Release Note

Release Date : March 2020

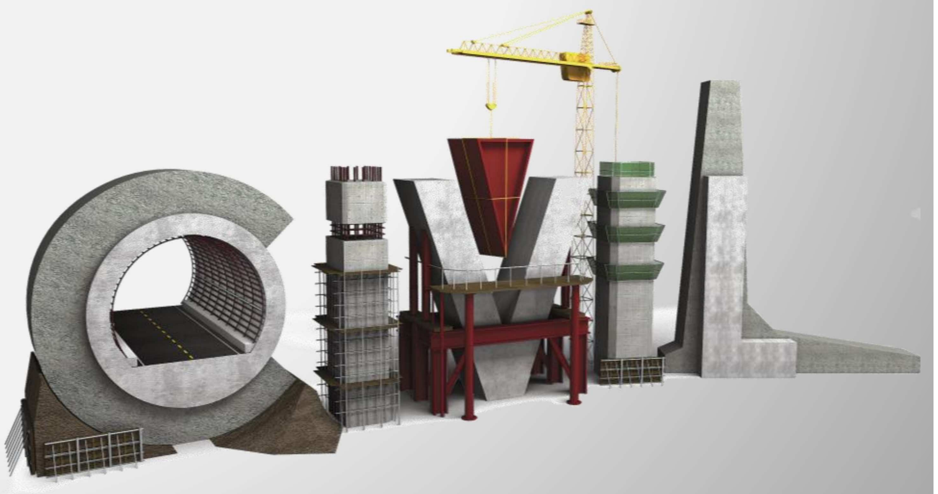
Product Ver. : Civil 2020 (v2.1)

DESIGN OF CIVIL STRUCTURES

Integrated Solution System for Bridge and Civil Engineering

Enhancements

1. Multiple stage post-tensioning in tendon
2. Auto division of the fiber section (Core and cover)
3. New option for Moving load optimization
4. Application rule change of Military Load Class
5. Improvement in calculation of torsional constant for closed composite section
6. Improvement of the element temperature calculation method for the composite section for C.S.
7. Improvement of the analysis speed for the inelastic time-history analysis
8. Improvement in GSD - Civil pushover hinge export
9. Bridge Assessment to the UK standard: CS 454/19
10. RC Design to IS 456:2000 & Crack calculations by IS 3370(Part 2):2009



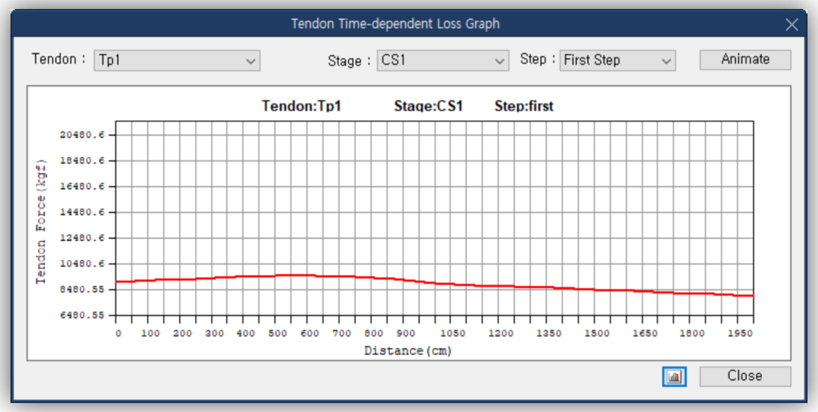
1. Multiple stage post-tensioning in tendon

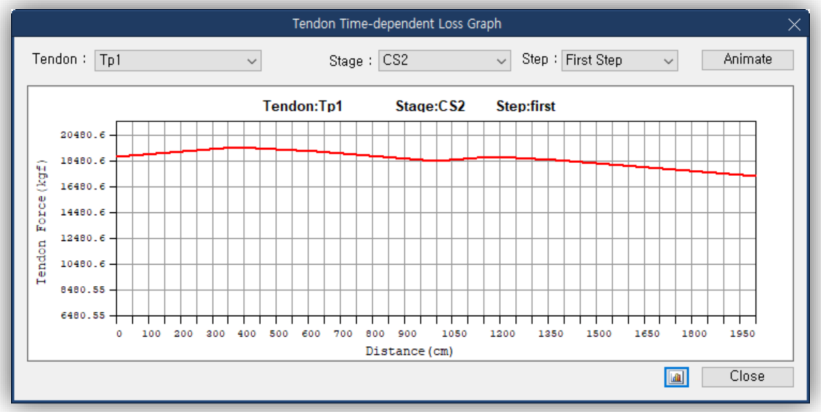
- Re-tensioning of tendon is now supported. Immediate losses and time-dependent losses which occurred before re-tensioning are removed and recalculated based on the summation of multiple stage stressing applied to the tendon starting from the time of re-tensioning.
- Re-tensioning of coupled tendon is not supported

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

Tensioning at stage 1

Re-tensioning at stage 2





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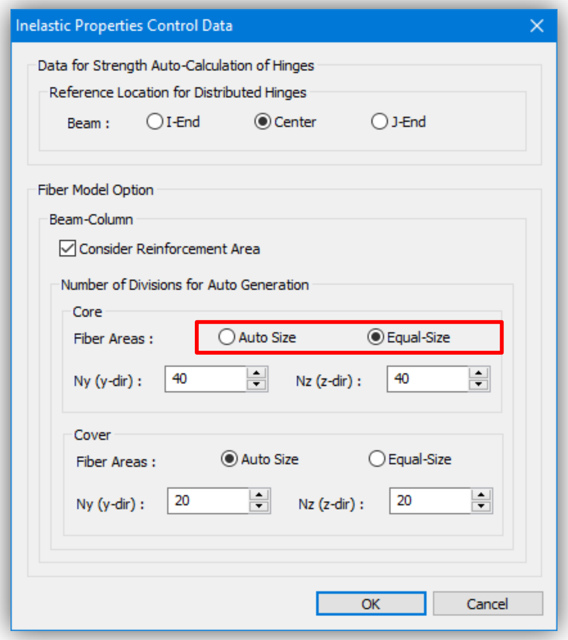
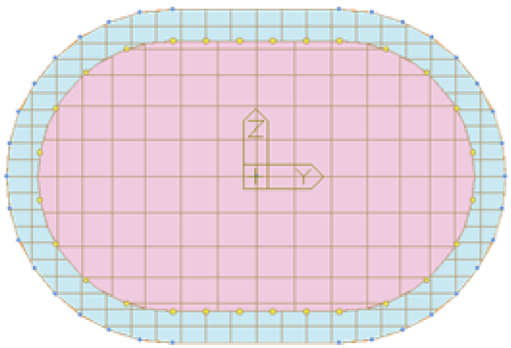
2. Auto division of the fiber section (core and cover)

- In earlier versions, the fiber section was to be manually divided into the core & cover regions and this was to be done for all such sections.
- Now, just the fiber hinge needs to be defined and the fiber division of the section can be done automatically, including differentiation for confined and un-confined concrete. Also, the fiber division can be equal size or auto size.

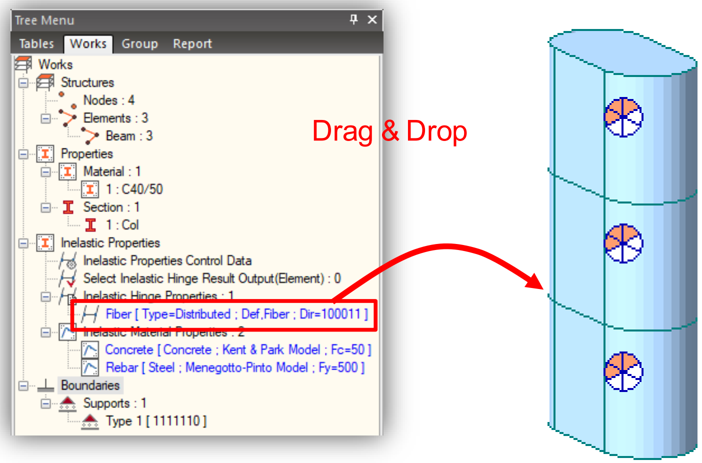
- ***Properties* > *Inelastic Material* > *Fiber Division of Section***

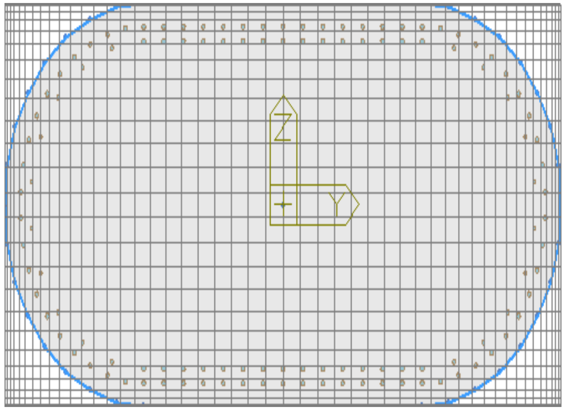


Inelastic Properties Control Data

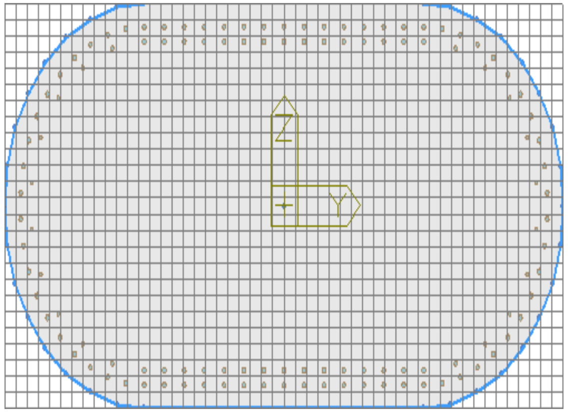


Fiber definition





Auto Size option

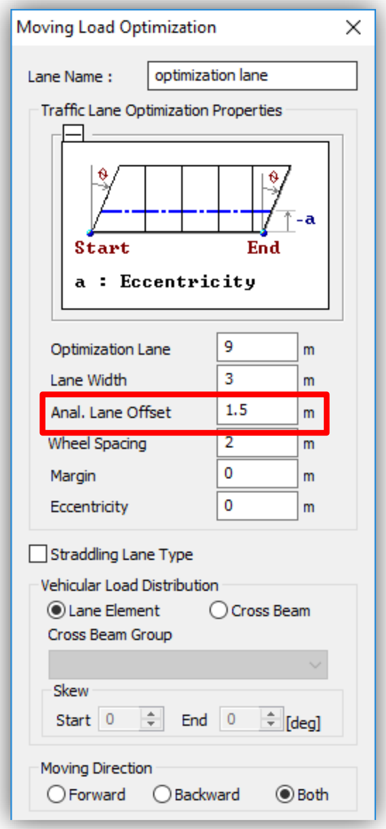


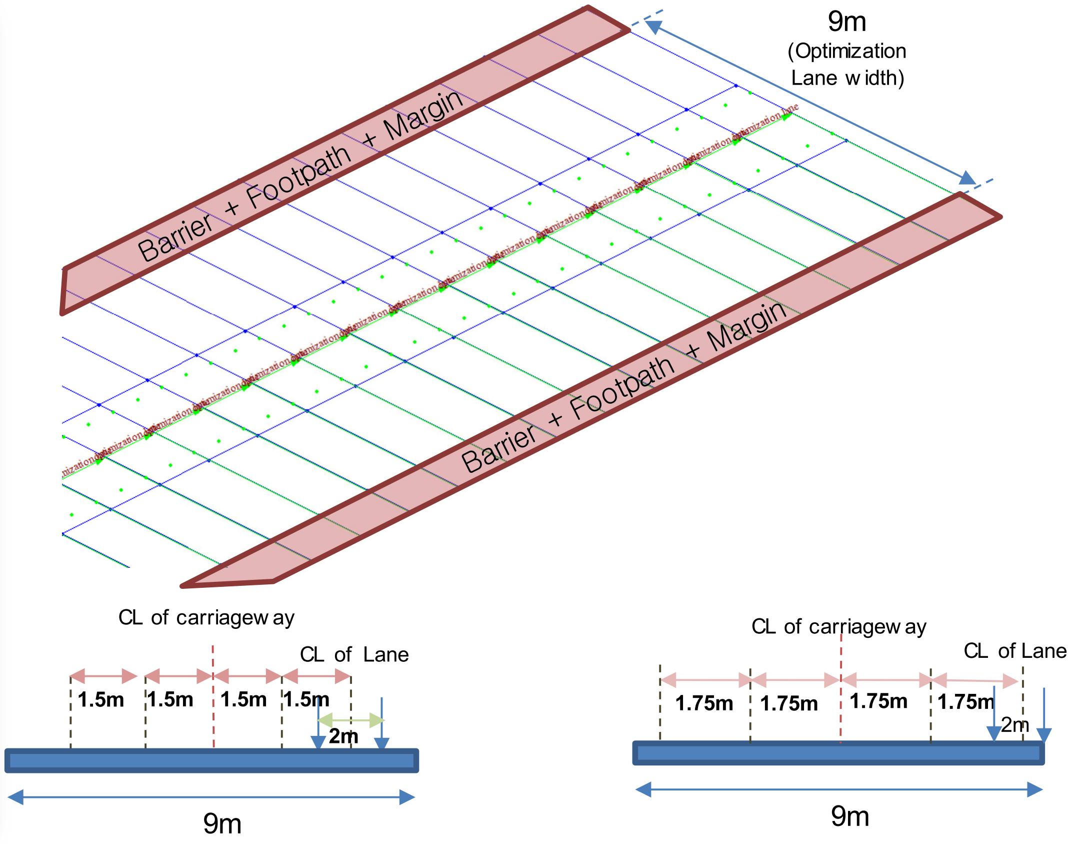
Equal Size option

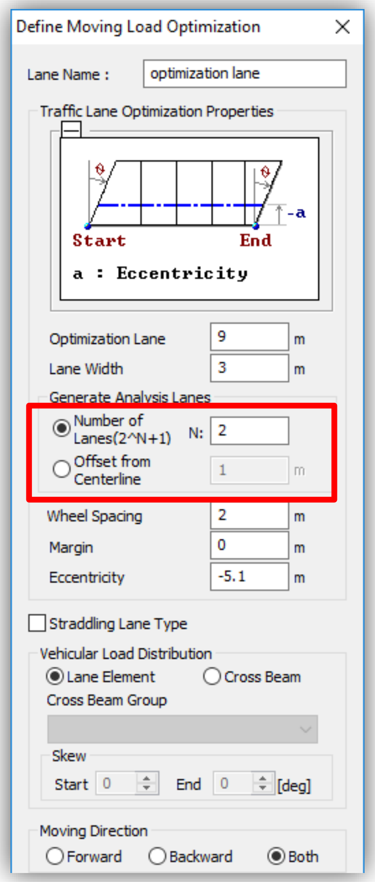
3. New option for moving load optimization

- In earlier versions of midas, there was auto calculation to control the critical position of the analysis lanes in moving load optimization. Lane offset had to be provided manually.
- In this version, the limitation is removed as the number of analysis lanes can be specified by the user and this ensures that vehicle is placed at the extreme ends of the optimization lane.

- ***Load > Moving Load > Traffic Line Lanes > Moving Load Optimization***
- ***Load > Moving Load > Traffic Surface Lanes > Moving Load Optimization***







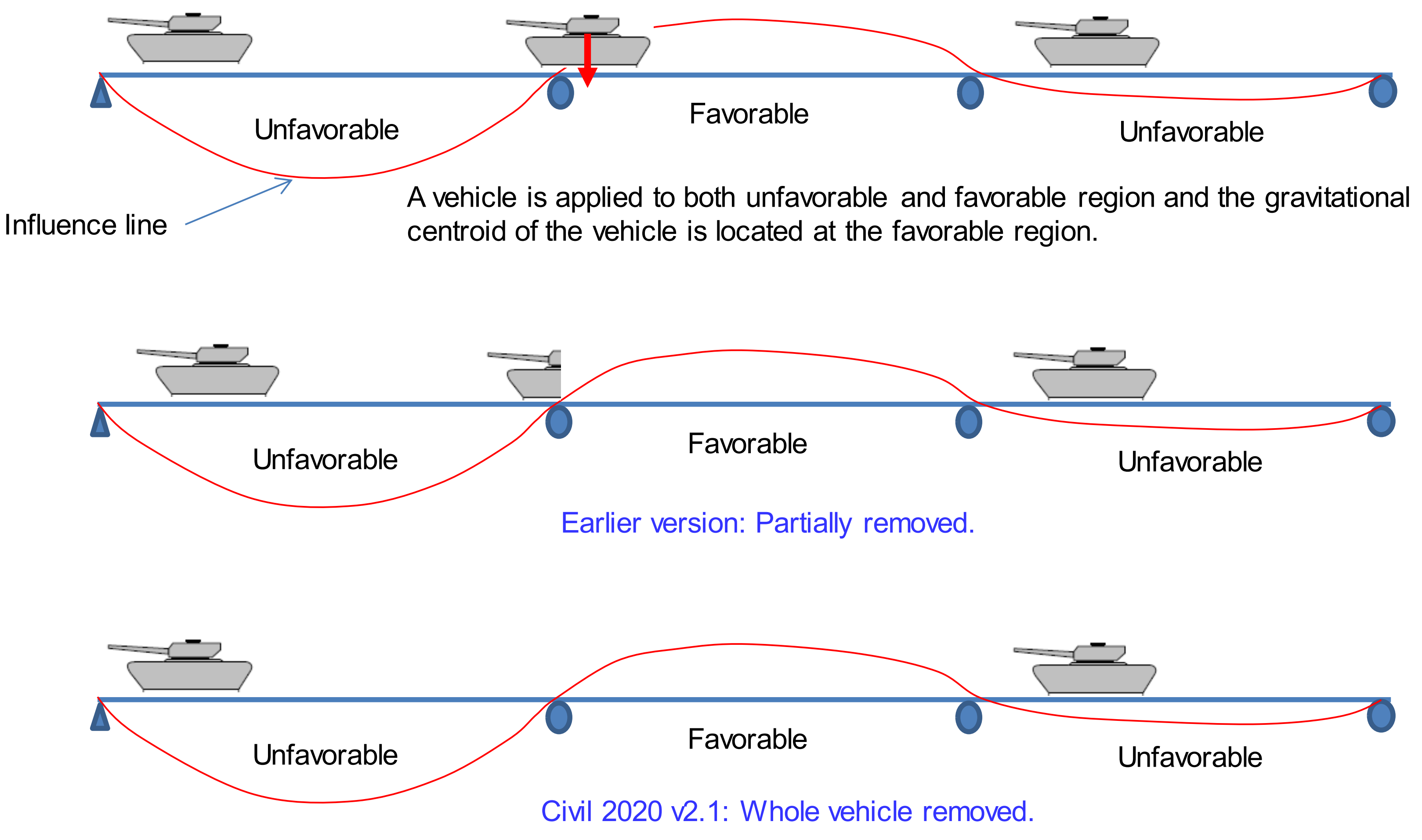
Previous version

Civil 2020 v2.1

4. Application rule change of Military Load Class

- In earlier version, to obtain the most unfavorable condition for the structure, even the partial vehicle load was considered.
- Now, only complete vehicle would be considered to obtain the worst effect on the structure.

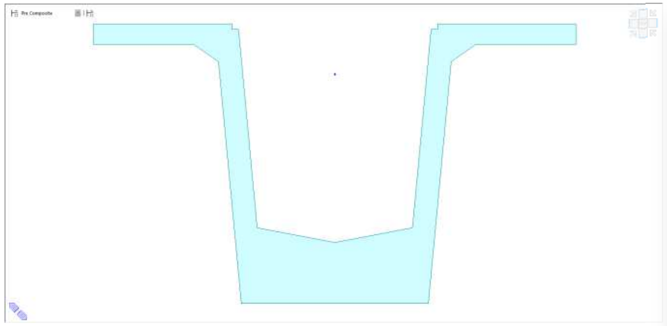
▪ ***Load > Moving Load > Moving Load Code > POLAND > Vehicle Add Standard > Military Load Class***



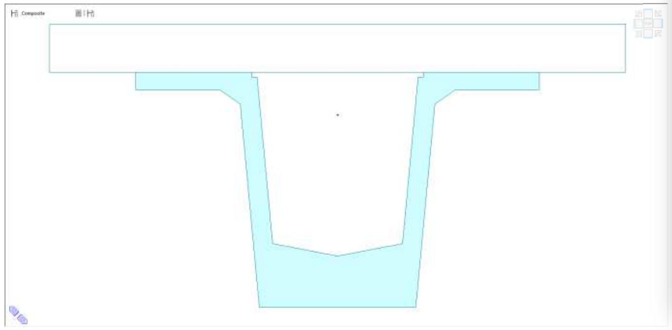
5. Improvement in calculation of torsional constant for closed composite section

- The torsional constant calculation has been improved for composite section which has open cross-section before composite and closed cross-section after composite, e.g. Super T girder.
- Now, the torsional constant is calculated according to finite element based analysis thus calculating for both before composite and after composite separately.

- ***Properties > Section Properties > Composite***



Part I



Part I + Part II

Section Properties

	Value(Before)	Value(After)	Unit
Area	5.361715e-001	1.230545e+000	m^2
Asy	4.831434e-001	4.645265e-001	m^2
Asz	6.130852e-001	5.972085e-001	m^2
Ixx	7.834168e-003	1.506723e-002	m^4
Iyy	1.011163e-001	2.928666e-001	m^4
Izz	1.123795e-001	6.331598e-001	m^4
Cyp	1.050000e+000	1.050000e+000	m
Cym	1.050000e+000	1.050000e+000	m
Czp	6.635581e-001	2.185895e-001	m
Czm	5.514419e-001	9.964105e-001	m
Qyb	0.000000e+000	0.000000e+000	m^2
Qzb	0.000000e+000	0.000000e+000	m^2
Peri:O	7.967478e+000	1.446748e+001	m
Peri:I	0.000000e+000	0.000000e+000	m
Center:y	1.050000e+000	1.500000e+000	m
Center:z	5.514419e-001	9.964105e-001	m
y1	-1.050000e+000	-1.050000e+000	m
z1	6.635581e-001	2.185895e-001	m
y2	1.050000e+000	1.050000e+000	m
z2	6.635581e-001	2.185895e-001	m
y3	4.070000e-001	4.070000e-001	m
z3	-5.514419e-001	-9.964105e-001	m
y4	-4.070000e-001	-4.070000e-001	m
z4	-5.514419e-001	-9.964105e-001	m

Close

Previous version

Section Properties

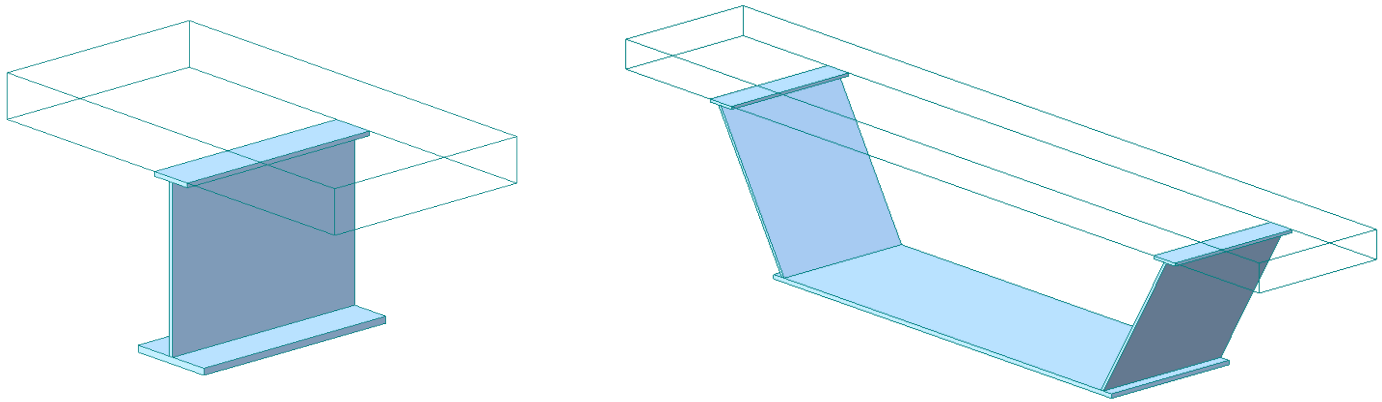
	Value(Before)	Value(After)	Unit
Area	5.361715e-001	1.230545e+000	m^2
Asy	1.237778e-001	7.374340e-001	m^2
Asz	2.125628e-001	2.803497e-001	m^2
Ixx	6.700396e-003	1.916471e-001	m^4
Iyy	1.011163e-001	2.928666e-001	m^4
Izz	1.123795e-001	6.331598e-001	m^4
Cyp	1.050000e+000	1.050000e+000	m
Cym	1.050000e+000	1.050000e+000	m
Czp	6.635581e-001	2.185895e-001	m
Czm	5.514419e-001	9.964105e-001	m
Qyb	0.000000e+000	0.000000e+000	m^2
Qzb	0.000000e+000	0.000000e+000	m^2
Peri:O	7.967478e+000	1.446748e+001	m
Peri:I	0.000000e+000	0.000000e+000	m
Center:y	1.050000e+000	1.500000e+000	m
Center:z	5.514419e-001	9.964105e-001	m
y1	-1.050000e+000	-1.050000e+000	m
z1	6.635581e-001	2.185895e-001	m
y2	1.050000e+000	1.050000e+000	m
z2	6.635581e-001	2.185895e-001	m
y3	4.070000e-001	4.070000e-001	m
z3	-5.514419e-001	-9.964105e-001	m
y4	-4.070000e-001	-4.070000e-001	m
z4	-5.514419e-001	-9.964105e-001	m

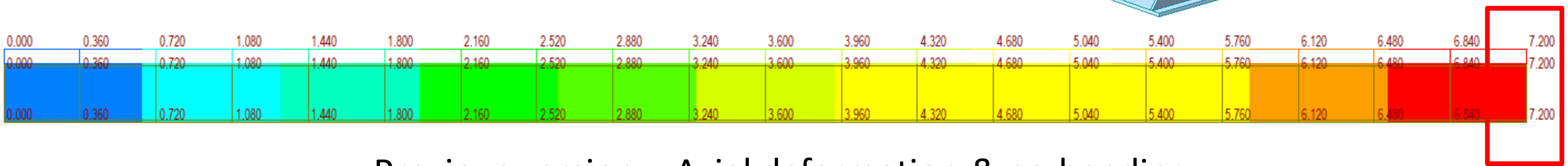
Close

Civil 2020 v2.1

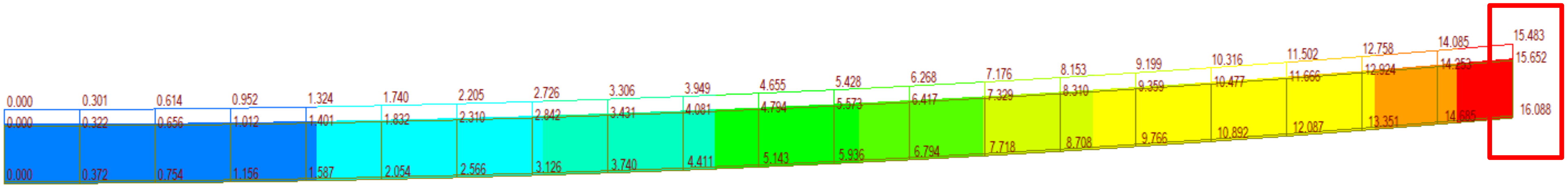
6. Improvement of the element temperature calculation method for the composite section for C.S.

- In earlier version, uniform temperature loads like system temperature, nodal temperature and element temperature were applied to transformed properties of composite beam elements.
- In new version, these loads are applied individually to each part based on temperature coefficient to predict more realistic behavior of structure, when composite section for construction stage are defined.





Previous version – Axial deformation & no bending

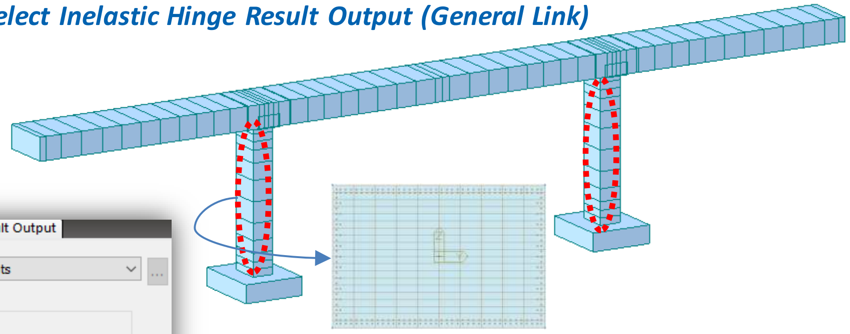


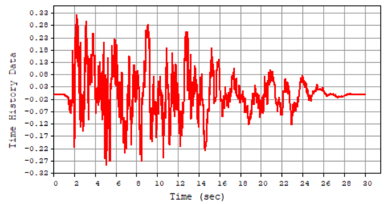
Civil 2020 v2.1 – Axial deformation & bending

7. Improvement in analysis speed for inelastic time history analysis

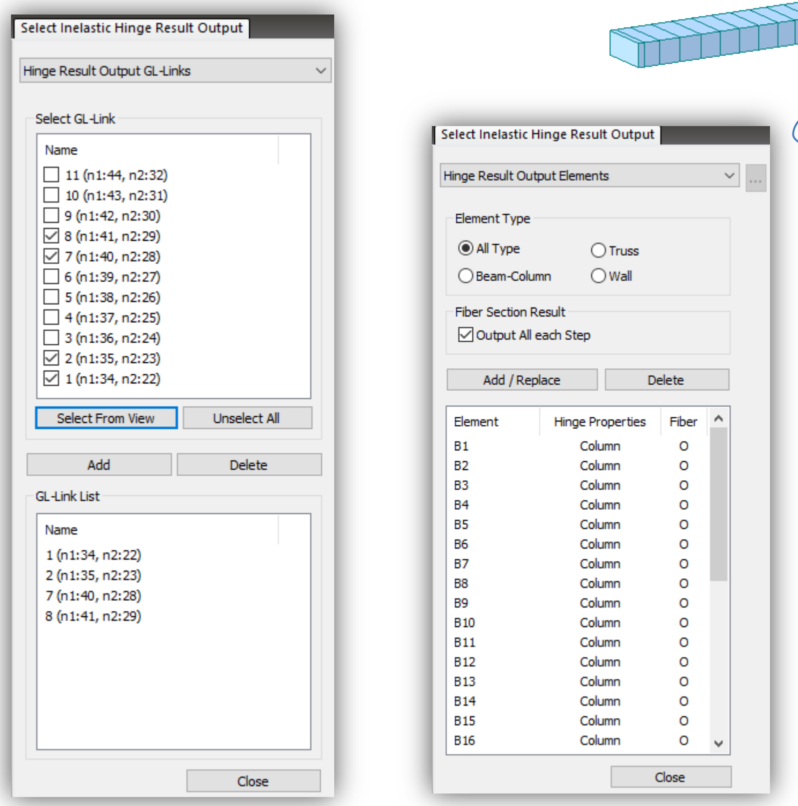
- The output for non-linear elastic time history analysis with fiber modelling could now be restricted to required elements or links. This drastically reduces the overall analysis time of the model.

- ***Properties > Inelastic Properties Control Data > Select Inelastic Hinge Result Output (Element)***
- ***Properties > Inelastic Properties Control Data > Select Inelastic Hinge Result Output (General Link)***



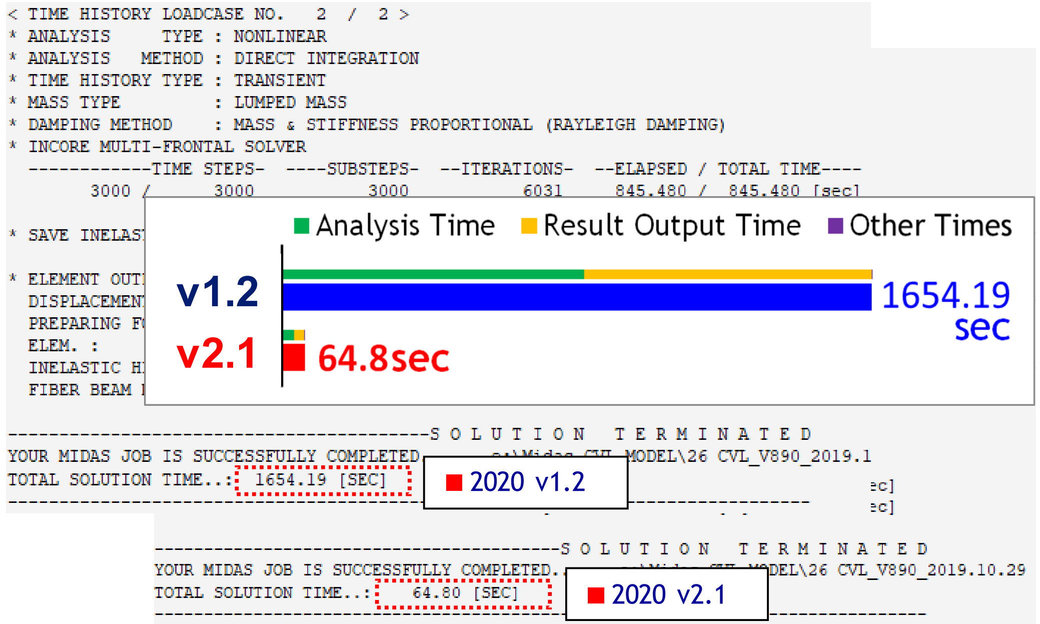


- Duration : 30 Second (3000Step)
- Model scale : 86 Beam elements
- Fiber cell : 28,248Pieces



Hinge Result Output (General Link)

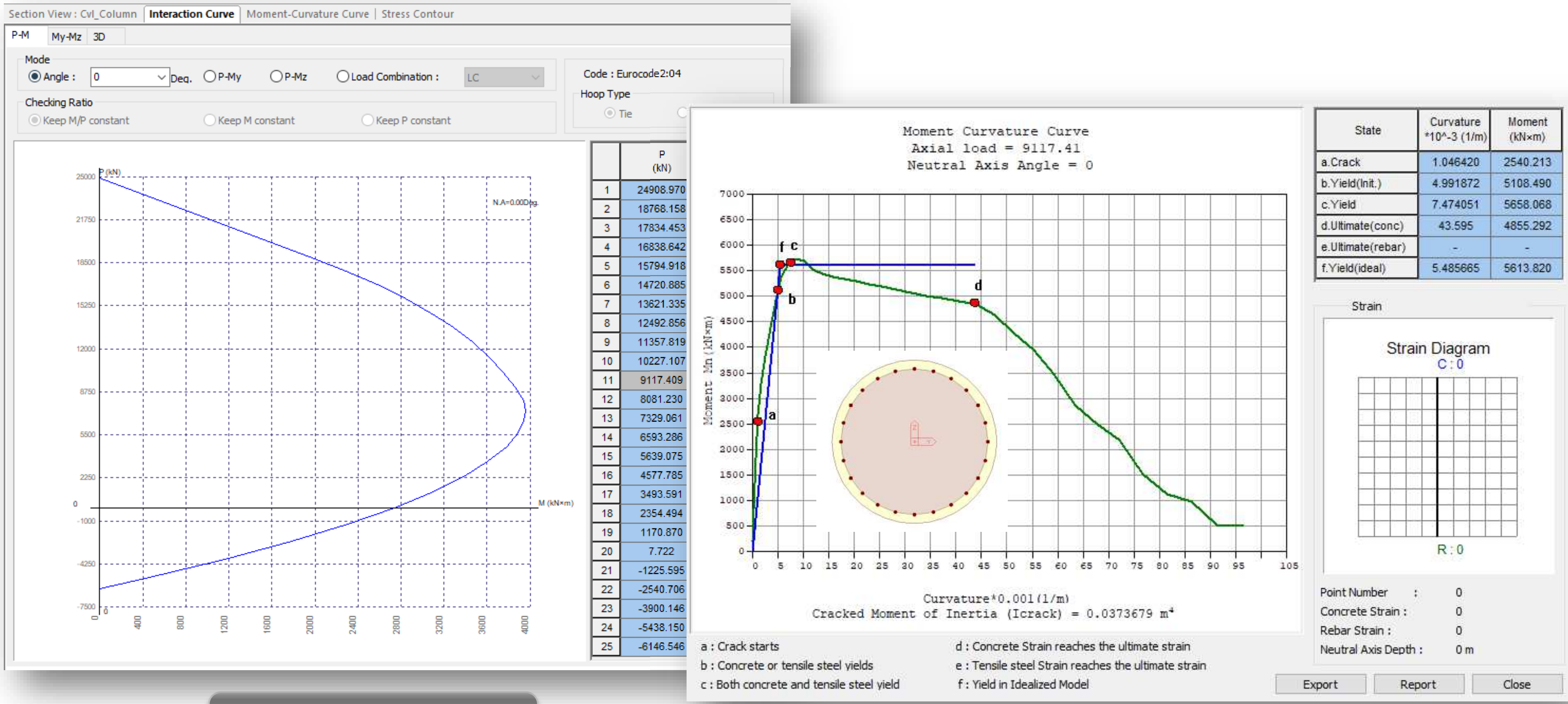
Hinge Result Output (Element)



8. Improvement in GSD Pushover Hinge Export

- In earlier version, the yield moment was taken from the PMM interaction curve generated for the design instead of idealized curve in the Moment-Curvature curve.
- In this version, the yield moments depending on axial forces are taken from the idealized curve in the moment-curvature curve when exporting hinge data for pushover analysis.

▪ ***Pushover > Hinge Properties > Define Pushover Hinge Type/Properties***



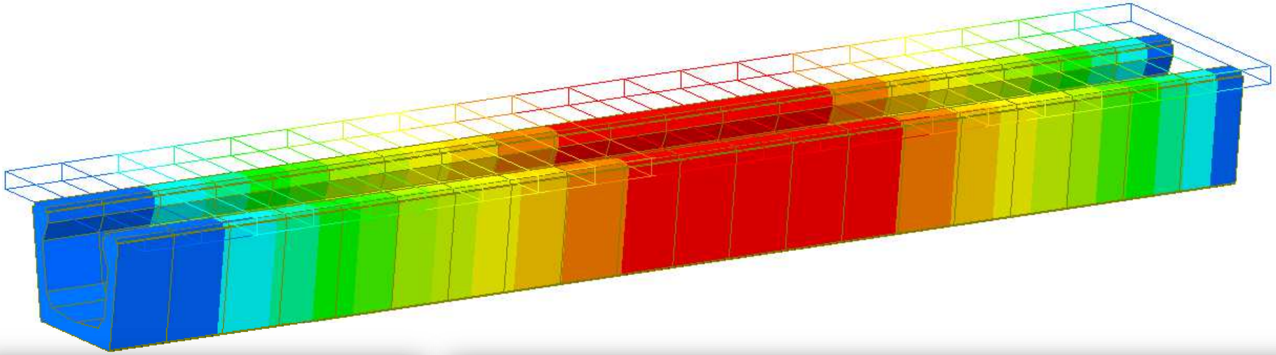
Previous version

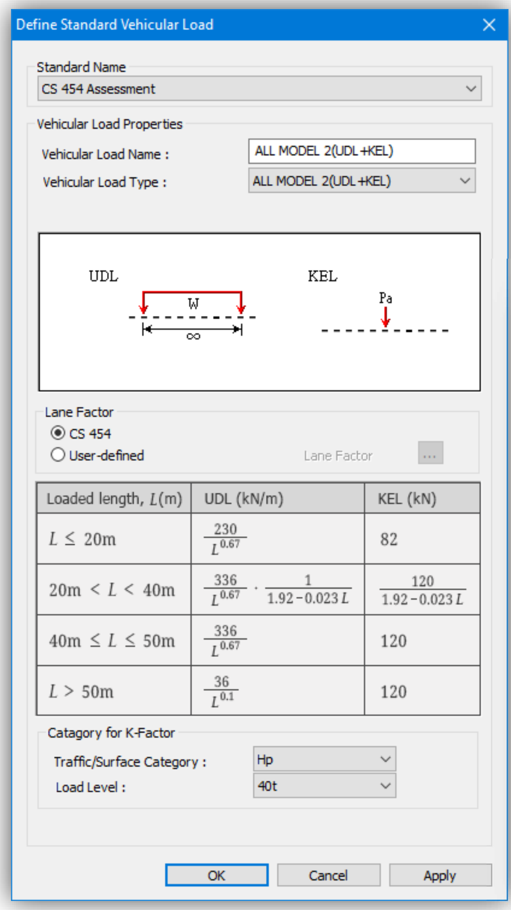
Civil 2020 v2.1

9. Bridge Assessment to the UK standard: CS 454/19

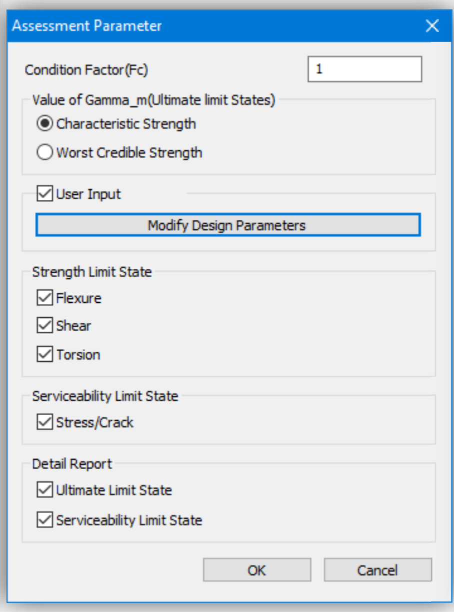
- Level 1 assessment can be performed now for **PSC Box & PSC Composite sections** in midas Civil. All model 2 vehicle is also introduced in accordance to CS 454 Assessment code.
- Assessment load combinations can be defined to obtain output for strength & service limit states.

- ***Load > Moving Load > Moving Load Code> BS> Vehicle > CS 454 Assessment***
- ***Rating> PSC Bridge > CS 454/19***

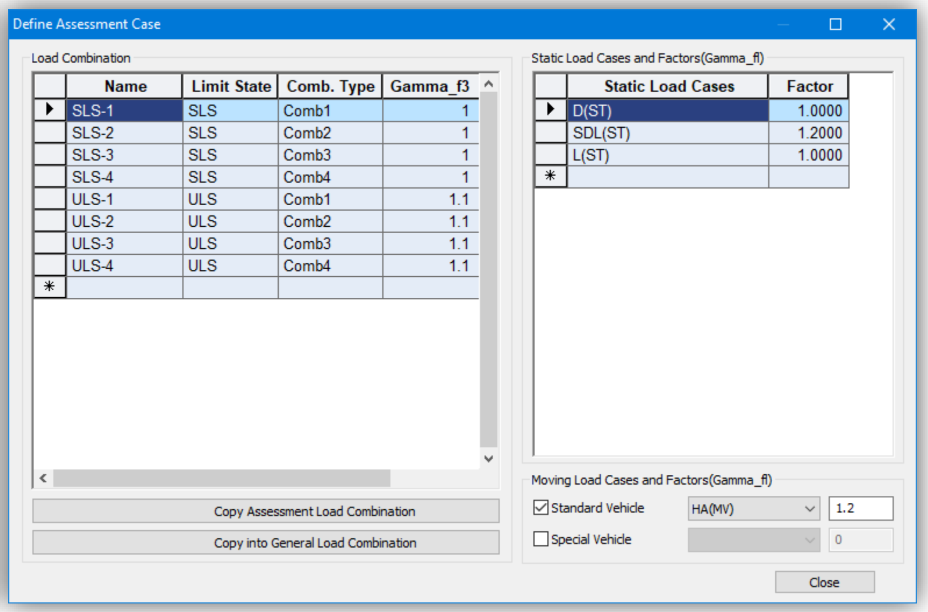




All Model 2 vehicle



Assessment Parameters

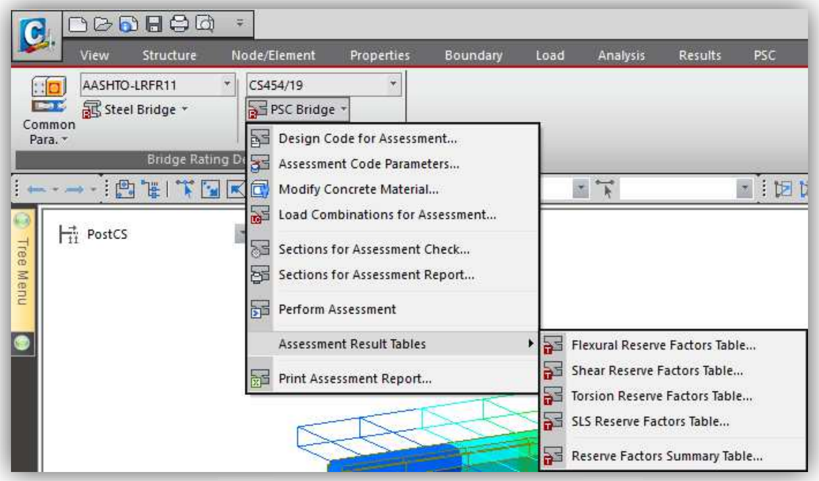


Load combination for assessment

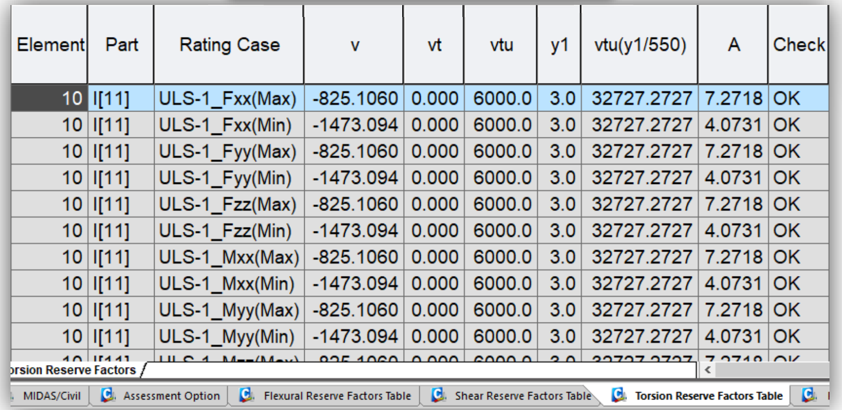
9. Bridge Assessment to the UK standard: CS 454/19

- Assessment results could be viewed in tabular format in midas Civil itself and these can be exported to excel file as well.
- Summary as well as detailed report is provided for Flexural, Shear, Torsion & Service limit state for Class 1 and 2 category.

▪ ***Rating> PSC Bridge > CS 454/19***

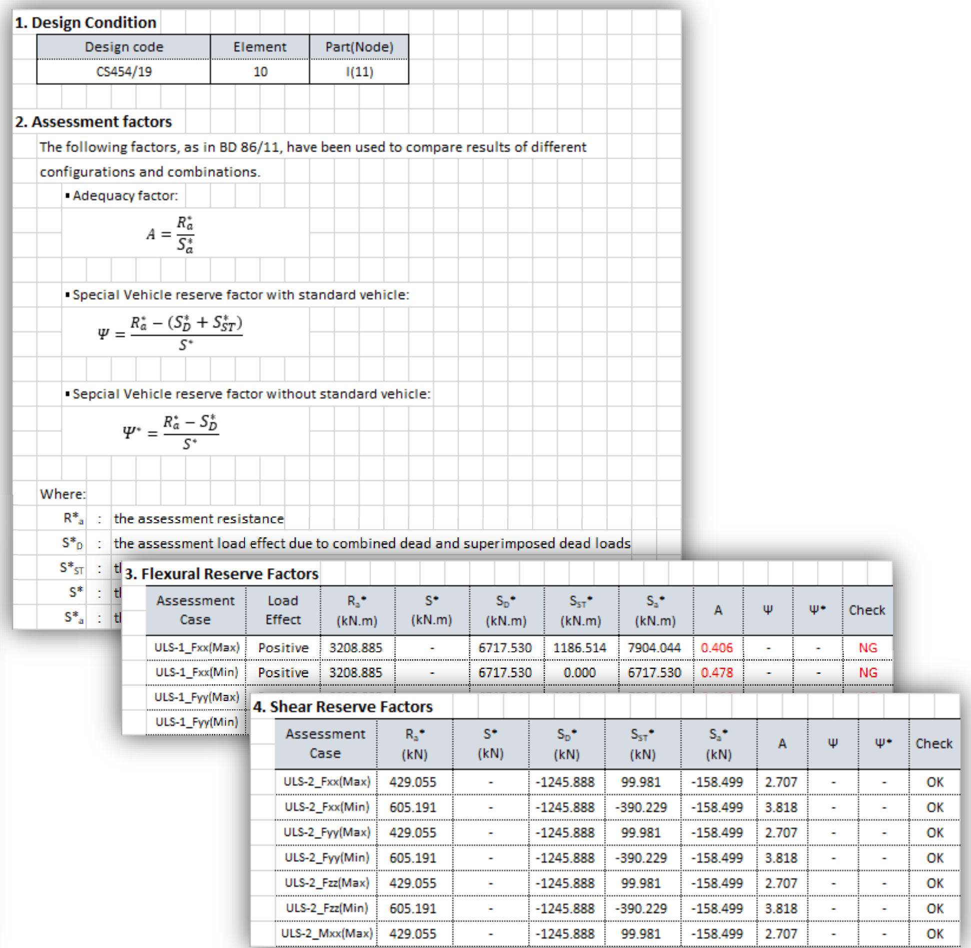


Assessment Result Tables



Element	Part	Rating Case	v	vt	vtu	y1	vtu(y1/550)	A	Check
10	I[11]	ULS-1_Fxx(Max)	-825.1060	0.000	6000.0	3.0	32727.2727	7.2718	OK
10	I[11]	ULS-1_Fxx(Min)	-1473.094	0.000	6000.0	3.0	32727.2727	4.0731	OK
10	I[11]	ULS-1_Fyy(Max)	-825.1060	0.000	6000.0	3.0	32727.2727	7.2718	OK
10	I[11]	ULS-1_Fyy(Min)	-1473.094	0.000	6000.0	3.0	32727.2727	4.0731	OK
10	I[11]	ULS-1_Fzz(Max)	-825.1060	0.000	6000.0	3.0	32727.2727	7.2718	OK
10	I[11]	ULS-1_Fzz(Min)	-1473.094	0.000	6000.0	3.0	32727.2727	4.0731	OK
10	I[11]	ULS-1_Mxx(Max)	-825.1060	0.000	6000.0	3.0	32727.2727	7.2718	OK
10	I[11]	ULS-1_Mxx(Min)	-1473.094	0.000	6000.0	3.0	32727.2727	4.0731	OK
10	I[11]	ULS-1_Myy(Max)	-825.1060	0.000	6000.0	3.0	32727.2727	7.2718	OK
10	I[11]	ULS-1_Myy(Min)	-1473.094	0.000	6000.0	3.0	32727.2727	4.0731	OK

Tabular output in midas Civil



1. Design Condition

Design code	Element	Part(Node)
CS454/19	10	I(11)

2. Assessment factors

The following factors, as in BD 86/11, have been used to compare results of different configurations and combinations.

- Adequacy factor:

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

- Special Vehicle reserve factor with standard vehicle:

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

- Sepcial Vehicle reserve factor without standard vehicle:

$$\Psi^* = \frac{R_a^* - S_D^*}{S^*}$$

Where:

R^*_a : the assessment resistance

S^*_D : the assessment load effect due to combined dead and superimposed dead loads

S^*_{ST} : t

S^* : t

S^*_a : t

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
ULS-1_Fxx(Max)	Positive	3208.885	-	6717.530	1186.514	7904.044	0.406	-	-	NG
ULS-1_Fxx(Min)	Positive	3208.885	-	6717.530	0.000	6717.530	0.478	-	-	NG
ULS-1_Fyy(Max)										
ULS-1_Fyy(Min)										

4. Shear Reserve Factors

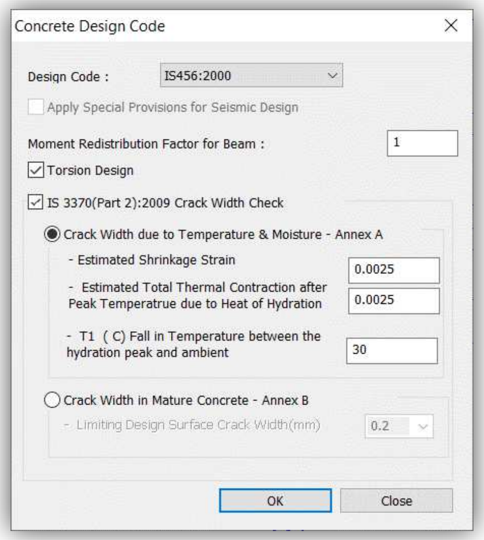
Assessment Case	R_a^* (kN)	S^* (kN)	S_D^* (kN)	S_{ST}^* (kN)	S_a^* (kN)	A	Ψ	Ψ*	Check
ULS-2_Fxx(Max)	429.055	-	-1245.888	99.981	-158.499	2.707	-	-	OK
ULS-2_Fxx(Min)	605.191	-	-1245.888	-390.229	-158.499	3.818	-	-	OK
ULS-2_Fyy(Max)	429.055	-	-1245.888	99.981	-158.499	2.707	-	-	OK
ULS-2_Fyy(Min)	605.191	-	-1245.888	-390.229	-158.499	3.818	-	-	OK
ULS-2_Fzz(Max)	429.055	-	-1245.888	99.981	-158.499	2.707	-	-	OK
ULS-2_Fzz(Min)	605.191	-	-1245.888	-390.229	-158.499	3.818	-	-	OK
ULS-2_Mxx(Max)	429.055	-	-1245.888	99.981	-158.499	2.707	-	-	OK

Excel report output

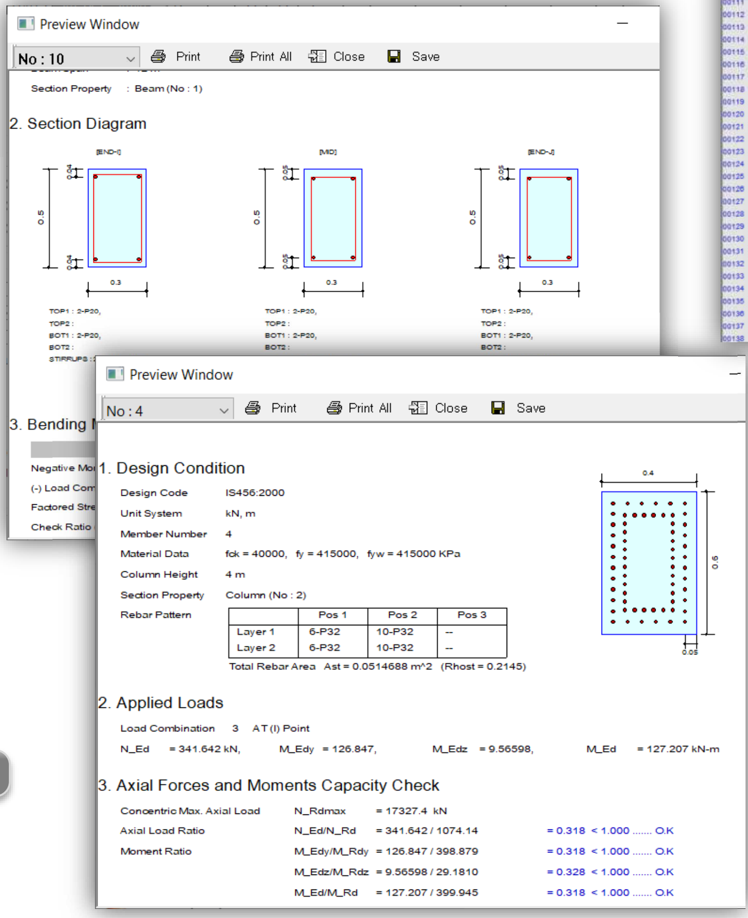
10. RC Design to IS 456:2000 & Crack calculations by IS 3370(Part 2):2009

- Reinforced Concrete Design as per IS 456: 2000 is now available in midas civil, where we can perform Beam Design, Beam Checking, Column Design, Column Checking
- We can generate Graphic/Detailed reports which include both Ultimate Limit State and Serviceability Limit State checks as per IS 456:2000. Also, Crack Width Checks as per IS 3370 (Part-2) :2009 can be obtained for Beams.

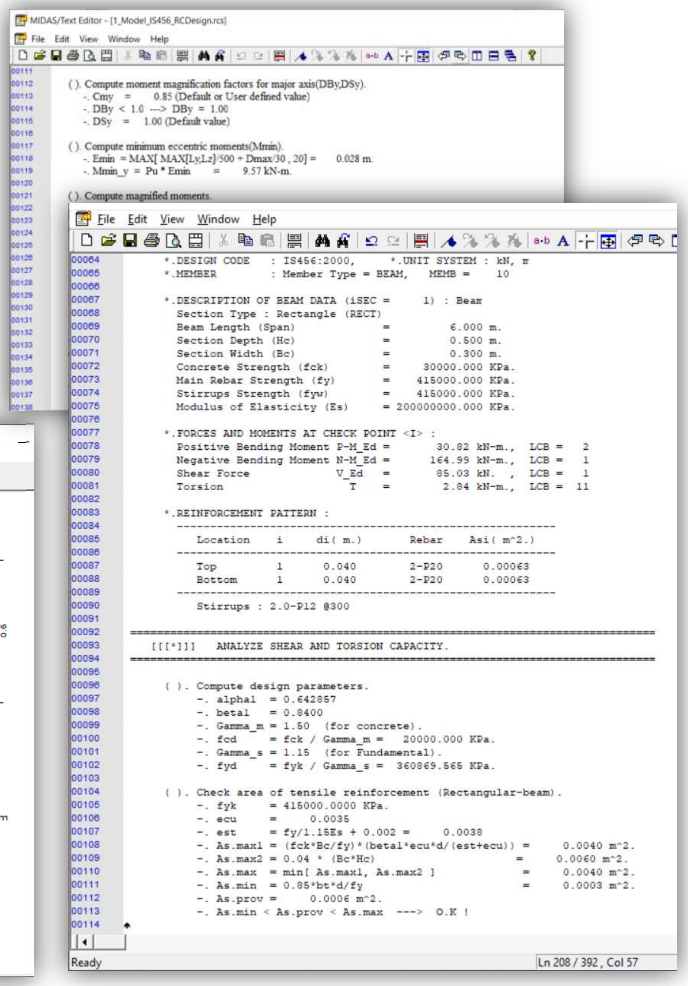
▪ ***Design > RC Design > IS456:2000***



Code options for IS456:2000 & IS 3370(Part 2):2009



Graphic report for beam & column design & checking



Detailed text output with crack calculations