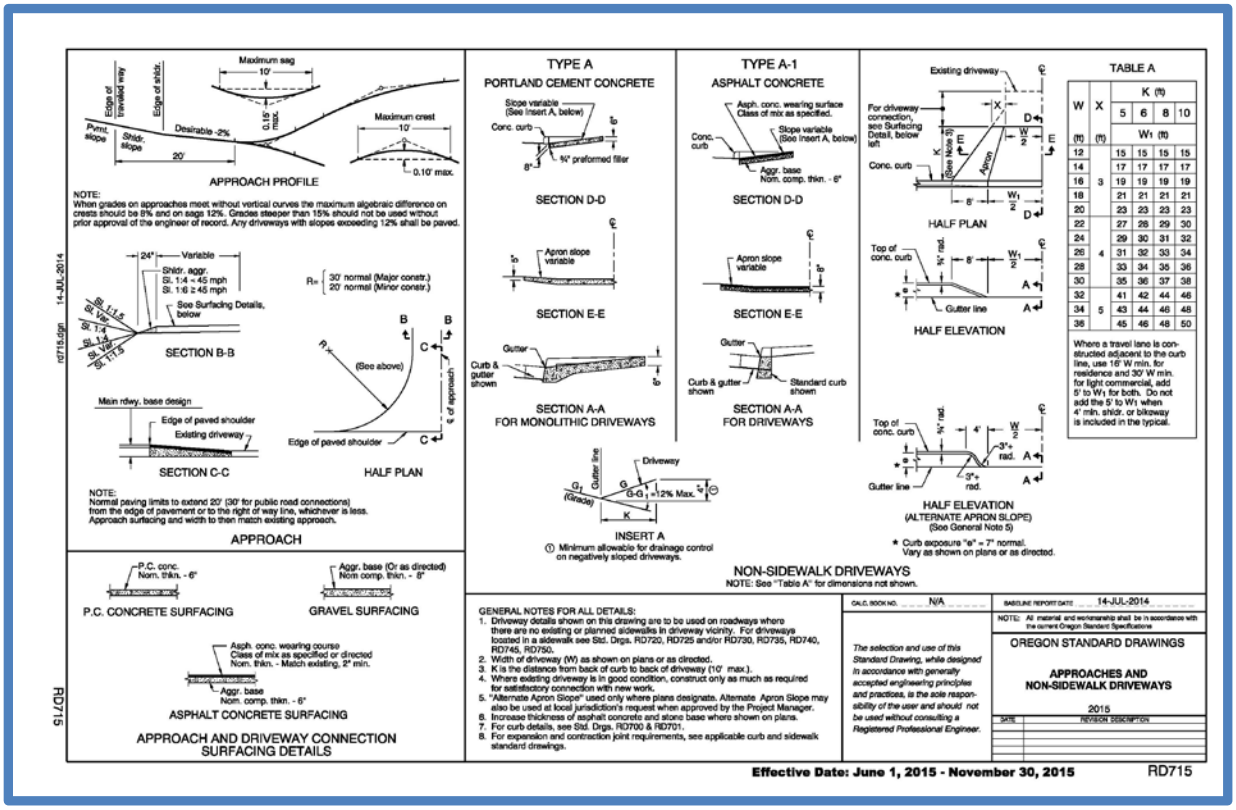
Module 09 MINOR APPROACHES & DRIVEWAYS Using InRoads

Introduction

This module will cover an area of modeling detail that falls outside the bounds of the **ROADWAY DESIGNER**.

A large amount of modeling is concentrated on the main roadway section, those areas that are generally 'typical'. However, some fine-tuning of the model is often done outside of the InRoads **ROADWAY DESIGNER**, after the 'typical' model is created. One of those areas is driveways and minor approaches.



These areas are often modeled by taking the main roadway model and 'manually' constructing the driveway edge features. Smaller driveways do this using a combination of **MICROSTATION** tools, the InRoads **DESIGN SURFACE** and **EDIT SURFACE** tools. Other minor approaches can use strategic geometry layout tools to build some of the driveway edges.

Purpose of this Module

The purpose of this module is to demonstrate the various tools and workflows used to model various driveway approaches that intersect with a main corridor.

Objectives of this Module

At the end of this module, you will be able to use the InRoads surface design tools and InRoads geometry to model various driveway approaches that intersect the main corridor.

Definition of Audience for future Modules

Please note that this module assumes that you have a certain level of competency with the software tools and will be asking you to execute some commands with very little instruction. This module was designed with a certain technical audience in mind, so ensure that you have the proper prerequisites.

Skill Level / Prerequisites:

The prerequisites for this module are the following:

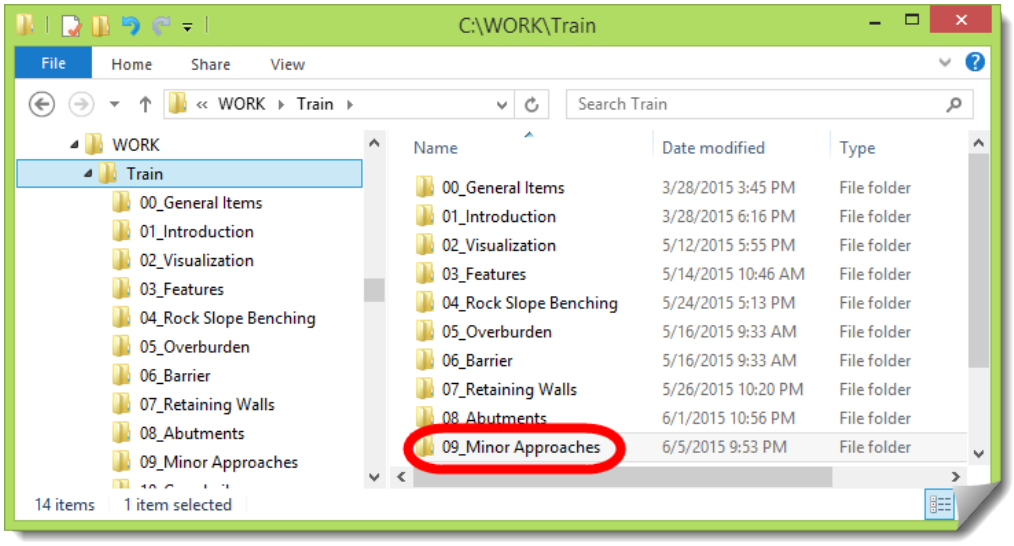
- Module 1 – Introduction to the Training Modules
- Module 2 – Visualization
- Module 3 – Working with InRoads Features
- Module 8 - Abutments
- MicroStation Basics
- InRoads Level 1

Module Files and Folders

Training Folders

You will be working on your own hard drive during this training. The module instructions will expect the training files and folders to be set up as shown here in order to align with the module directions.

You should have the **`09_Minor Approaches`** training folder and files on your local drive. The module folder and related files should be placed under the ***C:\WORK\Train*** folder, and look like this:



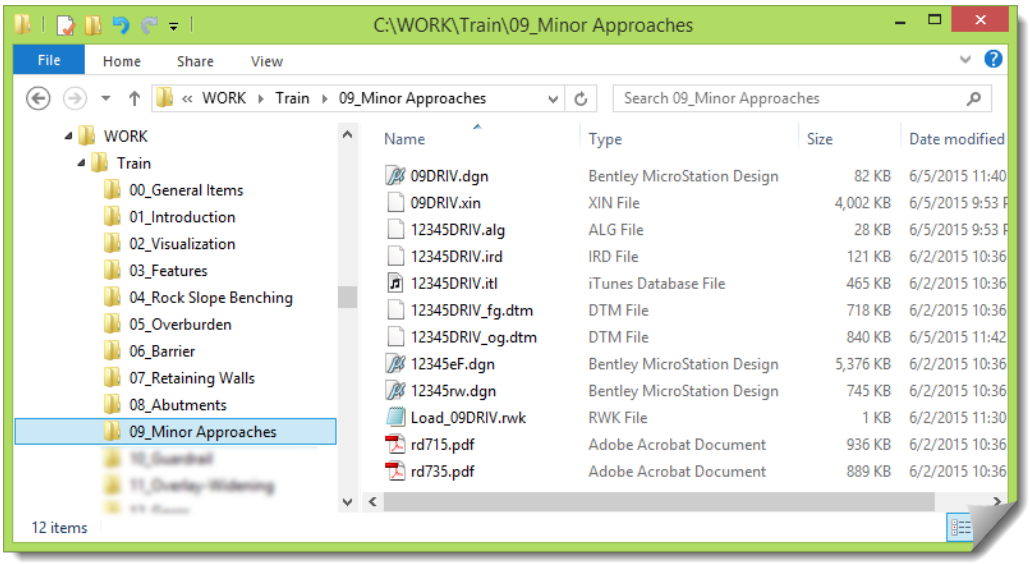
Training Files

The module folder contains all the files that will be used in these exercises including:

- **09DRIV.dgn**, the initial MicroStation file used at the start of the exercises
- **09DRIV.xin**, the InRoads configuration file for this work

There is an **RWK** file included in the module folder to assist in opening the InRoads files.

In this module folder, you should have these files:

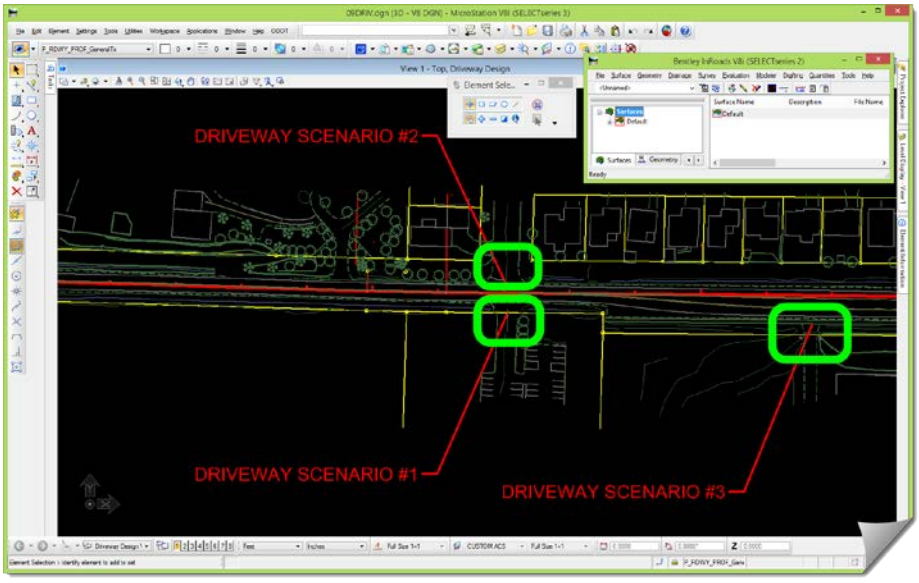


Technical Content of Training:

Project Orientation

REVIEW WORK AREA

The OG and FG surfaces, as well as the mainline alignment are already created. The focus of the work, as shown here, will be three areas where driveways or minor approaches will be constructed.



PREPARE MICROSTATION / INROADS DATA & FILES

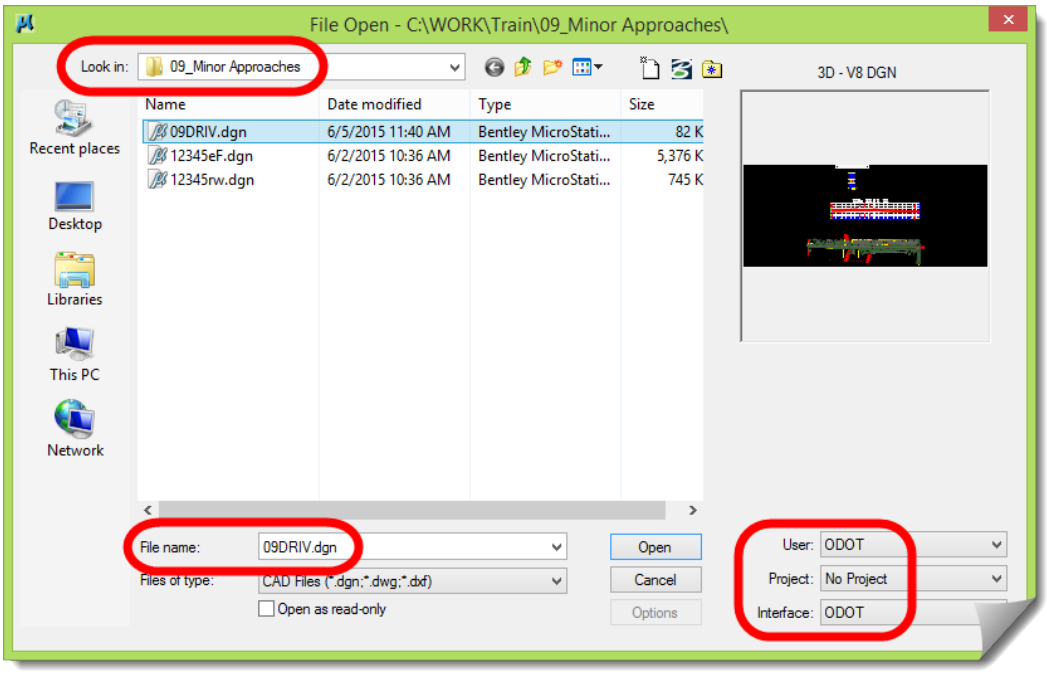
This section will get you into the DGN, load the module-specific XIN and other data files.

1) Launch InRoads

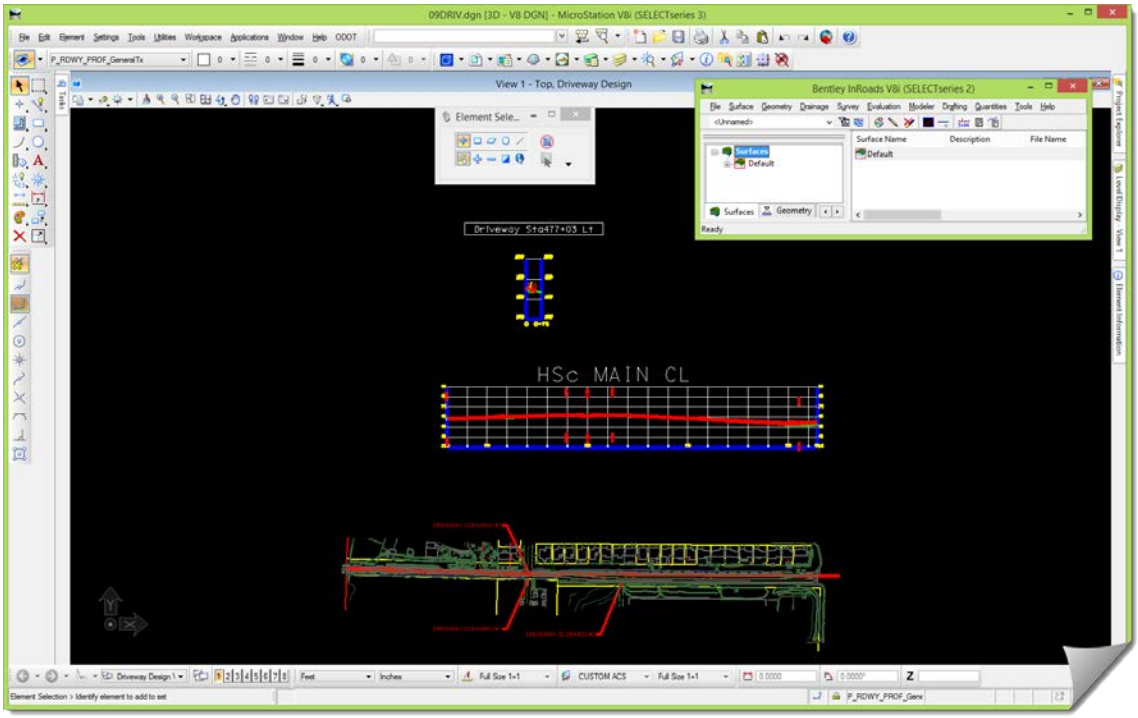
   Use whatever mechanism you are familiar with to get the software started.

2) When the **MICROSTATION MANAGER** opens, set the **User** and **Interface** to **ODOT**.

3) Browse to ***C:\WORK\Train\09_Minor Approaches***, select **09DRIV.dgn**, and [**Open**].

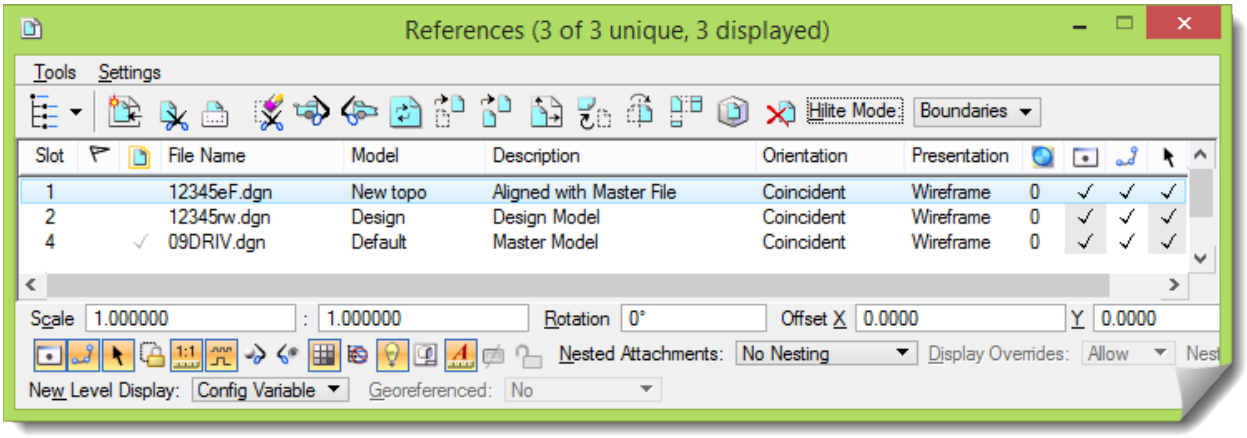


4) When the drawing opens, you'll see that it has some content.



5) Open Windows **File Explorer** and browse to the **`09_Minor Approaches`** folder.
6) Drag & drop **`Load_09DRIV.rwk`** into the InRoads interface to open the InRoads files.
7) Verify inside InRoads that the following files have been opened:
   - **`09DRIV.xin`**
   - **`12345DRIV_og.dtm`**
   - **`12345DRIV_fg.dtm`**
   - **`12345DRIV.alg`**
   - **`12345DRIV.itl`**
   - **`12345DRIV.ird`**
8) Feel free to review the project data just opened.

   You'll notice that this drawing has plan information as well as a couple of profiles. Make sure that you understand everything that you can about this information.
9) Review the MicroStation models and reference files that are attached to this drawing so that you are oriented to the DGN file that is open.



10) Move forward into the study portion of this module. Feel free to interact with the software as needed during your study in order to solidify any of the items under discussion.

Theory - Study

This topic is really about using various tools to construct the various features that will result in a surface model of either a driveway or minor approach. It's a combination of understanding the tools as well as the workflow. You will come to find that the workflow is not as rigid as one might initially think, and the goal of ensuring that all of the key driveway features are created is the overall driver of the results, not the exact work process.

This topic will be broken down this way:

- Discuss the generalized approach to this type of detailed modeling
- Identify some of the software tools that are related to this work
- Move into the hands-on and start putting this into practice

The challenge of this type of work is the free-form activity that takes place and the fact that it can be accomplished in various ways with the software. For this reason, it is strongly suggested that you break any step-like pattern to this module. Study the task, understand the goal of the task, review the suggested methodology to achieve the result, and then complete the activity using either the identified tools or any other that you are comfortable using.

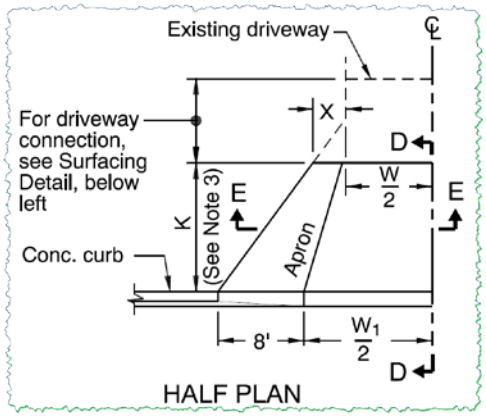
PROCESS OVERVIEW

Things to Consider

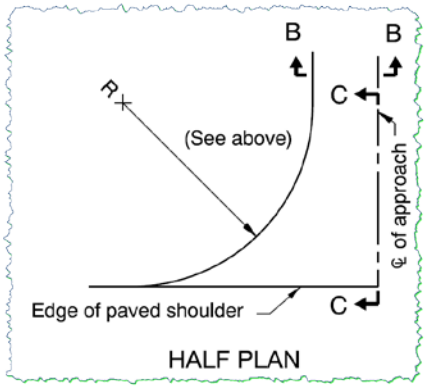
Categorizing Driveways & Approaches

There are three different types of minor approaches:

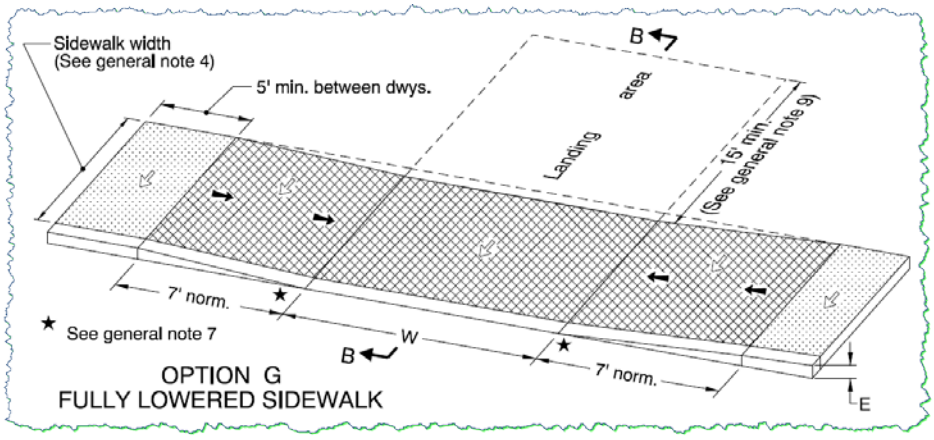
a. **Non-Sidewalk Driveways** – the details for this type of driveway are described in ODOT Standard Drawing RD715. (The PDF for this drawing is in the module folder for reference.)



b. **Minor Approach** – the details for this type of driveway are also described in ODOT Standard Drawing RD715. (The PDF for this drawing is in the module folder for reference.)



c. **Sidewalk Driveways** – the details for this type of driveway are described in ODOT Standard Drawings RD725 through RD750. (The PDF for this drawing (RD735) is in the module folder.)



High Level Modeling Overview

From a very high altitude orientation, driveway modeling can take on this general framework:

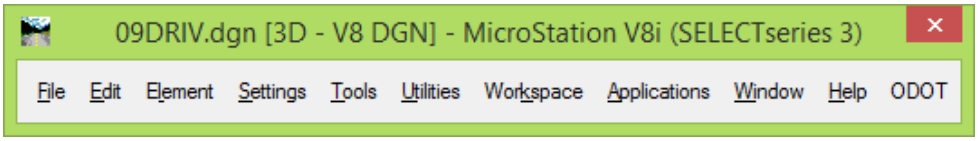
a. Model the main roadway as usually done
b. Identify the driveway or approach location
c. Determine its construction details from the applicable ODOT Standard drawings
d. Decide whether you will be building this driveway or approach in a separate surface model or integrating the new work into the main design model. The answer to this depends on the purpose behind this modeling, but in most cases, it will be built by modifying the main roadway design model. If this particular driveway or approach were being modeled as part of an existing street improvement project, it might be created in a surface separate from the main roadway. In this case, the main roadway model may not be modified. The other option, of course, is to model it as a corridor in the Roadway Designer, but that won't be covered here.
e. Map out the modeling approach. This entails thinking through what tools will be used and how they will be used. It's a determination of how much MicroStation versus InRoads will be used. This is dependent on the user and their comfort with certain software tools.
f. Systematically start constructing the model until it is complete

Techniques and Tools

This type of work is tool-centric, so the more tools that you understand and can use, the better off you will be. And remember, this covers the tools in both InRoads and MicroStation.

MicroStation Tools

The focus of this module will be the InRoads tools, but depending on your understanding of those tools, you may opt to leverage your MicroStation skills with this type of work instead.



A few specific MicroStation-related tasks that may be used include:

- Drawing Lines / Placing Shapes
- Modify / Break / Extend / Trim / Inserting and Deleting vertices / constructing Fillets
- Copy / Move up, down and parallel
- Snapping to InRoads displayed graphics
- Placing Fences
- 3D View Rotation

Using drawn or manipulated MicroStation graphics can be useful with this type of modeling.

InRoads–Specific Tools

Since the result and focus of these modules is an InRoads model, the key tools are naturally those found in InRoads, and specifically under the **SURFACE** and **GEOMETRY** categories.

The work done in this module will be utilizing the **DESIGN SURFACE** and **EDIT SURFACE** tools, as well as a few of the **GEOMETRY** tools. The greater familiarity that you have with these tools the better.

These include:

- **DESIGN SURFACE** tools:
  - **PLACE FEATURE** – used when creating new breaklines, primarily after certain breaklines have already been developed.
  - **GENERATE SLOPED SURFACE** – used to develop side slopes as well as testing slopes and developing assessment-level daylighting.
  - **GENERATE LONGITUDINAL FEATURE** – used to construct various breakline features when they can be defined relative to a breakline that already exists.
  - **DRAPE SURFACE** – used any place that a 'hard edge' is required to tie into an existing condition. For example, a sawcut line, or the driveway edge that needs to match original ground at the end of the drive.
  - **APPLY TEMPLATE** – used any place that a typical condition exists. This can leverage pre-created ECs and Components that are already in the Template Library, or utilize brand new sections needed specifically for a project.
- **EDIT SURFACE** tools:
  - **PARTIAL DELETE** – this tool is used to clip out portions of breaklines, like the face of curb, that need to be removed in the area of the driveway.
  - **DELETE FEATURE** – used any time a surface Feature is no longer needed, such as when added to the surface temporarily, in error, or later deemed not required.
  - **DELETE TRIANGLE** – used to remove inappropriate triangle connectivity. The related Delete Triangle by Filter tool can also be part of the process if the Exterior Boundary needs to be recreated.
  - **EDIT FEATURE POINTS** – used in any situation where any point in a Feature within the surface needs to be revised. Using this tool, points can also be added to surface features by snapping to graphics or surface data locations.
- **GEOMETRY** tools:
  - **MULTICENTER CURVE** – this tool can be used to create both a horizontal as well as a vertical alignment for any minor approaches that require radial returns.
  - **VIEW 3-D ALIGNMENT** – used to view a 3-D graphical linestring from a horizontal and vertical alignment. This 3-D linestring can be used as a basis for other tools.
- Other general tools:
  - **TRACKING** – used when a location or elevation from a surface or geometry is needed.
  - **IMPORT SURFACE FROM GRAPHICS** – a very useful command to create surface data from MicroStation graphics.
  - Key-in **SO=Station,Offset** – used to construct any information that is relative to a horizontal alignment, such as a driveway entrance.
  - **LOCATE LOCK** – when a user is working with both surface data and graphics, InRoads needs to know when the user is interested in the surface **Features** or MicroStation **Graphics**. This lock sends the correct signal to the software.
  - Various **VIEW** Surface or Geometry commands are used as desired.

Some of these tools will be discussed in more detail as they are used.

Practical Application - Hands-On Lab Exercises

UNDERSTANDING THE DETAILS

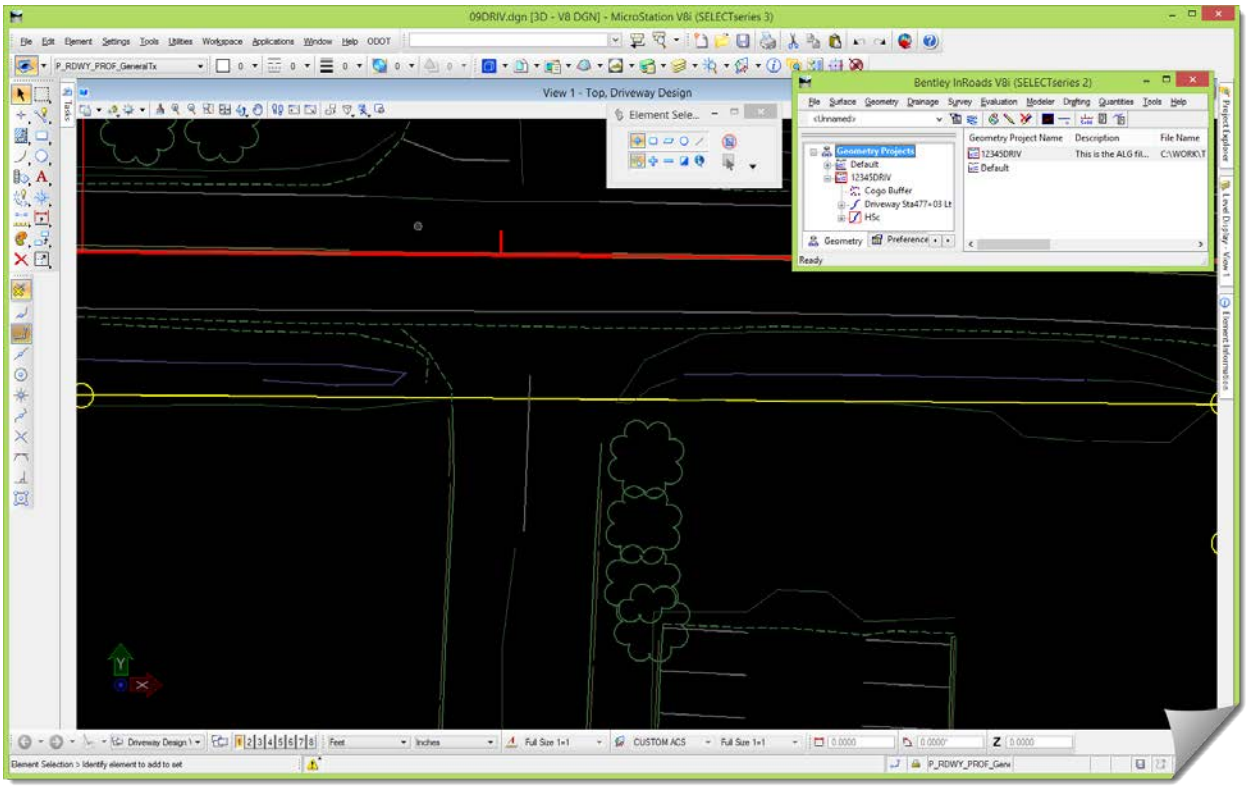
In this module, the details of the work will be covered piece-by-piece during the hands-on.

Review any relevant project data

At this point, you should be in **09DRIV.dgn** and have loaded the InRoads RWK data.

1) Select any graphics that you may have displayed in the area of the driveways or approaches and delete them from the MicroStation file.

It's best if you have a clean MicroStation file, free of graphics, in the area that will be worked on.



TIP: It might seem too rudimentary to say, but when doing this type of modeling, clarity of display, as well as understanding the exact graphics that *are* displayed, are the most fundamental starting points to consider.

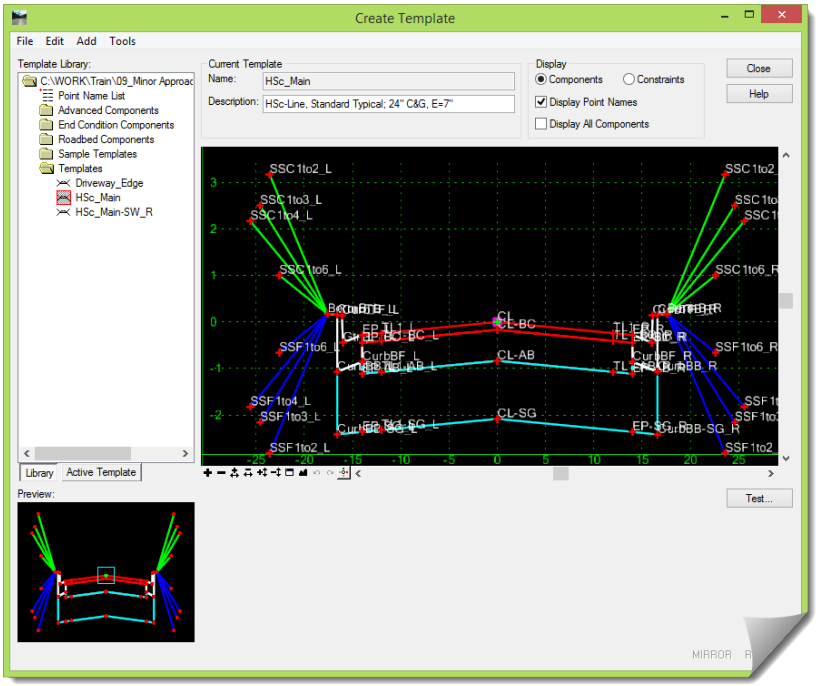
ALERT: Always be aware that the MicroStation line work that you are seeing is not always representative of the elements that create it. This is referring primarily to custom line styles. Some CAD Standards use offset lines, double-lines, and a variety of other line styles to represent simple line work. It may be beneficial to turn *off* the **Line Styles** under the **VIEW ATTRIBUTES** in instances where custom line styles are in use. Doing this will ensure that what you are seeing in MicroStation accurately reflects the actual elements.

Review Template Information

The design model was created with a specific template. This will be reviewed to gain some familiarity with the surface **Features** that you will be working with.

1) Open the **TEMPLATE LIBRARY** and review the **HSc_Main** template.

This template was used to create the FG design surface.



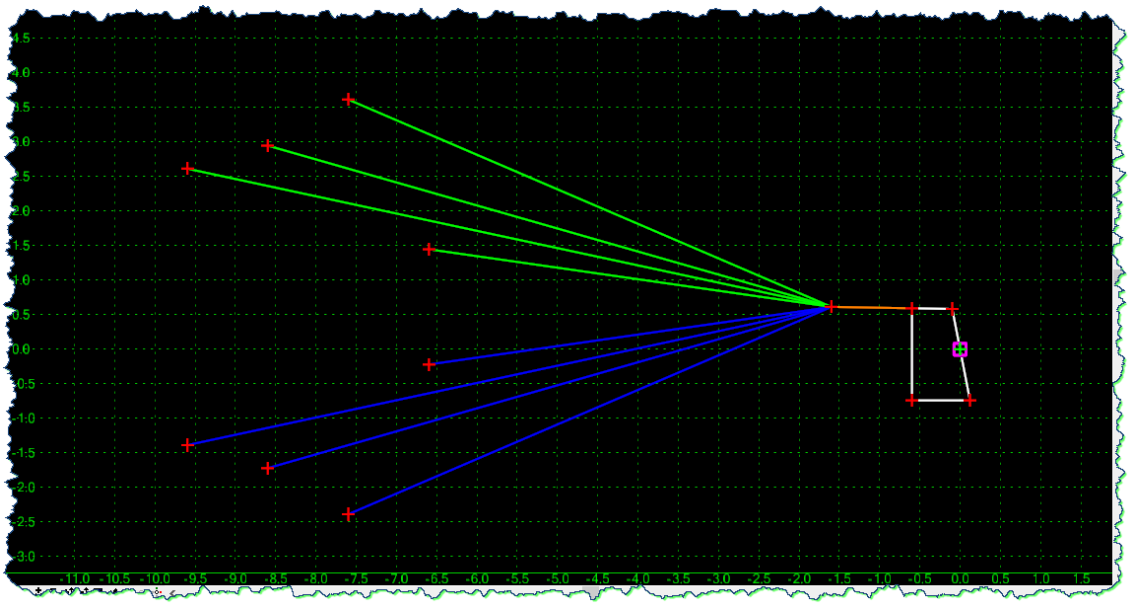
2) Particularly note the **Point Names** on the edges of the template, since these are the **Features** to which driveways and approaches are tied.

You should know these **Feature Names** and what breaklines they represent – **Gtr**, **CurbTF**, **CurbTB** and the others. Of course, they will also have the **_R** and **_L** suffix applied to them depending on which side of the roadway you are working.

3) Review the Template named **HSc_Main-SW_R** used in a later scenario.

4) Also, review the **`Driveway_Edge`** template.

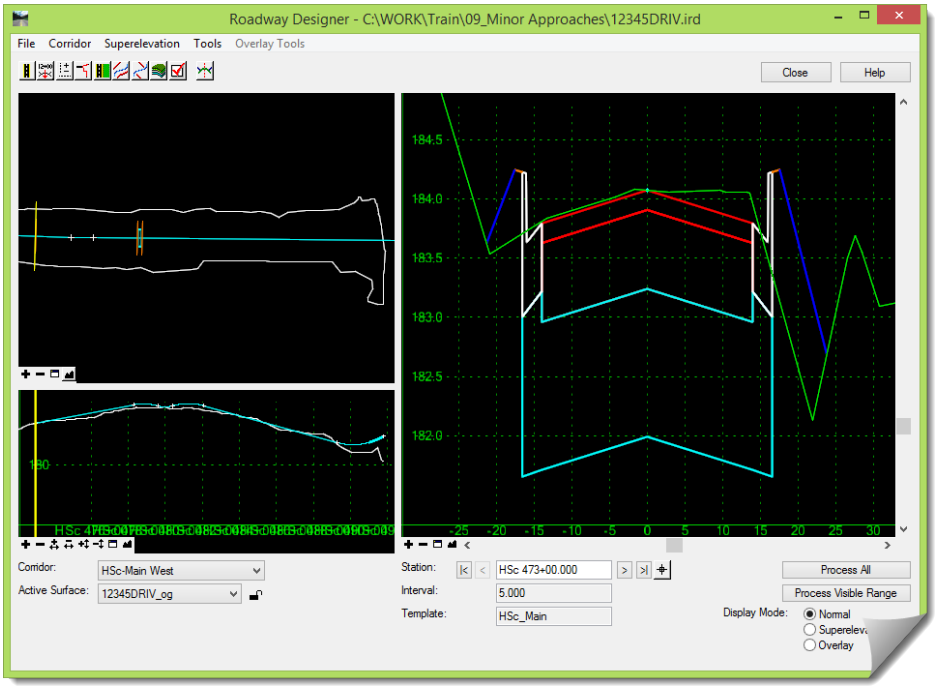
This template will be used with the **APPLY TEMPLATE** tool to model around the returns of the approach covered in the second scenario.



5) [**Close**] the **CREATE TEMPLATE** tool when your review is complete.

Review Roadway Designer Information

1) Open the **ROADWAY DESIGNER**.

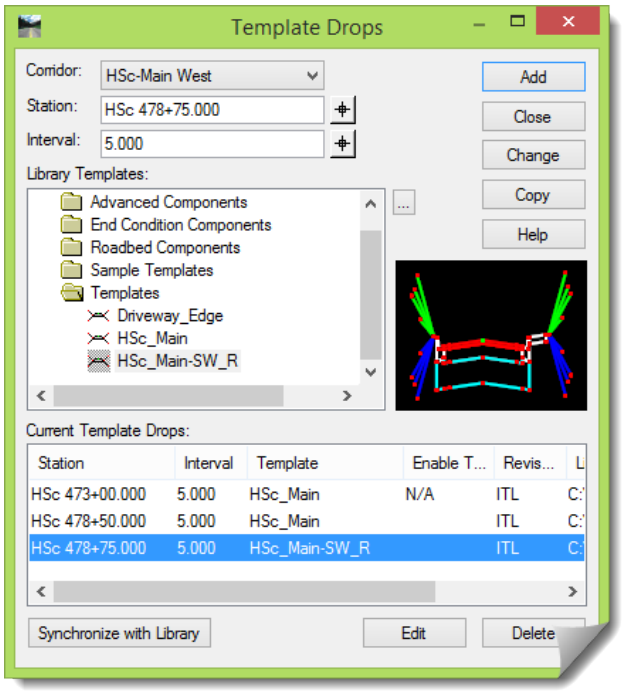


There is only one **Corridor** in the **ROADWAY DESIGNER**, **`HSc-Main West`**. This **Corridor** was used to create the FG design surface.

The relevant item to review here is the **TEMPLATE DROPS**.

2) Take note of the **TEMPLATE DROPS** so you are aware of what sections are being applied to the final design model, along with their location.

No modifications will be made here, and this review is only to make you aware of the data you will be working with later in this module.

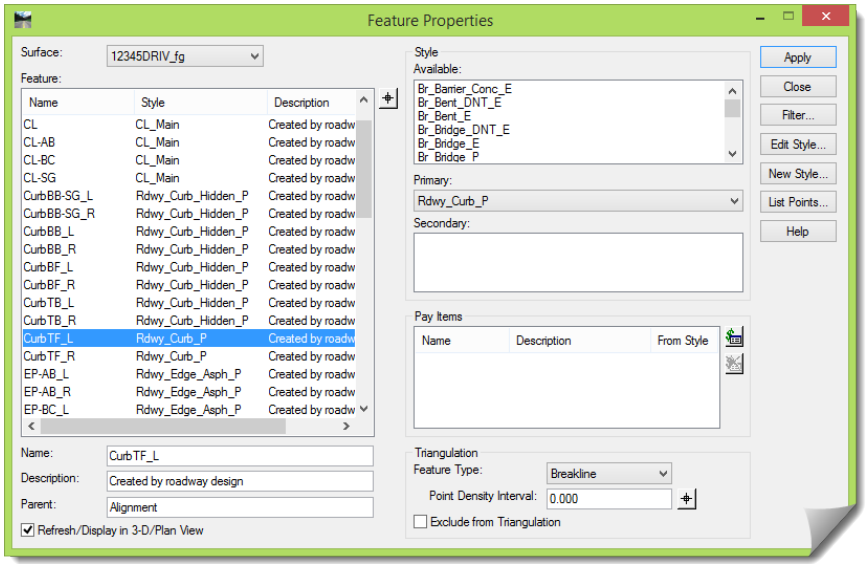


3) [**Close**] the **TEMPLATE DROPS** dialog box and the **ROADWAY DESIGNER**.

Review FG Surface Information

1) Open the **FEATURE PROPERTIES** and set the **Surface** to **`12345DRIV_fg`**.
2) Review and correlate the **Feature** listing shown there with the Templates just reviewed.

You should see familiar names because this FG surface was created with the earlier template.



3) [**Close**] the **FEATURE PROPERTIES** dialog box when your review is complete.

SCENARIO 1 - NON-SIDEWALK DRIVEWAY MODELING

This scenario will cover the modeling for a driveway defined within the ODOT Standard Drawing RD715. (Feel free to open **rd715.pdf** as necessary to review any relevant details.)

Because of the nature of the modeling, this module will be presented in a slightly different manner from earlier modules, and will be done in stages.

Driveway Details Review

Take as much time as you require to review the diagrams shown here, referring back to **rd715.pdf** as needed until you have a strong concept of what will be constructed.

The specific layout of any driveway is based on project-specific criteria. The constant in this is the correlation of the driveway layout and the table of dimensions shown on RD715.

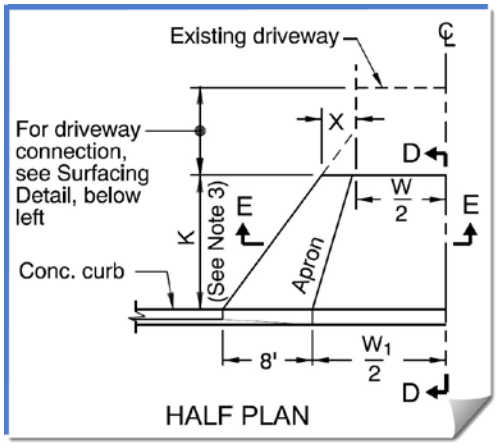
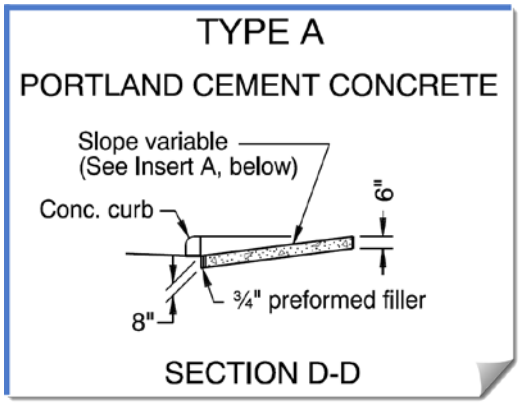


TABLE A

W (ft)	X (ft)	K (ft) 5	6	8	10
		W1 (ft)			
12	3	15	15	15	15
14		17	17	17	17
16		19	19	19	19
18		21	21	21	21
20		23	23	23	23



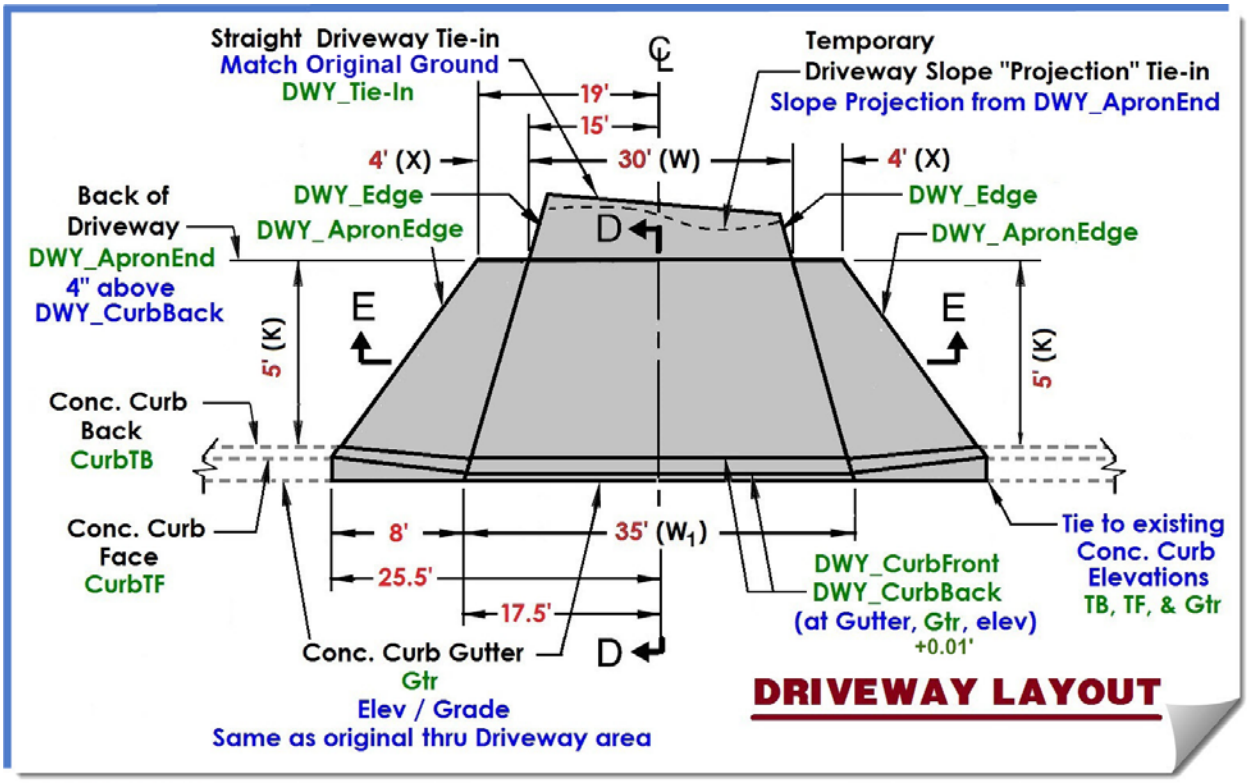
Naming Convention / Assigning Styles

This module is focusing on the modeling of driveways and minor approaches. In order to bring your attention to those features associated with this activity, specific names have been used to draw attention to driveway-specific features. These may or may not be the exact feature **Names** or **Styles** that you use on your project.

ALERT: Always be attentive to the feature **Names** and **Styles** used when creating new surface data. The **Names** used in this module are named in such a way as to increase your awareness of the activity performed and may or may not be the final **Names** or **Styles** used on your projects.

Understanding the specific layout and geometry of the driveway or approach is vital when doing this work. To the degree you understand what needs to be done, and the relationship between one element of the layout to another element, your InRoads modeling will go smoother. Every weakness in understanding the design criteria itself will result in modeling error and layout uncertainties. This understanding is independent from the use of the InRoads tools.

1) Review this expanded illustration below for the detailed construction of the driveway that will be done here, specifically noting:
   - Location descriptions (in black)
   - Feature Names (in green)
   - Elevational controls (in blue)
   - Dimensions (in red)
   - Section references tied to **`rd715.pdf`**



Refer back to the illustration above as needed as you move through this module.

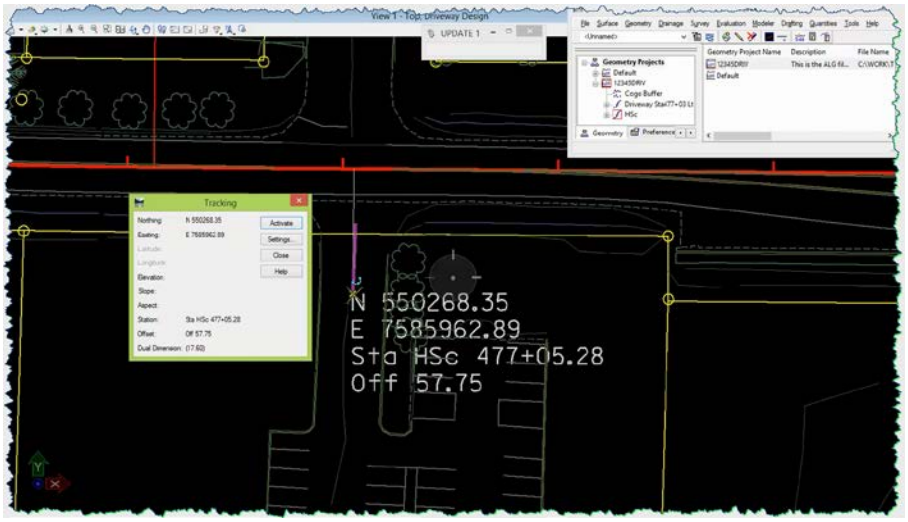
2) Note the critical dimensions that will be used for this driveway:
   - K = 5’
   - X = 4’
   - W = 30’
   - W_1 = 35’

Moving forward, there will be a version of the illustration above that shows either what will be done, or what was just finished. Use this illustration to map your upcoming actions or verify your progress. Before and after these illustrations will be a set of loose instructions to be executed. Study and understand what is being requested, and either follow those directions or follow through with your own technique. The goal here is not to follow steps, but obtain the result.

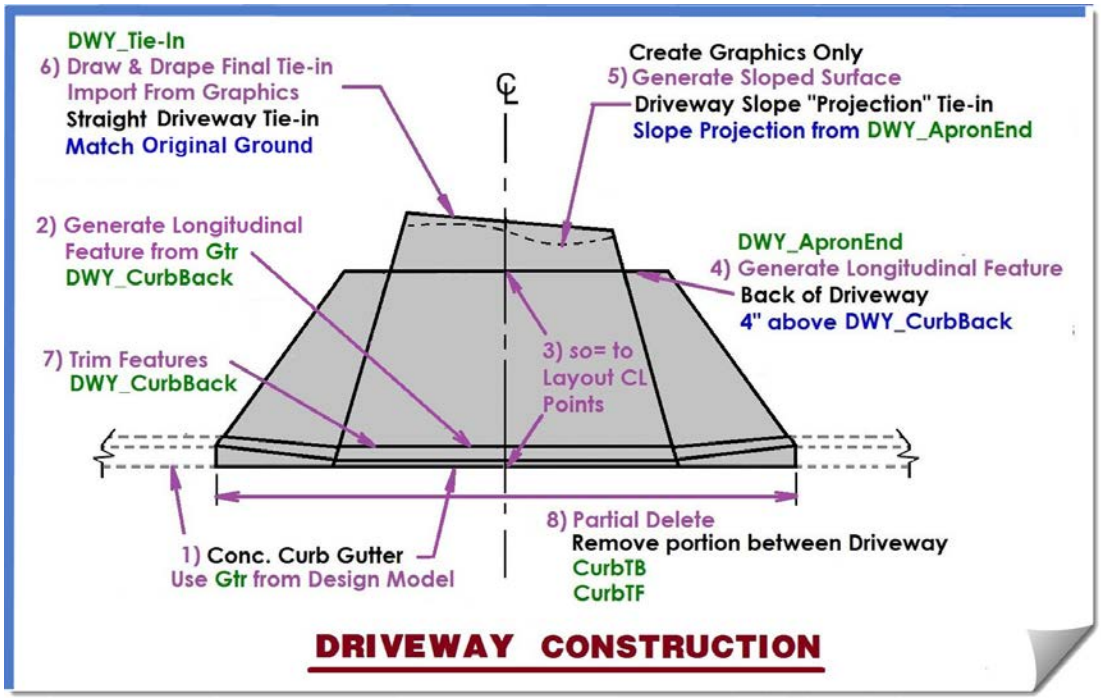
In addition to the steps that represent what will be constructed, there will be interspersed feedback that mentions how something had been decided or developed. You are not required to perform these actions since they have been done already, and utilized in moving forward. You *can* however, replicate the activity to reinforce your capacity to execute those steps.

For instance:

InRoads general **TRACKING** was used to determine the eventual location of the driveway at the Right-of-Way (Sta. 477+05 Right).



3) Study the first phase of the driveway **Feature** construction map, making sure you understand the direction that will be taken, as well as the tools used.



Driveway Layout - Phase 1

Referring back to the construction map, proceed with the layout of the first phase of modeling.

Step 1

1) Referring to **RD715, Type A**, the driveway apron start is at the back of the curb and the end of the driveway apron is the **K** value distance from it. In this case, we'll be using **5'**.

In this layout, the back of the curb position on the driveway should be slightly higher than the elevation of the gutter line for drainage purposes. To do this we will view the design **Gtr_R** feature and then offset it horizontally using the InRoads **GENERATE LONGITUDINAL FEATURE** tool **0.596'** to the right and **0.01'** higher. (See Std Dwg RD700 for curbs.)

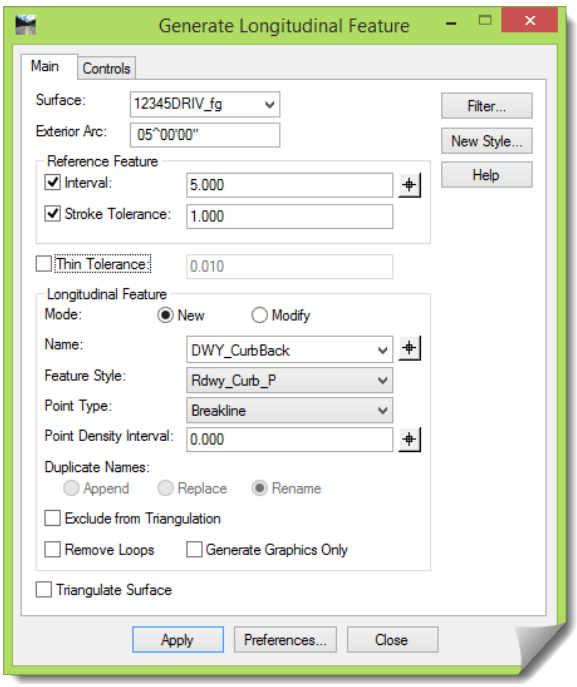
2) View the **Gtr_R Feature** from the design surface for orientation purposes.

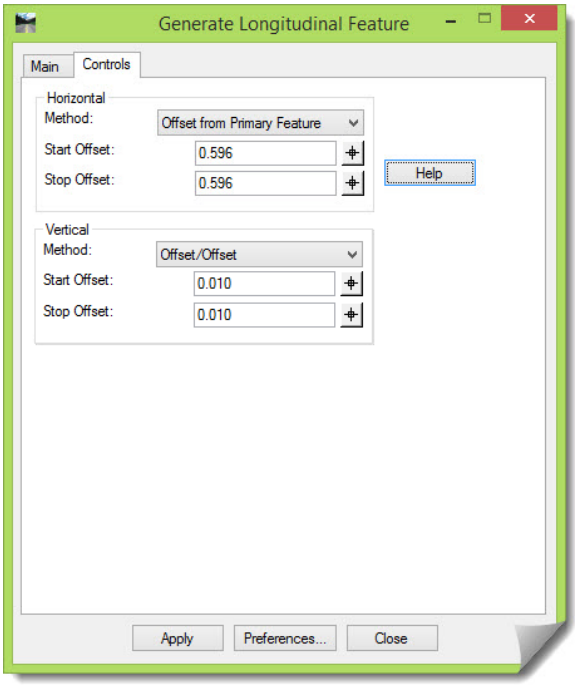
Step 2

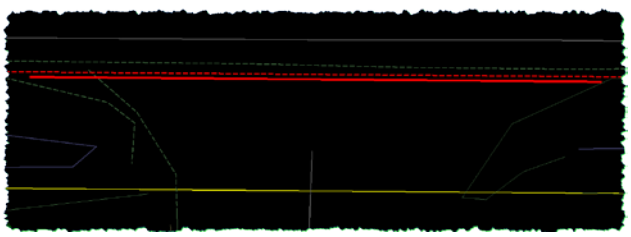
1) Using **GENERATE LONGITUDINAL FEATURE**, create the **DWY_CurbBack** horizontally offset **0.596'** and vertically offset **0.01'**.

Since the driveway extents aren't known yet, make it long enough to trim to the final limits later.

TIP: If you are unfamiliar with the **GENERATE LONGITUDINAL FEATURE** tool, in this instance, the **Help** file contains very good explanations of the **Interval** and **Stroke Tolerance** settings for the **Reference Feature**, as well as a few of the other options on this command. The specific settings for your work will sometimes be trial and error. The **Stroke Tolerance** will help hold the path course and its deflections; the **Interval** is dependent on your modeling density.





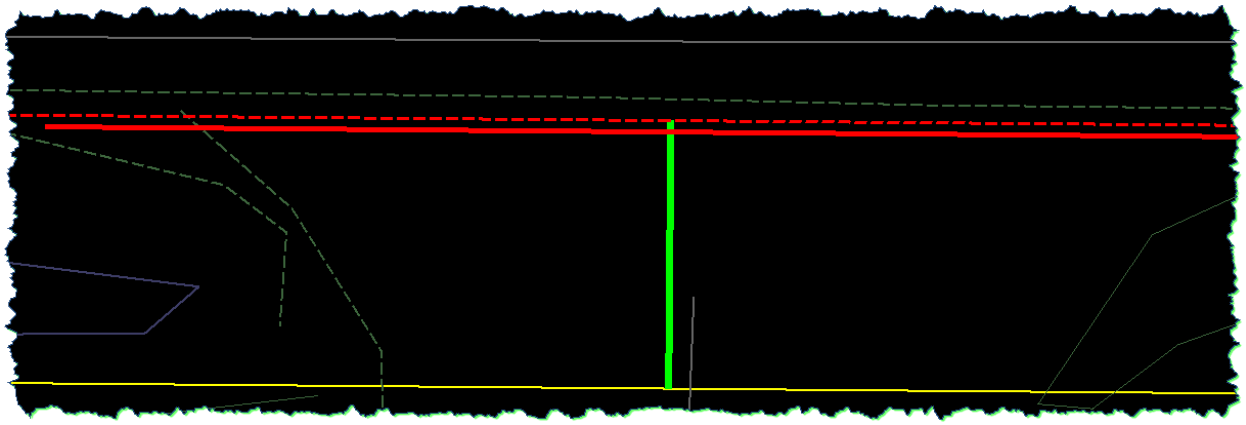


Step 3

Draw a MicroStation line that represents the centerline of the driveway.

1) Using the **Key-In** window, place the driveway centerline at **so=47705,16** and **so=47705,30**.

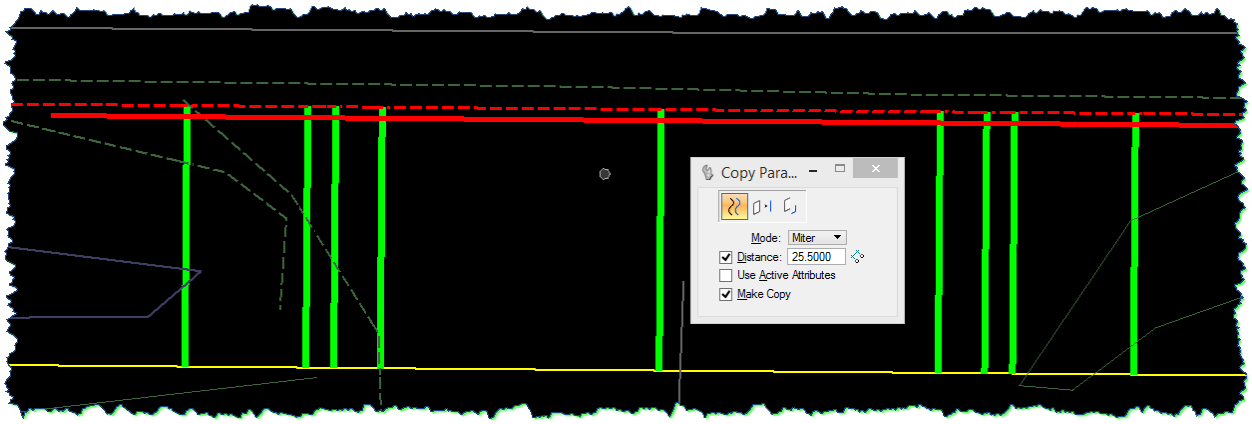
Remember earlier it was decided that the driveway would be at Station 477+05.00. This new centerline will be used as the main reference line when creating the extents of the driveway features (from left to right) of the driveway itself.



Now some construction elements will be created for the key driveway widths. These will be used later as guide lines and key points for snapping.

2) Using MicroStation **COPY PARALLEL**, create guide lines to use for developing the driveway.

Based on **Table A** of **RD715**, we will be using **W=30', K=5',** and by default **X=4'** and **W_1=35'**. From that standard drawing, we need to offset the centerline left and right for each of the variables: **W/2=15'**, **W_1/2=17.5'**, **X=4'+15'=19'**, and **W_1/2+8'=25.5'**.



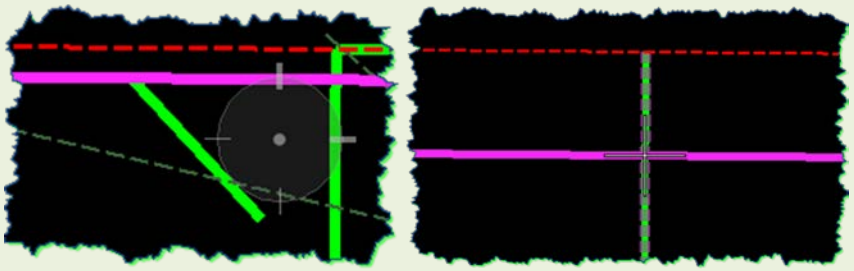
Step 4

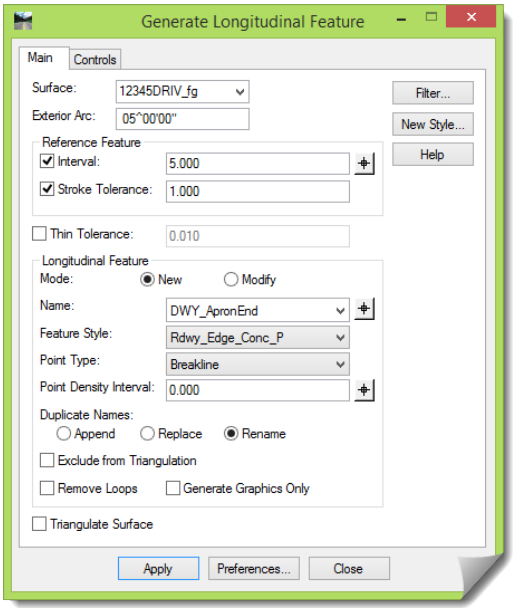
Now that we have the back of curb located Horizontally & Vertically, we can locate the back of the driveway apron. This particular driveway is descending from the roadway EP, so there needs to be a 4" rise (for drainage control purposes) before it can go down to meet the original ground surface (see standard drawing, Insert A, Note 1).

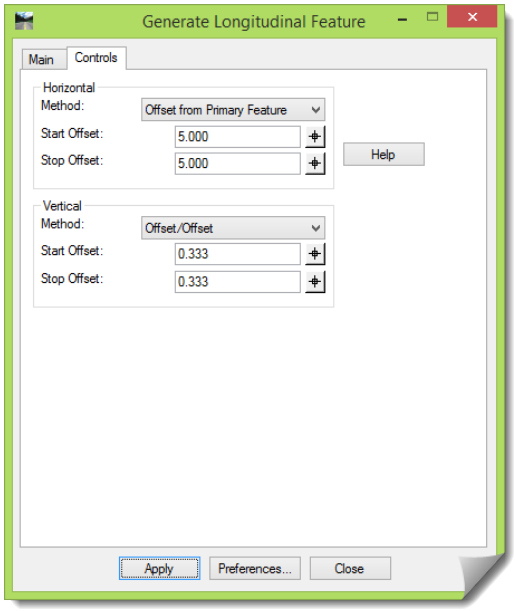
1) Use **GENERATE LONGITUDINAL FEATURE** for **DWY_ApronEnd** with H & V offsets = **5**' and **4"**, using **DWY_CurbBack** as the primary and reference element between the 19' offset guide lines.

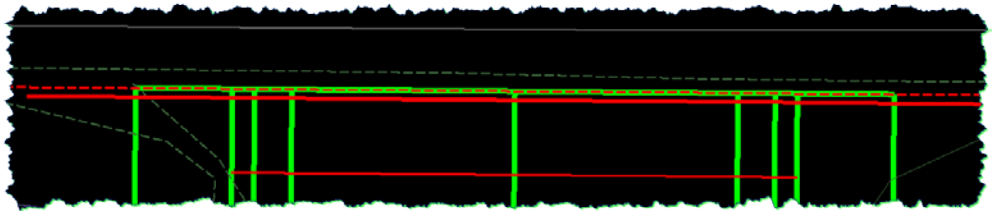
Since driveway guide lines are in place, use them to identify the start and end of this feature.

TIP: When using the InRoads **DESIGN SURFACE** tools, some commands like **GENERATE LONGITUDINAL FEATURE** prompt to *>Identify Reference Element* or *Feature*. In the case where there are elevation differences between the *Primary Feature* and any 'guide lines', the tracking for the **Start** and **End** will be skewed and won't work as expected (this can also occur when the MicroStation active depth is significantly different than the feature elevation). Where possible, use the **Intersection Snap** in MicroStation (with Ctrl+Shift) to establish the **Start** and **End** locations by snapping to the correct features (not the guide line elements) prompted by the tool in use. If the intersection snap tentatively picks up the guide line element, be sure to reposition until it picks up the feature instead.









Step 5

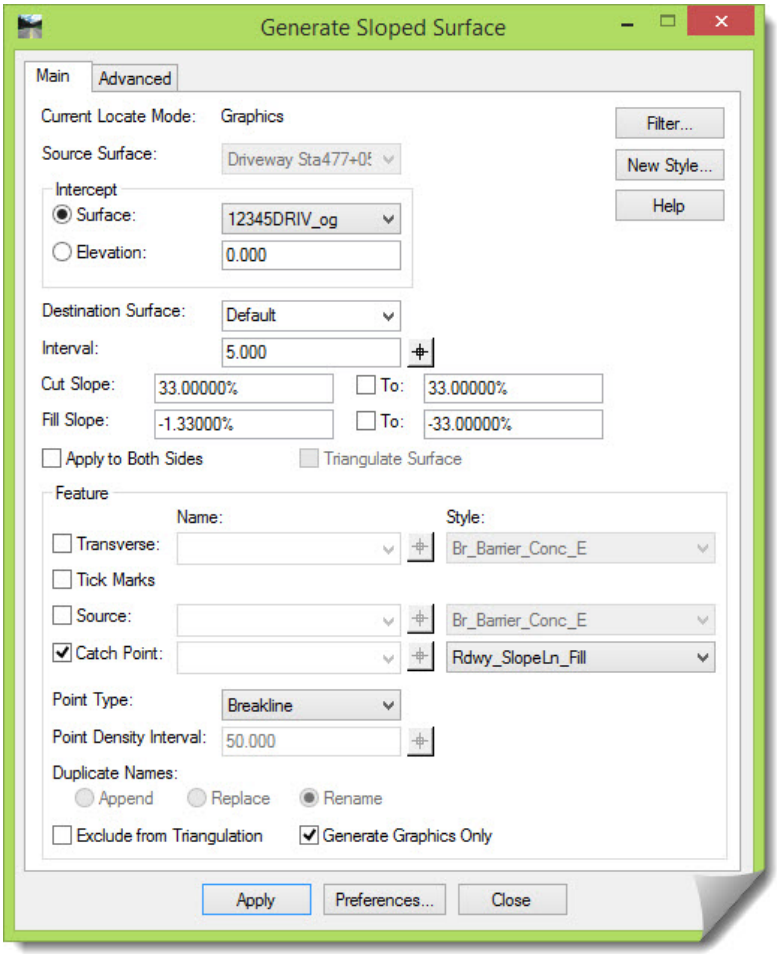
A sloped surface will be generated to define the location of the tie-in to existing grade at the end of the driveway (limits of grading). This slope is chosen by the designer and will vary as needed to meet specific project parameters (e.g. ROW location, max algebraic difference between apron slope and grading slope, etc.). This may require trial and error iterations to determine the location.

In this case, the maximum fill slope to maintain the 8% algebraic difference is **1.33%**.

1) Use the **GENERATE SLOPED SURFACE** tool in **Generate Graphics Only** mode to develop a guide line that projects a **1.33%** slope from the **DWY_ApronEnd** to the OG surface.

Some settings aren't needed, so will not be established. The critical settings are the **Intercept Surface**, the **Fill Slope**, the **Generate Graphics Only** toggle, and the settings for the **Catch Point**.

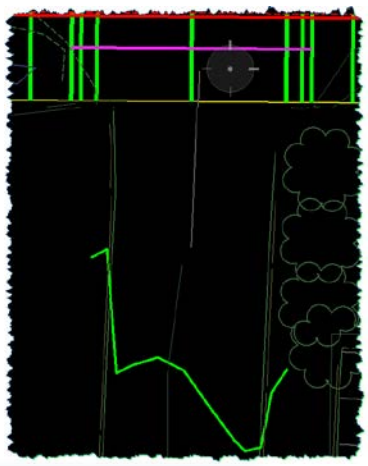
ALERT: Always be attentive to the **Styles** used when creating new surface data. As new work processes are introduced, new **Styles** may also be improved and created to support any new design activity. The **Styles** shown here may or may not be the final **Styles** used.



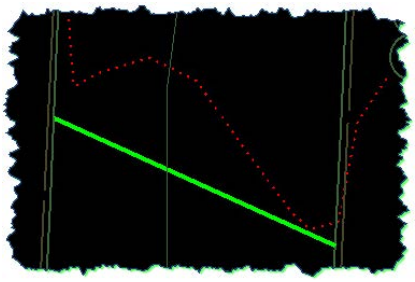
You may only be using this line as a guide to determine the approximate location depending on the results; a new line could then be drawn as a "straight" line at the furthest limit and draped onto the OG if desired. The results should be evaluated based on your design criteria, and the final location of the exact tie-in is up to the designer and the project modeling requirements.

Step 6

The resulting "daylight" is accurate but "ragged", so a straight line will be drawn from the existing driveway edge to driveway edge, draped onto the OG, and then imported into our design surface.

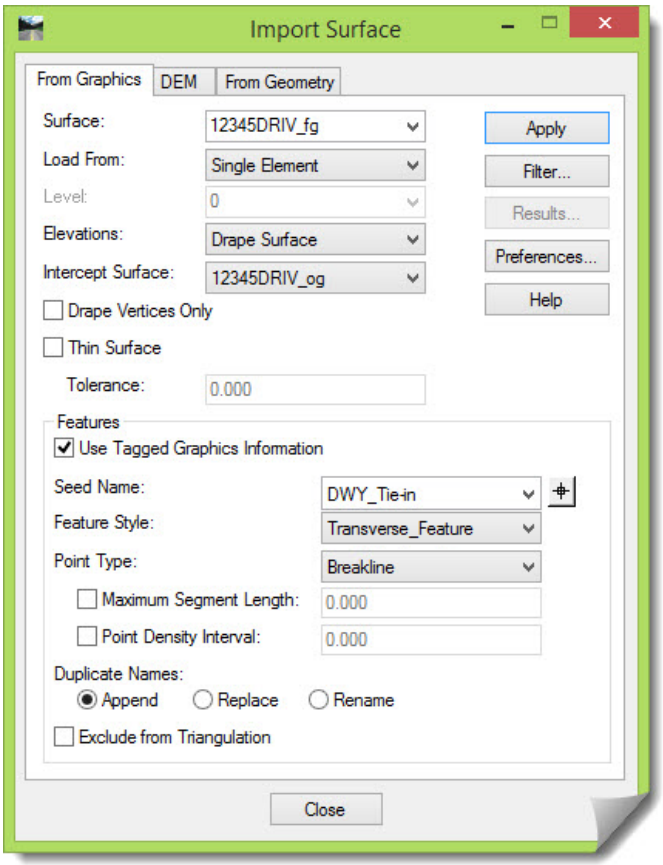


1) Draw a line in MicroStation that will represent the tie-in edge to match existing. Be sure that it extends from the left gutter feature to the right gutter feature.



ALERT: Although a skewed straight line is shown in this exercise, the actual tie-in location could be perpendicular to the driveway centerline in your actual design.

2) Use **IMPORT SURFACE FROM GRAPHICS** to bring the **DWY_Tie-in** feature into the surface and simultaneously drape it onto the OG surface.

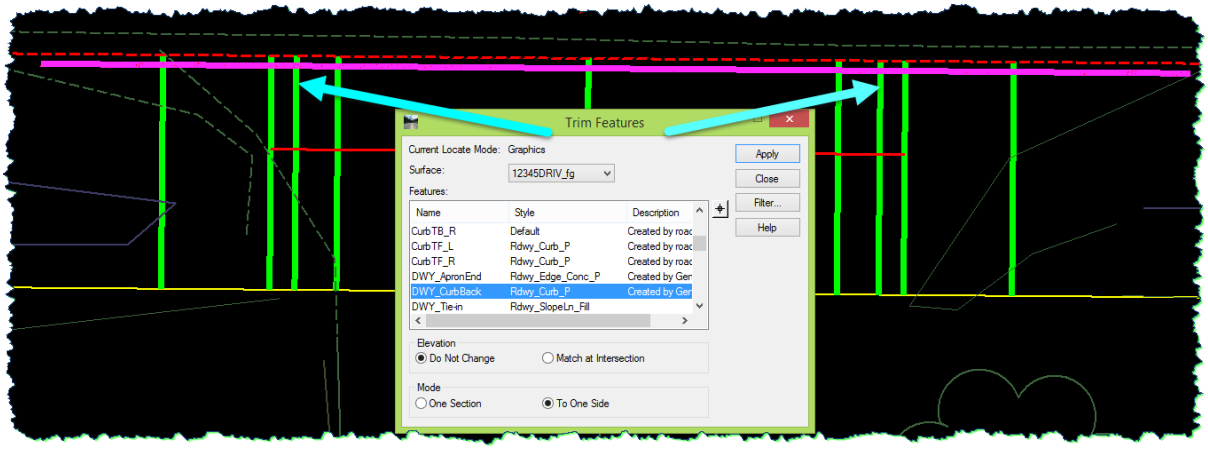


The projected sloped surface edge from Step 5 can be deleted since it's no longer needed.

Step 7

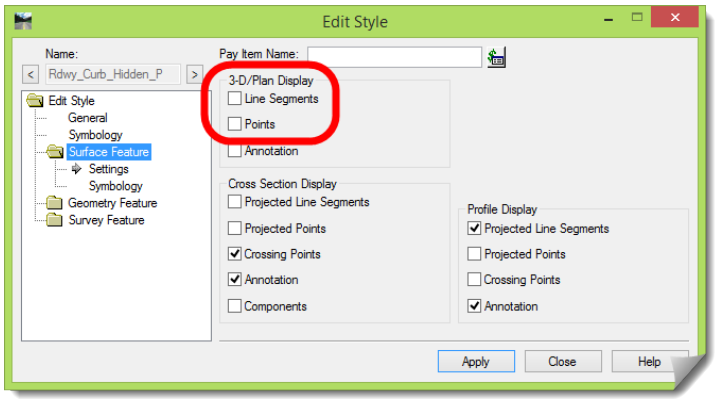
Some clean up will be done in preparation for creating some of the other driveway breaklines, and the first thing will be to trim back **DWY_CurbBack** to the extents of the driveway.

1) Using **TRIM FEATURES**, trim back **DWY_CurbBack** as shown here to the 35' **W_1** limits.



Step 8

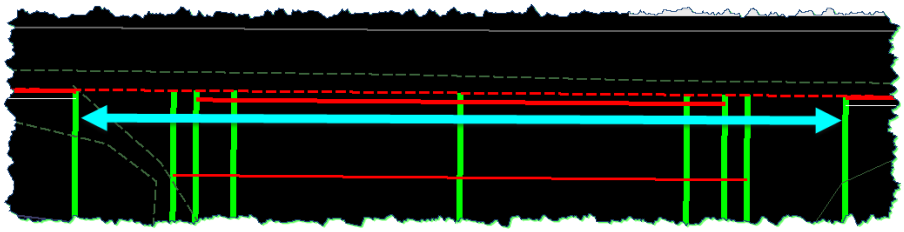
One item that has to be periodically dealt with is the configuration of some of the InRoads **Feature Styles**. The issue is that some of them are defined to be 'invisible' in **Plan Display**.



1) Temporarily change the **Style** of **CurbTB_R** (in **FEATURE PROPERTIES**) from **Rdwy_Curb_Hidden_P** to something that will view in plan, like **Transverse_Features** or **Default**. Then view that feature along with the **CurbTF_R** feature.

An alternative is to edit the assigned **Style** to view in **Plan**, realizing that such an edit will modify all **Features** using that **Style**.

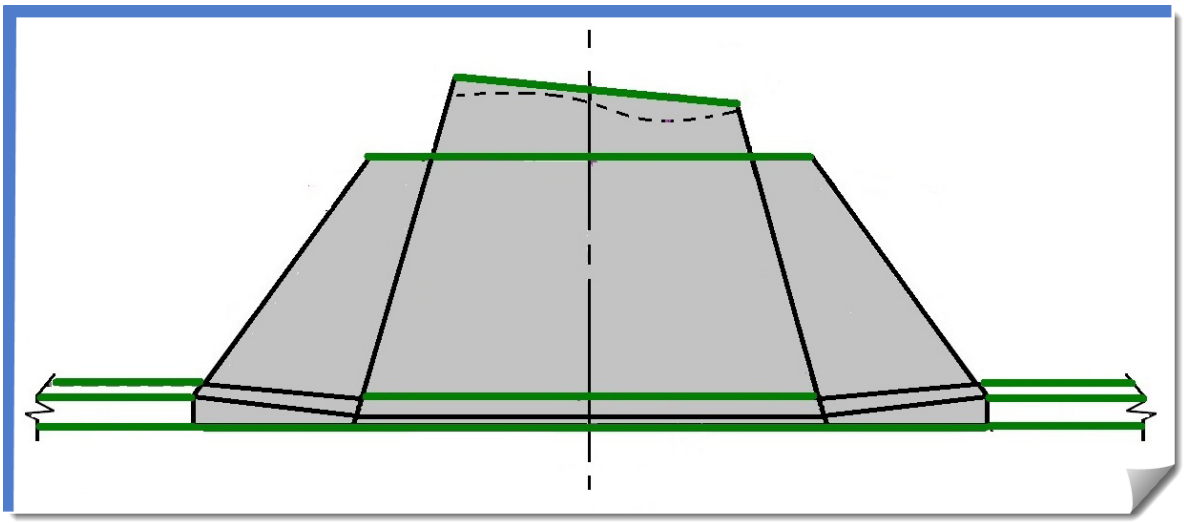
2) **PARTIAL DELETE** the **CurbTB_R** and **CurbTF_R** features between the 25.5' offset guide lines. This will create the curb cut for the driveway.



Driveway Layout - Phase 2

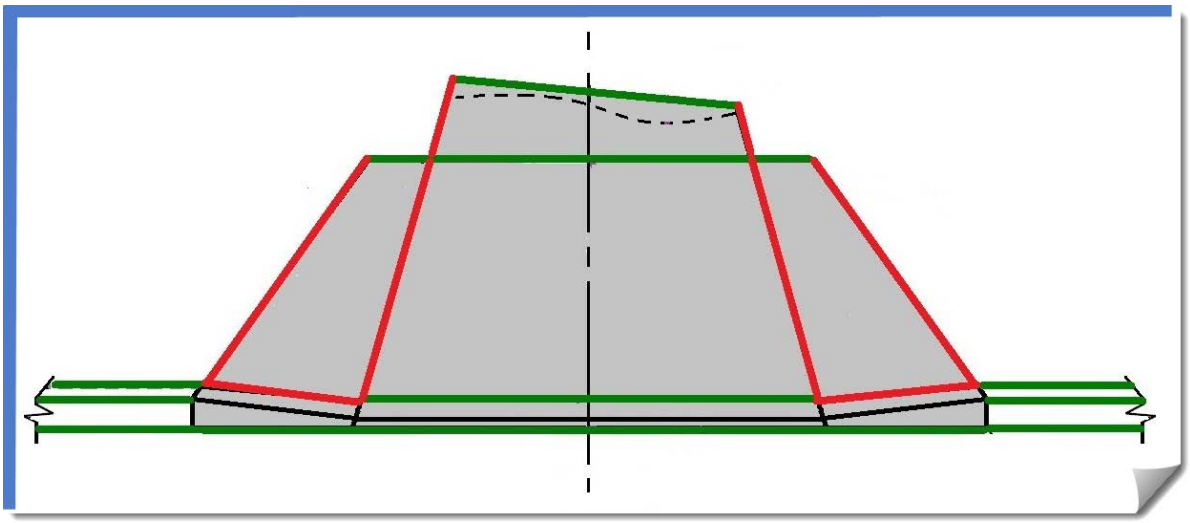
This section will take what has been laid out and develop additional breaklines from that data.

At this stage, the finished breakline features (shown in green below) should exist as part of the driveway.



Place Features

This section will create eight additional breakline segments per this illustration. (If you haven't already noticed, the illustrations here based on the Standard Drawings are slightly exaggerated in places.)

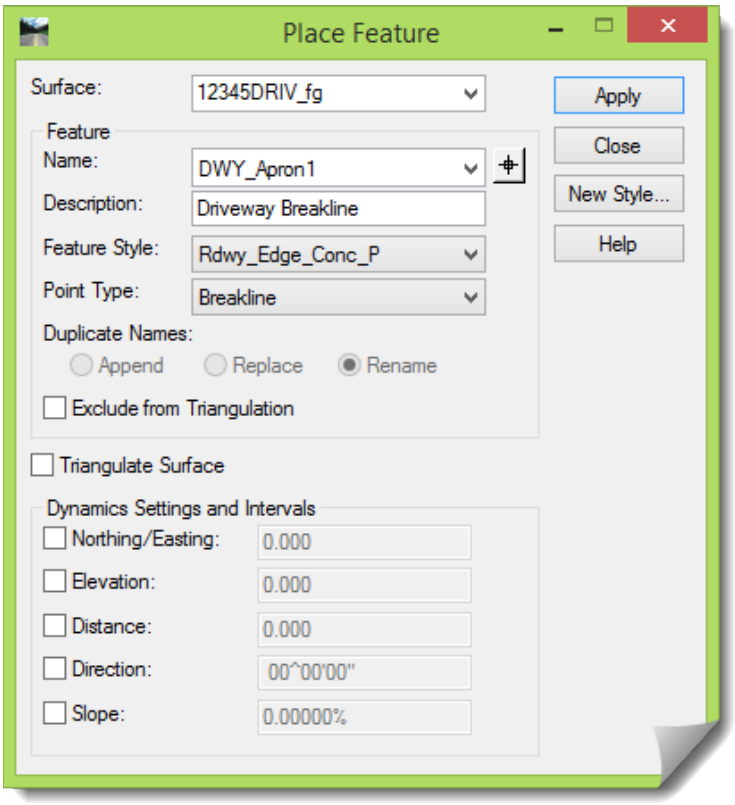


1) Using the **PLACE FEATURE** command, and snapping to the previously constructed breaklines, create the breakline features shown above in red.

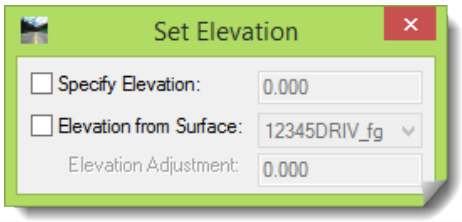
Name the breaklines any way that you want. As a suggestion, call them **DWY_Apron1**, **DWY_Apron2** and so on. Assign the **Style** called **Rdwy_Edge_Conc_P** to all of these features.

Make sure that you are accurately snapping to the existing breakline feature elevations. Once you are finished, look at the data in a rotated view, or otherwise check it to make sure that they were created correctly. If there are any errors, go to the **EDIT FEATURE POINT** command and correct the errors, or just delete that feature and recreate it.

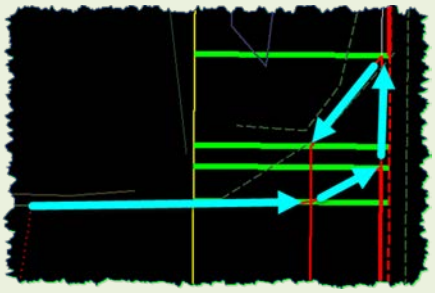
The initial settings of the **PLACE FEATURE** command are shown here for your referral:



When this command is applied, the secondary **SET ELEVATION** dialog box should have both options toggled *off*. This allows the command to extract the X, Y, and Z from the MicroStation snap location.

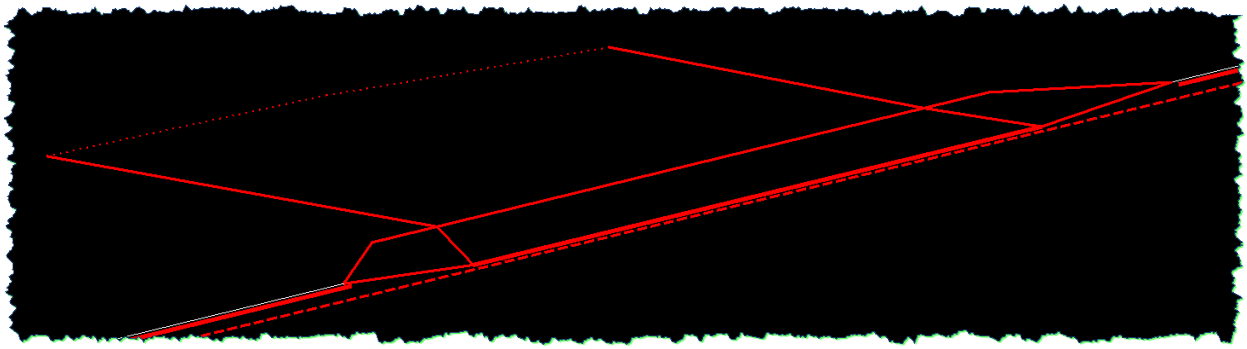


TIP: When using the **PLACE FEATURE** tool, well thought out paths can reduce the number of Features that have to be created and managed. In this case, a path like this can combine four breakline legs into one breakline **Feature**. (View rotated for graphical placement)



2) [**Close**] the **PLACE FEATURE** tool when the breaklines are completely created.

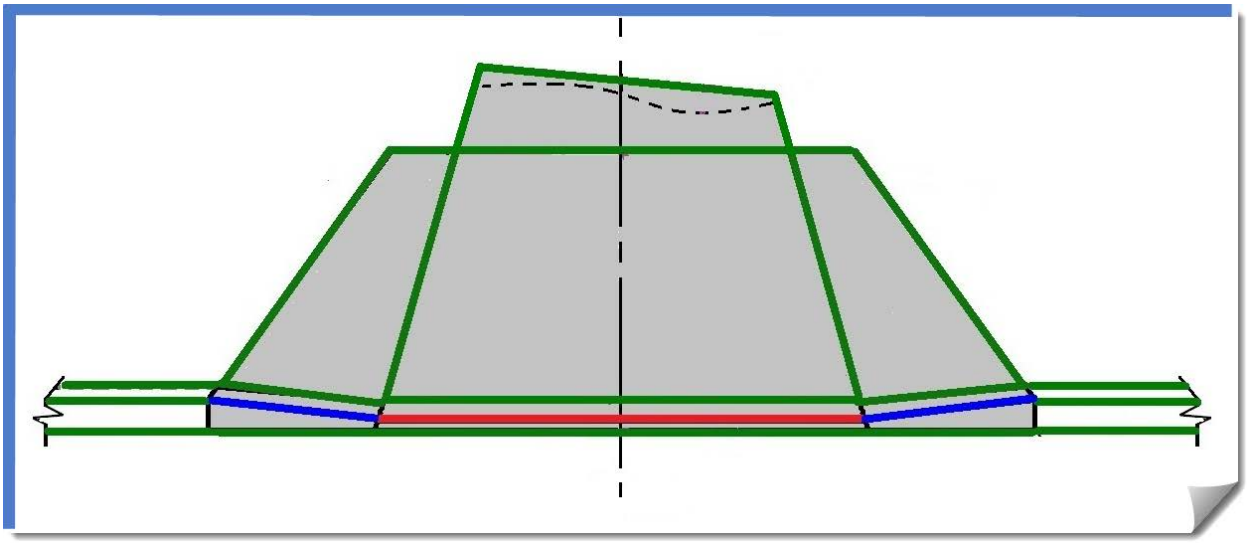
At this stage, your model should be looking like this:



Finishing the Driveway Breaklines

Three more breaklines need to be added:

- A breakline representing the face of curb continuity through the driveway that will be called **DWY_CurbFront**.
- Two breaklines, one on either side of the driveway, that connect the **CurbTF_R** feature and the **DWY_CurbFront** feature just described above.

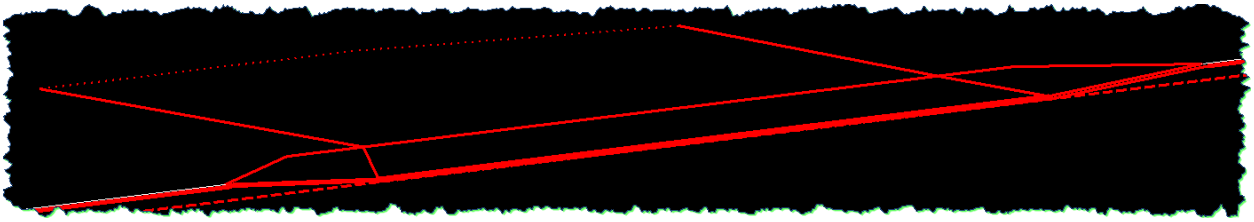


3) Using **GENERATE LONGITUDINAL FEATURE**, create a **Feature** called **DWY_CurbFront** that is horizontally **0.5'** offset and vertically **-0.01'** offset from the **DWY_CurbBack** feature, as shown above in red.

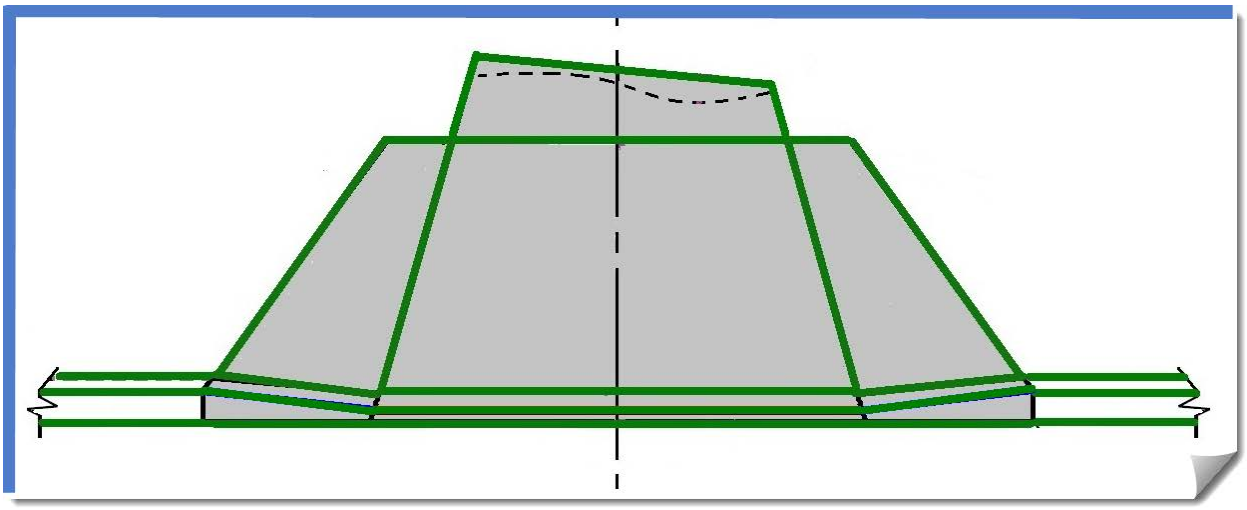
This will represent the front edge of the curb cut.

4) Using the **PLACE FEATURE** tool, construct the breaklines that will connect the **DWY_CurbFront** to the **CurbTF_R** features shown in blue above.

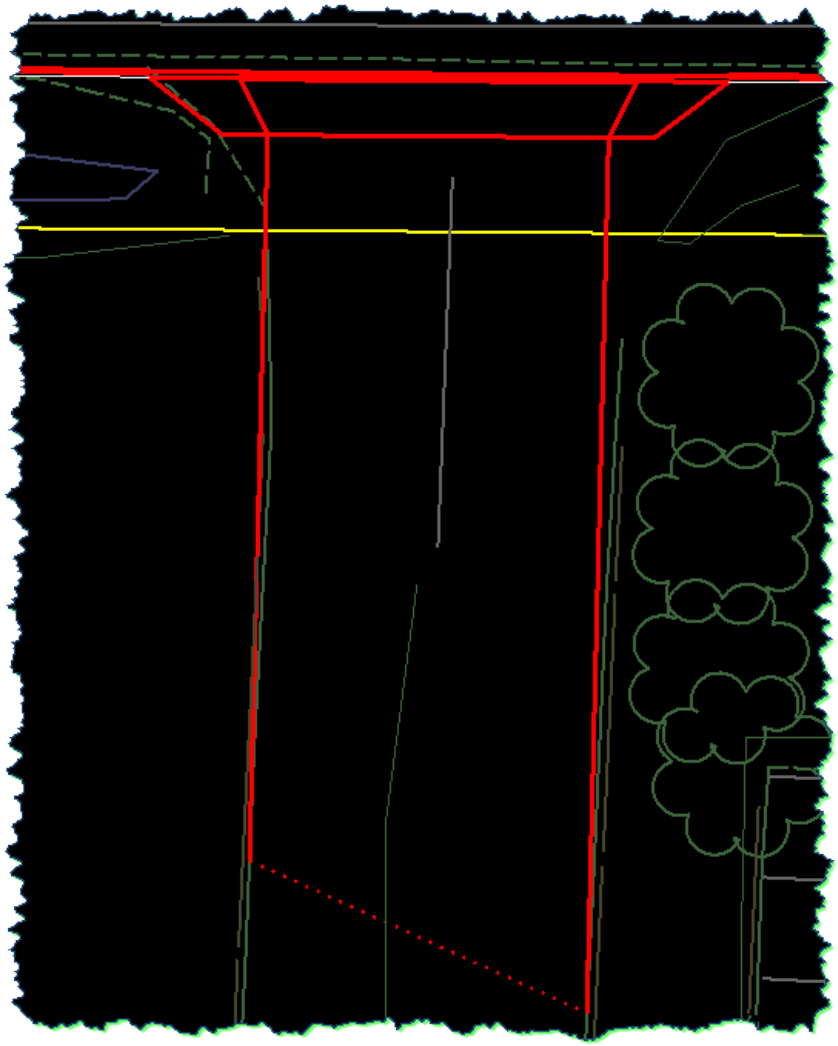
Maintain the **DWY_CurbFront** naming convention that you have been using.



The model so far should contain these breakline features (among others that were already in the FG surface when it was initially created).



5) **DELETE** the MicroStation guide lines that were drawn earlier.



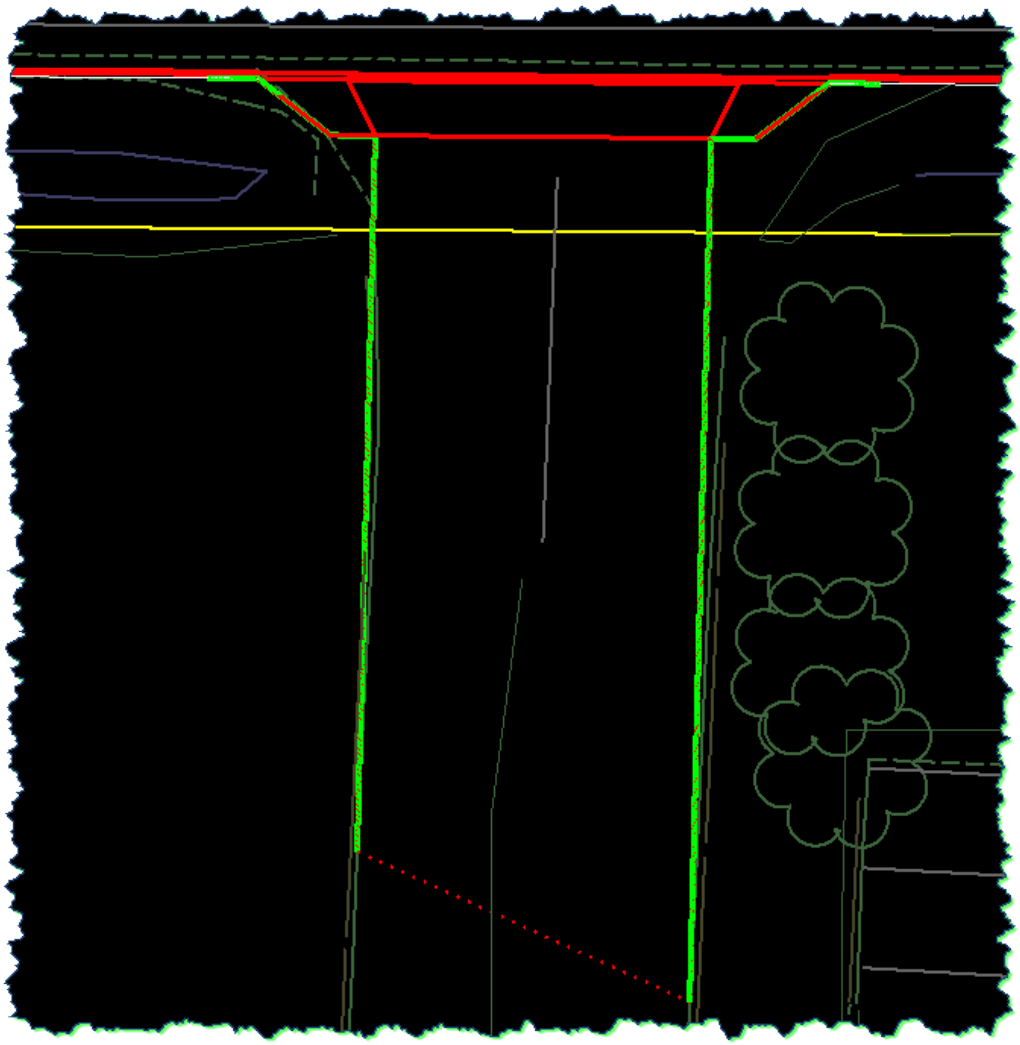
Tying into the Original Ground

As we close in on completing this driveway model, the **GENERATE SLOPED SURFACE** tool will be used to project slopes from the outer driveway breakline features to the OG surface.

If we consider the breaklines that we have so far, what would it take to develop, say a 1:3 slope projection to original ground from this driveway? How would you do it? Would you do it in pieces? …. Because that's more than likely what this model consists of, pieces of breaklines around the outer edge. Could you do it in one pass on either side?

Think about that a moment before you move on.

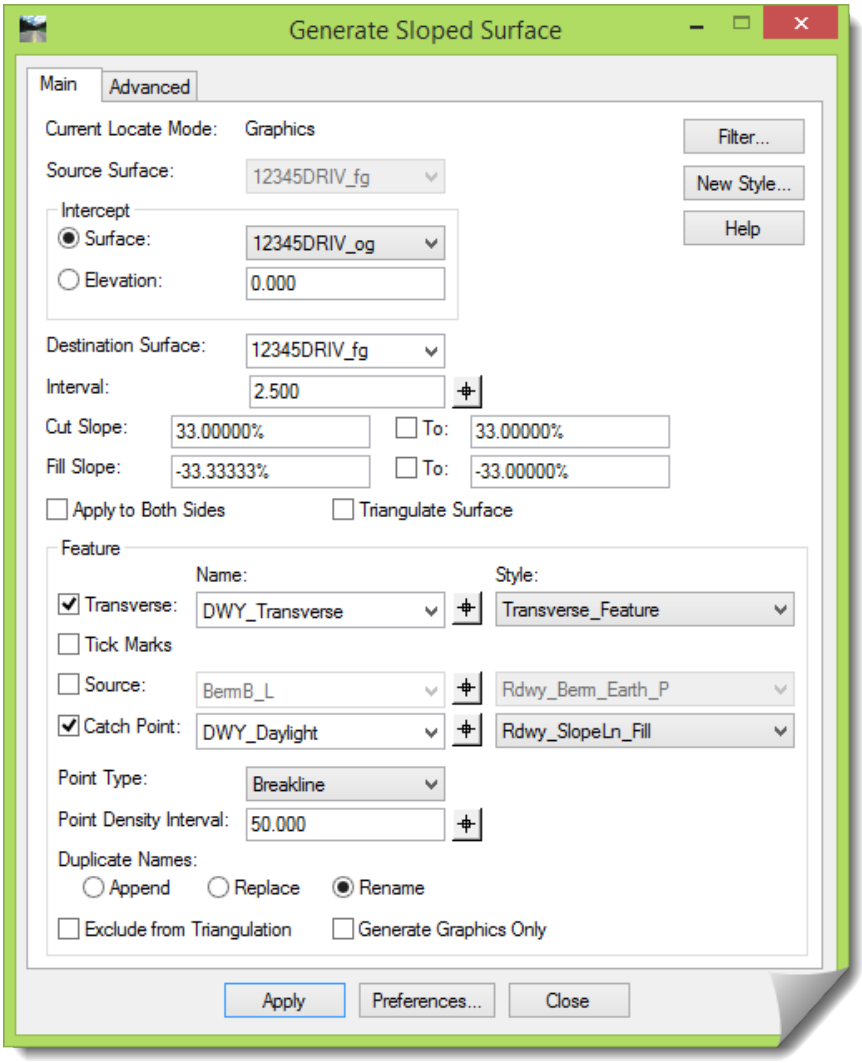
1) Draw a MicroStation smartline around the outer edge that needs the slope tied to the original ground, extending along the **CurbTB_R** feature as needed to match into the corridor catch slopes. Make sure you snap to each of the key elevational control points.



NOTE: As you move through this process, you may come to discover different ways to generate the various design elements of these driveways and approaches. Do not consider this work as having a rigid workflow. Modeling such as this can be done in a variety of ways with other InRoads and MicroStation tools.

2) Go to the **GENERATE SLOPED SURFACE** tool and project a **1:3** slope to the OG from the 3D MicroStation linestring that has been drawn. Add only the **Transverse** and **Catch Point** features to the surface.

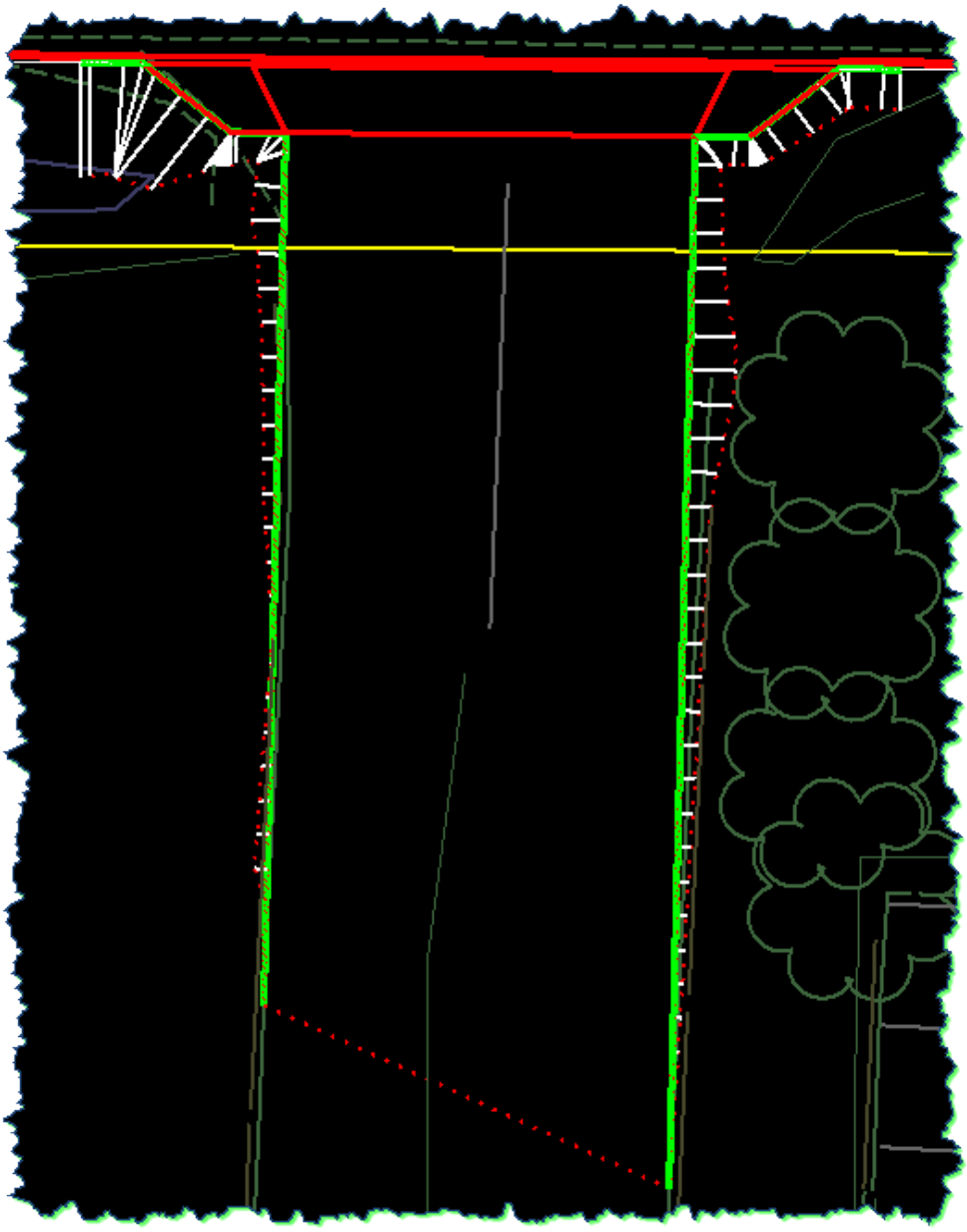
ALERT: The designer will need to use caution with how they use the **GENERATE SLOPED SURFACE** tool so that the slope rate used is the same as the corridor slopes at the match points on either side.



TIP: There are two **Interval** settings on this tool. The first one, titled just **Interval**, is the modeling spacing *along* the **Source** feature. It's analogous to the modeling interval in the **ROADWAY DESIGNER**. The second setting titled **Point Density Interval** refers to the density of the vertices along the **Transverse** breakline starting from the **Source** and ending at the **Catch**. In this modeling, a **50'** interval will result in a two point **Transverse** breakline since these **Transverse** breaklines are all less than 50' long.

The completed features should appear something like shown here.

Note that the density of the Interval used (in this case 2.50') can and should be adjusted to suit the modeling on your specific project.



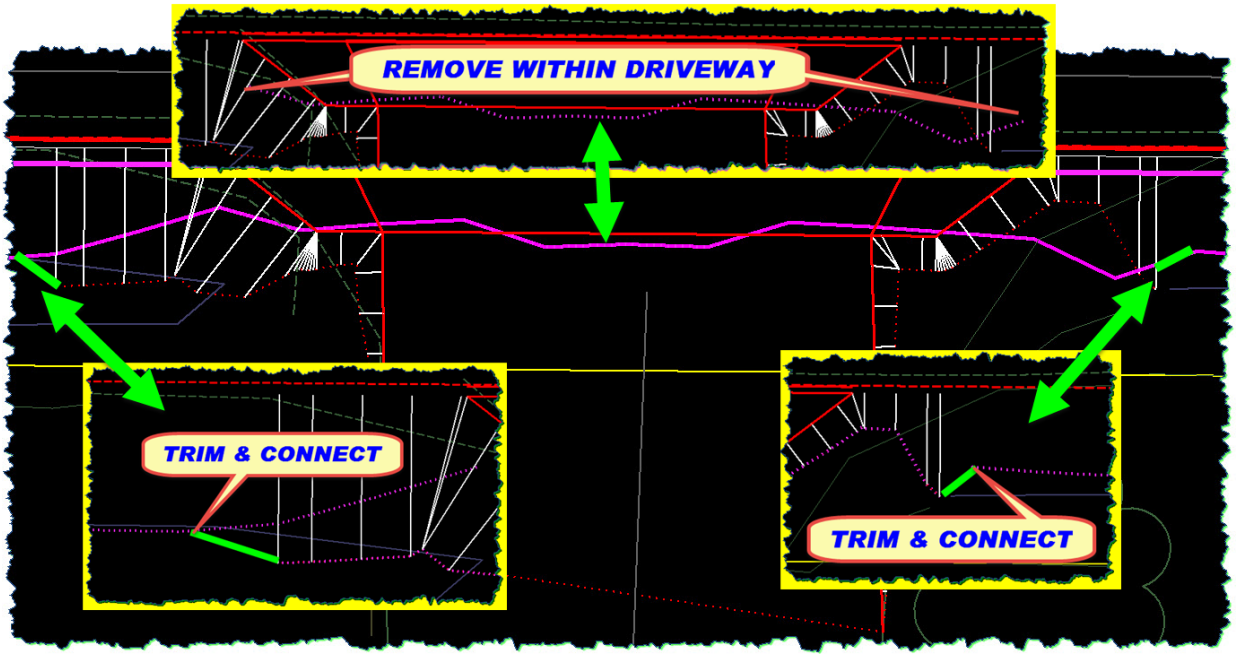
3) Delete the temporary 3D MicroStation smartlines from the first step that were used to project the slope from.

Keep in mind that these slopes will need to be tied into the side slopes of the roadway model.

Final Clean-up

The last stage of this work requires the use of the **PARTIAL DELETE** command to remove any other breaklines that are in the FG surface that are passing through this driveway.

This also includes a required modification to the **Exterior Boundary** as well as any other breaklines with 'hidden' plan display **Styles**.



1) Feel free to do any additional clean up and model review.
2) [**Save**] the final surface containing the driveway and prepare to move to the next section.

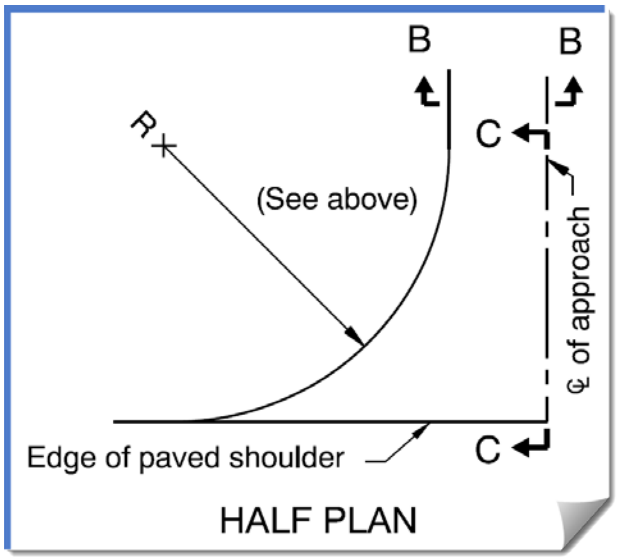
SCENARIO 2 - MINOR APPROACH MODELING

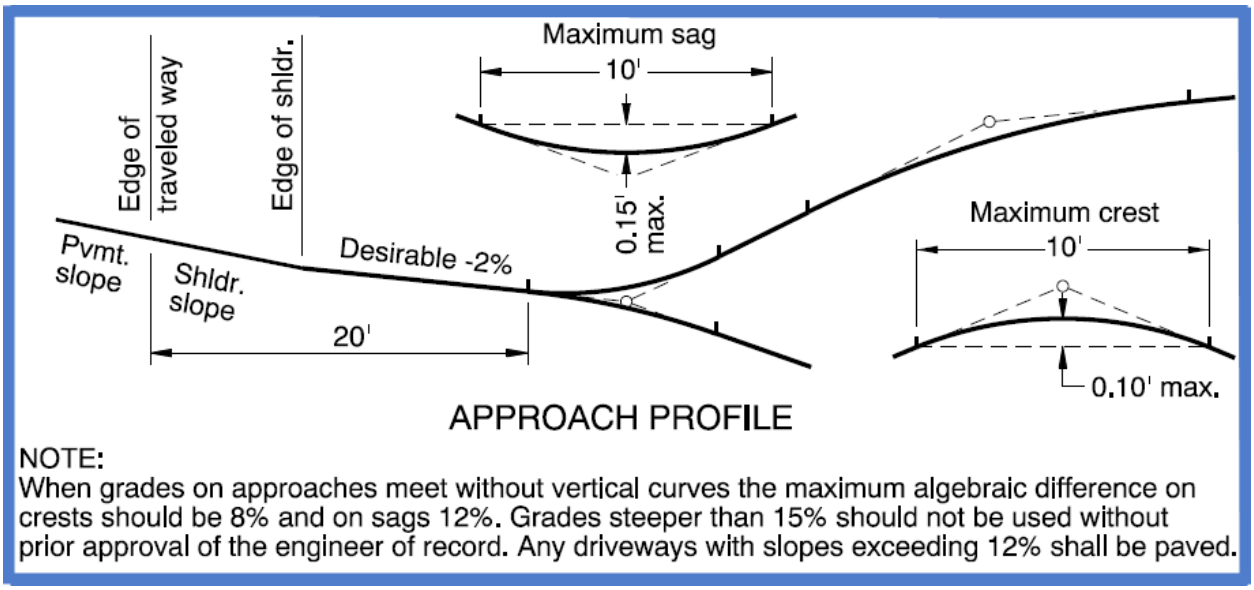
This scenario will cover the modeling for an approach defined within the ODOT Standard Drawing RD715. (Feel free to open **rd715.pdf** as necessary to review any relevant details.)

This approach will be different from the first scenario in that this layout will be partially driven off of a horizontal and vertical alignment. In addition to that, the returns will also be using geometry layout tools versus the **DESIGN SURFACE** tools used almost exclusively in the earlier driveway model.

Driveway Details Review

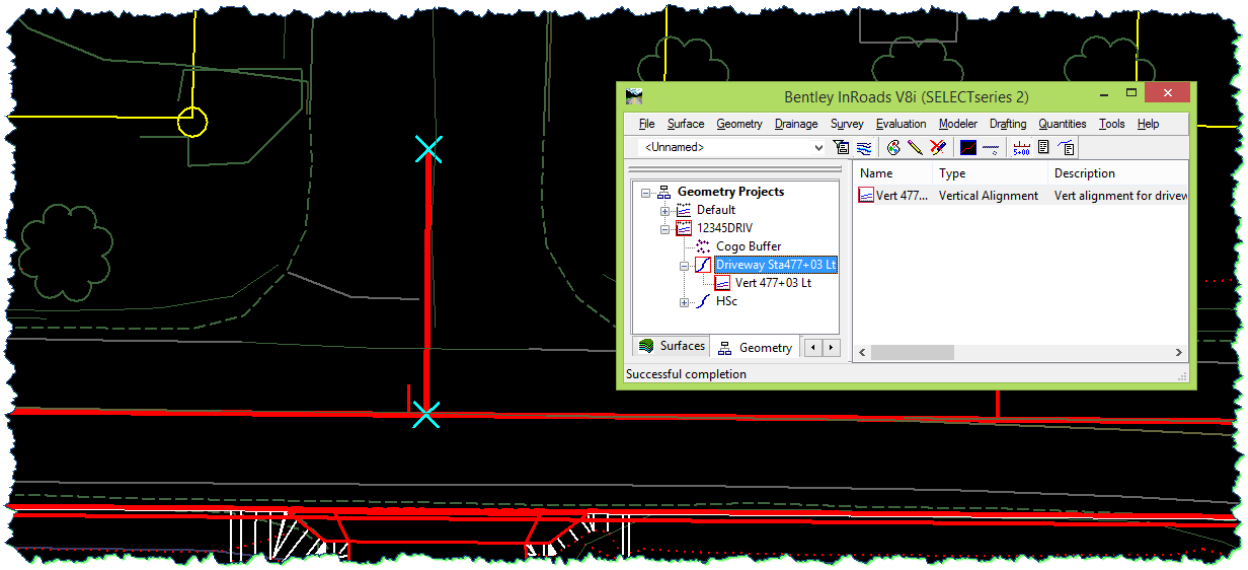
Take as much time as you require reviewing the diagrams shown here, as well as referring back to **rd715.pdf** as needed until you have a strong concept of what will be constructed.





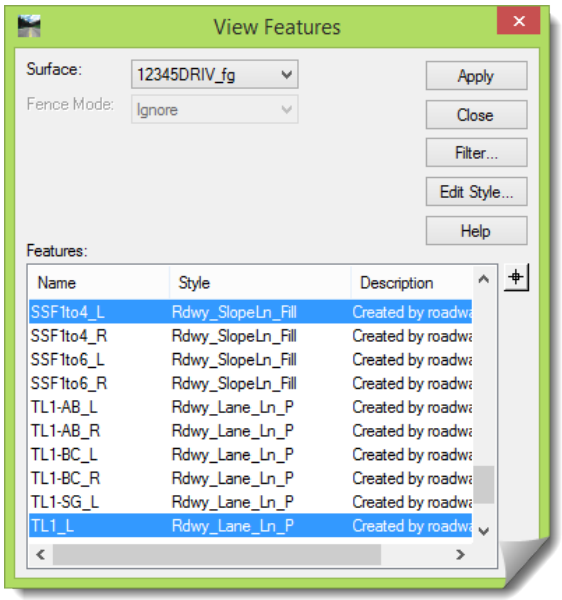
Both the horizontal and vertical alignments of the driveway approach are already done (**Driveway Sta477+03 Lt** and **Vert 477+03 Lt**). They start from the centerline of the mainline (**HSc**) and end at the tie-in to original ground at approach station 0+45.

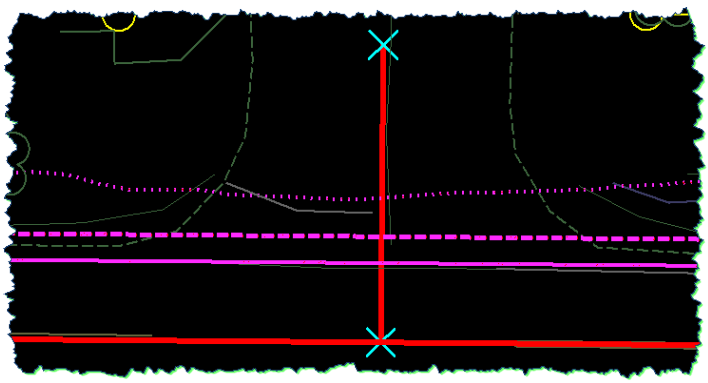
1) Make sure the Horizontal Alignment of **HSc** and **Driveway Sta 477+03 Lt** is viewed.



2) View the **TL1_L, Gtr_L** and **SSF1to4_L** features from the FG surface.

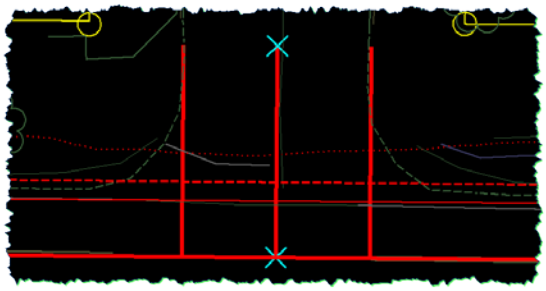
These lines will be the reference lines you will need for this exercise.



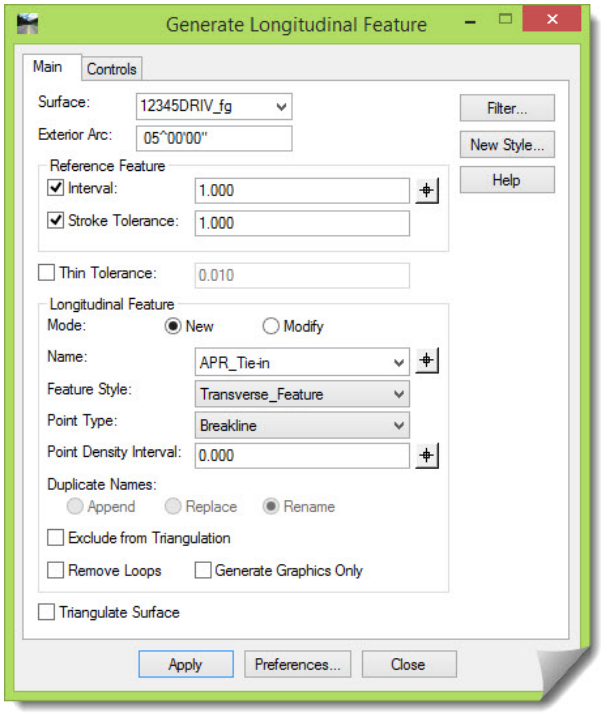


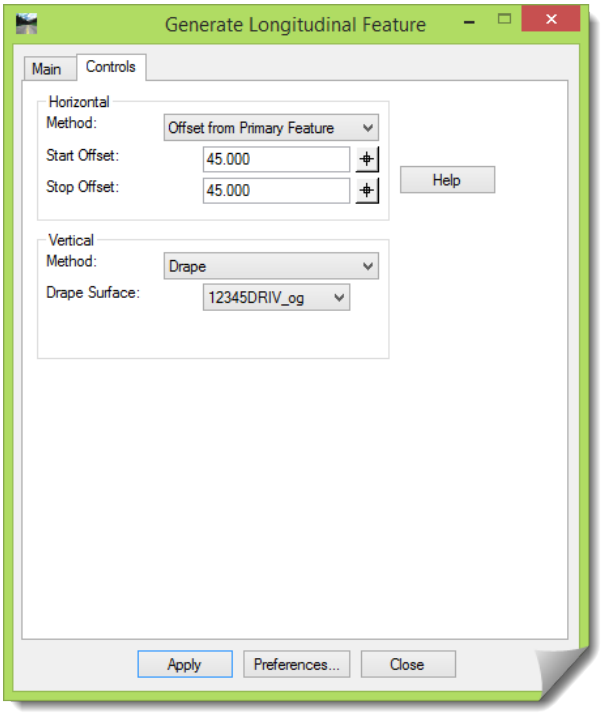
3) **COPY PARALLEL** the approach centerline using MicroStation **20'** left and right to establish the location for each of the edges.

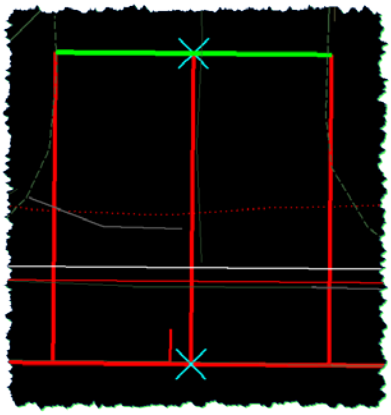
These "guide lines" will be used to snap to in the next step when creating the back edge.



4) Use the **GENERATE LONGITUDINAL FEATURE** to define the back of the approach. Set the **Interval** to **1.0'** (something small). Use a **Horizontal** offset of **45'** for this example, and set **Vertical** to **Drape** on the **OG Surface**. Select the centerline of **HSc** as both **Primary** & **Reference** graphics. Use the guide lines for the limits of the feature.



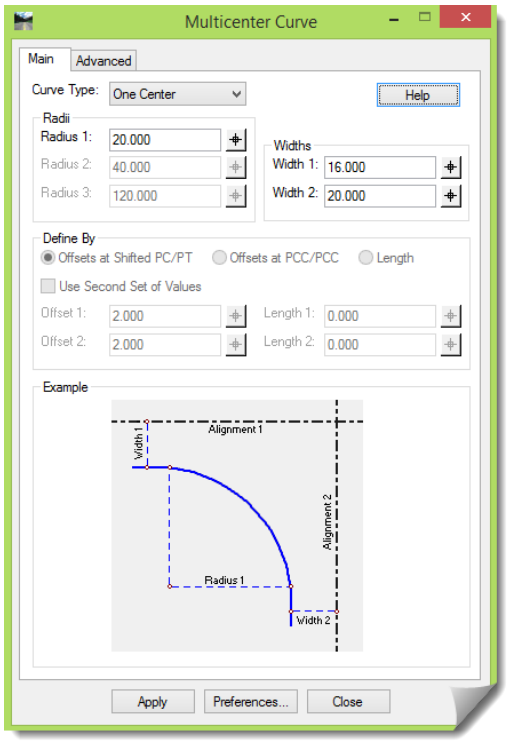


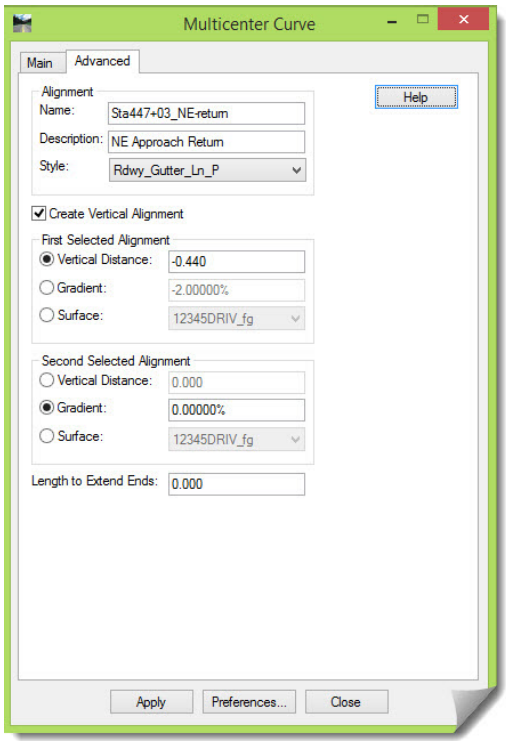


The **MULTICENTER CURVE** tool will be used to create the curve returns for each side of the approach. This tool is fairly intuitive and the diagram explains the settings that are required for the construction and execution. Not only does this tool create the **Horizontal** alignment for the return based on the settings on the **MAIN** tab, it can also create the **Vertical** alignment per the settings on the **ADVANCED** tab.

ALERT: The radius and width values may need to be adjusted according to the tie-in features used and the feature point location in the template used for modeling to ensure that the project-specific design radius corresponds to the top face of curb location.

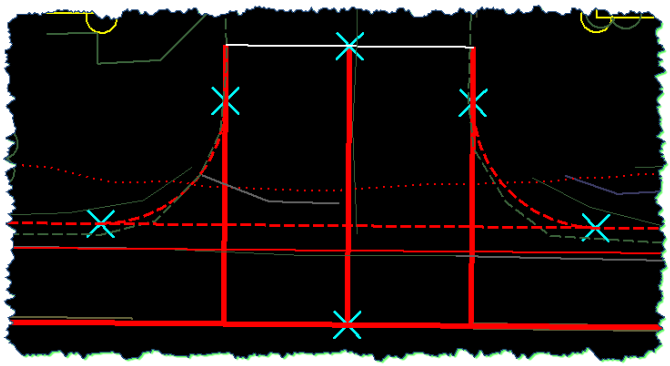
5) Open that tool, set the **Curve Type** to **One Center** and define the following:
   - Set **Radius** to **20'** per standard **RD715**
   - Set **Width 1** to **16.0'** and **Width 2** to **20'**
     - **Width 1** is the distance from the main road centerline to the gutter line
     - **Width 2** is the distance from the approach centerline to the gutter line
   - Set the **Alignment** name on the **ADVANCED** tab to something like **Sta477+03_NE-return**
   - Toggle *on* **Create Vertical Alignment**
   - For **First Selected Alignment** set **Vertical Distance** to **-0.440**. For **Second Selected Alignment** set **Gradient** to **0.0%**
     - **-0.44'** is the vertical offset from the main road centerline to the gutter elevation
   - Set **Extend Length** to **0.0**



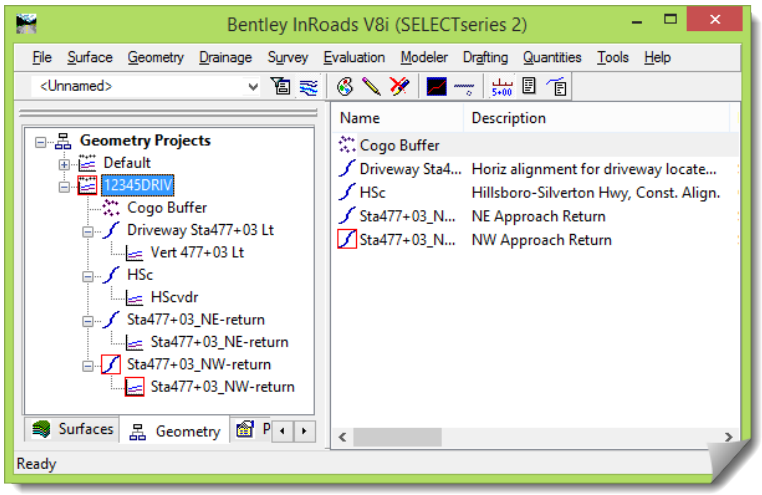


6) [**Apply**] following the prompts to make sure to select the correct alignment and quadrant (identify **HSc** for the first alignment).
7) Repeat this for the NW return, making sure to update the **Name** and **Description** fields.

The results should look like this in the plan view:

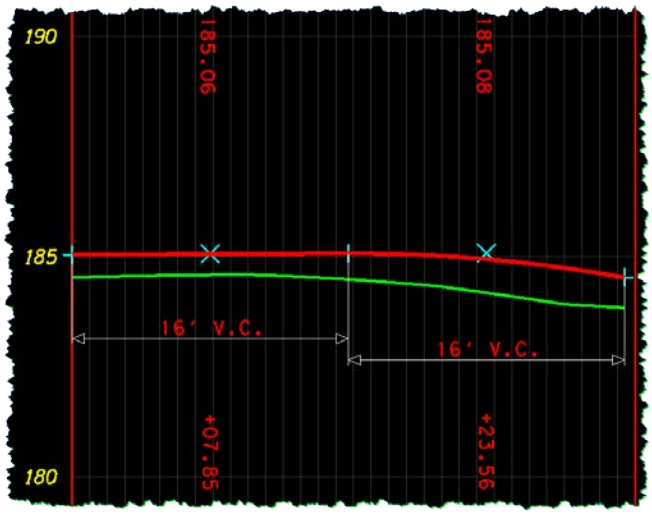


8) Verify that the alignments have been created in the InRoads **Workspace Bar**, and [**Save**] the geometry if it's correct.



9) View the returns in a profile to see how they were constructed.

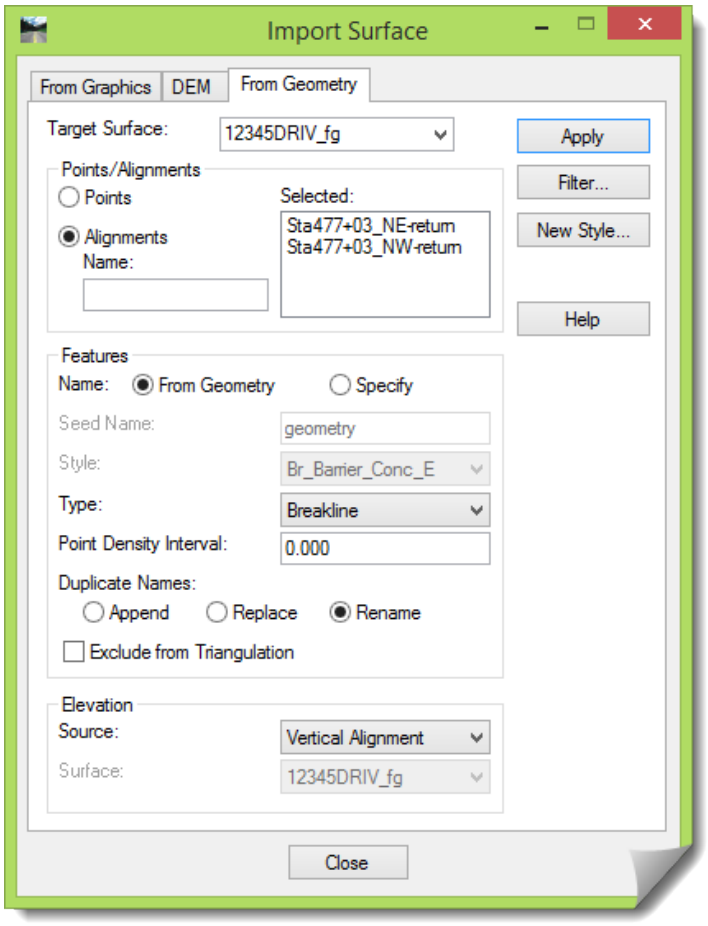
ALERT: The designer should always display the vertical alignment to verify that the tool generated an acceptable result. It may need to be revised with the Geometry tools.



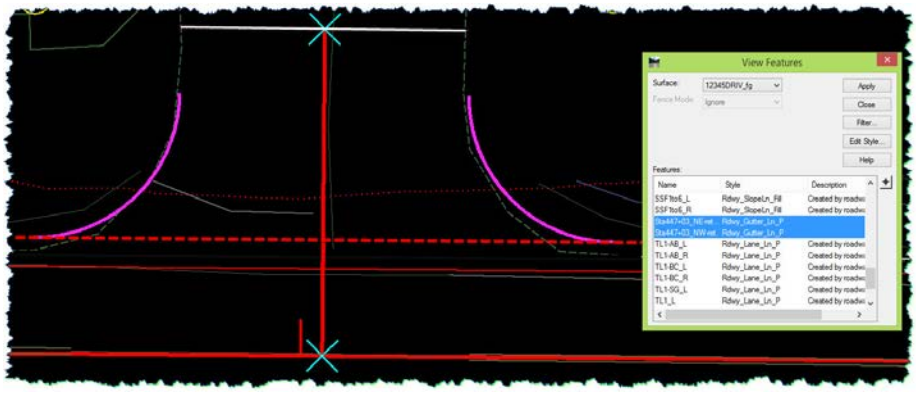
10) Import the returns into the FG surface using ***IMPORT SURFACE> FROM GEOMETRY***.

This tool will marry the horizontal and vertical alignments creating a 3D linestring, very similar to the geometry command **VIEW 3-D ALIGNMENT** does with its graphical display.

NOTE: When using this tool, the resulting feature interval is based on the chord height setting defined in the InRoads **PROJECT OPTIONS**.



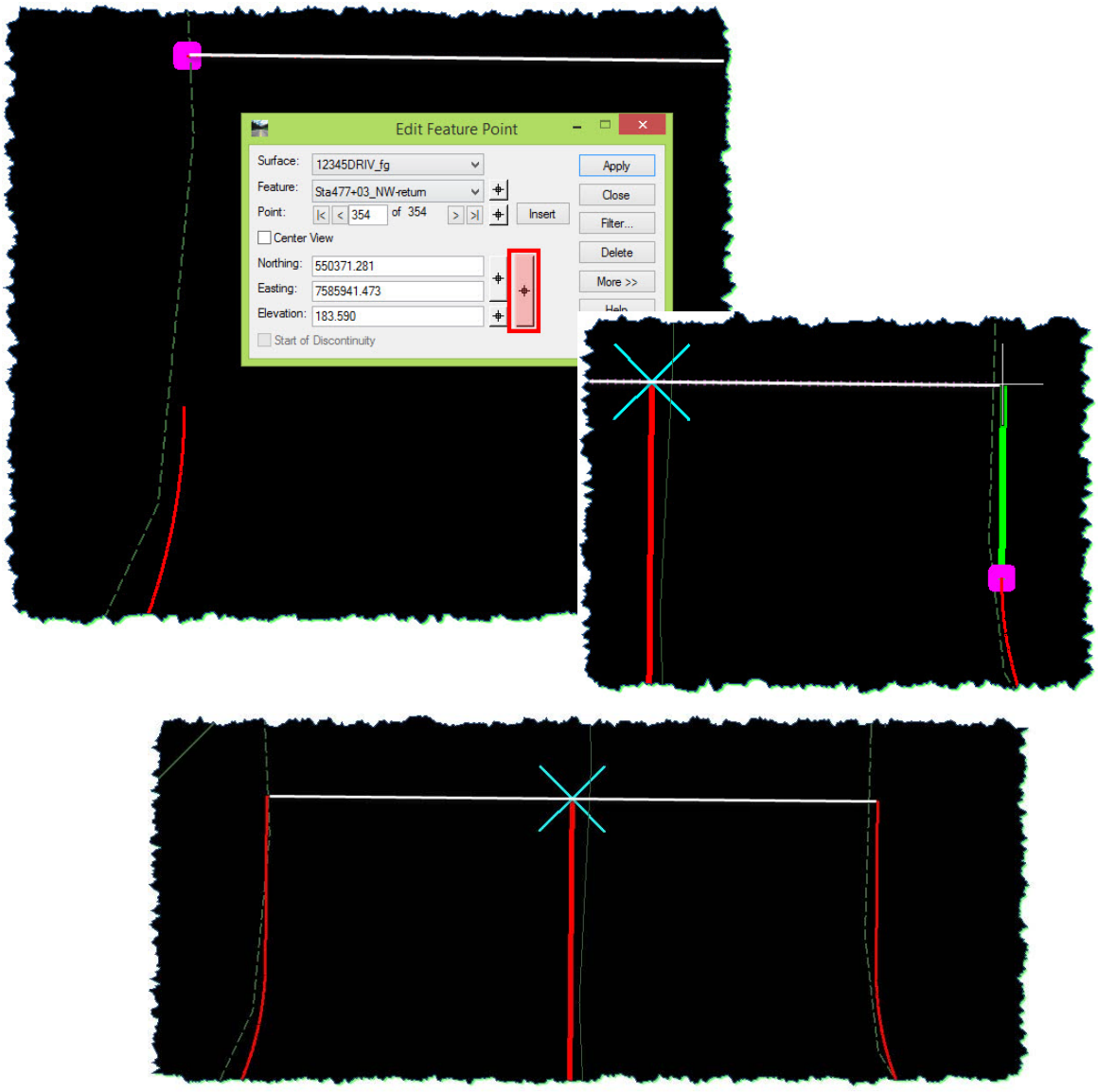
11) **DELETE** the graphics for the geometry returns as well as the 20' parallel guide lines, and view the new surface **Features** for those same elements to verify that they have been created and now exist in the surface model.



There are a number of ways to perform this next step. The desired result is to develop a breakline from the end of the return to the approach tie-in. A few options would include moving the last point on the return, inserting a new point on that breakline, or using the **PLACE FEATURE** tool.

12) Using the **EDIT FEATURE POINT** tool, move the last point of the return feature and snap it to the end of the approach tie-in feature. Do this for both returns.

Make sure you use the N,E,Elev **Locate** button. This will tie the driveway edge into the end of the driveway while making it all part of one feature with the return. Note that moving the last point as illustrated here is acceptable in this case since the density of data around the return is tight.



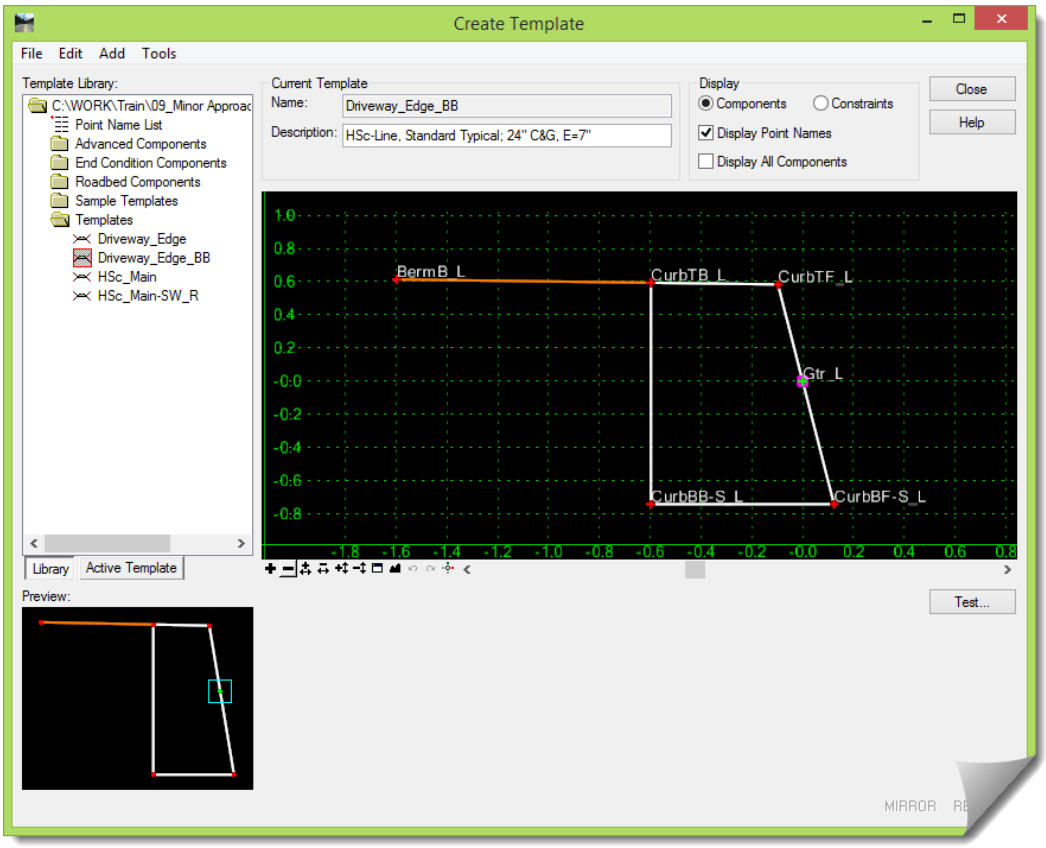
Now a partial template will be run around the radial returns and back toward the approach tie-in edge along the back. This template will be run without the Cut / Fill slopes.

13) Go to the **CREATE TEMPLATE** tool and browse to the **Templates** folder.

14) **Copy** the **`Driveway_Edge`** template, calling it **`Drive_Edge_BB`** (for backbone) and remove the Cut / Fill slopes.

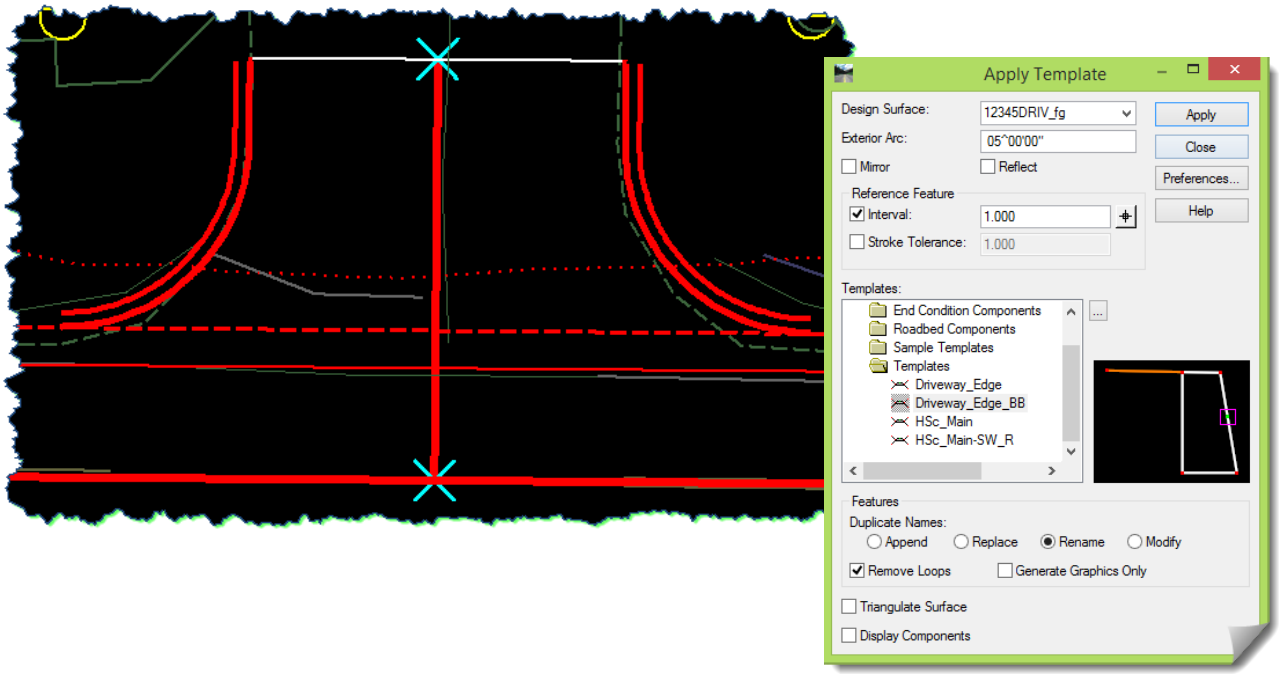
15) [**Save**] the **TEMPLATE LIBRARY** when you exit.

The template should look like this once it's been edited:



16) Using **APPLY TEMPLATE**, run this template around both approach edges.

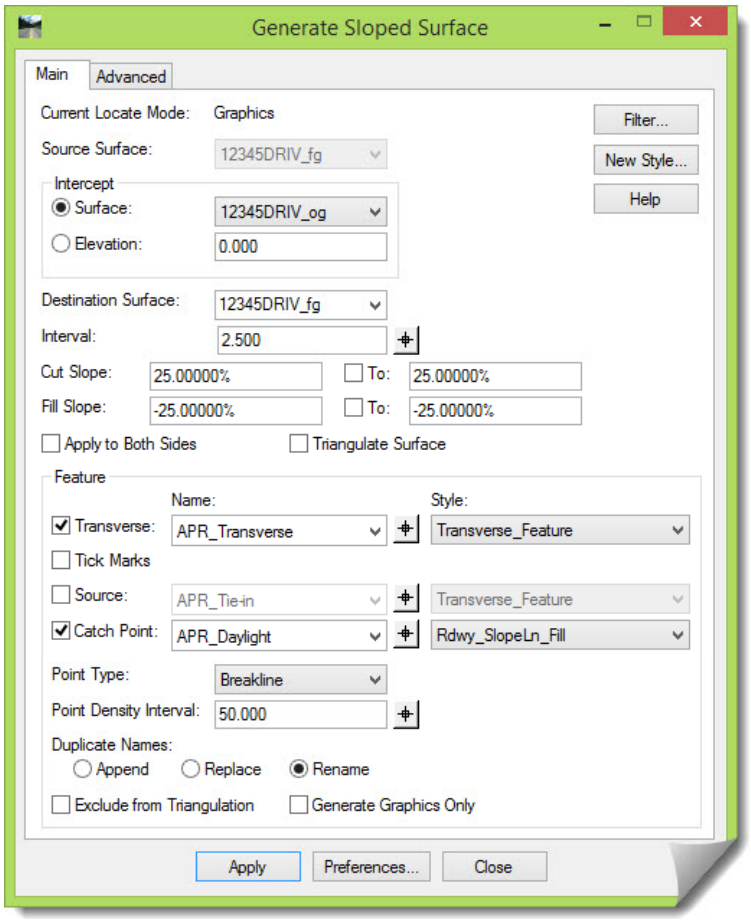
This tool was discussed in detail in the last module so you should be familiar with its operation, but remember to **Reflect** the template when running the right side.

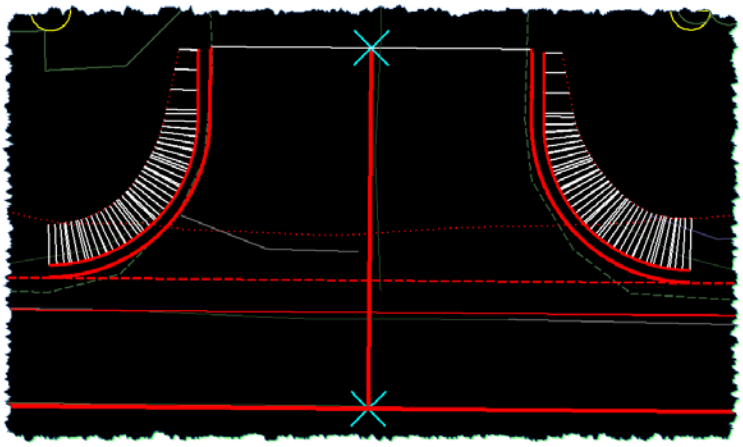


17) Use the **GENERATE SLOPED SURFACE** tool to create a **1:4** daylight slope grading similar to the earlier driveway modeling.

In this instance, the slope surface will be projected from the outermost feature, or graphic, that was created by the **APPLY TEMPLATE** activity.

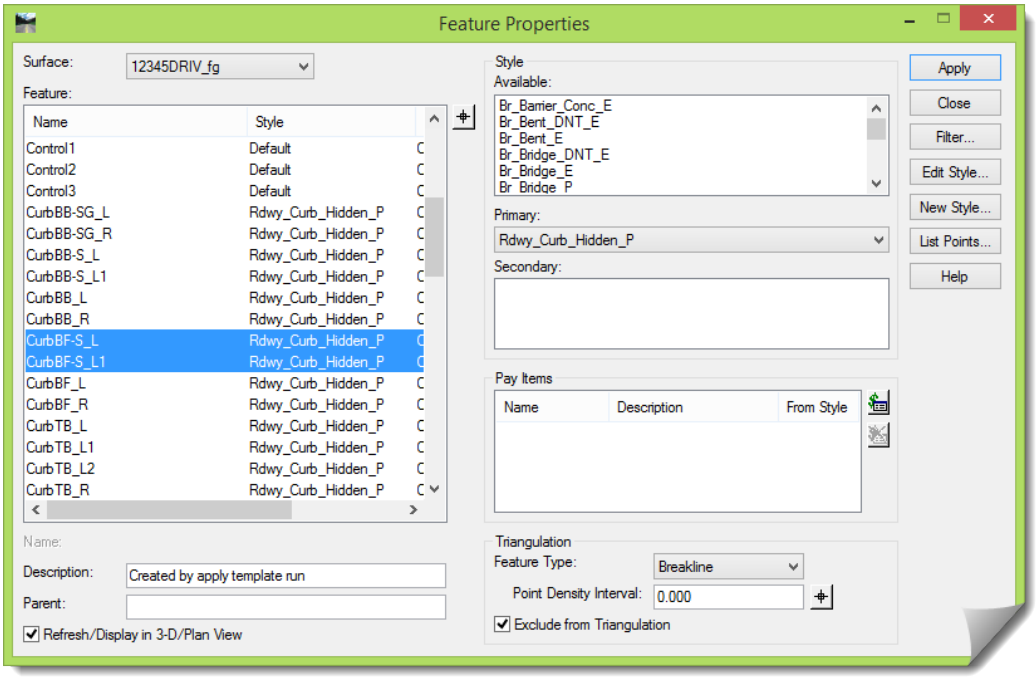
TIP: To reinforce the idea that different tools can be combined where needed if your project required targeting multiple surfaces, you could run the return as a **Corridor** in **ROADWAY DESIGNER**.





Because an isolated curb template was used without the roadway connected to it, the Feature **CurbBF-S_L** became integrated into the triangulation. This will have to be excluded.

18) Go to **FEATURE PROPERTIES** and set the **CurbBF-S** features to **Exclude from Triangulation**.

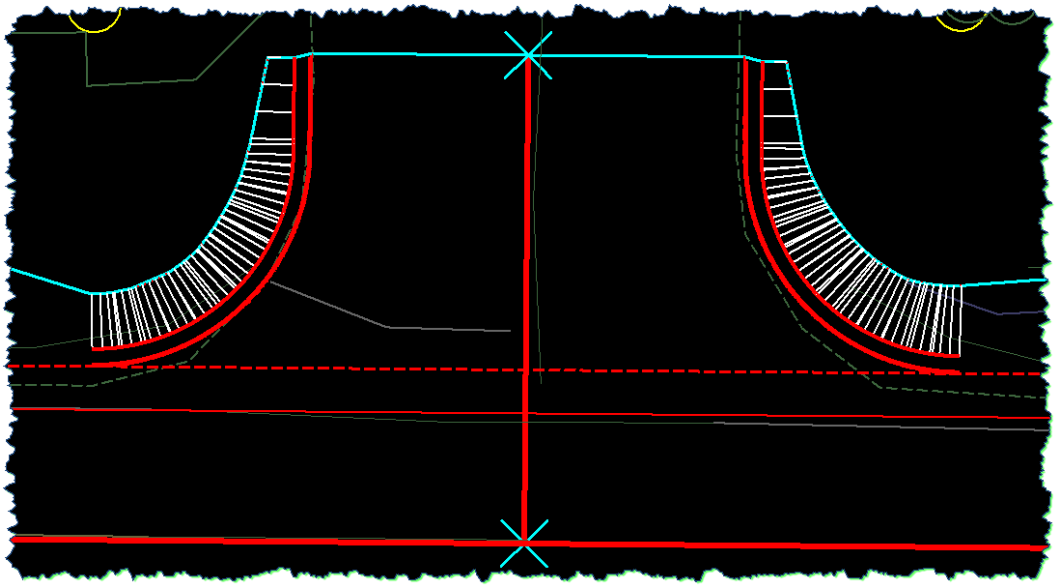


Similar to the first driveway scenario, and typical in any work of this nature, here are the closing clean-up items to finalize this approach:

- Rename Features to clean up the affixes (i.e. from **CurbBF-S_L** & **CurbBF-S_L1** to **CurbBF-S1_L** & **CurbBF-S2_L**, and so on)
- Trim out all of the features from the FG surface that run through the driveway opening
- Anything to the outside of **EP_L** will need to be partially deleted. Features should be "trimmed", or partially deleted, back to the new end points of the approach modeling.
- As previously mentioned, some of the curb features do not have a **Style** associated with them that can be viewed in Plan view. To address this, the **Style** must be temporarily changed to one that can be viewed to aid in the deletion process.
- Additional breaklines and **TRANSVERSE FEATURES** can be added as needed
- Modify the **Exterior Boundary** to include the new approach

TIP: The subject of **Features** that have **Styles** not configured to view in **Plan** has been mentioned several times. It may have been inferred from these statement that Features using these 'hidden' **Styles** cannot be edited. This is not true. For all of the work done earlier in this module, the InRoads **Locate Lock** has been set to **Locate Graphics**. With this **Lock** positioned to **Locate Features**, the 'hidden' plan display becomes less important, and in fact, these **Features** can indeed be edited with the **Locate Lock** in the **Features** position. Even though the **Feature** can be selected and edited, it will retain its 'hidden' display. It will not be seen, even during the edit. This is something that you may want to experiment with to reduce the need to change the **Styles** of these 'hidden' **Features**.

When this scenario is complete, the features should look similar to this:

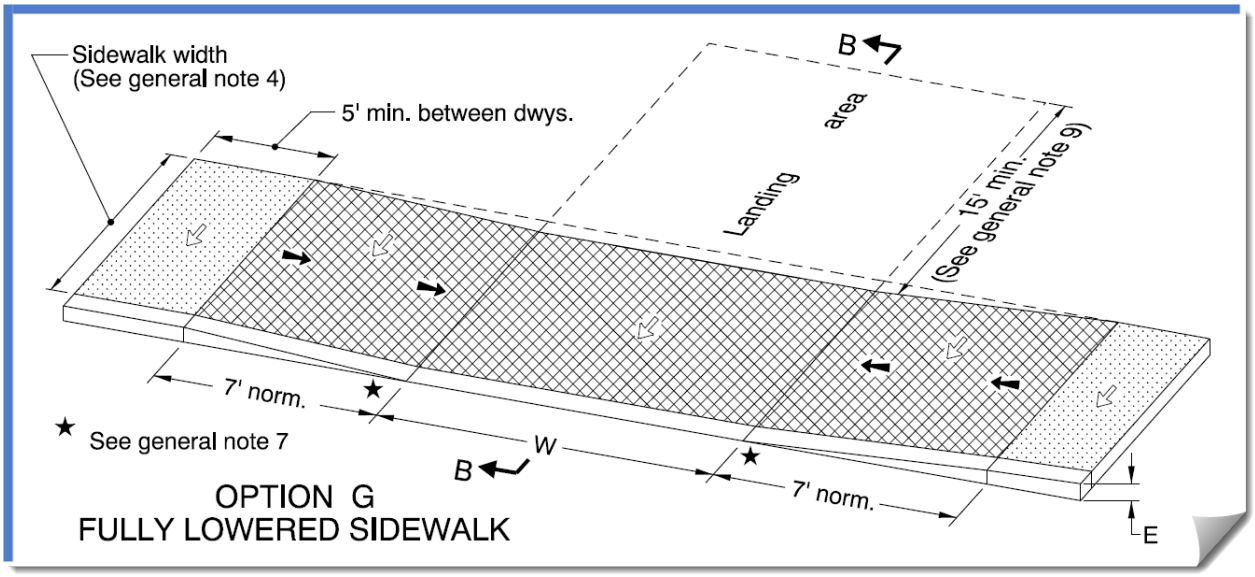


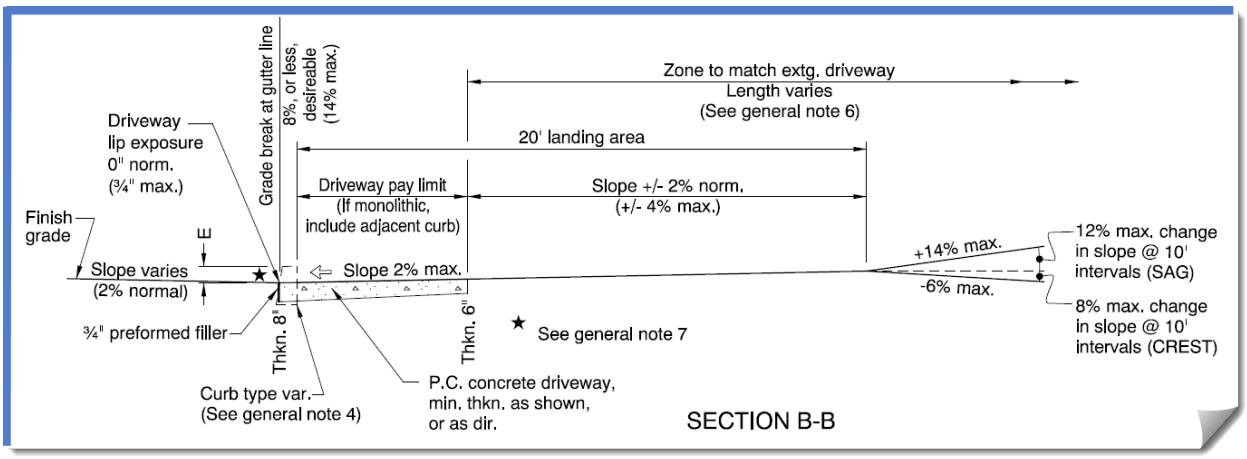
SCENARIO 3 - SIDEWALK DRIVEWAY MODELING

This last scenario is the final driveway/approach type with a sidewalk. It will be presented as a workflow for you to work through on your own, referencing tools with which you should already be familiar. The driveway in this example is defined by ODOT Standard Drawing **RD735, Option G**. (Feel free to open **`rd735.pdf`** , included in the module folder to review additional details.)

Driveway Details Review

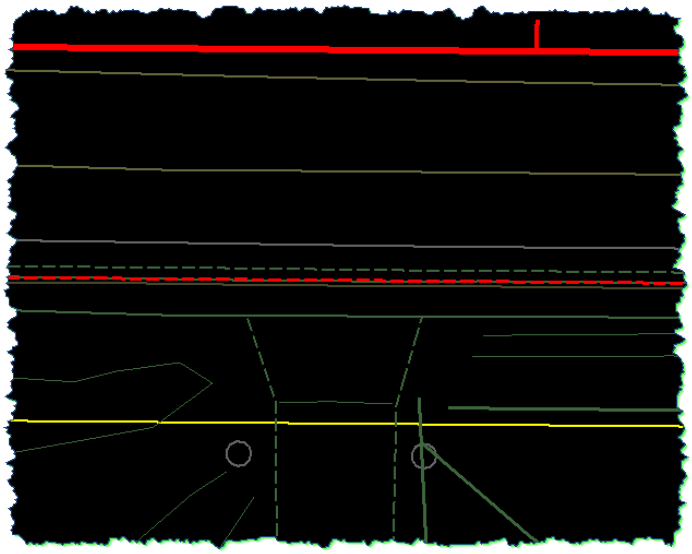
Take some time reviewing the illustrations shown here, as well as referring back to the PDF as needed (if only for readability) until you have a strong concept of what will be constructed.





The layout of this type of driveway is very similar to the first driveway in this module, except that this one has a slightly simpler configuration due to the parallel nature of the front and back of the sidewalk; however it has added complexity due to the maximum criteria that must be met.

Here are the details and integrated workflow guidance for this scenario:



a. The driveway is at station **481+68 Rt** and is **20'** Wide.

b. Since a Horizontal alignment doesn't exist, the driveway centerline can be drawn in MicroStation using the **SO=** key-in.

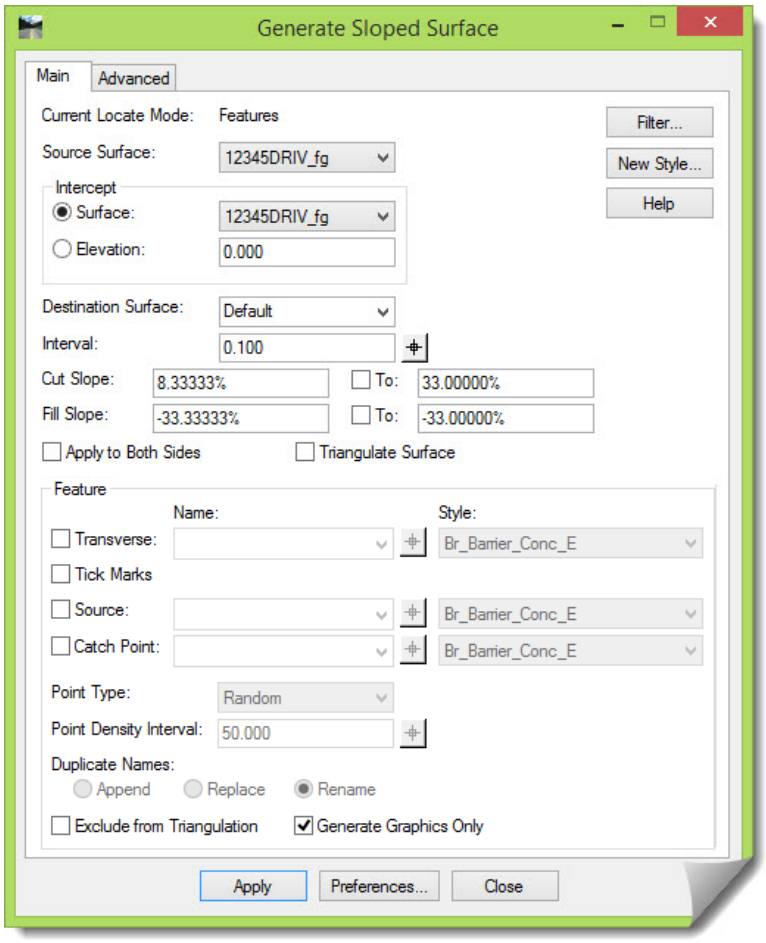
c. MicroStation can be used to copy the centerline as before, offsetting it **10'** both ways.

d. View the **Gtr_R** feature from the design surface as was done in the first driveway scenario.

e. Use **GENERATE LONGITUDINAL FEATURE** to create the driveway apron/sidewalk back line using the **Gtr_R** feature as the primary and reference element. Set the **Horizontal** offset to **6.597** (the offset difference from the gutter to the back of walk in this example) and the **Vertical** to **Transverse Slope** with a value of **+2.0%,** snapping to the intersecting driveway edge guide lines.

f. Using the **PLACE FEATURE** tool, create a feature on each side of the driveway from the endpoint of the driveway apron back line (just created in last step) to the intersection of **Gtr_R** and the edge guide line.

g. Use **GENERATE SLOPED SURFACE** to locate the back catch point of the ADA-compliant side slope ramps using the features that were just created.



h. Create a guide line from the back catch point of the graphic created in the last step perpendicular to the top face of curb and extend the guide line to intersect with the back of walk feature. (Alternatively, using the location of the catch point as a guide, offset the previously created guide lines a suitable distance to meet ADA-slope requirements.)

i. Using the **PLACE FEATURE** tool, snap to the intersection of the perpendicular guide line with the **WalkTB_R** feature and the **CurbTF_R** feature.

j. Connect the breaklines along the front of the driveway and back of sidewalk using **PLACE FEATURE** by snapping to the endpoints or intersections of any "transverse" features that were created in the previous steps with the corresponding longitudinal features for the front and back of curb through the driveway apron and the back of sidewalk. In the case of intersecting features, be sure to snap to the intersection of the “transverse” feature to get the correct elevation. The top face of curb should intersect with the **Gtr_R** feature at the bottom throat of the driveway.

k. **GENERATE LONGITUDINAL FEATURE** for the back of sidewalk berm (**1’** offset, **2%** transverse slope), using the back of walk features as the primary and reference element.

l. Check to see if the back tie-in slope of the driveway meets within 20' of the back of the curb using a +/-4.0% maximum grade for the landing area (within 14.0' from the back of apron feature already created) using **GENERATE SLOPED SURFACE** set to **Generate Graphics Only**.

m. Use the **GENERATE LONGITUDINAL FEATURE** from the driveway apron back line to establish the back of the landing area.
   - Horizontal offset= **14.0'** (20' Landing Area offset shown in detail – 6' sidewalk).
   - Vertical Transverse Slope of **-4.0%** (or up to +4.0% if required for drainage or other design needs).

n. Use **GENERATE SLOPED SURFACE** again to seek the original ground using the maximum **-6.0%** shown on RD735 (or alternatively +14% if in a cut situation).
   - If it catches the original ground within an acceptable distance, use **GENERATE LONGITUDINAL FEATURE** from the back of the landing area at **-6.0%**.
   - If it doesn't catch original ground soon enough:
   - Use **GENERATE LONGITUDINAL FEATURE** from the back of the landing area with a Horizontal offset = **10.0'** and a Vertical Transverse Slope of **-6.0%**.
     - Per Std Drawing RD735, grade breaks from here on out can be no less than 10' apart, therefore you must continue with alternating iterations of **GENERATE LONGITUDINAL FEATURE** and **GENERATE SLOPED SURFACE** from the previous grade break (at **-8.0%** maximum grade breaks for Crest curves or +**12.0%** for Sag curves) until you hit original ground. Making sure that your horizontal offset is no less than 10'.

o. **GENERATE SLOPED SURFACE** off the sides of the driveway behind the back of walk berm, projecting to OG at a sensible side slope.

p. As mentioned throughout this module, any surface features that run through the driveway will require partial deletions or trimming.

Conclusion

Congratulations, you have completed the Minor Approaches and Driveways module and should be another step closer to building a more complete design model with InRoads.

We leave you with our encouraging final thought – Do these modules with an attitude of application. Study them with the viewpoint that you are going to apply these new skills on your current or future project. Look into and beyond the exercise steps and motivate yourself to momentarily pause and consider past, present and future projects and how this information could be put into practice.