Review: IC Engine ALFASIC Composite Connecting Rod

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Abstract:
Connecting rod is most important part of IC engine. Its Intermediate link between the piston & the crank. Which used to converting reciprocating motion of the piston rotary motion of the crank. Now a day’s Aluminium material connecting rod are used in Automobile Internal combustion engine but aluminium connecting rod having a more weight & low stiffness as compare to ALFASIC Composite connecting rod. If connecting rod having more weight it’s consume more fuel the leads to increase in weight of engine as well as gross weight of vehicle.

According to above problem we need to find out new material which having similar mechanical properties but having less weight & high stiffness as compare to Aluminium IC connecting rod.

Keywords: Connecting rod, aluminium, ALFASIC Composite.

I. INTRODUCTION

The Internal combustion engine connecting rod is one of the most essential parts of the engine. It is subject to various complex roads due to gas pressure & the inertia forces of the reciprocating parts. The stresses induced into the connecting rod due to the thrust & the pull of the piston are bending stresses, tension & compression in the axial direction. The connecting rod should be able to withstand these forces in unfavourable environmental conditions. The design & the weight of the connecting rod determine the performance of the engine.

In this paper describe the design & modelling Analysis of IC engine connecting rod using two different Materials. 1st one aluminium material & second one aluminium fly ash silicon based composite material & compare to the farmer material to the new Material found to have less weight & better stiffness. By carrying out these modification to engine element will result ineffective reduction of weight increase of durability of particular part will lead to decrease of overall engine weight improvement in its traction parameter & increasing performance of engine.

II. Literature Review

“Static Analysis of connecting Rod for weight Optimization.” This research paper gives idea about the result weight of the connecting rod can be reduced by replacing the old material AB60 by Aluminium Fly ash silicon composite which has higher strength and is manufactured using industrial waste such as fly ash.
“Analysis and optimization of connecting rod using Alfasic composites”. This research is motivated by the 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. In this work connecting rod is replaced by aluminium based composite material reinforced with silicon carbide and fly ash. And it also describes the modelling and analysis of connecting rod. FEA analysis was carried out by considering two materials. The parameters like von misses stress, von misses strain and displacement 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.
[3] Prof. N.P. Doshi
“Analysis of Connecting Rod Using Analytical and Finite Element Method”.

The connecting rod is a major link inside of a combustion engine. It connects the piston to the crankshaft and is responsible for transferring power from the piston to the crankshaft and sending it to the transmission. The most common types of materials used for connecting rods are steel and aluminium. Connecting rods are widely used in variety of engines such as, in-line engines, V-engine, opposed cylinder engines, radial engines and oppose-piston engines. For the project work we have selected connecting rod used in light commercial vehicle of tata motors had recently been launched in the market. We found out the stresses developed in connecting

III. Design of Connecting Rod

The Connecting Rod consist of an eye at the small end to accommodate the piston pin a long shank & a big end opening split into two parts to accommodate the crank pin. The construction of connecting rod is illustrated. The connecting rod of an IC engine is made by drop forging process & the outer surfaces are left unfinished. The connecting rod is subjected to the force of gas pressure & the inertia force of the reciprocating part. It is one the most heavily stressed
Part. It is one of the most heavily stressed parts of the IC engine. Aluminium & Aluminium alloy are used for connecting rods of automobile engines.

The length of the connecting rod is an important consideration when the connecting rod is short as compared to the crank radius. It has greater angular swing resulting in greater side thrust on the piston in high-speed engine. Rod to the crank radius (L/r) is generally four or less than four.

Most of the connecting rods in High-Speed engines have an I-Section. It reduces the weight & inertia forces. It is also easy for forging. Most rods have a rifle-drilled hole through all the length from the small end to the big end to carry the lubricating oil to the piston pin bearing. In low-speed engines circular cross section is used.

IV. Design calculation of connecting rod in general

From standard:
1) Thickness of flange & web of the section = t
2) Width of the section B = 4t
3) Height of the section H = 5t
4) Area of the section A = 11t^2
5) Moment of inertia about X axis & y axis ratio is Ixx/Iyy = 3.2

So in the case of this section (Assumed Section) Proportion, shown above will be satisfactory.

Length of the connecting rod (L) = 2 times the stroke
= 2*58.6
=117.2 mm

Area of the I section

1) A = 2(4t^2) + (5t+2t)*t
2) A = 11t^2
3) Where,
4) Area of the section A = 11t^2
5) Ixx = 1/12(4t) (5t) ^3-1/12(4t-t) [(5t-2t) ]^3 = (419/12)t^4

Kxx ^2 = Ixx/A = 1.78t

According to Ranking – Gordon Formula
F=(Fc.A)/(1+a(l/Kxx))

Let,
A = c/s area of connecting rod
L = length of connecting rod
Fc = compressive yield stress.
F = buckling Load
Ixx & Iyy = moment of inertia about x-x & y-y axis respectively.
Kxx & Kyy = Radius of gyration of the Section About x-x and y-y axis respectively.

Pressure Calculation:
Consider a 150 cc engine
Engine type air cooled 4-stroke
Bore – Stroke (mm) = 57*58.6

Displacement = 150cc
Maximum power = 13.8 Bhp at 8500rpm
Maximum torque = 13.4 Nm at 6000 rpm
Compression ratio = 9.35/l
Density of petrol at 274k is 737.22*10^-9
Molecular weight m(petrol) = 114.228 g/mole
Ideal gas constant R = 8.3143 j/mol.K
& R specific = R/Mass

According to Ideal gas equation we have
P.v = M. R specific. T

=737.22* [10] (-9)x150
=0.11 kg

R specific = R/M = 8.314/0.11 = 75.581
P=m. R specific. T/v

Pressure p=15.18 Mpa

Fp= Force acting on piston
=Area x Gas pressure
FP = 38276.37N

Maximum inertia load on the piston
fi = mw^2r(1+l/n)

Here w=2*πn/60=890.117 rad/sec
R=l/2=29.3
N=l/r=117.2/29.3=4

According to calculation
Fi=3192.01 N

Hence F=Fp-Fi=35084.36 N

Putting this getting all value in Ranking – Gordon Formula

F=(Fc.A)/(1+a(l/Kxx))

1) For aluminium 360 (old material)
Fc = 170 N/mm2

Getting value of t=5.021 mm

2) For aluminium 6061 – (9%.sic) & (15% fly ash)
Fc = 363 N/mm2

Getting value of t=3.760 mm

Take a = constant
For aluminium & aluminium alloy is a= 0.002.

V. RESULT

For aluminium 360 (old material)
Total area of I section connecting rod is 11t^2
Hence we get A=277.31 [mm] ^2
And new composite material get $A = 155.51 \text{ mm}^2$

VI. CONCLUSIONS
In this paper we calculating the area of connecting rod I section for both material. New ALFASIC composite connecting the total area of I section is less than the old material connecting rod. Around 56.07% reduction of area we get. And this affecting the weight of connecting rod.
My objective are in this paper to review design of I section of new ALFASIC composite connecting rod for IC engine.

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