"DESIGN AND ASSEMBLY OF 4 CYLINDER ENGINE COMPONENTS WITH ITS THERMAL AND STRESS ANALYSIS"

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ABSTRACT: *Internal combustion engines produces mechanical work by converting the chemical energy of fuel in combustion chambers of the engines. The proper working of the components in the engine assures the better conversion of energy and increase in work done, which is the main objective of any engines. In the present work some important components of the engines are design and the modelling is done in CATIA V5 software tool. An attempt is made to study static and thermal analysis of the components. Finite Element Analysis (FEA) is performed to see the stress variations at critical locations using the ANSYS 14.0 software on piston, connecting rod and crankshaft by applying the boundary conditions. Static and thermal analysis is performed on the piston, connecting rod and crankshaft to know the stress variations on it. For piston the material considered is aluminium and for connecting rod and crankshaft material taken is Steel alloy. Also to design a real engine, having into account all necessary calculations are done.*

Keywords: IC Engine, CATIA design, Analysis, ANSYS.

INTRODUCTION

In the present world the transportation is made possible through engines in automobiles. The internal combustion engine was conceived and developed in the late 1800s. It has had a significant impact on society, and is considered one of the most significant inventions of the last century. All the types of vehicles have the internal combustion engine in which the energy released by burning of fuel is utilized to obtain the mechanical work. The engine system consists of mainly piston, cylinder, connecting rod, Von-Mises stress for connecting The main objective of this work is to knowing of designing process using CAD tool (CATIA) and also preparing components and assembly. This project is deals with the Modeling and analysis of a Four Cylinder Engine Assembly and analysis is done using ANSYS tool for every component which are developed in CATIA tool.

The main objective of analysis is to showing the heat transformations from one component to other applying boundary conditions and thermal loads are applied. This process is done for Piston Head, connecting rod and Crank Shaft.

The individual component analysis is done to decide the capability of component before rod. crank shaft and cam shaft. Hence the design and fabrication all the components of an engine is the important aspect. The designing of these parts and stress analysis are important aspect before continuing with their manufacture.

INTRODUCTION TO CATIA

CATIA is a fully automation software which relates with the mechanical field. It is graphical user interface which is easy to learn and also the software is feature based and parametric solid modelling. We can draw 2D and 3D models of a part and accordingly the assembly of the parts can be done in it. The shape or geometry of the model or Modules such as sketcher module used to design 2D drawings, part design module is used to design the 3D models of geometry, and Assembly work design is used to assemble the different parts which are drawn in the part design module. Kinematics is used to give the simulation or motion to the part bodies which are designed and assembled in part and assembly design modules. Assembly is dependent upon the values which are referred as constraints.

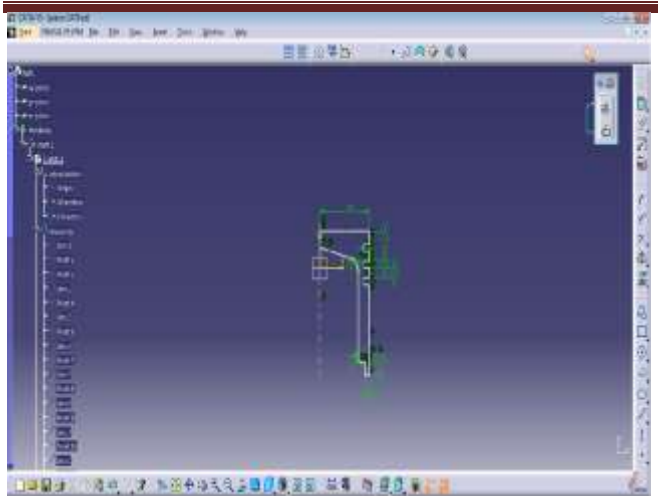
Different modules used in CATIA

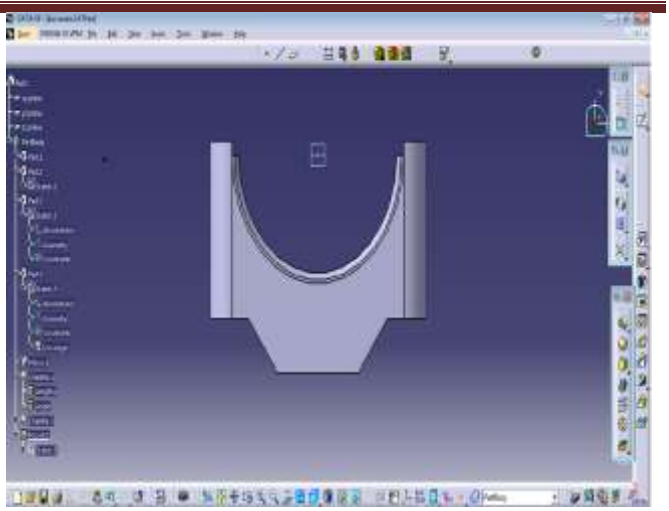
- Sketcher
- Part Design
- Assembly Design
- Kinematics

By Using the CATIA software the part designs were designed and assembly is made.

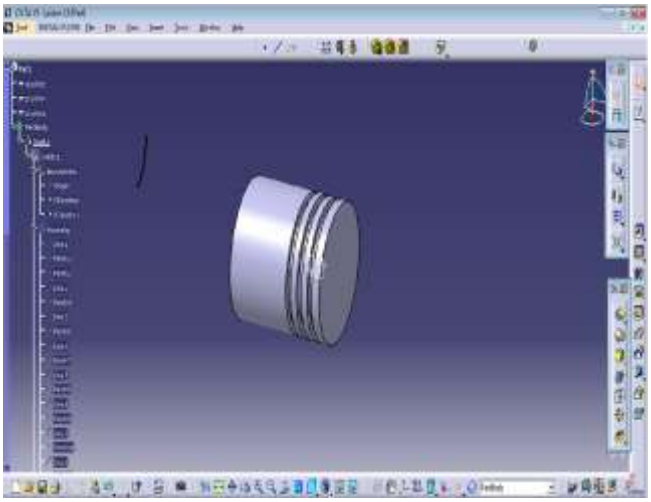
3. Design of Part

Outline diagram of piston:



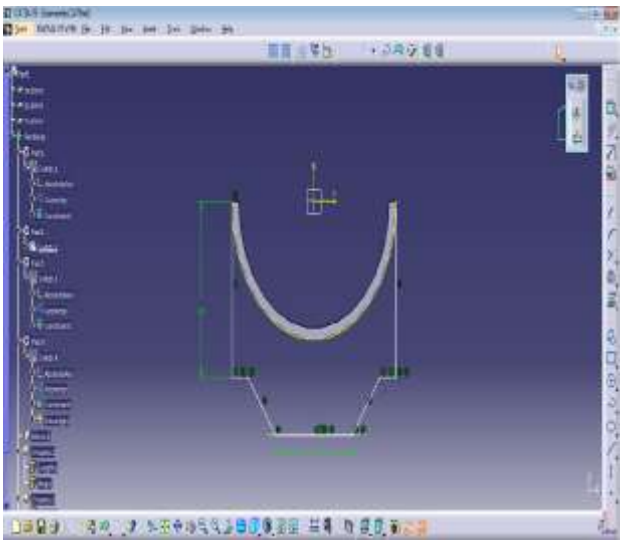


Completed view of piston :

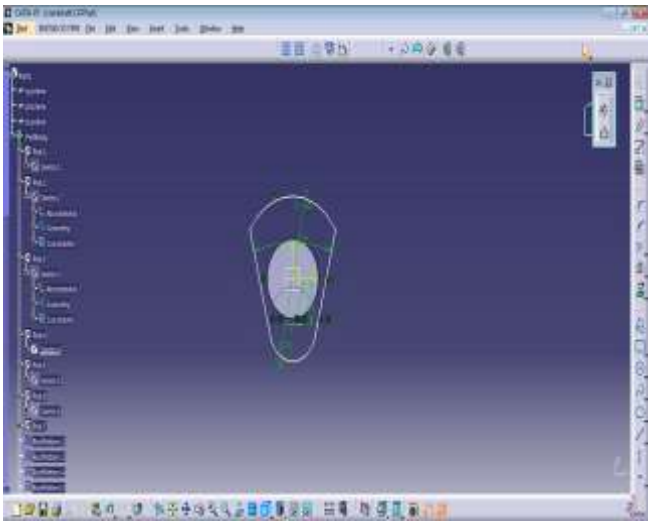


Outline diagram of connecting rod

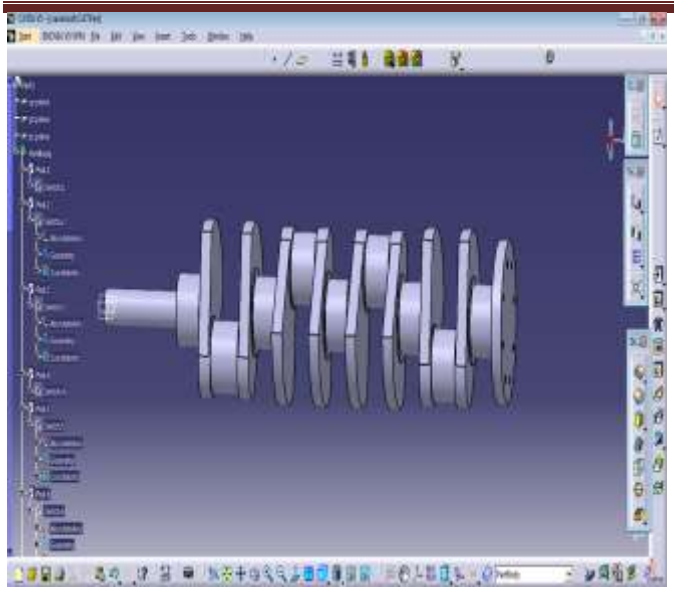
Outline diagram of crankshaft



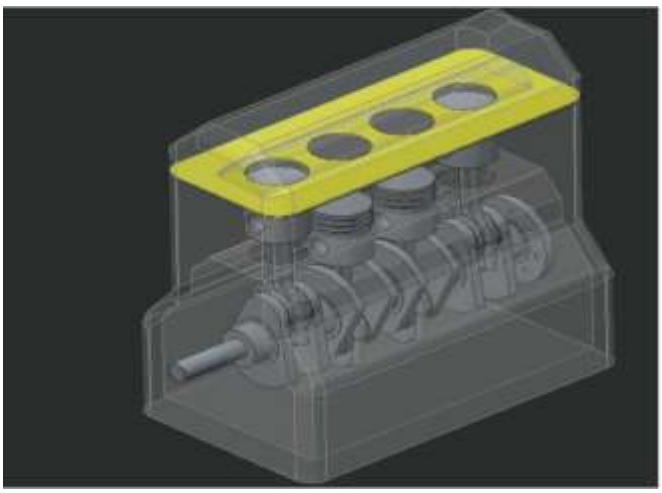
Completed view of connecting rod :



Completed view of crank shaft



After designing the components the assembly is done. The completed view of assembly.



4. INTRODUCTION TO ANSYS

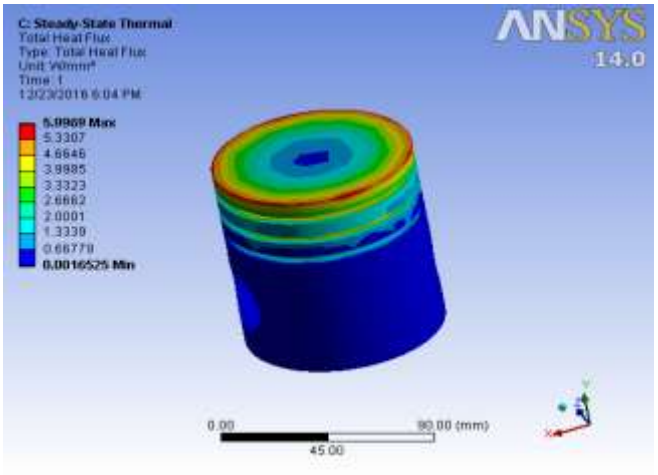
Catia and ANSYS workbench software are used for the Finite Element Analysis of the piston. After designing the model in CATIA, the CAT FILE has been converted to IGES format . This format enables the design to be compatible in the ANSYS software. After importing the design in ANSYS, the process of analysis begins.

The some steps are mentioned here which are followed for analysis.

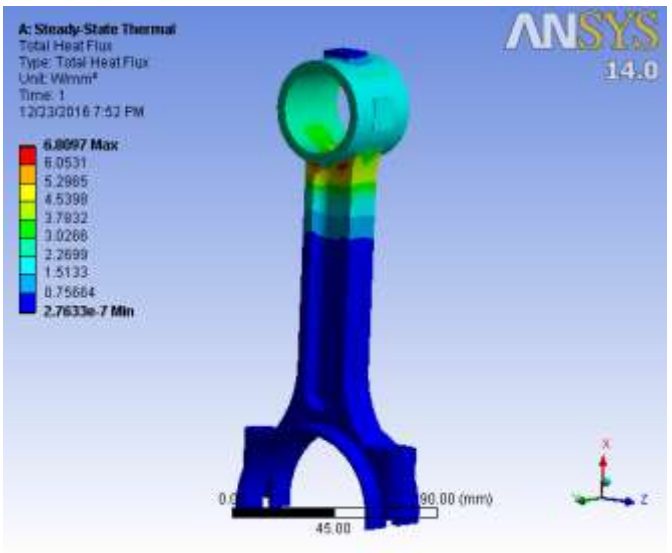
- Applying material to the model
- Meshing of the model
- Assigning thermal and geometric properties.
- Defining boundary conditions.
- Applying different loads.

The result obtained in ANSYS are presented here.

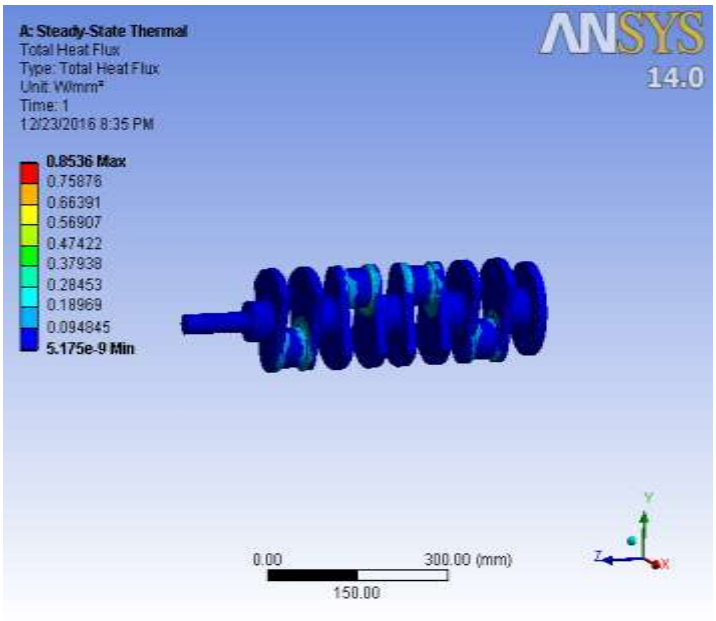
Heat Flux for piston



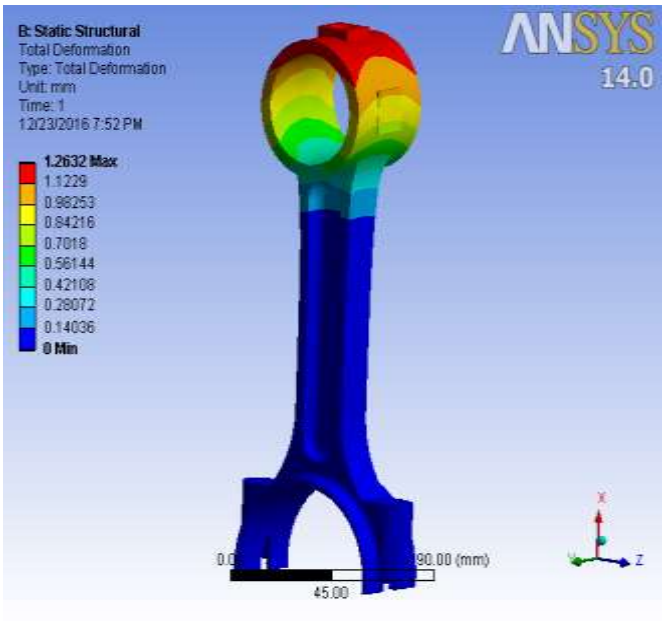
Heat Flux for connecting rod



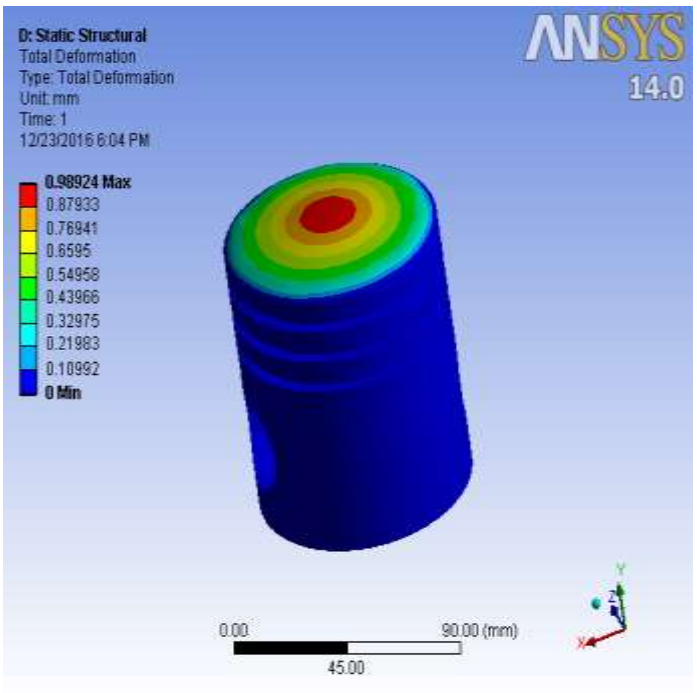
Heat Flux for Crank shaft



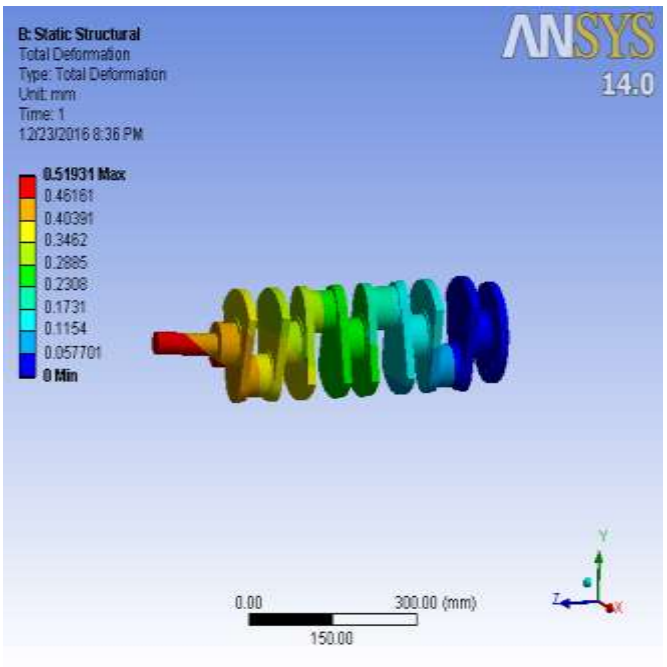
Deformation for piston



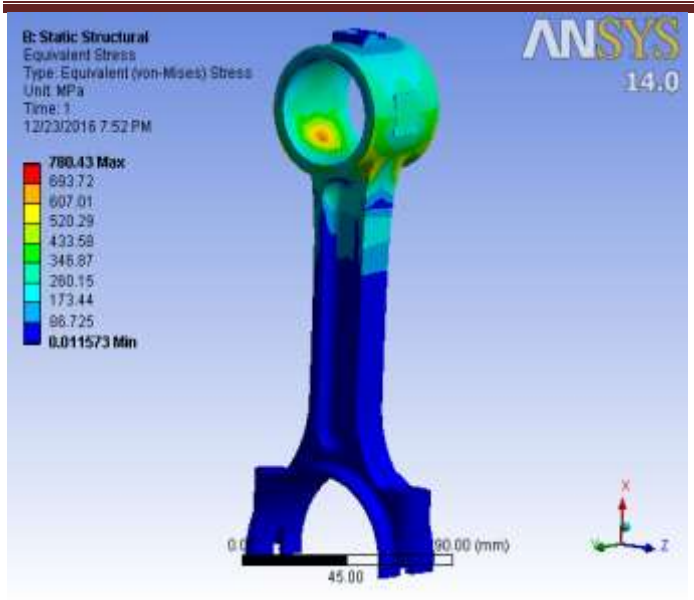
Deformation for crank shaft



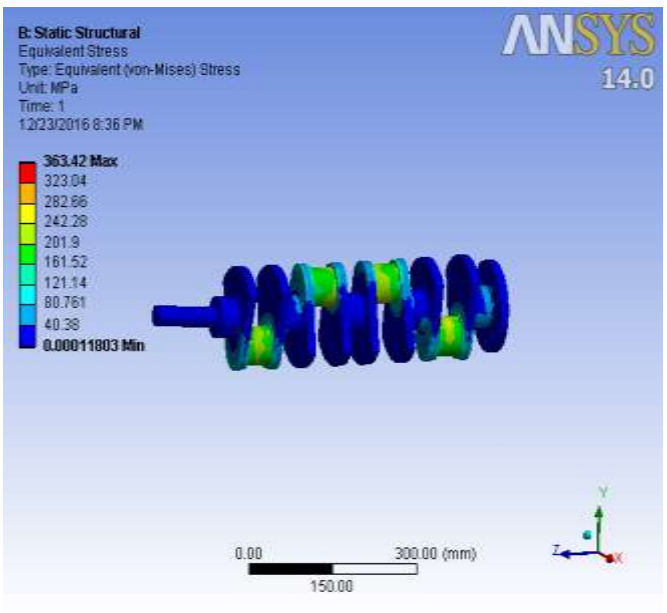
Deformation for Connecting Rod



Von-Mises stress for Connecting Rod



Von-Mises stress for crank shaft



5. RESULT AND DISCUSSION

Total heat flux is observed in piston along the edges with a value of 5.9969 W/mm^{2}and reduces to 0.0016525 W/mm^2 at the center and skirt of piston.Maximum displacement is observed at the top of the center of the piston. The maximum deformation occurs at the small end of the connecting rod. Von mises stress is maximum at the small end of connecting rod and goes on decreasing along the length of connecting rod. The maximum value of heat flux at the small end bearing and I section joint. The deformation is more towards the shaft end with minimum as zero at the flywheel end.The maximum value of stress is at the joint of big end of connecting rod and web.

6. CONCLUSION

- The main objective of this work is to knowing of designing process using CAD tool (CATIA) and also preparing components and assembly. This project is deals with the
- Modeling and analysis of a Four Cylinder Engine Assembly and analysis is done using ANSYS tool for every component which are developed in CATIA tool.
- The main objective of analysis is to showing the heat transformations from one component to other applying boundary conditions and thermal loads are applied. This process is done for Piston Head, connecting rod and Crank Shaft.
- The individual component analysis is done to decide the capability of component before they going to work in assembly.

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