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Research Paper

ANALYSING STRESS CONCENTRATION REDUCTION IN GEARBOX COVER AND FABRICATION

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Gearbox cover of a 3-wheeler commercial auto is designed and fabricated. The task is to reduce the stress concentration in the Gearbox cover due to internal pressures such as crank pressure and gear shaft pressure. While analyzing the stress, stress concentration is found to be more at a location of its bolts. The stress concentration is checked in three ways and selected the one which gives the minimum stress concentration. The three ways of reducing the stress concentration are design modification, material changing without design modification and material change with design modification. The minimum stress concentration reduction by using the design modification and material change are presented here. Analysing the best the best design, proper dies are fabricated to generate gearbox cover by using CNC milling machine. The CNC milling code is generated by using Edge cam software.

Keywords: Gear box cover, Stress reduction CNC milling

INTRODUCTION

With the use of new modelling and simulation technologies like CAD and CAE, helps the researcher to have a exposure on work for thinking it practically in the engineering field.

Gearboxes are frequently used in machine systems for power transmission, speed variation and/or working direction. Gearbox casings play a vital role as they house the transmission components (Lim and Singh, 1989). The Gearbox analysis can be done by making a proper process plan, which includes CAD model, generating the boundary conditions, material selection, properties of material and choosing the right casting process. A model has developed (Guan *et al.*, 2005) the transmission of vibration through bearings into the housing. With this directly vibrations generated in the Gearbox is to be reduced. So life of the total gearbox is going to increase.

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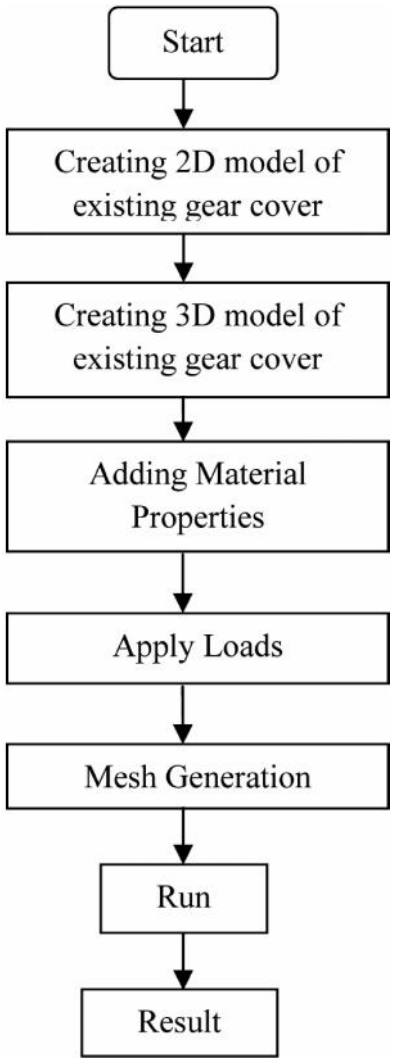
METHODOLOGY

The process of reducing the stress concentration follows the flowchart as shown in Figure 1. In material change and design modification if the stress concentration developed is less than stress developed in modified model then again there should be change in design modification in the flowchart.

Figure 1: Flow Chart for the Reduction of Stress in Model

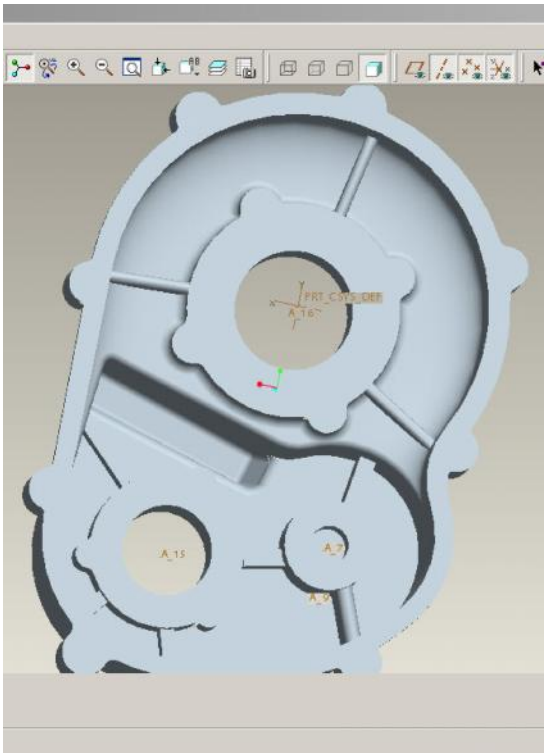


After the design finalizing and material selection, the die is then fabricated based on the changes by using CNC milling machine.

REDUCING THE STRESS CONCENTRATION

Design Modification in Existing Model: For modelling any component source data is very important, based up on this data only entire modelling will takes place, in this paper source data is collected from the Existing Model. Guan *et al.* (2005) based upon the data with the three dimensional modelling software the 3D model is developed with sketching the 2D model first. For this particular model the LM 25 material is applied. The pressure and centrifugal loads which are acting on the gearbox cover has to be applied with value of 0.303 N/mm^2 and angular velocity of 315 rad/s and angular acceleration of 5.23 rad/s^2. With the maximum element size 10 mm and minimum element size 2 mm solid mesh is

Figure 2: D Model of Gear Box Cover with Change in Design



applied to the (Tushar and Priadarshini, 2008) model. Design modification of 60 mm radius for the existing model has done using Pro-E software as shown in Figure 2.

Material Change in Existing Model: The materials used here are (Abbes *et al.*, 2005) 2014-O, 6061-O and 6063-O these materials posses less mechanical properties compared to LM25. The materials for the gearbox cover are selected based on the mechanical properties such as thermal conductivity and ultimate tensile strength.

Design Modification and Material Change in Existing Model: The radius are also changed, the concerned materials such as 2014-O, 6061-O and 6063-O are changed to reduce the stress concentration to minimum.

RESULTS AND DISCUSSION

Initially Existing gearbox is made up of LM 25 material. With the help of Solidworks software, COSMOS module Entire Analysis part had done. Number of steps involved in finalizing the best model with respect to its results by modifying its design.

Figure 3: Stress Developed in Different Modified Design Models with its Radius

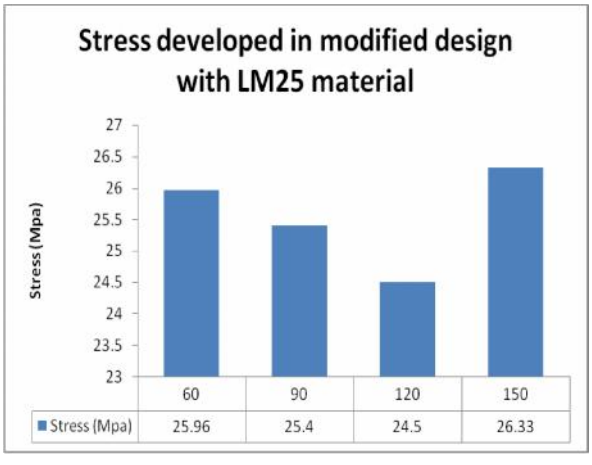


Figure 4: Stress Developed in Existing Model with Different Materials

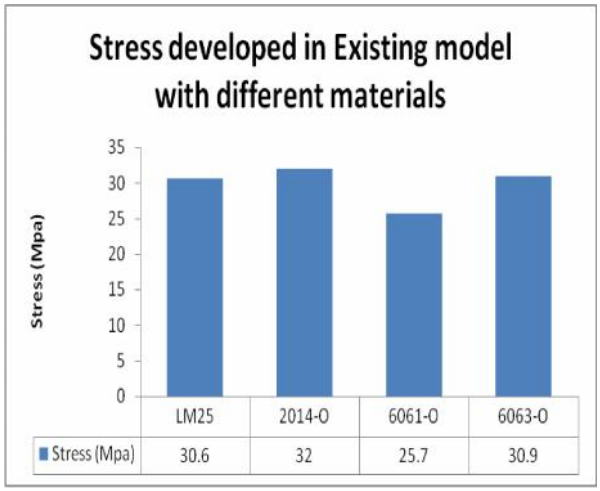
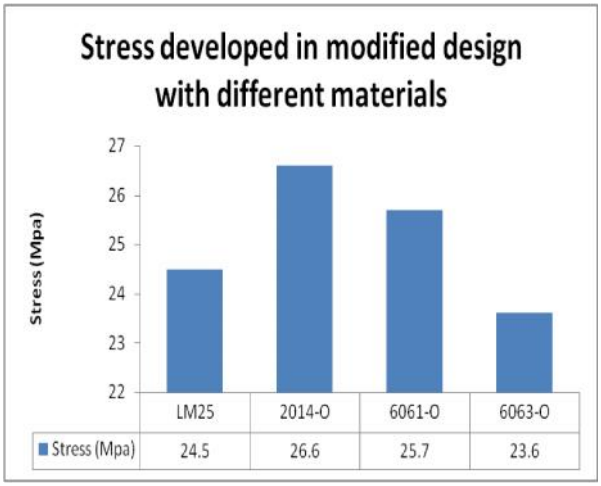


Figure 5: Stress Developed in Selected Modified Design Model with Different Materials



When there is a change in the existing model, radius to 120 mm the stress concentration is reduced to 24.5 Mpa from Figure 1. The stress concentration is reduced to 25.7 Mpa for 6061-O (Guan *et al.*, 2005) with the existing model. In the modified model when the radius is changed to 120 mm, with the 6063-O the stress concentration is reduced to 23.6 Mpa Figure 2.

The Von Mises stress with respected to the existing model and design change, how the minimum and maximum stress are varying are shown in the Table 1.

Table 1: Von Mises Stress

	Minimum (Mpa)	Maximum (Mpa)
Existing Model LM25	0.01071030	30.6433
Design Modification 60 mm Radius	0.00259962	25.9676
Design Modification 90 mm Radius	0.00440142	25.3744
Design Modification 120 mm Radius	0.02591270	24.2481
Design Modification 150 mm Radius	0.00871952	26.2936

Figure 6: Core of the Selected Design Modified Model

Figure 7: Cavity of the Selected Design Modified Model

By the use of CNC milling machine, the modified design is machined on mild steel. The core and cavity are machined based on the dimensions and change in the design.

Figure 8: Fabricated Gearbox Cover

CONCLUSION

The selected design based on the stress reduction, design modified model is 120 mm radius model with material 6063-O will had produced less stress 23.6 Mpa compared to other materials. This material satisfies two conditions they are less weight and less cost. With this design modified model core and cavities are generated with using vertical CNC milling machine. For this one NC code is generated from Pro-E and Edge cam tools. Outs of these two generated NC codes Pro-E tool generated NC code consume less machining time. With the help of extracted core and cavities prototypes are generated.

The final conclusion of this project is 120 mm radius model with 6063-O material will give very less stress and also core and cavities for selected model are generated within less time.

ACKNOWLEDGEMENT

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