Bentley® 2003 GEOPAK®
User Training Conference

Intersection Design with Site Modeler - Advanced

Hands-on Workshops

Presenter: Michael Gilham, Bentley Civil

Bentley Systems, Incorporated
685 Stockton Drive
Exton, PA 19341
www.bentley.com

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Intersection/Roundabout Design with GEOPAK Site - Advanced

TABLE OF CONTENTS

CREATE AND EDIT CURB RETURNS

CREATE COMPLEX TRAFFIC CIRCLE CENTER ISLAND

CREATE MEDIAN ISLANDS

1 Project Overview

CHAPTER OBJECTIVES

In this chapter we will:

- overview the original data supplied for this project.
- formulate a design strategy.

INTRODUCTION

Designers will realize that every “at grade” intersection has its own specific design issues.

What may look the same from plan view may be a totally different design vertically due to the existing vertical conditions or specific requirements.

The amount of reconstruction of existing roadway can completely change the designers approach to two seemingly similar geometrical layouts.

We shall investigate the design constraints of this particular project and formulate an initial design strategy. This strategy may need to be varied or modified further along the design path based on outcomes at each step, but we need some strategy to begin with to make a start.

We will overview the supplied data and constraints for this specific situation.

PROJECT OVERVIEW

This training session evolved from an actual project sent to GEOPAK by a client who was seeking assistance. The steps we will undertake in this training session mirror those formulated during the process of assisting the client.

We shall look at the information that was originally supplied when this project first started.

- The Client had completed a survey of the existing conditions and created a TIN file. They had completed the geometric layout of the new intersection and had designed a controlling Chain and Profile.
- The Chain (VAN1) and Profile (PROPVAN1), together forming the *Control Alignment***,** have been approved by the Project Engineer and could not be modified.
- Other constraints included the strict requirement to tie down to original within the existing right of way and a maximum length reconstruction on the service roads of 150 feet.

Review the Project Data

1. Open the file *C:\Data\Geo\Site\Roundabout\Chapter2\LHSRAB.dgn.*

   This file will initially display the reference file that contains the survey information from the existing intersection arrangement.

   In class, we shall discuss the existing arrangement on the intersection. Note that the controlling alignment is based on an existing overpass bridge.

2. Select the **File Reference** tool *(MS: File > Reference).*
3. Toggle off *existing.dgn* and toggle on *proposed.dgn*.

   We shall discuss the proposed layout and based on this layout, what are the requirements to begin a Site Modeler project.

4. Toggle off *proposed.dgn*.
5. Select the **MicroStation Level Display** tool (MS: *Settings > Level > Display).*
6. Turn on all levels in the active design file.

   This shows all of the plan view graphical elements required to begin this project.

   We shall discuss the graphical elements that are displayed and their significance.

7. Select the **Design and Computation Manager** tool *(Applications > GEOPAK Site > Design and Computations Manager)*.
8. Open the file *C:\Data\Geo\Site\Roundabout\site.ddb (File > Open).*
9. Close the Design and Computation Manager dialog.

DESIGN STRATEGY

We need to formulate a Design Strategy based on the constraints of the project, the given information and the desired project outcome.

This strategy could change during the course of this project due to design issues or constraints that are either unknown or unforeseen at this time.

Modification of a design strategy is typical of a lot of intricate design projects and the GEOPAK Site Modeler tools provide the User with the type of flexibility required to take changes into consideration as they arise.

PROJECT CONSTRAINTS

The Control Alignment is set. It cannot be changed.

Maximum allowable reconstruction of the services roads is 150 feet.

Right of way cannot be altered.

Hint This means we stay as close as possible to the existing intersection elements and elevations.

FORMULATE A DESIGN STRATEGY

There are a number of different design philosophies for designing roundabouts. We will not be examining all of the different theories in this class. The philosophy that we will use is one that treats the traffic circle portion of the intersections as an “upside down plate”. This means that irrespective of the orientation of the traffic circle, the outside edge is always forms a plane surface.

1. Given the project constraints, we need to design the intersection based around the control alignment and create the traffic circle portion of the intersection so it is as close to the existing intersection elevations as possible.
2. Creation of the Traffic Circle will be based on a plane that is defined relative to the Control Alignment. After the plane is created the outside edge of the Traffic Circle will be draped onto the construction plane and then the inside edge of the Traffic Circle will be created at a positive 2% slope from the outside edge.
3. We shall then analyze the difference in elevation between the outside edge of the Traffic Circle and the existing surface at critical points and, if required, redesign the Traffic circle until we are achieved a satisfactory stage of the design.
4. The incoming roadway profiles (other than the Control Alignment) will be designed based on the Traffic Circle elevations.
5. The incoming roadways will be modeled based on the design profiles.
6. Curb returns will initially be defined based on the most appropriate adjacent element then modified as required.
7. The median islands will be created based on the finished pavement surface.

2 Create the Traffic Circle

CHAPTER OBJECTIVES

In this chapter we will:

- create a Construction Object based on the Control Alignment.
- create and analysis the Traffic Circle.
- modify and re-analysis the Traffic Circle.

INTRODUCTION

Based on the design strategy that we have set, we need to devise a way to assign elevations to the outside edge of the traffic circle.

As an additional consideration, we should formulate this step with the thought that it may need to be redesigned (*probably will need to be redesigned*) and that we should create this element with the redesign issue in mind.

The use of Construction Objects with GEOPAK Site Modeler is a very powerful way to assign elevations to irregular or complex elements AND provide a way to make redesign a very fast and painless process.

TOOLS TO BE USED

The tools we will use in this chapter are:

- Site Modeler > Object > New.
- Site Modeler > Elements > Composite Section.
- Site Modeler > Elements > New/Edit > Drape on Model/Object.
- Site Modeler > Elements > New/Edit > Section.
- Site Modeler > Elements > Information.
- Site Modeler > Analysis > Profile.

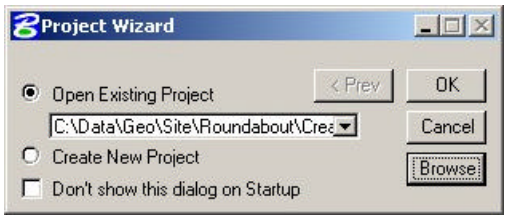
CREATE A CONSTRUCTION OBJECT

A *Construction Object* is defined as a Site Modeler Object that is in the Modeler project but not necessarily part of the Model. Its primary use is to simplify the process of assigning, and then reassigning, elevations to irregular or complex Site Modeler Elements.

The methodology we shall use to create the construction object is to create a new Object and, within that Object, define a surface plane based on the Control Alignment.

Open an Existing Project

1. Select the **Site Modeler** tool *(Applications > GEOPAK Site > Site Modeler > Site Modeling)*.



2. Click **Browse.**
3. Navigate to and select *C:\Data\Geo\Site\Roundabout\Chapter2\LHSRAB.gsf.*

   This is a Site Modeler project that has already been created that includes the existing ground TIN file as the Object "Ground 1" and a Model called "RAB" that has the Ground 1 Object as its base.
3. Click **OK**.

Create a Construction Object

1. Select the **Create New Object** tool *(Site Modeler menu: Object > New)*.

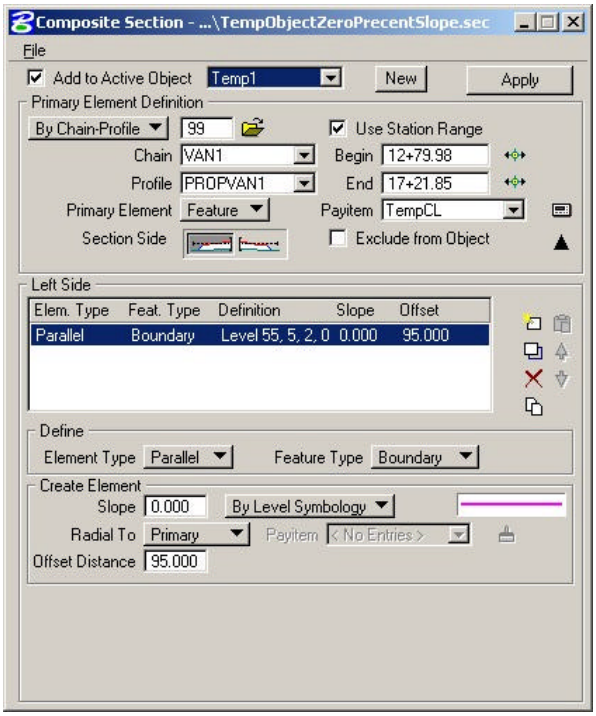
2. Enter the New Object information.

Object Type	Construction
Object Name	Temp1
Add to Active Model	Disable

3. Click **OK**.

Create the Construction Surface Using Composite Section

1. Select the **Composite Section** tool *(Site Modeler: Elements > Composite Section)*.
2. Select the Composite Sections setting file: *C:\Data\Geo\Site\Roundabout\Chapter2\TempObjectZeroPercentSlope.sec. (Site Modeler: File > Open).*



3. Define the **Primary Element Definitions.**

Add to Active Object	Enable
By Chain-Profile	99 (Job Number)
Chain:	VAN1
Profile:	PROPVAN1
Primary Element:	Feature
Payitem	\Drafting Standards\General\TempCL
Use Station Range	Enable
Begin	12+79.98
End	17+21.85

Warning Ensure that the Active Object is "Temp 1". Check the Active Object Control dialog.

4. Click **Apply**.

   We have now created a surface that is 190 feet wide (95 feet both sides of the control alignment) and is projected at 0% from on the control alignment.

   While this surface has no slope in the north/south direction, it will still drain based on the longitudinal slope of the alignment it was created from.

CREATE THE ROUNDABOUT OBJECT

Based on the design strategy that was discussed earlier, we will now start to create the elements that will make up our intersection (roundabout).

First, we need to create an Object to place the roundabout elements into.

Then we will drape the outside edge of the traffic circle onto the Construction Object.

The last step is to create the inside edge of the traffic circle to give us the 2% pavement cross slope within the traffic circle.

Create the Roundabout Object

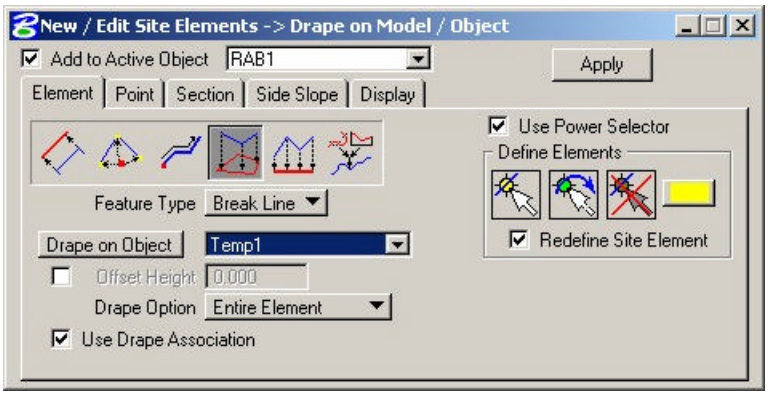
1. Select the **Create New Object** tool *(Site Modeler menu: Object > New).*
2. Enter the New Object information.

Object Type	Roadway
Object Name	RAB1 (overwrite default)
Add to Active Model	Enable

3. Click **OK**.

Create Outside Edge of Traffic Circle Element

1. Select the **New / Edit Element** tool *(Site Modeler menu: Element > New/ Edit).*



2. Click **Drape on Model/Object** on the Elements tab.
3. Enter the Element information.

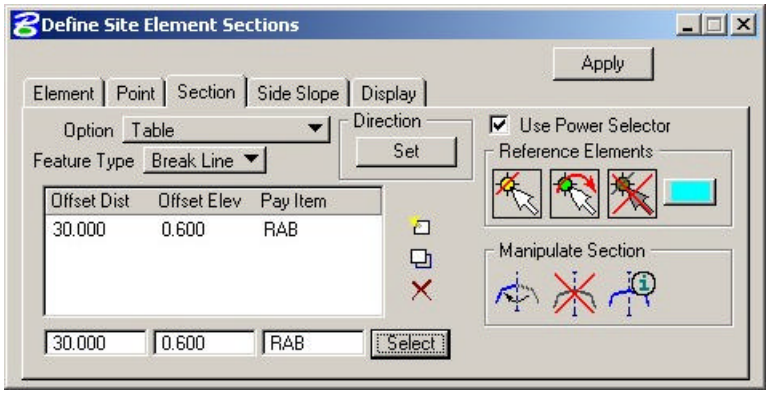
Add to Active Object	Enable
Feature Type	Break Line
Drape on Object	Temp 1
Offset Height	Disable
Drape Option	Entire Element
Use Drape Association	Enable
Use Power Selector	Enable
Redefine Site element	Enable

4. Click **Select Elements** in the Define Elements group box.
5. Select the outside edge of the traffic circle.

   The element highlights when selected. Make sure it is the same color as your highlight color.
6. Click **Apply**.

Create the Inside Edge of the Traffic Circle

1. Select the **New / Edit Element** tool *(Site Modeler menu: Element > New/ Edit)*.
2. Select the **Section** tab.



3. Enter the Section information.

Option	Table
Feature Type	Break Line

4. Enter the information in the edit boxes along the bottom.

Offset Distance	30
Offset Elevation	0.6

5. Click **Select** to find the DDB Pay Item and navigate to PayItem > Plan > Curbing > RAB Edge of Pavement.
6. Select the item and click **OK**.
7. Click **Add List Item**.
8. Click **Select Reference Elements** in the Reference Elements group box.
9. **Select and accept** the outside edge of the traffic circle**.**

Hint It is important that the outside edge element changes color to the color displayed in the Reference Elements group box.

10. Click **Set** in the Direction group box.
11. Point the direction of the dynamic graphic **inside** the selected element. Data point to accept the direction.
12. Click **Apply**.

    There should be a new element created and the contours of the RAB1 Object should indicate a 2% pavement cross slope.

Note This can be interrogated using the Analysis > Height tool.

ANALYZE THE TRAFFIC CIRCLE

At this time, we need to determine if this first attempt at the traffic circle meets the design constraints. Specifically, how close do we match the existing elevations? We need to determine the difference in elevation between the proposed and the existing.

The critical locations to check this difference in elevation are at the centerline of the incoming ramps and service roads.

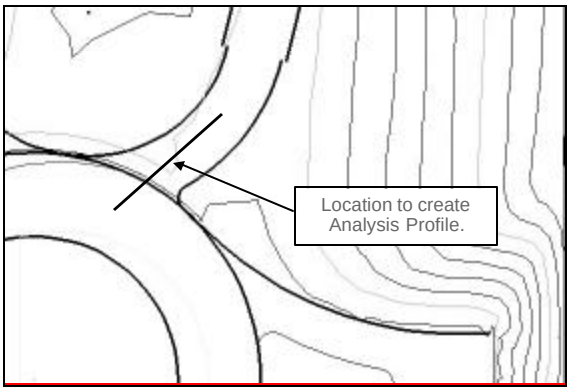
> ***Note*** As the control alignment has previously been set as a constraint, there is no need to check the elevation differences for these roads.

There is more than one tool that would be suitable for the analysis task that we have. The tool we will use is the Site Profile tool. Another option would be the Elevation Differences tool.

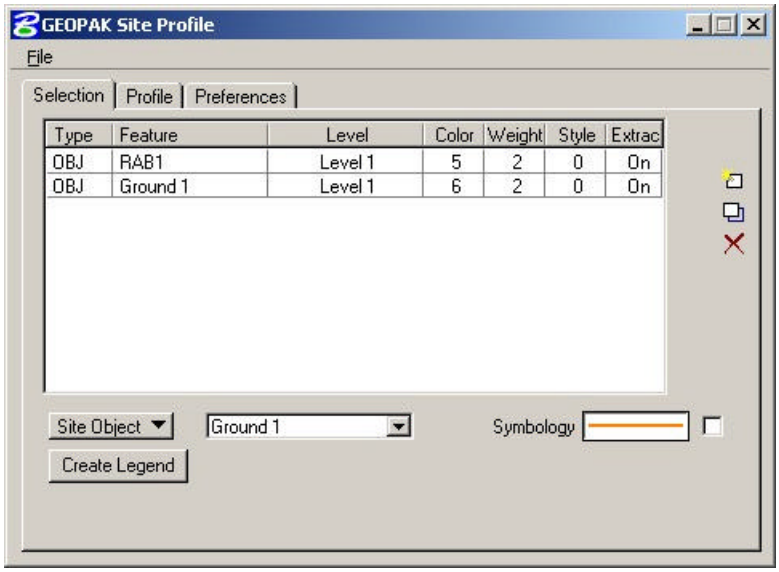
We will opt for the Profile tool in this case due to the very visual and specific feedback it provides.

Using the Site Profile Tool

1. Select the MicroStation **Saved Views** tool *(MS: Utilities menu > Saved Views)*.
2. Select PROFILE and click **Apply**.



3. Select the **Site Profile** tool. *(Site Modeler: > Analysis > Profiles)*.



4. Select **Site Object.**
5. Set the **Site Object** to RAB1.
6. Set the element symbology by double-clicking the sample line graphic.
7. Click **OK** to close Set Feature dialog.
8. Click **Add List Item** (right side of dialog).
9. Change the **Site Object** to Ground1.
10. Set the element symbology by double-clicking the sample line graphic.
11. Click **OK** to close Set Feature dialog.
12. Select the **Profile** tab.
13. Click **Place Element** and place two data points to create the line.

Note The line should pass from the traffic circle surface onto the North Ramp roadway at approximately the ramp centerline.

The profile view of the Site profile tool displays the two surfaces. We can immediately see the difference in elevation between them.

13. Select the **Preferences** tab.
14. Toggle on the Major and Minor Vertical Grid intervals.
15. Select the **Profile** tab.

    The Profile is displayed showing the vertical grid intervals.

Note Investigate the elevation difference in the same manner at the South Ramp and the North and South Service Roads.

MODIFY THE TRAFFIC CIRCLE

It has been determined that the current elevations of the traffic circle are not acceptable. We will modify these elevations and analyze the result.

As the traffic circle elevations are based on the plane created in the construction object, all we need to do is modify the construction object and the traffic circle automatically reflects these changes.

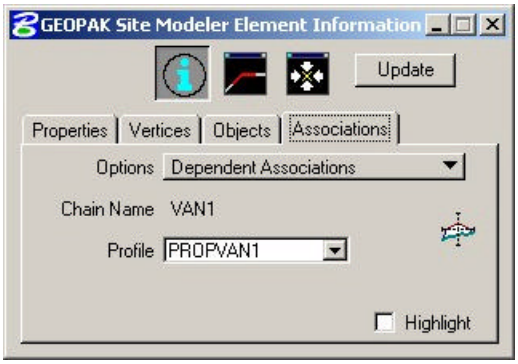
This can be accomplished due to the GEOPAK Site Modeler "association" technology. Site Modeler tracks and remembers the way that elements are created. Using this tracking system provides the user with a powerful tool to automatically update linked data.

If we remember back to what we have done, the construction object is a simple surface based on the control alignment chain and profile. The outside of the traffic circle is dependent on that construction surface and was created from it (Elements > New/Edit > Drape on Object). The inside of the traffic circle was created based on the outside element (Elements > New/Edit > Section). Therefore, if we modify the construction surface, all of the traffic circle elements update to reflect the surface change.

Modify the Construction Object

1. Select the **Site Modeler Element Information** tool *(Elements > Information)*.
2. Click **ID**.

3. *Select and accept* the construction centerline element.
4. Select the **Associations** tab.



 Composite Section

5. Set the **Options** to Dependent Associations.
6. Click **Composite Section** (to the right of profile).

   The Composite Section dialog opens with the settings used to create this element.

Note We will edit the Left Side and Right Side element so they provide a 1% cross slope from left to right.

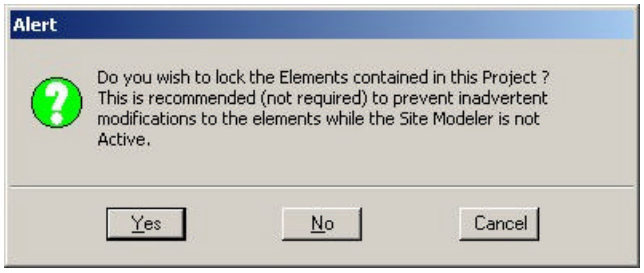
7. Click **Section Side** Left Side.
8. Select the parallel element.
9. Change the slope to 1%.
10. Click **Modify** (right side of list box).
11. Click **Section Side** Right Side.
12. Select the parallel element.
13. Change the slope to -1%.
14. Click **Modify** (right side of list box).
15. Click **Apply**.

    This updates all of the elements that are linked to the construction surface.
16. Refresh the MicroStation view to see the effect that this has had on the traffic circle.
17. Use the Site Profile tool to repeat the analysis of the incoming roadways to visually see the difference that this has made.

Note We will accept this design and move on to the next design stage.

Closing the Project

1. Close GEOPAK Site Modeler (*Site Modeler: Project > Exit*).
2. Click **Yes** to the Save alert.
3. Click **No** to the Lock Elements alert.



3 Create Additional Incoming Profiles

CHAPTER OBJECTIVES

In this chapter we will:

- design the incoming profiles for the ramps and service roads.

INTRODUCTION

Now that we have decided that the first design step is acceptable, the next logical step is to design the incoming roadway profiles.

This could have been completed earlier in the design process but would have been quite difficult and resulted in data that may have needed to be revised.

Starting this process now gives us a distinct advantage in that we now know what the elevations of the traffic circle are and we can use this information to make intelligent design decisions.

The process we shall use is as follows.

1. Create existing surface profiles based on the Model for each incoming roadway.
2. Design the proposed profile for each incoming roadway.

TOOLS TO BE USED

The tools we will use in this chapter are:

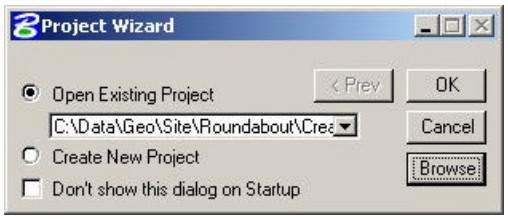
- Site Modeler > Object > Draw Profile.
- Applications > GEOPAK Site > Active Profile Control.
- Applications > GEOPAK Site > Geometry > Layout Profile (Component Based).

CREATE MODEL SURFACE PROFILES

To ensure that all students have the same data, we are using another dataset.

Open the Site Project

1. Open the file *C:\Data\Geo\Site\Roundabout\Chapter3\LHSRAB.dgn* (*MicroStation: File>Open*).
2. Select the **Site Modeler** tool *(Applications > GEOPAK Site > Site Modeler > Site Modeling).*

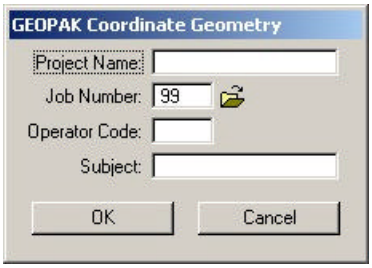


3. Click **Browse**.
4. Navigate to and select the file *C:\Data\Geo\Site\Roundabout\Chapter3\LHSRAB.gsf.*
5. Click **OK**.

View Chain Locations

We shall look at the location and extents of the chains before creating the profiles and discuss the significance of the chain ending point.

1. Select the **Coordinate Geometry** tool (*Applications > GEOPAK Site > Geometry > Coordinate Geometry*).



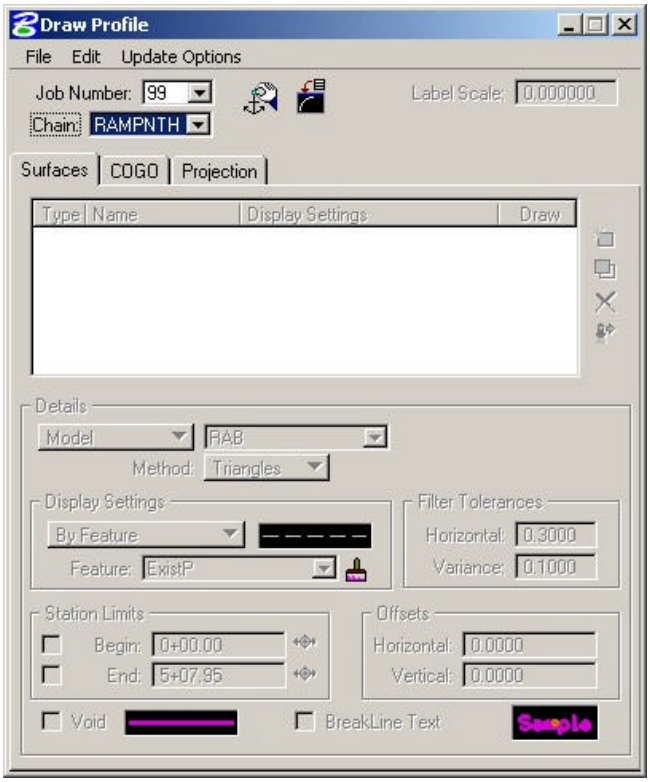
2. Select **Job Number** 99.
3. Click **OK**.
4. Set **Visualization** to temporary.
5. Click **Navigator**.
6. Lower (*minimize*) the COGO window.
7. In the Navigator dialog, set **Element** to Chain.
8. Select and visualize the chains – **RampSth, RampNth, ServSth and ServNth**.
9. Close Navigator – leave COGO open.

Create Model Surface Profiles

1. Select the **Object Draw Profile** tool (*Site Modeler: Object>Draw Profiles*).

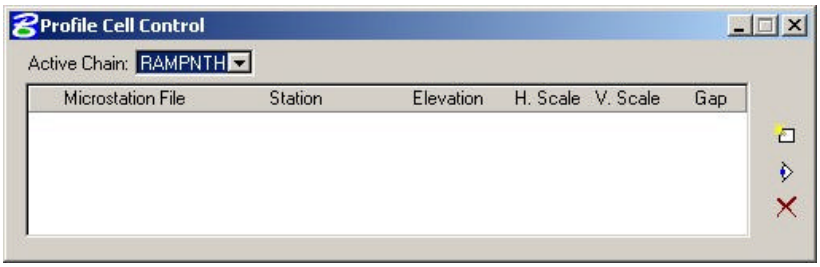
Note The Draw profile dialog should be familiar to most students as it is a standard GEOPAK tool. When used as a Site Modeler tool, it has additional functionality. It has the ability to not only create profiles from TIN files, but also from Site Objects and Models.

2. Set **Job Number** to 99.
3. Set **Chain** to RampNth.



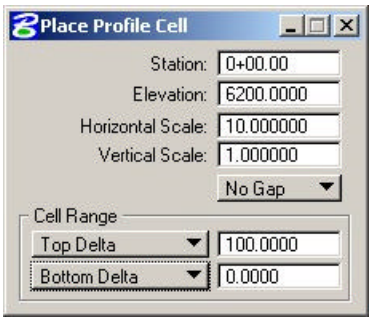
	Dialog Profile Cell Control
	Update Profile

4. Click **Dialog Profile Cell Control**.



	Place Profile Cell
	Activate Profile Cell
	Delete Profile Cell

5. Click **Place Profile Cell**.

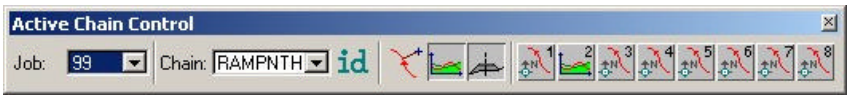


6. Enter the Profile Cell information.

Station	0+00
Elevation	6200
Horizontal Scale	10
Vertical Scale	1
Gap Option	No Gap
Cell Range: Top Delta	100
Cell Range: Bottom Delta	0

7. Place the Profile cell into a clear part of the graphics (in Window 2).

8. Select the **Active Chain Control** tool (*Applications>GEOPAK Site>Site Modeler>Active Chain Control*).



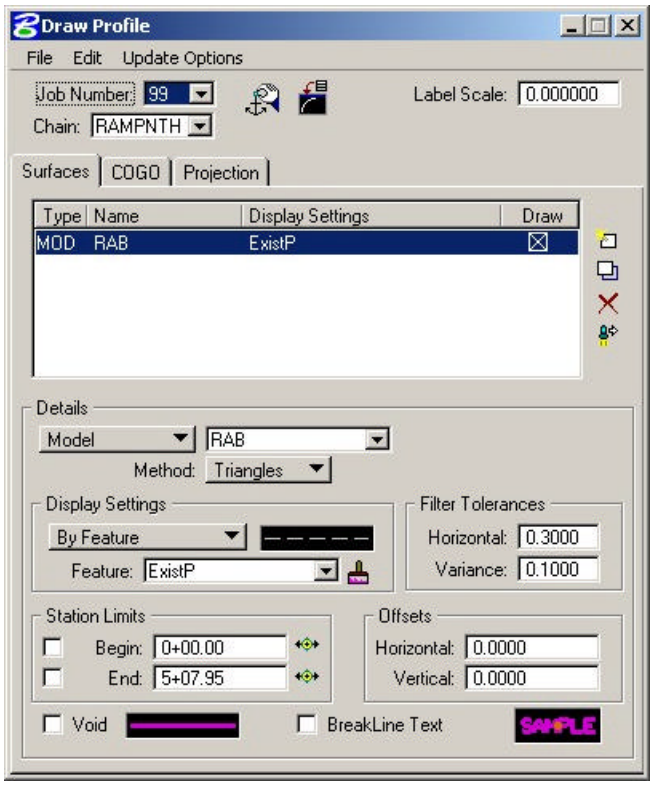
Job: 99	Active Job Number
Chain: RAMPNTH	Active Chain
id	Identify Curvilinear Reference
	Curvilinear Coordinates
	Profile Cell Status
	Cross Section Cell Status
1 2 3 4 5 6 7 8	Fit View Buttons (Right Click to Define Status).

9. Set Window 2 to a Profile view in the Active Chain Control.

   This is accomplished by *right clicking* on the View 2 button in the dialog and setting the view to profile.

Note This will coordinate between the plan and profile views of RampNth chain.

10. Enter the Draw Profile information.



Job Number	99
Chain	RAMPNTH
Details	Model > RAB, Method > Triangles
Display Settings	By Feature: Pay Item (*Drafting Standards* > *Profiles* > *ExistP*)

11. Click **Add Surface Settings**.

    When the surface is added to the list box, it is immediately drawn into the Profile Cell.

Note The same process will now be repeated to create the Model profiles for the Chains **RampSth**, **ServNth** and **ServSth**.

12. Exit and save the Site Modeler project.

    It is not required for the remainder of this chapter.

CREATING DESIGN PROFILES

Now that we have drawn the Model surface profiles, we are in the position where we can create design profiles. We already have some constraints that affect this next step. The Model profiles show us the elevation at the proposed traffic circle edge, so the design profiles must start at that elevation.

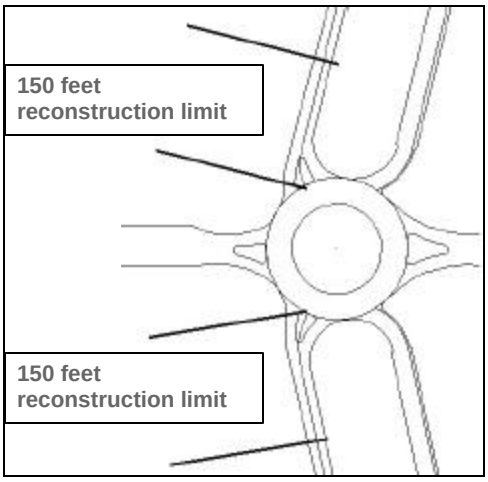
The cross slope of the traffic circles is 2%. For us to get a smooth transition for the incoming roadways to the traffic circle, we must start the design profiles using a 2% tangent from the location that we join to the traffic circle.

The service roads cannot be reconstructed any more than 150 feet. We will draw this location into the plan and profile to give us a visual indication of this design constraint.

Locate the Maximum Reconstruction Constraint in Plan

1. Select the **Place Line** tool. (*MicroStation > Place Line*).
2. Draw a line that is perpendicular to the tangent sections of the Chains **ServSth** and **ServNth** at there ending stations.
3. Copy the line parallel 150 feet back along the respective chain.

   This gives us the 150 feet reconstruction constraint in plan view.



Locate the Maximum Reconstruction Constraint in Profile

1. Set Active Chain Control (ACC) to the Chain **ServNth** and synchronize the views.

Note Synchronize the views by clicking in the ACC Plan View window and Profile View window.

2. Click **Curvilinear Coordinates** (Active Chain Control toolbox).

   As you move in plan view the curvilinear coordinates will display station and offset. As you move in profile view the curvilinear coordinates will display station and elevation.
3. In Plan, snap to the line that indicates the maximum extent of reconstruction.

4. Lock (*toggle on*) the **Station** and **Permanent Lock** controls in the Curvilinear Coordinates dialog.

   The stations may be different as we did not accurately draw the reconstruction limit line.

5. Select the **Place Line** tool (*Microstation>Place Line*).
6. Draw a line in the profile view.

Note Due to the effect of the curvilinear coordinates tool, the line is drawn at the correct station and can only be drawn vertically.

7. Unlock the Station and Permanent Lock controls.
8. Set Active Chain Control (ACC) to the Chain **ServSth** and synchronize the views.
9. **Follow Step 3 to Step 7 for the ServSth Chain.**

   This gives us the 150 feet reconstruction constraint in profile view.

Creating Design Profiles Using the Vertical Component Tools

Warning Wait and follow you Instructor before you attempt these steps if you have not used these tools before.

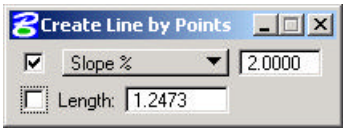
1. Set ACC to the chain **ServNth**.
2. Synchronize the views.
3. Use MicroStation view controls to set the allowable reconstruction portion to fill the plan and profile designated views.
4. Select the **Layout Profile (Component Based)** tool (*Applications > GEOPAK Site > Geometry > Layout Profile (Component Based)).*

	Tangent Tools
	Curve Tools
	Store Alignment Button/tool

5. Tear off the tangent tools and the curve tools.

Hint These tools provide an alternate to the VPI based Vertical Alignment Generator. They allow the user to place vertical components (tangents and curves) to assemble a profile. Where the user has many constraints (as it the situation here) they are a very useful alternative to the traditional GEOPAK design profile method.

6. Click **Create Profile Line by Points** (*Place VA Line toolbox*).



7. In Profile View, Snap to the end of the Model profile that represents the elevation at the edge of the traffic circle.
8. Set the slope to 2%.
9. Draw in the tangent.
10. Set the MicroStation snap control to nearest (*MS: Settings > Snaps > Nearest*).
11. Click **Create Profile Curve by 3 Pts** (*Place VA Curve toolbox*).
12. Snap to 3 locations on the Model profile in the area of the extent of reconstruction.

Note This gives us a vertical curve that represents the existing service road centerline – so w can join back to existing.

13. Click **Create Tangent Profile Curve** (*Place VA Curve toolbox*).
14. Select the profile tangent, data point in the profile view to designate a “through” point on the curve and then data point again to finish the curve.
15. Click **Create Profile Curve between 2 Elements** (*Place VA Curve toolbox*).
16. Select and accept the first profile curve.
17. Select and accept the second profile curve.
18. Data point to complete the new profile curve.

Storing the Proposed Profile

1. Select the **Store Alignment** (*Vertical Components toolbox*).

2. Key in the **Name** ServNth.
3. Select any proposed profile component from the profile view (Window 2).
4. Data point again to string the components together.
5. Data point again to actually store the alignment to COGO.
6. Click COGO – this will raise the COGO window.

You can see the commands that have been created to store the profile.

Hint Remember to follow the prompts displayed in the MicroStation message area during the design and store profile process.

Determine the Extent of Reconstruction

While we have the ServNth profile activated, we shall use this to determine the extent of reconstruction. Effectively, where the proposed profile joins back to the existing surface is the end of proposed reconstruction.

1. Set MicroStation snap to intersection mode.
2. Click **Curvilinear Coordinates**.
3. In the profile view, snap to the intersection of the existing and proposed profiles.
4. Lock the **Station** and **Permanent Lock** controls in the Curvilinear Coordinates dialog.
5. Click MicroStation **Partial Delete**.
6. In plan view, partial delete both of the ServNth edge of pavement elements.

Note As the Curvilinear Coordinates dialog locks us to a specific station, we are cutting the edge of pavement elements at the same location that the design profile joins to the existing profile.

Design the remaining Proposed Profiles.

1. Design the proposed profiles for the ServSth, RampNth and RampSth in the same way.

Hint Remember to partial delete the ServSth edge of pavement elements similar to exercise above.

4 Model the Incoming Roadways

CHAPTER OBJECTIVES

In this chapter we will:

- model the incoming roadway pavement areas based on the profiles we just designed and the alignment we were provided with.

INTRODUCTION

Now that chains and profiles have been created for all of the incoming roadways, the next step is to model the incoming roadway surfaces based on those design alignments. This involves defining the alignment elements, edge of pavements and curb and gutter sections in the Site Model. There are two methods that can be employed to do this. We will attempt both methods and discuss reasons to choose one method over the other. First, we will add the control alignment and then define the associated edge of pavement elements using the basic Site Modeler tools. Then we will define the other 4 incoming roadways using the Composite Section tool.

TOOLS TO BE USED

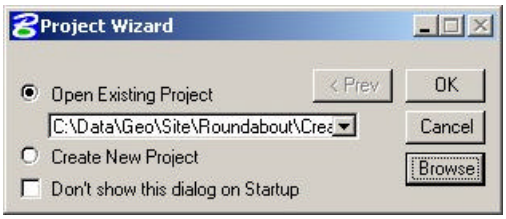
The tools we will use in this chapter are:

- Site Modeler > Elements > New/Edit > Alignment.
- Site Modeler > Elements > New/Edit > Slope/Offset from Site Element.
- Site Modeler > Elements > New/Edit > Section.
- Site Modeler > Elements > Composite Section.

Open the Site Project

Note To ensure that all students have the same data, we are using another dataset.

1. Open the file *C:\Data\Geo\Site\Roundabout\Chapter4\LHSRAB.dgn (MicroStation: File > Open).*
2. Select the **Site Modeler** tool *(Applications > GEOPAK Site > Site Modeler > Site Modeling).*



3. Click **Browse**.

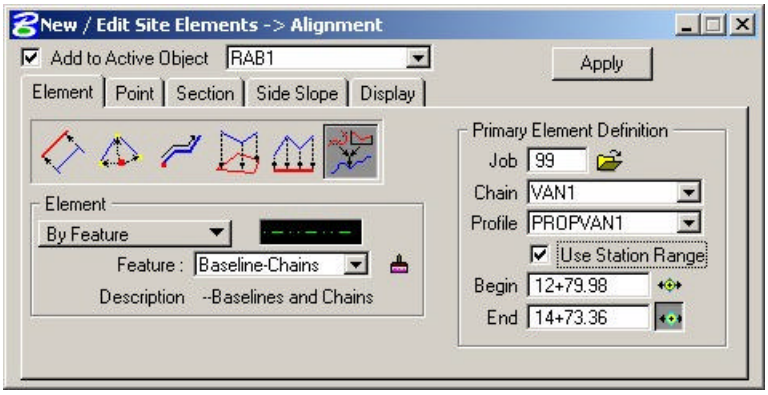
4. Navigate to and select the file *C:\Data\Geo\Site\Roundabout\Chapter4\LHSRAB.gsf.*
5. Click **OK**.

CREATE A ROADWAY SURFACE FROM THE CONTROL ALIGNMENT

Add the Control Alignment

1. Click **Level Display** *(MicroStation: Settings>Level>Display)*.
2. Disable Level 55.
3. Select the **Alignment** tool. (*Site Modeler: Elements>New/Edit>Alignment*).

Note We do not want the alignment element to impact on the traffic circle, only the pavement outside it. Because of this, we will add the Control Alignment to the Object in 2 parts, leaving out the portion across the Traffic Circle.



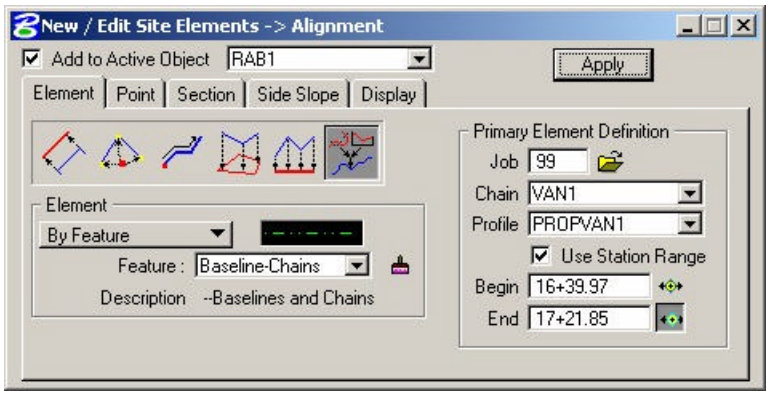
2. Enter the Alignment information.

Element	By Feature: Drafting Standards>General>Baseline-Chains
Job	99
Chain	VAN1
Profile	PROPVAN1
Use Station Range	Enabled
Begin Station	12+79.98
End Station	14+73.36

Hint The Instructor will discuss the Station Range settings.

3. Click **Apply**.

4. Reset the **Station Range** as shown below.

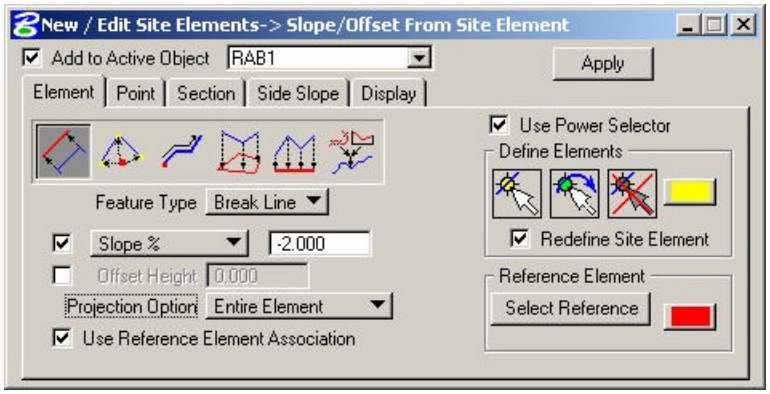


5. Click **Apply**.

   This adds the two required portions of the control alignment to the Object.

Add the Edge of Pavement Elements Relative to the Control Alignment

1. Click **Slope/Offset from Site Element**. (*Site Modeler: Element > New/Edit > Slope/Offset from Site Element*).



2. Enter the Slope/Offset information.

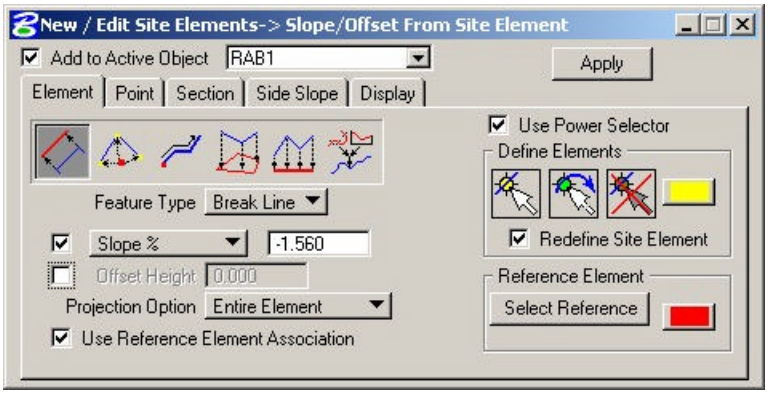
Add to Active Object	Enabled
Feature Type	Breakline
Slope %	Enabled, -2
Projection Option	Entire Element
Use Reference Element Association	Enabled
Use Power Selector	Enabled
Redefine Site Element	Enabled

Note There are two (2) different sections of the control alignment. The cross slope for the road area is -2%. The cross slope for the bridge area is -1.56%. We will need to project the edge of pavement elements to the centerline in 2 steps.

3. Click **Select Element** from the Define Elements group box.
4. Select the 2 western “edge of pavement” complex chains.
5. Click **Select Reference**.
6. Select and accept the western portion of the control alignment element.
7. Click **Apply**.

Note Now we shall repeat these steps for the right hand portion of the control alignment – the pavement over the bridge.

8. Modify the Slope/Offset information.

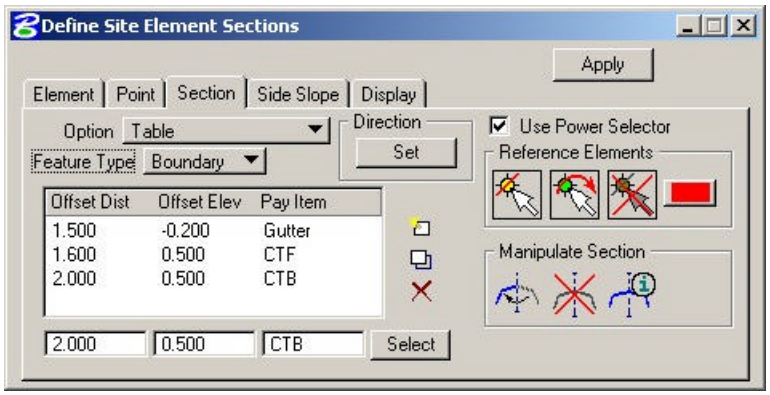


Add to Active Object	Enabled
Feature Type	Breakline
Slope %	Enabled, -1.56
Projection Option	Entire Element

9. Click **Select Element** from the Define Elements group box.
10. Select the two (2) eastern “edge of pavement” complex chains.
11. Click **Select Reference**.
12. Select and accept the left hand portion of the control alignment element.
13. Click **Apply.**

Add the Curb and Gutter Sections to the Edge of Pavement

1. Select the **Section** tool (*Site Modeler: Elements>New/Edit>Section*).



2. Enter the Section information.

Offset Distance	Offset Elevation	Pay Item
1.500	-0.200	PayItem > Plan > CURBING > Gutter
1.600	0.500	PayItem > Plan > CURBING > CTF
2.000	0.500	PayItem > Plan > CURBING > CTB

3. Set the Feature Type to **Boundary**.
4. Click **Select Reference Elements** from the Reference Elements group box.
5. Select the four (4) previously defined edge of pavement Site Elements.
6. Click **Set**.
7. Move the cursor into the graphics.

Note There is a dynamic graphic that is attached to the selected elements. GEOPAK is waiting for the User to set the positive horizontal (offset) direction for the section elements.

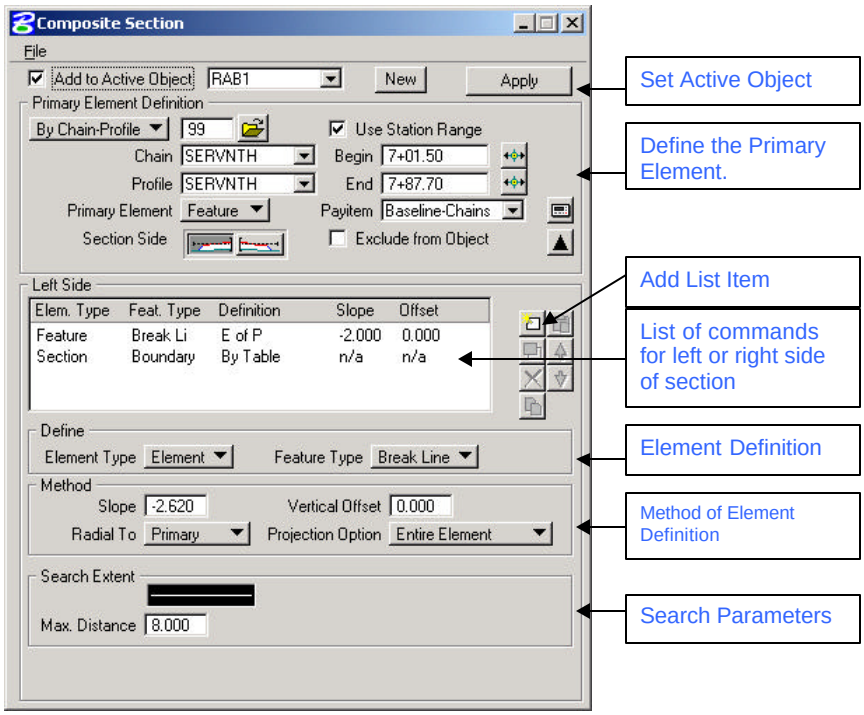
8. Click **outside** of the selected graphics (so the positive direction is to the outside of the edge of pavement).
9. Click **Apply**.

We have added the curb and gutter to the edge of pavement elements.

We will now create the other 4 incoming roadways in a more automated manner using Composite Section.

Add the North Service Road

1. Select the **Composite Section** tool (*Elements>Composite Section*).



Note A number of steps are required to populate this dialog with the required information. Below are dialog captures of each of these steps.

2. Select and delete the current “Left Side” row items.
3. Enter the **Primary Element** Definition group box information.

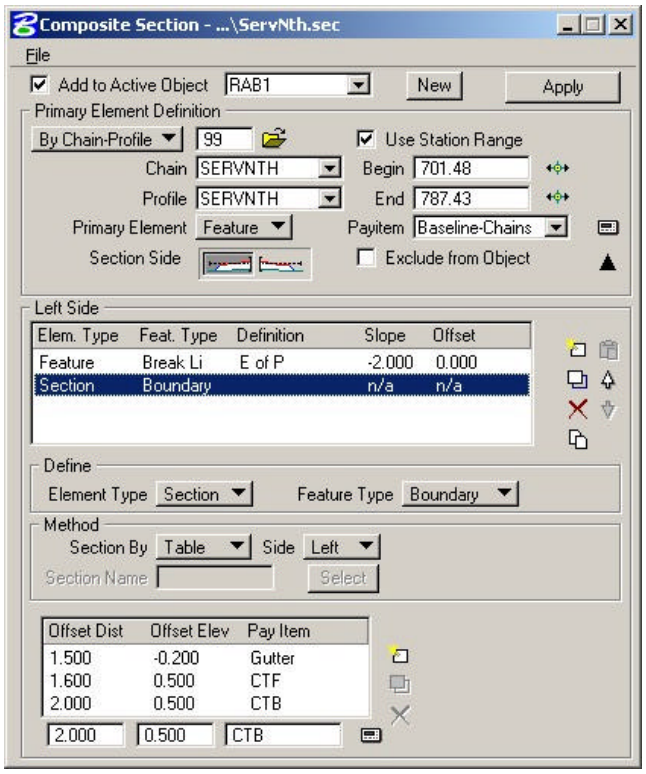
By Chain-Profile	99
Chain	SERVNTH
Profile	SERVNTH
Primary Element	Feature
Use Station Range	Enable
Begin Station	7+01.48
End Station	7+87.43
Payitem	Drafting Standards>General>Baseline-Chains

4. Enter the information required to define the edge of pavement elements.

Define: Element Type	Feature
Define: Feature Type	Breakline
Method: Slope	-2.0
Method: Vertical Offset	0.0
Method: Radial To	Primary
Method: Projection Option	Entire Element
Search Extent: Payitem	PayItem>Plan>CURBING>E of P
Search Extent: Max. Distance	32.0

5. Click **Add List Item** (*right of the list box*).

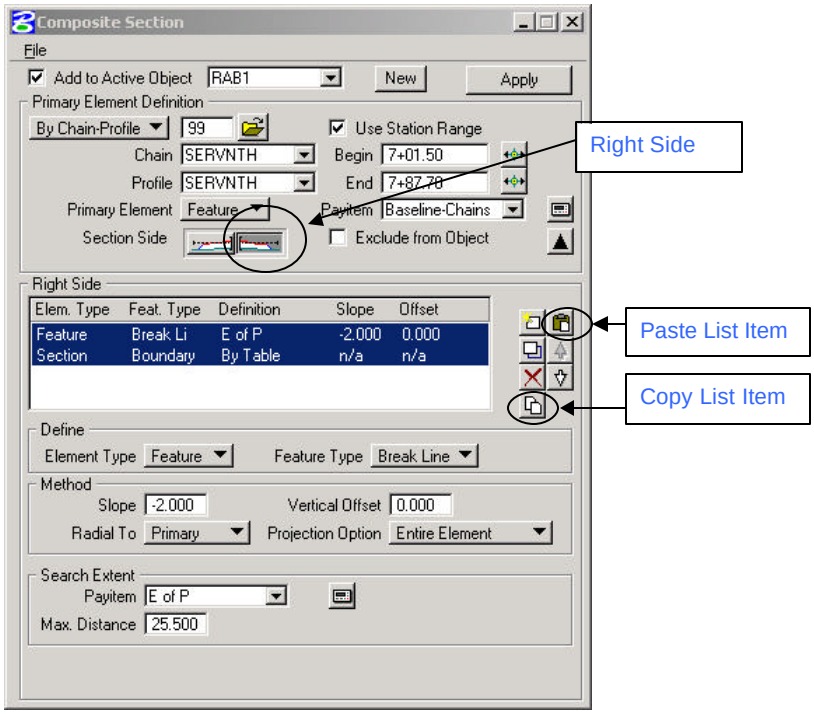
6. Enter the curb and gutter information.



Define: Element Type	Section
Define: Feature Type	Boundary
Method: Section By	Table
Method: Side	Left

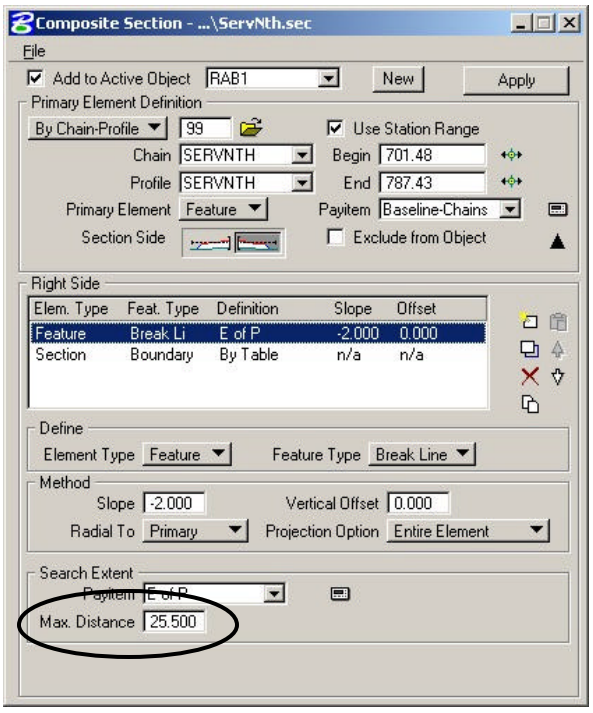
OFFSET DISTANCE	OFFSET ELEVATION	PAY ITEM
1.500	-0.200	PayItem>Plan > CURBING > Gutter
1.600	0.500	PayItem > Plan > CURBING > CTF
2.000	0.500	PayItem > Plan > CURBING > CTB

7. Click **Add List Item**.
8. Select both list items.
9. Click **Copy List Item**.



10. Click **Right Side**.
11. Click **Paste List Item**.

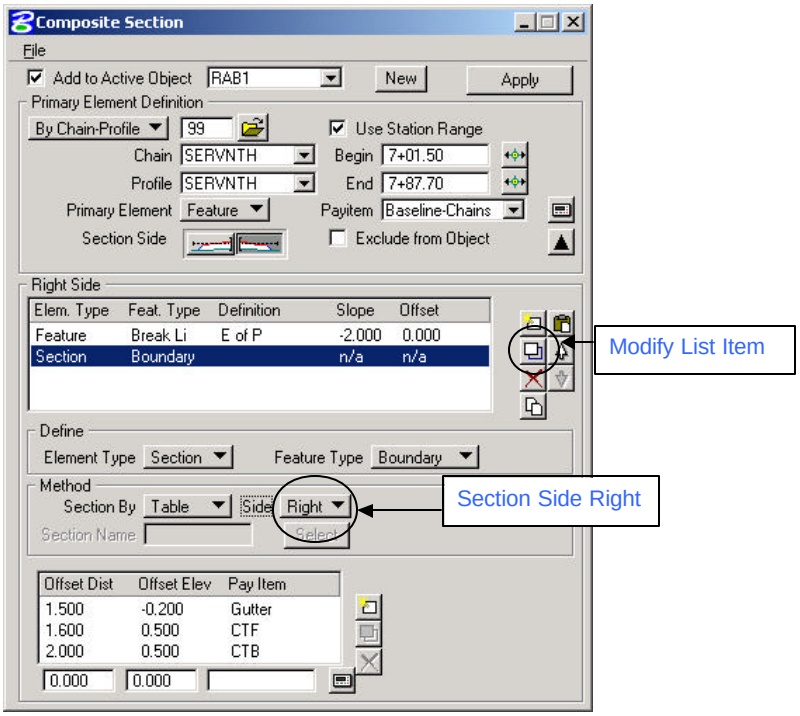
12. Select the first row item for the right side.



13. Reset the **Max. Distance** value to 25.50.

14. Click **Modify List Item**.

15. Edit the right side **Section** row.
16. Set the **Method: Side** to Right.



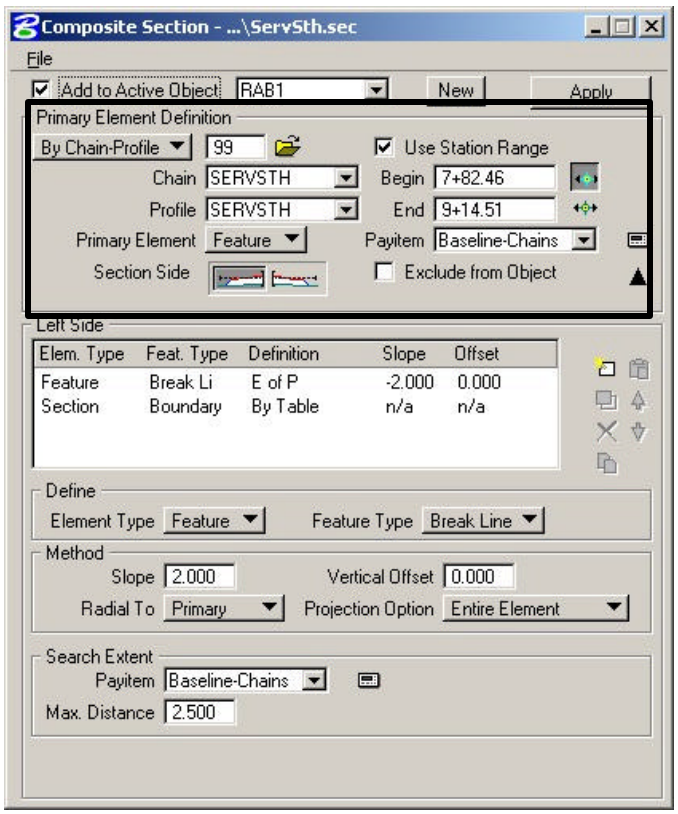
17. Click **Modify List Item**.
18. Click **Apply**.

Hint Composite Section settings files can be saved and reused. To save a file, use the File>Save option at the top of the dialog.

Add the South Service Road

Note The Composite Section files have been saved for the other roadways. We can open these files to complete the incoming roadways.

1. Continuing with the **Composite Section** tool.
2. Open the file *C:\Data\Geo\Site\Roundabout\Chapter4\ServSth.sec (File>Open)*.



3. Enter the **Primary Element** information.

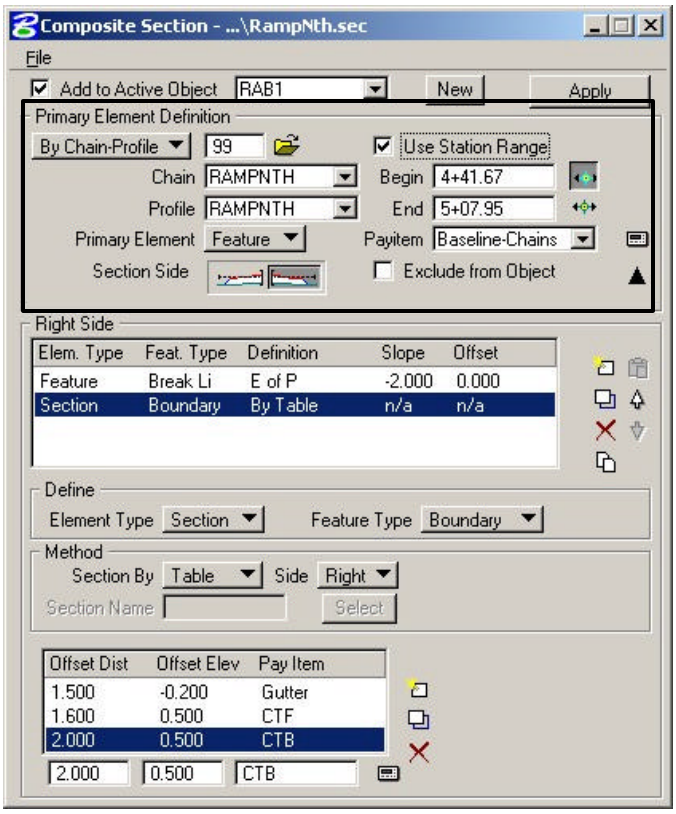
By Chain-Profile	99
Chain	SERVSTH
Profile	SERVSTH
Primary Element	Feature
Use Station Range	Enable
Begin Station	7+82.46
End Station	9+14.51
Payitem	Drafting Standards>General>Baseline-Chains

4. Click **Apply**.

Hint The Begin and End stations can be dynamically set. Click Set Station and snap to specific points in the DGN. Follow your instructor.

Add the North Ramp

1. Continuing with the **Composite Section** tool.
2. Open the file *C:\Data\Geo\Site\Roundabout\Chapter4\RampNth.sec (File>Open).*



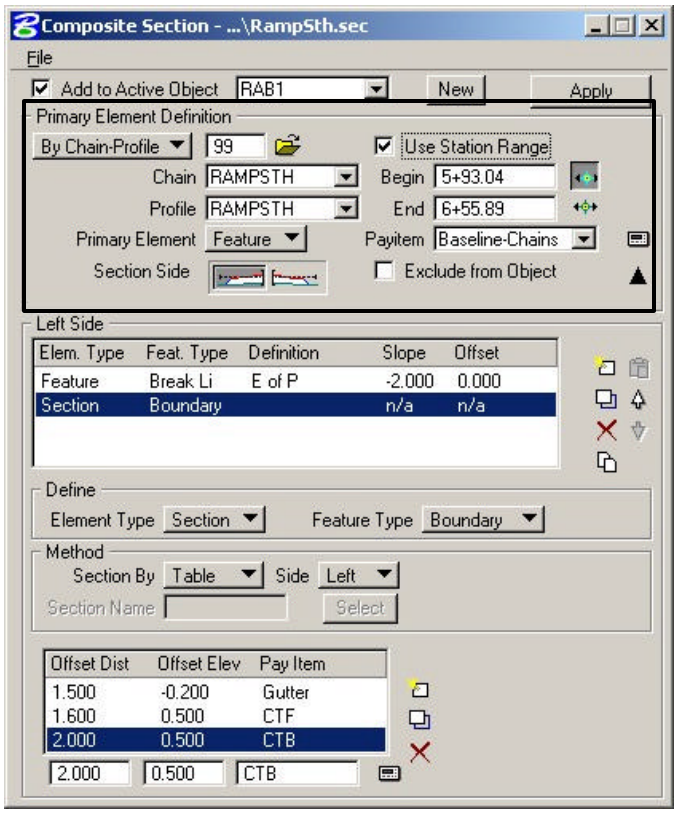
3. Enter the **Primary Element** information.

By Chain-Profile	99
Chain	RAMPNTH
Profile	RAMPNTH
Primary Element	Feature
Use Station Range	Enable
Begin Station	4+41.67
End Station	5+07.95
Payitem	Drafting Standards > General > Baseline-Chains

4. Click **Apply.**

Add the South Ramp

1. Continuing with the **Composite Section** tool.
2. Open the file *C:\Data\Geo\Site\Roundabout\Chapter4\RampSth.sec (File>Open).*



3. Enter the **Primary Element** information.

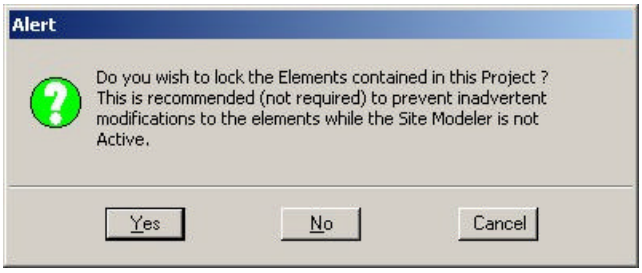
By Chain-Profile	99
Chain	RAMPSTH
Profile	RAMPSTH
Primary Element	Feature
Use Station Range	Enable
Begin Station	5+93.04
End Station	6+55.89
Payitem	Drafting Standards>General>Baseline-Chains

4. Click **Apply**.

This completes the areas of the incoming roads that can be defined based solely on the Chain and Profile for each roadway.

Saving and Exiting the Project

1. Close GEOPAK Site Modeler (*Site Modeler: Project>Exit*).
2. Click **Yes** to the Save alert.
3. Click **No** to the Lock Elements alert.



5 Create and Edit Curb Returns

CHAPTER OBJECTIVES

In this chapter we will:

- create the curb return elements and then, where required, edit these to ensure that all pavement areas provide smooth transitions and drain correctly.

INTRODUCTION

At this point, we have defined all of the larger pavement areas that have a direct relationship to a specific geometric element.

The traffic circle was defined based on a surface generated from the original control alignment. The incoming roadways have been based on their respective chains and profiles.

The curb return elements, in general, will be defined based on extending recently created pavement areas. Deciding where and how these elements will be created will require some educated Engineering design “best guesses”.

TOOLS TO BE USED.

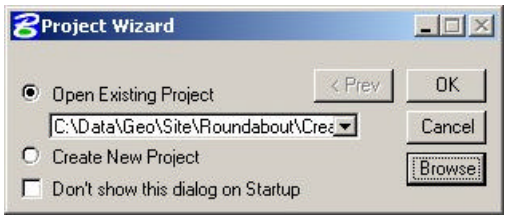
The tools we will use in this chapter are:

- Site Modeler > Elements > New/Edit > Slope/Offset from Site Element.
- Site Modeler > Elements > New/Edit > Drape On Model/Object.
- Site Modeler > Elements > Edit Profile.
- Site Modeler > Elements > Section.

DEFINE THE REMAINING EDGE OF PAVEMENT ELEMENTS

To ensure that all students have the same data, we are using another dataset.

1. Open the file *C:\Data\Geo\Site\Roundabout\Chapter5\LHSRAB.dgn* (*MicroStation: File>Open*).
2. Select the **Site Modeler** tool *(Applications > GEOPAK Site > Site Modeler > Site Modeling)*.

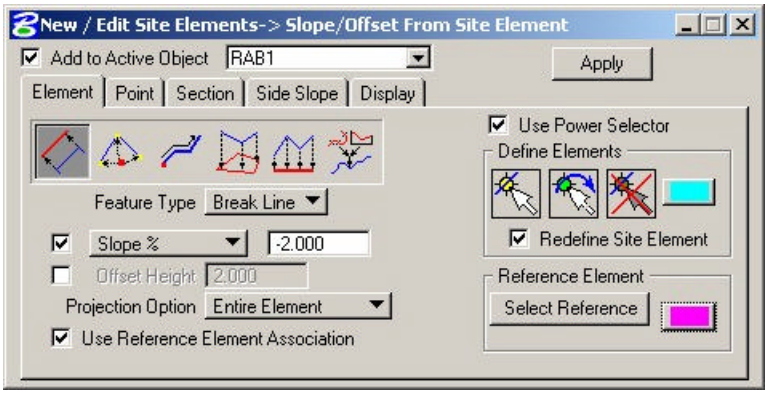


3. Click **Browse**.
4. Navigate to and select the file *C:\Data\Geo\Site\Roundabout\Chapter5\LHSRAB.gsf*.
5. Click **OK**.

Define the Curb Return Elements.

1. Select the **Slope/Offset from Site Element** tool. (*Site Modeler: Element > New/Edit > Slope/Offset from Site Element*).

Note Most of the remaining curb return elements can be defined by projecting from the outside edge of the traffic circle at –2%.

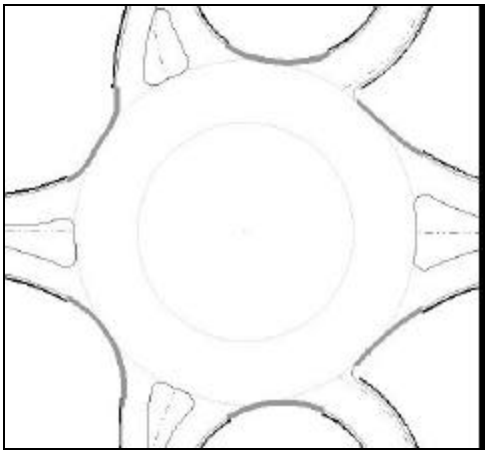


2. Enter the Slope/Offset From Site Element information.

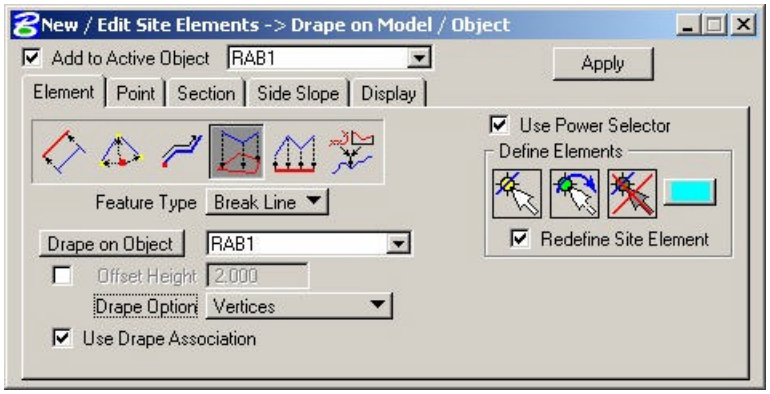
Feature Type	Break Line
Slope %	Enabled, -2.0
Projection Option	Entire Element
Use Reference Element Association	Enable
Use Power Selector	Enable
Redefine Site Element	Enabled

3. Click **Select Element** from the Define Elements group box.

   Select all of the curb return elements that are shown in heavy weight below.



4. Click **Reference Element>Select Reference.**
5. Select and accept the outside edge of the Traffic Circle.
6. Click **Apply**.
7. Select the **Drape on Model/Object** tool. (*Site Modeler: Element > New/Edit > Drape on Model/Object)*.

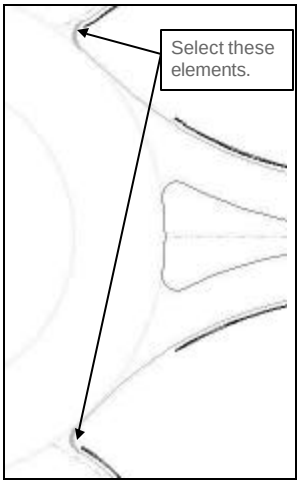


8. Enter the Drape on Model/Object information

Drape on Object	RAB1
Drape Option	Vertices

9. Click **Select Element** from the Define Elements group box.

   Select all of the curb return elements that are shown in heavy weight below.



10. Click **Apply**.

Redefine the Curb Return Elements using Edit Profile

The GEOPAK Site Modeler Edit Profile tool is a very powerful design tool. It allows the User to redefine any existing Site Element or series of Site Elements by creating a Profile view of the elements and then using Vertical Component tools to modify the elevations.

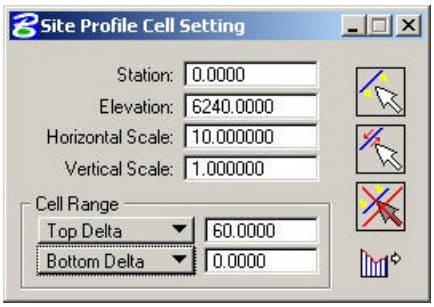
1. Access the **Active Site Profile** tool frame *(Site Modeler Menu: Elements>Edit Profile)*.

Profile Cell Status	
Identify Site Element Chain	
Vertical Component Tools	
Define Site Element Profile	
Curvilinear Coordinates	
Fit View Buttons	

2. Turn on View 2. *(MS: Windows > View 2)*.
3. Use the **Zoom/Window Area** (*MS: View Controls*).

   Find a clear drawing space to place the Element Profile.

4. Right click **Profile Cell Status** and select **Profile Cell Setting**.

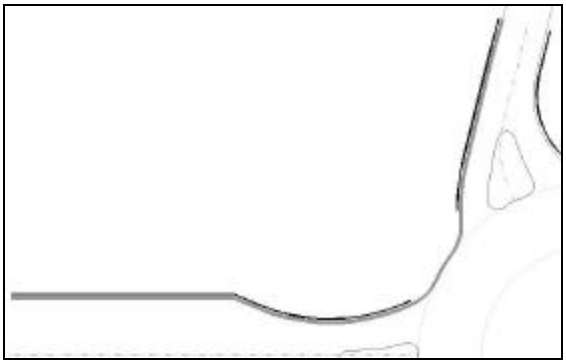


	Select Element
	Change Direction
	Delete Selection Set
	Place Site PCell (Profile Cell)

5. Enter the Site Profile Cell Settings information.

Station	0.0
Elevation	6240.0
Horizontal Scale	10.0
Vertical Scale	1.0
Cell Range: Top Delta	60.0
Cell Range: Bottom Delta	0.0

6. Click **Add Element PCell Chain**.
7. Select all of the edge of pavement elements shown in heavy line weight below.



Hint Each element needs to be selected and accepted. When the elements are correctly selected, they will highlight with a series of light blue dots over the element.

8. Click **Place Site PCell**.
9. Place the profile cell in a clear area of the previously opened view window 2.

10. On the **Active Profile Control** tool frame, right click on View 2 and set it to **Profile**.

Hint This will synchronize between Plan and Profile views.

11. Click **Vertical Component Tools**. *(Active Profile Control tool frame)*..

Use the Vertical Component tools to redefine the portions of the current profile where required.

Warning Follow your instructor. There will be a discussion on what portions of this profile need to be redefined and what portions must not be modified.

After the proposed vertical components have been added to the Profile, we need to return this new vertical information back to the Site Elements.

12. Click **Define Site Element Profile** *(Active Profile Control tool frame).*
13. Select and accept any proposed profile element.

    This strings all of the profile elements together.

14. Data point to accept the proposed profile.

    The profile information is now returned to the Site Element. The Profile element redraws to reflect the new state of the Site Element.

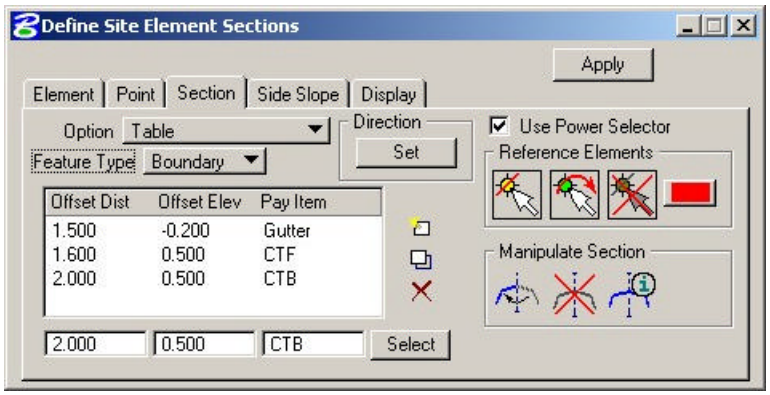
    We shall redefine the other five (5) curb returns using the same steps.

ADD CURB AND GUTTER SECTION TO CURB RETURNS

The curb returns have been defined to ensure a smooth pavement surface within the intersection. We now need to add the missing pieces of curb and gutter to the curb return elements.

Add Curb and Gutter Section

1. Select the **Section** tool (*Site Modeler: Elements > New/Edit > Section*).



2. Enter the Section information.

OFFSET DISTANCE	OFFSET ELEVATION	PAY ITEM
1.500	-0.200	PayItem > Plan > CURBING > Gutter
1.600	0.500	PayItem > Plan > CURBING > CTF
2.000	0.500	PayItem > Plan > CURBING > CTB

3. Set the Feature Type to **Boundary**.
4. Click **Select Reference Elements** from the Reference Elements group box.
5. Select the eight (8) previously defined edge of pavement Site Elements.
6. Click **Set**.
7. Move the cursor into the graphics.

Note There is a dynamic graphic that is attached to the selected elements. GEOPAK is waiting for the User to set the positive horizontal (offset) direction for the section elements.

8. Click **outside** of the selected graphics (so the positive direction is to the outside of the edge of pavement).
9. Click **Apply**.

   We have added the curb and gutter to the curb returns.

Saving and Exiting the Project

1. Close GEOPAK Site Modeler (*Site Modeler: Project>Exit*).
2. Click **Yes** to the Save alert.
3. Click **No** to the Lock Elements alert.

6 Create Complex Traffic Circle Center Island

CHAPTER OBJECTIVES

In this chapter we will:

- create the complex traffic circle center island.

INTRODUCTION

In Chapter 2 we originally defined the inside edge of the traffic circle. This was a temporary (and fast) method to give us a visual indication of what a 2% pavement slope would look like.

We now need to create the more complex median/island arrangement that was requested by the client.

TOOLS TO BE USED

The tools we will use in this chapter are:

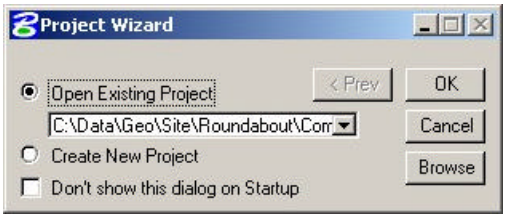
- Site Modeler>Elements>New/Edit>Section.
- Site Modeler>Elements>Composite Section.

CREATE THE CENTER ISLAND

Open the Site Project

Note To ensure that all students have the same data, we are using another dataset.

1. Open the file *C:\Data\Geo\Site\Roundabout\Chapter6\LHSRAB.dgn* (*MicroStation: File>Open*).
2. Select the **Site Modeler** tool *(Applications > GEOPAK Site > Site Modeler > Site Modeling)*.

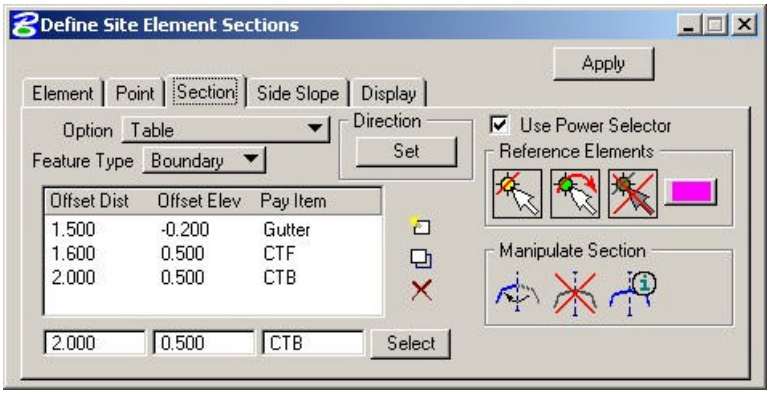


3. Click **Browse**.
4. Navigate to and select the file *C:\Data\Geo\Site\Roundabout\Chapter6\LHSRAB.gsf.*
5. Click **OK**.

Remove the Inside Traffic Circle Element

1. Select the **Section** tool (*Site Modeler: Elements > New/Edit>Section*).

Note The inside element of the traffic circle was created as a GEOPAK Site section element. To remove this element we use the Section tool.

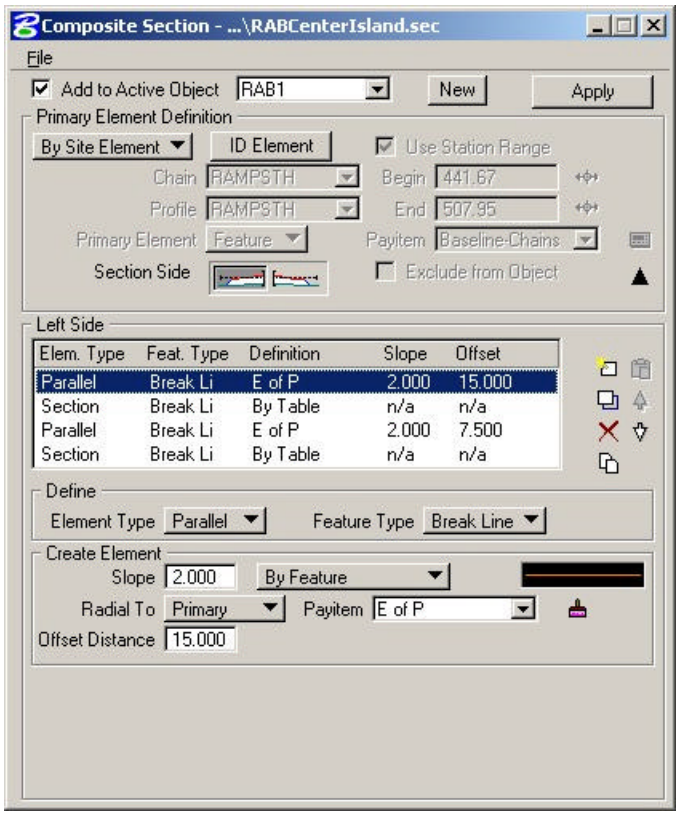


2. Click **Select Reference Elements** from the Reference Elements group box.
3. Select and accept the outside edge of the traffic circle.
4. Click **Delete Section** from the Manipulate Section group box.

   The section element is removed and the intersections re-triangulated.

Create the Complex Center Traffic Island

1. Select the **Composite Section** tool (*Elements>Composite Section*).

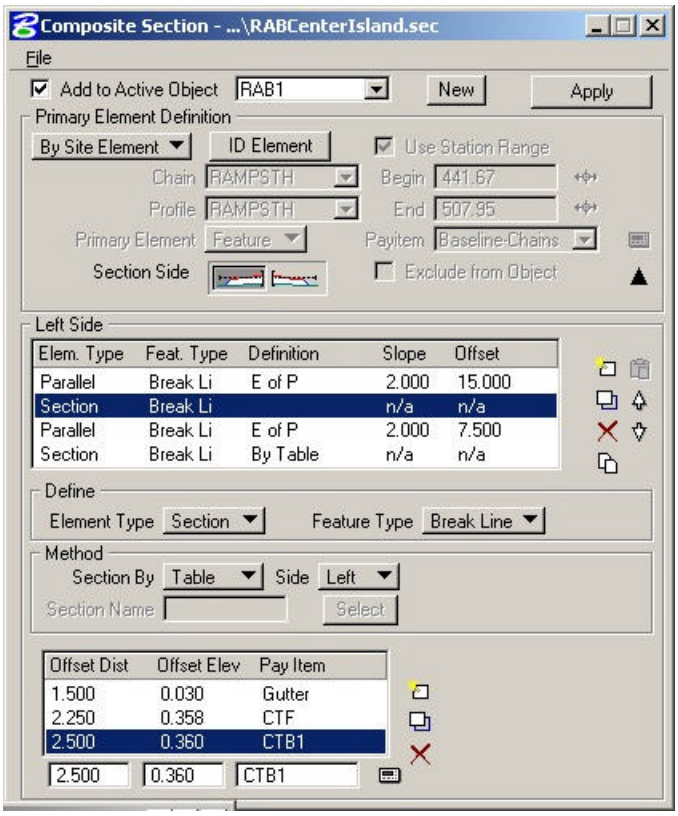


2. Open the file *C:\Data\Geo\Site\Roundabout\Chapter6\RABCenterIsland.sec (File>Open)*.

   This will populate the Composite Section tool with all of the elements required for the traffic island. The inside of the traffic circle has 2 pavement areas and 2 different types of curbing.

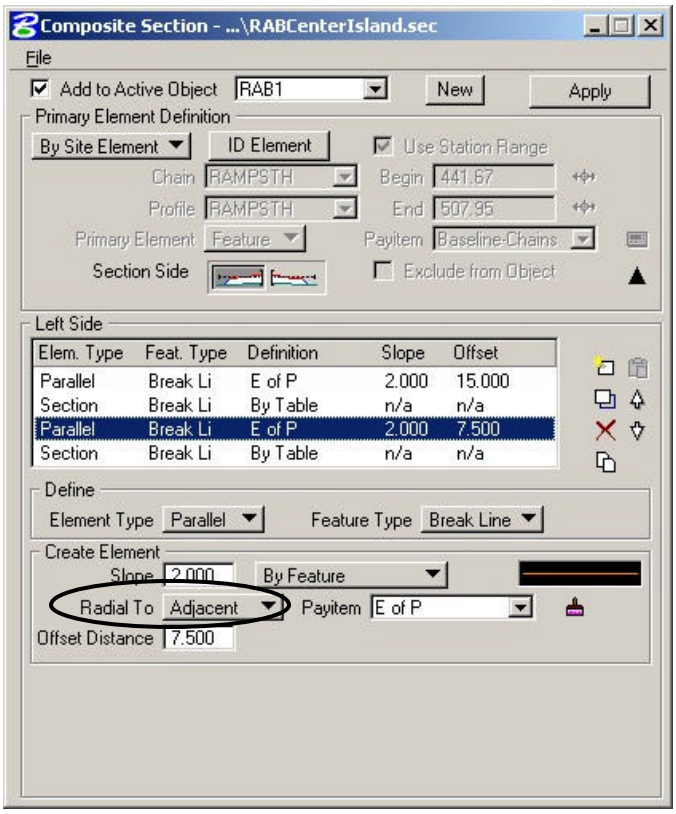
   The first row of the dialog creates the first pavement edge. The pavement is 15 feet wide at a pavement slope of 2% (*shown in the dialog above*).

The second row creates the first of the curbing sections.



The “gutter” portion of this section is actually created at the same slope as the adjacent pavement (2%). Then there is a curbing.

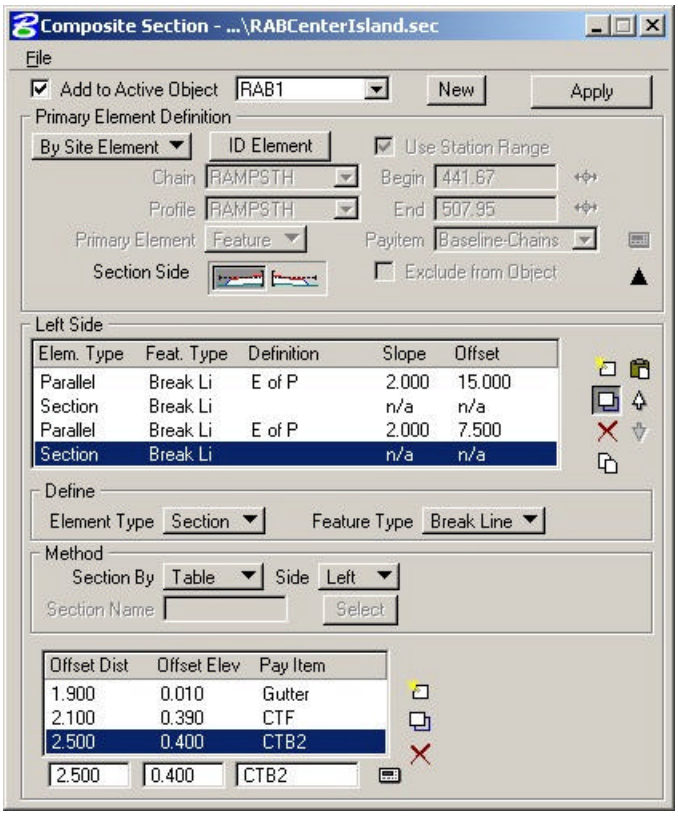
The third row creates the second pavement surface – in the finished intersection this will be a concrete pavement.



This pavement is also at a 2% slope but note that the elevations for this pavement edge will be based on the **adjacent** element rather than the primary element.

In effect, the edge of pavement elevations will be calculated from the top back of the curb.

The forth row creates the second of the curb and gutter sections.



This section also has a positive slope on the gutter section, thus forcing all surface water towards the outside of the traffic circle.

Note Draining water to the outside of the traffic circle is a typical design arrangement for this type of intersection. While it means that the circulating traffic have an adverse cross slope to maneuver, it does prevents ponding at the center island. If the cross slope falls towards the center island and the drainage inlets become blocked, the drainage runoff could pond (submerge) the entire intersection before it would drain away.

3. Click **ID Element** from the Primary Element Definition group box.
4. Select the outside edge of the traffic circle.
5. Click **Apply**.

Saving and Exiting the Project

1. Close GEOPAK Site Modeler (*Site Modeler: Project>Exit*).
2. Click **Yes** to the Save alert.
3. Click **No** to the Lock Elements alert.

7 Create Median Islands

CHAPTER OBJECTIVES

In this chapter we will:

- Create the median islands for the incoming roadways.

INTRODUCTION

The only portion of the project that has not been modeled is the traffic medians/islands.

These will now be created.

TOOLS TO BE USED

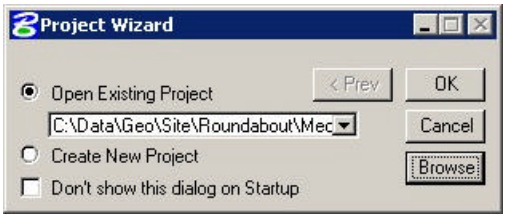
The tools we will use in this chapter are:

- Site Modeler > Elements > New/Edit > Drape on Model/Object.
- Site Modeler > Elements > Section.

Open the Site Project

Note To ensure that all students have the same data, we are using another dataset.

1. Open the file *C:\Data\Geo\Site\Roundabout\Chapter7\LHSRAB.dgn* (*MicroStation: File>Open*).
2. Select the **Site Modeler** tool *(Applications > GEOPAK Site > Site Modeler > Site Modeling)*.



3. Click **Browse**.
4. Navigate to and select the file *C:\Data\Geo\Site\Roundabout\Chapter7\LHSRAB.gsf.*
5. Click **OK**.

CREATING A MEDIAN

Create a Median Object

1. Select the **Create New Object** tool *(Site Modeler menu: Object > New)*.

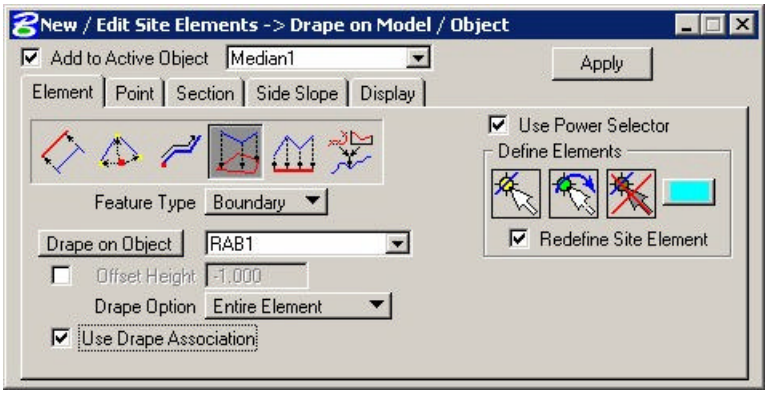
2. Enter the New Object information.

Object Type	Median
Object Name	Median1
Add to Active Model	Enable

3. Click **OK**.

Drape Outside of Median onto the RAB Object

1. Select the **New / Edit Element** tool *(Site Modeler menu: Element > New/ Edit)*.
2. Click **Drape on Model/Object** on the Elements tab.



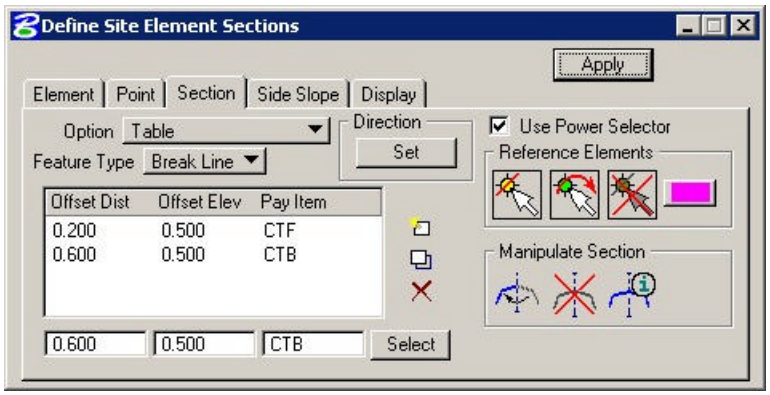
3. Enter the Element information.

Feature Type	Boundary
Drape on Object	RAB1
Offset Height	Disable
Drape Option	Entire Element
Use Drape Association	Enable
Use Power Selector	Enable
Redefine Site element	Enable

4. Click **Select Elements** in the Define Elements group box.
5. Select the purple graphic that represents the outside edge of one of the Medians.
6. Click **Apply**.

Add a Section to the Median Object

1. Select the **Section** tool.



2. Modify the Section information.

Offset Distance	Offset Elevation	Pay Item
0.200	0.500	PayItem > Plan > CURBING > CTF
0.600	0.500	PayItem > Plan > CURBING > CTB

3. Set the Feature Type to **Breakline**.
4. Click **Select Reference Elements** from the Reference Elements group box.
5. Select and accept the edge of median element that was created in the previous step.
6. Click **Set**.
7. Move the cursor into the graphics.
8. Click **inside** of the selected graphics (so the positive direction is to the inside of the median edge).
9. Click **Apply**.

   This completes the creation of the first of the four (4) medians.

Create remaining Medians.

1. Create the other 3 medians using the same process.

   This completes our intersection.