DESIGN AND ANALYSIS OF A CONNECTING ROD FOR PETROL ENGINE BY USING CREO AND ANSYS SOFTWARE

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ABSTRACT

The connecting rod is the linkage member between the piston and the crankshaft. Its main function is to transmit the push and pull from the piston pin to the crank pin and thus convert the reciprocating motion of the piston into rotary motion of the crank.In our paper we design two different connecting rod models (connecting rod and connecting rod) for a petrol engine for five different materials , aluminum alloy 6063, aluminum alloy7075 and Aluminum alloy 2014. Connecting rod modeled in 3D modeling software CREO parametric.In this paper the static analysis is to determine the deformation, stress and strain on the connecting rod by applying the pressure developed in the engine. Thermal analysis is to determine the temperature distribution and heat flux. Modeling is done in CREO and analysis is done in ANSYS.

***Key Words**: Connecting rod, Rotating crank shaft , Piston , Design and Analysis.*

I. INTRODUCTION

In a reciprocating piston engine, the connecting rod connects the piston to the crank or crankshaft. In modern automotive internal, the connecting rods are most usually made of steel for production engines, but can be made of aluminum or titanium for high performance engines, or of cast iron for applications such as motor scooters. They are not rigidly fixed at either end, so that the angle between the connecting rod and the piston can change as the rod moves up and down and rotates around the crankshaft. Condors', especially in racing engines, may be called "billet" rods, if they are machined out of a solid billet of metal, rather than being cast.Many researches have been focused on the expansion of the connecting rod regarding its design (Repgen, 1998; Tiwari, 2006), mass reduction (Lapp, et. al, 2010) and forging versus casting processes (Ilia, et.al, 2005; Visser, 2008). These investigations acquire fortunate results in the connecting rod development reducing drastically its cost and weight, which achieved an enhanced engine performance. Nowadays companies must become more and more competitive to keep their customers and attract new ones making R&D crucial in the automotive industry. This paper was focused on the quality and cost improvements through the connecting rod manufacturability enhancement.

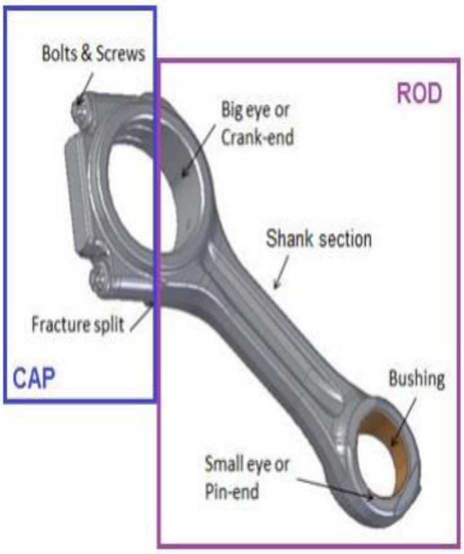


Fig.1 : connecting rod parts

II .EXPERIMENTAL SETUP ANDPROCEDURE

INTRODUCTION TO CAD

Computer-aided design (**CAD**) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, better communications through documentation, and to create a database for manufacturing. CAD output is frequently in the form of electronic files for print, machining, or other manufacturing operations. In mechanical design it is known as mechanical design automation (**MDA**) or **computer-aided drafting** (**CAD**), which includes the process of creating a technical drawing with the use of computer software. CAD may be used to design curves and figures in two-dimensional (2D)space; or curves, surfaces, and solids in three-dimensional (3D) space.

INTRODUCTION TO CREO

PTC CREO, formerly known as Pro/ENGINEER, is 3D modeling software used in mechanical engineering, design, manufacturing, and in CAD drafting service firms. It was one of the first 3D CAD modeling applications that used a rule-based parametric system. Using parameters, dimensions and features to capture the behavior of the product, it can optimize the development product as well as the design itself.The name was changed in 2010 from Pro/ENGINEER Wildfire to CREO. It was announced by the company who developed it, Parametric Technology Company

(PTC), during the launch of its suite of design products that includes applications such as assembly modeling, 2D orthographic views for technical drawing, finite element analysis and more.PTC CREO says it can offer a more efficient design experience than other modeling software because of its unique features including the integration of parametric and direct modeling in one platform. The software also has a more user friendly interface that provides a better experience for designers. It also has collaborative capacities that make it easy to share designs and make changes.

There are countless benefits to using PTC CREO. We'll take a look at them in this two-part series.

Table.1 : MATERIAL PROPERTIES

material	Density (g/cm^3)	Young's modulus (MPa)	Passion's ratio	Thermal conductivity (w/m-k)
Aluminum alloy 6063	2.70	68900	0.33	218
Aluminum alloy 7075	2.81	71700	0.29	173
Aluminum alloy 2014	2.70	73100	0.33	193

III .RESULTS ANDANALYSIS

INTRODUCTION TO FEA

Finite element analysis is a method of solving, usually approximately, certain problems in engineering and science. It is used mainly for problems for which no require solution, expressible in some mathematical form, is available. As such, it is a numerical more than an analytical method. Methods of this type are needed because analytical methods cannot cope with the real, complicated problems that are met with in engineering. For example, engineering strength of materials or the mathematical theory of elasticity can be used to calculate analytically the stresses and strains in a bent beam, but neither will be very successful in finding out what is happening in part of a car suspension system during cornering. One of the first applications of FEA was, indeed, to find the stresses and strains in engineering components under load. FEA, when applied to any realistic model of an engineering component, requires an enormous amount of computation and the development of the method has depended on the availability of suitable digital computers for it to run on. The method is now applied to problems involving a wide range of phenomena, including vibrations, heat conduction, fluid mechanics and electrostatics, and a wide range of material properties, such as linear-elastic (Hookean) behaviour and behaviour involving deviation from

Hooke's law (for example, plasticity or rubber-elasticity).

INTRODUCTION TO ANSYS

Structural Analysis

ANSYS Autodyn is computer simulation tool for simulating the response of materials to short duration severe loadings from impact, high pressure or explosions. ANSYS Mechanical is a finite element analysis tool for structural analysis, including linear, nonlinear and dynamic studies. This computer simulation product provides finite elements to model behaviour, and supports material models and equation solvers for a wide range of mechanical design problems. ANSYS Mechanical also includes thermal analysis and coupled-physics capabilities involving acoustics, piezoelectric, thermal–structural and thermo-electric analysis.

Fluid Dynamics

ANSYS Fluent, CFD, CFX, FENSAP-ICE and related software are Computational Fluid Dynamics software tools used by engineers for design and analysis. These tools can simulate fluid flows in a virtual environment — for example, the fluid dynamics of ship hulls; gas turbine engines (including the compressors, combustion chamber, turbines and afterburners); aircraft aerodynamics; pumps, fans, HVAC systems, mixing vessels, hydro cyclones, vacuum cleaners, etc.

STATIC ANALYSIS OF CONNECTING ROD

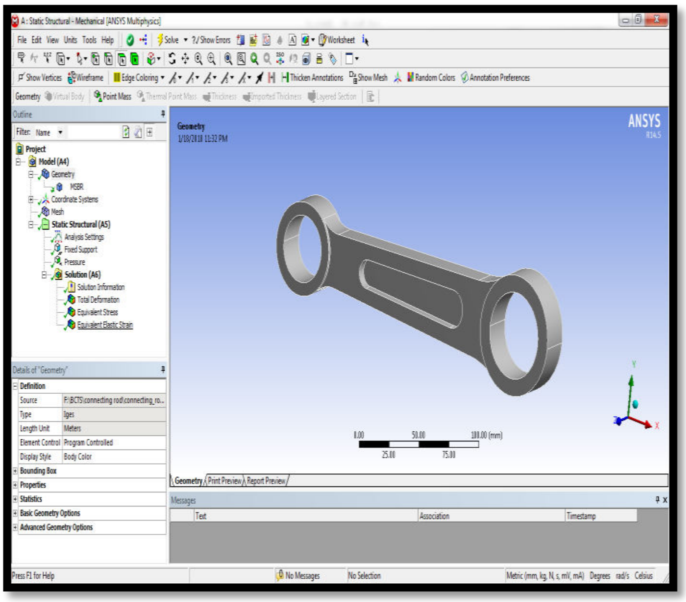
→→Ansys → Workbench→ Select analysis system → static structural → double click

→→Select geometry → right click → import geometry → select browse →open part → ok

→→ Select mesh on work bench → right click →edit

Double click on geometry → select MSBR → edit material →

Fig.2 : Imported model



Select mesh on left side part tree → right click → generate mesh →

Fig.3: Meshed model

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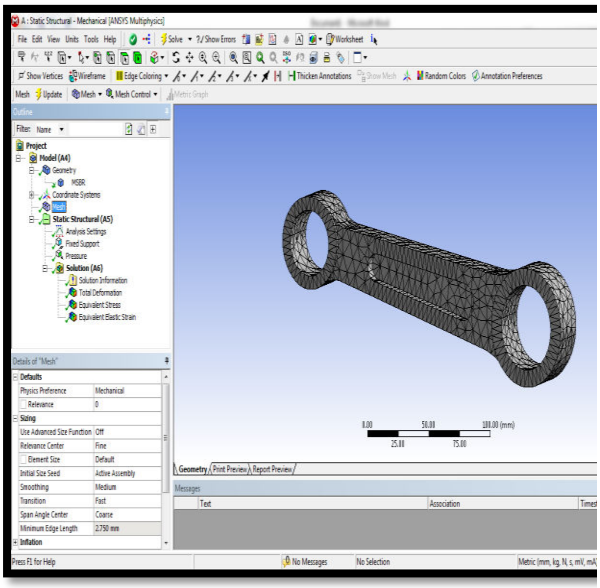
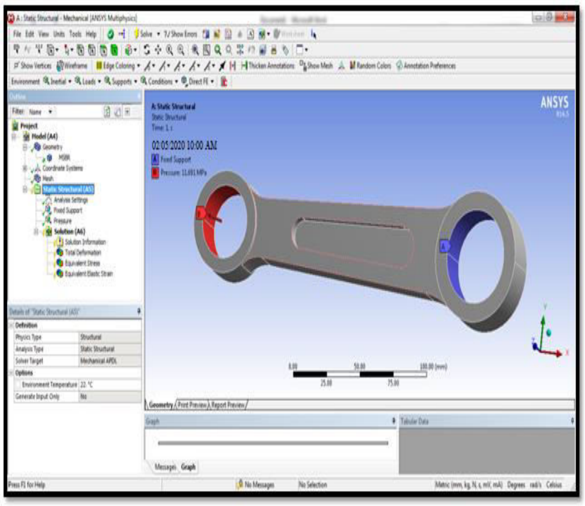


Select static structural right click → insert → select pressure and fixed support → Select displacement → select required area → click on apply → put X,Y,Z component zero →

Fig.4 : Boundary condition



Select force → select required area → click on apply → enter rotational velocity

Select solution right click → solve →

Solution right click → insert → deformation → total → Solution right click → insert → strain → equivalent (von-mises) →

Solution right click → insert → stress → equivalent (von-mises) →

Right click on deformation → evaluate all result

Material- aluminum alloy6063

Fig.5 : Deformation

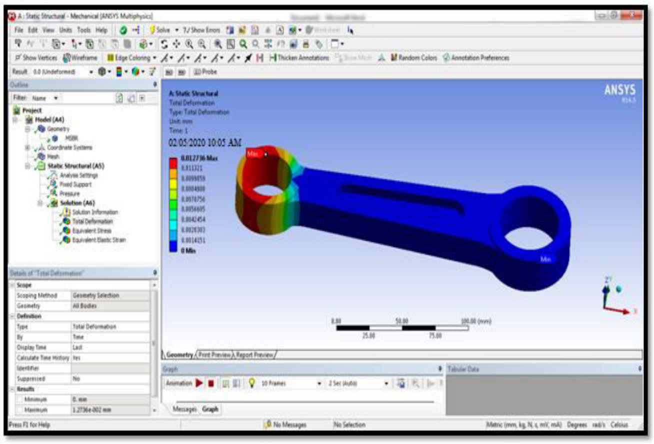


Fig.6 : Stress

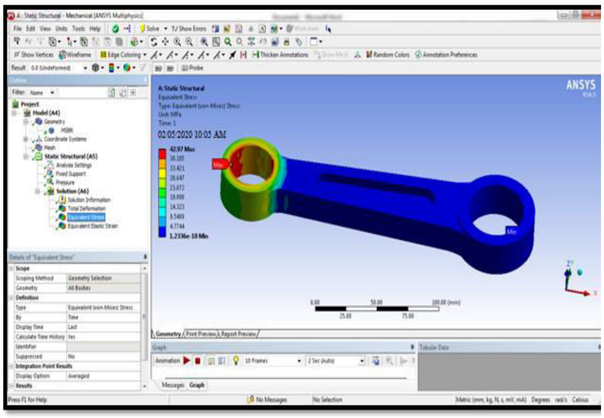
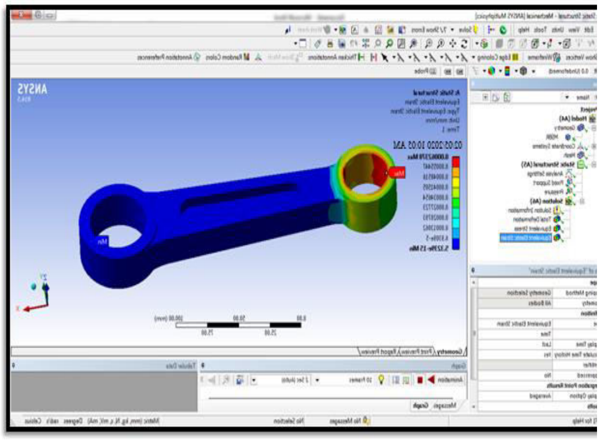


Fig.7 : strain



THERMAL ANALYSIS OF CONNECTING ROD

Material-aluminum alloy 6063

Fig.8 : Temperature distribution

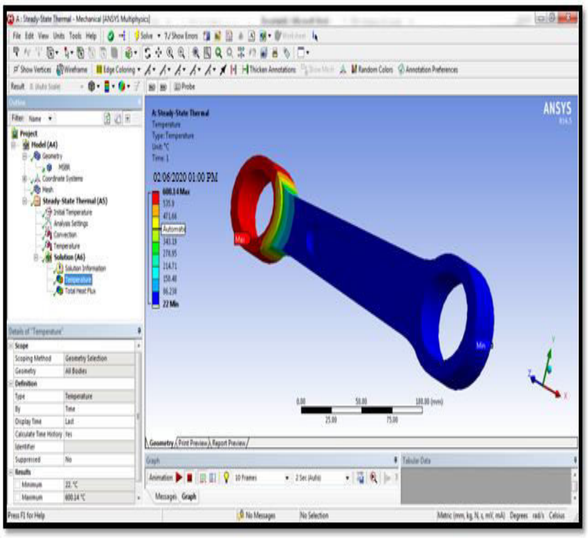
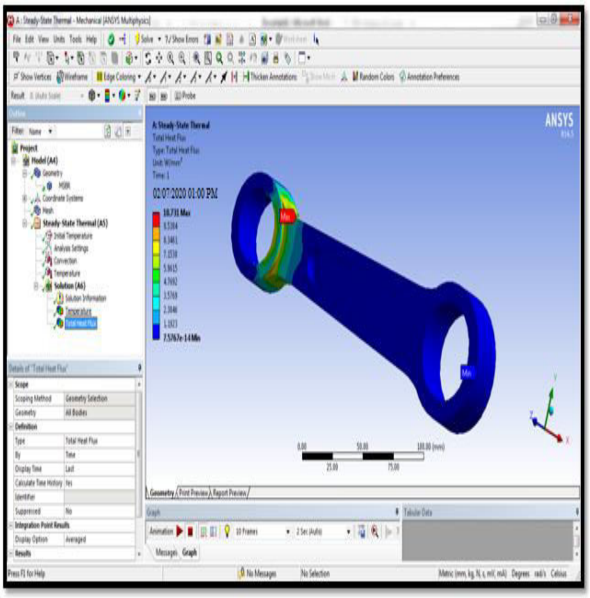


Fig.9 : Heat flux



RESULT:

Table.2 : Structural Analysis

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Models	Materials	Deformation (mm)	Stress(MPa)	Strain
Connecting rod	Aluminum alloy6063	0.012736	42.97	0.00062378
	Aluminum alloy7075	0.012446	44.166	0.0006161
	Aluminum alloy2014	0.012127	43.408	0.00059393

Table.3 : Thermal analysis

Models	Materials	Temperature (^0C)		Heat flux(w/mm^2)
		Max.	Min.	
Connecting rod				
	Aluminum alloy6063	600.14	22	10.731
	Aluminum alloy7075	600.16	21.961	9.3828
	Aluminum alloy2014	600.15	22	10.008

IV . CONCLUSION

The connecting rod is the linkage member between the piston and the crankshaft. Its main function is to transmit the push and pull from the piston pin to the crank pin and thus convert the reciprocating motion of the piston into rotary motion of the crank.In our paper we designed two different connecting rod models (connecting rod and connecting rod) for a petrol engine for five different materials , aluminum alloy 6063, aluminum alloy7075 and Aluminum alloy 2014. Connecting rod modeled in 3D modeling software CREO parametric.By observing the static analysis the stress values are less for aluminum alloy 6063 material when we compare the , aluminum alloy7075 and Aluminum alloy 2014. And when we compare the connecting rod models the stress value less for connecting rod. By observing the thermal analysis the heat flux values are more for aluminum alloy 6063 material when we compare the , aluminum alloy7075 and Aluminum alloy 2014. And when we compare the connecting rod models the heat flux value more for connecting rod. So it can be concluded the aluminum alloy 6063 material better performance and model is better model.

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