Location Module

Civil Engineering

Version 5.0

Softree Technical Systems Inc.

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Introduction

This manual is formatted to provide you with a hands-on tutorial, which can be used by novice or experienced users. The sample files referred to in the examples are provided on the Installation CD. If you inadvertently change any of these tutorial files, be sure to re-install them from the CD before the next user of the tutorial tries to access them.

Demonstration Mode

Demonstration Mode was created to allow you to preview functions before purchasing. In *Demonstration Mode*, printing and file saving are disabled. You will be warned that you are running in Demonstration Mode when you start-up. To find out if you are in demo mode, look for the text "DEMONSTRATION MODE" in the Help | About Location menu.

Conventions

The following conventions are used throughout the manual:

- Menu functions are delimited by a line "|"; e.g. File | Open means click on *File* in the menu bar and then click on *Open* in the pull-down area.
- File names will be in bold font i.e. **Tutorial\Location\combo design.DSN.** File extensions are in upper case for file selection purposes only**.**
- Checkboxes, dialog boxes, column headings, and button names are *italicized*.
- Whenever you are directed to highlight, select, or activate a field or object, it becomes the active field or object. For instance, "highlight the profile window" means that you should click on the profile title bar to activate it.
- The symbols "< >" with words in between require you to perform some keyboard function. For example <shift + enter> requires you to hold down the shift key and then press the enter key.
- Text saved in the sample files, is written within quotations " ".

Function Groups

The tools and procedures available in the Location Module are divided into *function groups*. Different licenses allow full access to different sets of function groups. For example the Auto Balance function group is not licensed to purchasers of the *Lite* versions of RoadEng. Unlicensed function groups can still be used but only in *Demonstration Mode.* To determine the privileges set for each function group:

1) Select the menu Module | Setup and then click on the *General* tab.
2) Click on the *Menus* button to activate the *Menu Customization Dialog* (see Figure 1.0).

Module | Setup can not be accessed unless a design file is open.

Function group items with a red circle before them are permitted in Demonstration Mode only. A checkmark beside an item indicates it has been enabled.

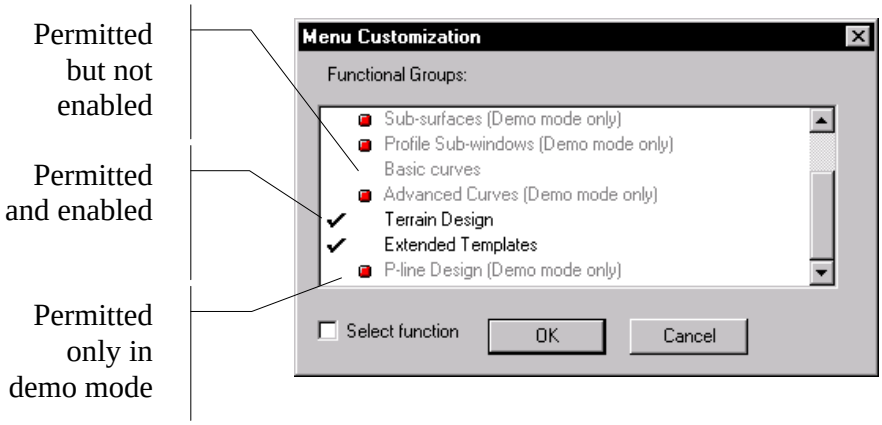

Figure 1.0: Function Groups Displayed in the Menu Customization Dialog Box

Function Groups Required for Examples
All required function groups are listed prior to each example in this manual. If you do not have permission to use all the required function groups, you may wish to skip the example. Also note that some function groups may be disabled even if *you* have permission to use them – this is so users with a lesser license can still do the example.

If you attempt to open a tutorial file containing function groups that are not permitted in your licensed software you will be prompted with the message box below:

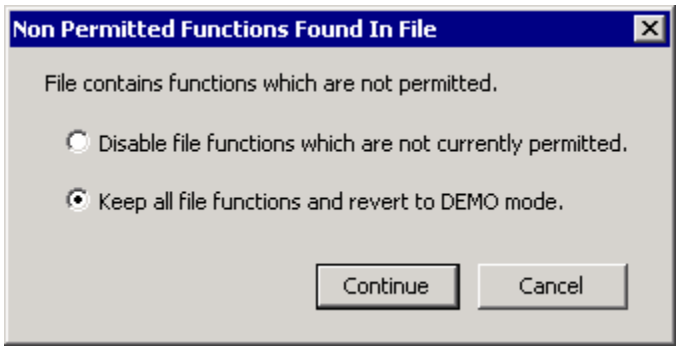

Figure 1.1: Function Groups Not Permitted Prompt

To continue the example you must respond *"Keep all file functions and revert to demo mode"*. In demo mode printing and saving are disabled.

On-line Help

Help information is available by choosing the *Help* menu or pressing F1. The On-line Help includes detailed technical information about menus, dialog boxes, and operation of the program.

It may be useful to refer to the On-line Help while working through the examples in this manual.

Checkpoints

It is not necessary to start at the beginning of this manual or to do all examples in the order they are provided. Checkpoints, indicated by a checkmark in this manual, are places where you can begin an example. All files required to start from a checkpoint are included in the installation.

Files required for Examples

Tutorial instructions refer to files without a full path name. The default directory structure for installing the Location example files is **C:\Program Files\Softree\RoadEng\Tutorial\Location**. The path for the install folder can be changed from the default, files will be referenced as **RoadEng\Tutorial\Location\<file>**.

Concepts

Examples in this document will illustrate tools at your disposal for solving typical road design problems. The steps in the examples may not be the only way to solve these problems.

There is no single step by step recipe for road design. Like most engineering methods, design will be approached differently by different engineers and will probably involve several design iterations to achieve an acceptable product. The Location software will allow you to design a road while giving you selected feedback so that you can make engineering decisions based on your priorities.

This section contains a glossary of terms and descriptions of program components that are used throughout the examples that follow.

- **P-Line vs. L-Line:** The P-Line (preliminary line) is a field surveyed road traverse. The L-Line is created in the Location Module and represents the designed centerline alignment in its correct vertical and horizontal positions. When a P-Line is used, by default it is displayed as a solid black line and the L-Line as a dashed red line. These lines appear in both Plan and Profile views.

- **Vertical Alignment:** In the Profile Window you have the capability of vertically controlling the L-Line position. This is done by creating Profile Points (VPI = Vertical Point of Intersection) along the length of the road. The Vertical Alignment defines grades and vertical curves.

- **Horizontal Alignment:** In the Plan Window you have the capability of horizontally controlling the L-Line position. This is done by creating Plan Points (PI = Point of Intersection) along the length of the road. The Horizontal Alignment defines the direction of road segments (tangents) and horizontal curves. When a P-Line is defined, initial horizontal alignment follows the P-Line; for lower standard roads further horizontal alignment may not be required.

- **Profile Points (VIP = Vertical Intersection Point):** These points are created in the Profile Window and they define the vertical alignment of the L-Line. They have no effect on the horizontal alignment. Profile points are represented as red boxes in the Profile Window and large red ticks in the Plan Window. (See Figure 1.2)

- **Plan Points (IP = Intersection Point):** These points are created in the Plan Window and they define the horizontal alignment of the L-Line. They have almost no effect on the vertical alignment. Plan Points are represented as red boxes in the Plan Window and large red ticks in the Profile Window. (See Figure 1.2)

- **Design Points:** This is the term used to describe all alignment points (Plan, Profile or Report – see above). Cross sections are calculated at all Design Points to generate earthworks and graphic displays. (See Figure 1.2)

- **Reporting Points:** These points are usually created automatically but can be created manually in the Plan or Profile windows. They have no effect on alignment. Report Points are used to display cross sections and to allow a more accurate representation of earthworks and graphic displays. They are represented as small red tick marks in the Plan and Profile Windows. (See Figure 1.2)

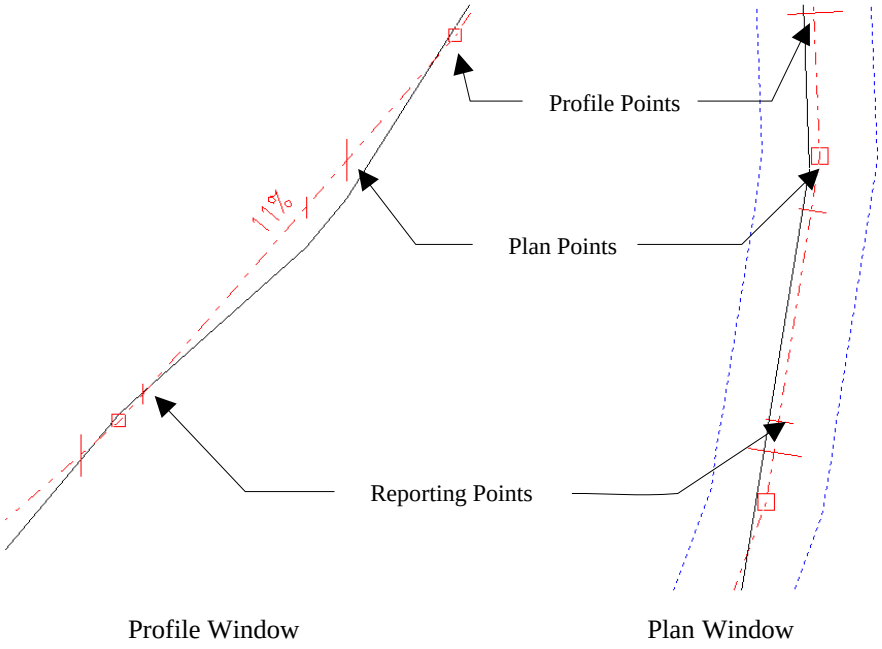

Figure 1.2: Profile and Plan Windows Showing All Three-point Types

- **Templates:** define the road prism (cross section shape) along the L-Line. Templates can be created as required and assigned by range, for features such as turnouts, passing lanes, cut benches and bridges. Once created, template tables can be saved for use in future designs. A Taper template is provided for transition between different templates.

- **Window Types:** Location Module has eight window types:

Plan Window- displays a plan view of the alignment. Editing in this window manipulates the horizontal alignment.

Profile Window- displays a profile view of the alignment. Editing in this window manipulates the vertical alignment.

Section Window- displays the designed cross section at a specific station. Editing in this window manipulates horizontal and/or vertical alignment.

Data Window- displays text or numeric information for each design point (such as volumes and slope stakes). The data can be exported to a spreadsheet for analysis and graphical output.

Multi-Plot Window- generates formatted output by placing other windows, graphics and text on a virtual page (paper space).

Horizontal Curve Panel- allows creation and adjustment of horizontal curves. Also allows co-ordinate and cogo edit of Plan Points (IPs).

Vertical Curve Panel- allows creation and adjustment of vertical curves. Also allows coordinate and cogo edit of Profile Points (VIPs).

Culvert Panel- allows creation and placement of culverts.

Figure 1.3: Window Types

- **Window Options**: A number of display options can be chosen for each of the five windows above (not for Panels). Window options are accessed by first, activating the desired window by clicking on its title bar and then choosing the View | [window name] Options menu. Right Click of the mouse also provides access to this menu. For a comprehensive list of all window options, refer to the on line help. Note that window options are saved in Screen Layouts.

- **Screen Layouts:** Options for all Windows can be saved in configuration files called Screen Layouts. Screen Layouts will be used extensively in the examples and are extremely valuable for saving and retrieving the large number of options available. The File | Save Screen Layout menu is used to create a new screen layout while the Screen Layouts pull-down in the standard tool bar is usually used to retrieve one.

- **Tool Bars:** contain buttons and other controls used to activate common functions. (See Figure below). They can be dragged with the mouse to float in the middle of the screen or to dock on any of the four sides of the main window. Use the View | Toolbar menu to create and destroy tool bars. Tool bar configurations are saved with Screen Layouts (see above).

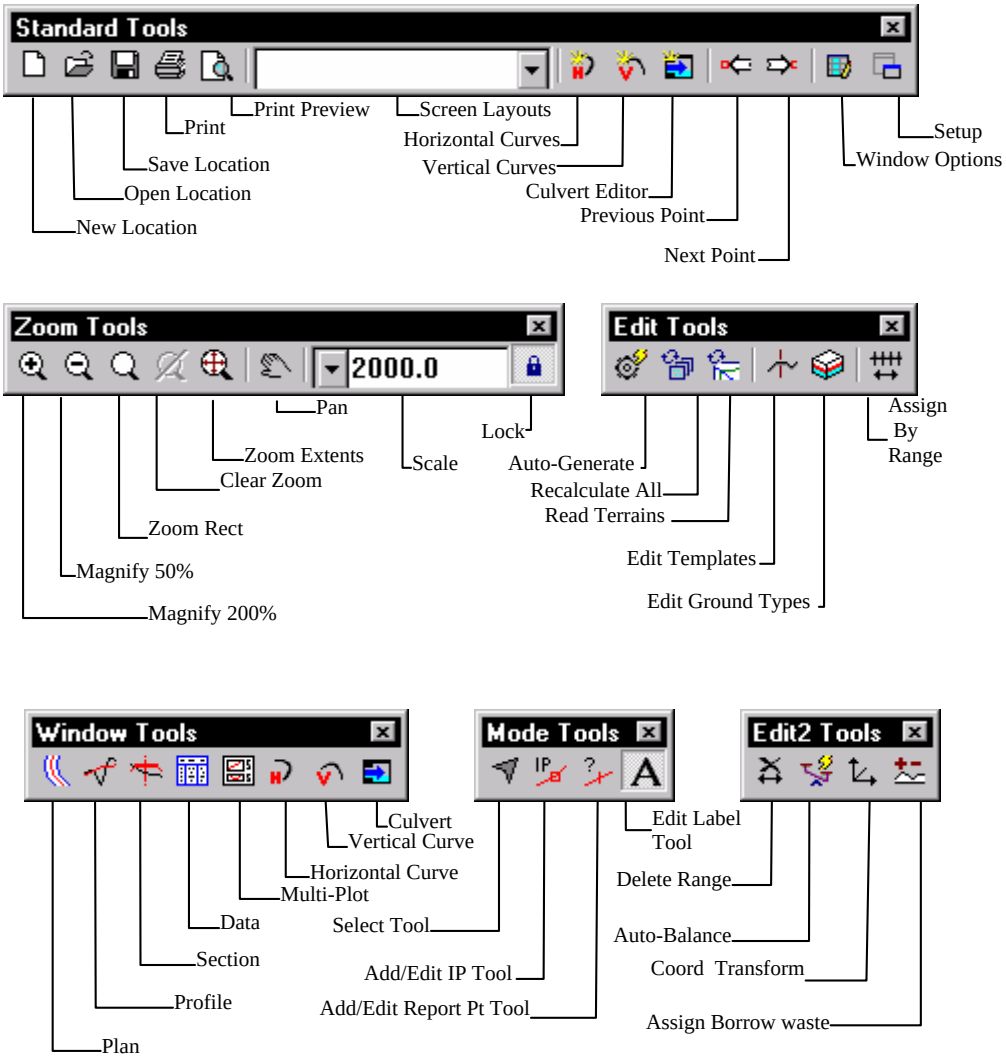

Figure 1.4: Location Tool Bars

Getting Started

This section introduces basic techniques for using the mouse and keyboard to create and edit alignments. It also covers window display options and saving and retrieving these options with *Screen Layout* files.

Editing with the mouse is the same in both the Profile and Plan Windows. These are described in one example. Editing with the mouse in the Section Window is a little different, so it will be described in its own example. Editing using co-ordinates will be described in the last example: editing with panels. First step is to start with simple keyboard editing. These examples do **not** attempt to create real road design projects (see the *Starting a New Design* section below for more realistic examples).

Keyboard Editing and Moving Around

All mouse alignment functions can be accomplished using only the keyboard. One advantage to this is that fine adjustments can be made. Table 1.0 shows the mouse and keyboard equivalent functions. You may wish to try some of these functions in the *Editing with the mouse* example below.

Table 1.0 Mouse and Keyboard equivalents

Mouse functions	Keyboard equivalents
Left button	<Enter>
Fine Movement	<Arrows>
Coarse Movement	<Control + Arrows>
Scrolling or Panning	<Shift + Arrows>= fine scroll <Pg. Up>= page up <Pg. Dn.>= page down <Shift + Pg. Up>= page left <Shift + Pg. Dn.>= page right

Editing with the Mouse in Profile or Plan

The following example illustrates how to create and edit L-Line points in the Profile Window. Editing in the Plan window is virtually identical except that the horizontal alignment is modified instead of the vertical alignment. However, a horizontal alignment must be created before Profile editing is possible. In this example an initial Horizontal alignment will be created.

1. File | Open, select **RoadEng\Tutorial\Location\Mouse_edit.dsn**. Press Open.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the “Non Permitted Functions Found in File” dialog appears, choose “Keep all functions and revert to DEMO Mode”.

A Profile, Plan, Section, and Data Window will appear as shown below.

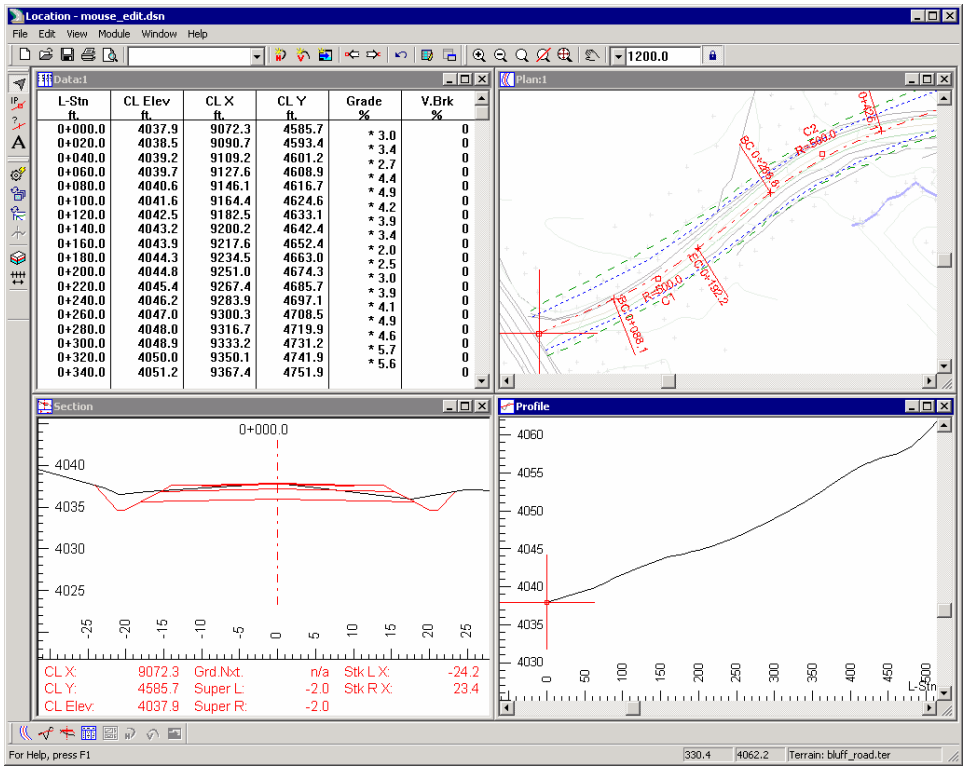

Figure 2.0: Design with a preliminary horizontal alignment

2. Click on the *maximize* button in the upper right corner of the Profile Window. If the Profile Window appears empty press the *Next Point* button once and the ground line will appear.

3. Position your mouse cursor in the Profile Window, if you do not see an *Add IP* cursor appear, **right** click and choose *Add/Edit IP Tool* from the popup menu.

4. Position your cursor roughly at the cross-hairs location shown in the Figure 2.1.

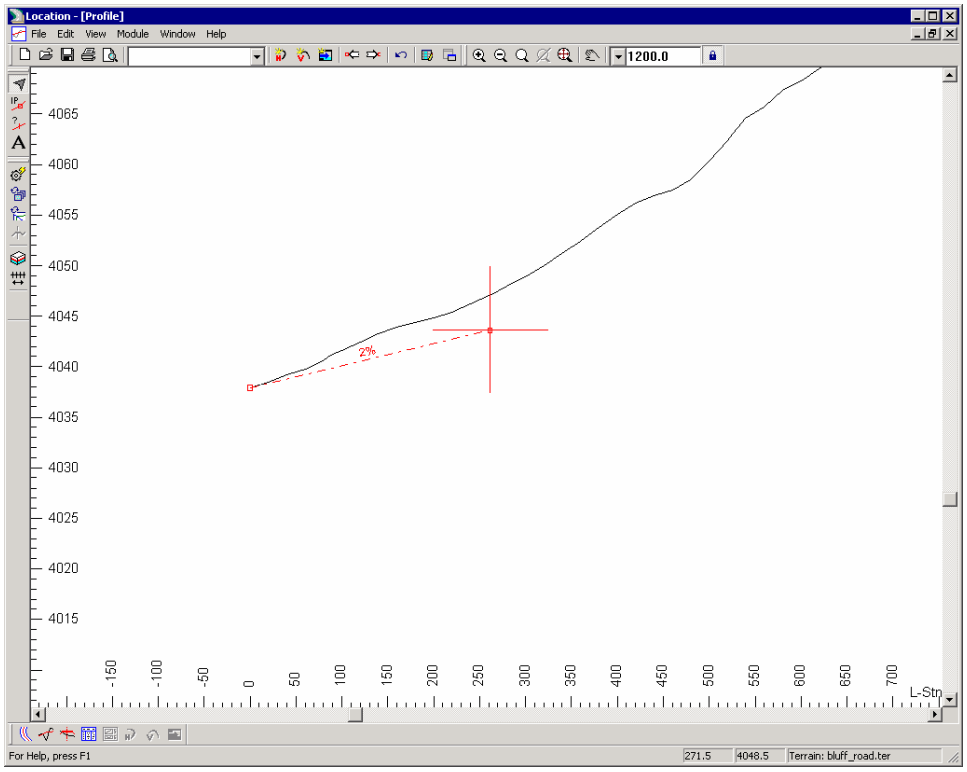

Figure 2.1: 1st Design Point

5. Left click once, and the cross- hairs will attach to your cursor. This creates a new, captured, Profile (VIP) Point.

A red dashed line, representing the first designed grade, will be attached from the beginning of your design to your cursor. When you move your mouse the grade line will follow it. The cursor is *captured*.

6. Left click again, at the position shown above. This will anchor the design point and release the cursor.

7. Minimize the Profile window by clicking on the minimize button in the upper right corner. Activate the Section window by clicking on the section button in the tool bar.

Notice that the Section Window now displays the updated current design point.

8. Maximize the Profile Window again.

9. Add another VIP by positioning the cursor roughly at the cross hair location shown below. Remember it takes two left clicks.

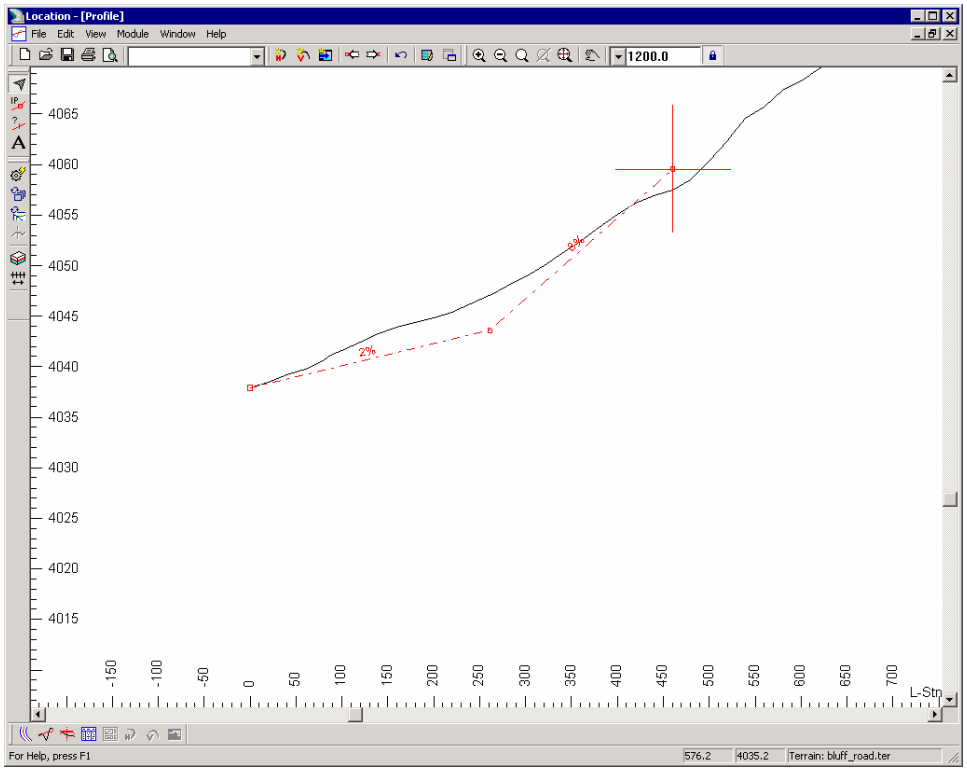

Figure 2.2: 2nd Design Point

10. After you have anchored the point shown above, move the cursor over the previous design point until it changes to the *Edit* cursor [ ]
11. Left click once, this will capture it and allow you to move the point to a new location.
12. Move the captured point to the position shown in the figure below. Left click again.

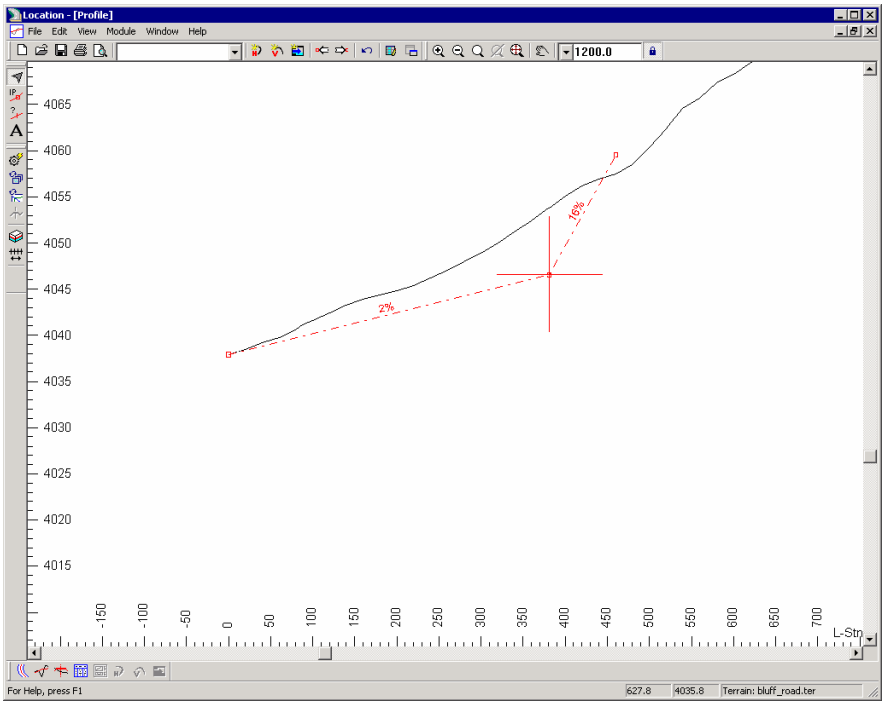

Figure 2.3: Editing 1st Design Point

13. Edit | Undo Profile Point Edit, to move the point back to where it was in Figure 2.1
14. Again, move the cursor over the middle design point and left click once to capture it.
15. This time press <Delete> key (located below the insert key on most keyboards) to remove the point.
16. Left click roughly where the point was before you deleted it. This inserts a new VIP *between* existing points.
17. Move the new captured point to the position shown in Figure 2.1 and left click to anchor it.

You have now used the mouse to do the following:

- Create a new point at the end of the alignment.
- Insert a new point between existing points.
- Edit an existing point.
- Delete an existing point.
- Undo an edit operation.

You can also cancel an edit by pressing the <escape> key when a point is captured. These tasks are performed in the same way in the Plan window (for horizontal alignment) and even for features in the Terrain module.

You may now want to try more of these operations to get used to the interface and train your fingers (by the way, it is wise to use different fingers for the left and right mouse keys).

You can use Edit | Undo to return the design to this state before continuing below.

18. Move the mouse over the middle point created above until you see the *Edit* cursor . Do NOT click.

19. Take your hand off the mouse (make sure the cursor does not change back into the *Add IP* cursor) and press <Enter> key to capture the point.

20. Keep your hand off the mouse and press the <up arrow> a few times. Notice how the captured point moves. Type <ctrl - up arrow> and notice that the point moves up in larger increments.

21. Type <Enter> again to anchor the point.

You have now done a vertical alignment without changing the station of the Profile point. The arrow keys allow small consistent incremental movements of your design points.

22. File | Close. Do not save changes

Moving Around in the Design

This section will illustrate a few of the ways to change the current cross section and the active window. Standard window functions (such as the Window menu, scroll bars and moving and sizing windows) are available but will not be covered explicitly in this tutorial.

To do the examples in this section the *P-Line Design*, and *Sub-surfaces* function groups should be enabled (see *Function Groups* in the introduction above and in the On-line help for more information)

1. File | Open, select **RoadEng\Tutorial\Location\ bluff_road.dsn.**

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Find the Window Tools toolbar in the lower left and click on the *Plan* button - leftmost (see figure below). This *activates* the Plan window.

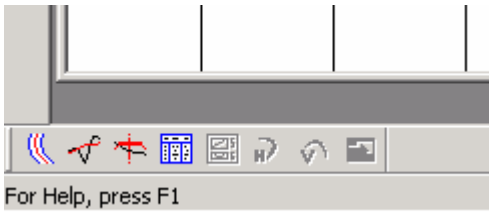

Figure 2.4: Window Tools Toolbar

3. Find the Mode Tools toolbar in the left side panel at the top and click on the *Select Tool* button ; you can also do this with a right click in most of the windows. This changes cursor and the way the mouse behaves.

NOTE: That the selection of toolbars displayed and their position is saved with the design and with screen layouts.

4. Move your cursor over the point in the Plan window marked with cross-hairs in the figure below. Click to make this the current design point. Notice that the section updates to show this station. This works in both the Plan and Profile windows.

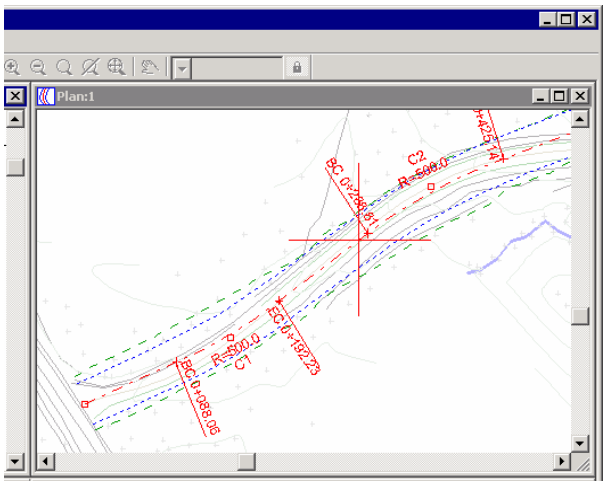

Figure 2.5: Point To Select In Plan Window.

5. Click on the Profile button in the Window Tools toolbar (see figure above) activate the Profile window. Note that the cross-hair is now between VIPs (Vertical Intersection Points) at the station selected in the previous step.

6. Find the Standard Tools toolbar at the top of your screen. Click on the *previous/next point* buttons and note how the current point changes in all windows and how the views will scroll to always show the new current point.

You have now practiced changing cross sections and windows. The next section will cover *zooming* and *panning*. The Zoom Tools toolbar allows you to zoom or pan once after selecting a function. If you have a mouse with a middle button and a roller you can zoom and pan at any time.

Figure 2.6: Zoom Tools Toolbar

7. Click the *Pan* button in the Zoom Tools toolbar, move your cursor over the Plan or Profile window and then click and drag with the left mouse button. Note how the view moves with your mouse. When you release the mouse the cursor changes back into its previous shape; you must click the *Pan* button again to initiate a second pan.

8. If you have a middle mouse (even if it is a roller), move your cursor over the Plan or Profile window, depress and hold the middle mouse button and note that the cursor changes to the Pan hand . Continue holding the middle mouse and drag to perform a Pan operation.

9. Click on the *Zoom Rectangle* button in the Zoom Tools toolbar, move your cursor over the Plan or Profile window and then click and drag with the left mouse. The rectangle that you see will be the extents of the zoomed window when you release the mouse. The *Zoom 200%* button has a similar effect while the Zoom 50% button zooms out again.

10. If you have a roller mouse, move your cursor over the Plan or Profile window and move the roller first one way then the other. The view will zoom in such a way that the point under the cursor will remain under the cursor.

Let's assume that you want to see a cross section in the middle of the sharp corner in this design (see Figure 2.5) but all the windows are showing some other place.

11. Type <Ctrl-J> (or select menu View | Jump To Station). Type **9999** into the station edit box and push OK. Now you are looking at the end of the design (you could have typed in the correct station number if you knew it).

12. Select the Plan window and click on the *maximize* button . You may want to minimize or close the Vertical Curve and Horizontal Curve Panels to allow for full viewing of the Plan Window

13. Zoom out until you can see the whole design using the *Zoom 50%* button or the *Zoom Extents* button or the mouse roller.

14. Now zoom in near the X shown in Figure 2.7 design (use the *Zoom Rectangle* button or the mouse roller with the cursor over the corner). You may also need to pan if you didn't zoom accurately.

15. Pick the *Select Tool* button from the Mode Tools toolbar and click on the point shown in the Figure 2.7.

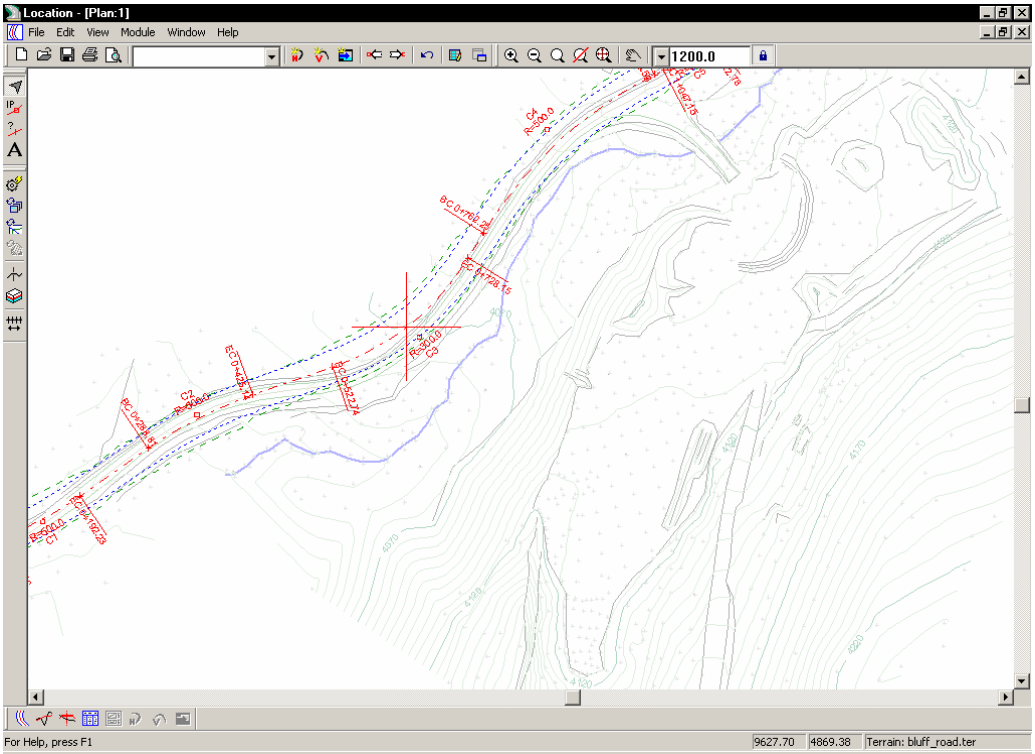

Figure 2.7: Zoomed Plan View With Scale Locked

The zoom function used so far could also be called a *magnify* function because all components of the zoomed window appear smaller (zoom out) or bigger (zoom in). For example, the symbols in the figure

above are larger because the Plan window is zoomed in. The scale shown in the Zoom Tools toolbar at the top of the screen has remained unchanged at 1200 and print and print preview do not show the zoom effect. The *Clear Zoom* button will remove any magnification.

The behaviour of the zoom tools can be modified by un-locking the scale in the Zoom Tools toolbar:

16. Be sure that the Plan window is still the active window. Click the *Lock Scale* button in the Zoom Tools toolbar so that it no longer appears depressed. If the Plan window was zoomed it will lose all magnification.

17. Use some of the zoom tools described above to zoom in and out. Notice that the *Scale* changes in the Zoom Tools toolbar and that symbols (and text) do not change size.

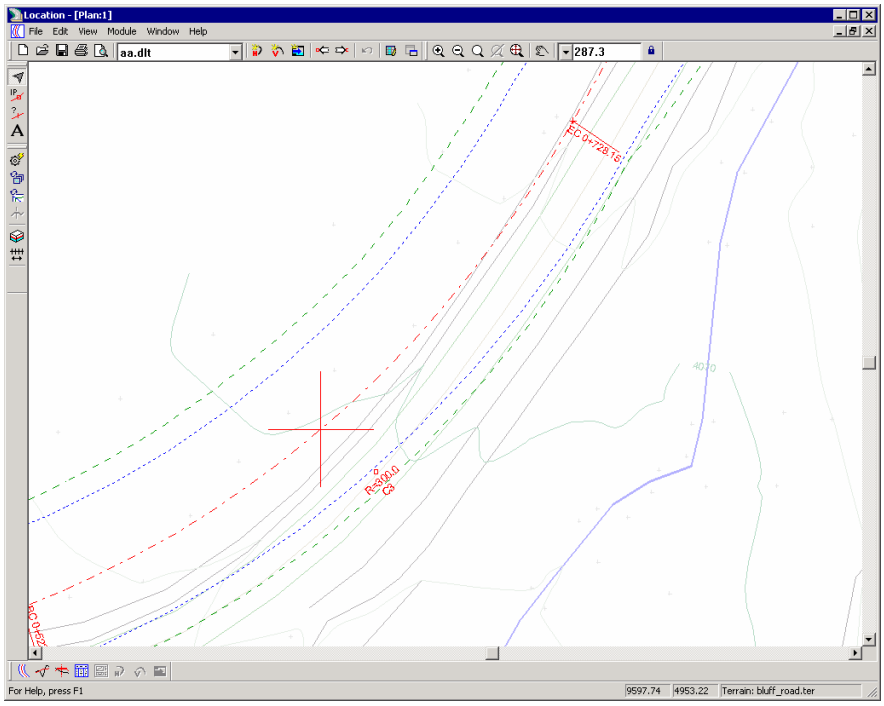

Figure 2.8: Zoomed Plan View with Scale Un-Locked

The state of the *Lock Scale* button can be different for different windows (if you activate the Profile window you will see that the scale is still locked). When you change the scale of a window you also change the scale of the print output.

This section has demonstrated several ways to move around in a Location design:

- Select with the mouse.
- Next/Previous design point.
- Jump to station <Ctrl-J>.
- Activate windows with the Window Tools toolbar.
- Zoom and Pan with the tool bar.
- Zoom and Pan with middle mouse button and roller.
- Zoom Extents.
- Zoom with the *Lock Scale* button on or off.

18. File | Close. Do not save changes

Editing with the mouse in the Section Window

The Section window allows editing of the vertical or horizontal alignments (while Profile window only allows edit of the vertical alignment and the Plan window only allows edit of the horizontal alignment). Editing of the alignment in the section window can be very useful for creating a preliminary design position.

NOTE: It is not possible to edit in the section window vertically in areas where vertical curves exist. Similarly it is not possible to edit the horizontal alignment in areas where horizontal curves exist.

In this example the vertical alignment will be modified in the section window.

1. Choose File | Open, select **RoadEng\Tutorial\Location\mouse_edit.dsn**

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Click on the Section button  the Window Tools toolbar to activate the Section window.
3. Select menu View | Jump to station and enter 288. Press OK. **<Ctrl-J>** would also open the station edit box.
4. Right click on the Section window and select *Add/Edit IP Tool* from the popup menu. (You could also use the Mode Tools toolbar).
5. Move the cursor over the intersection of the vertical dashed line (centerline) and the road top surface (this is the template attachment point). The *Vertical Alignment*  cursor will appear over the section window.
6. Left click and move the mouse up and down. Notice how the road surface line moves with your cursor – the cursor is *captured*.

Also note that the cursor moves in the Profile window and that some items in the status area under the section graphic update dynamically (you can see what the grades will be before you anchor the modified point). Instant feedback is available for many kinds of editing task.

7. Move the mouse until the road surface is at approximately at elevation 4055, left click a second time. This anchors the elevation of the design point and releases the mouse cursor. Notice the profile and all other window contents are updated.

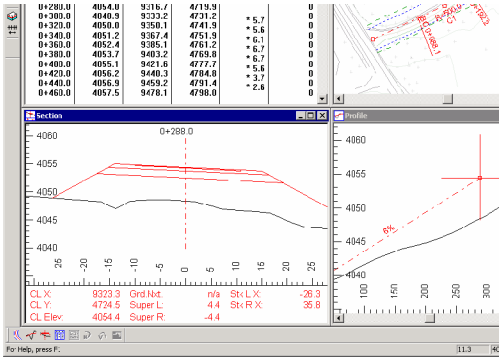

Figure 2.9: Section Window After Vertical Edit

In the previous step a VIP (Vertical Intersection Point) was modified. If the current point is not already a VIP the same operation will ADD a new VIP.

NOTE: In a procedure similar to the steps above the horizontal alignment can be modified in the Section window. Although it is possible to edit both vertically and horizontally at the same time in the Section window, it is not recommended. First it can be confusing unless you can see both the Plan and Profile windows in addition to the Section window. Second, it creates both vertical and horizontal IPs, which will define very sharp breaks if they are close to other IPs.

8. File | Close. Do not save changes.

Alignment Editing with the Panel Windows

This example illustrates how to create and edit alignment with the Horizontal and Vertical Curve panel windows. These panels create curves and allow IP points to be defined by coordinate or coordinate geometry (cogo). The concepts discussed here are similar for both vertical and horizontal alignment.

To do the examples in this section the *P-Line Design*, *Basic Curves*, and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

Adding a new IP in the Vertical Curves Panel

1. File | Open. Select **RoadEng\Tutorial\Location\mouse_edit.DSN.** This is the same design used in the previous tutorial. Maximize the RoadEng screen.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Press the *Vertical Curves* button to activate the vertical curves panel. All button used for Vertical curves are found in the vertical curve panel

3. Maximize the Profile Window (this can be done by double clicking on its title bar). The *IP and Tangent Parameters* area of the *Vertical Curves* Panel should appear as shown in the Figure 2.10. If it doesn't then press the until the IP field is enabled.

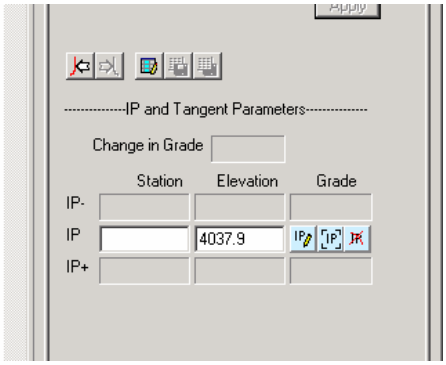

Figure 2.10: IP and Tangent Parameters Area Vertical Curves

4. Press the *Add New IP* button to open the Add Vertical IP dialog box.

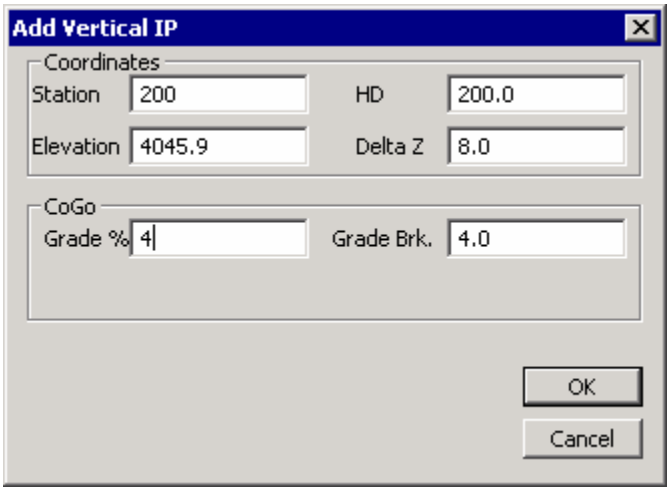

Figure 2.11: Add Vertical IP Dialog

5. Type **200** into the *HD* field, then type **4** into the Grade % field (see Figure below). Notice that the other fields update automatically. Press OK

The same result could be achieved by typing in the *HD* and *Delta Z* or *Station* and *Elevation*. The screen should look like the Figure 2.12.

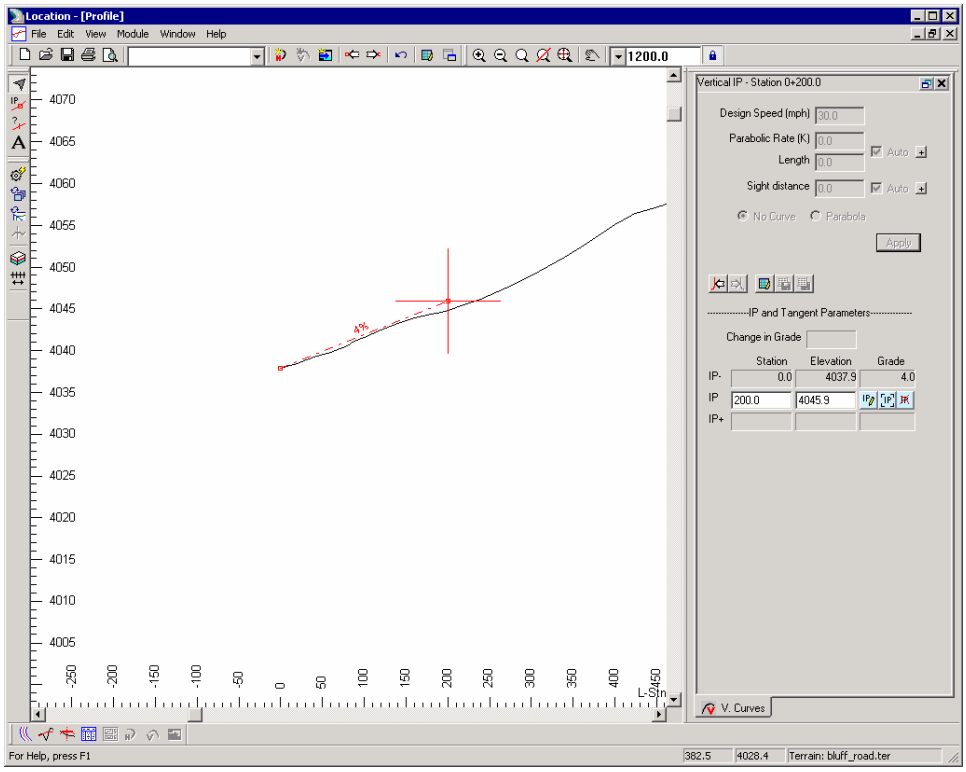

Figure 2.12: 2nd Design Point in the Profile Window

Modify an Existing IP in the Vertical Curves Panel

6. Press the *Previous IP* button . This will move the cursor back to the 1st vertical alignment point.

Notice that the *IP and Tangent Parameters* area shows the *Station* and *Elevation* of the current and next IP. It also shows the *Grade* of the previous and next tangents and the *Change in Grade*.

7. Type **4039** into the elevation field at the bottom of the panel. Press *Apply* to accept the change. The Profile window will show the new elevation.

8. Press the *Next IP* button to move to the second design point.

9. Press the *Modify IP* button. The *Modify Vertical IP* dialog will appear.

10. Change the *Delta Z* to **4**. Press OK. Notice that even though the numbers have been changed in the panel, there was no change in the Profile window. Press *Apply* to implement the changes.

11. Press the *Delete this IP* button to delete the current point.

Editing IPs in the Horizontal Curves Panel

12. Press the *Horizontal Curves* button to activate the horizontal curves panel. Note that you can now switch between horizontal to vertical panels by clicking on the tabs at the bottom V. Curves H. Curves.

13. Maximize the Plan window (this can be done by double clicking on the title bar).

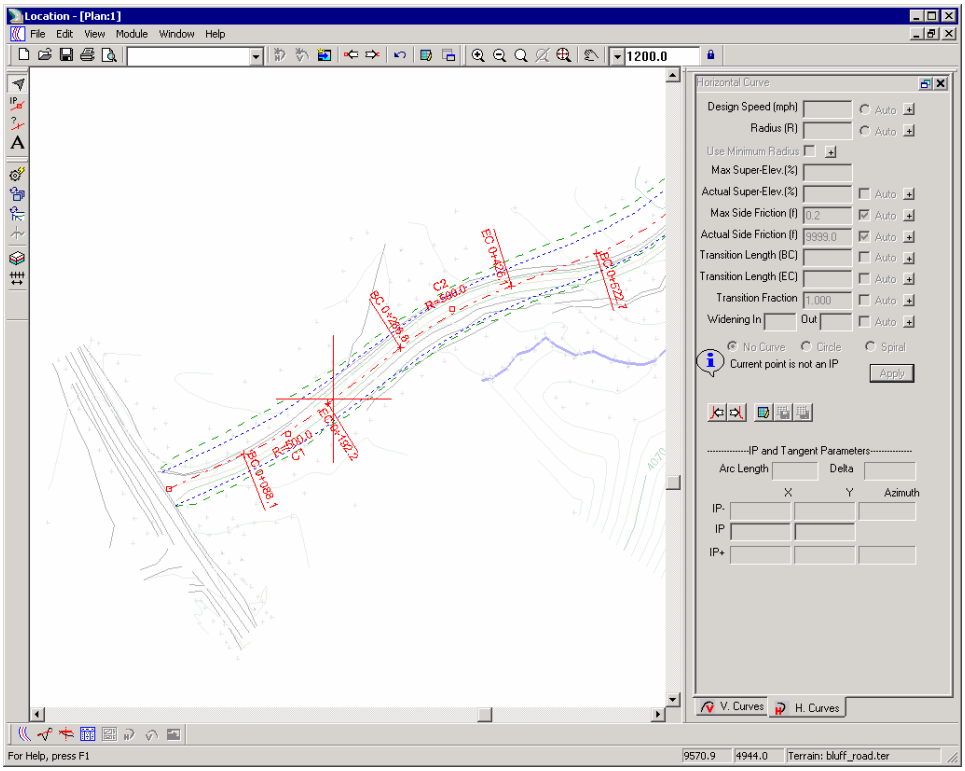

Figure 2.13: Plan Editing with the Horizontal Curve Panel

The previous sections covered editing vertical IPs in the vertical curve panel. The horizontal curves panel is conceptually the same. Both panels allow you to:

- Add a point at the end of the alignment (*Add New IP* button)
- Insert a point after the current point (*Add New IP* button)
- Edit an existing IP (*Modify IP* button or type directly in the fields in the panel – do not forget to press *Apply*)
- Delete the current point (*Delete this IP* button)
- Define IP locations by coordinate or other values - such as tangent *grade* in the profile and *azimuth* in the plan and *length* in both (*Add New IP* button or *Modify IP* button).

The curve panels are also covered in the sections dealing with curves.

14. You may wish to experiment further with the horizontal curves panel at this point. When you are finished, File | Close. Do not save changes.

Window Options and Screen Layouts

Every viewing window has associated display options (the panel windows are somewhat different). Window options can be modified in the associated options dialog box and can be saved for future use in *Screen Layout* files.

To do the examples in this section the *Terrain Design*, *Basic Curves*, should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. Choose File | Open. **RoadEng\Tutorial\Location\mouse_edit.DSN**.

The screen should look similar to the Figure 2.14 – this is the way it looked when the file was saved. The design files contain *design* data (alignment etc.) as well as *screen layout* data (window sizes, positions and options).

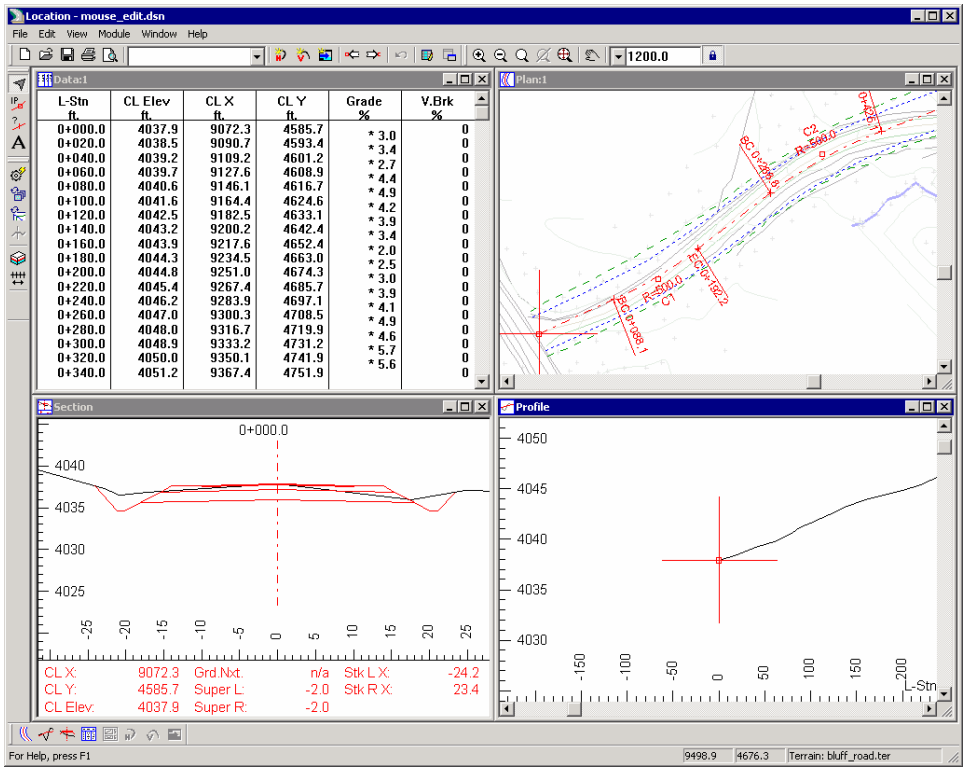

Figure 2.14: Screen Layout Saved with Example Design Files

2. File | Retrieve Screen Layout. **RoadEng\Tutorial\Location\plan and horizontal curves.DLT.**

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

This will set up the windows and options so the screen looks like the figure below – this is the way it looked when the screen layout **plan and horizontal curves.DLT** was saved. The screen layout file does *not* contain *design* data (alignment etc.) your alignment is unchanged.

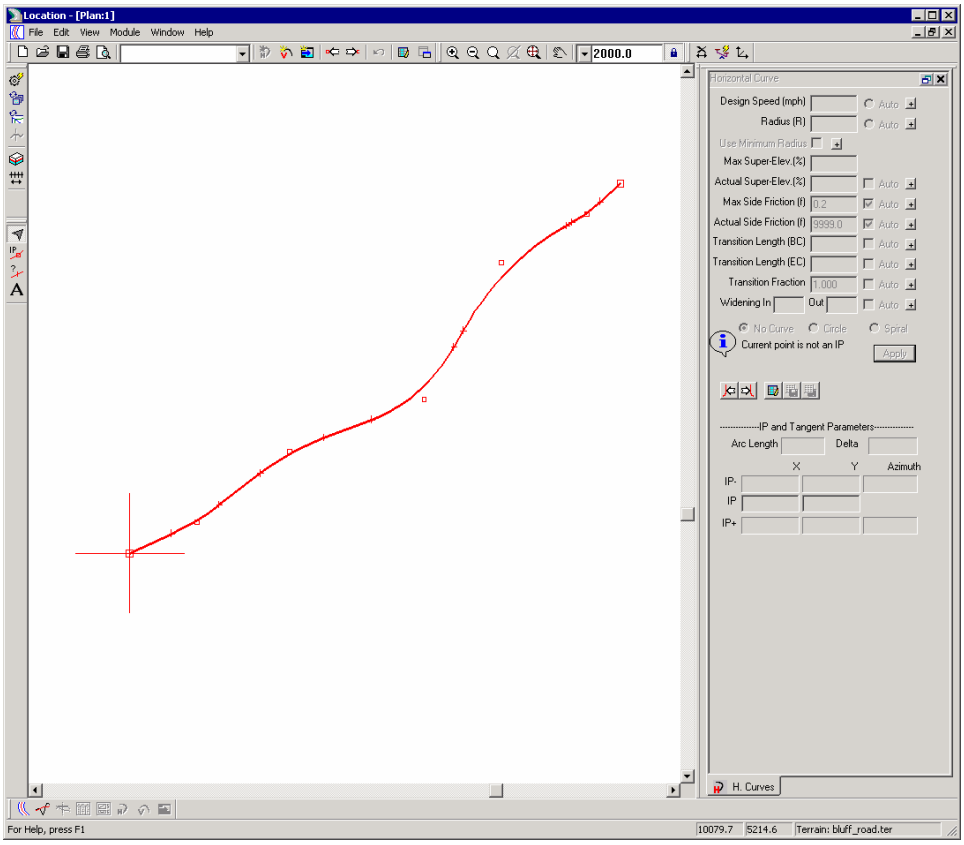

Figure 2.15: Screen Layout From DLT File

3. Click in the screen layout pull down box (see Figure 2.16) in the Standard Tools toolbar and select **normal.DLT**.

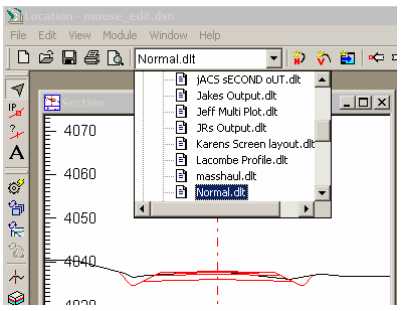

Figure 2.16: Selecting a Screen Layout From the Toolbar

You should notice that the screen display (windows, menus, labels etc) has changed. The underlying design has not changed. In effect, a screen layout is simply another way of looking at your design.

Experiment by selecting different screen layouts from the screen layouts pull down as in the previous step.

NOTE: normal.DLT is the File | New default screen layout. Modify normal.DLT to change the way a new designs look.

To create your own screen layouts, modify window options until the screen looks the way you want it, then File | Save Screen Layout.

4. Repeat step 2 to restore the screen layout shown in Figure 2.15.

5. Right click on the Plan window and select *Plan Options* from the popup menu.

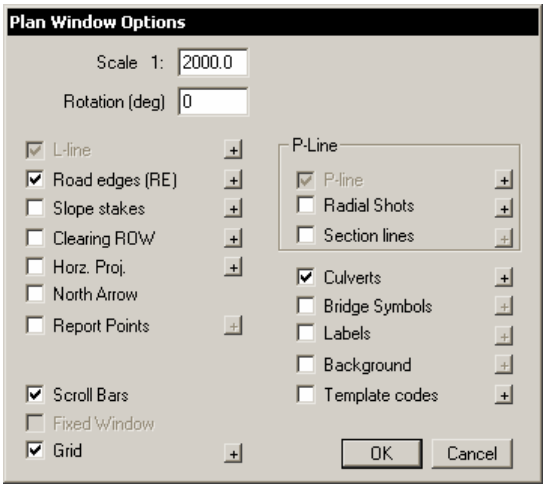

Figure 2.17: Plan Window Options

NOTE: The main display windows (Plan, Profile, Section and Data) have similar display options available from the right click menu, the Window Options button and the View | <window name> Options menu. Note that the toolbar button and menu item open the options dialog for the *active* window.

6. Turn on the Road Edges check box and the Grid check box. Then click the + button beside the *L-Line* item (*L-Line* is disabled and in the lower right); change the line-type to "42 Dash-Dot (.5mm)" and press *OK* then *OK* again to update the Plan view.

Notice the line-type for the centerline feature has changed.

7. Restore the Plan window (so it is no longer maximized). Close or minimize the Vertical and Horizontal Curve panels.

8. If you already have a Section window you can skip this step. Select menu Window | New Window | Section to and create a new Section window.

9. If you already have a Data window you can skip this step. Select menu Window | New Window | Data to create another new window.

10. Right click in the Data window and choose *Data Option*. Select only Plan Points for display (see Figure 2.18 – type the F1 key for help).

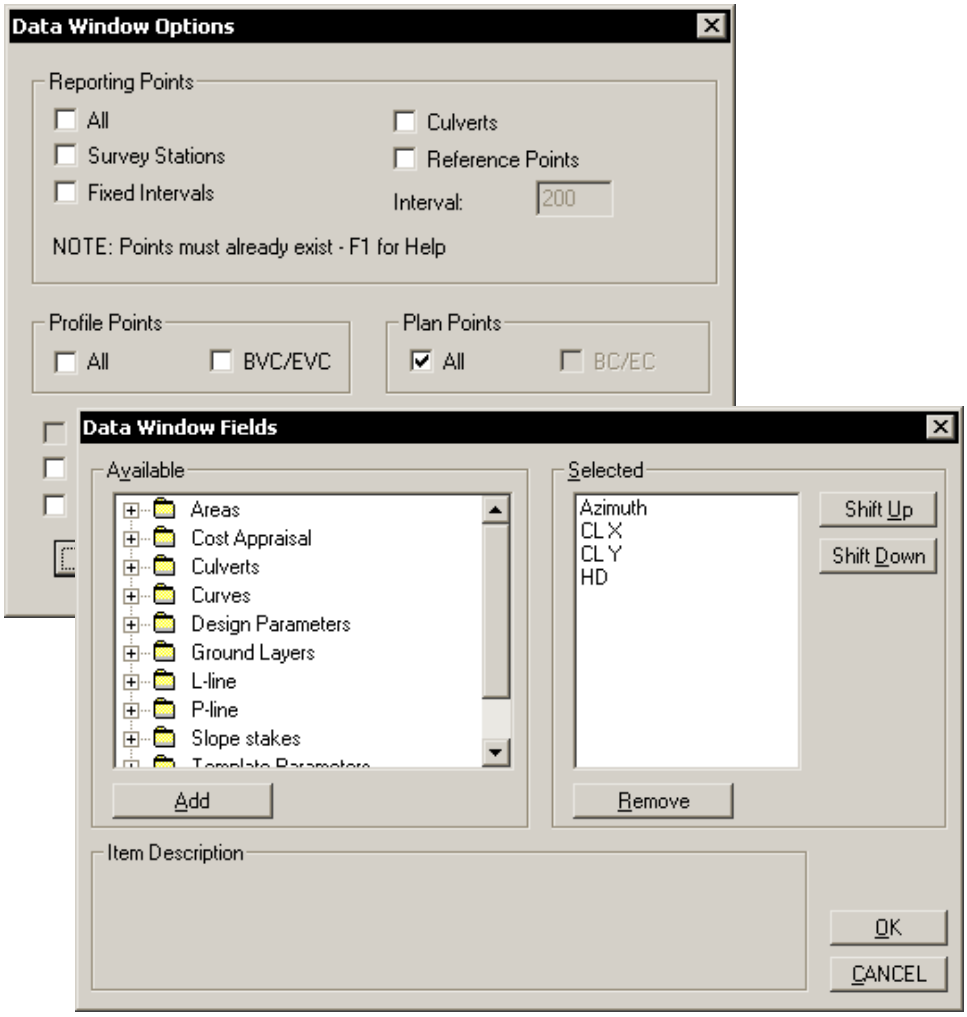

Figure 2.18 Data Window Options after Clicking the Columns *Button*

11. Press the *Columns* button and double click to open the *L-Line* folder from the *Available* list. Select *Azimuth and press Add* to move it from *Available* list to the *Selected* list (double click works too). Similarly add the *CL X*, *CL Y* and *HD* items. Now use the *Shift Up* button to move *HD* to the top of the selected list. Press *OK* and *OK* again will update the Data window.

12. Size and move the windows until the screen looks similar to the one shown in Figure 2.19.

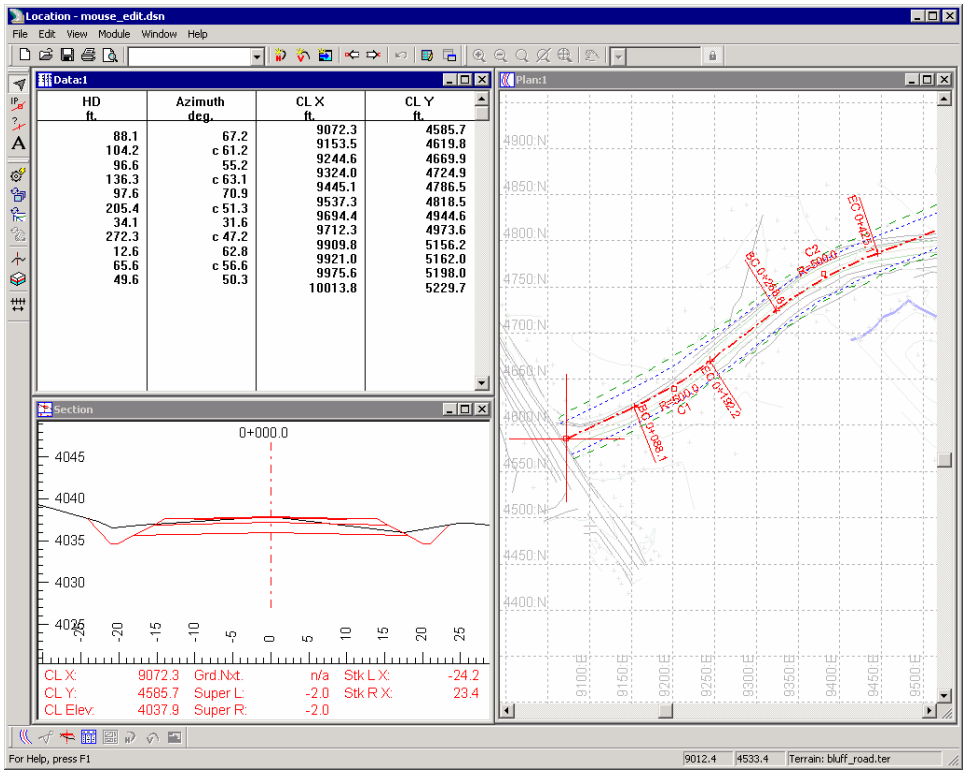

Figure 2.19: A New Screen Layout

13. File | Save Screen Layout to create a new screen layout file. Type **Plandatasection** in the file name field and press OK to save the new screen layout to the RoadEng folder on your hard drive. If you are prompted that this file already exists you may want to change the file name – see note below.

NOTE: Only screen layout files in the RoadEng folder on your hard drive will appear in the screen layouts pull down in the tool bar. You may, however, save screen layout files to any folder and retrieve them with the File | Retrieve Screen Layout menu.

14. Use the screen layout pull down in the toolbar to select a different screen layout (as in step 3). Your screen will update to a different configuration.

15. Repeat the step above, but this time pick **plandata section.DLT** created in step 13. Your screen will return to the way you set it up in steps 4 to 12.

NOTE: Screen layouts can save time that might be spent setting up options over and over again. It makes sense to save a screen layout for each design task that needs specific feedback. Screen layouts can also provide new users with the tools they need without them having to learn what options are available and where to set them.

16. Use the File | Delete File(s) menu to remove the screen layout file you created above. You will need to select *Screen Layout (*.DLT)* in the *Files of Type* pull down and then navigate to the RoadEng folder.

17. File | Close. Do not save changes.

Starting a New Design

This example illustrates how to create a new location design project. There is no single step-by-step recipe for road location but there are three steps that are common to all new designs:

- Define the original ground surface topography.
- Define the ground types and sub-surface layers.
- Define the cross section template(s).

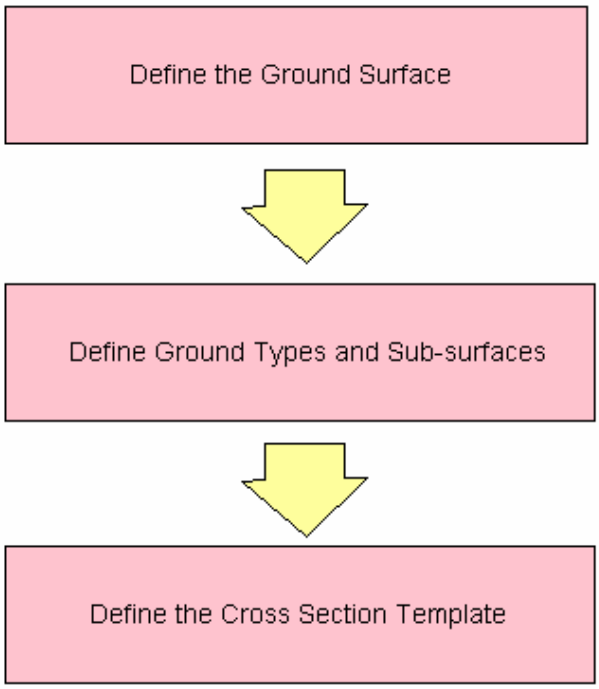

Figure 3.0:Steps required to Create a NewDesign

The Location design module creates a 3D model representing the completed roadway; this requires a ground surface, a road cross section (prism), horizontal and vertical alignments.

The original ground surface can be defined by a traverse with side shots created in the Survey/Map module (*.TR1 file) and/or by a Digital Terrain Model (TIN model) created in the Terrain module (*.TER file or a LandXML surface file (*.XML).

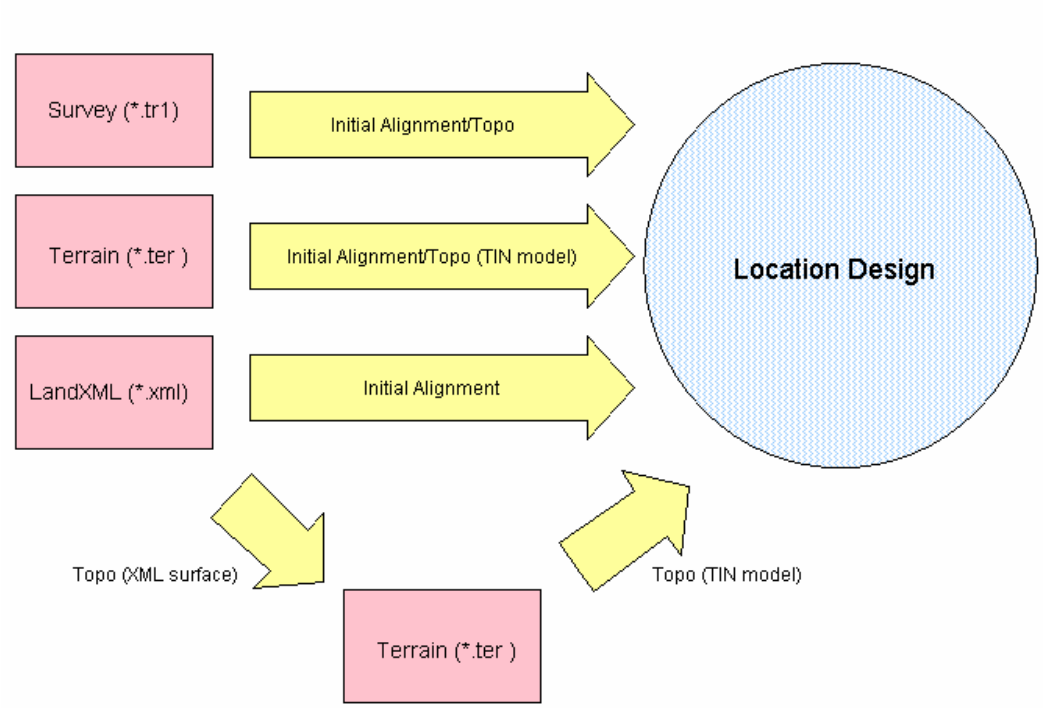

Figure 3.1: Ground Surface Data Sources

Defining the Ground Surface using a P-Line Survey

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant skip this tutorial.

To do this example the *P-line Design* function group must be enabled. See *Function Groups* (Module | Setup | Menus) in the On-line help for more information.

NOTE: Even if you do create a P-Line traverse it is often desirable to create a Terrain model from your traverse before creating a road alignment; in this case you may use **both** the P-Line and the DTM to define the ground surface.

A P-Line (Preliminary Line) traverse created in the Survey/Map module contains an initial alignment and cross sections. It also contains comments, ground layer material types and stream locations. See the Survey/Map module documentation for details and instructions for creating a P-Line traverse.

1. File | New. Open **\RoadEng\Tutorial\Location\survey design.TR1.**

NOTE: Make sure that your traverse is correct. If the survey notes are changed after starting the design, the design points after the change will be affected. This may require some re-design.

The following steps place a background image in the Plan window. An optional background image can display any graphical information that may be of use during the design process.

2. Activate the Plan window then right click in it and select *Plan Options* from the popup menu.

3. Click on the + button beside the *Background* check box then click the *Add* button. Choose **\RoadEng\Tutorial\Location\terrain design.TER** (see Figure 3.2) Press *Open*, then *OK* and *OK* a second time to load the background image.

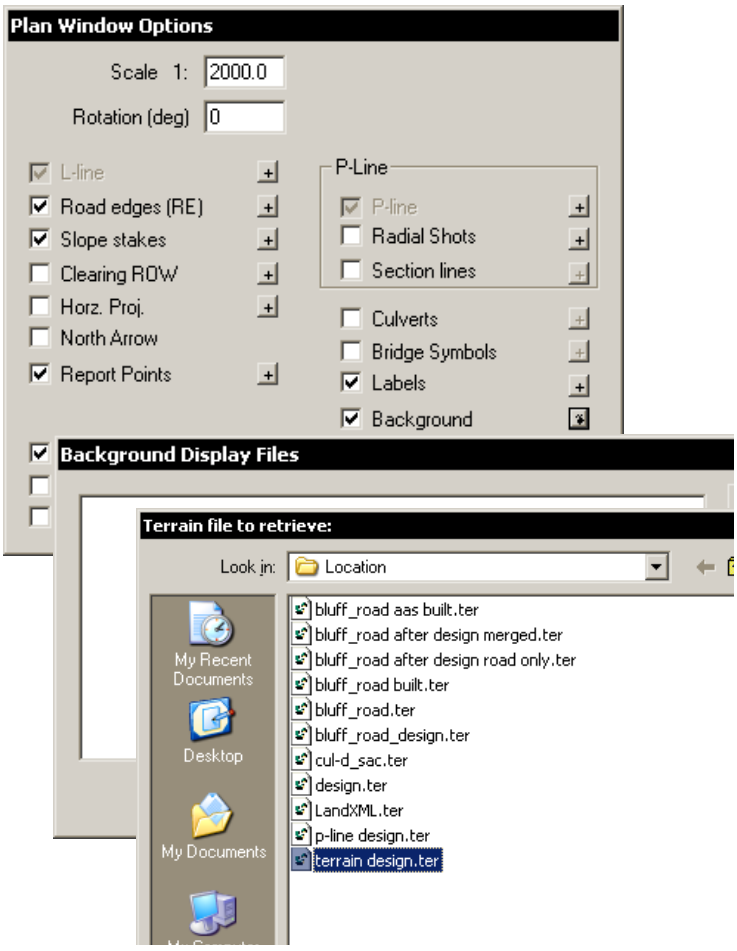

Figure 3.2: Adding a Terrain Background to the Plan Window

4. Choose menu File | Close. Do not save changes.

Defining the Ground Surface using a Terrain File

If you do not use Terrain files (*.TER) to import topographical information, you can skip this section. To do this example the *Terrain Design* function group must be enabled. See *Function Groups* (Module | Setup | Menus) in the On-line help for more information.

1. File | New. Open **\RoadEng\Tutorial\Location\bluff_road.TER.**

2. When prompted for the start coordinates, choose *Terrain current feature, all points*. This will generate an initial alignment using the currently selected terrain feature.

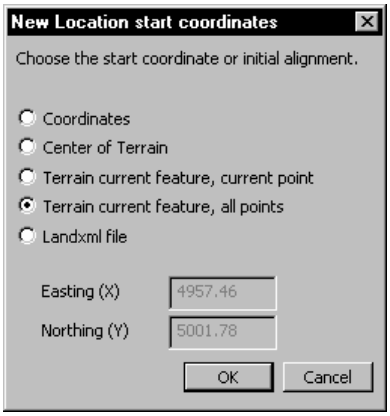

Figure 3.3: New Location Start Coordinates Dialog

NOTE: To use the *Terrain current feature* to initialize your alignment, the Terrain must be saved with the desired feature selected.

NOTE: If you use any of the other options when creating a new design, you will start with only *one* point; you will have to create all the horizontal alignment (see *Horizontal Alignment – Creating tangents for Curves* section). It is possible to move the initial point before creating the first tangent.

3. Choose menu File | Close. Do not save changes.

Defining the Ground Surface using a LandXML File

If you do not use Land XML files (*.XML) to import topographical information, you can skip this section. To do this example the *Terrain Design* function group must be enabled. See *Function Groups* (Module | Setup | Menus*)* in the On-line help for more information.

1. Choose File | New. Change the *File of Type* to LandXML (*.XML). Select and open **\RoadEng\Tutorial\Location\LandXML.XML.** Ensure Surface is enabled in the LandXML options. Press OK and then press Save. It will be saved as **LandXML.TER**

2. A New location start coordinates dialog box appears.When prompted choose *Landxml file*. Press OK. Select and open **\RoadEng\Tutorial\Location\LandXML Alignment.xml**. Press Open. An Import LandXML options dialog box opens. Press OK to generate an initial alignment.

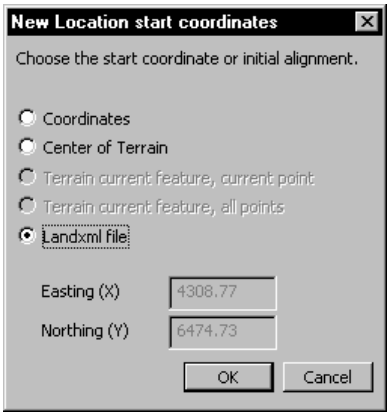

Figure 3.4: New Location Start Coordinates Dialog

3. Choose menu File | Close. Do not save changes.

Defining Ground Types and Sub-surface Layers

Ground type information can be used to determine slope angles and expansion and compaction factors.

If your design is based on a P-line survey (or combination terrain file and p-line survey), you can skip this section, since ground type and sub-surface information is included in the survey notes (ground type/ sub-surface information entered here will override the survey notes).

To do this example the *Sub-surface* function group must be enabled. See *Function Groups* (Module | Setup | Menus*)* in the On-line help for more information.

1. File | New. Open **RoadEng\Tutorial\Location\bluff_road.TER.**

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. When prompted for the start coordinates, choose *Center of the Terrain*. This will create a starting alignment point in the center of the terrain.

3. Choose Edit | Assign Parameters by Range and select the Sub Horizons tab. Type "HP/1/SR" into *Ground Layers* and press *Add/Edit* to define the ground material types along the alignment. This will add a 1 foot (project units) layer of hard pan (HP) over solid rock (SR).

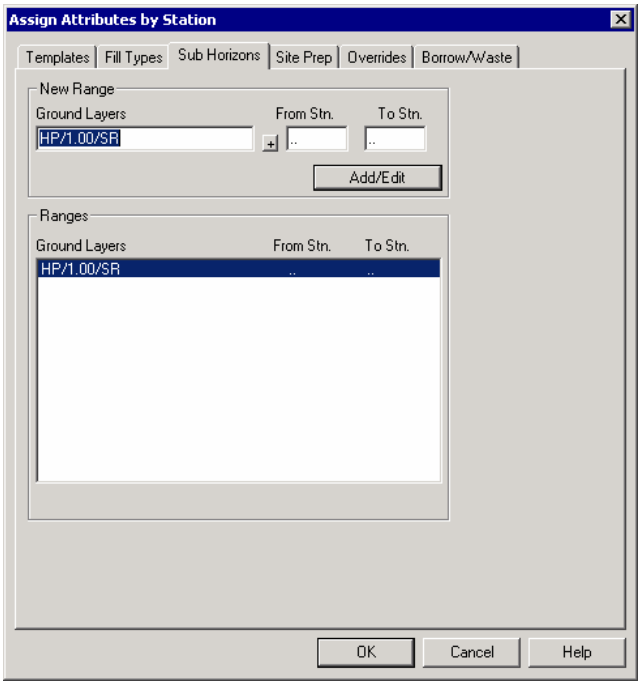

Figure 3.5: Edit | Assign Parameters by Range Dialog

4. Press *OK* to close the dialog box then *Yes* to recalculate.

NOTE: The layer (dashed line) now displayed in the cross section. "HP" and "SR" are defined in the ground types table (Edit | Edit Ground Types).

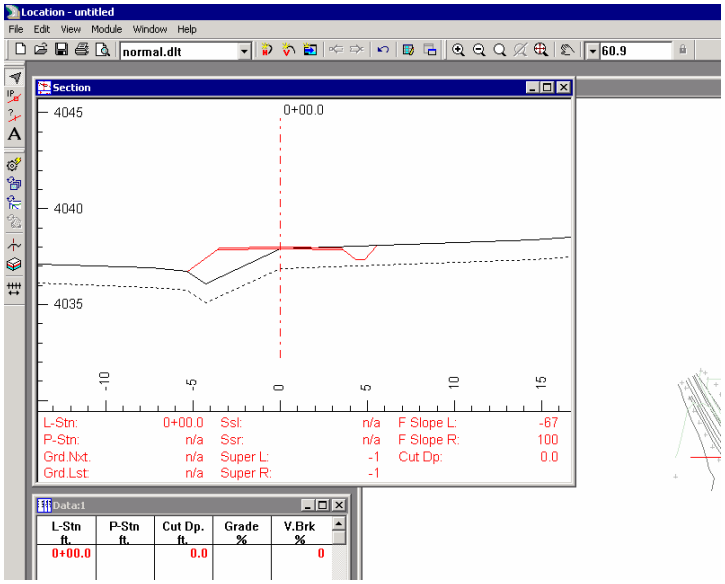

Figure 3.6: Cross Section Window with Sub-surfaces

5. Choose Edit | Edit Ground Types.

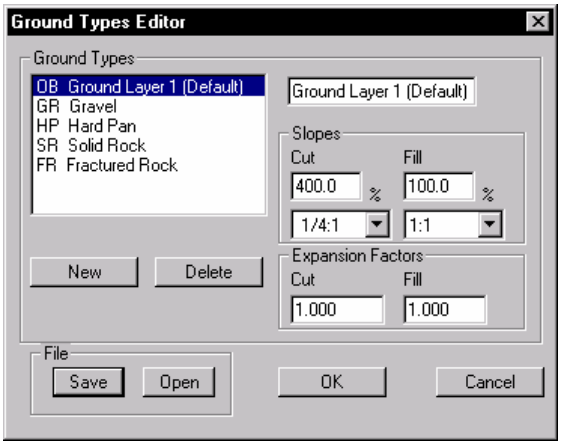

Figure 3.7: Ground Types Editor Dialog

6. Highlight *OB Overburden (Default)* and change the description to *Ground Layer 1* in the description area beside the list. Also change the *Fill* to a 1:1 ratio. Press OK.

NOTE: Ground information can be used to control the cut and fill slope angles for the template.

Define the Cross Section Template

7. Choose Edit | Edit Templates then press the *Open Table* button to get a template table from a file.

8. Select **RoadEng\standardmetric.TPL** and press Open. Press *OK* to leave the Template editor and *Yes* to recalculate (See the Section called *Templates* to learn how to create and assign templates).

NOTE: This step loads a table of templates for calculating road cross sections. You can create your own template tables (see Templates). You can skip this step if you are satisfied with the contents of normal.TPL (the File | New default).

You have now completed the critical steps required to start a new design.

9. File | Close. Do not save changes.

Design Techniques

Staying within constraints for a given project requires an iterative design approach where vertical and horizontal alignment and other road parameters are adjusted while trying to balance often-contradictory goals (i.e. high design speed vs. low earthwork volumes). RoadEng is designed to provide you with editing tools and feedback information to accelerate this process. The following exercises illustrate these tools and the various types of feedback; however, they are simplified to make the exercises concise and self-contained.

Horizontal Alignment – An Overview

Horizontal design involves finding the best alignment in the Plan view subject to various constraints. Simple geometric constraints may include a minimum curve radius and right of way boundaries. The horizontal alignment also affects earthwork volumes. However vertical alignment and template shapes also contribute to volumes and must be considered at the same time for a real design.

Before starting the following sections, it is recommended that you review the material covered in *Editing With The Mouse* and *Starting A New Design.*

Horizontal alignment is the same whether you created your design from a P-Line traverse (.TR1 file), from a Terrain model (.TER file) or from both (see *Starting a New Design* section above). These examples start with a design created from both the P-Line *and* the Terrain used in the example above.

Horizontal Alignment – Editing Tangents, Small Offsets

The alignment in this example consists of many short tangents with small angles between them and no curves; it is assumed that the corners will be smoothed during construction of the road. This kind of design is often suitable to low volume road design.

To do the examples in this section the *Terrain Design, Basic Curves and Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open **\RoadEng\Tutorial\Location\combo design.DSN**
2. File | Retrieve Screen Layout; and select **RoadEng\Tutorial\Location\tutorial_plan.DLT.** Press Open

This design contains vertical alignment. The horizontal alignment, however, is still coincident with the P-Line survey. This lies on the edge of an escarpment and the road would be better located uphill from the edge (Figure 4.0).

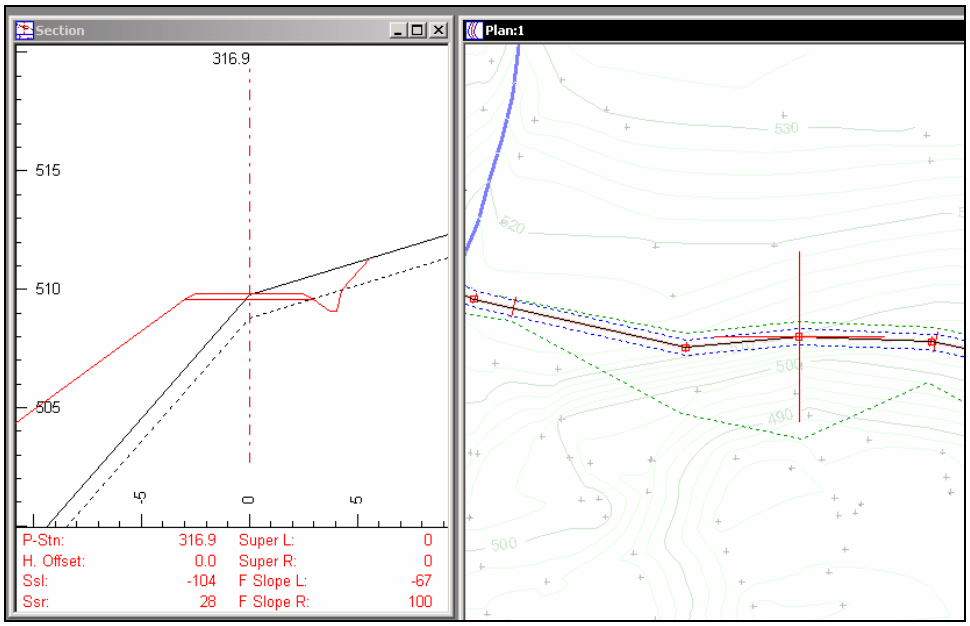

Figure 4.0: Excessive Fill Before Horizontal Alignment

3. Capture the point indicated in the figure above and move it up before re-anchoring it. You may work in the Plan window or the Section window (see the *Getting Started* chapter for information on point editing).

The green dashed line below the road in the Plan window represents the fill catch point (slope stake); notice how it changes after your edit.

4. Continue to adjust this same IP until the Section and Plan windows appear similar to the figure below.

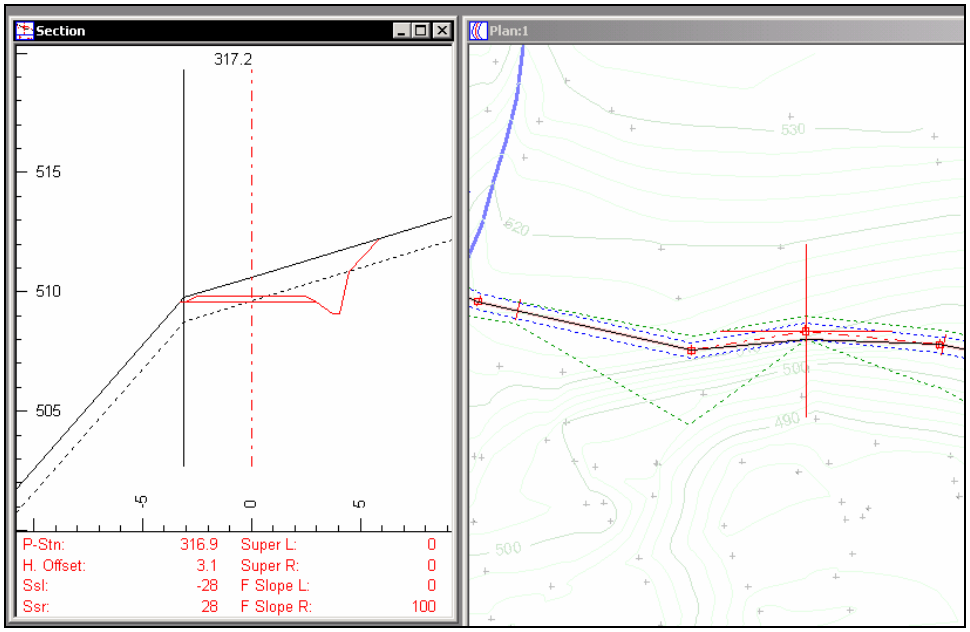

Figure 4.1: No Fill (full bench cut) After Horizontal Alignment

5. Horizontally align from the start of the road (right hand side in the Plan window) to the creek until there are no more excessive fills (see Figure 4.2). You can move *or* delete horizontal IPs.

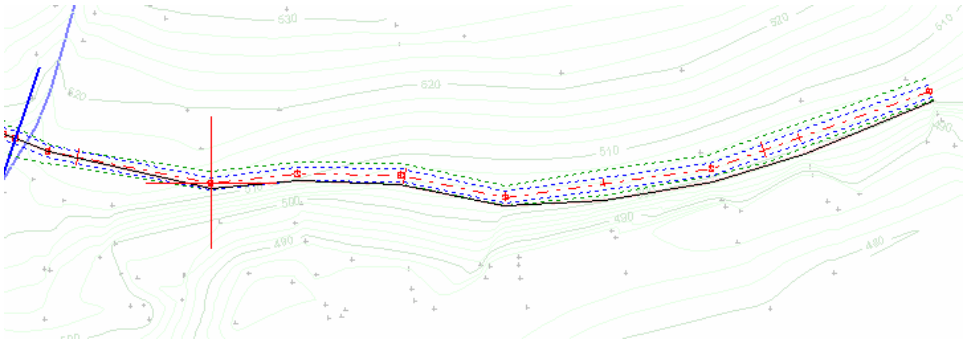

Figure 4.2: After Aligning the First Section of Road

The exercise above could have been accomplished almost in one step with the Edit | Auto Balance function. Figure 4.3 shows how you would set up the Auto Balance dialog box to perform this.

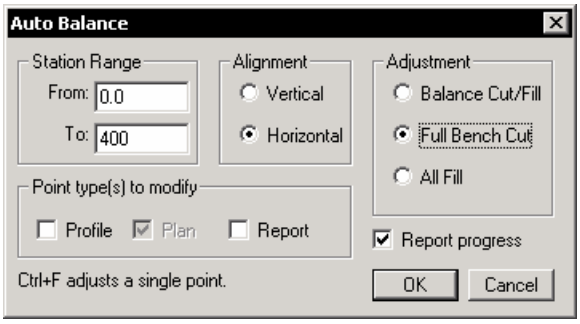

Figure 4.3: Edit | Auto Balance Dialog Box Set Up to Horizontally Align to Full Bench

Optional steps:

6. **Auto Balance** is only available if the **Auto Balance** function group is enabled. Enable this function group if you wish to try the following step. Use the Module | Setup menu, *General* tab, *Menus* button. See the *Functions Groups* section.

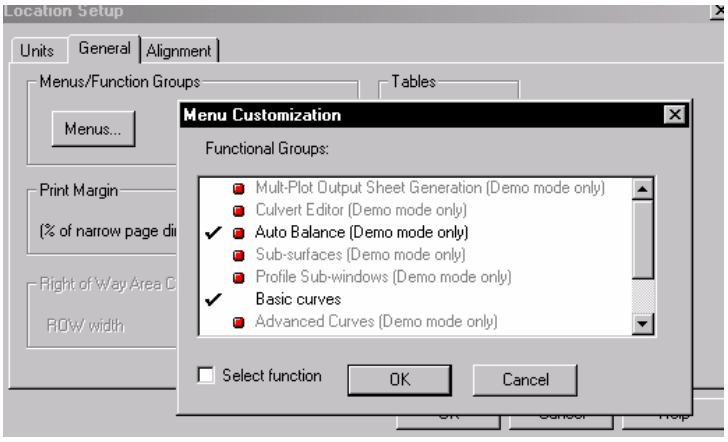

Figure 4.4: Menu Customization Dialog

7. Edit | Undo some of your alignment above so that you can see there is excessive fill once more. Use Edit | Auto Balance to re-align to full bench (as shown in the Figure 4.3- note *Station Range*). You may want to type <F1> once the dialog box is open to see online help.

Resume from Step 5 here if optional steps were skipped:

8. Proceed to step 3 in the next example. Or select File | Close to leave example. Do not save changes.

Horizontal Alignment – Creating tangents for Curves

Horizontal curves require the design of tangents before the curve can be created. The incoming *tangent* intersects with the outgoing *tangent* to define the *curve IP*. This section deals with two ways to create tangents.

To do the examples in this section the *Terrain Design*, *Basic Curves*, and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

NOTE: Tangents can also be modified after a curve has been created.

Skip the first two steps if you are continuing from the previous example.

1. File | Open. **\RoadEng\Tutorial\Location\combo design.DSN**.

2. File | Retrieve Screen Layout; select **\RoadEng\Tutorial\Location\tutorial_plan.dlt**. This will set up the windows to display feedback appropriate to this example. Press Open

3. View | Jump to Station or <Ctrl-J> then type **9999** in the station field. *OK* will set the last point in the design as the current point.

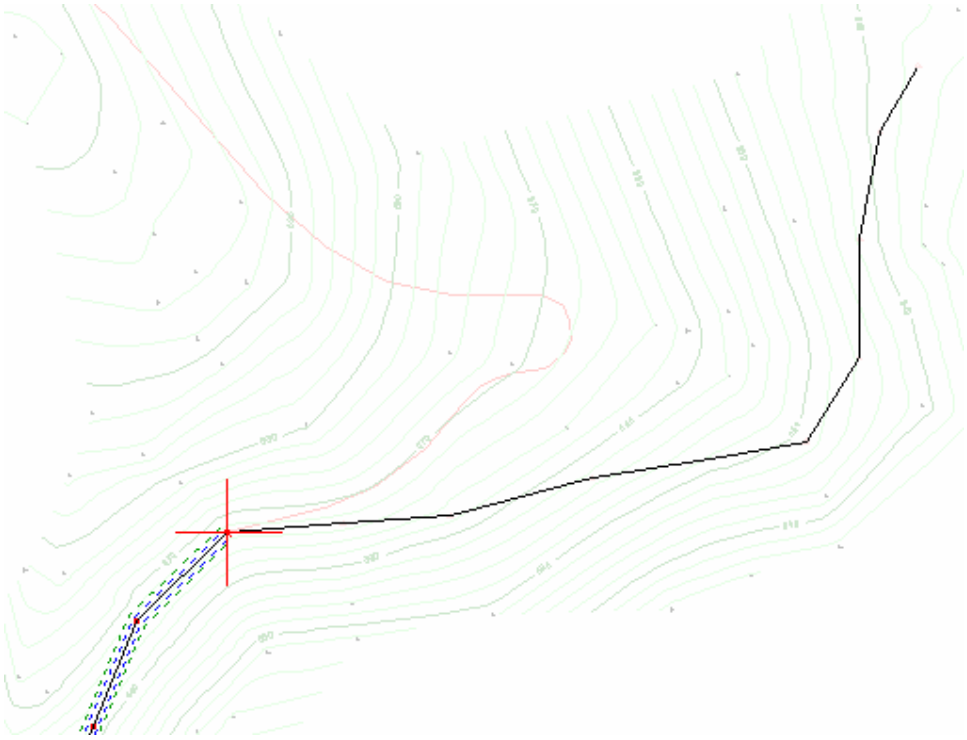

Figure 4.5: Plan View Showing the Last Point in the Design

4. Right click in the Plan window and choose *Plan Options*; clear the check boxes beside *Slope stakes* and *Road edges* (Press F1 key for help). After you press *OK*, the alignment will be a bit clearer. Note that slope stakes (catch points) are meaningless until both vertical and horizontal alignments are defined.

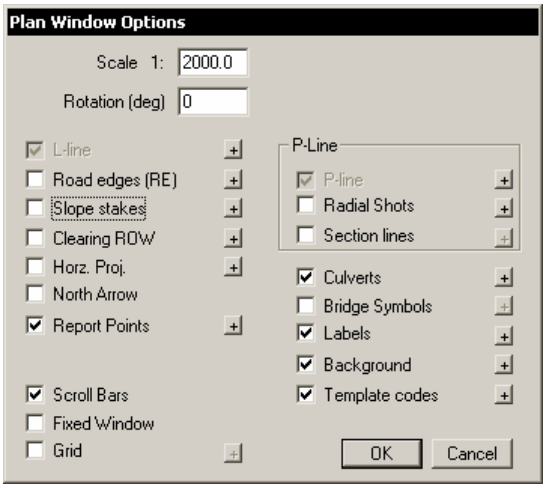

Figure 4.6: Plan Window Options

To complete the pre-curve alignment, new tangents will be created. This process is the same one you would use if there were no initial P-Line alignment – if the cross- hair in the figure were the *only* point in the alignment.

New tangents can be created with the mouse or the Horizontal curve panel (see Editing with the Mouse in Profile or Plan).

5. Use the mouse (*Add/Edit IP Tool* cursor) to create the tangents as shown in the Figure 4.7.

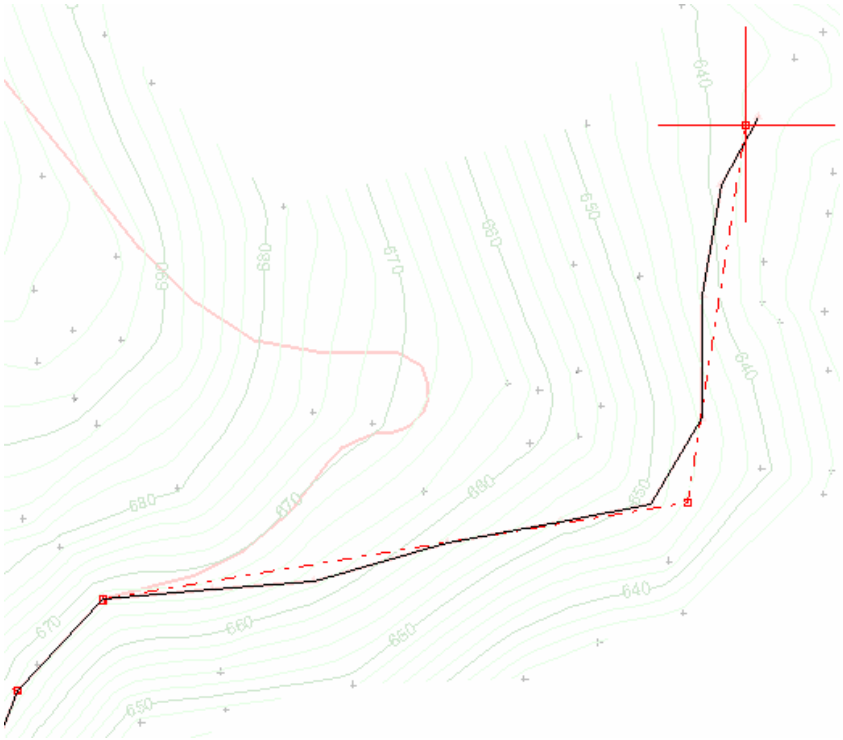

Figure 4.7: Plan View Showing New Tangents

The Data window now shows information about the new tangents. Change the Data window to show tangent length and azimuth instead of P-Line offset

The Data window now gives length and direction feedback about all tangents including the two tangents just created with the mouse. The figure above shows the first new tangent is 375.4m long at 81 degrees; the second is 223.0m long at 10 degrees and the angle between them is 72 degrees. The numbers in your display will be different, however, with this feedback available, it is possible to use the mouse to get close to any desired results by trial and error.

NOTE: The changes made to the Plan and Data window options could be saved in a screen layout. If you were to use File | Save Screen Layout you could create an updated version of the screen layout that you used in step 2 of this section; this new screen layout could be used when you encounter this type of design task in the future. See *Window Options and Screen Layouts* section.

To define tangents with exact azimuths and distances it is necessary to use the Horizontal Curve panel.

6. Press the *Next IP* button (if enabled) in the Horizontal Curve panel to make sure that the cross hair is on the last point in the design.

7. Press the *Delete this IP* button twice to remove the tangents added above (press C*ontinue* when prompted).

Your screen should look like it did at the start of this section.

8. Press the *Add New IP* button. Type **80** into the *Azimuth* field and **375** into the *H.Dist* field. Press OK to add a new point. Confirm that the Data window shows the same values.

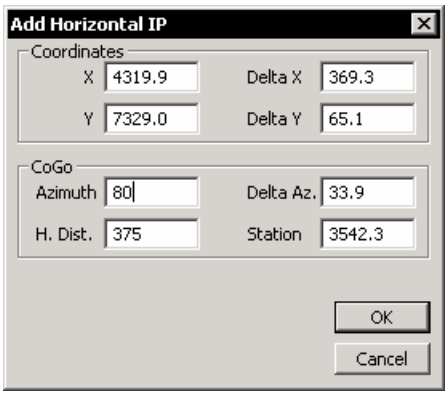

Figure 4.8: Add Horizontal IP Dialog Box

9. Press the *Add New IP* button again. This time type **-70** into the *Delta Az.* field and **220** into the *H.Dist* field. Press OK to add a second new point.

Neither of the methods used above for creating tangents is more correct than the other, both allow creation of curves afterward.

10. Select the Edit | Auto Generate menu and set it up to look like the figure below. Press *OK* to insert cross sections between the two IPs that you just created.

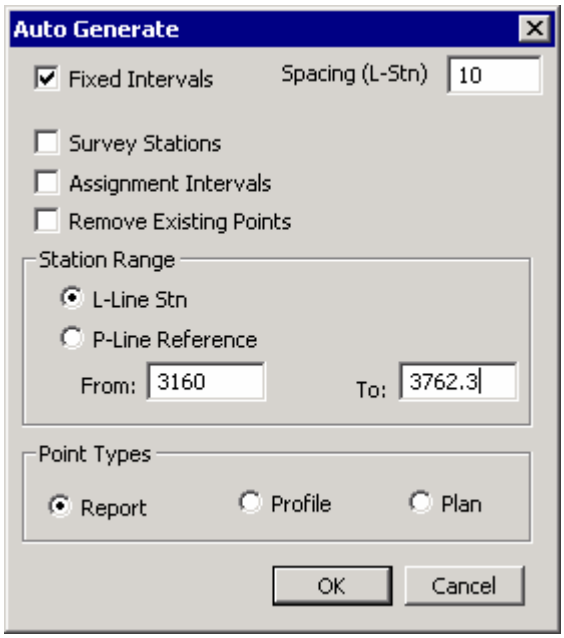

Figure 4.9: Auto Generate Dialog Set Up to Insert Cross Sections in the Recently Created Tangents

NOTE: Report points should be inserted into any new horizontal alignment to enhance the accuracy of volume calculations and to improve the display of graphics such as road edges.

You may skip the following step if you plan to continue with the next section.

11. Proceed to step 2 in Adding Horizontal Curves or select File | Close to leave the example. Do not save changes

Adding Horizontal Curves- Simple Mode

The tangents created in the section above are now ready for a horizontal curve. Skip the first step if you are continuing from the previous section.

To do the examples in this section the *Terrain Design*, *Basic Curves* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open **RoadEng\Tutorial\Location\simple horizontal curves.DSN**. The screen should look appear as the Figure 4.10.

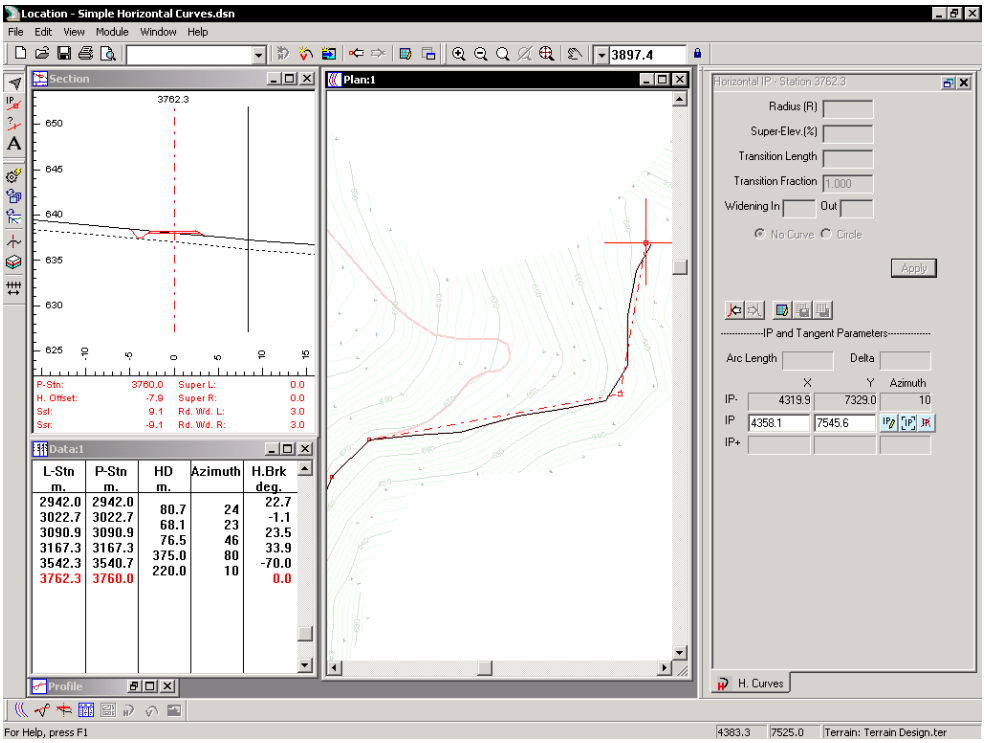

Figure. 4.10: Simple Horizontal Curves.DSN

2. Press the *Previous IP* button in the horizontal curve panel.
3. Select *Circle* in the top of the Horizontal Curve Panel and type in the data shown in the Figure 4.11 below. Press *Apply*

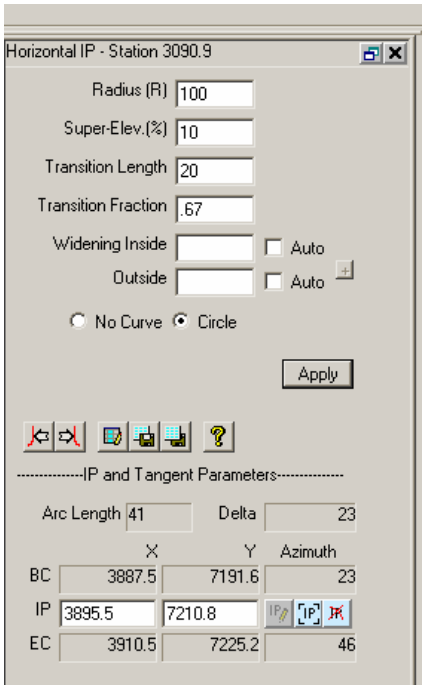

Figure 4.11: Top Part of the Horizontal Curves Panel

The new curve is now visible in the Plan window; note the *BC* (Begin Curve), *EC* (End Curve) and radius labels.

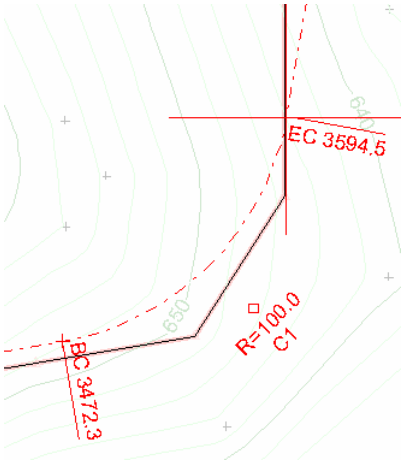

Figure 4.12: Horizontal Curve

4. Press the *Set Default Curve* button. This will save curve parameters for future use. Note that default curve parameters are saved with the Template table.

The curve parameters used above specify lane *Widening* and *Super Elevation*. To see how these are applied look at the Section window.

5. Press the *Previous Point* button in the tool bar (**not** the one in the curve panel) and notice what happens to the Section. Repeat until the current point has passed the beginning of the curve transition (*Super L* and *Super R* are both 0.0).

6. Press the *Next Point* button repeatedly and watch the Section window as you pass through the curve again.

The transition from no super elevation and no curve widening to full super elevation and full curve widening takes place over 20m (*Transition Length*) at each end of the curve. You may have noticed that the super elevation is 6.7% at the BC and EC points; this is because 2/3 of the transition happens outside of the curve (*Transition Fraction* is 0.67) and the rest happens inside the curve.

7. Press the *Previous IP* button in the horizontal curve panel until you reach station 3167 (see Figure 4.13).

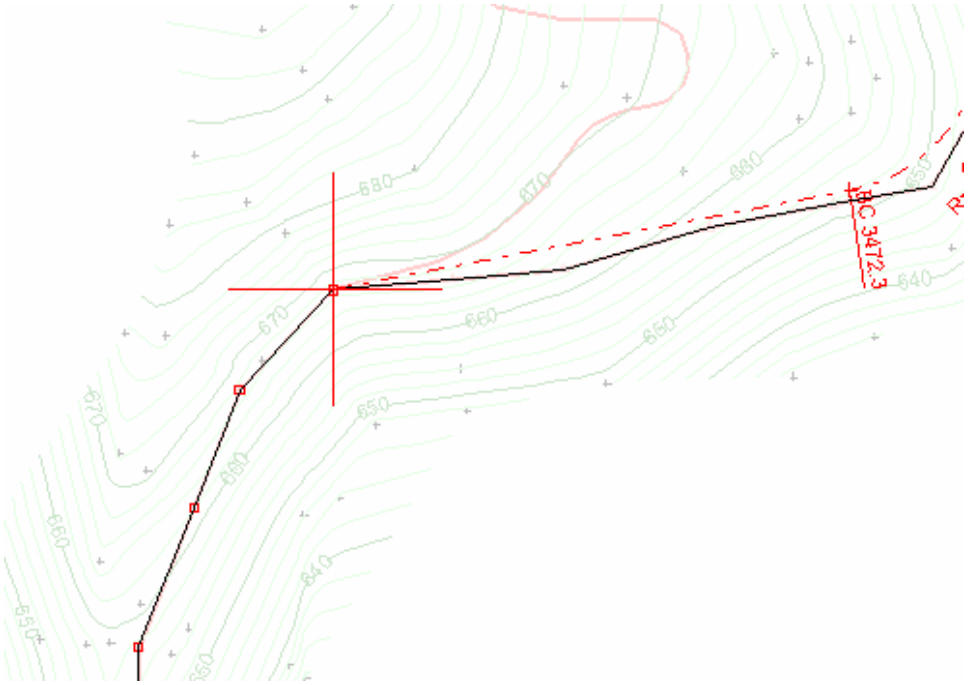

Figure 4.13: Station 3167, Second Curve Location

The alignment here is made of several short tangents (it follows the P-Line survey). In the next few steps you will set up tangents suitable for a curve and add the curve.

8. Use the mouse to capture and then delete the two points before the cross-hairs in the figure above (if you try to delete the IP at the cross-hairs you will be prompted to delete the curve you just created).

9. Capture the remaining point and move it so that the tangents resemble Figure 4.14.

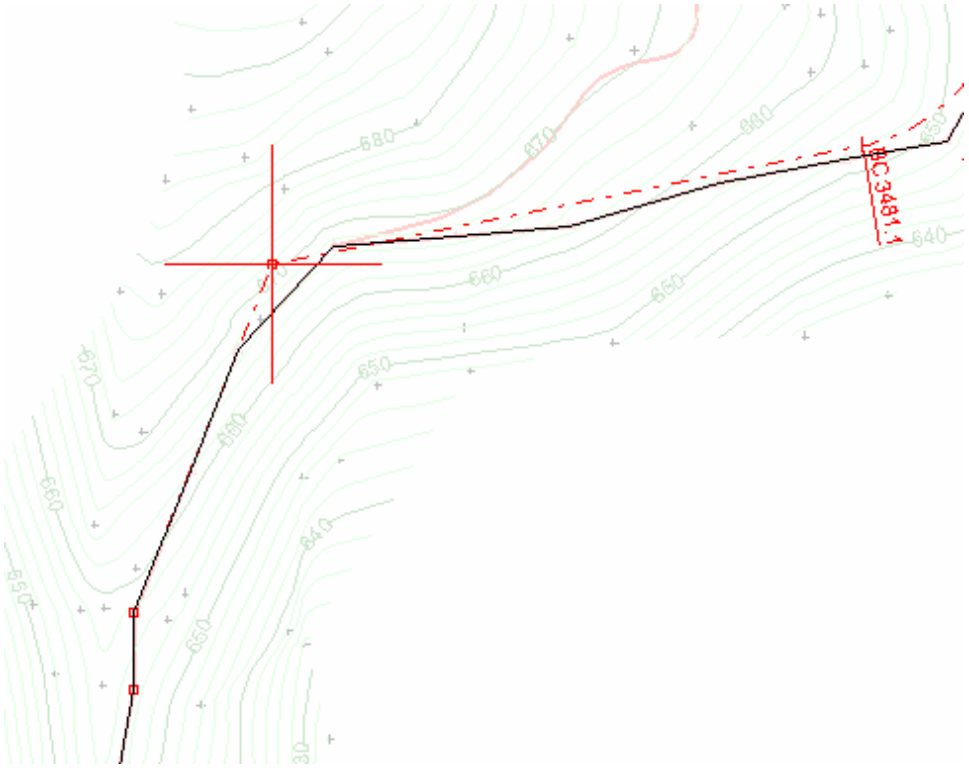

Figure 4.14: Ready for Second Curve

10. Click on the *Get Default Curve* button in the curve panel and then press *Apply*. A new curve with the same parameters as the first one will be inserted.

11. Zoom and Pan until you can see both curves as shown in Figure 4.15.

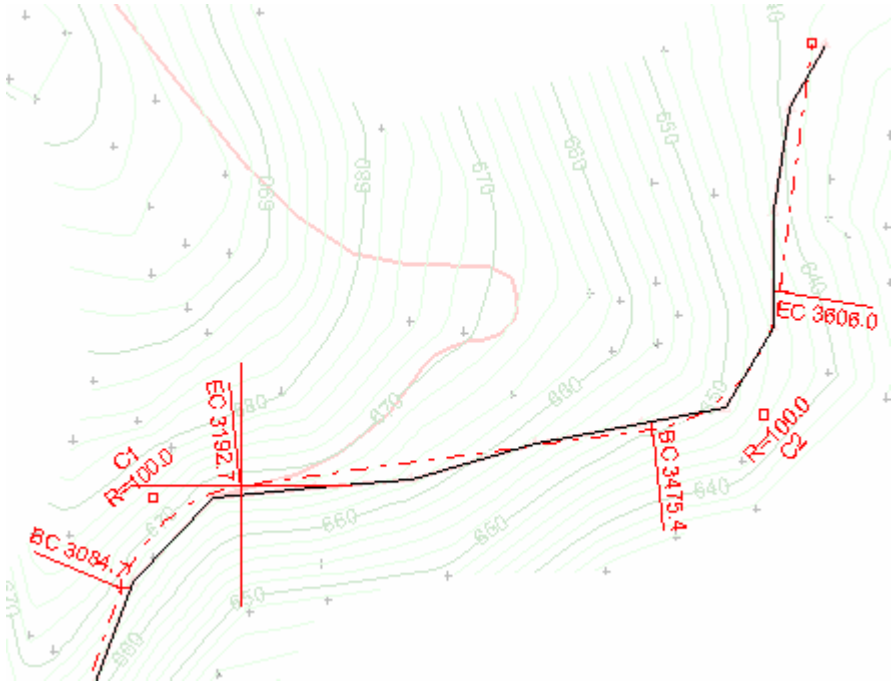

Figure 4.15: Two Curves Completed

12. Move the mouse cursor over the new curve IP (next to the radius label); notice that the *edit* cursor ⛶ appears (you should still be in *Add/Edit IP* mode). Capture the curve IP and notice that both curves adjust to fit as you move the mouse around. Also notice that the *IP and Tangent Parameters* fields at the bottom of the curve panel are also updating dynamically as you move the mouse.

If you move the IP so that the curve does not fit the tangents the computer should beep and the tangents will stop following the mouse.

13. Modify tangents and add curves throughout the design until you are comfortable with the process.

14. File | Close. Do not save changes.

Vertical Alignment – An Overview

Vertical design involves adjusting alignment grades and elevations to provide the best compromise between various constraints. Simple geometric constraints may include minimum curvatures and maximum allowable grade. The vertical alignment also affects earthwork volumes. However, horizontal alignment and template shapes also contribute to volumes and must be considered at the same time for a real design.

Before starting, it is recommended that you review the material covered in *Editing With The Mouse* and *Starting A New Design.*

Vertical alignment is the same whether you created your design from a P-Line traverse (.TR1 file), from a Terrain model (.TER file) or from both (see *Starting a New Design* section). This example starts with a design created from both a P-Line *and* a Terrain.

Vertical Alignment – With Grade and Volume Constraints

In this section a segment of road will be vertically aligned while staying within grade constraints and avoiding large fills.

The alignment in this example consists of many short tangents with small grade breaks between them and no curves; it is assumed that the corners will be smoothed during construction of the road. This kind of design is often suitable to low volume road design.

To do the examples in this section the *Terrain Design*, *Basic Curves*, *Profile Sub-windows* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open **\RoadEng\Tutorial\Location\combo design-V.DSN**. Press Open.

2. File | Retrieve Screen Layout; select **RoadEng\Tutorial\Location\profile.DLT**. This will set up the windows to display feedback appropriate to this example.

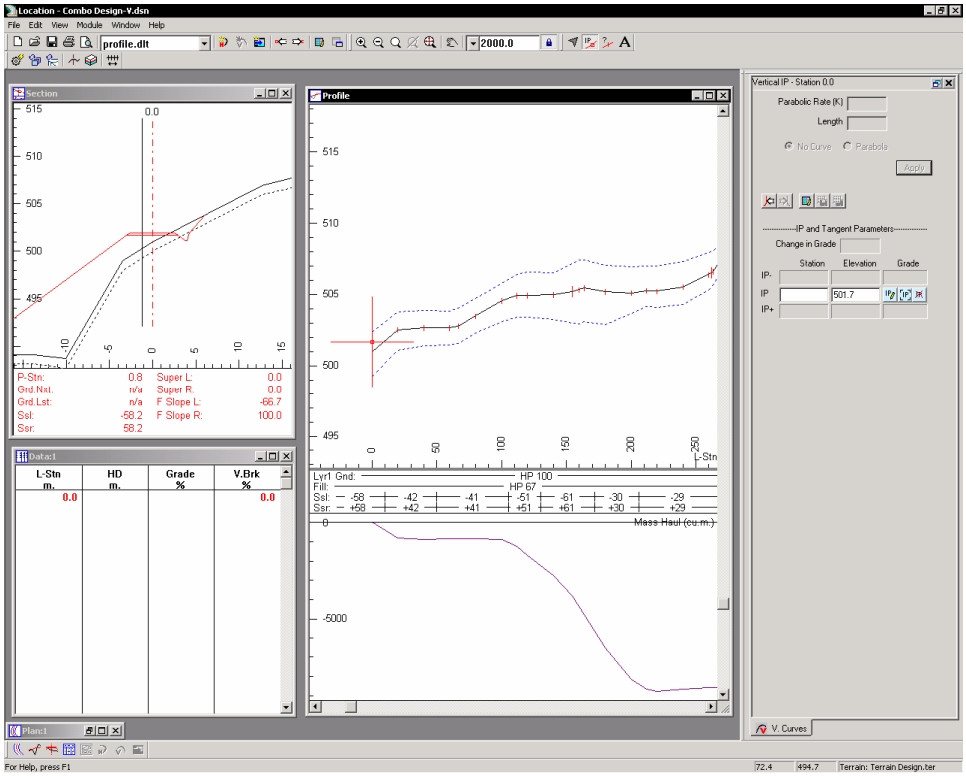

Figure 4.16: Screen After Opening Screen Layout

This design already contains horizontal alignment. Vertical alignment is impossible unless there is some horizontal alignment to follow (even if it is just the default P-Line alignment).

The vertical alignment is undefined (cross sections are assumed to have the sub-grade at the Ground elevation when no vertical alignment is specified).

3. Select the Edit | Auto Generate menu item. Set up the dialog box to create VIPs (Vertical Alignment Points or *Profile* points) at *Survey Stations* and *P-line Reference* (see figure below). Note that the station range does not include the whole road. Press *OK* to create an initial vertical alignment.

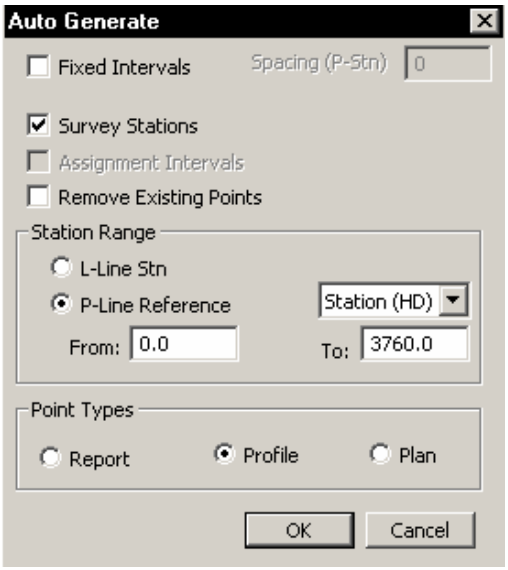

Figure 4.17: Auto Generate Dialog
Set up to Add IPs at Surveyed Stations

4. Use the *Next IP* button in the Vertical Curves panel to move along the alignment. Watch the Section window and keep moving until you get to station 164 (see Figure 4.18).

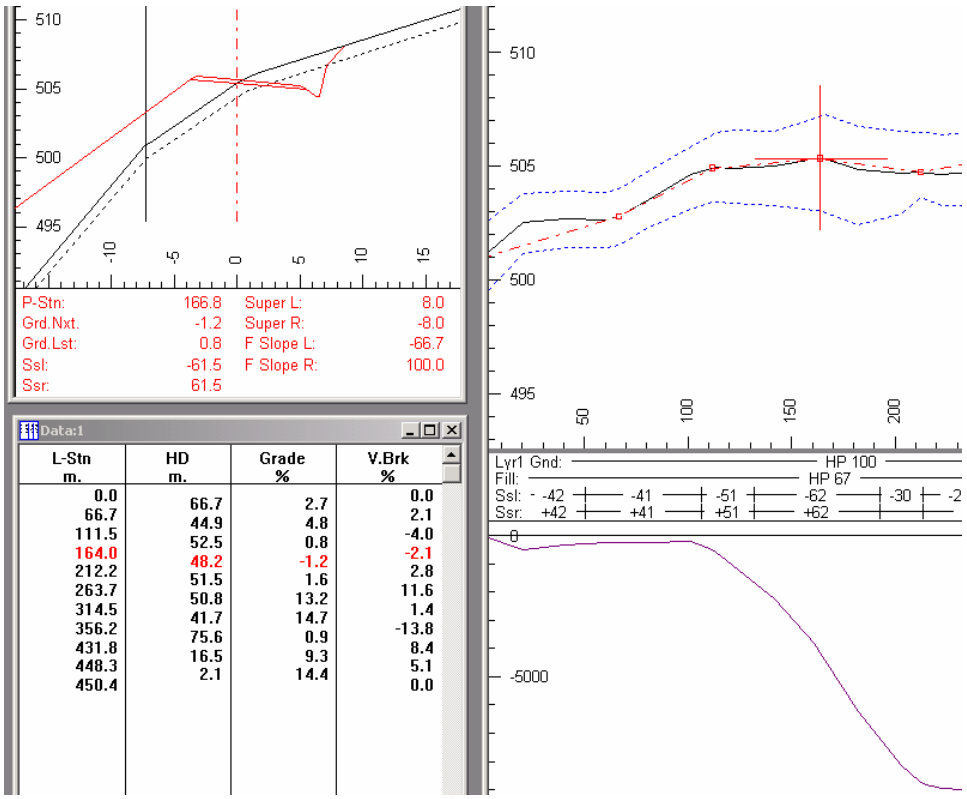

Figure 4.18: Excessive Fill Before Vertical Alignment

The cross section above shows a large fill that could be reduced by lowering the elevation of the alignment at this point. The *Mass Haul* diagram at the bottom of the Profile window also indicates a large fill.

5. Capture the VIP at this station with the mouse and move it *down* before re-anchoring it. You may work in the Profile window or the Section window (see the *Getting Started* chapter for information on point editing).

Notice how the Mass Haul changed after your edit (read the volume axis because it automatically scales).

6. Continue to adjust this same VIP until the Section and Profile windows appear similar to the figure below.

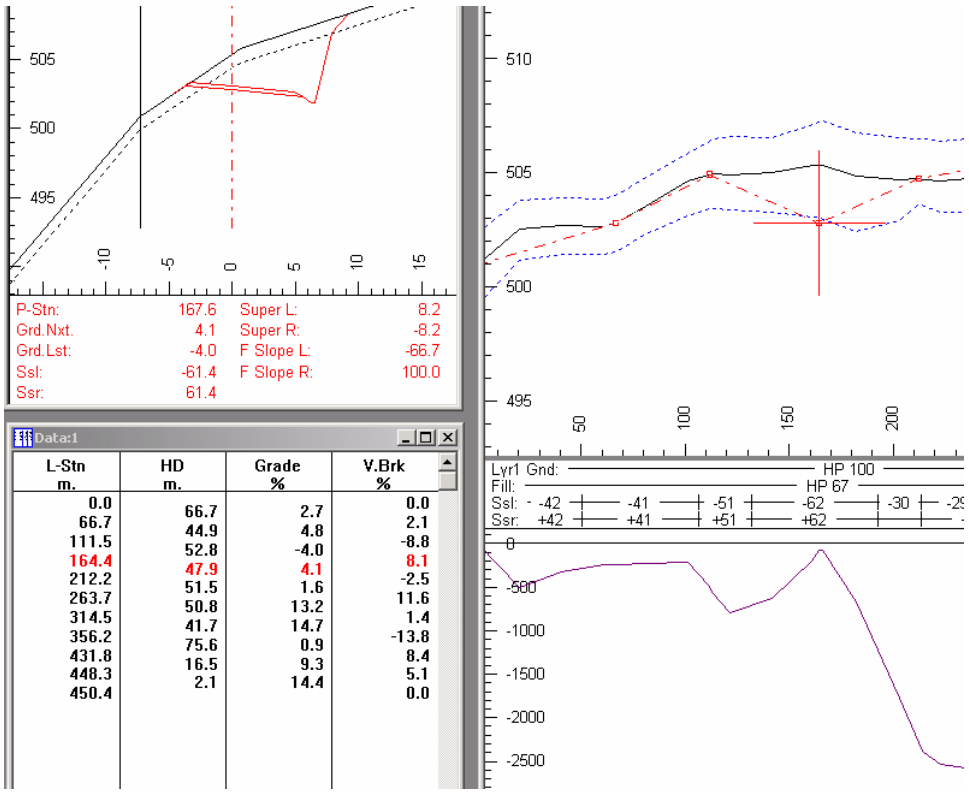

Figure 4.19: No fill (full bench cut) After Vertical Alignment

NOTE The dashed lines (blue) above and below the ground line are vertical projections of the *Road* Edges on ground (enabled in the Profile window options). The grade line must be under the lower of these for a *full bench* cross section (no fill).

7. Move your mouse cursor to the Profile window and capture the VIP just before the one you edited and notice the gray dashed lines that appear as you move the mouse as shown in Figure 4.20. These are *Grade Guides* (enabled and configured in the Profile window options). Also notice that the *Grade Nxt.* and *Grade Lst* items under the Section graphic are updating with you mouse moves.

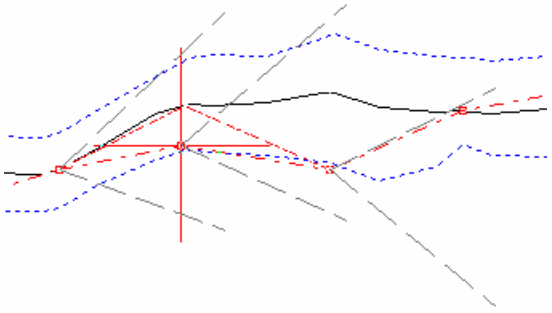

Figure 4.20: Point Captured in the Profile Window Showing Grade Guides

8. Re-anchor your VIP so that the red grade lines lie inside the Grade Guides (shown in figure above).

Notice that the Data window shows the current point highlighted in red and the grades and grade breaks for all VIPs.

9. Vertically align from the start of the road to station 350 until there are no more excessive fills, the maximum grade is 10% and there are no grade breaks greater than 6.0% (Figure 4.21). You can move *or* delete vertical VIPs.

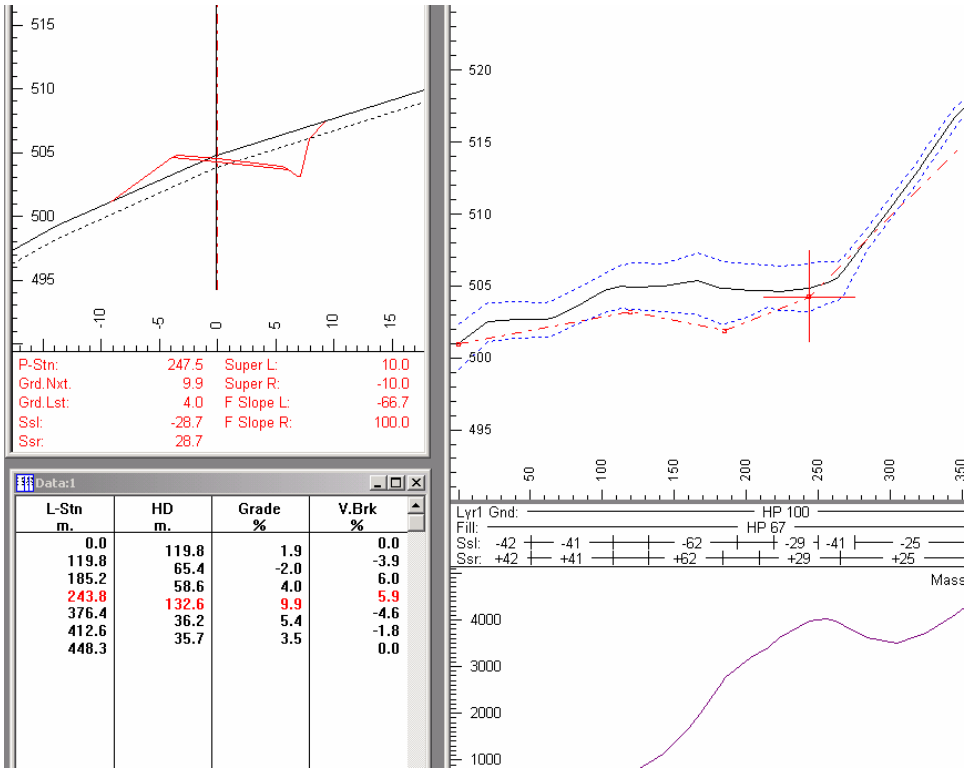

Figure 4.21: After Aligning the First Section of Road

In this section you have vertically aligned a few VIPs while paying attention to several types of feedback:

- Cross section qualitative appearance.
- Mass Haul volumes.
- Profile projection of *Road Edges*
- Profile *Grade Guides.*
- Section Grade display
- Data window *Grade* and grade break (*V. Brk*)

There are other sources of information that may also be useful:

- Profile and Section display of ground side slopes (*Ssl*, *Ssr*)
- Plan window *Slope Stake* display.

Changing the window display options or *Screen Layout* would allow you to see a different set of design parameters.

10. File | Close. Do not save changes.

Vertical Alignment – Creating tangents for Curves

Vertical curves (see also next section) require the design of tangents before the curve can be created. The incoming *tangent* intersects with the outgoing *tangent* to define the *curve IP*. This section deals with two ways to create tangents.

To do the examples in this section the *Terrain Design*, *Basic Curves* and *Sub-surfaces* function groups should be enabled (see *Function Groups* in the introduction above and in the On-line help for more information).

For simplicity, volumes and unstable cross sections will be ignored in this example (see the previous section, *Vertical Alignment – With Grade and Volume Constraints*, for more coverage of this).

1. File | Open. Select **\RoadEng\Tutorial\Location\Vertical curves.DSN**. Press Open
2. File | Retrieve Screen Layout. Select and retrieve **\RoadEng\Tutorial\Location\v-curve.DLT**. This will set up the windows to display feedback appropriate to this example
3. Zoom out until you can see the whole profile – if you do not have a roller mouse use the Zoom Extents button.
4. Zoom in on the start of the road indicated by the red cross-hair.

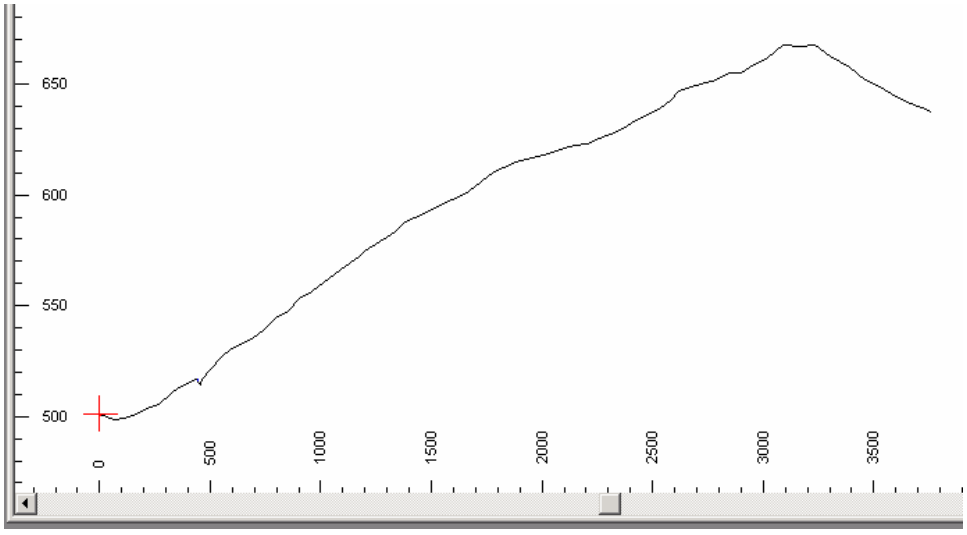

Figure 4.22: The Whole Profile

The next step is to create tangents to create the pre-curve alignment. New tangents will be created with the mouse and the Vertical curve panel (see Editing with the Mouse in Profile or Plan).

5. Use the mouse (*Add/Edit IP Tool* cursor) to create the tangents as shown in the Figure 4.23.

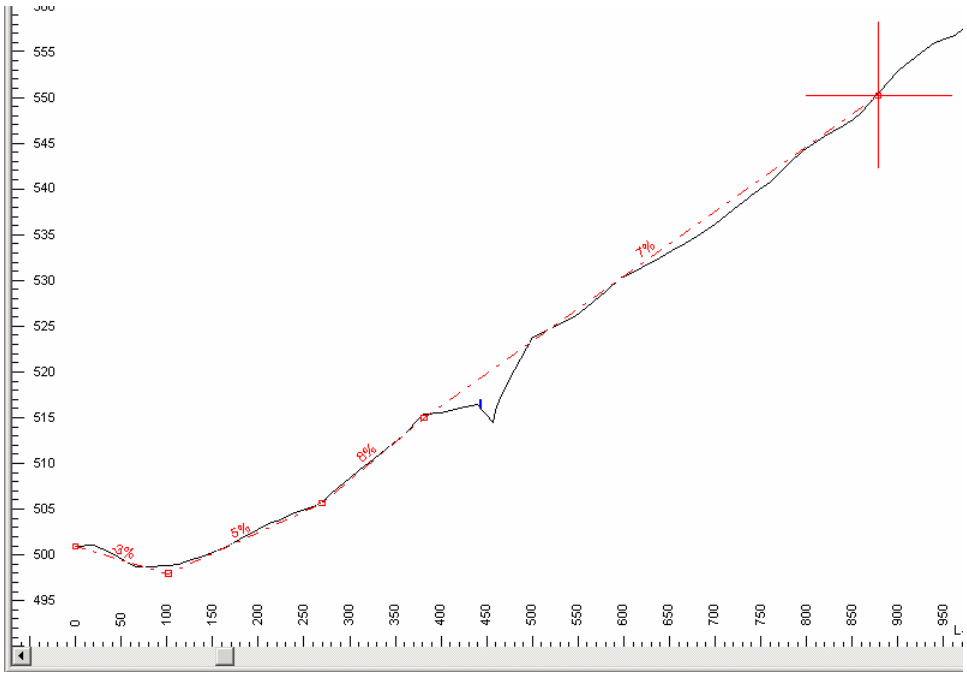

Figure 4.23: Plan View Showing New Tangents

In addition to the labels on the Profile, the Data window shows information about the new tangents as shown below.

Data:1

L-Stn m.	HD m.	Grade %	V.Brk %
0.0			0.0
101.6	101.6	-3.0	7.5
270.1	168.5	4.6	3.8
381.6	111.5	8.4	-1.3
878.6	497.0	7.1	0.0

Figure 4.24: Data Window Showing Grade *and Grade Break (*V. Brk.*)*

The Data window gives length and grade feedback about all tangents. The Vertical Curve panel displays similar information about tangents containing the current point. With this feedback available, it is possible to use the mouse to get close to any desired results by trial and error.

To define tangents with exact grades and lengths it is necessary to use the Vertical Curve panel.

6. Press the *Next IP* button (if enabled) in the Vertical Curve panel to make sure that the cross hair is on the last point in the design. If it is grayed out, you are at the last IP.

7. Type **880** into the *Station* field and **550** into the *Elevation* field in the *IP and Tangent Parameters* area of the Vertical Curve panel. Press *Apply* to update the design.

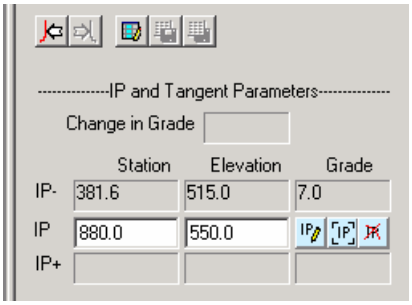

Figure 4.25: Using the Vertical Curve Panel to Define Station *and* Elevation *of an IP*

8. Press the *Add New IP* button. Type **500** into the *HD* field and **7.5** into the *Grade %* field. Press OK to add a new point. Confirm that the Data window shows the same values.

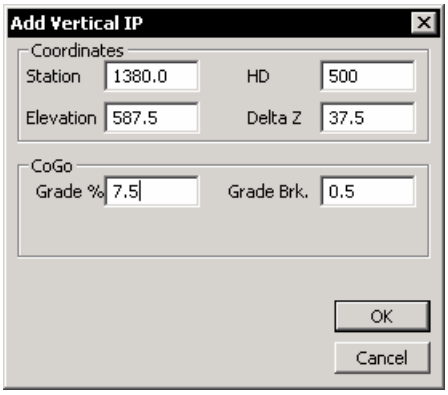

Figure 4.26: Add Vertical IP Dialog Box

9. Press the *Add New IP* button again. This time type **-2** into the *Grade Brk* field (the *HD* value will already be the same as for the previous tangent) Press OK to add a second new point.

10. Continue adding and modifying tangents until you are comfortable with the process.

Neither of the methods used above for creating tangents is more correct than the other, both allow creation of curves afterward.

11. File | Close. Do not save changes

Adding Vertical Curves- Simple Mode

To do the examples in this section the *Terrain Design*, *Basic Curves* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

The tangents created in the section above are now ready for vertical curves.

1. File | Open **\RoadEng\Tutorial\Location\vertical curves 2.DSN**.

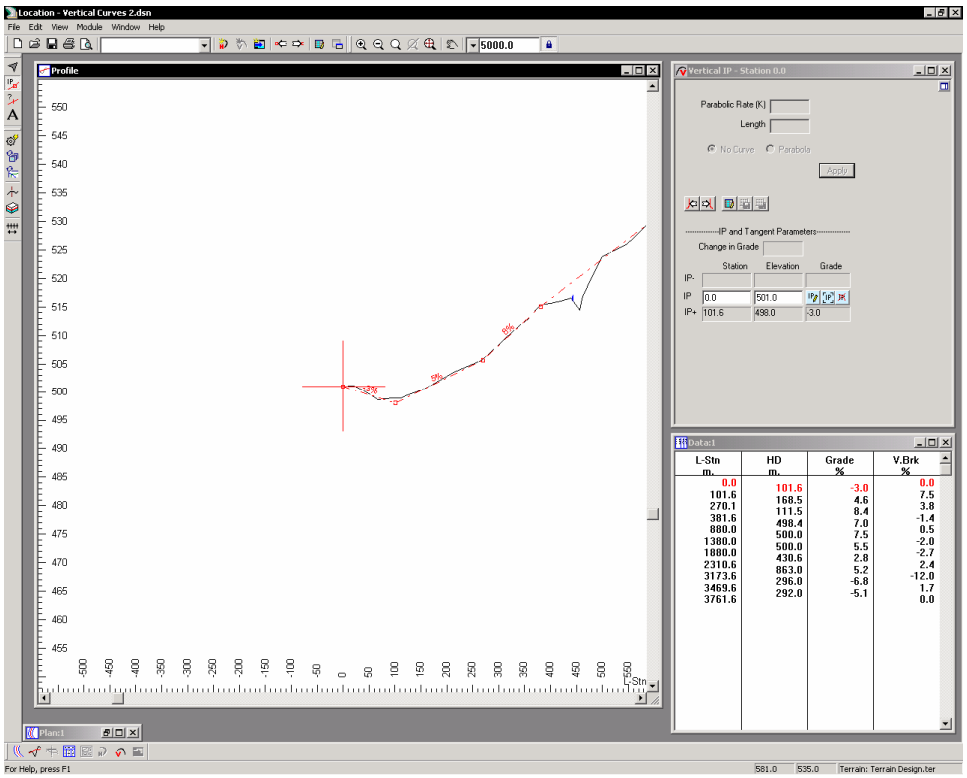

Figure 4.27: Vertical Curves 2.DSN

2. Press the *Next IP* button in the vertical curve panel.

3. Select *Parabola* in the top of the panel as shown in the Figure 4.28, and then type in *K* or *Length* (K and Length are **not** independent once the tangent grades are fixed). Press *Apply*.

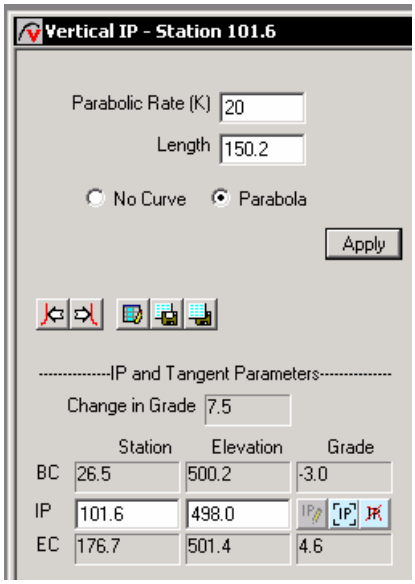

Figure 4.28: The Vertical Curves Panel

The new curve is now visible in the Profile window; note the *BVC* (Begin Vertical Curve), *EVC* (End Vertical Curve) and curvature labels.

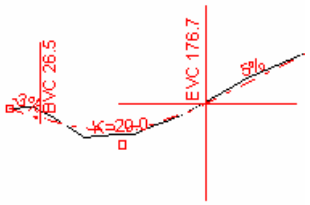

Figure 4.29: Vertical Sag Curve

4. Press the *Set Default Curve* button. This will save curve parameters for future use. Note that default curve parameters are saved with the Template table.

5. Press the *Next IP* button in the vertical curve panel.

6. Click on the *Get Default Curve* button in the curve panel and then press *Apply*. A new curve with the same K value as the first one is inserted.

7. Move the mouse cursor over the new curve IP (next to the K label); notice that the *edit* cursor appears (you should still be in *Add/Edit IP* mode). Capture the curve IP and notice that both curves adjust to fit as you move the mouse around. Also notice that the *IP and Tangent Parameters* fields at the bottom of the curve panel are also updating dynamically as you move the mouse.

If you move the IP so that the curve does not fit the tangents the computer should beep and the tangents will stop following the mouse.

8. Modify tangents and add curves throughout the design until you are comfortable with the process. Note that small grade breaks do not require a designed curve for a low volume road.

9. File | Close. Do not save changes.

Cross Sections

Introduction to Templates

Templates allow you to set parameters such as road width, surfacing, depths, shoulders, ditches and cut/fill slopes.

Templates interact with topography, super-elevation, sub-surfaces, and alignment(s) to produce a final design cross section. It is important to understand that templates are not static. Choosing the correct template and understanding its parameters and behaviour will significantly improve your design effectiveness.

Users will typically create a set of standard templates for use in common design situations.

The following example will introduce you to templates and the Template Editor. To do the examples in this section the *Terrain Design,* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open **\RoadEng\Tutorial\Location\bluff_road.DSN**.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Choose menu item Edit | Edit Templates.

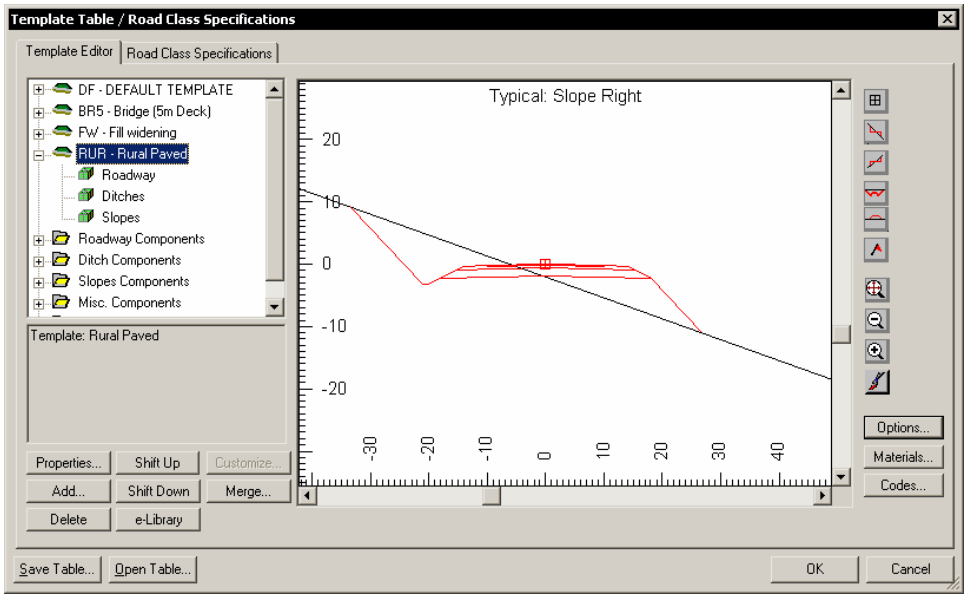

Figure 5.0: Edit | Edit Templates Dialog Box.

3. Click on the + sign beside *RUR-Rural Paved* to view the components (*Roadway*, *Ditches*, and *Slopes*) of the template as shown in the figure above.

4. Double click on *Roadway* to activate the Custom Component Properties dialog box.

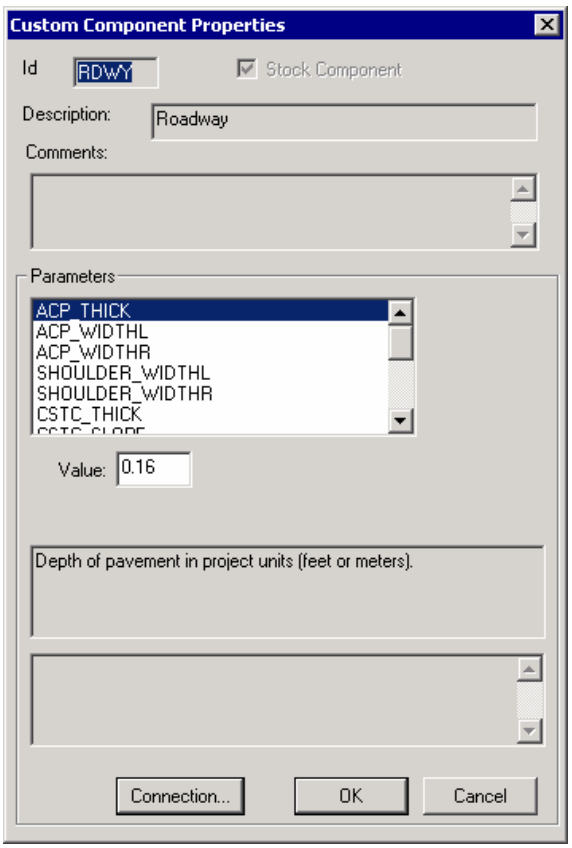

Figure 5.1: Roadway Component Properties

This Roadway component allows you to change various parameters such as pavement thickness, lane width shoulders, sub-base and base thicknesses and slopes.

5. Change the lane widths by changing ACP_WIDTHL and ACP_WIDTHR to **12**. Press *OK*.

Notice the road has widened.

6. Double click on *Ditches* to open the Ditch Properties dialog box.

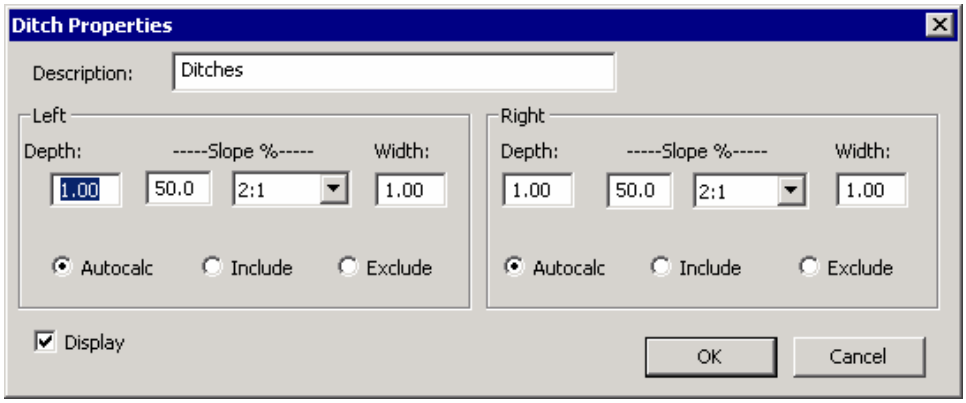

Figure 5.2: Default Ditch Component - Properties Dialog

7. In this dialog the user can specify a left and right ditch depth from top of subgrade, side slope and width of the ditch bottom. Also, the ditch can be *Included* or *Excluded* if *Autocalc* does not produce desired results. Press *Cancel*

8. Double click on *Slopes* to examine Slope Properties.

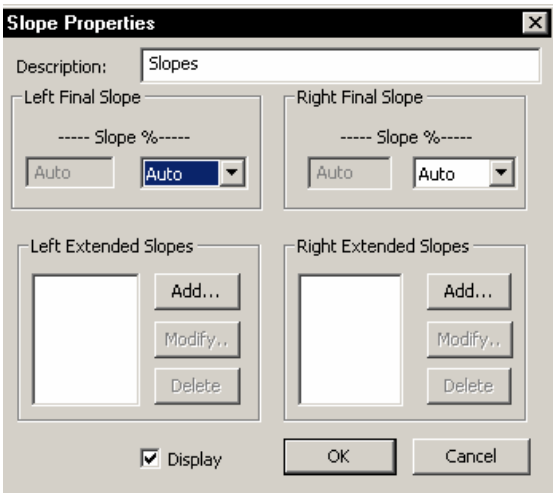

Figure 5.3: Slope Properties Dialog

In this dialog you can change the left or right final slope. If Auto is chosen, as is shown in the figure above, the slopes for cuts and fills will be taken from the material types found in the ground or used for fill respectively (Edit | Edit Ground Types allows you to define cut and fill angles for a table of materials). Choosing anything other than *Auto* will fix the slope and ignore the ground types. This dialog can also be used to define more sophisticated compound slopes. Press *Cancel.*

The ground slope buttons (shown at the right) allow you to review typical sections. It is import to note that these sections are hypothetical and may not exist in your design.

Typical Slope: Right
Typical Slope: Left
Typical: Cut
Typical: Fill

9. Select the "Slope to the Left" button  . Notice how the template changes. Try selecting some of the other ground slope control buttons.

10. Click on the Split screen view button in the upper right corner  . The screen shown below will appear showing the 4 typical ground situations at the same time.

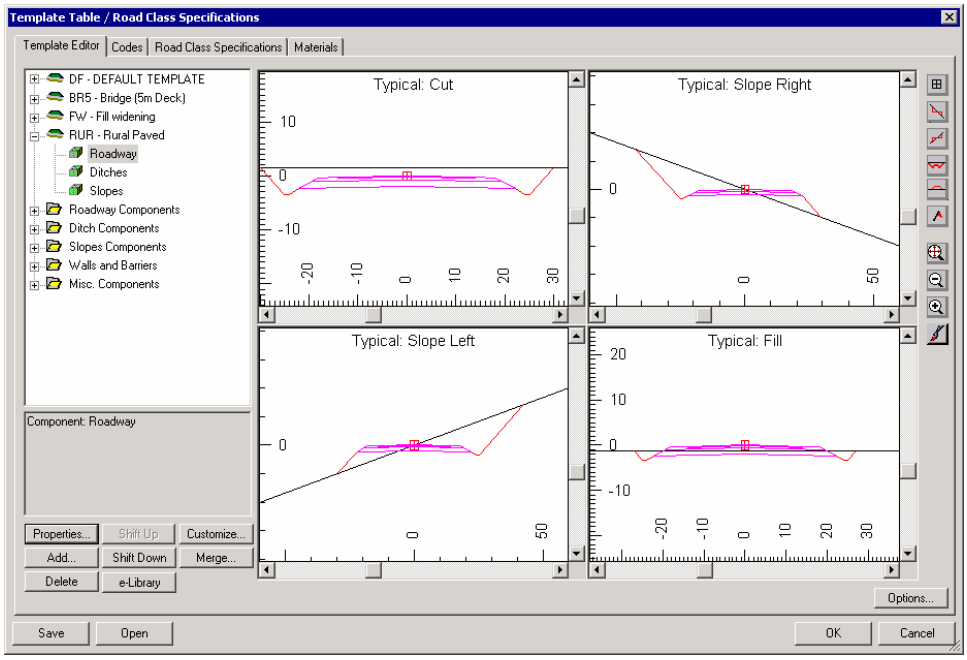

Figure 5.4: Split screen view showing the 4 typical sections.

11. Click on the Station button  on the right hand side of the screen and enter the value 300. Press OK.

On the screen you will see the template applied to station 300 of our design. This allows us to quickly see how the template will appear before it is assigned to a range of stations.

12. Select the "Slope to the Left" button  . To display a typical ground situation. In the tree control (left side of the template editor) click on Rural Paved and press the Properties button to open the template Properties dialog.

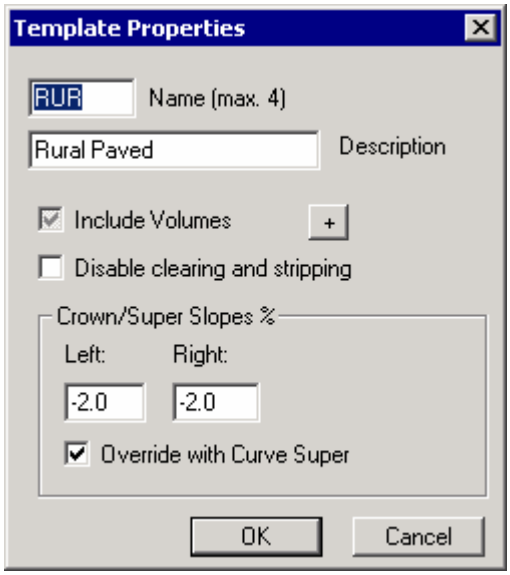

Figure 5.5: Template Properties Dialog.

13. Change the Crown/Super Slope to -5% on both sides. Press OK.

Notice how the Roadway component is altered by the new crown slopes. Some components are designed to adjust themselves to the prevailing crown or super-elevation slope.

Templates consist of one or more *Template Components.* Template components are building blocks. A group of stock template components is shipped with the software others are available from the internet. The e-Library button directly links users to templates continually updated by Softree. It is possible to create custom components. We will have a closer look at components in the next section but first we'll investigate how to mix and match components to create a template.

14. Double click on the Roadway Components folder to open it.

15. Right click on the "Rural Paved 2 - Left" component and choose menu Copy.

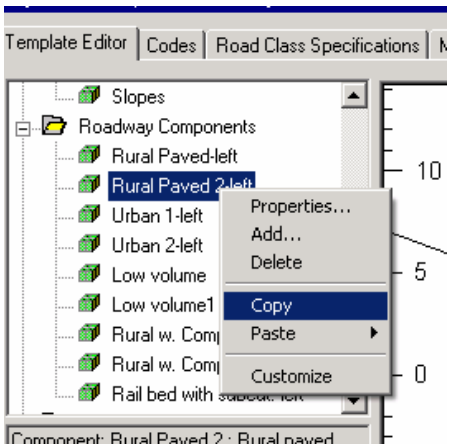

Figure 5.6: Copying a Component

16. Right click on the Roadway component in the RUR – Rural Paved template and choose menu Paste | Replace Existing.

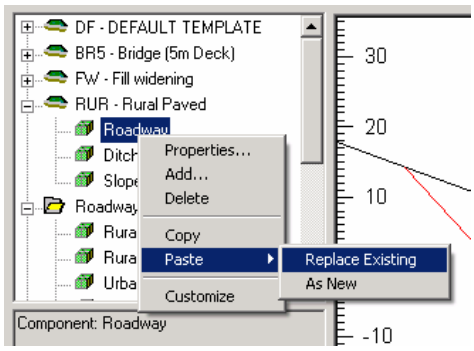

Figure 5.7: Pasting a Component

Notice that the Roadway component is only on the left side. This is because Rural Paved 2 is a one sided component. We will duplicate it on the right.

17. Right click and select Paste | As New - Right. This will create another roadway component on the right side. Notice the template now has Roadway component on both sides.

18. Press Cancel to exit the template Editor and File | Exit. Do not save changes.

Template Components

RoadEng templates are very flexible. Templates can be built to accommodate a wide range of design situations. Building custom templates can be quite complicated. It is best done by individuals with a computer programming background. Careful design and testing is required to ensure a custom template functions correctly. Fortunately, most users do not have to get down to this level of detail. Template components allow template programmers to package their work in an easy to use format for use by others.

This section will describes some of the basic concepts required to apply template components. The details of creating template components are not covered. Before we begin some basic concepts and definitions are required.

Template Component Concepts

Template Parameters

Template components have parameters allowing you to configure the object for your specific design. Template parameters can be any one of the following:

User	This is the most common type of parameter. It can be a numerical value or a slope percent.
Reference Feature X Offset	Allows you to specify an optional horizontal alignment instead of a numerical offset from center-line. See Reference Features for more information.
Reference Feature Y Offset	Allows you to specify an optional vertical alignment instead of a numerical offset from center-line. See Reference Features for more information.
Reference Surface	Allows you to specify a surface.
System	This variable is a predefined value such as super elevation or curve widening. It is only of interest to a template programmer and will not be discussed here.
Expression	This variable is used to enter a mathematical expression. It is only of interest to a template programmer and will not be discussed here.

Codes

Each template component has a set of pre-defined template codes. These point codes can be displayed in the Plan, Profile, Section or Data windows. In Profile and Plan the codes are connected by linear features such as a ditch-line or sidewalk offset.

Figure 5.9: Template Codes

Surfaces

Template surfaces are used to track and report material volumes. Each template can define up to 16 surfaces plus sub-grade. Material volumes are calculated between surfaces. Thus we can calculate and report cut and fill volumes below the sub-grade surface and up to 16 material fill volumes.

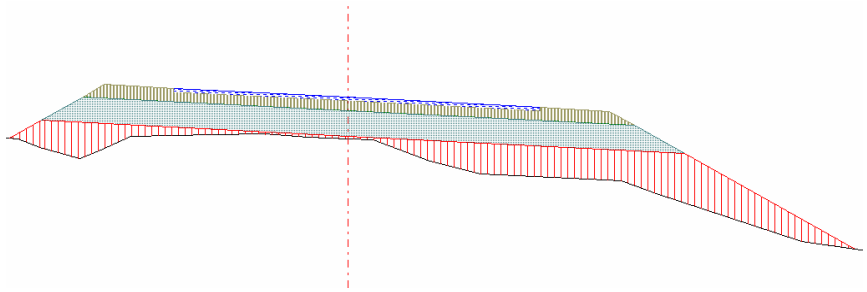

Figure 5.10: Template Surfaces and Enclosed Materials

Display and Reporting of Edge of Pavement Lines

1. File | Open, Select **RoadEng\Tutorial\Location\bluff_road.DSN**. Press Open.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Maximize the Section Window (this can be done by double clicking on the section window title-bar).

3. Choose menu View | Section Options. You can also right mouse click and select Section Options.

4. Turn on labels and click on the "+" sign beside the labels checkbox. The *Default Template Display Format* dialog will appear as shown in the next figure.

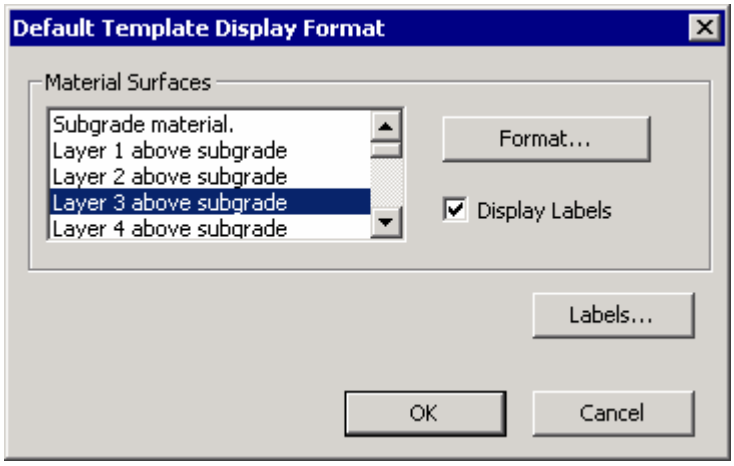

Figure 5.11: Default Template Display Format Dialog

5. Turn on display labels for Layer 3 above sub-grade and click on the Labels button. The *Label Selection and Formatting* Dialog box will appear as shown below.

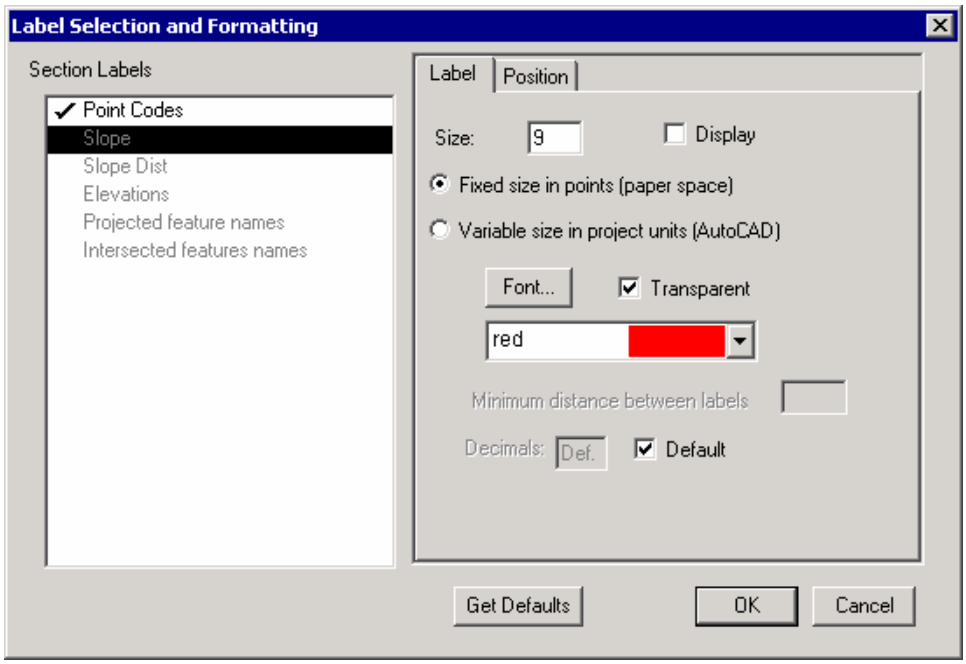

Figure 5.12: Label Selection and Formatting Dialog

6. Turn off the display for all label classes except Point Codes. Press OK 3 times to return to the main screen. Notice the point codes displayed in the section window.

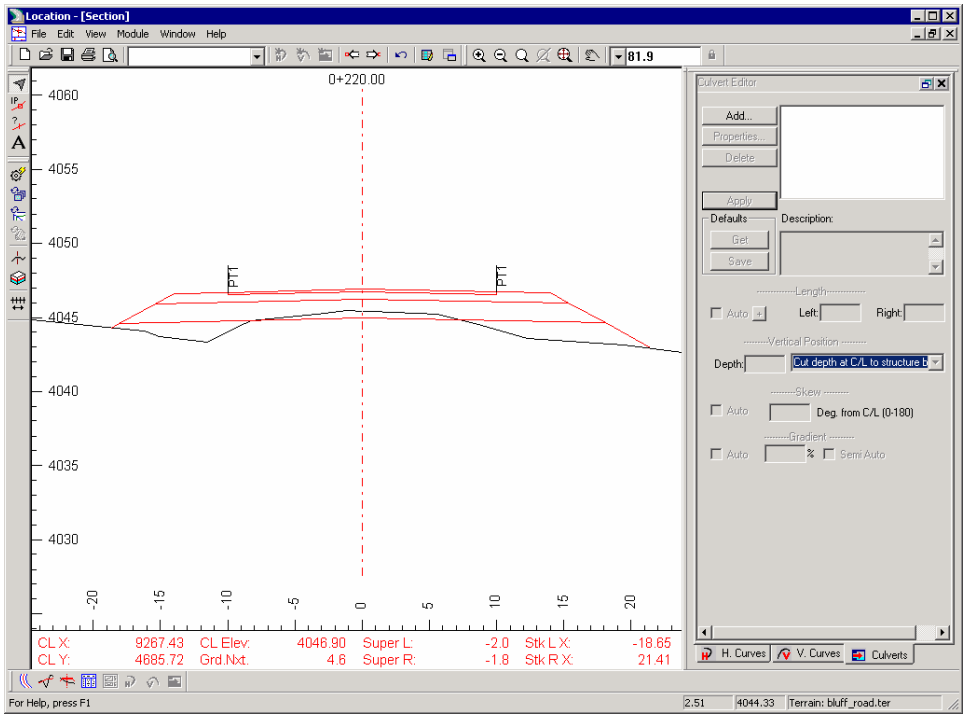

Figure 5.13: Edge of Pavement Template Point Code Labels

Next step is to look at the edge of the pavement lines in the Plan Window.

7. Choose menu Edit | Edit Templates and press the Codes button. Click the *Add* button.
8. Holding the Shift key down, select **PT1L** and **PT1R** by left clicking with the mouse. Press *Add*.

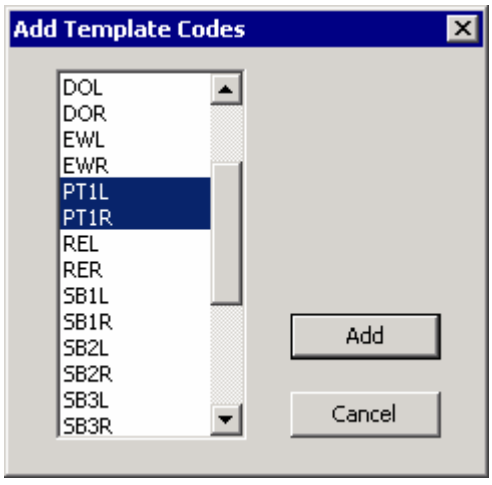

Figure 5.14: Add Template Points Dialog

9. With PT1L and PT1R still selected, choose an orange solid linetype (as shown below).

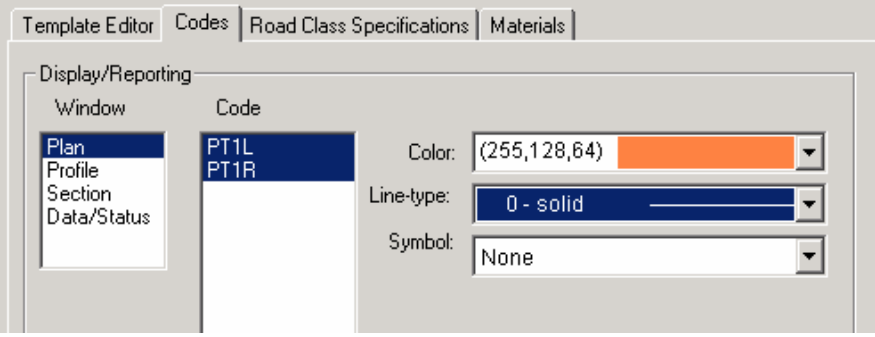

Figure 5.15 Plan Template Codes

10. Press OK and respond Yes to “Recalculate Road Alignment”

11. Maximize the Plan Window and zoom in a couple of times. You will see the edge of pavement (point code PT1) displayed.

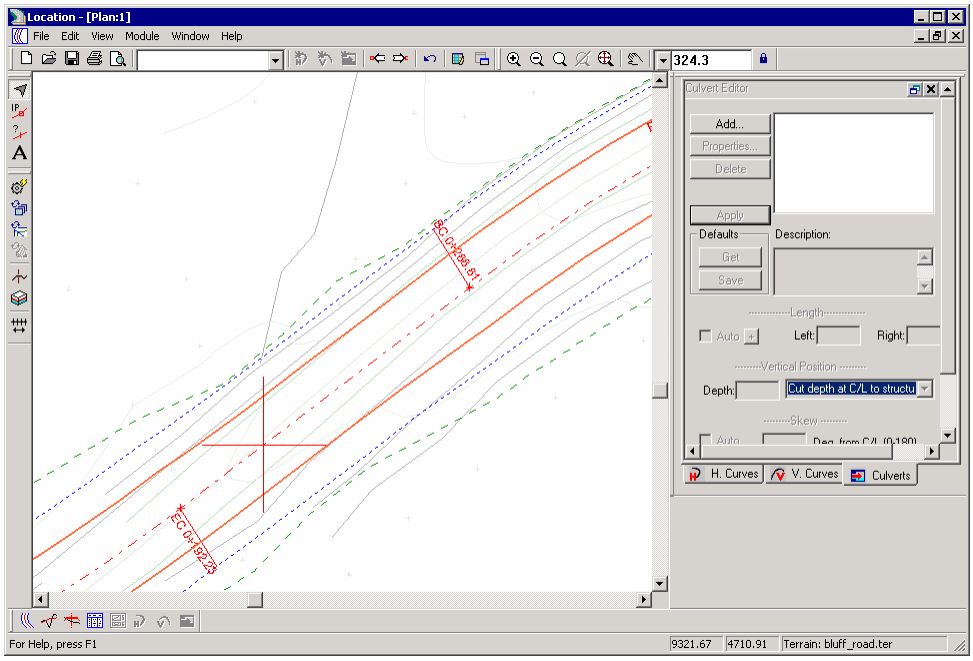

Figure 5.16 Road Edges in Plan View

NOTE: Using a similar procedure it is possible to display template codes in the Profile Window and report the coordinates in the Data Window.

Display and Reporting of Template Surfaces and Layers

Templates consist of one or more layers each of which is assigned a material. It is important to understand the layers which make up a template since different templates can have different layers. The documentation for the template should describe the various layers. It is also possible to display theses layers by hatching them.

12. Choose menu Edit | Edit Templates and press the Materials button.

13. Click on Srf-1 and change the description to “Base”. Click on the next code Srf-2 and change the description to Sub-base. Finally click on Srf-3 and change to the description to Pavement.

14. Press OK and respond “No” to “Recalculate the Alignment”.

15. Choose menu Window | Section to activate the Section window. Select menu View | Section Options.

16. Turn on Template (if it is not already on) and click on the “+” sign beside it. The *Default Template Display Format* dialog will appear as shown below.

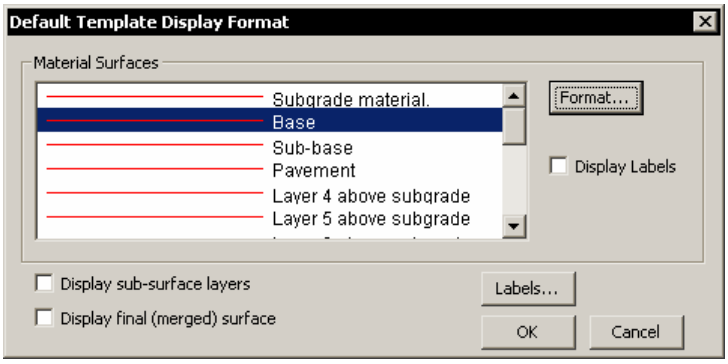

Figure 5.17 Default Template Display Format dialog

17. Select *Base* as shown above, click on Format Button and change the color to Blue and the hatch type to Vertical. Press OK 3 times to return to the main screen.

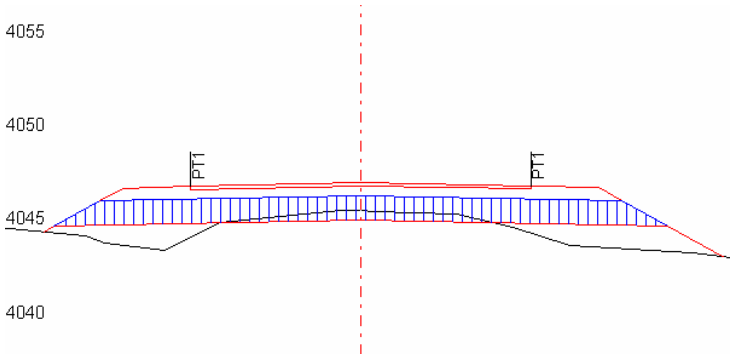

Figure 5.18 Base material hatched on in the cross section.

18. Choose menu Window | Data:1 to activate the Data Window.

19. Select menu View | Data Window Options. Click on the Columns button.

20. Open up the Volumes category and *add* Srf1 – Srf1V, Srf2 – Srf2V, and Srf3 – Srf3V to the selected list. Press OK twice to return to the main screen. Notice the Data:1 window has the material volumes displayed.

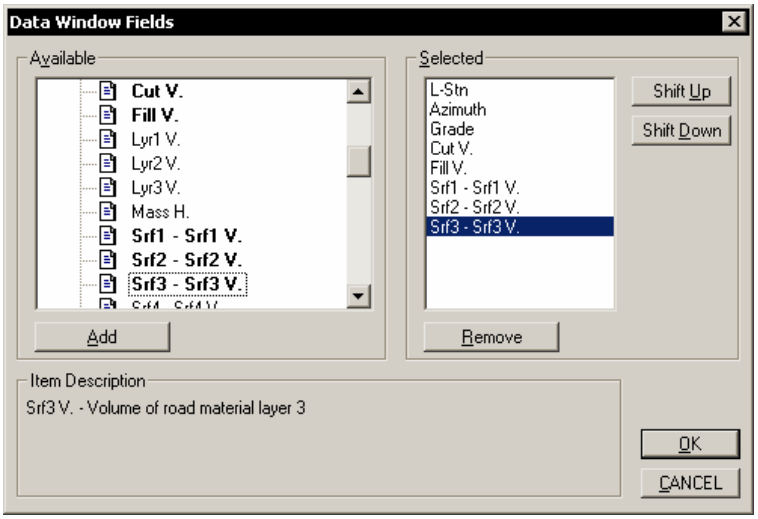

Figure 5.19 Material Volumes

21. Choose menu File | Exit. Do not save changes.

Template Assignments

Assigning a Roadside Barrier to a Range of Stations

Templates can be assigned to a range of stations. The following example will demonstrate how this is done by adding a road side barrier to a range of stations.

1. File | Open, Select **RoadEng\Tutorial\Location\bluff_road.DSN*. Press Open.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Select menu Edit | Edit Templates.
3. With template Rural Paved selected, right click and select menu *Copy*.
4. Right click and select menu *Paste* | *As New* to create a new template. The new template (xxx-Rural Paved) is highlighted and appears at the bottom of the list.
5. Click on the Properties button and change the Name of the new template to BAR and the Description to "Rural Paved with Barrier". Press OK.

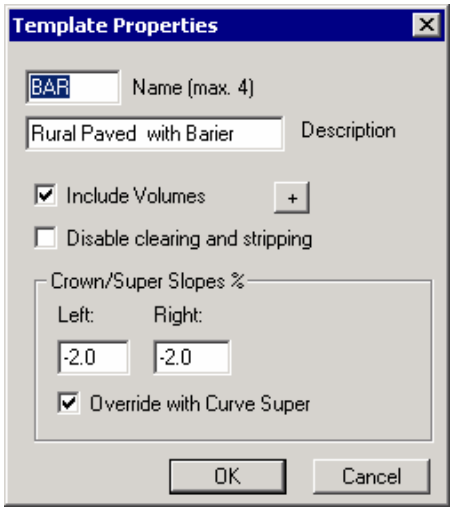

Figure 5.20: Template Properties

6. Open the "Walls and Barriers" folder and choose "Barrier - Left".

7. Right click to copy it to the clipboard and then open the new "Rural Paved with Barrier" template created above. Right click and choose menu Paste to add the new barrier component.

8. Double click on the barrier component and change the CL_OFFSET parameter to **11**. Press OK twice to exit the template editor and return to the main screen. Respond No to "Recalculate road alignment".

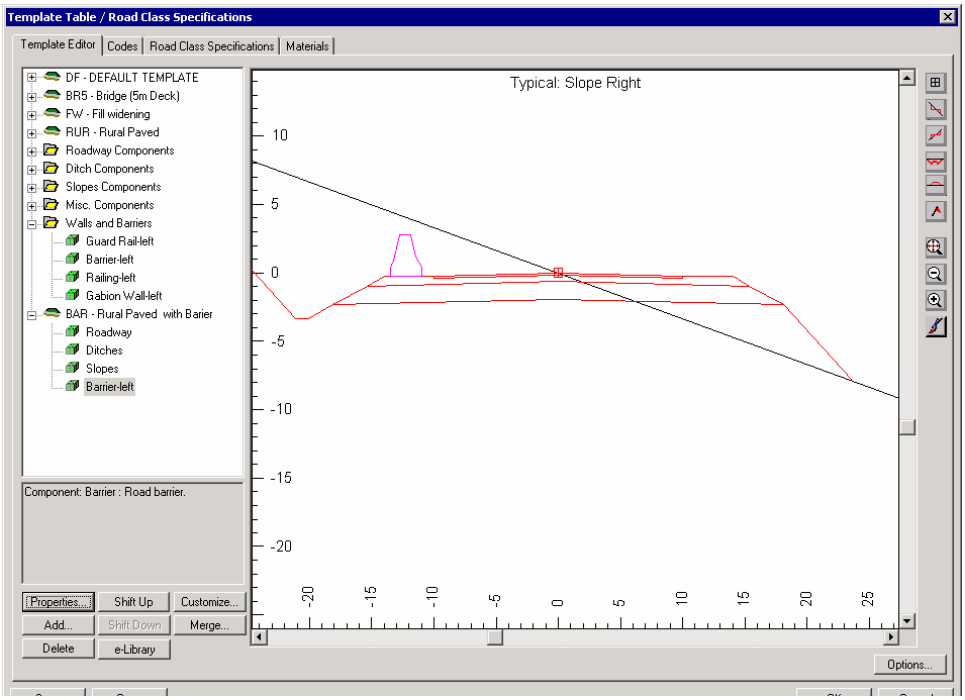

Figure 5.21: Rural Paved template with Barrier

9. Choose menu Edit | Assign Parameters by range.

The barrier will be placed between stations 840 and 1080.

10. In the Template Name dialog box choose Bar Rural Paved with Barrier. In the *From Stn*. edit box enter **840** and in the *To Stn* edit box enter **1080.** Press the *Add/Edit* button**.**

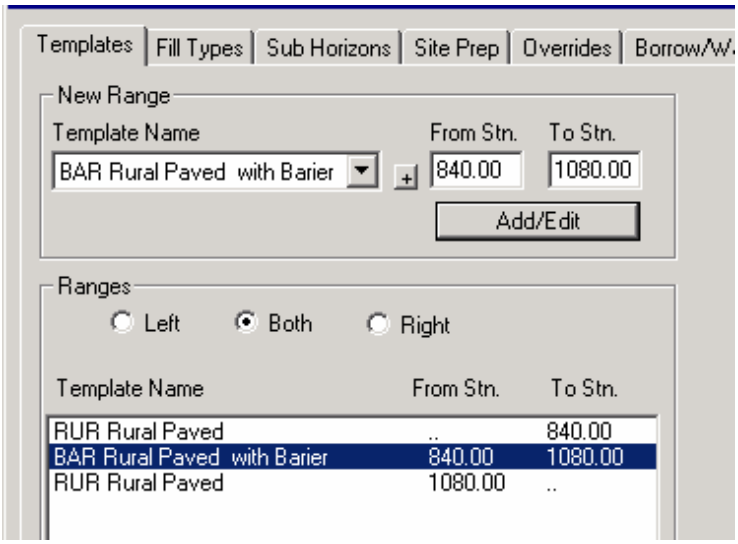

Figure 5.22: Assign the Taper First

11. Press OK to return to the main screen. Press Yes to "Recalculate road alignment".

12. Select menu View | Jump to Station and select station 1000. Maximize the Section window and notice the road side barrier.

13. Choose menu File | Exit. Do not save changes.

Template Parameter Overrides

The previous section demonstrated how an entire template can be assigned to a range of stations. To do this a new template was created and assigned to a station range.

It is often desirable to change a single template parameter such as road or shoulder width, ditch depth etc for a range of stations. Template Parameter Overrides provides an easy way to do this.

Creating a Turning Lane

This example will demonstrate parameter overrides by creating a turning lane at an approach to an intersection.

1. File | Open **\RoadEng\Tutorial\Location\bluff_road.DSN**.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Maximize the Plan window.

3. Choose menu Edit | Assign Parameters by Range. Select the Overrides tab.

4. In the Parameter List choose ACP_WIDTHL.

5. Click on first entry in the parameter list (Stn 0.0) and press the Modify button. Turn off *Use Default* and set the value to **30**. Press OK.

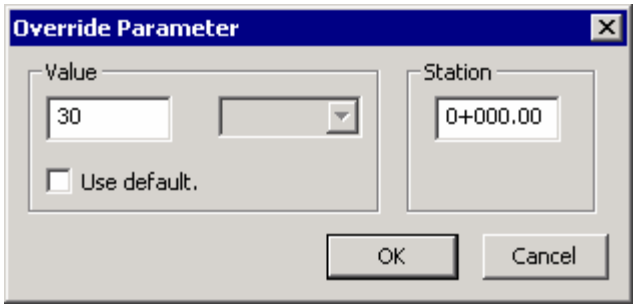

Figure 5.23: Override Parameter Dialog

6. Press the Add button and add a parameter value of **30** at station 110. Press OK.

7. Press the Add button and set the parameter value to **Use default** at station 200. Press OK.

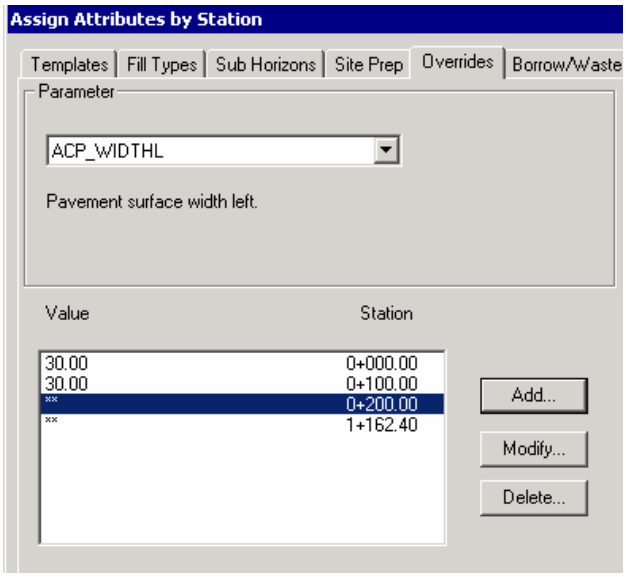

Figure 5.24: Override Parameter Dialog

8. Press OK to return to the main screen. Respond Yes to "Recalculate road alignment". Scroll and zoom the plan window to the beginning of the design. Notice the road edges in blue now display the additional lane width.

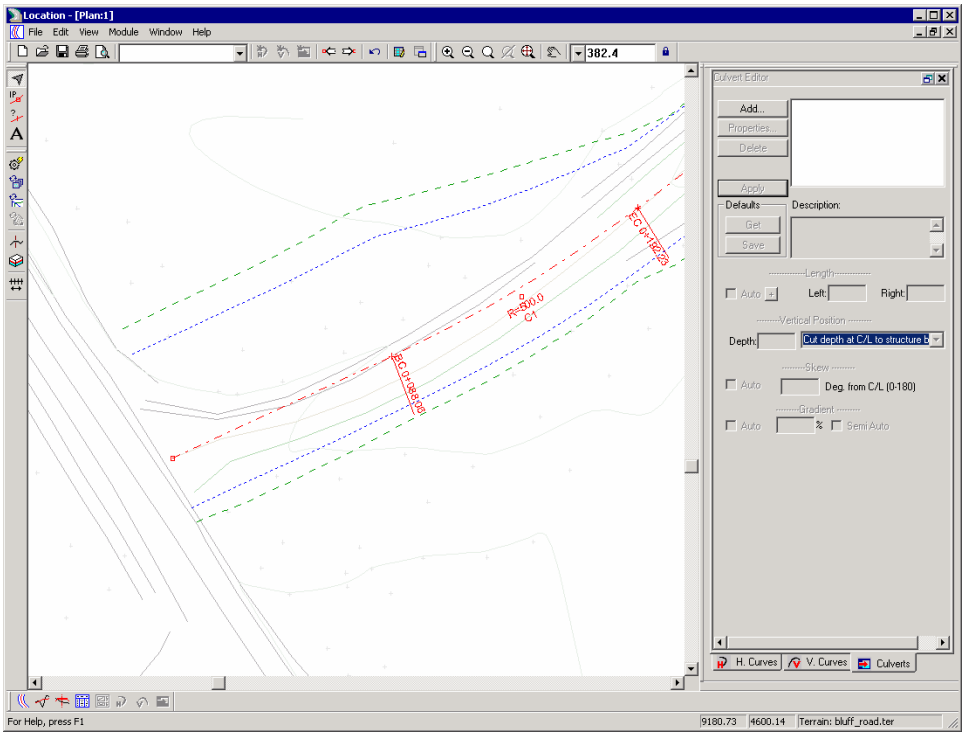

Figure 5.25: Turning Lane

9. Choose menu File | Exit. Do not save changes.

Ditch Control

This example discusses how to control the ditch grade by overriding the ditch depth by assigning elevations at stations along the alignment.

This example uses a specific template component ("Ditch by Elevation"). The operation and behavior of this component is explained. The logic and procedures used to create this component is not covered.

Adding the Ditch by Elevation Template Component

1. File | Open **\RoadEng\Tutorial\Location\ Ditch_profile_by_elev.dsn**. The screen now displays a cross section and a profile view as shown below.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

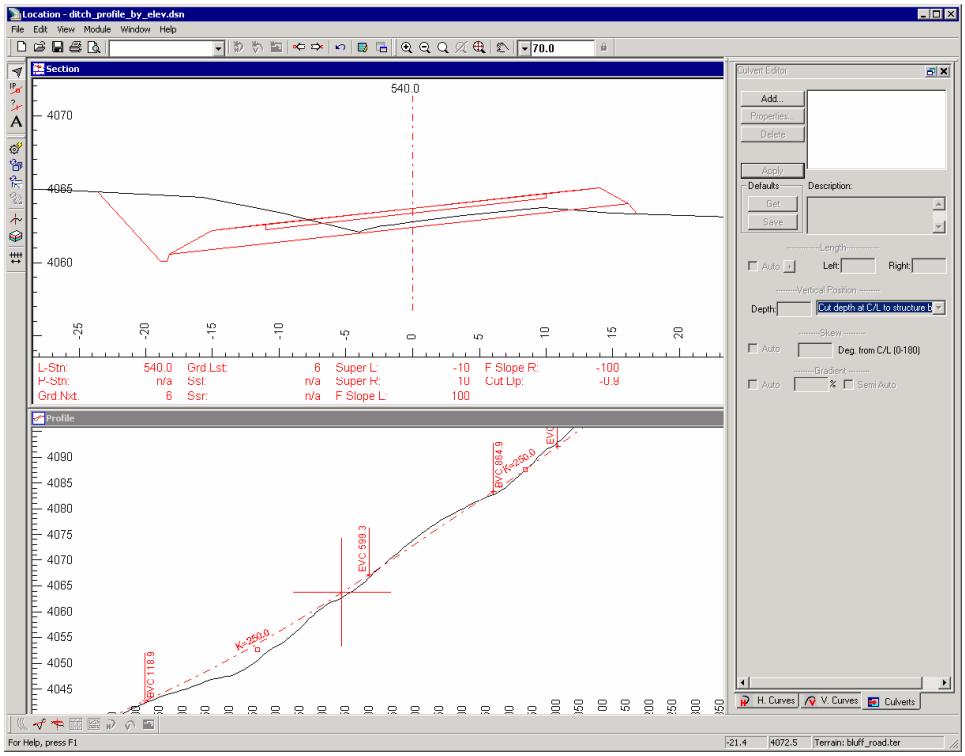

Figure 5.26: Cross Section and Profile View

2. Choose menu Edit | Edit Templates. The template editor should appear as shown in Figure 5.27.

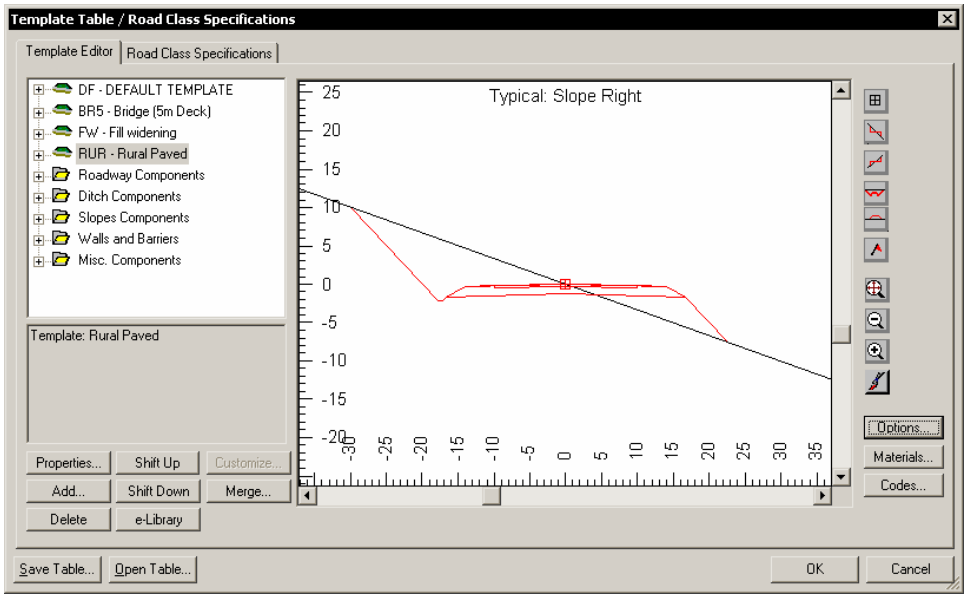

Figure 5.27: Template Editor Screen

The Rural Paved template is selected because it is assigned to the current section. The following steps replace the RUR – Rural Paved template ditch component with a *Ditch by Elevation Component* which was previously created.

3. Select the RUR – Rural Paved template. Select the *Ditches* component and press the *Delete* button.
4. Open the Ditch Components folder and select the *Ditch by elevation component*. Right click and choose menu *Copy*.
5. Again select the RUR – Rural Paved template by right clicking it and choose menu *Paste | As New*.
6. Press the *Shift Up* button so the new component lies between the existing Roadway and Slopes components as shown in the Figure 5.28.

NOTE: The order of components is important. If they are not in the correct order they will not attach to each other correctly.

7. Click on the show multiple views button  . The template editor should now appear as shown below.

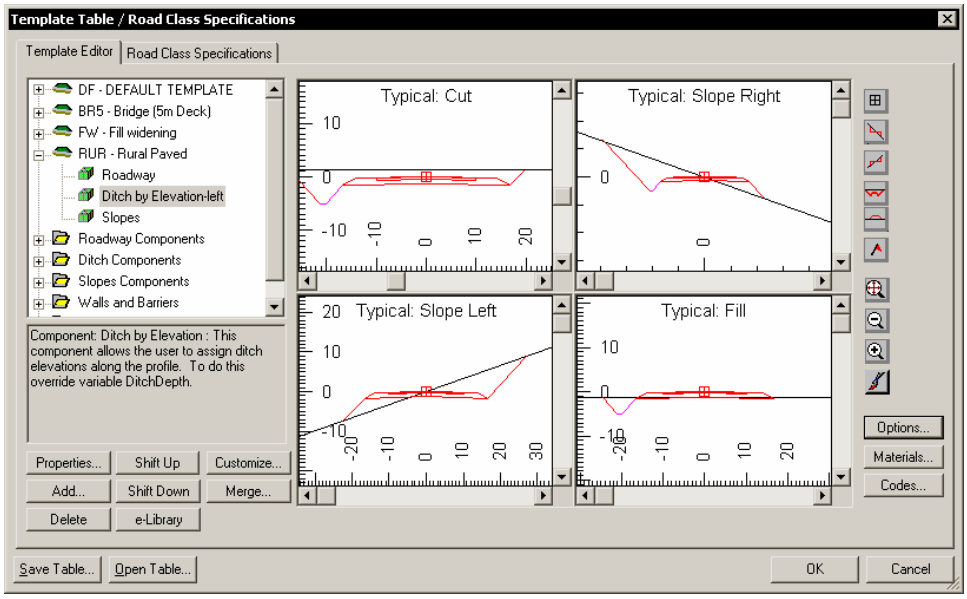

Figure 5.28: Template Editor Typical Views

8. Double click on the Ditch by Elevation component in RUR – Rural Paved template to activate the Properties dialog box. Here the slope and bottom width (DitchSlp and DitchBotWd parameters) can be changed. Change the ditch bottom width to **2** and press OK.

NOTE: The Ditch elevation parameter (DitchElev) is only set to a default value (-9999). You can override this parameter by explicitly setting elevations for the ditch at points along the alignment.

Displaying the ditch profile

9. Click on the Codes button. Select the Profile window. Press the *Add* button and choose "DIL" (Ditch Inside Left) and press Add. Choose a distinct line type to display the ditch in the profile window as shown in Figure 5.29.

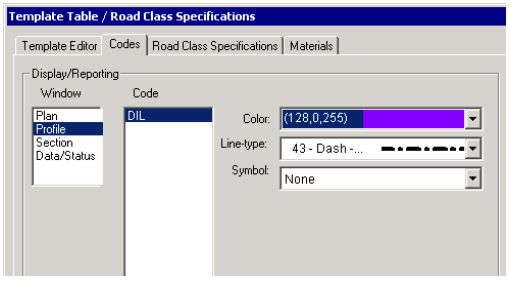

Figure 5.29: Template Editor Typical Views

10. Press OK to return from the Template Editor and NO to "Recalculate road alignment".

Before the road alignment is recalculated, the ditch elevations need to set explicitly using the Assign Parameters by Range. This option allows you to override template parameters at a specific station. Values in between are linearly interpolated.

11. Choose menu Edit | Assign Parameters by Range and then choose the *Overrides* tab.
12. From the drop down combo box select DitchElev (Left side).
13. Press the Modify button. De-select “Use Default” then change the value at station 0.0 from Default to 4035. Press the Add button to insert the value 4065 at station 650. Modify the last station and set the elevation to 4100.

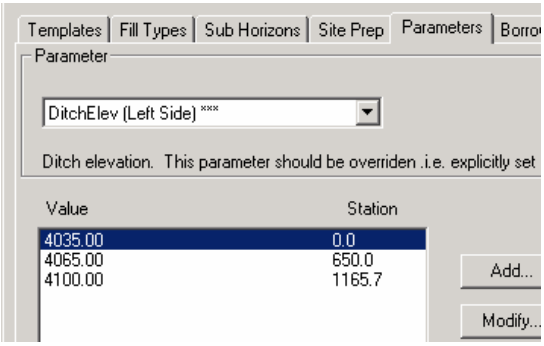

Figure 5.30: Assign Attributes by Station | Parameters Dialog

14. Press OK and say YES to “Re-calculate the alignment”.
15. Select menu View|Profile Options and the Profile Window Options dialog will appear.
16. Select the Template Codes item. Press OK. Your profile window should appear as shown in Figure 5.31.

Notice the ditch profile matches the elevations set in Step 13. Also notice where the ditch stopped when it day-lighted between stations 180 – 316.

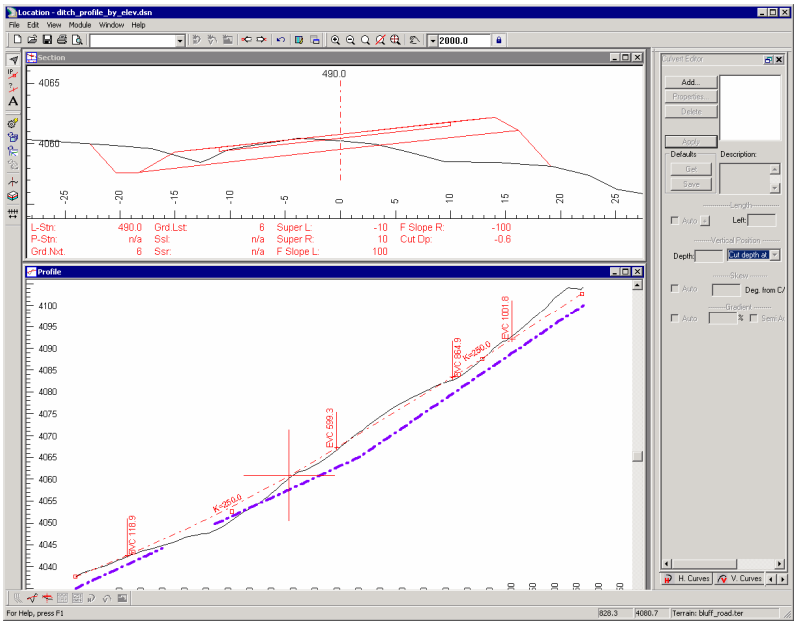

Figure 5.31: Profile with Ditch Displayed

17. Choose menu File | Exit. Do not save changes.

Controlling Templates with Alignments

Many template objects allow themselves to be controlled by horizontal or vertical alignments. This example will demonstrate how this is done.

Reference Features

Reference features are terrain features (points, poly-lines etc). They can be displayed as intersected or projected features (see below) in the Profile, Plan or Section windows or used for template control

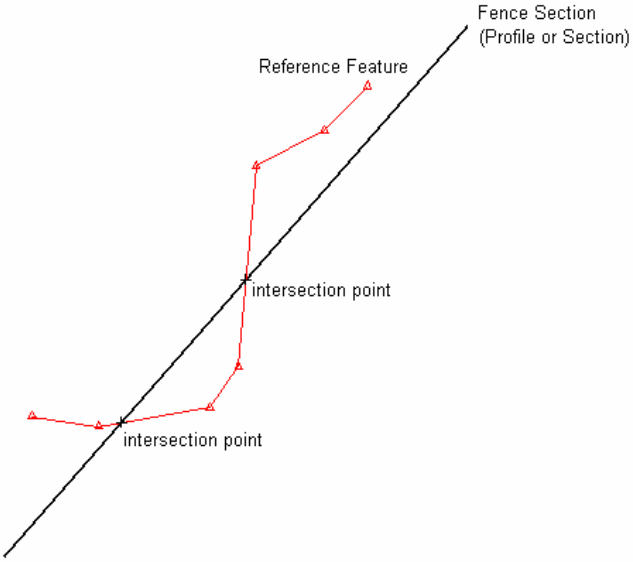

Figure 5.32: Intersected Reference Feature Plan View

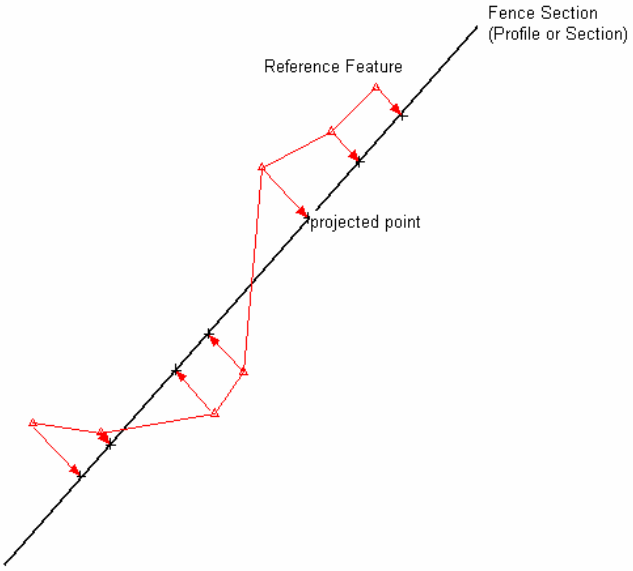

Figure 5.33: Projected Reference Feature Plan View

NOTE: Reference features can be used to display existing features such as underground utilities, driveways, existing culverts, cross road or rail alignments etc.

Defining Reference Features

1. File | **Open \RoadEng\Tutorial\Location\ Cul_de_sac.dsn.** The screen displays a cross section and a plan window.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

There are 3 steps in controlling templates with alignments:
- Define a reference terrain
- Define a reference feature
- Tie the template to the file

2. To define a *reference terrain,* choose menu Module | Setup | Alignment. In the Reference area click on the *Terrains button*. The *Reference Terrains* dialog box will open.

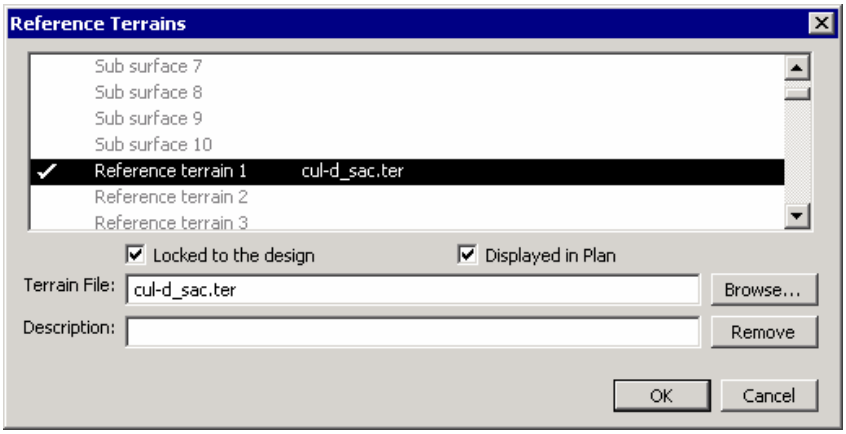

Figure 5.34: Reference Terrain Dialog

3. In the list box double click on *Reference terrain 1*. Click on the Browse button and choose file "Cul-d_sac.ter and press Open. Press OK again to return to the Location Setup dialog.

NOTE: The Top Surface is always selected. It also identifies the terrain file the design is based on.

4. To define the *Reference Features* click on the *Features button*. The *Reference Features* dialog box will appear as shown in Figure 5.35.

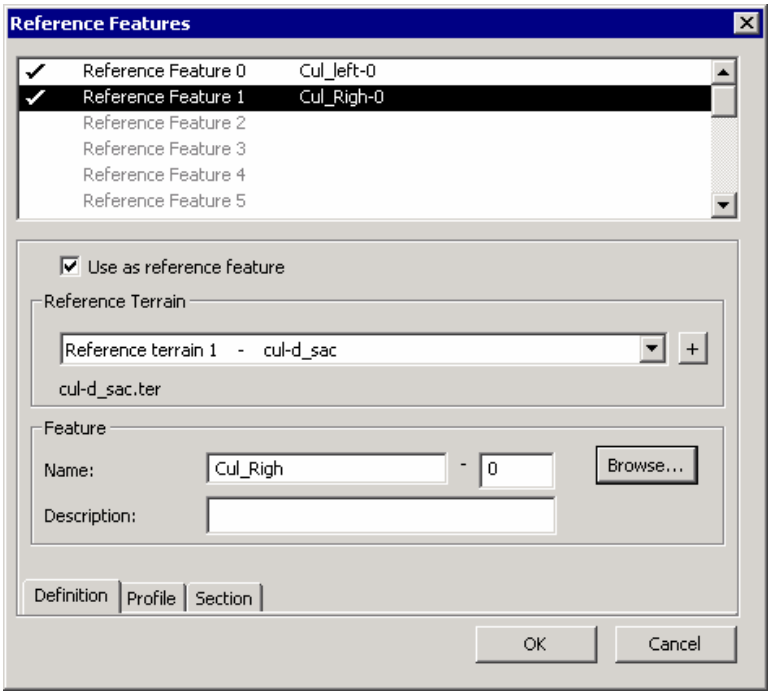

Figure 5.35: Reference Feature Dialog

5. In the list box double click on Reference Feature 0.
6. In the Reference Terrain Area choose “Reference Terrain - cul-d_sac”.
7. In the *Feature Area*, click on the Browse button. Choose Cul_Left and press OK.
8. Similarly setup Cul_right for Reference Feature 1. Press OK twice to return to the main screen..
9. With the Plan window active, choose menu View | Plan Options. Click on the “+” sign beside *Background*. Click on the Cul-d_sac.ter entry in the list and turn on *Display*. Press OK twice to return to the main screen.

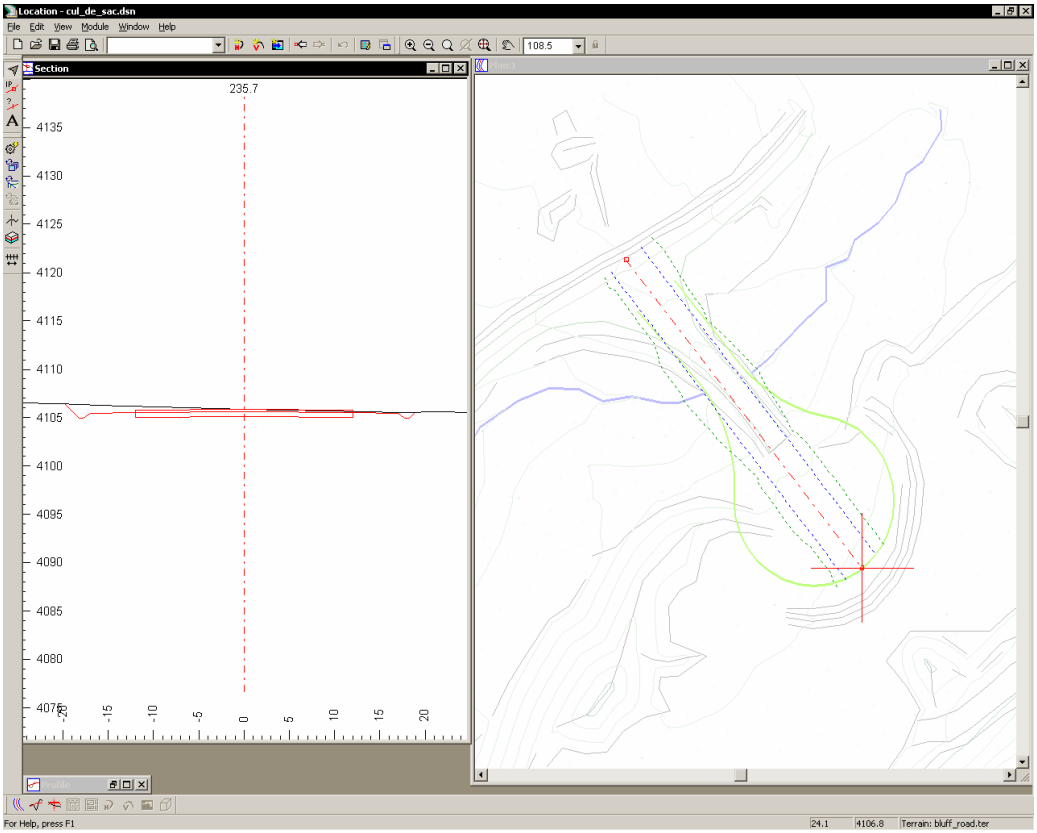

Figure 5.36.: Plan Window displaying Reference Features

Now to tie the template to the cul de sac. It is important to note that the cul de sac has been created as 2 features a left and right.

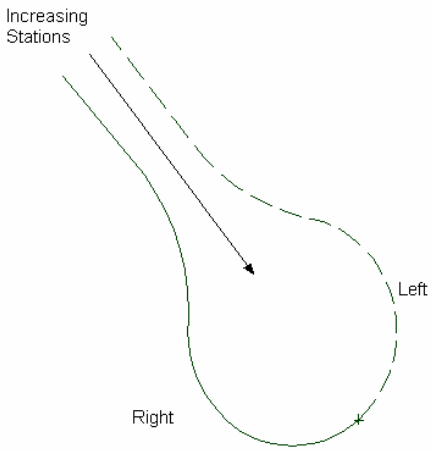

Figure 5.37.: Plan Window displaying Reference Features

10. To tie the template edge of the pavement to the reference feature, choose menu Edit | Edit Templates.
11. Open the Default template, select the Rural Paved 2 - left component. Set the ACP_WIDTH to be Reference Feature 0 (see below) in the Custom Component Properties Dialog.

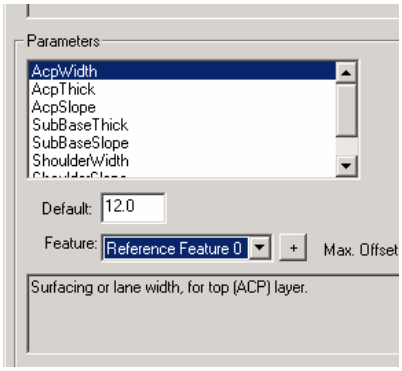

Figure 5.38: Plan Window displaying Reference Features

12. Similarly set the Rural Paved 2 – right component to use ReferenceFeature 1.
13. Press OK twice and respond yes to "Recalculate road alignment".

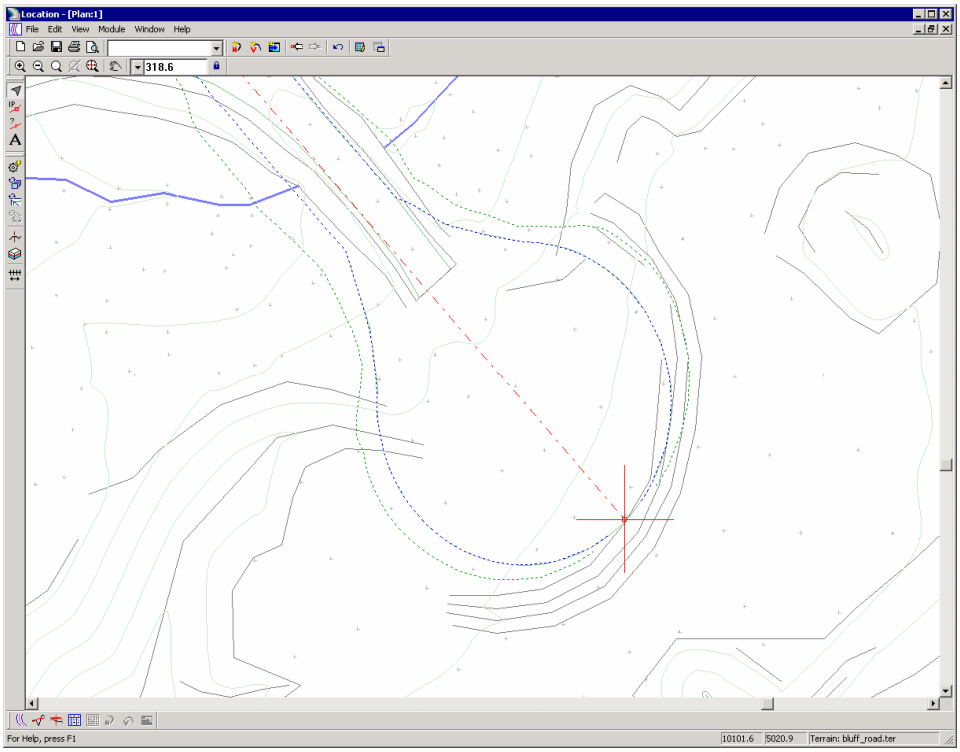

Figure 5.39: Plan Window displaying Cul de sac

14. Choose menu File | Exit. Do not save changes.

Earthwork

The location module provide facilities to calculate cut and fill quantities accounting for sub-surface layers. Facilities for stripping or removal of unwanted materials are also provided. A mass haul window located below the profile allows you to balance a road. This section will introduce some of these concepts.

Sub-surfaces

Sub-surface materials (sometimes called Stratum layers) and layer depths can be included in the digital model. Sub-surface layer depths can defined in:

- Survey (P-line) cross sections.
- Terrain TIN model surface.
- User Input by explicitly setting depths and materials by station range (menu Edit | Assign Parameters by Range | Sub Horizons).

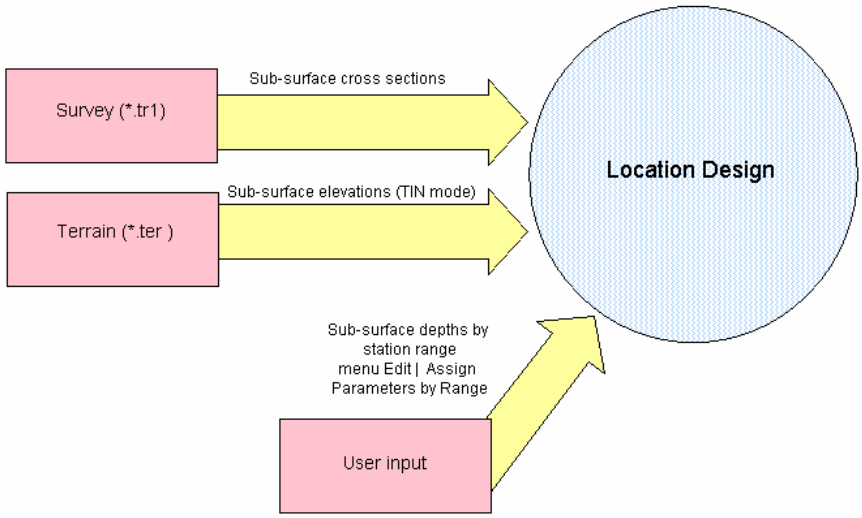

Figure 6.0: Sub-surface Model Data Sources

This example will explore the simplest of these 3 methods for creating a subsurface model i.e. *User Input* of sub-surface layers by station range.

1. File | Open, Select **RoadEng\Tutorial\Location\bluff_road.DSN.** Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Choose menu Edit | Assign Parameters by Range. Select the *Sub Horizons* tab.

3. In the New Range, press the "+" sign beside Ground layers. Layer 1 is **OB,** and enter C/L depth of **.8**. Change Layer 2 to **HP** for C/L depth of **3** and change Layer 3 to **SR** as shown in Figure 6.1 below. Press OK.

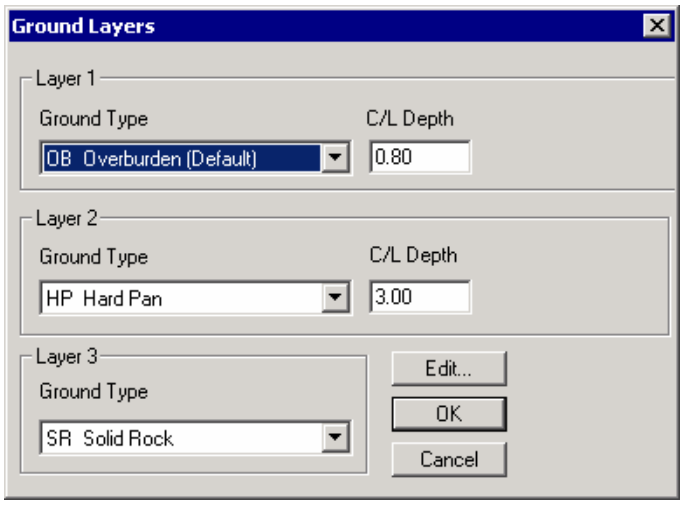

Figure 6.1: Ground Layers Dialog

4. Press the Add/Edit button to add the new interval.

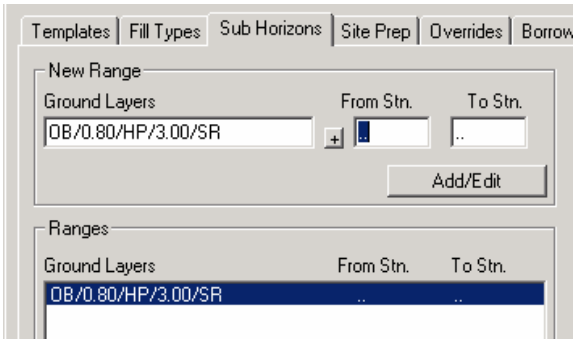

Figure 6.2: Sub Horizon Assignment

NOTE: leaving ".." in the *From Stn*. and *To Stn*. will assign the interval to the entire road.

5. Press OK to return to the main screen. Respond *Yes* to "Recalculate the road alignment".

6. Maximize the Section window and notice the sub-surface layers corresponding to OB, HP and SR.

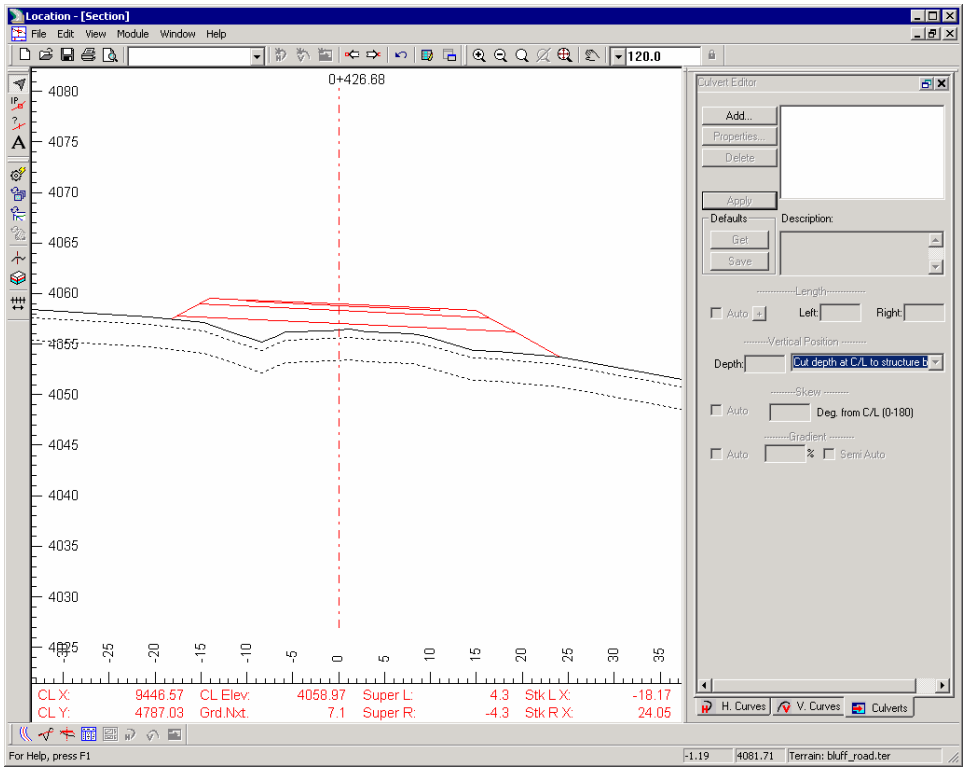

Figure 6.3: Sub Surfaces displayed in the Section Window

NOTE: Sub surface cut volumes can also be displayed in the Profile Window and reported in the Data Window. Each sub-surface layer has associated expansion and compaction factors.

Expansion/Compaction

Expansion and compaction is critical for calculating mass haul and estimating end haul. Even though the concept is simple, expansion and compaction can be confusing; especially when alternate reporting of cut and fill volumes is considered.

Cut and fill volumes and areas are multiplied by material expansion factors before being reported.

Expansion and compaction is usually reported in one of the following three styles:

Bank Volumes: (most common) In this system, cut and fill are reported as the equivalent volumes they would occupy in the natural state (in the bank or *in situ*). The reported cut volume is unmodified from the volume calculated in the road cross section.

Loose (trucked) Volumes: In this system, cut and fill are reported as the equivalent volumes they would occupy in a loose state. Both cut and fill volumes are modified (swelled) from the volume calculated in the road cross section.

Final (placed) Volumes: (not often used) In this system, cut and fill are reported as the volume calculated in the road cross section, regardless of expansion and compaction.

7. Expansion/compaction factors are set in menu Edit | Edit Ground Types. This activates the *Ground Types Editor* as shown in Figure 6.4.

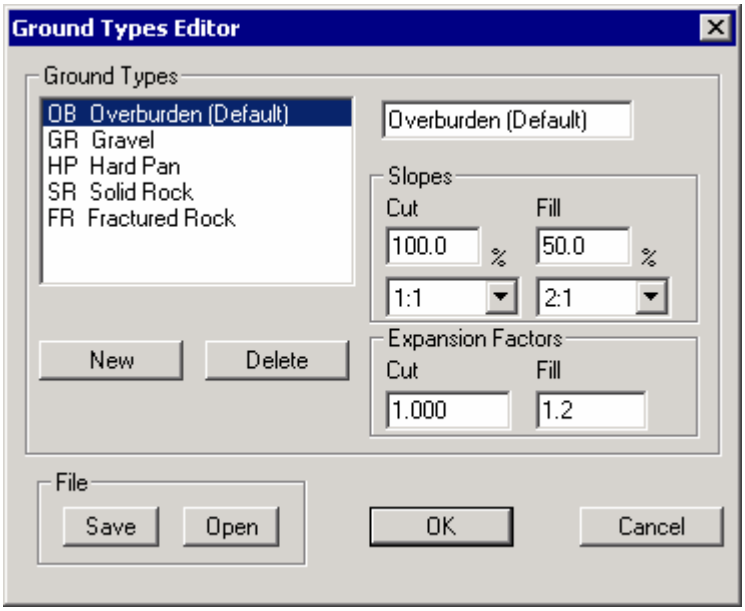

Figure 6.4: Expansion and Compaction Factors

8. Choose menu File | Exit. Do not save changes.

Stripping

Stripping allows for removal of unwanted materials such as overburden before the template is applied. The volume of stripped material is tracked and can be reported in the Data Window.

In this example we will strip topsoil 1 ft. of topsoil.

1. File | Open, Select **RoadEng\Tutorial\Location\bluff_road.DSN.* Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Maximize the Section Window.

3. Choose menu *Edit* | *Assign Parameters by Range*. Choose tab *Site Prep*.

In the Overburden Removal area, set the Depth from Topo to be **1** and set the Outside limits of the Stripping to be **2** feet (project units) beyond the Slope Stake position (see Figure 6.5). Press Add/Edit.

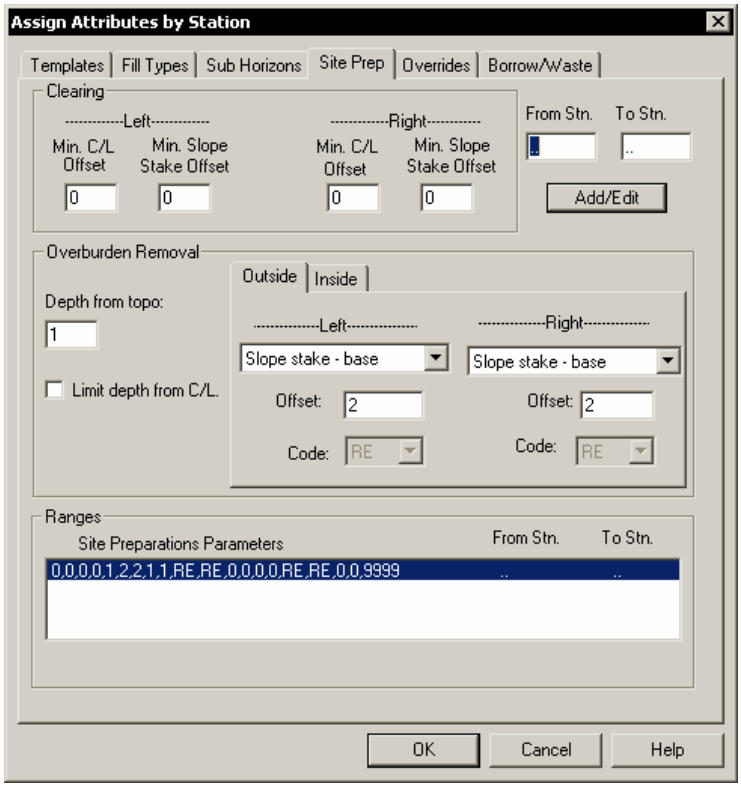

Figure 6.5: Stripping Assignment

4. Press OK to return to the main screen. Respond *Yes* to "Recalculate the road alignment". Notice the stripping layer displayed in the Section Window.

NOTE: If stratum layers are defined stripping will not go below the top layer.

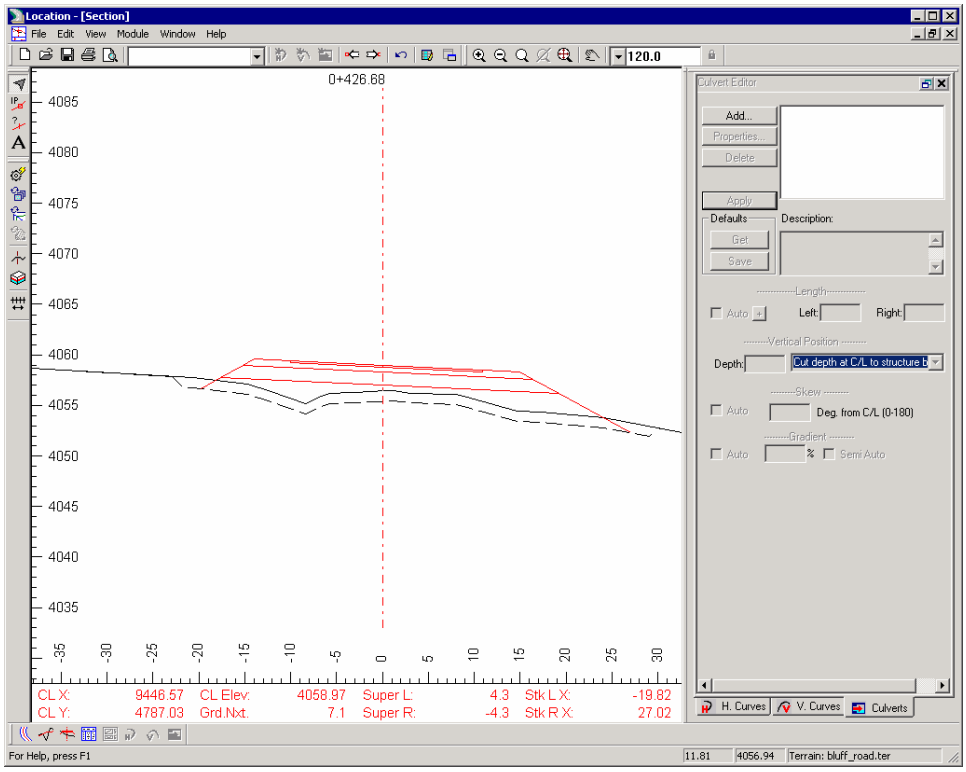

Figure 6.6: Stripping Displayed in the Section Window

5. Choose menu File | Exit. Do not save changes.

Mass Haul

Mass Haul is a graphic representation of accumulated mass and is used to determine the most efficient distribution of quantities. The Mass Haul at any station is the accumulated cut minus the accumulated fill up to that point. The difference in Mass Haul between two points indicates the volume of surplus (positive difference) or deficit (negative difference). The designer has to decide whether to change the Grade-Line, or whether borrow or waste can be justified. A balanced design is not always possible especially in steep ground conditions.

When the Mass Haul diagram crosses the zero axis cut and fill quantities are *balanced*; there is no material left over or required for the road up to this point.

If the Mass Haul is above the zero axis (positive) between *balance points* this indicates that material must be *Pushed* ahead. The distance between zero crossings (*balance points*) is the maximum *Push* or *Haul* distance.

If the Mass Haul is below the zero axis (negative) between balance points this indicates that material must be *Hauled* back. (This requires a tote road to move excavation equipment ahead of the fill segment).

The values at the peaks or valleys in the Mass Haul represent the volumes of material that must be *Pushed* or *Hauled* along the road. (This is less than the total excavation because material that is used as fill at the station where it was cut does not have to be moved along the road).

The following definitions are used to describe earthwork movement.

- *End Haul* - Excess volume that must be transported away from the site.
- *Free Haul* distance - is the station distance earth may move without additional compensation to the construction contractor.
- *Over Haul* distance also known as *Limit of Profitable Haul* (LPH) - is the station distance beyond which it is more economical to borrow or waste than to haul from the road bed.

Mass Haul Sub-view

In this section, you will be introduced to some of the tools available for balancing cuts and fills.

1. File | Open, Select **RoadEng\Tutorial\Location\bluff_road.DSN.** Press *Open*.

Note**:** If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Maximize the Profile Window and press the Zoom Extents button .

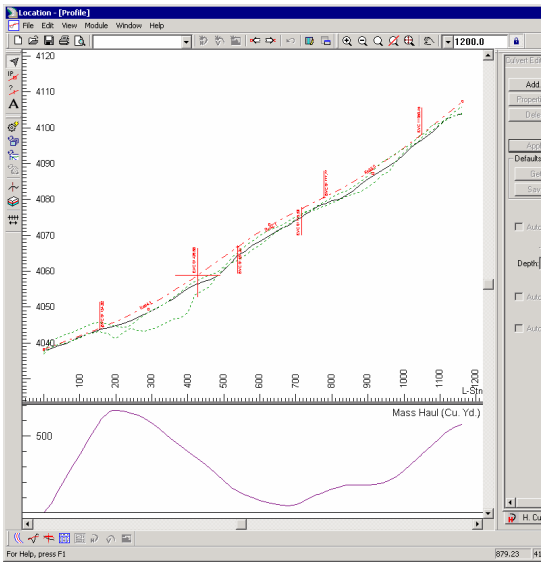

Figure 6.7: Mass Haul Graph

Notice in the mass haul graph at the end of the design there is an excess of approximately 580 Cu. Yd. Also, notice that at around station 200 there is an excess of 680 Cu. Yd. and at approximately station 660 that surplus has dropped to less than 50 Cu. Yd.

3. With the Profile Window maximized, choose menu View | Profile Options. In the Sub-windows group select Mass Haul and then click on the Options button to open the Mass Haul Graphic Options Dialog box as shown in Figure 6.8.

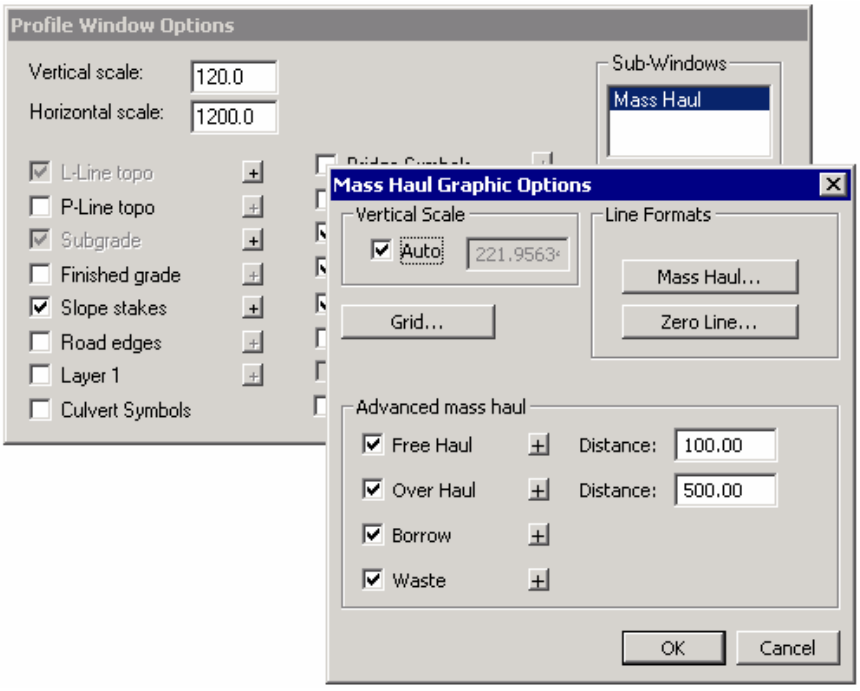

Figure 6.8: Mass Haul Graphic Options Dialog

4. In the Advanced mass haul area turn on Free Haul, Over Haul, Borrow, and Waste. Notice the Free Haul distance is set to 100 ft. and Over Haul distance is set to 500 ft. These values depend on the type of road construction equipment used. Press OK twice to return to the main screen.

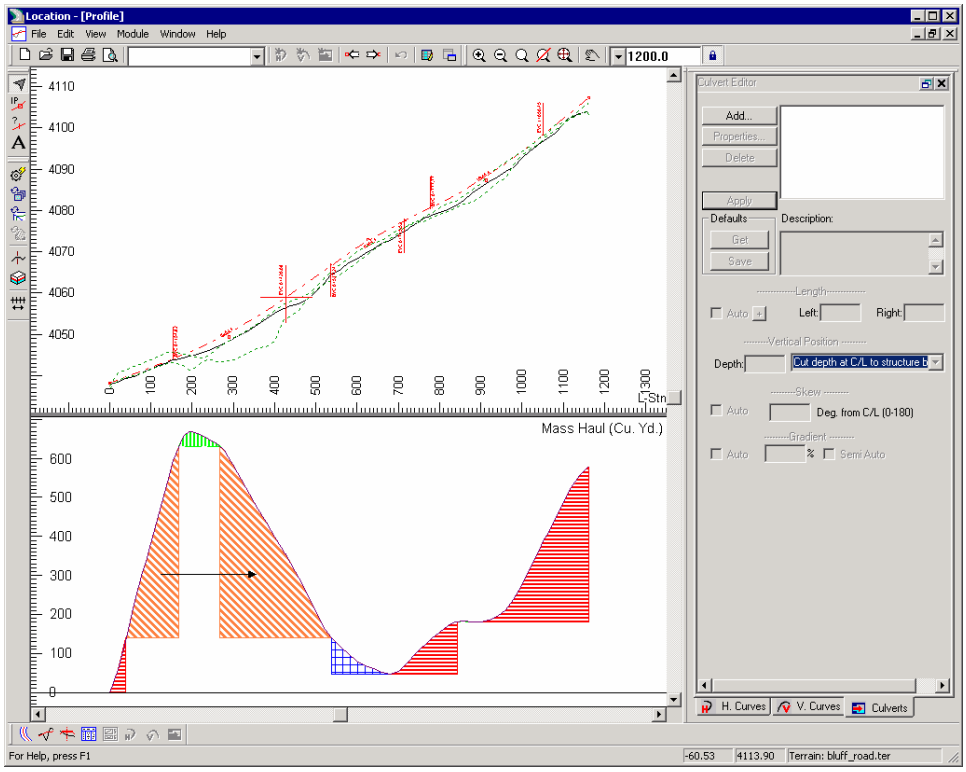

Figure 6.9: Mass Haul Showing Overhaul, Free Haul and Burrow/Waste

The Mass Haul Sub-view (Figure 6.9) shows the following material classifications.

	FreeHaul	Material which is pushed or pulled a distance less than the *Free Haul distance* (100 ft.).
	Overhaul	Material moved beyond *Free Haul Distance(100)* and less than the *Overhaul Distance (500)*.
	Borrow	Material which must be trucked in from outside the road project.
	Waste	Material which must be trucked outside the road project (End haul).

It is possible to modify the mass haul to account for borrow and waste.

5. Choose menu Edit | Assign Parameters by Range. Select the Borrow/Waste.
6. Enter 900 for the *Station* and -500 for the *Volume*. Press the Add/Update button.

.

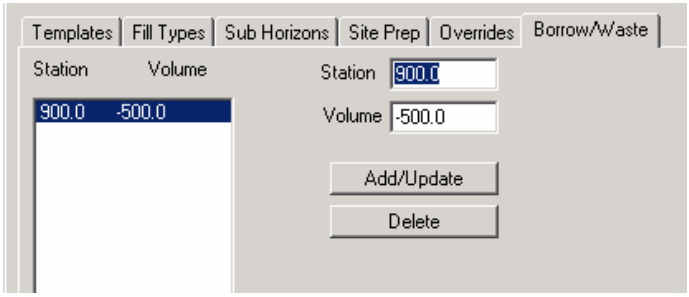

Figure 6.9 Earthwork Borrow/Waste dialog box.

7. Press OK and respond "Yes" to the "Recalculate road alignment" prompt.

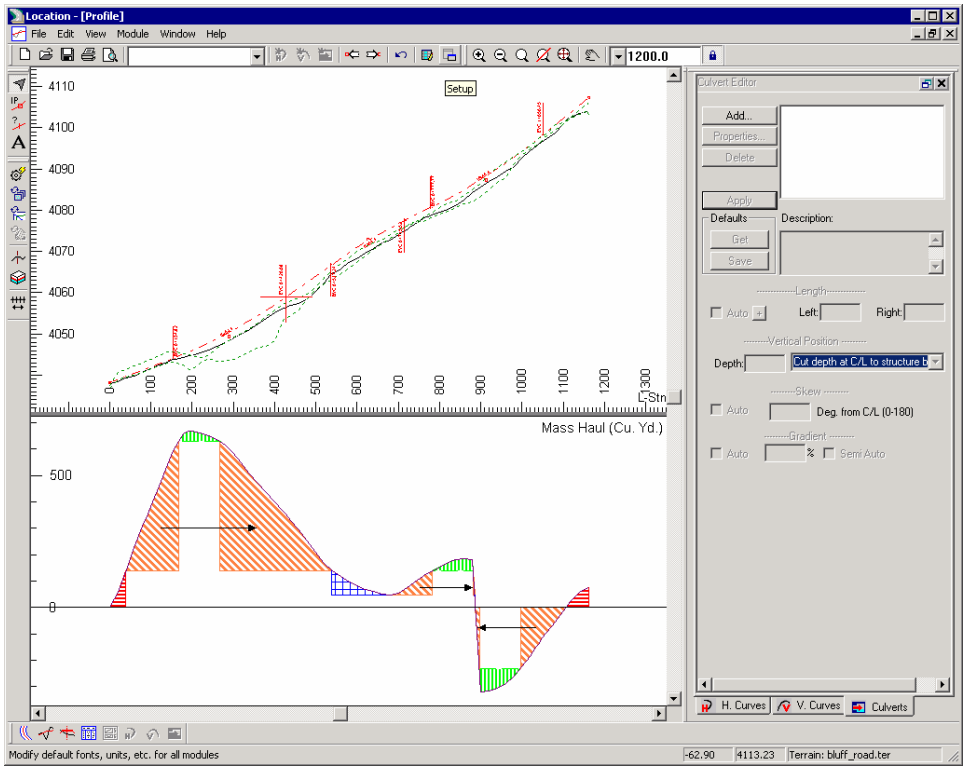

Figure 6.10 Earthwork Borrow/Waste dialog box.

Notice the revised Mass Haul graph as shown in Figure 6.10.

8. File | Close. Do not save changes.

Exporting Data to a Spreadsheet

Exporting information to a spreadsheet package may be very useful for extended analysis and reporting. In this section, you will see how to export data from the Location Module to a spreadsheet package.

1. File | Open, Select **RoadEng\Tutorial\Location\bluff_road.DSN.** Press *Open*.

Note**:** If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Click to highlight the Data Window title bar.

3. Select menu Edit | Copy Data Window to Clipboard or type <Control + C>. This will attach all data to the clipboard. (Alternately, File | Export Data to ASCII, will achieve the same result, except that this menu function allows copying to a file or clipboard, by station range, as shown in Figure 6.11).

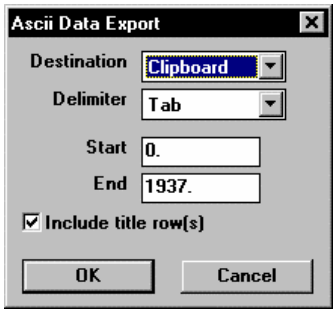

Figure 6.11 ASCII Data Export dialog box.

4. Run the spreadsheet package that you have loaded on your computer.

5. Paste the data into the new worksheet. <Control + V> will work for most windows applications.

The data that was in the Data Window will now appear in the spreadsheet.

6. File | Close. Do not save changes.

Culverts

This section demonstrates how to design drainage structures at streams and cross drain culverts.

Stream Crossing Culverts

If you use a P-Line traverse to create a new Location design (see the *Starting a New Design* chapter), a culvert will automatically be added at every stream defined in the traverse (*CRK* = creek column in the notes).

To do the examples in this section the *Terrain Design*, *Culvert Editor* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

In this example a culvert will be manually created at a stream crossing.

1. File | Open, Select **RoadEng\Tutorial\Location\template.DSN**. Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. File | Retrieve Screen Layout, Select and open **RoadEng\Tutorial\Location\culvert.DLT**.

This screen layout was saved with the Culvert Panel open; you can also open the Culvert Panel from the Standard Tools toolbar  , or from the Window | New Window menu.

3. Type <Control + J> and enter station **445**. Press *OK*.

Note the stream crossing the road just ahead of station 445 in the Plan window, shown in Figure 7.0

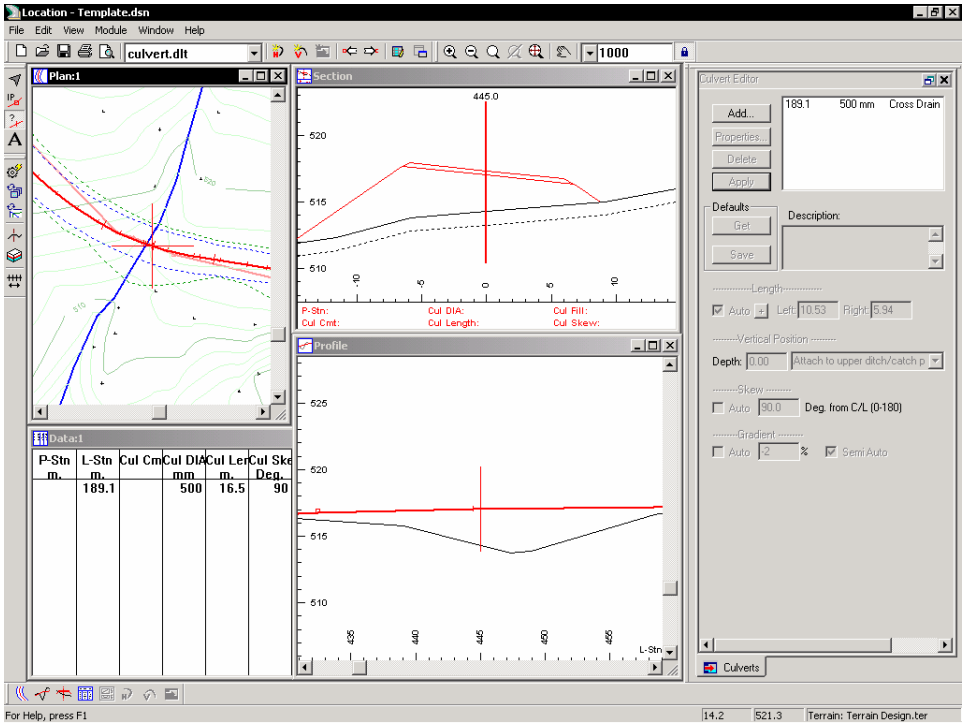

Figure 7.0: The Plan Window Shows a Stream (background Terrain graphic)

4. Right click in the Plan window and select the *Add/Edit Report Point Tool* (you could also use the *Mode Tools* toolbar).

5. Click in the Plan window to create a new Report point then move it over the stream (in figure above) and anchor. The Section will update to show the cross section at this point – it should be at approximately station **447**.

6. Click the *Add* button in the Culvert Panel (top right of your screen) and then select *Natural Channel (stream).* Press *OK* to update the culverts list and all windows.

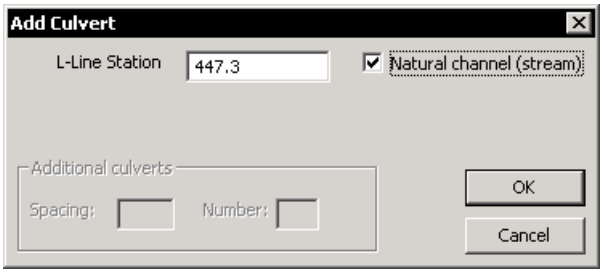

Figure 7.1: Adding a New Stream Crossing *Culvert*

7. Note that the culvert does not calculate *Auto Length* very well. Type **-0.5** in the *Vertical Position, Depth* field. Press *Apply*.

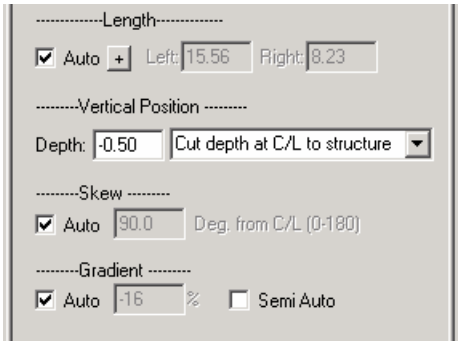

Figure 7.2: Parameters for a Culvert that Follows the Ground

Your culvert should now appear similar to the Figure 7.3. The *Auto Length* option causes the culvert to just fit between the fill slopes. The –0.5m value entered above is the *Cut Depth* at centerline; the negative value means that the culvert is above original ground instead of cut into it. The *Auto Gradient* option dips the culvert to fit the ground slope.

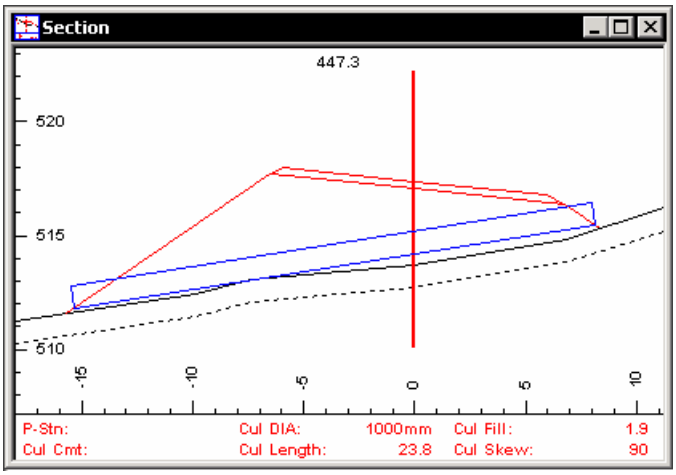

Figure 7.3: A Culvert that Follows the Ground

8. Try moving the alignment up and down a little (use the mouse in the Section window (do not forget to change to *Add/Edit* mode) – answer *OK* to the *Delete curve* prompt) and notice that the culvert is attached to the ground and changes length to fit between the fill slopes.

The following steps will convert the culvert into an open bottom arch, cut into the streambed.

9. Press the *Properties* button in the culvert editor and change the dialog so that it appears like the Figure 7.4 Press *OK*.

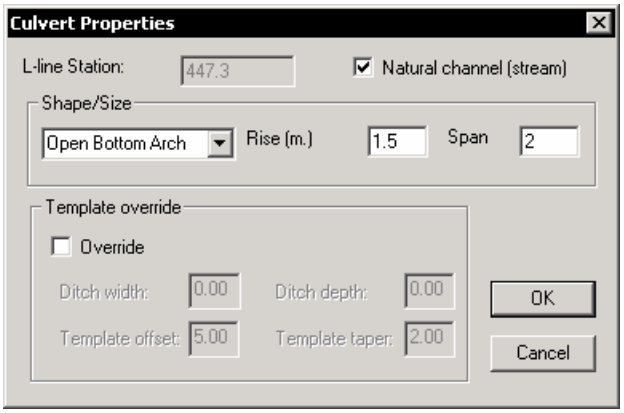

Figure 7.4: Culvert Properties Dialog

10. Set up the main culvert parameters as shown below. Turn off the *Auto Length* check box and set the lengths a little longer **16**m *left* and **9**m *right.* Set the *Vertical Position, Depth* field to **+0.5** to bury the edges of the arch. Finally adjust the skew to fit the stream as shown in the Plan: turn off *Auto* and set the *Skew* to **103** degrees. Press *Apply* to update all windows. Your final culvert design should be similar to Figure 7.6

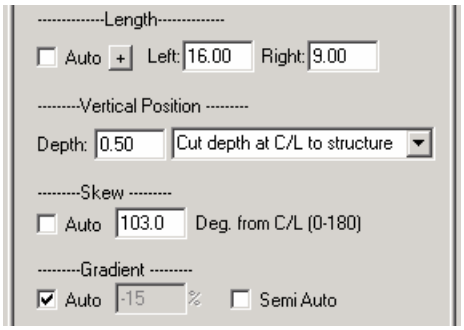

Figure 7.5: Parameters for the Pipe Arch Culvert

.

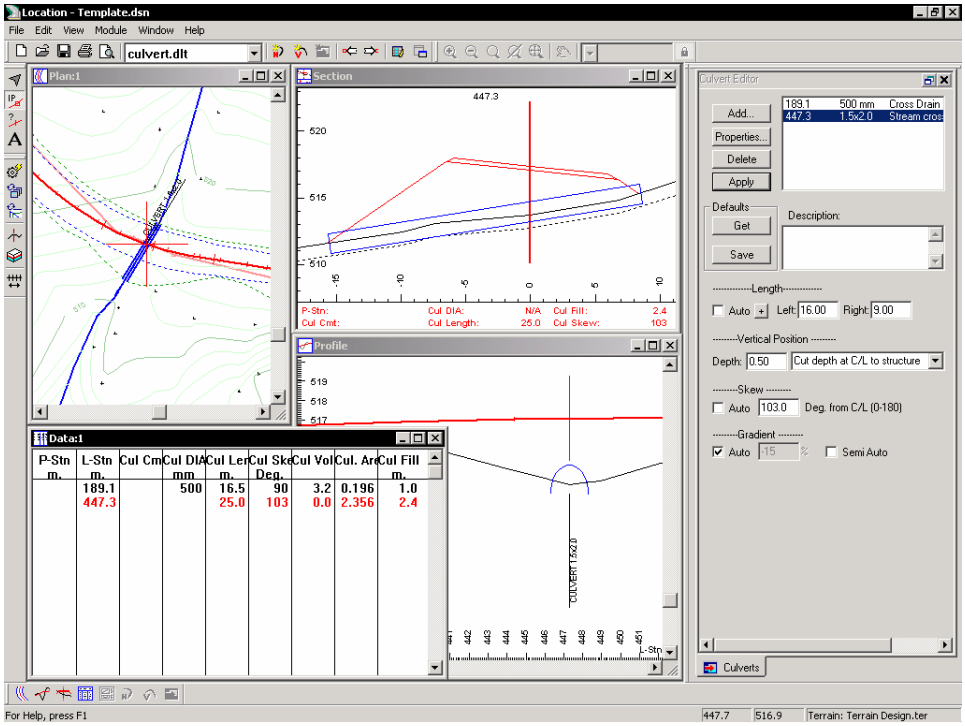

Figure 7.6: Pipe Arch Culvert

Cross Drains

Cross drains are added periodically along a road to drain the ditch. Unlike the stream crossing above cross drain culverts are more convenient if they move with the alignment.

11. Press the *Add* button and change the Add Culvert dialog box to match Figure 7.7. Press *OK*.

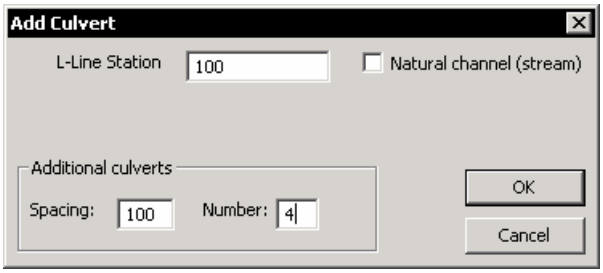

Figure 7.7: Add Culvert Dialog

12. Click with your mouse on each of the four new culverts to see what they look like.

13. When you get to the culvert at station **300**, press the *Delete* button to remove it. This is a bad place for a cross drain.

14. Click on the station 100 culvert again, then press the *properties* button and change the *Diameter* to 600mm as in the figure below. Note the Template override information – this is why the ditch appears deeper and wider near cross drain culverts. Press *OK* then press the *Apply* button to update.

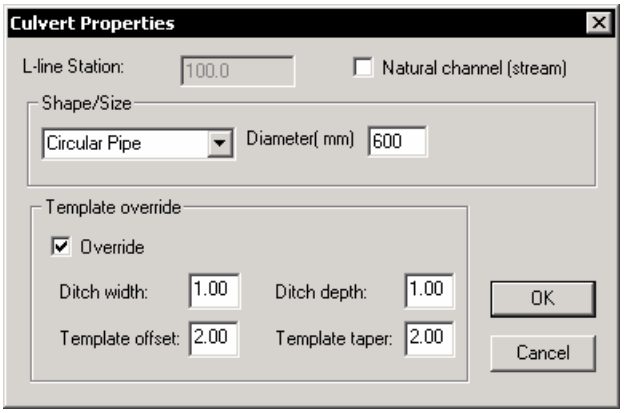

Figure 7.8: Culvert Properties Dialog

15. Press the *Save* button in the *Defaults* area. Respond *OK* to the warning prompt.

You have now modified the cross drain defaults. If you create any new culverts they will now be *600mm* in diameter. New designs get their default culverts from the **normal.DLT** screen layout – after this, culverts are stored with the design and will not be changed by retrieving layouts.

Default culverts can also be applied to *existing* culverts:

16. Select the three culverts between 189.1 and 400 by clicking and dragging with the mouse in the list of the culvert editor. Now press the *Get* button in the *Defaults* area and notice that all selected culverts in the list have been set to 600mm. Press *Apply.*

17. Click on the station 100 culvert again. Move the alignment up and down a little (use the mouse in the Section window.) Answer *OK* to the *Delete curve* prompt and notice that the culvert moves up and down with the road. There is often no need to re-design culverts after alignment changes.

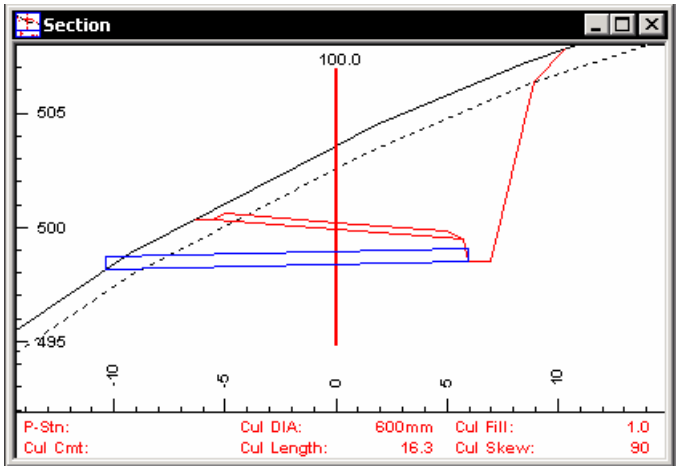

Figure 7.9: A Cross Drain Culvert with Ditch Template Override

18. File | Close. Do not save changes.

Drafting

This section describes basic functions for adding text, changing line-types, symbols and background graphics to create a finished drawing.

Labels

Labels displayed in the Plan and Profile Windows are formatted in two places. The View | [Plan or Profile] Options menu provides access to label formatting for the window (*group formatting*). The *Edit label tool* button A in the toolbar allows you to modify individual labels (*point formatting*) with the mouse. The Plan Window is used in the following examples but the same principles apply to the Profile Window.

To do the examples in this section the *P-Line Design* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

Group Formatting Labels

1. File | Open. Select **RoadEng\Tutorial\Location\drafting.DSN**. Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Click on the title bar of the Plan Window to activate it. Select View | Plan Options or right mouse click in the Plan window, then scroll down to Plan Options..

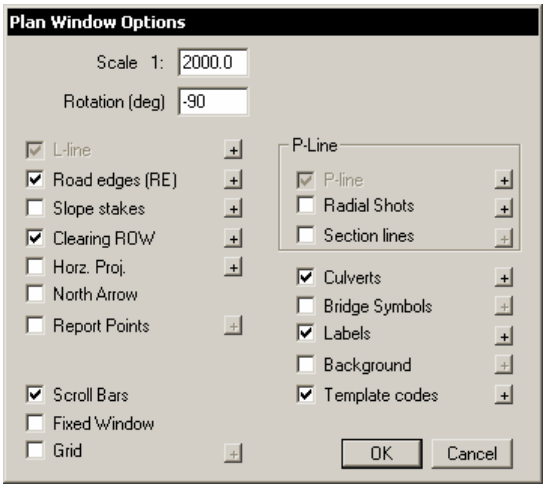

Figure 8.0: Plan Window Options Dialog Box

3. Click on the + button adjacent to the *Labels* item to activate the label Selection and Formatting dialog box.

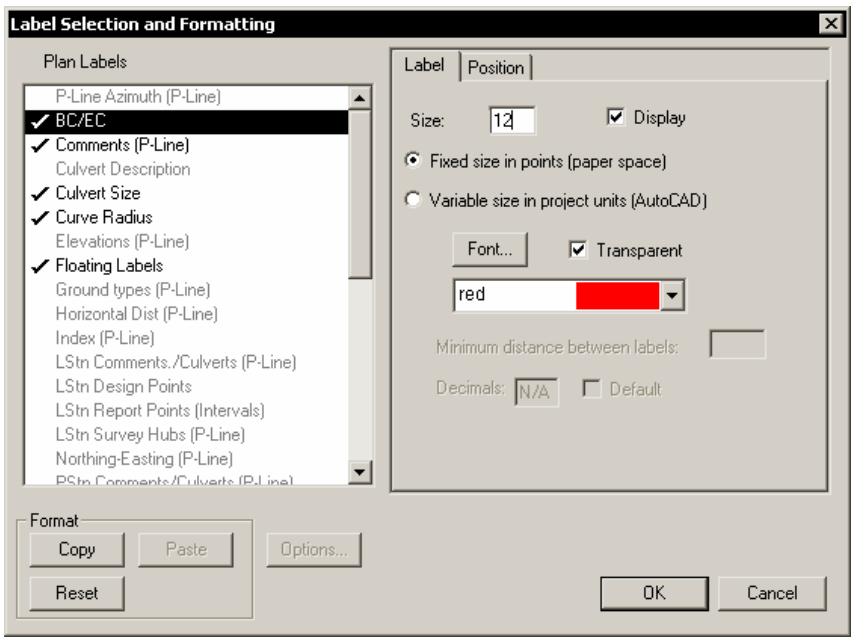

Figure 8.1: Label Selection and Formatting Dialog Box

The *Label Selection and Formatting* dialog box controls which labels are displayed (add or remove items with a double click in the list) and how they are formatted. See On-line Help (type F1) for details. Each item in the list refers to a group (or class) of labels. All labels in a group will have the same formatting unless *point formatting* is applied (see the next section).

4. Turn on the *Culvert Size* item and change the *BC/EC Labels* to font size **12** as shown in the figure above. Press *OK* to accept the label formatting and *OK* again to accept the rest of the Plan options. Note the changes in the Plan window.

NOTE: Label *group formatting* is saved in screen layouts. The previous three steps would have been unnecessary if you had retrieved a screen layout with the correct options and formatting defined.

There are two types of labels: Labels that are attached to traverse or design points and Floating Labels.

- **Feature Labels** are "attached" to traverse points or design points.
- **Floating Labels** are not associated with any specific feature.

Point Formatting Labels

5. Right click in the Plan window and select *Edit Label Tool*. This will change the cursor to the *Edit Label tool* cursor (alternately you could press the *Edit label tool* button A in the toolbar).

6. Use <Control + J> to jump to *L-Line Station* **666.6**.

7. Move your mouse cursor over the red *BC 666.6* label, when the cursor changes to a simple cross left click once. The label is now *selected* and should look like the one in Figure 8.2.

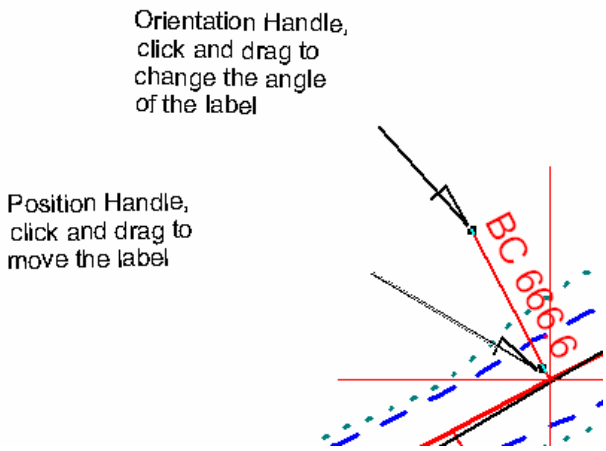

Figure 8.2: Selected Label with Edit Handles Visible

Moving a label

Notice when you place the cursor over the *text* of a selected label it changes to the ✣ Move cursor. Clicking and dragging with the Move cursor will reposition the label.

Rotating a label

Notice when you move the cursor over the *Orientation Handle* it changes shape to the ↻ Orientation cursor. Clicking and dragging with the Orientation cursor will allow you to rotate a label.

The curve label is a *Feature Label* as it is attached the curve; the anchor point will move only when the curve moves.

8. Reorient and reposition the label until it appears as shown below.

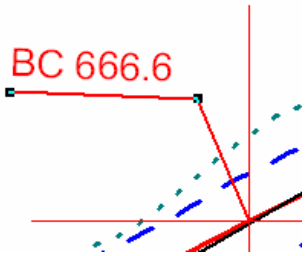

Figure 8.3: Label After Reorienting and Repositioning.

9. Double click on the text of the label you just edited. This opens the *Label Selection and Formatting* dialog box.

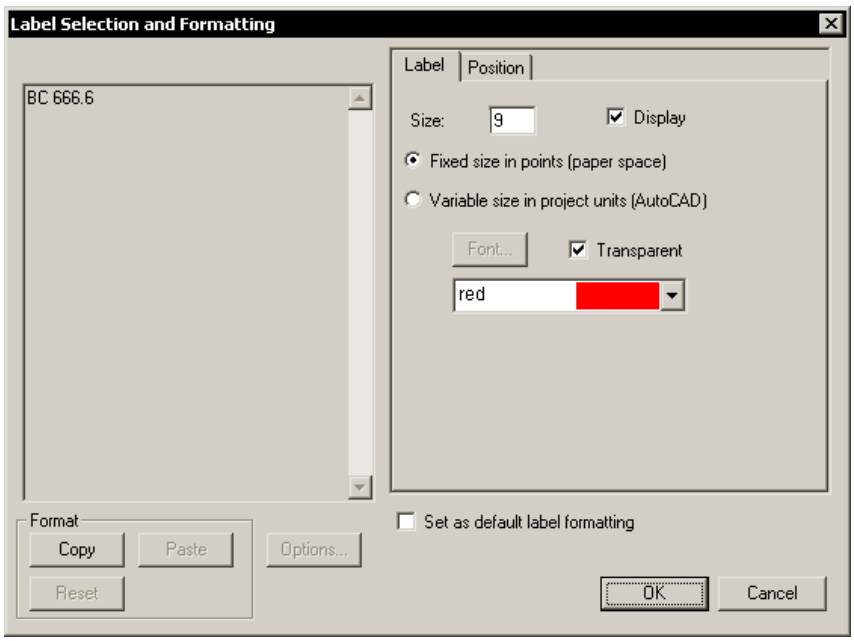

Figure 8.4: Label Selection and Formatting Dialog Box.

10. You could further edit the label here but instead, select *Reset* , to undo the previous *point formatting*. Press *OK*. Note that the label has returned to the previous *group formatting*.

11. <Control + J> to jump to L-Line Station **290.**

Notice that the EC, BC and curve radius labels are bunched up, and because of their orientation, the labels themselves are not clear.

12. Re-orient and re-position the labels, so that they appear similar to the figure below.

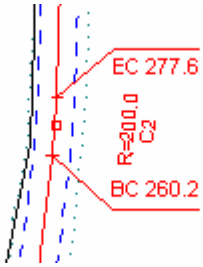

Figure 8.5: Labels after Re-positioning and Reorienting

Floating Labels

Floating Labels can be added anywhere in the Plan or Profile Windows. Unlike Feature Labels, Floating Labels can have their anchor point moved.

13. If you are not still in *Label Edit* mode, press the *Edit Label Tool* button in the toolbar, and the cursor will change to the label edit tool

14. Click on the left mouse button in the Plan Window, to open the Label Selection and Formatting dialog box.

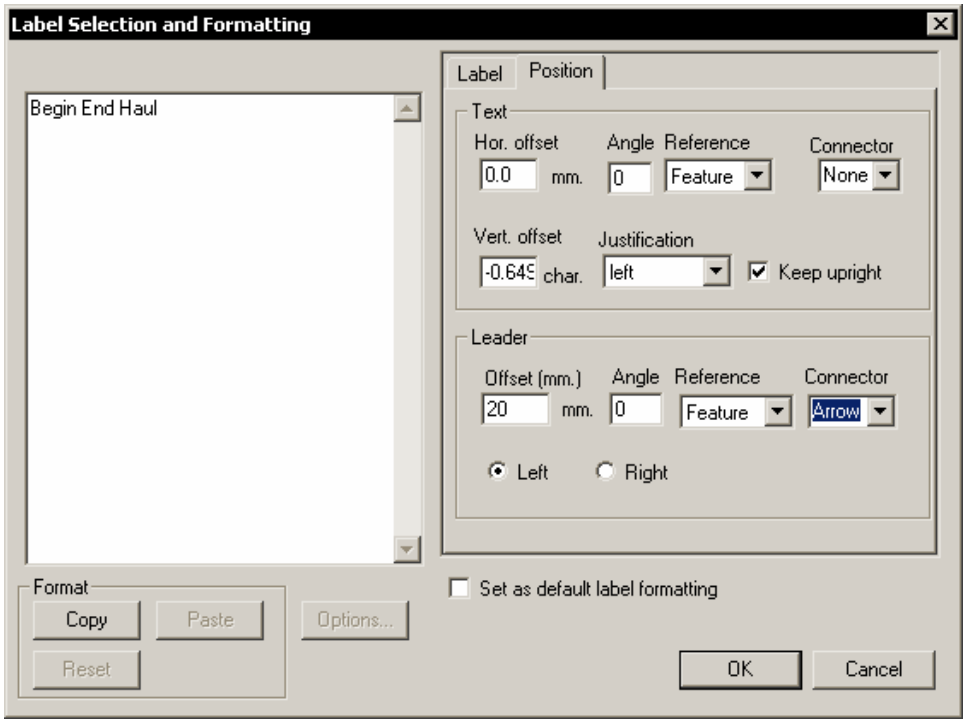

Figure 8.6: Edit Label Dialog Box

15. Change "*xxxxxxxx"* to "Begin End Haul". Click on the *Position* tab and change the *Leader* to have a 20mm *Arrow* as shown above. Press *OK*; the floating label will appear where you first clicked the mouse.

16. Adjust the label with the mouse until it looks similar to the Figure 8.7. Click and drag on the arrowhead handle to move the whole label.

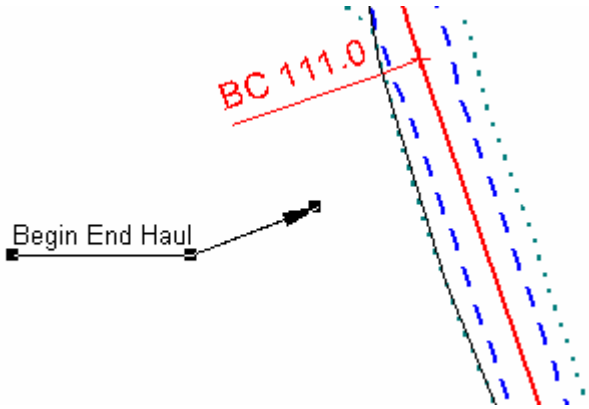

Figure 8.7: Floating Label

It is possible to change the Floating Label *group formatting* so that all new floating labels look like the label above.

NOTE: Floating Labels and label *point formatting* are saved in design files while group formatting is saved in design *and* screen layout files.

17. File | Close. Do not save changes.

Line-types and Symbols

Symbols and Line-types may be changed in any of the graphic windows for most of the items displayed. Lets experiment by changing the road edges in the Plan window.

To do the examples in this section the *P-Line Design* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open. Select **RoadEng\Tutorial\Location\drafting.DSN.** Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Click on the title bar of the Plan Window to activate it. Select menu View | Plan Options, and press the + button opposite *Road edges.* This opens the formatting dialog box shown below.

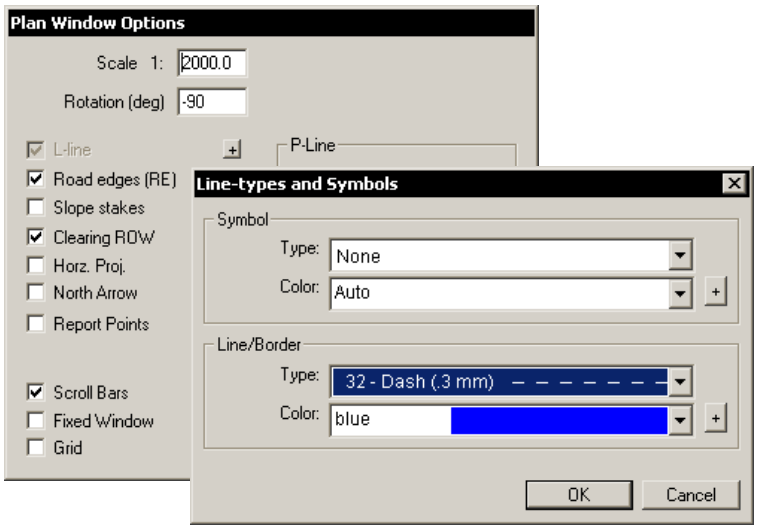

Figure 8.8: Line-types and Symbols Selection Dialog

3. Change the *Color, Line-type* and *Symbol.* Press *OK* and *OK* again. The line-type will change for both road edges.

NOTE: You can modify and create line-types and symbols in the Module | Setup dialog box, *General* tab. Line-types and Symbols tables are saved with the design but they can also be saved and retrieved to external files. **RoadEng\normal.TRF** contains the default Line-types and Symbols for new designs.

4. File | Close. Do not save changes

Background Terrain

A background terrain file may be displayed in the Plan Window for presentation or to assist in design. For example, special attention can be given to wet areas or unstable terrain if this information is displayed in the Plan Window. Property boundaries, rights of way and existing structures can be displayed. A background can also display contours.

To do the examples in this section the *P-Line Design* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open, Select **RoadEng\Tutorial\Location\drafting.DSN**. Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Activate the Plan Window. Select View | Plan Options to open the *Plan Window Options* dialog box shown below.

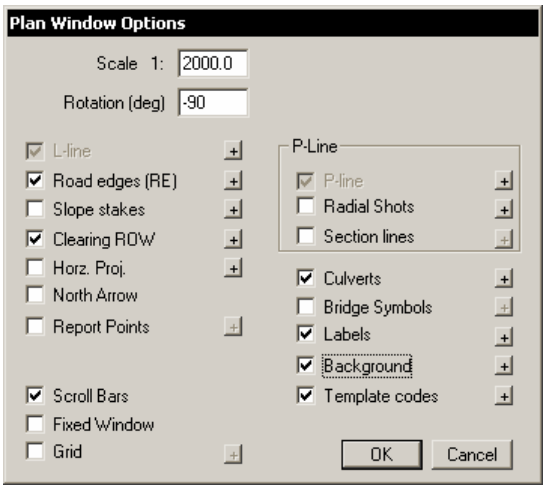

Figure 8.9: Plan Window Options Dialog Box.

3. Select *Background*, and then press the plus button [+] adjacent. This options the Background Display Files dialog box shown in the figure below.

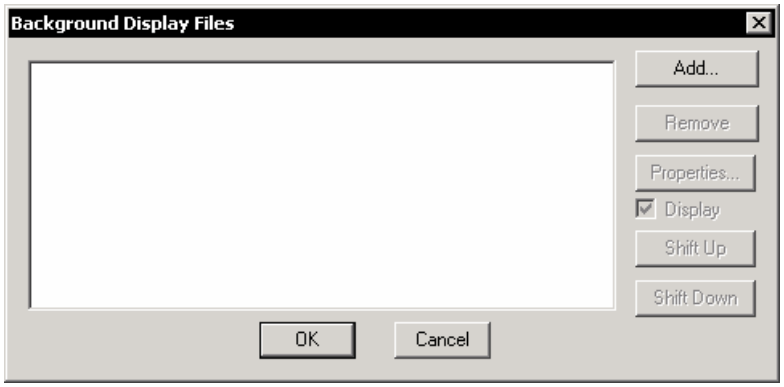

Figure 8.10: Background Display Dialog Box

4. Press the *Add* button. Select and open **RoadEng\Tutorial\Location\terrain design.TER.**.

5. Press the Properties button to open the dialog box below.

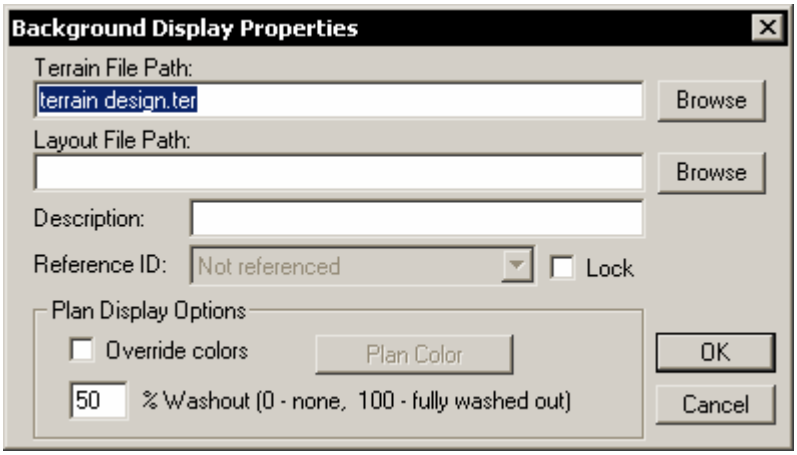

Figure 8.11: Background Display Properties with a Relative File Name

NOTE: Only the *name* of the Terrain background file is saved in the design file. It is wise, therefore, to use a *relative* file name whenever possible (instead of *full path*) so that if the files are moved to another folder or computer, Location design will still be able to find the background file.

The *Washout* factor allows you to control the intensity of the background graphics – the larger the washout factor the more faded the background image appears (so as not to distract from the foreground).

6. Press OK three times to close the dialog boxes and update the Plan window. Your Plan window should look similar to the figure below.

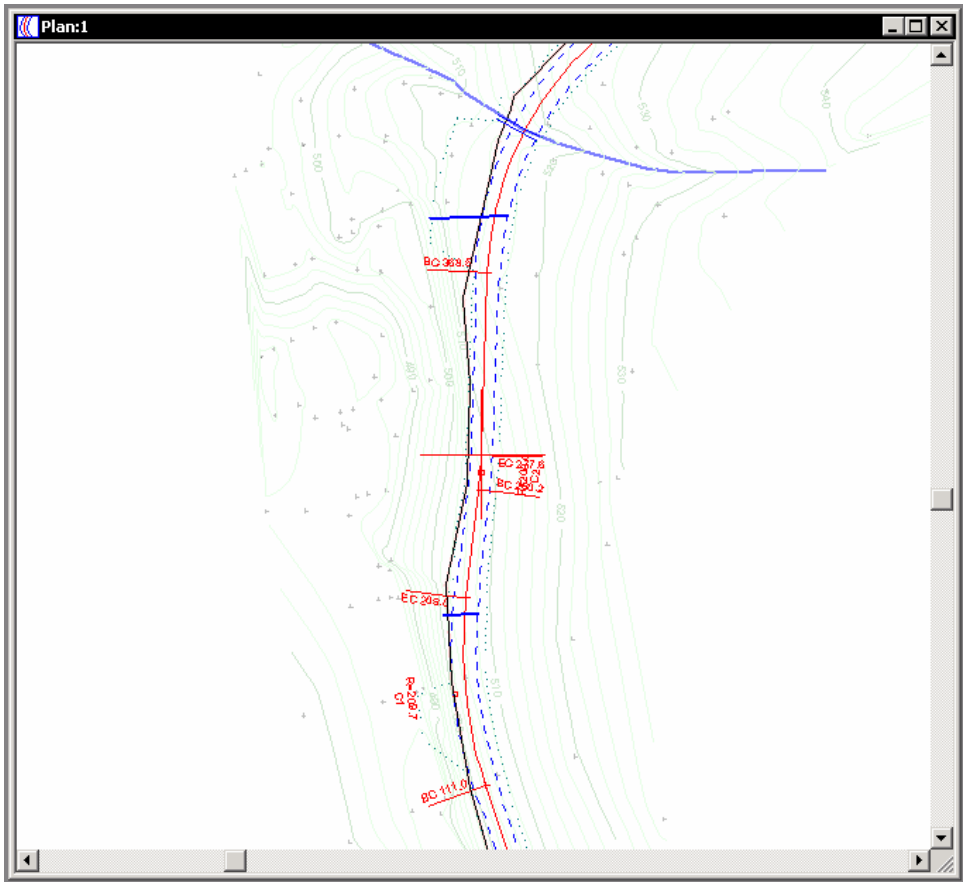

Figure 8.12: Background Terrain Added to a Road Design.

Background files are created in the Terrain Module (Module | To Terrain); see the Terrain Module tutorial and online help. If the Terrain file is modified you can update the Plan window by using the Edit | Read Terrain(s) menu.

7. File | Close. Do not save changes.

Output

Multi-plot is a page layout tool for creating output. Any of the main windows (Plan, Profile, Data, and Section) can be placed on a Multi-Plot sheet with other items such as a legend, a scale bar, a bitmap graphic, a Terrain file, Curve Tables, Template assignments, or a title block. This feature can be incorporated with screen layouts to retrieve most commonly used options and formats. In this section, you will learn how to create a Multi-Plot of a standard Plan over Profile Window.

To do the examples in this section the *P-Line Design, Multi-Plot Output Sheet Generation* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

Multi-Plot Example

1. File | Open, Select **RoadEng\Tutorial\Location\drafting.DSN.** Press *Open*.

Note**:** If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

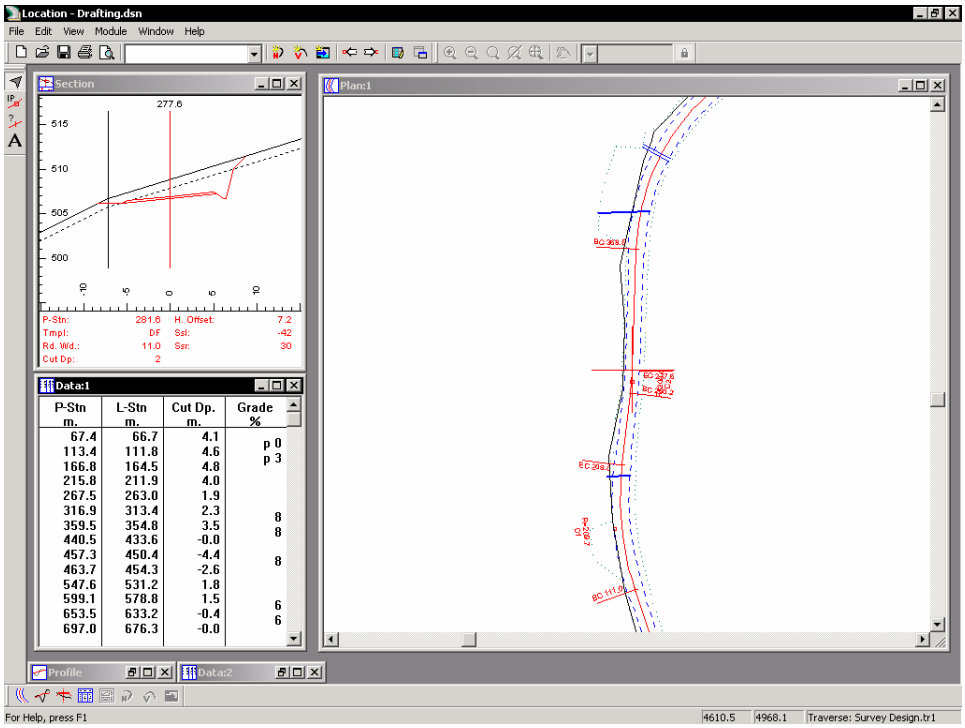

Figure 9.0: Drafting.DSN

2. From menu Window | New Window, select Multi-Plot. This will display the Multi-Plot Window. Maximize this new window.

NOTE: Multi-Plot setups apply to a specific paper size and orientation.

The orientation and size of the blank sheet, within the Multi-Plot Window, is determined by the selected printer set-up.

3. Use File | Print Setup to open the setup dialog box, change the orientation to Landscape, and the Paper size to 8.5” by 14” (legal). Press *OK*.

4. Select View | Multi-Plot Options to activate the dialog box. You can also access this dialog box by double clicking in the gray area in the Multi-Plot Window.

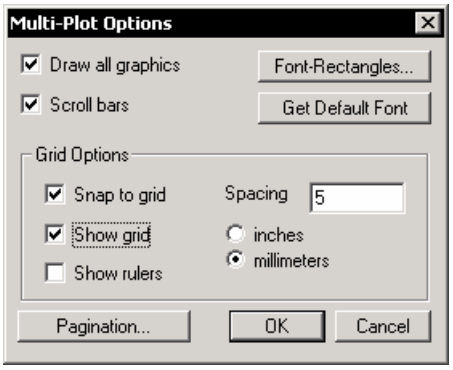

Figure 9.1: Multi-Plot Options Dialog Box.

5. Select *Show grid* and increase the *Spacing* to **5**mm as shown above. Press *OK*. A dot grid will cover the entire Multi-Plot sheet

6. From the menu Edit | New Sub-view, select Plan:1. A Plan *Sub-view* should appear in the center of your Multi-Plot Window.

Notice that there are 8 handles that you can click and drag to change the size of the sub-view. Click and drag anywhere else on the sub-view to move it. The <delete> key will remove the selected sub-view(s).

Notice, also, that the Plan is rotated automatically to best fit the rectangle with increasing stations running from left to right. In this case the Plan has been rotated automatically by approximately 90 degrees. See next section: *Plan Rotation.*

7. Resize and reposition the Plan sub-view. See the Figure 9.2.

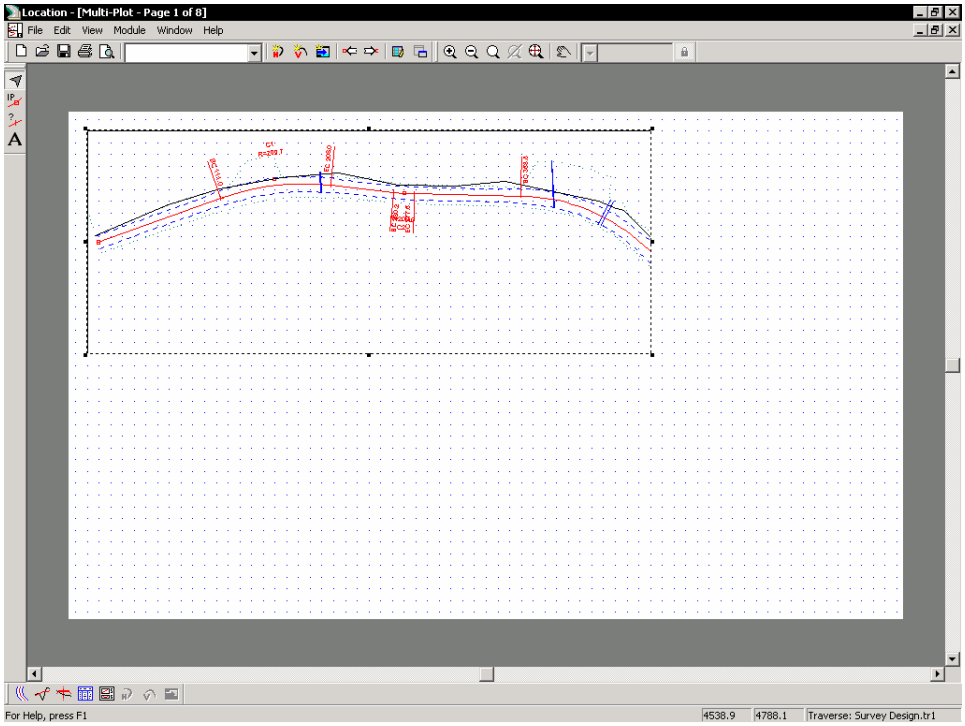

Figure 9.2: Plan Sub-view After Sizing and Positioning

8. From menu Edit | New Sub-view, select Profile:1. A Profile sub-view should appear in the center of the Multi-Plot. Adjust it to fit under the Plan sub-view.

A click on a sub-view will select it and deselect the previous sub-view. See also the note below.

NOTE: When you click outside all sub-views and drag the mouse you will create a selection rectangle. All sub-views inside or crossing the rectangle will be selected when you release the mouse. Also, <Control> click allows you to select/deselect sub-views without affecting the selection state of other sub-views. Group selected sub-views can be deleted or moved together.

Softree has created a screen layout that will position, orient, and format the Plan and Profile sub-views. In fact, the previous steps are performed automatically by the step below.

9. File | Retrieve Screen layout. Select and retrieve **\RoadEng\Tutorial\Location\output plan over profile.DLT.** Maximize the Multi-Plot Window.

The Multi-Plot Window should now resemble Figure 9.3.

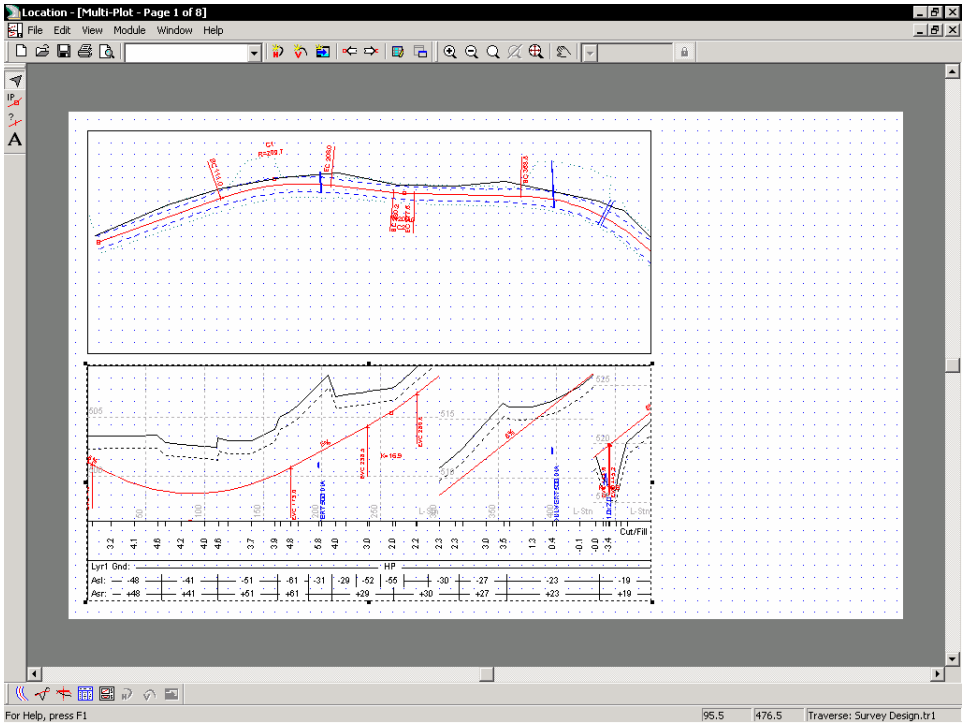

Figure 9.3: Multi-Plot Page 1 After Loading Screen Layout.

10. The Location Multi-Plot Window can automatically produce as many pages as required to show the entire design. Notice that the Multi-Plot Window title bar says that this is Page 1 of 8. Use <Control + N> to see what all the pages look like (View | Jump to Page also works).

11. Choose menu View | Multi-Plot Options to open the dialog box below. You can also access this dialog box by double clicking outside any sub-views in the Multi-Plot Window.

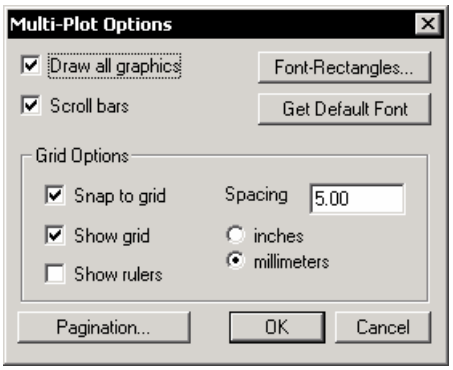

Figure 9.4: Multi-Plot Window Options

12. Click on the *Pagination* button.

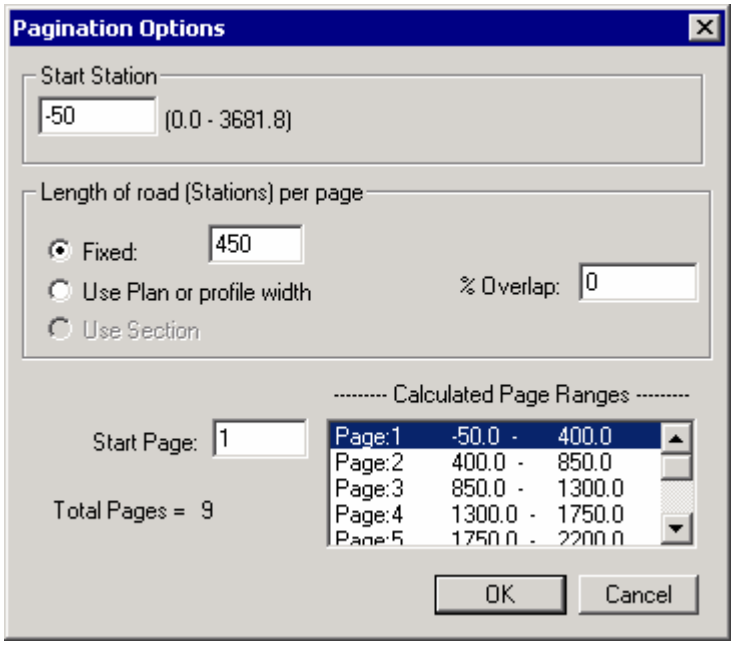

Figure 9.5: Multi-Plot Paging Options

13. Change the *Start Station* to **–50** this will leave a gap at the start of the first page. Note that the page size is set to use the size of the plan or profile sub-view – reducing the width of the Profile sub, for example, would reduce the page size from the current value of **480**. Change the *Length* to *Fixed*, **450**m and the overlap to **0** as shown above. Press *OK* and *OK*, again.

Plan Rotation

In this example the Plan sub-view is acceptable on most pages. The automatic pagination puts the page start station on the left side of the Plan sub-view and the end station on the right. This approach does not always work so it is possible to set the Plan sub-view scroll position and rotation manually.

14. Use <Control + N> or <Control + B> to get to page **6**.

15. Double Click on the Plan sub-view or use menu View | Multi-Plot Sub-view Options when the Plan window is selected.

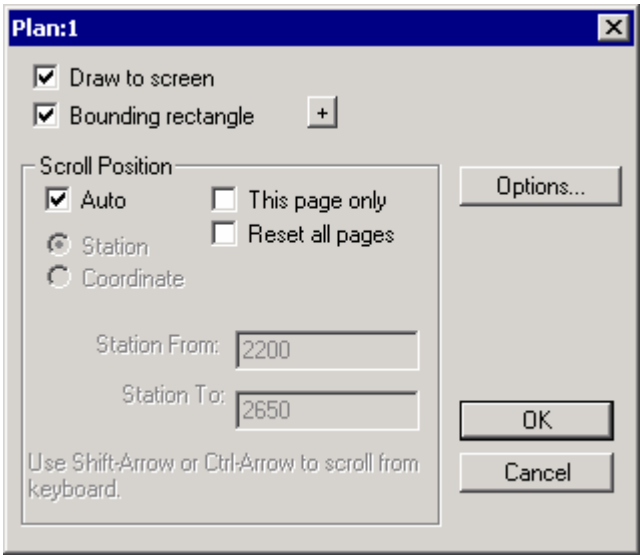

Figure 9.6: Plan Sub-view Options- AutoSetting

There is a similar options dialog box for all types of sub-views.

16. Click on the *Options* button.

NOTE: The same dialog box you see now is available from the View | Plan Options menu when the Plan Window is active. All the viewing options defined for the main Plan Window are displayed in the Multi-Plot Plan sub-view with the exception of the rotation angle.

17. Press *Cancel* to close the Plan Options dialog box.

18. Clear the *Auto* check box and click on the *Coordinate* button and set *This page only*. Press OK. Note the Plan position has not yet changed.

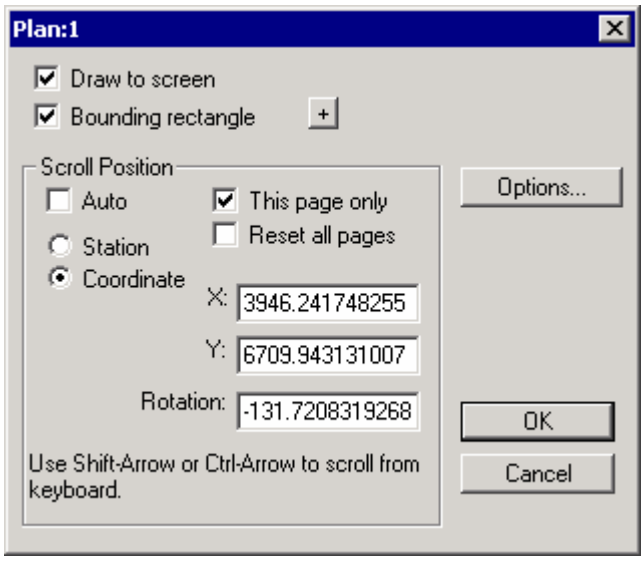

Figure 9.7: Plan Sub-view Options- Coordinate Setting

19. Type <Shift + arrow> to scroll or <Control + arrow> to rotate. <Shift + arrow> also works for the Profile sub-view if it is selected. (See note). Try to get the Plan sub-view to look like the figure below.

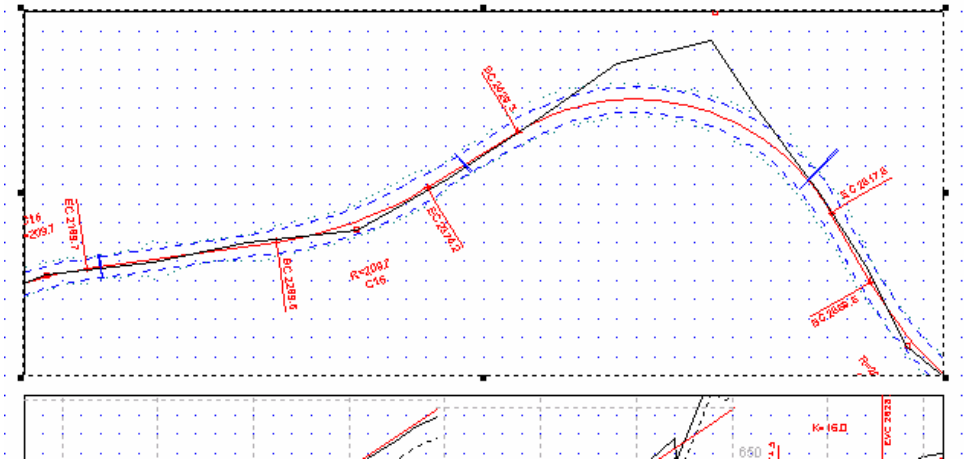

Figure 9.8: Plan Sub-view After Manually Scrolling and Rotating

20. Use <Control + N> or <Control + B> to view all the pages.

NOTE: Manual alterations to the Plan or Profile position and orientation can also be done by selecting the window and then pressing <shift+arrows>. A prompt may remind you that *Your Plan/Profile sub-view is set to scroll with the current page station range. Do you wish to scroll manually instead?* This operation will disable the *Auto* check box as in step 18 above. <Shift + arrows > will move the plan or profile in the direction of the arrow. <Control + arrows> will rotate the Plan sub-view around its center.

21. Continue to the next section or File | Close. Do not save changes.

Merging Multi-Plot Layouts

This exercise will add a title block to a Multi-Plot sheet. We will do this by merging the current Multi-Plot with a commonly used title block screen layout. If you are continuing from the exercise above you may omit steps 1 and 2.

To do the examples in this section the *P-Line Design, Multi-Plot Output Sheet Generation* and *Sub-surfaces* function groups should be enabled (see *Function Groups* in the introduction above and in the On-line help for more information)

1. File | Open, Select **RoadEng\Tutorial\Location\drafting.DSN.** Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the “Non Permitted Functions Found in File” dialog appears, choose “Keep all functions and revert to DEMO Mode”.

2. In the File | Print Setup dialog box, change the orientation to *Landscape*, and the Paper size to 8.5” by 14” (legal).

3. File | Retrieve Screen layout. Double click on **\RoadEng\Tutorial\Location\output plan over profile.DLT.** Maximize the Multi-Plot Window. The screen will appear like Figure 9.3 in the previous section

4. File | Merge Multi-Plot Layout. Select **\RoadEng\Tutorial\Location\output title block.DLT.** Press *OK*. The Multi-Plot sheet should now look like the figure below.

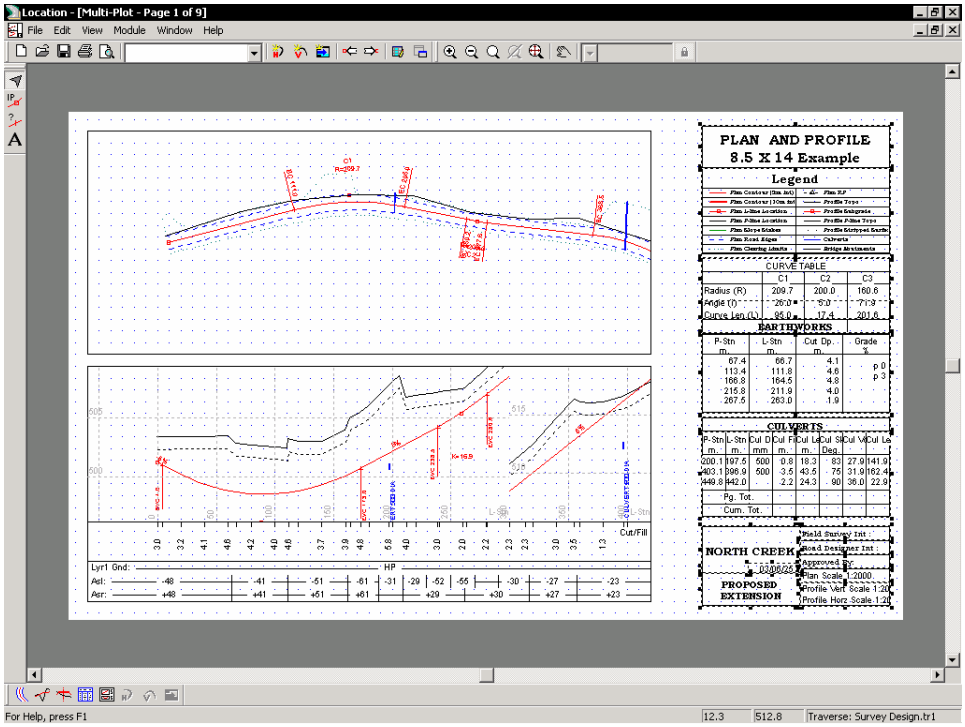

Figure 9.9: Multi-Plot After Merging with Output Title Block.DLT

Notice that all merged items are initially selected so that you can move them as a group if you wish.

Adding a Scale Bar

5. Select menu Edit | New sub-view. Select *Scale Bar*. A Scale bar will appear in the middle of your sheet.

6. Double click on the scale bar to activate the Scale Bar Sub-view Options dialog box.

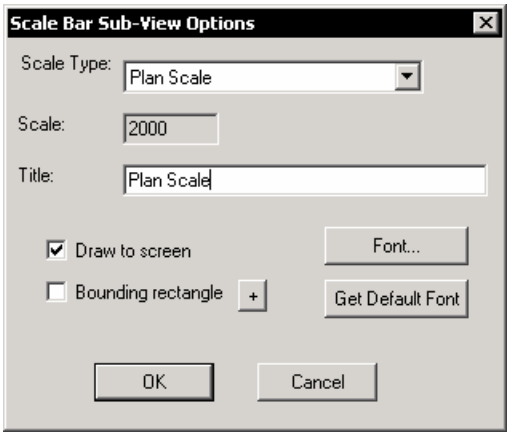

Figure 9.10: Scale Bar Sub-view Options Dialog Box

7. Keep the default *Plan Scale* from the *Scale Type:* pull-down box. Add in the optional *Title* **Plan Scale**. Press *OK*.

8. Resize and Reposition the Scale Bar sub-view, until it appears as in the Figure below (see note below).

NOTE: If you accidentally click on the Plan sub-view the scale bar will be inaccessible. Use the Edit | Shuffle Front to Back or <Control + K> to allow access to the scale bar.

NOTE: If the graphics on your screen are taking too long to redraw during moving and sizing operations you can temporarily disable display. Either turn off the *Draw to Screen* check in the sub-view options (see figure above), or turn off the *Draw All Graphics* check in the Multi-Plot options: (Figure 9.1).

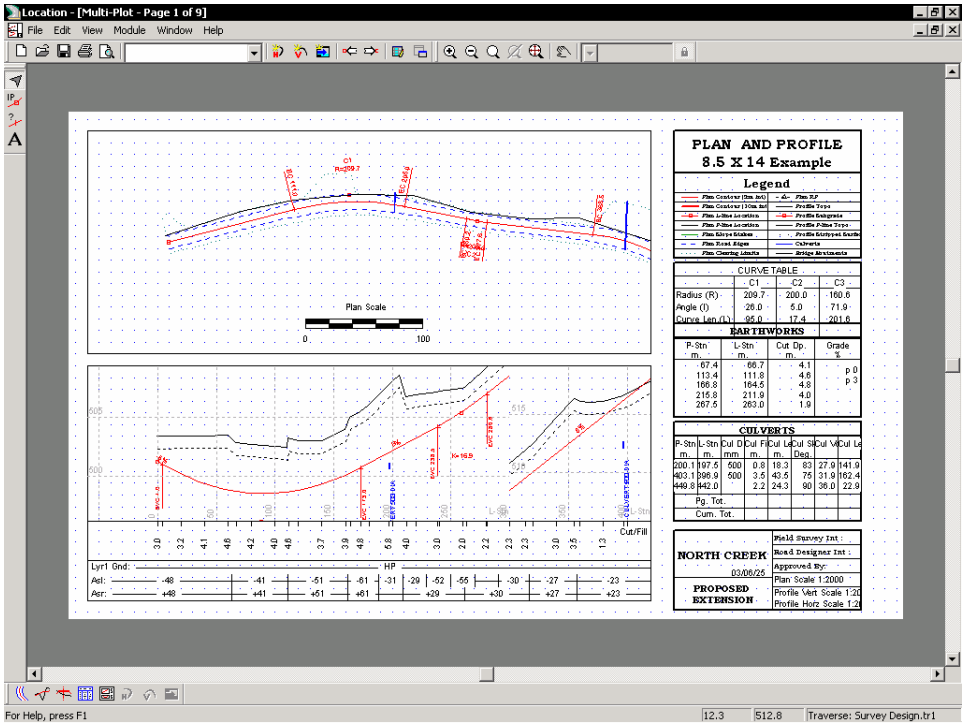

Figure 9.11 Final Multi-Plot Sheet

Creating a Legend

In this section you will learn how to create and modify a legend by replacing the one that came with the merged title block.

9. Select the legend shown in the figure above and press <delete> on your keyboard to remove the current legend.

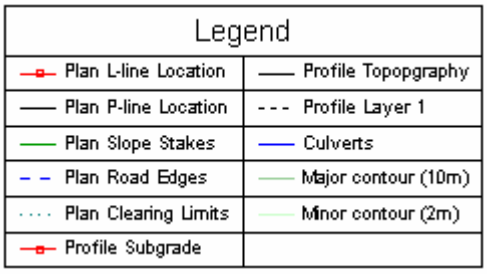

Figure 9.12: Legend

10. From menu Edit | New sub-view, select *Legend*. A legend should appear in your Multi-Plot window.

This legend initially contains all the lines and symbols used in your design. However, there will be duplicates (when the same line-type is used in two different windows) and some legend items may not be displayed in the Multi-Plot. You also may want to change some of the descriptions.

11. Choose menu View | Multi-Plot sub-view Options (or double click on the Legend); the dialog box shown in the figure below will appear. Note that you can change the title and appearance of the Legend here.

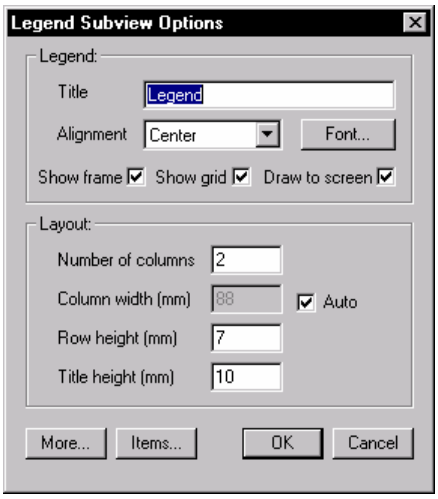

Figure 9.13: Legend Sub-view Options Dialog

NOTE: When the *Auto* check box is enabled, the frame in which they are found determines the width of the column. Making the frame smaller or larger by clicking and dragging on any of the eight handles will increase column width. If you disable the *Auto* option, the column width can be changed manually.

12. Press the *More* button to activate the More Legend Sub-view Options as shown in the figure below.

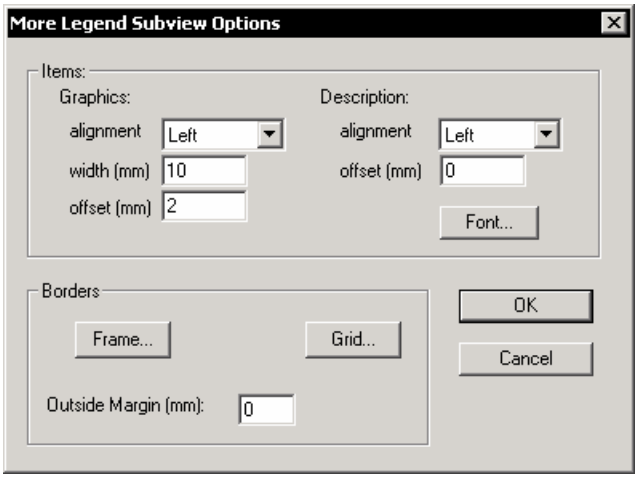

Figure 9.14: More Legend Subview Options Dialog

13. Change the *width* and *offset* items to match the figure above. (Pressing the *Frame* or *Grid* buttons changes the line-types used to draw each of these). Press OK, to return to the main dialog box.

14. Press the *Items* button.

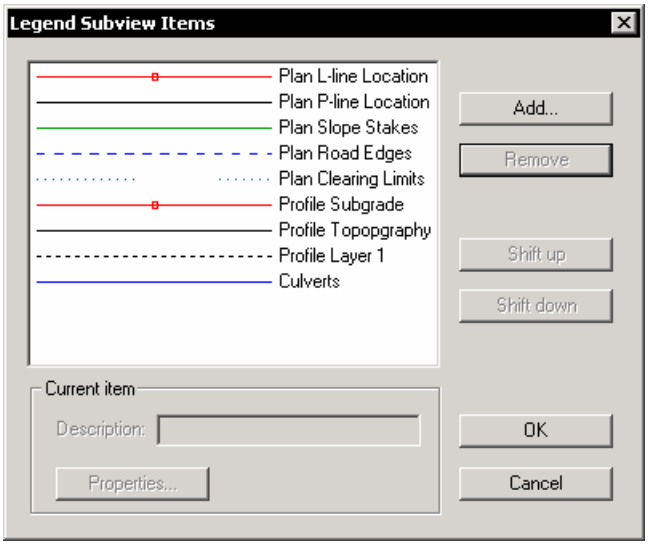

Figure 9.15: Legend Items *Dialog Box*

15. Change the description of "Plan Culverts" to "Culverts". Highlight the item and change the name in the *Description* box.

16. Remove all of the Items except for the ones shown above; highlight an item then press the *Remove* button.

17. *Shift down* "Culverts" to the bottom.

To change a line-type for a particular item, double click on the item or click *Properties*. There are no line-type changes for this example

If the Terrain background is turned on in Plan, then you should also display some of the Terrain line-types in the legend.

18. Add in the *Major contour (10m)* and *Minor contour (2m)* items shown in Figure 9.11. Press the *Add* button; choose a line-type or symbol. Press OK. Then add a *Description* for the resulting line-type.

19. Once you are done press *OK*, then *OK* again.

The Result is a Legend similar to the one shown in Figure 9.11.

20. Move and resize the legend so that it fills the gap created by deleting the original legend

NOTE: If this were a real output sheet you would now **save the screen layout** so that you could re-use it to print from any design. Then you would print your design.

21. Proceed to step 3 in the next section or select File | Close. Do not save changes.

Creating a Title Block

In this section you will create a title block, similar to the one used in the previous section.

To do the examples in this section the *P-Line Design, Multi-Plot Output Sheet Generation* and *Sub-surfaces* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open. Select **RoadEng\Tutorial\Location\drafting.DSN.** Press *Open*.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. In the File | Print Setup dialog box, change the orientation to *Landscape*, and the Paper size to 8.5 " by 14 " (legal).

3. File | Retrieve Screen layout. Select **RoadEng\Tutorial\Location\output plan over profile.DLT.** Maximize the Multi-Plot Window. Your screen will appear like Figure 9.3 in the previous section

4. From menu Edit | New Sub-view, select *Rectangle*.

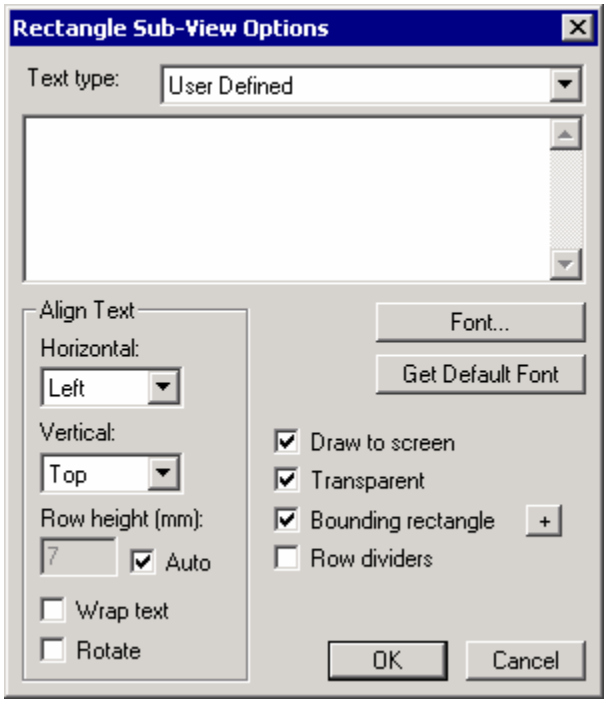

Figure 9.16: Rectangle Sub-view Options Dialog.

Rectangles can hold any text you wish to type or any of a number of pre-defined items found in the *Text type:* pull-down box.

Sometimes it is useful to use an *empty* rectangle just for its border graphic.

5. Type your name or some other text in the text box. Multiple lines are allowed. Change horizontal alignment to *Center*. Check the *Wrap text* option. Click on the *Font* button and change the size to 20. Press *OK* and *OK* again.

6. Arrange the new rectangle to the lower left as in the figure below.

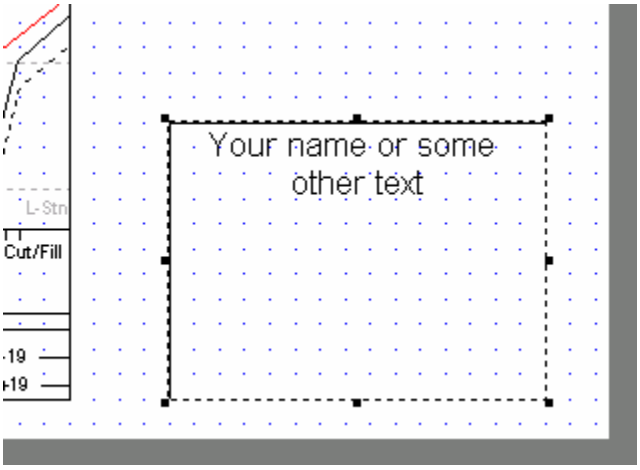

*Figure 9.17: A New Rectangle Sub-view with C*entered, *W*rapped *Text in a Large Font.*

7. Create two more rectangles. In the first select *Print Date* from the *Text type* combo box. In the second select *Design File Name* and be sure to check *Wrap text*.

8. Arrange the two new rectangles to fit in the first rectangle. Notice how the snap to grid feature helps line up edges. Do not forget about Edit | Shuffle Front to Back, <Control + K>, if you get one rectangle stuck behind the other.

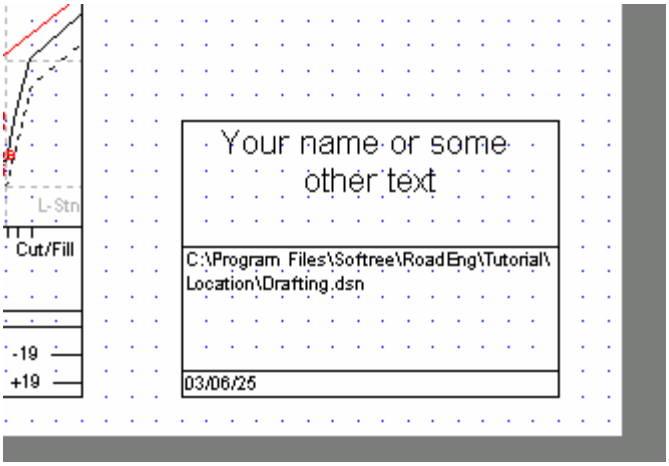

Figure 9.18: The Beginning of a Title Block

9. File | Close. Do not save changes.

Exporting Graphic Data in DWG Format

The Location module can export graphics and co-ordinates in DWG and DXF formats (AutoCAD). It can also export raw co-ordinates in an ASCII format.

In this example you will export the Plan view of a finished design so that a digital terrain model of the proposed road can be created and contoured.

To do the examples in this section the *Terrain Design,* and *Basic Curves* function groups should be enabled. See *Function Groups* in the introduction above and in the On-line help for more information.

1. File | Open. Select **RoadEng\Tutorial\Location\export.DSN**. Press Open.

Note: If you are using RoadEng® Lite or RoadEng® Civil Assistant and the "Non Permitted Functions Found in File" dialog appears, choose "Keep all functions and revert to DEMO Mode".

2. Select menu File | Save As and the *Choose Location Design Save name:* dialog box will appear.

3. Under the *Save File as type:* selection box, choose *AutoCAD Drawing (*.DWG).*

The DXF and DWG formats look the same if opened in AutoCAD. Softree's terrain module can read all three of these export formats but as of this printing there is no direct import of Location data into Terrain.

4. Keep the default name, ***Export***. Press *Save*. The *Export DWG/DXF Options* dialog box will appear. Change the dialog so that it has the same information as Figure 9.19

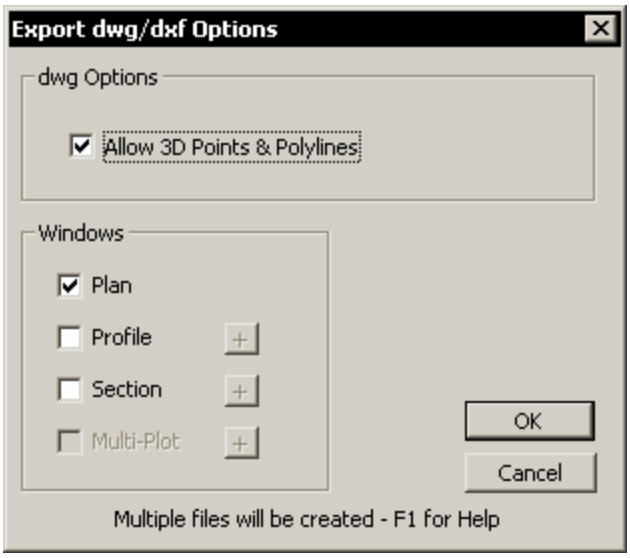

Figure 9.19: Select Layers for DXF Export Dialog.

Profile, Section , and Multi-Plot outputs are saved to separate files and, unlike the Plan output, contain little real co-ordinate information – they are pictures rather than models.

NOTE: Labels and some features must be *displayed* in the Plan, Profile or Section to be exported as entities.

5. Press *OK* to create the DWG file.

6. File | Close. Do not save changes.

The rest of this exercise uses the Terrain module. You may skip the remaining steps and just look at the finished output.

Optional Steps:

7. Select Module | To Terrain to start the Terrain module.

8. File | Open the file created above. Refer to section *Creating a contour map* in the Terrain Module Tutorial manual, on how to Import a DWG File.

9. Select the two slope stake features (SLOPE_ST). J*oin* and *Close* the features. Change the properties of this feature to be a *TIN Boundary*.

10. Edit | Calculate Terrain Model to create a TIN model and contours.

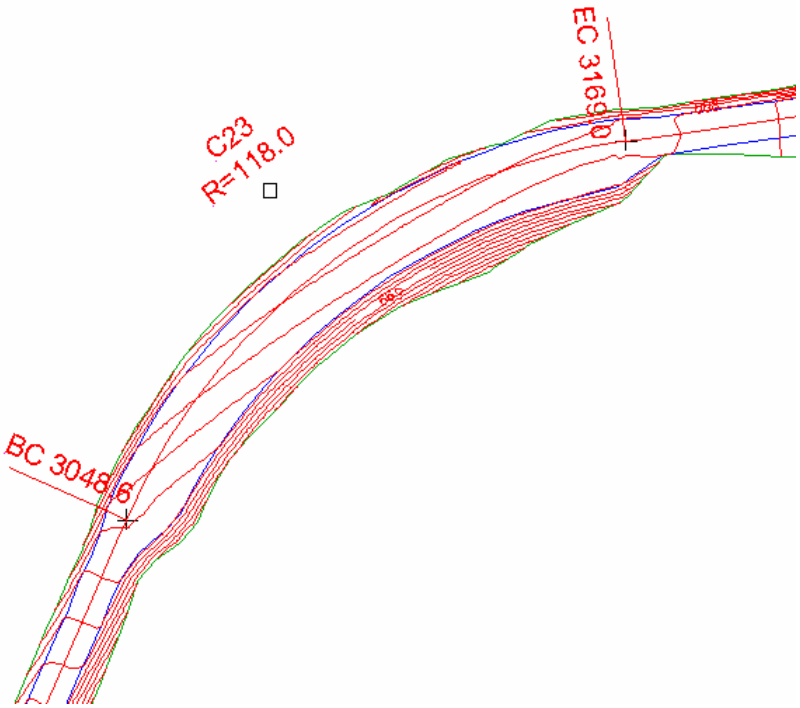

Figure 9.20: Contours Created in the Terrain Module from an Exported Location Design.

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