Introduction to Subassembly Composer

Subassembly Composer for Civil 3D

About

Autodesk Subassembly Composer for Civil 3D provides an interface for composing and modifying complex subassemblies, without the need for programming. It is typically used for creating bespoke assemblies, such as areas of corridors that are unique and can't be modelled using the standard subassemblies provided with Civil 3D.

Definition of Terms

Static Subassembly: Controlled by definitive values

Dynamic Subassembly: Controlled by variable parameters

Contents

1. Introduction

The aim of this whitepaper is to introduce new users to the Subassembly Composer and to provide an overview to give users the confidence to start creating their own static and dynamic subassemblies.

2. User Interface Overview

Autodesk Subassembly Composer user interface is composed of 5 main areas that can be moved and docked independently allowing the layout to be organised as required. This can be achieved by clicking and dragging a window into one of the icons that appear when a window is selected, identified in Fig 1 by the green square.

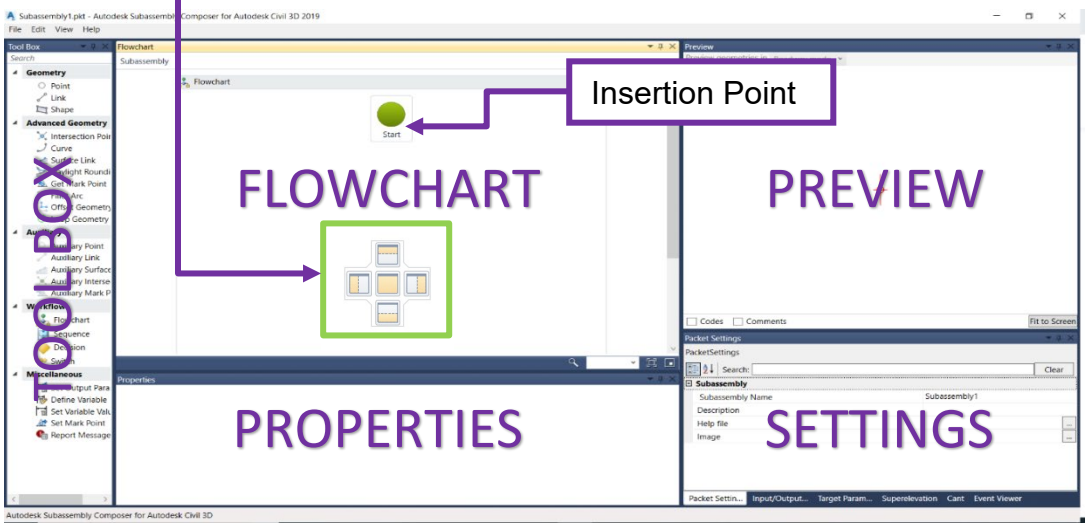

Fig 1: Subassembly Composer User Interface

Tool Box: Components used to build subassemblies.

Flowchart: Structure is created here.

Preview: Graphical representation of the object being created.

Properties: Select an object in '*Flowchart*' or '*Preview*' to see properties (similar to C3D).

Settings: Where much of the maintenance takes place. E.g. Naming, defining parameters.

Note: *The layout can be restored to the default position and organisation by navigating to the Menu Toolbar (Top left) > View > Restore default layout.*

3. Creating Parts Using Points, Links & Shapes – Static

To create a basic subassembly, Geometry is added to the Flowchart. This is achieved by selecting an item from Tool Box and dragging it into the Flowchart. Points are added and are connected by links to define the subassembly.

Each item in the Flowchart is controlled by the properties panel and is displayed graphically in the preview window as described in Fig 2. To create a static subassembly, definitive numerical values are added to the fields in the Property window.

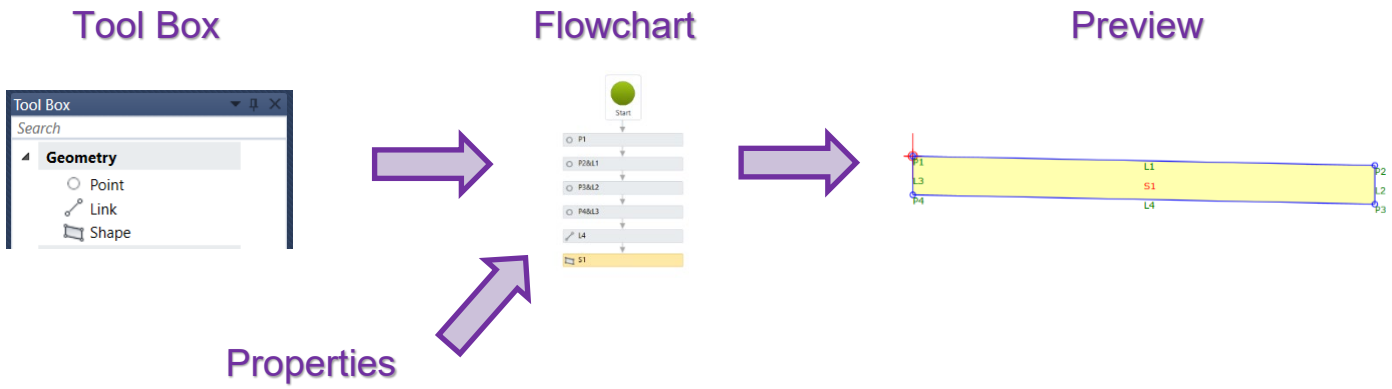

Fig 2: Workflow to create static subassembly

When adding Geometry from the Tool Box to the Flowchart the position of each item in the Flowchart can be controlled using the arrows on the keyboard. This will help to keep the Flowchart organised (Fig 3).

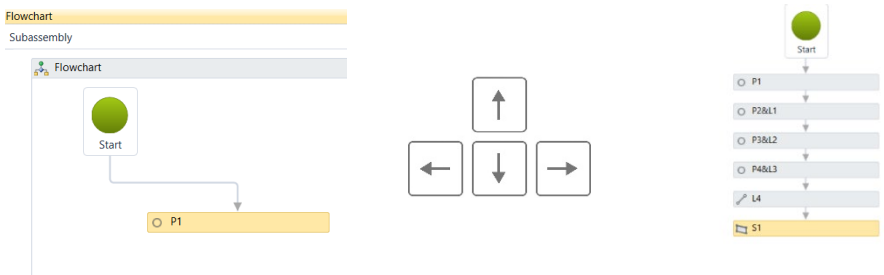

Fig 3: Organising the Flowchart

EXAMPLE 1: Creating a basic static subassembly

The example is based on assigning definitive values to the Geometry to control its behaviour.

P1

Select "**Point**" from the Tool Box and drag it into the Flowchart space. The point will automatically be connected to the 'Start' by a grey arrow.

Properties

- Point Geometry Type – Type = '**Delta X and Delta Y'**
- Point Geometry Properties - From Point = '**Origin'**. This will dictate the position of the point in relation to the insertion point. **Delta X = 0, Delta Y = 0.**

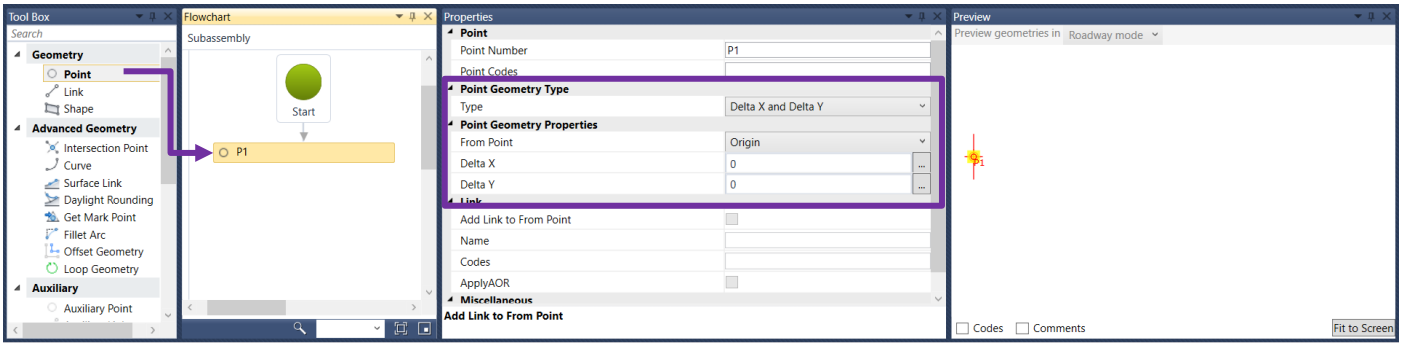

Fig 4: Point 1

P2&L1

Select "**Point**" from the Tool Box and drag it into the Flowchart space. The point will automatically be connected to the previously inserted point (P1) by a grey arrow.

Properties

- Point Geometry Type - Type - '**Slope and Delta X'**
- Point Geometry Properties - **Slope = -2.0%** (This will represent the cross fall) **Delta X = 10**
- Tick **'Add Link to From Point'** to automatically add links between points **(L1)**
- Use the '**Fit to screen**' option to preview changes.

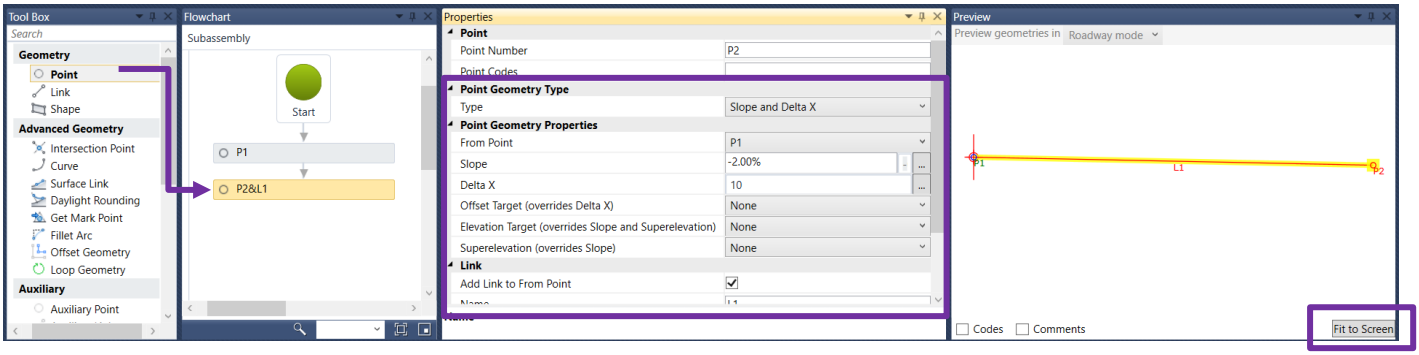

Fig 5: Point 2 Link 1

P3&L2

Select "**Point**" from the Tool Box and drag it into the Flowchart space. The point will automatically be connected to the previously inserted point (P2&L1) by a grey arrow.

Properties

- Point Geometry Properties - **Delta X = 0, Delta Y = -1** (press tab key on keyboard to execute)
- Tick **'Add Link to From Point'** to automatically add links between points **(L2)**

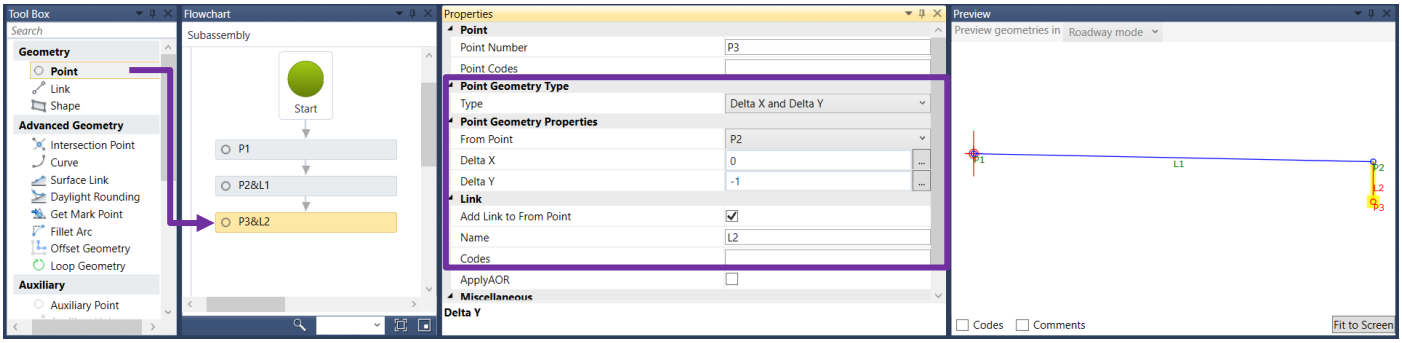

Fig 6: Point 3 Link 2

P4&L3

Select "**Point**" from the Tool Box and drag it into the Flowchart space. The point will automatically be connected to the previously inserted point (P3&L2) by a grey arrow.

Properties

- Point Geometry Properties – From Point = P1
- Delta X = 0, Delta Y = -1
- Tick **'Add Link to From Point'** to automatically add links between points **(L3)**

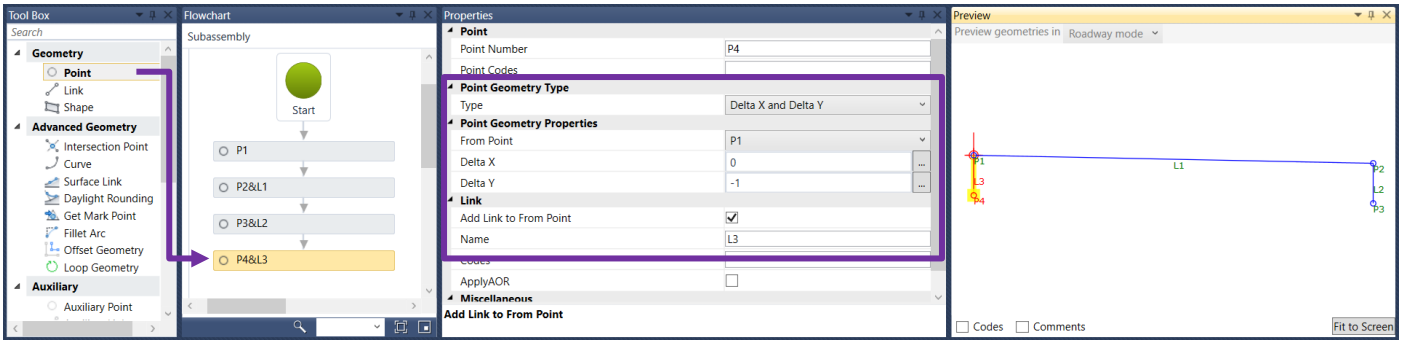

Fig 7: Point 4 Link 3

L4

Select "**Link**" from the Tool Box and drag it into the Flowchart space. The Link (L4) will automatically be connected to the previously inserted point (P4&L3) by a grey arrow.

Properties

- Position
- Start Point = P3
- End Point = P4

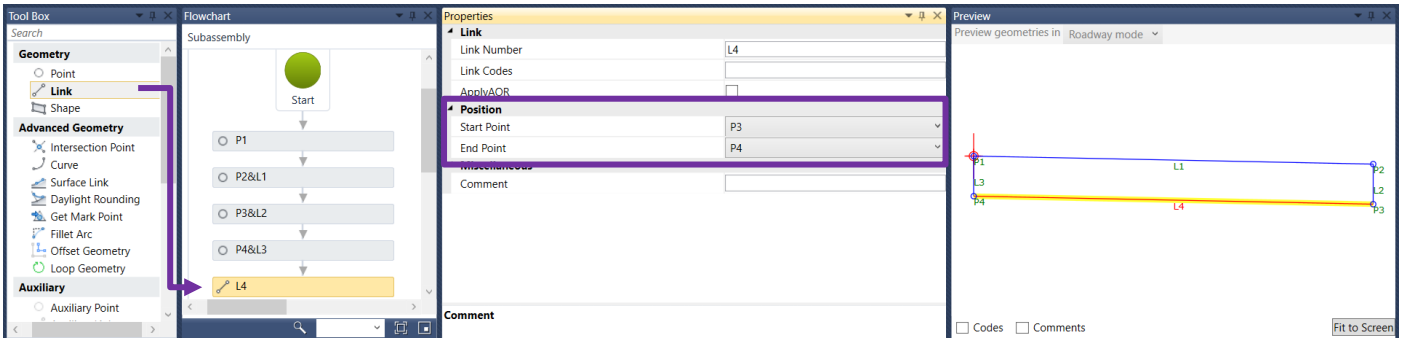

Fig 8: Link 4

S1

Select "**Shape**" from the Tool Box and drag it into the Flowchart space. The Shape (S1) will automatically be connected to the previously inserted Link (L4) by a grey arrow.

Properties

- Either select all links to add to the shape or **use the Green pick box in properties** and **select the internal space in the Preview panel**. The shape displayed in the preview will fill yellow when done.

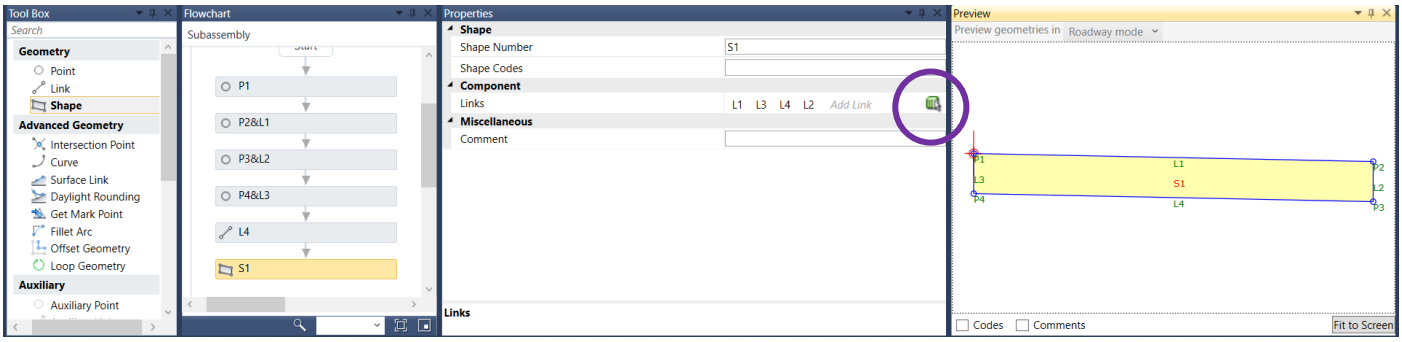

Fig 9: Shape

Note: *Units in subassembly composer will depend on the units of the drawing they are used in.*

E.g. if working in feet and inches 1 unit = 1 ft, but if working in metres 1 unit = 1m.

4. Using Parameters to Control Geometry - Dynamic

In the previous section the geometry of the subassembly was defined using definitive fixed numerical values defined in the properties, however at times this can be quite limiting.

The space identified as '*Settings*' in Fig 1 can be used to create parameters that can be used to define custom variables to control the geometry of the subassembly. This method offers more flexibility for the user when making use of the subassemblies inside Civil 3D.

The workflow is described in Fig 10.

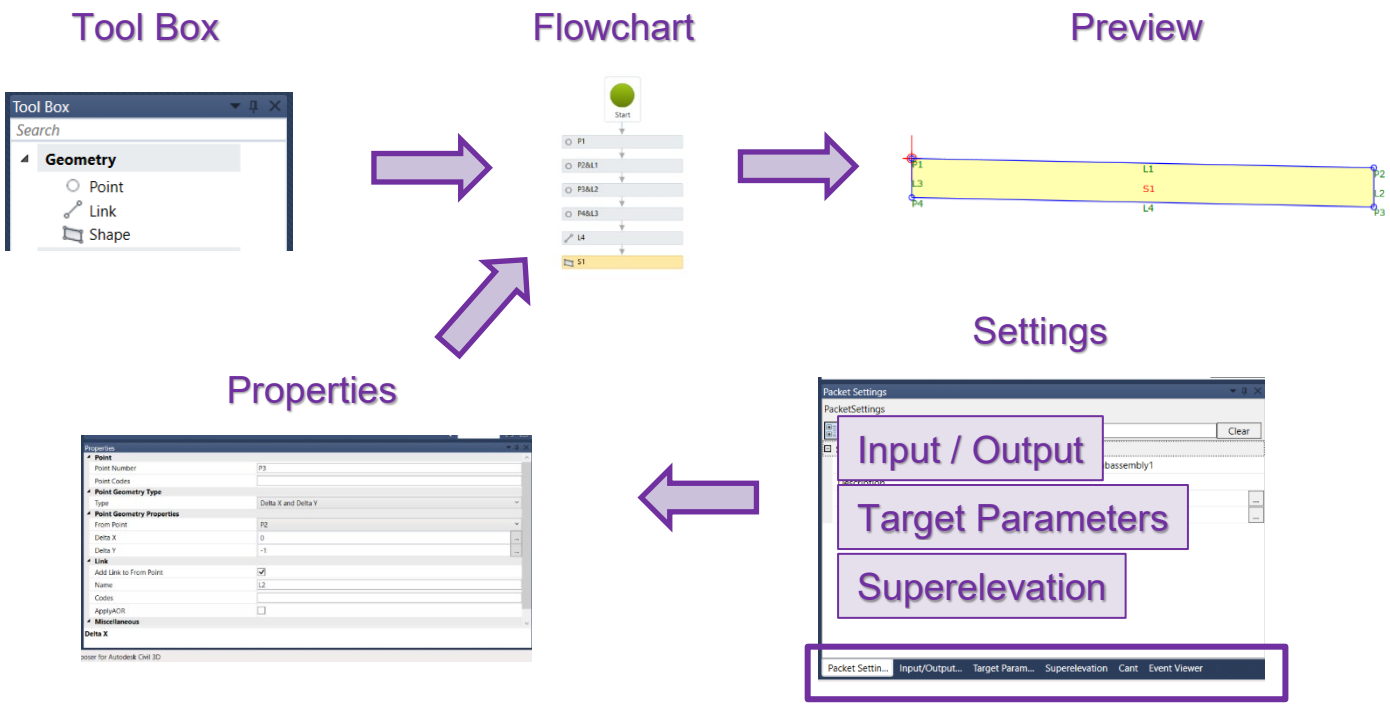

Fig. 10 Custom variables to Control Geometry Workflow

EXAMPLE 2: Input / Output Parameters to control measurements of subassembly parts

The example is based on creating and assigning custom values to the Geometry to control its behaviour by creating and assigning Input/Output Parameters.

The example uses the same geometry as is defined in EXAMPLE 1: Creating a basic static subassembly.

Create Custom Parameters

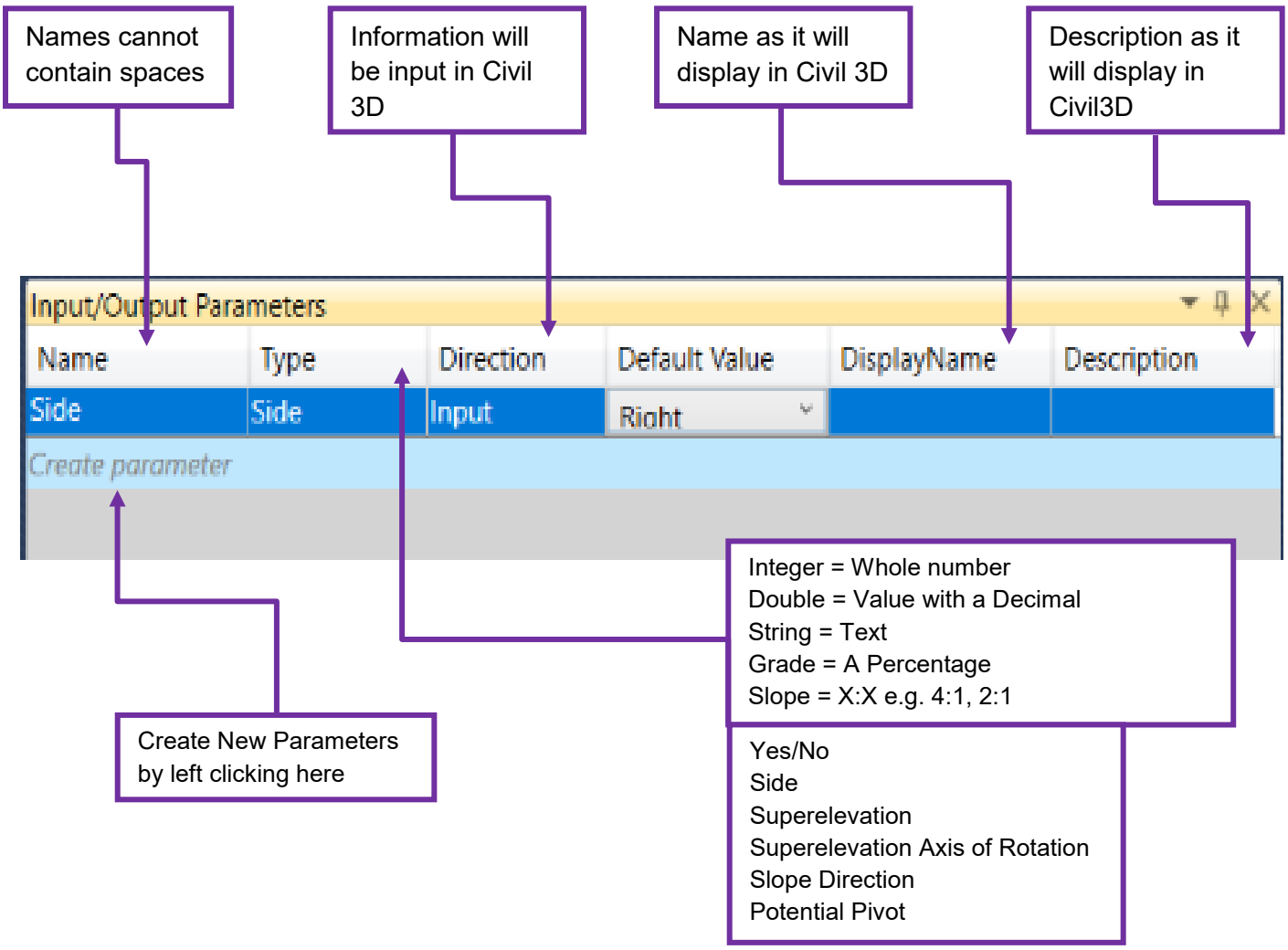

Fig 11: Input/Output Parameters Overview

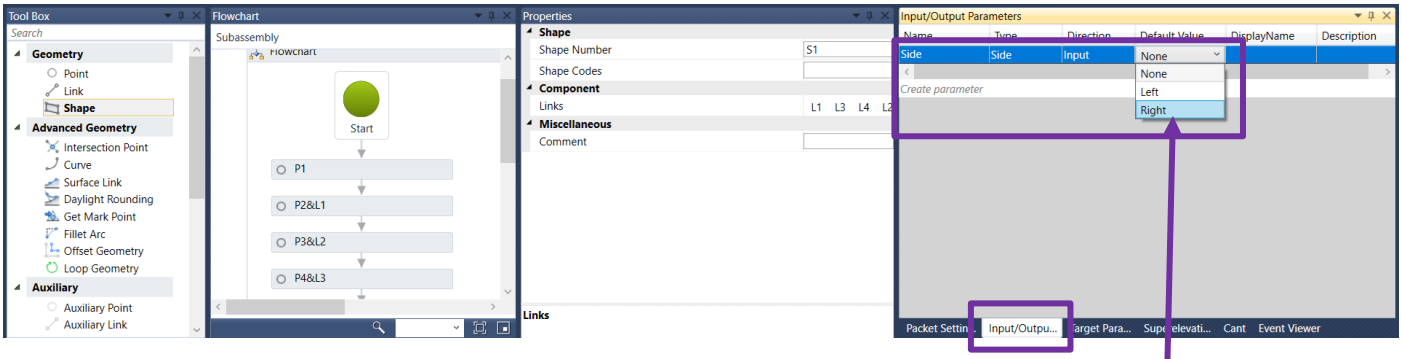

Fig 12: Default side parameter

Navigate to Packet Settings, select the **Input/Output tab**.

There is a **default parameter called Side** with a default value of none. **Change the default value to right.** By doing so, the assembly will default to the right when inserting the subassembly to the Assembly marker.

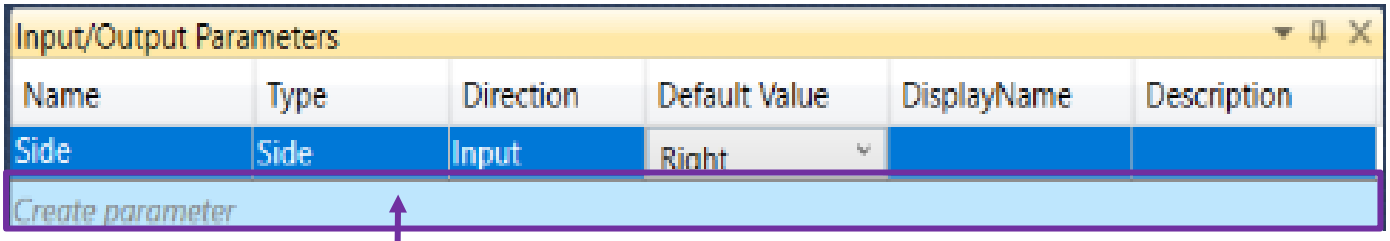

Fig 13: Create Parameter

Select the pale blue **Create parameter** option in Input/Output as identified above in Fig 13 and complete the relevant information. Example shown below in Fig 14.

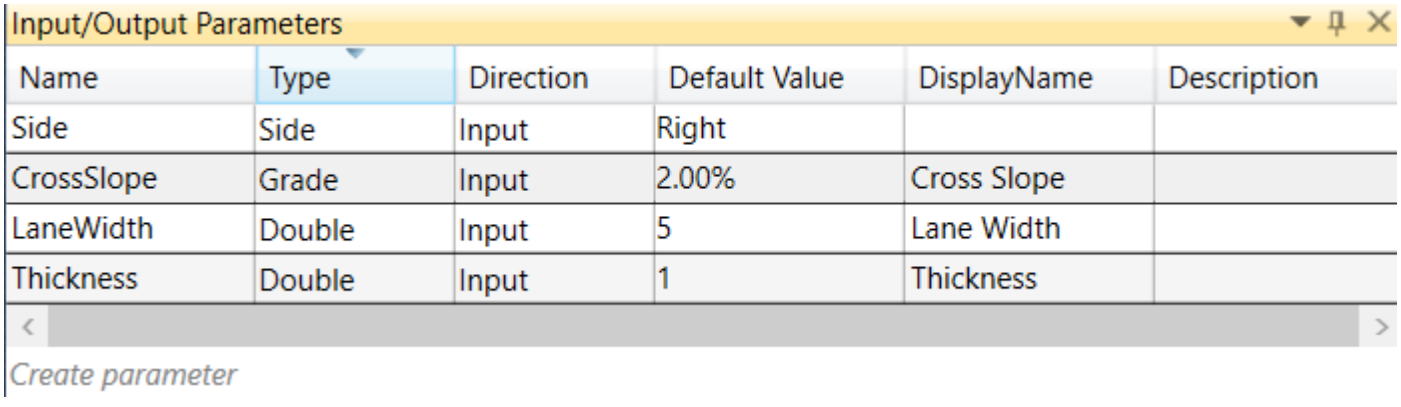

Fig 14: Input/Output Parameters

Assign Parameter

To control the geometry using the custom parameters created, each parameter must be assigned to the respective Geometry. As with EXAMPLE 1 the properties control the behaviour of the geometry therefore the new Input/Output parameters need to be assigned to the geometry in the properties window.

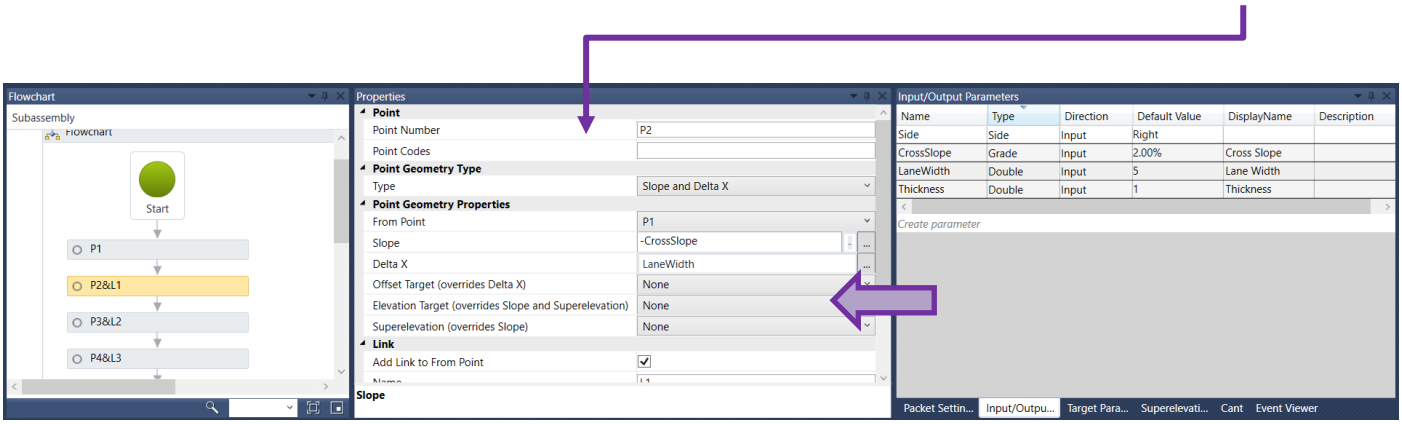

Fig 15: Assigning Parameters

To assign the parameter to the property of the relevant point, link or shape, simply type the parameter name into the property it has been designed to control. This is case sensitive so type the name exactly as it appears in the Input/Output parameters.

Example Assigning the Road Width parameter to P2&L1

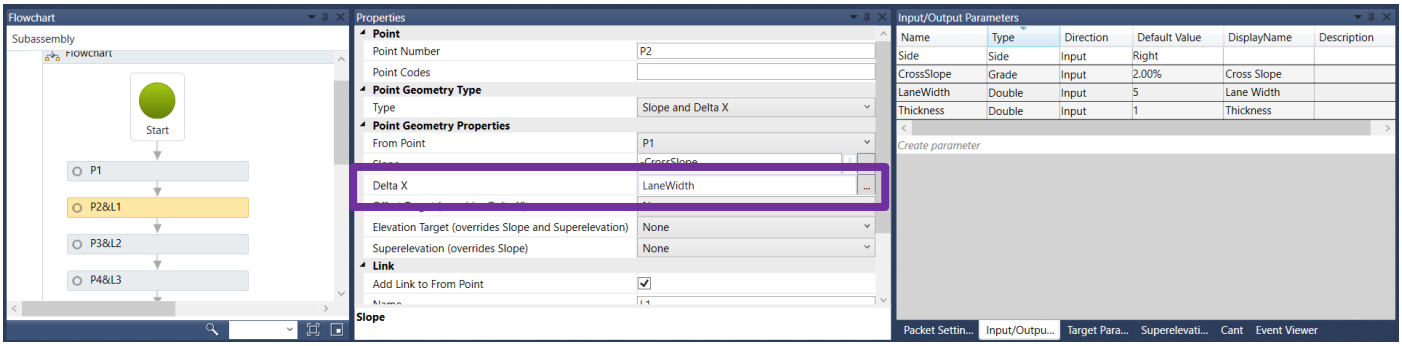

Fig 16: Example : Assigning RoadWidth Parameter

Select P2&L1 from the Flowchart

Properties

- Point Geometry Properties - Type **LaneWidth** into Delta X and Press enter
- The Delta X is now controlled by the LaneWidth Parameter.
- Enter a default value into the LaneWidth parameter to test.

Example Assigning the Cross Slope parameter to P2&L1

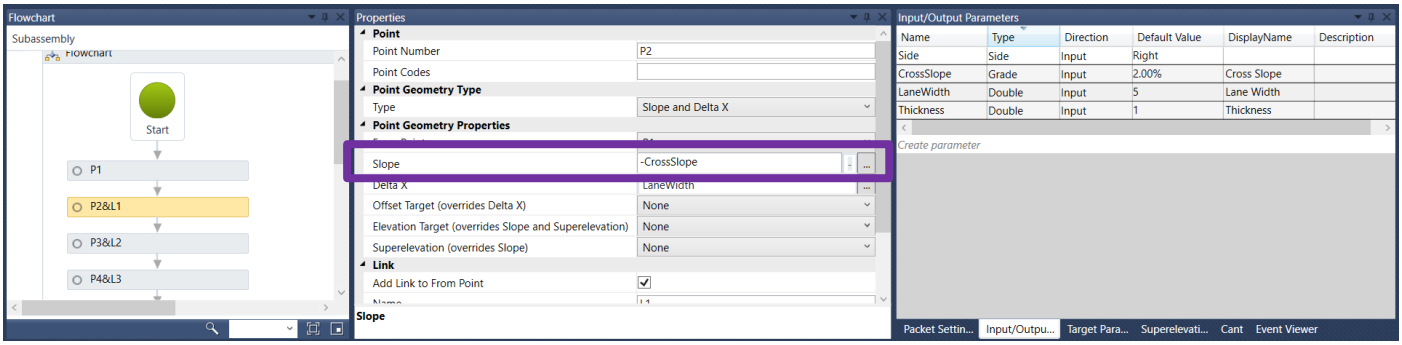

Fig 17: Example: Assigning Cross Slope Parameter

Select P2&L1 from the Flowchart

Properties

- Point Geometry Properties Type -**CrossSlope** into Slope and Press enter
- The Slope is now controlled by the CrossSlope Parameter.
- Enter a default value into CrossSlope parameter to test.

Example: Assign Thickness parameter to P3&L2 and P4&L3

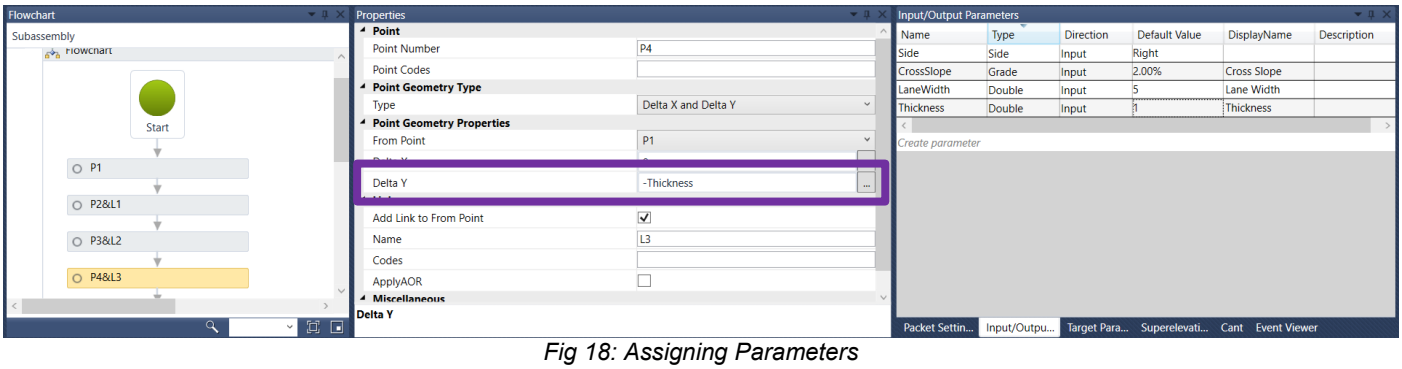

Fig 18: Assigning Parameters

Select P3&L2 from the Flowchart

Properties

- Point Geometry Properties - Type -**Thickness** into Delta Y & Press enter.
- The Delta Y is now controlled by the Thickness parameter.
- Enter a default value into Thickness parameter to test.

- **REPEAT FOR P4&L3**

Note: - Symbol before CrossSlope and Thickness denotes the value is negative.

5. Target Parameters

An important feature of subassemblies is their ability to target offsets. This can be useful when creating widenings, laybys etc. To enable subassemblies to perform this function, Target Parameters need to be created and assigned to the relevant part of the subassembly.

Create & Assign Target Parameter

To create Target Parameters, navigate to the Settings window as shown in Fig 1 and select **Target Parameters**. Like the Input/Output tab there is an option to create parameter.

Select **Create parameter** to create and define the new parameter. (Fig 19)

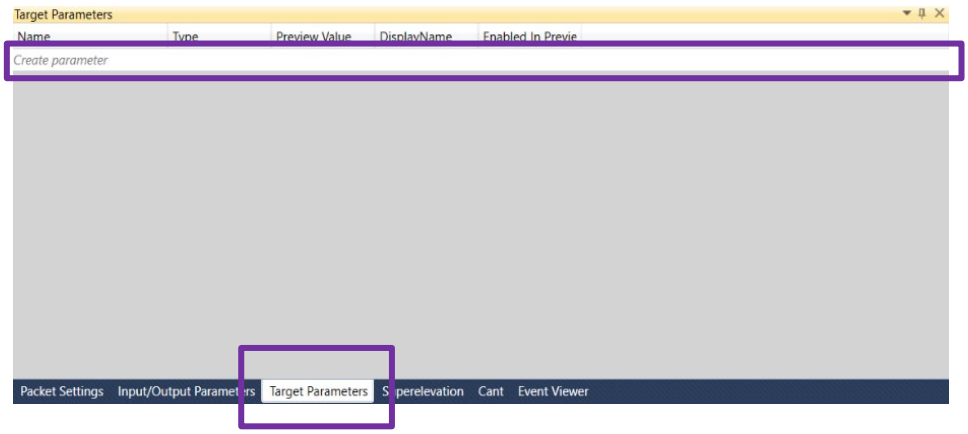

Fig 19: Create Target Parameters

Example: Create Offset Parameter

The below example shows how to create and assign a Lane Offset Parameter.

Select Target Parameter - Select Create Parameter and complete as described below (Fig 20).

Target Parameters

Name	Type	Preview Value	DisplayName	Enabled In Preview
LaneOffset	Offset	10	Lane Offset	☑
Create parameter				

Fig 20: Target Parameter - LaneOffset Example

Like creating and assigning Input/Output parameters, Target parameters also need to be assigned to the properties window to control the behaviour of the geometry.

Example: Assign Offset Parameter

In this example Point P2 is to follow the offset parameter.

Select P2&L1 in the Flowchart

Properties

- Point Geometry Properties - Offset Target (overrides Delta X) - Choose **LaneOffset** from the drop-down menu.

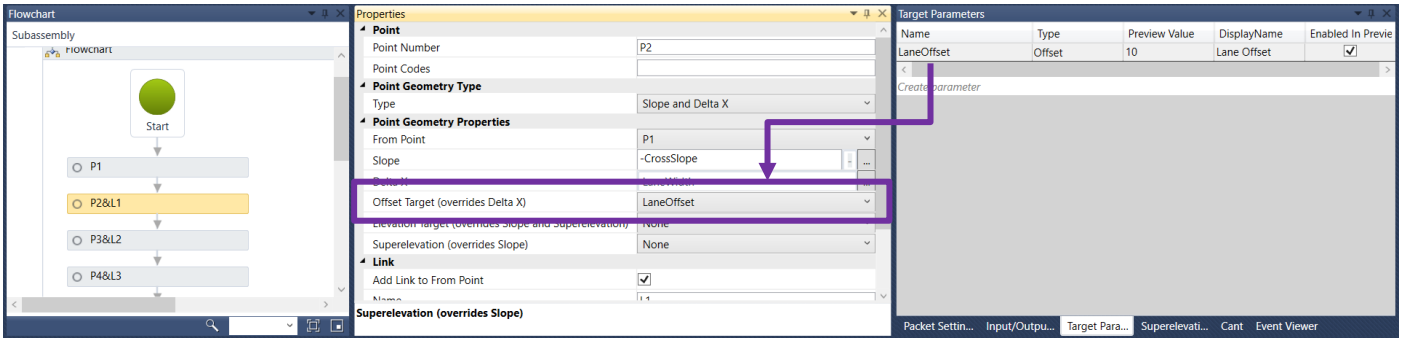

Fig 21: Assign Target Parameter - LaneOffset example

The subassembly can now target offset geometry in Civil3D and can be tested inside the Subassembly Composer.

6. Preview modes

In the Subassembly composer there are 2 no. preview modes to preview the geometry and parameters, Roadway mode and Layout mode.

Layout mode - Shows the preview based on any measurements or variables defined.

Roadway mode - Shows geometry utilising the targets (if they have been assigned).

Selecting a Preview mode

To choose which mode to preview the subassembly, navigate to the Preview window and select either Layout mode or roadway mode from the drop-down menu.

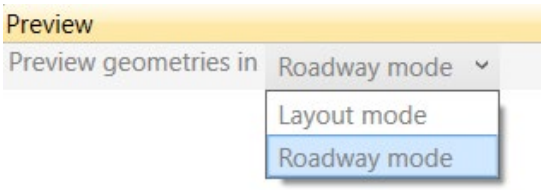

Fig 22: Preview modes

Example

To view the LaneOffset parameter and to test the parameter has been assigned correctly, change the Preview geometry to **Roadway mode.** The LaneOffset parameter should appear in the preview window.

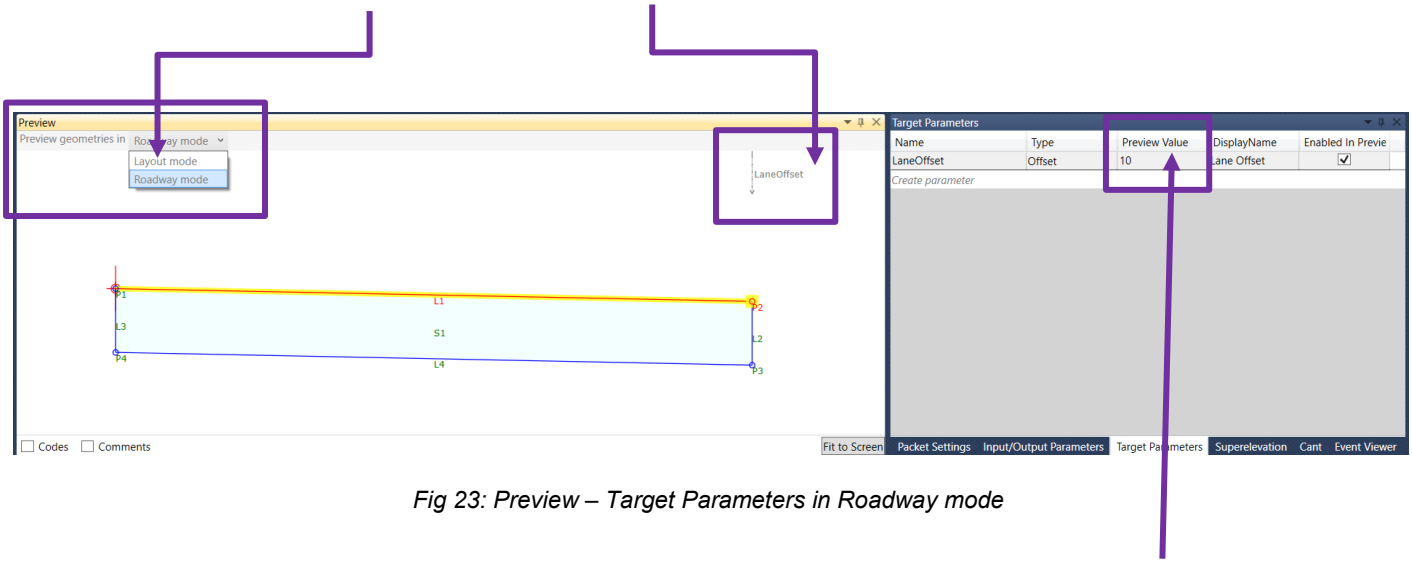

Fig 23: Preview – Target Parameters in Roadway mode

Change the Preview Value in Target Parameters to confirm the Lane offset is controlling the Geometry.

7. Adding Superelevation Properties

If the subassembly is to be used for a road, it is often practical to be able to apply Superelevation inside Civil 3D. To enable this feature Superelevation Input/Output parameters need to be created and assigned to the respective links.

Example: Create Superelevation parameters

Navigate to the Input/Output Parameters in the settings window and create 2 no. new Input/Output Parameters, **Superelevation** and **Superelevation Axis of Rotation.**

By adding the Type first the name and the description should automatically populate, however if these fields do not auto populate the information can be input manually.

The Default Value for superelevation will be set to Left inside Lane. If the default value is set to None no superelevation will be applied unless we tell it to.

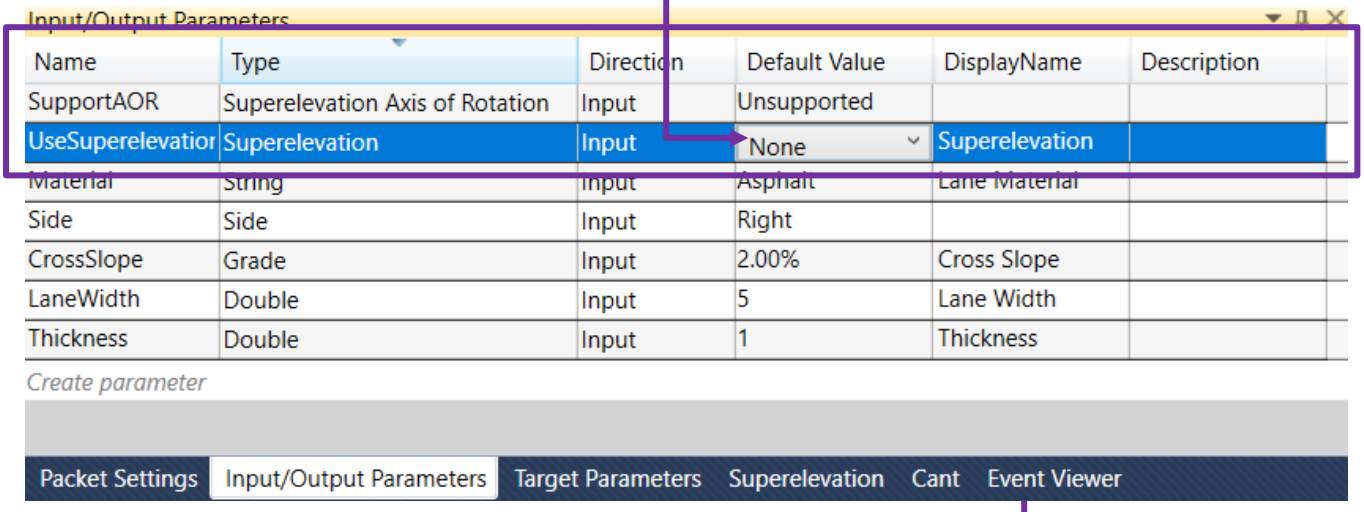

Fig 24: Superelevation & Superelevation Axis of rotation Example

By default the SupportAOR value should be set to Unsupported so we can assign which ever lane slope desired inside Civil3D,

Having created the superelevation parameters, they now need to be assigned to the respective links that require superelevation.

Example: Assign Superelevation parameters

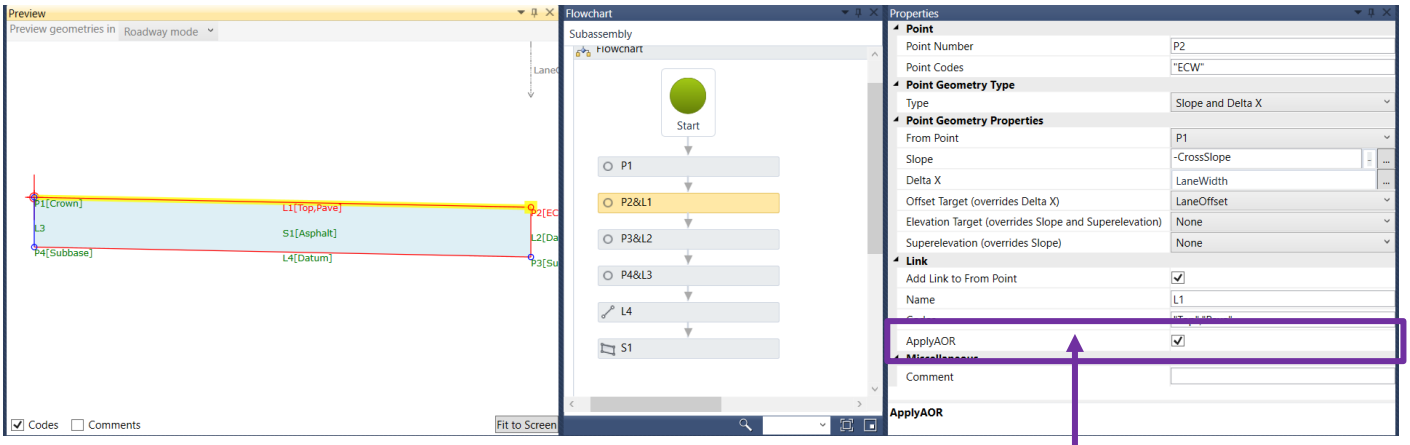

Fig 25: ApplyAOR

Select **P2&L1** in the Flowchart or select L1 in the preview window

Properties

- scroll down to Link and **Tick ApplyAOR**

As Link 4 (L4) is parallel to L1 it should also have the AOR applied.

Select **L4** in the Flowchart or in the preview window.

Properties

- scroll down and **Tick ApplyAOR**

To preview the superelevation make sure Roadway mode is turned on in the Preview window. Navigate to Target Parameters and untick Enable in Preview for any Target Parameters created (See Fig 26). This will prevent the Target Parameters interfering with the Superelevation.

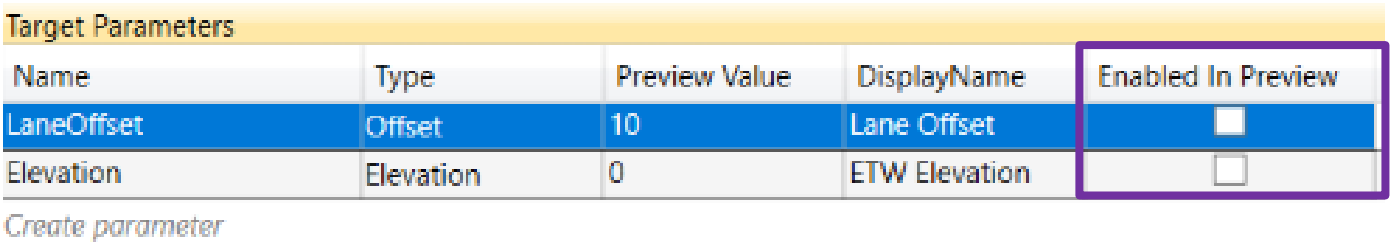

Fig 26: Turn off Enable in Preview

Although currently nothing will have changed if the Superelevation properties are changed and the Superelevation (overrides Slope) is set to the corresponding value the preview will update.

Example: Superelevation

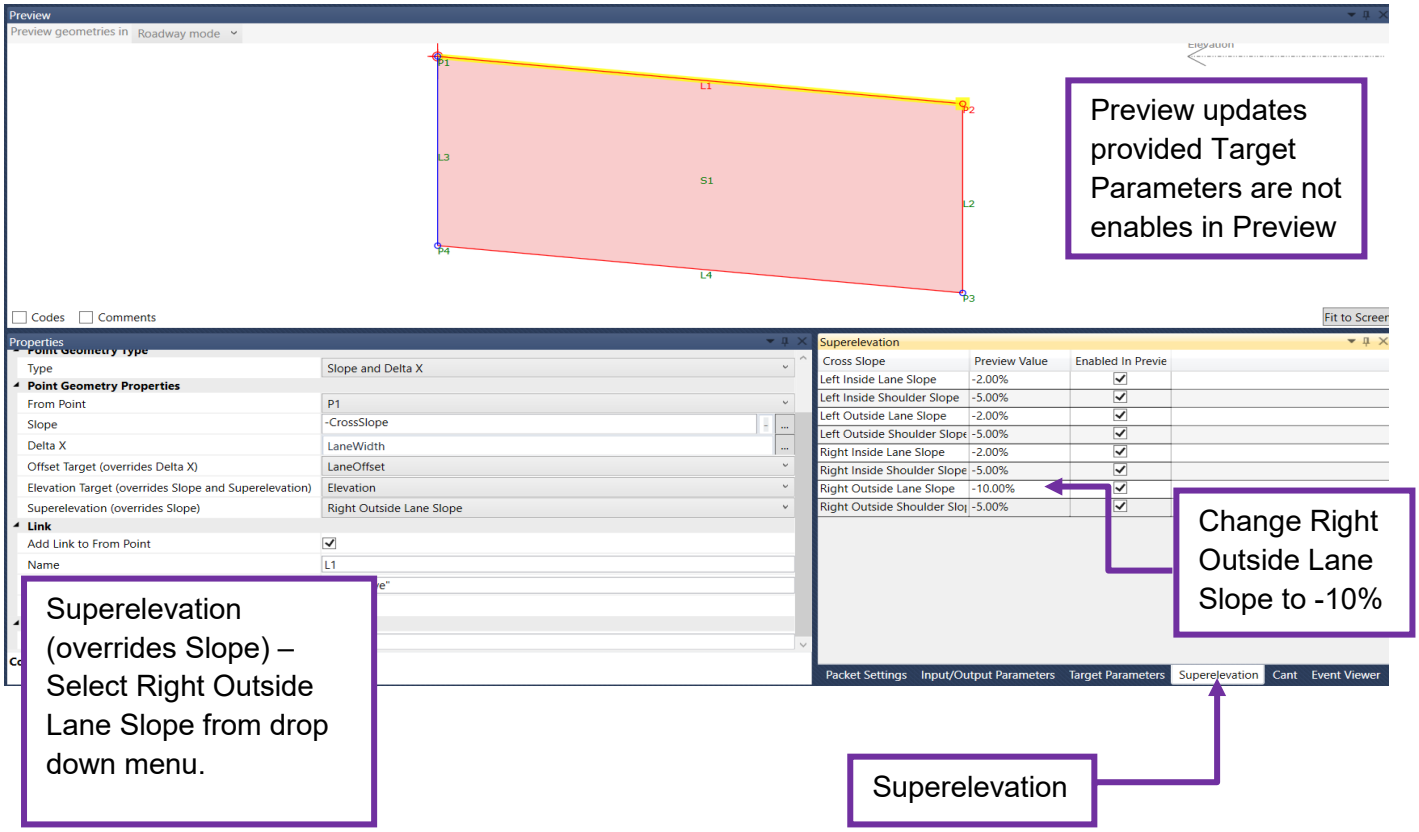

Fig 27: Testing Superelevation

8. Assigning codes to Points Links and shapes

Codes will be used to draw the feature lines, to create labelling on the links, create rendering materials for surfaces and the shape would be used for pulling Material Quantities.

To preview codes as they are assigned tick Codes in the preview window.

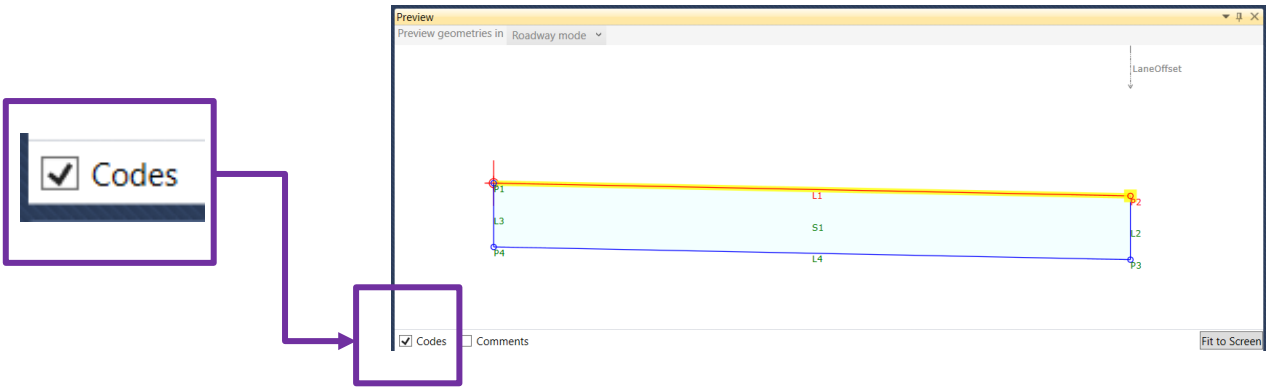

Fig 28: Preview Codes

To assign codes to a point, select the desired point in the Flowchart.

Properties

- Point Codes - “type the desired name.”

Example: P1 = “Crown” P2 = “ECW” P3 = “Subbase” P4 = “Subbase”

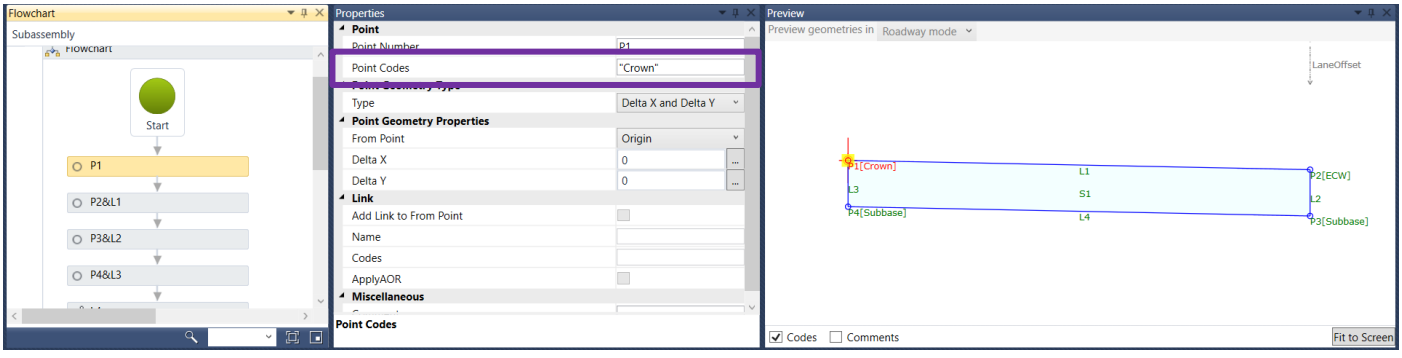

Fig 29: Adding codes to points

Note: *Codes for Point codes, Link Codes and Shape Codes must be in inverted commas.*

Assign Codes to Links

To assign codes to a Link, select the desired Link in the Flowchart.

Properties

- Link – Codes - “type the desired name”

Example: P2L1 = “Top”,”Pave” P3L2 = “Datum” L4 = “Datum”

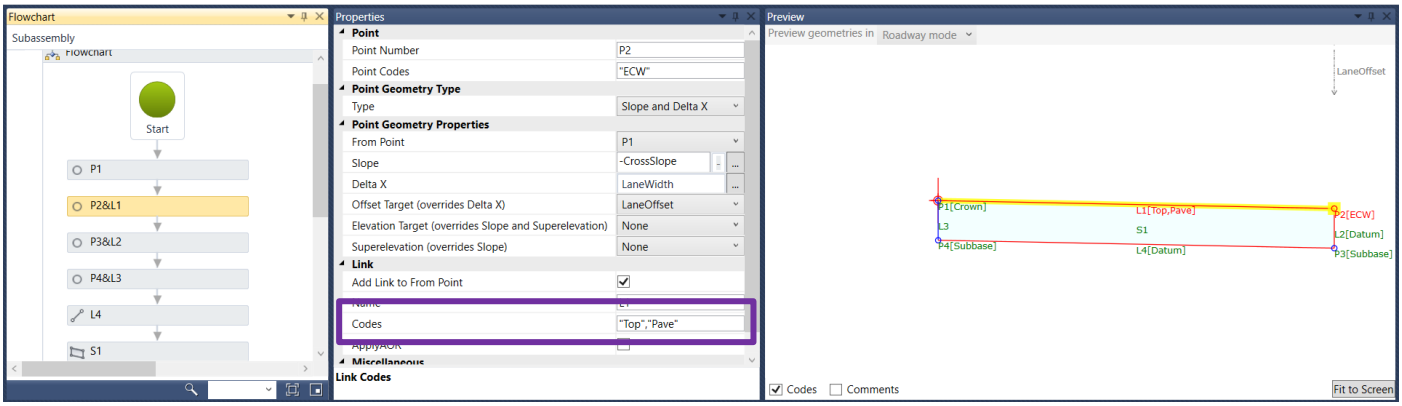

Fig 30: Adding codes to Links

Assign Codes to Shape

To assign codes to a Shape, select the desired Shape in the Flowchart.

Properties

Shape - Shape Codes “type the desired name”

Example: “Concrete”

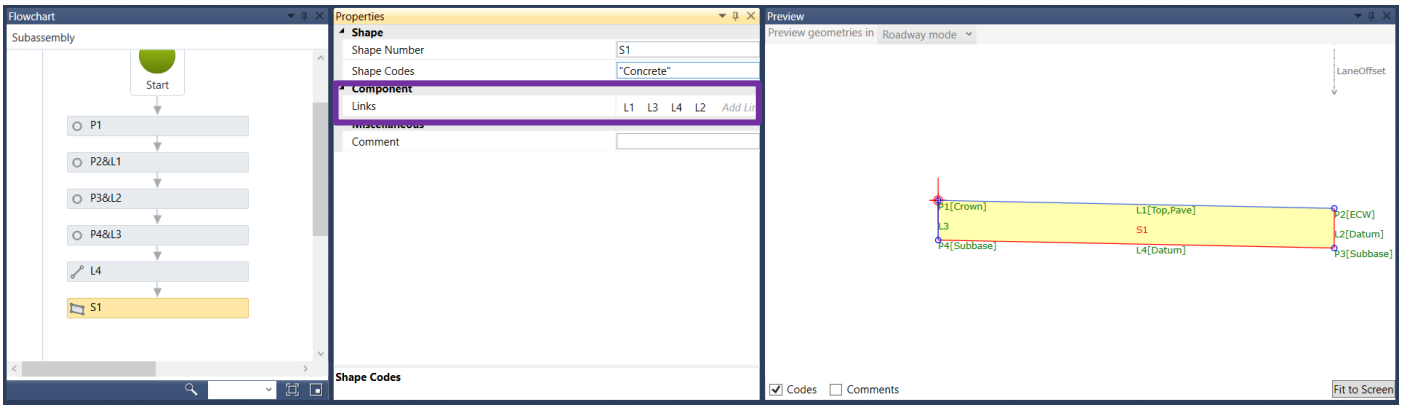

Fig 31: Adding codes to shapes

Note: *Codes for Point codes, Link Codes and Shape Codes must be in inverted commas.*

Assigning Parameters to Shape Codes

Whilst it is useful to be able to assign a fixed code to a shape such as “Concrete” as shown in Fig 31, it could at times be more beneficial to be able to assign a variable parameter that can be controlled inside Civil 3D. For example, having the ability to change the material of the Subassembly in Civil 3D.

To do this an Input/Output parameter has to be created and assigned to the shape code.

Example

To create a materials parameter, navigate to Input/Output Parameters and create a new Parameter.

Complete the relevant fields as shown below.

Name = Material, Type = String, Direction = Input, Default – Asphalt, Display Name = Lane Material

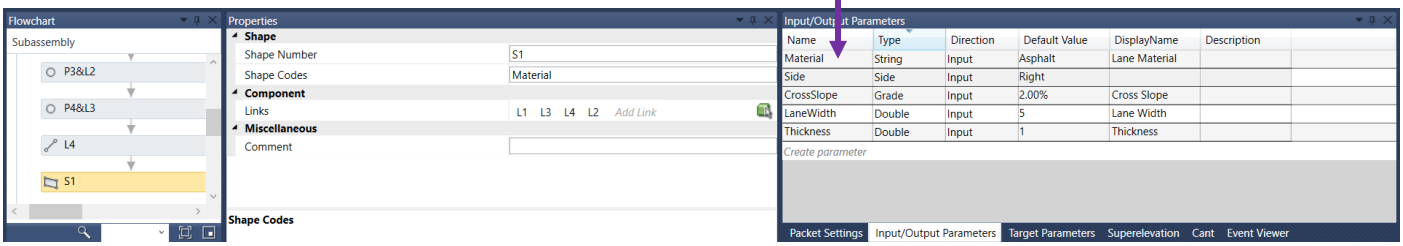

Fig 32: Assigning Parameters to Shape Codes

When the parameter has been created, add the parameter to the shape code by typing the Parameter name as defined in the Input/Output parameters into the shape Code. The preview window should display the Default value of the Material parameter.

Note: *To expand on this and assign additional courses and materials, add additional points links and shapes to the subassembly.*

9. Saving & Importing

Saving

Before saving the subassembly navigate to Packet Settings and give the subassembly a name and description, for example:

Subassembly Name = **MyCustomLane**

Description = **Custom Lane Objects**

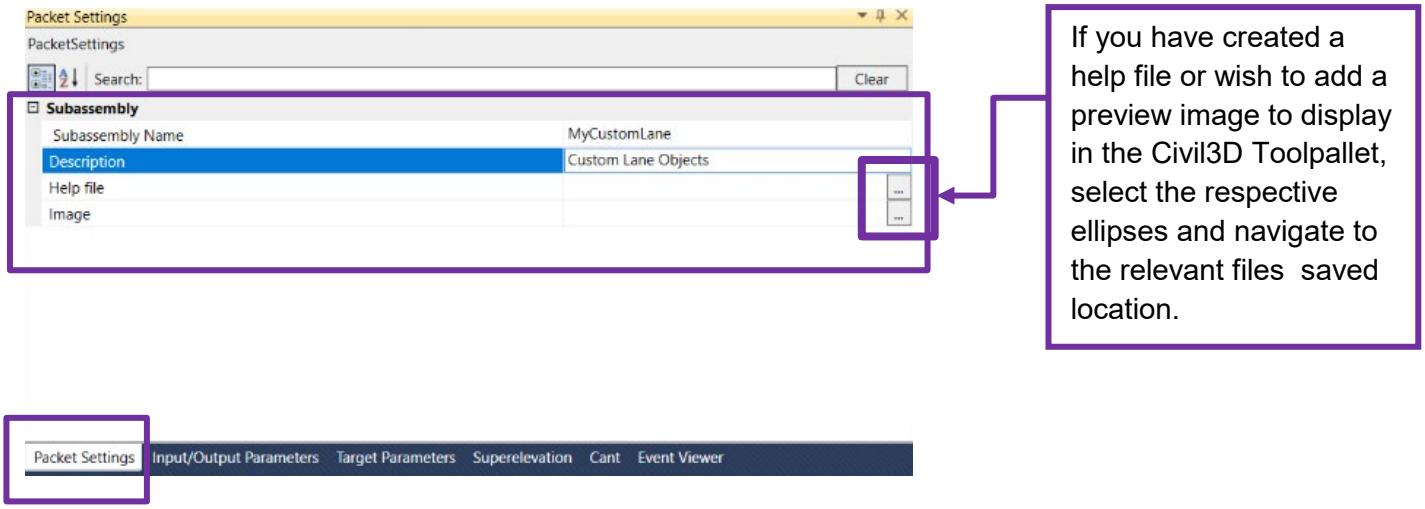

Fig 33:Packet settings

Having input the desired information into the Packet Settings navigate to File > Save as.

When the Save as window dialogue box opens type the name of your assembly e.g. MyCustomLane and make sure File Type is set to save as a Subassembly files (*.pkt).

Note: *.pkt files are essentially zip files containing everything necessary to use the link properly in C3D.*

Importing into C3D

To import a subassembly into Civil 3D, first open Civil 3D and turn on Tool palettes 

Create New “Custom” Tool palette > Import Subassemblies

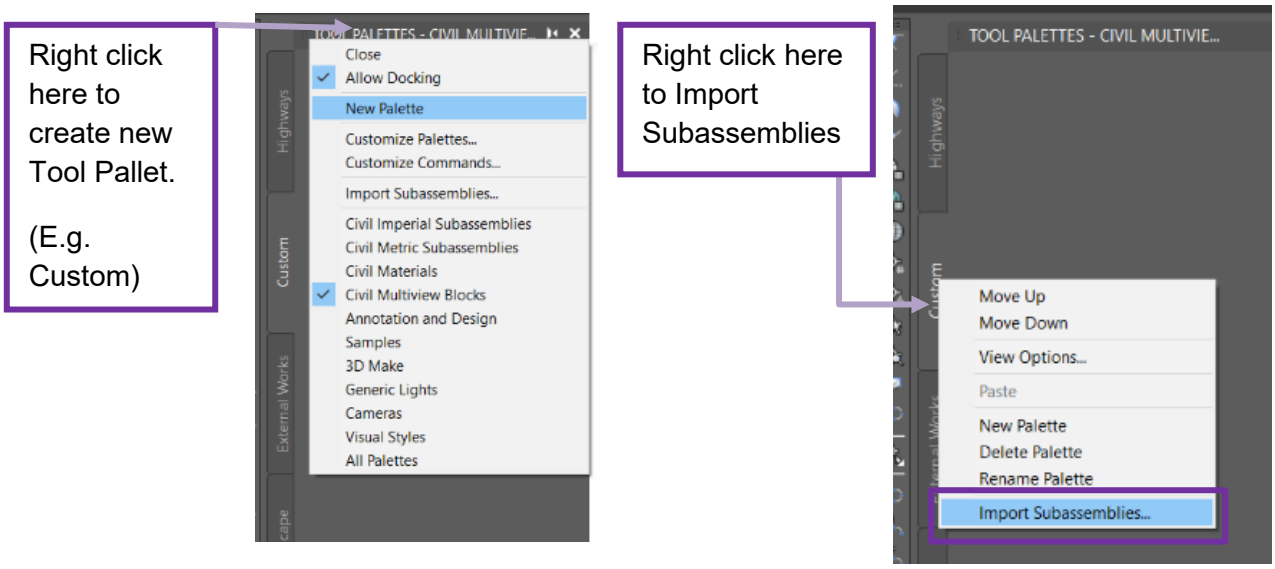

Fig 34: Create Tool Pallet & Import

When the import Subassemblies dialogue box opens navigate to saved location and define where the subassembly should be brought into. E.g. Tick Tool Palette, and choose Custom.

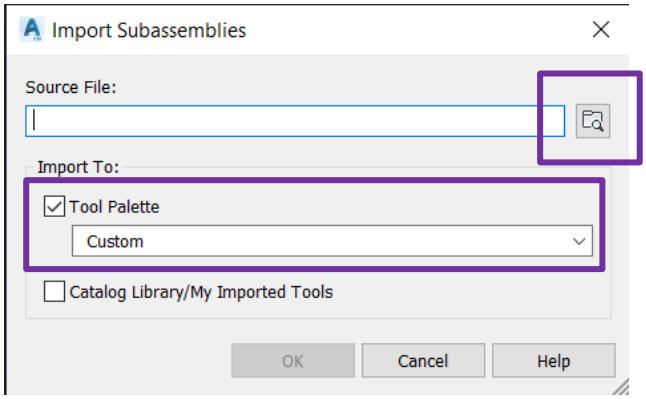

Fig 35: Import Subassemblies

Note: *It is recommended subassemblies are tested before using them on any projects.*