NATIONAL INSTITUTE OF TECHNOLOGY - KARNATAKA, SURATHKAL
THE INSTITUTION OF ENGINEERS - NITK CHAPTER
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Heat Transfer Analysis of fins in Heat Engine

Problem statement:

Air-Cooled Single Cylinder Engines generate a lot of heat which has to be dissipated efficiently through the methods of conduction and convection.There is a need for coming up with efficient fin designs in order to dissipate heat at the fastest rate.

Proposed solution:

The most common approach to enhance the Heat transfer is by using the extended surfaces called fins. A plain fin may increase the surface area but a special shape extended surface may increase heat transfer coefficient.The main purpose of using these cooling fins is to cool the engine cylinder by air. This project focuses on changing the shape and geometry of the fins to improve the heat co-efficient thus by increasing the heat transfer rate.

Technologies used:

- Autodesk® Fusion 360
- Ansys | Engineering Simulation Software

Methodology:

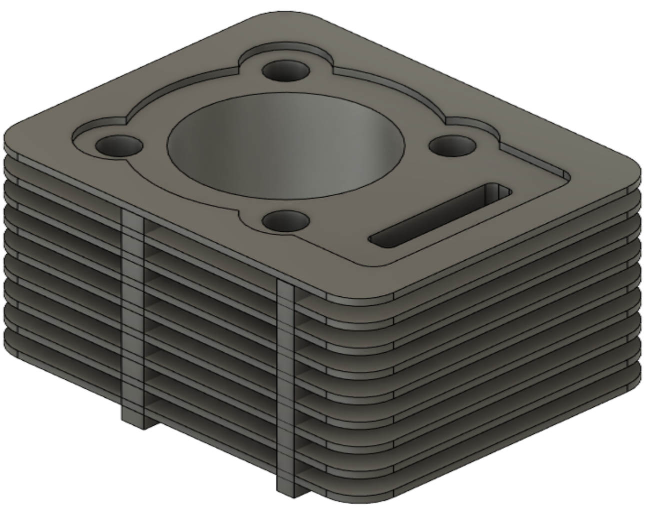
The following are the main objectives of the present work: 🎬

- To design a cylinder with fins for a 150cc engine by varying the geometry such as rectangular, circular and thickness of the fins.
- To determine static thermal properties of the proposed fin models. 🎬

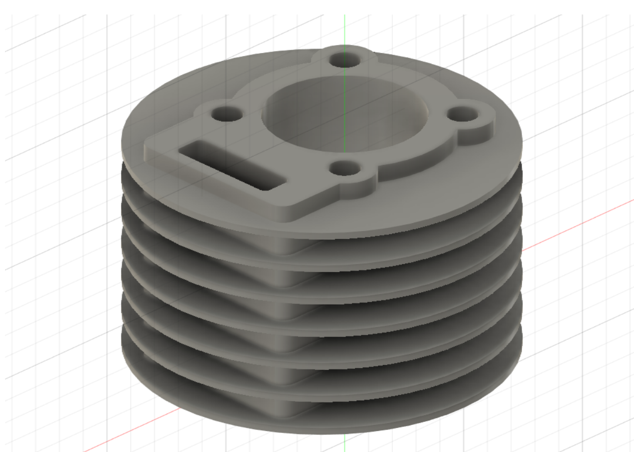
- To identify suitable alloy for the fabrication based on results obtained from finite element analysis and analytical methods.

Thermal analysis of an engine cylinder fins has been performed numerically by varying its geometry, shape and thickness of the fin i.e., heat fluxes for temperature and thermal analysis values. The geometry of the model is changed for analysis and the results obtained are consistent with expectations, in the sense that the temperature and heat transfer parameters like effectiveness and efficiency of the fin increase with change in their geometry and thickness of the fin.

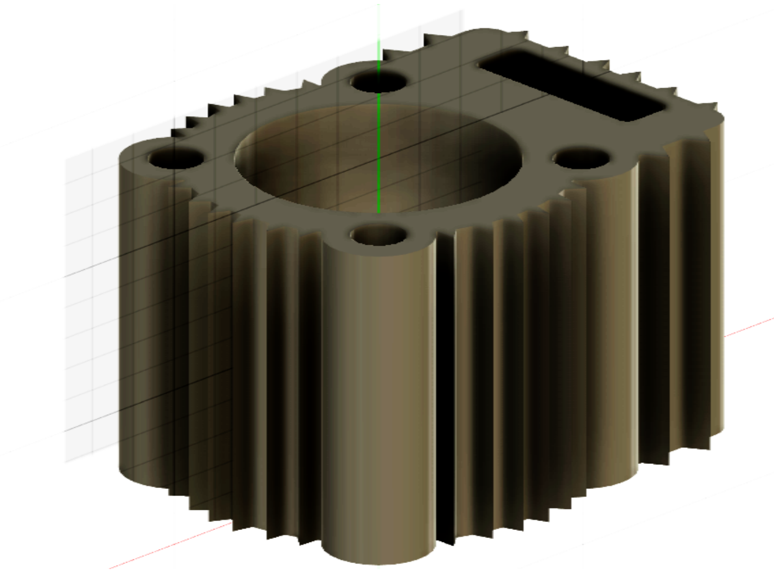
Fusion 360 model for the rectangular fin of an Engine :



Fusion 360 model for the circular fin of an Engine :

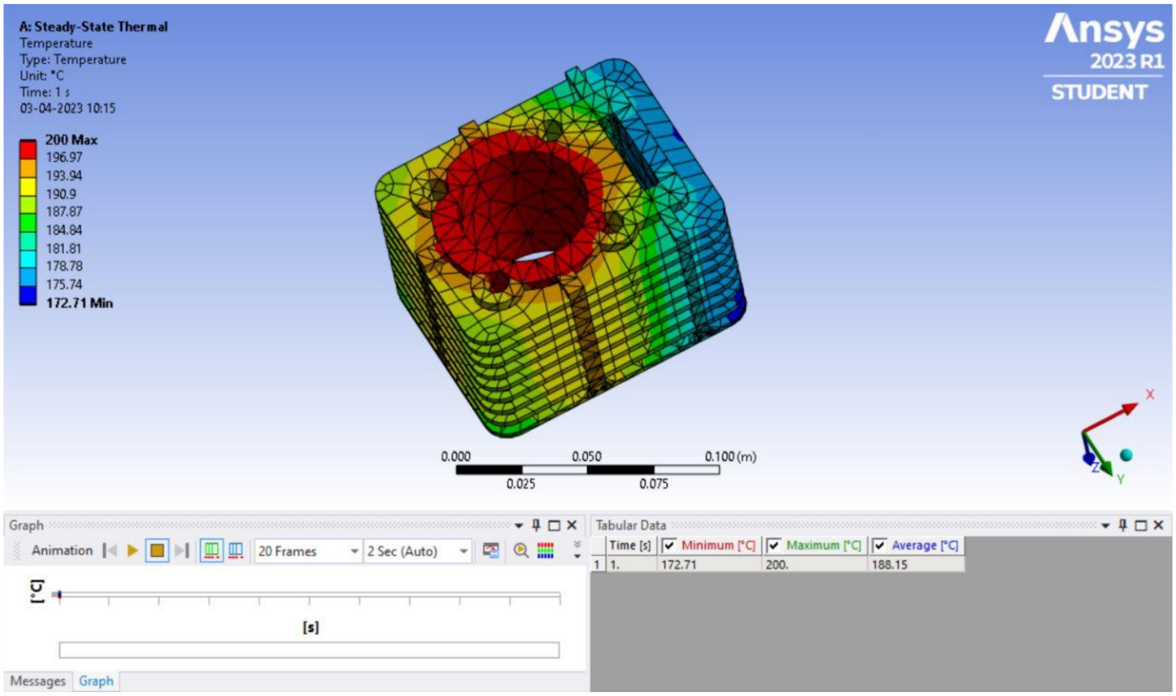


Fusion 360 model for the vertical fin of an Engine :

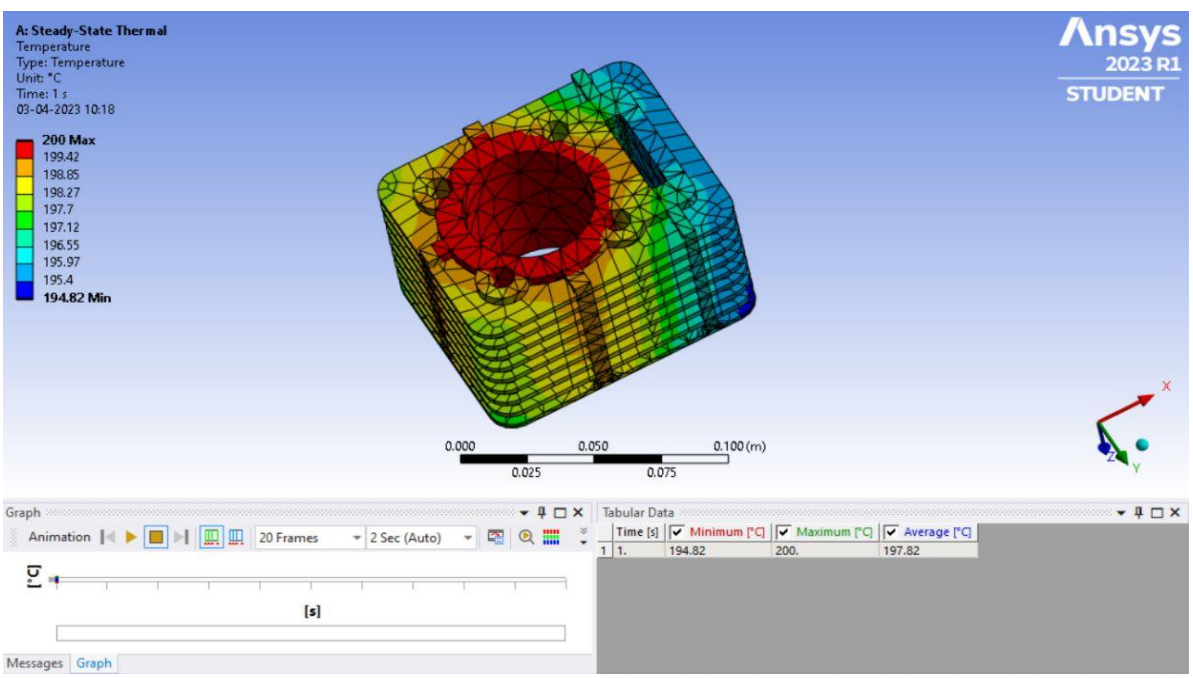


Fusion 360 model for the step fin of an Engine :

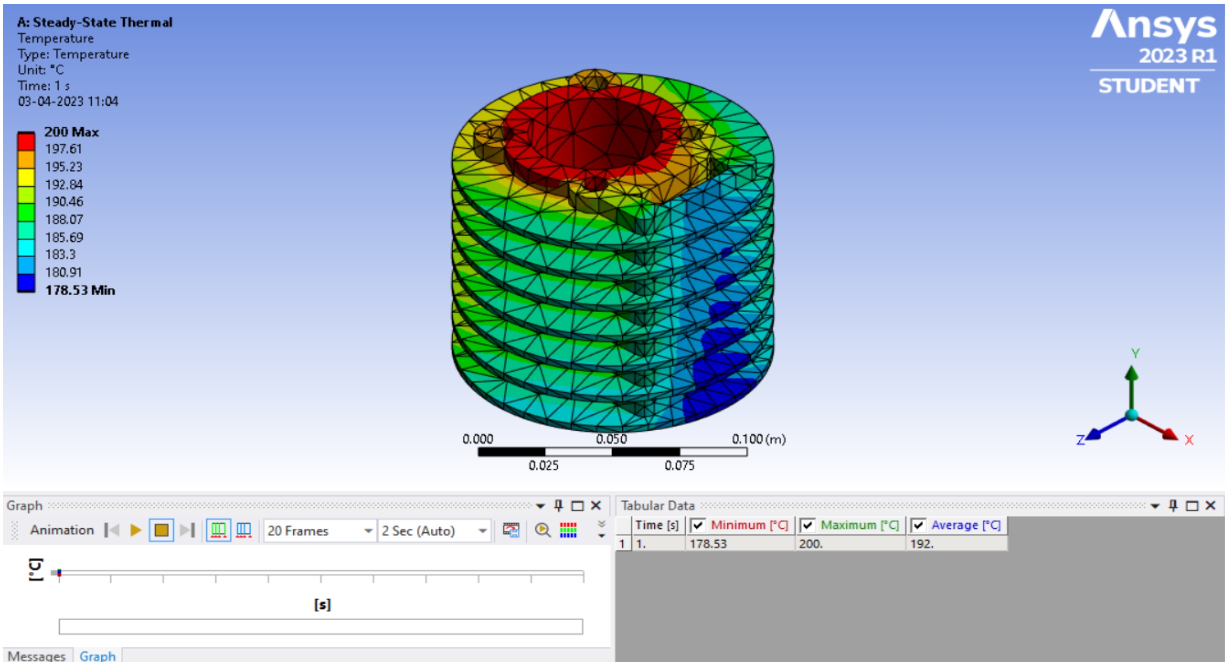
Temperature Distribution through the rectangular fin for the material (Aluminum):



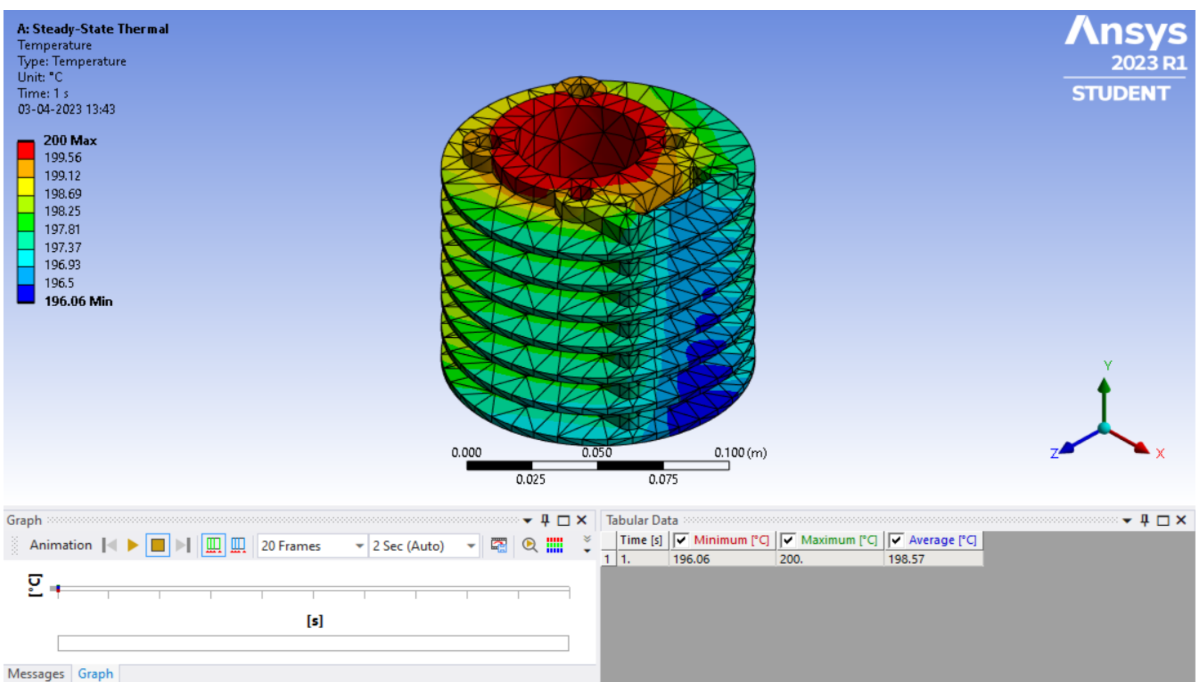
Temperature Distribution through the rectangular fin for the material (Magnesium):



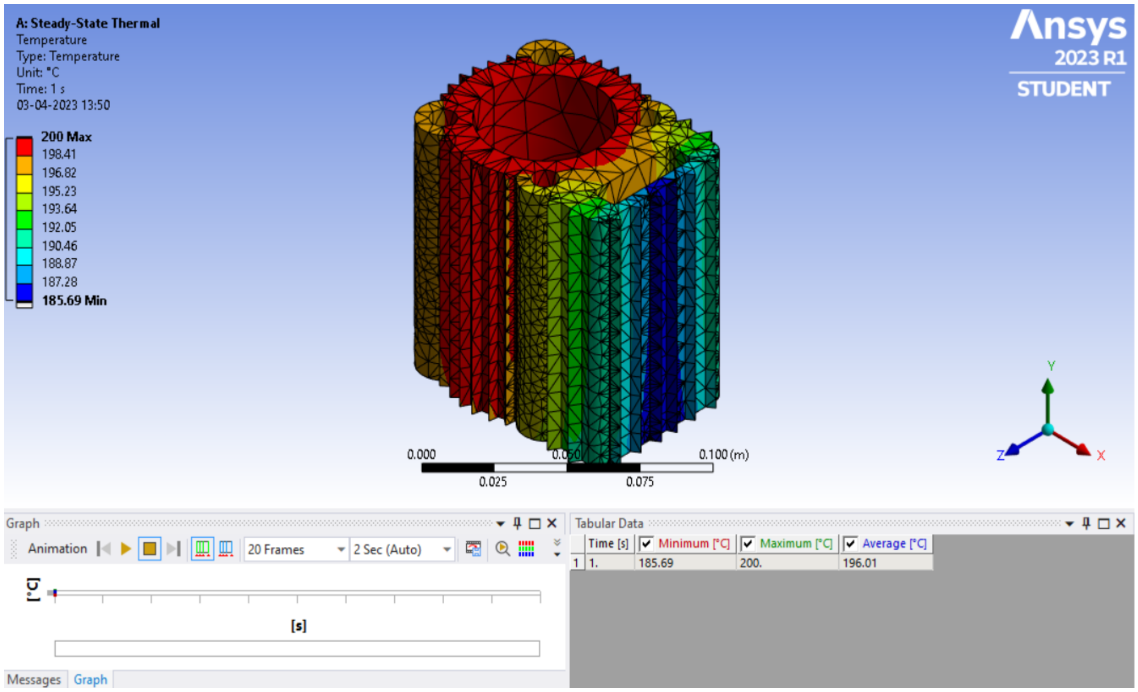
Temperature Distribution through the circular fin for the material (Aluminum):



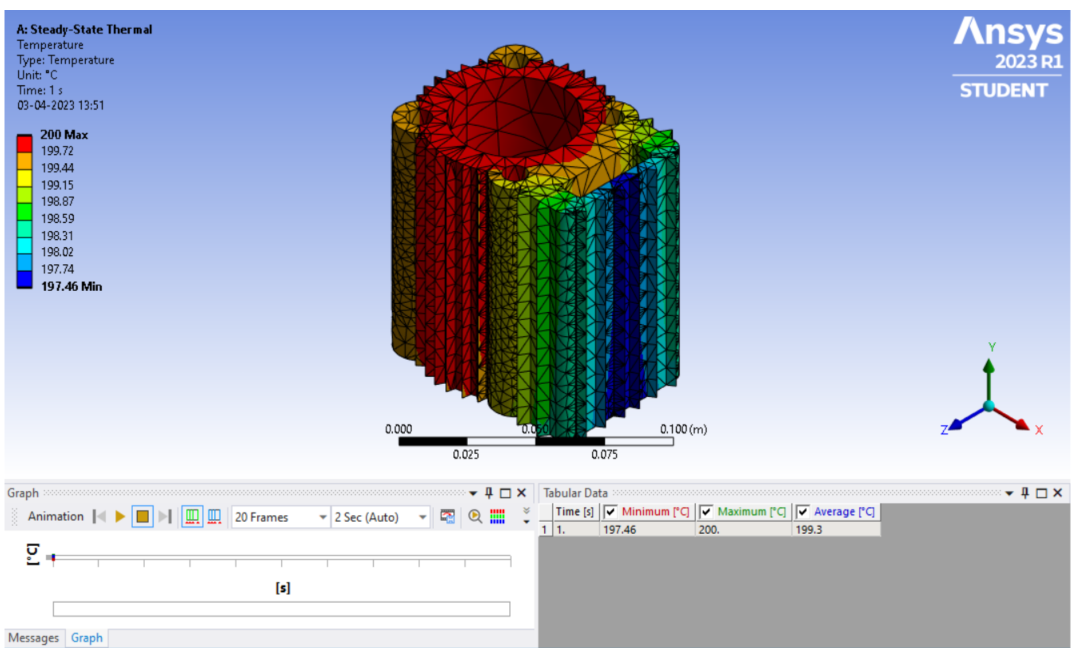
Temperature Distribution through the circular fin for the material (magnesium):



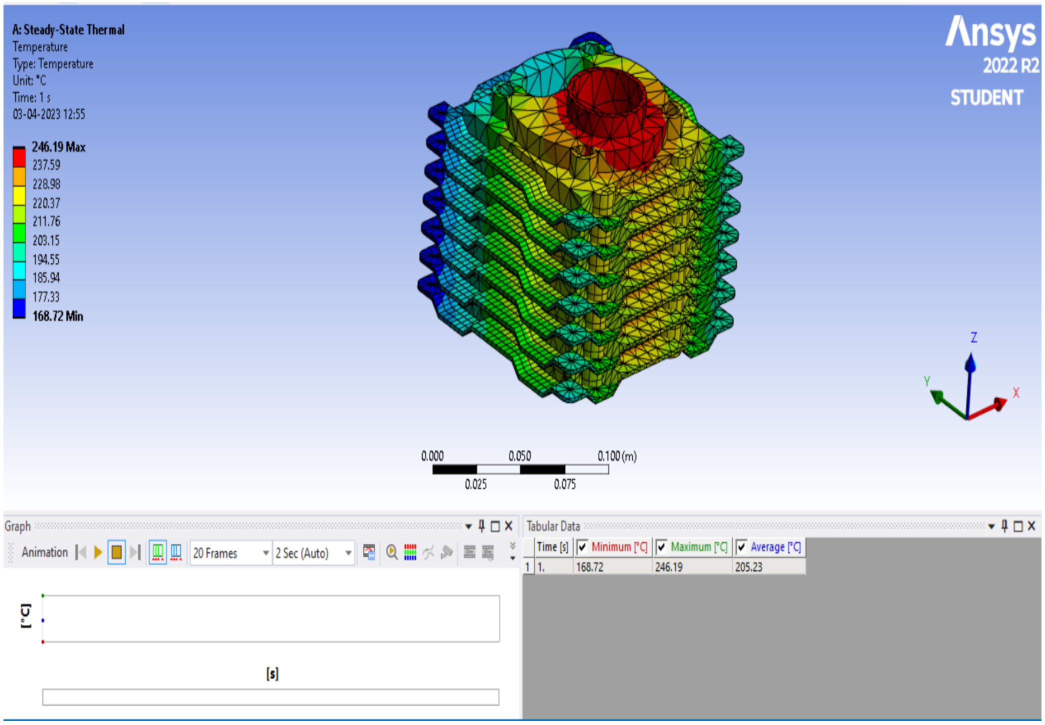
Temperature Distribution through the vertical fin for the material (Aluminum):



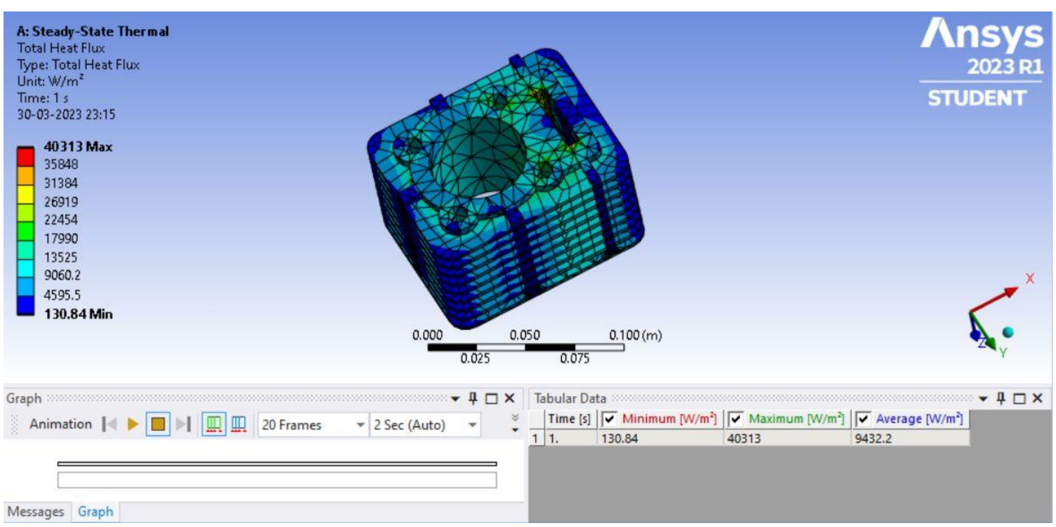
Temperature Distribution through the vertical fin for the material (magnesium):



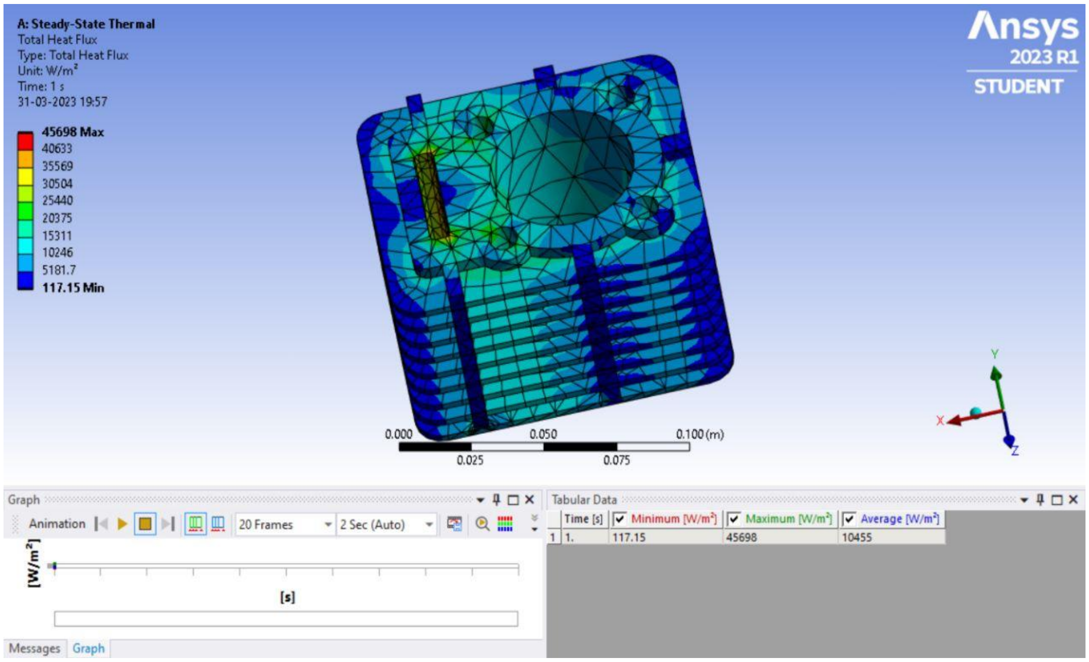
Temperature Distribution through the model of step fin for the material (Aluminum):



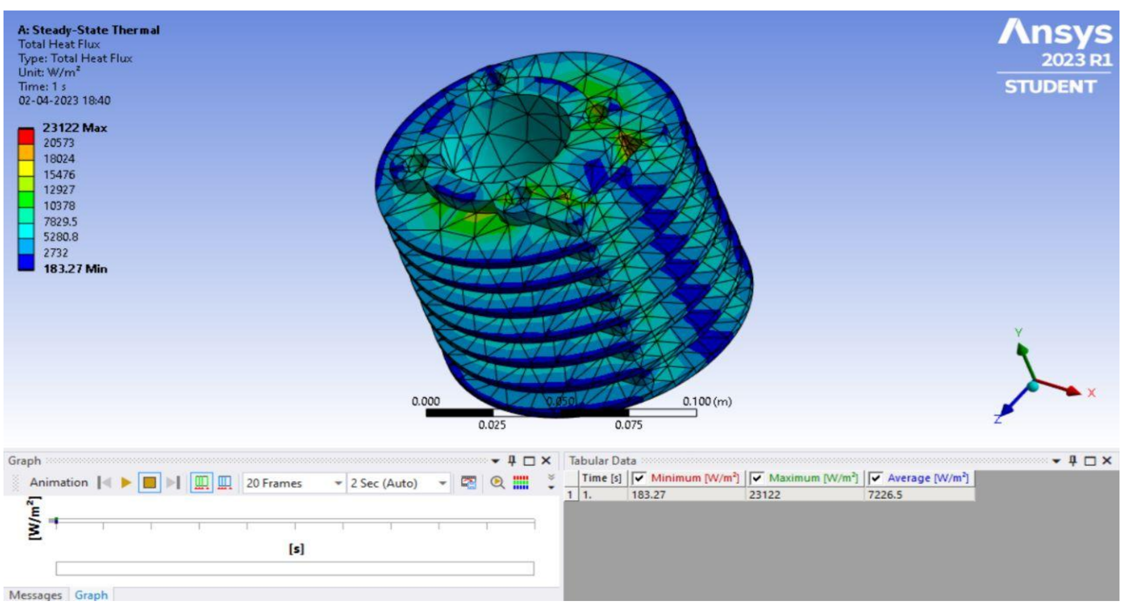
Heat Flux through the model of rectangular fin for the material (Aluminum)



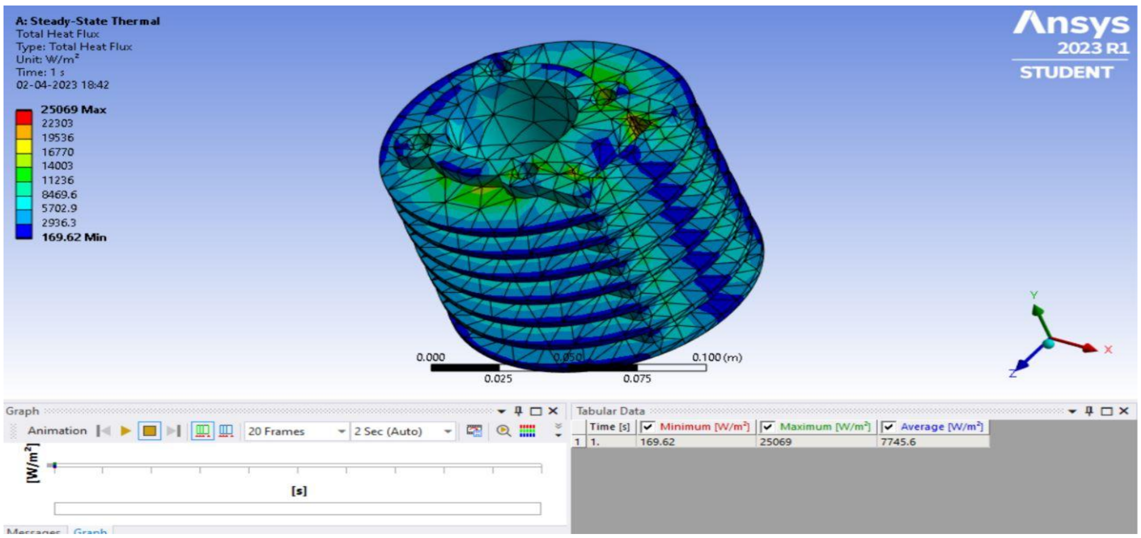
Heat Flux through the model of rectangular fin for the material (Magnesium)



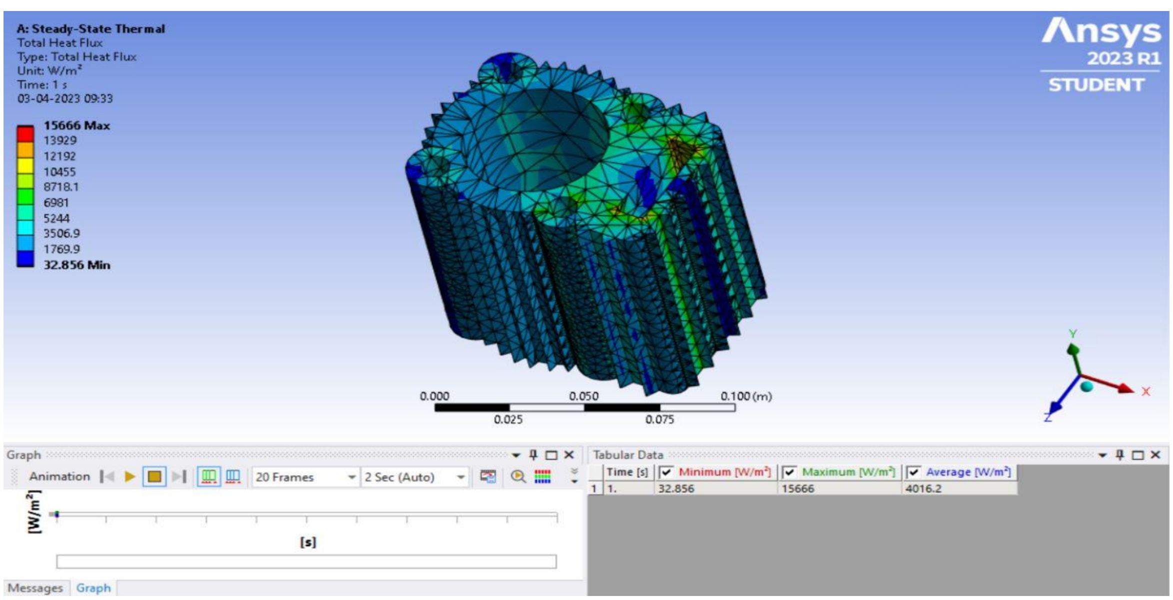
Heat Flux through the model of circular fin for the material (Alumunium)



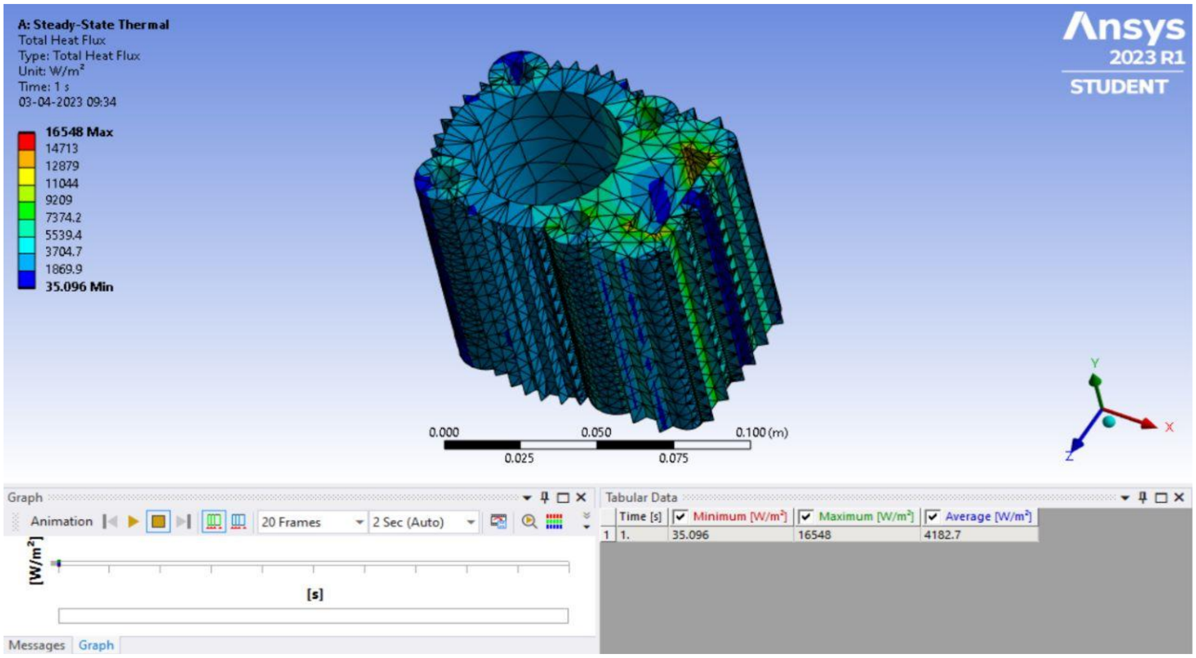
Heat Flux through the model of circular fin for the material (Magnesium)



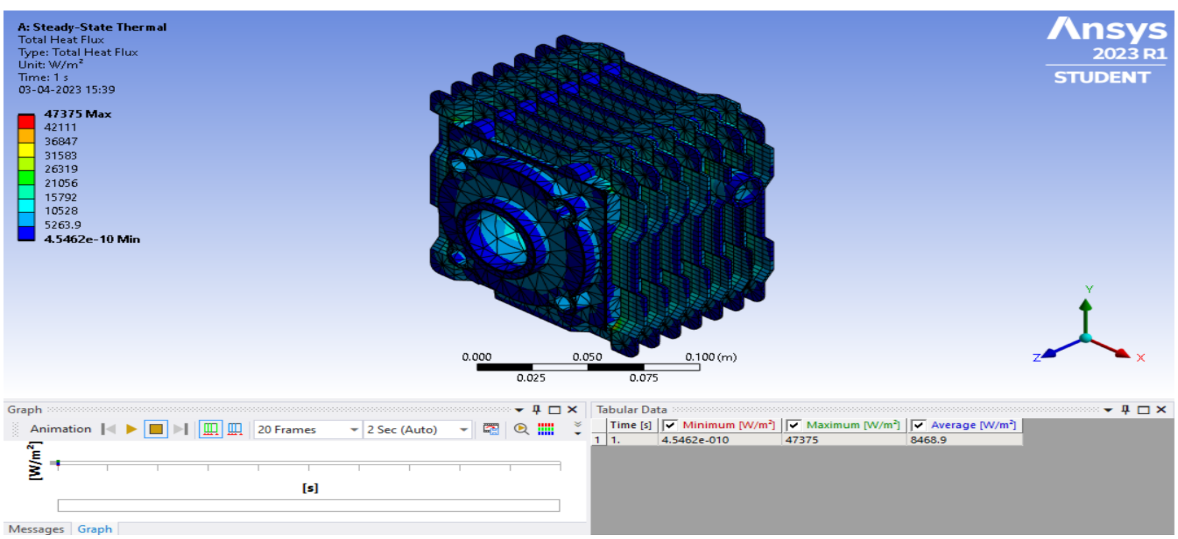
Heat Flux through the model of vertical fin for the material (Alumunium)



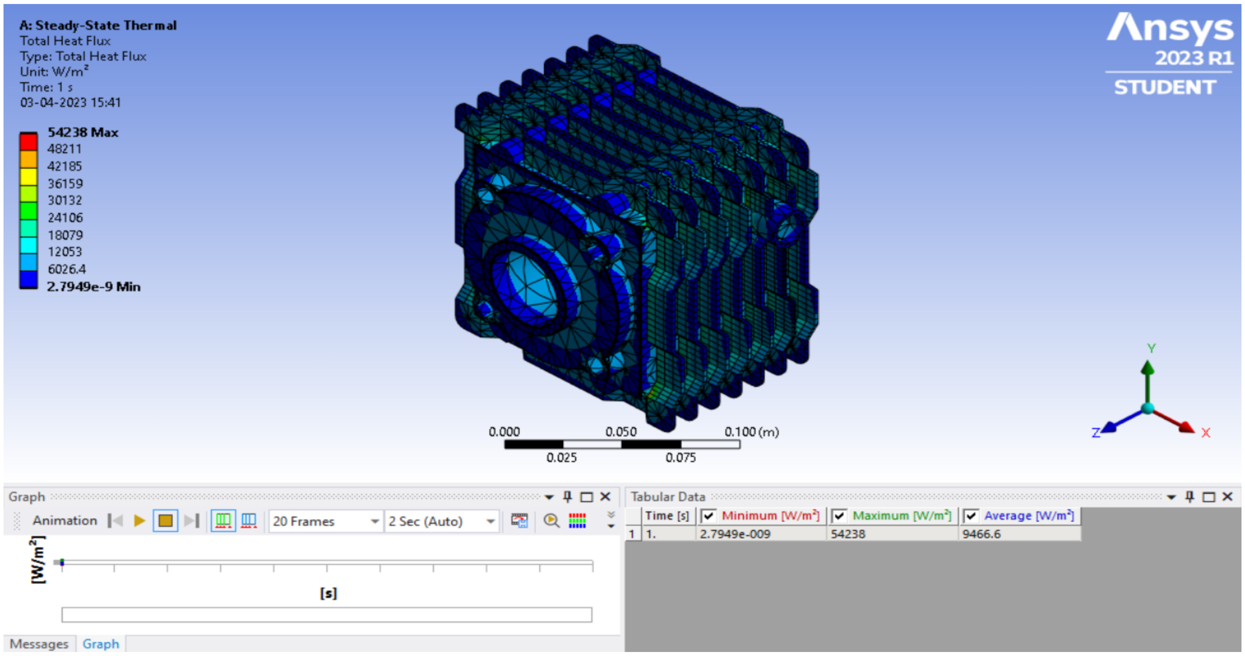
Heat Flux through the model of vertical fin for the material (Magnesium)



Heat Flux through the model of Step fin for the material(Aluminum):



Heat Flux through the model of Step fin for the material(Magnesium):



Results:

S.No	Type of Fins used	Material alloy used	Heat flux (W/m^2)
1.	Rectangular Fin	Aluminum	9432.2
2.	Rectangular Fin	Magnesium	10455
3.	Circular Fin	Aluminum	7226.5
4.	Circular FIn	Magnesium	7745.6
5.	Vertical Fin	Aluminum	4016.2
6.	Vertical Fin	Magnesium	4182.7
7.	Step Fin	Aluminum	8468.9
8.	Step Fin	Magnesium	9466.6

Conclusions :

By reducing the thickness and also by changing the shape of fin to circular shape, the weight of the fin body reduces thereby increasing the heat transfer and efficiency of the fin. The weight of the fin body is also reduced when magnesium is used.

References:

1. How Engine Cooling System Work?
2. fins - Recent models | 3D CAD Model Collection | GrabCAD Community Library
3. Internal combustion engine cooling - Wikipedia
4. https://www.idolz.com/en/2021/05/27/engine-cooling-system-how-it-works-and-main-components/
5. Thermal analysis of two wheeler engine fins - ScienceDirect

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