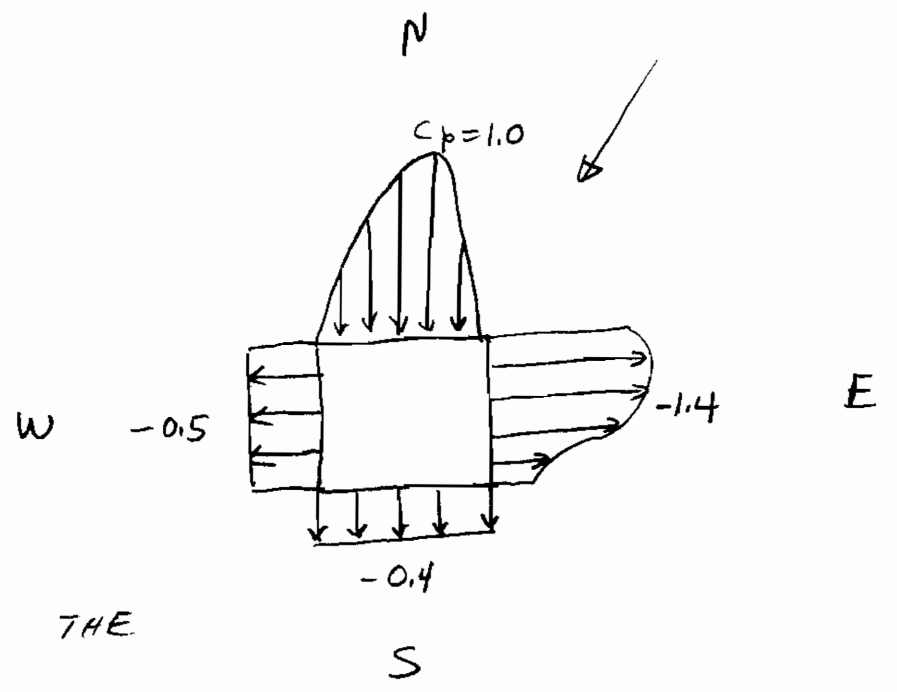
11.2

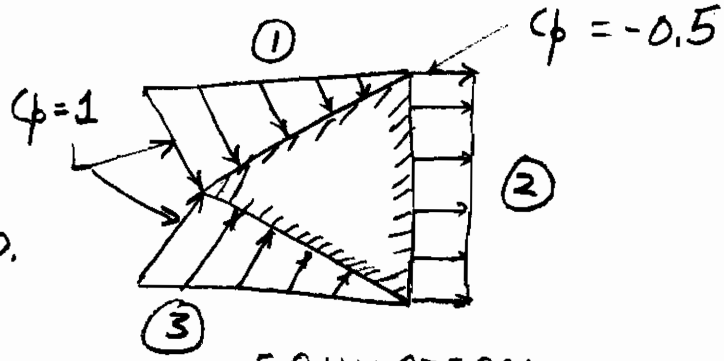
GIVEN: PRESSURE DISTRIBUTION AS SHOWN;



FIND: DIRECTION THE FLOW IS COMING FROM.

SOLUTION: HAS TO BE NW OR NE BECAUSE $C_p > 0$ ON NORTH SIDE OF SQUARE. I CHOOSE NE BECAUSE C_p PEAK ON NORTH SIDE IS SLIGHTLY SKEWED TO THE EAST.

11.3 (1)



GIVEN:

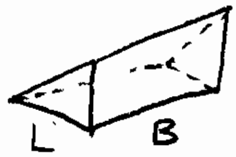
PRESSURE COEFFICIENTS AS SHOWN ON TRIANGULAR ROD.

FIND: Cd OF ROD.

EQUILATERAL TRIANGULAR ROD

SOLUTION;

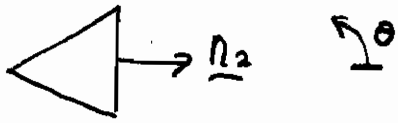
$$C_D = \frac{F_D}{\frac{1}{2}\rho V_0^2 A_p} \qquad A_p = LB$$



L IS THE LENGTH OF EACH FACE OF THE ROD.

$$F_D = F_{D1} + F_{D2} + F_{D3} \qquad F_{D1} = F_{D3}$$

$$F_D = 2F_{D1} + F_{D2}$$

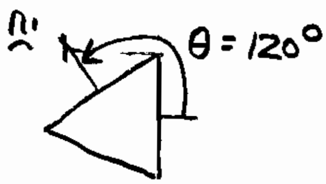


$$\theta = 0^\circ$$

$$F_{D2} = -\int_{A_2} p\cos\theta\, dA_2$$

$$p = p_0 + \tfrac{1}{2}\rho V_0^2 C_p$$

$$F_{D2} = -\left[p_0 + \tfrac{1}{2}\rho V_0^2(-.5)\right]LB$$



$$F_{D1} = -\int_{A_1}\left(p_0 + \tfrac{1}{2}\rho V_0^2 C_p\right)\cos(120^\circ)\, dA_1$$

$$C_p = \frac{S}{L}$$

$$F_{D1} = 0.5\, p_0 LB - \tfrac{1}{2}\rho V_0^2 B\int_{S=0}^{S=L}\left(\frac{S}{L}\right)(-0.5)\, ds$$

$$F_{D1} = 0.5\, p_0 LB + 0.5\left(\tfrac{1}{2}\rho V_0^2 B\right)\left(\tfrac{1}{L}\right)\tfrac{1}{2}S^2\Big|_0^L$$

11.3 (2)

$$F_{D1} = 0.5\, p_0 L B + \frac{1}{4}\left(\frac{1}{2}\rho V_0^2 L B\right)$$

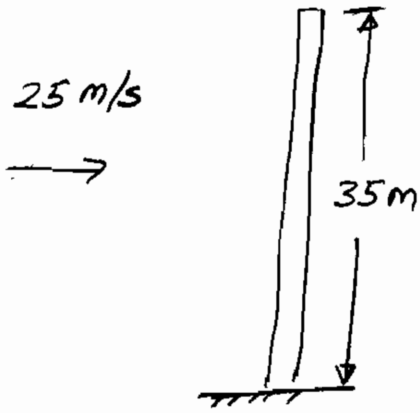
$$F_D = \overbrace{\cancel{p_0 L B} + \frac{1}{2}\left(\frac{1}{2}\rho V_0^2 L B\right)}^{2F_{D1}} - \overbrace{\cancel{p_0 L B} + 0{,}5\left(\frac{1}{2}\rho V_0^2 L B\right)}^{F_{D2}}$$

$$F_D = 1{,}0\left(\frac{1}{2}\rho V_0^2 L B\right)$$

$$C_D = \frac{1{,}0\left(\frac{1}{2}\rho V_0^2 L B\right)}{\frac{1}{2}\rho V_0^2 L B}$$

$$\boxed{C_D = 1{,}0}$$

11.8



GIVEN: 10 CM DIAMETER FLAG POLE AS SHOWN.

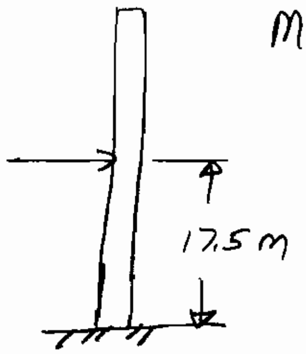
$p_o = 100\ kPa$ AND $T_0 = 20°C$.

FIND: ESTIMATE MOMENT AT BASE OF POLE.

SOLUTION: ASSUME, (1) 2-D DRAG ON POLE WITH NEGLIGIBLE END EFFECTS, (2) UNIFORM VELOCITY OF 25 m/s OVER ENTIRE POLE.

NOW $F_D = C_D A_p \frac{1}{2} \rho V_0^2$ IS THE RESULTANT DRAG FORCE WHICH ACTS AT CENTER OF POLE.

$M = (17.5m) F_D$



$$\rho = \frac{100{,}000}{(287)(293)} = 1.189\ \frac{kg}{m^3}$$

$$Re = \frac{D V_0}{\nu} = \frac{(0.1)(25)}{1.51 \times 10^{-5}} \qquad Re = 1.66 \times 10^5$$

FROM FIGURE 11.5 ; $C_D = 0.9$

$$F_D = (0.9)(0.1)(35)\left(\tfrac{1}{2}\right)(1.189)(25)^2 = 1170\ N$$

$$\boxed{M = 20{,}500\ N\text{-}m}$$