ss307-4.X – version 07.04.10

Description

This criteria is used to draw cut and fill side slopes using Standard Grading as defined in the Location & Design Manual, Volume 1, Roadway Design, Figure 307-4. The criteria will also draw the unpaved portion of the graded shoulder. An example of the side slope for a cut section is shown in Figure 1 below:
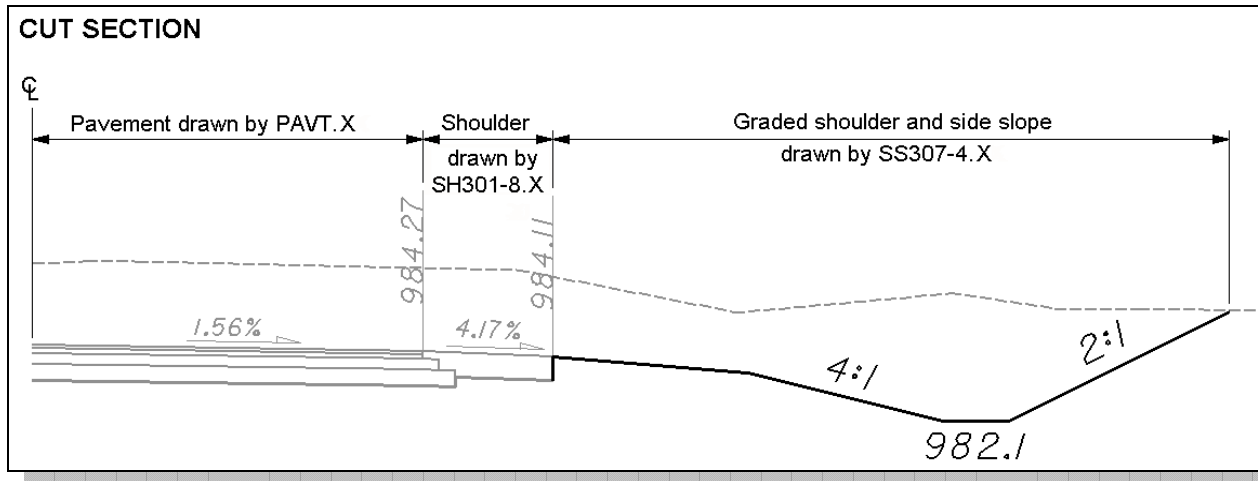

Figure 1

Inclusion Sequence

criteria files are written so that each individual file is responsible for drawing only a specific component of the proposed cross section design. This allows for greater flexibility when utilizing the criteria files to accommodate a wide variety of design scenarios. When a criteria run is processed, the user will specify the individual criteria files that will be used to draw each component. The order in which these components are specified is significant. Criteria files must be included in the order that they will process from the centerline out . For example, the pavement criteria must be included before the shoulder criteria which must be included before the side slope criteria. Each criteria file will start drawing where the previous criteria file ended.

The ODOT Standard criteria file **DEFINE.X** contains default definitions for some of the Define Variables used by ODOT's criteria files. **DEFINE.X** must always be included first in any criteria run.

In order to process **SS307–4.X**, a pavement and a shoulder criteria file must be included in the criteria run previous to **SS307–4.X**. The following ODOT standard pavement and shoulder criteria files are available on the ODOT GEOPAK Support Website:

Pavement Criteria	**Shoulder Criteria**
PAVT.X	SH301–8.X
PAVT_EXIST.X	SH301–8B.X
PAVT_OVERLAY1.X	SH301–9.X
PAVT_SHAPELESS.X	
PAVT_WIDEN.X	

Establishing the Graded Shoulder Width

The criteria will start processing from the proposed edge of the treated shoulder to draw the graded shoulder. The width of the graded shoulder can be determined by two methods:

- Meet a graphic line representing the graded shoulder location. This method should be used if the graded shoulder width is variable.

- Use a variable to set the graded shoulder width. This method should be used if the graded shoulder is a constant width.
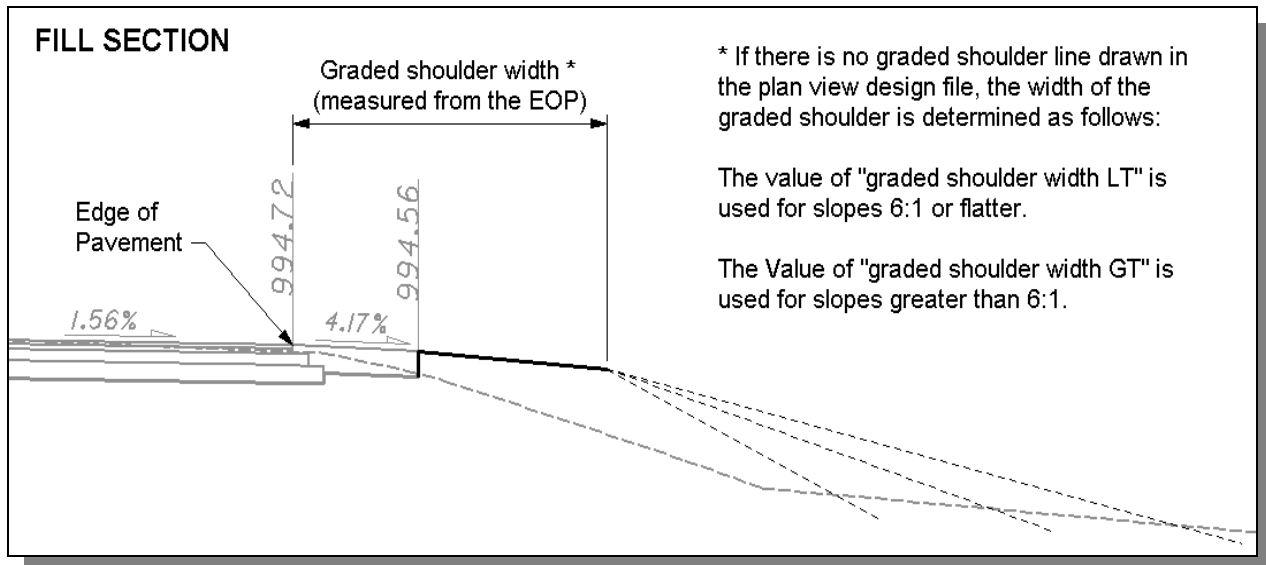

Figure 2

The criteria will always look for a graphic representation of the graded shoulder first. The DGN Variable **"~pr graded shoulder in dgn"** has been defined to establish the symbology for the graded shoulder line.   The variable is defined as follows within the criteria:

```
define_dgn "~pr graded shoulder in dgn" \
dgn = "proposed dgn file name" \
lvname = DT_P_Graded_Shoulder \
wt = 1, ByLevel \
co = 9, ByLevel
```

In order for the criteria to search for the graded shoulder line in the correct design file, the variable **"proposed dgn file name"** is used to establish the name of the design file that contains the graded shoulder line. This variable must be defined by the user before the criteria run can be processed.

If no graphics representing the graded shoulder are found, the criteria will set the width of the graded shoulder using the variables **"graded shoulder width lt"** (for fill sections where the slope is less than or equal to 6:1) or **"graded shoulder width gt"** (for fill sections steeper than 6:1 and all cut sections). See the Location & Design Manual, Volume 1, Figure 301-3 to determine the graded shoulder width. The default value for **"graded shoulder width lt"** is 8'. The default value for **"graded shoulder width gt"** is 10'.

The graded shoulder is drawn at a slope of 8.3%.

Cut Conditions

For cut conditions, the criteria will use the value of the variable **"cut foreslope"** to place the side slope. You can change the ditch foreslope by assigning a new value to **"cut foreslope"**. For example, assigning a value of 3 will result in a 3:1 foreslope for all sections in cut. The default value for **"cut foreslope"** is 4 (for a 4:1 slope).
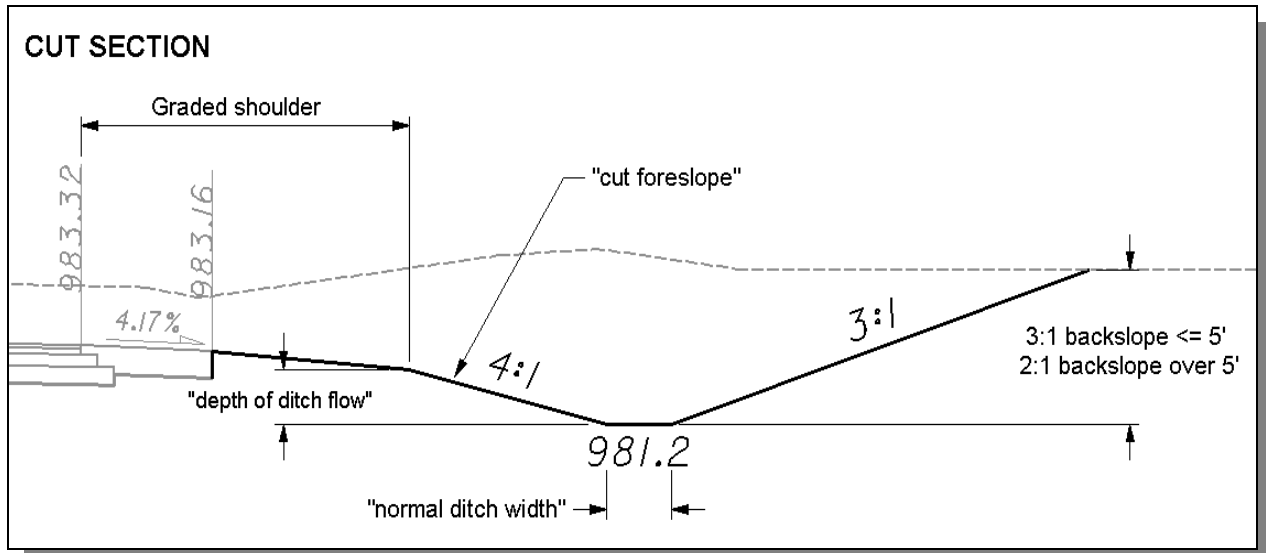

Figure 3

The depth of the ditch is measured from the graded shoulder and can be defined with the variable **"depth of ditch flow"**. The default depth for the ditch is 1.5'.

The width of the ditch is controlled by the variable **"normal ditch width"**. The default value is 2'.

The ditch backslope is determined by the criteria. A 3:1 backslope is used if the depth is 5' or less. A 2:1 backslope is used for ditches deeper than 5'.

Fill Conditions

For fill conditions, the side slope can be determined by the following two methods:

* The user can set a fixed side slope for all cross sections in fill.

* Allow the criteria to evaluate the fill height at each at each cross section to determine the side slope that will be placed.

The variable **"fill foreslope"** is used to control how the criteria will place the ditch foreslope. Set the value of **"fill foreslope"** to 0 and the criteria will evaluate the fill height at each section and select the side slope using the values specified in the table below.

Fill Height	Side Slope Placed
0' - 0.25'	8:1
0.25' - 2.0'	6:1
2.0' - 8.0'	4:1
8.0' - 16'	3:1
over 16'	2:1

The elevation at the end of the graded shoulder is compared to the elevation at the location where each slope intersects existing ground to determine which slope will be placed as shown in Figure 4 below.
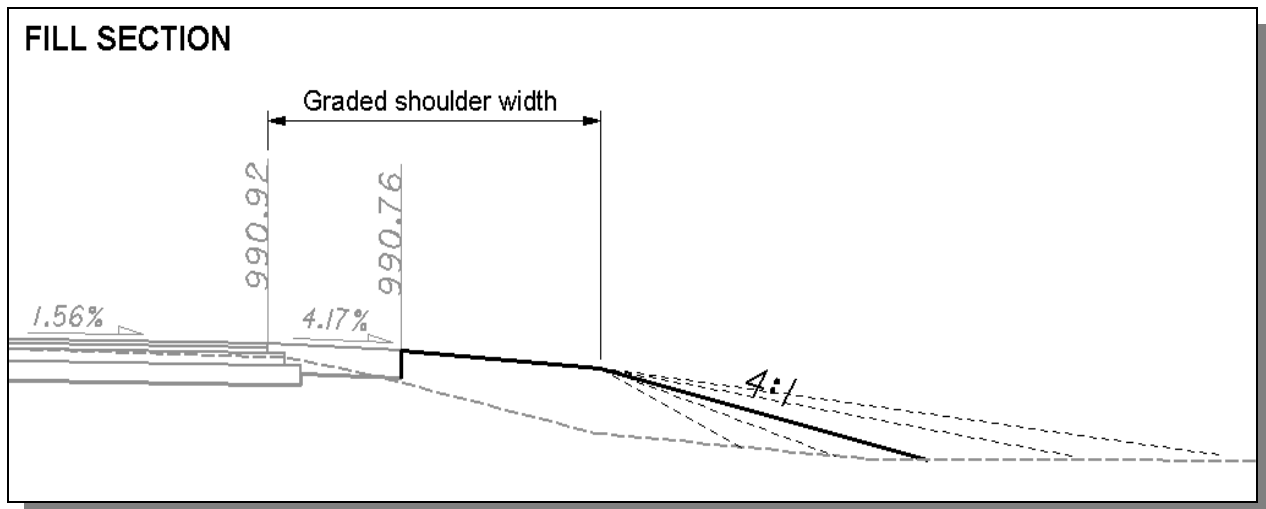

Figure 4

To force the criteria to place the same side slope for every cross section in fill, set the value of **"fill foreslope"** to the slope that you wish to place. This value must be specified as an integer. For example, set the value to 3 to place a 3:1 slope.

The default value for **"fill foreslope"** is 0.

After the side slope has been established, the criteria will next determine whether a ditch should be placed. The criteria will evaluate the slope of the existing ground at the point where the proposed side slope intersects existing ground. If the existing ground is sloping back towards the roadway, a ditch will be drawn as shown at

left in Figure 5. If the existing ground is sloping away from the roadway, the criteria will not place a ditch unless the existing ground slope is steeper than the value of the variable **"terminate slope"** as shown at right in Figure 5.
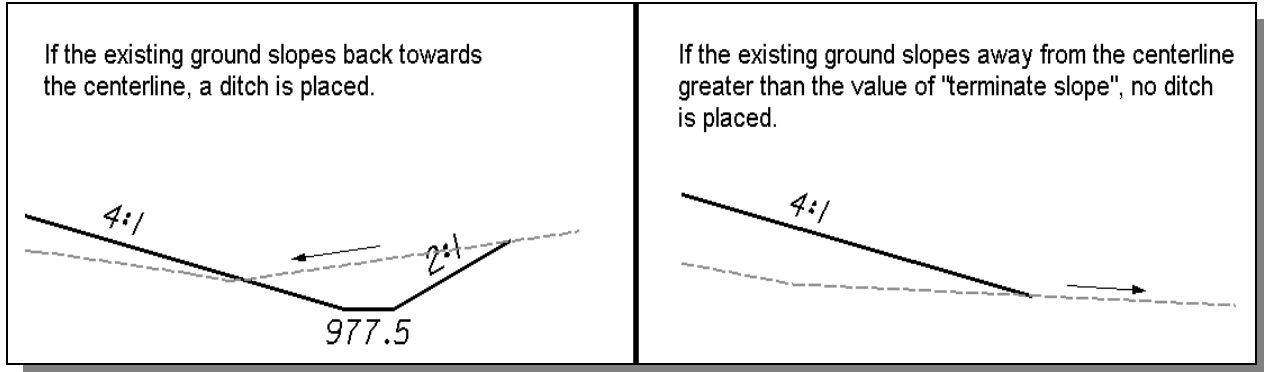

Figure 5

Changing the value of the variable **"terminate slope"** will control whether a ditch is placed. For example, if the existing ground is sloping away at a rate of 3% and the value of **"terminate slope"** is set to 2, no ditch will be placed since the existing ground slope is steeper than the value of **"terminate slope"**.   The value of **"terminate slope"** is set to 0 by default. Tip: Set **"terminate slope"** very large (ex. 20) to force a ditch in all cases.

The width of the ditch is 2' by default buy can be changed by assigning a new value for the variable **"normal ditch width"**.

For fill sections, the ditch backslope is 2:1.

For sections where the fill height is greater than 16 feet, a bench will be drawn as shown in Figure 6 below. The width of the bench is set to 10 feet by default and can be changed by assigning a new value for the variable **"bench width"**.
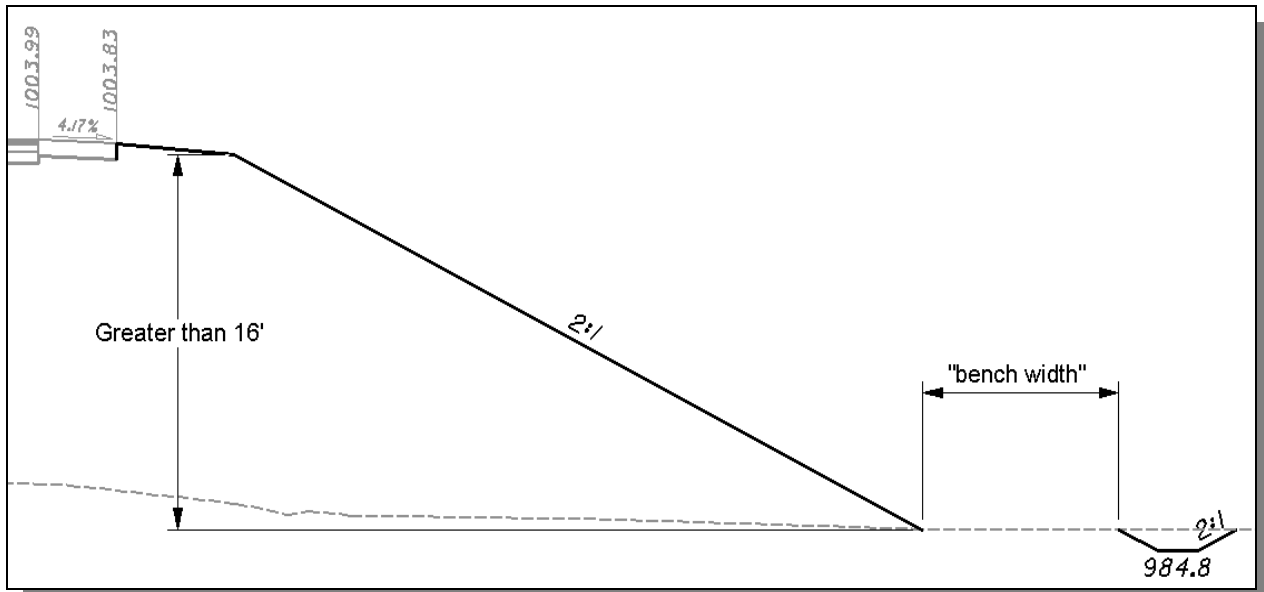

Figure 6

Drainage Considerations

After the side slope criteria has been processed for the first time, the designer must review the ditch elevations to ensure proper drainage. For sections in cut, the ditch elevation is determined by the variable **"depth of ditch flow"**. For sections in fill, the ditches are placed at the intersection of the side slope with existing ground. This may not result in ditches that flow as the user desires. The designer has two options to correct the ditch elevations to ensure proper flow:

> **Manually edit the cross sections.**
> If only a few sections need modified it is easiest to manually edit the cross sections to make the necessary changes.

> **Specify the ditch location with a COGO profile and/or graphic ditch line.**
> In cases where several cross sections need changed, the user has the option to define the ditch elevations by storing a COGO profile that represents the desired ditch profile. Additionally, the criteria provides the capability to specify the ditch offset by graphically drawing the ditch location in the plan view design file.

The steps to specify the elevation and location using a COGO profile and a graphic ditch line are detailed in the following sections.

SETTING THE DITCH ELEVATION WITH A COGO PROFILE

The criteria will allow the designer to specify a COGO profile to define the ditch elevations independently for the left and right sides of the cross sections. The variables **"special ditch profiles lt"** and **"special ditch profiles rt"** are used to specify the names of the profiles for the left and right side ditches respectively. By default, these variables have been set to look for a profile named "none". If a profile named "none" is found in the COGO database, the elevations of the profile will be used for the cross sections that fall within the station limits of the profile.

Multiple profiles can be specified for each side of the cross sections. For example, a new ditch profile has been defined for stations 53+00 to 61+00 on the right side. A second ditch profile has been defined from station 66+00 to station 71+00, also on the right side. Both profiles can be specified by separating each profile name by a coma as shown in the example below:
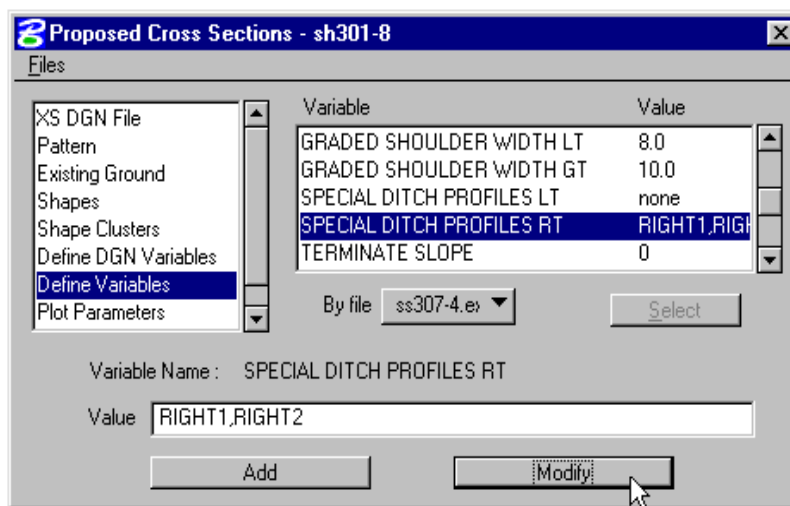

Figure 7

If a ditch profile has been specified, it does not matter whether the cross sections is in cut or fill. The side slope will be extended to meet the profile elevation as shown in the example below.
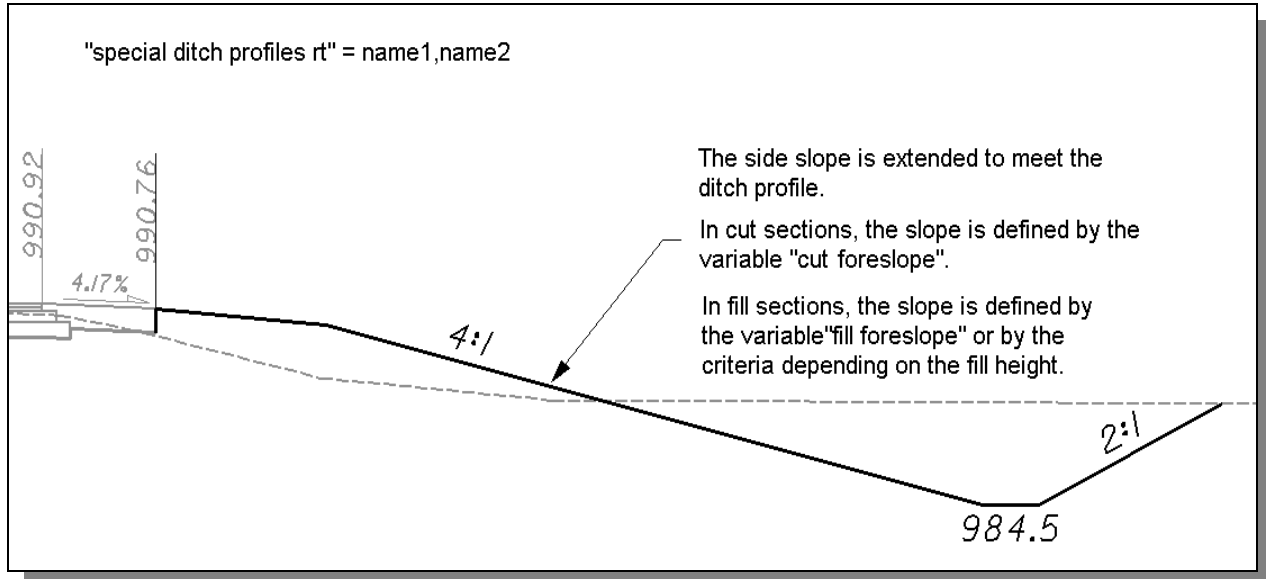

Figure 8

SETTING THE DITCH LOCATION WITH A COGO PROFILE AND A GRAPHIC DITCH LINE

In Figure 8 above, the ditch offset was established by extending the ditch foreslope to meet the profile elevation. In some cases this can result in ditches that extend further out than right-of-way constraints allow. The criteria will allow the designer to specify the horizontal location of the ditched graphically in the plan view design file as shown in Figure 9 on the following page.

The variable **"pr ditch in dgn"** is used to define the symbology for the graphic ditch line. The criteria will search the design file specified by the variable **"proposed dgn file name"** for the graphic ditch line. The variable is defined as follows within the criteria:

```
define_dgn "~pr ditch in DGN" \
        dgn = "proposed dgn file name" \
        lvname = DR_P_Ditch \
        wt = 1, byLevel \
        co = 11, byLevel
```

When a COGO Profile and a graphic ditch line is used to define the ditch offset and elevation, the ditch foreslope is determined by connecting the graded shoulder to the inside edge of the ditch as shown in the Figure 9. This may result in odd slopes (3.35:1 for example) or undesirable slopes.
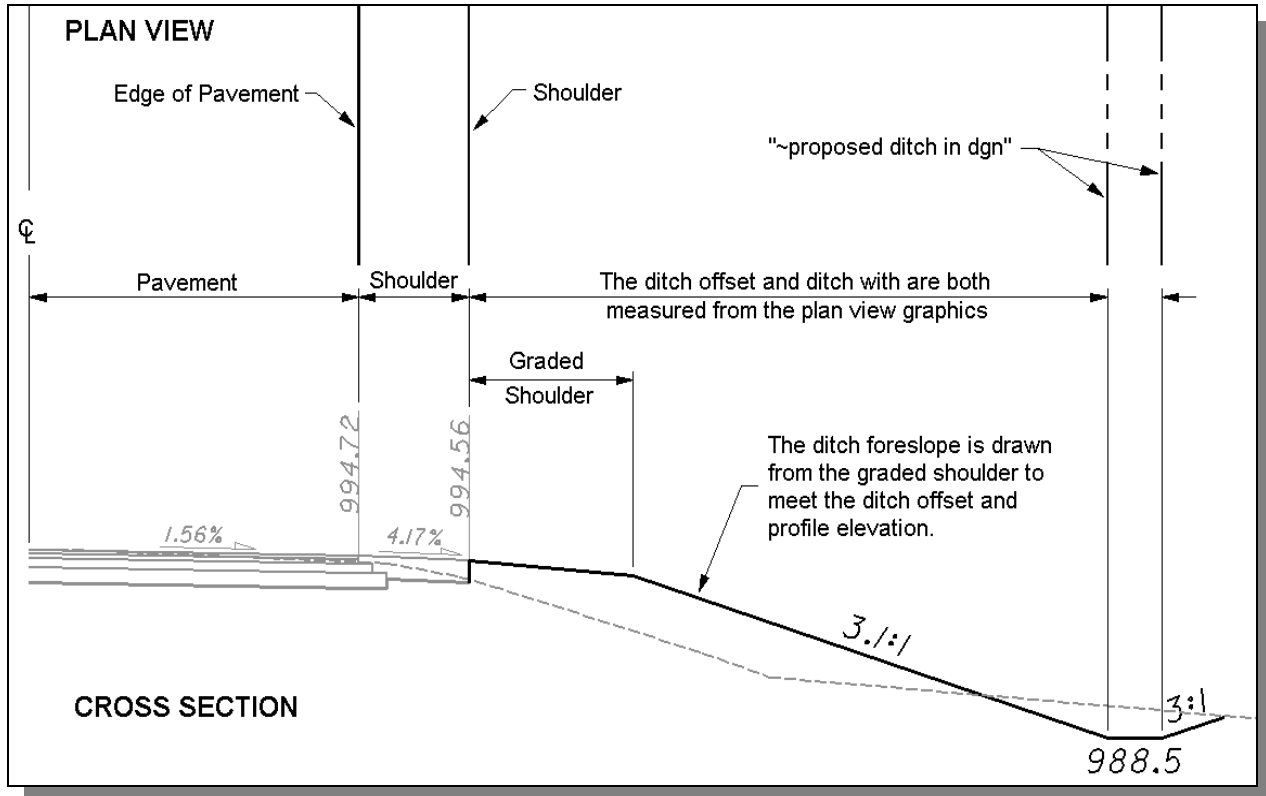
Figure 9

If two ditch lines are drawn in the plan view, the criteria will draw the width of the ditch to match the plan view graphics.

If only one ditch line is encountered, it is assumed that this line is at the center of the ditch. The ditch width is determined by the variable **"normal ditch width"** in this case.

NOTE: The graphic ditch line will only be used for the ditch offset if a COGO profile has been defined for the ditch elevations. If the criteria finds a graphic ditch line, but no profile has been defined by the variables, **"special ditch profiles lt"** (left side) or **"special ditch profiles rt"** (right side), the graphic ditch line will be ignored. The graphic ditch line will also be ignored in cases where the current cross section is outside the limits of the ditch profile.

Labels and Symbology

PROPOSED GRADING
The final cross section cut and fill lines representing the proposed grading are drawn on level 8. This level should always be shown on the final cross sections.

TEXT LABELS
The criteria will place several labels for the ditch elevation and the side slopes. The information will be placed on level XS_P_Annotation. The scale is determined from the user's input to the `define.x` variable **"XS Annotation Scale"**.

DITCH LABELS
The criteria provides two options for how the ditch labels will be placed. The variable **"ditch annotation style"** is used to select the desired label as shown in Figure 10 and 11 below. The default value is 0.

Figure 10
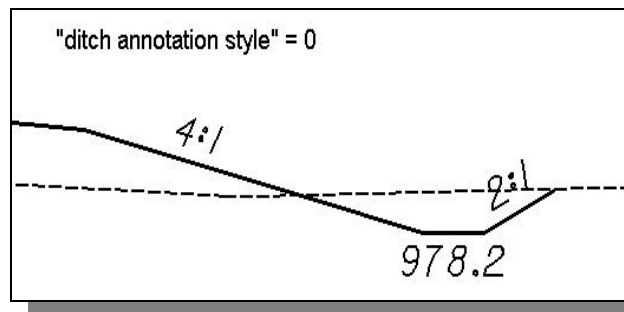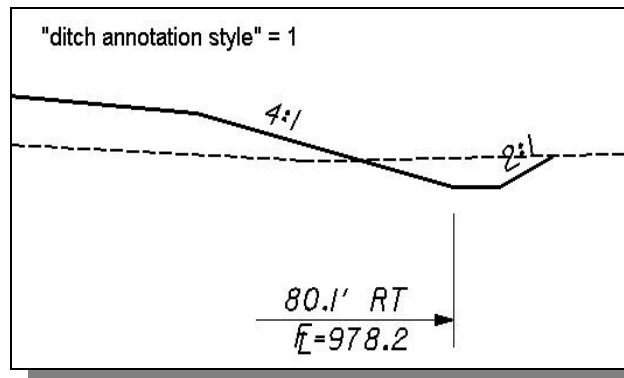

Figure 11

If the variable **"ditch annotation style"** is set to 1 as shown in Figure 11, the user must specify the name of the COGO chain that the criteria will use to measure the offset from. This is accomplished by use of the variable **"cl chain name"**. Be sure to assign the name of the chain that the criteria will use to measure the offsets from. The default value is "none".

Marked Points

GEOPAK has a simple, yet very important way of "remembering" where the locations of various points are during the drawing process. This is accomplished with marked points.

Some marked points are stored during the criteria processing that are only used temporarily and do not need to be "remembered" as processing continues. These points can be subsequently redefined by another criteria file. There are, however, certain key locations that must be referred to by multiple criteria files. The following marked points must be previously defined by the pavement and shoulder criteria files in order for the criteria to process correctly:

Edge of pavement	x1 y1
Edge of paved shoulder	x5 y5
Outside bottom of shoulder	x14 y14

SS307-4.x will store the following marked points during processing that should never be redefined by another criteria file:

Edge of graded shoulder	x10 y10
Inside edge of ditch	x33 y33
Center of ditch	x34 y34
Outside edge of ditch	x35 y35
Backslope break point	x36 y36
Proposed to existing ground	x37 y37
Construction limits	x40 y40

A piece of text is plotted on the cross sections at the location of each marked point as shown below. On the left side of the cross section, the plotted text is placed using the marked point number and appended with the letter "L". On the right side, the letter "R" is appended to the point number. This text is placed on level 51.
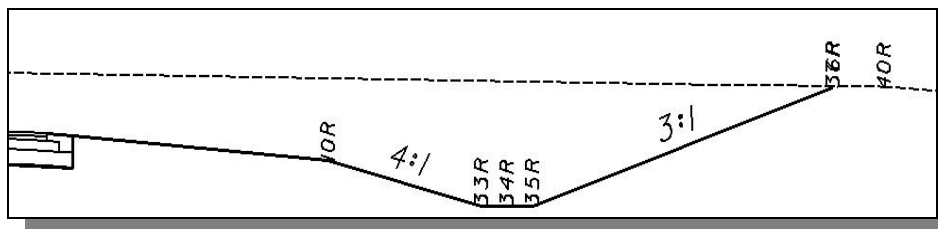

Figure 12

The GEOPAK Profile Grade report can be used to search for the marked point text and store a COGO chain and/or profile. For example, the Profile Grade Report can be instructed to search each cross sections for the text "40R" in order to store a COGO chain by measuring the offset from the centerline to the text origin. Once the chain is stored, it can be plotted as a construction limit line in the plan view design file using the Design and Computation Manager. For more information on the Profile Grade Report, see the GEOPAK documentation.

The marked point text is also useful for preliminary evaluation of the drainage ditches. For example, the criteria can be ran without a ditch profile or a graphic ditch line. In this case, the criteria will place default ditches using the values of the define variables. After the first run of the cross sections, the Profile Grade Report can be used to connect all of the 33L and 33R points as separate COGO ditch profiles. The ditch profiles can be edited using the Vertical Alignment Generator, and then a second criteria run can be processed using the variables "special ditch profiles lt" and "special ditch profiles rt" to force the criteria to draw the ditches meeting the new profiles.

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Define Variables

A summary of the variables defined in `SS307-4.x` is included below. Each variable has been assigned a default value within the criteria. The user should review the variables below to ensure that the default values are acceptable for the project. The value of each variable can be changed by the user before processing the criteria, as needed. See the **ODOT GEOPAK Road Training Guide, Part 2**, Chapter 5 for more information on modifying the default value of the variables.

Design File Variables

> **"PROPOSED DGN FILE NAME"**
> **"XS DGN FILE NAME"**
> These variables are used by the DEFINE_DGN variables to identify the base map MicroStation design file that contains the existing, proposed, and cross section graphics. The default value for each variable has been defined using a relative path as follows:
>
> ```
> define "PROPOSED DGN FILE NAME" ..\roadway\basemaps\nnnnnBP###.dgn
> define "XS DGN FILE NAME" ..\roadway\basemaps\nnnnnXC###.dgn
> ```
>
> By default GEOPAK will look for design files in the Working Directory assigned for the project. Using the directory structure defined in the **ODOT CADD Engineering Standards Manual**, Section 302, Project Directory Structure, the GEOPAK Working Directory should be defined as the `geopak` folder.
>
> The "`..`" syntax will instruct GEOPAK to look for the proposed design file by starting in the Working Directory, and then go up the project folder path one directory. From there, go into the `\roadway\basemaps` folder to find the file.
>
> The name of the design file must be edited to reflect the name of the plan view design file for your project. See the **ODOT CADD Engineering Standards Manual**, Section 304 File Naming Conventions for design file names.

Variables for the graded shoulder width:

> **"graded shoulder width lt"** (see Figure 2)
> This defines the graded shoulder width to be used for fill sections with a side slope less than or equal to 6:1. See the Location & Design Manual, Volume 1, Figure 301-3 to determine the graded shoulder width. The default value is 8'.
>
> **"graded shoulder width gt"** (see Figure 2)
> This defines the graded shoulder width to be used for fill sections with a side slope greater than 6:1 and for all cut sections. See the Location & Design Manual, Volume 1, Figure 301-3 to determine the graded shoulder width. The default value is 10'.

Variables specific to cut conditions:

"depth of ditch flow" (see Figure 3)
This variable defines the cut ditch depth measured from the end of the treated shoulder. The default value is 1.5'.

"cut foreslope" (see Figure 3)
This variable defines the cut ditch foreslope. **Note:** This variable must always specified as an integer. For example, setting the variable to a value of 3 will result in a 3:-1 side slope for all cross sections in cut. The default value is 4.

Variables specific to fill conditions:

"bench width" (see Figure 6)
For fill sections greater than 16' in height, a bench is drawn at the bottom of the fill, before the ditch. The default value for the bench width is 10'.

"bench width slope"
If the criteria determines that a bench needs to be placed, this variable is used to define the slope of the bench. The default value is 1 for a 1% slope.

"fill foreslope"
By default, the criteria will select the ditch foreslope in fill sections based on the fill height. This variable can be used to assign a constant slope that will be used on all sections in fill regardless of the fill height. Set the value to an integer to specify a fixed side slope. For example, setting the variable equal to 3 will result in 3:1 side slopes for all the cross sections in fill. Leave the value set to the default value of 0 for the criteria to select the appropriate ditch foreslope.

"~terminate slope" (see Figure 5)
For fill sections, If the existing ground is sloping away from the centerline, the criteria will not place a ditch unless the existing ground slope is steeper than the value of the variable **"terminate slope"**. For example, if the existing ground is sloping away at a rate of 3% and the value of **"terminate slope"** is set to 2, no ditch will be placed since the existing ground slope is steeper than the value of **"terminate slope"**. The value of **"terminate slope"** is set to 0 by default.

Variables for the ditches:

"normal ditch width" (see Figure 3)
This variable defines the width of the ditch. The default value is 2'.

"special ditch profiles lt" (see Figure 8)
This variable identifies the name of the COGO profile to be used on the left side of the pavement for the ditch. If the ditch profile is found at the station being processed, the side slope will be drawn to intersect the profile elevation. The default value is "none".

"special ditch profiles rt" (see Figure 8)

This variable identifies the name of the COGO profile to be used on the right side of the pavement for the ditch. If the ditch profile is found at the station being processed, the side slope will be drawn to intersect the profile elevation. The default value is "none".

Labeling Variables:

"cl chain name"
This variable identifies the name of the COGO chain to be used to label ditch offsets and bench offsets (see **"ditch annotation style"**). The default value is "none".

"ditch annotation style" (see Figure 10 & 11)
This variable sets the ditch annotation style for the labeling of the ditches. The default value is 0.

"construction limit offset" (see Figure 12)
This variable is used to define the distance from the point where the proposed cross section elements meet existing ground to the construction limits. The criteria will plot marked point text "40L" (left side) and "40R" (right side) on the cross sections at the construction limit location. The default value is 2'.

Define DGN Variables

The following DEFINE_DGN variables are used by the criteria to locate the MicroStation elements that `SS307-4.X` will search for in order to draw the side slopes.

These variables have been defined with the values listed below in accordance with ODOT standards and should never be redefined by the user.

Additionally, these variables have been defined as "hidden" variables and will not show up in the DEFINE_DGN Variables portion of the Proposed Cross Sections dialog box when preparing a criteria run.

"~pr graded shoulder in dgn"
The criteria will set the graded shoulder width automatically using the variables **"graded shoulder width lt"** or **"graded shoulder width gt"**. Occasionally, the graded shoulder will have a variable width. In this case, the designer has the option to draw the graded shoulder in the plan view design file. The criteria will look for a graphic graded shoulder line matching the symbology listed below. If a graded shoulder line is encountered, the criteria will ignore the value of the variables **"graded shoulder width lt"** and **"graded shoulder width gt"**.

```
define_dgn "~pr graded shoulder in dgn" \
      dgn = "proposed dgn file name" \
      lvname = DT_P_Graded_Shoulder \
      wt = 1, ByLevel \
      co = 9, ByLevel
```

"~pr ditch in DGN"
The criteria has the capability of placing the proposed drainage ditches at the location of a ditch line placed in the plan view MicroStation design file. This variable is used to define the symbology for the proposed ditch line. It is assumed that the ditch line is drawn at the inside edge of the drainage ditch. The variable has been defined as follows:

```
define_dgn "~pr ditch in DGN" \
      dgn = "proposed dgn file name" \
      lvname = DR_P_Ditch \
      wt = 1, ByLevel \
      co = 11, ByLevel
```

"~exist ground in XSDGN"
The criteria will search for the existing ground line in the cross section design file. This variable tells the criteria the symbology of the elements that make up the existing ground line. The name of the cross section design file is defined by the "XS DGN FILE NAME" variable. The variable has been defined as follows in the criteria:

```
define_dgn "~EXIST GROUND IN XSDGN" \
      dgn = "XS DGN FILE NAME" \
      lvname = XS_X_Ground_Line \
      wt = 1, ByLevel \
      co = 2, ByLevel
```