Computing PALF Week 3

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1 Problem

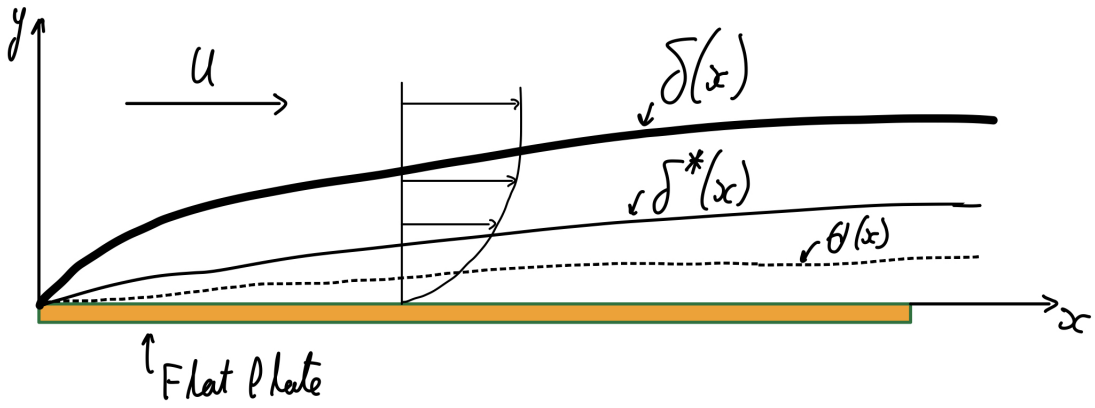

Figure 1: Boundary layer developing over a flat plate, with displacement thickness, displacement, and momentum thickness.

2 Reynolds number

Reynolds number with respect to the x direction

$$Re_x = \frac{\rho u x}{\mu}, \text{ where } \rho = 1.225\ kg/m^3,\ u = 20\ m/s,\ \mu = 1.81e-5\ Pas \tag{1}$$

3 Empirically derived BL equations

Laminar and turbulent boundary layer thickness:

$$\frac{\delta}{x}_l = \left(\frac{30}{Re_x}\right)^{0.5},\ \frac{\delta}{x}_t = \frac{0.38}{Re_x^{0.2}} \tag{2}$$

Displacement thickness:

$$\frac{\delta^*}{x} = \frac{1.721}{Re_x^{0.5}} \tag{3}$$

Momentum thickness:

$$\frac{\theta}{x} = \frac{0.664}{Re_x^{0.5}} \tag{4}$$

Laminar and turbulent skin friction coefficient:

$$C_{fl} = \left(\frac{8}{15 * Re_x}\right)^{0.5},\ C_{ft} = \frac{0.03}{Re_x^{0.2}} \tag{5}$$