OCF - Open Channel Flow

State of flow

Re → <500 laminar
>12500 turbulent

Critical, supercritical, subcritical

1 | >1 | <1

Froude number

very turbulent | less turbulent

G4 | G5

Black | Ash

Lab report

Top sheet → Index
Cover page ←

who on prac. app.

Exp. No, Exp Name, Obj, Signific/Scope, Apparatus, Datasheet, calc (details), Result, Disc., Assignment

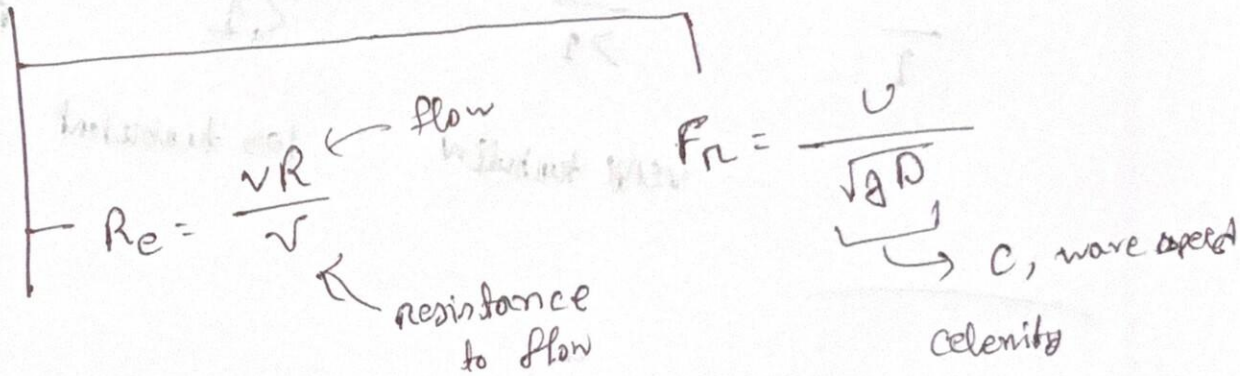
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~~Det~~

Exp 01 Determination of state of flow and critical depth in open channel

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State of flow




$Re < 500 \rightarrow$ laminar

$Re > 12500 \rightarrow$ turbulent ✓

else $\rightarrow$ transitional

For OEF, $v$ is ↓↓ as less x-section area in contact to offer resistance



Fr

$C > V \rightarrow$ subcritical ✓

$Q = AV$

$= B_y V$

$= B_y \uparrow V \downarrow$

$d \uparrow$

$C < V \rightarrow$ super

$C = V \rightarrow$ critical

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Critical depth

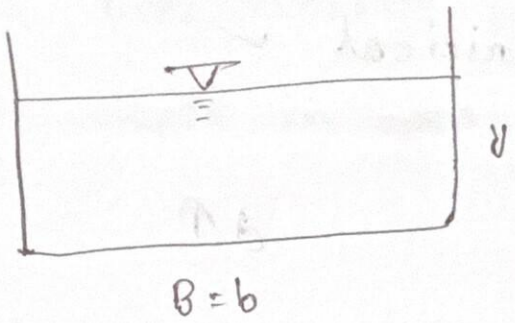
$$y_c = \sqrt[3]{\frac{Q^2}{g B^2}}$$

$$= \sqrt[3]{\frac{q^2}{g}}$$

B = top width

q = discharge per unit w

$= \frac{Q}{B}$




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Exp. NO

Exp. Name

Obj: 1. defn critical depth

2. State

Apparatus

Sample calc, Result

Datasheet

Discussion → exp. result | $y > y_c$ →
practical app | $y < y_c$ →
$y = y_c$ →

Q/A

$Q = 2850$ ~~2868~~ L/min

Slope = 0.062 %

width = 0.6 m (top, btm)

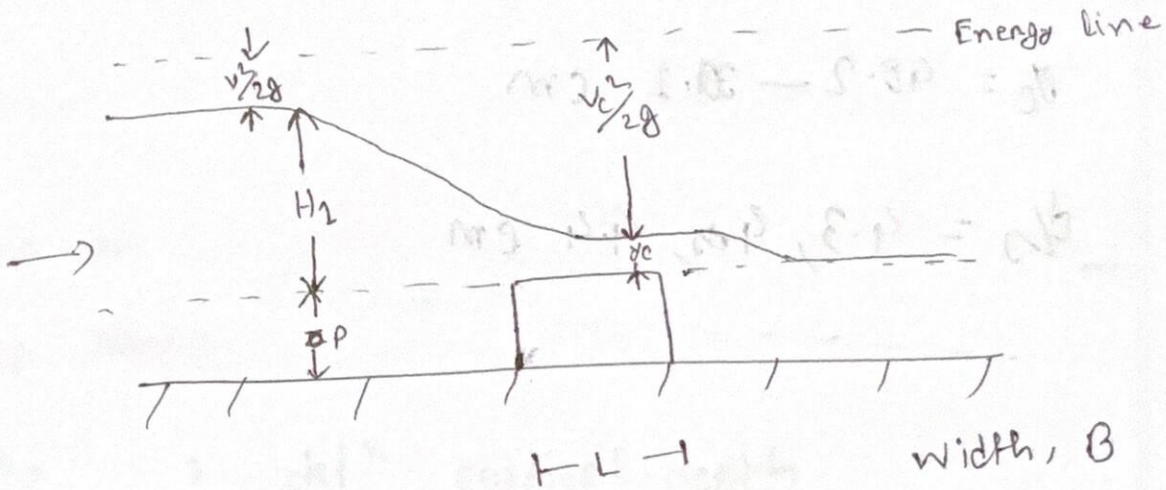
u/s = 51.5, 51.6, 51.4 cm

$d_c$ = 48.2 — 39.1 cm

d/s = 4.3, 4.3, 4.4 cm

## Flow Over a Broad Crested Weir

Weir — overflow structure




Use case

discharge measure on field, irrigation

Disadvantage

more energy loss

Sec 1 = Sec 2

$$\frac{P_1}{\gamma}^{0} + \frac{V_1}{2g} + Z_1^{P_1} = \frac{P_2}{\gamma}^{0} + \frac{V_2}{2g} + Z_2^{P_2}$$

$$\Rightarrow P + H_1 = \frac{V_2^2}{2g} + d + P$$

$$\Rightarrow V_2 = \sqrt{2g(H_1 - d)}$$

$$Q = AV = B \times d \times \sqrt{2g(H_1 - d)}$$

$$\Rightarrow H = {}^{*}\tfrac{3}{2} d_c$$

$$Q_t = \left(\frac{2}{3}\right)^{1.5} \sqrt{g}\, B H^{1.5}$$

→ indicates efficiency of actual discharge

$$C_d = \frac{Q_a}{Q_t}$$

$$\Rightarrow Q_a = C_d Q_t$$

$$= C_d \left(\tfrac{2}{3}\right)^{1.5} \sqrt{g}\, B H^{1.5}$$

| d | $Q_a$ |
|---|---|
| = | |
| = | |

$Q = k d^n$

## Calibration

$C_d \approx 0.8 - 0.85$

2nd method:

$$Q = ky^n$$

$$\Rightarrow \log Q = \log k + n \log y$$

$$Y = k + nX$$

$$n = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2}$$ ; $N \rightarrow$ # of data

$$k = \frac{(\Sigma Y) - n(\Sigma X)}{N}$$

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{N(\Sigma X^2) - (\Sigma X)^2} \sqrt{N(\Sigma Y^2) - (\Sigma Y)^2}}$$

$n \longrightarrow 0.6 \sim$

Discussion

1. $C_d$, range, why not (low)

   $C_d$ diff, efficien, — $\eta$ diff (actual, graph, theo)

2. calibration, graph related disc., linear, compare

3. regression

   real life

$B = 0.31\ m$

$H, d = 14.1\ cm = 0.141\ m$

$Q_a = 99.25\ m^3/hr$

$= 0.02757\ m^3/s$

$Q_t = \left(\frac{2}{3}\right)^{1.5} \times \sqrt{9.81} \times 0.31 \times 0.141^{1.5}\ m^3/s$

$= 0.02798\ m^3/s$

0.989




Advantages

Concrete material can be
in expensive
easy & installation
used for irrigation field

disadvantages

used water level
not to high

need low high
dead zone
used water
extreme
high

and calibrate
2 hour
not in