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Design and Thermal Analysis on Cylinder Fin by Varying By Aluminum Alloy

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ABSTRACT:

The 220cc engine cylinder is one of the major automobile components, 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 220cc 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 220cc engine is very difficult. The main purpose of using these cooling fins is to cool the 220cc engine cylinder by any air A parametric model of piston bore fins has been developed to predict the thermal behavior. The parametric model is created in 3D modeling software Solid works. Thermal analysis is done on the fins to determine variation temperature distribution over time. The analysis is done using ANSYS. Analysis is conducted by varying material. Presently Material used for manufacturing fin body is Cast Iron. In this thesis, it is replaced by aluminum alloy. By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for both condenser and evaporator. So using aluminum alloy is better.

INTRODUCTION TO HEAT ENGINES:

1.1 Heat Engines

Any type of engine or machine which derives heat energy from the combustion of fuel or any other source and coverts this energy into mechanical work is termed as a heat engine.

Heat engines may be classified as:

1. External Combustion Engines
2. Internal Combustion Engines

1.1.1 External Combustion Engines (E.C. Engines)

In this case, combustion of fuel takes place outside of the cylinder as in case of steam engines where the heat of combustion is employed to generate steam which is used to move a piston in a cylinder.

1.1.2 Internal Combustion Engines (I.C. Engines)

In this case, combustion of the fuel with oxygen of the air occurs within the cylinder of the engine. The internal combustion engines group includes engines employing mixtures of combustible gases and air, known as gas engines, those using lighter liquid fuel or spirit known as petrol engines and those using heavier liquid fuels, known as oil compression or diesel engines.

A Two-stroke S.I engine:

Dugald Clark invented the two stroke engine in the year 1878.The two strokes are literally “suction” and “exhaust”. In two stroke engine the cycle is completed in one revolution of the crank shaft. The main difference between two stroke and four stroke engines is in the method of filling the fresh charge and removing the burnt gases from the cylinder. In the four stroke engines these operations are performed by the engine piston during the suction and exhaust strokes respectively. In a two stroke engine, the filling process is accomplished by the charge compressed in the crankcase or by a blower.

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The induction of the compressed charge moves out the product of combustion through exhaust ports. Therefore no piston strokes are required for these two operations. Two strokes are sufficient to complete the cycle, one for compressing the fresh charge and the other for expansion or power stroke.

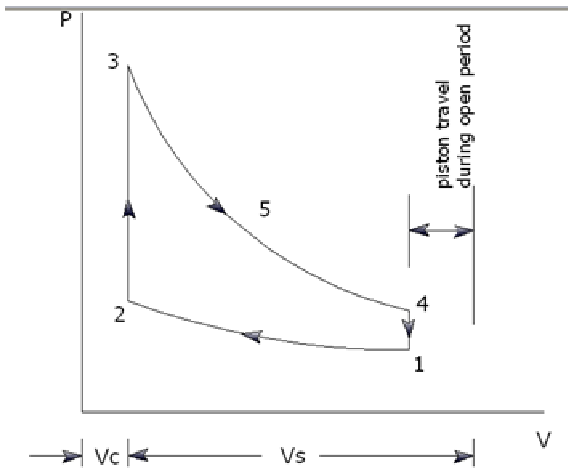

Fig 1: Ideal Indicator Diagram of Two-Stroke SI Engine

A Four stroke S.I engine:

In a four stroke engine, the cycle of operations are completed in four strokes of the piston or two revolutions of the crankshaft. During the four strokes, there are five events to be completed, viz., suction compression, combustion, expansion, and exhaust. Each stroke consists of 180 ^{0} of crankshaft rotation and hence a four stroke cycle is completed through 720 ^{0} of crank rotation. The cycle of operation for an ideal four stroke engine consists of the following strokes. (i) Suction or intake stroke; (ii) Compression stroke; (iii) Expansion or power stroke (iv) Exhaust stroke

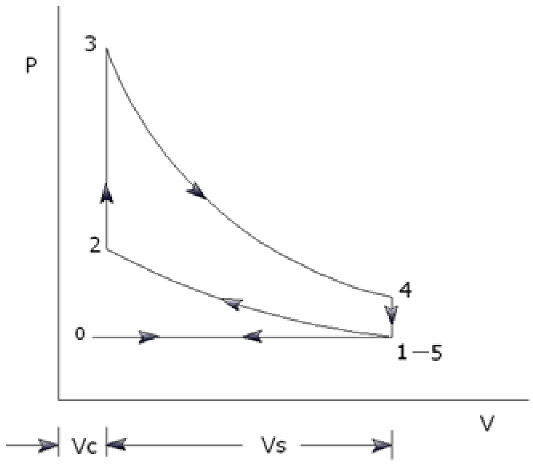

Fig 2: Ideal P-V Diagram of a Four –Stroke SI Engine.

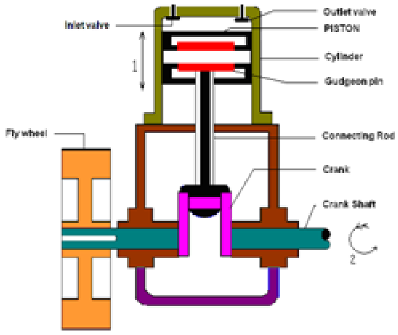

Fig 3: Parts of an I.C Engine.

I. INTRODUCTION TO SOLIDWORKS :

Solid works mechanical design automation software is a feature-based, parametric solid modeling design tool which advantage of the easy to learn windows ™ graphical user interface. We can create fully associate 3-D solid models with or without while utilizing automatic or user defined relations to capture design intent. Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. Numeric parameters can be associated with each other through the use of relations, which allow them to capture design intent.

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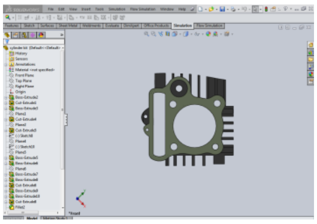
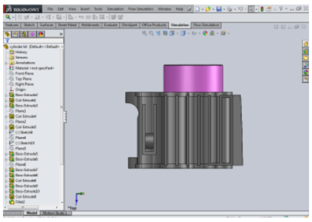
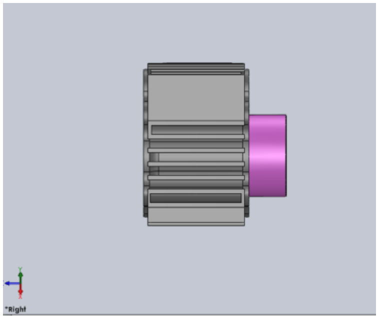
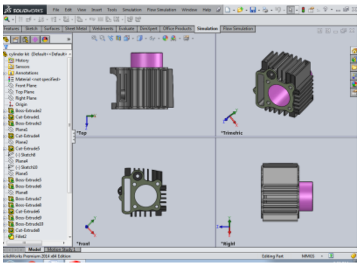
II. DESIGN OF CYLINDER FIN BODY

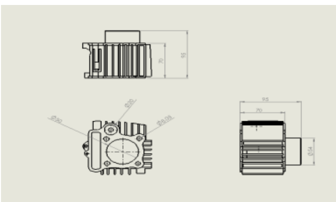
In this a cylinder fin body for 220cc motorcycle is modeled using parametric software SOLIDWORKS.











III. THERMAL ANALYSIS OF CYLINDER FINS

Material used: CAST IRON

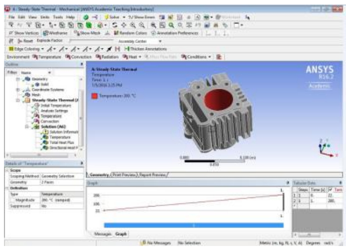


Figure: Input temperature

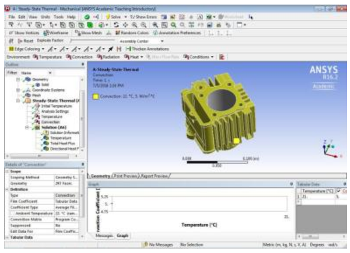


Figure: convection

IV. RESULTS:

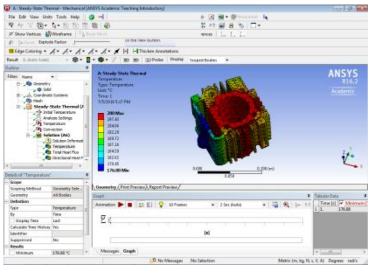


Figure: Temperature distribution

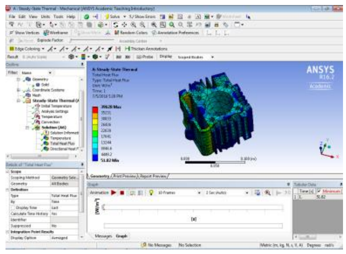


Figure: Total heat flux

Material used: Magnesium Alloy

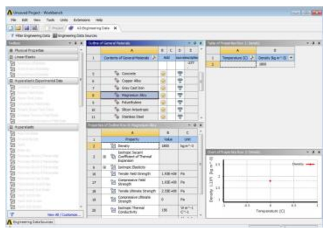


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Figure: Magnesium alloy material properties

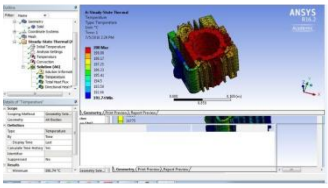

Figure: Temperature distribution

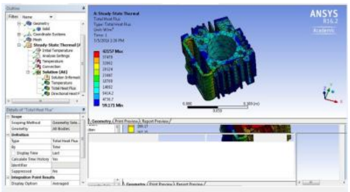

Figure: Total heat flux

Material used: Aluminium Alloy

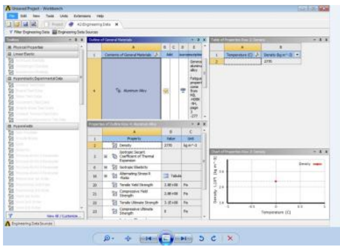

Figure: Aluminium alloy material properties

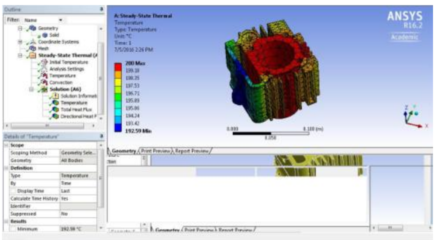

Figure: Temperature distribution

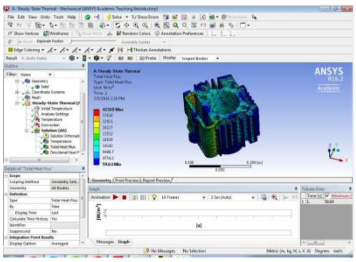

Figure: Total heat flux

V. RESULTS AND DISCUSSIONS

FEA has become a solution to the task of predicting failure due to unknown stresses by showing problem areas in a material and allowing designers to see all of the theoretical stresses within. This method of product design and testing is far superior to the manufacturing costs which would accrue if each sample was actually built and tested. In practice, a finite element analysis usually consists of three principal steps:

A. Preprocessing

The user constructs a model of the part to be analyzed in which the geometry is divided into a number of discrete sub regions, or elements," connected at discrete points called nodes." Certain of these nodes will have fixed displacements, and others will have prescribed loads. These models can be extremely time consuming to prepare, and commercial codes vie with one another to have the most user-friendly graphical "preprocessor" to assist in this rather tedious chore. Some of these preprocessors can overlay a mesh on a preexisting CAD file, so that finite element analysis can be done conveniently as part of the computerized draftingand- design process.

B. Analysis

The dataset prepared by the preprocessor is used as input to the finite element code itself, which constructs and solves a system of linear or nonlinear algebraic equations

$$Kijuj = fi$$

where u and f are the displacements and externally applied forces at the nodal points. The formation of the K matrix is dependent on the type of problem being attacked, and this module will outline the approach for truss and linear elastic stress analyses. Commercial codes may have very large element libraries, with elements appropriate to a wide range of problem types. One of FEA's principal advantages is that many problem types can be addressed with the same code, merely by specifying the appropriate element types from the library.

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C. Postprocessing

In the earlier days of finite element analysis, the user would pore through reams of numbers generated by the code, listing displacements and stresses at discrete positions within the model. It is easy to miss important trends and hot spots this way, and modern codes use graphical displays to assist in visualizing the results. A typical postprocessor display overlay colored contours representing stress levels on the model, showing a full field picture similar to that of photo elastic or moiré experimental results. After the solution has been obtained, there are many ways to present ANSYS' results.

	CAST IRON	MAGNESIUM ALLOY	ALUMINIUM ALLOY
TEMPERATURE DISTRIBUTION(Deg Centigrade)	176.8	191.74	192.59
TOTAL HEAT FLUX(W/M2)	39628	42157	42310

By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for both condenser and evaporator. So using aluminum alloy is better.

CONCLUSION:

The following conclusions can be drawn from the present work:

- The 220cc engine cylinder is one of the major automobile components, 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 220cc 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 220cc engine is very difficult. The main purpose of using these cooling fins is to cool the 220cc engine cylinder by any air A parametric model of piston bore fins has been developed to predict the thermal behavior.
- The parametric model is created in 3D modeling software Solid works. Thermal analysis is done on the fins to determine variation temperature distribution over time. The analysis is done using ANSYS. Analysis is conducted by varying material. Presently Material used for manufacturing fin body is Cast Iron. In this thesis, it is replaced by aluminum alloy.
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REFERENCES:

[1] Gibson, A.H.,"The Air Cooling of Petrol Engines, Proceedings of the Institute of Automobile Engineers", Vol. XIV (1920), pp. 243–275.

[2] Biermann, A.E., Pinkel, B.,"Heat Transfer from Finned Metal Cylinders in an Air Stream", NACA Report No.488 (1935).

[3] Thornhill, D., May, A.,"An Experimental Investigation into the Cooling of Finned Metal Cylinders, in a Free Air Stream", SAE Paper 1999-01-3307, (1999).

[6] Thornhill, D., Graham, A., Cunnigham, G., Troxier, P., Meyer, R.,"Experimental Investigation into the Free Air-Cooling of Air-Cooled Cylinders", SAE Paper 2003-32-0034, (2003).