Journal of Engineering and Applied Sciences 13 (Special Issue 6): 5224-5225, 2018
ISSN: 1816-949X

Design and Thermal Analysis of a Connecting Rod

A.R. Sivaram
Department of Mechanical Engineering, AMET University, Chennai, India

Abstract: A connecting rod is a major engine part that transfers motion from the piston to the crankshaft and functions as a lever arm. Connecting rod is used for transferring the reciprocating motion of the piston into rotary motion of the crank shaft. It is used to connecting piston and the crankshaft. In this study a connecting rod made up of copper alloy is modeled and analyzed. The properties of the connecting made up of copper alloy are compared with existing connecting rod made up of steel.

Key words: Connecting rod, copper alloy, steel, thermal analysis, compared, existing

INTRODUCTION

Connecting rod is used for transmitting power from piston to crankshaft. It is used transferring the reciprocating motion of the piston into rotary motion (Zhang *et al*., 2006). The small end of the connecting rod is connected to the piston pin, the piston pin's ends is connected to the piston. The piston pin provides a pivot point between the piston and connecting rod. Piston pin locks is used to hold the piston pin in its position. The finite element analysis for connecting rod assembly shape and optimization of connecting rod pin is described (Folgar, 1988; Rabb, 1996; Tu *et al*., 2004). Various properties of mechanical systems have been analyzed in detail (Yang *et al*., 1992; Fourmen and Chenot, 1996; Schwab *et al*., 2002). In this study, a connecting rod made up of copper alloy is designed and analyzed (Fung, 1996; Piffetau *et al*., 2000). The mechanical property of connecting rod made up of copper alloy is compared with the existing connecting rod made up of steel.

MATERIALS AND METHODS

The existing connecting rod is made up of stainless steel. The property of the existing connecting rod is given in Table 1. These properties are used to analyze the component in the ANSYS Software. These properties will be assigned to the model of the connecting rod. After assigning the properties to the model, the model is meshed. After the meshing process, the load conditions are applied then the analysis is done. Finally, the results are obtained. The obtained results represent the materials ability to withstand the load conditions. The same process is done for the proposed material without changing the connecting rod shape and load conditions.

Analysis: Figure 1 shows the thermal analysis result of the connecting rod made up of steel. Here, the properties of steel are studied as they change with temperature. When the material is heated up there will be change in the dimension that is called thermal expansion of that material. Figure 1 shows the thermal expansion of the connecting rod made up of steel. The different colors in the connecting rod denoted the different deformations. Red color area denotes the maximum thermal expansion.

Table 1: Material properties of existing connecting rod material

Properties	Values
Material	Steel SAE 8542
Density	11.7-8.03 (g/cm^3)
Melting point	1423 (°C)
Elastic modulus	183-214 (GPa)
Poisson's ratio	0.22
Tensile strength	452- 541 (MPa)
Thermal conductivity	45 (W/m-K)

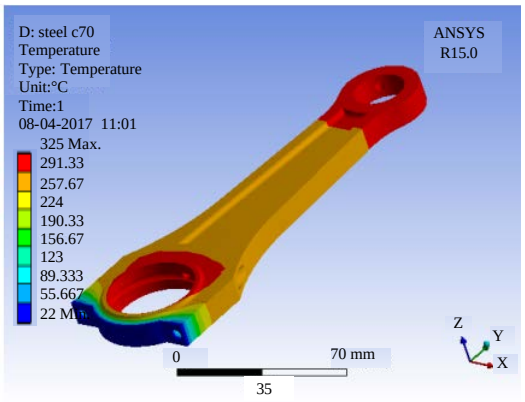

Fig. 1: Thermal analysis of connecting rod made up of steel

The analysis of the connecting rod made up of copper alloy is shown in Fig. 2. Figure 1 shows the thermal expansion of the connecting rod made up of copper alloy. The different colors in the connecting rod denoted the different deformations. Red color area denotes the maximum thermal expansion. The blue color area denotes the minimum thermal expansion.

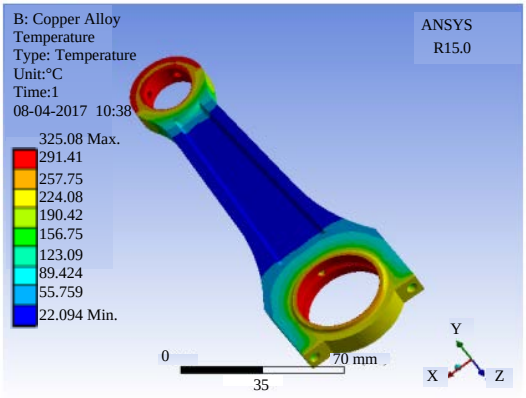

Fig. 2: Thermal analysis of connecting rod made up of copper alloy

Table 2: Result obtained from the analysis

Material name	Thermal withstand capability (°C)
Steel C70	325.0
Copper alloy	435.8

RESULTS AND DISCUSSION

The results shown in Table 2 are taken from the ANSYS WorkBench Software. The thermal withstand capability values of steel C70 and copper alloy are noted in Table 2 and the values are compared with both. By the comparison of the steel and copper alloy, the copper alloy has less thermal deformation than the steel. The steel can withstand up to 325°C and the copper alloy can withstand up to 435.8°C. The deformation is lesser than the copper alloy. So, we prefers the copper alloy for fabricate the connecting rod.

CONCLUSION

In this study, a connecting rod made up of copper alloy has been designed and analyzed. The connecting rod made up of copper alloy could exhibit better properties than the existing steel connecting rod. Thus, the modelling and analysis part shows the thermal strain and stress constants in the field of research and the values has been derived. By this analysis the proposed material copper alloy is safer than the existing material steel for the manufacturing of the connecting rod. By using the copper alloy we can increase the life of the connecting rod.

REFERENCES

Folgar, F., 1988. Fiber FP-metal matrix composite connecting rods: Design, fabrication and performance. Proceedings of the 12th Annual Conference on Composites and Advanced Ceramic Materials Part 1 of 2: Ceramic Engineering and Science Proceedings, March 28, 2008, John Wiley & Sons, Hoboken, New Jersey, ISBN:9780470374801, pp: 561-578.

Fourment, L. and J.L. Chenot, 1996. Optimal design for non steady state metal forming processes I. shape optimization method. Intl. J. Num. Methods Eng., 39: 33-50.

Fung, R.F., 1996. Dynamic analysis of the flexible connecting rod of a slider-crank mechanism. J. Vib. Acoustics, 118: 687-689.

Piffetau, S., D. Souchet and D. Bonneau, 2000. Influence of thermal and elastic deformations on connecting-rod big end bearing lubrication under dynamic loading. ASME J. Tribol., 122: 181-192.

Rabb, R., 1996. Fatigue failure of a connecting rod. J. Eng. Failure Anal., 3: 13-28.

Schwab, A.L., J.P. Meijaard and P. Meijers, 2002. A comparison of revolute joint clearance models in the dynamic analysis of rigid and elastic mechanical systems. Mechanism Mach. Theory, 37: 895-913.

Tu, D.H., S.L. Jiang and M.L. Cao, 2004. The FE analysis for 498 connecting rod assembly. Trans. CSICE, Vol. 2.

Yang, R.J., D.L. Dewhirst, J.E. Allison and A. Lee, 1992. Shape optimization of connecting rod pin end using a generic model. Finite Elements Anal. Design, 11: 257-264.

Zhang, J.C., X.H. Li and G. Sun, 2006. Connecting rod design based on finite element analysis. Tractor Farm Trans., Vol. 1.