

Civil Site Design



Design - Analyse - Visualise - Deliver

Table Drains



Advanced Road Design

Table Drains

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Table Drains

Table drains can be created using the dedicated Table Drain tool in the Design Data form, or using codes on the cross section with conditional deletions.

Starting Template

This is the starting template for design. Note that the left side has codes included for the table drain, and the right side does not.

Left Table Drain Sections

Assuming that the left side table drain should always occur, it would make sense to include the table drain in the cross section template. There are three components to this table drain, the fore slope, the bottom and the back slope, however we only need to create the fore slope and the bottom as we can use the batter to create as the back slope.

Step 1: Using the sample methodology as the previous section, create the following sections on the **Left** side of the template:

Fore slope Section

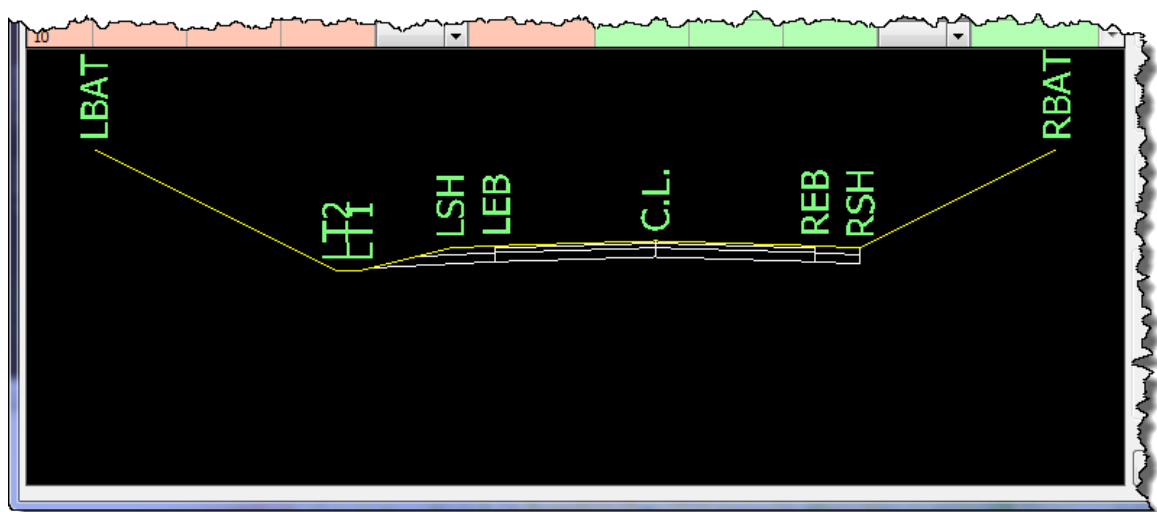
- New Code = **T1**
- Width of Section = **2m**
- Select **Vertical Distance**
- Vertical Distance = **-0.5m**
- Select Side to Apply = **Left**
- Plot Code? = Ticked **On**

Bottom Section

- New Code = **T2**
- Width of Section = **0.5m**
- Select **Vertical Distance**
- Vertical Distance = **0m**
- Select Side to Apply = **Left**
- Plot Code? = Ticked **On**

Important Note: Ensure you select **Left** for the **Select Side to Apply** option.

The completed template will look like (cut situation shown):



Automatic Table Drains – Table Drain Tool

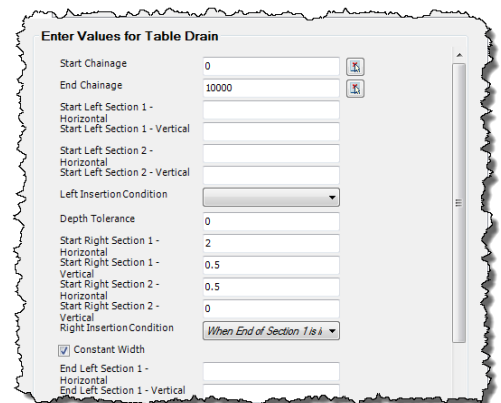
To do the automatic table drain read below:

This table drain is only required when the road cross section is in cut and as such we can use the **Table Drains** data entry in the **Design Data Form** to automatically control when the drain is applied to the cross section, specifically when the 'invert' (end of fore slope/start of the bottom) of the table drain is in cut. The geometry of the drain is the same as previously created in the template. It is made up of two sections, fore slope and bottom, with the right batter forming the back slope.

Step 2: From the **Design Data Form**, select the **Table Drains** Data Heading and click on the  button to add a new entry.

Step 3: In the **Table Drain** form enter the following type of inputs:

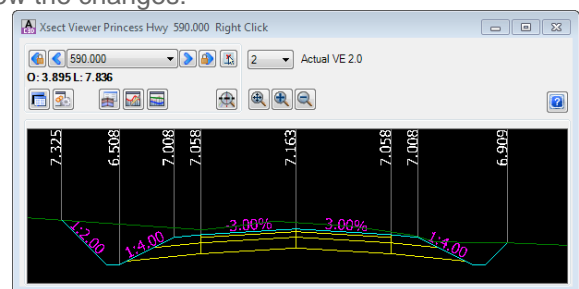
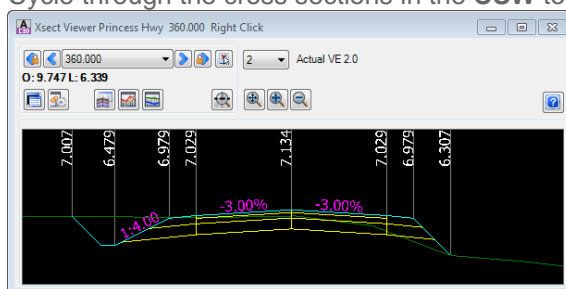
- Start Chainage = **0m**
- End Chainage = **10000m**
- Depth Tolerance = **0m**
- Start Right Section 1 – Horizontal = **2m**
- Start Right Section 1 – Vertical = **0.5m**
- Start Right Section 2 – Horizontal = **0.5m**
- Start Right Section 2 – Vertical = **0m**
- Constant Width = **Ticked**
- Right Insertion Condition = **When End of Section 1 is in Cut**
- Click on **Add/Update** to apply the table drain to the right of the road.



- Notes:**
- 1 The software considers **down** as positive when entering **Section 1** and **Section 2**.
 - 2 Leaving the **Left/Right** entries blank will **OMIT** the table drain on that side.
 - 3 For more information about the various **Left/Right Insert Conditions**, refer to the **ARD help system**.

Step 4: Click on the  button to close the **Design Data Form**.

Cycle through the cross sections in the **CSW** to review the changes:



Experiment: To explore the functionality of the table drain, graphically raise/lower a cross section (by changing the vertical design) to see the table drain on the right side automatically appear and disappear.

Important Note: The codes inserted into the cross section via the **Table Drains** control (**LT1/RT1 & LT2/RT2**) cannot be manipulated using any of the variation controls. This is also true for the batter codes (**LBAT & RBAT**).

Step 5: Close the **VGE** and **CSW** by clicking the **OK** and  buttons respectively.

Automatic Table Drain using Conditional Delete

Rather than using the **Table Drains** data entry to insert a table drain, the **Conditionally Delete Sections** variation could be used to achieve a similar result. The advantage is that the table drain can consist of any number of sections and can be further controlled using other variations.

The **Conditionally Delete Sections** variation works in a similar fashion to the Table Drains data entry allowing for the cut/fill depth of a code to be checked but provides the flexibility of specifying an optional additional depth check and the ability to define which codes of the cross section are removed.

To apply this methodology as the control for the LEFT table drain, you would need to:

1. Remove the existing **Table Drains** entry in the **Design Data Form**
2. Make sure your template includes codes for the table drain (in our example, **LT1 & LT2** codes/sections on the LEFT side of the template)
3. Add a **Conditionally Delete Sections** variation with the following settings:
 - Start Chainage = 0m
 - End Chainage = 1000m
 - Code to Trigger Variation = **LT2**
 - Delete if Code = **LT1**
 - Has Condition = **Fill Greater than**
 - with Value = 0m
 - Delete from Code = **LT1**
 - to Code (Inclusive) = **LT2**

Conditionally Delete Sections	
Start Chainage	0.000
End Chainage	1000.000
Code Existing to Trigger Variation	RT2
Delete if Code	LT1
has Condition	Fill Greater than
with Value	0.000
And/Or	And
Code	
has Condition	
with Value	
Delete from Code	LT1
to Code (Inclusive)	LT2

Note: The **Code to Trigger Variation** must be outside (looking from the **C.L.**) or the last code to be deleted by the variation and can **NOT** be the batter code (**LBAT/RBAT**) or any other automatic software inserted code (**Conditional Batters, Table Drains** etc.)

You will then have exactly the same behaviour as the Table Drain command, applied to Codes in your template. These codes can have Variations applied to them (unlike the codes added with the Table Drains command).

Grading the Left Table Drain

The left table drain needs to be independently graded to ensure that the sufficient drainage of the road. To achieve this, we need to create a string/profile which will have a separate alignment and vertical grading to the road. This string will then be used to control the invert of the left table drain. To maintain the integrity of the table drain we also need to maintain the fore slope.

Create the Left Table Drain String

An offset alignment can easily be created from the **Road Centreline Alignment** (or you can manually create alignment geometry for the drain invert location) and can then be used to create the string to control the left table drain. When grading the table drain you have two options:

1. Keep the foreslope of the drain and change the offset to set the invert elevation onto an independently graded string
2. Keep the offset and elevation of the string and set the invert of the table drain to use both the horizontal and vertical aspects of the string.

In the below example the foreslope is being maintained.

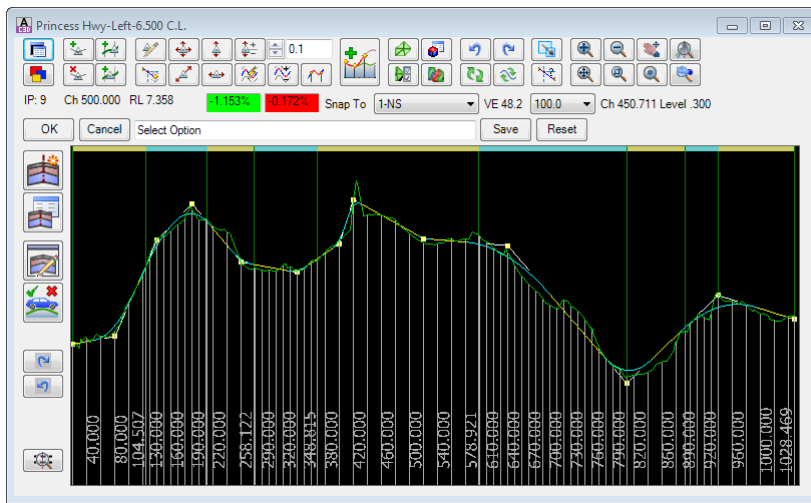
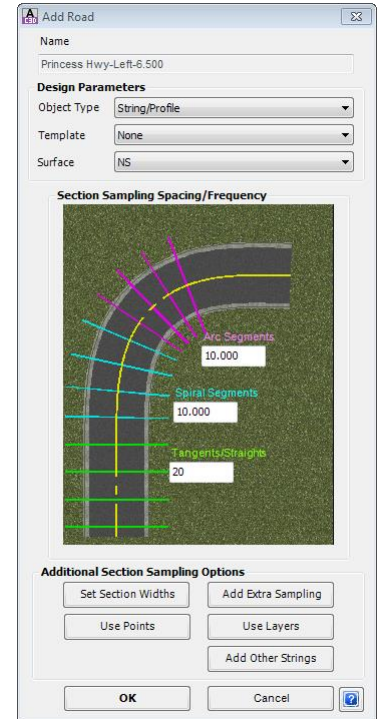
Step 6: Click on the **Design Panel** ➤ **String/Profile**  **Command** and select the **drainage** alignment created.

The **Add Road** form will open:

Make sure the the Road Type is set to **String/Profile**. Usually you would opt to not include a template onto this string (set and the Template to **None**) however it is acceptable to apply a template and use that to adjust the cross sections of the main road centreline.

Step 7: Set the Tangents/Straights spacing and click **Create/Update** to create the string.

The **VGE** will open to show the automatic vertical design of the **drain invert string**



Apply the Left Table Drain String

Step 8: Click on the **Select Panel** ➤ **Design Data Form**  **Command** and select the **main road** alignment.

From the **Design Data Form**, select the **Variation** Data Heading and click on the  button to add a new entry.

The **Variation Selection List** will open:

Step 9: Select **Set Code Offsets &/or Levels to String** and click **OK**

This will allow you to take a code from the current road cross sections and get it to adopt the elevations and/or offset of another string (in this case the invert drain).

Step 10: In the **Set Code Offsets &/or Levels to String** form enter the following:

- Code = **LT1**
- Start Chainage = **0m**
- End Chainage = **10000m**
- Select Method = **Hold Slope – Change Offset**
- String = **Princess Hwy-Left-6.500**

- Click on **Add/Update** to apply the entry


From the Design Data Form click on the  **Rebuild Models** button to update the surface.

Step 11: Close the **Design Data Form** by clicking on the  button.

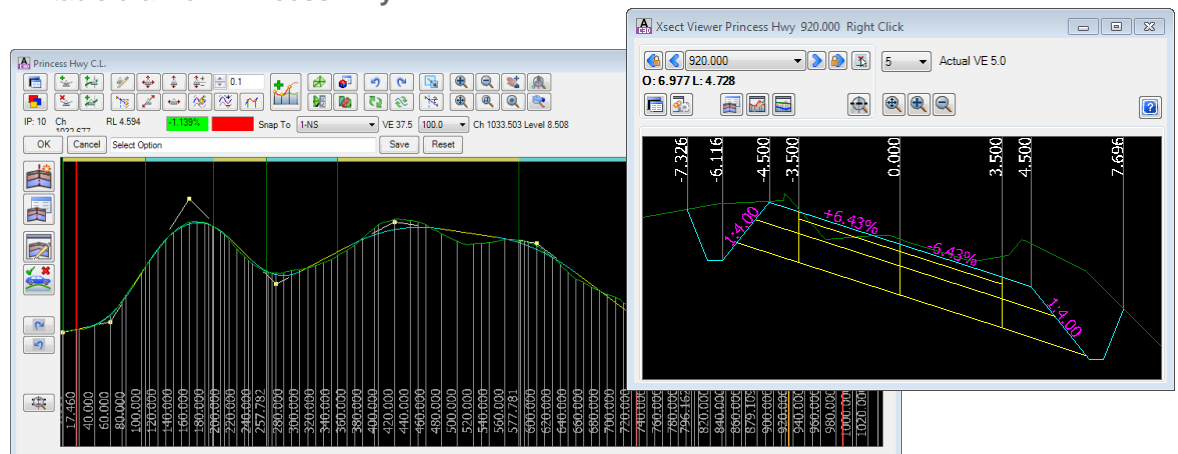
Important Note: The **Hold Slope - Change Offset Select Method** will maintain the slope of the code being varied thus resulting in a horizontal shift of the code relative to the alignment that defines the string. This needs to be taken into consideration when adjusting the vertical design of the **drain invert** string as the existing surface information shown in the **VGE** will NOT represent the existing surface of the code as its horizontal location varies.

Grade the Left Table Drain String


Now that we have setup the relationship between the left table drain (**LT1**) and the **Princess Hwy-Left-6.500** string, we can grade the string adjust the grade of the table drain.

Step 12: If not already open, open the **VGE** and a **CSW** for **Princess Hwy** (**Select Panel** > **Open Vertical Grading**  **Command** and right click to open a **CSW**).

Adjust the vertical grading of the **Princess Hwy-Left-6.500** string as required to grade the left table drain on **Princess Hwy**



*Hint: Whilst a **CSW** of **Princess Hwy** is open you will be able to adjust the vertical design of the **Princess Hwy-Left-6.500** and see the effect on cross section(s) of **Princess Hwy** dynamically.*

Step 13: Once you are satisfied with the vertical design of the **Princess Hwy-Left-6.500** and subsequently the left table drain, close all open **VGE**'s and **CSW**'s by clicking the **OK** and  buttons.