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DESIGN AND ANALYSIS OF ENGINE FINS

A Mini project Report

Submitted by

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(B19ME190L)

in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

in MECHANICAL ENGINEERING

Under the supervision of

Dr.G.SRINU, Assistant Professor, MED

Department of Mechanical Engineering

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL

(Autonomous Institute under Kakatiya University, Warangal)

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DEPARTMENT OF MECHANICAL ENGINEERING

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL

(An Autonomous Institute under Kakatiya University, Warangal)

CERTIFICATE

This is to certify that Mr**. A.Sravan** bearing roll number **B19ME190L** has carried out the bonafide seminar report entitled, **"DESIGN AND ANALYSIS OF ENGINE FINS"** in partial fulfilment of the requirement for the award of the degree of Bachelor of Technology in Mechanical Engineering.

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ABSTRACT

The Engine and Reciprocating air compressor cylinder is one of the major automobile components, which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder of engine, fins are provided on the surface of the cylinder to increase the rate of heat transfer. By doing thermal analysis on the cylinder fins of engine, it is helpful to know the heat dissipation inside the cylinder. 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 aim of the project is to analyze the thermal properties by varying geometry of cylinder fins using Ansys work bench19.2 version. The 3D model of the geometries are created using CATIA V5 and its thermal properties are analyzed using Ansys workbench19.2. The variation of temperature distribution over time is of interest in many applications such as in cooling. The accurate thermal simulation could permit critical design parameters to be identified for improved life. Presently Material used for manufacturing cylinder fin body is Aluminum Alloy which has thermal conductivity of 160 – 170 W/mk. presently analysis is carried out for cylinder fins using this material.

KEYWORDS: Dissipation, Thermal conductivity, cylinder, fins,3D model, CATIA V5, Ansys.

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A.Sravan(B19ME190L)

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. [1] Heat losses are a major limiting factor for the efficiency of internal combustion engines. Furthermore, heat transfer phenomena cause thermally induced mechanical stresses compromising the reliability of engine components. The ability to predict heat transfer in engines 2 plays an important role in engine development. Today, predictions are increasingly being done with numerical simulations at an ever earlier stage of engine development. These methods must be based on the understanding of the principles of heat transfer.

LITERATURE SURVEY

Cooling System of IC Engines: Heat engines generate mechanical power by extracting energy from heat flows, much as a water wheel extracts mechanical power from a flow of mass falling through a distance. Engines are inefficient, so more heat energy enters the engine than comes out as mechanical power; the difference is waste heat which must be removed. Internal combustion engines remove waste heat through cool intake air, hot exhaust gases, and explicit engine cooling.

Basic Principles: In this project objective is to check which material fits the most for the engine cylinder. The basic principle behind selecting a material is based on the thermal conductivity of the metal. Engine life and effectiveness can be improved with effective cooling. The cooling mechanism of the air cooled engine is mostly dependent on the fin design of the cylinder head and block. The heat is conducted through the engine parts and convected to air through the surfaces of the fins. Insufficient removal of heat from engine will lead to high thermal stresses and lower engine efficiency. As the air-cooled engine builds heat, the cooling fins allow the wind and air to move the heat away from the engine.

Low rate of heat transfer through cooling fins is the main problem in this type of cooling. Most internal combustion engines are fluid cooled using either air (a gaseous fluid) or a liquid coolant run through a heat exchanger (radiator) cooled by air.

OBJECTIVE:

- To design the fins using CATIA V5 software.
- To perform simulation using Ansys 19.2 workbench.
- To get the temperature and heat flux distribution in Static Thermal Analysis.
- To increase the effectiveness of cooling rate by increasing the length of fin.
- To improve the efficiency of fin by varying cross section type

THEORY OF FIN

Principles of Heat Transfer :

Heat is the transfer of thermal energy. Heat is always transferred from an object of higher heat to one with lower heat. Exchange of heat occurs till the body and the surroundings reach at the same temperature. The high-temperature body passes energy to the low-temperature one, eventually achieving thermal equilibrium. The tendency to thermal equilibrium, or even distribution of kinetic energy, is an expression of the second law of thermodynamics, the driving force of heat transfer. According to the second law of thermodynamics, 'Where there is a temperature difference between objects in proximity, heat transfer between them can never be stopped'; it can only be slowed down. Heat is the energy in transit between systems which occurs by virtue of their temperature difference when they communicate. Heat transfer generally occurs by following three ways:

Conduction:

Thermal conduction is a process of heat transmission from a section of higher temperature to a section of low temperature with a medium (solid, liquid, or gases) or between several mediums in direct physical contact. Conduction does not include any transfer of macroscopic portions of matter relative to one another. The thermal energy may be transmitted by means of electrons which are free to move by the lattice structure of the material. Movement of heat through materials; Fourier's law: $Q = -KA\ dT/\mathrm{dt}$

Convection:

The thermal convection is a process of energy, transference affected from the motion or mixing of a fluid medium. Convection is performing only in a fluid medium and is at once linked to the motion of medium itself. Macroscopic particles of a fluid movement in space cause the heat exchange, and for this reason convection constitutes the macroform of the heat transfer. The effectiveness of heat transfer through convection based largely upon the mixing movement of the fluid. With respect to the origin, types of convection are distinguished; forced and natural convection. Movement of heat by fluids; Newton's law of cooling:

$Q = \mathrm{hc}A(\ T\infty\ -\ TW)$

Radiation:

Radiation is the energy transfer in the form of waves through space without any medium other than conduction and convection. Conduction and convection require a medium like solid or gas but radiation only happen in space through electromagnetic waves. The black body is ideal surface for emits radiation at maximum rate, and the radiation transferred by a black body is called black body radiation. Absorptive α is another important property of a plane, is explained as the division of the radiation energy incident on a surface that is received by the surface. The entire radiation incident on it is absorbed by black body. That is, a blackbody is a perfect absorber (α=1) of radiation. Heat movement by transfer from one body to another:

$$Q = \in \sigma \left(T^4{}_1 - T^4{}_2\right)$$

Extended Surfaces (Fins):

In the heat transfer study, the surface that extends from an object is known as a fin. Fins are used to increase the rate of heat dissipation from or to the environment by increasing the rate of convection. The total of convection, conduction, or radiation of an object decides the amount of heat it dissipates. It increases with the difference of temperature between the environment and the object, also increasing the convection coefficient of heat transfer, or increasing the surface area. But, increase of the area also 4 causes increased resistance to the heat flow. Hence, coefficient of heat transfer is based on the total area (the base and fin surface area) which comes out to be less than that of the base. There are different types of shape and size fins used in engineering applications to increasing the heat transfer rate.

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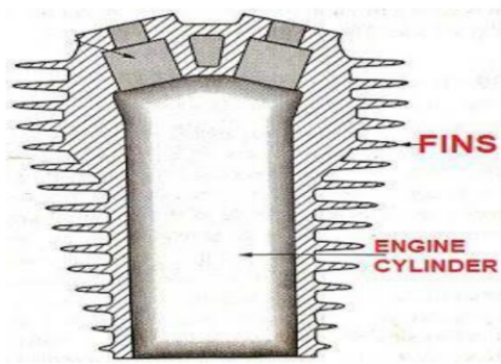
AIR COOLED SYSTEM

Air cooling is a method of dissipating heat. It works by expanding the surface area or increasing the flow of air over the object to be cooled, or both. An example of the former is to add cooling fins to the surface of the object, either by making them integral or by attaching them tightly to the object's surface (to ensure efficient heat transfer). In the case of the latter, it is done by using a fan blowing air into or onto the object one wants to cool. The addition of fins to a heat sink increases its total surface area, resulting in greater cooling effectiveness. There are two types of cooling pads are used in air cooling one is a honey comb and another one is excelsior. The amount of heat dissipated to air depends upon:

1) Amount of air flowing through the fins.
2) Fin surface area.
3) Thermal conductivity of metal used for fins.



Advantages of air cooling:

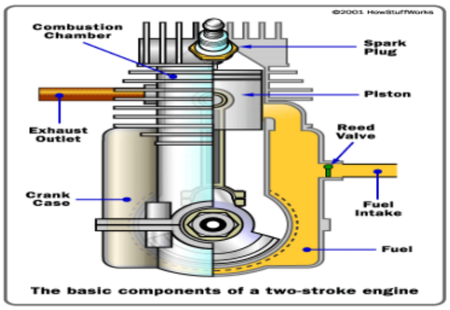
- Low initial investment (costs 10-15 percent as a AC)
- Runs at 1/5 th power consumption of AC
- Doesn't have any special insulation requirements in the rooms
- Simple mechanism. Maintenance is easy and can be done by anyone, Spare parts are easily and cheaply available
- Can humidify air in really dry areas
- Can operate without stabilizers

Disadvantages of air cooling

- Can function only in Dry regions where humidity is less. Cannot be used in coastal regions and areas with high pollution
- Cannot cool without humidification
- Uses a fair amount of water to operate right
- Cannot be precise with the temperature that the cooler will cool to.

APPLICATION OF FINS

- Fins mostly used in Internal combustion engine



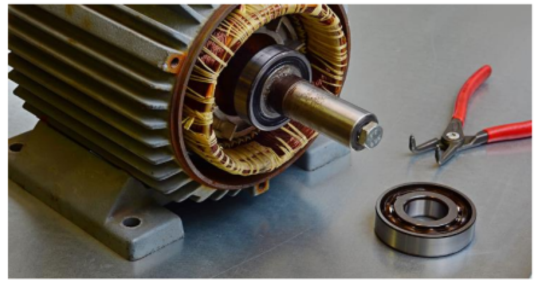
The basic components of a two-stroke engine

Fins used in 4stroke engine

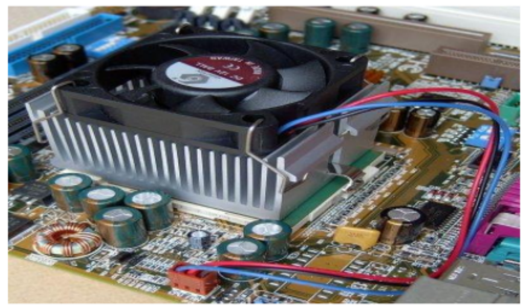
Fins used in 4stroke engine

- Fins used in Air compressors

➢ Fins used in induction motor

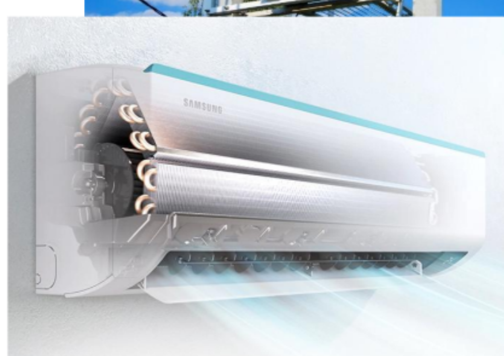


➢ Fins used in heat computers

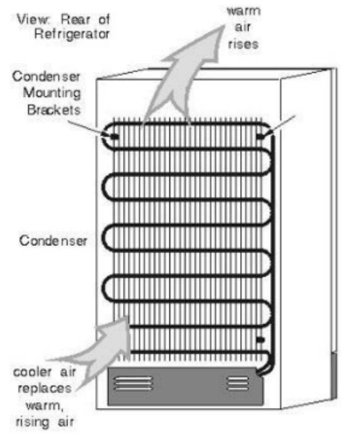


➢ Fins used in transformer

➢ Fins used in AC



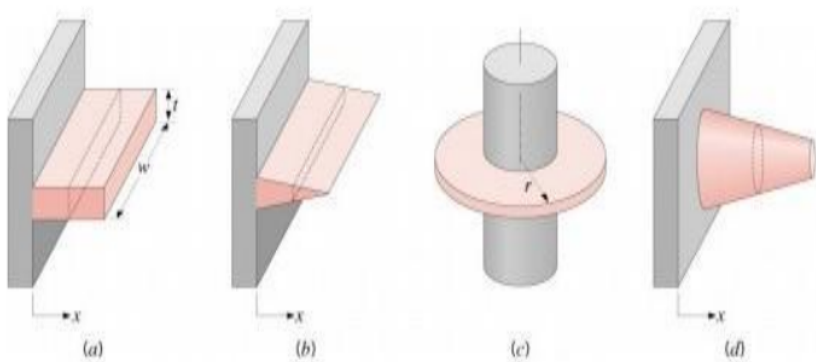
➢Fins used in refrigerator



➢ Fins in nature

TYPES OF FINS

The different types of fin geometries used in an IC engine are Rectangular fins, Triangular fins, Trapezoidal fins, Circular fins.



Types of Fin

Fin Material:

Cast iron: Cast iron is basically an alloy of carbon and silicon with iron. It is containing 2.4 – 3.7 % C, 1.1 – 2.8% Si, 0.3 – 1.1% Mn, 0.16% P and 0.11% S. Cast iron possess high fluidity and hence it cast into any complex shapes and thin sections. It has an excellent wear resistance of grey iron under lubricating sliding conditions has been attributed to the presence of graphite in the micro structure. It possesses high damping capacity in addition to that cast iron is provided the working conditions clean. The material properties of cast iron are given below.

Density	7593.48 Kg/m^3
Specific heat	0.4184 KJ/Kg K
Thermal conductivity	42.97 W/ m^2 K

Aluminum:

aluminum is a silvery white metal and it possess following characteristics:

Light metal, good conductivity, higher resistance to corrosion and very ductile. The melting point of aluminum alloy varies from 520 – 650 oC. It is common to see aluminum fins on engine cylinder and heat exchangers.

In general aluminum is mostly used as fin material because:

- It has good thermal conductivity compared to the cast iron
- Aluminum is lighter in weight.
- High corrosion resistance.
- High surface finish.

Density	2627.00 Kg/m^3
Specific heat	0.854 kJ/kgK
Thermal conductivity	161.00 W/mK

MODIFICATION WE DID IN OUR PROJECT:

Fins are the extended surfaces on engine to increase the rate of heat transfer due to the convection takes place with the ambient air. There are three methods to increase the heat transfer rate :

- ➢By increasing the convection heat transfer coefficient.
- ➢By increasing the length of fin to improve the effectiveness.
- ➢By varying the material we can improve the thermal efficiency.
- ➢By changing the different cross section we can decide the highly effective type.

DESING AND MODELLING:

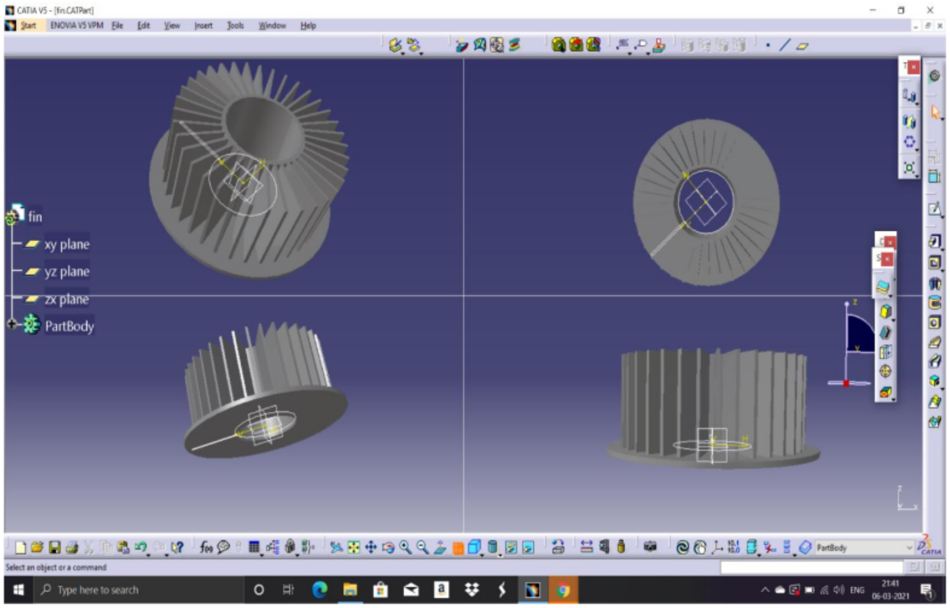
- ➢The design of engine fins done by using CATIA V5 R21 software.
- ➢CATIA is a Computer Aided Three dimensional Interactive Application. It is a solid modelling tool that unites the 3D parametric features to 2D tools and also addresses every design to manufacturing process. Catia provides the capaboility to visualise design in 3D.
- ➢Steps involved in design of fins using CATIA:

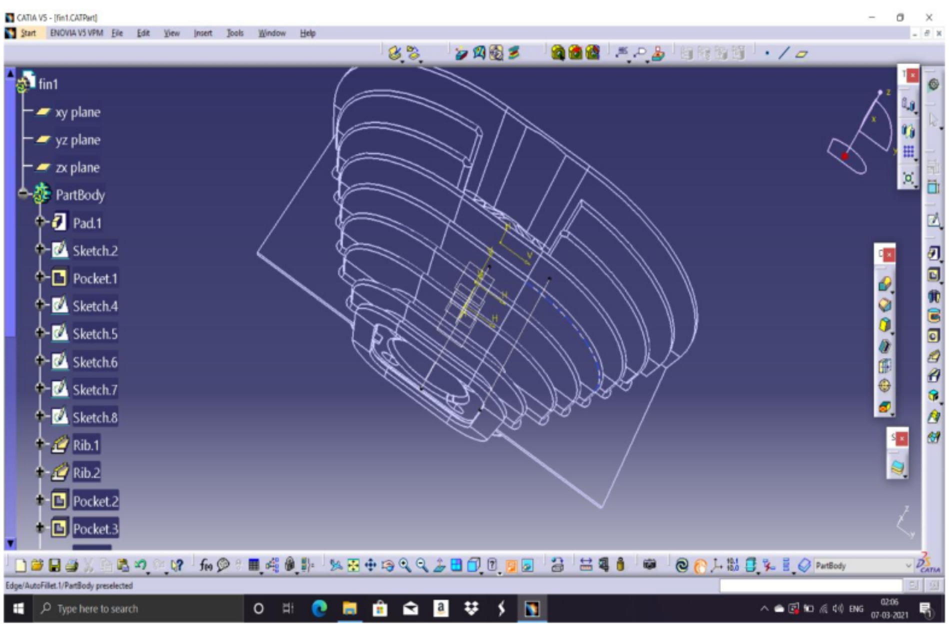
- Draw the individual components of the part in 2D using draw command.
- Set the dimensions for each line using dimensions command.
- Convert the 2D sketch to 3D using pad command.
- Make the holes using pocket command.
- Set the material as aluminium using material command.
- Assemble the individual components in the part drawing.

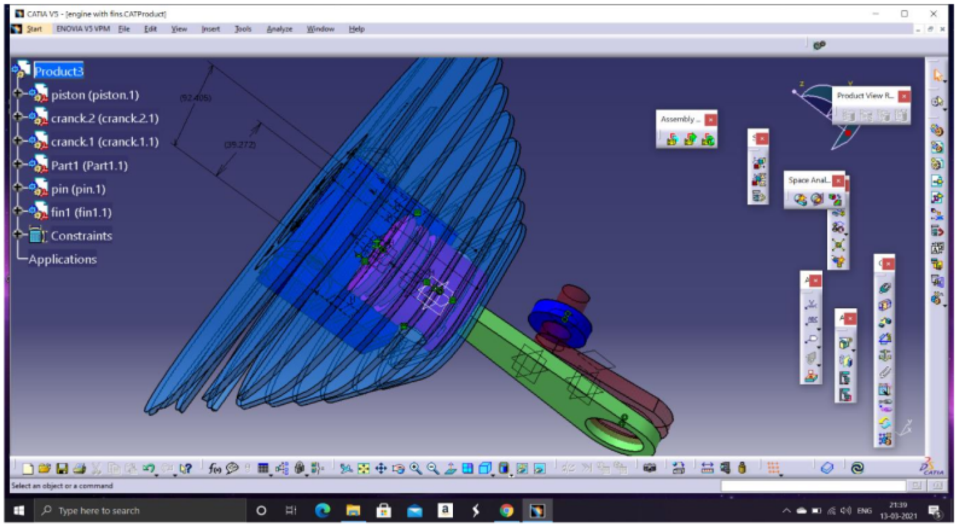
SPECIFICATIONS OF DESIGN:

- ➢Engine type: Kawasaki KX 450CC engine
- ➢Bore: 80mm
- ➢Stroke: 90mm
- ➢Compression Ratio:12.8 : 1
- ➢Fin length: max 80mm & min 20mm
- ➢Fin thickness: 3mm
- ➢Fin type: rectangular fin with curved edges

DESIGN MODELS IN CATIA:





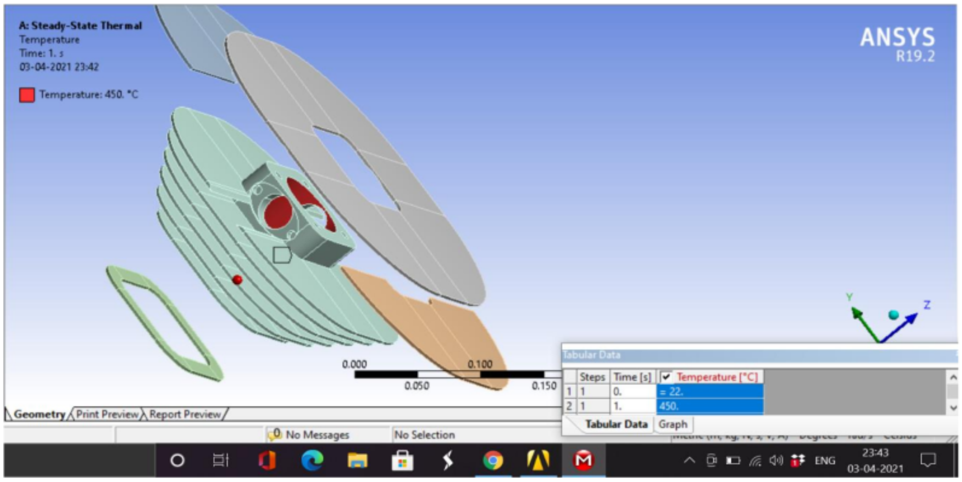


STATIC THERMAL ANALYSIS

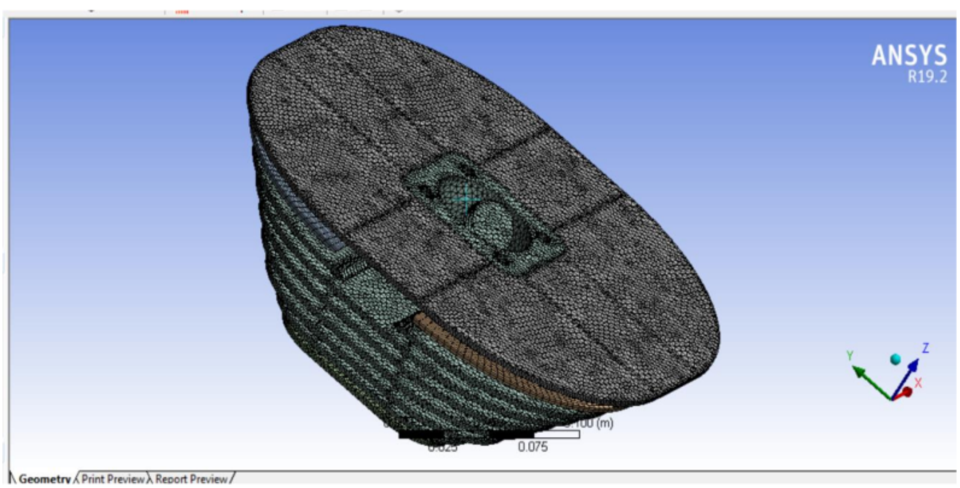
- Thermal static analysis is done by using Ansys 19.2 software.
- **ANSYS:** Ansys 19.2 is an advanced simulation software where we can do different analysis such as static analysis, dynamic analysis, fluid flow analysis, themal analysis etc..
- **Steps involved in Static thermal analysis:**

1. Engineering data
2. Geometry
3. Model
4. Meshing
5. Analysis
6. Results

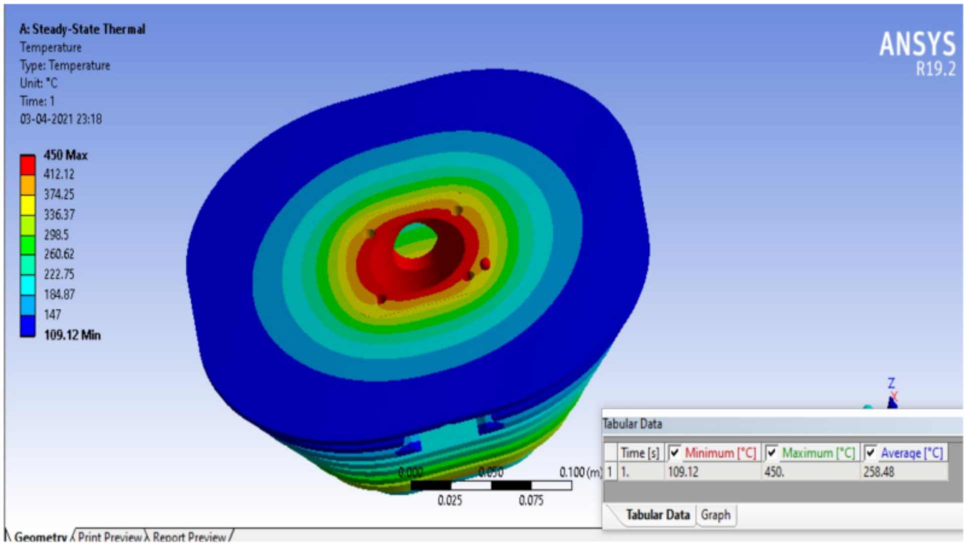
MODEL:



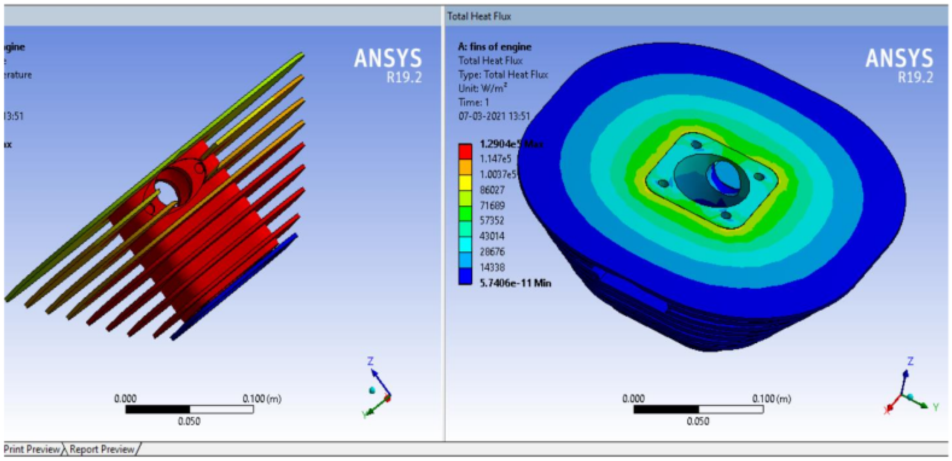
MESHING:



TEMPERATURE ANALYSIS



HEAT FLUX ANALYSIS



RESULTS OBTAINED:

1.Temperature (unit - °C)

For Circular Fin type

	Maximum temperature			Minimum temperature		
	2mm	2.5mm	3mm	2mm	2.5mm	3mm
Aluminium alloy 6061	650.27	650	650	610.62	606.68	601.17
Grey Cast Iron	651.69	650	650	270.22	266.51	252.63
Magnesium alloy	650.14	650	650	627.4	625.42	621.67

For Rectangular Fin Type

	Maximum temperature			Minimum temperature		
	2mm	2.5mm	3mm	2mm	2.5mm	3mm
Aluminium alloy 6061	650	650	650	377.23	363.46	352.5
Grey Cast Iron	650	650	650	40.986	40.124	39.196
Magnesium alloy	650	650	650	445.37	431.41	420.07

CONCLUSION:

- New Modern high efficient fins are designed using CATIA V5.
- Temperatures at different locations are obtained by ansys 19.2 workbench.
- Heat flux distribution at different locations obtained in the ansys 19.2

The effectiveness and efficiency of different fins calculated by varying the c/s and materials

REFERENCES:

1. Gardner, K. A., 1945, “Efficiency of Extended Surfaces,” Trans. ASME, 67, pp. 621–631. 2 Razelos, P., 2002, “A Critical Review of Extended Surface Heat Transfer,” Heat Transfer Eng., 246, pp. 11–28. 3 Razelos, P., 2005, “A New Approach of Extended Surface Heat Transfer,” Proceedings of IMECE2005, Paper 83057, Orlando, FL.
2. J. G. Bartas and W. H. Sellers," Radiation Fin Effectiveness," JOURNAL OF HEAT TRANSFER , TRANS. ASME , Serie s C , vol. 82 , no . 1. Feb., 1960, p. 73.
3. J. G. Bartas and W. H. Sellers," Radiation Fin Effectiveness," JOURNAL OF HEAT TRANSFER , TRANS. ASME , Serie s C , vol. 82 , no . 1. Feb., 1960, p. 73.
4. D. B. MacKay and E. L. Leventhal, "Radiant Heat Transfer From a Flat Plate Uniformly Heated Along One Edge," North American Aviation, Inc., Report M D 58-187, August, 1958.
5. J. E. Wilkins, Jr., "Minimizing the Mass of Thin Radiating Fins," Journal of Aeronautical Sciences, vol. 27, no. 2, Feb., 1960, p. 145.
6. E. N. Nilson and It. Curry, "The Minimum Weight Straight Fin of Triangular Profile Radiating to Space," Journal of Aeronautical Sciences, vol. 27, no. 2, Feb., 1960, p. 146.
7. J. E. Wilkins, Jr., " Minimum Mass Thin Fins Which Transfer Heat Only by Radiation to Surroundings at Absolute Zero," J. Soc. Indust. and Appl Math., Dec., 1960.

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