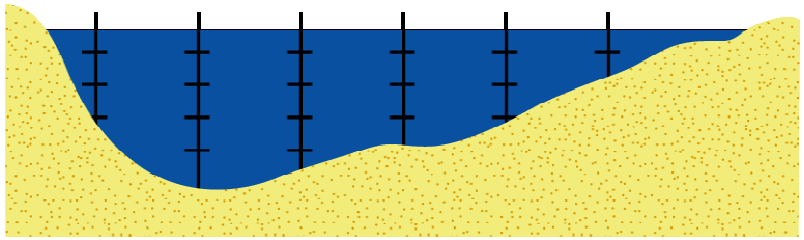
Discharge & Streamflow measurements

-Point velocity & velocity area method

$$Q = \int_{A} u \cdot dA \approx \sum_{n} u_i \cdot \Delta A_i$$



- Three point measurement (measured away from the water surface):

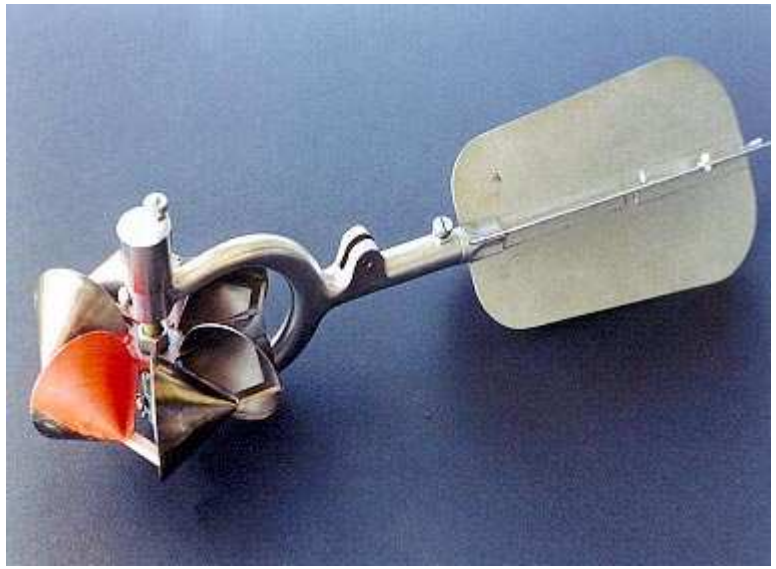
$$\bar{u} = 1/3\{u_{0.2} + u_{0.6} + u_{0.8}\}$$

or

$$\bar{u} = 1/4\{u_{0.2} + 2 \cdot u_{0.6} + u_{0.8}\}$$

Cub and propeller current meter

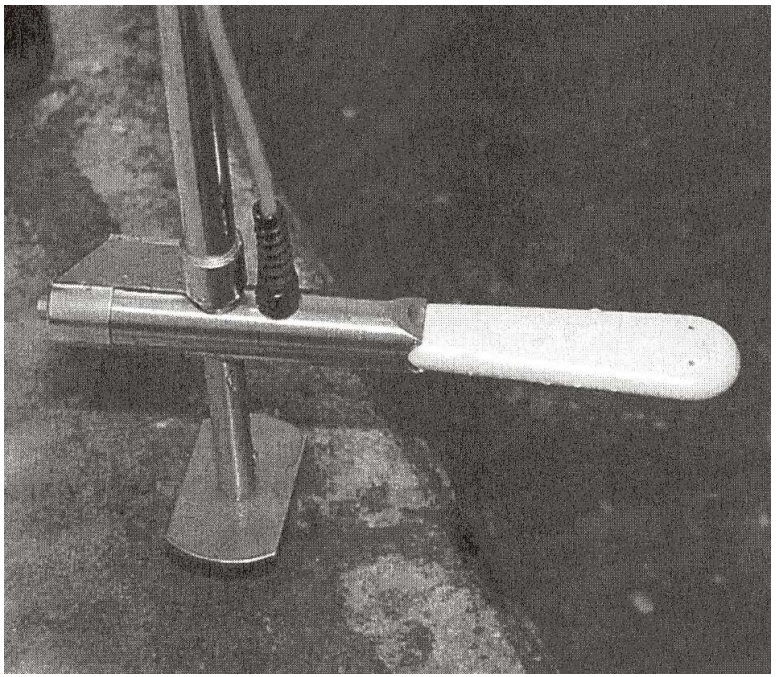
Cub

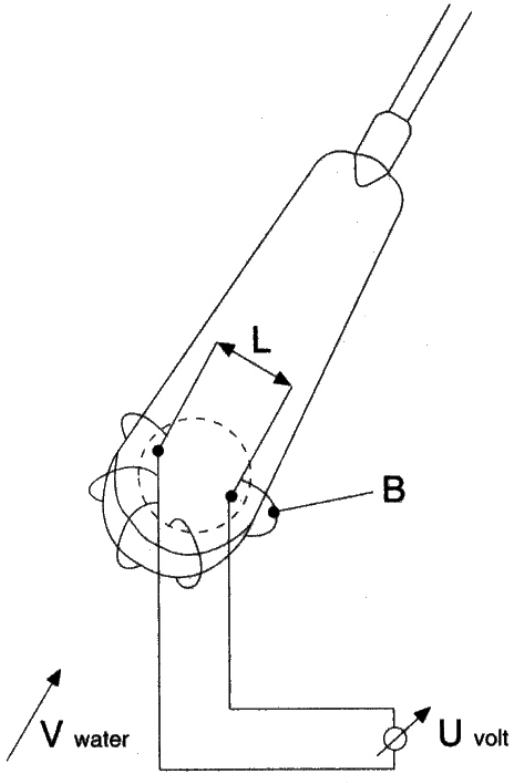


propellor

Wading

Electromagnetic streamflow

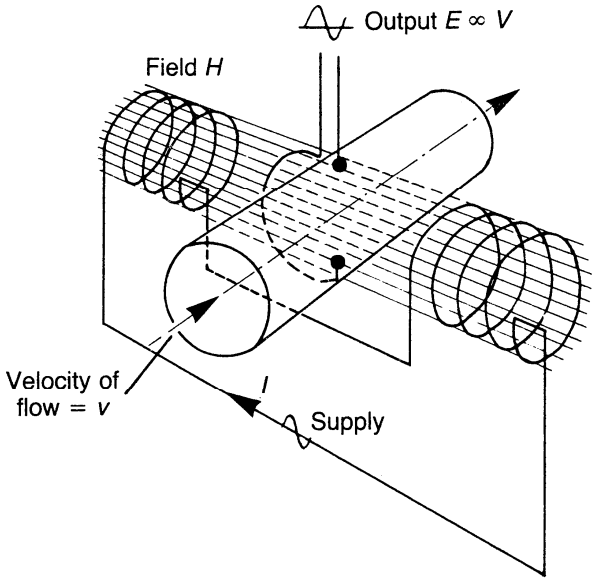




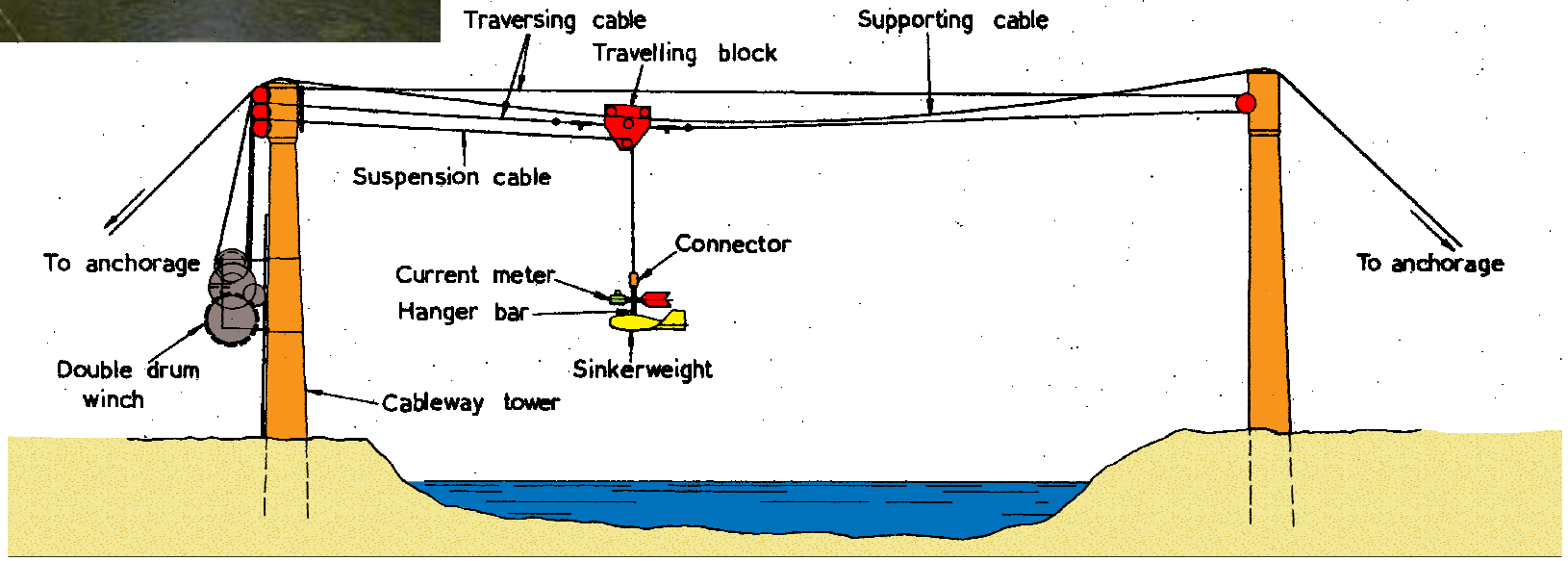
$$U = K \times B \times v_{water} \times L$$

Electromagnetic streamflow measurements (pipe flow)

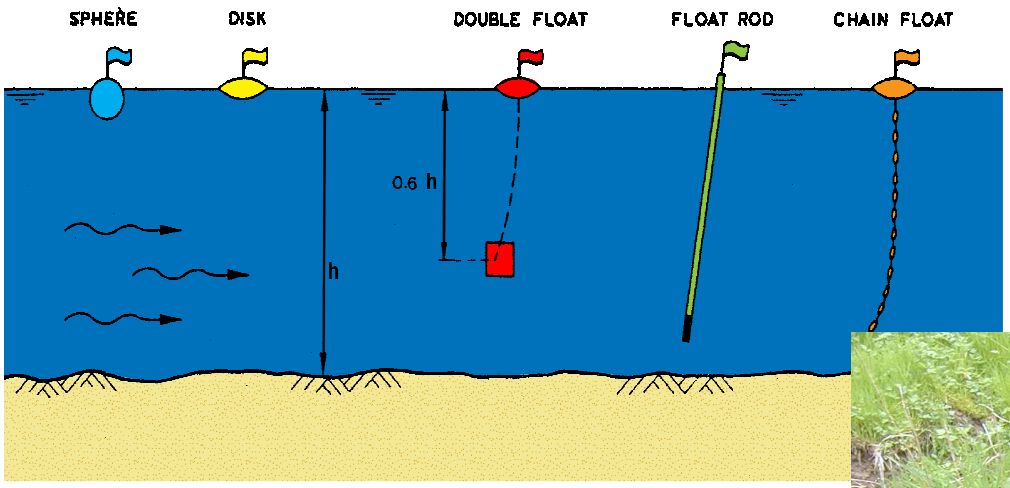
$$Q = K * \frac{U * L}{B}$$



Cable way


Traversing cable
Travelling block
Supporting cable
Suspension cable
To anchorage
Connector
Current meter
Hanger bar
To anchorage
Double drum winch
Sinkerweight
Cableway tower

Floats:

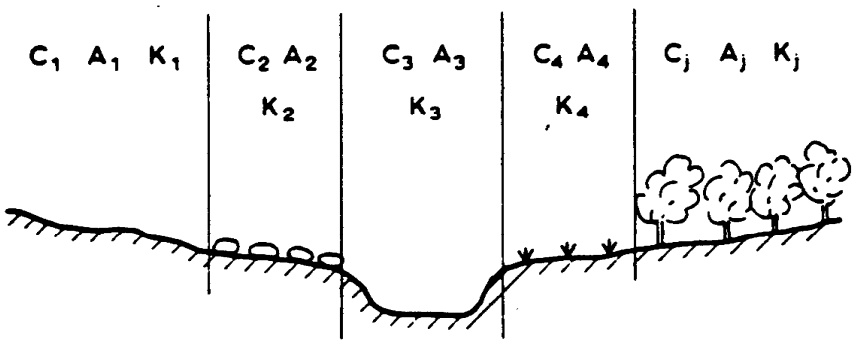


Floats:

Slope area method for estimation

1) actual discharge
2) flood surveying (afterwards)

Slope Area, based on Chezy



$$Q_j = \bar{u}_j \cdot A_j = C_j A_j \cdot R_j^{1/2} \cdot i^{1/2} = K_j \cdot i^{1/2}$$

Slope Area Method:

Based on Chezy equation:

$$Q = C * A * R^{1/2} * i^{1/2}$$

Q=discharge
C=roughness coeff
A=cross sectional area
R=depth
I=slope

Determine

Slope

Cross section

and Roughness coeff.

Table 7.1 *Values of Manning's n and Chezy's C*

Type of channel and description	Manning's coefficient n	Chezy's coefficient C			
		$R_h = 1\,m$	$R_h = 2.5\,m$	$R_h = 5\,m$	$R_h = 10\,m$
Excavated or dredged					
(1) Earth, straight and uniform					
a. Clean, recently completed	0.016 to 0.020	63 to 50	72 to 58	81 to 65	91 to 73
b. Clean, after weathering	0.018 to 0.025	55 to 40	64 to 46	72 to 52	81 to 59
c. With short grass, few weeds	0.022 to 0.033	45 to 30	53 to 35	59 to 40	67 to 44
(2) Rock cuts					
a. Smooth and uniform	0.025 to 0.040	40 to 25	46 to 29	52 to 33	59 to 37
b. Jagged and irregular	0.035 to 0.050	29 to 20	33 to 23	37 to 26	42 to 29
Natural streams					
Minor streams (top width at flood stage less than 30 m) on plains: clean, straight, full stage, no rifts or deep pools	0.025 to 0.033	40 to 30	46 to 35	52 to 40	59 to 44
Flood plains					
(1) Pasture, no brush					
a. Short grass	0.025 to 0.035	40 to 29	46 to 33	52 to 37	59 to 42
b. High grass	0.030 to 0.050	33 to 20	39 to 23	44 to 26	49 to 29
(2) Cultivated areas					
a. No crop	0.020 to 0.040	50 to 25	58 to 29	65 to 33	73 to 37
b. Mature row crops	0.025 to 0.045	40 to 22	46 to 26	52 to 29	59 to 33
c. Mature field crops	0.030 to 0.050	33 to 20	39 to 23	44 to 26	49 to 29

Riggs formula:
Simplified slope area method:

$$\log Q = 0.188 + 1.33 \log A + 0.05 \log i - 0.056 (\log i)^2$$

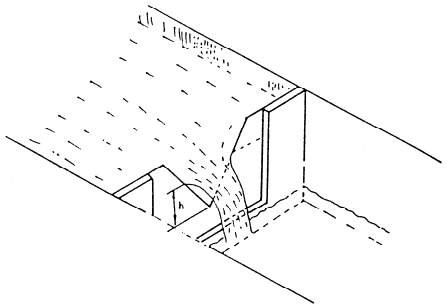
Continuous discharge measurements with structures (through stage and discharge formula)

Discharge formula

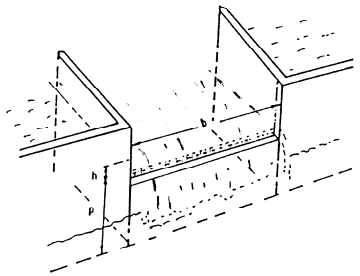
free falling water:

$$Q = \left(\frac{2}{3}\right)^{3/2} \cdot C_d \cdot b \cdot \sqrt{g} \cdot h^{3/2}$$

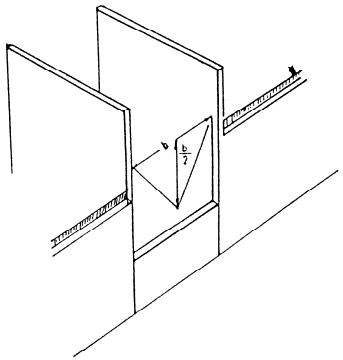
Q=discharge
C=coefficient
b= width
h=heigth above crest



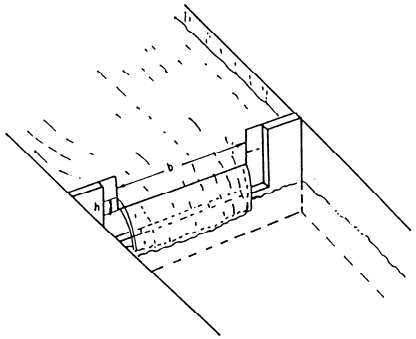
V- notch



Rectangular suppressed notch



V notch installed with training walls



Rectangular compressed notch

Examples of weirs

Free falling water when downstream level lower than the crest