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TRANSIENT THERMAL ANALYSIS OF PULSAR FINS USING ANSYS SOFTWARE

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Abstract- The engine block is the linchpin of vehicles that run on internal combustion, providing the powerhouse for the vehicle. It is called a "block" because it is usually a solid cast car part, housing the cylinders and their components inside a cooled and lubricated crankcase. This part is designed to be extremely strong and sturdy, because its failure results in failure of the car, which will not function until the engine block is replaced or repaired.

The main aim of the project is to analyze the thermal properties by varying geometry of cylinder block fins using ANSYS work bench. The 3D model of the geometries are created using CREO parametric and its thermal properties are analyzed using Ansys workbench 14.5. 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. 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

Key words: *pulsar fins, CREO software, ANSYS software*

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I. INTRODUCTION

Engine block

The internal combustion engine is an engine in which the combustion of a fuel (normally a fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber. 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. An engine block is the structure which contains the cylinders, and other parts, of an internal combustion engine. In an early automotive engine, the engine block consisted of just the cylinder block, to which a separate crankcase was attached. Modern engine blocks typically have the crankcase integrated with the cylinder block as a single component. Engine blocks often also include elements such as coolant passages and oil galleries.

Cylinder blocks

Cylinders cast in a single block of six, with integrated crankcase (turbocharger in background) A cylinder block is the structure which contains the cylinder, plus any cylinder sleeves and coolant passages. In the earliest decades of internal combustion engine development, cylinders were usually cast individually, so cylinder blocks were usually produced individually for each cylinder. Following that, engines began to combine two or three cylinders into a single cylinder block, with an engine combining several of these cylinder blocks combined together. In early engines with multiple cylinder banks — such as a V6, V8 or flat-6 engine — each bank was typically a separate cylinder block (or multiple blocks per bank). Since the 1930s, mass production methods have developed to allow both banks of cylinders to be integrated into the same cylinder block.

Most modern internal combustion engines are cooled by a closed circuit carrying liquid coolant through channels in the engine block, where the coolant absorbs heat, to a heat exchanger or radiator where the coolant releases heat into the air. Thus, while they are ultimately cooled by air, because of the liquid coolant circuit they are known as water-cooled. In contrast, heat generated by an air-cooled engine is released directly into the air. Typically this is facilitated with metal fins covering the outside of the cylinders which increase the surface area that air can act on.

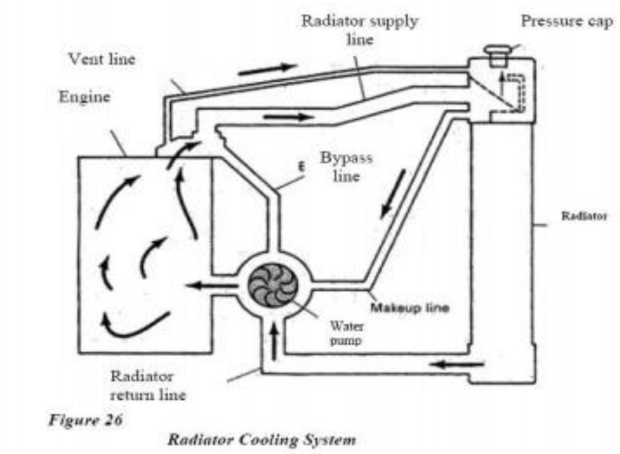


Figure 26 *Radiator Cooling System*

Fins:

A fin is a surface that extends from an object to increase the rate of heat transfer to or from the environment by increasing convection. The amount of conduction, convection, radiation of an object determines the amount of heat it transfers. Increasing the temperature difference between the object and the environment, increasing the convection heat transfer coefficient, or increasing the surface area of the object increases the heat transfer. Sometimes it is not economical or it is not feasible to change the first two options. Adding a fin to the object, however, increases the surface area and can sometimes be economical solution to heat transfer problems.

LITERATURE REVIEW

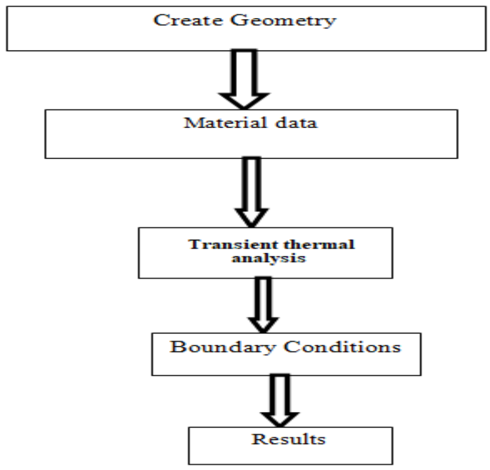
D. R. Parthasarathi et al [1] The cylinder block forms the basic framework of the engine, it houses the engine cylinders, which serve as bearings and guides for the pistons reciprocating in them. The analysis of the engine block is to be carried out to predict its behavior under static and dynamic loading. The cylinder block has to withstand the stresses and deformations due to loads acting on it. The solid model of the block is generated in CATIA V5 R21. The model is imported to HYPERMESH 11 through IGES format. The quality mesh is prepared in HYPERMESH for converged solution and the solver set as ANSYS in which loads and boundary conditions are applied for analysis. By using different materials Aluminium, Grey cast iron, Steel, Titanium and Brass. The static analysis is performed to predict the deformations and stresses. The model analysis using lanczo's algorithm to predict the natural frequencies and corresponding mode shapes

Objectives of the project

The following are the main objectives of the present work:

- To design cylinder with fins for a 150cc engine by varying the geometry such as rectangular, circular and curve shaped (parabolic) with different materials and temperatures.
- To determine the heat transfer coefficient with help of CFD analysis
- To determine thermal properties of the proposed fin models.
- To identify suitable alloy for the based on results obtained from finite element analysis and analytical method.

Methodology



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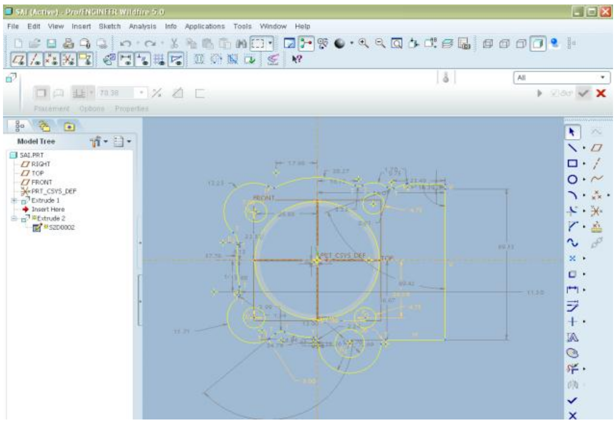
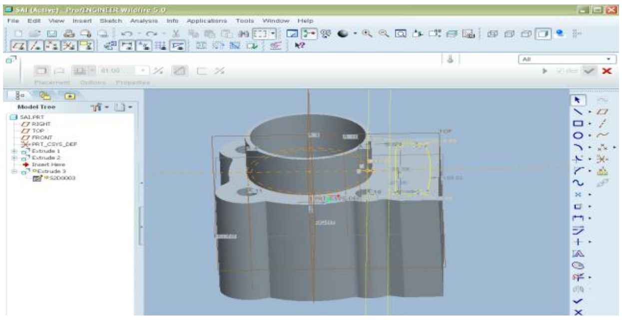
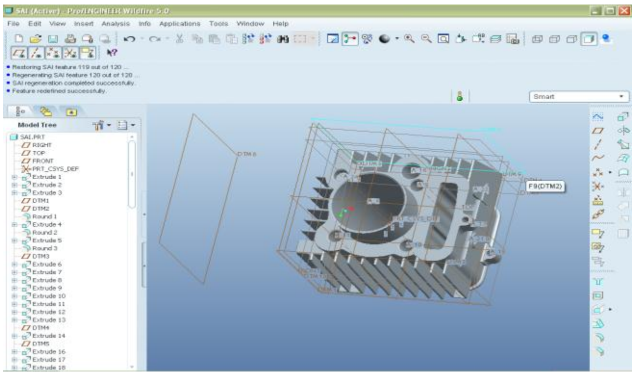
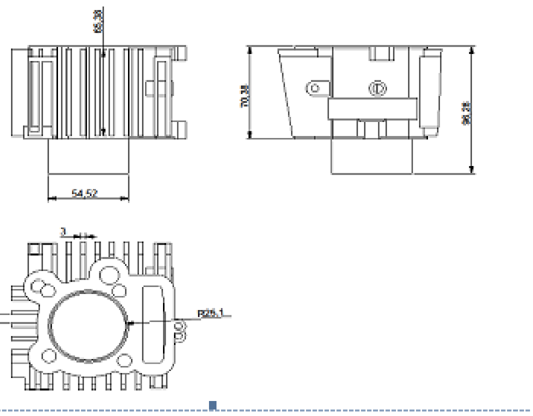
3d modeling using CREO software



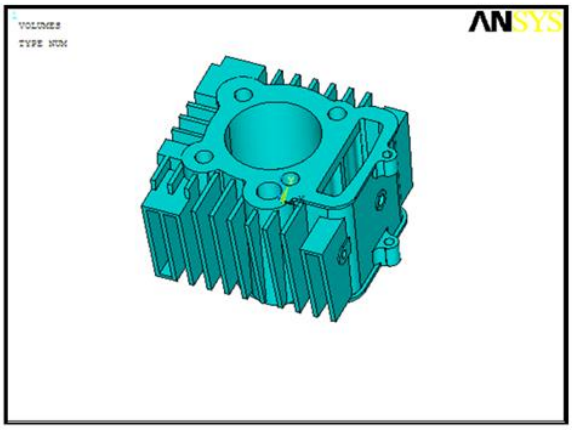




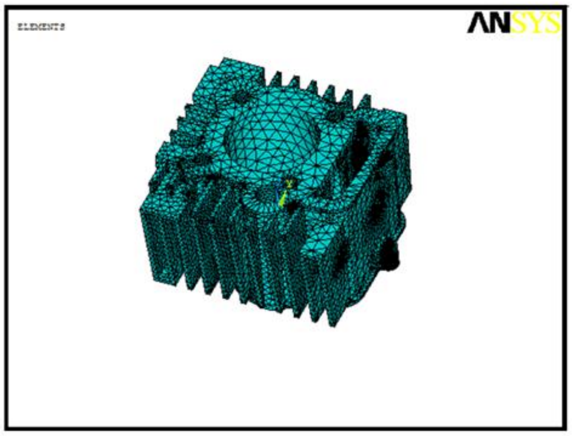
2d model



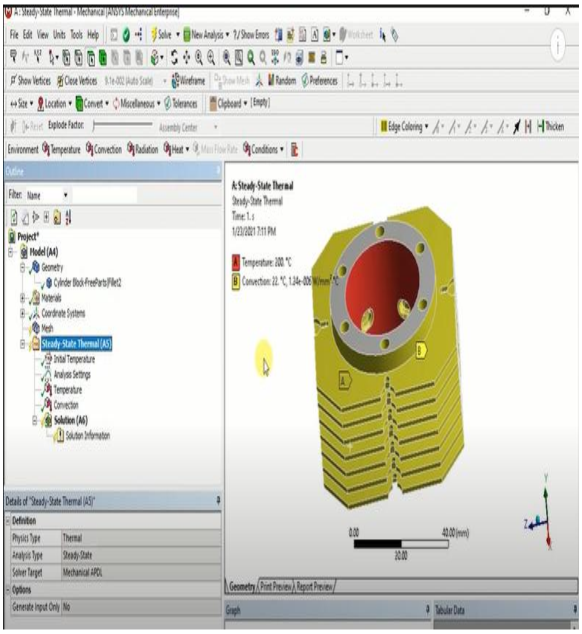
Import geometry



Meshing



Boundary conditions



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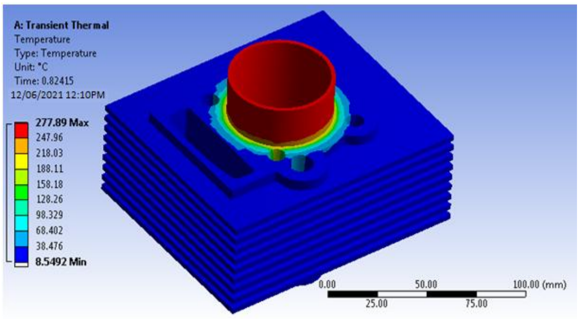
RECTANGULAR FINS

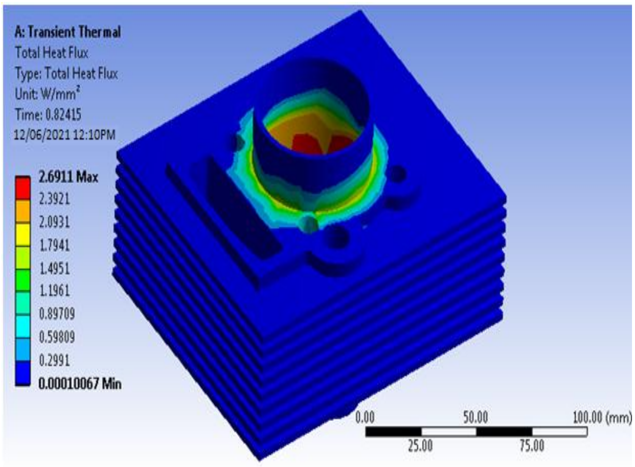
MATERIAL: CAST IRON

At temperature -200^{o}C

Temperature distribution



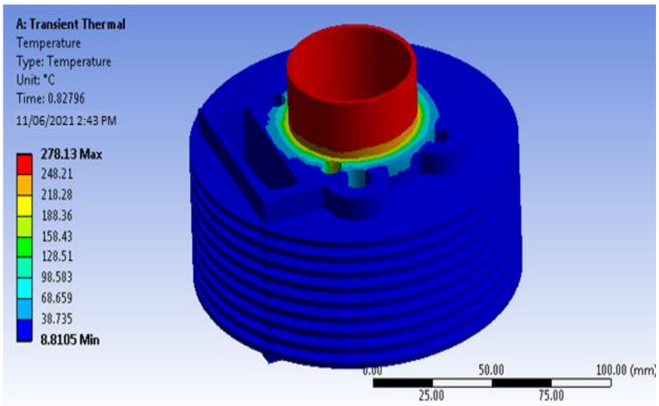
Heat flux



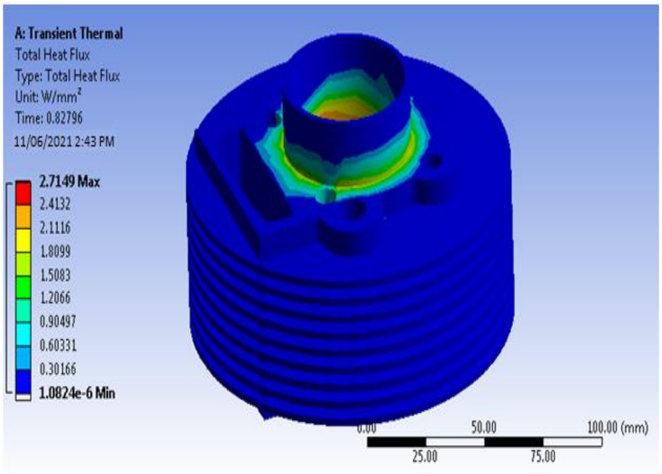
CYLINDERICAL FINS

MATERIAL: CAST IRON

At temperature -275^{o}C



Heat flux



RESULSTS AND DISCUSSIONS

CASE: 1 CYLINDERICAL FIN

MATERIALS	Inlet Temperatures(^{0}C)	Temperature distribution (^{0}C)	Heat flux (W/mm^2)
Cast iron	275	278.13	2.7149
	560	564.37	3.7906
	1020	1020	6.4992
Aluminum alloy 7475	275	279.82	7.0614
	560	603.3	12.434
	1020	1025.1	21.352

RECTANGULAR FINS

MATERIALS	Inlet Temperatures(^{0}C)	Temperature distribution (^{0}C)	Heat flux (W/mm^2)
Cast iron	275	277.89	2.6911
	560	564.22	3.6097
	1020	1020	6.1749
Aluminum alloy 7475	275	279.66	6.3826
	560	596.38	11.52
	1020	1024.2	19.878

AERODYNAMIC FINS

MATERIALS	Inlet Temperatures(^{0}C)	Temperature distribution (^{0}C)	Heat flux (W/mm^2)
Cast iron	275	278.05	2.625
	560	574.72	3.5038
	1020	1020	5.9864
Aluminum alloy 7475	275	279.61	3.994
	560	593.45	11.039
	1020	1023.9	19.298

CURVED FINS

MATERIALS	Inlet Temperatures(^{0}C)	Temperature distribution (^{0}C)	Heat flux (W/mm^2)
Cast iron	275	278.68	2.8957
	560	561.02	4.3058
	1020	1020.7	7.5072
Aluminum alloy 7475	275	279.62	7.688
	560	585.25	13.505
	1020	1026.3	23.567

CONCLUSION

The main aim of the project is to analyze the thermal properties by varying geometry of cylinder fins using Ansys work bench. The 3D model of the geometries are created using CREO and its thermal properties are analyzed using Ansys workbench 14.5. 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.

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. Curved fin shaped cylinder block can be used for increasing the heat transfer from the fins by creating turbulence for upcoming air.

SCOPE FOR FUTURE WORK

In the present computation, constant temperature boundary conditions are considered along the walls. The model presents an idealized situation. The solution of the conjugate heat transfer problem can be expected to yield predictions that are more exact. The computations can further be performed comparing different types of fin shapes.

- The present work can be further extended for different geometries of the inserts (fins) being used between the plates of the compact heat exchanger.

The computations are performed assuming the flow regime to be turbulence model and force convection. And changes of geometry make in only rectangular fin may be similar type of geometry can change in different geometry shape

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