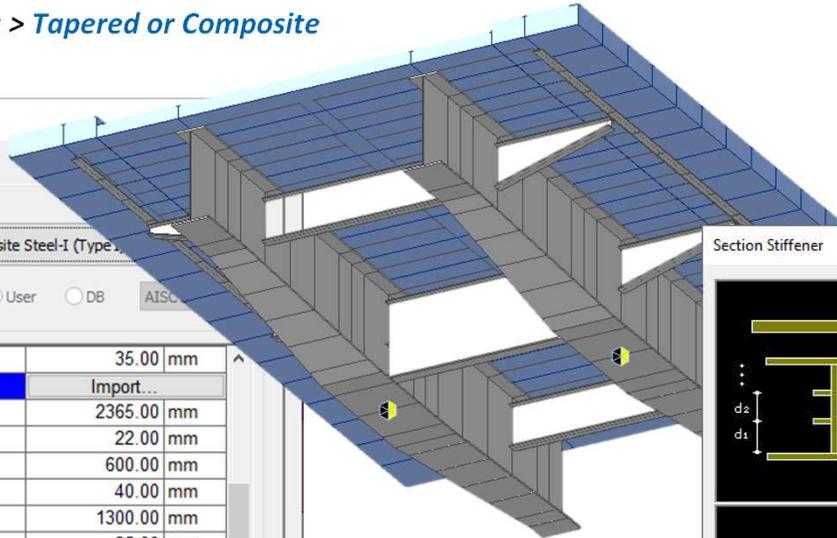
Ps 0.3 Pc 0.2

Ts/Tc 1.2

Offset : Center-Top

OK Cancel Apply

Tapered Composite Steel Section



Section Stiffener

Stiffener Properties

Name S1

Type Flat

H 150 mm

B 20 mm

Add Modify Delete

Stiffener

Position Both Left Right

Reference of d Top Bottom

N Left 1 N Right 1 N Bottom 0 N Top 0

C	d (mm)	Stiffener
✓	400	S1

OK Cancel

Longitudinal Stiffener