Analysis of Spur Gear Box Using Software tool Ansys

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Abstract - Gear box are used in almost all the machineries where the power is to be transmitted. In the wind turbines the vibration and cross wind pressure are the major reason for the failure of the of the cooling tower fan. The present study is focused on study the effects of various loading on the spur gear box of cooling tower fan, and study the stress and deformation on the gear box due to it.

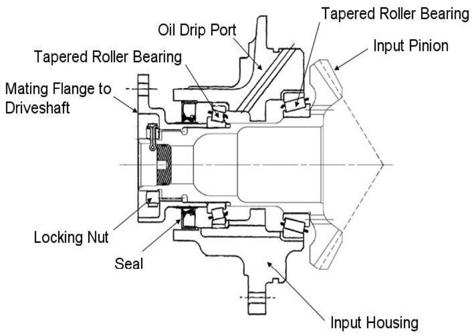
I. INTRODUCTION

Gearing is one of the most effective methods transmitting power and rotary motion from the source to its application with or without change of speed or direction. Gears will prevail as a critical machine element for transmitting power in future machines due to their high degree of reliability and compactness. The rapid development of heavy industries such as vehicle, shipbuilding and aircraft industries require advanced application of gear technology.

A gearbox consists of a set of gears, shafts and bearings that are mounted in an enclosed lubricated housing. They are available in a broad range of sizes, capacities and speed ratios. Their function is to convert the input provided by the prime mover into an output with lower speed and corresponding higher torque. In this thesis, analysis of the characteristics of helical gears in a gearbox is studied using finite element analysis.

The crucial requirement of effective power transmission in various machines, automobiles, elevators, generators, etc has created an increasing demand for more accurate analysis of the characteristics of gear systems. Furthermore the best way to diminution of noise in engine requires the fabrication of silence gear system. Noise reduction in gear pairs is especially critical in the rapidly growing today's technology since the working environment is badly influenced by noise. The most successful way of gear noise reduction is attained by decreasing of vibration related with them. The reduction of noise by vibration control can be achieved through a research endeavour by an expert in the field.

Gears can fail in many different ways, and except for an increase in noise level and vibration, there is often no indication of difficulty until total failure occurs. In general, each type of failure leaves characteristic clues on gear teeth, and detailed examination often yields enough information to establish the cause of failure. The general types of failure modes (in decreasing order of frequency) include fatigue, impact fracture, wear and stress rupture. Fatigue is the most common failure in gearing. Tooth bending fatigue and surface contact fatigue are two of the most common modes of fatigue failure in gears. Several causes of fatigue failure have been identified. These include poor design of the gear set, incorrect assembly or misalignment of the gears, overloads, inadvertent stress raisers or subsurface defects in critical areas, and the use of incorrect materials and heat treatments.



Input assembly of intermediate gearbox

II. OBJECTIVES

To predict the response of a rotating machinery system when acted upon by an external load (moment) such as Gear Box used in various motion and torque transmission applications. This can be achieved by the following actions:

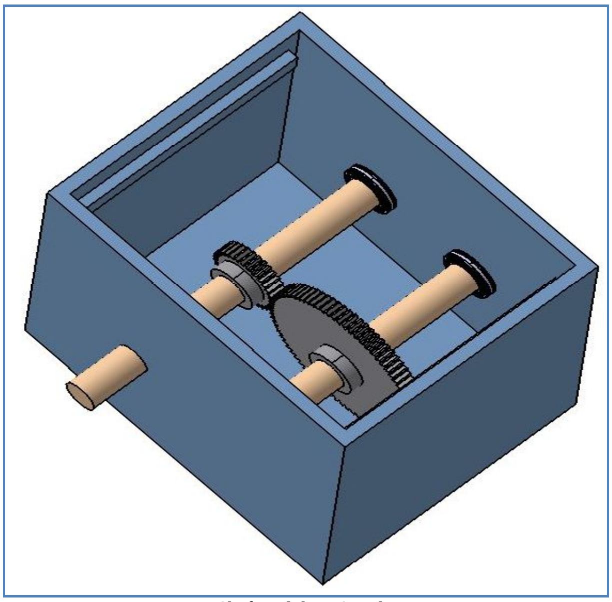
- Modelling the gear box without losing its geometry in CATIA software.
- Analyze and Compare the various strain and deformation of the model of spur gear box using FEM tool ANSYS.
- Generate the profile of spur gear teeth model to calculate the effect of gear bending, using three-dimensional model and compare the results of two materials.
- Perform parametric study to study the effect of varying load on the various stresses, strains on the spur gear model.

III. DESIGN & SIMULATION OF A GEARBOX

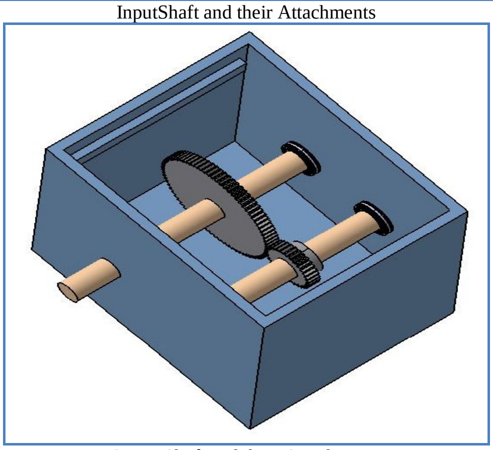
The design of the Gearbox model comprises the following components:2 Spur Gears with the following design data:

Parameter	Pinion	Gear
Type	Spur	Spur
No. of teeth	32	80
Pressure Angle	14.5	14.5
Diametral Pitch	16/Inch	16/inch
Module	1.5875mm	1.5875mm
Module	1.5875mm	1.5875mm
Material	Steel	Steel

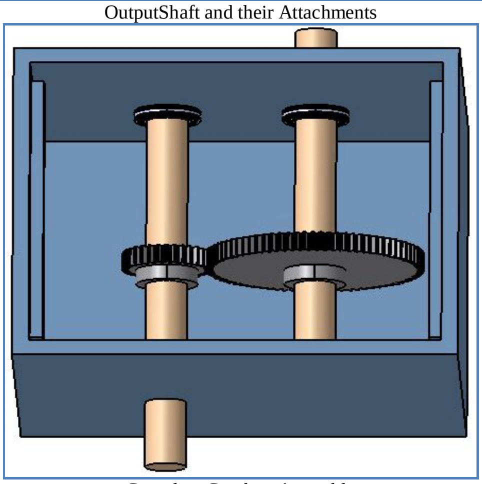
All the components were designed using CATIA (V5) software.



InputShaft and their Attachments



OutputShaft and their Attachments



Complete Gearbox Assembly

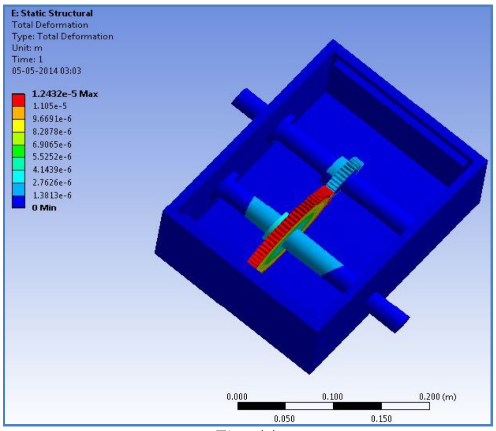


Fig.: (a)

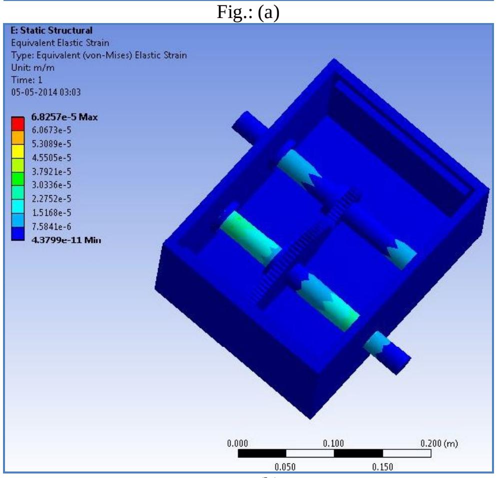


Fig.: (b)

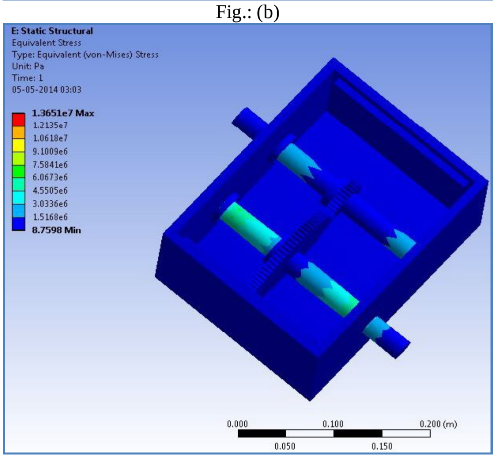


Fig.: (c)

Above Figure (a) to (c) Static Structural Analysis Results : Clockwise from left – Equivalent Stress, Total Deformation and Equivalent Strain.

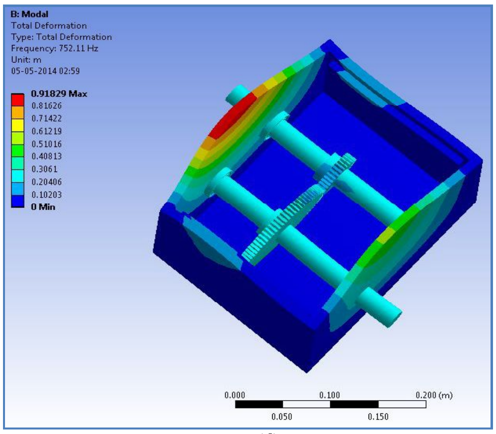


Fig.: (d)

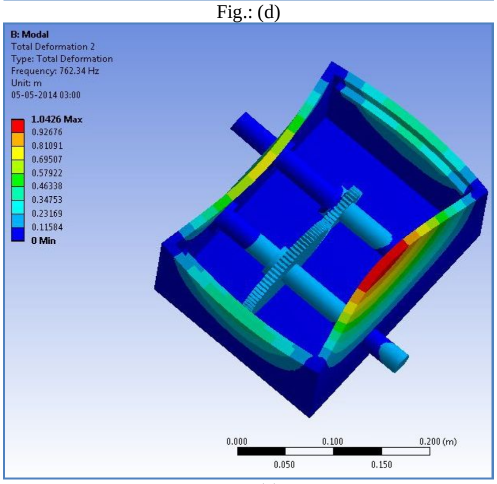
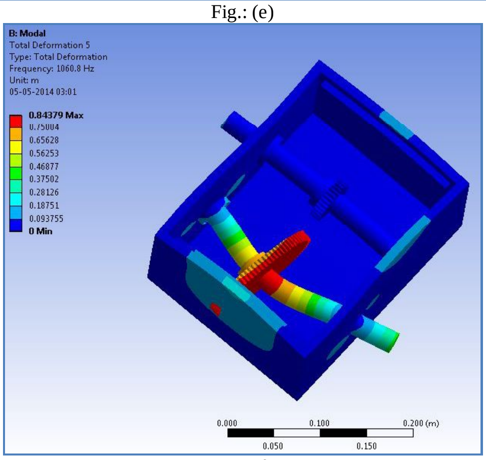


Fig.: (e)



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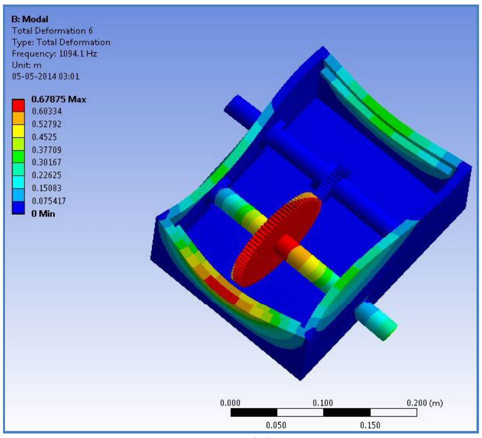

Fig.: (g)

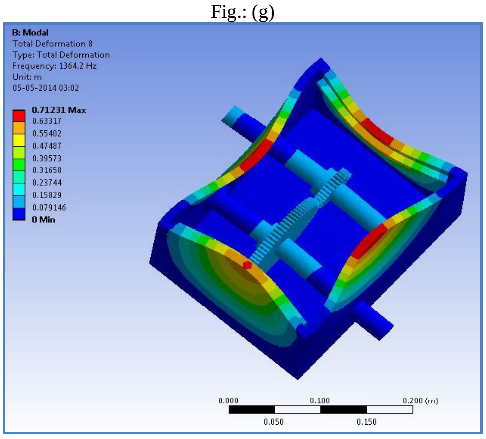

Fig.: (h)

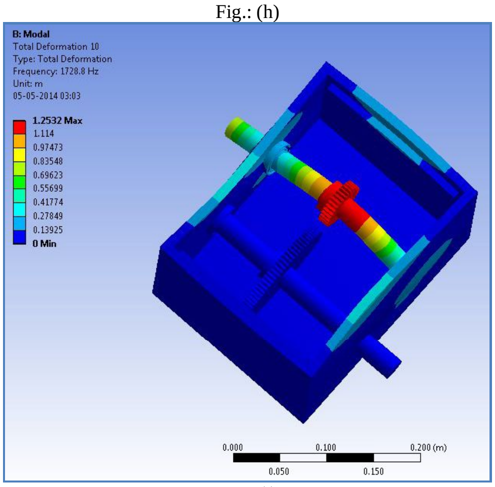

Fig.: (i)

Above Figure (d) to (i) Modal Analysis Results : Total Deformation from Mode 1 to Mode 6

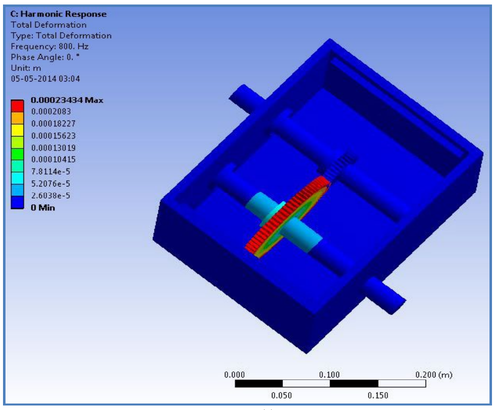

Fig.: (j)

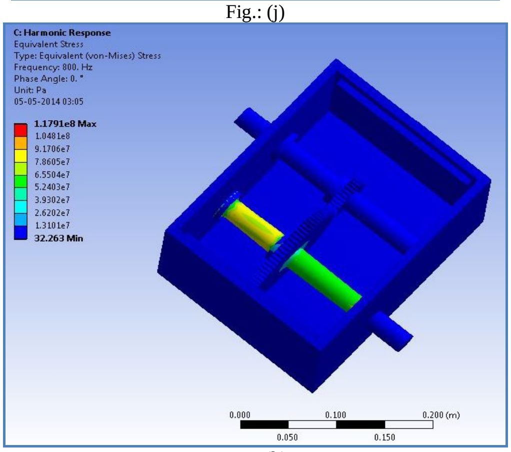

Fig.: (k)

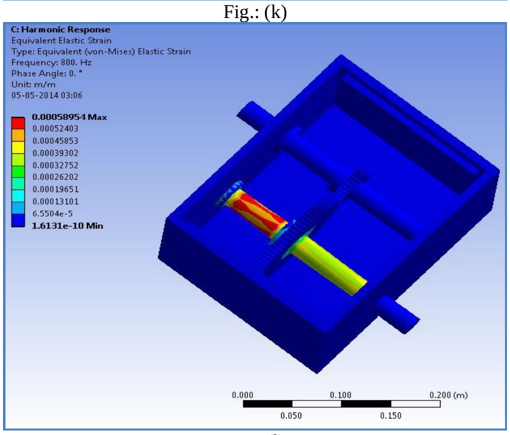

Fig.: (l)

Above Figure (j) to (l) shows Harmonic Response on Modal Analysis Results: Clockwise from left – Equivalent Strain, Total Deformation and Equivalent Stress.

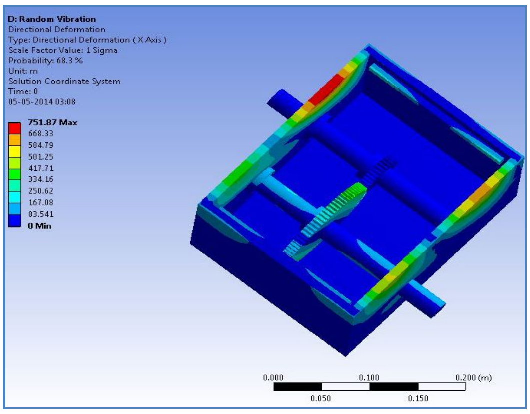

Fig.: (m)

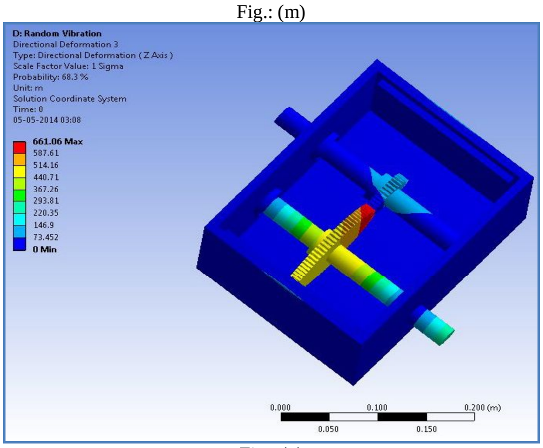

Fig.: (n)

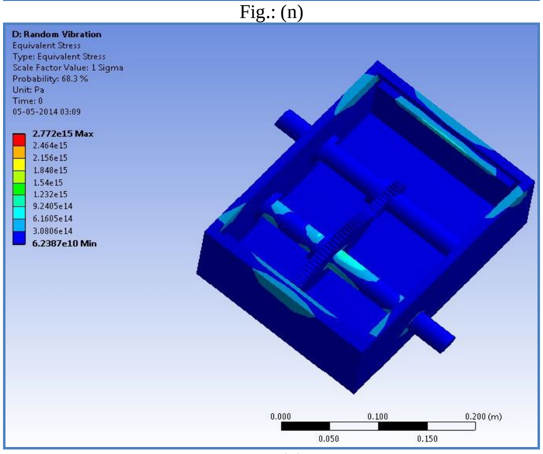

Fig.: (o)

Above Figure (m) to (o) shows Random Vibrations on Modal Analysis Results : Directional Deformations (along X, Y & Z) and Equivalent Stress.

IV. CONCLUSION

From the results, it is observed that the development of strain and deformation are the major cause of the noise and vibration generation in the gear box. The results from the Harmonic Response (in a frequency range of 0 – 800Hz) to the Modal analysis of the CAD Model in ANSYS generated 752Hz as the approximate resonance frequency. A reason for the deviation in the gear box alignment could be due to the presence of additional components like the driving motor, the additional planetary gear box, the magnetic braking system

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