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RESEARCH ARTICLE

A COMPARISON OF HEAT TRANSFER IN FINS WITH DIFFERENT CROSS-SECTIONS.

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Abstract

In machine components where heat is generated, it is necessary to remove residual heat from the chamber in order to prevent the failure caused by thermal stresses. Hence, maximum heat must be dissipated by the component into the atmosphere. Fins are help in achieving such heat transfer between the component and atmosphere. This research paper focuses on the geometrical aspects of fins for which the heat transfer that takes place is maximum. It is assumed that the tips of the fins are insulated.

Introduction:-

Fins are projections of component that help in heat transfer to take place between the control volume and surrounding atmosphere. The heat transfer takes place through conduction (between the walls of component and fins) and convection (heat transfer from fins to atmosphere)[1].
The heat transfer by conduction is given by[2]:

$$Q = \sqrt{hPkA}\,\theta_b \tanh mL$$

where,
Q = heat transfer by conduction
k = thermal conductivity of material
A = cross-sectional area
θ_b *= temperature difference*
L = length of heat travel

$$m = \sqrt{\frac{hP}{kA}}$$

Thermal analysis was carried out on fins with different cross-sections. The cross-sections taken into consideration were:

- Rectangular
- Square
- Circular
- Triangular

For heat transfer to be maximum with length as the variable, the length of fins with circular cross-section is the highest while that with triangular is minimum among the four cross-sections[3]. But when the length is the same in

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all the fins, the results are not the same. Analysis was carried out considering different parameters for different cross-sections.

A. Parameters

1. Rectangular Cross-Section

In thermal analysis of fin with rectangular cross-section, the dimensions taken were as below:
Width = 0.4 m
Thickness = 0.2 m
Length = 1 m

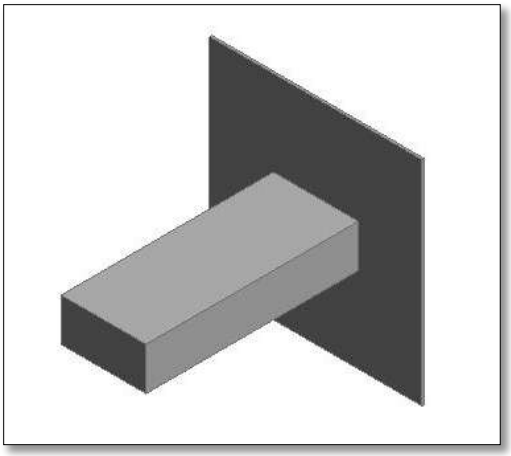

Figure 1:- Fin with rectangular cross-section

2. Square Cross- Section

In thermal analysis of fin with square cross-section, the dimensions taken were as below:
Width = 0.2 m
Thickness = 0.2 m
Length = 1 m

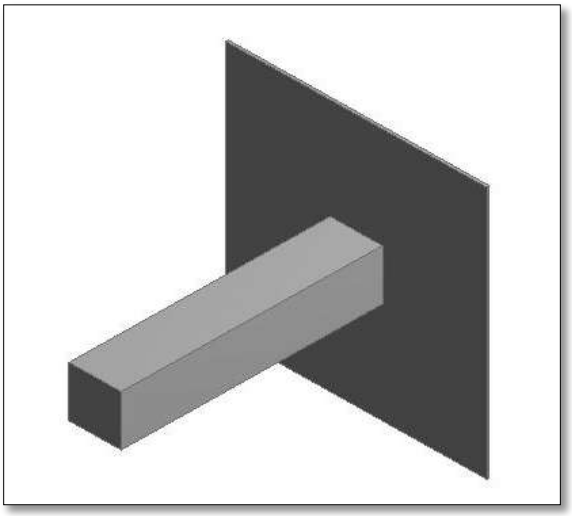

Figure 2:- Fin with rectangular cross-section

3. Circular Cross-Section

In thermal analysis of fin with rectangular cross-section, the dimensions taken were as below:
Diameter = 0.2 m
Length = 1 m

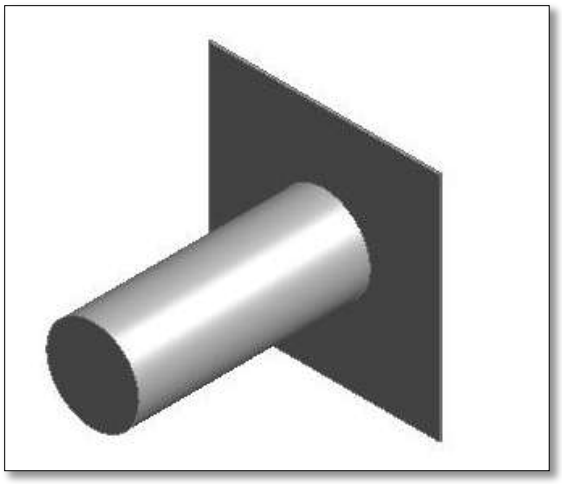

Figure 3:- Fin with circular cross-section

4. Triangular Cross-Section

In thermal analysis of fin with triangular cross-section, the dimensions taken were as below:
Length of each side of cross-section = 0.2 m
Length of fin = 1 m

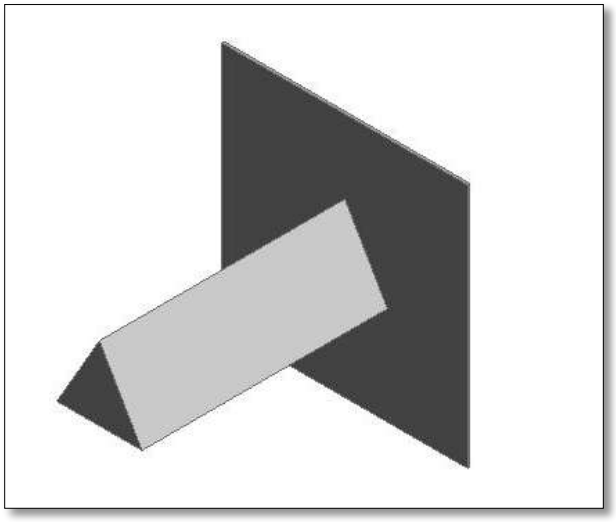

Figure 4:- Fin with triangular cross-section

B. Thermal Analysis on Fins with different cross-sections

Steady-state thermal analysis of fins withdifferent cross sections was carried out, all having the same length of 1000 mm and their tips insulated.
Material considered in analysis was "**aluminium**" whose thermal conductivity is 237.5 W/mK.Film coefficient is assumed to be 11.875 W/m^2K.
The results obtained were noted and plotted in graphical representation:

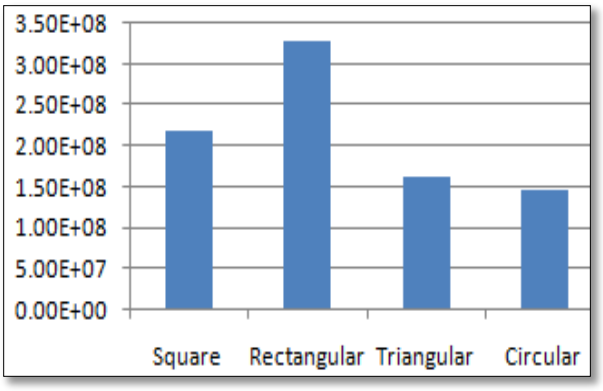

Figure 5:- Graphical representation of Heat Transfer in fins with different cross-sections

As shown in the graph, for a particular length, maximum heat transfer took place fin with rectangular cross-section. It was followed by square cross-section, circular and the minimum occurred in fin with triangular cross-section.

Conclusion:-

From this research paper, it can be concluded that the cross-section of the fins play a huge factor in heat transfer and it becomes an important parameter to choose the proper fin, depending upon the area of interest. For a fixed length, if the heat transfer required should be maximum, rectangular fins are appropriate. However, if the heat transfer taking place should be minimum, circular projections are said to be the better option.

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