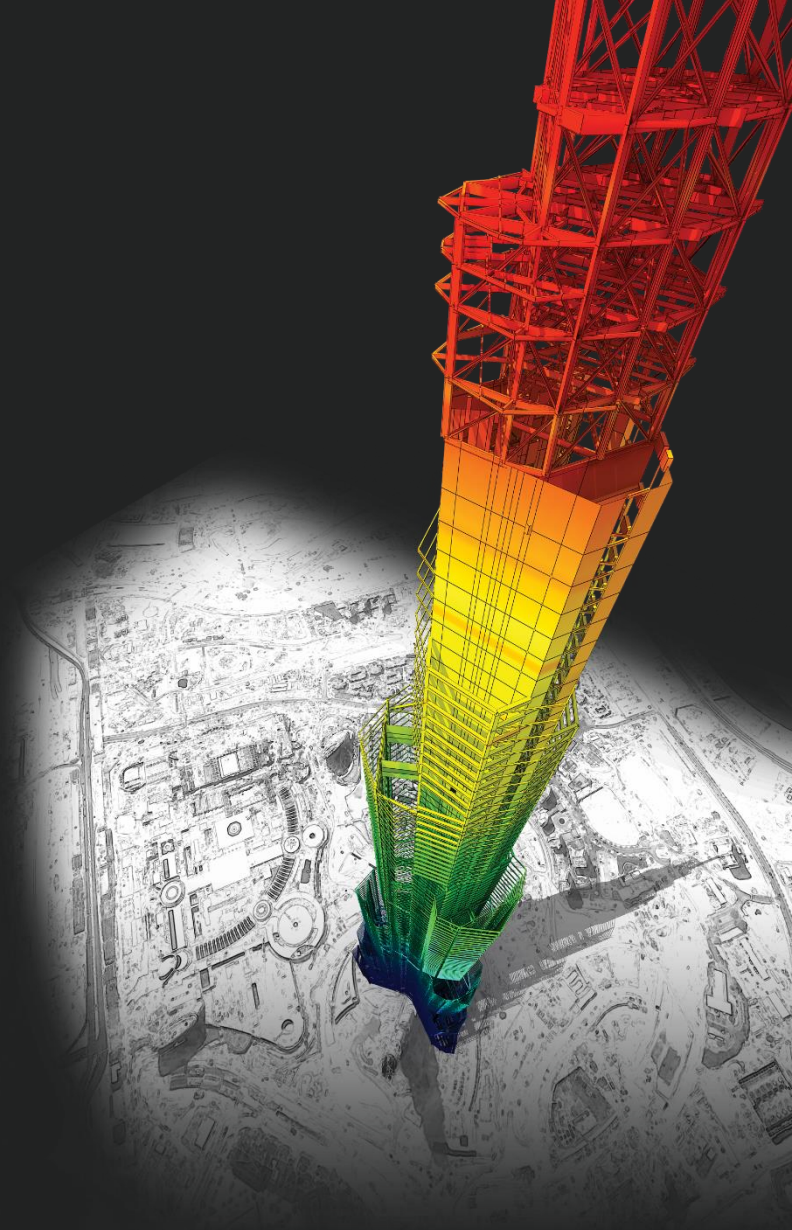


Release Note

Release Date : April. 2020

Product Ver. : midas Gen 2020 (v2.1) / Design+2020(v2.1)



DESIGN OF General Structures

Integrated Design System for Building and General Structures

Enhancements

• *midas Gen*

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• *midas Design+*

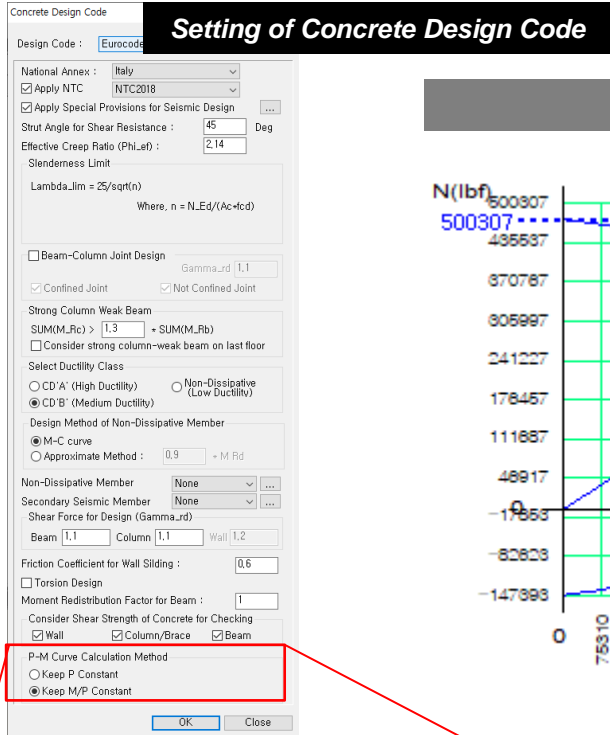
1) 新增鋼構耐震設計工具	30
2) 新增錨定螺栓設計模組	36

midas **Gen**

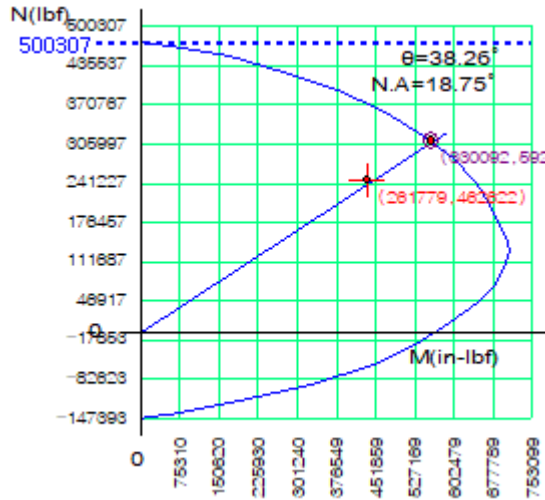
1. 優化RC柱構件設計功能

Add Design by Constant P

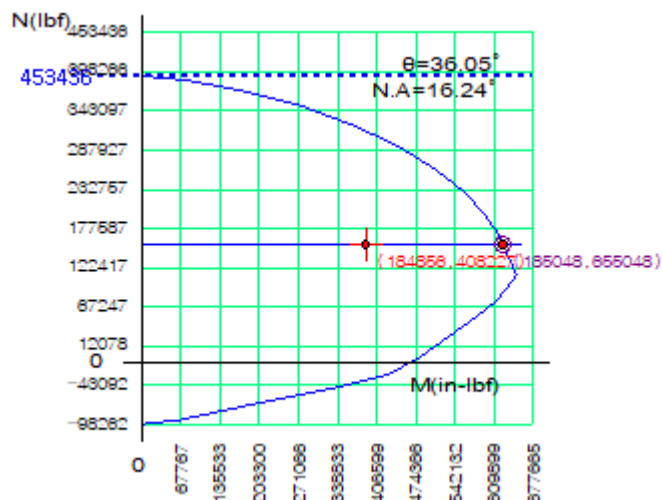
: KCI-USD12, ACI318-14, ACI318M-14, EN1992-1-1:2004, NTC 2018, TWN-USD100, NSR-10, IS456:2000



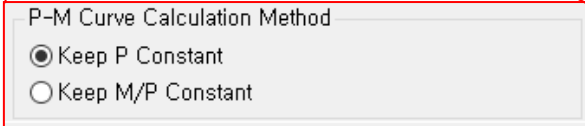
Keep M/P Constant



Keep Constant P (New)



Add Option



- Support seismic design by axial force(P) constant method.
- Apply axial force(P) constant method to all or individual columns, walls and braces

2. 優化歷時分析結果之能量圖顯示內容

Improvement of Energy Result Graph : Energy Percentage Result of all steps

Time History Energy Graph

Structure Energy Graph

Time History Energy Graph Select

- Dissipated Inelastic Energy (Eh) [Inelastic Hinge]
- Kinetic Energy (Ek)
- Elastic Strain Energy (Es)
- Damping Energy (Ed)
- Maxwell Damper Energy (Em) [Oil Damper]
- Velocity Dependent Device Energy (Ev) [Viscous | Viscoelastic Damper]
- Strain Dependent Device Energy (Et) [Elas. + Inel.][Steel | Hyst. Isolator]
- Isolator Device Energy (Eo)
- Plastic Strain Energy (Ep) [Plastic Material (Plate)]
- Input Energy (Ei)

Type of Display

- Cumulative Value Type
- Value Percentage

Time History Load Case

LD = 1 (DYNA)

Display Options

- No Fill Solid Fill

Percentage Text Result

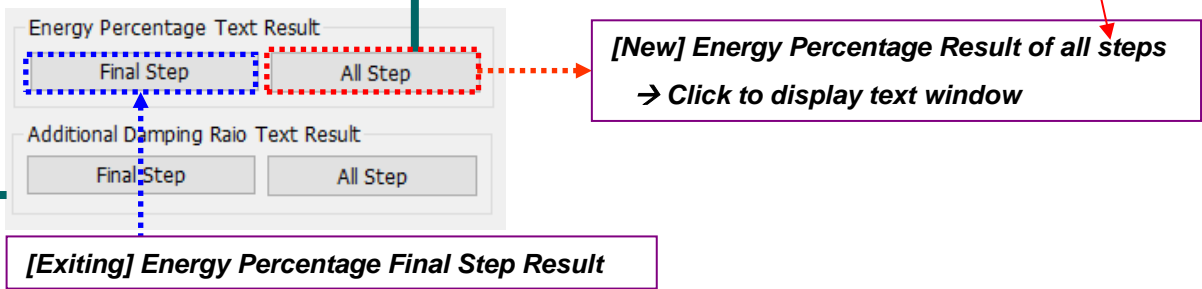
Apply Close

MIDAS/Text Editor - [ENERGY_PERCENT_ALL_STEP.F]

TIME HISTORY ANALYSIS | ENERGY RESULT PERCENTATE ; TIME HISTORY LOADCASE NO. = 1

Time (sec)	[1] Dissipated Inel. Energy (Eh)	[2] Kinetic Energy (Ek)	[3] Elastic Strain Energy (Es)	[4] Damping Energy (Ed)	[5] Maxwell Damper Energy (Em)	[6] Velocity Depen. Device Energy (Ev)	[7] Strain Depen. Device Energy (Et)	[8] Isolator Device Energy (Eo)	[9] Plastic Strain Energy (Ep)	[10] Input Energy (Ei)	[10] - Sum[1-9] Error (X)
0.010	0.000	98.727	0.236	0.606	0.002	0.000	0.248	0.178	0.000	100.000	0.000
0.020	0.000	98.037	0.403	0.818	0.004	0.000	0.427	0.309	0.000	100.000	0.000
0.030	0.000	97.042	0.658	1.073	0.006	0.000	0.706	0.512	0.000	100.000	0.000
0.040	0.000	95.852	0.978	1.321	0.010	0.000	1.062	0.775	0.000	100.000	0.000
0.050	0.000	94.529	1.345	1.545	0.015	0.000	1.477	1.085	0.000	100.000	0.000
0.060	0.000	93.090	1.750	1.751	0.020	0.000	1.945	1.441	0.000	100.000	0.000
0.070	0.000	91.521	2.194	1.945	0.026	0.000	2.467	1.844	0.000	100.000	0.000
0.080	0.000	89.826	2.673	2.128	0.033	0.000	3.040	2.297	0.000	100.000	0.000
0.090	0.000	88.048	3.174	2.294	0.041	0.000	3.650	2.790	0.000	100.000	0.000
0.100	0.000	86.218	3.685	2.442	0.051	0.000	4.283	3.318	0.000	100.000	0.000
0.110	0.000	84.365	4.199	2.575	0.061	0.000	4.932	3.875	0.000	100.000	0.000
0.120	0.000	82.484	4.707	2.691	0.073	0.000	5.595	4.456	0.000	100.000	0.000
0.130	0.000	80.581	5.198	2.791	0.087	0.000	6.229	5.051	0.000	100.000	0.000
0.140	0.000	78.657	5.663	2.875	0.102	0.000	6.848	5.652	0.000	100.000	0.000
0.150	0.000	77.159	6.094	2.945	0.118	0.000	7.432	6.249	0.000	100.000	0.000
0.160	0.000	75.568	6.485	3.002	0.136	0.000	7.972	6.835	0.000	100.000	0.000
0.170	0.000	74.100	6.832	3.048	0.155	0.000	8.461	7.402	0.000	100.000	0.000
0.180	0.000	72.759	7.132	3.086	0.177	0.000	8.891	7.943	0.000	100.000	0.000
0.190	0.000	71.588	7.382	3.115	0.200	0.000	9.260	8.453	0.000	100.000	0.000
0.200	0.000	70.567	7.581	3.141	0.225	0.000	9.561	8.922	0.000	100.000	0.000
0.210	0.000	69.714	7.729	3.162	0.253	0.000	9.794	9.346	0.000	100.000	0.000
0.220	0.000	68.929	7.828	3.182	0.283	0.000	9.959	9.719	0.000	100.000	0.000
0.230	0.000	68.510	7.876	3.202	0.315	0.000	10.058	10.058	0.000	100.000	0.000
0.240	0.000	68.154	7.878	3.224	0.349	0.000	10.094	10.298	0.000	100.000	0.000
0.250	0.000	67.952	7.838	3.243	0.386	0.000	10.072	10.500	0.000	100.000	0.000
0.260	0.000	67.896	7.760	3.277	0.426	0.000	9.998	10.641	0.000	100.000	0.000
0.270	0.000	67.973	7.648	3.311	0.468	0.000	9.877	10.722	0.000	100.000	0.000
0.280	0.000	68.171	7.505	3.350	0.513	0.000	9.716	10.743	0.000	100.000	0.000
0.290	0.000	68.475	7.336	3.395	0.561	0.000	9.523	10.707	0.000	100.000	0.000
0.300	0.000	68.871	7.146	3.448	0.611	0.000	9.304	10.618	0.000	100.000	0.000

Ready Ln 14 / 46 , Col 202 NUM



2. 優化歷時分析結果之能量圖顯示內容

Additional Damping Ratio of Energy Dissipation System is added.

Time History Energy Graph

Structure Energy Graph

Time History Energy Graph Select

- Dissipated Inelastic Energy (Eh) [Inelastic Hinge]
- Kinetic Energy (Ek)
- Elastic Strain Energy (Es)
- Damping Energy (Ed)
- Maxwell Damper Energy (Em) [Oil Damper]
- Velocity Dependent Device Energy (Ev) [Viscous | Viscoelastic Damper]
- Strain Dependent Device Energy (Et) [Elas. + Inel.][Steel | Hyst. Isolator]
- Isolator Device Energy (Eo)
- Plastic Strain Energy (Ep) [Plastic Material (Plate)]
- Input Energy (Ei)

Type of Display

- Cumulative Value Type
- Value Percentage

Time History Load Case

LD = 1 (DYNA)

Display Options

- No Fill Solid Fill

Percentage Text Result

Apply Close

MIDAS/Text Editor - [ADDITIONAL_DAMPING_RATIO_FINAL_STEP_F]

File Edit View Window Help

```

00001  TIME HISTORY ANALYSIS | ADDITIONAL DAMPING RATIO ; TIME HISTORY LOADCASE NO. = 1
00002  =====
00003  |
00004  |
00005  |
00006  |
00007  |
00008  |
00009  |
00010  |
00011  |
00012  |
00013  |
00014  |
00015  |
00016  |
00017  |
00018  |
00019  |
00020  |
00021  |
00022  |
    
```

Energy Graph		Additional Damping Ratio (%)
(1) Dissipated Inelastic Energy [Inelastic Hinge]	Eh	1.196
(2) Maxwell Damper Energy [Oil Damper]	Em	2.149
(3) Velocity Dependent Device Energy	Ev	0.000
(4) Strain Dependent Device [Steel Hyst. Isolator]	Et	2.959
(5) Isolator Device Energy	Eo	4.559
Total Dampoing Ratio		5.001

Ready Ln 21 / 21 , Col 10 CAP NUM

Energy Percentage Text Result

Final Step All Step

Additional Damping Ratio Text Result

Final Step All Step

[New] Additional Damping Ratio Result of final step

→ Click to display text window

2. 優化歷時分析結果之能量圖顯示內容

Additional Damping Ratio of Energy Dissipation System is added.

Time History Energy Graph

Structure Energy Graph

Time History Energy Graph Select

- Dissipated Inelastic Energy (Eh) [Inelastic Hinge]
- Kinetic Energy (Ek)
- Elastic Strain Energy (Es)
- Damping Energy (Ed)
- Maxwell Damper Energy (Em) [Oil Damper]
- Velocity Dependent Device Energy (Ev) [Viscous | Viscoelastic Damper]
- Strain Dependent Device Energy (Et) [Elas. + Inel.][Steel | Hyst. Isolator]
- Isolator Device Energy (Eo)
- Plastic Strain Energy (Ep) [Plastic Material (Plate)]
- Input Energy (Ei)

Type of Display

Cumulative Value Type

Value Percentage

Time History Load Case

LD = 1 (DYNA)

Display Options

No Fill Solid Fill

Percentage Text Result

Apply Close

MIDAS/Text Editor - [ADDITIONAL_DAMPING_RATIO_ALL_STEP]

TIME HISTORY ANALYSIS | ADDITIONAL DAMPING RATIO ; TIME HISTORY LOADCASE NO. = 1

Time (sec)	[Eh] Dissipated Inel. Energy Damping Ratio (%)	[Em] Maxwell Damper Energy Damping Ratio (%)	[Ev] Velocity Depen. Device Energy Damping Ratio (%)	[Et] Strain Depen. Device Energy Damping Ratio (%)	[Eo] Isolator Device Energy Damping Ratio (%)	[Ep] Plastic Strain Energy Damping Ratio (%)	Total Damping Damping Ratio (%)
0.010	0.00000	0.00240	0.00003	0.00240	0.00240	0.00000	100.00000
0.020	0.00000	0.00416	0.00002	0.00416	0.00416	0.00000	100.00000
0.030	0.00000	0.00694	0.00001	0.00694	0.00694	0.00000	100.00000
0.040	0.00000	0.01060	0.00001	0.01060	0.01060	0.00000	100.00000
0.050	0.00000	0.01503	0.00001	0.01503	0.01503	0.00000	100.00000
0.060	0.00000	0.02027	0.00000	0.02027	0.02027	0.00000	100.00000
0.070	0.00000	0.02643	0.00000	0.02643	0.02643	0.00000	100.00000
0.080	0.00000	0.03365	0.00000	0.03365	0.03365	0.00000	100.00000
0.090	0.00000	0.04195	0.00000	0.04195	0.04195	0.00000	100.00000
0.100	0.00000	0.05136	0.00000	0.05136	0.05136	0.00000	100.00000
0.110	0.00000	0.06199	0.00000	0.06199	0.06199	0.00000	100.00000
0.120	0.00000	0.07393	0.00000	0.07393	0.07393	0.00000	100.00000
0.130	0.00000	0.08726	0.00000	0.08726	0.08726	0.00000	100.00000
0.140	0.00000	0.10201	0.00000	0.10201	0.10201	0.00000	100.00000
0.150	0.00000	0.11827	0.00000	0.11827	0.11827	0.00000	100.00000
0.160	0.00000	0.13613	0.00000	0.13613	0.13613	0.00000	100.00000
0.170	0.00000	0.15571	0.00000	0.15571	0.15571	0.00000	100.00000
0.180	0.00000	0.17712	0.00000	0.17712	0.17712	0.00000	100.00000
0.190	0.00000	0.20045	0.00000	0.20045	0.20045	0.00000	100.00000
0.200	0.00000	0.22582	0.00000	0.22582	0.22582	0.00000	100.00000
0.210	0.00000	0.25331	0.00000	0.25331	0.25331	0.00000	100.00000
0.220	0.00000	0.28302	0.00000	0.28302	0.28302	0.00000	100.00000
0.230	0.00000	0.31507	0.00000	0.31507	0.31507	0.00000	100.00000

Energy Percentage Text Result

Final Step All Step

Additional Damping Ratio Text Result

Final Step All Step

[New] Energy Percentage Result of all steps
 → Click to display text window

3. 反力表格新增側推分析結果內容

Reaction table is provided for each step in pushover analysis.

The screenshot displays the 'Reaction Forces/Moments' dialog box on the left and the 'Records Activation Dialog' box in the center. The background shows a table of reaction forces for various steps.

#	Load	Step	FX (N)	FY (N)	FZ (N)	M (N-m)
1	PO-X(all)	po_0140	334881.358304	-1554840.85599	-4880873.10232	0.0
2	PO-X(all)	po_0140				
5	PO-X(all)	po_0140				
6	PO-X(all)	po_0140				
7	PO-X(all)	po_0140				
8	PO-X(all)	po_0140				
9	PO-X(all)	po_0140				
10	PO-X(all)	po_0140				
11	PO-X(all)	po_0140				
12	PO-X(all)	po_0140				
13	PO-X(all)	po_0140				
14	PO-X(all)	po_0140				
15	PO-X(all)	po_0140				
16	PO-X(all)	po_0140				
17	PO-X(all)	po_0140				
18	PO-X(all)	po_0140				
19	PO-X(all)	po_0140				
20	PO-X(all)	po_0140				
21	PO-X(all)	po_0140				
22	PO-X(all)	po_0140				
23	PO-X(all)	po_0140				
24	PO-X(all)	po_0140				
25	PO-X(all)	po_0140				
26	PO-X(all)	po_0140				
27	PO-X(all)	po_0140	-761741.962003	297560.345405	371117.766236	0.0
28	PO-X(all)	po_0140	-378013.330894	316478.525536	-151551.510801	0.0
29	PO-X(all)	po_0140	-247941.260380	2097.558199	430720.532647	0.0
30	PO-X(all)	po_0140	-118245.235881	65575.593188	-120178.442764	0.0
31	PO-X(all)	po_0140	-233357.266245	356154.463707	608703.794247	0.0
32	PO-X(all)	po_0140	8983.656902	384491.752882	-175947.504963	0.0
45	PO-X(all)	po_0140	465795.493556	51716.628791	164905.869632	0.0
46	PO-X(all)	po_0140	437153.102811	83820.034923	-156045.856362	0.0
47	PO-X(all)	po_0140	458257.789619	123466.170823	-100660.381189	0.0
48	PO-X(all)	po_0140	423457.694260	152996.515659	-145067.406933	0.0
49	PO-X(all)	po_0140	436738.166864	194700.383591	-151945.013462	0.0
50	PO-X(all)	po_0140	397893.204894	218742.613305	-189714.180162	0.0
51	PO-X(all)	po_0140	406184.377674	260194.829149	-195658.423983	0.0
52	PO-X(all)	po_0140	364872.604321	278137.967434	-233734.197300	0.0
53	PO-X(all)	po_0140	368834.533468	318355.582790	-239336.641907	0.0

Step 1. Open Records Activation Dialog box.

Step 2. Select Load case for pushover.

Step 3. Select Pushover step.

Step 4. Printout Reaction table

4. 優化非彈性歷時分析結果之呈現方式

- *Properties > Inelastic Properties > Inel. Control Data > Select Inelastic Hinge Result Output(Element/General Link)*
- *Load > Dynamic Loads > Time History Analysis Data > Global Control*

Select the element to print

- Press 'Add/Replace' button after selecting element on model view

Element	Hinge Properties	Fiber
B1	COLUMN	0
B2	COLUMN	0
B3	COLUMN	0
B4	COLUMN	0
B5	COLUMN	0

Select General Link to print

- Press 'Add' button after selecting GL-Link

Global Control Setting

- Set to output selected elements

Inelastic Hinge Status Result

- Check result of selected elements

- **Elements and General Links can be filtered for the output of inelastic time history analysis.**
- **Analysis time can be much reduced by selecting only the desired elements/general links.**

4. 優化非彈性歷時分析結果之呈現方式

Global Control Setting

- Set to Max/Min Result Only

Nonlinear Analysis Result Output Option

Inelastic Hinge : All each Step Output Option

All Inelastic Elements
(*, Very Long Time Required)

Selected Elements in Hinge Result Output
(*, Recommended)

No Step-by-Step Results
(*, Max/Min Result Only : Hinge Result Table)

Fiber Section : All each Step Output Option

Common with Inelastic Results Option

All Inelastic Elements
(*, Not Recommended : Very Long Time Required)

Selected Elements in Hinge Result Output
(*, Recommended)

No Step-by-Step Results
(*, Max/Min Result Only : Fiber Result Table)



Inelastic Hinge Status Result

- Check Max/Min result output

Inelastic Hinge Status

Inelastic Hinge Status

Function

Time History Load Cases Name

DYNA

Step

All

Time Func

Max

Min

Type of Result

Hinge Status (Deform, Level)

Ductility Factor(D/D1)

Ductility Factor(D/D2)

Deformation

Force

Status of Yielding

Status of Yielding (FEMA)

Performance (FEMA)

Components

Fx Fy Fz

Mx My Mz

Type of Value

Positive Negative

Abs Max.

Type of Display

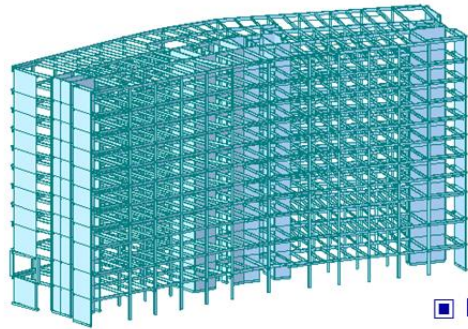
Contour Legend

Values Deform Undeformed

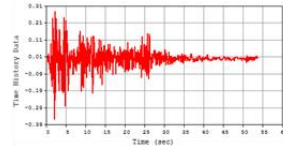
5. 優化非彈性歷時分析運算速度

- Reduction of analysis time by optimizing the inelastic time history analysis and improving the output algorithm for analysis results

3D Structure Hinge Model (12F)



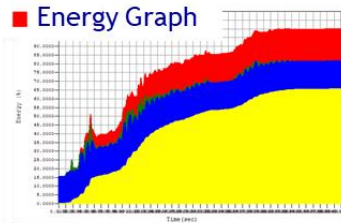
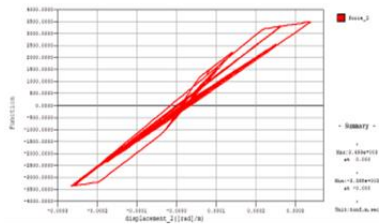
Dynamic Loading



Analysis End Time : 40 sec (4000 step)

Beam : 5,117 Element

Hinge Status : 4,050

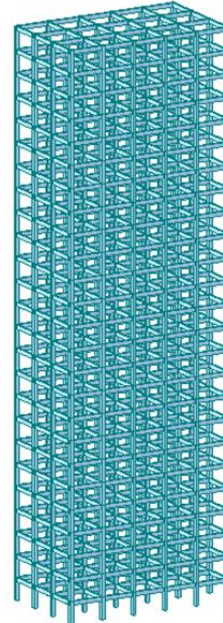


Total Analysis Time : Gen2020 v1.2 vs Gen2020 v2.1

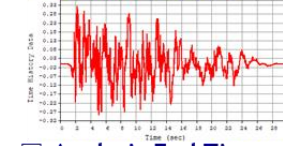


58% Time Save!!!

3D Fiber Wall Model (23F)



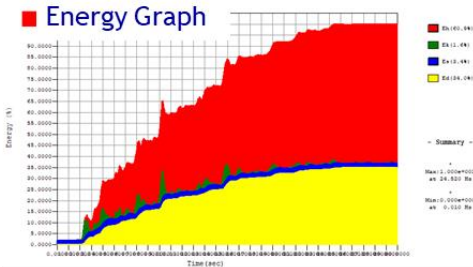
Dynamic Loading



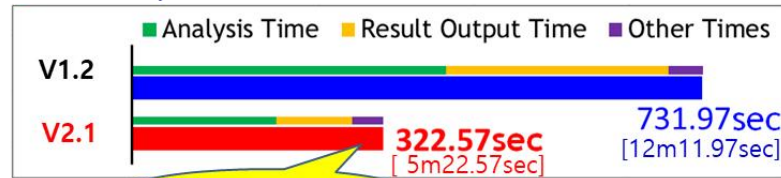
Analysis End Time : 30 sec (3000 step)

Beam : 1,550 Element

Hinge Status : 6,200



Total Analysis Time : Gen2020 v1.2 vs Gen2020 v2.1



56% Time Save!!!

6. 新增纖維元素之非彈性塑鉸分析結果表格

- Results > Results Tables > Inelastic Hinge > Fiber Beam Summary, Fiber Wall Summary

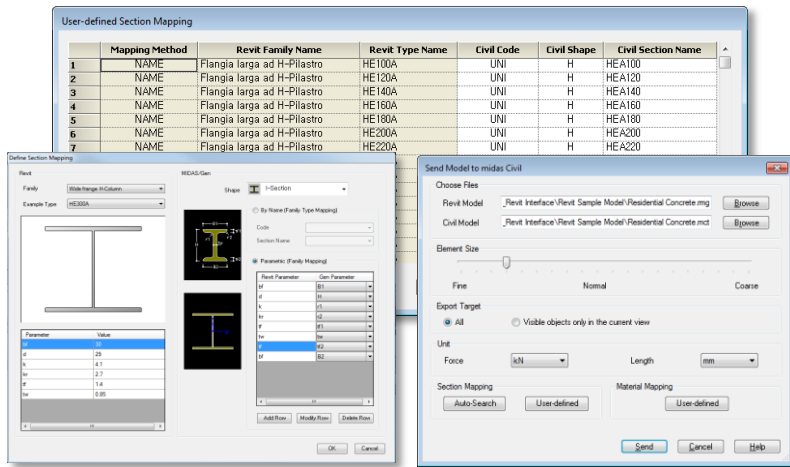
Fiber Beam Summary														
Element	Section Position	Material	Load	Cell	Minimum			Maximum						
					ϵ	Time/Step		ϵ	Time/Step					
Maximum and Minimum Strains at Each Section														
Element	Section	Load	Concrete						Steel					
			Minimum			Maximum			Minimum		Maximum			
Cell	ϵ	Time/Step	Cell	ϵ	Time/Step	Cell	ϵ	Time/Step	Cell	ϵ	Time/Step			
1	1-pos	DYNA	212	-1.31090e-003	3.080	2	4.51657e-003	3.090	234	-1.13533e-003	3.080	226	4.34048e-003	3.090
1	2-pos	DYNA	212	-3.65713e-004	2.990	212	6.49857e-004	6.050	234	-3.42752e-004	2.990	234	6.24902e-004	6.050
1	3-pos	DYNA	2	-2.26298e-004	3.100	212	3.83368e-004	2.660	229	-2.16190e-004	3.100	234	3.66219e-004	2.660
2	1-pos	DYNA	212	-4.33781e-004	2.080	212	1.16795e-003	5.950	234	-3.94597e-004	2.080	234	1.12444e-003	5.950
2	2-pos	DYNA	212	-1.60712e-004	2.180	212	4.11072e-004	4.560	234	-1.52268e-004	2.180	234	3.95087e-004	4.560
2	3-pos	DYNA	2	-3.94532e-004	3.060	212	7.49057e-004	3.060	226	-3.59973e-004	3.060	234	7.14507e-004	3.070
3	1-pos	DYNA	224	-2.35641e-004	2.890	212	9.42264e-004	5.950	235	-2.18520e-004	2.890	234	9.07028e-004	5.950
3	2-pos	DYNA	2	-1.55364e-004	3.060	212	2.61186e-004	2.360	226	-1.46279e-004	3.060	234	2.51061e-004	2.360
3	3-pos	DYNA	2	-4.04808e-004	3.020	212	1.01659e-003	3.030	226	-3.62026e-004	3.020	234	9.73654e-004	3.030

Fiber Wall Summary															
Story	Wall ID	Section Position	Material	Load	Cell	Minimum			Maximum						
						ϵ	Time/Step		ϵ	Time/Step					
Maximum and Minimum Strains at Each Section															
Story	Wall ID	Section	Load	Concrete						Steel					
				Minimum			Maximum			Minimum		Maximum			
Cell	ϵ	Time/Step	Cell	ϵ	Time/Step	Cell	ϵ	Time/Step	Cell	ϵ	Time/Step				
1F	1	1-pos	DYNA	1	-9.39160e-004	2.680	15	2.81189e-001	2.680	17	-7.11083e-004	2.360	24	2.80383e-001	2.680
1F	1	2-pos	DYNA	1	-8.67644e-004	2.680	15	1.67658e-001	2.680	17	-7.19437e-004	2.450	24	1.67176e-001	2.680
1F	1	3-pos	DYNA	1	-6.64995e-004	2.680	15	6.16266e-003	2.680	17	-6.45485e-004	2.680	24	6.14315e-003	2.680
1F	1	4-pos	DYNA	1	-4.82424e-004	2.680	15	2.32626e-003	2.680	17	-4.74398e-004	2.680	24	2.31824e-003	2.680
1F	1	5-pos	DYNA	1	-4.11744e-004	2.680	15	1.77338e-003	2.680	17	-4.05500e-004	2.680	24	1.76714e-003	2.680
2F	1	1-pos	DYNA	1	-4.08757e-004	2.680	15	1.77946e-003	2.660	17	-4.02511e-004	2.680	24	1.77321e-003	2.660
2F	1	2-pos	DYNA	1	-3.63986e-004	2.680	15	1.50301e-003	2.660	17	-3.58657e-004	2.680	24	1.49767e-003	2.660
2F	1	3-pos	DYNA	1	-2.97825e-004	2.680	15	1.15894e-003	2.660	17	-2.93668e-004	2.680	24	1.15478e-003	2.660
2F	1	4-pos	DYNA	1	-2.47810e-004	2.680	15	9.54822e-004	2.660	17	-2.44377e-004	2.680	24	9.51387e-004	2.660
2F	1	5-pos	DYNA	1	-2.21425e-004	2.680	15	8.47144e-004	2.660	17	-2.18374e-004	2.680	24	8.44092e-004	2.660
3F	1	1-pos	DYNA	1	-2.19067e-004	2.680	15	8.53079e-004	2.670	17	-2.16011e-004	2.680	24	8.50018e-004	2.670
3F	1	2-pos	DYNA	1	-1.99154e-004	2.680	15	7.72331e-004	2.670	17	-1.96387e-004	2.680	24	7.69557e-004	2.670
3F	1	3-pos	DYNA	1	-1.62067e-004	2.690	15	6.20154e-004	2.690	17	-1.59832e-004	2.690	24	6.17919e-004	2.690

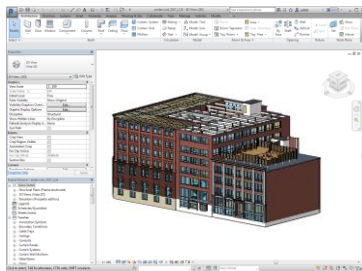
7. Gen-Revit 2020 轉換介面

Gen-Revit Link

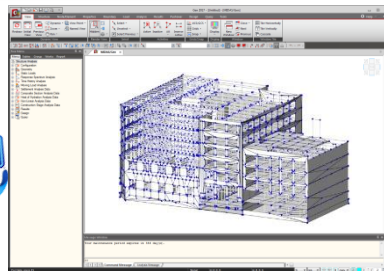
- **File > Import > midas Gen MGT File**
- **File > Export > midas Gen MGT File**



Send Model to midas Gen



Revit 2020



Gen2020

	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	>
Other Parameters	Hosted Area Load	>
	Material	<>
	Level	>

8. EC8塑鉸性質新增Strength Loss功能選項

Insert Strength loss option for EC8 hinge type

Directional Properties of Pushover Hinge : Eurocode 8 : 2004

Input Method
 Auto-Calculation User Input

Strength Loss
 Yes
 No [Figure](#)

Properties

Type
 Symmetric Asymmetric

Class of cross section
 Auto Class1 Class2

Primary Curve

Compliance Criteria

Damage Limitation (DL) (+) 1 *DY 1
 Significant Damage (SD) 0.75 *DU 0.
 Near Collapse (NC) 1 *DU 1

Initial Stiffness
 6EI/L 3EI/L 2EI/L
 User (+) 1 (-) 1
 Elastic Stiffness :

Yield Strength (MY)
 (+) (-)
 1 1 kN*m

Yield Rotation (DY)
 User Defined
 (+) (-)
 DY 1 1 [rad]
 DU 9 9 [rad]

OK

Strength Loss

Strength Loss : Yes

Strength Loss : No

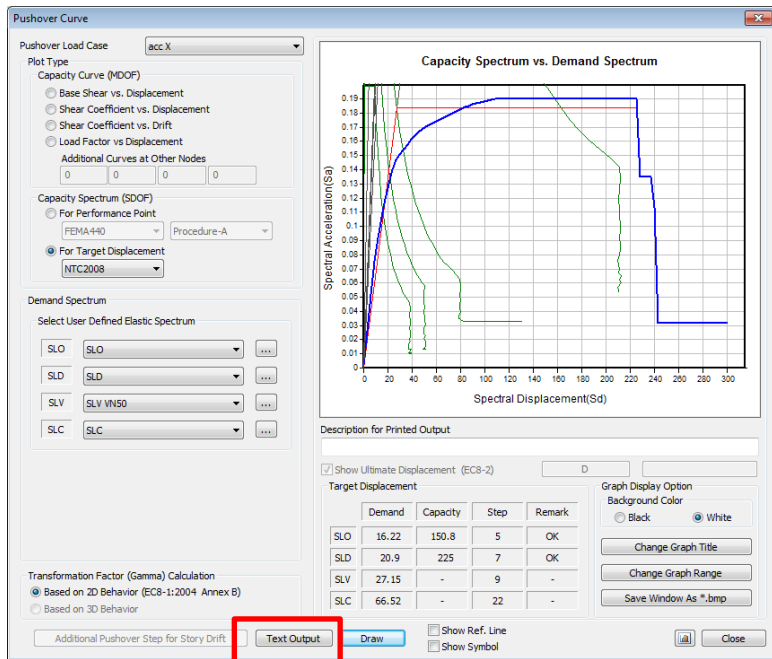
B8_Hyst_My-Ry_I-end_PO1

B8_Hyst_My-Ry_I-end_PO1

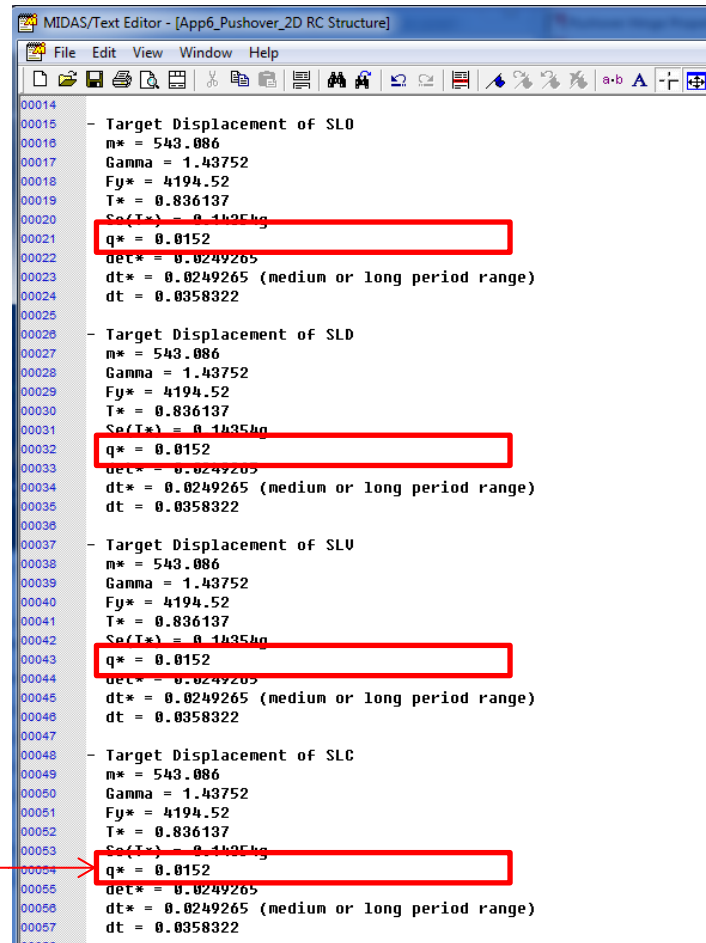
9. 優化磚石結構側推分析與後處理功能

Improvement about Masonry pushover analysis and post processing

1) Printout "q*" value in Text Output



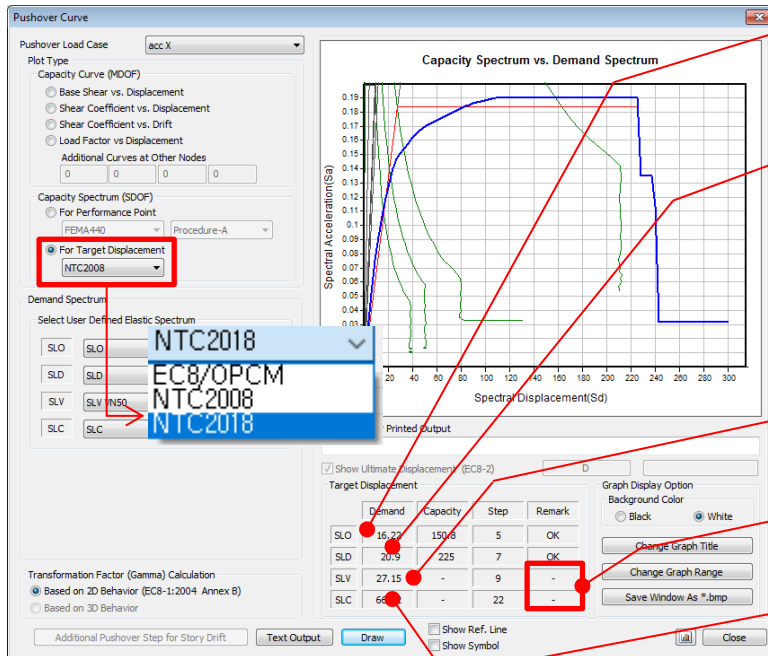
$$q^* = \frac{S_{de}(T^*)m^*}{F_y^*}$$



9. 優化磚石結構側推分析與後處理功能

Improvement about Masonry pushover analysis and post processing

2) Calculation for Target Displacement in Masonry as per NTC 2018



SLO
SLD x 2/3

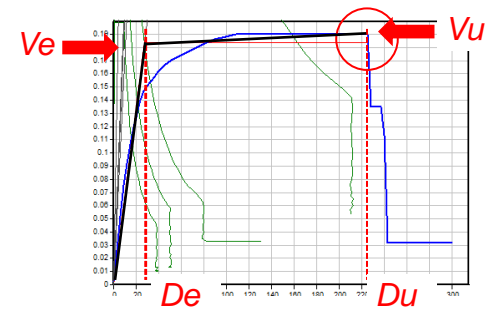
SLD
Capacity of SLD
= Min. Displacement of V_e and $\frac{3}{4} V_u$

* V_e = max shear of bilinear curve
* V_u = max shear of MDOF curve

SLV
Ultimate displacement (D_u) x 3/4

Add Remark for SLV & SLC

SLC
Ultimate displacement (D_u) x gamma



9. 優化磚石結構側推分析與後處理功能

Updating 'My' in Masonry with Pier hinge Type

- Default values of D/H will change depending on the building type..

M/MY	D/H
-E -0.3	-E -0.012
-D -0.3	-D -0.01
-C -1.001	-C -0.01
-B -1	-B None
A 0	A 0
B 1	B None
C 1.001	C 0.01
D 0.3	D 0.01
E 0.3	E 0.012

Default Values of D/H

Point	New Building	Existing Building
C	0.01	0.01
D	0.01	0.01

9. 優化磚石結構側推分析與後處理功能

Updating 'My' in Masonry with Spandrel Type

- Building type is added, i.e. New Buildings, Existing Buildings.
- Default values of D/H will change depending on the building type.

Direction	M/MY	D/H
-E	-0.3	-0.018
-D	-0.3	-0.015
-C	-1.001	-0.015
-B	-1	None
A	0	0
B	1	None
C	1.001	0.015
D	0.3	0.015
E	0.3	0.018

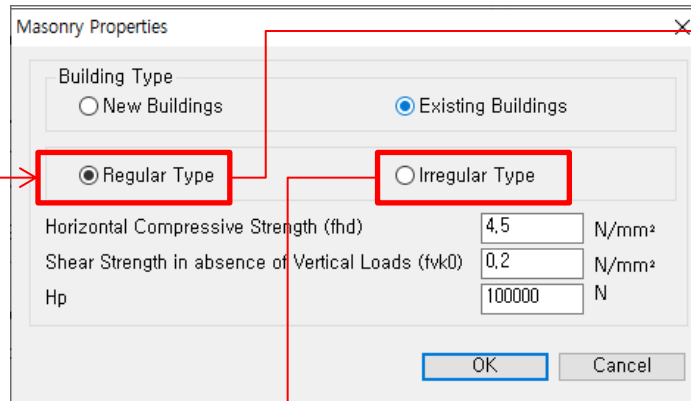
Default Values of D/H

Point	New Building	Existing Building
C	0.008	0.015
D	0.008	0.015

9. 優化磚石結構側推分析與後處理功能

Updating Fz in Masonry with Spandrel hinge Type

- Improvement of formula for shear resistance in irregular type



Shear Resistance =

$$\text{Min. } [V_t = ht f_{vko}, V_p = 2M_u/l]$$

where $M_u = \frac{H_p \cdot h}{2} \left(1 - \frac{H_p}{0.85 \cdot f_{kd} \cdot h \cdot t} \right)$

$$H_p \begin{cases} i) 0.4 \cdot f_{kd} \cdot h \cdot t \\ ii) H_p : \text{User Defined Value} \\ \text{minimum value} \end{cases}$$

Shear Resistance =

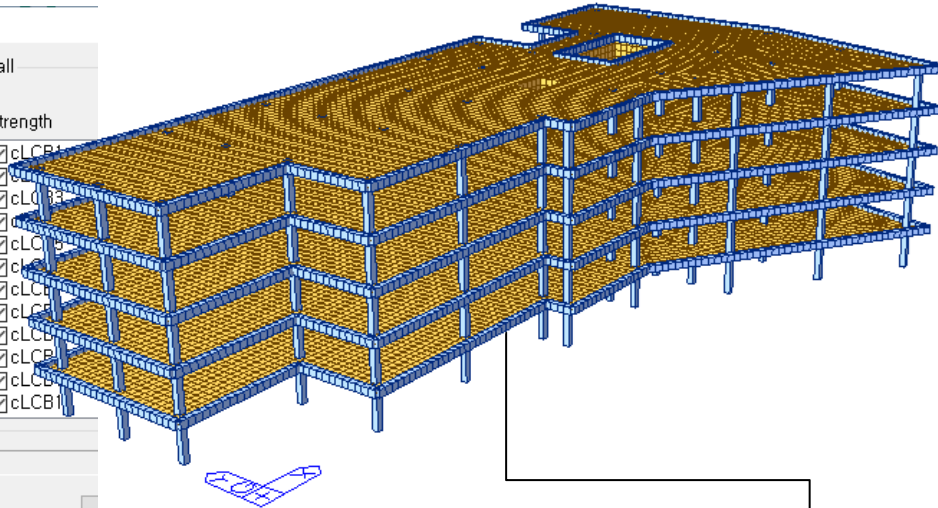
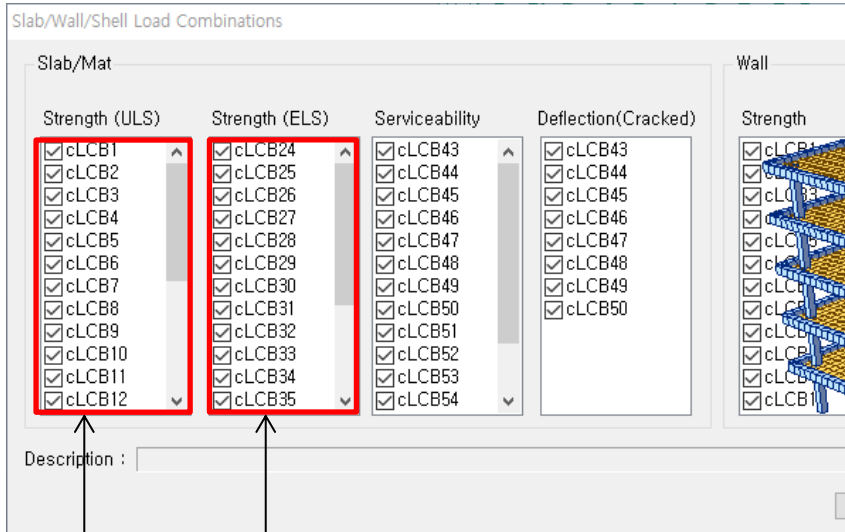
$$V_t = L \times T \times 1.5 f_{vko} / \beta \times \sqrt{1 + P / 1.5 f_{vko}}$$

where

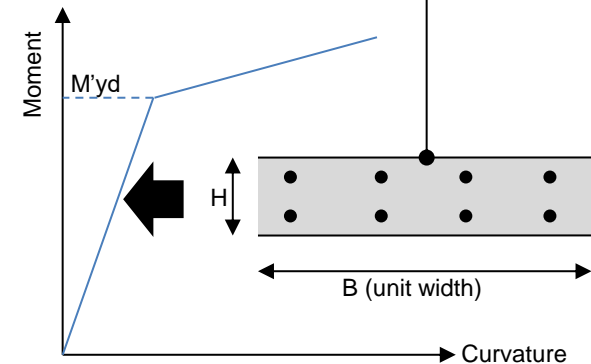
$$\beta \begin{cases} = 1.5 ; 1.5 \leq H/L \\ = H/L ; 1.0 < H/L < 1.5 \\ = 1.0 ; H/L \leq 1.0 \end{cases}$$

10. 新增NTC2018規範Non-dissipative element之版設計功能

Non-dissipative element design is added for slab.



• **Moment -Curvature Curve of Slab**



- Only 'Concrete Code Check' is supported

Strength (ULS)

: Add All load Combinations of ULS

Strength (ELS) (New)

: Add load combinations with seismic load as "ELS"

11. 優化EC2與NTC規範之版設計功能

Two checks are added, i.e. "Check ratio of x/d" and "Check Stress by Quasi-permanent Load combinations".

Check x/d as per NTC2018 4.1.2.1.2.1

```
<< BOTTOM >>
-. Information of Parameters.
Elem No. : 52
Thickness : 0.3000 m.
Materials : fck = 1631.5459 tonf/m^2.
           fcd = 1087.6973 tonf/m^2.
           fyk = 40788.6485 tonf/m^2.
Covering : dB = 0.0750 m.
           dT = 0.0750 m.
LCB No. : 1

-. Information of Design.
b = 0.0010 m. (by Code Unit Length).
d = 0.2250 m.
lambda = 0.800
a = lambda * x = 0.021 m.
eta = 1.000
Cc = eta*fcd*b*a = 0.0233 tonf.
M_Rd = Cc*(d-a/2) = 4.9982 tonf-m./m.

-. Information of Moments and Result.
Rein. Bar : D16 @300
As_req = 0.0003 m^2/m. ( 0.0003 m^2/m.)
M_Ed = 1.6544 tonf-m./m.
M_Rd = 4.9982 tonf-m./m.
RatM = M_Ed / M_Rd = 0.331 < 1.0 ----> O.K !
```

```
-. Check ratio of neutral axis depth to effective depth.
x/d = 0.053
Limit(x/d) = 0.450 ( fck <= 50 MPa.)
x/d ratio = 0.053/ 0.450 = 0.118 ----> O.K
```

Stress check by Quasi-permanent

```
-. Information of Parameters.
Elem No. : 51
LCB No. : 44
Materials : fck = 1631.5459 tonf/m^2.
           fyk = 40788.6485 tonf/m^2.
Thickness : 0.3000 m.
Covering : dB = 0.0750 m.
           dT = 0.0750 m.

-. Information of Checking.
gamma_c = 1.500 (for Concrete)
gamma_s = 1.150 (for Reinforcement)
fcd = fck / gamma_c = 1087.6973 tonf/m^2.
fyd = fyk / gamma_s = 35468.39002 tonf/m^2.
b = 0.0010 m. (by Code Unit Length).
d = 0.2250 m.
As_use = 0.0007 m^2/m. ( 0.0007 m^2/m.)

-. Information of Stress Checking Result.
k1 = 0.80000
k3 = 0.80000
(Assumed Uncracked Section)
M_Ed = 3.95 tonf-m./m.
n = 13.98215 (Long Term) .
fctm = 0.30 + fck / (2/3) = 194.24383 tonf/m^2.
fr1 = (1.6 - H/1000) * fctm = 252.51698 tonf/m^2.
fctm,fl = MAX( fctm, fr1 ) = 252.51698 tonf/m^2.
ybar_t = 0.1500 m.
lyy = 0.00030 m^4./m.
Ss_con (Tens.) = M_Ed*(H-ybar_t)/lyy = 254.61148 tonf/m^2.
Ss_con (Tens.) > fctm,fl ----> Check Cracked Section !!!

[ Dead Load Cases ]
M_Ed,D = 2.56 tonf-m./m.
M_Ed,L = 13.98215 (Long Term) .
n = 0.066 m.
X = 0.0003 m^4./m.
lcr = 0.0002 m^4./m.
ybar_t = 0.056 m.
Ss_conD = M_Ed,D*ybar_t/lcr = 442.81327 tonf/m^2.
Ss_stiD = M_Ed,D*(d-ybar_t)*n/lcr = 18688.77997 tonf/m^2.

[ Live Load Cases : Quasi-permanent ]
M_Ed,L = 0.03 tonf-m./m.
n = 13.98215 (Long Term) .
X = 0.0003 m^4./m.
lcr = 0.0002 m^4./m.
ybar_t = 0.056 m.
Ss_conL = M_Ed,L*ybar_t/lcr = 4.84833 tonf/m^2.
Ss_stiL = M_Ed,L*(d-ybar_t)*n/lcr = 204.62213 tonf/m^2.

[ Etc. Load Cases ]
M_Ed,E = 1.37 tonf-m./m.
n = 6.99107 (Short Term) .
X = 0.041 m.
lcr = 0.0002 m^4./m.
ybar_t = 0.041 m.
Ss_conE = M_Ed,E*ybar_t/lcr = 313.84428 tonf/m^2.
Ss_stiE = M_Ed,E*(d-ybar_t)*n/lcr = 9765.27236 tonf/m^2.

Ss_con = Ss_conD + Ss_conL + Ss_conE = 761.50587 tonf/m^2.
Ss_sti = Ss_stiD + Ss_stiL + Ss_stiE = 28658.67446 tonf/m^2.
S3_con > k3*fck = 704.19587 tonf/m^2. ----> Not Acceptable !!!
Ss_sti < k3*fyk = 32630.91882 tonf/m^2. ----> O.K !
```

```
[ Live Load Cases : Quasi-permanent ]
M_Ed,L = 0.03 tonf-m./m.
n = 13.98215 (Long Term) .
X = 0.0003 m^4./m.
lcr = 0.0002 m^4./m.
ybar_t = 0.056 m.
Ss_conL = M_Ed,L*ybar_t/lcr = 4.84833 tonf/m^2.
Ss_stiL = M_Ed,L*(d-ybar_t)*n/lcr = 204.62213 tonf/m^2.

[ Etc. Load Cases ]
M_Ed,E = 1.37 tonf-m./m.
n = 6.99107 (Short Term) .
X = 0.041 m.
lcr = 0.0002 m^4./m.
ybar_t = 0.041 m.
Ss_conE = M_Ed,E*ybar_t/lcr = 313.84428 tonf/m^2.
Ss_stiE = M_Ed,E*(d-ybar_t)*n/lcr = 9765.27236 tonf/m^2.

Ss_con = Ss_conD + Ss_conL + Ss_conE = 761.50587 tonf/m^2.
Ss_sti = Ss_stiD + Ss_stiL + Ss_stiE = 28658.67446 tonf/m^2.
S3_con > k3*fck = 704.19587 tonf/m^2. ----> Not Acceptable !!!
Ss_sti < k3*fyk = 32630.91882 tonf/m^2. ----> O.K !
```

4.1.2.1.2.1.
Per le travi continue, le travi di telai in cui possono essere trascurati gli effetti del secondo ordine e le solette, il rapporto x/d nelle sezioni critiche non deve comunque superare il valore 0.45 per $f_{ck} \leq 50$ MPa e 0,35 per $f_{ck} > 50$ MPa.

12. 優化Non-dissipative 之設計功能

Approximate Method is added : $M'_{yd} = \text{Reduction factor} * M_{Rd}$

Setting of Concrete Design Code

Design Code : Eurocode2

National Annex : Italy

Apply NTC : NTC2018

Apply Special Provisions for Seismic Design

Strut Angle for Shear Resistance : 45 Deg

Effective Creep Ratio (Phi_Lef) : 2.14

Slenderness Limit

Lambda_lim = 25/sqrt(n)
Where, n = N.Ed/(Ac*fc)

Beam-Column Joint Design

Gamma_rd : 1.1

Confined Joint Not Confined Joint

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)

Design Method of Non-Dissipative Member

M-C curve

Approximate Method : 0.9 * M Rd

Non-Dissipative Member : None

Secondary Seismic Member : 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

P-M Curve Calculation Method

Keep P Constant

Keep M/P Constant

OK Close

Design Method of Non-Dissipative Member

M-C curve

Approximate Method : 0.9 * M Rd

Add Option

Bending Moment Capacity

	END-I	MID	END-J
(-) Load Combination No.	21	21	5
Moment (M_Ed)	141604.88	59413.77	134663.44
Factored Strength (M_Rd)	152013.72	84276.96	123768.52
Check Ratio (M_Ed/M_Rd)	0.9315	0.7050	1.0880
Neutral Axis (x/d)	0.1670	0.1172	0.1445
(+) Load Combination No.	5	5	21
Moment (M_Ed)	99836.64	63882.84	96479.04
Factored Strength (M_Rd)	84427.01	84276.96	84489.36
Check Ratio (M_Ed/M_Rd)	1.1825	0.7580	1.1419
Neutral Axis (x/d)	0.1150	0.1172	0.1157

Elastic Bending Moment Capacity (for Non-Dissipative Element)

	END-I	MID	END-J
(-) Load Combination No.	53	53	37
Moment (M_Ed)	101482.80	38922.76	96260.94
Elastic Strength (M_yd')	143255.27	74502.94	112471.78
Check Ratio	0.7084	0.5224	0.8559
(+) Load Combination No.	37	37	53
Moment (M_Ed)	59714.55	43391.82	58076.53
Elastic Strength (M_yd')	74757.76	74502.94	74901.73
Check Ratio	0.7988	0.5824	0.7754

M_yd' = 0.9 * M_Rd

13. 優化非彈性材料模型

“Partial Safety Factor” is introduced in the Inelastic Material Model.

- Apply partial safety factors to the fiber model for pushover analysis and generate M-C curve for the design of non-dissipative elements

Concrete

Inelastic Material Model

Name : steel
Material Type : Concrete
Hysteresis Model : Kent & Park Model
Reference Material : B&C

Partial Safety Factor for Material: 1.0

stress (compression)

$K \cdot f_c$

$0.2K \cdot f_c$

ϵ_{co}

ϵ_{c1}

ϵ_{cu}

$Z \cdot K \cdot f_c$

Partial Safety Factor for Material: 1.5

Skeleton Curve

f_c : 24 N/mm² ϵ_{co} : 0.002

K : 1 Z : 1000000

ϵ_{cu} : 0.0025 $\epsilon_{c1} = 0.8/Z + \epsilon_{co}$

Partial Safety Factor for Material: 1.5

Moment (kN)

Curvature*0.001 (1/m)

Steel

Inelastic Material Model

Name : steel
Material Type : Steel
Hysteresis Model : Menegotto-Pinto Model
Reference Material : None

Partial Safety Factor for Material: 1.0

σ_s (tension)

f_y

$b \cdot E$

E

ϵ_y

ϵ_s

(tension)

Partial Safety Factor for Material: 1.5

Skeleton Curve

f_y : 400 N/mm² R_s : 20

E : 200000 N/mm² a_1 : 18.5

b : 0.5 a_2 : 0.15

Partial Safety Factor for Material: 1.5

Moment (kN)

Curvature*0.001 (1/m)

14. 優化EC2與NTC規範之RC梁柱接頭設計功能

Improvement of the check for hoop spacing in joint design

Detail report

```
( ). Compute horizontal hoops
-. Ash.req = Ash.req2 = 0.002 m^2.
-. Legs = 2
-. Num = 20
-. Ash.use = Av1+Legs*Num = 0.003 m^2.
-. Rat.Ash = Ash.req / Ash.use = 0.838 < 1.000 ---> O.K.

( ). Check space of horizontal hoops.
-. sh.min = MAX[ Bar Dia, Gravel Dia, 20mm ] + Bar Dia = 0.0345 m.
-. sh.use = 0.0308 m. < s.min ---> AN INCONGRUENT SPACING !!!
```

Review for constructability

Design result table

Printing Result Dialog

Code : Eurocode2:04.NTC2018 Unit : kN m Primary Sorting Option

Sorted by Member Property Results Strength Serviceability

MEMB	SE	Section	fck	fyk	CHK	LC	V-Rebar	N_Rdmax	Uc	N_Ed	M_Edy	M_Edz	V_Rdc.end	V_Rds.end	V_Rdc.mid	V_Rds.mid	LC	V_Ed.end	Rat-V.end	Ash.req
SECT	L	Bc Hc	Height	fyw		B		x	Rat-Uc	Rat-N	Rat-My	Rat-Mz	Rat-Vc.end	Rat-Vs.end	Rat-Vc.mid	Rat-Vs.mid	B	V_Ed.mid	Rat-V.mid	Rat-J
253		C1	24000.0	400000	J	4	26-7-D22	19339.7	0.019	267.920	579.245	7.40708	425.238	1134.57	431.760	1134.57	7	1082.58	0.954	0.00239
103	<input checked="" type="checkbox"/>	1.000 1.000	4.0000	400000	J	4	26-7-D22	19339.7	0.000	0.315	0.313	0.314	2.546	0.954	2.507	0.954	7	1082.58	0.954	0.838
335		C1	24000.0	400000	J	6	26-7-D22	19339.7	0.012	81.5272	74.5034	11.2563	397.202	1134.57	403.725	1134.57	7	1027.76	0.906	0.00241
103	<input type="checkbox"/>	1.000 1.000	4.0000	400000	J	6	26-7-D22	19339.7	0.000	0.032	0.032	0.031	2.588	0.906	2.546	0.906	7	1027.76	0.906	0.845

Printout "J" in red color In Design result table If sh.use < sh,min.

Graphic result

[JOINT]	y : 6 (l)	z : 6 (l)
Ash.req / Ash.use	0.00239 / 0.00285 = 0.838	0.00239 / 0.00285 = 0.838
Joint Ratio	0.838 < 1.000 O.K	0.838 < 1.000 O.K
Ash.jnt	Check Spacing	Check Spacing

Printout "Check Spacing" In graphic If sh.use < sh,min.

14. 優化EC2與NTC規範之RC梁柱接頭設計功能

Joint Design as per EC and NTC

→ Improvement in the check a hoop area and spacing in Joint design

Detail report

```
( ). Compute horizontal hoops to limit the maximum diagonal tensile stress of concrete.
[ NTC2018, 7.4.4.3.1 ]
- Nu_d = 0.055
- fctd = 1164.8469 KPa.
- fvj = {Vjhd/(bj+hjc)}^2 / (fctd + Nu_d*fcd) = 1305.825 KPa.
- Ash.req.1 = (fvj-fctd)*bj*hjw/tywd = 2.362e-004 m^2.

( ). Compute horizontal hoops to ensure integrity of the joint after diagonal cracking.
[ NTC2018, 7.4.4.3.1 ]
- Gamma_rd = 1.2000
- Beam Top Reinforcement : As1 = 0.0015 m^2.
- Beam Bottom Reinforcement : As2 = 0.0015 m^2.
- Ash.req.2 = Gamma_rd*(As1+As2)+fyd*(1.0-0.8*Nu_d)/tywd = 0.003 m^2.

( ). Compute horizontal hoops
- Ash.req = MIN[ Ash.req1, Ash.req2 ] = 2.362e-004 m^2.
- Legs = 2
- Num = 12
- Ash.use = Av1*Legs*Num = 0.002 m^2.
- Rat.Ash = Ash.req / Ash.use = 0.138 < 1.000 ----> O.K.

( ). Check space of horizontal hoops.
- sh.min = MAX[ Bar Dia, Gravel Dia, 20mm ] + Bar Dia = 0.0345 m.
- sh.use = 0.0498 m. > s.min ----> O.K.
```

1) For Ash_req 1(EC2:04_5.5.3.3(3))

$$\frac{A_{sh} \cdot f_{ywd}}{b_j \cdot h_{jw}} \geq \frac{\left(\frac{V_{jhd}}{b_j \cdot h_{jc}} \right)^2}{f_{ctd} + v_d f_{cd}} - f_{ctd}$$

2) For Ash_req2(EC2:04_5.5.3.3.(4))

a) In interior joints:

b) In exterior joints:

$$A_{sh} f_{ywd} \geq \gamma_{Rd} (A_{s1} + A_{s2}) f_{yd} (1 - 0.8 v_d) \quad A_{sh} f_{ywd} \geq \gamma_{Rd} A_{s2} f_{yd} (1 - 0.8 v_d)$$

• Ash_req = Min[Ash_req1, Ash_req2]

Design result table

Eurocode2:04 RC-Column Checking Result Dialog

Code : Eurocode2:04.NTC2018 Unit : kN , m Primary Sorting Option

Sorted by Member Property Results Strength Serviceability SECT MEMB

MEMB	SE	Section	fck	fjk	CHK	LC	V-Rebar	N_Rdma	Uc	N_Ed	M_Edy	M_Edz	V_Rdc.end	V_Rds.end	V_Rdc.mid	V_Rds.mid	LC	V_Ed.end	Rat-V.end	Ash.req
SECT	L	Bc Hc	Height	fyw		B		x	Rat-Uc	Rat-N	Rat-My	Rat-Mz	Rat-Vc.end	Rat-Vs.end	Rat-Vc.mid	Rat-Vs.mid	B	V_Ed.mid	Rat-V.mid	Rat-J
80	<input checked="" type="checkbox"/>	C2	24000.0	400000	OK	7	24-7-D22	17482.8	0.056	802.368	718.331	179.889	445.291	1021.12	451.896	1021.12	7	971.662	0.952	0.00116
202		0.900 1.000	4.5000	400000					0.000	0.363	0.358	0.342	2.182	0.952	2.150	0.952	7	971.662	0.952	0.679

Printout the result for Ash,req instead of Vjh ←

Graphic result

Change the results based on the hoop rebar area required

[JOINT]	y : 6 (l)	z : 4 (l)
Ash.req / Ash.use	0.00116 / 0.00171 = 0.679	0.00024 / 0.00171 = 0.138
Joint Ratio	0.679 < 1.000 O.K	0.138 < 1.000 O.K
Ash.jnt	2-12 D10	2-12 D10

14. 優化EC2與NTC規範之RC梁柱接頭設計功能

Joint Design as per EC and NTC

- An option is added to choose 'Confined' or 'Not confined' joint condition.

Setting of Concrete Design Code

Concrete Design Code
Design Code : Eurocode2

National Annex : Italy
Apply NTC : NTC2018
Apply Special Provisions for Seismic Design : ...
Strut Angle for Shear Resistance : 45 Deg
Effective Creep Ratio (PhiLef) : 2.14
Slenderness Limit
Lambda_lim = 25/sqrt(n)
Where, n = N.Ed/(Ac*fcid)

Beam-Column Joint Design Gamma_rd 1.1

Confined Joint Not Confined Joint

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)

Design Method of Non-Dissipative Member
 V-C curve
 Approximate Method : 0.9 + M Rd

Non-Dissipative Member : None
Secondary Seismic Member : 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

P-M Curve Calculation Method
 Keep P Curve
 Keep M/P

Beam-Column Joint Design Gamma_rd 1.1

Confined Joint Not Confined Joint

Add Option

midas Gen - RC-Column Checking [Eurocode2:04 & NTC2018] Gen 2020

```
(.) Check ratio of shear capacity.
- V.Ed / V.Rdc = 1.756
- V.Ed / V.Rds = 0.974
- V.Ed / V.RdMax = 0.418
- Rat_V = 0.974
```

```
(.) Calculate design shear force according to special provisions for seismic design.
- Alpha = 1.3000
- Height = 4000.0000 mm
- Vey1 = Alpha*(Mey1+Mey2)/Height = 273554.722 N.
- V.Edz = Vey1 = 273554.722 N.
```

```
(.) Calculate design shear force according to special provisions for seismic design.
- Alpha = 1.3000
- Height = 4000.0000 mm
- Vey1 = Alpha*(Mey1+Mey2)/Height = 273554.722 N.
- V.Edy = Vey1 = 273554.722 N.
```

[[[*]]] CALCULATE SHEAR CAPACITY ABOUT MAJOR AXIS. (MIDDLE)

```
(.) Compute design parameters.
- Gamma_c = 1.50 (for Fundamental or Earthquakes).
- Alpha_cc = 1.00 (Default or User Defined).
- fcd = Alpha_cc * fck / Gamma_c = 13.333 MPa.
- Gamma_s = 1.15 (for Fundamental or Earthquakes).
- fyd = fyk / Gamma_s = 347.826 MPa.
- Gamma_s = 1.15 (for Fundamental or Earthquakes).
- fywd = fyk / Gamma_s = 347.826 MPa.
- Gamma_s = 1.30
```

Joint condition is added.

midas Gen - RC-Column Design [Eurocode2:04 & NTC2018] Gen 2020

```
(.) Check ratio of shear capacity.
- V.Ed / V.Rdc = 1.756
- V.Ed / V.Rds = 0.974
- V.Ed / V.RdMax = 0.418
- Rat_V = 0.974
```

[[[*]]] CALCULATE BEAM-COLUMN JOINT CAPACITY ABOUT MAJOR AXIS.

```
(.) Compute joint geometry information.
[ NTC2018, 7.4.4.3.1 ]
- bc = 500.0000 mm.
- hc = 500.0000 mm.
- hw = 500.0000 mm.
- s = 500.0000 mm.
- 3/4*bc -> Confined joint.
- srels.
```

```
(for joint shear joint)
- s = 110.000 mm. (Hoop spacing for shear)
- Smax = MIN( 2*s, 150 mm ) = 150.000 mm.
```

```
(.) Compute horizontal shear force in local-z direction.
[ L08 = 1, POS = 1 ]
[ NTC2018, 7.4.4.3.1 ]
- Applied axial force : Pu = 186978.94 N.
- Applied shear force : Vcz = 21777.832 N.
- Beam Top Reinforcement : As1 = 2145.7527 mm^2.
- Beam Bottom Reinforcement : As2 = 2145.7527 mm^2.
- Gamma_rd = 1.2000 (Interior Column).
- Vjhdz = Gamma_rd * (As1+As2) * fyd - Vcz = 1769459.208 N.
```

```
(.) Check diagonal compression.
[ NTC2018, 7.4.4.3.1 ]
- Eta = 0.6 + (1-fck/250) = 0.5520
- Vjhd > Eta*fcd*sqrt(1-Nu_d/Eta)*b*j*h*c = 1301028.866 N.
- Rat = 1.361 > 1.0 -> Not Acceptable !!!
```

```
(.) Compute horizontal hoops to limit the maximum diagonal tensile stress of concrete.
[ NTC2018, 7.4.4.3.1 ]
- Nu_d = 0.056
- fctd = 1.0315 MPa.
- fvj = (Vjhd/(b*j+h*c))^2 / (fctd + Nu_d*fctd) = 50.587 MPa.
- Ash.req.1 = (fvj-fctd)*b*j*h*w/fywd = 46132.432 mm^2.
```

```
(.) Compute horizontal hoops to ensure integrity of the joint after diagonal cracking.
[ NTC2018, 7.4.4.3.1 ]
- Gamma_rd = 1.2000
- Beam Top Reinforcement : As1 = 2145.7527 mm^2.
- Beam Bottom Reinforcement : As2 = 2145.7527 mm^2.
- Ash.req.2 = Gamma_rd*(As1+As2)*fyd*(1.0-0.8*Nu_d)/fywd = 4918.709 mm^2.
```

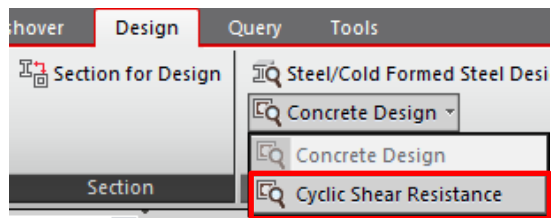
```
(.) Compute horizontal hoops
- Ash.req = MIN( Ash.req1, Ash.req2 ) = 4918.709 mm^2.
- Less
- Nu_s = 22
- Ash.use = Av1+Legs*Num = 4976.400 mm^2.
- Rat.Ash = Ash.req / Ash.use = 99.990 > 1.000 -> Not Acceptable !
```

```
(.) Check space of horizontal hoops.
- sh.min = MAX( Bar Dia, Gravel Dia, 20mm ) + Bar Dia = 37.0000 mm.
- sh.use = 28.1555 mm < sh.min -> AN INCONGRUENT SPACING !!!
```

15. 新增EN1998-3:2005與NTC2018規範之Cyclic Shear Resistance檢核

Check of Cyclic shear Resistance under ULS Design

- Design > result > Concrete Design > Cyclic Shear Resistance



Set Cyclic Shear Resistance Parameters

Set Cyclic Shear Resistance Parameters

Load Case/Combination

Cyclic Shear Resistance Table Type
 Show Selected Elements
 Show All Elements

Confidence Factor

Displacement Behavior Factor(qd)

Importance Factor(le)

Result Table for Cyclic shear Resistance checking									
Elem	Location	Seismic Element	Load	Cyclic Shear Resistance					
				VRy			VRz		
				Demand	Capacity	Remark	Demand	Capacity	Remark
Confidence Factor = 1.20, qd = 1.50, le = 1.50									
Press right mouse button and click 'Set Cyclic Shear Resistance Parameters' menu to change Load Case/Combination/Confidence Factor/Displacement Behavior Factor/Importance Factor									
353	I-end	Primary	ALL COMBINATION	18.0504	496.6250	OK	25.3188	430.5590	OK
353	J-end	Primary	ALL COMBINATION	18.0504	382.5840	OK	25.3188	285.4860	OK

Demand : Design Shear Force

Capacity : V_R by Equation below

A.3.3 Beams, columns and walls: shear

$$V_R = \frac{1}{\gamma_{el}} \left[\frac{h-x}{2L_V} \min(N; 0,55A_c f_c) + (1 - 0,05 \min(5; \mu_2^p)) \cdot \left[0,16 \max(0,5; 100\rho_{tot}) \left(1 - 0,16 \min\left(5; \frac{L_V}{h}\right) \right) \sqrt{f_c} A_c + V_w \right] \right]$$

Demand ≤ Capacity → O.K

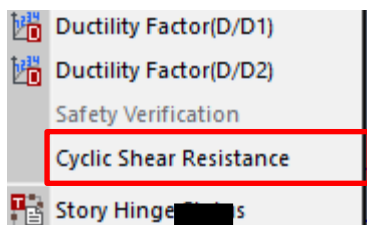
Demand > Capacity → N.G.

* Only RC beam and column is supported in Gen 2020 v2.1

15. 新增EN1998-3:2005與NTC2018規範之Cyclic Shear Resistance檢核

Check of Cyclic shear Resistance under Pushover analysis

- Pushover > Pushover Hinge Result > Cyclic Shear Resistance



Set Cyclic Shear Resistance Parameters

Set Cyclic Shear Resistance Parameters

Pushover Load Case: PO-X

Step for Demand:

- Life Safety (SLV)
- Collapse Prevention (SLC)
- User Defined (23)

Cyclic Shear Resistance Table Type:

- Show Selected Elements
- Show All Elements

Confidence Factor: 1.0

OK Cancel

Result Table for Cyclic shear Resistance checking

Elem	Location	Seismic Element	Load	Cyclic Shear Resistance					
				VRy			VRz		
				Demand	Capacity	Remark	Demand	Capacity	Remark
Step for Demand = USER (Step 23), Confidence factor = 1.00									
Press right mouse button and click 'Set Cyclic Shear Resistance Parameters' menu to change step or loadcase									
95	I-end	Primary	PO-X	42166.900	137079.00	OK	3501.6800	149689.00	OK
95	J-end	Primary	PO-X	42166.900	147994.00	OK	3501.6800	136127.00	OK

Demand : Design Shear Force

Capacity : V_R by Equation below

A.3.3 Beams, columns and walls: shear

$$V_R = \frac{1}{\gamma_{el}} \left[\frac{h-x}{2L_V} \min(N; 0,55A_c f_c) + (1 - 0,05 \min(5; \mu_s^{pl})) \cdot \left[0,16 \max(0,5; 100\rho_{tot}) \left(1 - 0,16 \min\left(5; \frac{L_V}{h}\right) \right) \sqrt{f_c} A_c + V_w \right] \right]$$

Demand ≤ Capacity → O.K

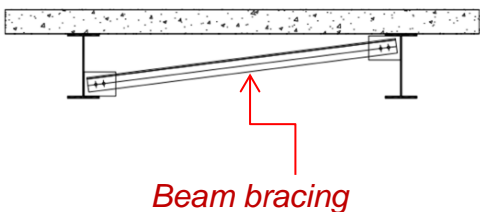
Demand > Capacity → N.G.

* Only RC beam and column is supported in Gen 2020 v2.1

midas **Design+**

1. 新增鋼構耐震設計工具

計算梁構件最大無支撐長度



Seismic Design Tool

Unbraced Length, Brace Strength, Link Stiffener, Beam Strength

CHK	Shape	Use DB	Name	Size						Material	Lateral Force Resisting System	Unbraced Length			
				Size1 (mm)	Size2 (mm)	Size3 (mm)	Size4 (mm)	Size5 (mm)	Size6 (mm)			Fy (MPa)	Es (MPa)	ry (mm)	Lb (m)
✓	H Section	✓	H 400x200x8/13	400.00	200.00	8.00	13.00	16.00	-	SS275	Special Moment Frames	275.00	210000.00	45.40	2.98
✓	H Section	✓	H 450x200x9/14	450.00	200.00	9.00	14.00	18.00	-	SS275	Intermediate Moment Frames	275.00	210000.00	44.00	5.71
✓	H Section	✓	H 496x199x9/14	496.00	199.00	9.00	14.00	20.00	-	SS275	Intermediate Moment Frames	275.00	210000.00	42.70	5.54
✓	H Section	✓	H 500x200x10/16	500.00	200.00	10.00	16.00	20.00	-	SS275	Intermediate Moment Frames	275.00	210000.00	43.30	5.62

AISC 341-16

(c) Beam bracing shall have a maximum spacing of

$$L_b = 0.19r_y E / (R_y F_y) \quad (D1-2)$$

where
 r_y = radius of gyration about y-axis, in. (mm)
**R_y = 1.1 usually.*

2b. Highly Ductile Members

In addition to the requirements of Sections D1.2a.1(a) and (b), and D1.2a.2(a) and (b), the bracing of highly ductile beam members shall have a maximum spacing of

$$L_b = 0.095r_y E / (R_y F_y)$$

For concrete-encased composite beams, the material properties of the steel section shall be used and the calculation for r_y in the plane of buckling shall be based on the elastic transformed section.

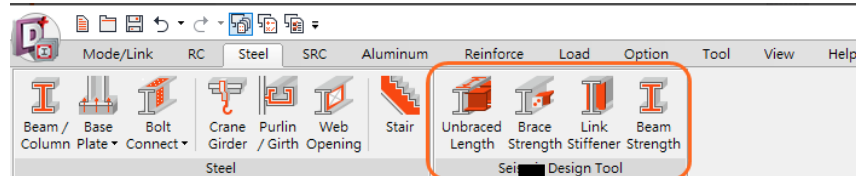
Korean code

Intermediated Moment
 $\rightarrow L_b = 0.17r_y E / F_y$

Special Moment Frames
 $\rightarrow L_b = 0.085r_y E / F_y$

1. 新增鋼構耐震設計工具

計算側向支承之軸力強度



AISC

1b. Point Bracing

In the direction perpendicular to the longitudinal axis of the beam, the required strength of end and intermediate point braces is

$$P_{br} = 0.02 \left(\frac{M_r C_d}{h_o} \right) \quad (A-6-7)$$

and, the required stiffness of the brace is

$$\beta_{br} = \frac{1}{\phi} \left(\frac{10M_r C_d}{L_{br} h_o} \right) \quad (\text{LRFD}) \quad (A-6-8a)$$

$$\beta_{br} = \Omega \left(\frac{10M_r C_d}{L_{br} h_o} \right) \quad (\text{ASD}) \quad (A-6-8b)$$

$$\phi = 0.75 \quad (\text{LRFD}) \quad \Omega = 2.00 \quad (\text{ASD})$$

where

L_{br} = unbraced length adjacent to the point brace, in. (mm)

M_r = largest of the required flexural strengths of the beam within the unbraced lengths adjacent to the point brace using LRFD or ASD load combinations, kip-in. (N-mm)

When the unbraced lengths adjacent to a point brace have different M_r/L_{br} values, the larger value shall be used to determine the required brace stiffness.

For intermediate point bracing of an individual beam, L_{br} in Equations A-6-8a or A-6-8b need not be taken less than the maximum effective length, L_b , permitted for the beam based upon the required flexural strength, M_r .

(a) When $\frac{P_r}{P_c} \geq 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9} \left(\frac{M_{rx} + M_{ry}}{M_{cx} + M_{cy}} \right) \leq 1.0 \quad (H1-1a)$$

(b) When $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left(\frac{M_{rx} + M_{ry}}{M_{cx} + M_{cy}} \right) \leq 1.0 \quad (H1-1b)$$

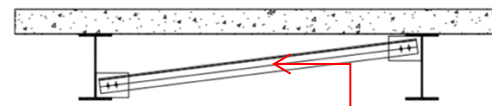
Koran code (LSD)

③ 횡지지가새 부재 검토 및 상세 - 0713.9.8

- 소요강도 $P_{br} = 0.02M_r C_d / h_o$

- 소요강성 $\beta_{br} = \frac{1}{\phi} \left(\frac{10M_r C_d}{L_b h_o} \right)$

(여기서 $\phi=0.75$, $M_r = M_u = R_y Z F_y$, $C_d = 1.0$)



(a) When $\frac{P_r}{P_c} \geq 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9} \left(\frac{M_{rx} + M_{ry}}{M_{cx} + M_{cy}} \right) \leq 1.0$$

(b) When $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left(\frac{M_{rx} + M_{ry}}{M_{cx} + M_{cy}} \right) \leq 1.0$$

Beam bracing as point bracing

Brace Design Variables				Brace Strength		
ϕMn (kN.m)	h_o (mm)	ϕ	Pbr (kN)	β_{br} (kN/m)	ϕPn (kN)	Ratio
248.82	387.00	0.75	25.72	3429.00	195.93	OK(0.066)
418.27	436.00	0.75	38.37	25582.57	195.93	OK(0.098)
472.73	482.00	0.75	39.23	26153.53	195.93	OK(0.200)
539.55	484.00	0.75	44.59	29727.27	195.93	OK(0.228)

1. 新增鋼構耐震設計工具

計算側向支承之軸力強度

Flexural strength of beam (it is defined by the user)

CHK	Beam					Brace					Bracing Type	Force				Brace Design Variables					Brace Strength	
	Shape	Use DB	Name	Material	Lb (m)	Shape	Use DB	Name	Material	Lb (m)		Use Sect. ϕMn	Cb	Mr (kN.m)	Cd	ϕMn (kN.m)	h _o (mm)	ϕ	Pbr (kN)	βbr (kN/m)	ϕPn (kN)	Ratio
<input checked="" type="checkbox"/>	H Section	<input checked="" type="checkbox"/>	H 400x200x8/13	SS275	4.00	Angle	<input checked="" type="checkbox"/>	L 100x7	SS275	2.00	Nodal Bracing	<input checked="" type="checkbox"/>	1.00	1000.00	2.000	277.60	387.00	0.75	28.69	4782.0	148.38	OK(0.097)
<input type="checkbox"/>	H Section	<input checked="" type="checkbox"/>	H 450x200x9/14	SS275	1.00	Angle	<input checked="" type="checkbox"/>	L 100x7	SS275	1.00	Nodal Bracing	<input checked="" type="checkbox"/>	1.00	0.00	2.000	418.27	436.00	0.75	37.37	25582.57	156.93	OK(0.098)
<input type="checkbox"/>	H Section	<input checked="" type="checkbox"/>	H 496x199x9/14	SS275	1.00	Angle	<input checked="" type="checkbox"/>	L 100x7	SS275	1.00	Nodal Bracing	<input checked="" type="checkbox"/>	1.00	0.00	2.000	472.73	482.00	0.75	39.23	26153.53	195.93	OK(0.200)

Axial strength of brace (it is defined by the user)

Nodal Brace → $P_{br} = 0.02 \left(\frac{M_r C_d}{h_o} \right)$

Relative Brace → $P_{br} = 0.02 \left(\frac{M_r C_d}{h_o} \right)$
0.008

[Combination stress check]

(a) When $\frac{P_r}{P_c} \geq 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9} \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0$$

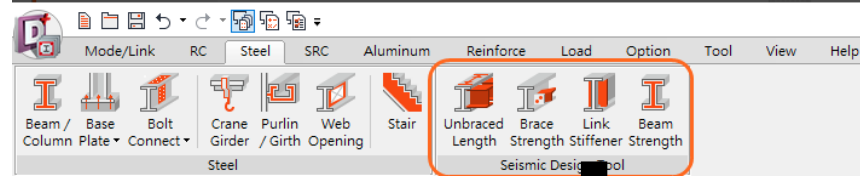
(b) When $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0$$

In here,
 Mr/Mc = 0 Because a brace does not have a moment
 Pr = Pbr
 Pc = ϕPn

1. 新增鋼構耐震設計工具

設計連桿梁加勁板



4. Link Stiffeners for I-Shaped Cross Sections

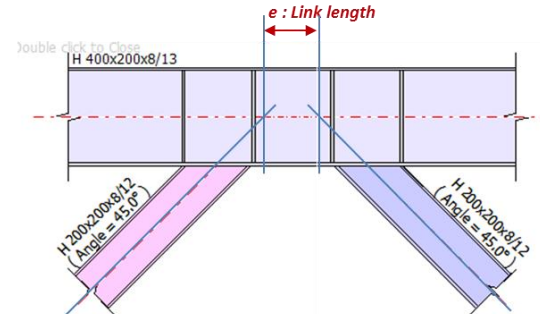
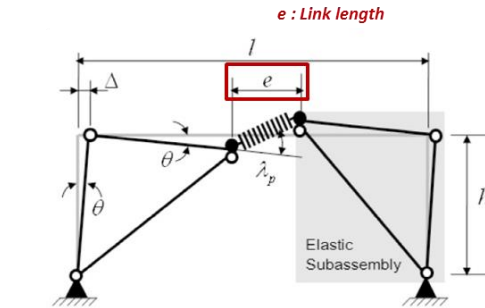
Full-depth web stiffeners shall be provided on both sides of the link web at the diagonal brace ends of the link. These stiffeners shall have a combined width not less than $(b_f - 2t_w)$ and a thickness not less than the larger of $0.75t_w$ or $\frac{3}{8}$ in. (10 mm), where b_f and t_w are the link flange width and link web thickness, respectively.

Links shall be provided with intermediate web stiffeners as follows:

- (a) Links of lengths $1.6M_p/V_p$ or less shall be provided with intermediate web stiffeners spaced at intervals not exceeding $(30t_w - d/5)$ for a link rotation angle of 0.08 rad or $(52t_w - d/5)$ for link rotation angles of 0.02 rad or less. Linear interpolation shall be used for values between 0.08 and 0.02 rad.
- (b) Links of length greater than or equal to $2.6M_p/V_p$ and less than $5M_p/V_p$ shall be provided with intermediate web stiffeners placed at a distance of 1.5 times b_f from each end of the link.
- (c) Links of length between $1.6M_p/V_p$ and $2.6M_p/V_p$ shall be provided with intermediate web stiffeners meeting the requirements of (a) and (b) in the preceding.

Intermediate web stiffeners shall not be required in links of length greater than $5M_p/V_p$.

Seismic Provisions for Structural Steel Buildings, July 12, 2016
American Institute of Steel Construction



Sect. F3.]

ECCENTRICALLY BRACED FRAMES (EBF)

9.1-75

Intermediate web stiffeners shall be full depth. For links that are less than 25 in. (630 mm) in depth, stiffeners shall be provided on only one side of the link web. The thickness of one-sided stiffeners shall not be less than t_w or $\frac{3}{8}$ in. (10 mm), whichever is larger, and the width shall not be less than $(b_f/2) - t_w$. For links that are 25 in. (630 mm) in depth or greater, intermediate stiffeners with these dimensions shall be provided on both sides of the web.

1. 新增鋼構耐震設計工具

設計連桿梁加勁板

Link Length = 'e'

CHK	Section			Material	Link		Link Stiffener									
	Shape	Use DB	Name		Length (m)	Angle (Deg.)	Zx (mm ²)	Aweb (mm ²)	Fy (MPa)	Mp (kN.m)	Vp (kN)	Mp/Vp (mm)	breq (mm)	treq (mm)	sreq (mm)	Dbl Stif.
<input checked="" type="checkbox"/>	H Section	<input checked="" type="checkbox"/>	H 400x200x8/13	SS275	1.00	45.00	1330000.00	2992.00	275.00	365.75	493.68	740.86	184.00	10.00	160.00	No

$A_{tw} = (d - 2t_f)t_w$ for I-shaped link sections (F3-4)

$M_p = F_y Z$ for $\alpha_s P_r / P_y \leq 0.15$ (F3-8)

$V_p = 0.6 F_y A_{tw}$ for $\alpha_s P_r / P_y \leq 0.15$ (F3-2) Minimum [Vp, Vn]

$V_n = 2 M_p / e$ (F3-7)

Full-depth web stiffeners shall be provided on both sides of the link web at the diagonal brace ends of the link. These stiffeners shall have a combined width not less than $(b_f - 2t_w)$ and a thickness not less than the larger of $0.75t_w$ or $\frac{3}{8}$ in. (10 mm), where b_f and t_w are the link flange width and link web thickness, respectively.

Links shall be provided with intermediate web stiffeners as follows:

- (a) Links of lengths $1.6M_p/V_p$ or less shall be provided with intermediate web stiffeners spaced at intervals not exceeding $(30t_w - d/5)$ for a link rotation angle of 0.08 rad or $(52t_w - d/5)$ for link rotation angles of 0.02 rad or less. Linear interpolation shall be used for values between 0.08 and 0.02 rad.
- (b) Links of length greater than or equal to $2.6M_p/V_p$ and less than $5M_p/V_p$ shall be provided with intermediate web stiffeners placed at a distance of 1.5 times b_f from each end of the link.
- (c) Links of length between $1.6M_p/V_p$ and $2.6M_p/V_p$ shall be provided with intermediate web stiffeners meeting the requirements of (a) and (b) in the preceding.

Intermediate web stiffeners shall not be required in links of length greater than $5M_p/V_p$.

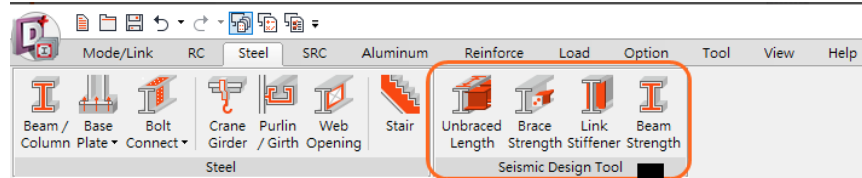
"No" : To provide on one side is possible
"Yes" : To provide on one side is not possible
***** it is just to inform whether one side is possible.**
And all results is for both side.

Link		Link Stiffener									
Length (m)	Angle (Deg.)	Zx (mm ²)	Aweb (mm ²)	Fy (MPa)	Mp (kN.m)	Vp (kN)	Mp/Vp (mm)	breq (mm)	treq (mm)	sreq (mm)	Dbl Stif.
5.00	45.00	-	-	-	-	-	-	-	-	-	-

If $e > 5M_p/V_p$, "-" will be output

1. 新增鋼構耐震設計工具

計算V型斜撐構架梁強度



Chk	Beam					Brace1					Brace2														
	Shape	Use DB	Name	Material	Length (m)	Shape	Use DB	Name	Material	Type	User	Ry	Length (m)	Cb	Angle (Deg.)	Shape	Use DB	Name	Material	Type	User	Ry	Length (m)	Cb	Angle (Deg.)
✓	H Section	✓	H 400x200x8/13	S5275	2.00	H Section	✓	H 200x200x8/12	S5275	Tension Brace	Γ	1.100	1.00	1.00	45.00	H Section	✓	H 200x200x8/12	S5275	Compression Brace	Γ	1.100	1.00	1.00	45.00

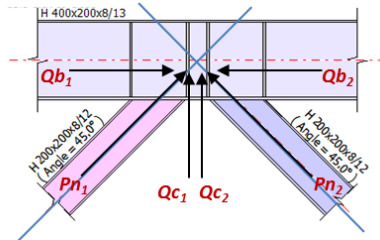
Dead Load			Live Load			Seismic Load			Brace1			Brace2			Design Forces			Design Strength			Strength Ratio						
Factor	Mux (kN.m)	Vuy (kN)	Factor	Mux (kN.m)	Vuy (kN)	Factor	Mux (kN.m)	Vuy (kN)	Fy (MPa)	Pn (kN)	Qb (kN)	Qc (kN)	Fy (MPa)	Pn (kN)	Qb (kN)	Qc (kN)	Fy (MPa)	Pux (kN)	Mux (kN.m)	Vuy (kN)	φPn (kN)	φMn (kN.m)	φVn (kN)	Pux / φPn	Mux / φMn	Vuy / φVn	Comb.
1.20	100.00	100.00	0.50	150.00	150.00	1.00	275.00	275.00	275.00	2271.20	1605.98	1605.98	275.00	512.70	362.53	362.53	275.00	1968.51	195.00	2163.51	1869.26	329.18	528.00	NG(1.053)	OK(0.592)	NG(4.098)	NG(1.580)

$F_D Mux_D Vuy_D F_L Mux_L Vuy_L$

In case of Tension,
 $Pn = Fy * Area * Ry$ (Tension)

In case of compression,
 Pn is the value considered the buckling

$Qb = Qc = Pn / \text{sqrt}(2)$
 * Angle is reflected only with 45.0°



$Pux = Qb_1 + Qb_2$

$Mux = F_D * Mux_D + F_L * Mux_L$

$Vuy = F_D * Vuy_D + F_L * Vuy_L + Qc_1 + Qc_2$

[Combination stress check]

(a) When $\frac{Pr}{Pc} \geq 0.2$

$$\frac{Pr}{Pc} + 8 \left(\frac{Mrx}{Mcx} + \frac{My}{My} \right) \leq 1.0$$

(b) When $\frac{Pr}{Pc} < 0.2$

$$\frac{Pr}{2Pc} + \left(\frac{Mrx}{Mcx} + \frac{My}{My} \right) \leq 1.0$$

In here,
 $Pr = Pux, Pc = \phi Pn$
 $Mrx = Mux, Mcx = \phi Mn$

2. 新增錨定螺栓設計模組 (ACI 318)

- 適用規範: ACI318-14(M), 11(M), 08(M), NSR-10
- 預埋式/後置式錨栓之間距、抗拉與抗剪強度以及組合應力比檢核

The screenshot displays the midas Design software interface for the RC Anchor Bolt design module. The 'Anchor Bolt' option is highlighted in the 'Load' menu. The 'Member' panel shows properties for member AB04, including material (Concrete: 3.915 ksi, Anchor Bolt: A36), plate section dimensions, and RC section details. The design diagram shows a plan view of a square anchor bolt layout with dimensions and a cross-section view showing the anchor bolt embedded in a concrete slab. The 'MIDASIT RC ANCHOR BOLT LIST' dialog shows two configurations: AB03 (24x24x0t) and AB04 (14x14x0t), both with L=5, R=5, T=5, B=5. The report window on the right provides a detailed calculation of tensile strength, including a table of material properties and design checks.

Category	N_u	N_c	$N_u / (\phi N_c)$	Note
Steel strength* (kip)	1.185	0.226	0.192	$\phi = 0.750$
Concrete breakout strength** (kip)	0.603	19.29	0.031	$\phi = 0.650$
Pullout Strength* (kip)	1.185	0.744	0.210	$\phi = 0.650$
Concrete side face blowout strength** (kip)				
Bond Strength of Adhesive Anchor** (kip)				

2. 新增錨定螺栓設計模組 (ACI 318)

錨定螺栓設計程序

Section

Section | Force | Anchor | Layout

Material
Concrete: 27 MPa
Anchor Bolt: KS-B-1016-4.6
 Light Weight Concrete
Factor: 1

Plate Section
Left: 80.00 mm
Right: 80.00 mm
Top: 80.00 mm
Bottom: 80.00 mm
Thickness: 6.00 mm

RC Section
 Crack Uncrack
Left: 120.00 mm
Right: 120.00 mm
Top: 120.00 mm
Bottom: 120.00 mm
Thickness: 500.00 mm
 Grout: 5.00 mm

Step 1.
定義混凝土與錨栓材料以及構件配置資訊

Force

Section | Force | Anchor | Layout

Force
Axial: 500.00 kN
Moment (x): 10.00 kN.m
Moment (y): 20.00 kN.m
Shear (x): 30.00 kN
Shear (y): 40.00 kN
Torsion: 5.00 kN.m
 Load Combinations (1) ...

Step 2.
定義設計外力。
(Axial, Moment, Shear, Torsion)

Anchor

Section | Force | Anchor | Layout

Anchor
Install Type: Cast-In-Place Anchor I
Anchor Type: Headed Stud
Diameter: M12
Length (hef): 180.00 mm
Pullout Strength (Np): 30.00 kN
Dist. of J/L-Bolt (eh): 30.00 mm

Strength Reduction Factor
Concrete, Tension: 0.650
Concrete, Shear: 0.750
Anchor, Tension: 0.750
Anchor, Shear: 0.650

Design
Breakout Strength Coefficient (kc): 10.000

Step 3.
定義錨栓資訊。

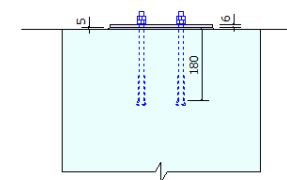
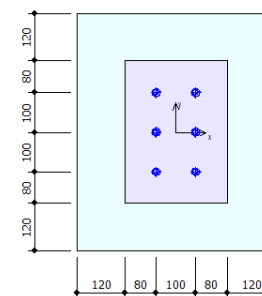
預埋式錨栓 : Headed Stud / Headed Bolt/ Hooked Bolt(L/J)
後置式錨栓 :
Expansion(Torque, Displacement), Undercut, Adhesive anchors

Layout

Section | Force | Anchor | Layout

Layout Type: Grid Type
Space (Int. x): 130.00 mm
Space (Int. y): 100.00 mm
Space (Ext. x): 100.00 mm
Space (Ext. y): 100.00 mm
Num. of Row: 3
Num. of Col: 2

Step 4.
定義錨栓的佈置方式以及數量與間距



2. 新增錨定螺栓設計模組 (ACI 318)

Summary Calculation Report

7. Calculation Summary

(1) Required edge distances, spacings, and thicknesses to preclude splitting failure

Category	Value	Criteria	Ratio	Note
Minimum spacing of anchors (mm)	100	72.00	0.720	s_{req} / s_{min}
Minimum edge distances (mm)	-	-	-	-
Limit of embedment depth (mm)	-	-	-	-

(2) Tensile strength

Category	N_{us}	N_n	$N_{us} / (\phi N_n)$	Note
Steel strength* (kN)	0.000	33.72	0.000	$\phi = 0.750$
Concrete breakout strength** (kN)	0.000	0.000	0.000	$\phi = 0.650$
Pullout Strength* (kN)	0.000	50.38	0.000	$\phi = 0.650$
Concrete side-face blowout strength** (kN)	-	-	-	-

* anchor having the highest loading

** anchor group (anchors in tension)

(3) Shear strength

Category	V_{us}	V_n	$V_{us} / (\phi V_n)$	Note
Steel strength* (kN)	8.333	26.98	0.475	$\phi = 0.650$
Concrete breakout strength** (Dir. X) (kN)	15.00	41.67	0.480	$\phi = 0.750$
Concrete breakout strength** (Dir. Y) (kN)	13.33	34.73	0.512	$\phi = 0.750$
Concrete pryout strength** (kN)	-	-	-	-

* anchor having the highest loading

** anchor group (relevant anchors)

(4) Combined Ratio

Category	Value	Criteria	Ratio	Note
Combined Ratio	0.512	1.000	0.512	

Detail Calculation Report

11. Required edge distances, spacings, and thicknesses to preclude splitting failure

[KDS 14 20 54 : 2016, Sec. 4.6(2)]

Calculation Summary (Required edge distances, spacings, and thicknesses to preclude splitting failure)

(1) Minimum center-to-center spacing of anchors

s_{min}	s_{req}	s_{req} / s_{min}
100mm	72.00mm	0.720

- $s_{min} = 100\text{mm}$
- $s_{req} = 6 d_s = 72.00\text{mm}$
- $s_{min} = 100\text{mm} > s_{req} = 72.00\text{mm} \rightarrow \text{O.K}$

(2) Check Distance from Concrete Edge to Center of Anchor Bolt

Post-installed anchors only.

(3) The limitations on the value of h_{ef}

Expansion or undercut post-installed anchors only.

(4) The critical edge distance (c_{ac})

Post-installed anchors only.

13. Calculate Shear Strength

Failure modes for anchors. (Shear loading)

(1) Steel strength

(2) Pullout Strength

(3) Concrete breakout strength

Calculation Summary (Shear strength)

(1) Calculate Strength of Steel

[KDS 14 20 54 : 2016, Sec. 4.4.1, ref. ACI 318-14 17.5.1]

- $\phi = 0.650$
- $f_{us} = \min(f_{us} , 1.9f_{ys} , 860.0) = 400\text{MPa}$
- $A_{se,v} = 84.30\text{mm}^2$

For cast-in headed stud anchor

- $V_{ss} = n A_{se,v} f_{us} = 33.72\text{kN} (n = 1)$

Where anchors are used with built-up grout pads

- $V'_{ss,grout} = 0.8 V_{ss} = 26.98\text{kN}$
- $V_{n1} / (\phi V_{ss}) = 0.475 < 1.0 \rightarrow \text{O.K}$

(2) Calculate Concrete Break-Out Strength

[KDS 14 20 54 : 2016, Sec. 4.4.2]

- $\phi = 0.750$
- $d_s = 12.00\text{mm}$
- $\lambda = 1.000$

Where l_a is the load-bearing length of the anchor for shear.

- $l_c = \min(8d_s , h_{ef}) = 96.00\text{mm}$

- 提供 設計摘要/詳細計算 等不同格式的報表內容。
- 報表中列出規範章節便於檢視計算內容。