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Design and Thermal Analysis of Fins

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ABSTRACT

One of the primary automotive components susceptible to severe temperature fluctuations and thermal stresses is the engine cylinder. A number of approaches may be used to represent the heat transfer processes in an internal combustion engine. From basic heat networks to multidimensional differential equation modeling, these approaches are available. Heat is generated during the combustion of fuel in an engine and Friction between the moving components produces additional heat. An air-cooled I.C. engine dissipates heat into the atmosphere by forced convection; fins on the cylinder's outer side assist in this process. The heat transfer rate is affected by vehicle velocity, fin design, and ambient temperature. Inadequate heat removal from the engine will result in excessive thermal stresses and reduced engine efficiency.Fins are another component that is utilized to remove heat from the engine to cool it. It is more useful to know the heat dissipation inside the cylinder for thermal analysis of engine cylinder fins. We know that increasing the surface area increases the rate of heat dissipation, thus designing such a huge complicated engine is quite complicated.In this research, we analyzed The heat transfer performance of an internal combustion engine by designing the fin and altering the thickness and material of the fins. The materials used in this analysis are aluminum 92 and 96%, stainless steel The primary goal of this work is to increase the heat transfer rate of cooling fins by modifying the thickness and material of the cylinder fins. That is why the analysis of fin is important to increase the heat transfer rate. The components are designed by using Unigraphics (nx CAD) and analysis is done by ANSYS. Presently Material used for manufacturing the fin body is Cast Iron. In this thesis, it is replaced by aluminum 92 and 96, stainless steel. Utilizing a finite element software ANSYS to analysis the materials

1.INTRODUCTION:

An Internal Combustion Engine (ICE) is a heat engine where the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine the expansion of the high temperature and high pressure gases produced by combustion apply direct force to some component of the engine. This force moves the component over a distance, transforming chemical energy into useful mechanical energy. A cylinder is the central working part of a reciprocating engine or pump, the space in which a piston travels. Multiple cylinders are commonly arranged side by side in a bank, or engine block, which is typically cast from aluminum or cast iron before receiving precision machine work.

In an I.C. engine, the temperature of the gases inside the engine cylinder may vary from 35^0C or less to as high as 2750^0C during the cycle. If an engine is allowed to run without external cooling, the cylinder walls, cylinder and pistons will tend to assume the average temperature of the gases to which they are exposed, which may be of the order of 1000 to 1500^0C. Obviously at such high temperature; the metals will lose their characteristics and piston will expand considerably and sieve the liner. Fins are set on the surface of the cylinder to improve the quantity of heat exchange by convection. When fuel is burned in an engine, heat is produced. Additional heat is also generated by friction between the moving parts. In air-cooled I.C engine, extended surfaces called fins are provided at the periphery of engine cylinder to increase heat transfer rate. That is why the analysis of fin is important to increase the heat transfer rate.

2. EXPERIMENTAL PROCEDURE:

1. **BUILD GEOMETRY**
2. **DEFINE MATERIAL PROPERTIES**
3. **GENERATE MESH**

3 BOUNDARY CONDITIONS

1. **OBTAIN SOLUTION**

4. CREATING 3D MODEL.

Construct a two or three dimensional representation of the object to be modeled and tested using the work plane coordinate system within ANSYS.

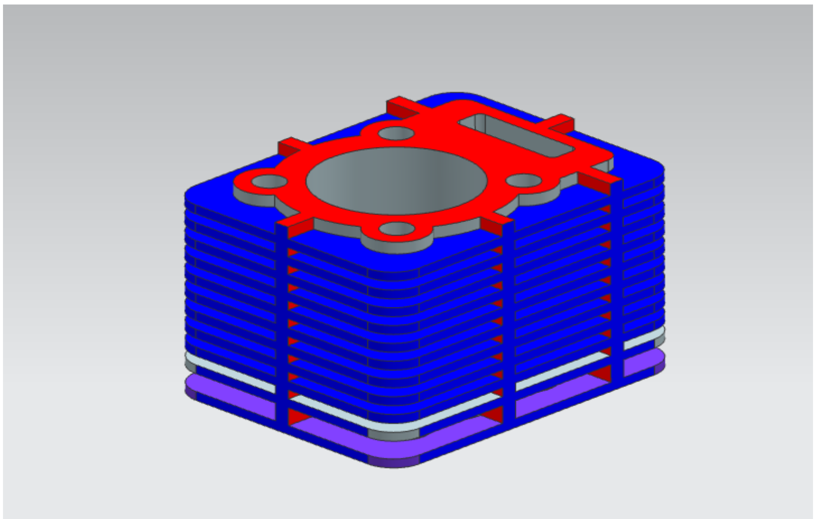


Figure .1 3-d model of enginge.

3-D dimensional views of the model

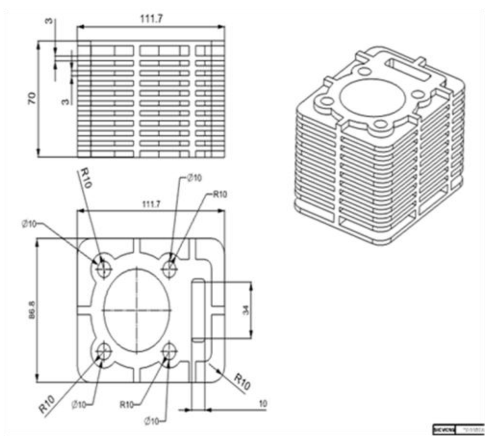


Fig.2. Fins with 3mm thickness

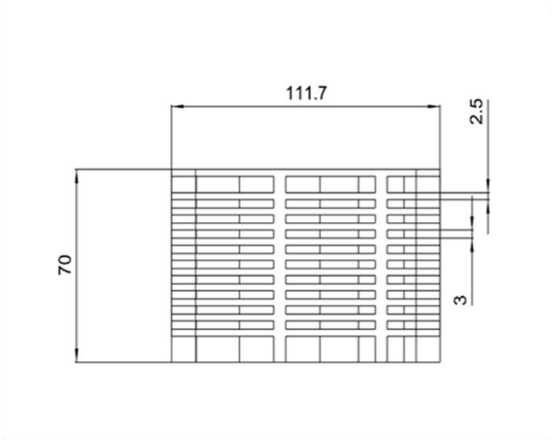


Fig.3. Fins with 2.5 mm thickness

5. DEFINE MATERIAL PROPERTIES

Now that the part exists, define a library of the necessary materials that compose the object (or project) being modeled. This includes thermal and mechanical properties.

S.NO	MATERIAL
1	CAST IRON
2	ALUMINIUM 92%
3	ALUMINIUM 96%
4	STAINLESS STEEL

6. GENERATE MESH

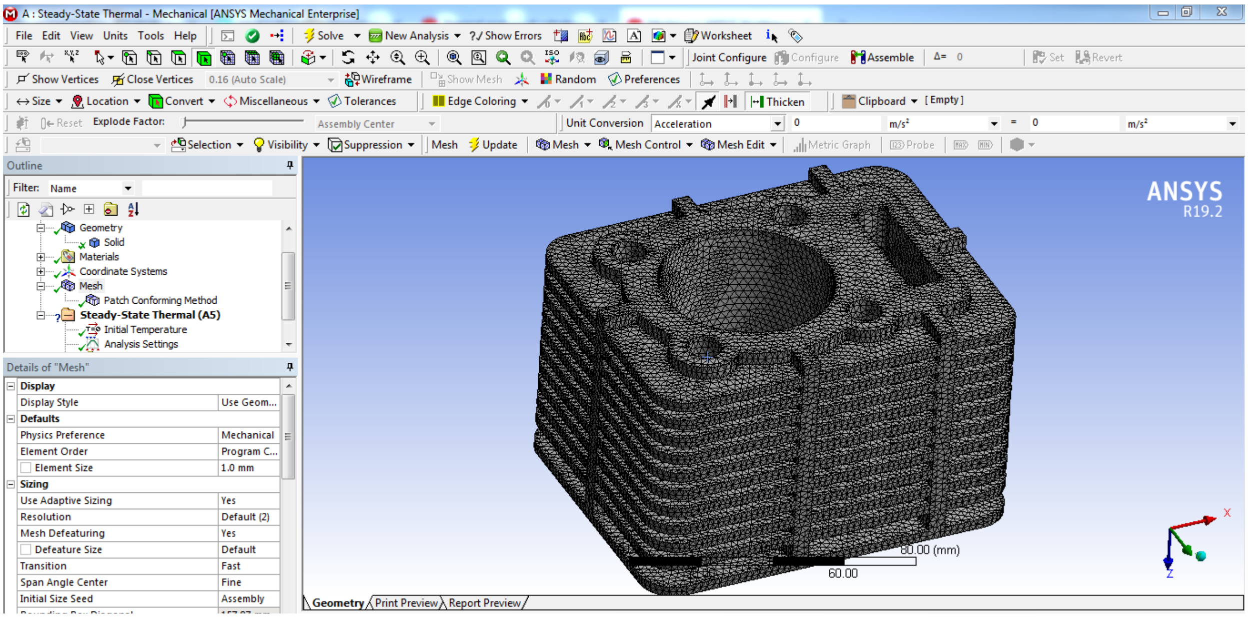


Figure 4 :Ansys workbench 3-d model after mesh

7.BOUNDARY CONDITIONS

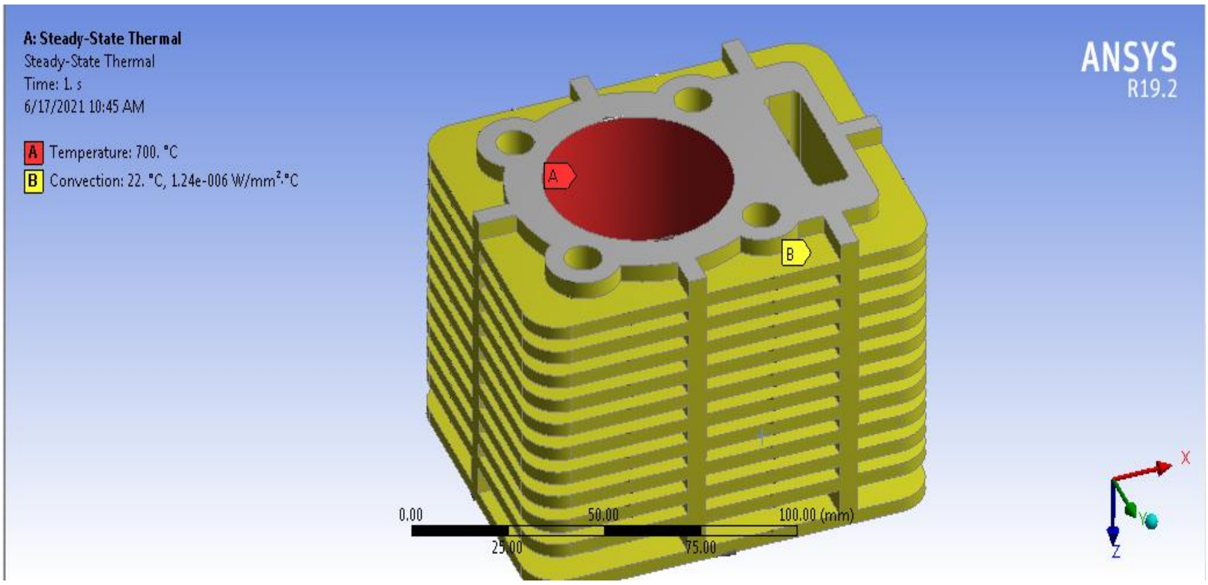


Figure 5.: Boundary conditionson 3-d part

8. OBTAIN SOLUTION

This is actually a step, because ANSYS needs to understand within what state (steady state, transient... etc.) the problem must be solved

The analysis results comparassion

1. CAST IRON

Cast Iron with Varyig Thickness of Fins

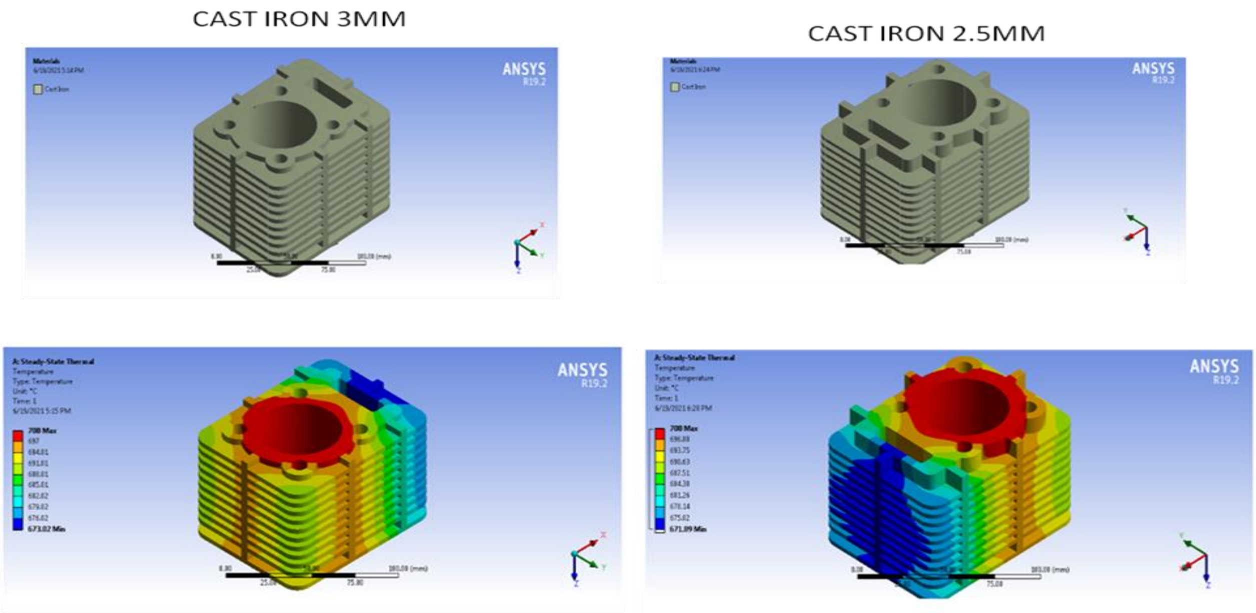


Figure 6.1 :Temperature Distribution on cast iron

2. ALUMINIUM 92%

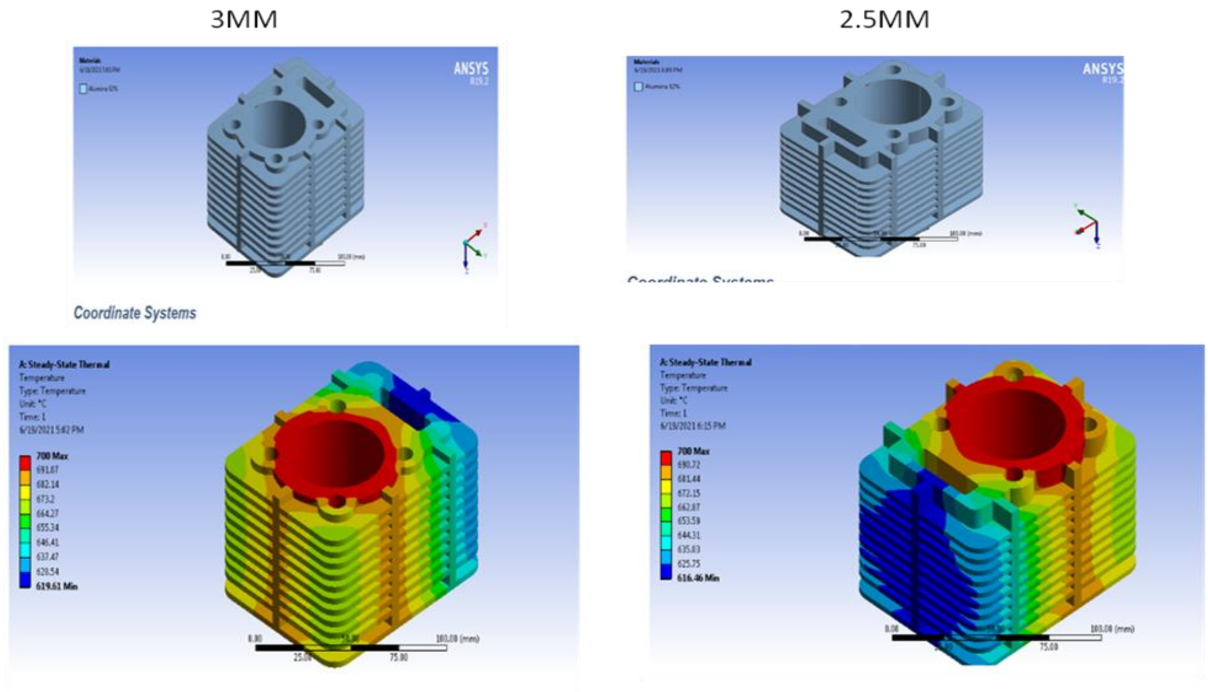


Figure 6..2 : Temperature Distribution on aluminium 92%

3.ALUMINIUM 96%

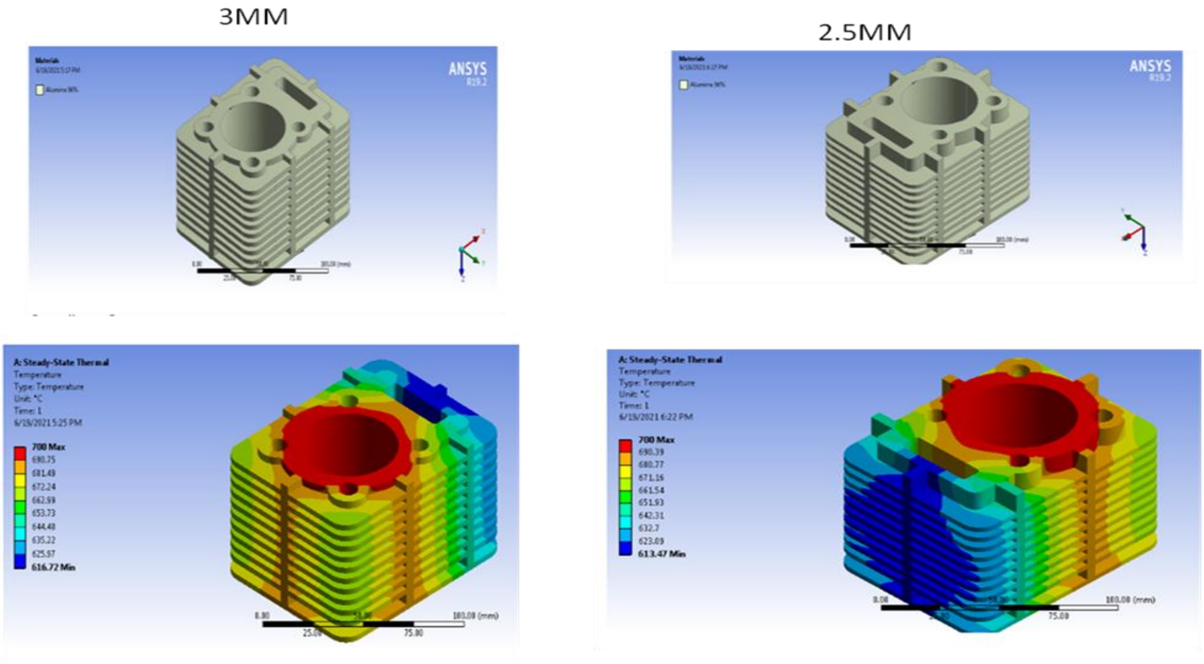


Figure 6.3 :Temperature Distribution on aluminium 96%

4.STAINLESS STEEL

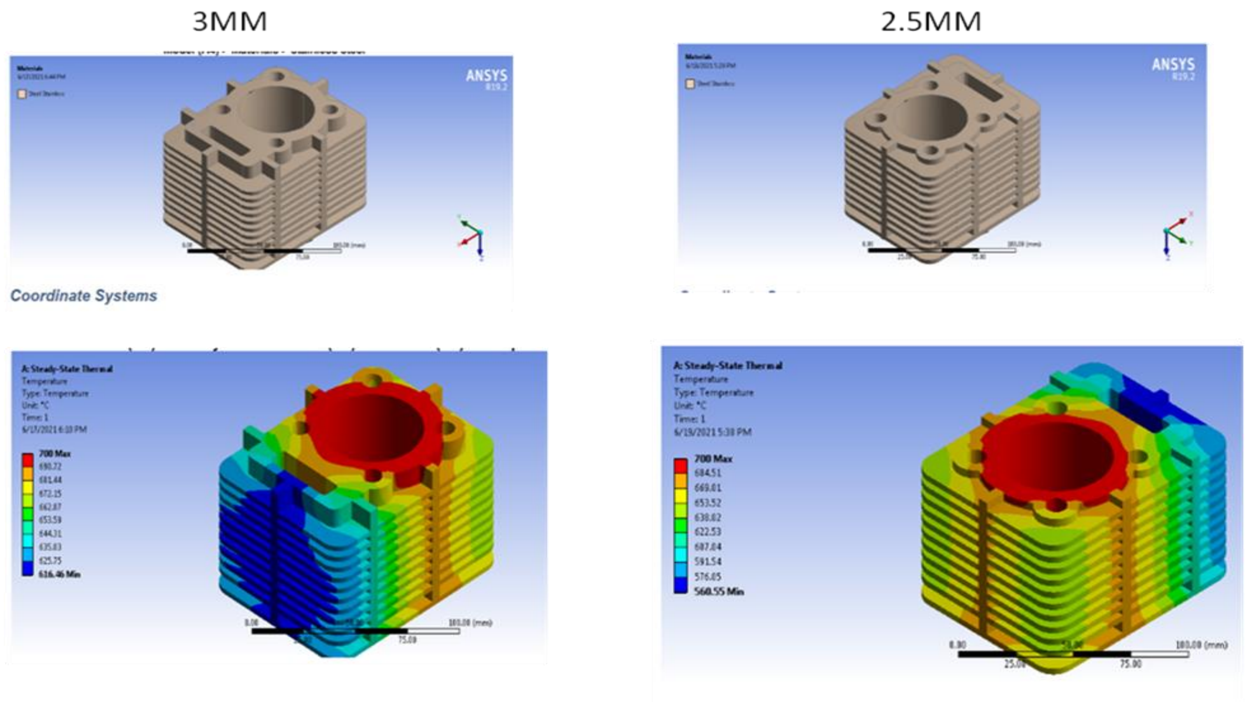
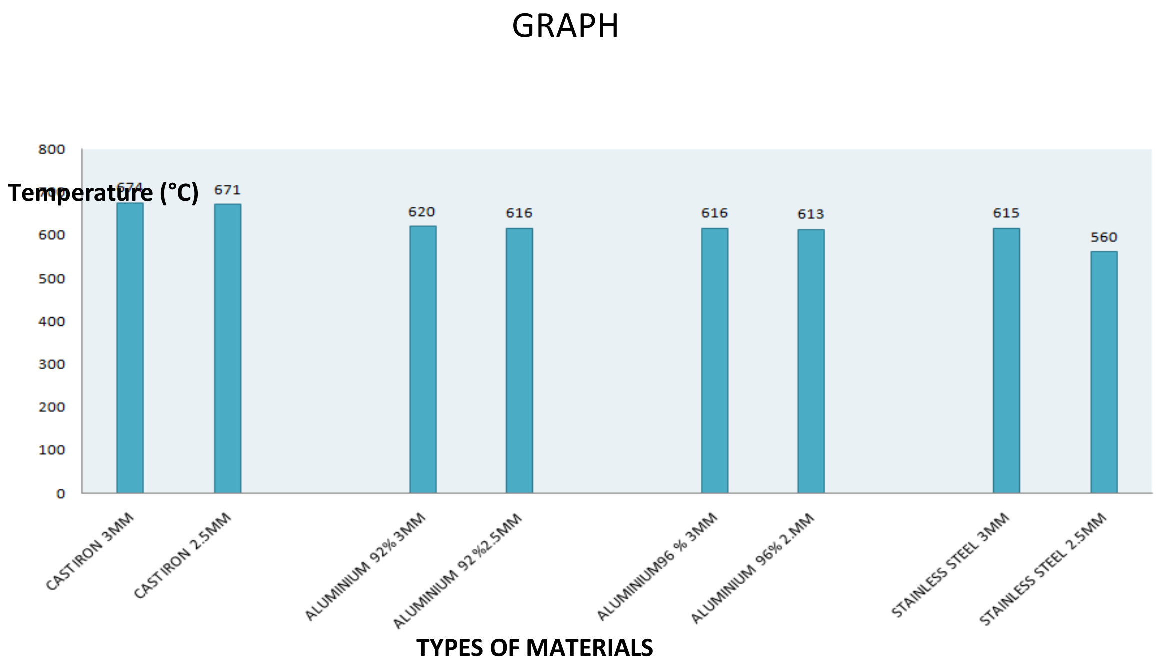


Figure 6.4 :Temperature Distribution on stainless steel

9.GRAPH



Temperature Variations in Materials

10.CONCLUSION

Design of fin plays an important role in heat transfer. There is a scope of improvement in heat transfer of air cooled engine cylinder fin if mounted fin's shape varied from conventional one. Contact time between air flow and fin (time between air inlet and outlet flow through fin) is also important factor in such heat transfer.

In this project , a cylinder fin body for motorcycle is modeled using software using Unigraphics software and analysis is done by ansys software. The thickness of the original model is 3mm, in this thesis it is reduced to 2.5mm.

Present used material for fin body is Cast Iron. In this thesis, thermal analysis is done for all the two materials Cast Iron and Aluminum alloy. The material for the original model is changed by taking the consideration of their densities and thermal conductivity. Density is less for Aluminum alloy compared with other two materials so weight of fin body is less using Aluminum alloy
so it concluded that the fins 2.5mm with aluminium material has a high heat transfer rate as compared to cast iron with 3mm thickness.

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