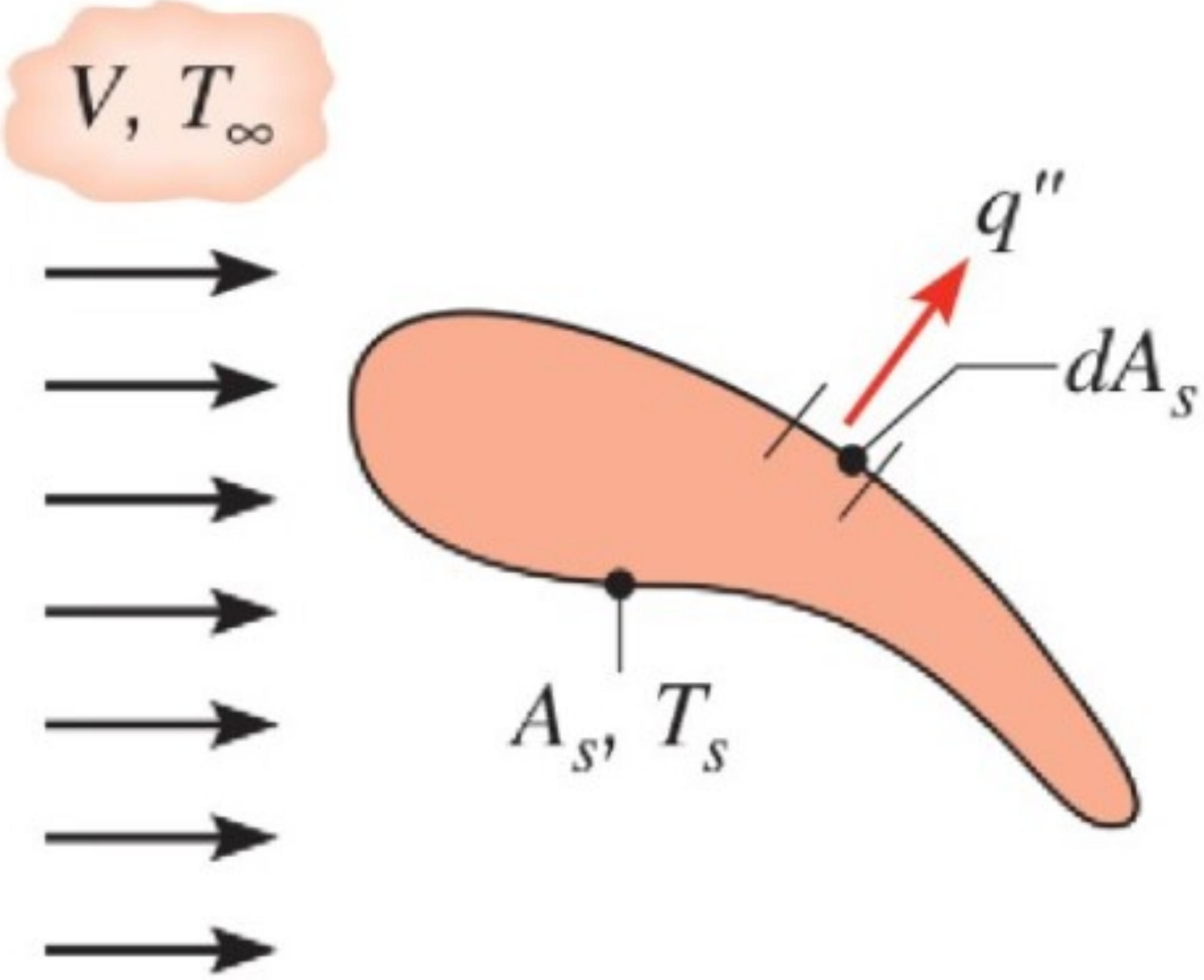
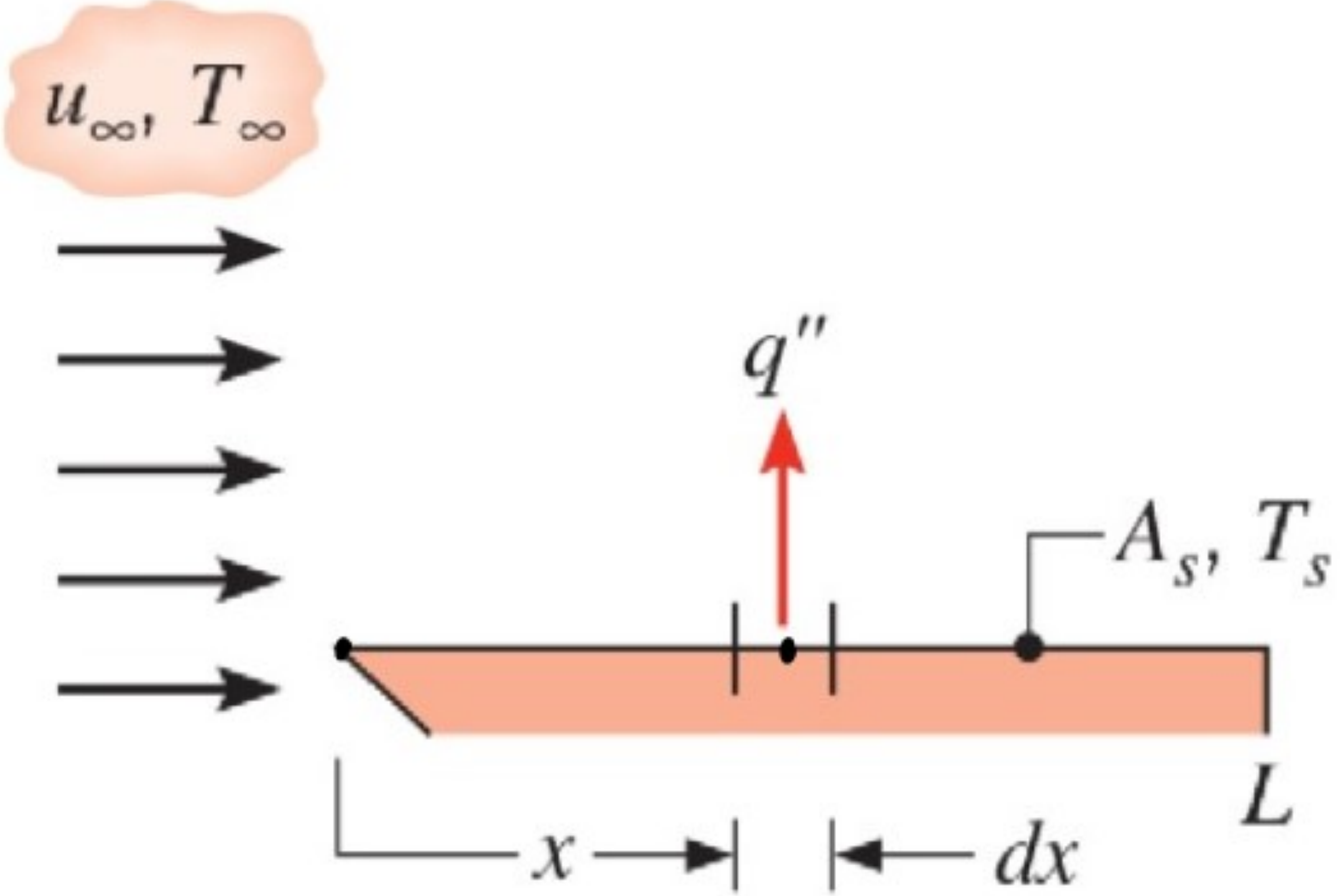
Local and Average Convection





$$q = \int_{A_s} q'' \, dA_s$$

$$q = (T_s - T_\infty) \int_{A_s} h \, dA_s$$

$$q = \bar{h} A_s (T_s - T_\infty)$$

$$\boxed{\bar{h} = \frac{1}{A_s} \int_{A_s} h \, dA_s}$$

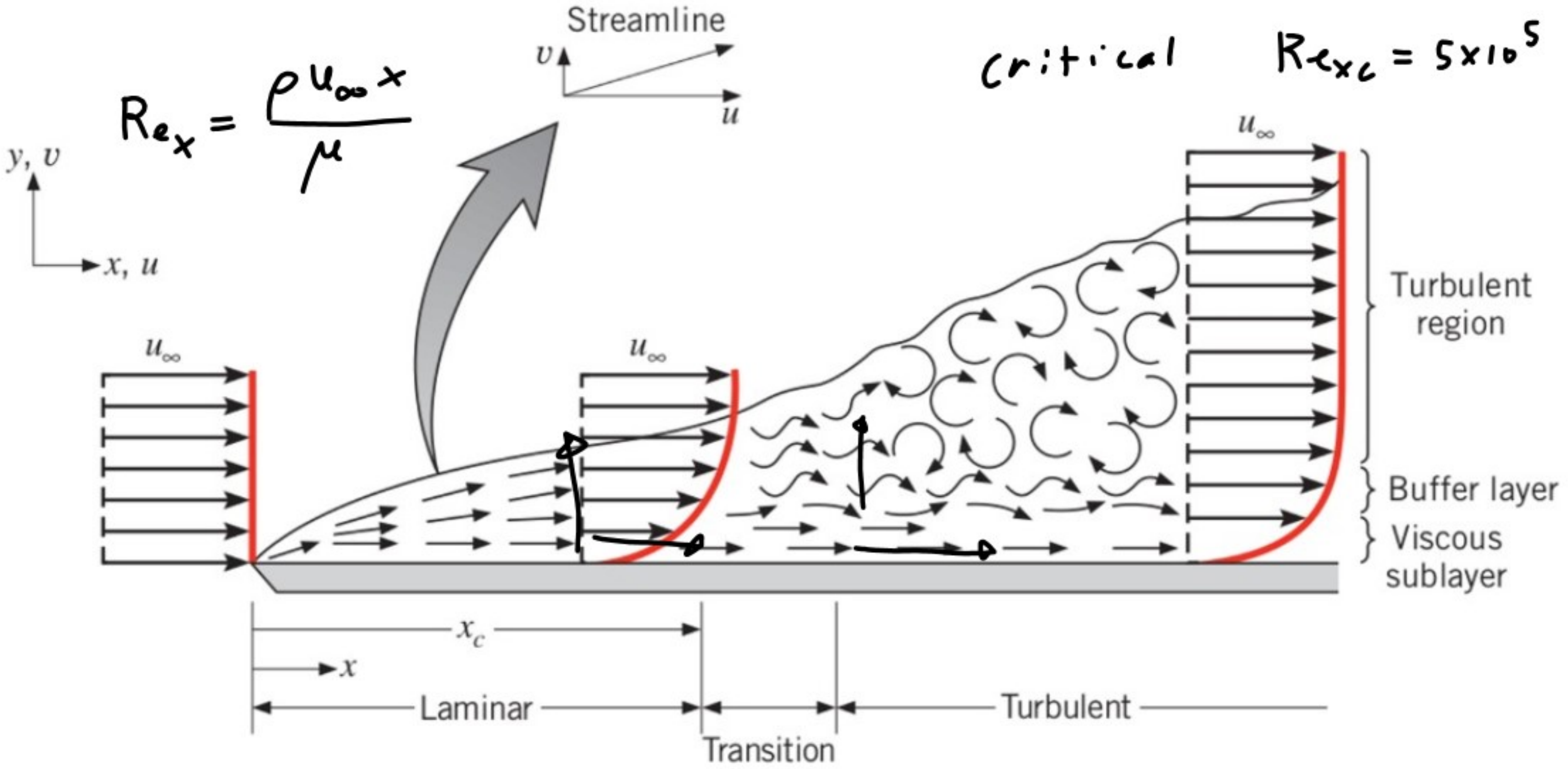
For flat plate

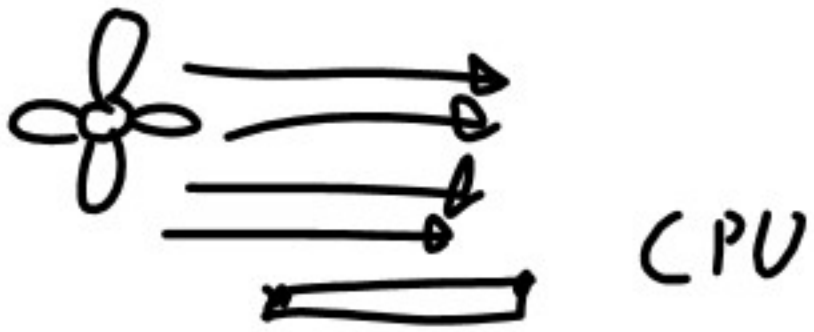
$$\bar{h} = \frac{1}{L} \int_0^L h(x) \, dx$$

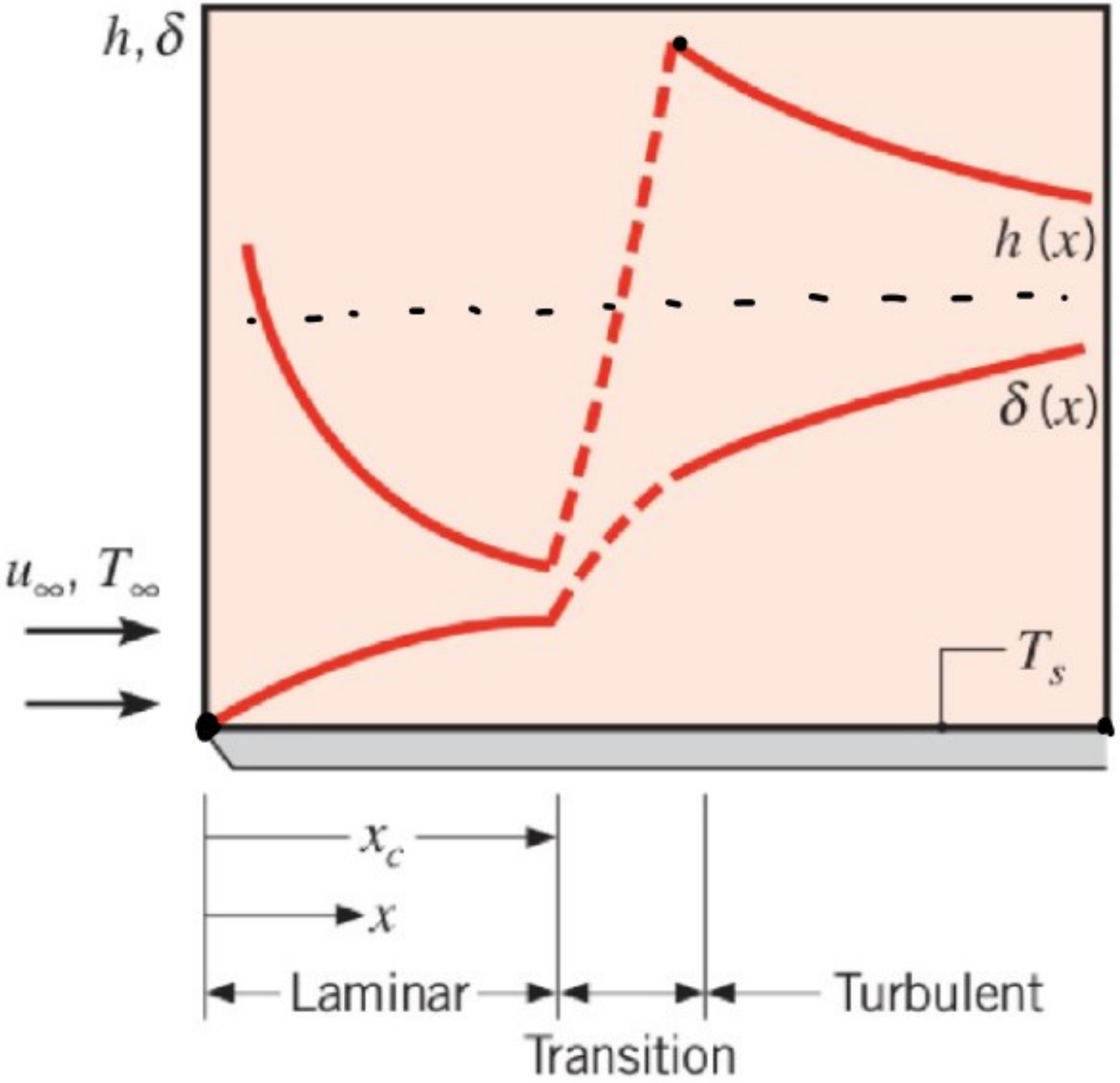
Laminar and Turbulent flow

$$Re_x = \frac{\rho u_\infty x}{\mu}$$

critical $Re_{x_c} = 5 \times 10^5$




CPU


h, δ
h (x)
δ (x)
u∞, T∞
Ts
xc
x
Laminar
Turbulent
Transition

Equations

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$$ Conservation or Mass

$$u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = \frac{-1}{\rho}\frac{dp_\infty}{dx} + \nu\frac{\partial^2 u}{\partial y^2}$$ Momentum

$$\underbrace{u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}}_{\text{advection}} = \underbrace{\alpha\frac{\partial^2 T}{\partial y^2}}_{\text{y axis conduction}} + \underbrace{\frac{\nu}{c_p}\left(\frac{\partial u}{\partial y}\right)^2}_{\text{viscous dissipation}}$$ Energy