Introduction to Bentley FlowMaster CE 365K, Hydraulic Engineering Design, Spring 2015

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Goals of the Tutorial

This tutorial will introduce you to the capabilities of the Bentley FlowMaster Program. This includes hydraulic design and analysis of pipes, channels and other flow elements, creating rating curves, and creating channel cross-sections.

Procedure

(1) Opening Bentley FlowMaster

Open the program by double-clicking the FlowMaster icon, seen below, on your desktop or click **Start > All Programs > Bentley > FlowMaster, and select FlowMaster**.



(2) Using Bentley FlowMaster

Once you are in the program, you should see the welcome window pictured below.

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	Introduction to FlowMaster
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In the welcome window, select **Create New Project**. A project titled **Untitled1.fm8** should appear under the Project Explorer Panel on the left. Right click on the project and choose **Save As**. **Navigate to the folder** you will be using to save your files, **enter a filename** and choose **Save**.



Before starting an analysis, it is important to check the default unit system for the project. Go to **Tools** on the top menu bar, and select **Options.** To change the unit system from US to SI, select **Reset Default-SI**, and click **Okay.** For this tutorial SI units will be used.

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1	Angle	radians	2	Fixed Point
2	Active Grate Weir Length	m	2	Fixed Point
3	Adjusted Weir Coefficient	SI	2	Fixed Point
4	Average End Depth Over Rise	%	2	Fixed Point
5	Bottom Width	m	2	Fixed Point
6	Bypass Flow	m³/s	2	Fixed Point
7	Centroid Elevation	m	2	Fixed Point
8	Channel Slope	m/m	5	Fixed Point
9	Clogging	%	2	Fixed Point
10	Crest Breadth	m	2	Fixed Point
11	Crest Elevation	m	2	Fixed Point
12	Crest Length	m	2	Fixed Point
13	Critical Depth	m	2	Fixed Point
14	Critical Elevation	m	2	Fixed Point
15	Critical Slope	m/m	5	Fixed Point
16	Curb Opening Length	m	2	Fixed Point
17	Depth	m	2	Fixed Point
18	Diameter	m	2	Fixed Point
19	Discharge	m³/s	2	Fixed Point
20	DischargeCoefficient		2	Fixed Point
21	Discharge Full	m³/s	2	Fixed Point
22	Distance	m	2	Fixed Point
23	Efficiency	%	2	Fixed Point

Under **File** in the menu tab, **select New**, then **select Worksheet**. In the **Create New Worksheet** you can explore the various flow elements that FlowMaster can analyze. An unlimited number of worksheets can be created within a project file to analyze a variety of flow elements. To begin, **select Open Channels** under Categories and then **double-click Rectangular Channel**.

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Rectangular Channel		ок	Cancel	Help

You will see the new worksheet for a rectangular channel on the screen. Select the tab next to **Solve For:** to view the channel variables FlowMaster can calculate. From these options **select Discharge.** Let's use FlowMaster to solve for the discharge of a **concrete rectangular channel** with a **longitudinal slope of 5%**, a **maximum depth of 0.3 meters**, and a **base width of 0.5 meters** using Manning's Equation. **Select** the tab next to **Friction Method**, and choose **Manning Formula**.

Under the **Solve For** tab are spaces to enter data for the rectangular channel. To enter the data for the Roughness Coefficient, select the ellipsis button, and expand the data field. A materials tab will appear on the screen. **Expand the Material Libraries, and Expand the MaterialLibray.xml**, pictured below. Scroll down through the materials, **select Concrete** and **click Okay**.

🛁 Worksheet : Rectangul	lar Channel - 1	Materials	Ξ
Uniform Flow Gradually V Solve For: Discharge	/aried Flow 🕘 Messag	Auminum Auminum Auminum structural plate 32 in CR	•
Roughness Coefficient: Channel Slope: Normal Depth: Bottom Width: Discharge:	0.000 0.00000 0.00 0.00 0.00	Auminum structural plate 32 in CR Histori Asbestos Cement Asphalt ditch Asphalt pavement (rough) Asphalt pavement (smooth) Asphalted cast iron (new) Bare soil Bare soil Best concrete Brick in motar Cast iron Select a single element.	-
Bottom Width must be	greater than zero.		
		OK Cancel	

Enter the Channel slope as a decimal, 0.05, in the channel slope field. **Enter** 0.3 in the **Normal Depth** Field, and **enter** 0.5 in the **Bottom Width** Field. The Discharge Field is highlighted in yellow because it is the field FlowMaster is solving for. To solve for the channel discharge select the solve button, 2. The results of the analysis are seen below.

Jniform Flow	Gradually V	aried Flow 🜖 N	lessages			
Solve For:	Discharge		• 2	Friction Method: Ma	nning Formula	•]
Roughness (Coefficient:	0.013		Flow Area:	0.15	m²
Channel Slop	be:	0.05000	m/m	Wetted Perimeter:	1.10	m
Normal Depti	n:	0.30	m	Hydraulic Radius:	0.14	m
Bottom Width	1:	0.50	m	Top Width:	0.50	m
Discharge:		0.68	m³/s	Critical Depth:	0.58	m
				Critical Slope:	0.00980	m/m
				Velocity:	4.56	m/s
				Velocity Head:	1.06	m
				Specific Energy:	1.36	m
				Froude Number:	2.66	
				Flow Type:	Supercritical	

(3) Creating a Rating Curve

FlowMaster can be used to create rating and plot curves for flow elements that have been analyzed. To create a rating curve, discharge versus depth chart, for this channel select the Rating Curve Button, Rating Curve. In the Plot field select Discharge (m³/s). In the Vs. field Select Normal Depth. Enter 0 as the Minimum Value, 0.3 as the Maximum Value, and 0.01 as the Increment Value. For this analysis we will only plot Discharge versus Normal Depth, so select OK. If the rating curve does not come out looking like what you expect, check that you are plotting discharge vs normal depth. The default is to plot Discharge vs Roughness.

Note: FlowMaster allows you to create a different kind of rating curve by check the varying box and selecting another variable in the Vs. Field.

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•	Vs:	Normal Depth (m)	• 0.00	0.30	0.01	
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€ + 10	🔲 Varying:	Channel Slope (m/ 🔫	0.00000	0.00000	0.00000	

A rating curve, pictured below, should appear on the screen. To customize the rating curve use the Chart Options tool by **selecting** the **Chart Options...** icon.



(4) Creating a Channel Cross-Section

Under the Analysis menu bar, select the **Cross Section** button. **Note: The rating curve window must be closed to create a channel cross-section. Enter** the **Report Title** in the Cross Section Setup, and select **OK**.

Report Title:	Cross Section f	or Rectan	gular Channe	1-1
Aspect Ratio:	1.00	H:V	🥅 Manua	al Scale
ОК	Cancel		Help	Ì

After selecting OK, the channel cross-section will appear on the screen. To print the crosssection, **click Print Preview** and then **click Print**.

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