# Release Note

Release Date : Dec. 2024

Product Ver. : CIVIL 2025 (v1.1)

# Enhancements

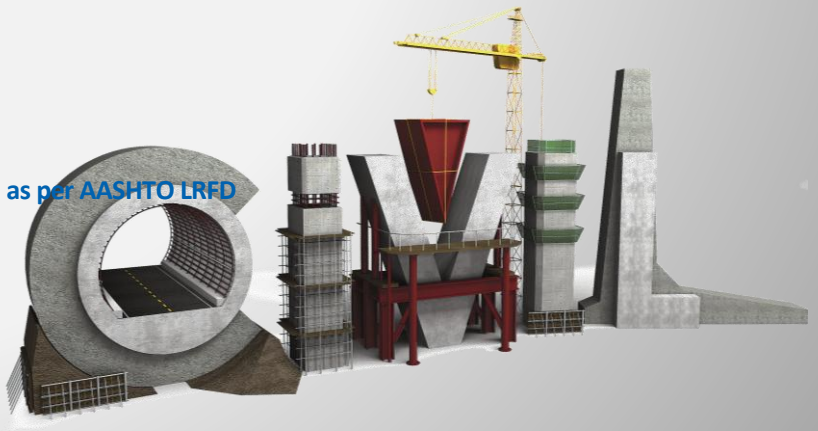
**Enhancements in CIVIL 2025 (v1.1)**

***- Pre & Post processing***

1. CQC 3 Directional Combination for Response Spectrum
2. Considering Elastic/General Link Forces in Moving Load Tracer
3. B-double rating vehicle as per AS 5100.7
4. Considering two trucks for substructure members or Elastic/General Link as per AASHTO LRFD Vehicle Loads
5. Moving patch load analysis as per AASHTO LRFD traffic loads
6. IRC Fatigue Vehicle
7. Time Dependent Materials as per SP/M/022 v 3.4, AS5100.5:2017(Amd 2:2024) and AS3600:2018(Amd 2)
8. Addition of Response Spectrum Function as per DPT.1301/1302-61:2018 and Eurocode Malaysia NA
9. Addition of H and Channel shape section database as per EN 10365
10. Addition of new Design Spectrum Database in Artificial Earthquake Data Generator
11. Addition of Element Stiffness Scale Factor

***- Design***

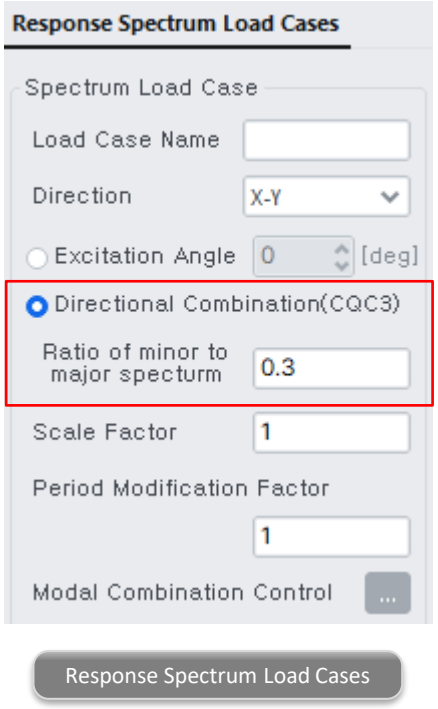
12. RC Design for 1D Beam & Column, Plate Beam & Column as per BS 5400
13. RC & Steel Design as per CSA S6:19
14. Response Modification Factor by members and components as per AASHTO LRFD
15. Addition of an option “Long-term Section Property of Cracked Composite Section: Rebar Area/3” as per AASHTO LRFD



## 1. CQC 3 Directional Combination for Response Spectrum

- The CQC3 rule has been developed to estimate the peak value of the combined response due to simultaneous application of the principal components of ground motion.
- The user defines the ratio ($\gamma$) of minor to major spectrum, and the program finds the critical angle and provides the maximum response for each component.

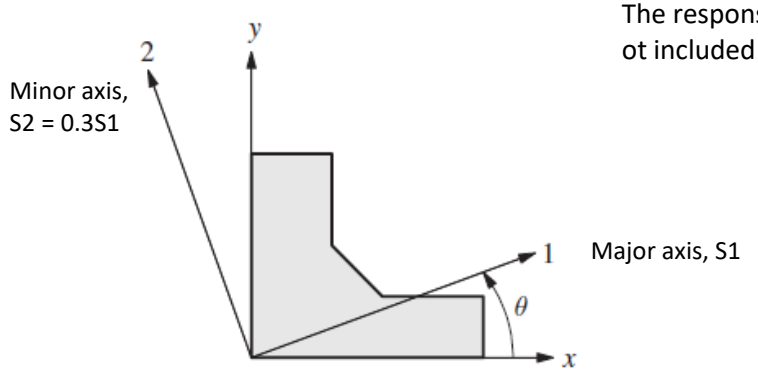
- ***Load > Dynamic Loads > RS Load Cases***




$$\theta_{cr} = \frac{1}{2}\tan^{-1}\left(\frac{2r_{xy}}{r_x^2 - r_y^2}\right)$$

$$r_{cr} \equiv r_{max} \simeq \left[(1+\gamma^2)\left(\frac{r_x^2 + r_y^2}{2}\right) + (1-\gamma^2)\sqrt{\left(\frac{r_x^2 - r_y^2}{2}\right)^2 + r_{xy}^2} + r_z^2\right]^{1/2}$$

The responses due to vertical ground motion, $r_z$ are n ot included in the CQC3 results.

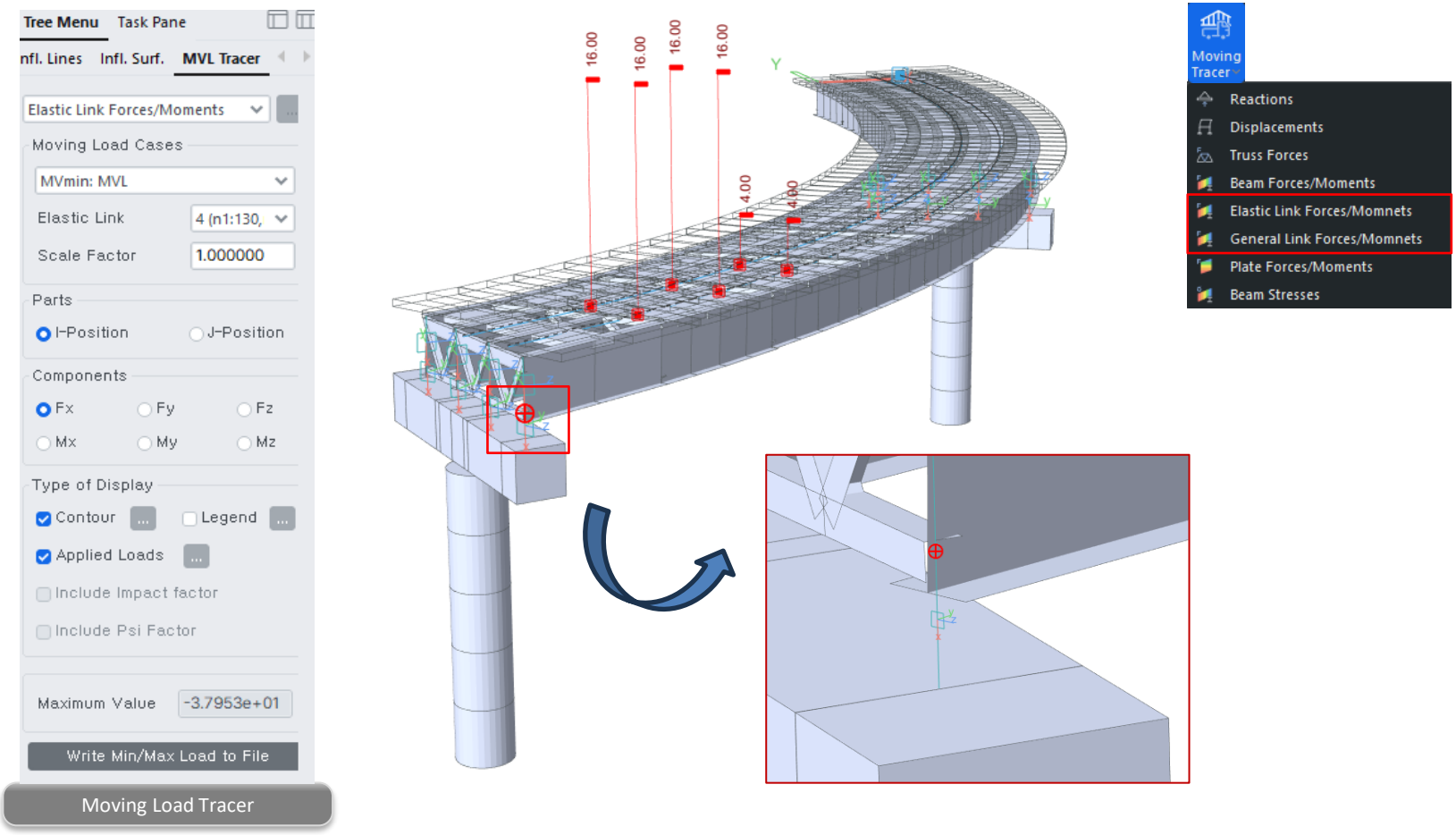



1 and 2: principal axes of ground motion

## 2. Considering Elastic/General Link Forces in Moving Load Tracer

- Bridge bearings are often simulated with Elastic Links or General Links to represent the stiffness of the bearings.
- Now, Moving Load Tracer supports Elastic Links and General Links to find the critical position of the vehicle loads and to convert it into equivalent static loads.

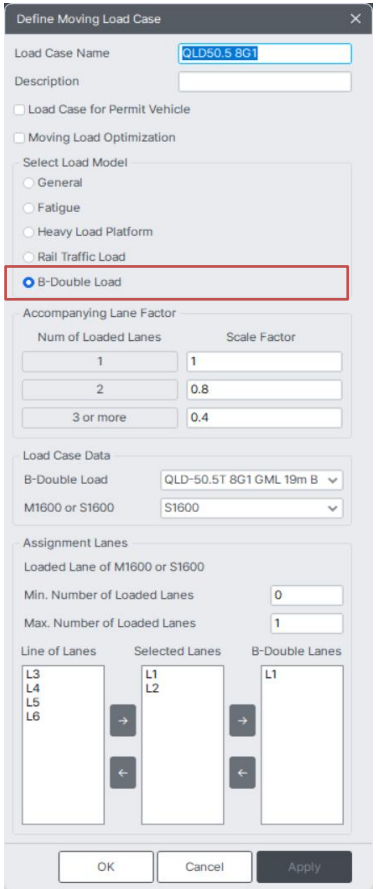
- ***Results > Analysis Result > Moving Tracer > Elastic Link Forces/Moments***
- ***Results > Analysis Result > Moving Tracer > General Link Forces/Moments***



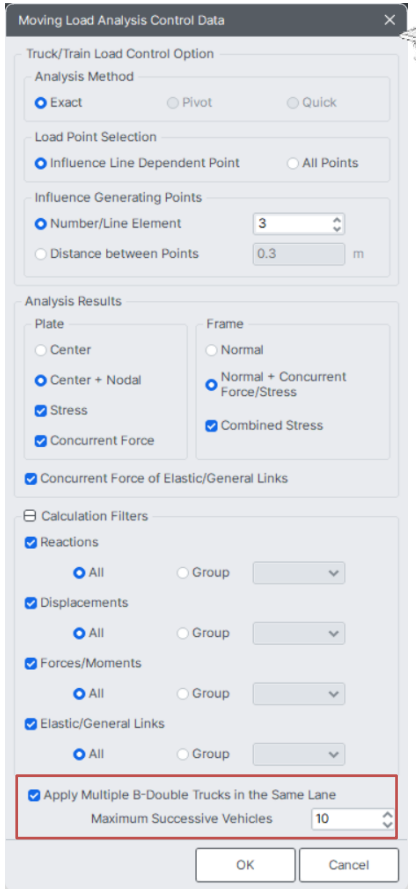
## 3. B-double rating vehicle as per AS 5100.7

- A B-double is defined in the Heavy Vehicle National Law (HVNL) as a combination consisting of a prime mover towing two semitrailers.
- New B-double assessment vehicle DB for Queensland(QLD) and Victoria(VIC) is now available. More than 2 B-double vehicles can be loaded by checking on the option in Moving Load Analysis control.

- ***Load > Moving Load > Moving Load Code : Australia***




Moving Load Cases



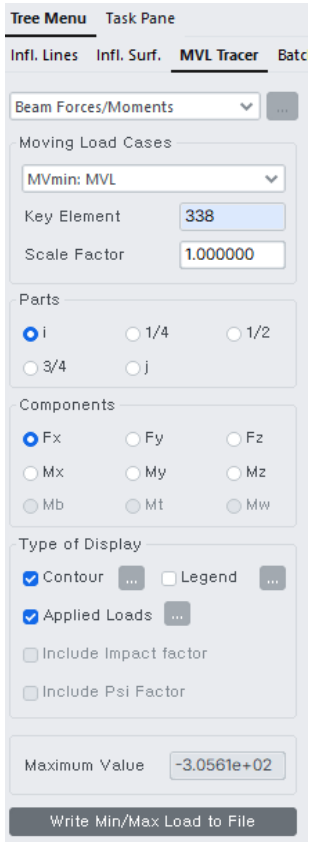

Moving Load Analysis Control

MB-double Vehicles

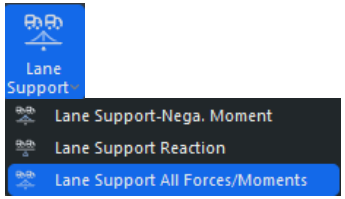
## 4. Considering two trucks for substructure members or Elastic/General Links as per ASHTO LRFD vehicle loads

- Although AASHTO LRFD says, "For negative moment between points of contraflexure under a uniform load on all spans, 90 percent of the effect of two design trucks combined with 90 percent of the effect of the design lane load, force components other than negative moment need to be determined based on the two-truck rule in some projects.
- Now, it is possible to select elements or links to apply the two-truck rule to obtain maximum results for all force components in moving load analysis.

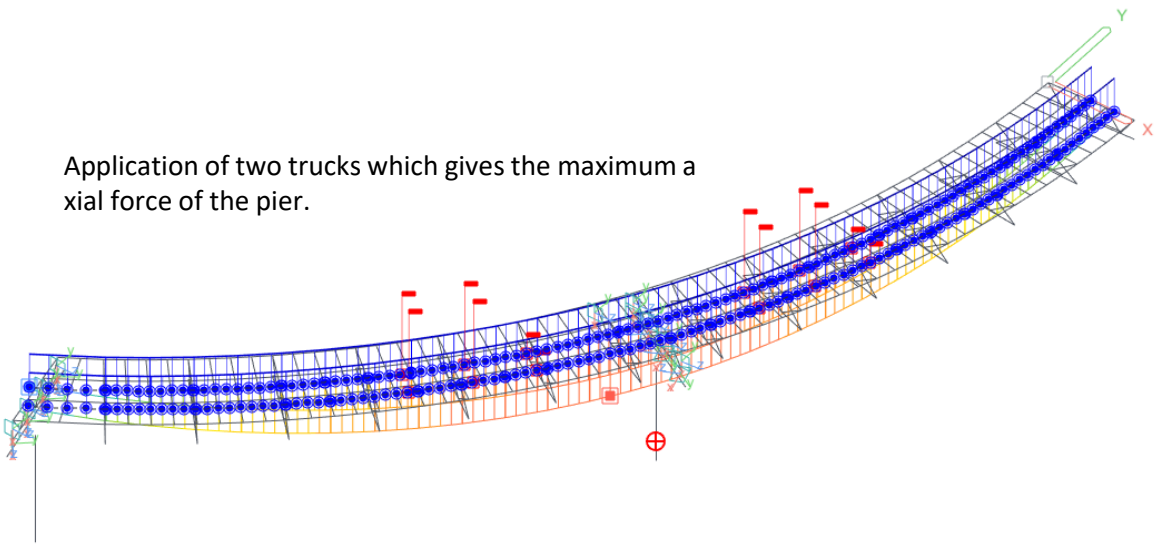
- ***Load > Moving Load > Lane Support > Lane Support All Forces/Moments***

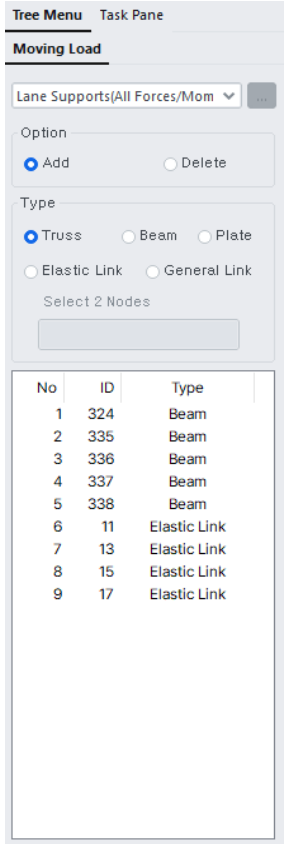



Moving Load Tracer




Application of two trucks which gives the maximum a xial force of the pier.



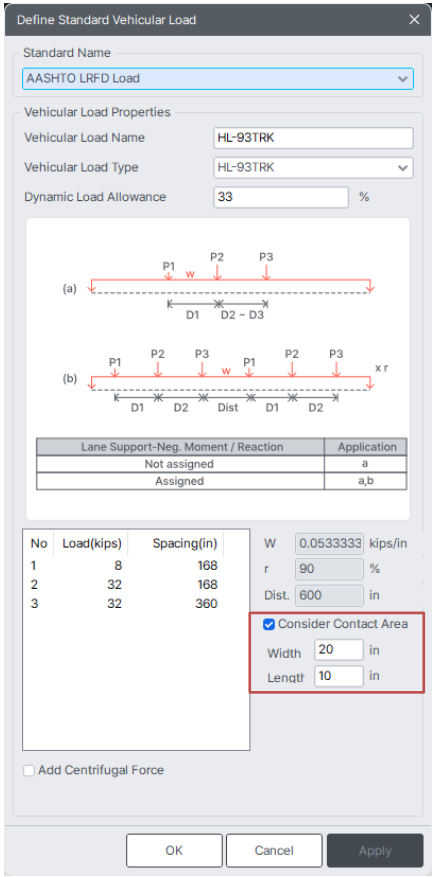




Lane Support All Forces/Moments

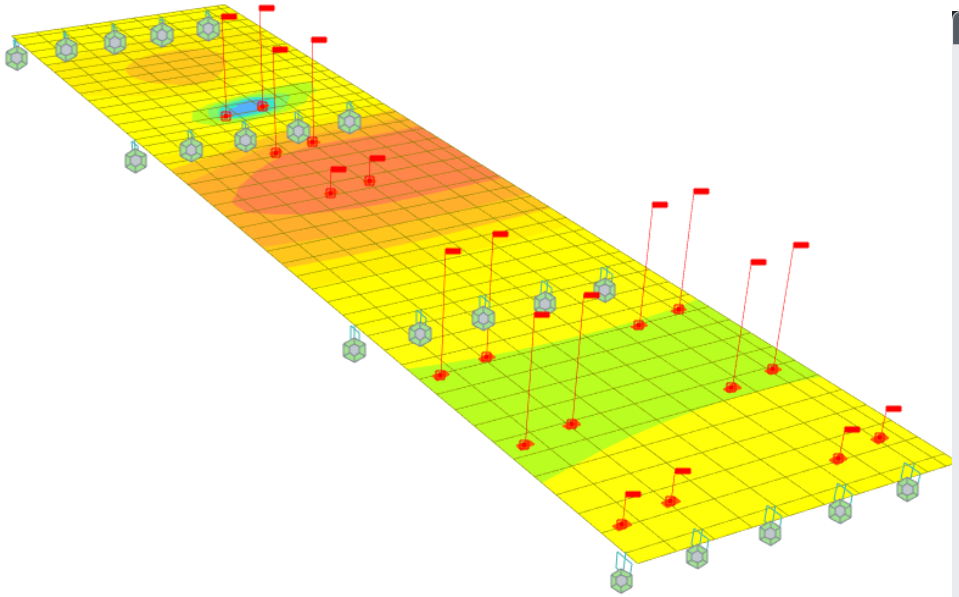
## 5. Moving patch load analysis as per AASHTO LRFD traffic loads

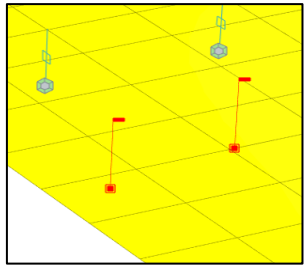
- The tire contact area of a wheel can be applied during moving load analysis. In this version, HL-93TRK, HL-93TDM, and HS20-FTG vehicles of AASHTO LRFD are only supported.
- The design forces of plate elements can be noticeably reduced with the patch/area loads compared to concentrated wheel loads.

▪ ***Load > Moving Load (AASHTO LRFD) > Vehicles***

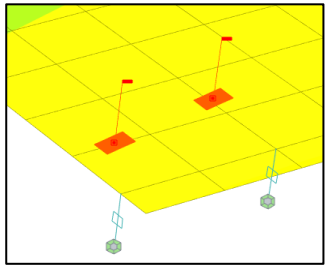



Standard Vehicle

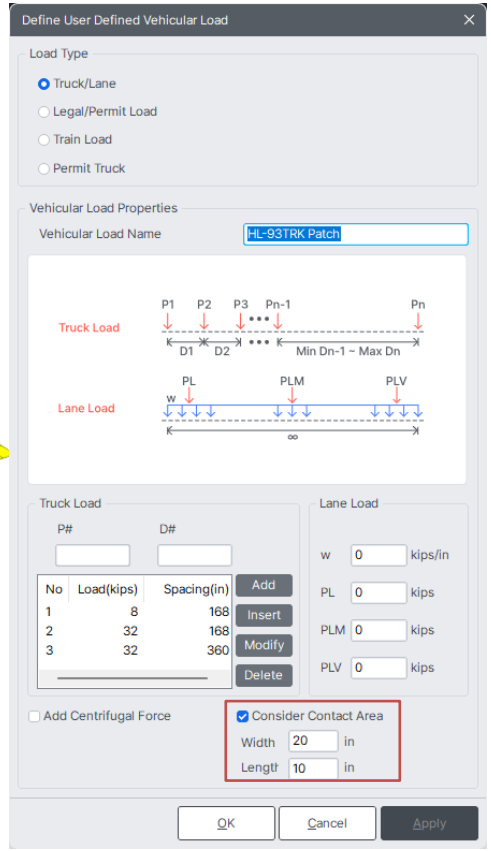




Concentrated wheel loads



Patch/area wheel loads

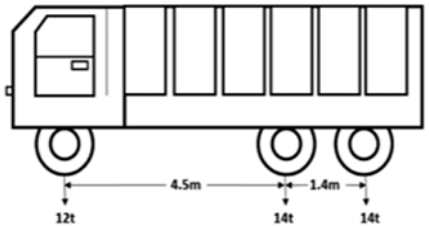
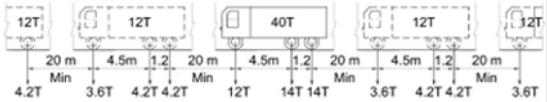
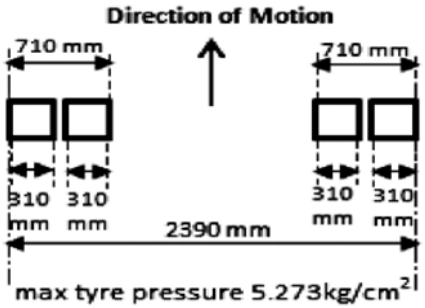


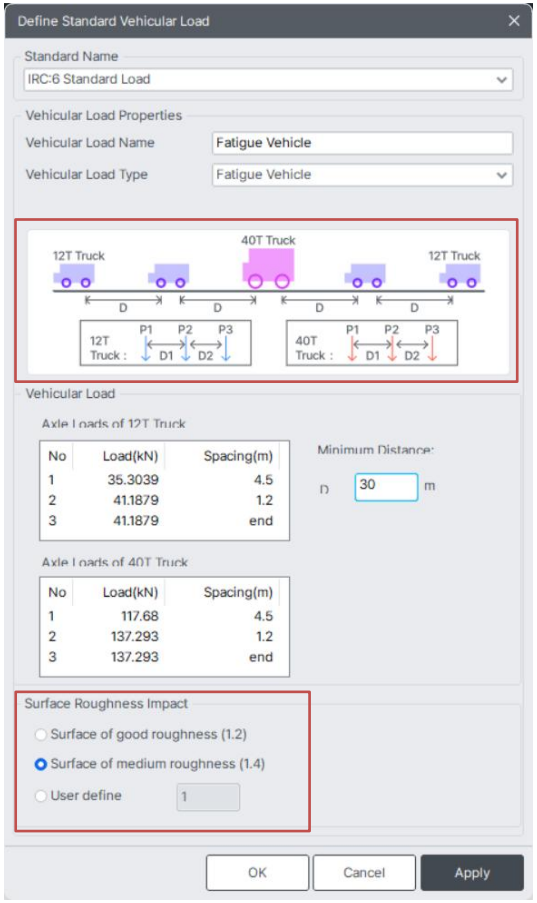

User-Defined Vehicle

## 6. Fatigue Vehicle to IRC 6 : Standard Load

- Fatigue Vehicle has been added to existing vehicle library of IRC 6 : Standard Load as per latest amendment to IRC : 6 Fatigue Load Clause 204.6.
- For assessment, impact factor has been replaced with surface roughness impact depending upon type of surface.

▪ ***Load > Load Type > Moving Load > Moving Load Code > India***

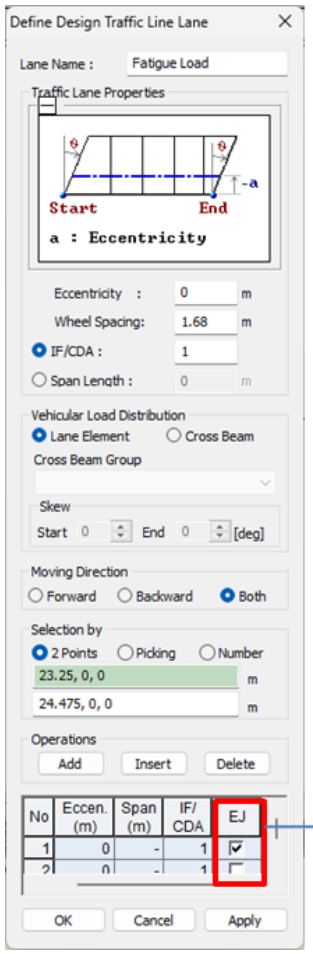
| S. No. | Clause No. | AS EXISTS IN THE CODE | PROPOSED NEW CLUASE / MODIFICATION | REMARKS |
|---|---|---|---|---|
| | | longitudinal direction of the bridge, shall be used for fatigue assessment with the fatigue load so positioned as to have worst effect on the detail or element of the bridge under consideration. The minimum clearance between outer edge of the wheel of the fatigue vehicle and roadway face of the kerb shall be 150 mm.<br>  <br><br>**Fig. 7A: Fatigue Truck** | increased by a dynamic amplification factor, $I_{ej}$ as given below:<br>$I_{ej} = 1.3(1-x/26) > 1.0$<br>where<br>x = distance of section/detail from nearest expansion joint.<br>  <br><br>Fig. 7A : Fatigue Load Train<br>NOTE: 1. Fatigue truck of 40 T must be included in Fatigue Load Train<br>2. Only such number of additional 12 T trucks shall be included in train as can be accommodated in influence line of detail under consideration<br>  <br><br>**Fig. 7B: T Arrangement Transverse Wheel Spacing and Tyre**<br>**Fig. 7: Fatigue Load (40T)**<br>The stress range resulting from the single passage of | second/more vehicles in lane included in line with Euro codes. |

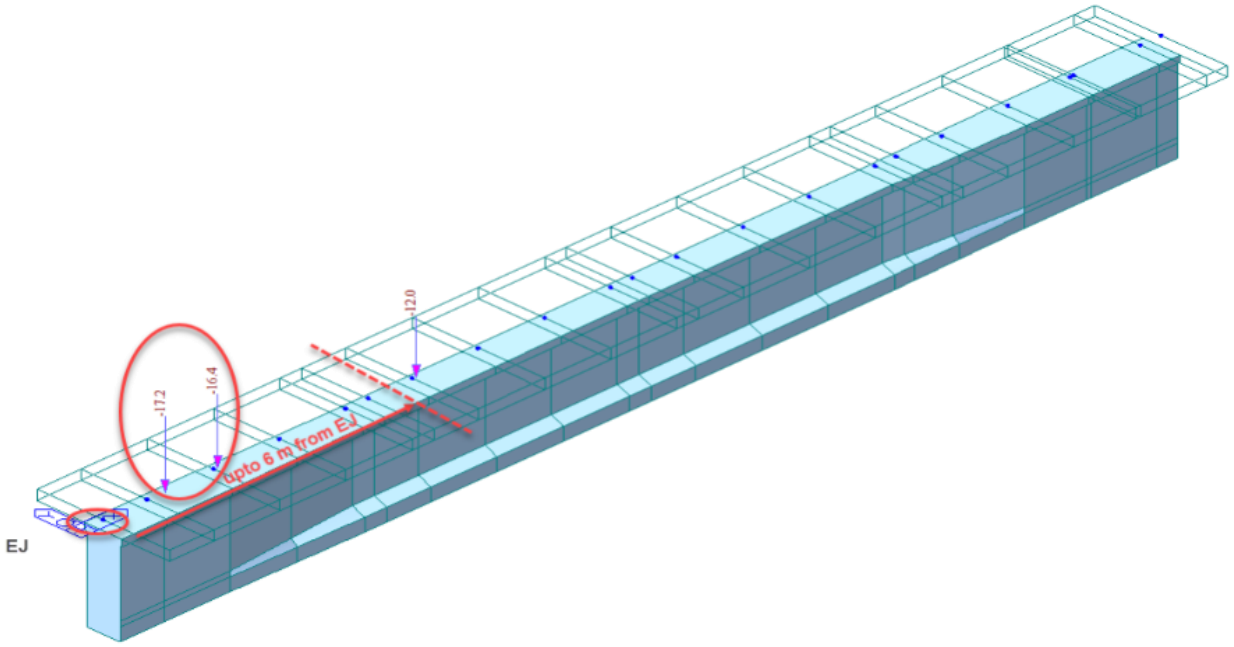


## 6. Fatigue Vehicle to IRC 6 : Standard Load

- The Traffic Lane Definitions now include an "EJ" checkbox for specifying expansion joint locations.
- For sections/ details within 6.0 m of the expansion joint, the fatigue load arrived as above shall further be increased by a dynamic amplification factor, $I_{ej.}$

- ***Load > Load Type > Moving Load > Moving Load Code > India***



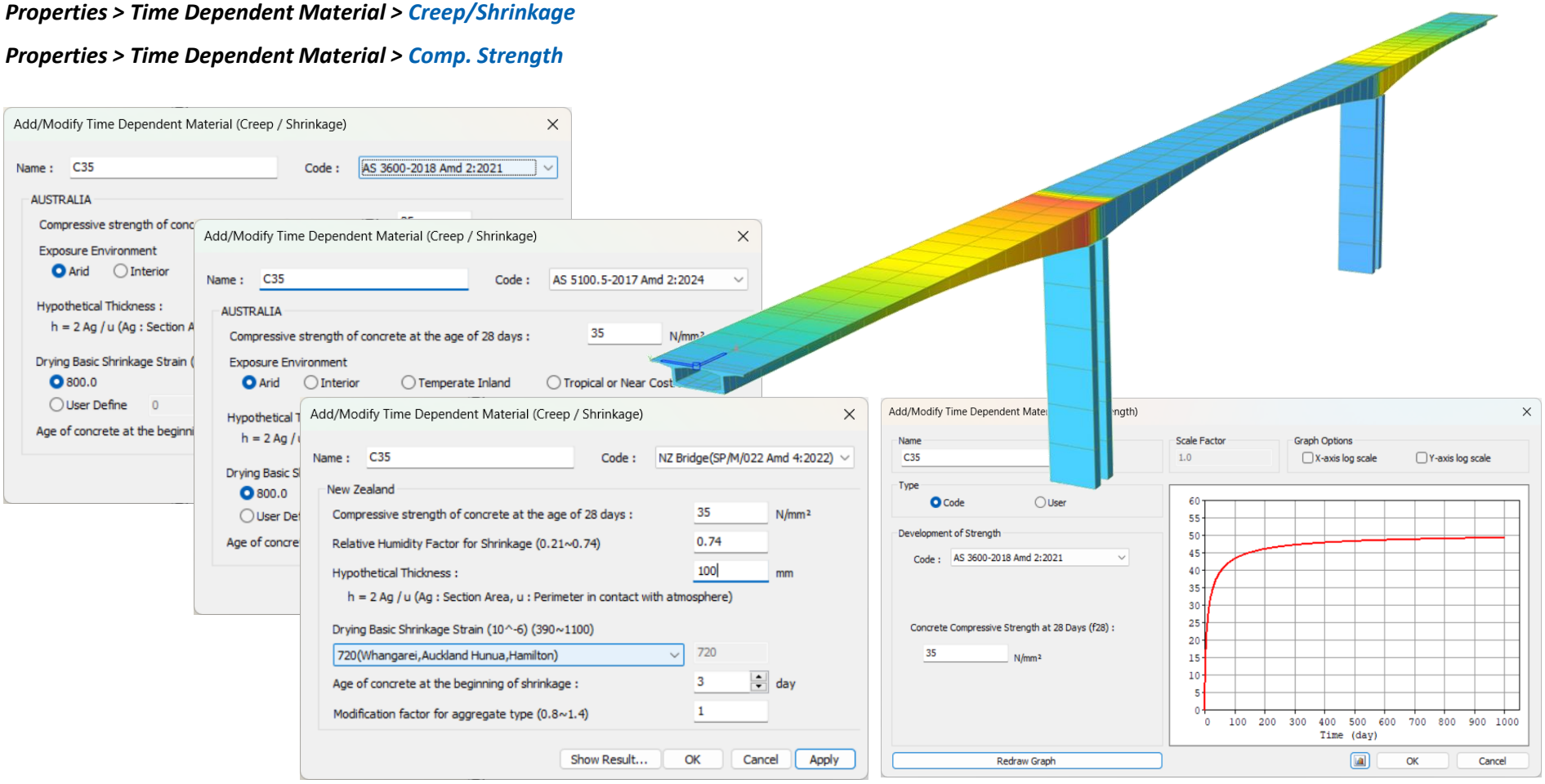

$$I_{ej} = 1.3\left(1 - \left(\frac{x}{26}\right)\right) \geq 1$$

$x$= distance of section/detail from nearest expansion joint

## 7. Time Dependent Materials as per the latest Australian and New Zealand Standards

- Time Dependent Materials (Creep, Shrinkage and Compressive Strength) as per the following Australian and New Zealand Standards are updated: SP/M/022 v 3.4, AS5100.5:2017(Amd 2:2024) and AS3600:2018(Amd 2).

- ***Properties > Time Dependent Material > Creep/Shrinkage***
- ***Properties > Time Dependent Material > Comp. Strength***



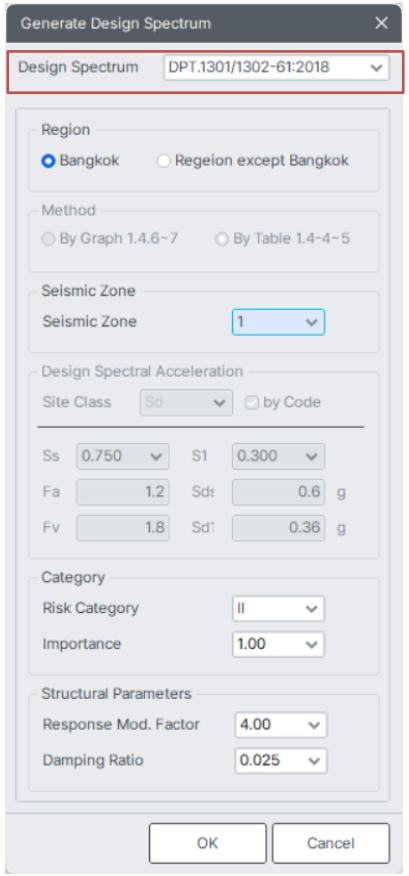

Creep & Shrinkage

Compressive Strength

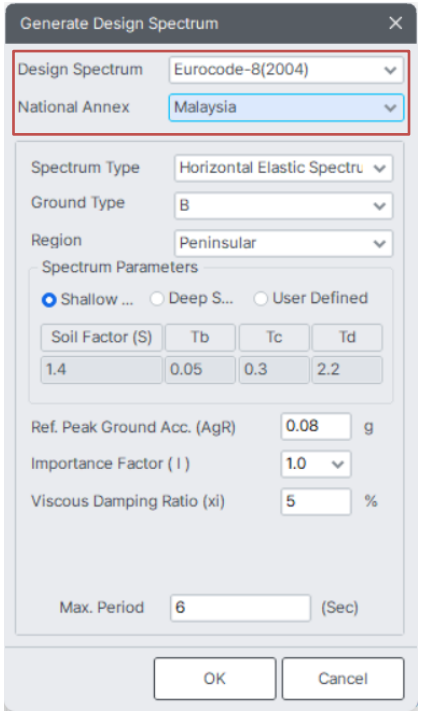
# 8. Addition of Response Spectrum Function as per DPT.1301/1302-61:2018 and Eurocode Malaysia NA

- Design Spectrums for Thailand specifications(DPT.1301/1302-61:2018) and Eurocode Malaysian National Annex are added.

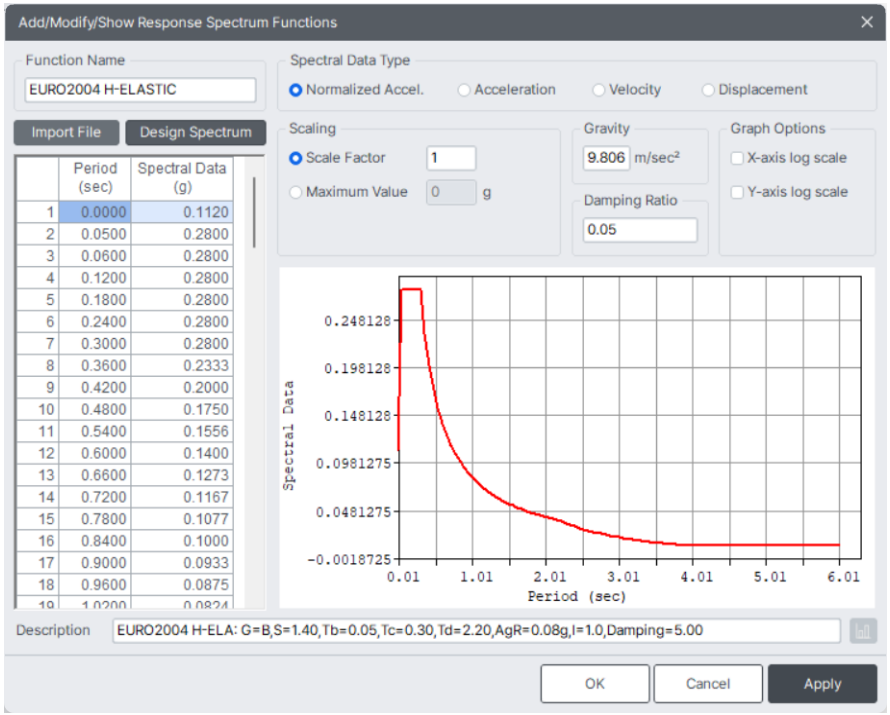
- ***Load > Dynamic Loads > RS Functions***




DPT1301/1302-61 Design Spectrum




MY EN 1998 Design Spectrum

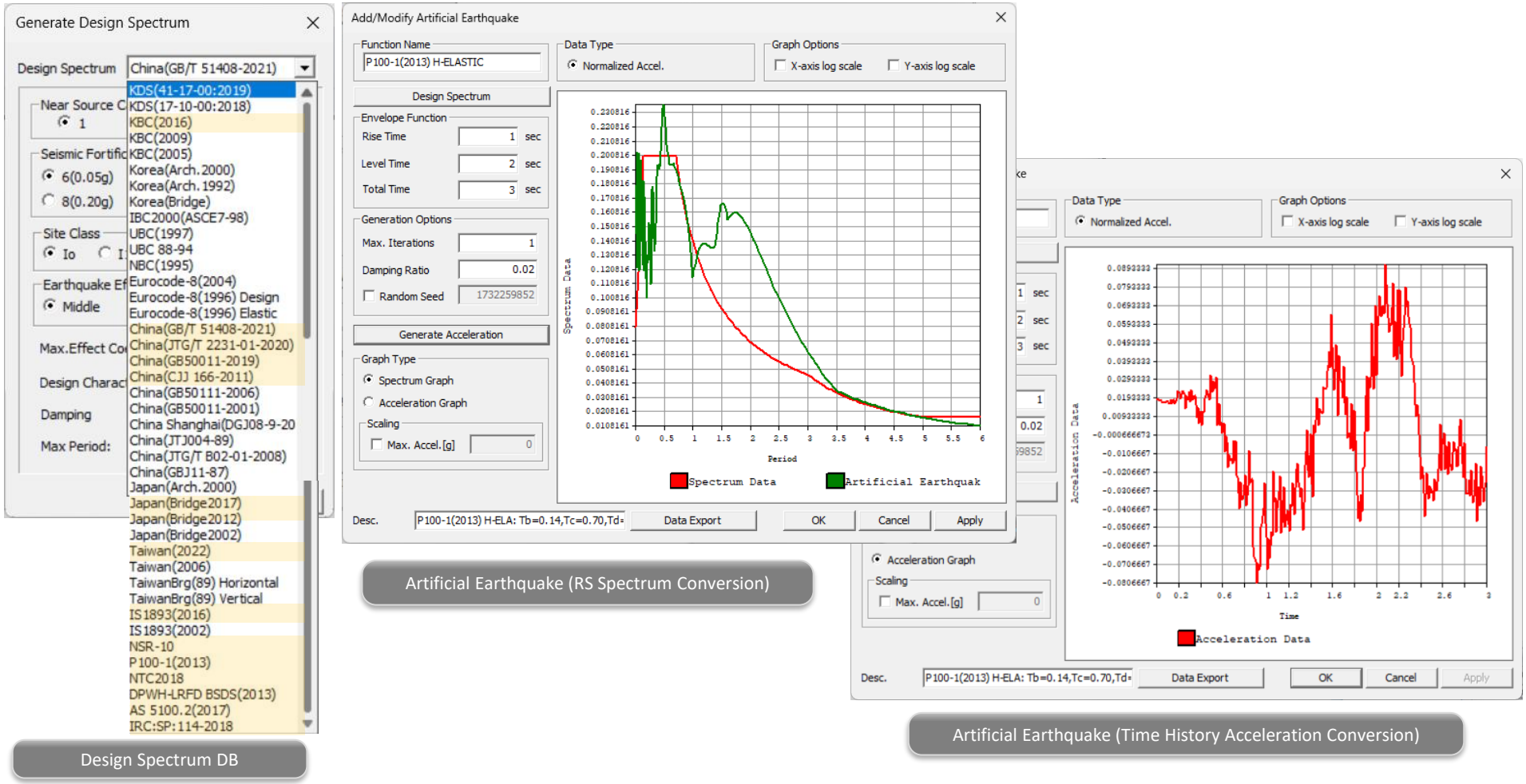



Response Spectrum Function

## 9. Addition of new Design Spectrum Database in Artificial Earthquake Data Generator

- AGS (Artificial Data Generation System for windows) extracts artificial earthquake and design response spectrum using the design spectrum of each standard. Following design spectra are now added: Taiwan (2022), IS1938(2016), NSR-10, P100-1(2013), NTC 2018, DBWH-LRFD BSDS(2013), AS 5100.2(2017), IRC:SP:114-2018, KBC(2016), China (GB/T 51408-2021), China(JTG/T 2231-01-2020), China (GB50011-2019), China (CJJ 166-2011), Japan(Bridge2017), Japan(Bridge 2012)

- ***Tools > Data Generator > Artificial Earthquake***




Design Spectrum DB

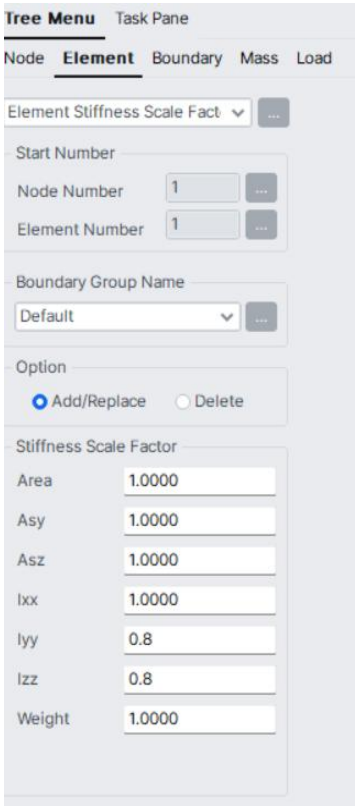
Artificial Earthquake (RS Spectrum Conversion)

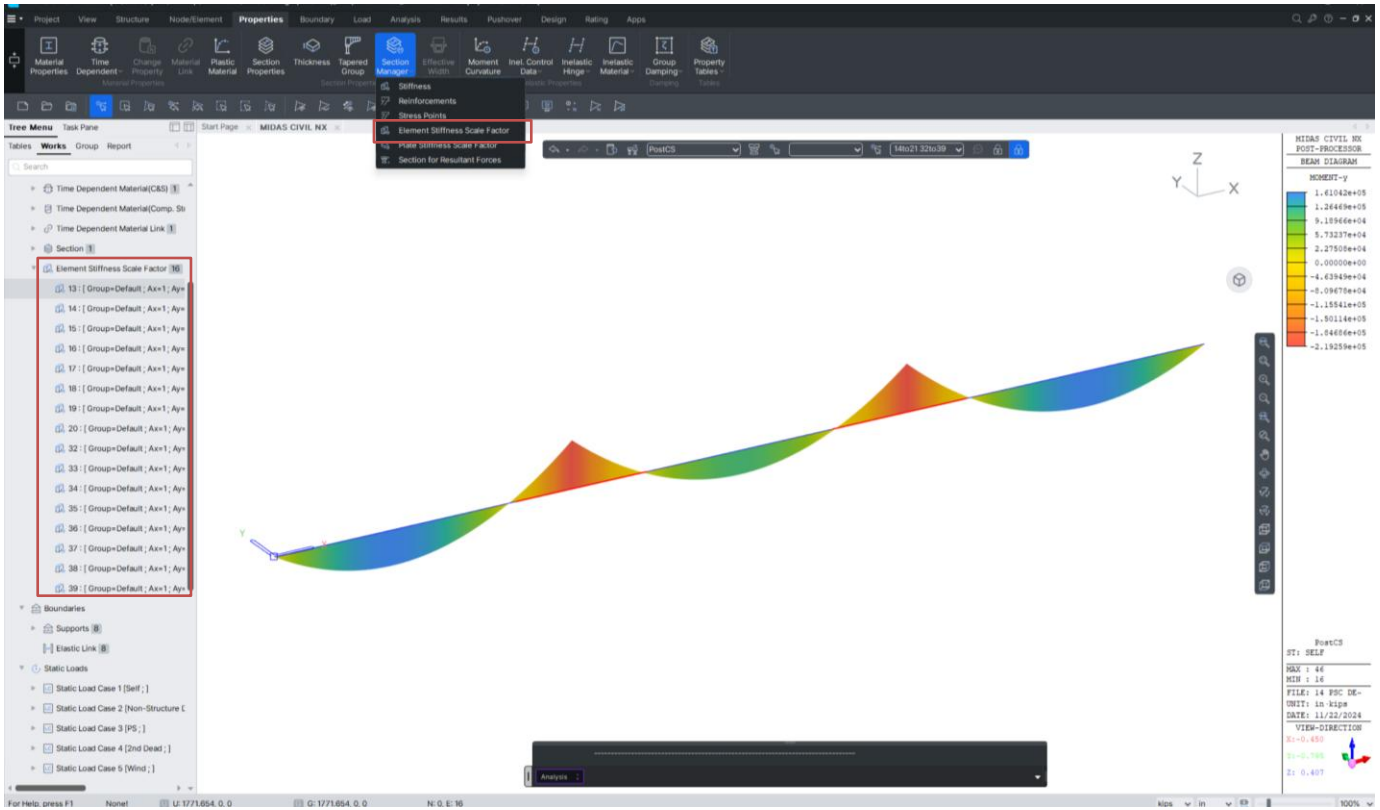
Artificial Earthquake (Time History Acceleration Conversion)

## 10. Addition of Element Stiffness Scale Factor

- Apply scale factors to the cross-sectional linear elements (Truss, Tension-only, Compression-only, Cable, Gap, Hook & Beam Elements). Specific stiffness may be reduced such as the case where the flexural stiffness of girders in the negative moment region may require reduction to reflect cracked sections of concrete.

▪ ***Properties > Section Manager > Element Stiffness Scale Factor***



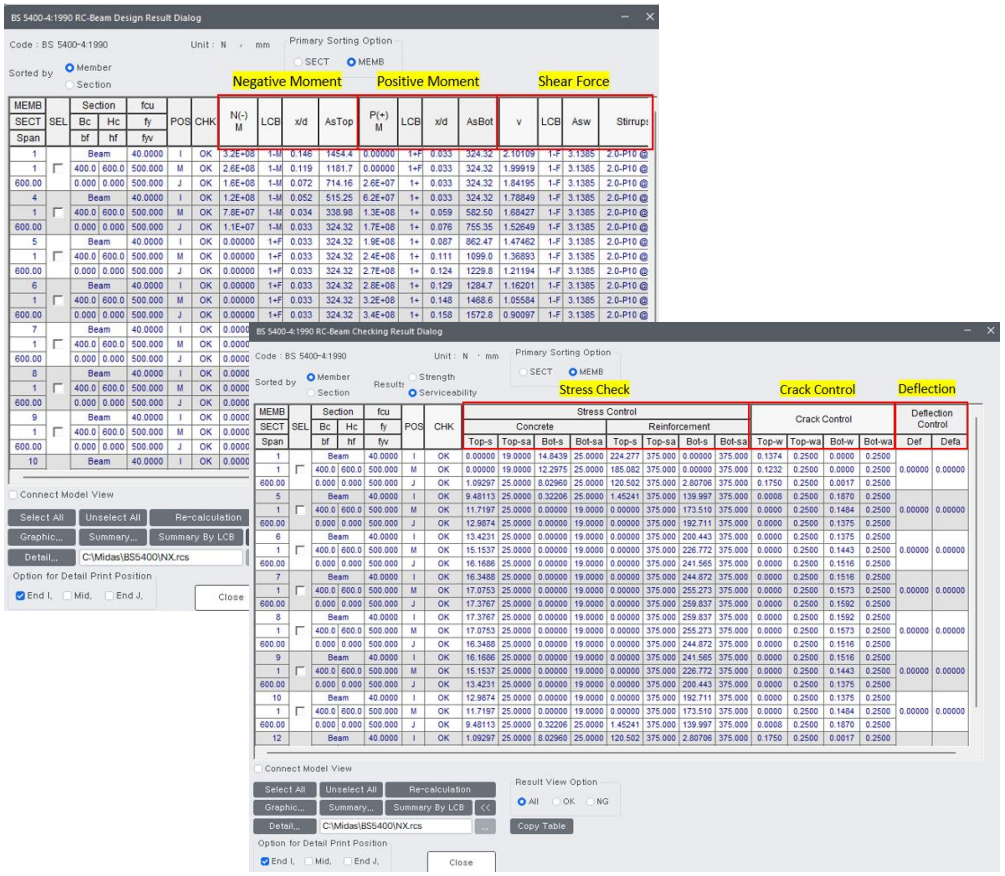




Element Stiffness Scale Factor

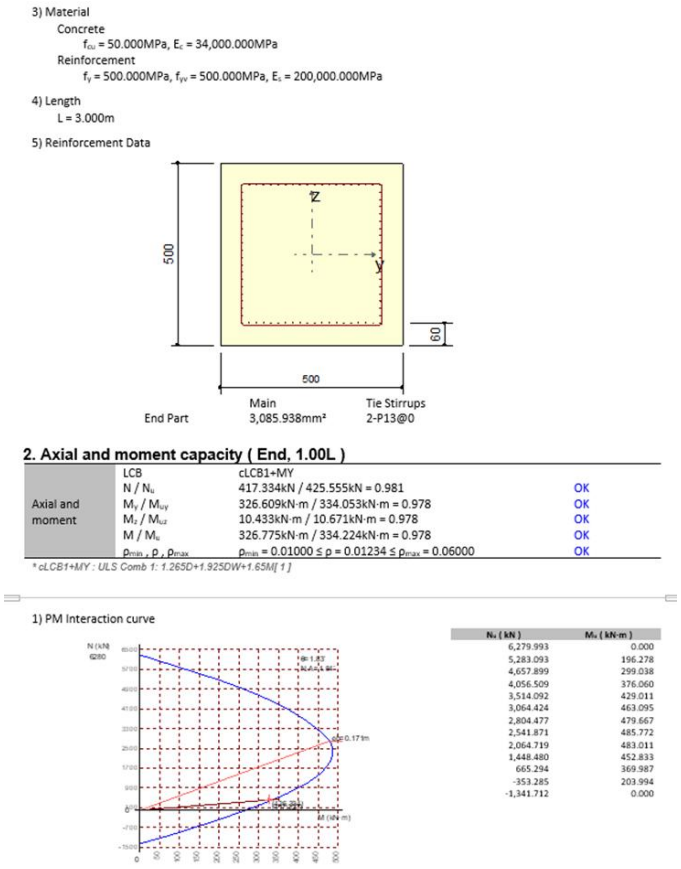
# 11. RC Design for 1D Beam & Column, Plate Beam & Column as per BS 5400

- Design and checking of RC frame elements to BS 5400 are newly introduced in midas.
- This feature can be applied to piers or RC beams.

▪ ***Design > RC Design > RC Code Design > Beam/Column Design***




Design Result Table




Detailed Calculation Report

## 12. RC Design for 1D Beam & Column, Plate Beam & Column as per BS 5400

- Design and checking of RC plate elements to BS 5400 are newly introduced in midas.
- This feature can be applied to culvert, pier walls or slabs where the stresses are distributed in one way.

▪ ***Design > RC Design > RC Code Design > Plate Beam/Column Design***

Plate Beam Design Result Dialog

Code : BS 5400-4:1990 Unit : kN, m / m

| Sub-Domain | SEL | Major Dir | CHK | Pos | Req_As | Elem. | Node | LCB_M | M | M_u | Ratio_M | Elem. | Node | LCB_V | v |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TC | ☐ | Dir1 | OK | Pos | 0.0020 | 521 | 567 | 2 | 117.005 | 117.096 | 0.9992 | 541 | 609 | 2 | 817.429 |
| | | | | Neg | 0.0003 | 541 | 608 | 2 | 0.00000 | 18.9725 | 0.0000 | | | | |
| TE | ☐ | Dir1 | OK | Pos | 0.0014 | 461 | 525 | 2 | 86.6913 | 86.7653 | 0.9991 | 441 | 504 | 2 | 1480.82 |
| | | | | Neg | 0.0022 | 421 | 3 | 2 | 125.076 | 125.169 | 0.9993 | | | | |
| BC | ☐ | Dir1 | OK | Pos | 0.0003 | 740 | 797 | 2 | 0.00000 | 25.8236 | 0.0000 | 740 | 798 | 2 | 611.203 |
| | | | | Neg | 0.0016 | 700 | 756 | 2 | 117.729 | 117.829 | 0.9991 | | | | |
| BE | ☐ | Dir1 | OK | Pos | 0.0019 | 620 | 1 | 2 | 137.500 | 137.613 | 0.9992 | 620 | 672 | 2 | 1591.02 |
| | | | | Neg | 0.0012 | 660 | 714 | 2 | 93.1388 | 93.2218 | 0.9991 | | | | |

Connect Mod
Select All
Detail...
Graphic...
Close

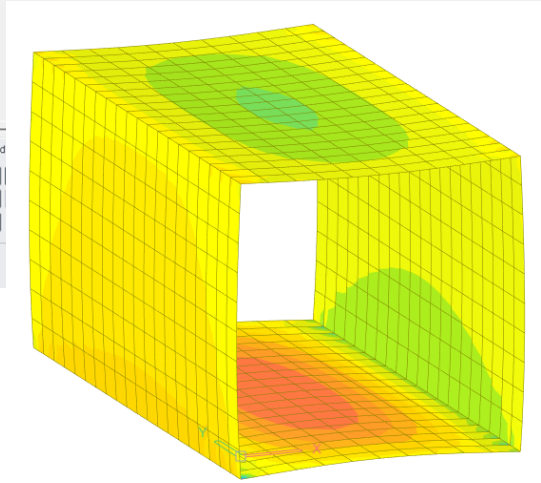


Plate Beam/Column Design Result Table

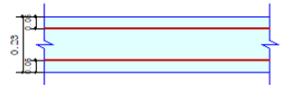
Preview Window

Name : TC(Dir1) Print Print All Close Save

1. Design Condition

Design Type : Plate Beam (1D)
Sub-Domain : TC
Design Code : BS 5400-4:1990
Unit System : kN, m, / m
Material Data : fcu = 24000, fy = 460000, fyv = 250000 KPa
Thickness : 0.23 m

2. Section Diagram



Element No : 521

Rebar Pattern Top Required Rebar Area = 0.00027 m²/m
Bot Required Rebar Area = 0.00199277 m²/m
Required Stirrups Spacing : 2.0-P13 @0.040

3. Bending Moment Capacity

| | Top(Negative) | Bottom(Positive) |
|---|---|---|
| Mu | 0.00 | 117.01 |
| Element No. | 541 | 521 |
| Load Combination | cLCB2 | cLCB2 |
| Mr | 18.97 | 117.10 |
| Check Ratio (Mu/Mr) | 0.0000 | 0.9992 |

4. Shear Capacity

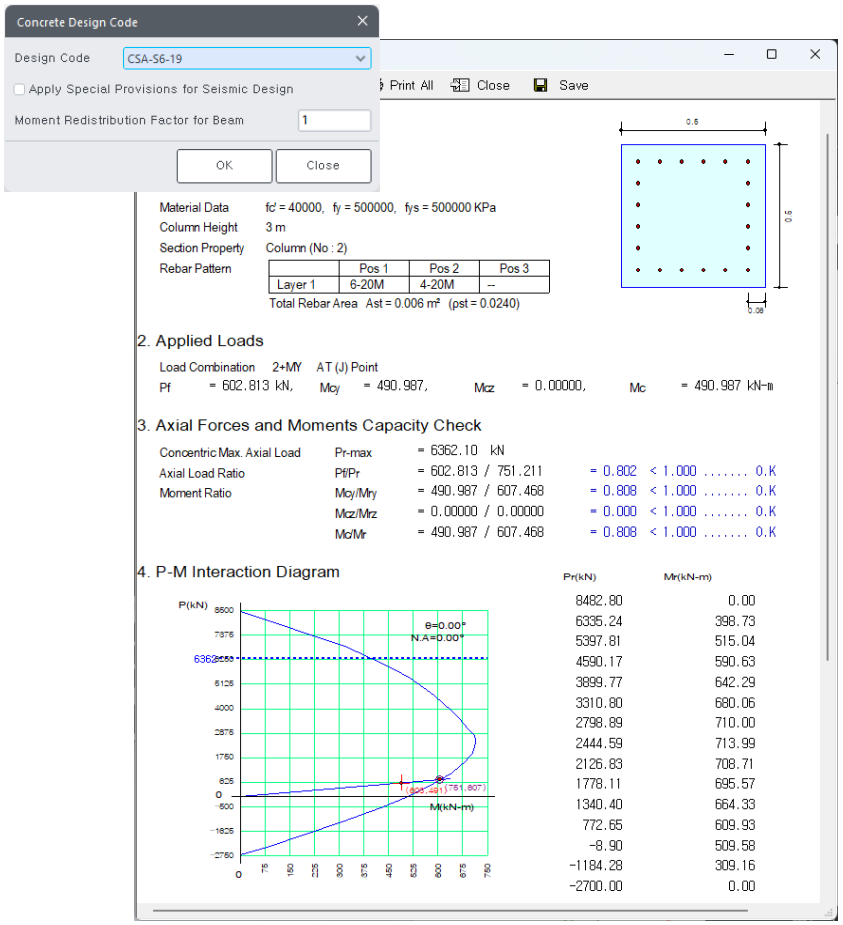
Element No. 541
Load Combination cLCB2
Applied Shear Resistance v = 817.429
Shear Strength (Out of plane) v_uc = 896.654 v_ur = 1441.67
Required Stirrups Spacing 0.04004 m
Shear Ratio v/v_u = 817.429 / 2338.32 = 0.350 < 1.000 ..... O.K

Plate Beam Design Summary

# 13. RC & Steel Design as per CSA S6:19

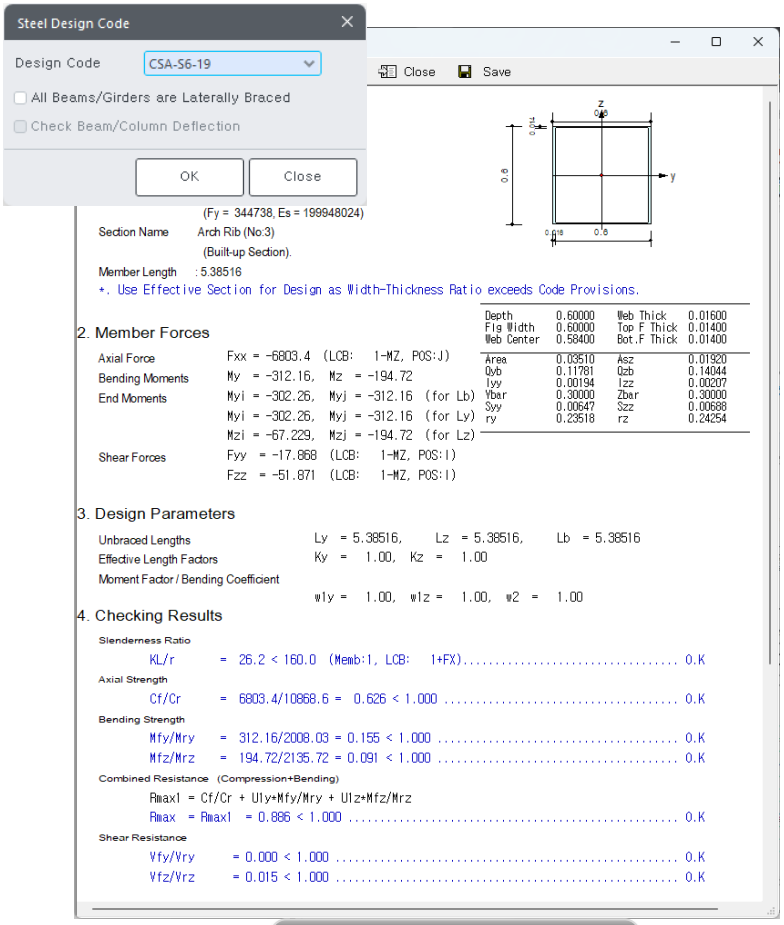
- RC member design and steel member design have been updated as per CSA S6: 19.

- ***Design > RC Design > Design Code Option***




RC Design Summary Report

- ***Design > Steel Design > Design Code Option***



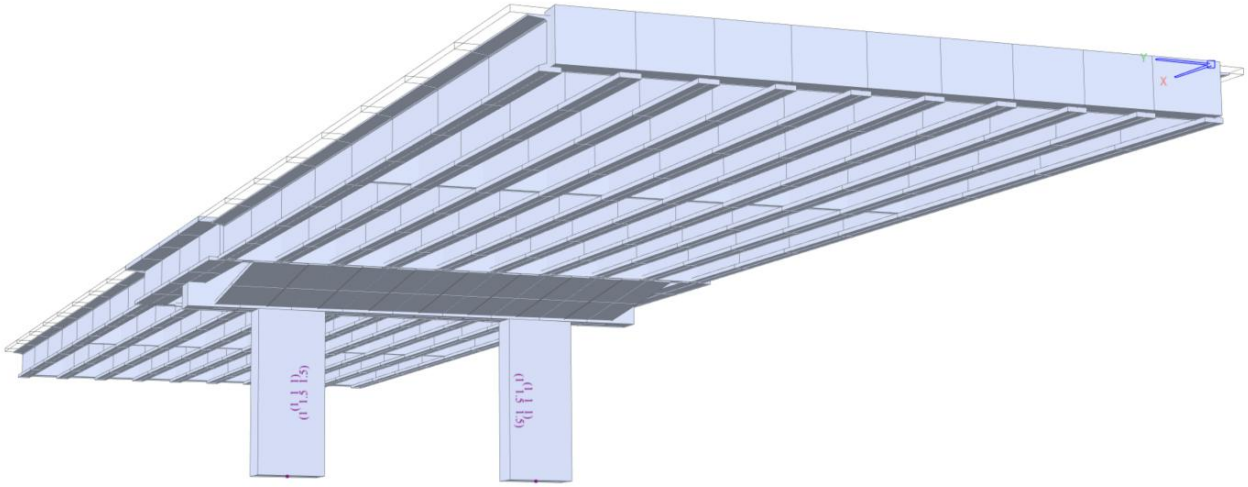

Steel Design Summary Report

## 14. Response Modification Factor by members and components as per AASHTO LRFD

- Seismic design force effects for substructures shall be determined by dividing the force effects resulting from elastic analysis by the appropriate response modification factor, R.
- In the previous version, only a single response modification factor could be applied. However, the current version allows for the application of response modification factors based on substructure types and load components.
- Applicable Code: AASHTO-LRFD

- ***Design > RC Design > Design Parameters > Response Modification Factor (R)***

Response Spectrum Modificatio n Factor Dialog



Start Page | MIDAS CIVIL NX | Response Modification Factor (R)

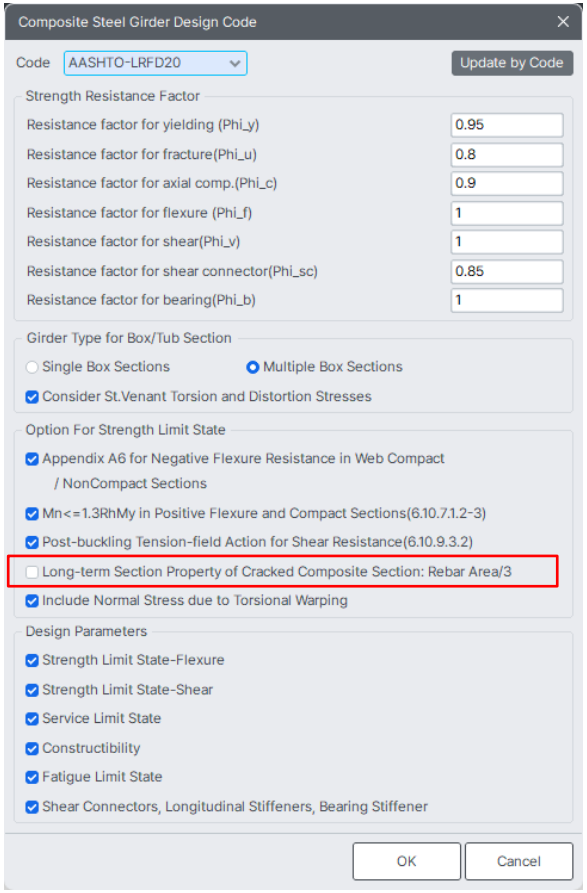
| Elem | R factor for Fx | R factor for Fy | R factor for Fz | R factor for Mx | R factor for My | R factor for Mz |
|---|---|---|---|---|---|---|
| 390 | 1.00 | 1.00 | 1.00 | 1.00 | 1.50 | 1.50 |
| 391 | 1.00 | 1.00 | 1.00 | 1.00 | 1.50 | 1.50 |

Response Spectrum Modificatio n Factor Table

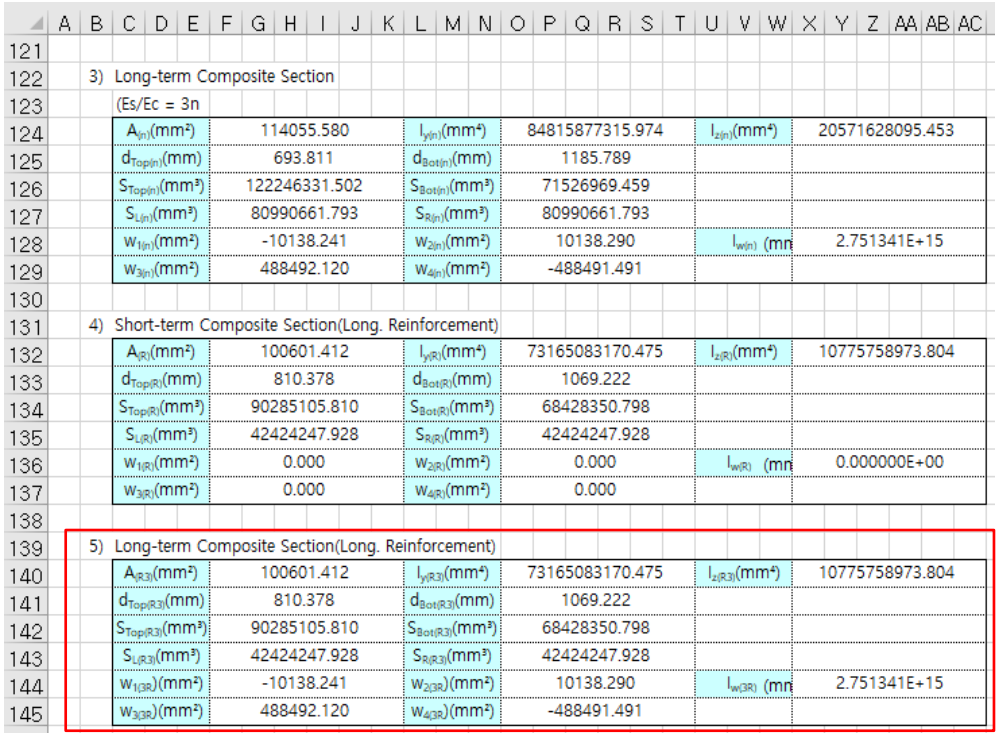
## 15. Addition of an option “Long-term Section Property of Cracked Composite Section: Rebar Area/3” as per AASHTO LRFD

- In previous versions, the long-term section properties of the composite girder subjected to negative moment were calculated as "Steel Section + Long. Reinforcement/3".
- Now, an option is added to determine the section properties as "Steel Section + Long. Reinforcement".

▪ ***Design > Composite Design > Design Code Option***




Composite Steel Girder Design Code Option



3) Long-term Composite Section

(Es/Ec = 3n

| | | | | | |
|---|---|---|---|---|---|
| $A_{(n)}$(mm²) | 114055.580 | $I_{y(n)}$(mm⁴) | 84815877315.974 | $I_{z(n)}$(mm⁴) | 20571628095.453 |
| $d_{Top(n)}$(mm) | 693.811 | $d_{Bot(n)}$(mm) | 1185.789 | | |
| $S_{Top(n)}$(mm³) | 122246331.502 | $S_{Bot(n)}$(mm³) | 71526969.459 | | |
| $S_{L(n)}$(mm³) | 80990661.793 | $S_{R(n)}$(mm³) | 80990661.793 | | |
| $w_{1(n)}$(mm²) | -10138.241 | $w_{2(n)}$(mm²) | 10138.290 | $I_{w(n)}$ (mm | 2.751341E+15 |
| $w_{3(n)}$(mm²) | 488492.120 | $w_{4(n)}$(mm²) | -488491.491 | | |

4) Short-term Composite Section(Long. Reinforcement)

| | | | | | |
|---|---|---|---|---|---|
| $A_{(R)}$(mm²) | 100601.412 | $I_{y(R)}$(mm⁴) | 73165083170.475 | $I_{z(R)}$(mm⁴) | 10775758973.804 |
| $d_{Top(R)}$(mm) | 810.378 | $d_{Bot(R)}$(mm) | 1069.222 | | |
| $S_{Top(R)}$(mm³) | 90285105.810 | $S_{Bot(R)}$(mm³) | 68428350.798 | | |
| $S_{L(R)}$(mm³) | 42424247.928 | $S_{R(R)}$(mm³) | 42424247.928 | | |
| $w_{1(R)}$(mm²) | 0.000 | $w_{2(R)}$(mm²) | 0.000 | $I_{w(R)}$ (mm | 0.000000E+00 |
| $w_{3(R)}$(mm²) | 0.000 | $w_{4(R)}$(mm²) | 0.000 | | |

5) Long-term Composite Section(Long. Reinforcement)

| | | | | | |
|---|---|---|---|---|---|
| $A_{(R3)}$(mm²) | 100601.412 | $I_{y(R3)}$(mm⁴) | 73165083170.475 | $I_{z(R3)}$(mm⁴) | 10775758973.804 |
| $d_{Top(R3)}$(mm) | 810.378 | $d_{Bot(R3)}$(mm) | 1069.222 | | |
| $S_{Top(R3)}$(mm³) | 90285105.810 | $S_{Bot(R3)}$(mm³) | 68428350.798 | | |
| $S_{L(R3)}$(mm³) | 42424247.928 | $S_{R(R3)}$(mm³) | 42424247.928 | | |
| $w_{1(3R)}$(mm²) | -10138.241 | $w_{2(3R)}$(mm²) | 10138.290 | $I_{w(3R)}$ (mm | 2.751341E+15 |
| $w_{3(3R)}$(mm²) | 488492.120 | $w_{4(3R)}$(mm²) | -488491.491 | | |

Design Report