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Design and Analysis of Circular Fin for Bike Engine

Nagendra S. R.[1] | Anjan Kumar[1] | Jeevesh S.[1] | Thasin M.[1] | P. A. Harari[2] | C. Prabhakar Reddy[3]

[1]Department of Mechanical Engineering, School of Engineering and Technology, CMR University, Bangalore, Karnataka, India.
[2]Assistant Professor, Department of Mechanical Engineering, School of Engineering and Technology, CMR University, Bangalore, Karnataka, India.
[3]Dean,School of Engineering and Technology, CMR University, Bangalore, Karnataka, India.
*Corresponding Author Email ID: praveen.h@cmr.edu.in

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ABSTRACT

The cylinder of the internal combustion engine is one of the major automobile component, which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder, fins are provided on the cylinder to increase the rate of heat transfer. By doing thermal analysis on the engine cylinder fins, it is helpful to know the heat dissipation inside the cylinder. The principle implemented in this project is to increase the heat dissipation rate by using the invisible working fluid, nothing but air. We know that, by increasing the surface area we can increase the heat dissipation rate, so designing such a large complex engine is very difficult. The main purpose of using these cooling fins is to cool the engine cylinder by air. The main aim of the project is to analyze the thermal properties by varying geometry, material, distance between the fins and thickness of cylinder fins. Parametric models of cylinder with fins have been developed to predict the transient thermal behaviour. The models are created by varying the geometry circular and also by varying thickness of the fins for both geometries. Thermal analysis is done on the cylinder fins to determine variation temperature distribution over time. The analysis is done using ANSYS. Thermal analysis determines temperatures and other thermal quantities. The accurate thermal simulation could permit critical design parameters to be identified for improved life. Presently material used for manufacturing cylinder fin body is cast iron. In this thesis, using materials copper and aluminium alloy 6082 are also analyzed.

KEYWORDS:Thermal analysis, Circular fins, Bike engine, Material selection.

1. INTRODUCTION

In engine when fuel is burned heat is produced. Additional heat is also generated by friction between the moving parts. Only approximately 30% of the energy released is converted into useful work. The remaining 70% must be removed from the engine to prevent the parts from melting [1]. For this purpose engine have cooling mechanism in engine to remove this heat from the engine some heavy vehicles uses water-cooling system and almost all two wheelers uses air cooled engines, because air-cooled engines are only option due to some advantages like lighter weight and lesser space requirement [2]. In an internal combustion engine, the expansion of the high-temperature and -pressure gases produced by combustion applies direct force to some component of the engine, such as pistons, turbine blades, or a nozzle. This force moves the component over a distance, generating useful mechanical energy [3]. We know that in case of internal combustion engines, combustion of air and fuel takes place inside the engine cylinder and hot gases are generated. The temperature of gases will be around 2300-2500°C [4]. This is a very high temperature and may result into burning of oil film between the moving parts and may result in seizing or welding of same. So, this temperature must be reduced to about 150-200°C at which the engine will work most efficiently. Too much cooling is also not desirable since it reduces the thermal efficiency [5].

2. MATERIALS AND METHODS

The methodology of the project work is to design cylinder with fins for Passion Plus 100cc bike engine, by changing the geometry, distance between the fins and thickness of the fins and to analyze the thermal properties of the fins. Analysis is also done by varying the materials of fins. Present used material for cylinder fin body is cast iron. Our aim is to change the material for fin body by analyzing the fin body with other materials and also by changing the geometry distance between the fins and thickness of the fins. For original model the thickness of fins is 2mm and distance between the fins is 7.5mm. For modified model the thickness of fins is 1.5mm and distance between the fins for combustion side 9.65mm and for opposite side 4.23 mm. The materials used are cast iron, copper and aluminium alloy 6082.

3. ANALYSIS ON ANSYS SOFTWARE

3.1. Case-1

Case-1 represents 6 fins, the minimum temperature is 221.58°C and maximum temperature is 240.02°C, the heat flux is 0.0445 W/m^2.

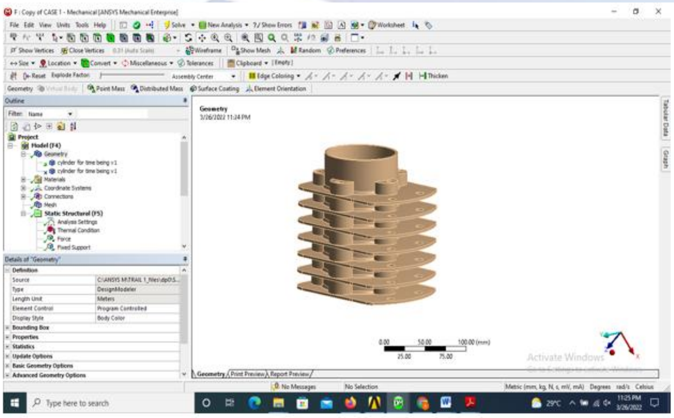

Fig. 1. Geometry

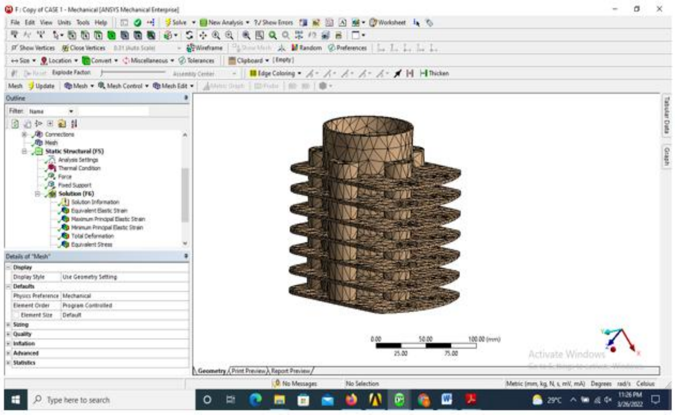

Fig. 2. Meshing

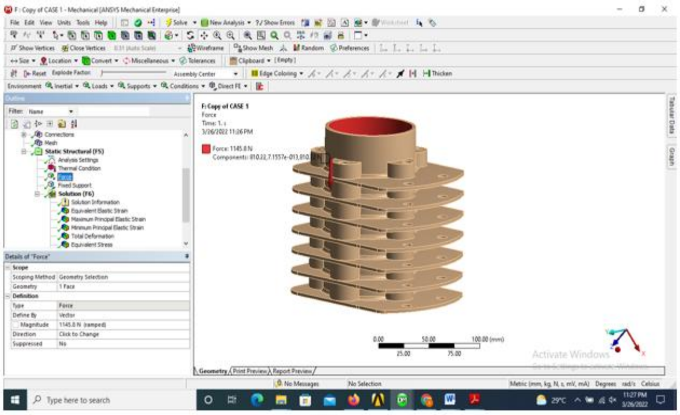

Fig. 3. Force

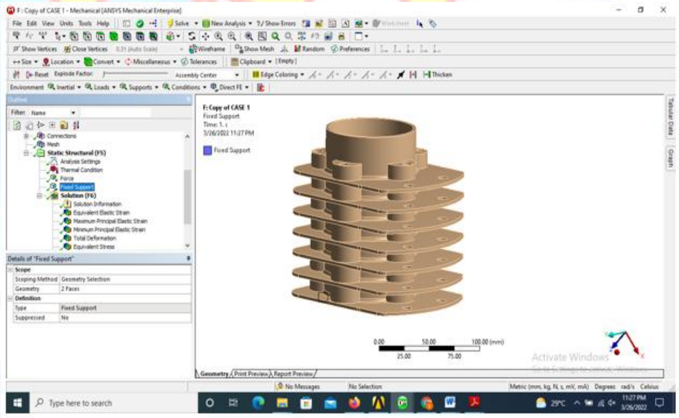

Fig. 4. Fixed support

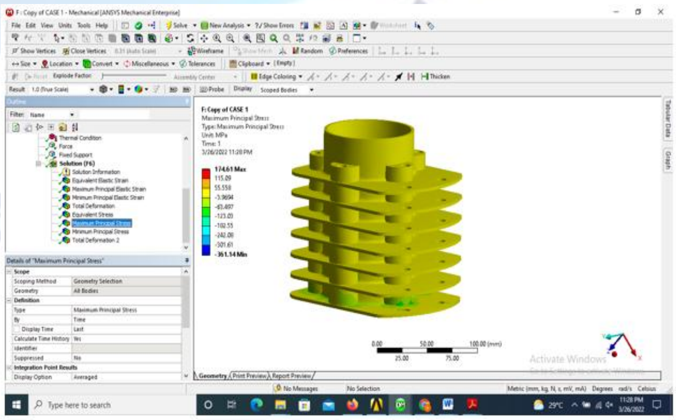

Fig. 5. Maximum principal stress

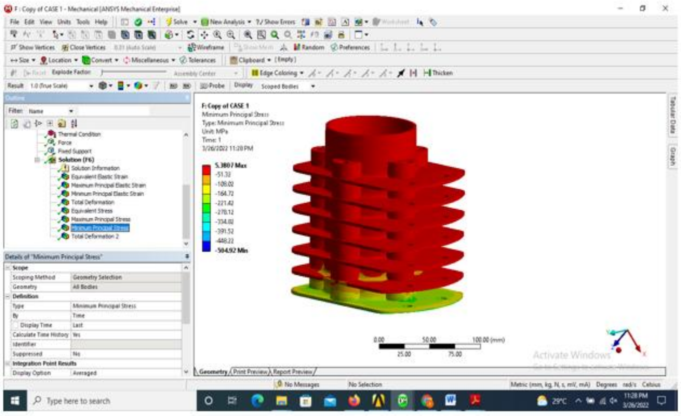

Fig. 6. Minimum principal stress

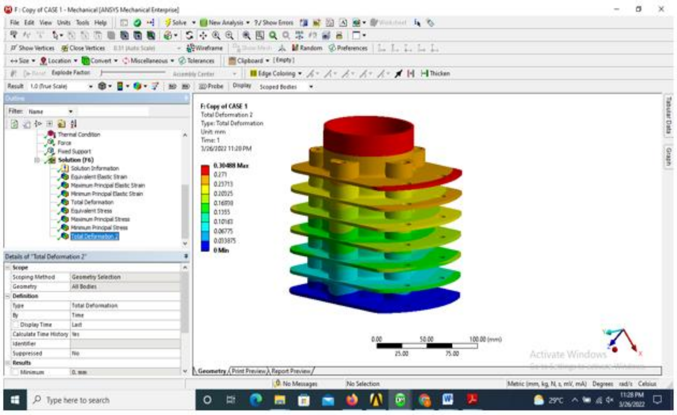

Fig. 7. Total deformation

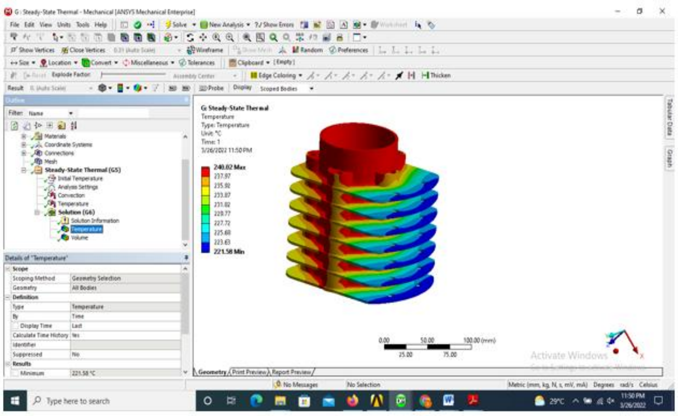

Fig. 8. Temperature

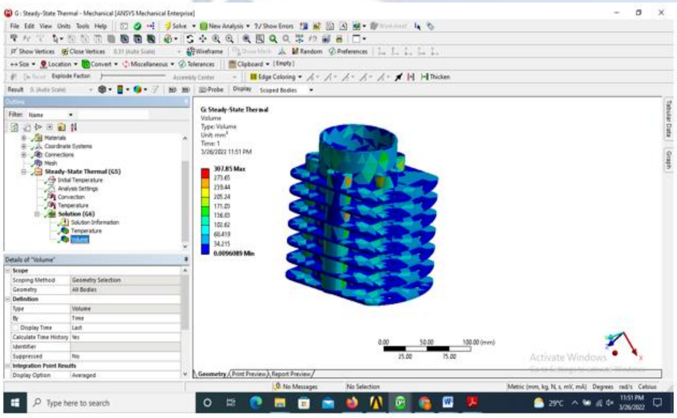

Fig. 9. Volume

3.2. Case-2

Case-2 represents 8 fins, the minimum temperature is 212.81°C and maximum temperature is 230°C, the heat flux is 0.040 W/m².

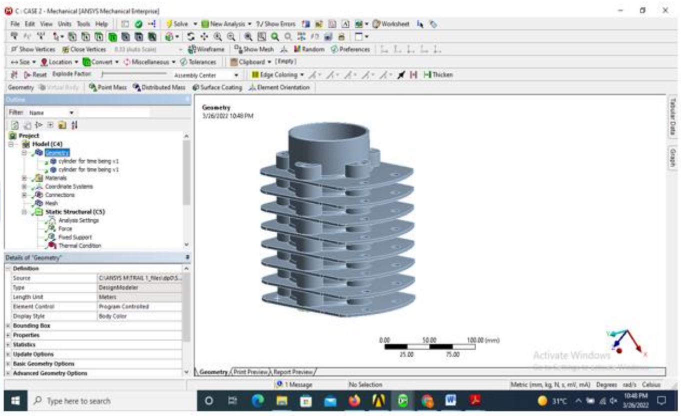

Fig. 10. Geometry

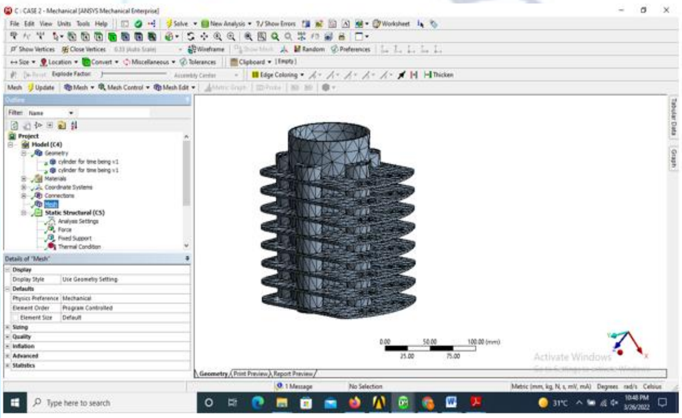

Fig. 11. Meshing

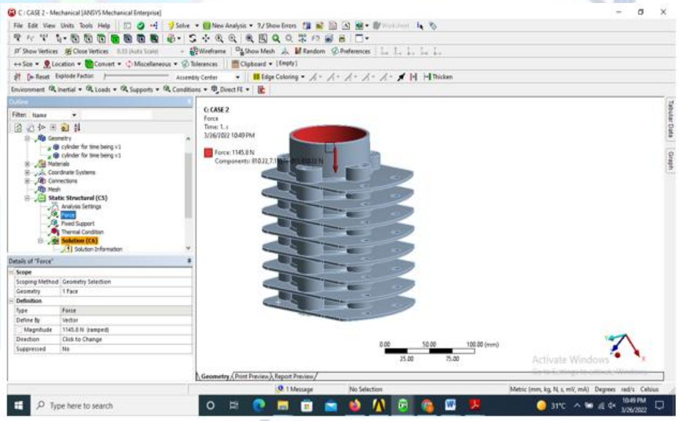

Fig. 12. Force

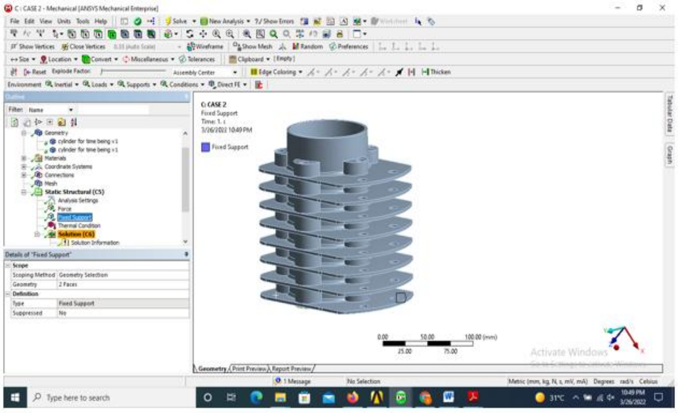

Fig. 13. Fixed support

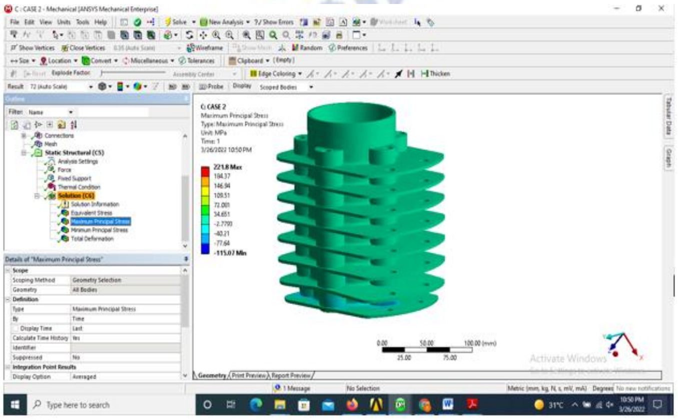

Fig. 14. Maximum principal stress

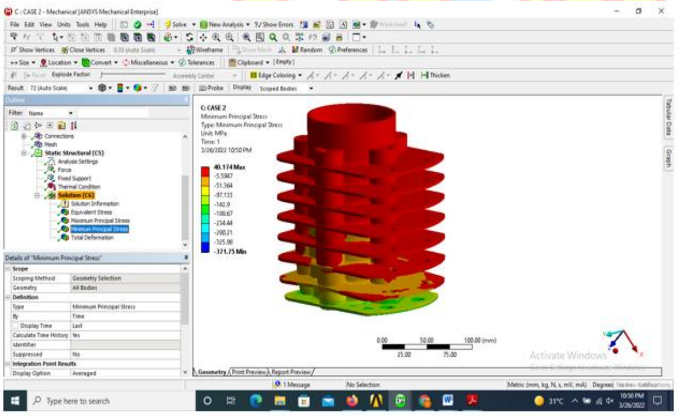

Fig. 15. Minimum principal stress

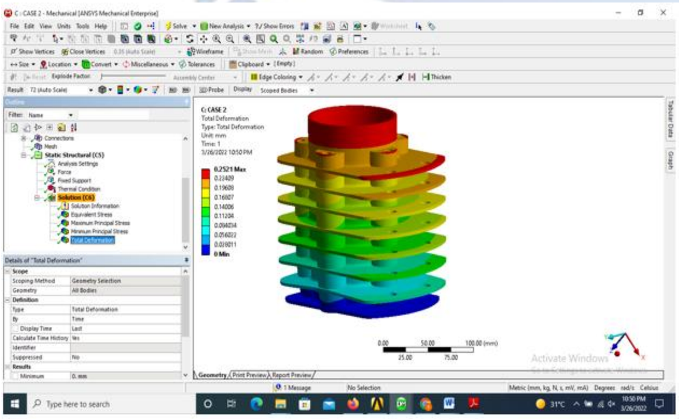

Fig. 16. Total deformation

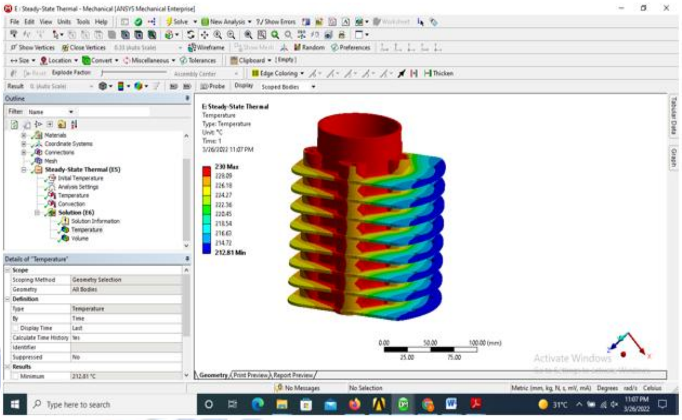

Fig. 17. Temperature

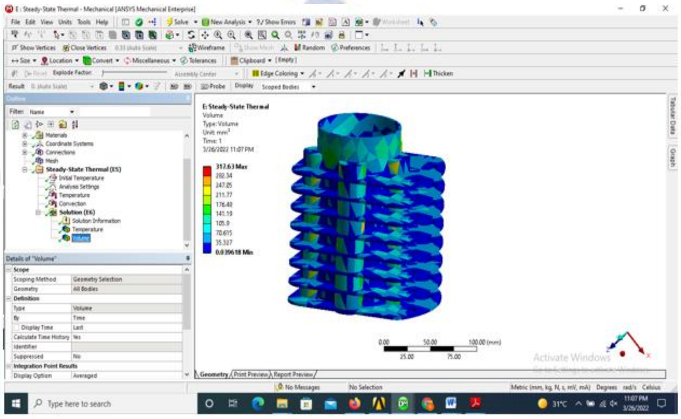

Fig. 18. Volume

3.3. Case-3

Case-3 represents 9 fins, the minimum temperature is 204.32°C and maximum temperature is 220°C, the heat flux is 0.470 W/m².

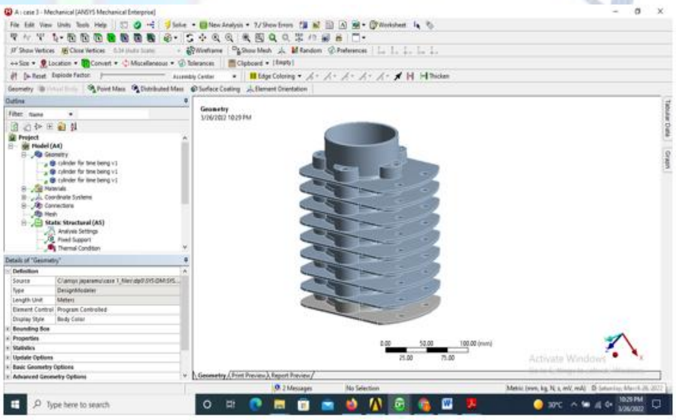

Fig. 19. Geometry

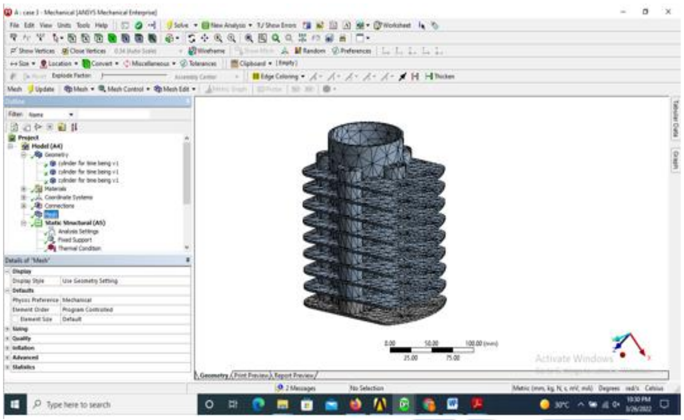

Fig. 20. Meshing

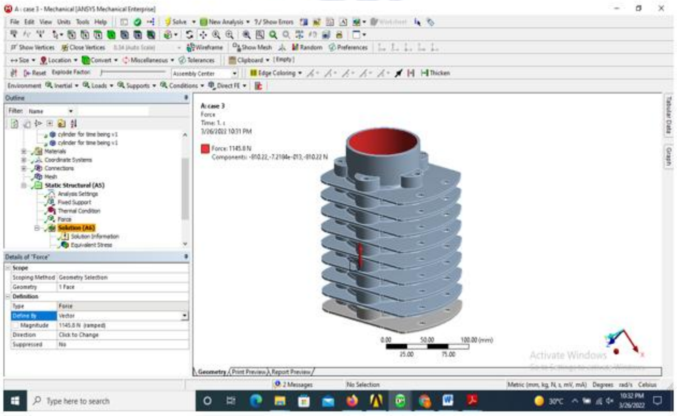

Fig. 21. Force

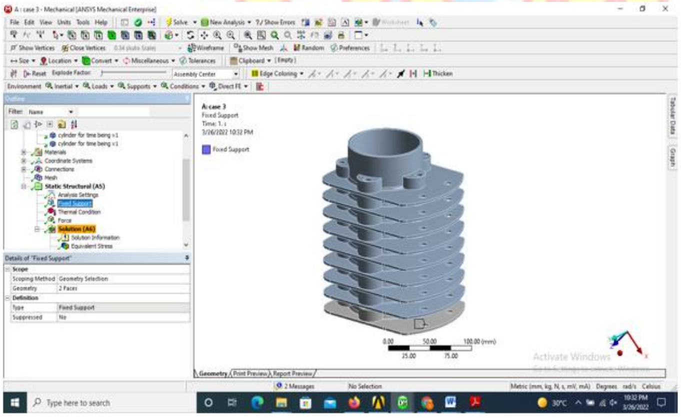

Fig. 22. Fixed support

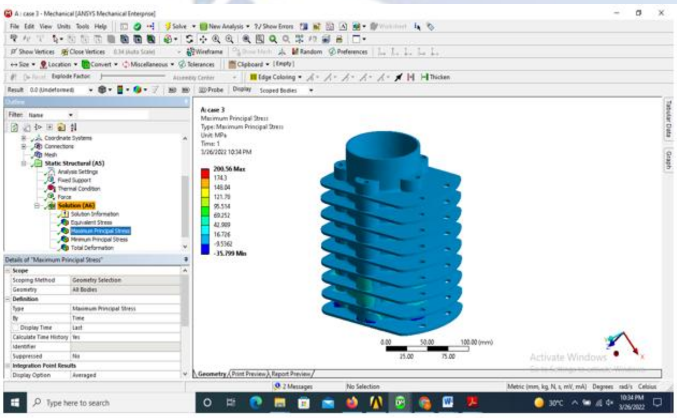

Fig. 23. Maximum principal stress

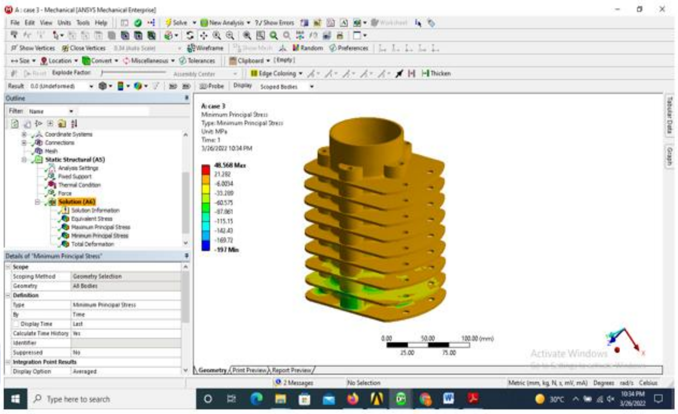

Fig. 24. Minimum principal stress

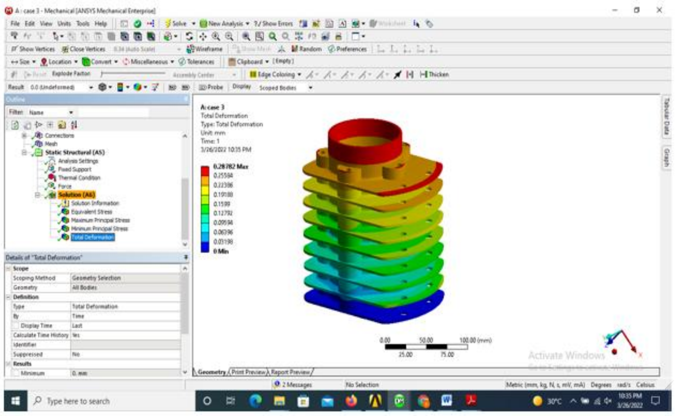

Fig. 25. Total deformation

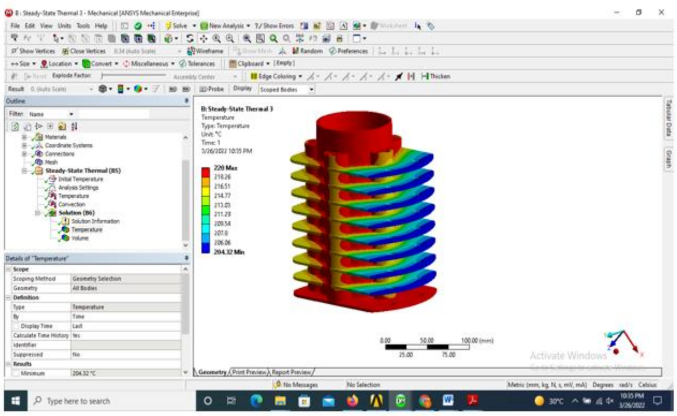

Fig. 26. Temperature

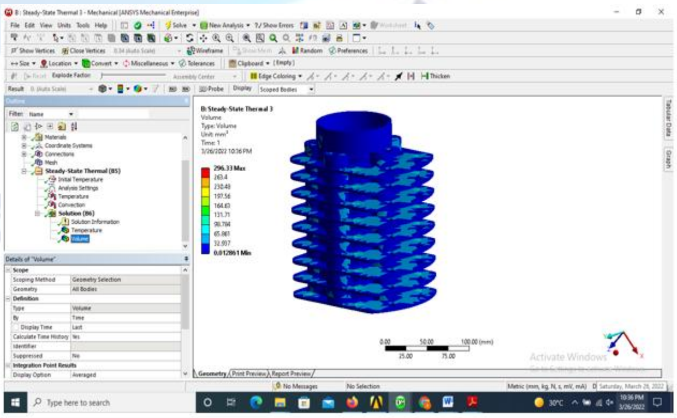

Fig. 27. Volume

4. CONCLUSION

There is wide scope of designing and modifying cooling fins for air cooled IC engines. This can improve heat transfer rate from engine which can be achieved by changing fin dimensions and shape, material. In present time aluminium alloys 6082 are used at the large scale for the manufacturing of cooling fins of IC engines and they shows better thermal conductivity than the conventional steel alloys. There can be created new geometry with porous like structure as cutting and bending of small portion of the fin geometry. This will increase surface area without material removing and also creates turbulence so there is a chance of getting higher heat transfer rate than the past experiments and research. Among three cases studied Case-3 gives better results as compared with Case-1 and Case-2.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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