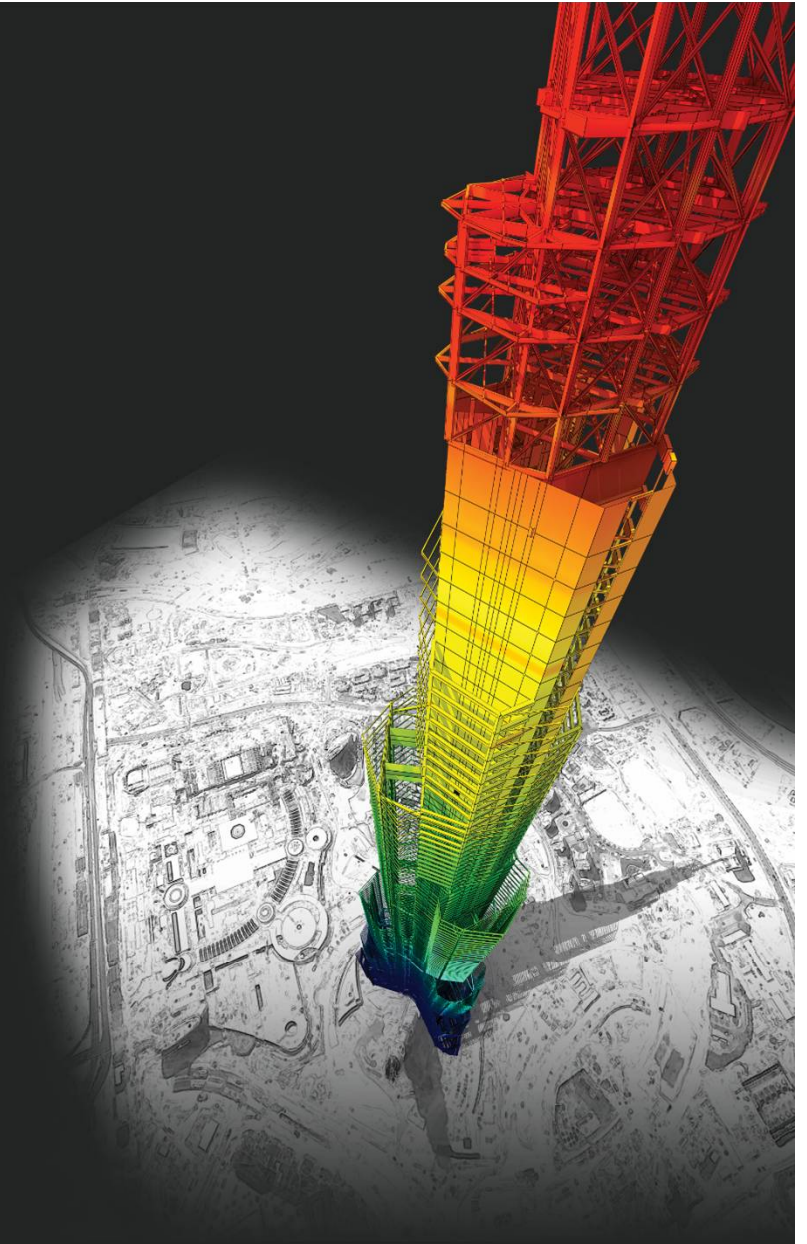


Release Note

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**

1) Non-Dissipative Element Design as per NTC2018	4
2) Enhancement of Stability coefficient table as per NTC 2018	9
3) Added Spectrum as per NTC 2018 in Static seismic load & Response Spectrum	10
4) Added user input for "qo" in RC design setting as per EC2	11
5) Added "Update Rebar Option" in shell/slab/wall design	12
6) Improvement of graphic report for column design	13
7) Specify Moment-Rotation Hinge Properties with multi curve	14
8) Added name box in thickness properties.	15
9) Bilinear type spring stiffness for surface spring support	16
10) Force/Stress contouring based on center value of plate elements	17
11) Added "Node" icon in tool bar	18

- **midas Design+**

1) Added moment bolt connection as per AISC	20
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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

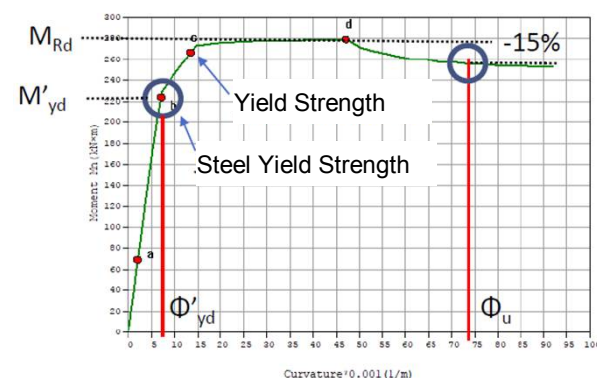
Le costruzioni soggette all'azione sismica, non dotate di appositi dispositivi d'isolamento e/o dissipativi, devono essere progettate in accordo con uno dei seguenti comportamenti strutturali:

- 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)

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

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:

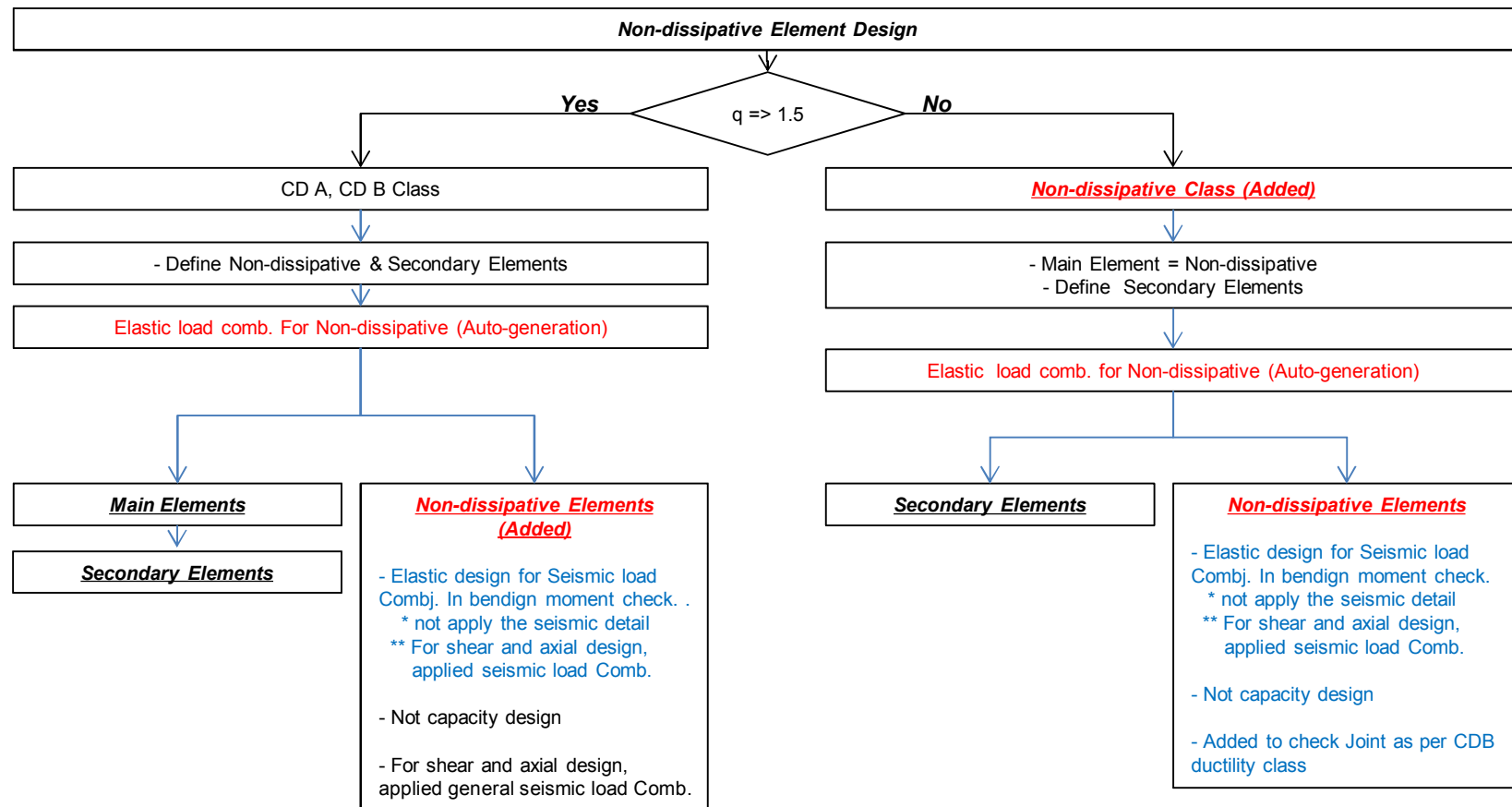
- a) non dissipative structural behavior,
- or
- b) dissipative structural behavior.

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

Material Data

General
Material ID: 3 Name: C30/37

Elasticity Data
Type of Design: Concrete
Steel Standard: DB
Product: EN04(RC)
Concrete Standard: DB
Code: C30/37

Type of Material
☒ Isotropic ☐ Orthotropic

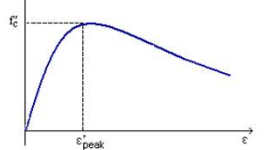
Plasticity Data
Plastic Material Name: NONE

Inelastic Material Properties for Fiber Model
Concrete: com Rebar: rebar

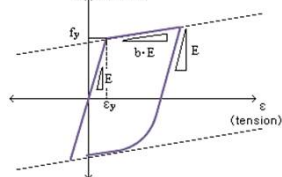
Thermal Transfer
Specific Heat: 0 J/mm-hr-°F
Heat Conduction: 0 J/mm-hr-°F
Damping Ratio: 0.05

OK Cancel Apply

stress (compression)



σ_x (tension)



Create seismic load for NDED

Spectrum Load Case

Load Case Name: Rx_elastic design
Direction: X-Y

☐ Auto-Search Angle
☒ Major ☐ Ortho

Excitation Angle: 0 [deg]
Scale Factor: 1
Period Modification Factor: 1

Modal Combination Control

Spectrum Functions
Function Name: [Sampling Method]
☒ NTC2018 H-DESIGN (0.05)

☐ Apply Damping Method
Damping Method: ...

☐ Correction by Damping Ratio

Interpolation of Spectral Data

Generate load combination for NDED

Automatic Generation of Load Combinations

Option
☒ Add ☐ Replace

Code Selection
☐ Steel ☒ Concrete ☐ SRC
☐ Cold Formed Steel ☐ Footing
☐ Aluminum

Design Code: Eurocode2:04
National Annex: Italy

Scale Up of Response Spectrum Load Cases
Scale Up Factor: 1 Rx_elastic de

Factor Load Case
Add Modify Delete

☐ Consider Interference Load

Generate Additional Load Combinations
☒ for Non-Dissipative

OK Cancel

Design Setting for NDED

Concrete Design Code

Design Code: Eurocode2:04

National Annex: Italy
☒ Apply NTC NTC2018

☒ Apply Special Provisions for Seismic Design

Strut Angle for Shear Resistance: 45 Deg
Effective Creep Ratio (Phi_ef): 2.143

Slenderness Limit
Lambda_lim = 25/sqrt(n)
Where, n = N_Ed/(A_c*f_cd)

☒ Beam-Column Joint Design Gamma_rd: 1.1

Strong Column Weak Beam
SUM(M_Rc) > 1.3 * SUM(M_Rb)
☐ Consider strong column-weak beam on last floor

Select Ductility Class
☐ CD'A' (High Ductility) ☐ Non-Dissipative (Low Ductility)
☒ CD'B' (Medium Ductility)

Non-Dissipative Element Non Diss.
Secondary Seismic Element None

Beam 1.2 Column 1.3 Wall 1.2

Friction Coefficient for Wall Sliding: 0.6

☐ Torsion Design

Moment Redistribution Factor for Beam: 1

Consider Shear Strength of Concrete for Checking
☒ Wall ☒ Column/Brace ☒ Beam

OK Close

1. Non-dissipative element design as per NTC2018

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

Define Inelastic material model

Material Data

General

Material ID : 3 Name : C30/37

Elasto Data

Type of Design : Concrete

Steel

Standard : DB

Product : DB

Concrete

Standard : EN4(RC)

Code : DB

Type of Material : ☒ Isotropic ☐ Orthotropic

Plasticity Data

Plastic Material Name : NONE

Inelastic Material Properties for Fiber Model

Concrete : con Rebar : rebar

Thermal Transfer

Specific Heat : 0 J/mm³·°C [F]

Heat Conduction : 0.05

Damping Ratio : 0.05

OK Cancel Apply

Concrete

stress (compression)

ϵ_{peak}

ϵ

Rebar

σ (tension)

ϵ_y

ϵ (tension)

Create seismic load for NDED

2

Name : Ex_ND

Type : Earthquake for Elastic (EE)

Add Modify Delete

Description :

No	Name	Type	Description
1	DL	Dead Load (D)	
2	LL	Live Load (L)	
3	Ex	Earthquake (E)	
4	Ey	Earthquake (E)	
5	Ex_ND	Earthquake for Elastic (EE)	
6	Ey_ND	Earthquake for Elastic (EE)	

3

Load Case Name : Ex_ND

Seismic Load Code : Eurocode-8(2004)

Recommended

Seismic Load Parameters

Ground Type : B

Spectrum Parameters

☒ Type1 ☐ Type2 ☐ User Defined

Soil Factor(S)	Tb	Tc	Td
1.2	0.15	0.5	2

Ref. Peak Ground Acc. (AgR) : 0.08 g

Behavior Factor (q) : 1.5

Lower Bound Factor (b) : 0.2

Importance Factor (I) : 1

Generate load combination for NDED

Automatic Generation of Load Combinations

Option

☒ Add ☐ Replace

Code Selection

☐ Steel ☒ Concrete ☐ SRC

☐ Cold Formed Steel ☐ Footing

☐ Aluminum

Design Code : Eurocode2:04

National Annex : Italy

Scale Up of Response Spectrum Load Cases

Factor : 1 Rx_elastic de

Add Modify Delete

4

Generate Additional Load Combinations

☒ for Non-Dissipative

OK Cancel

Description	LoadCase	Factor
DL + 1.0(0.3L) + 1.0(E)	Rx_elastic design(NRS)	0.3000
DL + 1.0(0.3L) + 1.0(E)	DL(ST)	1.0000
DL + 1.0(0.3L) + 1.0(E)	DL(NRS)	1.0000
SERV. 1.0 + (1.0LL) +	Ry_elastic design(NRS)	1.0000
SERV. 1.0 + (1.0LL) +	Rx_elastic design(NRS)	1.0000
SERV. 1.0 + (1.0LL) +	Ry_elastic design(NRS)	1.0000
SERV. 1.0 + (1.0LL) +	cLCB2(CBC)	1.30 + 1.5(1.0LL) + 1.5(0.6)WX
SERV. 1.0 + (1.0LL) +	cLCB3(CBC)	1.30 + 1.5(1.0LL) + 1.5(0.6)WY
SERV. 1.0 + (1.0LL) +	cLCB4(CBC)	1.30 + 1.5(0.7LL) + 1.5WX
SERV. 1.0 + (1.0LL) +	cLCB5(CBC)	1.30 + 1.5(0.7LL) + 1.5WY
SERV. 1.0 + (1.0LL) +	cLCB6(CBC)	1.30 + 1.5(1.0LL) + 1.5(0.6)WX
SERV. 1.0 + (1.0LL) +	cLCB7(CBC)	1.30 + 1.5(1.0LL) + 1.5(0.6)WY
SERV. 1.0 + (1.0LL) +	cLCB8(CBC)	1.30 + 1.5(0.7LL) + 1.5WX
SERV. 1.0 + (1.0LL) +	cLCB9(CBC)	1.30 + 1.5(0.7LL) + 1.5WY
SERV. 1.0 + (1.0LL) +	cLCB10(CBC)	1.00 + 1.0(0.3L) + 1.0EX
SERV. 1.0 + (1.0LL) +	cLCB11(CBC)	1.00 + 1.0(0.3L) + 1.0EY
SERV. 1.0 + (1.0LL) +	cLCB12(CBC)	1.00 + 1.0(0.3L) + 1.0EX
SERV. 1.0 + (1.0LL) +	cLCB13(CBC)	1.00 + 1.0(0.3L) + 1.0EY

Design Setting for NDED

Concrete Design Code

Design Code : Eurocode2:04

National Annex : Italy

☒ Apply NTC NTC2018

☒ Apply Special Provisions for Seismic Design

Strut Angle for Shear Resistance : 45 Deg

Effective Creep Ratio (Phi_e) : 2.143

Slenderness Limit

Lambda_lim = 25/sqrt(n)

Where, n = N_Ed/(Ac*fcd)

☒ Beam-Column Joint Design Gamma_rd 1.1

Strong Column Weak Beam

SUM(M_Rc) > 1.3 * SUM(M_Rb)

☐ Consider strong column-weak beam on last floor

Select Ductility Class

☐ CD'A' (High Ductility) ☐ Non-Dissipative (Low Ductility)

☒ CD'B' (Medium Ductility)

Non-Dissipative Element : Non Diss.

Secondary Seismic Element : None

5

Beam 1.2 Column 1.3 Wall 1.2

Friction Coefficient for Wall Sliding : 0.6

☐ Torsion Design

Moment Redistribution Factor for Beam : 1

Consider Shear Strength of Concrete for Checking

☒ Wall ☒ Column/Brace ☒ Beam

OK Close

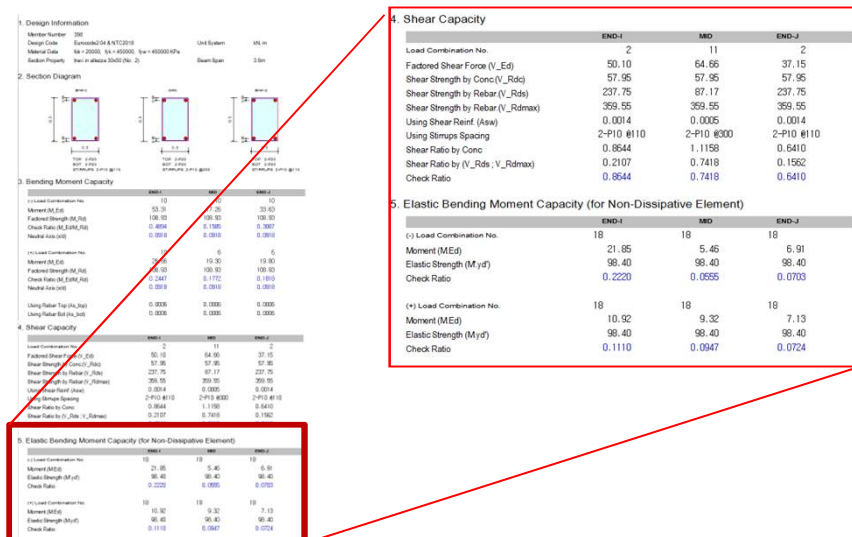
1. Non-dissipative element design as per NTC2018

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

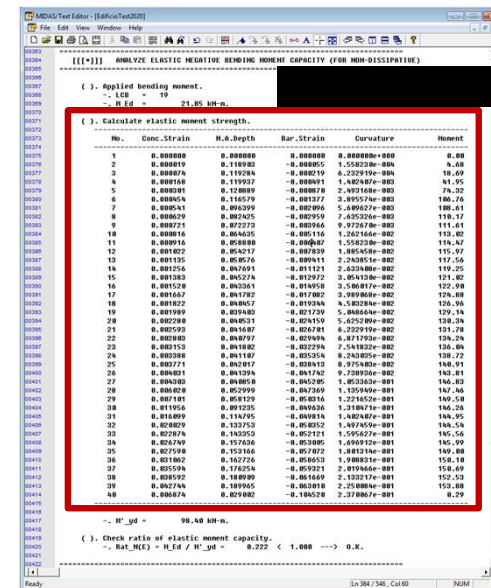
Design Result Table

Eurocode2:04 RC-Beam Checking Result Dialog																																		
Code : Eurocode2:04,NTC2018 Unit : kN , m Primary Sorting Option																																		
Sorted by <input type="radio"/> Member Results <input checked="" type="radio"/> Strength <input type="radio"/> SECT <input checked="" type="radio"/> MEMB																																		
<input checked="" type="radio"/> Property <input type="radio"/> Serviceability																																		
MEMB		Section		fck	PO S	CHK	Rebar				Negative Moment Strength				Positive Moment Strength				Shear Strength					Elastic Moment Capacity										
SECT	SE L	Bc	Hc	fyk			AsTop	AsBot	N(-) M_Ed	LC B	x/d	N(-) M_Rd	Rat-N	P(+) M_Ed	LC B	x/d	P(+) M_Rd	Rat-P	V_Ed	LC B	V_RdC	V_RdS	Rat-Vc	Rat-Vs	Rat-V	Seis. Class	N(-) M_Ed	LC B	N(-) M'_yd	Rat-N	P(+) M_Ed	LC B	P(+) M'_yd	Rat-P
Span		bf	hf	fyw																														
0	I	travi in altezza		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



Detail Report



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:

$$\theta = \frac{P \cdot d_{ER}}{V \cdot h} \quad [7.3.3]$$

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 $1/(1-\theta)$, 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

Add/Modify Seismic Load Specification

Load Case Name :

Seismic Load Code :

Structural Parameters

Fundamental Period : X-Dir. Y-Dir.

Seismic Load Direction Factor (Scale Factor)

X-Direction : Y-Direction :

Accidental Eccentricity

X-Direction (Ex) : ☒ Positive ☐ Negative ☐ None

Y-Direction (Ey) : ☒ Positive ☐ Negative ☐ None

Torsional Amplification

☐ Accidental Eccentricity ☐ Inherent Eccentricity

Additional Seismic Loads (Unit:N,mm)

Story	Add.-X	Add.-Y	Add.-RZ
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Seismic Load Profile... OK Cancel Apply

Response Spectrum

Generate Design Spectrum

Design Spectrum :

Max. Period : (Sec)

OK Cancel

Add/Modify/Show Response Spectrum Functions

Function Name :

Spectral Data Type : ☒ Normalized Accel.

Scaling : ☒ Scale Factor ☐ Maximum Value

Import File Design Spectrum

	Period (sec)	Spectral Data (g)
1	0.0000	0.0960
2	0.0250	0.0931
3	0.0500	0.0903
4	0.0750	0.0874
5	0.1000	0.0846
6	0.1250	0.0817
7	0.1399	0.0800
8	0.1500	0.0800
9	0.1750	0.0800
10	0.2000	0.0800
11	0.2250	0.0800
12	0.2500	0.0800
13	0.2750	0.0800
14	0.3000	0.0800

Spectral Data

Period (sec)

Description : NTC2018 H-DGN: G=B,S=1.20,Tb=0.14,Tc=0.42,Td=1.63,ag=0.08g,Fo=2.5,Tc*=0.30,q=3.00

OK Cancel Apply

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

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

Concrete Design Code

Design Code : Eurocode2:04

National Annex : Italy

☒ Apply NTC NTC2018

☒ Apply Special Provisions for Seismic Design

Strut Angle for Shear Resistance : 45 Deg

Effective Creep Ratio (Phi_ef) : 2.143

Slenderness Limit

$\Lambda_{lim} = 25/\sqrt{n}$

Where, $n = N_{Ed}/(A_c \cdot f_{cd})$

☒ Beam-Column Joint Design Gamma_rd 1.1

Strong Column Weak Beam

SUM(M_Rc) > 1.3 * SUM(M_Rb)

☐ Consider strong column-weak beam on last floor

Select Ductility Class

☐ CD'A' (High Ductility) ☐ Non-Dissipative (Low Ductility)

☒ CD'B' (Medium Ductility)

Non-Dissipative Element Non Diss. ...

Secondary Seismic Element None ...

Shear Force for Design (Gamma_rd)

Beam 1.2 Column 1.3 Wall 1.2

Friction Coefficient for Wall Sliding : 0.6

☐ Torsion Design

Moment Redistribution Factor for Beam : 1

Consider Shear Strength of Concrete for Checking

☒ Wall ☒ Column/Brace ☒ Beam

OK Close

EC8:04 Capacity Design

Structure Information

Structure Type : Frame System

Behavior Factor (q)

☐ Calculate by Program

Alpha_u / Alpha_1 : 1.1

☒ User Input

q 1.5 qo 4.5

Elastic Response Spectrum

Default By Function None

Spectrum Parameters

Soil Factor (S)	Tb	Tc	Td
1.2	0.15	0.5	2

Ref. Reak Ground Acc. (AgR) : 0.08 g

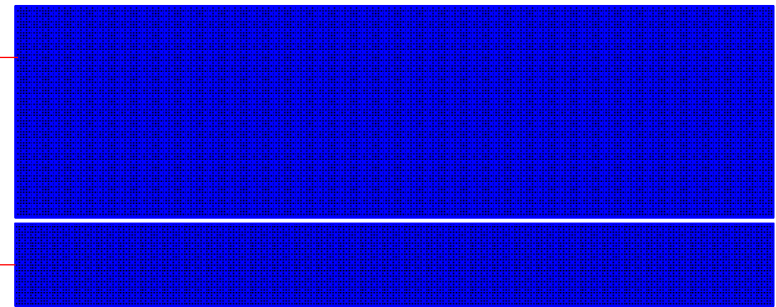
Importance Factor(I) : 1

Viscous Damping Ratio (xi) : 5 %

OK Cancel

Eurocod 08. Table 5.1

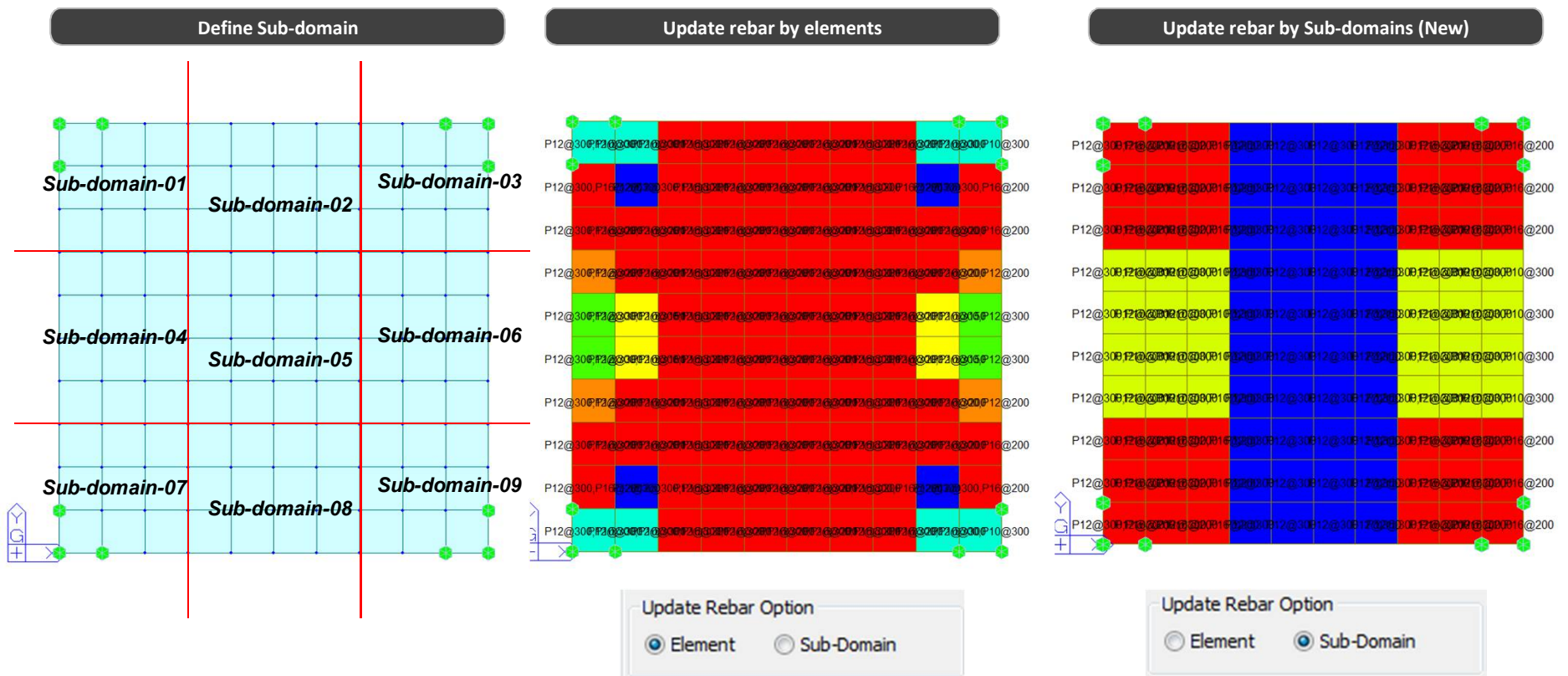
$$q = q_o k_w \geq 1,5$$



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

- Update rebar arrangement by sub-domain & by elements

Added methods to input rebar information



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
Design Shear Strength
Shear Ratio
Joint Shear Ratio

V_u = 198.243 kN (Load Combination : 16)
 $\phi V_c + \phi V_s$ = 276.331 + 842.734 = 1119.06 kN (A_s-H_{req} = 0.00053 m²/m, 2-P10 @30)
 $V_u / \phi V_n$ = 0.177 < 1.000 O.K
 $V_{hj} / \phi V_{nj}$ = 0.00000 / 0.00000 = 0.000 < 1.000 O.K

6. Shear Force Capacity Check (Middle)

Applied Shear Force
Design Shear Strength
Shear Ratio

V_u = 198.243 kN (Load Combination : 16)
 $\phi V_c + \phi V_s$ = 277.275 + 210.684 = 487.959 kN (A_s-H_{req} = 0.00053 m²/m, 2-P10 @120)
 $V_u / \phi V_n$ = 0.406 < 1.000 O.K

Midas Gen 2020 v1.1

3. Design for Shear

[END]

Applied Shear Force (V_{Ed})
Shear Ratio (V_{Ed} / V_{Rdc})
Shear Ratio (V_{Ed} / V_{Rds})
Shear Ratio (V_{Ed} / V_{Rdmax})
Shear Ratio
 $A_{sw-H_{req}}$

y : 3 (I)

39639.6 N
 39639.6 / 438445 = 0.090
 39639.6 / 837475 = 0.047
 39639.6 / 1716750 = 0.023
 0.090 < 1.000 O.K
 0.00393 mm²/m, 2-P10 @40

z : 9 (I)

35434.7 N
 35434.7 / 437307 = 0.081
 35434.7 / 991141 = 0.036
 35434.7 / 1741500 = 0.020
 0.081 < 1.000 O.K
 0.00393 mm²/m, 2-P10 @40

[MIDDLE]

Applied Shear Force (V_{Ed})
Shear Ratio (V_{Ed} / V_{Rdc})
Shear Ratio (V_{Ed} / V_{Rds})
Shear Ratio (V_{Ed} / V_{Rdmax})
Shear Ratio
 $A_{sw-H_{req}}$

y : 10 (1/2)

472545 N
 472545 / 414399 = 1.140
 472545 / 478557 = 0.987
 472545 / 1716750 = 0.275
 0.987 < 1.000 O.K
 0.00222 mm²/m, 2-P10 @70

z : 10 (1/2)

559460 N
 559460 / 412915 = 1.355
 559460 / 566366 = 0.988
 559460 / 1741500 = 0.321
 0.988 < 1.000 O.K
 0.00222 mm²/m, 2-P10 @70

[JOINT]

V_{jhd} / V_{js}
Joint Ratio
 $A_{sh,jnt}$

y : (I)

0.00000 / 0.00000 = 0.000
 0.000 < 1.000 O.K
 0.00000 mm², Not Use

z : (I)

0.00000 / 0.00000 = 0.000
 0.000 < 1.000 O.K
 0.00000 mm², 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

Add/Modify Pushover Hinge Properties

Name: BEAM Description:

Element Type: ☒ Beam/Column ☐ Wall

Material Type: ☒ RC / SRC (encased) ☐ Steel / SRC (filled) ☐ Masonry

Wall Type: ☐ Membrane ☐ Plate

Definition: ☒ Moment - Rotation (M- θ) ☐ Moment - Curvature (M- ϕ Lumped) ☐ Moment - Curvature (M- ϕ Distributed)

Hinge Type: ☒ Skeleton Model ☐ Fiber Model

Axial-Moment Interaction Type: ☐ None ☐ P-M Interaction ☒ P-M-M in Status Determination

Axial-Shear Interaction Type of RC: ☒ None ☐ P-Q Interaction

Fiber Section: ☐ Auto Generation ☒ User Defined

Section:

Fiber Name:

Out-of-plane Nonlinearity of Fiber Wall

Component Properties

Component Hinge Location Skeleton Curve

☐ Fx I&J-end Trilinear Type

☐ Fy I&J-end Trilinear Type

☐ Fz I&J-end Trilinear Type

☐ Mx I&J-end Trilinear Type

☒ My I&J-end FEMA

☒ Mz I&J-end FEMA

RC or SRC encased Yield Surface Properties

Input Method: ☒ Auto ☐ User

Type (X-Y-Z):

Yield Strength:

Interaction Method: M-M

Interpolation Method: M-M

Shape of the 1st and 2nd Interaction Curves

Directional Properties of Pushover Hinge : GSD Import Type

Input Method: ☐ Auto-Calculation ☒ User Input

Shape of FEMA Curve: ☒ General Type ☐ Perfect Plastic Type

Strength Loss: ☒ Yes ☐ No

Type of I-End & J-End: ☐ Symmetric ☒ Asymmetric

Unloading Stiffness Type: ☒ Origin-Oriented

Total Strength Loss at Point E, -E: Yes

Properties of I-end | Properties of J-end

☒ Multi-Curve Define Axial Force

Axial Force (P): 0,000 kN

Type: ☐ Symmetric ☒ Asymmetric

☒ User Defined

	M/MY	D/DY
-E	-0,2	-15
-D	-0,2	-10,5
-C	-1	-10
-B	-1	-1
A	0	0
B	1	1
C	1	10
D	0,2	10,5
E	0,2	15

Yield Strength (MY): 0,001 0,001 kN-m

Yield Curvature (DY): ☐ User Defined

Initial Stiffness: ☒ Elastic Stiffness : EI

Unloading Stiffness Parameter

Exponent in Unloading Stiffness Calculation: 0,4

Pinching-Rule Factor (0 ≤ λ ≤ 1,0): 0,5

Acceptance Criteria (Current Deform./ Yield Deform.)

	(+)	(-)
Immediate Occupancy (IO)	2	6
Life Safety (LS)	6	6
Collapse Prevention (CP)	6	6

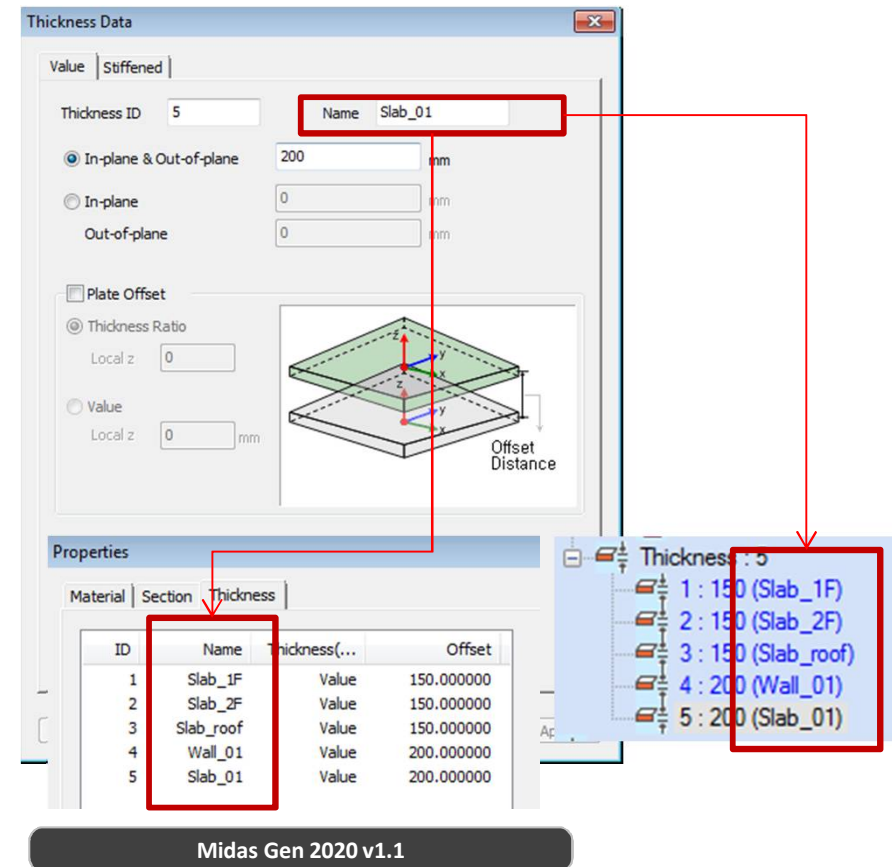
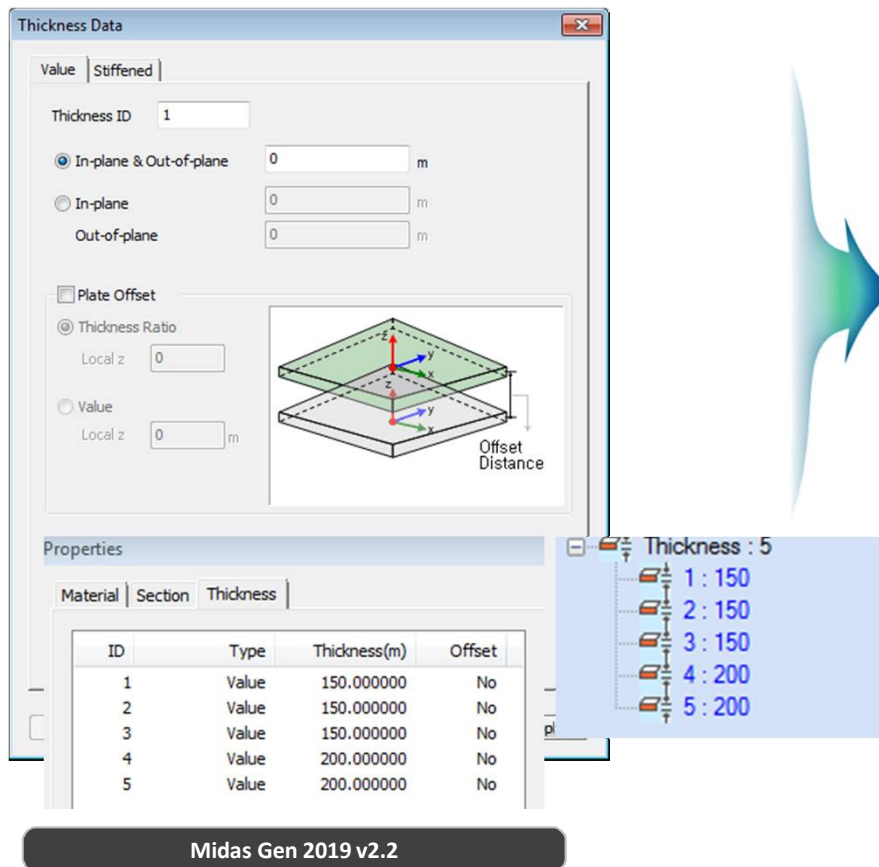
Primary Curve

OK Cancel

8. Added name box in thickness properties.

Usage classification for the same thickness

- **Properties > Section > Thickness**



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

Node Element Boundary Mass Load

Surface Spring Supports

Boundary Group Name
Default

Surface Spring
☒ Convert to Nodal Spring
☐ Point Spring
☐ Elastic Link
☐ Distributed Spring

$K = A_{eff} \times K_s$
 A_{eff} : Effective Area per Node
 K_s : Modulus of Subgrade Reaction

Element Type
Frame Face #1
Width : 0.6 m

Spring Type
Type : Multi-linear (Bi)

Modulus of Subgrade Reaction :
Node Local Axis (if defined)
Kx : 50000 kN/m³
Ky : 0 kN/m³
Kz : 0 kN/m³
PHU : 100 kN/m²
☐ Damping Constant / Area
Cx : 0 kN*sec/m³
Cy : 0 kN*sec/m³
Cz : 0 kN*sec/m³

Apply Close

Node Element Boundary Mass Load

Surface Spring Supports

Boundary Group Name
Default

Surface Spring
☒ Convert to Nodal Spring
☐ Point Spring
☒ Elastic Link
☐ Distributed Spring

$K = A_{eff} \times K_s$
 A_{eff} : Effective Area per Node
 K_s : Modulus of Subgrade Reaction

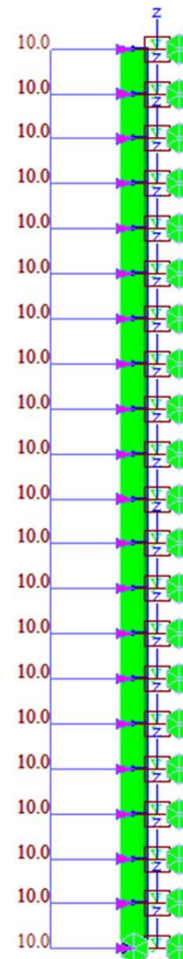
Element Type
Frame Face #1
Width : 0.6 m

Type : Multi-linear (Bi)
Direction : Normal(+)

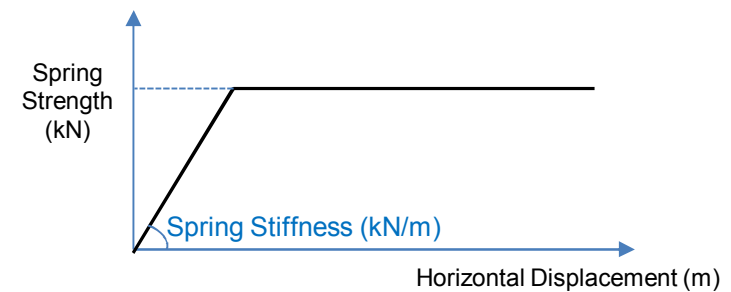
Modulus of Subgrade Reaction :
50000 kN/m³
Limit Strength :
100 kN/m²
Length of Elastic Link :
1 m

Apply Close

Surface Spring Support



Horizontal Soil Stiffness(kN)



$$\text{Spring Strength [kN]} = \text{Section Width [m]} \times \text{Element Length [m]} \times \text{PHU [kN/m}^2\text{]}$$

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

Add/Modify Plastic Material

Name: Steel Model: Von Mises

Plasticity Data

Initial Uniaxial Yield Stress: 340 N/mm²

Hardening: ☐ Isotropic ☒ Kinematic ☐ Mixed

Back Stress Coefficient: 0

Hardening Coefficient: 0 N/mm²

OK Cancel Apply

Yield Stress=340MPa

Tree Menu

Reactions Deformati... Forces Stresses Strains

Plane-Stress/Plate Stresses

Load Cases/Combinations: ST: Load Sum

Step: NL Step: 4

Stress Options

☐ Local ☒ UCS Current UCS

☐ Print UCS Axis

☒ Element ☐ Avg. Nodal

☐ Avg. Nodal Active Only

☒ Top ☐ Bottom

☐ Both Sides ☐ Abs Max

Components

☐ Sig-xx ☐ Sig-yy ☐ Sig-zz

☐ Sig-xy ☐ Sig-yz ☐ Sig-xz

☐ Sig-max ☐ Sig-min ☒ Sig-eff

☐ Max-Shear

Type of Display

☒ Contour ☐ Deform

☐ Values ☒ Legend

☐ Animate ☐ Undeformed

☐ Mirrored ☒ Disp. Opt.

☒ Yield Point

☐ Cutting Diagram

Apply Close

Display Option Detail

Contour

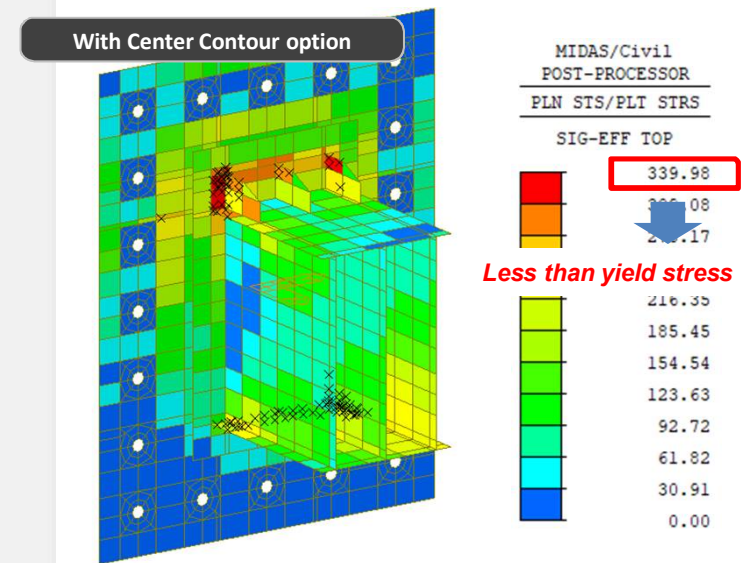
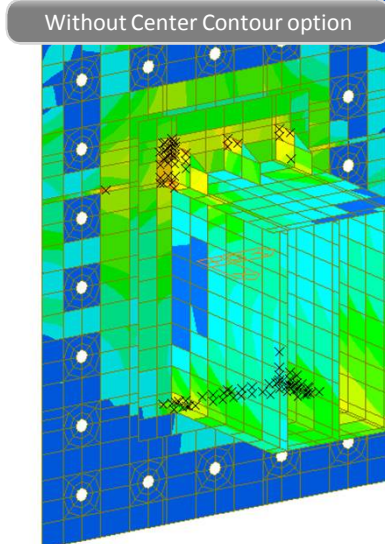
☒ Element Center

Value

☐ Max ☒ Element Center

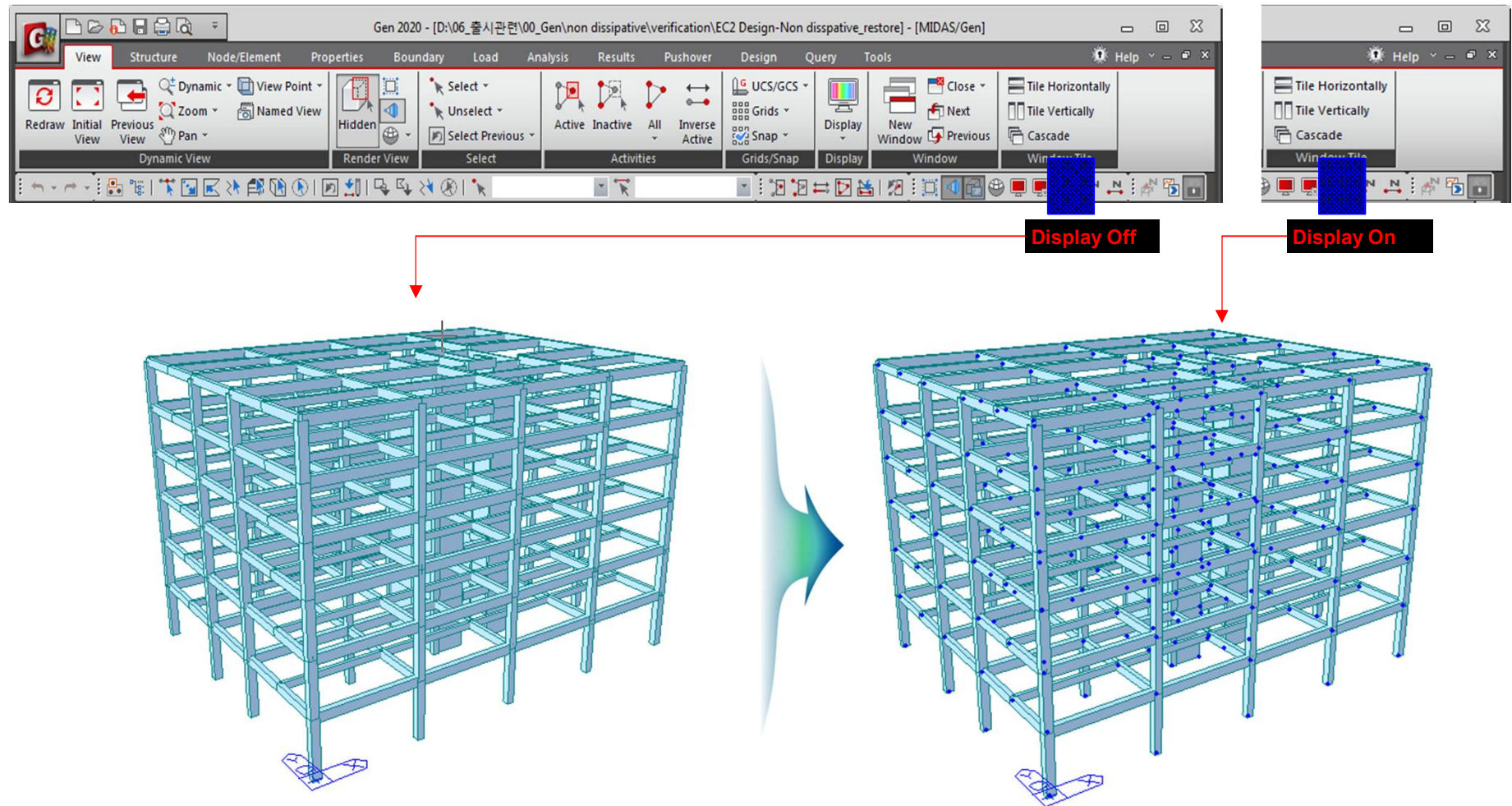
☒ Apply On OK

OK Cancel



11. Added "Node" icon in tool bar

Quick display on/off for Node



midas ***Design+***

1. Added moment bolt connection as per AISC

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

Auto-Generation of Detail/Summary Report

Auto-Generation of Drawing

MC01 (W24X55)

END PLATE 8 x 31 (A36)

BOLT (TOP) 4 - 3/4 (A325M)

BOLT (BOT.) 4 - 3/4 (A325M)

STIF. (TOP) -

STIF. (BOT.) -

1. Calculation Summary

(1) General requirement

Category	Value	Criteria	Ratio	Note
Required girder stiffener thickness (mm)	-	-	-	-
Required girder stiffener length (mm)	-	-	-	-
Width - thickness ratio of girder stiffener	-	-	-	-
No prying bolt moment strength (kN m)	0.000	420	0.000	

(2) End Plate

Category	Value	Criteria	Ratio	Note
Required end plate thickness (mm)	18.28	6.000	3.046	
Shear yielding strength of end plate (kN)	0.000	161	0.000	
Shear rupture strength of end plate (kN)	0.000	171	0.000	

(3) High Tension Bolt

Category	Value	Criteria	Ratio	Note
Shear rupture strength of compression bolts (kN)	0.000	283	0.000	
Bolt bearing / tear out failure of end plate (kN)	0.000	329	0.000	
Bolt bearing / tear out failure of column flange (kN)	0.000	1,625	0.000	

(4) Column Flange

Category	Value	Criteria	Ratio	Note
Required thickness of column flange for flexural yielding (mm)	33.27	11.82	0.355	

(5) Stiffener

Category	Value	Criteria	Ratio	Note
Strength of unstiffened column flange (kN)	0.000	4,721	0.000	
Local web yielding strength (kN)	0.000	1,569	0.000	
Web buckling strength (kN)	0.000	4,041	0.000	
Web crippling strength (kN)	0.000	2,996	0.000	

2. Calculate Design Forces

(1) Calculate the expected yield stress

- $F_y = 248 \text{ MPa}$
- $Z_x = 2,195,867 \text{ mm}^3$
- $M_{px} = 1.1 R_y F_y Z_x = 899 \text{ kN m}$

(2) Calculate the distance from the face of the column to the plastic hinge

- $d = 599 \text{ mm}$
- $b_f = 12.83 \text{ mm}$
- $L_p = \min (d/2, 3b_f) = 38.48 \text{ mm}$