۱۳۹ / / تاریخ: Structure. موضوع:

Heat can travel from one place to another place with 3 ways

1. Convection for liquid type objects
2. Conduction: for solid type object
3. radiation send matter for the type of the material it could be solid, liquid, ...

Different between energy and power:
power is the amount of energy that consums per time unit

energy balance for wall:

$$\underbrace{Q_{in} - Q_{out}}_{\text{heating the wall}} = \frac{dE_{wall}}{dt}$$

Q: energy (J)

$\dot{Q} = \frac{dQ}{dt}$ (J/s) → W   other definition of power

Conductive material how the material will to transfer heating and it indicates with k
water is high conductive and wood or plastic is low conductive

$\frac{\Delta T}{\Delta x}$ ⇒ Homo Assumption → $\frac{dt}{dx}$

$$Q_{cond,wall} = -kA\frac{dt}{dx} \rightarrow -kA\frac{T_1 - T_2}{L}$$

$$Q_{cond,wall} = \frac{T_1 - T_2}{R_{wall}}$$

↳ $R_{wall} = \frac{L}{kA}$ (C°/W)

the thicker wall, the less heat goes through it.

- $\frac{d \text{ anything}}{dt}$: How much everything change by time.

- $\frac{dt}{dx}$ → how much tempeture with the chage of X

$\frac{dT}{dx}$ → homo. Assumption → $\frac{\Delta T}{\Delta X}$

$$\dot{Q}_{cond.wall} = -kA\frac{dt}{dx}$$

$$\int_{x=0}^{L} \dot{Q}_{cond,wall}\,dx = -\int_{T=T_1}^{T_2} kA\,dt$$

$$\dot{Q}_{cond.wall} = kA\frac{T_2 - T_1}{L} \quad (W)$$

L → thickness

Simplified conclusion of
Fourier's law of heat conduction

$$\dot{Q} = kA \times \frac{\Delta T}{L}$$

- heat transfer throught a wall is a proportional to its Area

- It's proportional to the differnt of temprature and the conductivity

- Conductivity: willingness of material to transfer heat. The nit of conductivity is $\left(\frac{W}{m \cdot k}\right)$

$J/s = W$

k ... $= \frac{W}{m.k}$

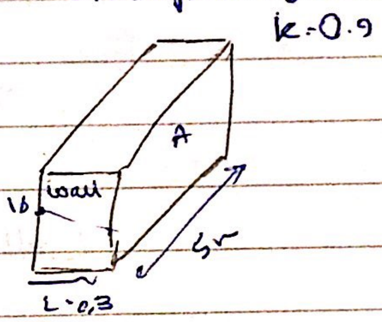
IT inversely proportional to the thickness!
why ^ the Ticker wall, the less heat goes through it!

Temprature unit,
$k = {}^{\circ}C + 273.15$
if we have a $\Delta T = 20^{\circ}C \rightarrow$

Ex: $T_1 = 25^{\circ}C \rightarrow 298k$ تبدیل
$T_2 = 5^{\circ}C \rightarrow$ ۲۷۸ k

Example:

Find the rate



$\dot{Q} = kA \frac{\Delta T}{L} \Rightarrow$
$\dot{Q} = 0.9 * 15 * \frac{16-2}{0.3} = 630\,W$

$\dot{Q}_{cond.wall} = kA \frac{T_1 - T_2}{L}$

$\dot{Q}_{cond.wall} = \frac{T_1 - T_2}{R_{wall}}$ (W)

$R_{wall} = \frac{L}{kA}$ (°C/W)

T_1 ——R—— T_2
$\dot{Q} = \frac{T_1 - T_2}{R}$

(a) heat flow

۱۳۹ / / تاریخ: موضوع: ____________

تمرین ۵:

$L = 0.4\ m$

$A = 20\ m^2$

$\Delta T = 25$

$k = 0.78\ \frac{W}{m}$

$$Q = kA\frac{\Delta T}{L} = 0.78 \times 20 \times \frac{25}{0.4}$$

$$= 975\ W$$

$$R_{wall} = \frac{L}{Ak} = \frac{0.4}{\underset{15.6}{\cancel{20 \times 0.78}}} = 0.025\ {}^{\circ}C/W$$