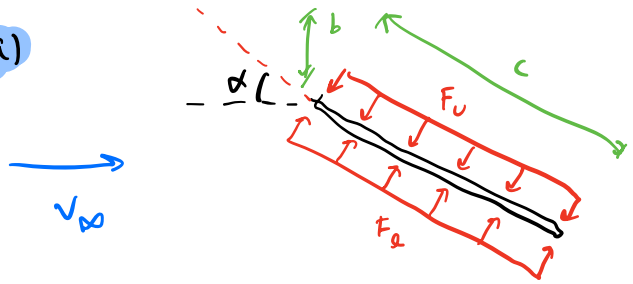
1) INFINITELY FLAT PLATE, CHORD c, WIDTH b, ANGLE OF ATTACK $\alpha$

DIFFERENT PRESSURES, BUT CONSTANT

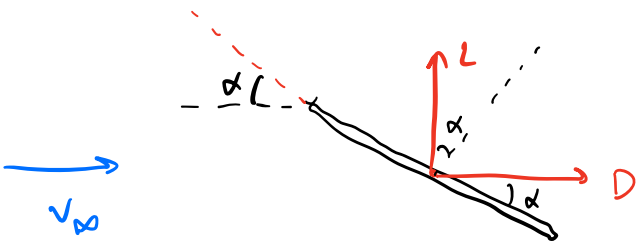
$P_u(s) = C_1$, $P_l(s) = C_2$, $C_2 > C_1$

1a)

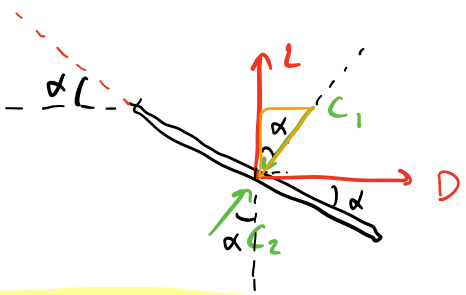



1b) Pascal, $1\ N/m^2$, $[Pa]$

1c)




1d) COMPUTE LIFT & DRAG DUE TO PRESSURE




$$L = [C_2 \cos\alpha - C_1 \cos\alpha] \cdot b \cdot c$$

$$D = [C_2 \sin\alpha - C_1 \sin\alpha] \cdot b \cdot c$$

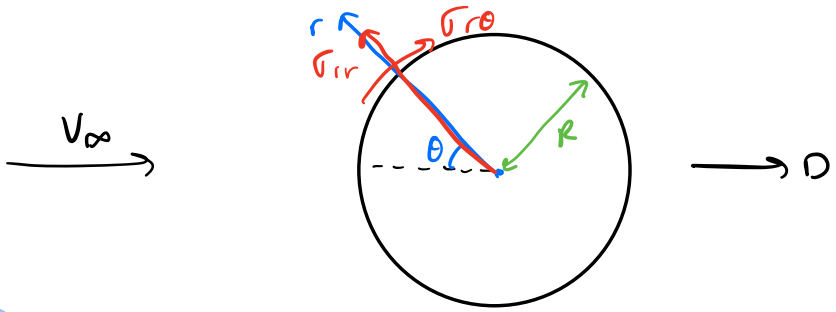
UNITS: NEWTON, $\frac{Kg \cdot M}{s^2}$

**2)** IDEALIZED FLOW OVER CYL W/ RADIUS R, $\sigma_{rr}$, $\sigma_{r\theta}$ FUNCTIONS OF ANGLE $\theta$

$$\sigma_{rr} = -A\cos 2\theta - B\cos\theta$$

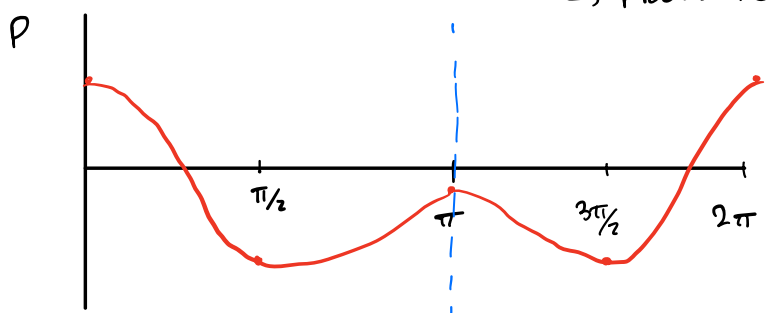
$$\sigma_{r\theta} = C\sin\theta$$

A, B, C CONSTANTS



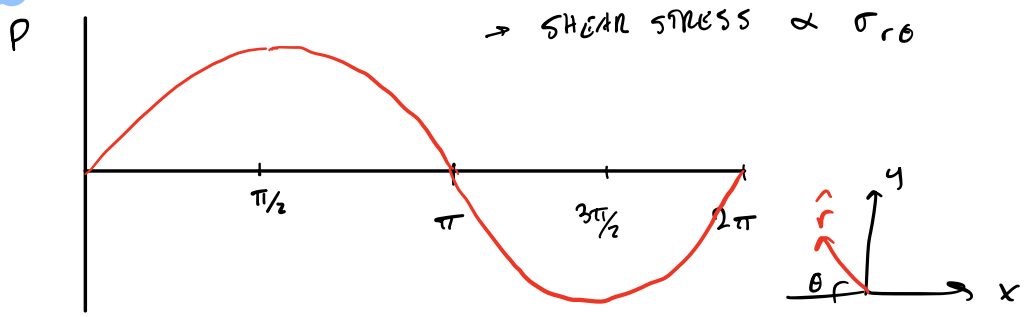

**2a)** SKETCH PRESSURE DISTRIBUTION FROM $\theta = 0, 2\pi$

→ PRESSURE $\propto$ $\sigma_{rr}$




**2b)** SKETCH SHEAR STRESS DIST.

→ SHEAR STRESS $\propto$ $\sigma_{r\theta}$




**2c)** COMPUTE PRESSURE DRAG $\quad \hat{r} = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$

$$\text{DRAG} = \int (\text{Pressure})\, dA \qquad dA = R W d\theta$$

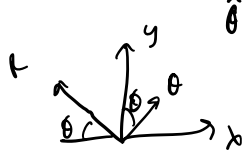
$$= 2\cdot\int_0^{\pi} -\sigma_{rr}\cdot\cos\theta\, dA = 2RW\cdot\int_0^{\pi}\left(-A\cos 2\theta - B\cos\theta\right)\cos\theta\, d\theta$$

→ WOLFRAM: $= 2RW \cdot \left[\frac{\pi B}{2}\right] = \pi RWB$

$W, B$ const → $\boxed{F_{D_p} = \pi RB}$

$\hat{\theta} = \sin\theta\,\hat{i} + \cos\theta\,\hat{j}$

**2d)** SHEAR DRAG:




$$= \int_0^{2\pi} \tau_{r\theta}\, dA = RW \cdot \int_0^{2\pi} C\sin\theta \cdot \sin\theta\, d\theta$$

→ WOLFRAM: $= RWC\pi$

$W, C$ const → $\boxed{F_{D_s} = RC\pi}$

**2e)** Compute lift on the cylinder

$$L = \int_0^{2\pi} -\tau_{rr} \cdot \sin\theta + \tau_{r\theta} \cdot \cos\theta\, d\theta$$

$$L = \int_0^{2\pi} \left[-\left(-A\cos 2\theta - B\cos\theta\right) \cdot \sin\theta + C\sin\theta \cdot \cos\theta\right] d\theta$$

Wolfram → $\boxed{L = 0}$

↳ makes sense logically as a symmetrical object

**3)** Airfoil matlab function

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