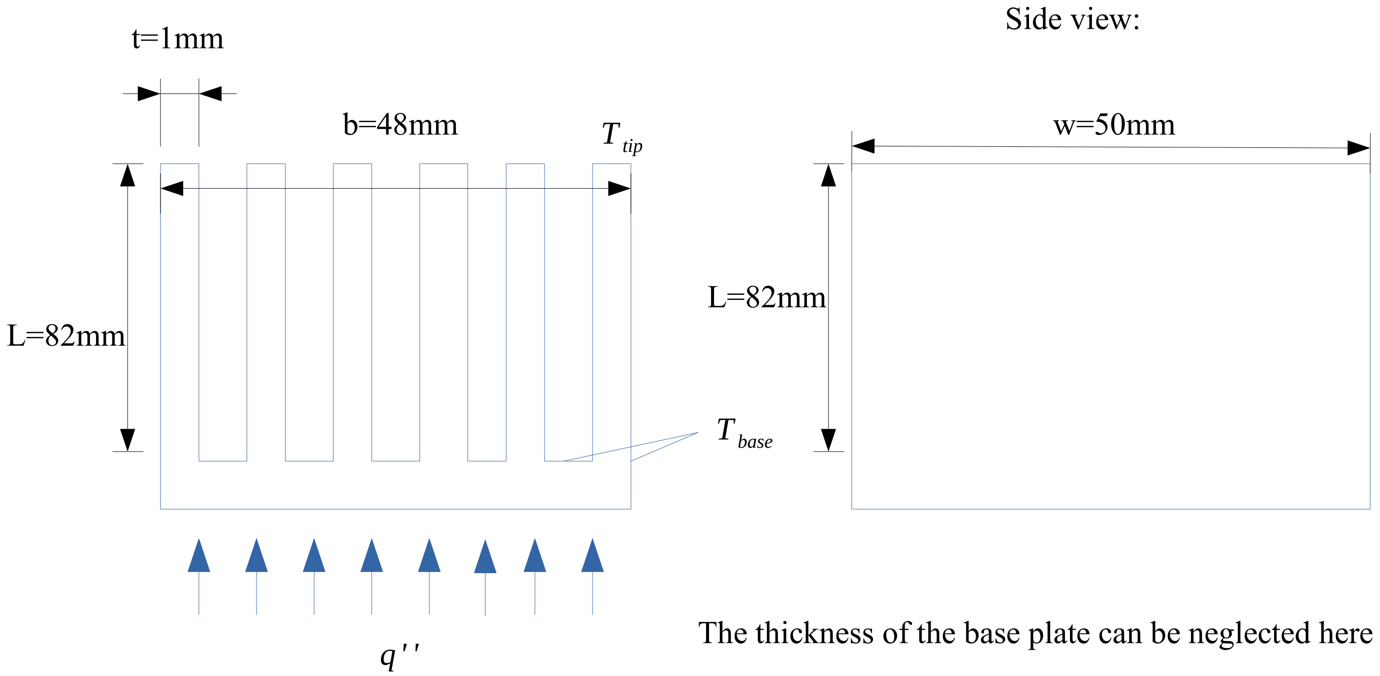
HW2, PP2



We assume a steady state condition, and the convection from the tip may be neglected. Hence, we use adiabatic tip condition. We use the equations in the table:

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: $h\theta(L) = -kd\theta/dx\|_{x=L}$	$\dfrac{\cosh m(L-x) + (h/mk)\sinh m(L-x)}{\cosh mL + (h/mk)\sinh mL}$	(3.70)	$M\dfrac{\sinh mL + (h/mk)\cosh mL}{\cosh mL + (h/mk)\sinh mL}$	(3.72)
B	Adiabatic $d\theta/dx\|_{x=L} = 0$	$\dfrac{\cosh m(L-x)}{\cosh mL}$	(3.75)	$M \tanh mL$	(3.76)
C	Prescribed temperature: $\theta(L) = \theta_L$	$\dfrac{(\theta_L/\theta_b)\sinh mx + \sinh m(L-x)}{\sinh mL}$	(3.77)	$M\dfrac{(\cosh mL - \theta_L/\theta_b)}{\sinh mL}$	(3.78)
D	Infinite fin $(L \to \infty)$: $\theta(L) = 0$	e^{-mx}	(3.79)	M	(3.80)

$\theta \equiv T - T_\infty$ $\quad m^2 \equiv hP/kA_c$

$\theta_b = \theta(0) = T_b - T_\infty$ $\quad M \equiv \sqrt{hPkA_c}\,\theta_b$

Here P is the perimeter of the fin, i.e. P = 2w + 2t

The base temperature can be calculated from the heat balance. The heat balance for this system is:

$$q = Nq_f + hA_{gaps}(T_b - T_{inf}) = 24\,W$$

The fin efficiency means how much heat is transferred by the fin compared to a situation where the fin would be at the base temperature everywhere, i.e

$$eff = q_f/(hA_f(T_b - T_{inf}))$$

The fin effectiveness means how much heat is transferred by the fin compared to a situation where there are no extended surfaces, i.e.

$$e = q_f/(hA_{base}(T_b - T_{inf}))$$

The tip temperature is calculated using the equations in the provided table