Analysis of Connecting Rod Using Al356 Master Alloy as an Alternate Material

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ABSTRACT:

The modern world entirely depends on transportation and one of the best ways of domestic transporting is through roads with the help of automobiles. When we talk about the automobile domestic transportation first thing which comes to mind is two wheelers and trucks, so connecting rod is integrated part of wheeled vehicle the main function of connecting rod is to connect piston to crank shaft which converts the reciprocating motion to rotating. Deliver driving torque to its piston cylinder and it must also bear the sudden load of vehicle.

In this present investigation connecting rod material is a major area of concentration. This paper contains a preparation of al356 master alloy, analysis and comparison of results with existing connecting rods manufactured by using SS material.

Method 1:- Study of Grain refinement process

Method 2:- Preparation of master alloy

Method 3:- Stress analysis

KEY WORDS:

Connecting Rod (Con rod), Al356 master alloy, FEM, Stress analysis.

INTRODUCTION:

In reciprocating engines, connecting rod interface between pistons to the crankshaft. Together with the arrangement of crankshaft and piston, they frame a basic component that changes over responding movement into rotating movement. It might also change rotating into responding movement. As the con rods are rigid they might transmit either a pushing or a draw so that the rod rotates the crank through half of the revolution I, e cylinder pushing and pulling. Prior components, similar to chains, could just force. Be that as it may, in few present two-stroke motors, the interfacing pole is just required to perform push capacity. Yet, today's interfacing bars are best known through their utilization in interior ignition motors, for example, car motors. Conrods are of an unmistakably diverse outline from prior structures, utilized as a part of steam motors and steam locomotors.

The report from theoretical and FEM examination says that the stress instigated in the little end of the conrod are more prominent than the stress affected at the greater end. For this examination the material of conrod is replaced by aluminum strengthened with boron carbide for Suzuki GS150R. A model of connecting rod is modeled by utilizing PRO E Wildfire 4.0. Also, examination is completed by using ANSYS programming. Exhibited the outcomes and reported that the working variable of safety is closer to theoretical value in aluminum boron carbide. This paper discusses different literatures that have been published in this field and presents a review of literature which will be helpful to new research in this field. Besides this while going through the literature it is observed that there is no master alloy prepared and analyzed over connecting rod design.

TYPES OF MATERIAL USED IN CONNECTING ROD

1. Steel

2. Aluminum

3. Aluminum combinations

4. Cast iron

How to choose right connecting rod?

There are two major categories for manufacturing of connecting rod – forged and billet, when it comes to material there are few options like steel, titanium and aluminum, each options have some advantages and disadvantages like mentioned below.

Material	Advantages	Disadvantages
Aluminum	Flexible in construction	Less durable In some cases
	Lower cost	
Steel	OEM material	opportunity to improve design
Titanium	Most durable	Expensive
	Light weight	Short fatigue life

Table – Materials used

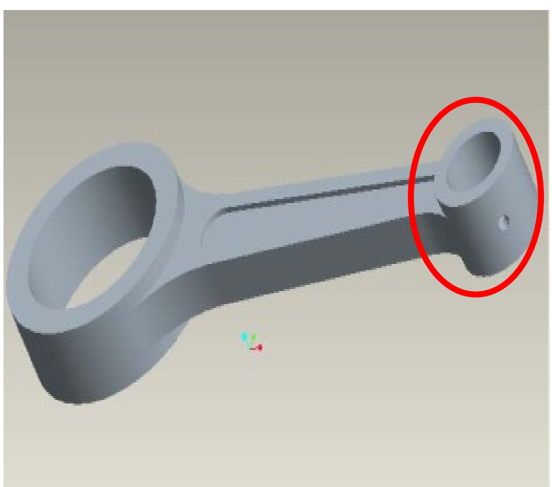


Fig. Stress concentration area.

Above figure showes exactly where the stress concentration is more in connecting rod of two wheler.

The significant stresses induced in connecting rod

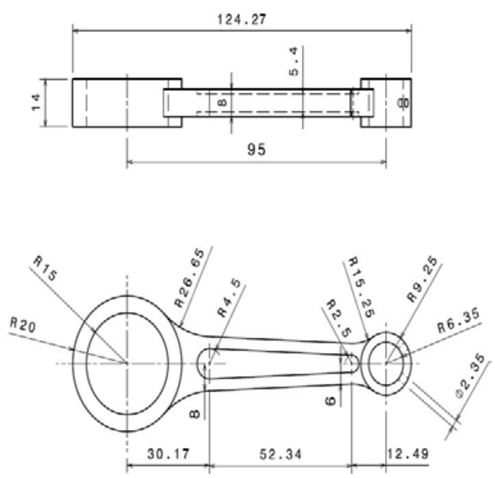
- Axial stresses: Stresses created because of barrel gas weight, which is compressive. What's more, latency strengths created in responding activity, which is both malleable and also compressive in nature.

- Bending stresses: Stresses Caused because of outward impacts.

Problem Statement

1. Two cases of connecting rod with different material and its behavior study by FEM analysis.
2. Subsequently, concluding al356 master alloy is an alternate material for manufacturing.

Case 1: Analysis of existing design by using stainless steel



	Stainless steel
Young's modulus (E)- Gpa	200
Poisson's ratio	0.3

Density – g/cm³	7.85
Ultimate tensile strength-Mpa	460
Tensile yield strength - Mpa	250
Compressive yield strength	250

Fig. Model preparation for analysis

Fig. Meshed model

Constraints and Loading:

After preparing the model ready for analysis, various constraints, supports and loads are applied, keeping in mind various boundary conditions. A Fixed Support is applied at crank end and a static load of 4319N is applied.

Fig. Loading and constraints

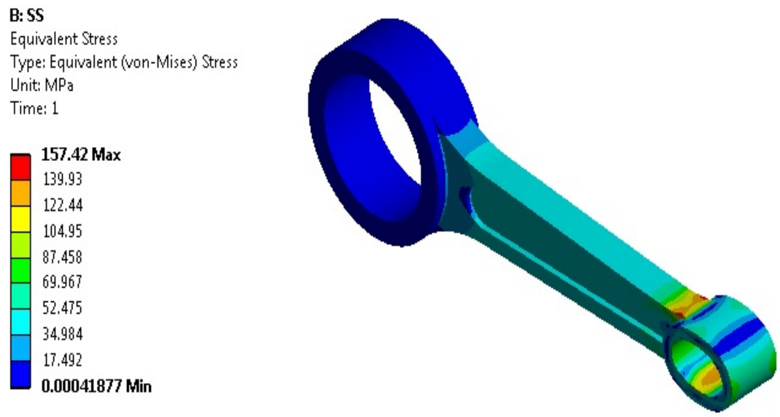


Fig. Equivalent Von-Mises Stress

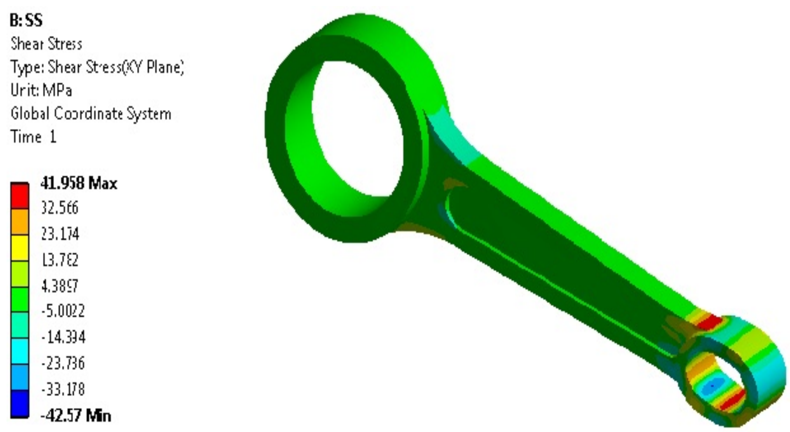


Fig. Shear Stress

Results:

Material	Von-Mises Stress (MPa)	Shear Stress (MPa)
Stainless Steel	157.42	41.958

Case 2: Master alloy preparation and stress analysis for comparison

Grain refiner**:** An element added to obtain finer grains and thereby reduce the probability of a brittle fracture due to concentration of grain boundary precipitates.

Grain refinement: It is an important technique for improving the metal castings. The addition of grain refiners in the form of master alloys containing potential nucleating particles, promotes the formation of fine structure by suppressing the growth of columnar and twin columnar grains. Meanwhile, casting with fine grains have improved cast ability and mechanical properties compared to large columnar grain castings. It is described as deliberate suppression of columnar grain growth in ingots and castings and formation of fine solidification structure thought the material.

Thermal reduction & Electrolysis:

The process in which titanium dioxide and diboron trioxide in crinoline alumina melts in presence of aluminum at 1000˚c. The master alloy produced by electrolysis has higher purity, though the rate of production is very low.

A digital temperature controller is used to control the temp between 800 -1000̊ c with intervals of 100̊ c

Time span – 45-75min

Temperature range – 800 – 1000̊ c

Reaction media – K2TiF6 salt with liquid Al in induction furnace

Composition of Al356:

Al	92.05
Cu	0.20
Fe	0.20
Mg	0.35
Mn	0.10
Si	7.00
Zn	0.10

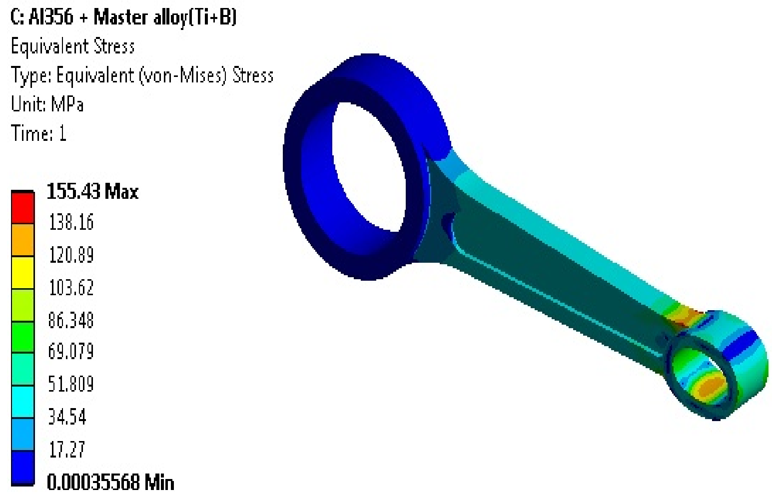


Fig. Equivalent Von-Mises Stress

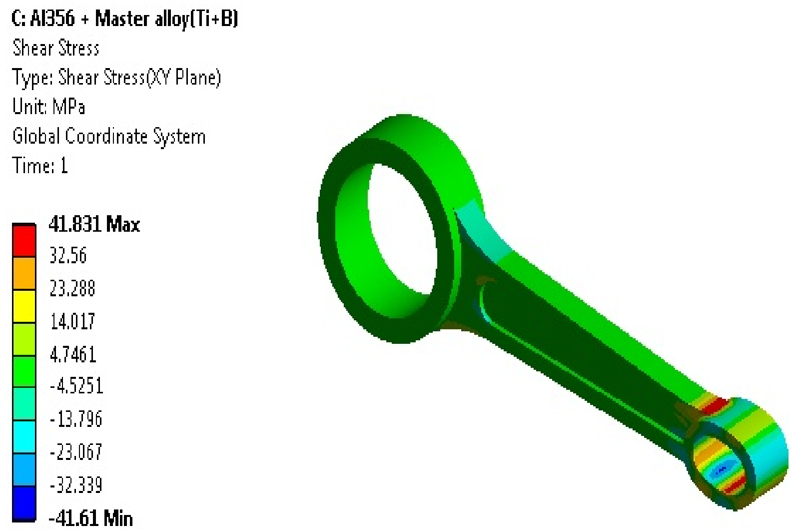


Fig. Shear Stress

Results:

Material	Von-Mises Stress (MPa)	Shear Stress (MPa)
Stainless Steel	155.43	41.83

RESULT and CONCLUSION:

Material	Von-Mises Stress (MPa)	Shear Stress (MPa)
Stainless Steel	157.42	41.958
AL356 + Master alloy (Ti+B)	155.43	41.831

It is observed from analysis that the area close to root of the smaller end (Piston end) of the connecting rod is subjected failure, may be because of higher crushing loads.

Also observed stress value is more in connecting rods manufactured by SS material. Our study and results of analysis suggests that the stresses can be lowered by using Al356 master alloy as an alternate material.

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