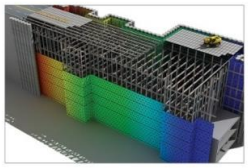
Release Notes

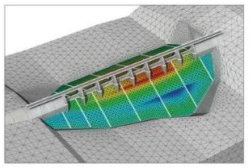
Release Date: September, 2019

Product Ver.: GTSNX 2019(v2.1)

GTS NX

Geo-Technical analysis System New eXperience





Integrated Solver Optimized for the next generation 64-bit platform

Finite Element Solutions for Geotechnical Engineering

MIDAS

Enhancements

1. Analysis

1.1 Construction Stage new analysis types:

- Heat Transfer, Thermal Stress, Seepage-Heat Stress

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1.4 Adding Prescribed Strain Function

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1. Analysis

1.1 New Heat Transfer, Thermal Stress, Seepage-Thermal Stress analysis types (Construction Stage) *Available upon request

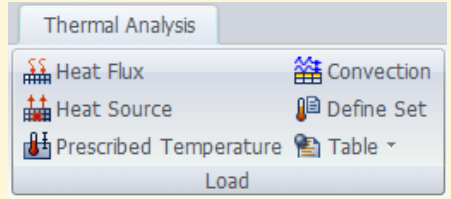
This analysis type can be used to model the thermal changes in the ground due to environmental changes, or due to the construction of facilities, such as buildings or pipelines. In GTS NX thermal energy can be exchanged based on following phenomenological ways: Conduction and Convection.
Thermal analyses (Heat Transfer, Thermal Stress, Seepage-Thermal Stress) are available as the steady state analysis and transient analysis (time dependent).

After the heat transfer analysis, results such as temperature distribution, temperature gradient, heat flow direction / size are printed.

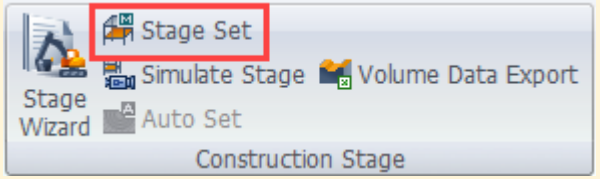
Thermal stress and thermal deformation due to generated/exchanged heat can be obtained from Thermal Stress analysis (thermo-mechanical study).

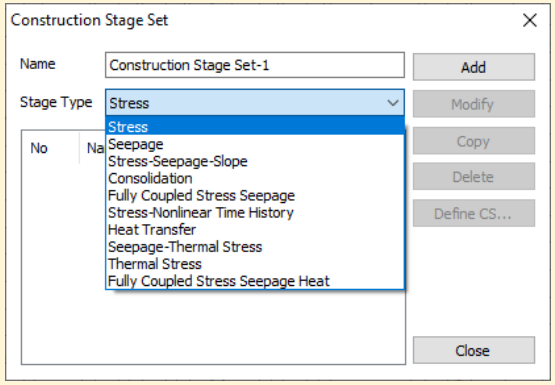
Seepage -Thermal Stress analysis allows for hydro thermo mechanical simulation.
Both structural analysis results and seepage / heat transfer analysis results are output.

Analyses are available from Construction Stage define window.

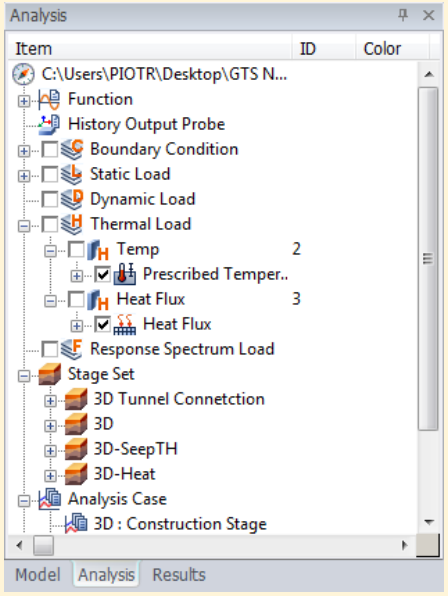


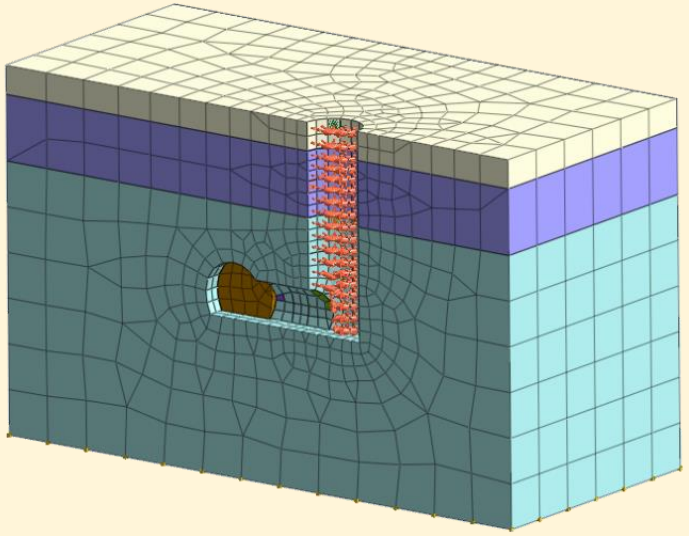
[Available thermal loads]





[Construction Stage Set window]

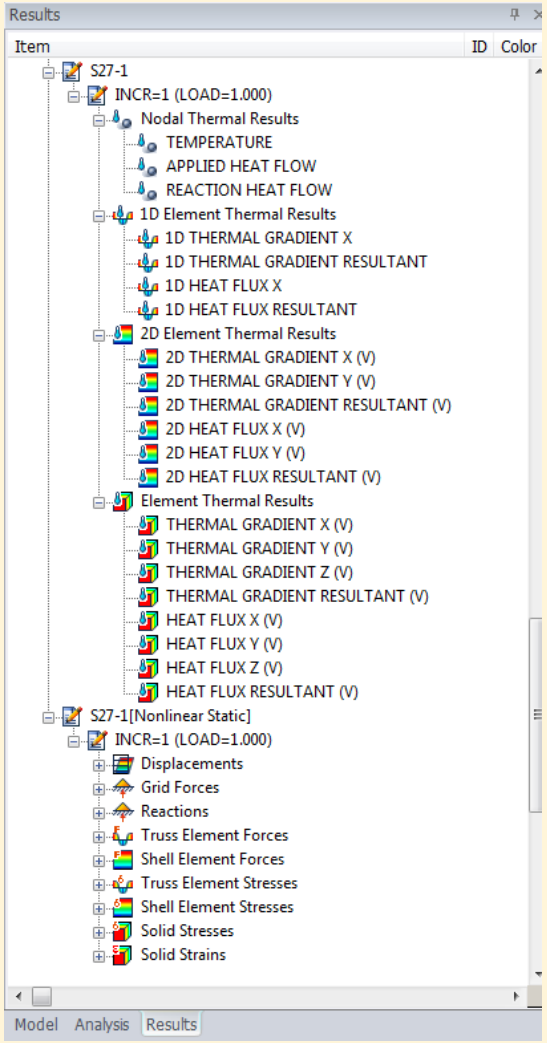




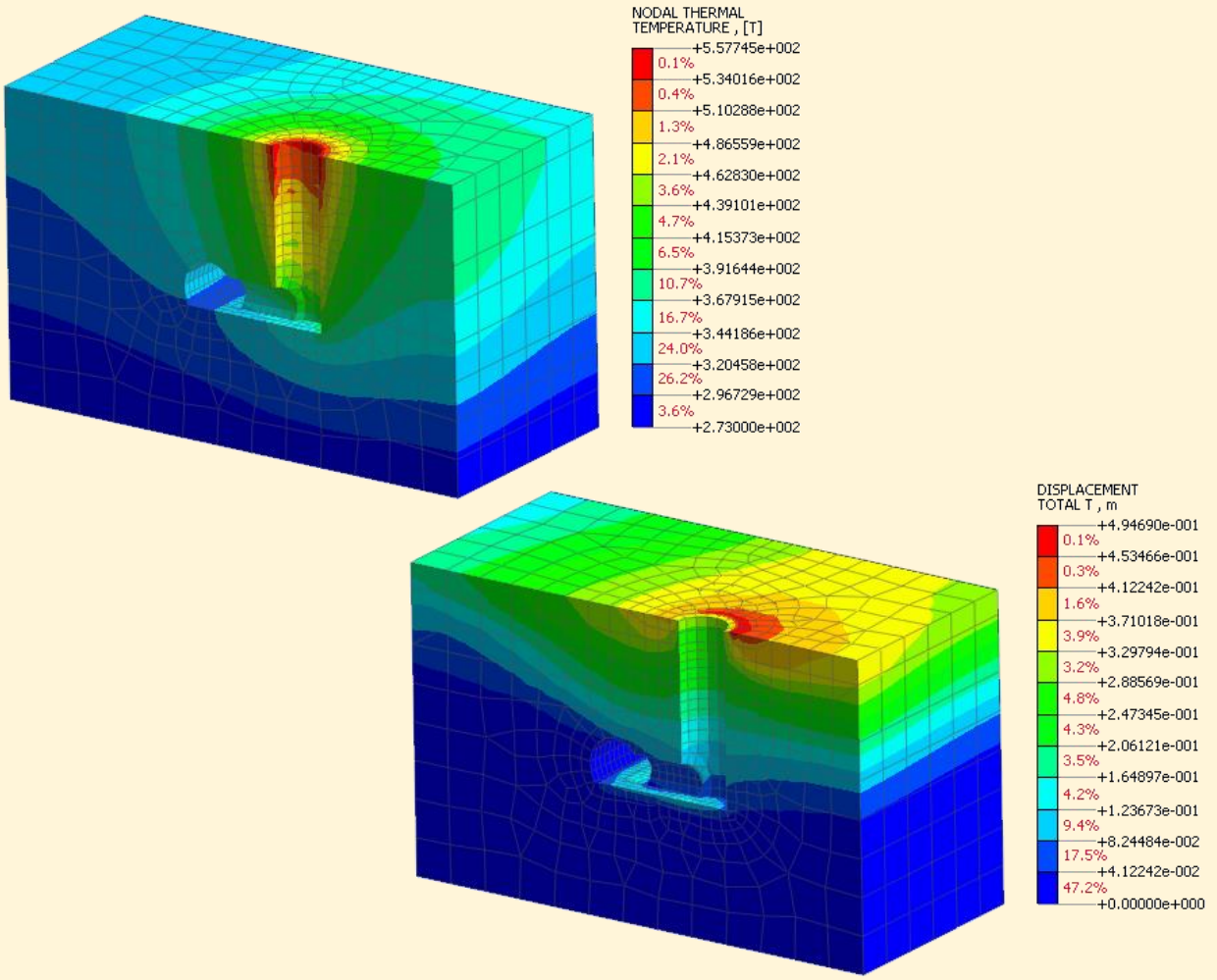
[Model with applied thermal loads]

1. Analysis

1.1 New Heat Transfer, Thermal Stress, Seepage-Thermal Stress analysis types (Construction Stage) *Available upon request



[Every CS output combines Heat Transfer and Structural results]



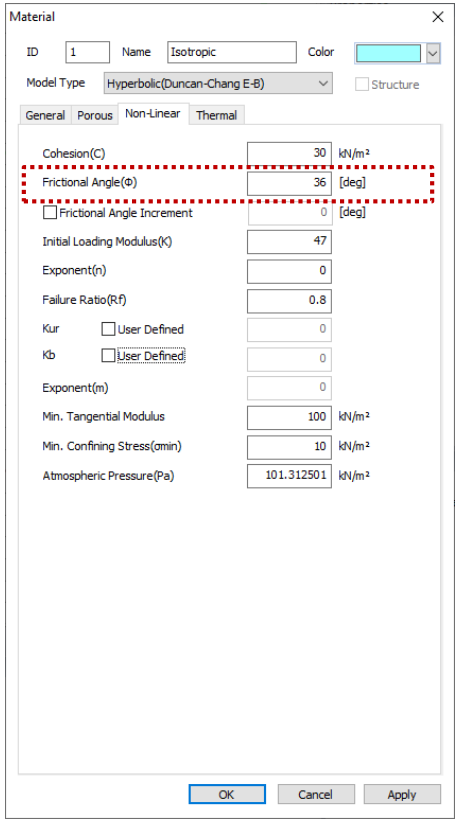
[Thermal Stress analysis results for lining thermal expansion analysis]

1. Analysis

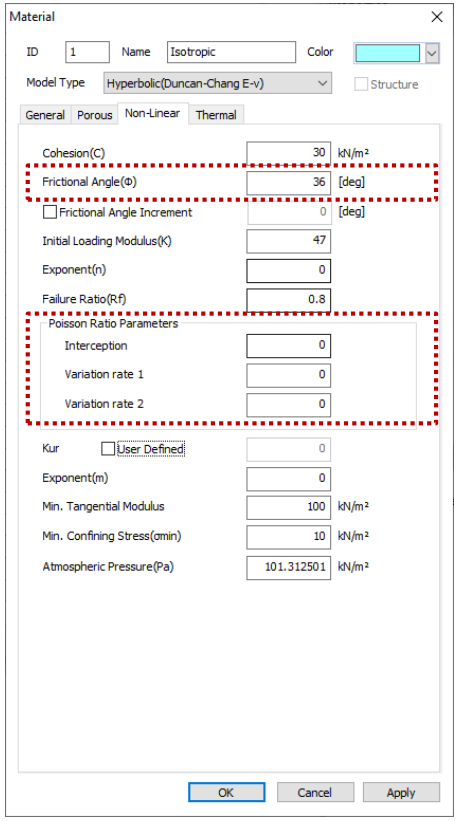
1.2 Improving Hyperbolic (Duncan-Chang) Model

- Previously Hyperbolic(Duncan-Chang) material has updated as two types such as Duncan-Chang E-B and Duncan-Chang E-v with additional parameters.

Mesh > Prop./Csys./Func. > Material > Isotropic > Hyperbolic(Duncan-Chang E-B) or Hyperbolic(Duncan-Chang E-v)



[Hyperbolic(Duncan Chang E-B)]



[Hyperbolic(Duncan Chang E-v)]

[Friction Angle Increment for E-B & E-v]

• In case of “Coarse grained soil”, frictional angle will be decreased with increased compression (σ3) so that it will consider this situation.

• Friction angle(Φ) will be defined by following equation,

$$\emptyset = \emptyset_0 - \Delta\emptyset \times \log\left(\frac{\sigma_3}{p_a}\right)$$

[Additional parameters for E-v(G, F, D)]

• Parameters have added for calculating Vt(Poisson’s ratio).

G: Distance to axis from initial poisson’s ratio

F: Rate of change for compression from initial poisson’s ratio

D: Rate of change for stress from initial poission’s ratio

• Parameters and limiation are defined by following equation,

$$E_t = Kp_a\left(\frac{\sigma_3}{p_a}\right)^m \left[1 - \frac{R_f}{(\sigma_1 - \sigma_3)_f}(\sigma_1 - \sigma_3)\right]^2$$

$$v_t = \frac{G - F \times \log\left(\frac{\sigma_3}{p_a}\right)}{\left\{1 - \frac{D(\sigma_1 - \sigma_3)}{Kp_a\left(\frac{\sigma_3}{p_a}\right)^m \left[1 - \frac{R_f}{(\sigma_1 - \sigma_3)_f}(\sigma_1 - \sigma_3)\right]}\right\}^2}$$

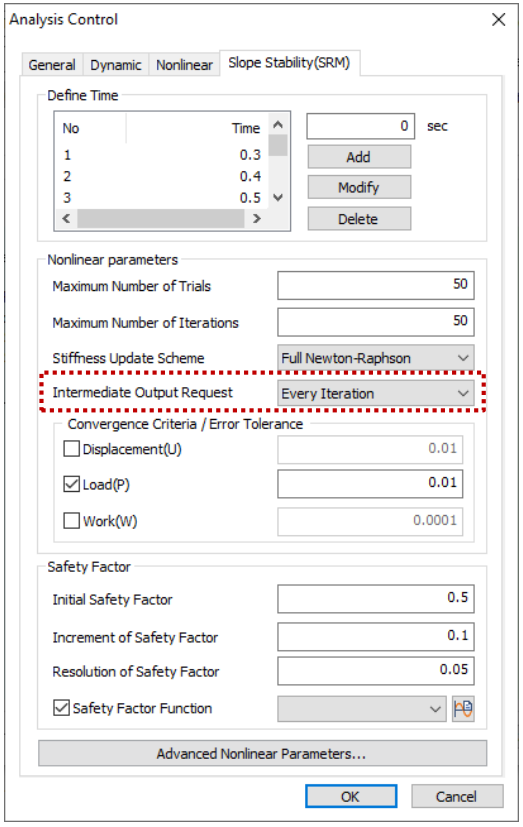
D > 0, 0 < G < 0.5, F < G

1. Analysis

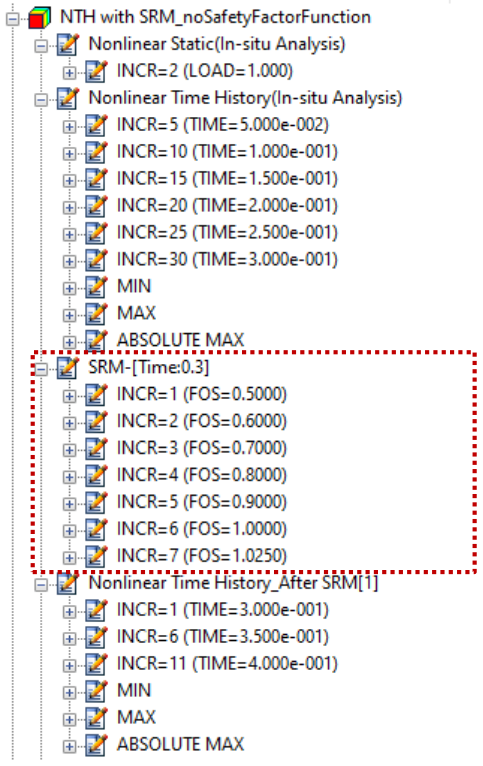
1.3 Improving Slope Stability Analysis(SRM)

- Previously it could be got the result of last iteration only. **It can find the results from each step which are selected by user** from now on.
- **SRF1 and SRF2 can use** for reduced function such as **friction angle and cohesion** respectively. And, User can consider **dilatancy angle(SRF3)** for reduced function additionally. **(※Safety factor function can apply only to Mohr-Coulomb model)**

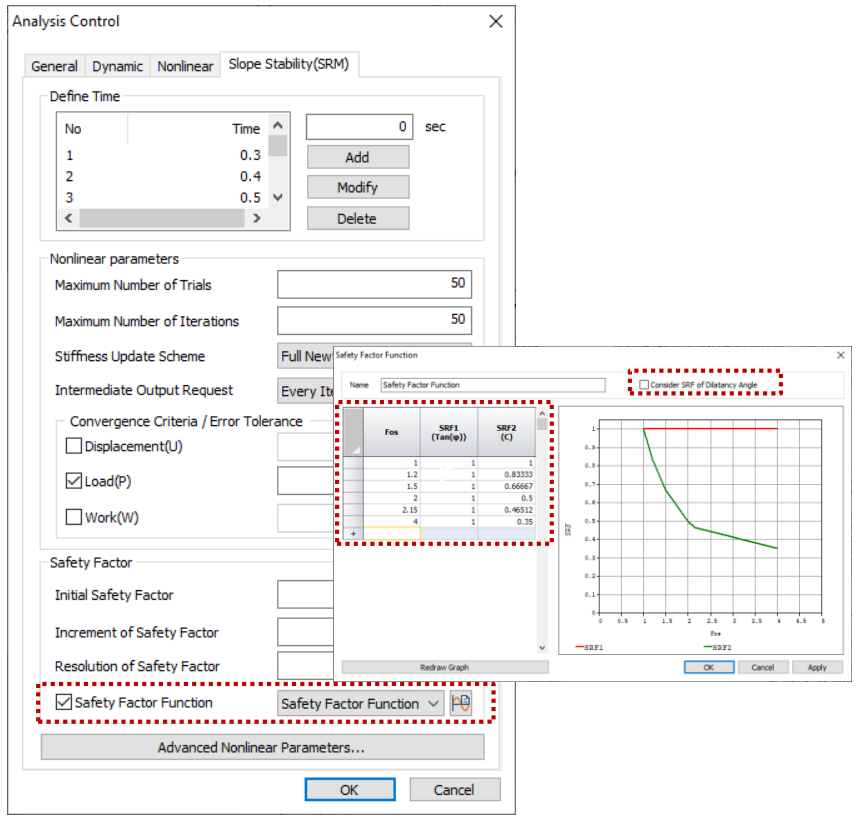
Analysis Case > Analysis Control > Slope Stability(SRM)



[SRM – Intermediate Output Request]



[Display the FOS from Every Stage]



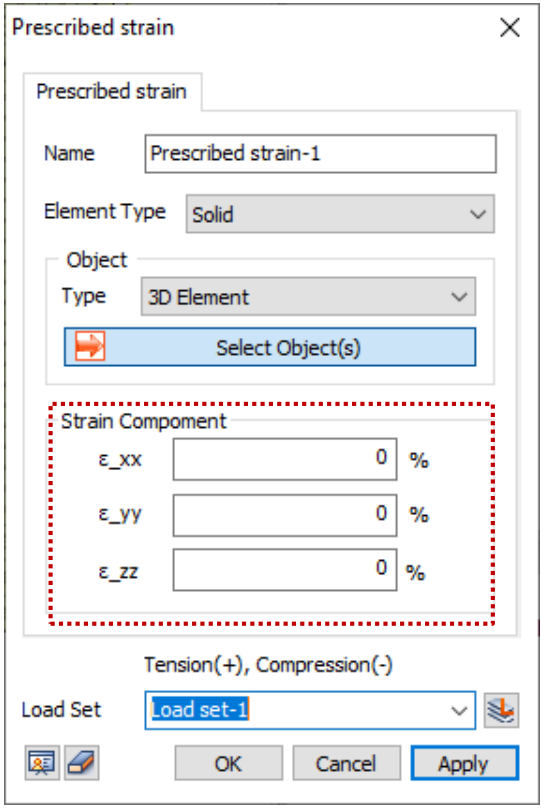
[SRM – Safety Factor Function]

1. Analysis

1.4 Adding Prescribed Strain Function

- Prescribed strain function is using to apply volumetric strain by compulsion, can be assumed volume loss from Jet Grouting method or compensation grouting.
  (※Prescribed strain will not be supported to linear analysis and dynamic analysis)

Static/Slope Analysis or Seepage/Consolidation Analysis > Load > Prescribed strain



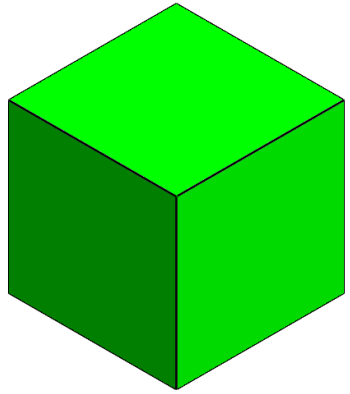
[Prescribed Strain]

[Element Type]

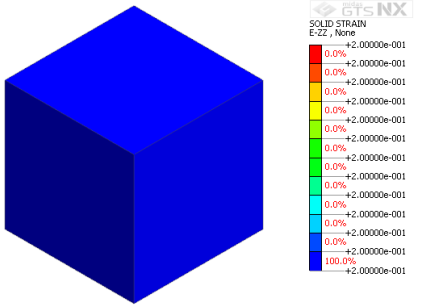
Truss/Embedded Truss, Beam/Embedded Beam, Shell, Plane Strain/Plane Stress, Axisymmetric, Solid

[Strain Component]

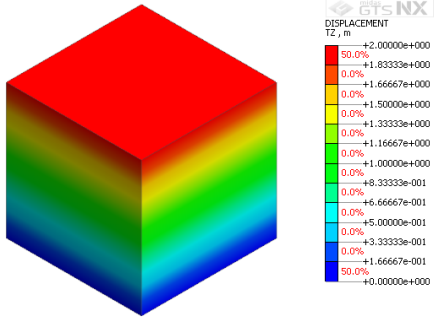
Applying volume strain to x, y, z axis



[To apply Prescribed Strain – Solid]



[Occurred Strain]



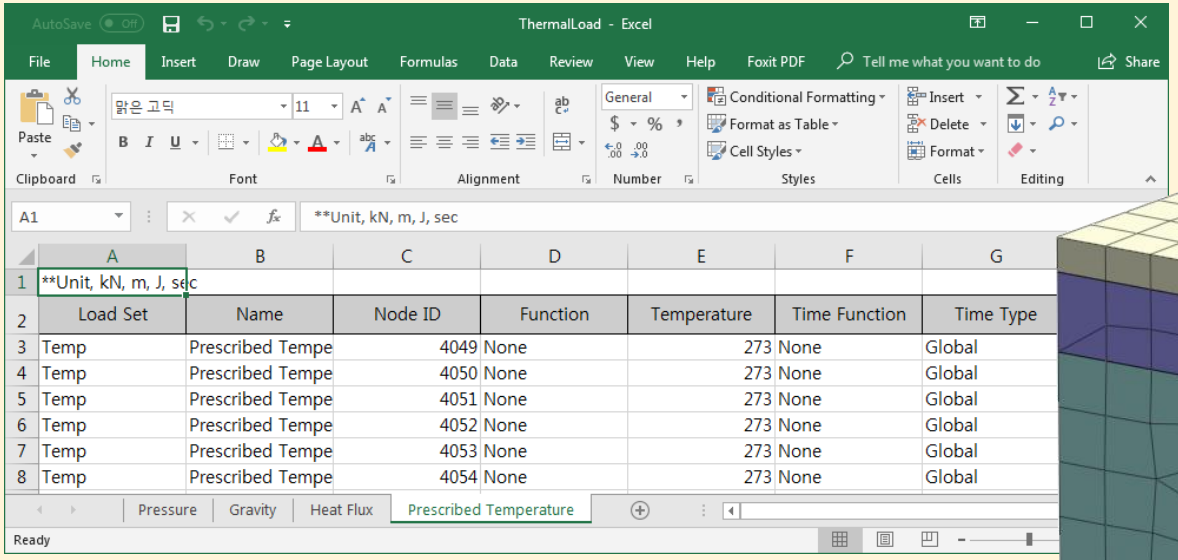
[Occurred Displacement]

2. Pre/Post Processing

2.1 Load Table import/export for thermal analyses

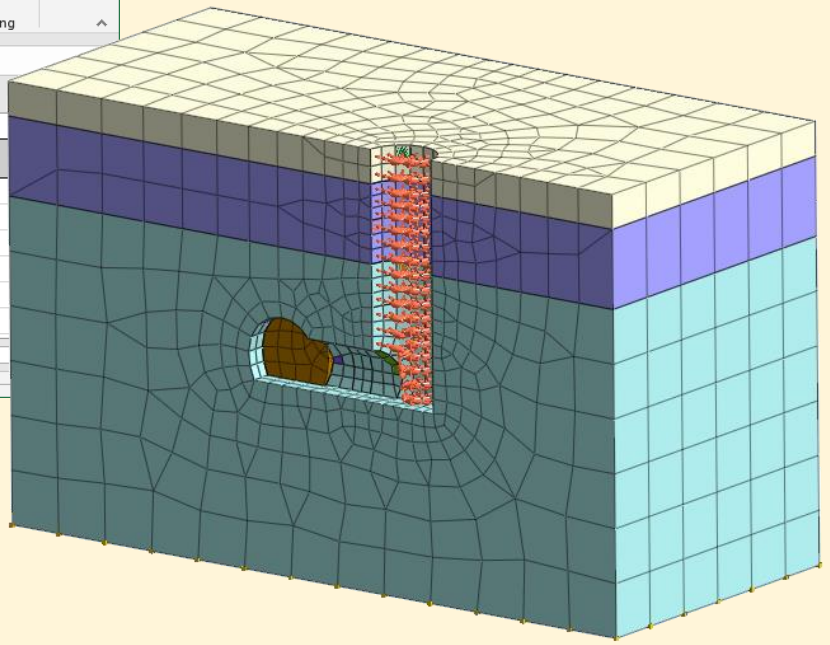
Cards for thermal loads has been added to manage large amount of data.
Users can import the amounts of load sets from excel file and export defined load sets (node/element number, magnitude, and direction) as well.

The sample of table for load sets (Load Table Sample.xlsx) can be found in the installation folder. (ex. C:\Program Files\MIDAS\GTS NX\Sample)



	A	B	C	D	E	F	G
1	**Unit, kN, m, J, sec						
2	Load Set	Name	Node ID	Function	Temperature	Time Function	Time Type
3	Temp	Prescribed Tempe	4049	None	273	None	Global
4	Temp	Prescribed Tempe	4050	None	273	None	Global
5	Temp	Prescribed Tempe	4051	None	273	None	Global
6	Temp	Prescribed Tempe	4052	None	273	None	Global
7	Temp	Prescribed Tempe	4053	None	273	None	Global
8	Temp	Prescribed Tempe	4054	None	273	None	Global

[Thermal Load Set to import]



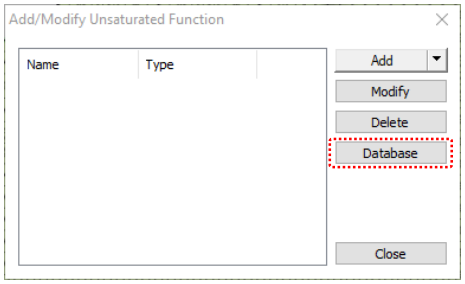
[Imported Temperatures and Heat Fluxes]

2. Pre/Post Processing

2.2 Database for Unsaturated Soil

- Previously, It was inputted (θ_r, θ_s. α, n) by user manually. It will be used for reference from database of those parameters which are provided by GTS NX from now on. (※ Permeability has inputted as default value. Porosity will be applied to analysis which is provided by Add/Modify function. This database will be using for reference of permeability from soil type)

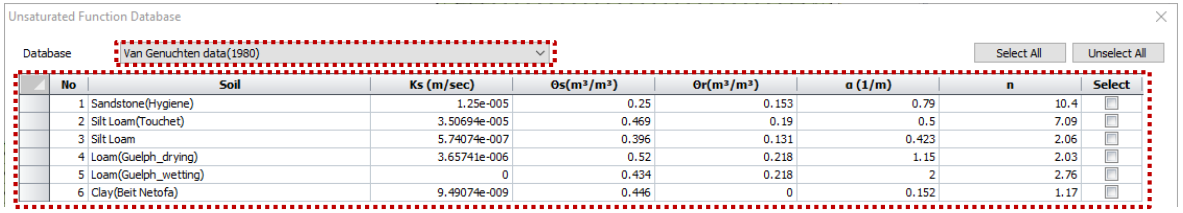
Mesh > Prop./Csys./Func. > Function > Unsaturated Property > Database



[Database for Unsaturated Function]

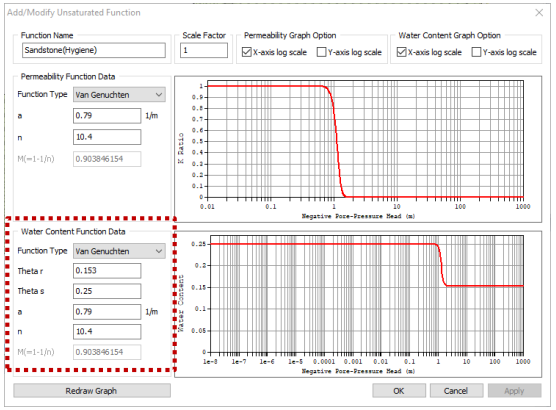
Select Database

Automatically generate selected function

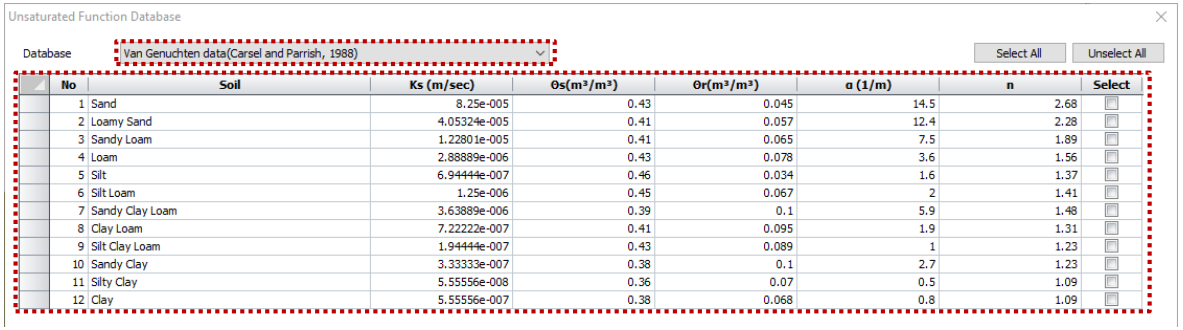


No	Soil	Ks (m/sec)	θs(m³/m³)	θr(m³/m³)	α (1/m)	n	Select
1	Sandstone(Hygiene)	1.25e-005	0.25	0.153	0.79	10.4	
2	Silt Loam(Touchet)	3.50694e-005	0.469	0.19	0.5	7.09	
3	Silt Loam	5.74074e-007	0.396	0.131	0.423	2.06	
4	Loam(Guelph_drying)	3.65741e-006	0.52	0.218	1.15	2.03	
5	Loam(Guelph_wetting)	0	0.434	0.218	2	2.76	
6	Clay(Beit Netofa)	9.49074e-009	0.446	0	0.152	1.17	

Reference - A Closed-form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils
- M. TH. VAN GENUCHTEN, 1980



[Automatically import Database]



No	Soil	Ks (m/sec)	θs(m³/m³)	θr(m³/m³)	α (1/m)	n	Select
1	Sand	8.25e-005	0.43	0.045	14.5	2.68	
2	Loamy Sand	4.05324e-005	0.41	0.057	12.4	2.28	
3	Sandy Loam	1.22801e-005	0.41	0.065	7.5	1.89	
4	Loam	2.88889e-006	0.43	0.078	3.6	1.56	
5	Silt	6.94444e-007	0.46	0.034	1.6	1.37	
6	Silt Loam	1.25e-006	0.45	0.067	2	1.41	
7	Sandy Clay Loam	3.63889e-006	0.39	0.1	5.9	1.48	
8	Clay Loam	7.22222e-007	0.41	0.095	1.9	1.31	
9	Silt Clay Loam	1.94444e-007	0.43	0.089	1	1.23	
10	Sandy Clay	3.33333e-007	0.38	0.1	2.7	1.23	
11	Silty Clay	5.55556e-008	0.36	0.07	0.5	1.09	
12	Clay	5.55556e-007	0.38	0.068	0.8	1.09	

Reference - Developing Joint Probability Distributions of Soil Water Retention Characteristics
- ROBERT F. CARSEL and RUDOLPH S. PARRISH, 1988

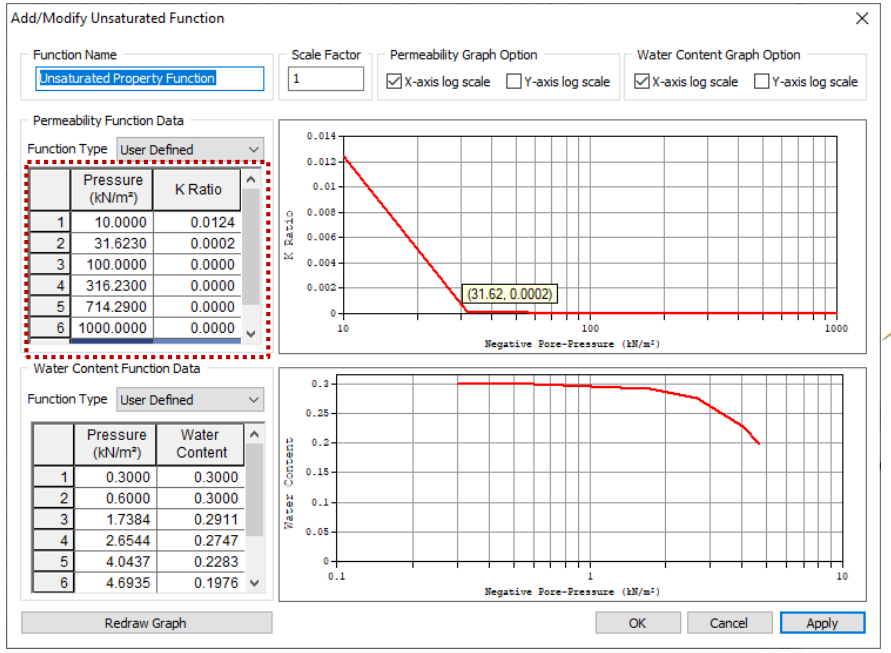
[Database from Soil Type]

2. Pre/Post Processing

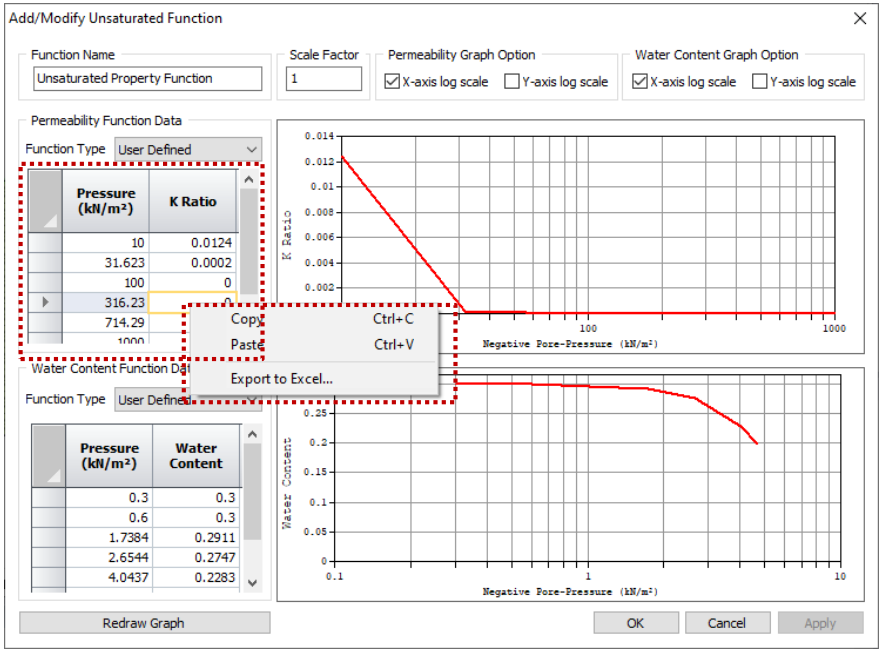
2.3 Improving the Interaction between Function Table and Excel

- It has updated to display real input values with upgrading the base of function table library.
- xls file will be created with **Export to Excel** function.

Mesh > Prop./Csys./Func. > Function



[Previously Function Table]



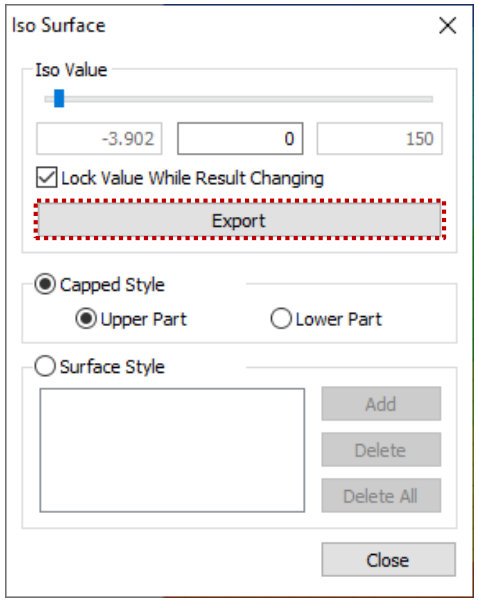
[Currently Function Table & Export function]

2. Pre/Post Processing

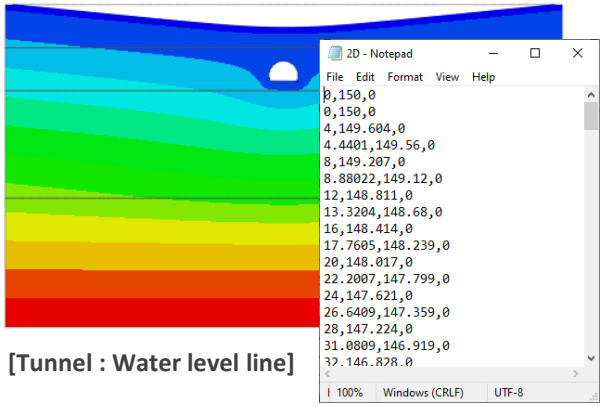
2.4 Extract from Result of Water Level(Line & Surface)

- From advanced view control( ), coordinate with 3D can be export with text file from result of water level.
- Decreased depth of water level can be defined easily and accurately with this function instead of measure function(F3).

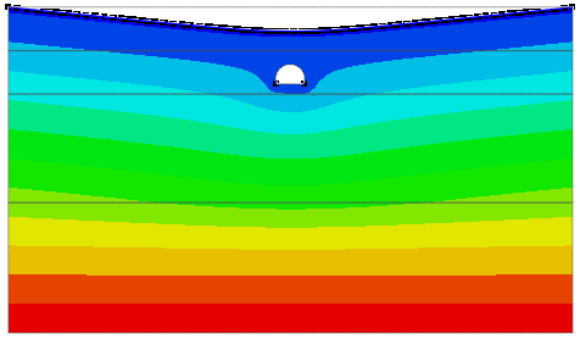
Advanced View Control > Iso value surface > Export



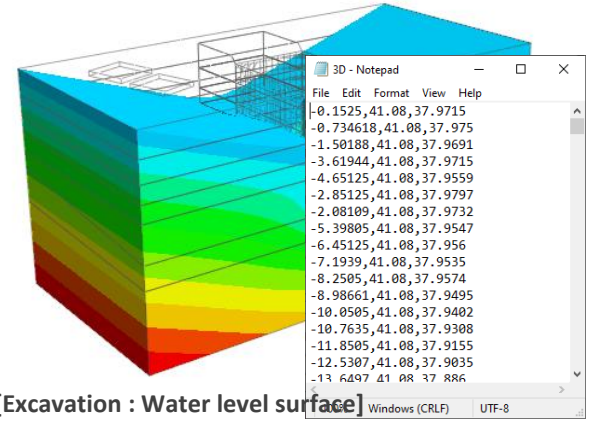
[Export Function]



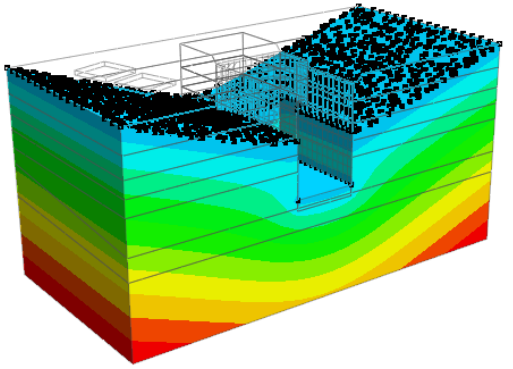
[Tunnel : Water level line]



[Decreased pore pressure]



[Excavation : Water level surface]



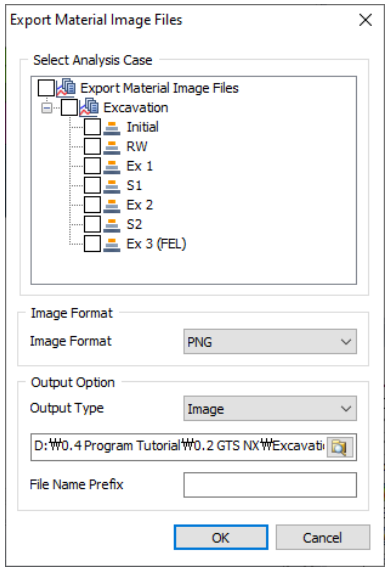
[Decreased pore pressure]

2. Pre/Post Processing

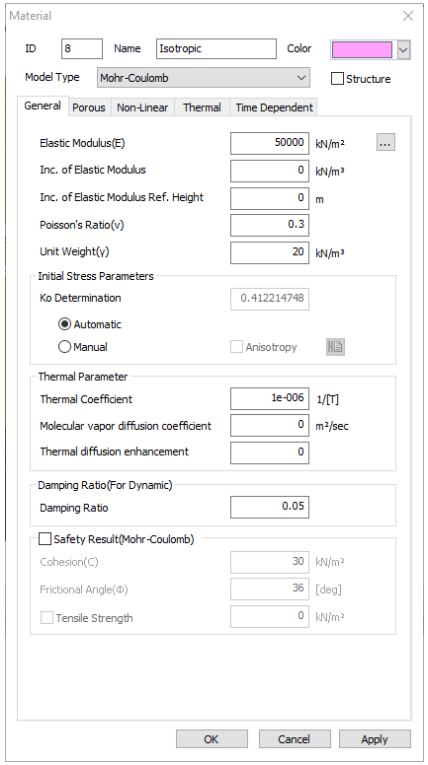
2.5 Extract with Word Formation from Input Parameter

- Information of parameters(General, Porous, Non-Linear) can be exported with image or word file.
- Information will be exported which is using from analysis case only. Analysis steps can be selected for extracting in case of construction stage analysis.

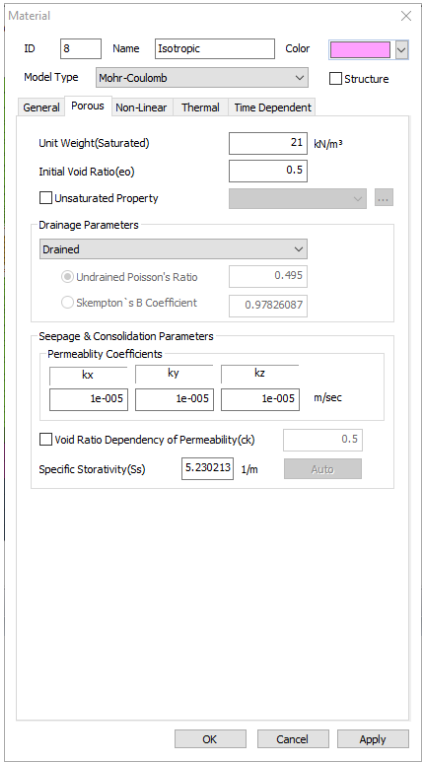
Tools > Export > Export Material Image



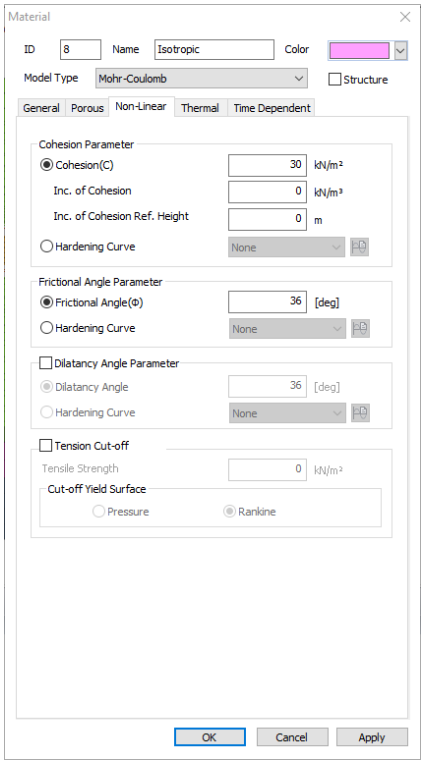
[Export Material Image]



[General]



[Porous]



[Non-Linear]

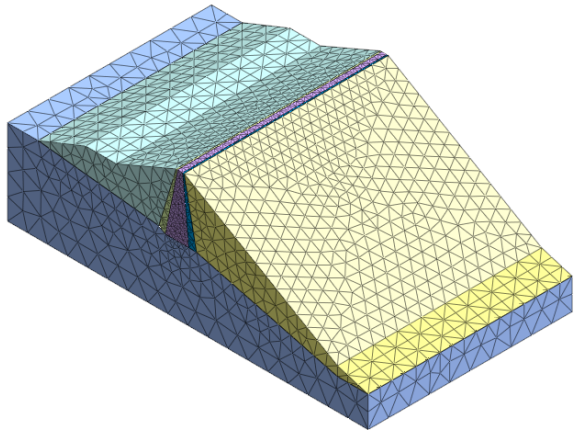
2. Pre/Post Processing

2.6 Adding the Extract Function to MIDAS Gen/Civil

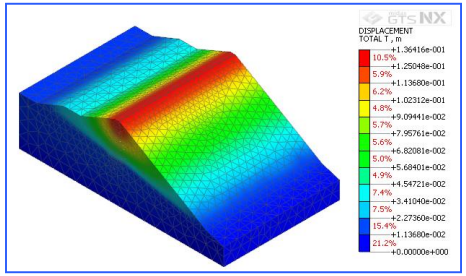
- GTS NX 2019(v2.1) can export *.mgt and *.mct to MIDS Gen and Civil. **(※Over than Gen v875, Civil v875 can be importing this exported file)**
- Static linear analysis can be carried out with those files(*.mgt / *.mct) from MIDAS Gen and Civil.

Menu > Export > Midas Gen…

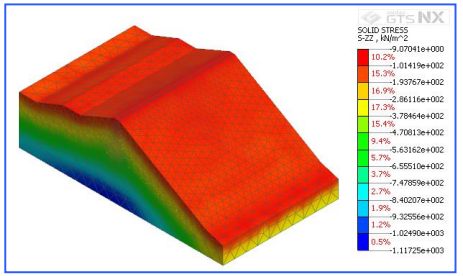
Menu > Export > Midas Civil…



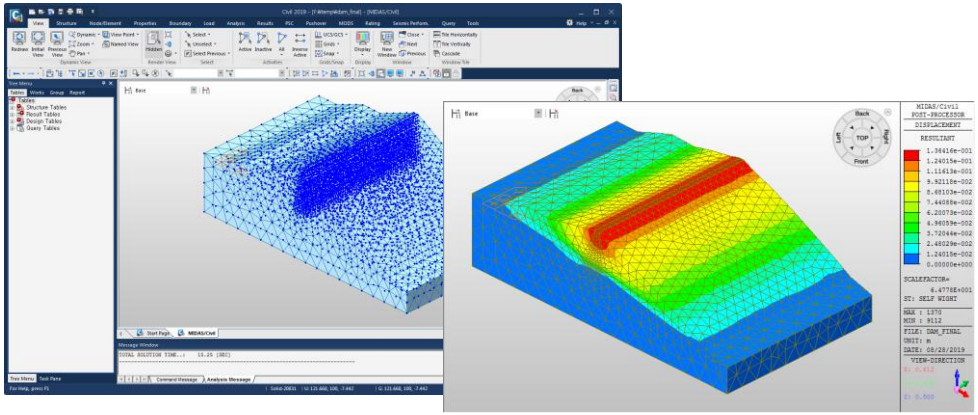
[Mesh with 3D solid]



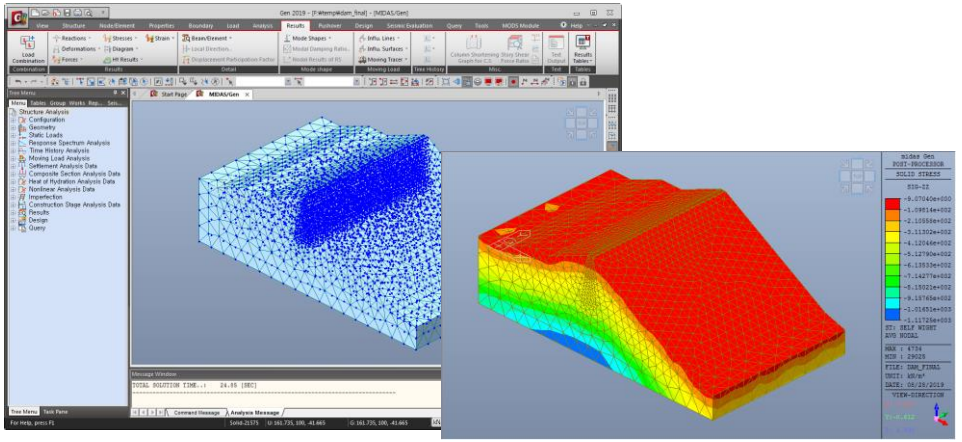
[Result of Linear Static analysis - DXYZ]



[Result of Linear Static analysis - DXYZ]



[Modeling with MIDAS Civil]



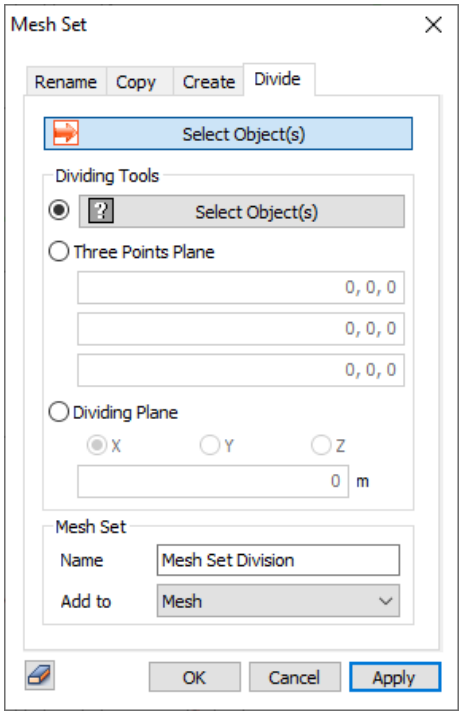
[Modeling with MIDAS Gen]

2. Pre/Post Processing

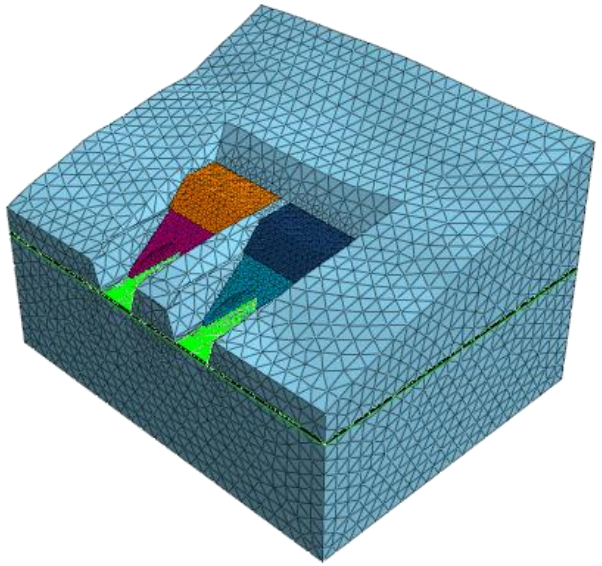
2.7 Dividing Mesh Set with Arbitrary Surface

- After to create mesh from 3D model, 3D mesh set can be divided by arbitrary surface. Dividing location will be determined by large volume under the divided surface. **(※ Dividing Surface will be considered only for plane surface. Curved surface is not supported)**
- This function is useful to divide mesh set which is created as one mesh. For example, mesh set can be divided two layers of soil from one layer with this divide function as below.

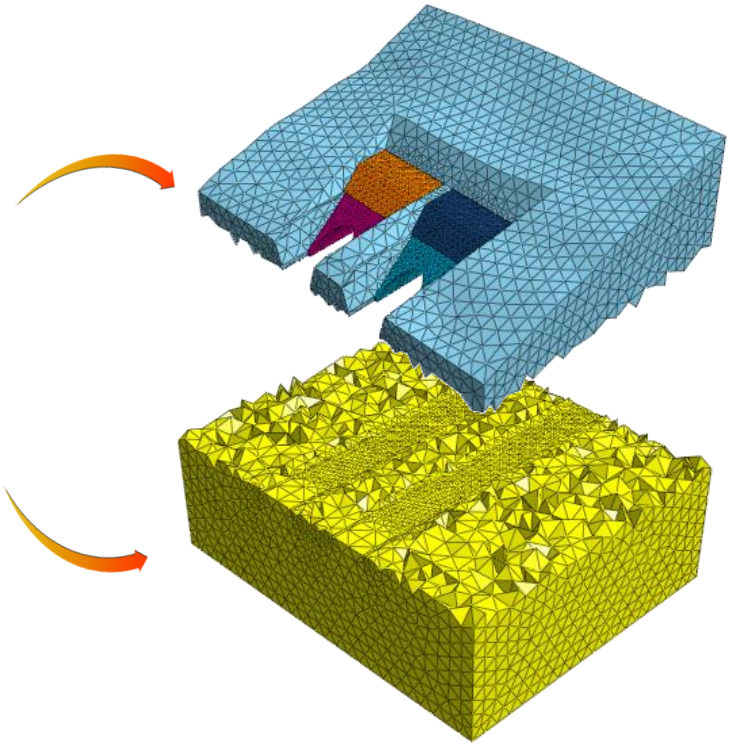
Mesh > Mesh Set > Divide



[Mesh Set Divide]



[Before Dividing]



[After Dividing]

2. Pre/Post Processing

2.8 Apply Nonlinear Time History to Type More Than One Stage from Construction Stage Analysis with Stress-Nonlinear Time History

- Previously, Stress-Nonlinear Time History analysis could been applied only 1 stage at last stage. Time history analysis can apply more than one stage.
- Now, only nonlinear time history type can be applied after nonlinear time history analysis stage(Stress analysis type can not be applied after nonlinear time history analysis stage).

  Ex) Stress → Stress → Nonlinear Time History → Nonlinear Time History : OK,
  Stress → Nonlinear Time History → Stress → Nonlinear Time History : NG

2.9 Improving Searching Method to Mother Element from Embedded Element

- Algorism has improved to search whether element is deactivated which is designated as mother element form embedded element during construction stage analysis.
  - Computation of every step which is activated embedded element ➔ Searching the activated element from computed step ➔ Designating & investigating the mother element from searched elements
- Display the error message for user from difficult to recognize with tiny error which is satisfied with tolerance.

  Ex) [error] node[216707] and node[216596] are located almost same but, they are not connected. Please make them same coordinate.

2.10 Changing the Default Method from Auto Connection

- Default method has changed from imprint to Boolean from auto connection function to consider frequency of usage.

2.11 Improving Initialize Function

- Previously, Advanced view control() was remained when initialize function applied. Advanced view will not be remained with applying initialize function from now on.

  (Result > etc. > Initialize)