Release Note

Release Date: July, 2018

Product Ver. : Gen 2019 (v1.1) and Design + 2019 (v1.1)
# Index

## midas Gen

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## midas Design+

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## 1. Member Design as per NTC 2018

<table>
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<tr>
<th>Reference in NTC 2018</th>
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</tr>
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<tbody>
<tr>
<td>-</td>
<td>Add Material of NTC2018 in DShop</td>
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<td>-</td>
<td>Add Material of NTC2018 in GSD</td>
</tr>
<tr>
<td>7.4.6.2.2</td>
<td>[Column] Modify the calculation of ‘Volume of concrete core’ in Check mechanical volumetric ratio of confining hoops within the critical regions.</td>
</tr>
<tr>
<td></td>
<td>[Wall End] Modify the calculation of mechanical volumetric ratio within the critical regions.</td>
</tr>
<tr>
<td>7.4.4.5.1</td>
<td>1) Shear strength in wall elements under seismic combination is reduced by a 0.4 factor. 2) Design shear force of wall elements use the shear force from analysis without any modification in CD “B”.</td>
</tr>
<tr>
<td>7.4.6.2.2</td>
<td>Minimum mechanical volumetric ratio is considered as 0.12 only for CD “A” in column and wall.</td>
</tr>
<tr>
<td>7.4.4.5.2.2</td>
<td>In wall element for seismic and non-seismic case, wall length for shear design is calculated by ‘d=0.9Lw’ and ‘z= 0.8Lw’</td>
</tr>
</tbody>
</table>
1. Member Design as per NTC 2018

- **Detail Report for Punching Shear Checking as per 6.4.4 and 6.4.5 of EN1992-1-1**

Basic control perimeter
\[ r_{hole} = 0.0000 \]
\[ r_{holt} = 0.0000 \]
\[ r_{hol} = \min\left[ \sqrt{r_{hole} r_{holt}}, 0.02 \right] = 0.0000 \]
\[ K = \min\left\{ 1 + \left( \frac{200}{0^3} \right)^{0.5}, 2.0 \right\} = 2.0000 \text{ (d in mm)} \]
\[ \gamma_{c} = 1.5000 \]
\[ U_{Rd,c} = \max\left[ 0.035+0.5\sqrt{f_{ck}}, (0.18/\gamma_{c})+100r_{hol}+f_{ck}^{-1}/3 \right] \mu = d \]
\[ = 402.1202 \text{ kN}. \]

\[ R_{fT} = \beta_{T} U_{Ed} / U_{Rd,c} - 1.747 > 1.0 \rightarrow \text{Not Acceptable!!!} \]
(Need Vertical Reinforcements.)

\[ f_{y} = 347065 \text{ MPa}. \]

\[ Asw / Sr = \beta_{x} U_{Ed} / (1.5 + f_{y} + f_{y,d},f) = 0.0009 \text{ m}^2/\text{n}. \]
(Calculating the outermost perimeter of shear reinforcement.)

\[ u_{out}, \text{ef} = \beta_{x} U_{Ed} / (U_{id},c) \mu = 0.0009 \text{ m}. \]

**Calculating “Area(Asw) / space(Sr)” of shear reinforcement.**

*as per EN 1992-1-1:2005/A1:2014*

\[ V_{vel,cr} = 0.75 v_{vel,1} + 1.5 (d / s_{r}) A_{sw} f_{pdm} \left[ 1 / (\alpha d) \right] \sin S K_{RV} - V_{vel,cr} \]

Where

- \( A_{sw} \) is the area of one perimeter of shear reinforcement around the column [mm²];
- \( s_{r} \) is the radial spacing of perimeters of shear reinforcement [mm];
- \( f_{pdm} \) is the effective design strength of the punching shear reinforcement according to \( f_{pdm} = 250 + 0.25 d f_{p,d} \) [MPa];
- \( d \) is the mean of the effective depths in the orthogonal directions [mm];
- \( \alpha \) is the angle between the shear reinforcement and the plane of the slab;
- \( V_{vel,cr} \) according to 6.4.4;
- \( K_{RV} \) is the factor, limiting the maximum capacity that can be achieved by application of shear reinforcement.

**NOTE** The value of \( K_{RV} \) for use in a country may be found in its National Annex. The recommended value is 1.5.
2. Improvement of post-processing in material nonlinear analysis

- Strain results are provided for plastic materials, i.e. Tresca, Von Mises, Mohr-Coulomb, Drucker-Prager, and Concrete Damage.

- Damage ratios for compression and tension are provided for the ‘Concrete Damage’ model.

Results > Tables > Results Tables > Plate/ Solid > Strain(local)/ Strain(Global)
2. Improvement of post-processing in concrete damage model

Results > Results > Strains > Plate Strains/ Solid Strains

- Total Strain
- Damage Ratio

- Components
  - Str-xx, Str-yy, Str-yy, Str-zz, Str-max, Str-min, Max-Shear

- Type of Display
  - Contour, Deform, Values, Legend, Animations, Undeformed, Mirrored

- Value Option
  - Max, Element Center

- Load Cases/Combinations
  - ST1: LOC1
- Step
  - NL Step 20

- Strain Options
  - Local, UCS Current UCS, Print UCS Axis
  - Avg Normal Active Only, Avg. Normal Active Only
  - Top, Bottom, Both Sides, Abs Max

- Damage Ratio
  - Total Strain, Plastic Strain

- Compressive
  - Tensile
  - Total
3. Structure wizard of transmission tower

- Tower wizard makes it easy to model the leg/body/arm part of a complex 3D tower structure.

Structure > Wizard > Tower > Tower Leg/Body/Arm
4. Improvement of post-processing in time-history analysis results

- The average and envelope load cases for the time-history load cases are generated in the table.
- The displacement and the member force are only supported.

Results > Time History > T.H Results > Time History Load Combination

<table>
<thead>
<tr>
<th>Time History Load Case</th>
<th>Result Type</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cball : TH ENV_User input name</td>
<td>The maximum absolute value among the selected load cases</td>
<td></td>
</tr>
<tr>
<td>Cbmax : TH ENV_User input name</td>
<td>The maximum value among the maximum value of selected load cases</td>
<td></td>
</tr>
<tr>
<td>Cbmin : TH ENV_User input name</td>
<td>The minimum value among the minimum value of selected load cases</td>
<td></td>
</tr>
<tr>
<td>Cbmax : TH AVR_User input name</td>
<td>The average value of the maximum value of selected load cases</td>
<td></td>
</tr>
<tr>
<td>Cbmin : TH AVR_User input name</td>
<td>The average value of minimum value of selected load cases</td>
<td></td>
</tr>
</tbody>
</table>

Identical value!
5. Improvement of Torsional Irregularity table

- The $\phi_p$ value is added in Torsional Irregularity Check Table as per the Colombia NSR-10 standard.
- The extreme irregular type is added in Remark field.

$\phi_p$ is the factor regarding the plan irregularity. If the structure has normal torsional irregularity (between 1.2 and 1.4) it must use $\phi_p$ as 0.9. If the structure has extreme torsional irregularity (more than 1.4), $\phi_p$ will be 0.8. If the structure is regular, $\phi_p$ will be 1.0.

---

Regular: Story Drift of Maximum Value $< 1.2\times$Story Drift of Average Value of Extreme Points

Irregular: $1.2\times$Story Drift of Average Value of Extreme Points $< \text{Story Drift of Maximum Value}$$< 1.4\times$Story Drift of Average Value of Extreme Points

Extreme Irregular: $1.4\times$Story Drift of Average Value of Extreme Points $< \text{Story Drift of Maximum Value}$
6. Automatic application of reduction factor for irregular structure (NSR-10)

- Response modification factor \( R \) is calculated using three reduction factors to consider the irregularity of structure as per the Colombia NSR-10 standard. \( R = \phi_a \phi_p \phi_r R_0 \)
- Height Irregularity (\( \phi_a \)), Plan irregularity (\( \phi_p \)), Redundancy Check (\( \phi_r \))

Enter the \( \phi_p \) obtained from the Torsional Irregularity table.

Calculation sheet of seismic load

Graph of the story force
7. Definition of Loading Area Group

- Loading Area Group can be defined by selecting an area to apply wind pressure.

**Structure > Group > B/L/T > Define Loading Area Group**
8. Wind pressure function

- Wind load is applied on the space structure according to user-defined function.
- Wind load is applied as the nodal load on the nodes composing the defined loading area.
9. Improvement of viscoelastic damper

- TRC dampers manufactured by Sumitomo Riko Company Limited is added to the viscoelastic material properties.

Boundary > General Link > Seismic Device Properties... > Viscoelastic Damper

4 element model

Viscoelastic material properties TRC Damper

4 element model

Mount

Bilinear of $K_2$

Shear strain dependence of $K_1$, $C_1$ and $C_2$
9. Improvement of viscoelastic damper

\[ \text{Total Components (} K_1(\text{Maxwell}) + K_2(\text{Voigt}) + C_1(\text{Maxwell}) + C_2(\text{Voigt}) \text{)} + \text{ Mount} \]

**Compression with other products**

- Verification model

```
<table>
<thead>
<tr>
<th>Force(N)</th>
<th>Deform(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.0</td>
<td>-0.6</td>
</tr>
<tr>
<td>-1.0</td>
<td>-0.8</td>
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<tr>
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<td>-1.0</td>
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<tr>
<td>-1.0</td>
<td>-1.2</td>
</tr>
<tr>
<td>-1.0</td>
<td>-1.4</td>
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<tr>
<td>-1.0</td>
<td>-1.6</td>
</tr>
<tr>
<td>-1.0</td>
<td>-1.8</td>
</tr>
<tr>
<td>-1.0</td>
<td>-2.0</td>
</tr>
</tbody>
</table>
```

- Input seismic wave

- Compression of historical loop

Mass = 5102.04 N/g
Elastic Stiffness = 10000 N/m
Undamped System
Mounting Stiffness = 1000000 N/m
9. Improvement of viscoelastic damper

**Boundary > General Link > Seismic Device Properties... > Viscoelastic Damper**

Compression with other products (Historical loop)

- **K₁ (Maxwell)**
- **K₂ (Voigt)**
- **C₁ (Maxwell)**
- **C₂ (Voigt)**

**Total Components** = (K₁ (Maxwell) + K₂ (Voigt) + C₁ (Maxwell) + C₂ (Voigt)) + Mount
10. Addition of Energy Result Graph

- Print out energy results graph for isolator and vibration control device in the nonlinear time history analysis.

\[ E_A = E_S + E_H \]

- **Addition of Energy Result Graph**
  - **Result > T.H Graph/Text > Time History Energy Graph**
  - Print out Energy Results graph for isolator and vibration control device in the nonlinear time history analysis.
10. Addition of Energy Result Graph

Result > T.H Graph/Text > Time History Energy Graph
10. Addition of Energy Result Graph

Result > T.H Graph/Text > Time History Energy Graph

- The shear span value is user input. If it is less than 0, it is treated as an error.
10. Addition of Energy Result Graph

Result > T.H Graph/Text > Time History Energy Graph

Result output of group distribution for each energy item
11. Multi-linear type elastic spring/ link for interface with GTS NX

- Reactions from Point Spring Support can be exported to GTS NX.
- Force-displacement results of soil can be imported from GTS NX into midas Gen, and the input data of the multi-linear Point Spring Supports are updated.

File > Export > Nodal Results for GTS

File > Import > Nodal Results for GTS
12. Multi-linear force-deformation function for Point Spring Support and Elastic Link

- Multiple linear type elastic springs are defined as functions without limitation.

Multi-linear is defined as 6 points in the previous version.
13. Nonlinear Elastic Links for Pushover Analysis

- Nonlinear behavior of the elastic links, i.e. comp.-only, tens.-only, multi-linear can be taken into account in the pushover analysis.
- Link forces imported from static analysis or construction stage analysis cannot be specified as initial loads for pushover analysis.
14. Tekla Structure 2018 Interface

- Tekla Structures interface is a tool provided to speed up the entire modeling, analysis, and design procedure of a structure by data transfer with midas Gen. Data transfer is limited to structural elements. Tekla Structure interface enables us to transfer a Tekla model data to midas Gen, and delivery back to the Tekla model file. midas Gen text file (*.mgt) is used for the roundtrip.

**File > Import > midas Gen MGT File**

**File > Export > midas Gen MGT File**

<table>
<thead>
<tr>
<th>Category</th>
<th>Features</th>
<th>Tekla ↔ Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL</td>
<td>concrete</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>steel</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>pre cast - wood and other types</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>Material user defined</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>ELEMENT TYPE/</td>
<td>vertical column</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>ROTATIONS</td>
<td>inclined column</td>
<td>&lt;&gt;</td>
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<td></td>
<td>straight beam</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>curved beam</td>
<td>&gt;</td>
</tr>
<tr>
<td></td>
<td>Slab</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>vertical panel</td>
<td>&gt;</td>
</tr>
<tr>
<td>2D ELEMENTS</td>
<td>Concrete panels and slab</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>BOUNDARY CONDITIONS</td>
<td>support</td>
<td>&gt;</td>
</tr>
<tr>
<td></td>
<td>beam end release</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>section offset</td>
<td>&gt;</td>
</tr>
<tr>
<td>STATIC LOAD</td>
<td>self weigh</td>
<td>&gt;</td>
</tr>
<tr>
<td></td>
<td>linear load (uniform or trapezoidal)</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>MERGE OPTION</td>
<td>new element</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>new element that divide other elements</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td></td>
<td>topology changes</td>
<td>&lt;&gt;</td>
</tr>
</tbody>
</table>
15. Reinforcement as per SS560: 2010

- Reinforcement as per Singapore SS560:2010 is added for the design.
1. SRC Column

- The automatic design / check of the SRC column is performed as per AISC-LRFD 10M.
2. CFT Column

- The automatic design / check of the CFT column is performed as per AISC-LRFD 10M.
3. Carbon fiber strengthened beam

- Reinforced concrete beam strengthened with FRP / carbon fiber is automatically designed or checked.
- ACI318-08/11/14, ACI318M-08/11/14, NSR-10, and KCI-USD07/12 are supported.

**Flow chart of neutral axis calculation**

- Calculation of neutral axis
- Calculate of design strain ($\varepsilon_{fd}$)
- Calculation of initial strain ($\varepsilon_{bi}$)
  - Assumption of neutral axis initial value (0.2$d$)
  - Calculation of effective strain ($\varepsilon_{fe}$)
  - Calculation of concrete strain ($\varepsilon_{c}$)
  - Calculation of the steel strain & stress ($\varepsilon_{s}$, $f_{s}$)
  - Calculation of carbon fiber stress ($f_{fe}$)
  - $F_{s} + F_{fe} = F_{c}$
  - No
  - Yes
  - Calculation of Flexural strength ($M_{Ws}$, $M_{Af}$, $\phi M_{n}$)
  - End of neutral axis calculation
4. Aluminum beam/column

- The aluminum beam / column design check is based on the Aluminum Design Manual (ADM1:2005) of AA (Aluminum Associate, USA).
- The automatic check of the aluminum beam / column is performed as per AISC-LRFD 10M.

< Design Code >
AA-ASD05
AA-ASD05M
AA-LRFD05
AA-LRFD05M

< Shape of Section>
Beam/Column
H Section
T Section
Angle
Channel
Box
Pipe
Solid Round
Solid Box

Beam/Column(General)
IJ-7781
IJ-8382
5. Improvement of Rib plate for base plate

- When the rib plate is inserted in the baseplate and the length of the rib plate is larger than 1/2 of the thickness of the base plate, the rib plate is created on the flange of the column.
- AISC-LRFD 10, ASIC-LRFD 05, Eurocode3:05, KSSC-LSD 16, and KSSC-LSD 09 are supported.