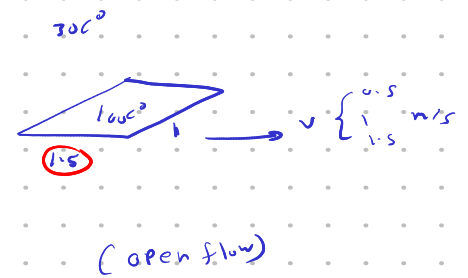


2. A flat steel plate is placed over a conveyor to transport it after curing process. If the initial temperature of the flat plate is 100°C and the ambient air temperature is 30°C , calculate the rate of heat transfer if the conveyor velocities of 0.5 , 1 and 1.5 m/s. Take the width of the plate to be 1m and its length in direction of motion is 1.5m .

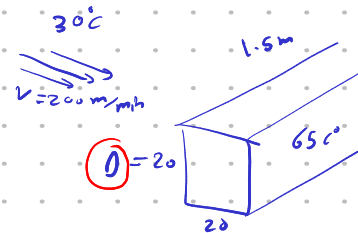
$T_f = \checkmark$
 $\beta = \checkmark$
 $Re = \frac{\rho V (L \text{ OR } D)}{\mu}$
 $Re = \frac{VL}{\nu} = \checkmark$
 $Re < Re_{cr} = 5 \times 10^5 \rightarrow L < x_{cr} \rightarrow \text{laminar}$
 $Nu_{avg} = \frac{h L_c}{k} = f(Re, Pr) \rightarrow h = \checkmark$
 $Q = \checkmark$



5. The components of an electronic system are located in a 1.5 m long horizontal duct whose cross section is $20\text{ cm} \times 20\text{ cm}$. The components in the duct are not allowed to come into direct contact with cooling air, and thus are cooled by air at 30°C flowing over the duct with a velocity of 200 m/min . If the surface temperature of the duct is not to exceed 65°C , determine the total power rating of the electronic devices that can be mounted into the duct.

Electronic

$T_f = \checkmark$
 $Re = \frac{VL}{\nu} = \checkmark$
 $Nu = \frac{hL_c}{k} \rightarrow h = \checkmark$
 $Q = A_s \cdot h \cdot (T_s - T_\infty) = \checkmark$



9. During plant visit, it was noticed that a 12 m long section of 10 cm diameter steam pipe is completely exposed to the ambient air. The temperature measurements indicate that the average temperature of the outer surface of the steam pipe is 75°C when the ambient temperature is 5°C . There are also light winds in the area at 10 km/h. Determine the amount of heat lost from the steam during 10 h long work day. Steam is supplied by a gas fired steam generator that has an efficiency of 80 percent, and the plant pays 0.54 LE/therm of natural gas (1 therm = 105500 kJ). If the pipe is insulated and 90 percent of the heat loss is saved, determine the amount of money this facility will save a year as a result of insulating the steam pipes. Assume the plant operates every day of the year for 10 h.

$$V = 10 \text{ km/hr} \rightarrow$$

$$T = 75^{\circ}\text{C}$$

$$T_f = \frac{T_s + T_{\infty}}{2} \quad \checkmark$$

$$V = 10 \text{ km/hr} \quad 5^{\circ}\text{C}$$



$$D = 10 \text{ cm} \quad T = 75^{\circ}\text{C} \quad L = 12 \text{ m}$$

$$\left. \begin{array}{l} Re \\ Pr \end{array} \right\} \rightarrow$$

$$Nu \rightarrow h \rightarrow Q \rightarrow E$$

$$\frac{E_{th} \times 0.9 \times 3600}{\eta} \times 0.54 = 26 \quad \checkmark$$

$$E_{th} = \frac{E_J}{105500 \times 10^3}$$