



GTS NX INTRODUCTION

沈約翰 (John)
john@midasuser.com.tw

CONTENTS

**Engineering-Grade Simulation of
MIDAS GTSNX**

Applications and Capabilities of GTS NX

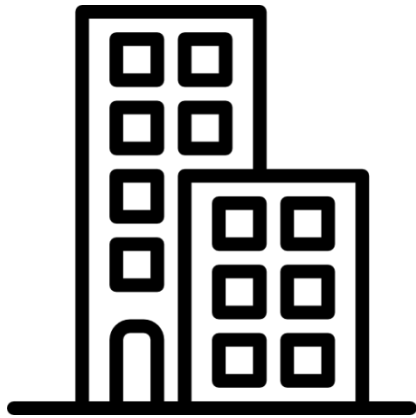
Enhanced the Design Workflow

Real-World Implementations/ Case Studies

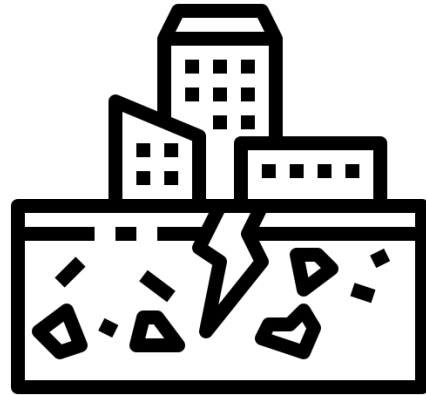
Fully Integrated System Approach



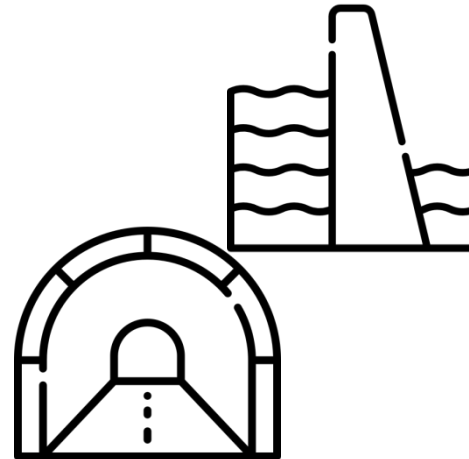
MIDAS GTS NX is a Finite Element Analysis software developed by MIDAS IT, specifically designed for advanced geotechnical engineering and soil-structural interaction analysis.



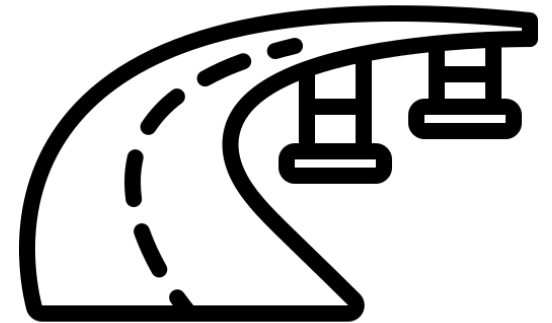
**Concrete / Steel
Behavior**



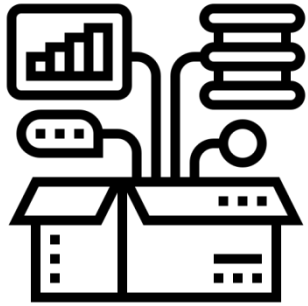
**Soil - Structure
Interaction**



**Tunnels, dams, and
underground structures**

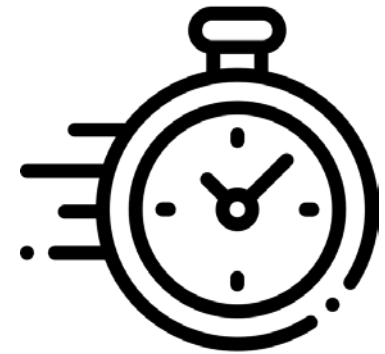


**Bridges, large
infrastructures and
other complex geometries**



GTS NX KEY FEATURES

FEATURE	DESCRIPTION
Advanced Material Models	Includes nonlinear concrete, steel, rock, and soil behaviors
3D solid modeling	Supports solid, shell, and beam elements for detailed modeling
Contact and interface	Models interactions between soil and structures, joints, and more
Automatic meshing & remeshing	Simplifies and refines complex mesh generation
3D solid modeling	Supports solid, shell, and beam elements for detailed modeling



Maximizing Efficiency with MIDAS GTS NX

Automated Meshing and Geometry Handling

Advanced Nonlinear Solvers

Integrated Modeling & Post-Processing

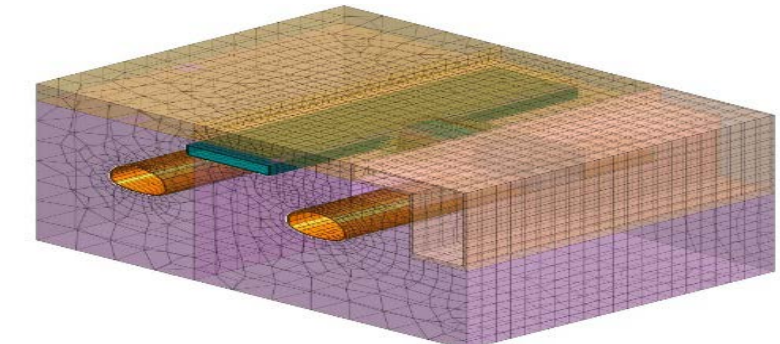
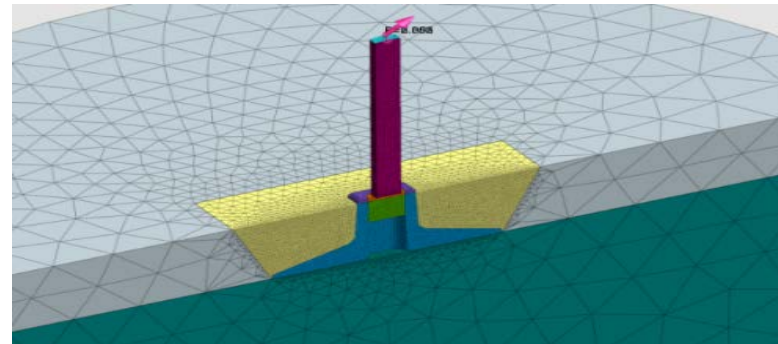
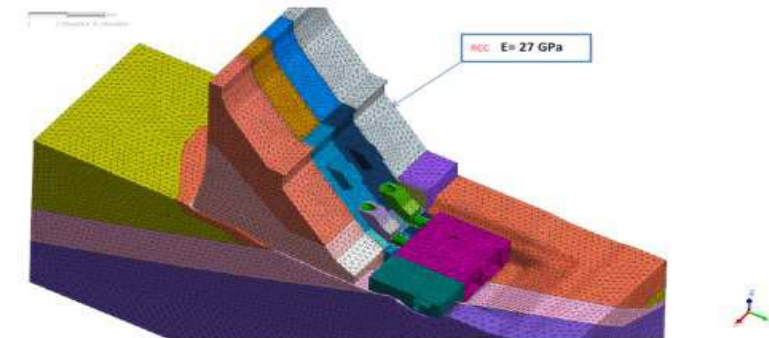
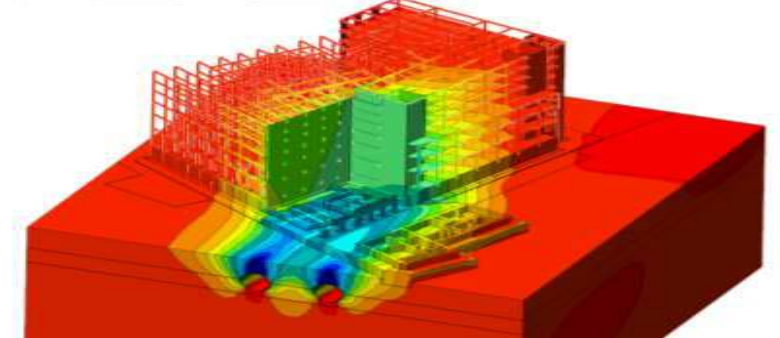
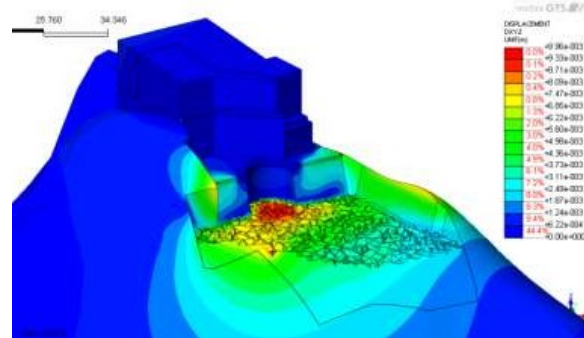
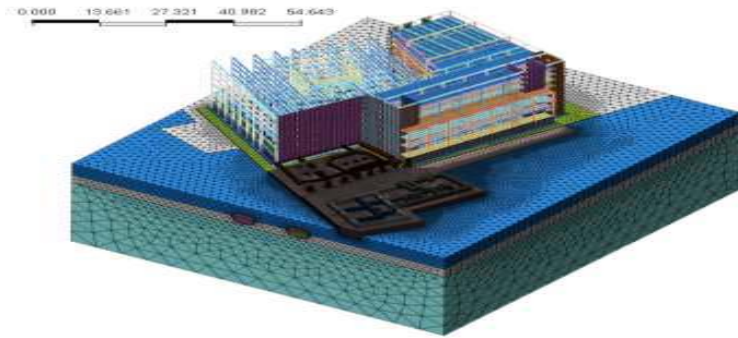
Template-Based Modeling & Reusability

Accurate Simulation Reduces Rework



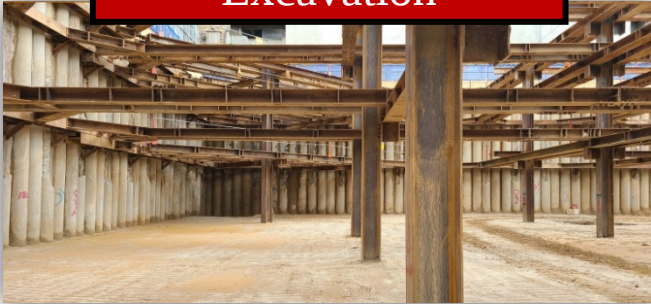
Our MIDAS commitment

- Committed to becoming experts in 2D/3D engineering
- Constantly providing technical support, materials, and training



REAL-LIFE KEY APPLICATIONS

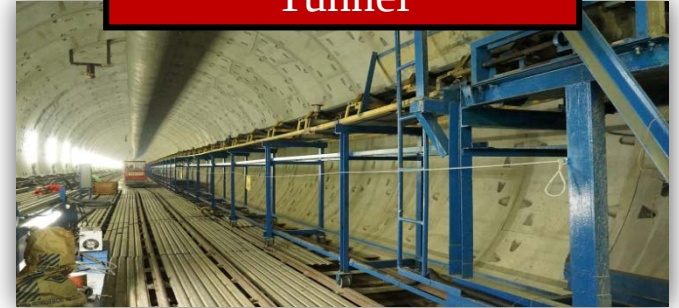
Excavation



Pile



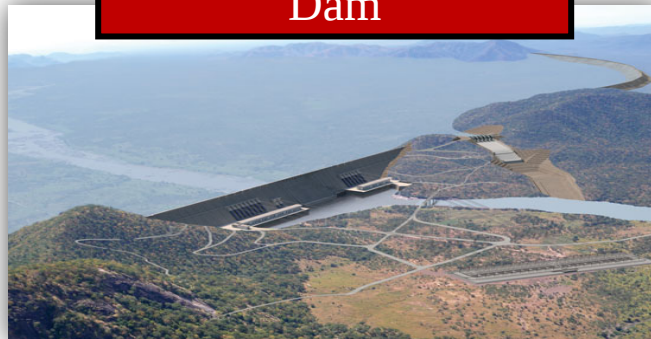
Tunnel



Slope Stability



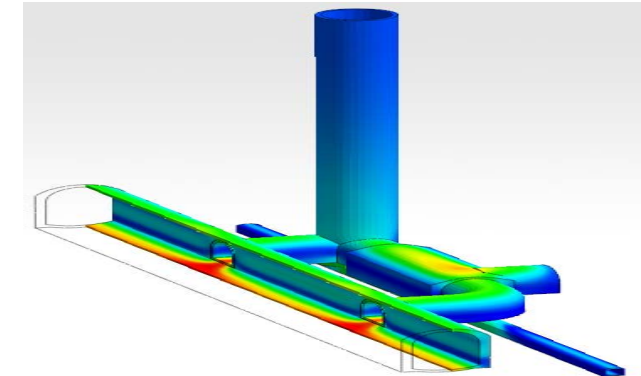
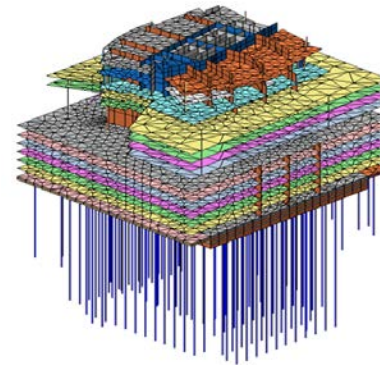
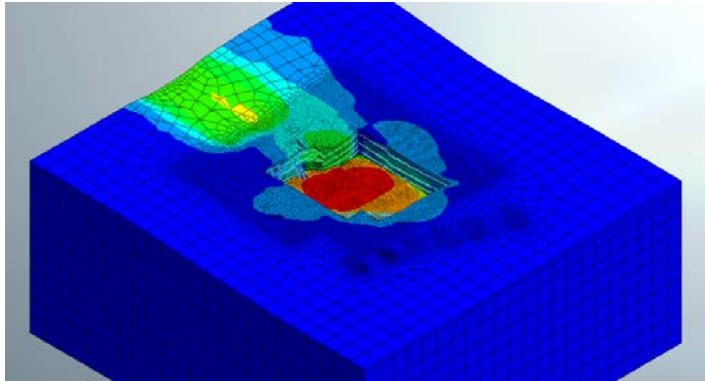
Dam



Soil-Structure
Behavior



ADVANTAGES OF 3D



MULTIPLE TYPE OF ANALYSES and SUB ANALYSIS

Static Analysis

- Linear static analysis
- Nonlinear static analysis

Construction Stage Analysis

- Stress (drained/undrained) analysis
- Seepage analysis for each stage
- Stress-seepage-slope coupled
- Consolidation analysis for each stage
- Fully coupled stress & seepage

Consolidation Analysis

- Consolidation analysis

Stress-Seepage Coupled Analysis

- Stress
- Steady-state
- Transient
- Stress seepage

Seepage Analysis

- Steady state seepage analysis
- Transient seepage analysis

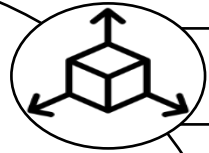
Dynamic Analysis

- Eigenvalue / Response Spectrum analysis
- Linear Time History (mode/direct methods)
- Nonlinear Time History analysis
- 1D/2D Equivalency Linear analysis
- Nonlinear time history + SRM Coupled

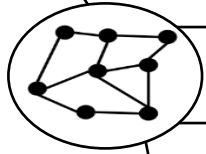
Slope Stability Analysis

- Strength Reduction Method (SRM)
- Strength Analysis Method (SAM)
- Construction stages Slope stability (SRM/SAM)

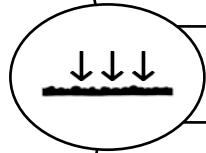
DESIGN PROCESS



Drawing geometries



Making meshes



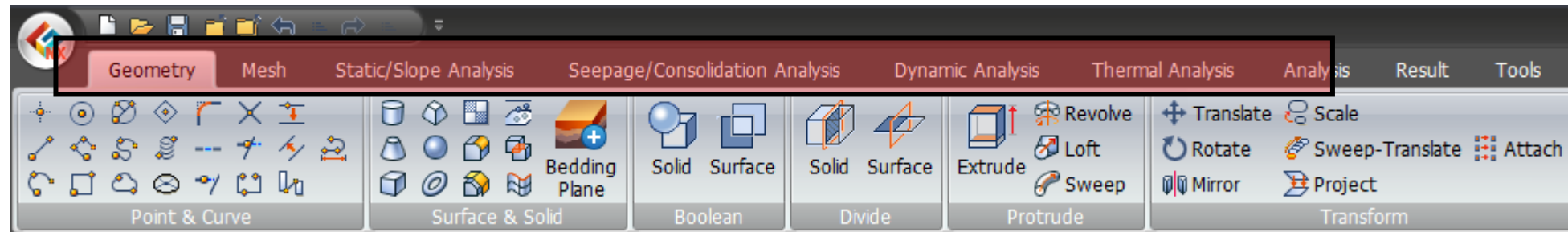
Assigning boundary conditions / loads



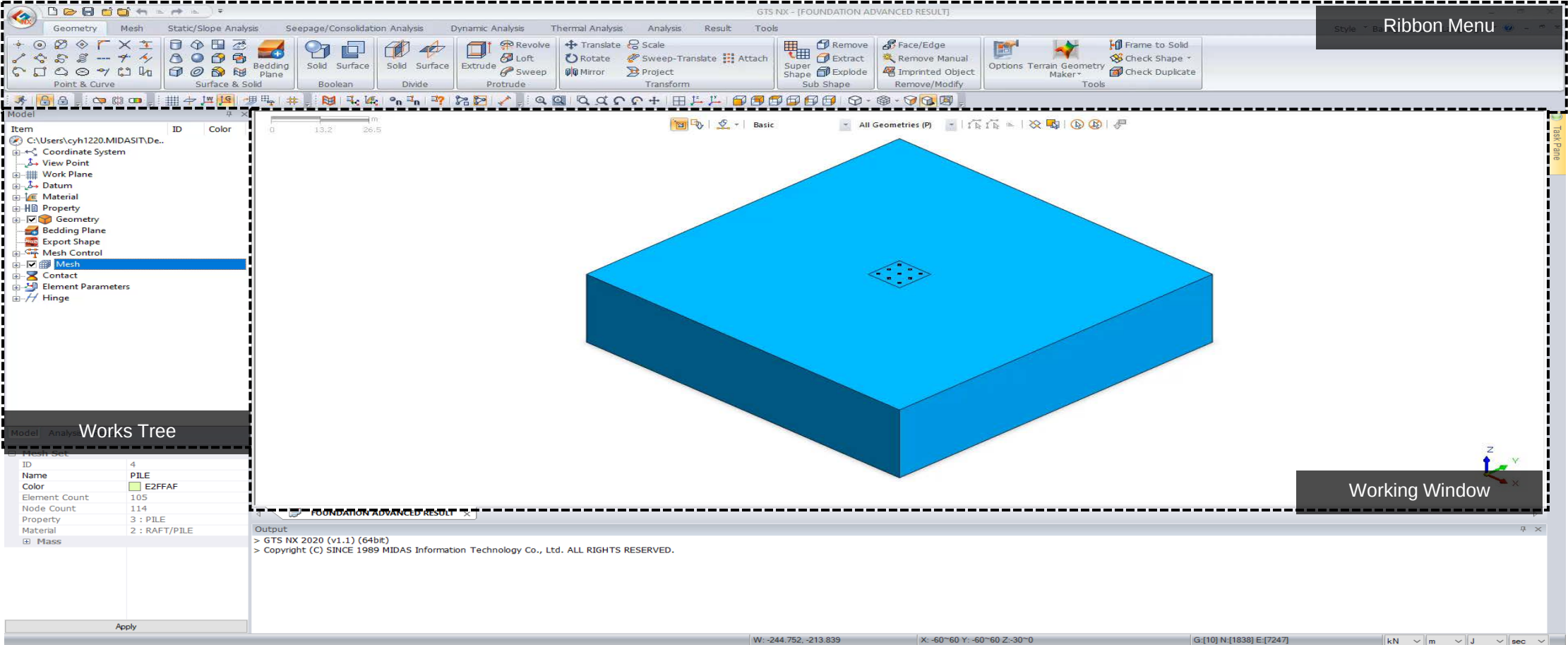
Running Analysis



Checking Result

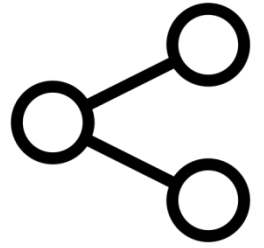


GRAPHICAL USER INTERFACE

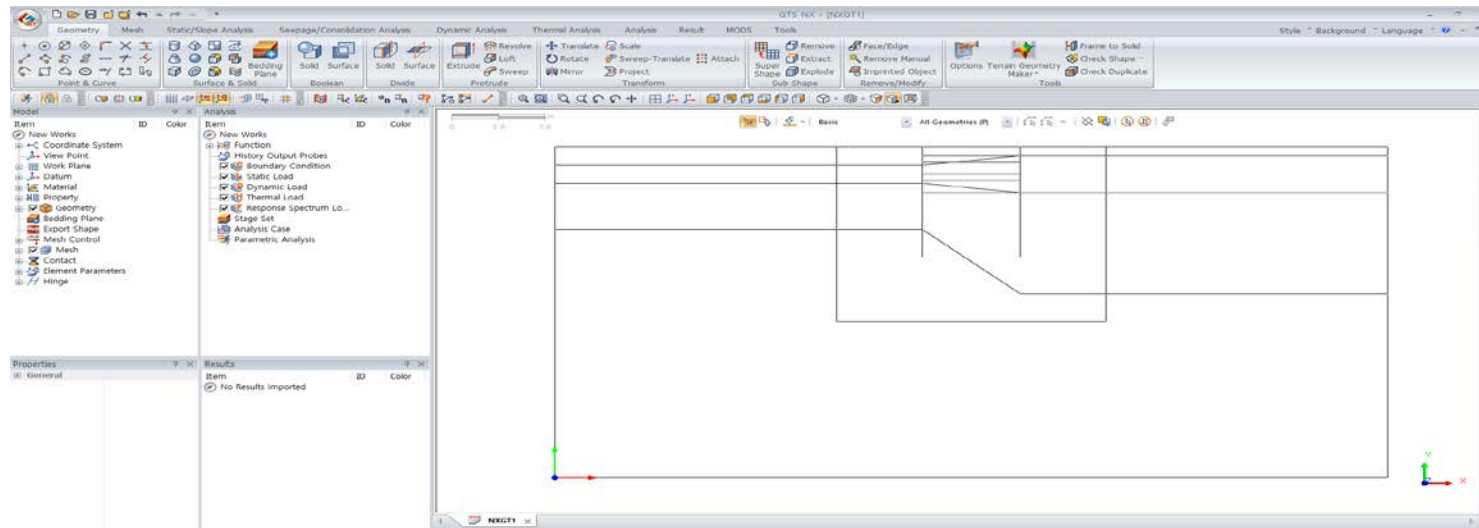


COMPATIBILITY

Works with most drawing files / CAD formats



File format	Description
*.dwg	AutoCAD drawing files
*.dxf	AutoCAD drawing interchange files
*.x_t; *.xmt_txt; *.x_b; *.xmt_bin	Parasolid (9 to 29) files
*.sat; *.sab; *.asat; *.asab	ACIS (R1 to 2018 1.0) files
*.stp; *.step	STEP (AP203, AP214) files
*.igs; *.iges	IGES (Up to 5.3) files



COMPREHENSIVE SOIL MODELS

Choose the appropriate soil model for your various projects

General

Mohr-Coulomb

Hardening Soil (small strain stiffness)

Sand

Modified UBCSAND

PM4Sand

Clay

Soft soil (Creep)

Modified Cam Clay

Sekiguchi-Ohta(Inviscid)

Sekiguchi-Ohta(Viscid)

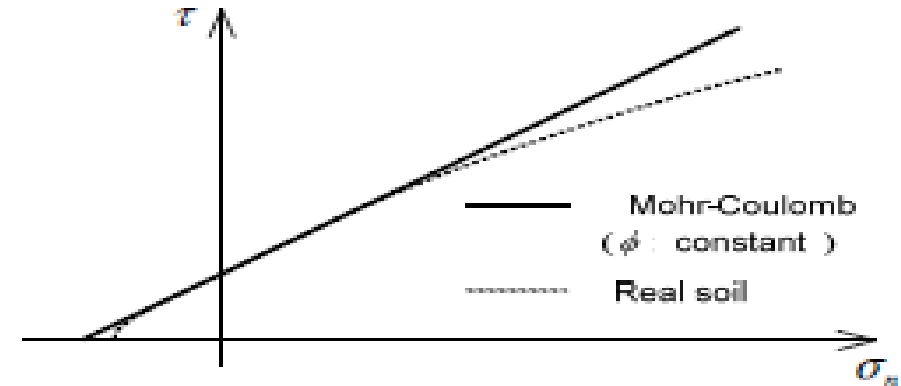
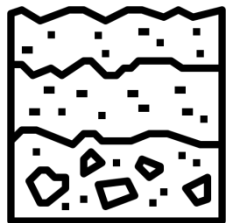
Generalized SCLAY1S

Rock

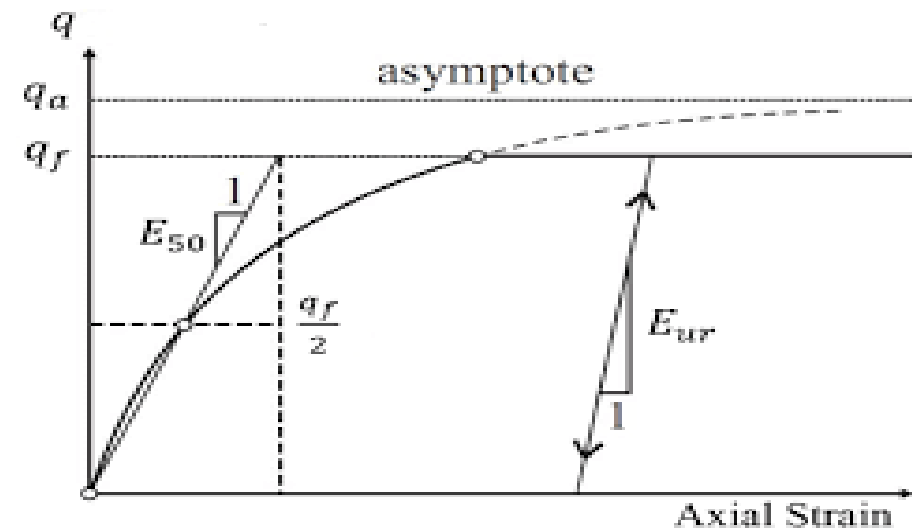
(Generalized) Hoek Brown

Jointed Rock Mass

CWFS



Mohr-coulomb



Hardening soil

COMPREHENSIVE ELEMENT LIBRARY

Saves time by just selecting the necessary elements from the database

1D Element

Geogrid
Truss
Beam

2D Element

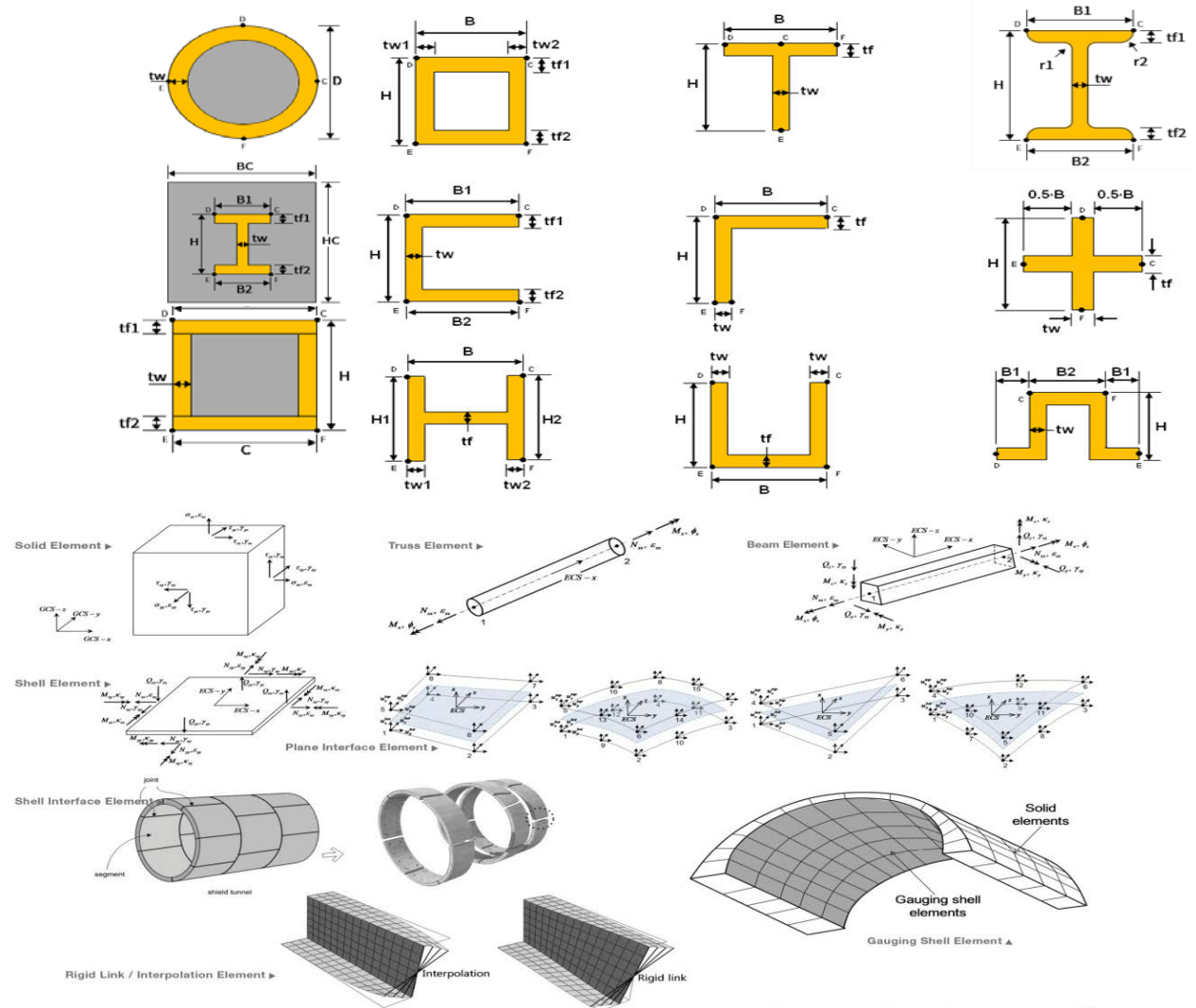
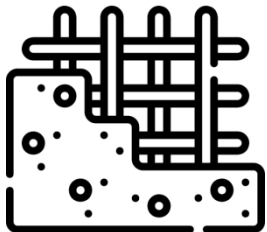
Shell
Gauging shell
Plane stress
Plane strain
Geogrid
Axisymmetric

3D Element

Solid

Others

Interface
Elastic / Rigid link
Pile interface / Pile tip
User specified behavior



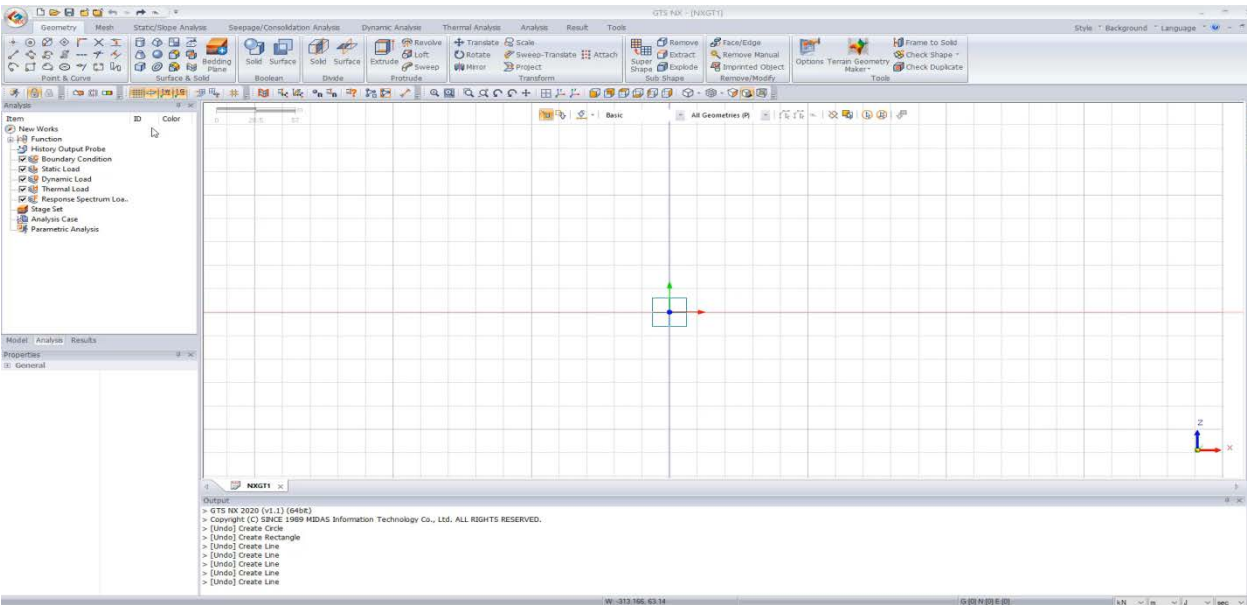
GEOMETRY

- From simple drawing modification to complex building up of geometries
- Intuitive and powerful geometry functions – extrude, sweep, boolean and etc.

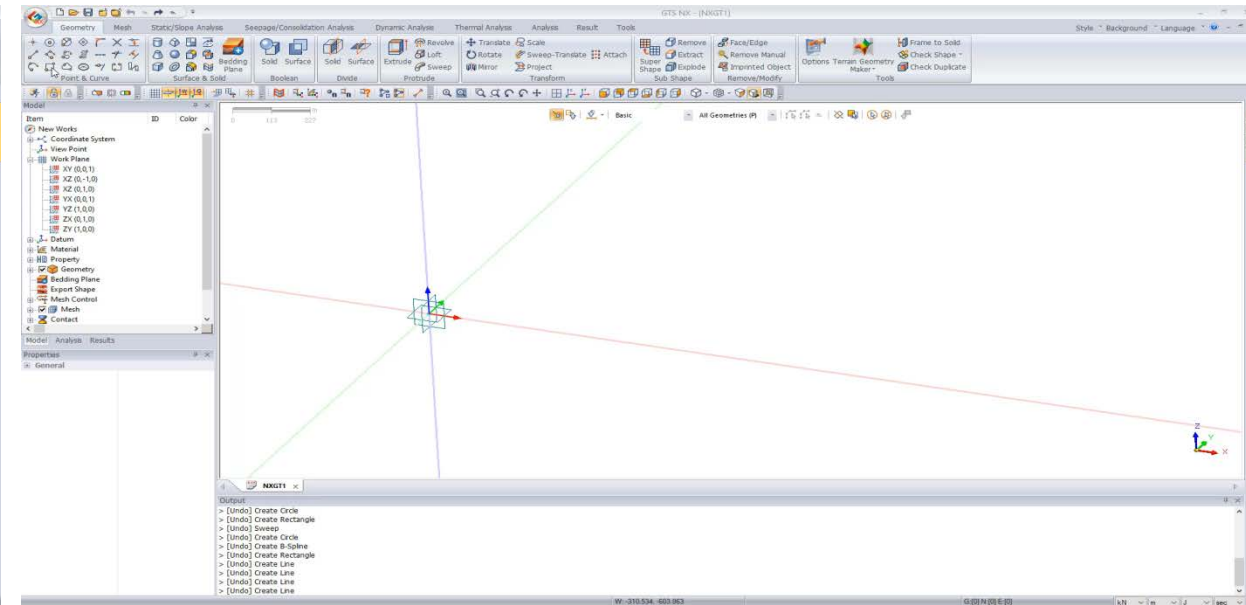


Line

Cylinder



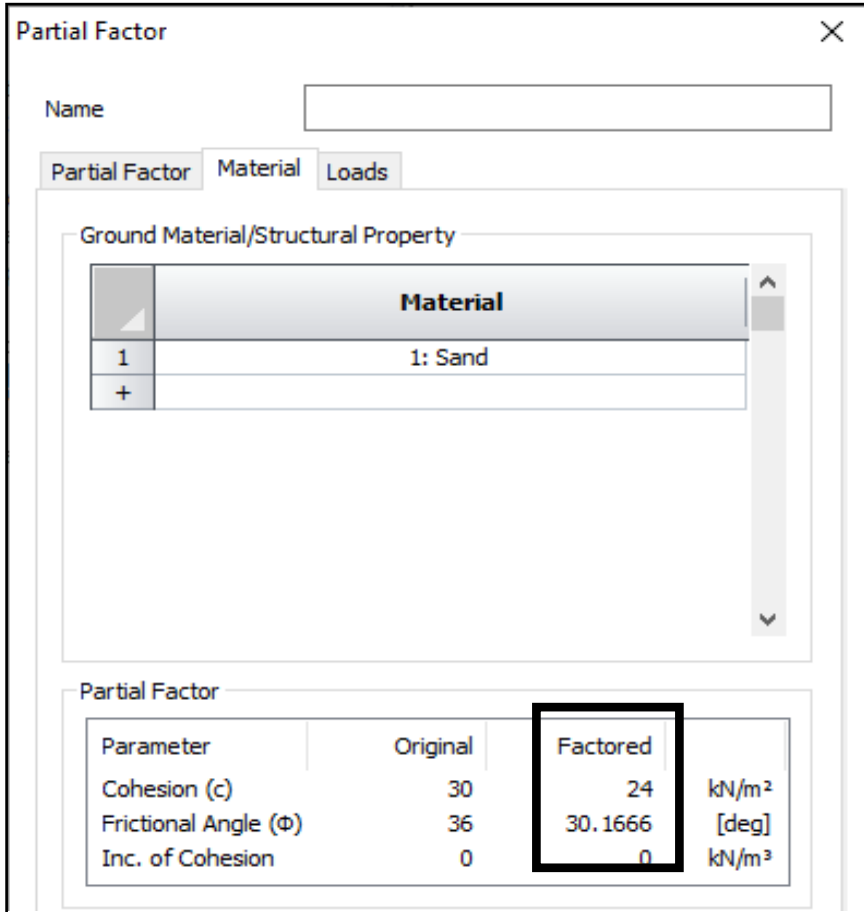
Line / Square / Circle



Extrude / Sweep

PARTIAL FACTORS

2D analysis can use the **partial factor** function which was developed based on Euro Code 7.



Partial Factor

Name

Partial Factor Material Loads

Ground Material/Structural Property

	Material
1	1: Sand
+	

Partial Factor

Parameter	Original	Factored	
Cohesion (c)	30	24	kN/m ²
Frictional Angle (Φ)	36	30.1666	[deg]
Inc. of Cohesion	0	0	kN/m ³

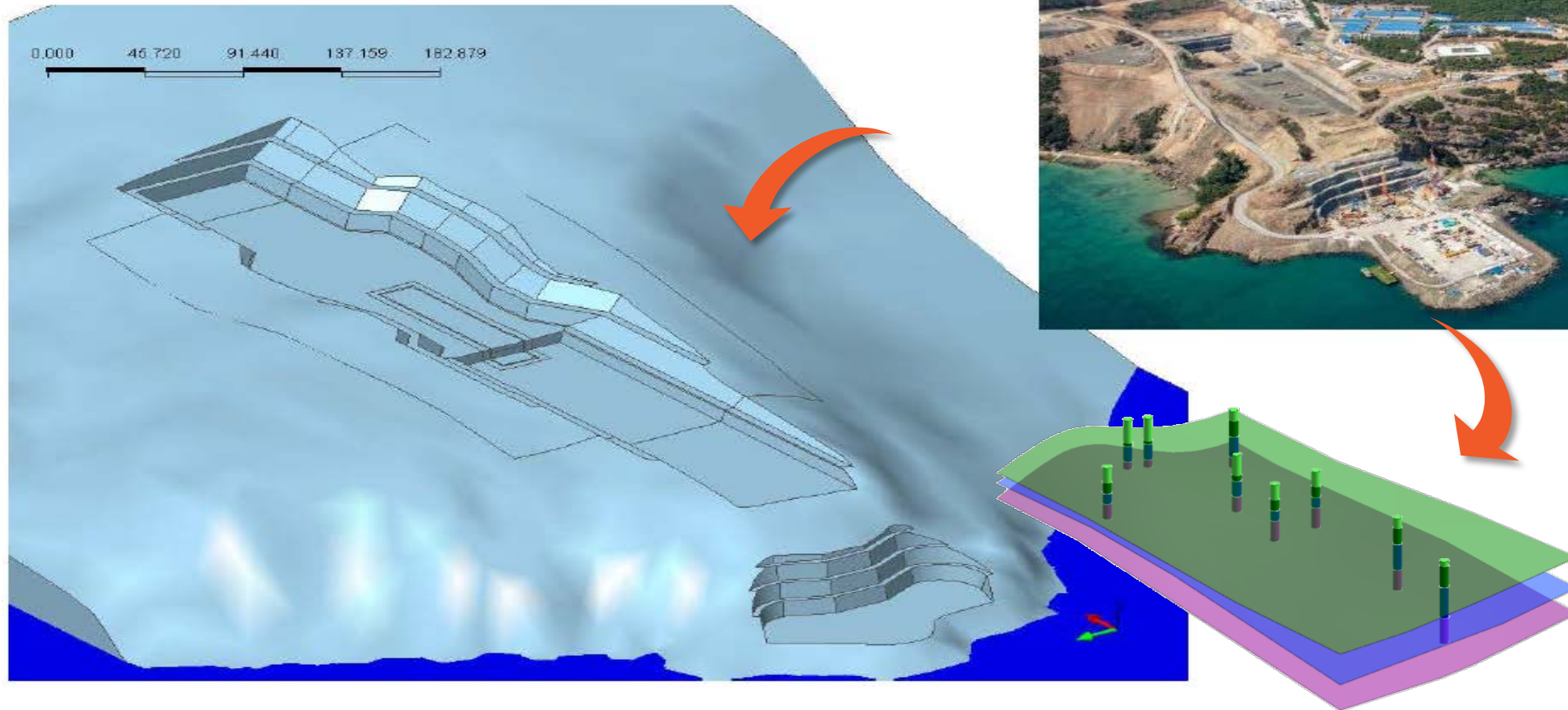
GTS NX is providing the database for this partial factor as below:

- Design Approach 1 Combination 1
- Design Approach 1 Combination 2
- Design Approach 2
- Design Approach 3...

Directly checking the original and factored parameters

TGM & Bedding plane wizard

Easily create the surface of the site by simple topography import

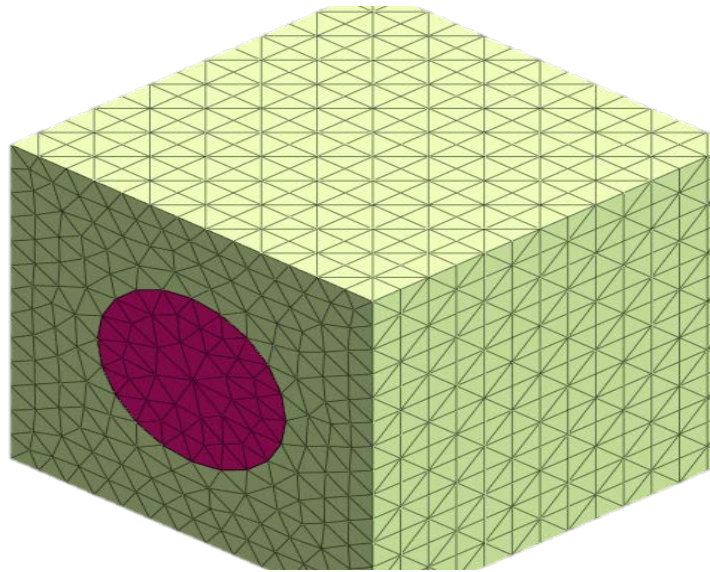
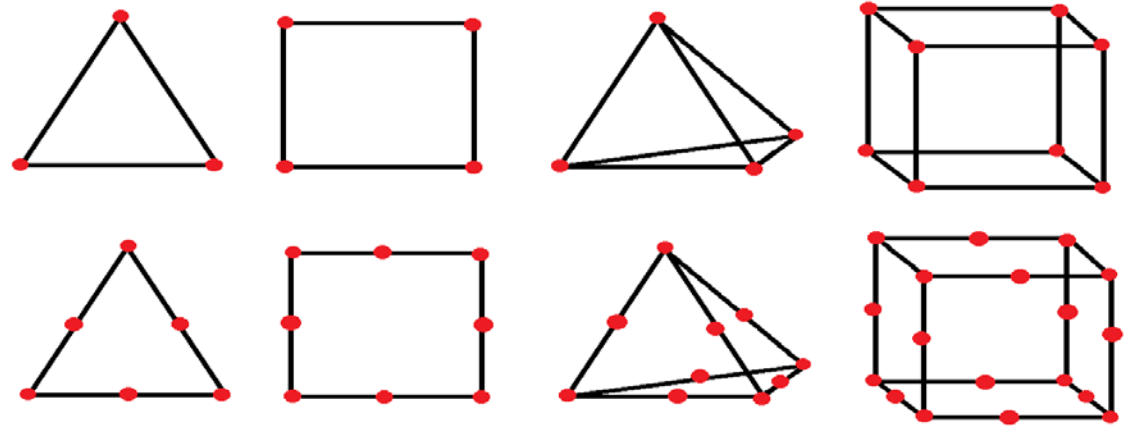


MIDAS

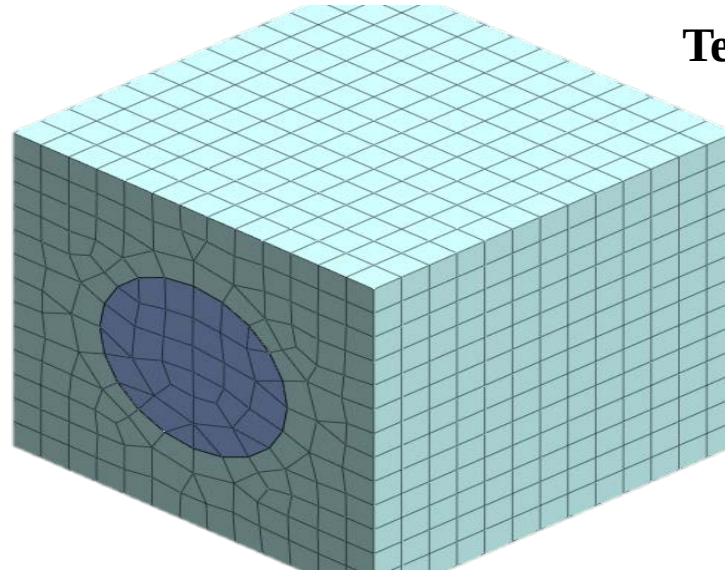
MIDAS

MESH

Powerful meshing algorithm with Hybrid technology

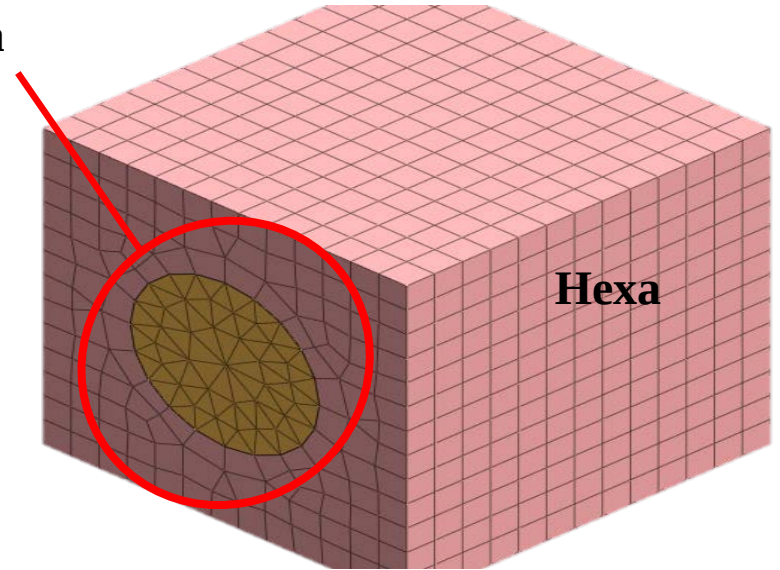


Tetrahedral



Hexahedral

Tetra



Hexa

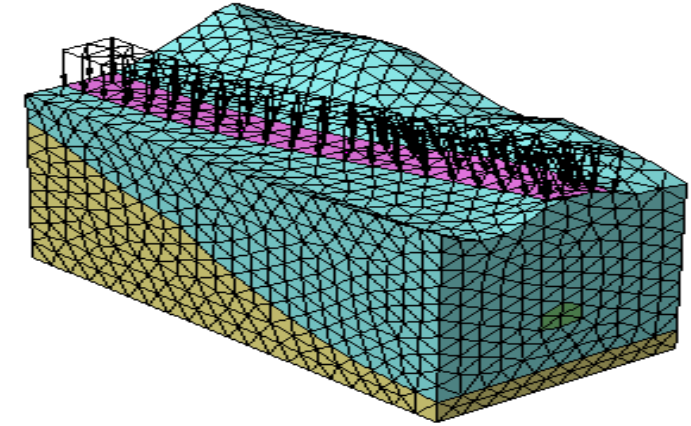
Tetra + Hexa(hybrid)

BOUNDARY CONDITION AND LOADS

Boundary

Constraint
Change Properties
Review
Water level
Nodal Head
Surface Flux

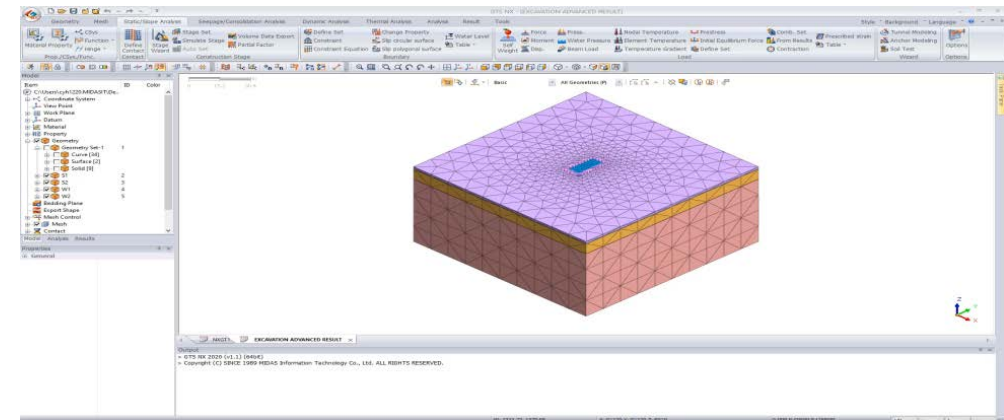
Slip Circle/Polygonal Surface
Draining Condition
Non Consolidation
Transmitting



Loads

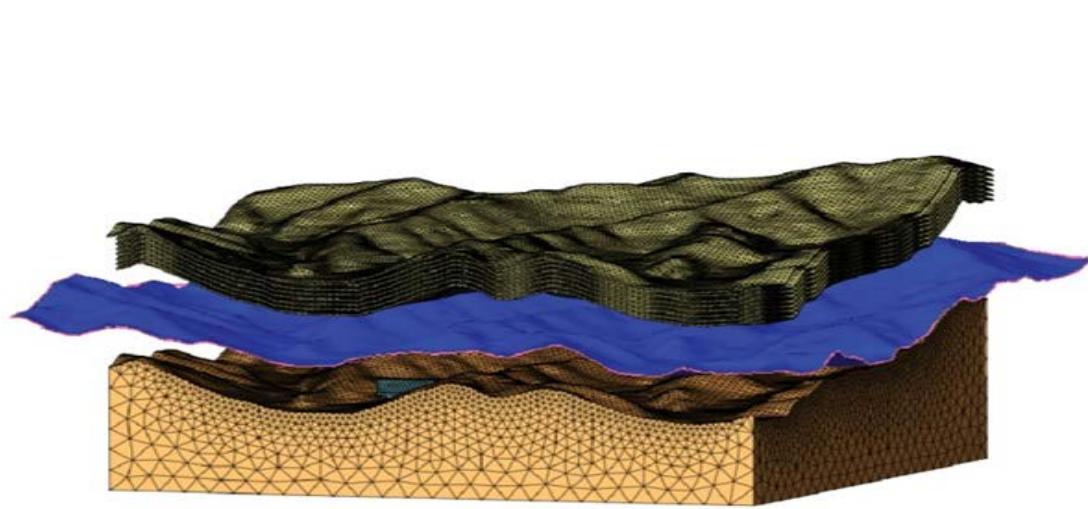
Self Weight
Force
Moment
Displacement
Pressure(Surge / Water)
Line Beam Load
Element Beam Load
Temperature
Pre-stress

Contraction
Initial Equilibrium Force
Combined Load
Response Spectrum
Ground Acceleration
Time Varying Static
Dynamic Nodal / Surface
Load to Mass
Train Dynamic Load Table

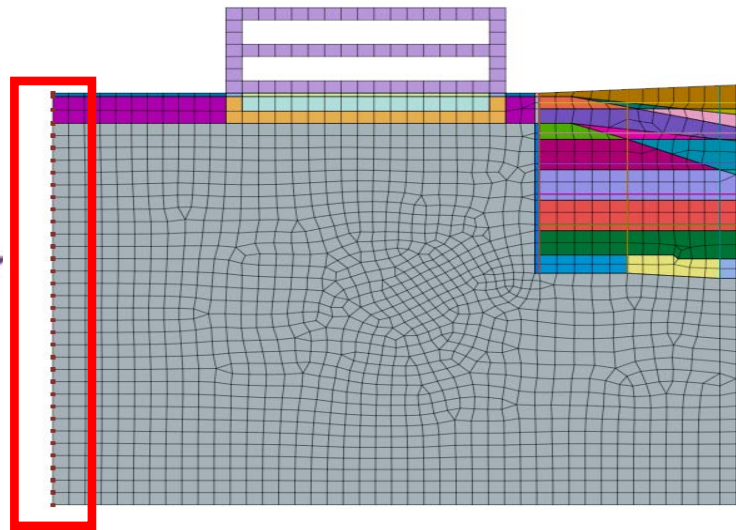


WATER CONDITION

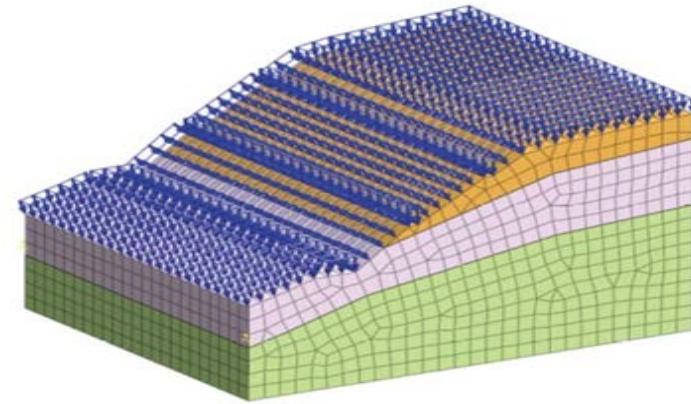
Nodal head, line & surface flux, water level



3D water level automatic generation



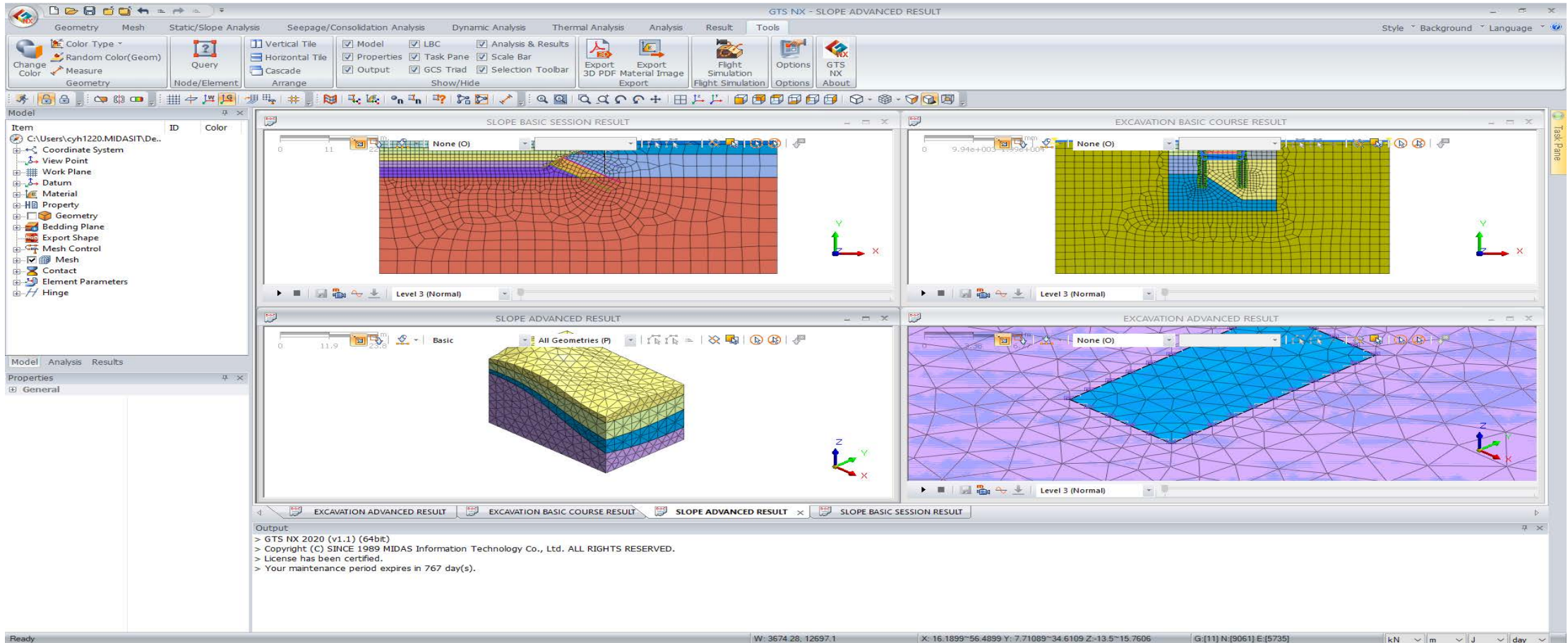
Nodal head for water level



Rainfall intensity input

MULTI WINDOWS

Compare various sections or different analyses in one program window



COMPREHENSIVE BREAKDOWN OF RESULTS

- 開挖區域3_8混凝土
- INCR=4 (LOAD=1.000)
- 1 Displacements
- 2 Grid Forces
- Reactions
- 3 Truss Element Forces
- 4 Beam Element Forces
- 5 Virtual Beam Forces
- Truss Element Stresses
- Beam Element Stresses
- Solid Stresses
- Truss Element Strains
- Beam Element Strains
- Solid Strains

- 1 Displacements
 - TOTAL TRANSLATION (V)
 - TX TRANSLATION (V)
 - TY TRANSLATION (V)
 - TZ TRANSLATION (V)
 - TOTAL ROTATION (V)
 - RX ROTATION (V)
 - RY ROTATION (V)
 - RZ ROTATION (V)
 - TXY TRANSLATION (V)
 - TYZ TRANSLATION (V)
 - TZX TRANSLATION (V)

水平變位TXY
垂直變位TZ

- 2 Grid Forces
 - TOTAL APPLIED FORC...
 - TX APPLIED FORCE
 - TY APPLIED FORCE
 - TZ APPLIED FORCE
 - TOTAL APPLIED MOM...
 - RX APPLIED MOMENT
 - RY APPLIED MOMENT
 - RZ APPLIED MOMENT
 - TOTAL INTERNAL FOR...
 - TX INTERNAL FORCE
 - TY INTERNAL FORCE
 - TZ INTERNAL FORCE
 - TOTAL INTERNAL MO...
 - RX INTERNAL MOME...
 - RY INTERNAL MOME...
 - RZ INTERNAL MOME...

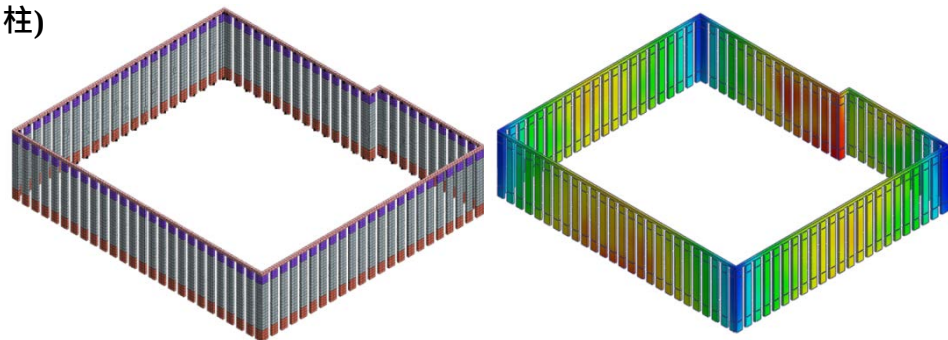
內力
Grid Force

- 3 Truss Element Forces
 - AXIAL FORCE
 - TORQUE
- 4 Beam Element Forces
 - AXIAL FORCE
 - SHEAR FORCE Y
 - SHEAR FORCE Z
 - TORQUE
 - BENDING MOMENT Y
 - BENDING MOMENT Z
- 5 Virtual Beam Forces
 - AXIAL FORCE
 - SHEAR FORCE Y
 - SHEAR FORCE Z
 - TORQUE
 - BENDING MOMENT Y
 - BENDING MOMENT Z

軸力
Axial Force

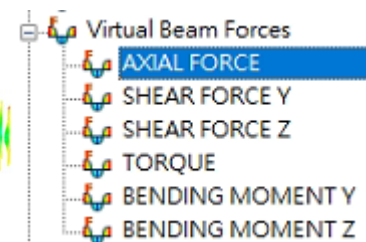
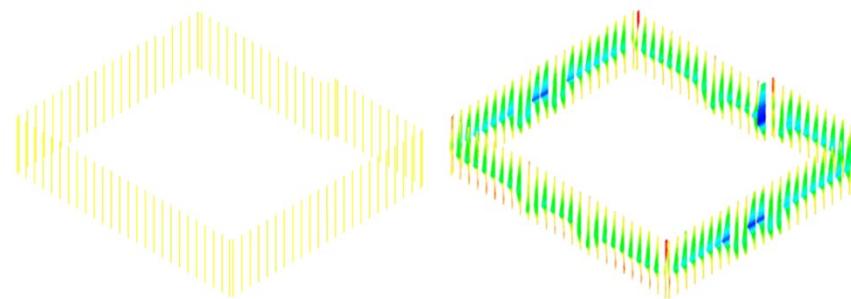
RESULT - VISUALIZATION

實體元素
(擋土柱)

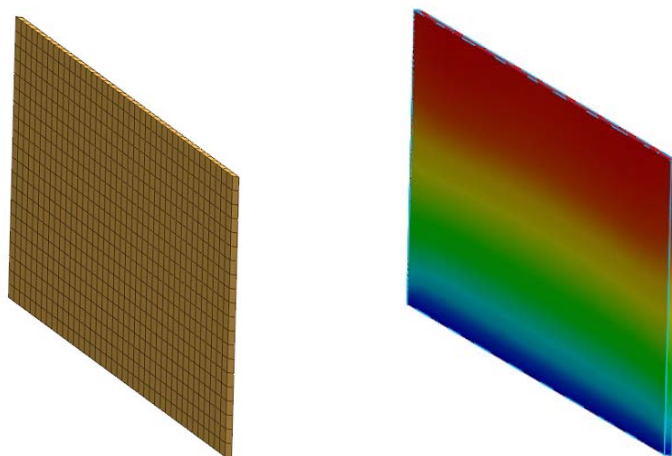


如何計算等效軸力?

虛擬梁(Virtual Beam)

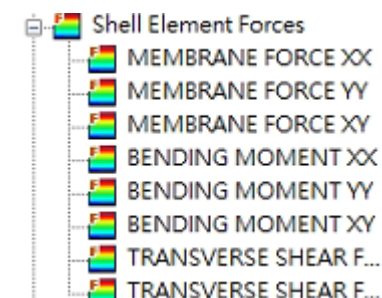
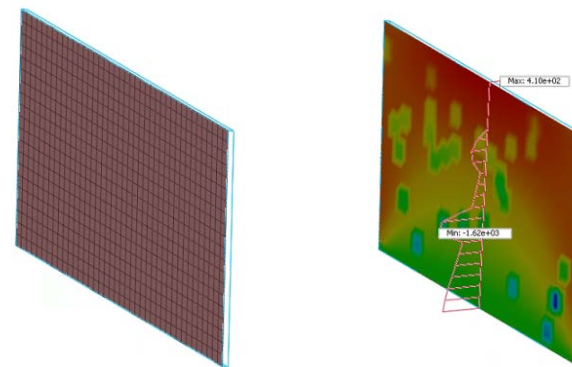


實體元素



如何得到受力方向大小?

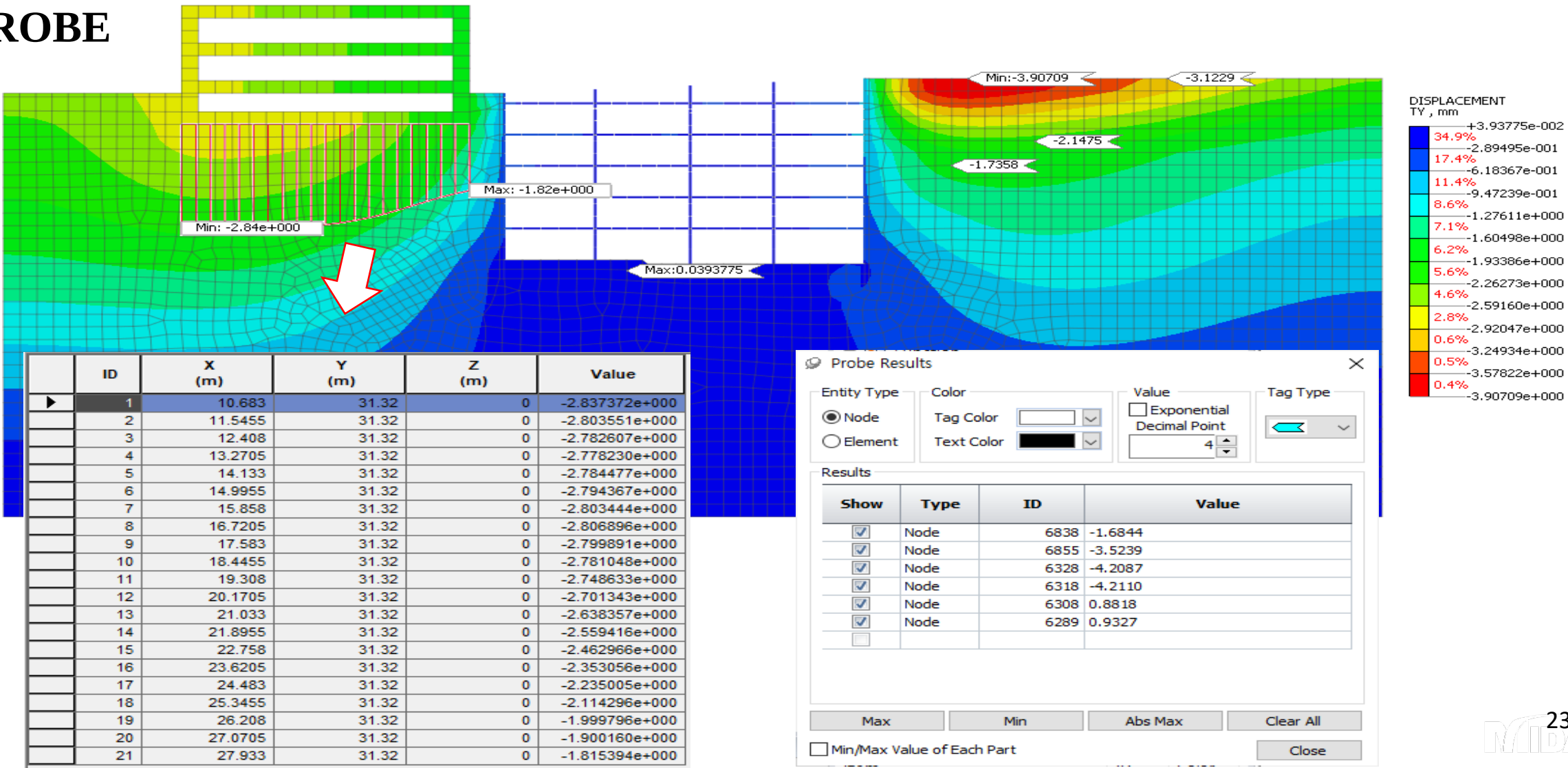
測量板(Gauging Shell)



MIDAS

RESULT - MULTIPLE METHODS FOR VERIFICATION

PROBE



RESULT - MULTIPLE METHODS FOR VERIFICATION

PLANE CLIPPING and PROBING

3D - 2D Wizard

Color

Tag Color

Text Color

Tag Type

Results

Show	X	Y	Z	Value
☒	61206.38	75000.00	-16094...	5.60292
☒	60000.00	124252...	-30033...	3.80053
☒	60000.00	89566.70	-31569...	8.07237
☒	79993.16	75000.00	-33249...	7.47216
☒	128922...	75000.00	-16114...	2.29593
☐				

Max

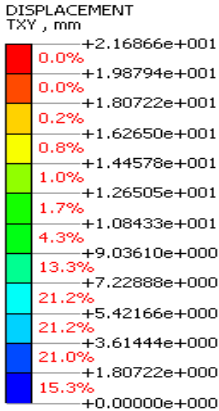
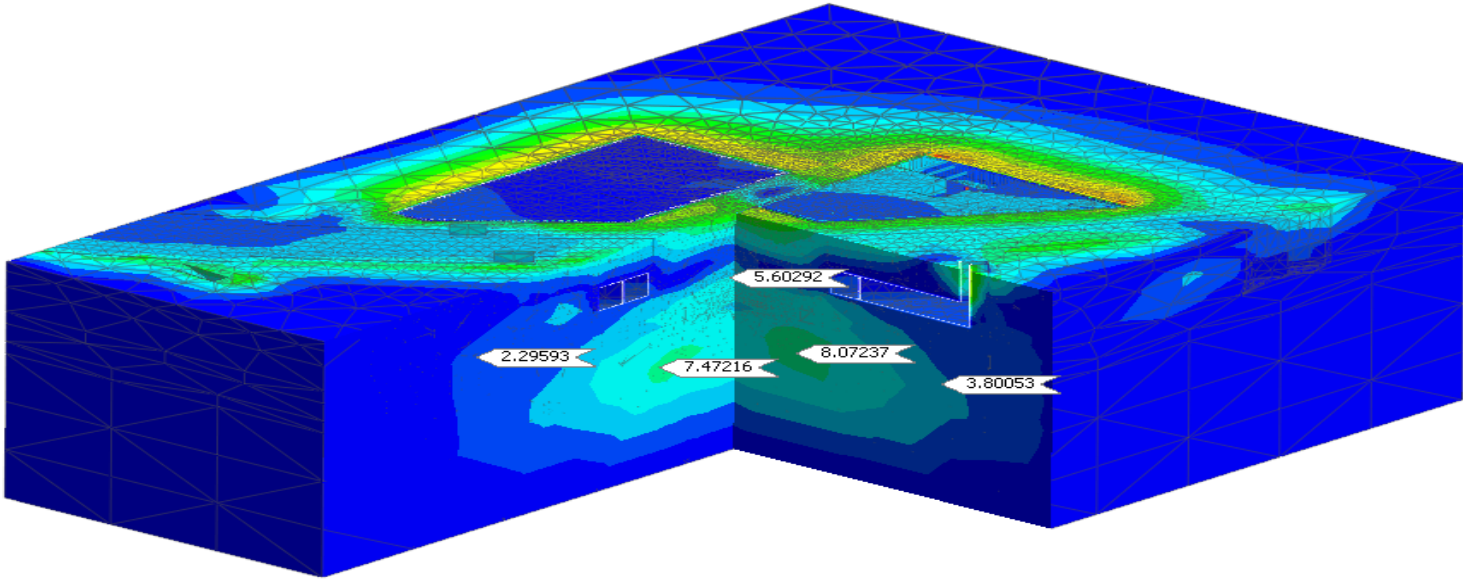
Min

Abs Max

☐ Show Points

Clear All

Close



RESULT - ANALYSIS

REPORT and EXPORT

materials and properties with "PDF" format

Material

Elastic										
Name	E (kN/mm ²)	Inc. of Elastic (kN/mm ²)	Inc. of E Ref. Height (mm)	ν	γ (kN/mm ³)	K α	Thermal Coeff. (1/T)	Molecular Vapor Diffusion Coeff. (mm/sec ²)	Thermal Diffusion Enhance ment	Damping Ratio
	γ_{self} (kN/mm ³)	e_{-0}	k_x (mm/sec)	k_y (mm/sec)	k_z (mm/sec)	S_0 (1/mm)	Conductiv ity (W/(mm·[T]))	Specific Heat (J/(ton·[T]))	Heat Gen. Factor	
5:Conc'	28	0	0	0.15	2.4e-008	-	1e-006	0	0	0.05
	2.1e-008	0.5	0.01	0.01	0.01	5.2302133 3e-009	0			
6:Steel	205	0	0	0.15	7.4e-008	-	1e-006			
	2.1e-008	0.5	0.01	0.01	0.01	5.2302133 3e-009	0			

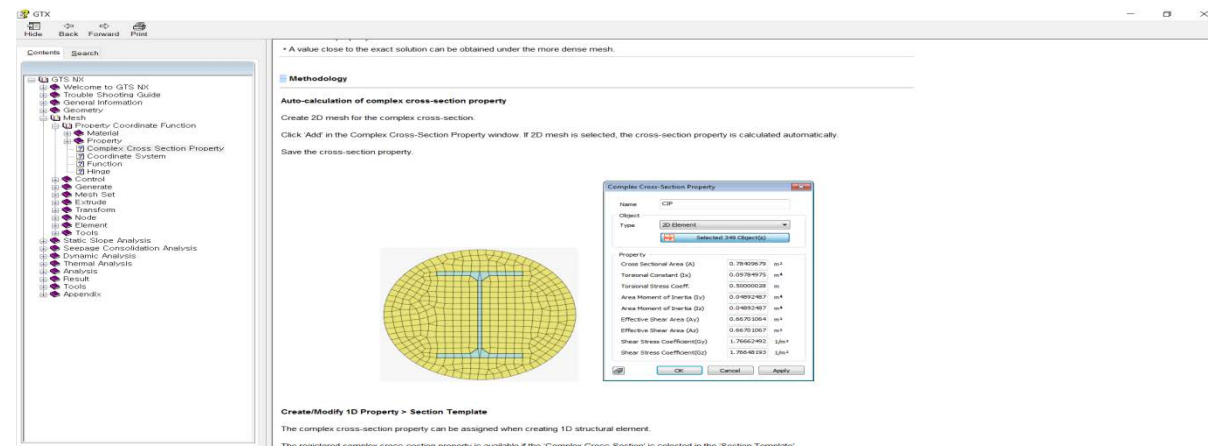
Results export with "WORD" format

3D PDF Directly checking every results from 3D PDF

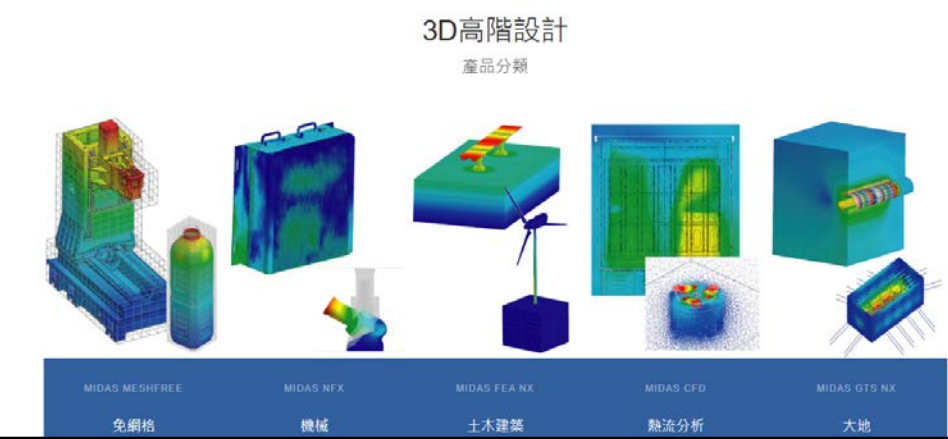
EXCAVATION_INITIAL_INCR=1 (LOAD=1.000)_Displacements
(V)_Current.png

TECHNICAL SUPPORTS

Help manuals / tutorials with various topics



Taiwan MIDAS Solid-Simulation website



<https://www.midasuser.com.tw/SolidSimulation/>

Online Courses / Case studies

Case Study Webinar Series

▶ PLAY ALL



Finite Element Method Approach to Pile Foundation of Silted Design
JACK NAWARAWA, GTI PREP
34:18



Finite Element Modeling of Tunnels in 2D&3D
Jedediah York
1:03:31



Numerical Modelling of a Metro Pedestrian Access Tunnel in Istanbul
SARA ARSLAN, ARS CONSULTANCY
48:03



Case Study: Deep Excavation under the Groundwater Table
Dr. Christine Haddad ARS
45:19



Project-based Training: Box Culvert Excavation Drawing
midas GEOTECH Training
36:49



Case Study: Deep shaft in Central London
James Eastham, Hill Nottingham
1:11:27

Case Study Webinar: Finite Element Method Approach...

MIDAS GEOTECH OFFICIAL
381 views • 3 months ago

Finite Element Modeling of Tunnels in 2D&3D | Most...

MIDAS GEOTECH OFFICIAL
571 views • 9 months ago

Case Study: Numerical Modelling of a Metro...

MIDAS GEOTECH OFFICIAL
294 views • 4 months ago

Case Study: Deep Excavation under the Groundwater Tabl...

MIDAS GEOTECH OFFICIAL
523 views • 5 months ago

Project based Training: Box Culvert Excavation Drawing...

MIDAS GEOTECH OFFICIAL
435 views • 9 months ago

Case Study: Deep shaft in Central London | midas GTS...

MIDAS GEOTECH OFFICIAL
278 views • 5 months ago

Online Tutorials - GTS NX

▶ PLAY ALL

These Tutorials show the basic workflow with the software. How to easily perform specific projects using GTS NX.



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Eurocode 2 2D Excavation Analysis with Partial Factor Function
midas GTS NX Training
48:41



MIDAS ACADEMY
How To Quickly Master The Geotechnical Design Report
midas GTS NX & GEO XD
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1:11:01



[GTS NX] Advanced tutorial: pile foundation construction...
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[GTS NX] Piles Foundation Complete Tutorial
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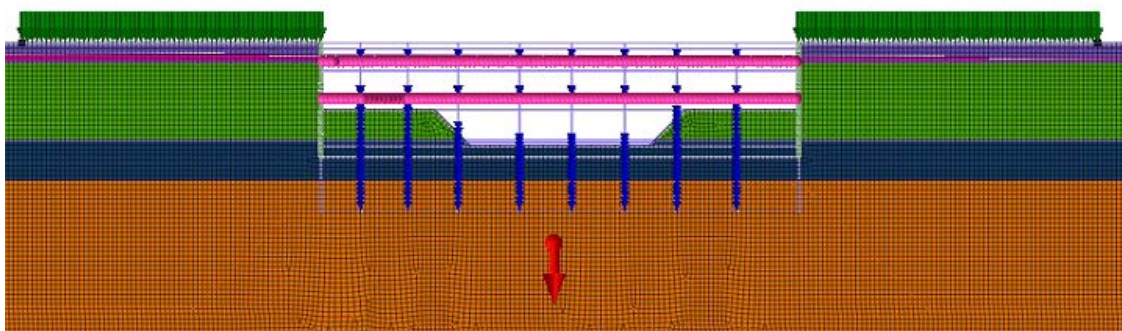
27



CASE STUDIES

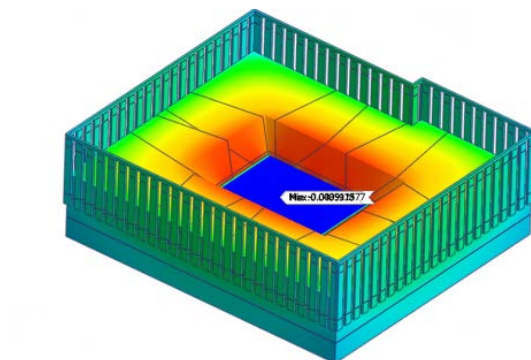


2D分析

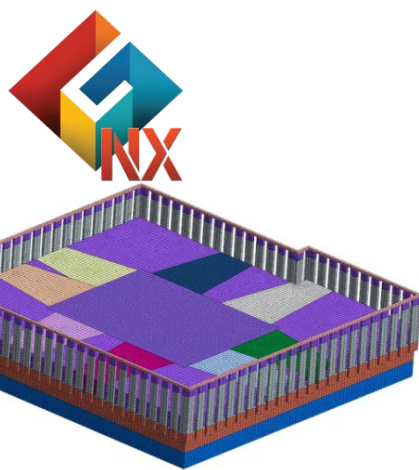
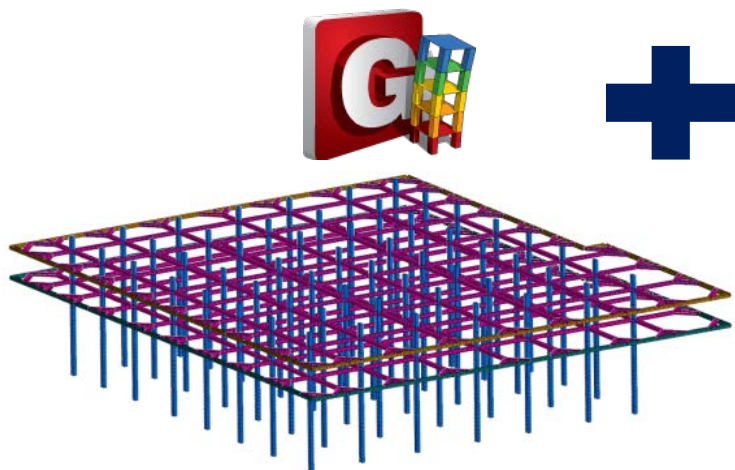
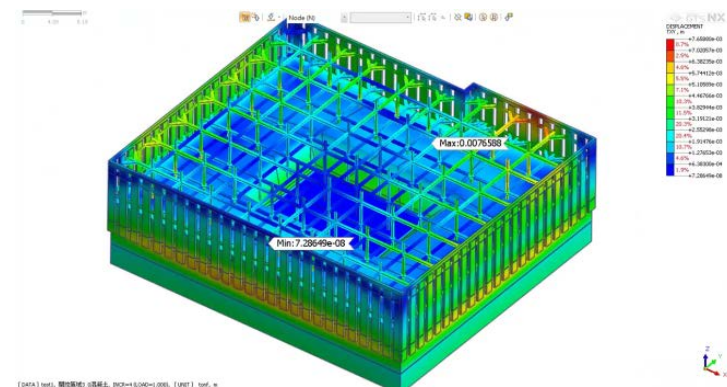


2D 建模只考慮模型的一個平面，縱向支撐、水平支撐和傾斜梁無法建模。

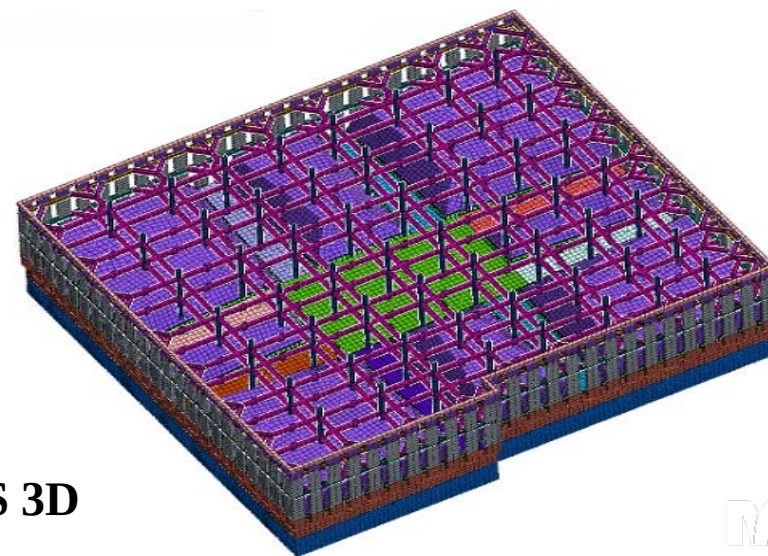
開挖面最大垂直位移 (m)



開挖面最大水平位移 (m)

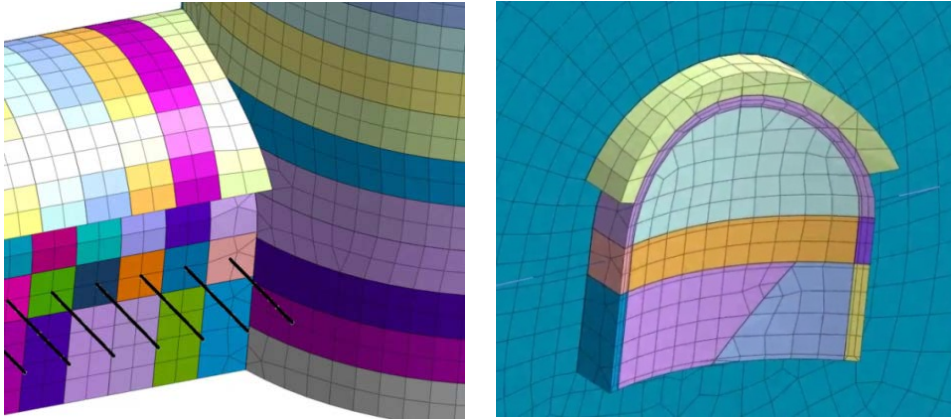


GEN+GTS 3D

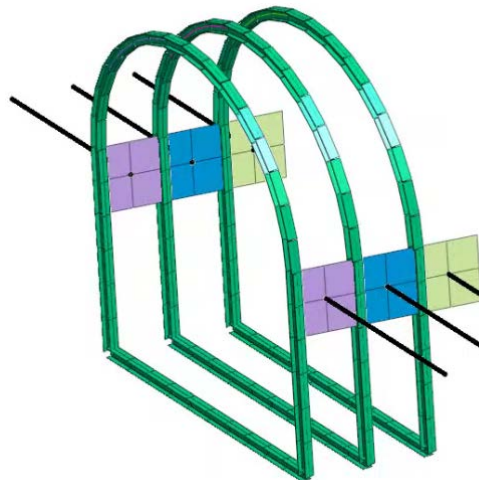


GTS NX NATM實例

Mixed Mesh with Fully Compatible Nodes



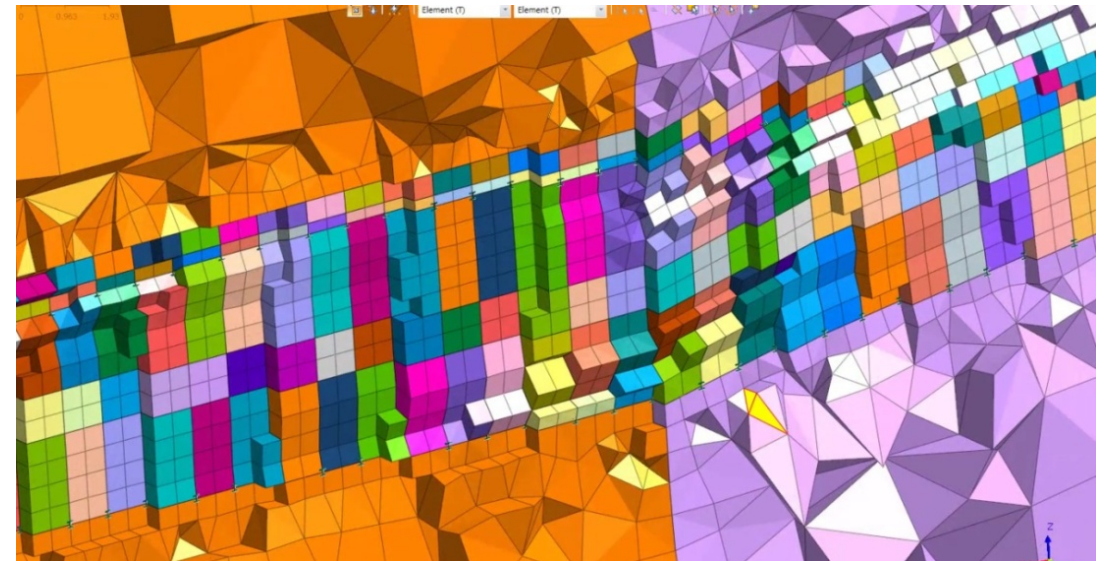
Shell Element(傳力裝置)



Beam Element(H型鋼)

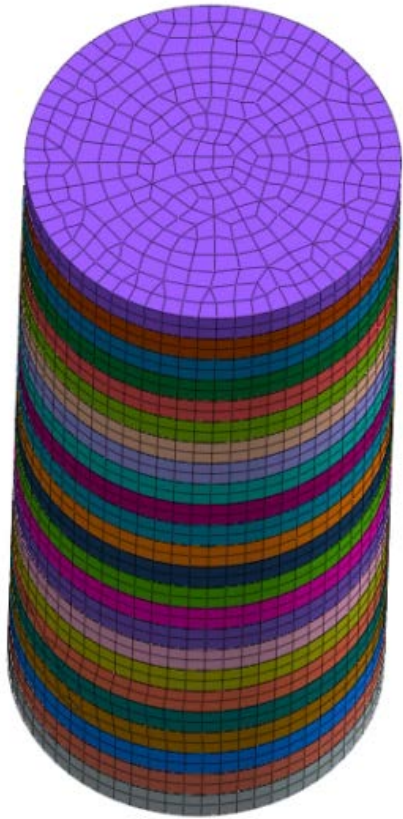
Embedded Truss Element
(Rock Bolt)

FEA NX 混合網格/全共點建模

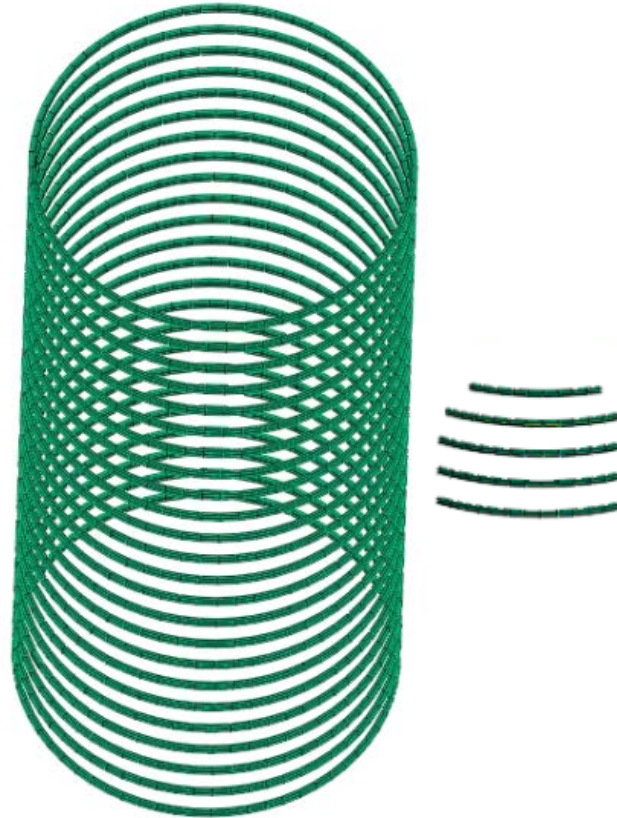


FEA NX Case Study: NATM Tunnel Analysis

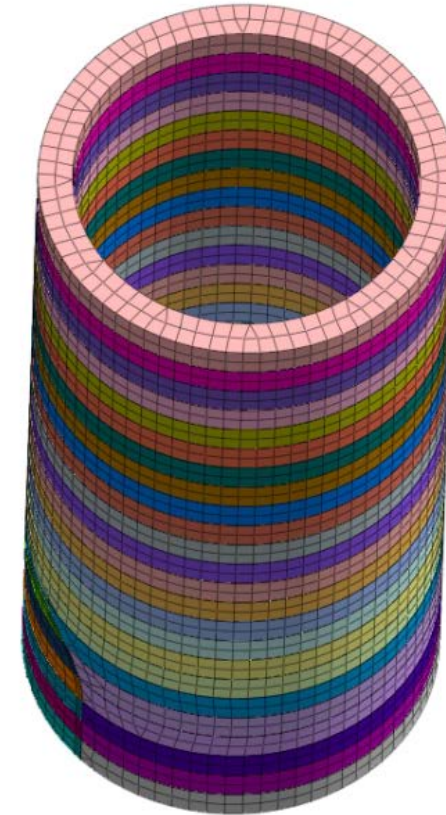
VERTICAL SHAFT



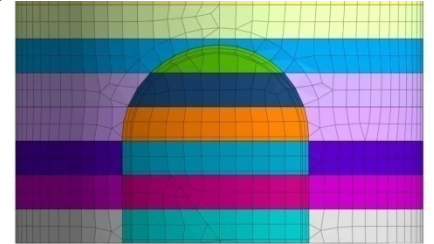
Vertical shaft excavation



Steel Bracing

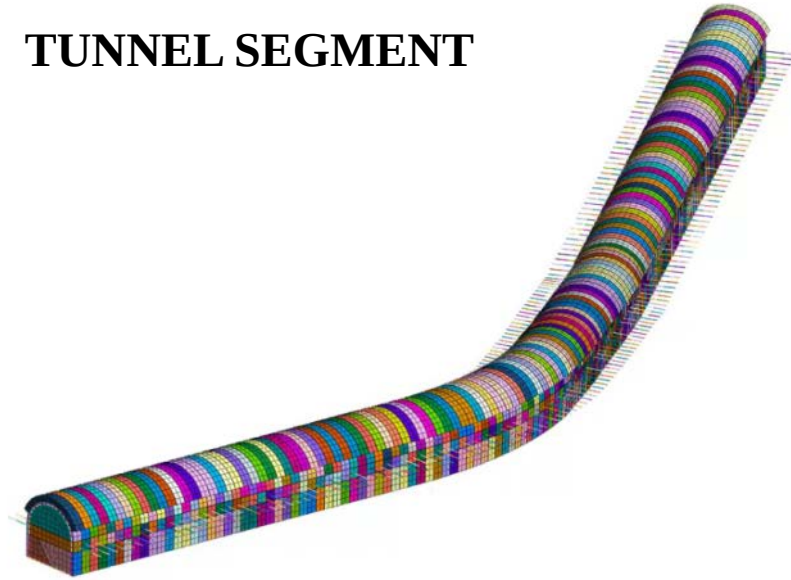


Backfill

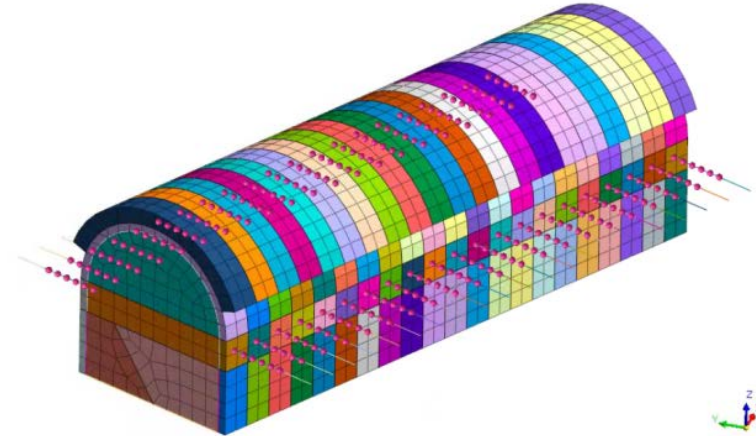
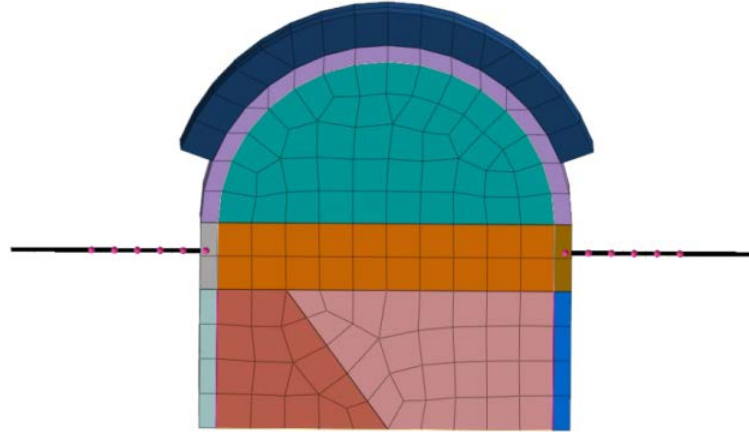


GTS NX Case Study: NATM Tunnel Analysis

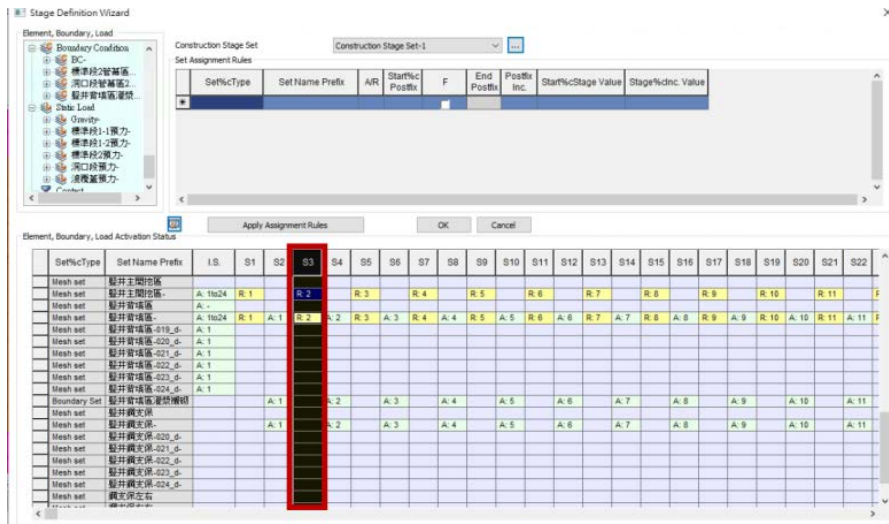
TUNNEL SEGMENT



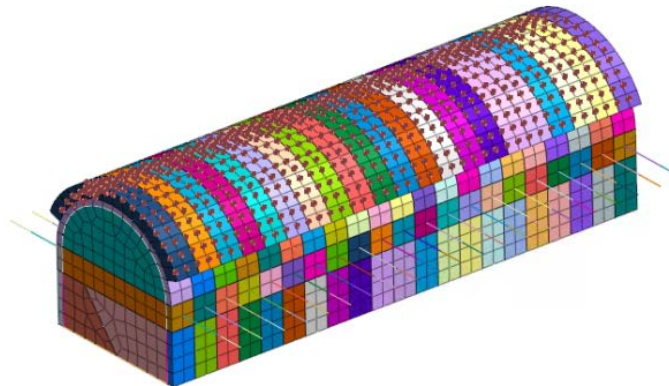
Anchors (Prestressed Application)



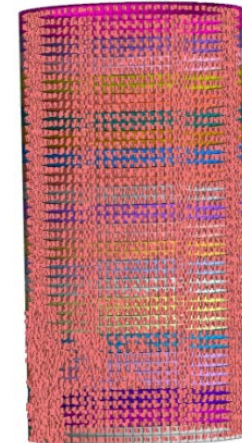
Construction Stage



管幕區變更材質



Backfill Grouting and Lining





GTS NX SLOPE STABILITY ANALYSIS

2D分析 - 方法 1

Stress Analysis Method (SAM)

2D分析 - 方法 2

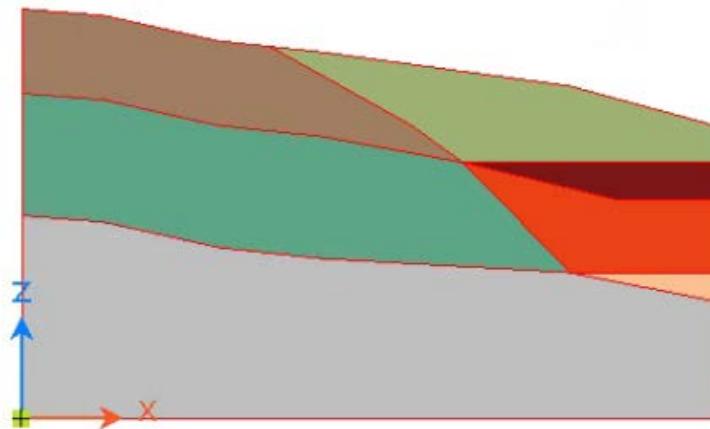
Strength Reduction Method (SRM)

3D分析

Strength Reduction Method (SRM)

GTS NX 2D SLOPE STABILITY ANALYSIS

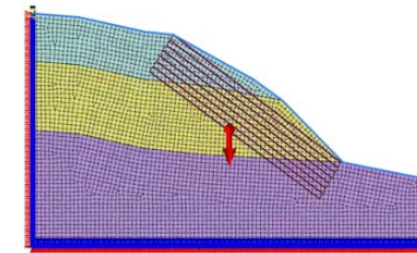
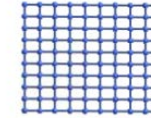
Post-Excavation Slope Stability Calculation



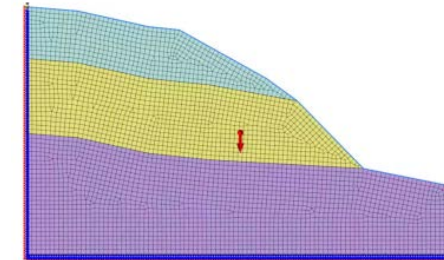
Weathered Soil
Weathered Rock
Soft Rock



2D分析-方式2.SAM

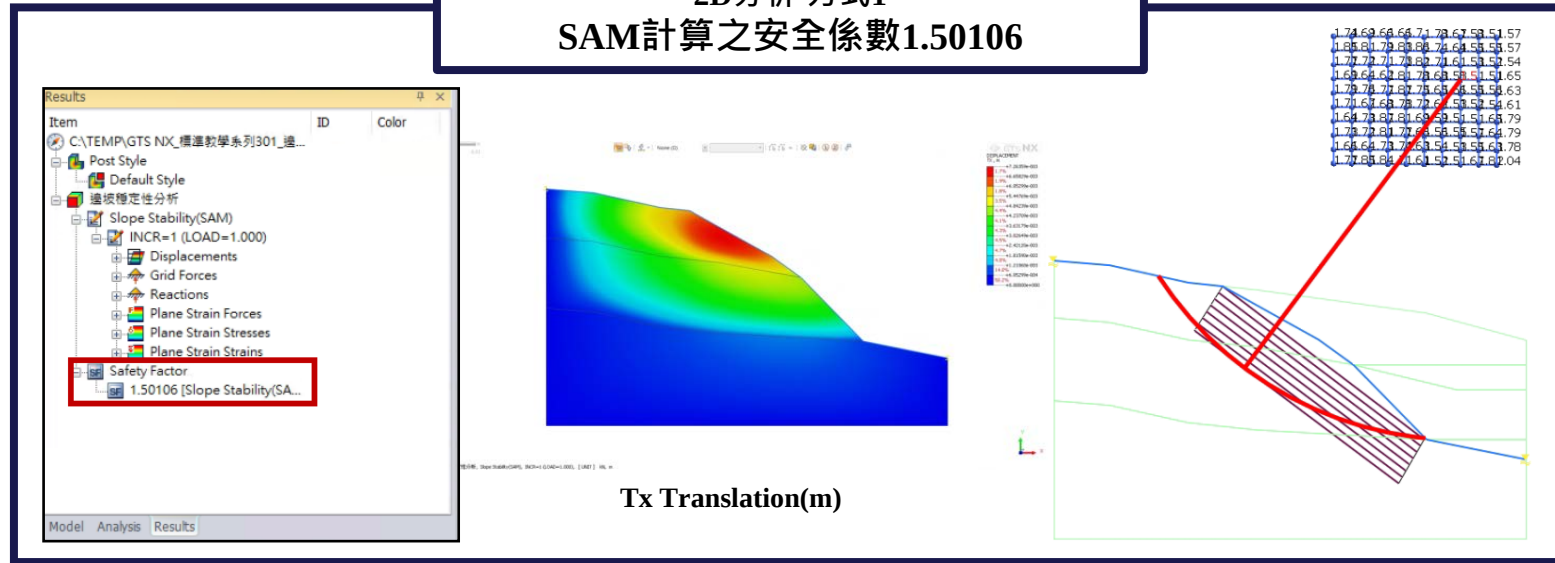


2D分析-方式3.SRM

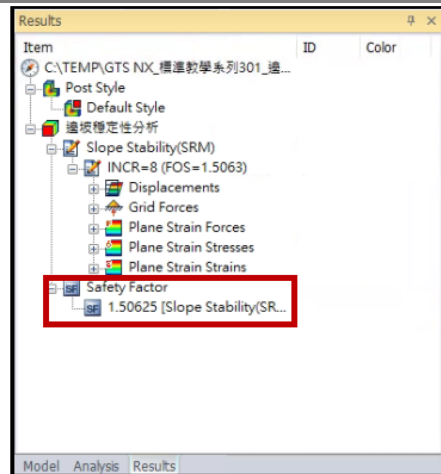


SRM gradually reduces the shear strength parameters (cohesion c and friction angle ϕ) of the slope foundation material until the analysis becomes unstable (diverges). At this point, slope failure is assumed to occur. The maximum strength reduction factor at this divergence point is taken as the minimum factor of safety for the slope.

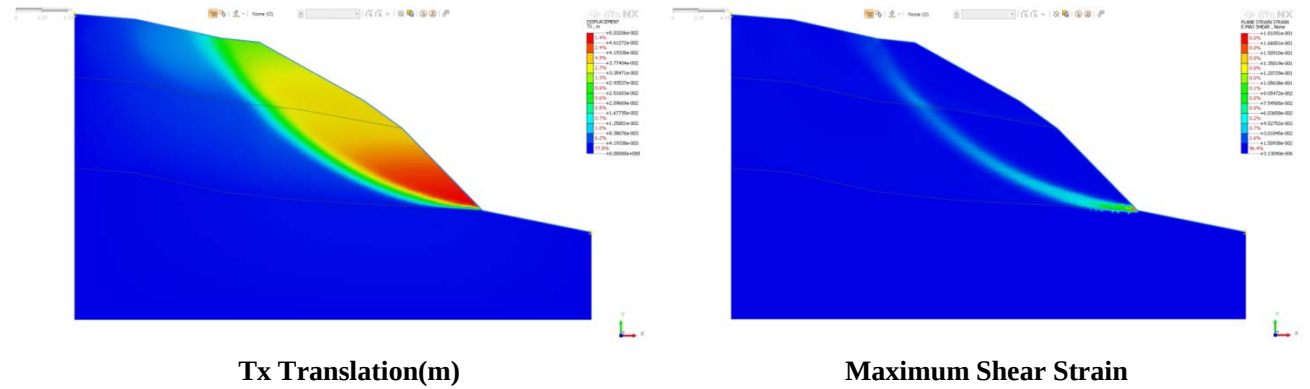
2D分析-方式1 SAM計算之安全係數1.50106



2D分析-方式2 SRM計算之安全係數1.50625

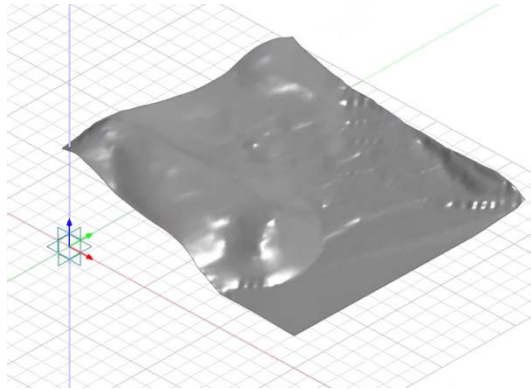


2D分析-方式2 SRM透過水平變形和最大剪切應變判斷破壞面



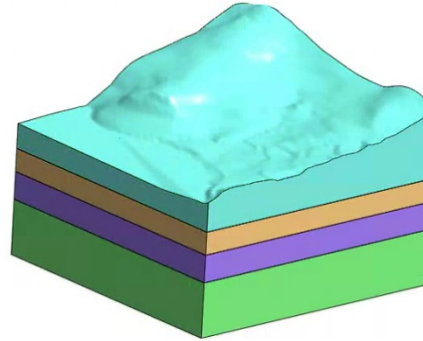
GTSNX 3D SLOPE STABILITY ANALYSIS

3DTerrain Surface Features

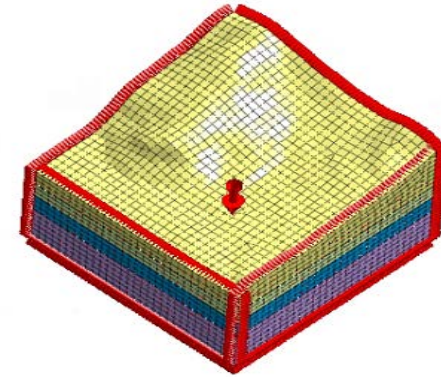


300m × 300m

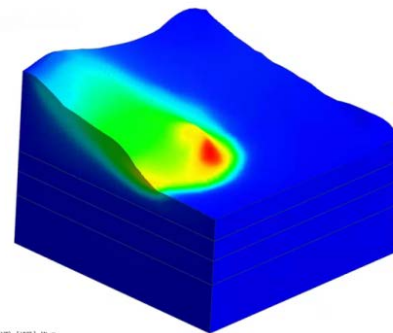
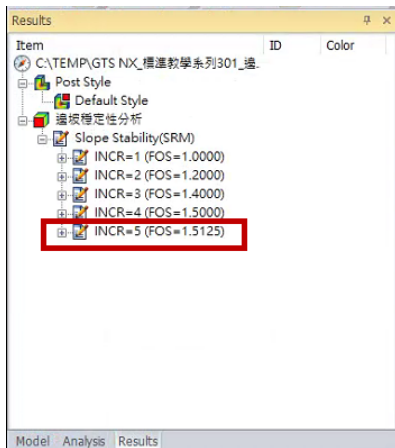
3DTerrain Solid Features



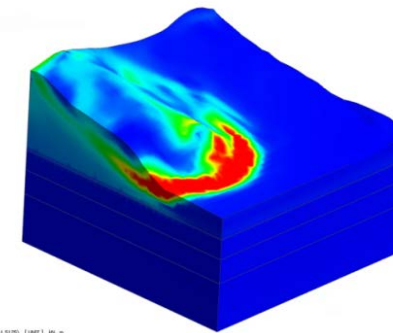
Self-Weight



3D分析
SRM計算之安全係數1.5125



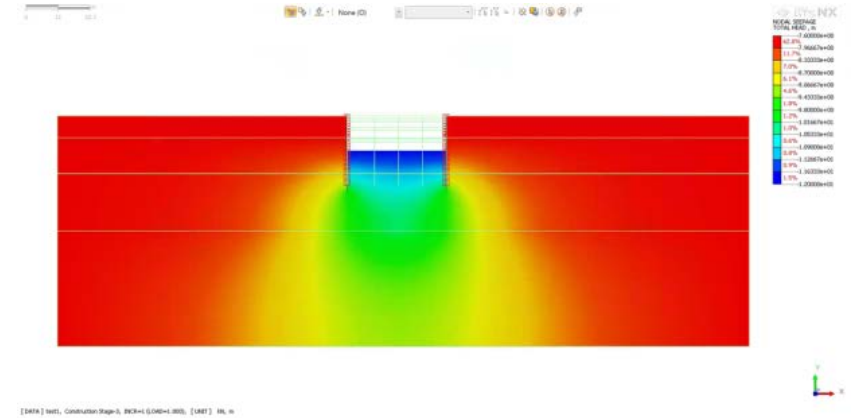
Tx Translation(m)



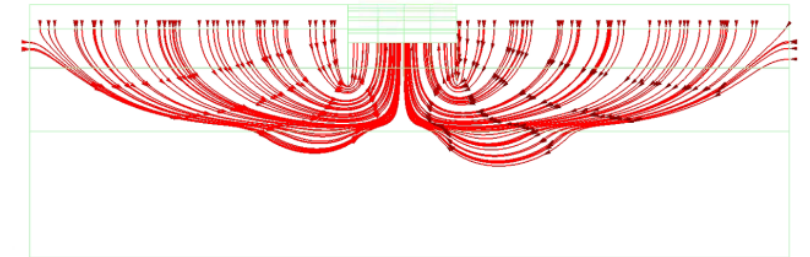
Maximum Shear Strain

GTS NX GROUNDWATER SIMULATION

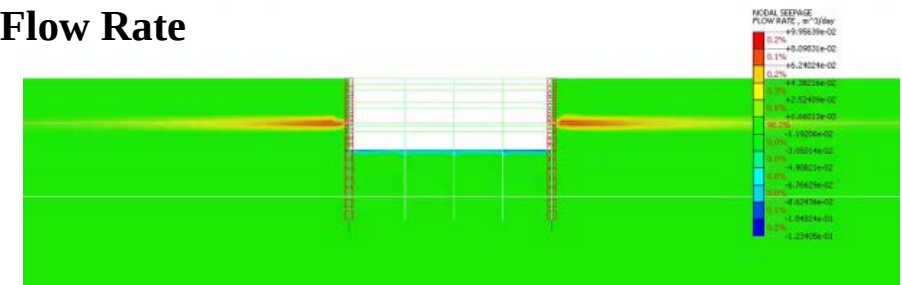
Total Head



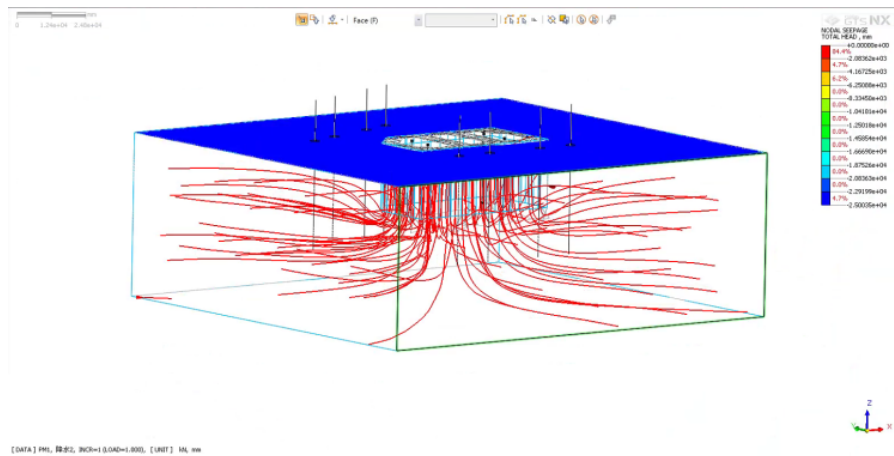
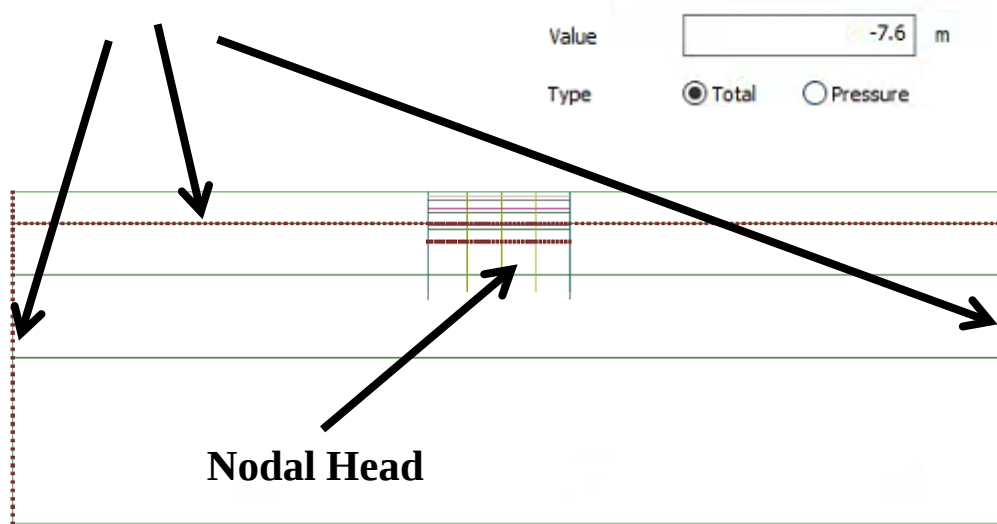
Flow Path



Seepage Flow Rate



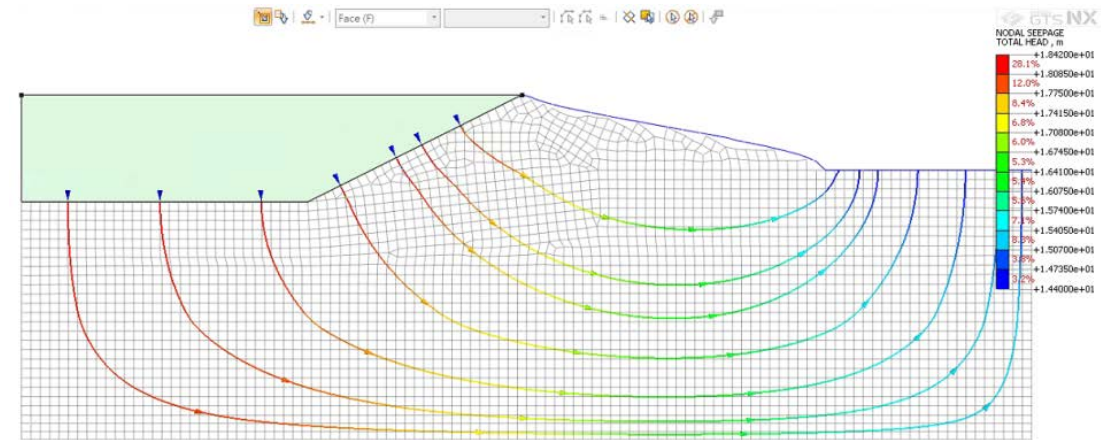
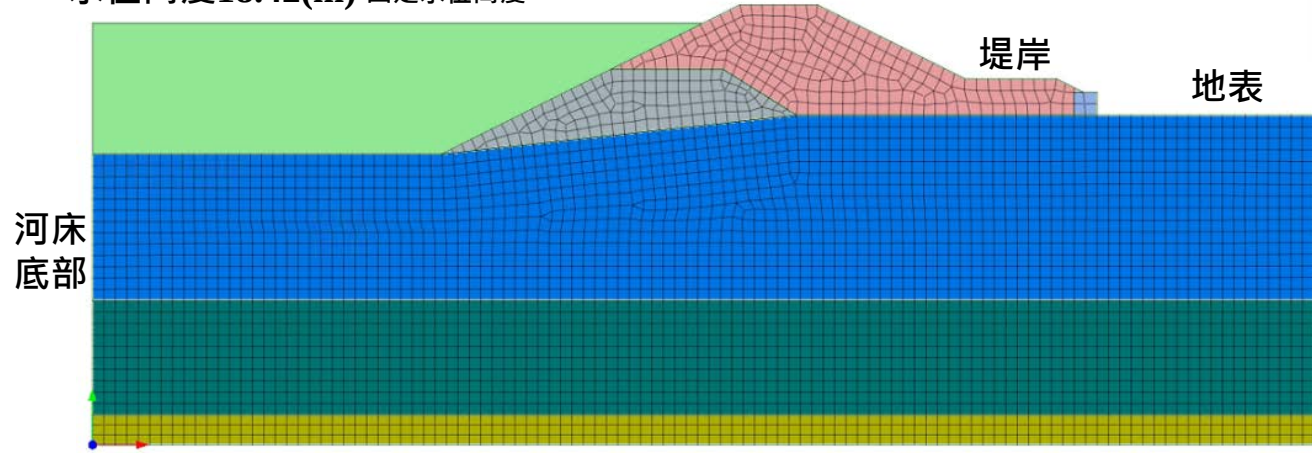
Nodal Head



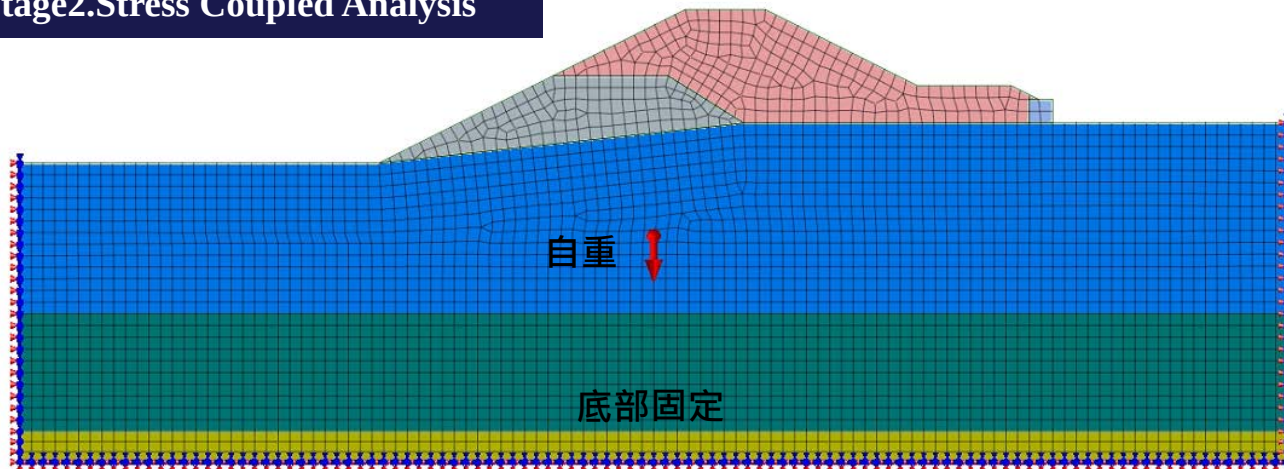
GTS NX Seepage-Stress Coupled Analysis

Stage1.Seepage Analysis

水位高度18.42(m) 固定水位高度



Stage2.Stress Coupled Analysis

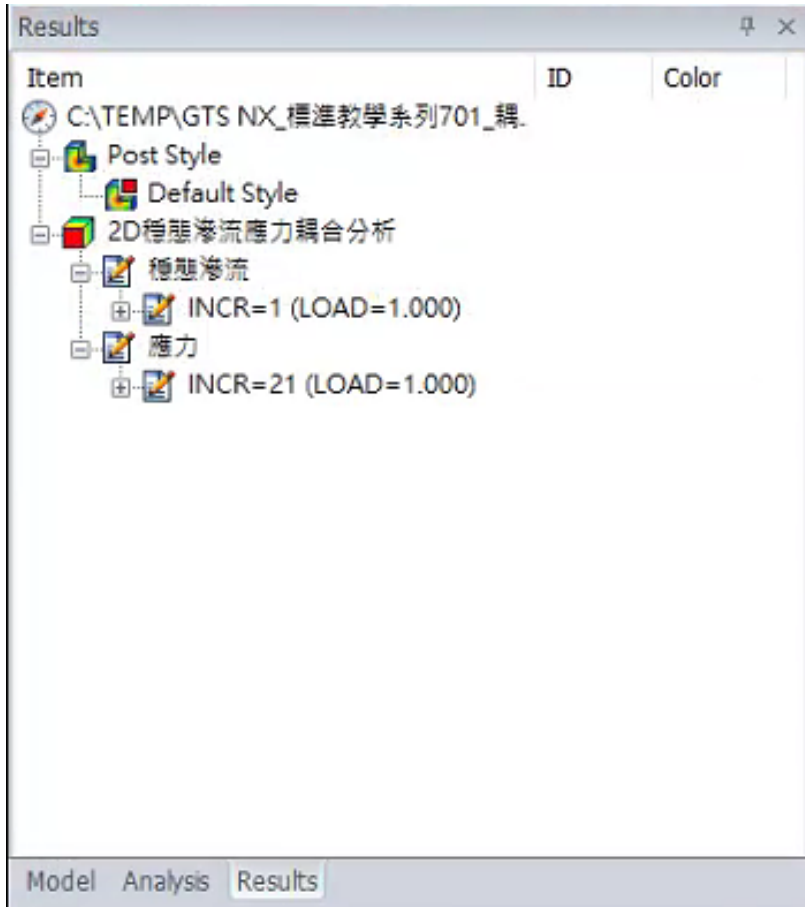


對稱

GTS NX Seepage-Stress Coupled Analysis

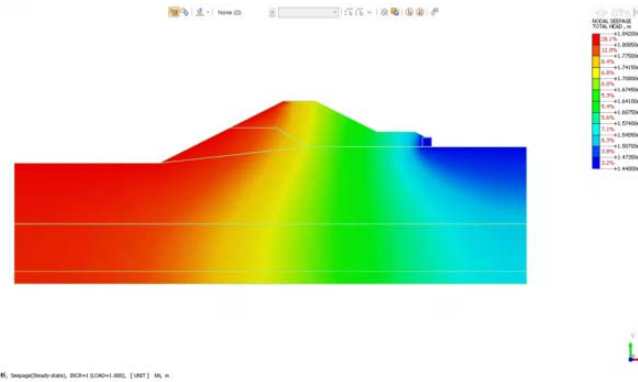
Results

穩態滲流 INCR=1：滲流結果
應力 INCR=21：應力結果

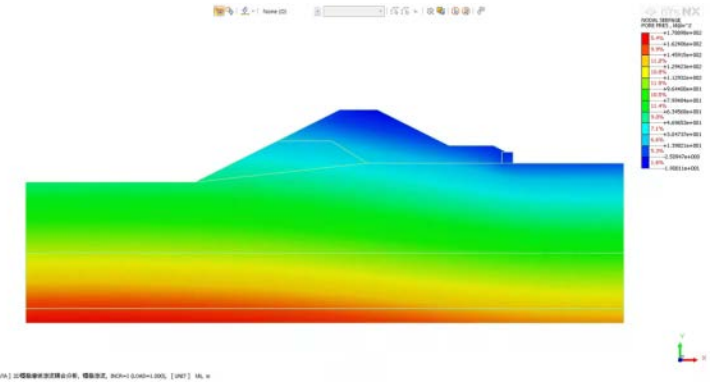


滲流結果

Total Head(m)

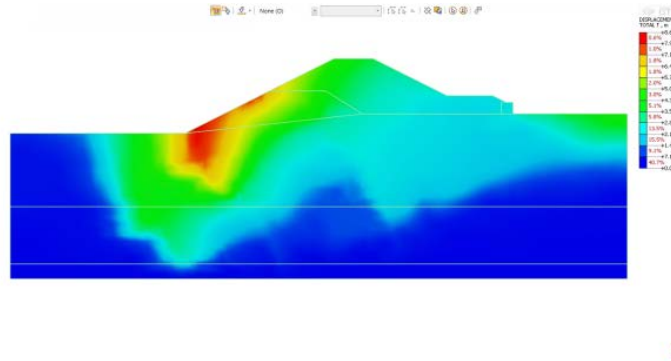


Pore Pressure(KN/m²)

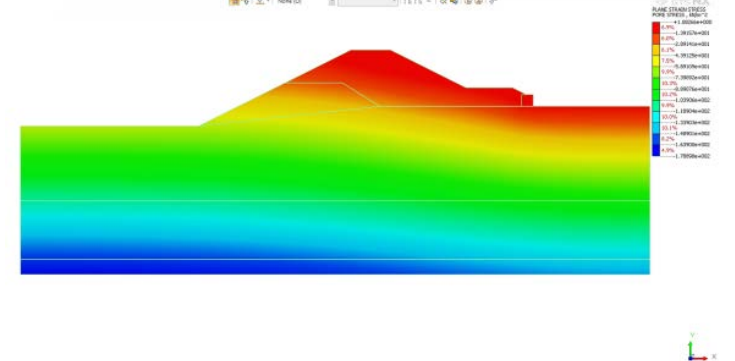


應力結果

Displacement Total(m)



Pore Stress(KN/m²)

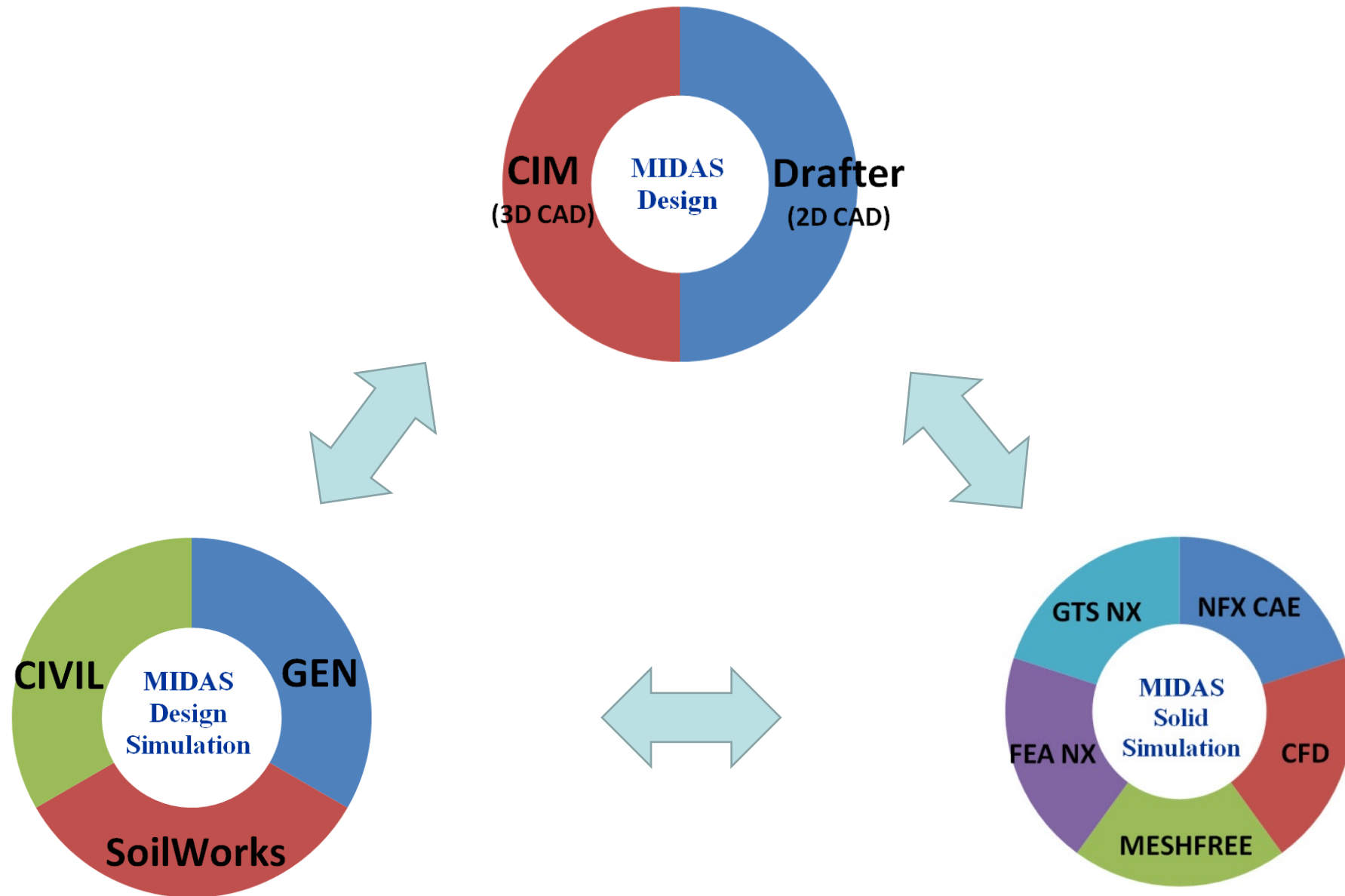




SYSTEM INTEGRATION

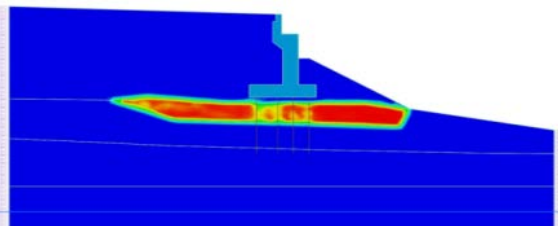


MIDAS INTEGRATION

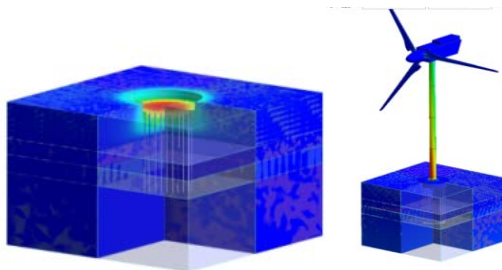


Solid Total Solution

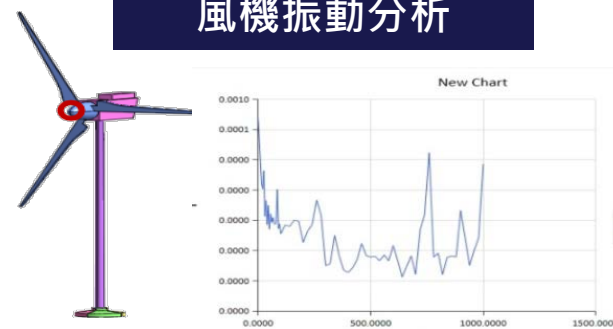
土壤液化分析



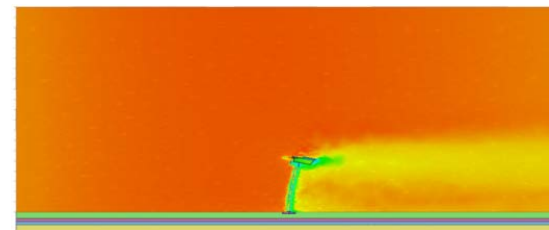
風機安裝施工階段分析



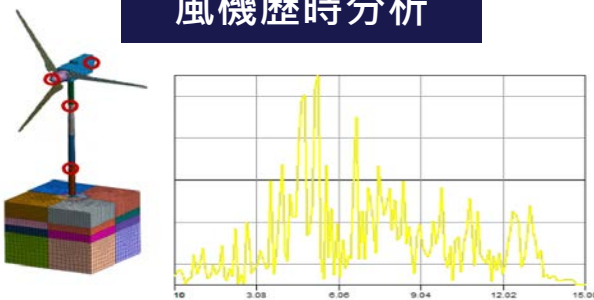
風機振動分析



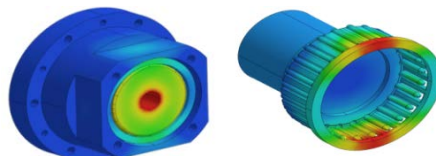
風機流固耦合分析



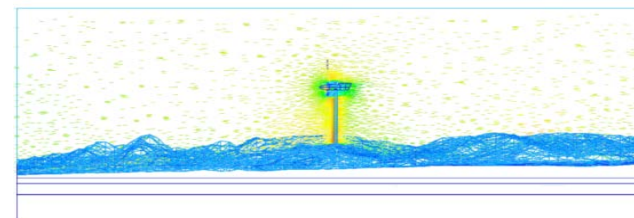
風機歷時分析



齒輪組分析

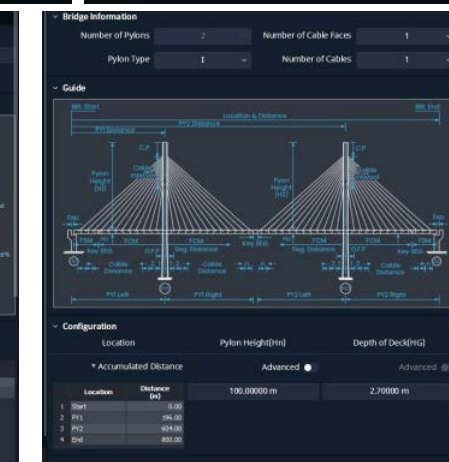
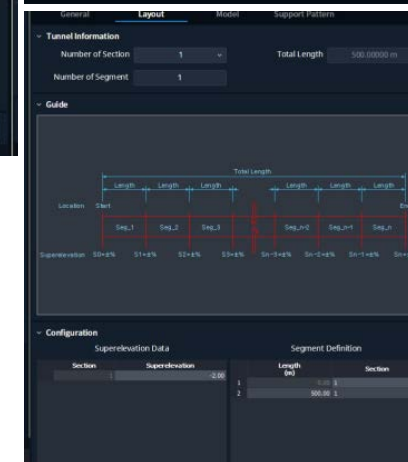
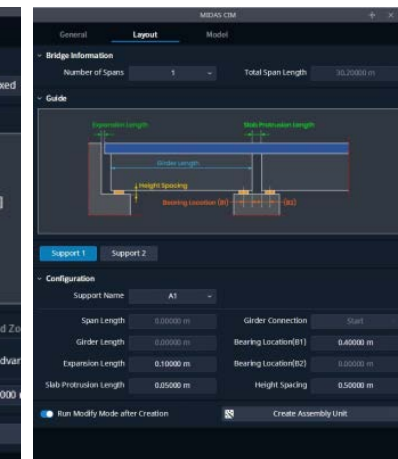
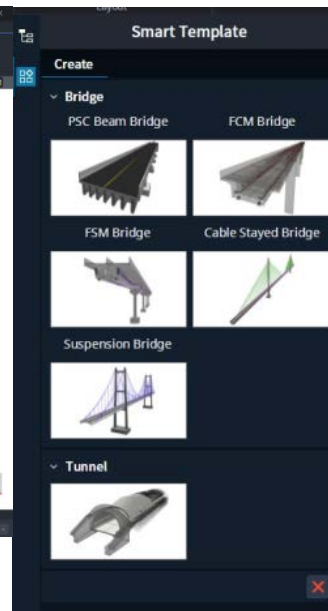
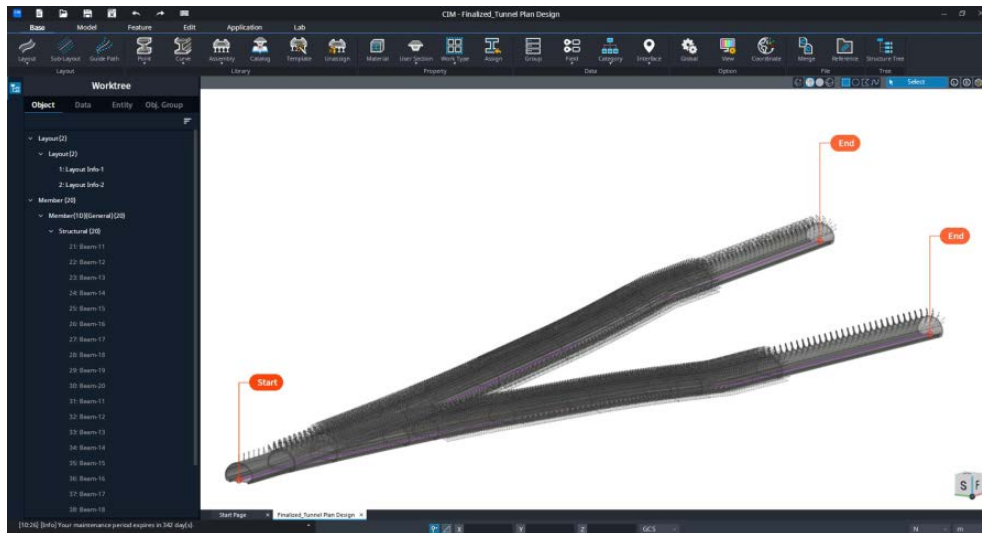


風機地形風場分析



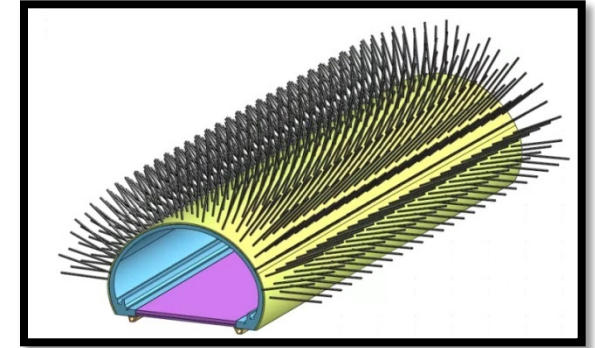
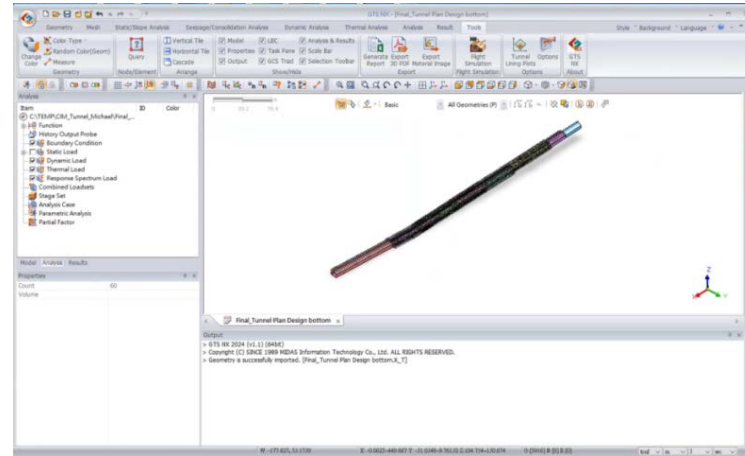
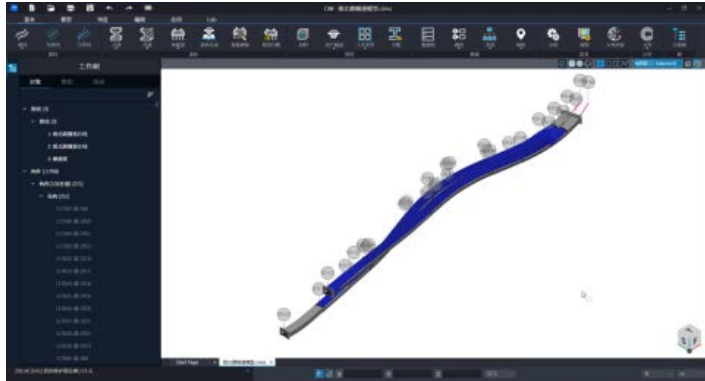
CIM + FEA/GTS 3D Model Integration

CIM-3DAutomatic Model Adjustment Along Alignment

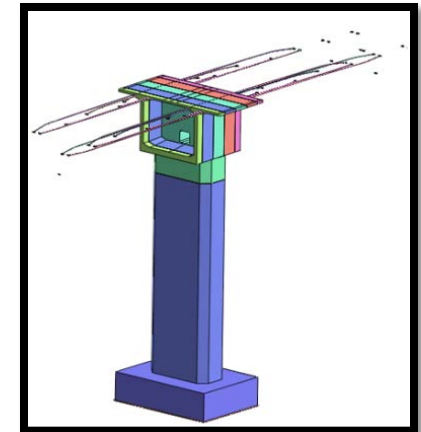
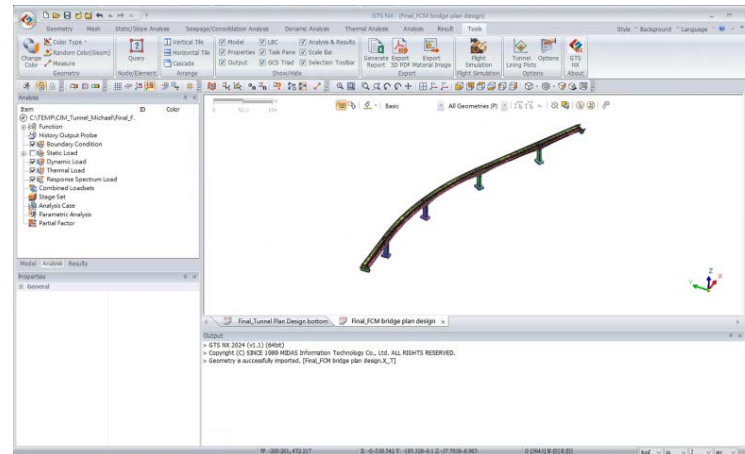
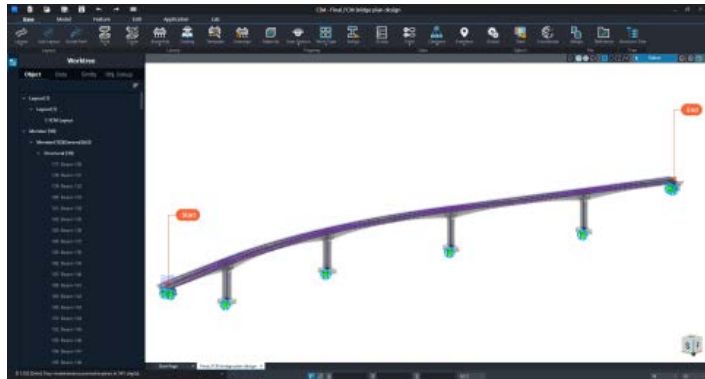


CIM+GTS 3D Model Integration

Tunnel

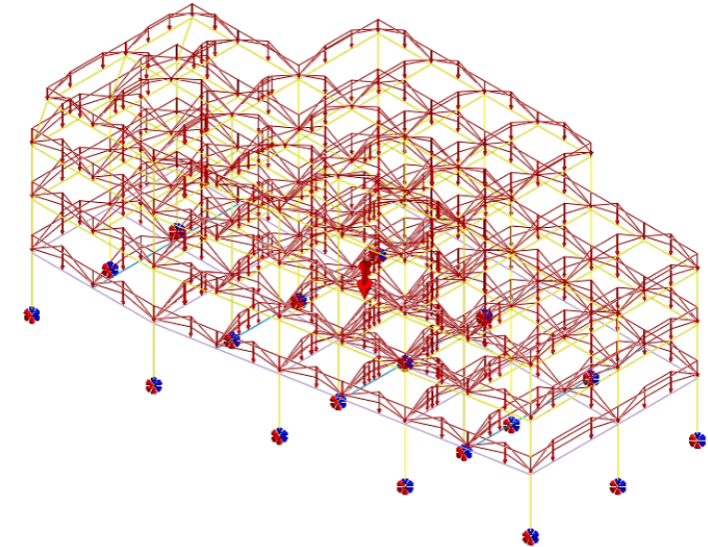
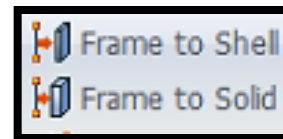
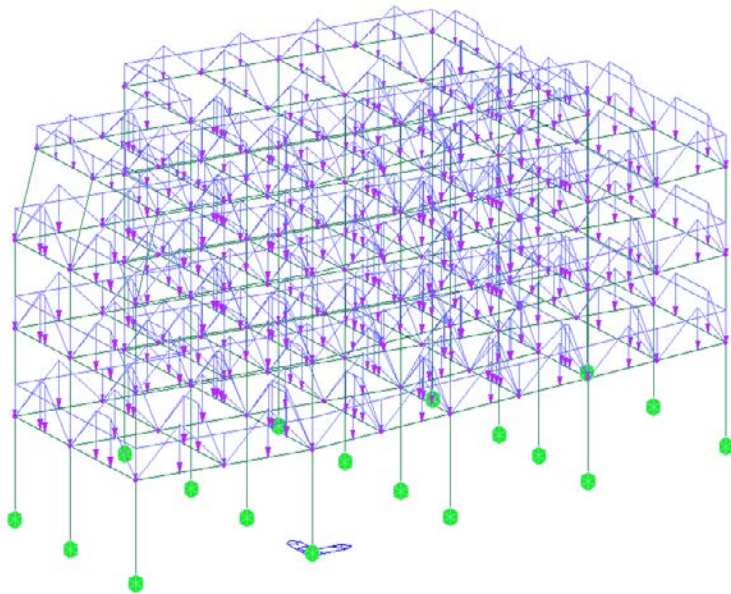
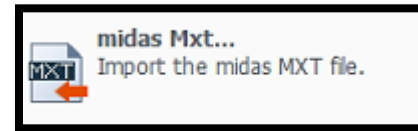
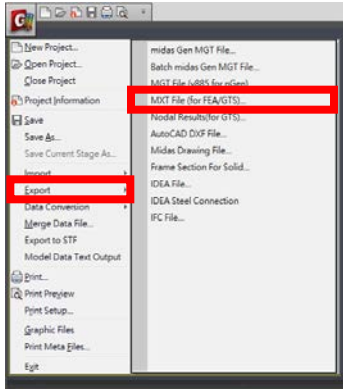


Bridge

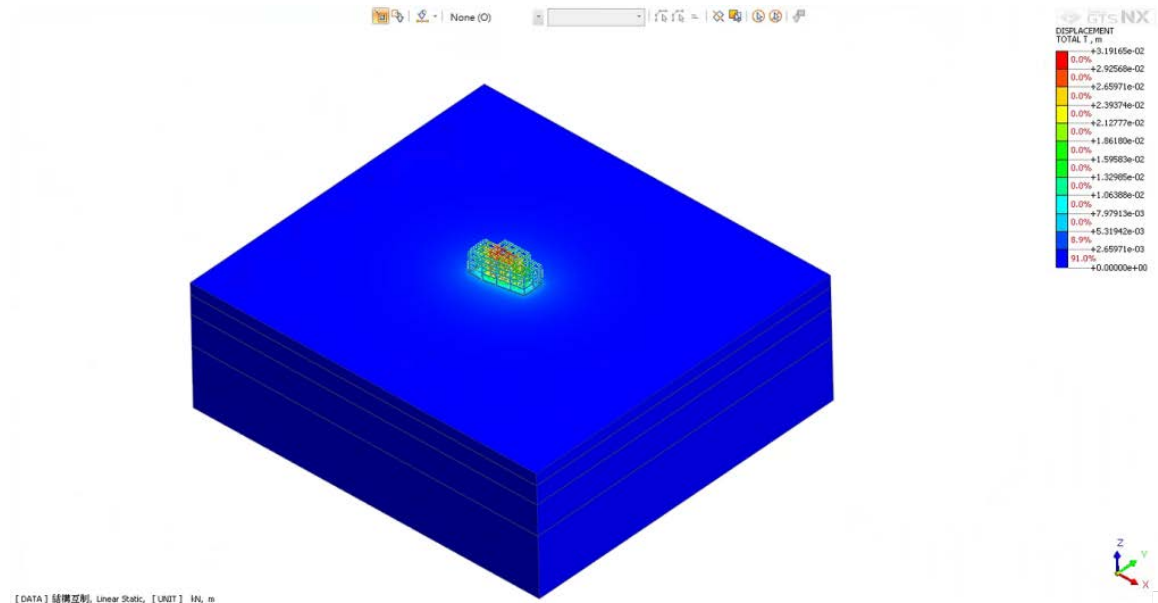
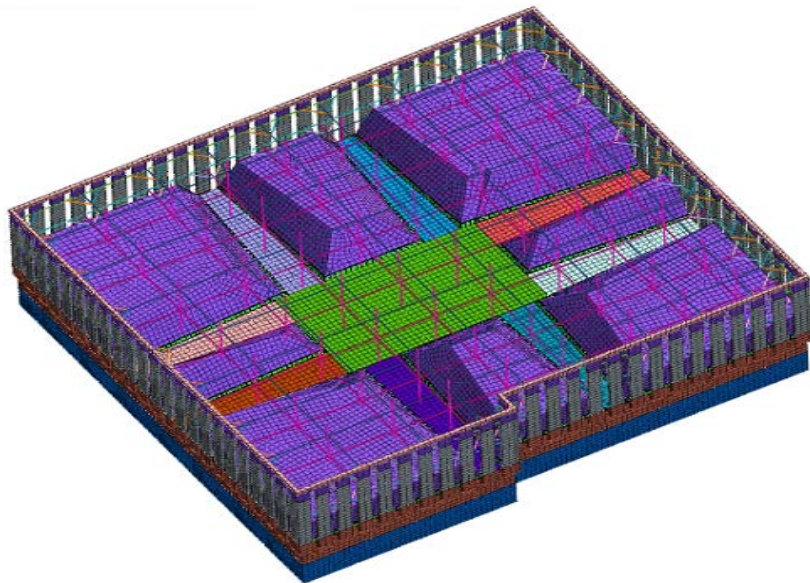
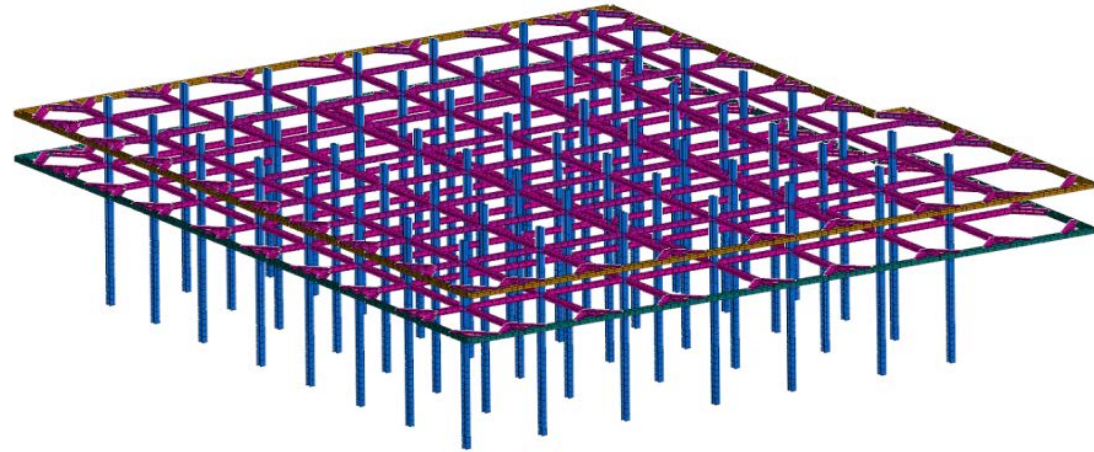
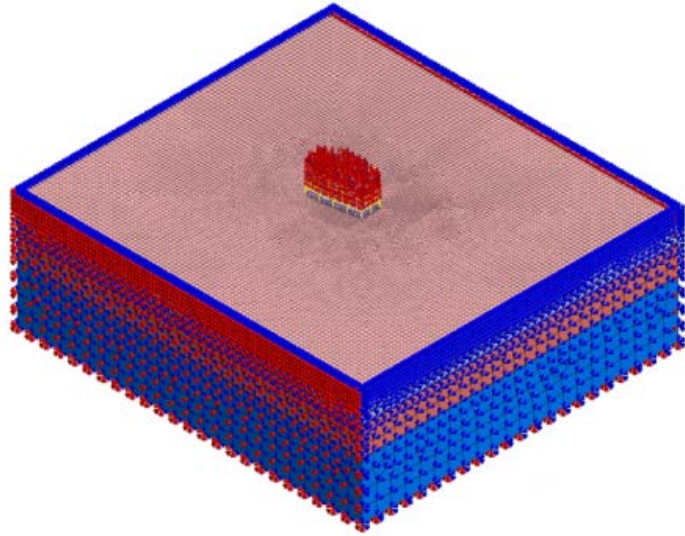


CIM>S NX
Direct Conversion of Solid Features

FEA or GTS NX & Gen | Structural Interaction Analysis



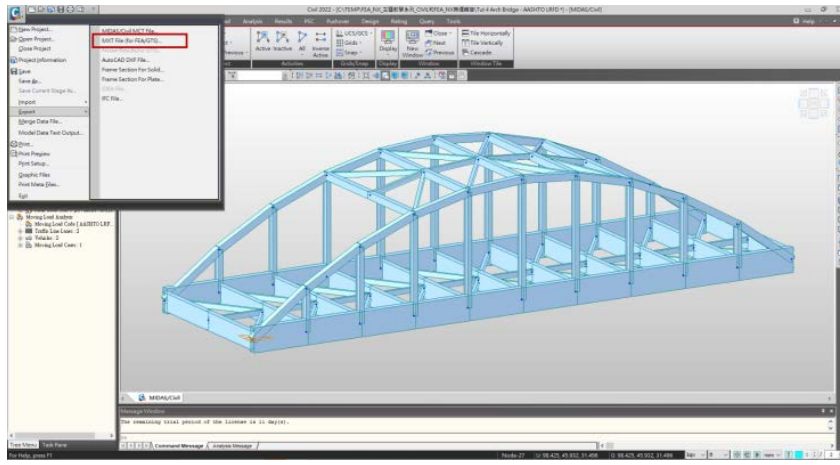
FEA or GTS NX & Gen | Structural Interaction Analysis



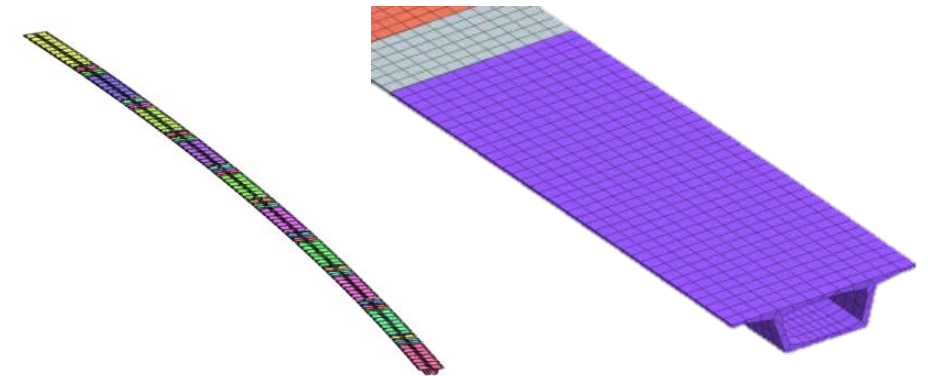
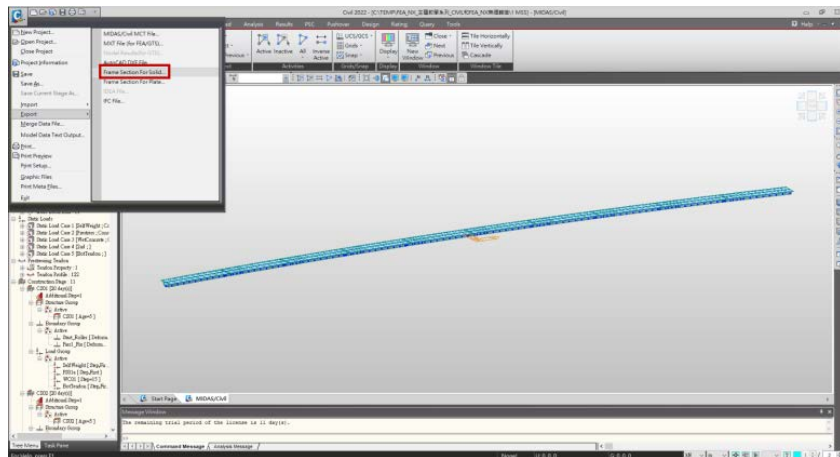
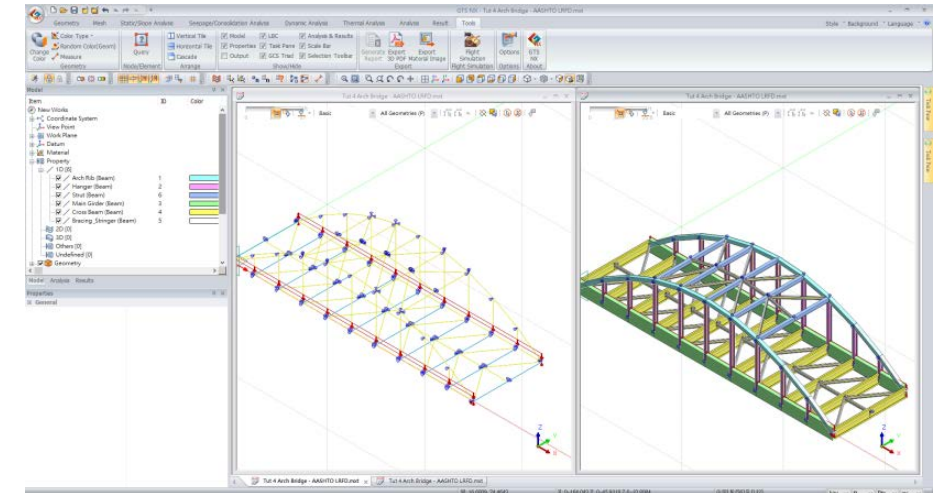
GTS / FEA NX+CIVIL Smooth Conversion



匯出MXT Files(*.mxt)檔案格式



元素&特徵無縫轉換



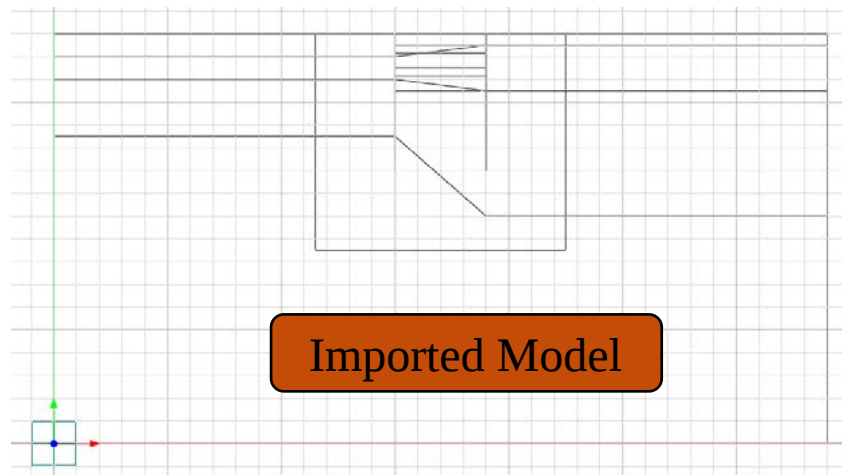
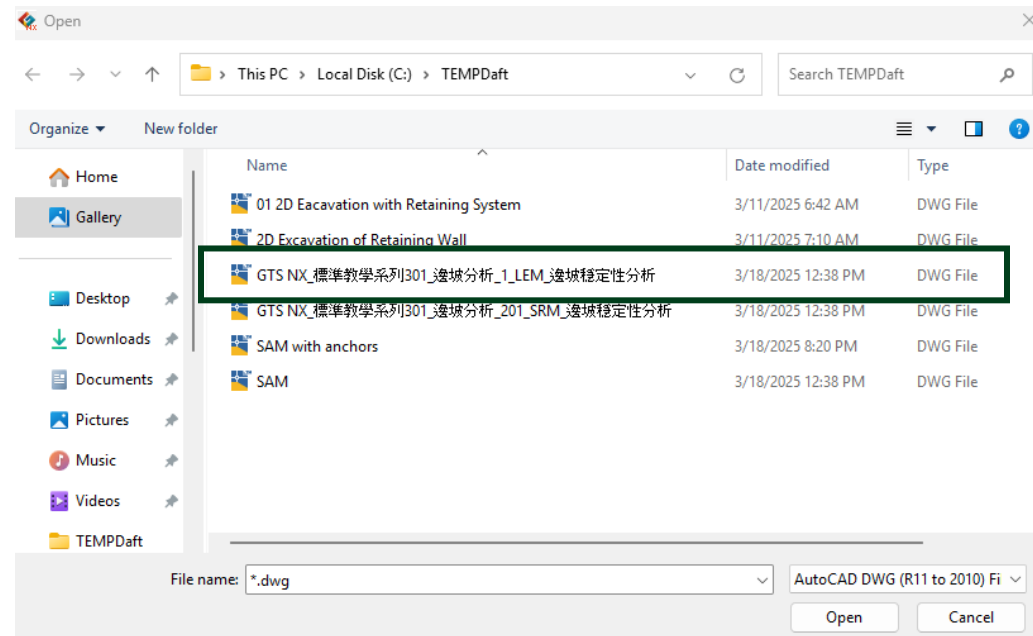
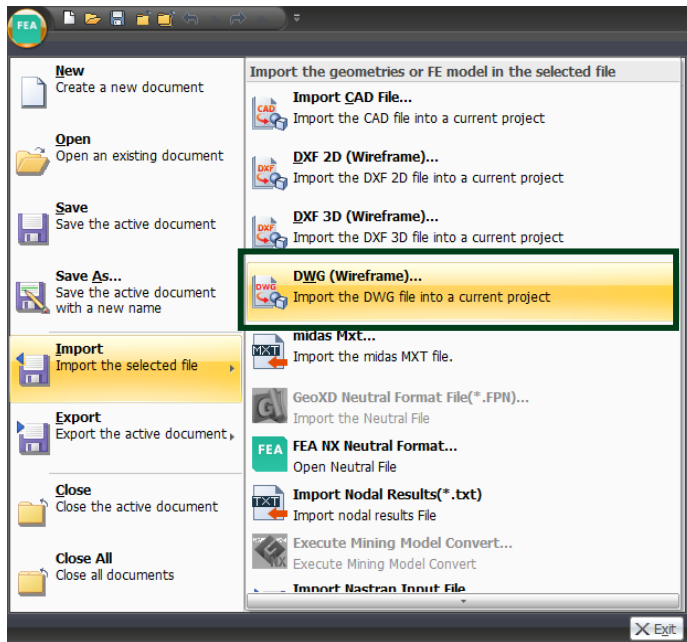


**THANK YOU FOR
LISTENING**

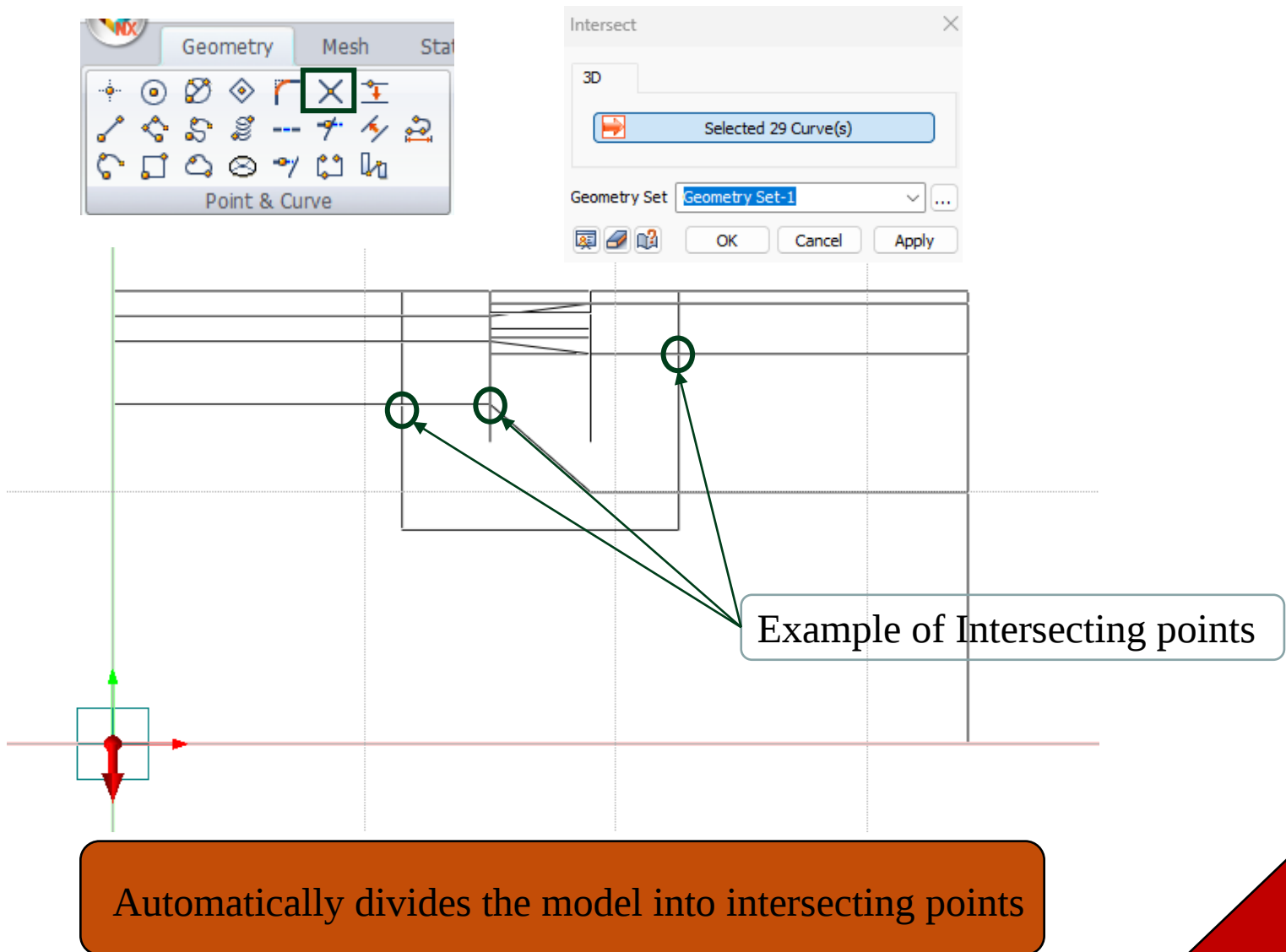
沈約翰 (John)
john@midasuser.com.tw

2D Excavation with Soil Retaining System

2D MODEL IMPORT



INTERSECT FUNCTION



SOIL MATERIAL

Add/Modify Material

No	Name	Type
1	SOIL1	Isotropic-Mohr-Coulomb
2	SOIL2	Isotropic-Mohr-Coulomb
3	SOIL3	Isotropic-Mohr-Coulomb
4	SOIL4	Isotropic-Mohr-Coulomb
5	CONCRETE	Isotropic-Elastic
6	STEEL	Isotropic-Elastic
7	Interface Mat...	Interface and Pile
8	Interface Mat...	Interface and Pile-Interface
9	Interface Mat...	Interface and Pile-Interface
10	Interface Mat...	Interface and Pile-Interface

Create...
Modify...
Excel
Export to Excel
Renumber
Database
Close

General steps for defining a specific soil material

Material

ID 1 Name SOIL1 Color [Color]

Model Type Mohr-Coulomb [Structure]

General Porous Non-Linear Thermal Time Dependent

Elastic Modulus(E) 15000 kN/m²
Inc. of Elastic Modulus 0 kN/m²
Inc. of Elastic Modulus Ref. Height 0 m
Poisson's Ratio(ν) 0.25
Unit Weight(γ) 18 kN/m³

Initial Stress Parameters
Ko Determination 0.5
☒ Automatic
☐ Manual ☐ Anisotropy

Thermal Parameter
Thermal Coefficient 1e-06 1/[T]
Molecular vapor diffusion coefficient 0 m²/sec
Thermal diffusion enhancement 0

Damping Ratio(For Dynamic)
Damping Ratio 0.05

☐ Safety Result(Mohr-Coulomb)
Cohesion(C) 30 kN/m²
Frictional Angle(ϕ) 36 [deg]
☐ Tensile Strength 0 kN/m²

DB

OK Cancel

Material

ID 1 Name SOIL1 Color [Color]

Model Type Mohr-Coulomb [Structure]

General Porous Non-Linear Thermal Time Dependent

Unit Weight(Saturated) 18 kN/m³
Initial Void Ratio(eo) 0.5

☐ Unsaturated Property

Drainage Parameters
Drained ☒ Undrained Poisson's Ratio 0.495
☐ Skempton's B Coefficient 0.983277592

Seepage & Consolidation Parameters
Permeability Coefficients
kx 1e-06 ky 1e-06 kz 1e-06 m/sec
☐ Void Ratio Dependency of Permeability(k) 0.5
Specific Storativity(Ss) 5.23021 1/m Auto

Material

ID 1 Name SOIL1 Color [Color]

Model Type Mohr-Coulomb [Structure]

General Porous Non-Linear Thermal Time Dependent

Cohesion(C) 5 kN/m²
Inc. of Cohesion 0 kN/m²
Inc. of Cohesion Ref. Height 0 m
Frictional Angle(ϕ) 30 [deg]

☐ Dilatancy Angle 0 [deg]
☐ Tension Cut-off
Tensile Strength 0 kN/m²
Cut-off Yield Surface
☐ Pressure ☒ Rankine

SOIL PROPERTY

Add/Modify Property

No	Name	Type	Sub-Type
1		2D	Shell
2	SOIL1	2D	Plane Strain
3	SOIL2	2D	Plane Strain
4	SOIL3	2D	Plane Strain
5	SOIL4	2D	Plane Strain
6	D-Wall	1D	Beam
7	S1(UB 610x229x...	1D	Truss
8	S2(UB 610x229x...	1D	Truss
9	Interface Proper...	Other	Interface
10	Interface Proper...	Other	Interface
11	Interface Proper...	Other	Interface
12	Interface Proper...	Other	Interface
13	Rigid Link	Other	Rigid Link

Create
Modify...
Copy
Delete
Import...
Renumber

Create/Modify 1D Property

Beam

ID 6 Name D-Wall Color

Material 5: CONCRETE

☐ Hinge Property

☐ Taper

	Section-i	Section-j
Cross Sectional Area(A)	1	1 m ²
Torsional Constant(I _x)	0.140596345	0.140596345 m ⁴
Torsional Stress Coeff.	0.682395003	0.682395003 m
Area Moment of Inertia(I _y)	0.083333333	0.083333333 m ⁴
Area Moment of Inertia(I _z)	0.083333333	0.083333333 m ⁴
Effective Shear Area(A _y)	0.833441841	0.833441841 m ²
Effective Shear Area(A _z)	0.833441841	0.833441841 m ²
Shear Stress Coefficient(G _y)	1.5	1.5 1/m ²
Shear Stress Coefficient(G _z)	1.5	1.5 1/m ²

Stress... Stress...

y Axis Variable Constant

z Axis Variable Constant

☐ Spacing 1 m

☒ Section... Solid Rectangle

Apply

Create/Modify 2D Property

Plane Strain

ID 2 Name SOIL1 Color

Material 1: SOIL1

Material CSys

☒ CSys Global Rectangular

☐ Angle 0 [deg]

Plane Strain Property

OK Cancel Apply

Truss

ID 7 Name S1(UB 610x229x101 @ 4 Color

Constitutive Behavior From Material

Material 6: STEEL

☐ Hinge Property

Cross Sectional Area(A) 0.0129 m²

Torsional Constant 0 m⁴

Torsional Stress Coeff. 0 m

Truss Property

☒ Spacing 4 m

☒ Section... H-Section

OK Cancel

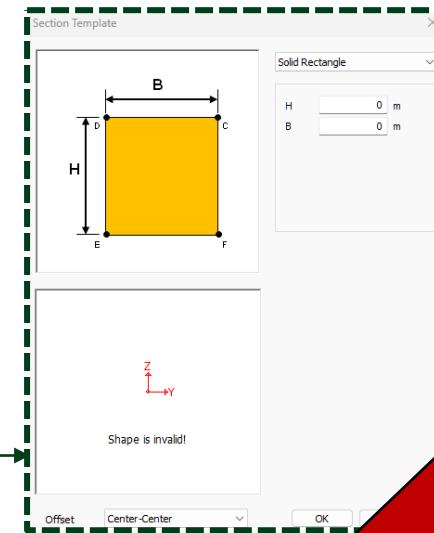
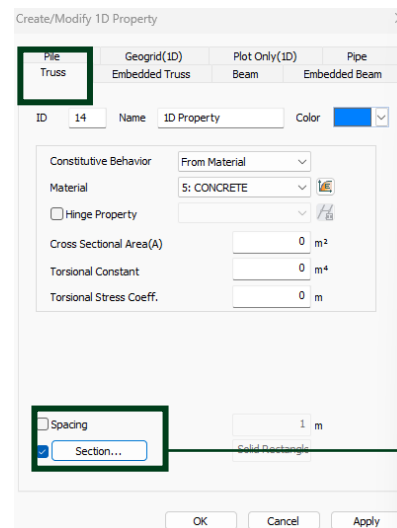
BEAM - TRUSS ELEMENT

Beam and Truss element comparison

Feature	Truss Element	Beam Element
Resists Axial Force	✓ Yes	✓ Yes
Resists Bending	✗ No	✓ Yes
Resists Shear	✗ No	✓ Yes
Resists Torsion	✗ No	✓ Yes
Degrees of Freedom (DOF)	3 per node (UX, UY, UZ)	6 per node (UX, UY, UZ, RX, RY, RZ)
Transfers Moments	✗ No	✓ Yes
Typical Application	Trusses, cables	Beams, frames

Truss Library

Note: Spacing defines the distance between each individual element that will be generated along a line or curve when using truss-type elements.



ELEMENT PROPERTY

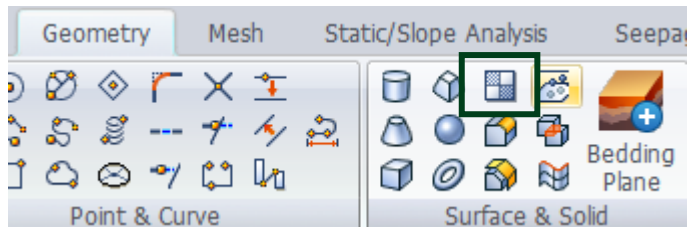
Ground Property

Name	Interface (SOIL 1)	Interface (SOIL 2)	Interface (SOIL 3)	Interface (SOIL 4)	SOIL 1	SOIL 2	SOIL 3	SOIL 4
Type	Other	Other	Other	Other	2D	2D	2D	2D
Model Type	Interface	Interface	Interface	Interface	Plane Strain	Plane Strain	Plane Strain	Plane Strain
Interface Type	Line	Line	Line	Line				
Material	SOIL 1	SOIL 2	SOIL 3	SOIL 4	SOIL 1	SOIL 2	SOIL 3	SOIL 4

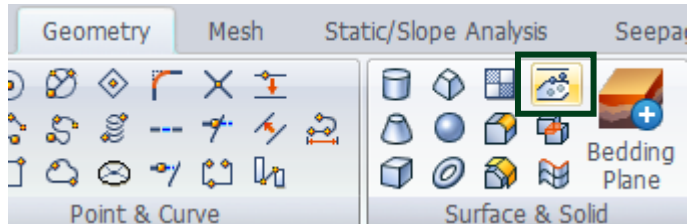
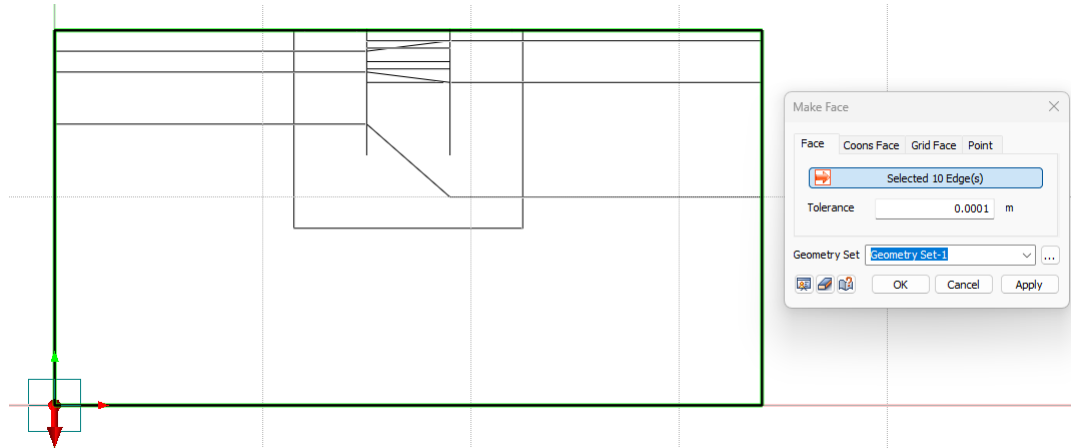
Structural Property

Name	D-Wall	S1	S2
Type	1D	1D	1D
Model Type	Beam	Truss	Truss
Material	CONCRETE	STEEL	STEEL
Section	Solid Rectangle	H-Section	H-Section
Section Size	1x1m @ 1m c/c	UB 610x229x101 @ 4m c/c	UB 610x229x101 @ 4m c/c

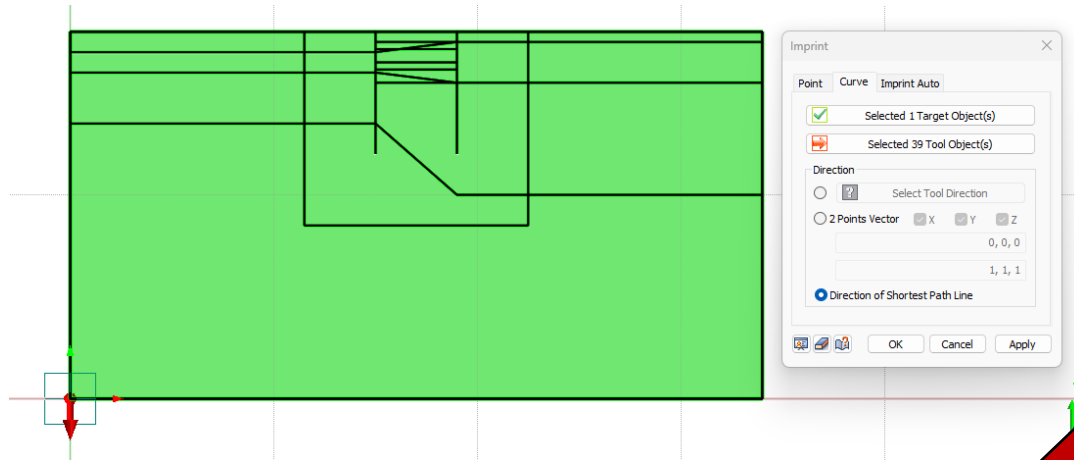
GEOMETRIC MODEL



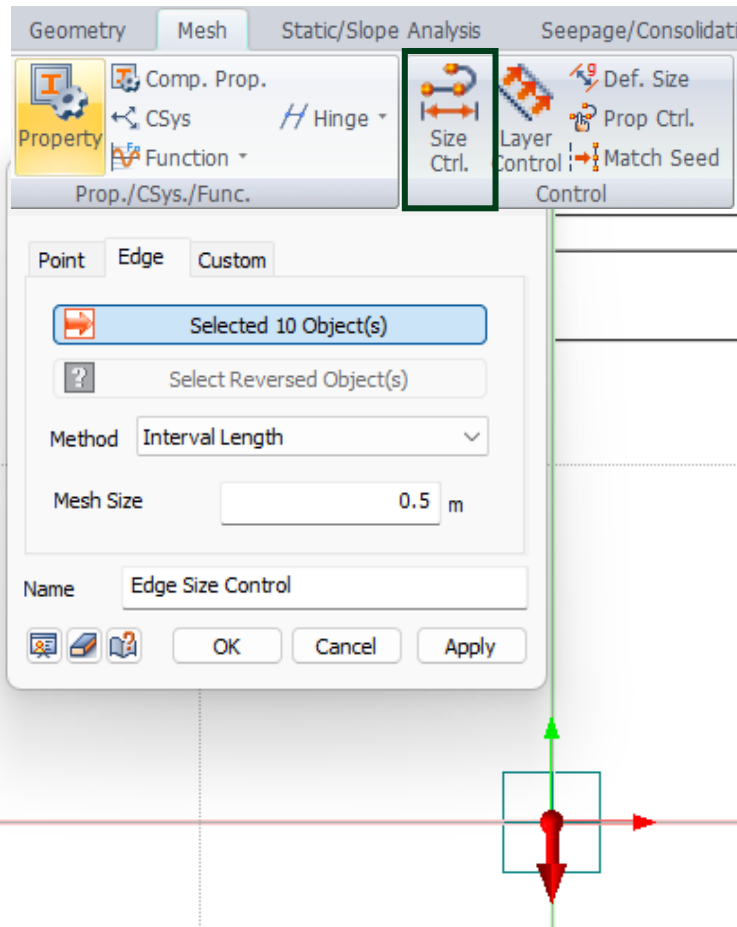
Face Function



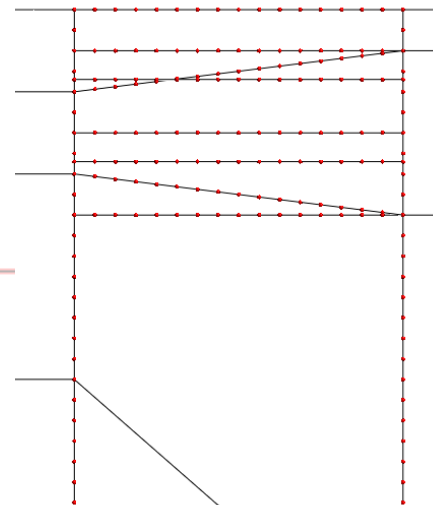
Imprint Function



MESH - SIZE CONTROL



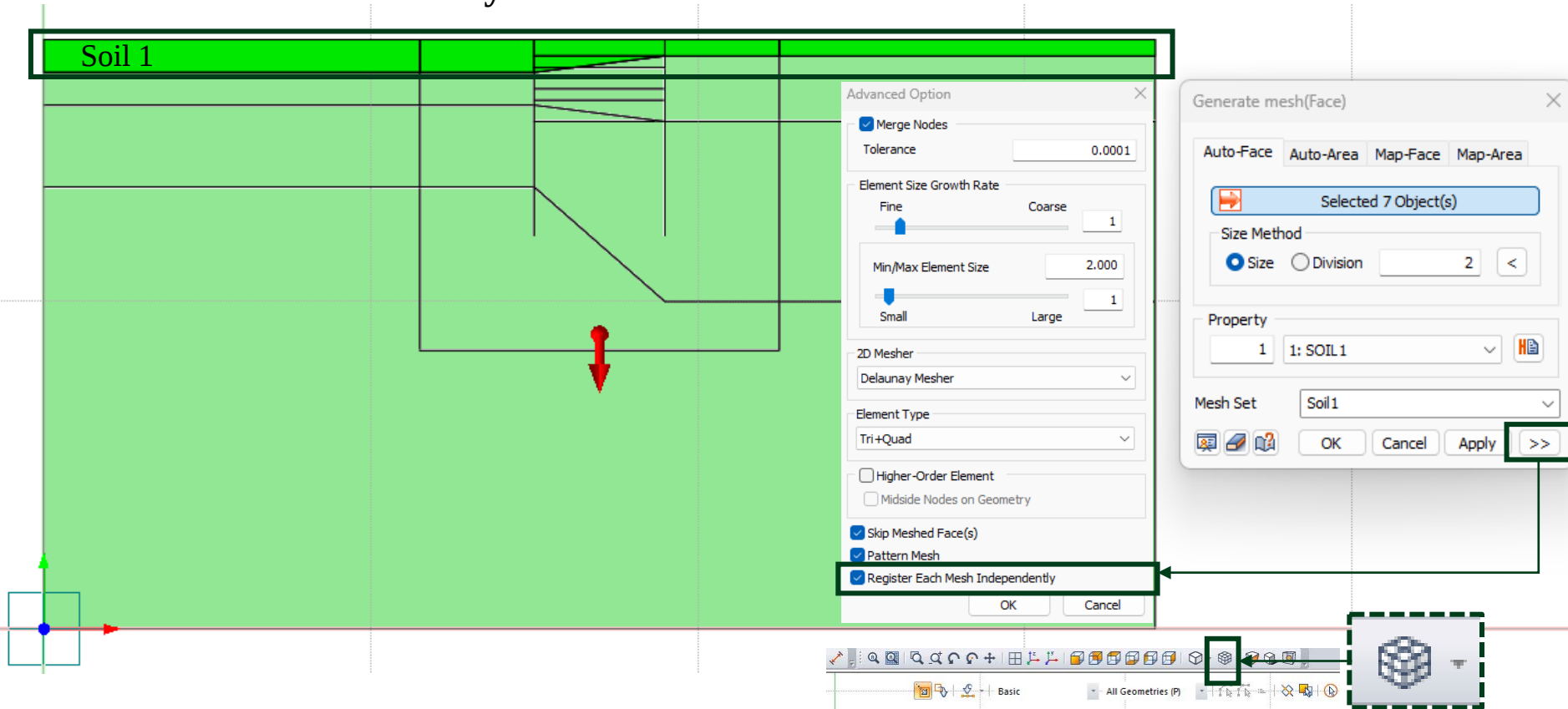
Mesh size control to increase the accuracy in plastic area



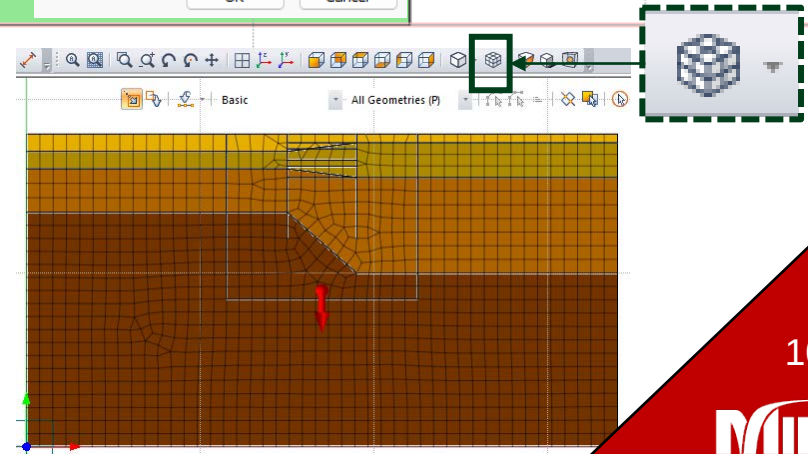
Mesh size of 0.5 m

MESH - GENERATE MESH

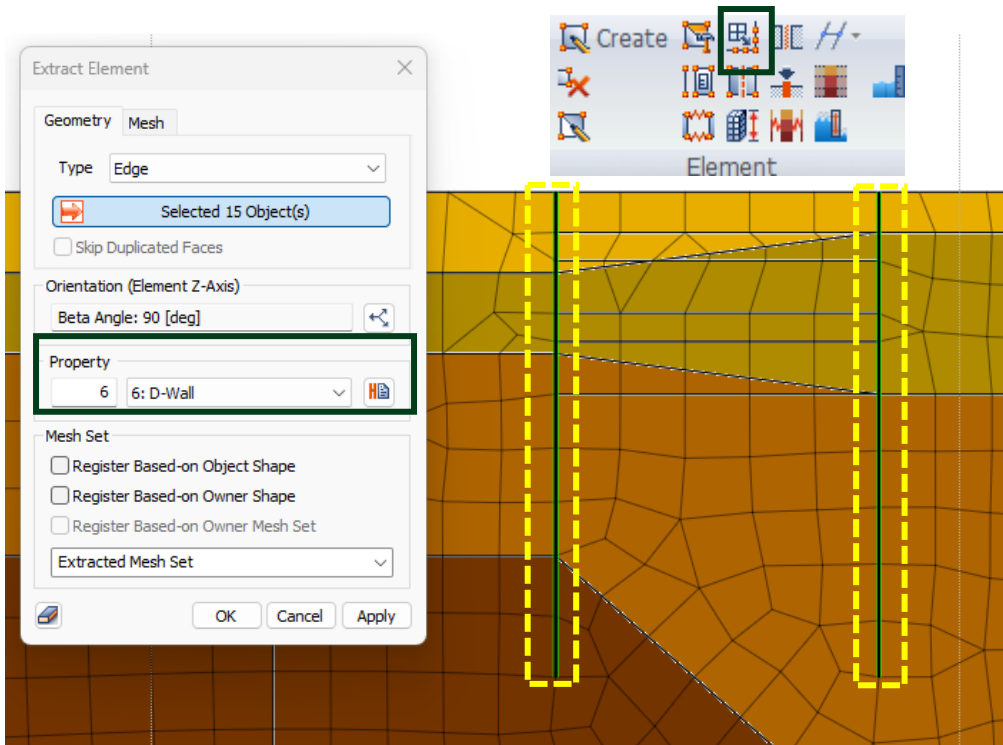
Generate mesh for soil layer 1



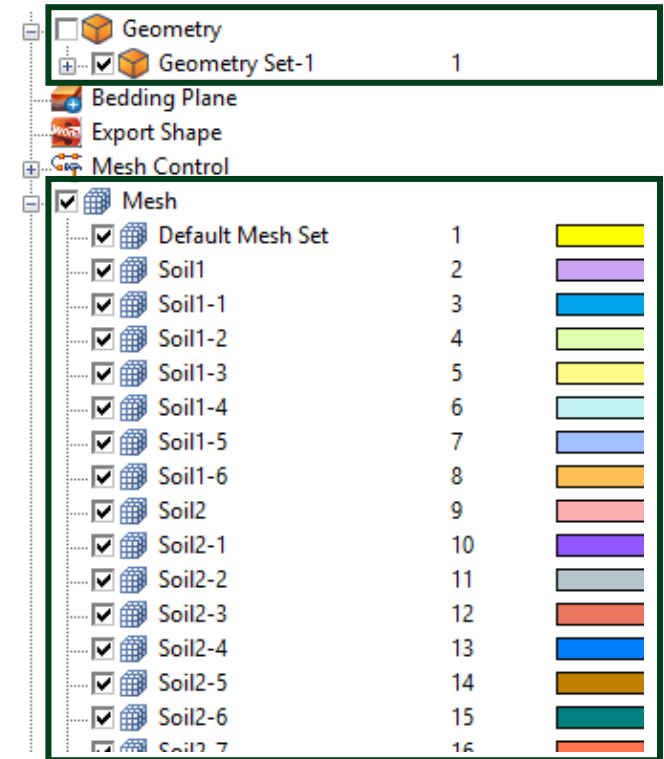
To show 'Property color'
Display Mode (Mesh) → Property color



MESH - EXTRACT ELEMENT

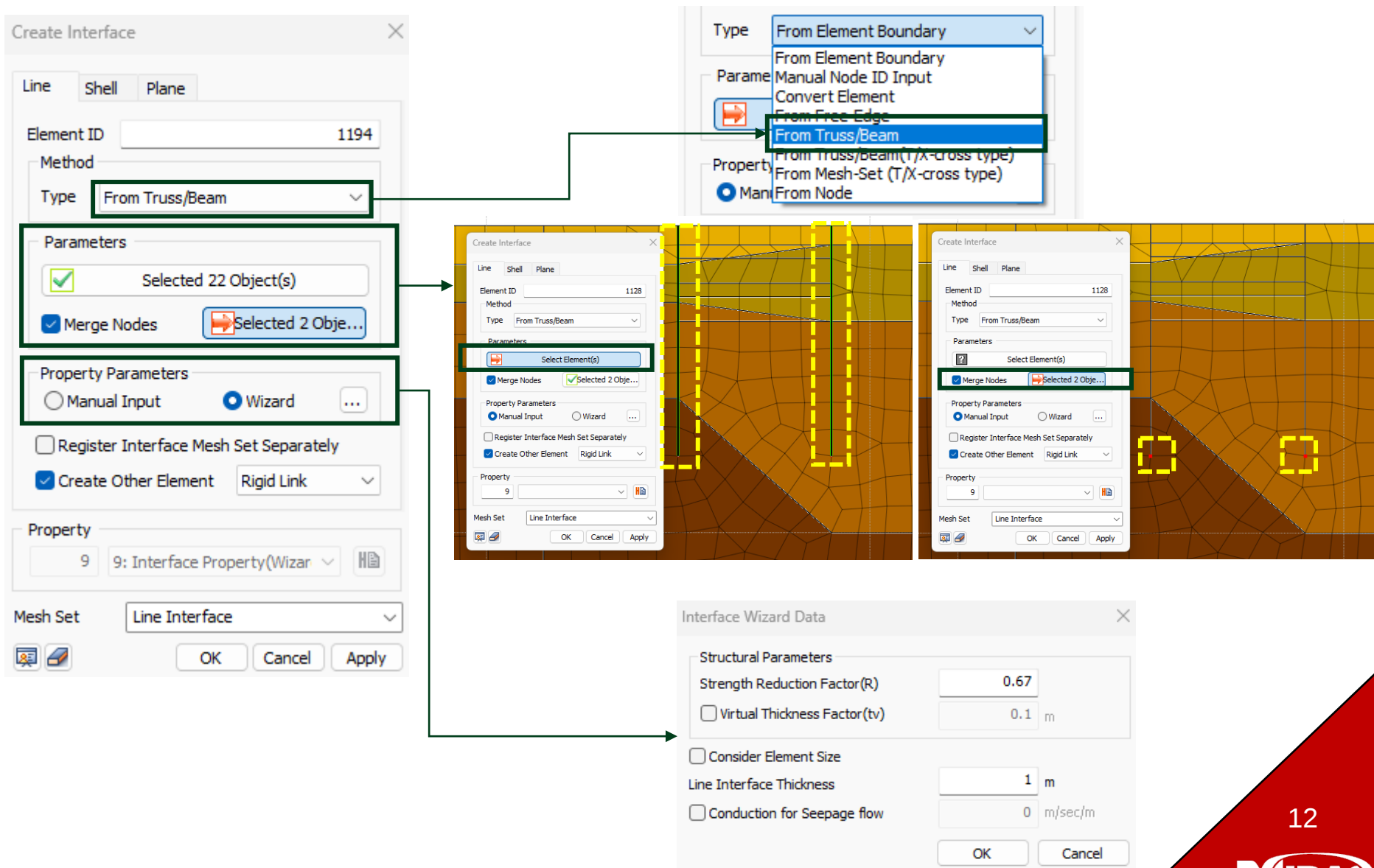


‘Extract elements’ for retaining wall



Note: By using the ‘Extract Elements’ function, it is needed to open geometry and corresponding mesh set

INTERFACE



INTERFACE WIZARD

Interface Wizard equation from Midas GTX NX manual

$$K_n = E_{\text{oed},i} / t_v$$

$$K_t = G_i / t_v$$

$$C_i = R \times C_{\text{soil}}$$

Here,

$$E_{\text{oed},i} = 2 \times G_i \times (1 - \nu_i) / (1 - 2 \times \nu_i)$$

$$G_i = R^2 \times G_{\text{soil}}$$

$$G_{\text{soil}} = E / (2(1 + \nu_{\text{soil}}))$$

Where:

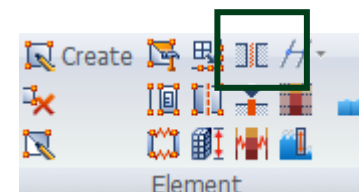
K_n : Normal Stiffness Modulus

K_t : Shear Stiffness Modulus

t_v : Virtual Thickness Factor

R: Strength Reduction Factor

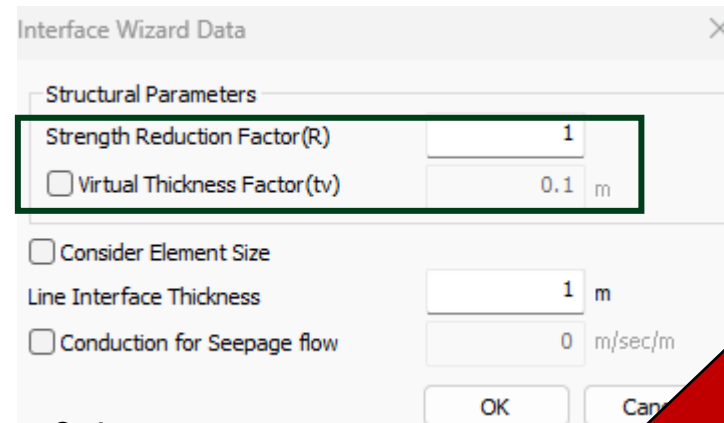
C_i : Interface Cohesion



Normal Stiffness Modulus (K_n) is the elasticity modulus for **bonding and un-bonding behavior** in the normal direction to the interface element

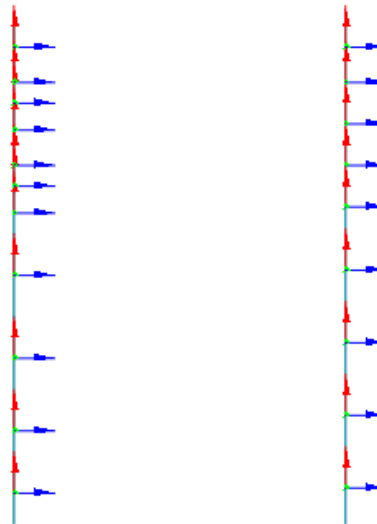
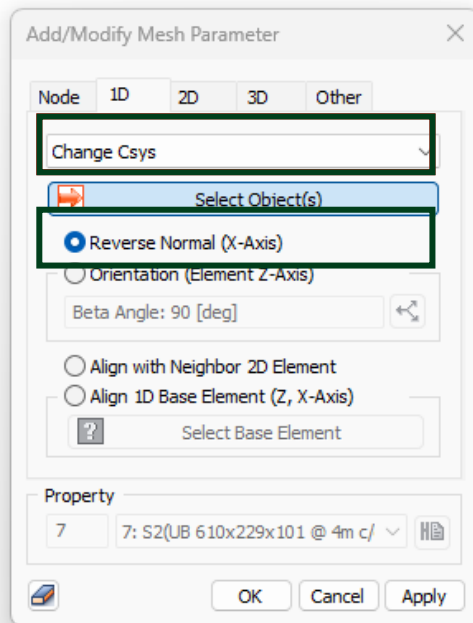
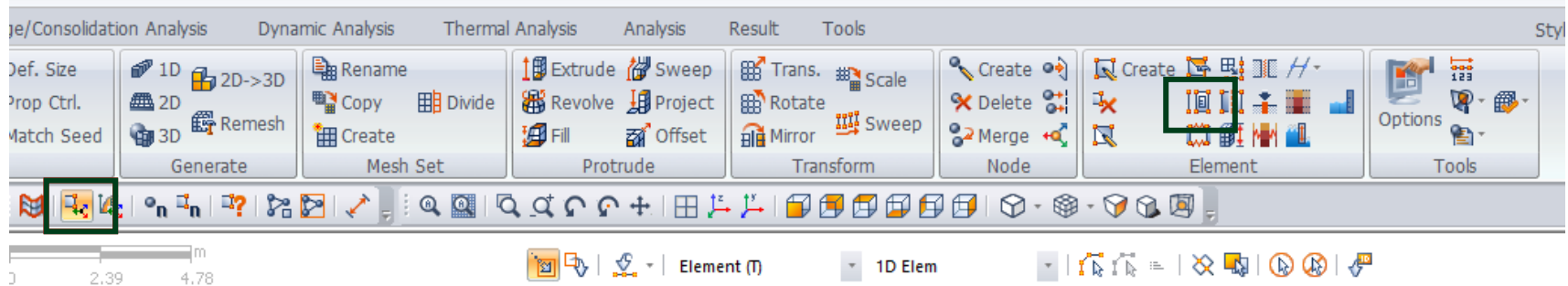
Shear stiffness modulus (K_t) is the elasticity modulus for **slip behavior** in the normal direction to the interface element

Strength Reduction Factor	R
Sandy Soil/Steel Material	0.6~0.7
Clay/ Steel Material	0.5
Sandy Soil/ Concrete	0.8~1.0
Clay / Concrete	0.7 ~ 1.0



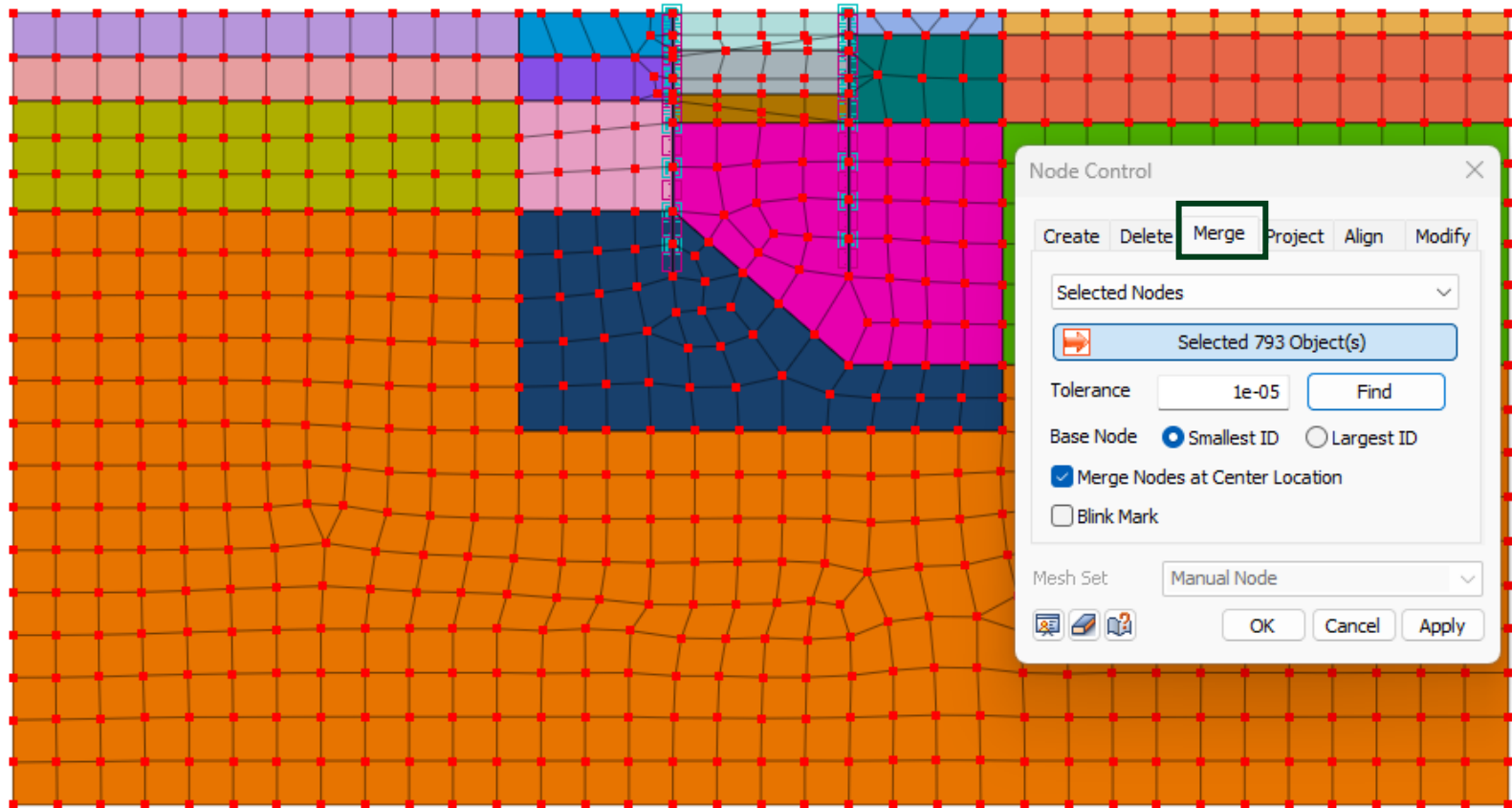
The general **Virtual Thickness Factor** range is **0.01 ~ 0.1**
(If the stiffness is high, use a smaller value)

LOCAL AXIS READJUSTMENT



Changing the axis of the local retaining wall axis

MERGE NODE

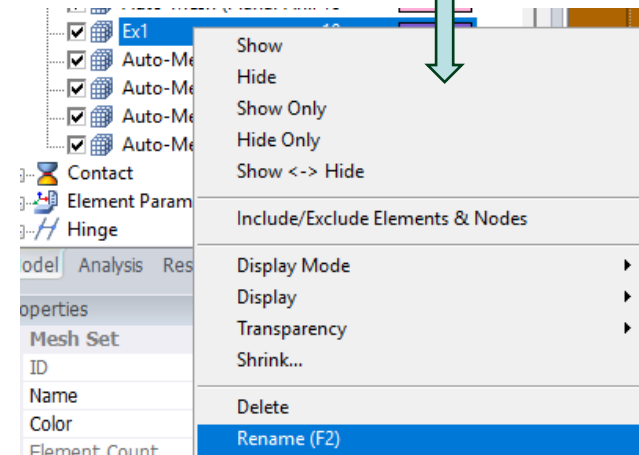
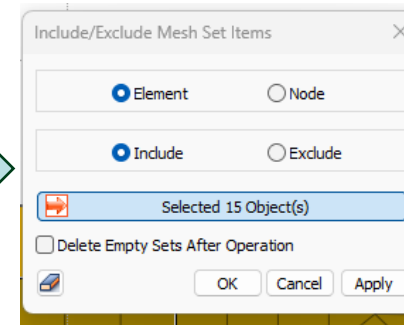
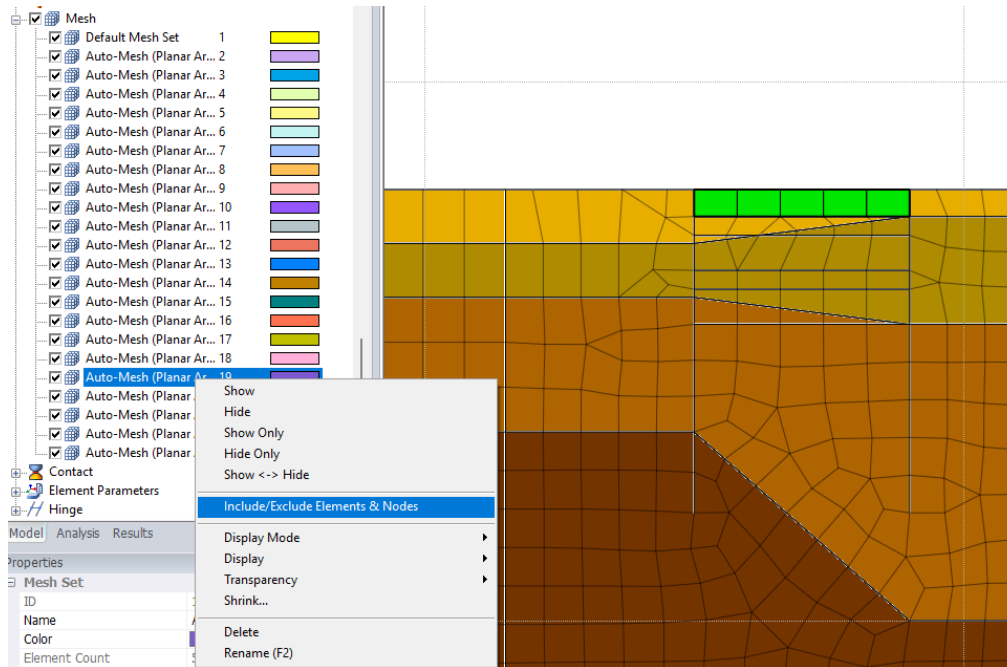


Checking the merge node function for interface

Selecting all nodes → Mesh → Node → Merge → Find

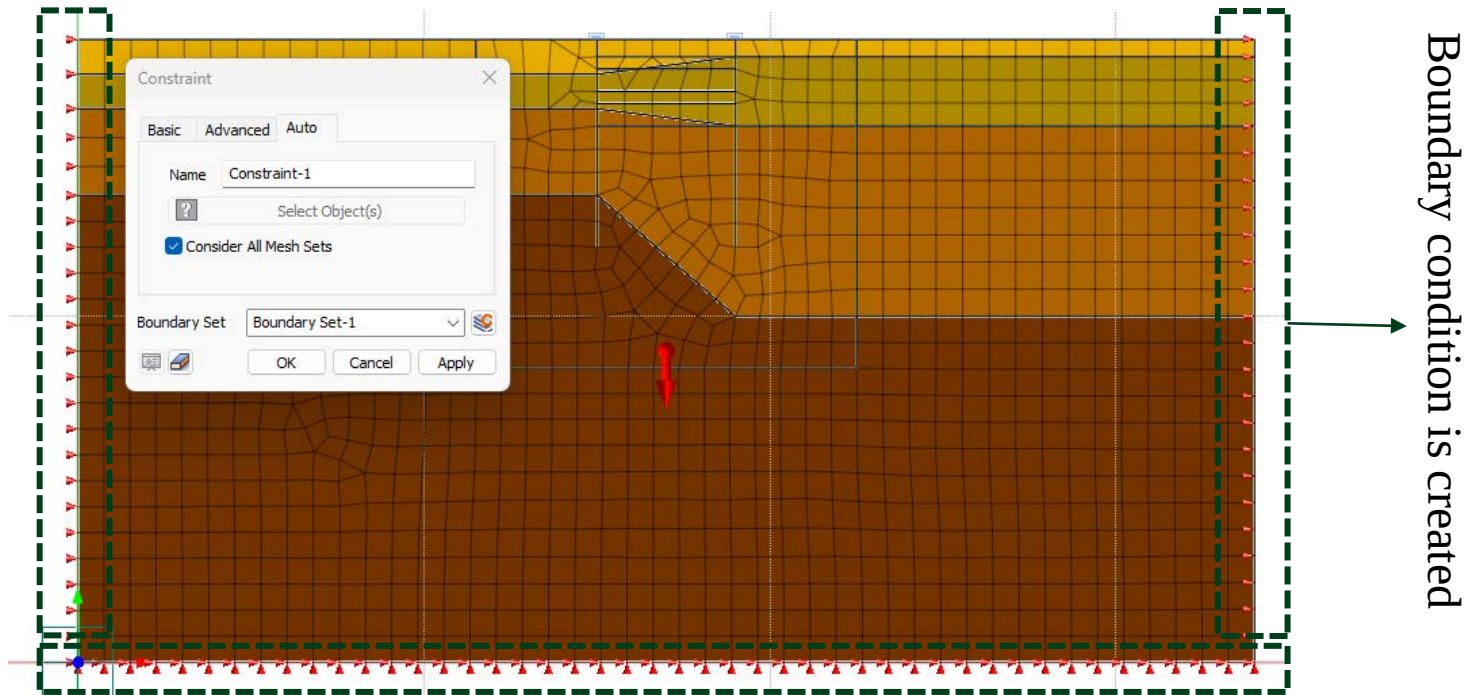
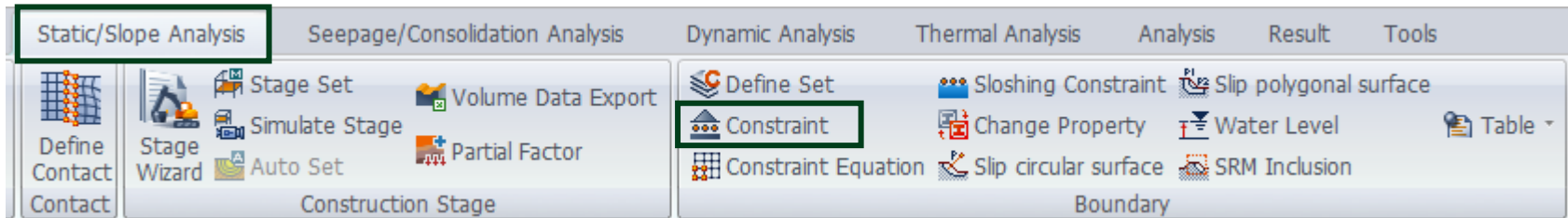
MESH GROUPING

Model Tree



NOTE: Step is generally done for organizing meshes

BOUNDARY CONDITION



NOTE: Automatic constraint creates a fix restrictions (restrained x and y axes) on the bottom part of soil model, and pin restriction on the sides (restrained y axis).

CONSTRUCTION STAGE

Construction Stage Set

Name: Excav

Stage Type: Stress

No	Name	Type
1	Excav	Stress

Buttons: Add, Modify, Copy, Delete, Define CS...

Define construction stage:

Stage Name → Set Data → Initial condition → Save → New

Define Construction Stage

Construction Stage Set Name: Excav-RW

Stage ID: 1: Initial

Stage Name: Initial

Stage Type: Stress

Buttons: Move to Previous, Move to Next, New, Insert, Delete

Set Data

- Mesh
- Default Mesh Set
- Ex1
- Ex2
- Ex3
- Line Interface
- RW
- Rigid Link Mesh
- Soil1
- Soil1-1
- Soil1-2
- Soil1-3
- Soil1-5
- Soil1-6
- Soil2
- Soil2-1
- Soil2-10
- Soil2-11
- Soil2-12
- Soil2-13
- Soil2-14
- Soil2-3
- Soil2-4
- Soil2-6
- Soil2-7
- Soil2-8
- Soil2-9

Activated Data

- Mesh
- Default Mesh Set
- Ex1
- Ex2
- Ex3
- Rigid Link Mesh
- Soil1
- Soil1-1
- Soil1-2
- Soil1-3
- Soil1-5
- Soil1-6
- Soil2
- Soil2-1
- Soil2-10
- Soil2-11
- Soil2-12
- Soil2-13
- Soil2-14
- Soil2-3
- Soil2-4
- Soil2-6
- Soil2-7
- Soil2-8
- Soil2-9
- Boundary Condition

Deactivated Data

- Mesh
- Boundary Condition
- Static Load
- Combined Load Sets
- Contact

Buttons: Analysis Control..., Output Control...

Initial Condition

☐ Define Water Level For Global

0 m None

☐ Define Water Level For Mesh Set

Input Water Level...

☐ Sub Stage...

☐ LDF... Copy To Specific Stage...

☒ Clear Displacement

☒ Clear Strain

☐ Slope Stability(SRM)

☐ Slope Stability(SAM)

Buttons: Save, Close

CONSTRUCTION STAGE 1

Define Construction Stage

Construction Stage Set Name: Excav-RW

Stage ID: 1: Initial
Stage Name: Initial
Stage Type: Stress

Buttons: Move to Previous, Move to Next, New, Insert, Delete

Set Data

- Mesh
 - Default Mesh Set
 - Ex1
 - Ex2
 - Ex3
 - Line Interface
 - RW
 - Rigid Link Mesh
 - Soil1
 - Soil1-1
 - Soil1-2
 - Soil1-3
 - Soil1-5
 - Soil1-6
 - Soil2
 - Soil2-1
 - Soil2-10
 - Soil2-11
 - Soil2-12
 - Soil2-13
 - Soil2-14
 - Soil2-3
 - Soil2-4
 - Soil2-6
 - Soil2-7
 - Soil2-8

Activated Data

- Mesh
 - Default Mesh Set
 - Ex1
 - Ex2
 - Ex3
 - Rigid Link Mesh
 - Soil1
 - Soil1-1
 - Soil1-2
 - Soil1-3
 - Soil1-5
 - Soil1-6
 - Soil2
 - Soil2-1
 - Soil2-10
 - Soil2-11
 - Soil2-12
 - Soil2-13
 - Soil2-14
 - Soil2-3
 - Soil2-4
 - Soil2-6
 - Soil2-7
 - Soil2-8
 - Soil2-9
- Boundary Condition

Deactivated Data

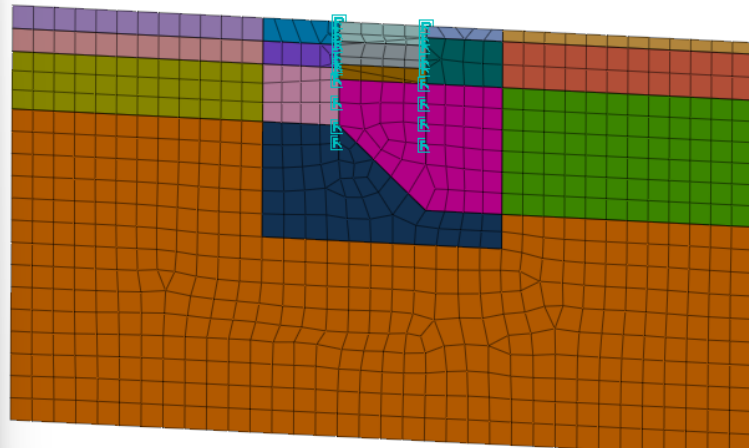
- Mesh
 - Boundary Condition
 - Static Load
 - Combined Load Sets
 - Contact

Initial Condition

- ☐ Define Water Level For Global
 - 0 m None
- ☐ Define Water Level For Mesh Set
 - Input Water Level...
- ☐ Sub Stage...
- ☐ LDF...
 - Copy To Specific Stage...
- ☒ Clear Displacement
 - ☒ Clear Strain
- ☐ Slope Stability(SRM)
- ☐ Slope Stability(SAM)

Buttons: Save, Close

Geometries (P)



Stage 1: Initial Conditions

CONSTRUCTION STAGE 2

Define Construction Stage

Construction Stage Set Name: Excav-RW

Stage ID: 2: RW
Stage Name: RW
Stage Type: Stress

Buttons: Move to Previous, Move to Next, New, Insert, Delete

Set Data

- Mesh
 - Default Mesh Set
 - Ex1
 - Ex2
 - Ex3
 - Line Interface
 - RW
 - Rigid Link Mesh
 - Soil1
 - Soil1-1
 - Soil1-2
 - Soil1-3
 - Soil1-5
 - Soil1-6
 - Soil2
 - Soil2-1
 - Soil2-10
 - Soil2-11
 - Soil2-12
 - Soil2-13
 - Soil2-14
 - Soil2-3
 - Soil2-4
 - Soil2-6
 - Soil2-7
 - Soil2-8

Activated Data

- Mesh
 - Line Interface
 - RW
 - Boundary Condition
 - Static Load
 - Combined Load Sets
 - Contact

Deactivated Data

- Mesh
 - Rigid Link Mesh
 - Boundary Condition
 - Static Load
 - Combined Load Sets
 - Contact

Initial Condition

- ☐ Define Water Level For Global
0 m None ...
- ☐ Define Water Level For Mesh Set
Input Water Level...

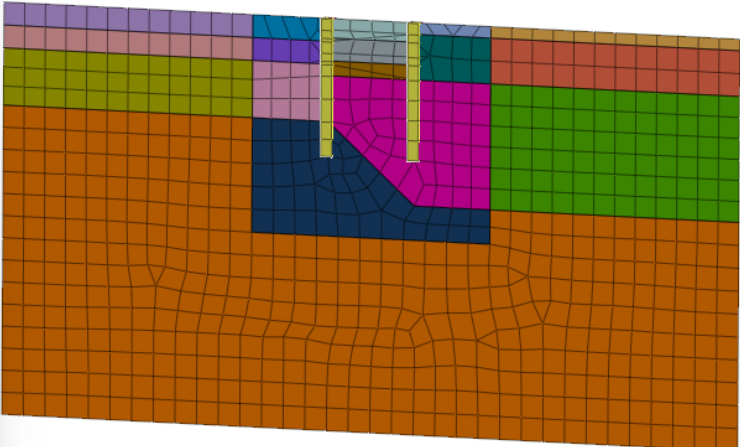
Sub Stage...

☐ LDF...

☐ Clear Displacement
☒ Clear Strain

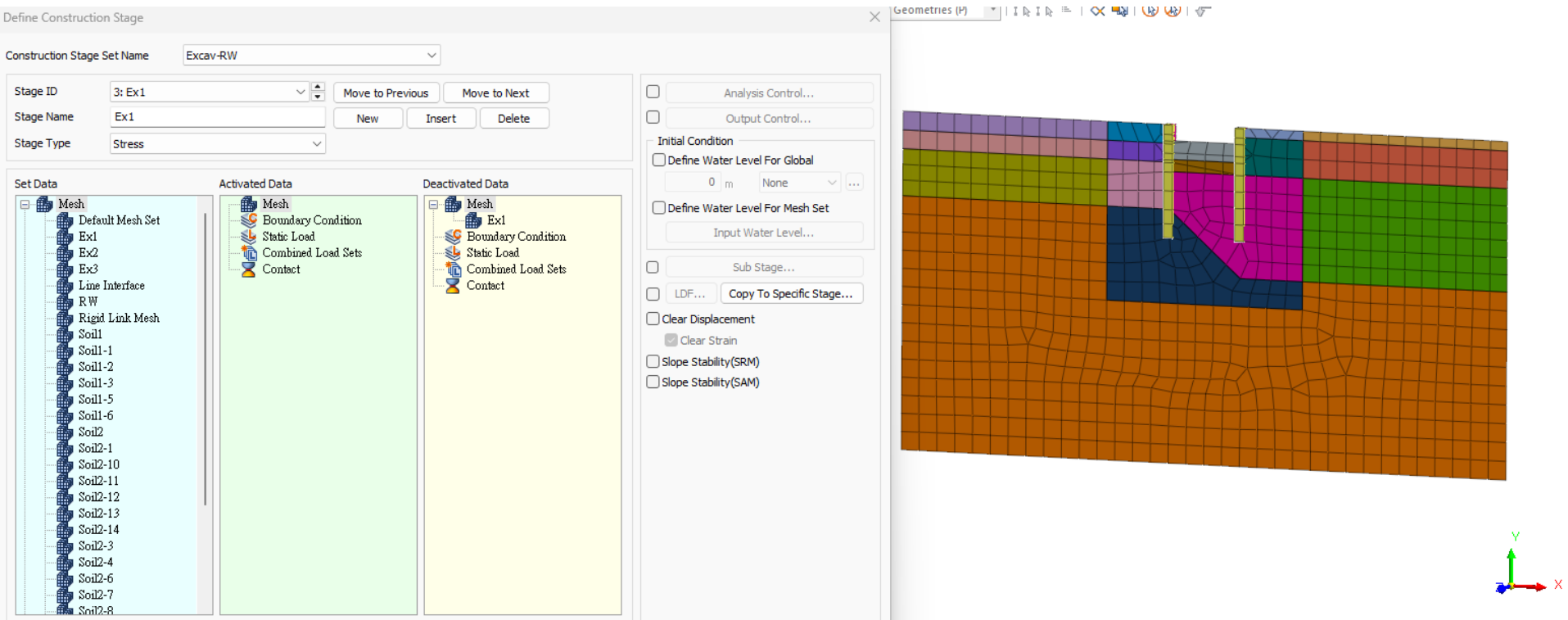
☐ Slope Stability (SRM)
☐ Slope Stability (SAM)

Geometries (PJ)



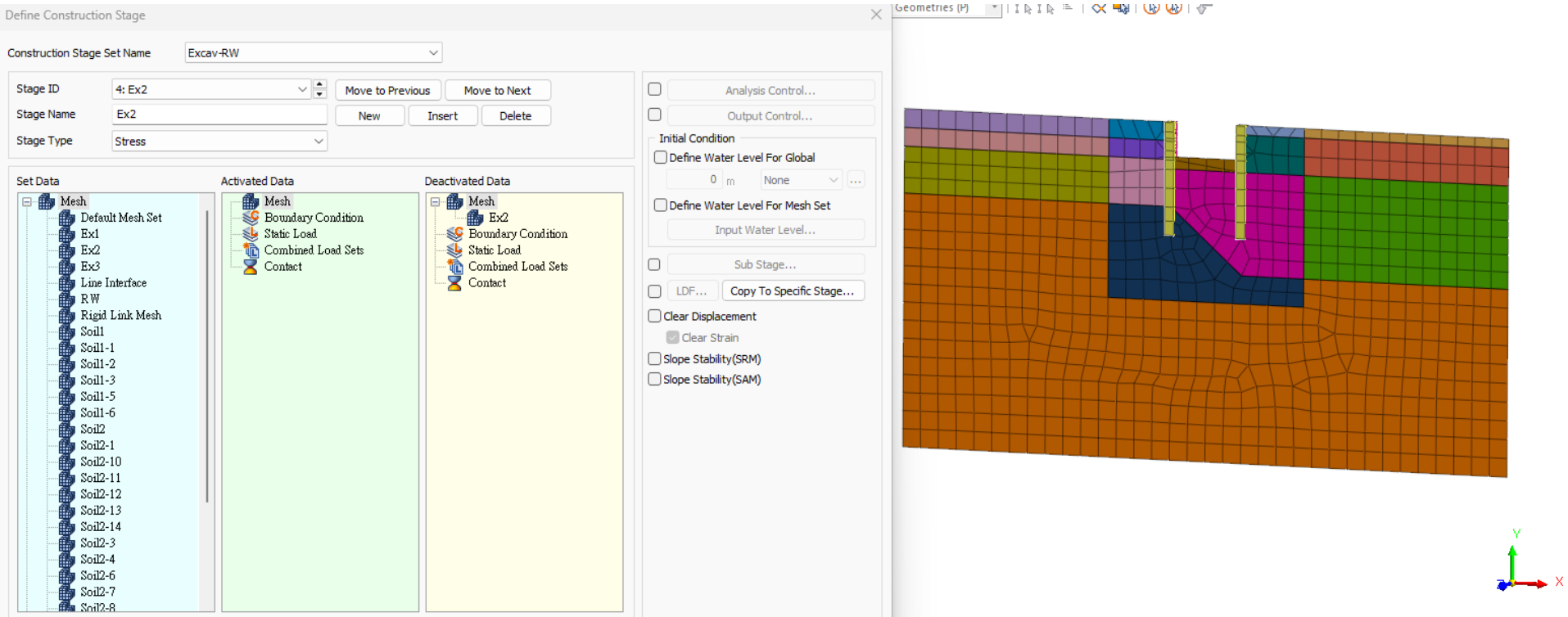
Stage 2: Retaining Wall

CONSTRUCTION STAGE 3



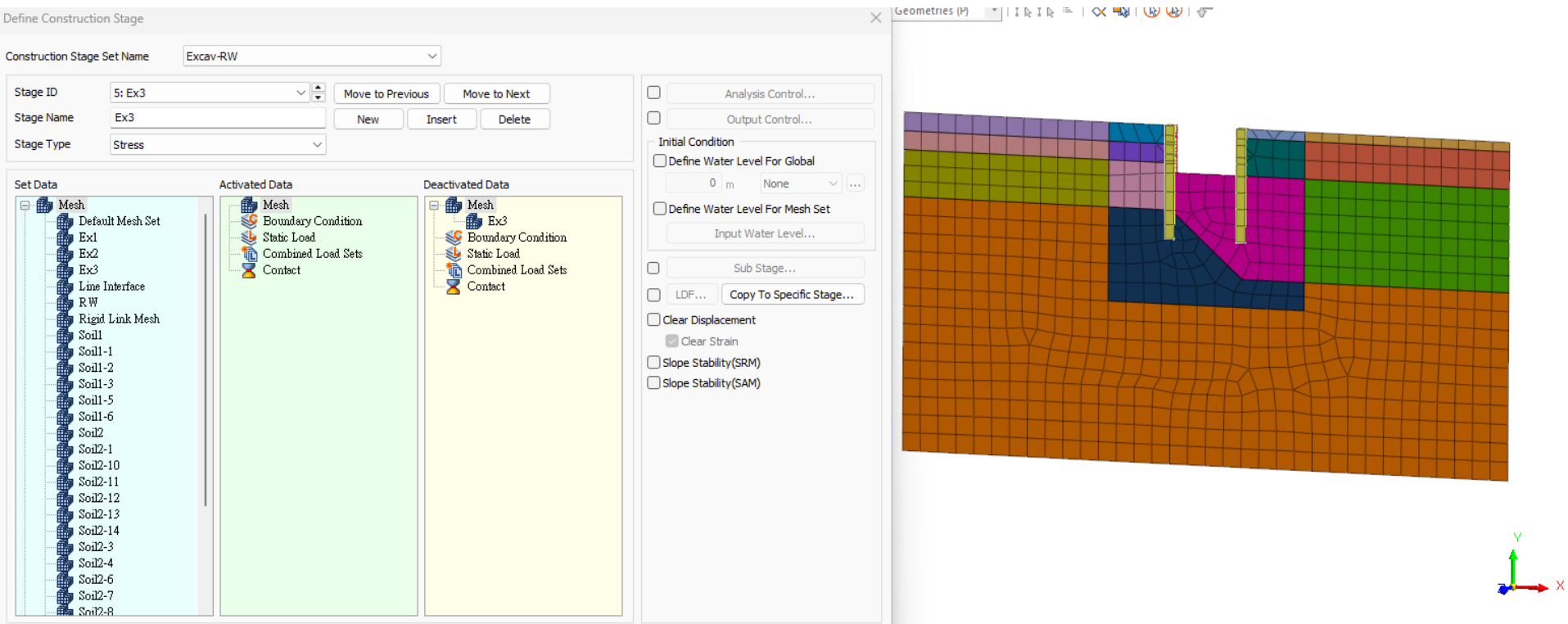
Stage 3: Excavation Layer 1

CONSTRUCTION STAGE 4



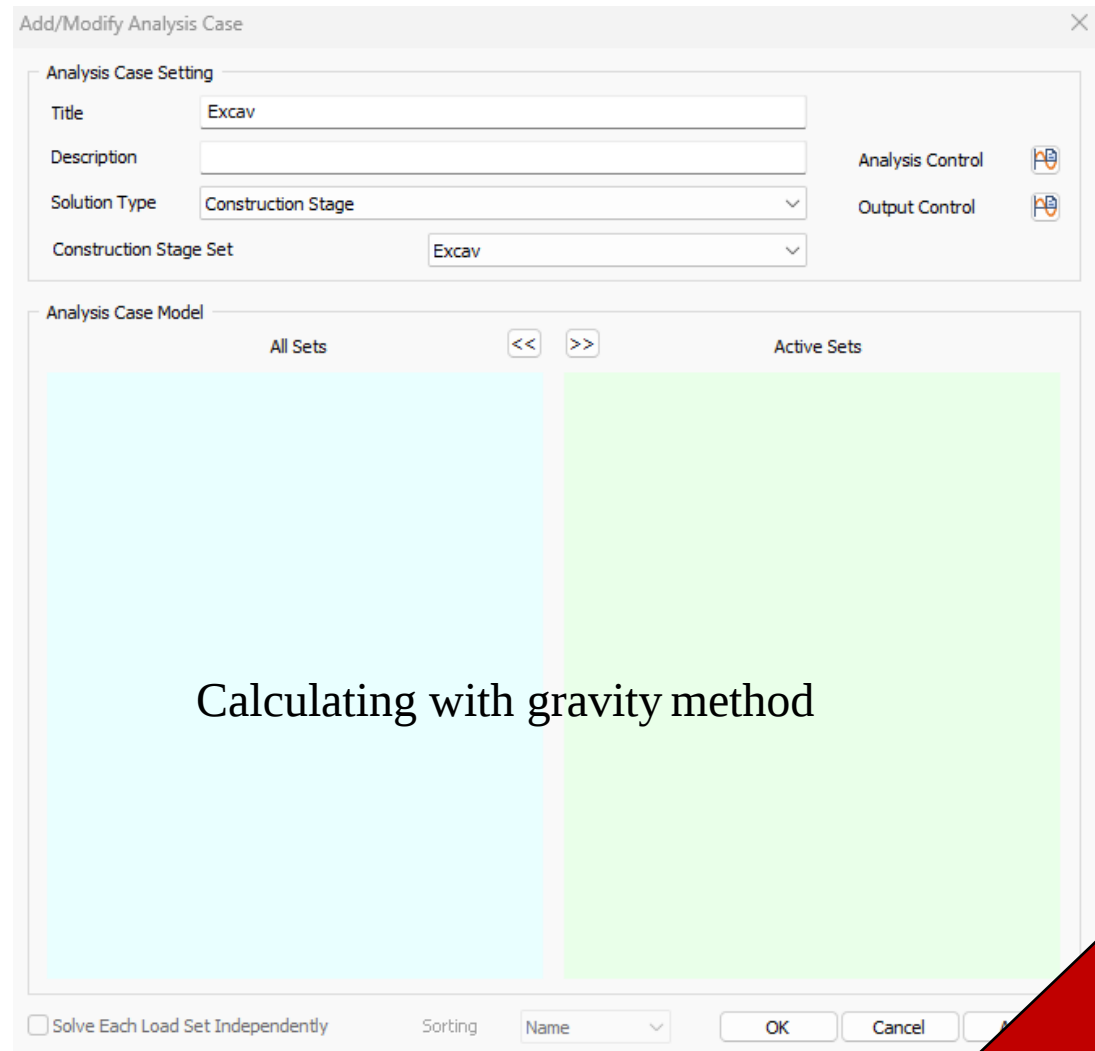
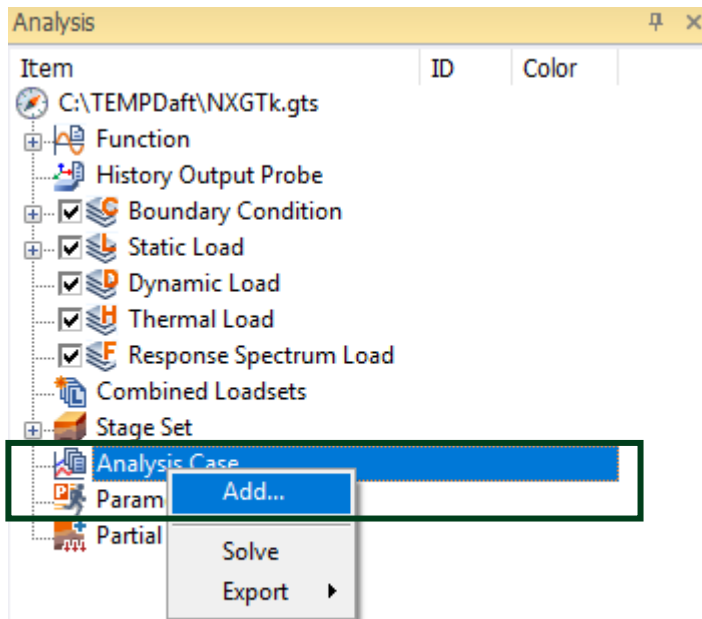
Stage 4: Excavation Layer 2

CONSTRUCTION STAGE 4

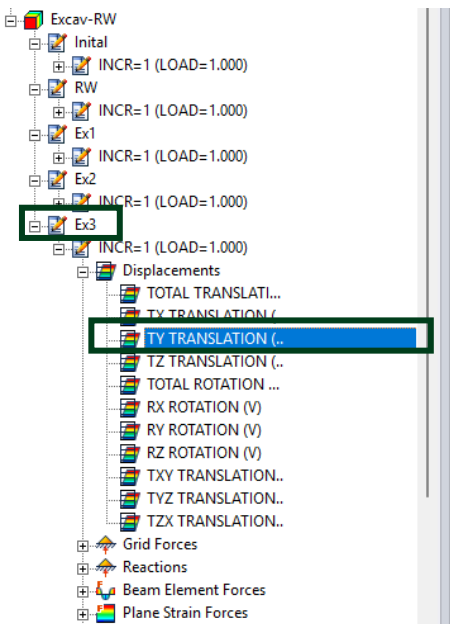


Stage 4: Excavation Layer 3

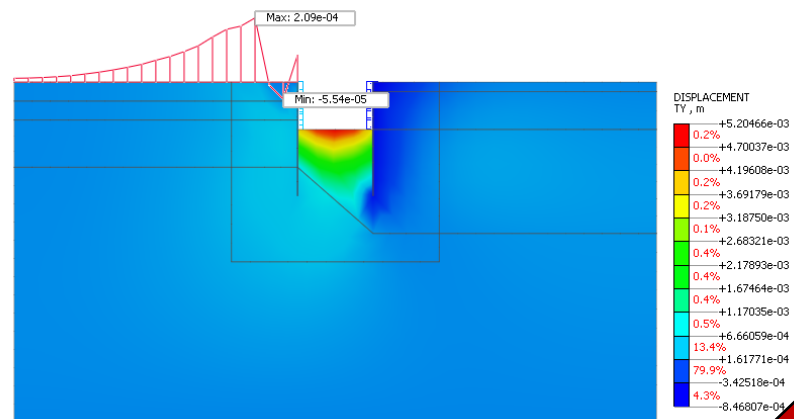
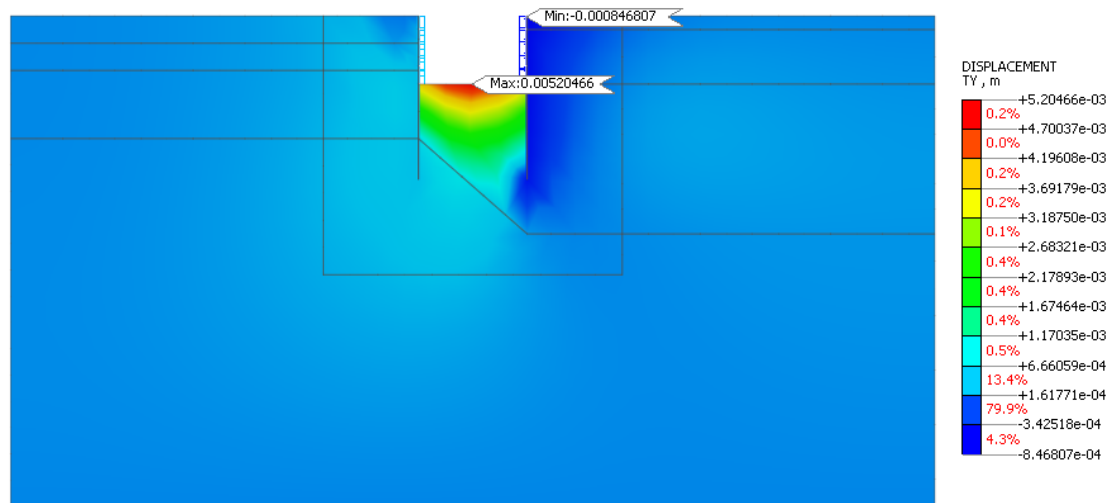
ANALYSIS CONTROL



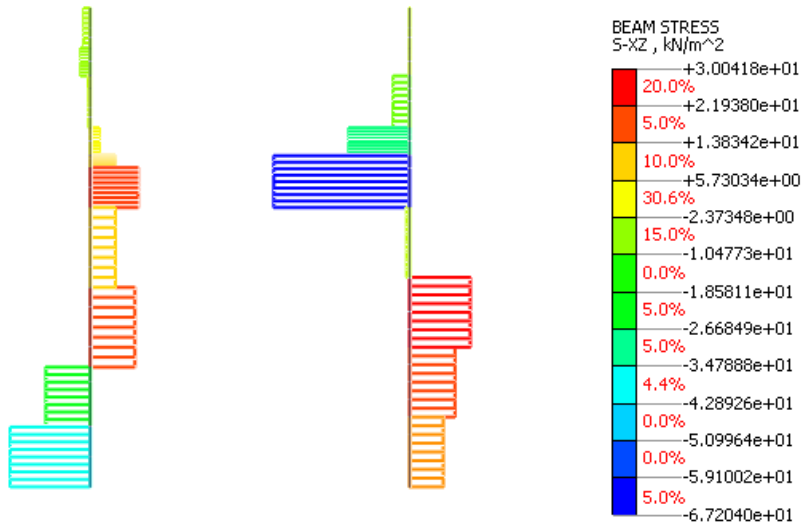
RESULT - VERTICAL DISPLACEMENT



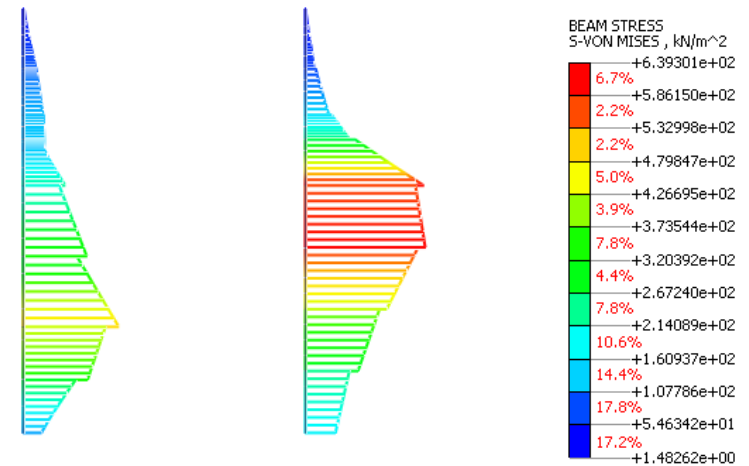
Result → Advanced → Cutting
Diagram



RESULT - BEAM STRESSES



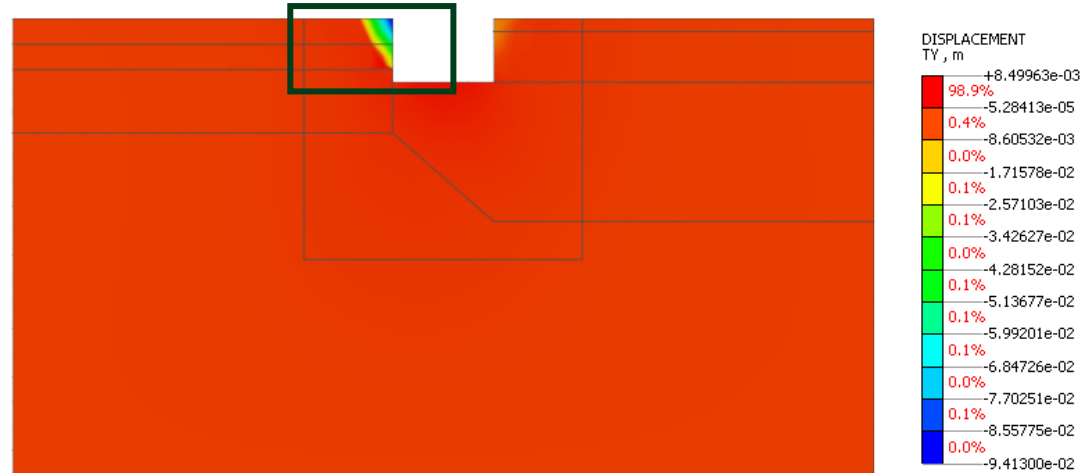
Shear force
Retaining Wall



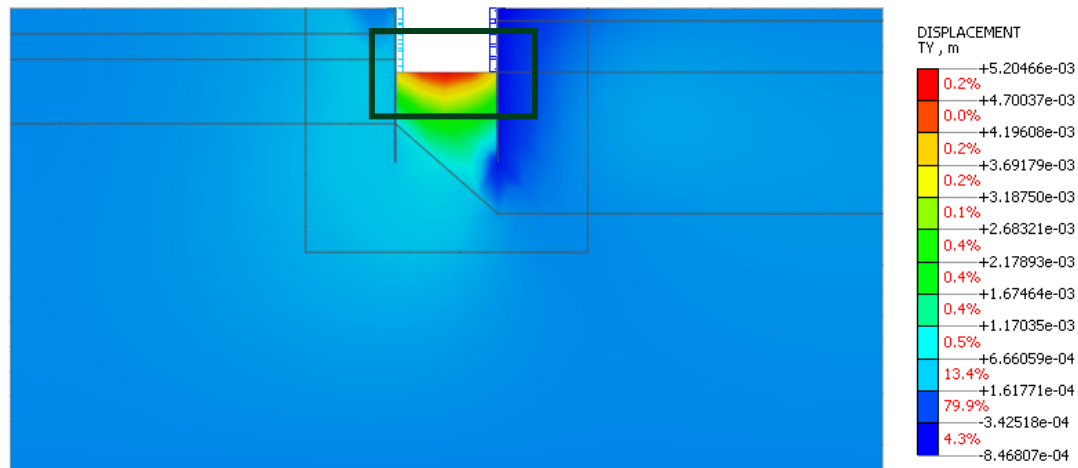
Bending moment
Retaining Wall

RESULT - COMPARISON

Total Displacement
Without RW



Total Displacement
With RW



The comparison highlights the effect of the Retaining Wall in the excavation model.

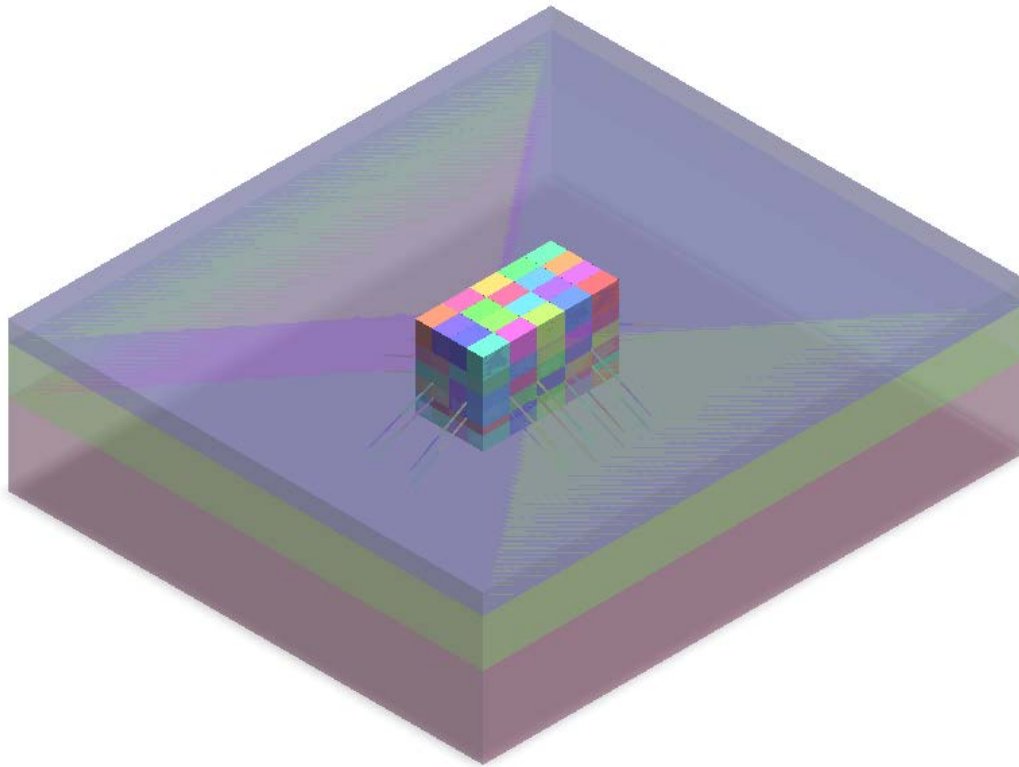


3D Excavation with Soil Retaining System

沈約翰

john@midasuser.com.tw

PROJECT CASE OVERVIEW



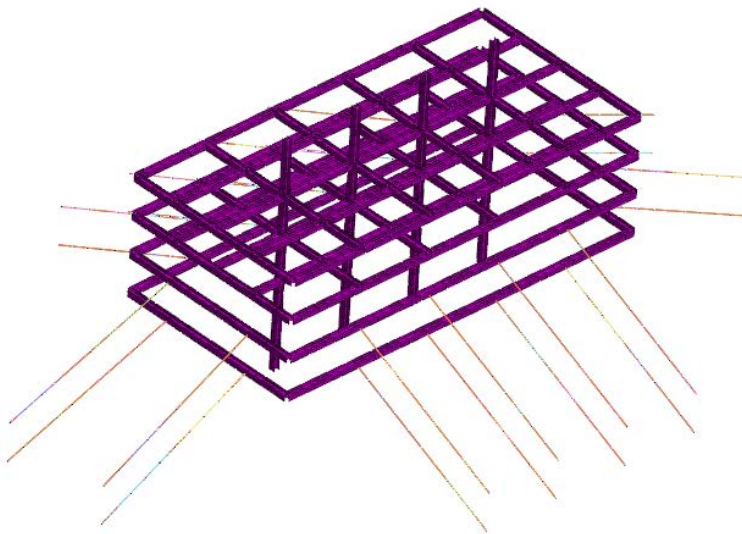
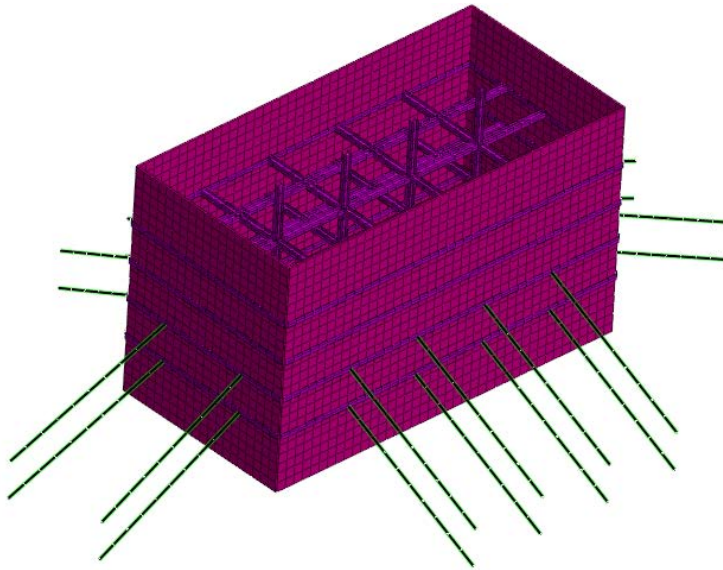
Project Overview

Rectangular Excavation : 10 x 20m
Depth: 12m

Soil Property	Depth (m)
Buried Layer	0 - 3
Colluvium	3 - 7
Weathering Soil	7 - 12

PROJECT CASE OVERVIEW

Structural Support Overview



Element	Details
Retaining Wall	All throughout the excavation faces
King Post	4 pieces; Laid along the centerline of the longitudinal distance
Prestressed Anchors	8 pieces per longitudinal face; 4 pieces per transverse face
Braces	4 sets starting from the first excavation layer
Struts	2 sets starting from the first excavation layer

DESIGN FLOW

Pre-Processes

1. Geometry / Model setup
2. Material and Properties
3. Boundary Conditions
4. Mesh Generation
 - Geotechnical elements
 - Structural elements

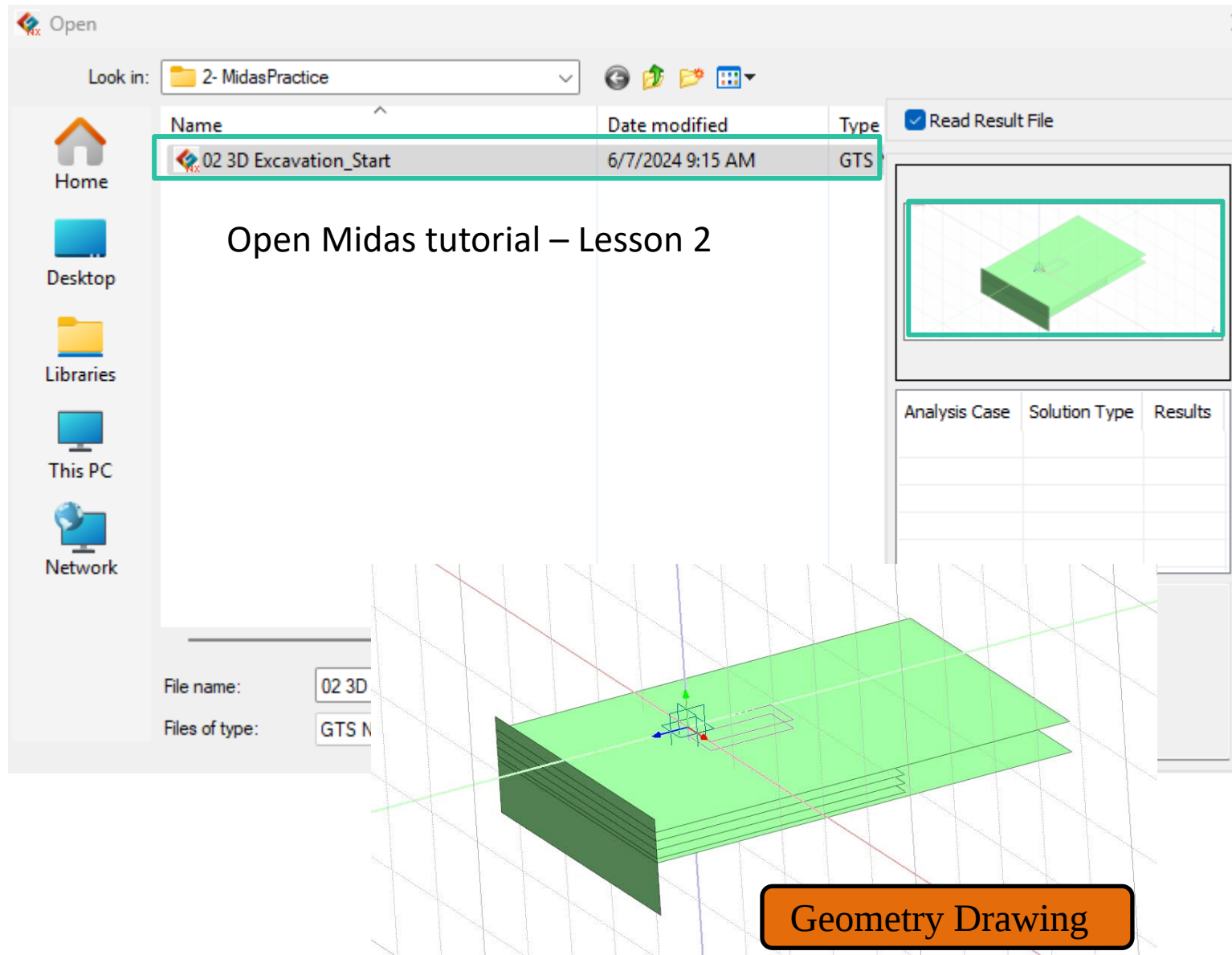
Solving

1. Analysis Case
 - Linear
 - Non Linear
 - Construction Stage
 - Slope Stability
 - Etc.
2. Stage Sets
3. Analysis Control Settings
 - Dynamic settings
 - Thermal settings
 - Age settings
 - Etc.

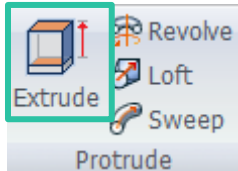
Post-Processes

1. Data Validation
2. Result Interpretation
3. Analysis Presentation
 - Graphs
 - Contour plots
 - Animations
4. Data Exports
 - Data Transfer
 - System Integration

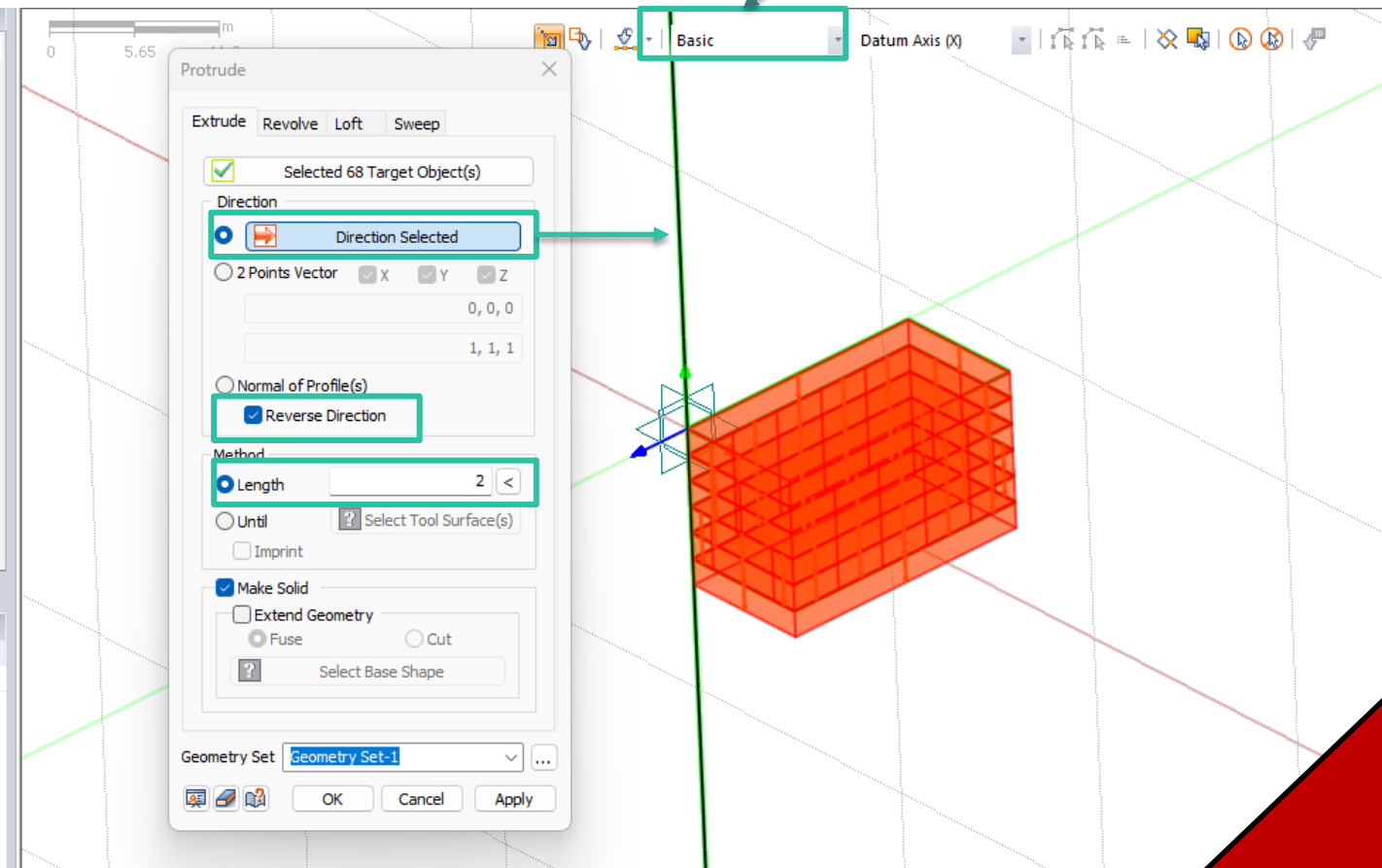
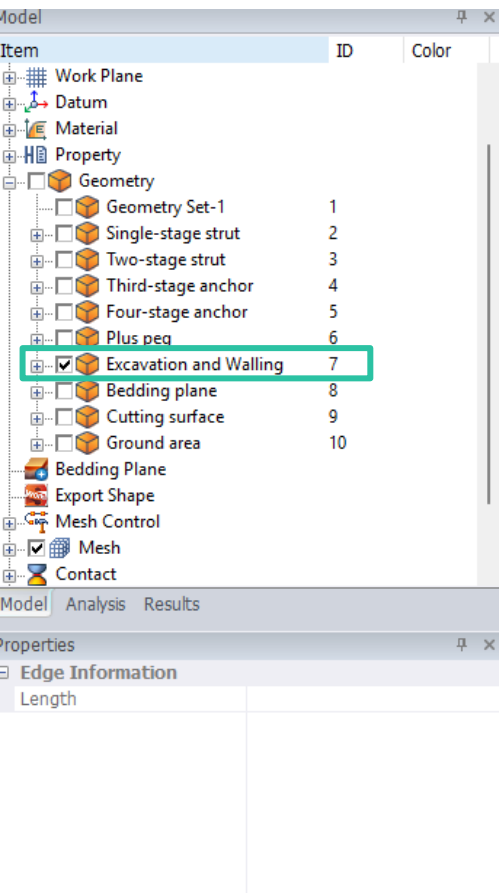
3D MODEL IMPORT



GEOMETRY MODELING

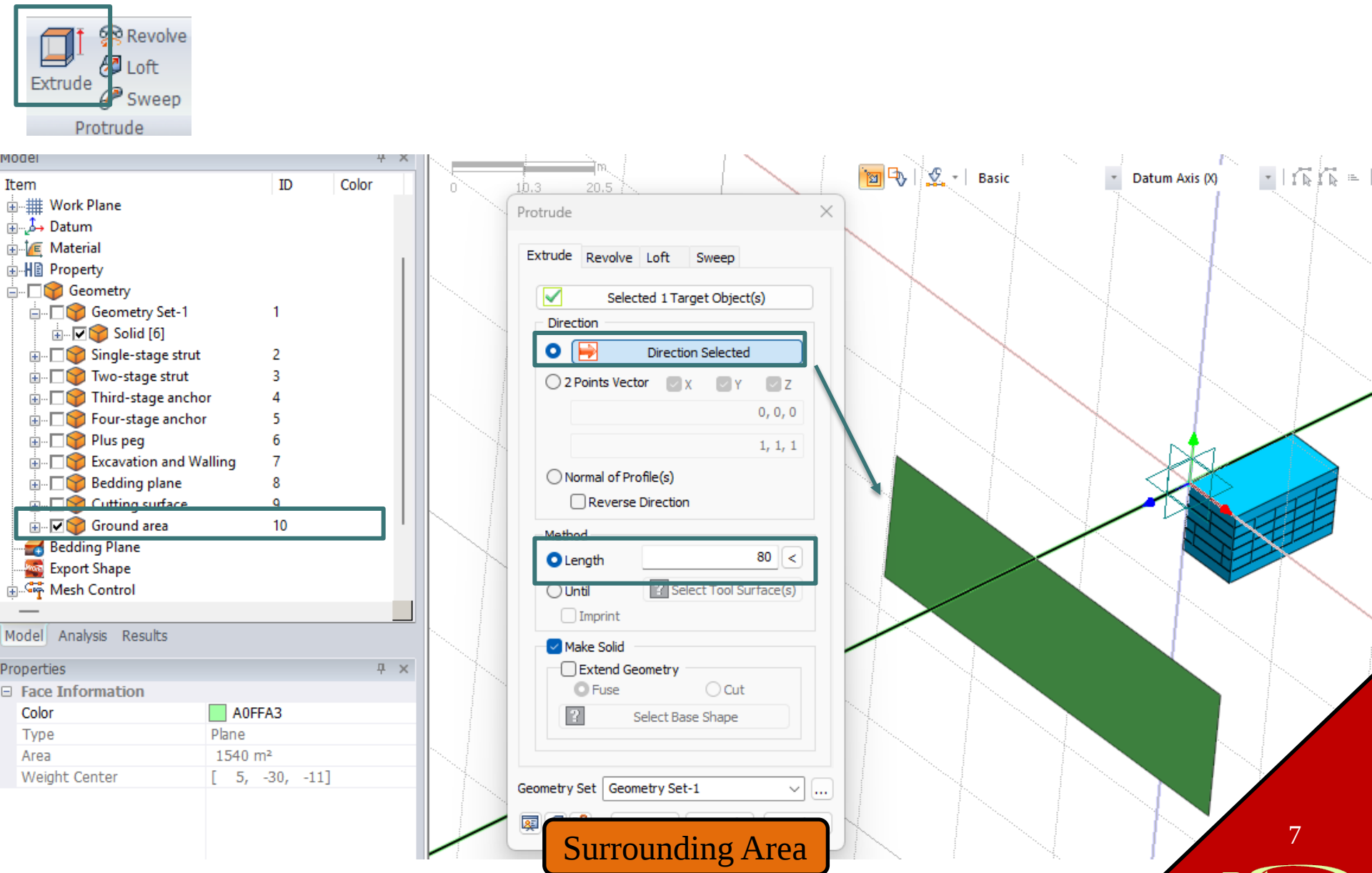


Change into 'Edge', then 'Select All'

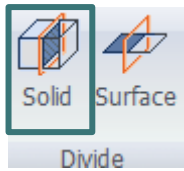


Excavation Area

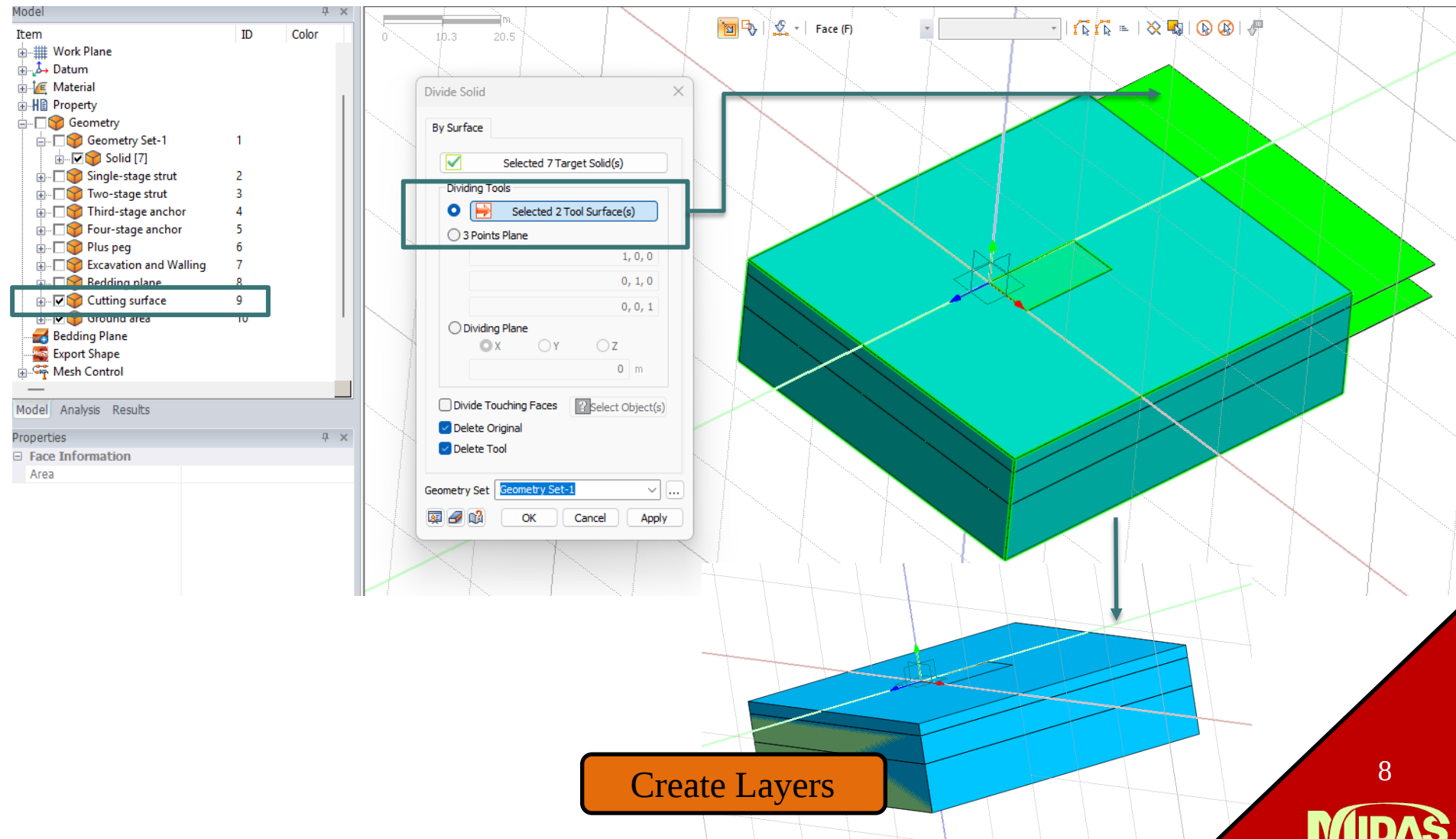
GEOMETRY MODELING



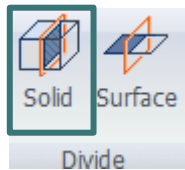
GEOMETRY MODELING



Divide Solid Function creates partition for the soil model



GEOMETRY MODELING



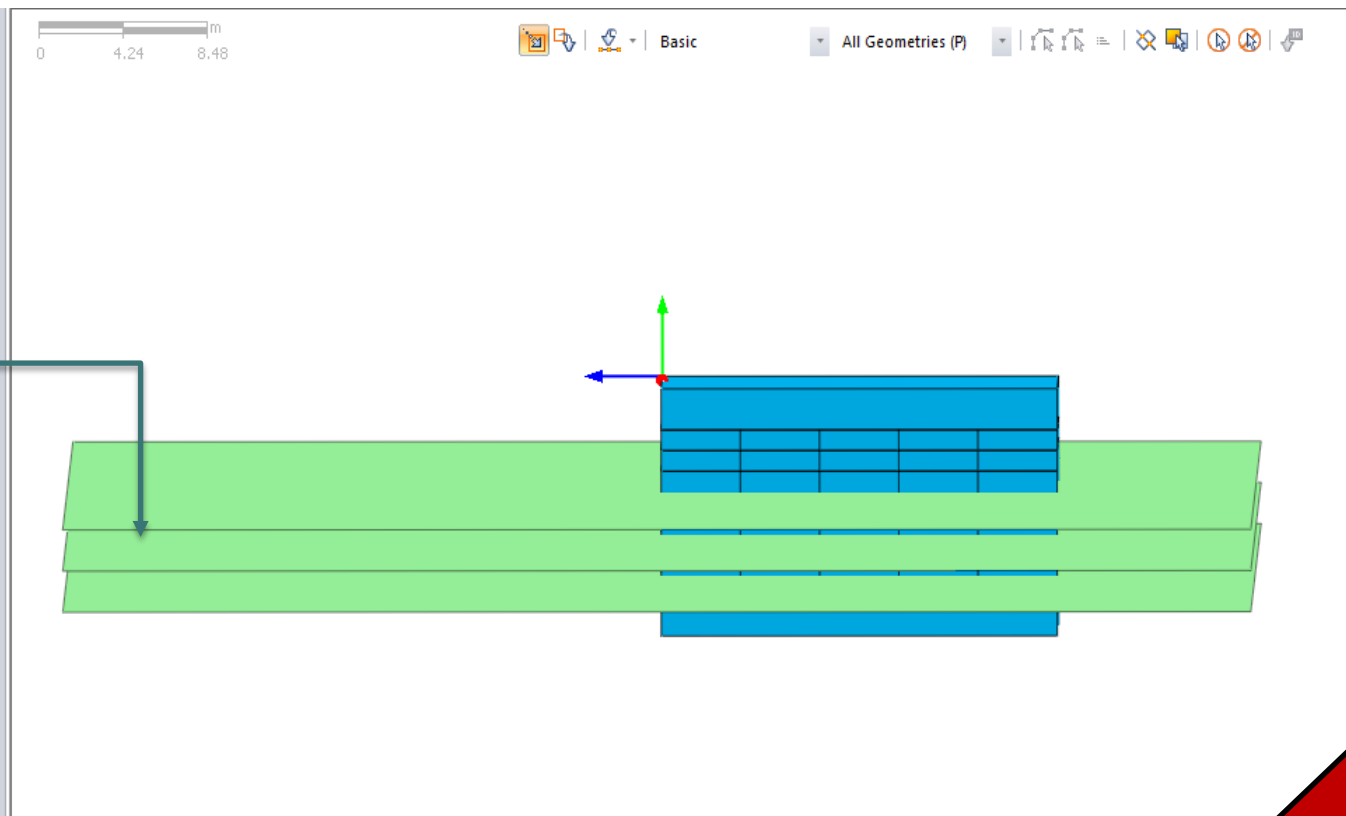
Model

Item	ID	Color
☒ Extrude	158	
☐ Extrude(1)	160	
☒ Extrude(2)	161	
☐ Extrude(3)	162	
☐ Extrude(2)	163	
☐ Single-stage strut	2	
☐ Two-stage strut	3	
☐ Third-stage anchor	4	
☐ Four-stage anchor	5	
☐ Plus peg	6	
☐ Excavation and Walling	7	
☒ Bedding plane	8	
☐ Cutting surface	9	
☐ Ground area	10	
Bedding Plane		
Export Shape		
☐ Mesh Control		
☒ Mesh		
☐ Contact		

Model Analysis Results

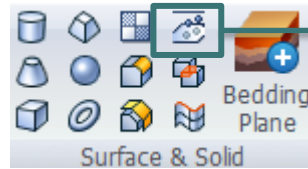
Properties

Name	
ID	154
Name	Extrude
Color	00BFFF
Volume	400 m³

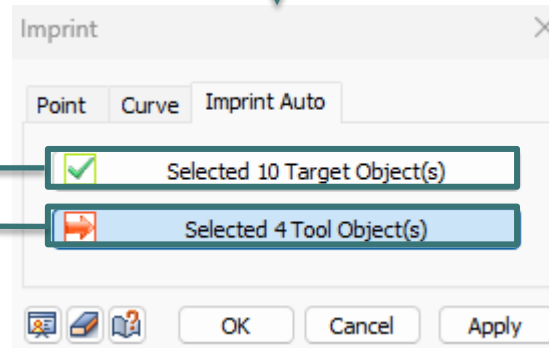


Bedding Plane

GEOMETRY MODELING

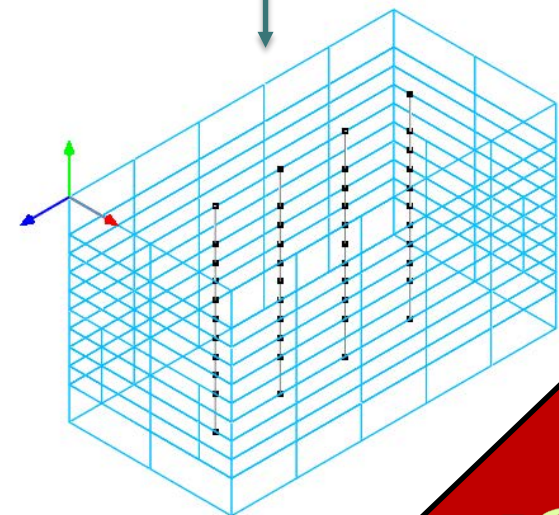
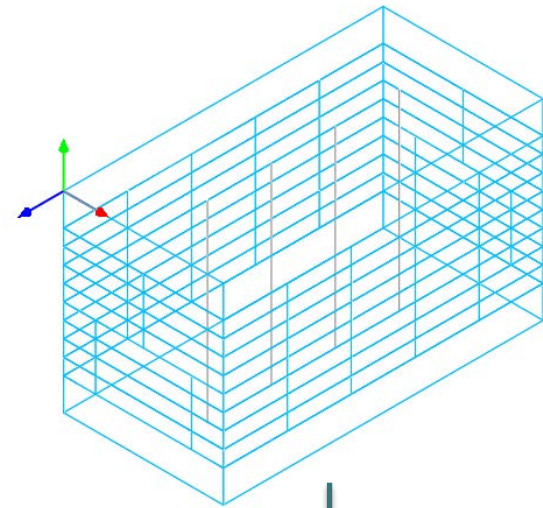


Excavation Area
Plug Pegs

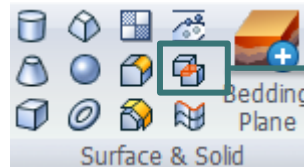
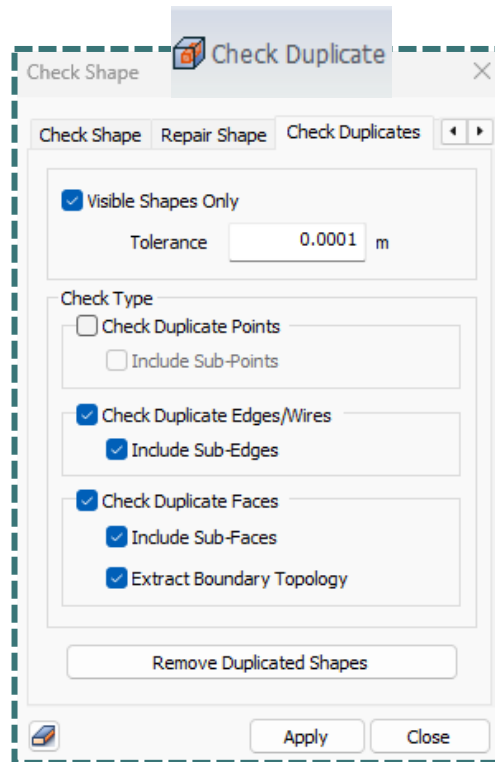


Imprint Function projects edges (pegs) onto another face

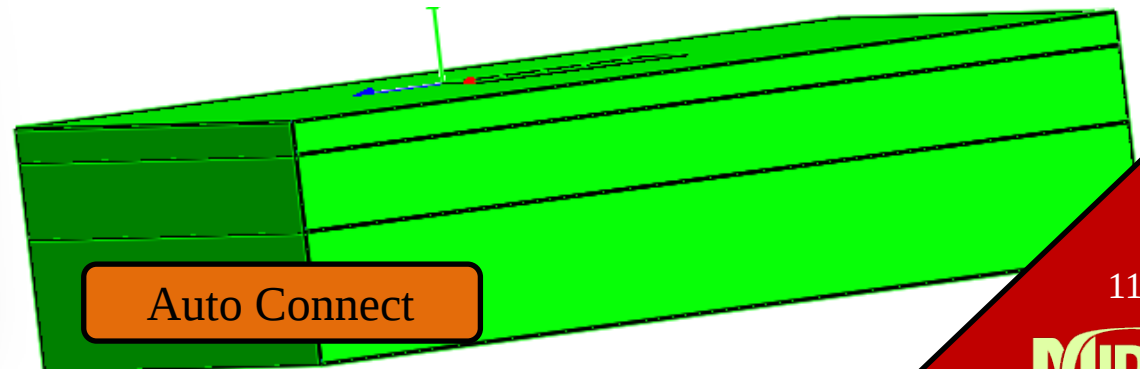
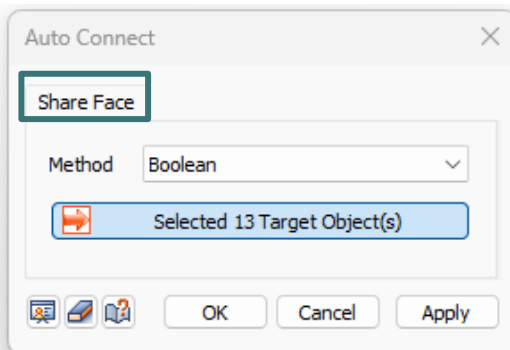
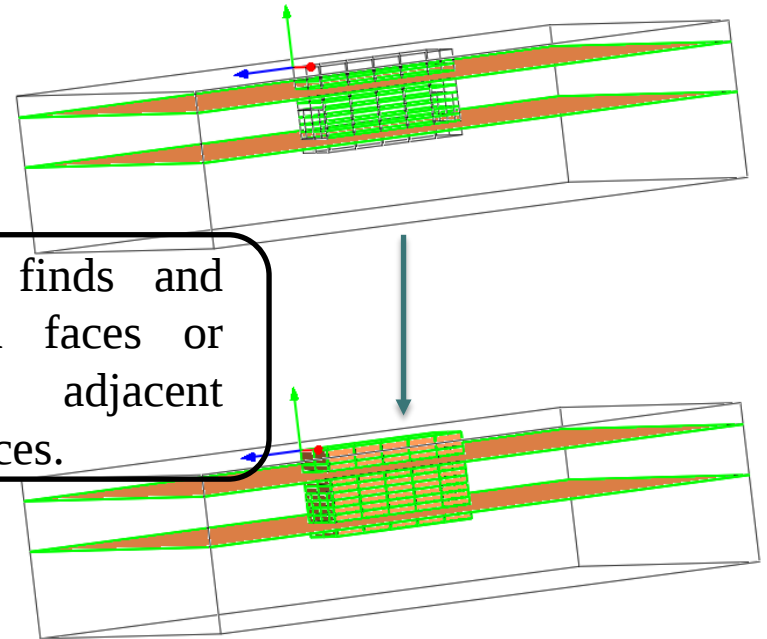
Imprint



GEOMETRY MODELING



Auto Connect finds and connects shared faces or edges between adjacent volumes or surfaces.



Auto Connect

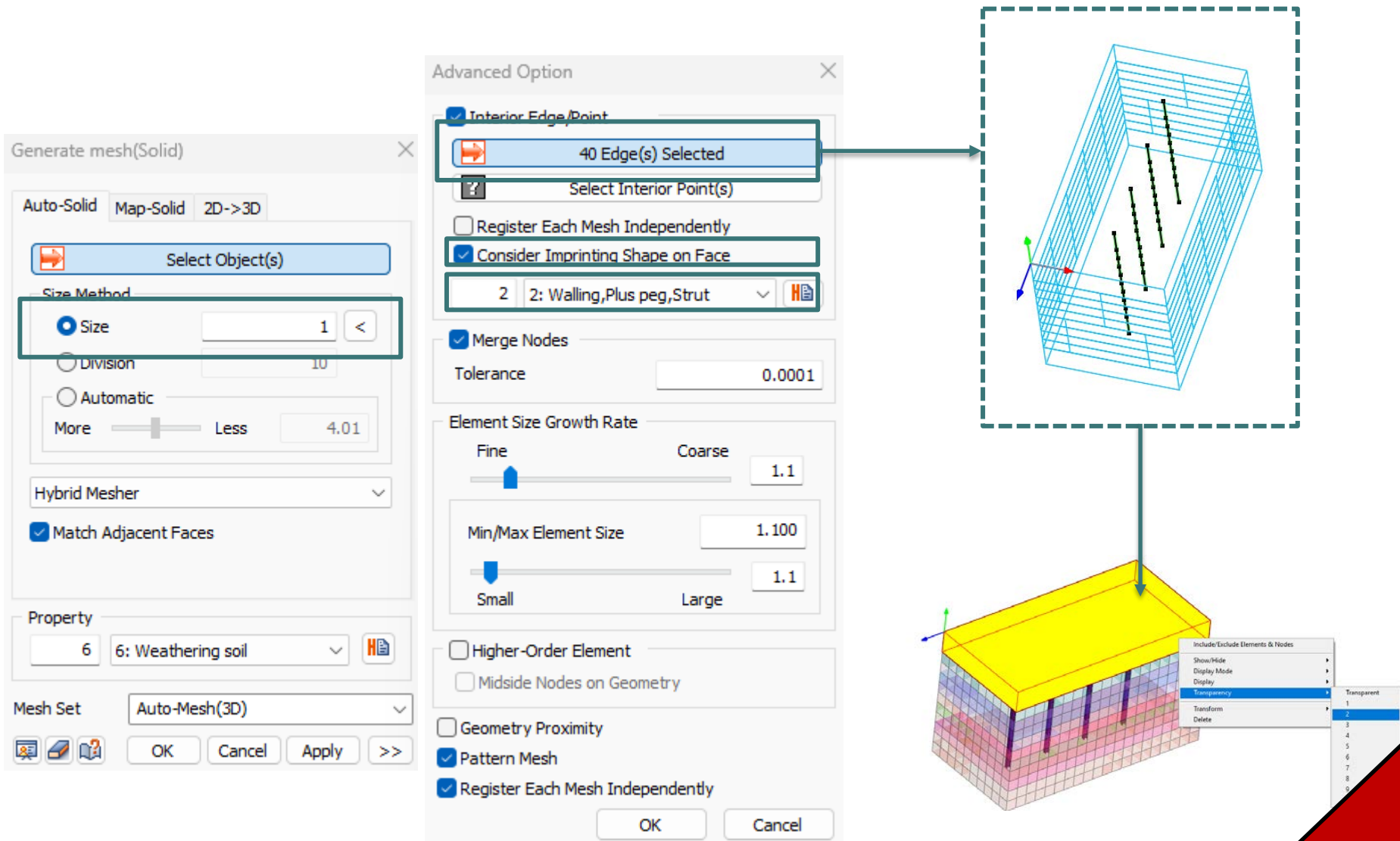
PROPERTIES - SOIL MATERIAL

Name	Buried layer	Colluvium	Weathering soil
Material	Isotropic	Isotropic	Isotropic
Model Type	Hardening Soil	Hardening Soil	Hardening Soil
Poisson's Ratio	0.333	0.306	0.384
Unit Weight	16	17	20
K0	0.5	0.441	0.74
Unit Weight (Saturated)	20	20	22
Initial Void Ratio	0.5	0.5	0.5
Drainage Parameters	Drained	Drained	Drained
Permeability	1	1	1
E50ref	22,000	43,000	150,000
Eoedref	22,000	43,000	150,000
Eureref	66,000	129,000	450,000
Failure Ratio	0.9	0.9	0.9
Reference Pressure	12	47	110
Power of Stress Level Dependency	0.5	0.5	0.5
Friction Angle	30	34	38
K0nc	0.5	0.441	0.384
Dilatancy Angle	0	4	5
Cohesion	5	10	15

PROPERTIES- STRUCTURAL MATERIAL

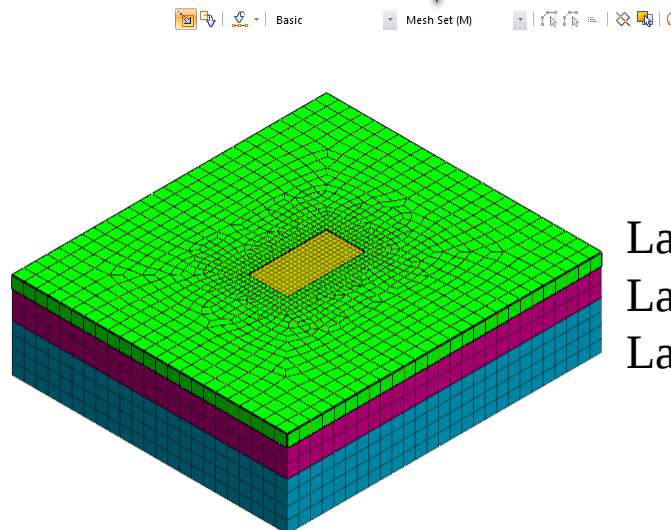
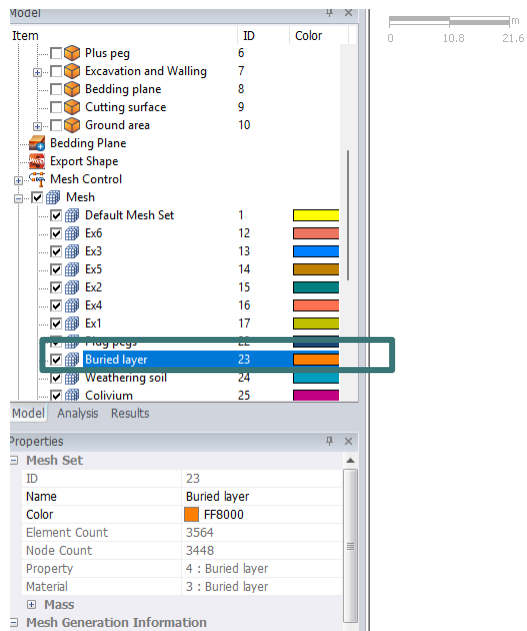
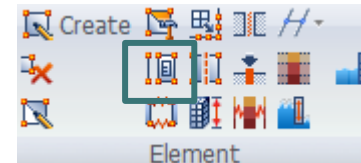
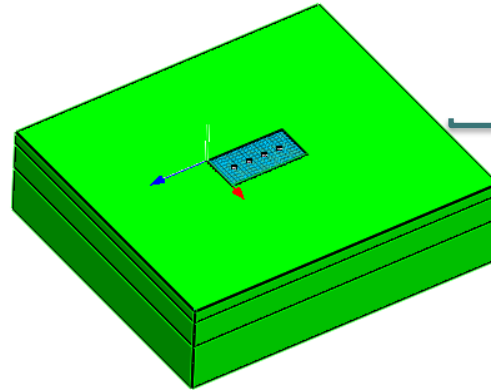
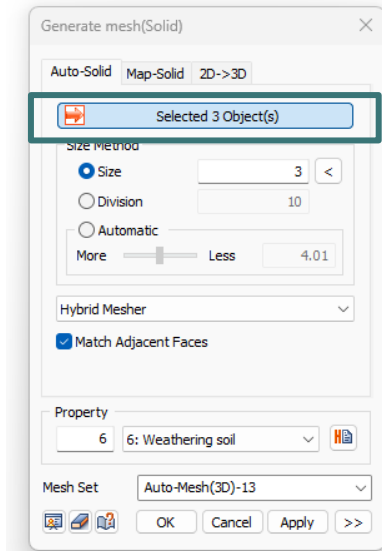
Name	Structure material 1	Structure material 2
Material	Isotropic	Isotropic
Model Type	Elastic	Elastic
Elastic Modulus	210,000,000	200,000,000
Poisson's Ratio	0.3	0.3
Unit Weight	76.98	76.98

3D MESH



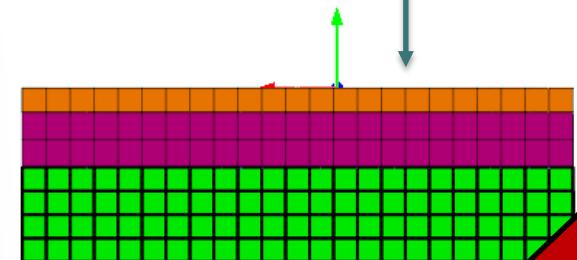
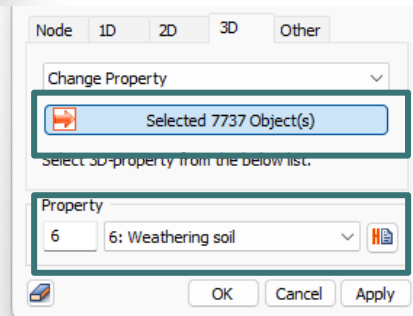
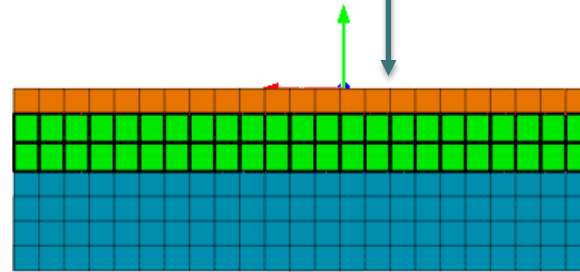
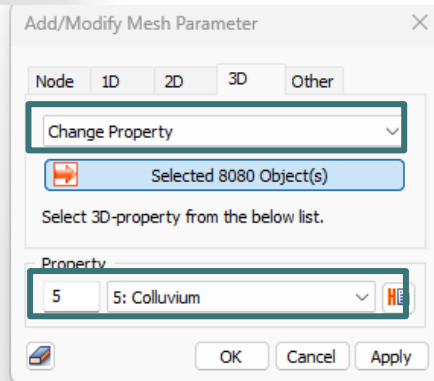
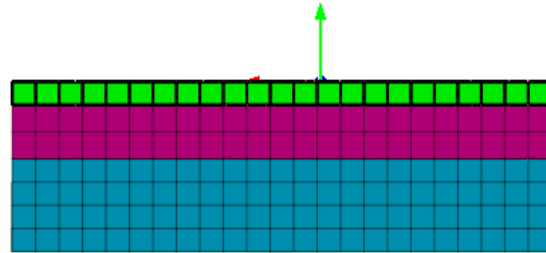
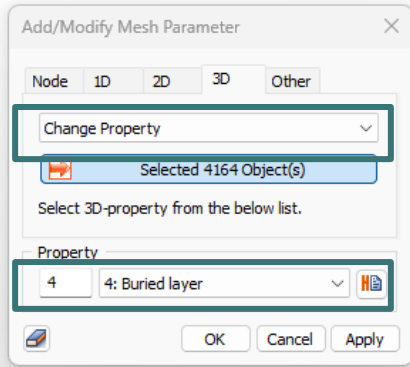
NOTE:Generate meshes with nodes connected to interior edges

3D MESH

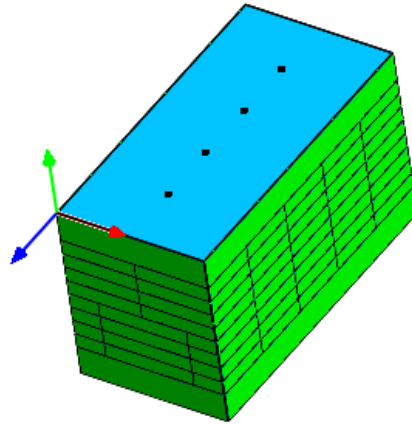
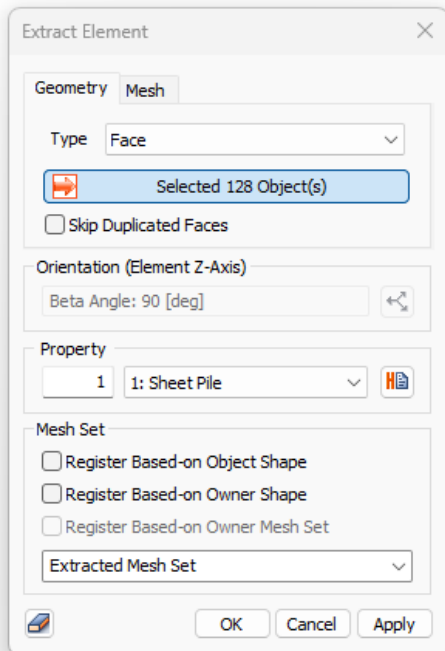


Layer 1: Buried Layer
Layer 2: Colluvium
Layer 3: Weathering Soil

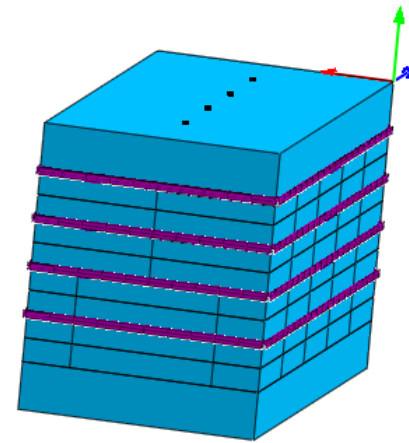
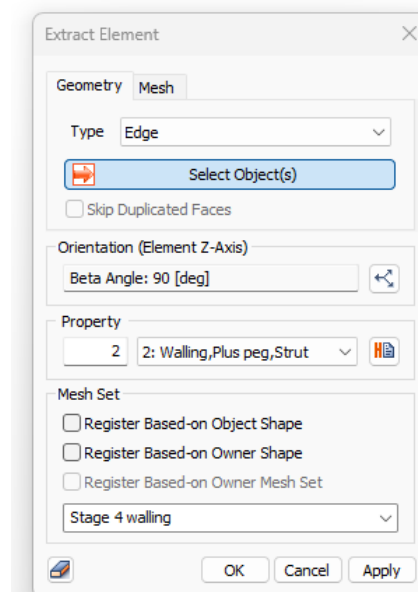
3D MESH - PARAMETER CHANGE



3D MESH - ELEMENT

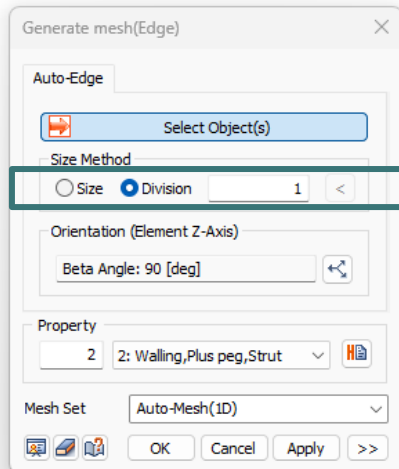


Retaining Wall

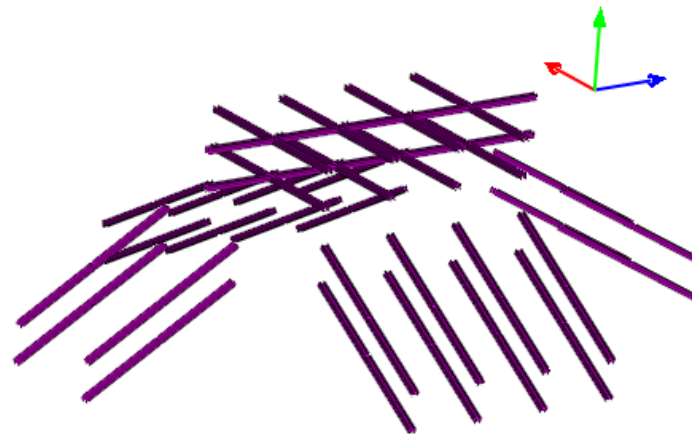
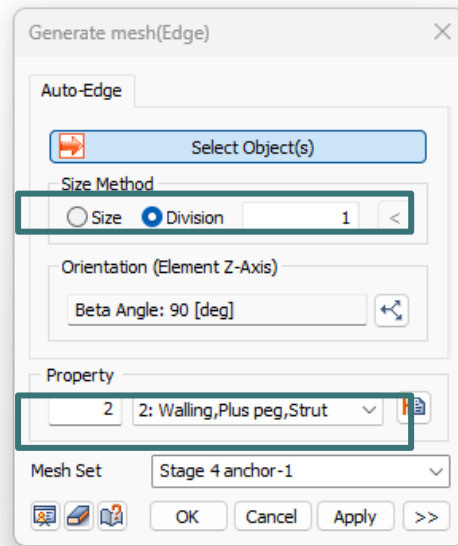
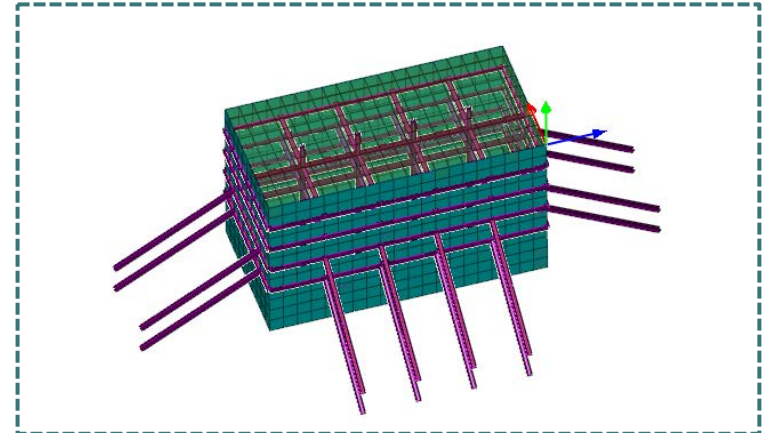


Brace

1D MESH - STRUTS and ANCHORS

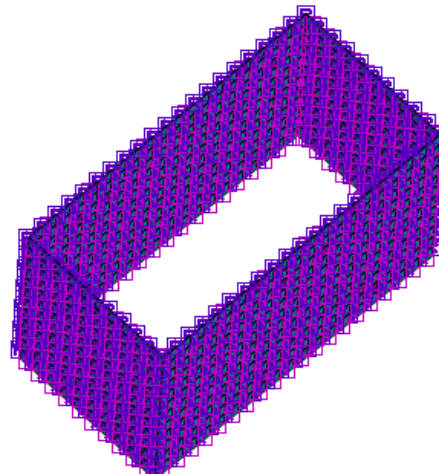
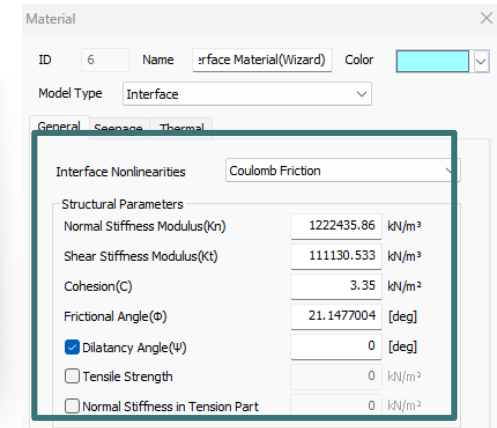
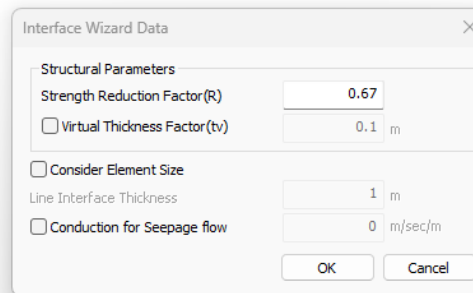
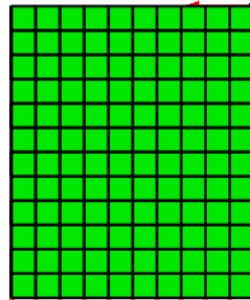
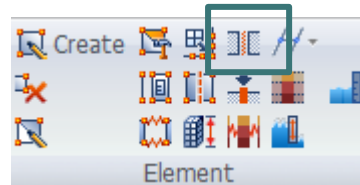
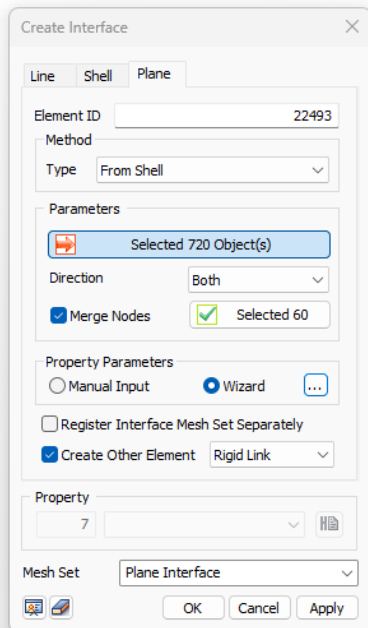


Struts



Anchors

SOIL - STRUCTURE INTERACTION



Interface

NOTE: Guidelines for the interface calculation and strength reduction factors (R) are all in the FEA Manual.

INTERFACE WIZARD

Interface Wizard equation from Midas GTX NX manual

$$K_n = E_{\text{oed},i} / t_v$$

$$K_t = G_i / t_v$$

$$C_i = R \times C_{\text{soil}}$$

Here,

$$E_{\text{oed},i} = 2 \times G_i \times (1 - \nu_i) / (1 - 2 \times \nu_i)$$

$$G_i = R^2 \times G_{\text{soil}}$$

$$G_{\text{soil}} = E / (2(1 + \nu_{\text{soil}}))$$

Where:

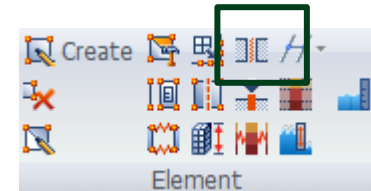
K_n : Normal Stiffness Modulus

K_t : Shear Stiffness Modulus

t_v : Virtual Thickness Factor

R: Strength Reduction Factor

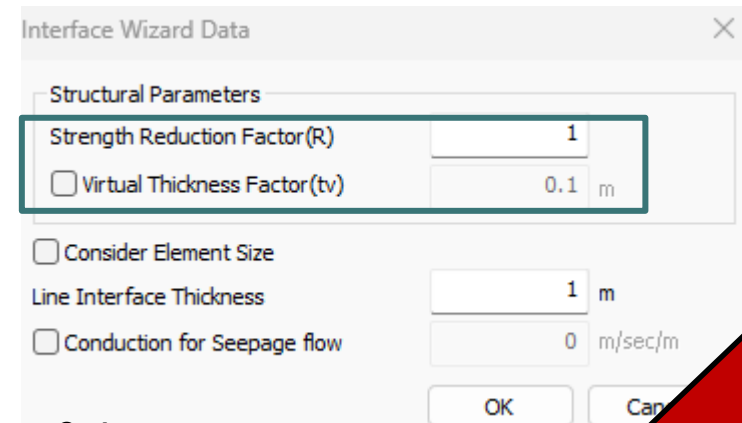
C_i : Interface Cohesion



Normal Stiffness Modulus (K_n) is the elasticity modulus for **bonding and un-bonding behavior** in the normal direction to the interface element

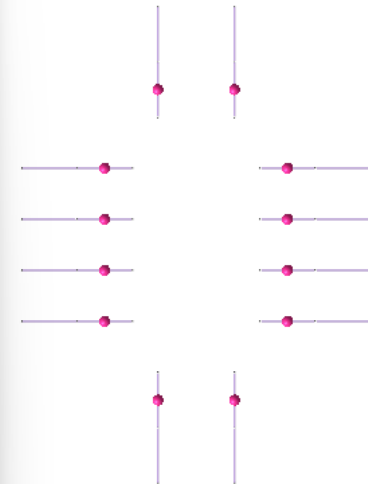
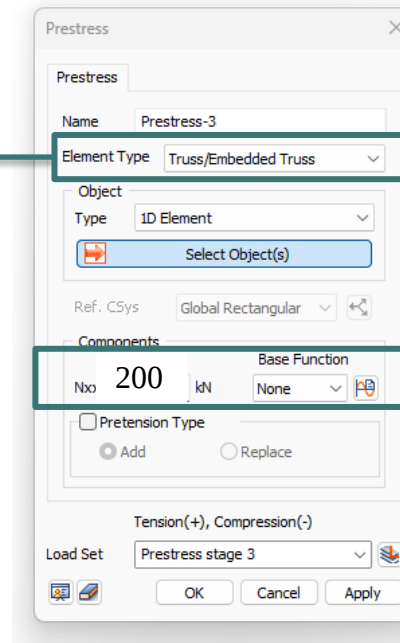
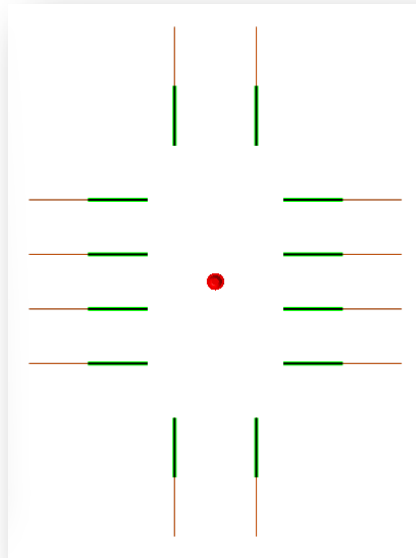
Shear stiffness modulus (K_t) is the elasticity modulus for **slip behavior** in the normal direction to the interface element

Strength Reduction Factor	R
Sandy Soil/Steel Material	0.6~0.7
Clay/ Steel Material	0.5
Sandy Soil/ Concrete	0.8~1.0
Clay / Concrete	0.7 ~ 1.0



The general **Virtual Thickness Factor** range is **0.01 ~ 0.1**
(If the stiffness is high, use a smaller value)

PRESTRESSING

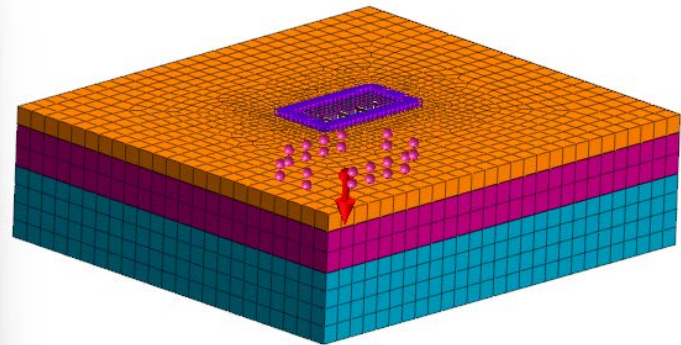
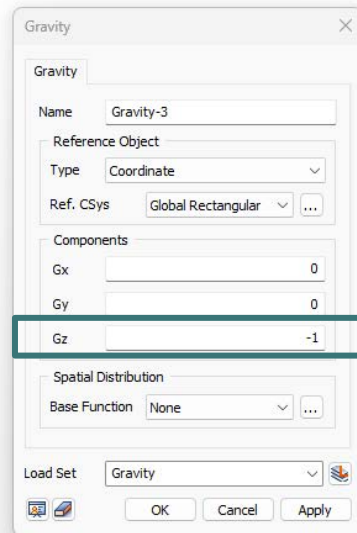


Selecting the length of anchors should add a prestressed load

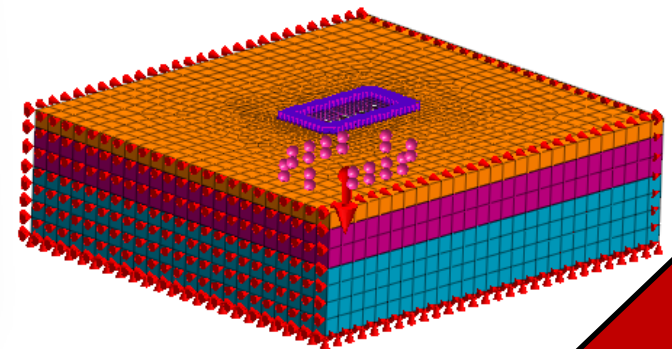
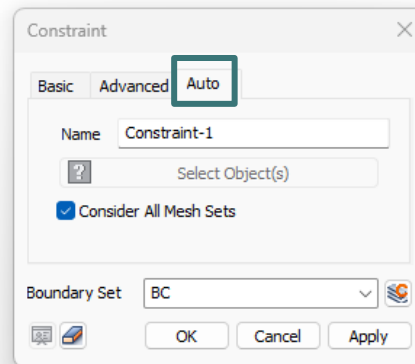
Prestressed: 200 kN

CONSTRAINTS

Gravity

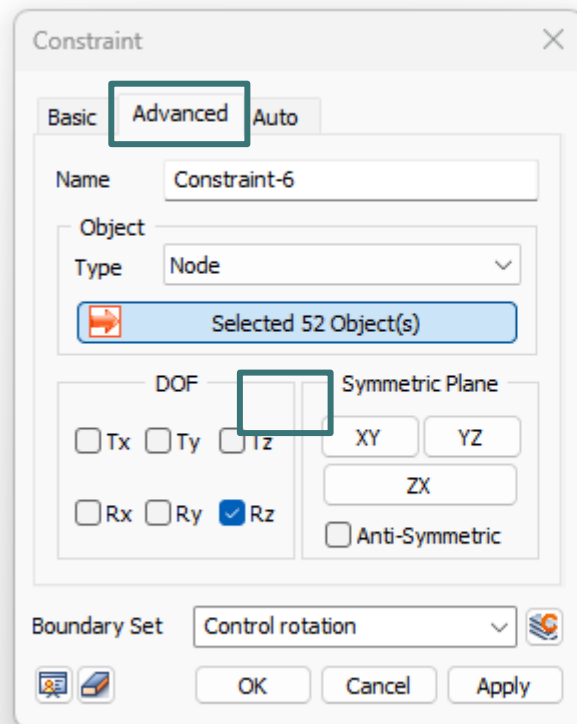


Boundary Condition

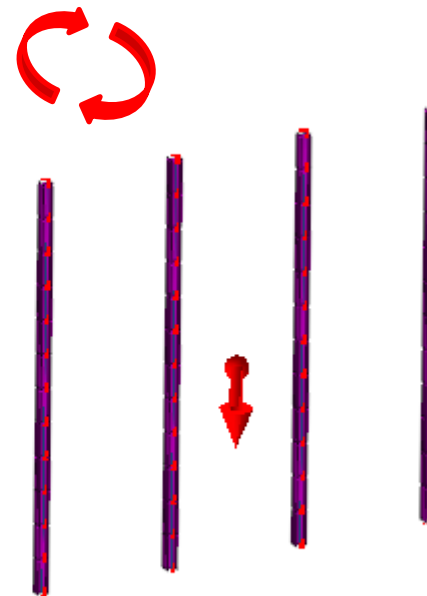


CONSTRAINTS

Rotational Constraints



Prevents Rz rotation



The deformation or rotation is constrained to prevent the degree of freedom errors for the pegs.

CONSTRUCTION STAGE

Define Construction Stage

Construction Stage Set Name

Construction Stage Set-1

Stage ID

1: Initial

Move to Previous

Move to Next

Stage Name

Initial

New

Insert

Delete

Stage Type

Stress

Set Data

Activated Data

Deactivated Data

Mesh
Buried layer
Colivium
Default Mesh Set
Ex1
Ex2
Ex3
Ex4
Ex5
Ex6
Plane Interface
Plug pegs
Rigid Link Mesh
Sheet pile
Stage 1 strut
Stage 1 walling
Stage 2 strut
Stage 2 walling
Stage 3 anchor
Stage 3 walling
Stage 4 anchor
Stage 4 walling
Weathering soil
Boundary Condition
BC
Control rotation

Mesh
Buried layer
Colivium
Default Mesh Set
Ex1
Ex2
Ex3
Ex4
Ex5
Ex6
Rigid Link Mesh
Weathering soil
Boundary Condition
BC
Static Load
Gravity
Combined Load Sets
Contact

Mesh
Boundary Condition
Static Load
Combined Load Sets
Contact

☐ Analysis Control...

☐ Output Control...

Initial Condition

☐ Define Water Level For Global

0 m None ...

☐ Define Water Level For Mesh Set

Input Water Level...

☐ Sub Stage...

☐ LDE Conv To Specific Stage...

☒ Clear Displacement

☒ Clear Strain

☐ Slope Stability (SRM)

Sort By

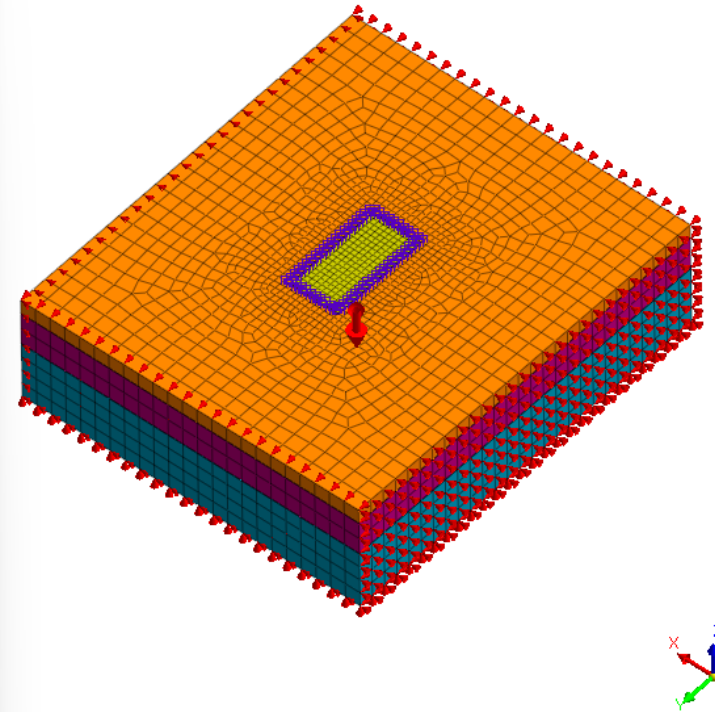
Name

Show Data

Activate

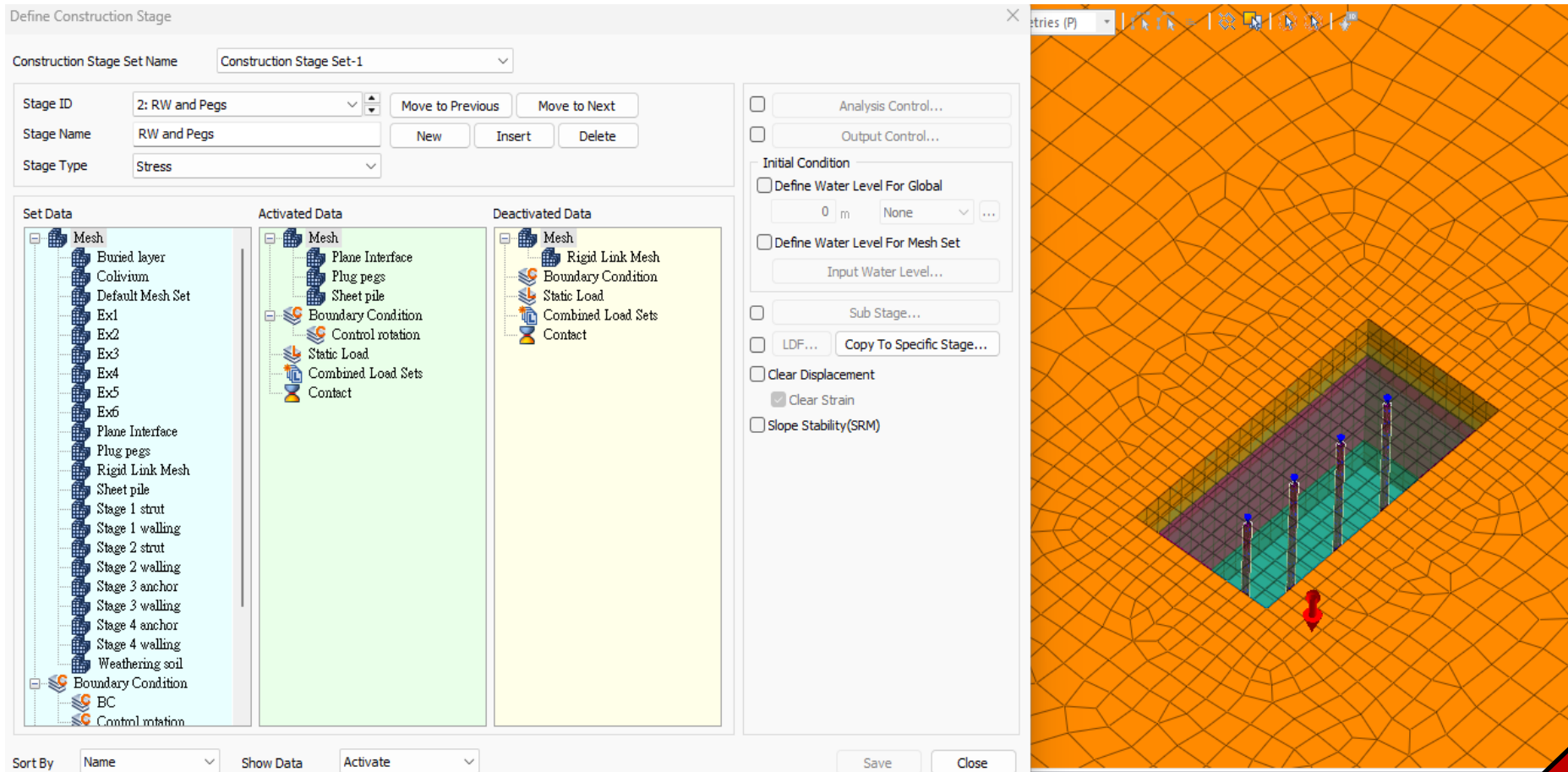
Save

Close



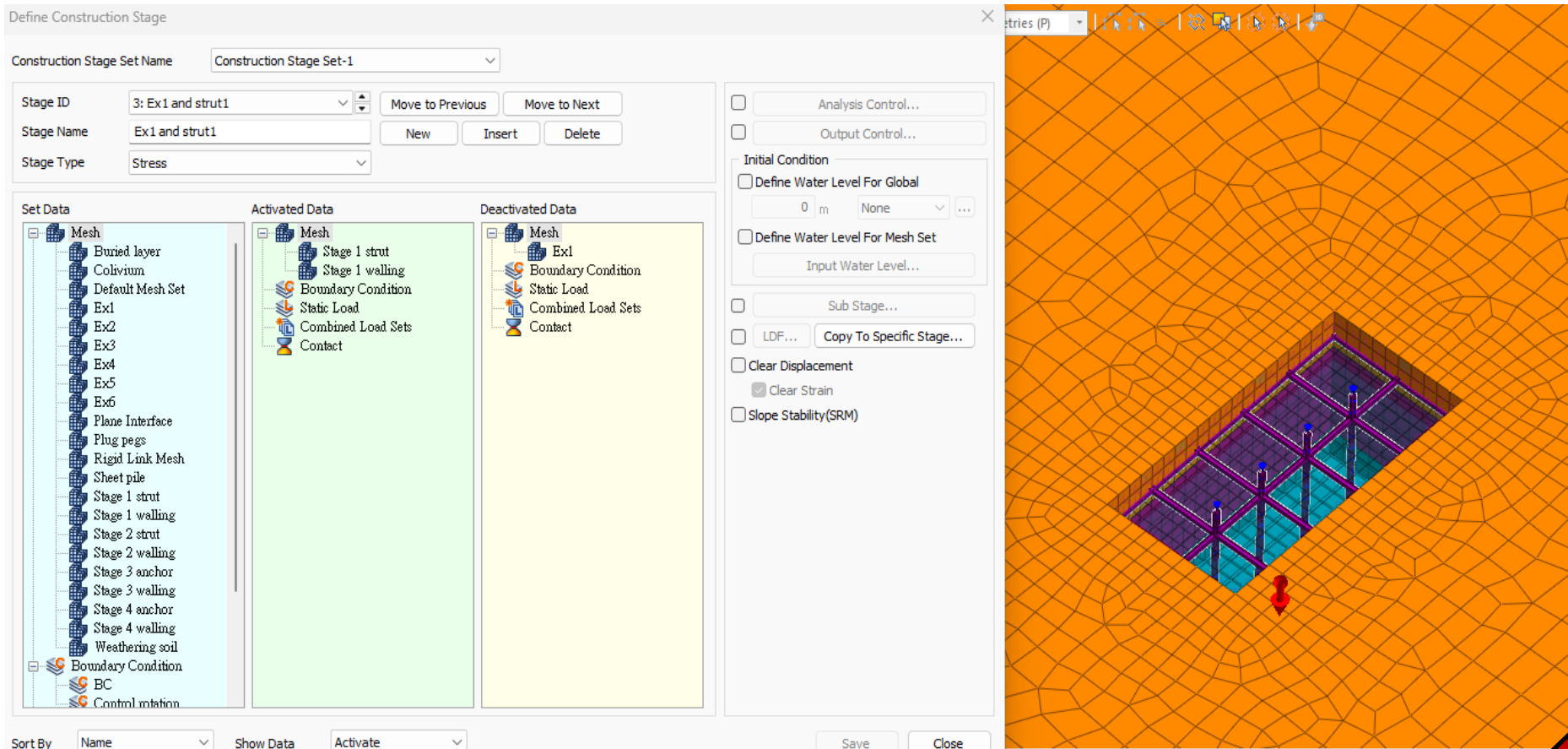
Stage 1: Initial Condition

CONSTRUCTION STAGE



Stage 2: Sheet Pile and Pegs

CONSTRUCTION STAGE



Stage 3: Excavation Layer 1 and Strut Layer 1

CONSTRUCTION STAGE

Define Construction Stage

Construction Stage Set Name: Construction Stage Set-1

Stage ID: 4: Ex2 and Strut2 | Move to Previous | Move to Next

Stage Name: Ex2 and Strut2 | New | Insert | Delete

Stage Type: Stress

Set Data

- Mesh
- Buried layer
- Colivium
- Default Mesh Set
- Ex1
- Ex2
- Ex3
- Ex4
- Ex5
- Ex6
- Plane Interface
- Plug pegs
- Rigid Link Mesh
- Sheet pile
- Stage 1 strut
- Stage 1 walling
- Stage 2 strut
- Stage 2 walling
- Stage 3 anchor
- Stage 3 walling
- Stage 4 anchor
- Stage 4 walling
- Weathering soil
- Boundary Condition
- BC
- Control rotation

Activated Data

- Mesh
- Stage 2 strut
- Stage 2 walling
- Boundary Condition
- Static Load
- Combined Load Sets
- Contact

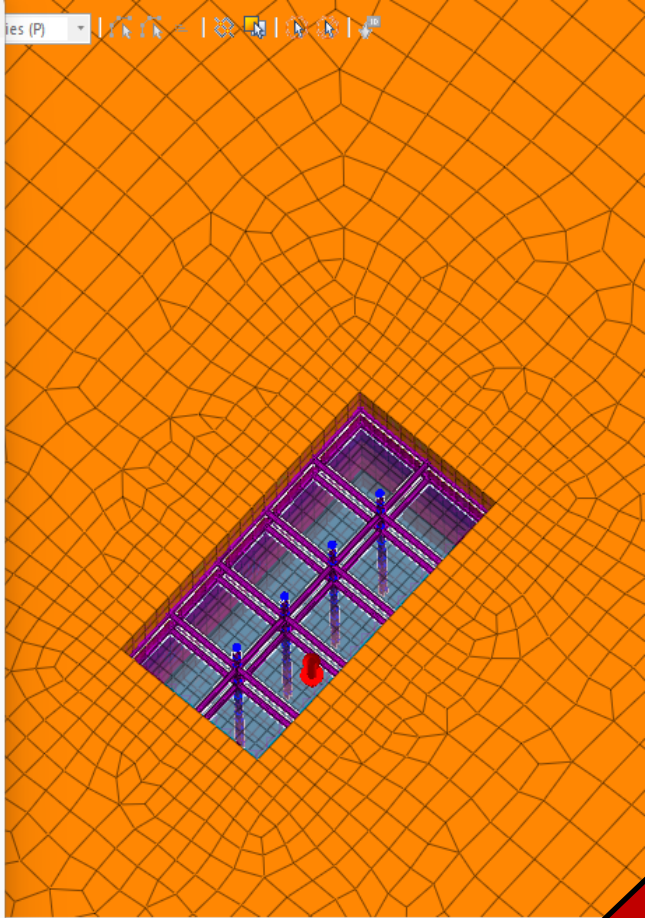
Deactivated Data

- Mesh
- Ex2
- Boundary Condition
- Static Load
- Combined Load Sets
- Contact

Initial Condition

- ☐ Define Water Level For Global
0 m | None
- ☐ Define Water Level For Mesh Set
Input Water Level...
- ☐ Sub Stage...
- ☐ LDF... | Copy To Specific Stage...
- ☐ Clear Displacement
☒ Clear Strain
- ☐ Slope Stability (SRM)

Sort By: Name | Show Data: Activate | Save | Close



Stage 4: Excavation Layer 2 and Strut Layer 2

CONSTRUCTION STAGE

Define Construction Stage

Construction Stage Set Name: Construction Stage Set-1

Stage ID: 5: Ex3 and anchor3 | Move to Previous | Move to Next

Stage Name: Ex3 and anchor3 | New | Insert | Delete

Stage Type: Stress

Set Data

- Mesh
 - Buried layer
 - Colivium
 - Default Mesh Set
 - Ex1
 - Ex2
 - Ex3
 - Ex4
 - Ex5
 - Ex6
 - Plane Interface
 - Plug pegs
 - Rigid Link Mesh
 - Sheet pile
 - Stage 1 strut
 - Stage 1 walling
 - Stage 2 strut
 - Stage 2 walling
 - Stage 3 anchor
 - Stage 3 walling
 - Stage 4 anchor
 - Stage 4 walling
 - Weathering soil
 - Boundary Condition
 - BC
 - Control rotation

Activated Data

- Mesh
 - Stage 3 anchor
 - Stage 3 walling
 - Boundary Condition
 - Static Load
 - Prestress stage 3
 - Combined Load Sets
 - Contact

Deactivated Data

- Mesh
 - Ex3
 - Boundary Condition
 - Static Load
 - Combined Load Sets
 - Contact

Analysis Control...

Output Control...

Initial Condition

- ☐ Define Water Level For Global
 - 0 m | None
- ☐ Define Water Level For Mesh Set
 - Input Water Level...

Sub Stage...

LDF... | Copy To Specific Stage...

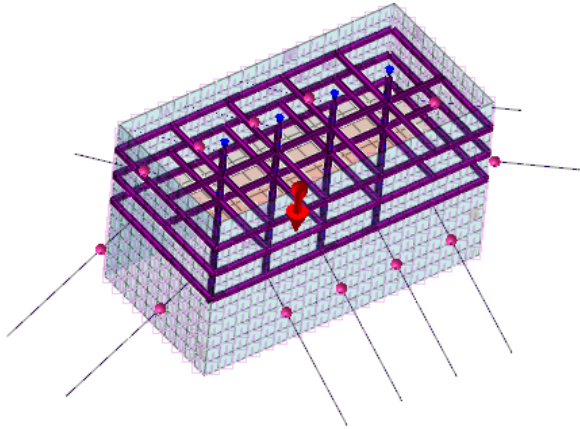
☐ Clear Displacement

☒ Clear Strain

☐ Slope Stability(SRM)

Sort By: Name | Show Data: Activate

Save | Close



Stage 5: Excavation Layer 3 and Strut Layer 3

CONSTRUCTION STAGE

Define Construction Stage

Construction Stage Set Name: Construction Stage Set-1

Stage ID: 6: Ex4 and anchor4 | Move to Previous | Move to Next

Stage Name: Ex4 and anchor4 | New | Insert | Delete

Stage Type: Stress

Set Data	Activated Data	Deactivated Data
- Mesh - Buried layer - Colivium - Default Mesh Set - Ex1 - Ex2 - Ex3 - Ex4 - Ex5 - Ex6 - Plane Interface - Plug pegs - Rigid Link Mesh - Sheet pile - Stage 1 strut - Stage 1 walling - Stage 2 strut - Stage 2 walling - Stage 3 anchor - Stage 3 walling - Stage 4 anchor - Stage 4 walling - Weathering soil - Boundary Condition - BC - Control rotation	- Mesh - Stage 4 anchor - Stage 4 walling - Boundary Condition - Static Load - Prestress stage 4 - Combined Load Sets - Contact	- Mesh - Ex4 - Boundary Condition - Static Load - Combined Load Sets - Contact

Initial Condition

- ☐ Define Water Level For Global: 0 m, None
- ☐ Define Water Level For Mesh Set: Input Water Level...

Sub Stage...

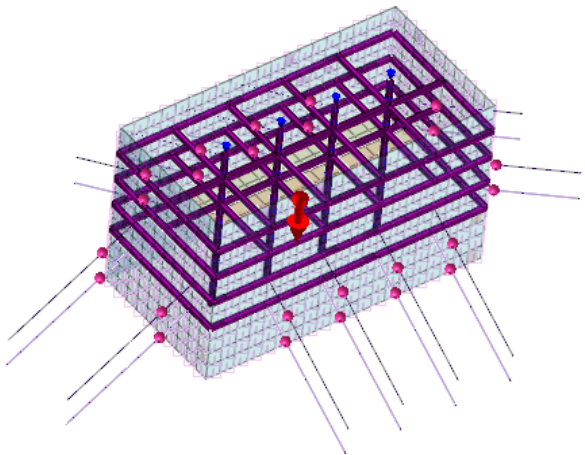
☐ LDF... | Copy To Specific Stage...

☐ Clear Displacement

☒ Clear Strain

☐ Slope Stability (SRM)

Sort By: Name | Show Data: Activate | Save | Close



Stage 6: Excavation Layer 4 and Strut Layer 4

CONSTRUCTION STAGE

Define Construction Stage

Construction Stage Set Name: Construction Stage Set-1

Stage ID: 7: Ex5 Move to Previous Move to Next

Stage Name: Ex5 New Insert Delete

Stage Type: Stress

Set Data

- Mesh
- Buried layer
- Colivium
- Default Mesh Set
- Ex1
- Ex2
- Ex3
- Ex4
- Ex5
- Ex6
- Plane Interface
- Plug pegs
- Rigid Link Mesh
- Sheet pile
- Stage 1 strut
- Stage 1 walling
- Stage 2 strut
- Stage 2 walling
- Stage 3 anchor
- Stage 3 walling
- Stage 4 anchor
- Stage 4 walling
- Weathering soil
- Boundary Condition
- BC
- Control rotation

Activated Data

- Mesh
- Boundary Condition
- Static Load
- Combined Load Sets
- Contact

Deactivated Data

- Mesh
- Ex5
- Boundary Condition
- Static Load
- Combined Load Sets
- Contact

Analysis Control...

Output Control...

Initial Condition

☐ Define Water Level For Global
0 m None ...

☐ Define Water Level For Mesh Set
Input Water Level...

☐ Sub Stage...

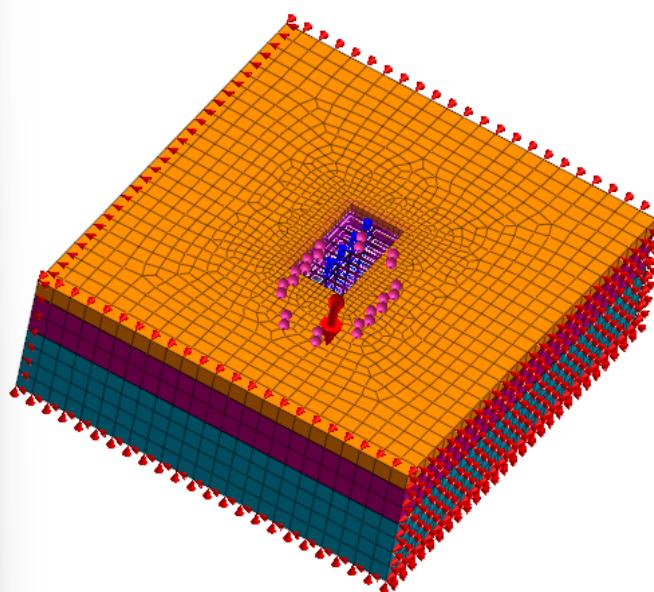
☐ LDF... Copy To Specific Stage...

☐ Clear Displacement
☒ Clear Strain

☐ Slope Stability(SRM)

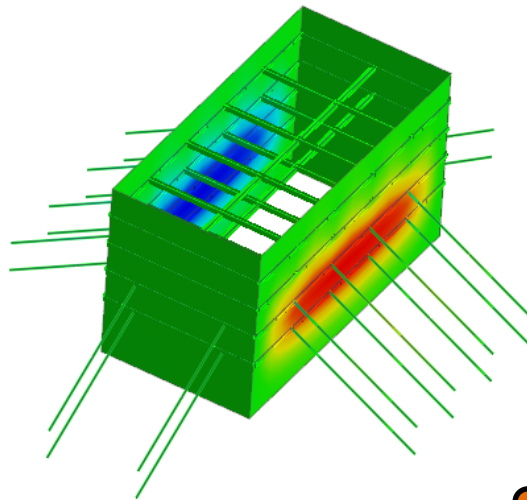
Sort By: Name Show Data Activate

Save Close



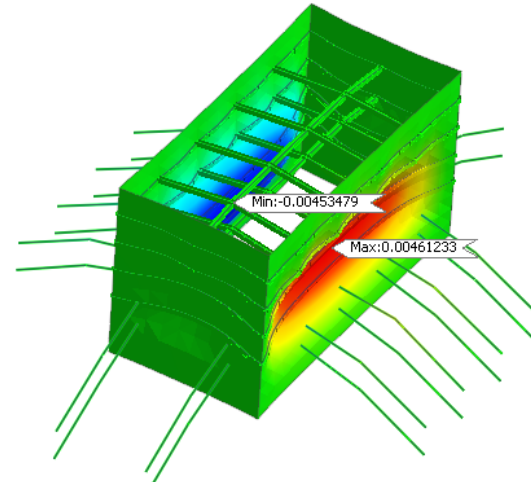
Stage 7: Excavation Layer 5

RESULTS



DISPLACEMENT
TX, m

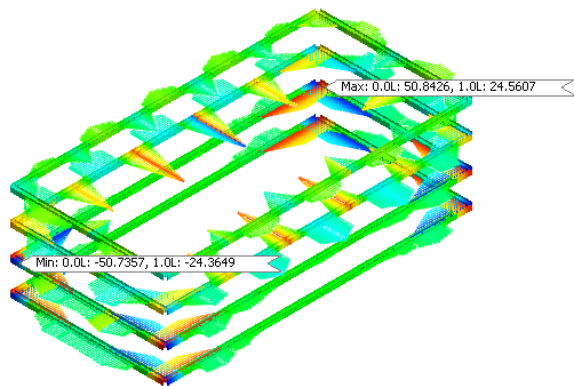
4.3%	+4.61233e-03
2.4%	+3.85007e-03
2.9%	+3.08781e-03
3.9%	+2.32555e-03
6.2%	+1.56329e-03
12.2%	+8.01029e-04
47.4%	+3.87693e-05
6.9%	-7.23491e-04
4.3%	-1.48575e-03
2.7%	-2.24801e-03
2.5%	-3.01027e-03
4.3%	-3.77253e-03
4.3%	-4.53479e-03



DISPLACEMENT
TX, m

4.3%	+4.61233e-03
2.4%	+3.85007e-03
2.9%	+3.08781e-03
3.9%	+2.32555e-03
6.2%	+1.56329e-03
12.2%	+8.01029e-04
47.4%	+3.87693e-05
6.9%	-7.23491e-04
4.3%	-1.48575e-03
2.7%	-2.24801e-03
2.5%	-3.01027e-03
4.3%	-3.77253e-03
4.3%	-4.53479e-03

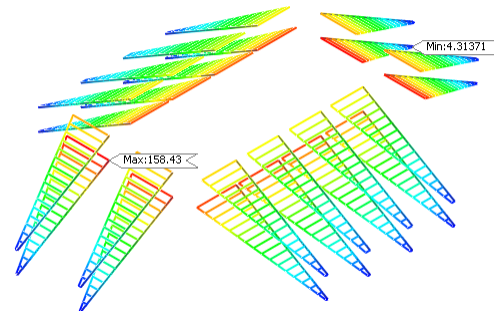
Horizontal Displacement



BEAM FORCE
BENDING MMNT Y, kN*m

1.4%	+5.08426e+01
1.8%	+4.23778e+01
2.7%	+3.39129e+01
3.3%	+2.54480e+01
6.9%	+1.69832e+01
18.0%	+8.51830e+00
27.8%	+5.34363e-02
24.1%	-8.41143e+00
8.3%	-1.68763e+01
1.1%	-2.53412e+01
1.1%	-3.38060e+01
1.5%	-4.22709e+01
1.5%	-5.07357e+01

Bending Moment



TRUSS FORCE
AXIAL, kN

11.1%	+1.58430e+02
11.1%	+1.45587e+02
5.6%	+1.32744e+02
4.9%	+1.19901e+02
0.0%	+1.07058e+02
1.4%	+9.42148e+01
22.2%	+8.13718e+01
9.7%	+6.85288e+01
0.0%	+5.56858e+01
1.4%	+4.28428e+01
1.4%	+2.99997e+01
1.4%	+1.71567e+01
31.3%	+4.31371e+00

Truss Axial Force

RESULTS

On-Curve Diagram

Name: Diagram-3

Cutting Diagram Mode:
☒ Cutting Line ☐ Cutting Plane

Define Positions:
Type: 2-Points Line

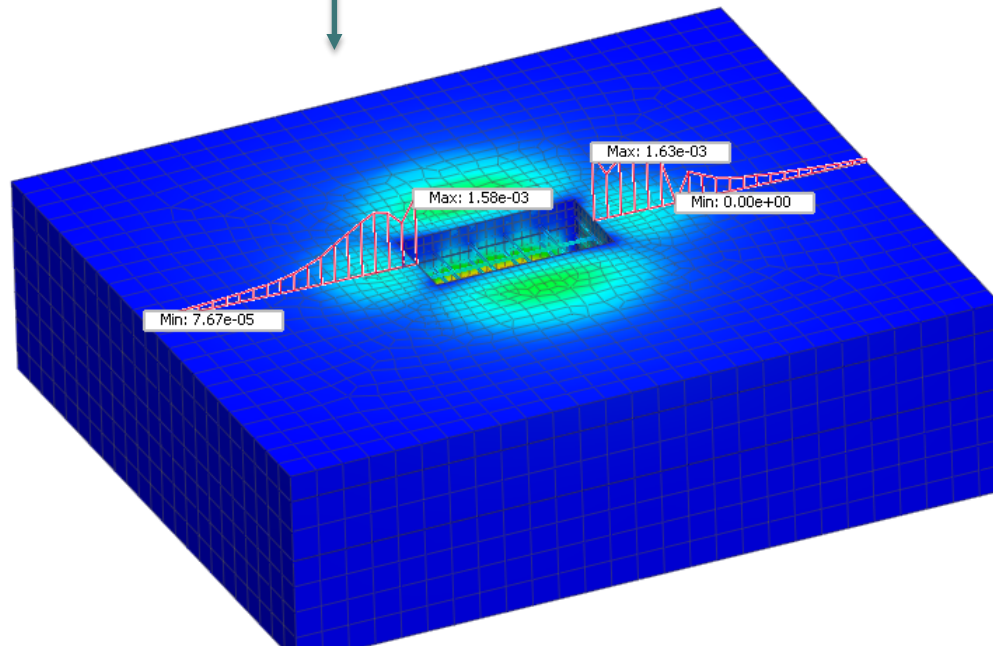
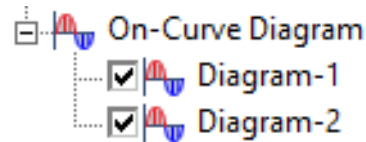
Point 1: -204.596, 0, -96.1478

Point 2: 1, 0, 0

Direction: (+)Z Dir. Division: 20

☐ Reverse

OK Cancel Apply



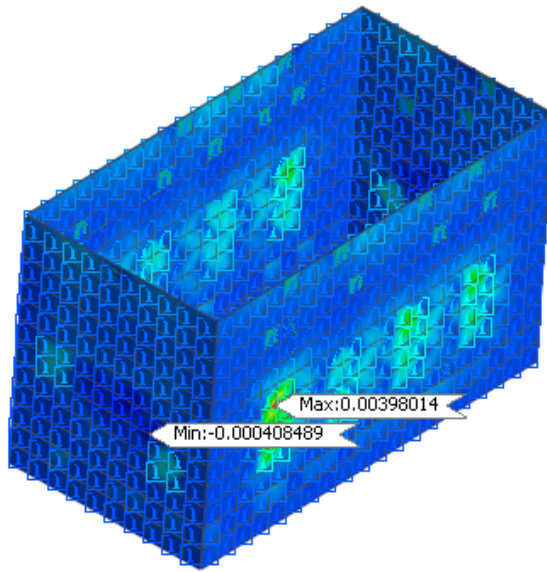
DISPLACEMENT
TOTAL T, m

0.1%	+4.94906e-03
0.2%	+4.53664e-03
0.3%	+4.12422e-03
0.4%	+3.71179e-03
0.9%	+3.29937e-03
1.3%	+2.88695e-03
2.9%	+2.47453e-03
3.9%	+2.06211e-03
5.7%	+1.64969e-03
9.0%	+1.23726e-03
19.0%	+8.24843e-04
56.3%	+4.12422e-04
	+0.00000e+00

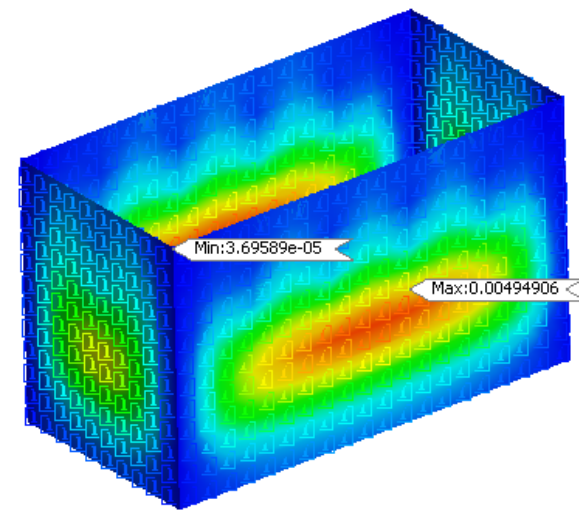
Displacement Diagram

Total Displacement

RESULTS



Interface Displacement



Total Displacement