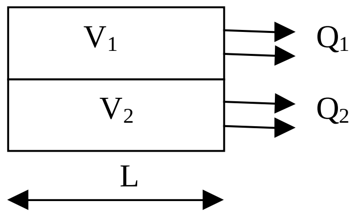
10. APPENDIX

2.3.1 Derivation of Thermal conductors in Parallel



This can be derived by using effective thermal conductivity K_e has been shown (see section thermal conductivity 2.1)

$$Q = K_e\,(\Delta T)/\,L \tag{1}$$

where Q is the heat flux (the amount of heat flowing per unit time), K_e is the effective thermal conductivity, L is the length of the material and ΔT is the temperature gradient.

In this case, the dimensions L is identical for both components 1,2, whereas the heat flowing through each component is different as it is the volume presented by V_1 and V_2 by each component.

Therefore,

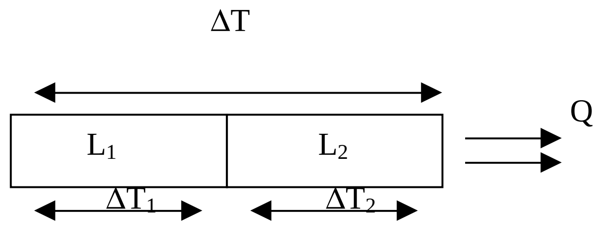
$$Q = Q_1V_1 + Q_2V_2 \tag{2}$$

$$K_e\Delta T/L = V_1K_1\Delta T_1/L + V_2K_2\Delta T_2/L$$

where ΔT_1 and ΔT_2 are the temperature gradients for materials 1 and 2, which have no difference giving

$$K_e = K_1V_1 + K_2V_2 \tag{3}$$

2.3.2 Derivation Thermal conductors in Series



This can be derived by using effective thermal conductivity K_e has been shown (see section thermal conductivity 2.1)

$$Q = K_e\,(\Delta T)/\,L \qquad (1)$$

where Q is the heat flux (the amount of heat flowing per unit time), K_e is the effective thermal conductivity, L is the length of the material and ΔT is the temperature gradient.

The Q is identical through both L_1 and L_2, and is driven by the temperature difference ΔT.

The thermal conductivities of the two components K_1 and K_2 for materials (*1* and *2*) respectively. Given that $L = L_1 + L_2$, it follows

$$\Delta T = Q\,L/\,K_e = \Delta T_1 + \Delta T_2 \qquad (4)$$

So that

$$Q\,(L_1+L_2)/\,K_e = Q\,(L_1/\,K_1) + Q\,(L_2/\,K_2) \qquad (5)$$

So that the effective thermal conductivity is given by

$$(L_1 + L_2)/\,K_e = (L_1)/\,K_1 + (L_2)/\,K_2 \qquad (6)$$