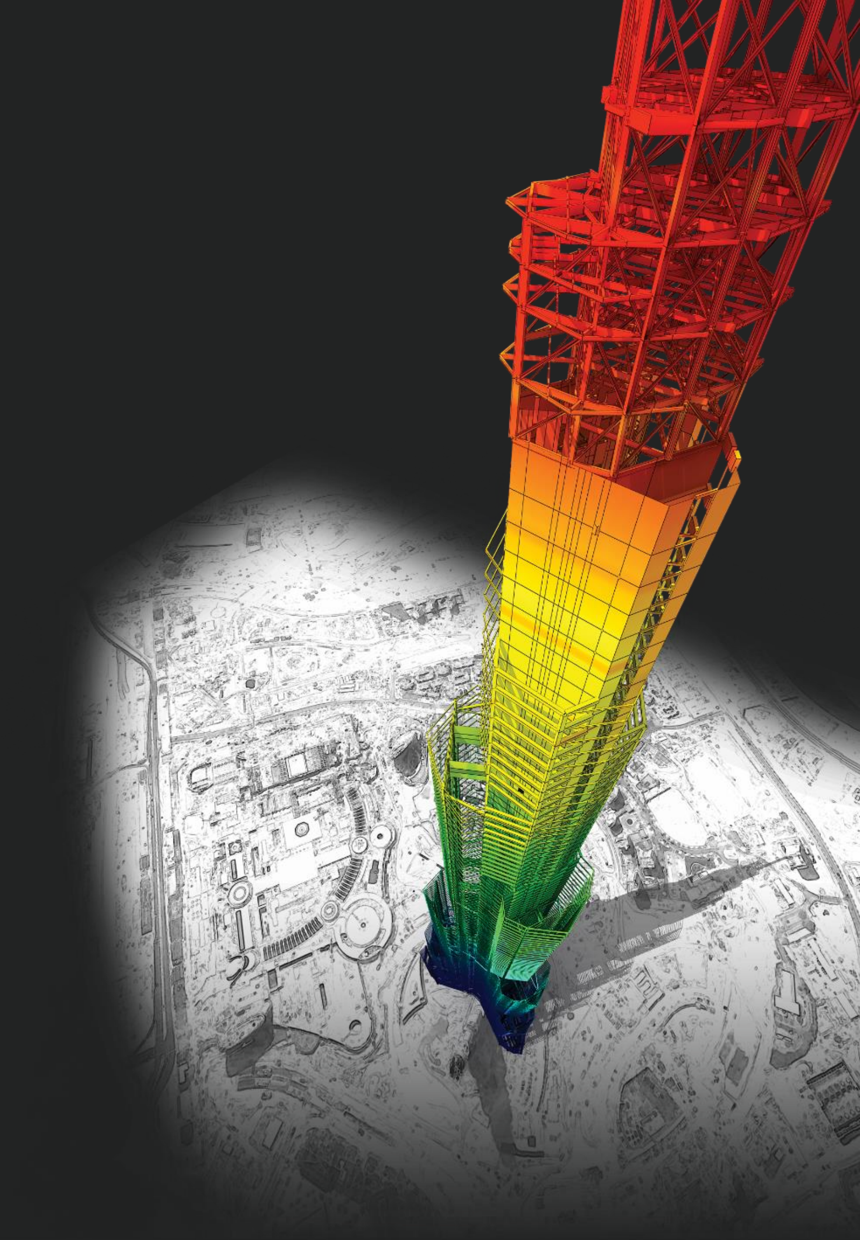
# Release Note

**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



## midas Design+

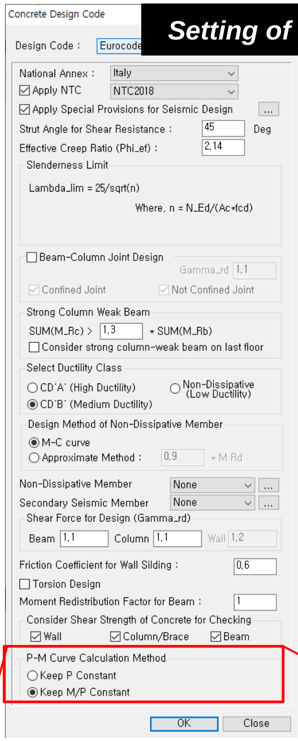
*midas* ***Gen***

# 1. 優化RC柱構件設計功能

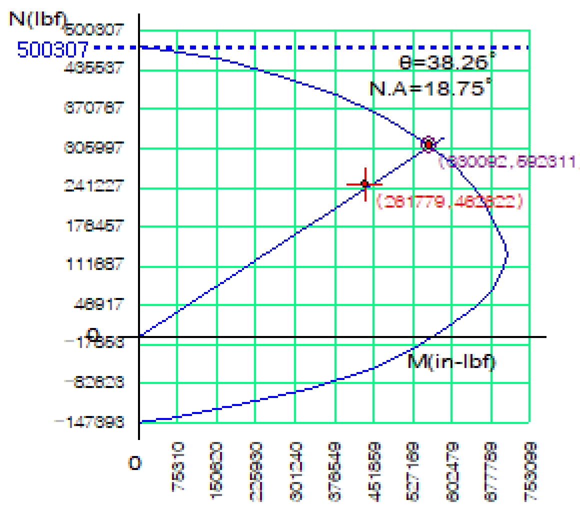
## *Add Design by Constant P*

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

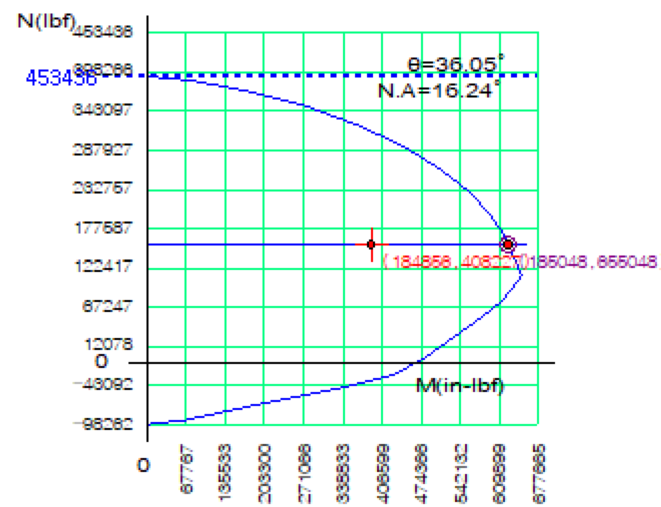
**Setting of Concrete Design Code**



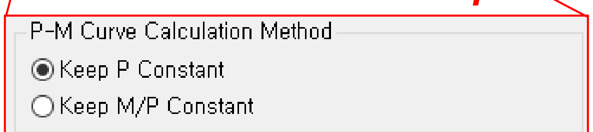

**Keep M/P Constant**




**Keep Constant P (New)**



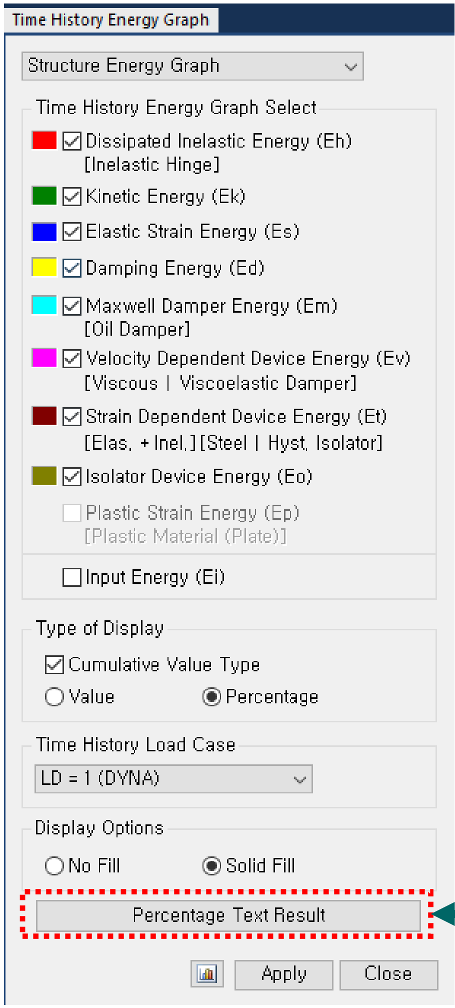

***Add Option***

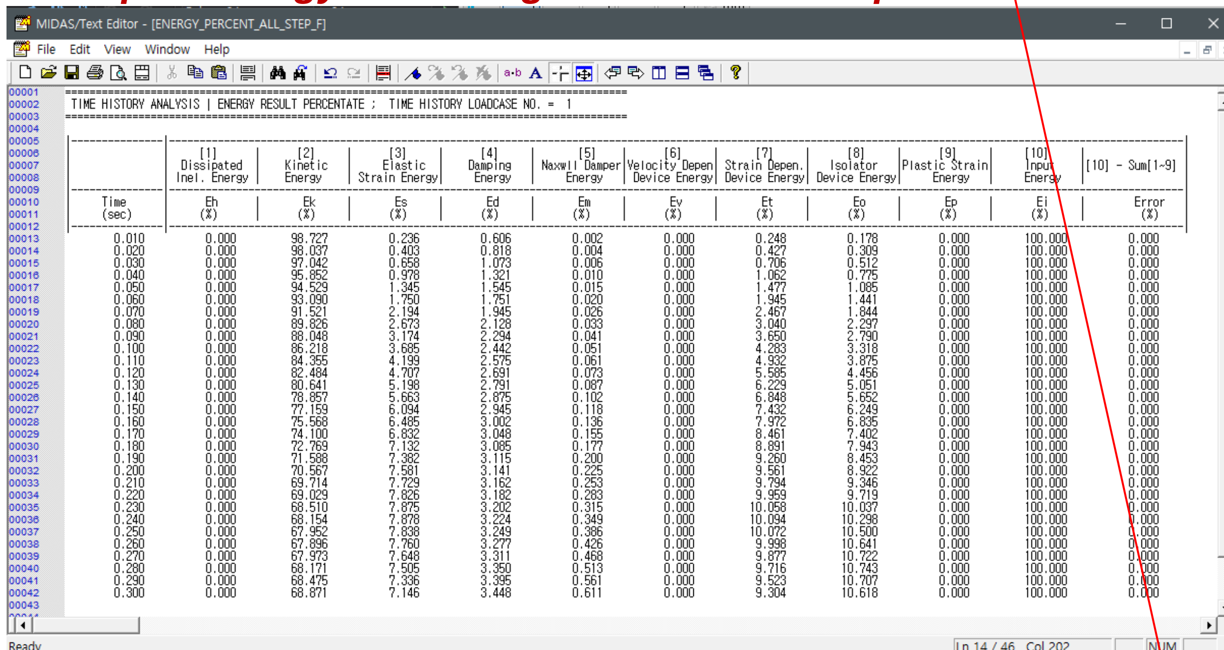



- *Support seismic design by axial force(P) constant method.*
- *Apply axial force(P) constant method to all or individual columns, walls and braces*

# 2. 優化歷時分析結果之能量圖顯示內容

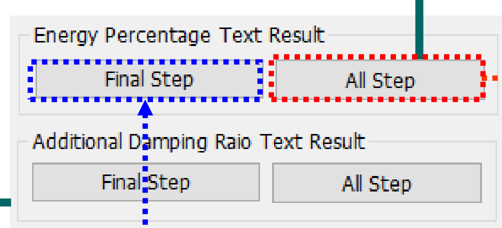
## *Improvement of Energy Result Graph : Energy Percentage Result of all steps*




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

| | [1] Dissipated Inel. Energy | [2] Kinetic Energy | [3] Elastic Strain Energy | [4] Damping Energy | [5] Naxwll Damper Energy | [6] Velocity Depen Device Energy | [7] Strain Depen. Device Energy | [8] Isolator Device Energy | [9] Plastic Strain Energy | [10] Input Energy | [10] - Sum[1~9] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Time (sec) | Eh (%) | Ek (%) | Es (%) | Ed (%) | Em (%) | Ev (%) | Et (%) | Eo (%) | Ep (%) | Ei (%) | Error (%) |
| 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 | 84.355 | 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 | 5.585 | 4.456 | 0.000 | 100.000 | 0.000 |
| 0.130 | 0.000 | 80.641 | 5.198 | 2.791 | 0.087 | 0.000 | 6.229 | 5.051 | 0.000 | 100.000 | 0.000 |
| 0.140 | 0.000 | 78.857 | 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 | 72.769 | 7.132 | 3.085 | 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 | 69.029 | 7.826 | 3.182 | 0.283 | 0.000 | 9.959 | 9.719 | 0.000 | 100.000 | 0.000 |
| 0.230 | 0.000 | 68.510 | 7.875 | 3.202 | 0.315 | 0.000 | 10.058 | 10.037 | 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 | 3.249 | 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 |



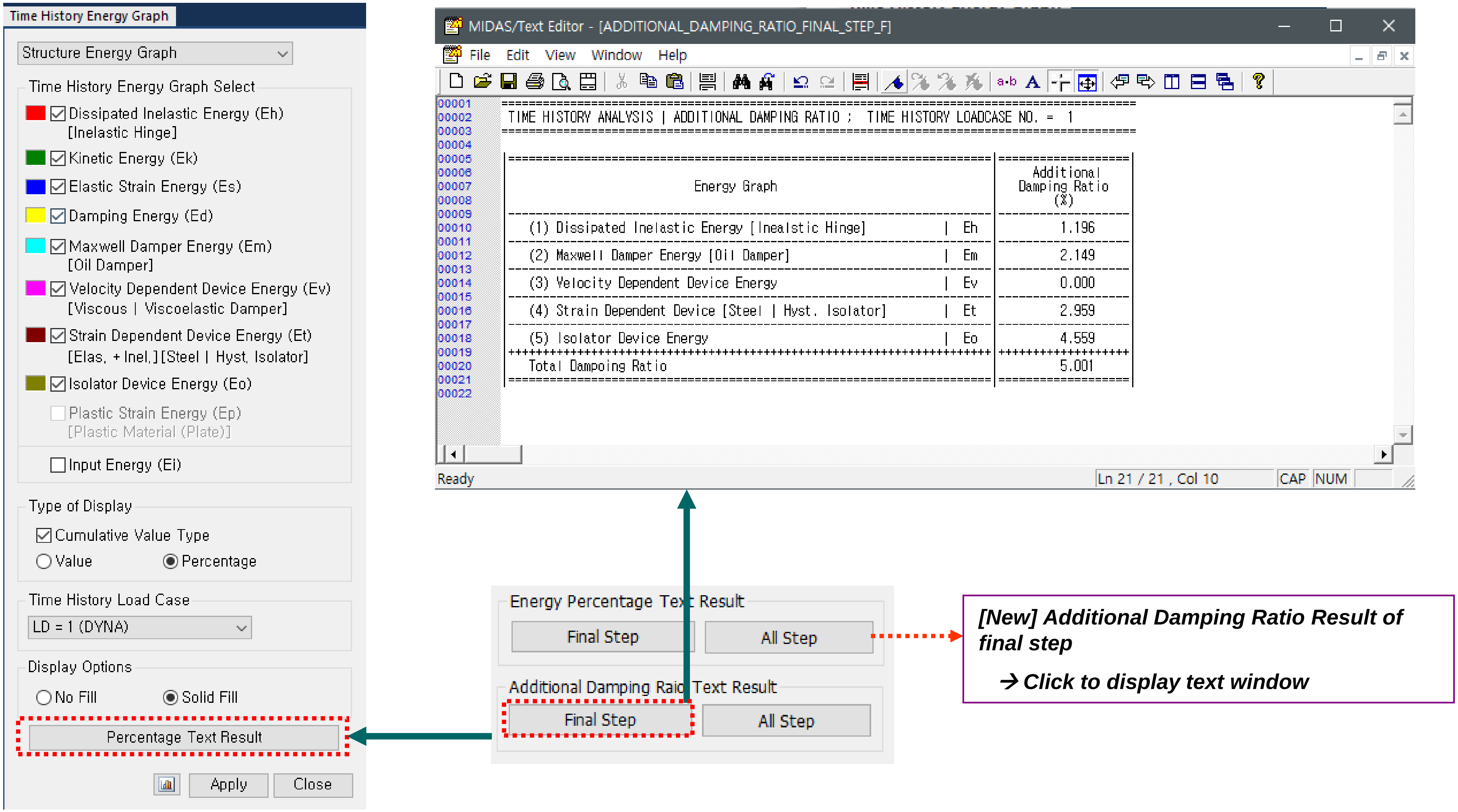

***[New] Energy Percentage Result of all steps***

***→ Click to display text window***

***[Exiting] Energy Percentage Final Step Result***

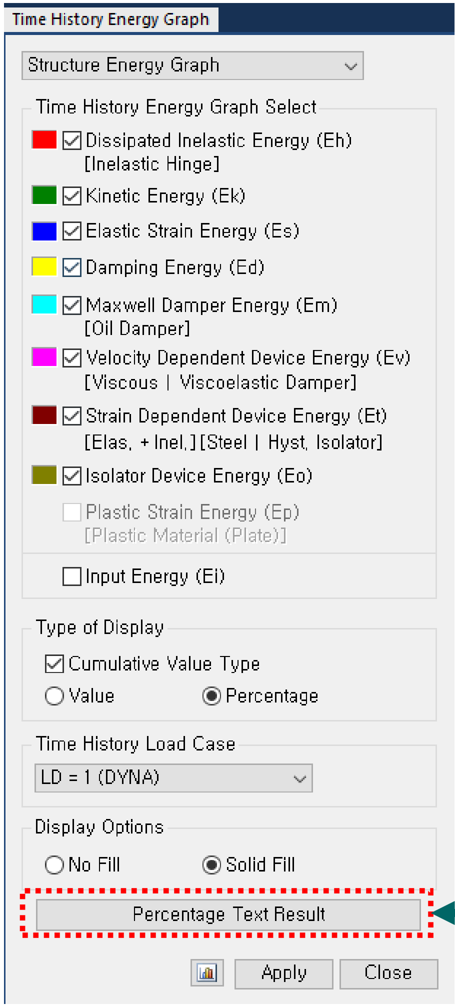
# 2. 優化歷時分析結果之能量圖顯示內容

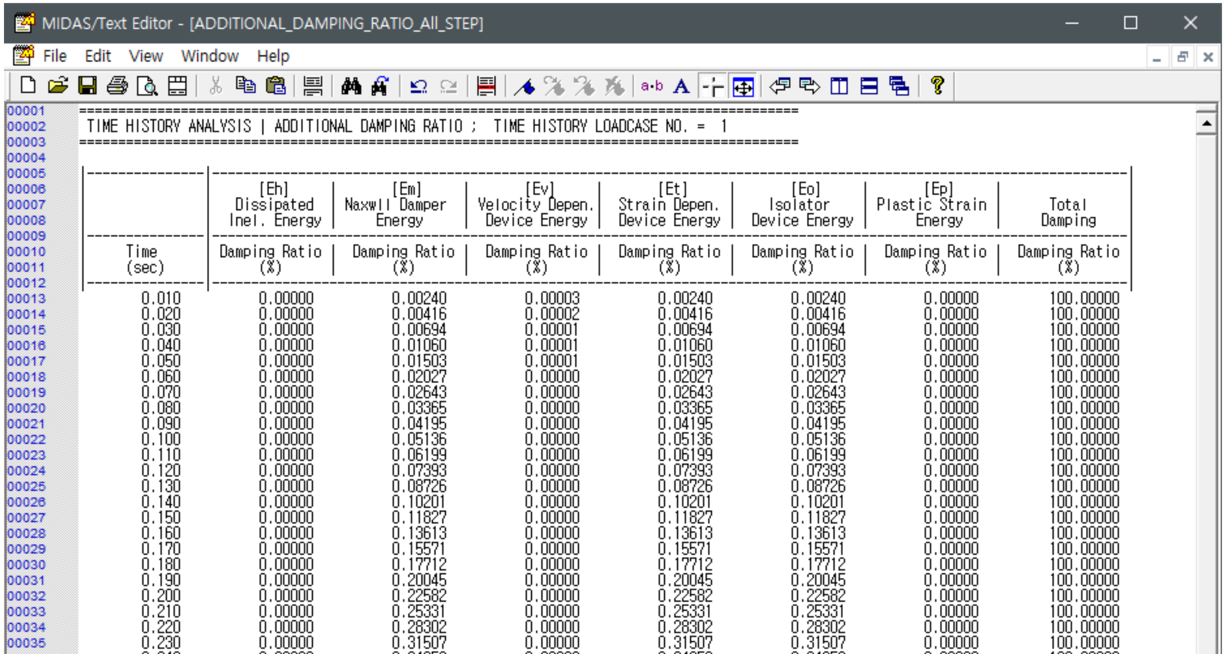
***Additional Damping Ratio of Energy Dissipation System is added.***



# 2. 優化歷時分析結果之能量圖顯示內容

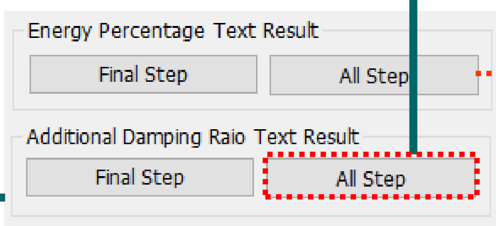
## *Additional Damping Ratio of Energy Dissipation System is added.*




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

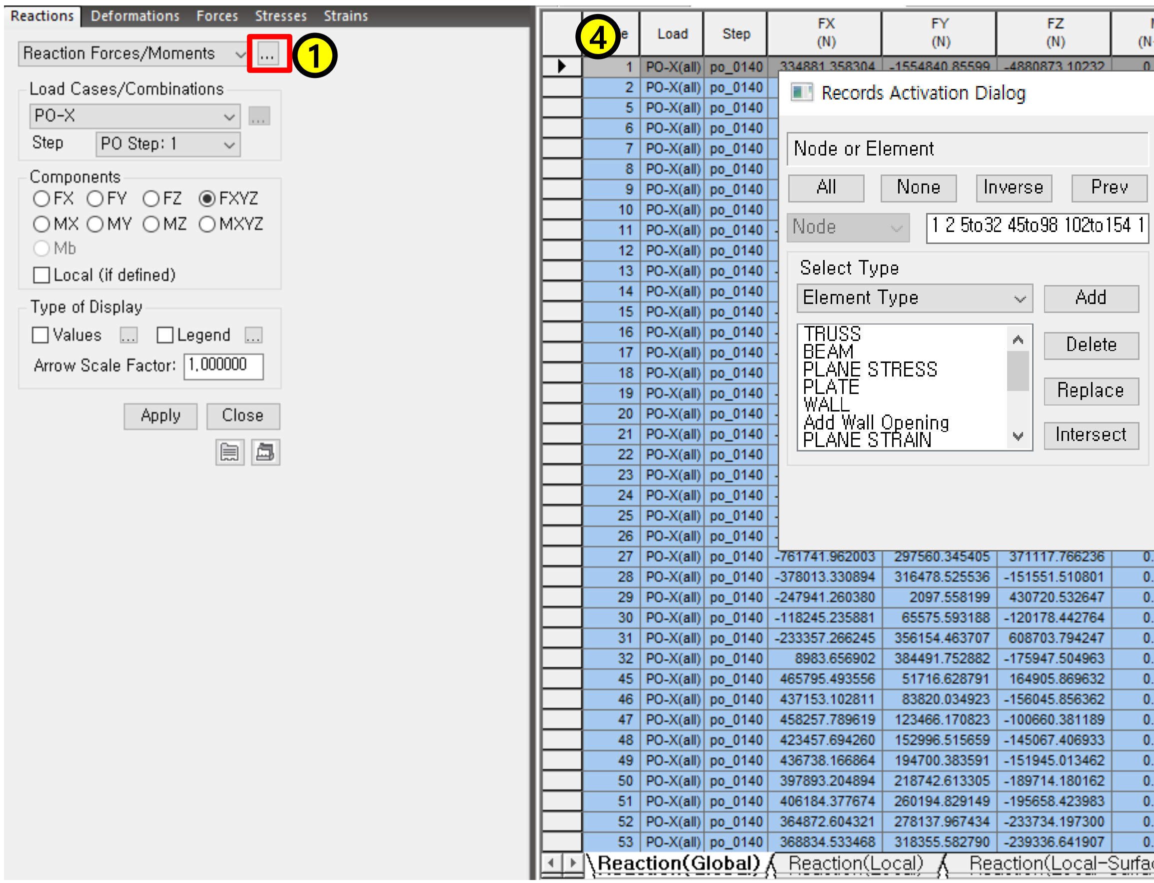
| Time (sec) | [Eh] Dissipated Inel. Energy Damping Ratio (%) | [Em] Naxwll Damper Energy Damping Ratio (%) | [Ev] Velocity Depen. Device Energy Damping Ratio (%) | [Et] Strain Depen. Device Energy Damping Ratio (%) | [Eo] Isolator Device Energy Damping Ratio (%) | [Ep] Plastic Strain Energy Damping 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 |

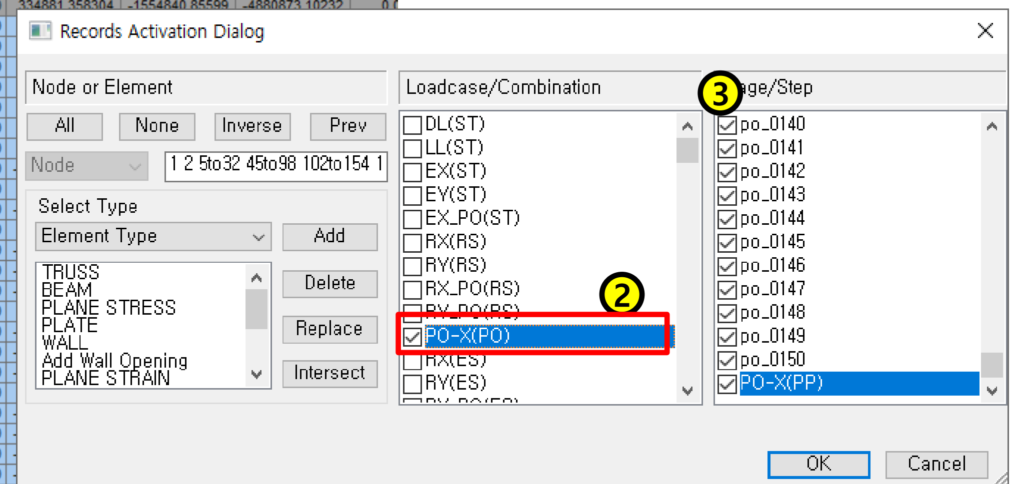



***[New] Energy Percentage Result of all steps***
***→ Click to display text window***

# 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.***




***Step 1. Open Records Activation Dialog box.***

***Step 2. Select Load case for pushover.***

***Step 3. Select Pushover step.***

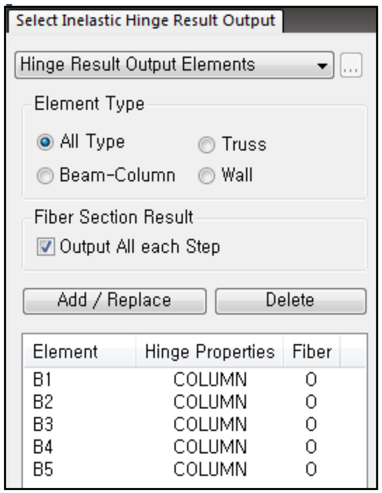
***Step 4. Printout Reaction table***

# 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*

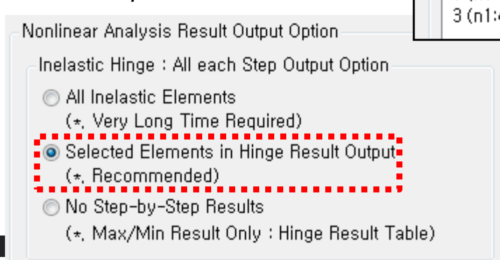
### Select the element to print

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



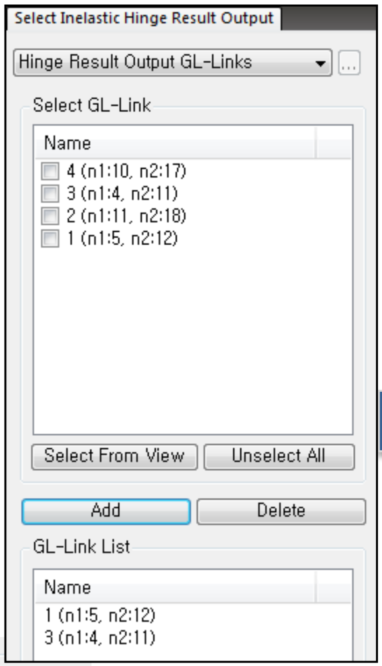

### Global Control Setting

- *Set to output  selected elements*



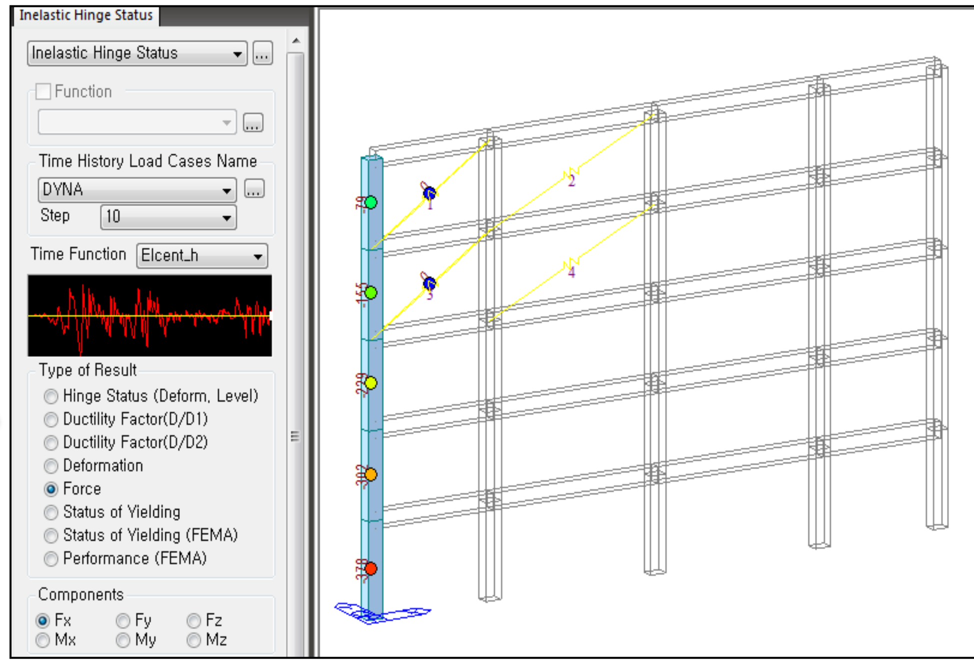

### Select General Link to print

- *Press 'Add' button after*
- *Selecting GL-Link*




### Inelastic Hinge Status Result

- *Check result of selected elements*

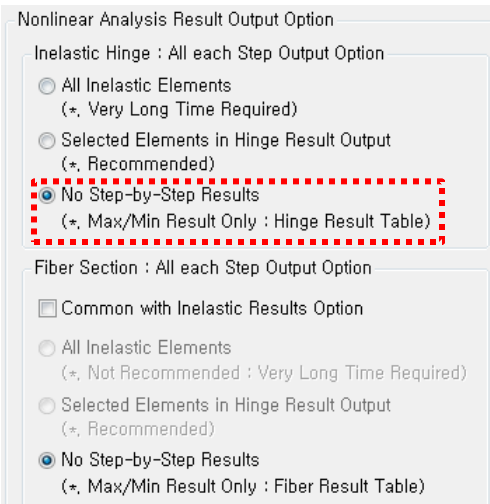



- ***Elements and General Links can be filtered for the output of inelastic time history analysis.***
- ***Analysis time can be much reduced by selecting only the desired elements/general links.***

# 4. 優化非彈性歷時分析結果之呈現方式

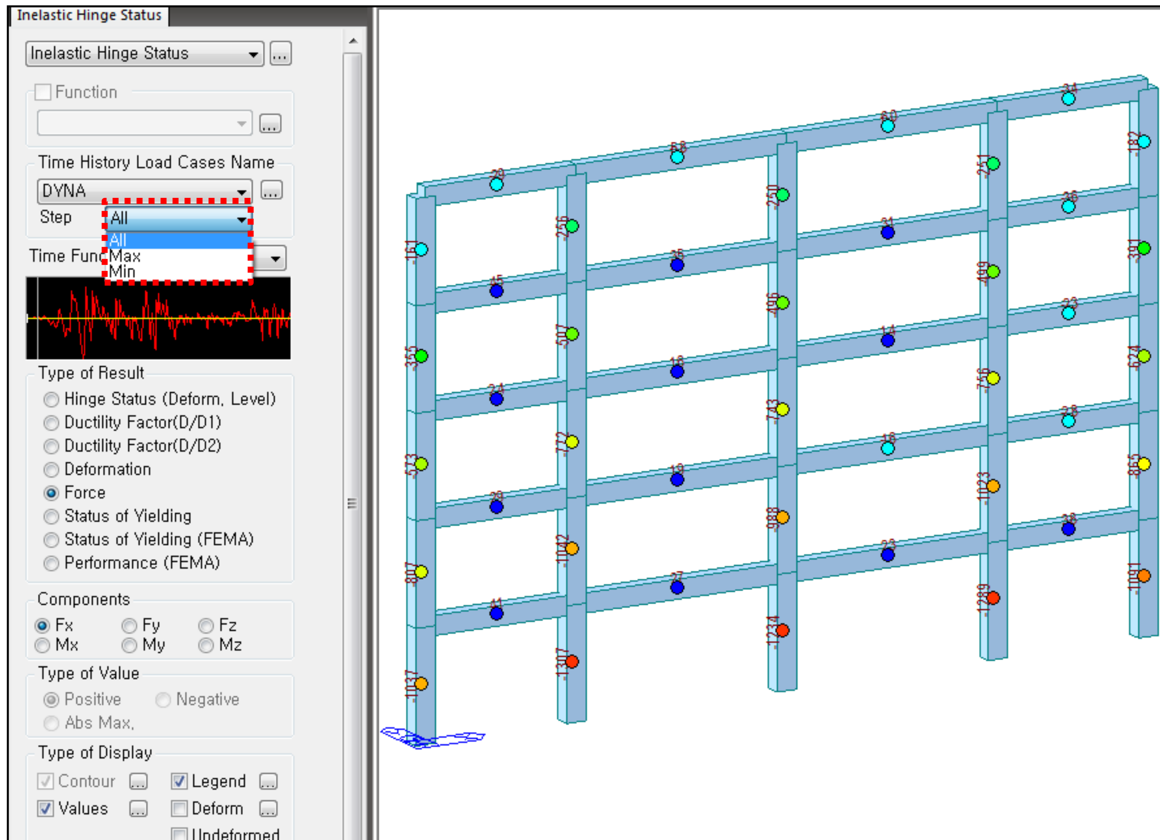
**_Global Control Setting_**

*- Set to Max/Min Result Only*




**_Inelastic Hinge Status Result_**

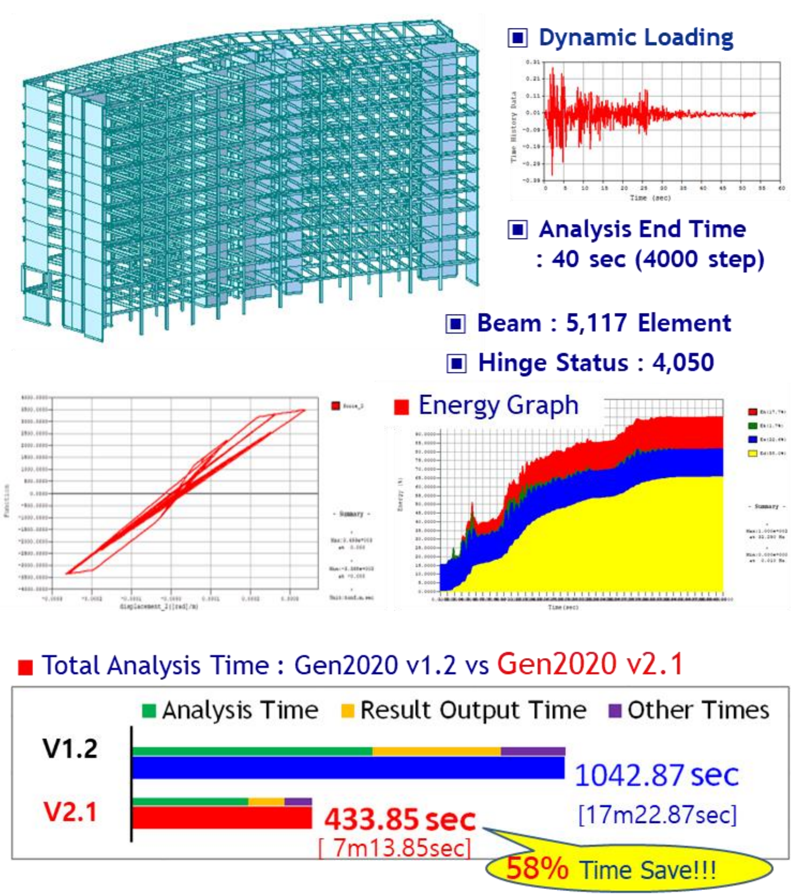
*- Check Max/Min result output*



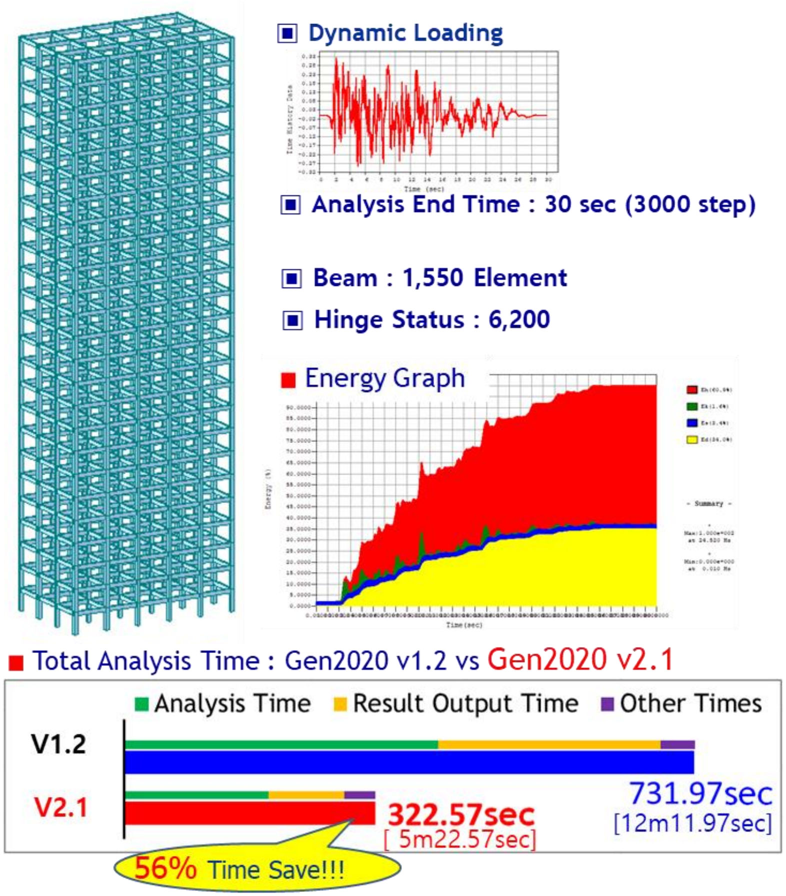
# 5. 優化非彈性歷時分析運算速度

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

**3D Structure Hinge Model (12F)**




**3D Fiber Wall Model (23F)**



# 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 Beam Summary /

### *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

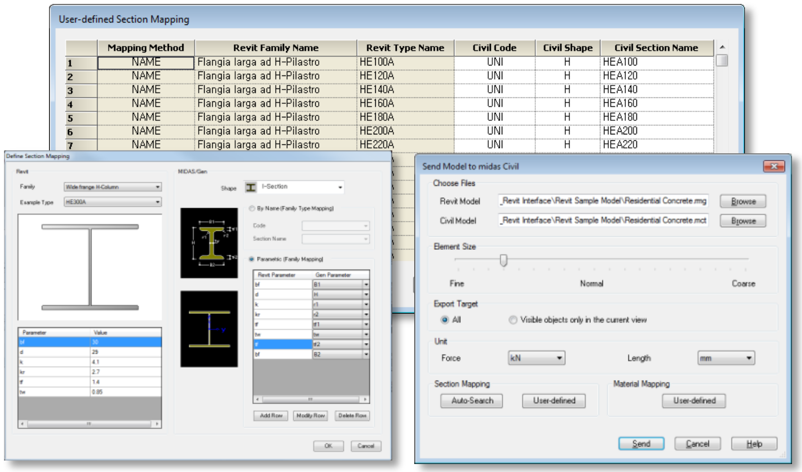
| Story | Wall ID | Section | Load | Concrete | | | | | | Steel | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | | | Maximum | | | Minimum | | | Maximum | | |
| | | | | Cell | ε | Time/Step | Cell | ε | Time/Step | Cell | ε | Time/Step | Cell | ε | Time/Step |
| 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 |

\Fiber Wall Summary /

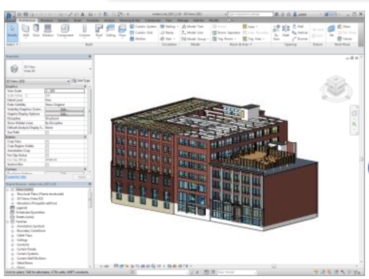
# 7. Gen-Revit 2020 轉換介面

## *Gen-Revit Link*

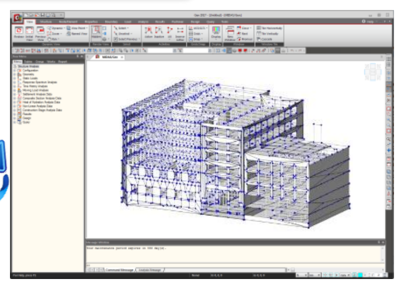
- ***File > Import > midas Gen MGT File***
- ***File > Export > midas Gen MGT File***




Send Model to midas Gen



Revit 2020

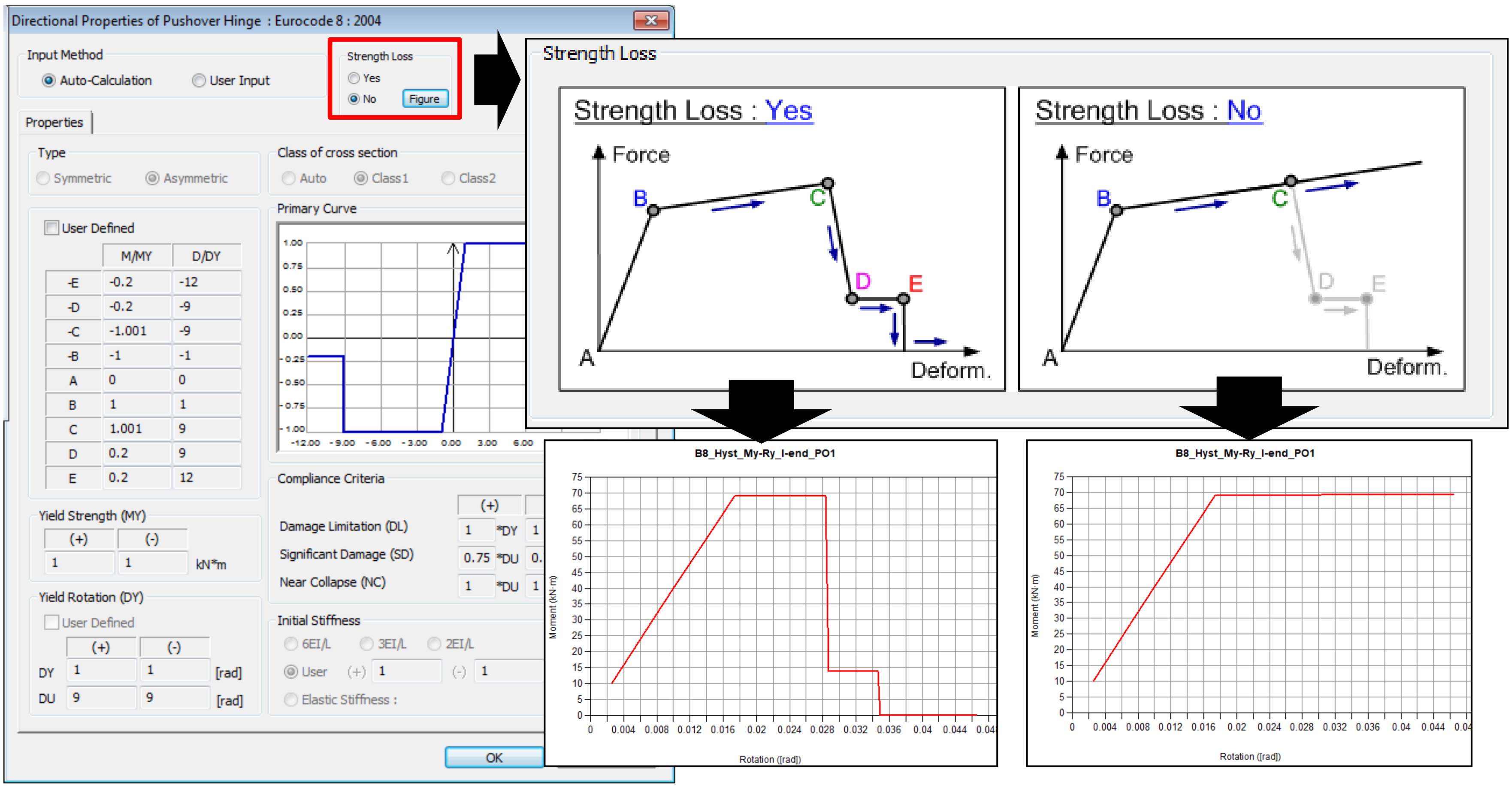


Gen2020

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

# 8. EC8塑鉸性質新增Strength Loss功能選項

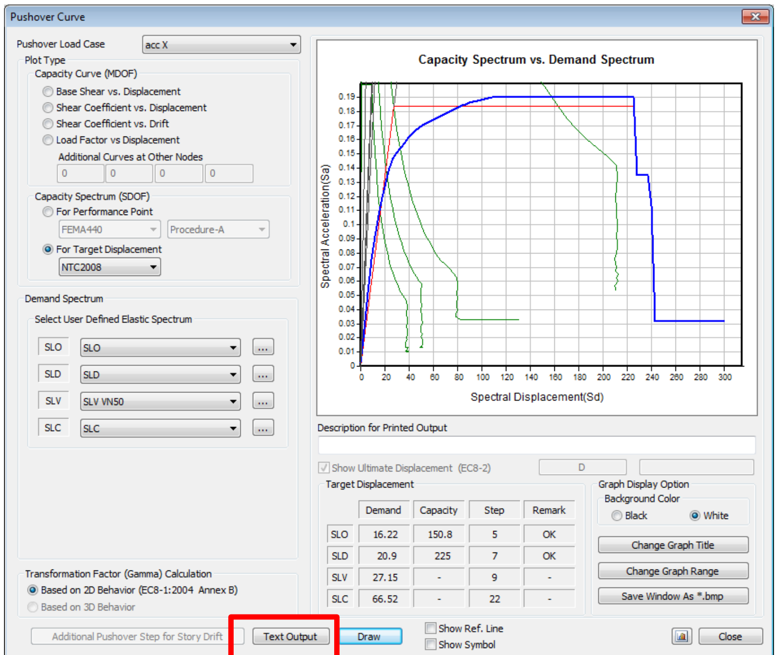
## *Insert Strength loss option for EC8 hinge type*



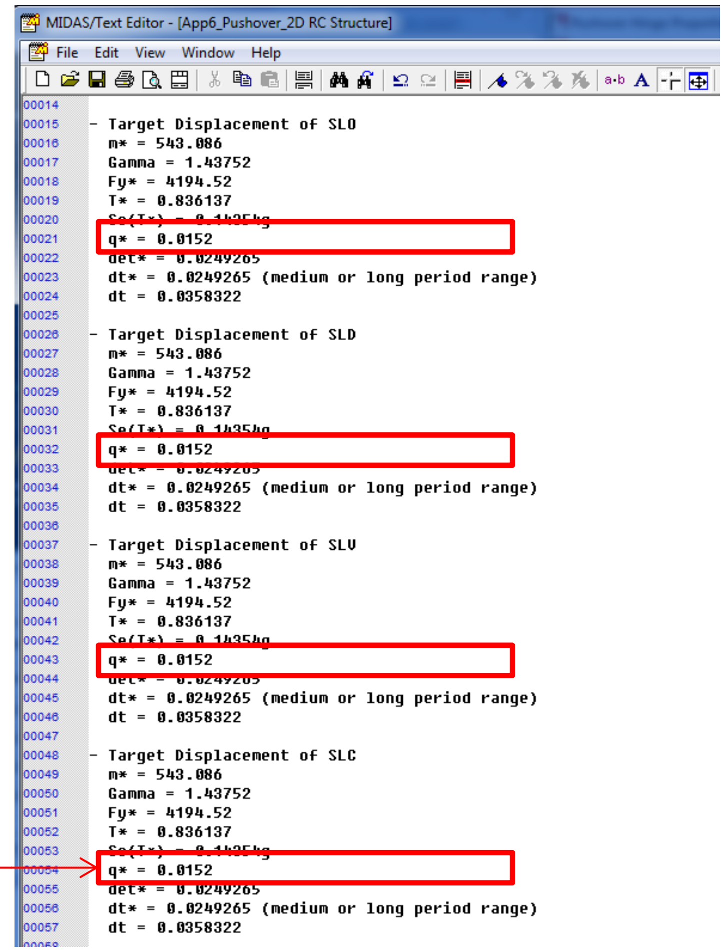
# 9. 優化磚石結構側推分析與後處理功能

## *Improvement about Masonry pushover analysis and post processing*

*1) Printout “q*” value in Text Output*



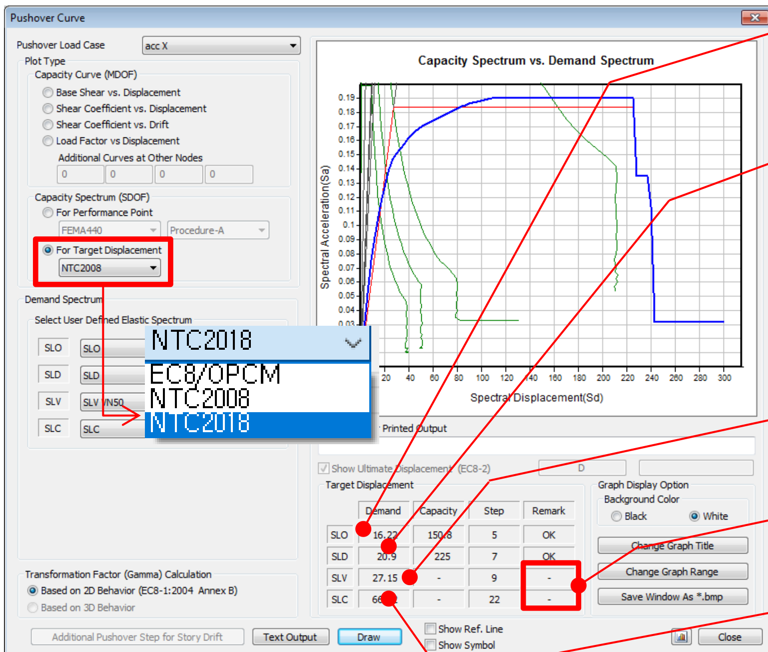

$$q^* = \frac{S_{Ae}(T^*)m^*}{F_y^*}$$



# 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

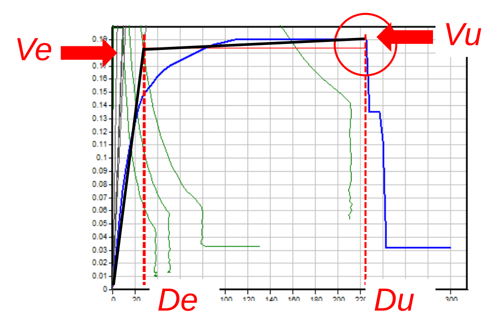
**SLD**: Capacity of SLD
= Min.Displacement of Ve and ¾ Vu

*Ve = max shear of bilinear curve
*Vu = max shear of MDOF curve

**SLV**: Ultimate displacement (Du) x 3/4

Add Remark for SLV & SLC

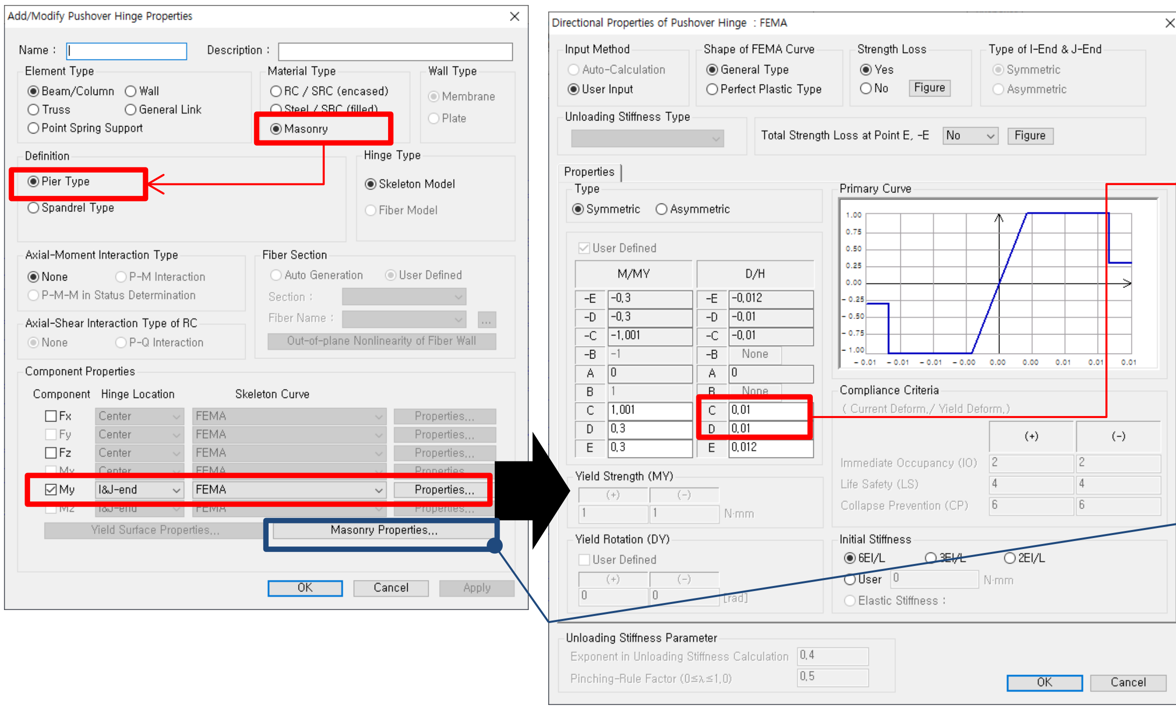
**SLC**: Ultimate displacement (Du) x gamma



# 9. 優化磚石結構側推分析與後處理功能

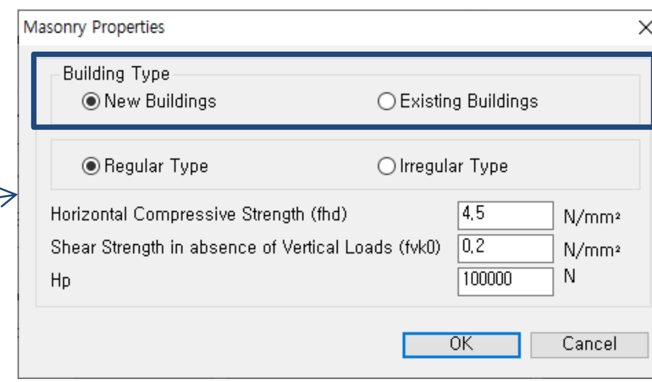
## *Updating 'My' in Masonry with Pier hinge Type*

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




### *Default Values of D/H*

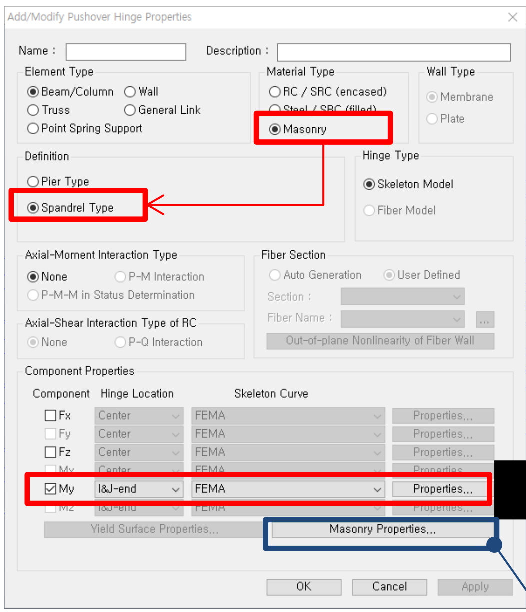
| Point | New Building | Existing Building |
|---|---|---|
| C | 0.01 | 0.01 |
| D | 0.01 | 0.01 |

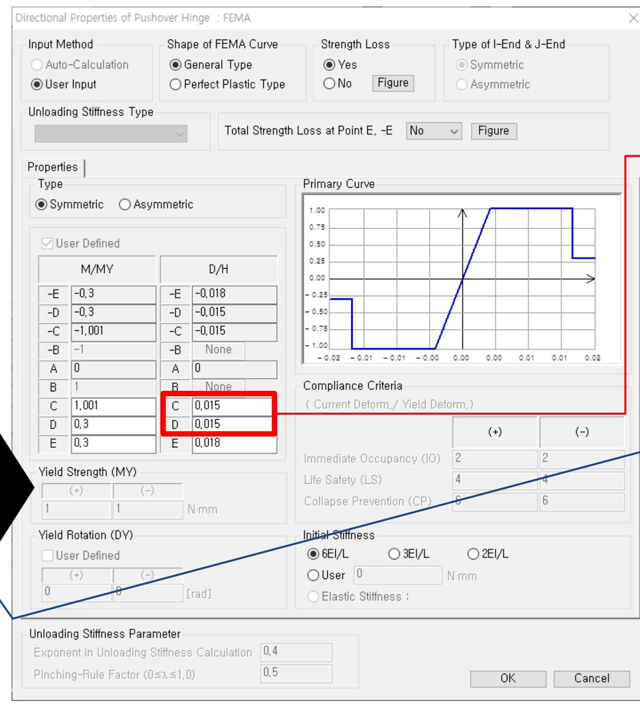


# 9. 優化磚石結構側推分析與後處理功能

## *Updating ‘My’ in Masonry with Spandrel Type*

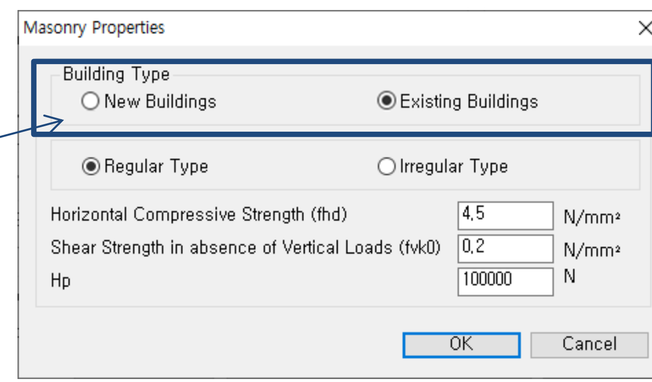
- *Building type is added, i.e. New Buildings, Existing Buildings.*
- *Default values of D/H will change depending on the building type.*




*Default Values of D/H*

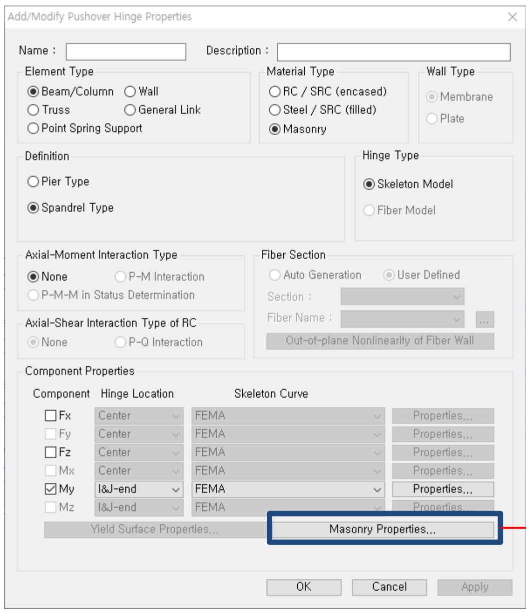
| Point | New Building | Existing Building |
|---|---|---|
| *C* | *0.008* | *0.015* |
| *D* | *0.008* | *0.015* |

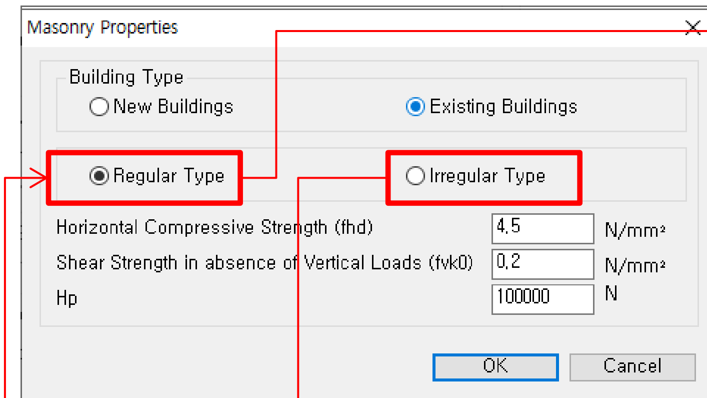


# 9. 優化磚石結構側推分析與後處理功能

## Updating Fz in Masonry with Spandrel hinge Type

- *Improvement of formula for shear resistance in irregular type*




*Shear Resistance =*

*Min. [* $V_t = htf_{vko}, V_p = 2M_u/l$ *]*

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

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

*Shear Resistance =*

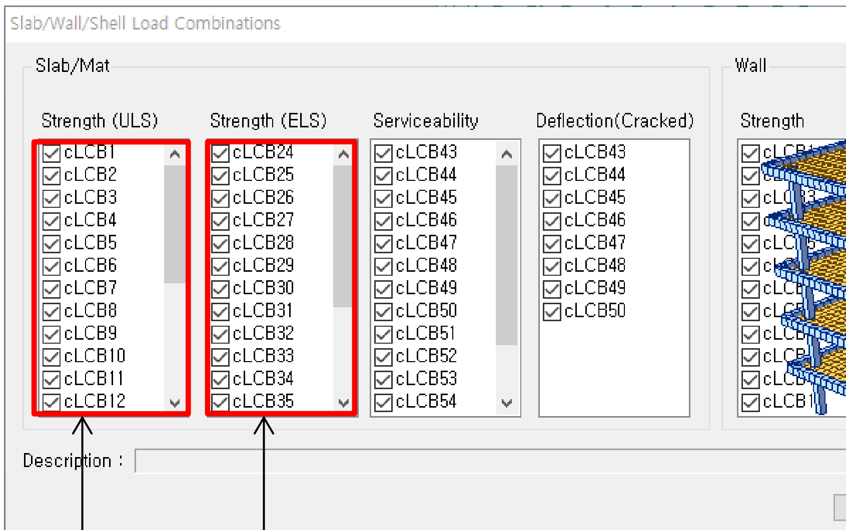
$$V_t = L \times T \times 1.5 f_{vko}/\beta \times \sqrt{1 + P/1.5 f_{vko}}$$

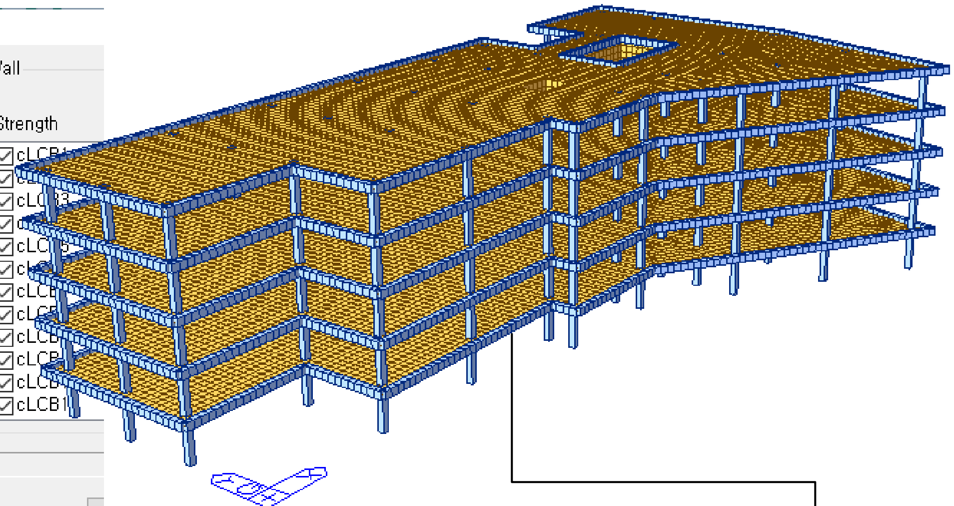
*where*

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

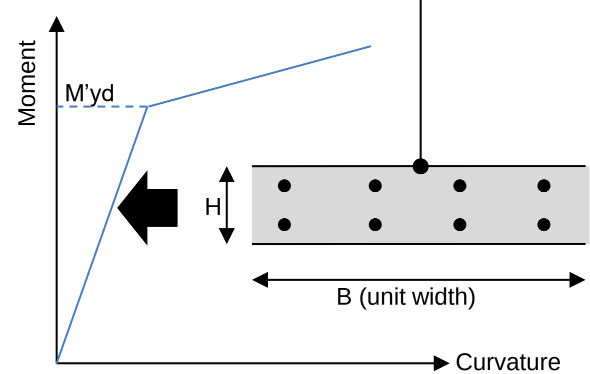
# 10. 新增NTC2018規範Non-dissipative element之版設計功能

***Non-dissipative element design is added for slab.***



- ***Moment -Curvature Curve of Slab***




- ***Only 'Concrete Code Check' is supported***

***<u>Strength (ULS)</u>***
: Add All load Combinations of ULS

***<u>Strength (ELS) (New)</u>***
: 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  --->  0.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  --->  0.K
```

### Stress check by Quasi-permanent

```
-. Information of Parameters.
   Elem No.  : 91
   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 =  1087.69729 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     =     0.60000
   k2     =     0.45000
   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  =      0.15209 m.
   Iyy     =      0.00230  m^4./m.
   Ss_con (Tens.) = M_Ed*(H-ybar_t)/Iyy =   254.61148 tonf/m^2.
   Ss_con (Tens.) > fctm,fl              ---> Check Cracked Section !!!

  [ Dead Load Cases ]
  M_Ed_D  =         2.56  tonf-m./m.
  n       =     13.98215( Long Term ).
  X       =        0.056 m.
  Icr     =         0.0003  m^4./m.
  ybar_t  =        0.056 m.
  Ss_conD = M_Ed_D*ybar_t/Icr       =   442.81327 tonf/m^2.
  Ss_stlD = M_Ed_D*(d-ybar_t)*n/Icr = 18688.77997 tonf/m^2.

  [ Live Load Cases : Quasi-permanent ]
  M_Ed_L  =         0.03  tonf-m./m.
  n       =     13.98215( Long Term ).
  X       =        0.056 m.
  Icr     =         0.0003  m^4./m.
  ybar_t  =        0.056 m.
  Ss_conL = M_Ed_L*ybar_t/Icr       =     4.84833 tonf/m^2.
  Ss_stlL = M_Ed_L*(d-ybar_t)*n/Icr =   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.
  Icr     =         0.0002  m^4./m.
  ybar_t  =        0.041 m.
  Ss_conE = M_Ed_E*ybar_t/Icr       =   313.84428 tonf/m^2.
  Ss_stlE = M_Ed_E*(d-ybar_t)*n/Icr =  9765.27236 tonf/m^2.

  Ss_con  = Ss_conD + Ss_conL + Ss_conE =   761.50587 tonf/m^2.
  Ss_stl  = Ss_stlD + Ss_stlL + Ss_stlE = 28658.67446 tonf/m^2.
  Ss_con > k2*fck =   734.19567 tonf/m^2.   ---> Not Acceptable !!!
  Ss_stl < k3*fyk = 32630.91882 tonf/m^2.   ---> 0.K !
```

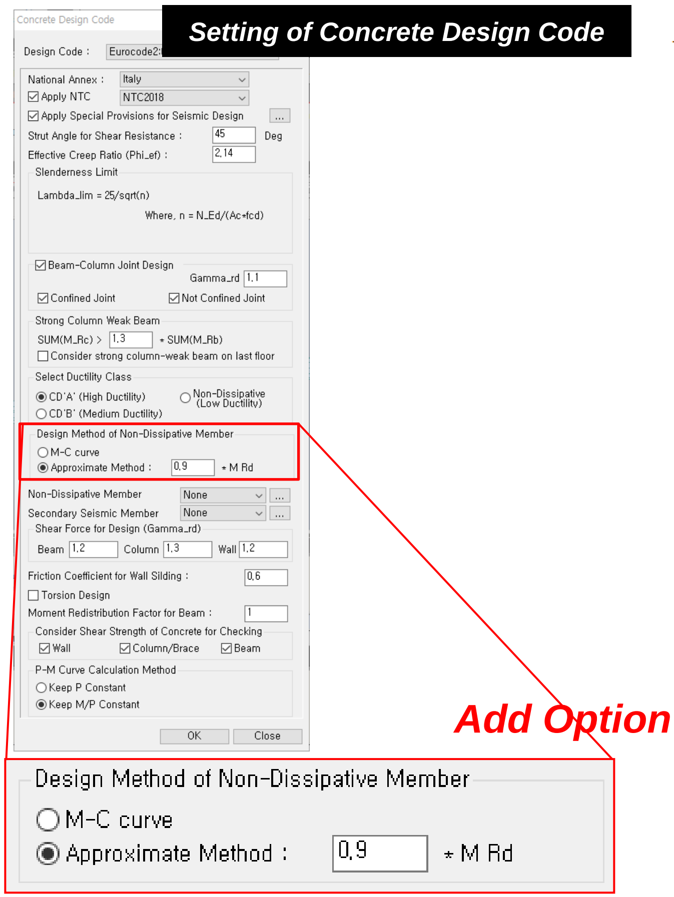

```
[ Live Load Cases : Quasi-permanent ]
M_Ed_L  =         0.03  tonf-m./m.
n       =     13.98215( Long Term ).
X       =        0.056 m.
Icr     =         0.0003  m^4./m.
ybar_t  =        0.056 m.
Ss_conL = M_Ed_L*ybar_t/Icr       =     4.84833 tonf/m^2.
Ss_stlL = M_Ed_L*(d-ybar_t)*n/Icr =   204.62213 tonf/m^2.

[ Etc. Load Cases ]
M_Ed_E  =         1.37  tonf-m./m.
n       =      6.99107( Short Term ).
X       =        0.041 m.
Icr     =         0.0002  m^4./m.
ybar_t  =        0.041 m.
Ss_conE = M_Ed_E*ybar_t/Icr       =   313.84428 tonf/m^2.
Ss_stlE = M_Ed_E*(d-ybar_t)*n/Icr =  9765.27236 tonf/m^2.

Ss_con  = Ss_conD + Ss_conL + Ss_conE =   761.50587 tonf/m^2.
Ss_stl  = Ss_stlD + Ss_stlL + Ss_stlE = 28658.67446 tonf/m^2.
Ss_con > k2*fck =   734.19567 tonf/m^2.   ---> Not Acceptable !!!
Ss_stl < k3*fyk = 32630.91882 tonf/m^2.   ---> 0.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 : $M'_{yd}$ = Reduction factor * $M_{Rd}$*




**Beam Design Report**

. 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 |

M_yd' = 0.9 * M_Rd

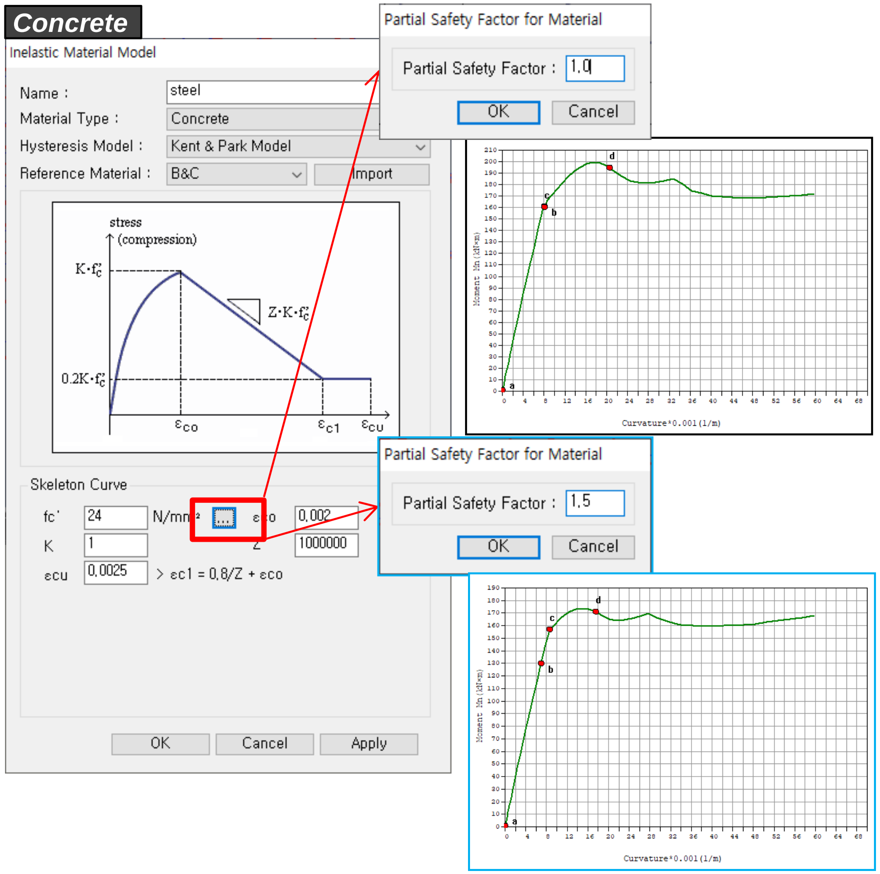
Elastic Bending Moment Capacity (for Non-Dissipative Element)

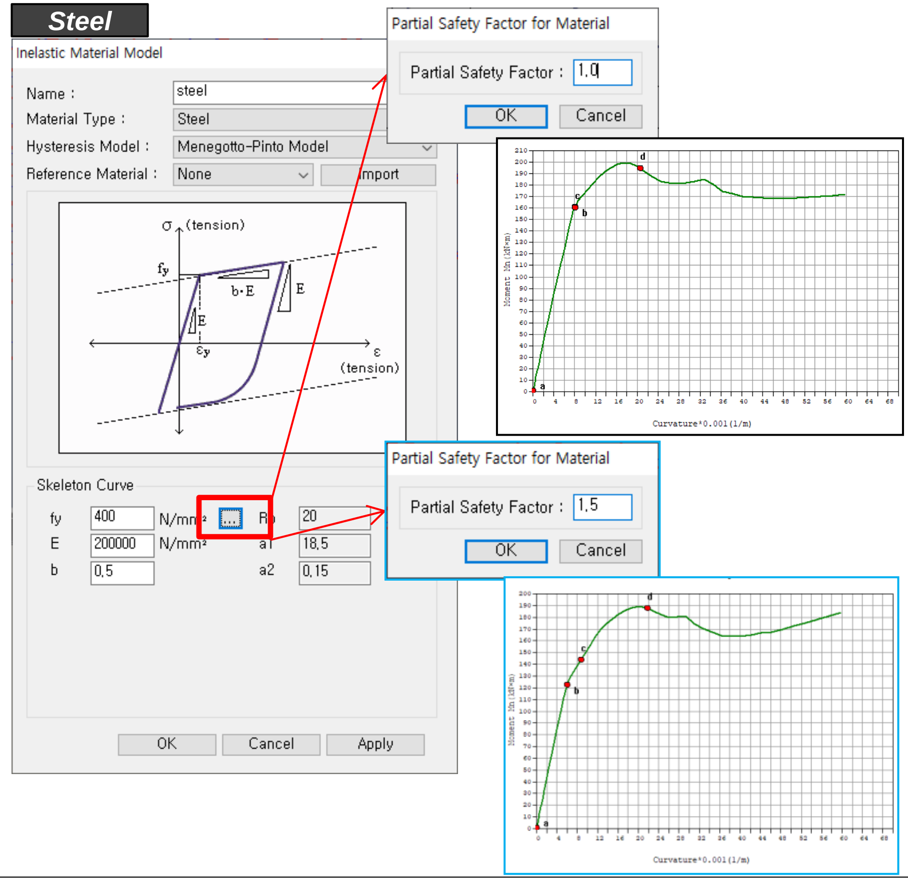
| | END-I | MID | END-J |
|---|---|---|---|
| (-) Load Combination No. | 53 | 53 | 37 |
| Moment (M.Ed) | 101482.80 | 38922.76 | 96260.94 |
| Elastic Strength (M.yd') | 143255.27 | 74502.94 | 112471.78 |
| Check Ratio | 0.7084 | 0.5224 | 0.8559 |
| (+) Load Combination No. | 37 | 37 | 53 |
| Moment (M.Ed)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

# 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*



# 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***

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

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

Sorted by: (●) Member ( ) Property   Results: (●) Strength ( ) Serviceability

Primary Sorting Option: ( ) SECT (●) MEMB

| MEMB | SEL | Section | | fck | fyk | CHK | LCB | V-Rebar | N_Rdmax | Uc | N_Ed | M_Edy | M_Edz | V_Rdc.end | V_Rds.end | V_Rdc.mid | V_Rds.mid | LCB | V_Ed.end | Rat-V.end | Ash.req |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SECT | | Bc | Hc | Height | fyw | | | | | Rat-Uc | Rat-N | Rat-My | Rat-Mz | Rat-Vc.end | Rat-Vs.end | Rat-Vc.mid | Rat-Vs.mid | | V_Ed.mid | Rat-V.mid | Rat-J |
| 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 | | 1.000 | 1.000 | 4.0000 | 400000 | | | | | 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 | | 1.000 | 1.000 | 4.0000 | 400000 | | | | | 0.000 | 0.032 | 0.032 | 0.031 | 2.588 | 0.906 | 2.546 | 0.906 | 7 | 1027.76 | 0.906 | 0.845 |

### ***Graphic result***

| [ JOINT ] | y : 6 (I) | z : 6 (I) |
|---|---|---|
| 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/fywd                 =    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)/fywd =        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))*

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

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

a) In interior joints:

$$A_{sh} f_{ywd} \geq \gamma_{Rd}(A_{s1}+A_{s2}) f_{yd}(1-0{,}8\,\nu_d)$$

b) In exterior joints:

$$A_{sh} f_{ywd} \geq \gamma_{Rd} A_{s2} f_{yd}(1-0{,}8\,\nu_d)$$

- ***Ash_req = Min[Ash_req1, Ash_req2]***

**Design result table**

Eurocode2:04 RC-Column Checking Result Dialog

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

Sorted by: ◉ Member ○ Property

Results: ◉ Strength ○ Serviceability

Primary Sorting Option: ○ SECT ◉ MEMB

**Printout the result for Ash,req instead of Vjh**

| MEMB | SEL | Section | | fck | fyk | CHK | LCB | V-Rebar | N_Rdmax | Uc | N_Ed | M_Edy | M_Edz | V_Rdc.end | V_Rds.end | V_Rdc.mid | V_Rds.mid | LCB | V_Ed.end | Rat-V.end | Ash.req |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SECT | | Bc | Hc | Height | fyw | | | | | Rat-Uc | Rat-N | Rat-My | Rat-Mz | Rat-Vc.end | Rat-Vs.end | Rat-Vc.mid | Rat-Vs.mid | | V_Ed.mid | Rat-V.mid | Rat-J |
| 80 | ☑ | 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 |

**Graphic result**

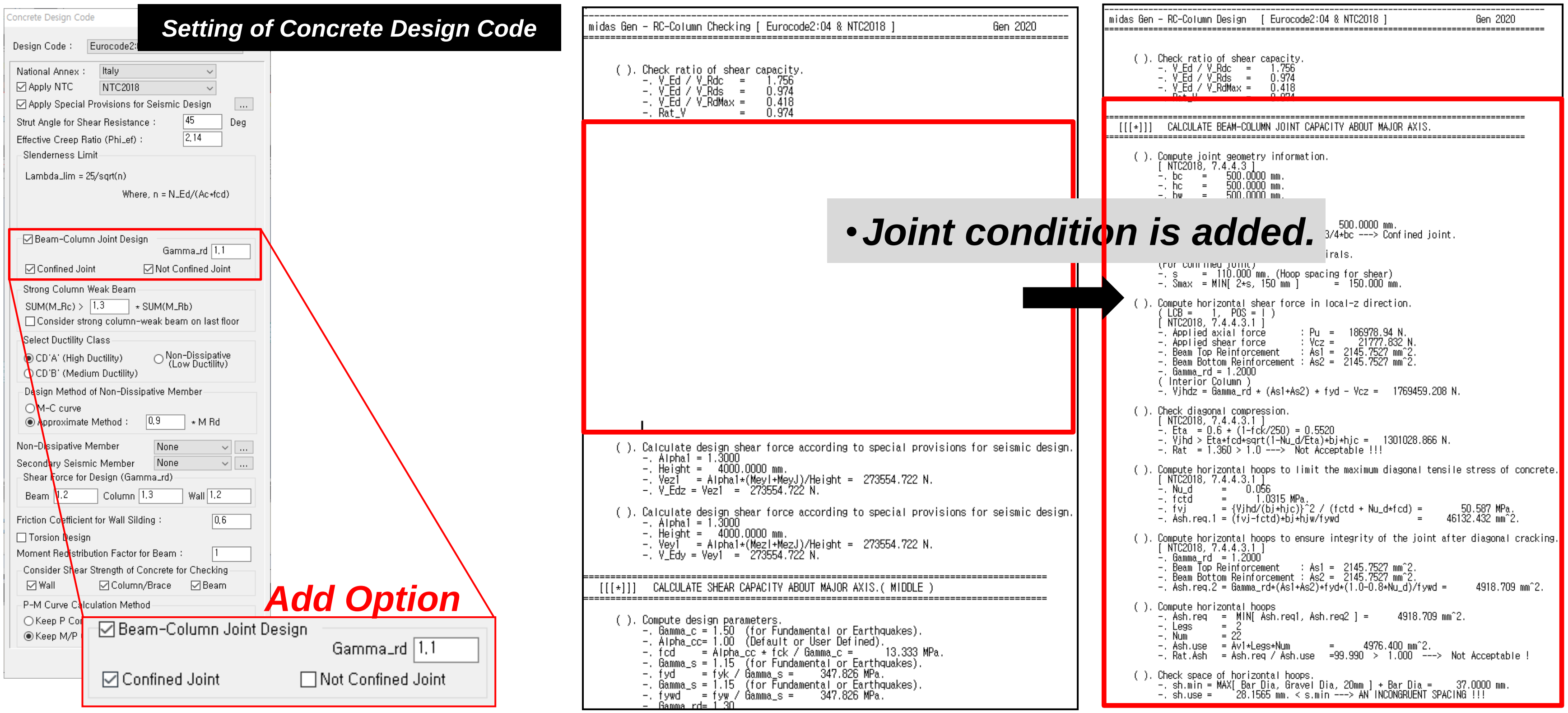
**Change the results based on the hoop rebar area required**

| [ JOINT ] | y : 6 (I) | z : 4 (I) |
|---|---|---|
| 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*

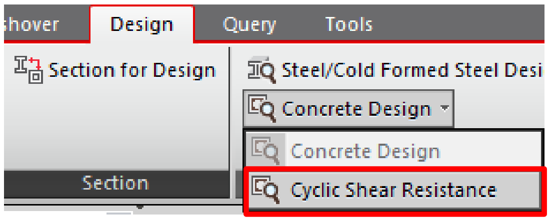
- *An option is added to choose Confined' or 'Not confined' joint condition.*



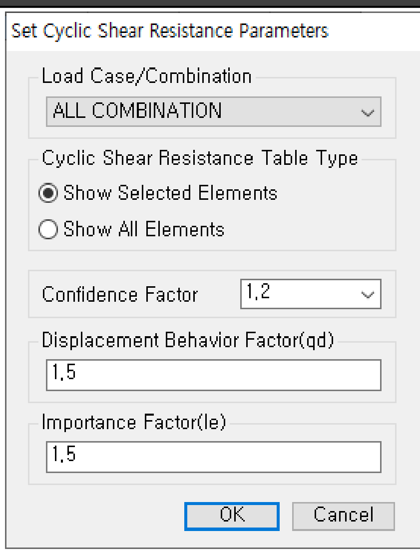
# 15. 新增EN1998-3:2005與NTC2018規範之Cyclic Shear Resistance檢核

## *Check of Cyclic shear Resistance under ULS Design*

- *Design > result > Concrete Design > Cyclic Shear Resistance*




**Set Cyclic Shear Resistance Parameters**




**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, Ie = 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 COMB | 18.0504 | 496.6250 | OK | 25.3188 | 430.5590 | OK |
| 353 | J-end | Primary | ALL COMB | 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***

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

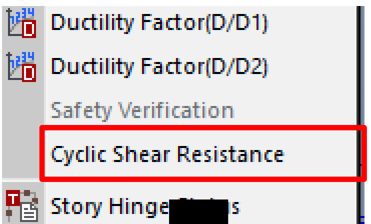
***Demand ≤ Capacity → O.K***
***Demand > Capacity → N.G.***

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

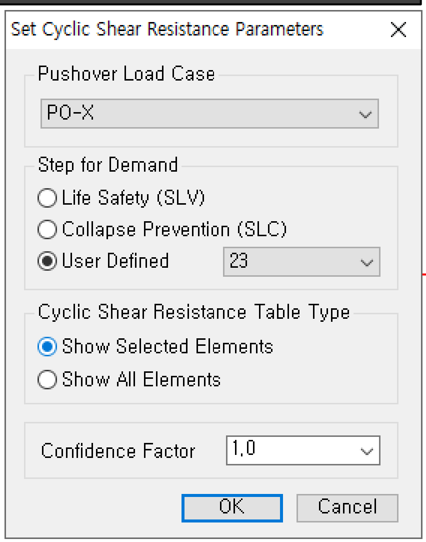
# 15. 新增EN1998-3:2005與NTC2018規範之Cyclic Shear Resistance檢核

## Check of Cyclic shear Resistance under Pushover analysis

- *Pushover > Pushover Hinge Result > Cyclic Shear Resistance*




**Set Cyclic Shear Resistance Parameters**




**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**

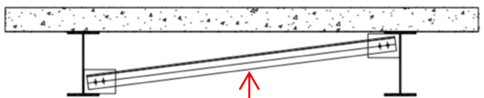
$$V_R = \frac{1}{\gamma_{el}}\left[\frac{h-x}{2L_V}\min(N;0{,}55A_c f_c) + \left(1-0{,}05\min(5;\mu_\Delta^{pl})\right)\cdot\left[0{,}16\max(0{,}5;100\rho_{tot})\left(1-0{,}16\min\left(5;\frac{L_V}{h}\right)\right)\sqrt{f_c}A_c + V_w\right]\right]$$

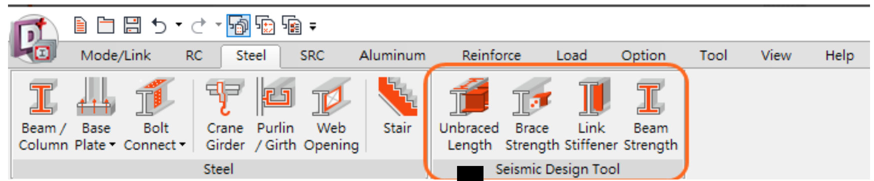
**Demand ≤ Capacity → O.K**
**Demand > Capacity → N.G.**

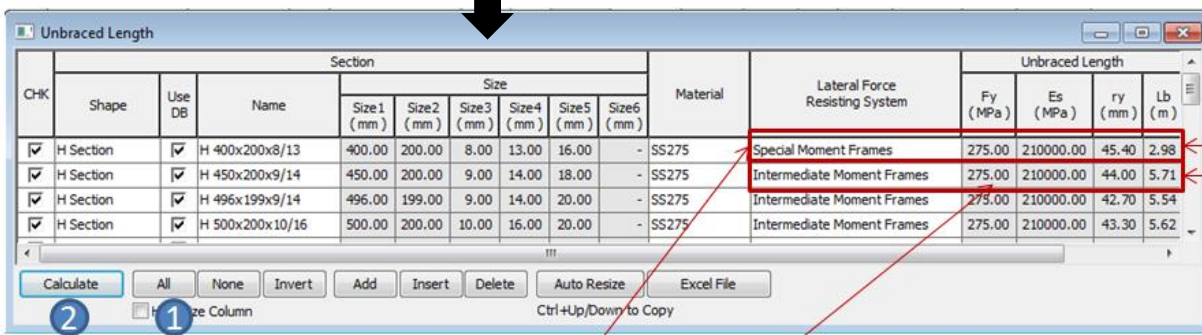
** Only RC beam and column is supported in Gen 2020 v2.1* midas Design+

# 1. 新增鋼構耐震設計工具

*計算梁構件最大無支撐長度*




| CHK | Section: Shape | Use DB | Name | Size1 (mm) | Size2 (mm) | Size3 (mm) | Size4 (mm) | Size5 (mm) | Size6 (mm) | Material | Lateral Force Resisting System | Unbraced Length: 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

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

where

$r_y$ = radius of gyration about y-axis, in. (mm)

**Ry = 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 $L_b = 0.095 r_y E/(R_y F_y)$. 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***

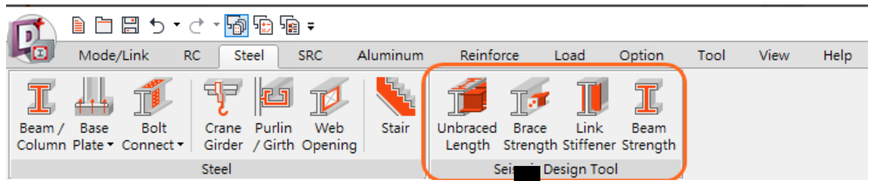
**→ Lb = 0.17ry E/Fy**

***Special Moment Frames***

**→ Lb = 0.085ry E/Fy**

# 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

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

and, the required stiffness of the brace is

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

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

$\phi = 0.75$ (LRFD) $\quad \Omega = 2.00$ (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 $\frac{P_r}{P_c} \geq 0.2$

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

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

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

## Koran code (LSD)

③ 횡지지가새 부재 검토 및 상세 – 0713.9.8

- 소요강도 $P_{br} = 0.02 M_r C_d / h_0$
- 소요강성 $\beta_{br} = \frac{1}{Ø}\left(\frac{10 M_r C_d}{L_b h_0}\right)$

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

*Beam bracing as point bracing*

(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 $\frac{P_r}{P_c} < 0.2$

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

| Brace Design Variables | | | | | Brace Strength | |
|---|---|---|---|---|---|---|
| øMn (kN.m) | ho (mm) | ø | Pbr (kN) | ßbr (kN/m) | øPn (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. øMn | Cb | Mr (kN.m) | Cd | øMn (kN.m) | ho (mm) | ø | Pbr (kN) | ßbr (kN/m) | øPn (kN) | Ratio |
| ☑ | H Section | ☑ | H 400x200x8/13 | SS275 | 4.00 | Angle | ☑ | L 100x7 | SS275 | 2.00 | Nodal Bracing | ☑ | 1.00 | 1000.00 | 2.000 | 277.60 | 387.00 | 0.75 | 28.69 | 4782.07 | 148.38 | OK(0.097) |
| ☐ | H Section | ☑ | H 450x200x9/14 | SS275 | 1.00 | Angle | ☑ | L 100x7 | SS275 | 1.00 | Nodal Bracing | ☑ | 1.00 | 0.00 | 2.000 | 418.27 | 436.00 | 0.75 | [illegible] | 25582.57 | 195.93 | OK(0.098) |
| ☐ | H Section | ☑ | H 496x199x9/14 | SS275 | 1.00 | Angle | ☑ | L 100x7 | SS275 | 1.00 | Nodal Bracing | ☑ | 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 $\frac{P_r}{P_c} \geq 0.2$

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

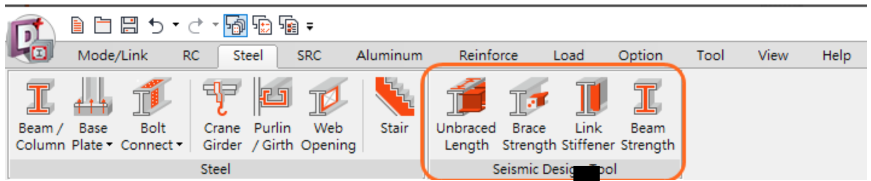
(b) When $\frac{P_r}{P_c} < 0.2$

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

*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 ⅜ 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.

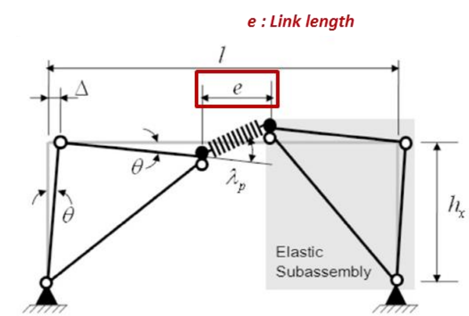
(c) Links of length between $1.6M_p/V_p$ and $2.6M_p/V_p$ shall be provided with intermediate web stiffeners meeting the requirements of (a) and (b) in the preceding.

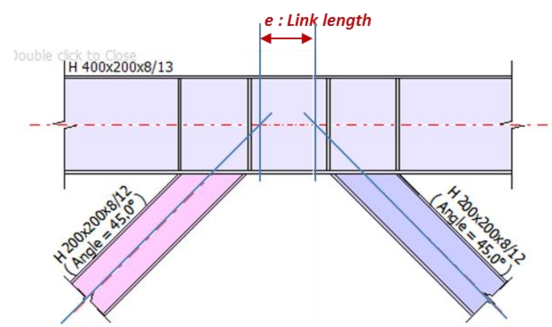
Intermediate web stiffeners shall not be required in links of length greater than $5M_p/V_p$.

*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 ⅜ 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: Shape | Section: Use DB | Section: Name | Material | Link: Length (m) | Link: Angle (Deg.) | Link Stiffener: Zx (mm³) | Aweb (mm²) | Fy (MPa) | Mp (kN.m) | Vp (kN) | Mp/Vp (mm) | breq (mm) | treq (mm) | sreq (mm) | Dbl Stif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ☑ | H Section | ☑ | 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 |

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

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

$V_p = 0.6 F_y A_{lw}$ for $\alpha_s P_r / P_y \le 0.15$ (F3-2)

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

Minimum [Vp, Vn]

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 ⅜ 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 $5M_p/V_p$.

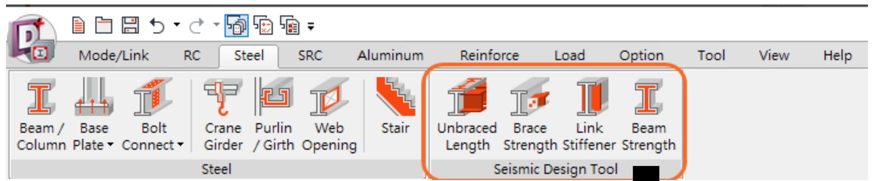
*"No" : To provide on one side is possible*
*"Yes" : To provide on one side is not possible*
****** it is just to inform whether one side is possible.*
*And all results is for both side.*

| Link: Length (m) | Link: Angle (Deg.) | Link Stiffener: Zx (mm³) | Aweb (mm²) | Fy (MPa) | Mp (kN.m) | Vp (kN) | Mp/Vp (mm) | breq (mm) | treq (mm) | sreq (mm) | Dbl Stif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 45.00 | - | - | - | - | - | - | - | - | - | - |

*If e>5Mp/Vp, "-" 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*




*$L_b$ of beam*

*Unbraced length of brace*

| CHK | Beam | | | | | | Brace1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section | | | | | | Section | | | | | Ry | | | | |
| | Shape | Use DB | Name | Material | Length (m) | Cb | Shape | Use DB | Name | Material | Type | User | Ry | Length (m) | Cb | Angle (Deg.) |
| ☑ | H Section | ☑ | H 400x200x8/13 | SS275 | 2.00 | 1.00 | H Section | ☑ | H 200x200x8/12 | SS275 | Tension Brace | ☐ | 1.100 | 1.00 | 1.00 | 45.00 |

| Brace2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Section | | | | | Ry | | | | |
| Shape | Use DB | Name | Material | Type | User | Ry | Length (m) | Cb | Angle (Deg.) |
| H Section | ☑ | H 200x200x8/12 | SS275 | Compression Brace | ☐ | 1.100 | 1.00 | 1.00 | 45.00 |

| Design Force | | | | | | | Check Result of Brace | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dead Load | | | Live Load | | | Seismic Load | Brace1 | | | | Brace2 | | | |
| 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) |
| 1.20 | 100.00 | 100.00 | 0.50 | 150.00 | 150.00 | 1.00 | 275.00 | 2271.20 | 1605.98 | 1605.98 | 275.00 | 512.70 | 362.53 | 362.53 |

| Check Result of Beam | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Design Forces | | | Design Strength | | | Strength Ratio | | | |
| Fy (MPa) | Pux (kN) | Mux (kN.m) | Vuy (kN) | øPn (kN) | øMn (kN.m) | øVn (kN) | Pux / øPn | Mux / øMn | Vuy / øVn | Comb. |
| 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 / 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 $\frac{P_r}{P_c} \geq 0.2$

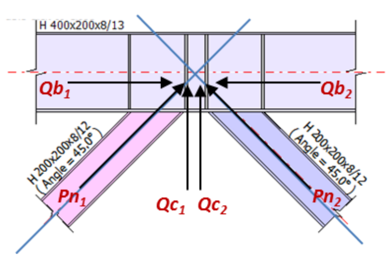
$$\frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \leq 1.0$$

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

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

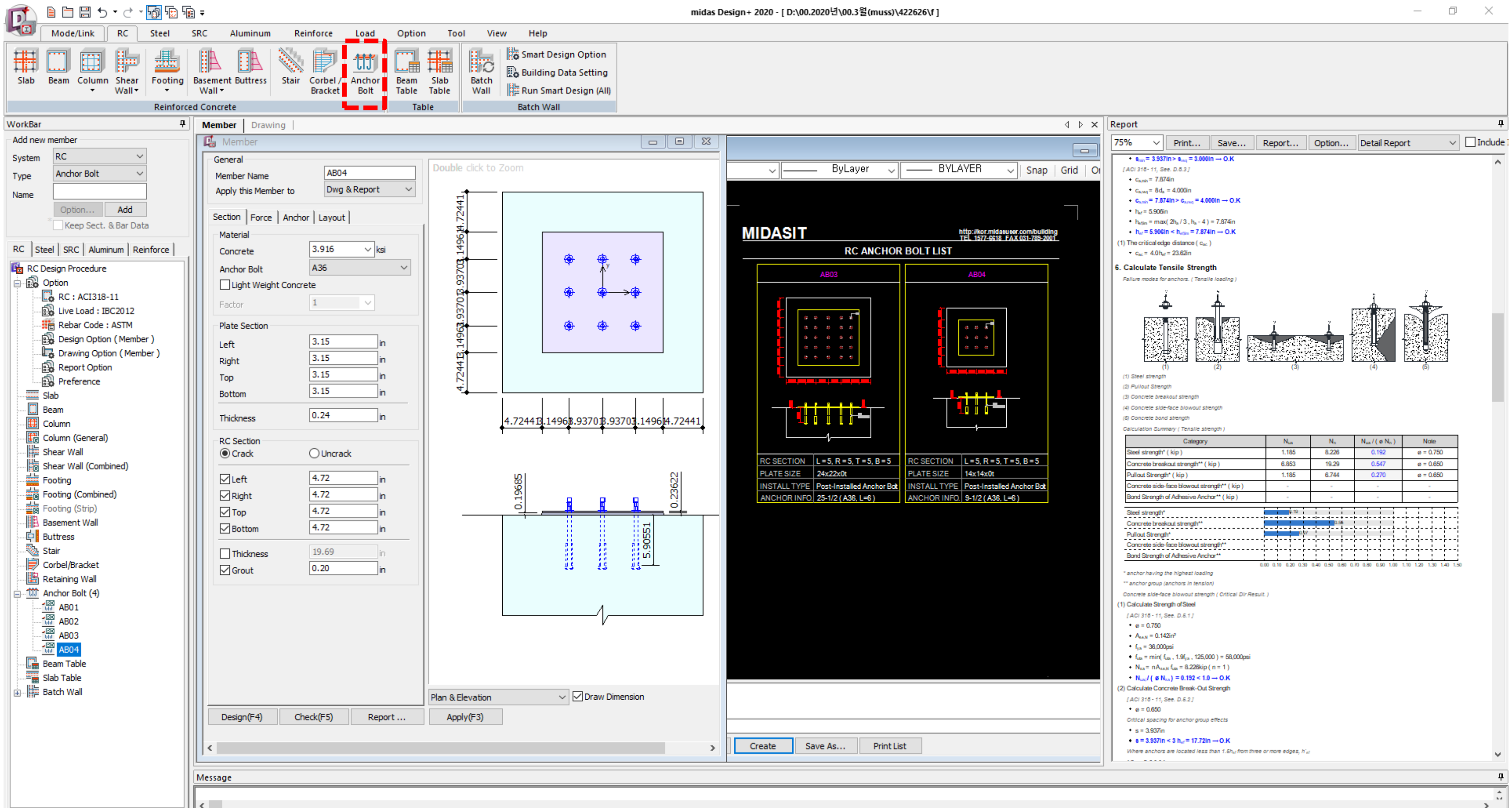
0.0

*In here,*
*Pr = Pux, Pc = ϕPn*
*Mrx = Mux, Mcx = ϕMn*



# 2. 新增錨定螺栓設計模組 (ACI 318)

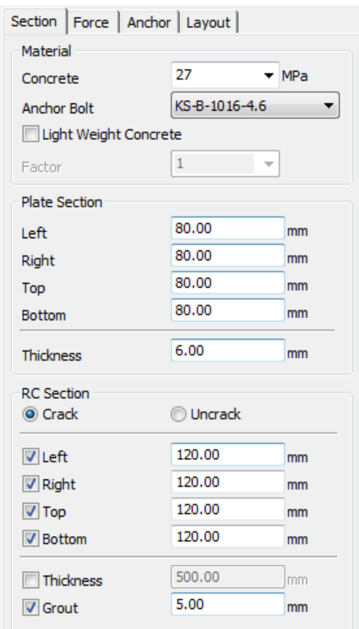
- *適用規範：ACI318-14(M),11(M),08(M),NSR-10*
- *預埋式/後置式錨栓之間距、抗拉與抗剪強度以及組合應力比檢核*



# 2. 新增錨定螺栓設計模組 (ACI 318)

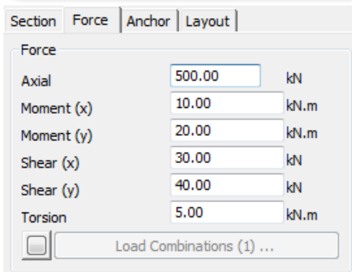
## *錨定螺栓設計程序*

### Section



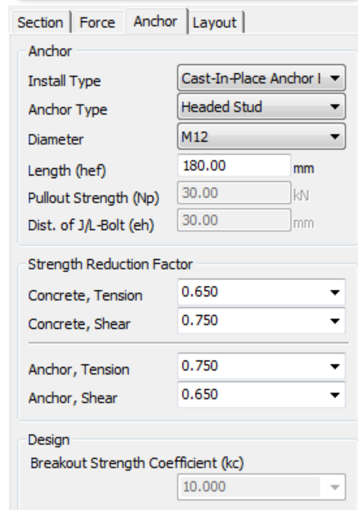

**Step 1.**
*定義混凝土與錨栓材料以及構件配置資訊*

### Force




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

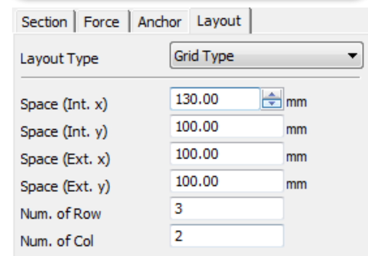
### Anchor

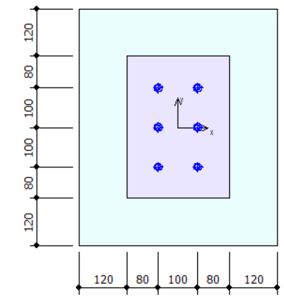



**Step 3.**
*定義錨栓資訊.*

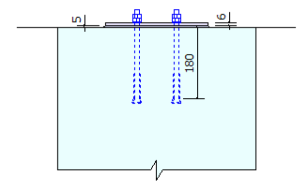
*預埋式錨栓：Headed Stud / Headed Bolt/Hooked Bolt(L/J)*
*後置式錨栓：*
*Expansion(Torque, Displacement), Undercut, Adhesive anchors*

### Layout




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

** anchor having the highest loading*

*** anchor group (anchors in tension)*

(3) Shear strength

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

- *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。*

**Detail Calculation Report**

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

*[ KDS 14 20 54 : 2016, See. 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 |

- $s_{min}$ = 100mm
- $s_{req}$ = 6 $d_a$ = 72.00mm
- **$s_{min}$ = 100mm > $s_{req}$ = 72.00mm → 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, See. 4.4.1, ref. ACI 318-14 17.5.1 ]*

- ø = 0.650
- $f_{uta}$ = min( $f_{uta}$ , 1.9$f_{ya}$ , 860.0 ) = 400MPa
- $A_{se,V}$ = 84.30mm²

*For cast-in headed stud anchor*

- $V_{sa}$ = n $A_{se,V}$ $f_{uta}$ = 33.72kN ( n = 1 )

*Where anchors are used with built-up grout pads*

- $V`_{sa,grout}$ = 0.8 $V_{sa}$ = 26.98kN
- **$V_{us,i}$ / ( ø $V_{sa}$ ) = 0.475 < 1.0 → O.K**

(2) Calculate Concrete Break-Out Strength

*[ KDS 14 20 54 : 2016, See. 4.4.2 ]*

- ø = 0.750
- $d_a$ = 12.00mm
- λ = 1.000

*Where $l_e$ is the load-bearing length of the anchor for shear.*

- $l_e$ = min( 8$d_a$ , $h_{ef}$ ) = 96.00mm