FLOW MEASUREMENT IN CHANNELS – NOTCHES – WEIRS - PARSHALL FLUME

A measuring device is, therefore, fixed in the initial reach of the field channel system of every chak. The device should be located on a 10 to 20 m straight reach. If a drop is available in this portion, it can be combined with the measuring device.

If Self-Regulated (SR) outlet is used to deliver the water, separate measuring devices may not be necessary as this outlet delivers almost constant discharge (upto 10% variation) under given modular range.

A good measuring device indicates the discharge with preferably single guage reading and it should be reasonably accurate within the given range of discharge. The device should not be unduly sensitive to changes in the type of flow and levels of upstream and downstream, particularly the approach velocity in the upstream and some silting or erosion on the downstream.

For small discharges the above conditions are satisfied by the following measuring devices:

a) V-notch

b) Cut-throat flume

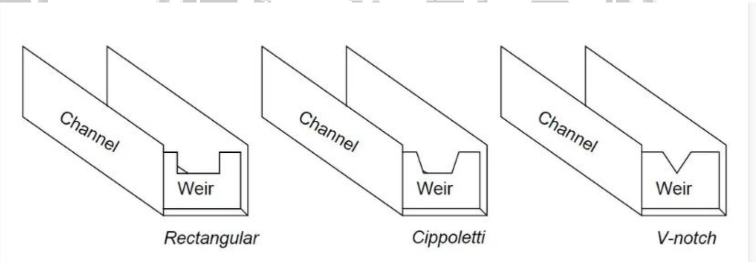
c) Replogle flume.

If drop/fall is available, V-Notch is suitable device. If not, Replogle Flume may be selected, as it is easy to construct, low in cost. The Cutthroat flume if available in pre-fabricated form can also be used provided setting is properly worked out and executed.

V-Notch:

Generally 90° V-notch is quite often used to measure small discharge (say upto 30 to 40 lps) in field channels where falls are available. The downstream water level must be at least 15 cm below the vertex or crest of the notch. This implies an available drop of about 45 to 50 cm. Advantages of V-notch are its low cost and ease in construction. Figure-19.1 shows the fixing of 90° V-notch in field channel.

A very different style of variable-area flow meter is used extensively to measure flow rate through open channels, such as irrigation ditches. If an obstruction is placed within a channel, any liquid flowing through the channel must rise on the upstream side of the obstruction. By measuring this liquid level rise, it is possible to infer the rate of liquid flow past the obstruction.



At a condition of zero flow through the channel, the liquid level will be at or below the crest (lowest point on the opening) of the weir. As liquid begins to flow through the channel, it must spill over the crest of the weir in order to get past the weir and continue downstream in the channel.

In order for this to happen, the level of the liquid upstream of the weir must rise above the weir's crest height. This height of liquid upstream of the weir represents a hydrostatic pressure, much the same as liquid heights in piezometer tubes represent pressures in a liquid flowstream through an enclosed pipe.

The height of liquid above the crest of a weir is analogous to the pressure differential generated by an orifice plate. As liquid flow is increased even more, a greater pressure (head) will be generated upstream of the weir, forcing the liquid level to rise. This effectively increases the cross-sectional area of the weir's "throat" as a taller stream of liquid exits the notch of the weir (Note).

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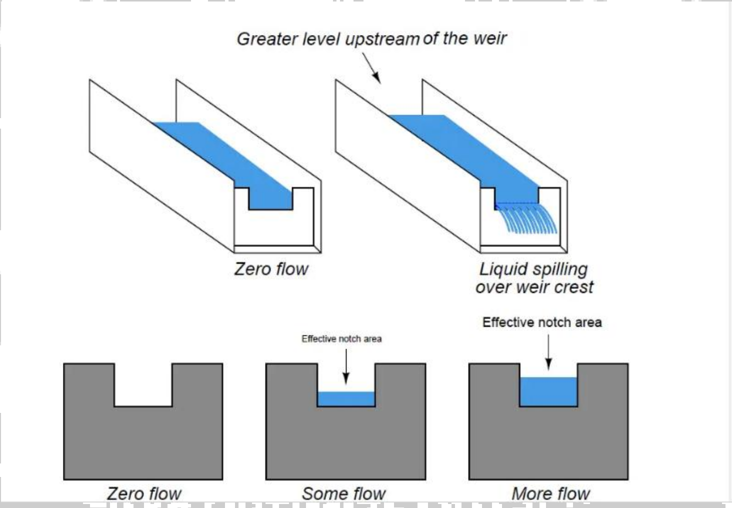

Parshall Flume

The Parshall Flume is an economical and accurate way of measuring water flow in open channels and non-full pipes. Originally the flume was developed to measure surface waters, water rights apportionment, and irrigation flows. However, its use has expanded to include measuring sewage flow (both in pipe and treatment plants), industrial discharges, dam seepage, and other applications.

Parshall Flume Materials

Openchannelflow manufactures Parshall Flumes in several different materials:

Aluminum

Great for portable flumes or remotes sites where it's difficult to bring materials in. Lightweight and robust construction, aluminum does cost more than most other materials.

Fiberglass (FRP / GRP)

A good combination of lightweight, cost-competitive, and good corrosion resistance

For sewage applications, fiberglass is THE material of choice

Galvanized Steel

Where cost is the concern (and the water clean), galvanized steel is the material of choice

Although heavy, it is easy to repair and withstands abuse well - a perfect material for water rights, irrigation, and surface water flows

Stainless Steel

While more expensive than other materials, stainless steel is an excellent material when the flow stream is:

Abrasive

Corrosive

High sustained temperatures

or where physical abuse may occur

Parshall Flume Accessories

To help you focus on your flow numbers - and not how you got them - Openchannelflow also offers a wide range of accessories, including:

Piping / end connections

Flow condition options

Flowmeter mounts

Sampler / parameter mounts

Custom configurations (nesting, extended / reduced sidewalls, etc.)

Parshall Flume Applications

The versatility of the Parshall Flume sees it used in several diverse applications, including:

Sewage Treatment Plants

Watershed Monitoring

Edge-of-Field Runoff

Dam Seepage

Stream Gauging

Industrial Discharge Monitoring

Mine Discharge

Irrigation Canals

Spring Discharge Measurement

How a Parshall Flume Operates

A Parshall Flume is a fixed, hydraulic structure used to measure water flow in an open channel or non-full pipe. The flume accelerates flow by both a contraction of the parallel sidewalls and a drop in the throat's floor elevation. The contraction and drop accelerate the flow from a slow, subcritical state to a faster, supercritical one. The transition is similar to the transition in air from subsonic to supersonic regimes.

As a result, the flow can be accurately determined in the upstream, converging section of the flume by taking a single depth reading at a specific point of measurement.

Short-throated flumes like the Parshall have only one point of measurement (Ha) at which the flow rate can be determined. A level reading taken upstream of the point of measurement will result in the flume over reading, while one taken downstream will result in the flume under reading (as the flow accelerates and the water surface draws down towards the throat).

Developing the Parshall Flume

While working at the U.S. Soil Conservation Service, Dr. Ralph L. Parshall saw a need for more accurate measurement of surface waters – particularly irrigation / water rights flows. At that time, weirs and Venturi flumes were used to measure flow rates, but both devices had shortcomings. Starting in 1915 with the sub-critical Venturi flume, Dr. Parshall made a series of modifications, ultimately leading to his Improved Venturi flume.

The critical improvement that Dr. Parshall introduced was a drop in the floor in the throat section of the flume. The constriction of the throat creates the head to flow relationship. By sloping the floor down here, the resulting flume can withstand relatively high degrees of submergence without affecting the flow rate.