MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE GWALIOR

Department of Mechanical Engineering

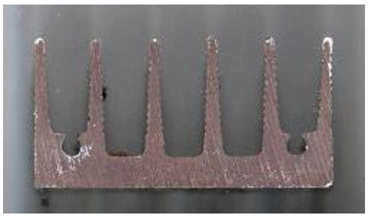
REPORT OF SKILL BASED MINI PROJECT

Heat and Mass Transfer (120513)

Title of Project: Fins or extended surfaces

Introduction: In this course we have learnt about analysis of a fin, types of fins, steady state heat flow equation, fin efficiency, fin effectiveness.

Description of Model



What is a fin?

Fins are surfaces that extend from an object to increase the rate of heat transfer to or from the environment by increasing convection.

Applications of a fin

Fins are most commonly used in heat exchanger devices such as radiator in cars, computer CPU heat sinks, and heat exchangers in power plants.

Pin efficiency: -

$$\eta_{fin} = \frac{Q_{Actual} \text{ (Actual heat transfer)}}{Q_{max} \text{ (Maximum heat transferred when the whole fin is at base temperature)}}$$

Heat transfer through a fin: -

- **<u>CASE 01</u>**
  INFINITELY LONG FIN

Infinitely Long Fin ($T_{fin\ tip}=T$)

- For a sufficiently long fin the temperature at the fin tip approaches the ambient temperature

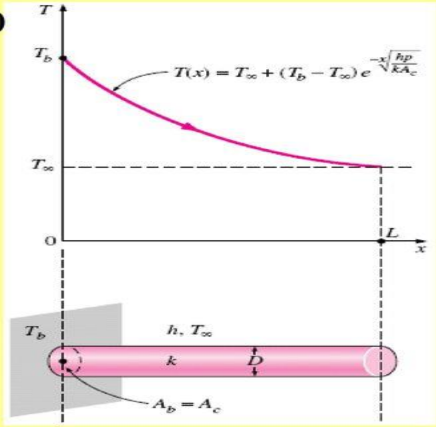
Boundary condition: $\theta(L\rightarrow\infty)=T(L)-T_\infty=0$

- When $x\rightarrow\infty$ so does $e^{mx}\rightarrow\infty$ ⇒ $C_1=0$
- @ $x=0$: $e^{mx}=1$ ⇒ $C_2=\theta_b$
- The temperature distribution:

$$\frac{T(x)-T_\infty}{T_b-T_\infty}=e^{-mx}=e^{-x\sqrt{hp/kA_c}} \qquad (3\text{-}60)$$

- *heat transfer* from the entire fin

$$\dot{Q}=-kA_c\left.\frac{dT}{dx}\right|_{x=0}=\sqrt{hpkA_c}\,(T_b-T_\infty) \qquad (3\text{-}61)$$



- **CASE 02**
  SHORT FIN WITH INSULATED TIP

Adiabatic Tip

- Boundary condition at fin tip:

$$\left.\frac{d\theta}{dx}\right|_{x=L}=0 \qquad (3\text{-}63)$$

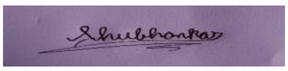
- After some manipulations, the temperature distribution:

$$\frac{T(x)-T_\infty}{T_b-T_\infty}=\frac{\cosh m(L-x)}{\cosh mL} \qquad (3\text{-}64)$$

- *heat transfer* from the entire fin

$$\dot{Q}=-kA_c\left.\frac{dT}{dx}\right|_{x=0}=\sqrt{hpkA_c}\,(T_b-T_\infty)\tanh mL \qquad (3\text{-}65)$$

SUBMITTED BY:
KUMAR SHUBHANKAR



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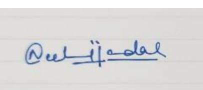

SUBMITTED TO: -

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