Analysis of Low-Speed Diesel Engine Connecting Rod Made of AL360

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Abstract. Connecting rod is one of the most important and critical components in an engine. The scientists should work on it in order to improve its performance. In the current study, in order to analyse the stress and deformation surrounding the connecting rod, the 3D model is built. A connecting rod made of AL360 is investigated in this study. Stress distribution and deformation of a con-rod made of AL360 are carried out.

1. Introduction

In an engine, connecting rod is one of the most important components [1, 2-5]. If it is damaged engine stops working. And, generally, the performance of the engine depends of the performance of its components especial the connecting rod. According to the results and observations from the previous studies, fatigue and other factors are the sources of the connecting rods failure [6-12]. A connecting rod is subjected to several loads. Therefore, it is important for a con-rod to be able to withstand these loads that acts on it [13].

Con-rod works under a complex stress condition [3, 14]. During the working process, the con-rod is affected by the alternating loads such as vibration, fatigue load and electromagnetic vibration, which will cause the relative movement of the contact surface of the parts. This kind of fretting phenomenon appears on the contact surface of con-rod small end and bushing, which not only causes fretting wear and fretting fatigue, but also leads to insufficient interference of bushing. As a result, the movement of the con-rod and the piston will not be coordinated, which will cause certain impact on the engine, increase the engine noise, and even have the possibility of cylinder pulling. Therefore, the analysis of fretting characteristics of bushing contact has guiding significance to improve the service life of bushing.

In recent years, FEA has become commonplace, and is now widely used and employed in many fields and application. Using FEA, very complicated stress problems can now be obtained where analytical solutions cannot be investigated. And the FEA is so important method that even introductory treatments of mechanics of materials.
In this study, in order to analyse the stress and deformation surrounding the connecting rod, the 3D model is built. A low connecting rod made of AL360 is investigated in this study. Stress distribution and deformation of a con-rod made of AL360 are carried out in this study.

2. Materials and Methods

2.1. Materials
To get a good performance the material selected should have good mechanical properties. AL360 and AL25 were used in the present. The material properties of the diesel engine con Rod are presented in Table 1.

|                | AL360 | Alloy 25 |
|----------------|-------|----------|
| Young’s Modulus(Gpa) | 69    | 131      |
| Density(Kg/m3)    | 2700  | 8360     |
| Poisson’s Ratio   | 0.33  | 0.29     |

2.2. Methods
In the proposed study, the 3-D model of the connecting rod built. Creo 2.0 was adopted to build a 3-D model of the connecting rod. The model of the present problem is shown in Fig. 1. For analysis, ANSYS, R. 19 workbench was adopted in the present study.

To choose the appropriate mesh size for this model, the mesh sizes were specified as 4 mm, 6 mm, 8 mm, 10 mm and 12 mm respectively. Thus the new model having all the mesh sizes was used. The results were measured and evaluated to select the optimum mesh size that will result in system reliability. Table 1 shows the results obtained.

As per Table 1, the maximum stress as well as the deformation values with 8 mm mesh size was more reliable. Considering the stability of measurement performance, it is apparent that 8 mm mesh size is the most suitable for the problem statement.
Based on the current convergence test, the 8 mm discrete sized mesh was utilized in this model. Fig. 2 shows the con-rod model after meshing. Fig. 3 shows the boundary condition setting of the current study.

Table 2. Comparison of different mesh sizes.

| Mesh size (mm) | Maximum stress (MPa) | Maximum deformation (mm) |
|---------------|----------------------|--------------------------|
| 1             | 4                    | 83.028                   | 0.29634                  |
| 2             | 6                    | 73.601                   | 0.29632                  |
| 3             | 8                    | 73.257                   | 0.29627                  |
| 4             | 10                   | 73.812                   | 0.29625                  |
| 5             | 12                   | 69.956                   | 0.29629                  |

Figure 2 Meshing of 3-D numerical analysis con-rod model

Figure 3 Boundary conditions for the con-rod assembly model.

3. Results and Discussion
In this study, in order to analyse the stress and deformation surrounding the connecting rod, the 3D model is built. A connecting rod made of AL360 is investigated in this study. Stress distribution and
also deformation of con-rod made of AL360 are carried out. Stresses of connecting rod big and small ends, also are carried out, in this study. Fig. 4 shows the maximum stress of the connecting rod made of AL360. It is observed from Fig. 4 that the maximum stress, is 92.815MPa. Fig. 5 shows stress of connecting rod big and small ends. It can be seen from Fig.5 that the maximum stress on the bearing surface at the connecting rod big end is 68MPa, and the maximum stress on the bearing surface at the connecting rod small end is 32MPa. Fig. 6 shows the deformation of the connecting rod assembly made of Al360. It is observed from Fig. 6 that the maximum deformation is 0.8861mm.

Figure 4 Stress distribution of con-rod made of AL360.

(a) stress at con-rod big end
4. Conclusion
Stress distribution and deformation of a con-rod made of AL360 were carried out. According to the results carried out, the maximum stress is located at the oil hole edge on the bearing surface of the connecting rod big end. The stress at the connecting rod body middle section is uniform and its value is about 55 MPa. The maximum stress of the con-rod made of AL360, is 92.815MPa. The maximum deformation of the con-rod made of AL360, is 0.8861.

Finally, the scientists should work on the connecting rod in order to improve its performance.
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