

2008 Roads and Bridges User Conference - East

WS - 15

Exploring Template Points and Constraints

Presenter: Patrick Evans, Bentley Systems, Inc.

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

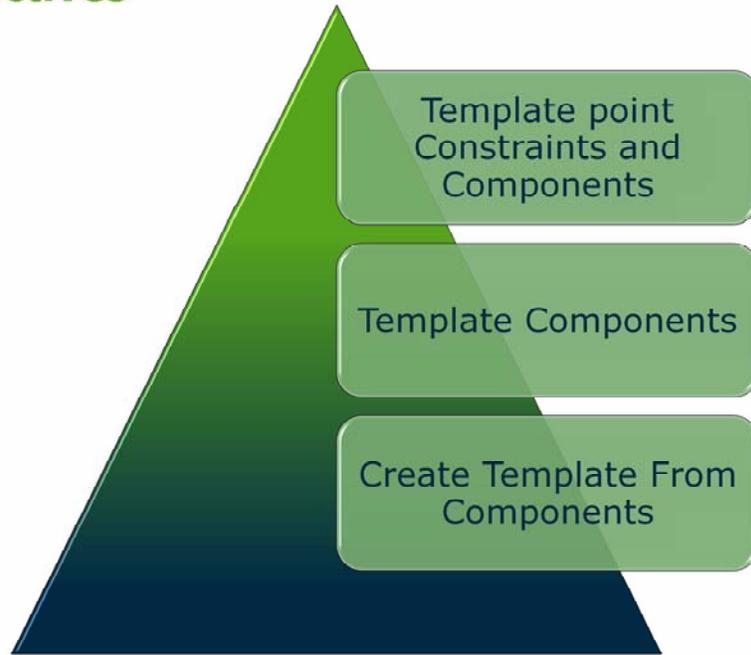
Exploring Template Points and Constraints



This module is an introduction to the Create Template tool. You will learn the basics of creating and editing templates and the components and points that make up the templates.

12/1/08

Objectives



In this lesson we will...

- Learn about template point constraints and components
- Create template components
- Create a complete template from the components

12/1/08

Constraints on Template Points

Constraints on Template Points

- Constraints
 - Used to manage the behavior of template points
 - How points move with respect to one another
 - A single point can have up to 2 constraints
 - Fully constrained points are red (two constraints)
 - Partially constrained points are yellow (one constraint)
 - Unconstrained points are green (no constraints)

Point constraints are used to manage the behavior of template points. They are used so that if a point is moved in a template, either by you editing the template or by the application of point controls during design processing, all the points related to the point being moved will behave in a predictable manner.

- A template point has a maximum of two constraints on it. A point with two constraints is considered “fully constrained.” A point that is fully constrained is represented by a red plus sign.
- A point that has only one constraint on it is considered “partially constrained” and is shown as a yellow plus sign.
- A point with no constraints (unconstrained) is shown as a green plus sign.

Constraints can also be labeled so that during the design process the value of labeled constraints may be changed. For example, the template may have a constraint label called *Thickness* that controls the thickness of the asphalt wearing surface. This thickness can be changed so that one template can be used for different asphalt depths, without having to edit the template.

12/1/08

Types of Constraints

Roadway Designer provides a variety of constraint types for roadway template design as described below. This course discusses the Horizontal, Vertical, and Slope constraints.

Horizontal

The child point remains at the specified horizontal distance from the parent point.

Vertical

The child point remains at the specified vertical distance from the parent point.

Slope

The child point maintains the specified slope from the parent point. Slope constraints can, additionally, have rollover values assigned to them. Rollover values are used to set the slope constraint based on a high side slope difference and a low side slope difference relative to a reference point which defines the controlling slope to the parent point. Slope constraints are absolute. Slopes going from lower-left to upper-right are positive regardless of whether the child point is to the left or right of the parent.

Horizontal Maximum

The child point has two parent points and remains at the specified horizontal distance from the parent point that is farthest to the right (has the maximum horizontal or X value).

Horizontal Minimum

The child point has two parent points and remains at the specified horizontal distance from the parent point that is farthest to the left (has the minimum horizontal or X value).

Vertical Maximum

The child point has two parent points and remains at the specified vertical distance from the parent point that is highest (has the maximum vertical or Y value).

Vertical Minimum

The child point has two parent points and remains at the specified vertical distance from the parent point that is lowest (has the minimum vertical or Y value).

12/1/08

Vector Offset

The child point is projected onto the vector defined by two parent points. If the offset is not zero, then the child point will maintain a perpendicular offset from the parent vector at the specified offset value. Negative values indicate an offset to the left of the vector defined by the parent points. Positive values indicate an offset to the right. If the offset is zero, the child point is located on the parent vector.

Project to Surface

This constraint must be used in conjunction with one of the previously defined constraints. The other constraint will define the projection direction. The child point will then be projected to the surface with the specified name. If the surface does not exist, or no solution is found, the point will remain where it is placed in the template.

Project to Design

This constraint is similar to Project to Surface, except that the point is projected to the design surface of the template. A projection value is given to indicate whether the projection is to be to the left or to the right. Again, the point must also be constrained by one of the previous constraints, excluding the Project to Surface constraint, so that a direction for the projection may be determined. If no solution is found, then the point will remain where it is placed in the template.

Angle Distance

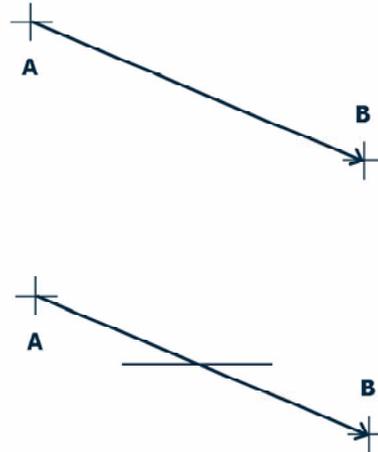
Use this command to fully constrain a point in the template. This constraint requires two parent points, a distance, and an angle. The point is constrained to the location defined by the distance from the first parent, and the angle from the first parent relative to the vector defined by the two parent points. This constraint creates a rigid-body rotation. When selected, no other constraint types are available.

12/1/08

Visual Indicators for Parent-Child Relationship

Constraints on Template Points

- Parent-Child point relationship
 - Point B is the Child of Parent point A
 - Arrow points from Parent point to Child point
- Horizontal Constraint
 - Child is horizontally constrained to parent



Parent-Child Point Relationship

When a point is constrained, it is constrained from either one or two other points. Points are constrained in a two dimensional (cross section) plane. Constraints can affect only the point's offset and elevation, which is the X and Y coordinates in a cross section view. Point constraints are also directional. The direction forms a parent-child relationship between points. If point B is constrained by point A, point A is said to be the parent of point B. When viewing the constraints, the parent point has a blue arrow pointing to the child point. To see the constraints in a template, set the Constraints radio button located in the Display portion of the Create Template dialog.

Horizontal Constraint

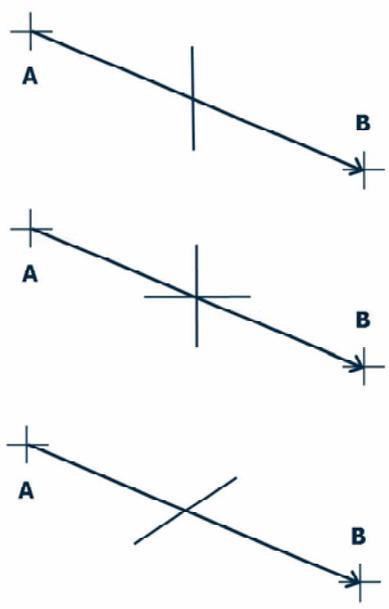
A horizontal constraint is when a child is horizontally constrained to the parent. When you move the parent point, the child point moves at a constant horizontal distance from that point, which is specified when the constraint is established. A white horizontal line crossing over the blue arrow indicates a horizontal constraint.

12/1/08

Visual Indicators for Vertical, Horizontal, and Slope Constraint

Constraints on Template Points

- **Vertical Constraint**
 - Child is vertically constrained to Parent
- **Horizontal and Vertical Constraint**
 - Child is horizontally and vertically constrained to Parent
- **Slope Constraint**
 - Child and Parent are constrained by slope



S

Vertical Constraint

A vertical constraint is when a child is vertically constrained to the parent. When you move the parent point, the child point moves at a constant vertical distance to that point, which is specified when the constraint is established. A white vertical line crossing over the blue arrow indicates a vertical constraint.

Horizontal and Vertical Constraint

A horizontal and vertical constraint is when a child is horizontally and vertically constrained to the parent. When you move the parent point, the child point moves at a constant horizontal and vertical distance to that point, which is specified when the constraint is established. A white horizontal and vertical line crossing over the blue arrow indicates a horizontal and vertical constraint. When a point has two constraints, such as horizontal and vertical constraints, that point is fully constrained and is shown in red.

12/1/08

Slope Constraint

A slope constraint is when a child is constrained to the parent by the slope between the two points. When you move the parent point, the child point moves at a constant slope with respect to the parent point, which is specified when the constraint is established. A white diagonal line crossing over the blue arrow indicates a slope constraint. When a point has only one constraint, such as a slope constraint, it is called a partially constrained point and is shown in yellow.

12/1/08

LESSON NAME: OPENING A PROJECT (INROADS USER)

LESSON OBJECTIVE:

In this lesson the student will learn to access an InRoads project in preparation for designing a model in Roadway Designer. Note, this lesson is for InRoads users only. For GEOPAK users, please proceed to the next lesson on the next page.

➤ EXERCISE: GETTING STARTED (INROADS USER)

This exercise will guide you through the steps to get started

1. Go to **Start > Programs > Bentley > InRoads Group Athens > InRoads Suite**.
2. The instructor will provide the appropriate path location for this project. When the MicroStation Manager appears select the file: **Plan.dgn** and press **OK**.
3. When the InRoads Explorer appears, go to **File > Open** from the InRoads menu.
4. When the Open dialog appears select the InRoads project file: **My_Project.rwk** and press **OK**.

Opening the *RWK* project file opens the following files:

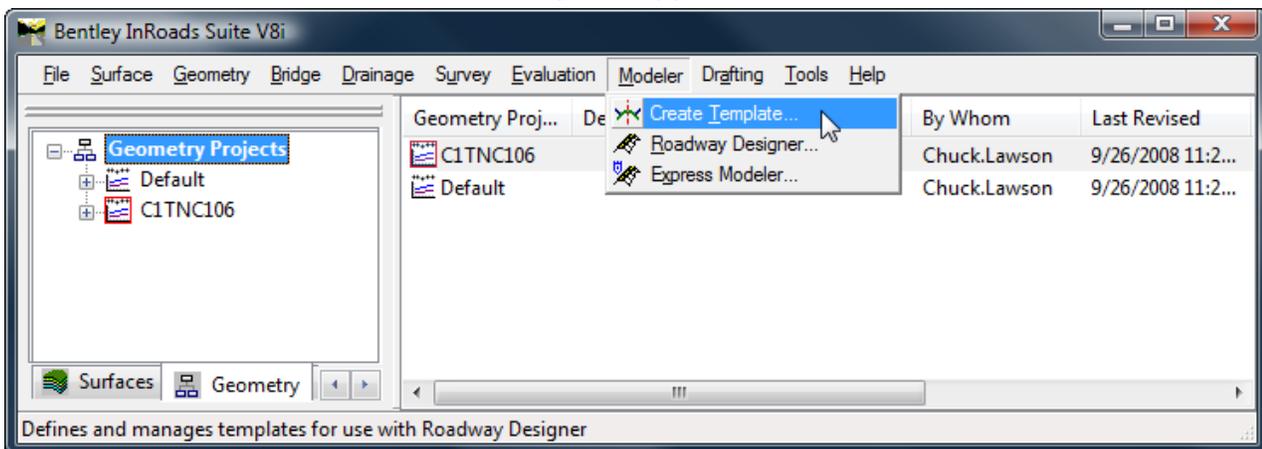
CMJOB001.alg

Templates.itl

Original.dtm

Default_Styles.xin

5. Select **Modeler > Create Template** from the InRoads Explorer menu to access the Create Template Application.



12/1/08

LESSON NAME: OPENING A PROJECT (GEOPAK USER)

LESSON OBJECTIVE:

In this lesson the student will learn to access a GEOPAK Corridor Modeler project in preparation for designing a model in Roadway Designer. Note, this lesson is for GEOPAK users only.

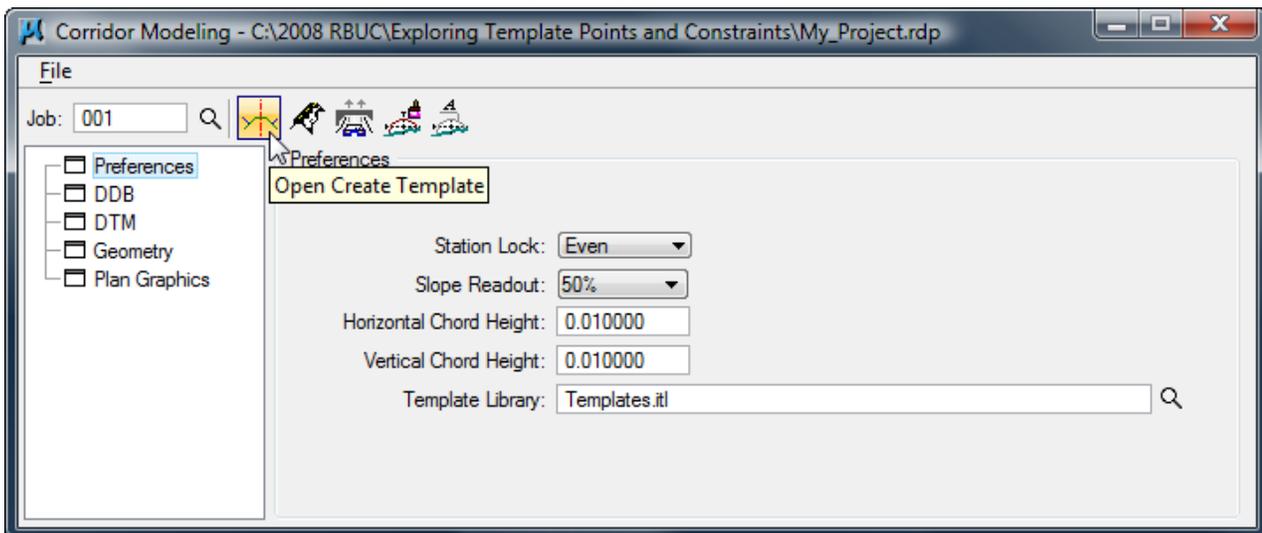
➤ EXERCISE: GETTING STARTED (GEOPAK USER)

This exercise will guide you through the steps to get started

1. Go to **Start > Programs > Bentley > MicroStation V8i > Bentley MicroStation V8i**.
2. The instructor will provide the appropriate path location for this project. When the MicroStation Manager appears select the file:
Plan.dgn and press **OK**.
3. Go to **Applications > Road > 3D Tools > Corridor Modeling**.

IMPORTANT: A prompt will appear asking to re-import the DDB file. Make sure to select **Cancel**.

4. Select the GPK job number **001**
5. Choose **File > Load** from the Corridor Modeling dialogue.
6. Load the Corridor Modeler project file entitled **My_Project.rdp**.
7. Choose the **Open Create Template** icon from the Corridor Modeling dialogue to access the Create Template Application.



12/1/08

LESSON NAME: OBSERVING TEMPLATE CONSTRAINTS BEHAVIOR

LESSON OBJECTIVE:

In this lesson the student will learn to select a template, move points and observe the behavior, change point constraints, and delete components.

➤ **EXERCISE: THIS EXERCISE WILL GUIDE YOU THROUGH MAKING A TEMPLATE ACTIVE AND DISPLAYING A COMPONENT'S CONSTRAINTS.**

1. Double-click the Template named *Constraints Behavior* from the *Constraints* folder.

This makes the template *Constraints Behavior* the current template.

2. Set the *Constraints* and *Display Point Names* in the *Display* portion of the Create Template dialog.

- Point 1 is the parent of Point 2.
- Point 2 is the child of Point 1.
- Point 2 is horizontally and vertically constrained to Point 1.
- Point 2 is the parent of Point 3.
- Point 3 is the child of Point 2.
- Point 3 is horizontally and vertically constrained to Point 2.

➤ **EXERCISE: THIS EXERCISE WILL GUIDE YOU THROUGH MOVING TEMPLATE POINTS AND MODIFYING POINT CONSTRAINTS.**

1. Right-click on *Point 1* and select **Move Point**.

Observe how the Points 1, 2 and 3 move as a rigid body.

2. Right-click to exit **Move Point**.

3. Right-click on *Point 2* and notice that **Move Point** is no longer available.

It is not possible to move a fully constrained point.

Let's see what happens when we remove the vertical constraint from Point 2.

4. Double-click *Point 2*.

The Point Properties dialog opens.

5. Change *Constraint 2* from *Vertical* to *None* and click **Apply**, then **Close**.

Notice the color of the point turned from red to yellow.

6. Move *Point 1*.

Notice the horizontal distance between Points 1 and 2 remains the same.

7. Move *Point 2*.

Notice the horizontal distance between Points 1 and 2 remain the same.

12/1/08

Also notice that the horizontal and vertical distance remains the same between Points 2 and 3.

8. Double-click *Point 2* again.
9. Change *Constraint 1* from *Horizontal* to *Slope* and click **Apply**, then **Close**.
10. Move *Points 1 and 2*.

Notice the behavior is similar to before. However, Point 2 is now constrained at a constant slope from point 1 instead of at a constant horizontal distance.

➤ **EXERCISE: THIS EXERCISE WILL GUIDE YOU THROUGH DELETING COMPONENTS FROM A TEMPLATE.**

11. Delete the component by right-clicking with your cursor directly over the component and selecting **Delete Component**.

Notice there is also a **Delete Components** command that is used to delete multiple components.

12/1/08

Adding and Deleting Constraints Graphically

Constraints on Template Points

- Adding and Deleting Constraints Graphically
 - Right-click on points to add and delete constraints
 - Horizontal and vertical constraints are important
 - Pavement layers
 - Superelevation
 - Transitioning
 - Helps to relocate points

In addition to editing the template point constraints using the Point Properties dialog, you can right-click on any point to access **Add Constraint** or **Delete Constraints**. This is very handy for making quick adjustments to the template constraints.

Delete Constraints removes all constraints from the point.

Add Constraint lets you pick the type of constraint you want to add to the point.

Full Constraint adds both horizontal and vertical constraints to a point.

Right-click on the child point you want to constrain, select **Add Constraint**, and select the point constraint you want to add. Then click the parent point and key in the offsets or slope values of the child point from the parent. Setting the appropriate constraints on points is important to achieve the desired results when pavement layers, superelevation, and transitioning are introduced to the design. Using the Point Properties dialog is helpful for adjusting point constraints after the initial point placement.

12/1/08

LESSON NAME: OBSERVING TEMPLATE CONSTRAINTS BEHAVIOR

LESSON OBJECTIVE:

In this lesson the student will learn to add and delete constraints and components.

➤ **EXERCISE: THIS EXERCISE WILL GUIDE YOU THROUGH MAKING A TEMPLATE ACTIVE AND DISPLAYING A COMPONENT'S CONSTRAINTS.**

1. Continue working on the template library used in the last practice activity
2. Select the *Add and Delete Constraints* template and make it the current template.
3. Set the *Components* and *Display Point Names* options in the *Display* area of the Create Template dialog.
4. Right-click on the *CL_AGGR_B_BOT* point and select **Delete Both Constraints**.

Notice the color of the point turns from red to green.

5. Delete the constraints on the *EOP_AGGR_B_BOT* and *SHDR_AGGR_B_BOT* points.
6. Right-click on the *CL_AGGR_B_BOT* point and select **Add Constraint > Full Constraint**.
7. Click on the *CL_AGGR_A_BOT* point.
The Add Full Constraint dialog opens.
8. Key-in a *Horizontal Offset* of 0.0 and a *Vertical Offset* of -1.0 and click **OK**.
9. Right-click on the *EOP_AGGR_B_BOT* point and select **Add Constraint > Full Constraint**.
10. Click on the *EOP_AGGR_A_BOT* point.
The Add Full Constraint dialog opens.
11. Key-in a *Horizontal Offset* of 0.0 and a *Vertical Offset* of -1.0 and click **OK**.
12. Right-click on the *SHDR_AGGR_B_BOT* point and select **Add Constraint > Slope**.
13. Click on the *EOP_AGGR_B_BOT* point. The Add Slope Constraint dialog opens.
14. Key-in a *Slope* of -6.0% and click **OK**.
15. Right-click on the *SHDR_AGGR_B_BOT* point again and select **Add Constraint > Slope**.
16. Click on the *SHDR_AGGR_A_BOT* point.
17. Key-in a *Slope* of -25.0% and click **OK**.

12/1/08

18. Right-click on the Current Template Window and select **Delete Components**.
19. Hold down the left mouse button and draw a line across a few components.
Release the left mouse button when done.
To undo the deletion, press the **CTRL+Z** buttons on the keyboard.

The Sign of the Distance and Slope

Add New Component Commands

- **Component Slopes and Distances**
 - Parent point is placed first
 - Child placed to the right (x) of Parent is positive distance
 - Child placed to the left (x) of Parent is negative distance
 - Child placed above (y) the Parent is positive distance
 - Child placed below (y) the Parent is negative distance
 - Slope is algebraic slope

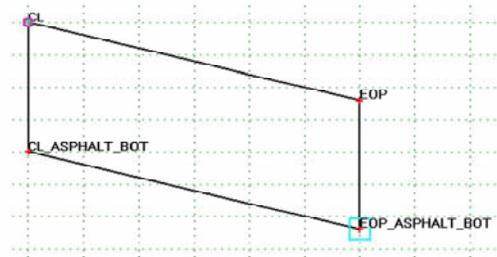
When defining components with precision input, the sign of the distance is dependent on the parent-child relationship. The parent is always the first point placed when creating template components. The distance is positive if the parent has a lower X or Y value than the child. The distance is negative if the parent has a higher X or Y value than the child. The sign of the component slope is based on the mathematical slope.

12/1/08

Simple Component

Add New Component Commands

- Simple Component
 - Creates constrained parallelogram for pavement layers and sidewalks
 - Provide the following data:
 - Component Name and Style
 - Slope, Thickness and Width



A component is a set of points that define an open or closed shape. Each component, whether open or closed, can represent a different material or area of interest.

Components are saved in the template library and are normally stored in a separate folder in the *Template Library* folder structure.

To create a component, first select **File > New Template** and name the template component. Then, use **Add > Simple** or **Add > Constrained** to build the component. Each component has a name and an assigned feature style.

There are five types of components:

- Simple
- Constrained
- Unconstrained
- Null Point

12/1/08

- End Condition

As you add template components, the area under the graph changes to represent the parameters for the component input type. This is called the Current Component area.

A simple component typically represents a section of pavement or sidewalk. It is a closed parallelogram that is defined by slope, thickness, and width. The top points are constrained by horizontal and slope constraints. The lower points are constrained to the points directly above them by horizontal and vertical constraints.

The Constrained, Unconstrained, and End Condition component types are discussed later in this chapter. Null Points are more advanced than this course and are therefore not discussed during this training.

Note for GEOPAK Users:

The type of template components used affect how GEOPAK end area volumes are computed and how cross section reports are generated.

If your workflow only requires dirt quantities, and not individual pavement layer end area volumes, you can use any type of component as described in this training guide.

However, if your workflow requires end area volumes for each pavement layer or if the workflow requires detailed cross section reports, your templates must be defined using non-closed components. The issue with closed components is that the top, bottom, and sides of the component all share the same feature and graphic symbology. Since these are all the same GEOPAK cannot determine what each line represents. Furthermore, closed shapes also result in multiple lines at the same location in the cross section. For example, the line representing the bottom of the pavement is coincident with the line representing the top of the base.

The recommended workflow to combat this issue is to create templates from non-closed components. The top of the surfacing layer is created as one non-closed component. The sides and bottom of subsequent pavement layers for base, sub base, etc. are created using additional non-closed components. Each component should be associated with a different feature so the resulting graphic symbology is unique. Having unique graphic symbology for each pavement layer allows the GEOPAK end area volume and cross section report tools to process correctly.

Simple components are closed shapes by definition and therefore should not be used when pavement layer end area volumes are required. Both Constrained and Unconstrained components can be closed or non-closed. To create non-closed components, right click and disable the Closed Shape option. Null Points and End Condition components are non-closed by definition.

12/1/08

LESSON NAME: CREATING A TEMPLATE OF SIMPLE COMPONENTS

LESSON OBJECTIVE:

In this lesson the student will learn to create templates by adding simple components and saving the template library.

➤ **EXERCISE: CREATING A TEMPLATE**

1. Browse to the folder named *Components* in the Create Templates dialog.
2. Create a template named *12' Concrete Pavement w/8' Shoulder*.

➤ **EXERCISE: STARTING DYNAMIC SETTINGS**

3. Select **Tools > Dynamic Settings**.
4. If set, clear the *Apply Affixes* option in the Dynamic Settings dialog.
5. Set the *Horizontal* and *Vertical Step* to **0.1**.

➤ **EXERCISE: ADDING A SIMPLE COMPONENT**

6. Right-click on the Current Template window and select **Add New Component > Simple**.
7. Setup the *Current Component* portion of the Create Template dialog as follows:

Component Name: **CONCRETE**

Style: **P_ROAD_Concrete**

Slope: **-2.000%**

Thickness: **1.000**

Width: **12.000**

8. Place the component at the origin of the Current Template window.
9. Right-click on the Current Template window and select **Add New Component > Simple**.
10. Setup the *Current Component* portion of the Create Template dialog as follows:

Component Name: **CONCRETE**

- ❗ Since this is the same name as the first component created, the name is automatically appended with a 1 resulting in Concrete1 as the component name.

Style: **P_ROAD_Concrete**

Slope: **-6.000%**

Thickness: **1.000**

Width: **8.000**

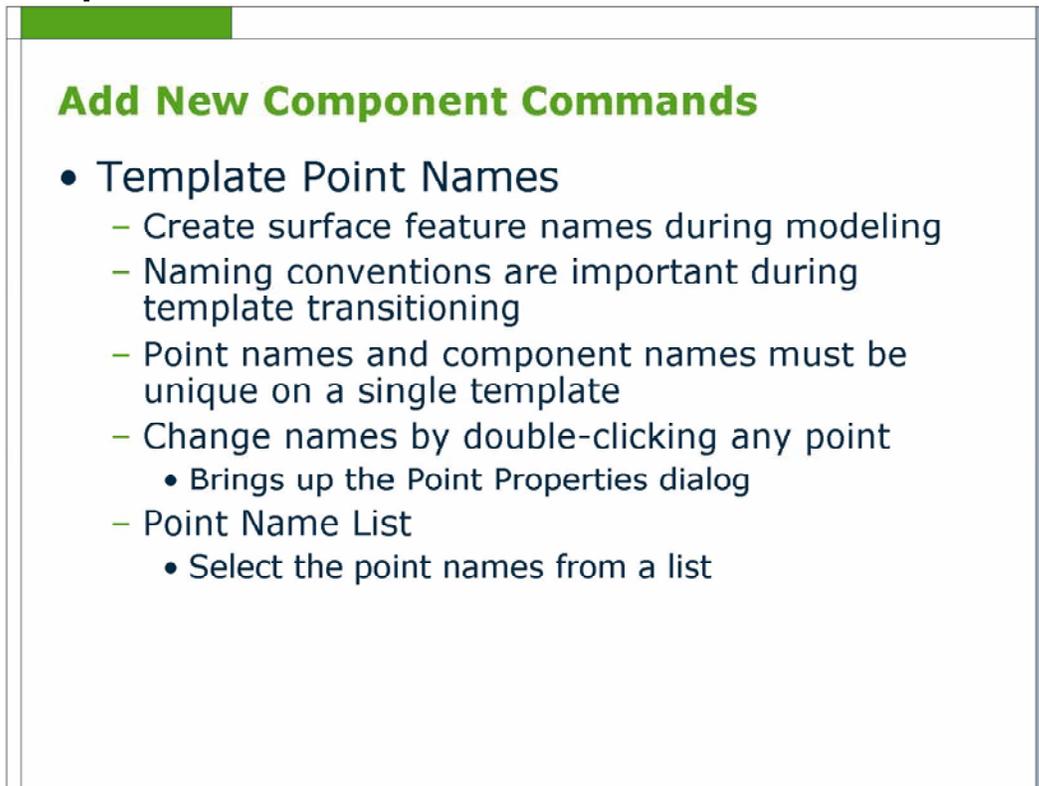
12/1/08

11. Place the component at the right edge of pavement point of the Current Template window.

Save Template Library

12. Select **File > Save** in the Create Template dialog.

Template Point Names



The screenshot shows a dialog box with a green header bar. The title is "Add New Component Commands" in green. Below the title is a bulleted list:

- **Template Point Names**
 - Create surface feature names during modeling
 - Naming conventions are important during template transitioning
 - Point names and component names must be unique on a single template
 - Change names by double-clicking any point
 - Brings up the Point Properties dialog
 - Point Name List
 - Select the point names from a list

Templates are used by the Roadway Designer to create surfaces of the proposed roadway. Each template point will be connected longitudinally to the next template drop, based on the interval, to form longitudinal breakline surface features. The names of those features are the name of the template points. Therefore, establishing a standard naming convention for template points is important to the quality of the proposed surface.

Likewise, individual component names also appear in the ensuing surfaces. These components are used for volume calculations, so standard naming conventions should be applied to ensure consistent results.

When transitioning between two templates (going from a two-lane to a four-lane roadway, for example), the Roadway Designer attempts to connect template points of the same name to model the transition. Template transitioning makes consistent

12/1/08

template component and template point naming even more important. Each template point name and component name must be unique within a template. For accurate volume calculations and surface creation (especially during template transition), different templates should use consistent component and template point names. Roadway Designer automatically appends the name with a unique number if the same name is chosen during template creation. Also, Roadway Designer provides for automatic prefixes and suffixes (such as LT_ and RT_) when components are created or added to the left or right side of the origin point. Prefixes and suffixes for template point names are defined using **Tools > Options** in the Create Template dialog.

Editing template point names is accomplished by right-clicking on a template point and selecting **Edit Point**. Double-clicking the point also invokes **Edit Point**. This opens the Point Properties dialog, where the point name and surface feature style are changed. After you change the point name, click **Apply**. The **Next >** and **< Previous** buttons help to change multiple points by moving from point to point within the same template. Enabling the *Display Points Names* option in the *Display* portion of the Create Template dialog allows you to visually verify the point names.

The Point Name List is used to create template point names. These names are then selected during component creation or editing to reduce time spent keying in the names. To add names to the Point Name List, right-click on Point Name List in the Template folders and select **Edit**, or double-click on Point Name List.

12/1/08

LESSON NAME: EDITING TEMPLATE POINT NAMES

LESSON OBJECTIVE:

In this lesson the student will learn to create and edit template point names.

- **EXERCISE: CONTINUE TO WORK ON THE TEMPLATE NAMED 12' CONCRETE PAVEMENT W/8' SHOULDER. THE TEMPLATE COMPONENTS HAVE BEEN ADDED, BUT THE NAMES SHOULD BE CHANGED TO REFLECT A STANDARD NAMING CONVENTION.**

1. Right-click on the *Point Names List* and select **Edit**.
The Point Name List dialog opens.
2. Key-in CL_CONC_BOT in the *Name* field.
3. Select the Style *P_COGO_MainCL* and click **Add**.
4. Key-in EOP_CONC_BOT in the *Name* field.
5. Select the Style *P_ROAD_EdgeOfPavement* and click **Add**.
6. Key-in SHDR_CONC_BOT in the *Name* field.
7. Select the Style *P_ROAD_Shoulder* and click **Add**, then **Close**.
8. Double-click the point located at the template origin.
The Point Properties dialog opens.
9. Change the point *Name* to CL and click **Apply**.
10. Click the **Next >** button which will move you down one point.
11. Change the Name as follows: Click **Apply**, then **Next >** and repeat.
Name :
CL_CONC_BOT
EOP
EOP_CONC_BOT
SHDR
SHDR_CONC_BOT
12. Close the Point Properties dialog.
13. Right-click on the vertical segment separating the road and shoulder and select the **Merge Components** command.
Now the merged component is named *CONCRETE*.
14. Double-click on the component to verify the name.

12/1/08

15. Select **File > Save** in the Create Template dialog.

Constrained and Unconstrained Components



Add New Component Commands

- **Constrained**
 - Creates any component
 - Median barrier, curb and gutter, complex pavement sections, retaining walls, etc.
 - Points are automatically constrained horizontally and vertically
- **Unconstrained**
 - Creates any component
 - No points are constrained
 - Constraints are added manually

Add New Component > Constrained is used to create open and closed shaped template components using precision input. You can access this command by either right-clicking on the Current Template window or selecting it from the pull-down menu.

Examples of constrained components include median barriers, curb and gutter sections, retaining walls, and complex pavement sections.

Constrained components are created with horizontal and vertical constraints already applied to each point.

Both closed and open shaped components can be created. The option to make the component closed or open is selected by right-clicking on the Current Template window during component creation.

When creating template points, the Dynamic Settings dialog is used to define point names and styles. The Dynamic Settings dialog is also used to enter the precise location for the points.

12/1/08

The basic workflow for creating a constrained component is to:

- Select **Add New Component > Constrained**.
- Key-in the *Component Name* and select the *Style* in the Current Component area.
- Key-in the *Point Name* and select the *Style* in the Dynamics Settings dialog.
- Select the key-in type (hs= for example) and key-in the precision value (12.0,2.0% for example) in the Dynamics Settings dialog.
- Press the Enter or Tab key on the keyboard.
- Repeat these steps until the last template point is placed.
- Right-click on the Current Template window and select **Finish**.

Add New Component > Unconstrained is also used to create open and closed shape template components using precision input. You can access this command by either right-clicking on the Current Template window or selecting it from the pull-down menu.

This command works the same as using **Add New Component > Constrained** except the components are created without any constraints on the points. The constraints are added manually using **Edit Point** or **Add Constraint**, accessed by right-clicking on any template point.

12/1/08

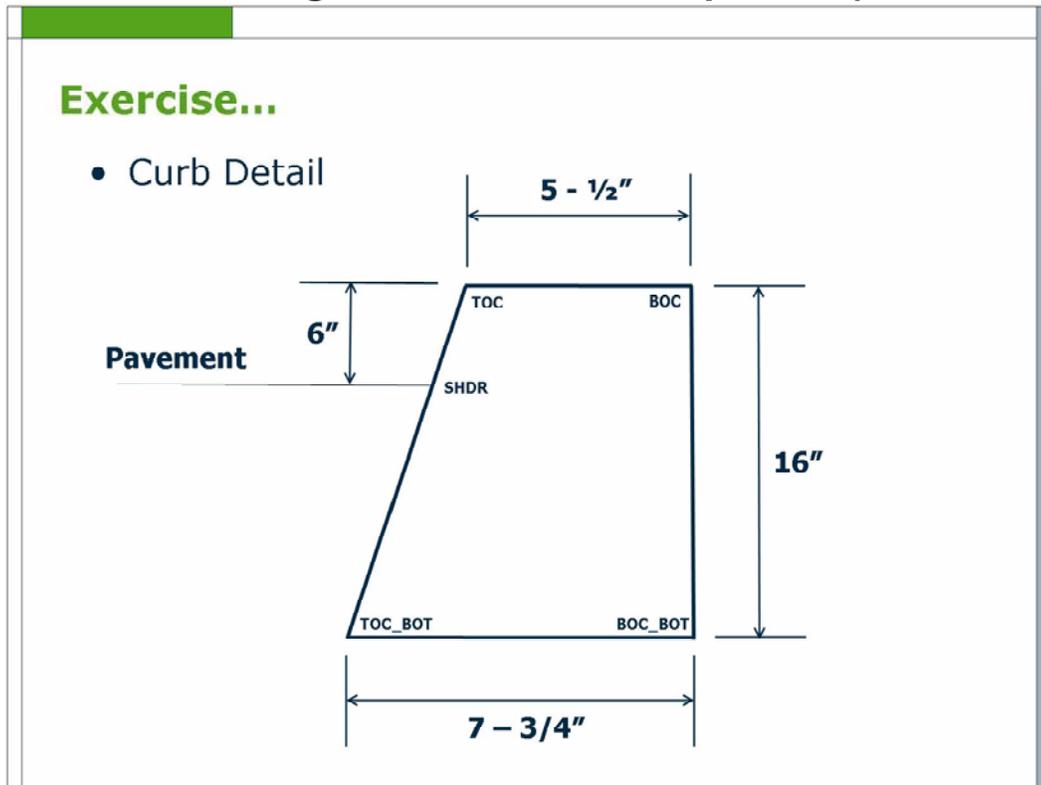
LESSON NAME: ADDING A CONSTRAINED COMPONENT

LESSON OBJECTIVE:

In this lesson the student will learn to create a concrete curb comprised of a constrained component.

- **EXERCISE: CREATE A TEMPLATE NAME**
 1. Browse to the folder named *Components* in the Create Templates dialog.
 2. Create a template named *Curb*.
- **EXERCISE: PREPARING THE SETTINGS BEFORE COMPONENT CREATION**
 3. If the Dynamic Settings dialog is not displayed, select **Tools > Dynamic Settings**.
 4. If set, clear the *Display Point Names* check box.

Practice - Adding a Constrained Component (continued)



12/1/08

➤ **EXERCISE: CREATING A CONSTRAINED COMPONENT**

5. Right-click on the Current Template window and select **Add New Component > Constrained**.

6. Setup the *Current Component* portion of the Create Template dialog as follows:

Component Name: CONCRETE CURB

Style: P_ROAD_ConcreteCurb

7. Setup the Dynamic Settings dialog as follows:

Point Name: SHDR (Select from the list)

Apply Affixes: disabled

Precision Input: xy = 0,0

8. Press the **Enter** key

❗ The default units for precision input are feet. You can enter other units with the proper specification, such as 6" instead of 0.5.

❗ Watch the prompts in the lower left corner of the Create Template dialog. When creating a component using precision key-in, an ESC allows you to go back.

9. Set up the Dynamic Settings dialog as follows:

Point Name: TOC

Apply Affixes: disabled

Precision Input: xy = 0.07,0.5 (from similar triangles)

10. Press the **Enter** key.

11. Set up the Dynamic Settings dialog as follows:

Point Name: BOC

Apply Affixes: disabled

Precision Input: hs = 5.5",0.0

12. Press the **Enter** key.

13. Set up the Dynamic Settings dialog as follows:

Point Name: BOC_BOT

Apply Affixes: disabled

Precision Input: dl = 0.0,-16"

14. Press the **Enter** key.

15. Set up the Dynamic Settings dialog as follows:

Point Name: TOC_BOT

Apply Affixes: disabled

12/1/08

Precision Input: dl = -7.75",0

16. Press the **Enter** key.
17. Right-click on the Current Template Window and select **Finish**.
18. Enable the *Display Point Names* option.

Save the Template Library

19. Select **File > Save** in the Create Template dialog.

12/1/08

Basic Component Creation Workflow

Creating Components

- Basic Component Creation Workflow
 - Open a Template Library
 - Select Create Template
 - Navigate to folder where template will be stored
 - Create a new template
 - Select the Dynamic Settings
 - Create components
 - Save the Template Library

Basic Component Creation Workflow

- Open the *Template Library*.
- Select **Open Create Template** icon. This brings up the Create Template dialog.
- Navigate to the template folder used for components.
- Select **File > New > Template** from the Create Template dialog. Name the new template, which is a component.
- Select **Tools > Dynamic Settings** if the Dynamic Settings dialog is not open.
- Select **Add > Simple** or **Add > Constrained** from the Create Template dialog.
- Add template components by using the Dynamic Settings dialog to specify the *Point Name* and *Style*, and the point locations.
- Select **File > Save** from the Create Template dialog to save the template library.

12/1/08

Creating End Conditions

Creating End Conditions

- End Conditions
 - Used to create cut and fill treatments
 - Consist of End Condition Components
 - Target Types
 - Surface
 - Specify any surface or select Active Surface
 - Elevation
 - Feature XY, Feature Elevation, Feature XYZ
 - Alignment XY, Alignment Elevation, Alignment XYZ

End conditions are template components which are used to model cut and fill treatments. They are added to the end of simple, constrained, and unconstrained components.

End conditions are created like other template components. End conditions consist of template points and individual components, and appear as line segments. They are different than simple and constrained components because they have the ability to target surfaces, elevations, alignments and surface features.

An example of this targeting is a design criteria which specifies a 4:1 fill slope if a fill height under 6 feet is encountered. The target type is the original ground surface.

To create an end condition, first select **File > New Template** and name the template. Then use **Add New Component > End Condition** to build the end conditions. End conditions are stored in the template library and normally are created in a separate folder in the template library.

12/1/08

Target Types

Target types are specified in the Current Component portion of the Create Template dialog, which appears below the Current Template window during end condition creation.

Target types are defined only for end condition components, and are a property of that component. To edit a target type, open the Component Properties dialog by double-clicking on the component or by right-clicking on the component and selecting **Edit Component**.

A solution can intercept multiple targets and target types. A ditch design, for example, may intercept an alignment that represents the bottom of the ditch and then intercept the original ground surface to form the backslope of the ditch.

Surface – targets the active surface or any specified surface. Using the active surface as the target helps when you are applying the end conditions to different projects. This is because the end condition will still work even though the target surface name may be different, so long as it is designated as the active surface.

Elevation – targets any specified elevation.

Feature XY – targets the horizontal offset of any specified surface feature.

Feature Elevation – targets the vertical elevation of any specified surface feature.

Feature XYZ – targets the horizontal offset and vertical elevation of any specified surface feature.

Alignment XY – targets the horizontal offset of any specified alignment.

Alignment Elevation – targets the vertical elevation of any specified alignment.

Alignment XYZ – targets the horizontal offset and vertical elevation of any specified alignment.

Style Elevation – targets the elevation of any specified style.

Style XY – targets the horizontal offset of any specified style.

Style XYZ – targets the horizontal offset and vertical elevation of any specified style.

12/1/08

End Conditions Settings

End Conditions Settings

- **Priority**
 - Establishes the order in which components are applied and tested
 - Applies to segments branching from a single point
- **Check for Interception**
 - Component searches for target
- **Place Point At Interception**
 - Places a point when target is hit
- **End Condition is Infinite**
 - Extends the last segment to target
- **Do Not Construct**
 - Point is used to solve position of other points
 - Point is skipped when drawing component

End Condition Priority

Simple end conditions consist of cut and fill segments. When creating the roadway design, each condition will be tested in a specific order. That order is called the priority, which is numeric, and is assigned during end condition creation. The most desirable conditions are assigned the lowest priority numbers. The most desirable condition, and the first condition to be tested, has a priority of 1. The next condition to be tested has a priority of 2, and so on.

For example, a design criteria calls for two fill conditions; 4:1 fill slope for an 8 foot fill height and a 3:1 fill slope for a 10 foot fill height. In this example, the target of each condition is the original ground surface. Each condition will be tested starting with lowest priority number. The first condition to successfully intersect the target, which is the original ground surface in this example, will be applied.

Priority is used when more than one end condition starts at the same point. In order for an end condition segment to be placed and used in the design, a segment or one of the

12/1/08

segments connected to that segment must successfully intercept its target. If a segment or its connected segments do not intercept their targets, that group of segments fails and the next group of segments, with the next higher priority, are tested. It is important that end conditions have at least one solution that will not fail to intercept their targets.

End Condition Settings

As you create the end conditions, there are several settings that will have to be considered to obtain the desired results. These settings are enabled or disabled and are set using the Dynamic Settings dialog during end condition point creation. To edit end condition settings, open the Point Properties dialog by double-clicking on the end condition point or by right-clicking on the point and selecting **Edit Point**.

Check for Interception – when set, the line segment will search for the specified target. If not set, the line segment will be created at its full width regardless of whether it intersects the target, provided that one of the segments connected to this segment successfully intersects the target.

Place Point at Interception – when set, a point will be placed at the location of the interception. If not set, the line segment will be created at its full width, provided that one of the segments connected to this segment successfully intersects the target.

End Condition is Infinite – when set, the line segment will automatically be extended to intercept the target. If not set, the line segment will only extend to its maximum constraint to meet its target. This applies only to the last line segment in an end condition.

Do Not Construct – If set, the end point of the line segment will be used as a reference point to find a subsequent point. The point will be solved like any other end condition point, but that point will be skipped when drawing the final component segments. This is normally not set and is used only for more complex condition testing.

12/1/08

LESSON NAME: CREATING END CONDITIONS

LESSON OBJECTIVE:

In this lesson the student will learn to create an end condition and save the template library.

➤ **EXERCISE: CREATE A NEW TEMPLATE NAME**

1. Browse to the folder named *End Conditions* in the Create Templates dialog.
2. Create a template named *Simple Cut and Fill*.

➤ **EXERCISE: START THE DYNAMIC SETTINGS**

3. Select **Tools > Dynamic Settings**, if not already displayed.
4. Set the *Display Point Names* check box.

➤ **EXERCISE: CREATE END CONDITION COMPONENTS**

5. Right-click on the Current Template Window and select **Add New Component > End Condition**.

The example design criteria calls for a 6:1 fill slope at fill heights between 0' to 5'.

6. Setup the *Current Component* portion of the Create Template dialog as follows:

Name: 6:1 FILL FOR 30'

Style: P_ROAD_FillLine

Target Type: Surface

Priority: 1

Surface: <Active>

7. Setup the Dynamic Settings dialog as follows:

Point Name: BOC (select from list)

Apply Affixes: Disabled

Precision Input: xy = 0,0

8. With your cursor in the xy=0,0 field, press the **Enter** key on your keyboard.

9. Setup the Dynamic Settings dialog as follows:

Check for Interception: Enable

Place Point at Interception: Enable

End Condition is Infinite: Disabled

Do Not Construct: Disabled

Point Name: 6:1 FILL (key-in the name)

Point Style: P_ROAD_FillLine

12/1/08

Apply Affixes: Disabled

Precision Input: hs = 30.0,-1:6

10. With your cursor in the *hs = 30.0,-1:6* field, press the **Enter** key on your keyboard.
11. Right-click on the Current Template window and select **Finish**.
12. Right-click on the *BOC* point on the Current Template Window and select **Add New Component > End Condition**.
The example design criteria calls for a 3:1 fill slope for fill heights greater than 5'.
13. Setup the *Current Component* portion of the Create Template dialog as follows:
Name: 3:1 FILL
Style: P_ROAD_FillLine
Target Type: Surface
Priority: 1
Surface: <Active>
14. Setup the Dynamic Settings dialog as follows:
Check for Interception: Enable
Place Point at Interception: Enable
End Condition is Infinite: Enable
Do Not Construct: Disabled
Point Name: 3:1 FILL
Point Style: P_ROAD_FillLine
Apply Affixes: Disabled
Precision Input: hs = 40.0,-1:3
15. With your cursor in the *hs = 40.0,-1:3* field, press the **Enter** key on your keyboard.
16. Right-click on the Current Template Window and select **Finish**.
17. Right-click on the *BOC* point in the Current Template window and select **Add New Component > End Condition**.
The example design criteria calls for a 3:1 cut slope for all cut conditions.
18. Setup the *Current Component* portion of the Create Template dialog as follows:
Name: 3:1 CUT
Style: P_ROAD_CutLine
Target Type: Surface
Priority: 1

12/1/08

Surface: <Active>

19. Setup the Dynamic Settings dialog as follows:

Check for Interception: Enable

Place Point at Interception: Enable

End Condition is Infinite: Enable

Do Not Construct: Disabled

Point Name: 3:1 CUT

Point Style: P_ROAD_CutLine

Apply Affixes: Disabled

Precision Input: hs = 40.0,33.3%

20. With your cursor in the *hs = 40.0,33.3%* field, press the **Enter** key on your keyboard.

21. Right-click on the Current Template Window and select **Finish**.

Save the Template Library

22. Select **File > Save** in the Create Template dialog.

12/1/08

LESSON NAME: ADDING A DITCH END COMPONENT

LESSON OBJECTIVE:

In this lesson the student will learn to create a ditch end component.

➤ EXERCISE: CREATE DITCH END COMPONENTS

Continue to work on the end condition template named *Simple Cut and Fill*.

1. Right-click on the 3:1 *FILL* point in the Current Template window and select **Add New Component > End Condition**.

2. Setup the Current Component portion of the Create Template dialog as follows:

Name: DITCH

Style: P_ROAD_Ditch

Target Type: Surface

Priority: 1

Surface: <Active>

3. To place the second point, set up the Dynamic Settings dialog as follows:

Point Name: DITCH BOTTOM (select from list)

Check for Interception: Disabled

- i** This forces this line segment to be placed.

End Condition is Infinite: Disabled

Do Not Construct: Disabled

Apply Affixes: Disabled

Precision Input: hs = 5,-1:4

4. With your cursor in the *hs = 5,-1:4* field, press the **Enter** key.

5. Setup the Dynamic Settings dialog as follows:

Point Name: DITCH BACKSLOPE (select from list)

Check for Interception: Disabled

- i** This forces this line segment to be placed.

End Condition is Infinite: Disabled

Do Not Construct: Disabled

Apply Affixes: Disabled

Precision Input: hs = 5,0

6. With your cursor in the *hs = 5,0* field, press the **Enter** key.

12/1/08

7. Setup the Dynamic Settings dialog as follows:
 - Point Name: DAYLIGHT* (select from list)
 - Check for Interception: Enable*
 - Place Point at Interception: Enable*
 - End Condition is Infinite: Enable*
 - Do Not Construct: Disabled*
 - Apply Affixes: Disabled*
 - Precision Input: hs = 5,25%*
8. With your cursor in the *hs = 5,25.0%* field, press the **Enter** key.
9. Right-click on the Current Template window and select **Finish**.

Save the Template Library

10. Select **File > Save** to save the template library.

12/1/08

Testing the End Conditions

Testing End Conditions

- Testing End Conditions
 - Verify the solutions and priority
 - Test multiple targets
- Workflow
 - Select Test button
 - Brings up Test End Conditions dialog
 - Edit the Priority if necessary
 - Select Draw
 - Move cursor over End Conditions

Testing End Conditions

End Conditions can be tested prior to and during end condition creation. Testing simulates how the end conditions will behave during modeling, without using the Roadway Designer.

To test that the end conditions produce the desired results, select the **Test** button located under the Current Template window. This opens the Test End Conditions dialog. The window in the Test End Conditions dialog displays non-end-condition components as solid lines and end conditions as dotted lines. The scale of this window is dynamic and view controls are located at the bottom.

To test the end conditions, select one of the available targets and select the **Draw** button located on the right side of the dialog. Move your cursor over the testing window. The end conditions will change from a dotted line to a solid line, revealing the final solution for the proposed target intercept. If there are any priority conflicts, you will receive a warning message. Select the Check Priorities button to review and edit the priority of each end condition.

12/1/08

LESSON NAME: TESTING THE END CONDITIONS

LESSON OBJECTIVE:

In this lesson the student will learn to test end conditions and change their priority.

Continue to work on the end condition template named *Simple Cut and Fill*.

➤ EXERCISE: TEST THE END CONDITIONS AND CHANGE THE PRIORITY

1. Select **Test** located under the Current Template window.
A warning will be given about the template having end condition priority conflicts.
2. Select **Check Priorities** on the right side of the Test End Conditions window.
Notice that *BOC* point is a bold white color, which is an indicator of the point that has the priority conflicts.
3. Select **Edit**.
Notice that all the end conditions have the same priority number.
4. Put your cursor in each of the fields and notice the segments highlighting.
5. Assume that fill is the most desirable condition and change the *Priority* of the *3:1 FILL* to 2 and the *Priority* of the *3:1 CUT* to 3.
6. Click **OK**, then **Close**.
7. Click **Draw** on the right side of the Test End Conditions window.
8. Move your cursor over the end conditions.
9. Change the *Use Surface Slope* to 10.00% and click **Draw** again.
10. Move your cursor over the end conditions.
11. Close the Test End Conditions dialog.

Save the Template Library

12. Select **File > Save** to save the template library.
13. Exit MicroStation.

12/1/08

Basic End Condition Component Creation Workflow

Creating End Conditions

- Basic End Condition Component Creation Workflow
 - Open a Template Library
 - Select Create Template
 - Navigate to folder where template will be stored
 - Create a new template
 - Create End Condition components
 - Test the End Conditions
 - Save the Template Library

Basic End Condition Component Creation Workflow

- Open the *Template Library*.
- Select **Open Create Template** icon. This brings up the Create Template dialog.
- Navigate to the template folder used for *End Condition* components.
- Select **File > New > Template** from the Create Template dialog. Name the new template, which is an end condition component.
- Select **Tools > Dynamic Settings** if the Dynamic Settings dialog is not open.
- Select **Add > End Condition** from the Create Template dialog.
- Add end condition components by using the Dynamic Settings dialog to specify the *Point Name* and *Style*, and the point locations.
- Select **File > Save** from the Create Template dialog to save the template library.

12/1/08

Summary and Review

Summary and Review

You are now able to...



Before continuing let's
reinforce what
you have learned!

Summary

You are now able to:

- Understand template point constraints and components
- Create template components
- Create a complete template from the components

12/1/08

Questions

Before continuing, let's reinforce what you have learned.

1. True or False, Point constraints are used to manage the behavior of template points?
 - True
 - False

2. A "Fully Constrained" point contains a maximum of how many constraints?
 - A** - None
 - B** - One
 - C** - Two
 - D** - Three

3. Name three types of Constraints?
 - A** -
 - B** -
 - C** -

4. True or False, the top points of a simple component are constrained to points directly below them by horizontal and vertical constraints?
 - True
 - False

5. Which template component that is used to model cut and fill treatments?
 - A** - Constrained
 - B** - Simple
 - C** - End Condition
 - D** - Unconstrained

12/1/08

Answers

1. True or False, Point constraints are used to manage the behavior of template points?

True - Point constraints are used to manage the behavior of template points. They are used so that if a point is moved in a template, either by the user editing the template or by the application of point controls during the design processing, all the points related to the point being moved will behave in a predictable manner.

2. A “Fully Constrained” point contains a maximum of how many constraints?

C - A point with two constraints is considered “fully constrained”.

3. Name three types of Constraints.

A - Horizontal Constraint

B - Vertical Constraint

C - Slope Constraint

4. True or False, the top points of a simple component are constrained to points directly below them by horizontal and vertical constraints?

False - The lower points are constrained to points directly above them by horizontal and vertical constraints.

5. What is the template component that is used to model cut and fill treatments?

C – End Conditions are template components which are used to model cut and fill treatments. They are added to the end of simple, constrained, and unconstrained components.

12/1/08