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2. Heat transfer by conduction (steady-state)

Fourier's law of heat conduction

$$q_x = -k_A A \frac{dT_A}{dx}$$

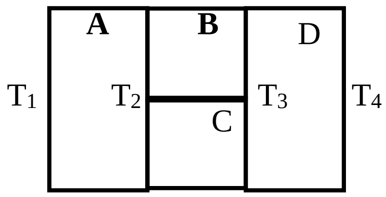
Where k is thermal conductivity of the wall's material , (W/m.K)

A is area of the Wall, (m^2)

x is the heat flow direction , (m)

T is the temperature of the Wall , (°C)

Example:



$$q = \frac{T_1 - T_4}{\frac{L_1}{k_A A_A} + \frac{1}{\frac{1}{\frac{L_2}{k_B A_B}} + \frac{1}{\frac{L_3}{k_C A_C}}} + \frac{L_3}{k_D A_D}}$$

$$q = \frac{(573 - 295)\ K}{\frac{0.1\ m}{35\ \frac{W}{mK}(0.09x1)\ m^2} + \frac{1}{\frac{1}{\frac{0.2\ m}{12\ \frac{W}{mK}(0.06x1)\ m^2}} + \frac{1}{\frac{0.2\ m}{23\ \frac{W}{mK}(0.03x1)\ m^2}}} + \frac{0.08\ m}{5\ \frac{W}{mK}(0.09x1)\ m^2}}$$

$$q = \frac{278}{0.031 + 0.07 + 0.177} = 1000\,W$$

b) $$q = \frac{(573 - T_{y=10cm})\ K}{\dfrac{0.1\ m}{35\ \dfrac{W}{mK}(0.09x1)\ m^2}} = 1000\ W$$

$$(573 - T_{y=10cm}) = 31.7$$

$$T_{y=10cm} = 541.3\ K$$

$$q = \frac{(573 - T_{y=30cm})\ K}{\dfrac{0.1\ m}{35\ \dfrac{W}{mK}(0.09x1)\ m^2} + \dfrac{1}{\dfrac{1}{\dfrac{0.2\ m}{12\ \dfrac{W}{mK}(0.06x1)\ m^2}} + \dfrac{1}{\dfrac{0.2\ m}{23\ \dfrac{W}{mK}(0.03x1)\ m^2}}}} = 1000\ W$$

$$(573 - T_{y=30cm}) = 101$$

$$T_{y=30cm} = 472\ K$$