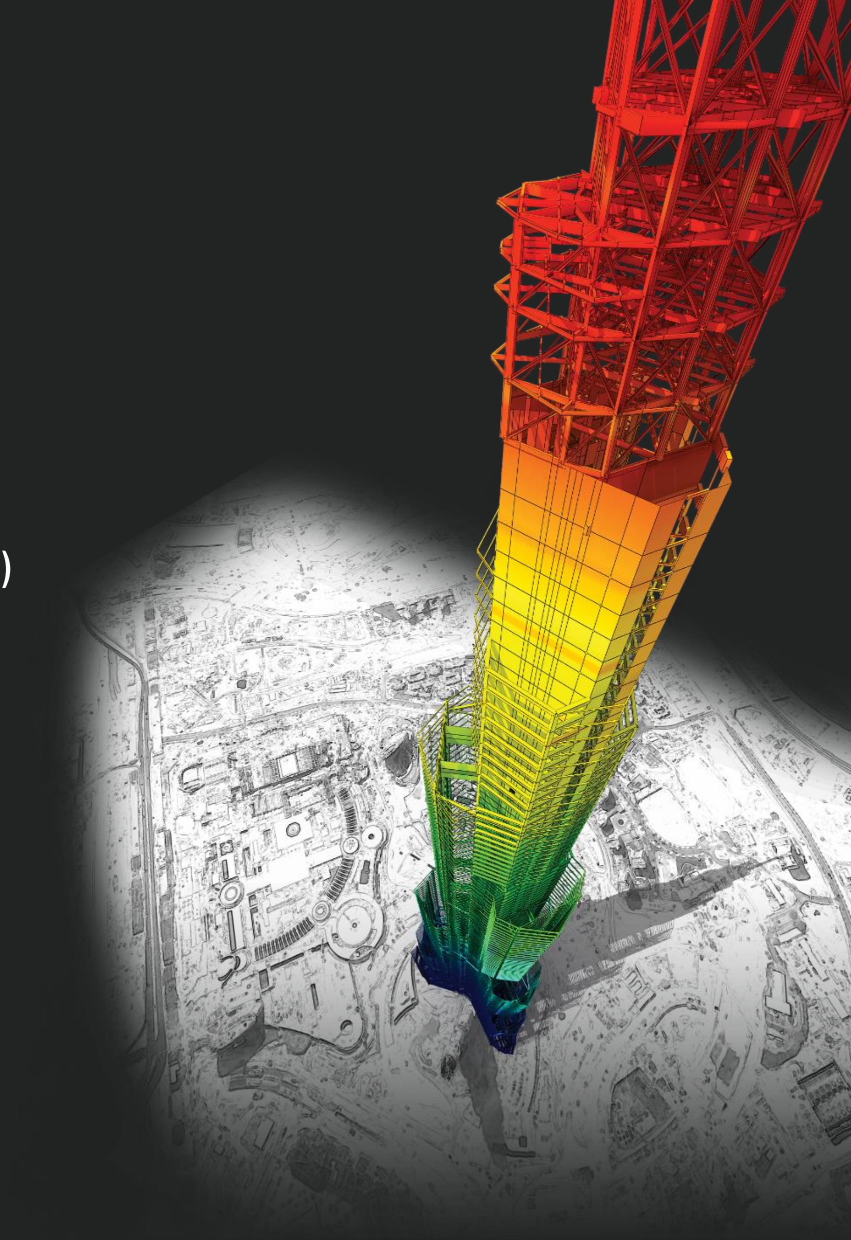
Release Note

Release Date : June. 2021

Product Ver. : midas Gen 2021 (v2.1) and Design+2021(v2.1)



DESIGN OF General Structures

Integrated Design System for Building and General Structures

Enhancements

- ***midas Gen***

- ***midas Design+***

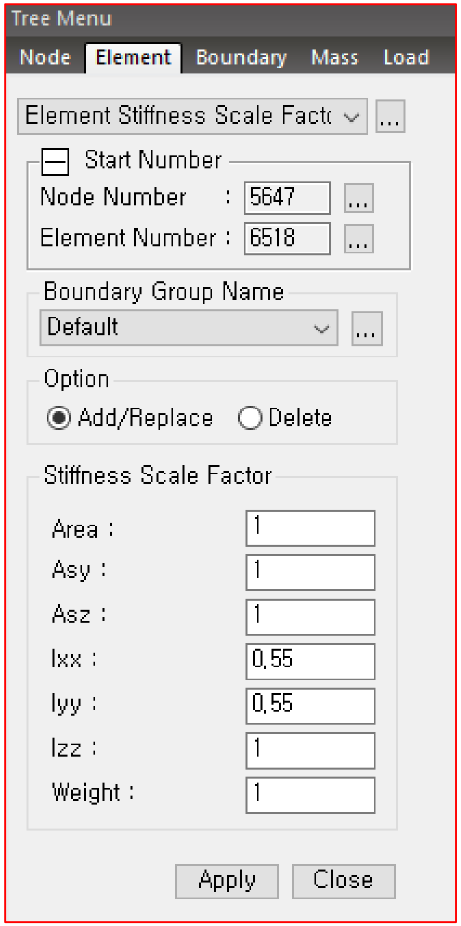
midas ***Gen***

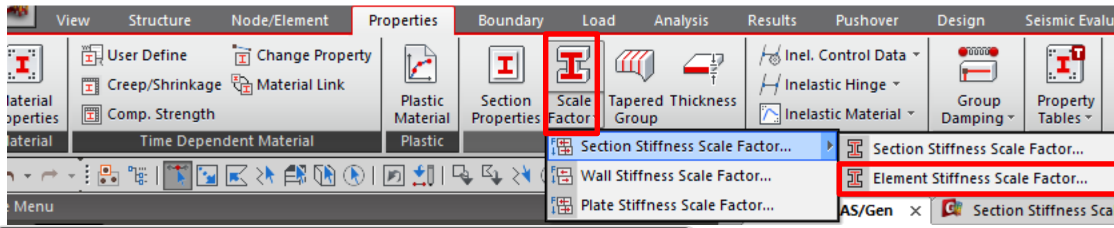
1. Improvement of Section Stiffness Scale Factor

Add element stiffness scale factor

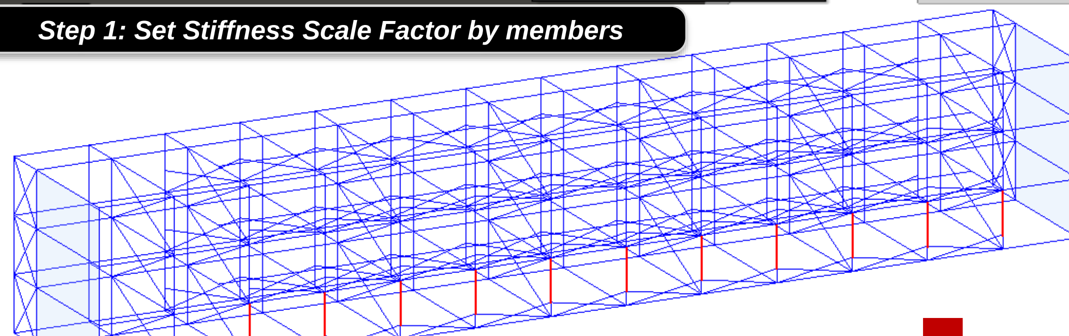
- The stiffness can be adjusted by members.

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





Step 1: Set Stiffness Scale Factor by members



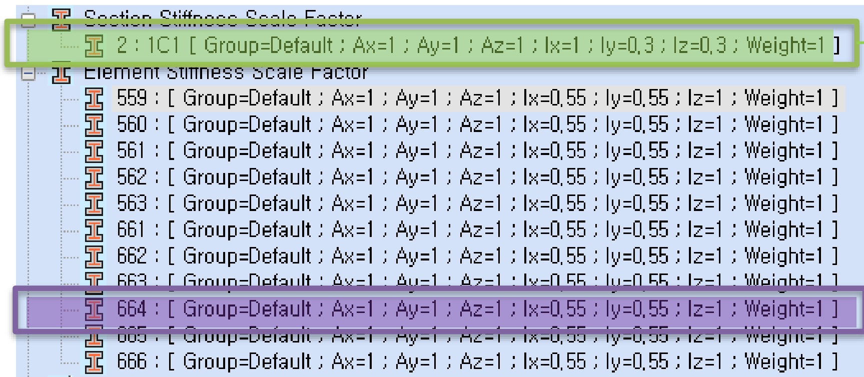
Step 2: Check or Modify Element Stiffness Scale Factor Table

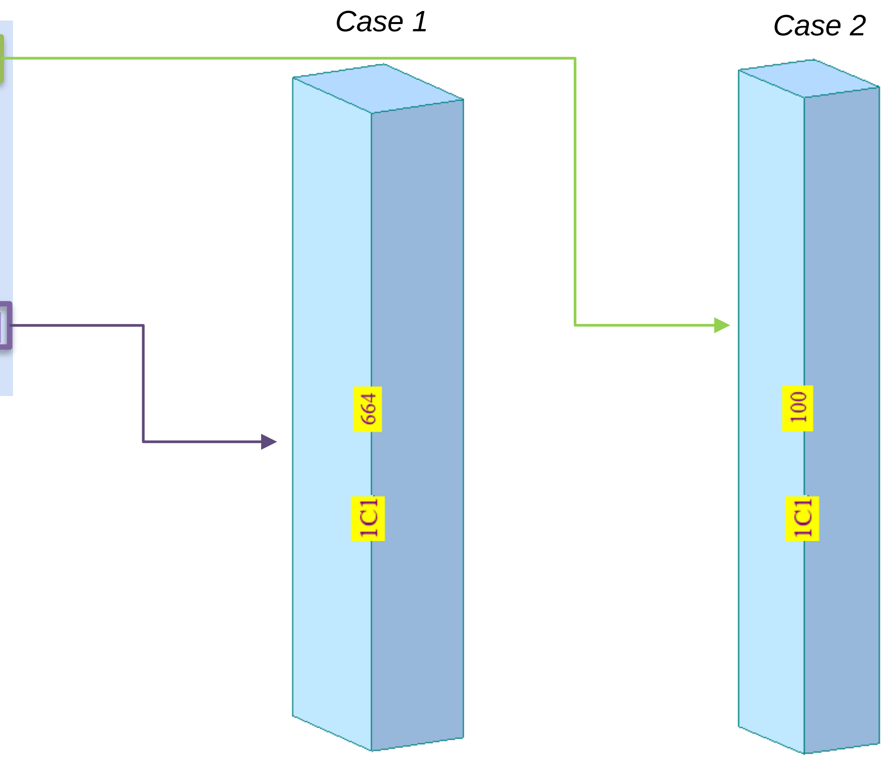
MIDAS/Gen | Element Stiffness Scale Factor

Elem	Section ID	fArea	fAsy	fAsz	fIxx	fIyy	fIzz	fWgt	Part	Group
559	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
560	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
561	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
562	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
563	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
661	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
662	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
663	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
664	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default
665	2	1.0000	1.0000	1.0000	0.5500	0.5500	1.0000	1.0000	Before	Default

1. Improvement of Section Stiffness Scale Factor

Element Stiffness Scale Factor(E.S.S.F.) takes precedence over Section Stiffness Scale Factor(S.S.S.F.).





Case1 : Both S.S.S.F. and E.S.S.F are applied to "1C1".
→ E.S.S.F is considered in an analysis.

Case 2: Only S.S.S.F is applied to "1C1".
(Element Stiffness Scale Factor is not applied)
→ S.S.S.F is considered in an analysis.

Case 1:

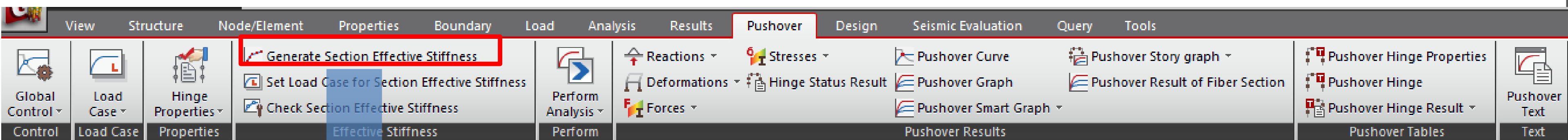
- *Section Name : 1C1(ID:2)*
- *Element Number: 664*

Case 2:

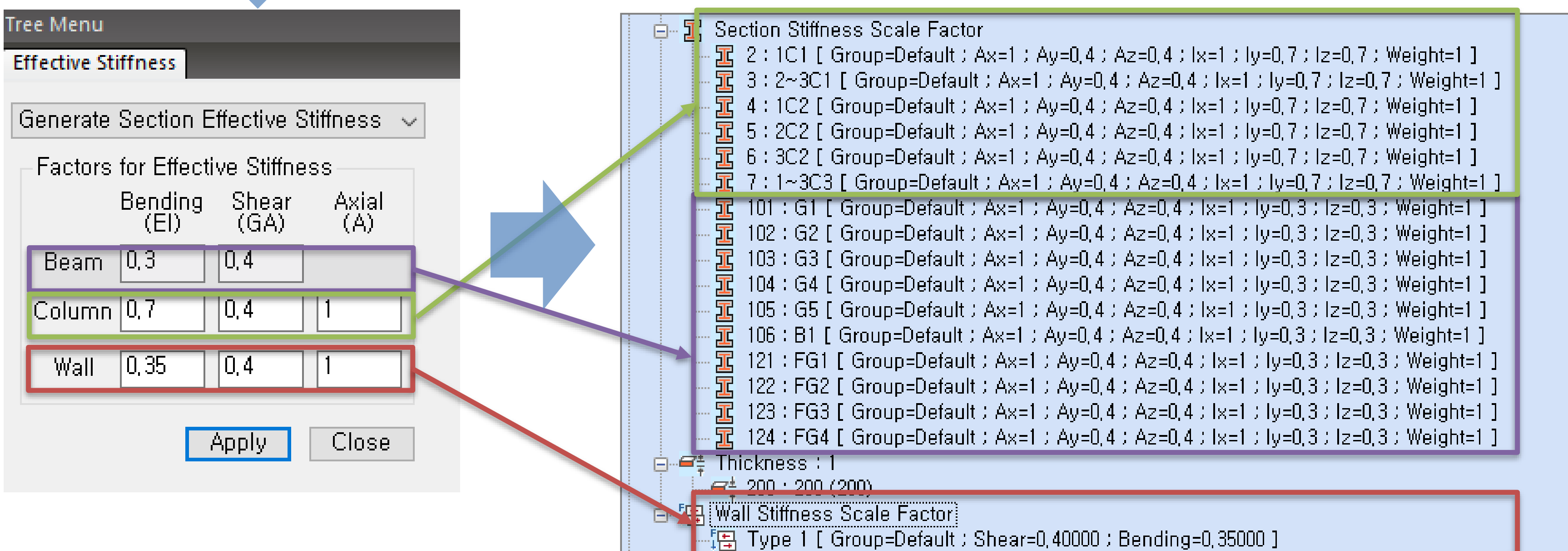
- *Section Name : 1C1(ID:2)*
- *Element Number: 100*

1. Improvement of Section Stiffness Scale Factor

Supports the control of a section scale factor collectively for each member type

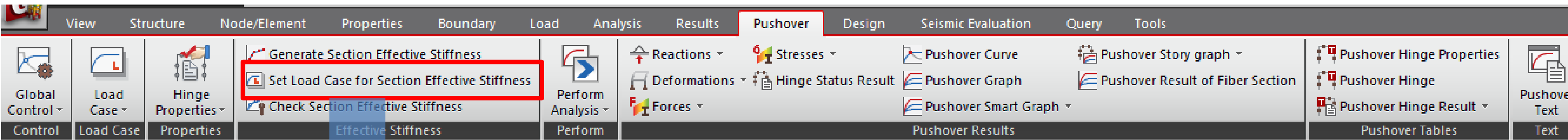


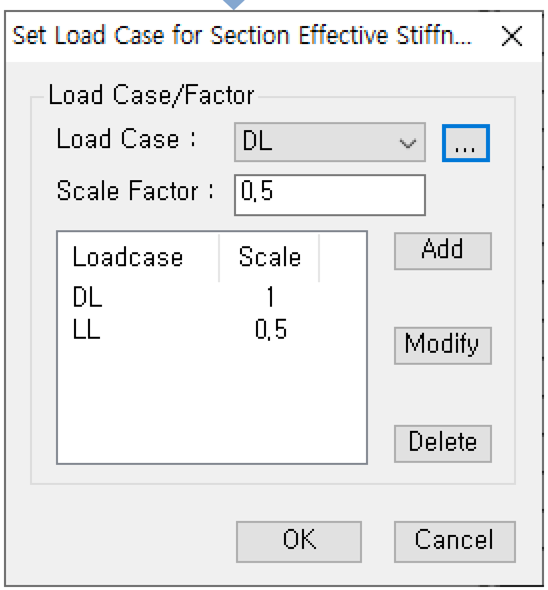
Pushover > Effective Stiffness > ***Generate Section Effective Stiffness***



1. Improvement of Section Stiffness Scale Factor

Supports auto-calculation of the effective stiffness ratio of the column according to the column axial force by gravity load





Step 1: Set the scale factor gravity load in order to calculate the column axial force

✓ Note

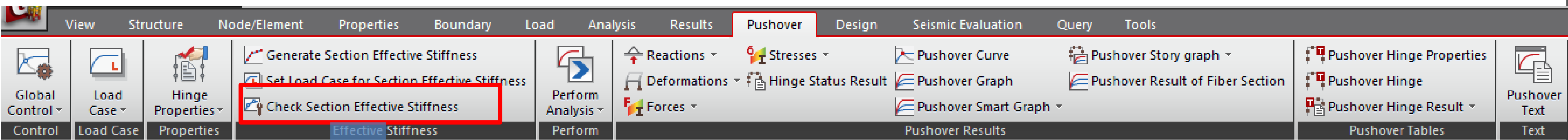
6.4.1.2 Stiffness

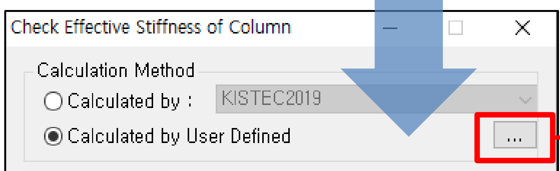
Component stiffnesses shall be calculated according to accepted principles of mechanics. Sources of flexibility shall include flexure, shear, axial load, and reinforcement slip from adjacent connections and components. Stiffnesses should be selected to represent the stress and deformation levels to which the components will be subjected, considering volume change effects (temperature and shrinkage) combined with design earthquake and gravity load effects.

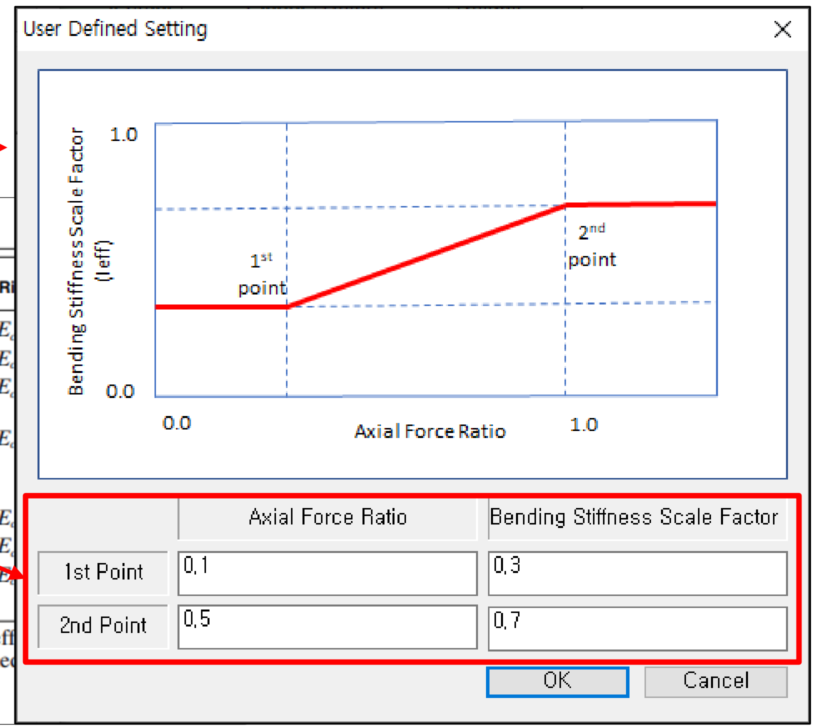
Reference Code : 6.4.1.2 as per FEMA273

1. Improvement of Section Stiffness Scale Factor

Step 2 : Select the calculation method.
Step 3 : In case of "by User Defined", input the axial force ration and bending stiffness scale factor for each point.







✓ **Note**

Table 10-5. Effective Stiffne

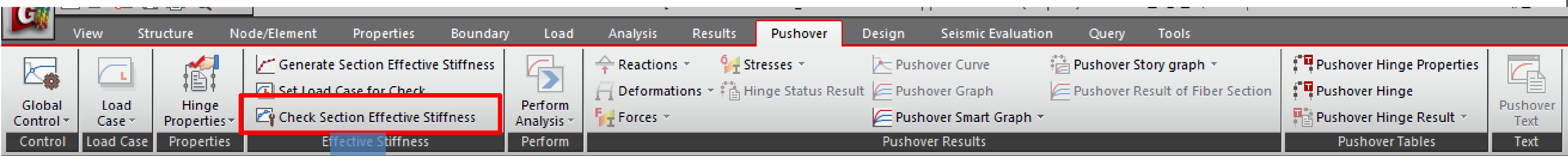
Component	Flexural Rigidity	Shear Ri
Beams—nonprestressed[a]	$0.3E_cI_g$	$0.4E_c$
Beams—prestressed[a]	E_cI_g	$0.4E_c$
Columns with compression caused by design gravity loads $\geq 0.5A_gf'_c$	$0.7E_cI_g$	$0.4E_c$
Columns with compression caused by design gravity loads $\leq 0.1A_gf'_c$ or with tension	$0.3E_cI_g$	$0.4E_c$
Beam–column joints	Refer to Section 10.4.2.2.1	
Flat slabs—nonprestressed	Refer to Section 10.4.4.2	$0.4E_c$
Flat slabs—prestressed	Refer to Section 10.4.4.2	$0.4E_c$
Walls-cracked[b]	$0.5E_cA_g$	$0.4E_c$

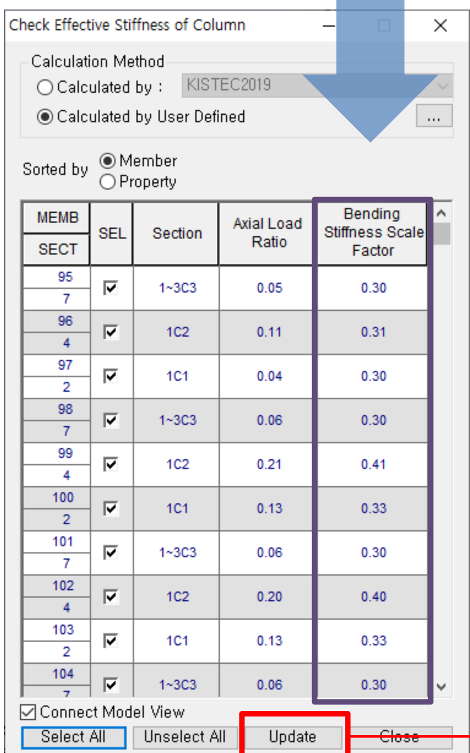
[a]For T-beams, I_g can be taken as twice the value of I_g of the web alone. Otherwise, I_g should be based on the eff
For columns with axial compression falling between the limits provided, flexural rigidity should be determined
not performed, the more conservative effective stiffnesses should be used.
[b]See Section 10.7.2.2.

Reference Code : ASCE41-17 Table 10-5

1. Improvement of Section Stiffness Scale Factor

Step 4 : Check and update the effective stiffness factor of columns.

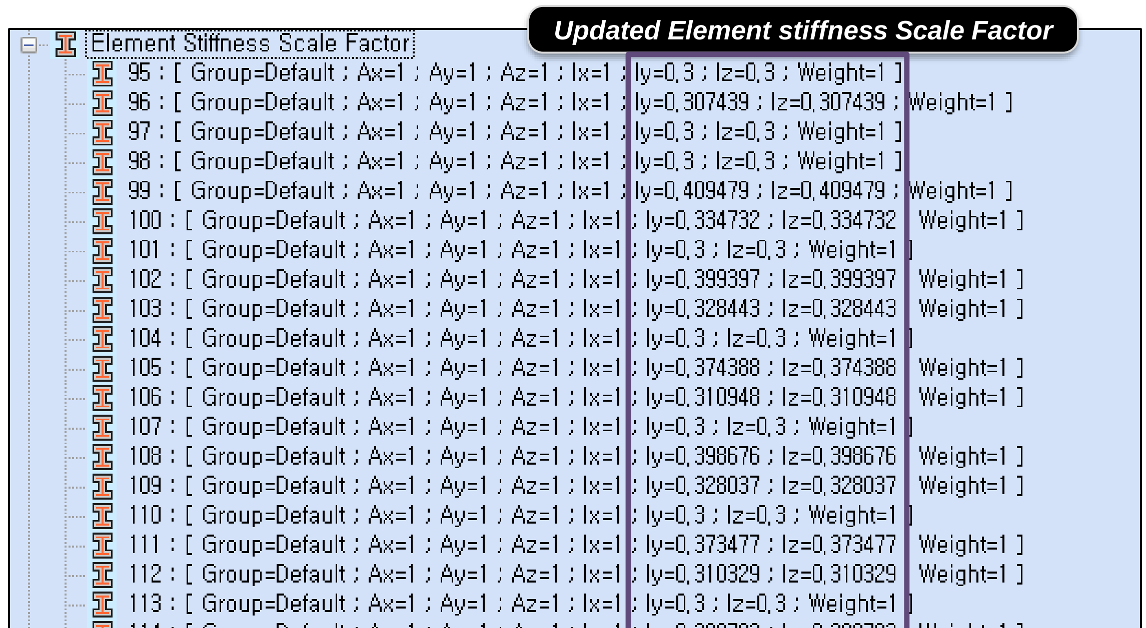




If you click 'Update' button, the flexural stiffness factor of the selected member is updated in the model.

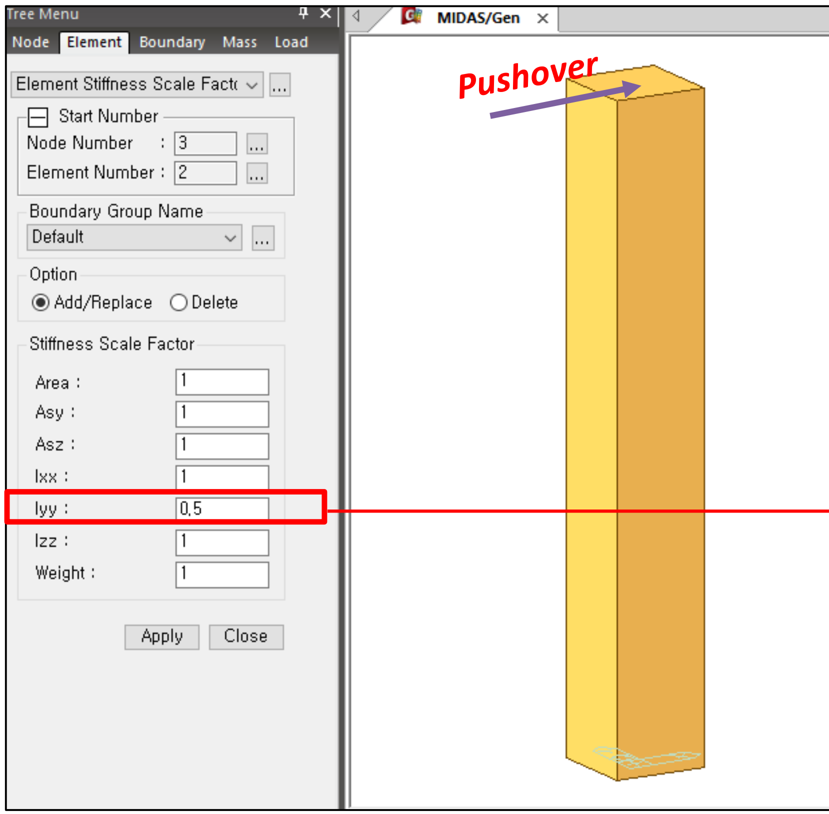
The updated stiffness factor is reflected in the 'Element stiffness Scale Factor'.

Updated Element stiffness Scale Factor



1. Improvement of Section Stiffness Scale Factor

- Hinge rotations are calculated by the element stiffness scale factor.



Safety Verification result

Elem	Location	Seismic Element	Load	Verify Ductile Mechar		
				My		
				Demand	Capacity	Remark
Step for Demand = USER (Step 1), Confidence factor = 1.00						
Press right mouse button and click 'Set Safety Parameters' menu to change step or loadcase						
1	I-end	Primary	test	0.00014182	0.03613520	OK

Beam Summary result

Type	Elem	Hinge Location	Pushover Hinge Prop.	Load	Step	Deform	Force
M-Theta	1	I-end	column	test	1	3.832e-004	9.645651

$$\theta = M/(Scale\ Factor\ x\ K)$$

	Default (Iyy=1.0)	Iyy=0.50
Moment (M)	19.151625kNm	9.645651kNm
K (=3EI/L for Column)	136031.3	136031.3
Scale Factor	1.0	**0.5**
Hinge rotation(θ)	0.0001408	0.00014182

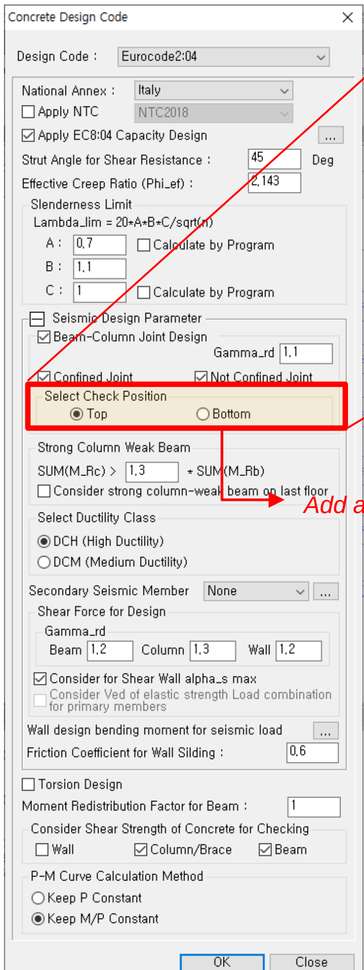
2. Improvement of Joint Design as per EC2:04 & NTC2018

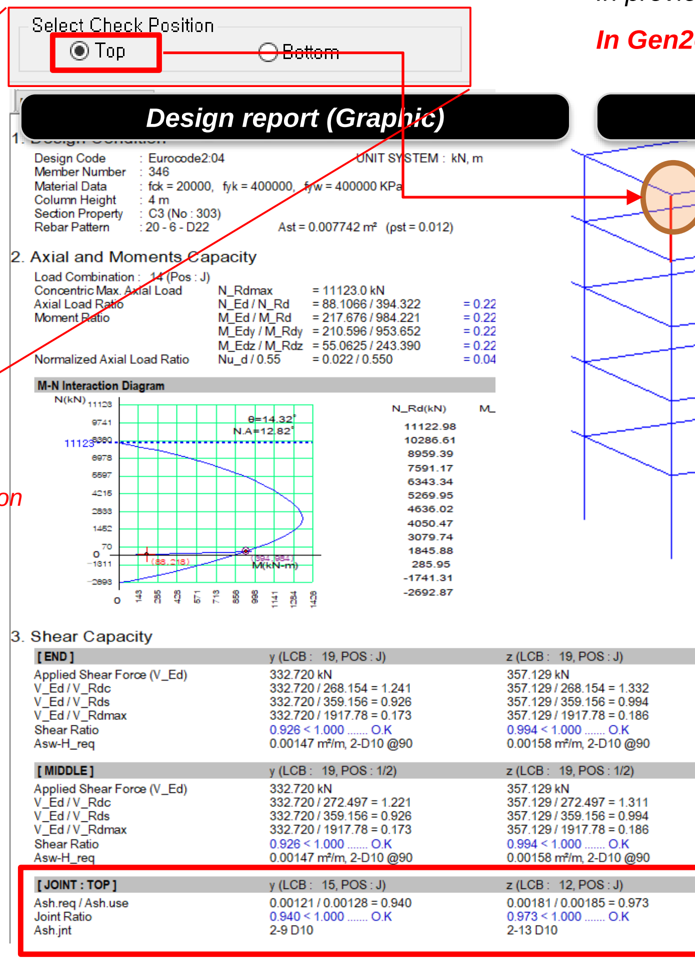
Add option to check joint position

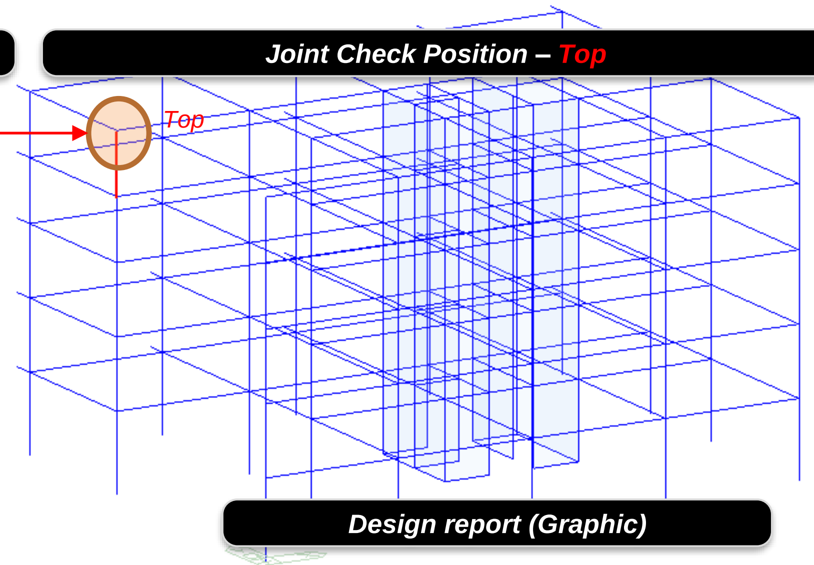
- Available joint design on both ends of the columns

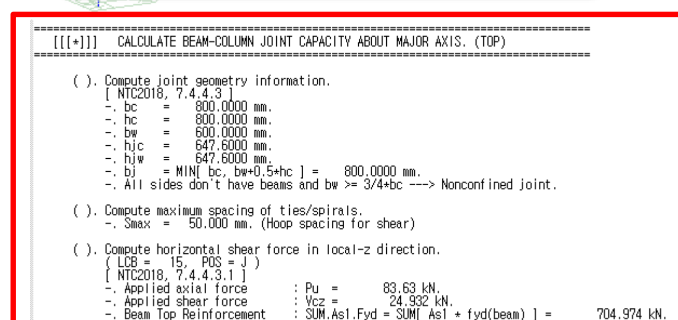
In previous version, joint check of roof story was not supported.

In Gen2021 v2.1, joint check is possible for all stories.









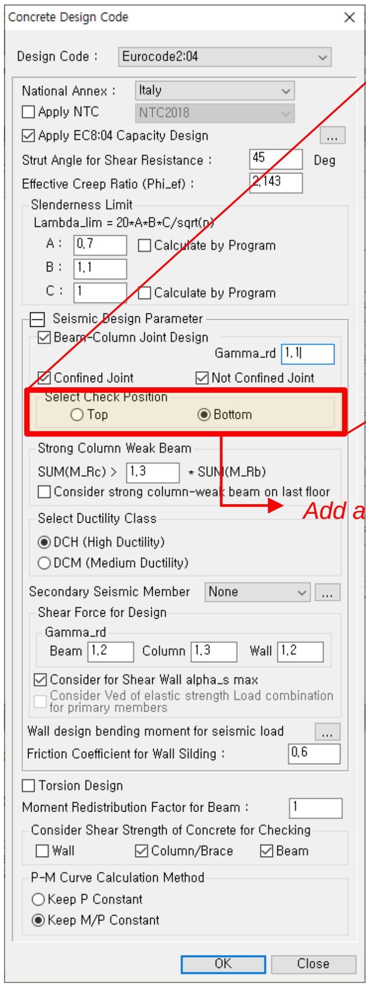
2. Improvement of Joint Design as per EC2:04 & NTC2018

Add option to check joint position

- Available joint design on both ends of the columns

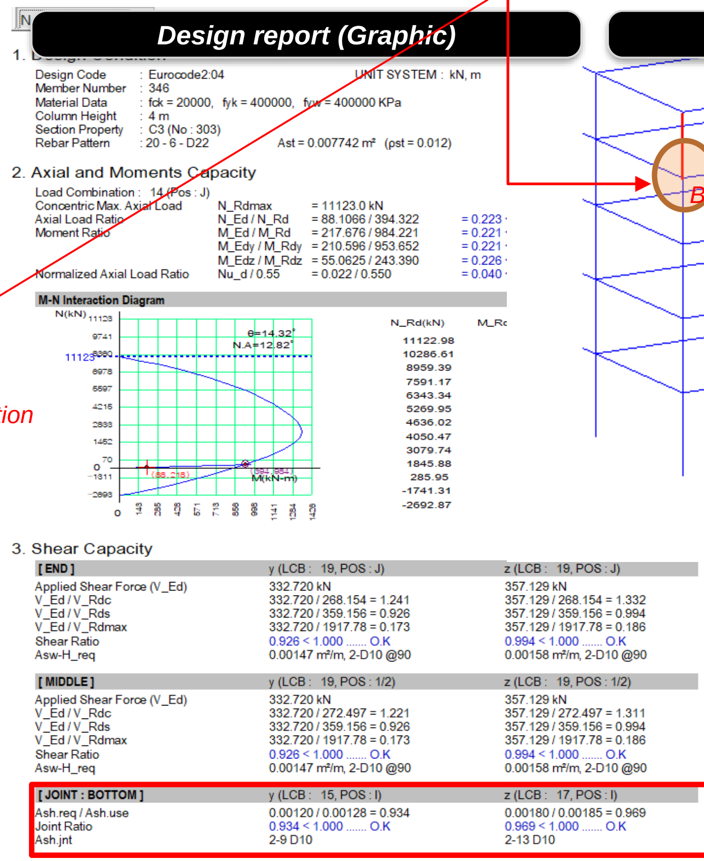
In previous version, joint check of roof story was not supported.

In Gen2021 v2.1, joint check is possible for all stories.



Add as option

Design report (Graphic)



1. Design Condition

Design Code : Eurocode2:04 UNIT SYSTEM : kN, m
Member Number : 346
Material Data : fck = 20000, fyk = 400000, fyw = 400000 KPa
Column Height : 4 m
Section Property : C3 (No : 303)
Rebar Pattern : 20 - 6 - D22 Ast = 0.007742 m² (pst = 0.012)

2. Axial and Moments Capacity

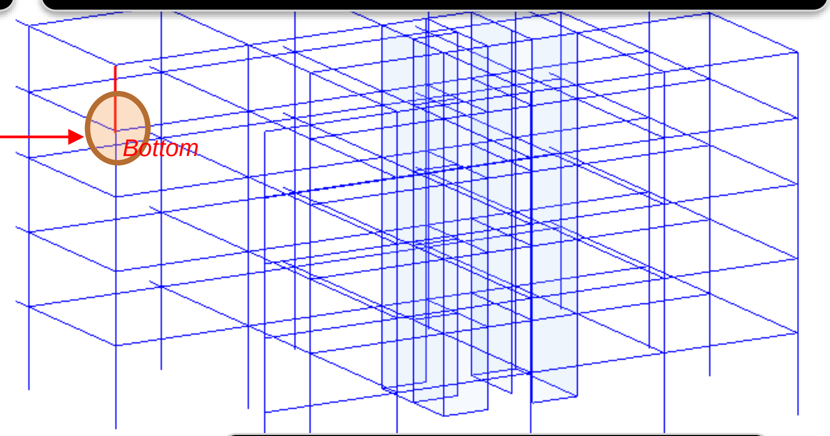
Load Combination : 14 (Pos : J)
Concentric Max. Axial Load N_Rdmax = 11123.0 kN
Axial Load Ratio N_Ed / N_Rd = 88.1066 / 394.322 = 0.223
Moment Ratio M_Ed / M_Rd = 217.676 / 984.221 = 0.221
M_Edy / M_Rdy = 210.596 / 953.652 = 0.221
M_Edz / M_Rdz = 55.0625 / 243.390 = 0.226
Normalized Axial Load Ratio Nu_d / 0.55 = 0.022 / 0.550 = 0.040

M-N Interaction Diagram

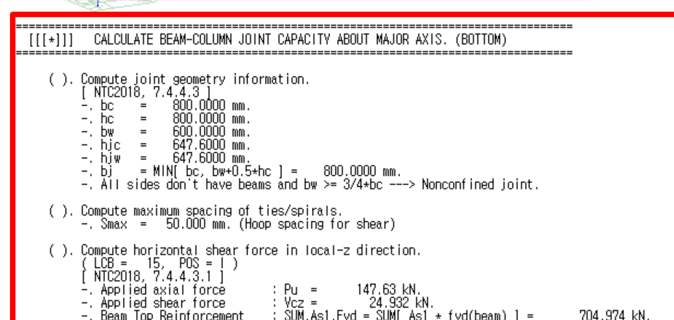
3. Shear Capacity

[END]	y (LCB : 19, POS : J)	z (LCB : 19, POS : J)
Applied Shear Force (V_Ed)	332.720 kN	357.129 kN
V_Ed / V_Rdc	332.720 / 268.154 = 1.241	357.129 / 268.154 = 1.332
V_Ed / V_Rds	332.720 / 359.156 = 0.926	357.129 / 359.156 = 0.994
V_Ed / V_Rdmax	332.720 / 1917.78 = 0.173	357.129 / 1917.78 = 0.186
Shear Ratio	0.926 < 1.000 .... O.K	0.994 < 1.000 .... O.K
Asw-H_req	0.00147 m²/m, 2-D10 @90	0.00158 m²/m, 2-D10 @90
[MIDDLE]	**y (LCB : 19, POS : 1/2)**	**z (LCB : 19, POS : 1/2)**
Applied Shear Force (V_Ed)	332.720 kN	357.129 kN
V_Ed / V_Rdc	332.720 / 272.497 = 1.221	357.129 / 272.497 = 1.311
V_Ed / V_Rds	332.720 / 359.156 = 0.926	357.129 / 359.156 = 0.994
V_Ed / V_Rdmax	332.720 / 1917.78 = 0.173	357.129 / 1917.78 = 0.186
Shear Ratio	0.926 < 1.000 .... O.K	0.994 < 1.000 .... O.K
Asw-H_req	0.00147 m²/m, 2-D10 @90	0.00158 m²/m, 2-D10 @90
[JOINT : BOTTOM]	**y (LCB : 15, POS : I)**	**z (LCB : 17, POS : I)**
Ash.req / Ash.use	0.00120 / 0.00128 = 0.934	0.00180 / 0.00185 = 0.969
Joint Ratio	0.934 < 1.000 .... O.K	0.969 < 1.000 .... O.K
Ash.jnt	2-9 D10	2-13 D10

Joint Check Position – Bottom



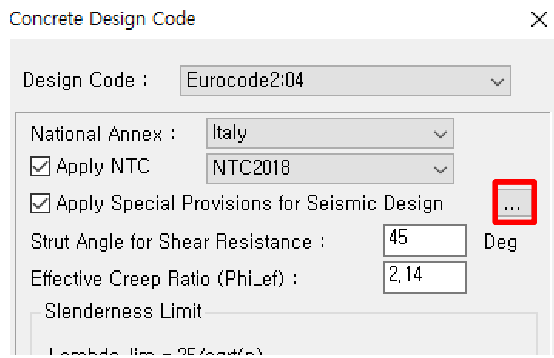
Design report (Graphic)

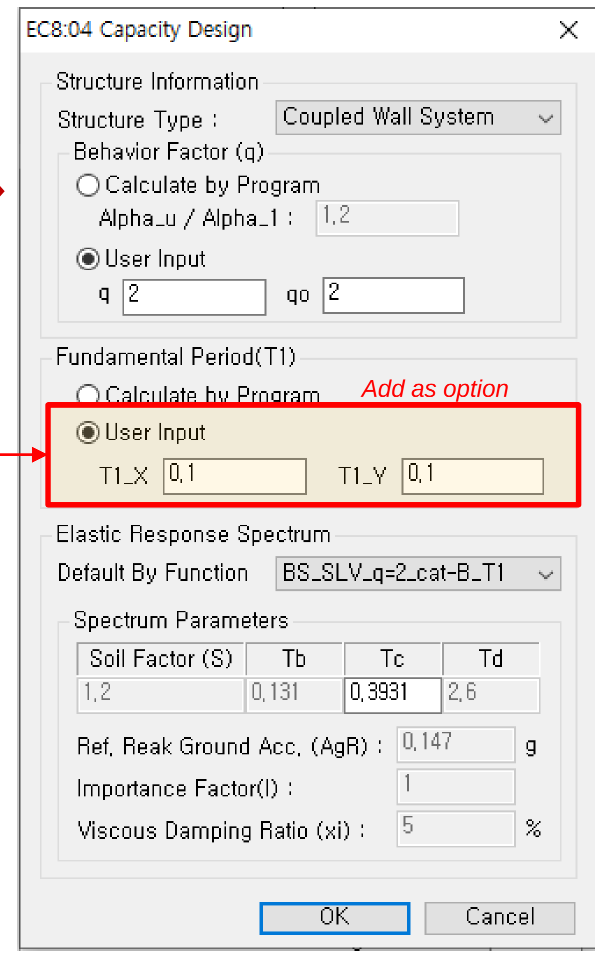


```
[[[*]]]   CALCULATE BEAM-COLUMN JOINT CAPACITY ABOUT MAJOR AXIS. (BOTTOM)

  ( ). Compute joint geometry information.
       [ NTC2018, 7.4.4.3 ]
       -. bc    =    800.0000 mm.
       -. hc    =    800.0000 mm.
       -. bw    =    600.0000 mm.
       -. hjc   =    647.6000 mm.
       -. hjw   =    647.6000 mm.
       -. bj    = MIN[ bc, bw+0.5*hc ] =    800.0000 mm.
       -. All sides don't have beams and bw >= 3/4*bc ---> Nonconfined joint.

  ( ). Compute maximum spacing of ties/spirals.
       -. Smax  =    50.000 mm. (Hoop spacing for shear)

  ( ). Compute horizontal shear force in local-z direction.
       ( LCB =   15,  POS = I )
       [ NTC2018, 7.4.4.3.1 ]
       -. Applied axial force     : Pu  =      147.63 kN.
       -. Applied shear force     : Vcz =      24.932 kN.
       -. Beam Top Reinforcement  : SUM.As1.Fyd = SUM[ As1 * fyd(beam) ] =      704.974 kN.
```

3. User Definition of T1 for shear design as per EC8:04 & NTC2018

- Allow to define the fundamental period(T1) directly for slender wall shear design





Applied equation : 5.25 (EC8:04)

$$V_{Ed} = \varepsilon \cdot V'_{Ed} \qquad (5.24)$$

where

V'_{Ed} is the shear force from the analysis;

ε is the magnification factor, calculated from expression (5.25), but not less than 1,5:

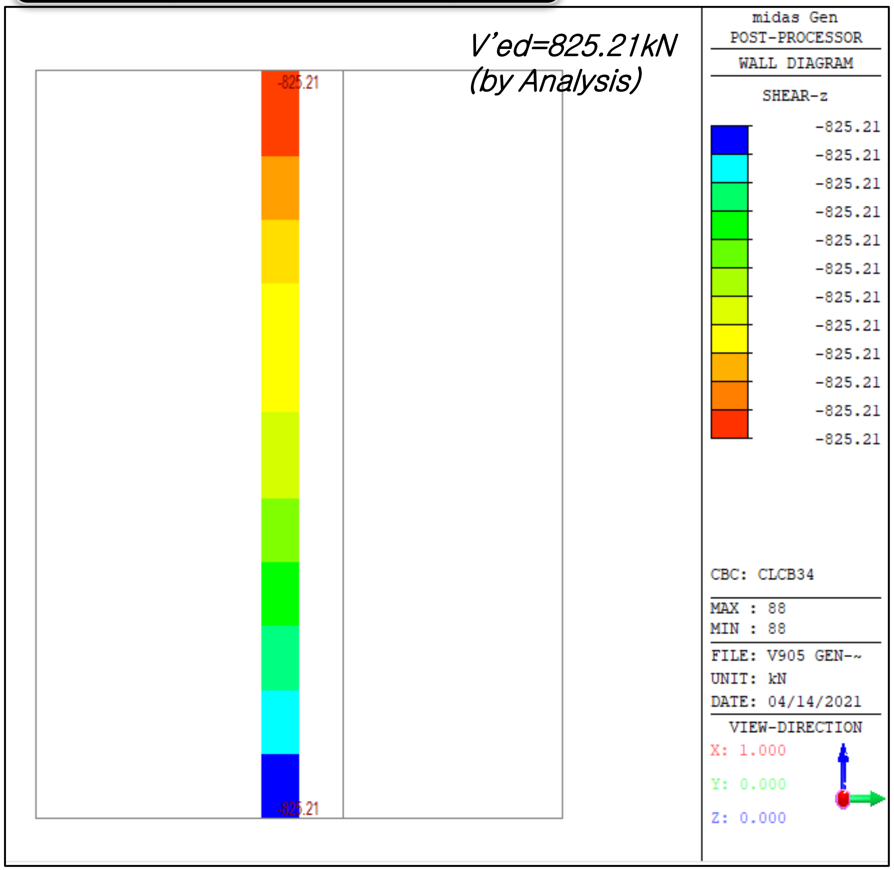
$$\varepsilon = q \cdot \sqrt{\left(\frac{\gamma_{Rd}}{q} \cdot \frac{M_{Rd}}{M_{Ed}}\right)^2 + 0{,}1\left(\frac{S_e(T_C)}{S_e(T_1)}\right)^2} \le q \qquad (5.25)$$

T_1 is the fundamental period of vibration of the building in the direction of shear forces V_{Ed};

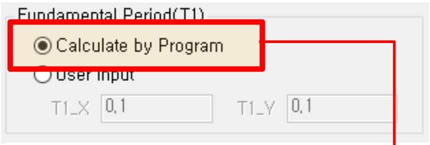
3. User Definition of T1 for shear design as per EC8:04 & NTC2018

- Allow to define the fundamental period(T1) directly for slender wall shear design

Analysis Shear Force (V'ed)



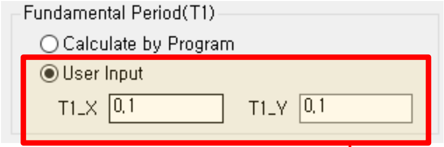
Applied Shear Force(Ved=ε *V'ed)



T1 = 1.2486sec(Calculated by Gen)
ε = 2.0
*→Ved=2.0*825.21=1650.43kN*

Shear Capacity

Applied Shear Force	V_Ed	= 1650.43 kN (Load Combination : 1)
Shear Ratio by Conc	V_Ed/V_Rdc	= 1650.43 / 476.234 = 3.4656
Shear Ratio by V_Rds	V_Ed/V_Rds	= 1650.43 / 1395.39 = 1.1828
Shear Ratio by V_Rdmax	V_Ed/V_Rdmax	= 1650.43 / 986.047 = 1.6738



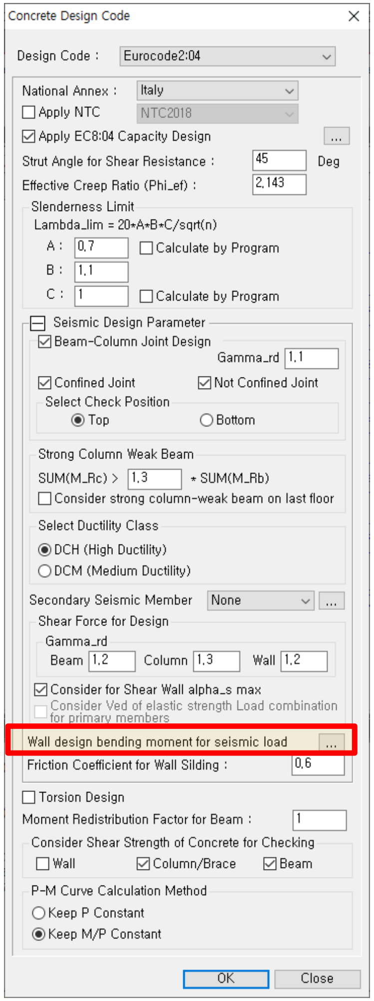
T1 = 0.1sec(User input)
ε = 1.56
*→Ved=1.56*825.21=1287.67kN*

Shear Capacity

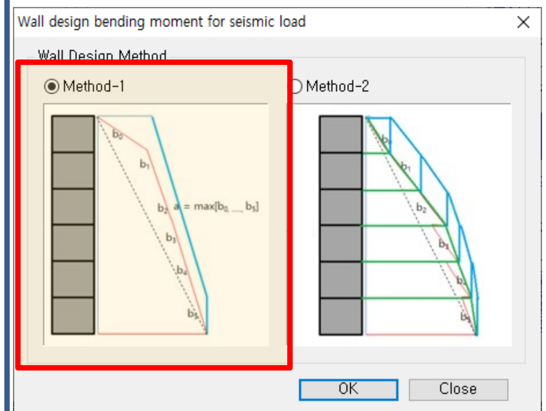
Applied Shear Force	V_Ed	= 1287.67 kN (Load Combination : 1)
Shear Ratio by Conc	V_Ed/V_Rdc	= 1287.67 / 565.751 = 2.2760
Shear Ratio by V_Rds	V_Ed/V_Rds	= 1287.67 / 1131.97 = 1.1376
Shear Ratio by V_Rdmax	V_Ed/V_Rdmax	= 1287.67 / 973.873 = 1.3222

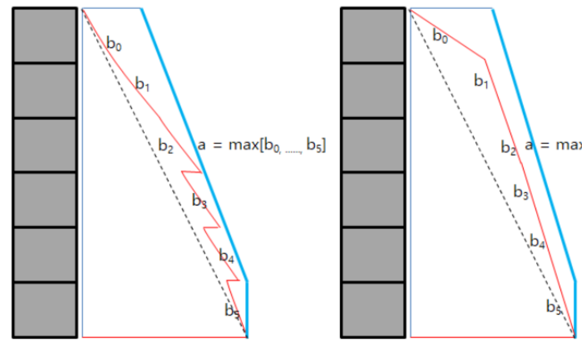
4. New method of Wall design moment calculation as per NTC2018

- Method 2 is an alternative method in which the upper wall design moment is applied excessively to the code method(Method 1).



Method 1 : current procedure.

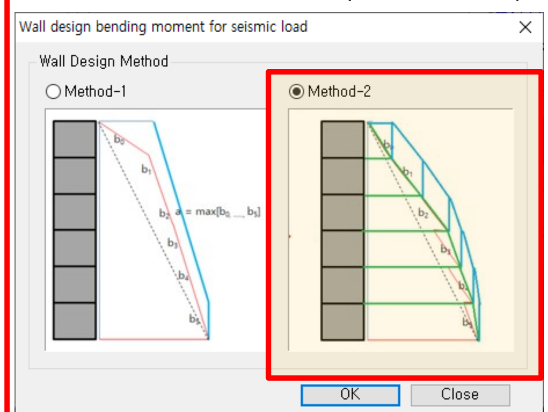


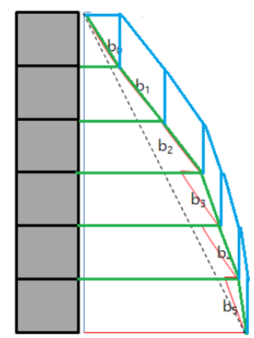


1) *Red : Analysis values*

2) *Blue :* ***Use max value among red diagram's slope at last floor***

Method 2 : New method as request from code(EC & NTC)





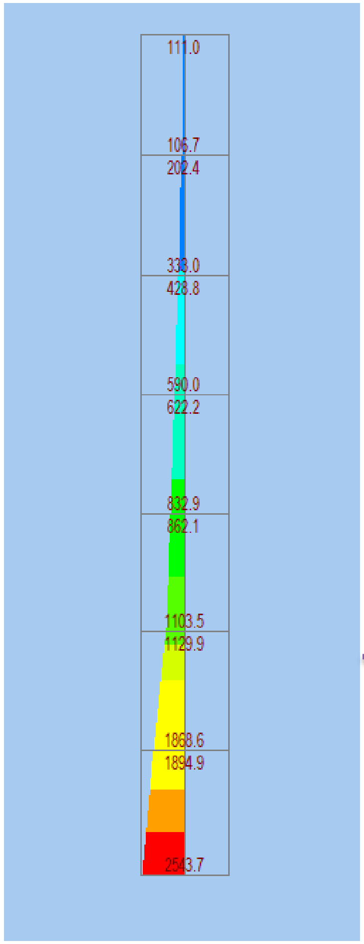
1) *Red : Analysis values*

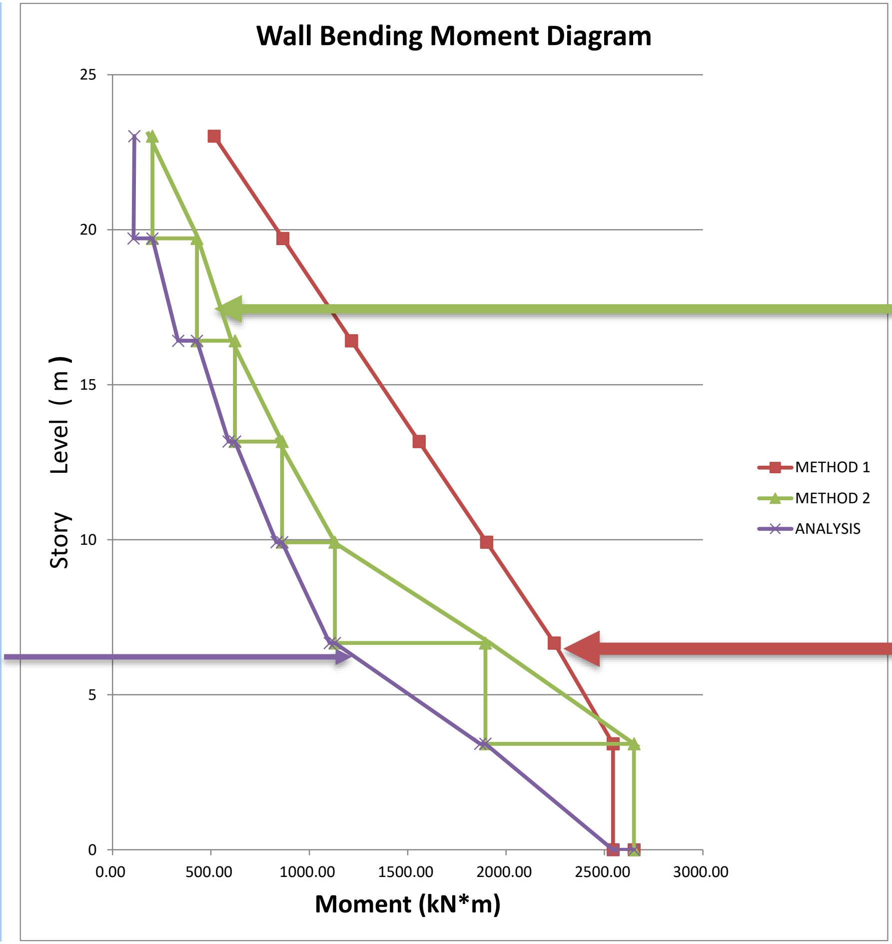
2) *Green : max envelope bending moment results*

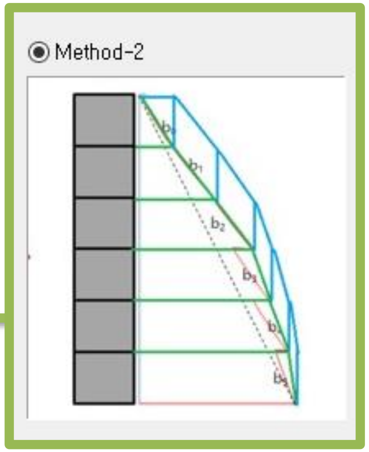
3) *Blue :* ***translation of green diagram on Z direction***

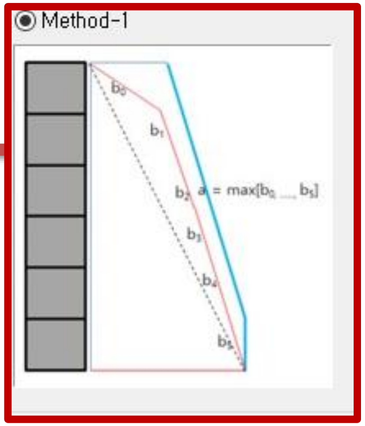
4. New method of Wall design moment calculation as per NTC2018

- Method 2 is an alternative method in which the upper wall design moment is applied excessively to the code method(Method 1).



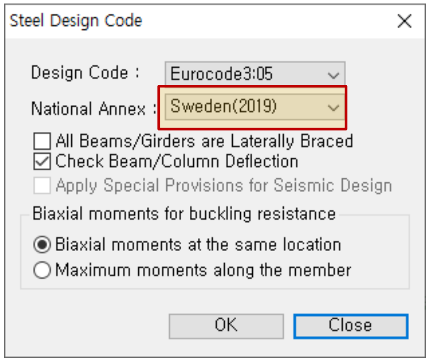


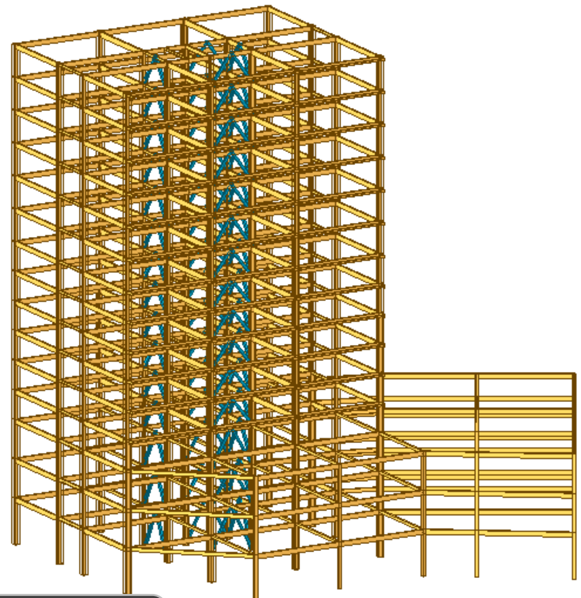




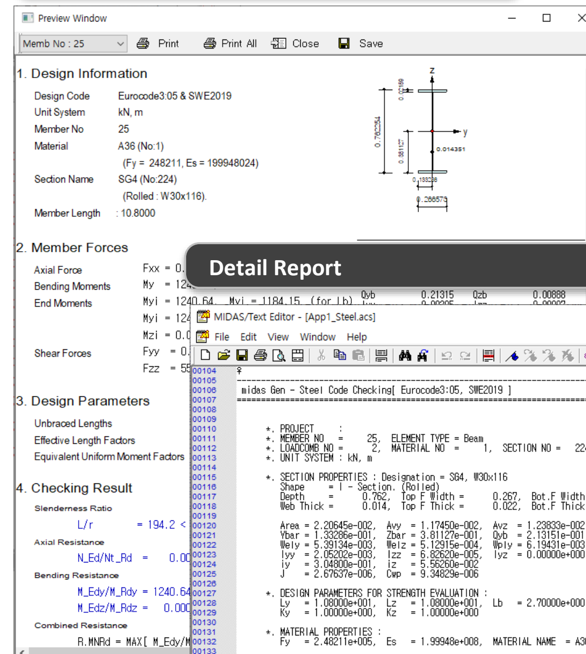
5. Addition of New Sweden National Annex in Eurocode

Add Sweden National Annex (BFS2019:1) of Steel Design

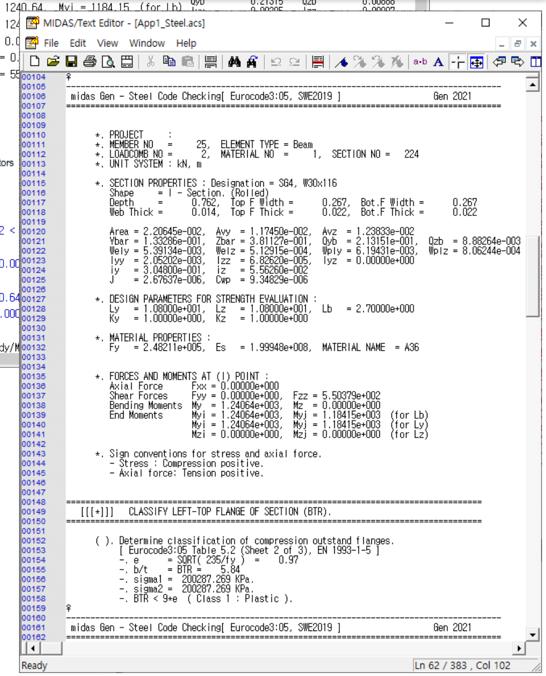




Graphic Report (Summary Report)



Detail Report



Design Result Table

Eurocode3:05 Code Checking Result Dialog

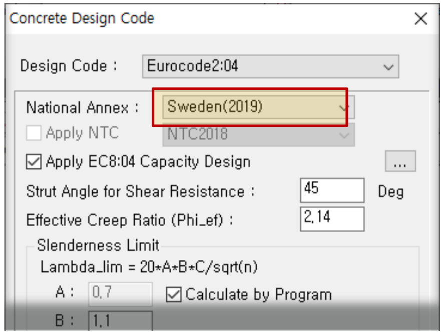
Code : EC3:05, SWE2019 Unit : kN , m

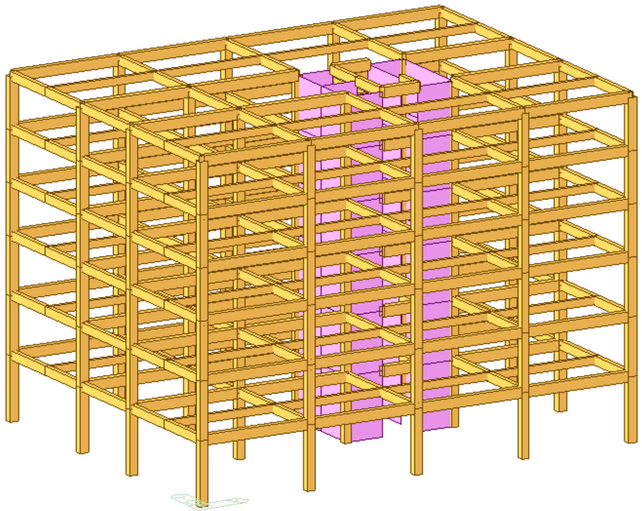
Sorted by: Member / Property (selected) — Change... Update... — Primary Sorting Option: SECT / MEMB

CHK	MEMB / COM	SECT / SHR	SEL	Section / Material	Fy	LCB	Len / Lb	Ly / Lz	Ky / Kz	Bmy / Bmz	N,Ed / N,Rd	My,Ed / Mb,Rd	My,Ed / My,Rd	Mz,Ed / Mz,Rd	Vy,Ed / Vy,Rd	Vz,Ed / Vz,Rd	T,Ed / T,Rd	Def / Defa
OK	254	221	☐	SG1, W24x76		2	12.0000	12.0000	1.000	1.000	0.00000	-458.65	-458.65	0.00000	0.00000	181.729	-	-0.0142
	0.707	0.165		A36	248211		4.00000	12.0000	1.000	1.000	3587.05	648.575	813.491	116.329	0.00000	1101.29	-	0.04800
OK	251	222	☐	SG2, W18x55		3	3.00000	3.00000	1.000	1.000	0.00000	-235.96	-235.96	0.00000	0.00000	141.276	-	-0.0016
	0.518	0.194		A36	248211		2.00000	3.00000	1.000	1.000	2594.20	0.00000	455.555	75.2479	0.00000	729.078	-	0.02400
OK	125	223	☐	SG3, W18x55		6	6.00000	6.00000	1.000	1.000	0.00000	228.311	228.311	0.00000	0.00000	114.076	-	-0.0031
	0.501	0.156		A36	248211		2.00000	6.00000	1.000	1.000	2594.20	0.00000	455.555	75.2479	0.00000	729.078	-	0.02400
	24	224		SG4, W30x116			10.8000	10.8000	1.000	1.000	0.00000	1274.54	1274.54	0.00000	0.00000	-562.25	-	-0.0465

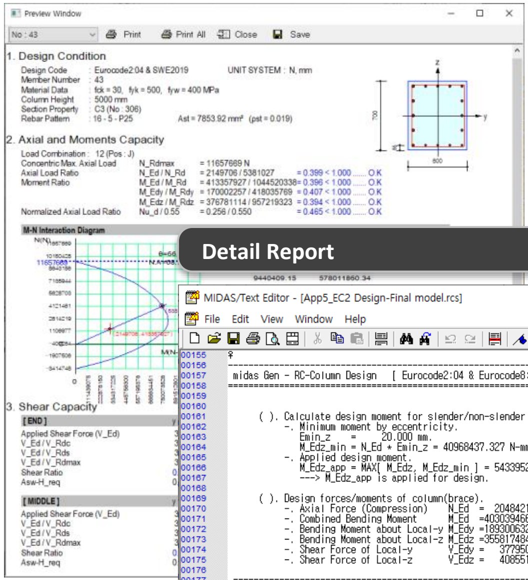
5. Addition of New Sweden National Annex in Eurocode

Add Sweden National Annex (BFS2019:1) of RC Design

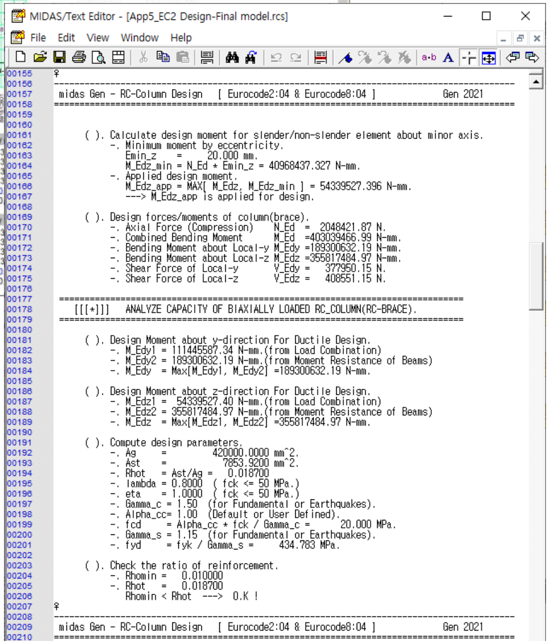




Graphic Report (Summary Report)



Detail Report



Design Result Table

Eurocode2:04 RC-Column Design Result Dialog

Code : EC2:04,SWE2019   Unit : N , mm   Primary Sorting Option: SECT / MEMB

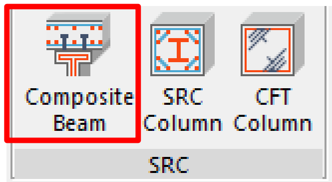
Sorted by: Member / Property

MEMB / SECT	SEL	Section / Bc	Hc	fck / Height	fyk / fyw	LCB	Uc / Rat-Uc	N_Ed / Rat-N	M_Ed / Rat-M	Ast	V-Rebar	LCB	V_Ed.end / V_Ed.mid	Rat-V.end / Rat-V.mid	Asw-H.e / Asw-H.m	H-Rebar.end / H-Rebar.mid	Ash.req / Ash.us	Rat-Ash	J-Rebar
0	☐	C1		30.0000	500.000	10	0.471	2694578	1.1E+09	11781	24-7-P25	12	395581	0.978	4524.0	2-P12 @50	4731.50	0.972	Failure
106		600.0	600.0	4500.0	400.000		0.856	0.983	0.974			13	555884	0.830	3258.2	2-P10 @40	4869.48		
0	☐	C1A		30.0000	500.000	13	0.249	1496645	4.2E+07	6872.2	14-5-P25	13	431672	0.959	3098.8	2-P12 @70	2229.69	0.986	2-10 P12
156		500.0	600.0	5000.0	400.000		0.454	0.188	0.190			13	431672	0.986	3098.8	2-P10 @50	2262.00		
0	☐	C2		30.0000	500.000	11	0.333	763175	9.9E+08	10799	22-6-P25	11	389761	0.964	3231.4	2-P12 @70	3300.71	0.955	2-22 P12
206		600.0	600.0	4000.0	400.000		0.605	0.912	0.927			11	419465	0.939	2458.6	2-P10 @60	3455.76		
0	☐	C3		30.0000	500.000	10	0.261	675835	7.5E+08	7853.9	16-5-P25	12	411273	0.898	2513.3	2-P12 @90	3216.31	0.975	2-21 P12
306		600.0	700.0	4000.0	400.000		0.474	0.780	0.770			12	393064	0.880	2303.9	2-P10 @60	3298.68		

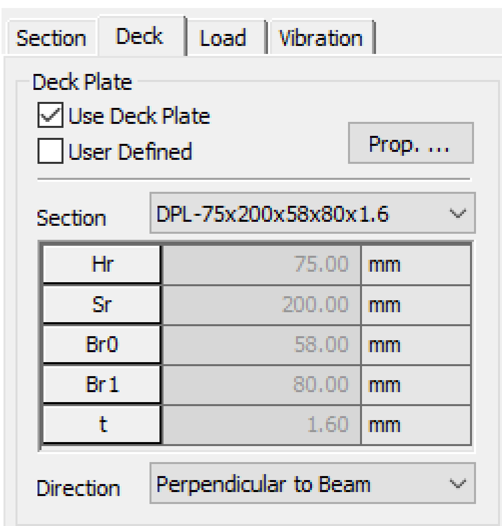
midas ***Design+***

1. User define of Deck Plate of composite beam module

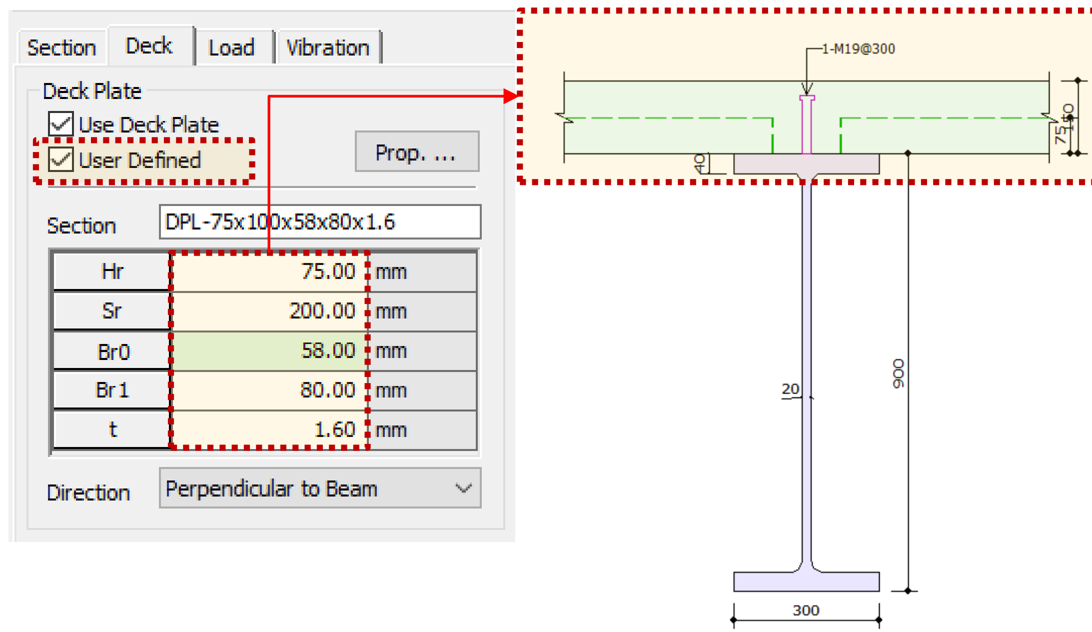
- *Deck plate section of composite beam can be customized.*



Use DB Section



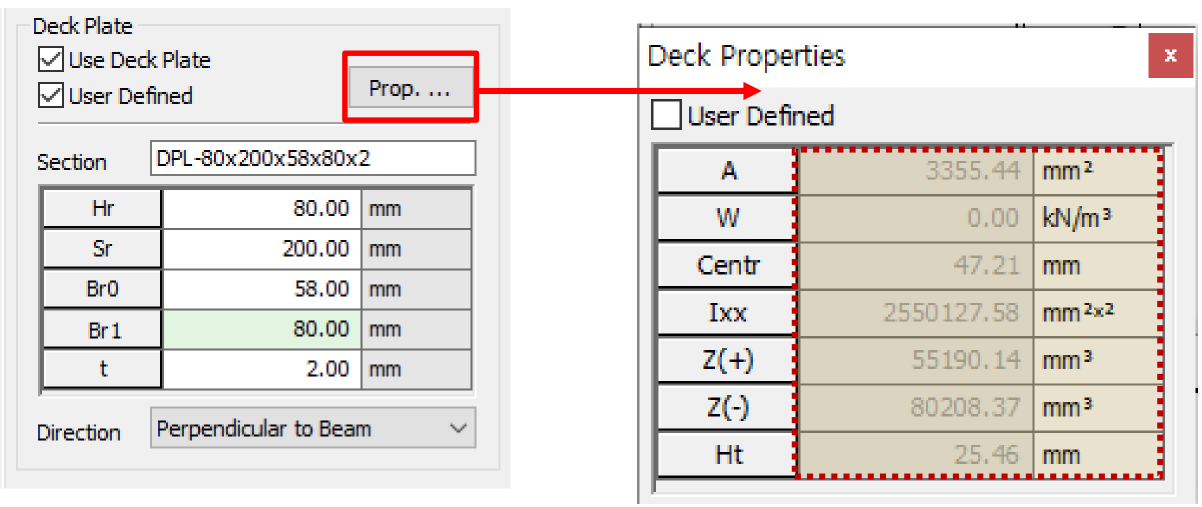
User Defined Section



1. User define of Deck Plate of composite beam module

- *Section properties can be directly input by the user for both DB section and user-defined section.*

User Defined Section | **Auto-Calculated Deck Properties & Report**



(4) Deck Plate : DPL-80x200x58x80x2

- Direction : Perpendicular to Beam

H_r	S_r	B_{r0}	B_{r1}	t	H_t
80.00mm	200mm	58.00mm	80.00mm	2.000mm	25.46mm

A	W	C_y	I_{xx}	Z(+)	Z(-)
3,355mm²	0.000kN/m³	47.21mm	2,550,128mm⁴	55,190mm³	80,208mm³

1.DB section: The properties defined in the DB are applied.

*2. **User Defined section: Automatic calculation value applied. (Calculated as section property for Thin-Wall Section)***