Al-Mustaqbal University / College of Technical Engineering
Department of Fuel and Energy Technical Engineering
Class (Third Year)
Subject (Heat Transfer-2) / Code (UOMU0206062)
Lecturer (Asst. Lect. Sameer Saad Raheem)
2nd term – Lecture No. 2 & Lecture Name (Fin Efficiency)

Fin Efficiency

The temperature of a fin drops along the fin, and thus the heat transfer from the fin will be less because of the decreasing temperature difference toward the fin tip. To account for the effect of this decrease in temperature on heat transfer, we define fin efficiency as,

تنخفض درجة حرارة الزعنفة على طول الزعنفة، وبالتالي فإن انتقال الحرارة من الزعنفة سيكون أقل بسبب انخفاض فرق درجة الحرارة نحو طرف الزعنفة.

very long fins

$$\eta_f = \frac{Q_f}{Q_{max}} = \frac{\sqrt{hPkA_c}\,\theta_b}{hA_f\theta_b} = \frac{1}{aL}$$

Where A_f is the surface area of the fin .

fins with insulated tips

$$\eta_f = \frac{Q_f}{Q_{max}} = \frac{\sqrt{hPkA_c}\,\theta_b\tanh aL}{hA_f\theta_b} = \frac{\tanh aL}{aL}$$

since **Afin = pL** for fins with constant cross section. The last equation can also be used for fins subjected to convection provided that the fin length L is replaced by the corrected length **Lc**. Fin efficiency relations are developed for fins of various profiles and are plotted,
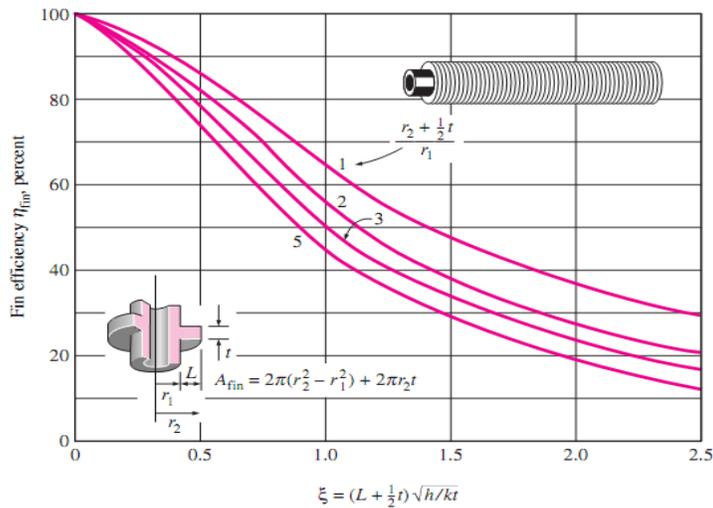
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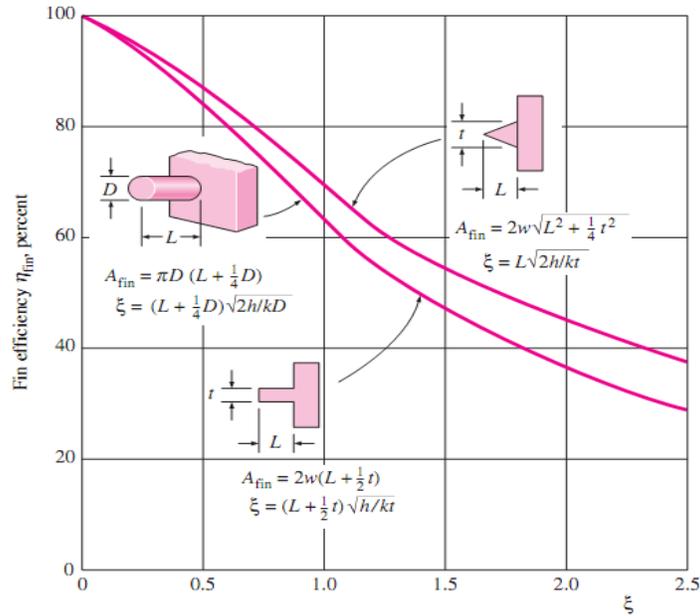
Efficiency of circul

ar, rectangular, and triangular fins on a plain surface of width w

Efficiency of circular fins of length L and constant thickness t

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Fin Effectiveness

The performance of the fins is judged on the basis of the enhancement in heat transfer relative to the no-fin case and is expressed in terms of the fin effectiveness

ε_{fin}, defined as

يتم الحكم على أداء الزعانف على أساس التعزيز في انتقال الحرارة بالنسبة لحالة عدم وجود زعانف، ويعبر عنها بدلالة فعالية الزعنفة.

Factors Affecting Effectiveness(العوامل المؤثرة على الفعالية)

1. Thermal conductivity of the material

2. Surface heat transfer coefficient

3. Fin dimensions (length, thickness, shape)

4. Fin geometry

## Types of Fins Based on Effectiveness: (أنواع الزعانف على أساس الفعالية)

· Long, thin fins → Low effectiveness

· Short, wide fins → High effectiveness

· Fins made of good conductive materials → Higher effectiveness

$$\varepsilon_{fin} = \frac{\dot{Q}_{fin}}{\dot{Q}_{no\ fin}} = \frac{\dot{Q}_{fin}}{hA_b\ (T_b - T_\infty)} = \frac{\text{Heat transfer rate from the fin of } base\ area\ A_b}{\text{Heat transfer rate from the surface of } area\ A_b}$$

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$$\varepsilon_{fin} = \frac{A_{fin}}{A_b} \eta_{fin}$$

Fin efficiency and fin effectiveness are related to each other by,
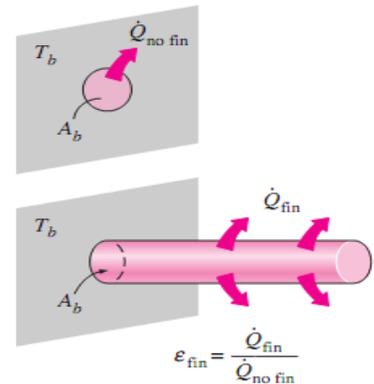
$$\varepsilon_{fin} = \frac{\dot{Q}_{fin}}{\dot{Q}_{no\ fin}}$$

The effectiveness of **a long fin** is determined to be,

$$\varepsilon_{long\ fin} = \frac{\dot{Q}_{fin}}{\dot{Q}_{no\ fin}} = \frac{\sqrt{hpkA_c}\,(T_b - T_\infty)}{hA_b\,(T_b - T_\infty)} = \sqrt{\frac{kp}{hA_c}}$$

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Primary References

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- *Kern, D.Q., Process Heat Transfer, McGraw-Hill.*

Additional Reference

- *Çengel, Y.A. & Ghajar, A.J., Heat and Mass Transfer: Fundamentals and Applications, McGraw-Hill.*