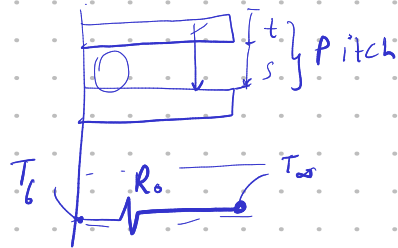


13. Annular fins of rectangular cross section surrounds a 25mm diameter tube. The fin length is 37.5mm and the thickness is 3.2mm. The fins are made of mild steel ( $k = 45 \text{ W/m.K}$ ). If the air passes over the tube such that  $h = 28 \text{ W/m}^2\text{.K}$  and the temperatures of the base and air are  $260^\circ\text{C}$  and  $93^\circ\text{C}$  respectively. Calculate the rate of heat transfer per meter length of the tube if the fin spacing (pitch) is 6.8mm.

$T_b - T_\infty$  |  $\sqrt{T_b = 260^\circ\text{C}}$

$$q_o = (h A_t \theta_b) \eta_o = \frac{T - T_\infty}{R_o}$$



$$A_t = N_f A_{f,ext} + A_b$$

$$H = N_f (t+s) \quad A_f = \pi (r_o^2 - r_i^2) \times 2 + 2\pi r_o t$$

$$A_b = 2\pi r_i (H - N_f t)$$

$\eta_o$  = subtracting in efficiency of relative area of fins

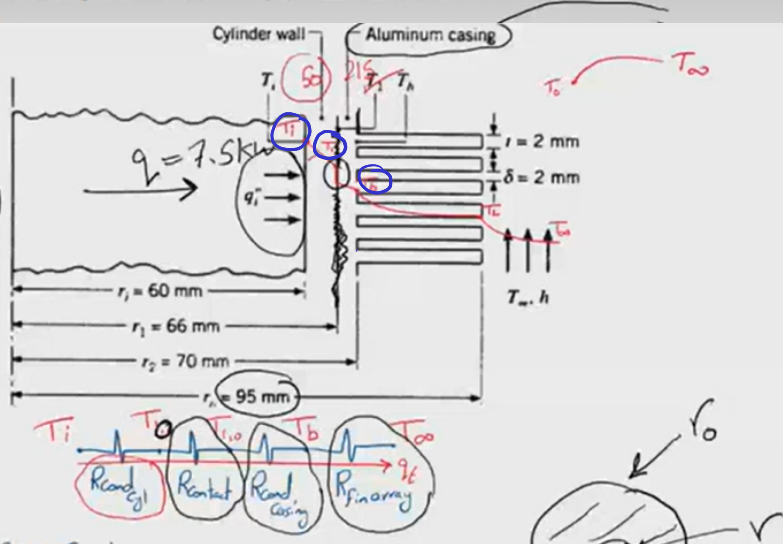
$$\eta_o = 1 - \frac{N_f A_f}{A_t} (1 - \eta_f)$$

16. It is proposed to air cool the cylinder wall of a combustion chamber by adding an aluminum casing with 30 annular fins of  $k = 215 \text{ W/m.K}$  to the cylinder wall of  $k = 50 \text{ W/m.K}$ . The cold air is at  $45^\circ\text{C}$  with  $h = 150 \text{ W/m}^2\text{.K}$ . The heat transfer rate from the inner cylinder wall is  $q = 7.5 \text{ kW}$ . If the contact resistance between the cylinder wall and the casing is  $10^{-4} \text{ m}^2\text{K/W}$ , draw the temperature distribution and the thermal resistance for the configuration and then calculate, (a) the fin efficiency  $\eta_f$  and overall efficiency  $\eta_o$ , (b) the temperature of the inner and outer cylinder wall ( $T_i$  and  $T_o$ ) and the fin base temperature  $T_b$  and (c) The fin effectiveness.

$$q_{total} = \frac{T_b - T_\infty}{R_{fin array}}$$

$$= (\eta_o A_{total}) (h \theta_b)$$

$$R_{fin array} = \frac{1}{\eta_o A_t h}$$



$$q = \eta_o h A_t \theta_b$$

$$A_t = N_f A_f + A_b$$

$$H = N_f (t+s)$$

$$A_f = 2\pi (r_o^2 - r_i^2) + 2\pi r_o t$$

$$A_b = 2\pi r_i (H - N_f t)$$

$$\eta_o = 1 - \frac{N_f A_f}{A_t} (1 - \eta_f)$$

Notes: Per unit width  $\rightarrow$  Carrey  $Lt$

