

DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 5.6.0

TUTORIAL # 13 RIPRAP SIZING CALCULATION



KVL Consultants, Inc.

RIPRAP SIZING ANALYSIS

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RIPRAP SIZING CALCULATION FOR BANK PROTECTION

DATE UPDATED: FEBRUARY 22, 2019 TUTORIAL TIME: 30 MINUTES

1.0 PROBLEM STATEMENT

To estimate the riprap sizing for bank protection using "*Channel Banks on Curved Reach*" type with the following given design parameters:

- The Cross Section "STUDYREACHROSSSECTION"
 - Parameters for Hydraulics and Geometry:
 - Design Flow Rate (cfs): 3200
 - Channel Slope (ft/ft): 0.015
 - Design Manning's n (Channel, LOB, ROB): 0.035
 - > The geometric data (station and elevation) of the cross section:

Station (X)	Elevation (Y)	Notes
100	100	
106	98	
156	98	Left Bank Station
166	95	
191	95	
201	98	Right Bank Station
251	98	
257	100	

- Parameters for Channel Banks:
 - Bank Slope Angle (Degrees): 45.00
 - Specific Weight for Stone (lb/cu ft): 150.00
 - Specific Weight for Water (lb/cu ft): 62.40

2.0 STEP-BY-STEP PROCEDURES

- Step 1: Establish a New Project and Default Set-up
- Step 2: Prepare the Cross Section Geometry
- Step 3: Calculate Riprap Sizing

Step 4: Report and Document the Results

2.1 STEP 1 - ESTABLISH A NEW PROJECT AND DEFAULTS SET-UP

(a) Click the DDMSW icon on the Desktop or Program menu to launch the **DDMSW**. Click **OK** to accept the software disclaimer as is shown in the following figure.



After the **DDMSW** is launched, the **SELECT PROJECT** window is automatically opened as is shown in the following figure.

Li	st		De <u>t</u> ails
Look for			
Reference 🔶	Date	ID	Title
KVLEXAMPLE7A	03/02/2016	00096	Rational Method Tutorial
KVLEXAMPLE8	01/01/2011	00050	Street Drainage Examples
KVLEXAMPLE9	03/01/2016	00051	HEC-1 Tutorial - Custom Storm Event
LATEROSIONEXAMPLE	03/31/2014	00052	Lateral Erosion Example
LAUNCHABLERIPRAP	01/01/2012	00053	River Mechanics Example - Launchable RipRap
MCMICKENDAM - RUN 3	11/24/2015	00033	sediment yield analysis
MCMICKEN_SY_464D	11/24/2015	00034	sediment yield analysis
PROJECTXSECTIONS	02/24/2016	00058	River Mechanics Cross Section Datasets
RIPRAPSIZING1	03/03/2016	00134	River Mechanics Example - Riprap Sizing
RIPRAPSIZINGFCD	01/01/2012	00054	River Mechanics Example - Riprap Sizing
SEDIMENTYIELD1	03/03/2016	00060	River Mechanics Example - Sediment Yield
SEDIMENTYIELDFCD	01/01/2012	00055	River Mechanics Example - Sediment Yield
TASK1110_LATEROSION	02/29/2016	00088	Assignment No. 4 - Task 1.1.10_Lenth to Distance Labeling
TASK1111_LATEROSION	02/29/2016	00089	Assignment No. 4 - Task 1.1.11_Lateral Erosion Project
TASK1111_SCOUR	02/29/2016	00090	Assignment No. 4 - Task 1.1.11_Import Total Scour
TASK1112_LRIPRAP	02/29/2016	00091	Assignment No. 4 - Task 1.1.12_Launchable Riprap
1			F

- (b) Click the Add button on the Select Project window to start a new project (or you can start a new project by File → New Project → Add).
- (c) Select **River Mechanics** checkbox and click the **OK** button on the **New PROJECT OPTIONS** form.
- (d) Type "*RIPRAPSIZING1*" into the **Reference** textbox. This is the name of this newly created project. Users can choose any name for the Reference textbox as long as it does not exist in the current **DDMSW** project database.
- (e) Type into the Title textbox a brief descriptive title of this project. (Optional)
- (f) Type into the Location textbox the location of this project. (Optional)
- (g) Type into the Agency textbox the agency or company name. (Optional)
- (h) Check River Mechanics Only checkbox for this project.
- (i) Type a detailed description of this project into the comment area under the **Project Reference** frame. *(Optional)*
- (j) On the **Modification Date**, use the current date.
- (k) Click Save button to save the entered data.
- (I) Click **OK** button on the **SELECT PROJECT** window, and click **OK** button on the pop-up message box. The following figure shows what the window looks like.

Select Proj	ject								
		<u>L</u> ist				Deta	ails		
Project R	Reference	_				Project Def	aults]
Project ID	00084	Refer	ence RIPRAPSIZING1						
Title	Riprap Sizing T	utorial				Soils	FCDMC		
Location	Maricopa Coun	ty, Arizo	na			Land Us	FCDMC		
Agency	Flood Control D	istrict o	f Maricopa County						
	River Mechar	iics On	у						
This tutoria DDMSW to	Il is set-up to give evaluate riprap r	e a ster materia	-by-step instruction on he Is for bank protection pro	ow to use jects	*				
Modificatio	n Date 02/22/20)19	R	<u>@</u>]	nfo	P <u>r</u> int	elete A	\dd	<u>o</u> к

Note: the **Project ID** 00084 in the above figure is the database records unique read-only identifier of the project, which is automatically generated by the program when a new project is created. When the users create a new project, the **Project ID** of this new project will not be the same as the **Project ID** shown in the above figure.

2.2 STEP 2 - PREPARE THE CROSS SECTION AND HYDRAULIC DATA

Only one (1) cross section data, the "STUDYREACHCROSSSECTION", will be used for this tutorial. This cross section data will be imported from another project.

(a) To import the first cross section data (Study Location Cross Section Data), open the IMPORT CROSS SECTIONS FROM ANOTHER PROJECT form (River Mechanics → Import Cross Sections from Another Project). Use the following data on the form.

•	Import Project Reference:	PROJECTXSECTIONS
•	Option:	Specific Cross section
•	Import Cross Section ID:	STUDYREACHCROSSSECTIONS

Import Cross Sections From Another Project	t
Import Project Reference	PROJECTXSECTIONS
Option	Specific Cross Section
Import Cross Section ID	STUDYREACHCROSSSECTION
	Import OK

(b) Once the specified data have been selected, click the **Import** button. Select **Yes** to proceed, and hit **OK** to close the **IMPORT CROSS SECTION FROM ANOTHER PROJECT** form.

Question	X
?	This will import Cross Section STUDYREACHCROSSSECTION from PROJECTXSECTIONS to the current project. - Data with the same ID will be overwritten. Do you want to continue?
	Yes No

(c) To check if the bridge cross section data has been successfully imported, open the NATURAL CROSS SECTIONS form (River Mechanics → Cross Section Geometry). For the Cross Section ID, select "STUDYREACHCROSSSECTION" by clicking the Selector button at the right side of the ID textbox.



Compare the geometric data on the **NATURAL CROSS SECTIONS** form against the tabulated data listed below. Make necessary data edits or adjustments on the form, if necessary. Click **OK** to close the form.

Station (X)	Elevation (Y)	Notes
100	100	
106	98	
156	98	Left Bank Station
166	95	
191	95	
201	98	Right Bank Station
251	98	
257	100	

(d) To check if the imported hydraulic data has all the correct Flow Rates (cfs), Slopes (ft/ft), and Manning's n (Channel, LOB, and ROB) data, open the CROSS SECTION HYDRAULICS form (River mechanics → Cross Section Hydraulics). Make sure that the Cross Section ID is set to "STUDYREACHCROSSSECTION" and only the "Design" checkbox is checked. Please note the dominant flow event will not be used in the Riprap Sizing analysis.

River Mechanics - Cross Section Hyd	rauli	cs						
Section ID	_	Entire Cross	Section —					
STUDYREACHCROSSSECTION		Source	Calculate	Data	-	🔽 Design	Dominant	
		Total Scour		Flow Rat	e (cfs)	3200		
Cross Section ID	^			Slop	e (ft/ft)	0.015000		
STUDTREACHCRUSSSECTION			Manni	ing's n Ch	nannel	0.035		Man's n
			м	anning's	n LOB	0.035		
			M	anning's i	n ROB	0.035		
			1	Flow Area	(sqft)	328.86		
	•		Wette	ed Perime	eter (ft)	155.35		
			A	erage Wi	dth (ft)	73.12		
	Ξ.			Top Wi	dth (ft)	153.98		
	•		Hyd	raulic De	pth (ft)	2.14		
			Normal of	or Max De	pth (ft)	4.50		
٠	Ŧ			Velocity ((ft/sec)	9.73		
	-							
Info Print	<u>С</u> ор	y <u>D</u> elete	<u>A</u> dd	<u>G</u> rapt	n <u>X</u> S	ection <u>D</u> etai	I Update	<u>o</u> k:

Compare the imported data on the form against the actual data as follows:

•	Cross Section ID:	STUDYREACHCROSSSECTION
•	Design Flow Rate (cfs):	3200
•	Design Slope (ft/ft):	0.015
•	Design Manning's n (Channel,	LOB, and ROB): 0.035

- (e) If everything checks out, click the **Update** button to update the hydraulic analysis results. If not, make sure to replicate the above figure, then click **Update**.
- (f) On the SELECT OPTION form, select "This Record" and click OK. Hit Yes to continue.



After the update, the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** window looks like the following figure.

River Mechanics - Cross Section Hydra	ulics				
Section ID	Entire Cross	Section			
STUDYREACHCROSSSECTION	Source	Calculate Data	🔽 Design	Dominant	
	Total Scour	Flow Rate (cfs)	3200		
Cross Section ID A	^	Slope (ft/ft)	0.015000		
STUDYREACHCROSSSECTION		Manning's n Channel	0.035		Man's n
		Manning's n LOB	0.035		
		Manning's n ROB	0.035		
		Flow Area (sq ft)	328.86		
		Wetted Perimeter (ft)	155.35		
		Average Width (ft)	73.12		
		Top Width (ft)	153.98		
·	-	Hydraulic Depth (ft)	2.14		
		Normal or Max Depth (ft)	4.50		
4	•	Velocity (ft/sec)	9.73		
	^				
	-				
Info Print	Copy Delete	<u>A</u> dd <u>G</u> raph X S	ection Detai	I Update	<u>o</u> k

(g) Click OK to close the RIVER MECHANICS - CROSS SECTION HYDRAULICS form.

2.3 STEP 3 - CALCULATE RIPRAP SIZE

(a) From the menu bar of main application window, click **River Mechanics** → **Riprap** to open the **River Mechanics** - **Riprap** window.



River Mechanic	s - Riprap					X
	List			Details		
ID 🔺	Cross Section ID	D50 (ft)		Туре		
						_
						_
						-
						_
						_
						-
						_
						_
•						4
	He	Ip 💽 🧑 Info	P <u>r</u> int <u>D</u> el	ete <u>A</u> dd	Update	<u>о</u> к

- (b) Click Add button on the RIVER MECHANICS RIPRAP window.
- (c) Enter "CHNL1" into the Location ID textbox
- (d) Browse for "Channel Banks on Curved Reach" in the Type textbox
- (e) Click **OK** on the **SELECT TYPE** dialog box.
- (f) Check Use Cross Section ID check box
- (g) Browse for "STUDYREACHCROSSSECTION" in the Section ID textbox.
- (h) Click **OK** on the **SELECT CROSS SECTION ID** dialog box.
- (i) Enter "3" into the **Bank Slope (H:V)** textbox
- (j) Enter "150.00" into the Specific Weight Stone (lb/cu ft) textbox
- (k) Enter "62.40" into the Specific Weight Water (lb/cu ft) textbox
- (I) Select "*Angular*" from the drop down for Riprap **Type** in the **Safety Factor** frame.
- (m) Click the **Save** button.
- (n) Click Update button to compute riprap median size D50 (ft).
- (o) Highlight "*This Record*" in the SELECTION OPTION window and click OK. Click Yes when the CALCULATE RIPRAP SIZE dialog box opens.



After the update process is finished, the window looks like what is shown in the following figure. Click **OK** to close the window.

River Mecha	nics - Riprap							_				
List					Details							
ID					1							
Location ID	CHNL1	se Cross	s Section ID									
Туре	Channel Banks on Curved Reach											
Section ID												
Channel B	anks on Curved R	each	Grad	ation (ft)	Safety	Factor		Thickness				
Avg Velocity (ft/s) 9.73		9.73	D15	1.32	Type	Angular	-	Placed Under	water 🔳			
Bank Slope (H:V) 3:1		D50	2.64	Value	1.00		Factor	1.50				
Specific Weight Stone (lb/cu ft) 150.00		150.00	D85	3.43	Default	1.00						
Specific Weight Water (lb/cu ft) 62.4		62.40	D100	4.22	Custom			Thickness (ft)	3.96			
	D50 (ft)	2.64										
		<u></u>	elp 6	Info	P <u>r</u> int	Delete	Ad	ld Update	<u>0</u> K			

2.4 STEP 4 - REPORT AND DOCUMENT THE RESULTS

In this section, the instruction will be given on how to view, print, and export the calculation results of the riprap sizing.

(a) Click the **Print** ... button on the **RIVER MECHANICS** – **RIPRAP** window. A report will be generated as is shown in the following figure.

		Fibod Controll Dreinage Des	District of Mario	pa County								
Page 1	RIVER MECHANICS - RIPRAP Project Reference: RIPRAP SIZING 1											4/17/2018
D	Туре	Section ID	Design Q (cfs)	Slope (foft)	Width (ft)	Average Velocity (105)	Specific Weight Stone (Ib/cu ft)	Specific Weight Water (ib/cu ft)	Bank Slope (H:V)	Safety Factor	050 (71)	Thickness (ft)
CHNL1	Channel Banks on Curved Reach	STUDYREACHCROSSSECTION	3,200	0.02	73.12	9.73	150.00	62.40	3:1	1.00	2.64	3.96

- (b) To print the results, click the printer symbol (B).
- (c) To export the results in PDF format or other formats, click the export symbol (🚵)
- (d) More detailed information for cross section hydraulics can also be viewed, printed, and exported by clicking the **Print...** button under **Cross Section Hydraulics** menu.

This concludes this tutorial for sediment yield analysis.