GTS NX

New eXperience of Geo-Technical analysis System

Piled Raft Foundation Analysis

Advanced Course

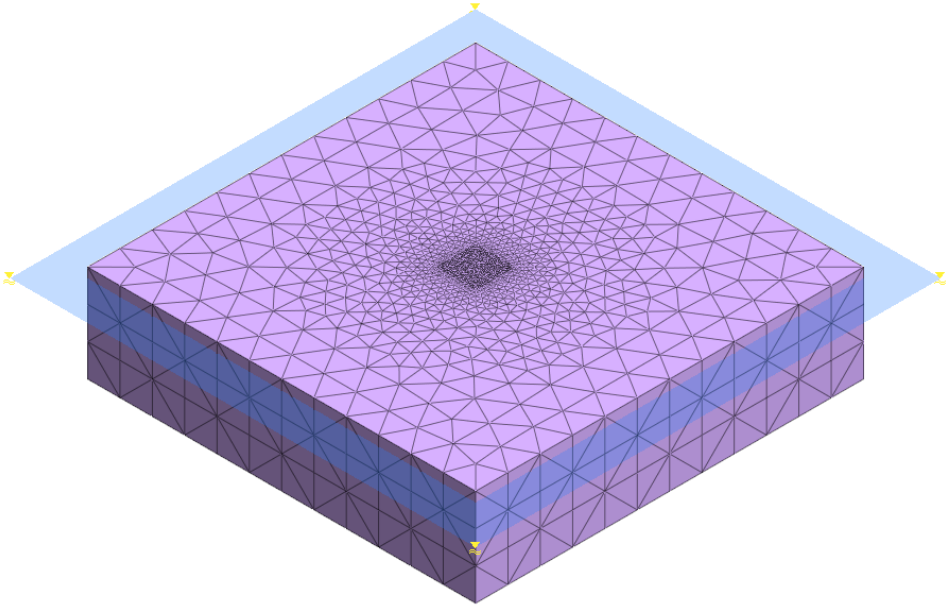
MIDAS

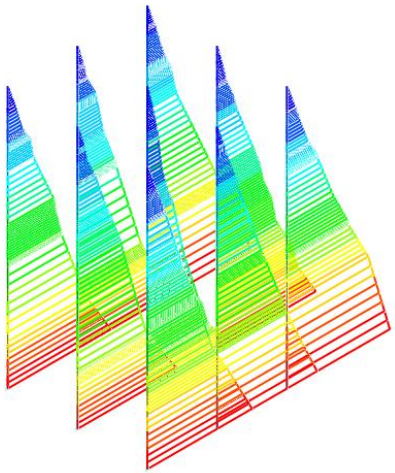
Modeling and Analysis Summary

The model represents 3 stage for piled raft analysis, the raft will be supported group pile (9 numbers).

This tutorial is aiming on performing the analysis to check shaft resistance and tip bearing of piles and forces from piles and raft.

This tutorial will be carried out with “Stress Analysis” and will be considered water level which is 3.0 below from ground level.





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Ground

[unit : kN, m]

Name	Soil
Material	Isotropic
Model Type	Mohr-Coulomb
General	
Elastic Modulus (E) [kN/m^2]	5000
Poisson's Ratio (v)	0.35
Unit Weight (γ) [kN/m^3]	18
Ko	0.5
Porous	
Unit Weight (Saturated) [kN/m^3]	21
Drainage Parameters	Drained
Non-Linear	
Cohesion (c) [kN/m^2]	4
Frictional Angle (Φ) [deg]	30

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Structure

[unit : kN, m]

Name	Pile / Raft
Material	Isotropic
Model Type	Elastic
Elastic Modulus (E) [kN/m^2]	35000000
Poisson's Ratio (v)	0.2
Unit Weight (γ) [kN/m^3]	25

Pile Interface / Tip

[unit : kN, m]

Name	Pile Interface	Pile Tip
Ultimate Shear Force	100	-
Shear Stiffness Modulus (Kt)	5000	-
Normal Stiffness Modulus (Kn)	50000	-
Tip Bearing Capacity	-	100
Tip Spring Stiffness	-	50000

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Geometry Modeling

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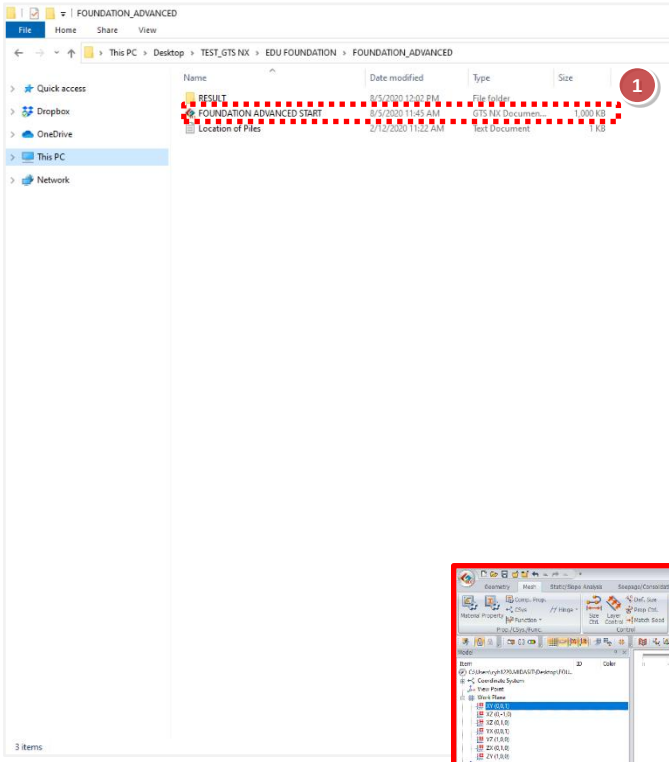
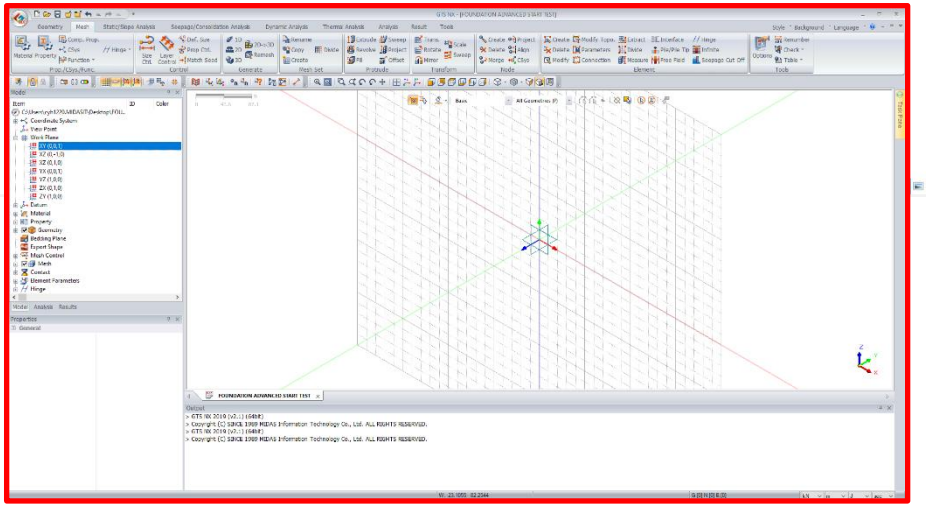
Starting

Procedure

1. Open the start file

   “FOUNDATION ADVANCED START””





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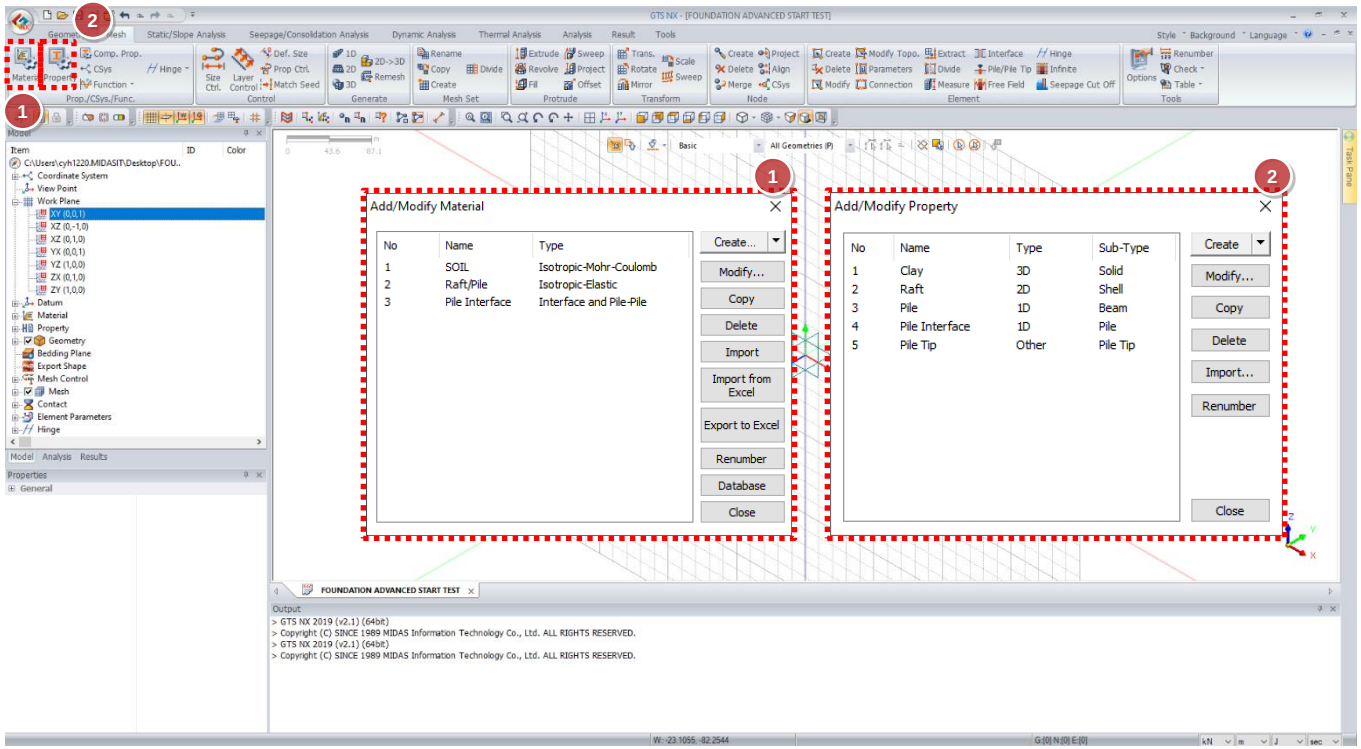
Check the properties

Procedure

1. Check existing materials (Mesh > Prop./CSys./Func. > Material)
2. Check existing properties (Mesh > Prop./CSys./Func. > Property)



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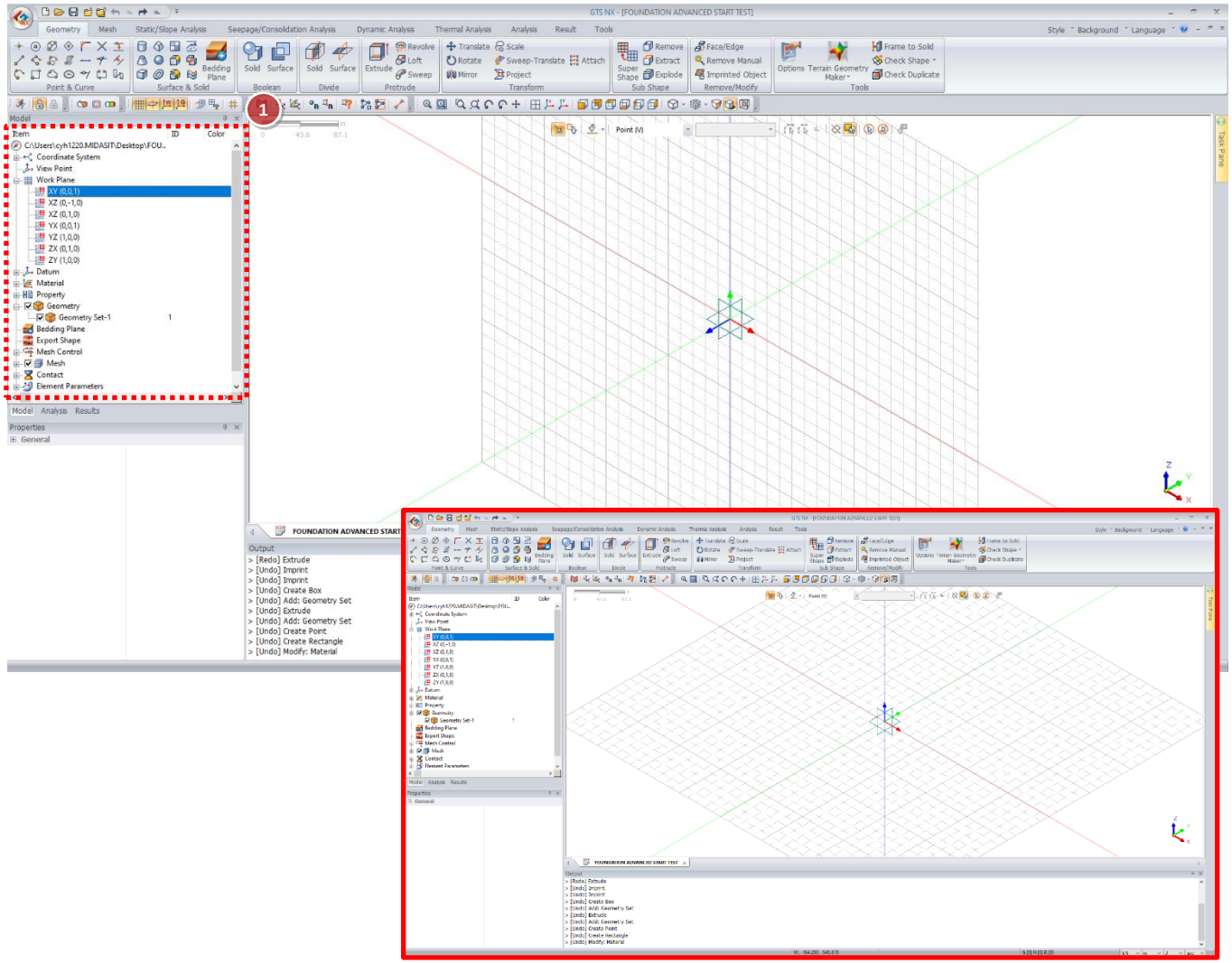
Change Work Plane

Procedure

1. Open “Work Plane” tree
   Double click “XY(0,0,1)”

   [Information]
   You can select work plane to draw or import cad on selected plane



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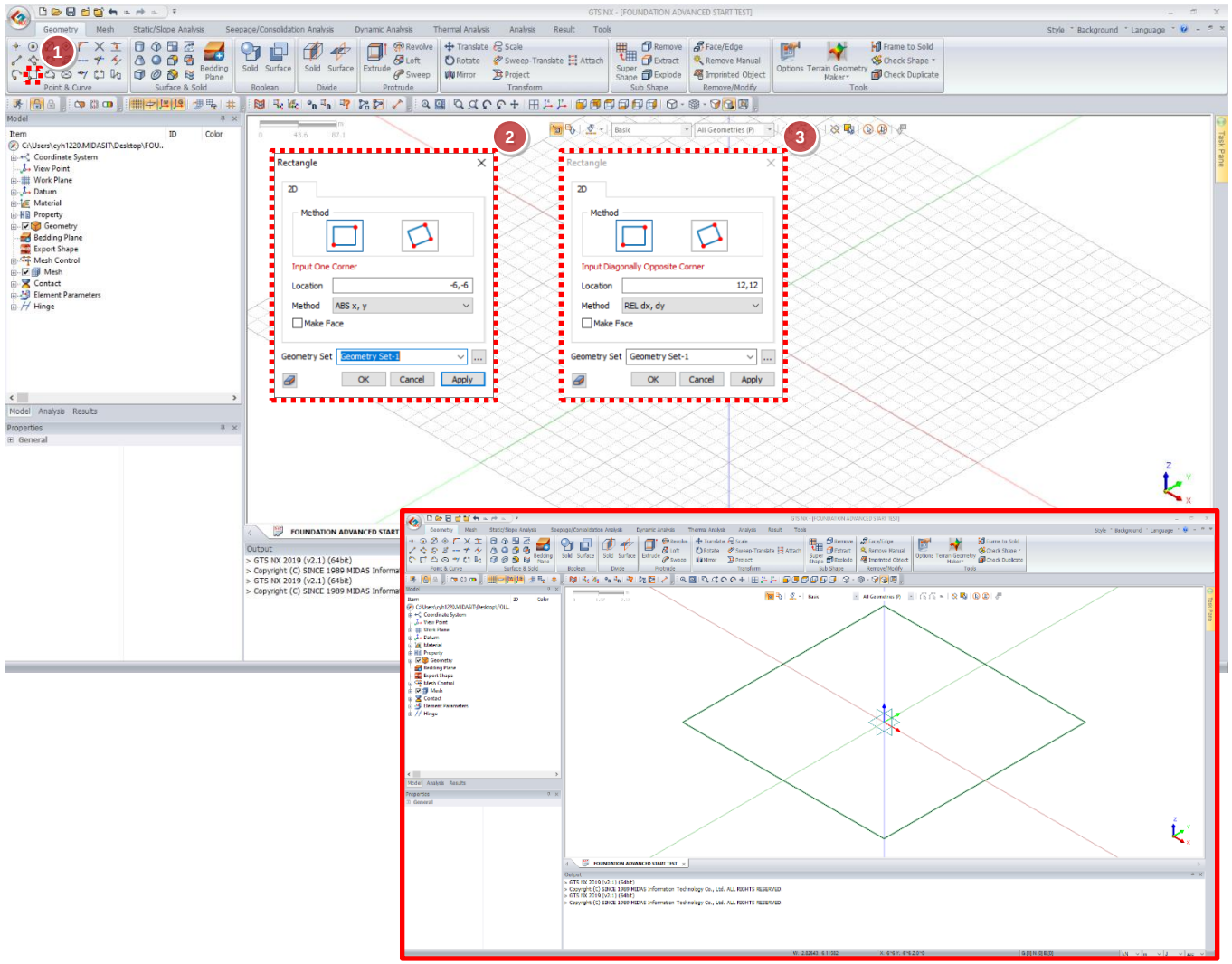
Create rectangle for raft

Procedure

1. Click “Rectangle”
2. Location: -6,-6
   Method: ABS x,y
   Click “Apply”
3. Location: 12,12
   Method: REL dx,dy
   Click “OK”



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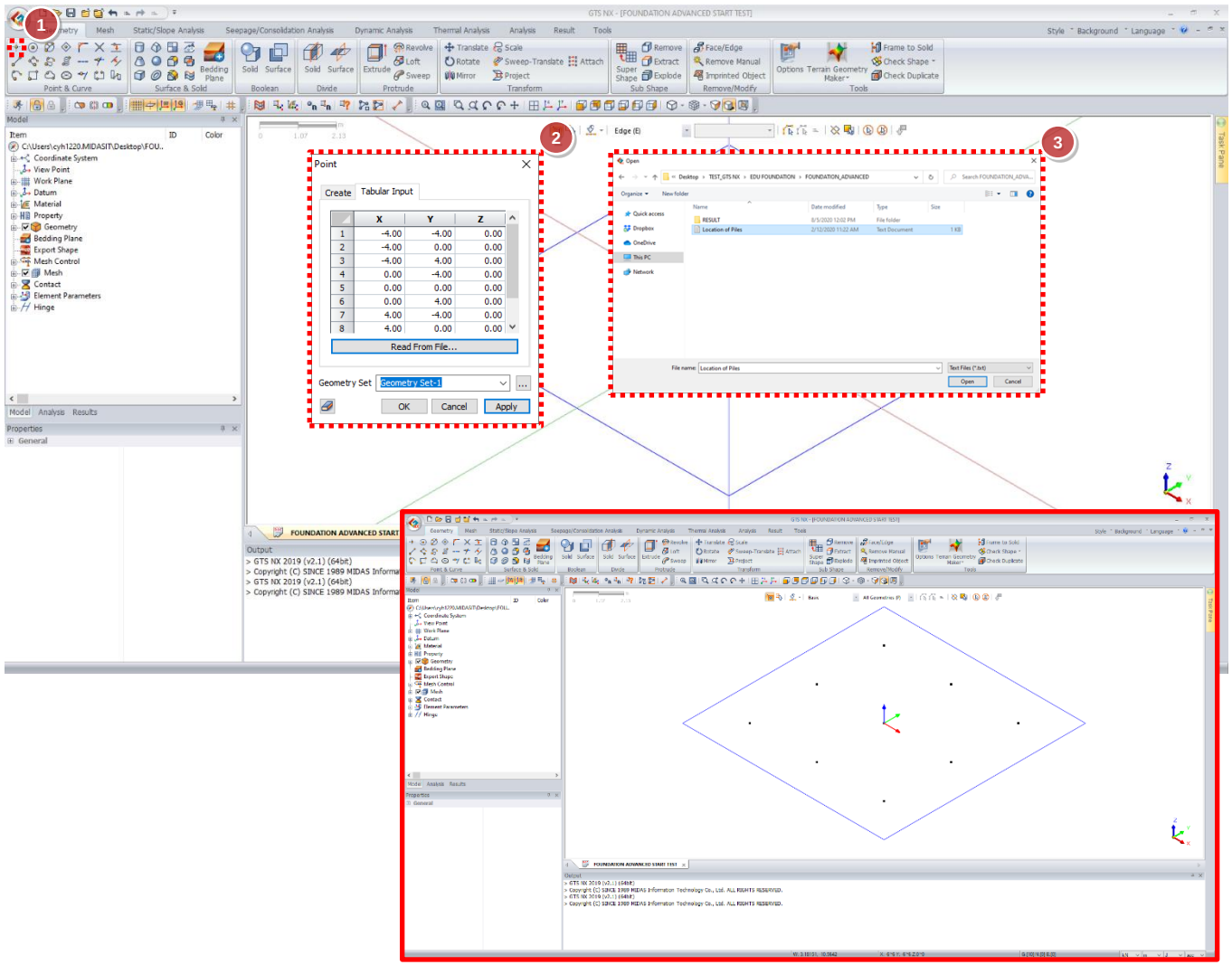
Create Pile geometry

Procedure

1. Click “Point”
2. Go to “Tabular Input” tab
   Click “Read From File…”
3. Select “Location of Piles”
   Click “Open”

   Click “OK”



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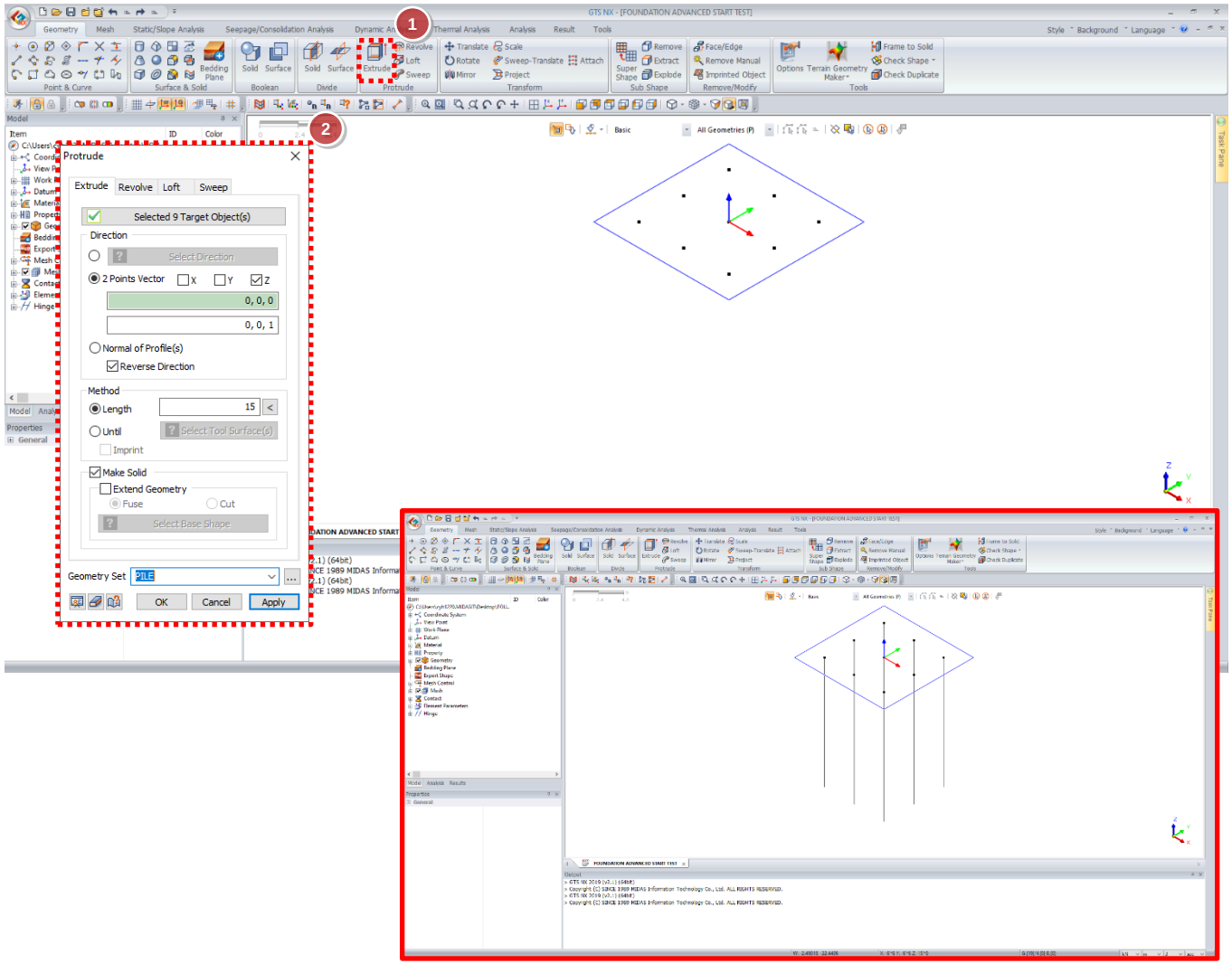
Create Pile geometry

Procedure

1. Click “Extrude”

2. Select Target Object(s)
   (9 Points)
   Select 2 Points Vector Z only
   Check on Reverse Direction
   Length: 15
   Geometry Set: PILE
   Click “OK”



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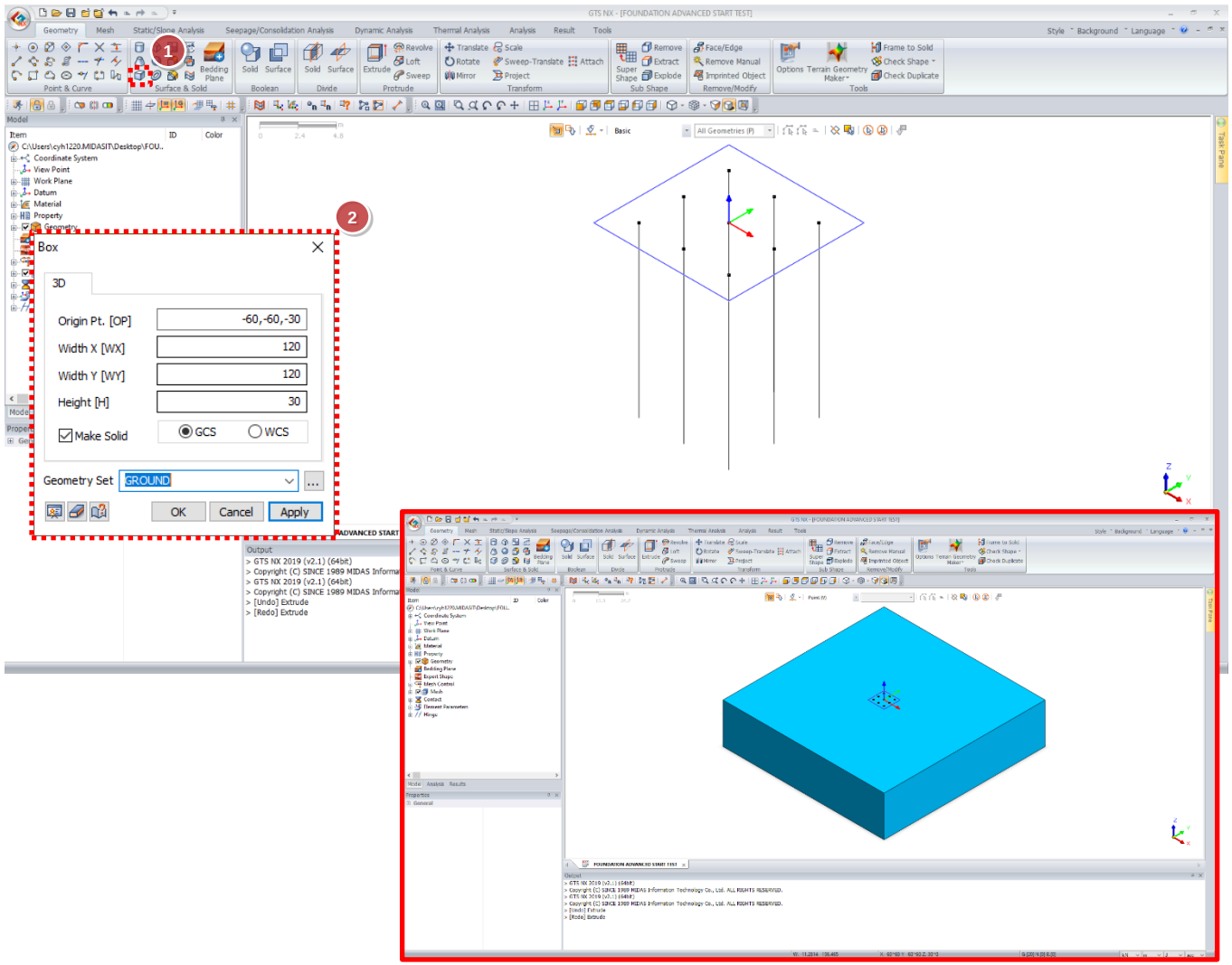
Create Ground geometry

Procedure

1. Click “Box”

2. Orign Pt.: -60,-60,-30
   Width X: 120
   Width Y: 120
   Height: 30
   Geometry Set: Ground
   Click “OK”

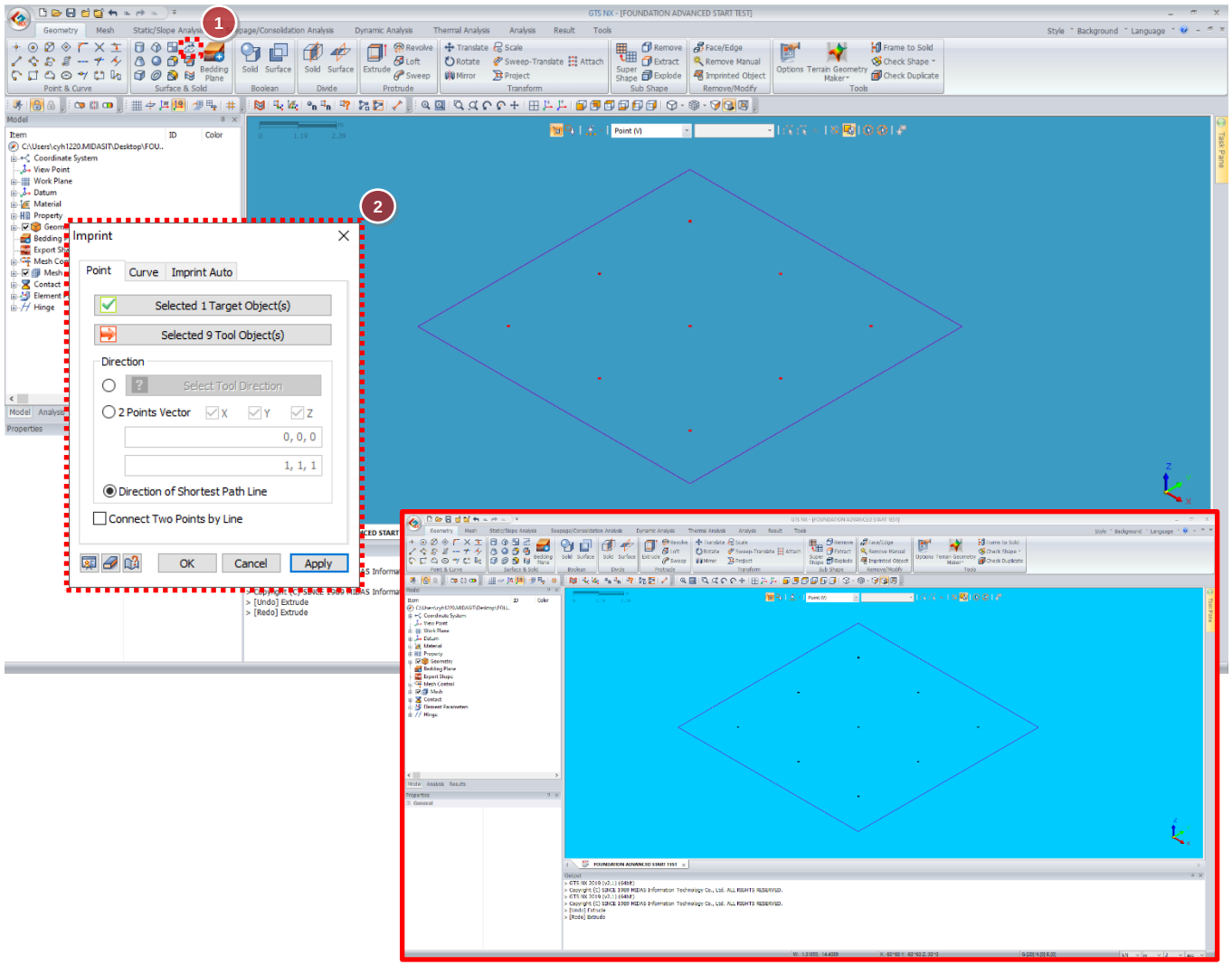


Imprint points on ground surface

Procedure

1. Click “Imprint”

2. Point tab
   Select Target Object:
   ground surface
   Select Tool Object:
   point of pile head (9 Nos.)
   Select “Direction of Shortest Path Line”
   Click “OK”

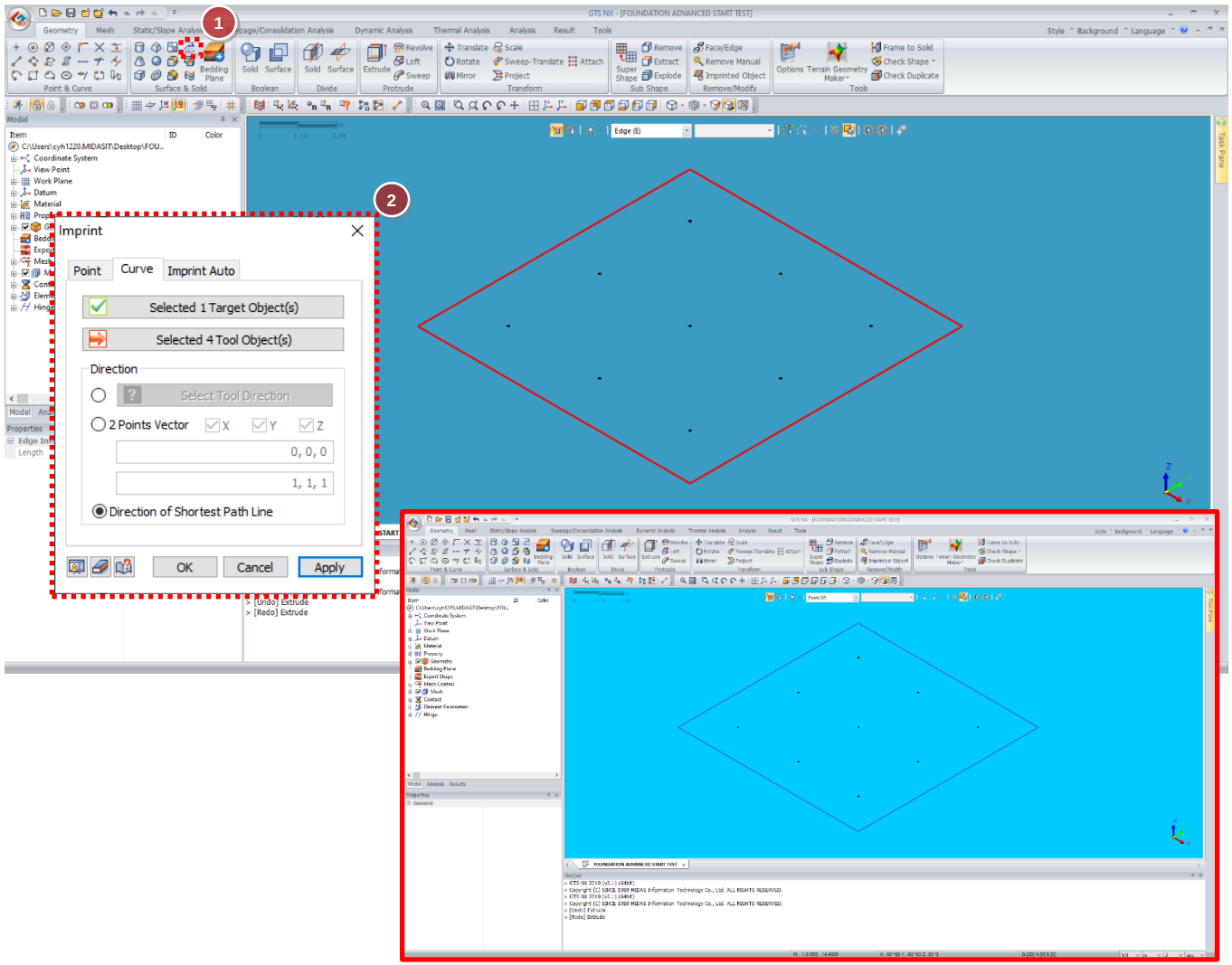


Imprint curves on ground surface

Procedure

1. Click “Imprint”

2. Curve tab
   Select Target Object:
   ground surface
   Select Tool Object:
   lines for raft (4 Nos.)
   Select “Direction of Shortest Path Line”
   Click “OK”

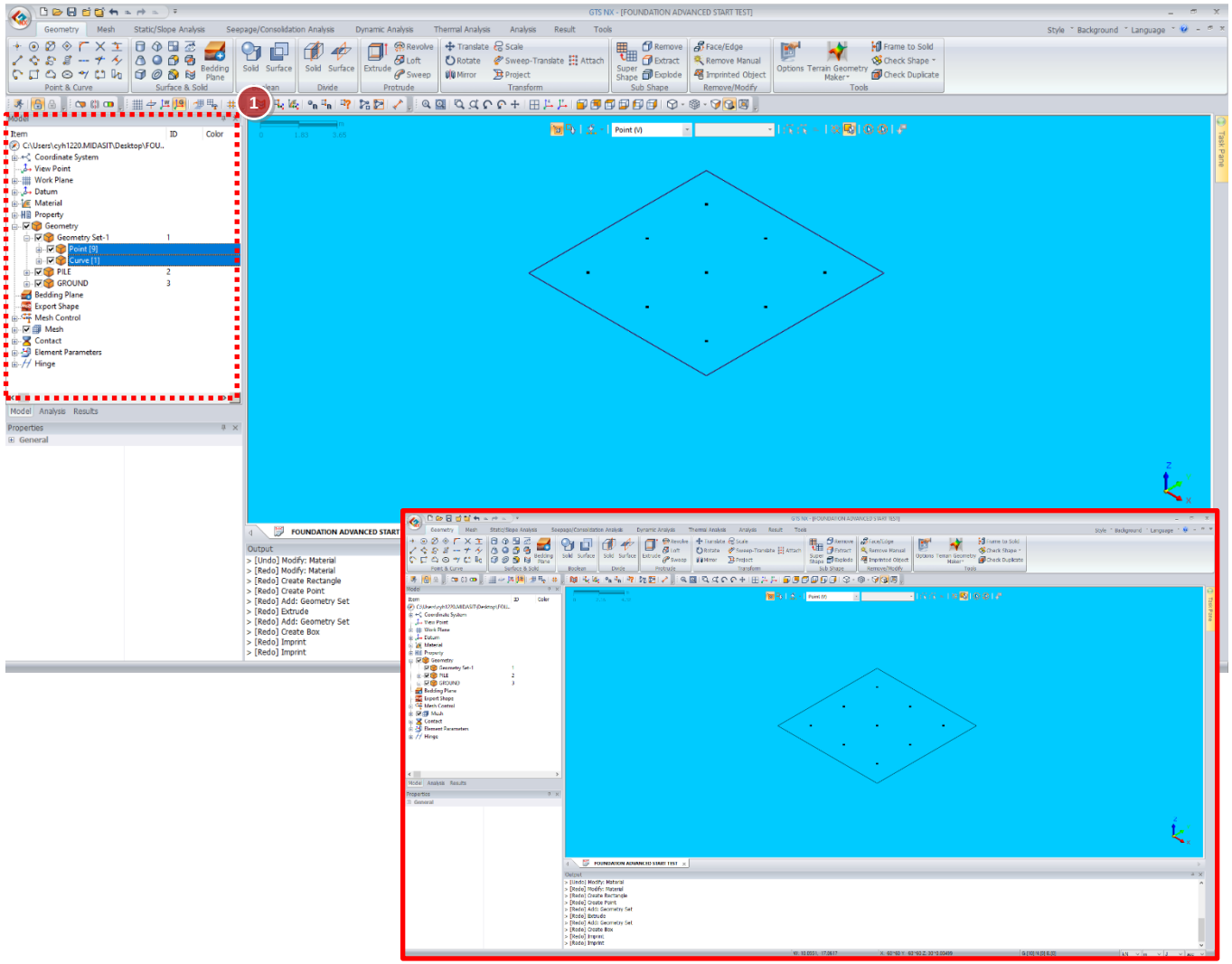


Imprint curves on ground surface

Procedure

1. Open Geometry tree
   Delete Points (9) and Curve (1) under Geometry Set-1

   [Information]
   After imprint stage, lines and points will be remained which are imprinted on the face.



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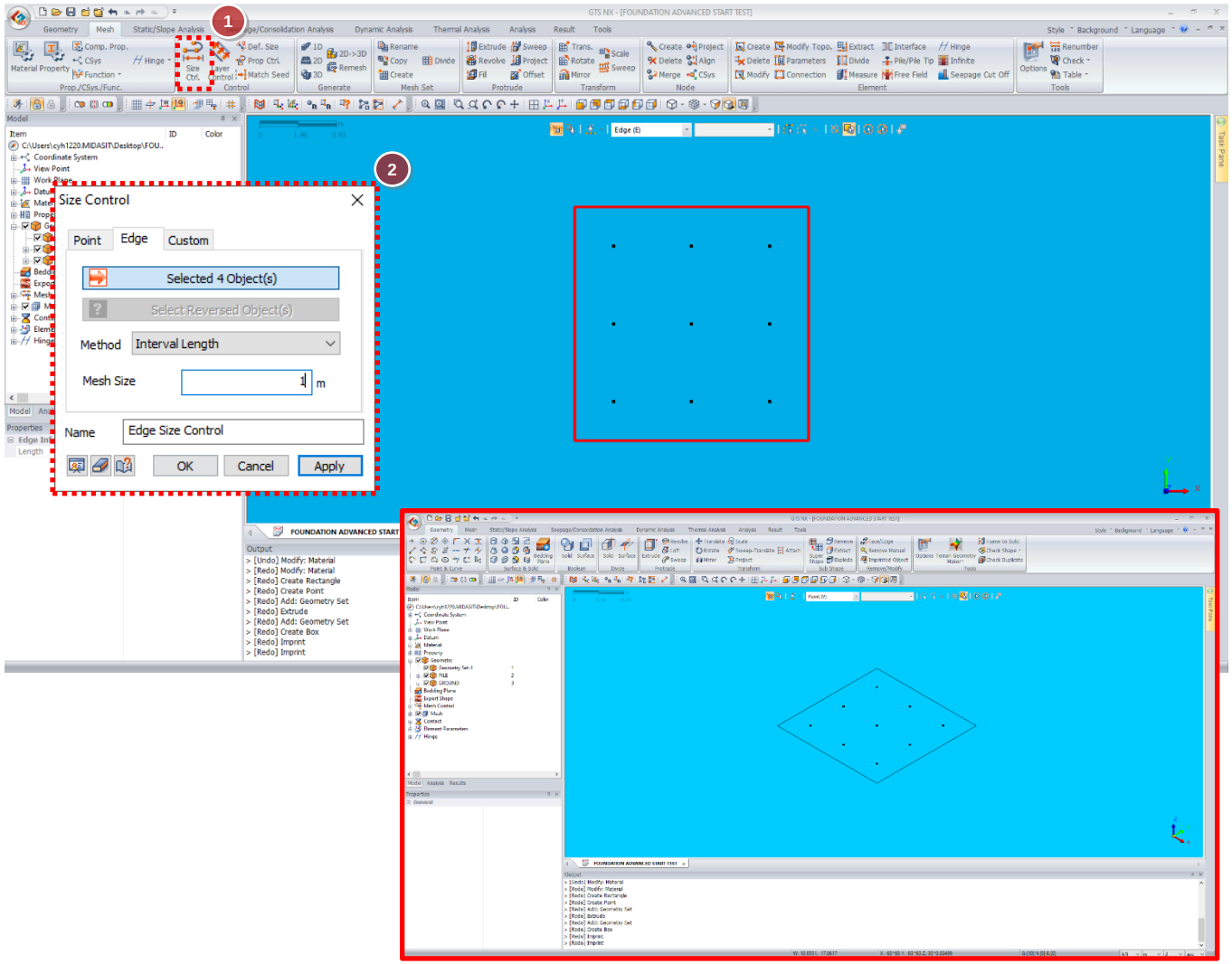
Control mesh size

Procedure

1. Click “Size Ctrl.”

2. Edge tab
   Select 4 lines from raft
   Mesh Size: 1m
   Click “OK”



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Mesh Generation

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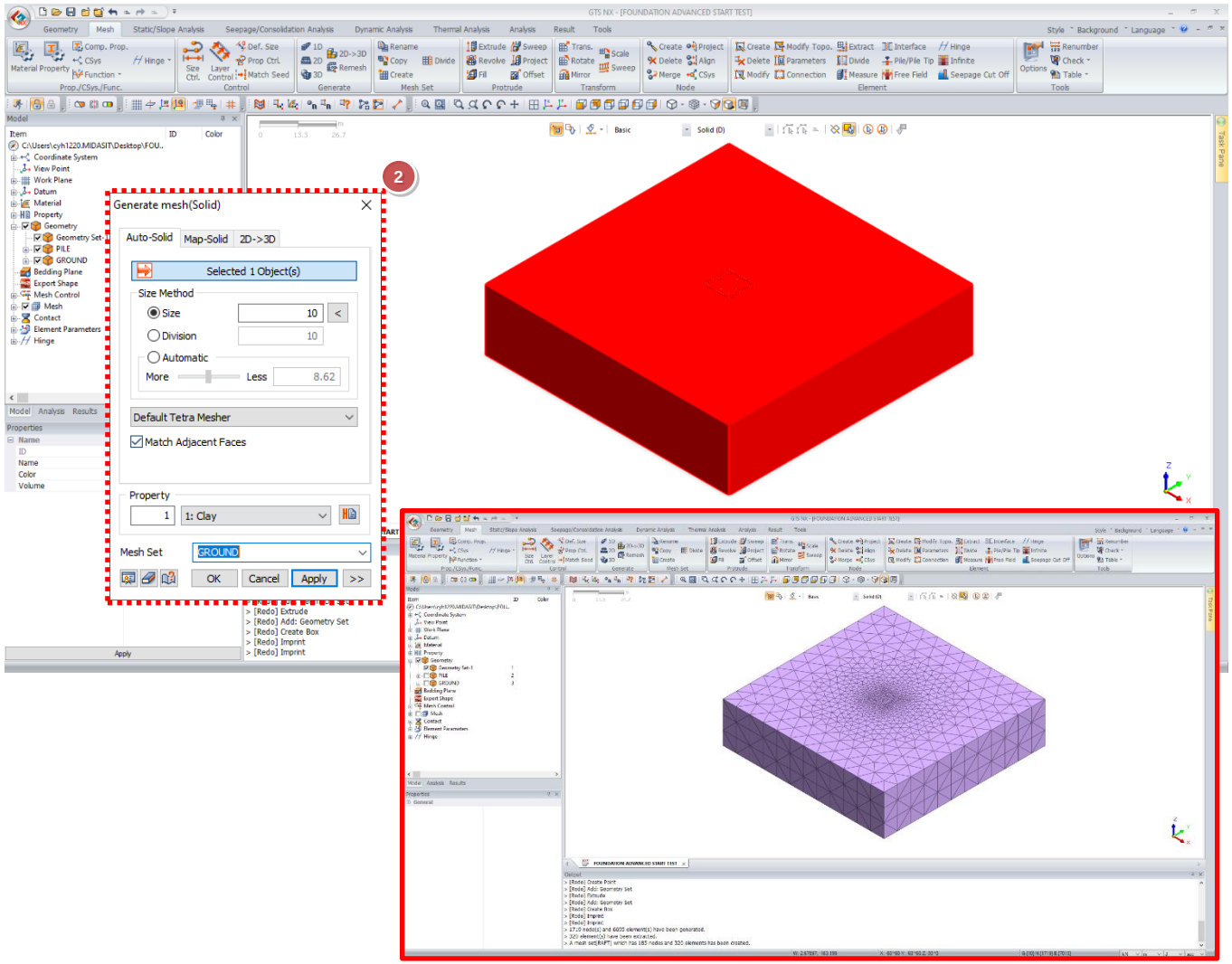
Generate the mesh for ground

Procedure

1. Select Solid
   Right click from mouse
   Click “Generate Mesh”

2. Size Method: 10 m
   Mesh Set: GROUND
   Click “OK”



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Generate the mesh for raft

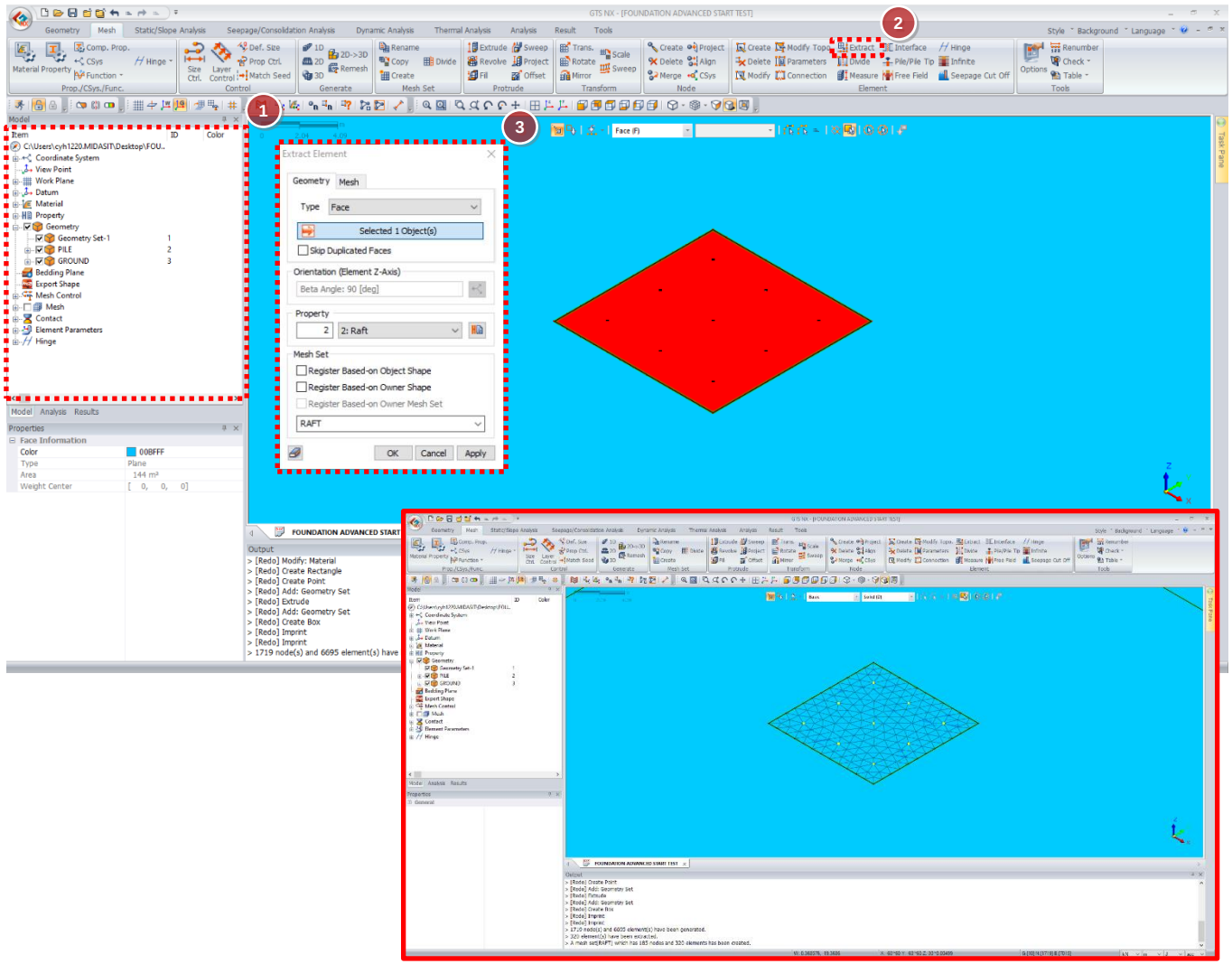
Procedure

1. <Geometry Tree>
   Show every geometry

   <Mesh Tree>
   Hide every mesh set

2. Click “Extract”

3. Type: Face
   Select face of raft
   Mesh Set: RAFT
   Click “OK”



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Generate the mesh for pile

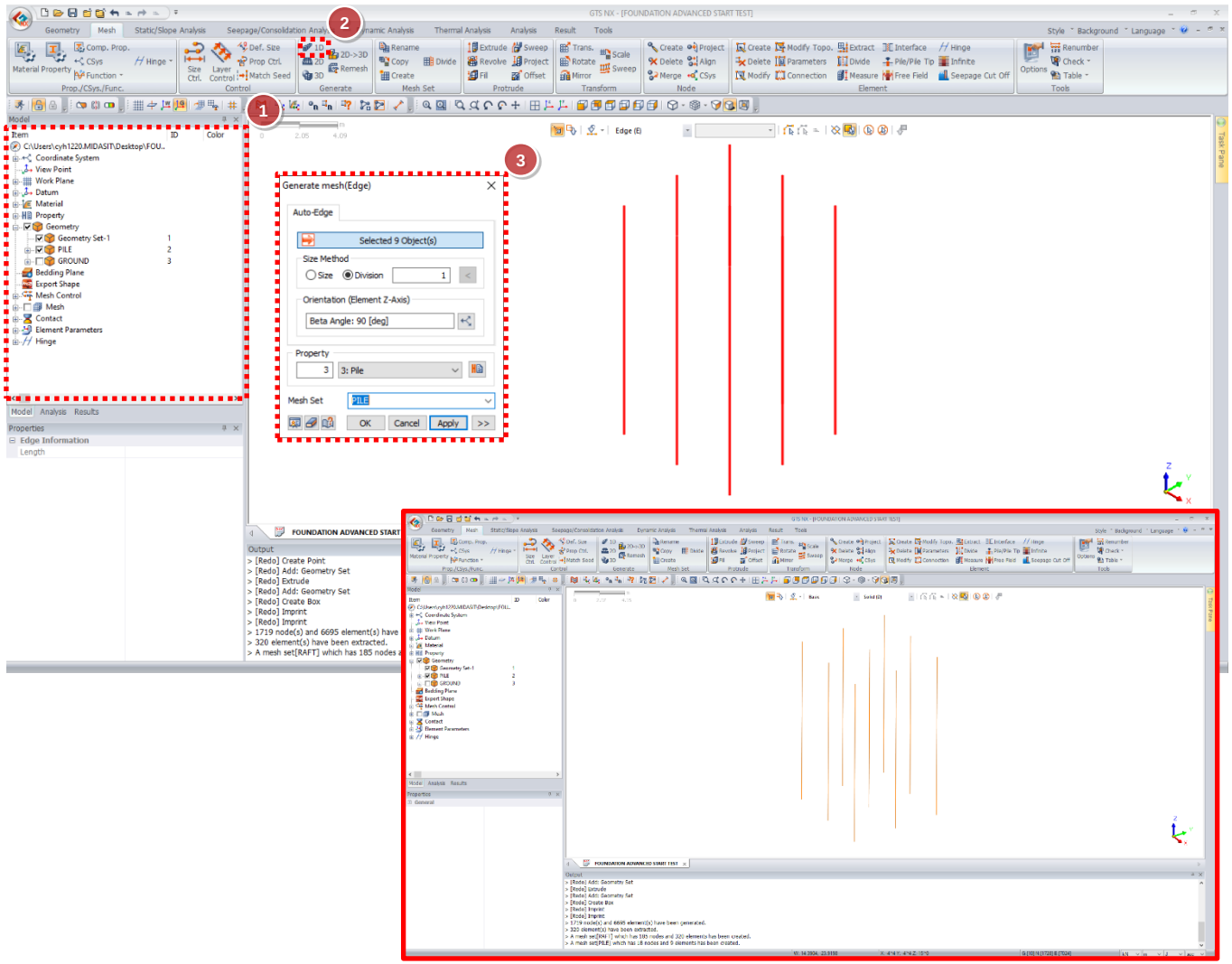
Procedure

1. <Geometry Tree>
   Show only pile geometry

   <Mesh Tree>
   Hide every mesh set

2. Click “1D”

3. Division: 1
   Property: Pile
   Mesh Set: PILE
   Click “OK”



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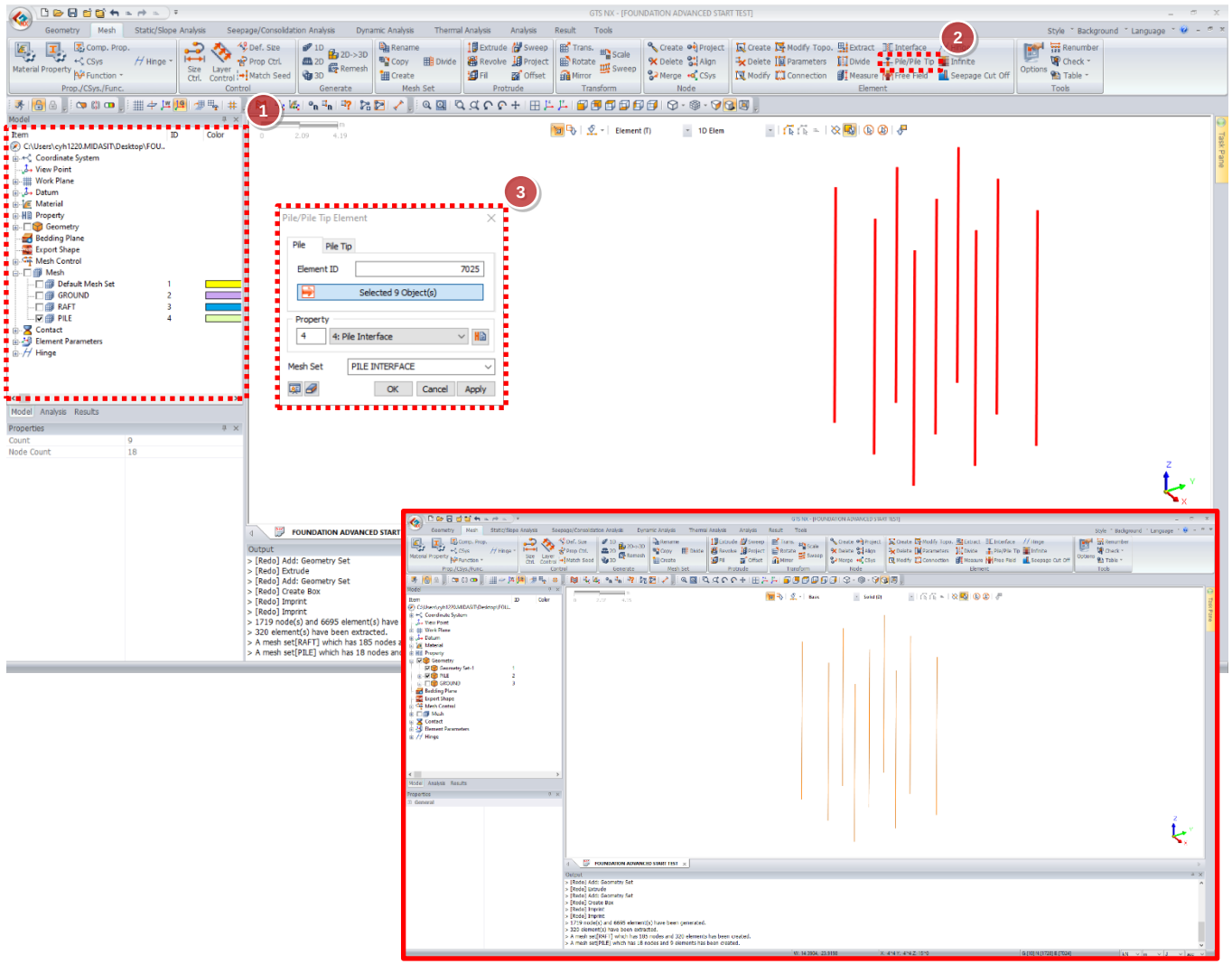
Generate the mesh for pile interface

Procedure

1. <Geometry Tree>
   Hide every geometry

   <Mesh Tree>
   Show only PILE mesh set
2. Click “Pile/Pile Tip”
3. Select piles (9 Nos.)
   Click “Apply”



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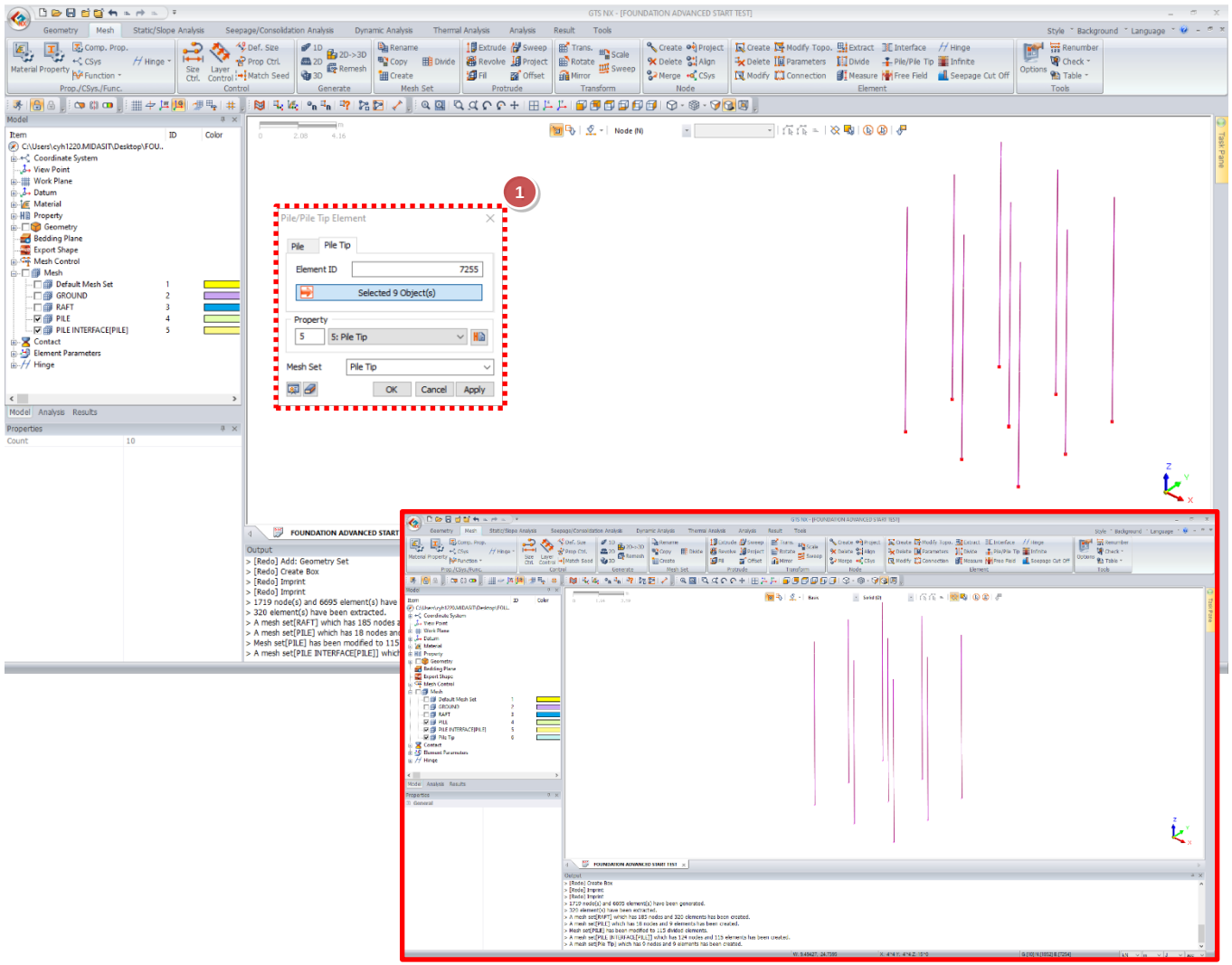
Generate the mesh for pile tip

Procedure

1. Go to Pile Tip tab
   Select pile toes (9 Nos.)
   Mesh Set: Pile Tip
   Click “OK”



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Generate the mesh for pile tip

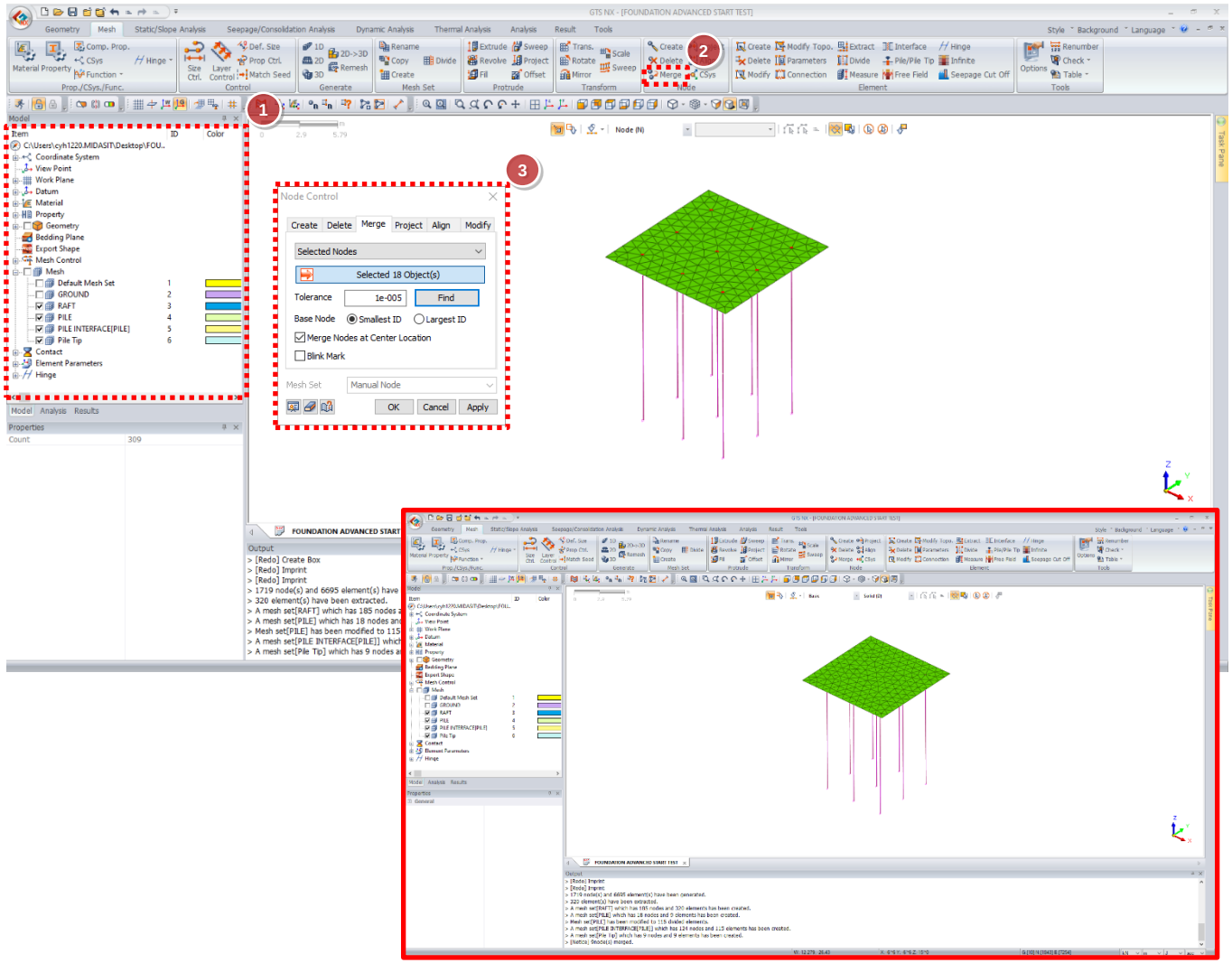
Procedure

1. <Geometry Tree>
   Hide every geometry

   <Mesh Tree>
   Hide only GROUND mesh

2. Click “Merge”

3. Select every nodes (Ctrl+a)
   Click “Find”
   Selected object will be changed to 18 Nos.
   Click “OK”



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Load & Boundary Condition

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05 Load & Boundary Condition

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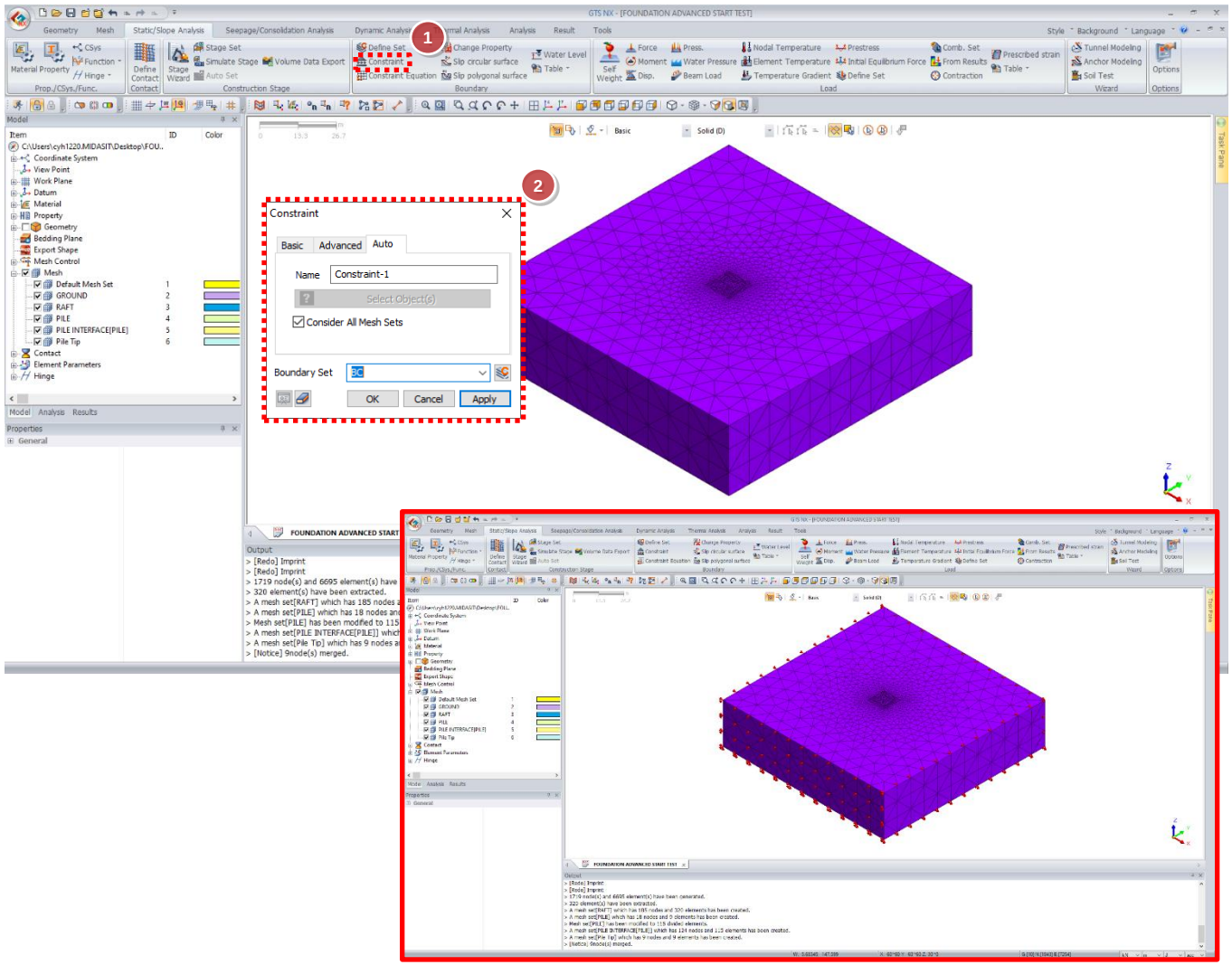
Make boundary condition to ground

Procedure

1. Click “Constraint”
2. Go to “Auto” tab
   Boundary Set name “BC”
   Click “OK”



GTS NX

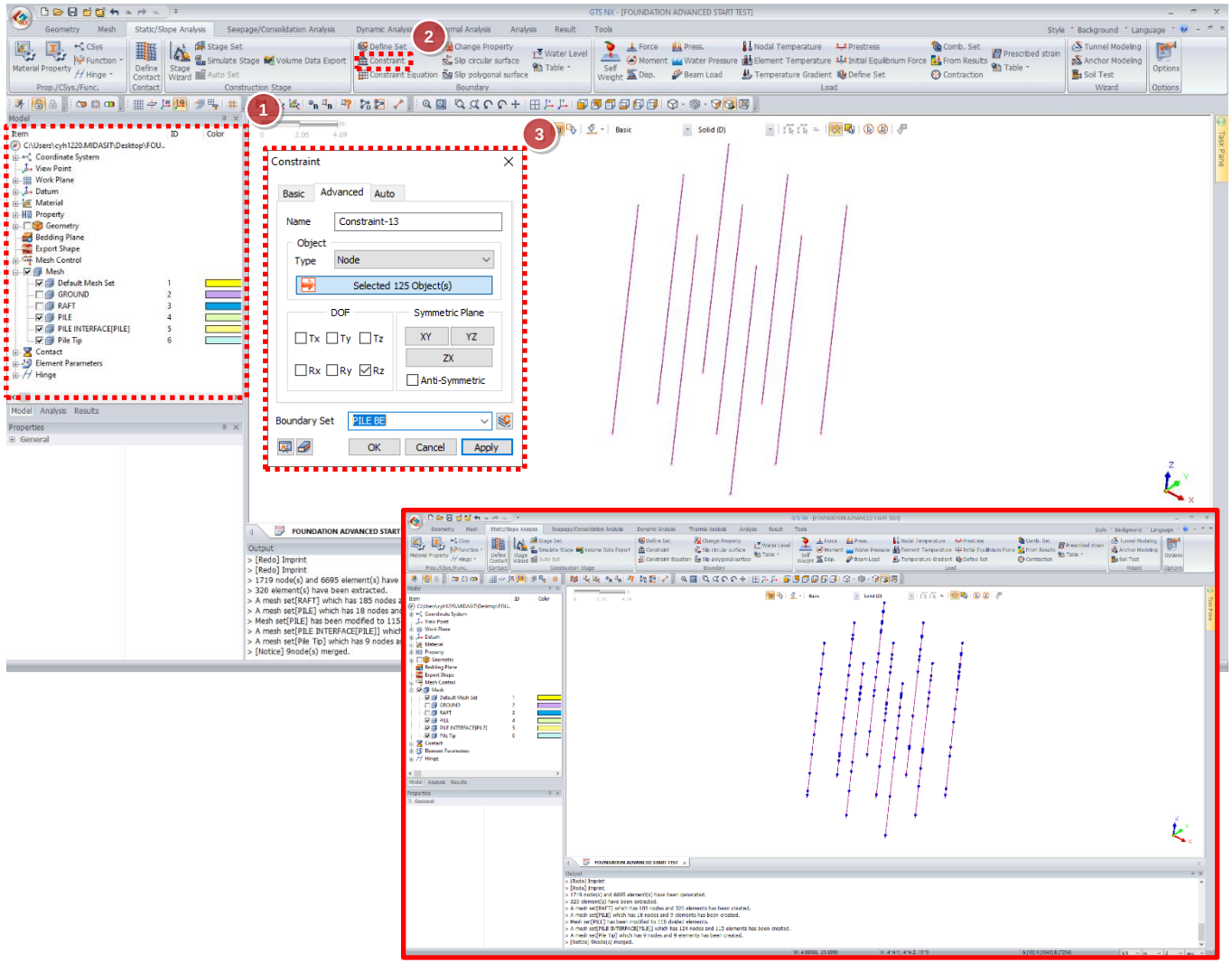
Make boundary condition to piles

Procedure

1. <Geometry Tree>
   Hide every geometry
2. <Mesh Tree>
   Show Pile / Pile Interface / Pile Tip

   Click “Constraint”

   Go to “Advanced” tab
   Select every piles (Ctrl+a)
   Check on “Rz”
   Boundary Set: PILE BC
   Click “OK”



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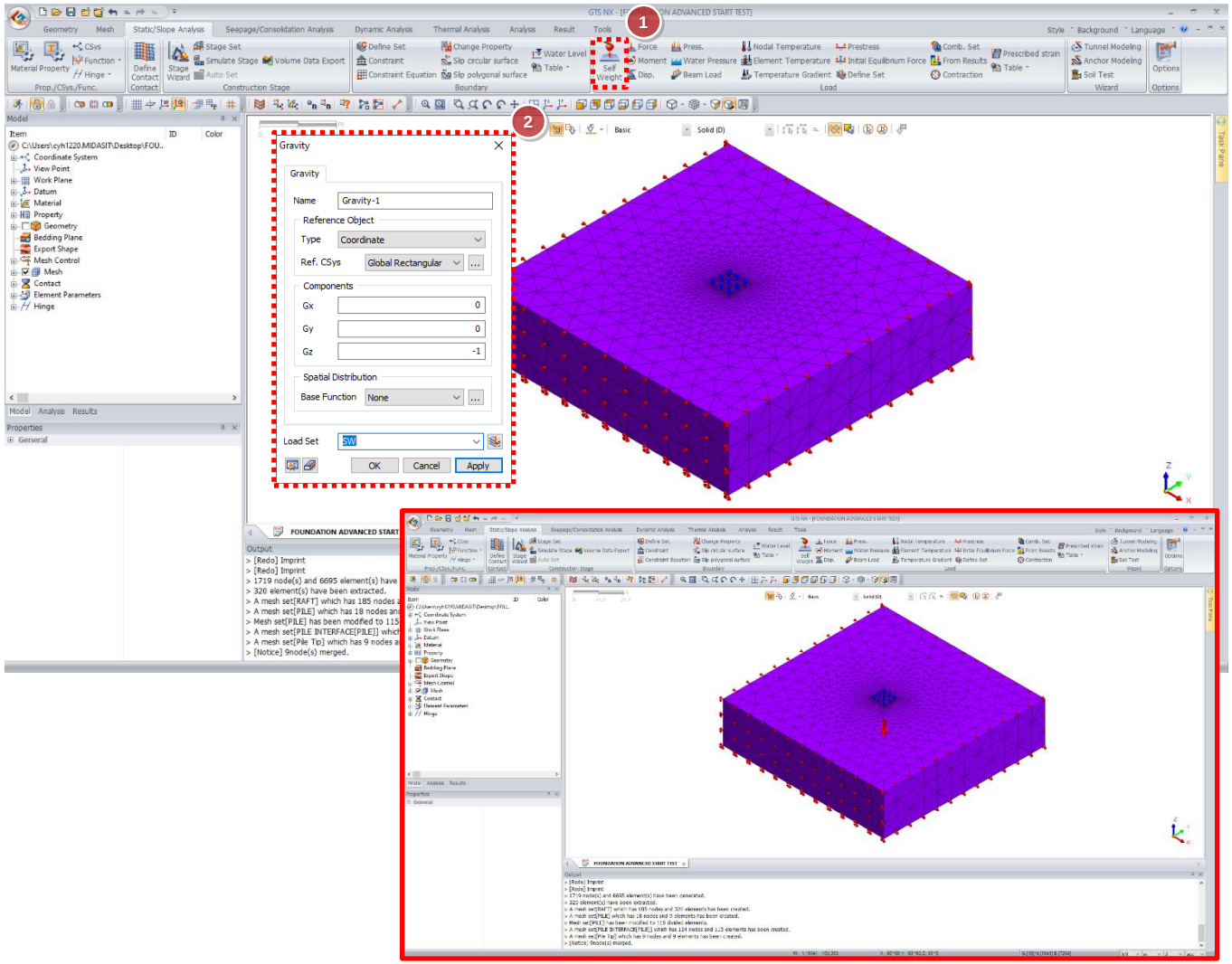
Make self weight

Procedure

1. Click “Self Weight”
2. Load Set name “SW”
   Click “OK”



05 Load & Boundary Condition

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Make surcharge

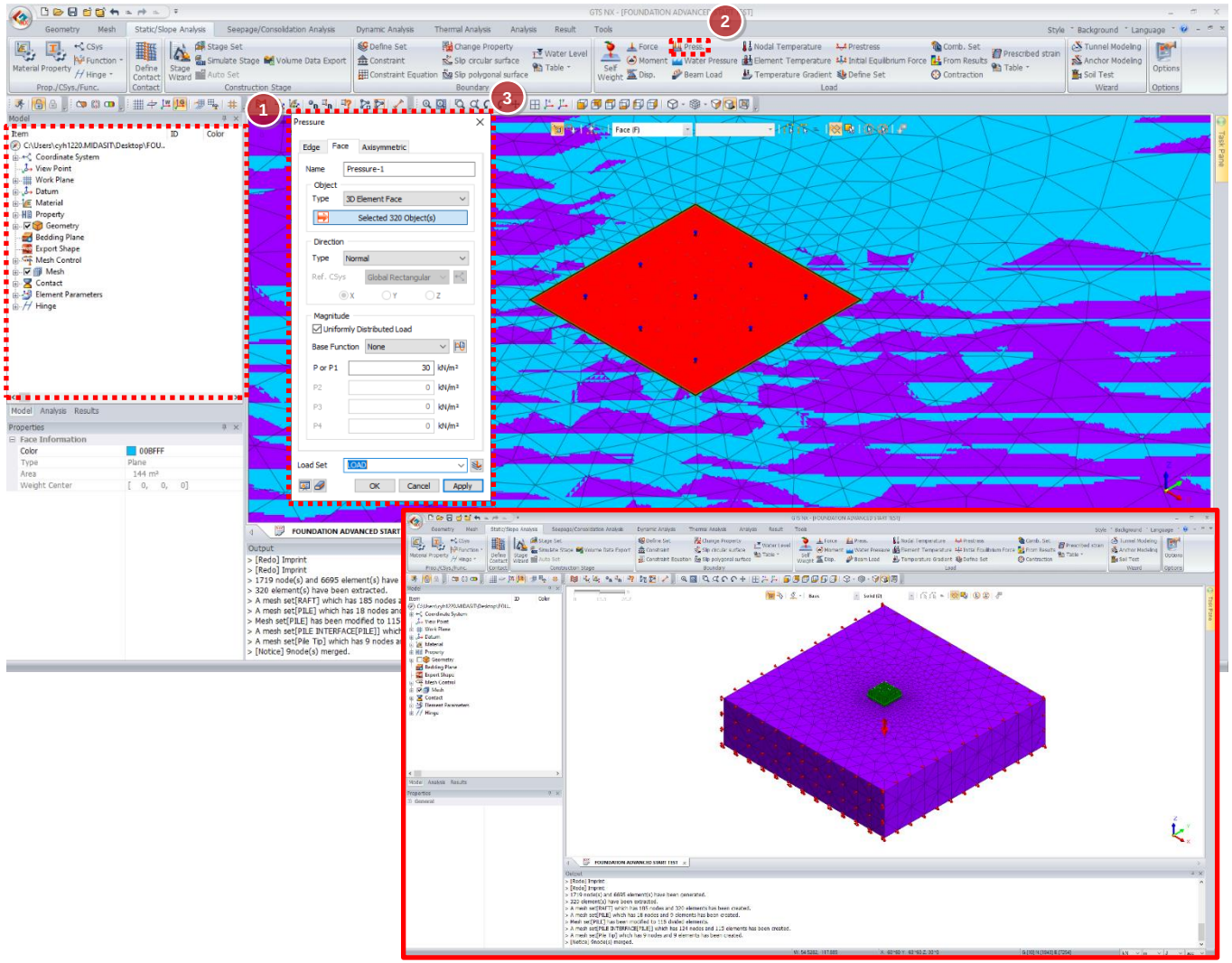
Procedure

1. <Geometry Tree>
   Show every geometry

   <Mesh Tree>
   Show every mesh

2. Click “Press.”

3. Go to “Face” tab
   Object type “3D Element Face”
   Selection method change to face (F)
   Select raft part
   P or P1: 30
   Load Set: LOAD
   Click “OK”



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Define Analysis Stage

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06 Define Analysis Stage

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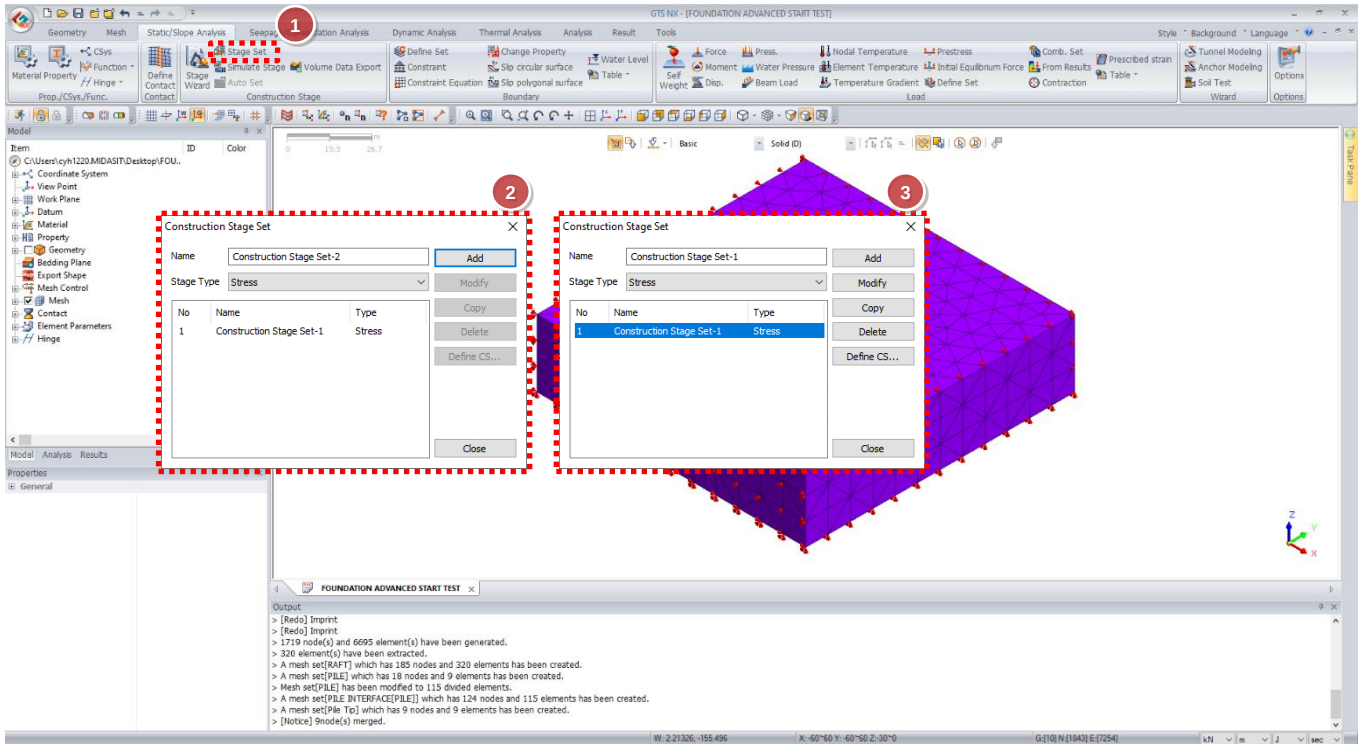
Define stage type

Procedure

1. Click “Stage Set”
2. Stage Type
   “Stress”
   Click “Add”
3. Select created stage set
   Click “Define CS…”



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Initial Stage

Procedure

Stage Name “INITIAL”

<Activate>
GROUND
BC
SW

<Deactivate>
-

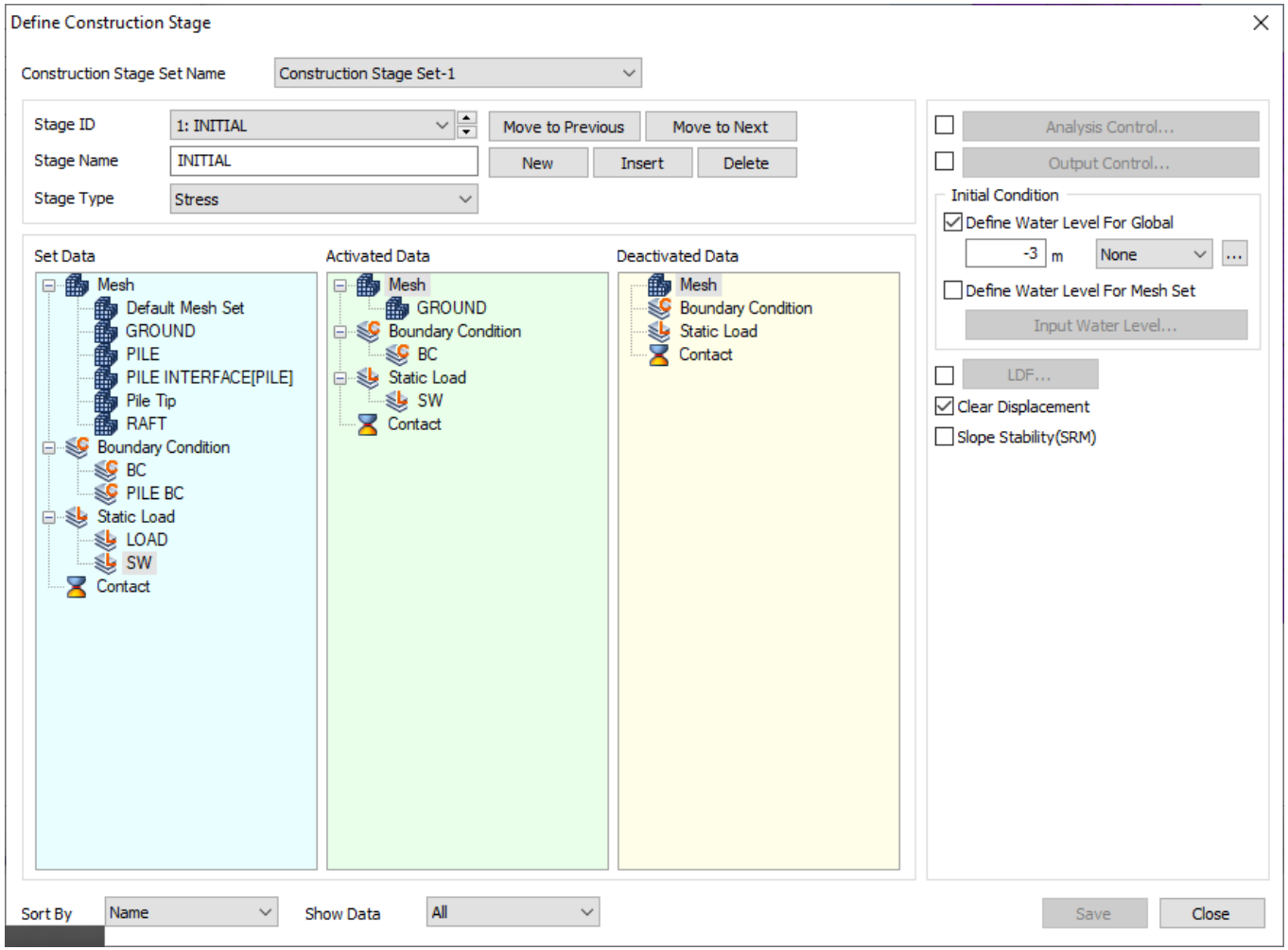
<Water Level For Global>
-3 m

Check on “Clear Displacement”

Click “Save”

Click “New”

[Information]
If you want to define flat water level, you can just give value for height which is follow global coordinate.



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Initial Stage

Procedure

Stage Name “PILED RAFT”

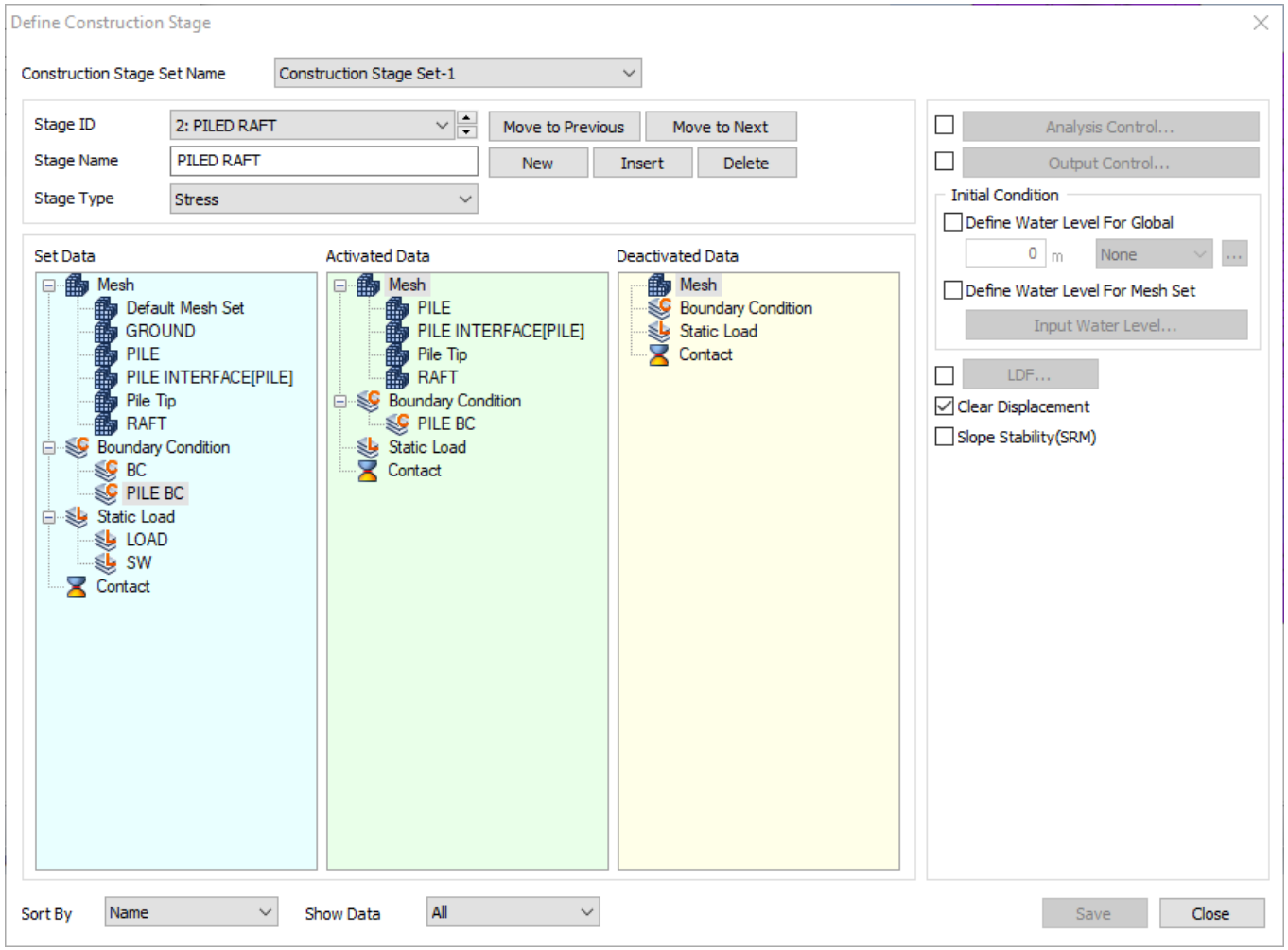
<Activate>
PILE
PILE INTERFACE
PILE TIP
RAFT
PILE BC

<Deactivate>
-

Check on “Clear Displacement”

Click “Save”

Click “New”



06 Define Analysis Stage

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Initial Stage

Procedure

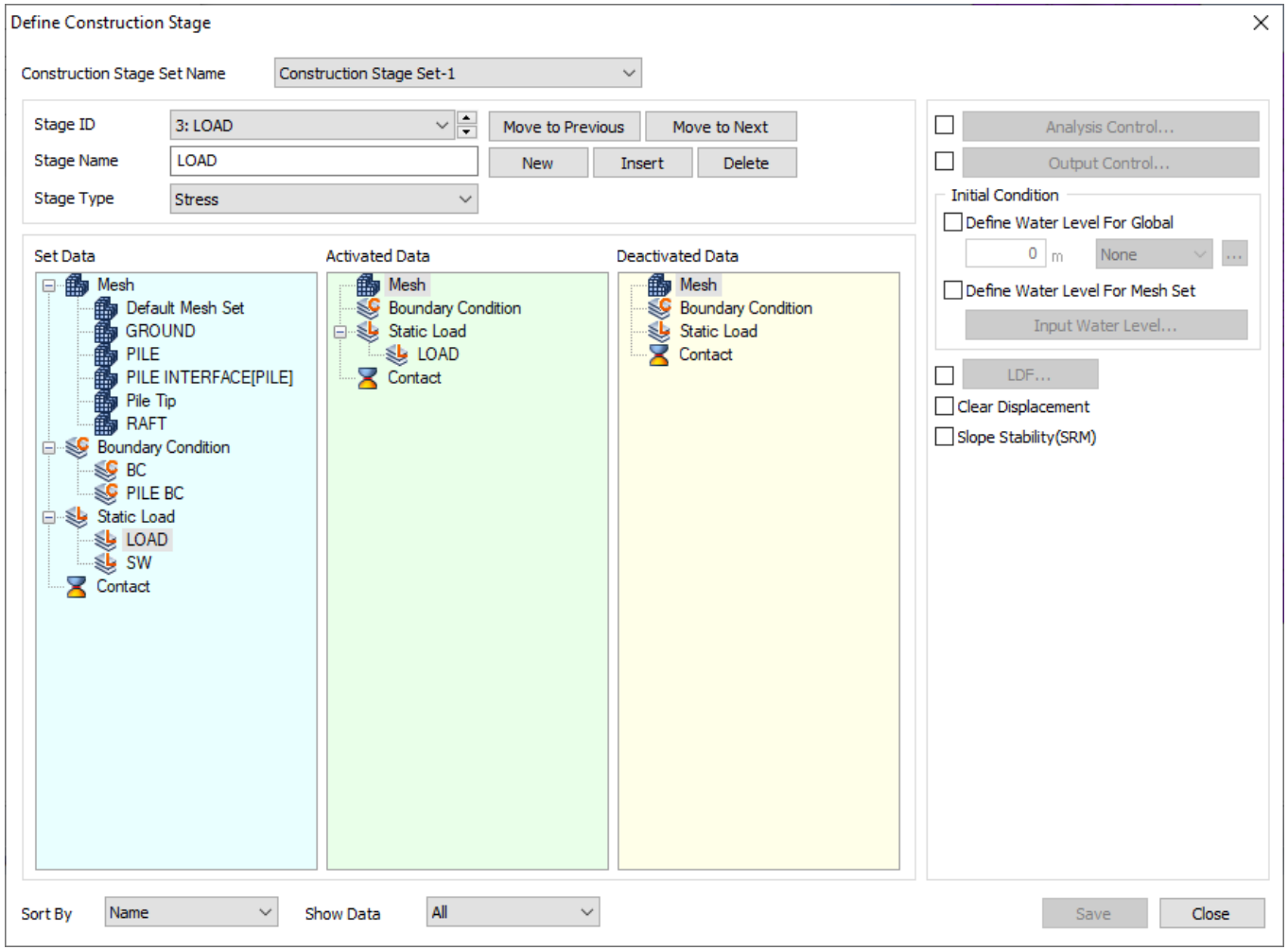
Stage Name “LOAD”

<Activate>
LOAD

<Deactivate>
-

Click “Save”

Click “Close”



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Analysis Case

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Define stage type

Procedure

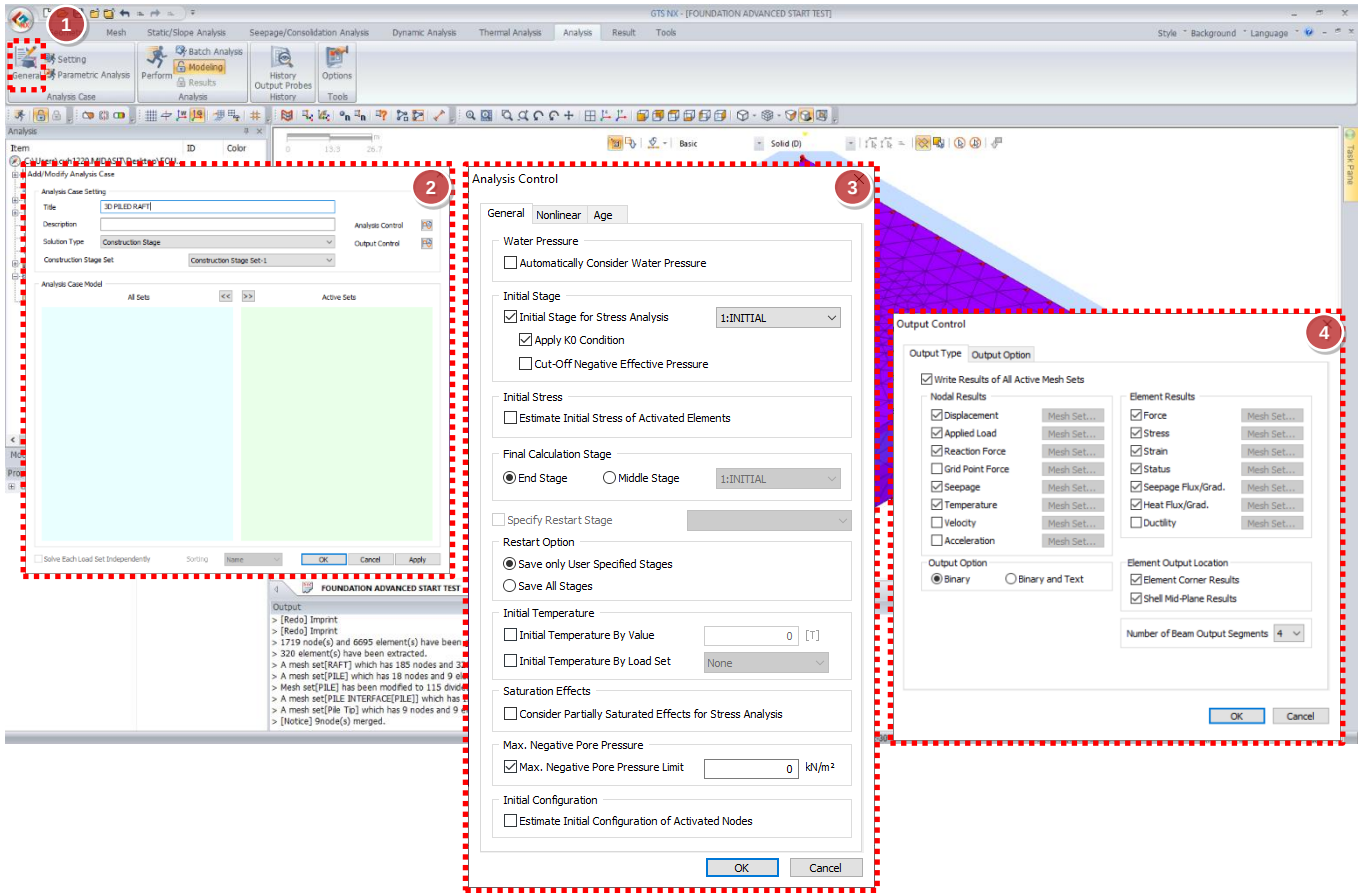
1. Click “General”

2. Title: 3D PILED RAFT
   Construction Stage Set:
   Construction Stage Set-1
   Click “Analysis Control”

3. General tab
   Check on “Initial Stage for…”
   Check on “Apply K0 Condition”
   Click “OK”

4. Click “Output Control”
   Check on “Strain”
   Click “OK”

   Click “OK”



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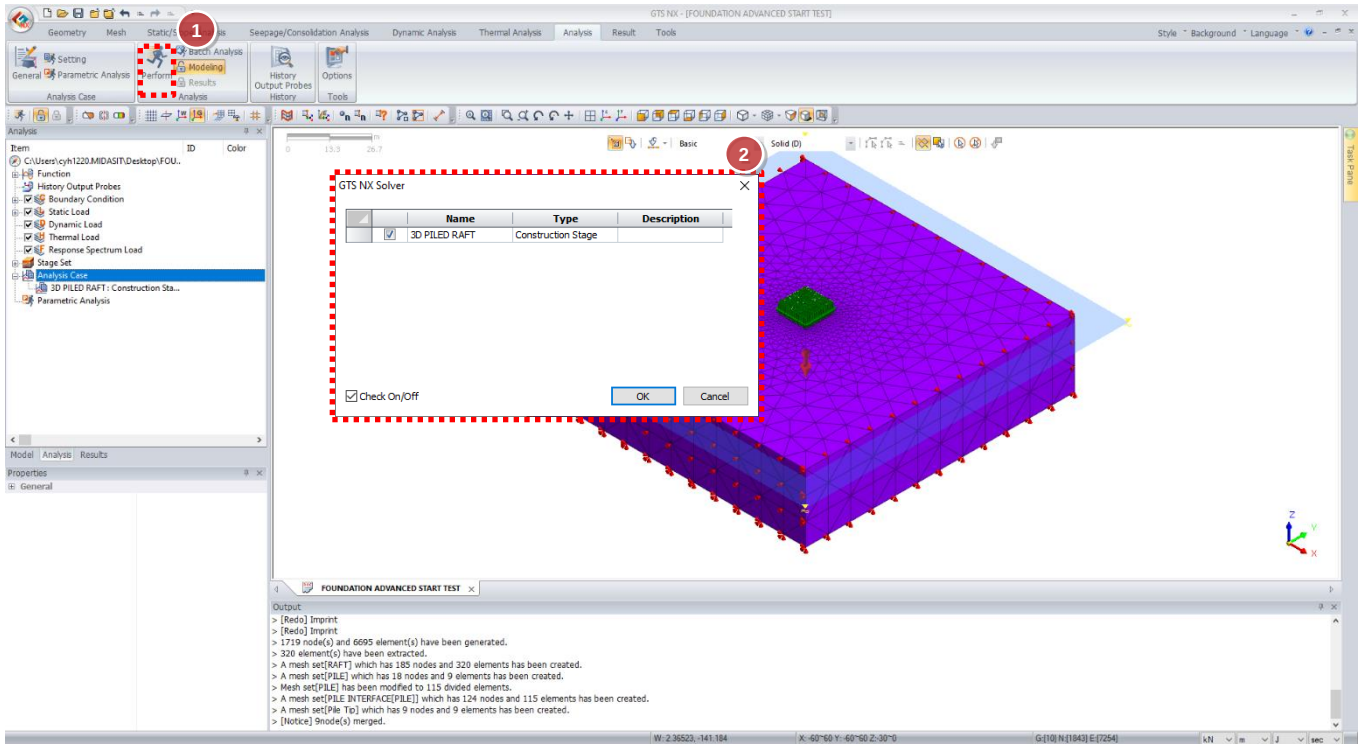
Perform the analysis

Procedure

1. Click “Perform”
2. Check on 3D Raining Effect
   Click “OK”



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Result Checking

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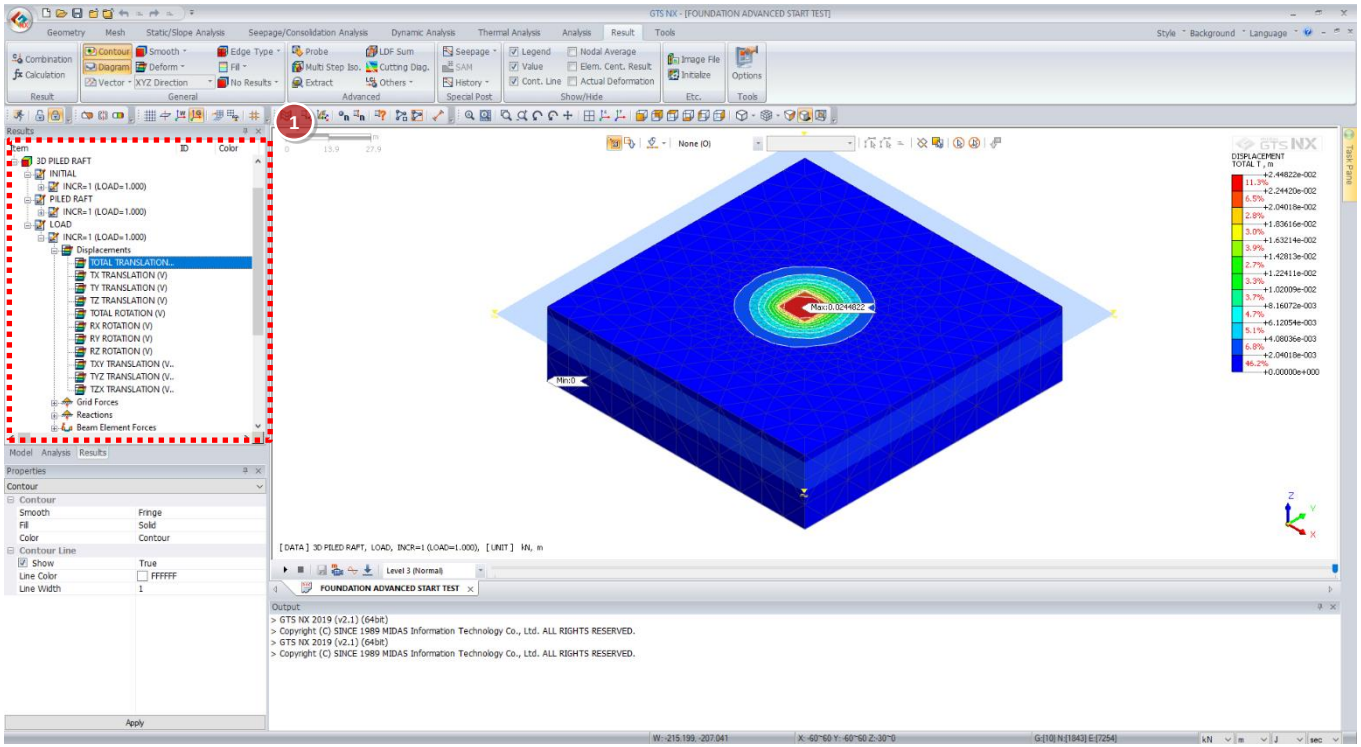
Total Displacement

Procedure

1. Displacement > TOTAL TRANSLATION



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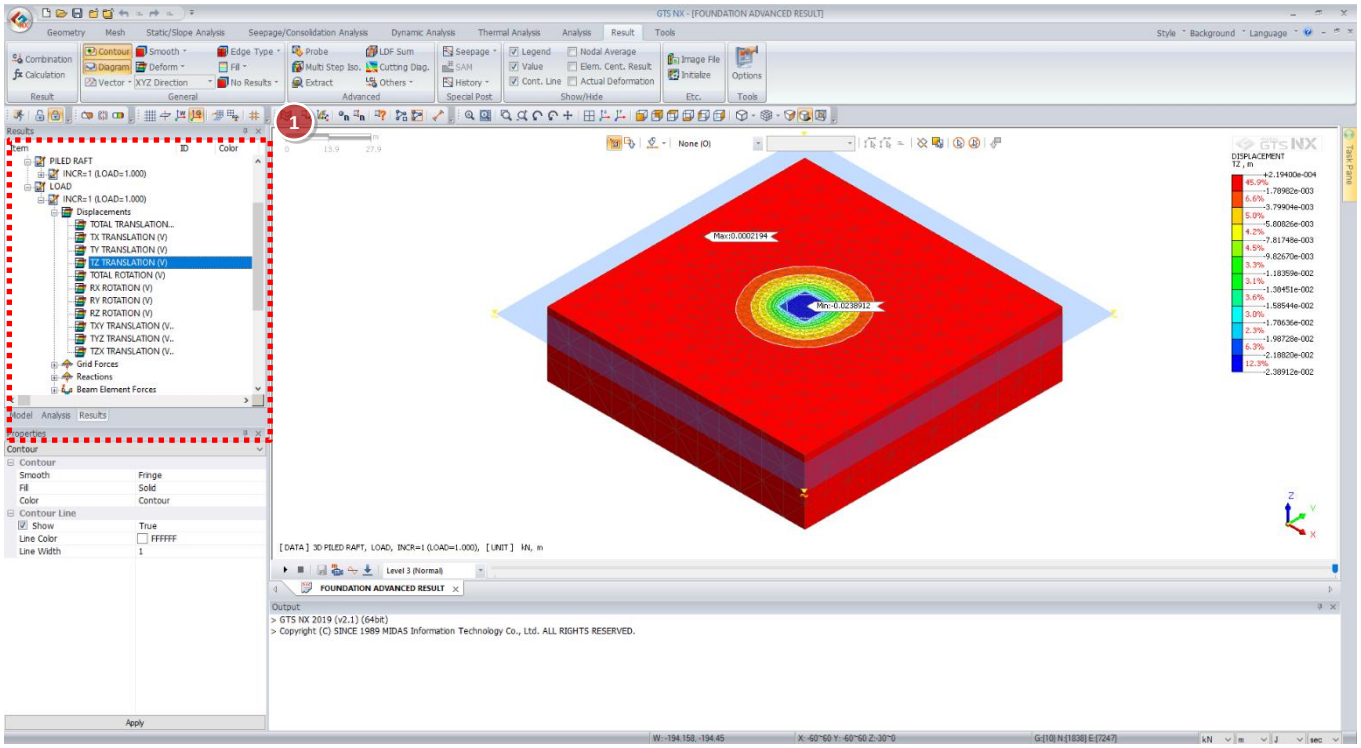
Settlement of Ground

Procedure

1. Displacement > TZ TRANSLATION(V)

   [Information]
   Please show only ground mesh set



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Settlement of Ground with clipping plane

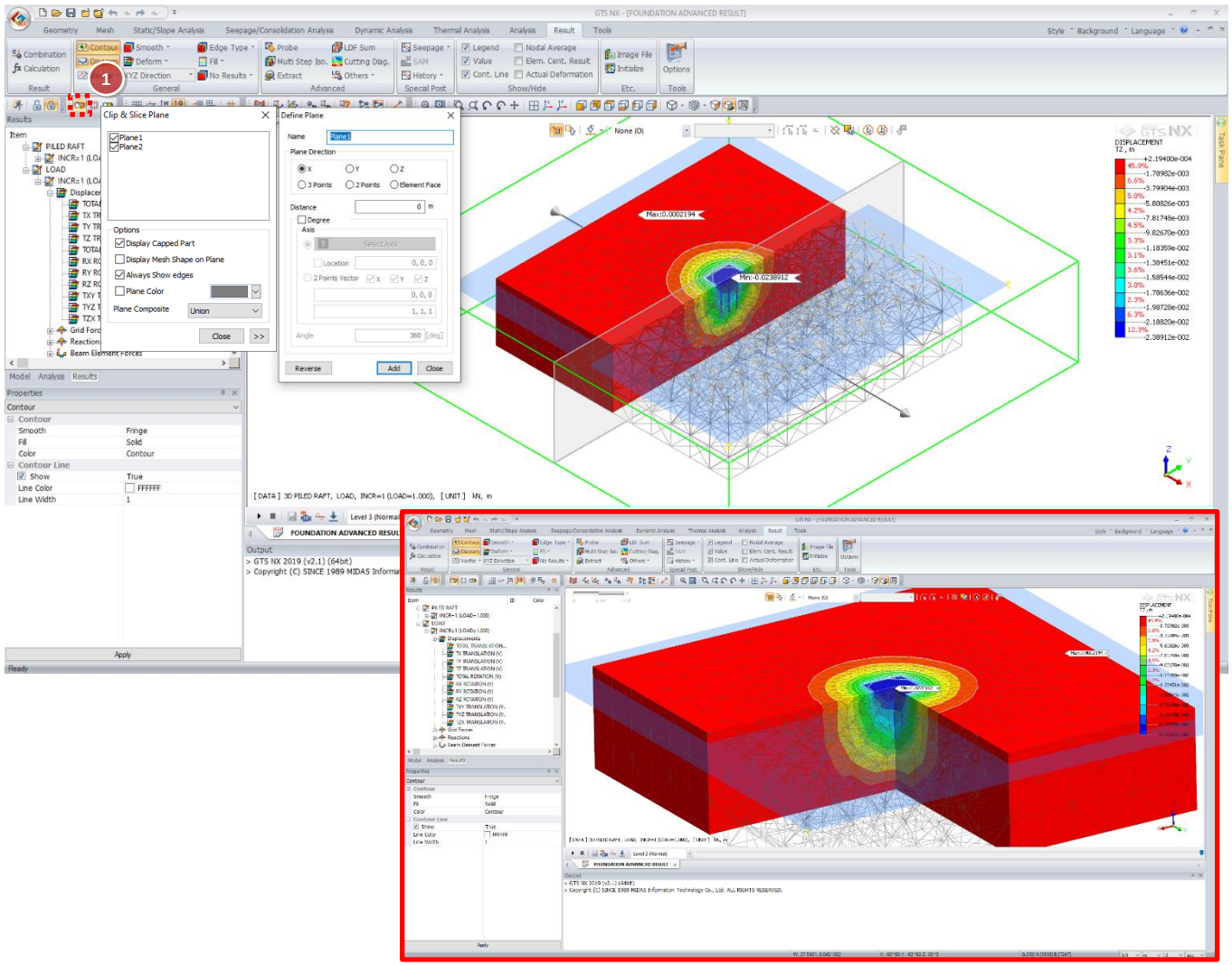
Procedure

1. Click “Clipping Plane”

   Select “x” Direction
   Click “Add”

   Select “Y” Direction
   Click “Add”
   Click “Close”

   Plane Composite: “Union”
   Click “Close”



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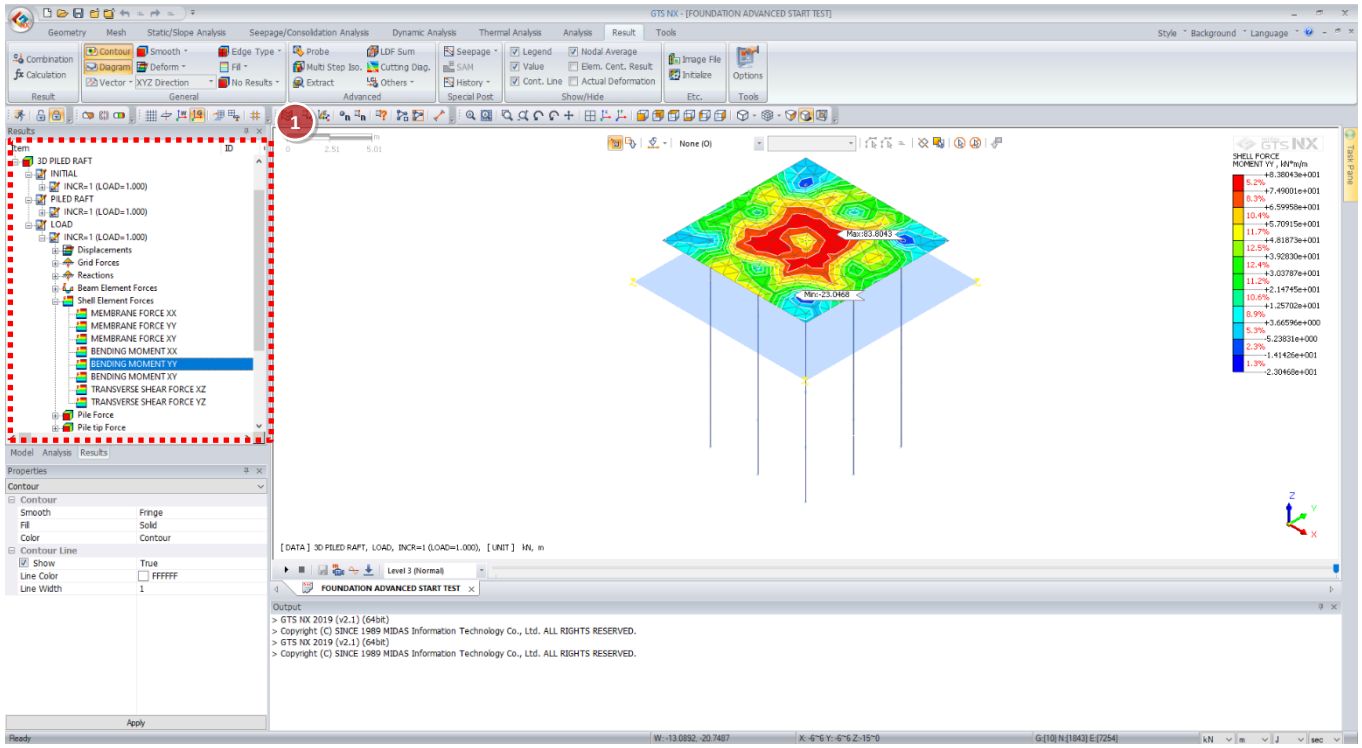
Bending moment from raft

Procedure

1. Shell Element Forces > BENDING MOMENT

[Information]
Please show raft/pile/pile interface/pile tip mesh



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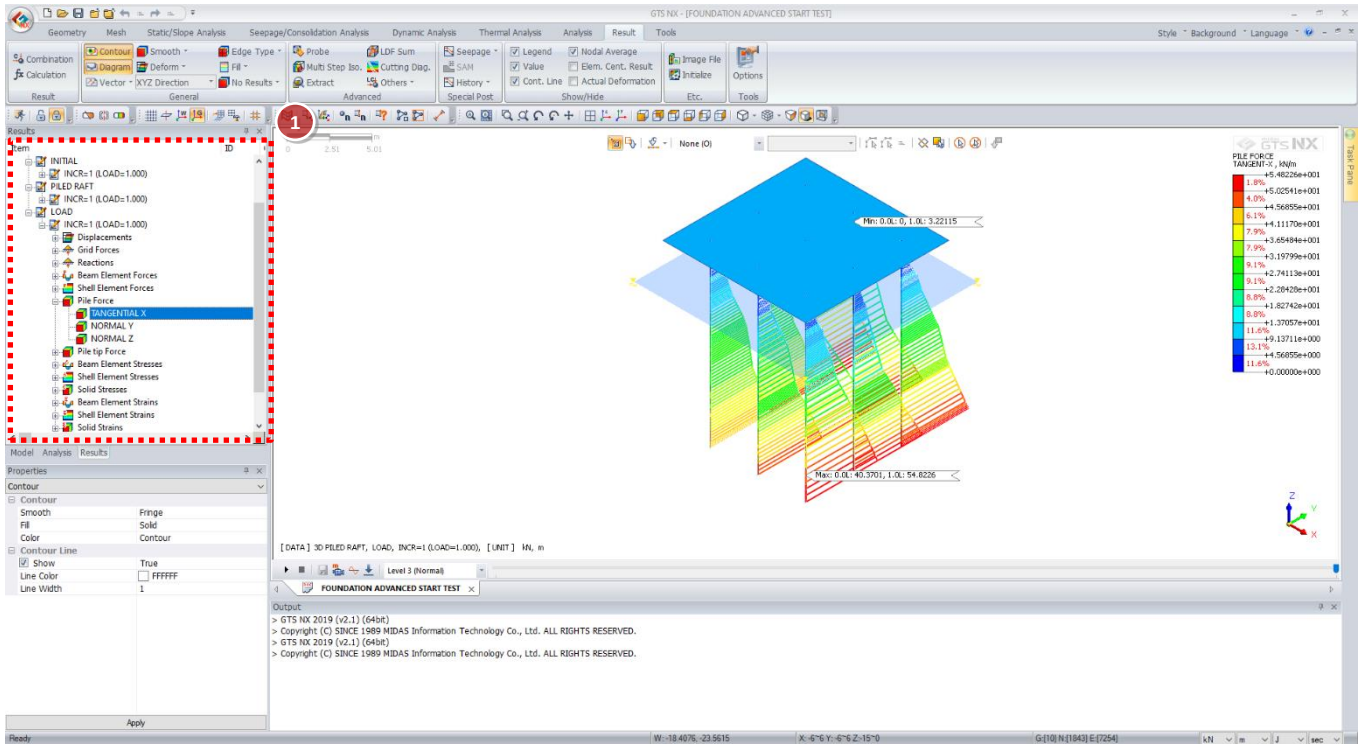
Shaft resistance from piles

Procedure

1. Pile Force > TANGENTIAL X



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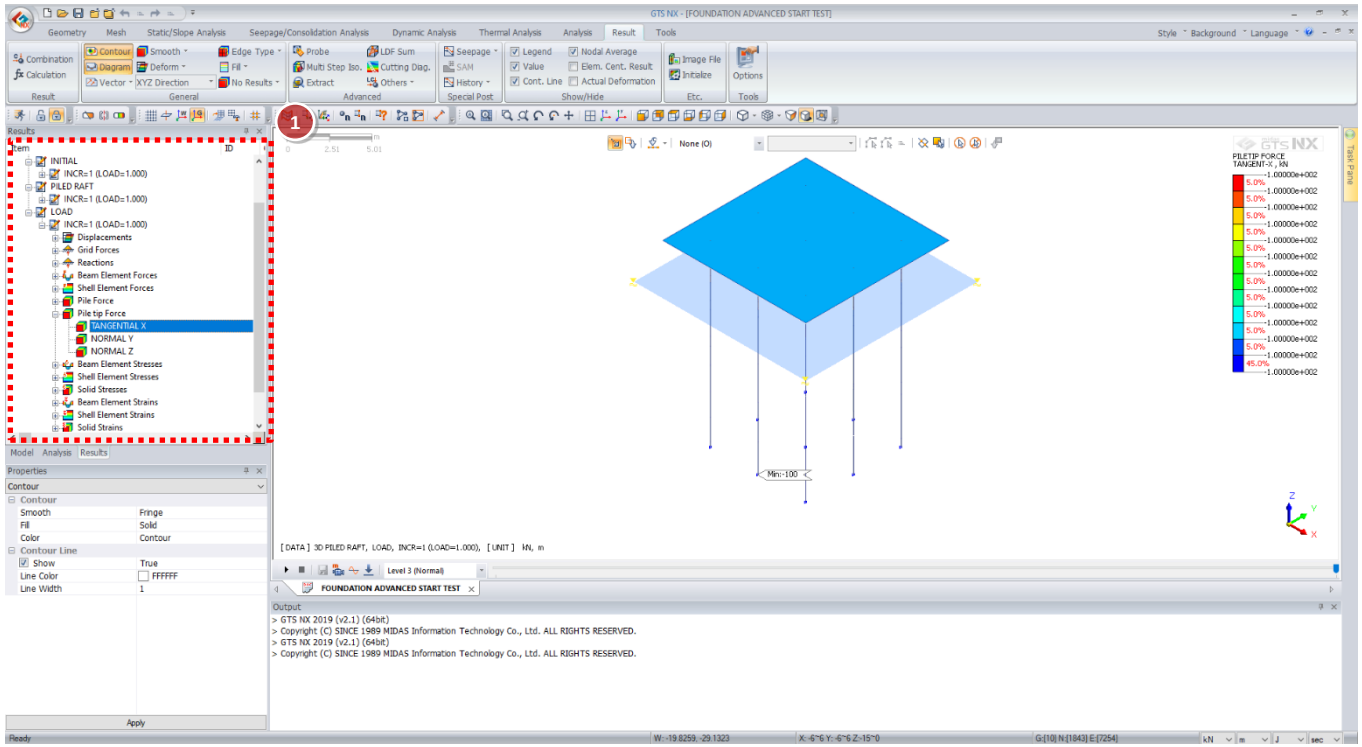
Tip bearing from piles

Procedure

1. Pile Tip Force > TANGENTIAL X



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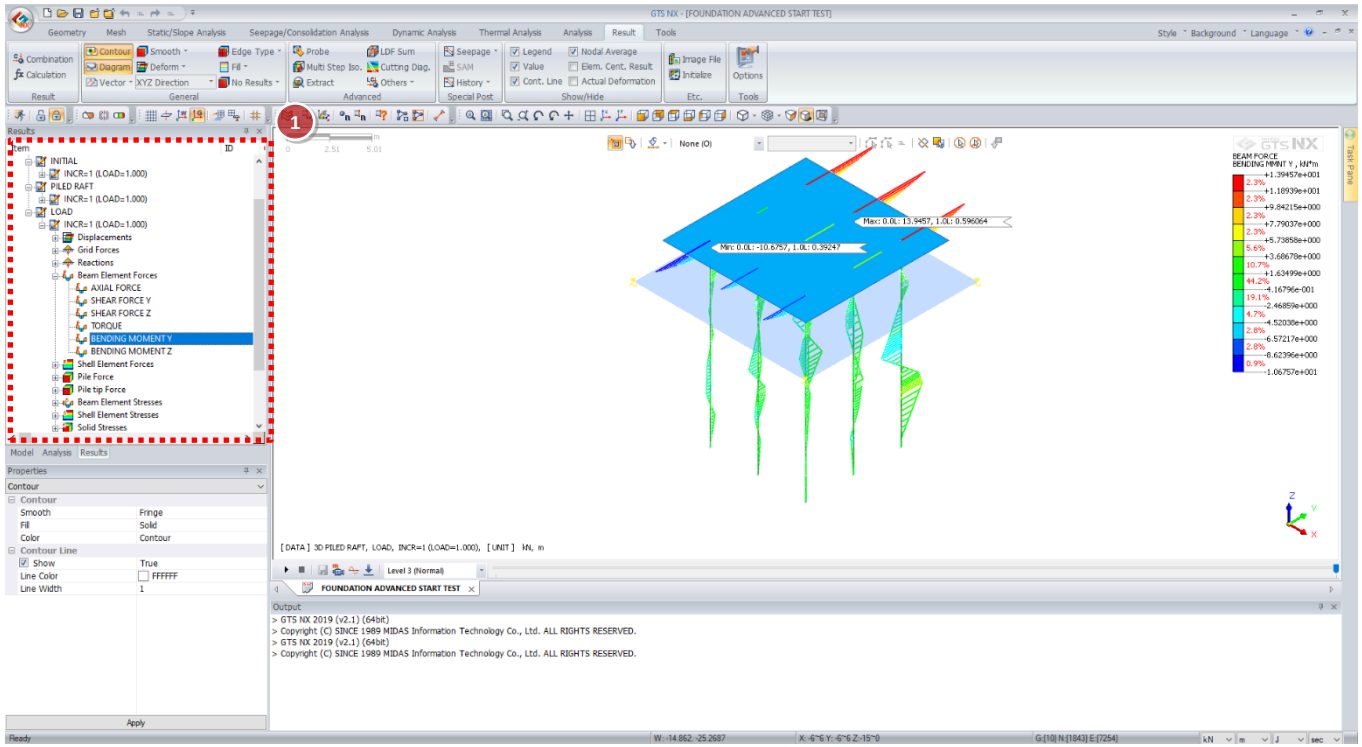
Bending moment of piles

Procedure

1. Beam Element Forces > BENDING MOMENT Y



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Thank you!

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