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Design, analysis and optimization of 12 cylinder v-type diesel engine components

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Abstract: The designing, material selection and stress analysis are important processes in mechanical engineering design. The below brief study deals with the afore-mentioned processes conducted on the piston, connecting rod and crankshaft of a 12 cylinder V-type engine used for wood cutting application. The objective of this study was to optimize the weight of the given parts and increase their capacities to withstand different loads by means of iterative design changes as well as material selection for the three components. Pre-existing engine data and empirical relationships were used to generate a mathematical model for the design procedure and Ashby standards were followed for material selection for the above-mentioned parts. The Computer Aided Design (CAD) modelling and analysis of these parts was conducted in the Solidworks software.

Keywords: Optimization, piston, connecting rod, crankshaft, material selection.

1. Introduction

Three of the very important components of V12 engine are connecting rod, crankshaft and piston which are involved in most of the engine failure cases. Hence, we have taken these components as the focus of our study. Thus, we have made the following objectives to achieve optimized strengths for the three components.

The effect of reciprocating inertia forces and bending forces plays a vital role in the performance of a connecting rod. Connecting rod undergoes large repetitive loads of varying values and hence we need to increase its fatigue strength.

The key component of the engine that converts the reciprocating linear motion of the piston to rotational motion is the crankshaft. The cyclic changes in gas pressure inside the cylinder encourage the crankshaft torsional vibrations. In order to eliminate the leading cause responsible for part failure, it needs modification for withstanding the high torsional stress.

Engine performance is improved, if the weight of the components is reduced optimally. Weight can be reduced by changing the size, shape or material of the component. In this study, we have aimed to reduce the weight of the components through changes in their shapes and materials.

The above mentioned objectives were decided for a 12 cylinder V-type engine used in wood cutting application. The following table gives the engine specifications and operating parameters that are necessary for calculations