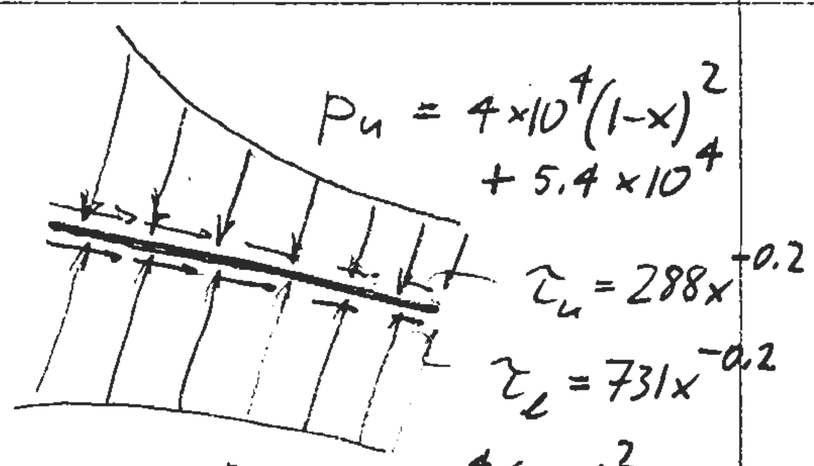
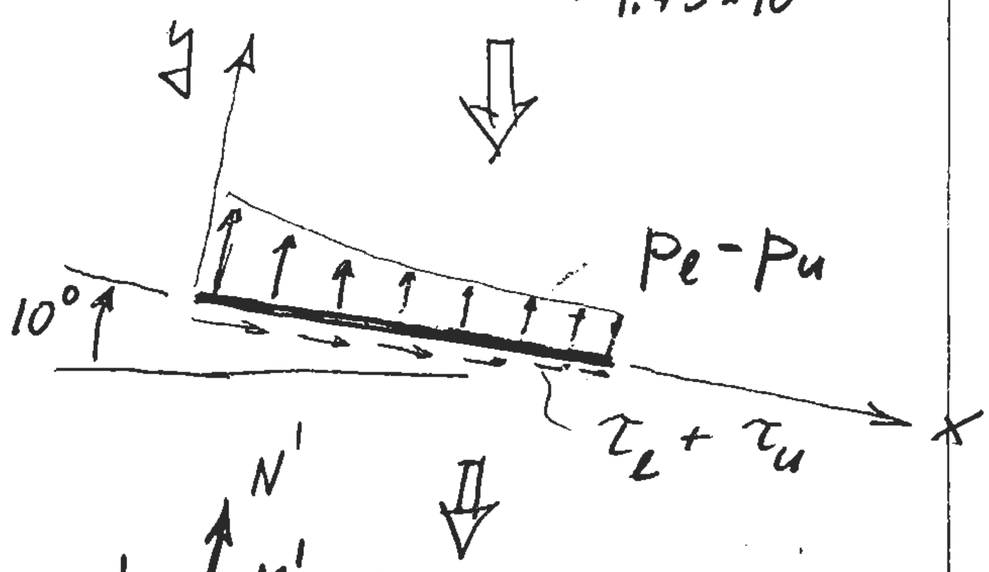
(Anderson 1.4)

Chord $c = 1\ m$

Because airfoil is a flat plate, only the net top & bottom forces matter. (less stuff to integrate).





$$p_l - p_u = 1.19\times10^5 - 2\times10^4(1-x)^2 \ Pa$$

$$\tau_l + \tau_u = 1019\,x^{-0.2} \ Pa$$

$$N' = \int_0^{1m} (p_l - p_u)\,dx = \left(1.19\times10^5 x - \frac{2}{3}\times10^4(1-x)^3\right)\Big|_0^1$$

$$\boxed{N' = 1.19\times10^5 - 6.67\times10^3 = 1.123\times10^5\ N/m}$$

$$\boxed{A' = \int_0^{1m} (\tau_l + \tau_u)\,dx = \frac{1}{0.8}\,1019\,x^{0.8}\Big|_0^1 = 1.274\times10^3\ N/m}$$

$$M'_{LE} = \int_0^{1m} -(p_l - p_u)\,x\,dx = \int_0^1 \left(-1.19\times10^5 x + 2\times10^4(x - 2x^2 + x^3)\right)dx$$

$$= \left(-\frac{1}{2}\,1.19\times10^5 x^2 + 2\times10^4\left(\frac{1}{2}x^2 - \frac{2}{3}x^3 + \frac{1}{4}x^4\right)\right)\Big|_0^1$$

$$= \left(-5.95\times10^4 + 2\times10^4\left(\frac{1}{2} - \frac{2}{3} + \frac{1}{4}\right)\right)$$

$$\boxed{M'_{LE} = -5.783\times10^4\ N}$$

$$L' = N'\cos\alpha - A'\sin\alpha = 1.104\times10^5\ N/m$$

$$D' = N'\sin\alpha + A'\cos\alpha = 2.076\times10^3\ N/m$$

$$M'_{c/4} = M'_{LE} + \frac{1}{4}N' = -3.02\times10^4\ N$$

$$x_{cp} = -M_{LE}/N' = 0.515\ m$$