UNIVERSIDAD NACIONAL DE INGENIERÍA

FACULTAD DE INGENIERÍA AMBIENTAL

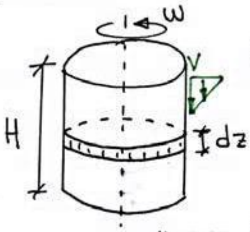
ESCUELA PROFESIONAL DE INGENIERIA DE HIGIENE Y SEGURIDAD INDUSTRIAL

Curso : Dinámica de Fluidos
Código del curso : HH221
Sección : E
Docente : Mag. Ing. Omar Bejarano
Ciclo : IV
Fecha : 16 de Mayo
Periodo Académico: 2017-I

SOLUCIONARIO EXAMEN PARCIAL

Problema 01

Analizando la superficie lateral:



$dA = 2\pi . R . dz$

$dT_L = R . dF$

T_L: Torque

$\tau = \mu \frac{V}{e}$ Ya que la distribución de la velocidad es lineal.

$\frac{V.x}{e} = V(x) \quad \tau = \mu \frac{dv}{dx}$

$$\tau = \mu . \frac{\omega . R}{e}$$

$$\tau = dF/dA = \frac{\mu \omega . R}{e}$$

$$dF = \frac{\mu . \omega . R}{e} . dA = \frac{\mu . \omega . R}{e} . 2\pi . R . dz$$

Multiplicando por R:

$$dF . R = R . \left(\frac{\mu . \omega . R^2 . 2\pi}{e} dz \right)$$

$$dT_L = R . \left(\frac{2\pi . \mu . \omega . R^2}{e} dz \right)$$

$$dT_L = \frac{2\pi . \mu . \omega . R^3}{e} dz$$

Integrando:

$$T_L = \frac{2\pi . \mu . \omega . R^3}{e} \int_0^H dz$$

$$T_L = \frac{2\pi \mu . \omega . R^3 . H}{e}$$

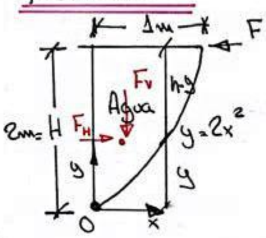
Remplazando valores

$T = 0,796 \ N.m$

Potencia:

$T . \omega = 15 \ W$

Problema 02



ancho de la compuerta = 2m

$$F_H = \rho . g \times h_{c.g} \times A = 9,81 \times 1 \times 4 = 39,24 \ kN$$

$$F_V = \rho . g \times \forall = 9,81 \times \text{ancho} \times \int_0^1 (2-y) . dx$$

$$F_V = 9,81 \times 2 \times \int_0^1 (2-2x^2) . dx$$

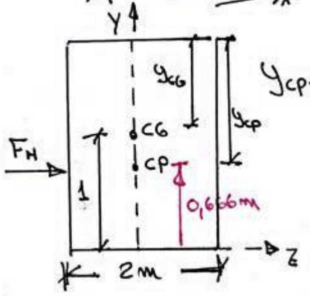
$$F_V = 26,16 \ kN$$

$\Sigma M_O = 0$ (considerando solo los efectos del líquido)

$$X_1 . F_V = \int_0^1 9,81 \times 2 \times (2-y) x . dx$$

$$X_1 . 26,16 \ kN = \int_0^1 19,62 (2-2x^2) x \, dx$$

$$X_1 = 0,375 m$$



$$y_{cp} - y_{cg} = \frac{I_{xx} \gamma . \sin\theta}{F_H}$$

$$y_{cp}-y_{cG} = \frac{2^4}{12} \times \frac{9,81 . \sin 90}{39,24}$$

$y_{cp}-y_{cG} = 0,333\ m$

$y_1 = 1 - 0,3333\ m = 0,666\ m$

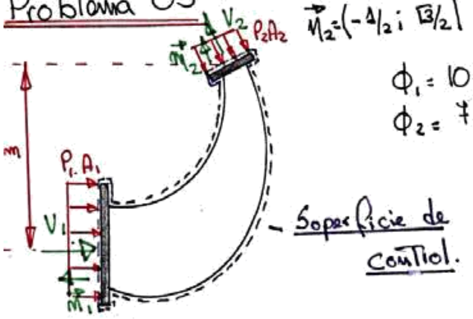
$\sum M_0 = 0$

$F \times H = F_H . y_1 + F_V . x_1$

$F \times 2 = 39,24 . 0,666 + 26,16 . 0,375$

$F = 17,97\ KN$

Problema 03



$\vec{n}_2 = (-1/2 ; \sqrt{3}/2)$

$\phi_1 = 10\ cm$

$\phi_2 = 7\ cm$

$\vec{n}_1 = (-1,0)$

Caudal $= 0,1\ m^3/s$

$\dot{m} = 0,1 \frac{m^3}{s} \times \frac{1}{1 m^3/1000 Kg} = 100\ Kg/s$

$A_1 = 7,854.10^{-3}\ m^2$

$A_2 = 3,8485.10^{-3}\ m^2$

Por continuidad

$\dot{V} = A.V$

$2 \rightarrow \dot{V} = A.V_1 \rightarrow V_1 = \dot{V}/A_1 = 12,73\ m/s$

$V_2 = \dot{V}/A_2 = 25,98\ m/s$

Bernoulli entre 1 y 2:

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2$$

$$\frac{1500}{9,81} + \frac{12,73^2}{2 \times 9,81} = \frac{P_2}{9,81} + \frac{25,98^2}{2 \times 9,81} + 3$$

$P_2 = 1214,12\ KPa$

$$F + W + \oint_{sc} P(-\vec{n}). dA = \oint_{sc} \rho \vec{V}_r (\vec{V}_r . dA)$$

$W = (0, -80)\ KN$

$$\oint_{sc} P(-n). dA = -P_1 A_1 \vec{n}_1 - P_2 A_2 \vec{n}_2$$

$$= -1500 . 7,854.10^{-3} (-1,0) - 1214,12 . 3,8485.10^{-3} . (-1/2 ; \sqrt{3}/2)$$

$= (11,781;0) + (2,3363 ; -4,0465)$

$= (14,117 ; -4,0465)\ KN$

$$\oint \rho \vec{V}_r (\vec{V}_r . dA) = \dot{m} (\vec{V}_2 - \vec{V}_1)$$

$$= 100 \times \left[25,98 . \left(-\frac{1}{2} ; \frac{\sqrt{3}}{2}\right) - 12,73 . (+1,0) \right]$$

$= (-2572 ; 2249,93)\ N$

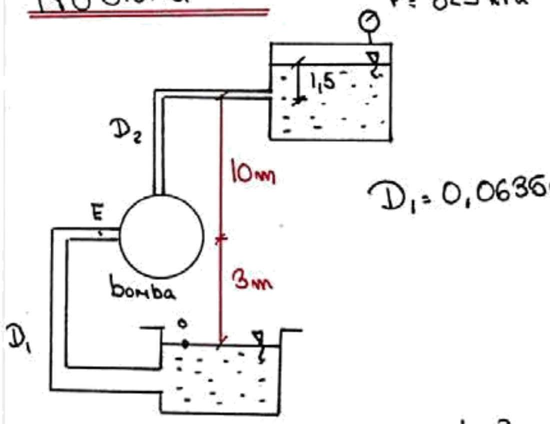
$F + (0,-80) + (14,117 , -4,0465) = (-2,572 ; 2,24993)$

$F = (-16,69 ; 86,3)\ KN$

$R_x = -16,69\ KN$

$R_y = 86,3\ KN$

Problema 04



$D_1 = 0{,}0636m$

$$\dot{V} = 1000\ lt/min \cdot \frac{1min}{60s} \times \frac{1m^3}{1000\ lt}$$

$$\dot{V} = 0{,}0167\ m^3/s$$

Bernoulli entre 0 y E:

a) $$\cancel{\frac{P_0}{\gamma}} + \cancel{\frac{V_0^2}{2g}} + \cancel{Z_0} = \frac{P_E}{\gamma} + \frac{V_E^2}{2g} + Z_E$$

$$0 = \frac{P_E}{\gamma} + \frac{V_E^2}{2g} + Z_E$$

$A \cdot V_E = \dot{V}$ $\qquad A_E = 3{,}1669 \times 10^{-3}\ m^2$

$V_E = 5{,}2733\ m/s$

$$0 = P_E / 0{,}85 \cdot 9{,}81 + \frac{5{,}2733^2}{2 \times 9{,}81} + 3$$

$P_E = -36{,}83\ kPa$

b) $$\frac{P_E}{\gamma} + \frac{V_E^2}{2g} + \cancel{Z_e} + H_{bomba} = \frac{P_s}{\gamma} + \frac{V_s^2}{2g} + Z_s + \text{perdidas}$$

$$\frac{-36{,}83}{9{,}81 \times 0{,}85} + \frac{5{,}2733^2}{2 \times 9{,}81} + H_{bomba} = \frac{825 + (1{,}5 \cdot 9{,}81 \times 0{,}85)}{9{,}81 \times 0{,}85} + 10 + \frac{1{,}2 \cdot 5{,}2733^2}{2 \times 9{,}81}$$

$H_{bomba} = 115{,}14\ m$

$$\text{Potencia} = \frac{\gamma \cdot H_{bomba} \cdot \dot{V}}{\eta_{bomba}}$$

$$= \frac{9{,}81 \times 115{,}14 \cdot 0{,}0167 \times 0{,}85}{0{,}75}$$

Potencia = 21,38 kW