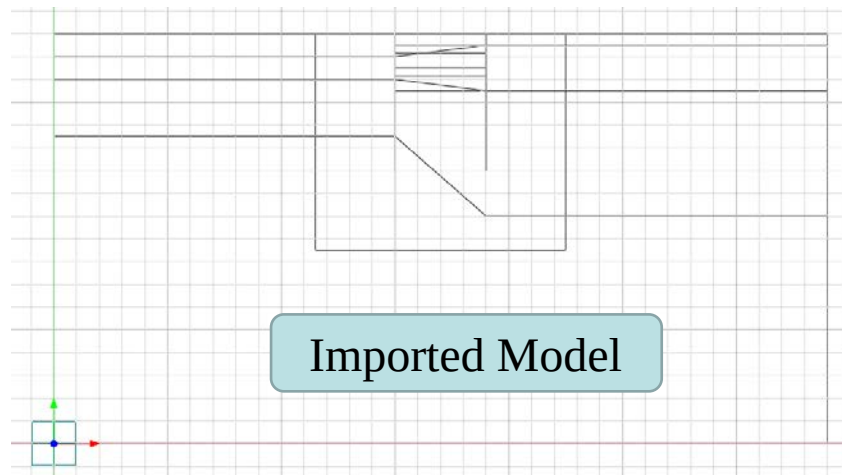
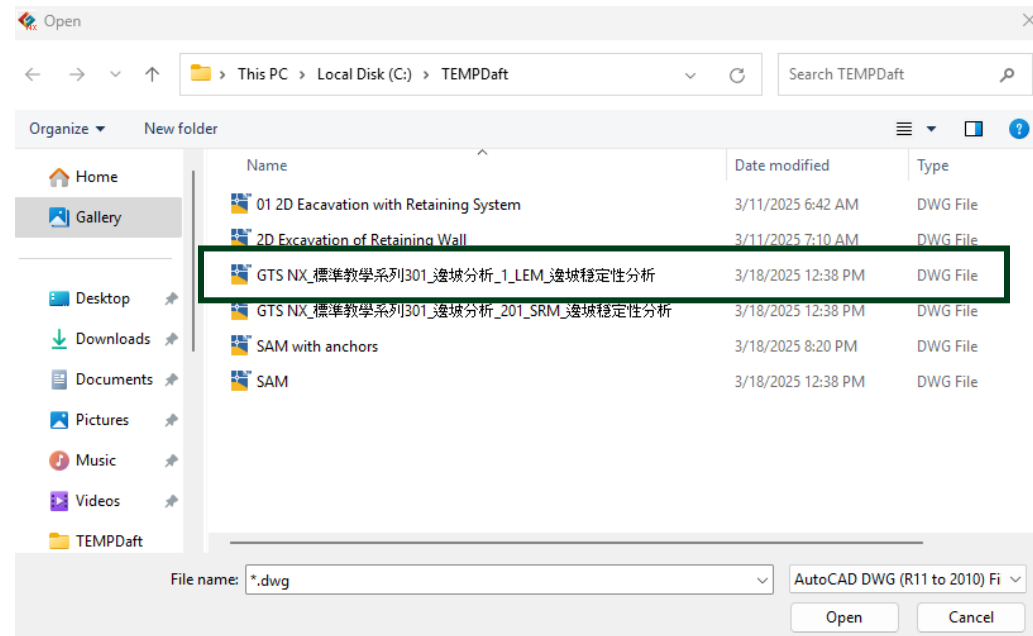
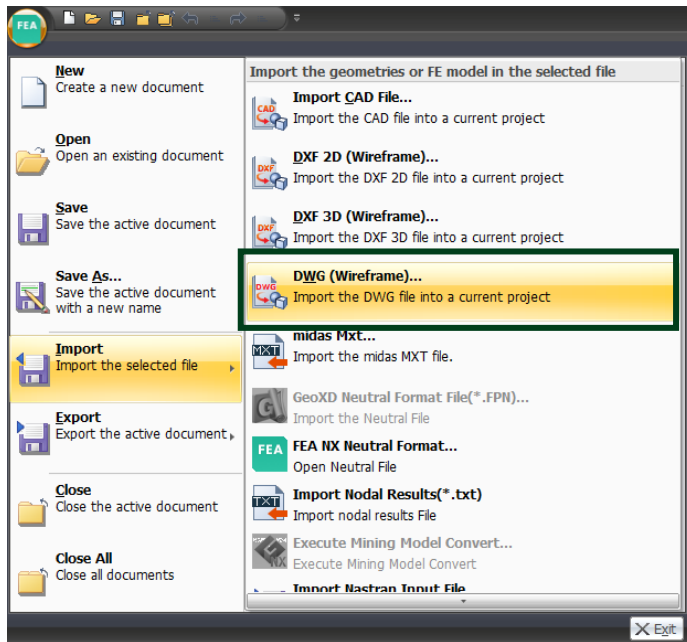
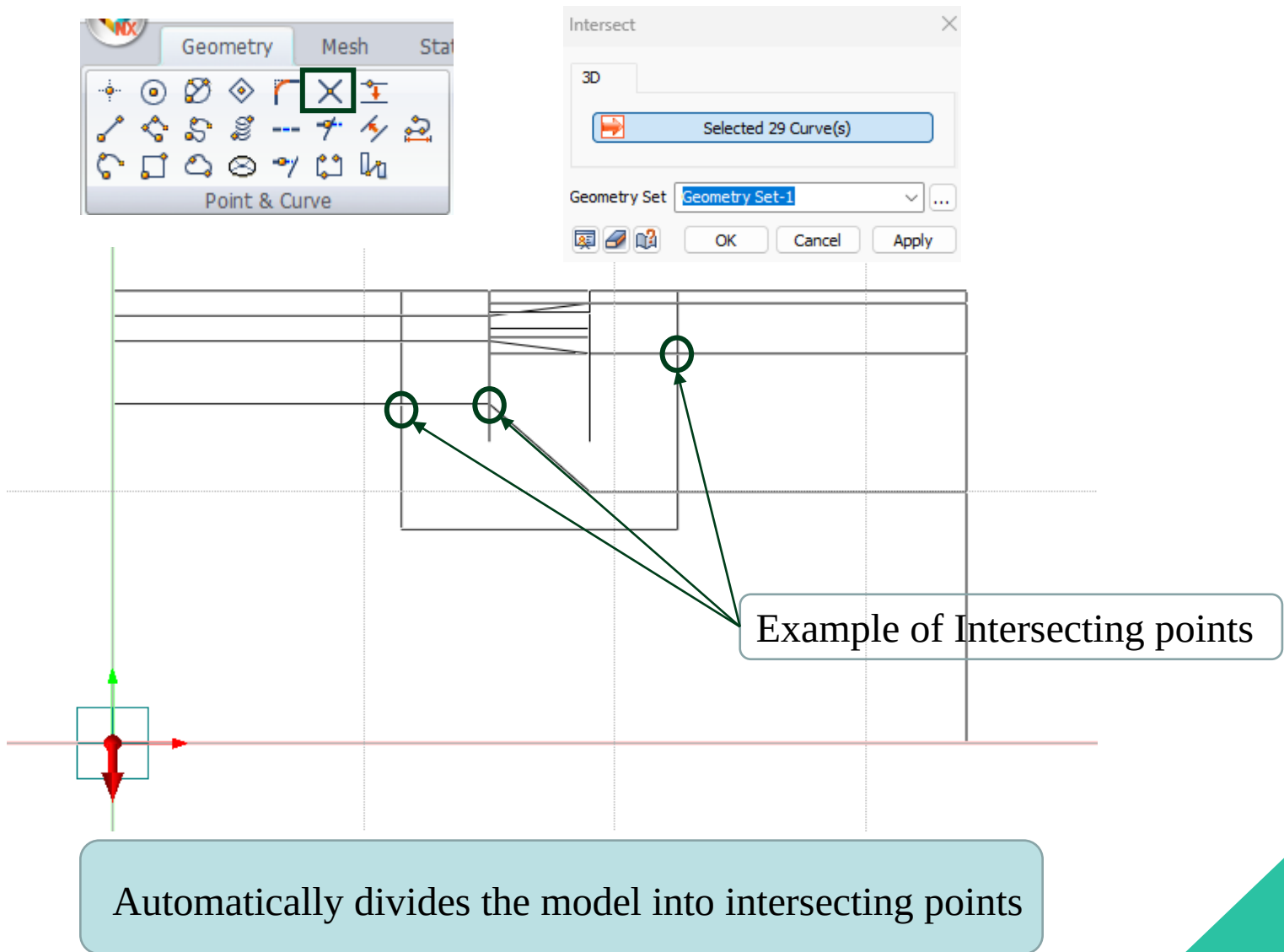


2D Excavation with Soil Retaining System

2D MODEL IMPORT



INTERSECT FUNCTION



SOIL MATERIAL

Add/Modify Material

No	Name	Type
1	SOIL 1	Isotropic-Mohr-Coulomb
2	SOIL 2	Isotropic-Mohr-Coulomb
3	SOIL 3	Isotropic-Mohr-Coulomb
4	SOIL 4	Isotropic-Mohr-Coulomb
5	CONCRETE	Isotropic-Elastic
6	STEEL	Isotropic-Elastic
7	Interface Mat...	Interface and Pile-Interface
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 SOIL 1 Color [Color Box]

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 SOIL 1 Color [Color Box]

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 Storage(Ss) 5.23021 1/m Auto

Material

ID 1 Name SOIL 1 Color [Color Box]

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...
Renum...

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(Ix)	0.140596345	0.140596345 m ⁴
Torsional Stress Coeff.	0.682395003	0.682395003 m
Area Moment of Inertia(Iy)	0.083333333	0.083333333 m ⁴
Area Moment of Inertia(Iz)	0.083333333	0.083333333 m ⁴
Effective Shear Area(Ay)	0.833441841	0.833441841 m ²
Effective Shear Area(Az)	0.833441841	0.833441841 m ²
Shear Stress Coefficient(Gy)	1.5	1.5 1/m ²
Shear Stress Coefficient(Gz)	1.5	1.5 1/m ²

Stress... Stress...

y Axis Variable Constant

z Axis Variable Constant

☐ Spacing 1 m

☒ Section... Solid Rectangle

Apply

Beam Property

Create/Modify 2D Property

Plane Strain

ID 2 Name SOIL1 Color

Material 1: SOIL1

Material CSys

☒ CSys Global Rectangular

☐ Angle 0 [deg]

OK Cancel Apply

Plane Strain Property

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

☒ Spacing 4 m

☒ Section... H-Section

OK Cancel

Truss Property

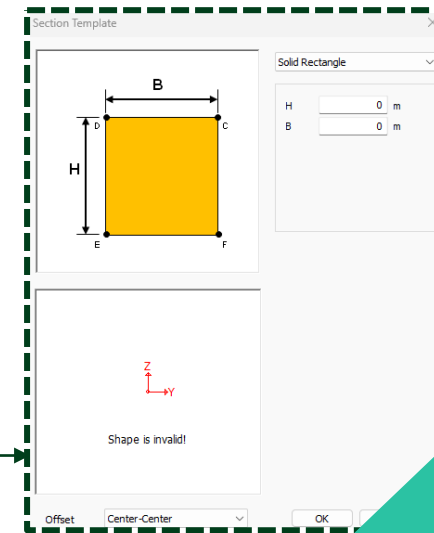
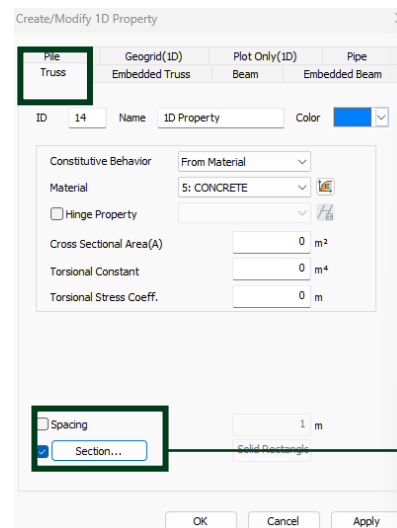
BEAM - TRUSS ELEMENT

Beam and Truss element comparison

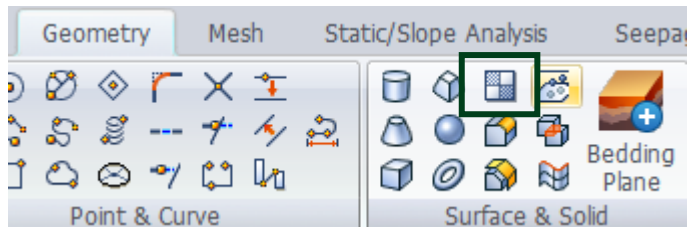
Feature	Truss Element	Beam Element
Resists Axial Force	✓ Yes	✓ Yes
Resists Bending	✗ No	✓ Yes
Resists Shear	✗ No	✓ Yes
Resists Torsion	✗ No	✓ Yes
Degrees of Freedom (DOF)	3 per node (UX, UY, UZ)	6 per node (UX, UY, UZ, RX, RY, RZ)
Transfers Moments	✗ No	✓ Yes
Typical Application	Trusses, cables	Beams,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

Truss Library

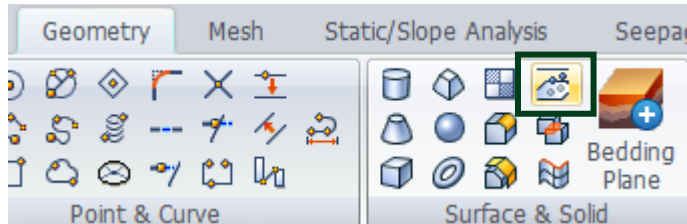
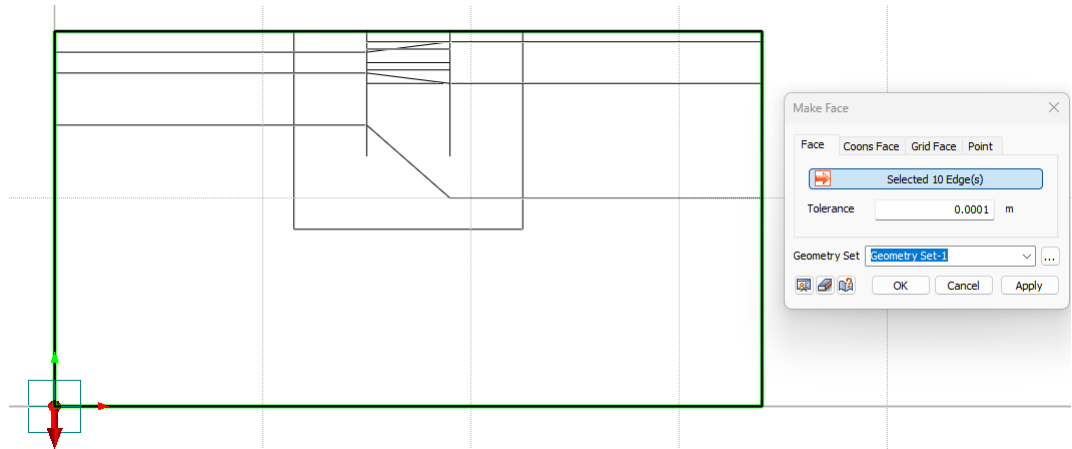
Note: Spacing defines the distance between each individual element that will be generated along a line or curve when using truss-type elements.



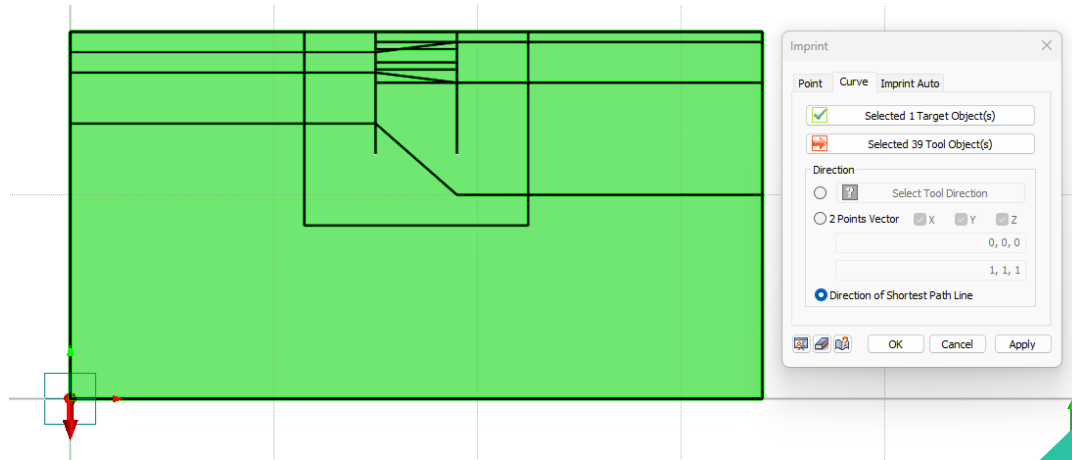
GEOMETRIC MODEL



Face Function



Imprint Function



ELEMENT PROPERTY

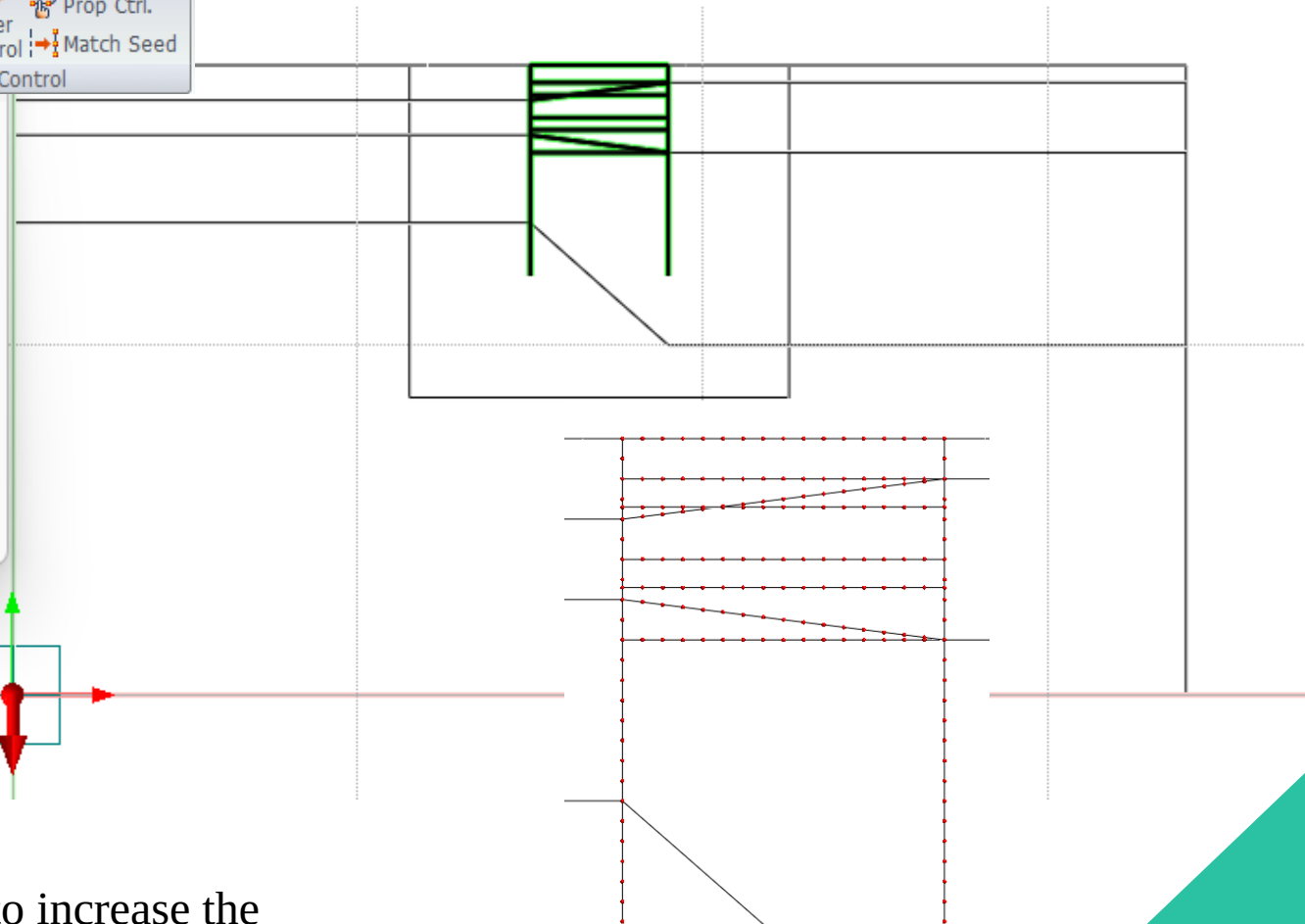
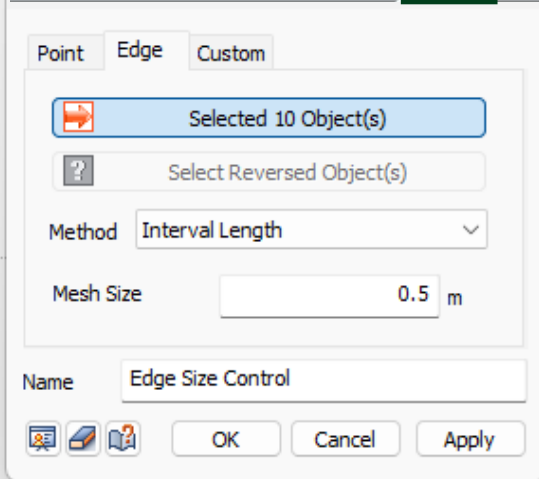
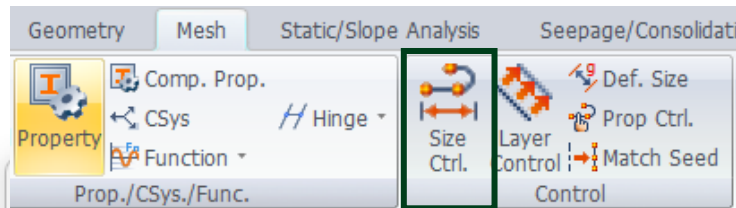
Ground Property

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

MESH - SIZE CONTROL

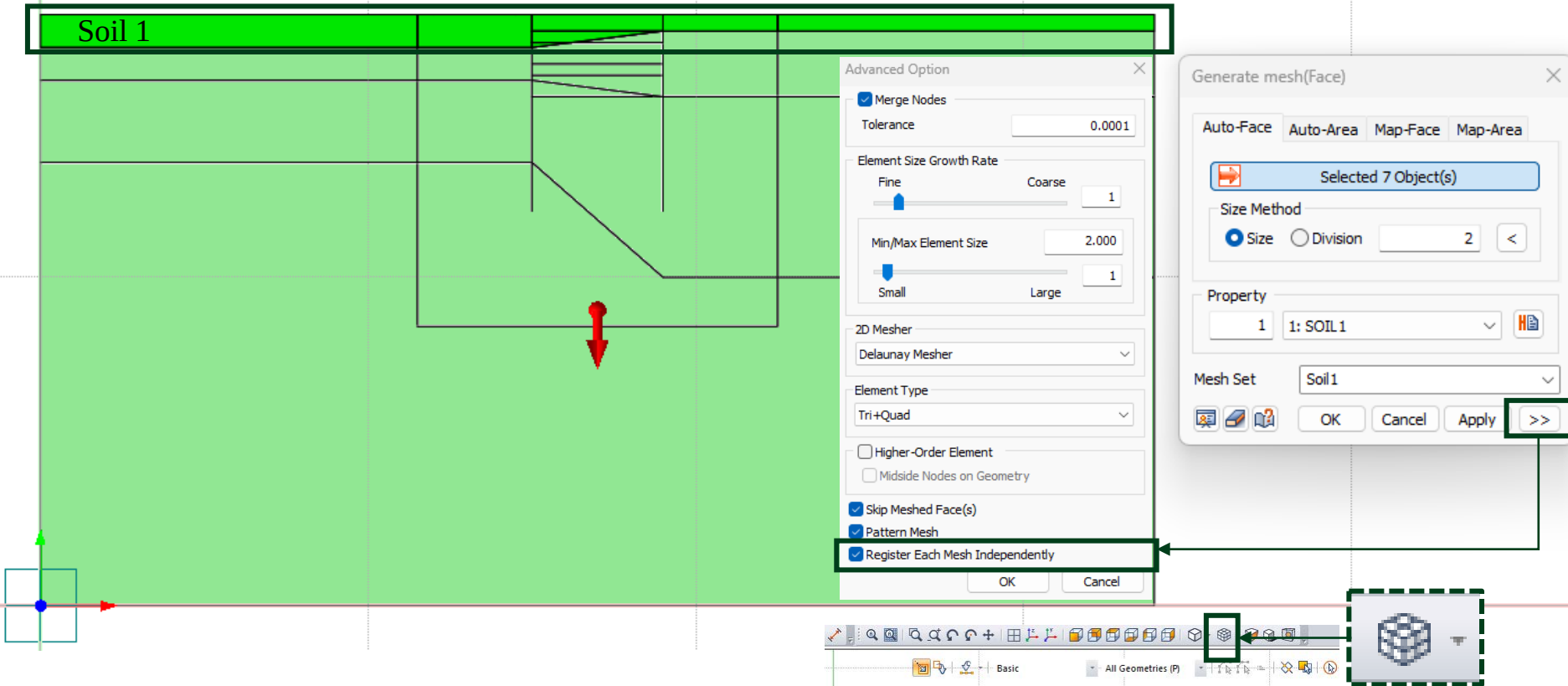


Mesh size control to increase the accuracy in plastic area

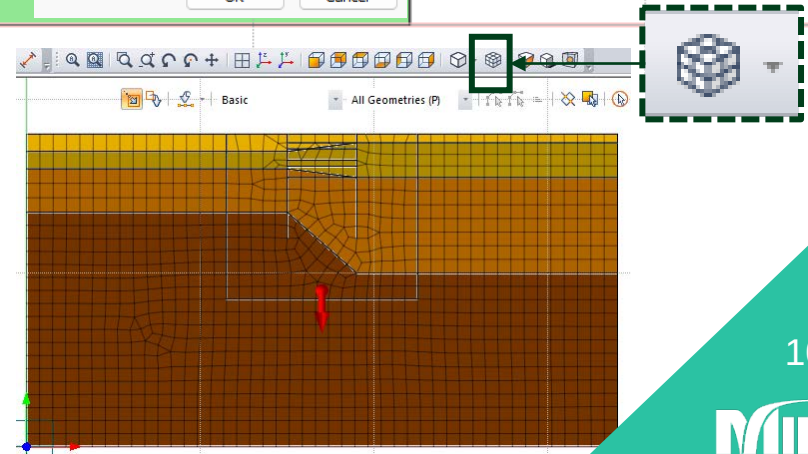
Mesh size of 0.5 m

MESH - GENERATE MESH

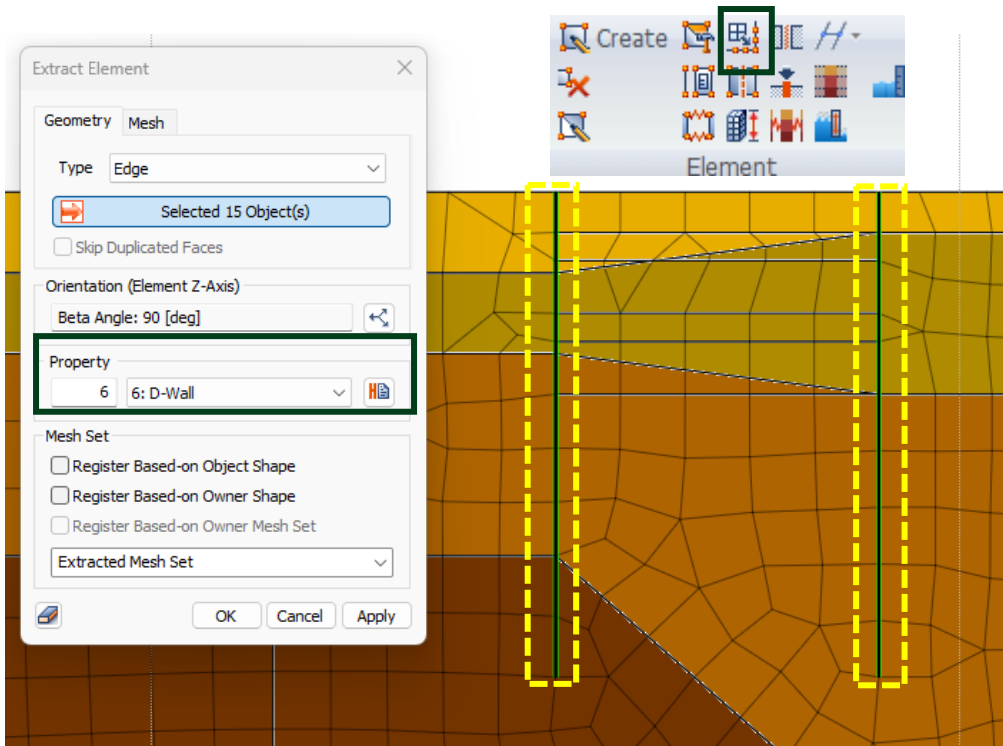
Generate mesh for soil layer 1



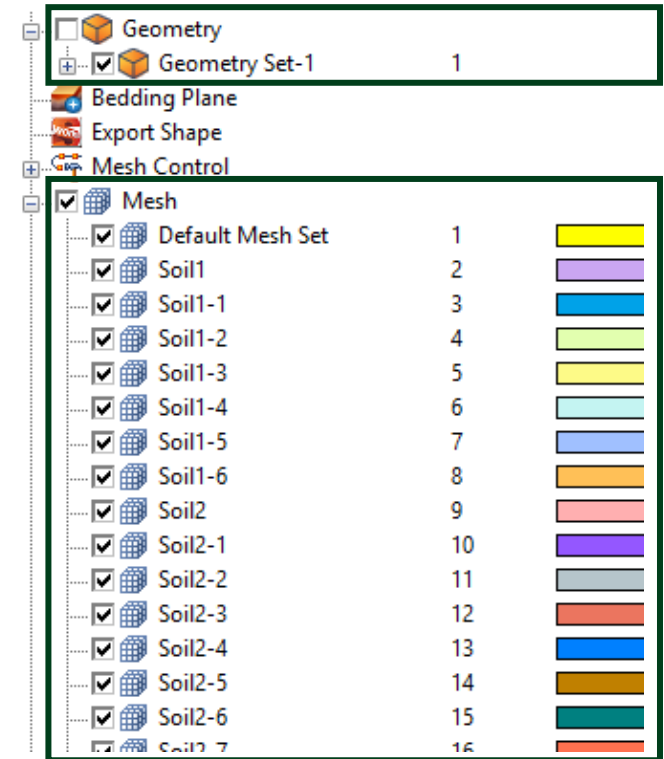
To show 'Property color'
Display Mode (Mesh) → Property color



MESH - EXTRACT ELEMENT

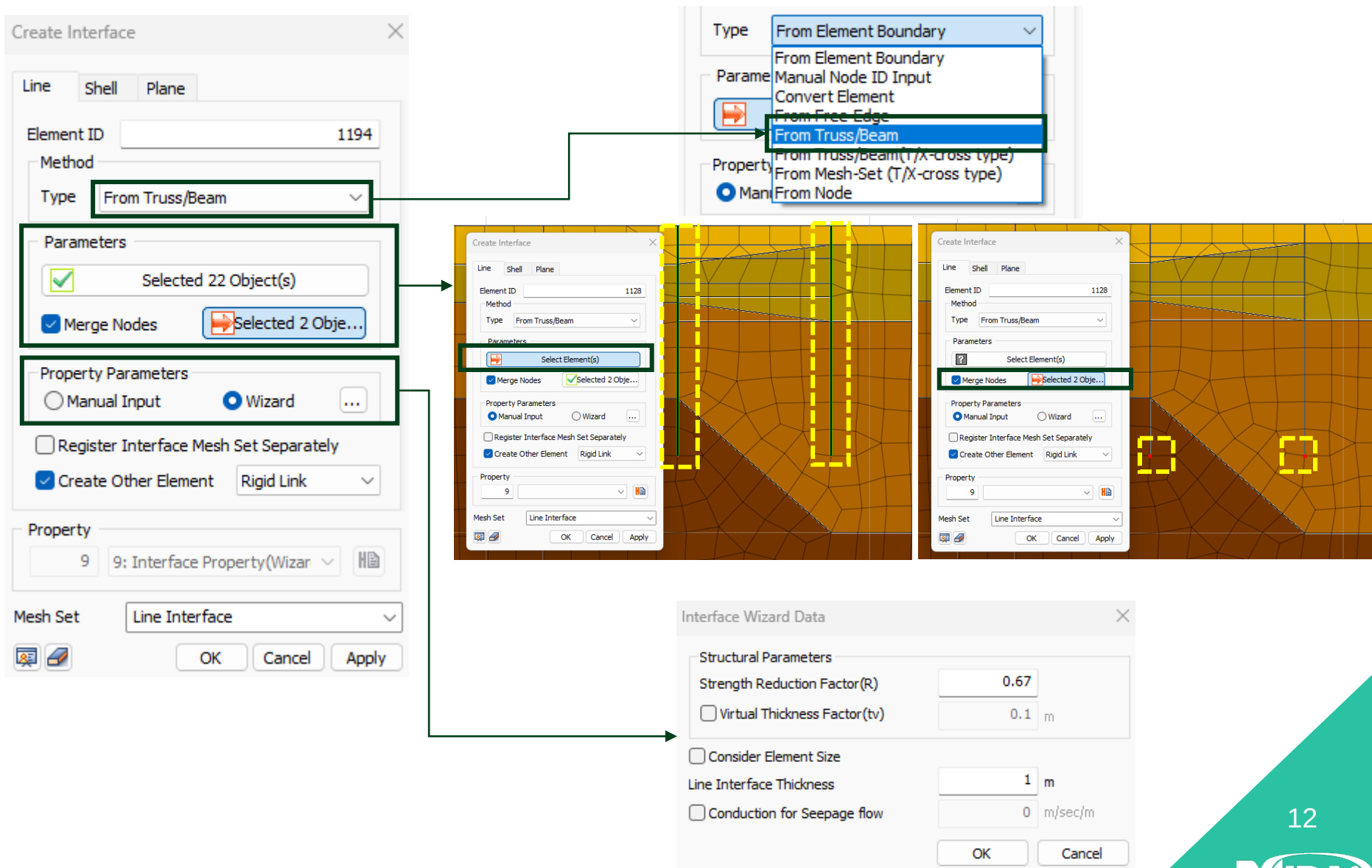


‘Extract elements’ for retaining wall



Note: By using the ‘Extract Elements’ function, there 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:

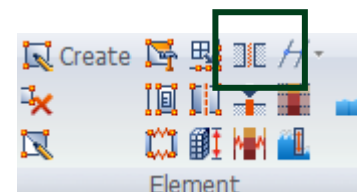
K_n : Normal Stiffness Modulus

K_t : Shear Stiffness Modulus

t_v : Virtual Thickness Factor

R: Strength Reduction Factor

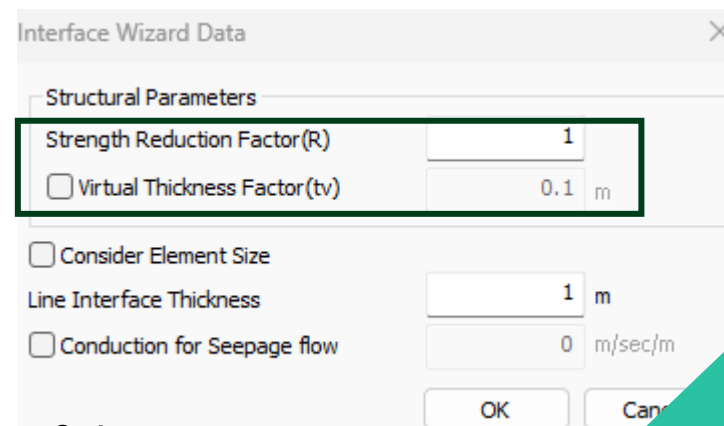
C_i : Interface Cohesion



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

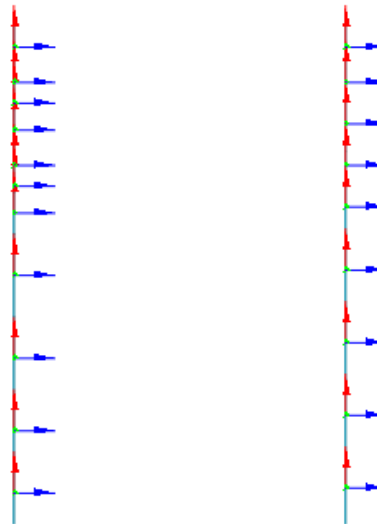
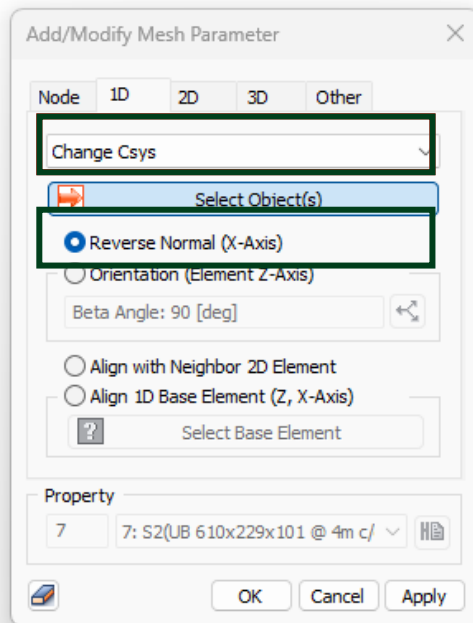
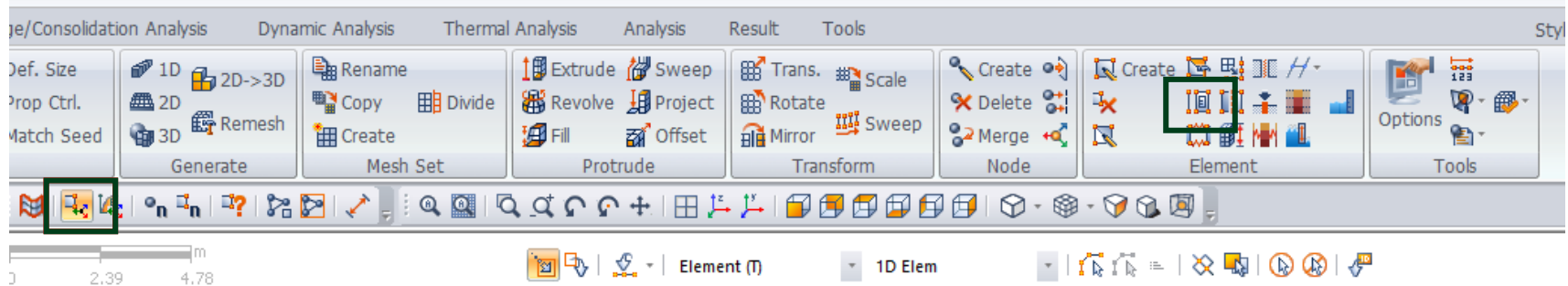
Shear stiffness modulus (Kt) is the elasticity modulus for **slip behavior** in the normal direction to the interface element

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



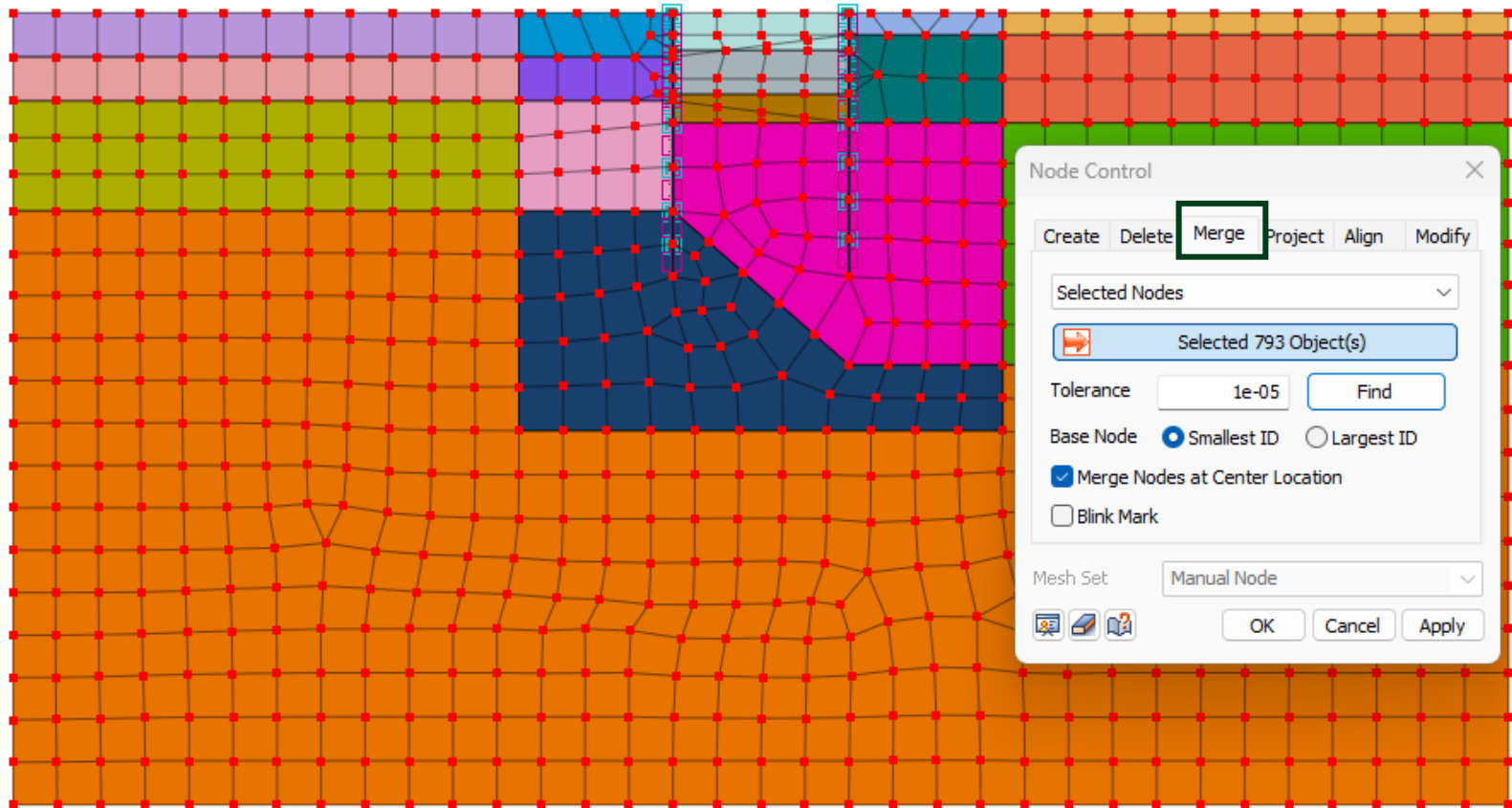
The general **Virtual Thickness Factor** range is **0.01 ~ 0.1**
(If the stiffness is high, use a smaller value)

LOCAL AXIS READJUSTMENT



Changing the axis of the local retaining wall axis

MERGE NODE

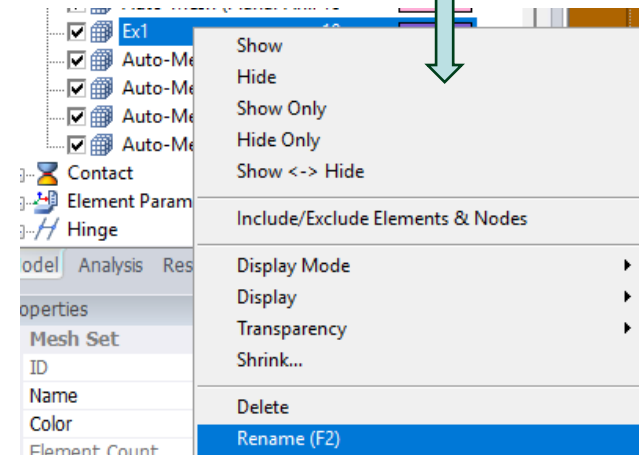
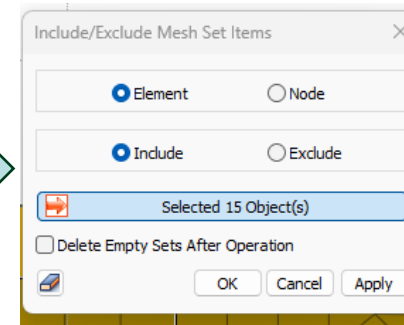
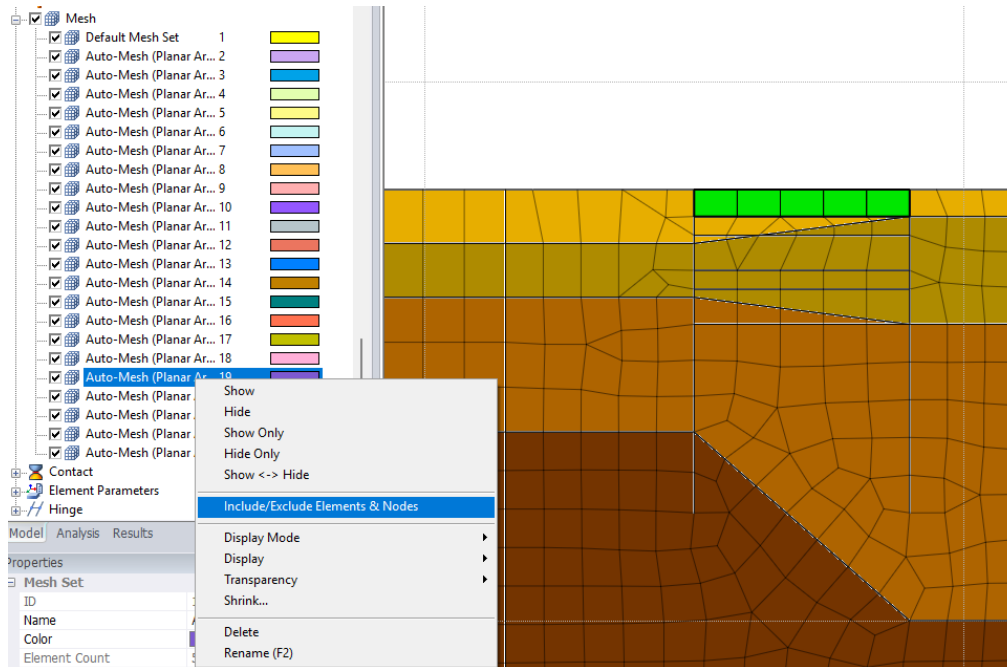


Checking the merge node function for interface

Selecting all nodes → Mesh → Node → Merge → Find

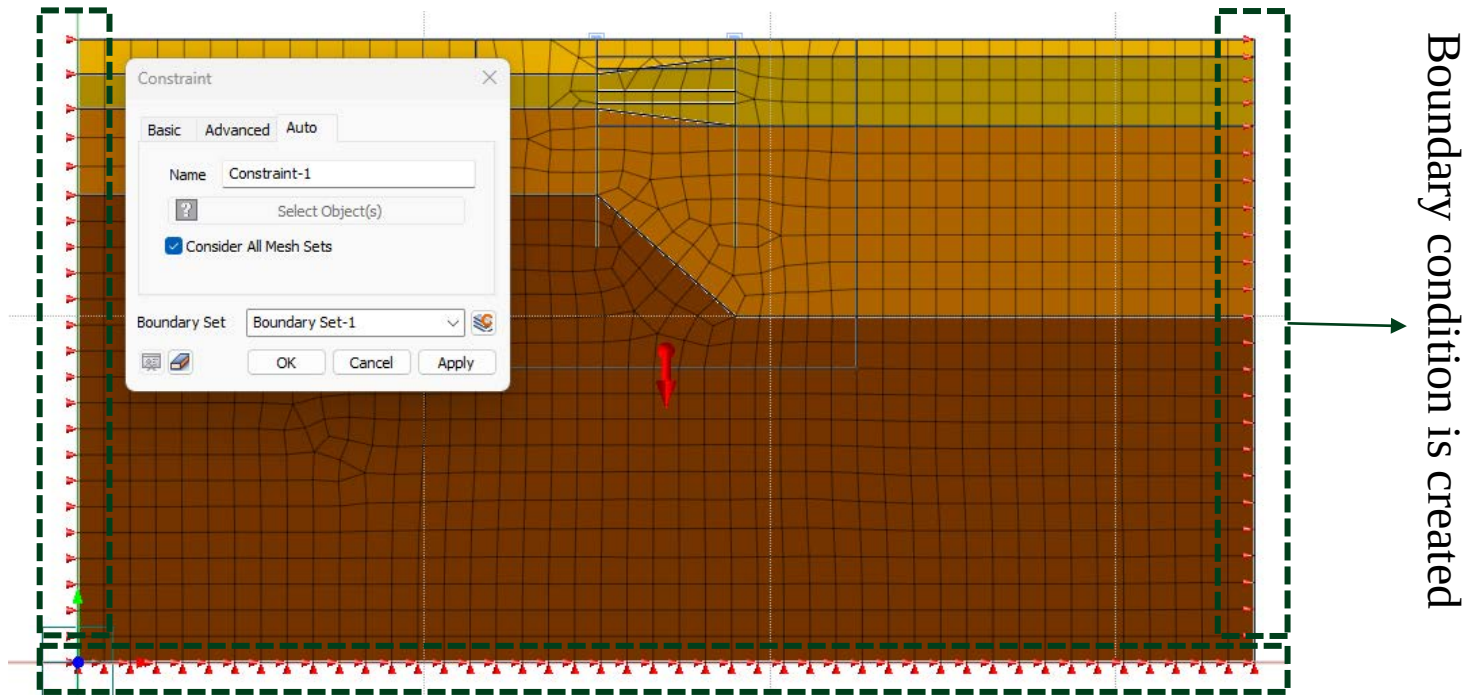
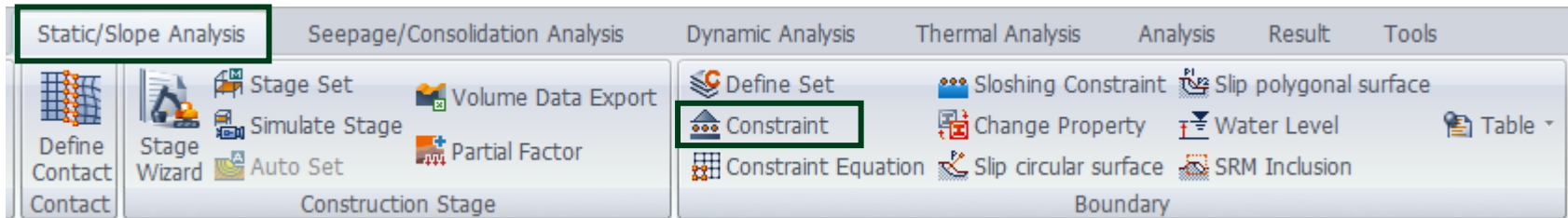
MESH GROUPING

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

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

Sort By: Name

Show Data: Activate

Buttons: Save, Close

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...

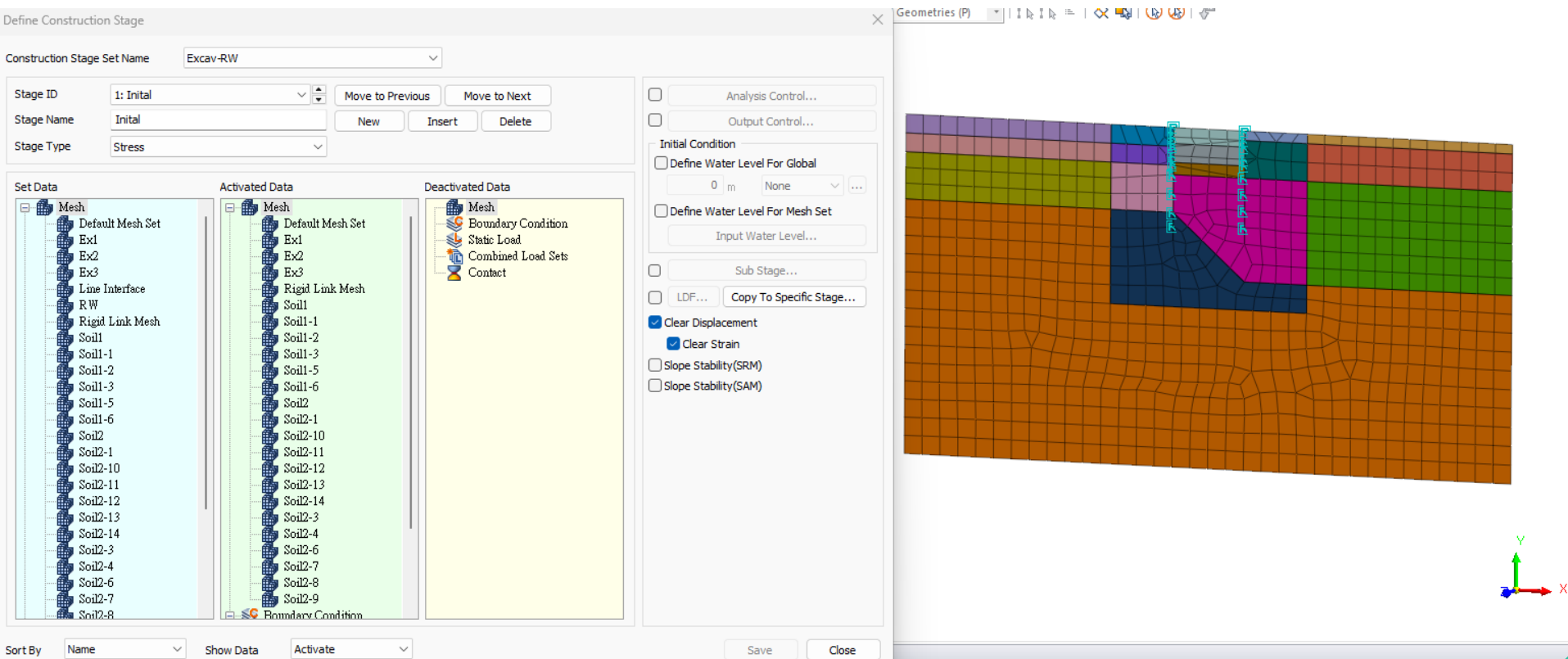
☒ Clear Displacement

☒ Clear Strain

☐ Slope Stability(SRM)

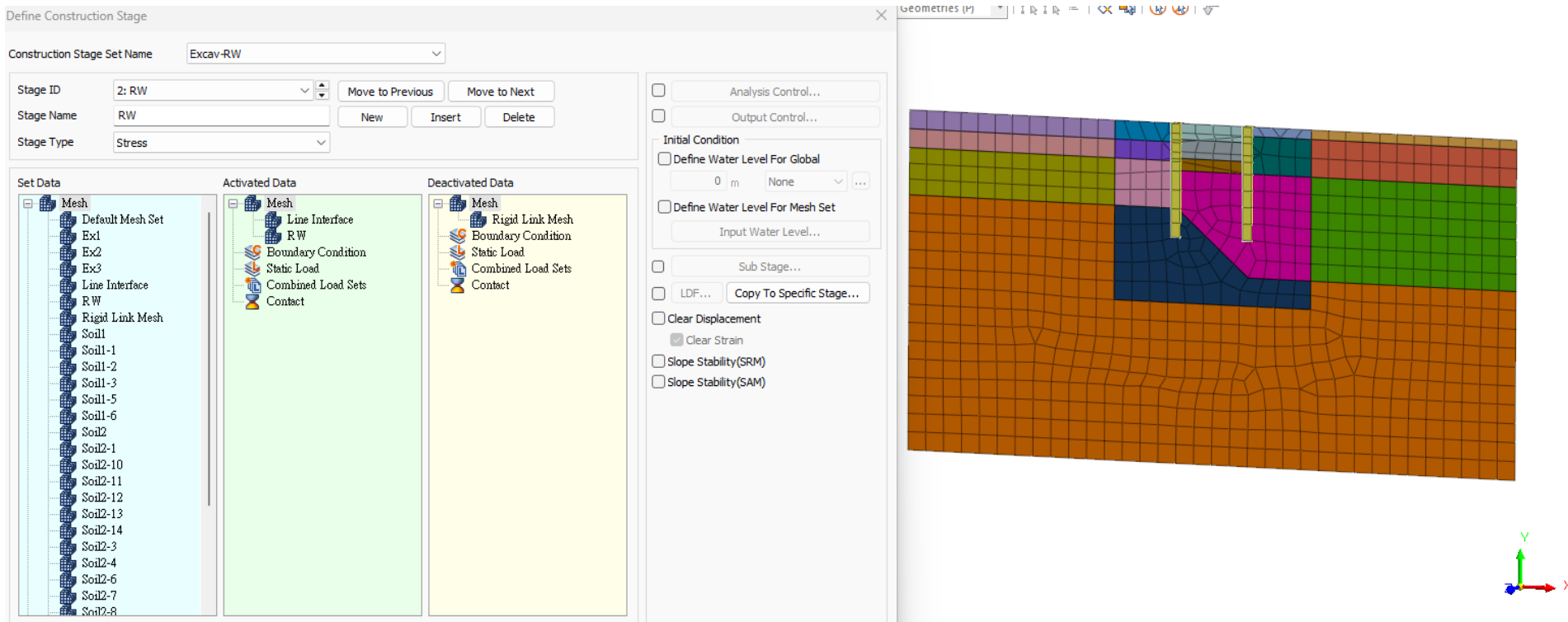
☐ Slope Stability(SAM)

CONSTRUCTION STAGE 1



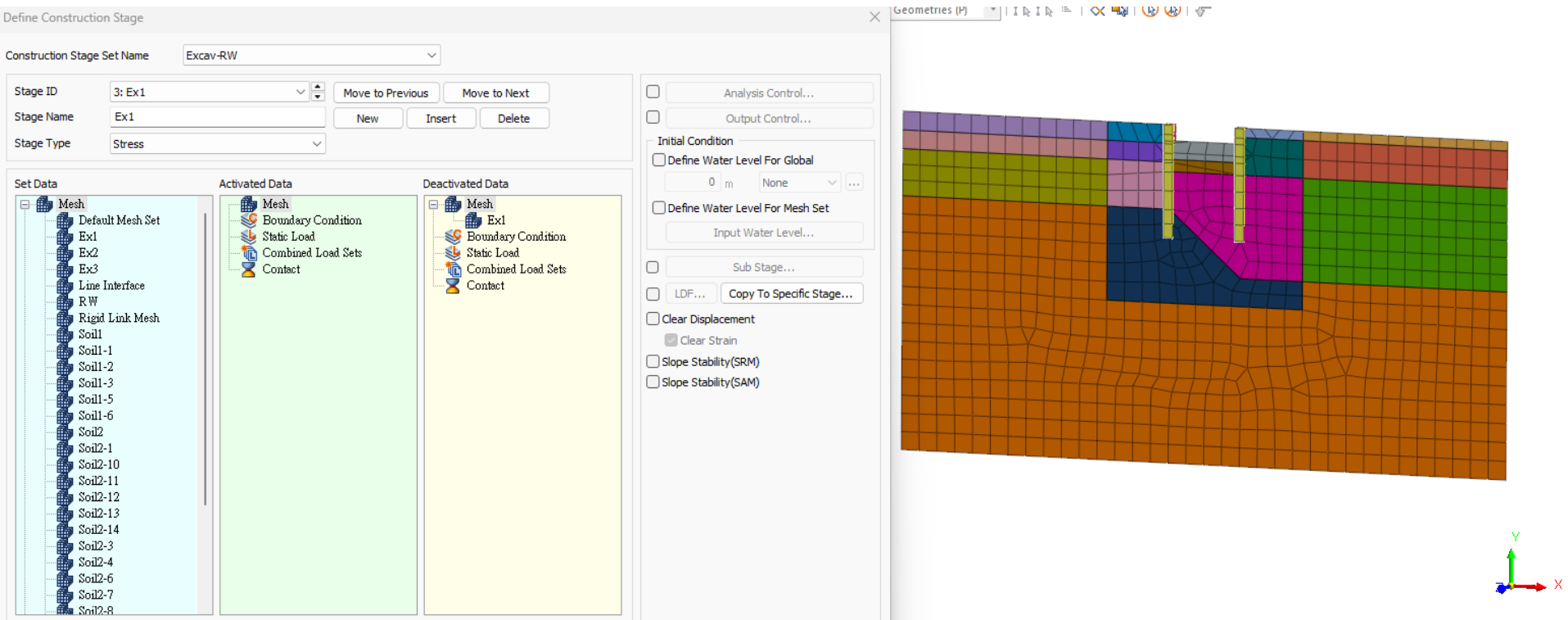
Stage 1: Initial Conditions

CONSTRUCTION STAGE 2



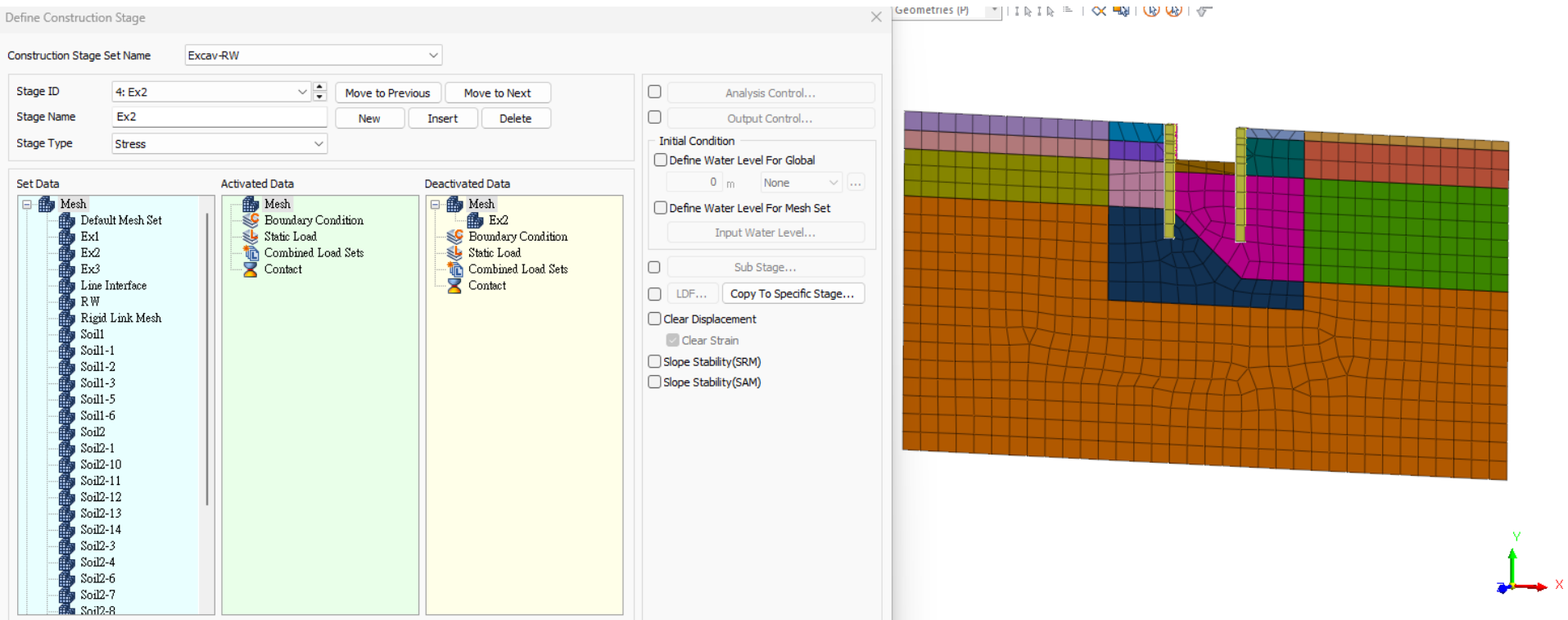
Stage 2: Retaining Wall

CONSTRUCTION STAGE 3



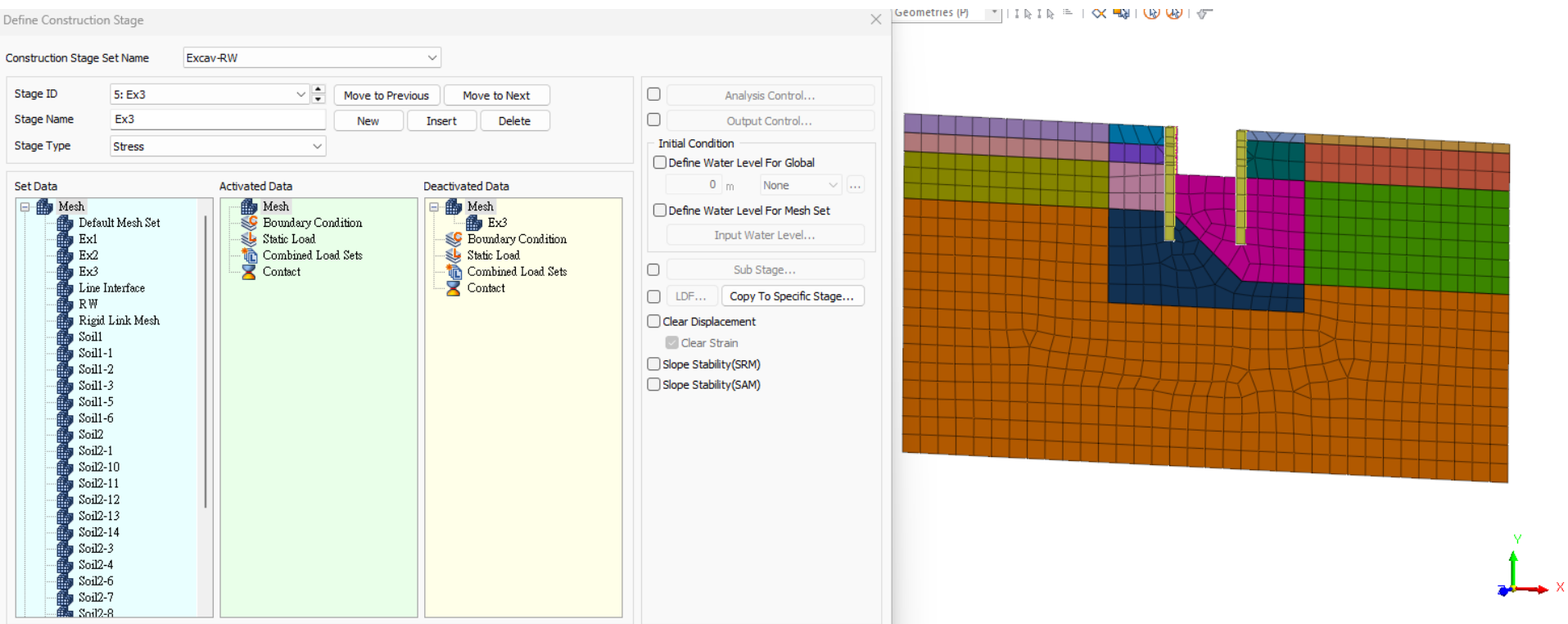
Stage 3: Excavation Layer 1

CONSTRUCTION STAGE 4



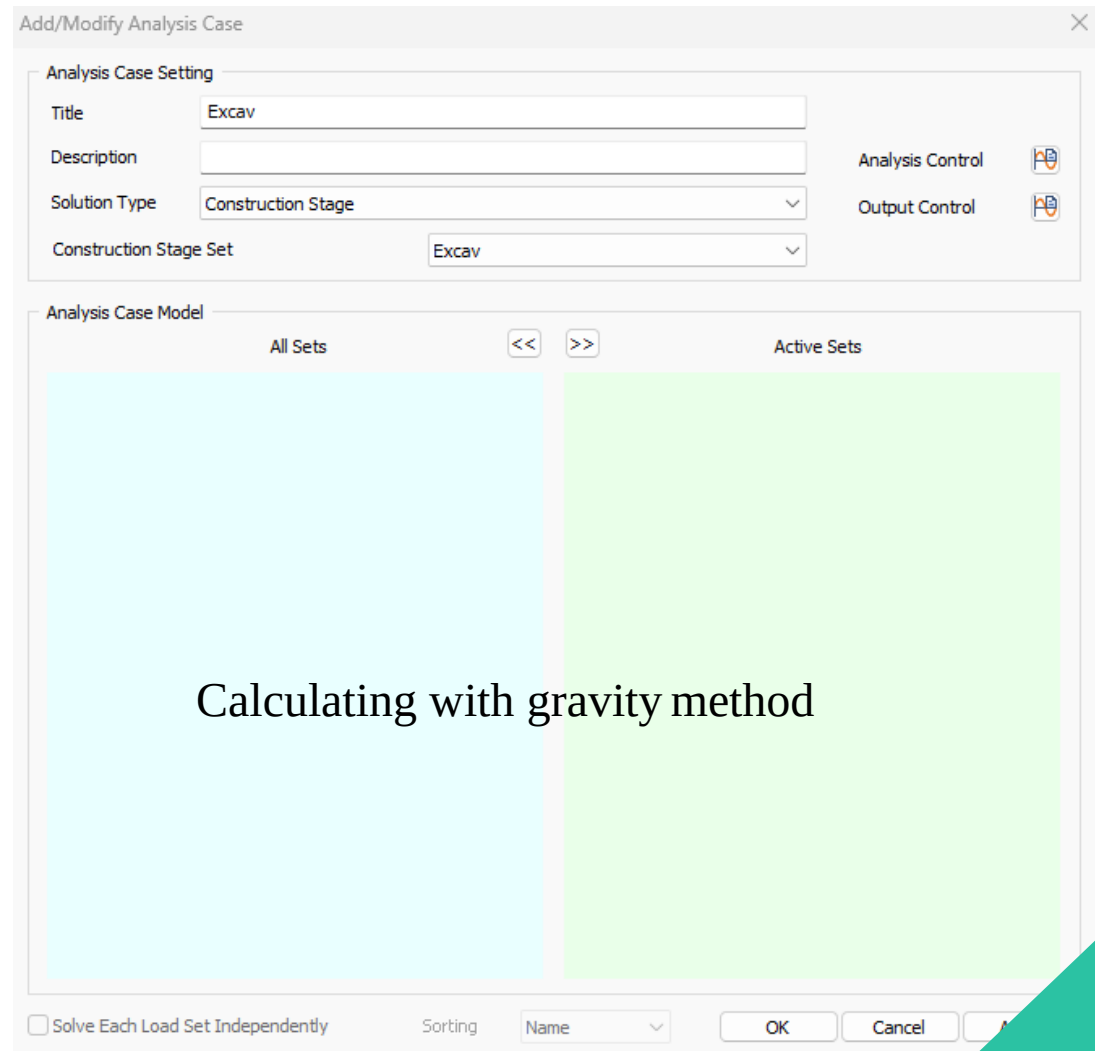
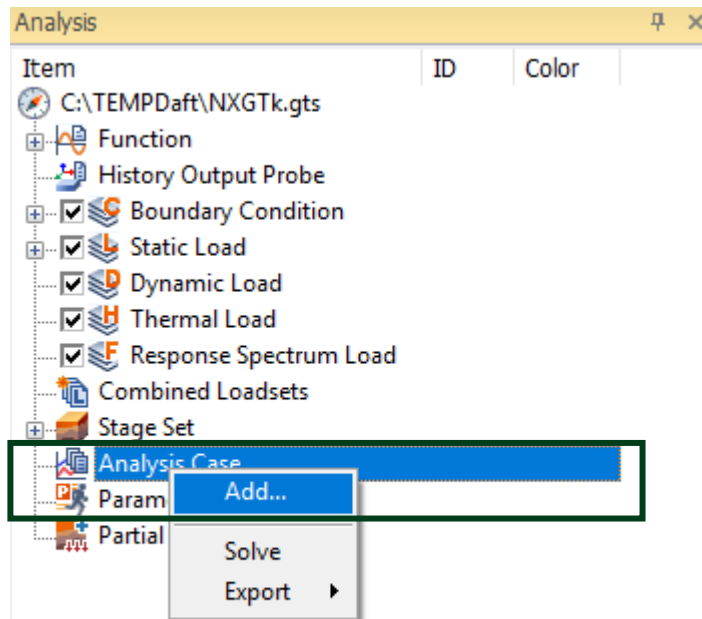
Stage 4: Excavation Layer 2

CONSTRUCTION STAGE 4

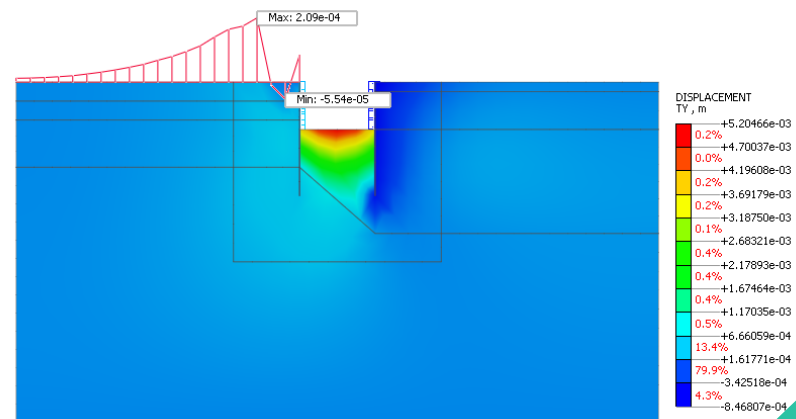
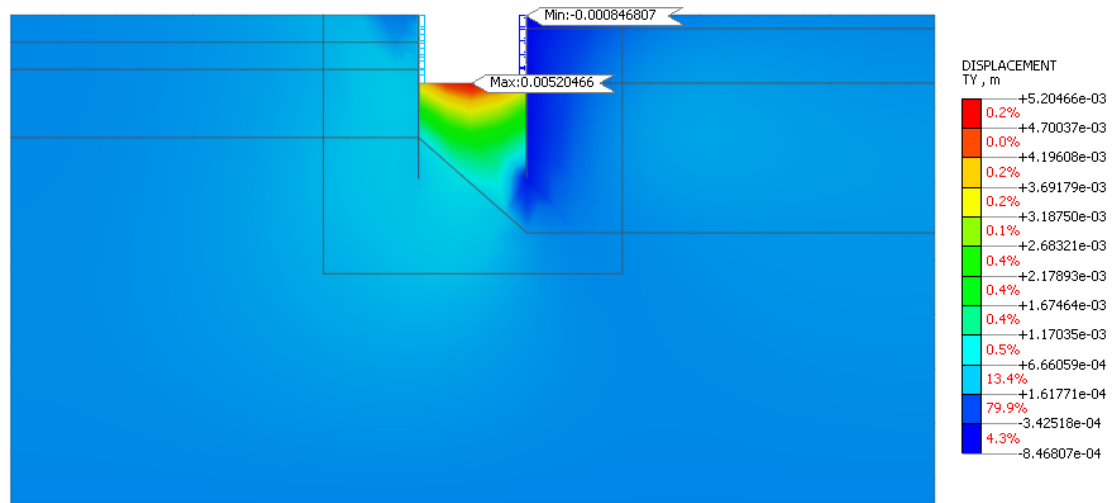
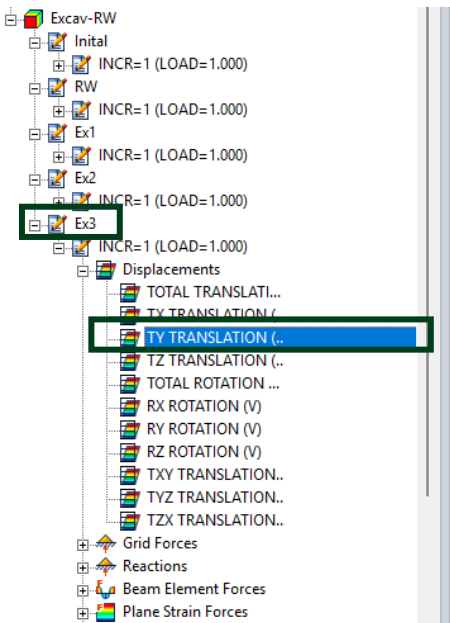


Stage 4: Excavation Layer 3

ANALYSIS CONTROL

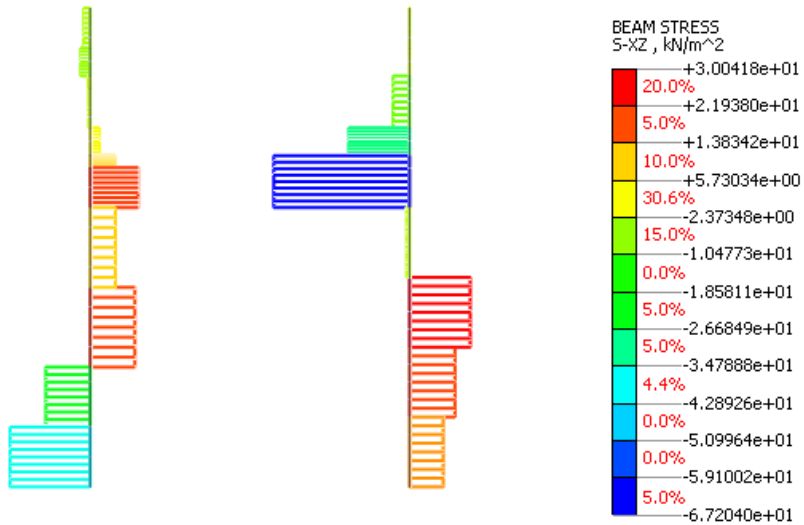


RESULT - VERTICAL DISPLACEMENT

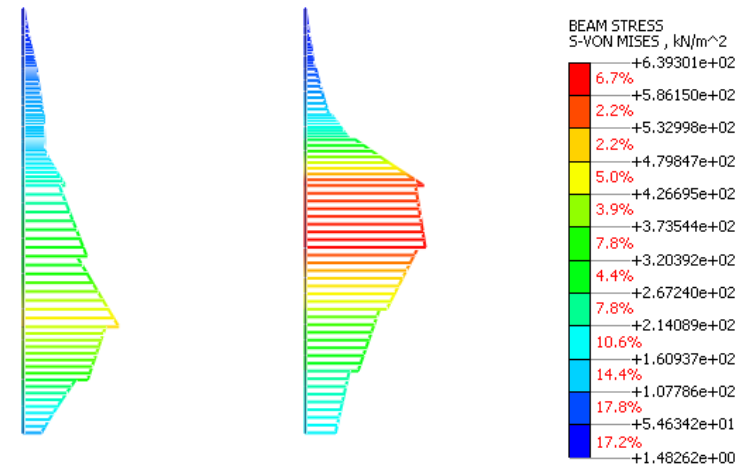


Result → Advanced → Cutting
Diagram

RESULT - BEAM STRESSES



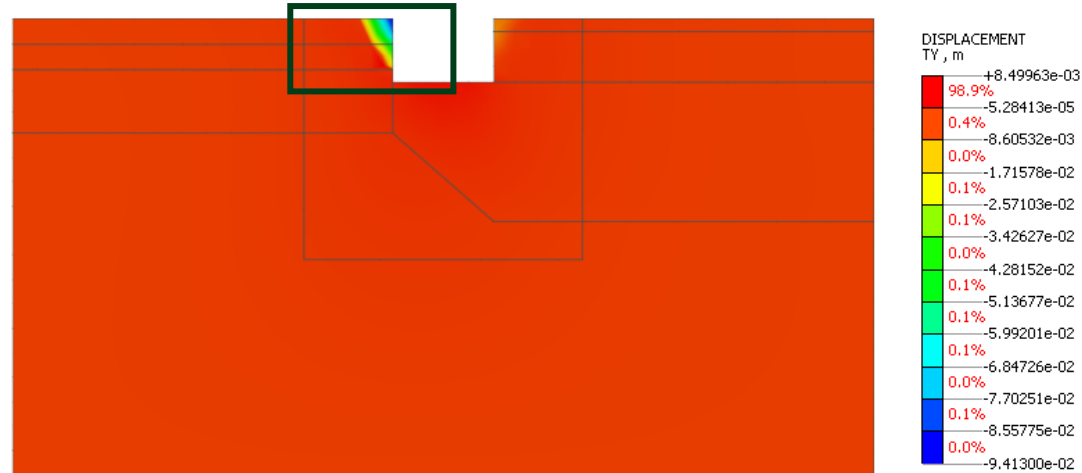
Shear force
Retaining Wall



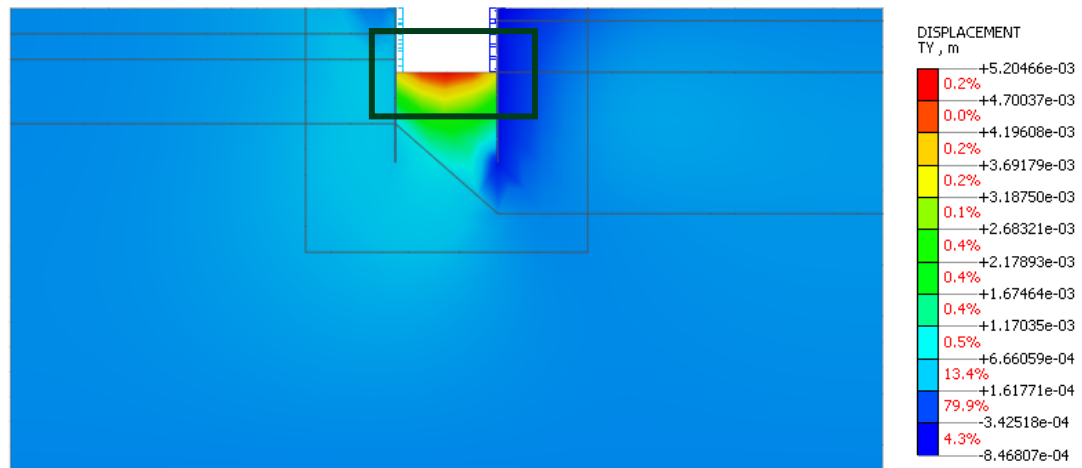
Bending moment
Retaining Wall

RESULT - COMPARISON

Total Displacement
Without RW



Total Displacement
With RW



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