Comparative Study of Gray cast Iron and Aluminum Material of Connecting Rod for Four Stroke Single Cylinder Engine

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Abstract: The connecting rod is the intermediate member between the piston and the crankshaft. Its primary 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 crankpin our project we design a connecting rod for a four stroke single cylinder engine for three different materials like Gray cast Iron and Aluminum alloy. Both the designs are modeled in 3D modeling software catiya v5 /Engineer. Structural analysis is done on the connecting rod to verify the strength of the connecting rod by using Structural steel and Aluminum alloy by applying the loads finding out stress strain and total deformation for the two different materials. The analysis is done to verify the better material for connecting rod to reduce the cost.

Key words: 3D-Modeling, Connecting rod, Ansys and Alloy.

1. Introduction

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. This current thesis deals with the off study, the optimization part. 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. It can also achieve the objective of reducing the weight of the engine component, thus reducing inertia loads, such as stress strain and total deformation of three different materials are taken and the comparative study is conducted for reducing engine weight and improving engine performance and fuel economy.

2. Pressure Calculations for 150cc Petrol Engine

Suzuki gs 150 r specifications

Engine type: air cooled 4-stroke sohc

Bore $\times stroke(mm) = 57 \times 58.6$

Displacement =149.5cc

Maximum power = 13.8bhp @8500rpm

Maximum torque = 13.4nm @ 6000 rpm

Compression ratio =9.35/1

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Density of petrol $C_8H_{18} = 737.22 \frac{kg}{m^3}\ at\ 60F$

= 0.00073722 kg/cm^3

=0.00000073722kg/mm^3

T = 60f =288.855k =15.55^{o}c

Mass = density $\times$ *volume*

M = 0.00000073722$\times$ 149500

M = 0.11kg

Molecular wt. For petrol = 144.2285 g/mole

Pv = mrt

$P = \frac{mRT}{V} = \frac{0.11 \times 8.3143 \times 288.555}{0.11422 \times 0.0001495} = \frac{263.9}{0.00001707}$

P = 15454538.533 j/m^3 = n/m^2

P =15.454 n/mm^2

Table 1 Properties of materials.

Materials selected	Aluminum	Structural steel
Young's Modulus	7.1e10	2e11
Poisson's Ratio	0.33	0.3
Tensile Ultimate strength	3.1e8	4.6e8
Tensile Yield strength	2.8E8	2.5E8
Density	2770	7850

Model of connecting rod

The following Fig.no.1 shows

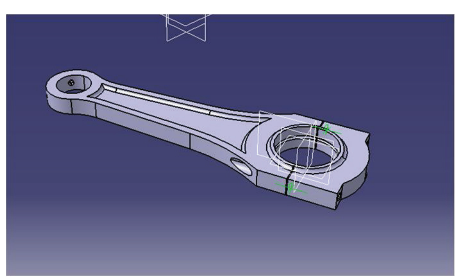
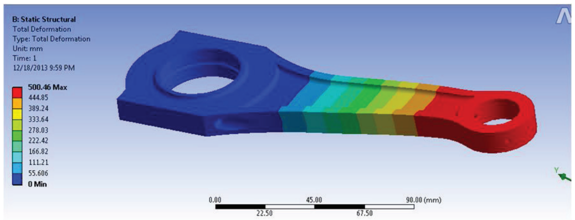


Fig.no.1 the catiya model of connecting rod

Choosing Material for Structural Steel

Structural Analysis For Structural Steel Total Deformation When 500n Of Load Applied Fig.No.2



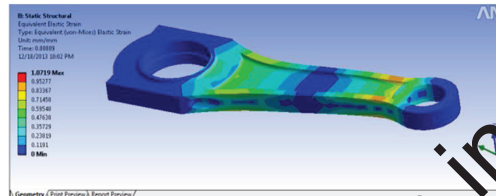
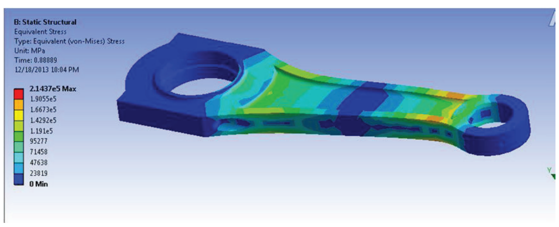


Fig.no.2 Total deformation

Fig.No.3 Voimic Strain energy

Equivalent voimic strain when 500n of load applied fig.no.3

Equivalent von-mises stress when 500nof load applied fig .no.4



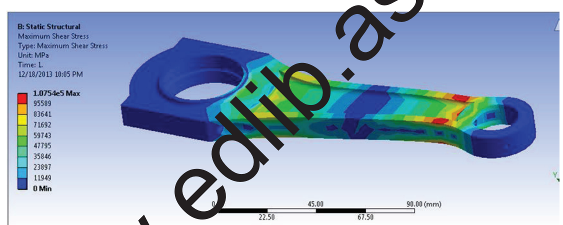


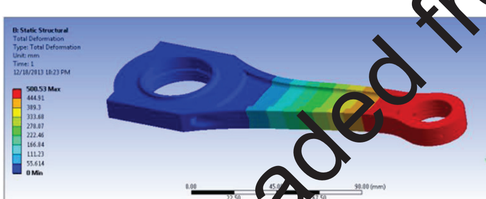
Fig .no.4 Von-Mises

Fig.no.5 Shear Stress

Maximum Shear Stress When 500N of Load Applied Fig.No.5

Choosing Material for Aluminum

Total Deformation When 500N Of Load Applied Fig.No.6



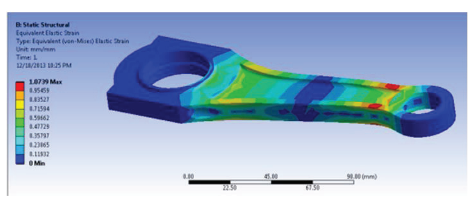
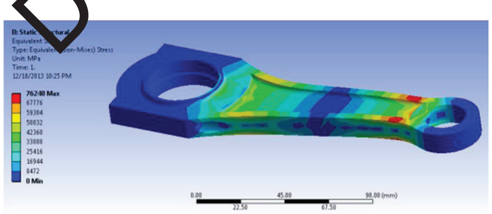


Fig.no.6 Total Deformation

Fig.no.7 Strain Energy

Elastic strain when 500n of load applied fig.no.7

Von-mises stress when 500n of load applied fig.no.8



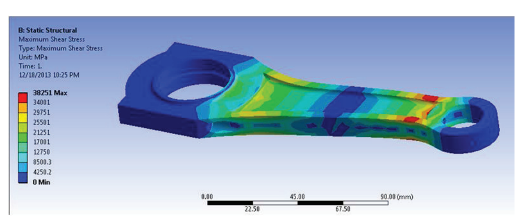


Fig.No.8 Von-Mises Stress

Fig.no. 9 shear stress

Maximum shear stress when 500n of load applied fig .no. 9

Table -2. Loads Distribution

Load/material	Von-mises Elastic strain	Von-mises Elastic stress	Maximum shear stress	Total deformation
GRAY CAST IRON				
500N	1.0719	1.074e5	1.074e5	500.46
1000N	2.1437	2.1437e5	2.1508e5	1000.9
1500N	3.215	3.219e5	3.219e5	1501.35
ALUMINUM				
500N	1.0739	38251	38251	500.53
1000N	2.1478	76503	76503	1001.1
1500N	3.2215	114753	114753	1501.59

4. Conclusion

In our project we have designed a connecting rod for a 150cc engine and modeled in 3D modeling software carina v5/Engineer. Actual cross section connecting rod is I – section, we have changed the cross section to H – section. By changing the cross section, the weight of connecting rod is reduced by 10gms.Present used material for connecting rod is Aluminum and structural steel. We are replacing with Aluminum alloy A360. By replacing it with Aluminum alloy A360, the weight of the connecting rod reduces about 4 times than using Carbon steel since density of Aluminum alloy A360 is very less as compared with structural steel. We have done structural and modal analysis on the connecting rod using two materials and Aluminum alloy. By observing the structural analysis results, the stress values obtained for both materials are less than their respective yield stress values. So using Aluminum alloy A360 is safe. By comparing the stress values for both materials, it is slightly less for Aluminum alloy A360 than structural steel. By observing the modal analysis results, we determined natural frequencies. So we can conclude that Aluminum alloy A360 is better for connecting rod.

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