



# 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.

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## Agenda

- Civil Task Overview
- Hands on Labs
  - Placement methods
  - Modification
    - Route alteration
    - Changing placement methods
  - Routing
    - Straight
    - Branching
  - Deliverables
    - Reports
    - Drawings

## 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.

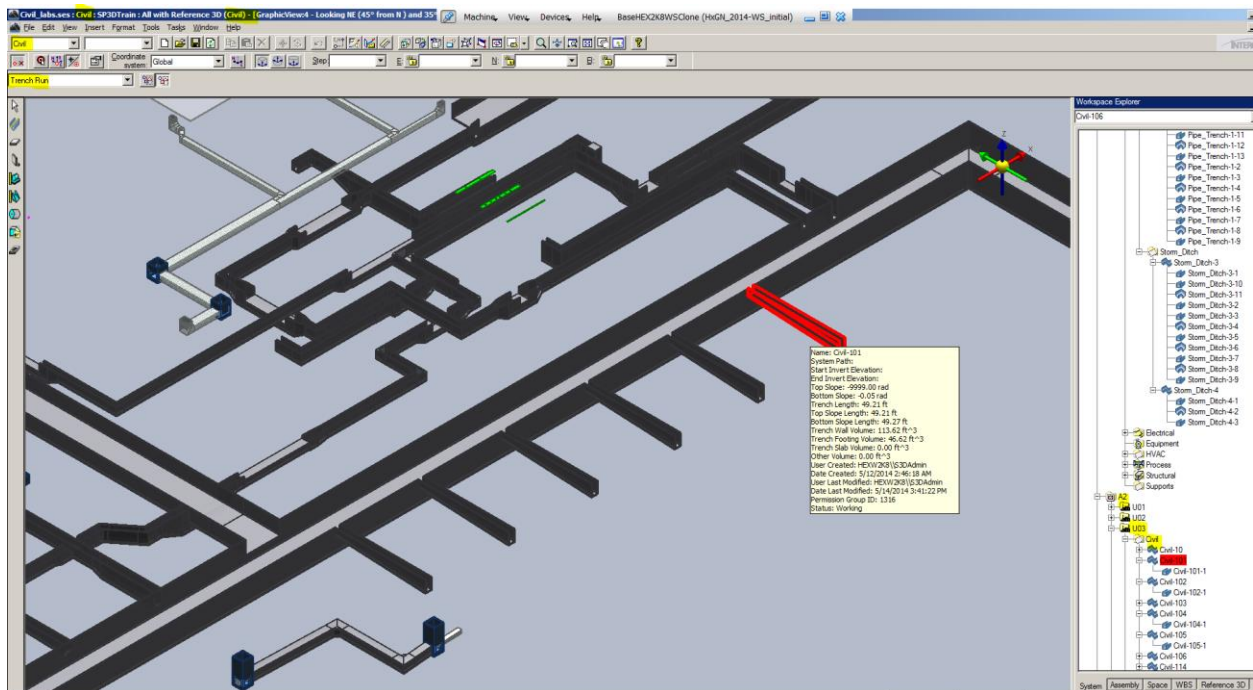
# Modelling of Trenches and Ditches

## Placement Methods, Trench Run Parameters

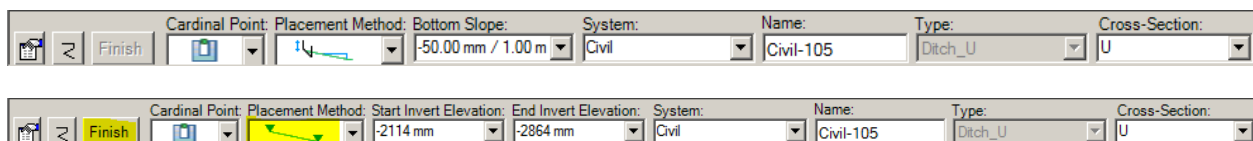
Test various placement methods on existing trenches to understand differences and purposes.

### Lab 01 – Modification of Placement Methods

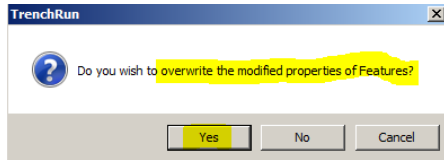
1. Start Smart 3D using template **Civil\_labs**.
2. Ensure that session is in **Civil Task**, your Active Permission Group is **Civil**, and the Locate Filter is set to **Trench Run**
3. Activate the saved view **U03-Trench Placement**.



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



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

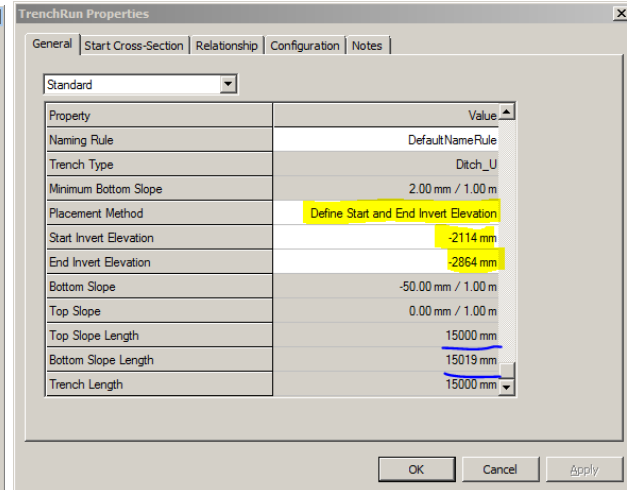
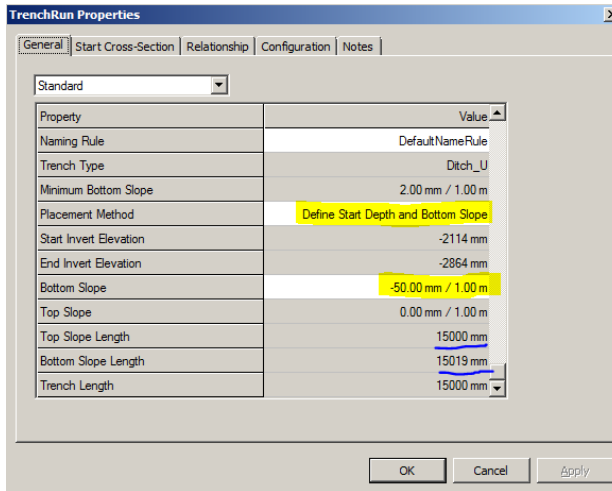


TrenchRun

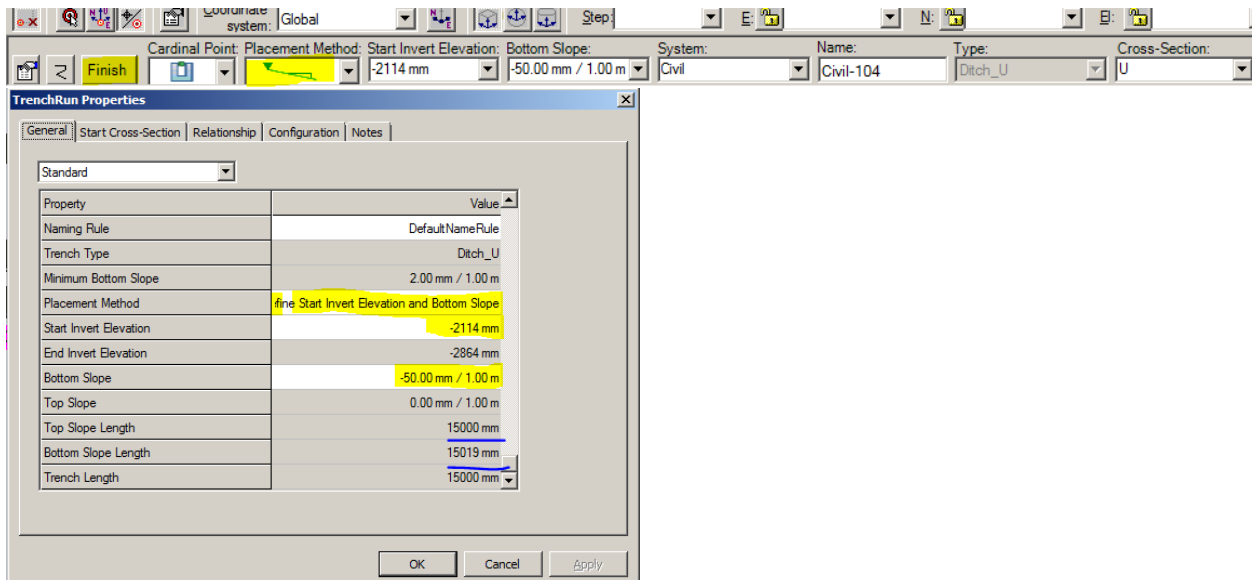
Do you wish to overwrite the modified properties of Features?

Yes No Cancel

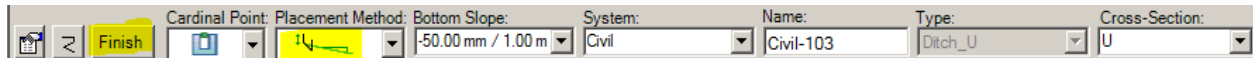
**Note:** This change should recalculate input parameters to match new method, but retain existing topology.



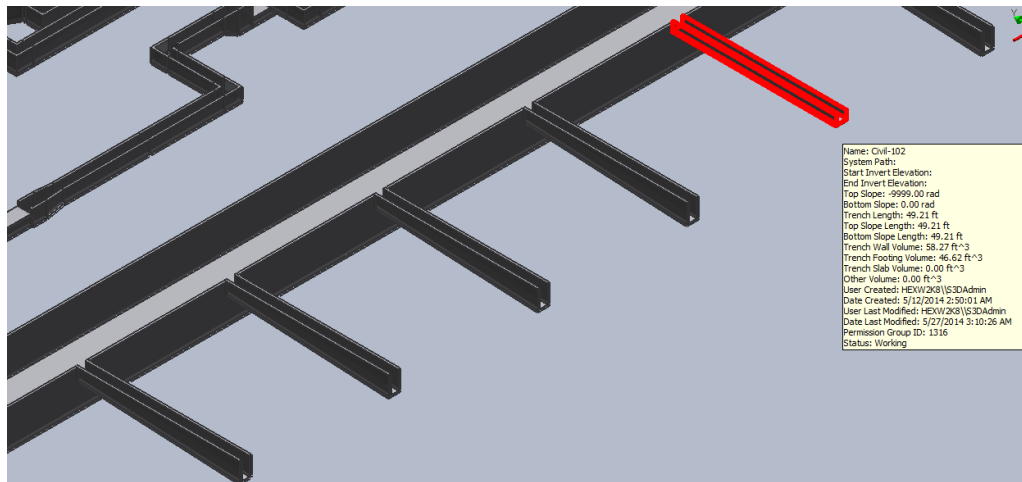
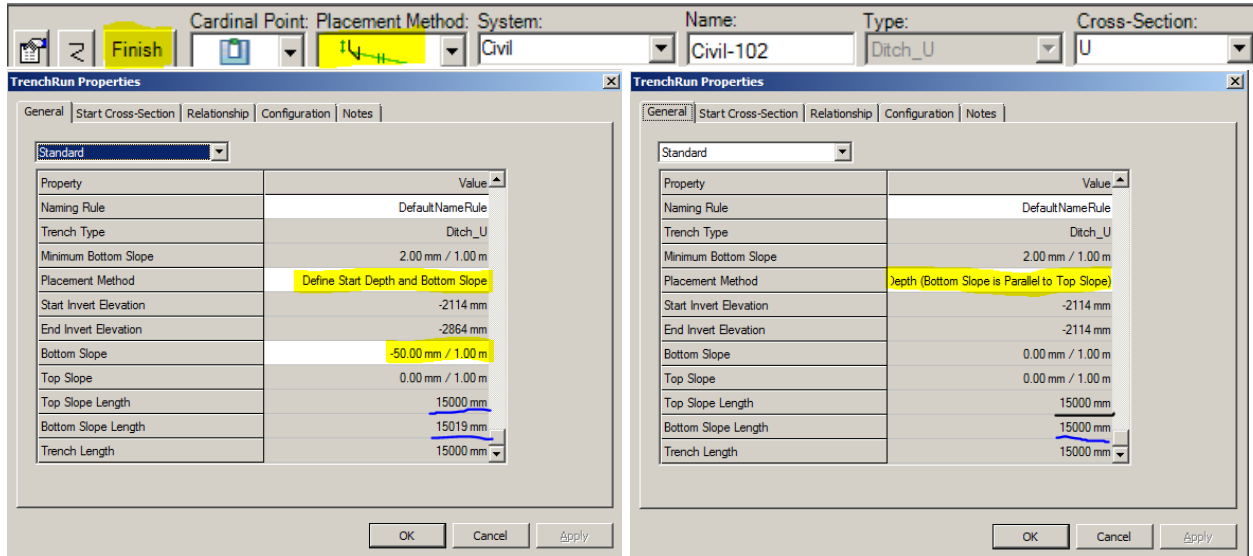
- Similarly change the 3<sup>rd</sup> branch to **Start Depth and Invert Elevation** method.



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

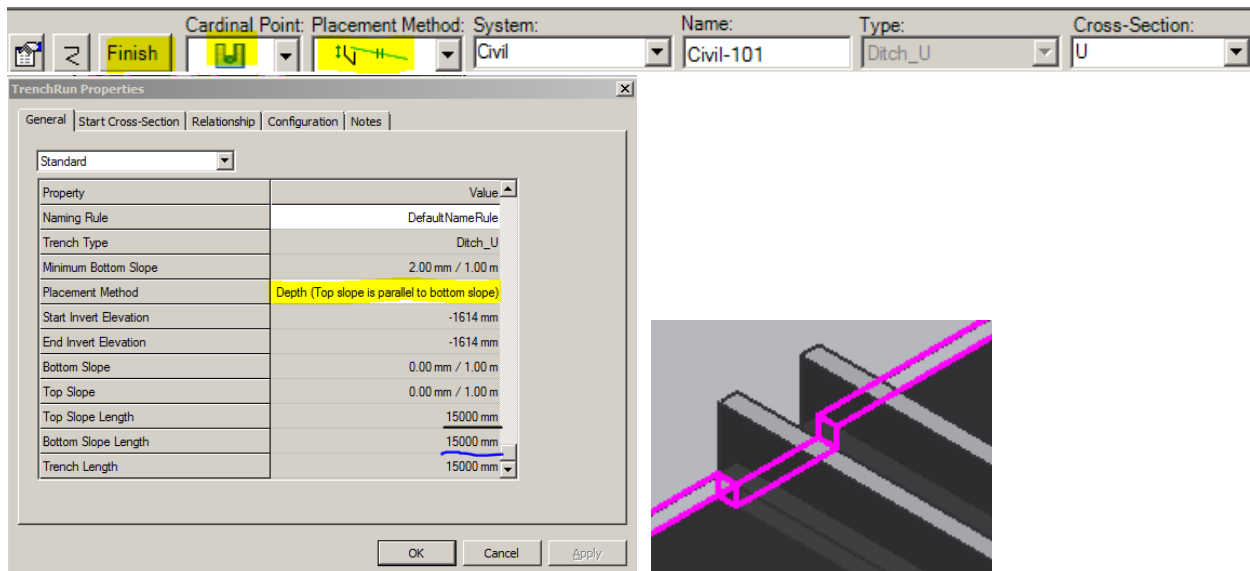


...and the 5<sup>th</sup> to the last **Start Depth (bottom slope is parallel to top slope)** method, which is the only one changing geometry .





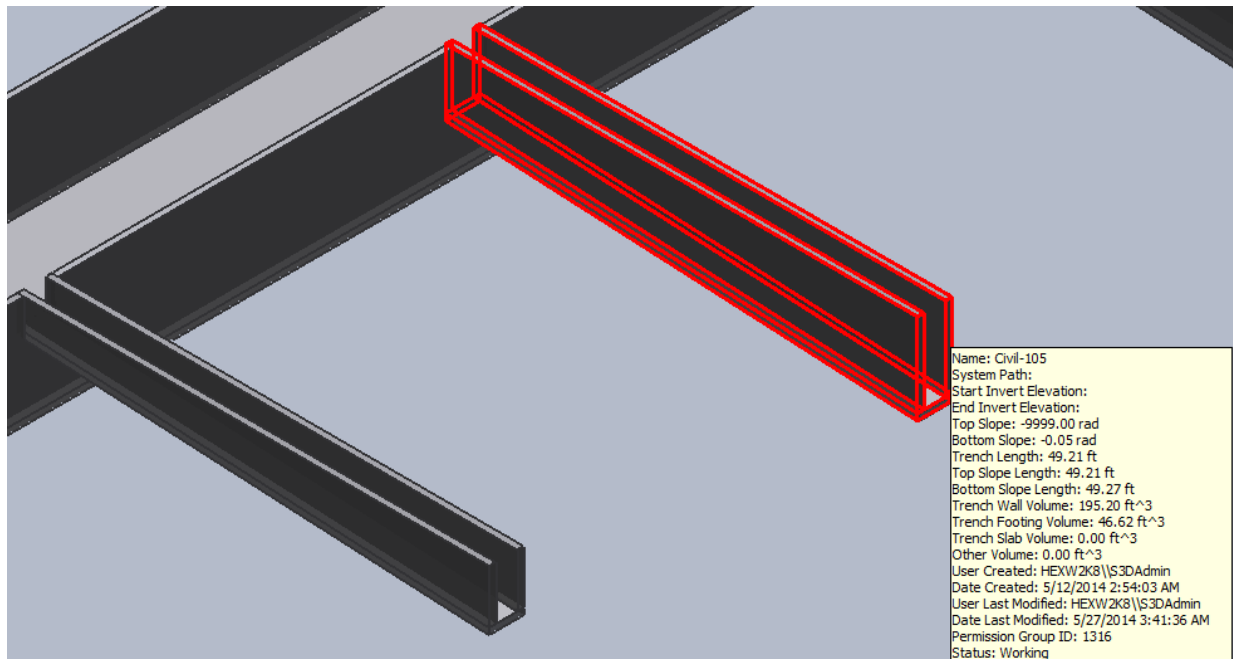
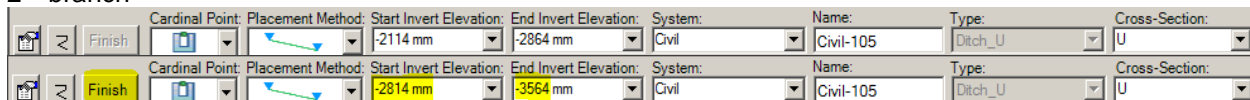
- Select the 6<sup>th</sup> branch and change Cardinal Point from the 8-Top Center to 2-Bottom Center and note that only opting with this Cardinal Point is **“Start Depth (top slope is parallel to bottom slope)”** and change to that method.







## Lab 02 – Modification of Inverted Elevation

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

### 2<sup>nd</sup> branch



### 3<sup>rd</sup> branch

		Finish	Cardinal Point:	Placement Method:	Start Invert Elevation:	Bottom Slope:	System:	Name:	Type:	Cross-Section:
		Finish	Cardinal Point:	Placement Method:	Start Invert Elevation:	Bottom Slope:	System:	Name:	Type:	Cross-Section:
					-2114 mm	-50.00 mm / 1.00 m	Civil	Civil-104	Ditch_U	U
					-2814 mm	-50.00 mm / 1.00 m	Civil	Civil-104	Ditch_U	U

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

### 1<sup>st</sup> and 4<sup>th</sup> branches

**TrenchRun Properties**

General | Start Cross-Section | Relationship | Configuration | Notes

Category: Dimensions

Property	Value
Cardinal Point	8-Top Center
Inside Left Width	250 mm
Inside Right Width	250 mm
Inside Width	500 mm
Inside Depth	500 mm
Area	0.27 m <sup>2</sup>
Depth	650 mm
Width	800 mm
Perimeter	4500 mm
Footing Thickness	150 mm
Wall Thickness	150 mm

OK Cancel Apply

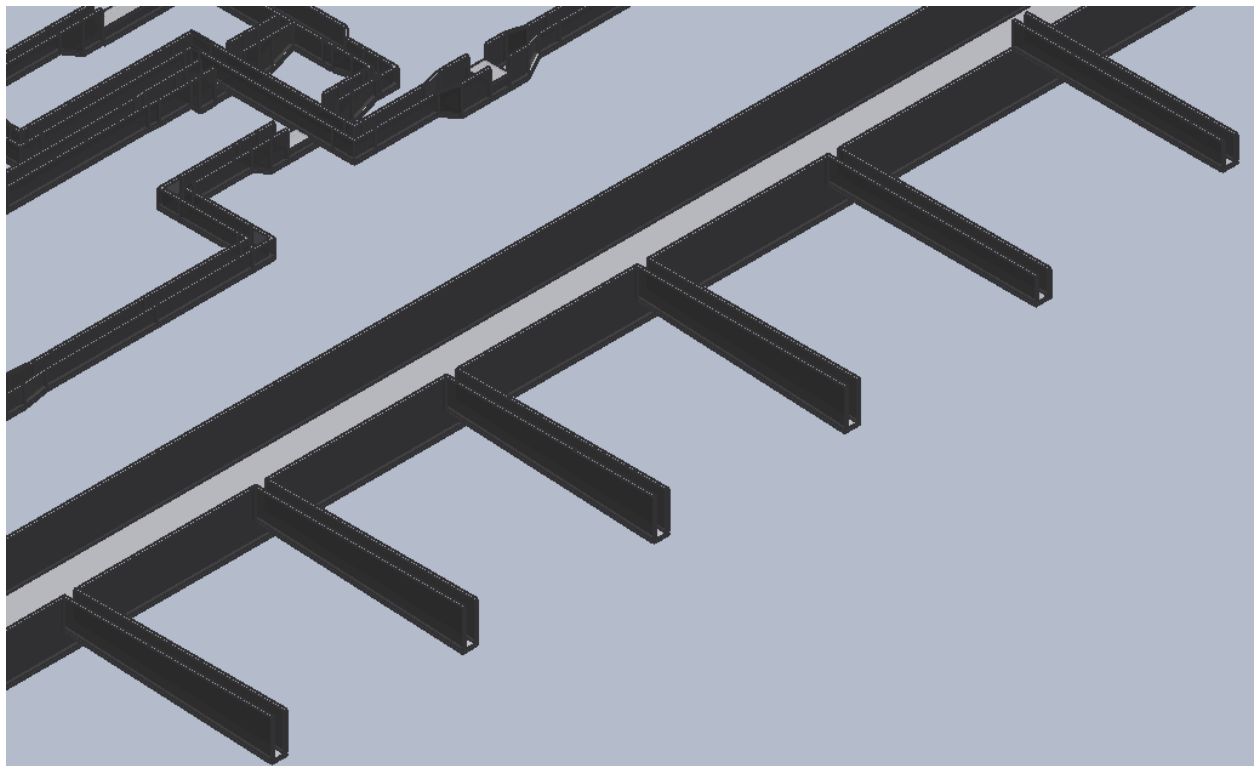
**TrenchRun Properties**

General | Start Cross-Section | Relationship | Configuration | Notes

Category: Dimensions

Property	Value
Cardinal Point	8-Top Center
Inside Left Width	250 mm
Inside Right Width	250 mm
Inside Width	500 mm
Inside Depth	1200 mm
Area	0.27 m <sup>2</sup>
Depth	650 mm
Width	800 mm
Perimeter	4500 mm
Footing Thickness	150 mm
Wall Thickness	150 mm

OK Cancel Apply



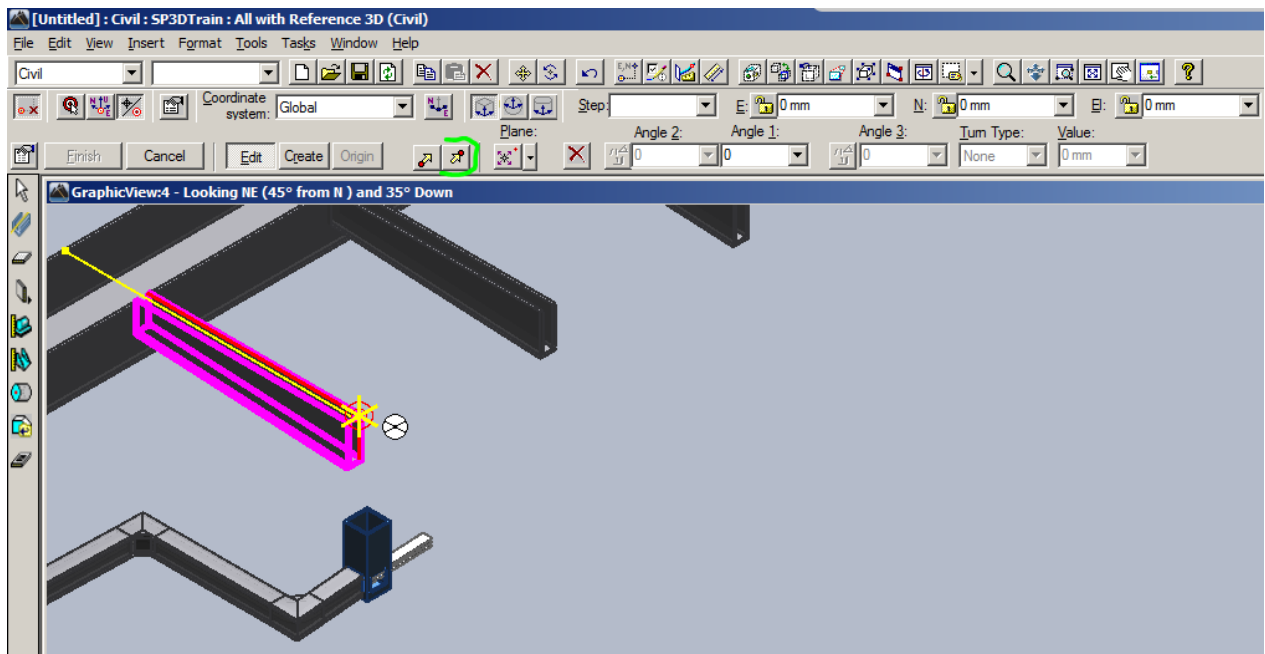
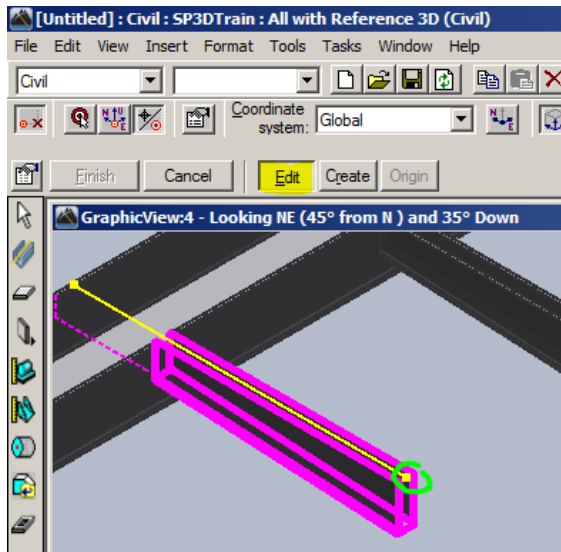
Note: Changing of Invert Elevations, or Start Depth without changing length keep same geometry (with exception of parallel placements).

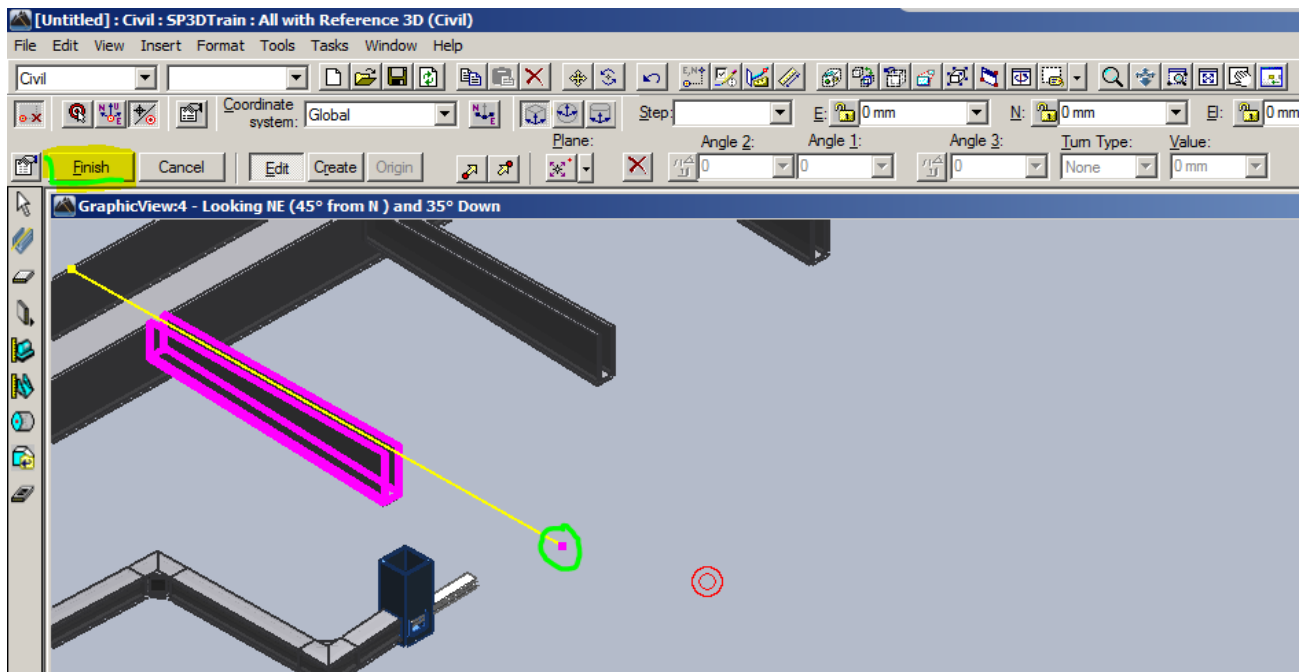
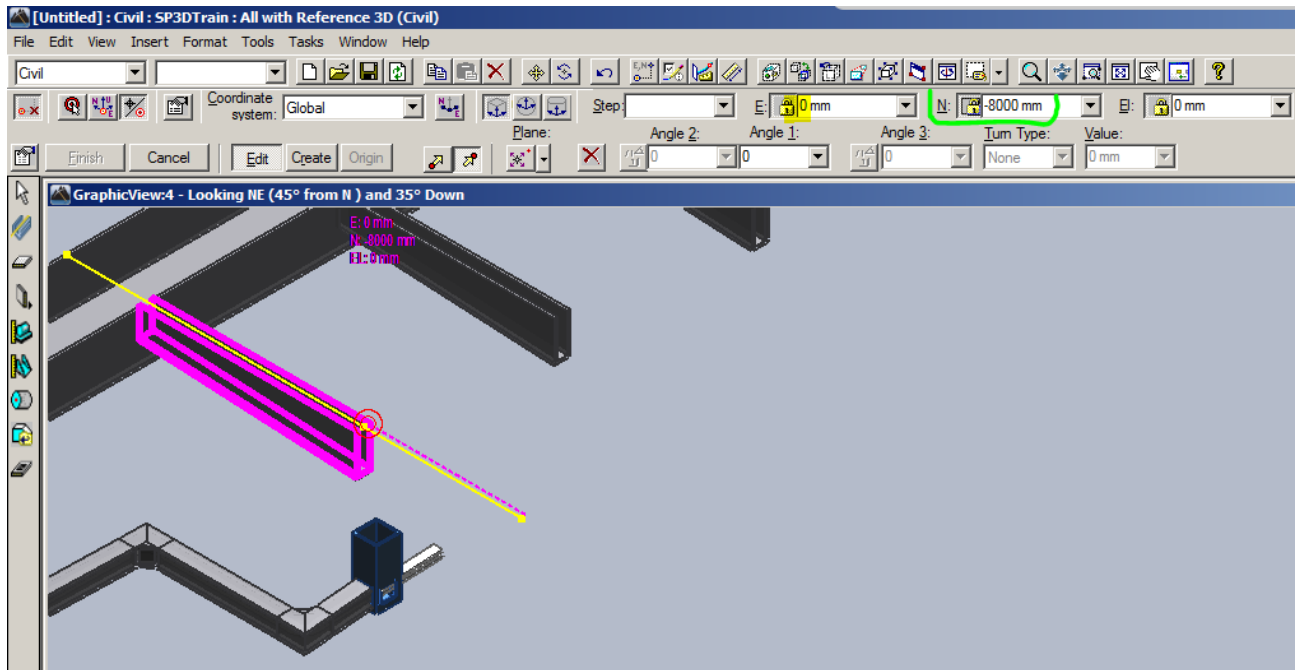
## Trench Run topology

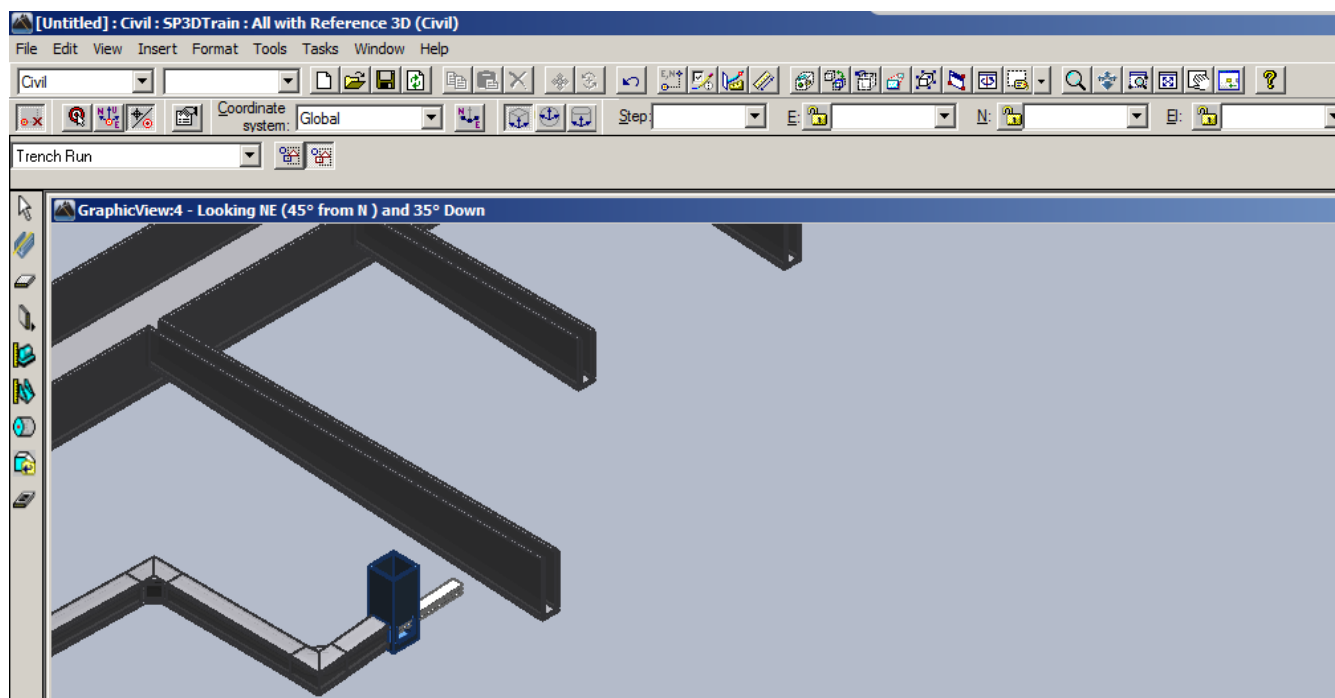
### Lab 03 – Modification of Routing Topology (length, direction, upper elevation)

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

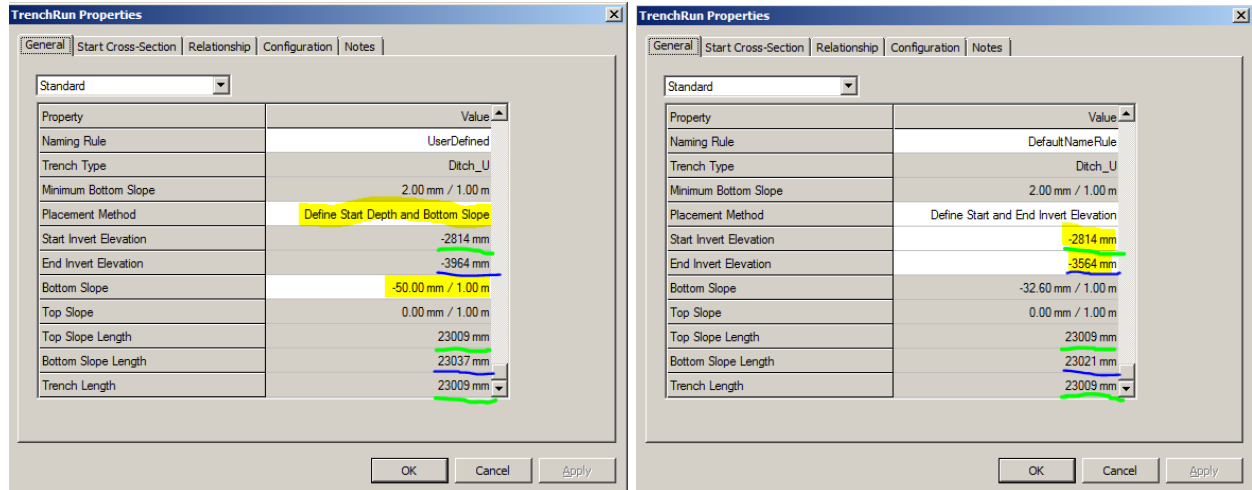
1. Extend all trenches 8 m south.  
Select **Trench Run**, select the path, click **Edit**, select the last vertex and move it (using e.g. Pin Point).





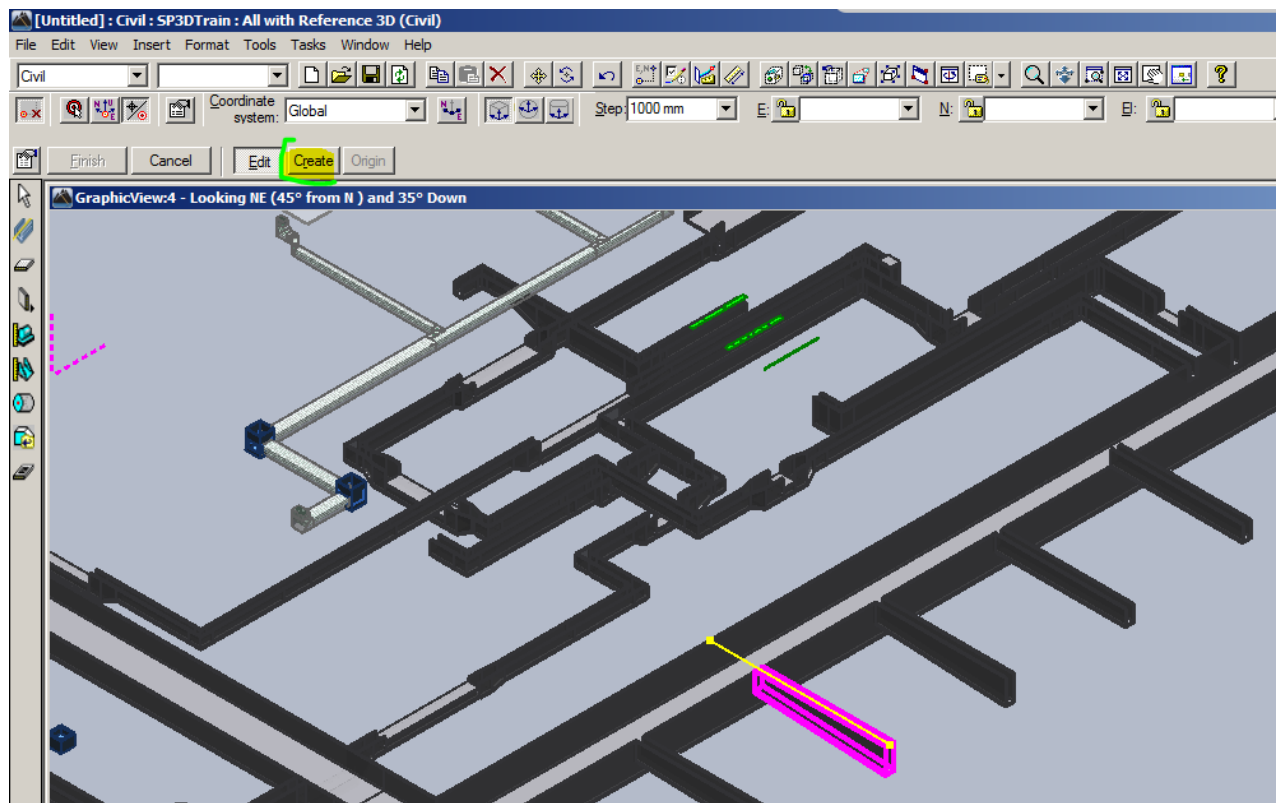


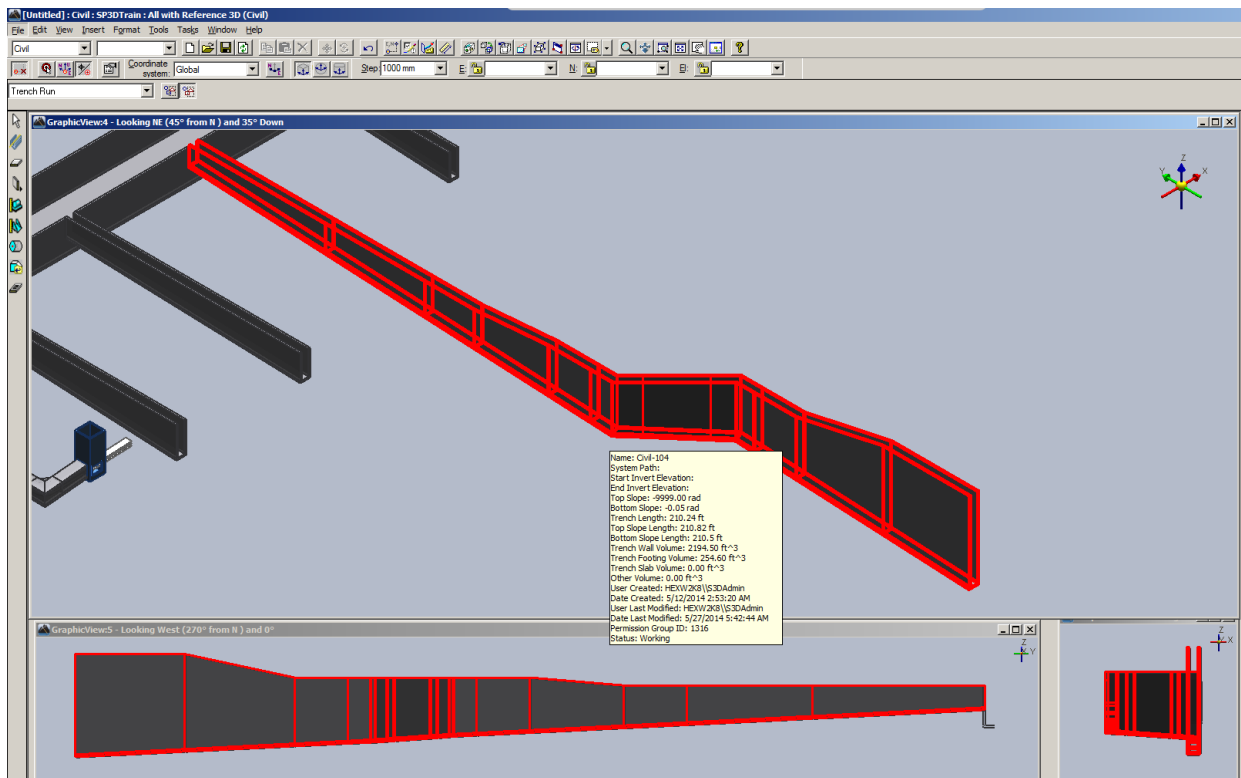
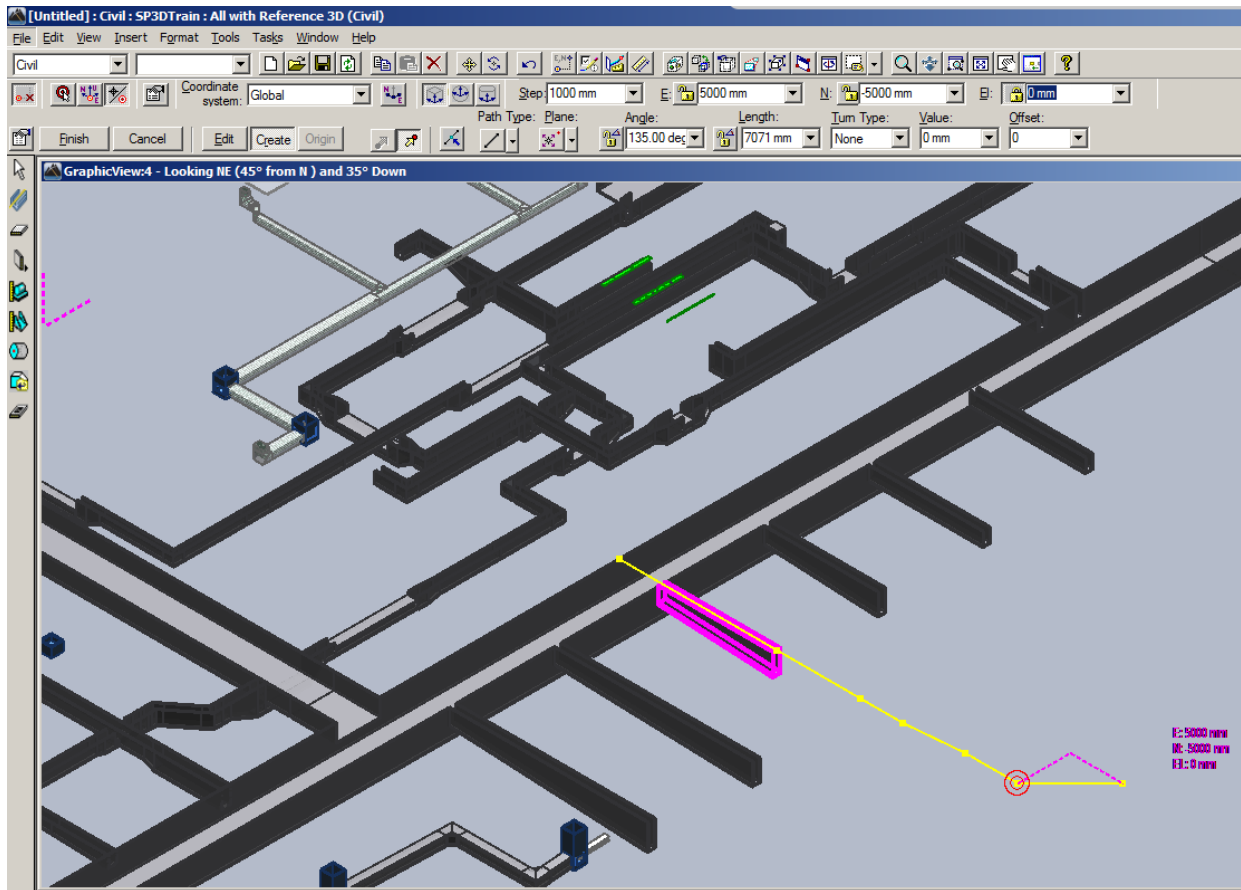
Note: Geometry will differ if an elevation is defined at the end, or if there is a relative slope per length unit.



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

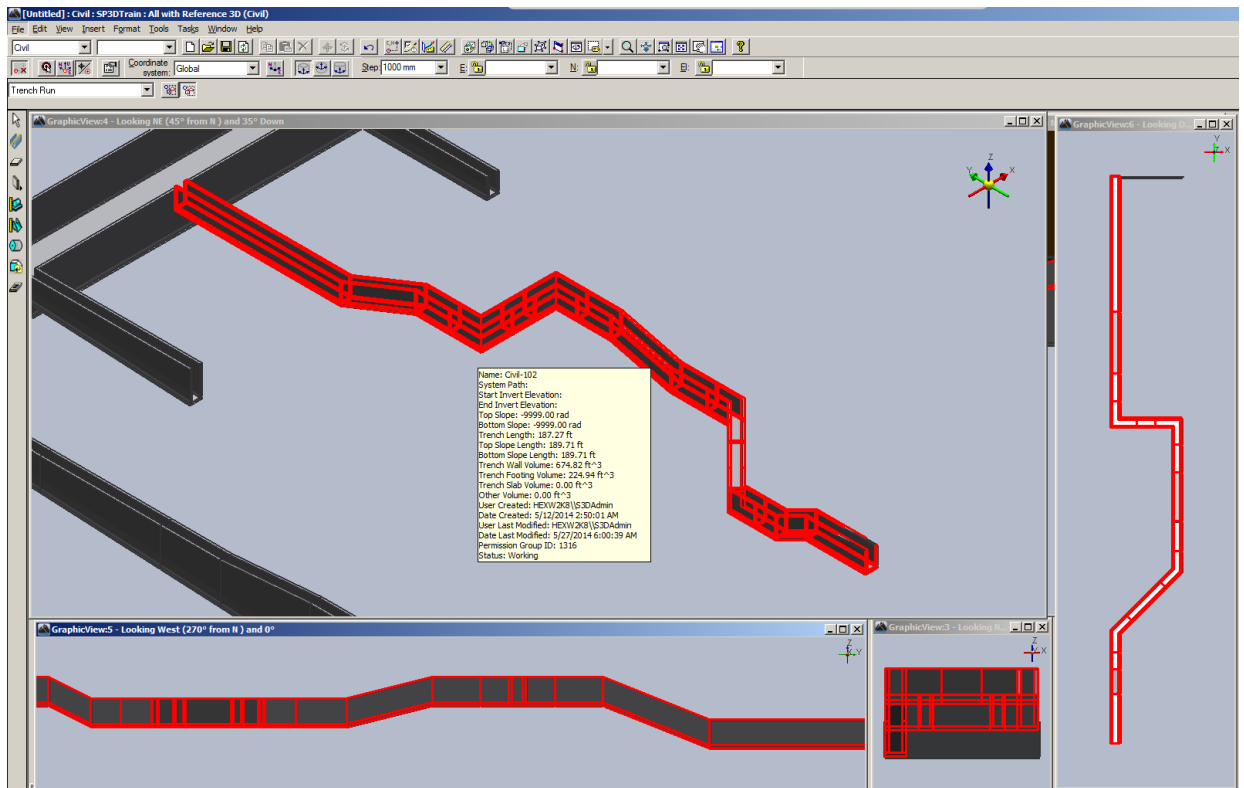
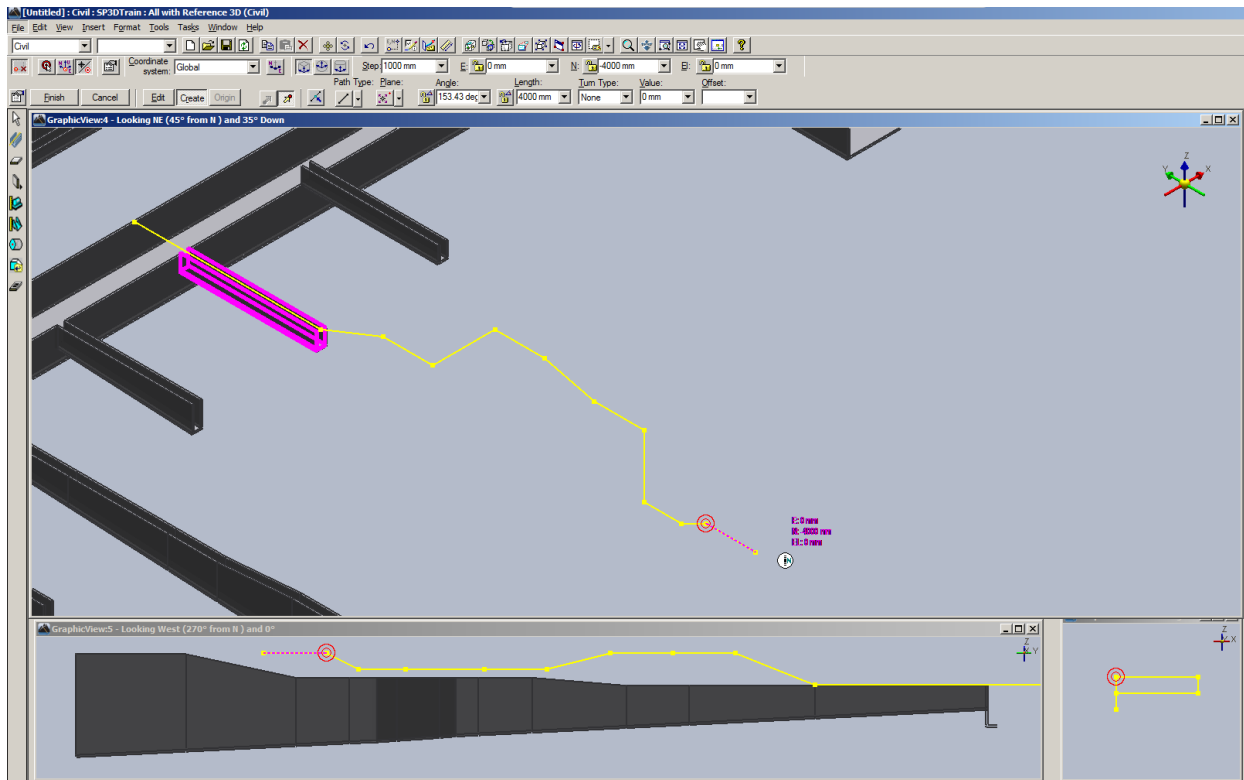
Note: Top Cardinal Point placement with bottom slope or inverted elevations can change upper edge (above ground) and maintain slope of drainage ditches or pipe trenches







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



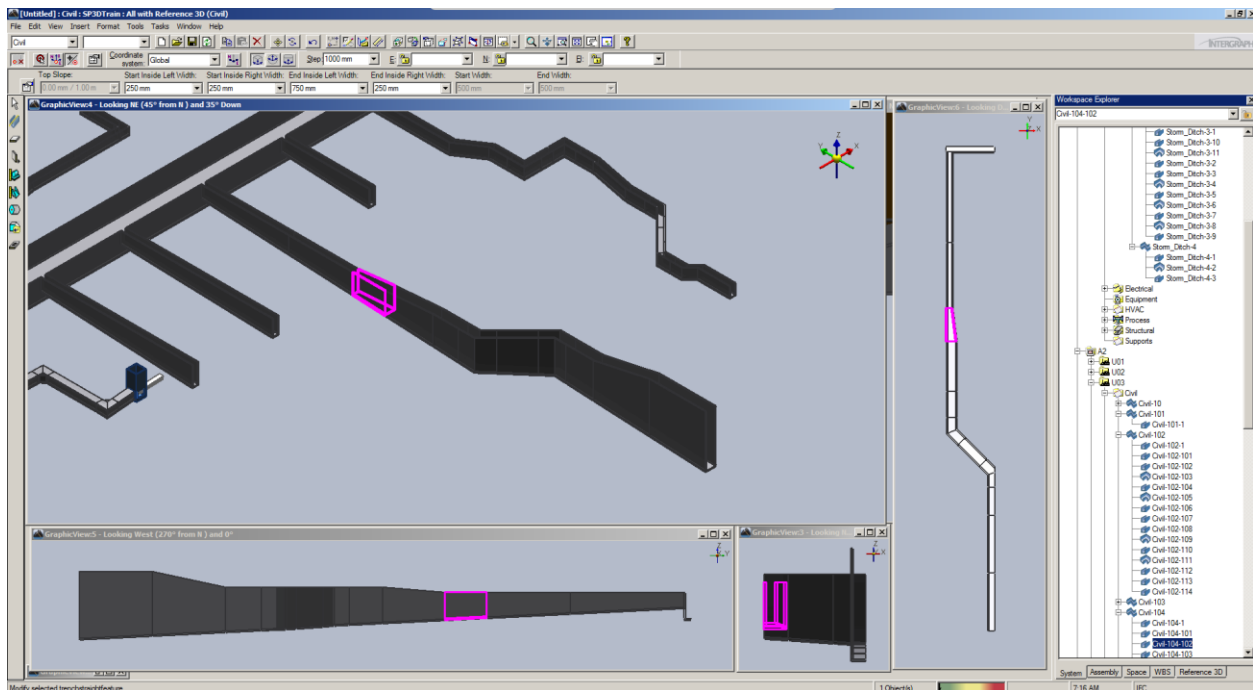
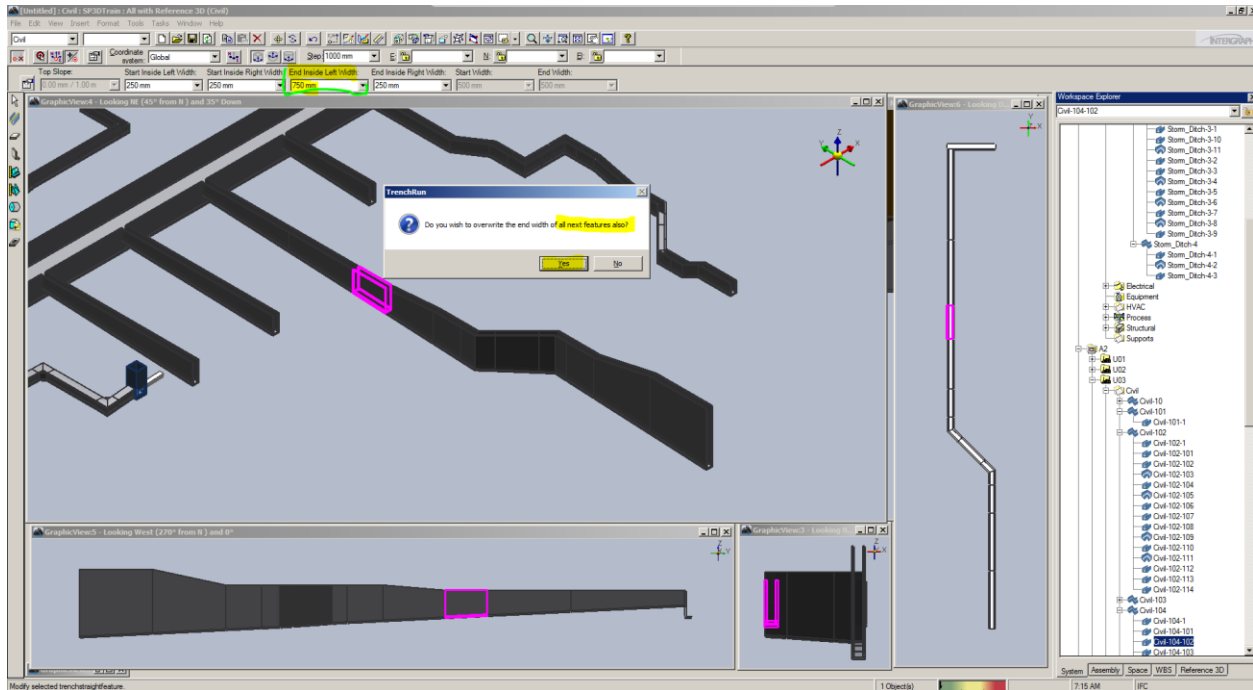


## Trench Features

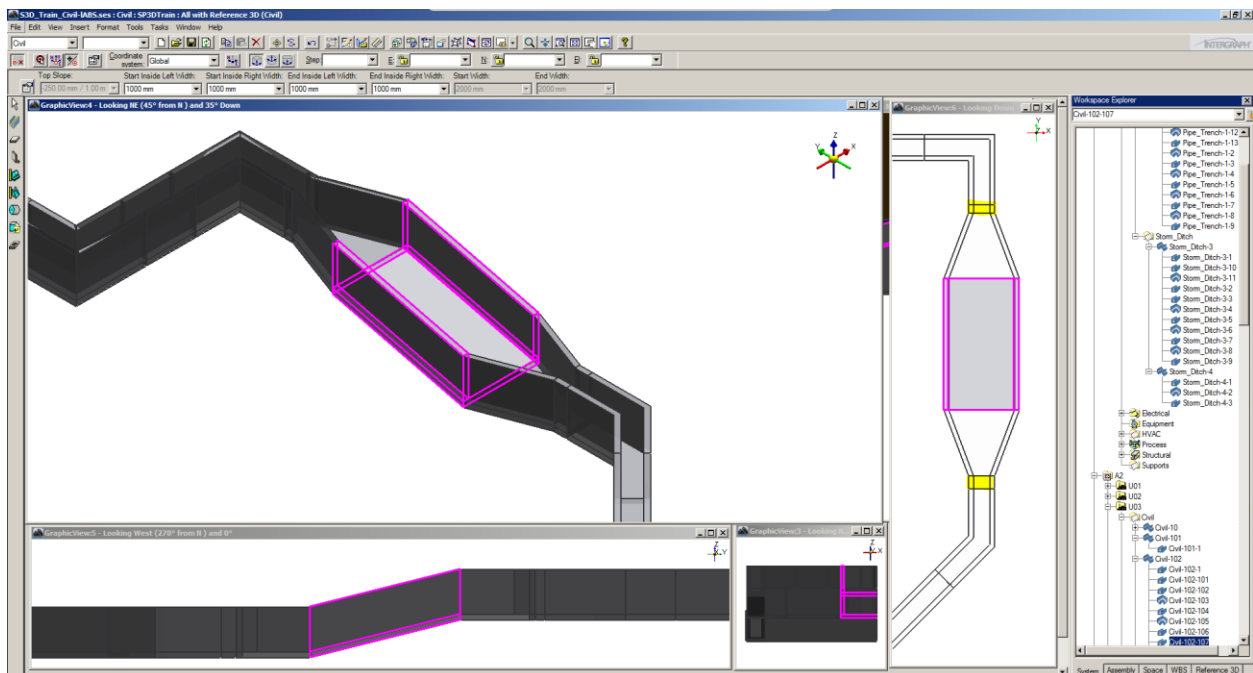
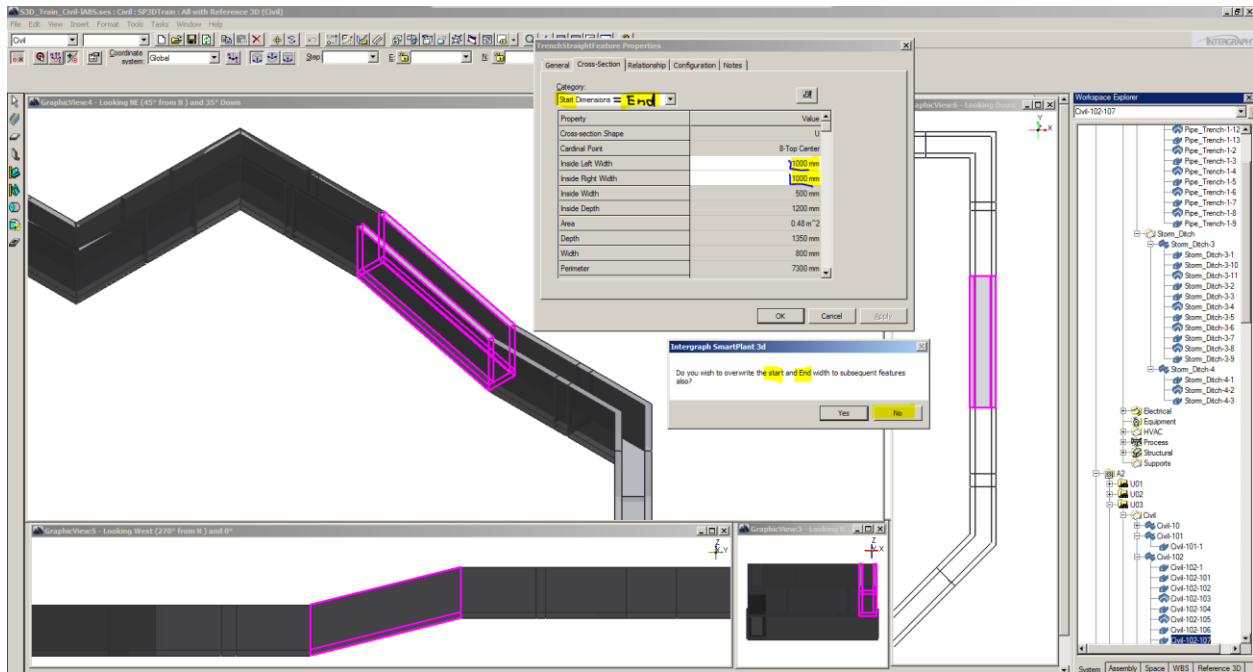
Transitions can be created by modifying cross sections of trench features

### 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).

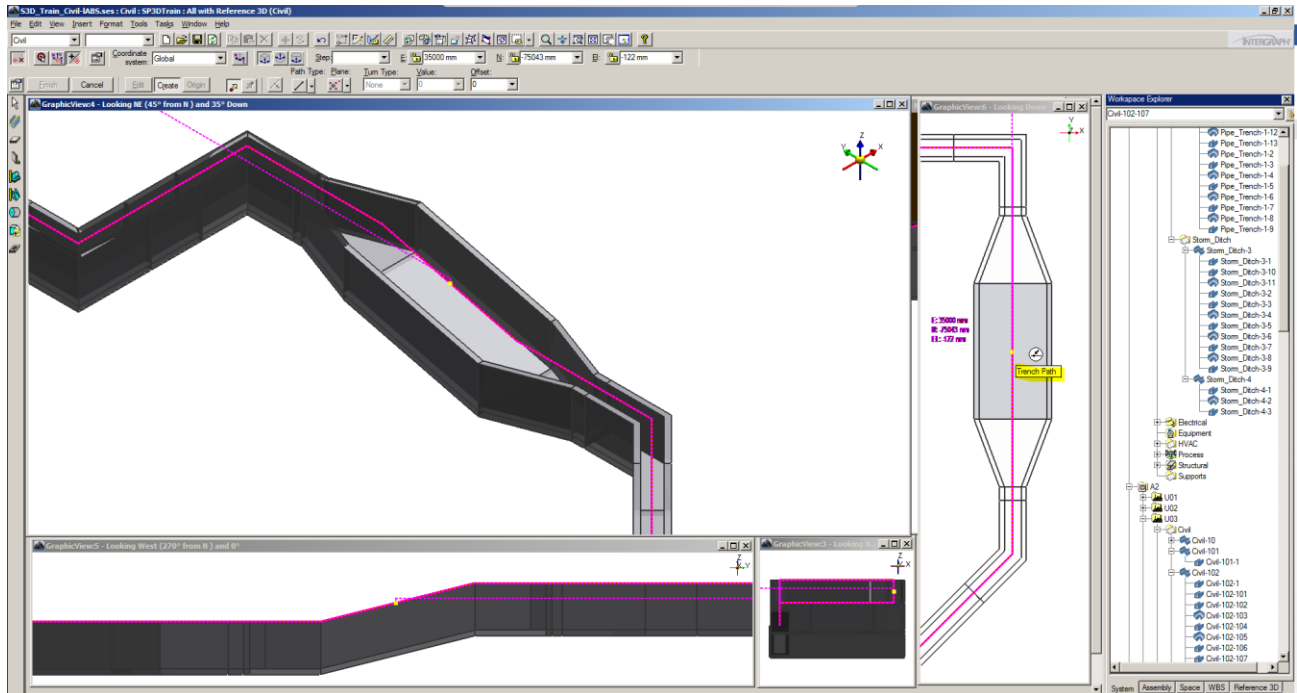


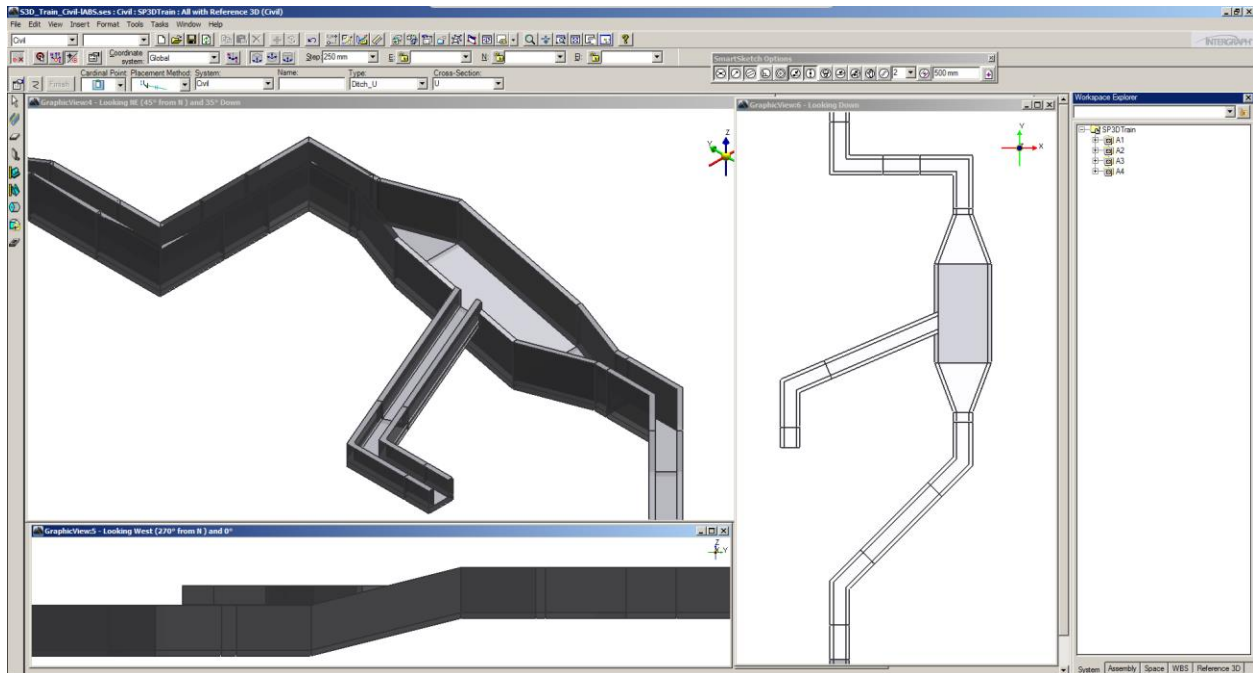
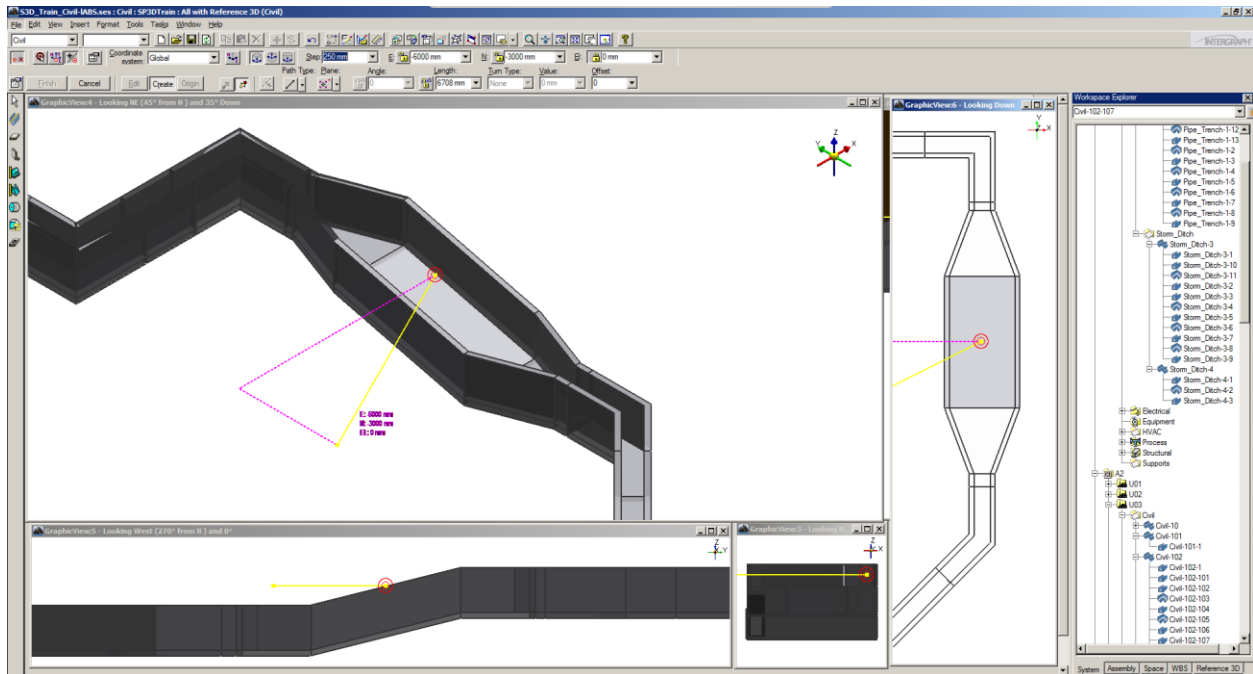
## Branching Trenches

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 or 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

**Grid Wizard - Create Coordinate System**

Name: UC-01  
System: Underground\_Cables  
Grid Type: Grids  
Origin: Global  
Reference CS: Global  
East (X): -40000 mm  
North (Y): -150000 mm  
Up (Z): -1500 mm  
Bearing: N 0.00 deg E

**Grid Wizard - Create Elevation Planes**

Reference CS: UC-01  
Start plane: 0 mm  
Copies: 4  
Spacing: 500 mm  
End plane: 2000 mm  
Name rule: Global Position  
Nesting level: Primary  
Type: Working Point (W.P.)

Location	Type	Name	Nesting level	Global Location	Spacing
1 0 mm	Working Point (W.P.)	EI -1.500 m	Primary	-1500 mm	0 mm
2 500 mm	Working Point (W.P.)	EI -1.000 m	Primary	-1000 mm	500 mm
3 1000 mm	Working Point (W.P.)	EI -0.500 m	Primary	-500 mm	500 mm
4 1500 mm	Working Point (W.P.)	EI 0.000 m	Primary	0 mm	500 mm
5 2000 mm	Working Point (W.P.)	EI 0.500 m	Primary	500 mm	500 mm

**Grid Wizard - Create Grid X-Planes**

Reference CS: UC-01  
Start plane: 0 mm  
Copies: 9  
Spacing: 10000 mm  
End plane: 90000 mm  
Name rule: Position  
Nesting level: Primary  
Type: N-S Grid Plane

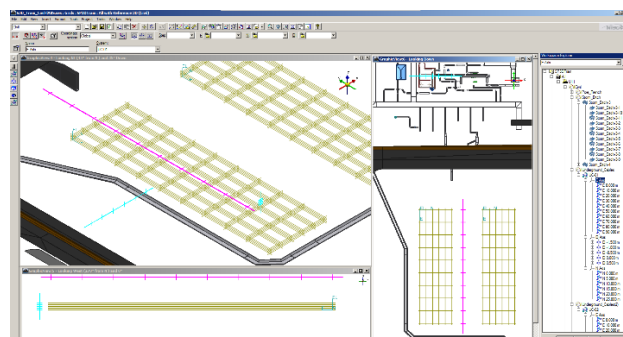
Location	Type	Name	Nesting level	Global Location	Spacing
5 40000 mm	N-S Grid Pl.	E 40.000 m	Primary	0 mm	10000 mm
6 50000 mm	N-S Grid Pl.	E 50.000 m	Primary	10000 mm	10000 mm
7 60000 mm	N-S Grid Pl.	E 60.000 m	Primary	20000 mm	10000 mm
8 70000 mm	N-S Grid Pl.	E 70.000 m	Primary	30000 mm	10000 mm
9 80000 mm	N-S Grid Pl.	E 80.000 m	Primary	40000 mm	10000 mm
10 90000 mm	N-S Grid Pl.	E 90.000 m	Primary	50000 mm	10000 mm

**Grid Wizard - Create Grid Y-Planes**

Reference CS: UC-01  
Start plane: 0 mm  
Copies: 5  
Spacing: 5000 mm  
End plane: 25000 mm  
Name rule: Position  
Nesting level: Primary  
Type: E-W Grid Plane

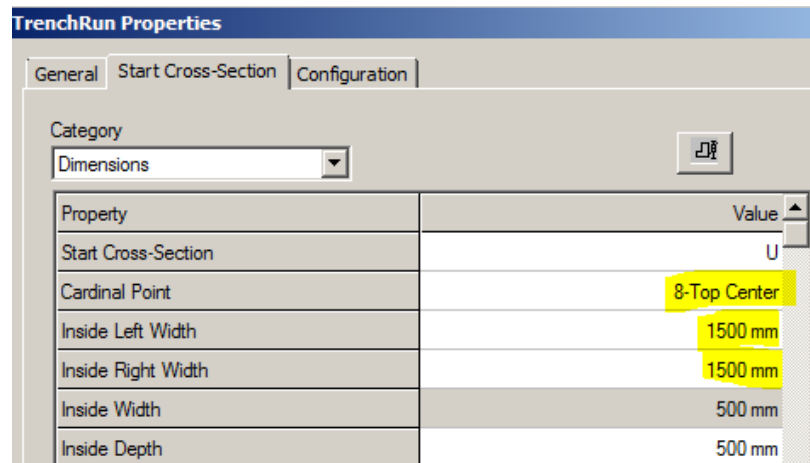
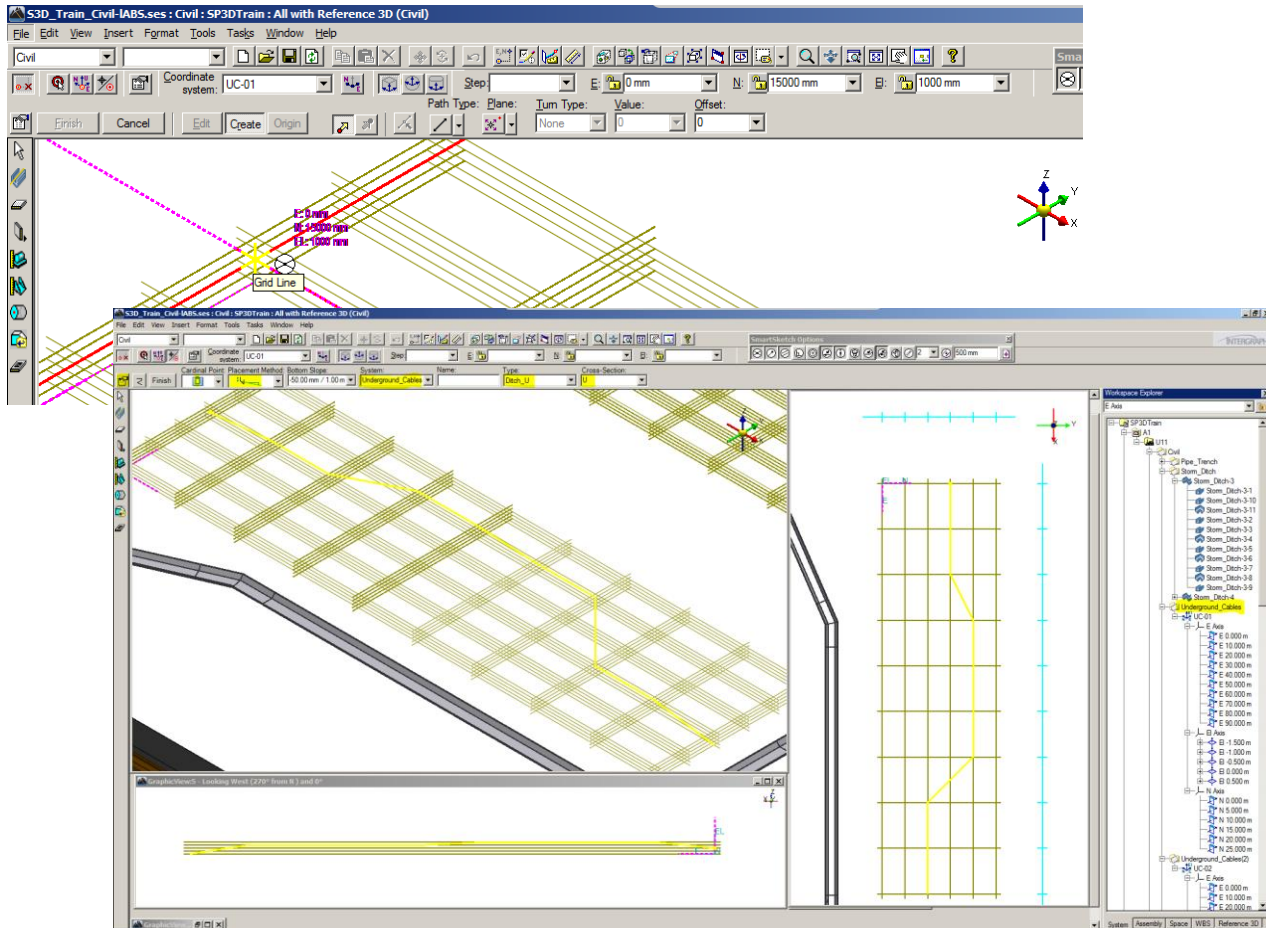
Location	Type	Name	Nesting level	Global Location	Spacing
1 0 mm	E-W Grid Pl.	N 0.000 m	Primary	-150000 mm	0 mm
2 5000 mm	E-W Grid Pl.	N 5.000 m	Primary	-145000 mm	5000 mm
3 10000 mm	E-W Grid Pl.	N 10.000 m	Primary	-140000 mm	5000 mm
4 15000 mm	E-W Grid Pl.	N 15.000 m	Primary	-135000 mm	5000 mm
5 20000 mm	E-W Grid Pl.	N 20.000 m	Primary	-130000 mm	5000 mm
6 25000 mm	E-W Grid Pl.	N 25.000 m	Primary	-125000 mm	5000 mm

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

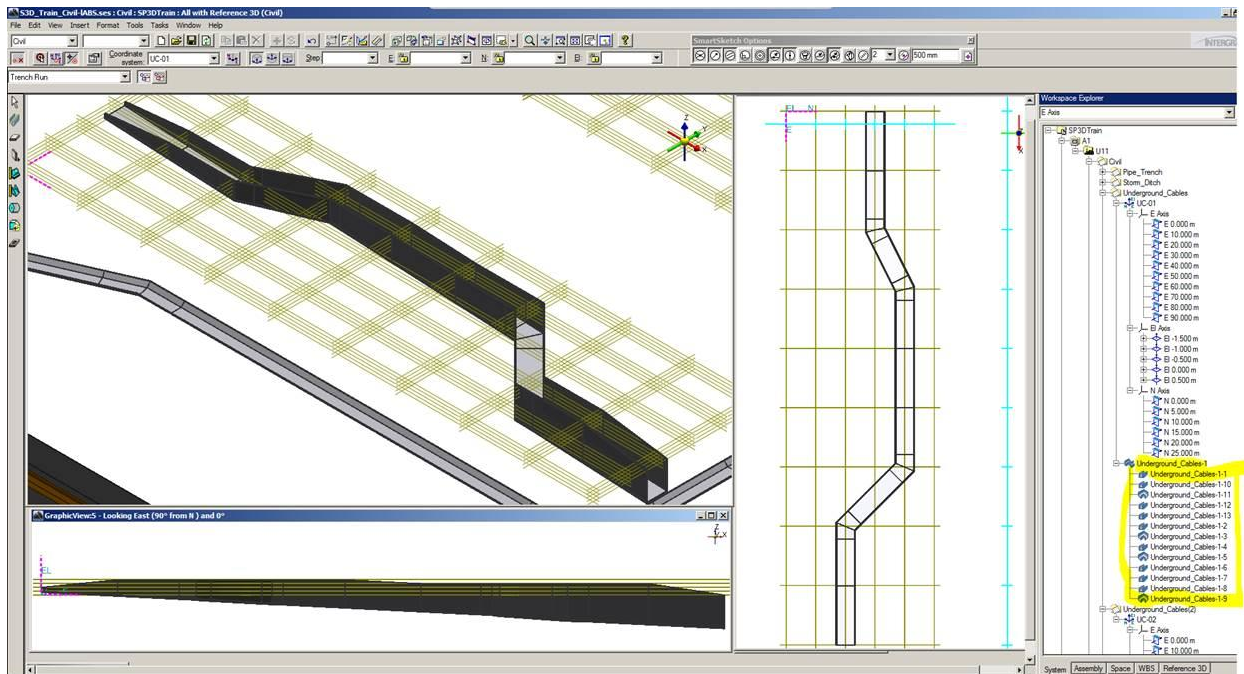


## Lab 07 – Designing Trenches Using Grids

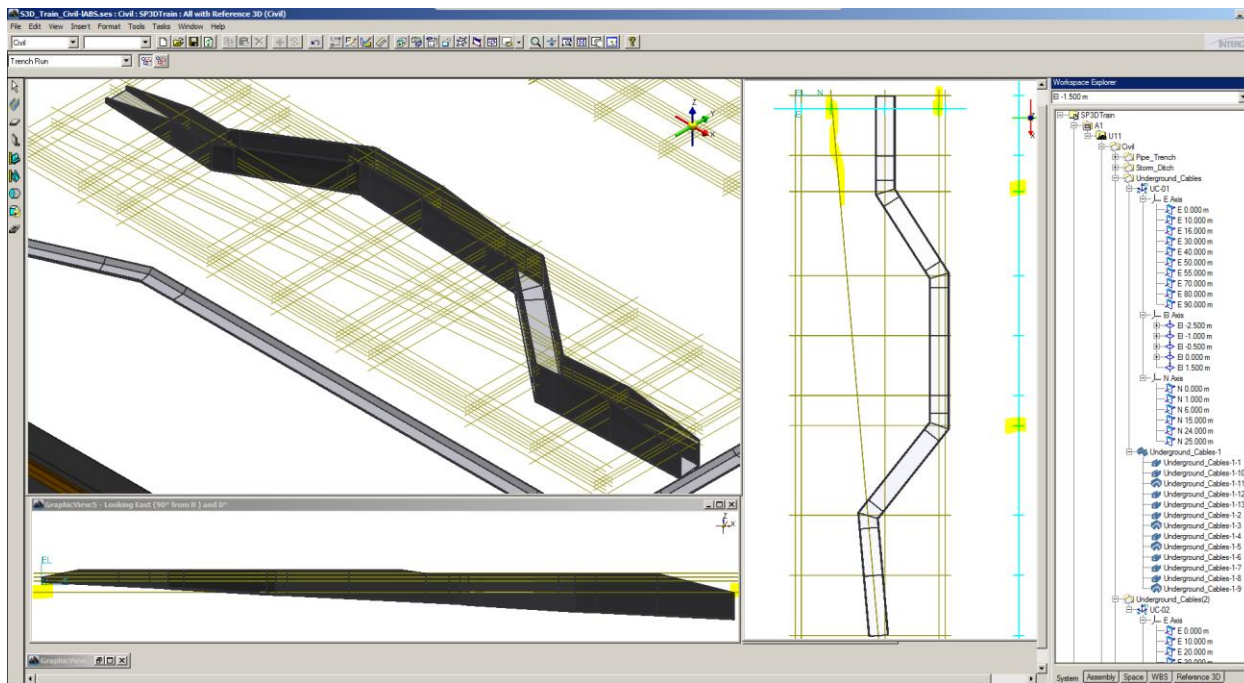
1. In the SmartSketch Ribbon bar select new **UC-01** Grid CS as the Active Coordinate System and reposition the target to the Origin and turn on Relative Tracking.
2. Start the **Place Trench** command. Use top center CP 8, and placement method with start depth and slope -5% to create Ditch-U with a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

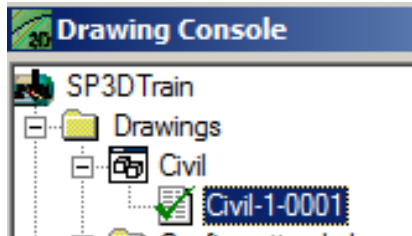


## Deliverables

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

### Lab 08 – Drawings

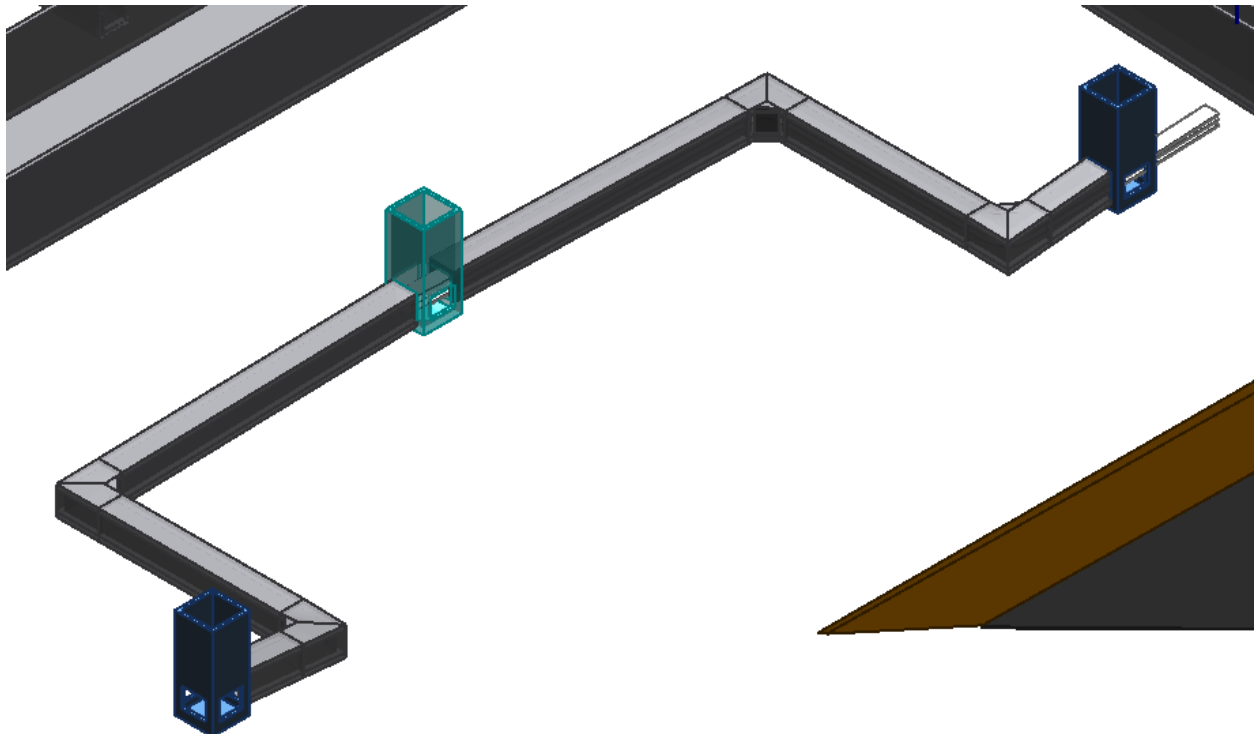
1. Open the Drawing Console and locate Civil Drawings. Open it using **Edit** from context menu.



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

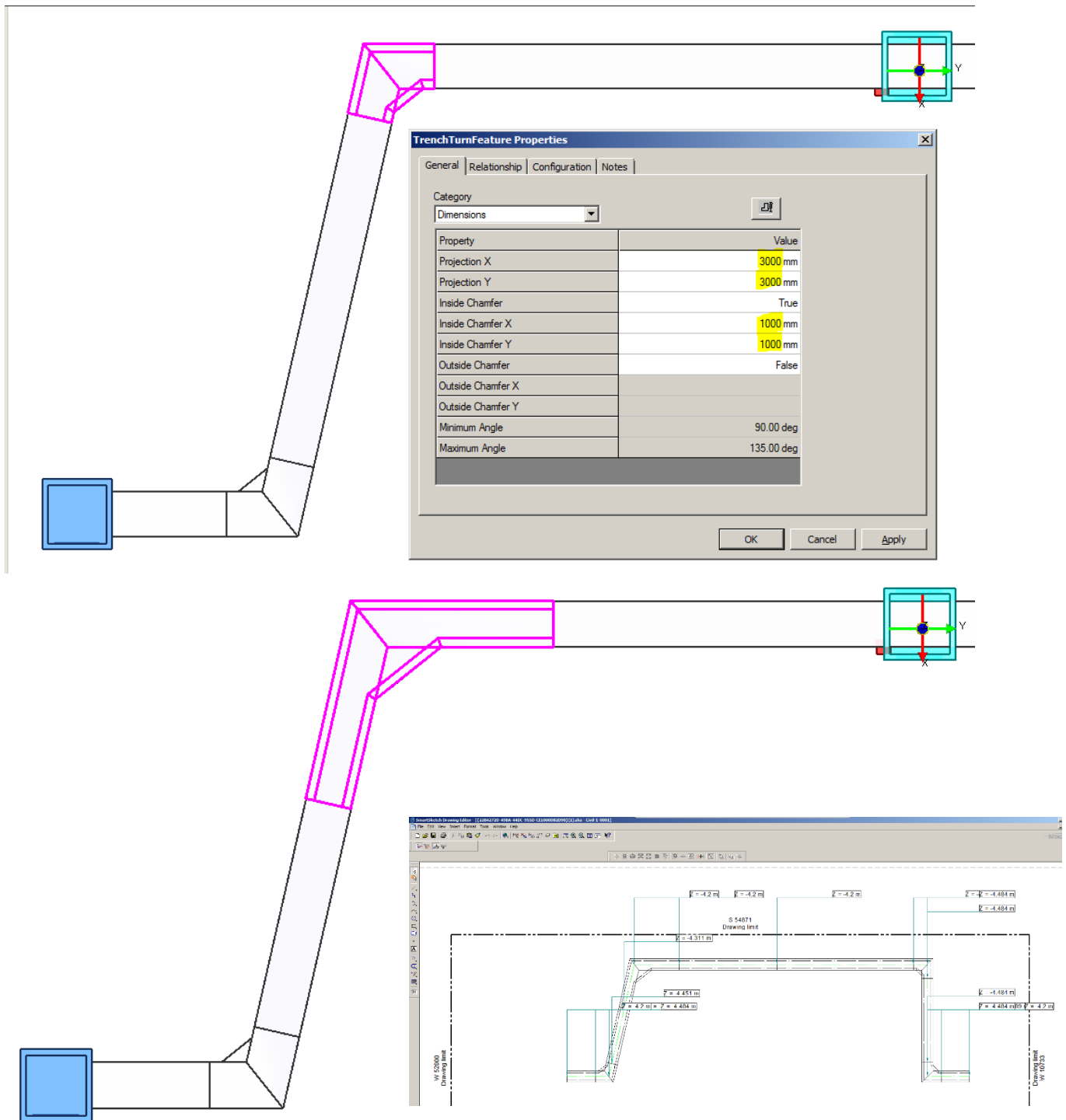
Note: Drawing is out of date. Update it (Right-click then click **Update Now**).

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





#### 4. Modify mirrored part and update drawing





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