DESIGN EVALUATION OF FATIGUE LIFE OF CONNECTING ROD USED IN HERO HONDA MOTOR CYCLE

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ABSTRACT
The connecting rod is the most relevant part of an automotive engine. The connecting rod is subjected to an extremely complex state of loading. High compressive and tensile loads are due to the combustion of fuel and connecting rod’s mass of inertia respectively. The objective of this dissertation is to investigate the failure analysis of the connecting rod of Hero Honda Motor Cycle. Detailed analysis will be done to determine the stress, strain and total deformation in the present design of the connecting rod for the given loading conditions using the suitable tools. Fatigue Analysis is compared with the experimental results and further experimental results will be validated by using suitable tools.

KEYWORDS: FEA; Static; connecting rod load analysis; connecting rod stress analysis; etc

I. INTRODUCTION
The connecting rod is a major link inside 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. There are different types of materials and production methods used in the creation of connecting rods. The most common types of Connecting rods are steel and aluminum. The most common types of manufacturing processes are casting, forging and powdered metallurgy. Connecting rods are widely used in variety of engines such as, in-line engines, V-engine, opposed cylinder engines, radial engines and Opposed-piston engines

Summary of Researchers Works on Connecting Rod / Literature Review

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Title</th>
<th>Year</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fatigue Behavior and Life Predictions of Forged Steel and Powder Metal Connecting Rods</td>
<td>May-2004</td>
<td>This study investigates and compares fatigue behavior of forged steel and powder metal connecting rods.</td>
</tr>
<tr>
<td>2</td>
<td>Dynamic analysis of loads and stresses in connecting rods</td>
<td>6 Feb 2006.</td>
<td>Detailed load analysis under service loading conditions was performed for a typical connecting rod, followed by quasi-dynamic finite element analysis (FEA) to capture stress variations over a cycle of operation.</td>
</tr>
<tr>
<td>3</td>
<td>Fatigue analysis of connecting rod U650 tractor in the finite element code ANSYS</td>
<td>2008</td>
<td>FEM is evaluated as a useful approach to recognize the critical points and fatigue life time of the reciprocating components such as connecting rod.</td>
</tr>
</tbody>
</table>
Failure analysis of a fractured connecting rod  
May-2010  
Behavior of the connecting rod into the start point for crack initiation before the occurrence of catastrophic failure.

Stress Analysis of I.C.Engine Connecting Rod by FEM  
March-2012  
The stresses induced in the small end of the connecting rod and the stresses induced at the big end.

Nonlinear static finite element analysis and optimization of connecting rod  
June-2012  
Nonlinear static analysis is carried out on piston end and crank end of connecting rod and further study was conducted to explore weight reduction opportunities for a production of connecting rod.

Fatigue Numerical Analysis for Connecting Rod  
Nov-Dec 2012  
The complete understand of the mechanisms involved as well as the reliability of the numerical methodology to reduce project lead time and prototypes cost reduction.

Design And Finite Element Analysis Of Aluminium-6351 Connecting Rod  
May - 2013  
Static analysis is done to determine the von Misses stress, elastic strain, total deformation in the present design.

FEM analysis of the isothermal forging of a connecting rod from material previously deformed by ECAE  
July -2013  
Two set of dies are designed to perform a two stroke forging process and to obtain the desired nano structured part.

Stress and Fatigue of Connecting Rod in Light Vehicle Engine  
Dec-2013  
Stress distribution and fatigue life of CR in light vehicle engine were analyzed using the commercial 3D finite element software.

Research Gap: From the literature review it is seen that most studies on IC Engines connecting rod, Heavy Vehicle connecting rod had focus on axial stress, critical surface of connecting rod, weight of connecting rod, the connecting rod failure & structural analysis of connecting rod and all these results are carried only FEA software method there is no any experimentation and validation results are found. However very less research done on the stress distribution and fatigue life of CR in light vehicle engine are analyzed using the commercial 3D finite element software recommend the best alternative design for the connecting rod through experimentation and validation.

Problem Definition: Past research and experiences had indicated that during the operation of the engine, the connecting rod undergoes tensile, compression, and buckling loading. In many cases, the major reason behind the engine failure is the occurrence of the connecting-rod failure and sometimes, such a failure can be attributed to the broken connecting rod. In particular, the new analysis will examine the calculations for the stresses and fatigue failure of the connecting rod of Hero Honda Motor Cycle.

Objectives:
- Find out the problem areas by studying the existing system of linkages
- Identification of different parameters for redesign of the connecting rod
- Analyze the alternative geometry for connecting rod using CAE software
- Recommend the best alternative design for the connecting rod through experimentation and validation.

Scope:
The dissertation will focus on the stresses and fatigue failure of the component for evolving the best design of connecting rod. CAE software for analysis will be deployed for simulation and the results will be compared for improvement further.

Typical Steps involved in this project work are mentioned as below:
Following steps will be performed to execute this project. Following table gives details of steps and expected schedule.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Task</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>Literature Review Understanding functional requirements of connecting rod</td>
<td>Compiled per the review of published papers on the research topic</td>
</tr>
</tbody>
</table>
To study existing functional requirements and list advantages and limitations of existing design

Attempt to understand the formulation and application of empirical equations for the given case

CAD modeling for the existing application

3D model creation using CATIA/ UG/ or any other suitable 3D interface

Analysis using CAE

Design validation using Nastran or any other suitable CAE interface

Design modification for the application

By utilizing the inputs from CAE

Analysis for the modified configuration elements

Design validation using Nastran or any other suitable CAE interface

Testing and Validation

Experimentation over the test setup (if any)

Report Writing

Documenting results for proposed solution

II. 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
    o Creating the model.
    o Defining the element type
    o Defining material properties
    o Meshing criteria
    o Applying loads
    o Applying boundary conditions

  • Solution 1: Assembly of equations and obtaining solution for structural analysis
  • Solution 2: FE modeling for fatigue analysis using inputs from solution 1.

  • Post processing: Review of results

III. EXPERIMENTATION

Structural strength for the connecting rod would be verified over an UTM for tensile loading. The load applied at one end shall be determined through mathematical treatment for the problem. Static load would be applied to record the stresses over the component. Strain gauge shall be placed over the component as determined by FEA particularly for region of high stress. As for the fatigue life determined by the FE analysis the same shall be compared with historical data with the sponsoring company. The type and nature of the connecting rod resembling the previous application shall be referred to for comparison and validation. The physical experimentation for fatigue life is not feasible to conduct since the duration of testing exceeds 1000 hrs. of continuous exposure to cyclic loading. The validation for this work shall be exclusively effected by referring to static test for “Load vs. Stress”

IV. CONCLUSION

It has been concluded that Finite Element Analysis is best suitable method for predicting the Fatigue Life of any component. FEM has been evaluated as a useful approach to recognize the critical points and fatigue life time of the reciprocating components such as connecting rod.

REFERENCES


AUTHORS’ BIOGRAPHY

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