FINITE ELEMENT ANALYSIS OF CONNECTING ROD OF MG-ALLOY

Akash Digamber Dhane
Department of Mechanical Engineering, PDVVP College of Engg, Ahmednagar, Maharashtra
* akashdhane@gmail.com

ABSTRACT

The automobile engine connecting rod is a high volume production, critical component. It connects reciprocating piston to rotating crankshaft, transmitting the thrust of the piston to the crankshaft. Every vehicle that uses an internal combustion engine requires at least one connecting rod depending upon the number of cylinders in the engine. As the purpose of the connecting rod is to transfer the reciprocating motion of the piston into rotary motion of the crankshaft. Connecting rods for automotive applications are typically manufactured by forging from either wrought steel or powdered metal. the material used for this process is Mg-Alloy and also finite element analysis of connecting rod

INTRODUCTION

Connecting rods for automotive applications are typically manufactured by forging from either wrought steel or powdered metal. They could also be cast. However, castin gs could have blow-holes which are detrimental from durability and fatigue points of view. The fact that forgings produce blow-hole-free and better rods gives them an advantage over cast rods. Between the forging processes, powder forged or drop forged, each process has its own pros and cons. Powder metal manufactured blanks have the advantage of being near net shape, reducing material waste. However, the cost of the blank is high due to the high material cost and sophisticated manufacturing techniques. With steel forging, the material is inexpensive and the rough part manufacturing process is cost effective. Bringing the part to final dimensions under tight tolerance results in high expenditure for machining, as the blank usually contains more excess material. The main objective of this study was to explore weight and cost reduction opportunities for a production forged steel connecting rod. This has entailed performing a detailed load analysis. Therefore, this study has dealt with two subjects, first, dynamic load and quasi-dynamic stress analysis of the connecting rod. The loads acting on the connecting rod as a function of time were obtained. The relations for obtaining the loads and accelerations for the connecting rod at a given constant speedof the crankshaft were also determined. Quasidynamic finite element analysis was performed at several crank angles. The stress-time history for a few locations was obtained. The difference between the static FEA, quasidynamic FEA was studied.

Based on the observations of the quasi-dynamic FEA, static FEA and the load analysis results, the load for the optimization study was selected. The results were also used to determine the variation of R-ratio, degree of stress multiaxiality, and the fatigue model to be used for analyzing the fatigue strength. The component was optimized for weight and cost subject to fatigue life and space constraints and manufacturability. It is the conclusion of this study that the connecting
rod can be designed and optimized under a load range comprising tensile load corresponding to 360° crank angle at the maximum engine speed as one extreme load, and compressive load corresponding to the peak gas pressure as the other extreme load. Furthermore, the existing connecting rod can be replaced with a new connecting rod made of C-70 steel that is 10% lighter and 25% less expensive due to the steel's fracture crack ability. The fracture crack ability feature facilitates separation of cap from rod without additional machining of the mating surfaces. Yet, the same performance can be expected in terms of component durability.

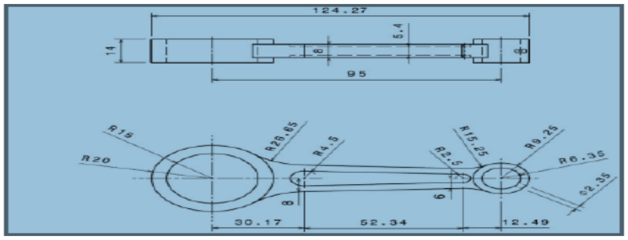
FORMAT

METHODOLOGY

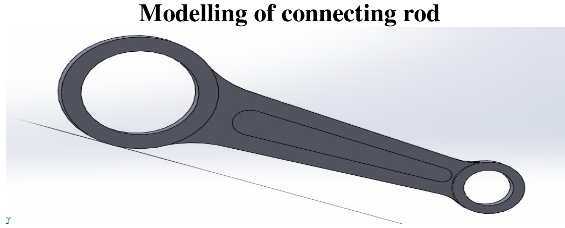
FINITE ELEMENT ANALYSIS

Finite element method is used to analyze structures by computer simulations and therefore it helps to reduce the time required for prototyping and to avoid numerous test series.The modeling and analysis will be done using Finite element Analysis software.
Steps for finite element analysis:
FEA is mainly divided into three following stages:
Preprocessing
Creating the model.
Defining the element type
Defining material properties
Meshing
Applying loads
Applying boundary conditions
Solution: Assembly of equations and obtaining solution
Post processing: Review of result.

DRAWING OF CONNECTING ROD

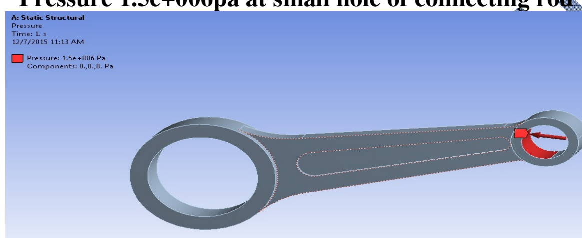


Modelling of connecting rod

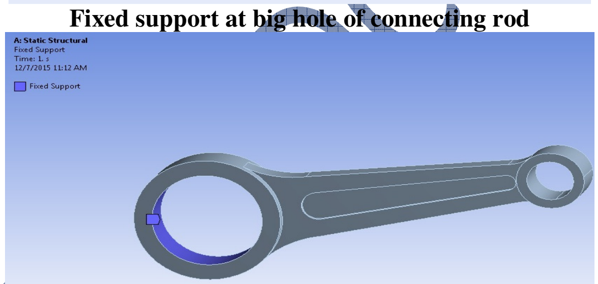


Apply the boundary conditions

Pressure 1.5e+006pa at small hole of connecting rod

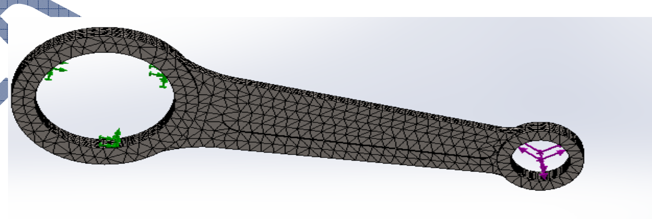


Fixed support at big hole of connecting rod



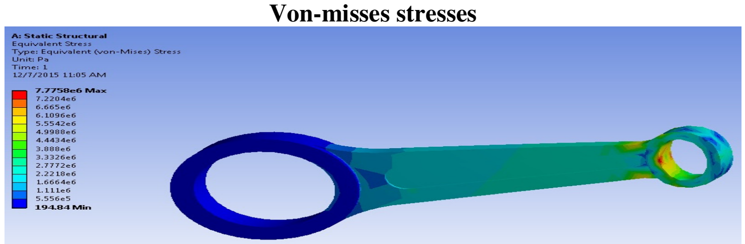
MESHING OF CONNECTING ROD ON ANSYS

Number of elements 22171
Number of nodes 37068



FEA of connecting rod

Von-misses stresses



Equivalent Elastic strain

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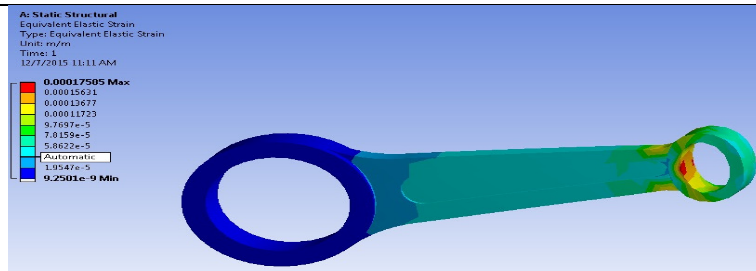
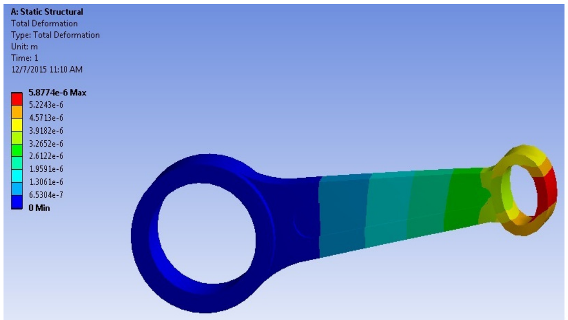
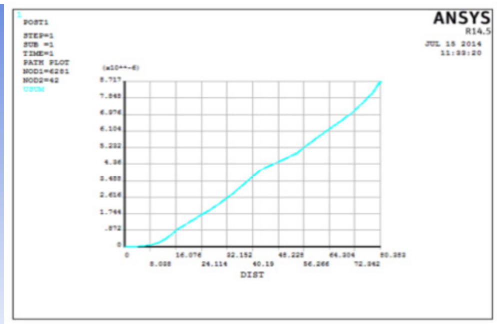


Total deformation





MECHANICAL PROPERTIS OF MG-ALLOY

Material selected	Mg-alloy
Compressive yield strength	193 mpa
Tensile yield strength	193 mpa
Youngs modulus	4.5e+10
density	1800kg m-3

FEA RESULTS

Von-misses stress	7.75587e6 pa
Elastic strain	0.00017585 m/m
Total deformation	5.874e-6 pa

CONCLUSIONS

a. Maximum deformation occurred at the small end.
b. Maximum Von-mises strain occurred at the upper part of the big end and minimum at the lower part of the big end.
c. Maximum Von-mises stress occurred at the shank and minimum at the big end.
d. Maximum strain energy was observed at the centre of the shank and minimum at the lower part of the big end.

FUTURE SCOPE

This study is based on the static structural module. Further analysis of connecting rod can be done under dynamic environment.

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