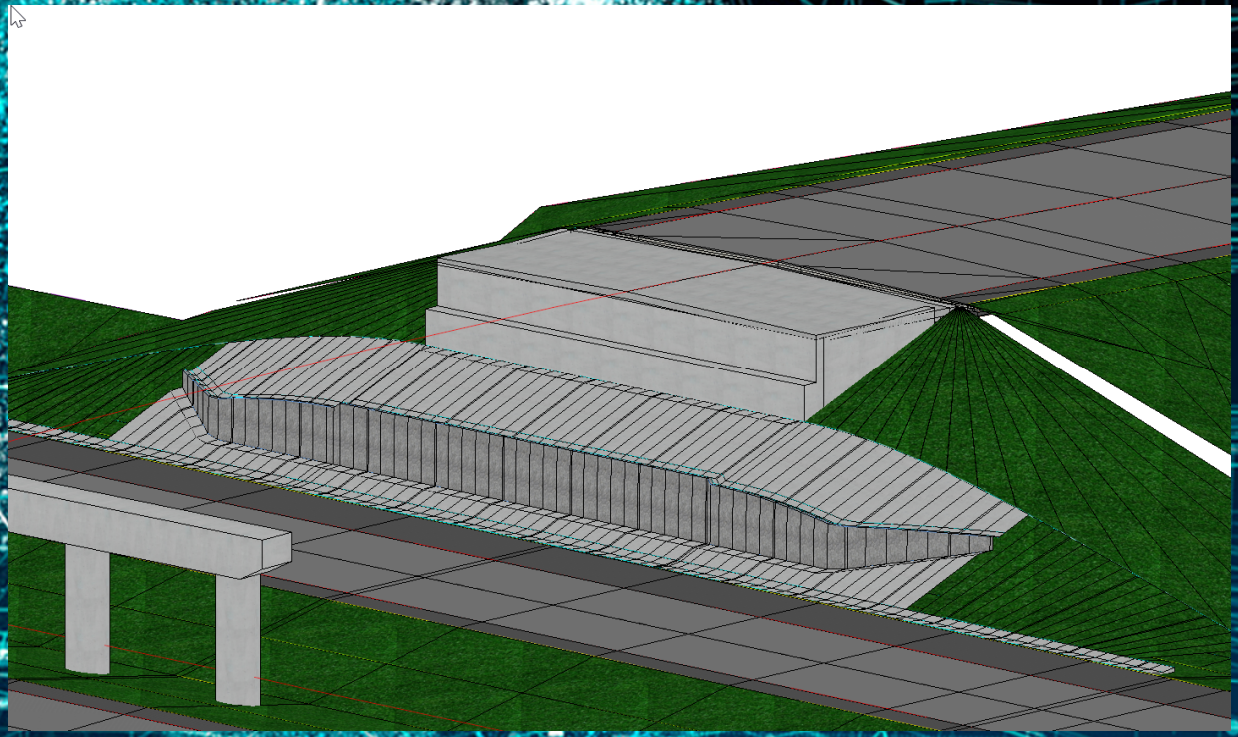
PARSONS

CDOT – ORD ADDITIONAL TRAINING



Workspace 10.10.01.03

Albert Herrera & Marc Bachand

09/14/2022

AGENDA

1. Introductions
2. Critical Design Limit (CDL) Template
3. Critical Design Feature (CDF) Template
4. Abutment Grading for Bridge Replacement Projects
5. Surface Treatment Methods and Templates
6. Widening Project Templates

INTRODUCTIONS

ALBERT HERRERA

- 21 yrs Experience (18 yrs w/ Parsons)
- Colorado Native (CSU Graduate)
- Denver Office (Roadway Design Manager)
- Parsons Mobility Solutions (80+ Employees)

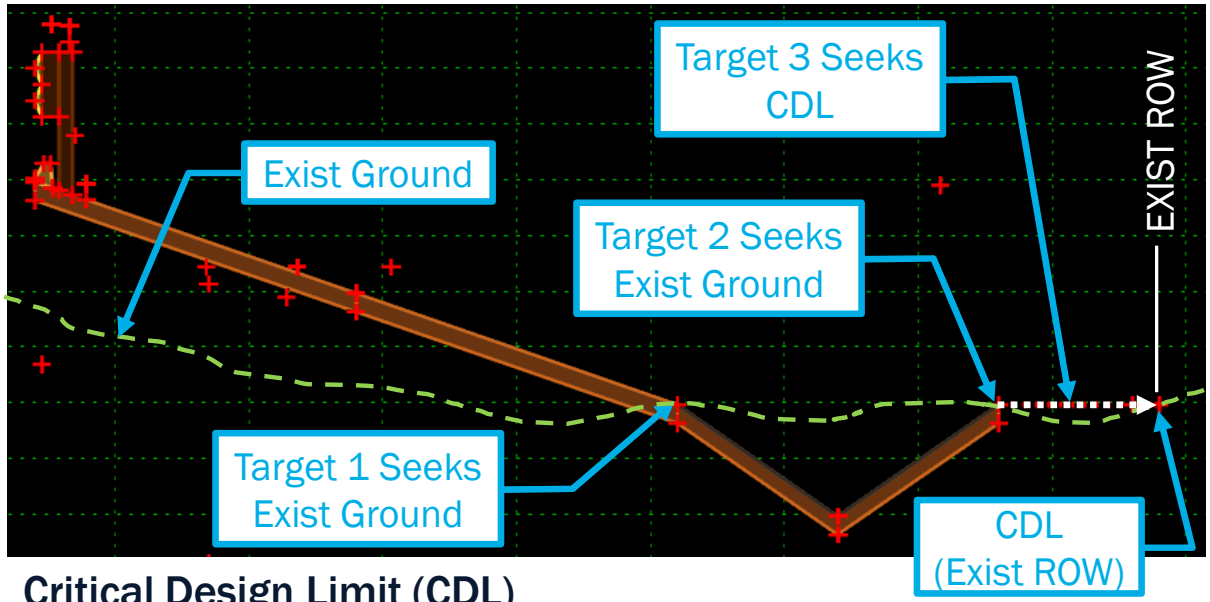
MARC BACHAND

- 22 yrs Experience (9 yrs w/ Parsons)
- Albany, New York
- Parsons XD Services Group
- Training, Support, & 3D Modeling Lead
- Bentley Premier Scholar

CRITICAL DESIGN LIMIT (CDL) TEMPLATE

CRITICAL DESIGN LIMIT (CDL)

Templates

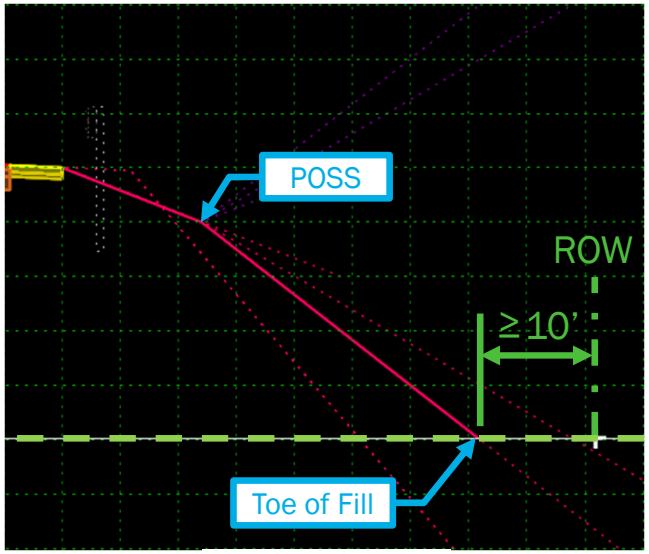


Critical Design Limit (CDL)

- Elements along a project that define boundaries/obstacles to design against:
  - Exist/Prop ROW
  - Bodies of Water
  - Roads/Railroads
  - Utilities
- Setting Template Targets using Target Aliasing to these type of CDL's will help automate the roadside slopes that are necessary based on solutions.
- Typical order of solutions include:
  - Clear Zone Slopes
  - Guardrail
  - Barrier
  - Retaining Wall

AUTOMATED CDL TEMPLATE

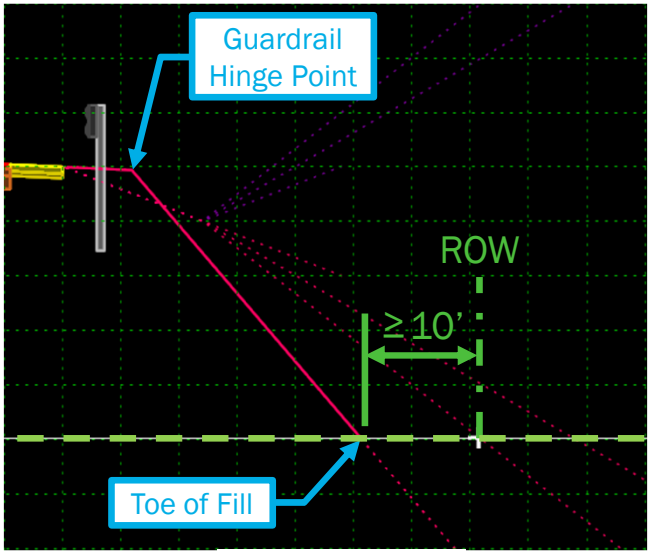
Based on ROW Location & Priorities (Combining multiple templates into one)



Solution 1

Clear Zone Slopes

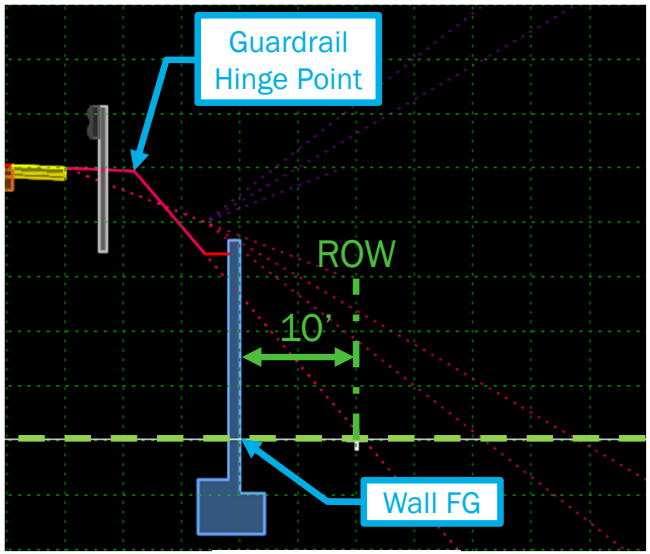
- Slopes vary between 6:1 to 3:1
- Toe of Fill provides 10’ Clear Zone to ROW



Solution 2

Guardrail w/ Slope

- Slope dependent on Geotech Analysis
- Toe of Fill provides 10’ Clear Zone to ROW



Solution 3

Guardrail w/ Wall

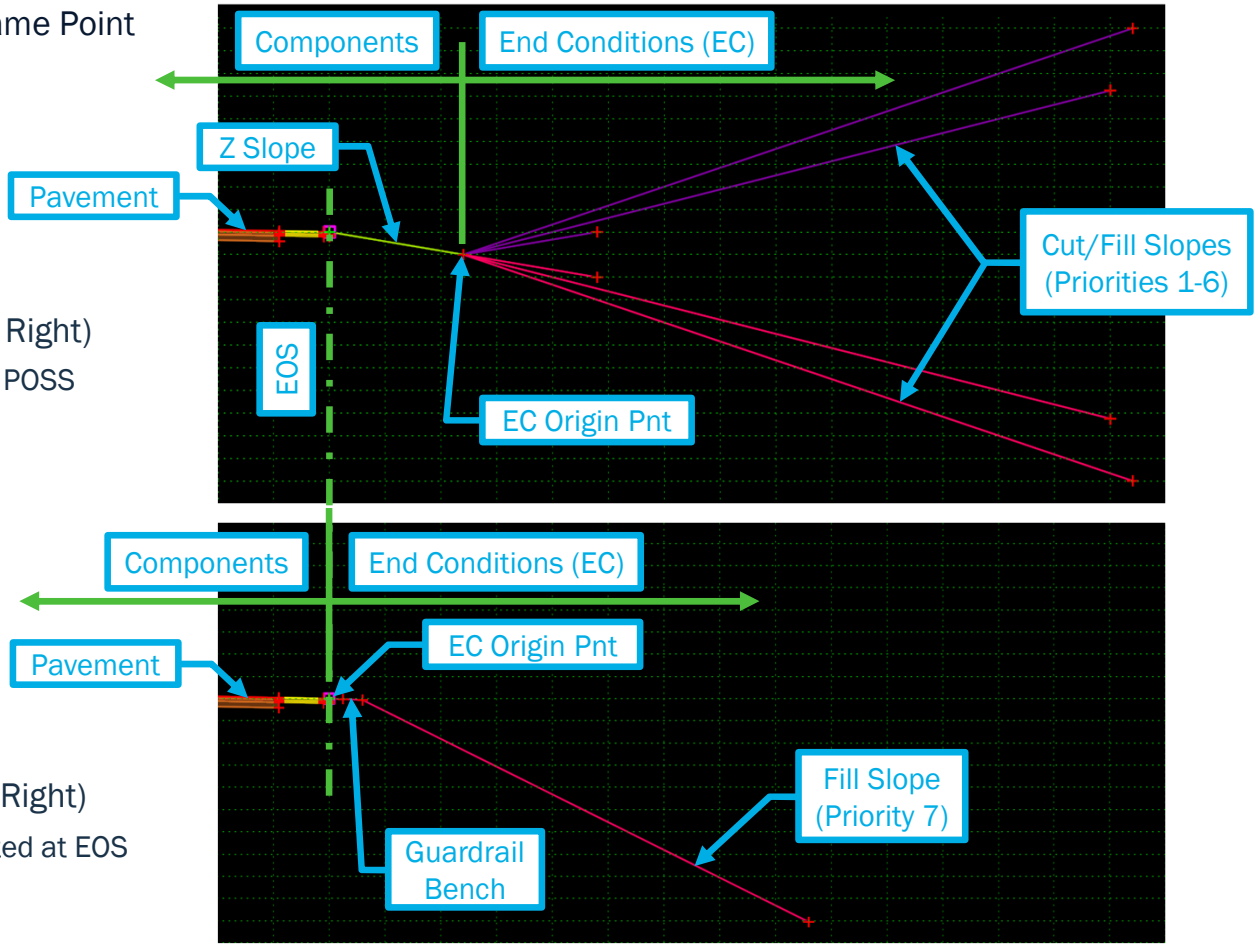
- Wall height varies dependent on ROW
- 10’ Clear Zone between Wall to ROW

4.7.6 Clearance from Slope to Right of Way Line

The minimum clearance from the right of way line to the catch point of a cut or fill slope should be 10 feet for all types of cross sections, but the desirable clearance is 20 feet. Access for maintenance activities should be considered.

UNDERSTANDING END CONDITION ORIGINS

EC's Must Begin from Same Point



Template 1

(Cut and Fill w/ Z-Slope - Right)

- EC Origin point located at POSS

Template 2

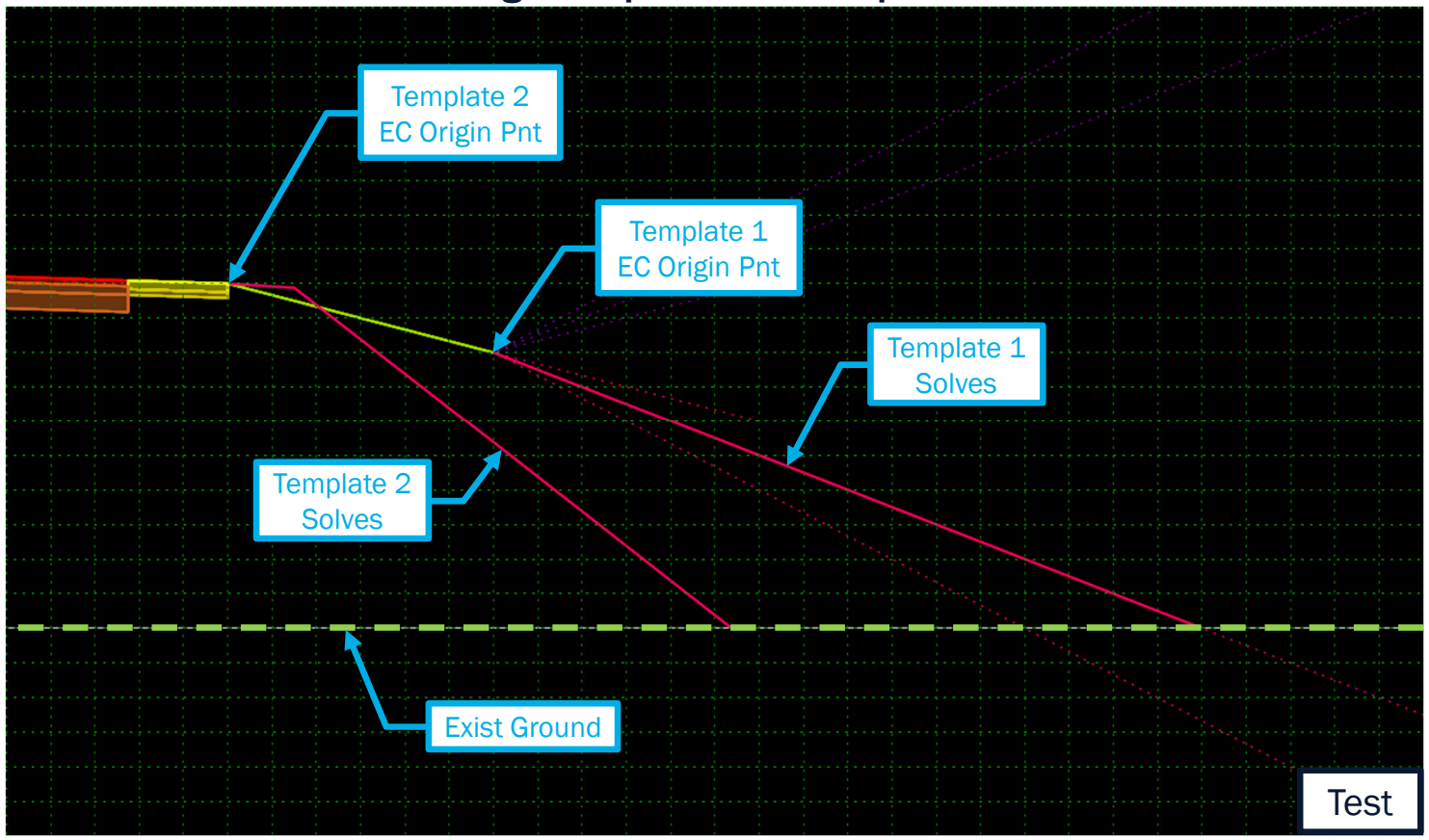
(Fill with Guardrail - Right)

- EC Origin point located at EOS

COMBINING TEMPLATES W/ DIFFERENT EC ORIGINS

Produces Multiple Solutions at Once

Testing: Template 1 + Template 2

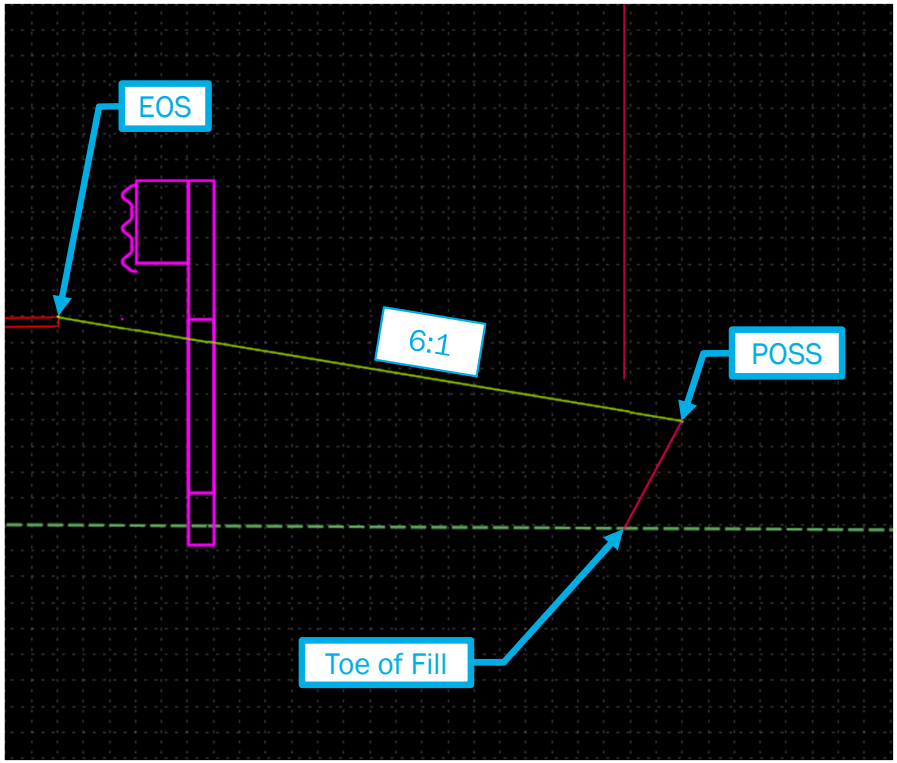


USING TEMPLATES W/ DIFFERENT EC ORIGINS

Produces Undesirable Results

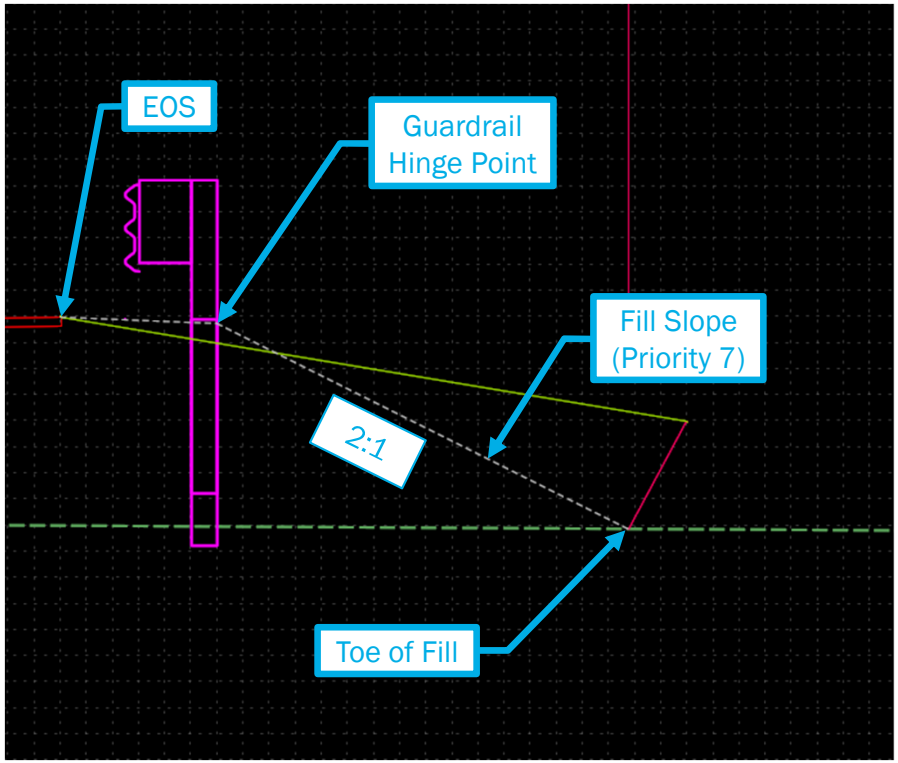
Corridor Solution

- Does not match Template 1 or Template 2



Explanation of Corridor Solution

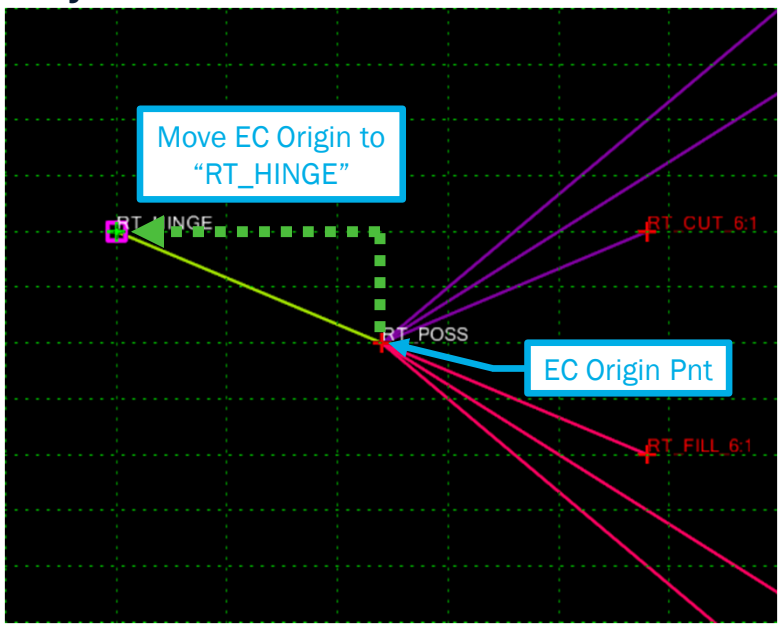
- Dashed line represents Template 2 solution



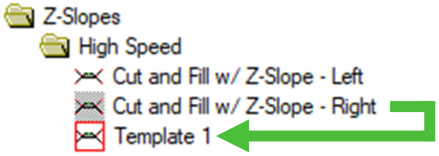
FIXING TEMPLATE 1

Moving EC Origin Point

Objective:

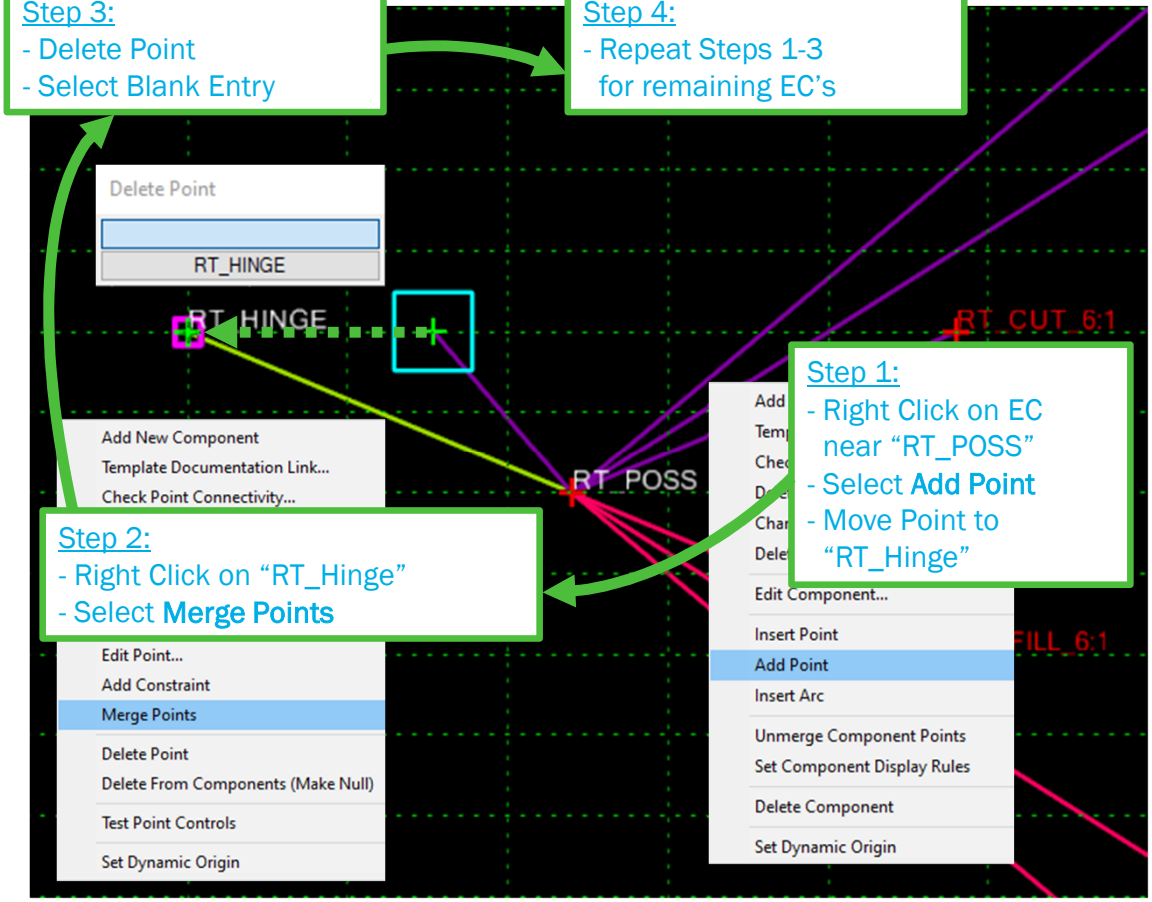


- Copy "Cut and Fill w/ Z-Slope – Right" and Rename to "Template 1"



Copy/Rename

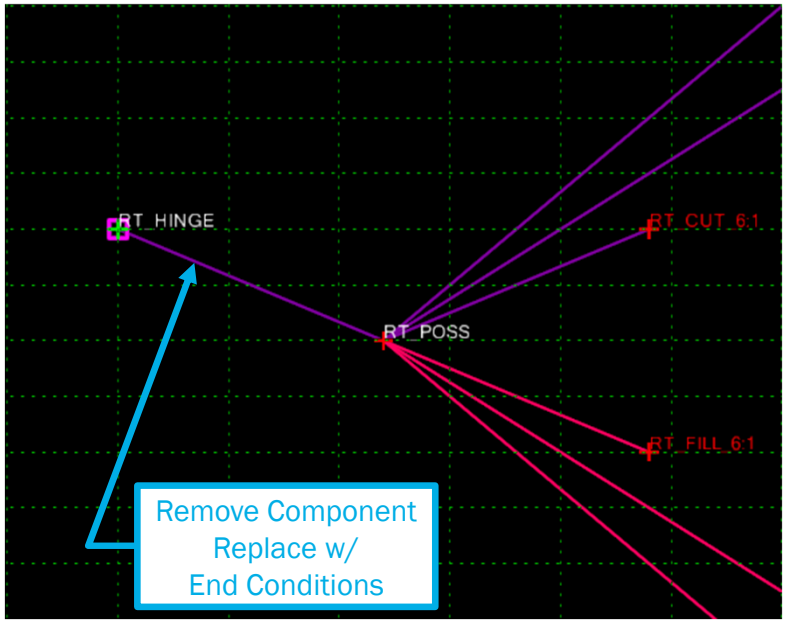
Instructions:



FIXING TEMPLATE 1

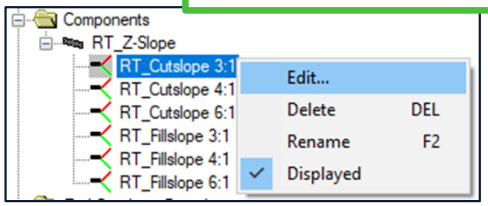
Removing Z Slope Component

Objective:

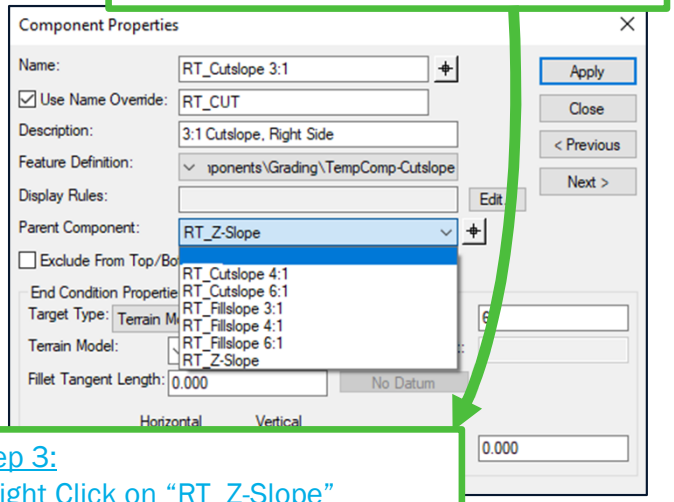


Instructions:

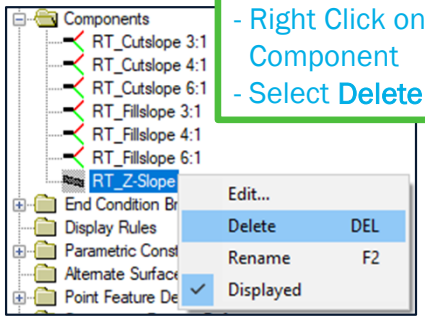
Step 1:
- Right Click on EC
- Select **Edit...**



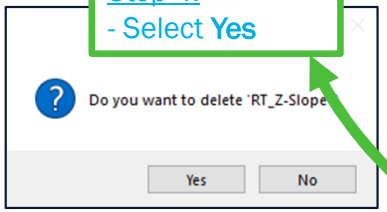
Step 2:
- Click on Parent Component
- Select Blank Underlined Entry
- Repeat Steps 1-2 for all EC's



Step 3:
- Right Click on "RT_Z-Slope" Component
- Select **Delete**



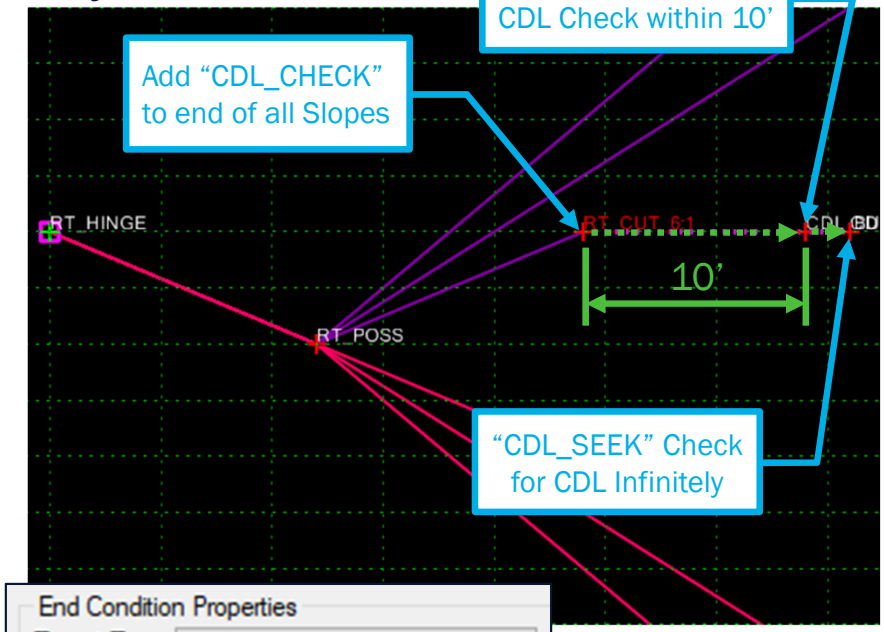
Step 4:
- Select **Yes**

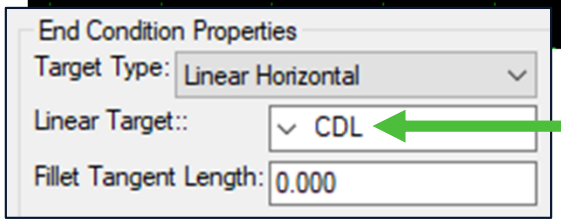


FIXING TEMPLATE 1

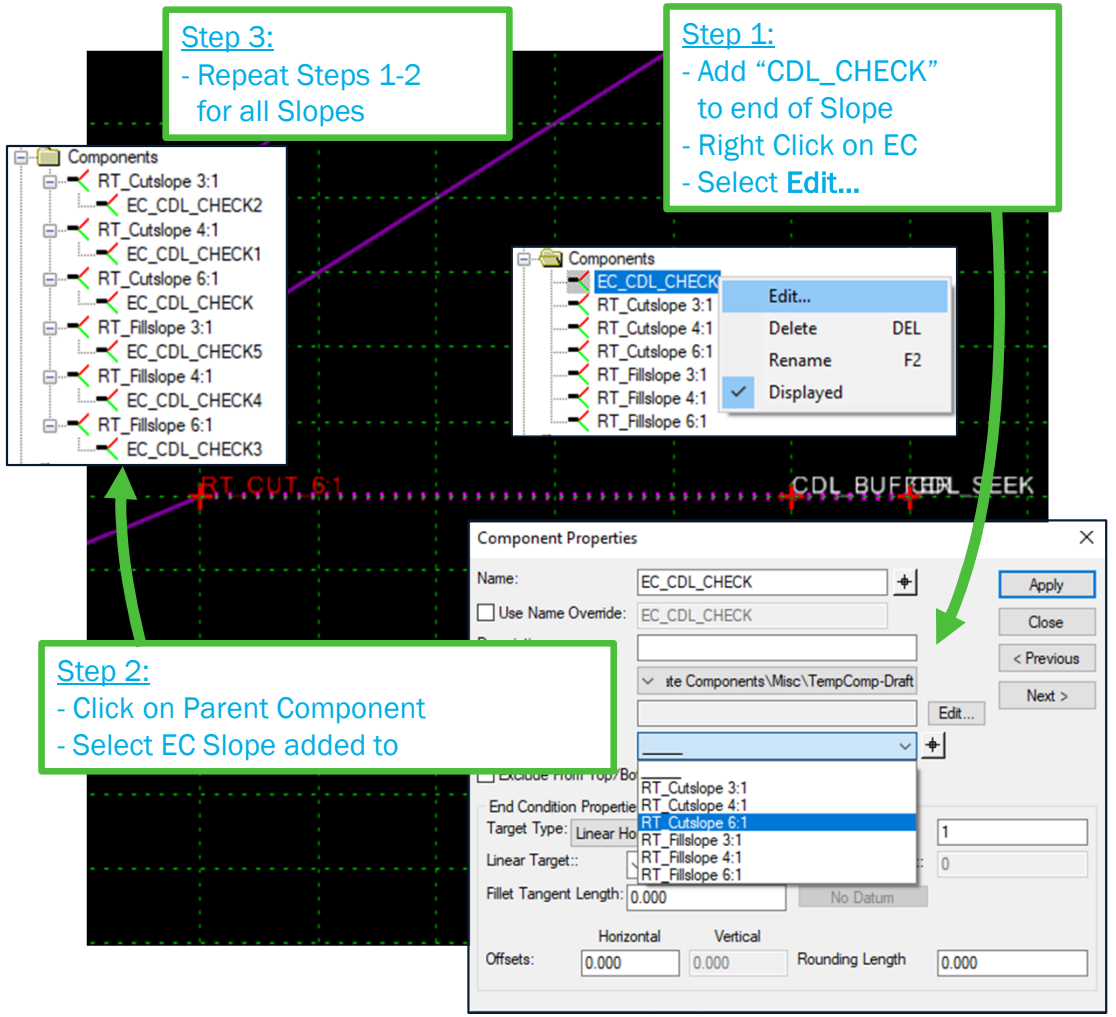
Adding CDL Check EC

Objective:





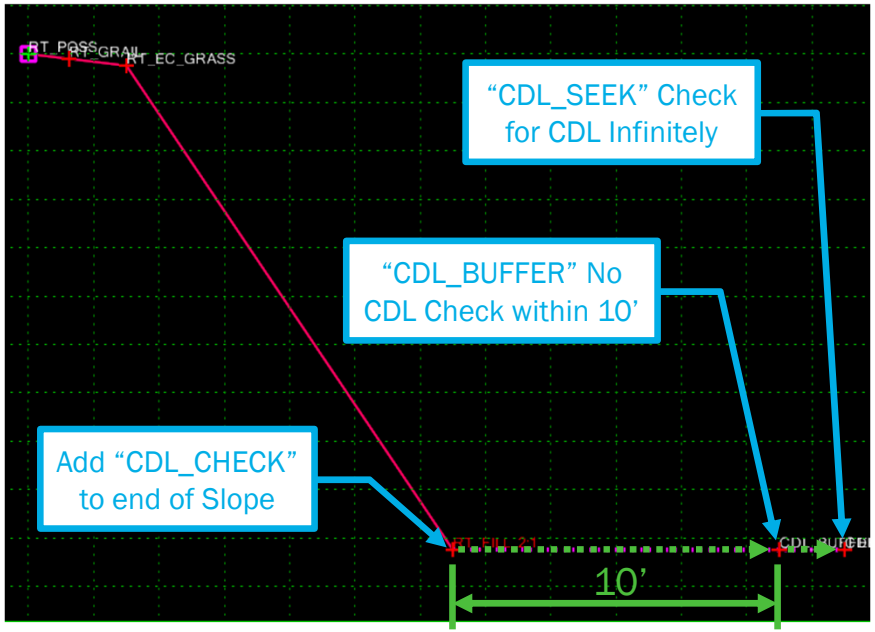
Instructions:



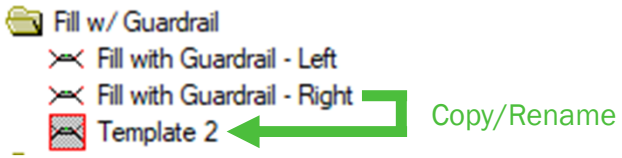
CREATING TEMPLATE 2

Adding CDL Check EC

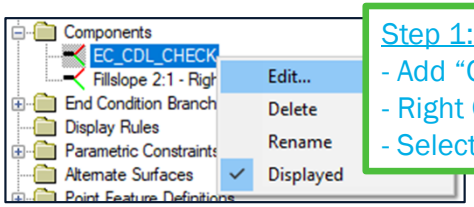
Objective:



- Copy "Fill with Guardrail – Right" and Rename to "Template 2"

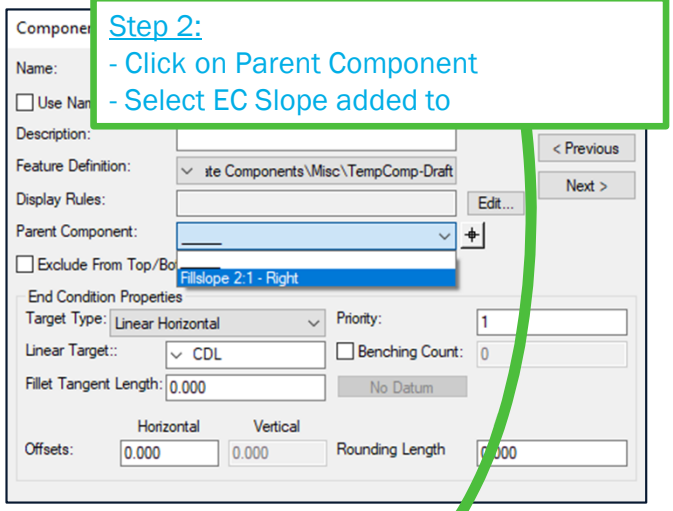


Instructions:

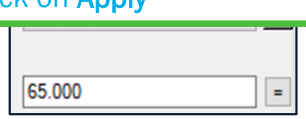


Step 1:
- Add "CDL_CHECK" to end of Slope
- Right Click on EC
- Select **Edit...**

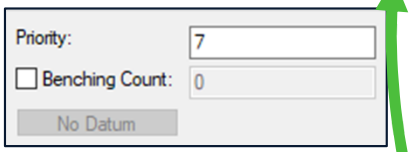
Step 2:
- Click on Parent Component
- Select EC Slope added to

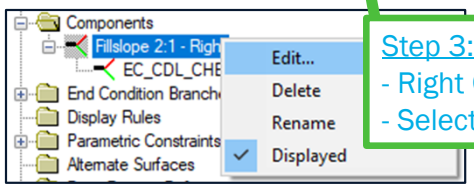


Step 5:
- Change "RT_FILL_2:1" Horiz. Distance to "65"
- Click on **Apply**



Step 4:
- Change Priority to "7"
- Click on **Apply**



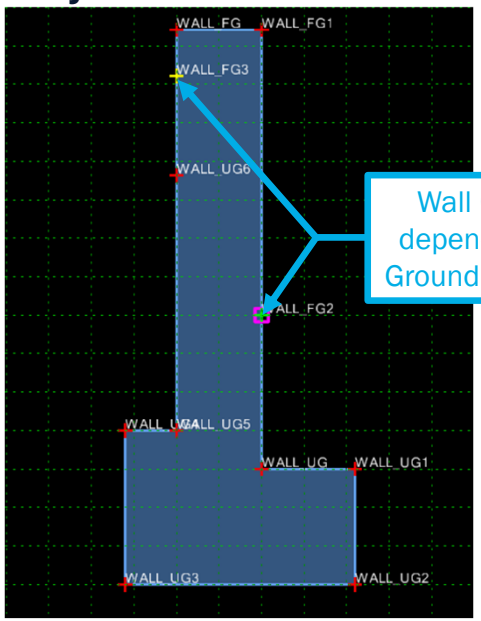


Step 3:
- Right Click on "Fillslope 2:1 - Right"
- Select **Edit**

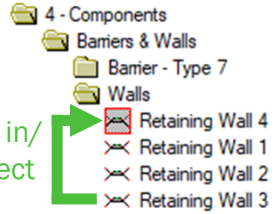
CREATING WALL TEMPLATE

Wall Component for Solution 3

Objective:



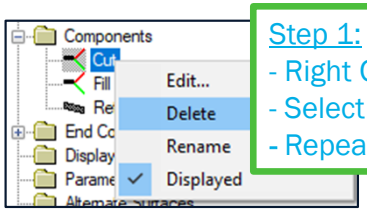
Wall Component dependent on Exist Ground and Fill Slope



Drag in/ Reflect

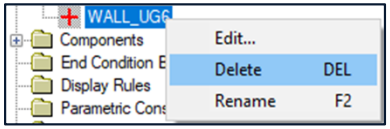
- Create “New Template” under Walls and Rename to “Retaining Wall 4”
- Drag “Retaining Wall 3” in and “Reflect” template

Instructions:

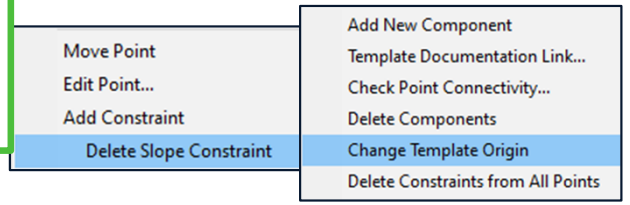


Step 1:
- Right Click on “Cut” EC
- Select **Delete**
- Repeat for “Fill” EC

Step 2:
- Right Click Point “WALL_UG6”
- Select **Delete**



Step 3:
- Right Click Point “WALL_FG2”
- Select **Delete Slope Constraint**
- Select **Change Template Origin**



Step 4:
- Revise Points with following Constraints

WALL_FG1 (Constraints):
- Type: Horizontal
- Parent: WALL_FG2
- Value: -0.001
- Type: Vertical
- Parent: WALL_FG
- Value: 0.000

WALL_FG (Constraints):
- Type: Horizontal
- Parent: WALL_FG3
- Value: 0.001
- Type: Vertical
- Parent: WALL_FG3
- Value: 0.500

WALL_FG3 (1st Constraint):
- Type: Horizontal
- Parent: WALL_FG2
- Value: -1.00
- Label: Wall-Width

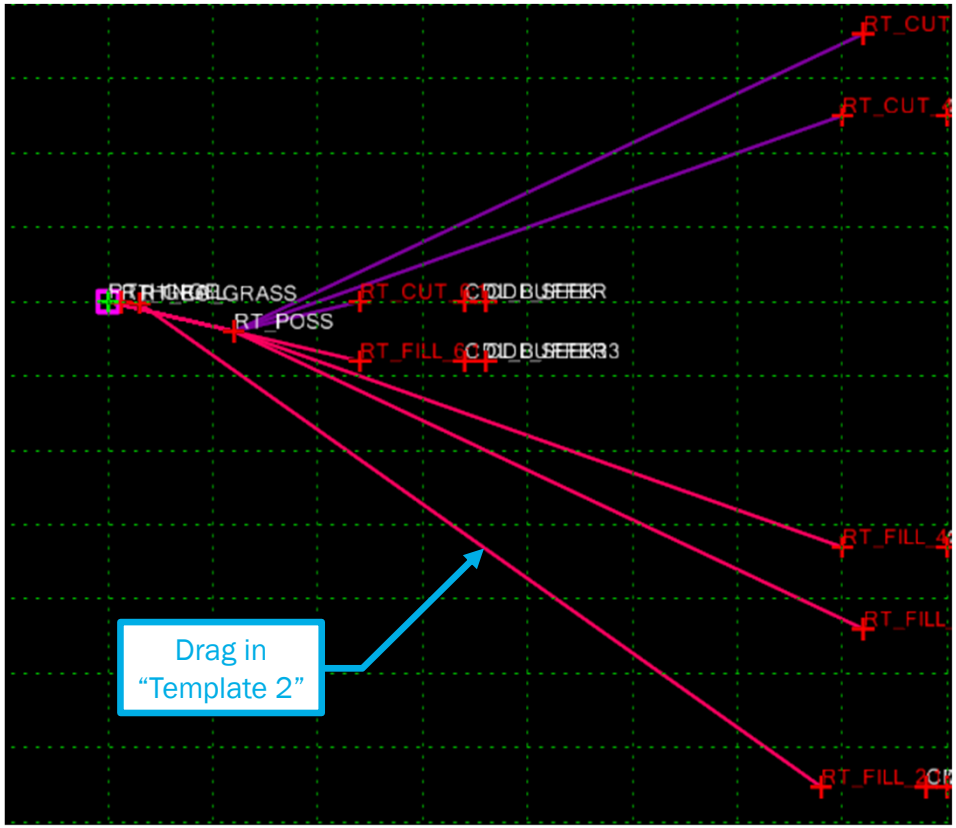
WALL_UG4 (Constraints):
- Type: Vertical
- Parent: WALL_UG5
- Value: 0.000
- Type: Horizontal
- Parent: WALL_UG5
- Value: -0.605

WALL_UG (Constraints):
- Type: Horizontal
- Parent: WALL_FG2
- Value: 0.000
- Label:
- Type: Vertical
- Parent: WALL_FG2
- Value: -2.000
- Label: Wall-Embed

CREATE CDL TEMPLATE

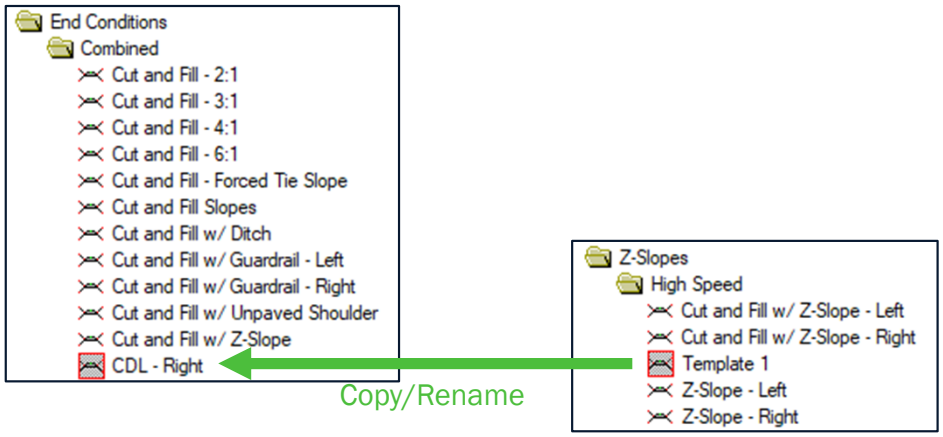
Combine Template 1 + Template 2

Objective:

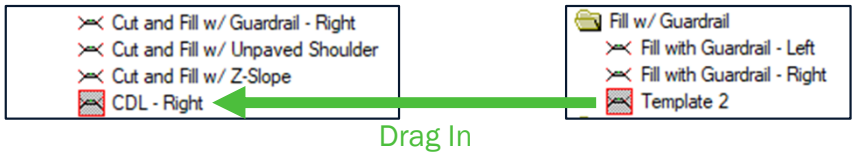


Instructions:

Step 1:
- Copy “Template 1” & Paste under “Combined” folder & Rename to “CDL – Right”



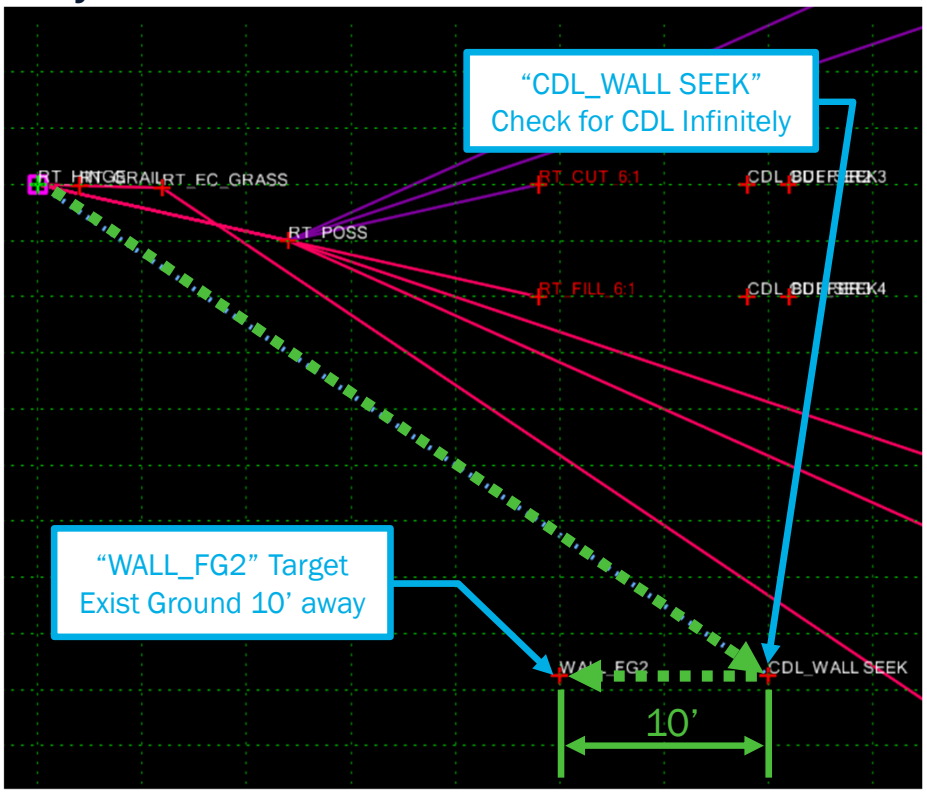
Step 2:
- Drag in “Template 2” and place directly on point “RT_HINGE”



CREATE CDL TEMPLATE

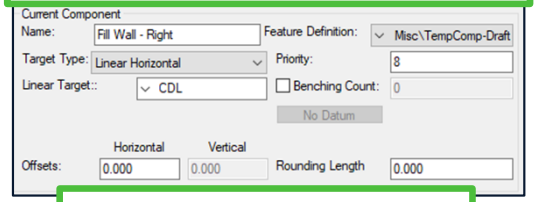
Add Retaining Wall End Conditions

Objective:

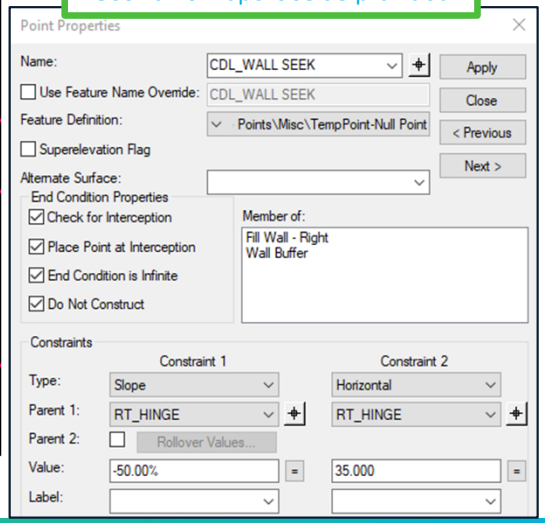


Instructions:

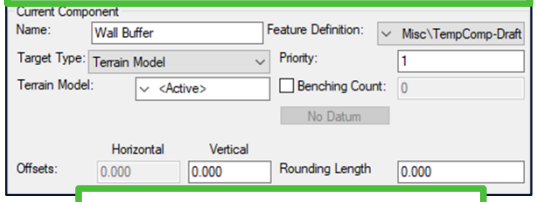
Step 1:
- Right Click Point "RT_Hinge"
- Select **Add New Component/End Condition**
- Set Component Properties as provided
- Set Point about +35' Horiz. & -20' Vert.
- Right Click & Select **Finish**



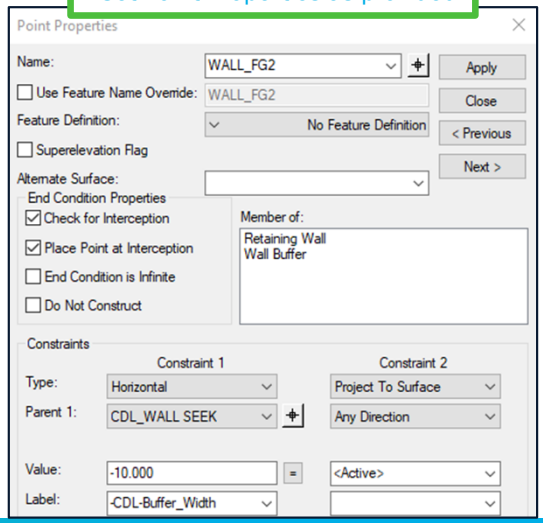
Step 2:
- Right Click new Point
- Select **Edit...**
- Set Point Properties as provided



Step 3:
- Right Click Point "CDL_WALL SEEK"
- Select **Add New Component/End Condition**
- Set Component Properties as provided
- Set Point about -10' Horiz. & 0' Vert.
- Right Click & Select **Finish**



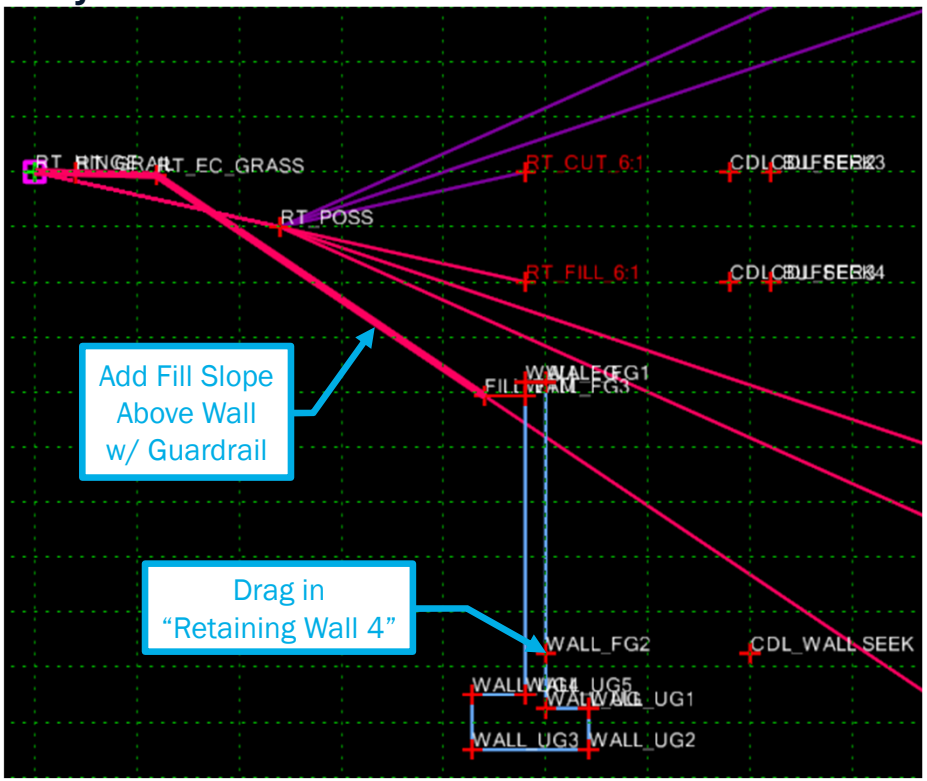
Step 4:
- Right Click new Point
- Select **Edit...**
- Set Point Properties as provided



CREATE CDL TEMPLATE

Add Retaining Wall Components

Objective:

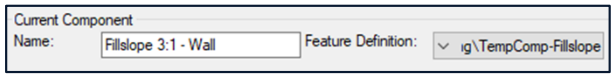


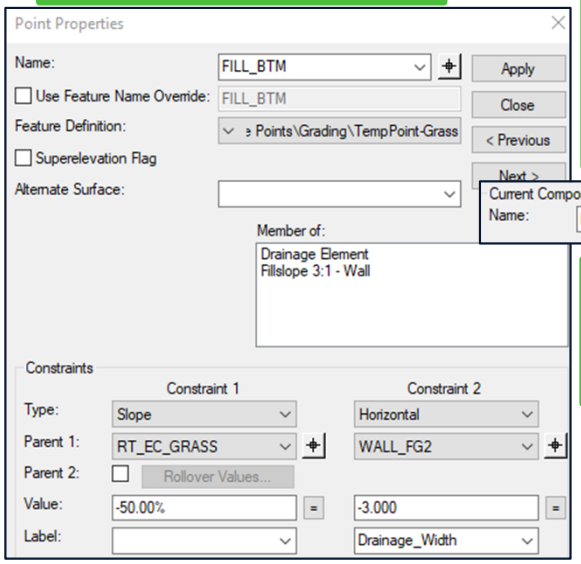
Instructions:

Step 1:
- Drag in "Retaining Wall 4" and place directly on point "WALL_FG2"
- Right Click Point "WALL_FG3"
- Select **Move Point**
- Set Point about -10' Elev.

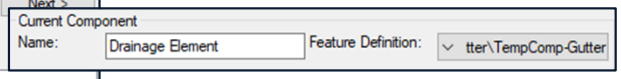
Step 2:
- Right Click Point "RT_Hinge"
- Select **Add New Component/Constrained**
- Set Component Properties as provided
- Set new Points on "RT_GRAIL", "RT_EC_GRASS" & Last Point about -10' Elev along Guardrail Slope
- Right Click & Select **Finish**

Step 3:
- Right Click new Last Point
- Select **Edit...**
- Set Point Properties as provided



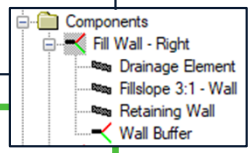


Step 4:
- Right Click Point "FILL_BTM"
- Select **Add New Component/Constrained**
- Set Component Properties as provided
- Set new Point on "WALL_FG3"
- Right Click & Select **Finish**



Step 5:
- Right Click Point "WALL_FG3"
- Select **Edit...**
- Set 2nd Constraint as provided

WALL_FG3 (2nd Constraint):
- Type: Vertical
- Parent: FILL_BTM
- Value: 0.00



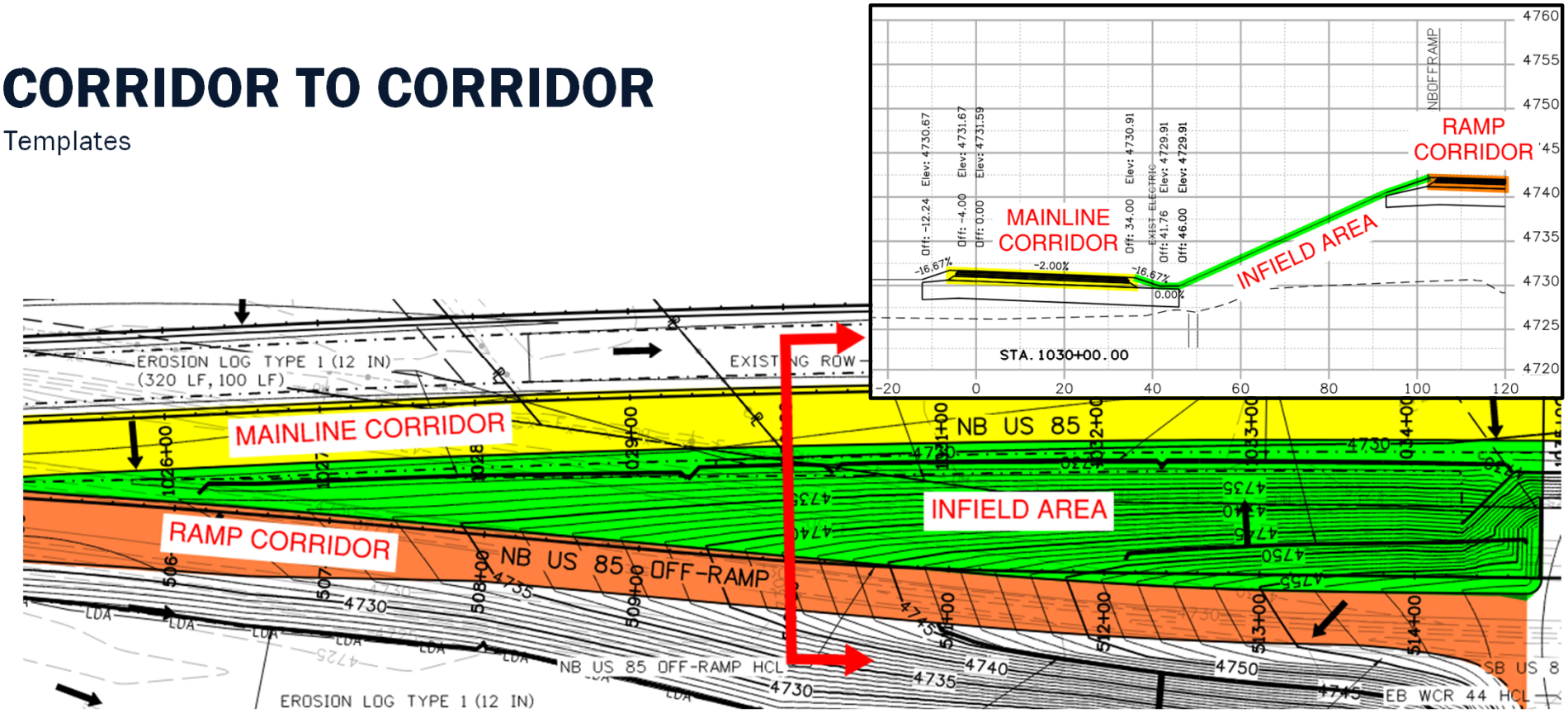
Step 6:
- Set "Fill Wall - Right" as Parent Component for all new Wall Solution Components

QUESTIONS?

CRITICAL DESIGN FEATURE (CDF) TEMPLATE

CORRIDOR TO CORRIDOR

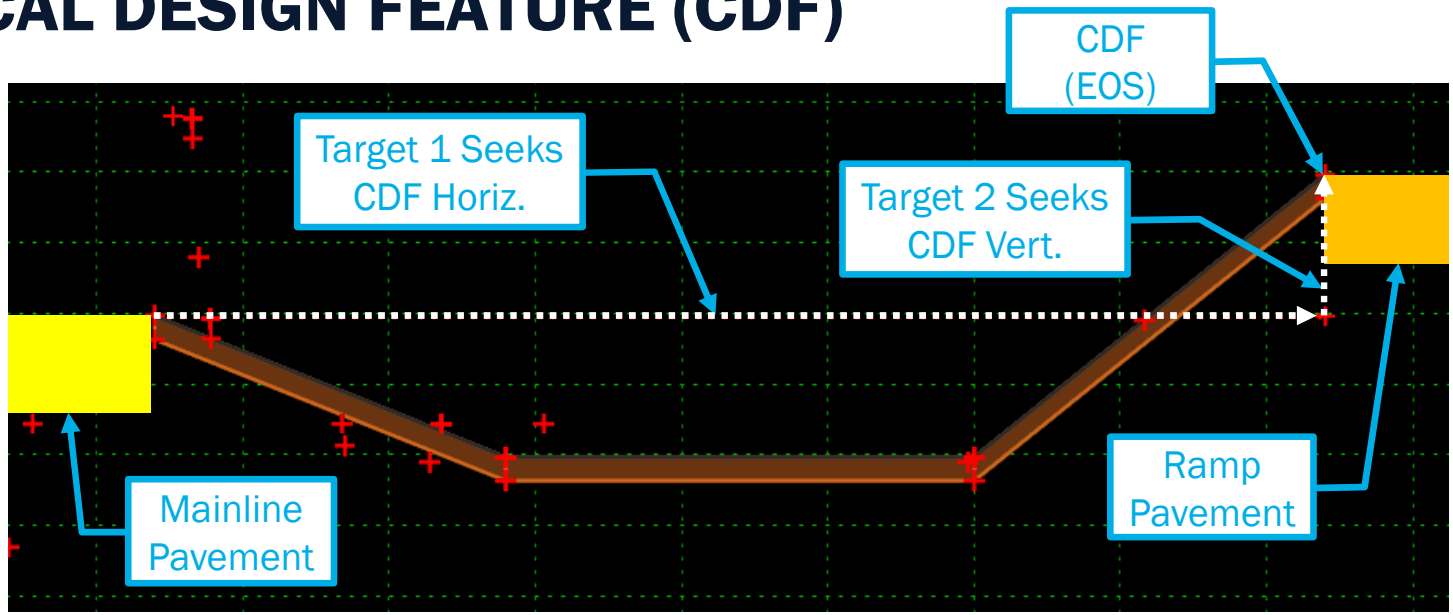
Templates



- Corridors running parallel to each other in close proximities pose issues of overlapping side slopes. (i.e. Infield areas within interchanges).
- Corridor clipping may be an option but not ideal.
- Cleanest modeling approach is to model entire infield area from one corridor connected to the second corridor.

CRITICAL DESIGN FEATURE (CDF)

Templates

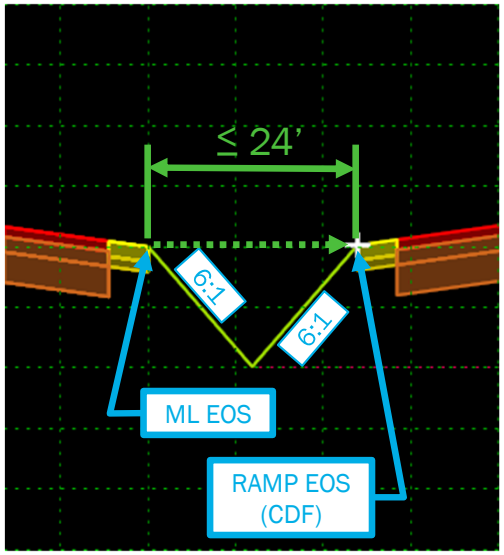


Critical Design Feature (CDF)

- Features along a corridor that should be tied to by another corridor in order to complete the design between the corridors:
  - Edge of Shoulder
  - POSS
  - Bottom of Ditch
- Similar to a CDL, setting Template Targets using Target Aliasing to these type of CDF's will help automate the design between corridors based on display rules.
- Setup for the CDF's within a template and corridor are the same procedures as taken for setting up the CDL's.

AUTOMATED CDF TEMPLATE

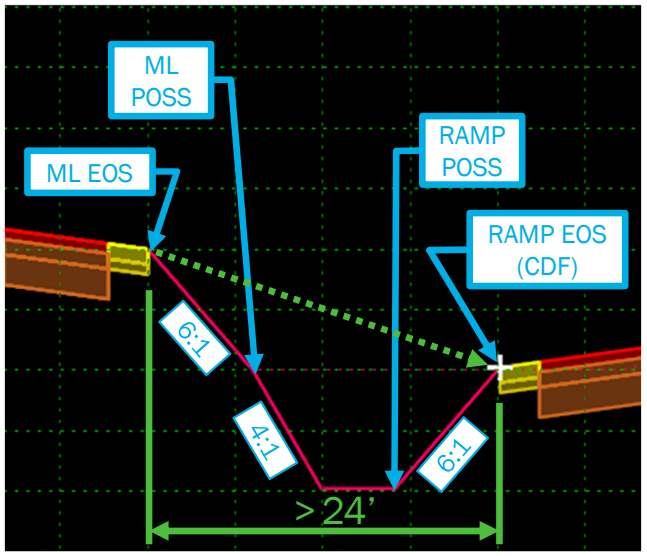
Based on CDF Location (Combining multiple templates into one)



Solution 1

EOS’s ≤ 24’

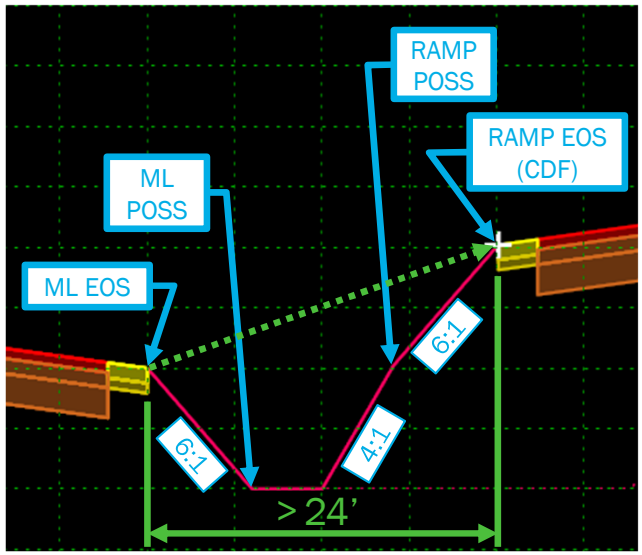
- 6:1 Slopes between EOS’s
- Typical grading near Physical Gore Nose



Solution 2

EOS’s > 24’ and ML Above Ramp

- 6:1 Slopes to POSS Points
- 4:1 Slope beyond ML POSS to Ramp POSS forming trapezoidal ditch



Solution 3

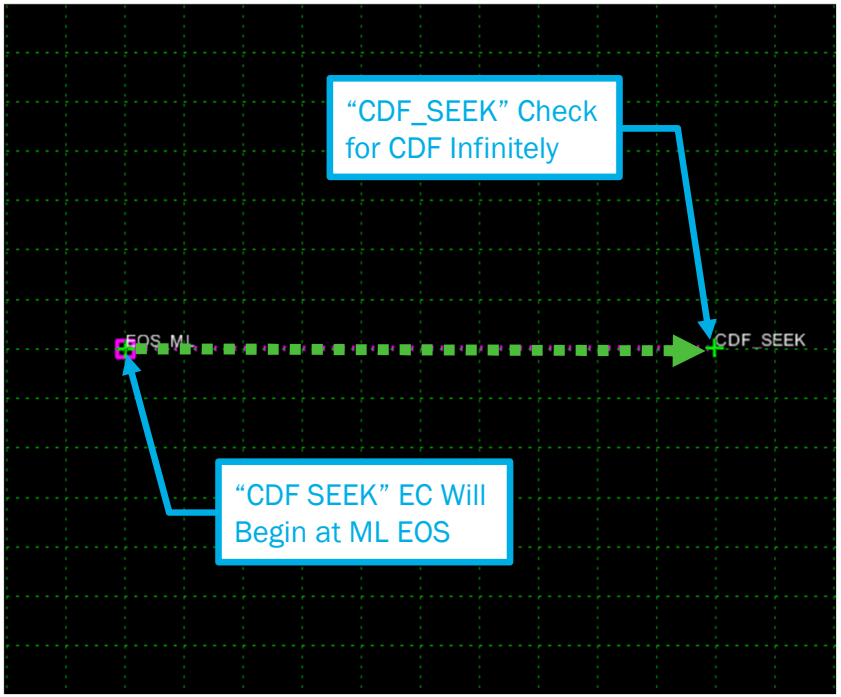
EOS’s > 24’ and ML Below Ramp

- 6:1 Slopes to POSS Points
- 4:1 Slope beyond Ramp POSS to ML POSS forming trapezoidal ditch

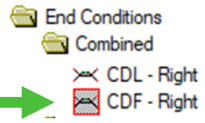
CREATING CDF TEMPLATE

Adding CDF Check EC

Objective:

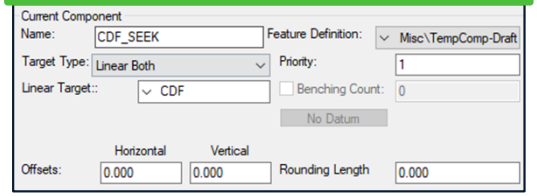


- Create "New Template" under Combined and Rename to "CDF - Right"

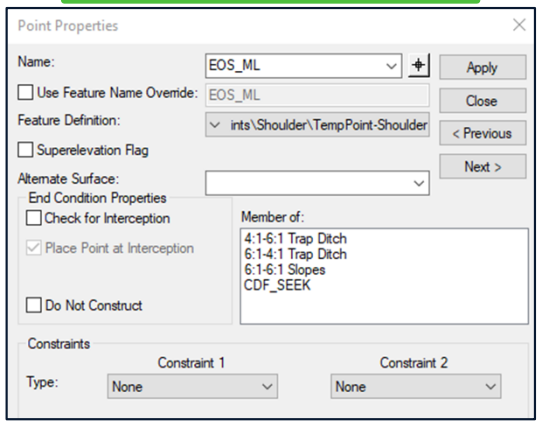


Instructions:

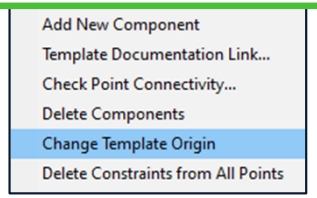
Step 1:
- Right Click near Template Origin
- Select **Add New Component/End Condition**
- Set Component Properties as provided
- Set Point near Origin & 2nd Point about +20' Horiz. & 0' Vert.
- Right Click & Select **Finish**



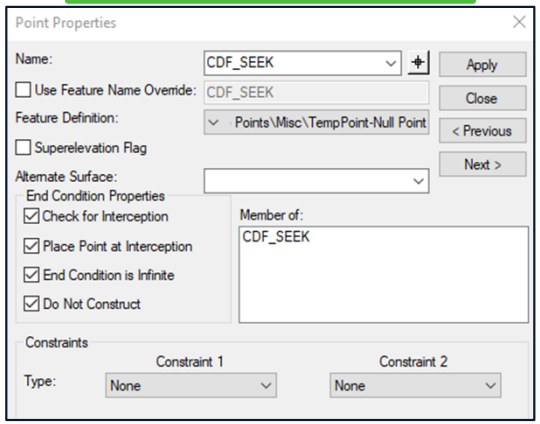
Step 2:
- Right Click Point near Origin
- Select **Edit...**
- Set Point Properties as provided



Step 3:
- Right Click Point "EOS_ML"
- Select **Change Template Origin**



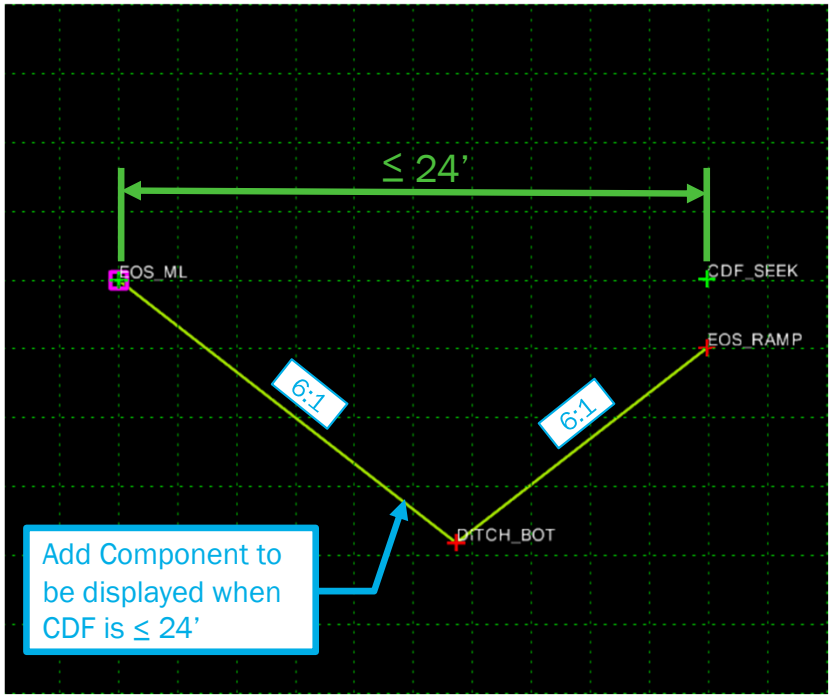
Step 4:
- Right Click 2nd new Point
- Select **Edit...**
- Set Point Properties as provided



CREATING CDF TEMPLATE

Adding 6:1 Slopes Solution

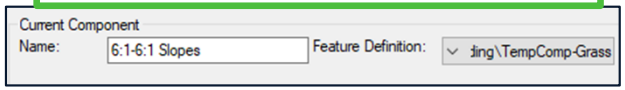
Objective:



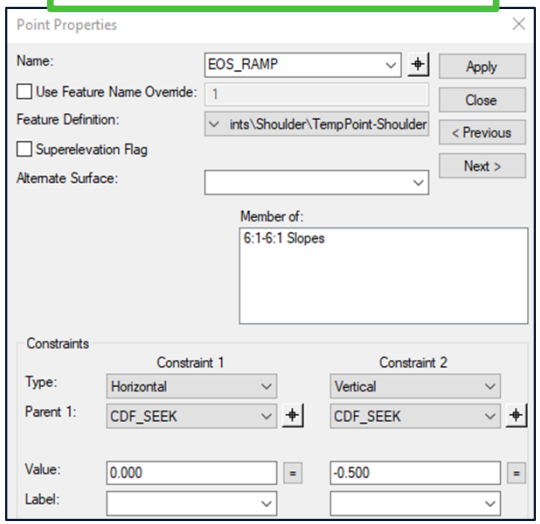
- Point "EOS_RAMP" will be moved on to Point "CDF_SEEK" once all Components have been added
- Points "EOS_RAMP" & "CDF_SEEK" Must Not be Merged

Instructions:

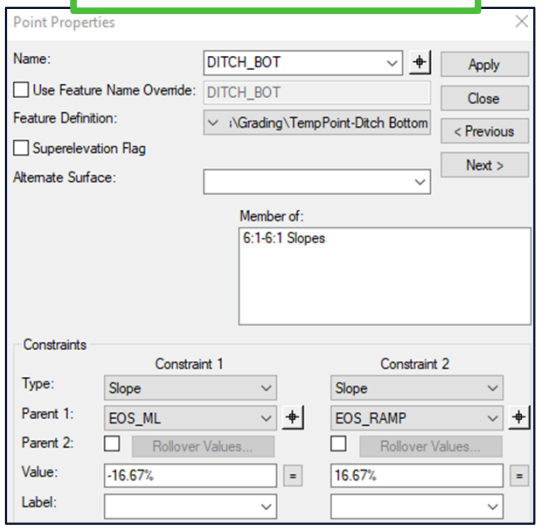
Step 1:
- Right Click Point "EOS_ML"
- Select **Add New Component/Constrained**
- Set Component Properties as provided
- Set 1st Point about +10' Horiz. & -2' Vert.
- Set 2nd Point 0.5' below "CDF_SEEK"
- Right Click & Select **Finish**



Step 2:
- Right Click Point below "CDF_SEEK"
- Select **Edit...**
- Set Point Properties as provided



Step 3:
- Right Click 1st new Point
- Select **Edit...**
- Set Point Properties as provided

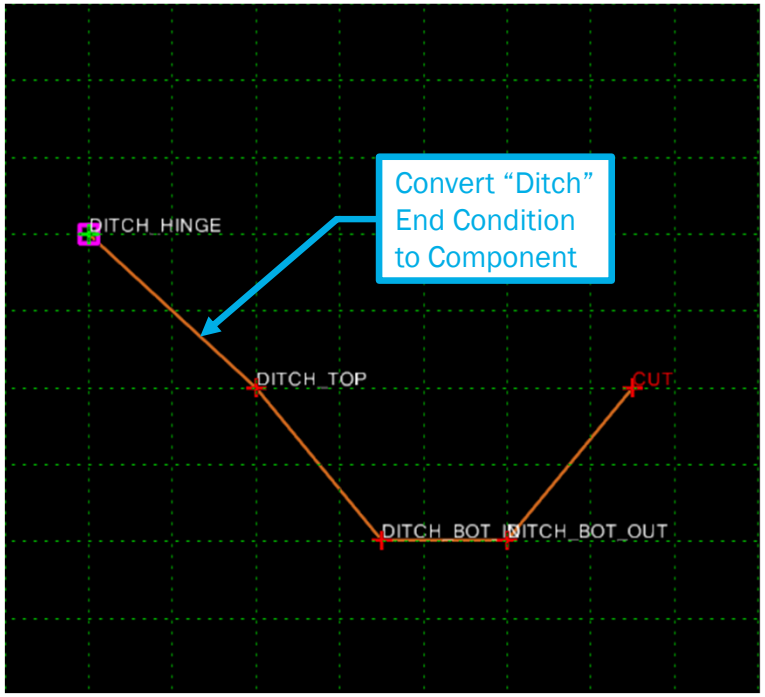


Step 4: (Preparing Template for Solution 2)
- Right Click Point "CDF_SEEK"
- Select **Move Point**
- Set Point about +40' Horiz. & -2' Vert.
- Left Click to set Point

CREATING DITCH TEMPLATE

Ditch Template to be used for Solution 2 & 3

Objective:

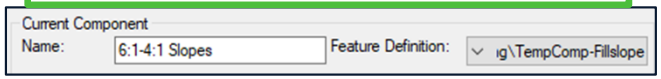


Copy/ Rename

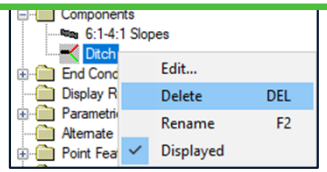
- Copy "Ditch 1" Paste/Rename to "Ditch 1 - Component"

Instructions:

Step 1:
- Right Click Point "DITCH_HINGE"
- Select **Add New Component/Constrained**
- Set Component Properties as provided
- Set new Points on every existing point of EC
- Right Click & Select **Finish**



Step 2:
- Right Click "Ditch" EC
- Select **Delete**



Step 3:
- Right Click Point "DITCH_TOP"
- Select **Edit...**
- Set Point Properties as provided

Point Properties:
- Name: POSS_ML
- Feat. Def.: TempPoint-POSS

Constraints

- Type: Horizontal	- Type: Slope
- Parent: DITCH_HINGE	- Parent: DITCH_HINGE
- Value: 12.000	- Value: -16.67%

Step 4:
- Right Click Point "CUT"
- Select **Delete Both Constraints**

Step 5:
- Right Click Point "CUT"
- Select **Move Point**
- Set Point about +40' Horiz. & -2.5' Vert.
- Left Click to set Point

Step 6:
- Right Click Point "DITCH_BOT_OUT"
- Select **Edit...**
- Set Point Properties as provided

Point Properties:
- Name: POSS_RAMP
- Feat. Def.: TempPoint-POSS

Constraints

- Type: Horizontal	- Type: Slope
- Parent: CUT	- Parent: CUT
- Value: -12.000	- Value: 16.67%

Step 7:
- Right Click Point "DITCH_BOT_IN"
- Select **Edit...**
- Set Point Properties as provided

Point Properties:
- Name: DITCH_BOT_IN
- Feat. Def.: TempPoint-Ditch Bottom

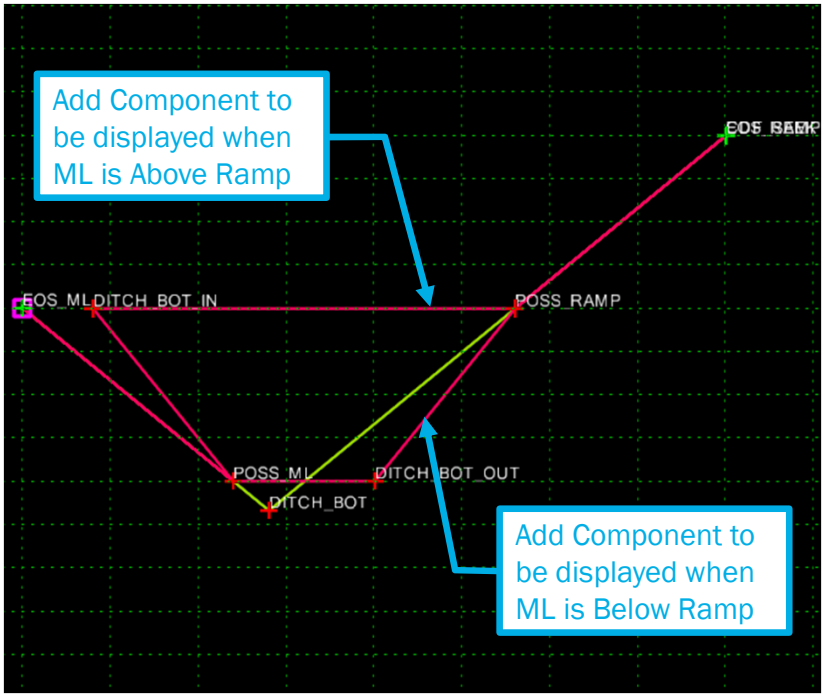
Constraints

- Type: Vertical	- Type: Slope
- Parent: POSS_RAMP	- Parent: POSS_ML
- Value: 0.000	- Value: -25.00%

CREATING CDF TEMPLATE

Adding ML Above & Below Ramp Solutions

Objective:



Instructions:

Step 1:
- Drag in "Ditch 1 - Component" & place directly on Point "EOS_ML"

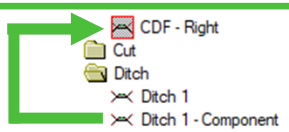
Drag in

Step 2:
- Right Click Point "CUT"
- Select **Move Point**
- Set Point on "EOS_RAMP"
- Right Click Point "EOS_RAMP"
- Select **Merge Points**
- Click on "Cut" to Delete Point

Step 3: (Preparing Template for Solution 3)
- Right Click Point "CDF_SEEK"
- Select **Move Point**
- Set Point about +40' Horiz. & +2' Vert.
- Left Click to set Point

Step 4:
- Drag in/Reflect "Ditch 1 - Component" & place directly on Point "EOS_RAMP"

Drag in/ Reflect



Step 5:
- Right Click Component "6:1-4:1 Slopes1"
- Select **Rename** (Rename to "4:1-6:1 Slopes")

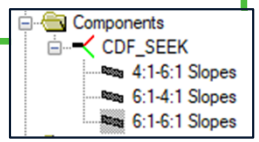
Step 6:
- Right Click Point "CUT"
- Select **Move Point**
- Set Point on "EOS_ML"
- Right Click Point "EOS_ML"
- Select **Merge Points**
- Click on "Cut" to Delete Point

Step 7:
- Right Click Point "POSS_RAMP1"
- Select **Merge Points**
- Click on "POSS_RAMP1" to Delete Point

Step 8:
- Right Click Point "DITCH_BOT_IN1"
- Select **Edit Point...**
- Rename Point to "DITCH_BOT_OUT"
- Click on **Apply**
- Click on **Close**

Step 9:
- Right Click Point "EOS_RAMP"
- Select **Edit Point...**
- Revise Vertical Constraint Value to "0.000"
- Click on **Apply**
- Click on **Close**

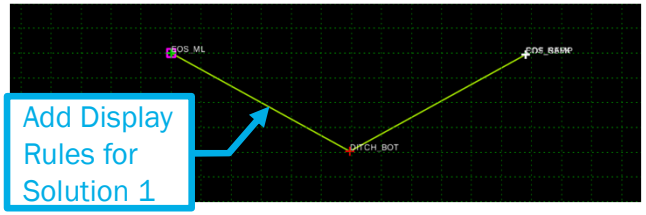
Step 10:
- Set "CDF_SEEK" as Parent Component for all new Components



CREATING CDF TEMPLATE

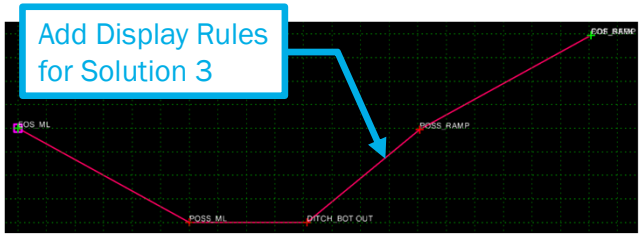
Adding Display Rules

Objective:



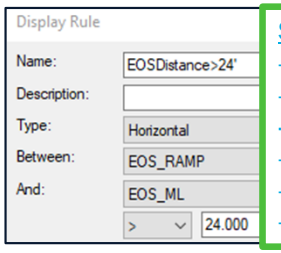
Add Display Rules for Solution 1

Add Display Rules for Solution 2



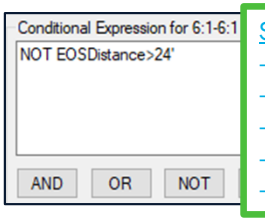
Add Display Rules for Solution 3

Instructions:



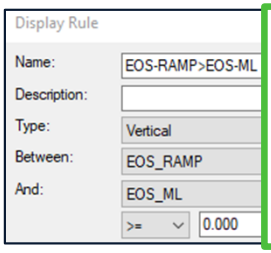
Step 1:
- Right Click “6:1-6:1 Slopes”
- Select **Edit...**
- Select **Edit...** Next to Display Rules
- Click on **Add**
- Create the following Display Rule
- Click on **OK**

Step 5:
- Right Click “4:1-6:1 Slopes”
- Select **Edit...**
- Select **Edit...** Next to Display Rules

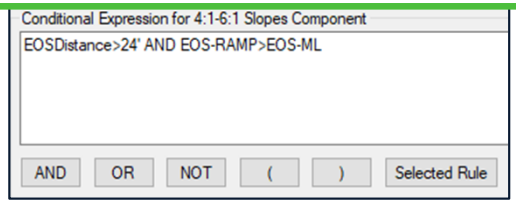


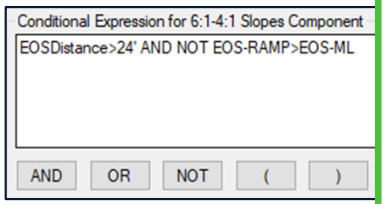
Step 2 (Add to Conditional Expression):
- Click on **NOT**
- Select “EOSDistance>24’” from Display Rules
- Click on **Selected Rule**
- Expression should read as the following
- Click **OK,** Click on **Close**

Step 6 (Add to Conditional Expression):
- Select “EOSDistance>24’” from Display Rules
- Click on **Selected Rule**
- Click on **AND**
- Select “EOS-Ramp>EOS-ML” from Display Rules
- Click on **Selected Rule**
- Expression should read as the following
- Click **OK,** Click on **Close**



Step 3:
- Right Click “6:1-4:1 Slopes”
- Select **Edit...**
- Select **Edit...** Next to Display Rules
- Click on **Add**
- Create the following Display Rule
- Click on **OK**





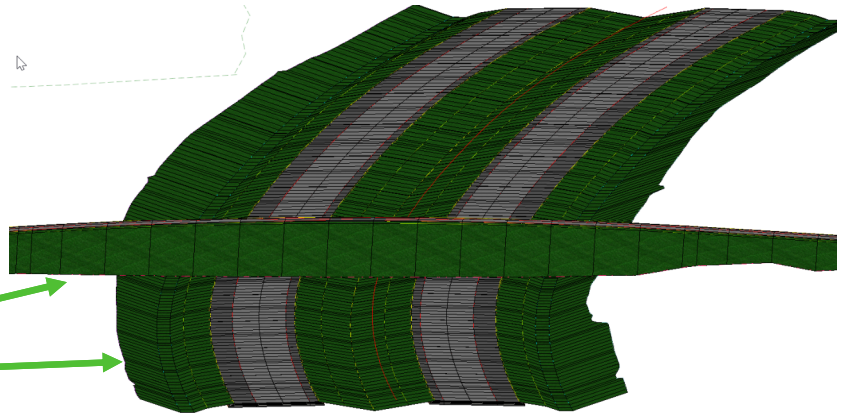
Step 4 (Add to Conditional Expression):
- Select “EOSDistance>24’” from Display Rules
- Click on **Selected Rule**
- Click on **AND,** Click on **NOT**
- Select “EOS-Ramp>EOS-ML” from Display Rules
- Click on **Selected Rule**
- Expression should read as the following
- Click **OK,** Click on **Close**

QUESTIONS?

ABUTMENT GRADING FOR BRIDGE REPLACEMENT PROJECTS

ABUTMENT GRADING

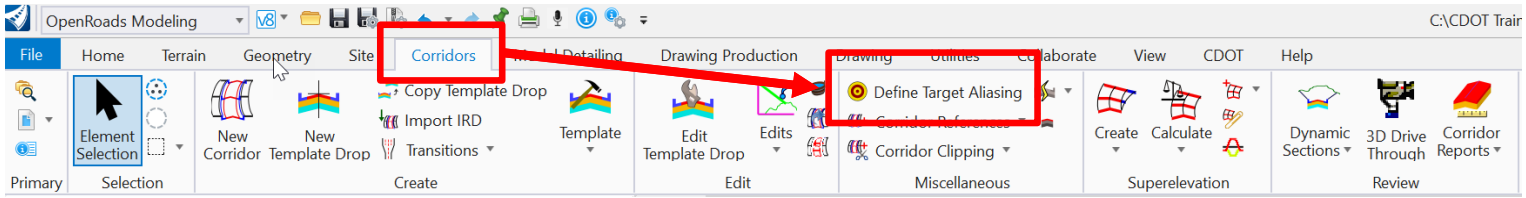
1. Project Set up
   a) Copy the Corridors_Start.dgn file to a working folder and rename.
   b) Open the file with OpenRoads Designer using the CDOT workspace
2. Corridor Set up
   a) Note the configuration of the corridors. To model grading around a bridge, we start off by modeling both corridors as if the other was not there



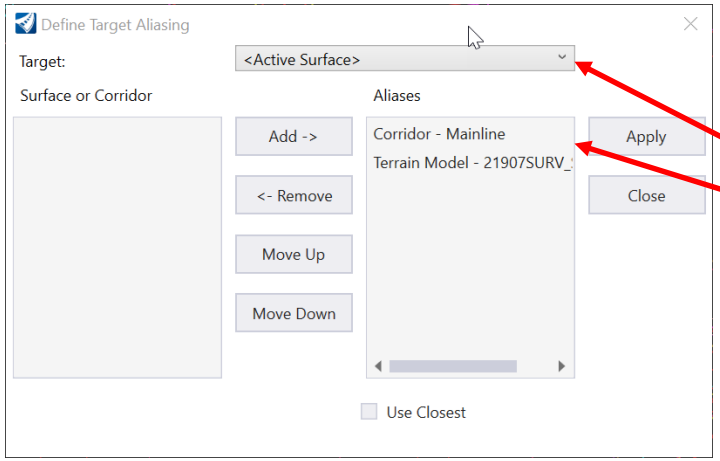
Note: Both corridors modeled to grade to existing ground. Do not add bridge templates to the upper corridor

ABUTMENT GRADING

2. Corridor Set up – Cont.
   b) Tie the two corridors together by using Target Aliasing



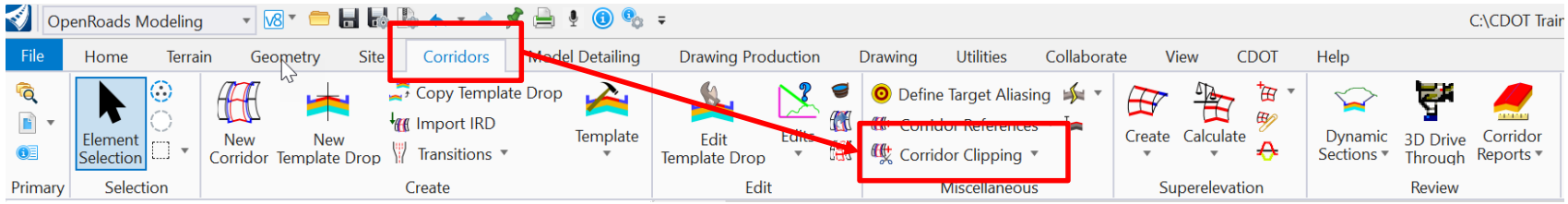
   c) The upper corridor should target the lower corridor
   d) We can use the <Active Surface> target to choose what "surface" the corridor fill seek and in what order

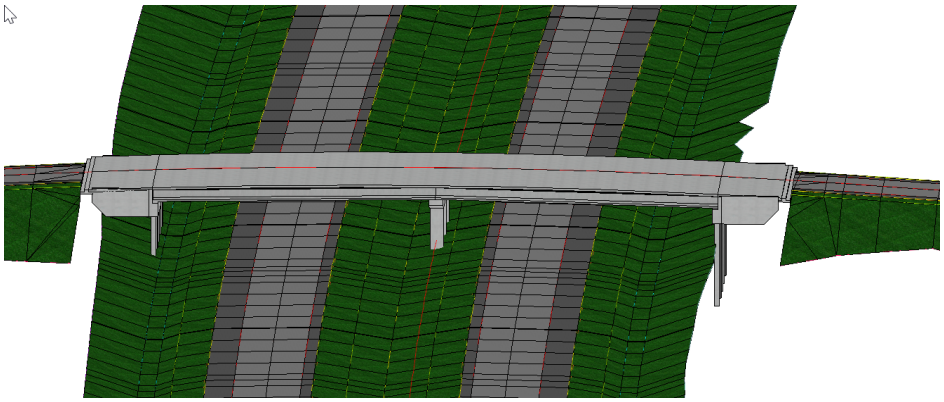


- Note target name
- **Order of targets is important. Proposed work (i.e. the upper corridor) should go first in the list

ABUTMENT GRADING

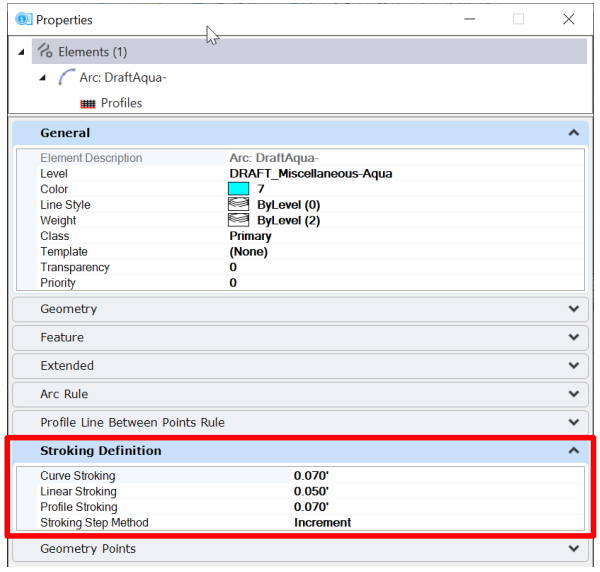
3. Attach Bridge Model and Clip Corridor
   a) Bridge models are only 3d dgn files so attach bridge model directly to Default 3d model
      i. If bridge model does not exist, you can skip this step
   b) Note limit of bridge and clip upper corridor. Clip limits should extend from approach slab to approach slab
   c) To clip a corridor simply draw a MicroStation shape around the area you want to clip
      Note: Make sure the shape encompasses the entire area you want clipped, including any corridor end conditions.

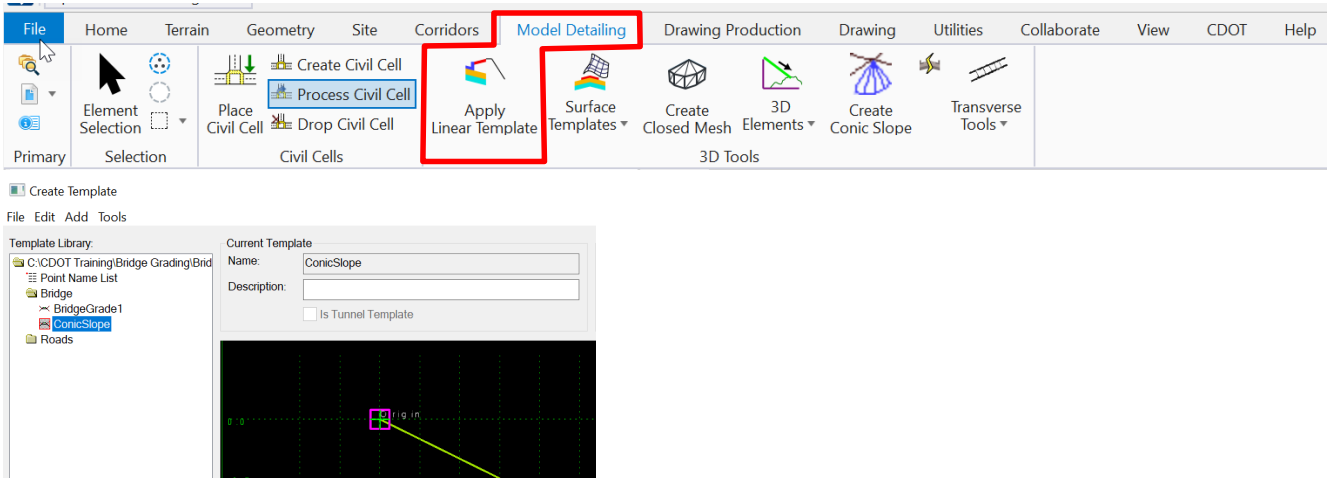




ABUTMENT GRADING

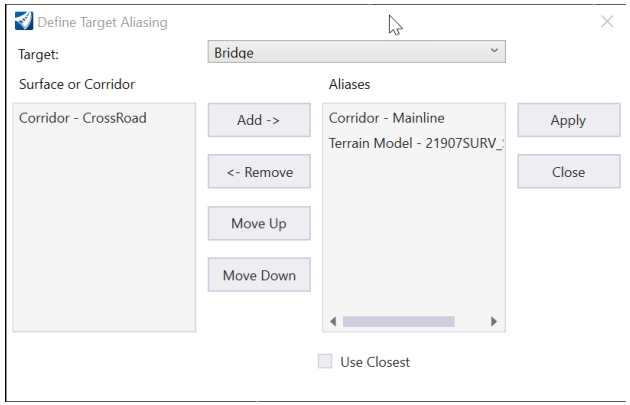
4. Add Bridge Abutment Grading
   a) Develop conic slopes for grading outside abutment limits
      i. Place small arc (R=0.5 ft) at tie point of road grading and bridge grading
      ii. Determine elevation based on roadway edge elevation and set profile using “Profile By Constant Elevation”. This can be determined approximately using the roadway edge of shoulder at the approach slab.
      iii. We will be using a linear template to model the conic slopes. Linear template template drop interval is based on the linear stroking distance defined in properties. Since this is such a small distance to get sufficient template drops use 0.05 ft.

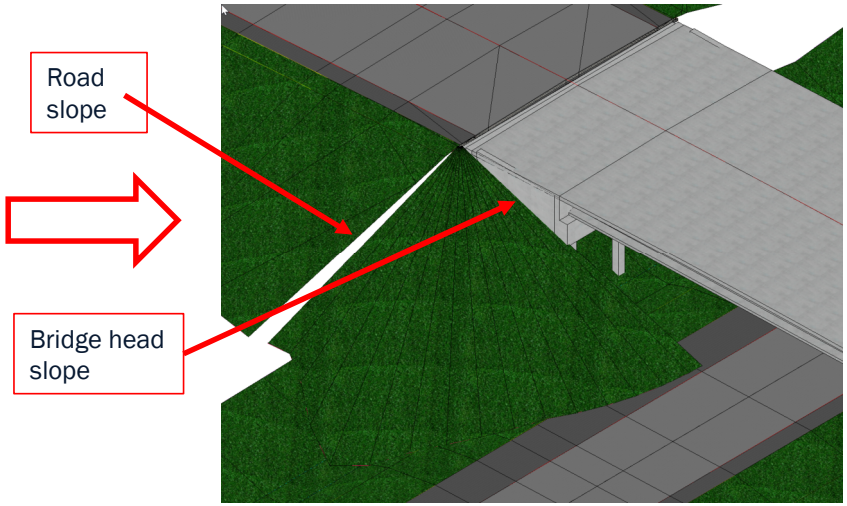




ABUTMENT GRADING

4. Add Bridge Abutment Grading - Cont.
   a) Develop conic slopes for grading outside abutment limits – Cont.
      iv. Add target alias for conic slope. Target proposed first then existing.



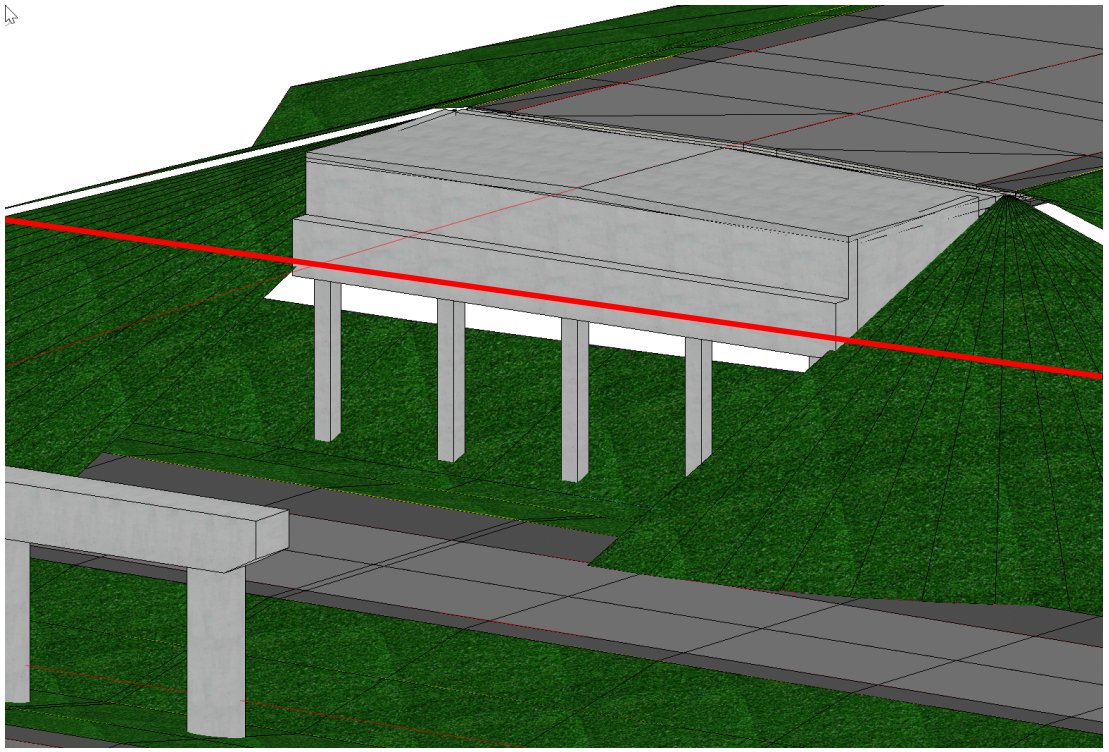


   v. Typically, conic slopes vary from one end to the other, i.e. roadway slope adjacent to roadway and bridge head slope at wing wall. This can be done by using parametric constraints. In this example the slope appears to be constant at 1:3 so we will not add parametric constraints.
   vi. Repeat this procedure for the other side of the bridge.

ABUTMENT GRADING

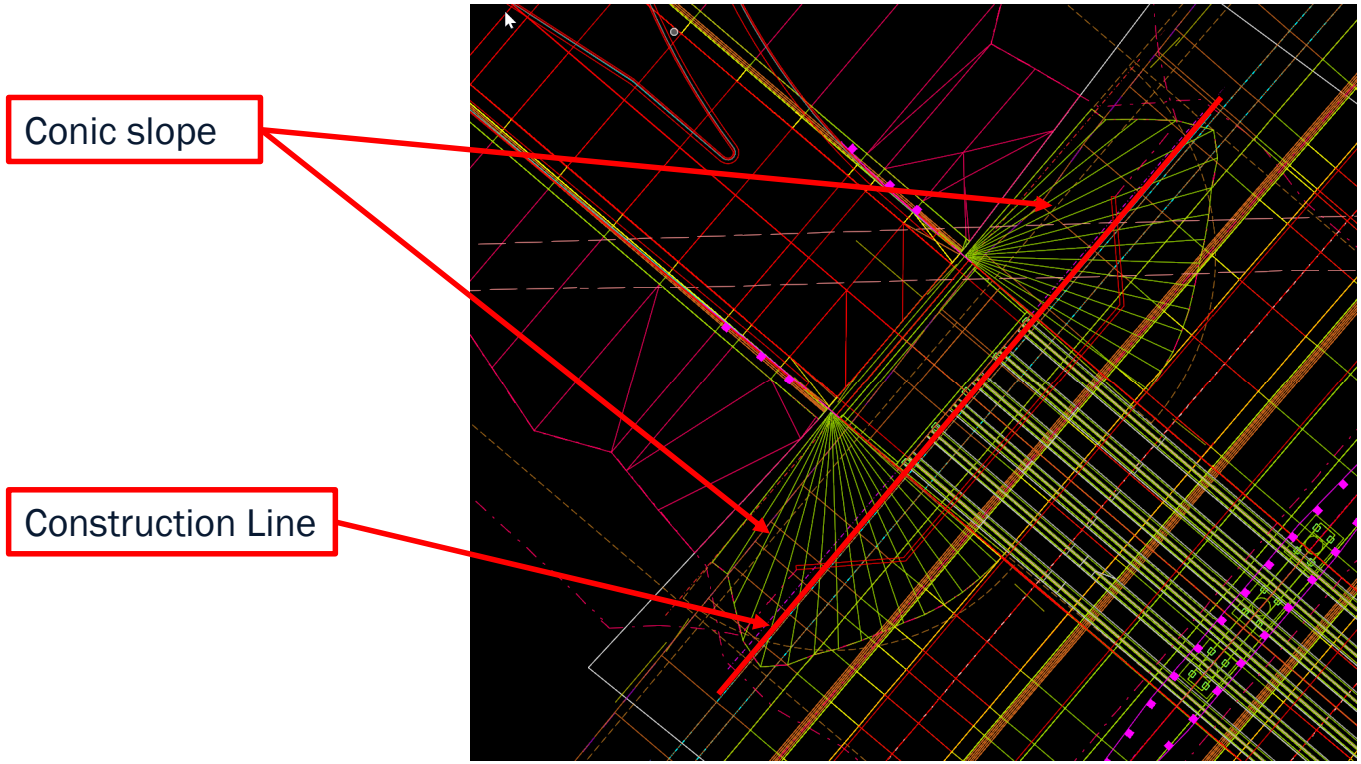
5. Construct bridge head slope grading (horizontal and vertical)

Note:
Horizontally this is the front face of the abutment and can be located graphicly.
Vertically this is usually set by structure requirement for minimum abutment embedment depth.



ABUTMENT GRADING

5. Construct bridge head slope grading (horizontal and vertical) – Cont.
   a) Set construction line at front face of abutment and extend limits of line to cover all of the conic slope limits on both sides of the abutment
   b) Set a temporary profile using constant elevation at 4733.85



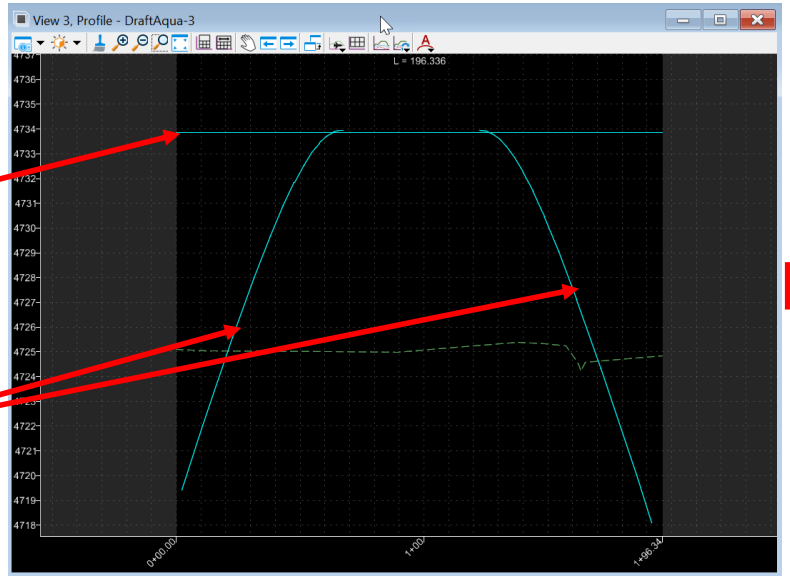
ABUTMENT GRADING

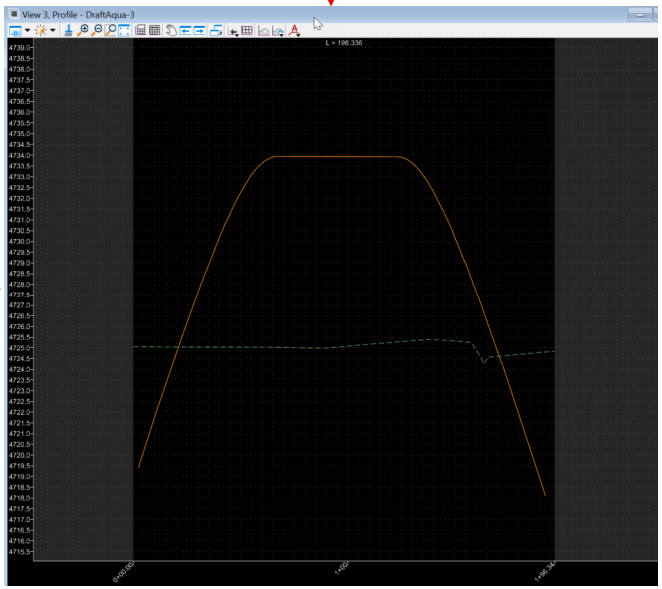
5. Construct bridge head slope grading (horizontal and vertical) – Cont.
   c) Profile construction line using abutment grade elevation and conic slopes

Connect conic slope lines using a fixed line for this example.
Note: A best fit profile would be required if specific bridge head slope elevation is required

Head slope elevation from bridge group

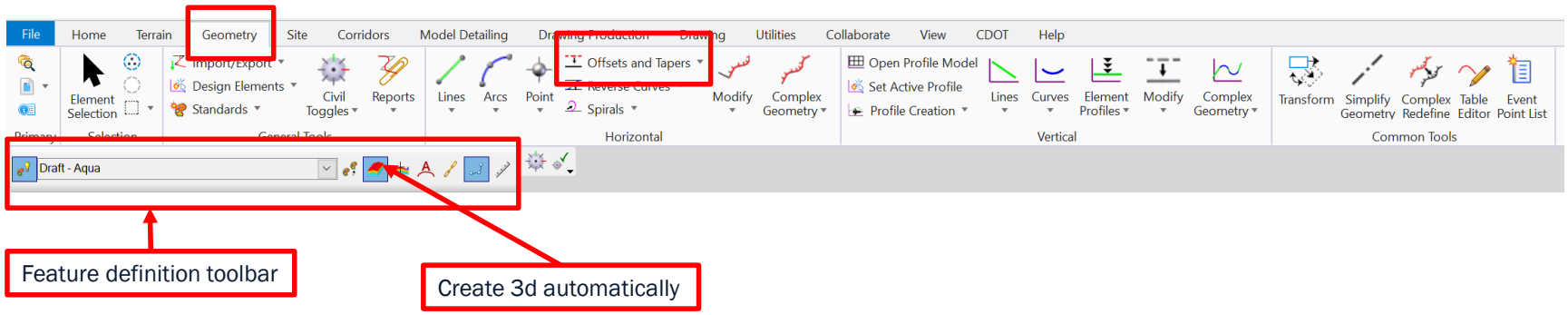
Conic slopes





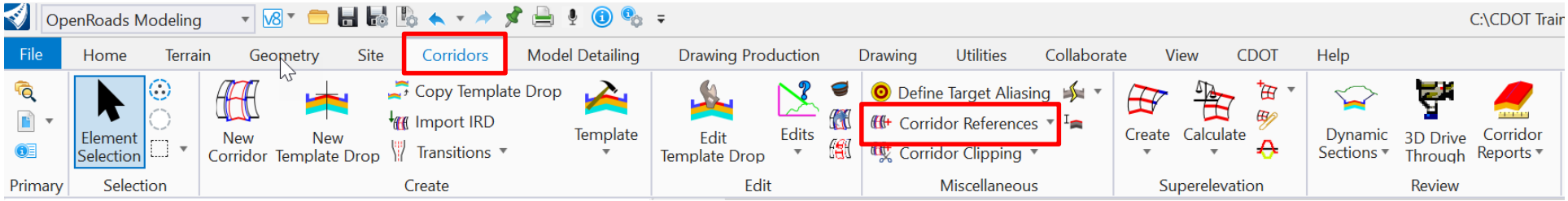
ABUTMENT GRADING

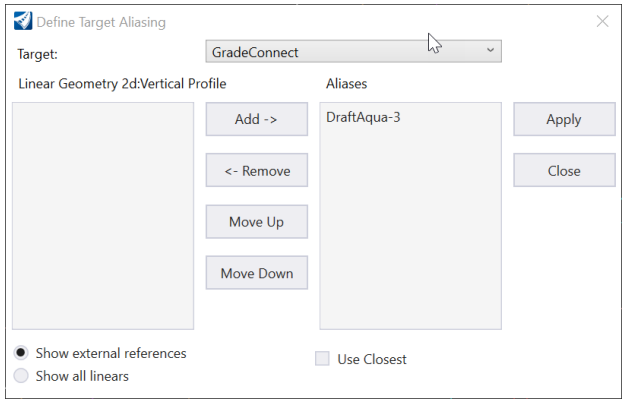
5. Construct bridge head slope grading (horizontal and vertical) – Cont.
    d) Construct bridge head slope grading including retaining wall location
        i. Using single offset partial tool create an offset line from the edge of shoulder with 0 offset. Ensure “create 3d automatically” is toggled down on the Feature Definition toolbar. Using an offset geometry as the base for the grading template will allow linear stroking to be modified.
        ii. Snap to limits of construction line created in step 5
        iii. Change linear stroking to 2 ft

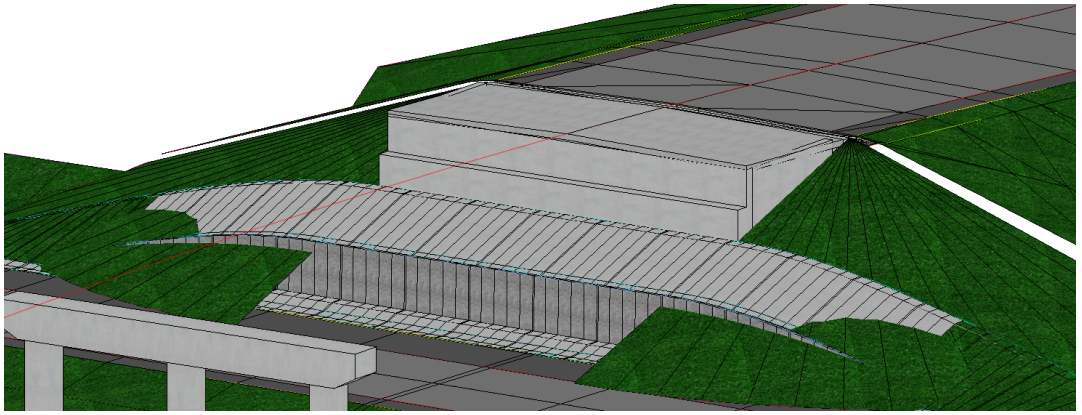


ABUTMENT GRADING

5. Construct bridge head slope grading (horizontal and vertical) – Cont.
    d) Construct bridge head slope grading including retaining wall location
        iv. Add linear template to offset line (Use template: BridgeGrade1)
        v. Add corridor reference to linear template. Ensure you select the 3d instance of the head slope line created in step 4.
        vi. Define target alias for “GradeConnect”

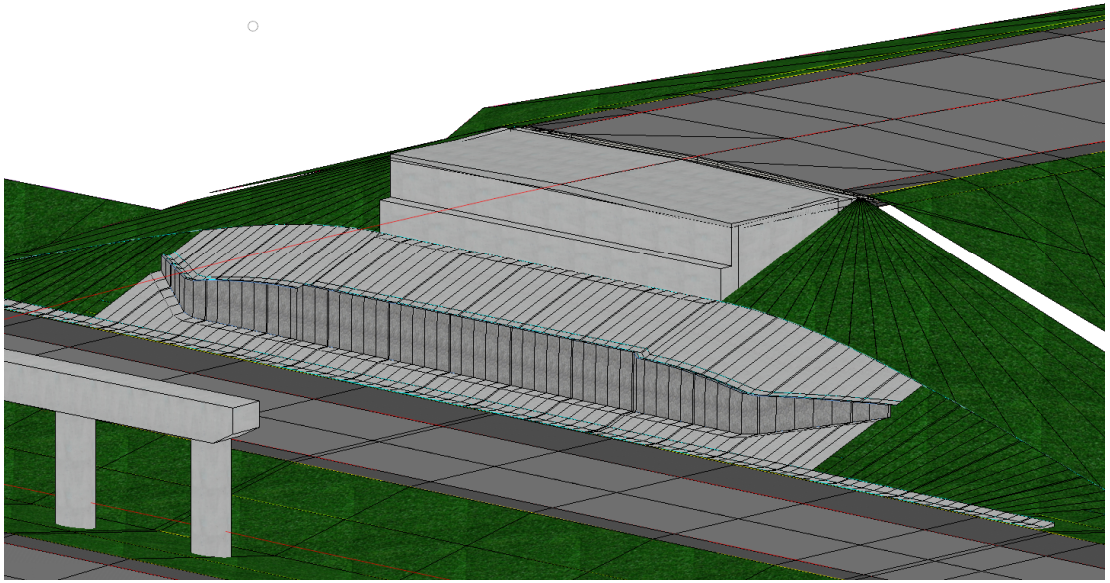


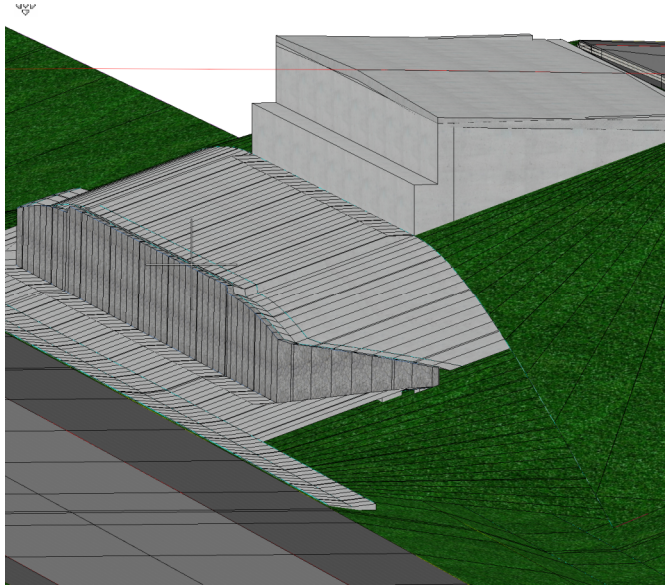




ABUTMENT GRADING

6. Clean up and finalize model
    a) Add point control to follow wall location
    b) Clip conic slopes in front of wall
    c) Add parametric constraints to remove bench





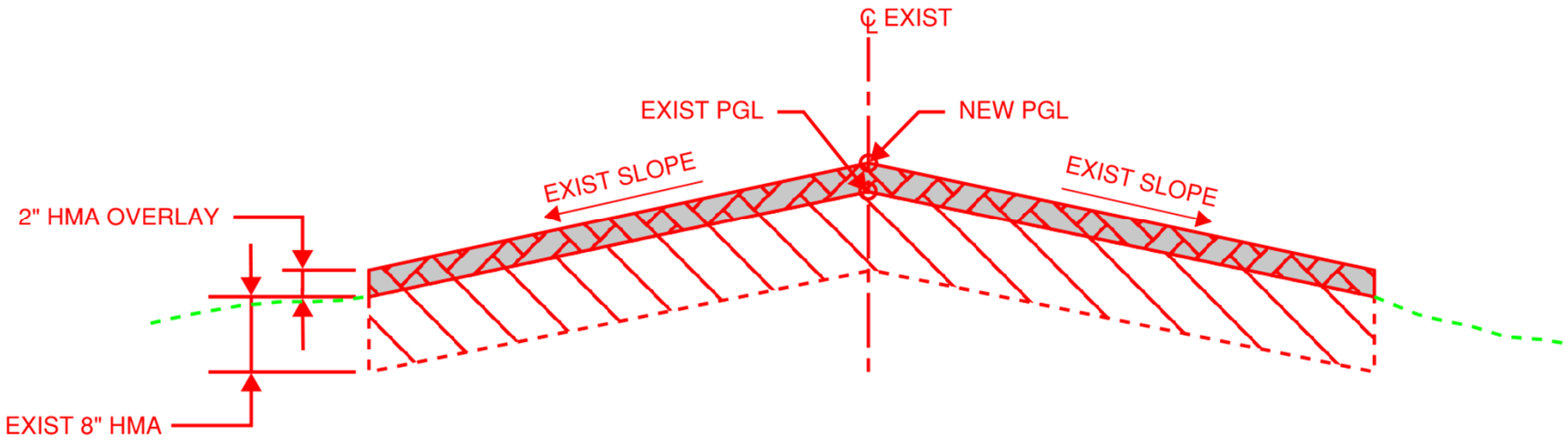
QUESTIONS?

SURFACE TREATMENT METHODS & TEMPLATES

- Understanding various Methods
- Creating Templates for each Method

OVERLAY ONLY (MATCH EXIST SLOPE)

Surface Treatment Methods

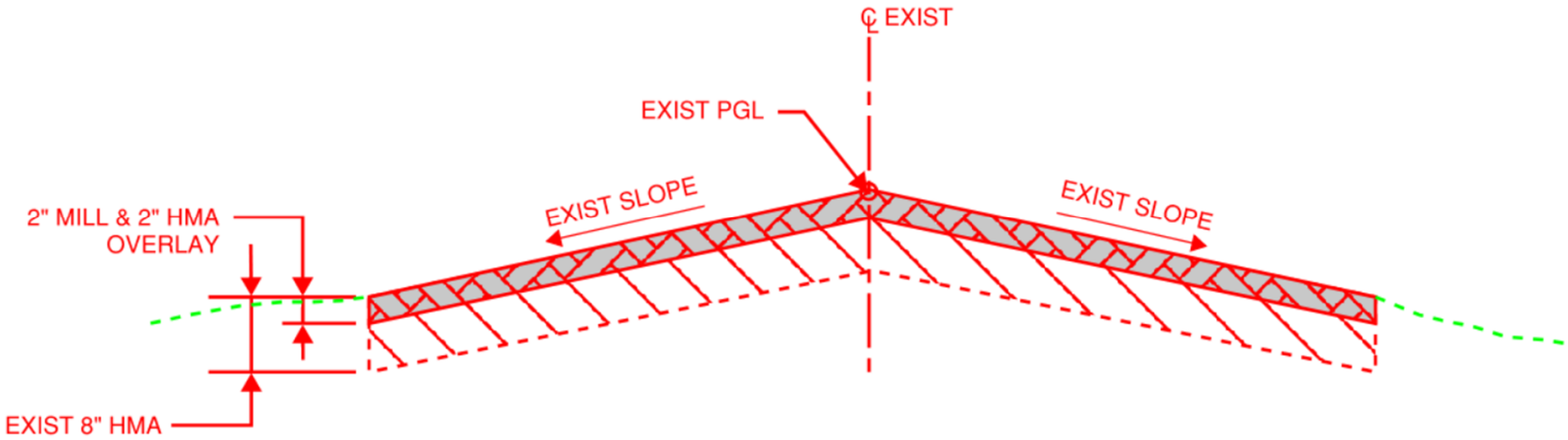


Overview:

- No Milling involved
- Constant Overlay thickness of new pavement directly above existing pavement
- Pavement matches existing cross slope
- New PGL above Existing PGL matches Overlay thickness
- Additional Side Slope Grading may be involved

EQUAL MILL & OVERLAY (MATCH EXIST SLOPE)

Surface Treatment Methods

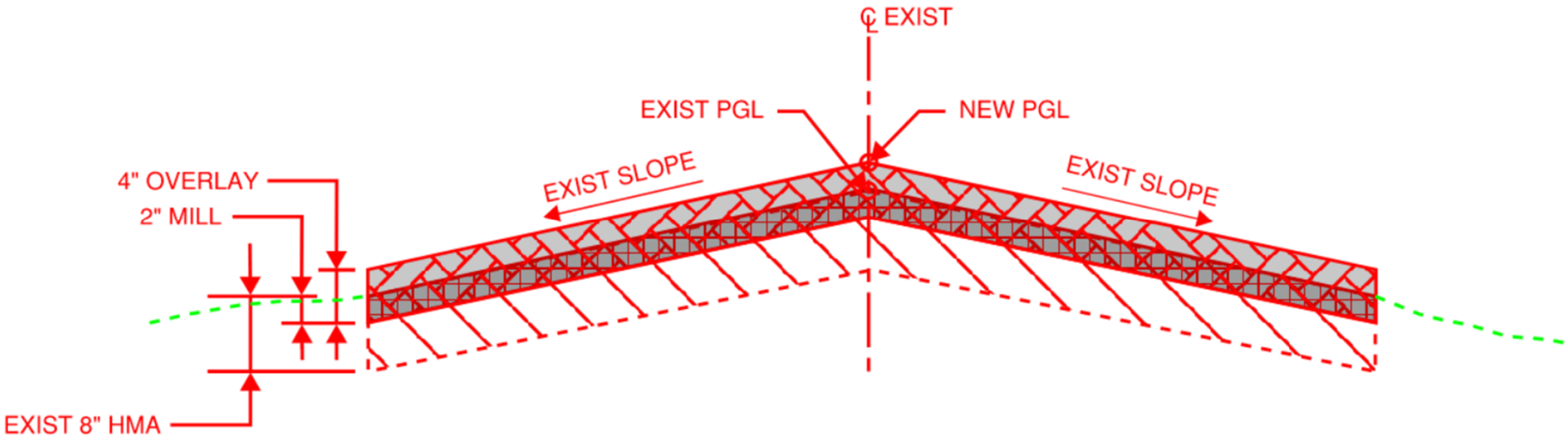


Overview:

- Mill entire width of pavement the same depth as will be Overlayed with new pavement
- Pavement matches existing cross slope
- New PGL matches Existing PGL
- No Side Slope Grading necessary

MILL W/ ADDITIONAL OVERLAY (MATCH EXIST SLOPE)

Surface Treatment Methods

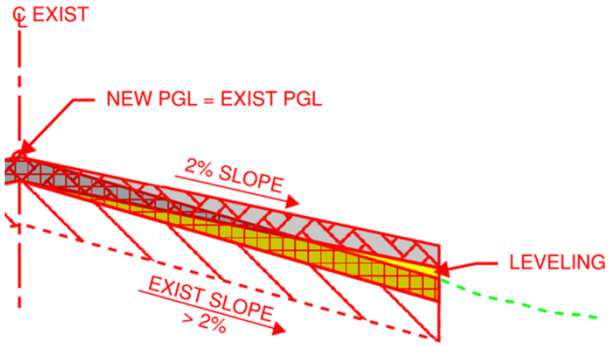


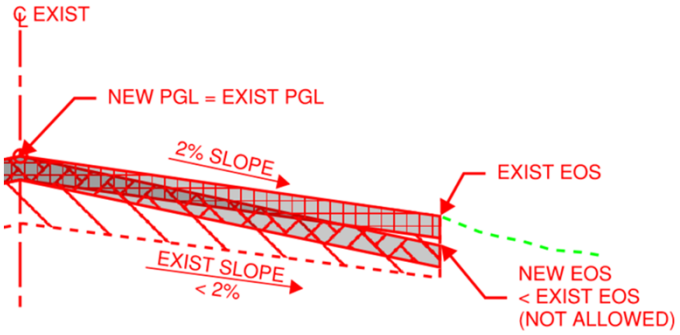
Overview:

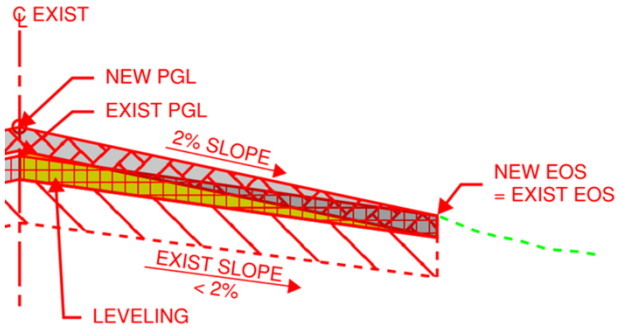
- Mill entire width of pavement less than Overlay thickness
- Overlay thickness exceeds Milling thickness
- Pavement matches existing cross slope
- New PGL matches delta of Overlay thickness minus Milling thickness
- Additional Side Slope Grading may be involved

MILL & OVERLAY w/ LEVELING (2% CROSS SLOPE CORRECTION)

Surface Treatment Methods







Case 1: (Exist Slope > 2% Slope)

- New 2% Slope above Exist Slope (Allowed)
- Requires Leveling
- New PGL matches Exist PGL
- Additional Side Slope Grading may be involved

Case 2: (Exist Slope < 2% Slope)

- New 2% Slope below Exist Slope (**Not Allowed**)
- Would leave sub-standard pavement section
- New PGL matches Exist PGL

Case 3: (Exist Slope < 2% Slope)

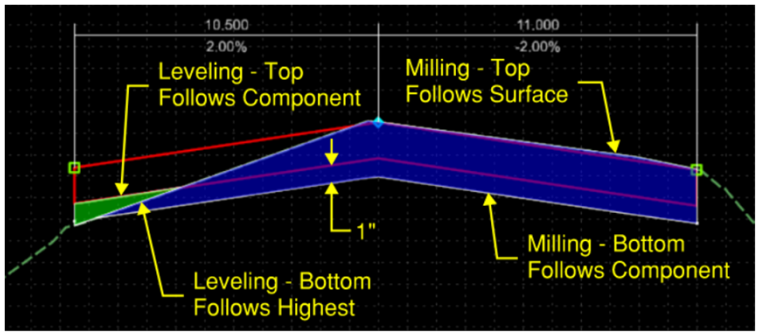
- New 2% Slope above Exist Slope (Allowed)
- Requires Leveling
- New PGL above Exist PGL
- No Side Slope Grading necessary

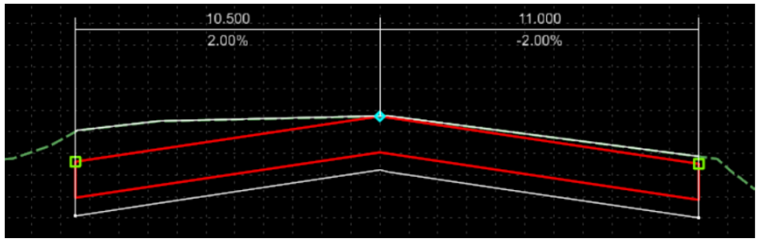
Overview:

- Case 1 & 3 Allowed but Not Case 2
- Difficult to design when exist slope varies (> & < 2%)
- Requires New PGL when exist slope < 2%
- Must consider exist cross slopes on either side of ℄

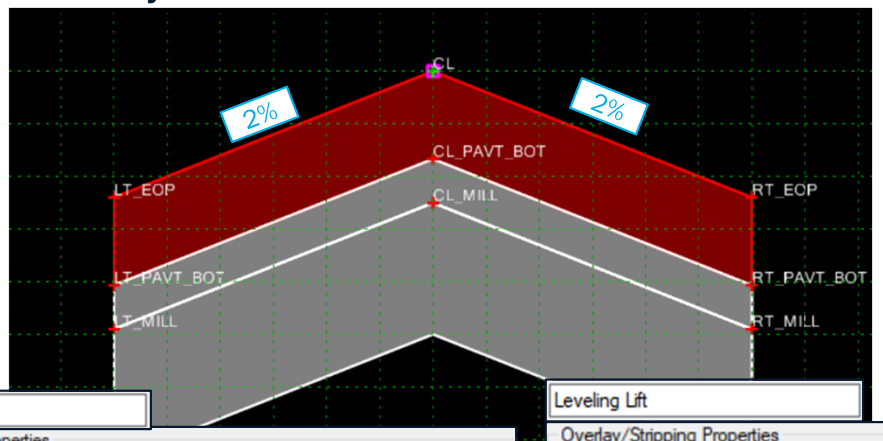
CDOT ITL OVERLAY TEMPLATE

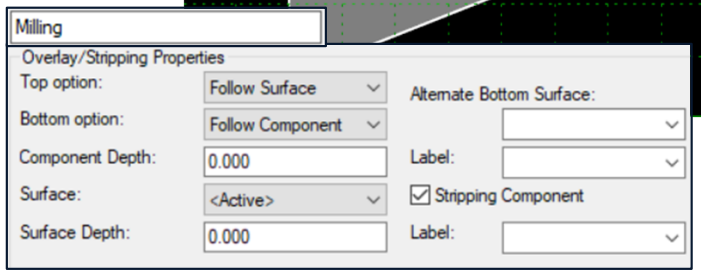
Surface Treatment Template

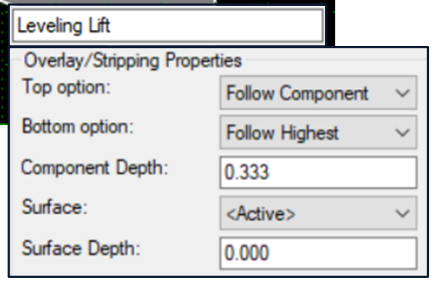


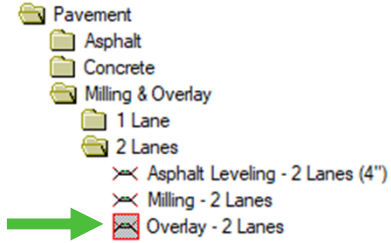


Overlay - 2 Lanes









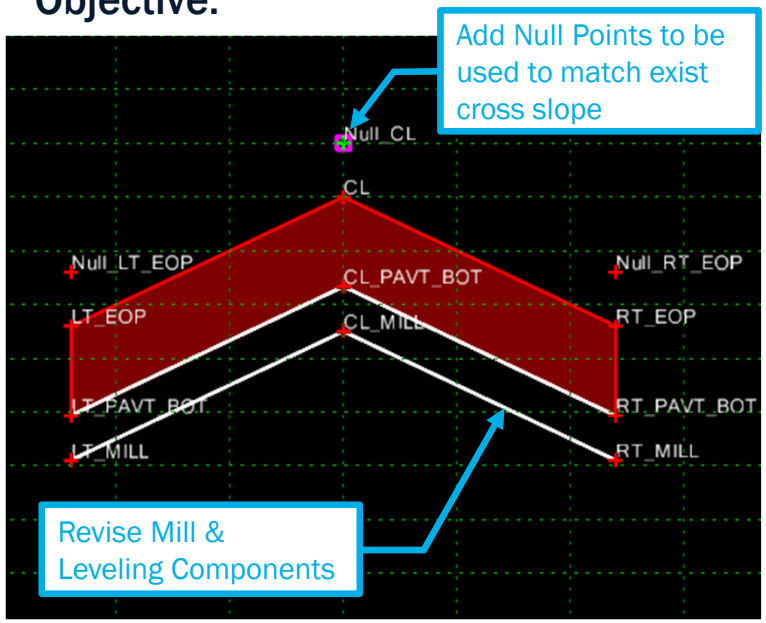
Overview:

- Template forces a 2% cross slope and does not match existing cross slope. If existing cross slope is < 2%, template will force cut beneath existing pavement resulting in sub-standard section.
- Top of Milling is set to follow existing ground and bottom follows 1” below asphalt component
- Leveling follows below asphalt component and bottom follows highest between existing ground or 4” depth of leveling. If more than 4” of leveling is required, template will not handle that.

CREATING OVERLAY TEMPLATE (MATCH EXIST SLOPE)

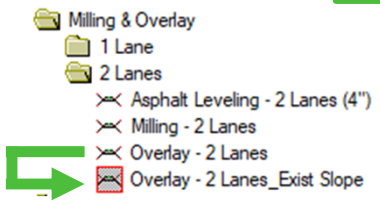
Revise Mill & Leveling Components & Add Null Points

Objective:



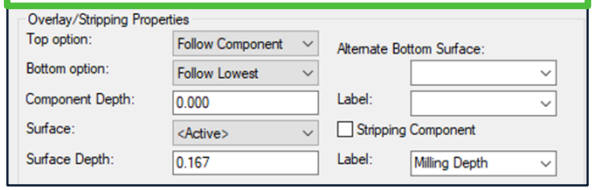
- Copy "Overlay – 2 Lanes" Paste/Rename to "Overlay – 2 Lanes_Exist Slope"

Copy/ Rename

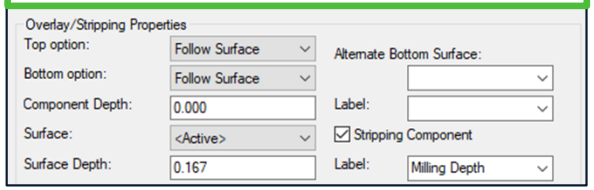


Instructions:

Step 1:
- Right Click "Leveling Lift" Component
- Select **Edit...**
- Set Component Properties as provided
- Click **Apply**, Click **Close**



Step 2:
- Right Click "Milling" Component
- Select **Edit...**
- Set Component Properties as provided
- Click **Apply**, Click **Close**



Step 3:
- Create 3 Null Points, above "CL", "LT_EOP" & "RT_EOP"
- Right Click over each point
- Select **Add New Component/Null Point**
- Set each Null Point about 0.10' above original point
- Right Click each Null Point
- Select **Edit...**
- Set each Null Point Properties as provided
- Click **Apply**, Click **Close**
- Set Null_CL as new Template Origin

Point Properties:
- Name: Null_CL
- Feat. Def.: TempPoint-Null Point

Constraints

- Type: Horizontal	- Type: Vertical
- Parent: CL	- Parent: CL
- Value: 0.000	- Value: 0.100

Point Properties:
- Name: Null_LT_EOP
- Feat. Def.: TempPoint-Null Point

Constraints

- Type: Horizontal	- Type: Slope
- Parent: Null_CL	- Parent: Null_CL
- Value: -12.000	- Value: 2.00%
- Label: LT_Pavt_Width	- Label:

Point Properties:
- Name: Null_RT_EOP
- Feat. Def.: TempPoint-Null Point

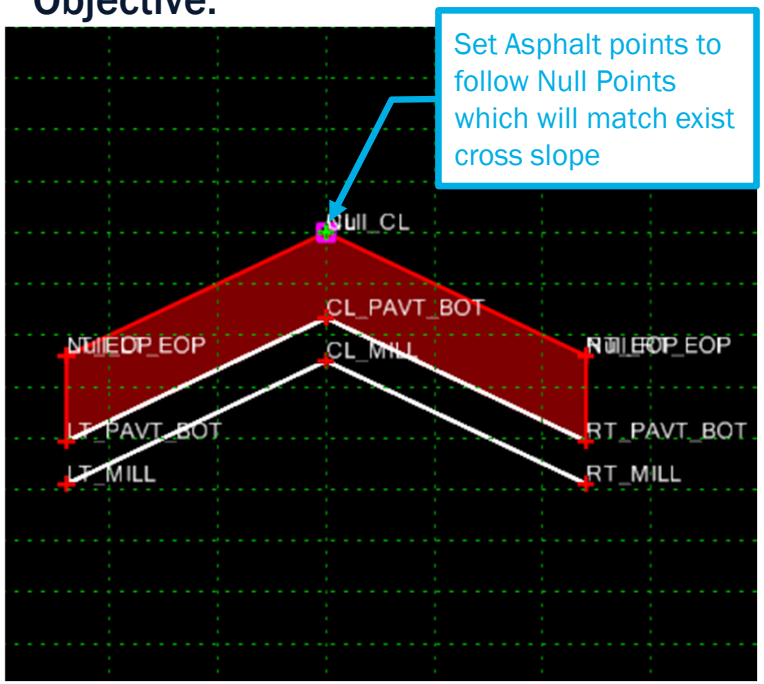
Constraints

- Type: Horizontal	- Type: Slope
- Parent: Null_CL	- Parent: Null_CL
- Value: 12.000	- Value: -2.00%
- Label: RT_Pavt_Width	- Label:

CREATING OVERLAY TEMPLATE (MATCH EXIST SLOPE)

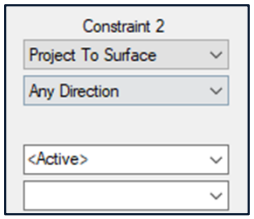
Revise Null Points & Asphalt Points

Objective:



Instructions:

Step 1:
- Right Click Points “Null_LT_EOP” & “Null_RT_EOP”
- Select **Edit...** for each Point
- Revise 2nd Point Constraint as provided
- Click **Apply**, Click **Close**



Step 2:
- Right Click Points “CL”, “LT_EOP” & “RT_EOP”
- Select **Edit...** for each Point
- Revise Point Properties as provided
- Click **Apply**, Click **Close**

CL (Constraints):

- Type: Horizontal	- Type: Vertical
- Parent: Null_CL	- Parent: Null_CL
- Value: 0.000	- Value: 0.000
- Label:	- Label: Overlay Above Exist

LT_EOP (Constraints):

- Type: Horizontal	- Type: Vertical
- Parent: Null_LT_EOP	- Parent: Null_LT_EOP
- Value: 0.000	- Value: 0.000
- Label:	- Label: Overlay Above Exist

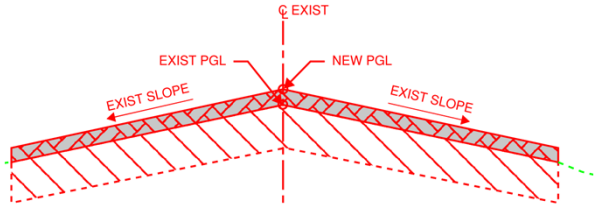
RT_EOP (Constraints):

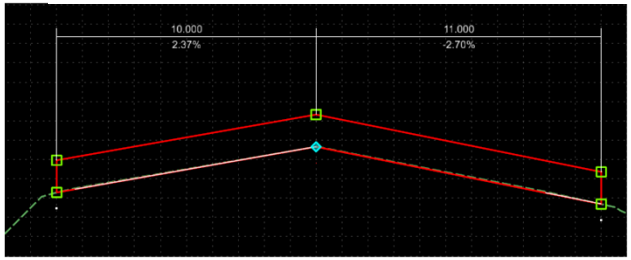
- Type: Horizontal	- Type: Vertical
- Parent: Null_RT_EOP	- Parent: Null_RT_EOP
- Value: 0.000	- Value: 0.000
- Label:	- Label: Overlay Above Exist

EXAMPLES OF OVERLAY TEMPLATE (MATCH EXIST SLOPE)

One Template handles various Methods with use of Parametric Constraints

Overlay Only (Match Exist Slope)

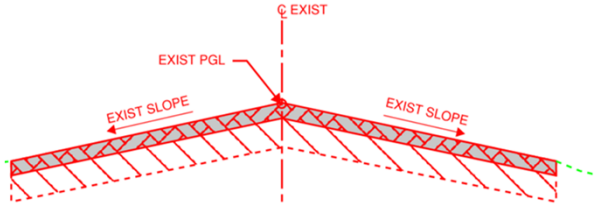


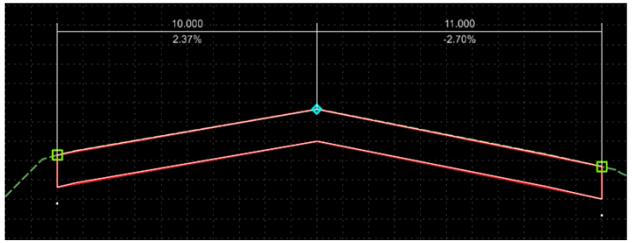


Parametric Constraint	
Enabled	☑
Constraint Label	Milling Depth
Start Value	0.0000
Stop Value	0.0000

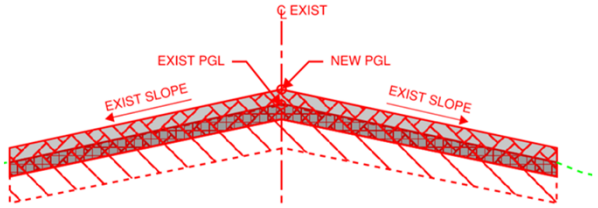
Parametric Constraint	
Enabled	☑
Constraint Label	Overlay Above Exist
Start Value	0.1667
Stop Value	0.1667

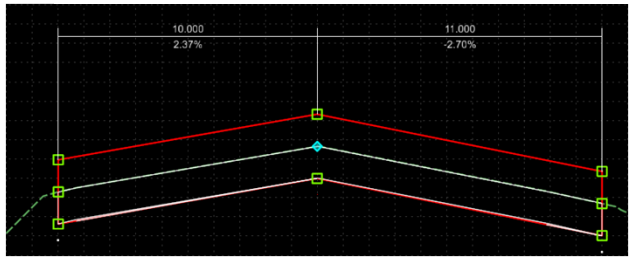
Equal Mill & Overlay (Match Exist Slope)





Mill w/ Additional Overlay (Match Exist Slope)





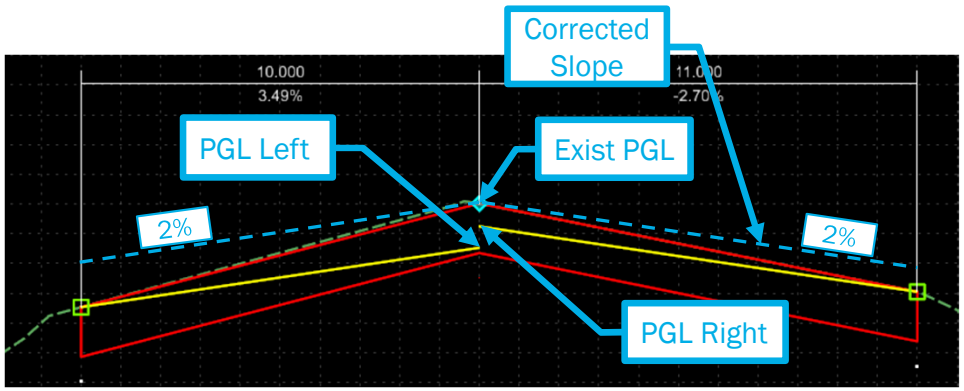
Parametric Constraint	
Enabled	☑
Constraint Label	PavtLift1_Thickness
Start Value	-0.3333
Stop Value	-0.3333

Parametric Constraint	
Enabled	☑
Constraint Label	Overlay Above Exist
Start Value	0.1667
Stop Value	0.1667

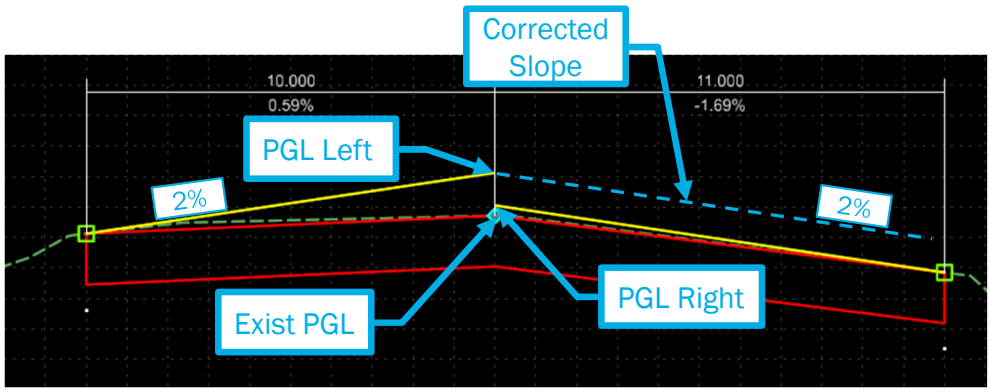
UNDERSTANDING OVERLAY TEMPLATE (SLOPE CORRECTION)

PGL Based on whether Exist Slopes are > or < 2%

Exist Slope > 2% Slope



Exist Slope < 2% Slope



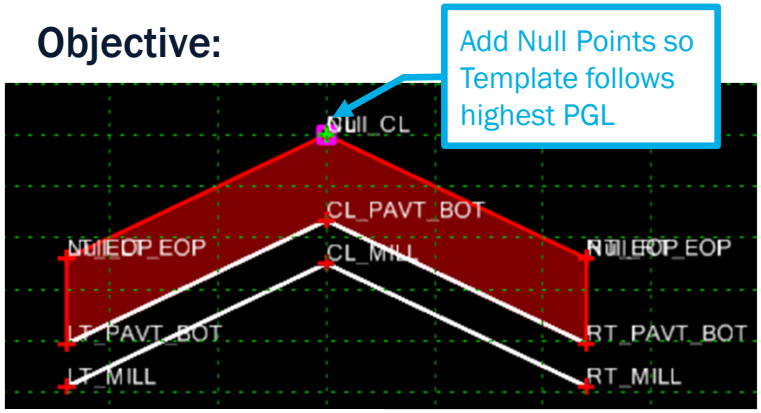
Overview:

- In each case presented above, the Template has 3 different PGL's to follow "PGL Left", "Exist PGL" or "PGL Right".
- Both "PGL Left" & "PGL Right" are projected PGL's that are 2% cross slopes from the Existing EOP's to the CL.
- The Template must always use the highest of the 3 PGL's to ensure the desirable pavement section is maintained.
- Vertical Maximum constraints will be used between the 3 PGL's which will force the Template to use the highest.

CREATING OVERLAY TEMPLATE (SLOPE CORRECTION)

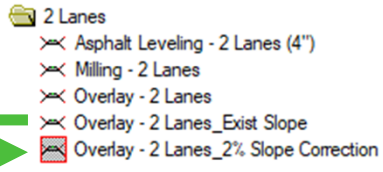
Null Points define Highest PGL to follow

Objective:



- Copy "Overlay – 2 Lanes_Exist Slope" Paste/Rename to "Overlay - 2 Lanes_2% Slope Correction"

Copy/ Rename



Instructions:

Step 1:
- Create 2 Null Points, above & below Point "CL"
- Right Click over Point "CL"
- Select **Add New Component/Null Point**
- Set one Null Point about 0.10' above & one below "CL"
- Right Click each Null Point, Select **Edit...**
- Set each Null Point Properties as provided
- Click **Apply**, Click **Close**
- This will set both new Null Points directly on top of "CL"

Point Properties:
- Name: Null_LT_2%_CL
- Feat. Def.: TempPoint-Null Point

Constraints

- Type: Horizontal	- Type: Slope
- Parent: Null_CL	- Parent: Null_LT_EOP
- Value: 0.000	- Value: 2.00%
- Label:	- Label: LT_Pavt_Slope

Point Properties:
- Name: Null_RT_2%_CL
- Feat. Def.: TempPoint-Null Point

Constraints

- Type: Horizontal	- Type: Slope
- Parent: Null_CL	- Parent: Null_RT_EOP
- Value: 0.000	- Value: -2.00%
- Label:	- Label: RT_Pavt_Slope

Step 2:
- Create Null Point to determine Vertical Maximum between Null Points created in previous step
- Right Click over Point "CL"
- Select **Add New Component/Null Point**
- Set Null Point about 0.10' above "CL"
- Right Click Null Point, Select **Edit...**
- Set Null Point Properties as provided
- Click **Apply**, Click **Close**
- This will set new Null Point directly on top of "CL"

Point Properties:
- Name: Null_2%_CL_Max
- Feat. Def.: TempPoint-Null Point

Constraints

- Type: Horizontal	- Type: Vertical Maximum
- Parent: Null_CL	- Parent: Null_LT_2%_CL
	- Parent: Null_RT_2%_CL
- Value: 0.000	- Value: 0.000

Step 3:
- Set Point "CL" to Vertical Maximum so entire Template moves to highest PGL
- Right Click Point "CL", Select **Edit...**
- Set Point Properties as provided
- Click **Apply**, Click **Close**

CL (Constraints):

- Type: Horizontal	- Type: Vertical Maximum
- Parent: Null_CL	- Parent: Null_CL
	- Parent: Null_2%_CL_Max
- Value: 0.000	- Value: 0.000
- Label:	- Label: Overlay Above Exist

Step 4:
- Revise Points with following Constraints

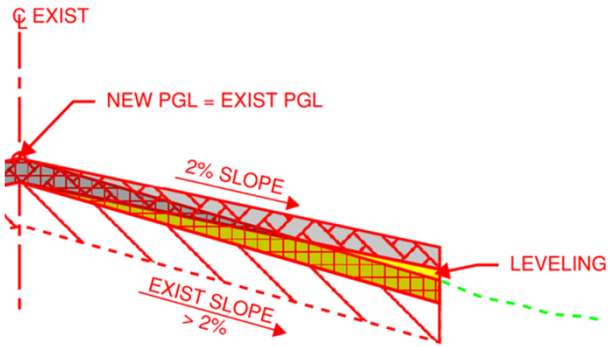
LT_EOP (2nd Constraint):
- Type: Slope
- Parent: CL
- Value: 2.00%
- Label: LT_Pavt_Slope

RT_EOP (2nd Constraint):
- Type: Slope
- Parent: CL
- Value: -2.00%
- Label: RT_Pavt_Slope

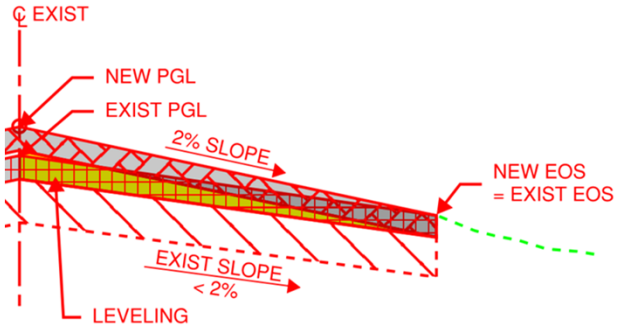
EXAMPLES OF OVERLAY TEMPLATE (SLOPE CORRECTION)

One Template follows Highest PGL

Exist Slope > 2% Slope



Exist Slope < 2% Slope



QUESTIONS?

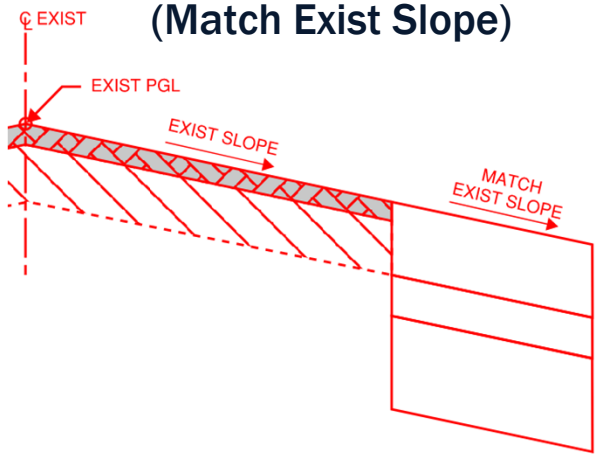
WIDENING PROJECT TEMPLATES

- Understanding various Methods
- Creating Templates for each Method

OVERLAY & WIDEN (MATCH EXIST & 2% SLOPE)

Widening Methods

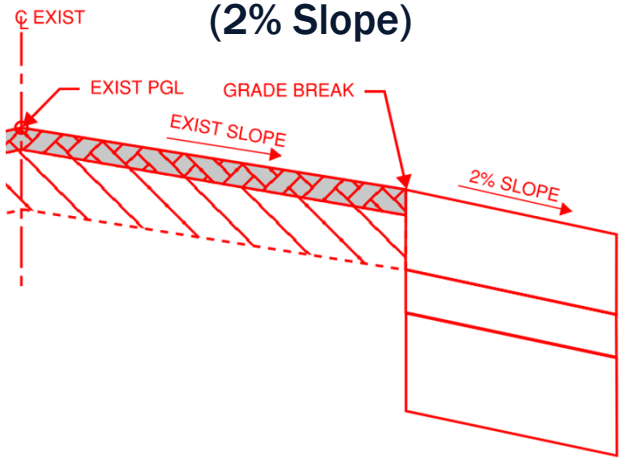
Overlay & Widen (Match Exist Slope)



Overview:

- Widening finished grade dependent on Mill and Overlay method
- Widening matches existing cross slope (Uniform slope)
- Varying of existing cross slope extended into Widening
- Additional Side Slope Grading involved with Widening

Overlay & Widen (2% Slope)



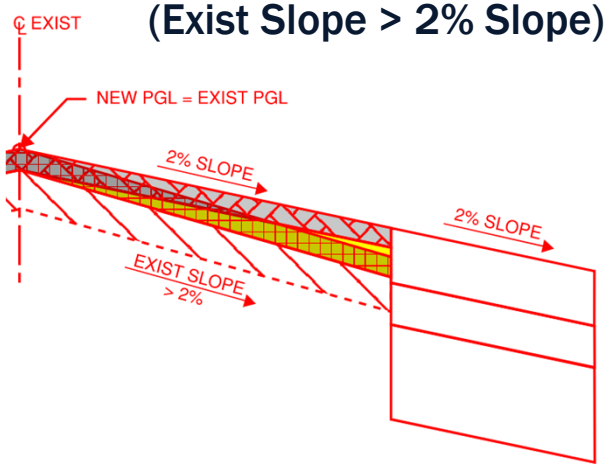
Overview:

- Widening finished grade dependent on Mill and Overlay method
- Widening provided at constant 2% cross slope
- Grade break created between existing and widened pavement
- Additional Side Slope Grading involved with Widening

OVERLAY & WIDEN (SLOPE CORRECTION)

Widening Methods

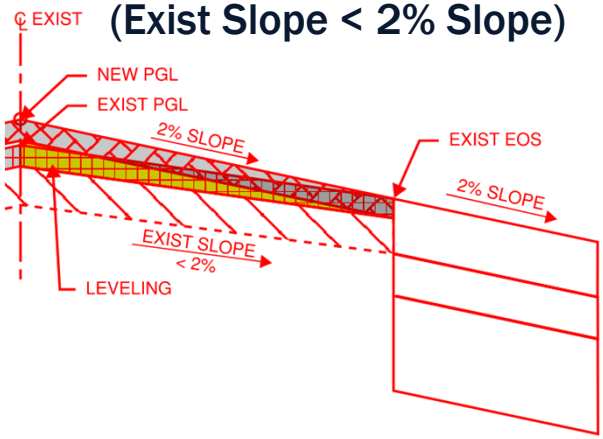
Overlay & Widen (Exist Slope > 2% Slope)



Overview:

- New 2% Slope above Exist Slope (Allowed)
- Overlay & Widening at constant 2% cross slope
- Requires Leveling
- New PGL matches Exist PGL
- Additional Side Slope Grading involved with Widening

Overlay & Widen (Exist Slope < 2% Slope)

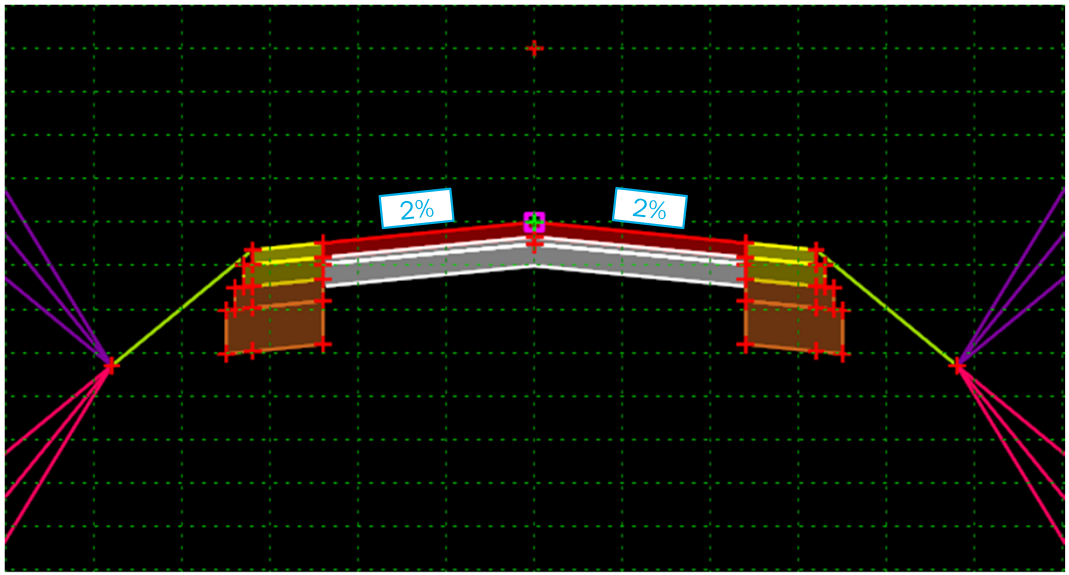


Overview:

- New 2% Slope above Exist Slope (Allowed)
- Overlay & Widening at constant 2% cross slope
- Requires Leveling
- New PGL above Exist PGL
- Additional Side Slope Grading involved with Widening

CDOT ITL OVERLAY & WIDENING TEMPLATE

2 Lane - Widening - HMA Full Depth



Milling

Overlay/Stripping Properties

Top option:	Follow Surface	Alternate Bottom Surface:	
Bottom option:	Follow Component		
Component Depth:	0.000	Label:	
Surface:	<Active>	Stripping Component	
Surface Depth:	0.000	Label:	

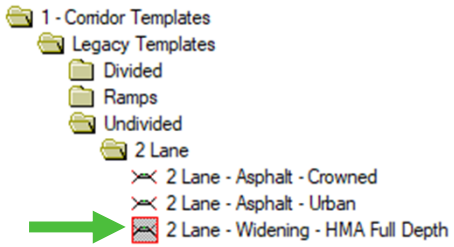
Leveling Lift

Overlay/Stripping Properties

Top option:	Follow Component
Bottom option:	Follow Highest
Component Depth:	0.333
Surface:	<Active>
Surface Depth:	0.000

Overview:

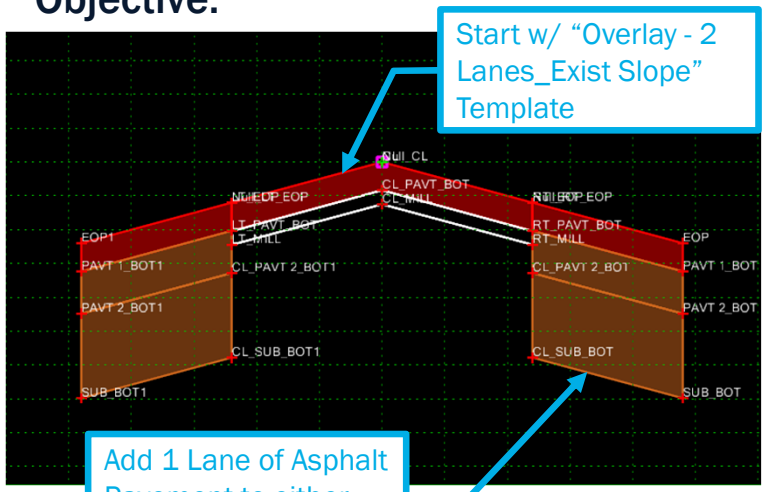
- Template forces a 2% cross slope for Overlay & Widening and does not match existing cross slope. If existing cross slope is < 2%, template will force cut beneath existing pavement resulting in sub-standard section.
- Milling and Leveling portion of template are the same from the CDOT Overlay template and thus have the same parameters.



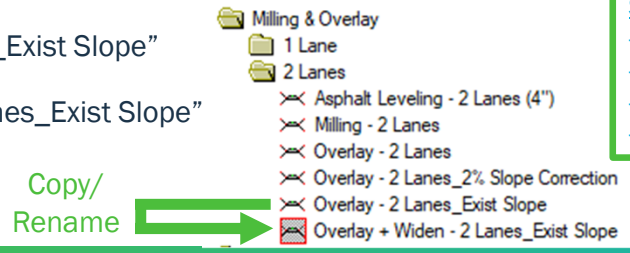
CREATING WIDENING TEMPLATE (MATCH EXIST SLOPE)

Add to Overlay Template to create Widening Template

Objective:

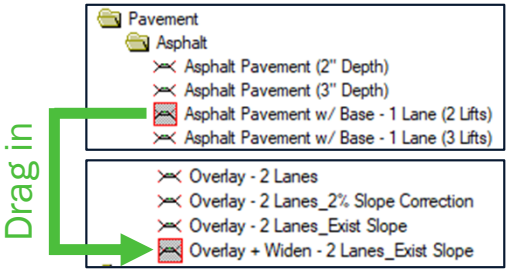


- Copy "Overlay - 2 Lanes_Exist Slope" Paste/Rename to "Overlay + Widen - 2 Lanes_Exist Slope"



Instructions:

Step 1:
- Drag in "Asphalt Pavement w/ Base - 1 Lane (2 Lifts)" & place directly on Point "RT_EOP"
- Click on "RT_EOP" when prompted to **Merge CL1 With Point**



Step 2:
- Right Click Point "EOP"
- Select **Edit...**
- Set 2nd Constraint Properties as provided
- Click **Apply**, Click **Close**

EOP (2nd Constraint):
- Type: Vector-Offset
- Parent: CL
- Parent: RT_EOP
- Value: 0.000

Step 3:
- Drag in/Reflect "Asphalt Pavement w/ Base - 1 Lane (2 Lifts)" & place directly on Point "LT_EOP"
- Click on "LT_EOP" when prompted to **Merge CL1 With Point**

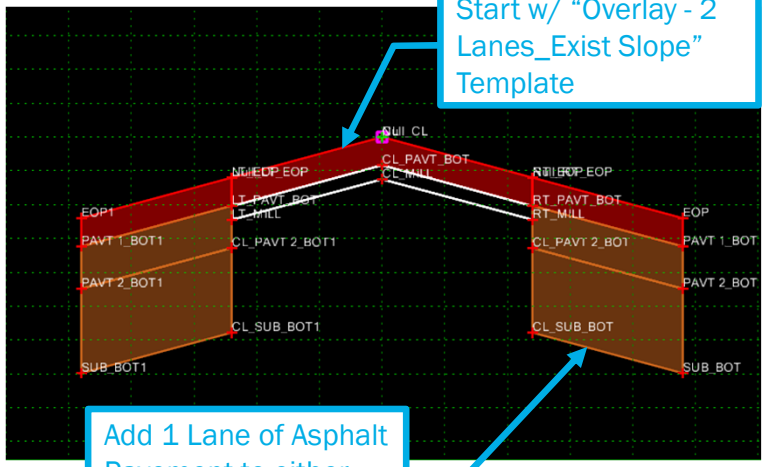
Step 4:
- Right Click Point "EOP1"
- Select **Edit...**
- Set 2nd Constraint Properties as provided
- Click **Apply**, Click **Close**

EOP1 (2nd Constraint):
- Type: Vector-Offset
- Parent: CL
- Parent: LT_EOP
- Value: 0.000

CREATING WIDENING TEMPLATE (2% SLOPE)

Add to Overlay Template to create Widening Template

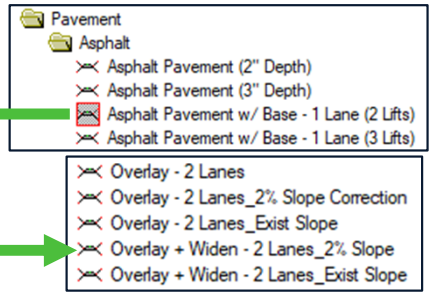
Objective:



Instructions:

Step 1:
- Drag in "Asphalt Pavement w/ Base - 1 Lane (2 Lifts)" & place directly on Point "RT_EOP"
- Click on "RT_EOP" when prompted to **Merge CL1 With Point**

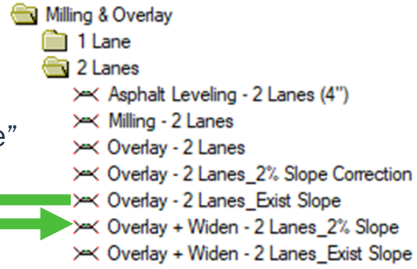
Drag in



Step 2:
- Drag in/Reflect "Asphalt Pavement w/ Base - 1 Lane (2 Lifts)" & place directly on Point "LT_EOP"
- Click on "LT_EOP" when prompted to **Merge CL1 With Point**

- Copy "Overlay - 2 Lanes_Exist Slope" Paste/Rename to "Overlay + Widen - 2 Lanes_2% Slope"

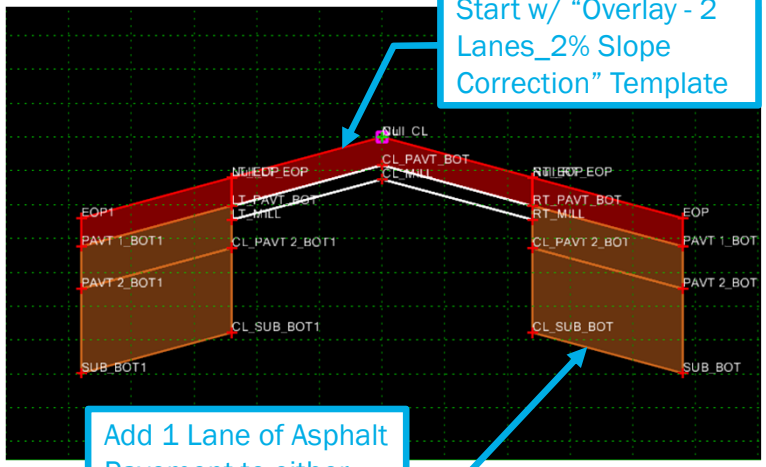
Copy/ Rename



CREATING WIDENING TEMPLATE (SLOPE CORRECTION)

Add to Overlay Template to create Widening Template

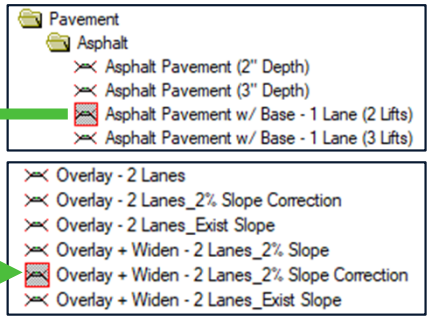
Objective:



Instructions:

Step 1:
- Drag in "Asphalt Pavement w/ Base - 1 Lane (2 Lifts)" & place directly on Point "RT_EOP"
- Click on "RT_EOP" when prompted to **Merge CL1 With Point**

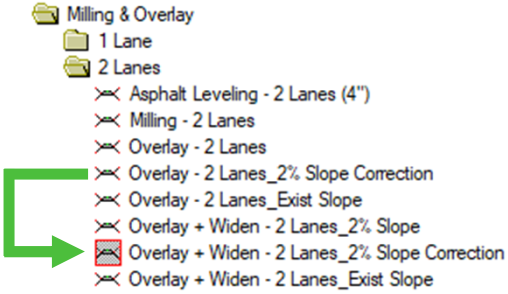
Drag in



Step 2:
- Drag in/Reflect "Asphalt Pavement w/ Base - 1 Lane (2 Lifts)" & place directly on Point "LT_EOP"
- Click on "LT_EOP" when prompted to **Merge CL1 With Point**

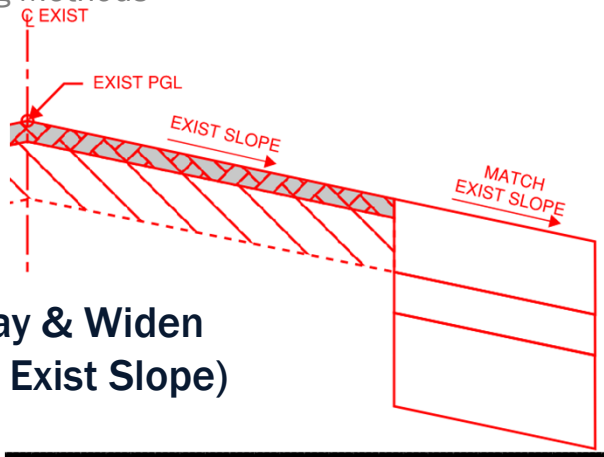
- Copy "Overlay - 2 Lanes_2% Slope Correction" Paste/Rename to "Overlay + Widen - 2 Lanes_2% Slope Correction"

Copy/ Rename

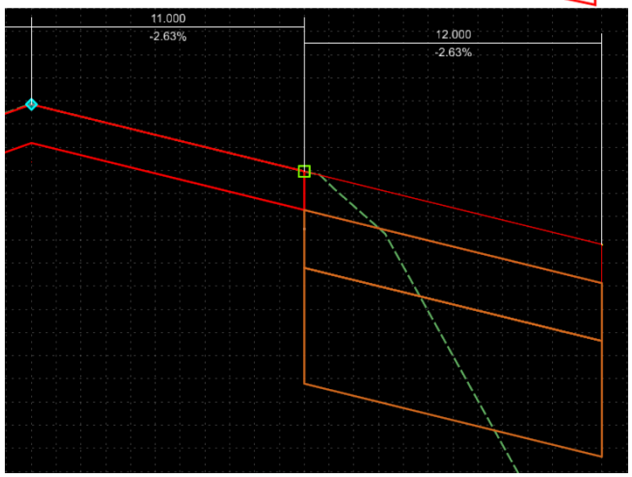


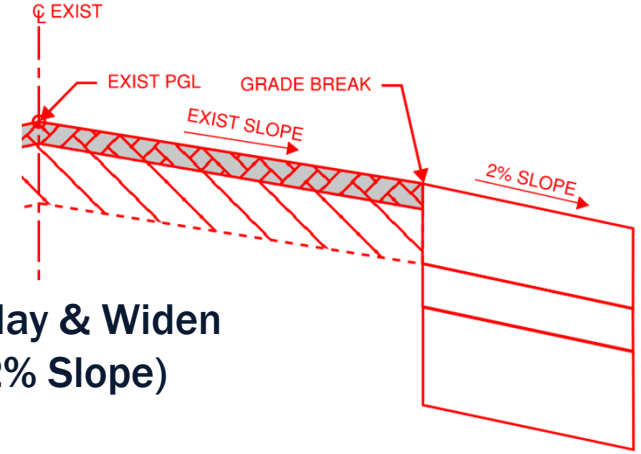
EXAMPLES OF WIDENING TEMPLATES (EXIST & 2% SLOPE)

Widening Methods

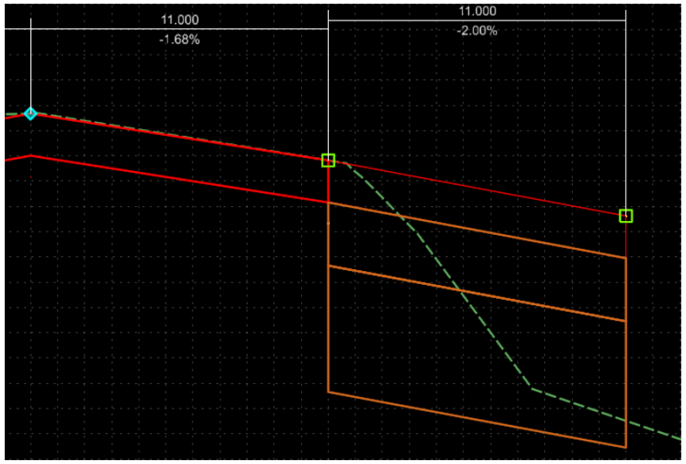


Overlay & Widen (Match Exist Slope)



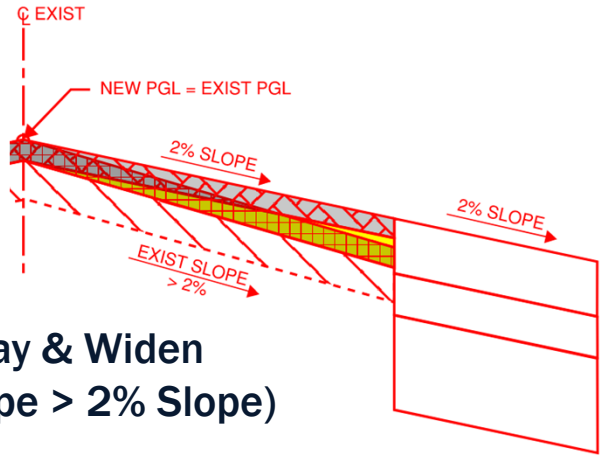


Overlay & Widen (2% Slope)

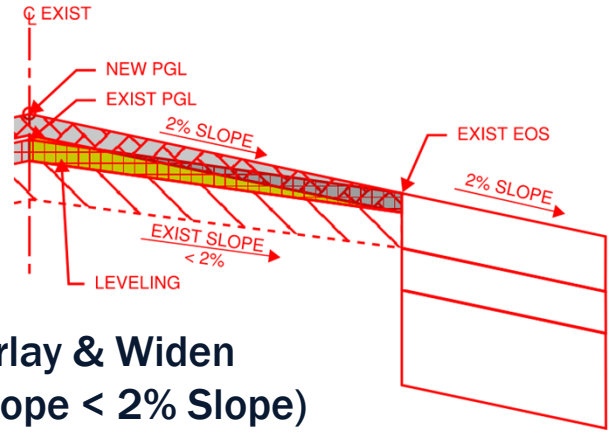


EXAMPLES OF WIDENING TEMPLATES (SLOPE CORRECTION)

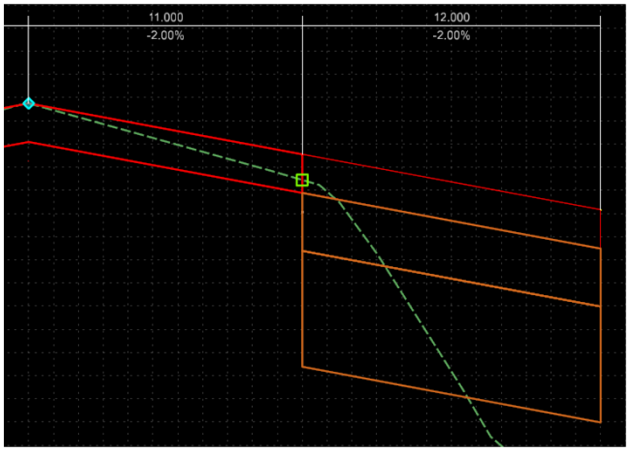
Widening Methods

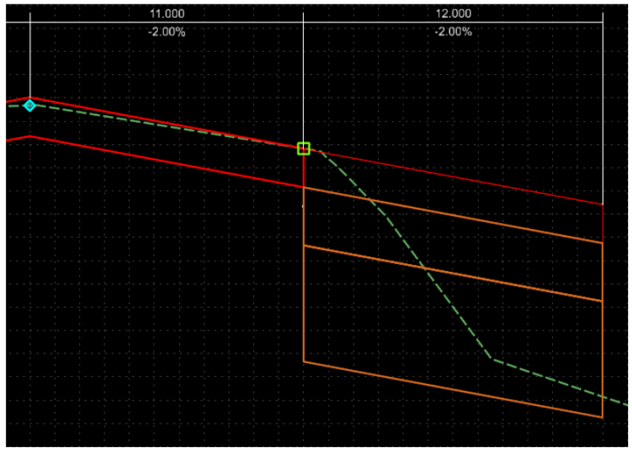


Overlay & Widen
(Exist Slope > 2% Slope)



Overlay & Widen
(Exist Slope < 2% Slope)





QUESTIONS?