Release Note

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Product Ver. : Civil 2020 (v1.1)

DESIGN OF CIVIL STRUCTURES

Integrated Solution System for Bridge and Civil Engineering

Enhancements

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2. Multiple Modulus of Elasticity for Composite Prestressed Girder
3. Improvement in Prestressed Composite Bridge Wizard: Non-continuous Precast Beam
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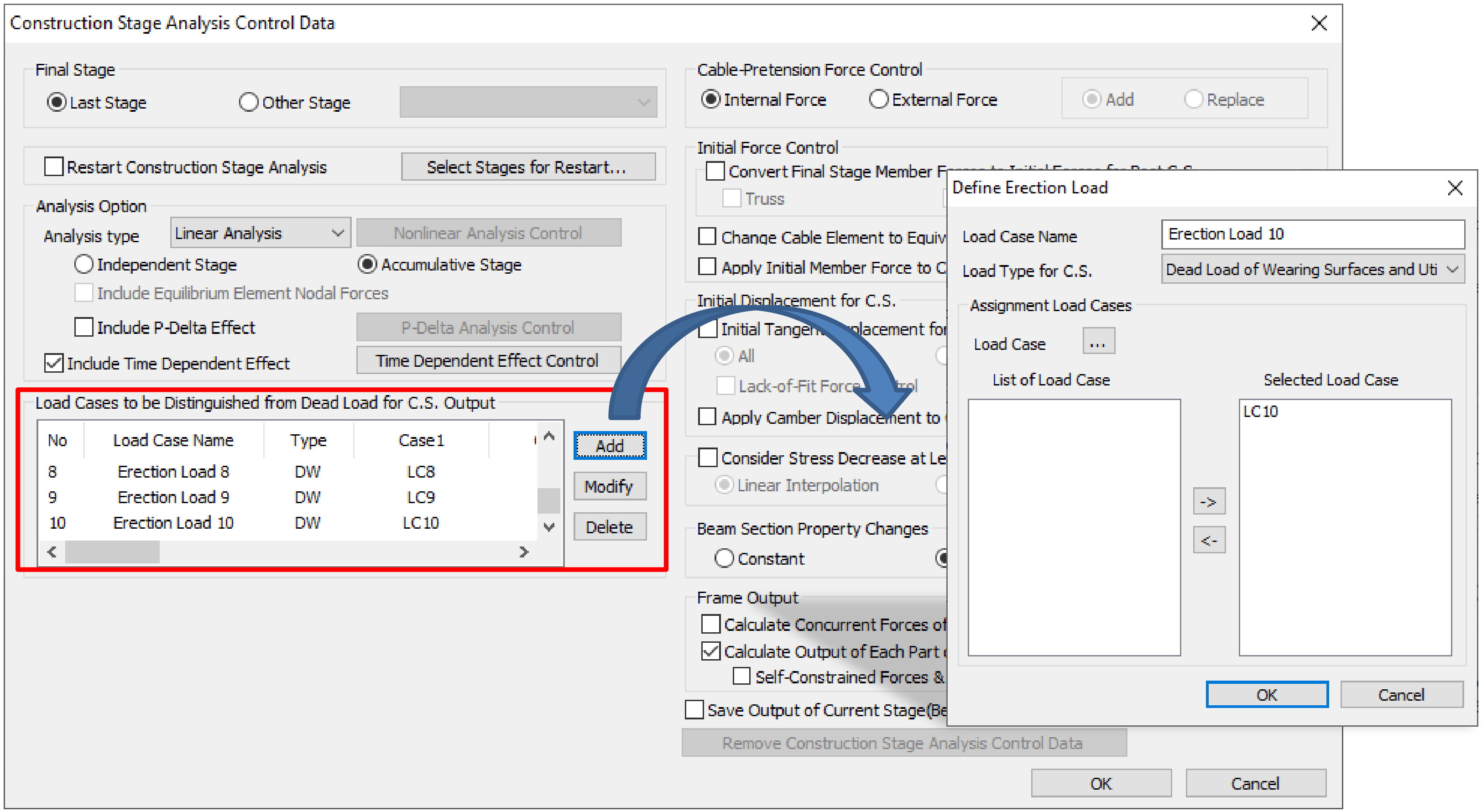
11. Precast Section DB: AS
12. Response Spectrum Function: AS 5100.2: 2017
13. User-Defined Drying Basic Shrinkage Strain: AS 5100.5-2017
14. Relaxation of Tendons: AS 5100.5-2017
15. User-Defined Stress Limit for Crack Check: AS 5100.5-2017
16. Dynamic Load Allowance for Expansion Joint: AASHTO LRFD
17. Standard Vehicles: Indiana Department of Transportation
18. Standard Vehicles: Colombian CCP-14
19. Auto-Generation of Load Combination: BS 5400
20. Design Report in Czech
21. Response Spectrum Function: Philippines DPWH-BSDS 2013
22. India Material Database Update
23. IRS Load Combination
24. Prestressed Concrete Design by IRS Concrete Bridge Code

1. Maximum Number Limit of Erection Load Cases for Construction Stage Analysis

- Maximum limit in the number of erection load cases is increased from 5 to 10.
- More erection loads can be applied during construction stage and the results can be viewed with different erection load cases and hence different load factors in the load combination.

- ***Analysis > Analysis Control > Construction Stage***

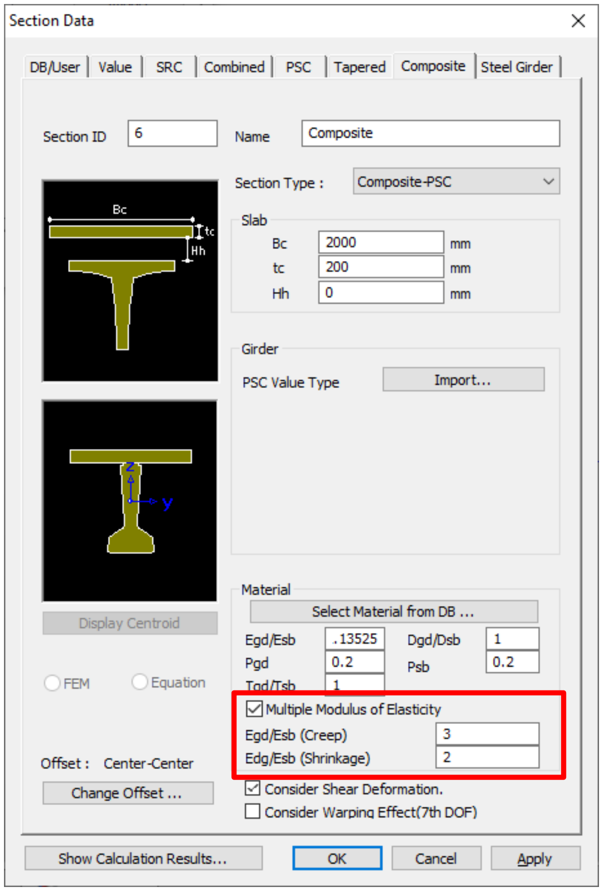


Construction Stage Analysis Control Data

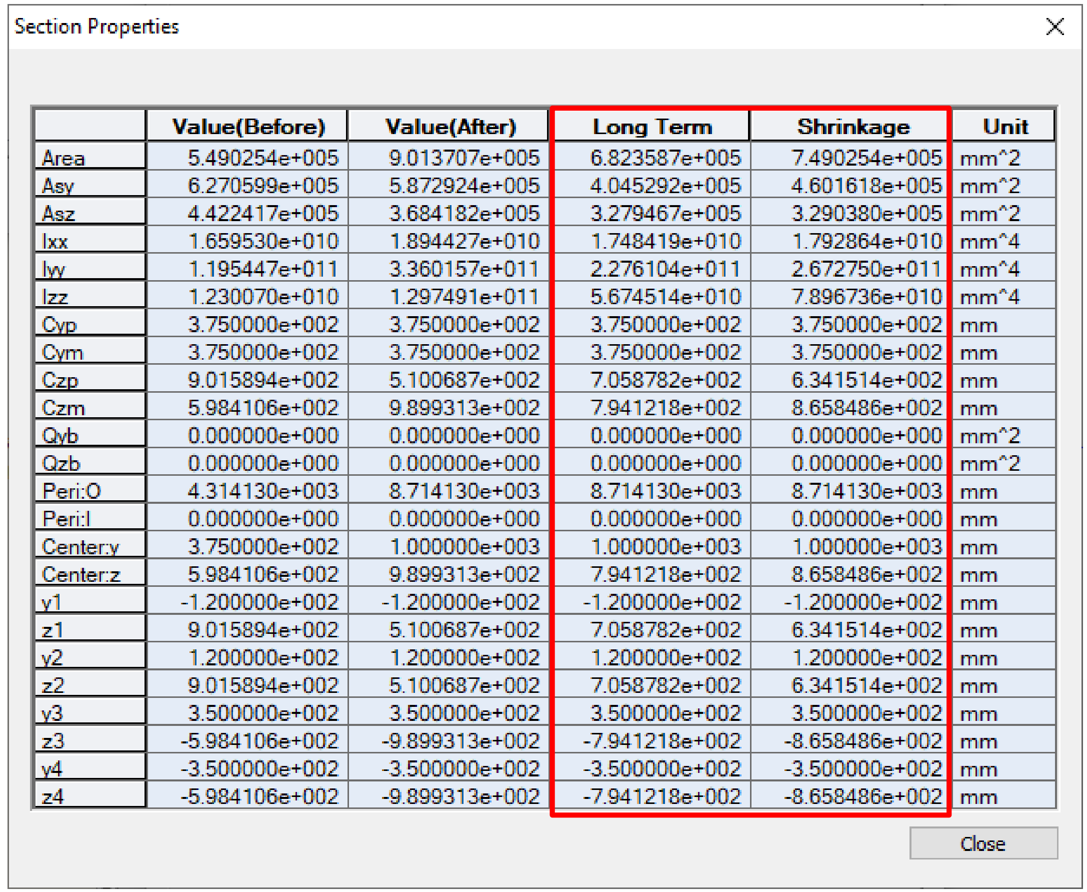
2. Multiple Modulus of Elasticity for Composite Prestressed Girder

- The modular ratio between slab concrete and girder concrete can be defined to determine the creep-transformed section properties of the composite section.
- The tendon and reinforcement are not taken into account to calculate the creep-transformed section properties and hence approximate stresses.

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



Composite PSC section



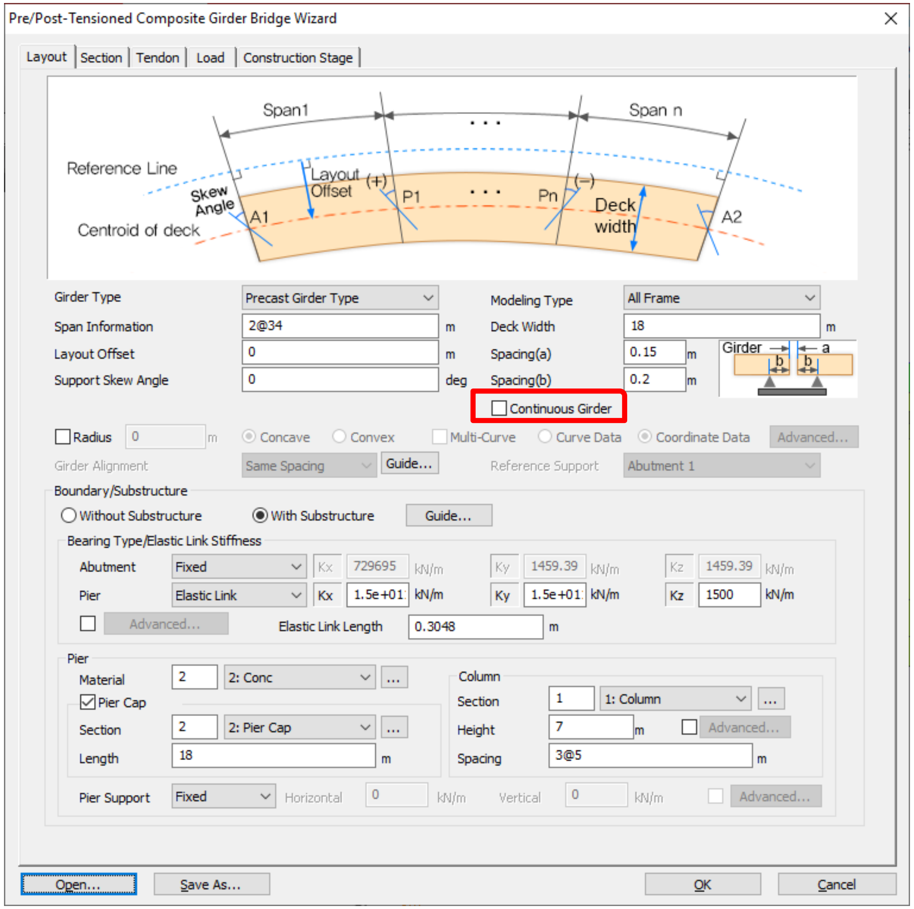
	Value(Before)	Value(After)	Long Term	Shrinkage	Unit
Area	5.490254e+005	9.013707e+005	6.823587e+005	7.490254e+005	mm^2
Asy	6.270599e+005	5.872924e+005	4.045292e+005	4.601618e+005	mm^2
Asz	4.422417e+005	3.684182e+005	3.279467e+005	3.290380e+005	mm^2
Ixx	1.659530e+010	1.894427e+010	1.748419e+010	1.792864e+010	mm^4
Iyy	1.195447e+011	3.360157e+011	2.276104e+011	2.672750e+011	mm^4
Izz	1.230070e+010	1.297491e+011	5.674514e+010	7.896736e+010	mm^4
Cyp	3.750000e+002	3.750000e+002	3.750000e+002	3.750000e+002	mm
Cym	3.750000e+002	3.750000e+002	3.750000e+002	3.750000e+002	mm
Czp	9.015894e+002	5.100687e+002	7.058782e+002	6.341514e+002	mm
Czm	5.984106e+002	9.899313e+002	7.941218e+002	8.658486e+002	mm
Qyb	0.000000e+000	0.000000e+000	0.000000e+000	0.000000e+000	mm^2
Qzb	0.000000e+000	0.000000e+000	0.000000e+000	0.000000e+000	mm^2
Peri:O	4.314130e+003	8.714130e+003	8.714130e+003	8.714130e+003	mm
Peri:I	0.000000e+000	0.000000e+000	0.000000e+000	0.000000e+000	mm
Center:y	3.750000e+002	1.000000e+003	1.000000e+003	1.000000e+003	mm
Center:z	5.984106e+002	9.899313e+002	7.941218e+002	8.658486e+002	mm
y1	-1.200000e+002	-1.200000e+002	-1.200000e+002	-1.200000e+002	mm
z1	9.015894e+002	5.100687e+002	7.058782e+002	6.341514e+002	mm
y2	1.200000e+002	1.200000e+002	1.200000e+002	1.200000e+002	mm
z2	9.015894e+002	5.100687e+002	7.058782e+002	6.341514e+002	mm
y3	3.500000e+002	3.500000e+002	3.500000e+002	3.500000e+002	mm
z3	-5.984106e+002	-9.899313e+002	-7.941218e+002	-8.658486e+002	mm
y4	-3.500000e+002	-3.500000e+002	-3.500000e+002	-3.500000e+002	mm
z4	-5.984106e+002	-9.899313e+002	-7.941218e+002	-8.658486e+002	mm

Creep Transformed Section Properties

3. Improvement in Prestressed Composite Bridge Wizard: Non-continuous Precast Beam

- New option is introduced to apply non-continuous condition for the precast beams between neighboring spans.
- Bending moment is released at the slab connecting two spans.

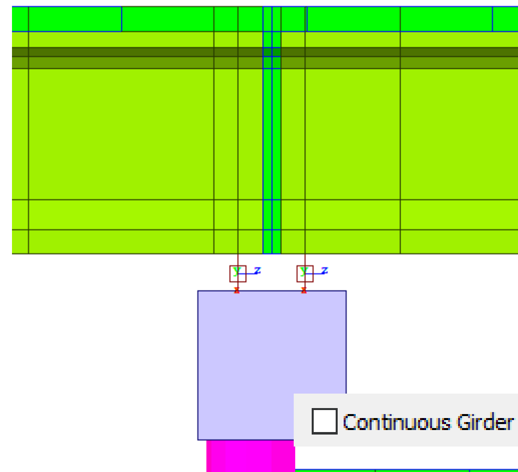
▪ ***Structure > Wizard > Prestressed Composite Bridge***



Precast Composite Girder Bridge Wizard

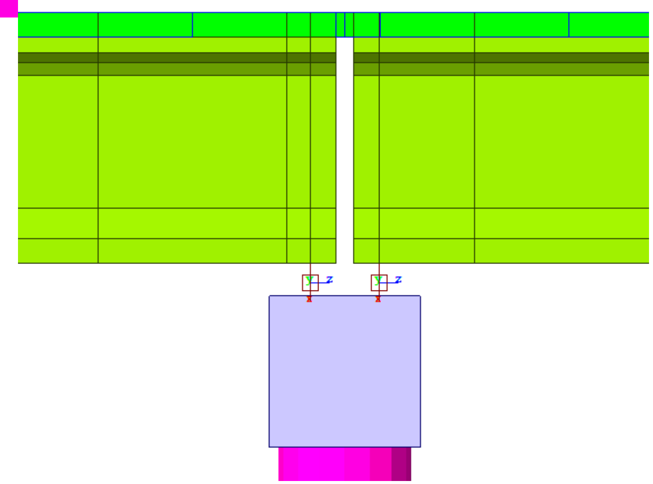
☑ Continuous Girder

Continuous condition



☐ Continuous Girder

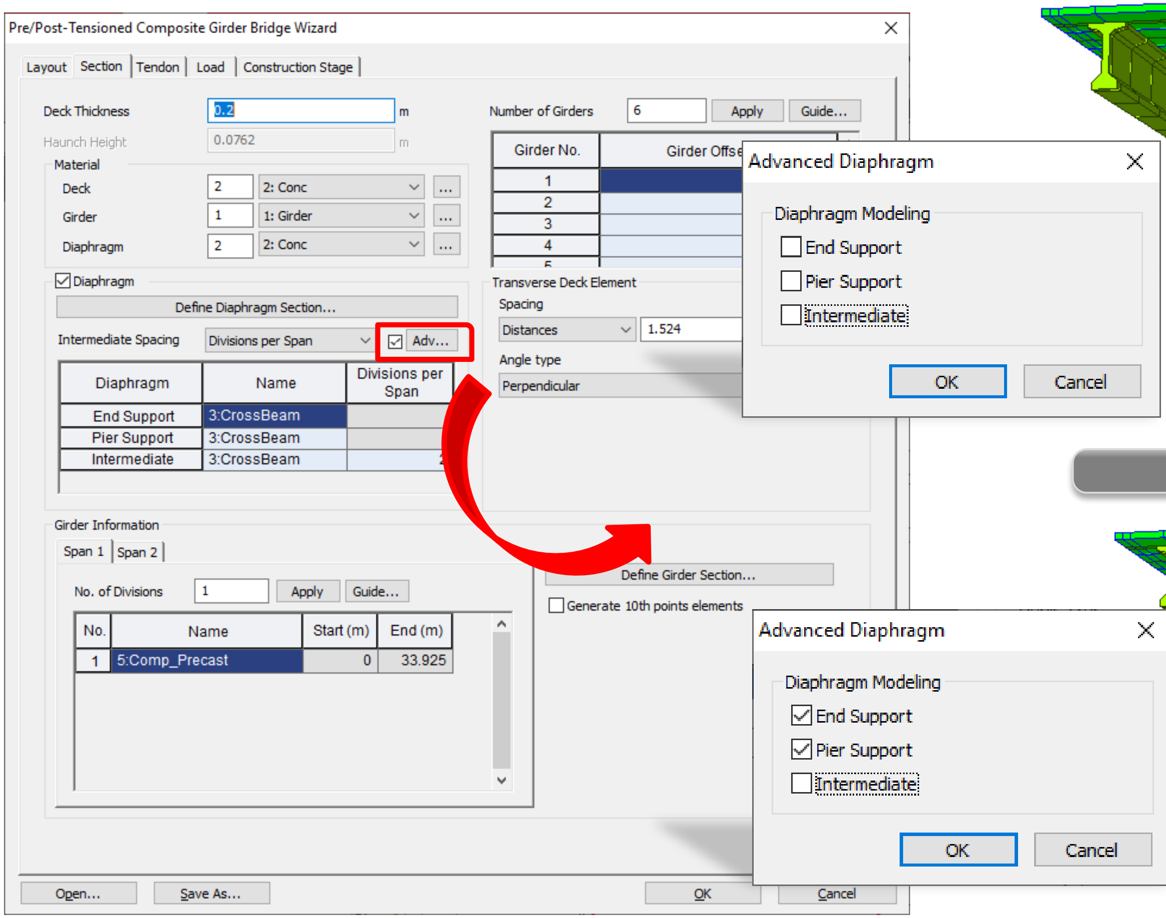
Non-continuous condition



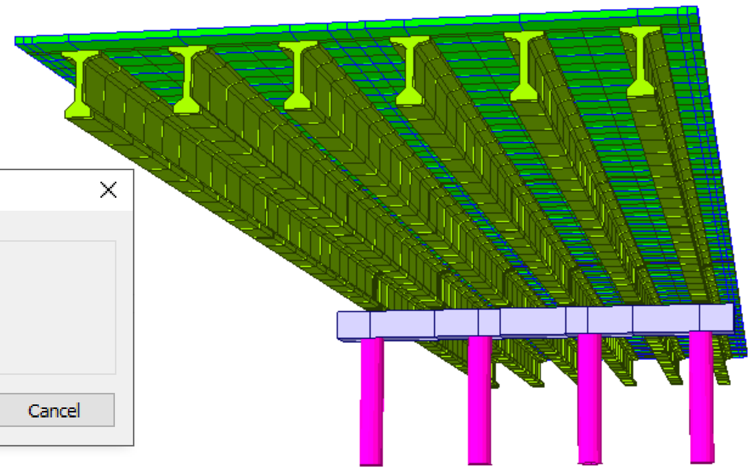
4. Improvement in Prestressed Composite Bridge Wizard: Diaphragm

- Individual diaphragms can be included/excluded in the modeling of prestressed composite girder bridge.

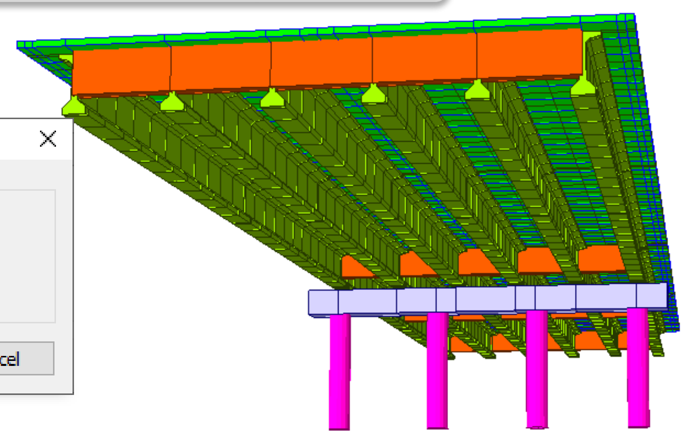
- ***Structure > Wizard > Prestressed Composite Bridge***



Precast Composite Girder Bridge Wizard



No Diaphragm

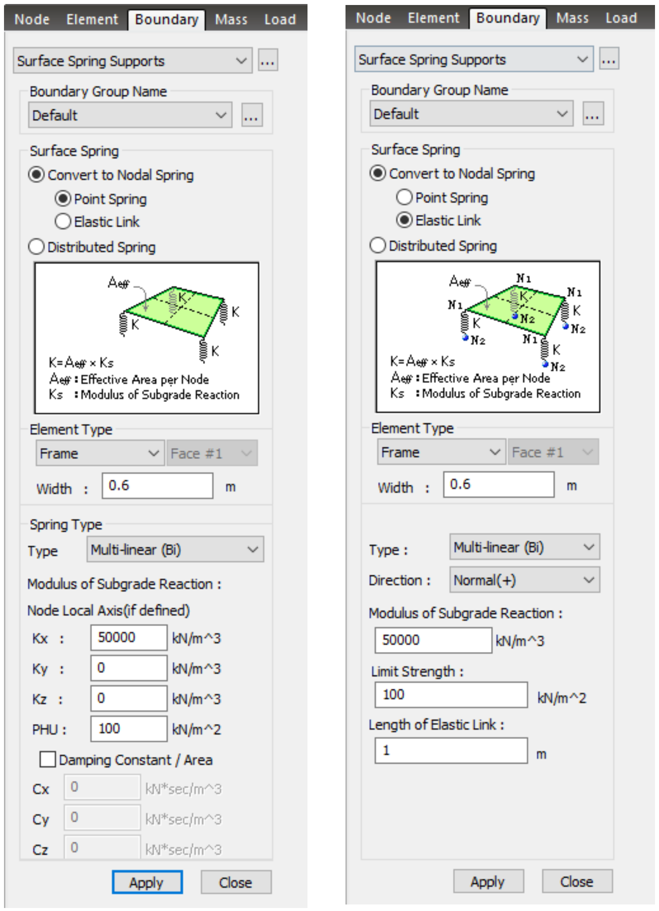


No Intermediate Diaphragm

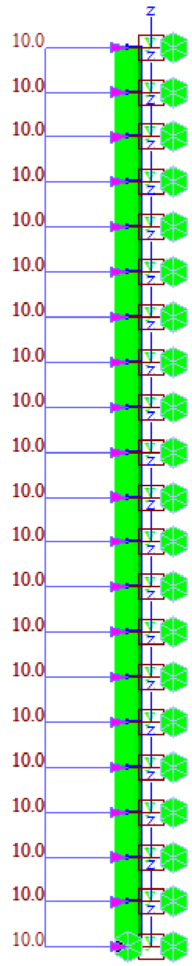
5. Bilinear Type Spring Stiffness for Surface Spring Support

- Bilinear spring type is added in the Surface Spring Support to simulate the strength limit of the soil. The strength limit should be defined by the user.
- Both Point Spring Support and Elastic Link are supported.

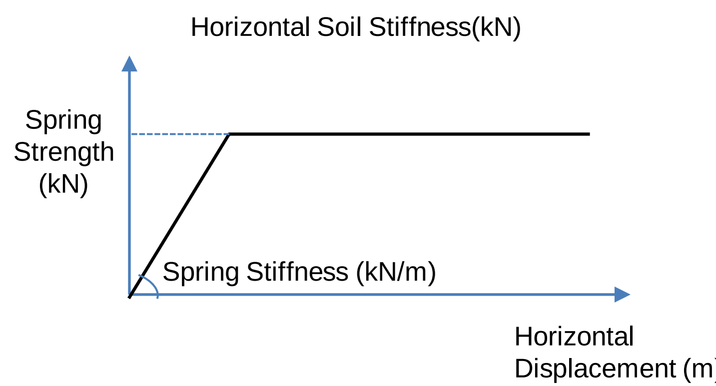
▪ ***Boundary > Spring Supports > Surface Spring***



Surface Spring Support



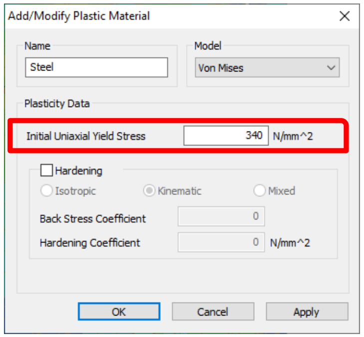
Spring Strength [kN]
= Section Width [m] × Element Length [m] × PHU [kN/m^2]



6. Force/Stress Contouring based on Center Value of Plate Elements

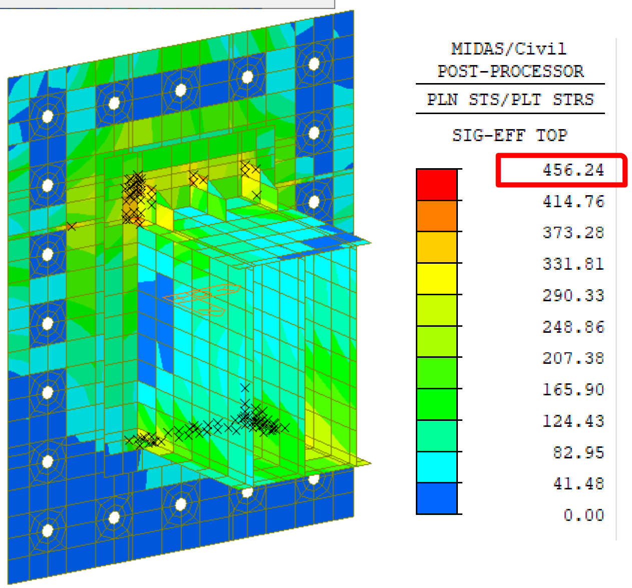
- Stresses at the node are determined by the linear interpolation of Gauss points, which often leads to stress exceeding yield stress in the material nonlinear analysis.
- Plate stress contour can now be displayed using the value at the element center instead of element nodes. The center values will not exceed the yield stress.

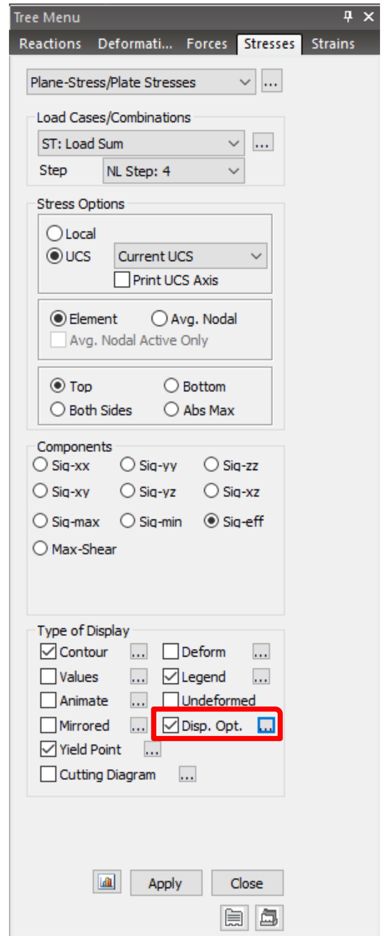
▪ ***Results > Results > Stresses > Plane-Stress/Plate Stresses***

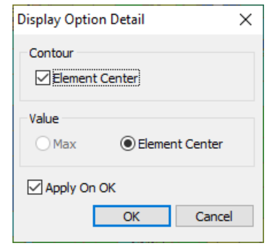


Yield Stress=340MPa

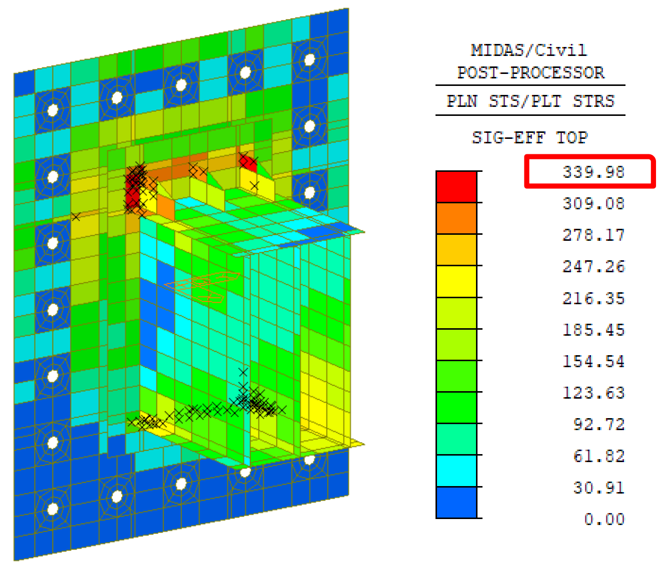
Larger than yield stress







Less than yield stress



Without Center Contour option

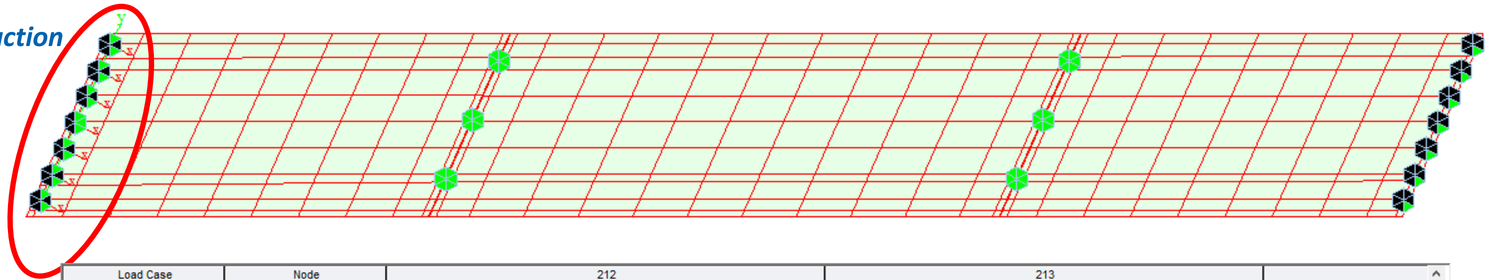
With Center Contour option

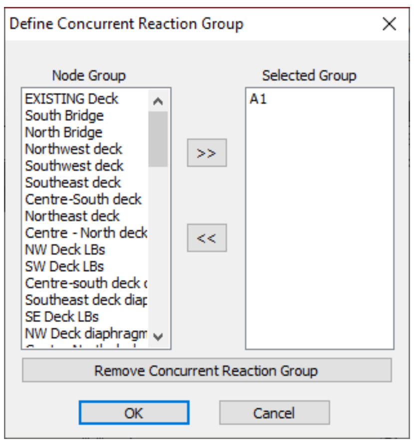
7. Concurrent Reactions of Moving Load Analysis with respect to Node Local Axis

- Concurrent reactions due to moving load case can be viewed with respect to node local axis as well as global axis.
- This is useful to check concurrent reactions in the skewed bridges or horizontally curved bridges.

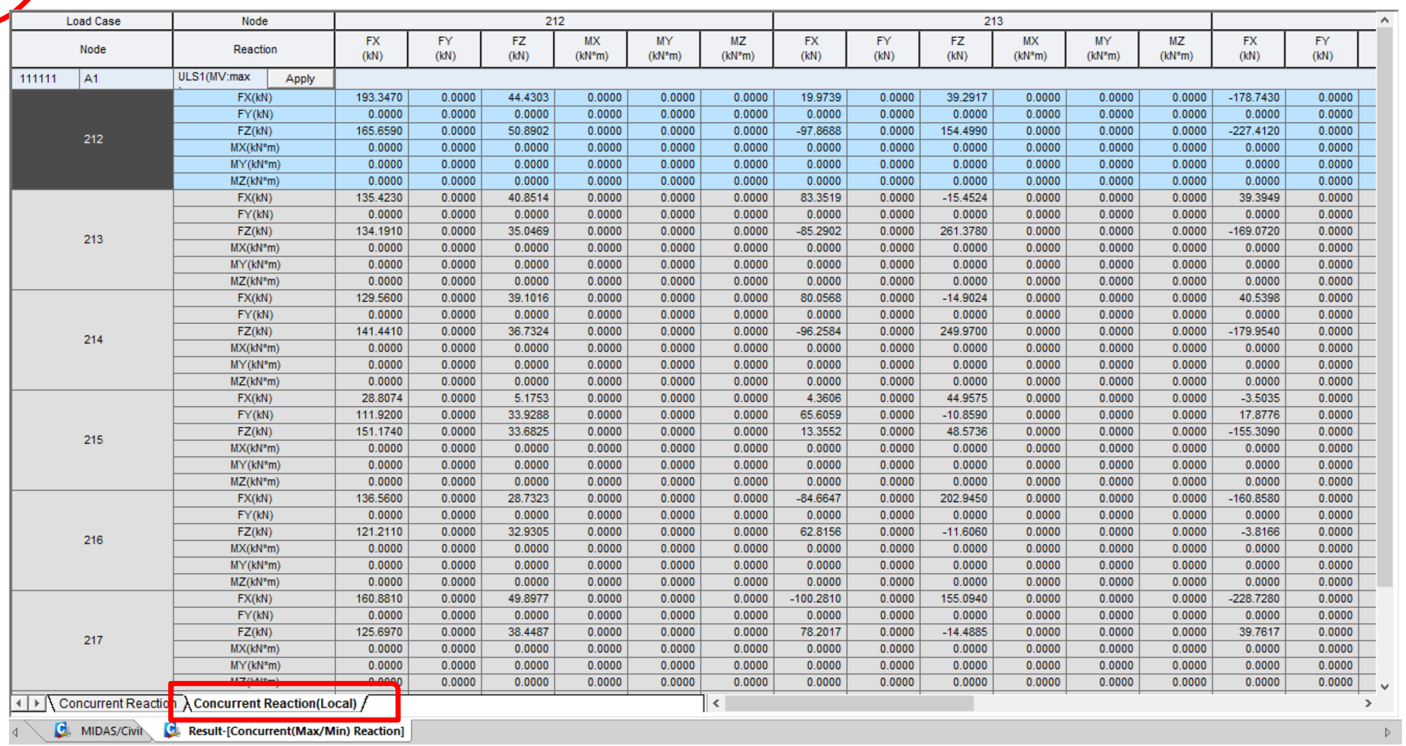
- ***Result Tables > Concurrent Reaction***

Support and Node Local axis not parallel to global axis in the skewed bridge





Concurrent Reaction Group



Load Case	Node	212						213							
Node	Reaction	FX (kN)	FY (kN)	FZ (kN)	MX (kN*m)	MY (kN*m)	MZ (kN*m)	FX (kN)	FY (kN)	FZ (kN)	MX (kN*m)	MY (kN*m)	MZ (kN*m)	FX (kN)	FY (kN)
111111 A1	ULS1(MV:max Apply														
212	FX(kN)	193.3470	0.0000	44.4303	0.0000	0.0000	0.0000	19.9739	0.0000	39.2917	0.0000	0.0000	0.0000	-178.7430	0.0000
	FY(kN)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	FZ(kN)	165.6590	0.0000	50.8902	0.0000	0.0000	0.0000	-97.8688	0.0000	154.4990	0.0000	0.0000	0.0000	-227.4120	0.0000
	MX(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MY(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MZ(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
213	FX(kN)	135.4230	0.0000	40.8514	0.0000	0.0000	0.0000	83.3519	0.0000	-15.4524	0.0000	0.0000	0.0000	39.3949	0.0000
	FY(kN)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	FZ(kN)	134.1910	0.0000	35.0469	0.0000	0.0000	0.0000	-85.2902	0.0000	261.3780	0.0000	0.0000	0.0000	-169.0720	0.0000
	MX(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MY(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MZ(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
214	FX(kN)	129.5600	0.0000	39.1016	0.0000	0.0000	0.0000	80.0568	0.0000	-14.9024	0.0000	0.0000	0.0000	40.5398	0.0000
	FY(kN)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	FZ(kN)	141.4410	0.0000	36.7324	0.0000	0.0000	0.0000	-96.2584	0.0000	249.9700	0.0000	0.0000	0.0000	-179.9540	0.0000
	MX(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MY(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MZ(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
215	FX(kN)	28.8074	0.0000	5.1753	0.0000	0.0000	0.0000	4.3606	0.0000	44.9575	0.0000	0.0000	0.0000	-3.5035	0.0000
	FY(kN)	111.9200	0.0000	33.9288	0.0000	0.0000	0.0000	65.6059	0.0000	-10.8590	0.0000	0.0000	0.0000	17.8776	0.0000
	FZ(kN)	151.1740	0.0000	33.6825	0.0000	0.0000	0.0000	13.3552	0.0000	48.5736	0.0000	0.0000	0.0000	-155.3090	0.0000
	MX(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MY(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MZ(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
216	FX(kN)	136.5600	0.0000	28.7323	0.0000	0.0000	0.0000	-84.6647	0.0000	202.9450	0.0000	0.0000	0.0000	-160.8580	0.0000
	FY(kN)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	FZ(kN)	121.2110	0.0000	32.9305	0.0000	0.0000	0.0000	62.8156	0.0000	-11.6060	0.0000	0.0000	0.0000	-3.8166	0.0000
	MX(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MY(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MZ(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
217	FX(kN)	160.8810	0.0000	49.8977	0.0000	0.0000	0.0000	-100.2810	0.0000	155.0940	0.0000	0.0000	0.0000	-228.7280	0.0000
	FY(kN)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	FZ(kN)	125.6970	0.0000	38.4487	0.0000	0.0000	0.0000	78.2017	0.0000	-14.4885	0.0000	0.0000	0.0000	39.7617	0.0000
	MX(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MY(kN*m)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	MZ(kN*m)	[illegible]	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

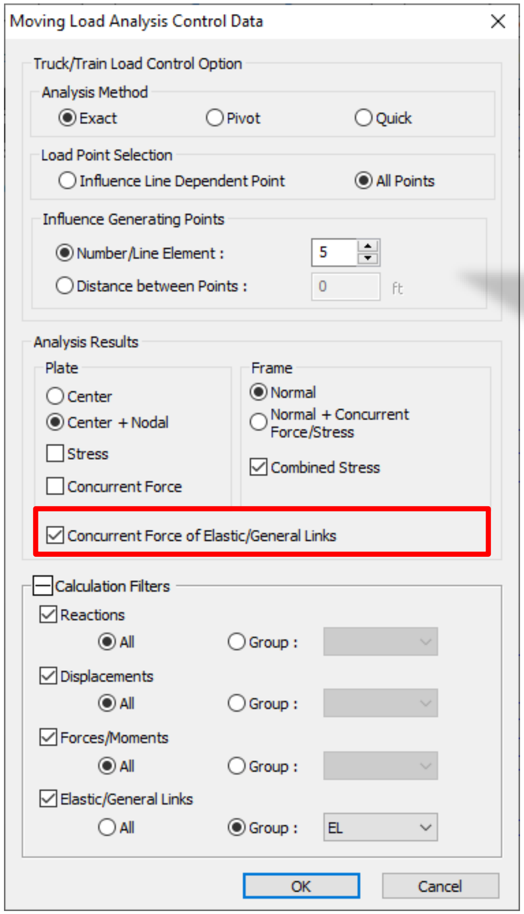
Concurrent Reaction (Local)

Concurrent Reaction Table

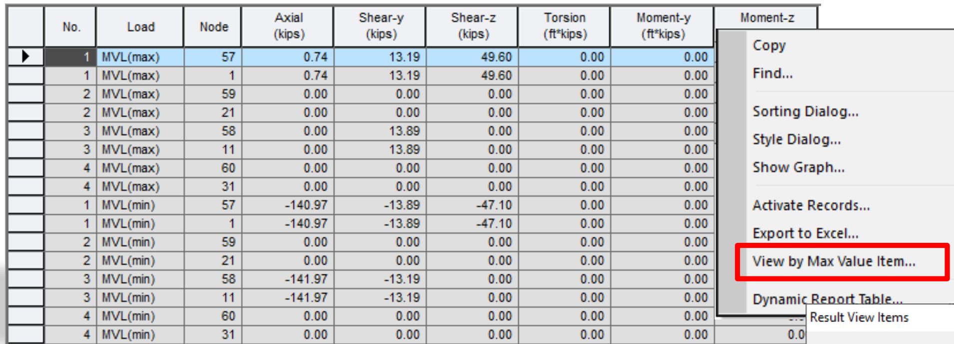
8. Concurrent Forces of Elastic Links and General Links for Moving Load Analysis

- Concurrent forces of Elastic Links and General Links are provided for the moving load analysis.
- This is useful when the bearings of the bridge are simulated using Elastic links.

- ***Analysis > Analysis Control > Moving Load, Result Tables > Elastic Link, Result Tables > General Link***

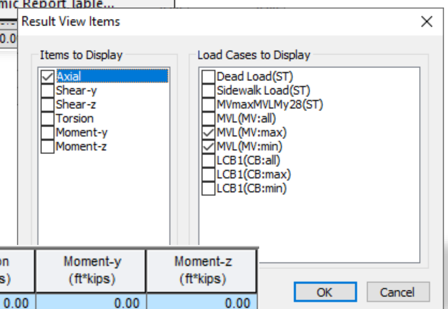


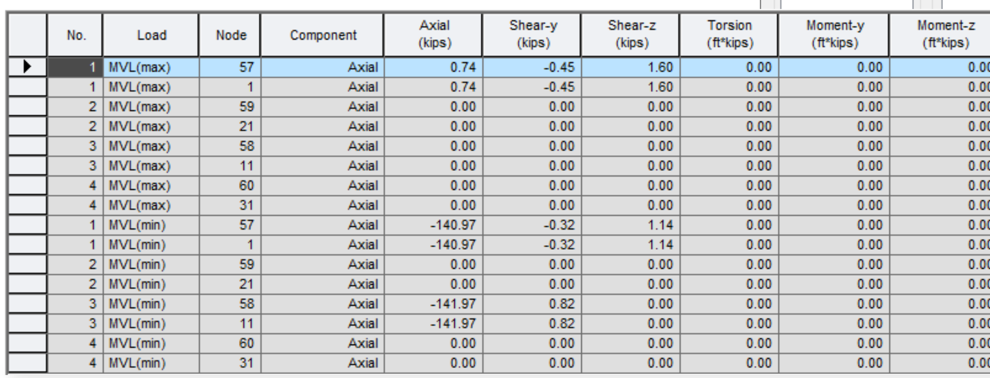
Moving Load Analysis Control



No.	Load	Node	Axial (kips)	Shear-y (kips)	Shear-z (kips)	Torsion (ft*kips)	Moment-y (ft*kips)
1	MVL(max)	57	0.74	13.19	49.60	0.00	0.00
1	MVL(max)	1	0.74	13.19	49.60	0.00	0.00
2	MVL(max)	59	0.00	0.00	0.00	0.00	0.00
2	MVL(max)	21	0.00	0.00	0.00	0.00	0.00
3	MVL(max)	58	0.00	13.89	0.00	0.00	0.00
3	MVL(max)	11	0.00	13.89	0.00	0.00	0.00
4	MVL(max)	60	0.00	0.00	0.00	0.00	0.00
4	MVL(max)	31	0.00	0.00	0.00	0.00	0.00
1	MVL(min)	57	-140.97	-13.89	-47.10	0.00	0.00
1	MVL(min)	1	-140.97	-13.89	-47.10	0.00	0.00
2	MVL(min)	59	0.00	0.00	0.00	0.00	0.00
2	MVL(min)	21	0.00	0.00	0.00	0.00	0.00
3	MVL(min)	58	-141.97	-13.19	0.00	0.00	0.00
3	MVL(min)	11	-141.97	-13.19	0.00	0.00	0.00
4	MVL(min)	60	0.00	0.00	0.00	0.00	0.00
4	MVL(min)	31	0.00	0.00	0.00	0.00	0.00

Elastic Link Force Table





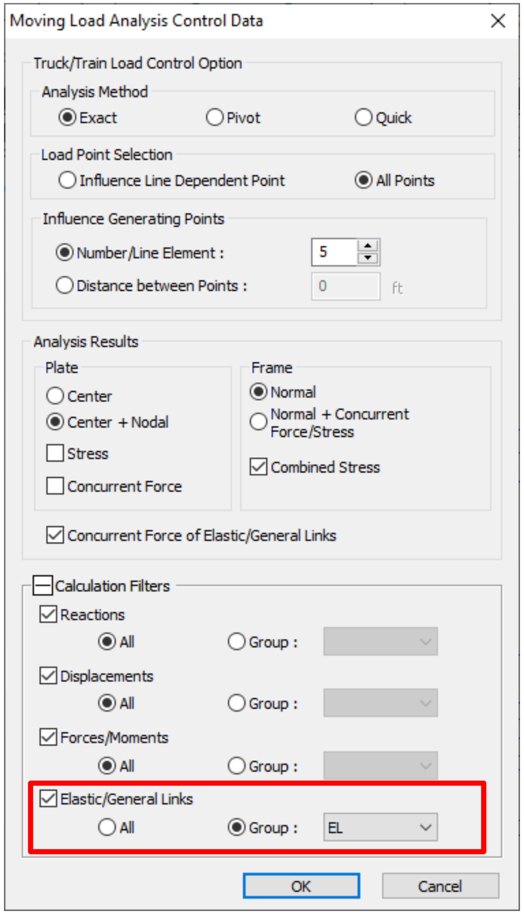
No.	Load	Node	Component	Axial (kips)	Shear-y (kips)	Shear-z (kips)	Torsion (ft*kips)	Moment-y (ft*kips)	Moment-z (ft*kips)
1	MVL(max)	57	Axial	0.74	-0.45	1.60	0.00	0.00	0.00
1	MVL(max)	1	Axial	0.74	-0.45	1.60	0.00	0.00	0.00
2	MVL(max)	59	Axial	0.00	0.00	0.00	0.00	0.00	0.00
2	MVL(max)	21	Axial	0.00	0.00	0.00	0.00	0.00	0.00
3	MVL(max)	58	Axial	0.00	0.00	0.00	0.00	0.00	0.00
3	MVL(max)	11	Axial	0.00	0.00	0.00	0.00	0.00	0.00
4	MVL(max)	60	Axial	0.00	0.00	0.00	0.00	0.00	0.00
4	MVL(max)	31	Axial	0.00	0.00	0.00	0.00	0.00	0.00
1	MVL(min)	57	Axial	-140.97	-0.32	1.14	0.00	0.00	0.00
1	MVL(min)	1	Axial	-140.97	-0.32	1.14	0.00	0.00	0.00
2	MVL(min)	59	Axial	0.00	0.00	0.00	0.00	0.00	0.00
2	MVL(min)	21	Axial	0.00	0.00	0.00	0.00	0.00	0.00
3	MVL(min)	58	Axial	-141.97	0.82	0.00	0.00	0.00	0.00
3	MVL(min)	11	Axial	-141.97	0.82	0.00	0.00	0.00	0.00
4	MVL(min)	60	Axial	0.00	0.00	0.00	0.00	0.00	0.00
4	MVL(min)	31	Axial	0.00	0.00	0.00	0.00	0.00	0.00

Concurrent Forces of Elastic Links

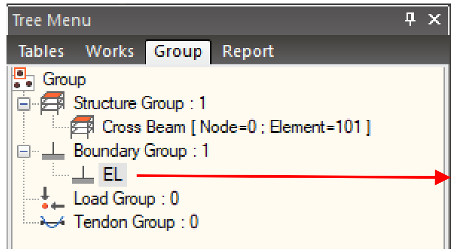
9. Analysis Filtering of Elastic Links and General Links in Moving Load Analysis

- The user can choose a group of Elastic Links and General Links to be analyzed for the moving load cases.
- This filter option makes the analysis time much shorter when there are a lot of Elastic Links / General Links in the model.

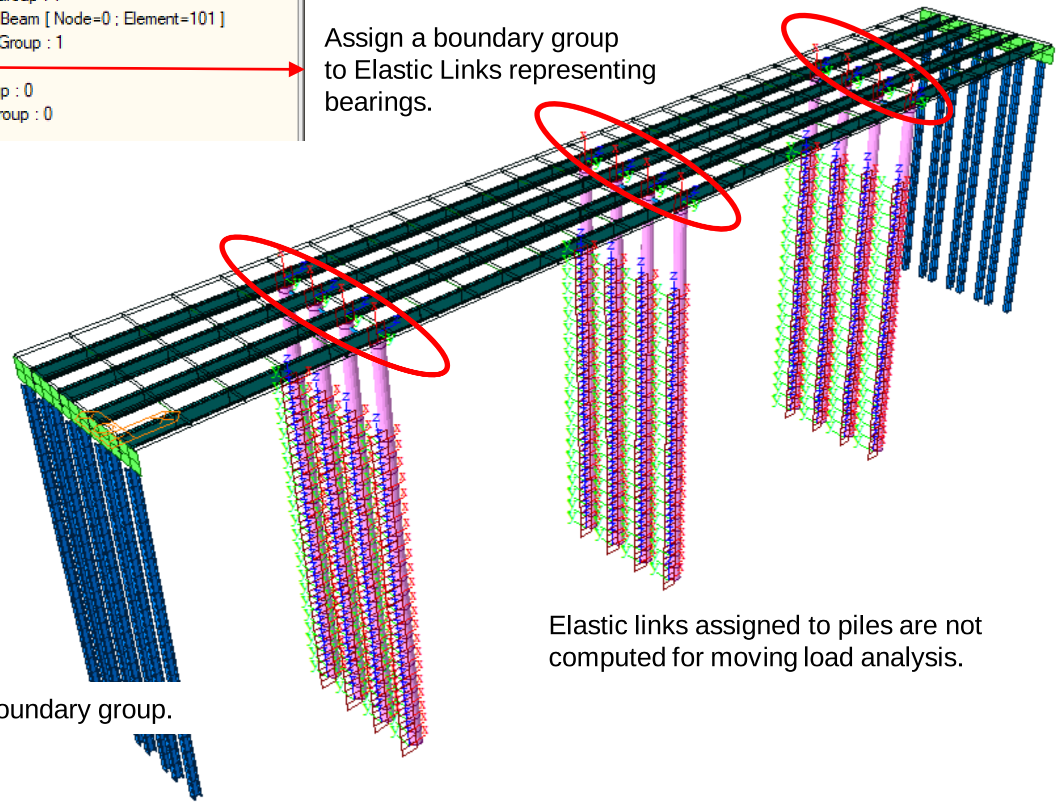
▪ ***Analysis > Analysis Control >*** ***Moving Load***



Moving Load Analysis Control



Assign a boundary group to Elastic Links representing bearings.



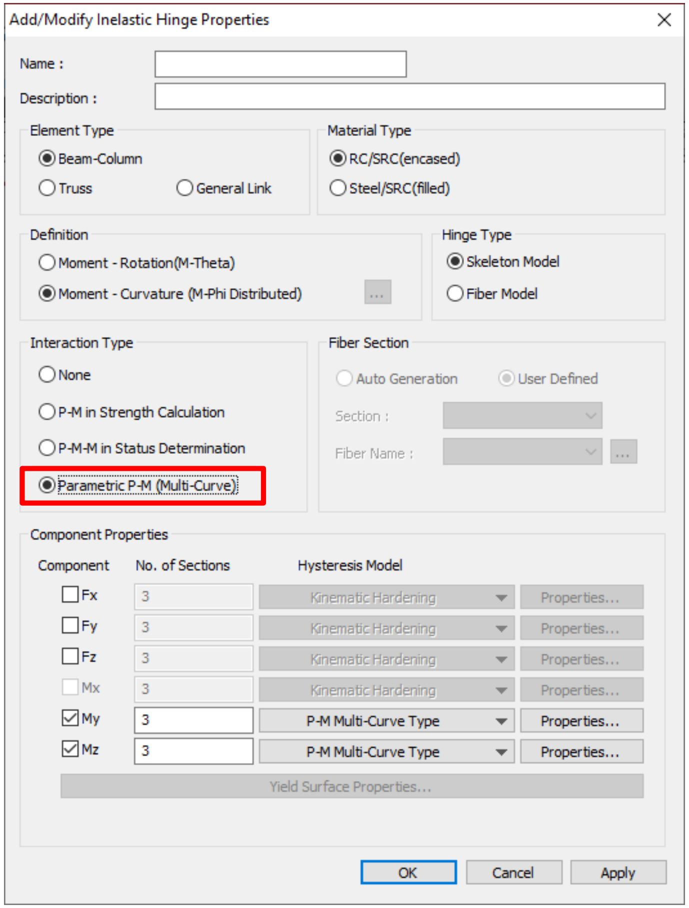
Select the boundary group.

Elastic links assigned to piles are not computed for moving load analysis.

10. New Inelastic Hinge Type: Parametric P-M (multi-curve)

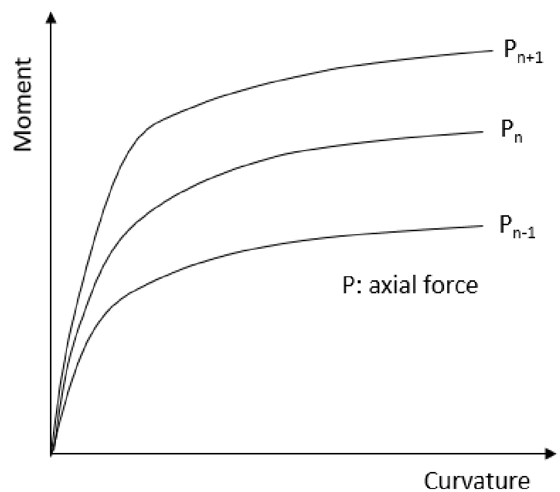
- Parametric P-M (multi-curve) is a new inelastic hinge type described by bending moment vs. curvature relationship which is a function of the axial force.
- Unlike the other types of hinge, the moment vs. curvature relationship can be defined by the user depending on the axial forces.

- ***Properties > Inelastic Properties > Inelastic Hinge***



Inelastic Hinge Properties

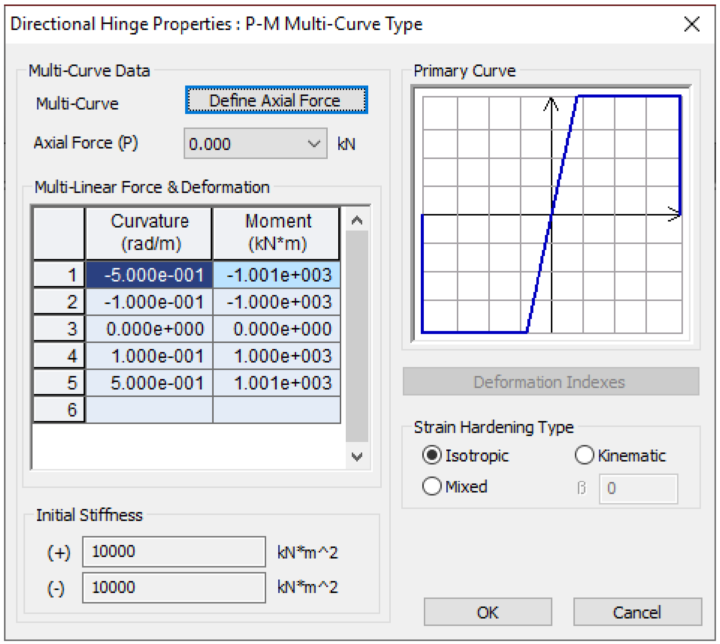
- The flexural behavior of the beam element is described by bending moment vs. curvature relationship. This relationship is input in the form of multilinear functions. The moment vs. curvature relationship is a function of the axial force.
- The flexural behavior of the beam element is defined by two bending vs. curvature relationships, one for each principal plane of inertia. Interaction between the two bending moments (My and Mz) are not taken into account.



10. New Inelastic Hinge Type: Parametric P-M (multi-curve) continued

- Ultimate positive and negative curvature can be specified.
- This hinge type can be applied to nonlinear static or nonlinear time history analysis.

▪ ***Properties > Inelastic Properties > Inelastic Hinge***



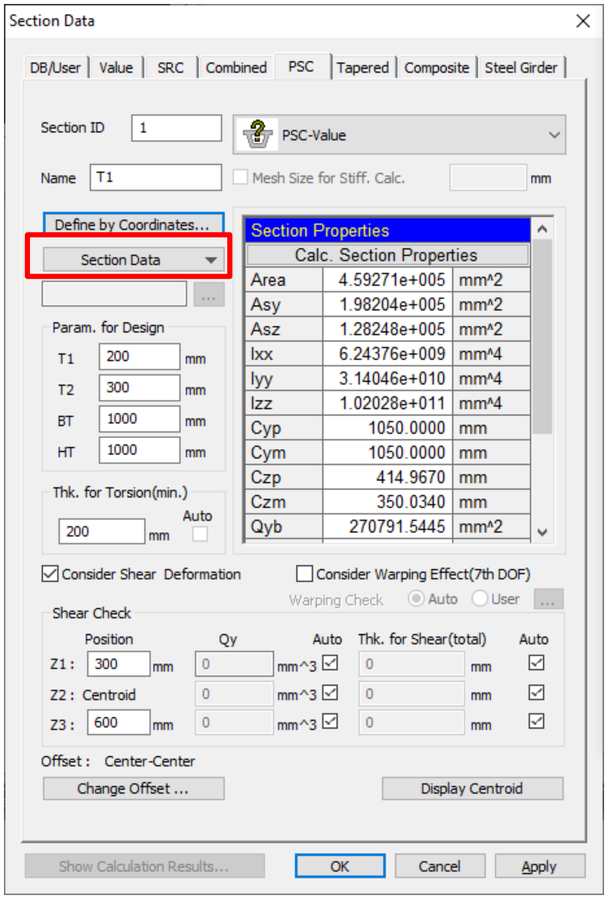
P-M Multi-Curve Type

- P-M Multi-Curve Type allows for bilinear and multilinear plasticity.
- The first data point corresponds to negative rupture and the last data point corresponds to positive rupture. One data point – the zero point – must be at the origin. A different number of data points can be used for the positive and negative sections of the curve.
- Moment and curvature relationship can depend on the axial force and the dependence can be different in tension and in compression. The number of axial forces must be two at least.
- To obtain the bending moment-curvature curve for a level of axial force not input, interpolation is used. This interpolation is performed, not on the bending moment-curvature curves, but on the moment-plastic curvature curves. The moment-plastic curvature curves are automatically calculated from the bending moment-curvature curves.
- Strain hardening can be isotropic, kinematic or mixed. The moment-curvature relationship can either be symmetric or non-symmetric. Whether it is symmetric or non-symmetric, entire moment-curvature curve should be entered.

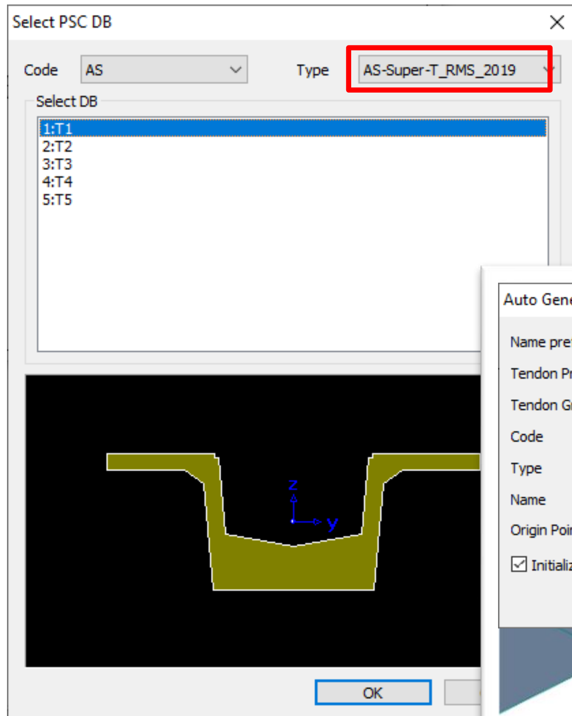
11. Precast Concrete Girder Section Database Update: AS-Super T RMS 2019

- AS-Super T RMS 2019 T1, T2, T3, T4, T5
- This section database is also updated in the Tendon Template.

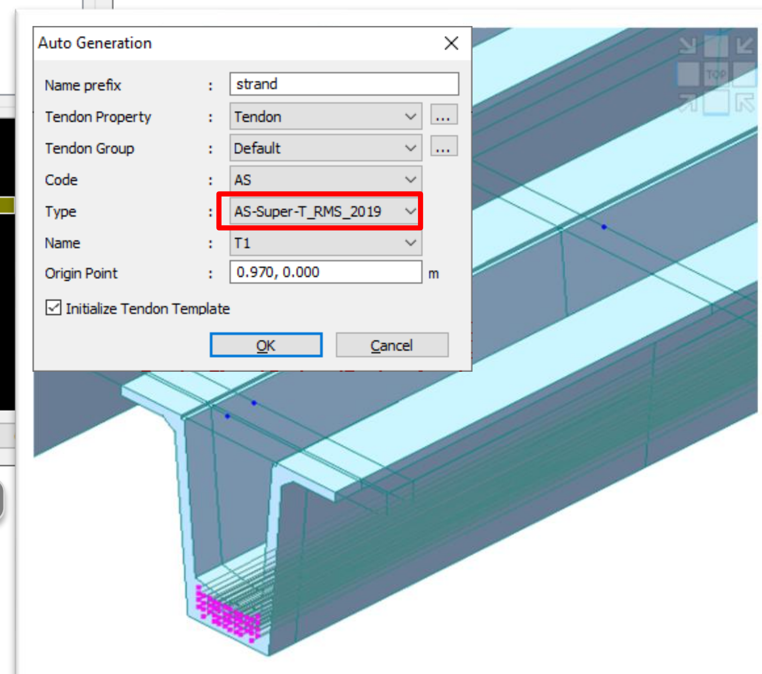
- ***Properties > Section > PSC***



Section Data



AS-Super-T RMS 2019 DB

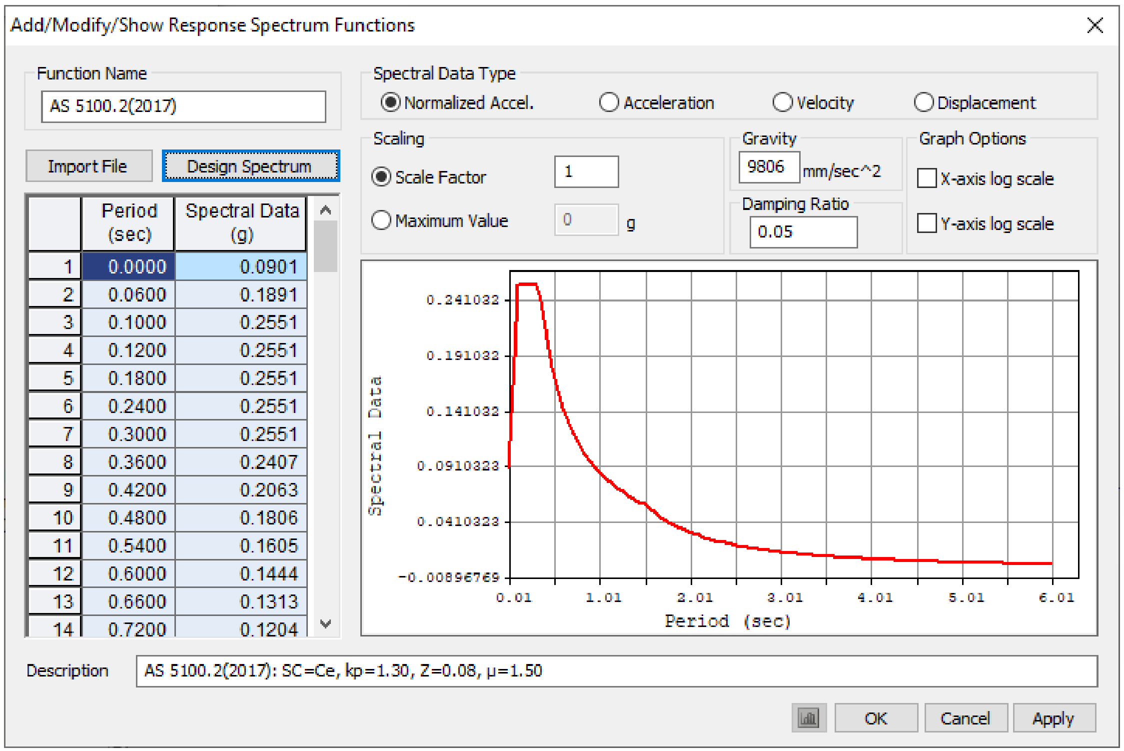


Tendon Template

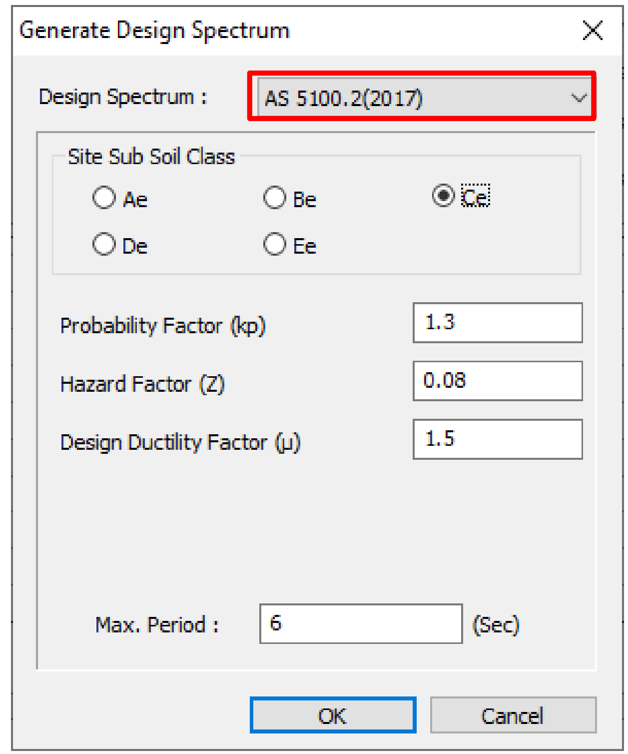
12. Response Spectrum Function: AS 5100.2: 2017

- Response spectrum function as per AS 5100.2: 2017

- ***Load > Response Spectrum Data >*** ***RS Functions***



Response Spectrum Functions

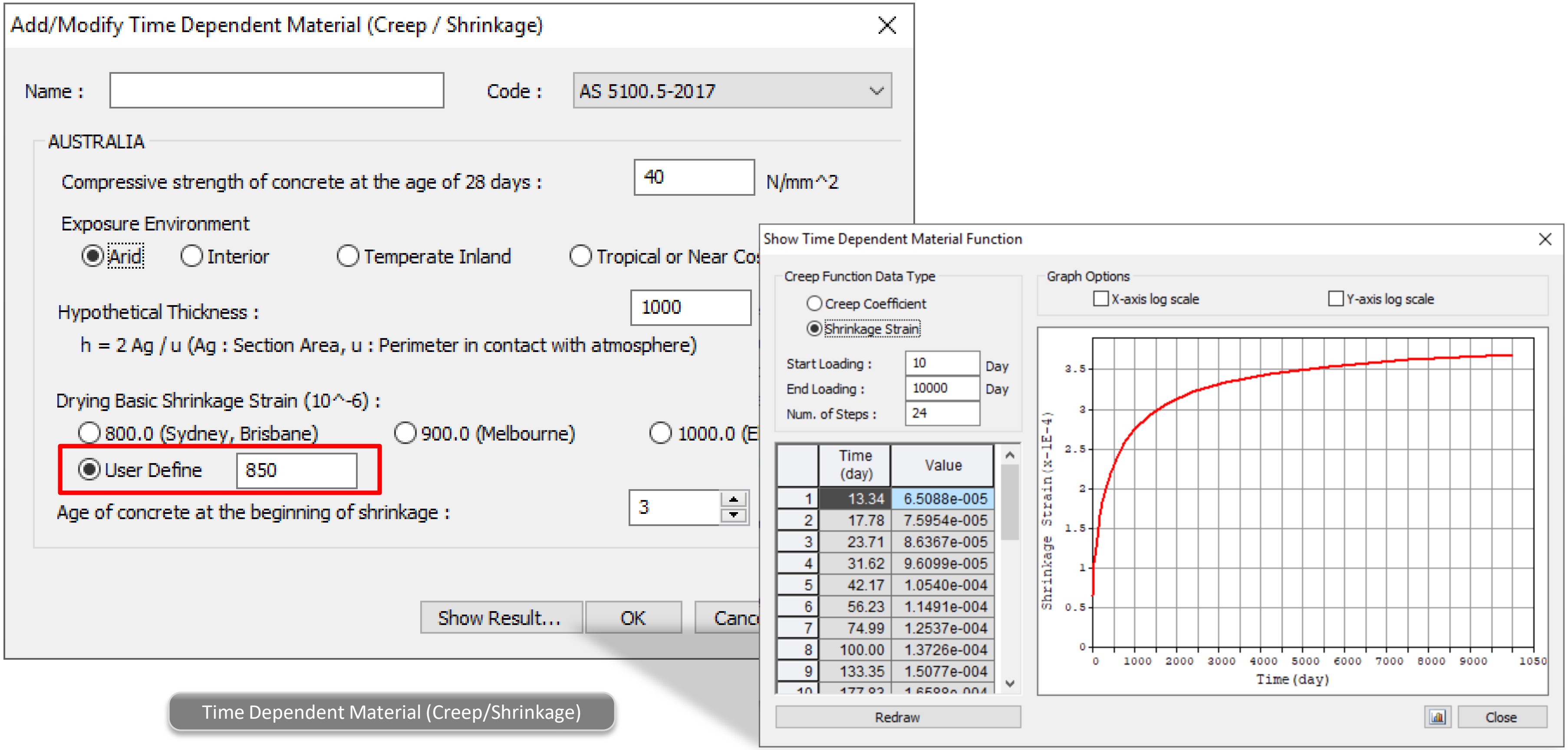


Design Spectrum

13. User-Defined Drying Basic Shrinkage Strain: AS 5100.5-2017

- The development of shrinkage strain can be defined using user-defined drying basic shrinkage strain as well as recommended values for each cities when applying AS 5100.5-2017.

- ***Properties > Time Dependent Material > Creep/Shrinkage***



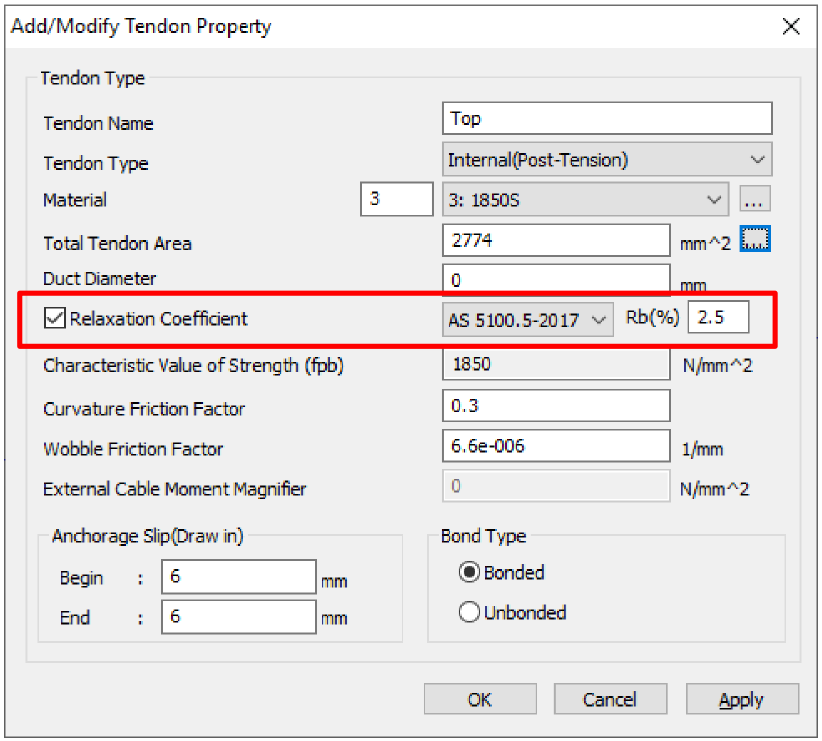
Time Dependent Material (Creep/Shrinkage)

Shrinkage development

14. Relaxation of Tendons: AS 5100.5-2017

- Prestress loss due to the relaxation of tendon is calculated as per equation 3.3.4.3 of AS 5100.5-2017 using user-defined basic relaxation, Rb.
- Rb(%) is the basic % relaxation of a tendon at 1,000 hour.

- ***Load > Load Type > Temp./Prestress***
- ***Load > Prestress Loads > Tendon Property***



Tendon Property

3.3.4.2 *Basic relaxation*

The basic relaxation of a tendon (R_b) after one thousand hours at 20°C and $0.8f_{pb}$ shall be determined in accordance with AS/NZS 4672.1.

3.3.4.3 *Design relaxation*

Subject to Clause 3.3.4.4, the design relaxation of a tendon (R) shall be determined from the following equation:

$$R = k_6\, k_7\, k_8\, R_b \qquad \ldots 3.3.4.3$$

where

k_6 = a coefficient, dependent on the duration of the prestressing force

= $\log\,[5.4(j)^{1/6}]$

j = time after prestressing, in days

k_7 = a coefficient, dependent on the stress in the tendon as a proportion of f_{pb}, determined from Figure 3.3.4.3

k_8 = a coefficient, dependent on the average annual temperature (T) in degrees Celsius, taken as $T/20$ but not less than 1.0

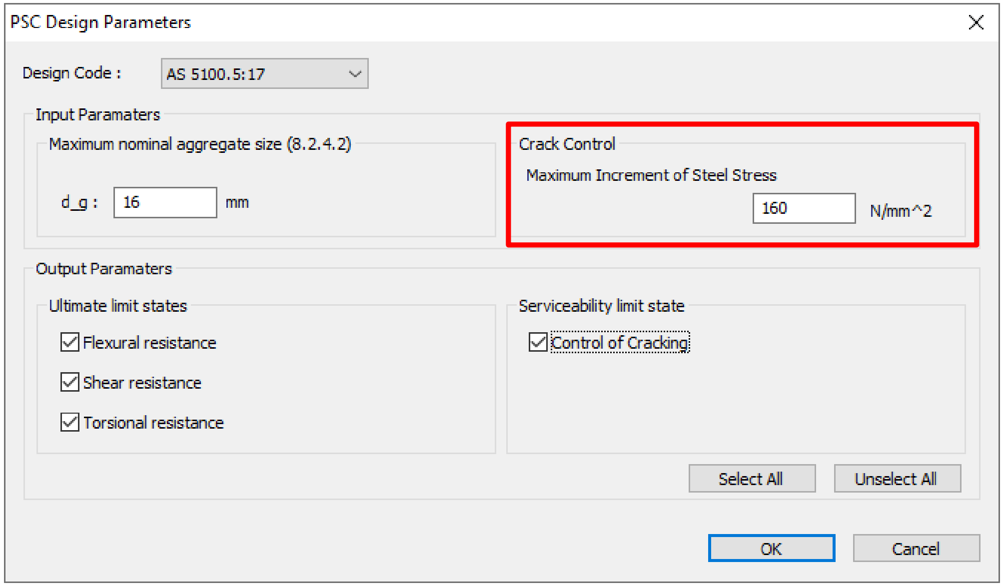
R_b = basic relaxation of a tendon after one thousand hours at 20°C, as specified in Clause 3.3.4.2

AS 5100.5-2017 Specification

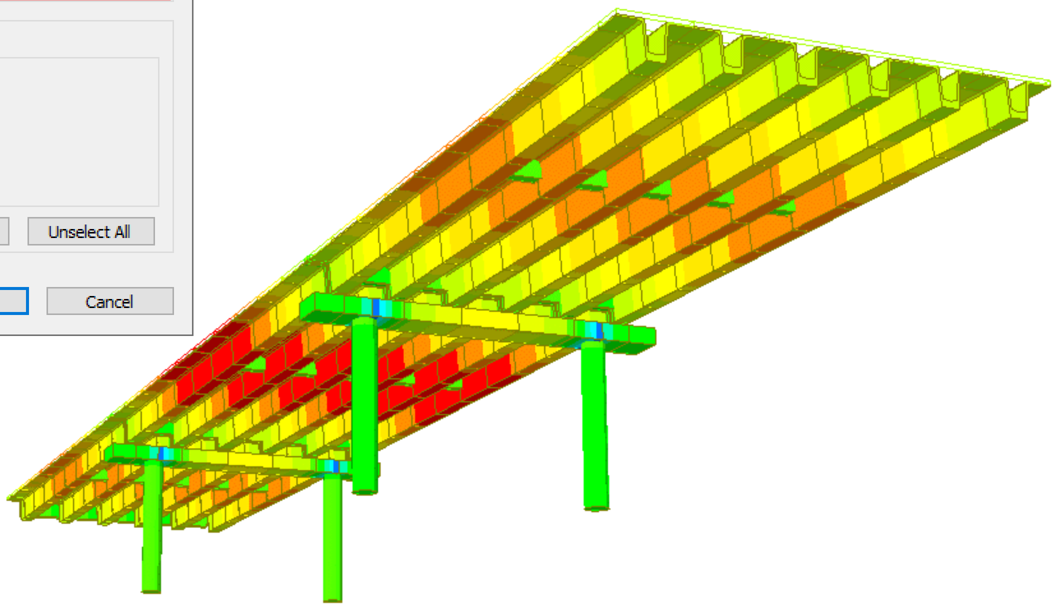
15. User-Defined Stress Limit for Crack Check: AS 5100.5-2017

- For the crack control for flexure in prestressed beams, the maximum increment of steel stress was fixed as 160 MPa in the previous version.
- Now, it can be defined by the user.

▪ ***PSC > Design Parameter > AS 5100.5: 17***



PSC Design parameter

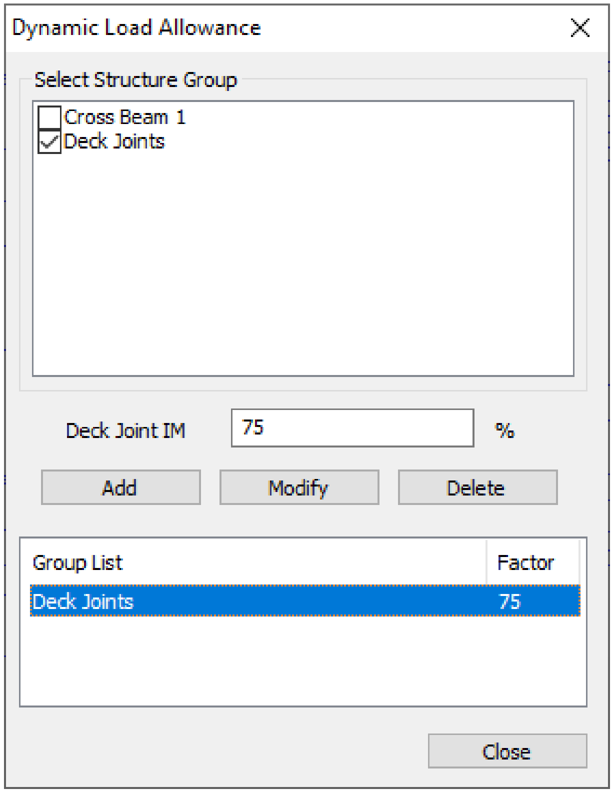


Super T Girder Bridge

16. Dynamic Load Allowance for Expansion Joint: AASHTO LRFD

- Dynamic load allowance is defined in the Vehicle dialog in the moving load analysis by AASHTO LRFD.
- Different dynamic load allowance can now be applied to a separate structure group using this new feature.

- ***Load > Load Type > Moving Load > Moving Load Code > AASHTO LRFD***
- ***Load > Moving Load Analysis Data > Dynamic Load Allowance***

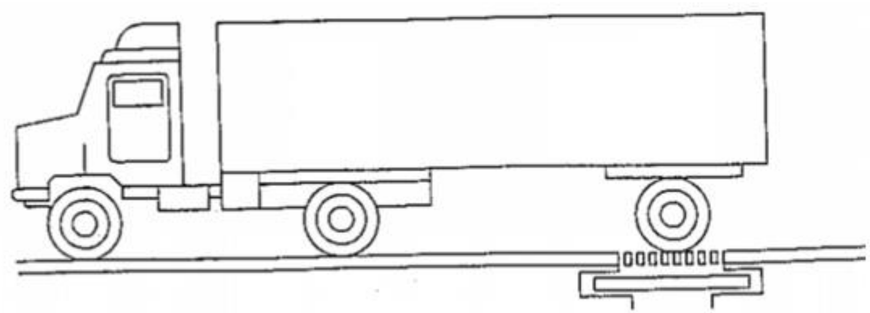


Dynamic Load Allowance

Table 3.6.2.1-1—Dynamic Load Allowance, *IM*

Component	IM
Deck Joints—All Limit States	75%
All Other Components:	
• Fatigue and Fracture Limit State	15%
• All Other Limit States	33%

AASHTO LRFD Specification

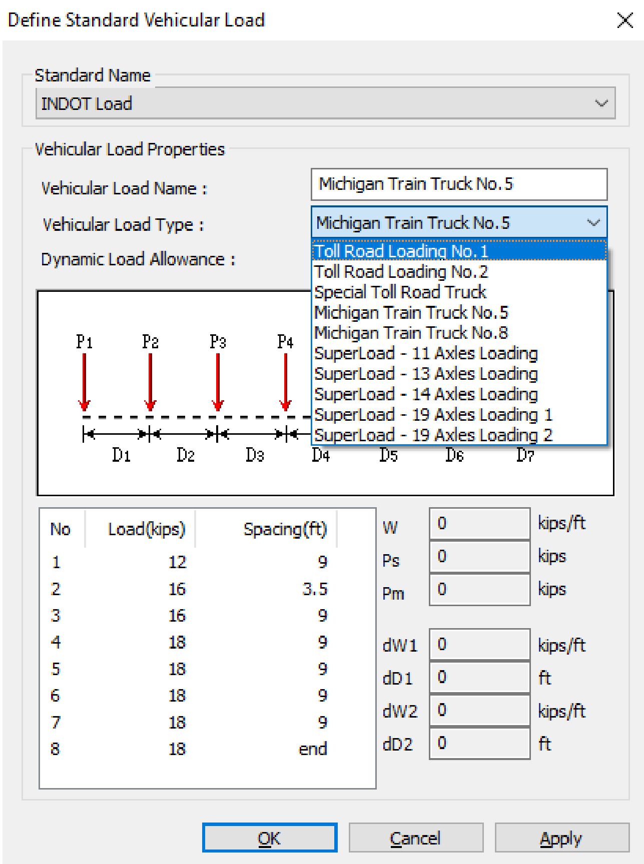


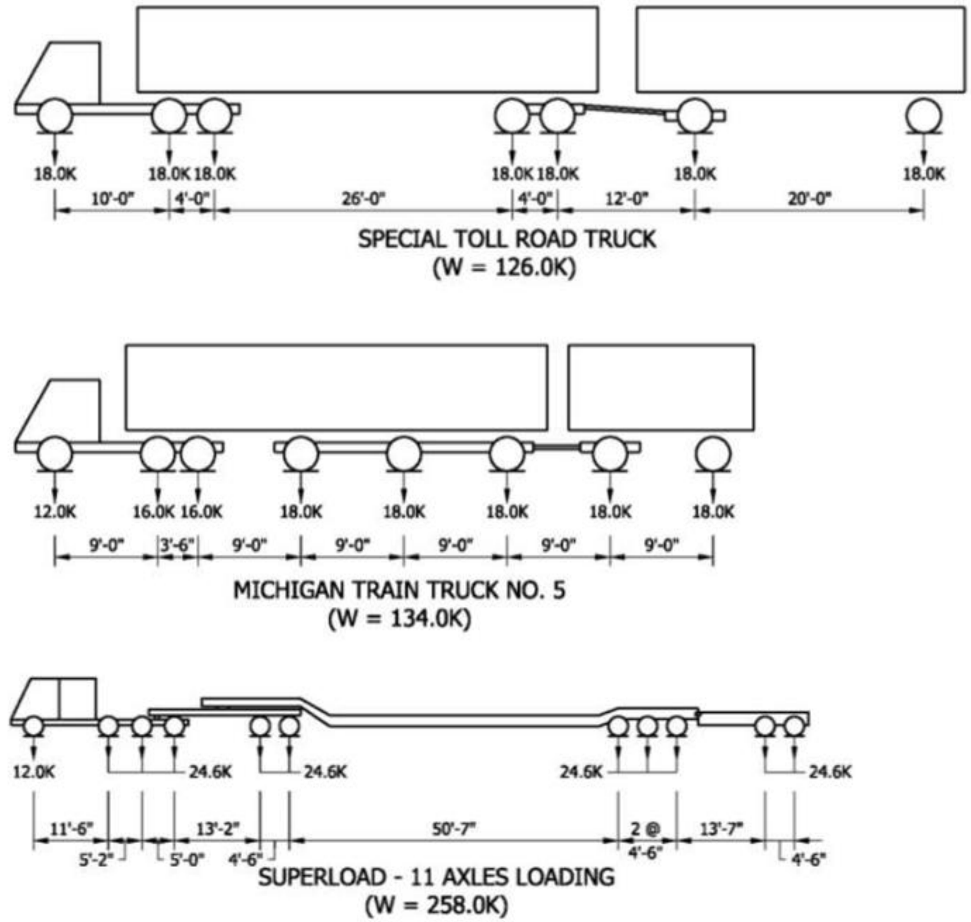
Truck loads on the deck joint

17. Standard Vehicles: Indiana Department of Transportation

- Toll Road Loading No.1, Toll Road Loading No.2, Special Toll Road Truck, Michigan Train Truck No.5, Michigan Train Truck No.8
- SUPERLOAD - 11 Axles Loading, SUPERLOAD - 13 Axles Loading, SUPERLOAD - 14 Axles Loading, SUPERLOAD - 19 Axles Loading 1, SUPERLOAD - 19 Axles Loading 2

- ***Load > Load Type > Moving Load > Moving Load Code >*** ***AASHTO LRFD***
- ***Load > Moving Load Analysis Data >*** ***Vehicles***



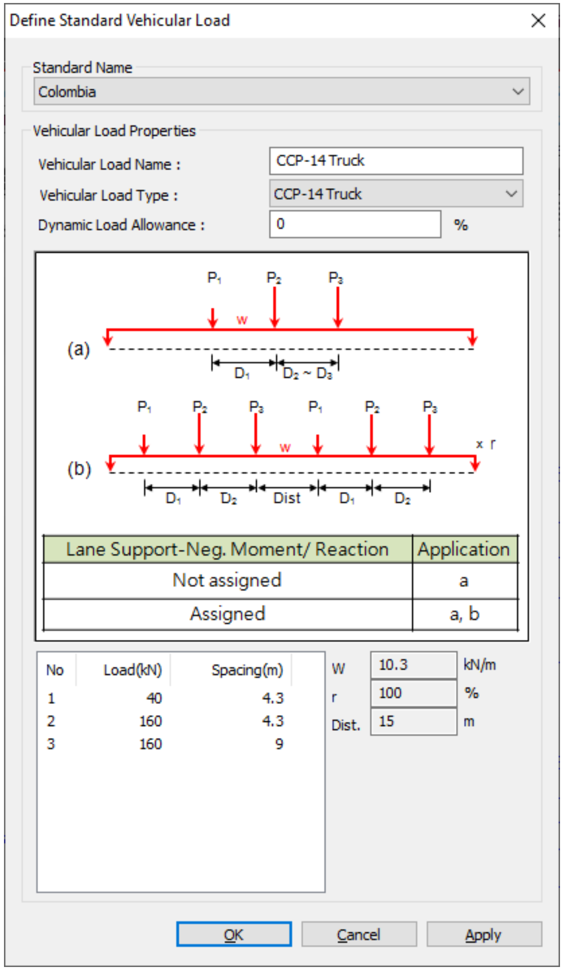


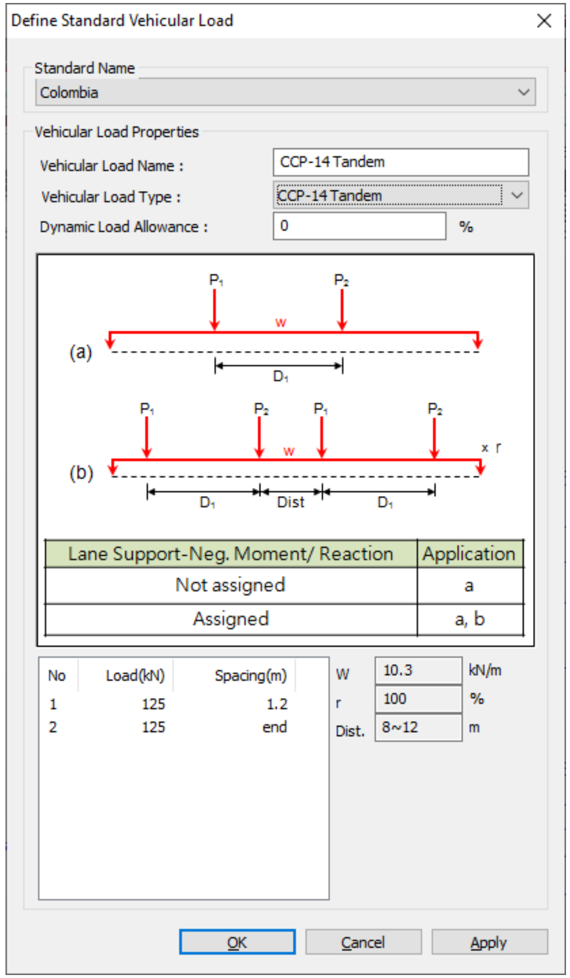
INDOT Load Rating Vehicles

18. Standard Vehicles: Colombian CCP-14

- CCP-14 Truck, CCP-14 Tandem

- ***Load > Load Type > Moving Load > Moving Load Code > AASHTO LRFD, Load > Moving Load Analysis Data > Vehicles***





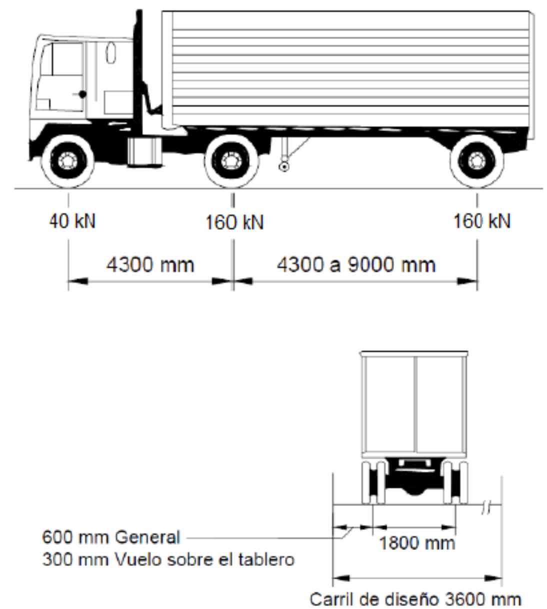
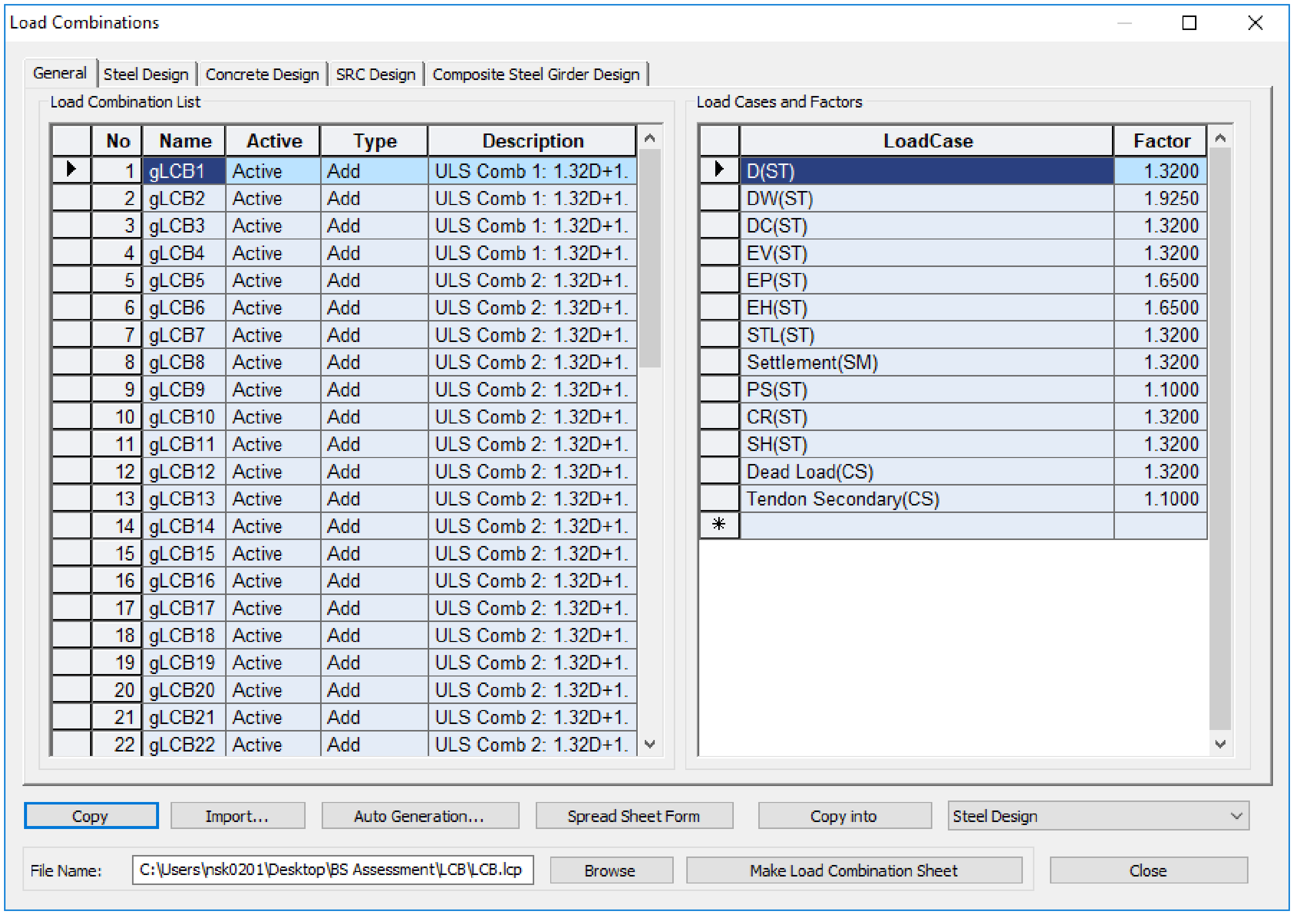


Figura 3.6.1.2.2-1 — Características del Camión de Diseño

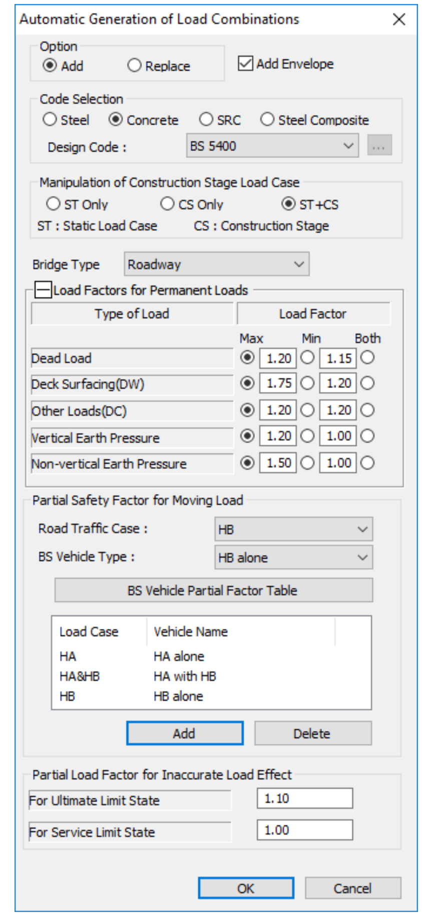
19. Auto-Generation of Load Combination: BS 5400

- Auto-generation of load combinations with respect to BS 5400 is now available for concrete structures.

■ ***Results >*** ***Load Combination***



ULS and SLS combinations



Selecting BS 5400 for Auto Load Combinations

20. Design Report in Czech

- The design reports are provided in Czech for the composite steel girder design and prestressed concrete girder design as per Eurocode.

- ***Design > Composite Design > Excel Report, PSC > PSC Design > Excel Report***

1 **Podmínky návrhu**

1.1 Návrhové parametry

■ Dílčí součinitele

γ_C pro beton	1.50	γ_V pro spřahovací trny	1.25
γ_S pro betonářskou výztuž	1.15	γ_{Ff} pro ekvivalentní konstantní rozkmit napětí	1.00
γ_{M0} pro konstrukční ocel	1.00	γ_{Mf} pro únavovou pevnost	1.00
γ_{M1} pro konstrukční ocel	1.10	$\gamma_{Mf,s}$ pro únavovou pevnost trnů ve smyku	1.00

1.2 Materiálové informace

■ Konstrukční ocel

f_{sk} = 355.000 MPa E_s = 205000.000 MPa

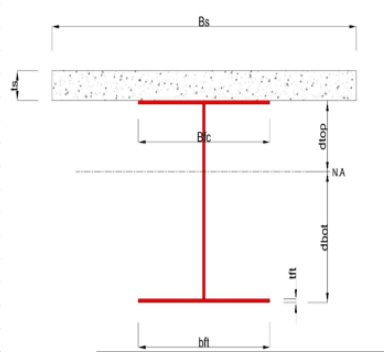
■ Beton

f_{ck} = 40.000 MPa E_{cm} = 35220.462 MPa

■ Výztuž

f_{yk} = 400.000 MPa E_r = 205000.000 MPa

1.3 Informace o průřezu



Elem_172_i | Elem_172_j

Design Report – EN 1994-2

1.Nastavení posudku

1.1 Návrhové parametry

- Dílčí součinitele pro mezní stav únosnosti (EN 1992-1-1:2004, 2.4.2.4)

Návrhové situace	γ_c beton	γ_s betonářská výztuž	γ_s předpjatá výztuž
Trvalé & Dočasné	1.500	1.150	1.150
Mimořádné	1.200	1.000	1.000

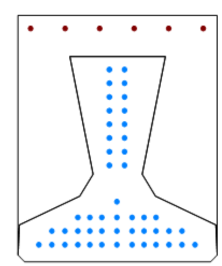
- součinitel α_{cc}, α_{ct} : Součinitel pro dlouhodobé účinky únosnosti v tlaku a tahu.

α_{cc} = 0.850 (pro únosnost betonu v tlaku)

α_{ct} = 1.000 (pro únosnost betonu v tahu)

1.2 Průřezy

Průřezové charakteristiky		Ekviv. průř. (kab., výzt.) (Nosník)	Ekviv. průř. (Po spřažení) (Nosník + Deska)
A	(mm^2)	301674.143	663314.768
I_y	(mm^4)	19347928584.907	45420636187.532
y_{st}	(mm)	-	460.290
y_{sb}	(mm)	-	414.710
y_t	(mm)	469.682	310.261
y_b	(mm)	280.318	439.739
Z_{st}	(mm^3)	-	98678220.689
Z_{sb}	(mm^3)	-	109523952.519
Z_t	(mm^3)	39392059.949	146394744.529
Z_b	(mm^3)	20227260.040	103290078.773



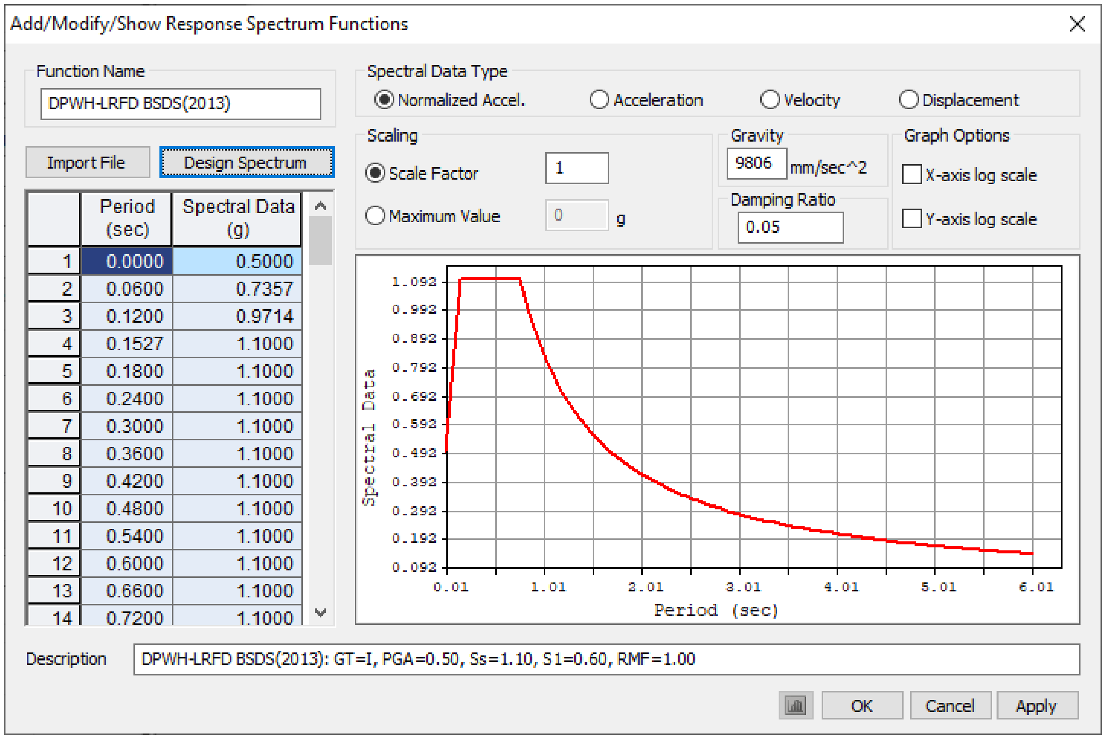
7_I | 264_I | Bending Resistance | Shea ...

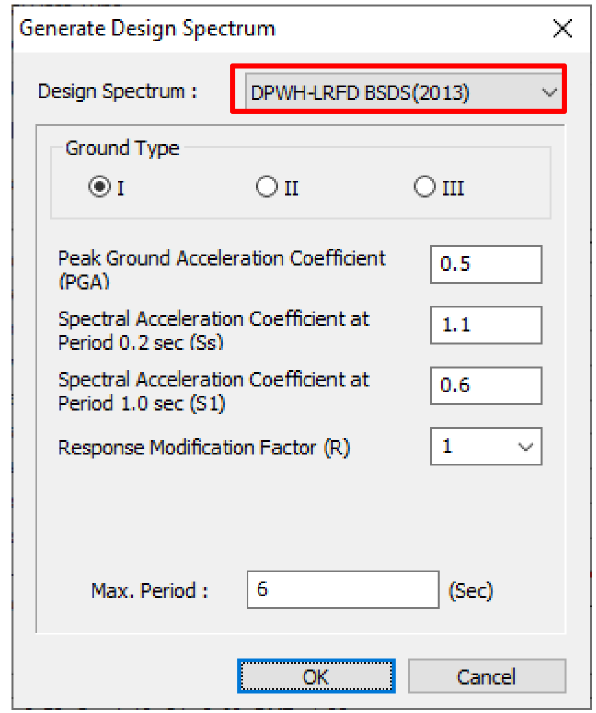
Design Report – EN 1992-2

21. Response Spectrum Function: Philippines DPWH-BSDS 2013

- Department of public works and highways bridge seismic design specifications 2013, Philippines

- ***Load > Response Spectrum Data > RS Functions***





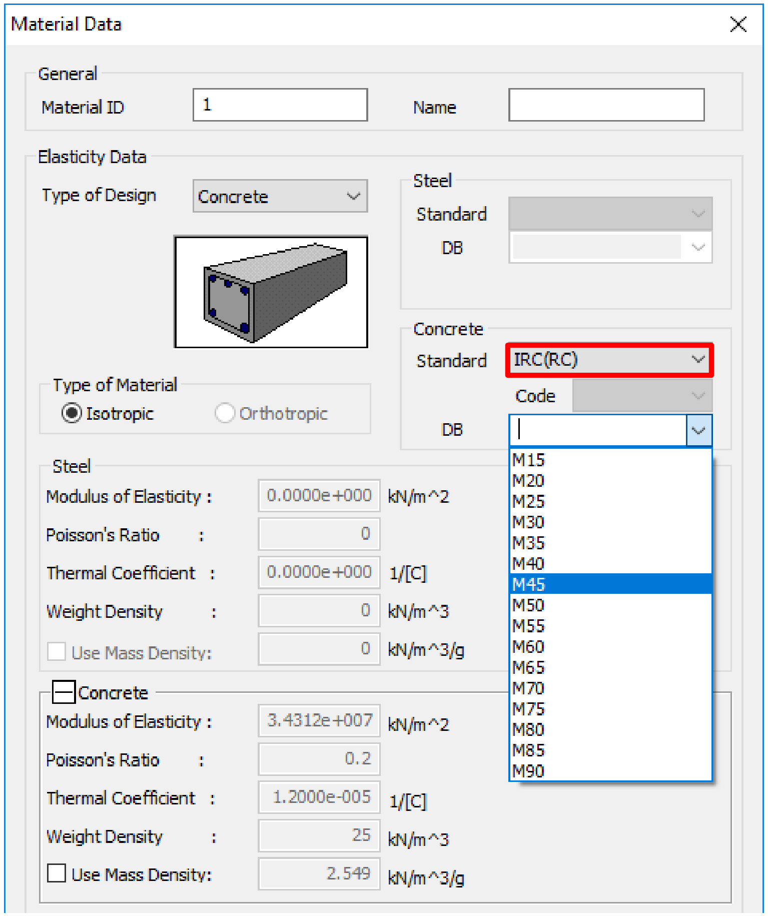
Response Spectrum Functions

Design Spectrum

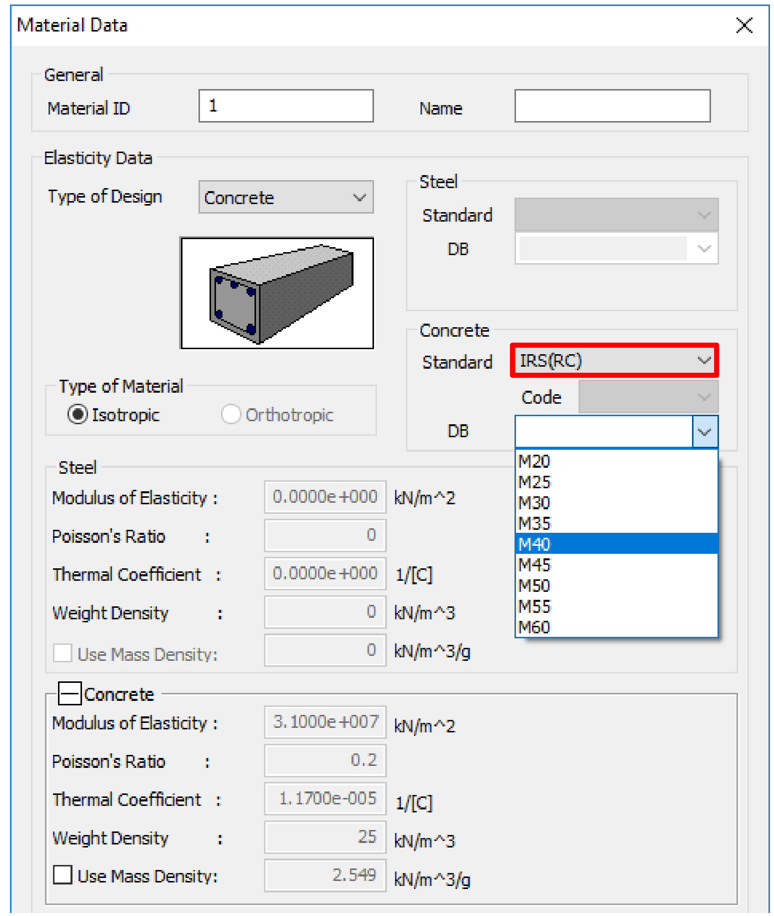
22. India Material Database Update

- Concrete: IRC:112-2011, IRS Concrete Bridge Code

- ***Properties > Material > Concrete***



IRC:112-2011

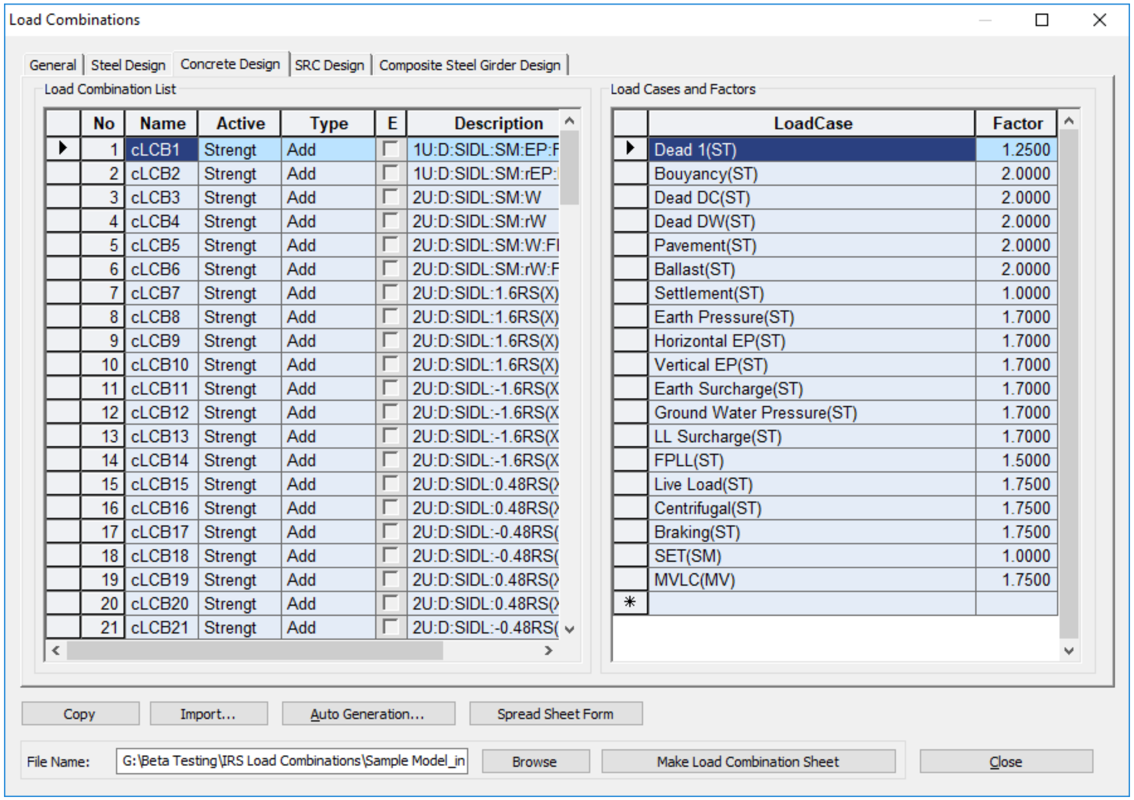


IRS Concrete Bridge Code

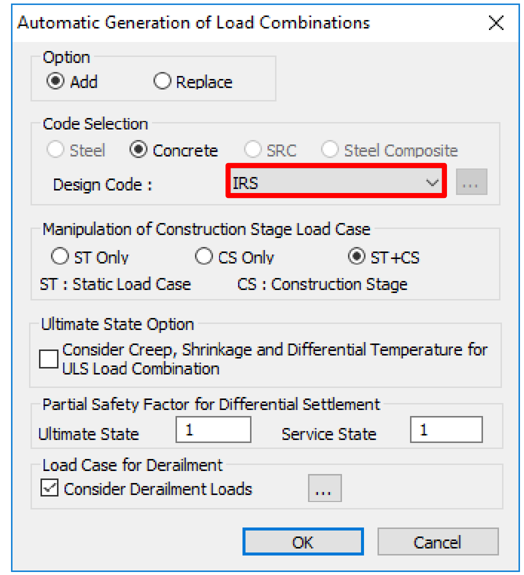
23. IRS Load Combination

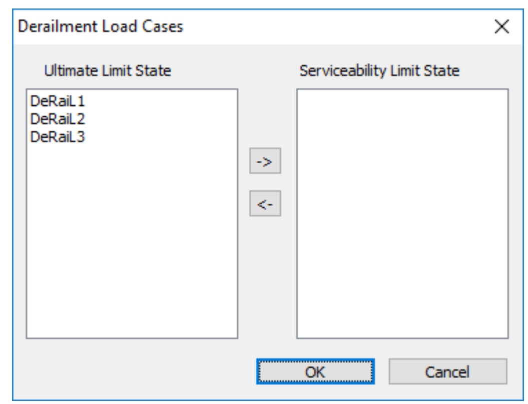
- Load combination can now be auto-generated based on recommendations in IRS Concrete Bridge Code, including derailment loads
- These load combination could be used for IRS PSC design

- ***Results > Load Combination***



Load Combination dialogue box

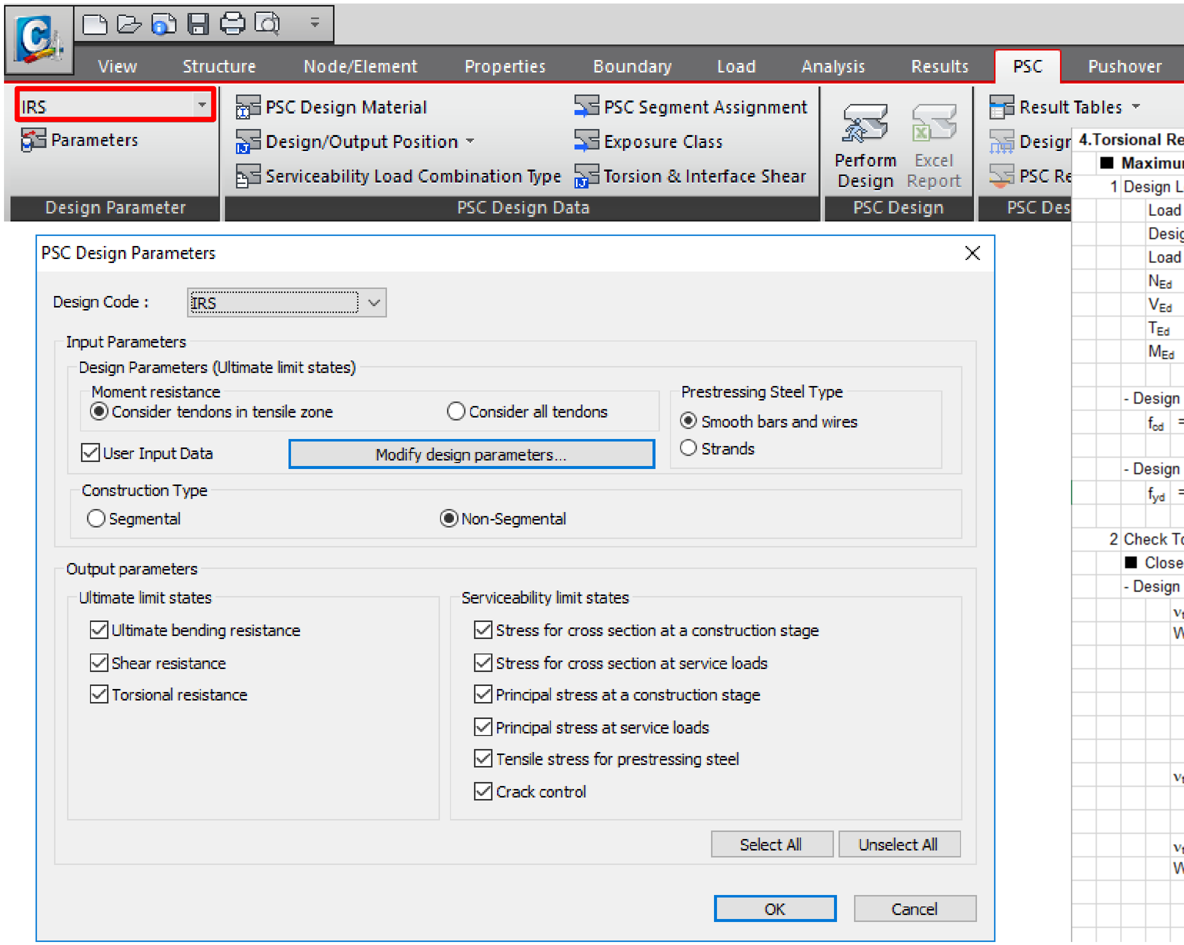




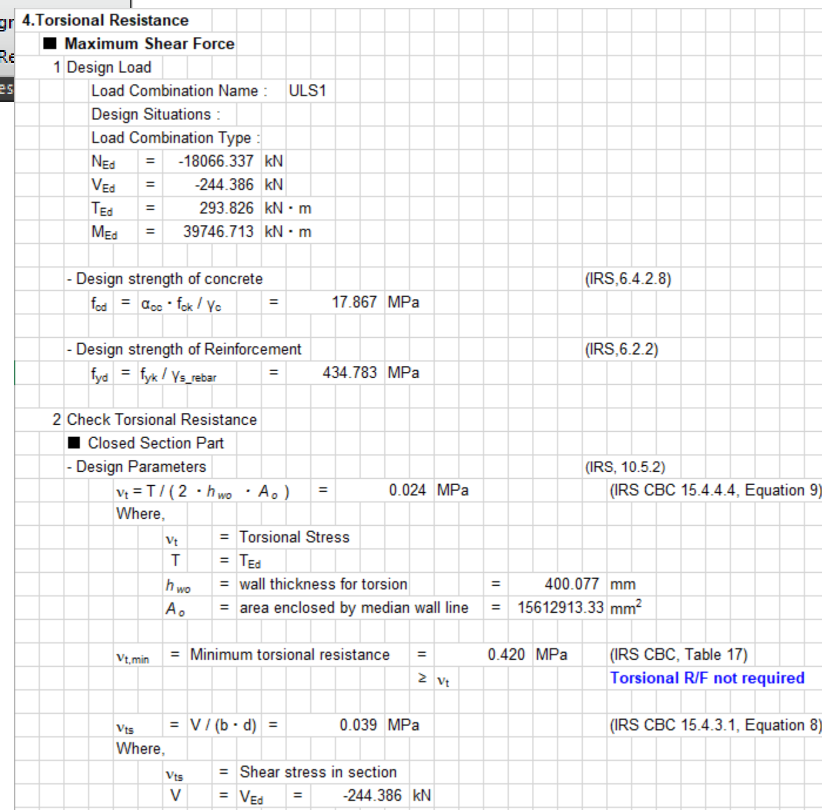
24. Prestressed Concrete Design by IRS Concrete Bridge Code

- Prestressed concrete girder design by IRS Concrete Bridge Code is now available.

▪ ***PSC > Design Parameter > Parameters > IRS***



Input & Output parameters



4.Torsional Resistance

■ Maximum Shear Force

1 Design Load

Load Combination Name : ULS1

Design Situations :

Load Combination Type :

N_{Ed} = -18066.337 kN

V_{Ed} = -244.386 kN

T_{Ed} = 293.826 kN · m

M_{Ed} = 39746.713 kN · m

- Design strength of concrete (IRS,6.4.2.8)

$f_{cd} = \alpha_{cc} \cdot f_{ck} / \gamma_c$ = 17.867 MPa

- Design strength of Reinforcement (IRS,6.2.2)

$f_{yd} = f_{yk} / \gamma_{s\_rebar}$ = 434.783 MPa

2 Check Torsional Resistance

■ Closed Section Part

- Design Parameters (IRS, 10.5.2)

$v_t = T / (2 \cdot h_{wo} \cdot A_o)$ = 0.024 MPa (IRS CBC 15.4.4.4, Equation 9)

Where,

v_t = Torsional Stress

T = T_{Ed}

h_{wo} = wall thickness for torsion = 400.077 mm

A_o = area enclosed by median wall line = 15612913.33 mm^2

$v_{t,min}$ = Minimum torsional resistance = 0.420 MPa (IRS CBC, Table 17)

≥ v_t **Torsional R/F not required**

v_{ts} = V / (b · d) = 0.039 MPa (IRS CBC 15.4.3.1, Equation 8)

Where,

v_{ts} = Shear stress in section

V = V_{Ed} = -244.386 kN

Excel Report