ME33A - Mecánica de Fluidos

Pauta ejercicio 2

Semestre Primavera 2008

Problema 1

Parte (a)

$$\tau = \mu \cdot \frac{du}{dr} = \mu \cdot \frac{\Delta u}{\Delta r} = \mu \cdot \frac{U}{a} = \mu \cdot \frac{\omega \cdot R}{a} \tag{1}$$

$$Torque = R \cdot F = R \cdot \tau \cdot A = R \cdot \mu \cdot \frac{\omega \cdot R}{a} \cdot (2 \cdot \pi \cdot R \cdot H) = \frac{2 \cdot \pi \cdot \mu \cdot \omega \cdot R^3 \cdot H}{a} \tag{2}$$

Parte (b)

$$\tau = \mu \cdot \frac{du}{dz} = \mu \cdot \frac{\Delta u}{\Delta z} = \mu \cdot \frac{U}{b} = \mu \cdot \frac{\omega \cdot r}{b} \tag{3}$$

$$Torque = \int r dF = \int r \tau dA = \int_0^R r \mu \frac{\omega r}{b} 2\pi r \, dr \tag{4}$$

$$Torque = \frac{2\pi\mu\omega}{b} \int_0^R r^3 \, dr = \frac{\pi\mu\omega R^4}{2b} \tag{5}$$

Parte (c) Para $T_{fondo}/T_{anular} \leq 100$

$$\frac{aR}{4bH} \leq \frac{1}{100} \tag{6}$$

o bien

$$\frac{b}{a} \geq \frac{25R}{H} \tag{7}$$

(Además deben graficar $\frac{b}{a}$ versus $\frac{R}{H}$, que es una recta.)

Problema 2

$$F_V = \int P \, dA_y = \int \rho g h b \, dx \tag{8}$$

Pero $h = D - y$, $x = ay^3$, y $dx = 3ay^2 \, dy$. Luego:

$$F_V = \int_0^D \rho g (D - y) b 3 a y^2 \, dy = \frac{\rho g b a D^4}{4} = 7{,}62 \; kN \tag{9}$$

El momento de F_V con respecto al punto O es:

$$x'F_V = \int x\, dF_V = \int xP\, dA_y = \int x\rho ghb\, dx \tag{10}$$

$$x'F_V = \rho gb \int_0^D ay^3(D-y)3ay^2 dy = \frac{\rho gba^2D^7}{14} = 3{,}76\ kN\ m \tag{11}$$

Haciendo un DCL de la compuerta, se tiene:

$$\sum M_O = x'F_V + y'F_H - H \cdot F_R = 0 \tag{12}$$

$$y'F_H = \int y\, dF_H = \int yP\, dA_x = \int y\rho ghb\, dy = \rho gb \int_0^D y(D-y)dy = \frac{\rho gbD^3}{6} = 4{,}23\ kN\ m \tag{13}$$

Luego $F_R = 5{,}71\ kN$