Lecture Notes: Stream Gauging, dated 11-05-2020

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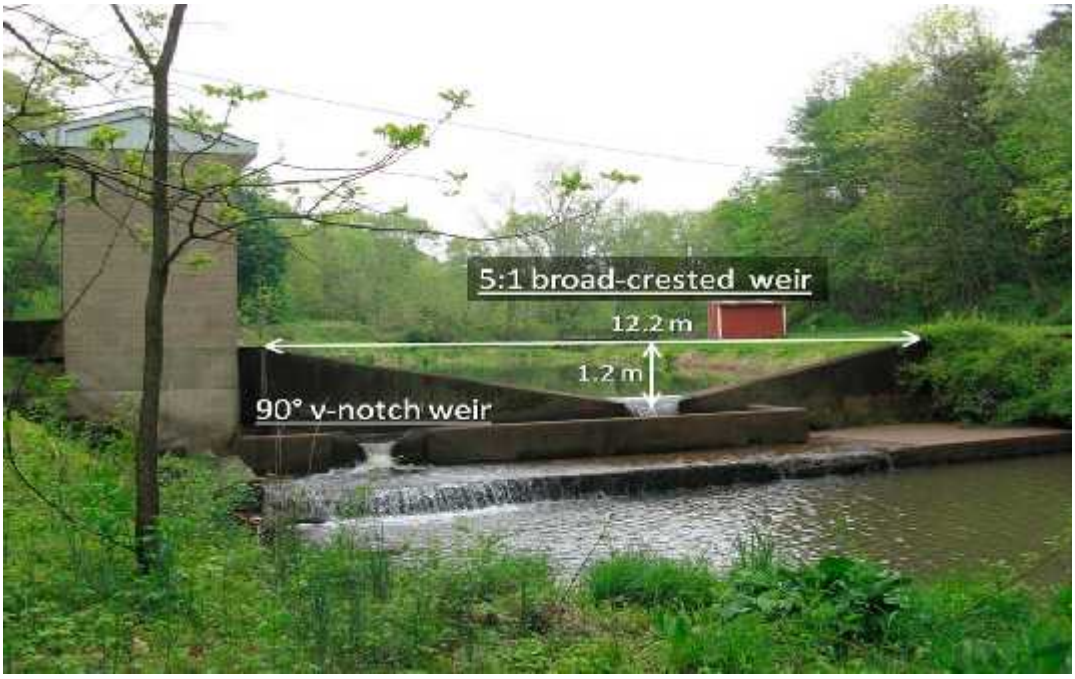
What is stream:

A stream is a path / road in which water flow / travel. Channel, waterway, Nallah & river are the examples of streams.

Stream Gauging:

Definition: It is a technique / process of measurement of water flowing in a stream / nallah / river / canal. It is measured at a particular section of the stream. The unit of measurement may be liter/second, m^3/second (cumec), m^3/hour, m^3/day, gallon/minute or cubic feet/second (cusec). Below are given some photographs, collected from different sources to give an idea of streamflow measurement.


5:1 broad-crested weir
12.2 m
1.2 m
90° v-notch weir

Importance of stream gauging:

The stream gauging data have a wide variety of uses. Some important uses of stream gauging data are:

1. Used in design of water storage structures like nallah bund, embankment, dam etc.
2. Useful in flood forecast.
3. Useful in drought forecast.
4. Used to quantify runoff of a watershed for water harvesting.
5. Used to quantify irrigation water for efficient management.
6. To develop the historical record for research & other purposes.
7. To design drinking water schemes for cities.
8. To estimate the soil erosion of watershed.
9. Help the quantification of components of hydrological cycle.

Selection of suitable section of a stream:

Following point shall be considered in selection of section

1. The bank of stream should be stable. It should not be prone to bank erosion
2. Bed of the stream should be stable.
3. Section should be free from vegetation growth
4. Section should be straight no curve shape.
5. It should be conveniently accessible. Well connected with road.

Straight section of stream will be preferred for streamflow measurement.

The curved shape of stream may be avoided for measuring site.

Methods of Streamflow measurements:

Various methods are adopted for streamflow measurements some are:

1. Volumetric Method (Drum method)
2. Velocity-Area method
3. Slope-Area method
4. Weirs Method
5. Flumes method

1.Volumetric Method (Drum Technique):

i) Drum/container of suitable size is selected.

ii) Volume of container is determined.

iii) The flow of stream is diverted to this drum.

iv) Time to fill this drum is recorded with the help of a Stop Watch.

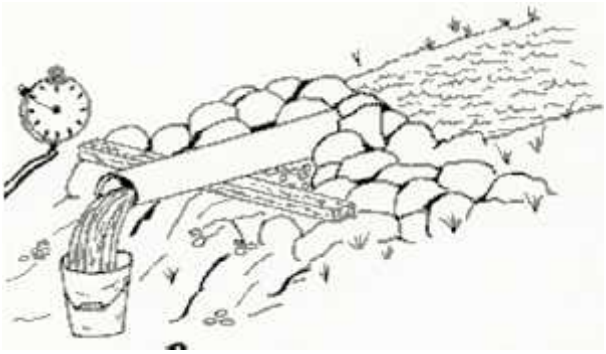
v) For accuracy drum is filled for 3-5 times & filling time is noted.

vi) stream flow is calculated with formula Q = Volume / Time

Photographs of various sizes of drums are given below which may be suitable for stream flow measurements.


redbeanco

The flow of stream is diverted to a point where drum can be filled with its flow for measurements.



Example:

i) Size of drum is 60 liters.
ii) Drum is filled five times.
iii) Time recorded by stop watch are 5.2, 5.0, 5.3, 5.2 & 5.4 seconds.

Mean filling time will be= (5.2+5.0+5.3+5.2+5.4) sec. / 5

= 5.22 sec.

Discharge = 60 lit / 5.22 sec.

= 11.49 lps.

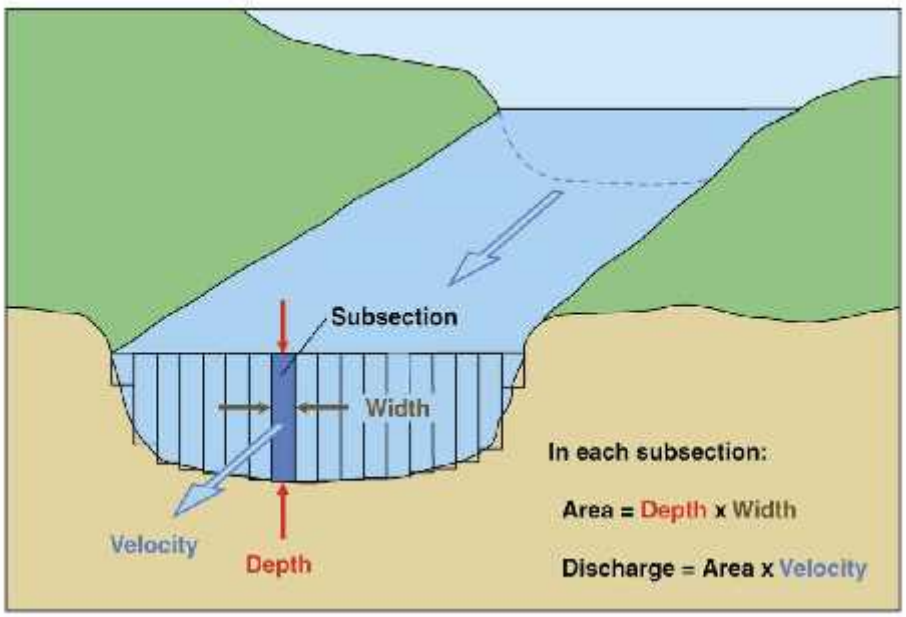
2.Velocity-Area Method:

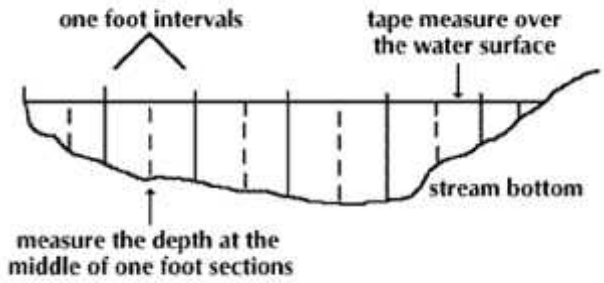
Stream flow is measured by equation:

Q (m^3/sec) = A (m^2) X V (m/sec)

Determination of Area of Cross Section of Stream (A):

i) The width of stream is divided into number of sub sections having equal width
ii) The depth of both ends of subsection is measured & recorded.





$A = ½(W_S x D_1) + W_S x ½(D_1 + D_2) + W_S x ½(D_2 + D_3) + W_S x ½(D_3 + D_4) +$

$W_S x ½(D_4 + D_5) + ½(W_S x D5)$

Suppose a 24 m wide river is marked into 6 segments each of 4 m.

The depth recorded are 0.8, 1.2, 1.4, 1.5 & 0.5 m respectively for D_1, D_2, D_3, D_4 & D_5. Then

A = ½(4mx0.8m)+ 4mx ½(0.8m+1.2m)+ 4mx ½(1.2m+1.4m)+ 4mx ½(1.4m+1.5m)+ 4mx ½(1.5m+0.5m)+ ½(4mx0.5m)

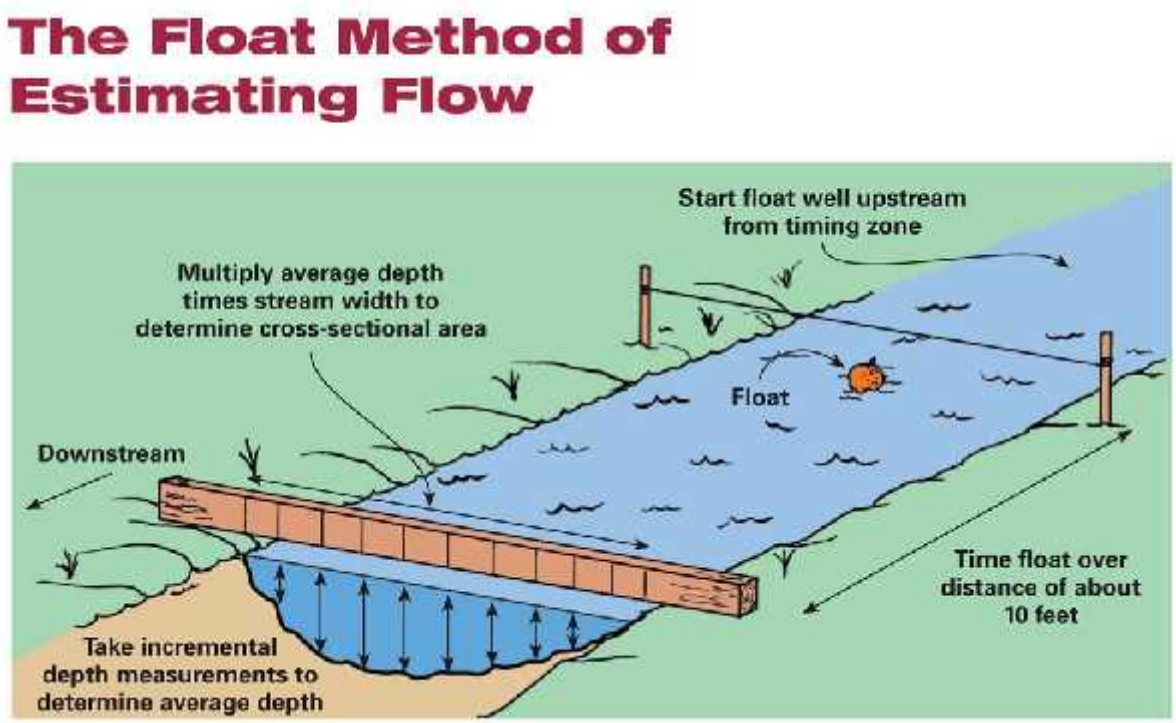
= 21.6 m^2.

The velocity is measured by following method

i) Float method
ii) Current meter
iii) Dilution method

Float Method:

A straight section of about 30 m is identified in a stream. A float is dip into the start of this 30 m section. Time to travel 30 m distance is recorded with the help of stop watch. This exercise is done 3 to 5 times & mean travelling time is calculated. It is the maximum velocity of stream but we need mean velocity of stream hence correction factor of 0.8 is multiplied with the maximum velocity of flow. This velocity (V, m/sec) when multiplied by cross sectional area (A, m^2) of stream gives the discharge (Q, m^3/sec) of the stream.



Consider the cross-sectional area of stream as 21.6 m^2

Suppose velocity of float were recorded 5 times & the mean of this five-time surface velocity was 1.1 m/sec then

Mean velocity of stream will be 1.1 m/sec x 0.8 = 0.88 m/sec

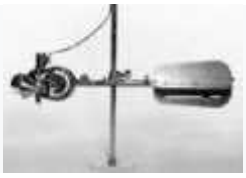
Discharge of stream Q = 21.6 m^2 x 0.88 m/sec

= 19.008 m^3/sec

Velocity of flow in a stream is also measured by current meters.

Current Meter:

Meters are devices that measure the stream flow by directly measuring the current. There are many different types of meters by the most common is the Pygmy meter, the vortex meter, the flow probe, and the current meter: They are briefly described below.

- 

Pygmy meter: a wheel is rotated by water flow and the rate of the rotation signifies the water velocity. It is primarily used in measuring discharge. [7]

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Vortex meter: velocity is proportional to the downstream frequency of the vortex flow and is read on a digital readout. It is used for measuring flow in pipes. [8]

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Flow probe: the flow turns a propeller that sends the water velocity data to a digital readout display in ft/s or m/s [9]

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Current meter: electronic pulses determine water velocity. Can be used in large bodies of water like oceans to measure the current. [10]
