

RECLAMATION

Managing Water in the West

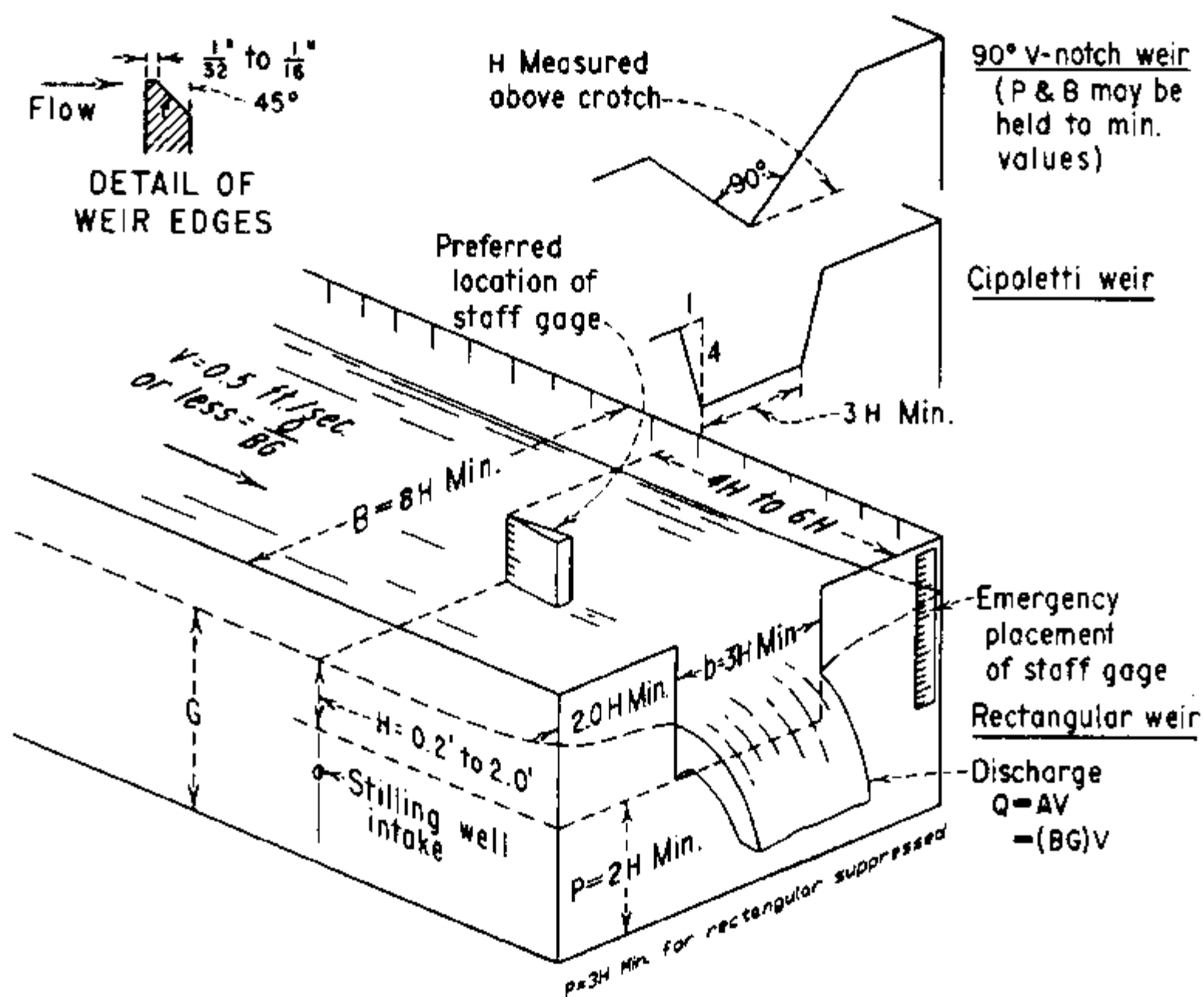
Sharp-Crested Weir Calibration

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U.S. Department of the Interior
Bureau of Reclamation



WEIR PROPORTIONS
RECTANGULAR, CIPOLETTI AND 90° V-NOTCH

Fully Contracted Flow

- Weir box is large enough that flow through weir opening is unaffected by proximity of the sidewalls or floor
 - Weir box could be wider and/or deeper and it would not change the flow
- Standard equations apply
 - Easy to integrate into automated data collection network
 - One equation computes flow rate from measured head

Partially Contracted Flow

- Weir box is too small
 - too shallow or too narrow
- Flow does not contract fully as it passes through the opening
- Changes discharge vs. head rating of the structure
- Standard equations do not apply
- Difficult to integrate into data collection network

Kindsvater-Carter method, 1957

- Rectangular or V-notch weirs
- Generic discharge equation with coefficients that vary as a function of dimensionless ratios involving weir and weir box dimensions and head
- Tedious to apply using charts to look up coefficients
- Difficult to integrate resulting rating table into SCADA system

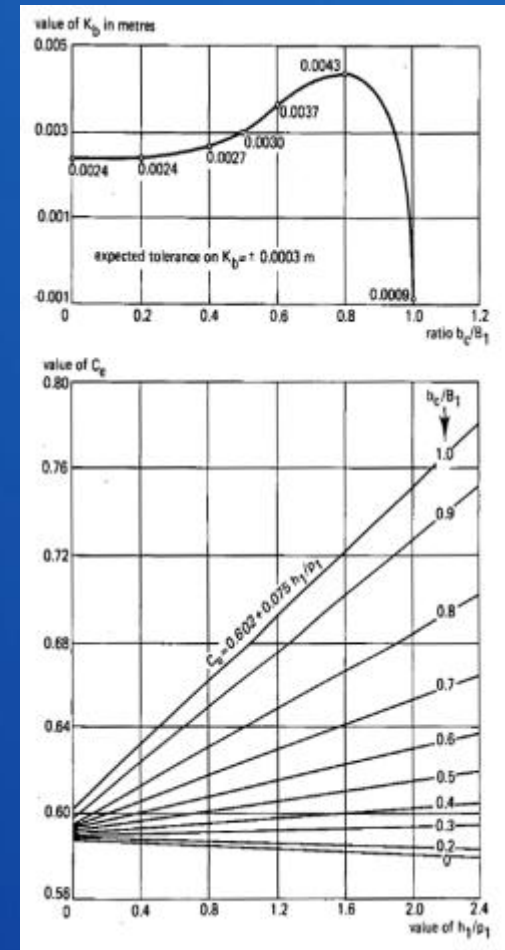
Application to Rectangular Weirs

$$Q = C_e \frac{2}{3} \sqrt{2g} b_e h_e^{1.5}$$

$$b_e = b_c + K_b$$

$$h_e = h_1 + K_h$$

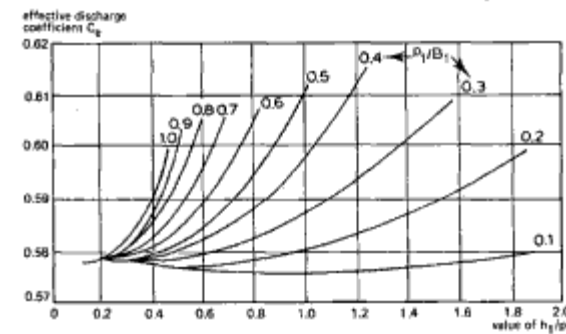
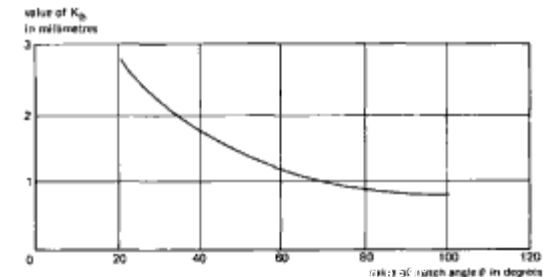
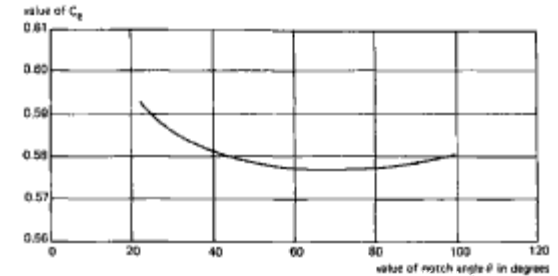
($K_h = 0.001$ m for all cases)



Application to V-Notch Weirs

$$Q = C_e \frac{8}{15} \sqrt{2g} \tan \frac{\theta}{2} h_e^{2.5}$$

$$h_e = h_1 + K_h$$



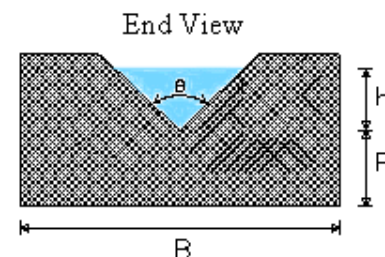
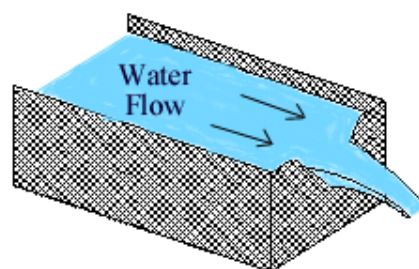
V-Notch (Triangular) Weir Calculator

Discharge and Head Calculations, Equations, and Guidelines for water flow measurement in streams and channels

To: [LMNO Engineering home page \(more calculations\)](#) [Unit Conversions](#) [Trouble printing?](#)

Weirs: [Rectangular](#) [Cipoletti Weir](#) End Depth: [Circular](#) [Rectangular](#) [Triangular](#)

Flumes: [Parshall](#), [Trapezoidal](#), [Rectangular](#), and [U shape](#) [Parshall \(submerged\)](#)



Solve for:

Discharge

<http://www.LMNOeng.com>

Discharge, Q (cfs, ft³/s):

Head, h (ft):

Select Units:

Discharge in ft³/s or cfs

Notch Angle, theta (degrees):

Head in feet

Discharge Coefficient, C:

Notch Angle in Degrees

Head Correction Factor, k (ft):

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Click to Calculate

Will be computed

1.0

90.0

Will be computed

Will be computed

Topics: [Introduction](#) [Equations](#) [Installation Guidelines and Equation Applicability](#) [Error Messages](#) [References](#)

Introduction

Weirs are typically installed in open channels such as streams to determine discharge (flowrate). The basic principle is that discharge is directly related to the water

USBRWeir Spreadsheet

- Automates application of Kindsvater-Carter method
 - Rectangular weirs
 - V-notch weirs
 - Cipoletti weirs
- Produces rating tables and simplified rating equations for partially contracted weirs

Microsoft Excel - USBR Weir, beta 5.xls

USB Sharp-Crested Weir Calculator Spreadsheet Version beta_5, June 7, 2005

Weir Location: XYZ Canal, Rectangular Contracted Weir No. 1

Weir Description: Example weir

Generated by: Tony Wahl

Date: 10/1/2005

Weir Type: 90° V-notch weir
Rectangular suppressed weir
Cipoletti weir, fully contracted
V-notch weir (25° to 100°), fully contracted

Units: ☒ English Units (ft, ft/s)
☐ Metric Units (m, m/s)

Weir and Approach Channel Dimensions:

Weir width, b_2 : 4 ft

Weir height, p_1 : 3.1 ft

Approach channel width, B_1 : 6 ft

Rating Table Range and Resolution:

Minimum head, h_1 : 0.21 ft

Maximum head, h_2 : 0.8 ft

Head measurement resolution: 0.01 ft

Dimension Check
This weir is partially contracted, and can be calibrated.
For fully contracted flow, change one or more of the following:
Increase approach channel width to 7.200 ft.

Ditchrider's Head-Discharge Rating Table

Measured Head, ft	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.2	---	1.26	1.35	1.44	1.53	1.63	1.73	1.82	1.93	2.03
0.3	2.13	2.34	2.35	2.48	2.57	2.69	2.80	2.92	3.04	3.16
0.4	3.28	3.40	3.53	3.65	3.78	3.91	4.04	4.17	4.31	4.44
0.5	4.58	4.72	4.88	5.00	5.14	5.28	5.43	5.57	5.72	5.87
0.6	6.02	6.17	6.32	6.48	6.63	6.79	6.94	7.10	7.26	7.42
0.7	7.59	7.75	7.91	8.08	8.25	8.42	8.59	8.76	8.93	9.10
0.8	9.27	---	---	---	---	---	---	---	---	---

Curve fit rating equation: $Q = 12.0233 \cdot h^{1.4953}$

Rating Table

Ditchrider's Head-Discharge Rating Table

Measured Head, ft	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.2	---	1.26	1.35	1.44	1.53	1.63	1.73	1.82	1.93	2.03
0.3	2.13	2.24	2.35	2.46	2.57	2.69	2.80	2.92	3.04	3.16
0.4	3.28	3.40	3.53	3.65	3.78	3.91	4.04	4.17	4.31	4.44
0.5	4.58	4.72	4.86	5.00	5.14	5.28	5.43	5.57	5.72	5.87
0.6	6.02	6.17	6.32	6.48	6.63	6.79	6.94	7.10	7.26	7.42
0.7	7.59	7.75	7.91	8.08	8.25	8.42	8.59	8.76	8.93	9.10
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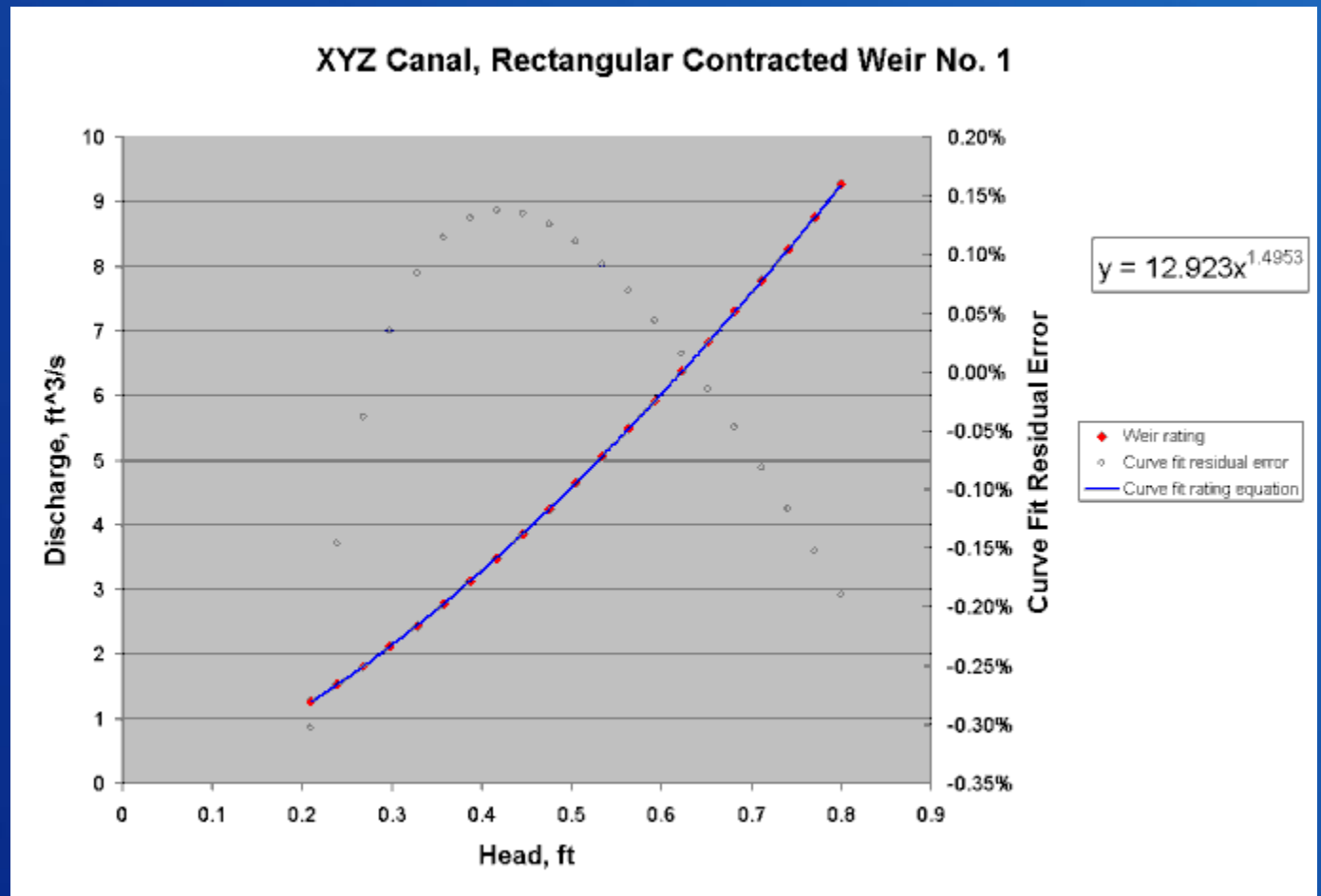
Curve fit rating equation: $Q = 12.9233 * h^{1.4953}$

Input

Ready

RECLAMATION

Rating Curve and Equation



Obtaining USBRWeir.xls

- www.usbr.gov/pmts/hydraulics_lab/usbrweir