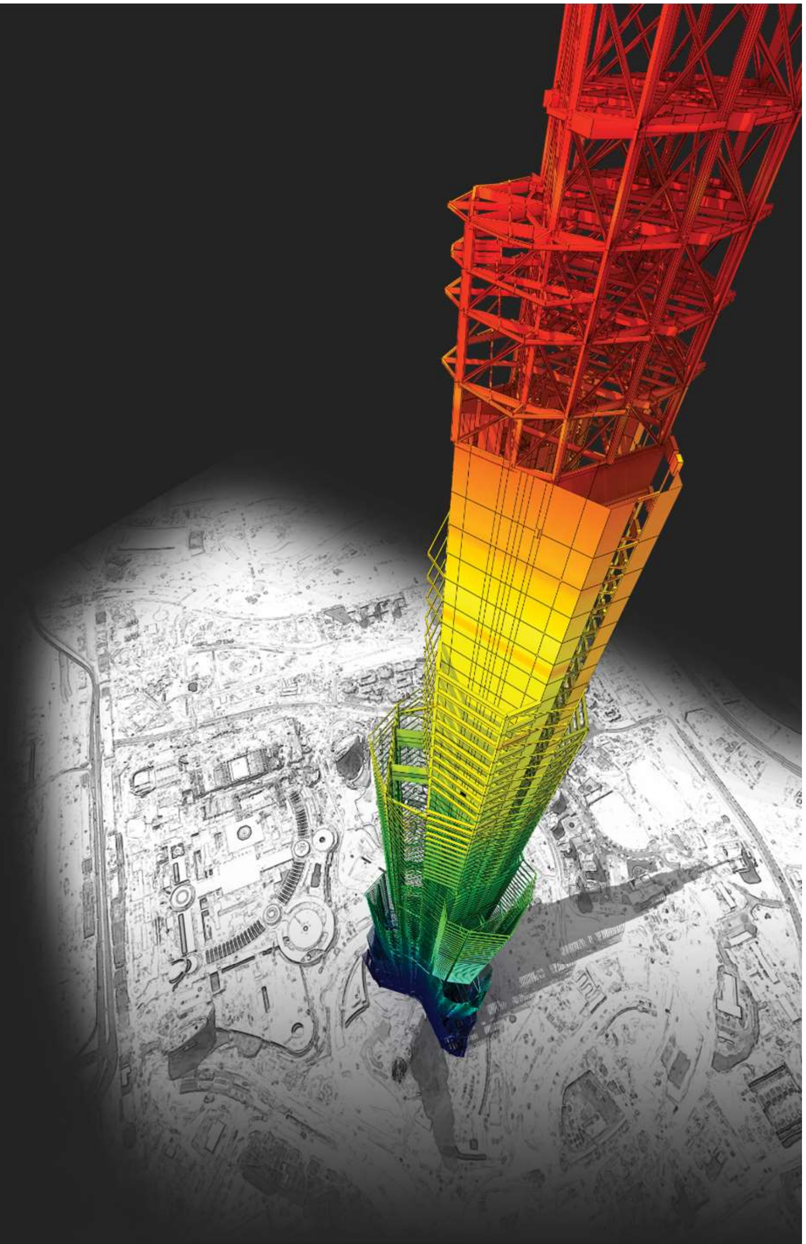
Release Note

Release Date : August. 2019

Product Ver. : midas Gen 2020 (v1.1) and Design+ 2020 (v1.1)



DESIGN OF General Structures

Integrated Design System for Building and General Structures

Enhancements

• *midas Gen*

• *midas Design+*

midas Gen

1. Non-dissipative element design as per NTC2018

In NTC 2018

NTC18 7.2.2. CRITERI GENERALI DI PROGETTAZIONE DEI SISTEMI STRUTTURALI

COMPORTAMENTO STRUTTURALE

Le costruzioni soggette all'azione sismica, non dotate di appositi dispositivi d'isolamento e/o dissipativi, devono essere progettate in accordo con uno dei seguenti comportamenti strutturali:

a) comportamento strutturale non dissipativo,

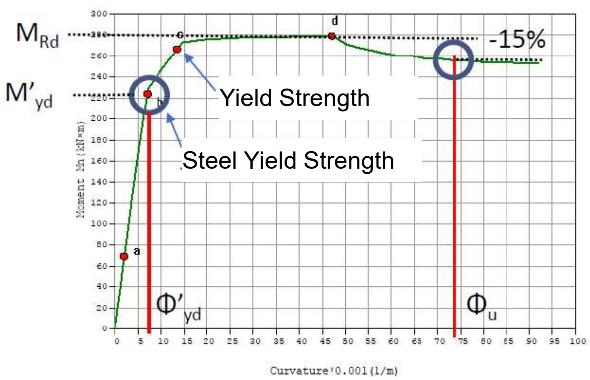
oppure

b) comportamento strutturale dissipativo.

7.4. COSTRUZIONI DI CALCESTRUZZO

7.4.1. GENERALITÀ

Nel caso di comportamento strutturale non dissipativo, la capacità delle membrature deve essere valutata in accordo con le regole di cui al § 4.1, senza nessun requisito aggiuntivo, a condizione che in nessuna sezione si superi il momento resistente massimo in campo sostanzialmente elastico, come definito al § 4.1.2.3.4.2. Per i nodi trave-pilastro di strutture a comportamento non dissipativo si devono applicare le regole di progetto relative alla CD "B" contenute nel § 7.4.4.3. Per le strutture prefabbricate a comportamento non dissipativo si devono applicare anche le regole generali contenute nel § 7.4.5.



Non-Dissipative Element Design (NDED)

$$M'_{yd} > M_{Ed}$$

M'_{yd} : Bending resistance in elastic status

M_{ed} : Design bending moment by elastic load combinations

NTC18 7.2.2.

Buildings subject to seismic action, not equipped with appropriate insulation and / or dissipative devices, must be designed in accordance with one of the following structural behaviors:

a) non dissipative structural behavior,

or

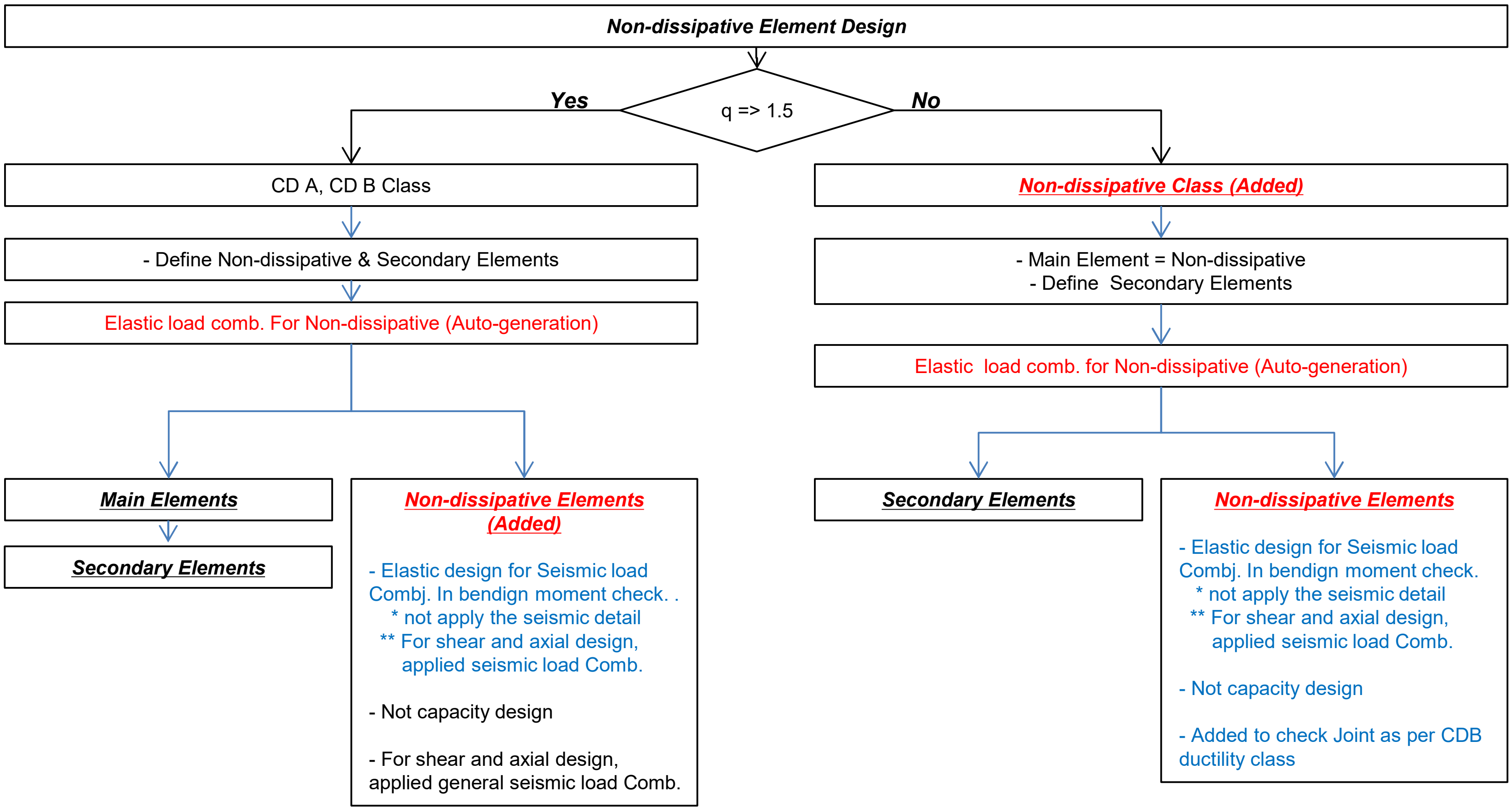
b) dissipative structural behavior.

NTC18 7.4.1.

In the case of non-dissipative structural behavior, the capacity of the members must be evaluated in accordance with the rules set out in § 4.1, without any additional requirements, provided that in no section does the maximum moment of resistance in a substantially elastic field be exceeded, as defined in § 4.1.2.3.4.2. For beam-column Joint of structures with non-dissipative behavior, the design rules relating to CD "B" contained in § 7.4.4.3 must be applied. For prefabricated structures with non-dissipative behavior, the general rules contained in § 7.4.5 must also be applied.

1. Non-dissipative element design as per NTC2018

Flowchart of Non-dissipative Elements Design

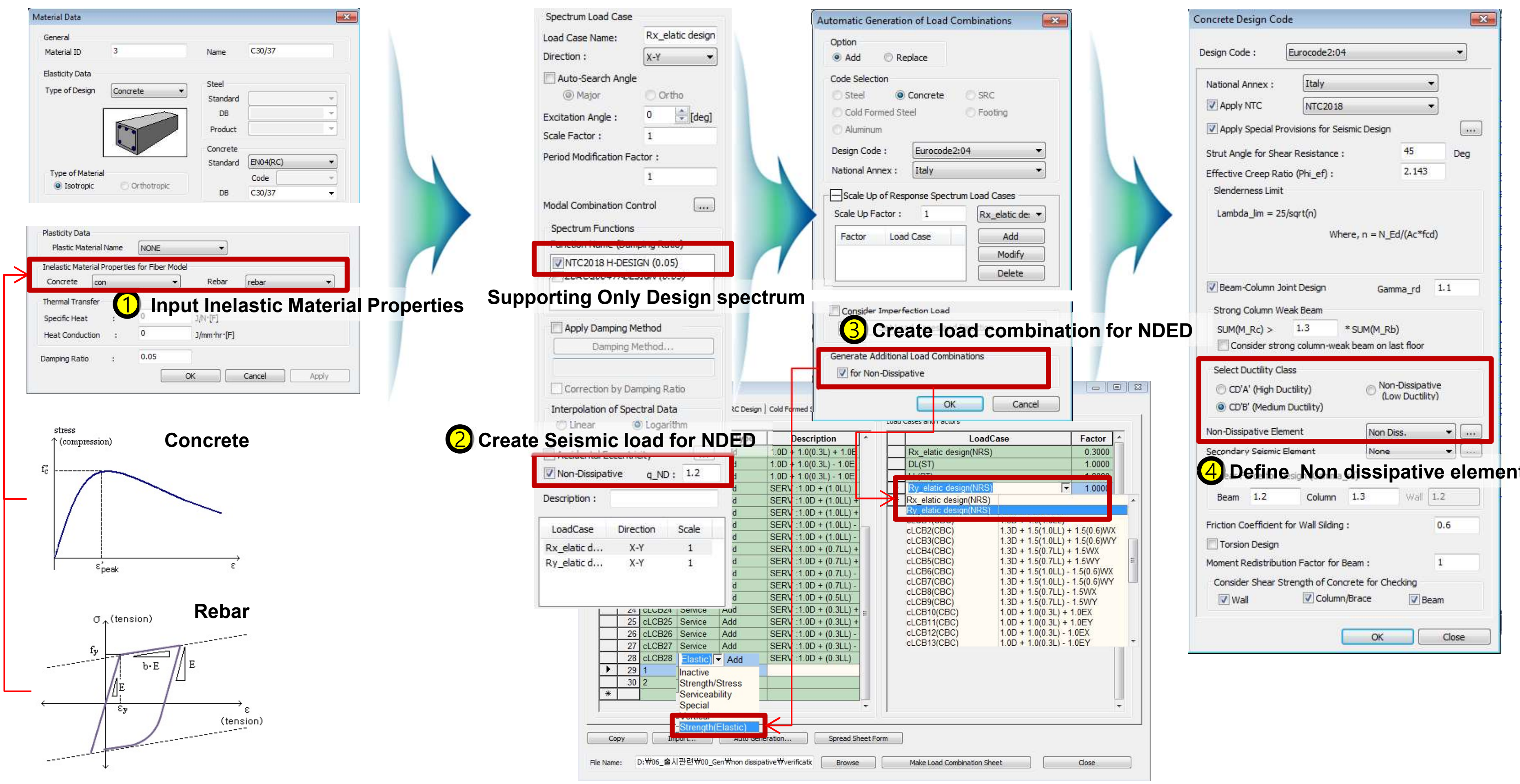


***** This release version is supporting only a beam, columnn and wall member in code checking***

1. Non-dissipative element design as per NTC2018

Procedure of Non-Dissipative Element Design (NDED) – Response Spectrum

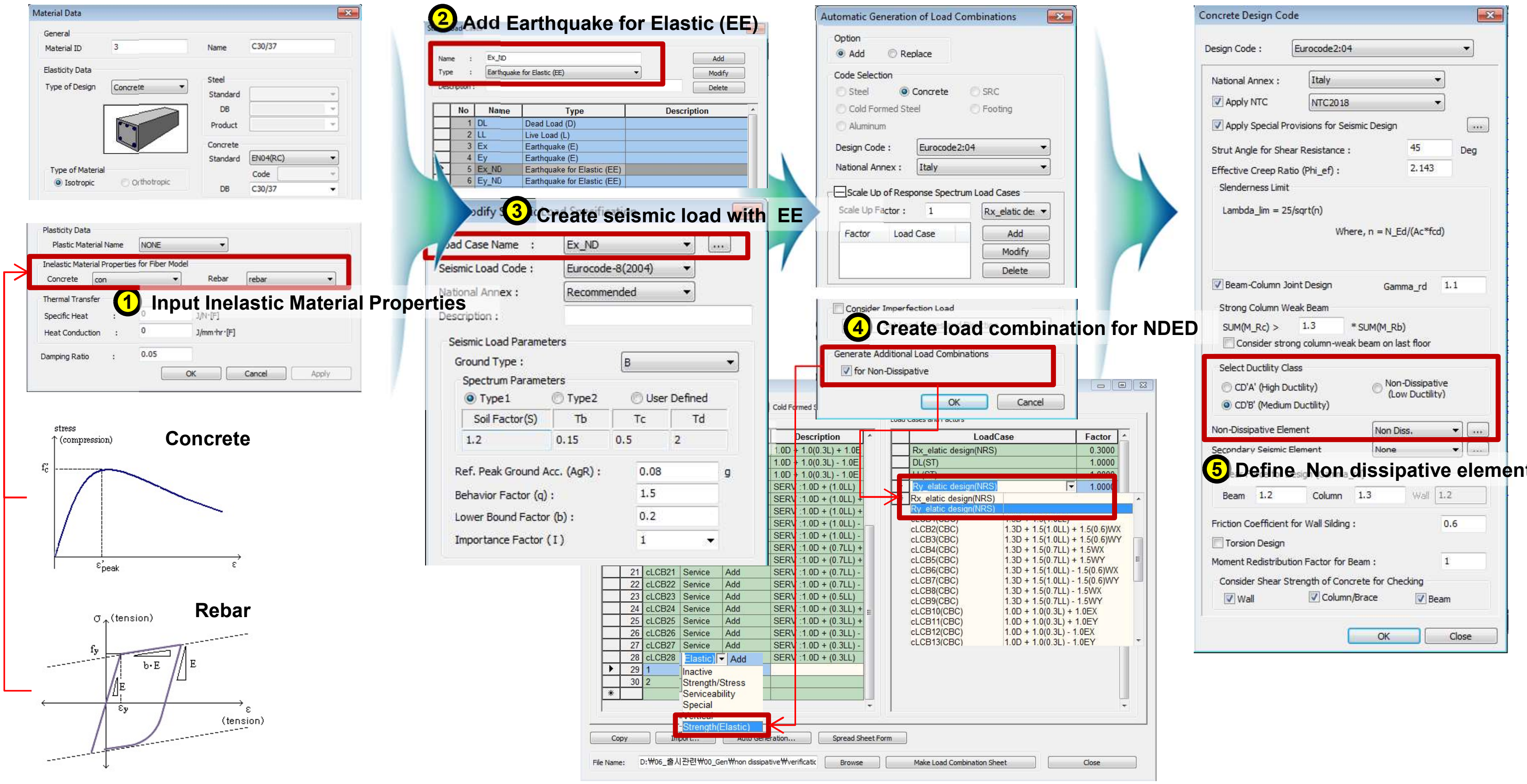
Define Inelastic material model | **Create seismic load for NDED** | **Generate load combination for NDED** | **Design Setting for NDED**



1. Non-dissipative element design as per NTC2018

Procedure of Non-Dissipative Element Design (NDED) – Static Seismic Load

Define Inelastic material model	Create seismic load for NDED	Generate load combination for NDED	Design Setting for NDED



1. Non-dissipative element design as per NTC2018

Design Result of Non--Dissipative Element Design (NDED) : Supporting only Design Checking

Design Result Table

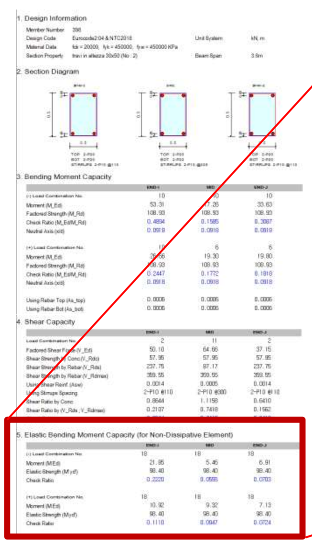
Eurocode2:04 RC-Beam Checking Result Dialog

Code : Eurocode2:04,NTC2018   Unit : kN , m   Primary Sorting Option: SECT / MEMB

Sorted by: Member / Property   Results: Strength / Serviceability

MEMB / SECT / Span	SEL	Section Bc / bf	Section Hc / hf	fck / fyk / fyw	POS	CHK	Rebar AsTop	Rebar AsBot	Negative Moment Strength N(-) M_Ed	LCB	x/d	N(-) M_Rd	Rat-N	Positive Moment Strength P(+) M_Ed	LCB	x/d	P(+) M_Rd	Rat-P	Shear Strength V_Ed	LCB	V_Rdc	V_Rds	Rat-Vc	Rat-Vs	Rat-V	Elastic Moment Capacity Seis. Class	N(-) M.Ed	LCB	N(-) M'.yd	Rat-N	P(+) M.Ed	LCB	P(+) M'.yd	Rat-P
0		travi in altezz		20000.0	I	OK	0.0006	0.0006	53.3142	10	0.09	108.928	**0.49**	26.6571	10	0.09	108.928	**0.24**	50.0967	2	57.9545	237.749	0.86	0.21	**0.86**	N.D.	21.849	19	98.401	0.22	10.925	19	98.401	0.11
2	☐	0.300	0.500	450000	M	OK	0.0006	0.0006	17.2613	10	0.09	108.928	**0.16**	19.2975	6	0.09	108.928	**0.18**	64.6646	11	57.9545	87.1748	1.12	0.74	**0.74**	N.D.	21.849	19	98.401	0.22	10.925	19	98.401	0.11
3.6000		0.000	0.000	450000	J	OK	0.0006	0.0006	33.6289	10	0.09	108.928	**0.31**	19.8028	6	0.09	108.928	**0.18**	37.1465	2	57.9545	237.749	0.64	0.16	**0.64**	N.D.	21.849	19	98.401	0.22	10.925	19	98.401	0.11

Graphic Report



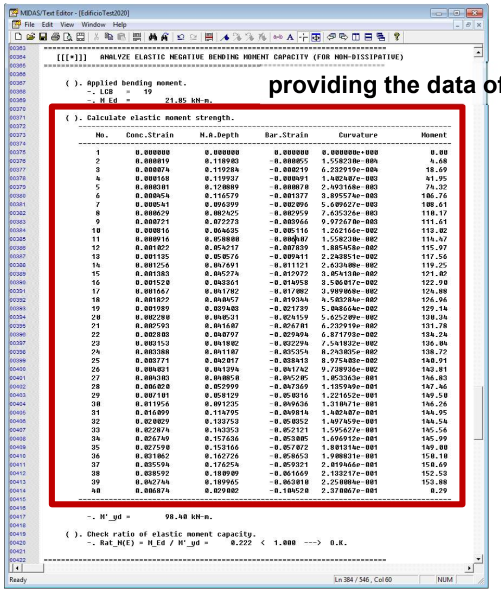
4. Shear Capacity

	END-I	MID	END-J
Load Combination No.	2	11	2
Factored Shear Force (V_Ed)	50.10	64.66	37.15
Shear Strength by Conc.(V_Rdc)	57.95	57.95	57.95
Shear Strength by Rebar.(V_Rds)	237.75	87.17	237.75
Shear Strength by Rebar.(V_Rdmax)	359.55	359.55	359.55
Using Shear Reinf. (Asw)	0.0014	0.0005	0.0014
Using Stirrups Spacing	2-P10 @110	2-P10 @300	2-P10 @110
Shear Ratio by Conc	0.8644	1.1158	0.6410
Shear Ratio by (V_Rds ; V_Rdmax)	0.2107	0.7418	0.1562
Check Ratio	0.8644	0.7418	0.6410

5. Elastic Bending Moment Capacity (for Non-Dissipative Element)

	END-I	MID	END-J
(-) Load Combination No.	18	18	18
Moment (M.Ed)	21.85	5.46	6.91
Elastic Strength (M'.yd')	98.40	98.40	98.40
Check Ratio	0.2220	0.0555	0.0703
(+) Load Combination No.	18	18	18
Moment (M.Ed)	10.92	9.32	7.13
Elastic Strength (M.yd')	98.40	98.40	98.40
Check Ratio	0.1110	0.0947	0.0724

Detail Report



providing the data of Moment-Curvature Curve

2. Enhancement of Stability coefficient table as per NTC 2018

About NTC18 chap. 7.3.1 – (this is to consider in wishlist)

Effetti delle non linearità geometriche

Le non linearità geometriche sono prese in conto attraverso il fattore θ che, in assenza di più accurate determinazioni, può essere definito come:

$$\theta = \frac{P \cdot d_{Er}}{V \cdot h} \qquad [7.3.3]$$

dove:

P è il carico verticale totale dovuto all'orizzontamento in esame e alla struttura ad esso sovrastante;

d_{ER} è lo spostamento orizzontale medio d'interpiano allo *SLV*, ottenuto come differenza tra lo spostamento orizzontale dell'orizzontamento considerato e lo spostamento orizzontale dell'orizzontamento immediatamente sottostante, entrambi valutati come indicato al § 7.3.3.3;

V è la forza orizzontale totale in corrispondenza dell'orizzontamento in esame, derivante dall'analisi lineare con fattore di comportamento q;

h è la distanza tra l'orizzontamento in esame e quello immediatamente sottostante.

Gli effetti delle non linearità geometriche:

- possono essere trascurati, quando θ è minore di 0,1;
- possono essere presi in conto incrementando gli effetti dell'azione sismica orizzontale di un fattore pari a 1/(1−θ), quando θ è compreso tra 0,1 e 0,2;
- devono essere valutati attraverso un'analisi non lineare, quando θ è compreso tra 0,2 e 0,3.

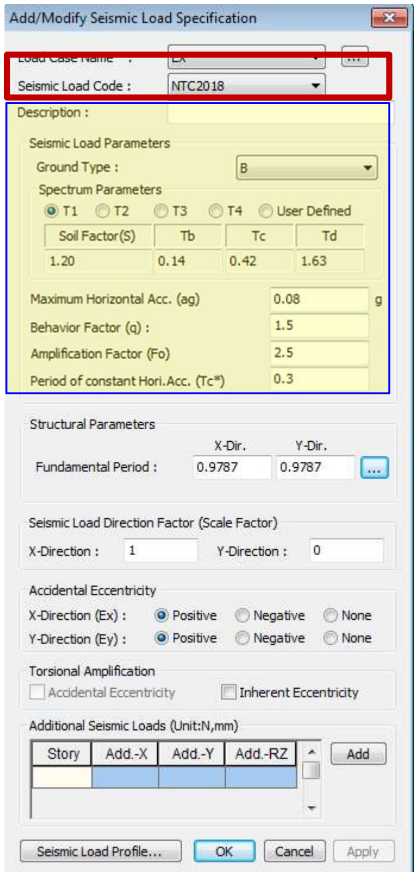
Il fattore θ non può comunque superare il valore 0,3.

Load Case	Story	Story Height (m)	Vertical Load (kN)	Story Shear Force (kN)	Modified Story Drift (m)	Beta (Beta)	Stability Coefficient (Theta)	Allowable Limit	Remark	P-Delta Incremental Factor (ad)
Cd=1, Ie=1, Scale Factor=2.5										
SLVx(RS)	5F	3.2	26503.4572	646.7074	0.0186	1	0.2384	0.3	P-Delta Direct Analysis	
SLVx(RS)	4F	3.2	43667.3343	994.4165	0.0208	1	0.2859	0.3	P-Delta Direct Analysis	
SLVx(RS)	3F	3.2	60831.2115	1267.5691	0.0202	1	0.3257	0.3	Redesign	
SLVx(RS)	2F	13.2	88294.3753	1658.6257	0.0521	1	0.1802	0.3	P-Delta Increment	1.2662
SLVx(RS)	1F	3.2	105458.2525	1690.8036	0.003	1	0.0583	0.3	OK	1

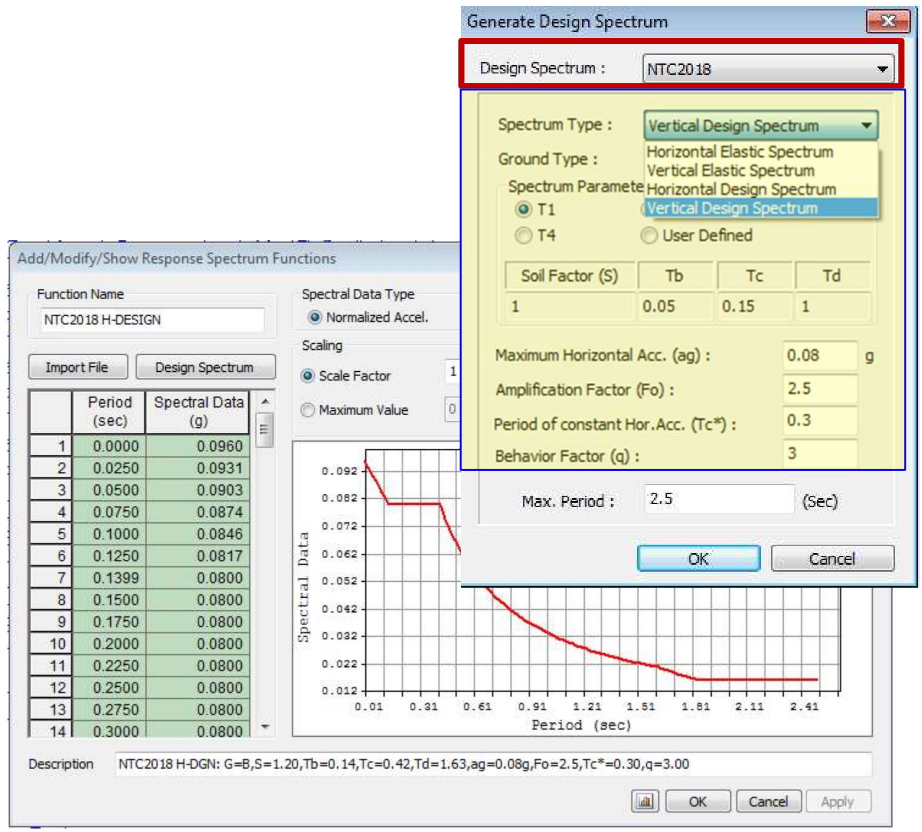
- *If "Theta" is less than 0.1, "O.K" is printed*
- *If "Theta" exceeds 0.1 and is less than 0.2, "P-Delta Increment" is printed*
- *If "Theta" exceeds 0.2 and is less than 0.3, "P-Delta Direct Analysis " is printed*
- *If "Theta" exceeds 0.3, "Redesign" is printed*

3. Added spectrum as per NTC 2018 in static seismic Load & response spectrum

Static Seismic Load

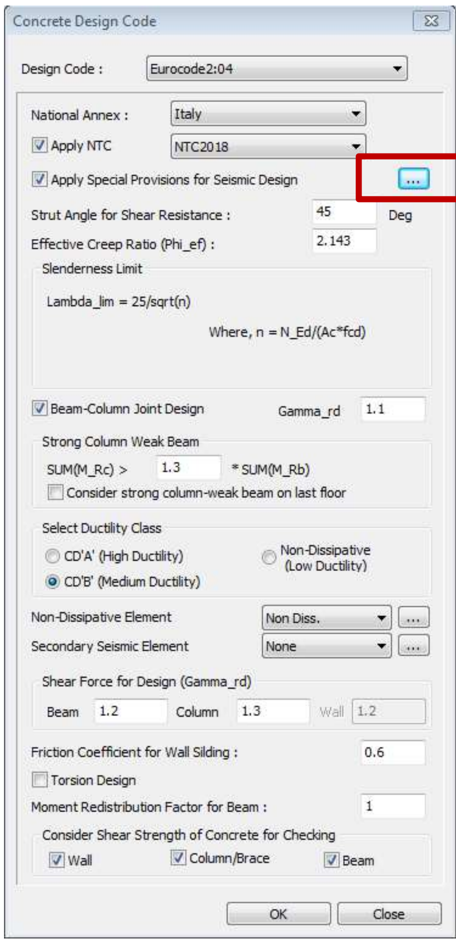


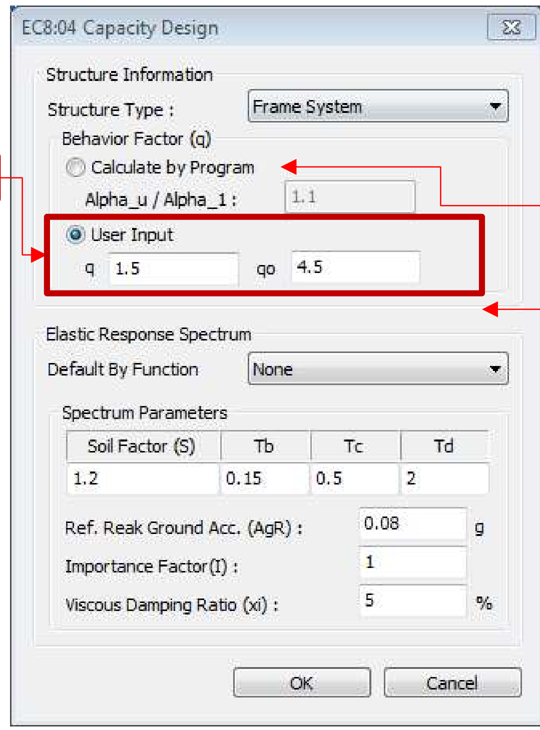
Response Spectrum



4. Added user input for "*qo*" in RC design setting as per EC2

- Definition of "*qo*" by user
- Design considering "*qo*" for irregular structures





Eurocod 08. Table 5.1

$$q = q_o k_w \geq 1{,}5$$

Table 5.1: Basic value of the behaviour factor, q_o, for systems regular in elevation

STRUCTURAL TYPE	DCM	DCH
Frame system, dual system, coupled wall system	$3{,}0\alpha_u/\alpha_1$	$4{,}5\alpha_u/\alpha_1$
Uncoupled wall system	3,0	$4{,}0\alpha_u/\alpha_1$
Torsionally flexible system	2,0	3,0
Inverted pendulum system	1,5	2,0

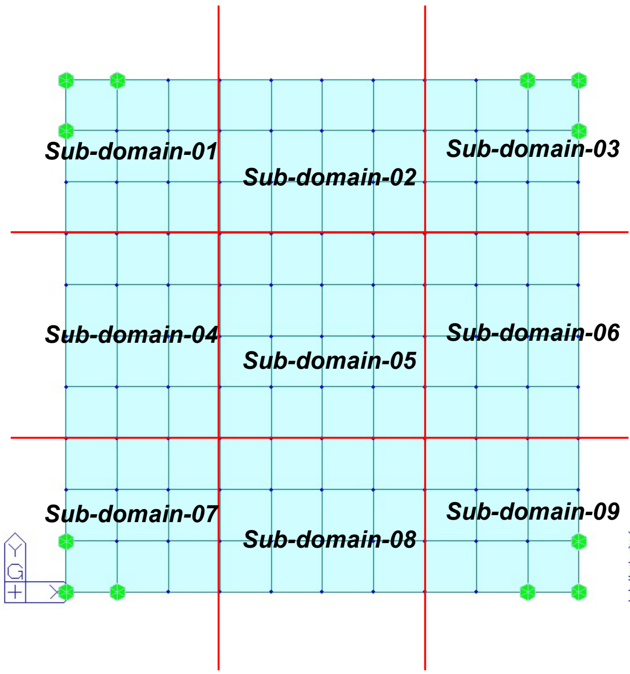
(3) For buildings which are not regular in elevation, the value of q_o should be reduced by 20% (see **4.2.3.1(7)** and Table 4.1).

5. Added "Update Rebar Option" in shell/slab/wall design

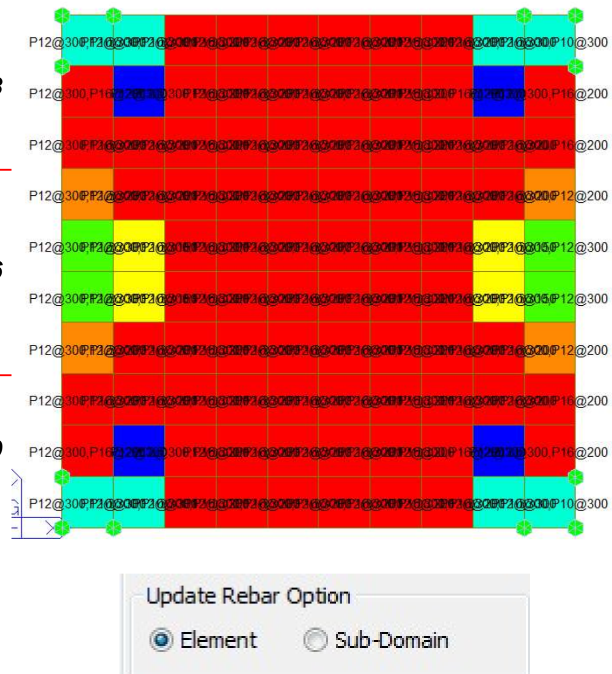
- Update rebar arrangement by sub-domain & by elements

Added methods to input rebar information

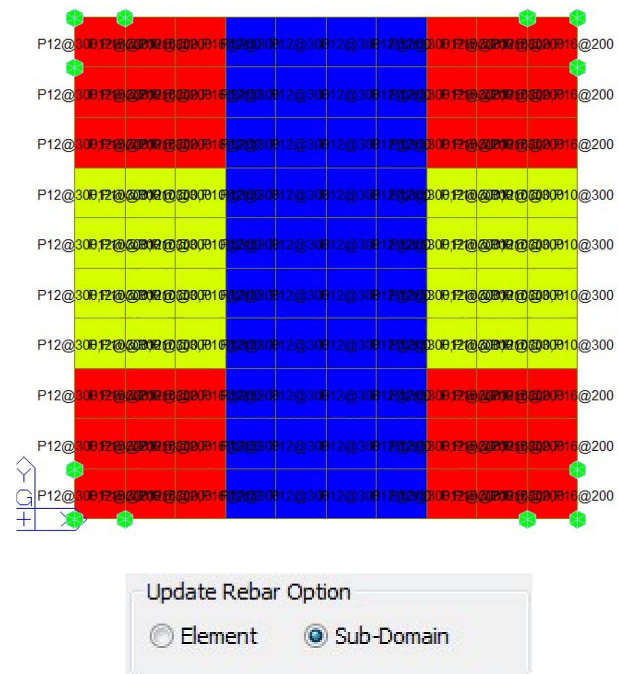
Define Sub-domain



Update rebar by elements



Update rebar by Sub-domains (New)



6. Improvement of graphic report for column design

Printout shear design result for each direction in graphic report (RC column)

Midas Gen 2019 v2.2

5. Shear Force Capacity Check (End)

Applied Shear Force	Vu	= 198.243 kN (Load Combination : 16)
Design Shear Strength	φVc+φVs	= 276.331 + 842.734 = 1119.06 kN (As-H_req = 0.00053 m^2/m, 2-P10 @30)
Shear Ratio	Vu/φVn	= 0.177 < 1.000 .... O.K
Joint Shear Ratio	Vhj/φVnj	= 0.00000 / 0.00000 = 0.000 < 1.000 .... O.K

6. Shear Force Capacity Check (Middle)

Applied Shear Force	Vu	= 198.243 kN (Load Combination : 16)
Design Shear Strength	φVc+φVs	= 277.275 + 210.684 = 487.959 kN (As-H_req = 0.00053 m^2/m, 2-P10 @120)
Shear Ratio	Vu/φVn	= 0.406 < 1.000 .... O.K

Midas Gen 2020 v1.1

3. Design for Shear

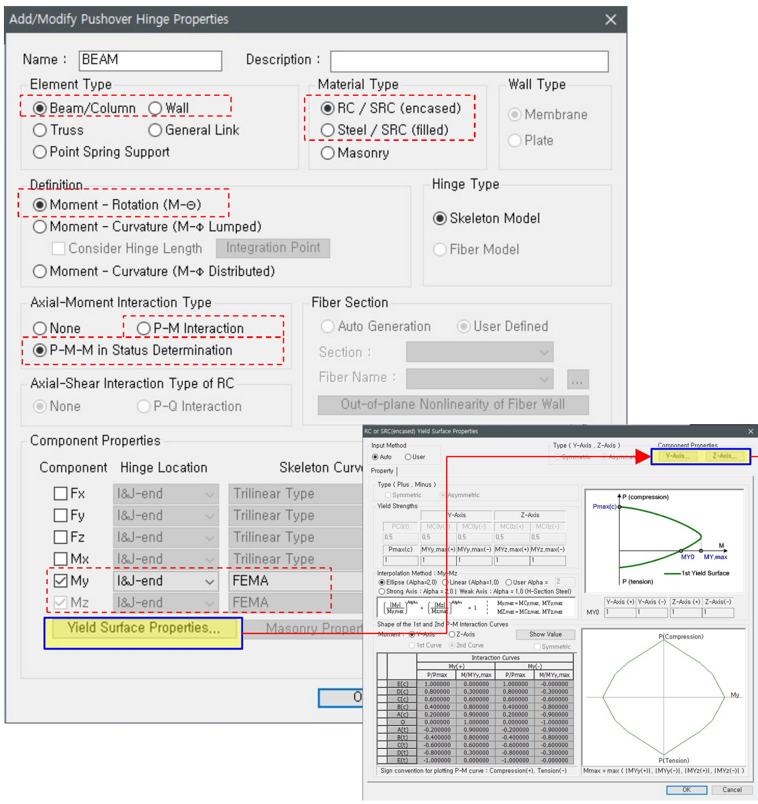
[END]	y : 3 (I)	z : 9 (I)
Applied Shear Force (V_Ed)	39639.6 N	35434.7 N
Shear Ratio (V_Ed/V_Rdc)	39639.6 / 438445 = 0.090	35434.7 / 437307 = 0.081
Shear Ratio (V_Ed/V_Rds)	39639.6 / 837475 = 0.047	35434.7 / 991141 = 0.036
Shear Ratio (V_Ed/V_Rdmax)	39639.6 / 1716750 = 0.023	35434.7 / 1741500 = 0.020
Shear Ratio	0.090 < 1.000 .... O.K	0.081 < 1.000 .... O.K
Asw-H_req	0.00393 mm^2/m, 2-P10 @40	0.00393 mm^2/m, 2-P10 @40
[MIDDLE]	**y : 10 (1/2)**	**z : 10 (1/2)**
Applied Shear Force (V_Ed)	472545 N	559460 N
Shear Ratio (V_Ed/V_Rdc)	472545 / 414399 = 1.140	559460 / 412915 = 1.355
Shear Ratio (V_Ed/V_Rds)	472545 / 478557 = 0.987	559460 / 566366 = 0.988
Shear Ratio (V_Ed/V_Rdmax)	472545 / 1716750 = 0.275	559460 / 1741500 = 0.321
Shear Ratio	0.987 < 1.000 .... O.K	0.988 < 1.000 .... O.K
Asw-H_req	0.00222 mm^2/m, 2-P10 @70	0.00222 mm^2/m, 2-P10 @70
[JOINT]	**y : (I)**	**z : (I)**
Vjhd / Vjs	0.00000 / 0.00000 = 0.000	0.00000 / 0.00000 = 0.000
Joint Ratio	0.000 < 1.000 .... O.K	0.000 < 1.000 .... O.K
Ash.jnt	0.00000 mm^2, Not Use	0.00000 mm^2, Not Use

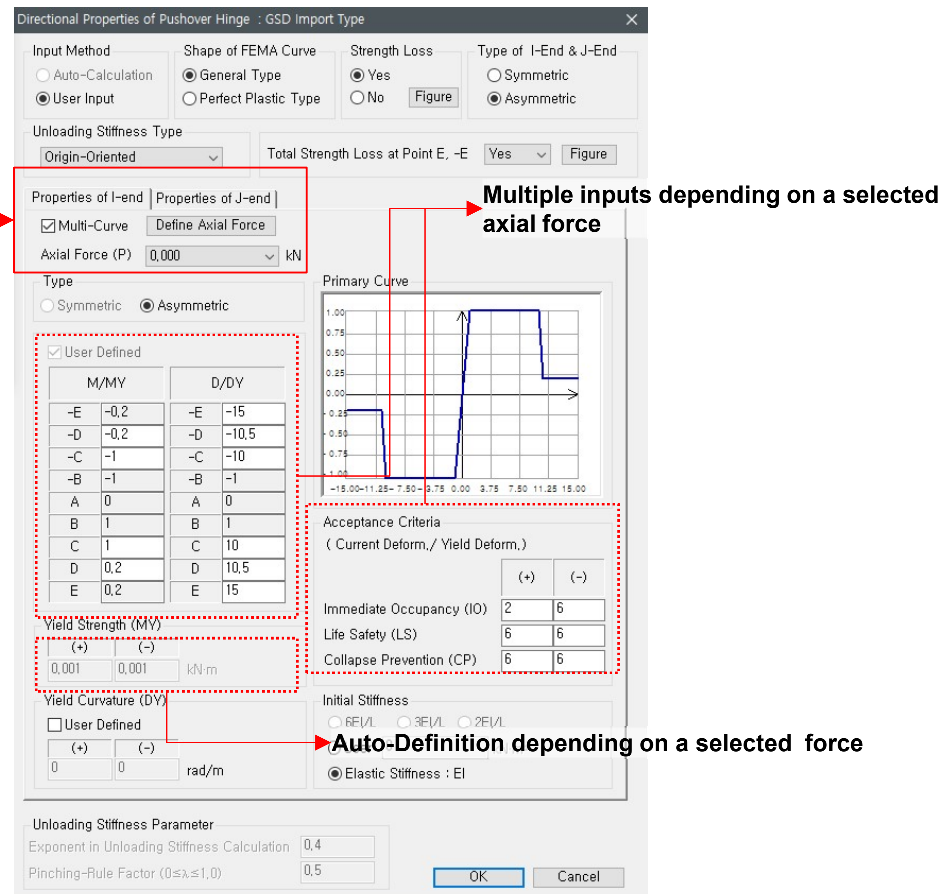
7. Specify Moment-Rotation hinge properties with multi curve

• Definition of hinge curve and yield strength depending on axial force in FEMA type

▪ ***Pushover > Properties > Define Pushover Hinge Properties***

FEMA Multi-Curve

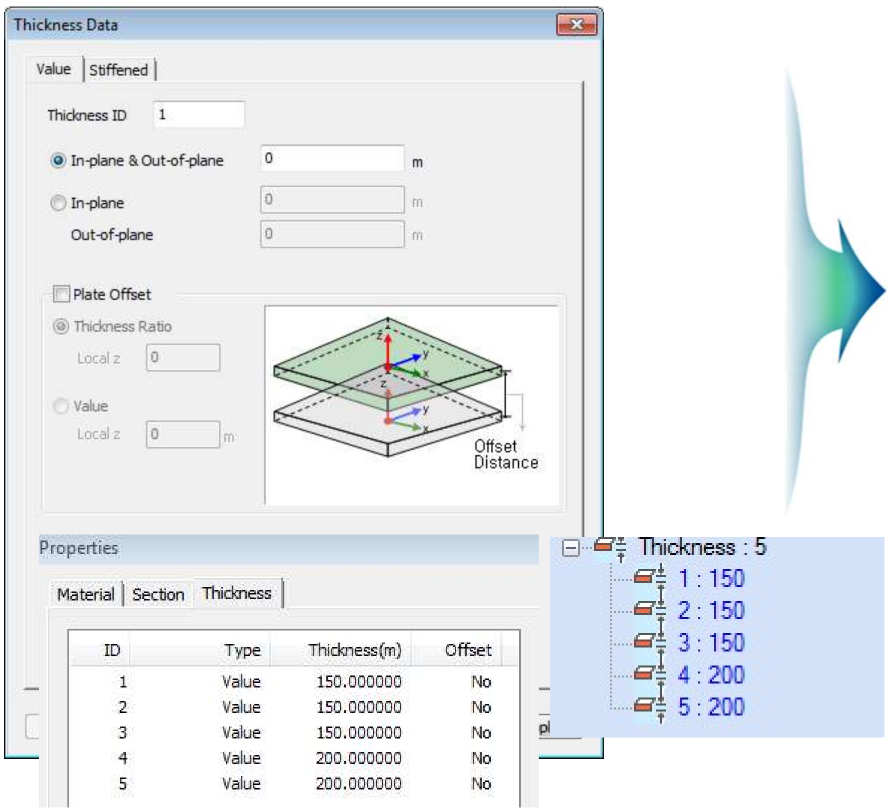




8. Added name box in thickness properties.

Usage classification for the same thickness

- ***Properties > Section > Thickness***



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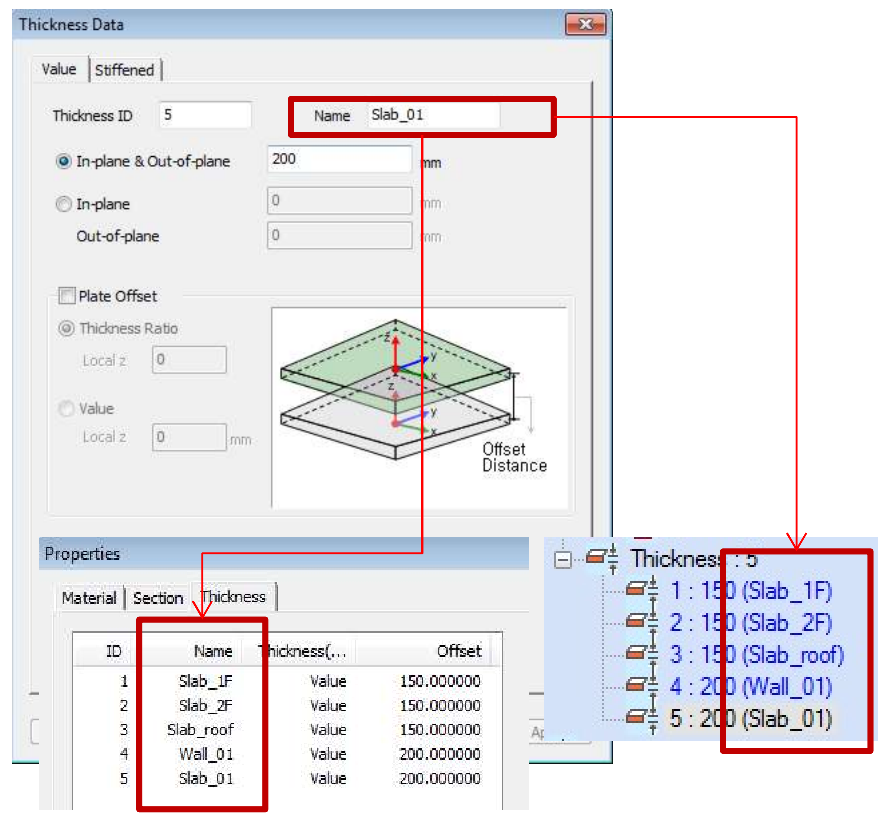
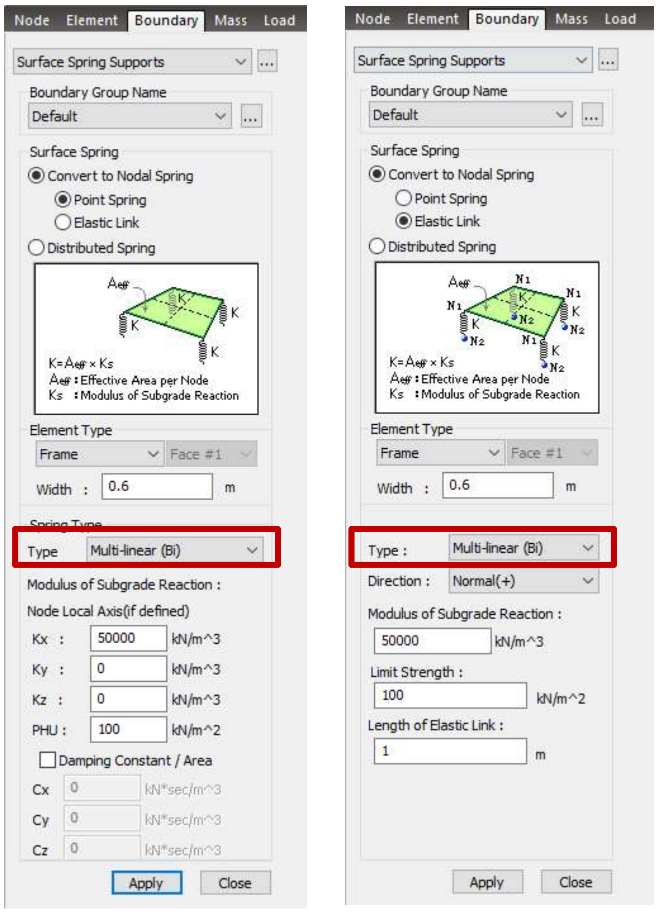


Midas Gen 2020 v1.1

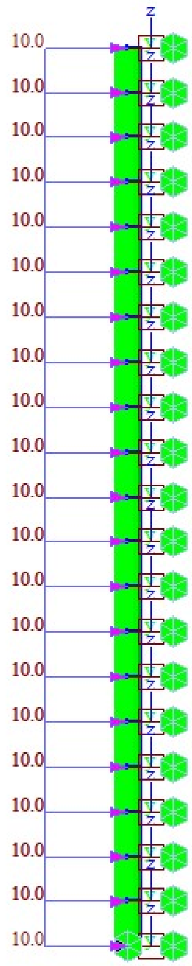
9. Bilinear type spring stiffness for surface spring support

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

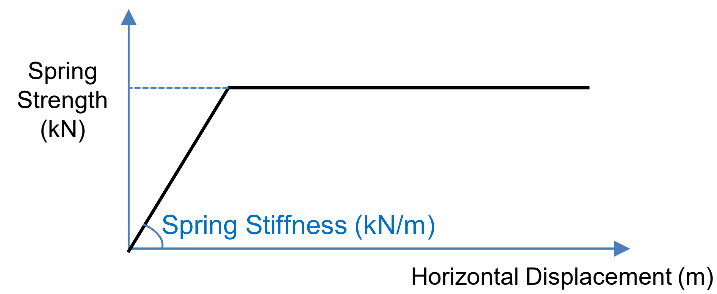
▪ ***Boundary > Spring Supports > Surface Spring***



Surface Spring Support



Horizontal Soil Stiffness(kN)

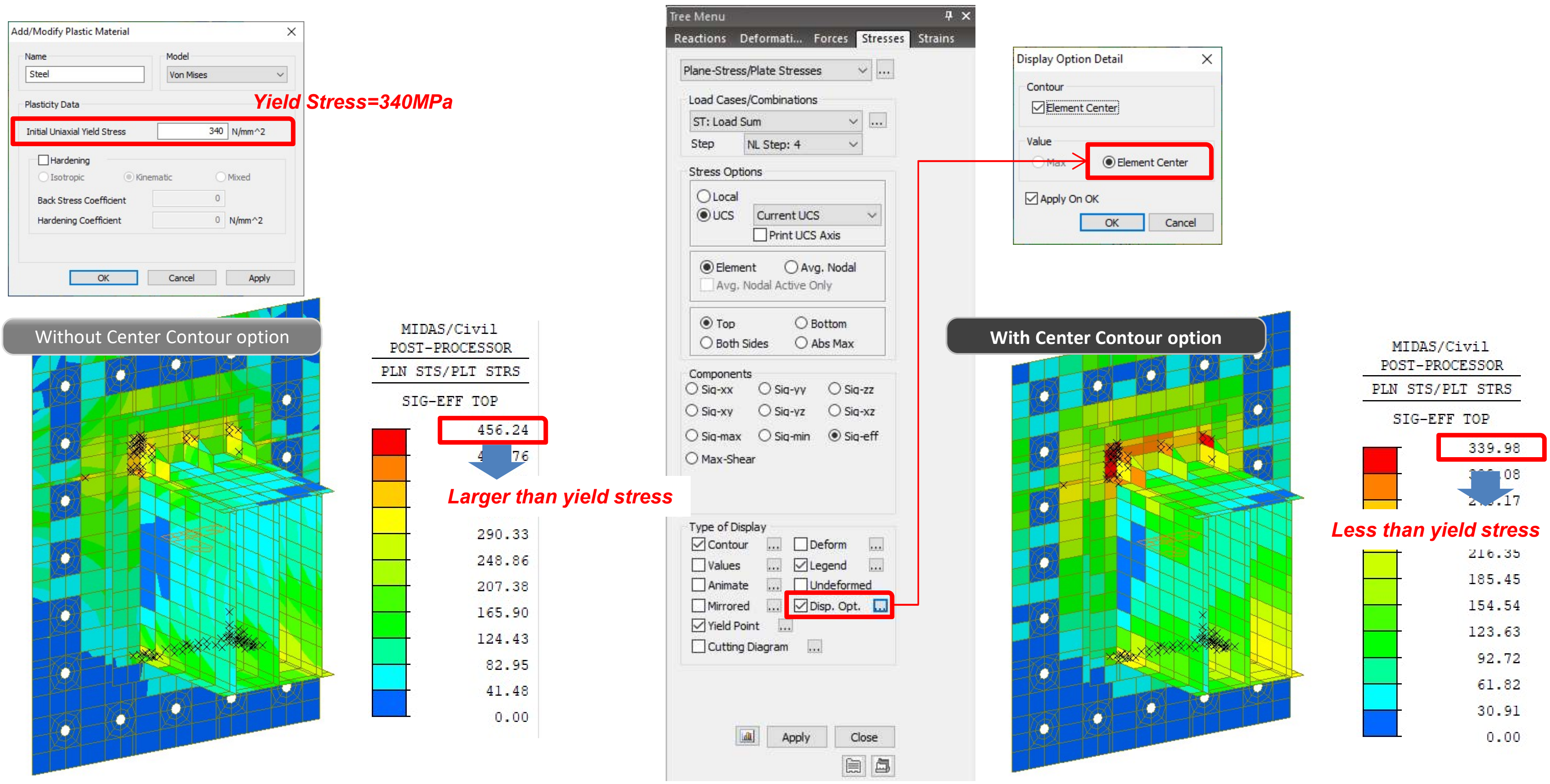


Spring Strength [kN]
= Section Width [m] × Element Length [m] × PHU [kN/m²]

10. Force/Stress contouring based on center value of plate elements

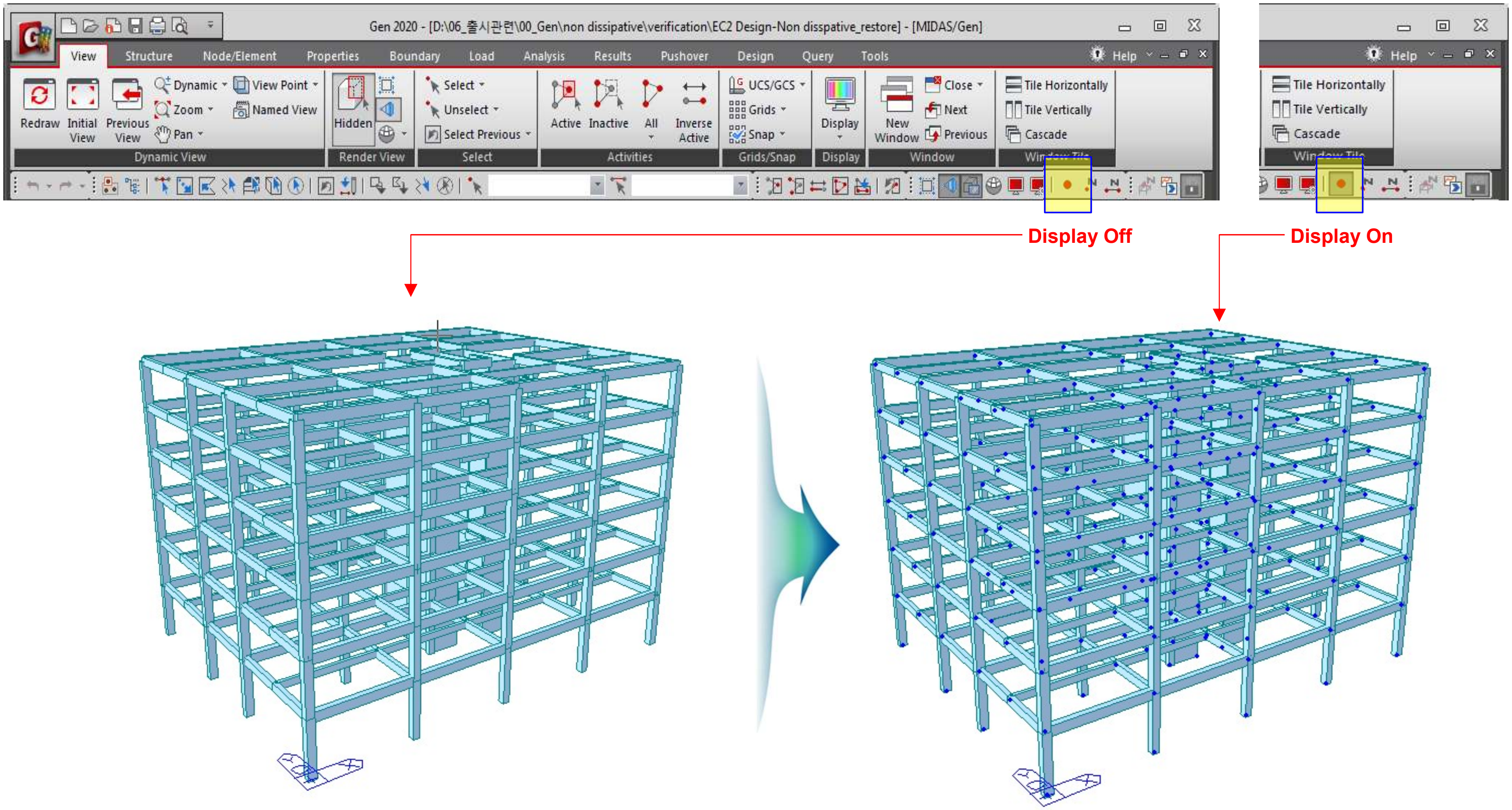
- Stresses at the node are determined by the linear interpolation of Gauss points, which often leads to stress exceeding yield stress in the material nonlinear analysis.
- Plate stress contour can now be displayed using the value at the element center instead of element nodes. The center values will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

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



11. Added "Node" icon in tool bar

Quick display on/off for Node



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1. Added moment bolt connection as per AISC

Supporting AISC-URFD05(M) / AISC-URFD10(M) / AISC-URFD16(M)