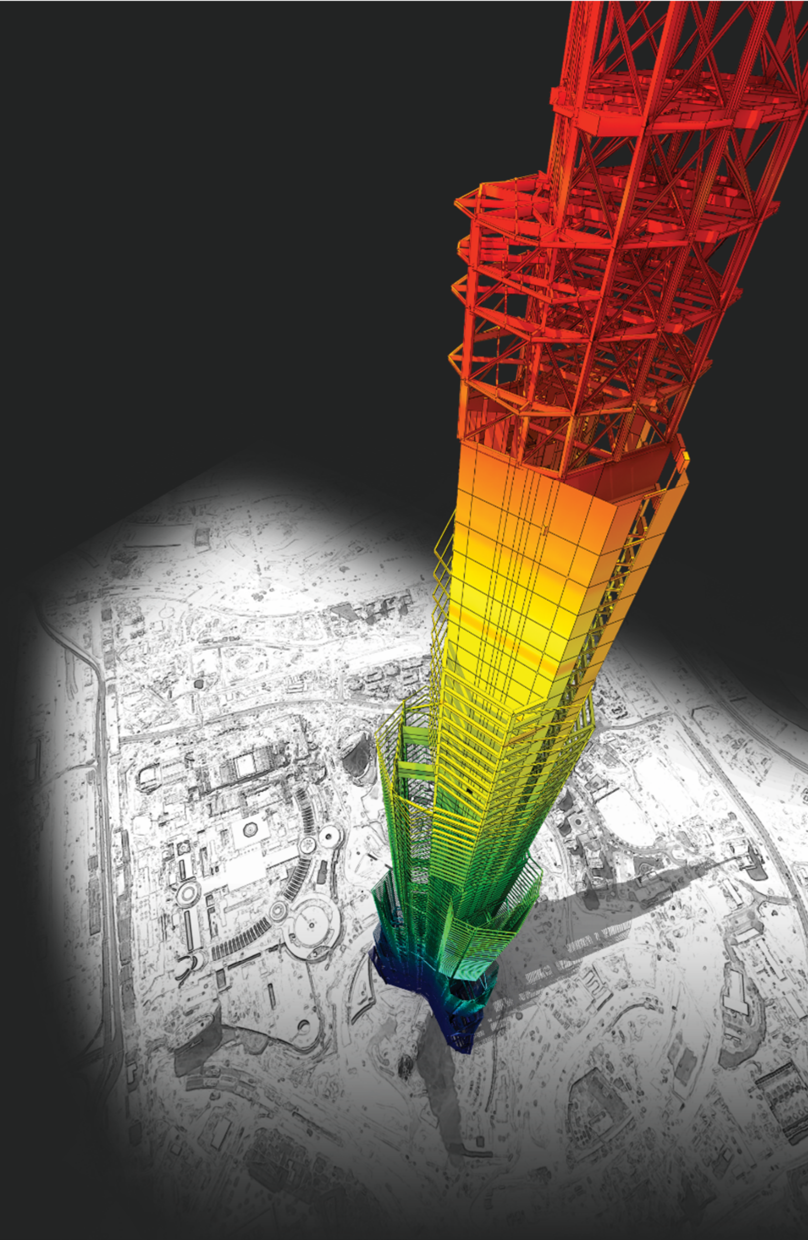
Release Note

Release Date : December. 2020

Product Ver. : midas Gen 2021 (v1.1) and Design+2021(v1.1)



DESIGN OF General Structures

Integrated Design System for Building and General Structures

midas Gen

Enhancements

- ## *midas Gen*

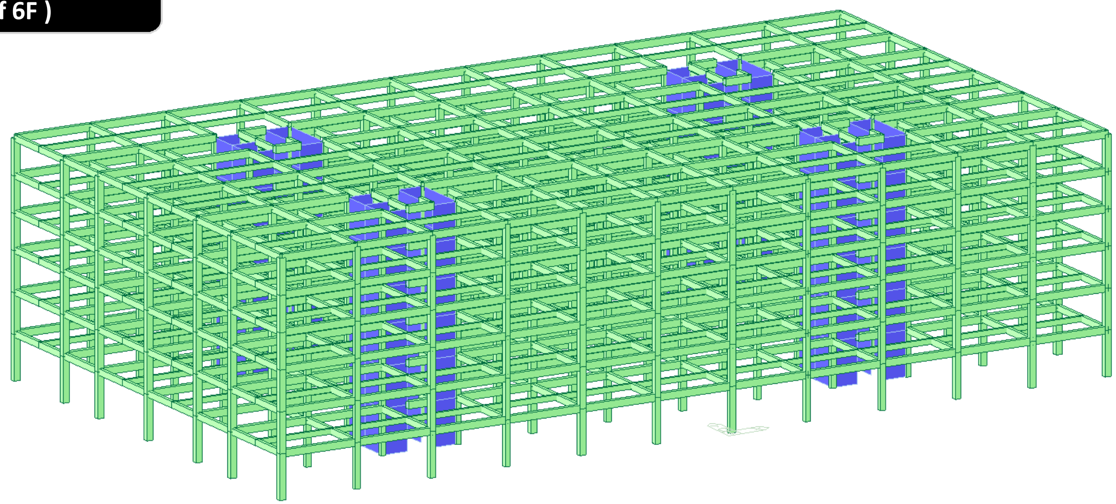
- ## *midas Design+*

1. Improvement of design speed for Non-dissipative elements

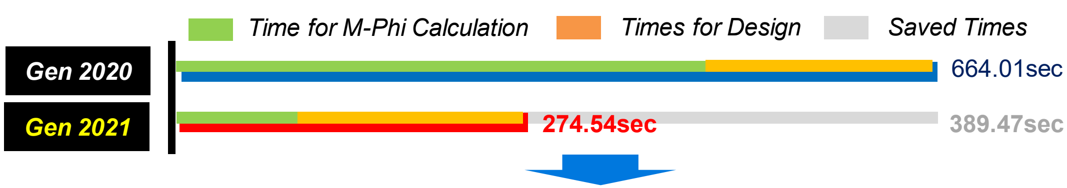
- *Reduction of design time by optimizing m-phi calculation and improving the output algorithm*

Example Model (RC structure of 6F)

- ✓ *Beam/Column : 1,974 Elements*
- ✓ *Wall : 216 Elements*
- ✓ *Load Combination : 100*



[Total ND Design Time : Gen 2020 vs Gen 2021(New Version)]



60% reduction in design time

2. Improvement of Non-dissipative Design as per NTC2018

Non-dissipative in flexural & Shear design – Design Table

- Output of separated results for ULS except seismic action) and ELS with seismic modified by q for non-dissipative elements

Ultimate Strength Check (LC_A) in graphic design

** LC_A : Load combination to check ULS(Ultimate Limit State) except seismic loads*

Code : Eurocode2:04,NTC2018   Unit : kN , m

Primary Sorting Option: ○ SECT ◉ MEMB

Sorted by: ◉ Member ○ Property

Results: ◉ Strength ○ Serviceability ○ Elastic

MEMB	SEL	Section		fck	fyk	CHK	LCB	V-Rebar	N_Rdmax	Uc	N_Ed	M_Edy	M_Edz	V_Rdc.end	V_Rds.end	V_Rdc.mid	V_Rds.mid	LCB	V_Ed.end	Rat-V.end	Ash.req
SECT		Bc	Hc	Height	fyw					Rat-Uc	Rat-N	Rat-My	Rat-Mz	Rat-Vc.end	Rat-Vs.end	Rat-Vc.mid	Rat-Vs.mid		V_Ed.mid	Rat-V.mid	Rat-J
373	☑	P30x60		25000.0	450000	MV	19	14-5-P16	3611.27	0.000	114.887	267.411	67.9358	115.741	131.478	116.749	131.478	35	135.439	1.030	0.00000
1		0.300	0.600	3.2000	450000					0.000	0.998	1.083	1.090	1.170	1.030	1.160	1.030	35	135.439	1.030	0.000

Elastic Strength Check (LC_E) in graphic design

** LC_E : Load combination to check ELS(Elastic Limit State)*

Code : Eurocode2:04,NTC2018   Unit : kN , m

Primary Sorting Option: ○ SECT ◉ MEMB

Sorted by: ◉ Member ○ Property

Results: ○ Strength ○ Serviceability ◉ Elastic

MEMB	SEL	Section		fck	fyk	CHK	Seis. Class	LCB	M.Edy	M.Edz	Rat-My	Rat-Com	V_Rdc.end	V_Rds.end	V_Rdc.mid	V_Rds.mid	LCB	V_Ed.end	Rat-V.end	Ash.req
SECT		Bc	Hc	Height	fyw				M'.ydy	M'.ydz	Rat-Mz		Rat-Vc.end	Rat-Vs.end	Rat-Vc.mid	Rat-Vs.mid		V_Ed.mid	Rat-V.mid	Rat-J
373	☑	P30x60		25000.0	450000	OK	N.D.	51	214.132	54.2597	0.849	0.987	106.276	131.478	105.268	131.478	43	105.100	0.989	0.00000
1		0.300	0.600	3.2000	450000				252.227	107.695	0.504		0.989	0.799	0.998	0.799	43	105.100	0.998	0.000

Serviceability Check (LC_S) in graphic design

** LC_S : Load combination to check SLS(Serviceability Limit State)*

Sorted by: ◉ Member ○ Property

Results: ○ Strength ◉ Serviceability ○ Elastic

○ SECT ◉ MEMB

MEMB	SEL	Section		fck	fyk	CHK	Stress Control								
SECT		Bc	Hc	Height	fyw		LC	sig-ct	sig-cta	LC	sig-cc	sig-cca	LC	sig-s	sig-sa
373	☑	P30x60		25000.0	450000	OK		0.00000	2564.96	70	1134.84	15000.0	-	0.00000	0.00000
1		0.300	0.600	3.2000	450000										

2. Improvement of Non-dissipative Design as per NTC2018

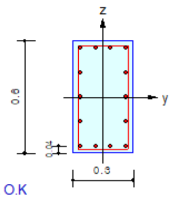
Non-dissipative in flexural & Shear design : Graphic report

- Output a design results for ULS, ELS and SLS separately in design reports.

Design result for ULS(Ultimate Limit State)

1. Design Condition

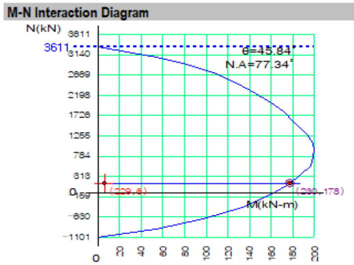
Design Code	: Eurocode2:04 & NTC2018	UNIT SYSTEM : kN, m
Member Number	: 373	
Material Data	: fck = 25000, fyk = 450000, fyw = 450000 KPa	
Column Height	: 3.2 m	
Section Property	: P30x60 (No : 1)	
Rebar Pattern	: 14 - 5 - P16	Ast = 0.002814 m² (ρst = 0.016)



2. Axial and Moments Capacity

Load Combination : 1 (I)			
Concentric Max. Axial Load	N_Rdmax	= 3611.27 kN	
Axial Load Ratio	N_Ed / N_Rd	= 229.268 / 229.761	= 0.998 < 1.000 .... O.K
Moment Ratio	M_Ed / M_Rd	= 6.48468 / 178.003	= 0.036 < 1.000 .... O.K
	M_Edy / M_Rdy	= 4.58536 / 124.006	= 0.037 < 1.000 .... O.K
	M_Edz / M_Rdz	= 4.58536 / 127.702	= 0.036 < 1.000 .... O.K

M-N Interaction Diagram



N_Rd(kN)	M_Rd(kN-m)
3611.27	0.00
3332.70	55.00
2959.27	107.00
2462.15	145.43
1977.21	172.00
1553.66	189.17
1296.51	197.30
1077.98	199.77
674.34	196.74
189.02	176.10
-351.87	133.72
-893.85	53.35
-1101.13	0.00

3. Shear Capacity

[END]	y : 1 (J)	z : 1 (J)
Applied Shear Force (V_Ed)	1.81597 kN	0.31087 kN
V_Ed / V_Rdc	1.81597 / 126.642 = 0.014	0.31087 / 118.248 = 0.003
V_Ed / V_Rds	1.81597 / 61.0435 = 0.030	0.31087 / 131.478 = 0.002
V_Ed / V_Rdmax	1.81597 / 497.250 = 0.004	0.31087 / 535.500 = 0.001
Shear Ratio	0.014 < 1.000 .... O.K	0.003 < 1.000 .... O.K
Asw-H_use	0.00067 m²/m, 2-P8 @150	0.00067 m²/m, 2-P8 @150

[MIDDLE]	y : 1 (1/2)	z : 1 (1/2)
Applied Shear Force (V_Ed)	1.81597 kN	0.31087 kN
V_Ed / V_Rdc	1.81597 / 127.858 = 0.014	0.31087 / 119.558 = 0.003
V_Ed / V_Rds	1.81597 / 61.0435 = 0.030	0.31087 / 131.478 = 0.002
V_Ed / V_Rdmax	1.81597 / 497.250 = 0.004	0.31087 / 535.500 = 0.001
Shear Ratio	0.014 < 1.000 .... O.K	0.003 < 1.000 .... O.K
Asw-H_use	0.00067 m²/m, 2-P8 @150	0.00067 m²/m, 2-P8 @150

Design result for ELS(Elastic Limit State)

4. Elastic Bending Moment Capacity

	y : 2 (I)	z : 2 (I)
Moment (M.Ed)	81.7143 kN-m	21.7915 kN-m
Elastic Strength (M'.yd')	254.437 kN-m	118.530 kN-m
Check Ratio	0.321 < 1.000 .... O.K	0.184 < 1.000 .... O.K
Check Combined Ratio (sqrt((M_Edy/M'_ydy)^2 + (M_Edz/M'_ydz)^2))		0.370 < 1.000 .... O.K

5. Elastic Shear Capacity

[END]	y : 2 (J)	z : 2 (J)
Applied Shear Force (V_Ed)	12.1481 kN	40.1526 kN
V_Ed / V_Rdc	12.1481 / 120.093 = 0.101	40.1526 / 111.195 = 0.361
V_Ed / V_Rds	12.1481 / 61.0435 = 0.199	40.1526 / 131.478 = 0.305
V_Ed / V_Rdmax	12.1481 / 497.250 = 0.024	40.1526 / 535.500 = 0.075
Shear Ratio	0.101 < 1.000 .... O.K	0.361 < 1.000 .... O.K
Asw-H_use	0.00067 m²/m, 2-P8 @150	0.00067 m²/m, 2-P8 @150

[MIDDLE]	y : 2 (1/2)	z : 2 (1/2)
Applied Shear Force (V_Ed)	12.1481 kN	40.1526 kN
V_Ed / V_Rdc	12.1481 / 121.029 = 0.100	40.1526 / 112.203 = 0.358
V_Ed / V_Rds	12.1481 / 61.0435 = 0.199	40.1526 / 131.478 = 0.305
V_Ed / V_Rdmax	12.1481 / 497.250 = 0.024	40.1526 / 535.500 = 0.075
Shear Ratio	0.100 < 1.000 .... O.K	0.358 < 1.000 .... O.K
Asw-H_use	0.00067 m²/m, 2-P8 @150	0.00067 m²/m, 2-P8 @150

Design result for SLS(Serviceability Limit State)

6. Serviceability : Stress Limit Check

	Load Combination	Stress(s)	Allowable Stress(sa)	Stress Ratio(s/sa)
Concrete (Tensile)	-	0.00	2564.96	0.0000
Concrete (Compression)	3(C)	1095.15	15000.00	0.0730
	-	0.00	0.00	*****
Rebar	-	0.00	0.00	*****
Check Linear Creep	*****	*****	*****	*****

3. Improvement for Shear design as per NTC2018

Design Shear force of primary elements according to NTC 2018

- When calculating a design shear force for primary elements, member force can be limited by a resistance demand for ELS load combinations.

7.2.2. CRITERI GENERALI DI PROGETTAZIONE DEI SISTEMI STRUTTURALI

PROGETTAZIONE IN CAPACITÀ E FATTORI DI SOVRARESISTENZA

La domanda di resistenza valutata con i criteri della progettazione in capacità può essere assunta non superiore alla domanda di resistenza valutata per il caso di comportamento strutturale non dissipativo.

Le strutture di fondazione e i relativi elementi strutturali devono essere progettati sulla base della domanda ad essi trasmessa dalla struttura sovrastante (si veda § 7.2.5) attribuendo loro comportamento strutturale non dissipativo, indipendentemente dal comportamento attribuito alla struttura su di essi gravante.

The resistance demand evaluated with the capacity design criteria can be assumed not higher than the resistance demand evaluated for the case of non dissipative structural behavior.

Design report (Detail)

```
==============================================================================
  [[[*]]]   CALCULATE DATA OF SPECIAL PROVISIONS FOR SEISMIC DESIGN.
==============================================================================

    ( ). Design parameters.
         -. fyk  = 450000.00000 KPa.
         -. phi     = 1.0

    ( ). Bending strength for design shear force.
         -. MeI+ =       66.455 kN-m.((I, Clockwise))
         -. MeJ- =       96.206 kN-m.((J, Clockwise))
         -. MeI- =       96.206 kN-m.((I, Counter-Clockwise))
         -. MeJ+ =       66.455 kN-m.((J, Counter-Clockwise))

    ( ). Calculate design shear force according to special provisions for seismic design.
         -. Alphal   = 1.0000
         -. Span     =     4.3000 m.
         -. VzG      =    -10.004 kN.  (by Gravity-Direction Load).
         -. Clockwise
            Ve11_CW = VzG + Alphal*(MeI+ + MeJ-)/Span =      27.824 kN.
            Ve12_CW = VzG - Alphal*(MeI+ + MeJ-)/Span =     -47.832 kN.
            Ve1_CW  = MAX[ |Ve11_CW|, |Ve12_CW| ] =      47.832 kN.
         -. Counter-Clockwise
            Ve11_CCW= VzG + Alphal*(MeI- + MeJ+)/Span =      27.824 kN.
            Ve12_CCW= VzG - Alphal*(MeI- + MeJ+)/Span =     -47.832 kN.
            Ve1_CCW = MAX[ |Ve11_CCW|, |Ve12_CCW| ] =      47.832 kN.

         -. Ve1(M)  = MAX[ |Ve1_CW|, |Ve1_CCW| ]  =      47.832 kN.  (by Moment Strength).
         -. Ve1(E)  =     17.186 kN.  (by Elastic Load Combination).
         -. Ve1     = MIN[ Ve1(M), Ve1(E) ]      =      17.186 kN.
         -. VzOrg   =    -18.902 kN.  (by Strength Load Combination).
         -. V_Ed    = MAX[ |VzOrg|, Ve1 ] =      18.902 kN.
```

VzOrig = Design shear force by ULS load combination

Ve1(M) = Design shear force by flexural strength of member.

Ve1(E) = Design shear force by ELS load combination.

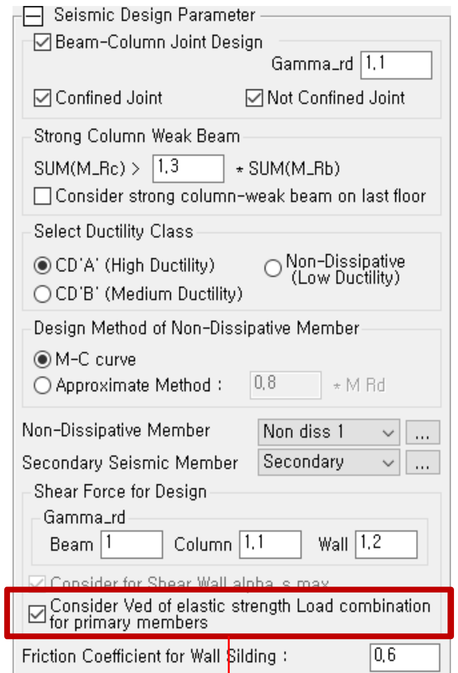
V_Ed = Max [VzOrig, Min[Ve1(M), Ve1(M)]]

3. Improvement for Shear design as per NTC2018

Design Shear force of primary elements according to NTC 2018

- When calculating a design shear force for primary elements, member force can be limited by a resistance demand for ELS load combinations.

Design Setting → **Check off option** → **Check on option**



Option is added.

Check off option

```
==============================================================================
  [[[*]]]  CALCULATE DATA OF SPECIAL PROVISIONS FOR SEISMIC DESIGN.
==============================================================================

   ( ). Design parameters.
        -. fyk  = 450000.00000 KPa.
        -. phi    = 1.0

   ( ). Bending strength for design shear force.
        -. MeI+ =       66.455 kN-m.((I, Clockwise))
        -. MeJ- =       96.206 kN-m.((J, Clockwise))
        -. MeI- =       96.206 kN-m.((I, Counter-Clockwise))
        -. MeJ+ =       66.455 kN-m.((J, Counter-Clockwise))

   ( ). Calculate design shear force according to special provisions for seismic design.
        -. Alpha1  = 1.0000
        -. Span    =      4.3000 m.
        -. VzG     =     -10.004 kN.  (by Gravity-Direction Load).
        -. Clockwise
           Ve11_CW = VzG + Alpha1*(MeI+ + MeJ-)/Span =      27.824 kN.
           Ve12_CW = VzG - Alpha1*(MeI+ + MeJ-)/Span =     -47.832 kN.
           Ve1_CW  = MAX[ |Ve11_CW|, |Ve12_CW| ] =      47.832 kN.
        -. Counter-Clockwise
           Ve11_CCW= VzG + Alpha1*(MeI- + MeJ+)/Span =      27.824 kN.
           Ve12_CCW= VzG - Alpha1*(MeI- + MeJ+)/Span =     -47.832 kN.

        -. Ve1     = MAX[ |Ve1_CW|, |Ve1_CCW| ]  =      47.832 kN.
        -. VzOrg   =     -18.902 kN.  (by Strength Load Combination).
        -. V_Ed    = MAX[ |VzOrg|, Ve1 ] =      47.832 kN.
```

--> V_Ed = Max [VzOrig, Ve1(M)]

Check on option

```
==============================================================================
  [[[*]]]  CALCULATE DATA OF SPECIAL PROVISIONS FOR SEISMIC DESIGN.
==============================================================================

   ( ). Design parameters.
        -. fyk  = 450000.00000 KPa.
        -. phi    = 1.0

   ( ). Bending strength for design shear force.
        -. MeI+ =       66.455 kN-m.((I, Clockwise))
        -. MeJ- =       96.206 kN-m.((J, Clockwise))
        -. MeI- =       96.206 kN-m.((I, Counter-Clockwise))
        -. MeJ+ =       66.455 kN-m.((J, Counter-Clockwise))

   ( ). Calculate design shear force according to special provisions for seismic design.
        -. Alpha1  = 1.0000
        -. Span    =      4.3000 m.
        -. VzG     =     -10.004 kN.  (by Gravity-Direction Load).
        -. Clockwise
           Ve11_CW = VzG + Alpha1*(MeI+ + MeJ-)/Span =      27.824 kN.
           Ve12_CW = VzG - Alpha1*(MeI+ + MeJ-)/Span =     -47.832 kN.
           Ve1_CW  = MAX[ |Ve11_CW|, |Ve12_CW| ] =      47.832 kN.
        -. Counter-Clockwise
           Ve11_CCW= VzG + Alpha1*(MeI- + MeJ+)/Span =      27.824 kN.
           Ve12_CCW= VzG - Alpha1*(MeI- + MeJ+)/Span =     -47.832 kN.
           Ve1_CCW = MAX[ |Ve11_CCW|, |Ve12_CCW| ] =      47.832 kN.

        -. Ve1(M)  = MAX[ |Ve1_CW|, |Ve1_CCW| ]  =      47.832 kN.  (by Moment Strength).
        -. Ve1(E)  =       17.186 kN.  (by Elastic Load Combination).
        -. Ve1     = MIN[ Ve1(M), Ve1(E) ]        =      17.186 kN.
        -. VzOrg   =     -18.902 kN.  (by Strength Load Combination).
        -. V_Ed    = MAX[ |VzOrg|, Ve1 ] =      18.902 kN.
```

--> V_Ed = Max [VzOrig, Min[Ve1(M), Ve1(E)]]

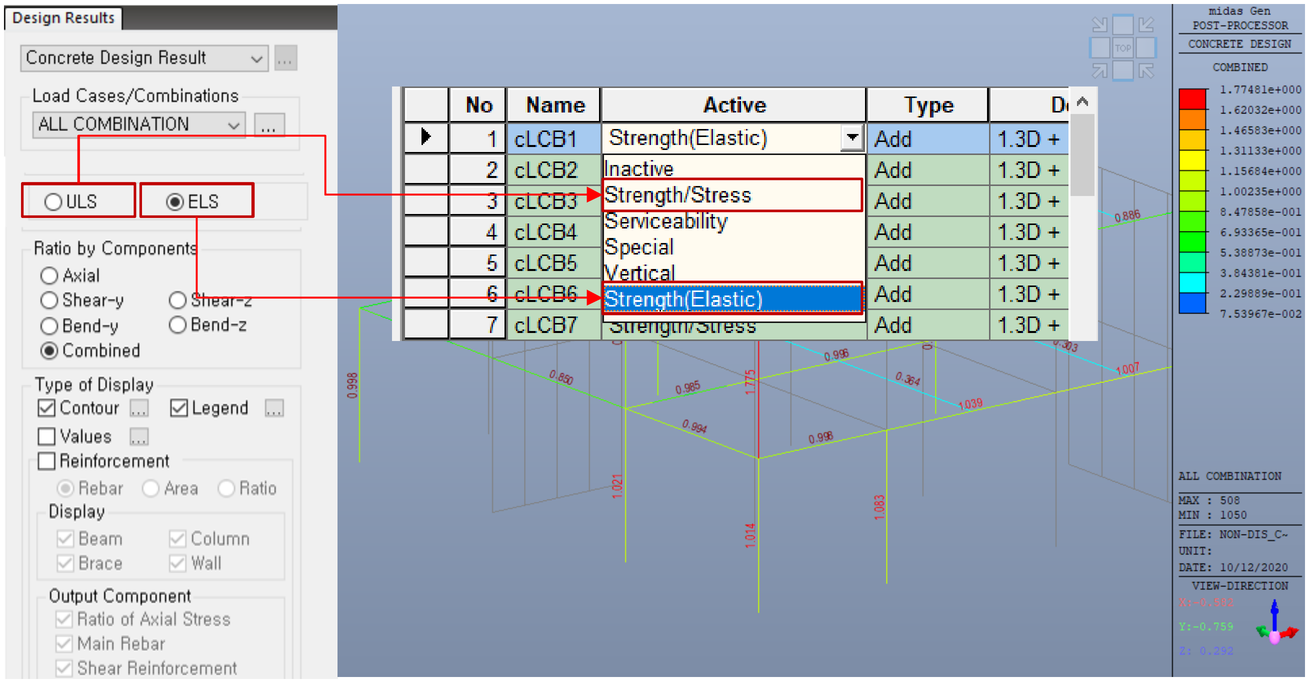
VzG = Design shear force by load combination with only gravity loads.

Ve1(M) = Design shear force by flexural strength of member.

Ve1(E) = Design shear force by ELS load combination.

4. Concrete design result for ELS load combination

Add Graphic result for ELS Load combination.

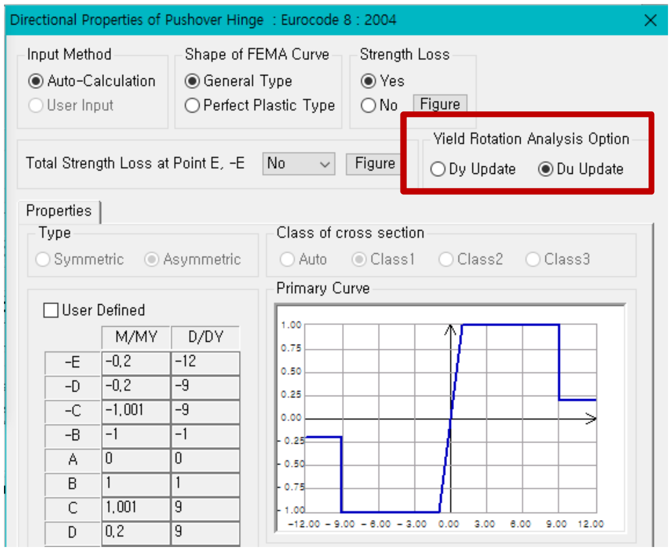


- ✓ *ULS : Load combinations assigned to "Strength/Stress" type in Load combination dialog box*
- ✓ *ELS : Load combinations assigned to "Strength(Elastic)" type in Load combination dialog box*

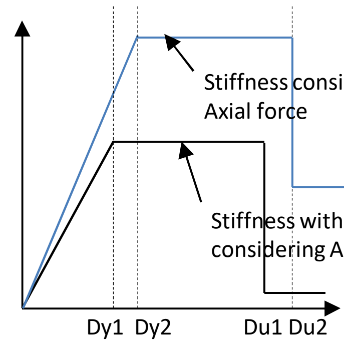
5. Improved Hinge Curve Model as per EC 8 :2004

New hinge curve model as per Eurocode 8 :2004

- Add a hinge curve with "Du update" type



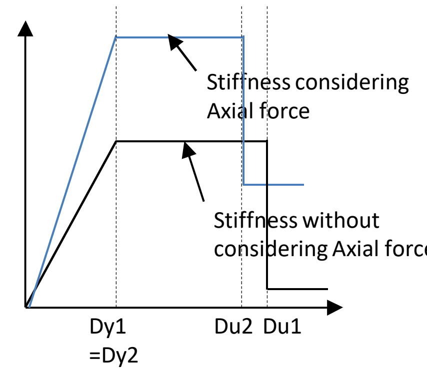
Dy Update (supporting in old version)



* Du1 - Dy1 = Du2 – Dy2

Stiffness and Dy are changed by axial force Under PMM or PM type.

Du Update (Add to Gen2021 newly)



Stiffness and Du are changed by axial force Under PMM or PM type.

✓ Note

[Calculation of Du (= θu, Ultimate Rotation)]

$$\theta_{um} = \frac{1}{\gamma_{el}} 0,016 \cdot (0,3^{\nu}) \left[\frac{\max(0,01;\omega')}{\max(0,01;\omega)} f_c\right]^{0,225} \left(\min\left(9;\frac{L_V}{h}\right)\right)^{0,35} 25^{\left(\alpha \rho_{sx} \frac{f_{yw}}{f_c}\right)} \left(1,25^{100\rho_d}\right)$$

[Calculation of Dy (= θy, Yielding Rotation)]

$$\theta_y = k \times \varepsilon_y \div Depth\ of\ element$$

* ε_y : Yielding strain at tensile face

	k				
	rectangular section			circular section	
hinge type	column	beam	wall	column	beam
none	2.1	1.7	2	2.25	-
PM e PMM	2.1	1.7	2	2.25	-
Displacemet based Seismic Design of Structures- pg 165					
Priestley; Calvi; Kowalsky					

6. Irregularity reduction factors as per NSR-10

- *Results > Results Tables > Story> Stiffness Irregularity Check, Capacity Irregularity Check, and Mass Irregularity Check*

Output reduction factors (Phi_p)

Stiffness Irregularity Check

		(m)	(m)	(m)	(kN)	Story Stiffness	Upper Story Stiffness 0.6K (Upper)	Upper Story Stiffness 0.7K (Upper)	Upper 3 Story Stiffness(Avg.) 0.7K (3 Stories)	Upper 3 Story Stiffness(Avg.) 0.8K (3 Stories)	Remark	Phi_p
Ey	12F	46.00	4.00	-0.0000	0.00	-	0.00	0.00	0.00	0.00	Regular	1.0
Ey	11F	42.00	4.00	-0.0000	0.00	-	-199998.58	-	-116665.84	-133332.39	Extreme Irregular	0.8
Ey	10F	38.00	4.00	-0.0000	0.00	-	-264205.86	-	-270785.92	-309469.62	Extreme Irregular	0.8
Ey	9F	34.00	4.00	-0.0000	0.00	-	-339744.66	-	-312646.87	-357310.71	Extreme Irregular	0.8
Ey	8F	30.00	4.00	-0.0000	0.00	-	-406558.07	-	-392975.56	-449114.93	Extreme Irregular	0.8
Ey	7F	26.00	4.00	-0.0000	0.00	-	-776743.33	-	-592295.69	-676909.36	Extreme Irregular	0.8
Ey	6F	22.00	4.00	0.0000	0.00	1830963.85	-4291921.05	-	-2129253.18	-2433432.20	Regular	1.0
Ey	5F	18.00	4.00	0.0000	0.00	1511336.03	1098578.31	-	-1543922.36	-1764482.70	Regular	1.0
Ey	4F	14.00	4.00	0.0000	0.00	1154767.03	906801.62	-	-889210.44	-1016240.50	Regular	1.0
Ey	3F	9.50	4.50	0.0000	0.00	3028926.91	692860.22	808336.92	1049315.61	1199217.84	Regular	1.0
Ey	2F	5.00	4.50	-0.0000	0.00	-	1817356.15	2120248.84	1328840.33	1518674.66	Extreme Irregular	0.8
Ey	1F	0.00	5.00	-0.0000	0.00	-	-688215.48	-	708555.90	809778.17	Extreme Irregular	0.8

\Stiffness Irregularity(X) / Stiffness Irregularity(Y) /

Capacity Irregularity Check

	(m)	(m)	([deg])	(kN)	Shear …th1 (kN)	Story Shear Strength Ratio1	Remark1	Phi_p1	Angle2 ([deg])	Story Shear Strength2 (kN)	Upper Story Shear Strength2 (kN)	Story Shear Strength Ratio2	Remark2	Phi_p2
12F	46.00	4.00	0.00	8786.5611	0.0000	0.0000	Regular	1.0	90.00	8552.2528	0.0000	0.0000	Regular	1.0
11F	42.00	4.00	0.00	8786.5611	8786.5611	1.0000	Regular	1.0	90.00	8552.2528	8552.2528	1.0000	Regular	1.0
10F	38.00	4.00	0.00	8786.5611	8786.5611	1.0000	Regular	1.0	90.00	8552.2528	8552.2528	1.0000	Regular	1.0
9F	34.00	4.00	0.00	10218.4451	8786.5611	1.1630	Regular	1.0	90.00	9984.1368	8552.2528	1.1674	Regular	1.0
8F	30.00	4.00	0.00	10218.4451	10218.4451	1.0000	Regular	1.0	90.00	9984.1368	9984.1368	1.0000	Regular	1.0
7F	26.00	4.00	0.00	10478.7876	10218.4451	1.0255	Regular	1.0	90.00	10244.4793	9984.1368	1.0261	Regular	1.0
6F	22.00	4.00	0.00	10478.7876	10478.7876	1.0000	Regular	1.0	90.00	10244.4793	10244.4793	1.0000	Regular	1.0
5F	18.00	4.00	0.00	12821.8706	10478.7876	1.2236	Regular	1.0	90.00	12587.5623	10244.4793	1.2287	Regular	1.0
4F	14.00	4.00	0.00	12821.8706	12821.8706	1.0000	Regular	1.0	90.00	12587.5623	12587.5623	1.0000	Regular	1.0
3F	9.50	4.50	0.00	15392.7533	12821.8706	1.2005	Regular	1.0	90.00	15158.4450	12587.5623	1.2042	Regular	1.0
2F	5.00	4.50	0.00	15392.7533	15392.7533	1.0000	Regular	1.0	90.00	15158.4450	15158.4450	1.0000	Regular	1.0
1F	0.00	5.00	0.00	17484.7772	15392.7533	1.1359	Regular	1.0	90.00	17841.7063	15158.4450	1.1770	Regular	1.0

\Capacity Irregularity /

Mass Irregularity Check

		(m)	(m)	…ss (…g)	Adjacent Story Mass 1.5M(Upper) (kN/g)	Adjacent Story Mass 1.5M(Lower) (kN/g)	Story Mass Ratio	Remark	Phi_p
Ex	Roof	50.00	0.00	333.843	0.000	612.228	0.545	Regular	1.0
Ex	12F	46.00	4.00	408.152	500.764	612.228	0.815	Regular	1.0
Ex	11F	42.00	4.00	408.152	612.228	624.901	0.667	Regular	1.0
Ex	10F	38.00	4.00	416.600	612.228	637.573	0.680	Regular	1.0
Ex	9F	34.00	4.00	425.049	624.901	639.878	0.680	Regular	1.0
Ex	8F	30.00	4.00	426.585	637.573	642.182	0.669	Regular	1.0
Ex	7F	26.00	4.00	428.121	639.878	662.919	0.669	Regular	1.0
Ex	6F	22.00	4.00	441.946	642.182	683.657	0.688	Regular	1.0
Ex	5F	18.00	4.00	455.771	662.919	727.651	0.688	Regular	1.0
Ex	4F	14.00	4.00	485.101	683.657	771.646	0.710	Regular	1.0
Ex	3F	9.50	4.50	514.431	727.651	802.248	0.707	Regular	1.0
Ex	2F	5.00	4.50	534.832	771.646	0.000	0.693	Regular	1.0
Ex	1F	0.00	5.00	147.850	802.248	0.000	0.184	Regular	1.0

\Mass Irregularity(X) / Mass Irregularity(Y) /

✓ Note

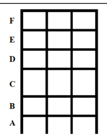
According to Table A.3-7 in NSR-10, Gen is reporting Reduction factor, ø in seismic design forces to account for Irregularity check

1.Stiffness Irregularity(Soft Story) Check

- *Regular Structures $ø_a = 1.0$*
- *Irregular Structures $ø_a = 0.9$*
- *Extreme Irregular Structures $ø_a = 0.8$*

Tipo 1aA — Piso flexible
$\phi_a = 0.9$
$0.60 \text{ Rigidez } K_D \leq \text{Rigidez } K_C < 0.70 \text{ Rigidez } K_D$
o
$0.70 (K_D+K_E+K_F)/3 \leq \text{Rigidez } K_C < 0.80 (K_D+K_E+K_F)/3$

Tipo 1bA — Piso flexible extremo
$\phi_a = 0.8$
$\text{Rigidez } K_C < 0.60 \text{ Rigidez } K_D$
o
$\text{Rigidez } K_C < 0.70 (K_D+K_E+K_F)/3$

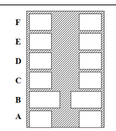


2.Capacity Irregularity (Weak Story) check

- *Regular Structures $ø_a = 1.0$*
- *Irregular Structures $ø_a = 0.9$*
- *Extreme Irregular Structures $ø_a = 0.8$*

Tipo 5aA — Piso débil
$\phi_a = 0.9$
0.65 Resist. Piso C ≤ Resist. Piso B < 0.80 Resist. Piso C

Tipo 5bA — Piso débil extremo
$\phi_a = 0.8$
Resistencia Piso B < 0.65 Resistencia Piso C

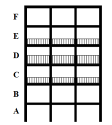


3.Mass irregularity Check

- *Regular Structures $ø_a = 1.0$*
- *Irregular Structures $ø_a = 1.0$*

Tipo 2A — Distribución masa — $\phi_a = 0.9$

$m_D > 1.50\, m_E$
o
$m_D > 1.50\, m_C$

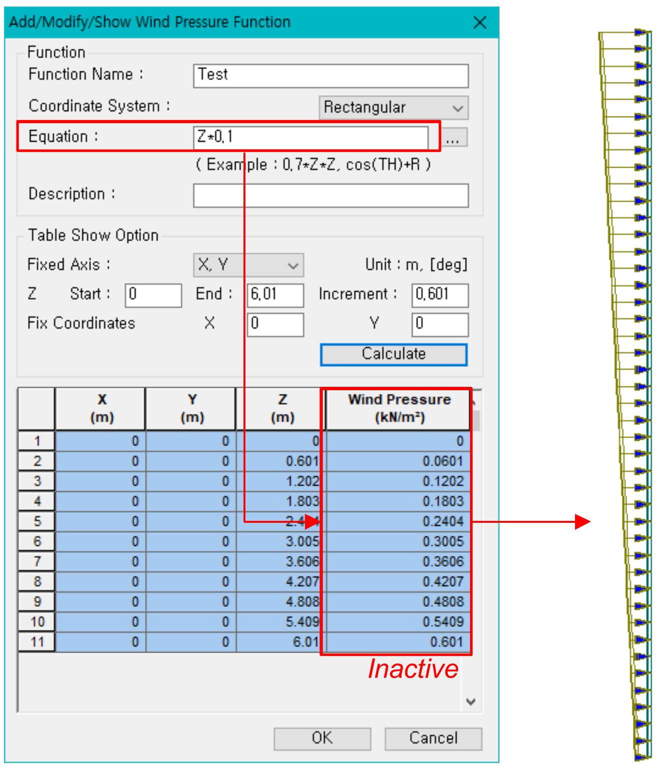


7. Improvement of wind pressure function

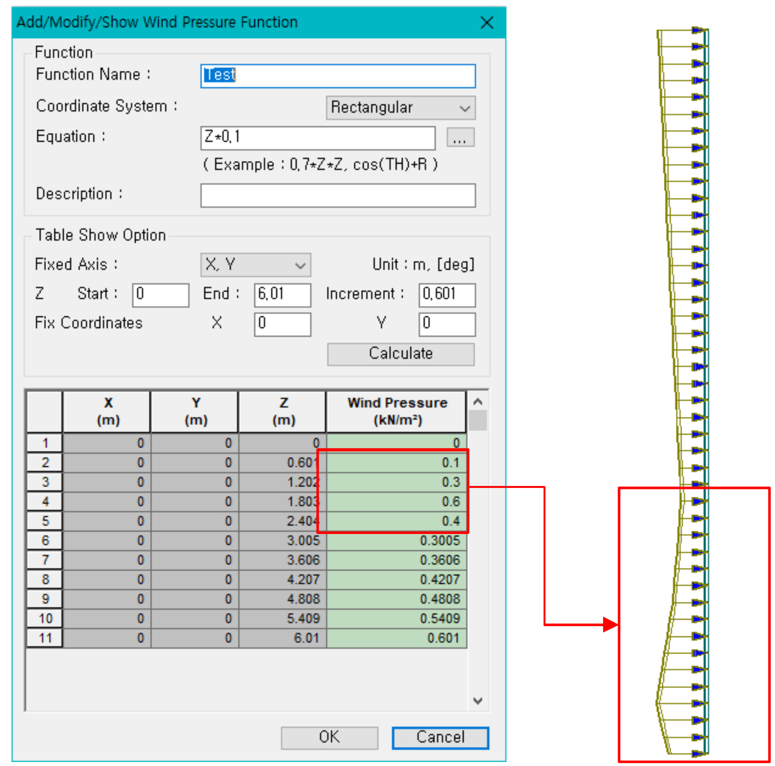
Input of wind pressure by table editing

- Wind Pressure generated by equation can be edited in table and updated to the model.

Gen 2020



Gen 2021 v1.1 (New version)

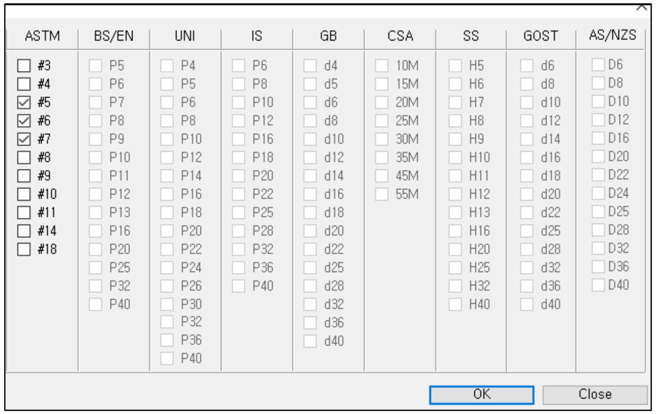


When editing the table values, wind pressure is modified automatically.

8. Renewal of Rebar Information Dialog Box

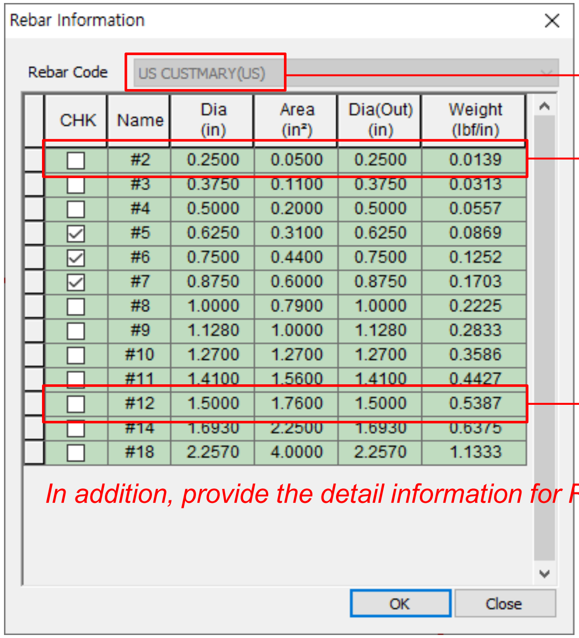
- *Provide rebar information for diameter, area, and weight in dialog box*
- *Add #2 and #12 rebar in U.S Customary (U.S Imperial) DB*

Gen 2020



Provide only the feature to select rebar size.

Gen 2021 v1.1 (New version)



CHK	Name	Dia (in)	Area (in²)	Dia(Out) (in)	Weight (lbf/in)
☐	#2	0.2500	0.0500	0.2500	0.0139
☐	#3	0.3750	0.1100	0.3750	0.0313
☐	#4	0.5000	0.2000	0.5000	0.0557
☑	#5	0.6250	0.3100	0.6250	0.0869
☑	#6	0.7500	0.4400	0.7500	0.1252
☑	#7	0.8750	0.6000	0.8750	0.1703
☐	#8	1.0000	0.7900	1.0000	0.2225
☐	#9	1.1280	1.0000	1.1280	0.2833
☐	#10	1.2700	1.2700	1.2700	0.3586
☐	#11	1.4100	1.5600	1.4100	0.4427
☐	#12	1.5000	1.7600	1.5000	0.5387
☐	#14	1.6930	2.2500	1.6930	0.6375
☐	#18	2.2570	4.0000	2.2570	1.1333

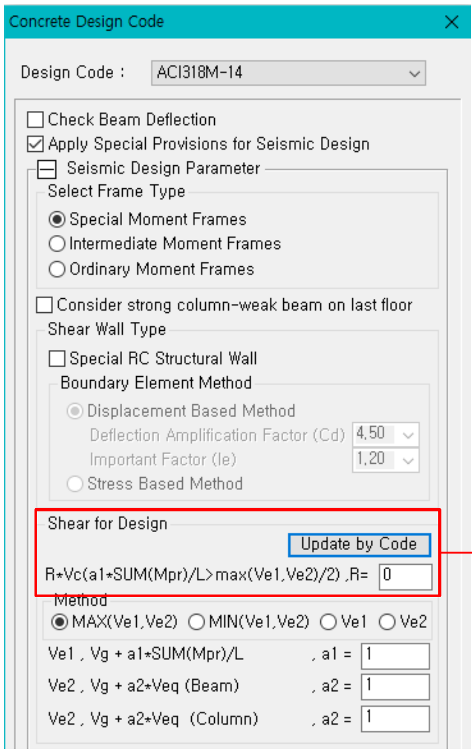
In addition, provide the detail information for Rebar DB

Add #2 and #12 rebar in U.S Customary(U.S) code

9. Improvement of concrete shear strength in SMF as per ACI

Reduction factor (R) for Vc is not used in mid-span of member.

- 'Vc=0' is considered only both ends of the member.



*Vc in Design = R*Vc*

Gen 2020

3. Design for Shear

[END]	y : 8 (J)	z : 8 (J)
Applied Shear Force (Vu)	40.5926 tonf	20.4299 tonf
Design Shear Strength (φVc+φVs)	0.00000 + 62.4078 = 62.4078 tonf	0.00000 + 62.4078 = 62.4078 tonf
Shear Ratio	0.650 < 1.000 ...... O.K	0.327 < 1.000 ...... O.K
As-H_req	0.00330 m²/m, 4-D13 @100	0.00166 m²/m, 4-D13 @100

[MIDDLE]	y : 8 (1/2)	z : 8 (1/2)
Applied Shear Force (Vu)	40.5926 tonf	20.4299 tonf
Design Shear Strength (φVc+φVs)	0.00000 + 41.6052 = 41.6052 tonf	0.00000 + 41.6052 = 41.6052 tonf
Shear Ratio	0.976 < 1.000 ...... O.K	0.491 < 1.000 ...... O.K
As-H_req	0.00330 m²/m, 4-D13 @150	0.00166 m²/m, 4-D13 @150

Gen 2021 v1.1 (New version)

3. Design for Shear

[END]	y : 8 (J)	z : 8 (J)
Applied Shear Force (Vu)	40.5926 tonf	20.4299 tonf
Design Shear Strength (φVc+φVs)	0.00000 + 62.4078 = 62.4078 tonf	0.00000 + 62.4078 = 62.4078 tonf
Shear Ratio	0.650 < 1.000 ...... O.K	0.327 < 1.000 ...... O.K
As-H_req	0.00330 m²/m, 4-D13 @100	0.00166 m²/m, 4-D13 @100

[MIDDLE]	y : 10 (1/2)	z : 3 (1/2)
Applied Shear Force (Vu)	50.2696 tonf	36.5179 tonf
Design Shear Strength (φVc+φVs)	33.0322 + 41.6052 = 74.6374 tonf	32.0340 + 41.6052 = 73.6392 tonf
Shear Ratio	0.674 < 1.000 ...... O.K	0.496 < 1.000 ...... O.K
As-H_req	0.00140 m²/m, 4-D13 @150	0.00083 m²/m, 4-D13 @150

✓ Note

Seismic provision in ACI 318M-19

18.6.4 *Transverse reinforcement*

18.6.4.1 Hoops shall be provided in the following regions of a beam:

(a) Over a length equal to twice the beam depth measured from the face of the supporting column toward midspan, at both ends of the beam

(b) Over lengths equal to twice the beam depth on both sides of a section where flexural yielding is likely to occur as a result of lateral displacements beyond the elastic range of behavior.

18.6.5 *Shear strength*

18.6.5.1 *Design forces*—The design shear force V_e shall be calculated from consideration of the forces on the portion of the beam between faces of the joints. It shall be assumed that moments of opposite sign corresponding to probable flexural strength, M_{pr}, act at the joint faces and that the beam is loaded with the factored tributary gravity load along its span.

18.6.5.2 *Transverse reinforcement*—Transverse reinforcement over the lengths identified in 18.6.4.1 shall be designed to resist shear assuming $V_c = 0$ when both (a) and (b) occur:

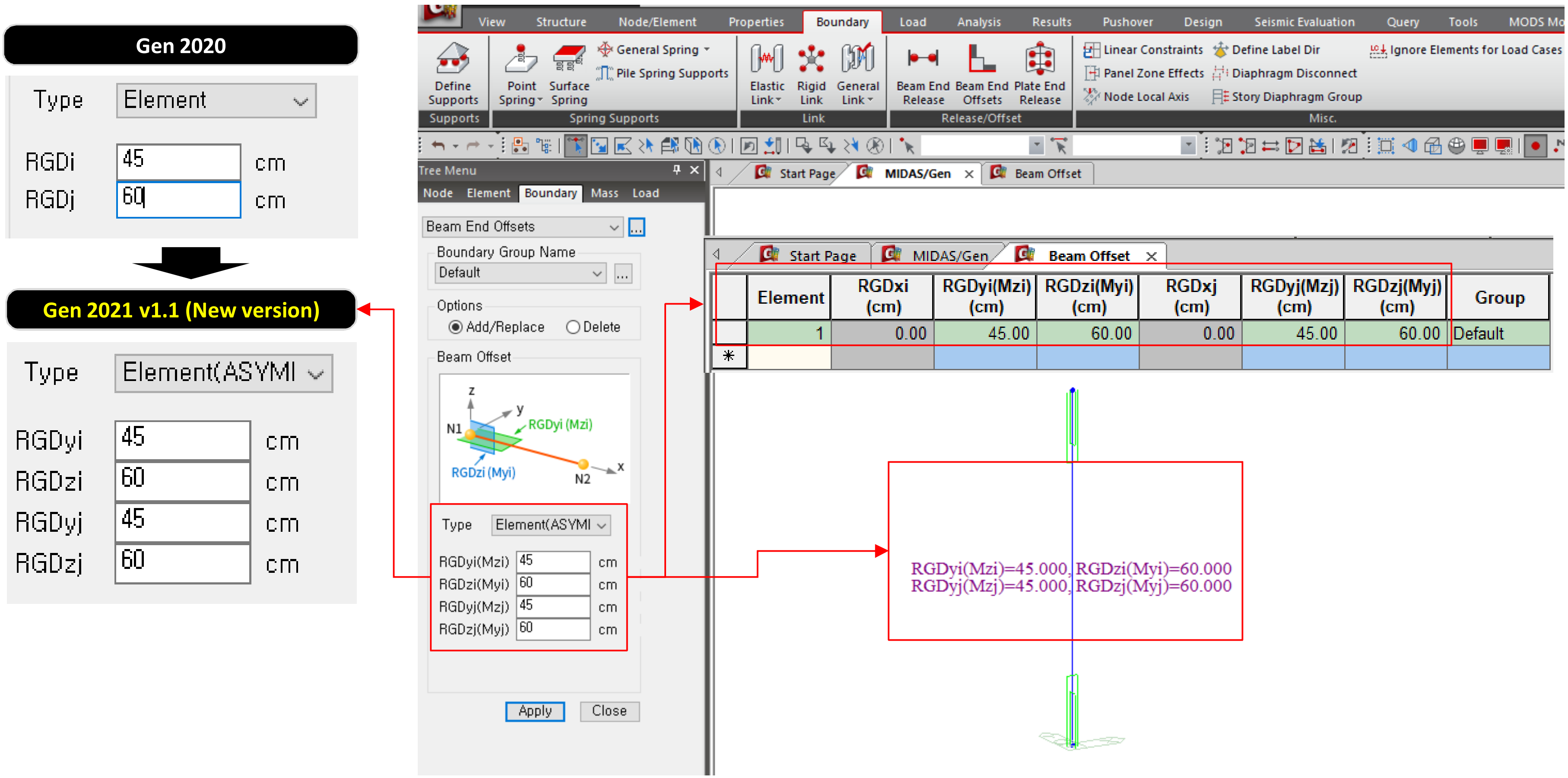
(a) The earthquake-induced shear force calculated in accordance with 18.6.5.1 represents at least one-half of the maximum required shear strength within those lengths.

(b) The factored axial compressive force P_u including earthquake effects is less than $A_g f_c'/20$.

10. Beam End Offset for *Asymmetric setting*

Add element type (Asymmetric)

- Set a beam end offset by each direction.

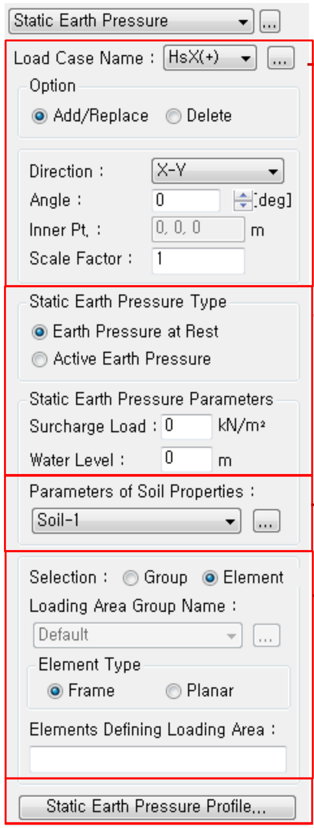


11. Static earth pressure function

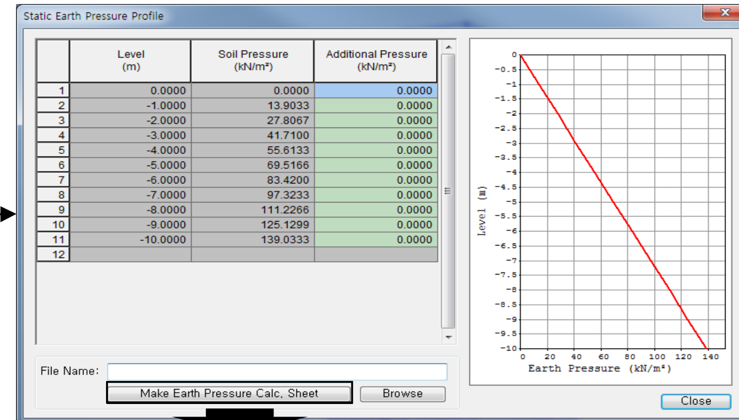
Add static earth pressure of function type.

- When editing the table values, earth pressure shape in the model is modified automatically.

*Load > Static Loads > Lateral > **Earth Pressure > Static Earth Pressure***



- Set Load Case & Direction
- Set Earth pressure type, Surcharge load, and water level
- Select the function for Soil Properties
- Set Loading Area
- Check a loading curve by level



	Level (m)	Soil Pressure (kN/m²)	Additional Pressure (kN/m²)
1	0.0000	0.0000	0.0000
2	-1.0000	13.9033	0.0000
3	-2.0000	27.8067	0.0000
4	-3.0000	41.7100	0.0000
5	-4.0000	55.6133	0.0000
6	-5.0000	69.5166	0.0000
7	-6.0000	83.4200	0.0000
8	-7.0000	97.3233	0.0000
9	-8.0000	111.2266	0.0000
10	-9.0000	125.1299	0.0000
11	-10.0000	139.0333	0.0000
12			

Calculating Sheet

```
Surcharge Load                          : s  =      0.000 kN/m²
Ground Level                            : GL =      0.000 m
Water Level                             : WL =      0.000 m

Coefficient of Earth Pressure at Rest  : K0 = 1-sin(PHI)
 [Jaky's formula]
Soil Stress Friction Angle              : PHI = (12*N)^0.5+15 ([deg])
 [Dunham]

Soil Density             : GAMMA   = Density of Soil Property
Water Density            : GAMMA.w =      9.807 kN/m³
Scale Factor             : SF      =      1.000

Earth Pressure at Level z : pz = K0*s + K0*(GAMMA*z-GAMMA.w*(WL-z)) + GAMMA.w*(WL-z)
```

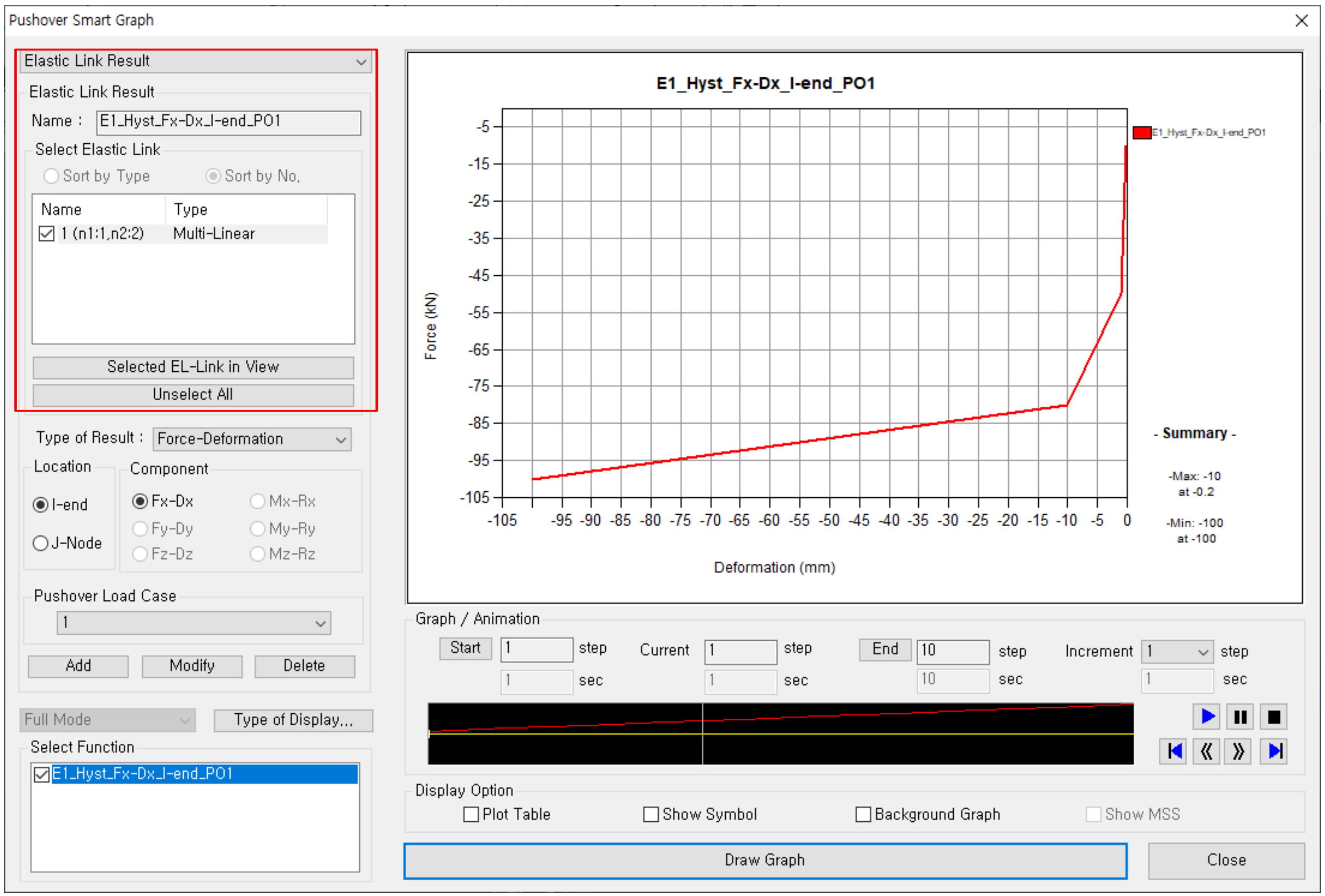
(). STATIC EARTH PRESSURE PROFILE

LEVEL (m)	PHI ([deg])	K0	GAMMA (kN/m³)	GAMMA.w (kN/m³)	p(z) (kN/m²)	ADD. p(z) (kN/m²)
0.000	30.000	0.500	18.000	9.807	0.000	0.000
-1.000	30.000	0.500	18.000	9.807	13.903	0.000
-2.000	30.000	0.500	18.000	9.807	27.807	0.000
-3.000	30.000	0.500	18.000	9.807	41.710	0.000
-4.000	30.000	0.500	18.000	9.807	55.613	0.000
-5.000	30.000	0.500	18.000	9.807	69.517	0.000
-6.000	30.000	0.500	18.000	9.807	83.420	0.000
-7.000	30.000	0.500	18.000	9.807	97.323	0.000
-8.000	30.000	0.500	18.000	9.807	111.227	0.000
-9.000	30.000	0.500	18.000	9.807	125.130	0.000
-10.000	30.000	0.500	18.000	9.807	139.033	0.000

12. Elastic link graphic result in pushover analysis

Add graphic output of the elastic link (multi-linear type) in pushover analysis

Pushover > > Pushover Results > Pushover Smart Graph > ***Elastic Link Graph***



Select Elastic Link

All elastic links assigned to the model are displayed in the list.
For same type, multiple selections are possible.

Type of Result

1. ***[Force-Deformation]*** *: Force/Deform.*
2. ***[Force]*** *: Force / Time*
3. ***[Deformation]*** *: Deformation/Time*

Location/Component

1. ***Location*** *: Output position of elements*
2. ***Component****: Stress-Deform/ Moment-Rotation angle In element axis.*

Graph/Animation

The animation function checks the results in a specific section.
It can be checked in conjunction with the table results

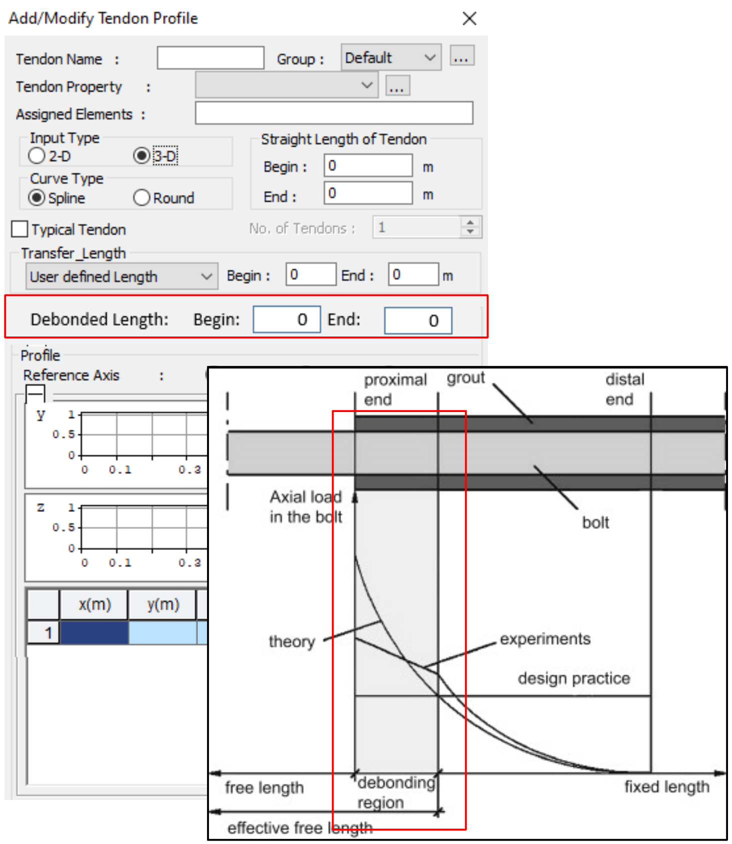
Display Option

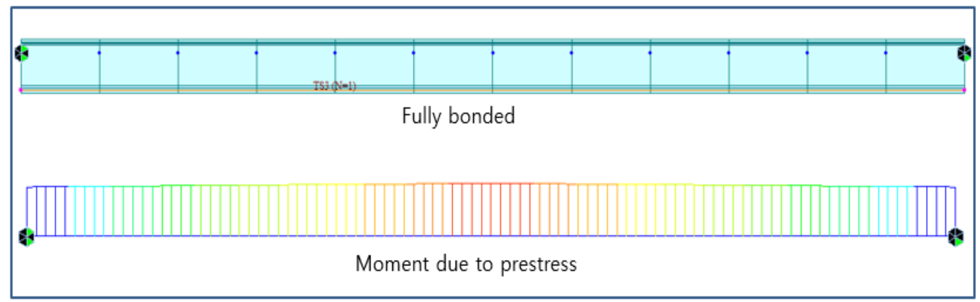
After checking each item, click the [Graph] button to apply it to the graph.

13. Debonded Length of Pretensioned Beam

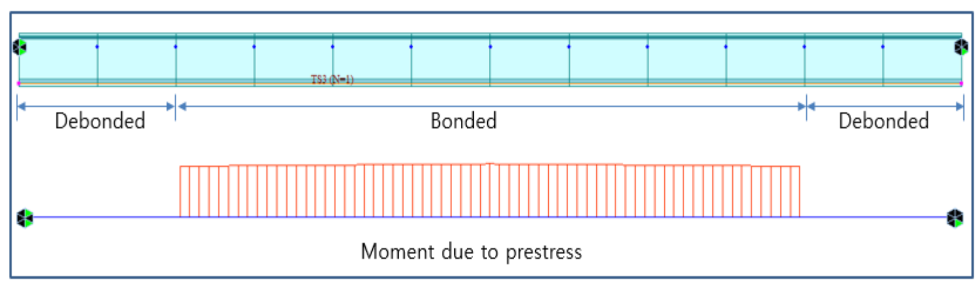
- *Debonded length of pretensioned beam can be directly defined when creating strands from the 'Tendon Profile' dialog box.*
- *Define the actual whole length of strand including debonded parts at both ends and then enter the lengths for debonded parts.*

Load > Temp./Prestress > Prestress Loads > ***Tendon Profile***





When debonded length has 0, Tendon Primary Moment Diagram

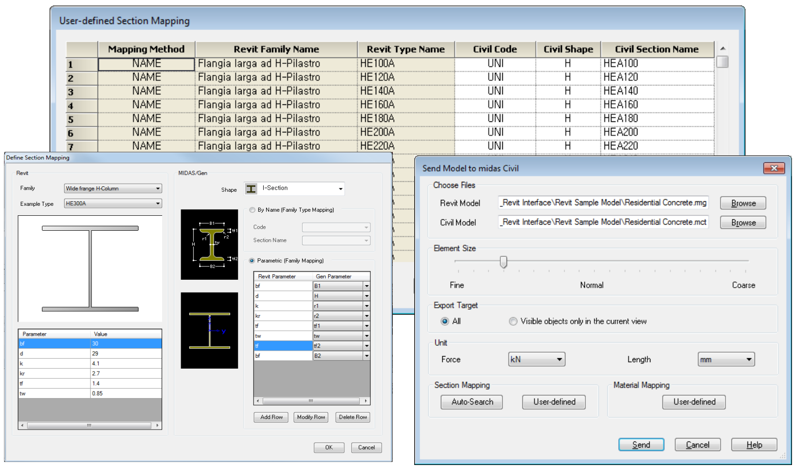


When debonded length has Non-Zero, Tendon Primary Moment Diagram

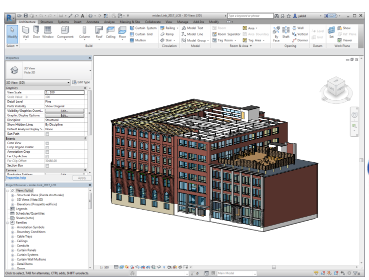
14. Revit 2021 Interface

Gen-Revit Link

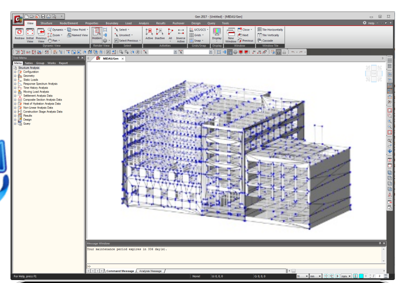
- ***File > Import > midas Gen MGT File***
- ***File > Export > midas Gen MGT File***



Send Model to midas Gen



Revit 2021



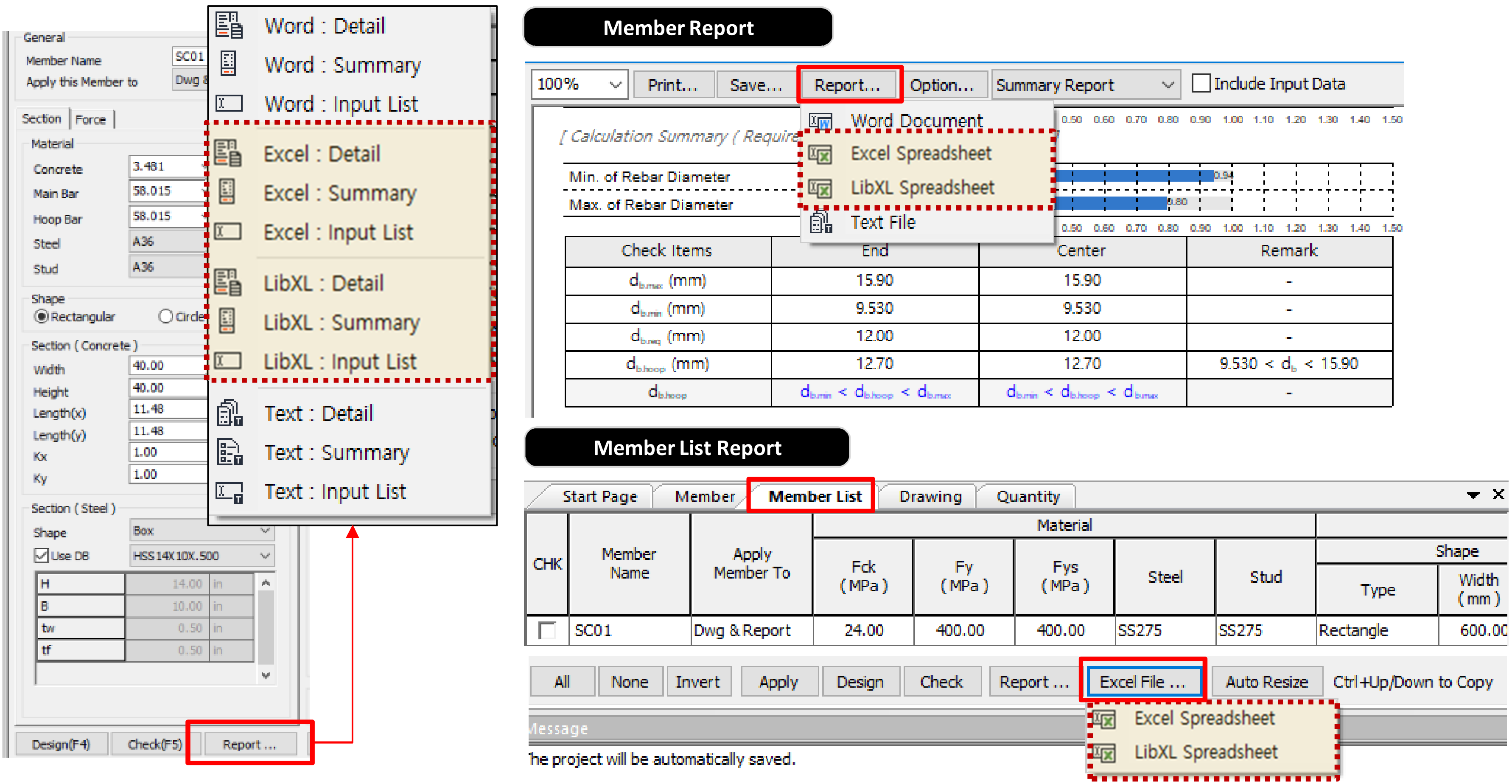
Gen 2021 v1.1 (New version)

	Functions	Revit <> Gen
Linear Elements	Structural Column	<>
	Beam	<>
	Brace	<>
	Curved Beam	>
	Beam System	>
	Truss	>
Planar Elements	Foundation Slab	<>
	Structural Floor	<>
	Structural Wall	<>
	Wall Opening & Window	>
	Door	>
	Vertical or Shaft Opening	>
Boundary	Offset	>
	Rigid Link	>
	Cross-Section Rotation	>
	End Release	>
	Isolated Foundation Support	>
	Point Boundary Condition	>
	Line Boundary Condition	>
	Wall Foundation	>
	Area Boundary Condition	>
Load	Load Nature	>
	Load Case	>
	Load Combination	>
	Hosted Point Load	>
	Hosted Line Load	>
	Hosted Area Load	>
Other Parameters	Material	<>
	Level	>

midas Design+

1. Report of Excel format

Generate a report of excel format.



1. Report of Excel format

Excel Report

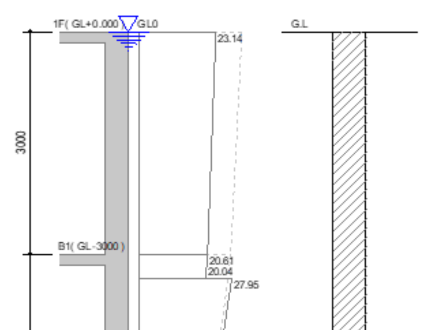
- Provides high-quality output
- All functions of Excel can be used.

(5) *Calculate the Horizontal Ground Reaction Force Coefficient* $\left(\frac{K_H}{Layer}2\right)$

- $K_{H1} = \frac{\frac{4{,}082kN}{m^2}}{m}$
- $K_{H2} = \frac{\frac{5{,}695kN}{m^2}}{m}$
- $K_{H3} = \frac{\frac{8{,}770kN}{m^2}}{m}$

(6) Calculate Displacement of Ground (Load Combination Factor is applied.)

H (m)	u(z) (mm)	u(z)-u(z)B (mm)	KH (kN/m²/m)	p(z) (kN/m²)	p(z) I/R (kN/m²)
0.000	14.17	14.17	4,082	57.84	23.14
3.000	12.62	12.62	4,082	51.54	20.61
3.333	12.27	12.27	4,082	50.09	20.04
3.333	12.27	12.27	5,695	69.88	27.95
6.000	8.329	8.329	5,695	47.43	18.97
6.667	7.085	7.085	5,695	40.35	16.14
6.667	7.085	7.085	8,770	62.13	24.85
9.000	2.217	2.217	8,770	19.44	7.776
10.00	0.000	0.000	8,770	0.000	0.000



LibXL Report

- Very fast output generation speed
- Expression in the same format as Text Report

(2) Calculate the Acceleration Response Spectrum (Sa)

- Fa = 1.120
- Fv = 0.840
- SDS = 2.5 S Fa x 2 / 3 = 0.373
- SD1 = S Fv x 2 / 3 = 0.112
- T0 = 0.2 SD1 / SDS = 0.0600 sec.
- TS = SD1 / SDS = 0.300 sec.
- TL = 5.000 sec.
- Sa = 2.746m/s²

(3) Calculate the Acceleration Response Spectrum of Base Rock (Sv)

- Sv = Sa / ω0 = 0.175m/s

(4) Calculate the Horizontal Ground Reaction Force Coefficient (KH / Layer 1)

- KH1 = 4,082kN/m²/m
- KH2 = 5,695kN/m²/m
- KH3 = 8,770kN/m²/m

(5) Calculate the Horizontal Ground Reaction Force Coefficient (KH / Layer 2)

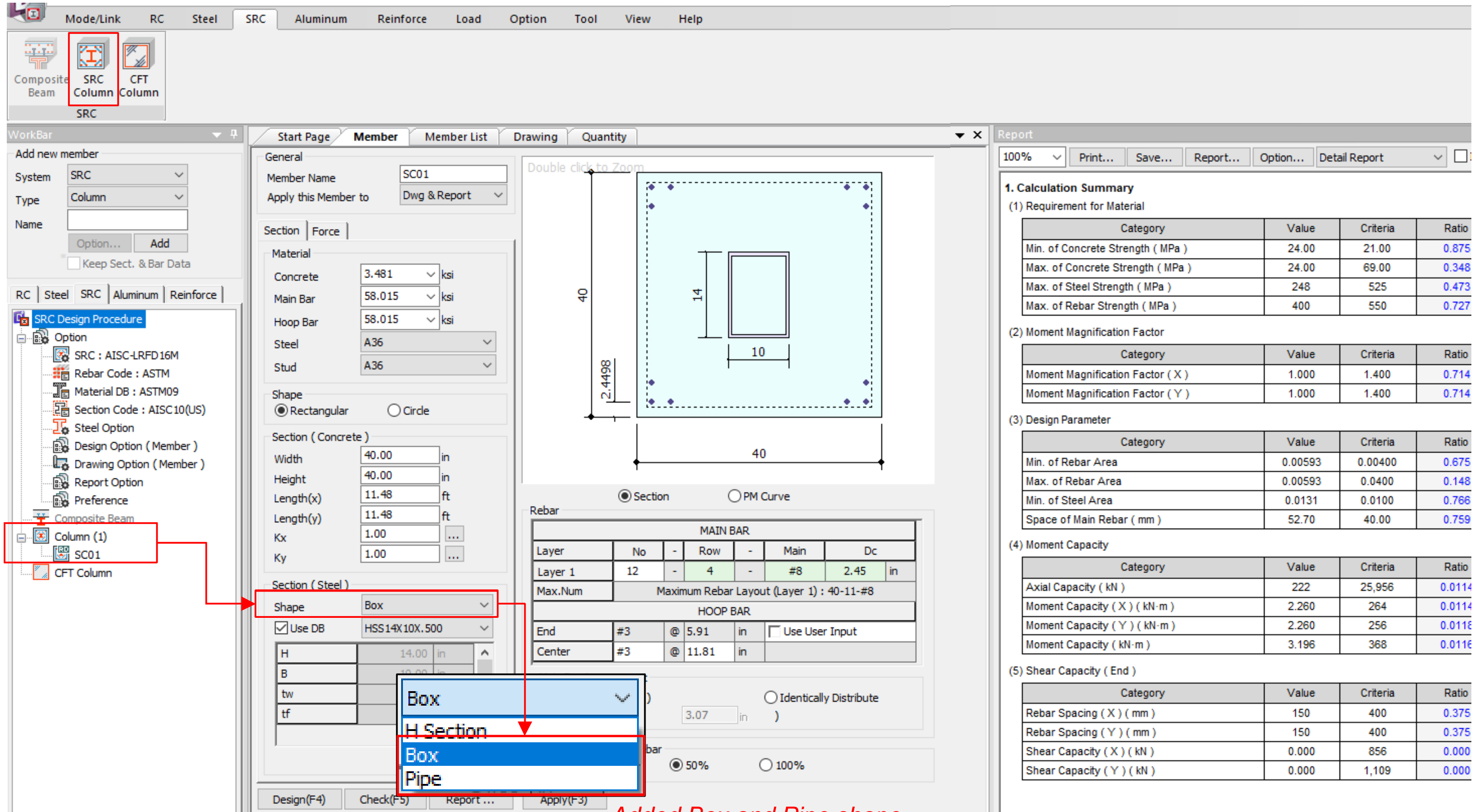
- KH1 = 4,082kN/m²/m
- KH2 = 5,695kN/m²/m
- KH3 = 8,770kN/m²/m

(6) Calculate Displacement of Ground (Load Combination Factor is applied.)

H (m)	u(z) (mm)	u(z)-u(z)B (mm)	KH (kN/m²/m)	p(z) (kN/m²)	p(z) I / R (kN/m²)
0.000	14.17	14.17	4,082	57.84	23.14
3.000	12.62	12.62	4,082	51.54	20.61
3.333	12.27	12.27	4,082	50.09	20.04
3.333	12.27	12.27	5,695	69.88	27.95
6.000	8.329	8.329	5,695	47.43	18.97
6.667	7.085	7.085	5,695	40.35	16.14
6.667	7.085	7.085	8,770	62.13	24.85
9.000	2.217	2.217	8,770	19.44	7.776
10.00	0.000	0.000	8,770	0.000	0.000

2. SRC column module with box and pipe shape

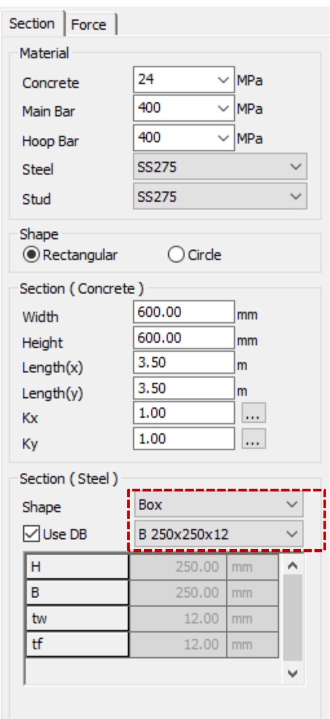
- *Applied Design Code : AISC-LRFD16(M),10(M)*
- *Applied Steel Shape : H section, Box, Pipe*

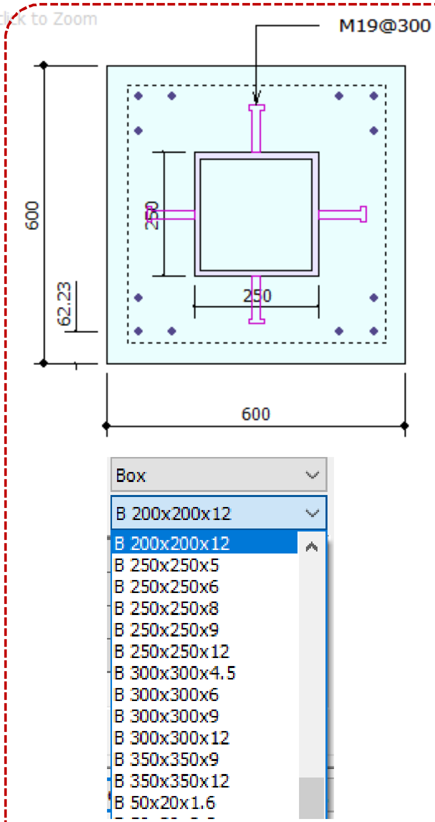


Added Box and Pipe shape

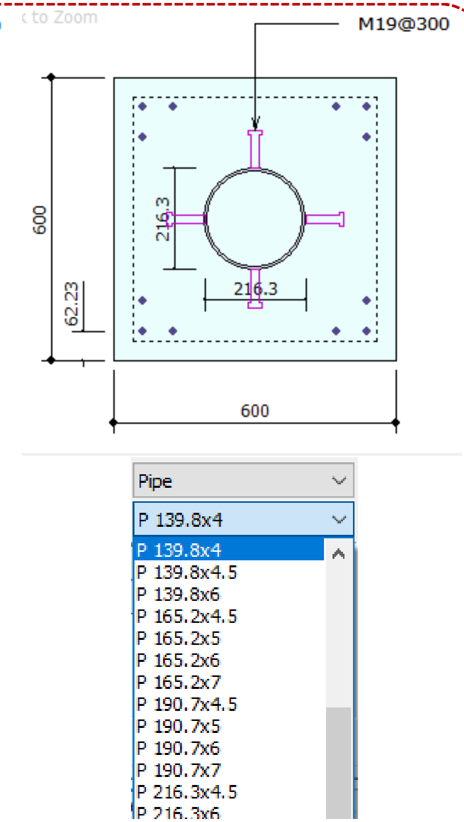
2. SRC column module with box and pipe shape

Example

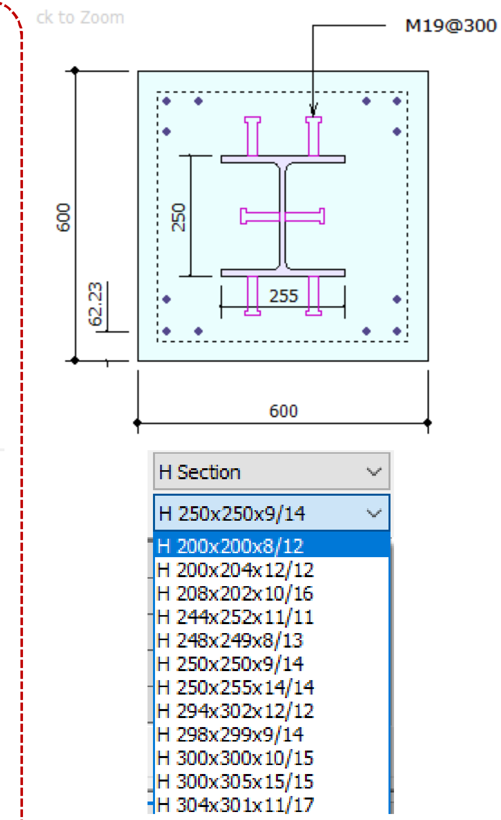




SRC column with Box section



SRC column with Pipe section

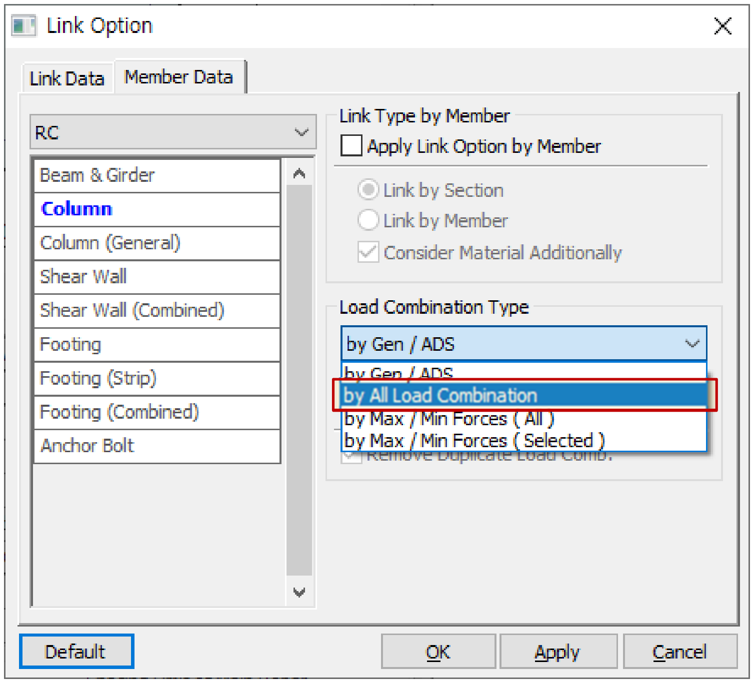


SRC column with H-section

3. Midas link Option

- *Add "by all combination" type in load combination type.*

*Link Option > **Member Data***



- *Supporting linkage feature for all combinations created in Gen*

[by All Load Combination] Support List

✓ **RC**
Column / General Section Column
Shear Wall / Combined Wall
Footing (Isolated/Combined/Strip)
Anchor Bolt

✓ **Steel**
Beam / Column
Bolt Connection (EC3)
Moment Connection(KSSC, AISC, EC3)
Baseplate / Embedded Plate
Web Opening
Welding

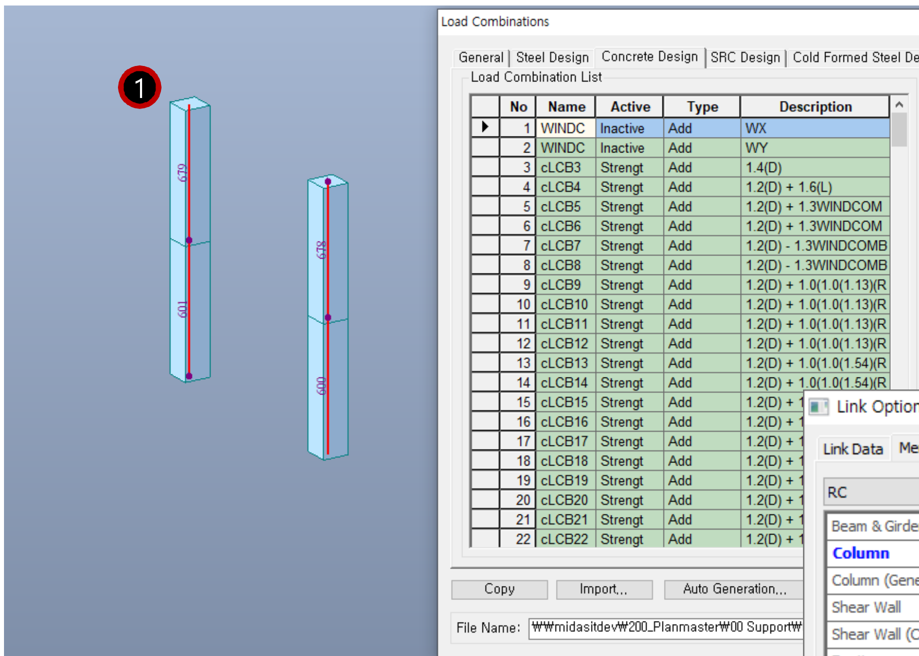
✓ **SRC**
Column
CFT Column

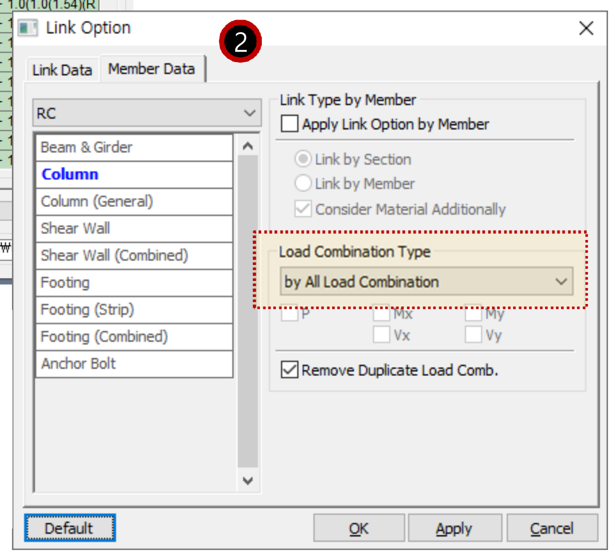
✓ **Aluminum**
Beam / Column
General Section Beam / Column

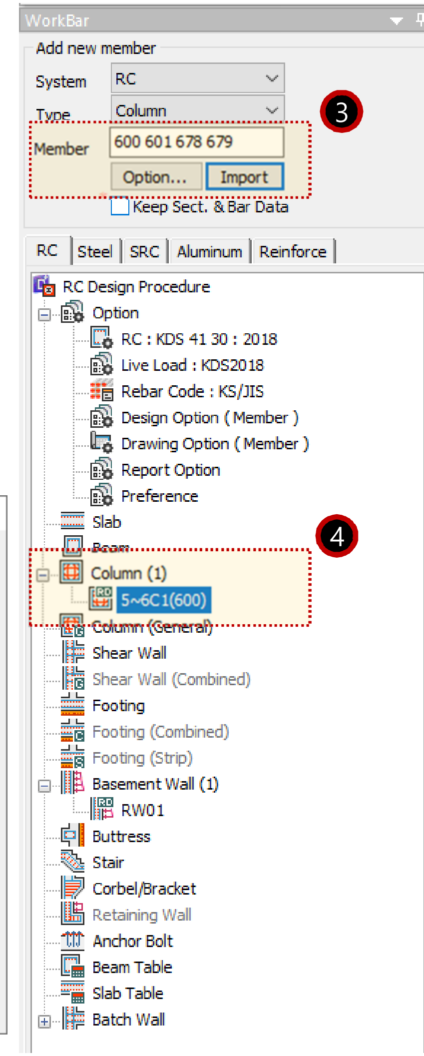
✓ **Reinforce**
Reinforced Beam
Reinforced Column

3. Midas link Option

Example for "by All Combination" Type







1.Generate a load combinations and select a column.

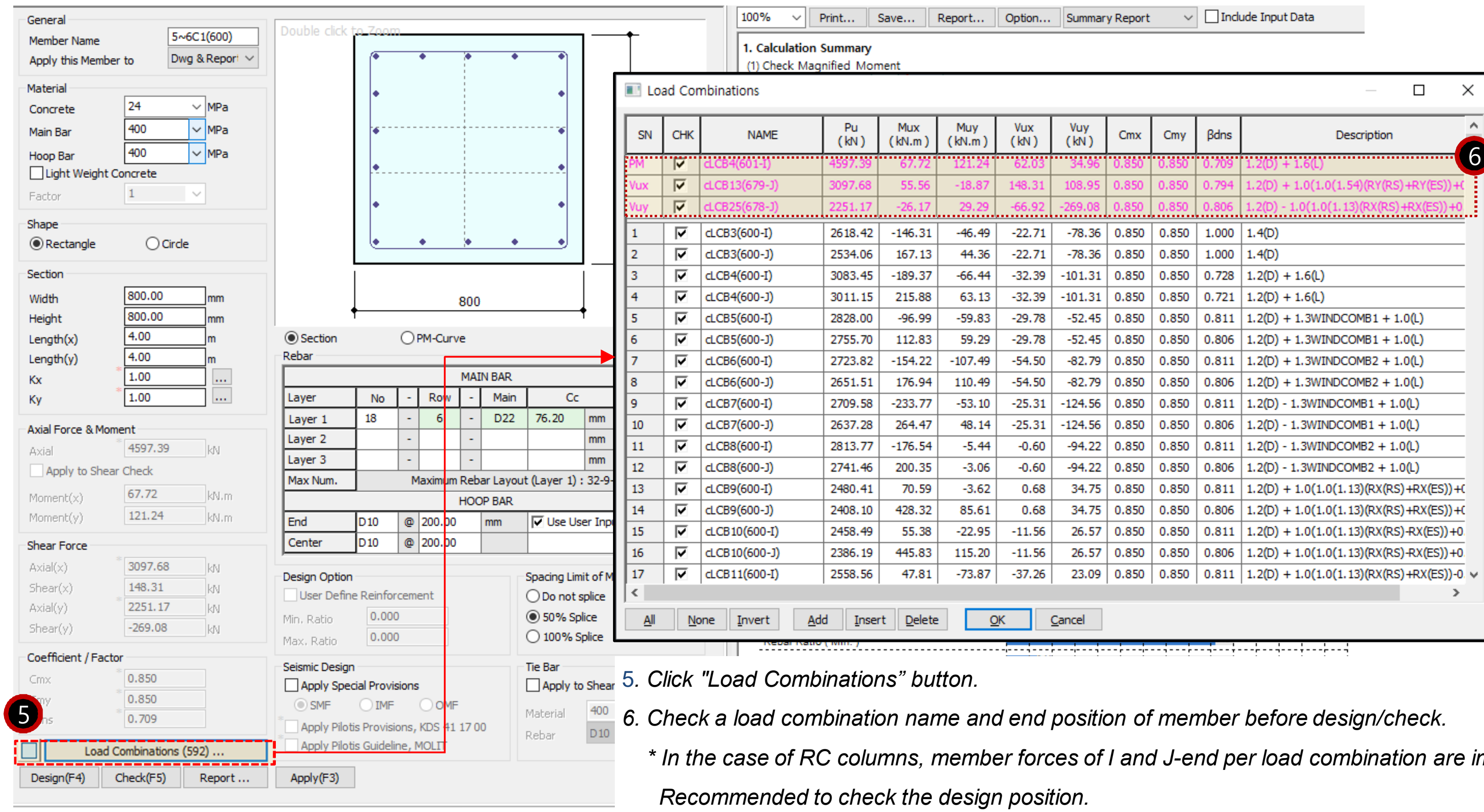
2. Set Load Combination Type to by All Load Combination
in Link Option> Member Data> Column tab.

3. Check Member No. and import Design information of members.

4. Check Member List in RC tree menu.

3. Midas link Option

Example for "by All Combination" Type



5. Click "Load Combinations" button.

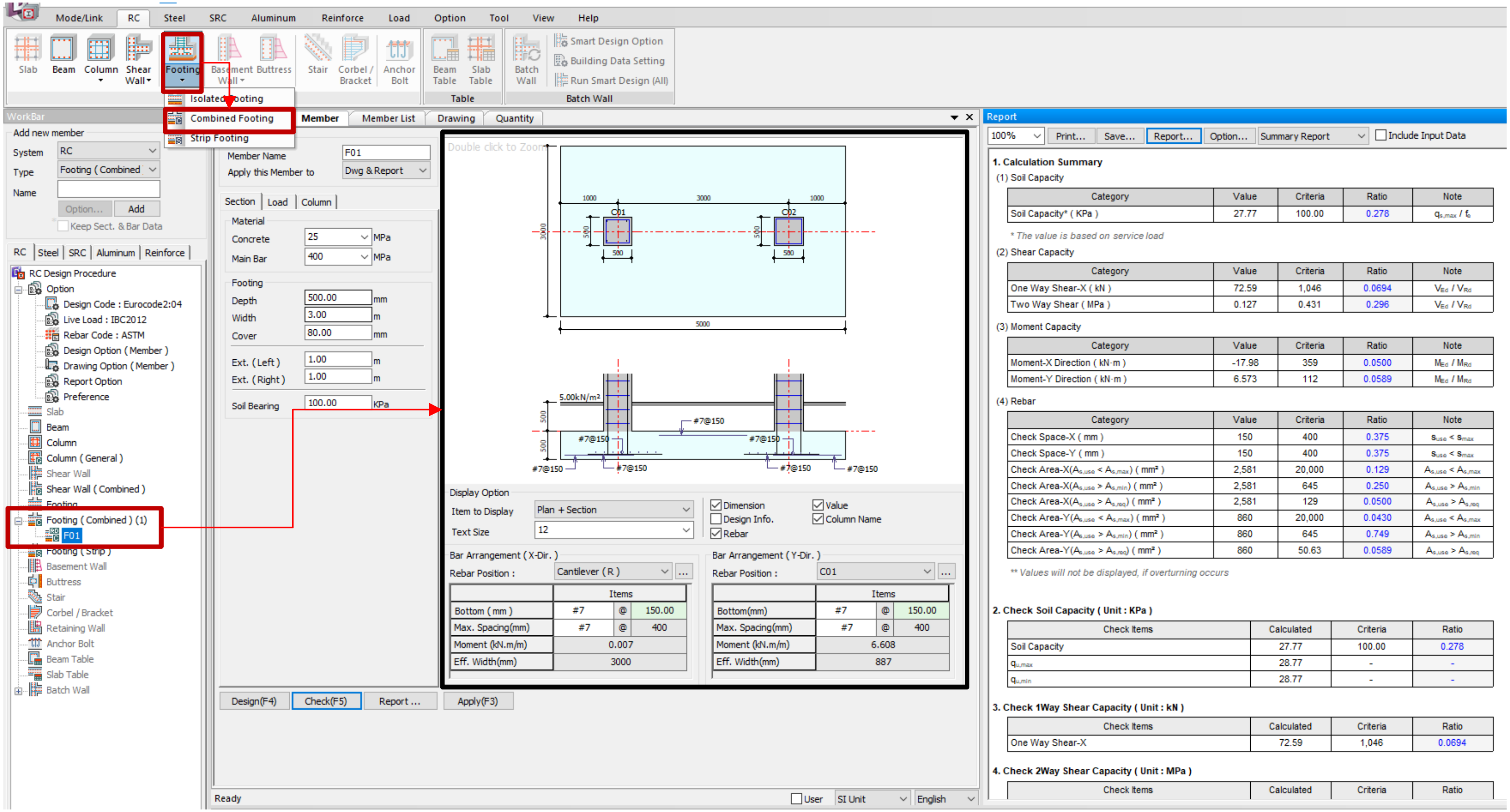
6. Check a load combination name and end position of member before design/check.

** In the case of RC columns, member forces of I and J-end per load combination are imported.*

Recommended to check the design position.

4. Combined footing design as per Eurocode

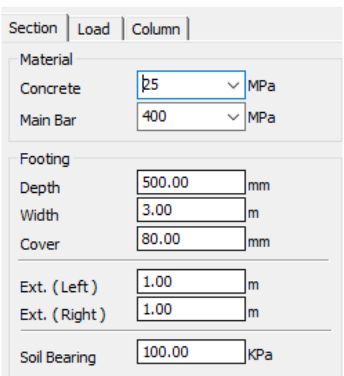
Support combined footing design as per Eurocode 2: 04



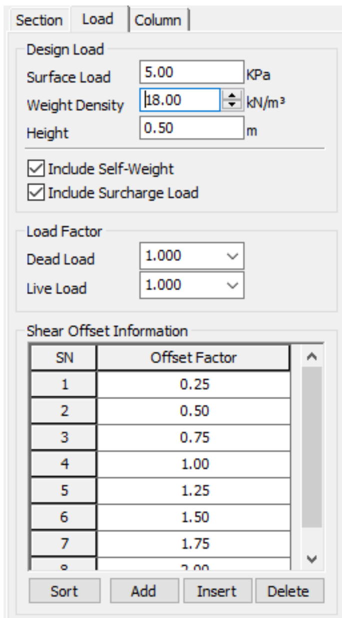
4. Combined footing design as per Eurocode

Procedure of Combined Footing Design

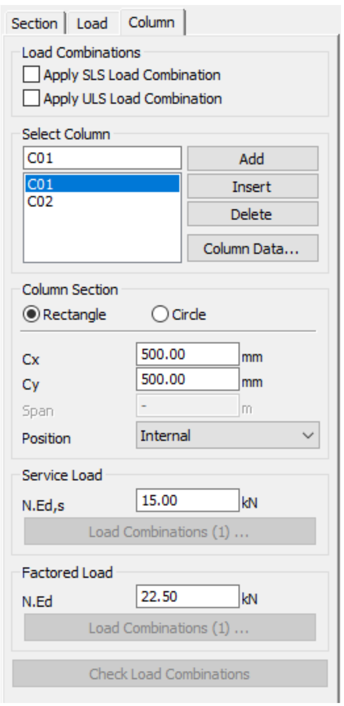
Define Section



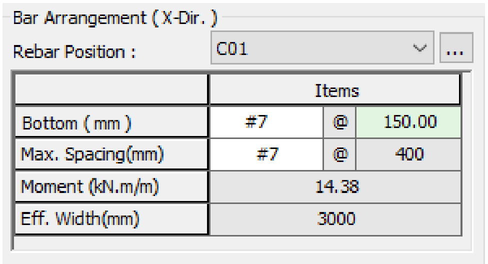
Define Load



Define column information



Define Rebar Arrangement



Step 1.
Define concrete, rebar material, soil bearing and footing element information.

Step 2.
Define Load Data.
(Design load, factor, shear offset information)

Step 3.
Define column element and applied load information.

Step 4.
Define Bar arrangement layout & spacing

4. Combined footing design as per Eurocode

Summary design report

3. Check 1Way Shear Capacity (Unit : kN)

Check Items	Calculated	Criteria	Ratio
One Way Shear-X	72.59	1,046	0.0694

4. Check 2Way Shear Capacity (Unit : MPa)

Check Items	Calculated	Criteria	Ratio
Two Way Shear-Column Face	0.184	3.825	0.0480
Two Way Shear-UserD	0.107	0.431	0.248
Two Way Shear-2D	0.0193	0.431	0.0447
Two Way Shear	0.107	0.431	0.248

5. Check Moment Capacity (Unit : kN·m/m)

Check Items	Calculated	Criteria	Ratio
Moment-X Direction(Cantilever)	0.0140	359	0.0000391
Moment-X Direction(Column)	14.38	359	0.0400
Moment-X Direction(Span)	-17.98	359	0.0500
Moment-X Direction	-17.98	359	0.0500
Moment-Y Direction	6.573	112	0.0589

Detail design report

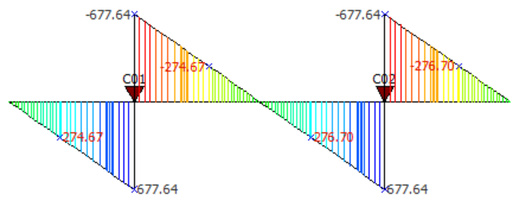
3. Check One-Way Shear (Direction X)

(1) Calculate ratio of shear capacity

Column	D_{eff} (mm)	k	ρ	V_{Rdx1} (kN)	V_{Rdx2} (kN)	V_{Ed} (kN)	$V_{Rd,max}$ (kN)	Ratio	Remark
C01	409	1.699	0.00631	1,046	793	72.59	1,046	0.0694	OK
C02	409	1.699	0.00631	1,046	793	72.59	1,046	0.0694	OK

- $k = \min[1 + \sqrt{200/d}, 2.0] = 1.699$
- $\rho_l = \min[A_{sl}/b_w d, 0.02] = 0.00631$
- $C_{Rd,c} = 0.18 / \gamma_c = 0.120$
- $V_{Rdx1} = [C_{Rd,c}\ k\ (100\ \rho_l\ f_{ck})^{1/3} + k_1\ \sigma_{cp}]\ b_w\ d = 1{,}046kN$
- $V_{Rdx2} = [0.035\ k^{3/2}\ f_{ck}^{1/2} + k_1\ \sigma_{cp}]\ b_w\ d = 793kN$
- $V_{Rdx} = V_{Rd,c} = 1{,}046kN$
- $V_{Edx} = 72.59kN$
- **$V_{Edx} / V_{Rdx} = 0.0694 \rightarrow$ O.K**

Diagram

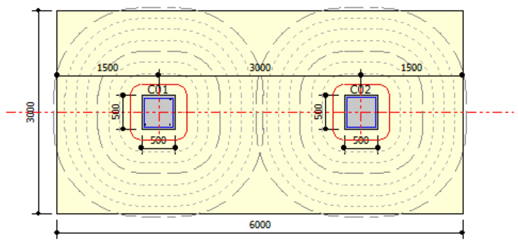


4. Check Two-Way Shear

(1) Calculate Shear at Face of Column

Column	Position	Offset (mm)	U (mm)	β	k	V_{Ed} (MPa)	$V_{Rd,max}$ (MPa)	Ratio	Remark
C01	Interior	0.000	2,000	6.497	0.000	0.184	3.825	0.0480	OK
C02	Interior	0.000	2,000	6.497	0.000	0.183	3.825	0.0478	OK

- $U = 2{,}000mm$
- $a = (\frac{e_x}{b_y})^2$, $b = (\frac{e_y}{b_x})^2$
- $\beta = 1+1.8\sqrt{a+b} = 6.497$
- $v_{Ed} = \frac{\beta N_{Ed}}{U d} = 0.184MPa$
- $f_{cd} = \alpha_{cc}\ f_{ck} / \gamma_c = 0.000MPa$



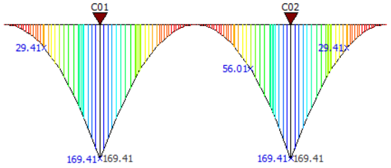
5. Calculate moment capacity

(1) Calculate moment capacity (Direction X)

Position	Top/Bottom	f_{yd} (MPa)	z (mm)	A_s (mm²)	M_{Ed} (kN·m/m)	M_{Rd} (kN·m/m)	Ratio	Remark
Cantilever(L)	Bottom	348	400	2,581	0.0140	359	0.0000391	OK
Colm (C01)	Bottom	348	400	2,581	14.38	359	0.0400	OK
Span (C01-C02)	Top	348	400	2,581	-17.98	359	0.0500	OK
Colm (C02)	Bottom	348	400	2,581	14.38	359	0.0400	OK
Cantilever(R)	Bottom	348	400	2,581	0.00746	359	0.0000208	OK

- $M_{Rd} = f_{yd}\ A_s\ z$

(2) Bending Moment Diagram (Direction X)

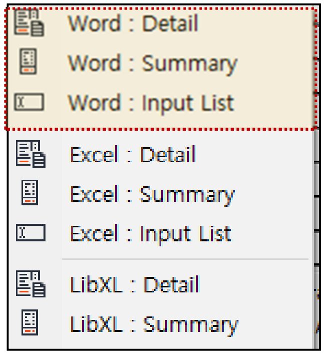


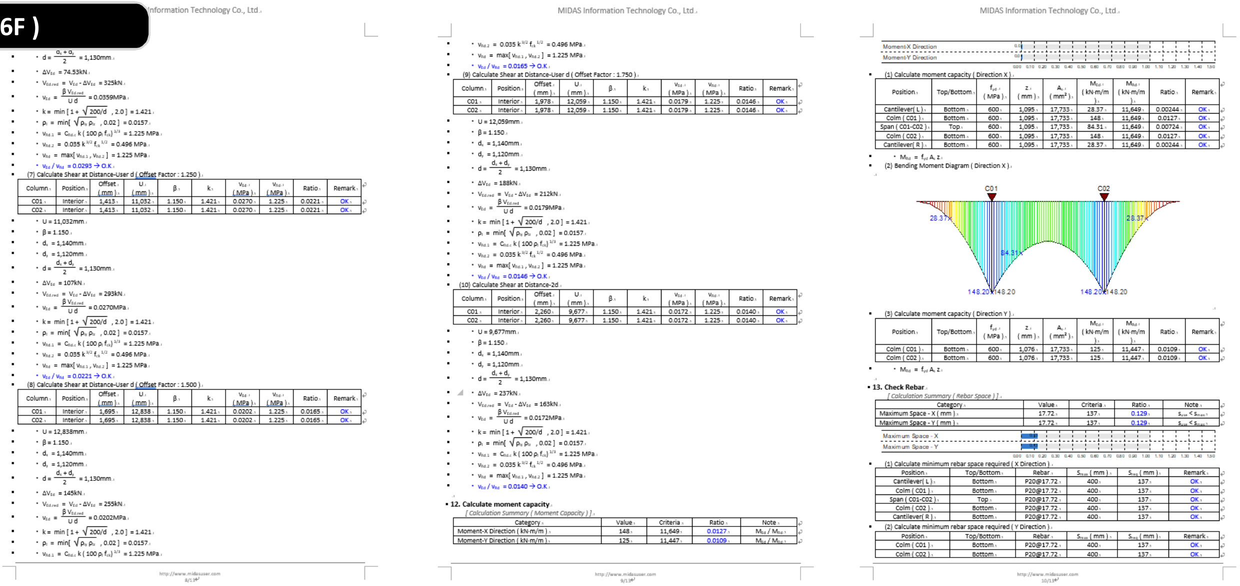
5. Reporting speed for MS word format

- *Reporting time for MS word format has been reduced by improving algorithm.*

Example Model (RC structure of 6F)

- ✓ *National Code : Eurocode2:04*
- ✓ *Module: Combined Footing Design*
- ✓ *Report Page : 13 EA*





[Reporting Time : Design+ 2020 vs Design+ 2021 (New Version)]

99% reduction in reporting time