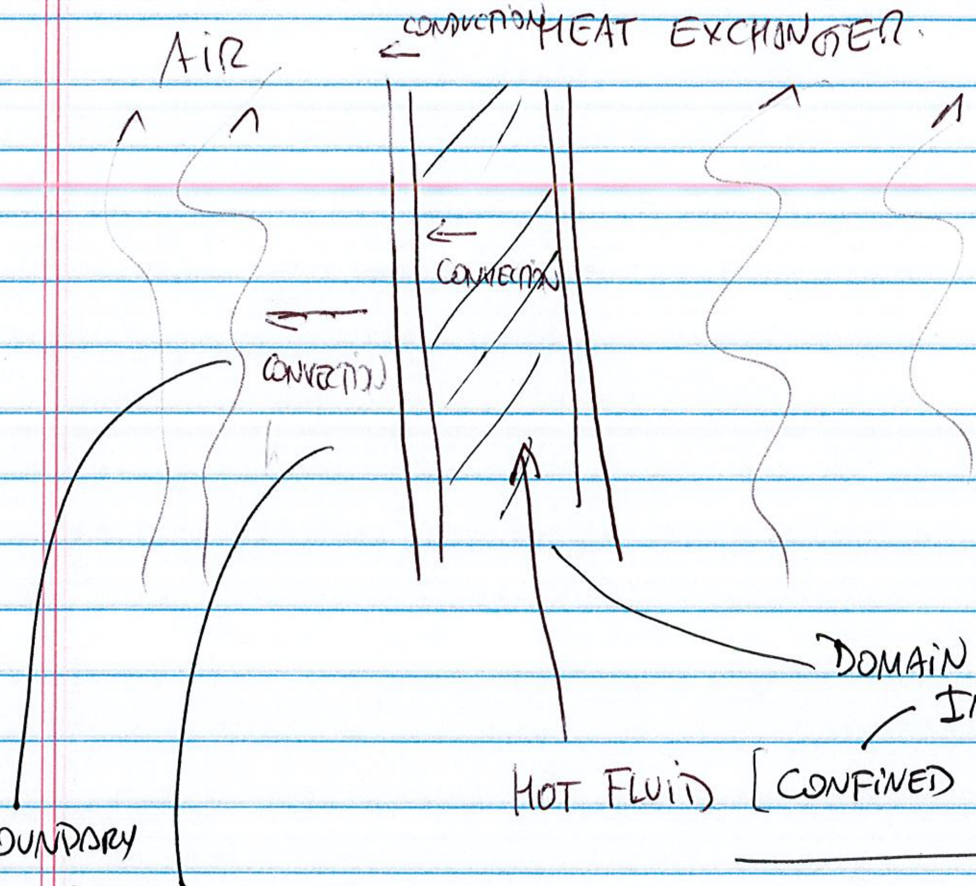
NOTES LECTURE 2-22-18



INTERNAL CONVECTION

HOT FLUID [CONFINED CONVECTION]

BOUNDARY CONDITIONS

UNCONFINED CONVECTION

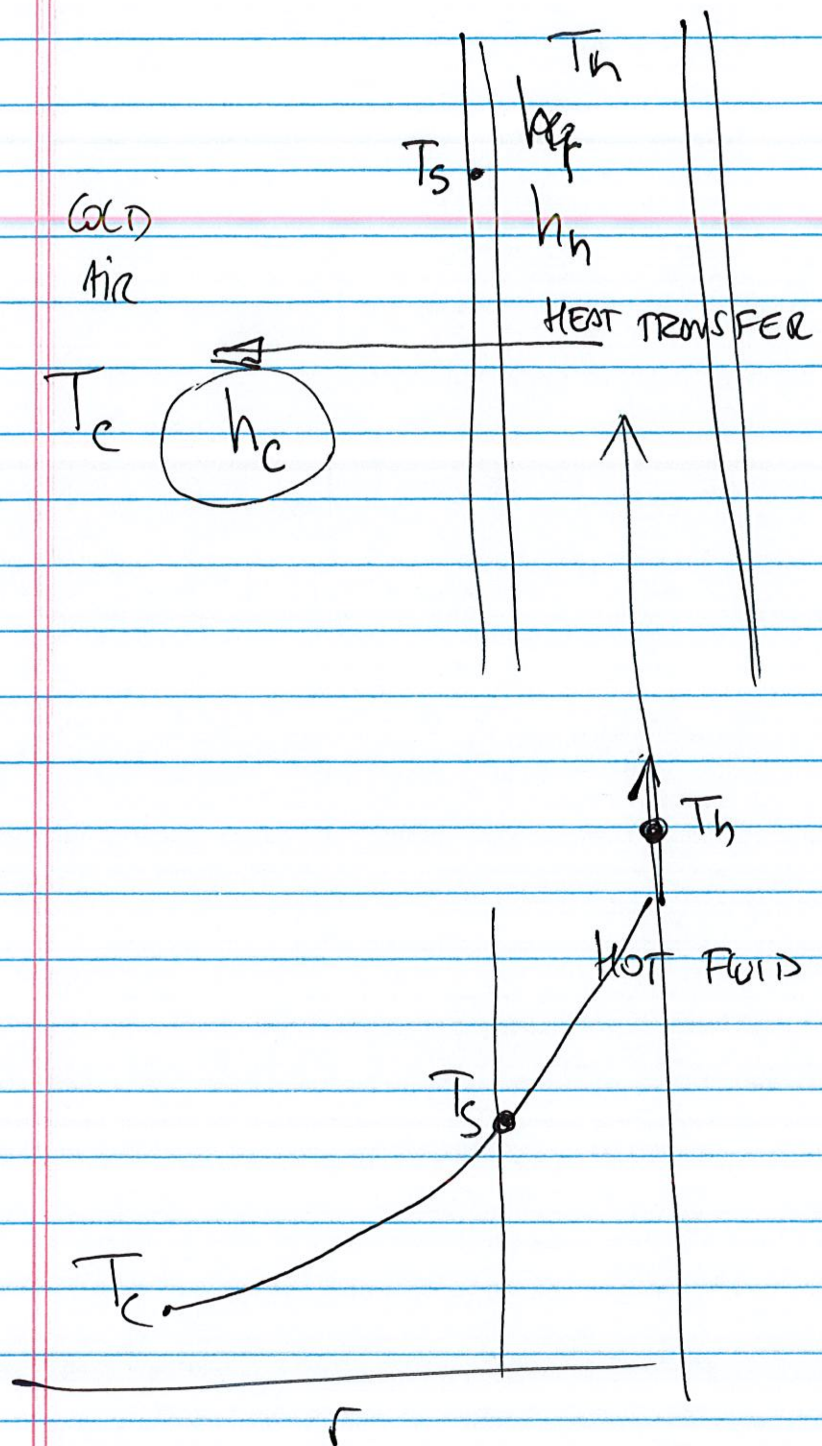
CHAPTER 6 OF THE TEXTBOOK ONLY COVERS THIS CONVECTION (EXTERNAL CONVECTION

NO COVERED IN THE CLASS TEXT BOOK.

General Equation of Energy Transport

$$\frac{\partial T}{\partial t} + \underbrace{\nabla \cdot \underline{u} T}_{\text{INTERNAL CONVECTION}} = K \nabla^2 T + \dot{q}$$

BOUNDARY CONDITIONS



What happens with the conduction through the air

how could we include the conduction in the fluid when we also have convection?

h_c estimation will combine convection & conduction

Combining conduction & convection is done by using the <u>boundary layer concept</u>

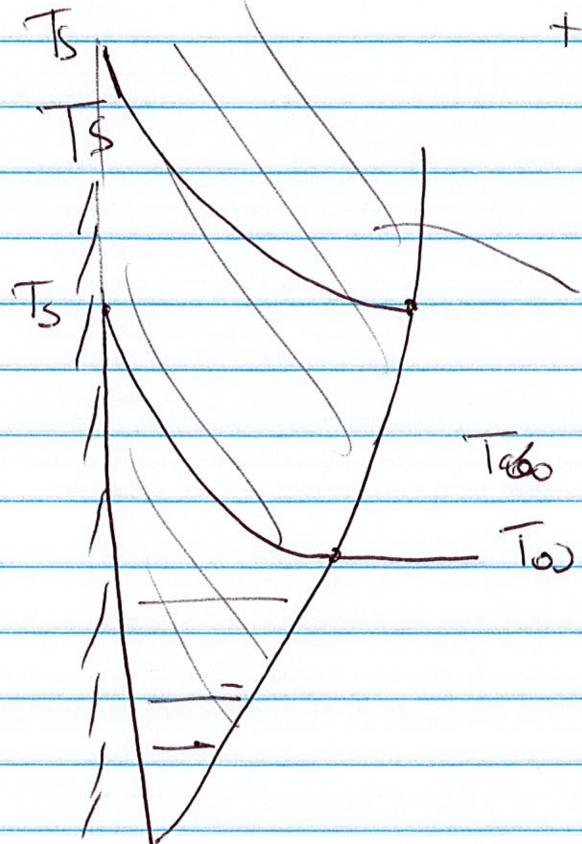
$$\nabla \cdot \underline{u}\, T$$

$$\frac{\partial}{\partial x_i} e_i \cdot u_j e_j T = \frac{\partial (u_i T)}{\partial x_i} =$$

$i = x, y, z$

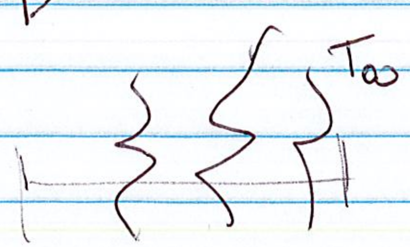
$$= \frac{\partial}{\partial x}\left[u_x T\right] + \frac{\partial}{\partial y}\left[u_y T\right] + \frac{\partial}{\partial z}\left[u_z T\right]$$

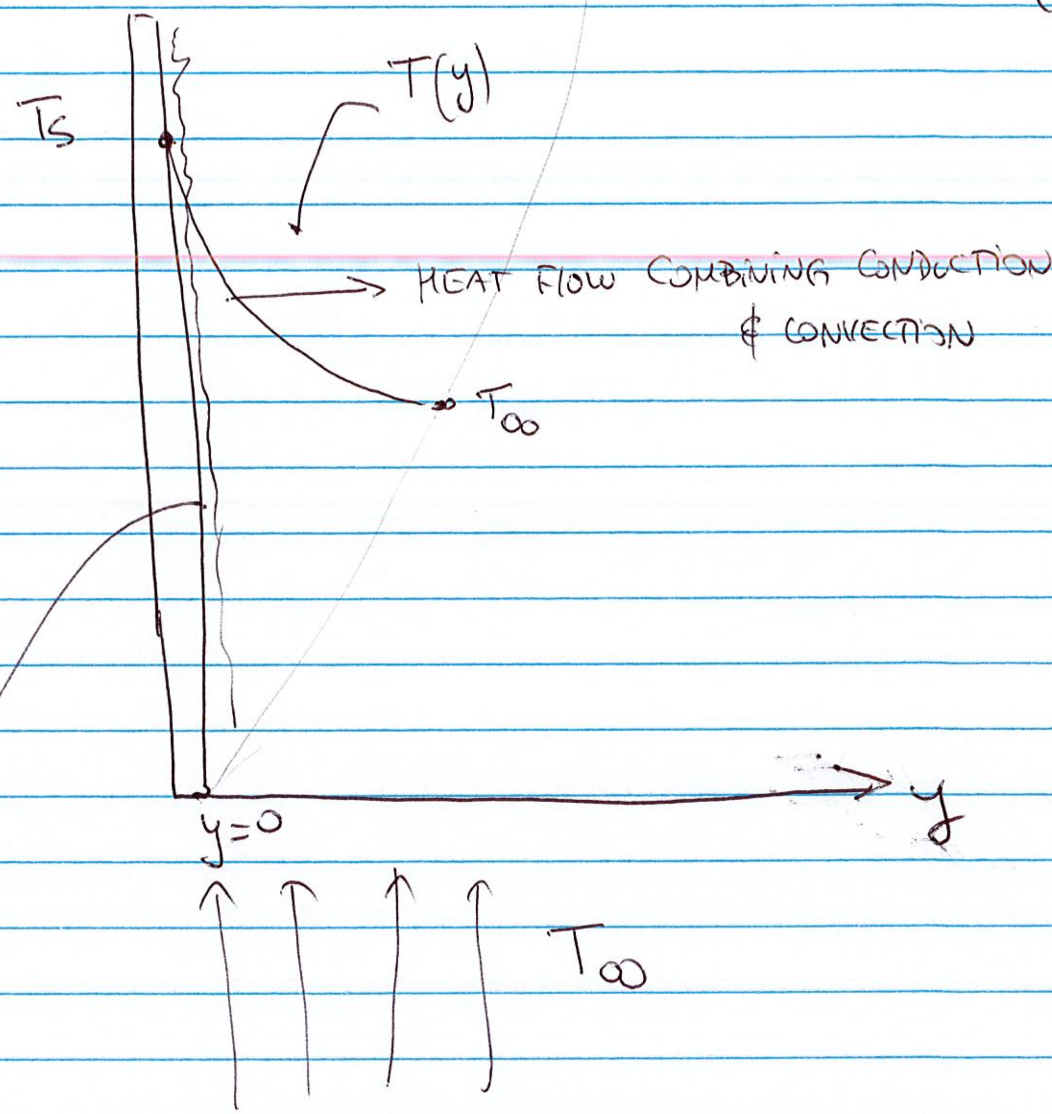
$T_s > T_\infty$



boundary layer.

If we assume that the boundary layer close to surface move very slowly.





if the fluid close to surface does not move, close to surface will be only conduction.

$$q''_{cond.} = -K_{fluid} \left. \frac{dT(y)}{dy} \right|_{y=0} = \text{HEAT FLUX}$$

$$q'_{conv} = h(T_s - T_\infty)$$

under steady state

$$\underbrace{-k_{fluid} \left.\frac{dT(y)}{dy}\right|_{y=0}}_{\text{CONDUCTION CLOSE TO THE BOUNDARY}} = \underbrace{h\,[T_s - T_\infty]}_{\text{Convection far away from surface}}$$

$$\boxed{h = \frac{-k_{fluid} \left.\frac{dT(y)}{dy}\right|_{y=0}}{T_s - T_\infty}}$$