LAB 7 - Building Components

This lab demonstrates the various methods of creating components, setting component and point properties, and illustrating how point constraints work. There are three basic options used to create components; simple, constrained/unconstrained, and end condition.

Chapter Objectives:

- Build a simple component
- Build a constrained component
- Build an end condition component
- Demonstrate the commonly used constraints; horizontal, vertical, slope, and vector/offset

Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

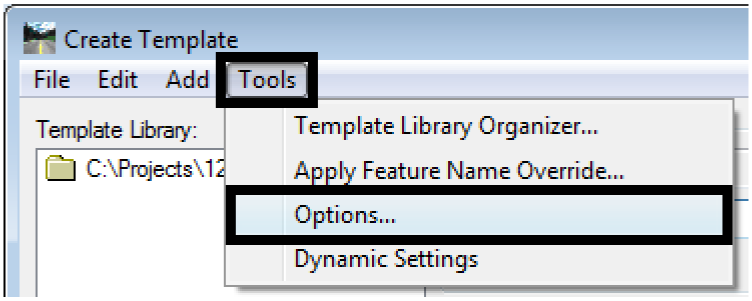
Lab 7.1 - Build A Simple Component

Use the simple option to build a regular closed shape component with horizontal and slope constraints such as those used for building pavement components.

1. Open MicroStation and InRoads using the ***12345DES_Model.dgn*** file found in the directory ***C:\Projects\12345\Design\Drawings\Reference_Files***.
2. Select **File > Open** from the InRoads menu bar.
3. Select the ***C:\Projects\12345\Design\InRoads\DES12345_Templates.itl*** from the available files.
4. **<D> Open** then **<D> Cancel** the ***Open*** dialog box.
5. Select **Modeler > Create Template** from the InRoads menu bar.

Setting up ***Template Options*** makes point placement easier. For this lab, affixes will be turned off so that the component can be used on either side of the template. The step value will be set so to a small value so that when creating a template, components will snap to the correct points.

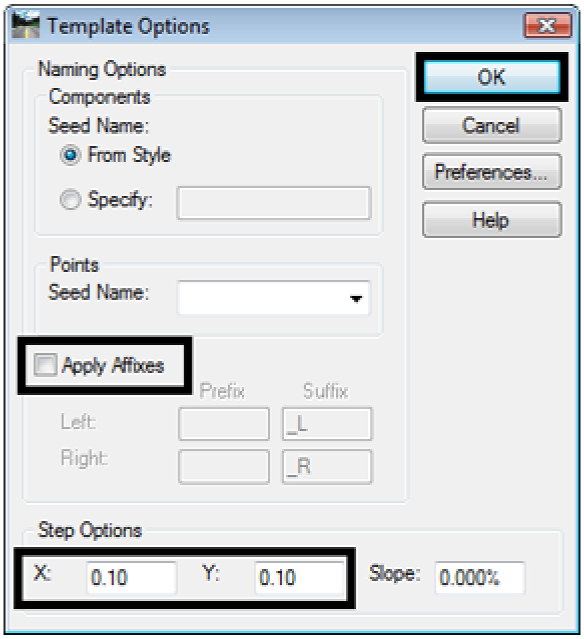
6. Select **Tools > Options** from the ***Create Template*** menu bar.



7. Toggle off ***Apply Affixes***.

8. Set the ***X*** and ***Y Step Options*** to ***0.10***.

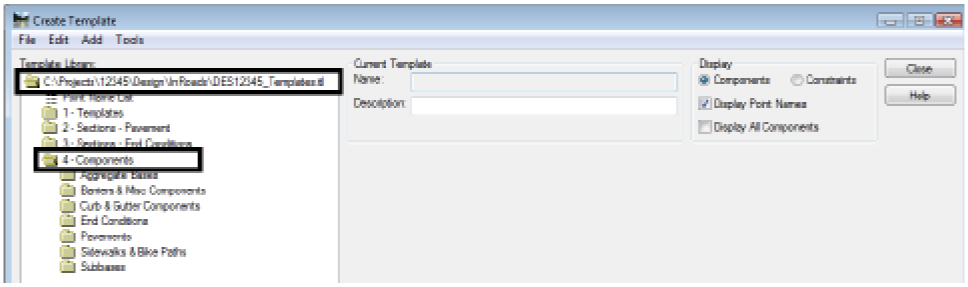
9. **<D> OK**.



The next series of steps creates a new project specific folder to store the components that will be created in the lab. Creating project specific folders in the template library makes easier to find project specific components.

10. **<D> <D>** on the root folder in the Template Library pane to expand the folder structure.

11. **<D> <D>** on the ***4 - Components*** folder to expand the folder.

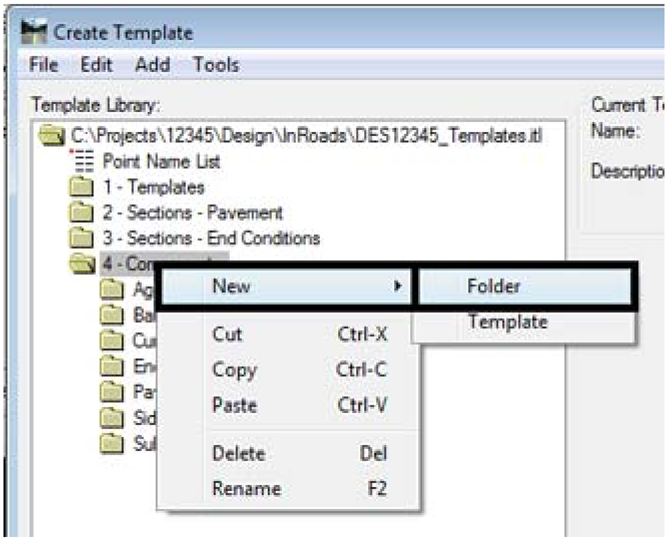


● Components ○ Constraints

☑ Display Point Names

□ Display All Components

12. **<R>** on the ***4 – Components*** and select **New > Folder** from the right click menu.

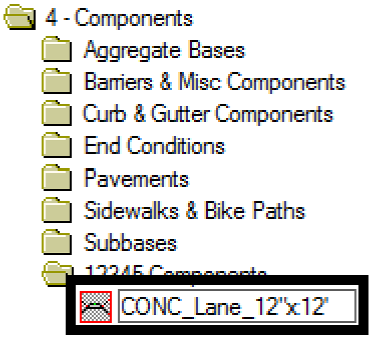


13. Key in ***12345 Components*** for the folder name.

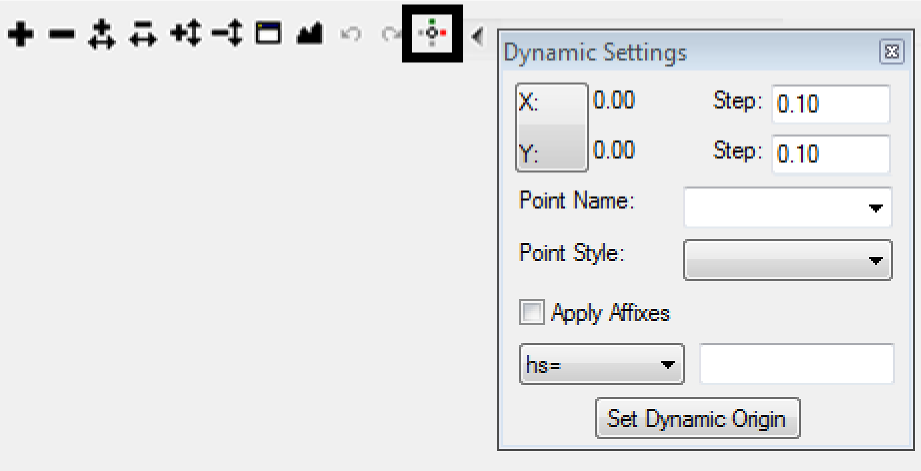
Components are the building blocks of templates. Create a pavement component using the ***Simple*** option. This option is used because it automatically sets up the constraints of the component.

14. **<R>** on the ***12345 Components*** folder and select **New > Template** from the right click menu.

15. Key in ***CONC_Lane_12”x12’*** for the component name.



16. **<D>** on the ***Dynamic Settings*** button to display the Dynamic Settings tool settings box.



Dynamic Settings

X: 0.00 Step: 0.10

Y: 0.00 Step: 0.10

Point Name:

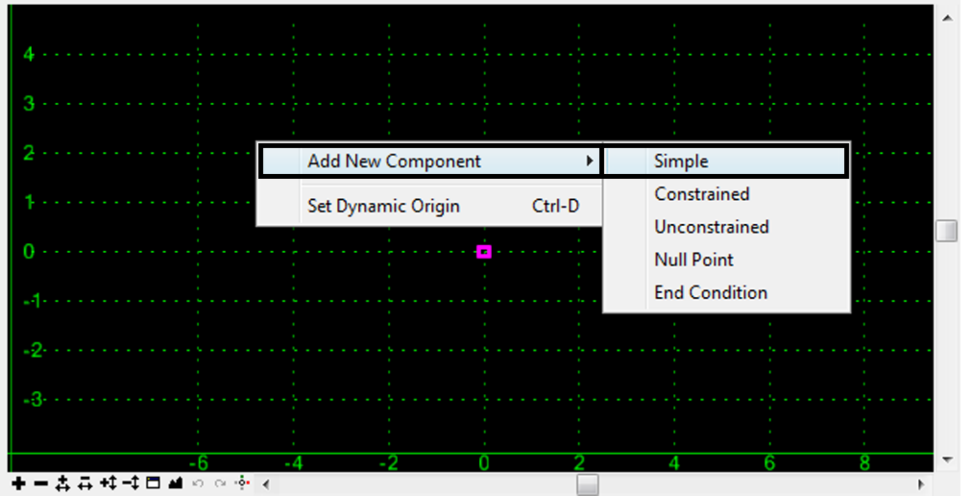
Point Style:

□ Apply Affixes

hs=

Set Dynamic Origin

17. **<R>** In the Template View window and Select **Add New Component > Simple** from the right click menu.



Add New Component ▸

Set Dynamic Origin Ctrl-D

Simple

Constrained

Unconstrained

Null Point

End Condition

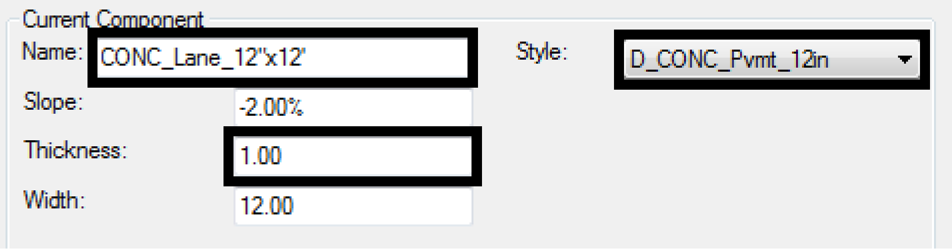
The next steps define the style that the component will use, the point names, and the origin of the component.

18. In the ***Current Component*** area, key in ***CONC_Lane_12"x12'*** into the ***Name*** field.

19. Set the Style to **D_CONC_Pvmt_12in** using the drop down menu.

20. Key in ***1*** for the ***Thickness.***

Note: This is where the values of all the constraints are set. If needed, these values can be modified later.



Current Component

Name: CONC_Lane_12"x12'

Style: D_CONC_Pvmt_12in

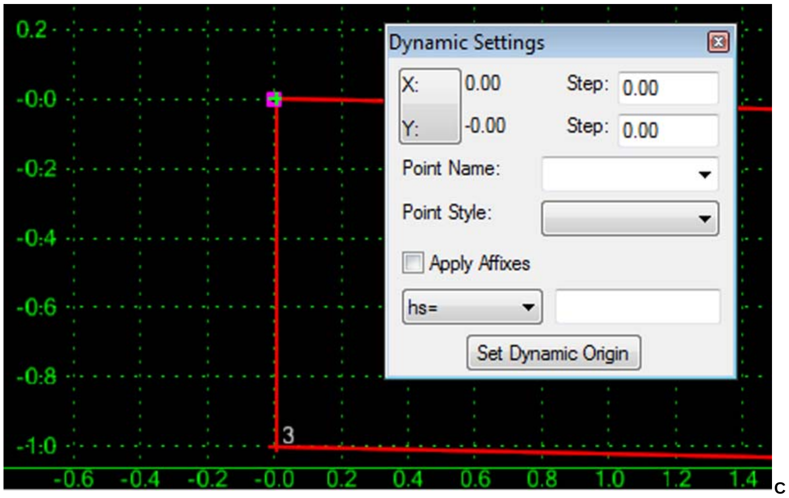
Slope: -2.00%

Thickness: 1.00

Width: 12.00

21. Move the pointer into the magenta square (this is the template origin and is usually at the coordinate 0,0). Adjust the pointer location until the ***Dynamic Settings*** readout is ***0.00*** for both ***X*** and ***Y***.

22. **<D>** to place the element.



Dynamic Settings

X: 0.00 Step: 0.00

Y: -0.00 Step: 0.00

Point Name:

Point Style:

☐ Apply Affixes

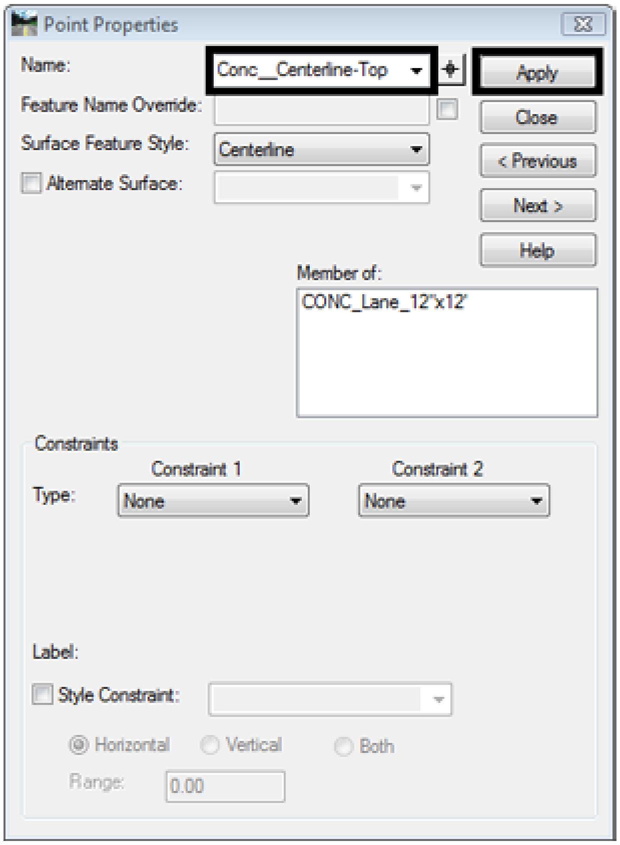
hs=

Set Dynamic Origin

23. **<D> <D>** on the origin.

24. Select ***Conc_Centerline-Top*** from the ***Name*** drop down menu.

25. **<D> Apply**.



Point Properties

Name: Conc__Centerline-Top

Feature Name Override: □

Surface Feature Style: Centerline

□ Alternate Surface:

Member of: CONC_Lane_12"x12'

Constraints

	Constraint 1	Constraint 2
Type:	None	None

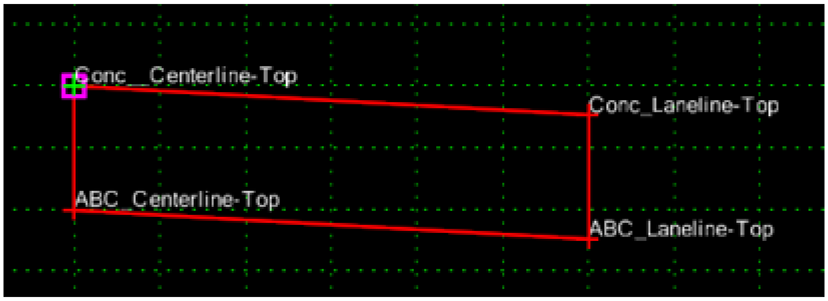
Label:

□ Style Constraint:

● Horizontal ○ Vertical ○ Both

Range: 0.00

26. **<D> Next** and rename the remaining points as shown below using the ***Name*** pull-down menu.

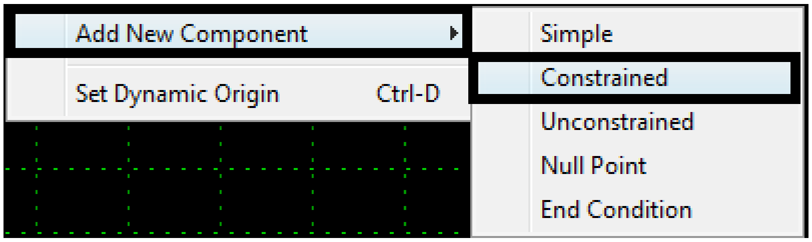


This completes the creation of a simple, closed shaped component with horizontal and slope constraints.

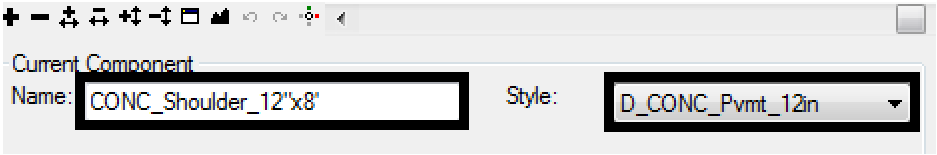
Lab 7.2 - Build a Constrained Component

In addition to building regular closed shape components, irregular and/or open shaped components can be created using the contrained or unconstrained options for adding components. They can also be used to build linear, non-end condition components. Use the constrained option to define horizontal and/or vertical constraints (such as a horizontal or vertical offset from another point). Use the unconstrained method to define points that don't depend on other points for their placement.

1. **<R>** on the ***12345 Components*** folder and select **New > Template** from the right click menu.
2. Key in ***CONC_Shoulder_12"x8'*** for the component name.
3. **<R>** In the Template View window and Select **Add New Component > Constrained** from the right click menu.

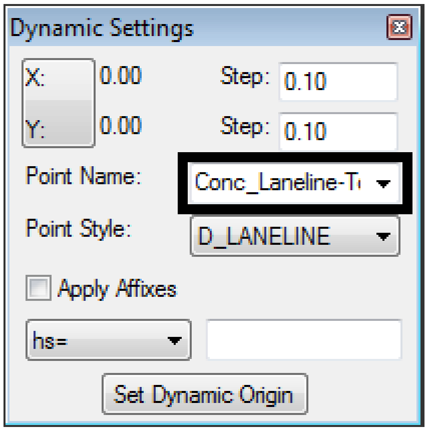


4. In the ***Current Component*** area, key in ***CONC_Shoulder_12"x8'*** into the ***Name*** field.
5. Set the Style to **D_CONC_Pvmt_12in** using the drop down menu.


Current Component
Name: CONC_Shoulder_12"x8'
Style: D_CONC_Pvmt_12in

When placing constrained or unconstrained components, each point of the component must be placed individually. Use the ***Dynamic Settings*** dialog box is to enter point names, styles, and locations.

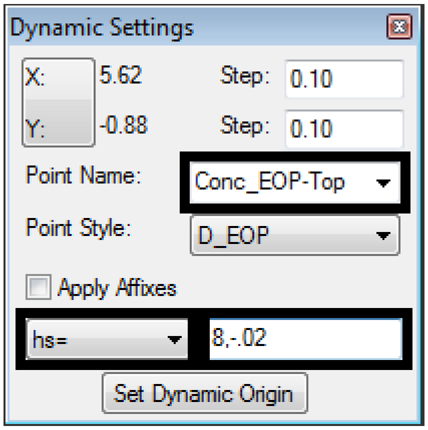
6. Select ***Conc_Laneline-Top*** from the ***Point Name*** drop down menu on the ***Dynamic Settings*** dialog box.



X: 0.00 Step: 0.10
Y: 0.00 Step: 0.10
Point Name: Conc_Laneline-T
Point Style: D_LANELINE
□ Apply Affixes
hs=

7. Move the pointer on to the template origin and **<D>**.
8. ***Dynamic Settings*** dialog box, Select ***Conc_EOP-Top*** from the ***Point Name*** drop down menu.
9. Change the key in mode to ***hs=*** (horizontal distance and slope).

10. Key in ***8,-.02*** in the key in field. This is the horizontal distance and slope from the previously placed point.



Dynamic Settings

X: 5.62 Step: 0.10

Y: -0.88 Step: 0.10

Point Name: Conc_EOP-Top

Point Style: D_EOP

□ Apply Affixes

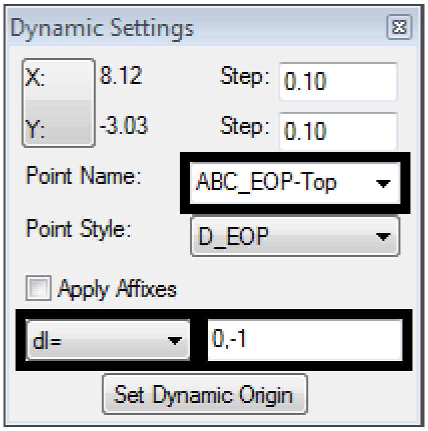
hs= 8,-.02

11. Press the ***Enter*** key to place the point.

12. Select ***ABC_EOP-Top*** from the ***Point Name*** drop down menu.

13. Change the key in mode to ***dl=*** (horizontal and vertical distance from the last entered point).

14. Key in ***0,-1*** in the key in field. This is the horizontal distance and vertical distance from the previously placed point.



Dynamic Settings

X: 8.12 Step: 0.10

Y: -3.03 Step: 0.10

Point Name: ABC_EOP-Top

Point Style: D_EOP

□ Apply Affixes

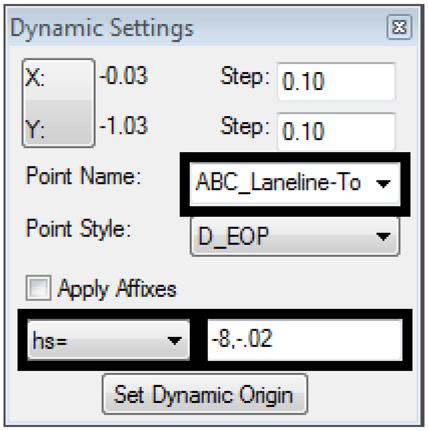
dl= 0,-1

15. Press the ***Enter*** key to place the point.

16. Select ***ABC_Laneline-Top*** from the ***Point Name*** drop down menu.

17. Change the key in mode back to ***hs=*** (horizontal distance and slope).

18. Key in ***-8,-.02*** in the key in field.



Dynamic Settings

X: -0.03 Step: 0.10

Y: -1.03 Step: 0.10

Point Name: ABC_Laneline-To

Point Style: D_EOP

□ Apply Affixes

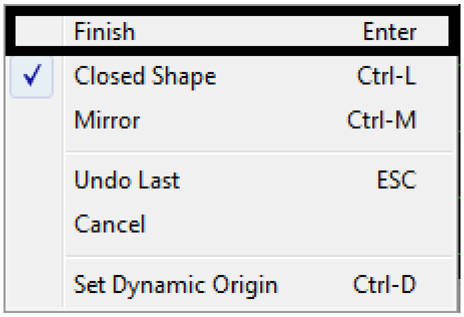
hs= -8,-.02

19. Press the ***Enter*** key to place the point.

20. **<R>** anywhere. This dialog box is where you define if the shape is closed or not.

21. Verify that ***Closed Shape*** is toggled **On.**

22. Select ***Finish*** from the right click menu to complete the component.



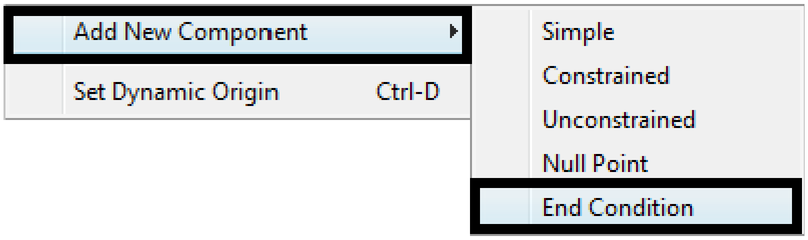
You should now understand how to create a constrained, closed shaped component. By reviewing the steps above, now you should also be able to also create unconstrained and open shaped components simply by choosing different options from the dialog boxes that were introduced.

Lab 7.3 - Build an End Condition Component

In theses next steps you will use the end condition option to create a linear component that can seek a target. This lab will focus on the point property called ***End Condition is Infinite***. Once you understand the steps to evaluate the effects of this property on and end condition, use the same steps to test the effects of other end condition point properties. Many of these properties determine how the component will behave when a target is found.

1. Create a new template as described in the previous lab and name it ***6to1_Fill***.

2. **<R>** In the Template View window and Select **Add New Component > End Condition** from the right click menu.

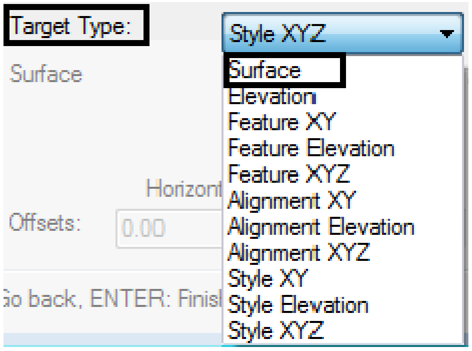


3. Key in ***6 to 1 Fill*** for the ***Name***.

4. Select ***D_Toe-of-Fill*** for the ***Style***.

Additional component properties are required for end conditions. These determine what the end condition attempts to tie to (the Target) and the order in which it is processed (the Priority).

5. **<D>** on the ***Target Type*** drop down menu. Examine the options available.

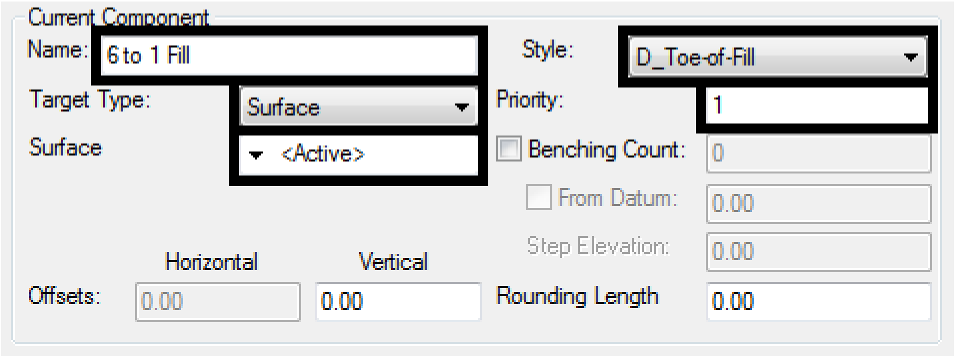


6. Select ***Surface*** from the ***Target Type*** drop down menu.

7. **<D>** on the ***Surface*** drop down menu. Notice that either Active or a particular surface can be selected.

8. Select ***Active*** from the drop down menu**.** This will allow the end condition to solve regardless of the surface specified in Roadway Designer.

9. Key in ***1*** for the ***Priority***.


Current Component

Name: 6 to 1 Fill

Style: D_Toe-of-Fill

Target Type: Surface

Priority: 1

Surface: <Active>

□ Benching Count: 0

□ From Datum: 0.00

Step Elevation: 0.00

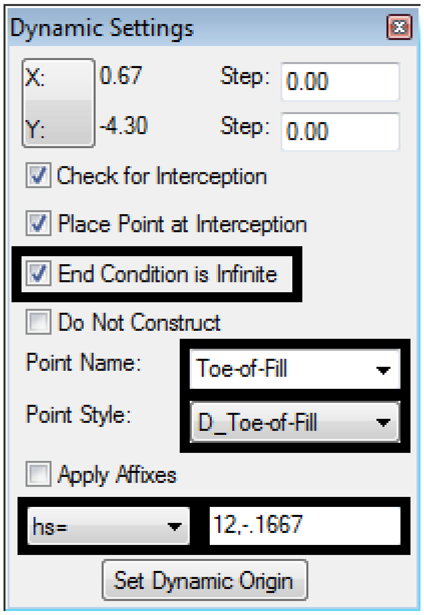
	Horizontal	Vertical
Offsets:	0.00	0.00

Rounding Length 0.00

> ***Note:*** This example illustrates an end section with one component. When there are several components defined in an end condition, they are evaluated in order of their assigned ***priority***. A component with a priority of 1 will be evaluated before a component with a priority of 2.

Next, additional point properties, such as point names, will be defined for the end condition. Use the ***Dynamic Settings*** dialog box to finish defining these properties.

10. In the ***Dynamic Settings*** dialog box, select ***POSS*** for the ***Point Name***.
11. Move the pointer on to the template origin and **<D>**.
12. In the ***Dynamic Settings*** dialog box, toggle on ***End Condition is Infinite***. This option allows a component to "stretch" until a target is found.
13. Select ***Toe-of-Fill*** for the ***Point Name***.
14. Change the key in mode to ***hs=.***
15. Key in ***12,-.1667***. and press ***Enter***. (This value could also be typed in as ***12,-1:6***).



Dynamic Settings

X: 0.67 Step: 0.00

Y: -4.30 Step: 0.00

☑ Check for Interception

☑ Place Point at Interception

☑ End Condition is Infinite

□ Do Not Construct

Point Name: Toe-of-Fill

Point Style: D_Toe-of-Fill

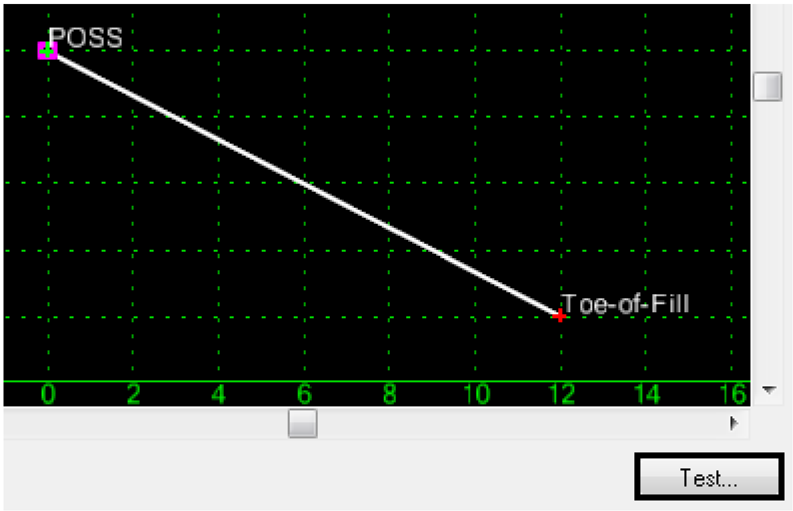
□ Apply Affixes

hs= 12,-.1667

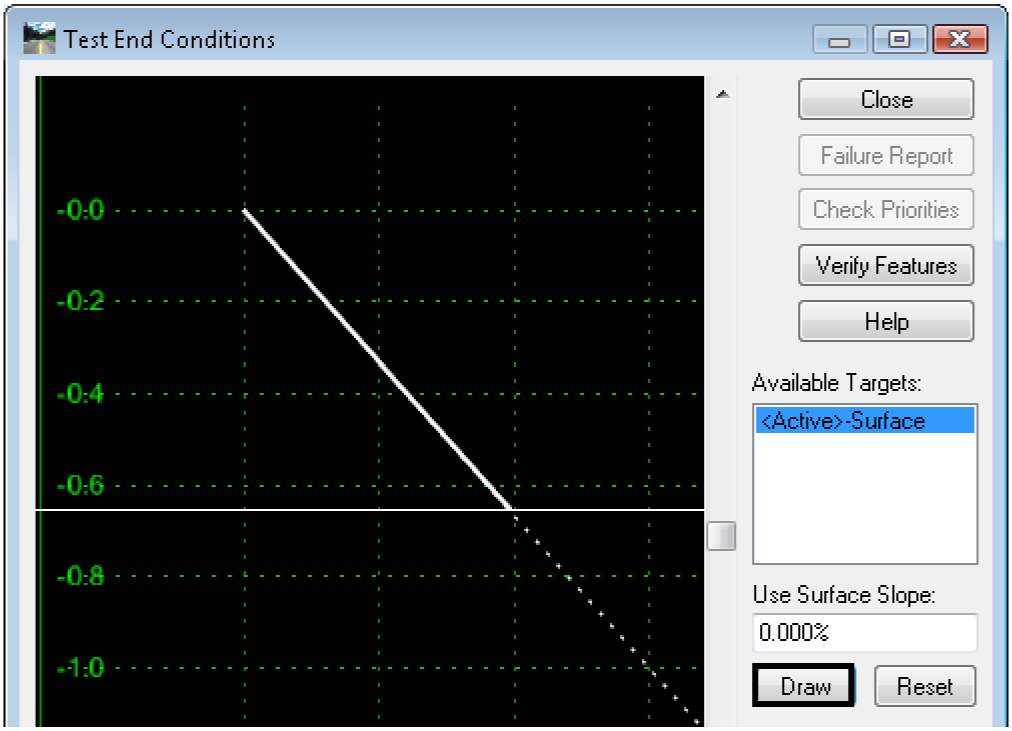
16. **<R>** and select ***Finish*** from the right click menu.

The steps above created a component that will seek a target at a -1:6 slope for a horizontal distance up to 12 feet. However, because the option ***End Condition is Infinite*** was toggled ***On***, the component ignores the horizontal distance criteria and will seek a target beyond the 12 foot limitation.

17. In the ***Create Template*** dialog box, **<D>** the ***Test*** button located to the bottom right of the Template View window as shown below.



18. In the ***Test End Conditions*** dialog box, **<D>** the **Draw** button.



Available Targets:
<Active>-Surface

Use Surface Slope:
0.000%

19. Move the pointer up and down in the view area to see how the end condition performs.

Note: The dotted line in the ***Test End Condition*** view window shows the component at the defined slope and length. As the proposed surface moves beyond the limits of the defined component, the result of the ***End Condition is Infinite*** toggled **On** is that the end condition solution expands beyond the original limits of the component. **<D> Close**.

20. **<D> <D>** on the ***Toe-of-Fill*** point.
21. Toggle off ***End Condition is Infinite*.**
22. **<D> Apply** and **<D> Close**.
23. **<D> Test**.
24. In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how the end condition behaves.
25. **<D> Close**.

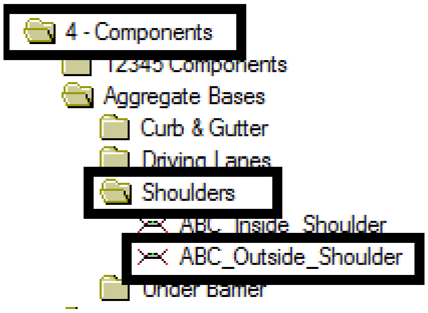
    Note: When the ***End Condition is Infinite*** option is **Off,** the end condition solution is limited to the limits of the originally defined component.

26. Select **File > Save** the ***Create Template*** dialog box.

Lab 7.4 - How Point Constraints Work

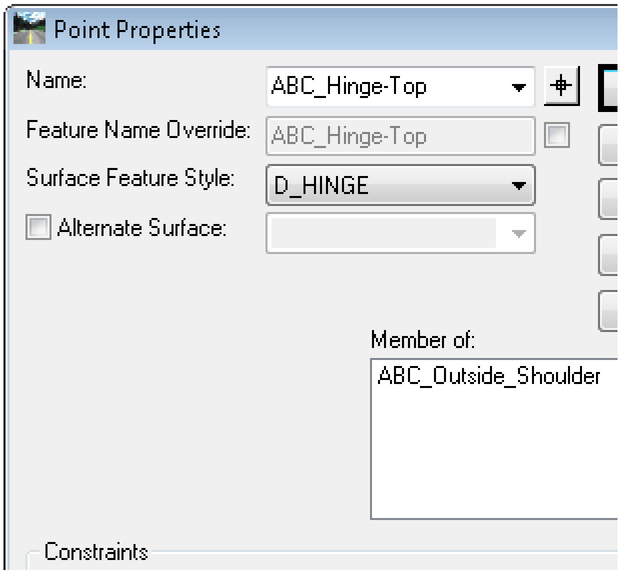
Point constraints are used to form a relationship between points. This relationship is used to change the shape of the components based on events that occur within the corridor. The following steps will demonstrate how to assign and modify point controls, and how to evaluate a component by making changes to point controls. change, create the impact of

1. Verify the ***Create Template*** dialog box is open.
2. Open the folder ***4 – Components > Aggregate Bases > Shoulders***.
3. **<D> <D>** on the **ABC_Outside_Shoulder** component.



4. **<D> <D>** on the **ABC_Hinge-Top** point.
5. In the **Point Properties** dialog box, notice that this point has both a ***Horizontal*** and ***Slope*** constraint.

6. Change the ***Slope*** constraint to **None** and **<D> Apply**. This will allow the point to move up and down independent of any other point.



Point Properties

Name: ABC_Hinge-Top

Feature Name Override: ABC_Hinge-Top □

Surface Feature Style: D_HINGE

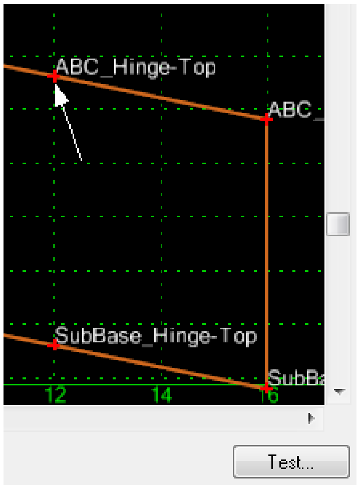
□ Alternate Surface:

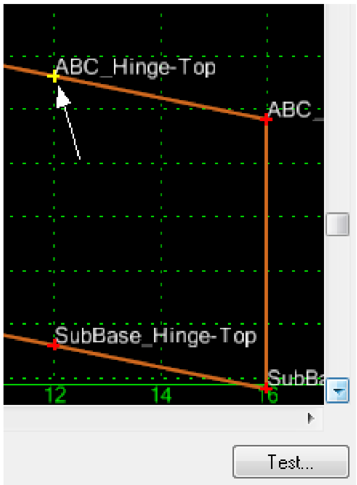
Member of: ABC_Outside_Shoulder

Constraints

7. **<D> Close**.

8. Notice in the ***Create Template*** view window how the point symbol (+) changes from red to yellow. This color change means the point has changed from fully constrained to partially constrained.





9. **<R>** on the **ABC_Hinge-Top** point and select **Move Point** from the menu.

Note: The ***Move Point*** command will not appear in the menu if the point is fully constrained.

10. Because the point still has a ***Horizontal*** constraint, it will only move up and down while maintaining the 12 foot offset from the constraint point, ***ABC_Shoulder-Top***.

11. **<R>** to exit the **Move** command.

12. **<D> <D>** on the **Subbase_Hinge-Top** point.
13. Notice that ***Subbase_Hinge-Top*** is constrained both horizontally and vertically to ***ABC_Hinge-Top***. Therfore, if ABC_Hinge-Top moves, Subbase_Hinge-Top will follow according to what is entered in the constraint ***Value:*** field. The next few step will demonstrate how this works.
14. **<D> Close**.
15. **<R>** on the **ABC_Hinge-Top** point and select **Move Point** from the menu.
16. Notice how the point ***Subbase_Hinge-Top*** stays 0.5 feet directly below point ***ABC_Hinge-Top.*** This is because the point has a ***Horizontal*** constraint of **0** and a ***Vertical*** constraint of **-0.5**. from ABC_Hinge-Top.
17. **<R>** to exit the **Move** command.

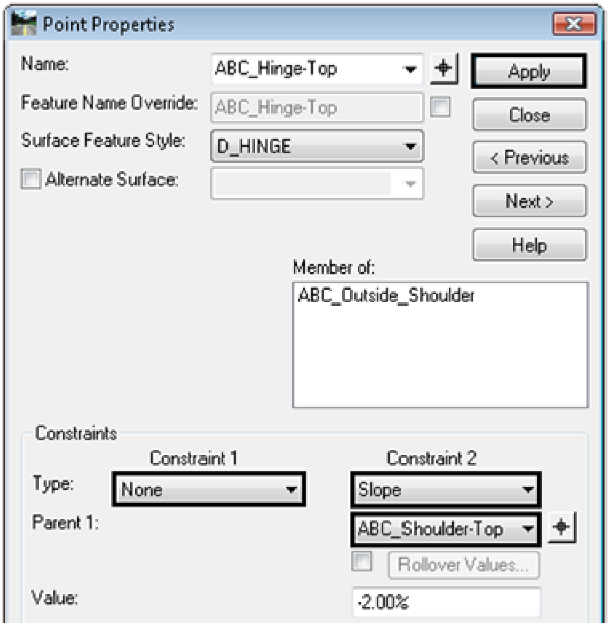
    The point ***ABC_EOP-Top*** is also fully constrained by ***ABC_Hinge-Top.*** The difference with this point it that it that the second constraint is by ***Vector-Offset*** instead of Vertical.

18. **<D> <D>** on the **ABC_EOP-Top** to look at the ***Vector/Offset*** constraint.
19. Notice that this type of constraint uses two parent points instead of one. The slope between the two parent points determines the “vector” at which the point will be placed.
20. **<D> Close**.
21. Move the point ***ABC_Hinge-Top*** again and notice how the point ***ABC_EOP-Top*** moves with it. The ***Vector/Offset*** constraint forces the point ***ABC_EOP-Top*** to maintain the same slope defined by ***ABC_Shoulder-Top*** and ***ABC_Hinge-Top.***
22. **<R>** to exit the **Move** command.

The next few steps demonstrate how ABC_Hinge-Top behave with a vertical constraint and without a horizontal constraint.

23. **<D> <D>** on the **ABC_Hinge-Top** point.
24. Change the **None** constraint back to **Slope.**

25. Set the **Parent 1** to ***ABC_Shoulder-Top*** and change the **Horizontal** constraint to **None**.



Point Properties

Name: ABC_Hinge-Top

Feature Name Override: ABC_Hinge-Top □

Surface Feature Style: D_HINGE

□ Alternate Surface:

Member of: ABC_Outside_Shoulder

Constraints

	Constraint 1	Constraint 2
Type:	None	Slope
Parent 1:		ABC_Shoulder-Top
		□ Rollover Values...
Value:		-2.00%

26. **<D> Apply**.

Note: When you click ***Apply***, the two constraints will switch places. This is because the ***None*** constraint will always end up as ***Constraint 2***.

27. **<D> Close**.

28. **Move the point ABC_Hinge-Top** again an notice that now the point only moves to teh left and right. The ***Slope*** constraint forces it to maintain a -2.0% slope from the point ***ABC_Shoulder-Top***.

29. **<R>** to exit the **Move** command.

30. Reset the point ***ABC_Hinge-Top*** back to its original setup. **<D> <D>** on the point, change the **None** constraint back to **Horizontal**, and set **Parent 1:** to ***ABC_Shoulder-Top.***

31. **<D> Apply**.

32. **<D> Close**.

Chapter Summary:

- Use a simple component to quickly generate an unconstrained closed shape. *Lab 7.1 -Build A Simple Component* showed how to modify point names in using the Point Properties dialog.
- The next lab, *Lab 7.2 -Build a Constrained Component*, demonstrated how to create a constrained component from scratch using the Dynamic Settings dialog box and various methods for the key-in.

- *Lab 7.3 -Build an End Condition Component* explored the special features of an end condition component. For end condition components there are additional options in the Dynamic Settings dialog box which determine how end condition points in relation to a target.
- In *Lab 7.4 -How Point Constraints Work* several constraint options were explored including Horizontal, Vertical and Vector-Offset. This lab demonstrated how changing the constraint method affects the points position and how points react to the Parent it is constrained to.