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Stress Analysis of Gearbox Casing Using ANSYS Workbench

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Abstract: ***For a three wheeler gearbox cover is designed and analysed. The aim is to find out the stresses in gearbox cover because of internal pressures like gear shaft pressure and crank pressure. In this project modeling is done by CATIA software and analysis is done by ANSYS Work bench. To reduce stresses we have three ways they are design modification, with out design modification material changing and with design modification and material change.***

Keywords: Gearbox cover, ANSYS,stresses, design , material change.

1. Introduction

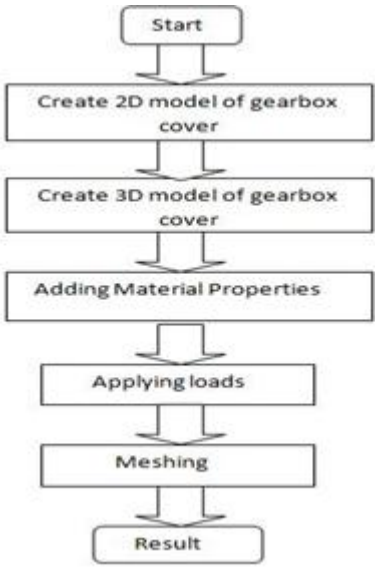
A Gearbox casing is a shell in which a train of gears are sealed ,The gearbox casing covers transmission components like shafts and gears.In machine systems gearboxes are used for power transmissions ,speed variations. A process plan for gearbox analysis includes CAD model, applying boundary conditions,selection of material, materialproperities and choosing good casting process.The developed model can transmit vibrations through bearings in to the housing.Thus the reduction of vibrations which is generated in the gearbox.So that life of gearbox is going to increase.

The gearbox casing analysis is very essential because to predict casing behaviour under different operating conditions and decide exact dimensions, typically casing failure occurs at 800rpm to 3200rpm to damage gearbox.

Many authors are analysed by experimentally as well as using softwares, some authors are presented as follows, they found that natural frequencies of simulated values were within 5% of the experimental values and similarly mode shapes of the simulated and experimental are very similar.

2. Process Chart

The following flowchart shows the steps that reducing vibrations.If vibrations developed is lessthan when vibrations developed in modified design ,when material change and design modification,then again design modification should be change in the flow chart.



3. Modeling and FEM Analysis of Gearbox Casing Component

The Three dimensional gearbox casing component of was built by using CATIA software and ANSYS Workbench was used for pre processing,solving and post processing.The material properties of LM24 was taken from the Norton website.

Figure 1: Gearbox casing component

3.1 Excitation Forces

There are three types of excitation forces. First type is the unbalanced running speed and mechanical looseness. As per grade and ISO 1940 excitation due to un balance and mechanical looseness is not considered.

The second eWxcitation force is due to running the engine at

3200RPM.To prevent gear box casing resonance the component contain separation margin 20% on harmonic existing frequency.

The third excitation is due to meshing of gear tooth. However some excitation forces due to meshing of gear tooth at input shaft rotating at a speed of 3200RPM, hence at corresponding excitation the frequency of gear mesh is considered.

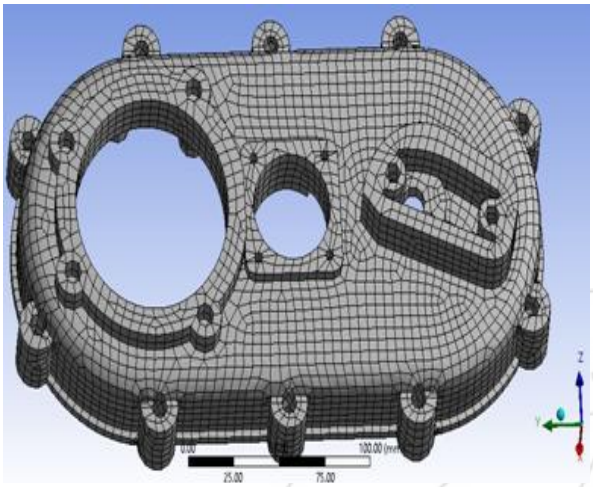


Figure 1: Gear box casing meshing model

4. Specifications

The following data is provided for modeling and analyzing

Weights acting on the gear box casing
Material used = LM24
Piston weight = 200g=0.2kg
Gears weight =4.7kg
Connecting rod weight = 130g =0.13kg
Crank case weight = 500g=0.5kg
Area of smaller hole =802.277mm^2
Area of larger hole =1987.65mm^2
Speed of the engine =3600RPM

Total weight =0.2+4.7+0.13+0.5 = 5.53kg
Total load acting on the casing =5.53*9.81 =54.25N

5. Formulation

1. Bearing Pressure
Bp = Bearing load per area i.e.,
Bp = W/A N/mm^2
Where W= 54.25N
A=1420.78 mm^2
Therefore Bp = 0.303N/mm^2

2. Angular Velocity

W = 2πN /60
Where w=Angular velocity rad/sec
N= Speed in rpm
Therefore W= 315 rad/sec

3. Angular Acceleration

α = W/T
Where α = Angular acceleration rad/sec^2
Therefore α = 5.25rad/sec^2

6. Analysis Method

Stress Analysis:
By applying boundary conditions the static analysis of the model can be performed similarly forces which are calculated are also applied on the component.

Static:
The total casing component is attached to the assembly by using bolts under fixed condition .This paper contain analysis of gearbox casing by FEM .In this paper static structural has been analyzed on gearbox and thus stresses on the component can be determine. Paper also determines the casing inner surface and circulating oil which can be found small and it will neglected. The main objective of the work is

- To carry out structural analysis using ANSYS Workbench for analyze effect of stresses on the component
- In future for design modification and optimization of component for better performance output
- There is a possible of reverse engineering in design of gearbox casing

1. Preparation of model for analysis:

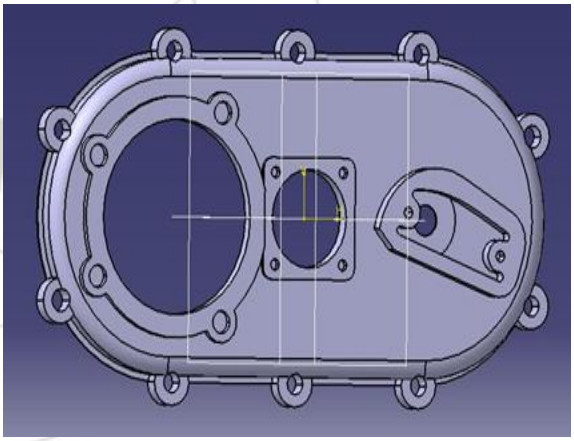


Figure: Modeling of gear box casing using dimensions

2. Mesh Generation:

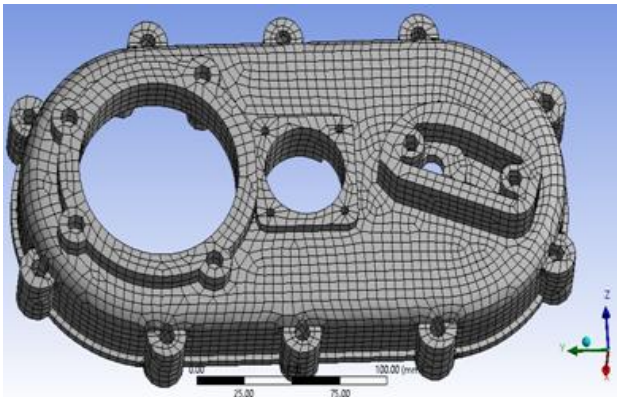


Figure: Gearbox casing FEA model

7. Applying Boundary Conditions and Loads

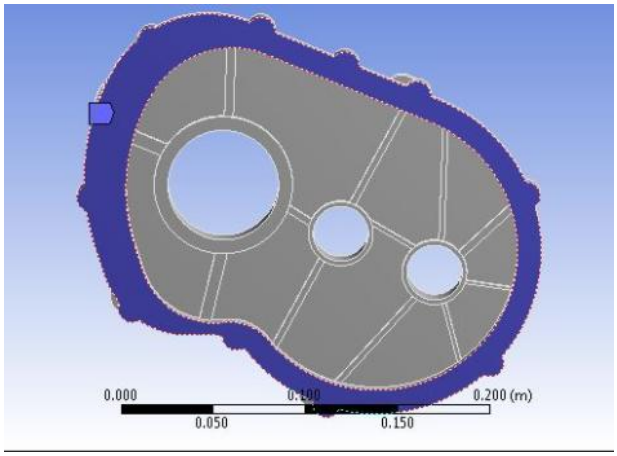


Figure: Fixed support of gear box casing

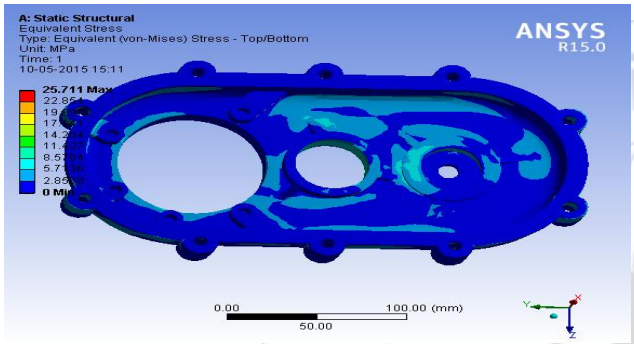


Figure: Deformation of casing after applying loads

Von Misses Stress	
Existing model LM25	26.66N/mm^2
LM24	25.711N/mm^2

The main aim of the paper to determine the stress distribution along the gearbox casing and is to apply ANSYS software.

Conclusion

By reviewing this paper it shows clearly that stress analysis and stresses generated in the gearbox casing can plays a vital role while gearbox designing. so its very important to understand while designing.

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