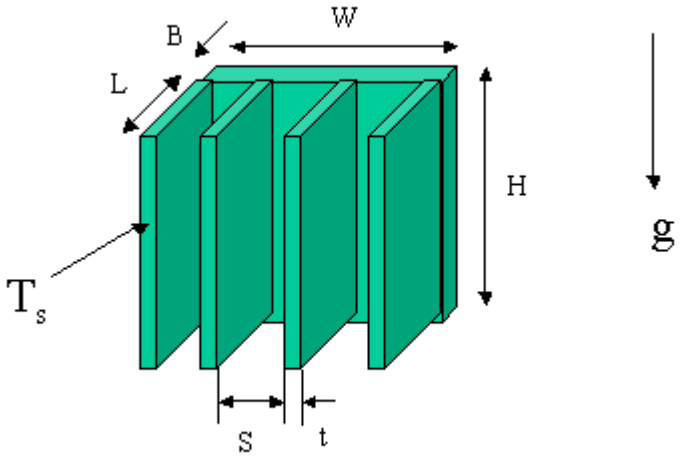
Optimum Spacing of Fins of a Heat Sink in Natural Convention

We know that increasing the contact surface between a heat source and the ambient will increase the rate of heat transfer. Heat sinks are popular tools for extending the heat transfer surface. However, if the fins are packed too closely the flow through them will be significantly reduced and therefore the heat transfer coefficient will decrease. We are interested in finding an optimum spacing for the fins in such a situation depicted below:



Extruded Heat Sink Configuration

Bar-Cohen and Rohsenow have found that if the fin thickness is small relative to the fin spacing, the following equation can be used for estimating the optimum spacing and the optimum heat transfer from a heat sink in natural convection:

$$S_{opt} = 2.714 \frac{H}{Ra^{1/4}}$$

where

$$Ra = \frac{g.\beta.(T_s - T_\infty).\rho^2.H^3}{\mu^2}.\Pr$$

$$\bar{h} = 1.31 \frac{k}{S_{opt}}$$

and

$$\dot{Q} = \bar{h}.(2nLH).(T_s - T_\infty)$$

where

$$n = \frac{W}{(S+t)}$$