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Improving the Life of an Engine Block by Varying Materials

Kollu Srinivasa Rao
MTech Student
Kakinada Institute Of Technology & Science, Divili,
Andhra Pradesh, India.

Mr. Sanmala Rajasekhar
Associate Professor
Kakinada Institute Of Technology & Science, Divili,
Andhra Pradesh, India.

Mr. A.V. Sridhar
Associate Professor
Kakinada Institute Of Technology & Science, Divili,
Andhra Pradesh, India.

ABSTRACT:

The cylinder block is the largest part of the engine. Its upper section carries the cylinders and pistons. Normally, the lower section forms the crankcase, and supports the crankshaft. Cylinder blocks made of aluminum are lighter than cast-iron blocks of the same size. The major engine components include the cylinder block, cylinder head, pistons, connecting rods and crankshaft. Internal combustion engine cooling uses either air or a liquid to remove the waste heat from an internal combustion engine. For small or special purpose engines, air cooling makes for a lightweight and relatively simple system, if we use materials with better waste heat dissipation it will help in achieving better efficiencies and long life of engine.

This thesis was conducted to study the thermal fluxes in various materials of engine block at various operating temperatures. Thermal analysis is done on the engine block by varying the materials. Presently we considered ALUMINUM 7475, CARBON STEEL AISI 1095, INCOLE 713C, NICKEL ALUMINUM BRONZE ALLOY.

Keywords: ***Engine, Materials, Cylinder, Heat, air cooling, combustion, crankshaft, pistons, connecting rods, cast-iron, Carbon steel, Nickel Aluminum, Bronze alloy.***

I. INTRODUCTION

A V8 engine is an eight-cylinder V engine with the cylinders mounted on the crankcase in two sets of four cylinders, in most cases set at a right angle to each other, but sometimes at a narrower angle, with all eight pistons driving a common crankshaft.

In its simplest form, it is basically two inline-four engines sharing a common crankshaft. However, this simple configuration, with a flat- or single-plane crankshaft, has the same secondary dynamic imbalance problems as two straight-4s, resulting in vibrations in large engine displacements. Since the 1920s most V8s have used the somewhat more complex crossplane crankshaft with heavy counterweights to eliminate the vibrations. This results in an engine that is smoother than a V6, while being considerably less expensive than a V12 engine. Most racing V8s continue to use the single plane crankshaft because it allows faster acceleration and more efficient exhaust system designs.

ENGINE BLOCK

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.

Most engine blocks are made of cast iron, although in the late 1990s, some made from plastic and other experimental materials were being used in prototype cars with the hope of developing more lightweight, efficient vehicles. A cast iron one can comprise a substantial portion of the weight of the car, and usually requires multiple people to be removed and worked on safely.

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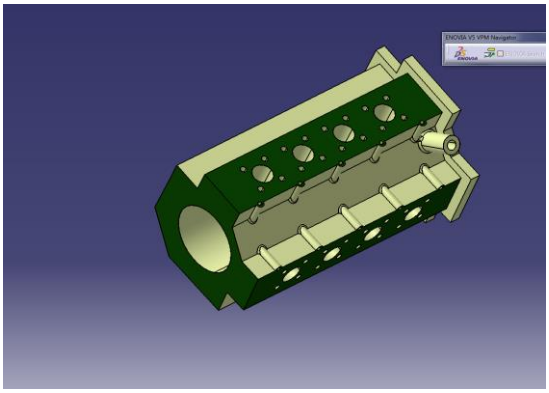
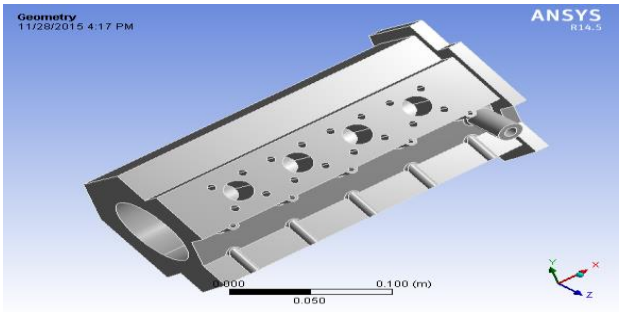
DESIGN OF ENGINE CYLINDER BLOCK

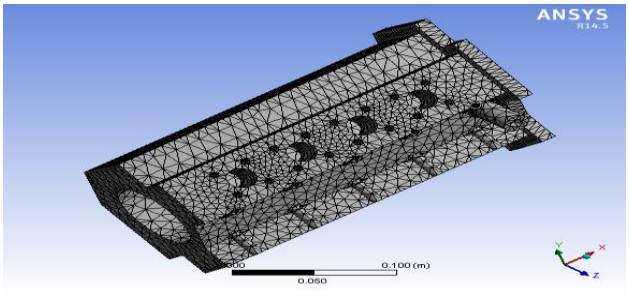


THERMAL ANALYSIS OF ENGINE BLOCK AT 142^{O}C

IMPORT MODEL



MESH MODEL



ENGINE BLOCK WITH AL 7475 AT 142^{O}C

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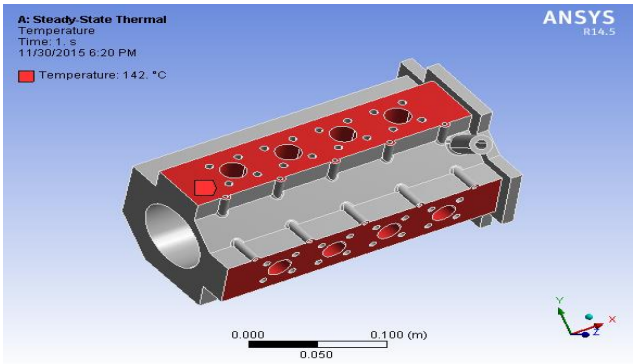

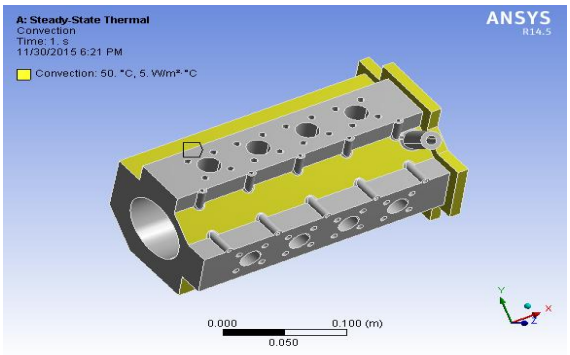

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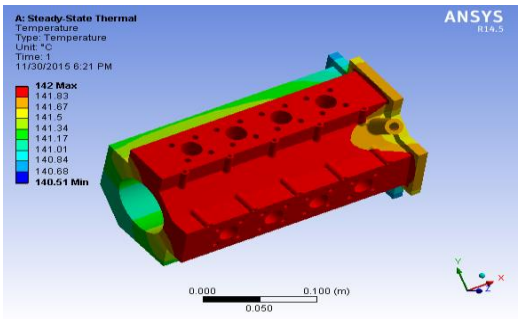

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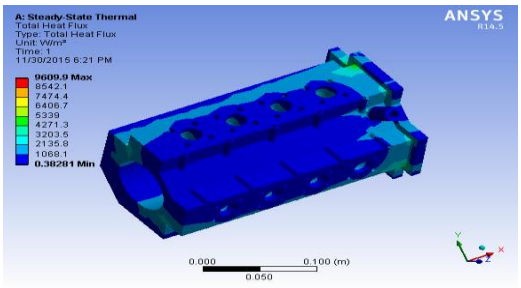

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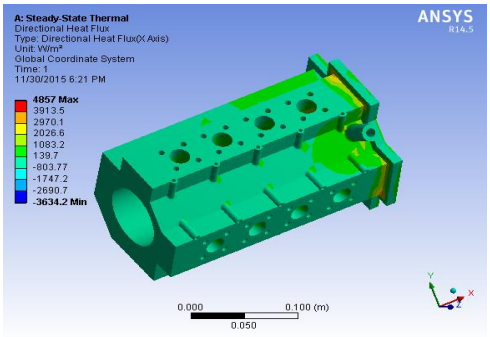

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ENGINE BLOCK WITH CARBON STEEL AISI 1095 AT 142^{O}C

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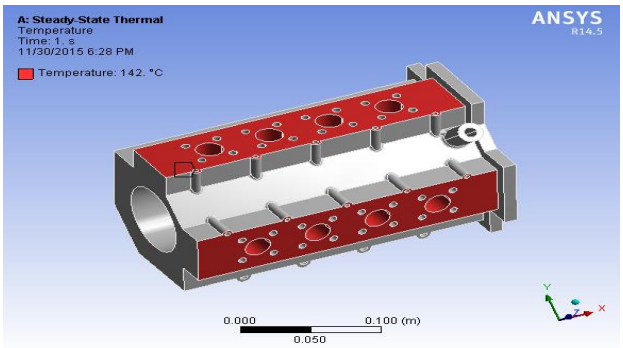

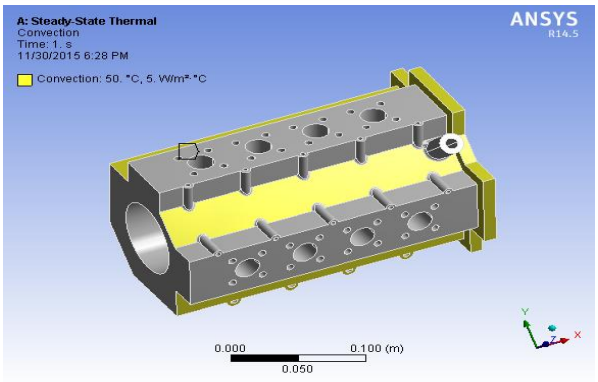

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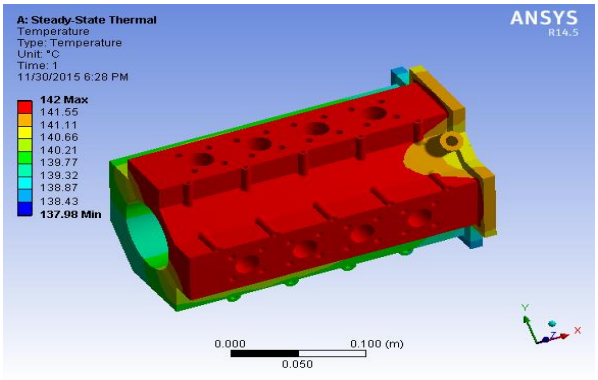

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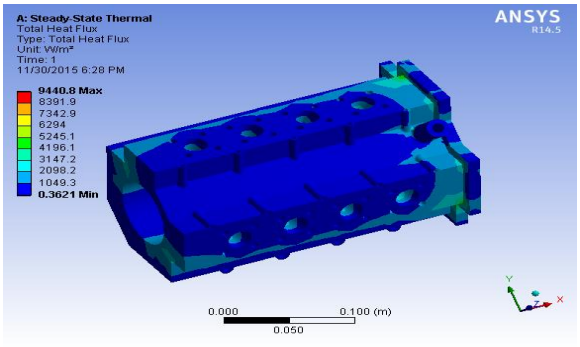

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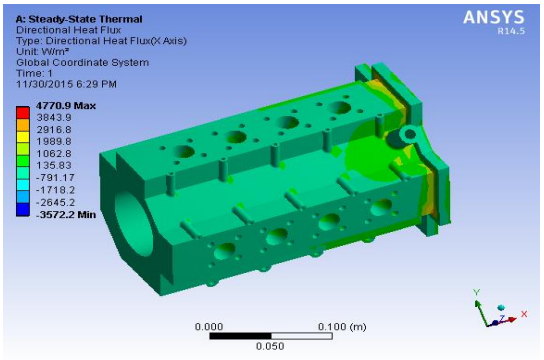

ENGINE BLOCK WITH INCOLE 713C AT 142^{O}C

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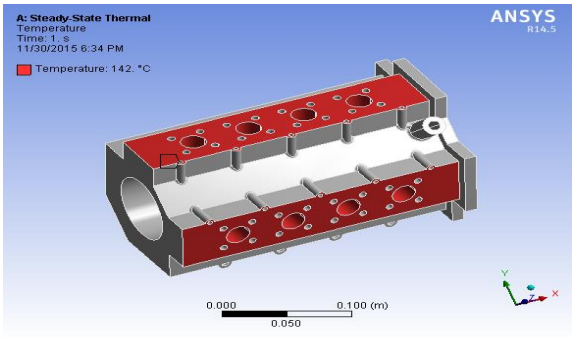

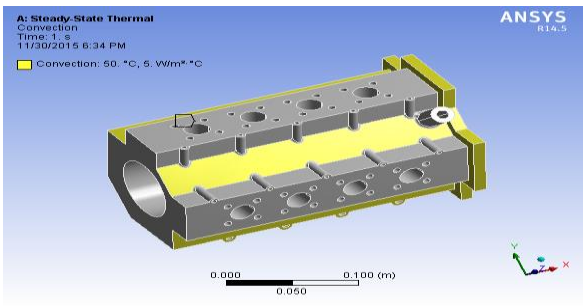

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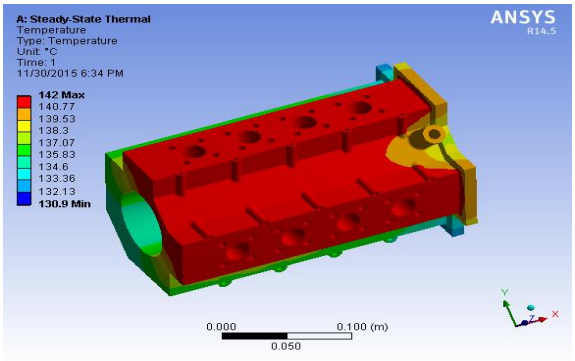

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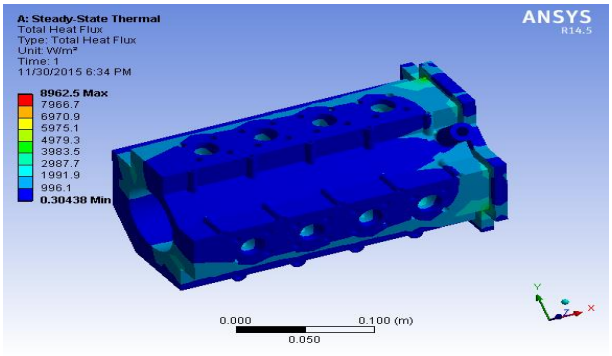

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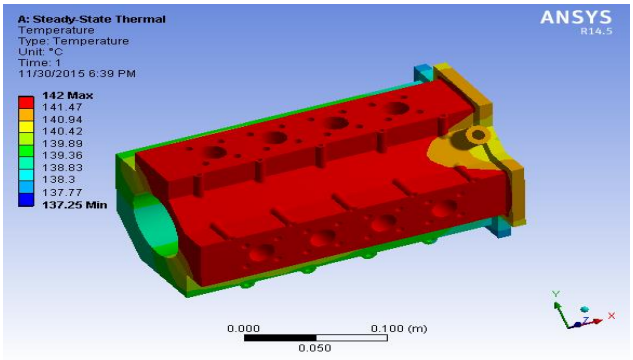

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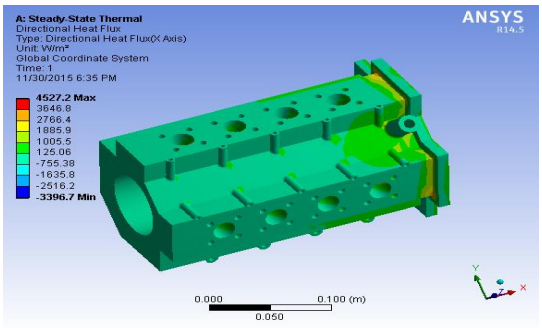

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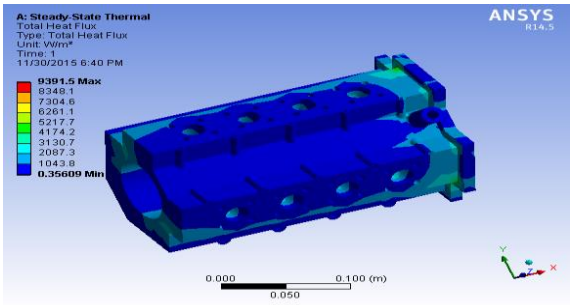

ENGINE BLOCK WITH NICKEL ALUMINUM BRONZE ALLOY AT 142^{O}C

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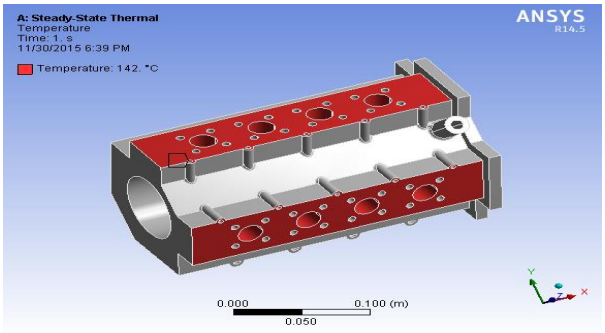

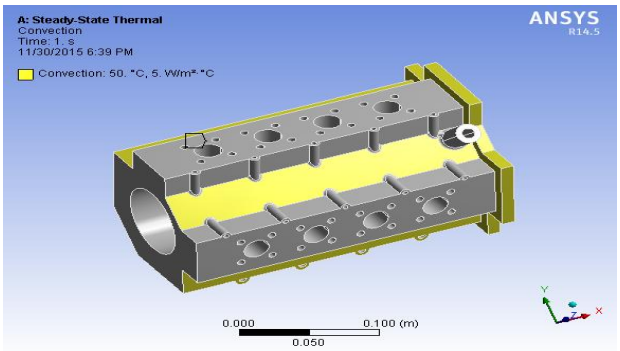

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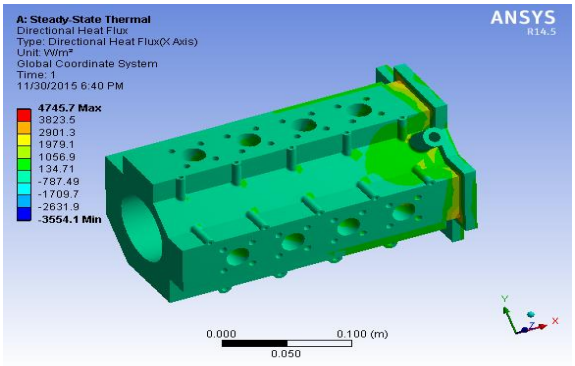
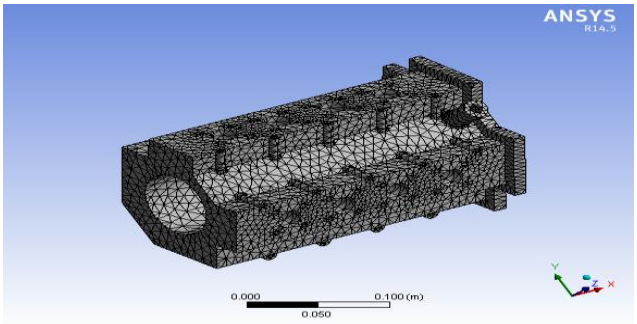


THERMAL ANALYSIS OF ENGINE BLOCK AT 248^{O}C



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ENGINE BLOCK WITH AL 7475 AT 248^{O}C

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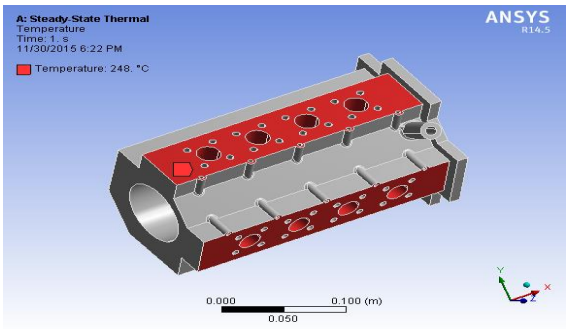

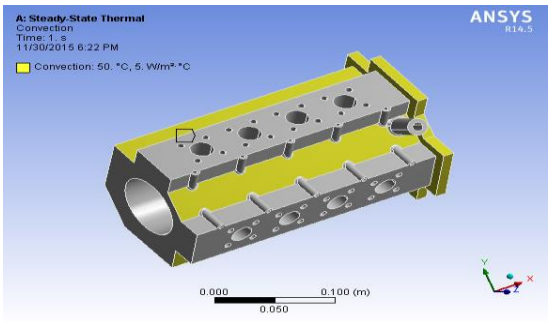

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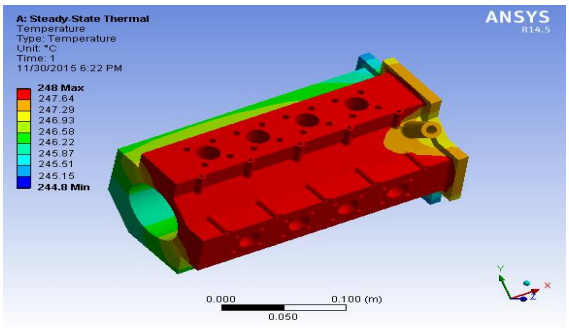

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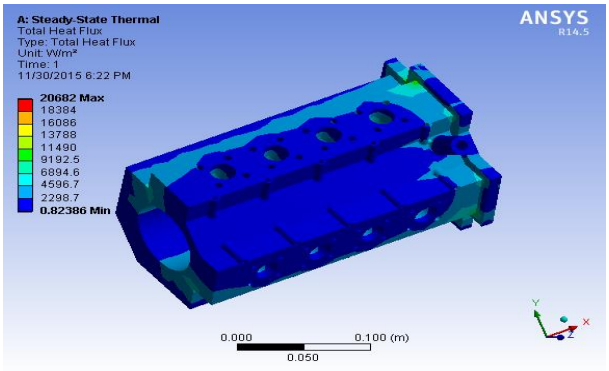

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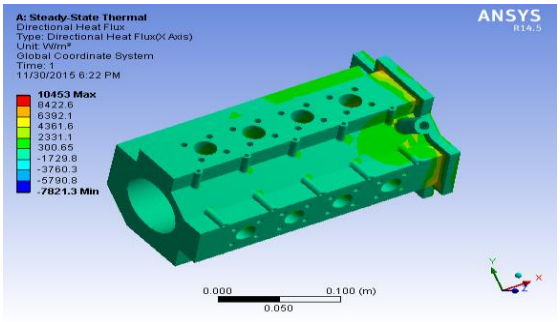

ENGINE BLOCK WITH CARBON STEEL AISI 1095 AT 248^{O}C

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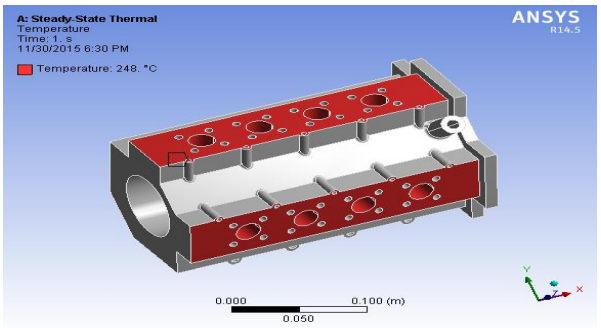

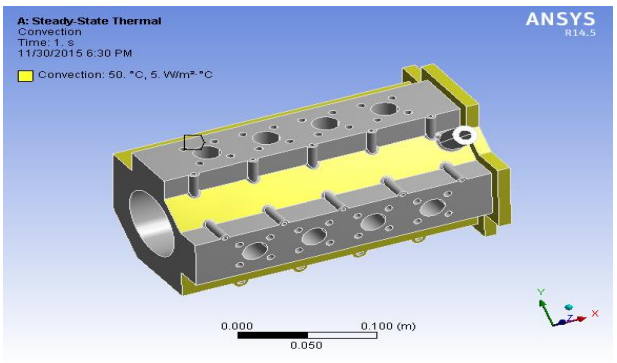

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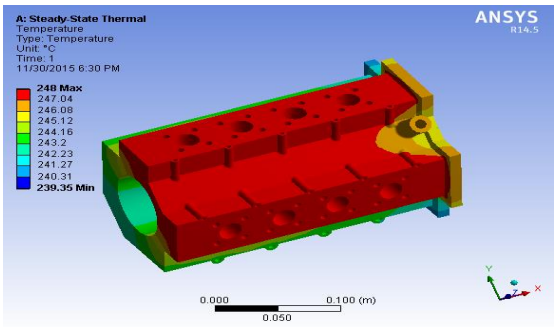

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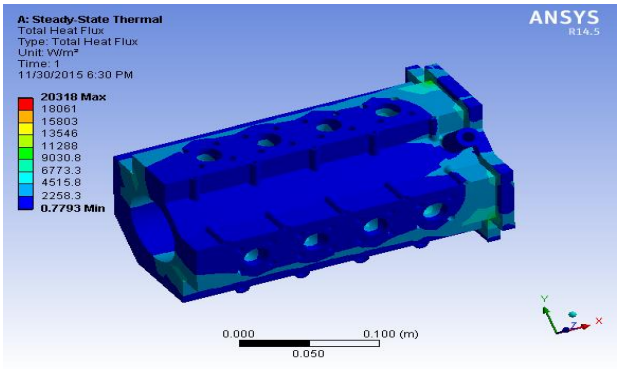

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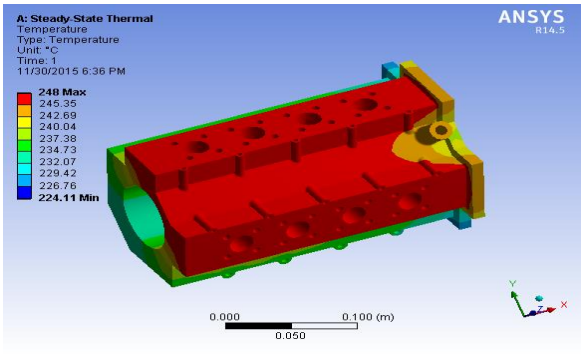

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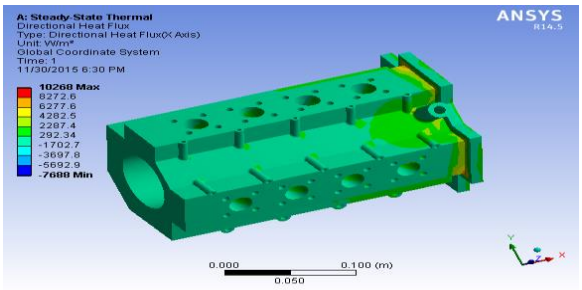

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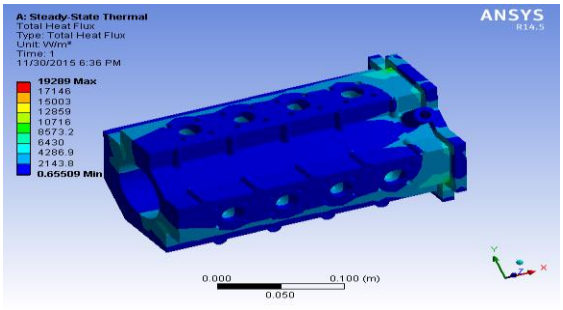

ENGINE BLOCK WITH INCOLE 713C AT 248^{O}C

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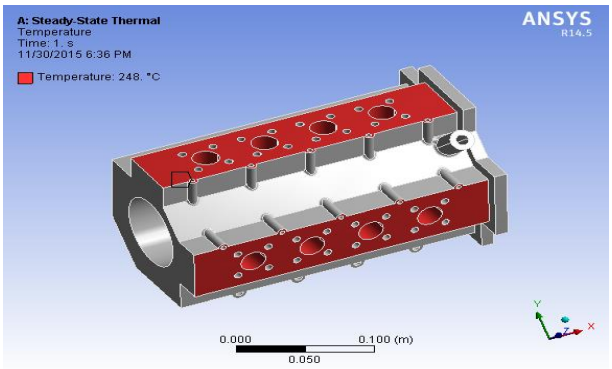

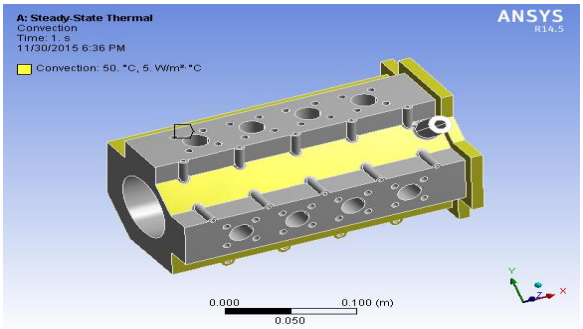

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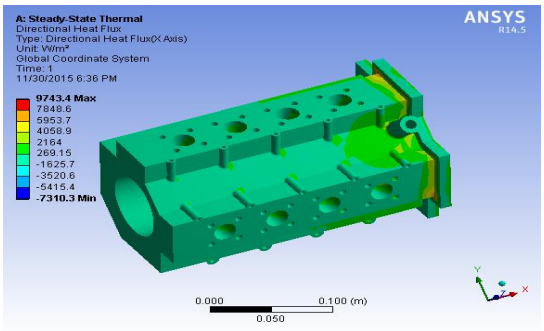

ENGINE BLOCK WITH NICKEL ALUMINUM BRONZE ALLOY AT 248^{O}C

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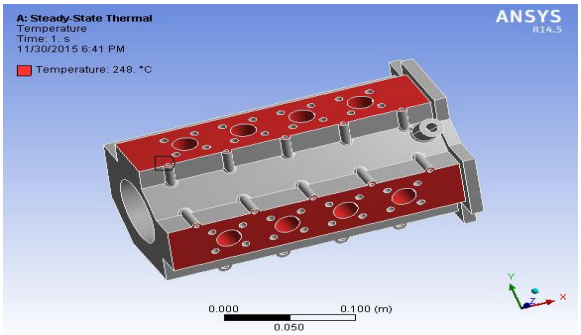

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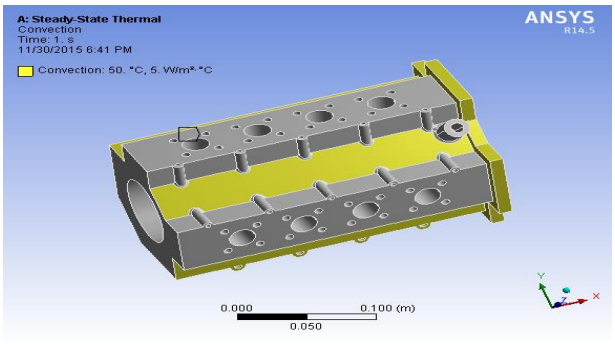

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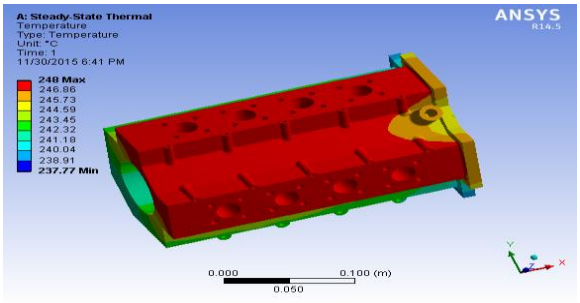

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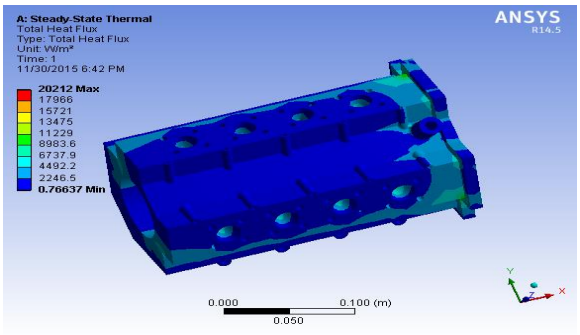

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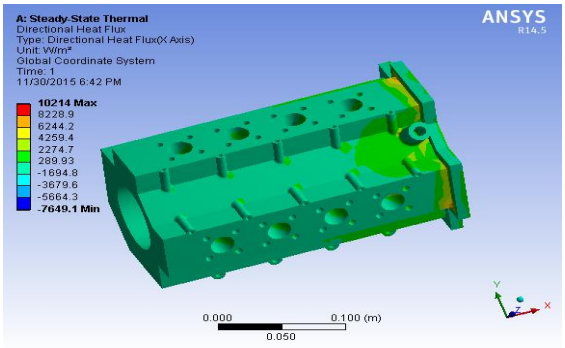

ENGINE BLOCK WITH AL 7475 AT 317^{O}C

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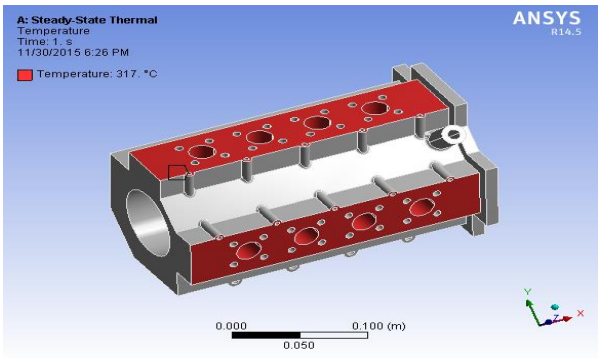

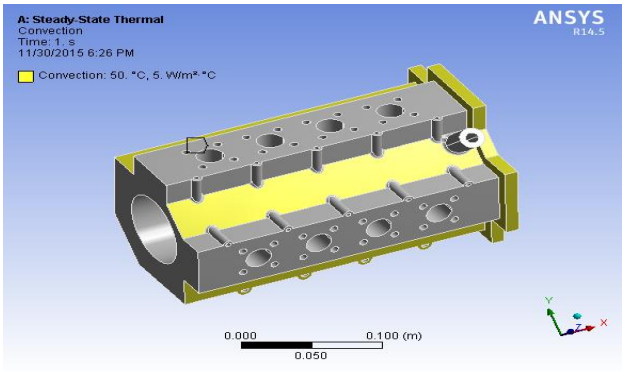

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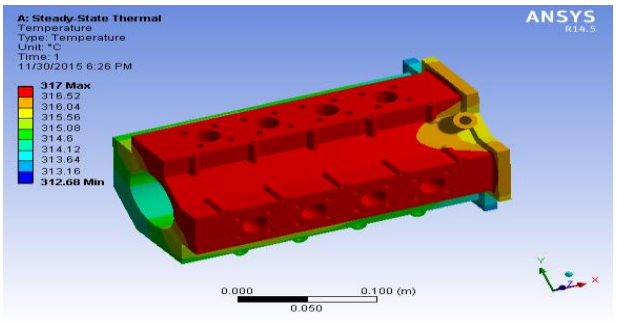

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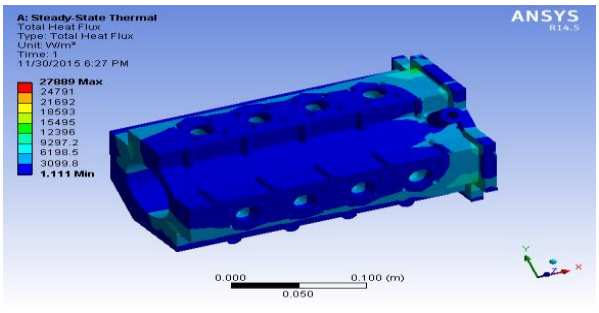

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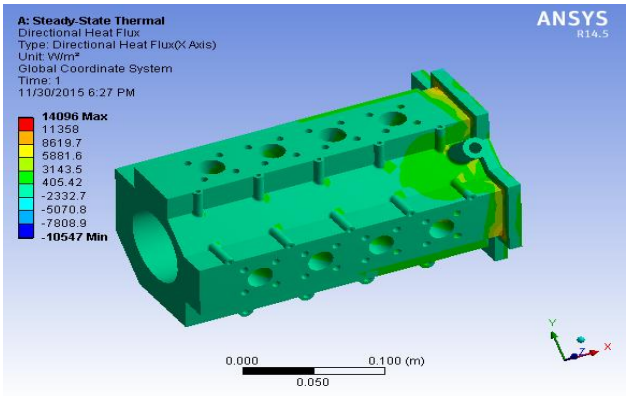
DIRECTIONAL HEAT FLUX



ENGINE BLOCK WITH CARBON STEEL AISI 1095 AT 248^{O}C

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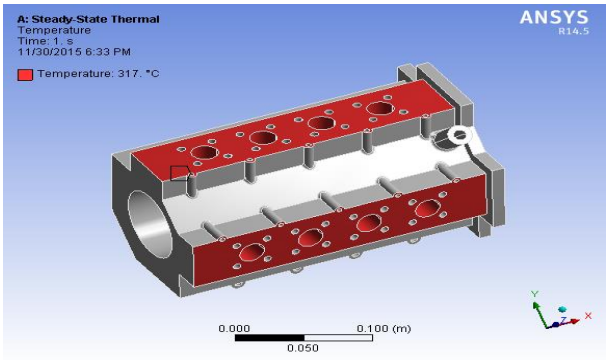
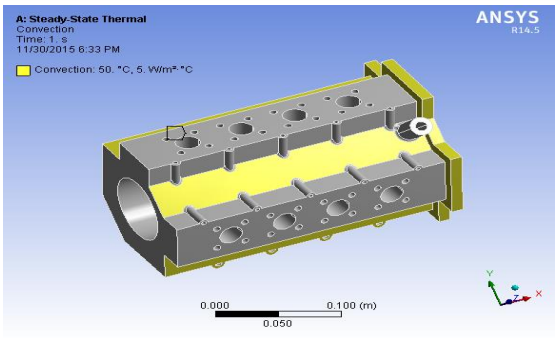
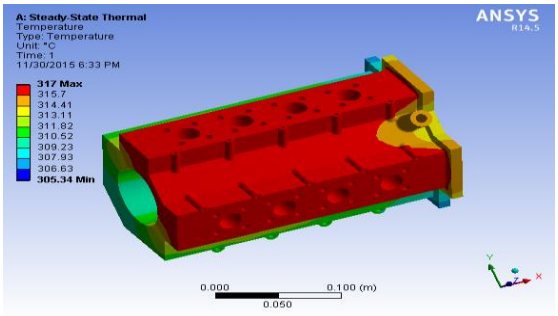
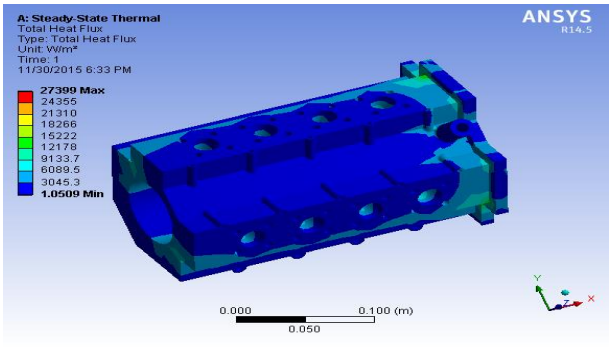




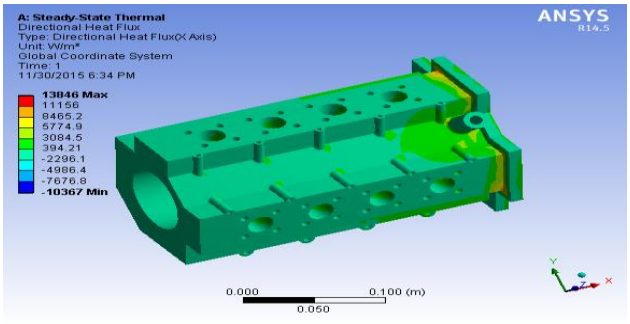
TEMPERATURE



TOTAL HEAT FLUX

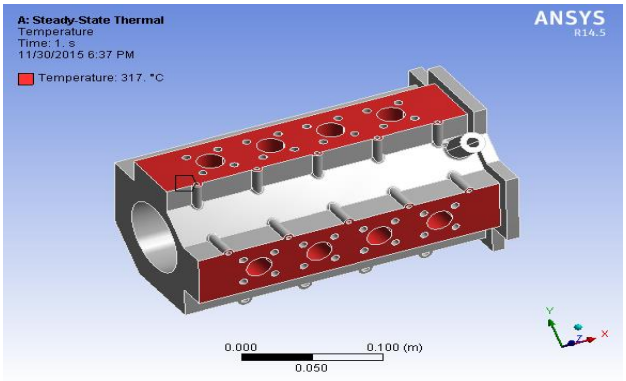


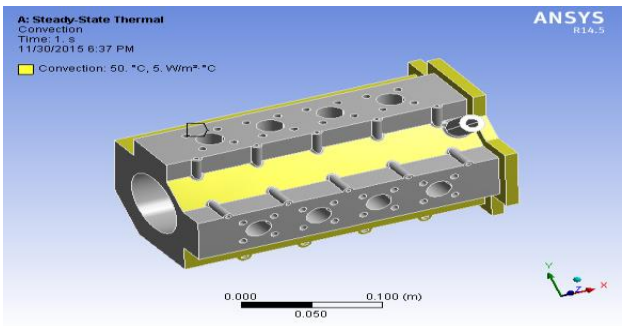
DIRECTIONAL HEAT FLUX



ENGINE BLOCK WITH INCOLE 713C AT 248^{O}C

INPUT DATA





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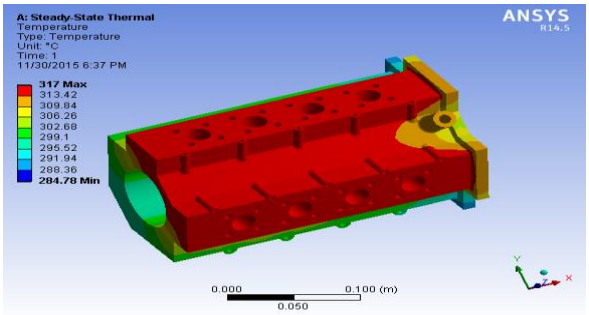
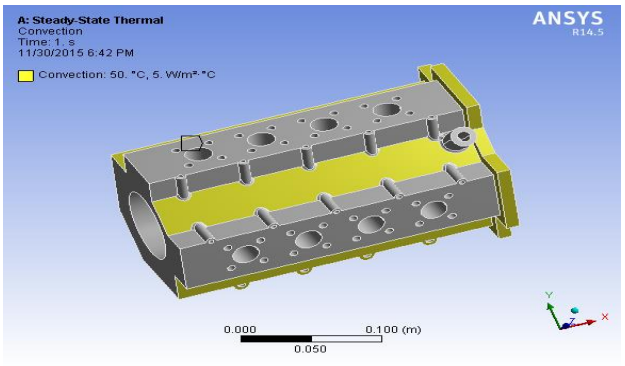
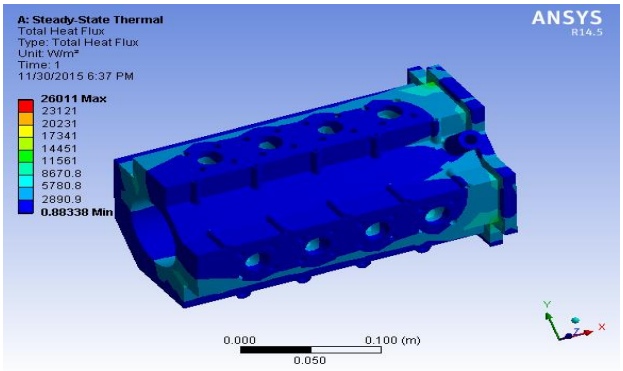
TEMPERATURE





TOTAL HEAT FLUX



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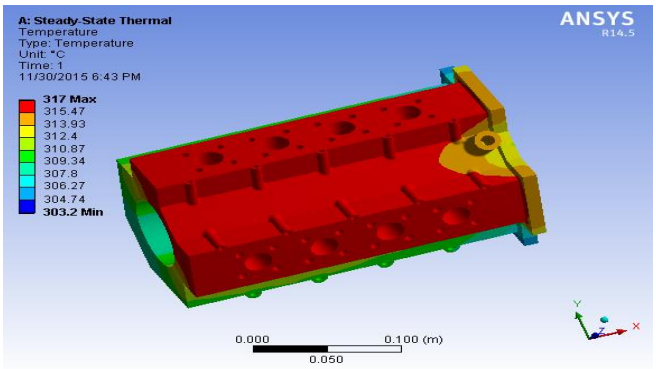
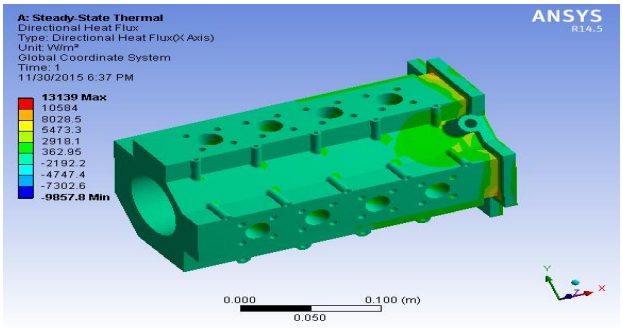
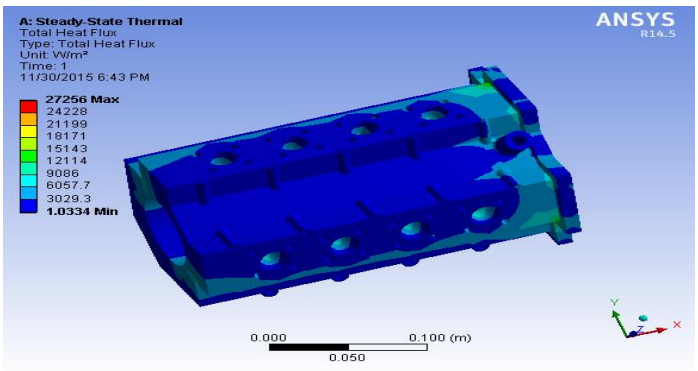


DIRECTIONAL HEAT FLUX

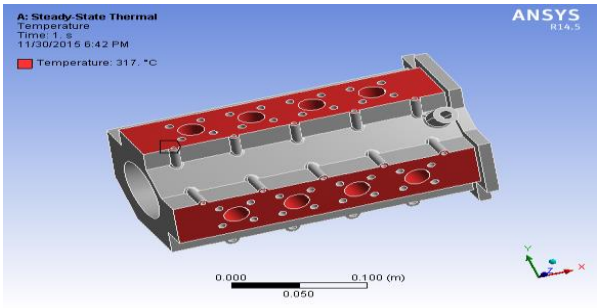


TOTAL HEAT FLUX



ENGINE BLOCK WITH NICKEL ALUMINUM BRONZE ALLOY AT 248^{O}C

INPUT DATA



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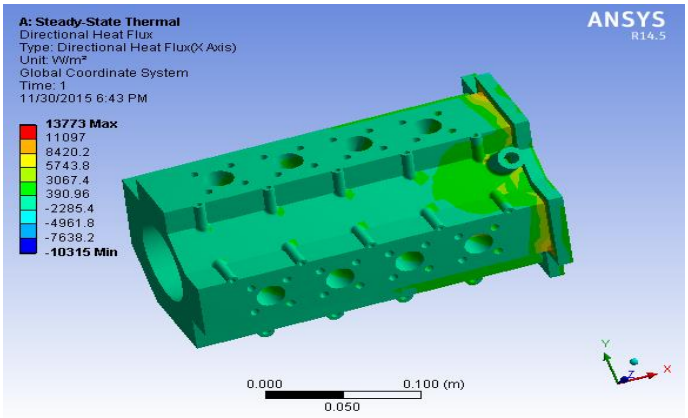

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THERMAL ANALYSIS RESULTS OF ENGINE BLOCK AT 142^{O}C

	TEMPERATURE		HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
AL 7475	140.51	142	0.38281	9609.9	-3634.2	4857
CARBON STEEL AISI 1095	137.98	142	0.3621	9440.8	-3572.2	4770.9
INCOLE 713C	130.9	142	0.30438	8962.5	-3396.7	4527.2
NICKEL ALUMINIMUM BRONZE ALLOY	137.25	142	0.35609	9391.5	-3554.1	4745.7

THERMAL ANALYSIS RESULTS OF ENGINE BLOCK AT 248ºC

	TEMPERATURE		HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
AL 7475	244.8	248	0.82386	20682	-7821.3	10453
CARBON STEEL AISI 1095	239.35	248	0.7793	20318	-7688	10268
INCOLE 713C	224.11	248	0.65509	19289	-7310.3	9743.4
NICKEL ALUMINIMUM BRONZE ALLOY	237.77	248	0.76637	20212	-7649.1	10214

THERMAL ANALYSIS RESULTS OF ENGINE BLOCK AT 317ºC

	TEMPERATURE		HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
AL 7475	312.68	317	1.111	27889	-10547	14096
CARBON STEEL AISI 1095	305.34	317	1.0509	27399	-10367	13846
INCOLE 713C	284.78	317	0.88338	26011	-9857.8	13139
NICKEL ALUMINIMUM BRONZE ALLOY	303.2	317	1.0334	27256	-10315	13773

CONCLUSION

In this thesis we have analyzed the engine block with various materials on the same model, as here we are going to do a thermal analysis with various materials as to result the best material for the better use even in higher temperatures and higher loads.

Here in this project we have designed a V-8 engine block in Catia software with the given parameters, and this design have been analyzed in Ansys software with the materials AL 7475, CARBON STEEL AISI 1095 GRADE, INCOLE 713C, NICKEL ALUMINUM BRONZE ALLOY.

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As if we see the analysis part we have considered the engine block at various rpm with temperatures as follows

- If the vehicle runs at 1400rpm the temperature rises is 142^{o}C
- If so the vehicle runs at 3200 rpm the temperature rises is 24^{o}C
- If so the vehicle runs at 4400 rpm the temperature rises at 317^{o}C

So above are the 3 different cases with which we have analyzed the engine with various materials.

In the first case the engine block is analyzed at 1400rpm at 142 ^{o}c temperature with given 4 types of materials, as if we compare the results of the model the heat flux (8962.5) is very less in the Incole 713C material, as if we see in the directional heat flux (4527.2) Incole 713C is the best material for the product. So in this case we can conclude that the Incole 713C is the best material and gives the better life output for the product.

In the second case the engine block is analyzed at 3200rpm at 248 ^{o}c temperature with given 4 types of materials, as if we compare the results of the model the heat flux (19289) is very less in the Incole 713C material, as if we see in the directional heat flux (9743.4) Incole 713C is the best material for the product. So in this case we can conclude that the Incole 713C is the best material and gives the better life output for the product.

In the third case the engine block is analyzed at 4400rpm at 317 ^{o}c temperature with given 4 types of materials, as if we compare the results of the model the heat flux (26011) is very less in the Incole 713C material, as if we see in the directional heat flux (13139) Incole 713C is the best material for the product. So in this case we can conclude that the Incole 713C is the best material and gives the better life output for the product.

So after all the analysis work and the comparison of the products we can clearly observe that at any rpm weather it is in high speed or in the low speed the heat flus and the directional heat flux is very less in the Incole 713C material only and also lowest temperatures are recorded in Incole 713C, so as per the comparison and the results we can conclude that the Incole 713C is the best material with the better output with better life efficiency.

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block"Mitshibushi motors,Technical review no.16 [2004]

AUTHOR DETAILS

1. STUDENT

Kollu srinivasarao received the BTech degree in mechanical engineering from Chaitanya Institute Of Science And Technology Kakinada JNTU, India, in 2012, and pursuing MTech in Thermal Engineering from Kakinada Institute of Technology And science , JNTUK India.

2. GUIDE 1

Mr. sanmala Rajasekhar received BTech degree and received MTech (PH.D). Currently he is working as Associate Professor at Kakinada Institute of Technology and science, JNTUK India.

3. GUIDE 2

Mr. A.V.Sridhar received BTech degree and received MTech degree .Currently he is working as Associate Professor at Kakinada Institute of Technology and science, JNTUK India.