Analysis of Connectiong Rod for Various Composite Materials

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Abstract: The connecting rod of automobile engine is a high-volume production critical component. Every vehicle that uses an internal combustion engine requires at least one connecting rod. Connecting rod is the intermediate link between the piston and the crank. And is responsible to transmit the push and pull from the piston pin to crank pin, thus converting the reciprocating motion of the piston to rotary motion of the crank. Generally connecting rods are manufactured using carbon steel and in recent days' aluminium alloys are finding its application in connecting rod. Connecting rod use of composite material to weight and cost as well as to improve to mechanical property. finite element analysis of connecting rod is done by considering the materials vice. The best combination of parameters like von misses stress and strain, deformation, factor of safety and weight reduction is criticized by changed of material.The fatigue strength is the most significant factor in the process. The study includes that the determination of loads acting on the connecting rod.

Keywords*: Connecting rod, ANSYS, Composite, Diesel Engine, FEA, AHP*

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1. INTRODUCTION

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. It has mainly three parts namely- a pin end, a shank region and a crank end. Pin end is Connected to the piston assembly and crank end is connected to crankshaft.Lighter connecting rods help to decrease lead caused by forces of inertia in engine as it does not require big balancing weight on crankshaft. Application of metal matrix composite enables safety increase and advances that leads to effective use of fuel and to obtain high engine power.They can be produced either by casting, powder metallurgy or forging. Due to its large volume production, it is only logical that optimization of the connecting rod for its weight or volume will result in large-scale savings.

2. AIM OF THE PROJECT

To enhance the physical properties of connecting rod by utilising composite materials.

3.OBJECTIVE OF THE PROJECT

The various composite materials will be analysed with the help of CAD.

The best material in the analysis will be used to manufacture the connecting rod and will be physically tested and the results will be compared with CAD analysis results.

4. RESULTS AND DISSCUSION OF ANALYSIS

1. ANSYS RESULTS

Mathematicallycalculation to engine data maximum force apply in connecting rod is 56800 N
And static structural analysis for four different material and its stress, displacement, and strain value given bellow table.

Table 1.1 Comparisons of stress, strain, displacement for different materials

Sr	Material	Compressive load			Tensile load		
		Stress (MPa)	Displacement (mm)	Strain	Stress (MPa)	displacement (mm)	Strain
1	C70S6	689.18	0.22517	0.0032832	651.3	0.2687	0.003126
2	Al360	699.88	0.78449	0.011419	655.12	0.93964	0.0010892

3	EN8D	689.18	0.22517	0.0032832	651.3	0.2687	0.0031267
4	42CrMo4	690.52	0.22549	0.0032896	652.35	0.26875	0.0031315

Afteransysanalysis we find weigh, stiffness, and AHP method four different materials.so we conclude that EN8D material will be selected for experimental analysis.

2. EXPRIMENT RESULT

Experiment is performed in UTM at Rajkot metlab Rajkot, to measure tensile and compressive load maximum force can withstand.

85780 N tensile force maximum can withstand, 149020 max. compressive force can withstand.

As per ansys analysis maximum tensile and compressive force 56800 N, so it is very clear that practical compressive and tensile force more than calculated in ansys. So, design is safe

5.LITERATURE REVIEW

Kuldeep B, Arun L.R, Mohammed Faheem

FEA analysis was carried out by considering two materials. The parameters like von misesstress, von misses strain and displacements were obtained from ANSYS software. Compared to the former material the new material found to have less weight and better stiffness. It resulted in reduction of 43.48% of weight, with 75% reduction in displacement. Weight can be reduced by changing the material of the current AL360 connecting rod to hybrid ALFASiC composites.

MarthanapalliHariPriya, K.Manohar Reddy

A connecting rod for a 150cc engine has been modeled in 3D modeling software cero. The actual cross section connecting rod is I – section, which have been changed to cross section H By changing the cross section, the weight of connecting rod is reduced by 10gms.The material used for connecting rod is carbon steel which is replaced with Aluminum alloy A360. By comparing the stress values for both materials, it is slightly less for Aluminum alloy A360 than carbon steel.

Leela Krishna Vegi, Venu Gopal Vegi

Currently existing connecting rod is manufactured by using Carbon steel. In this drawing is drafted from the calculations. A parametric model of Connecting rod is modelled using CATIA V5 R19 software and to that model, analysis is carried out by using ANSYS 13.0 SoftwareFinite element analysis of connecting rod is done by considering the materials, Forged steel.The weight of the forged steel material is less than the existing carbon steel.

Christy V Vazhappilly, P.Sathiamurthi

Steel connecting rod connecting rod can be designed and analysis under a load ranging from tensile load, corresponding to various degree 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. The study analysis includes the determination of loads acting on the connecting rod as a function of time for finding out the minimum stress area to remove the material. Furthermore, the existing connecting rod material can be replaced with a new composite material.

Marmik M Dave, Manish P Vekariya

Material c70s6 is more suitable for fracture split process during manufacturing of connecting rod. Due to fracture, split process we can reduce overall cost of production and labour.The connecting rod finite element analysis is proposed in ANSYS 14, and Critical location of Maximum Stress, Maximum Strain and total Deformation with Von-meshes criteria for the connecting rod has been identified. The structural model of the connecting rod was prepared by utilizing the (PRO-E Creo) and material is C 70 S6.

Abhinav Gautam, K PriyaAjit

It is observed that the area close to root of the smaller end is very prone to failure, may be due to higher crushing load due to gudgeon pin assemblyStatic analysis is done by fixing the smaller end and load is applied at bigger end of connecting rod.A static stress analysis of connecting rod made up of SS 304 used in Cummins NTA 885 BC engine is conducted, using finite element method. After measuring the dimension of connecting rod, model is developed in CATIA V5 software and imported to ANSYS WORKBENCH 14.0 software

Pravardhan S. Shenoy and Ali Fatemi

The optimized geometry is 10% lighter than the current connecting rod for the same fatigue strength, in spite of

lower yield strength and endurance limit of C-70 steel compared to the existing forged steel. Reduction in machining operations achieved by using C-70 steel and utilization of the fracture splitting process reduces the production cost by about 25%. The study results in an optimized connecting rod that is 10% lighter and 25% less expensive, as compared to the existing connecting rod.

R.Luri, C.J.Luis,D. Salcedo, J.Leon, J.P.Fuerts, I.Puerts

Design of a set of dies employed to manufacture a connecting rod by forging a billet of nanostructured aluminium alloy SPD(severe plastic deformation) to produce the nanostructure materialMoreover, the dimensions of the ECAE(Equal Channel Angular Extrusion) die required to manufacture the initial billet to be forged have been determined.Finite element and finite volume simulation have been run by using nanostructured 5083-AA flow rule, in order to design the dies.

Q.Wang, F.He

Centralized controlled automatic billet&temperature control system.3d cad/cam technology has been use both cross-rolling and reducing rolling operation Precision forging to use hydraulic hammersQuality of connecting rods can be improved by compound die, combing trimming, punching & calibrating operation.

J.P. FuertesO, MurilloJ, LeónC, LuisaD, SalcedoI.PuertasR. Luri

The forgeability of an **AA5754** connecting rod manufactured from two different states: **after an annealing heat treatment** (N0) and after having been **previously ECAP deformed** with two passages (N2). The isothermal forging temperature finally selected is **150 ºC.** It is observed that the connecting rod manufactured after N2 shows an increase in the **micro hardness values of 21 %,** in relation to the connecting rod forged from the N0 state.

Binayak Sen, PushparenuBhattacharjee, Uttam Kumar Mandal

The choice of material has been inspected and examined for a connecting rod with the help of different MCDM methods. Copras Method,Moora Method , Topsis Method , Vikor Method , Aras Method TOPSIS and VIKOR, methods results to be the most advisable to the focused decision making, The top-ranked alternative by VIKOR method is very much nearer to the ideal solution.

Xiaolei Zhu, Jing Xu, Yang Liu, Bo Cen, Xiaofeng Lu, Zhuo Zeng

Connecting rod cap and connecting bolts of a reciprocating compressor are subjected to complex dynamic loads therefore they are of critical machine elements. The causes for the failure of connecting rod cap and connecting bolts after approximately 175200h in service have been investigated. chemical composition, hardness measurement, impact test and tensile test led to the conclusion that the connecting rod cap material was equivalent to Chinese Standard GB–35Cr and also consistent with American grade–UNS J02501and the connecting bolts were coincide with Chinese Standard GB–ZG270-500 and also in agreement with American grade –UNS G51350. The components of connecting rod cap and connecting bolts material conform to the requirements.The metallographic structure of connecting rod cap sample is ferrite and pearlite, and the connecting rod bolt sample's microstructure of substrate is tempered sorbate. Both of them correspond to the standards organization map.Stress concentration on the terminal of the connecting rod cap shall be strictly controlled in the process of maintenance and inspection appraisal may be done on the part of the curvature change of the connecting rod cap when it is necessary.

6. CONCLUSIONS

A connecting rod forms a basic element of an internal combustion (IC) engine, which performs the function of converting the reciprocating motion of the piston into angular effort of the crank. The objective of this study is to optimize connecting rod for its weight and manufacturing costs, taking into account the recent developments. Weight can be reduced by changing the material of the connecting rod to hybridcomposites material.The actual cross section connecting rod is i – section, which have been changed to cross section h – section. By changing the cross section, the weight of connecting rod is reduced.Due to use of composite material for manufacturing of connecting rod, to improve varies properties Varies types of method available for the selection of composite material. For this optimization problem, high priority is given to the weight of the connecting rod. Change in the material, there by resulting in significant reduction in the machining cost is the key factor in the optimization process. During optimization, weight and cost are dealt separately.

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