Design and Analysis of IC Engine Piston with Different Material

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Abstract: In today's world scenario, there is tremendous development in the field of automobile and every day, there is a new invention to do better out transport facility. Also company may concentrated on very important fact, service after sale it is consider spinal code in the field of automobile. Most of the company may spend their 50% of their income on research and development to make their vehicle better. Previously this task is very expensive in absence of recent technology, for testing and design like CAD/CAM and the analysis software like Ansys software, the prediction is very difficult about any product. Also CFD play major role for the aerodynamic designing for the automobile. Using Different CAD/CAM software one can design the product as per the requirement, and can also manufacture easily on CNC machine. This project work is based on composite materials used in automobile; there are lots of composite materials used in automobile application. In this case, we are studying the scope of different material combinations for manufacturing compositepistons.In this study two different models of composite pistons are studied under engine operating conditions with different material combinations, for model development we use Catia V5 and forAnalysis we use Ansys 15.0

Keywords: *CAD/CAM,CFD,Computer Numerical Control,Ansys,Catia,Composite Materials.*

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INTRODUCTION:

The internal combustion engine is an engine in which the burning of a fuel occurs in a confined space called a combustion chamber. This exothermic reaction of a fuel with an oxidizer creates gases of high temperature and pressure, which are permitted to expand. The defining feature of an internal combustion engine is that useful work is performed by the expanding hot gases acting directly to cause movement, for example by acting on pistons, rotors, or even by pressing on and moving the entire engine itself.

This contrasts with external combustion engines, such as steam engines, which use the combustion process to heat a separate working fluid, typically water or steam, which then in turn does work, for example by pressing on a steam actuated piston

STRUCTURE OF PAPER

The paper is organized as follows: In Section 1, the introduction of the paper is provided along with the structure, important terms, objectives and overall description. In Section 2 we discuss related work. In Section 3 We have given the Experimental work i.e process involved in powder mettalurgy A Section 4we have giv*en* results and analysis discussed in the abstract. Section 5we have given the conclusion and future scope 6 It includes References.

OBJECTIVES

In mechanical engineering, sliding cylinder with a closed head (the piston) that is moved reciprocally in a slightly larger cylindrical chamber (the cylinder) by or against pressure of a fluid, as in an engine or pump. The cylinder of a steam engine is closed by plates at both ends, with provision for the piston rod, which is rigidly attached to the piston, to pass through one of the end cover plates by means of a gland and stuffing box (steam-tight joint).The cylinder of an internal combustion engine is closed at one end by a plate called the head and open at the other end to permit free oscillation of the connecting rod, which joins the piston to the crankshaft. The cylinder head contains the spark plugs on spark-ignition (gasoline) engines and usually the fuel nozzle on compression-ignition (diesel) engines; on most engines the valves that control the admission of fresh air–fuel mixtures and the escape of burned fuel are also located in the head.

Composites refers to an object that is composed of two separate metals joined together. Instead of being a mixture of two or more metals, like alloys, bimetallic objects consist of layers of different metals. Trimetal and tetra metal refer to objects composed of three and four separate metals respectively.

RELATED WORK

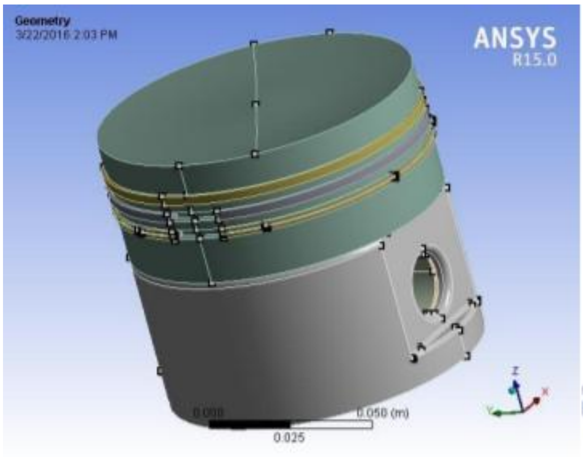
The internal combustion engine is an engine in which the burning of a fuel occurs in a confined space called a combustion chamber. This exothermic reaction of a fuel with an oxidizer creates gases of high temperature and pressure, which are permitted to expand. The defining feature of an internal combustion engine is that useful work is performed by the expanding hot gases acting directly to cause movement, for example by acting on pistons, rotors, or even by pressing on and moving the entire engine itself

BOUNDARY CONDITIONS

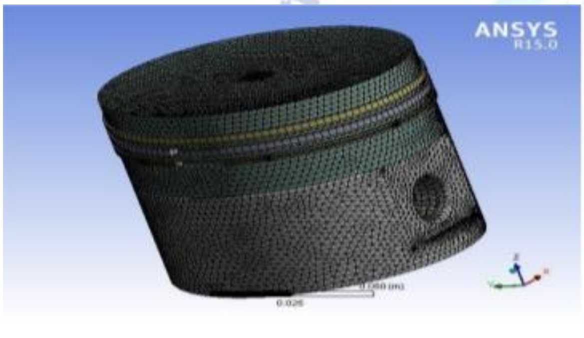
The main aim to save the piston at elevated working conditions. The size of the piston is a constraine for particular working conditions. To reduce the weight of the piston weight to strength ratio needs to be decreased for better performance of piston. The piston material can be improved by using diffrernt combinations to improve the thermal properties and mechanical properties of the piston. The composite materials improve the high loading capacity and thermal properties at elevated conditions. Since the geometry of the piston and working condition is constant, the material used for piston is variable here to study the bheaviour of piston with different material under constant loading conditions gives enough results to study the piston.

THERMAL ANALYSIS OF MODEL-1 PISTON WITH CAST IRON

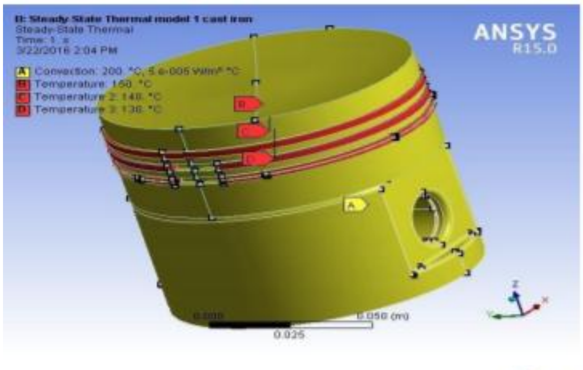
IMPORT MODEL



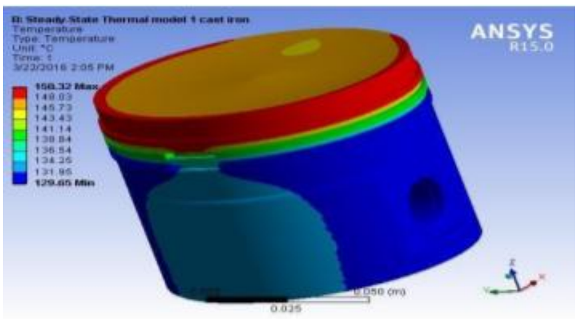
MESH MODAL:



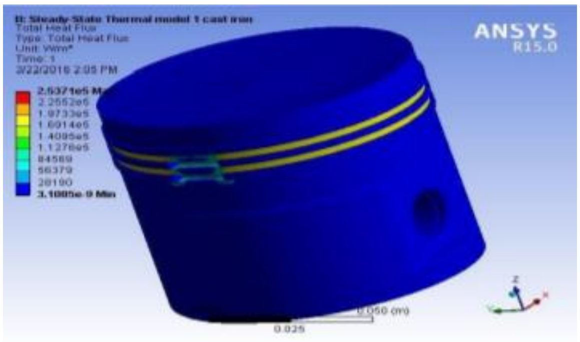
INPUT DATA



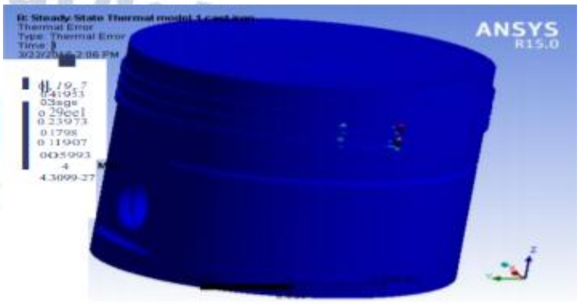
TEMPERATURE



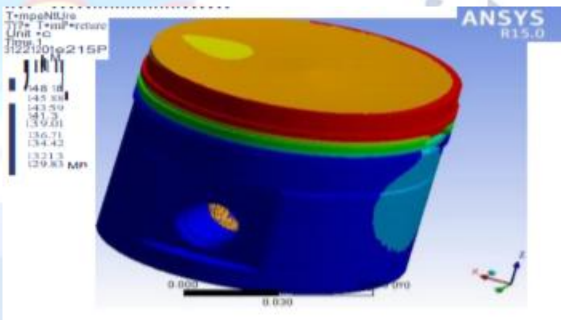
TOTAL HEAT FLUX



THERMAL ERROR



THERMAL ANALYSIS OF MODEL 1 PISTON WITH AL2024/CAST IRON TEMPERTURE:



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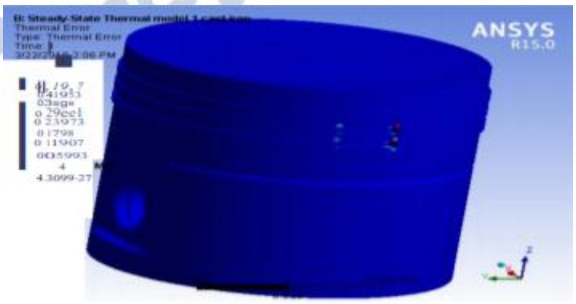
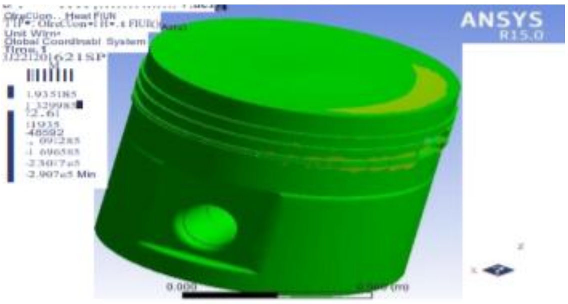


DIRECTIONAL HEAT FLUX



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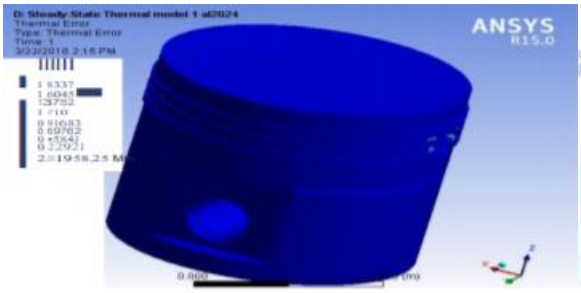
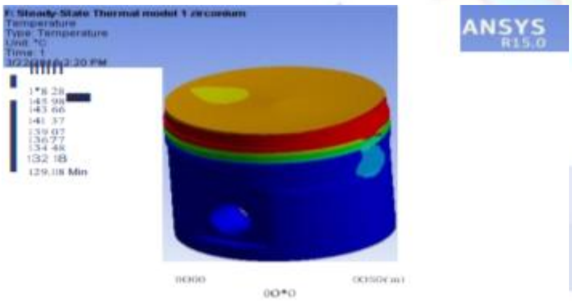


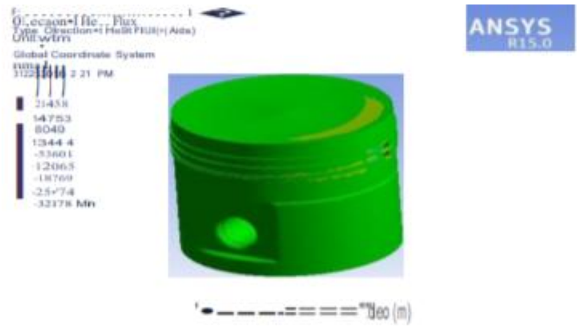
THERMAL ANALYSIS OF MODEL - 1PISTON WITH ZIRCONIUM/CAST IRON

TEMPERTURE:



TOTAL HEAT FLUX

DIRECTIONAL HEAT FLUX



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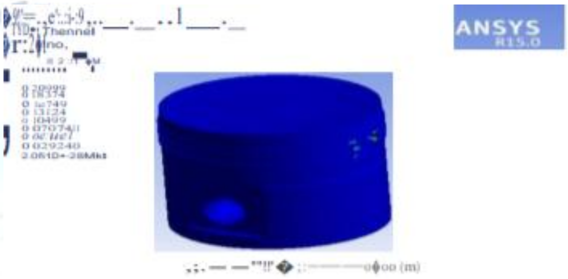

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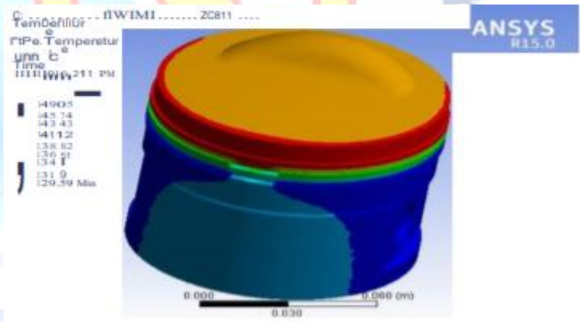

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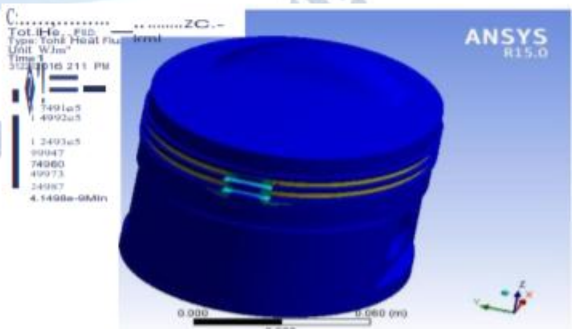

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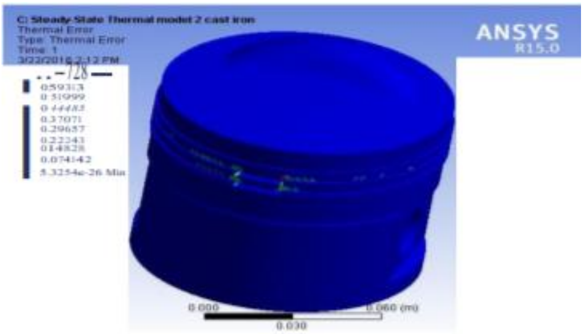

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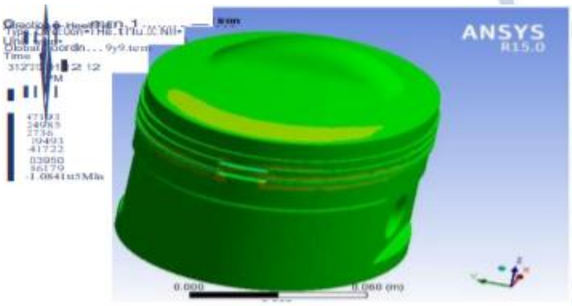
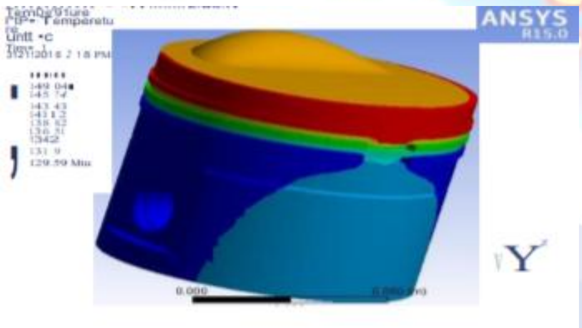


THERMAL ANALYSIS OF MODEL - 2 PISTON WITH AL-2024/CAST IRON TEMPERTURE:



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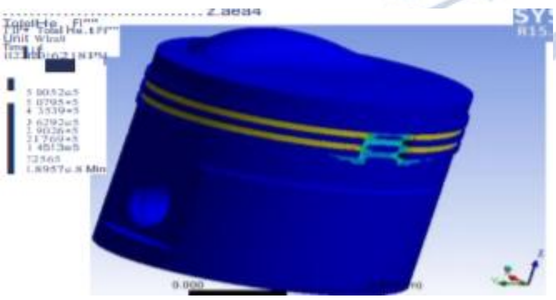

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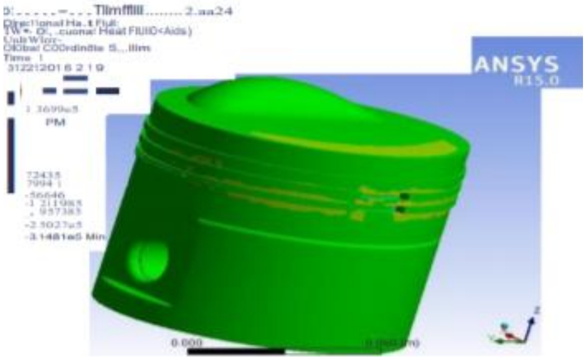

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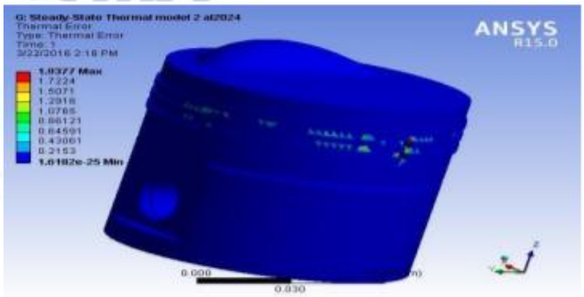
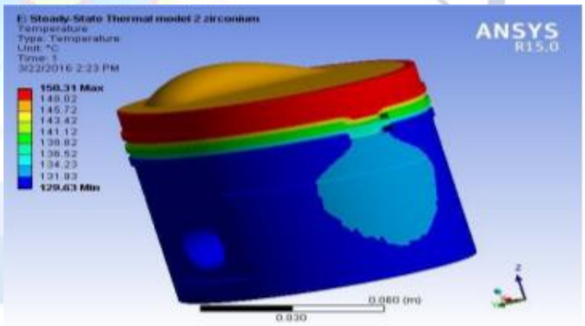


THERMAL ANALYSIS OF MODEL 2 PISTON WITH ZIRCONIUM/CAST IRON TEMPERTURE



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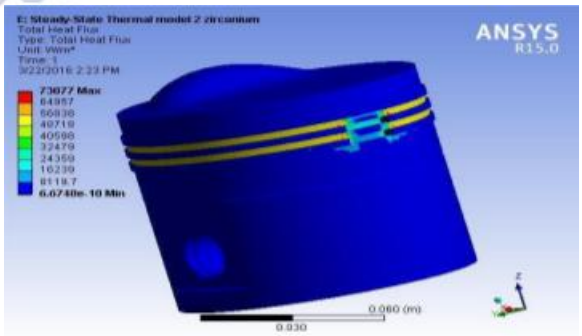

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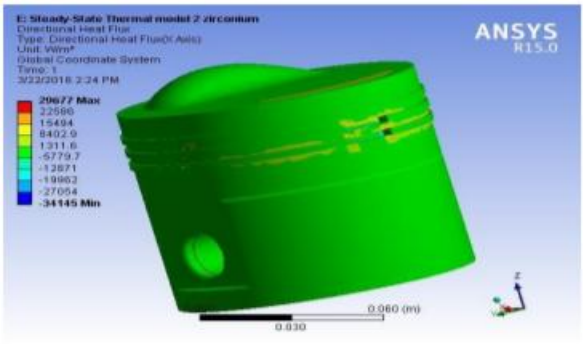

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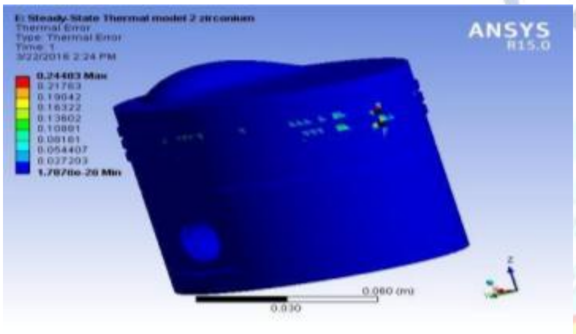

RESULTS

RESULTCOMPARISONTABLEFOR MODEL1

Mo del 1	Temperature (°C)		Total HeatFlux (W/m^2)		Directional Heat Flux (W/m^2)		Error	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Cas t iron	129.65	150.32	3.11E-09	2.54E+05	-1.32E+05	1.06E+05	4.31E-27	0.5394
Al2 024	129.83	150.47	2.03E-08	6.76E+05	-2.91E+05	2.54E+05	2.62E-25	2.0629
Zir con ium	129.88	150.56	1.50E-09	75565	-32178	28163	2.85E-26	0.2362 4

RESULTCOMPARISONTABLEFOR MODEL2

Mo del 2	Temperature (°C)		Total HeatFlux (W/m^2)		Directional Heat Flux (W/m^2)		Error	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Cas t iron	129.59	150.35	4.15E-09	2.25E+05	-1.08E+05	91651	5.33E-26	0.6728
Al2 024	129.59	150.35	1.70E-08	6.53E+05	-3.15E+05	2.66E+05	1.62E-25	1.9377
Zir con ium	129.63	150.31	6.67E-10	73077	-34145	29677	1.79E-26	0.2448 3

CONCLUSION

This project work is based on bi-metallic piston used in automobile. There are lots of bimetallic components used in automobile application. In this case, bimetallic piston rod is identified with two metals. It reduces the thermal stress in the material to overcome this serious problem. Here in this thesis we have designed two different model pistons using CAD software – CATIA and Thermal analysis is done using two different materials i.e., AL 2024 and Zirconium. Along with cast iron, complete cast-iron model and model using al2024 and zirconium are tested using Ansys 15.0.As from the results obtained, if we compare the values from tables and graphs, we can conclude that for both models zirconium material has the life standard because zirconium develops very less fluxes when compared with aluminium and cast-iron. Also instead of manufacturing a complete zirconium piston it costs less when we us it in bimetallic concept.

FUTURE SCOPE

The study on this project is done using only two materials i.e., - Al 2025 and Zirconium. So, study can be further extended by considering different materials for the study. Also, the bi-metals used in this study can be replaced by different Metal matrix composites.

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