Exp 1

Hydrostatic force

$$F = \rho g \, \bar{y} \sin\alpha \, A$$

($\bar{y} \sin\alpha$ → h)

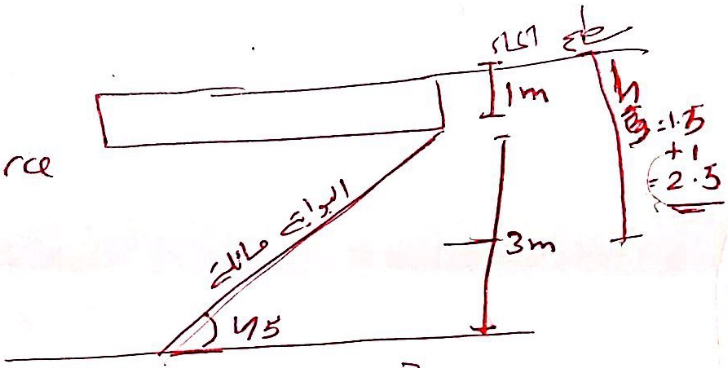
(A → Area of Gate)

(α ← الزاوية مع سطح الماء .)

$\bar{y}$: دائماً المسافة من نص البوابة لسطح الماء

y_{cp} : مكان تأثير القوة (*) وهي دائماً أكبر من $\bar{y}$

$$y_{cp} = \bar{y} + \frac{I}{\bar{y} A}$$



[1] Compute hydrostatic force

(ρg ← 9810, $\bar{y}\sin\alpha = h$ ← 2.5)

$$F = 9810 * 2.5 * 4.24$$

$$\boxed{F = 103.986 \text{ KN}}$$

$$\sin 45 = \frac{3}{x}$$

$$x = \frac{3}{\sin 45} = 4.24 \text{ m}$$

$$A = 4.24 * 1 \quad (1 \to \text{width})$$

[2] Compute ycp

$$y_{cp} = \bar{y} + \frac{I}{\bar{y} A} \quad , \quad \bar{y} = \frac{h}{\sin\alpha} = \frac{2.5}{\sin(45)}$$

$$\bar{y} = 3.535$$

$$I = \frac{b h^3}{12} = \frac{1 * 2.5^3}{12} = 1.302$$

$$y_{cp} = 3.535 + \frac{1.302}{3.535 * 4.24} \quad (4.24 \to A)$$

$$\boxed{y_{cp} = 3.6218 \text{ m}}$$

يعني اذا زادت ال y_{cp} ← تزيد ال $\bar{y}$ بفرق صغير

((Slightly increase))

[1]

أوفر الطاقة

Exp 2

oriffice and Jet flow

$$\text{head Pressure} = \frac{V^2}{2g} + h_L$$

$$V_{theo} = \sqrt{2gh} \quad , \quad Q_{theo} = \underbrace{\frac{\pi}{4} * d^2}_{A} * \underbrace{\sqrt{2gh}}_{V}$$

h_L is always Greater than Zero.

so alway actual flow velocity is always less then theoritical flow velocity

Discharge coefficint cd :

$$Cd = \frac{Q_{actual}}{Q_{theoritica}} \quad Q_{actual} \rightarrow \frac{\text{Volume}}{\text{time}}$$

$$Q_{theo} * Cd = Q_{actual}$$

Velocity coefficent Cv :

$$CV = \frac{V_{actual}}{V_{theoritical}}$$

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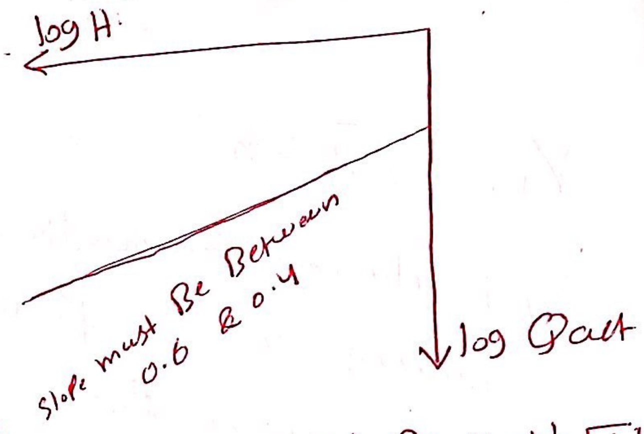
(*) اذا كان في عندك سرعة عالX وسرعة عالY
بتطبق القوانين هاي

$$V_{actual} = \frac{X}{\sqrt{\frac{2Y}{g}}}$$

(X → احداثيات)

$$C_v = \frac{X}{2\sqrt{Yh}}$$

المعرفة من خلال **cd**
من الرسم



[1] طلع ال Slope

$$Slope = C_d \sqrt{2g}\, \frac{\pi}{4} d^2$$

get Cd

Exp 3

Very importan notes : ارجع عالمانيوال ☒

معادلة ال Energy

$$E_1 = E_2$$

$$Z_1 + \frac{V_1^2}{2g} + \frac{P_1}{\rho g} = Z_2 + \frac{V_2^2}{2g} + \frac{P}{\rho g}$$

$\frac{P}{\rho g}$ ↳ Pressure head or Static head

$\frac{V_2^2}{2g}$ ↳ Velocity head

مبدأ حفظ الطاقة

$$Q_1 = Q_2$$

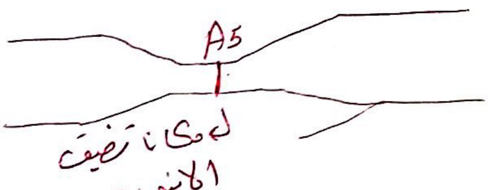
$$Q_{theo} = A_5 \sqrt{\frac{2g(h_1 - h_5)}{1 - \left(\frac{A_5}{A_1}\right)^2}}$$

$$Q_{act} = Q_{tho} * cd$$

$$Q_1 = Q_5$$

$$A_1 V_1 = A_5 V_5$$

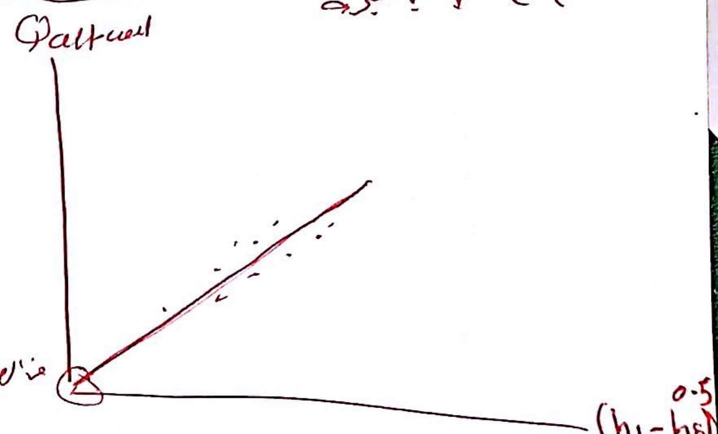
$$V_1 = \frac{A_5 V_5}{V_1}$$



cd يعطي الميل

~~Slope~~

$$Slope = cd\, A_5 \sqrt{\frac{2g}{1 - \left(\frac{A_5}{A_1}\right)^2}}$$



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Exp 4 Impact of Water Jet

(displacement → S)

(*) $V_0^2 = V_{nozzle}^2 - 2gS$

(*) Momentum = mass (m) * velocity (V) $= \rho Q V$

(*) Force = Mass (m) * V_0 (velocity) $(1 - \cos\theta)$

or $\rho Q V_0 (1 - \cos\theta)$

(*) اذا كانت الزاوية 90 بكون Flat plate

$F = m * V_0$ تتغير المعادلة

or $= \rho Q V_0$

(*) for hemi-sphere , الزاوية 180

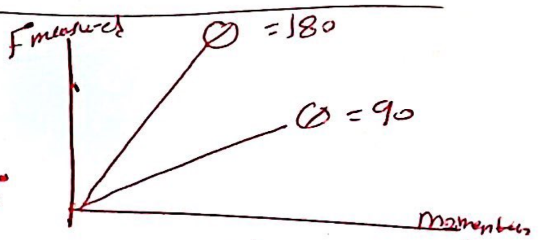
$F = m * V * (2)$ (← 1 - -1)

(*) في ال 120 يكون Cone بس مو متأكد.

كيف اعرف انو هي ؟ احسب ال slope

اذا ال slope = 1 فذلك الغرض بتطلع الزاوية

يعني 90 Flat plate



if $V_1 \longrightarrow$ $V_2 \longrightarrow$ $V_0 = V_1 - V_2$

if $V_1 \longrightarrow$ $V_2 \longleftarrow$ $V_0 = V_1 + V_2$

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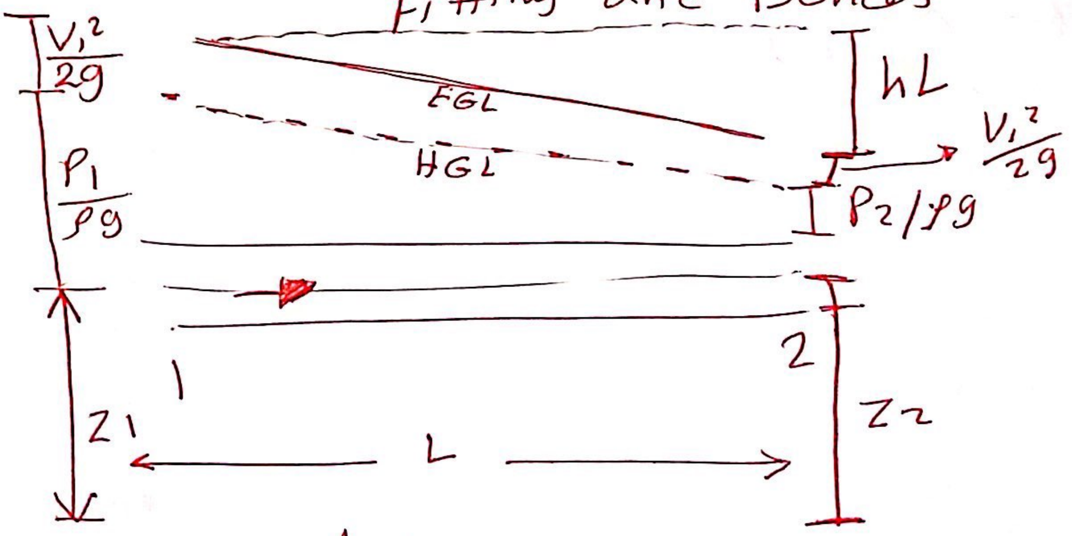
Exp 5 friction in Pipe and losses from fitting and Bends



$E_1 = E_2 + h_L$

$h_L = h_1 - h_2$

or $E_1 - E_2$

h_L = major + minor

h_L = + fitting

$$h_L = \frac{f \times L \times V^2}{D \times 2g}$$

f ← friction (given)
L → طول ال pipe
V^2 → السرعة داخل ال pipe = V_2 given
→ major hL

D → Diameter of Pipe

(*) ارجع عالملاحظات بالسؤال

Laminar flow ⇒ friction $f = \frac{64}{Re}$

Re ← رينولد نمبر

$$Re = \frac{\rho V D}{\mu}$$

μ ← ميو (فيسكوسيتي)

$$h_L \text{ for laminar} = \frac{32 \mu L V}{\rho g D^2}$$

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Minor head loss

$$h_L = K \frac{V^2}{2g}$$

given data