

TABLE 3.4 Temperature distribution and heat loss for fins of uniform cross section

Case	Tip Condition ($x = L$)	Temperature Distribution θ/θ_b	Fin Heat Transfer Rate q_f
A	Convection heat transfer: $h\theta(L) = -kd\theta/dx _{x=L}$	$\frac{\cosh m(L-x) + (h/mk) \sinh m(L-x)}{\cosh mL + (h/mk) \sinh mL}$ (3.75)	$M \frac{\sinh mL + (h/mk) \cosh mL}{\cosh mL + (h/mk) \sinh mL}$ (3.77)
B	Adiabatic: $d\theta/dx _{x=L} = 0$	$\frac{\cosh m(L-x)}{\cosh mL}$ (3.80)	$M \tanh mL$ (3.81)
C	Prescribed temperature: $\theta(L) = \theta_L$	$\frac{(\theta_L/\theta_b) \sinh mx + \sinh m(L-x)}{\sinh mL}$ (3.82)	$M \frac{(\cosh mL - \theta_L/\theta_b)}{\sinh mL}$ (3.83)
D	Infinite fin ($L \rightarrow \infty$): $\theta(L) = 0$	e^{-mx} (3.84)	M (3.85)
$\theta \equiv T - T_\infty$ $\theta_b = \theta(0) = T_b - T_\infty$		$m^2 \equiv hP/kA_c$ $M \equiv \sqrt{hPkA_c}\theta_b$	

TABLE 3.5 Efficiency of common fin shapes

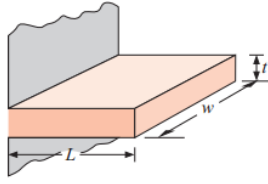
Straight Fins

Rectangular^a

$$A_f = 2wL_c$$

$$L_c = L + (t/2)$$

$$A_p = tL$$

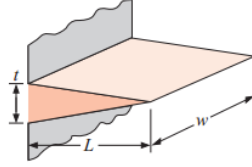


$$\eta_f = \frac{\tanh mL_c}{mL_c} \quad (3.94)$$

Triangular^a

$$A_f = 2w[L^2 + (t/2)^2]^{1/2}$$

$$A_p = (t/2)L$$



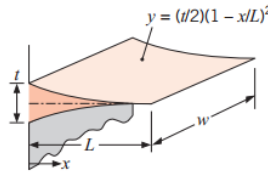
$$\eta_f = \frac{1}{mL} \frac{I_1(2mL)}{I_0(2mL)} \quad (3.98)$$

Parabolic^a

$$A_f = w[C_1L + (L^2/t)\ln(tL + C_1)]$$

$$C_1 = [1 + (t/L)^2]^{1/2}$$

$$A_p = (t/3)L$$



$$\eta_f = \frac{2}{[4(mL)^2 + 1]^{1/2} + 1} \quad (3.99)$$

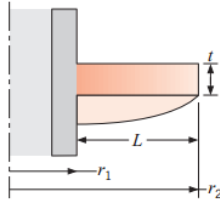
Circular Fin

Rectangular^a

$$A_f = 2\pi(r_{2c}^2 - r_1^2)$$

$$r_{2c} = r_2 + (t/2)$$

$$V = \pi(r_2^2 - r_1^2)t$$



$$\eta_f = C_2 \frac{K_1(mr_1)I_1(mr_{2c}) - I_1(mr_1)K_1(mr_{2c})}{I_0(mr_1)K_1(mr_{2c}) + K_0(mr_1)I_1(mr_{2c})} \quad (3.96)$$

$$C_2 = \frac{(2r_1/m)}{(r_{2c}^2 - r_1^2)}$$

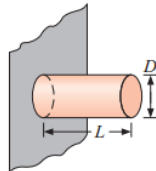
Pin Fins

Rectangular^b

$$A_f = \pi DL_c$$

$$L_c = L + (D/4)$$

$$V = (\pi D^2/4)L$$

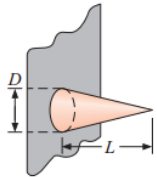


$$\eta_f = \frac{\tanh mL_c}{mL_c} \quad (3.100)$$

Triangular^b

$$A_f = \frac{\pi D}{2} [L^2 + (D/2)^2]^{1/2}$$

$$V = (\pi/12)D^2L$$



$$\eta_f = \frac{2}{mL} \frac{I_2(2mL)}{I_1(2mL)} \quad (3.101)$$

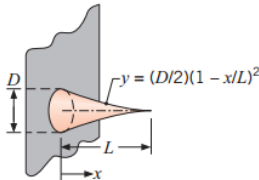
Parabolic^b

$$A_f = \frac{\pi L^3}{8D} \{C_3C_4 - \frac{L}{2D} \ln [(2DC_4/L) + C_3]\}$$

$$C_3 = 1 + 2(D/L)^2$$

$$C_4 = [1 + (D/L)^2]^{1/2}$$

$$V = (\pi/20)D^2L$$



$$\eta_f = \frac{2}{[4/9(mL)^2 + 1]^{1/2} + 1} \quad (3.102)$$

^a $m = (2h/kt)^{1/2}$.

^b $m = (4h/kD)^{1/2}$.

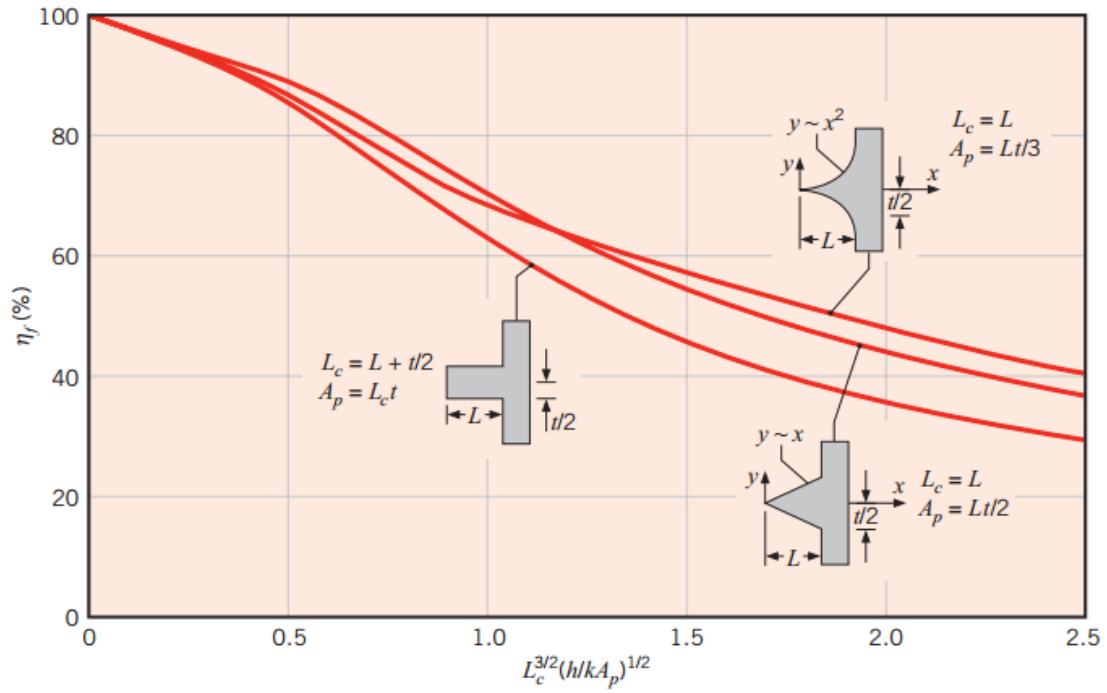


FIGURE 3.19 Efficiency of straight fins (rectangular, triangular, and parabolic profiles).

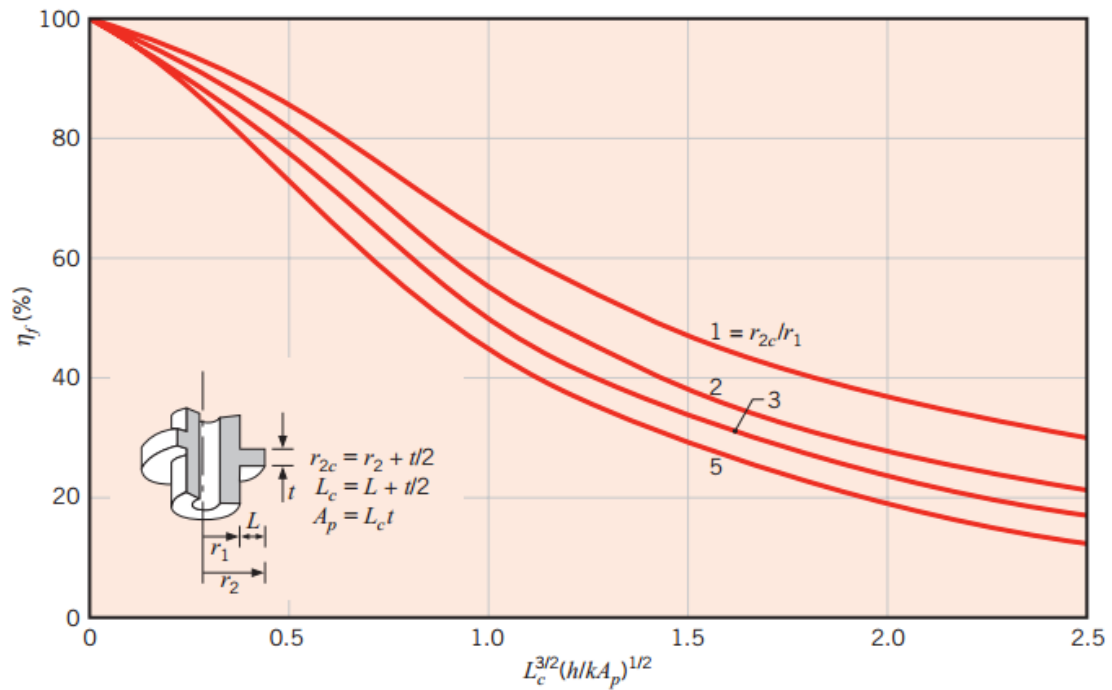


FIGURE 3.20 Efficiency of annular fins of rectangular profile.