Measurements for water

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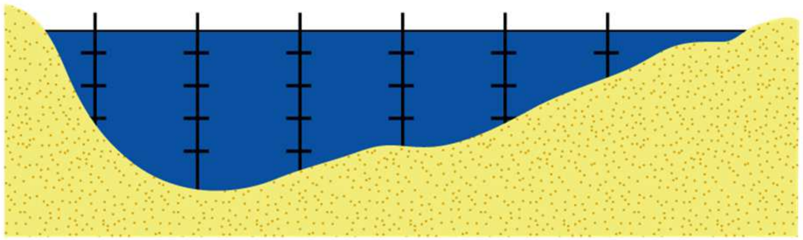
Waterbalans: Discharge streamflow

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

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

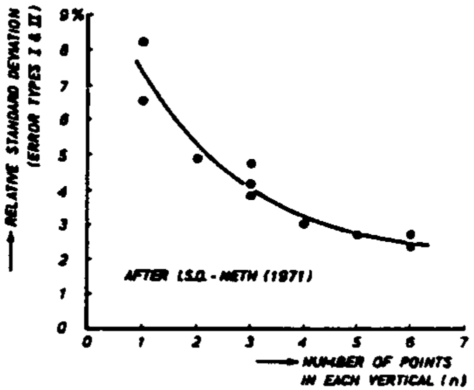


Figure 5.3: *Influence number of points in the vertical*

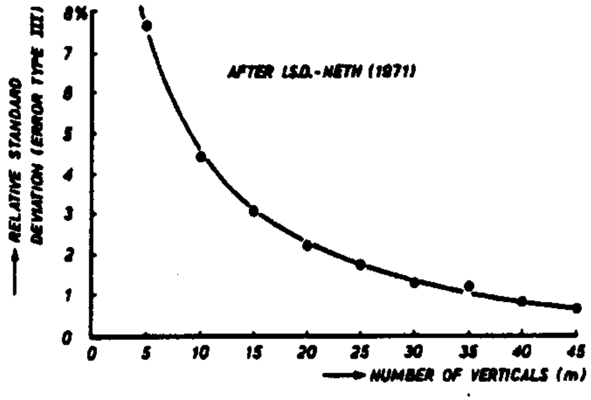
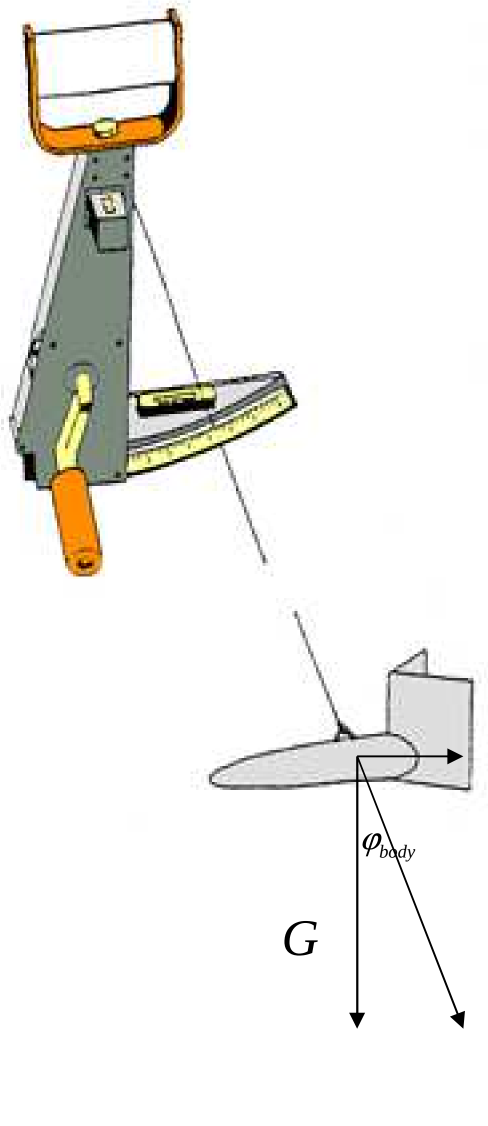


Figure 5.4: Influence number of verticals in the cross-section

Pendulum



$$\tan\varphi_{body} = \frac{F_N}{G}$$

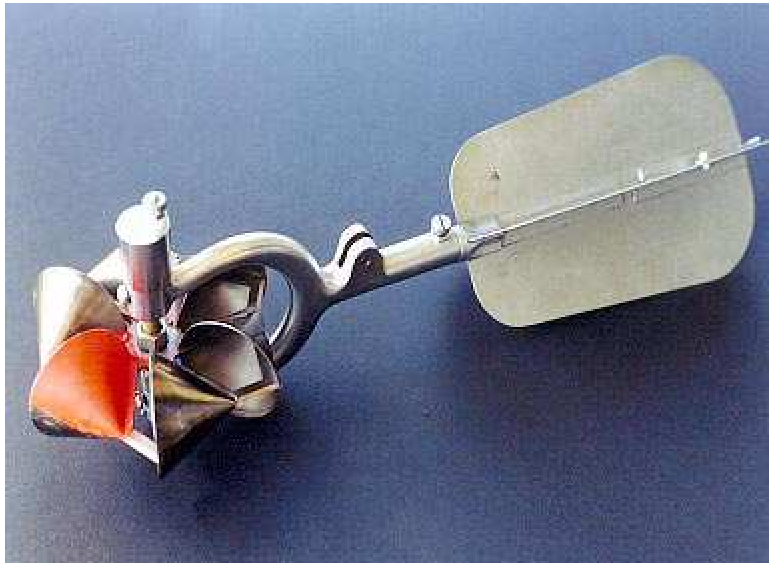
hence

$$\overline{u}^2 = coefficient \cdot \tan\varphi_{body}$$

$$F_N = C_N \cdot 1/2 \cdot \rho \cdot u^2 \cdot A$$

Cub and propeller current meter

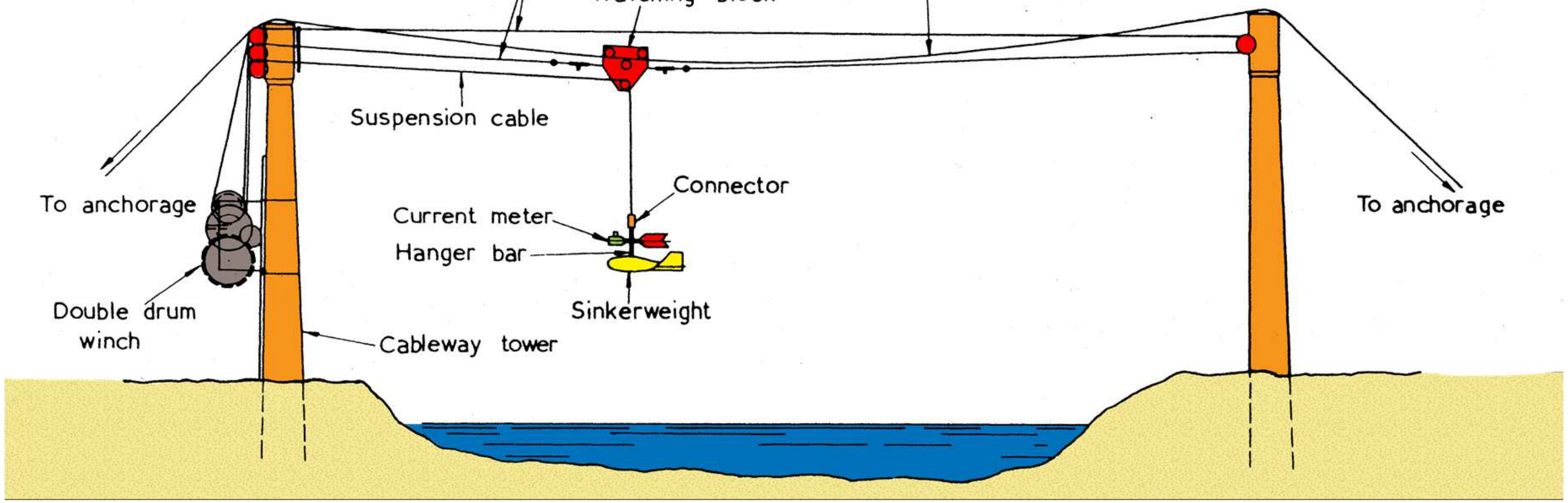
Cub

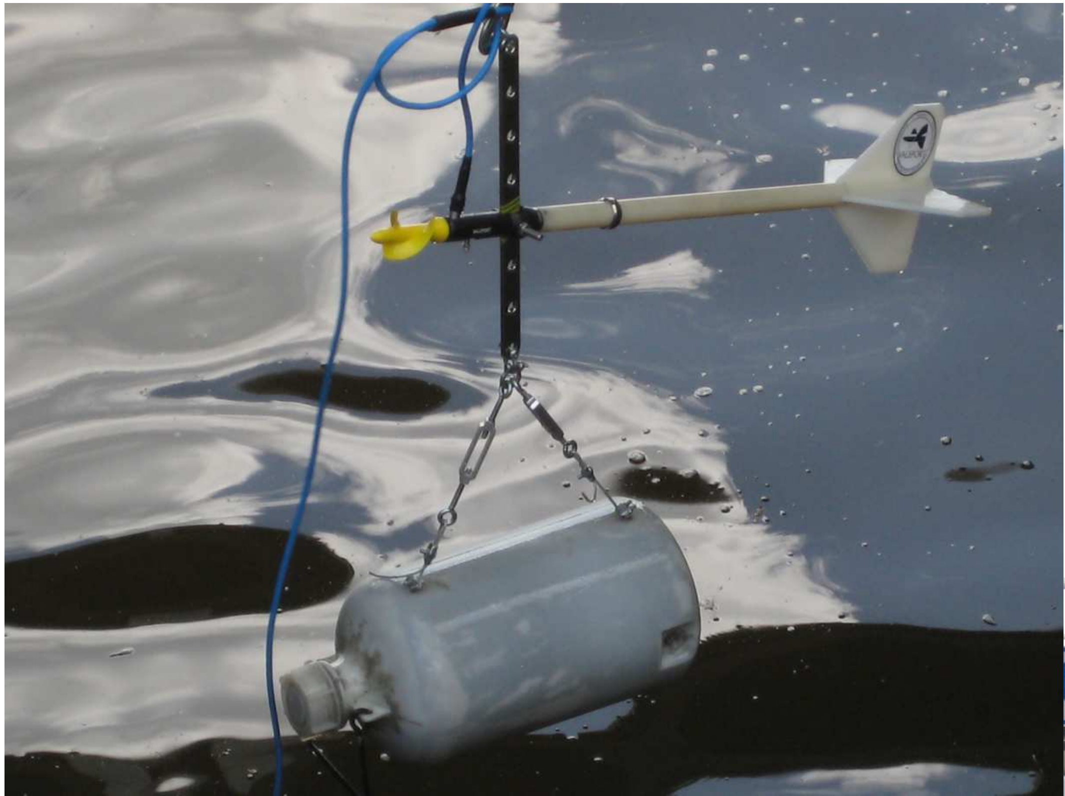


propellor

Wading

Cable way

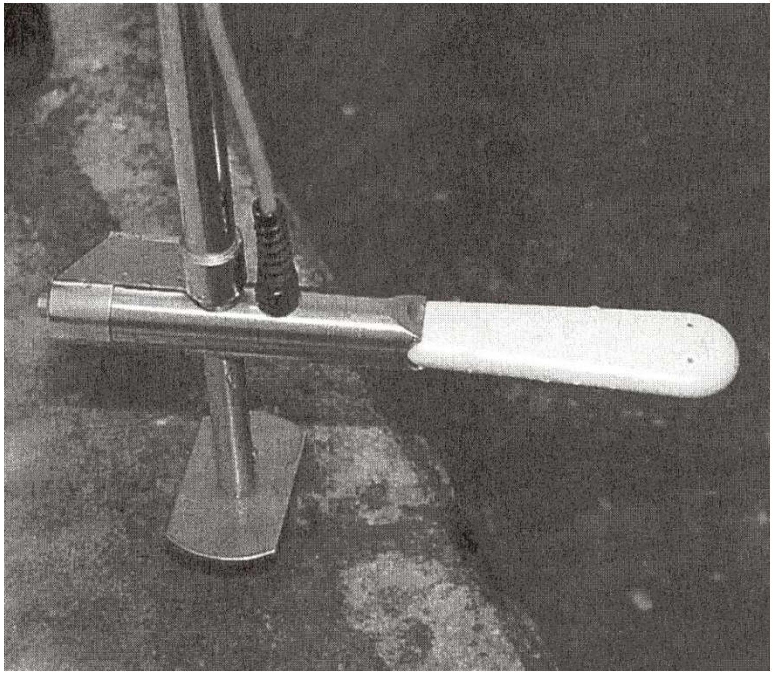

Traversing cable
Travelling block
Supporting cable
Suspension cable
To anchorage
Connector
Current meter
Hanger bar
Double drum winch
Sinkerweight
Cableway tower
To anchorage

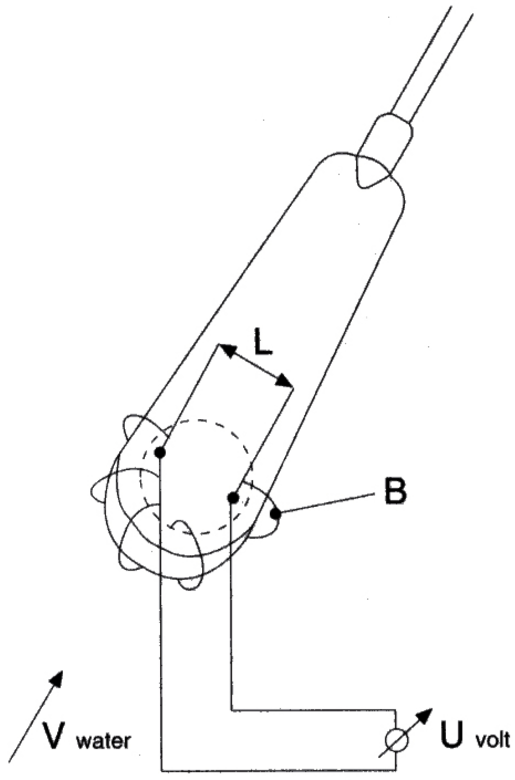



tdiepbrug

Bridge support

Electromagnetic streamflow

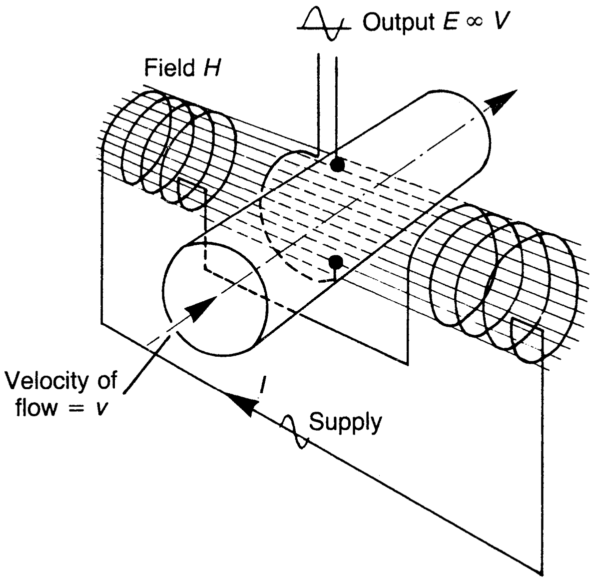


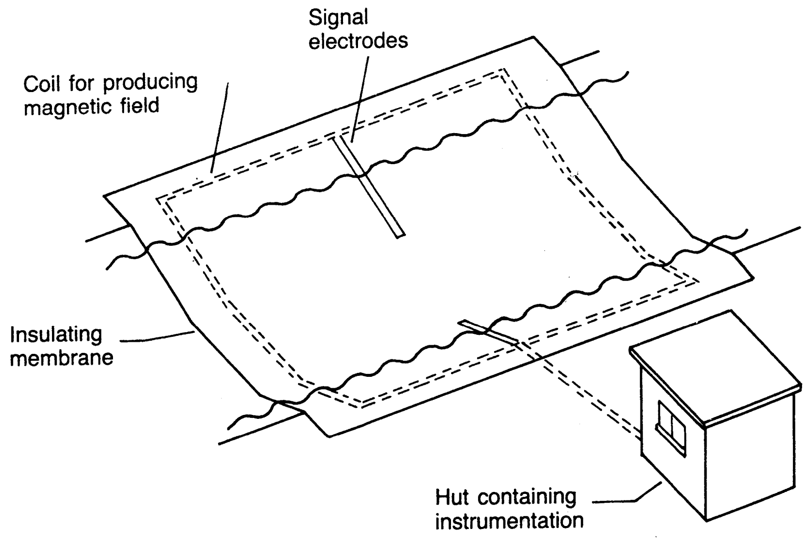


$$U = K \times B \times v_{water} \times L$$

Electromagnetic streamflow measurements (pipe flow)

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





Schematic view of electromagnetic gauge with coil installed below channel bed

Acoustic Doppler Current Profiler
ADCP

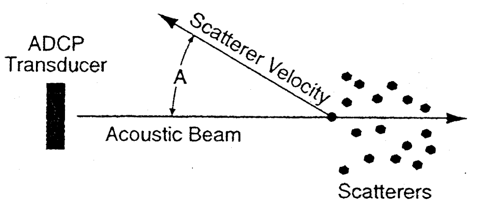
The principles of doppler

$$F_d = F_s \cdot \frac{v}{c}$$

F_d	is the Doppler shift frequency
F_s	is the frequency of the sound under stagnant condition
v	is the relative velocity between the sound source and the sound receiver [m/s]
c	is the speed of sound [m/s]

detected frequency **increases** for objects moving toward the observer

in water:

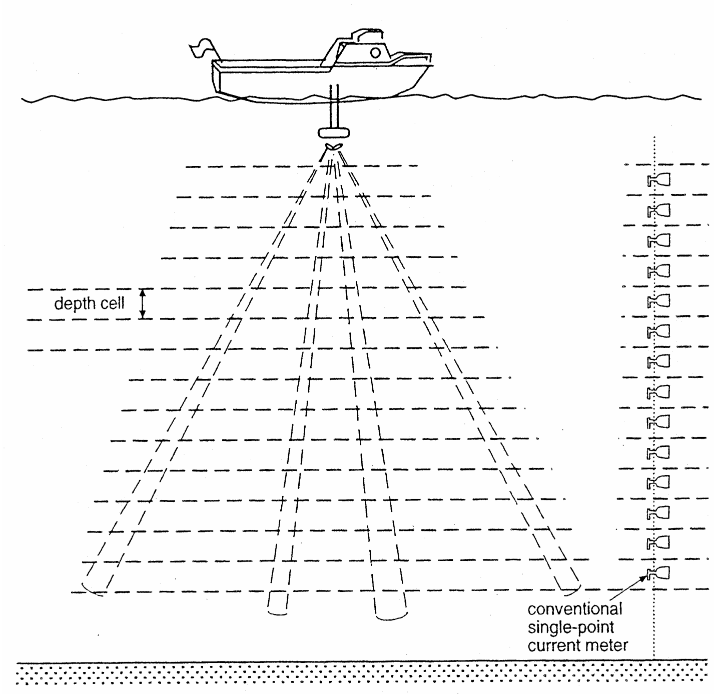


Transmitting and receiving: $F_d = 2 \cdot F_s \cdot \frac{v}{c}$

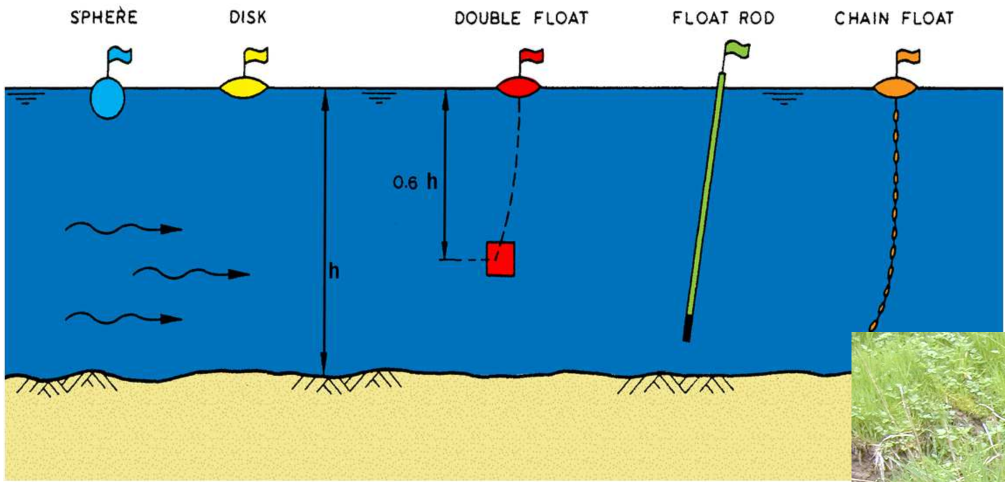
Component parallel to flow: $F_d = 2 \cdot F_s \cdot \frac{v}{c} \cdot \cos A$

ADCP

Pro’s:
-continuous
-almost complete vertical
-velocity in 3-dimensions
Cons:
-Deep water
-Expensive, trained personnel

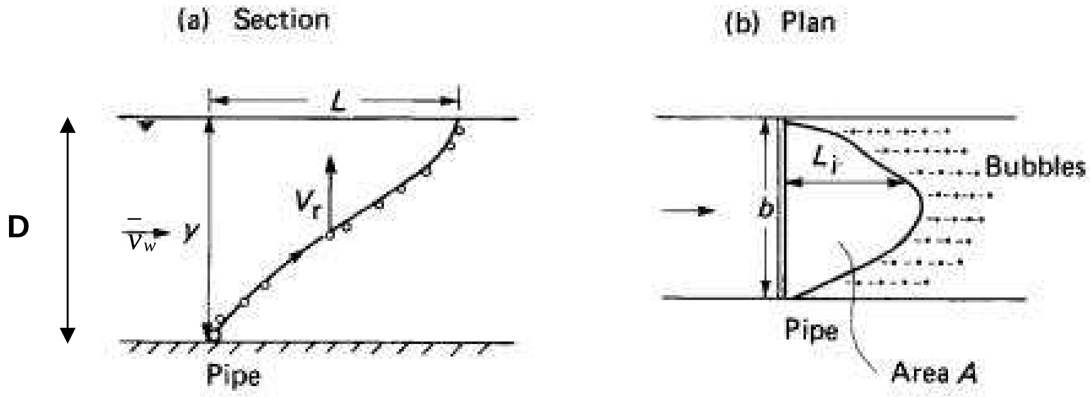


Floats:



Floats:
Scheldt fieldwork, tidal movement

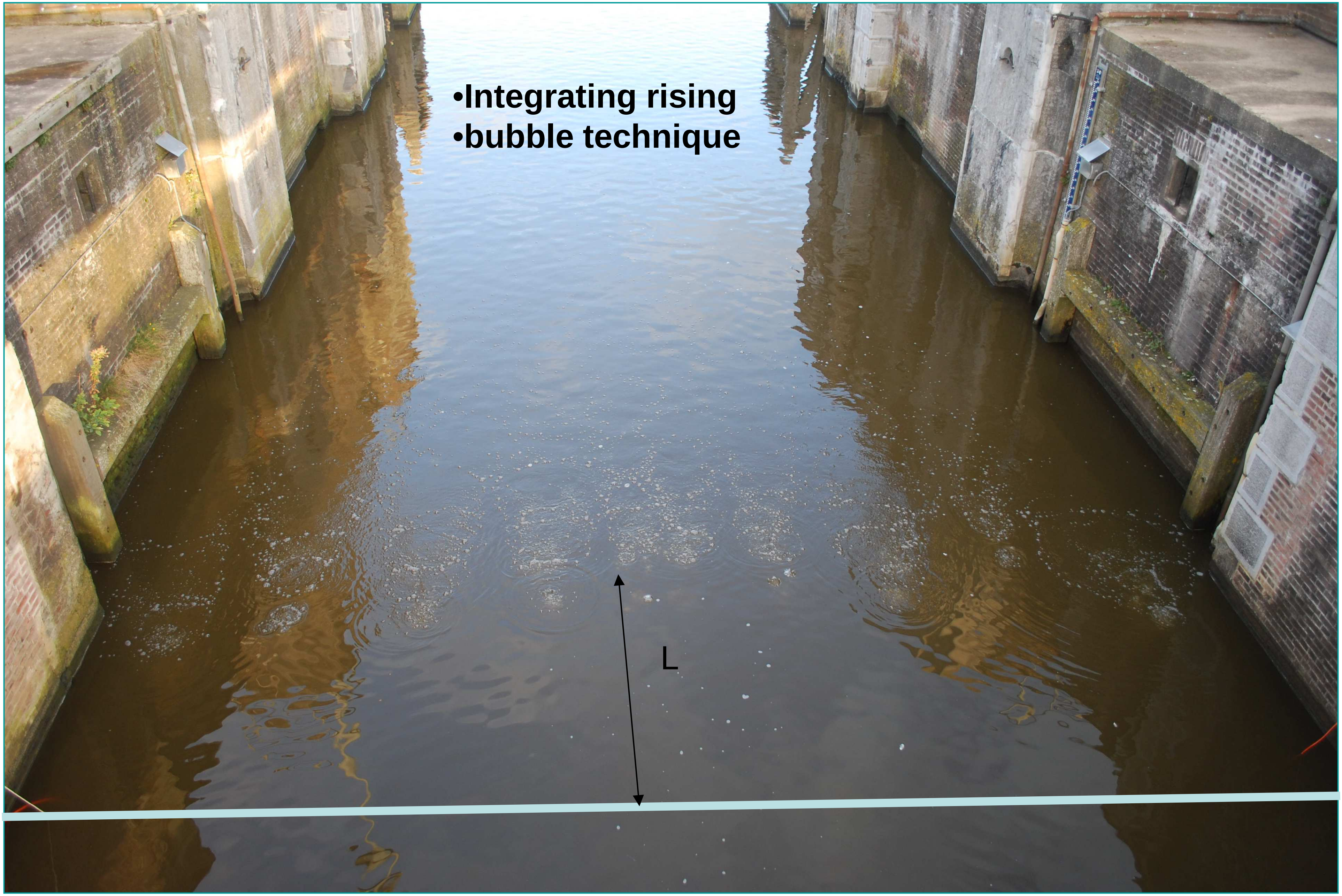
Integrating rising bubble technique



$$T = \frac{L}{\bar{v}_w} = \frac{D}{v_r}$$

$$q = \bar{v}_w D = v_r L$$

$$Q = v_r A$$


•Integrating rising
•bubble technique
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