Heat transfer through the wall could be modeled as steady and one-dimensional.

The temperature of the wall in this case depends one one direction only (the X-direction) and can be expressed as T(x)

$$\left(\text{Rate of heat transfer into the wall}\right)-\left(\text{Rate of heat transfer out of the wall}\right)=\left(\text{Rate of change of the energy of the wall}\right)$$

$$\dot{Q}_{in} - \dot{Q}_{out} = \frac{dE_{WALL}}{dt}$$

In steady operation, the rate of heat transfer through the wall is constant.

$$\dot{Q}_{cond,wall} = -KA\left[\frac{dT}{dX}\right]$$ Fourier's law of heat

Temperature unit:

K=C+273.15

From the Fourier's law, we can get a transfer the function to:

$$\dot{Q}_{cond,wall} = KA\frac{T_1-T_2}{L}$$

$$R_{wall} = \frac{L}{KA} \quad => \quad \dot{Q}_{cond,wall} = \frac{T_1-T_2}{R_{wall}}$$

Conduction resistance of the wall:Thearmal resistance of the wall against heat conduction

Thermal resistance of a medium depends on the geometry and the thermal properties of the wall

Question:

L=0.4m, A=20m², ΔT=25K,k=0.78$\frac{W}{mk}$,find the rate of heat transfer through the wall

$$\dot{Q}_{cond,wall} = KA\frac{T_1-T_2}{L} = 0.78 \text{ x } 20 \text{ x } \frac{25}{0.4} = 975 \text{ W}$$

By using the resistance concept,

$$R_{Wall} = \frac{\Delta T}{L} = \frac{0.4m}{0.78Wm^{-1}K^{-1}*20m^2} \approx 0.0256KW^{-1}$$

$$\dot{Q} = \frac{\Delta T}{R_{Wall}} = \frac{25K}{0.0256KW^{-1}} \approx 976.6W;$$