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Original Article

Calculation Analysis of Heat Transfer on the Surface of Engine Cylinders with Unequal Size of Material and Expanded Surfaces

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Abstract *- The use of vehicles in daily life for some enterprise and domestic applications has expanded considerably, so the engine cycle running time is exceptionally longer. In this way, due to the continuous movement, a large amount of heat is produced. When this heat is not transmitted properly, the engine becomes brittle very quickly, and the life of the engine is reduced due to the development of heat. To extend the life of the engine, the heat dissipation is expanded by finning the outside of the engine room. The texture of the fin and the material used for the fin increase its heat dissipation capacity and increase cooling for proper operation of the engine. Current work 2 - Focuses on the design of circular and tapered wings for the engine. The temperature distribution and heat dissipation on the end surface of the two shapes were observed by steady-state thermal analysis. Alusil and silumin were selected as fin materials, and computational evaluation was also performed using FEM. Based on the results of the FEM examination and the comparison of the current size and material of the fin with the appropriate material, the optimal shape of the fin is selected.*

Keywords – *FEM, fin effectiveness, fin efficiency, Temperature distribution, Thermal analysis.*

I. INTRODUCTION

An engine is a gadget that converts one type of life force into another. A heat engine is a device that converts the life force of fuel into thermal energy and uses this thermal energy for auxiliary work. Heat engines can be broadly classified as a) internal combustion engines b) external burning engines. In terms of the number of strokes, the engine can be assigned to i) two-stroke engines ii) four-stroke engines. In both stroke engines, the cycle ends with a reversal of the driving rod [2-3]. Ports are available on both stroke engines and are used on bikes and cruisers.

A. Air cooling using fans

Engine cycle running times are increasing due to the huge expansion in-vehicle usage, which has greatly expanded for some businesses and everyday life home applications. Due to this ignition, a parcel of heat is created - half of the engine heat is sent as waste gases during smoke ****** while at the same time a large amount of heat is released inside the engine, which becomes more brittle very quickly if the engine is not emptied and the engine life is reduced due to heat dissipation. To manage this heating problem, the cooling framework will probably be the most important element [1–4]. Most of the cutting edge inside the burning engine cools the fluid, which adds more weight and extra cost by sending such a framework to the most surprising framework and bike engine method. To reduce costs, a basic yet efficient framework is used on the bike, called an air-cooled framework. Figure 1.

To make the air cooling more efficient, both the engine chamber and the head are protected with metal wings for further cooling. The air-cooled engine follows the basic device of direct movement of air over the engine to remove heat from the engine body. To make this cooling process faster and more efficient, the engine body is expanded using metal wings that create a surface area. The faster surface area helps to achieve better air contact on the incoming engine, which brings a better heat dissipation rate. Specifically, the convection generates heat flow from the engine room and travels up to the metal wings [5–6]. When the bike starts rolling, naturally cold air goes over the engine wings and transmits heat through a direct convection process.

To reduce heat dissipation, the engine is packed using aluminum or carbon steel. Aluminum wings are used for forward-thinking ordinary bike engines. The use of composite materials provides another measure of engine cooling with a much greater effect on heat dissipation [10-12]. There will be the effect of fin Improved by the following factors:

The contact area, circumference, thermal conductivity and heat transfer coefficient must be greater than unity. Figure 2. Use of materials with high thermal conductivity.

An increase in the ratio of the contact area from the edge. Pulkit Sagar et al. [7] reduce heat transfer by changing the shape of the wings and the hardness of the surface. The model was created by the blade size and stiffness of the jumps. By changing the geometry, bikes and other engine-powered vehicles also have the effect of radiating heat through the blades. Raviullah et al. [8] researched the healing properties of engines by changing the material geometry of the chamber fin. When fin blades operate with enormous temperature differences between the base and the enveloping liquid, the effect of the temperature-subordinate thermal conductivity of the fin material must be borne in mind to investigate whether its thermal performance is correct. Rated from. Mohsin A. Ali 1 et al. [9] attempted to isolate the effects of thermal diffusion velocity from blade surfaces using CFDs for different sizes and wing geometry. In this work, the blade geometry was changed to improve the heat transfer rate at different speeds. N. Fani Raja Rao et al. Temporary thermal testing determines the temperature and other thermal quantities that change after some time. The analysis was carried out by disassembling the chamber fin using aluminum alloy material A204 and additionally using a mixture of high thermally conductive aluminum amal-6061 and magnesium.

Current work deals with the design of engine models with circular and tapered wings. Current models of engines with rectangular wings were also designed. The wings have been shown solely to give a sense of proportion. The wings have been shown solely to give a sense of proportion. Let's focus on FEM results

a) Types of wings

Using compounds with high thermal conductivity on the perimeter effect on the contact area and the heat dissipation capacity of the wings.

2 engine model design

Current design

The rectangular winged engine cylinder is designed using CATIA, as shown in Figure 3. Cylinder and fan dimensions are measured with a Honda Shine engine. The characteristics of the engine on which the measurements are measured are given in Table 1 below.

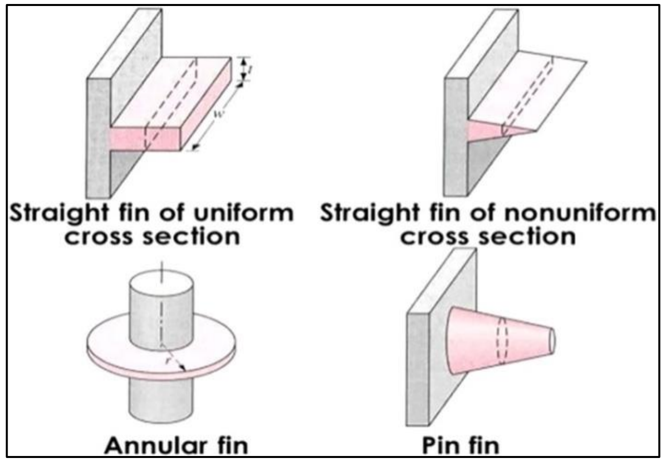

Fig. 1 Engine model with the taper and circular fin

One of the factors influencing the Finn effect is the increase in the ratio of the contact area to the perimeter. The engine was redesigned with the taper and circular shaped wings to study the effect of the ratio of the contact area to the cylinder circumference. 3D models of these designs are shown in Figure 4, as shown below

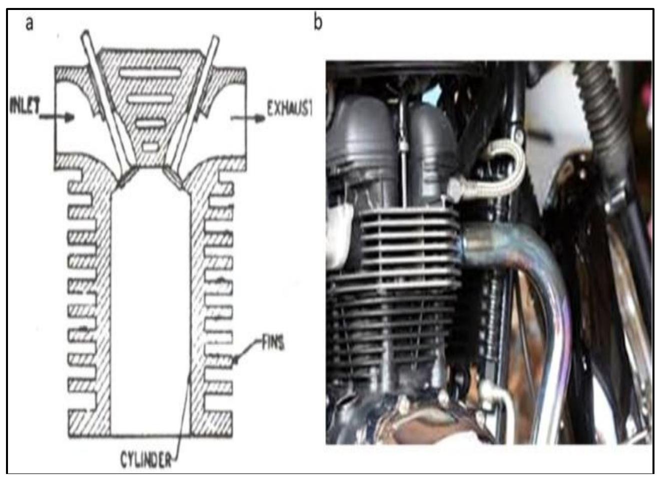

Fig. 2 Internal Combustion engine (a) schematic view; (b) real image

Table 1. Engine specification

Parameter	**Value**
Engine type air-cooled	4 stroke, BS-VI engine
Displacement	124 cc
Maximum power	10.74 PS 7500 rpm
Maximum torque	11 Nm 6000 rpm
Number of cylinders	1
The cooling system	air-cooled
Compression ratio	10.0: 1
Stroke	63.1 mm
Bore	50 mm

Table 2. Properties of aluminum

Parameter	Value
Youngs Modulus	80 Gpa
Poison ratio	0.33
Density	2770 kg / m^3
Thermal expansion	23 10_6_K
Thermal Specific heat	87.5 J / kg K
Thermal conductivity	204.2W / mK

Table 3. Properties of silumin and alusil

Parameter	Value
Youngs Modulus	85Gpa to 100Gpa
Poison ratio	0.34 0.34
Density	2730 kg/m^3 to 2760 kg/m^3
Thermal expansion	19 10_6.K to 19 10_6 K
Thermal Specific heat	1451 J/kgK
Thermal conductivity	175W/mK to 180W/mK

Table 4. Input parameter

Parameter	Value
Engine cylinder temperature	750º C
Ambient temperature	35 º C
Heat transfer coefficient	20 / m^{2}K

B. Existing material

Current models of rectangular winged engine cylinders are assigned with the characteristics of aluminum. The structural and thermal properties of aluminum are given in Table 2 below.

C. New Material Selection

The strength and physical properties of all metals are higher when their composition is combined with other (or) higher amounts of other materials. Therefore, when aluminum is mixed with silica, its properties improve. As the silica composition changes with the aluminum composition, aluminum alloys are formed. The use of materials with high conductivity also enhances the effect of the wings. Aluminum alloys containing silica have a higher thermal conductivity than pure aluminum. In this case, two aluminum alloys: silumin (80.2% Al; 10% Si); Alusil (75% Al; 20% Si), is assigned to the feathers. The structural and thermal properties of silumin and allocil are given in Table 3 below. To enrich aluminum alloys, a process consisting of the following three steps is required (a) heating the alloy to extreme eutectic temperatures; (B) cooling and (c) aging hardening.

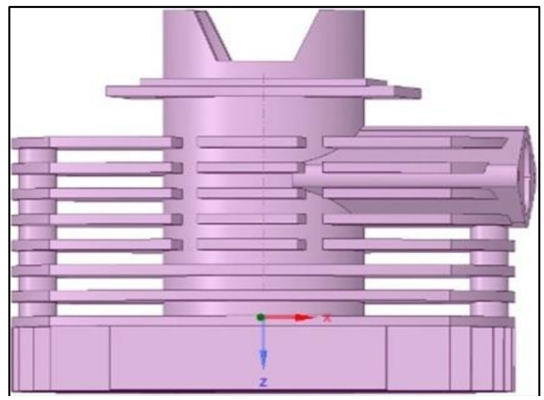

Fig. 3D model of an engine cylinder with fins

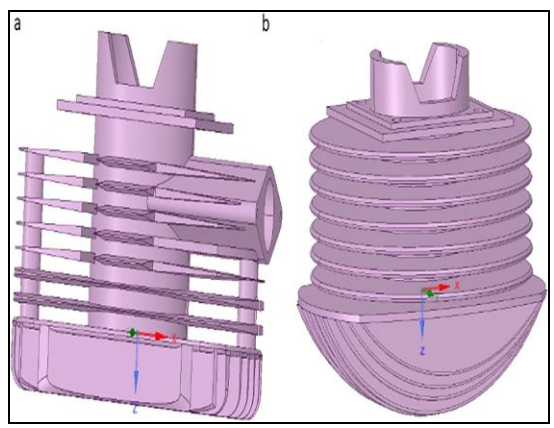

Fig. 4 3D model of engine (a) taper fins; (b) circular fins

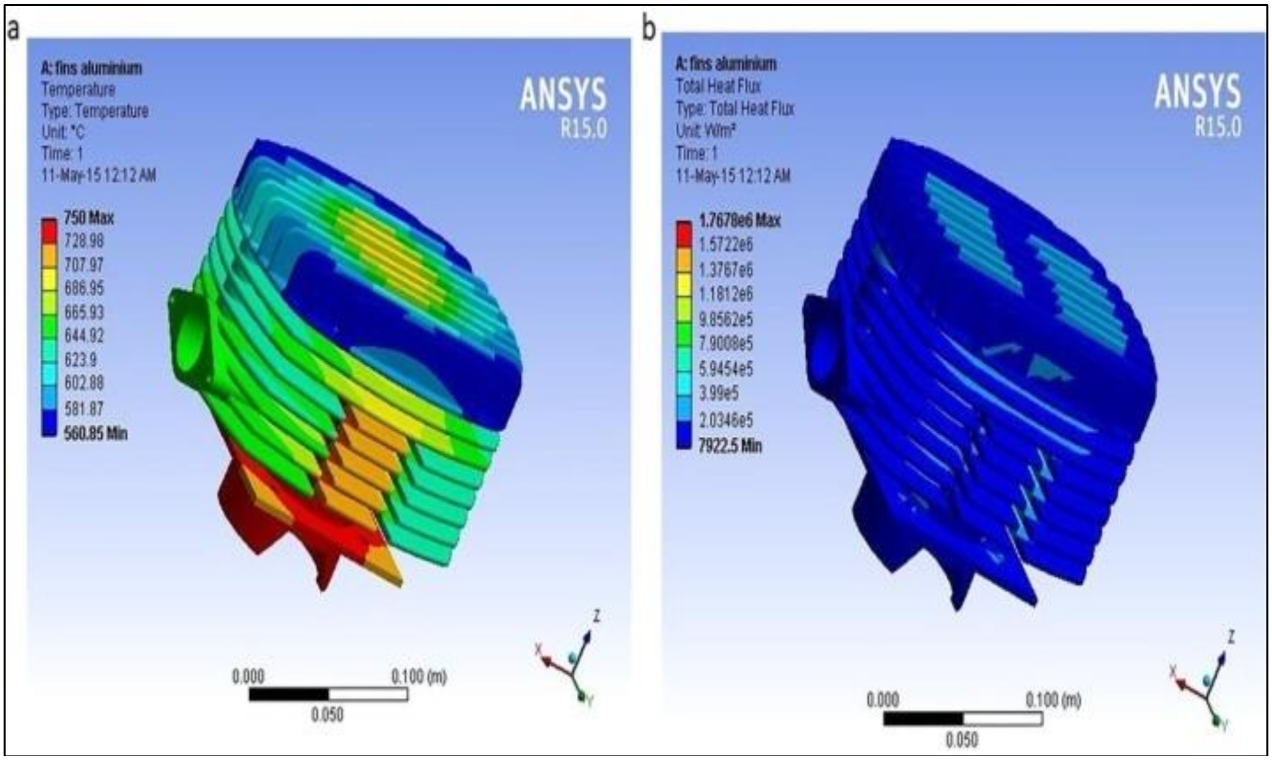

Fig. 5 Existing Model (a) Temperature distribution; (b) Heat flux

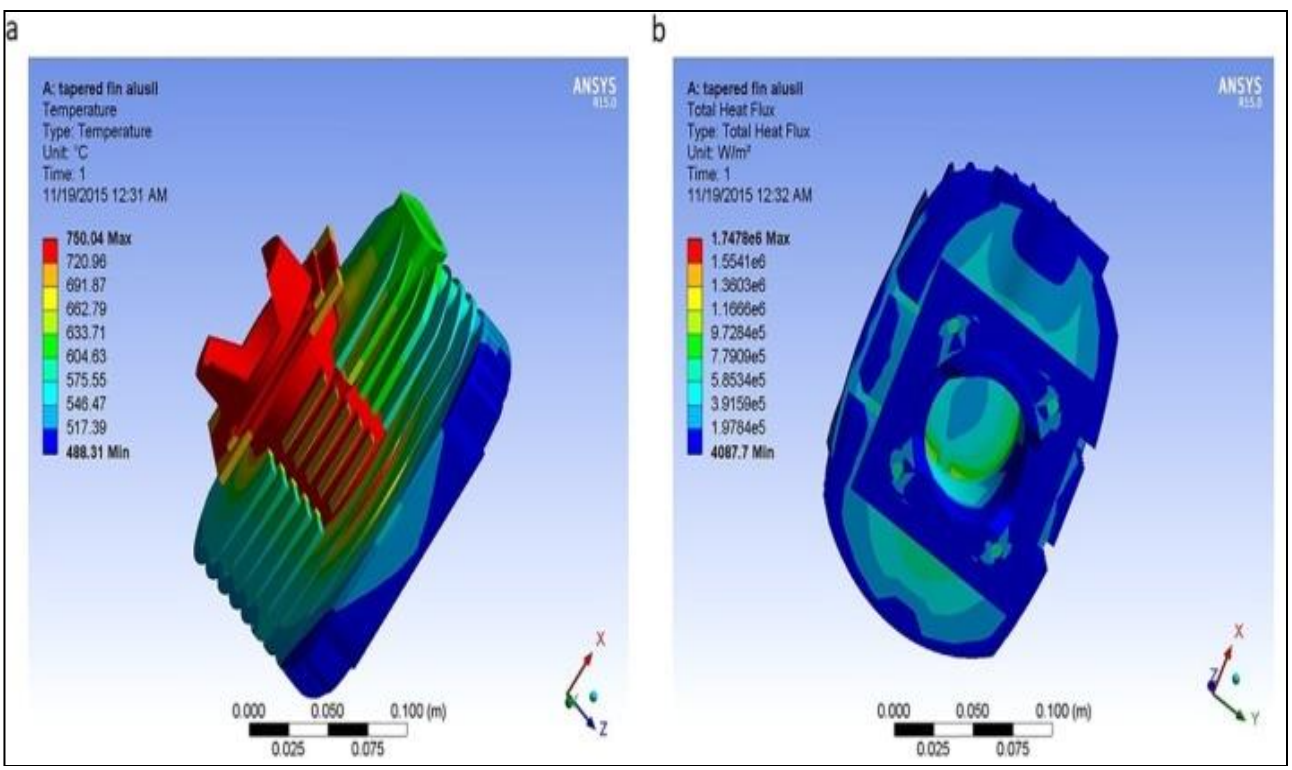

Fig. 6 Taper fins with silumin (a) Temperature distribution; (b) Heat flux.

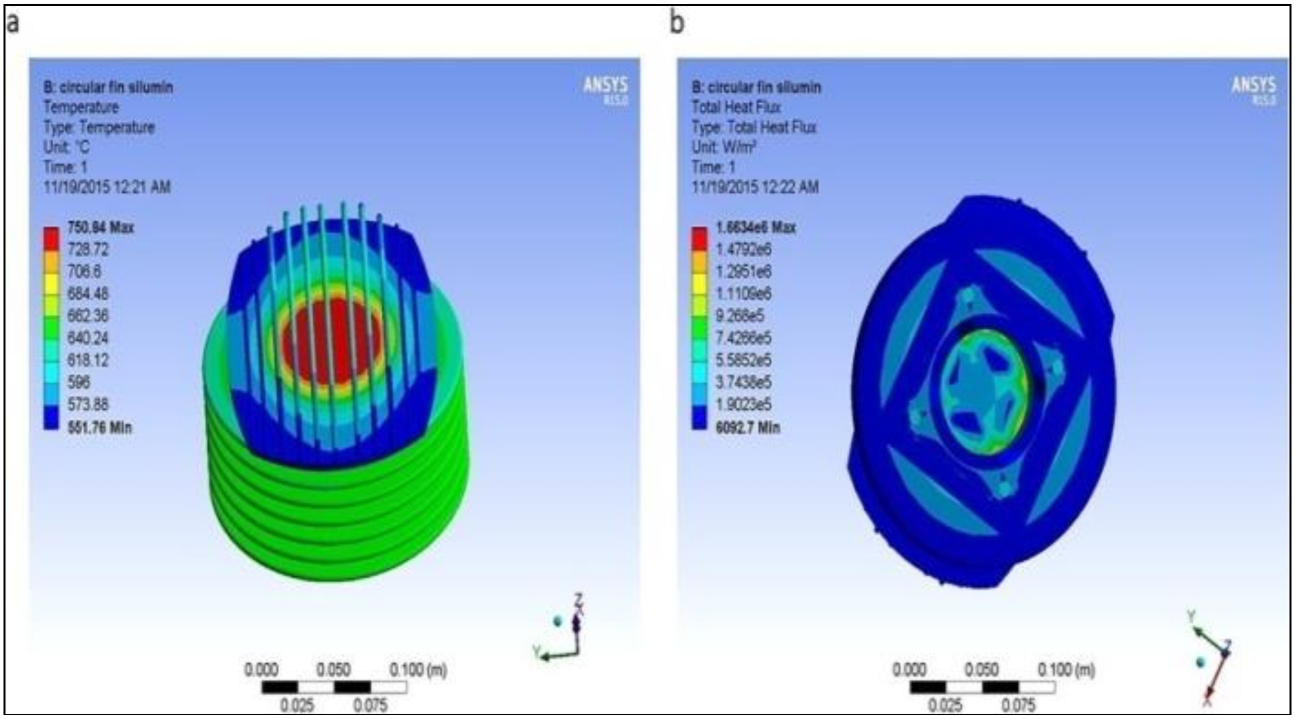

Fig. 7 Taper fins with alusil (a) Temperature distribution; (b) Heat flux

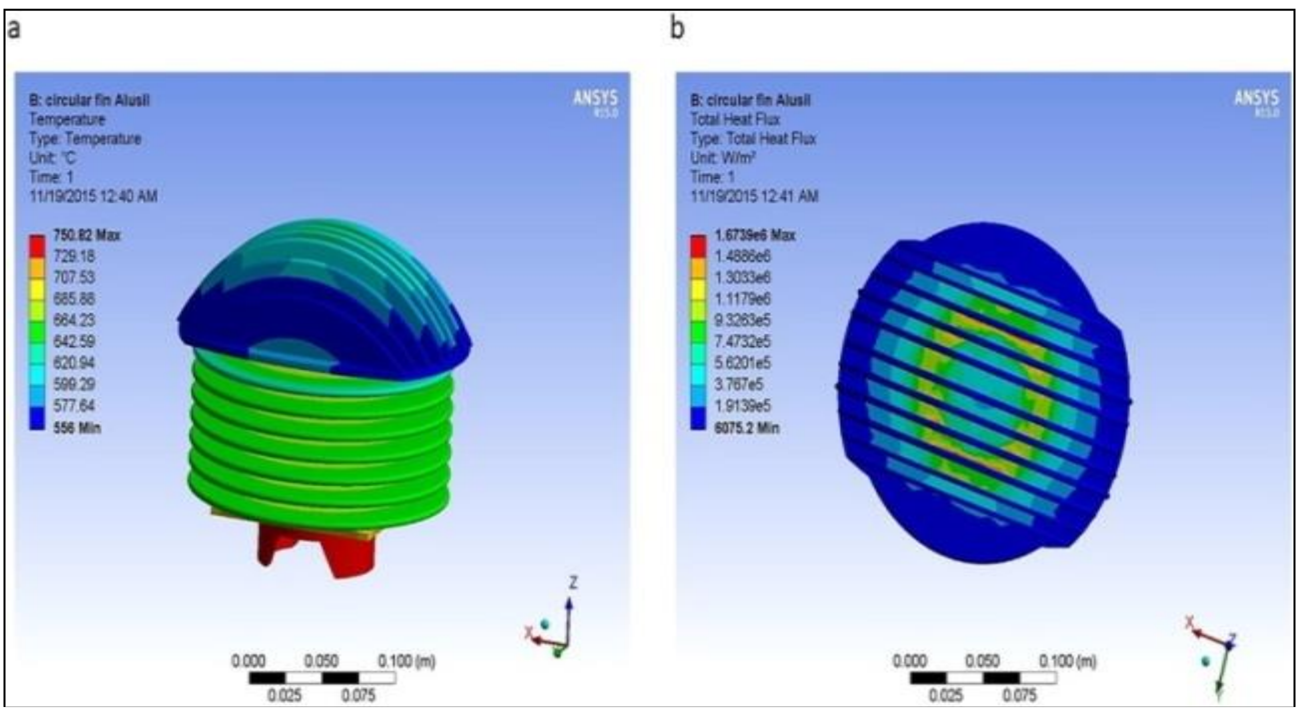

Fig. 8 Circular fins with silumin (a) Temperature distribution; (b) Heat flux

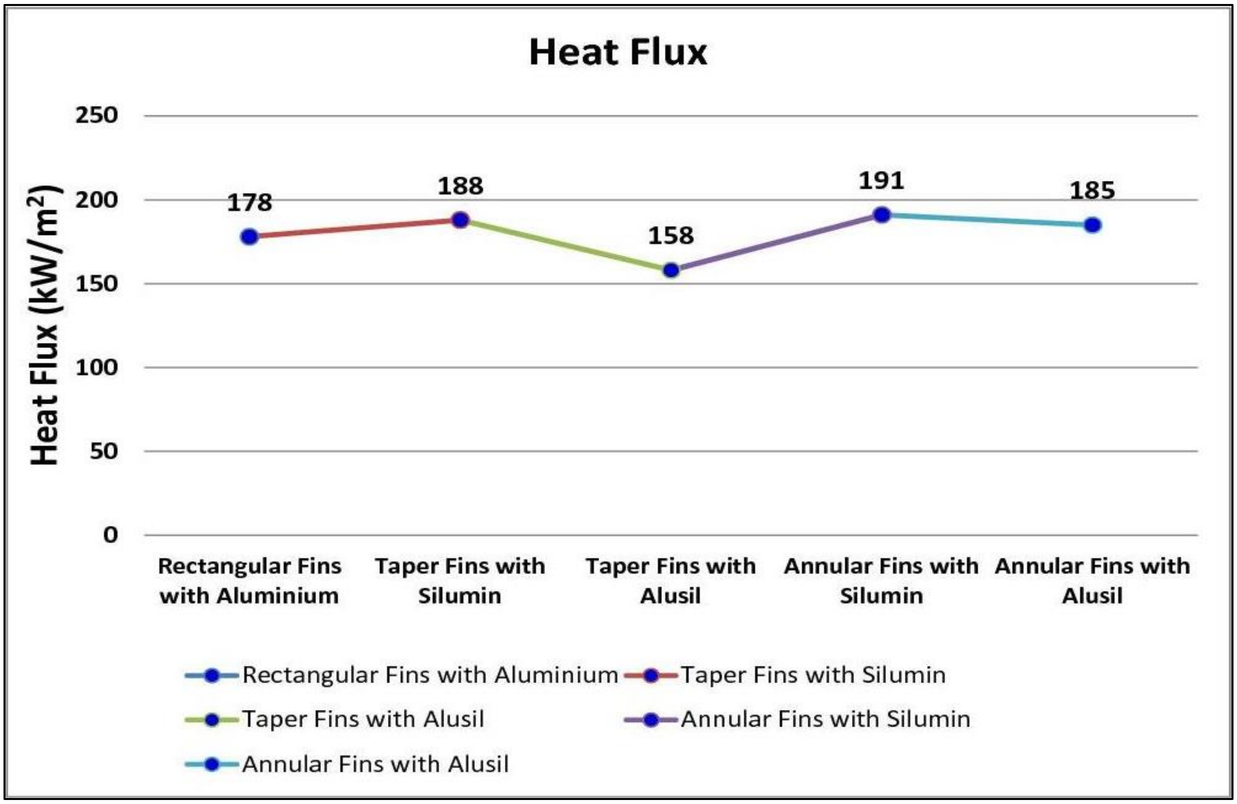

Fig. 9 Circular fins with Alusil (a) Temperature distribution; (b) Heat flux

II. RESULTS & DISCUSSION

The above material properties are assigned to the fins of the engine, and the FEM analysis is carried out based on the input parameters such as temperature at the engine core (or) inside engine cylinder surface, Ambient temperature around the fin surface and the heat transfer coefficient whose values are shown in below Table 4. As the combustion takes place inside the engine cylinder, the temperature inside the surface will be the maximum. As the engine is air-cooled by the extended surfaces, convection plays a vital role.

The results of FEM analysis for the existing and proposed design models have been depicted as images in the following subheadings. FEM results of an existing design with Aluminum

The temperature distribution and the heat transferred per unit area of the engine cylinder with the aluminum fin of the rectangular cross-section has been shown in above Fig.5. The analytical results show that a maximum temperature of 750°C was recorded at the engine cylinder head, and a minimum temperature of 560 °C was recorded at the fin tip. The heat transfer is maximum at the base of the cylinder, and it was recorded as 1.7 106 W/m2. At the surface of the fin, it dissipates, and the heat flux was 7922 W/m2.

A. FEM results of taper fins with silumin

Fig. 6 depicts the change of temperature and heat flux at different locations of an engine cylinder with taper fins of Silumin material. The maximum and the minimum temperature at the cylinder surface and the fin surface were 750 °C and 483 °C respectively. The heat dissipation from the engine cylinder to the fin tip was 1.7 × 106 to 4014 W/m2.

B. FEM results of taper fins with Alusil

The temperature distribution and the heat transferred per unit area of the engine cylinder with Alusil fin of taper cross-section has been shown in the above Fig. 7. The analytical results show that a maximum temperature of 750 °C was recorded at the engine

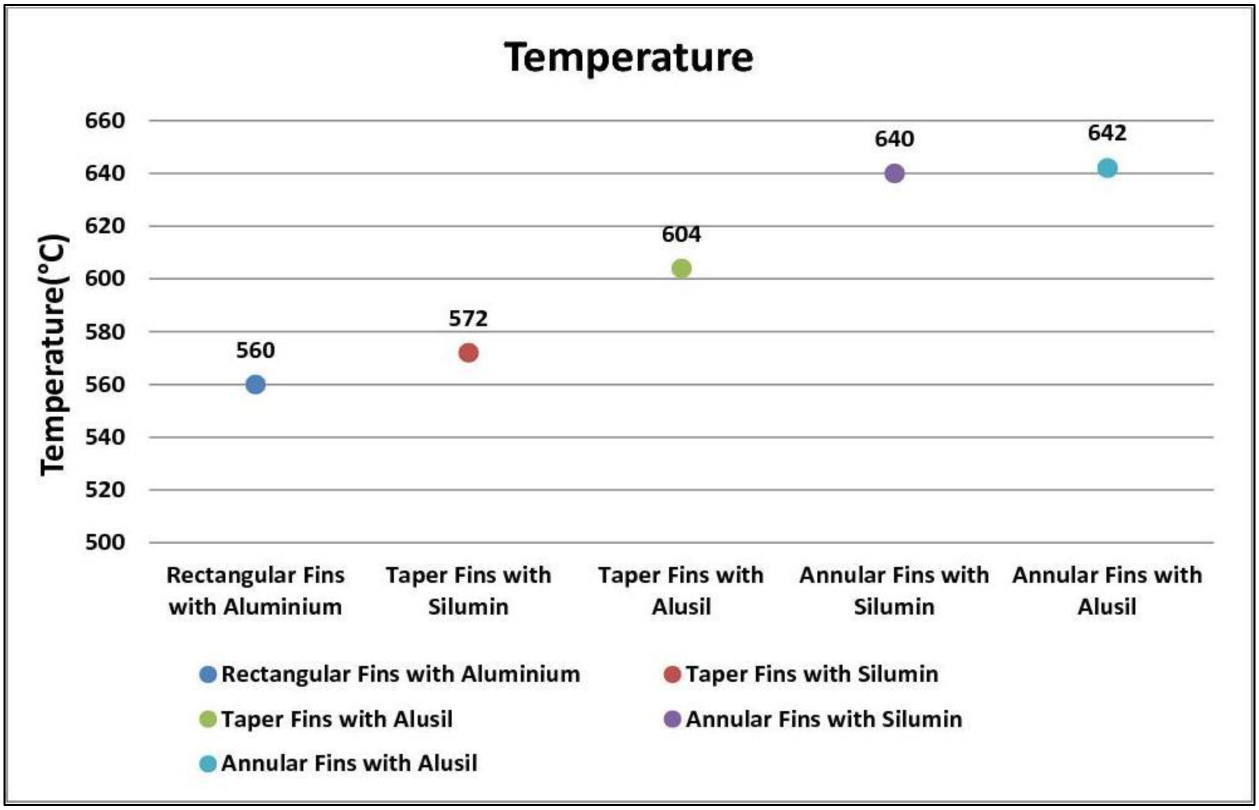

Fig. 10 Heat flux Vs. Fin Models

C. FEM results of spherical wings with silumin

Fig. 8 shows the change in temperature and heat flux at different locations of the engine cylinder with spherical wings of silumin material. The maximum and minimum temperatures at the cylinder surface and end surfaces are 750 C and 551 C, respectively. Heat dissipation from engine cylinder to fin tip is 1.7 106 to 6100 W / m2.

D. FEM results of circular wings with elusil

The heat distribution and heat transferred to the unit area of the engine cylinder with the alucil fin of the annular cross-section are shown in Figure 9 above. Show analytical results

The maximum engine temperature was recorded at 750 C

The cylinder head at the fin tip and the minimum temperature recorded was 568 C. The heat transfer is maximal at the base of the cylinder and is recorded as 1.7 106 W / m2, and at the surface of the fin, it is dissipated, and the heat flux is 6076 W / m2. Comparison of heat flux and temperature with fan size and material

The heat flux values at the fin surface and the temperature at the fin tip obtained from FEM analysis were compared between the wings of different shapes and materials. Fig. 10 and 11

As a graph showing the variation of heat flux with the shape and material of the fin. The values are tabulated in Table 5 below.

The graph shown in Figure10 shows that the engine transfers heat from the cylinder to the final surface at a rate of 1.91 105 W/m^2 compared to the rectangular and tapered wings. The annular fin with silumin material shows higher heat transfer than the annular fin with alloysil material.

The variation of temperature at the tip of the fin is graphed with the Fin model as shown in Fin 11. Notice the annular wings showing

The mum temperature at the fin tip is 640° C compared to other fin models

The end Engine models with different cross-sections such as rectangular, taper and annual are designed using Katia. The engine model with rectangular wings made of aluminum was evaluated by FEM. Engine cylinders with tappers and circular wings made of silumine and allocil were also analyzed. The temperature distribution results and the observed heat flux from the FEM indicate that the annular wings made of aloesil material can rapidly increase heat transfer from the engine cylinders to the atmosphere. The annulus-shaped fin engine cylinder made with Alusil has proven to be a superior material to reduce engine brittleness and increase its lifespan.

III. STATEMENT OF COMPETITIVE INTEREST

The authors state that they have no competing financial interests or personal relationships that appear to affect the work reported in this paper.

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