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**Chapter 17**

**Roadway Designer**

**Paved Approach**

**Design**

17.1 Group Exercise: Paved Approach Design..... 17-1



### 17.1 Group Exercise: Paved Approach Design

Designing an approach can be a complex and iterative process. There are an abundance of criteria to consider such as min/max slopes, stopping sight distance, drainage and R/W constraints – just to name a few.

There are many techniques in Roadway Designer that can be used to model an approach. This presentation will cover the workflow used to model a Paved Approach.

#### Project Review: Paved Approach – Bighorn 2+97.99 RT

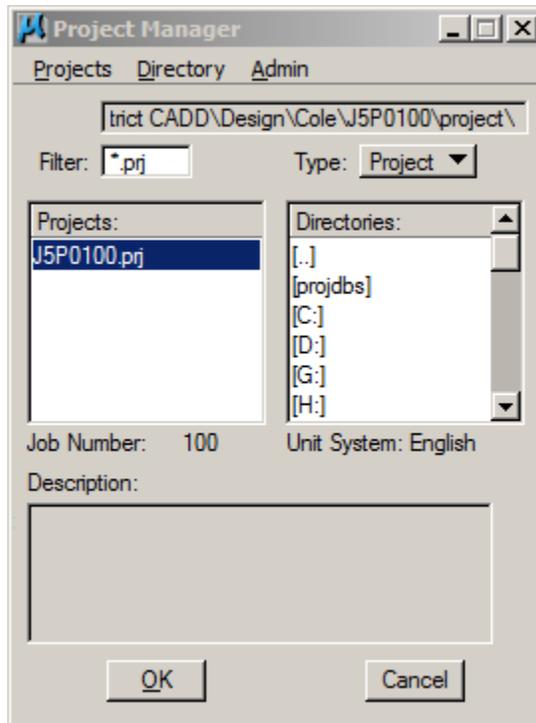


- 1) Open the **plan.dgn**.

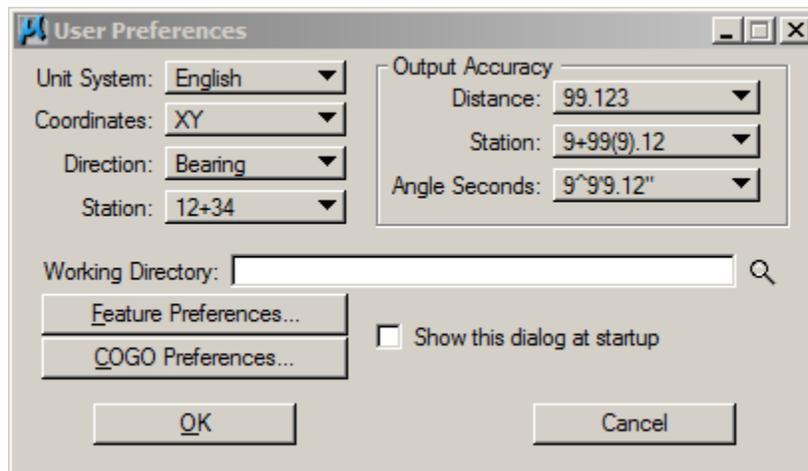
Review the plan graphics for the approach at **Bighorn Drive 2+97.99 Right**

2) Using **Project Manager** open the following project:

pw:\District CADD\Design\Randolph\J5P0100\project\J5P0100.prj



3) Change the project preferences to the following:.

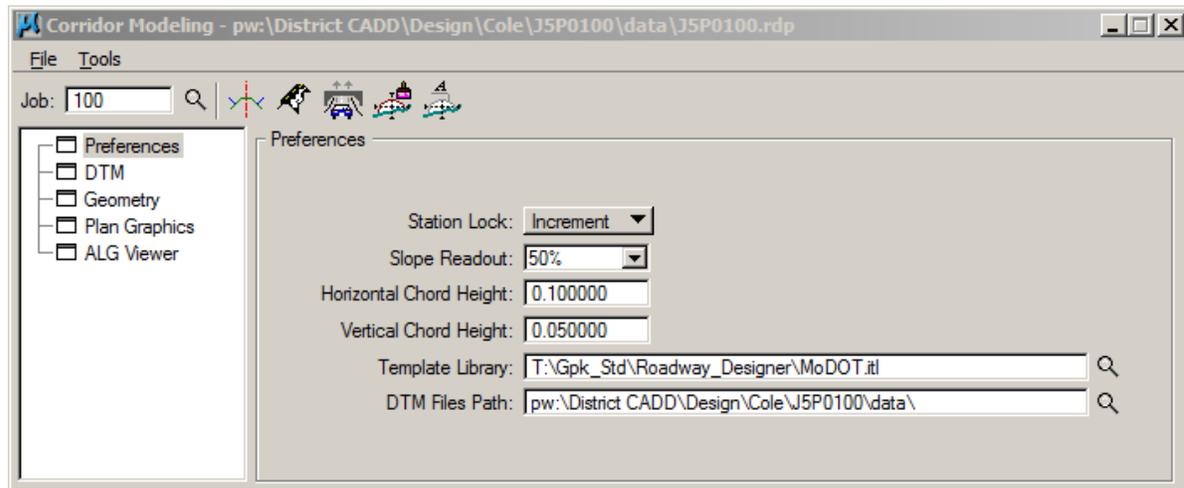


4) Select **ClsUser** as the project user.

5) From the GeoPak Road Tool Palette, select **Corridor Modeling**:



6) Verify and/or set the following settings in the **Preference** section:



Select **File > Save As** and save the preferences as **J5P0100.rdp**

7) In **Corridor Modeling DTM** section, import the J5P0100 tin.

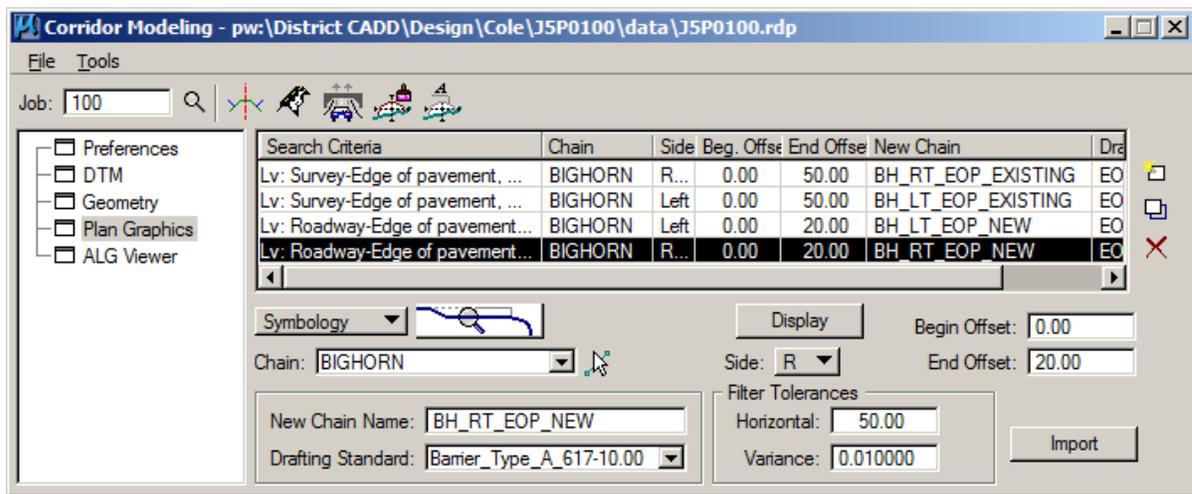
8) In the **Corridor Modeling > Geometry** section, import the **Bighorn** chain and **BighornEx** profile.

Use a Drafting Standard of **MoDOT\_Proposed\_Baseline**

9) In **Corridor Modeling** import the following **Bighorn** plan graphics:

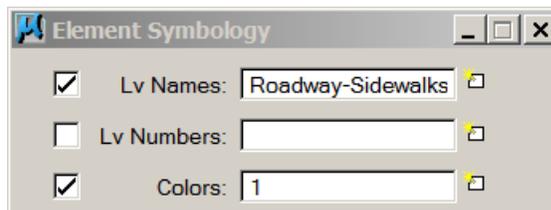
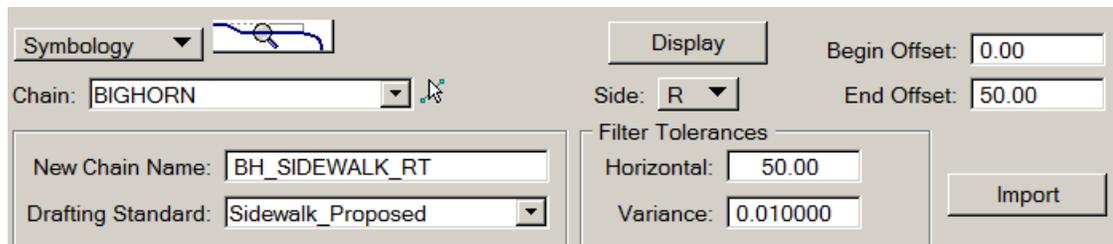
- Remember in order to import plan graphics you have to be in the file that contains the plan geometry. Existing items are located in the topo.dgn, proposed items are located in the Plan.dgn.

<u>Plan Graphic</u>	<u>New Chain Name</u>	<u>Drafting Standard</u>
Right Existing EOP	BH_RT_EOP_EXISTING	EOP Existing
Left Existing EOP	BH_LT_EOP_EXISTING	EOP Existing
Right New EOP	BH_RT_EOP_NEW	EOP New
Left New EOP	BH_LT_EOP_NEW	EOP New



Save the **Corridor Modeling** settings to a file called **J5P0100.rdp**

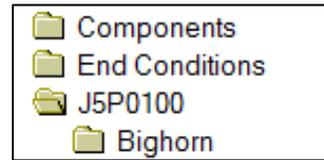
10) Also in **Corridor Modeler** import the right Bighorn Sidewalk line and call the new chain **BH\_Sidewalk\_RT**.



11) Open the **Create Template** dialog and save the file to your data folder calling the file **J5P0100.itl**.

12) In the **Create Template** dialog create the following directory structure:

**J5P0100 > Bighorn**



13) In **Create Template** dialog copy the **Slope Correction Widening with No Overlay** from the MoDOT section of the Template Library into the Bighorn folder.

Delete the Right Shoulder and End Conditions and reconstruct the right side using the following:

**Components:**

**Right Side**

Curb and Gutter Type B – 609-10.52  
Sidewalk Surface

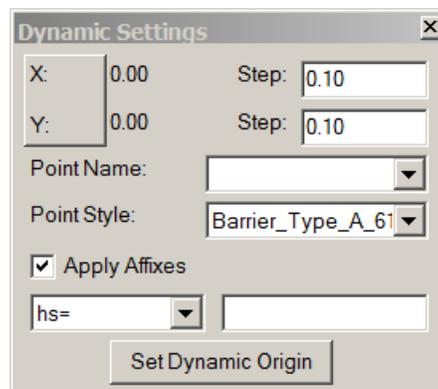
**End Conditions:**

**Right Side**

Ditch 1  
Fill Slope Combined

\*Notes

- a) Use Dynamic Settings, set the Step to 0.1 and toggle on Apply Affixes
- b) Check Priorities on End Conditions.
- c) Save and close the Template Library.



14) Back in **Corridor Modeling** set the Template Library File to the **J5P0100.itl** located in your data folder.

Save the **Corridor Modeling** settings.

15) Open **Roadway Designer** and create a corridor named “Bighorn” using the Bighorn chain and BighornEx profile.

16) In **Roadway Designer** go to **Corridor > Template Drops** and apply the **Slope Correction Widening with No Overlay** template to the Bighorn corridor.

Station 1+90.15  
Interval 50ft

17) In **Roadway Designer** go to **Corridor > Display References** and display the following three (Plan Graphic) alignments.

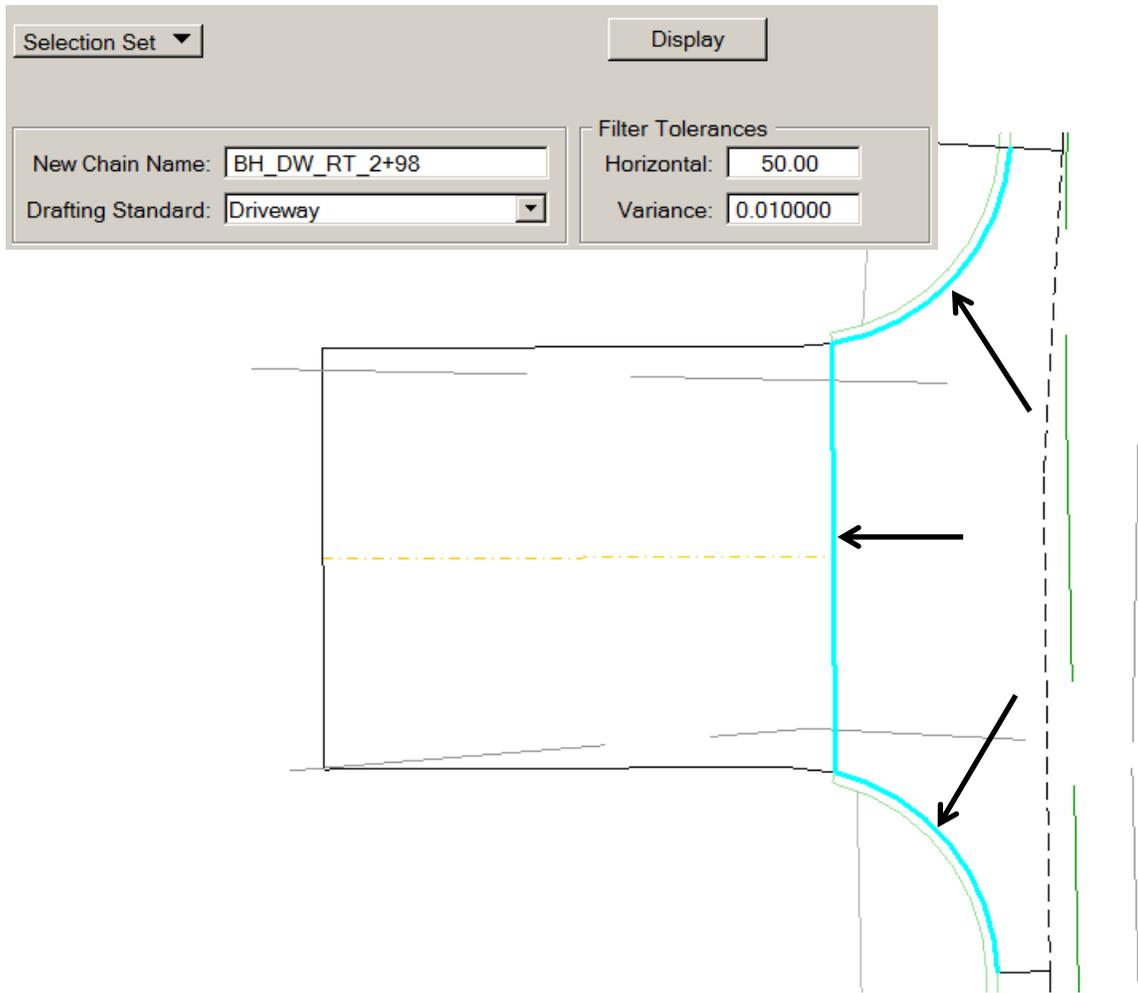
Display References:		
	Name	Right of Way
Alignment	BH_RT_EOP_EXISTING	True
Alignment	BH_RT_EOP_NEW	True
Alignment	BH_Sidewalk_RT	True

18) In **Roadway Designer** review the sections.

19) Save the Roadway Designer settings as **J5P0100.ird**.

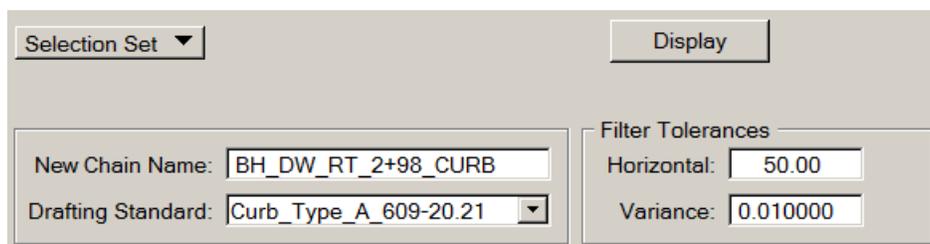
20) Close **Roadway Designer**

21) In **Corridor Modeler** import the following Plan Graphic along Bighorn at station 2+98 using the Section Set method and call the new chain **BH\_DW\_RT\_2+98**.



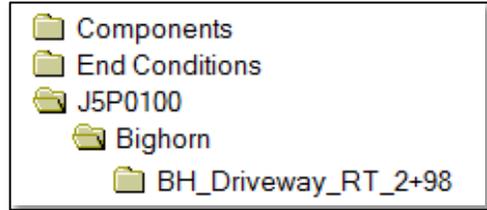
Note - The stationing of this alignment will go from the bottom to the top.

22) Also in **Corridor Modeler > Plan Graphics** import the two radius return curbs and call the new chain **BH\_DW\_RT\_2+98\_CURB**.



23) In the **Create Template** dialog create the following directory structure:

**J5P0100 > Bighorn > BH\_Driveway\_RT\_2+98**



24) In **Corridor Modeler > Create Template** we are going to create a template called **Driveway Front** for the entrance pad portion of the Paved Approach with the following component and End Conditions:

First right click on the “**BH\_Driveway\_RT\_2+98**” folder and select **New > Template**

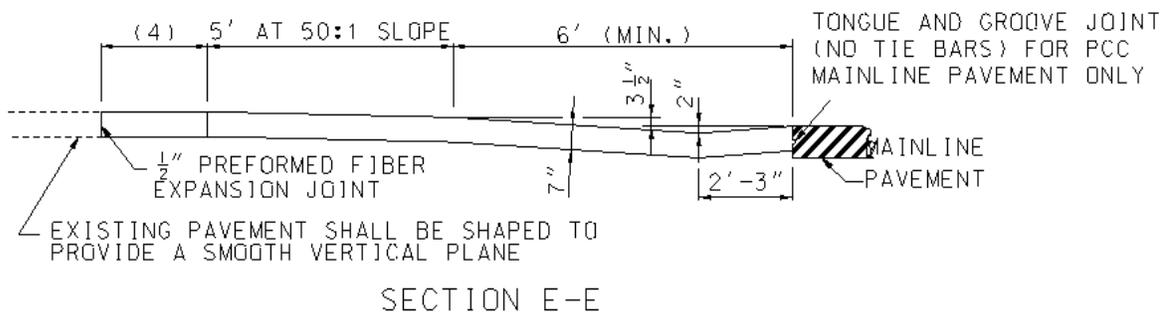
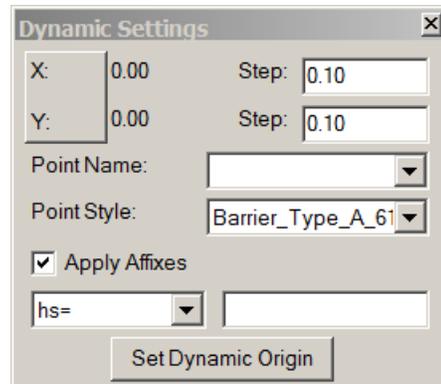
**Left Side:**

**Components:**

- Pavement layer 1 Concrete
- Pavement layer 1 Concrete
- Integral Curb Type A Over 6 inch 609-20.21
- Sidewalk Surface

**End Conditions:**

Fill Slope 2 (3:1)



\*Notes

- a) Use Dynamic Settings, set the Step to **0.1** and toggle on Apply Affixes
- b) Adjust the first pavement width to **2'-3"** with a **2"** slope (drop).
- c) Adjust the second pavement width to **3'-9"** with a **-12.22%** slope (rise).
- d) Adjust the Curb height to be **8"** (modify the “**Curb\_Surf\_Top\_L**” point)
- e) In the “**Pvmt\_Layer\_1\_Conc\_T11\_L**” point set the style constraint to “**Driveway**”
- f) Change the Sidewalk Width to 1ft.
- g) Save and close the Template Library.

25) Continuing in the same template, set up the following Component Display Rule to remove the Curb and Sidewalk when no Curb plan graphic is present:

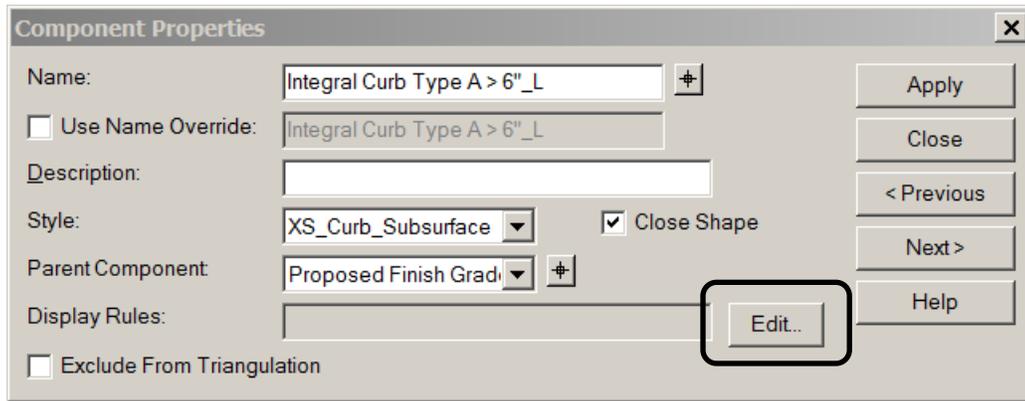
*Component Display Rules - This functionality allows you to apply one template that changes based on what is occurring at a particular station. It frees you from knowing where a change in conditions might require a different template and allows the rules within a template to make modifications.*

Before we setup the display rule we need to have a switch to either turn on the component if GeoPak sees a particular plan graphic style. To do this we will use a “Null Point”.

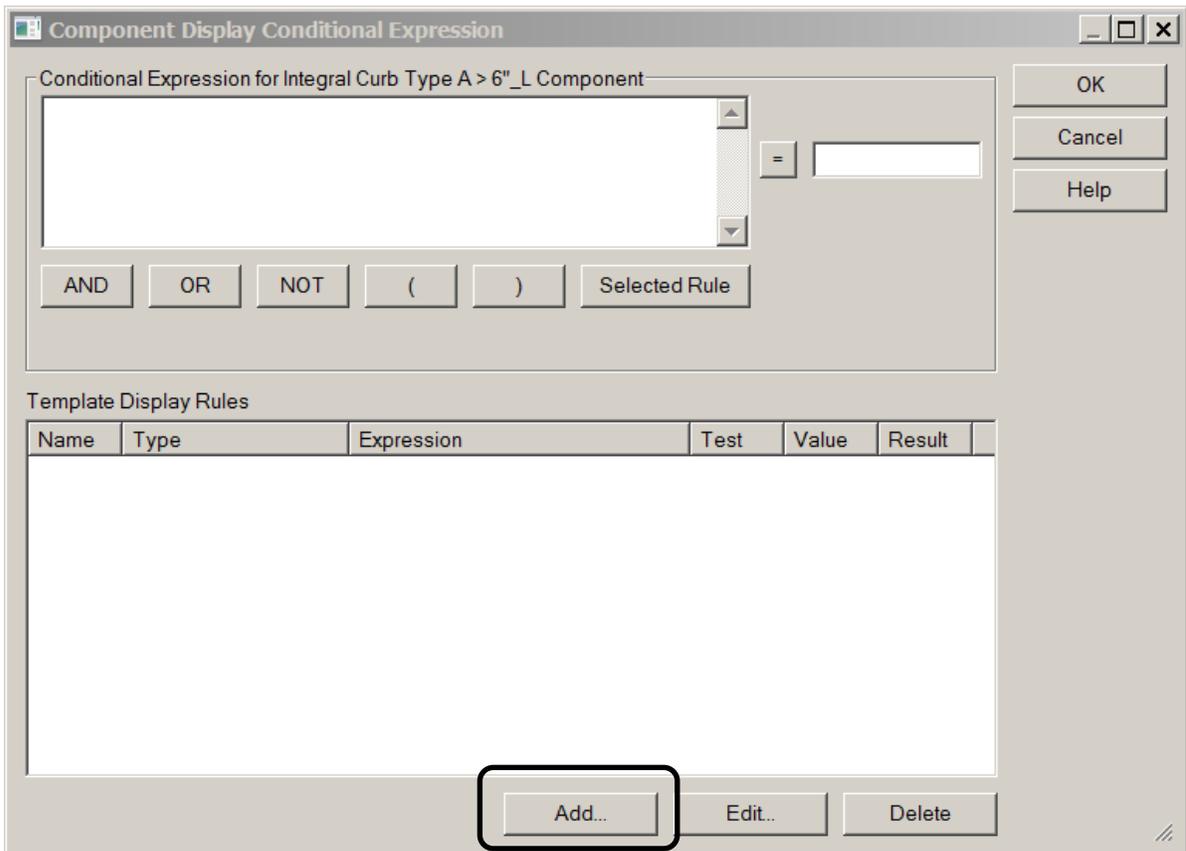
Right click and select “Add New Component” > “Null Point”. Place point 2-3 feet above the template origin.

26) Continuing with setting up the Component Display Rule.

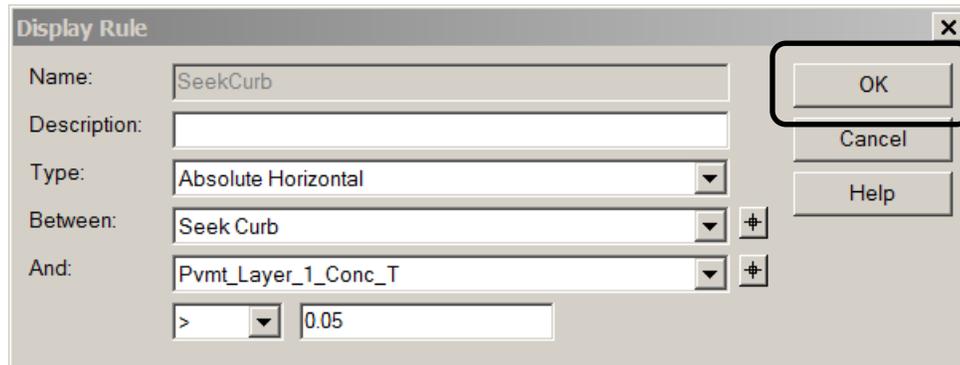
Double right click on the Integral Curb to open up the Component properties. Once open select **“Edit”** in the lower right hand corner of the dialog.



Select **“Add”**

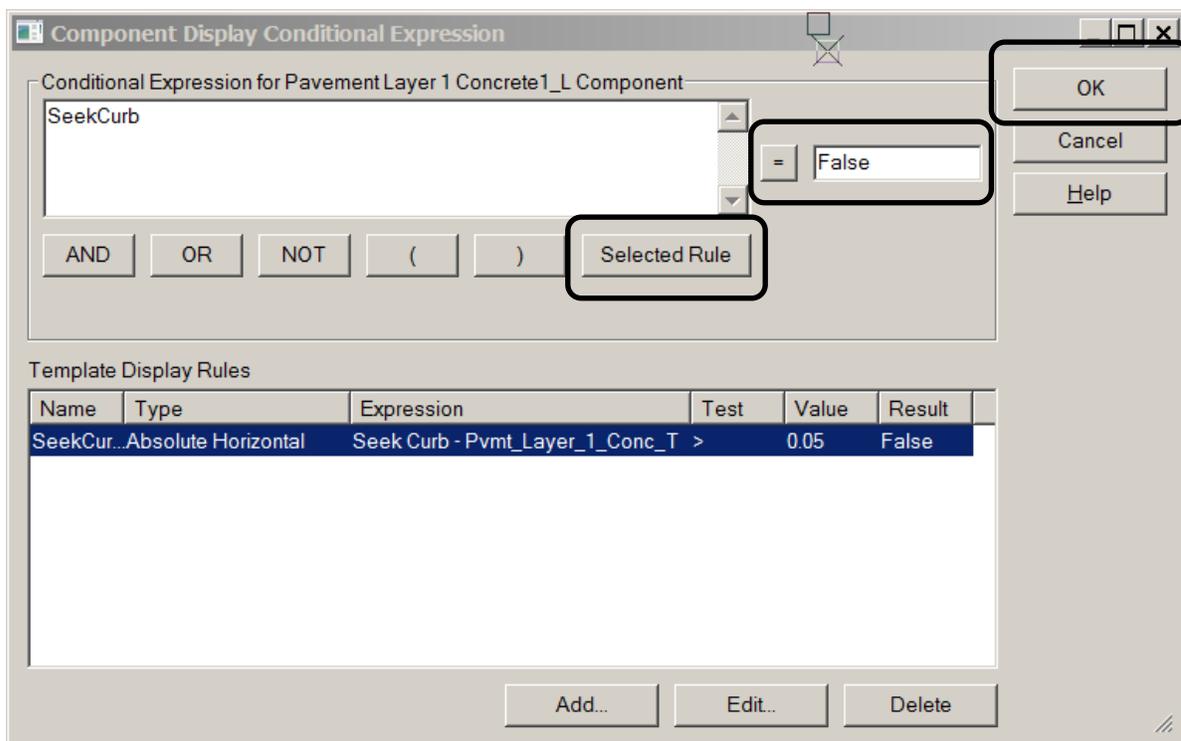


27) Set the Display Rule setting as follows:



Select “OK”

In the dialog below highlight the template Display Rule and select “Selected Rule”.



Click on the equals sign and the rule should equal “False”.

Select “OK” and “Apply” the changes to the component.

28) Back at the template the Curb should now be turned off since the SeekCurb null point is still sitting at the origin point.

Move the SeekCurb Null Point off the origin and the Curb should reappear.

29) To make the Curb surface, Sidewalk, and Fill Slope to all disappear with the Curb we need to make them all “Childs” of the Curb.

First make the Curb reappear by moving the “SeekCurb” null point off the origin.

Make the following Parent-Child relationships:

Parent	Child (edit this component)
Integral Curb Type A > 6" _L	Proposed Finish Grade_L
Integral Curb Type A > 6" _L	Sidewalk Surface_L
Sidewalk Surface_L	Proposed Finish Grade1_L
Sidewalk Surface_L	Fill Slope 2_L

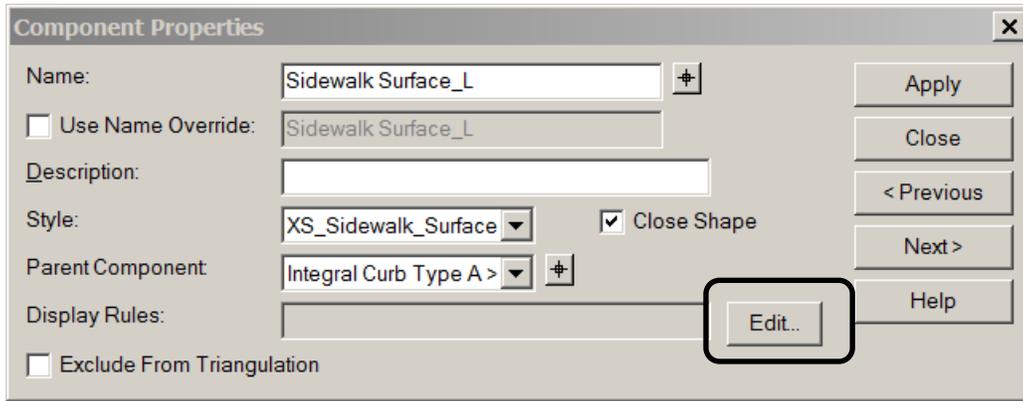
30) Continuing in the same template, another Component Display Rule needs to be set up to remove the Sidewalk when no Sidewalk plan graphic is present:

Before we setup the display rule we need to have a switch to either turn on the component if GeoPak sees a particular plan graphic style. To do this we will use a “Null Point”.

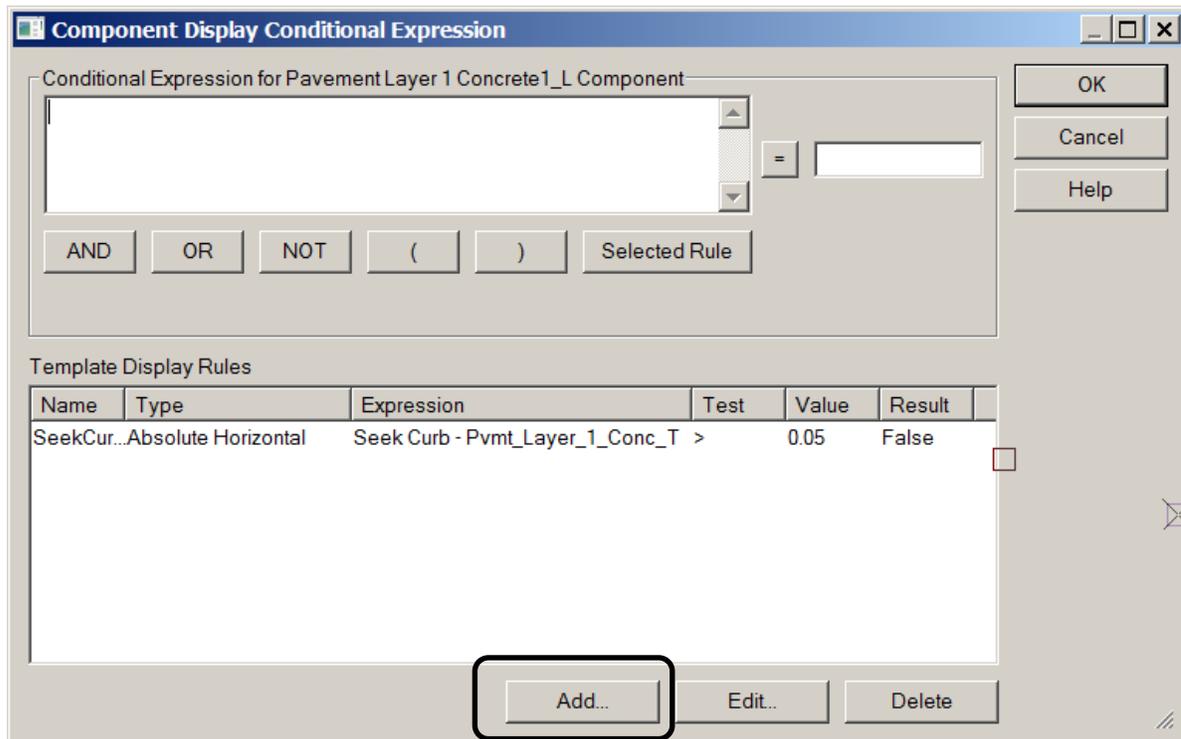
Right click and select “Add New Component” > “Null Point”. Place point 1-2 feet above the “SeekCurb” Null Point above the template origin.

31) Continuing with setting up the Component Display Rule.

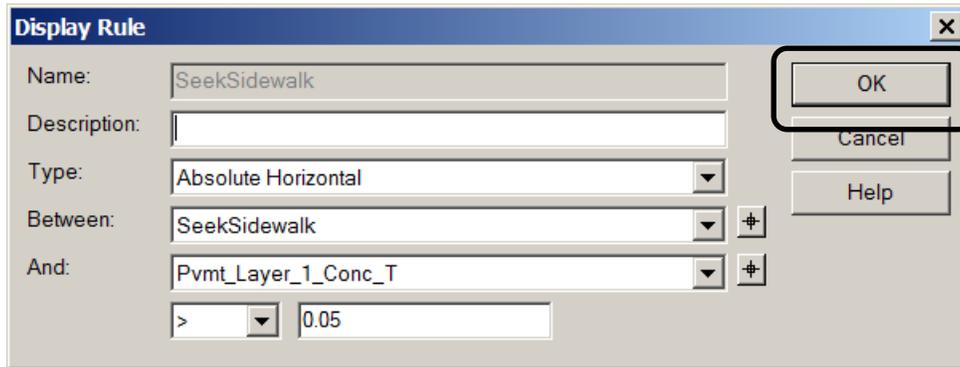
Double right click on the Sidewalk to open up the Component properties. Once open select “**Edit**” in the lower right hand corner of the dialog.



Select “**Add**”

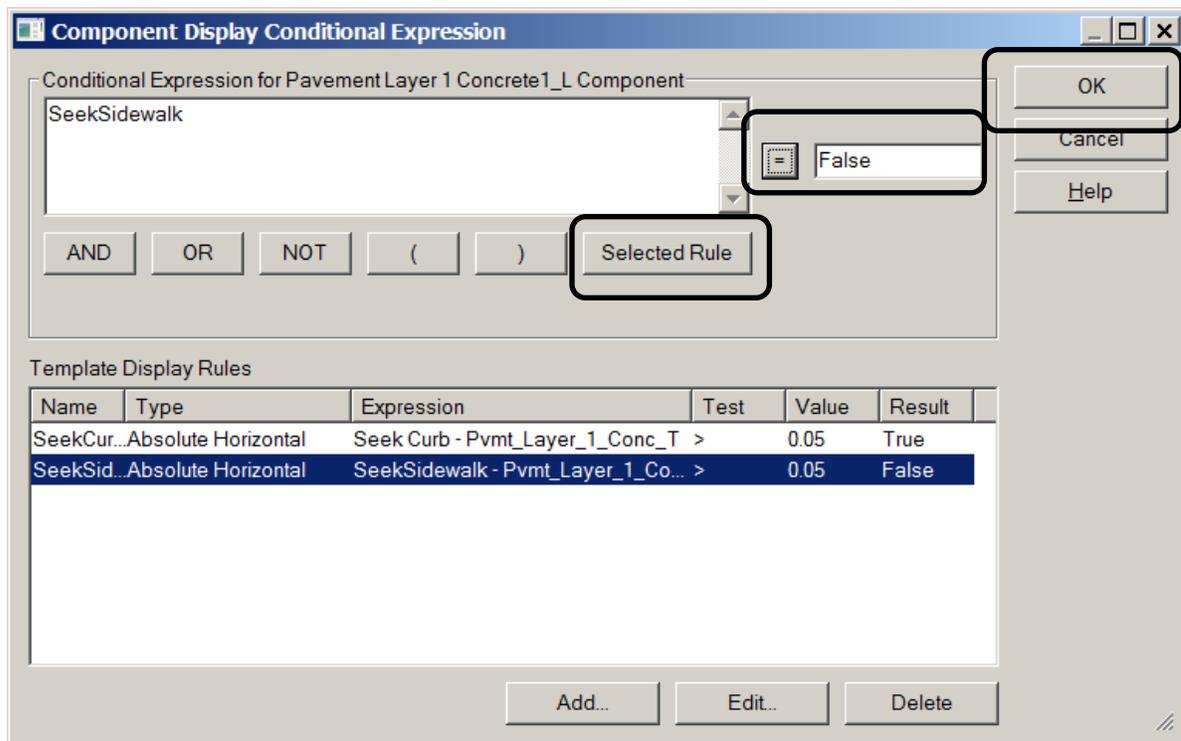


32) Set the Display Rule setting as follows:



Select “OK”

In the dialog below highlight the template Display Rule and select “Selected Rule”.



Click on the equals sign and the rule should equal “False” when the “SeekSidewalk” Null Point is above the template origin.

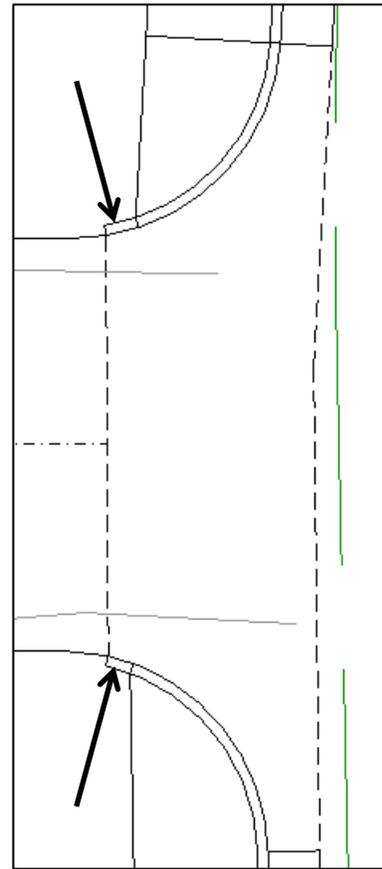
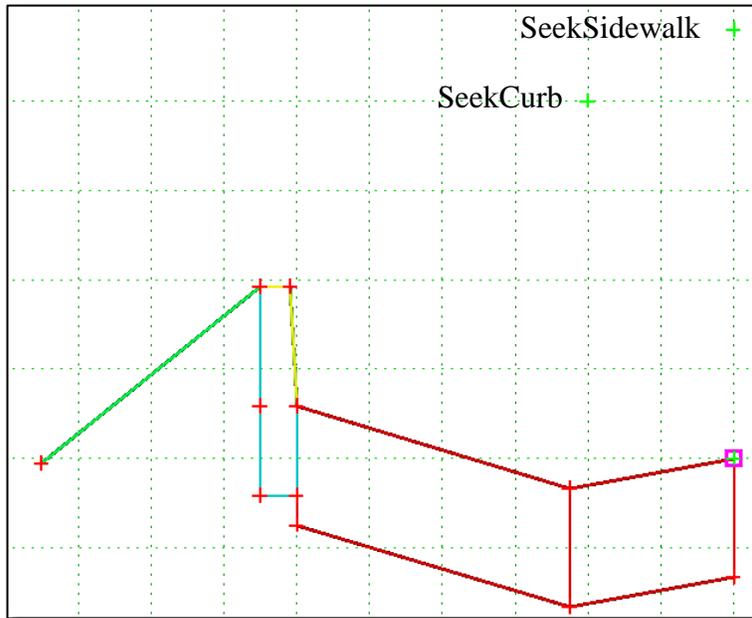
Select “OK” and “Apply” the changes to the component.

33) When no shoulder is present there needs to be an End Condition to tie to ground.

Add the following End Condition to the back of Curb

**End Conditions:**

Fill Slope 2 (3:1)



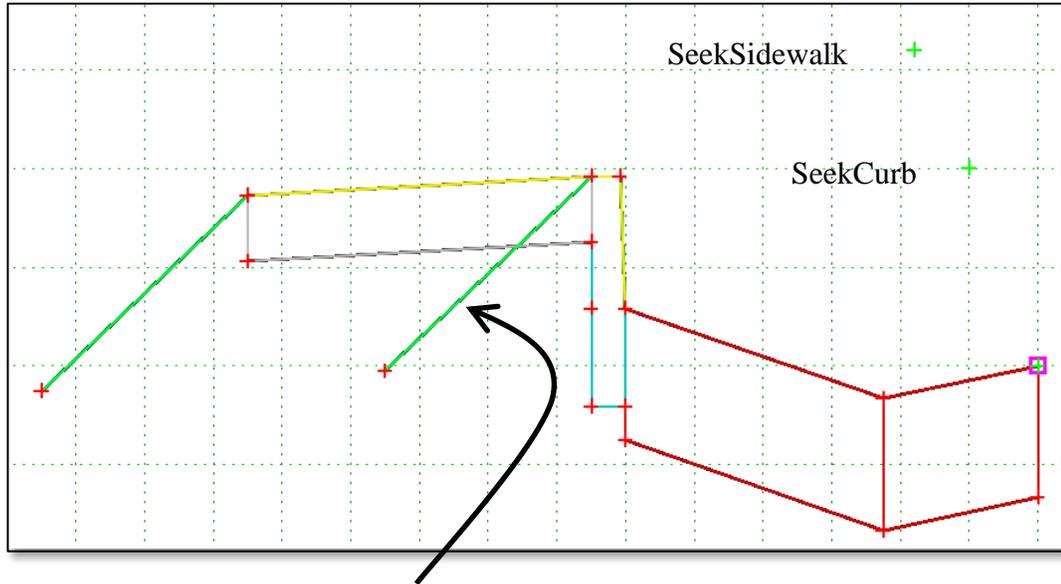
To make the Fill Slope disappear with the Curb we need to make it a “Child” of the Curb.

Make the following Parent-Child relationships:

Parent	Child (edit this component)
Integral Curb Type A > 6" _L	Fill Slope 2_L

34) Move both Null Points off the (X=0) template origin.

In this scenario we have two End Conditions. The display of the End Condition nearest the Curb needs to turn off when the sidewalk is displayed (sidewalk line is found).



Modify the Fill Slope 2 Display Rule to the following:

**Component Properties** ✕

Name:  Apply

Use Name Override:  Close

Description:

Style:  < Previous

Parent Component:  Next >

Display Rules:  Edit... Help

Exclude From Triangulation

---

**End Condition Properties**

Target Type:  Priority:

Surface:   Benching Count:

From Datum:

Step Elevation:

Offsets: Horizontal:  Vertical:  Rounding Length:

35) Move both Null Point above the template origin.

Save template Library.

36) Reopen **Roadway Designer** and create a corridor named “**BH\_DW\_RT\_2+98**” using the **BH\_RT\_EOP\_NEW** chain and **None** for the profile. Use the following station range:

Start Station: 18+17.01  
 End Station: 18+56.04

37) To set the vertical for this corridor, we are going to use a Point Control to tie to the Bighorn Edge of Pavement.

Corridor: BH\_DW\_RT\_2+98

Control Description: TIE TO BIGHORN EOP NEW

Point: Pvmt\_Layer\_1\_Conc\_

Mode:  Horizontal  Vertical  Both

Control Type: Corridor Point

Corridor: Bighorn

Reference Point: Pvmt\_Surf\_Conc\_T11

Station Limits: Start: 18+17.01, Stop: 18+56.04

Horizontal Offsets: Start: -0.01, Stop: -0.01

Vertical Offsets: Start: 0.00, Stop: 0.00

Priority: 1

Enabled	Priority	Name	Start Station	Stop Station	Mode	Type	Cont
X	1	Pvmt_Layer_1_Conc_T	18+17.01	18+56.04	Both	Corridor Point	Bigho

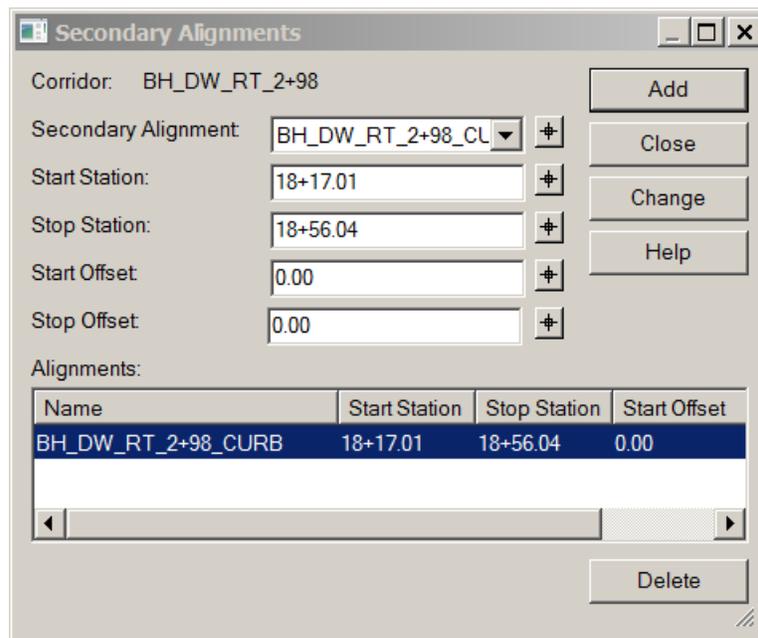
38) In **Roadway Designer** go to **Corridor > Template Drops** and apply the **Driveway Front** template to the **BH\_DW\_RT\_2+98** corridor.

Station 18+17.01  
Interval 0.5ft

39) In **Roadway Designer** go to **Corridor > Display References** and display the following two (Plan Graphic) alignments.

Display References:		
	Name	Right of ...
Alignment	BH_SIDEWALK_RT	True
Alignment	BH_RT_EOP_NEW	True

40) In **Roadway Designer** go to **Corridor > Secondary Alignments** and add in the following alignment.



41) In **Roadway Designer** review the sections.

42) Save the Roadway Designer settings as **J5P0100.ird**.

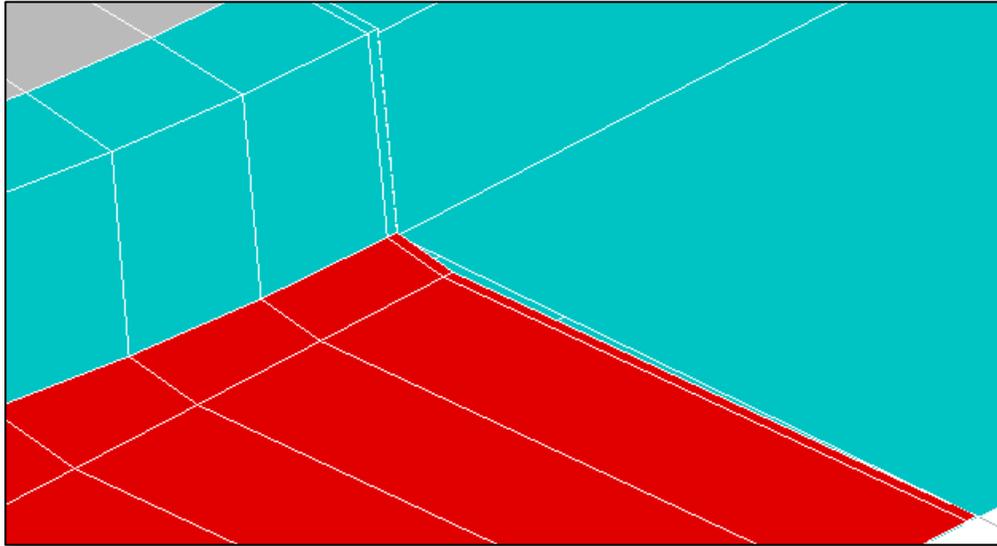
43) In **Roadway Designer** go to **Corridor > Create Surface** and create a model in the **DTM.dgn** file.

Review model in area of Bighorn and Paved Approach.

44) In the next few steps we are going to fix minor issues in the model.

See next page.

45) **Fix #1)** The Paved approach gutter does not match Curb and Gutter Section.



To fix this issue we are going to use a Parametric Constraint. We need to modify the points that control the slope of the Paved Approach. Change both to slope values and add in the following Labels for each.

Paved Approach 1 Slope = PA 1 SLOPE

Paved Approach 2 Slope = PA 2 SLOPE

Go to **Tools > Parametric Constrains**, and set the following values:

Corridor: BH\_DW\_RT\_2+98

Constraint Label: PA 1 SLOPE

Start Value: 7.41%

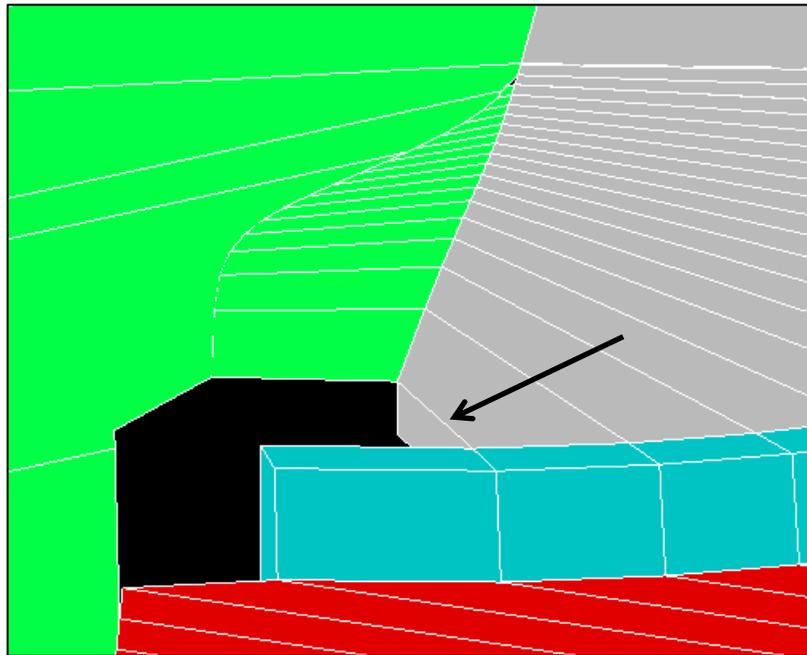
Stop Value: 7.41%

Station Limits: Start: 18+17.01, Stop: 18+56.04

Enabled	Name	Start Value	Stop Value	Start Station	Stop Station
X	PA 1 SLOPE	0.07	0.06	18+55.00	18+56.04
X	PA 2 SLOPE	-0.12	0.06	18+55.00	18+56.04
X	PA 1 SLOPE	0.06	0.07	18+17.01	18+18.00
X	PA 2 SLOPE	0.06	-0.12	18+17.01	18+18.00

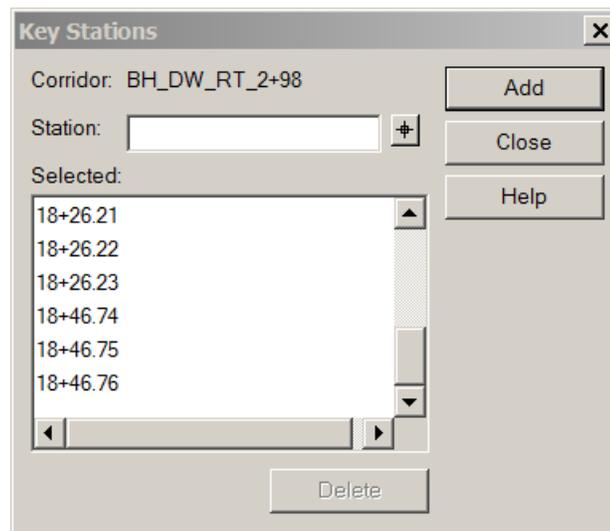
Rerun model to see if correction has been made.

46) **Fix #2)** Sidewalks have kink on back edge.



To fix this issue we are going to add in extra sections using the “**Key Station**” tool.

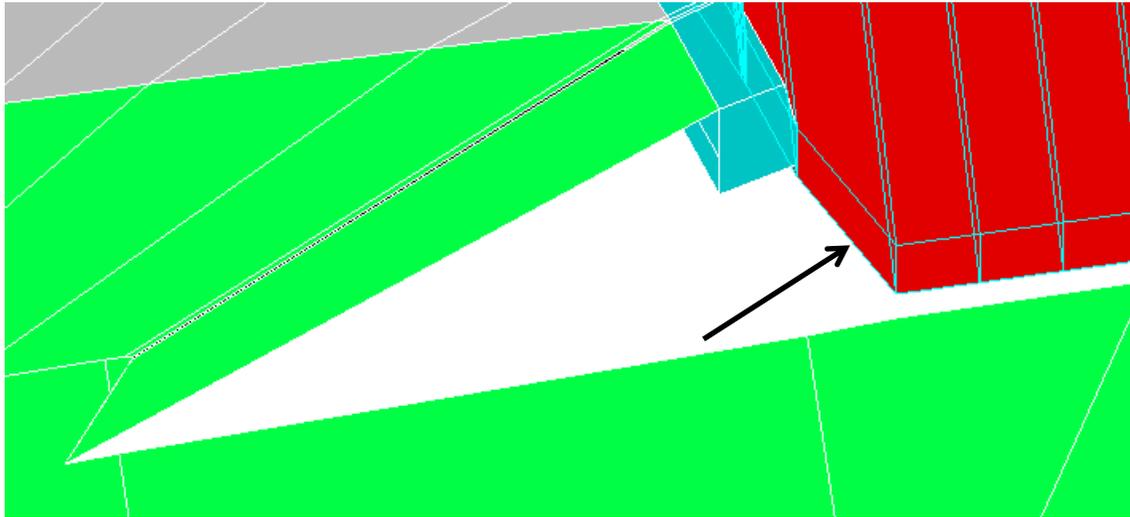
Go to **Corridor > Key Stations**, and set the following values:



Try getting the station information from Plan.dgn MicroStation file.

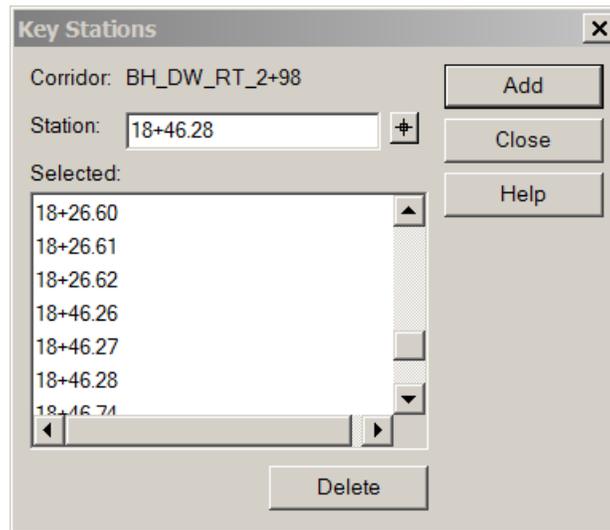
Rerun model to see if correction has been made.

47) **Fix #2)** Pavement has kink on back edge.



To fix this issue we are going to add in extra sections using the “**Key Station**” tool.

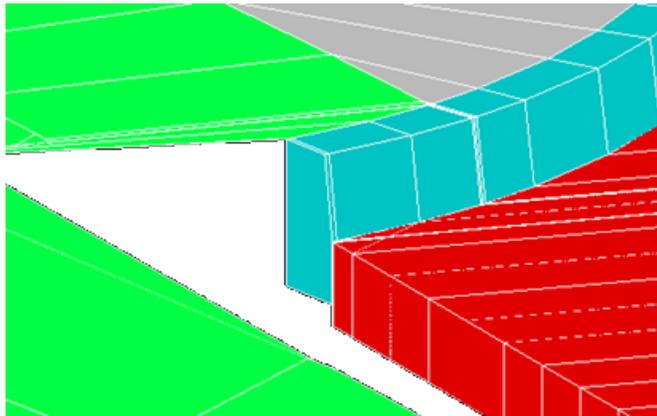
Go to **Corridor > Key Stations**, and set the following values:



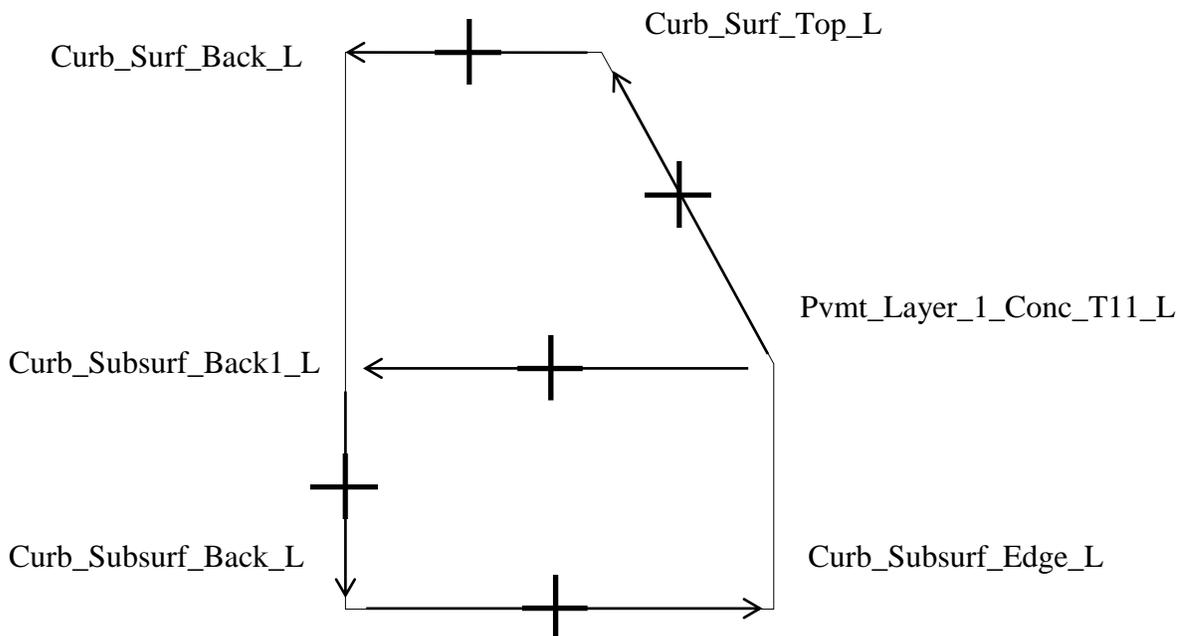
Try getting the station information from Plan.dgn MicroStation file.

Rerun model to see if correction has been made.

48) **Fix #3)** Curb should transition down to a Fill Condition only past the sidewalk line. To transition the template from a Curb to a Fill End Condition we are going to use a Parametric Constraint. But first before we can setup the parametric constrain we need to modify the constraints in the Curb. Open the template library and move the “Seek Curb” null point to edit curb.



Below is a diagram of the constraints applied in the Curb section of the template:

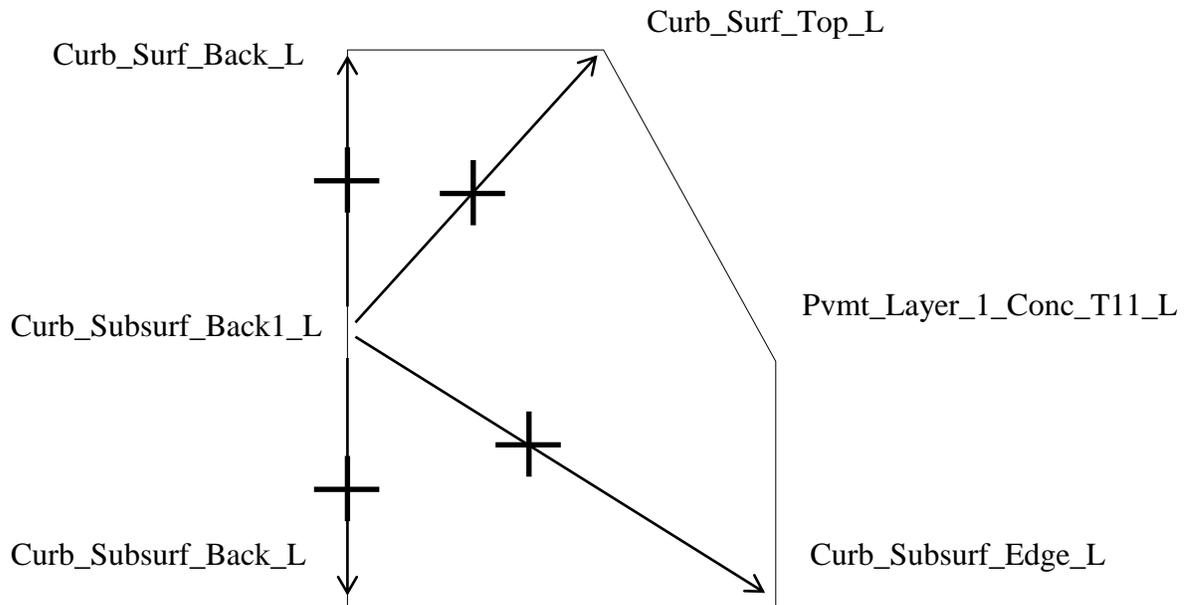


To make this template transition down from a Curb to just an End condition we will need to adjust the constraint.

49) Delete both Constraints on the following points:

Curb\_Surf\_Back\_L, Curb\_Subsurf\_Back1\_L, Curb\_Subsurf\_Back\_L, Curb\_Surf\_Top\_L, Curb\_Subsurf\_Edge\_L

Right Click and apply “**Full Constraints**” to the points in the direction of the arrows below:



50) Using a **Value Equation** modify the **Curb\_Surf\_Back\_L** vertical constraint as follows:

The image shows two software dialog boxes. The first is titled "Constraint 2" and has a dropdown menu set to "Vertical". Below it, a dropdown menu is set to "Curb\_Subsurf\_Back1\_L" with a plus sign icon to its right. A text box contains the value "0.67". A square box highlights the "=" button next to the text box. The second dialog box is titled "Value Equation" and contains the following text:  $=_{\$}(\text{Curb\_Subsurf\_Back\_L}) -_{\$}(\text{Pvmt\_Layer\_1\_Conc\_T11\_L}) = 0.67$ . Below this equation, there are three dropdown menus: "Horizontal Difference", "Curb\_Subsurf\_Back\_L", and "Pvmt\_Layer\_1\_Conc\_T11\_L", each with a plus sign icon to its right. At the bottom, there is a "Multiplier:" label followed by a text box containing "-1.34". On the right side of the "Value Equation" dialog, there are three buttons: "OK", "Cancel", and "Help".

51) Modify the **Curb\_Surf\_Top\_L** by switching “Horizontal” constraint to a “Slope” constraint as follows:

52) Using a **Value Equation** modify the **Curb\_Surf\_Top\_L** vertical constraint as follows:

53) Using a **Value Equation** modify the **Curb\_Subsurf\_Back\_L** vertical constraint as follows:

54) Modify the **Curb\_Subsurf\_Edge\_L** point by switching the Horizontal Constraint's parent point to the **Pvmt\_Layer\_1\_Conc\_T11\_L** point:

55) Modify the **Curb\_Subsurf\_Edge\_L** point by switching Vertical Constraint's parent point to the **Curb\_Subsurf\_Back\_L** point:

56) In order to adjust the curb width using a parametric Constraint we need to create a label for the point that controls the width of the Curb. In this case it will be the **Curb\_Subsurf\_Back1\_L** point.

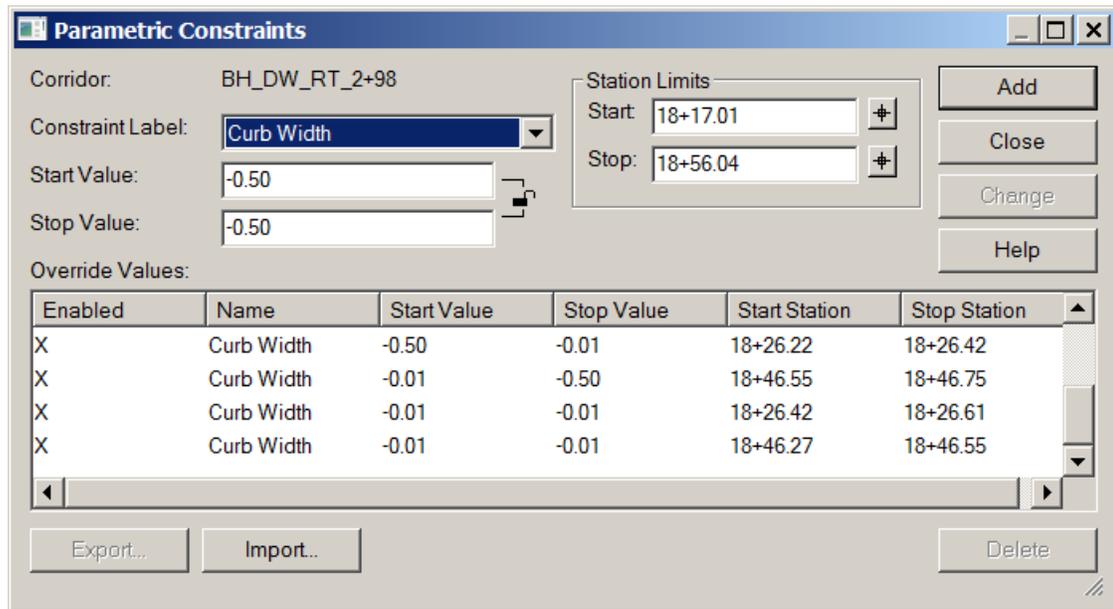
For that point use a label with the name of “**Curb Width**”

57) Move the “**Seek Curb**” point back over the origin and save the template Library.

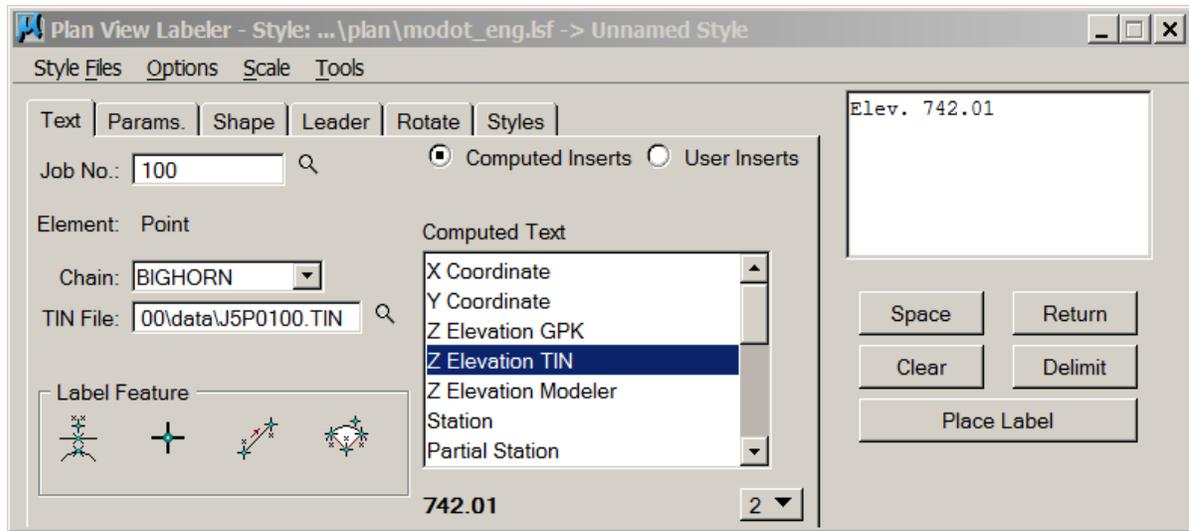
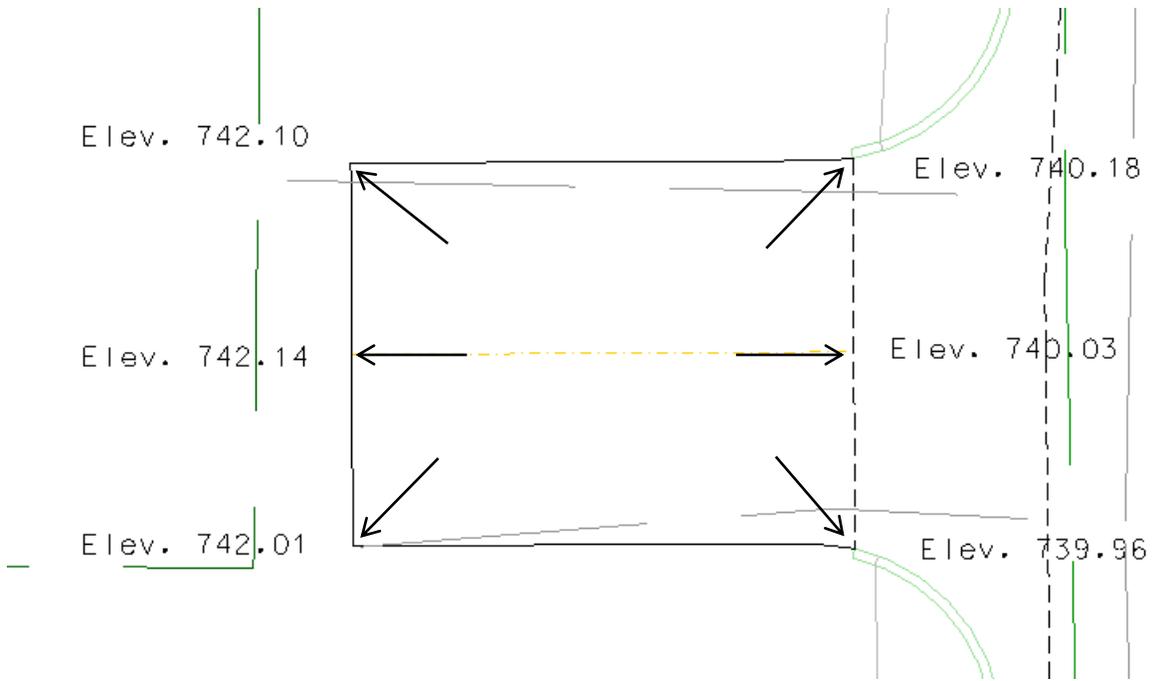
58) Back in Roadway Designer update the Template Drop by selecting “**Synchronize with Library**”.

59) Select **Tools > Parametric Constraints** and define the following override values:

<u>Start Station</u>	<u>End Station</u>	<u>Start Value</u>	<u>End Value</u>
18+26.22	18+26.42	-0.50	-0.01
18+26.42	18+26.61	-0.01	-0.01
18+45.55	18+46.75	-0.01	-0.50
18+46.27	18+46.55	-0.01	-0.01



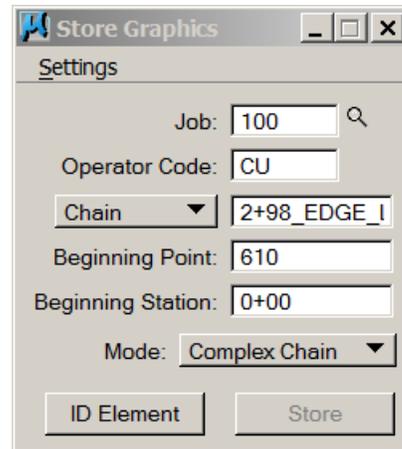
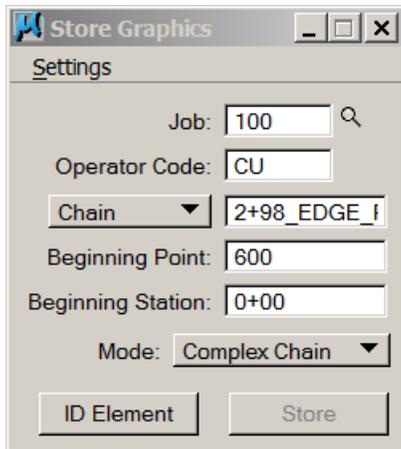
60) Using the **Plan View Labeler** tool and the **J5P0100.tin** extract elevation from the end of the Paved Approach. To get the elevations from the mid section of the Paved Approach use either the components view in the **dtm.dgn** model or the **proposed surface tin**.



61) Using the **Store Graphics** tool store two chains that represents the edges of the Paved Approach:

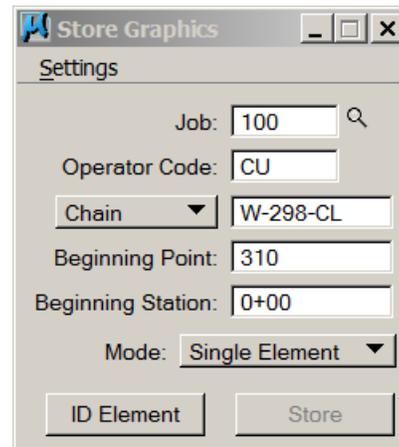
Job # 100  
 Operator Code CU  
 Chain Name 2+98\_EDGE\_RT  
 Beginning Point 600  
 Beginning Station 0+00

Job # 100  
 Operator Code CU  
 Chain Name 2+98\_EDGE\_LT  
 Beginning Point 610  
 Beginning Station 0+00



62) Using the **Store Graphics** tool now store a chain that represents the CL of the driveway:

Job # 100  
 Operator Code CU  
 Chain Name BH\_DW\_2+98\_CL  
 Beginning Point 310  
 Beginning Station 0+00



63) Using the **Vertical Alignment Generator** to create profiles for the two chains just stored using the elevation information extracted using the Plan View Labeler.

**2+98\_EDGE\_RT** (Use same name for profile)

<u>Station</u>	<u>Elevation</u>
0+00.00	742.10
0+26.26	740.18



**2+98\_EDGE\_LT** (Use same name for profile)

<u>Station</u>	<u>Elevation</u>
0+00.00	742.01
0+26.27	739.96

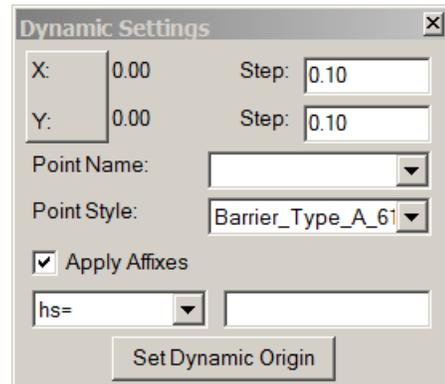
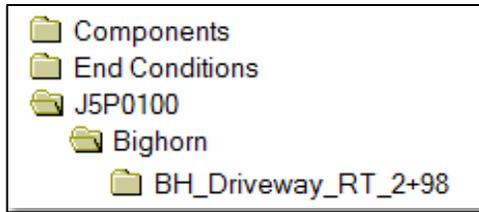
**BH\_DW\_2+98\_CL** (Use same name for profile)

<u>Station</u>	<u>Elevation</u>
0+00.00	742.14
0+26.25	740.03

64) In the **Corridor Modeling > Geometry** section, import the following chains and profiles:

<u>Chain</u>	<u>Profile</u>	<u>Drafting Standards</u>
<b>BH_DW_2+98_CL</b>	<b>BH_DW_2+98_CL</b>	<b>MoDOT_Proposed_Baseline</b>
2+98_EDGE_LT	2+98_EDGE_LT	EOP New
2+98_EDGE_RT	2+98_EDGE_RT	EOP New

65) In **Corridor Modeler > Create Template** we are going to create a template called “**Driveway Back**” for the back portion of the Paved Approach with the following component and End Conditions:



First right click on the “**BH\_Driveway\_RT\_2+98**” folder and select **New > Template**

**Left Side:**

**Right Side**

**Components:**

**Components:**

Pavement layer 1 Concrete

Pavement layer 1 Concrete

**End Conditions:**

**End Conditions:**

Fill Slope 2 (3:1)

Fill Slope 2 (3:1)

\*Notes

- a) Use Dynamic Settings, set the Step to **0.1** and toggle on Apply Affixes
- b) Adjust the pavement width to **8ft**
- c) Merge vertical pavement line
- d) Save and close the Template Library.

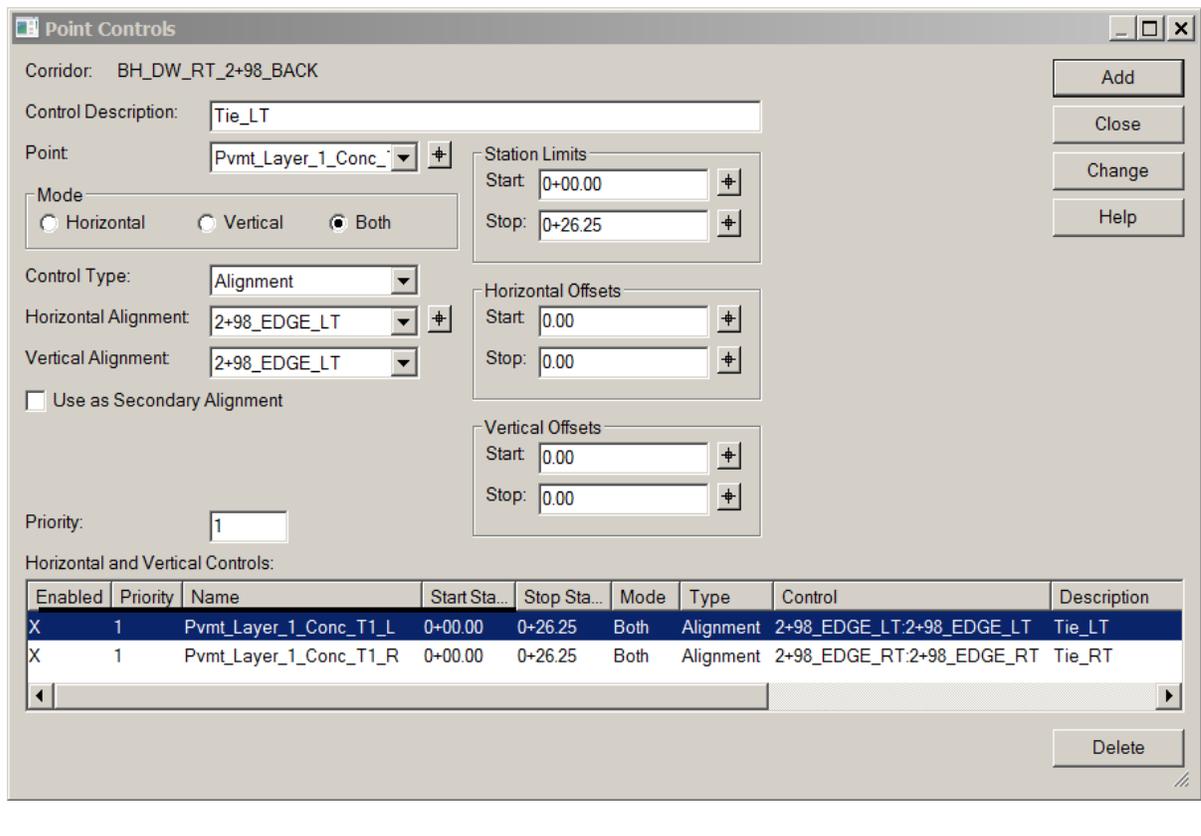
66) Reopen **Roadway Designer** and create a corridor named “**BH\_DW\_RT\_2+98\_BACK**” using the **2+98\_CL** chain and profile.

67) In **Roadway Designer** go to **Corridor > Template Drops** and apply the **Driveway Back** template to the **BH\_DW\_RT\_2+98\_BACK** corridor.

Station 0+00  
Interval 1ft

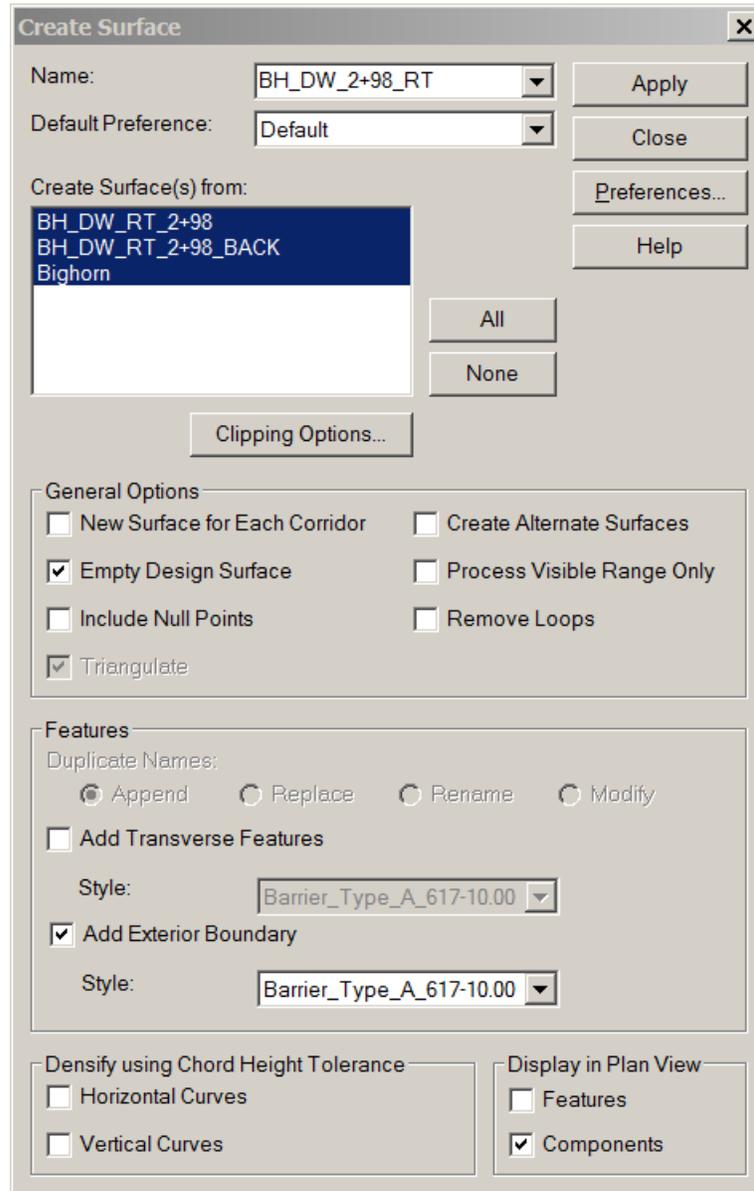
68) In **Roadway Designer** go to **Corridor > Point Control** and tie the edge of pavements to the two chains and profiles just created. Set up the point controls as follows:

Control Description	Point	Horz. and Vert. Alignment
Tie_LT	Pvmt_Layer_1_T1_L	2+98_EDGE_LT
Tie_RT	Pvmt_Layer_1_T1_R	2+98_EDGE_RT



69) Open the dtm.dgn file and from Roadway Designer select **Corridor > Create Surface**

Name: BH\_DW\_2+98\_RT  
 Create Surface from: BH\_DW\_RT\_2+98, BH\_DW\_2+98\_BACK, BIGHORN  
 Add Exterior Boundary: Checked On  
 Components: Check On



70) Select Apply to create the Paved Approach model.

Review Paved Approach model in dgn file.