NOTES LECTURE 2-27-2018

EXAMPLE PROBLEM IN LECTURE 5

because wind is parallel to the length $L = 10\,m$

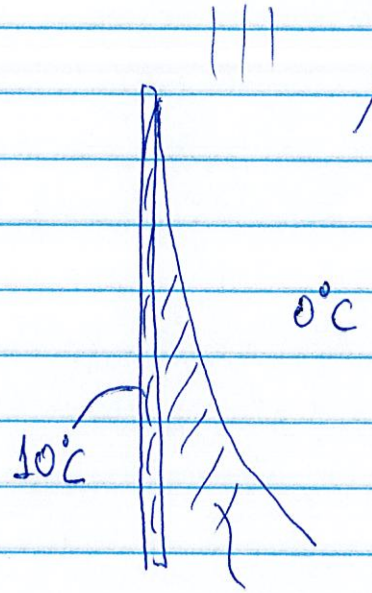
$$Re = \frac{u_{wind} \times 10\,m \times \rho_{air}}{\mu_{air}\big|_{at}}$$

at temperature 0°C

at temperature 10°C

at average temp 5°C

film temperature



How do we the properties of Air [From Tables] in the Appendix of the book we have tables.

T°C	K_{air}	ρ_{air}	μ_{air} [Pa.s]	C_{air}	$Pr = \frac{C_{air}\mu_{air}}{K_{air}}$
50			Very Small		
60			numbers		
70			so in		
80			the table are multiplied		

(2)

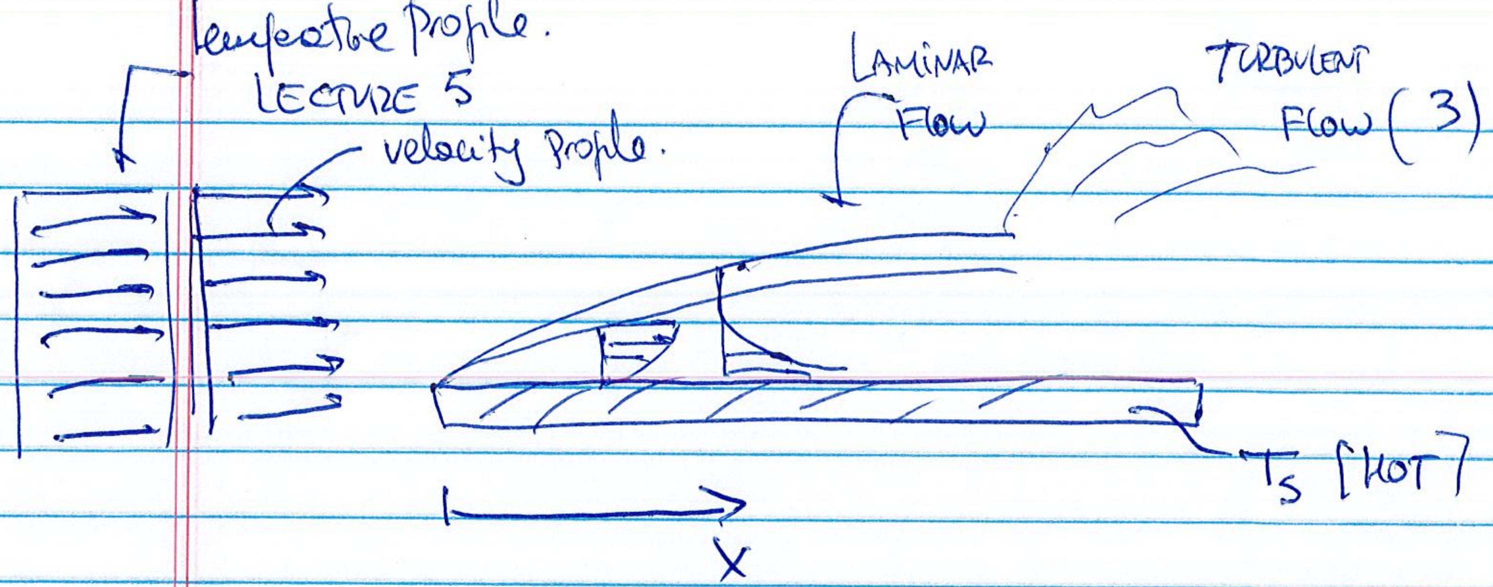
T °C	Kair	ρair	μair (Pa.s) ×10⁵	Cair	Pr
5		20	2		

If you check in the table it could be a different number, I am inventing the value now

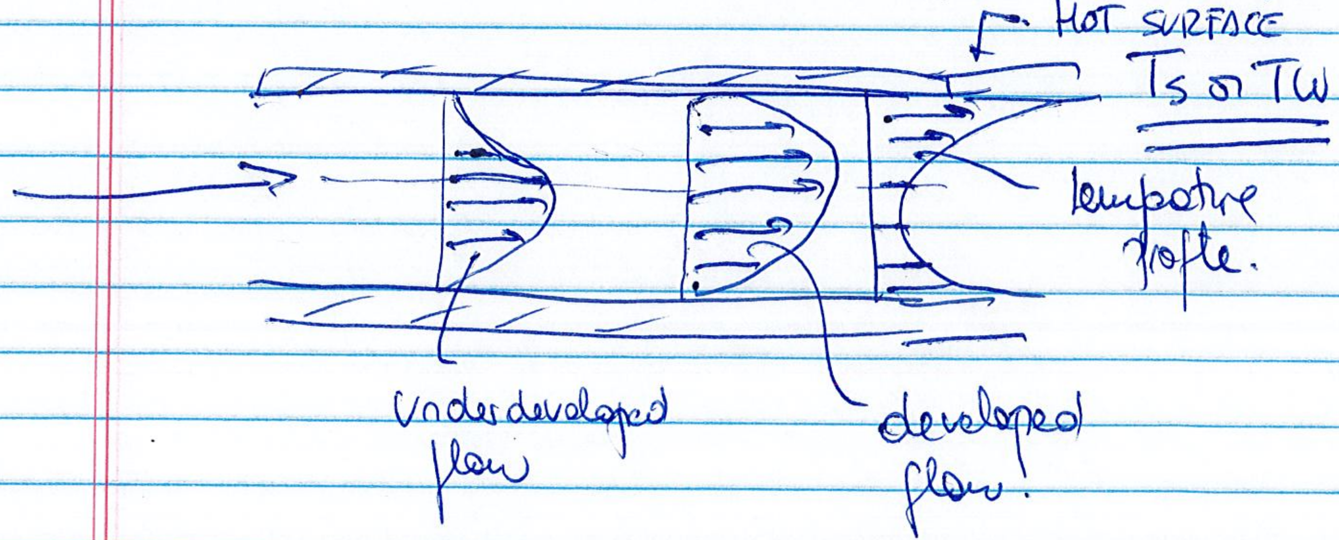
$$\mathrm{Re} = \frac{u_{wind} \times 820\ \mathrm{kg/m^3} \times 10\ \mathrm{m}}{2 \times 10^{-5}\ \mathrm{Pa.s}}$$

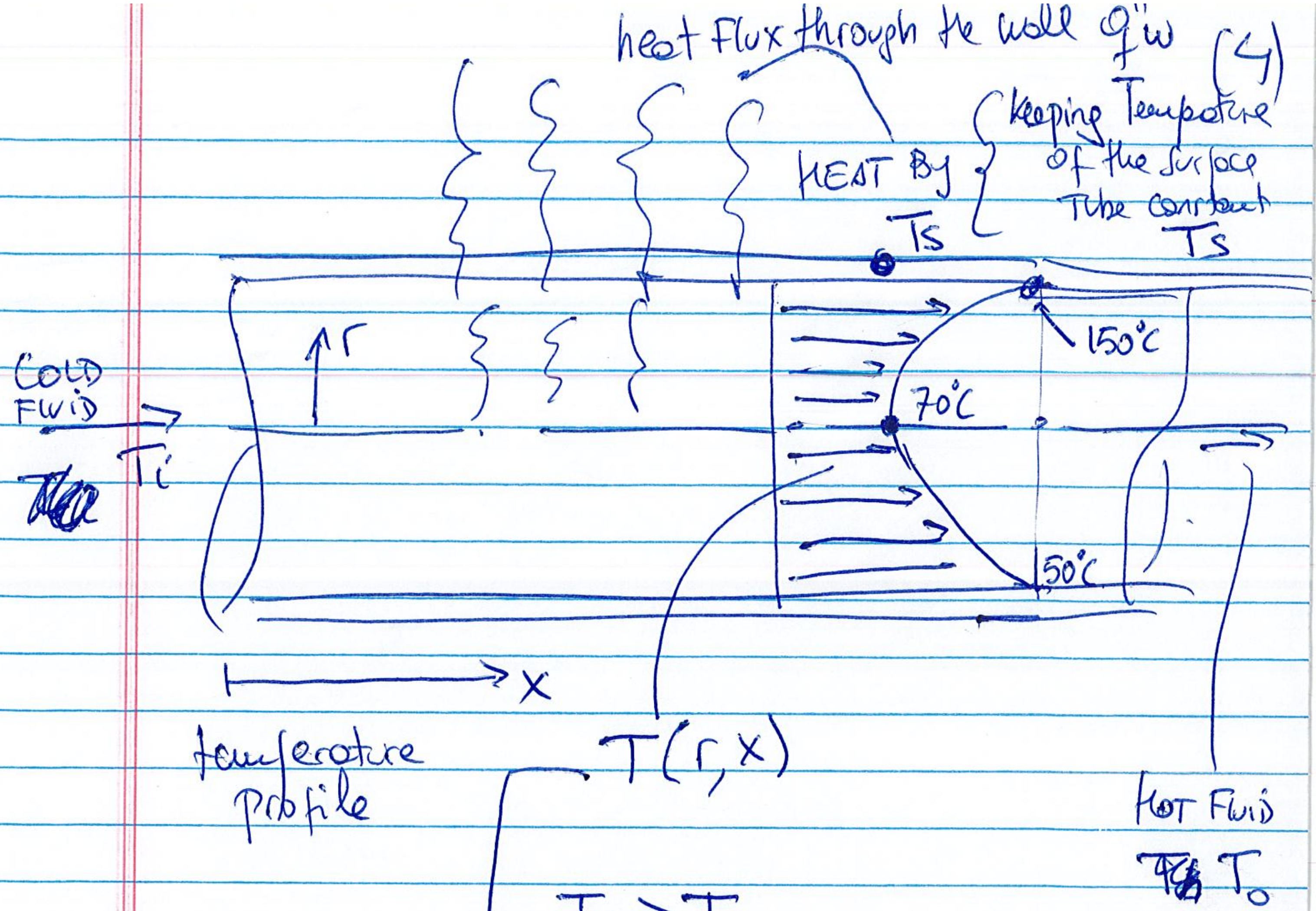
$5\ \frac{km}{h} \rightarrow m/s$

0.00002



For X large boundary layer becomes too large and not well defined because the fluid is not confined





$T_o > T_i$

We are going to transform

$T(r,x)$ into $\overline{T}(x)$

$\boxed{\text{Average}}$

Integration in the radius

$$T(r, x) \longrightarrow \overline{T}(x)$$

$$\dot{m}\, C\, \overline{T}(x) = \int_0^{A_c} \underbrace{\rho u \, dA_c}_{\dot{m}} \, T(r, x)$$

$\dot{m}$: mass flowrate Kg/s

C: HEAT CAPACITY KJ/Kg K

$\overline{T}$: Average temperature in r

$\rho u \, 2\pi r dr \, T(\cancel{x}, r)$

$$\underbrace{\cancel{\frac{Kg}{s}} \times \frac{KJ}{\cancel{Kg}\,\cancel{K}} \times \cancel{K}}_{KWatts}$$

$$\rho u = \frac{Kg}{m^{\cancel{3}}_{m^2}} \times \frac{\cancel{m}}{s} = \frac{Kg}{m^2 s}$$

$$\underbrace{\rho u}_{\frac{Kg}{\cancel{m^2} s}} \cdot \underbrace{dA_c}_{\cancel{m^2}} = \dot{m}$$

$$A_c = \pi R^2$$

$$A_c(r) = \cancel{2\pi}\,\pi r^2$$

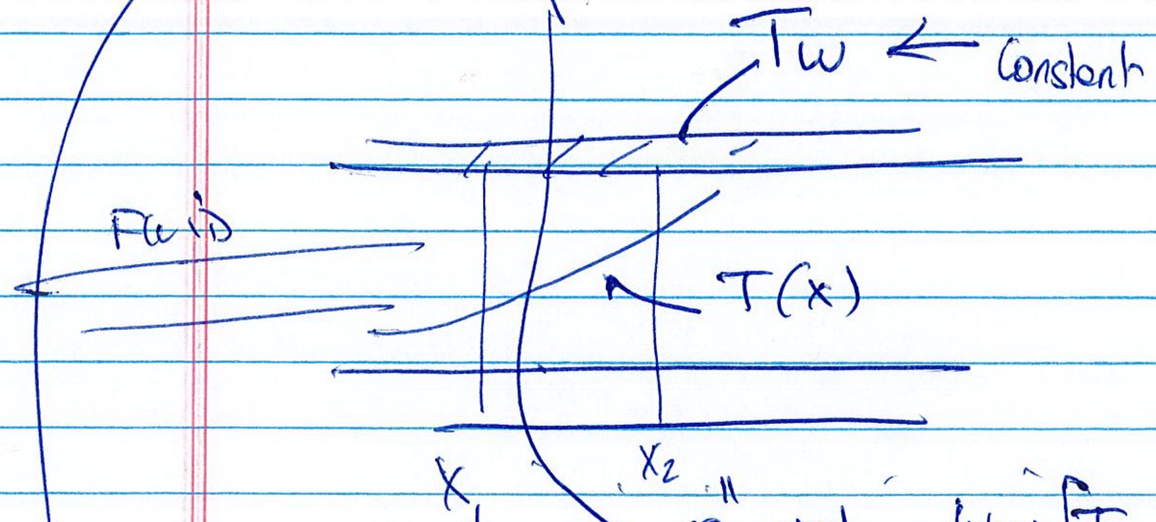
$$dA_c = 2\pi R$$

$$dA_c(r) = 2\pi r$$

(6)

$$\boxed{\frac{d\bar{T}(x)}{dx} = \frac{q''_w P}{\dot{m} C}}$$

APPLY TO ANY SYSTEMS BECAUSE IT IS COMING FROM FIRST LAW OF THERMODYN.



$$q''_w(x_1) = h(x_1)\left[T_w - T(x=x_1)\right]$$

$$q''_w(x_2) = h(x=x_2)\left[T_w - T(x=x_2)\right]$$

$$q''(x) = h(x)\left[T_w - \bar{T}(x)\right]$$