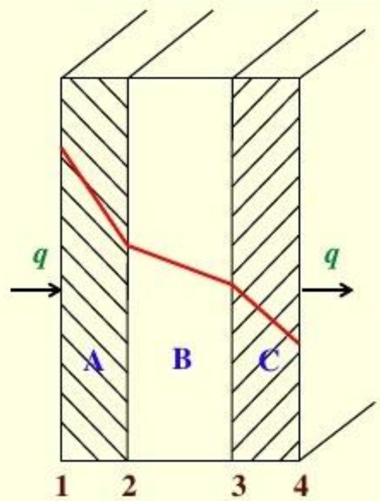
Conduction through Composite Wall



Since Heat Flow through all sections must be SAME ;

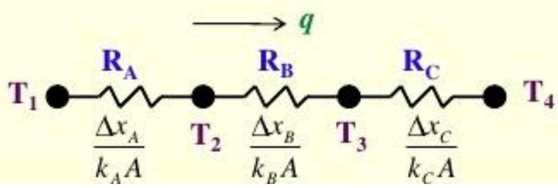
$$q = -k_A\, A\,\frac{T_2 - T_1}{\Delta x_A} = -k_B\, A\,\frac{T_3 - T_2}{\Delta x_B} = -k_C\, A\,\frac{T_4 - T_3}{\Delta x_C}$$

Thus, solving the equations would result in,

$$q = \frac{T_1 - T_4}{\Delta x_A / k_A A + \Delta x_B / k_B A + \Delta x_C / k_C A}$$

ELECTRICAL ANALOGY :

1. HT Rate = Heat Flow
2. k, thickness of material & area = Thermal Resistance
3. ΔT = Thermal Potential Difference.

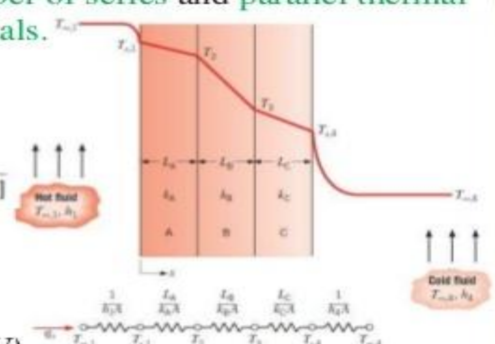


$$HeatFlow = \frac{Thermal\ Potential\ Difference}{Thermal\ Resistance}$$

$$q = \frac{\Delta T_{overall}}{\sum R_{th}}$$

2.6 The Composite Wall (multilayer plane)

The composite walls that involve any number of series and parallel thermal resistances due to layers of different materials.



$$q_x = \frac{T_{\infty,1} - T_{\infty,4}}{\Sigma R_t}$$

$$q_x = \frac{T_{\infty,1} - T_{\infty,4}}{[(1/h_1 A) + (L_A/k_A A) + (L_B/k_B A) + (L_C/k_C A) + (1/h_4 A)]}$$

$$q_x = \frac{T_{\infty,1} - T_{s,1}}{(1/h_1 A)} = \frac{T_{s,1} - T_2}{(L_A/k_A A)} = \frac{T_2 - T_3}{(L_B/k_B A)} = \cdots$$

2.7 Overall heat transfer coefficient (U)

With composite systems, it is often convenient to work with an *overall heat transfer coefficient U*, which is defined by an expression analogous to Newton's law of cooling. Accordingly,

$$q_x \equiv UA\,\Delta T \qquad (7)$$

where ΔT: is the overall temperature difference.