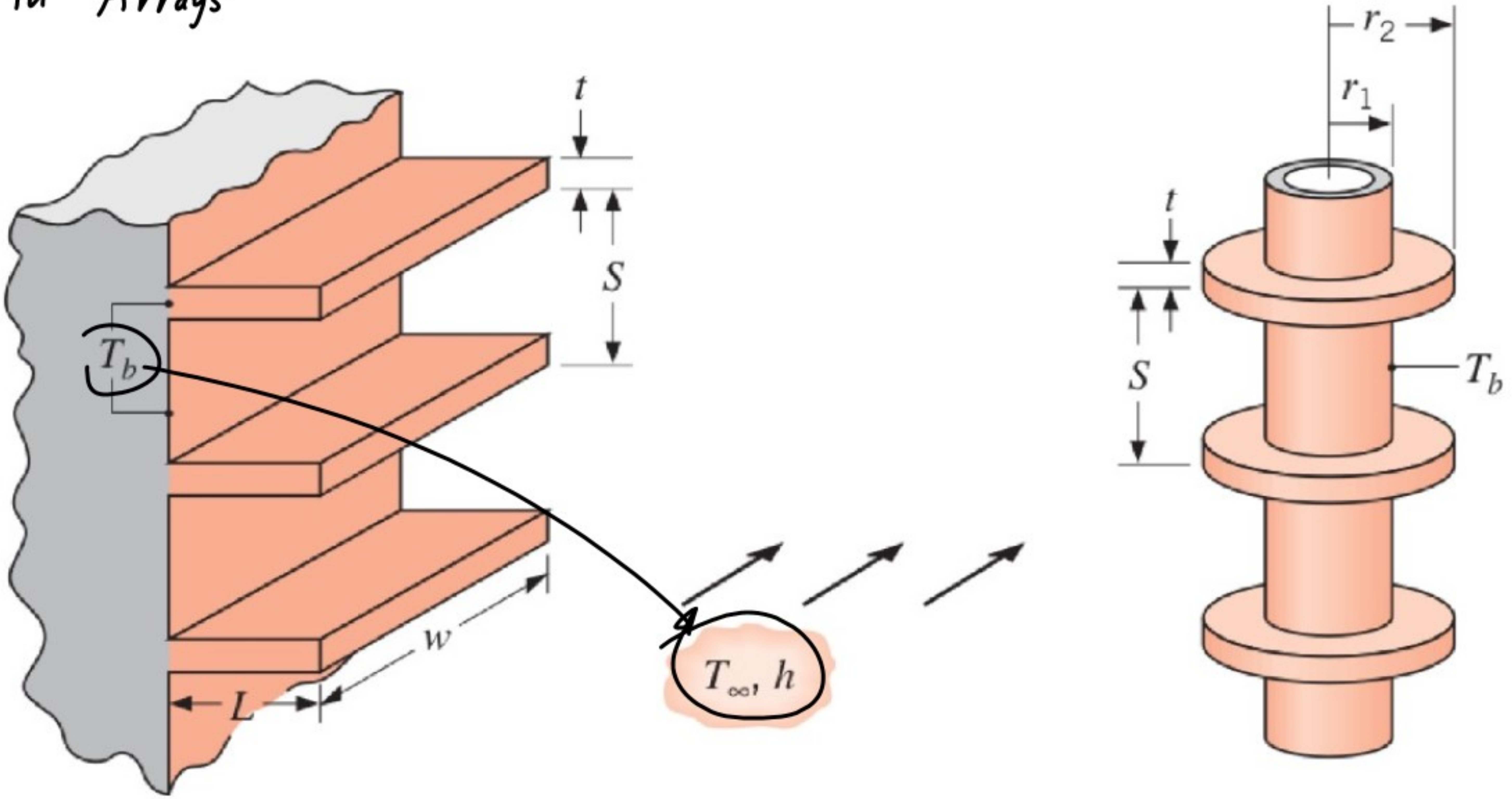
Fin Arrays



Overall Efficiency

$$\eta_o = \frac{q_t}{q_{max}} = \frac{q_t}{hA_t\theta_b}$$

$$A_t = NA_f + A_b$$

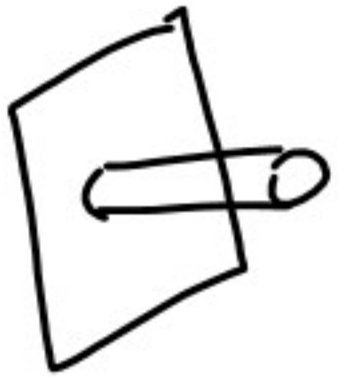
$$R_{t,o} = \frac{\theta_b}{q_t} = \frac{1}{\eta_o h A_t}$$

$$q_t = N\eta_f hA_f\theta_b + hA_b\theta_b$$

$$= h(N\eta_f A_f + (A_t - NA_f))\theta_b$$

$$= hA_t\left(1 - \frac{NA_f}{A_t}(1-\eta_f)\right)\theta_b$$

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



A brass rod 100 mm long and 5 mm in diameter extends horizontally from a casting at 200°C. The rod is in an air environment with $T_\infty = 20°C$ and $h = 30$ $W/m^2 \cdot K$. What is the temperature of the rod 25, 50, and 100 mm from the casting?

$$\theta(x) = T(x) - T_\infty$$

$$\theta_b = T_b - T_\infty$$

$$\frac{\theta(x)}{\theta_b} = \frac{\cosh(m(L-x)) + \frac{h}{mK}\sinh(m(L-x))}{\cosh mL + \frac{h}{mK}\sinh mL}$$

$$m^2 = \frac{hP}{KA_c} = \frac{h \pi D}{K \frac{\pi D^2}{4}} = \frac{4h}{KD}$$

$$P = \pi D =$$

$$A_c = \pi r^2 = \frac{\pi D^2}{4}$$

$$K = 110 \frac{W}{mK}$$

$$\theta_b = 200°C - 20°C = 180\,K$$

$$m = \sqrt{\frac{4h}{KD}} = \sqrt{\frac{4 \cdot 30 \frac{W}{m^2K}}{110 \frac{W}{mK}\, 0.005\,m}} = 13.43 \frac{1}{m}$$

x (m)	$\theta(x)$	$T(x)$ °C
$x_1 = 0.025$	136.5	156.5
$x_2 = 0.05$	108.9	128.9
$L = 0.1$	87.0	107.0

2D Conduction

$$\nabla^2 T + \frac{\dot{q}}{K} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$$

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\dot{q}}{K} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$$

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$