HxGN LIVE
HEXAGON'S GLOBAL NETWORK
2-5 JUNE 2014
LAS VEGAS, NV

Intergraph Smart™ 3D

Session 2150: Working with the Civil Engineering Task

The new Civil Engineering task enables the routing of ditches and trenches of varying cross sections with or without slope. Connections between trenches can be modeled. Trenches can be reported, processed on drawings, and published to SmartPlant Foundation.

June 4, 2014

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Introduction

The Civil Engineering task is a brand new task in Intergraph Smart™ 3D 2014 R1 designed for onshore plants and material handling industries (e.g. mines (MHE).

The task will cover linear ground and underground structures like roads, ditches, trenches, underground utility tunnels, etc.

- **Trenches**

  Deep underground channels (mostly for pipes or cables)
- **Ditches**

  Open drainage for collecting (e.g. storm water)
- Utility tunnels
- Traffic & Communication design
  - Roads
  - Railroads

Environment

The Civil task is just at beginning and currently on the Vertical Toolbar (VTB) has only one own command, **Place Trench,** and several commands from Structural and Equipment tasks. Other civil objects can be placed as Civil Equipment

The **Place Trench** command has its own Ribbon bar command with Smart Steps.

Modification

- Trench Run
  - Modification of path
  - Changing of placement method and parameters
  - Branching
- Trench Feature
  - Changing of Cross Section parameters (width)
  - Modification of turn features (length, chamfers)

Deliverables

Several samples of output configuration are delivered:

- Reports
  - Two predefined report templates
  - SPRDirect with specific labels
- Drawings
  - Three predefined Ortho Drawing View Styles
  - Two predefined Key Plan styles.

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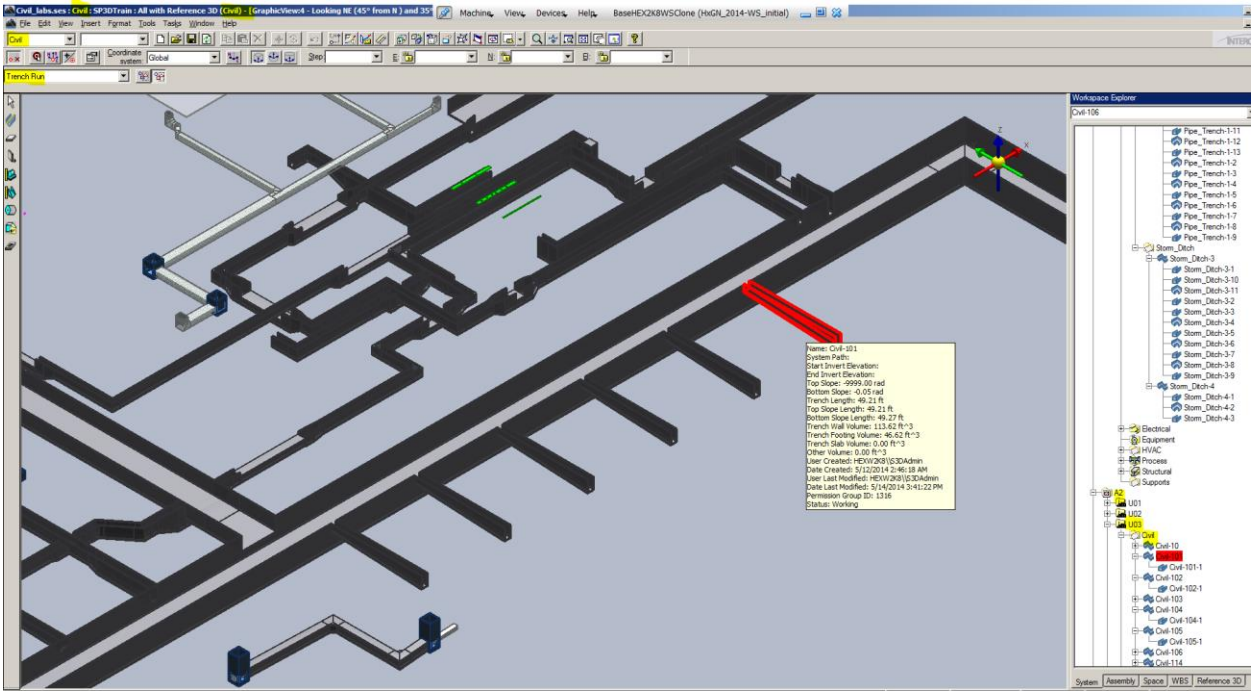
Modelling of Trenches and Ditches

Placement Methods, Trench Run Parameters

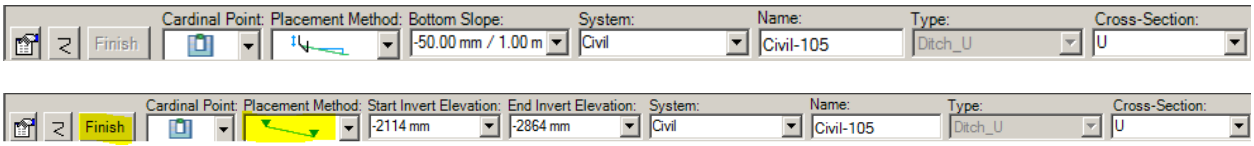
Test various placement methods on existing trenches to understand differences and purposes.

Lab 01 – Modification of Placement Methods

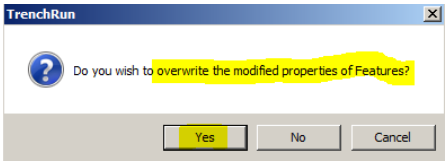
1. Start Smart 3D using template **Civil_labs**.
2. Ensure that session is in **Civil Task**, your Active Permission Group is **Civil**, and the Locate Filter is set to **Trench Run**
.
3. Activate the saved view **U03-Trench Placement**.



4. Select the 2nd branch from East (**Civil-105**) and change placement method from the Placement Method by **Start Depth and Slope** to **Start and End Invert Elevation**.

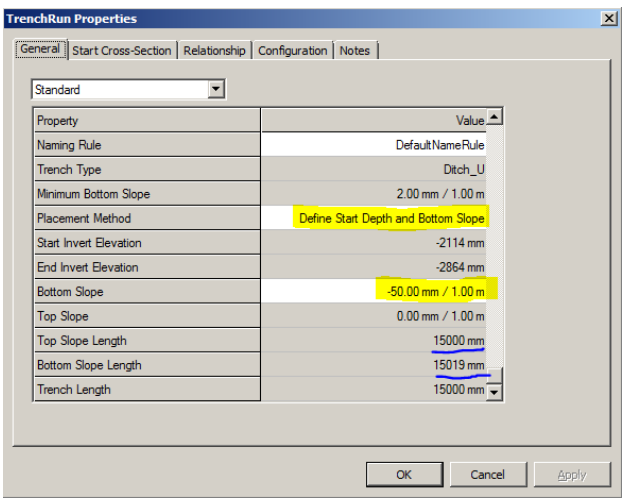


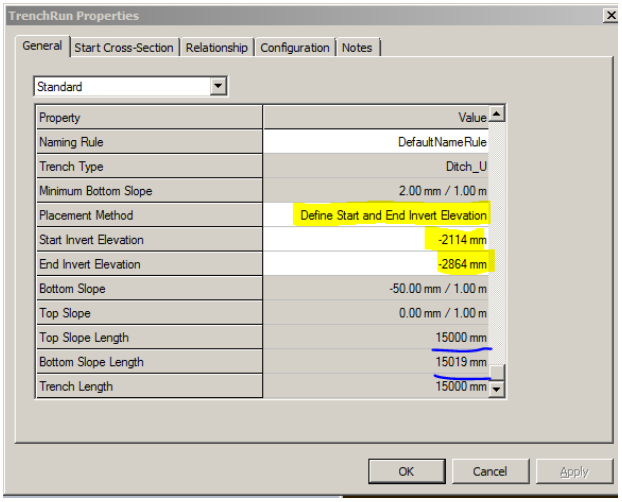
5. Confirm recalculation of manually modified parameters of features by default values from catalog.



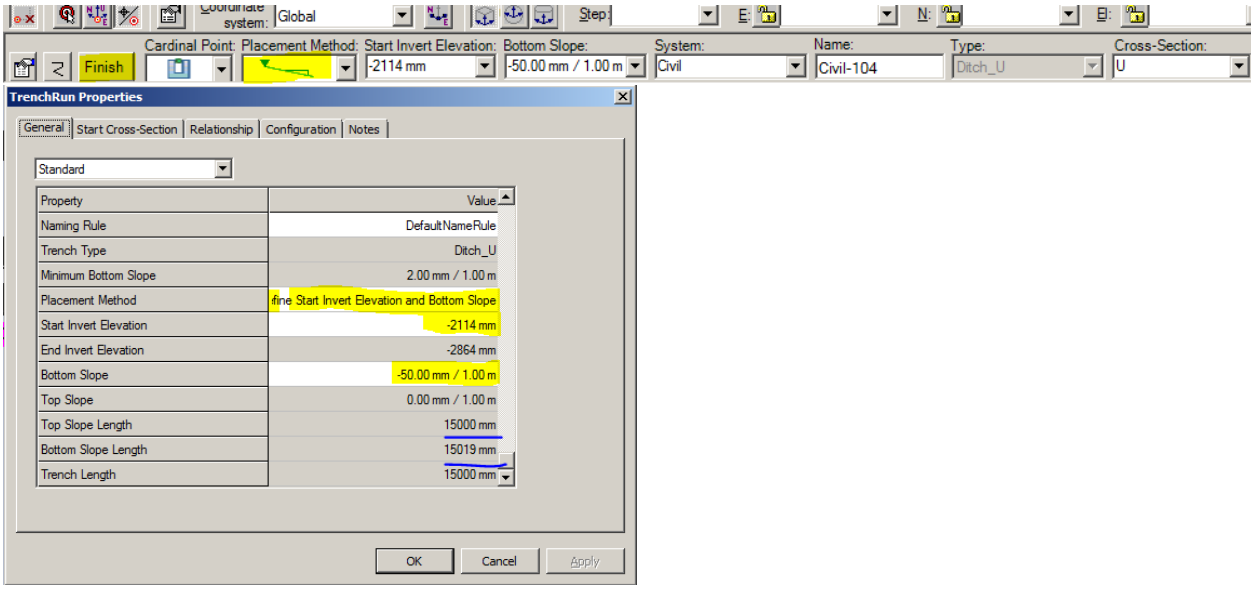

```
---------------------------
TrenchRun
---------------------------
Do you wish to overwrite the modified properties of
Features?
---------------------------
Yes    No    Cancel
```

Note: This change should recalculate input parameters to match new method, but retain existing topology.

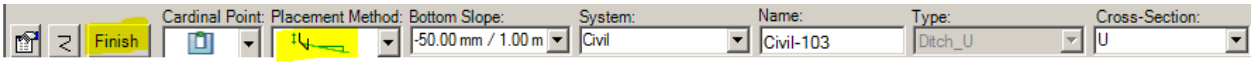




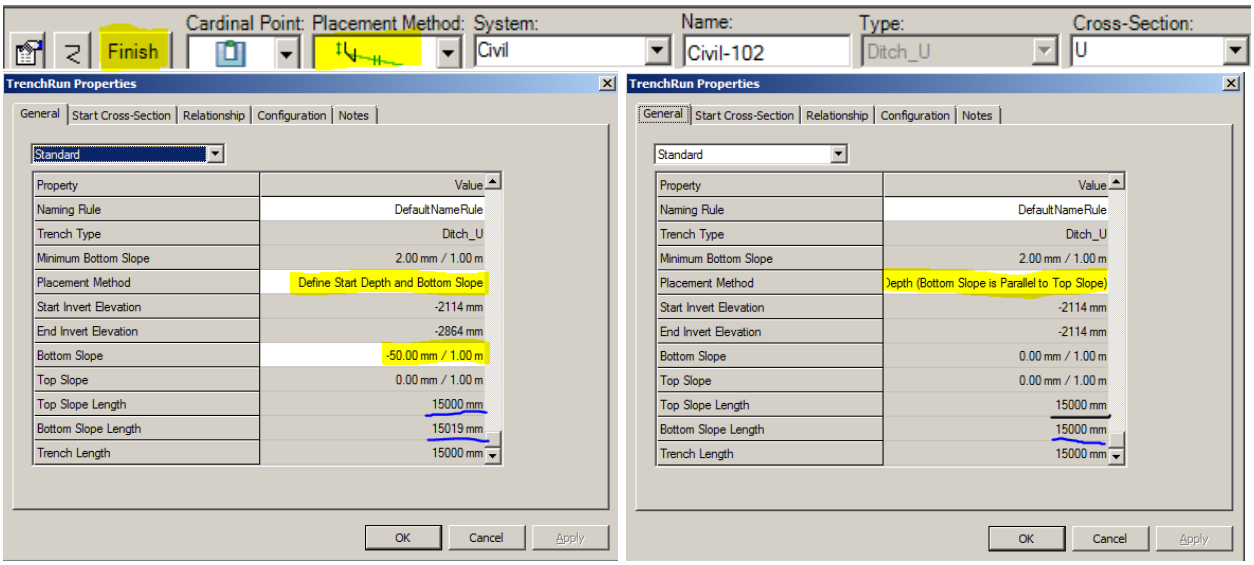
6. Similarly change the 3rd branch to **Start Depth and Invert Elevation** method.

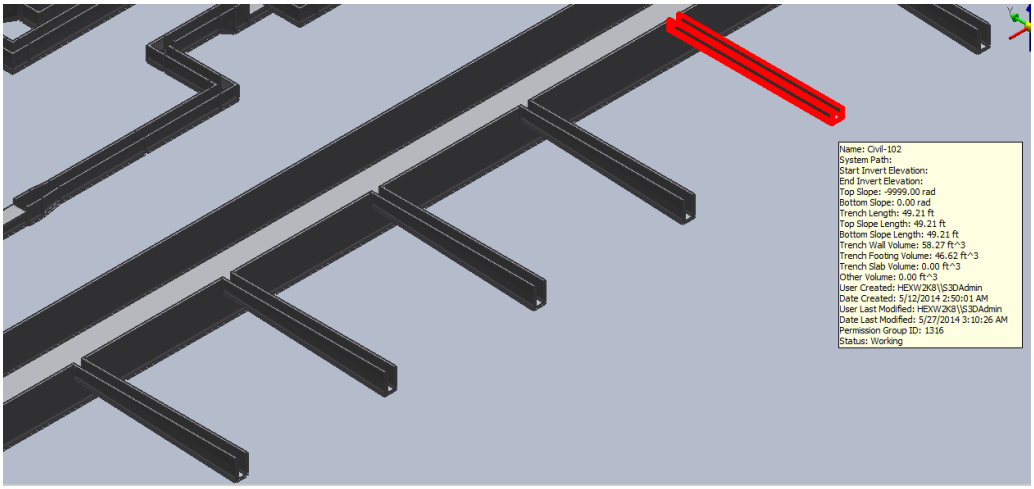


7. To have all options, change the 4th branch to **Start Depth and Bottom Slope** method...

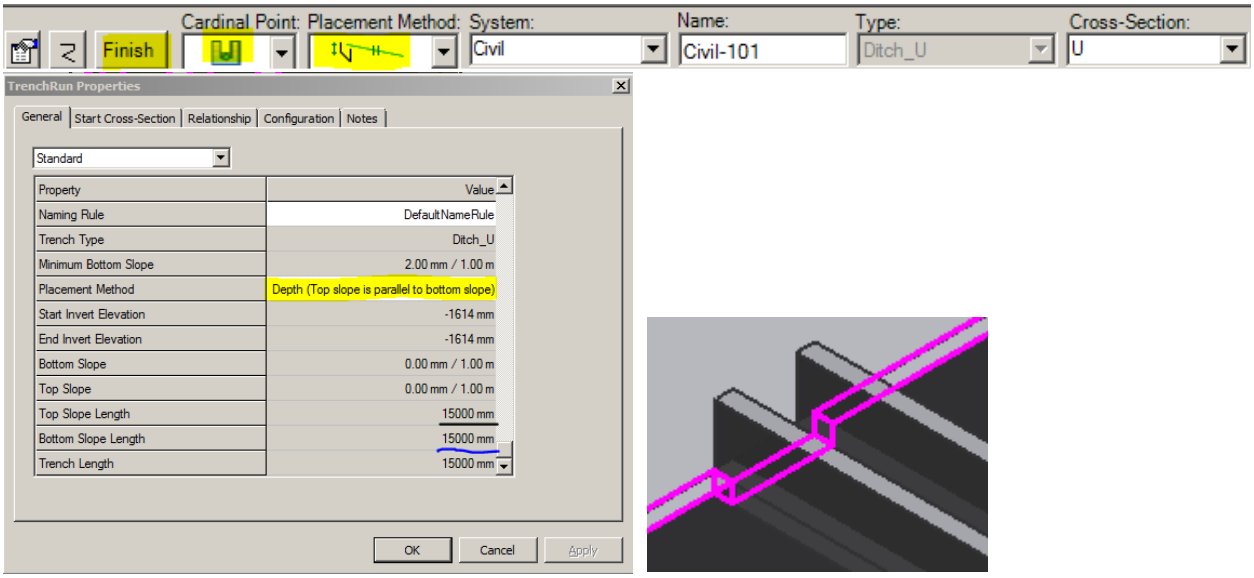


…and the 5th to the last **Start Depth (bottom slope is parallel to top slope)** method, which is the only one changing geometry .





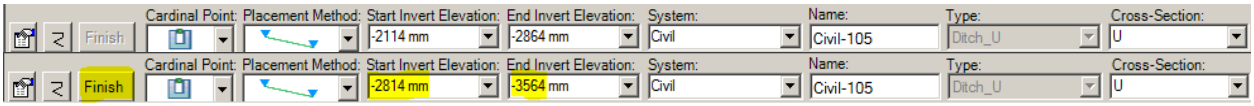
8. Select the 6th branch and change Cardinal Point from the 8-Top Center to 2-Bottom Center and note that only opting with this Cardinal Point is "**Start Depth (top slope is parallel to bottom slope)**" and change to that method.

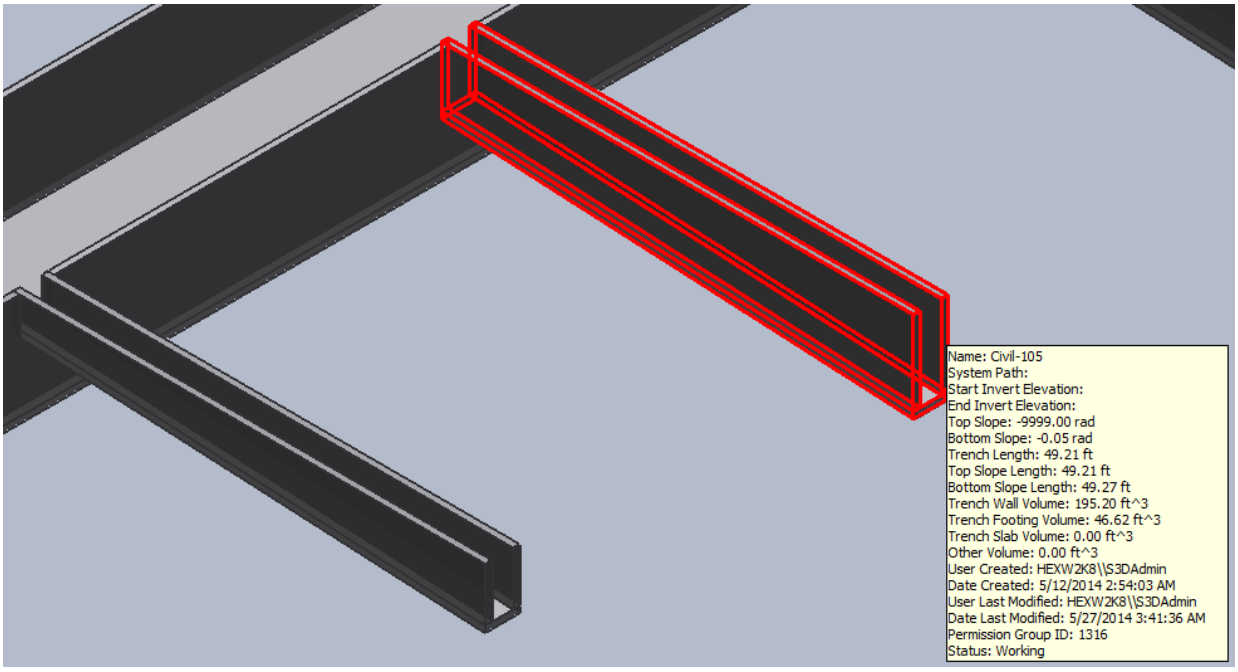


Lab 02 – Modification of Inverted Elevation

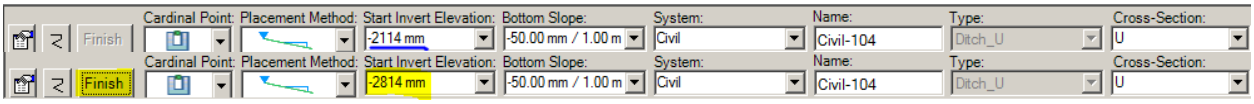
1. In the next round of modifications, lower *all* directly editable invert (bottom) elevations 700 mm down.

2nd branch



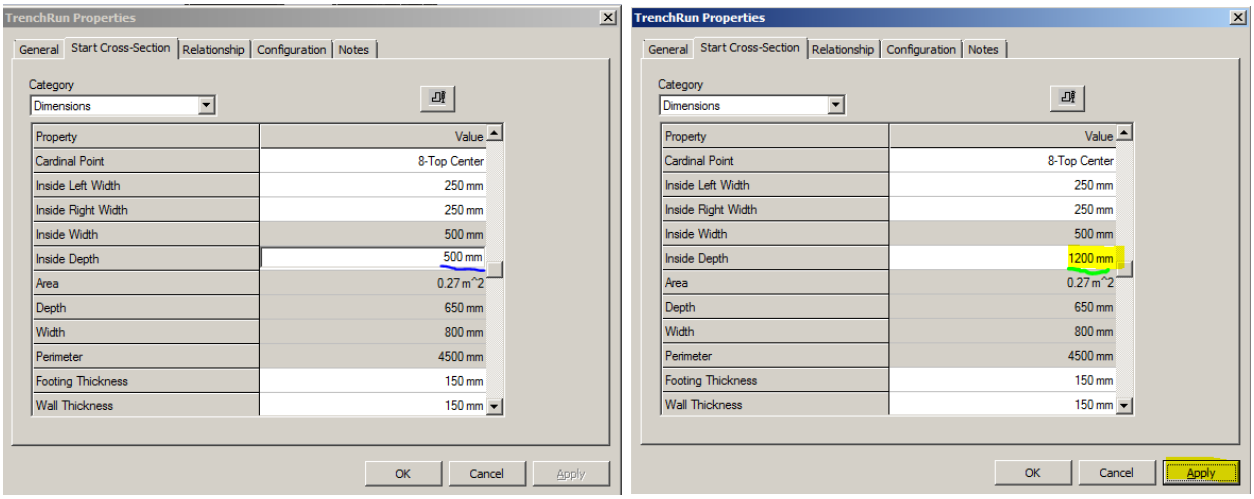


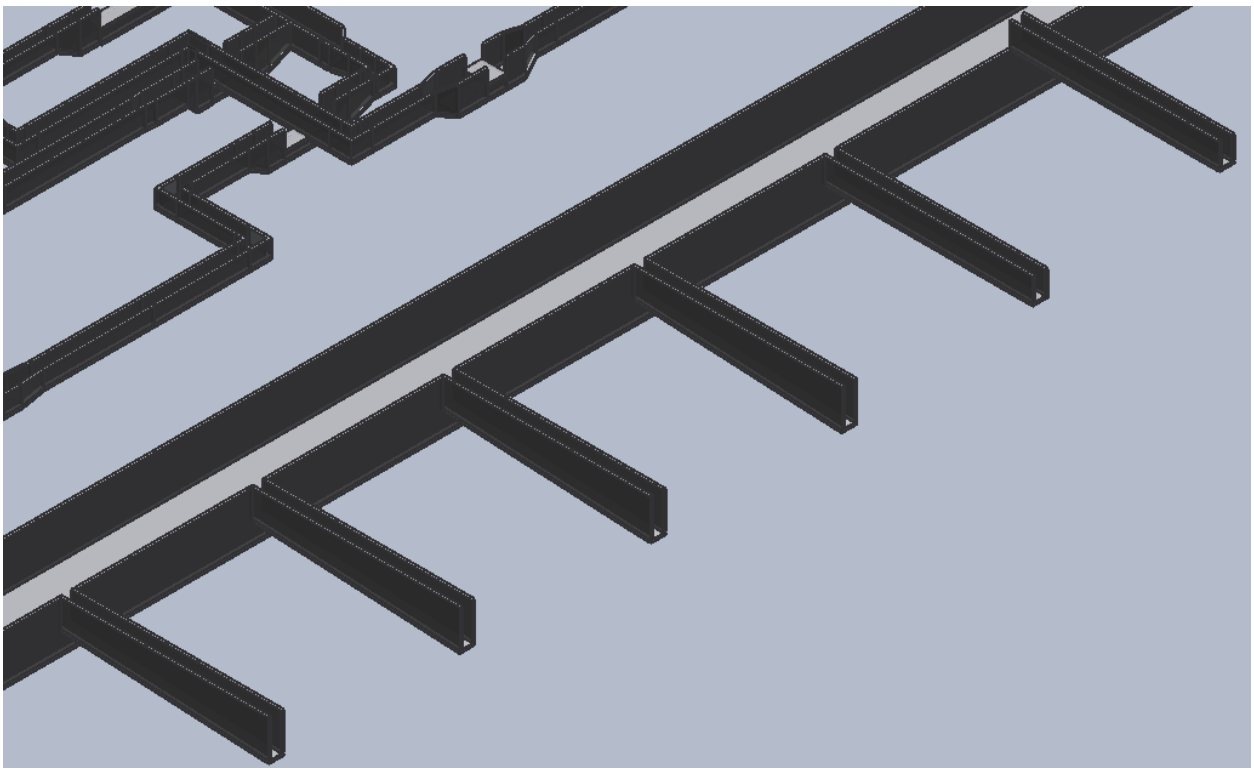
3rd branch



2. Others need to be modified indirectly by modifying depth through the Start Cross-Section tab.

1st and 4th branches





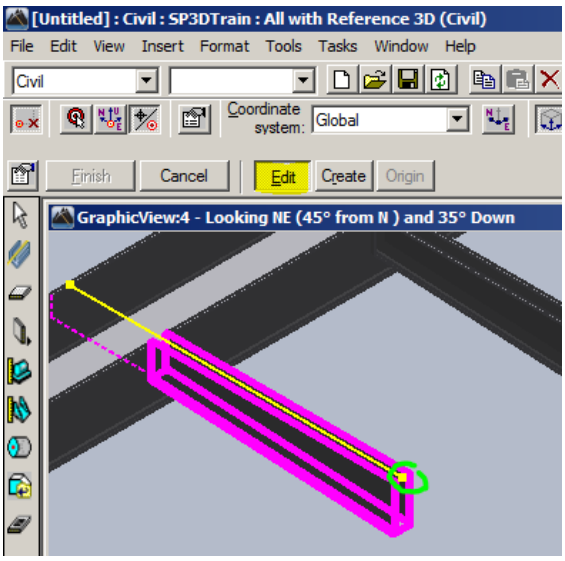
Note: Changing of Invert Elevations, or Start Depth without changing length keep same geometry (with exception of parallel placements.

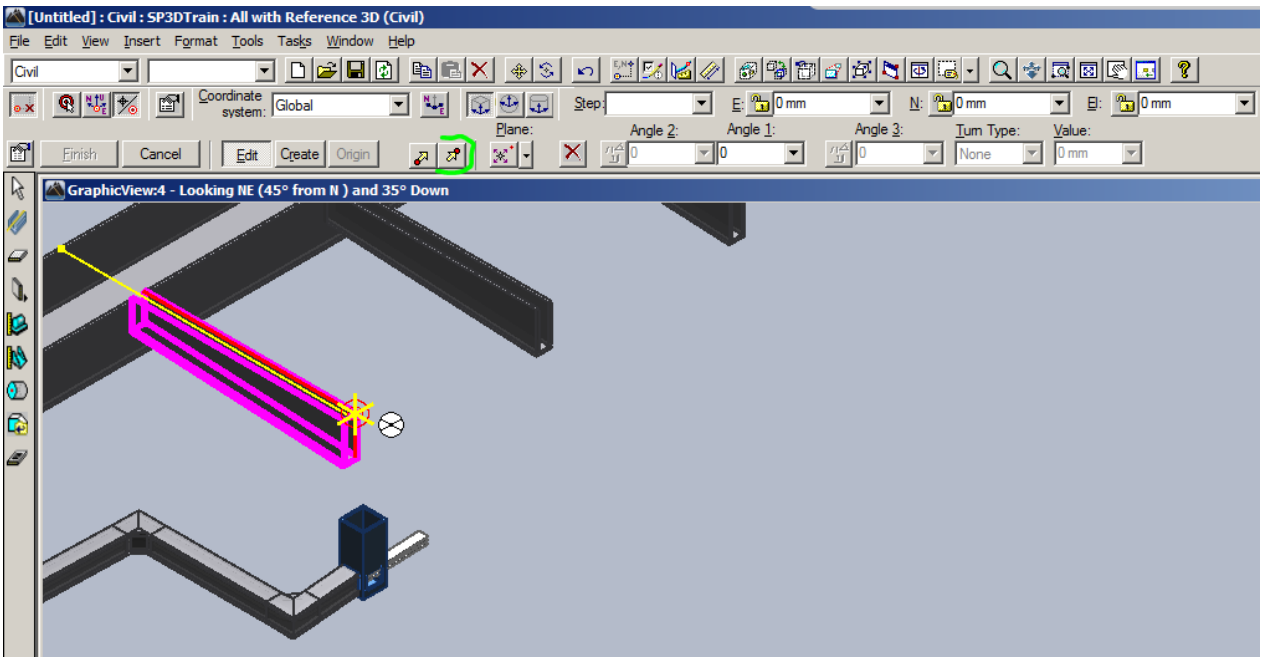
Trench Run topology

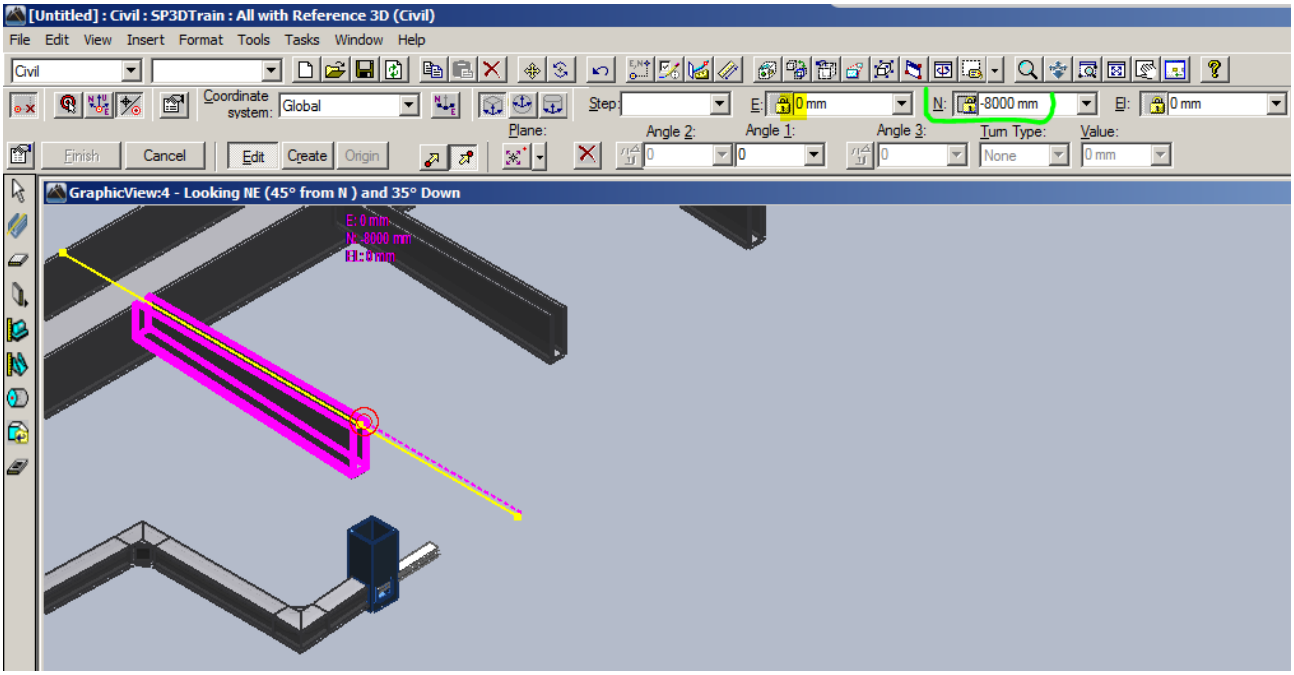
Lab 03 – Modification of Routing Topology (length, direction, upper elevation)

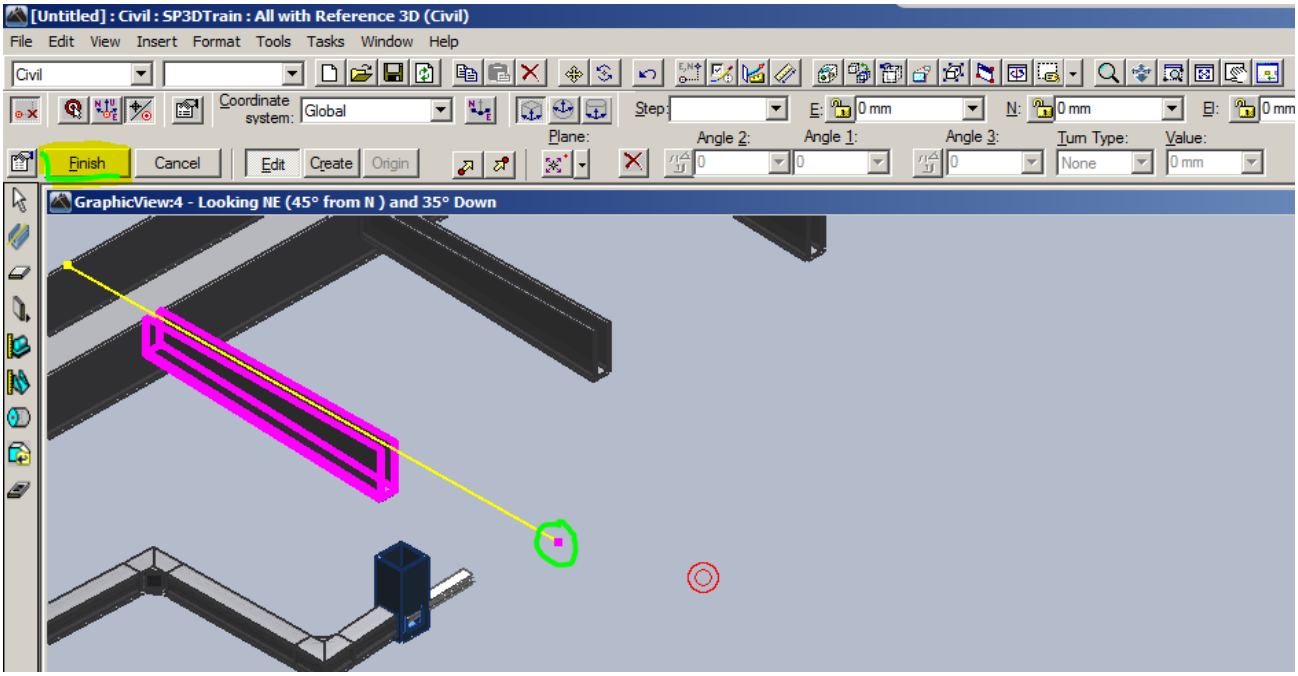
Extending trenches, directional changes (inserting Turn Features, and modification of elevation can be done by extending or editing of the Trench Path.

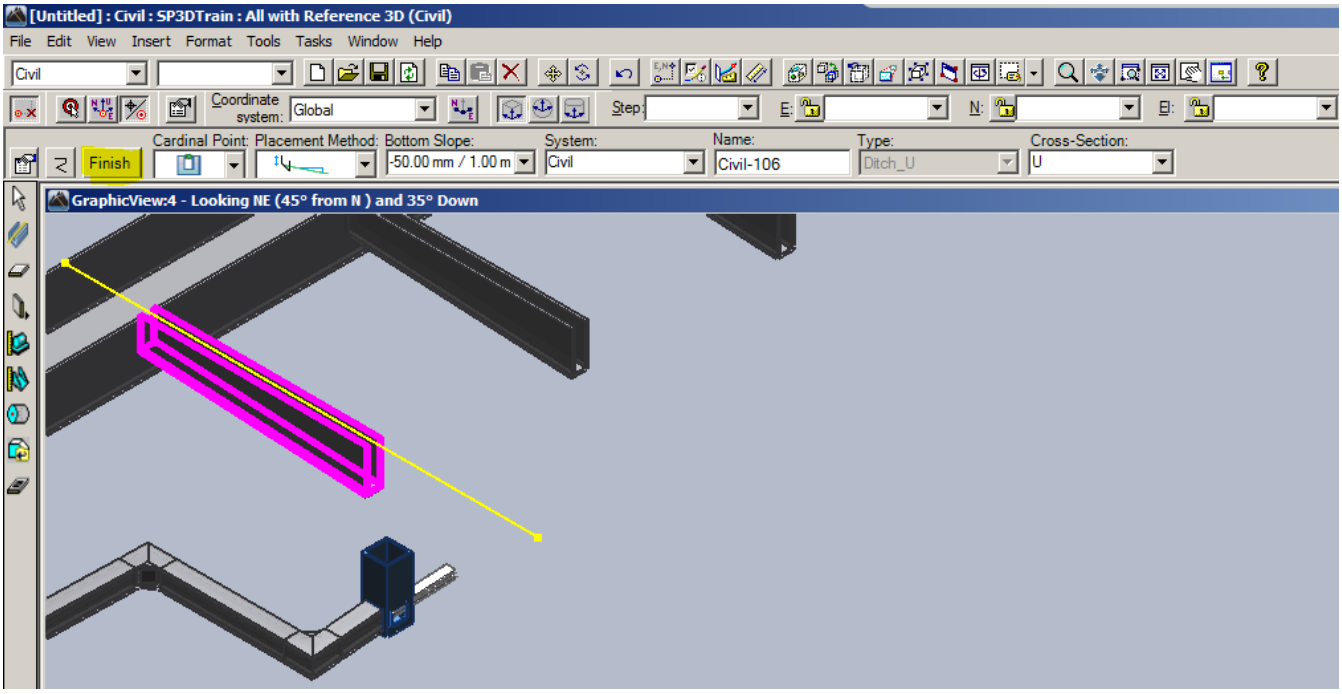
1. Extend all trenches 8 m south.
   Select **Trench Run**, select the path, click **Edit**, select the last vertex and move it (using e.g. Pin Point).

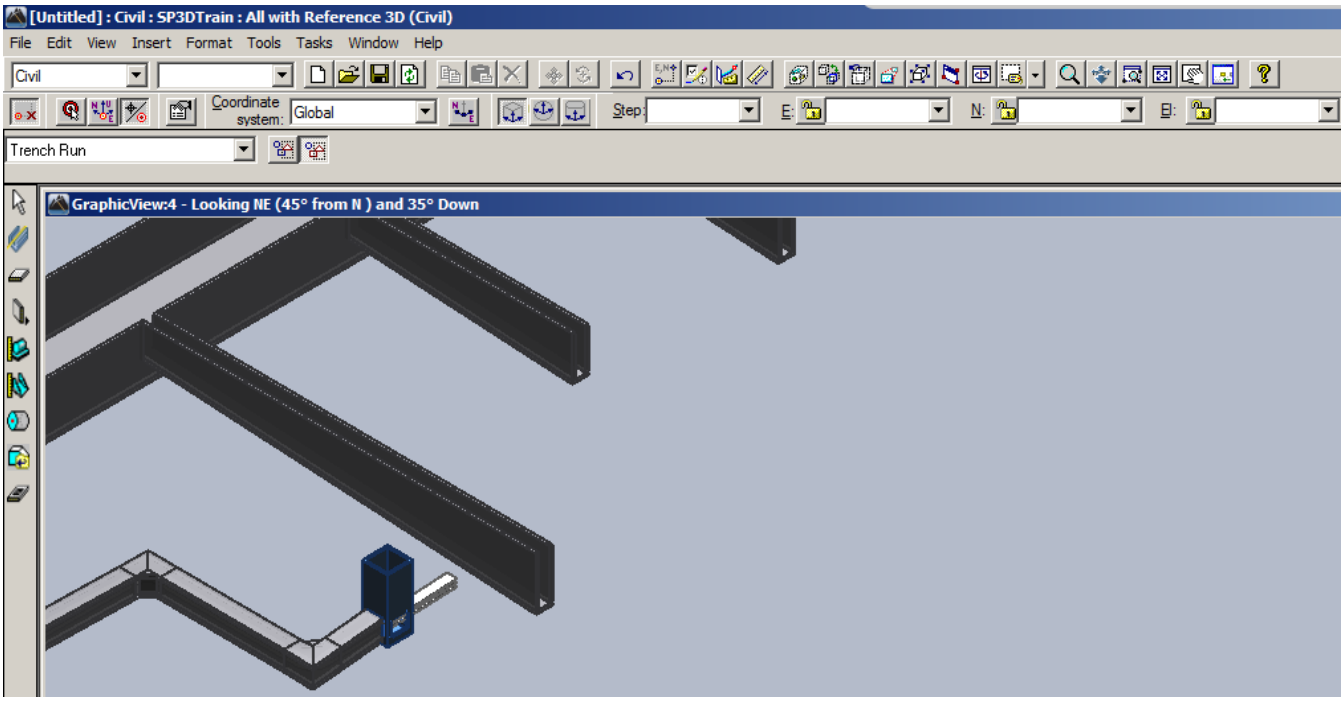




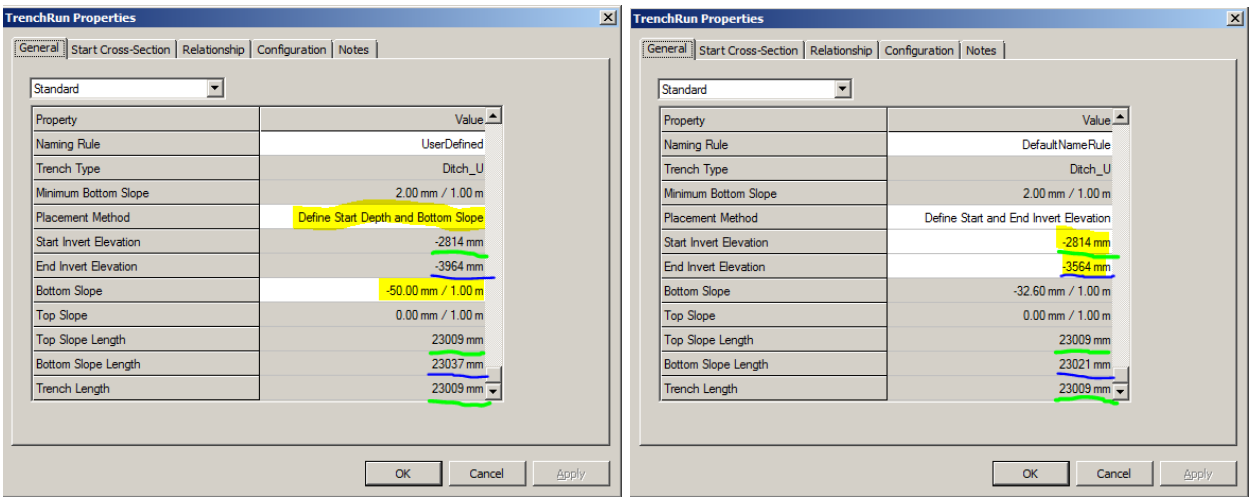

[Untitled] : Civil : SP3DTrain : All with Reference 3D (Civil)
File Edit View Insert Format Tools Tasks Window Help
Civil
Coordinate system: Global
Step:
E: 0 mm
N: -8000 mm
El: 0 mm
Plane:
Angle 2:
Angle 1:
Angle 3:
Turn Type:
Value:
Finish
Cancel
Edit
Create
Origin
None
GraphicView:4 - Looking NE (45° from N) and 35° Down


[Untitled] : Civil : SP3DTrain : All with Reference 3D (Civil)
File Edit View Insert Format Tools Tasks Window Help
Civil
Coordinate system: Global
Step:
E: 0 mm
N: 0 mm
El: 0 mm
Plane:
Angle 2:
Angle 1:
Angle 3:
Turn Type:
Value:
Finish
Cancel
Edit
Create
Origin
None
GraphicView:4 - Looking NE (45° from N) and 35° Down



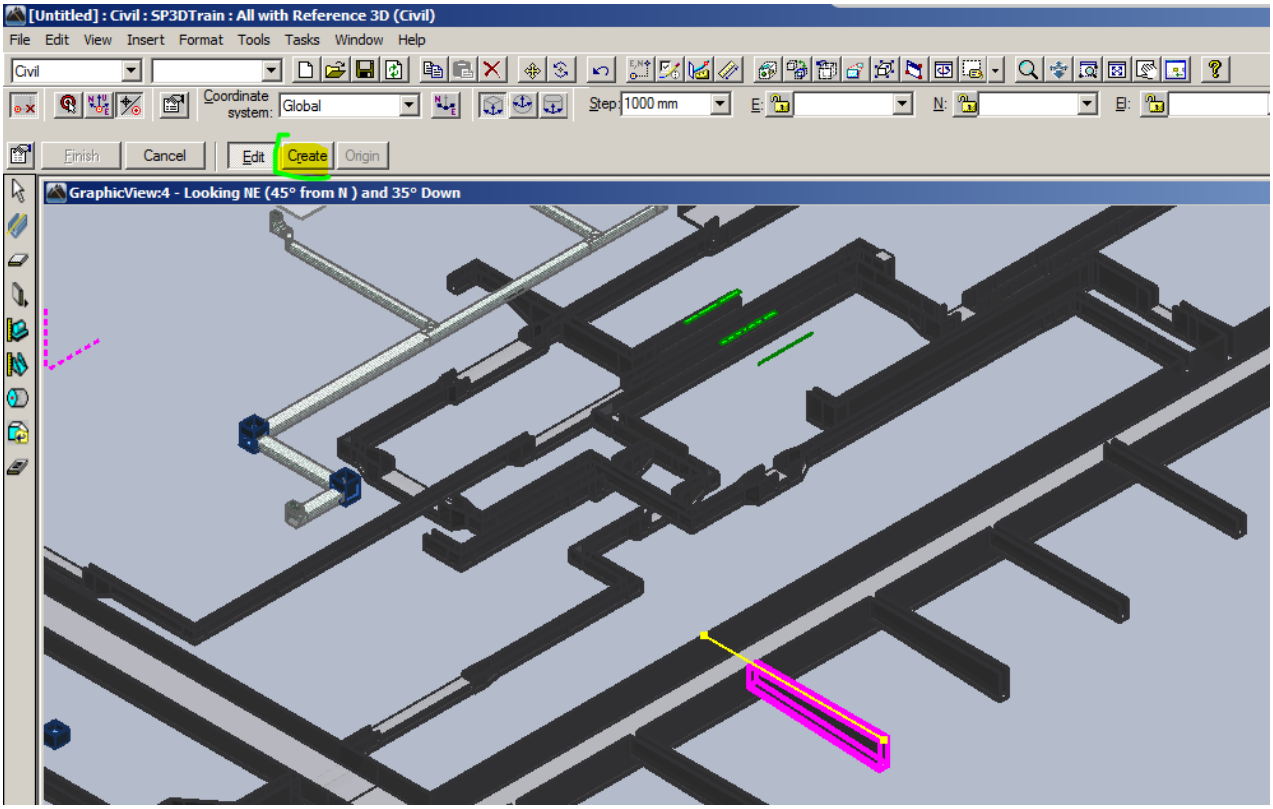


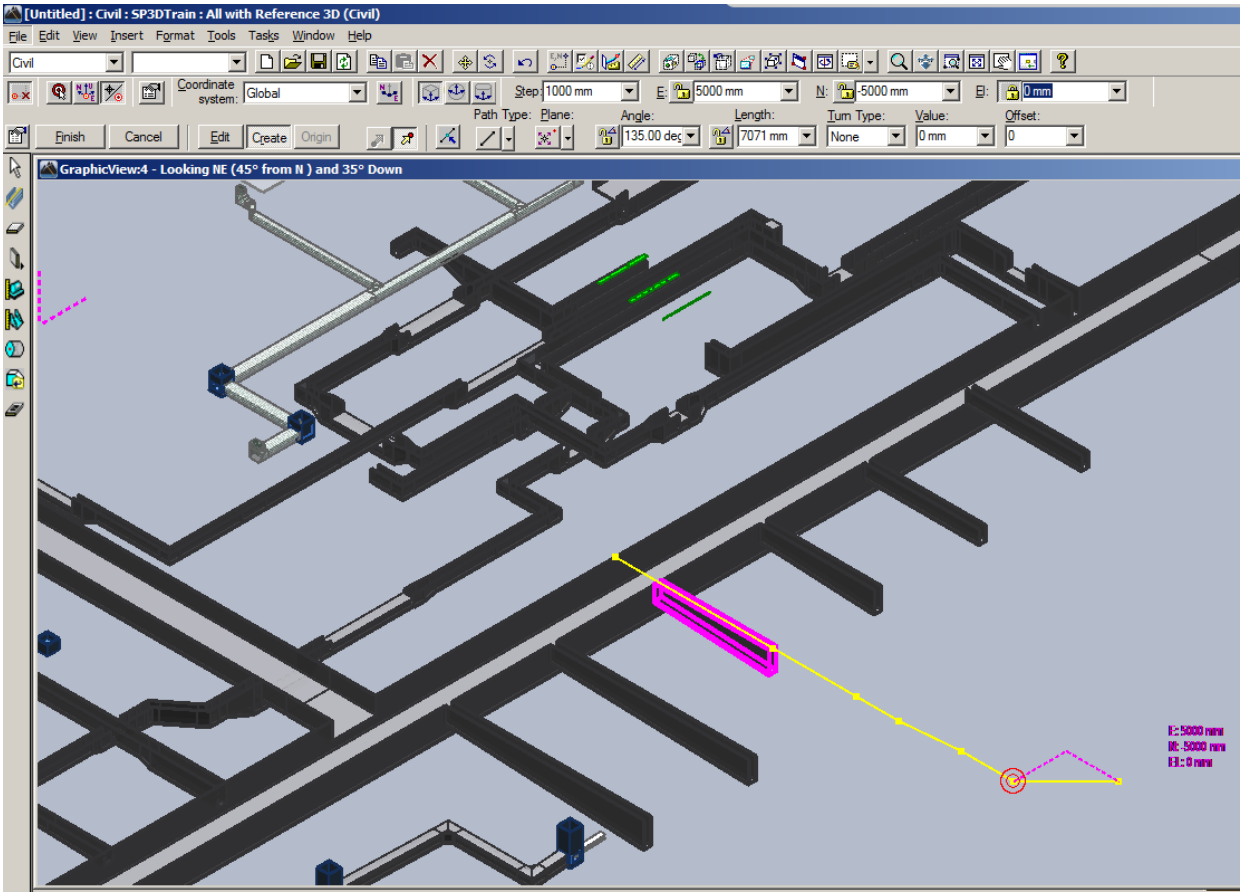
Note: Geometry will differ if an elevation is defined at the end, or if there is a relative slope per length unit.

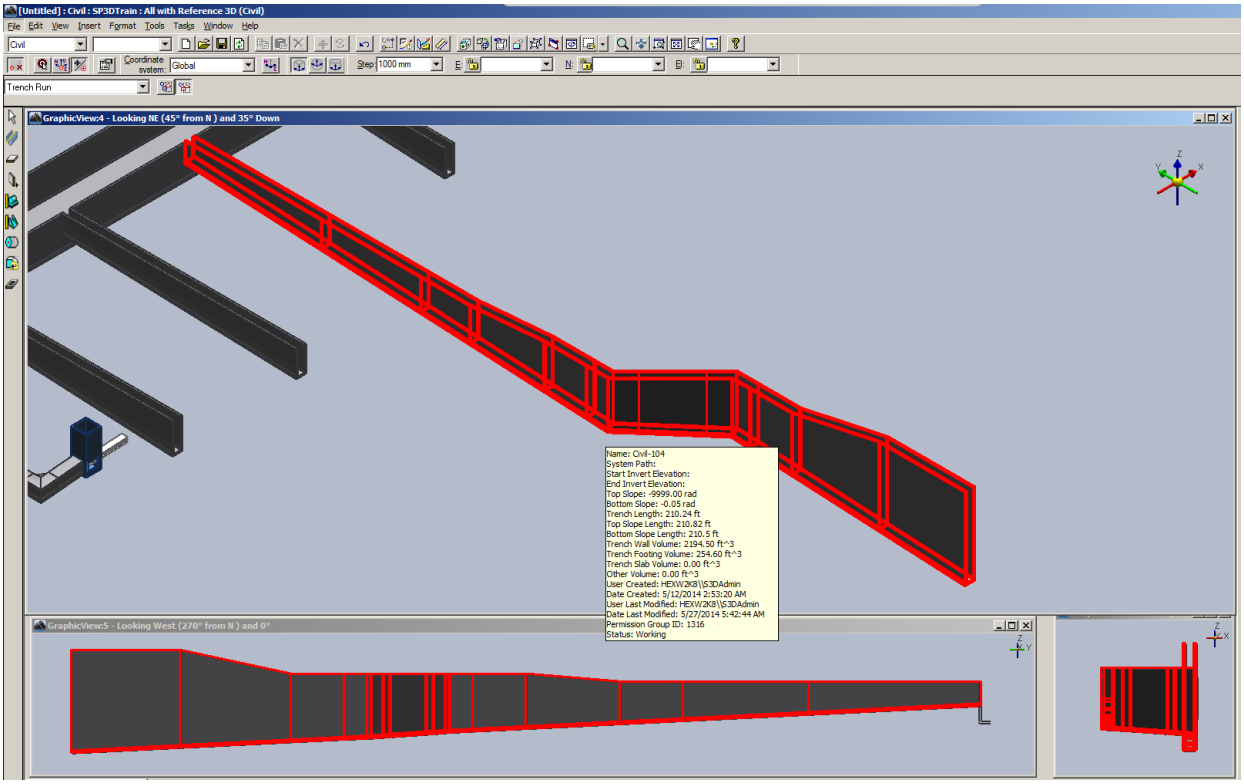


2. To add a new leg for transition, elevation, or direction change use **Create** and continue routing from the end vertex.

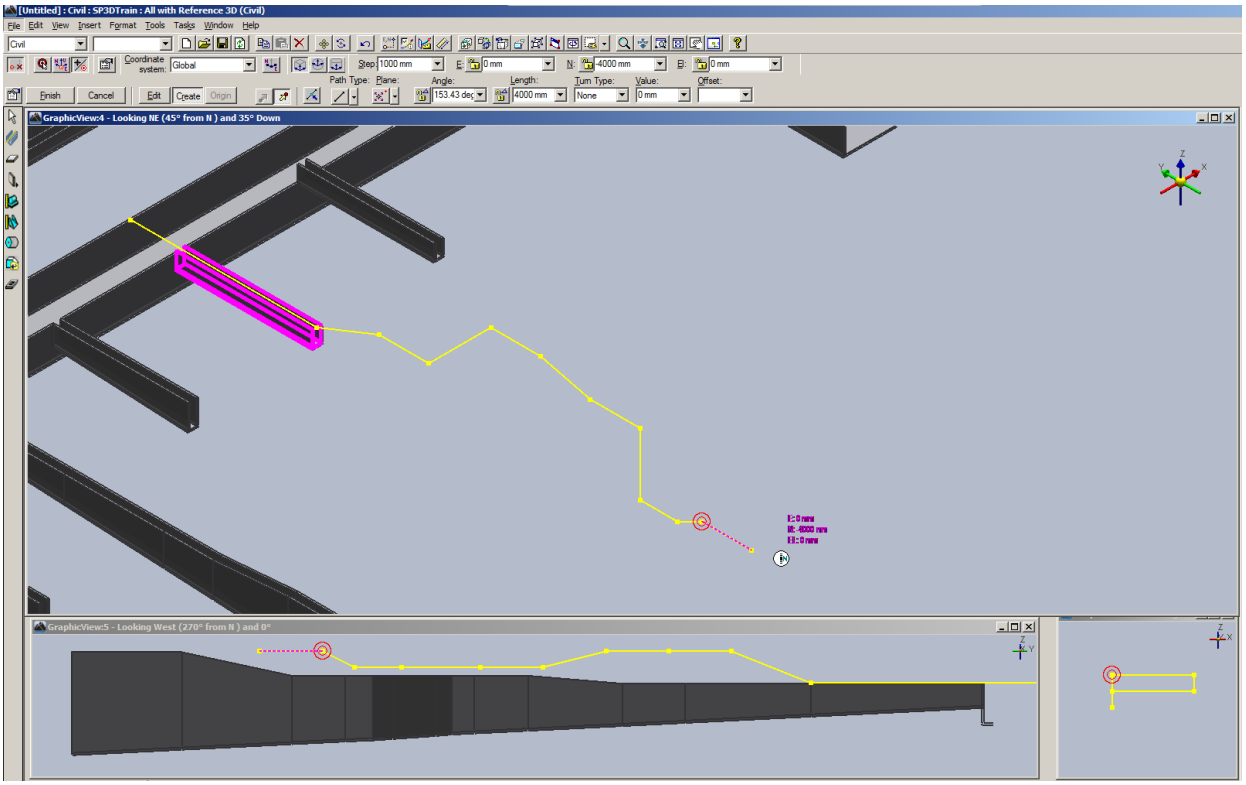
Note: Top Cardinal Point placement with bottom slope or inverted elevations can change upper edge (above ground) and maintain slope of drainage ditches or pipe trenches

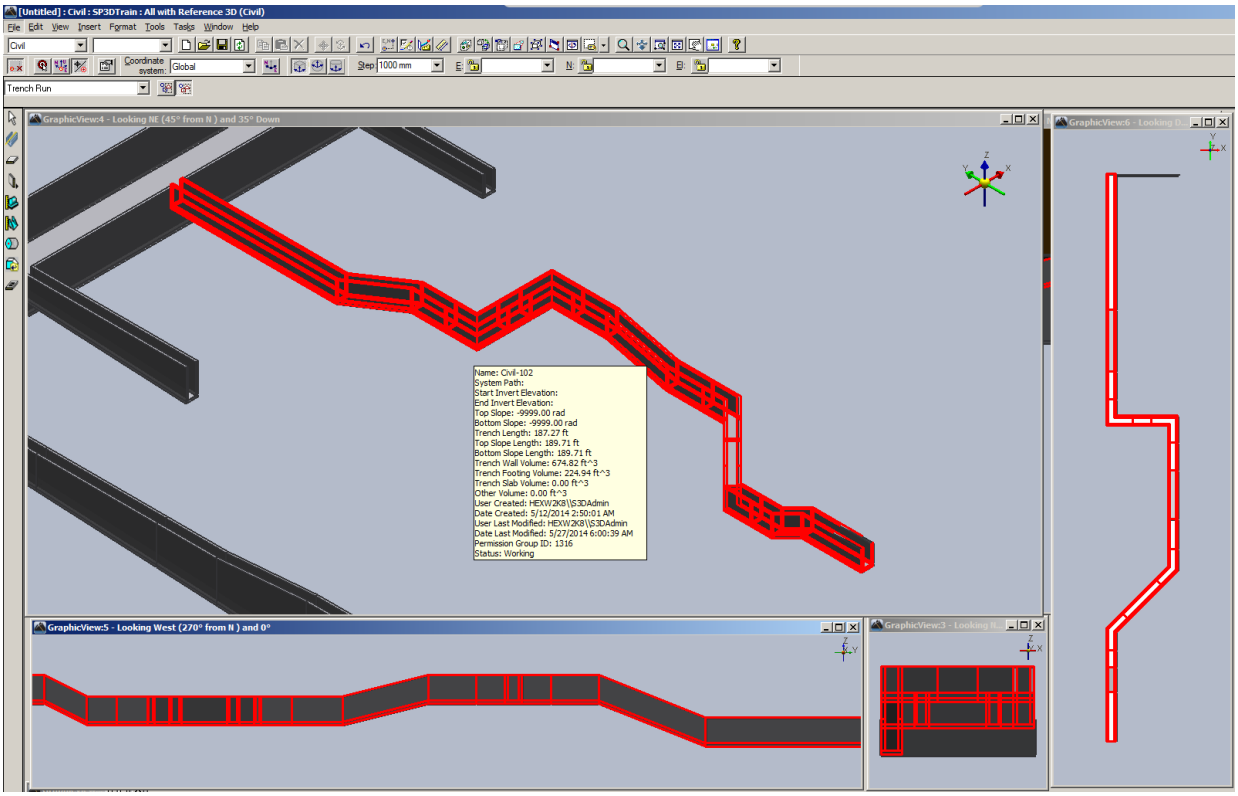



[Untitled] : Civil : SP3DTrain : All with Reference 3D (Civil)
File Edit View Insert Format Tools Tasks Window Help
Civil
Coordinate system: Global
Step: 1000 mm
E: 5000 mm
N: -5000 mm
El: 0 mm
Path Type: Plane: Angle: Length: Turn Type: Value: Offset:
Finish Cancel Edit Create Origin
135.00 deg
7071 mm
None
0 mm
0
GraphicView:4 - Looking NE (45° from N) and 35° Down


[Untitled] : Civil : SP3DTrain : All with Reference 3D (Civil)
File Edit View Insert Format Tools Tasks Window Help
Trench Run
GraphicView:4 - Looking NE (45° from N) and 35° Down
Name: Civil-104
System Path:
Start Invert Elevation:
End Invert Elevation:
Top Slope: -9999.00 rad
Bottom Slope: -0.05 rad
Trench Length: 210.24 ft
Top Slope Length: 210.82 ft
Bottom Slope Length: 210.5 ft
Trench Wall Volume: 2194.50 ft^3
Trench Footing Volume: 254.60 ft^3
Trench Slab Volume: 0.00 ft^3
Other Volume: 0.00 ft^3
User Created: HEXW2K8\\S3DAdmin
Date Created: 5/12/2014 2:53:20 AM
User Last Modified: HEXW2K8\\S3DAdmin
Date Last Modified: 5/27/2014 5:42:44 AM
Permission Group ID: 1316
Status: Working
GraphicView:5 - Looking West (270° from N) and 0°

3. Similarly the model can be modified trenched with parallel top and bottom placement. Ensure that you have at least 5 segments in a straight direction for further modifications.



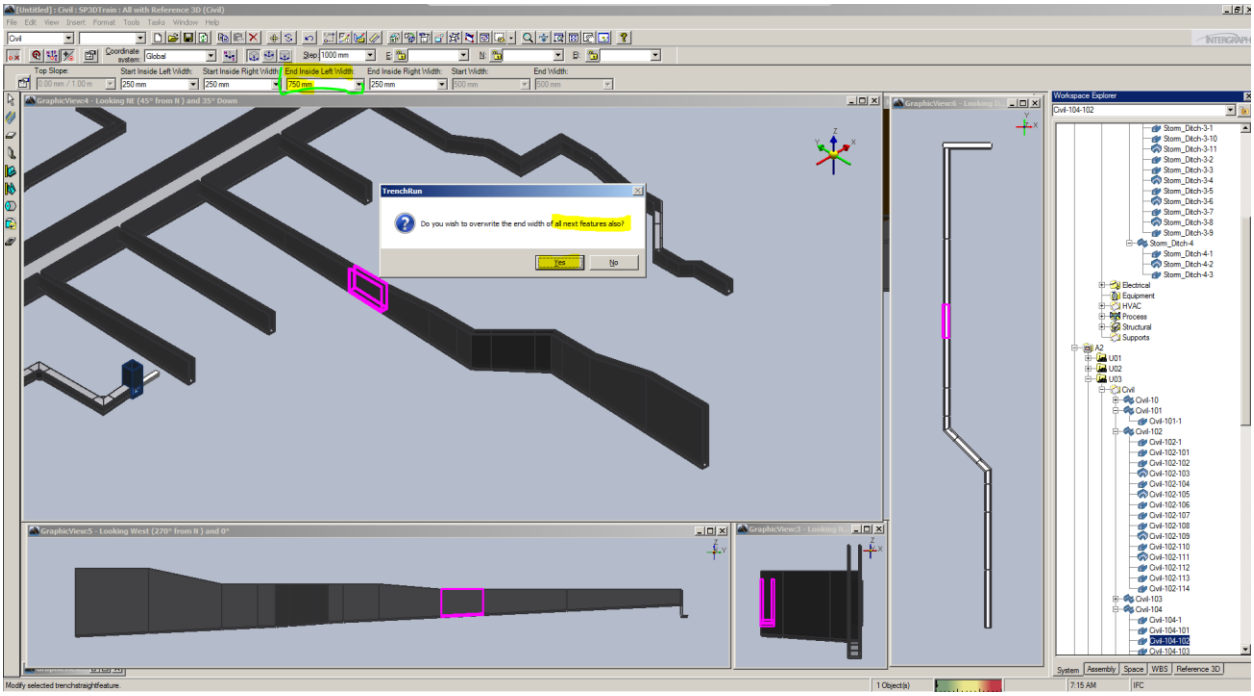


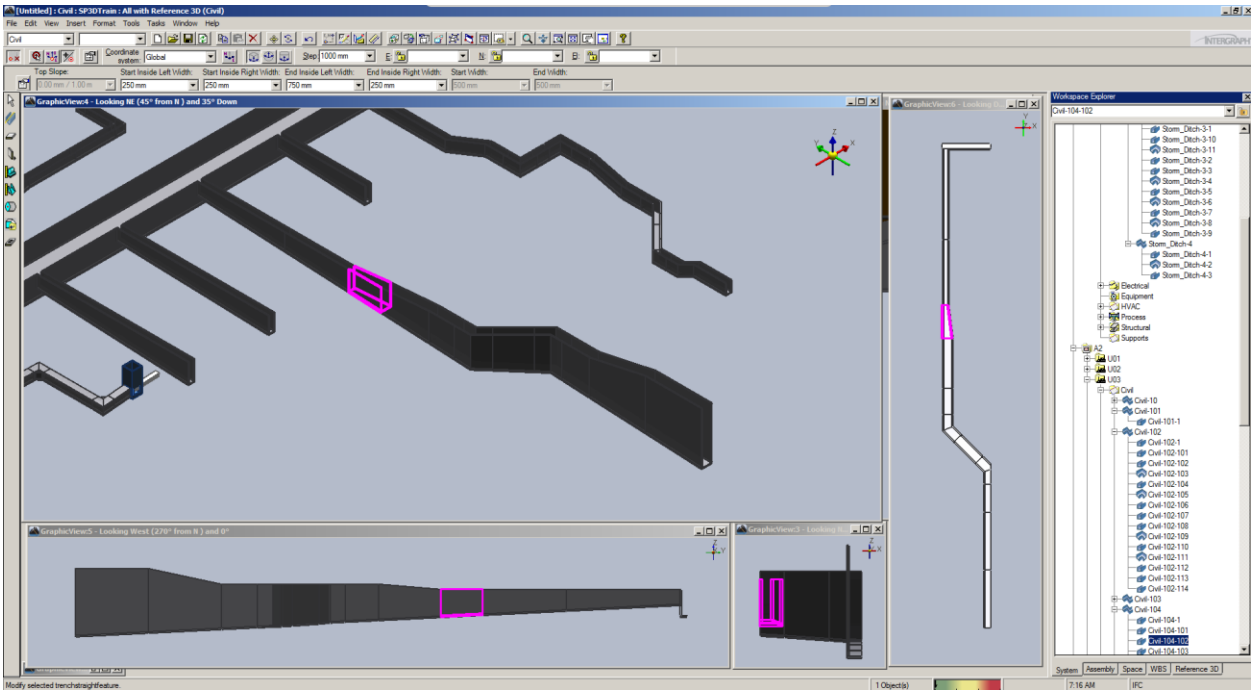
Trench Features

Transitions can be created by modifying cross sections of trench features

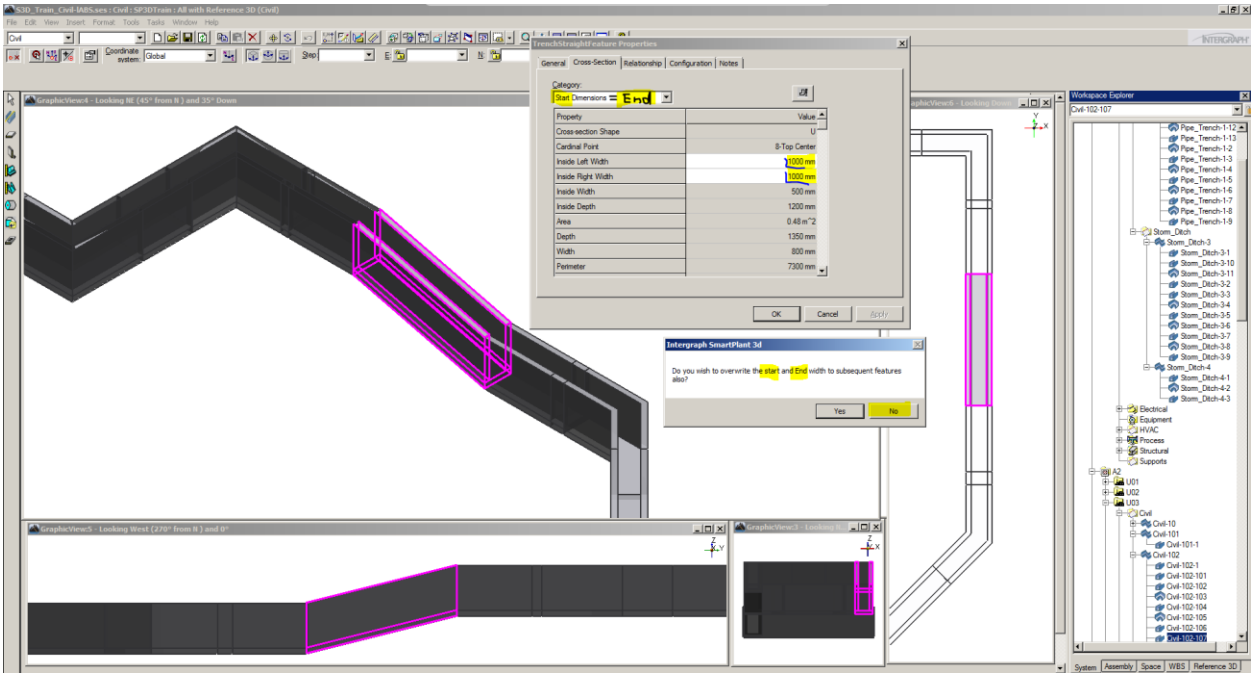
Lab 04 – Modification of Features (width, transitions, direction changes)

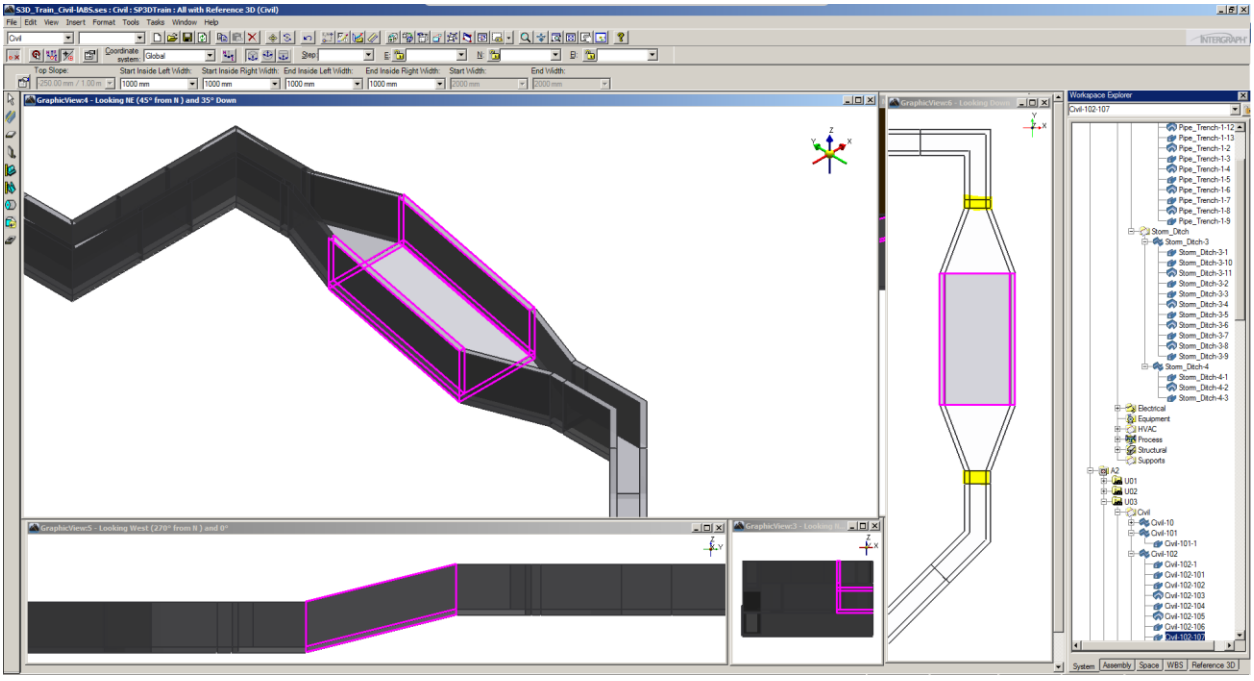
1. Modify the **End Inside Left Width** of Straight Feature of **Civil-104** and change it from 250 mm to 750 mm for selected and all next features.





2. Modify (using the **Straight Feature** Properties form) all four (**Start Inside Left Width**, **Start Inside Right Width**, **End Inside Left Width** and **End Inside Right Width** of Straight Feature of **Civil-102** and change them from 250 mm to 1000 mm for just the selected (Use **No** when asked about changing all next features).



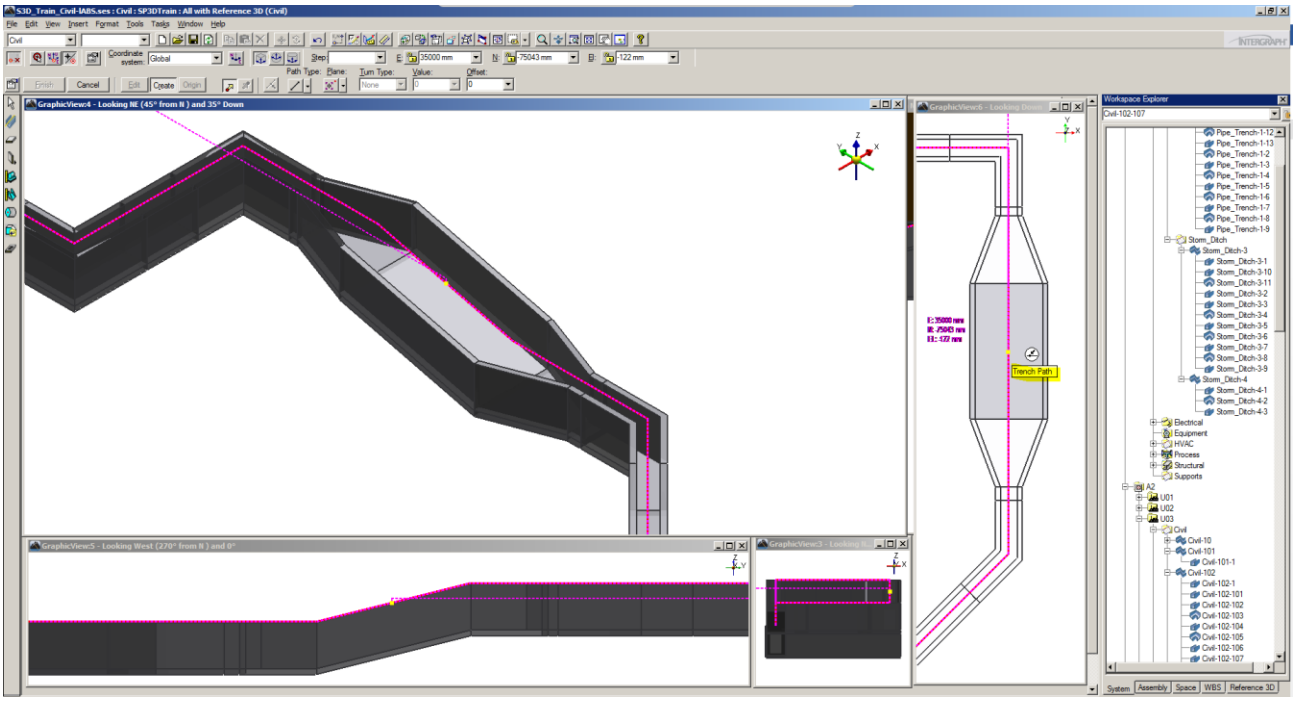


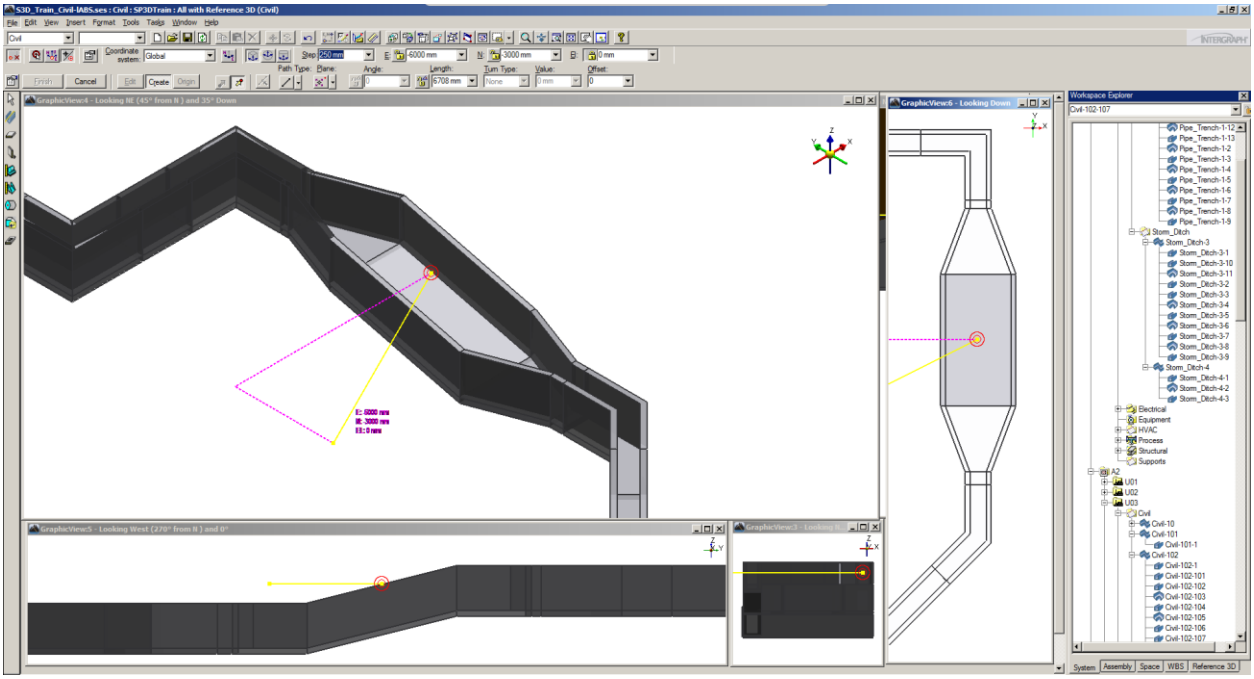
Branching Trenches

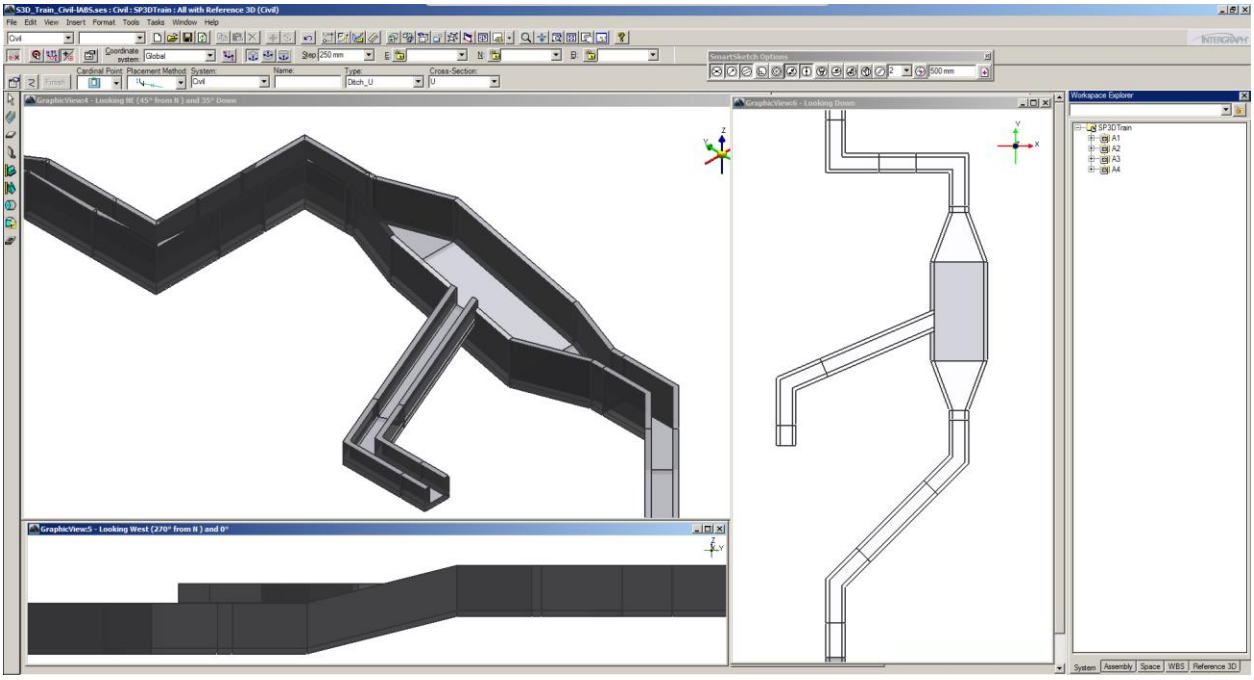
There are planned branch features, but currently branches can be created by creating a new Trench Path from an existing Trench Path.

Lab 05 – Creation of Branch

1. Start **Place Trench** command. Ensure you have selected the same Trench Type and system as the “header” branch, and start 3D Sketch by selecting the Trench Path of the SF you want to branch off. Lock onto that Trench Path with the middle mouse button, and position it while locked to coordinates where you want to start.







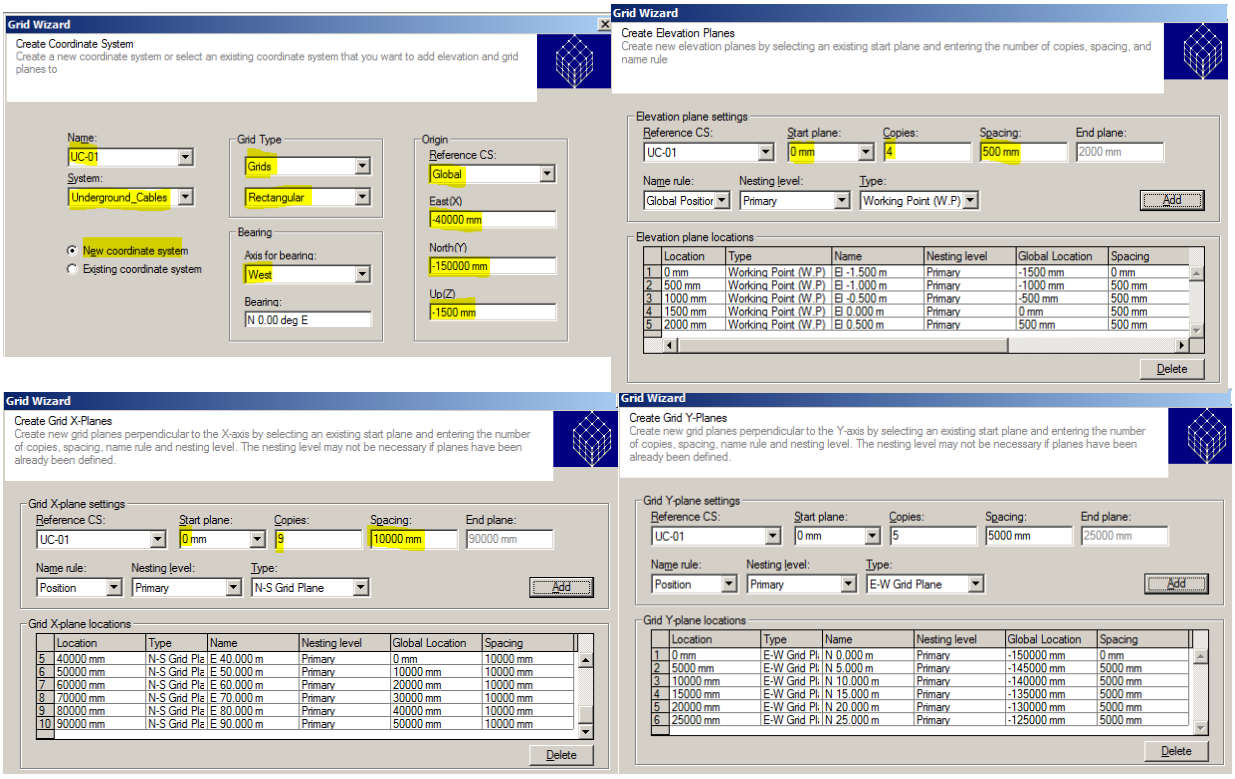
Routing Using Grids

For trenches placed in an early phase of the design (proposals, basic design), and with the expectation that some overall dimensions might be changed, it might be helpful to use a coordinate system with a grid.
It might be either a grid used for related structures of separate grid just for Civil objects. Important is to plan ahead and use grid for related objects as modifications of grid per design will impact ALL associated objects and disconnecting (removing associativity) is not a simple operation.

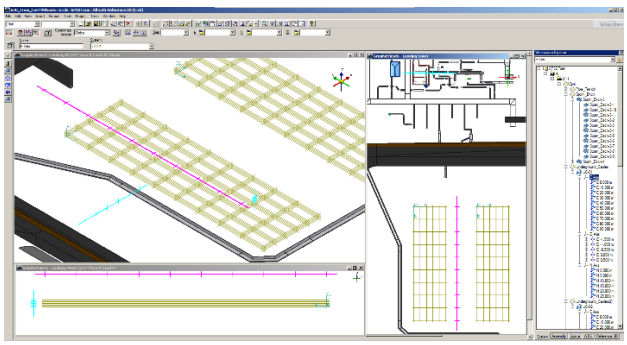
Lab 06 – Grid Placement

1. Create a new Generic System **Underground_Cables** under Place regular grid named **UC-01** to coordinates: **-10** m; **-130** m; **-1.5** m as child of the above system with following grid planes:

5 elevations	per 500 mm / 20 in
10 grid planes in EW direction	per 10 m / 30 ft
6 grid planes in NS direction	per 5 m / 15 ft

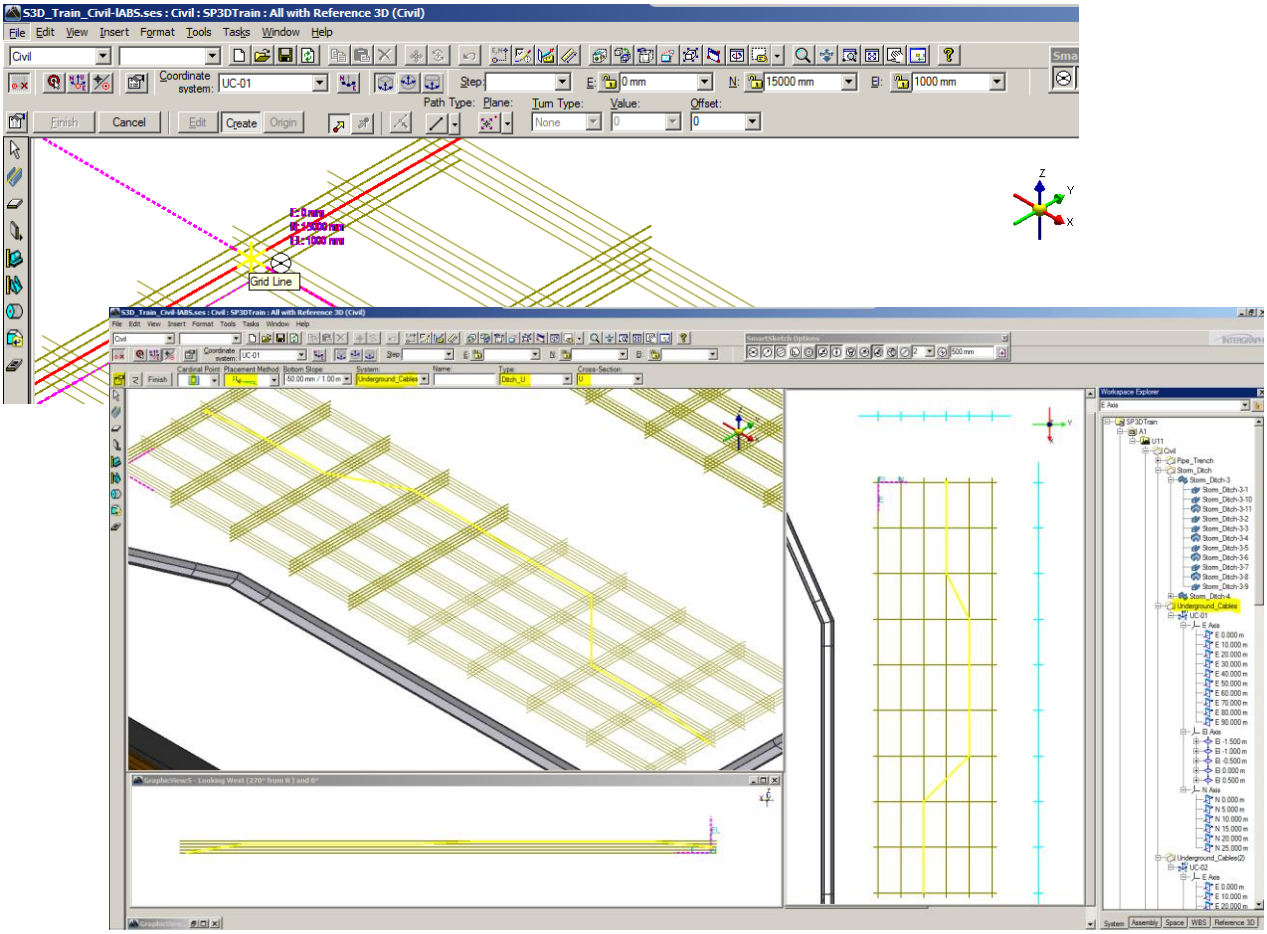


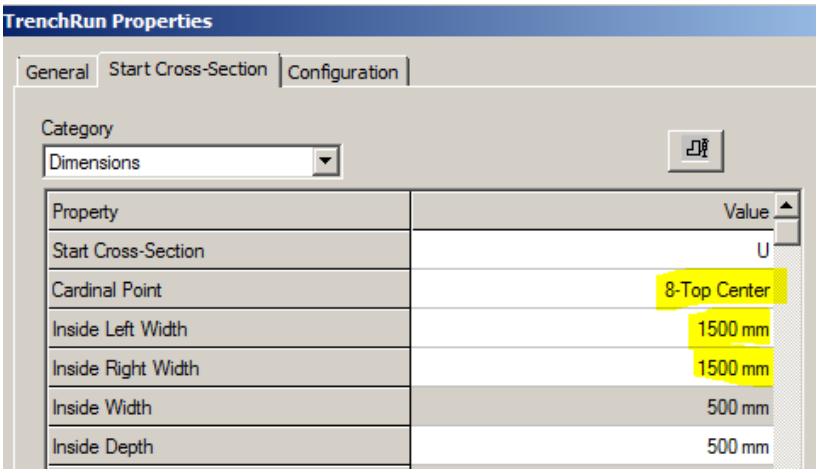
2. Copy that grid 1 times by 50 m to East

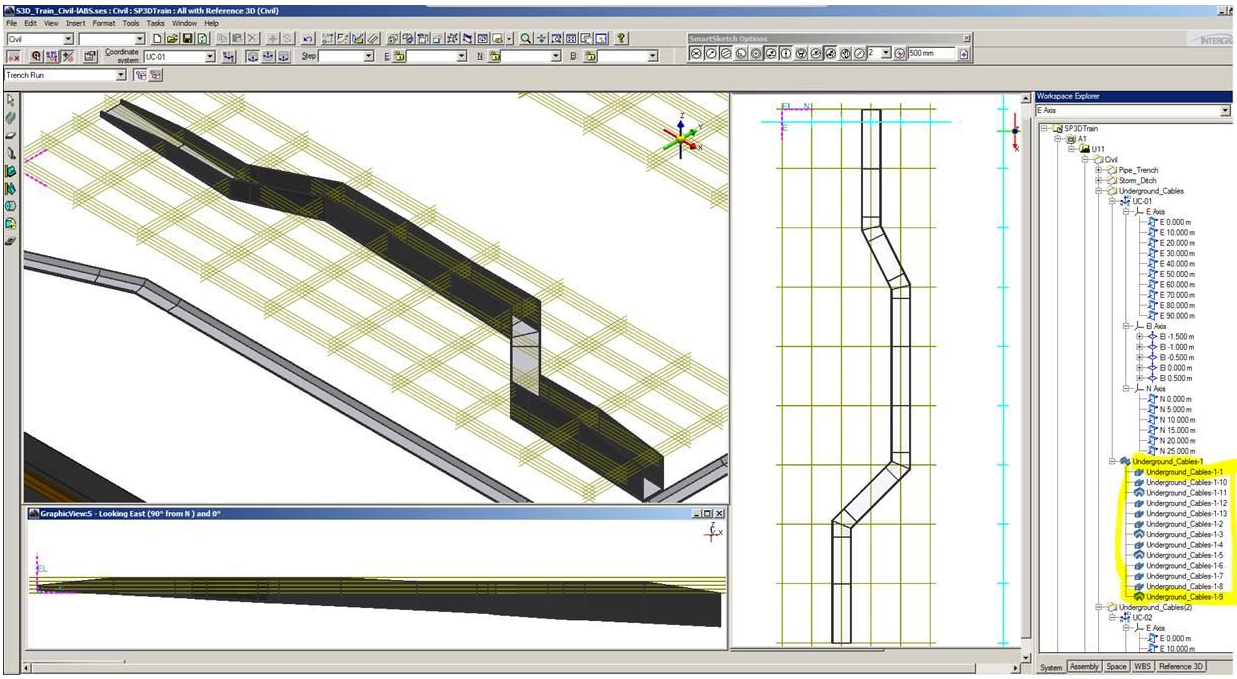


Lab 07 – Designing Trenches Using Grids

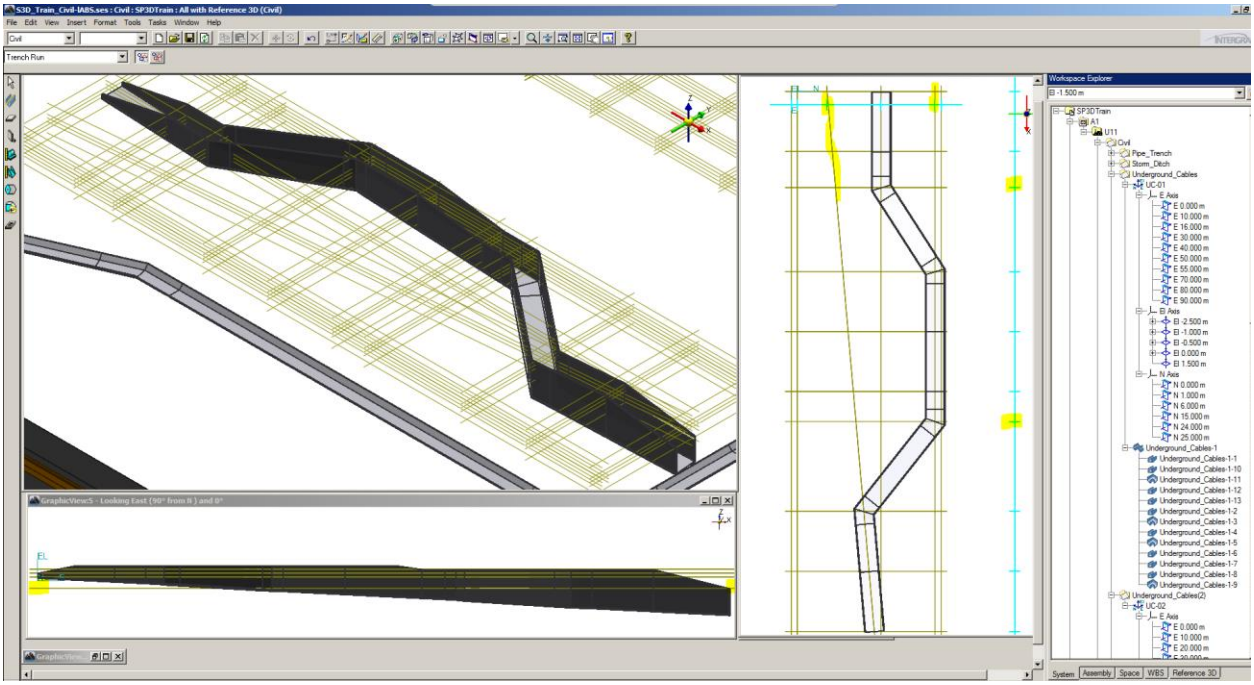
1. In the SmartSketch Ribbon bar select new **UC-01** Grid CS as the Active Coordinate System and reposition the target to the Origin and turn on Relative Tracking.
2. Start the **Place Trench** command. Use top center CP 8, and placement method with start depth and slope -5% to create Ditch-U with a total width of 3 m.
3. Route the locking to the grid nodes.







4. After placement, modify some grid planes to which the **Trench Path** was locked.

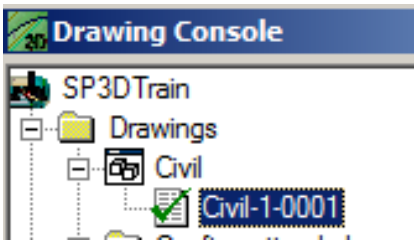


Deliverables

Smart 3D 2014 R1 includes three predefined Ortho Drawing View Styles and two report templates.

Lab 08 – Drawings

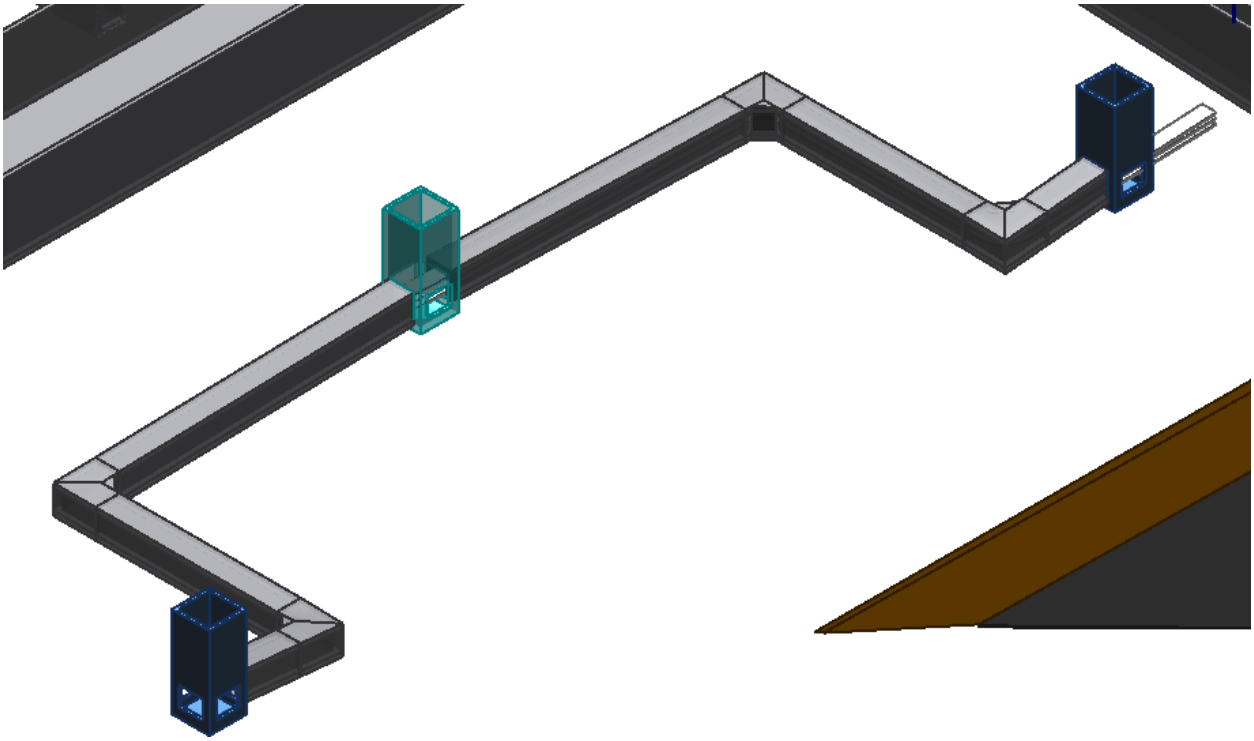
1. Open the Drawing Console and locate Civil Drawings. Open it using **Edit** from context menu.



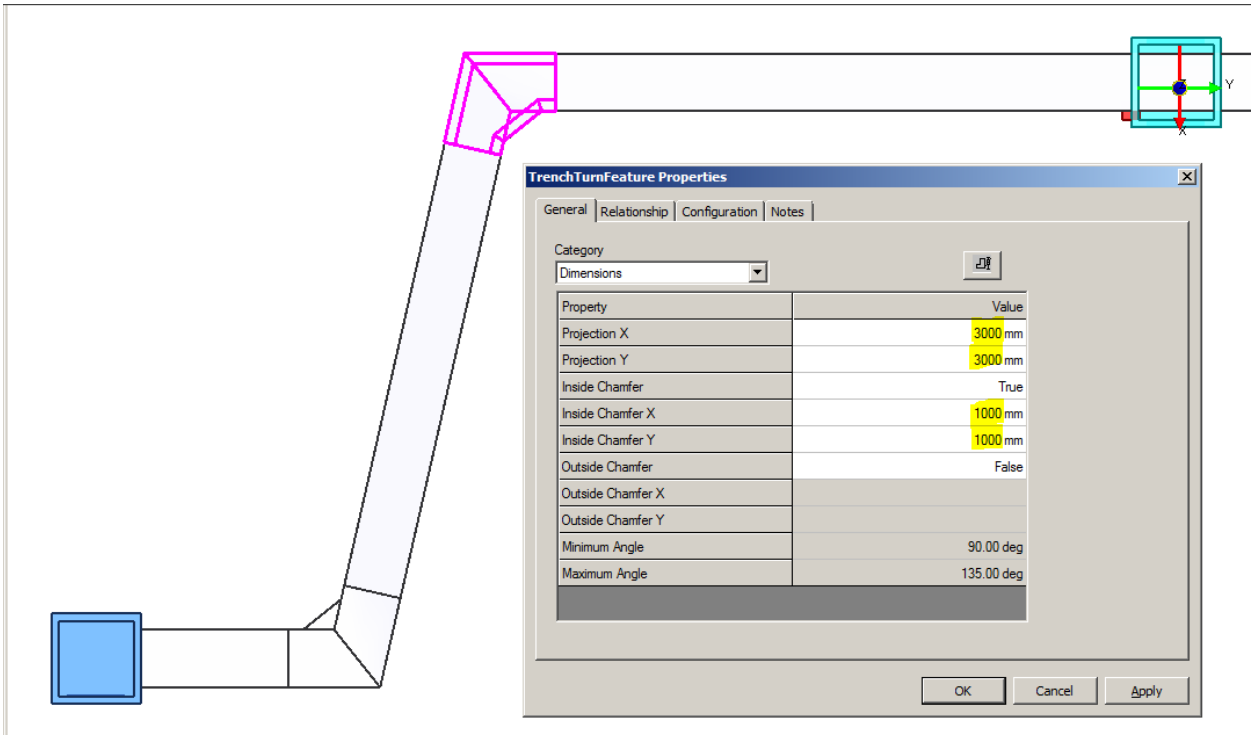
2. Using the 2D/3D Selection command, locate the upper 90deg Trench Turn Feature in model.

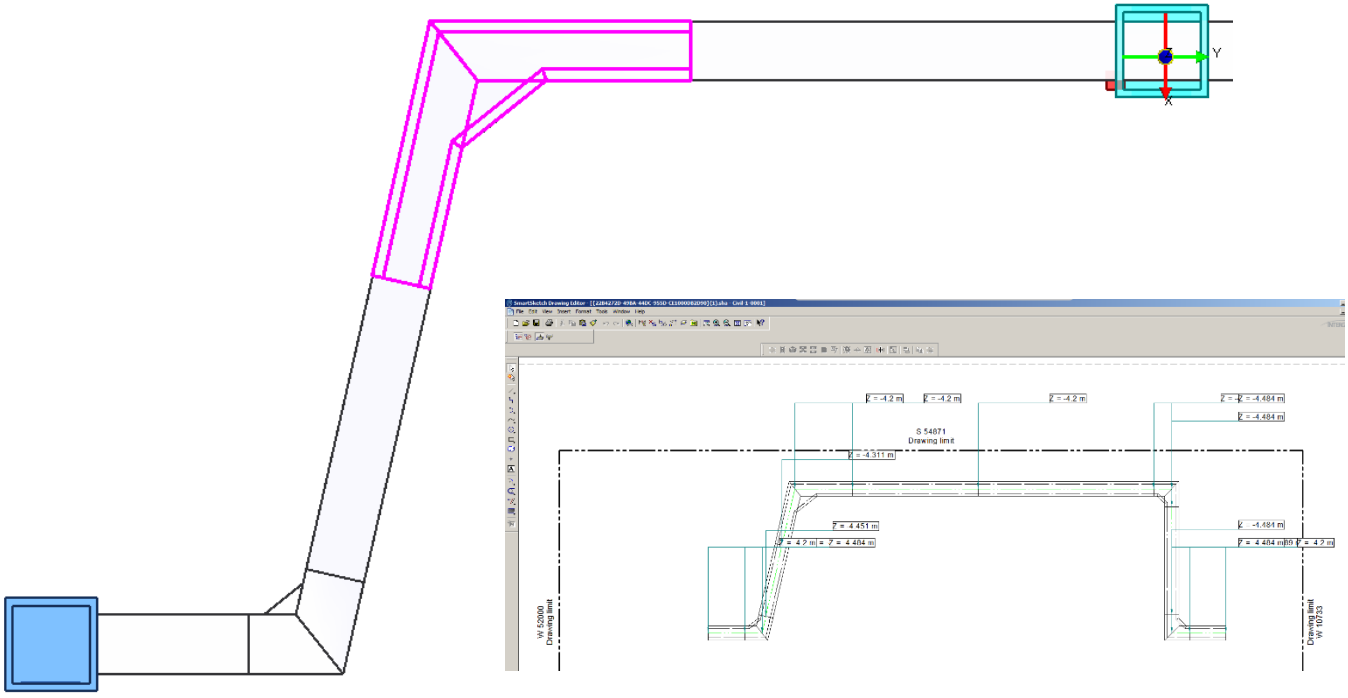
Note: Drawing is out of date. Update it (Right-click then click **Update Now**).

3. Mirror copy the Trench Run into the same system around the center of the pulpit equipment.



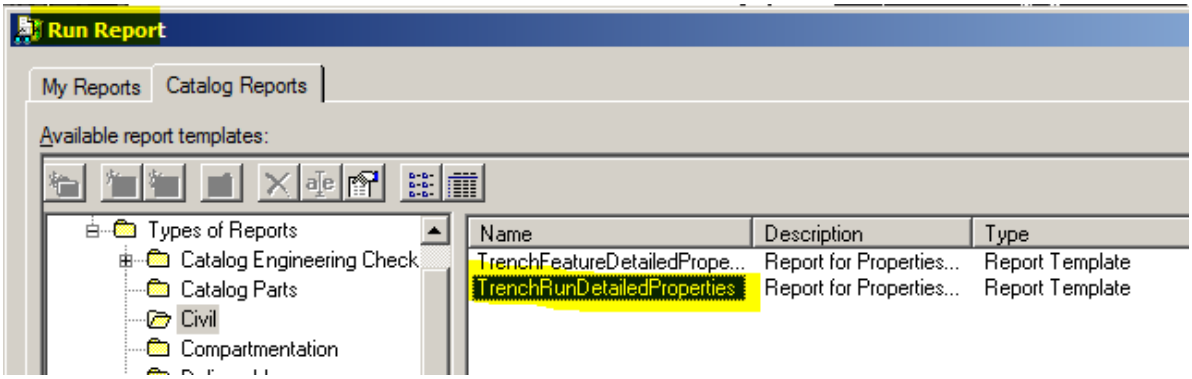
4. Modify mirrored part and update drawing

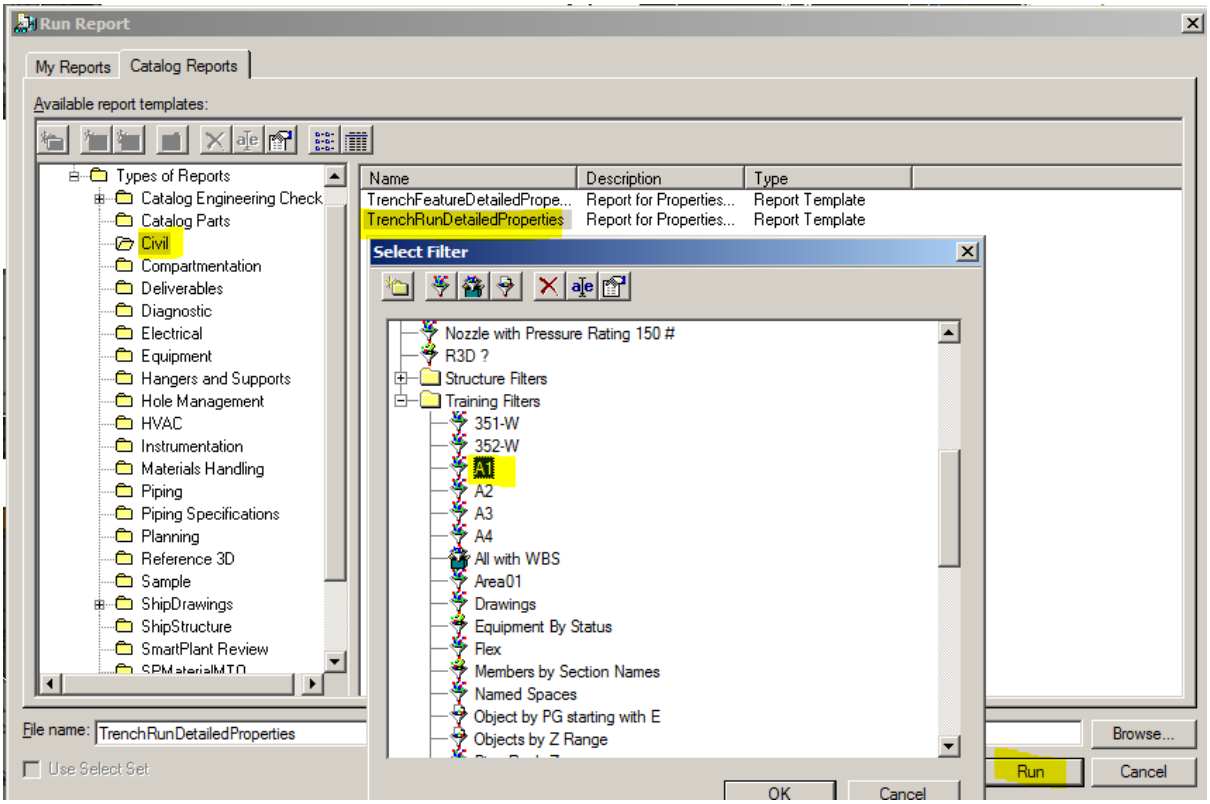


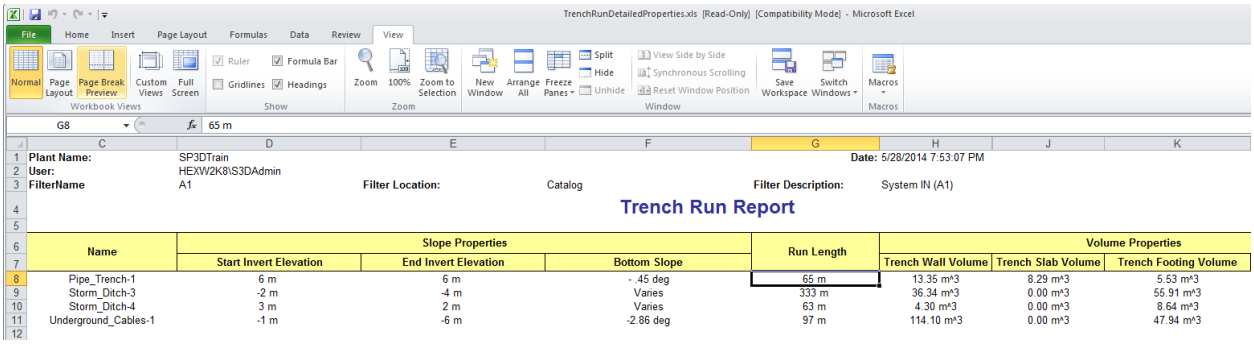


Lab 09 – Report

1. Run the report of the newly placed Trench Runs from Lab 7 under the **Underground_Cables** system.







TrenchRunDetailedProperties.xls [Read-Only] [Compatibility Mode] - Microsoft Excel

1	Plant Name:	SP3DTrain				Date: 5/28/2014 7:53:07 PM		
2	User:	HEXW2K8\S3DAdmin						
3	FilterName	A1	Filter Location:	Catalog		Filter Description:	System IN (A1)	

Trench Run Report

Name	Slope Properties			Run Length	Volume Properties		
	Start Invert Elevation	End Invert Elevation	Bottom Slope		Trench Wall Volume	Trench Slab Volume	Trench Footing Volume
Pipe_Trench-1	6 m	6 m	- .45 deg	65 m	13.35 m^3	8.29 m^3	5.53 m^3
Storm_Ditch-3	-2 m	-4 m	Varies	333 m	36.34 m^3	0.00 m^3	55.91 m^3
Storm_Ditch-4	3 m	2 m	Varies	63 m	4.30 m^3	0.00 m^3	8.64 m^3
Underground_Cables-1	-1 m	-6 m	-2.86 deg	97 m	114.10 m^3	0.00 m^3	47.94 m^3

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