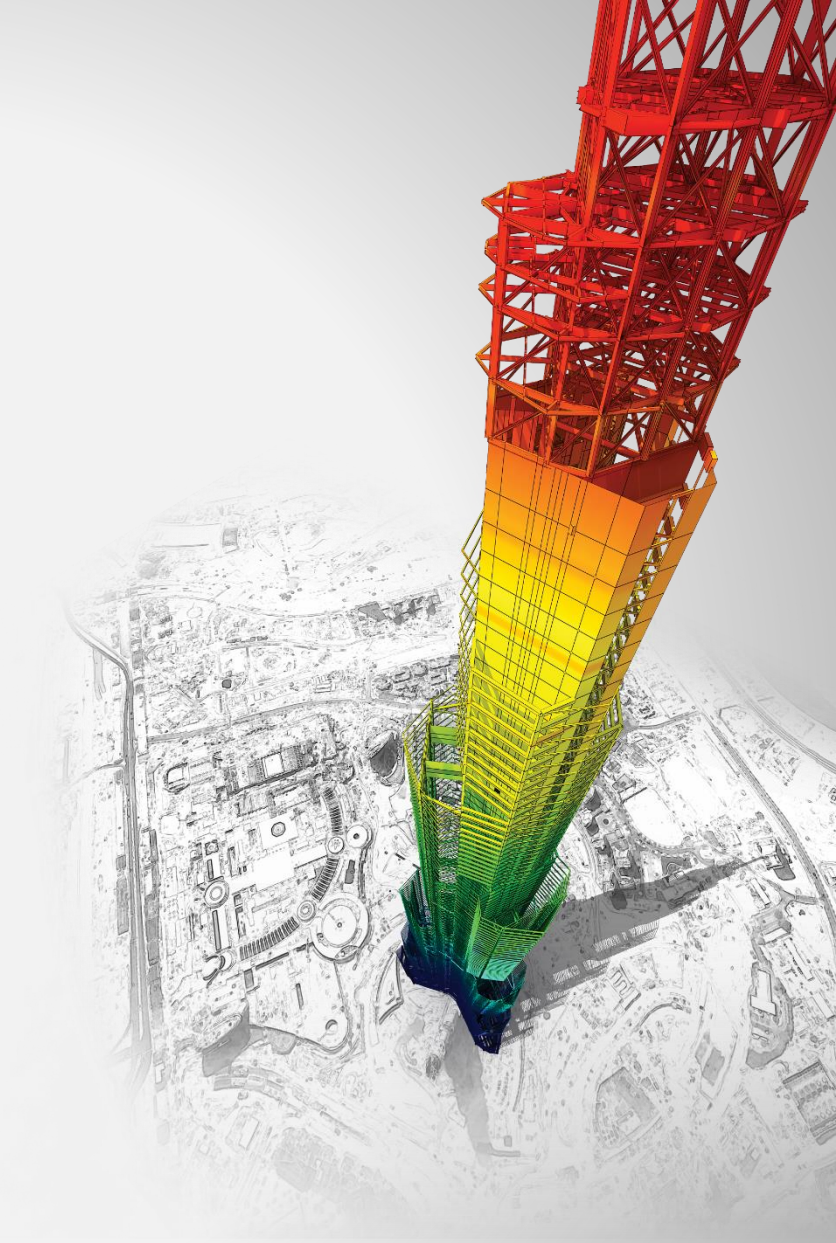
Release Note

Release Date : Feb. 2016

Product Ver. : Gen 2016 (v2.1) and Design+ 2016 (v1.3)



DESIGN OF General Structures

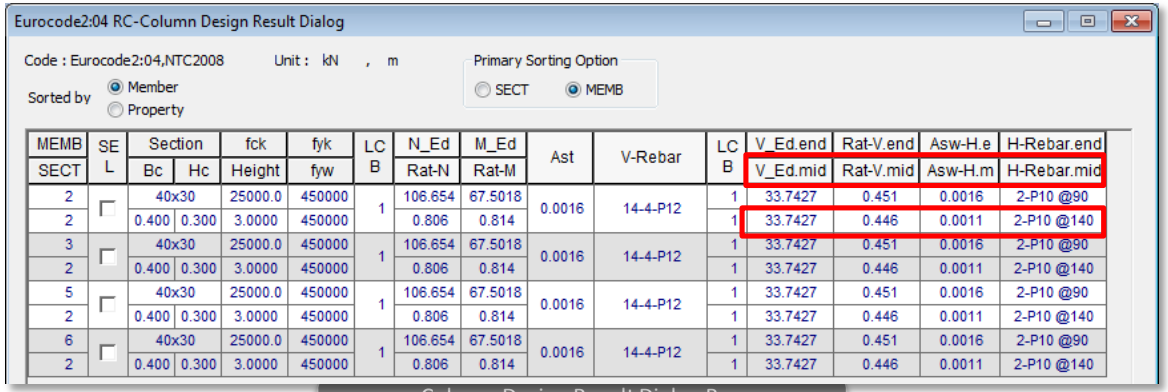
Integrated Design System for Building and General Structures

Enhancements

1. Improvement in RC Column Design/Checking

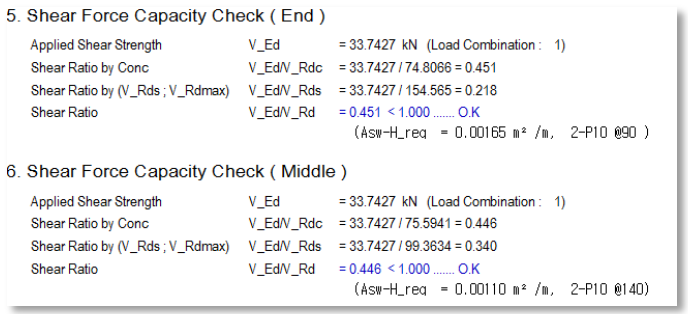
- In concrete columns design/checking, shear verification results can now be displayed not only the critical end position among i-end and j-end but also the middle of the member.
- This feature is very useful to verify the design results as per special seismic provision since different stirrup spacing should be assigned between critical position and middle position. This affects the following design code: Eurocode2, Eurocode8, NTC, ACI318, BS8110, CSA-A23.3, TWN-USD, IS456, AIJ-WSD, KCI-USD, KSCE-USD, AIK-USD, AIK-WSD, GB50010

- ***Design > RC Design > Concrete Code Design > Column Design***

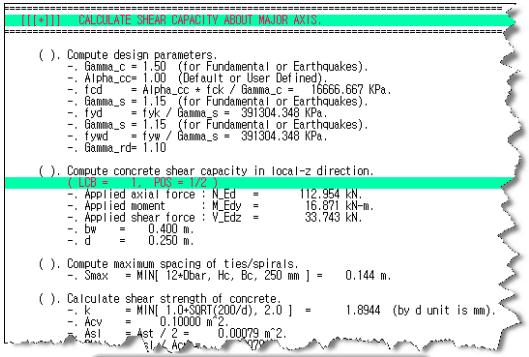


MEMB / SECT	SEL	Section Bc	Section Hc	fck / Height	fyk / fyw	LCB	N_Ed / Rat-N	M_Ed / Rat-M	Ast	V-Rebar	LCB	V_Ed.end / V_Ed.mid	Rat-V.end / Rat-V.mid	Asw-H.e / Asw-H.m	H-Rebar.end / H-Rebar.mid
2		40x30		25000.0	450000	1	106.654	67.5018	0.0016	14-4-P12	1	33.7427	0.451	0.0016	2-P10 @90
2		0.400	0.300	3.0000	450000		0.806	0.814			1	33.7427	0.446	0.0011	2-P10 @140
3		40x30		25000.0	450000	1	106.654	67.5018	0.0016	14-4-P12	1	33.7427	0.451	0.0016	2-P10 @90
2		0.400	0.300	3.0000	450000		0.806	0.814			1	33.7427	0.446	0.0011	2-P10 @140
5		40x30		25000.0	450000	1	106.654	67.5018	0.0016	14-4-P12	1	33.7427	0.451	0.0016	2-P10 @90
2		0.400	0.300	3.0000	450000		0.806	0.814			1	33.7427	0.446	0.0011	2-P10 @140
6		40x30		25000.0	450000	1	106.654	67.5018	0.0016	14-4-P12	1	33.7427	0.451	0.0016	2-P10 @90
2		0.400	0.300	3.0000	450000		0.806	0.814			1	33.7427	0.446	0.0011	2-P10 @140

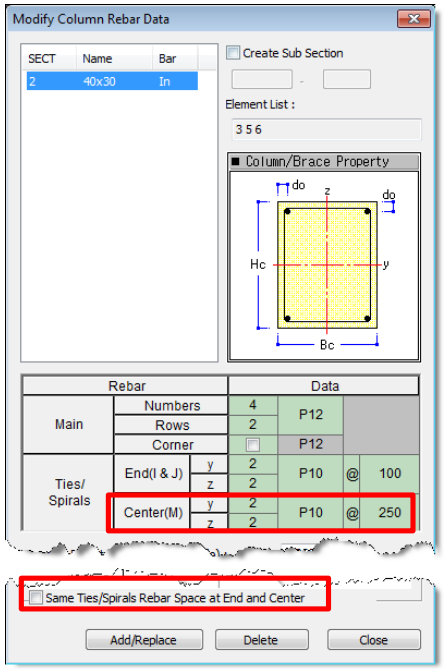
Column Design Result Dialog Box



Graphic Report



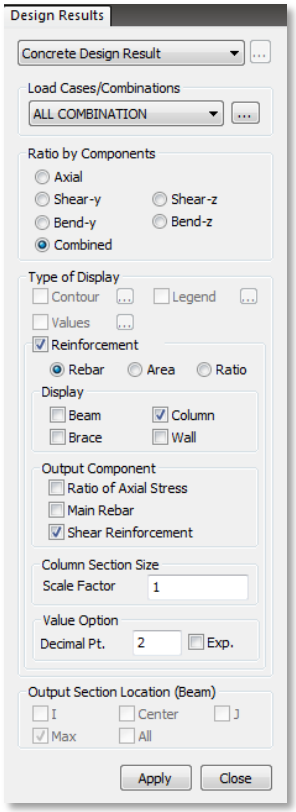
Detail Report

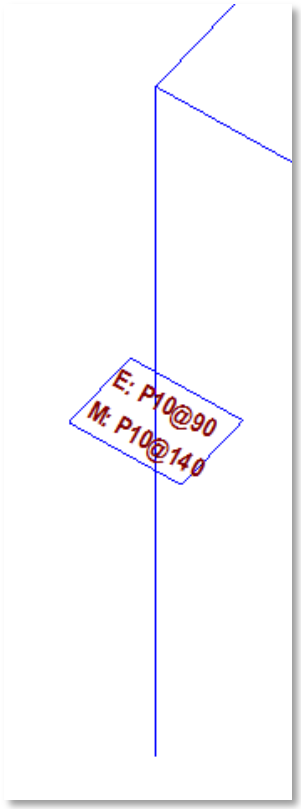


Modify Column Rebar Data

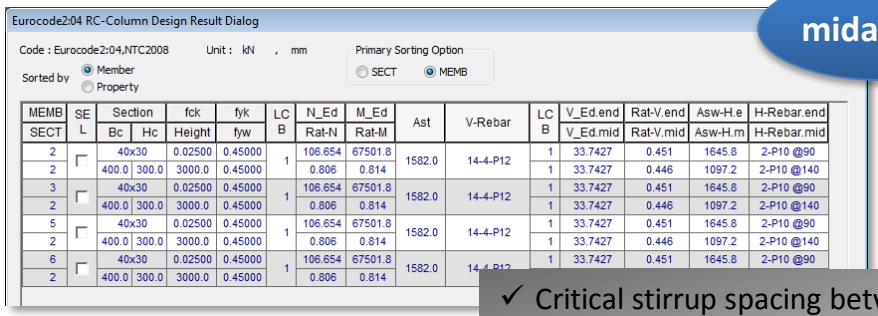
- In Concrete Design Result dialog box, shear reinforce results can be displayed for the middle position as well as the critical results between i-end and j-end.
- Stirrup spacing of middle position as well as critical position can be separately exported into midas Dshop European version for column drawings.

- ***Design > RC Design > Concrete Code Design > Column Design***





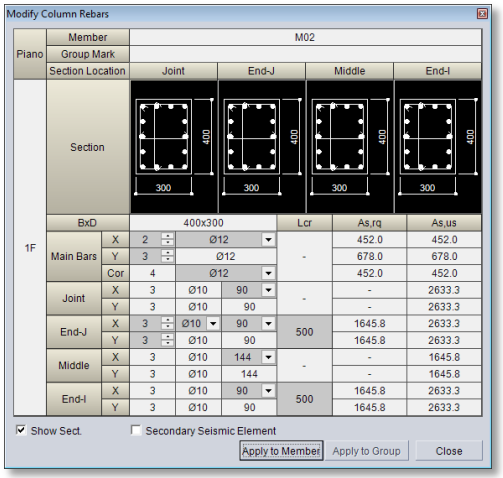
Concrete Design Results



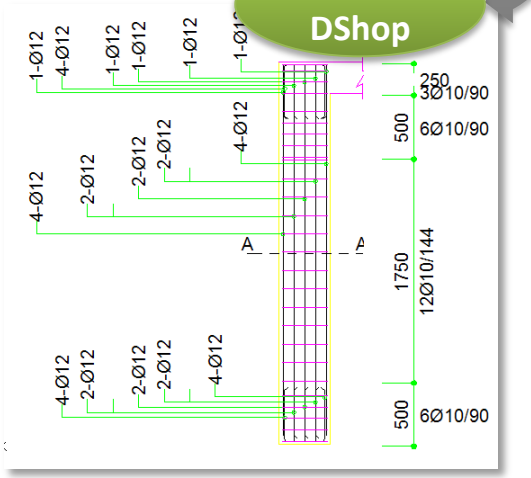
MEMB SECT	SEL	Section Bc	Section Hc	fck Height	fyk fyw	LCB	N_Ed Rat-N	M_Ed Rat-M	Ast	V-Rebar	LCB	V_Ed.end V_Ed.mid	Rat-V.end Rat-V.mid	Asw-H.e Asw-H.m	H-Rebar.end H-Rebar.mid
2		40x30		0.02500	0.45000	1	106.654	67501.8	1582.0	14-4-P12	1	33.7427	0.451	1645.8	2-P10 @90
2		400.0	300.0	3000.0	0.45000		0.806	0.814			1	33.7427	0.446	1097.2	2-P10 @140
3		40x30		0.02500	0.45000	1	106.654	67501.8	1582.0	14-4-P12	1	33.7427	0.451	1645.8	2-P10 @90
2		400.0	300.0	3000.0	0.45000		0.806	0.814			1	33.7427	0.446	1097.2	2-P10 @140
5		40x30		0.02500	0.45000	1	106.654	67501.8	1582.0	14-4-P12	1	33.7427	0.451	1645.8	2-P10 @90
2		400.0	300.0	3000.0	0.45000		0.806	0.814			1	33.7427	0.446	1097.2	2-P10 @140
6		40x30		0.02500	0.45000	1	106.654	67501.8	1582.0	14-4-P12	1	33.7427	0.451	1645.8	2-P10 @90
2		400.0	300.0	3000.0	0.45000		0.806	0.814							

midas Gen

- ✓ Critical stirrup spacing between two ends
- ✓ Stirrup spacing at middle position
- ✓ Critical length



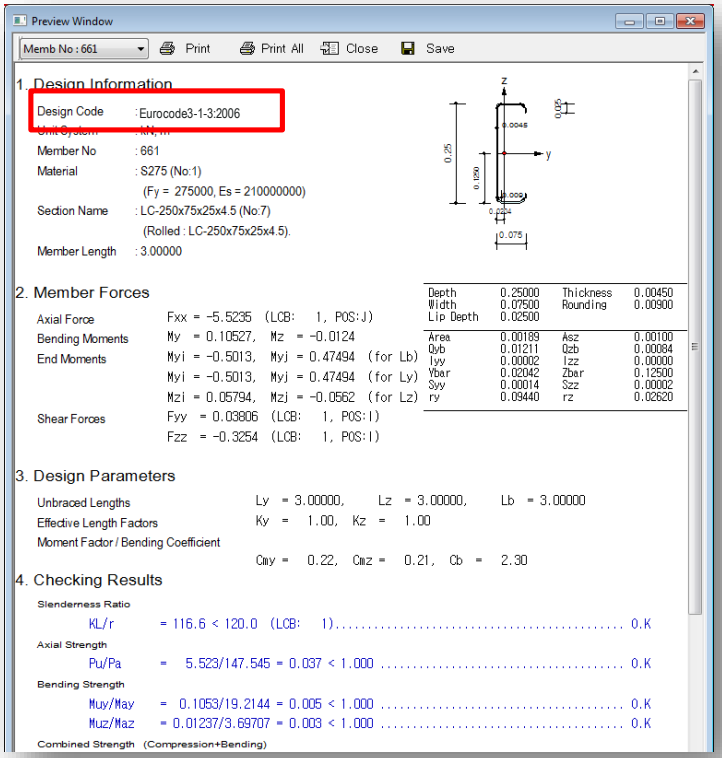
midas DShop



2. Cold-formed Steel Code Checking as per EN1993-1-3:2006

- Cold-formed lipped channel and upright section can be verified as per EN1993-1-3:2006. Iteration option to refine reduction factor for buckling of lipped channel is provided as per the clause 5.5.3.2(3).
- For cold-formed section, metallic coating thickness and type of forming can be specified by the user in Section Option dialog box.
- For lipped channel, effective section properties can be automatically calculated. Calculated values can be checked in Effective Section Properties table. For user type upright section for which the section dimension is specified by the user, effective section property need to be entered by the user directly.

▪ ***Design > Cold formed Steel Design***



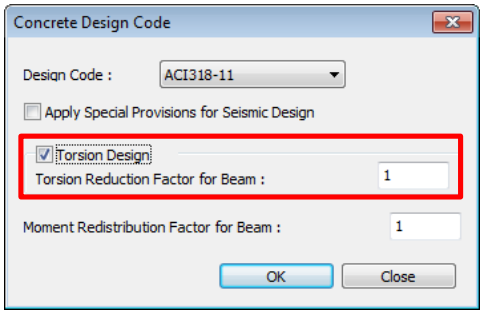
Tendon Effective Force Graph

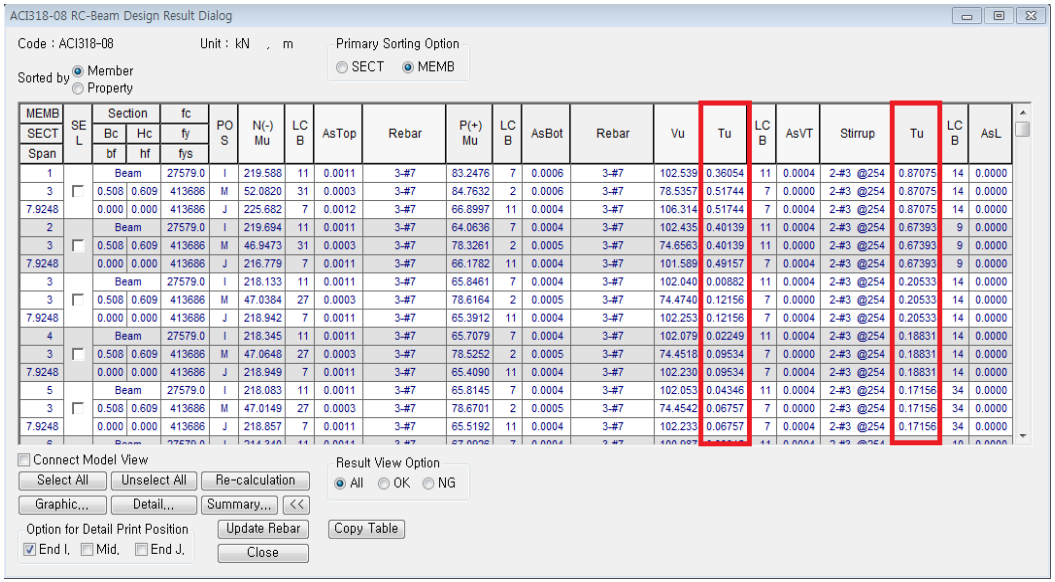
- **Design Scope of Lipped Channel**
  - ✓ **Effective section properties**
  - ✓ **Resistance of Cross Section**
    - ▪ Axial resistance
    - ▪ Bending moment resistance
    - ▪ Shear resistance
    - ▪ Combined axial and bending
    - ▪ Combined shear, axial and bending moment
  - ✓ **Buckling Resistance**
    - ▪ Flexure buckling
    - ▪ Torsional buckling
    - ▪ Lateral torsional buckling
    - ▪ Compression and bending buckling
  - ✓ **Serviceability Limit State**
    - ▪ Deflection
- **Design Scope of Upright Section**
  - ✓ **Resistance of Cross Section**
    - ▪ Axial resistance
    - ▪ Bending moment resistance
    - ▪ Combined axial and bending
  - ✓ **Buckling Resistance**
    - ▪ Flexure buckling
    - ▪ Torsional buckling
    - ▪ Lateral torsional buckling
    - ▪ Compression and bending buckling

3. RC beam Torsion Design/Checking as per ACI318-11/08

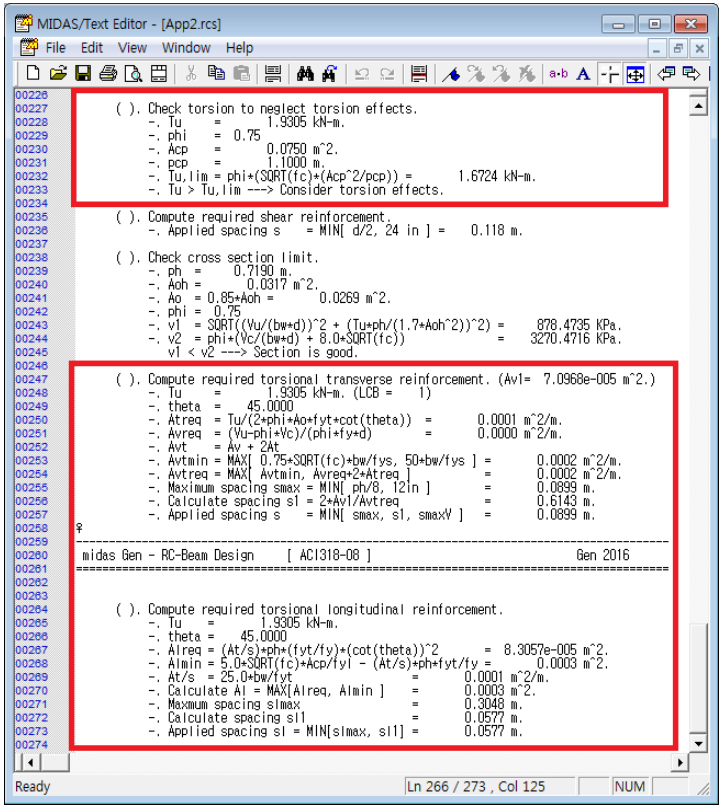
- In RC Code Design and Code Checking, torsion design has been newly added as per ACI318-11/08. The user can select the option if torsion verification is included or not in Concrete Design Code dialog box.

▪ ***Design > RC Design > Design Code > ACI318-11/08***





Design Result Dialog Box



Detail Report

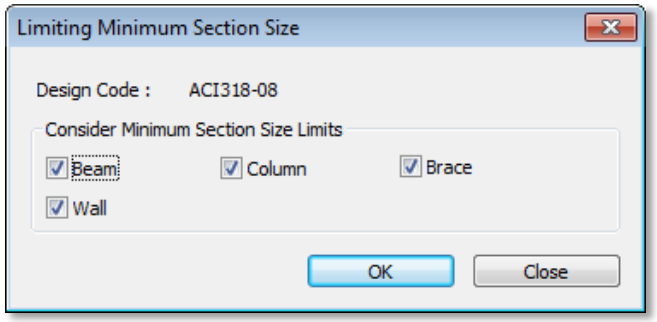
4. Limiting Minimum Section Size for ACI318-11/08

- Using Limiting Minimum Section Size function, the user can choose whether to apply the minimum section size requirements provided in the design codes or not. All boxes are checked as the default setting.
- NSCP2010 states in section 421.6.1.1 that, " The shortest cross sectional dimension, measured on a straight line passing through the geometric centroid, shall not be less than 300mm except for buildings or structures regulated by NSCP Volume III (Housing Code) and BP 220." This allows the engineers following this design standard to use smaller section dimensions for projects like, housing projects, etc.
- In previous versions, in order to design the sections having section size less than the prescribed minimum section size limits the users had to transfer the design forces to midas Design+ or use excel sheets. In the new version, user can uncheck the box for minimum section size limits so that the program will not apply these limits for RC structural design as per ACI 318-08 and ACI 318-11.

- ***Design > Concrete Design Parameter > Limiting Minimum Section Size***

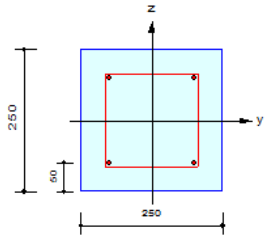
```
*.midas Gen - RC-COLUMN  Analysis/Design Program.

*.PROJECT        :
*.DESIGN CODE    : ACI318-08,      *.UNIT SYSTEM : kN, mm
  (Note. Nonhomogenous equation in the code are written in U.S. Customary units in the report)
*.MEMBER         : Member Type = COLUMN ,  MEMB =    82,  LCB =    2,  POS =    J

*.DESCRIPTION OF COLUMN  DATA (iSEC =     1) : Edge Column
  Section Type : Rectangular with Ties (RT)
  Section Height (HTc)            =      4876.800 mm.
  Section Depth  (Hc)             =       250.000 mm.
  Section Width  (Bc)             =       250.000 mm.
  Concrete Cover to C.O.R. (do)   =        63.500 mm.
  Concrete Strength (fc)          =         0.028 kN/mm^2.
  Modulus of Elasticity (Ec)      =        24.856 kN/mm^2.
  Main Rebar Strength (fy)        =         0.414 kN/mm^2.
  Ties/Spirals Strength (fys)     =         0.276 kN/mm^2.
  Modulus of Elasticity (Es)      =       199.948 kN/mm^2.

*.DESCRIPTION OF APPLIED FACTORS FOR DESIGN/CHECKING.
  Live Load Reduction Factor =  0.880  (Axial)
  Special Provisions For Seismic Design : Special Moment Frames.
   -. Seismic Scale Up Factor for Shear (a1) = 1.000
   -. Seismic Scale Up Factor for Shear (a2) = 1.000
   -. Applied Scale Up Factor for Shear = MAX[Shear by a1, Shear by a2]

*.REBAR PATTERN = RT -  4 -  2 - P20          Unit :  mm.
  ---------------------------------------------------------
     i          dyi          dzi       Rebar          Asi
  ---------------------------------------------------------
     1      -61.500      -61.500      1-P20     314.16000
     2      -61.500       61.500      1-P20     314.16000
     3       61.500       61.500      1-P20     314.16000
     4       61.500      -61.500      1-P20     314.16000
  ---------------------------------------------------------
```

Member Types Supporting Limiting Minimum Section Size Limits



Design Condition

Design Code	: ACI318-08	UNIT SYSTEM : kN, mm
Member Number	: 74 (PM), 59 (Shear)	
Material Data	: fc = 0.027579, fy = 0.413686, fys = 0.27579 kN/mm^2	
Column Height	: 4876.8 mm	
Section Property	: Edge Column (No : 1)	
Rebar Pattern	: 4 - 2 - P20	Ast = 1256.64 mm^2 (Rhost = 0.020)

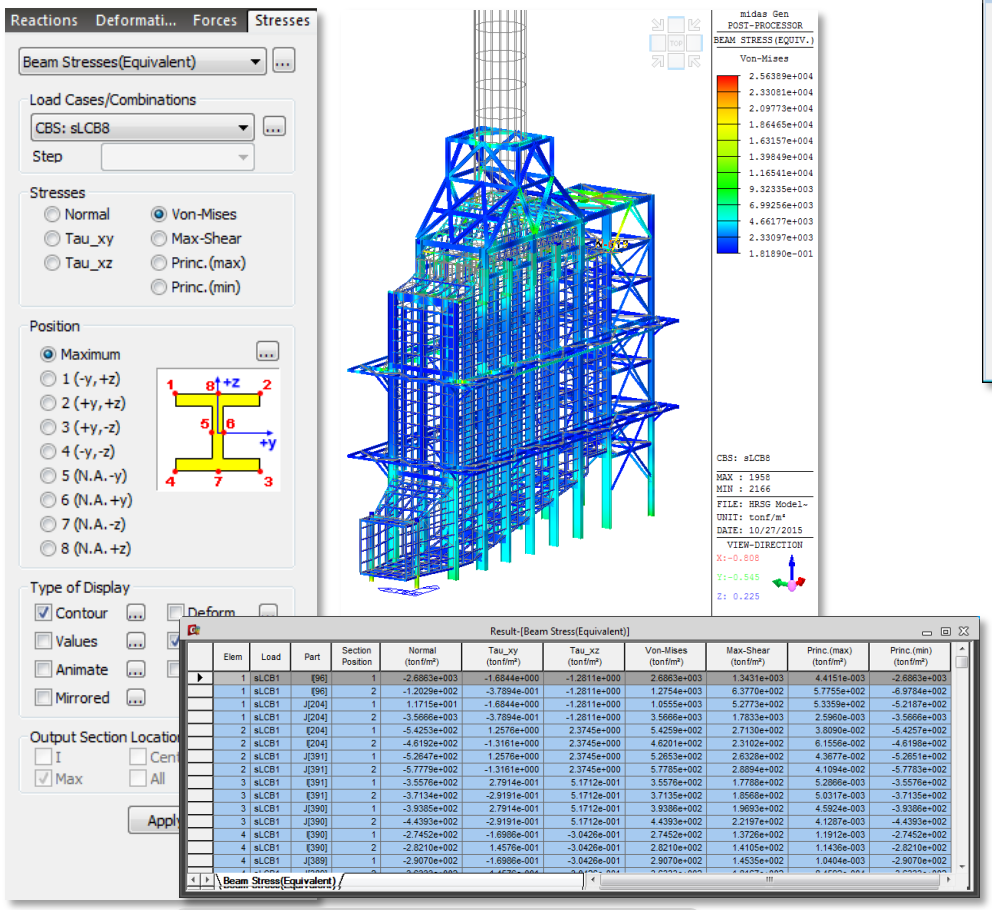


Design Results for smaller section size

5. Displaying Von Mises & Maximum Shear Stress Contour in Model View

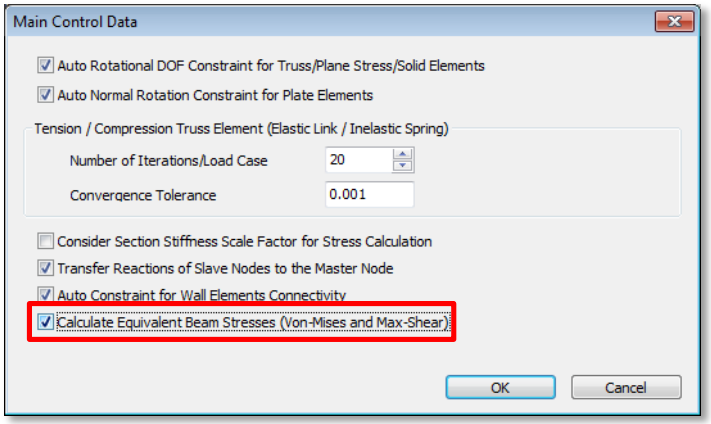
- Von-mises or Tresca stresses can now be verified for beam elements. In the previous version, beam stress contour was provided for normal and shear stress only. In order to check Von-mises or Tresca stress, Beam Detail Analysis function was used which allow the user to check equivalent stress for each element one by one. In the new version, entire equivalent stress distribution can be verified using stress contour. This feature is extremely useful to verify the stress of irregular shape steel structure.

- ***Result > Stresses > Beam Stresses (Equivalent)***

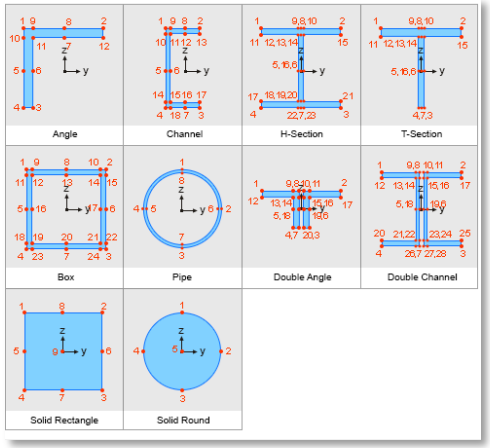


Elem	Load	Part	Section Position	Normal (tonf/m²)	Tau_xy (tonf/m²)	Tau_xz (tonf/m²)	Von-Mises (tonf/m²)	Max-Shear (tonf/m²)	Princ.(max) (tonf/m²)	Princ.(min) (tonf/m²)
1	sLCB1	[96]	1	-2.6863e+003	-1.6844e+000	-1.2811e+000	2.6863e+003	1.3431e+003	4.4151e-003	-2.6863e+003
1	sLCB1	[96]	2	-1.2029e+002	-3.7894e-001	-1.2811e+000	1.2754e+003	6.3770e+002	5.7755e+002	-6.9784e+002
1	sLCB1	J[204]	1	1.1715e+001	-1.6844e+000	-1.2811e+000	1.0555e+003	5.2773e+002	5.3359e+002	-5.2187e+002
1	sLCB1	J[204]	2	-3.5666e+003	-3.7894e-001	-1.2811e+000	3.5666e+003	1.7833e+003	2.5960e-003	-3.5666e+003
2	sLCB1	[204]	1	-5.4253e+002	1.2576e+000	2.3745e+000	5.4259e+002	2.7130e+002	3.8090e-002	-5.4257e+002
2	sLCB1	[204]	2	-4.6192e+002	-1.3161e+000	2.3745e+000	4.6201e+002	2.3102e+002	6.1556e-002	-4.6198e+002
2	sLCB1	J[391]	1	-5.2647e+002	1.2576e+000	2.3745e+000	5.2653e+002	2.6328e+002	4.3677e-002	-5.2651e+002
2	sLCB1	J[391]	2	-5.7779e+002	-1.3161e+000	2.3745e+000	5.7785e+002	2.8894e+002	4.1094e-002	-5.7783e+002
3	sLCB1	[391]	1	-3.5576e+002	2.7914e-001	5.1712e-001	3.5576e+002	1.7788e+002	5.2866e-003	-3.5576e+002
3	sLCB1	[391]	2	-3.7134e+002	-2.9191e-001	5.1712e-001	3.7135e+002	1.8568e+002	5.0317e-003	-3.7135e+002
3	sLCB1	J[390]	1	-3.9385e+002	2.7914e-001	5.1712e-001	3.9386e+002	1.9693e+002	4.5924e-003	-3.9386e+002
3	sLCB1	J[390]	2	-4.4393e+002	-2.9191e-001	5.1712e-001	4.4393e+002	2.2197e+002	4.1287e-003	-4.4393e+002
4	sLCB1	[390]	1	-2.7452e+002	-1.6986e-001	-3.0426e-001	2.7452e+002	1.3726e+002	1.1912e-003	-2.7452e+002
4	sLCB1	[390]	2	-2.8210e+002	1.4576e-001	-3.0426e-001	2.8210e+002	1.4105e+002	1.1436e-003	-2.8210e+002
4	sLCB1	J[389]	1	-2.9070e+002	-1.6986e-001	-3.0426e-001	2.9070e+002	1.4535e+002	1.0404e-003	-2.9070e+002

Beam Stresses (Equivalent) Contour and Table



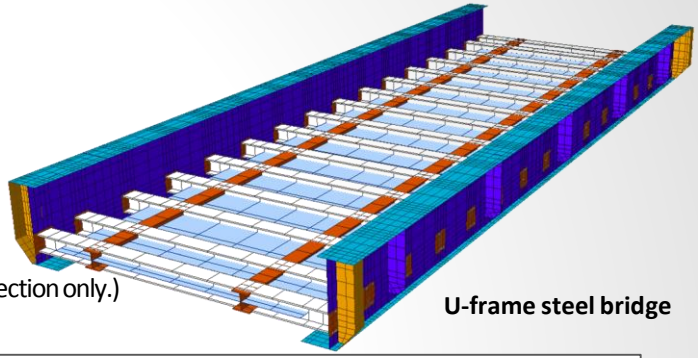
Main Control Data



Applicable Section Shape and Stress Points

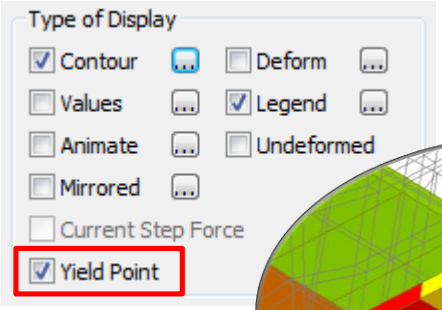
6. Material Nonlinear Analysis with Beam Elements

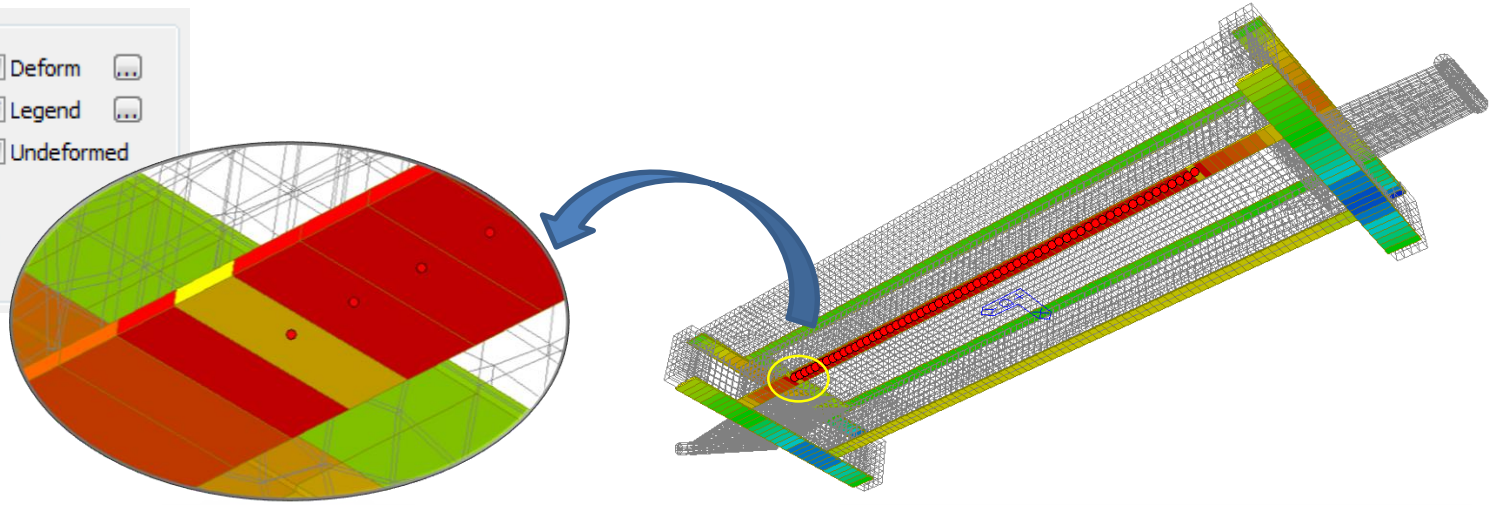
- Stress resultant beam model is introduced to apply beam elements in the material nonlinear analysis. Thus, not only plate elements but also beam elements can be used for the analysis in which both geometric nonlinear effect and material nonlinear effect need to be taken into account. This feature would be useful for the nonlinear stability analysis of U-frame steel bridges which are often simulated using both beam elements and plate elements to represent cross beams and main girders, respectively. The previous version could not solve this type of model.
- The von Mises yield criterion is used as the basis of the model.
- The stress-strain curve is linear elastic/perfectly plastic (i.e. zero hardening).
- Plastic axial force and plastic bending moment about major axis and minor axis are only calculated.
- The coupled effect between axial force and moment is not considered.
- Non-composite steel section is only supported. (Channel, I-Section, T-Section, Box, Pipe, Rectangle, Round section only.)



U-frame steel bridge

- ***Properties > Plastic Material > von-Mises***
- ***Results > Forces > Beam Forces/Moments***





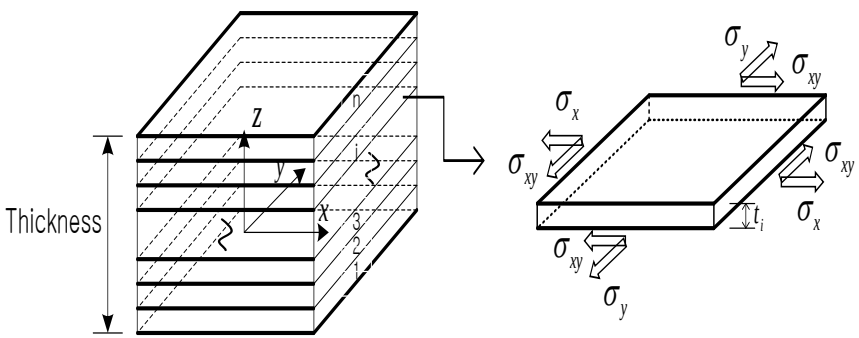
Plastic axial hinges in the beam elements

7. Material nonlinear analysis of a layer in plate elements

- Algorithm of material nonlinear analysis of a layer of plate element is updated from 3-dimensional condition base (five stress components and zero transverse normal stress and strain) to plane stress condition base (three in-plane stress and zero transverse normal stress and non-zero transverse normal strain).
  Assumption of zero transverse normal strain of previous algorithm has some restrain on the in-plane deformation in a layer. Therefore, stiffness of a layer could be over estimated in the previous version.
- Due to this change, the results of material nonlinear analysis in this version may be a bit different from the previous versions depending on the model.

- ***Properties > Plastic Material***
- ***Analysis > Analysis Control > Nonlinear Analysis***

Layered model of a plate for material nonlinearity



Constitutive relation : stress resultant vs. strains

Membrane & Bending

$$\begin{Bmatrix} N_x \\ N_y \\ N_{xy} \\ M_x \\ M_y \\ M_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{16} & B_{11} & B_{12} & B_{16} \\ A_{12} & A_{22} & A_{26} & B_{12} & B_{22} & B_{26} \\ A_{16} & A_{26} & A_{66} & B_{16} & B_{26} & B_{66} \\ B_{11} & B_{12} & B_{16} & D_{11} & D_{12} & D_{16} \\ B_{12} & B_{22} & B_{26} & D_{12} & D_{22} & D_{26} \\ B_{16} & B_{26} & B_{66} & D_{16} & D_{26} & D_{66} \end{bmatrix} \begin{Bmatrix} \varepsilon_x^0 \\ \varepsilon_y^0 \\ \varepsilon_{xy}^0 \\ \kappa_x \\ \kappa_y \\ \kappa_{xy} \end{Bmatrix}$$

Integration throught thickness using simpson rule

$$\left(A_{ij}, B_{ij}, D_{ij}\right) = \int_{-h/2}^{h/2} Q_{ij}^{(k)} \left(1, z, z^2\right) dz$$

Shear

$$\begin{Bmatrix} V_{xz} \\ V_{yz} \end{Bmatrix} = \begin{bmatrix} \frac{5}{6}Gt & \\ & \frac{5}{6}Gt \end{bmatrix} \begin{Bmatrix} \gamma_{xz} \\ \gamma_{yz} \end{Bmatrix} \left(G = \text{Shear modulus},\ t = \text{thickness}\right)$$

7. Material nonlinear analysis of a layer in plate elements (continued)

Update material elasto-plastic behavior in a layer

Previous version : 3-dimensional base

$$\left\{ \sigma_{xx} \quad \sigma_{yy} \quad \sigma_{xy} \quad \sigma_{xz} \quad \sigma_{yz} \,,\ \sigma_{zz} = \varepsilon_{zz} = 0 \right\}$$

Plate

$$\begin{Bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \sigma_{xy} \\ \sigma_{xz} \\ \sigma_{yz} \end{Bmatrix} = \frac{E}{\left(1-\nu^2\right)} \begin{bmatrix} 1 & \nu & & & \\ \nu & 1 & & & \\ & & \frac{(1-\nu)}{2} & & \\ & & & \frac{(1-\nu)}{2\kappa} & \\ & & & & \frac{(1-\nu)}{2\kappa} \end{bmatrix} \begin{Bmatrix} \varepsilon_{xx} \\ \varepsilon_{yy} \\ \gamma_{xy} \\ \gamma_{xz} \\ \gamma_{yz} \end{Bmatrix} \quad \begin{pmatrix} \kappa = 6/5 \\ \sigma_{zz} = 0,\ \varepsilon_{zz} = 0 \end{pmatrix}$$

Updated version : plane stress base

$$\left\{ \sigma_{xx} \quad \sigma_{yy} \quad \sigma_{xy} \,,\ \sigma_{zz} = 0,\ \varepsilon_{zz} \neq 0 \right\}$$

Plane Stress condition

$$\begin{Bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \sigma_{xy} \end{Bmatrix} = \frac{E}{\left(1-\nu^2\right)} \begin{bmatrix} 1 & \nu & \\ \nu & 1 & \\ & & \frac{1-\nu}{2} \end{bmatrix} \begin{Bmatrix} \varepsilon_{xx} \\ \varepsilon_{xx} \\ \gamma_{xy} \end{Bmatrix}$$

Using integration algorithm for a Axisymmetric condition with added strain

Axisymmetric condition

$$\begin{Bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \sigma_{xy} \\ \sigma_{\theta\theta} \end{Bmatrix} = \frac{E}{(1+\nu)(1-2\nu)} \begin{bmatrix} 1-\nu & \nu & & \\ \nu & 1-\nu & & \\ & & \frac{1-2\nu}{2} & \\ & & & 1-\nu \end{bmatrix} \begin{Bmatrix} \varepsilon_{xx} \\ \varepsilon_{yy} \\ \gamma_{xy} \\ \varepsilon_{\theta\theta} \end{Bmatrix}$$

Added strain $\varepsilon_{\theta\theta}^{e\ tr} = \varepsilon_{\theta\theta}^{e\ tr} - \dfrac{\sigma_{\theta\theta}}{D_{44}}$ $\left(D_{44} = \dfrac{E(1-\nu)}{(1+\nu)(1-2\nu)} \right)$

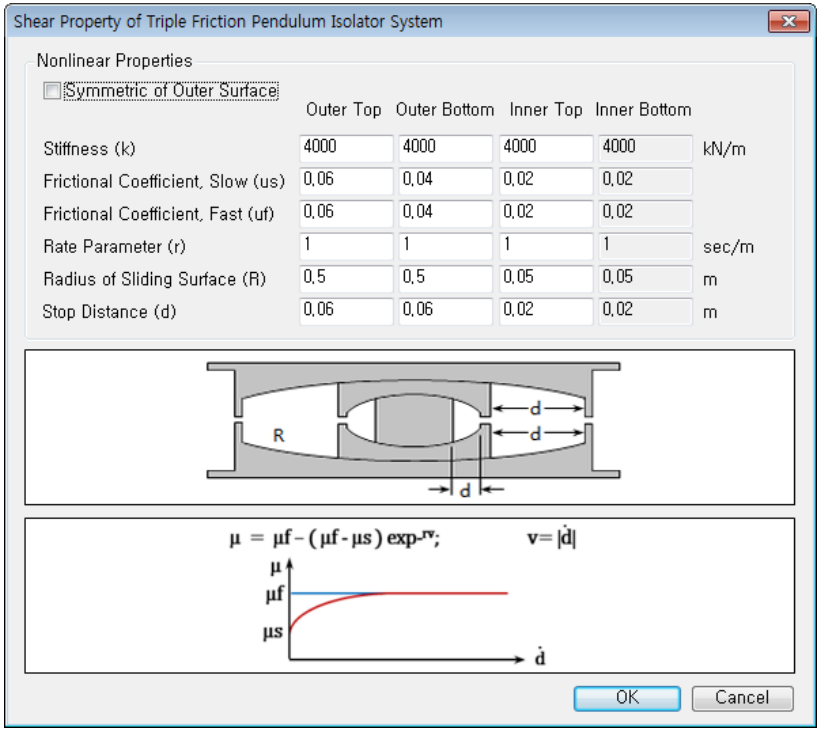
Iteration for required Consition $\sigma_{\theta\theta} = 0$

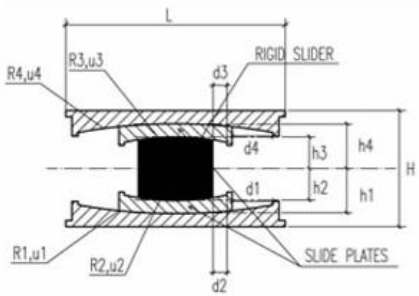
-. Computational method for plasticity – theory and applications Ch. 9 (DRJ Owen 2008)
-. Structural analysis of laminated anisotropic plates (James M. Whitney 1987)

8. Triple Friction Pendulum Isolator

- The Triple Friction Pendulum Isolator (TFPI) is now implemented. The TFPI exhibits multiple changes in stiffness and strength with increasing amplitude of displacement. It is known that the TFPI offers better seismic performance, lower bearing costs, and lower construction costs as compared to conventional seismic isolation technology. The properties of each of the bearing's three pendulums are chosen to become sequentially active at different earthquake strengths. As the ground motions become stronger, the bearing displacements increase. At greater displacements, the effective pendulum length and effective damping increase, resulting in lower seismic forces and bearing displacements.

- ***Boundary > Link > General Link > General Link Properties***



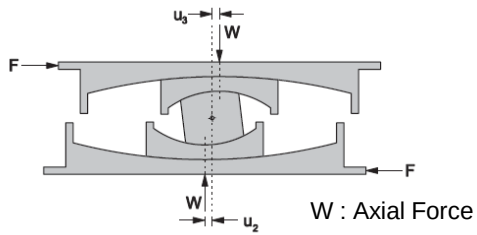


Triple Pendulum Bearing

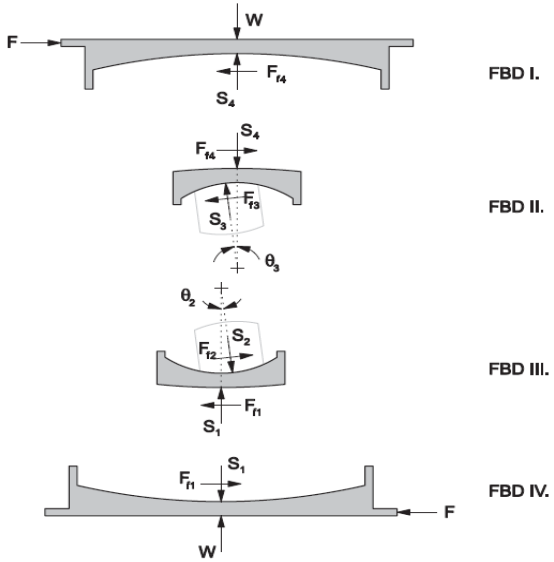
8. Triple Friction Pendulum Isolator (continued)

Behavior of Triple Friction Pendulum Isolator (Sliding Regime I)

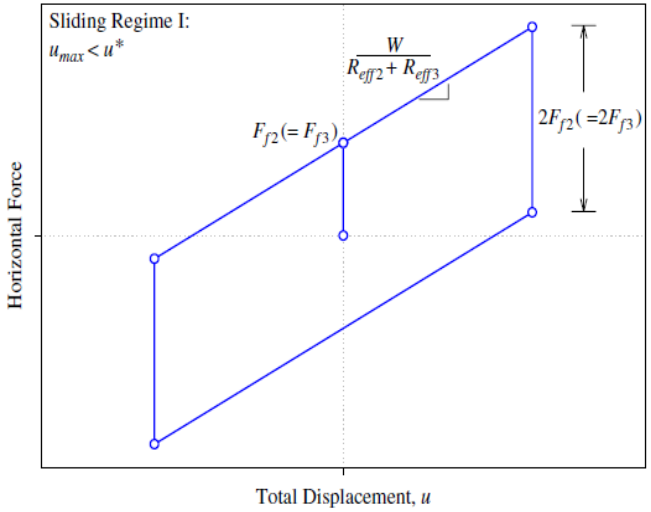
- **Displaced shape**



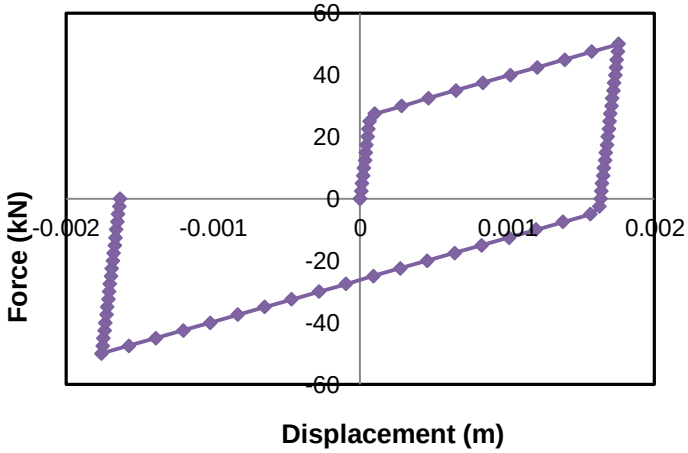
- **Free body diagrams of the triple FP**



Sliding occurs on surface 2 and 3 only.
Motion has not yet been initiated on surfaces 1 and 4.



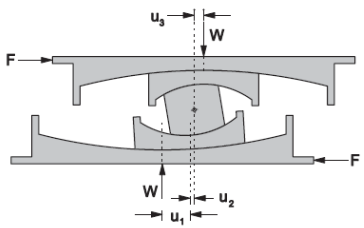
Force-Displacement



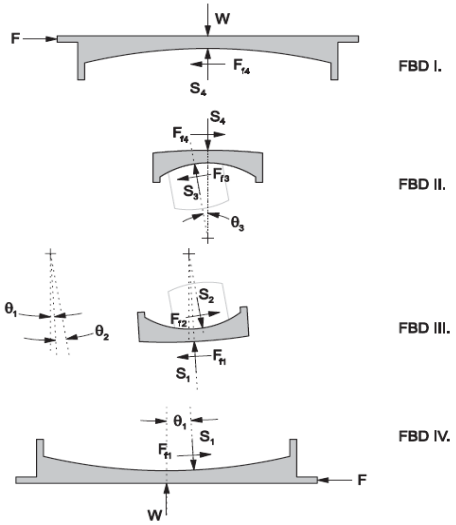
8. Triple Friction Pendulum Isolator (continued)

Behavior of Triple Friction Pendulum Isolator (Sliding Regime II)

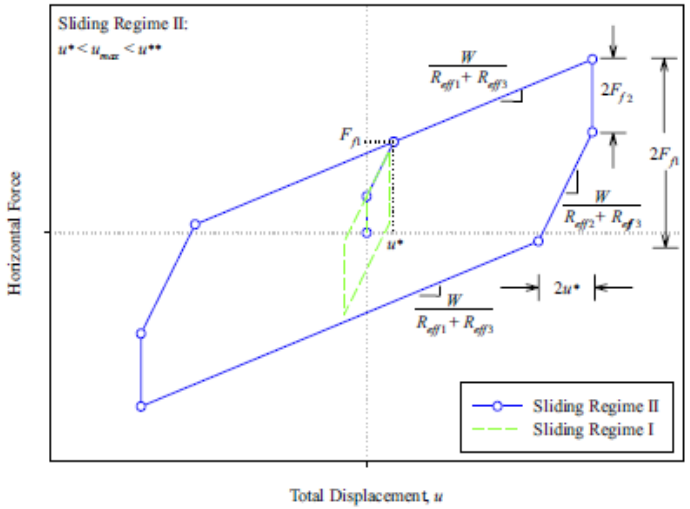
- **Displaced shape**



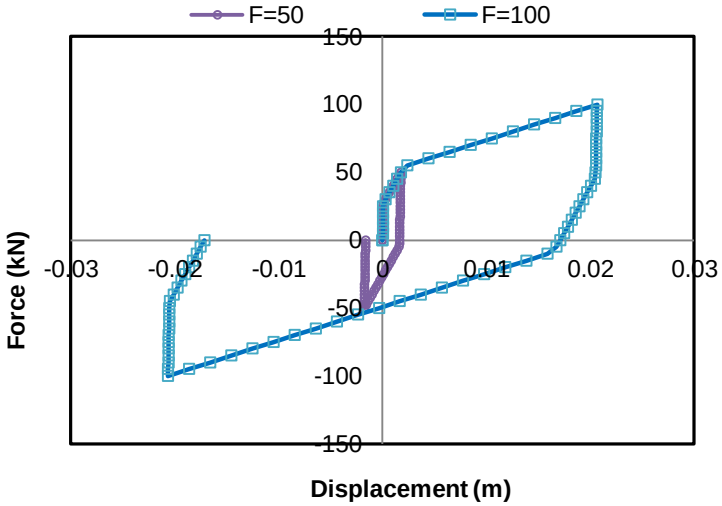
- **Free body diagrams of the triple FP**



Sliding occurs on surface 1 and 3.
Motion has not yet been initiated on surface 4, and there is constant displacement on surface 2.

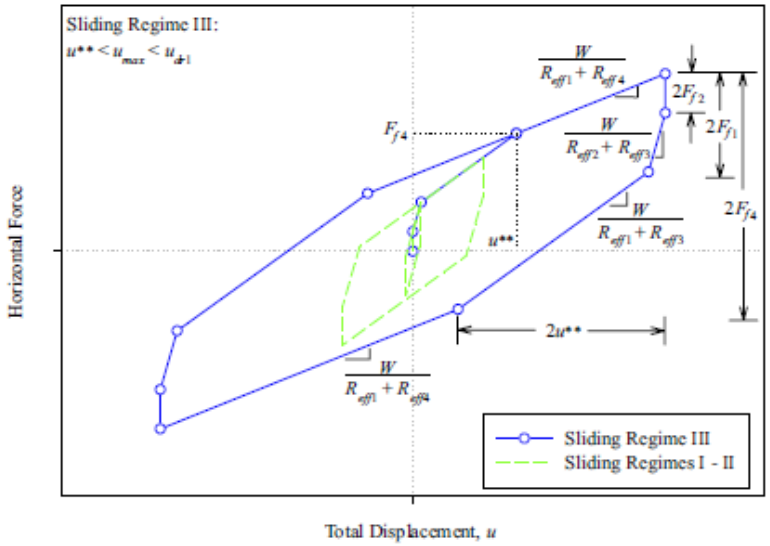


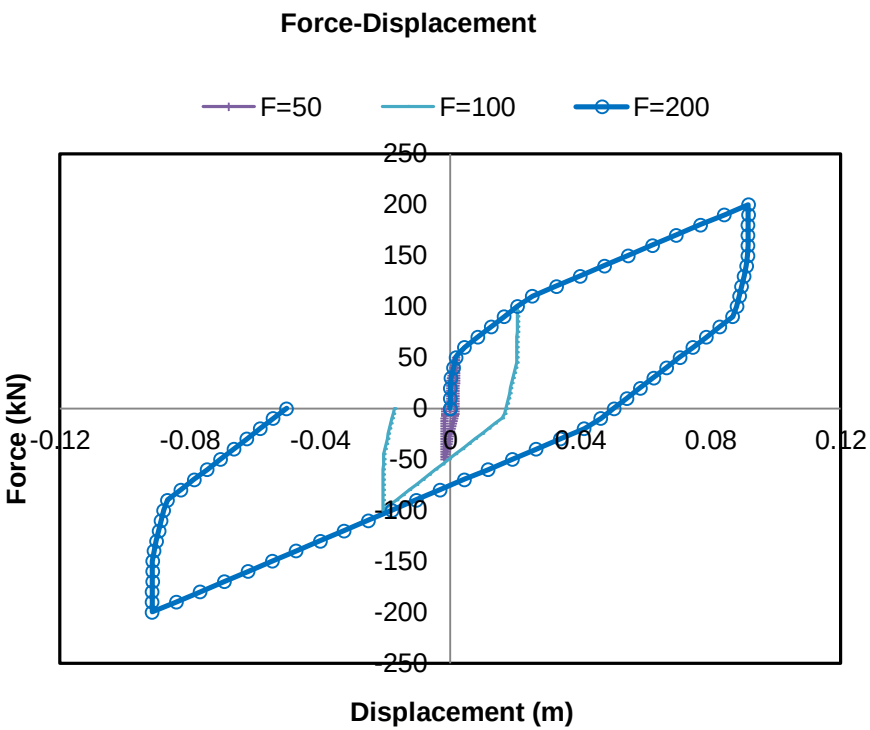
Force-Displacement



8. Triple Friction Pendulum Isolator (continued)

Behavior of Triple Friction Pendulum Isolator (Sliding Regime III)



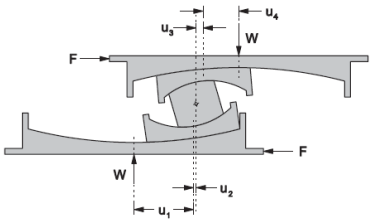


Sliding stop on surface 3 and starts on surface 4.
Sliding on surface 1 and 4.

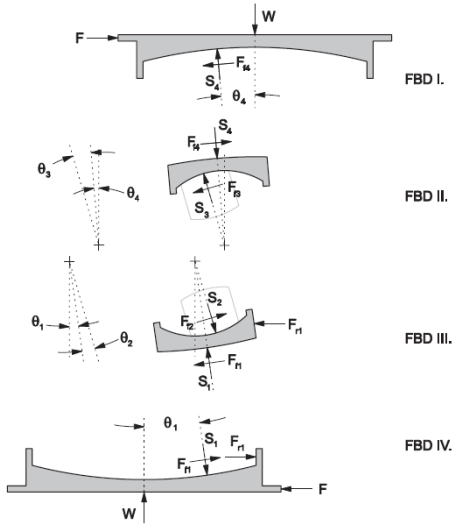
8. Triple Friction Pendulum Isolator (continued)

Behavior of Triple Friction Pendulum Isolator (Sliding Regime IV)

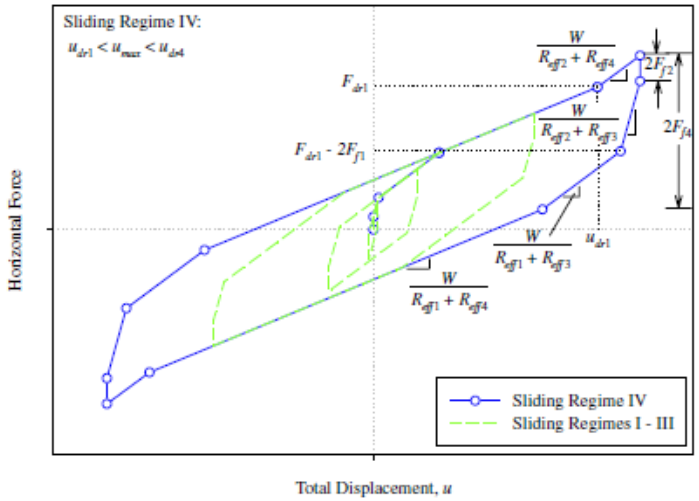
- **Displaced shape**



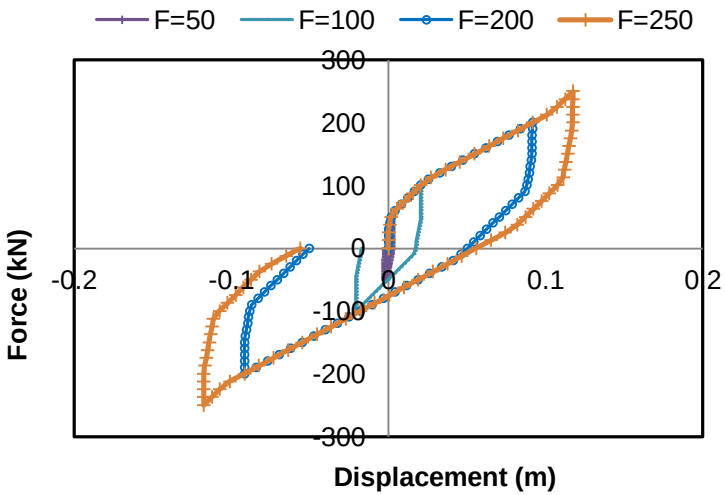
- **Free body diagrams of the triple FP**



The slider is on the displacement restrainer on surface 1.
Sliding occurs on surface 2 and 4, and the displacement on surface 3 remains constant.

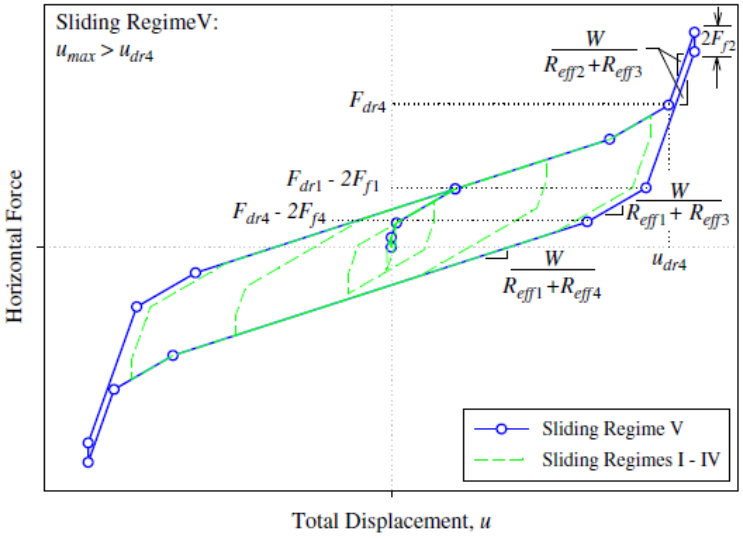


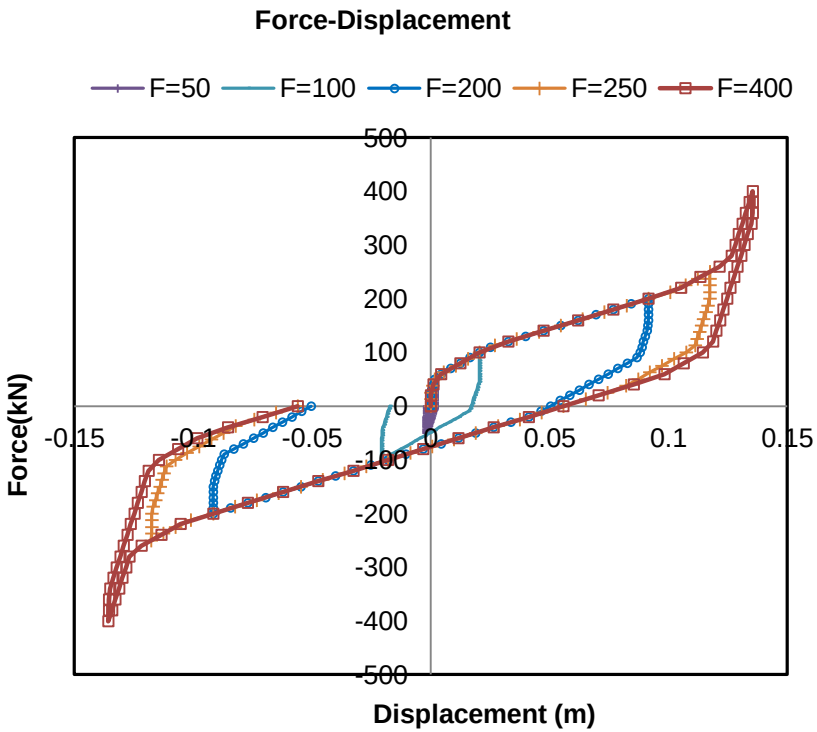
Force-Displacement



8. Triple Friction Pendulum Isolator (continued)

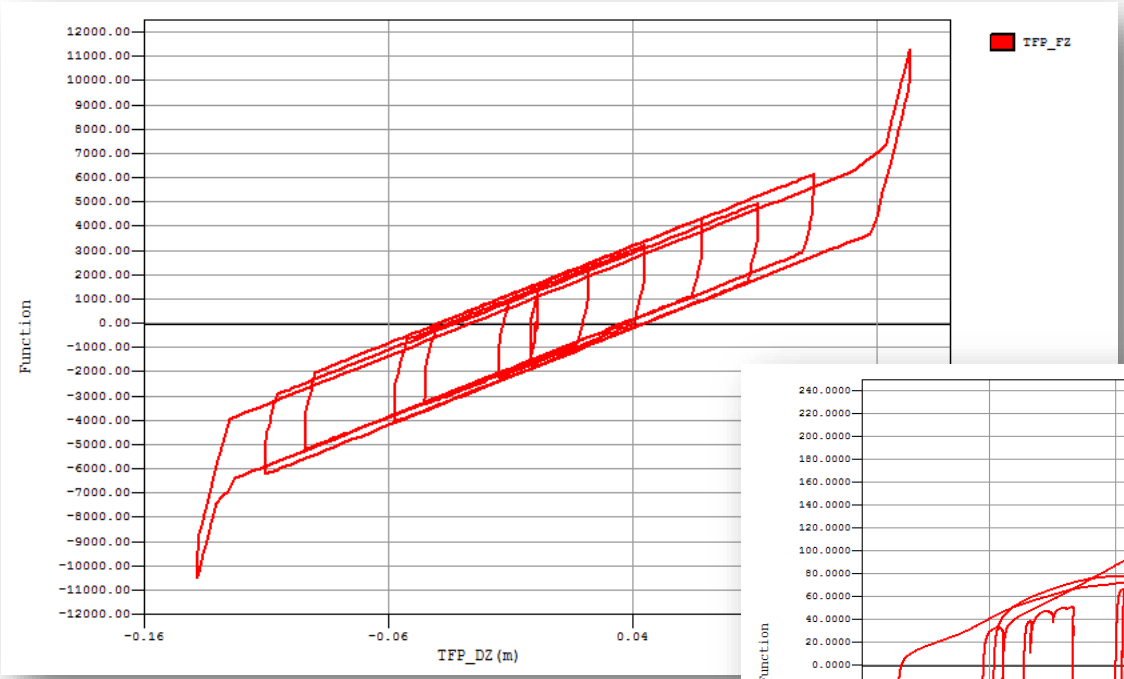
Behavior of Triple Friction Pendulum Isolator (Sliding Regime V)

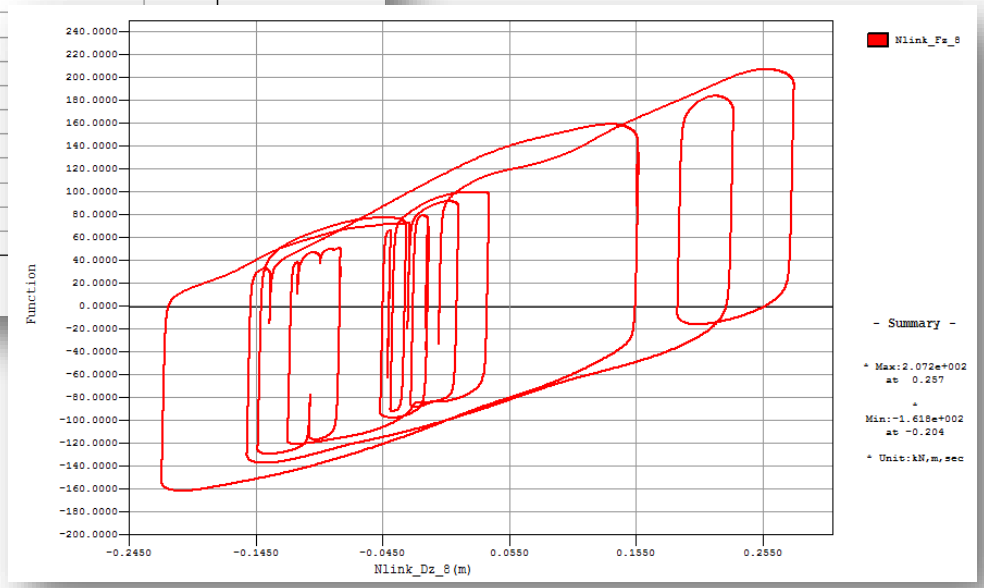




8. Triple Friction Pendulum Isolator (continued)

TFP Shear Force-Displacement history under ground acceleration

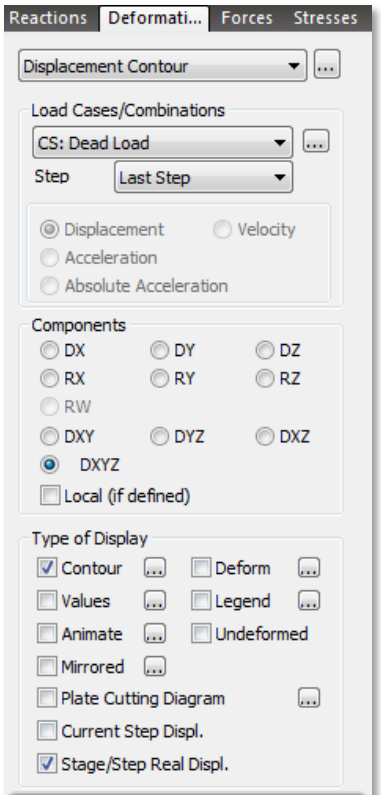




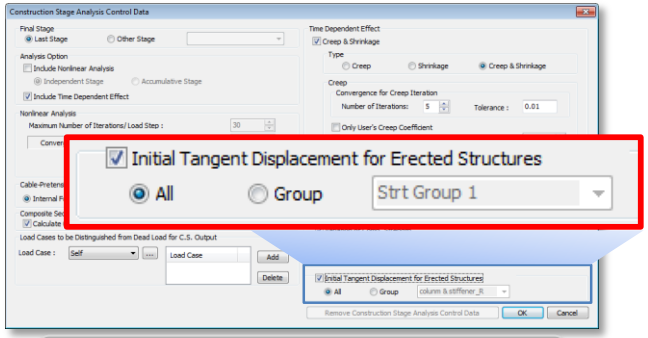
9. Plotting Tangential Displacements for Erected Structures (Stage/Step real displacement)

- Real displacements of the elements which will be created in the next stage considering the rotational angle of nodes resulting form each current stage can be calculated. This function can be used for fabrication campers for structural steel and precast concrete members.
- In order to calculate real displacements, “Initial Tangent Displacement for Erected Structures” option must be checked on in Construction Stage Analysis Control dialog box. This function cannot be used with Include Nonlinear Analysis option.

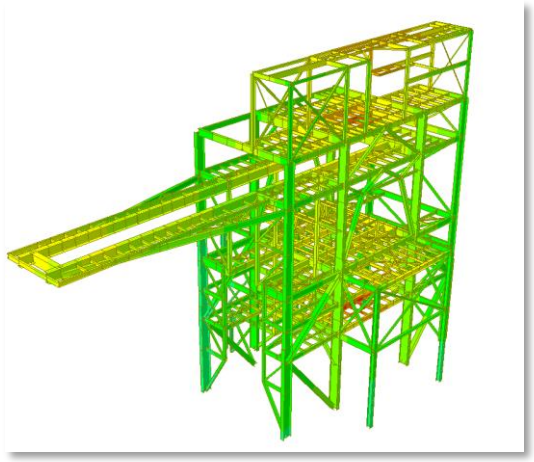
- ***Analysis > Construction Stage Analysis Control***
- ***Results > Deformations > Deformed Shape / Displacement Contour***

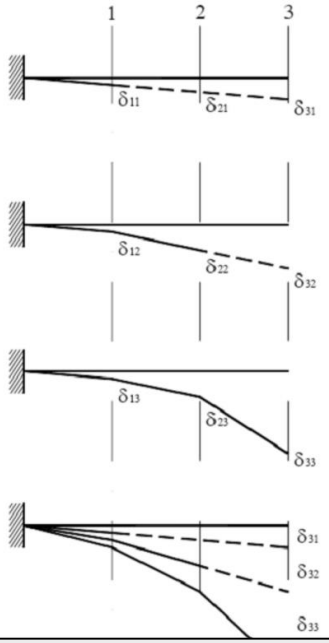


Displacement Contour



Construction Stage Analysis Control





Legend: δ(a),(b): Displacement at the point (a), stage (b)

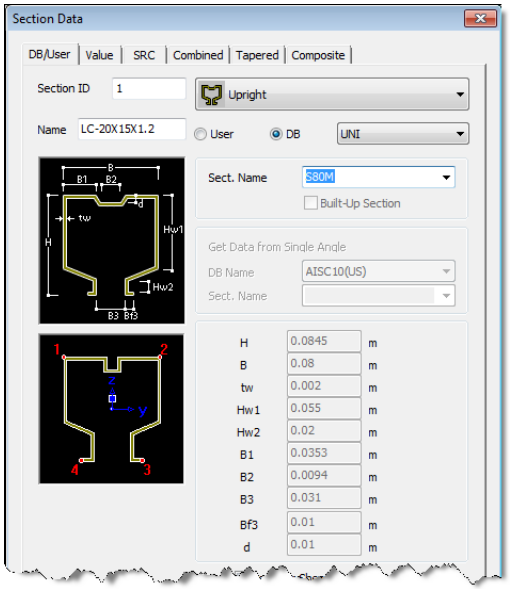
Real disp. at the point 1: δ11+ δ12+ δ13
Real disp. at the point 2: δ21+ δ22+ δ23
Real disp. at the point 3: δ31+ δ32+ δ33

Net disp. at the point 1: δ11+ δ12+ δ13
Net disp. at the point 2: δ22+ δ23
Net disp. at the point 3: δ33

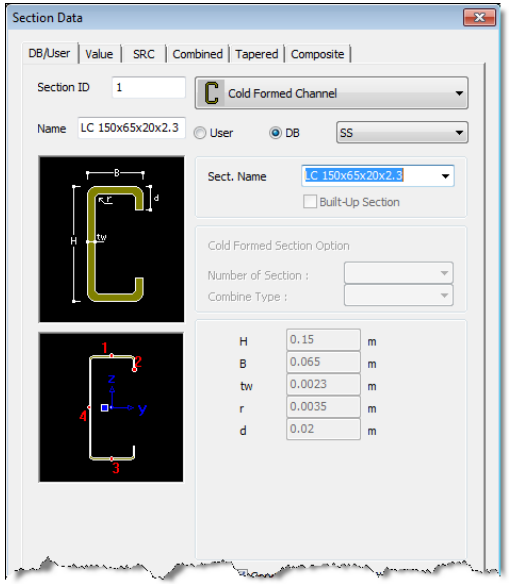
10. New Section and Material Database

- Cold-formed Channel, Pipe, Box and Upright section DB as per UNI (Italian standard) and SS (Singaporean Standard) has been newly implemented.
- Steel section DB as per ICHA (Chilean standard) has been added for Angle, Double Angle, Star Battened Angle, I-shape, Channel, Double Channel and Lipped channel.
- Cold-formed material DB as per EN10326, EN 10149-2 and EN 10149-3 has been newly implemented.

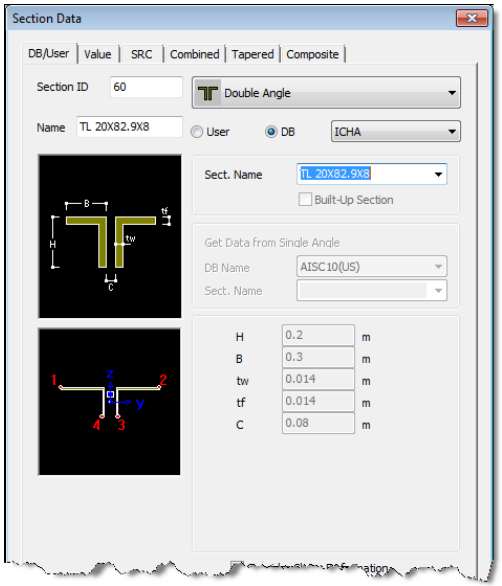
- ***Properties > Section Properties***
- ***Properties > Material Properties***



UNI Upright Section



SS Cold Formed Channel



ICHA Double Angle

11. Nodal Coordinate Table in UCS

- Nodal coordinates can now be checked and modified in the User Coordinate System. This feature is useful to check or modify nodal coordinates in inclined slab or rotated plan in Global XY plane.
- Spreadsheet format node table is compatible with MS Excel to copy, paste and modify the data. The table can be inserted into Dynamic Report.

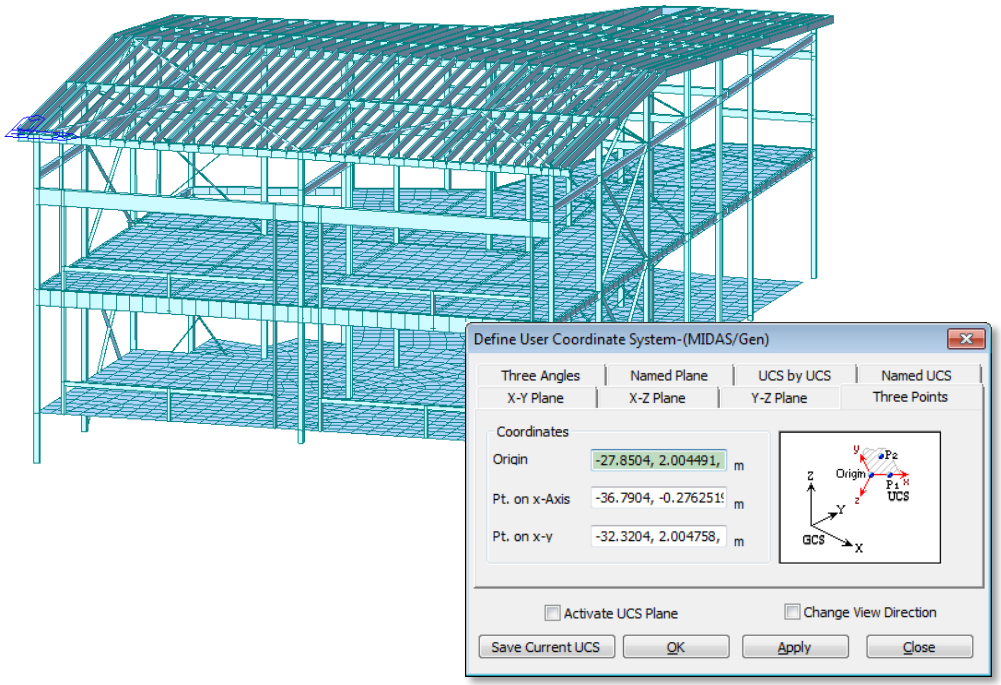
▪ ***Node/Element > Nodes Table***

Nodes

Node	X'(cm)	Y'(cm)	Z'(cm)
1	-1250.000000	0.000000	1850.000000
2	1250.000000	0.000000	1850.000000
3	-1250.000000	0.000000	-1850.000000
4	1250.000000	0.000000	-1850.000000
5	-1250.000000	2570.000000	1250.000000
6	1250.000000	2570.000000	1250.000000
7	-1250.000000	2570.000000	-1250.000000
8	1250.000000	2570.000000	-1250.000000
9	-1250.000000	3076.000000	1250.000000
10	1250.000000	3076.000000	1250.000000
11	-1250.000000	3076.000000	-1250.000000
12	1250.000000	3076.000000	-1250.000000
13	-1250.000000	3540.000000	1250.000000
14	1250.000000	3540.000000	1250.000000
15	-1250.000000	3540.000000	-1250.000000
16	1250.000000	3540.000000	-1250.000000
17	-1250.000000	4080.000000	1250.000000

Nodes(GCS) | Nodes(UCS)

Node Table in User Coordinate System



User Coordinate System for Inclined Plane

12. Improvement on Plate Local Axis

- Using Plate Local Axis function, local axis of plate element can be aligned along with global axis or cylindrical axis (±X, ±Y, ±Z, ±R, ±TH) for checking results. This function is useful for unstructured meshes or cylindrical structure.
- In the previous version, there was no way to delete the defined local axis. In the new version, Add/Replace or Delete option can be used to re-define or delete the pre-defined plate local axis.

- ***Design > Steel Code Checking***
- ***Design > Steel Optimal Design***

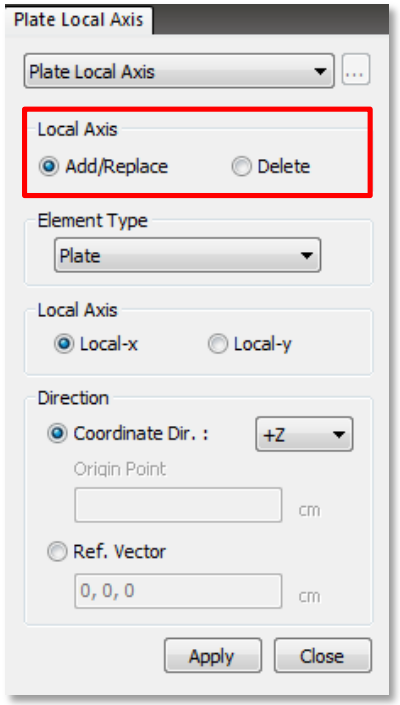


Plate Local Axis

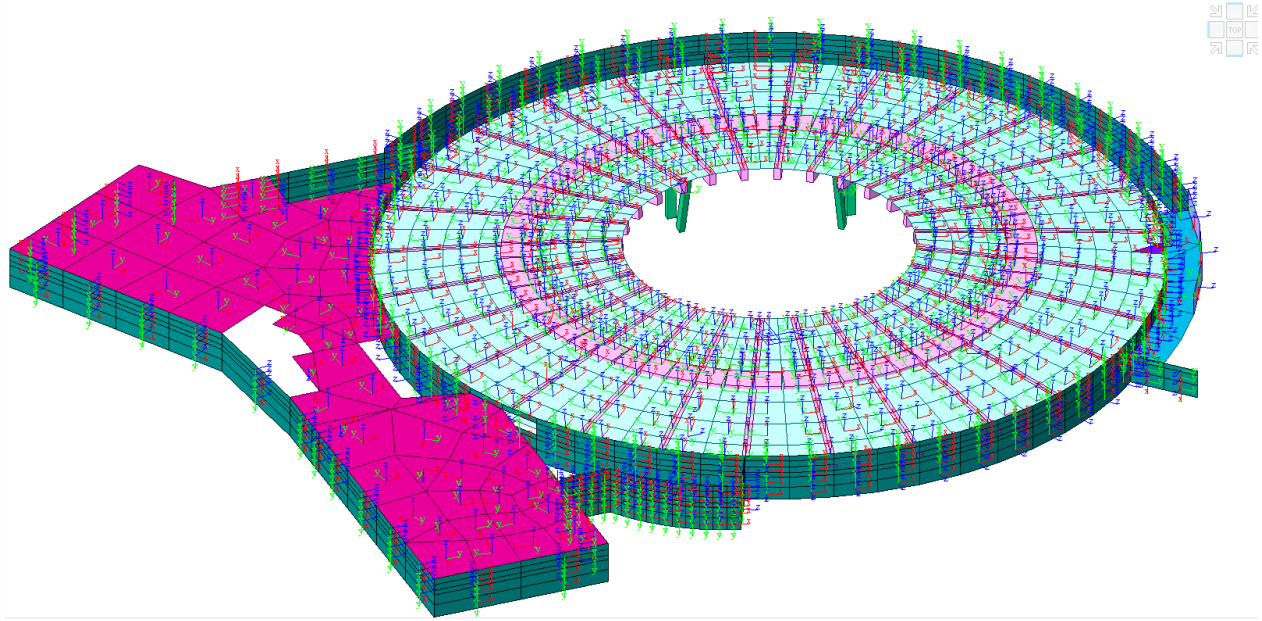
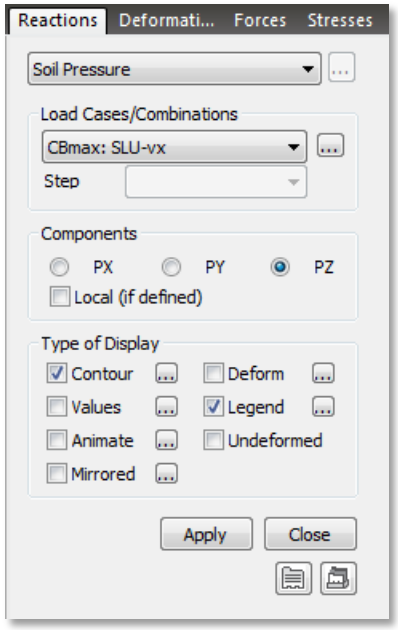


Plate Local Axis for Round Shape Slab

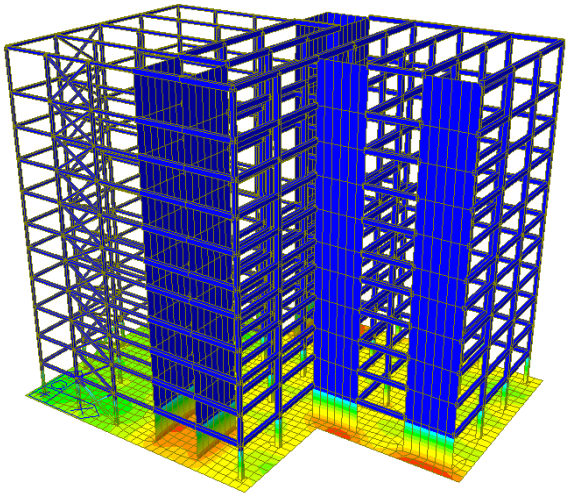
13. Improvement on Soil Pressure

- Soil pressure contours were provided on the beam, plate or solid elements representing subgrade beam, mat foundation or retaining wall. In the new version, following improvements have been made:
  - ✓ In case of inclined mat foundation, projection area can be considered. In the previous version, soil pressure was identically calculated for inclined foundation when the soil spring was assigned along with Global Coordinate System.
  - ✓ In the previous version, soil pressure was incorrectly calculated when surface spring supports were entered more than twice for vertical spring and horizontal spring separately. In the new version, soil pressure and effective area by directions (Kx, Ky, Kz) are now separately stored.
  - ✓ Effective area to calculate soil pressure was initialized as zero when soil stiffness is changed in Point Spring Support Table. It is now corrected calculated.
  - ✓ In the new version, Modulus of Subgrade values can be checked and modified in Surface Spring Support table for compression-only type springs.

- ***Results > Reactions > Soil Pressure***



Soil Pressure



Soil Pressure Contour

Surface Spring Support

Element	Type	Distributed Type	Local Axis	Face	Edge	Width (m)	Spring Type	Modulus of Subgrade	Group
1	PLATE	Planar(Face)		Face #			Comp-Only	1000.00	Default
2	PLATE	Planar(Face)		Face #			Comp-Only	1000.00	Default
3	PLATE	Planar(Face)		Face #			Linear	1000.00	Default
4	PLATE	Planar(Face)		Face #			Comp-Only	1000.00	Default
5	PLATE	Planar(Face)		Face #			Comp-Only	1000.00	Default
6	PLATE	Planar(Face)		Face #			Linear	1000.00	Default
7	PLATE	Planar(Face)		Face #			Comp-Only	1000.00	Default
8	PLATE	Planar(Face)		Face #			Comp-Only	1000.00	Default

Surface Spring Support Table

Point Spring Support

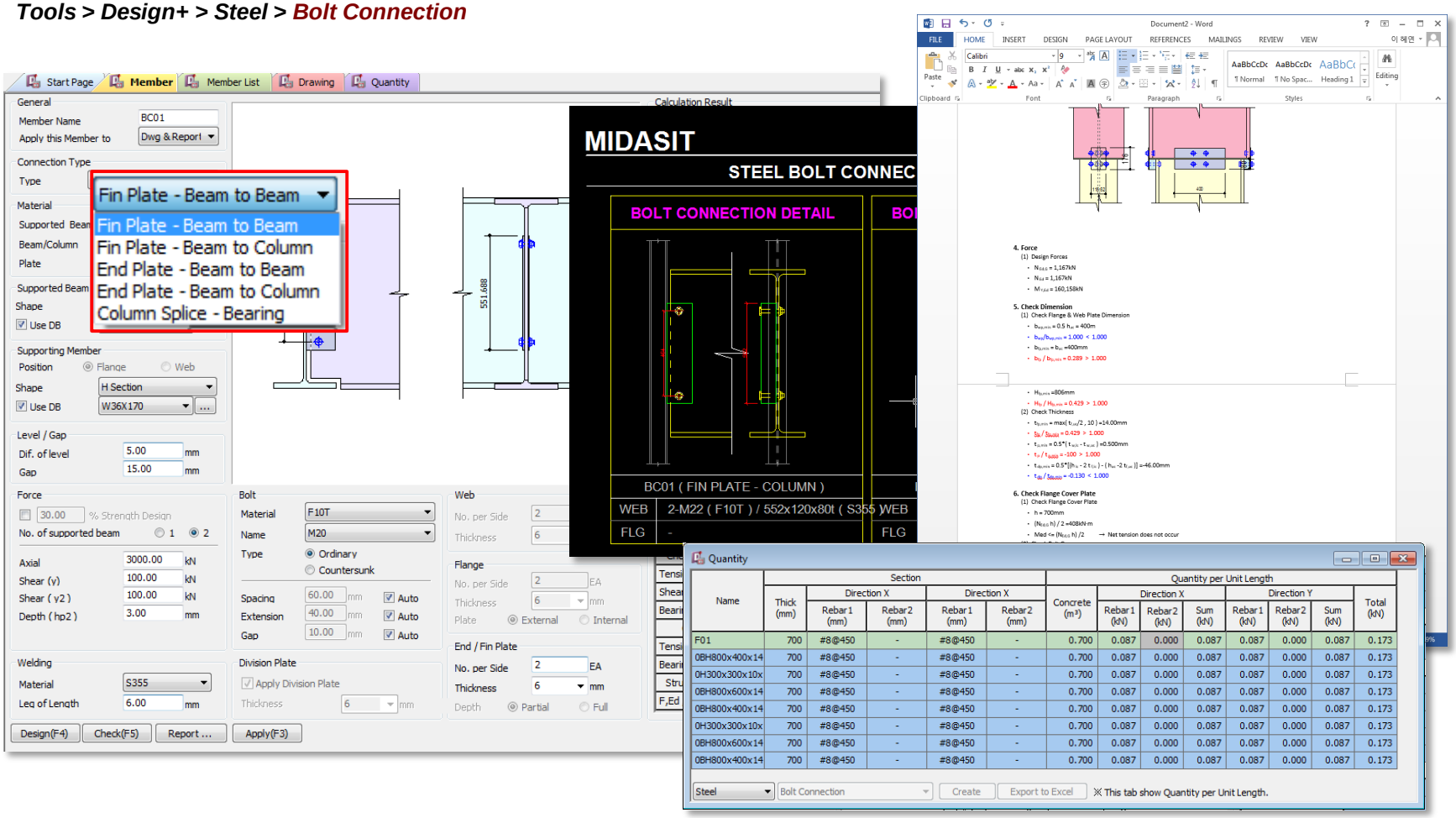
Node	Type	SDx (kN/m)	SDy (kN/m)	SDz (kN/m)	SRx (kN-	SRy (kN-	SRz (kN-	Damping	KX (kN/m³)	KY (kN/m³)	KZ (kN/m³)	Direction	Multi-Linear
1426	Linear	85946.890	85946.890	17189.378	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1427	Linear	83459.726	83459.726	16691.945	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1428	Linear	83364.590	83364.590	16672.918	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1429	Linear	83306.076	83306.076	16661.215	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1430	Linear	83220.490	83220.490	16644.098	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1431	Linear	83287.994	83287.994	16657.598	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1432	Linear	92114.633	92114.633	18422.926	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1433	Linear	95801.480	95801.480	19160.296	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1434	Linear	95908.652	95908.652	19181.730	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1435	Linear	94793.280	94793.280	18958.656	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1436	Linear	89472.003	89472.003	17894.400	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1437	Linear	95021.533	95021.533	19004.306	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm
1438	Linear	95644.721	95644.721	19128.944	0.00	0.00	0.00	☐	97910.67	97910.67	19582.13	Dx(+)	Unsymm

Point Spring Support Table

1. Bolt Connection Design/Checking as per EN1993-1-1:2005

- Following type of bolt connection can be verified as per EN1993-1-1:2005: Fin Plate (Beam and Beam connection), Fin Plate (Beam and Column connection, End Plate (Beam and Beam connection), End Plate (Beam and Column connection), Column Splice (Bearing connection).
- Once the design/checking is completed, midas Design+ provides member list, drawing and quantity table.

- ***Tools > Design+ > Steel > Bolt Connection***



Input Design Parameters

- Supporting and Supported Member Size
- Plate and Bolt Dimension
- Welding Information
- Design Forces

Check Supported Member

- Bolt Group Shear Verification
- Plate Bolt Bearing Verification
- Web Bolt Bearing Verification
- Shear Verification of Plate
- Flexure Verification of Plate
- Buckling Verification of Plate
- Shear Verification of Web
- Notch Verification
- Local Stability Verification

Check Supporting Member

- Welding Check
- Shear and Bearing Verification

Tying Resistance

- Tension Resistance of Plate
- Bolt Shear Verification of Plate
- Bolt Bearing of Plate
- Tension Resistance of Beam Web
- Bolt Bearing Verification of Beam Web

Fin Plate Connection Design Process

Input Design Parameters

- Supporting and Supported Member Size
- Plate and Bolt Dimension
- Welding Information
- Design Forces

Check Supported Member

- Welding Check
- Shear Resistance of Web
- Notch Resistance
- Local Stability Verification

Check Connection

- Connection of Bolt Group
- Shear Verification of Plate

Check Supporting Member

- Check Supporting Member

Tying Resistance

- Check Plate and Bolts
- Check Web Resistance of Supporting Member

End Plate Connection Design Process

Input Design Parameters

Check Flange and Web Dimension

Check Thickness

Net Tension Verification of Flange Cover Plate

Cover Plate Resistance Verification

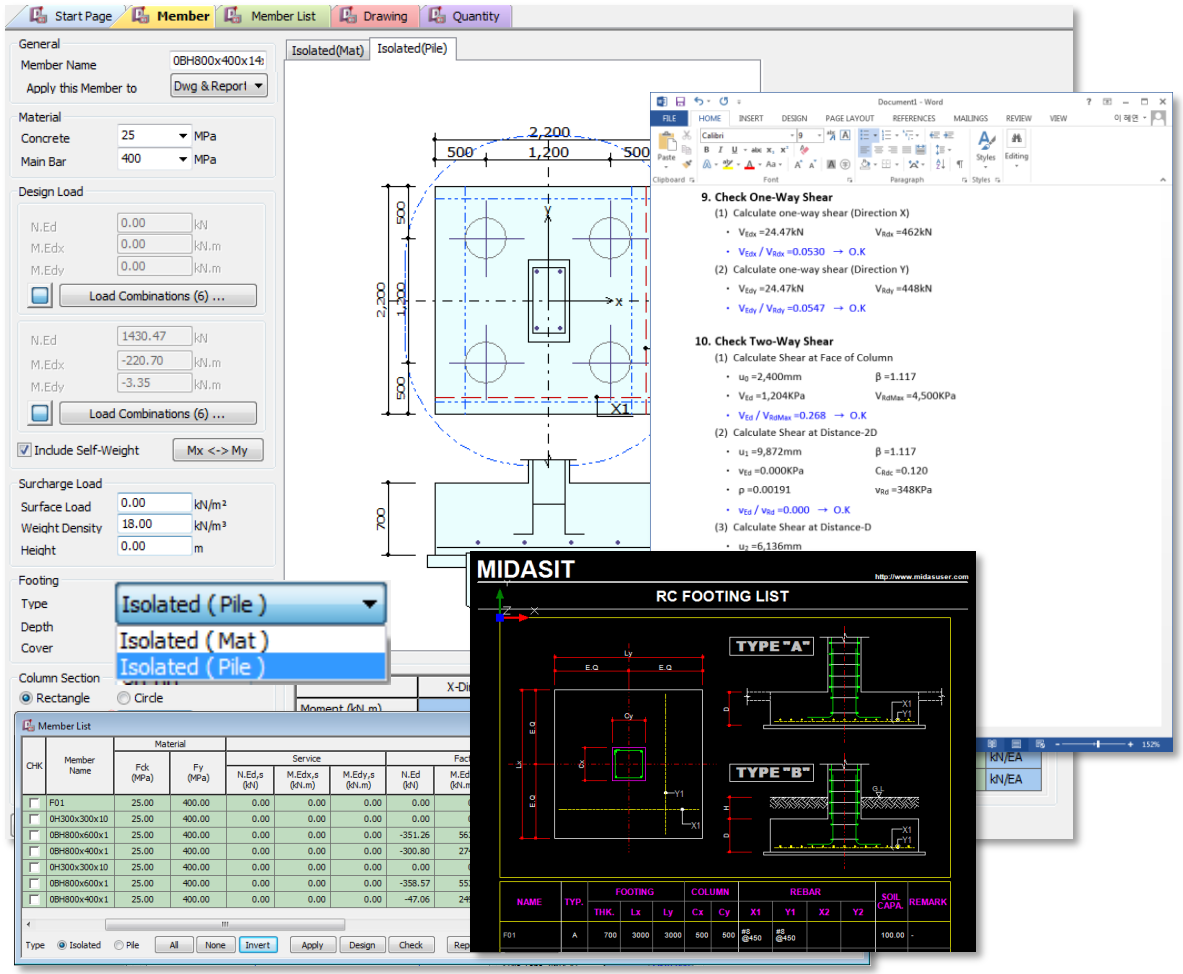
Bolt Group Resistance Verification

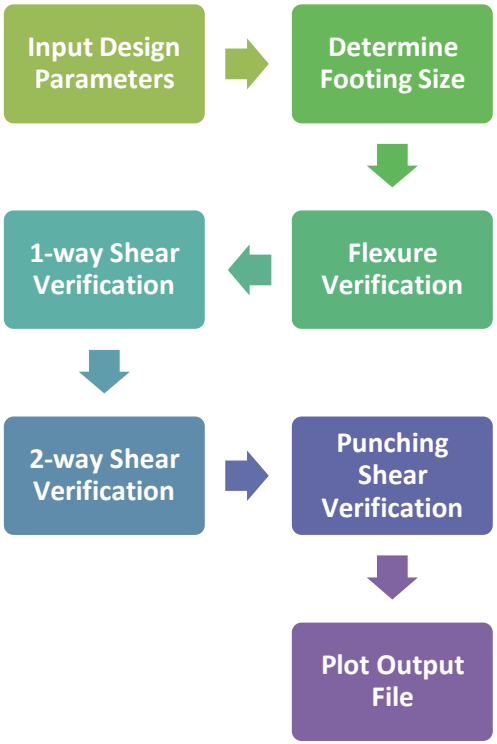
Bearing Connection Design Process

2. Isolated Footing Design/Checking as per EN1992-1-1:2004

- Isolated mat and pile foundation can be verified as per EN1992-1-1:2004.
- Once the design/checking is completed, midas Design+ provides member list, drawing and quantity table.

▪ ***Tools > Design+ > RC > Footing***





Isolated Footing Design Process