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Fatigue Life Improvement of an Elevator Drive Shaft by Using Composites

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ABSTRACT

The fatigue crash calculation and deterrence is very important for the conveyance/drive shafts which have to transfer weighty torque. Thus a correct design and the fixation methods should be taken to prevent the fatigue failure and to improve the fatigue life of the shaft.

In this work a complete study of an elevator drive shaft is done. The failure of the shaft has occurred at low stresses and high cycles due to the improper design of the failure prone areas (i.e. keyway slot). The different methods such as increasing the radius of curvature of the keyway slot, & by using boron composite the stress is condensed and the number of life cycles of the shaft is improved.

***Keywords*—** Elevator drive shaft, fatiuge, Number of life cycles.

I. INTRODUCTION

The majority of the shafts have been failed due to repeated loads. Fatigue leads an important path for finding the structural damages and need to calculate the stresses and failure cycles were considerable parameters. To conserve and utilizing properly the natural resources and proper form of energy weight reduction has been the main thing in many areas, in current situation it can be achieved initially by taking the good material proper design optimization and better manufacturing process one of the most effective potential items for weight reduction is the optimization of composite material.

Some of the papers have been mentioned that the different loading conditions of conventional material as well as other composite materials Some of the papers were given the Calculations, Proper standard designing and Formulae were be considered.

II. METHODOLOGY

- Investigation of the problem is done by the various literature surveys.
- Standard dimensions and boundary conditions were considered as per ASME.
- Using Catia software Modeling and meshing of elevator shaft has been made.
- Using ANSYS, boundary condition & loading conditions are applied to the model of elevator drive shaft so that the stresses are found analytically and theoretical calculation is done to find failure cycles.

A. Geometric parameters

i. Design of a shaft, pulley and its specifications

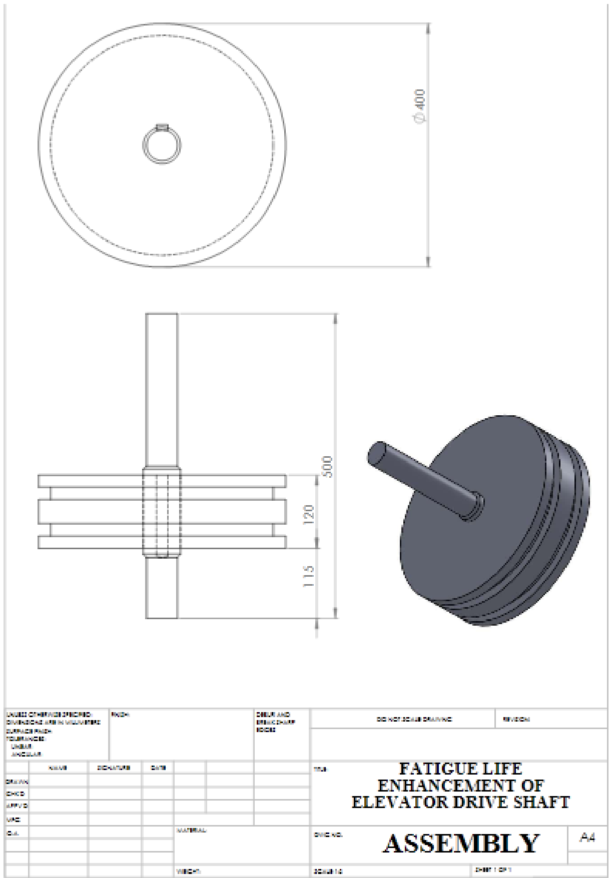

Fig.1. 2d model of assembly

The specifications all are represented in fig.1, Total length of the shaft is 500mm stepped diameter of the shaft with keyway is 60mm thickness of the key is 10mm keyway length, depth, width are 150, 5 & 8 respectively. Outer diameter of the pulley is 400mm inner diameter of the pulley is 60mm & thickness of the pulley is 120mm.

ii. Meshed model of drive shaft & pulley

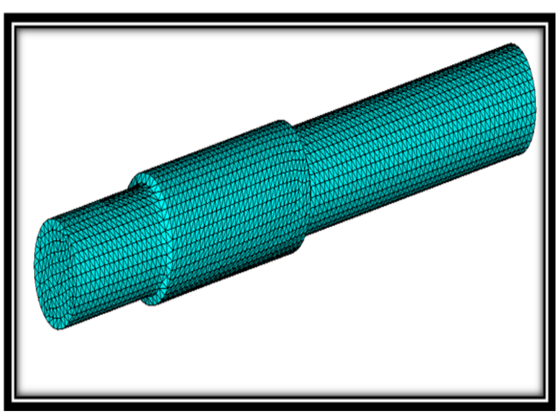

Fig 1. Meshed model of shaft

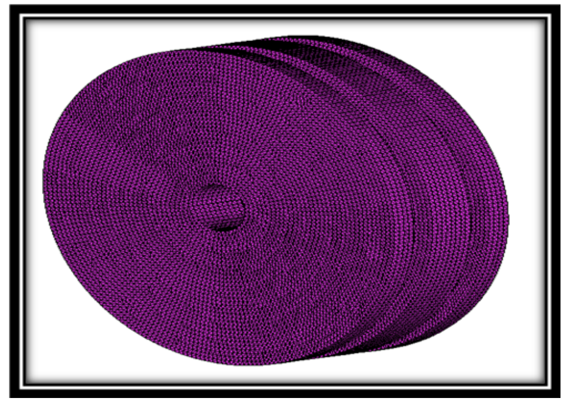

Fig 2. Meshed model of pulley

iii. Boundary condition

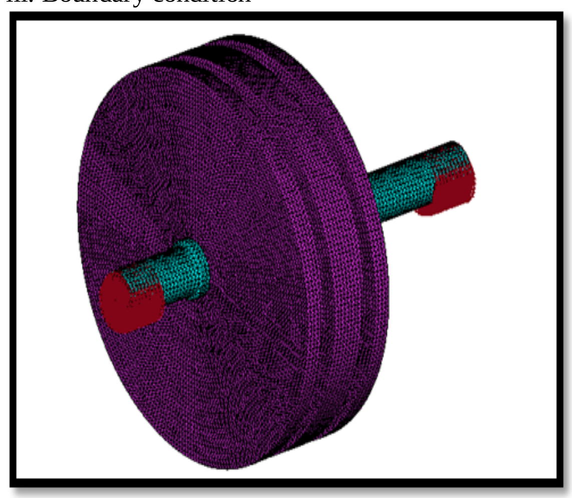

Fig.3. Boundary conditions of a shaft

Boundary condition applied for shaft fixed in all directions and loaded centrally, the utmost load applied is 740kg.

B. Material properties

Table I Represents the material properties

Material	Young's modulus	Poisons ratio	Yield strength	Density
St52	210Gpa	0.3	340Mpa	7860kg/m^3
Boron	235e3Mpa	0.23	1100Mpa	2.7g/cm^3

III. RESULTS AND DISCUSSION

Results

1. Analytical Results for st52

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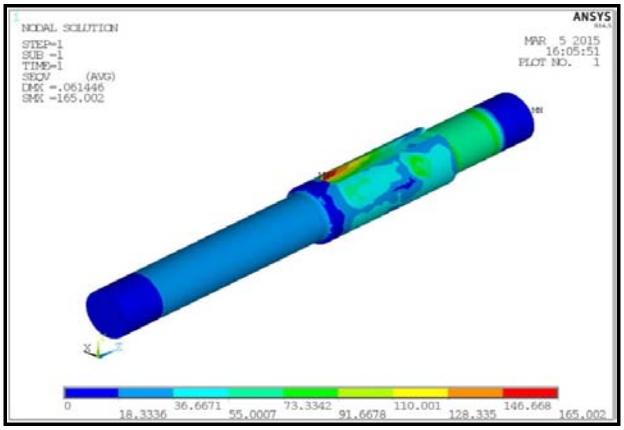

Fig.4 Von mises stress for st52 (165Mpa)

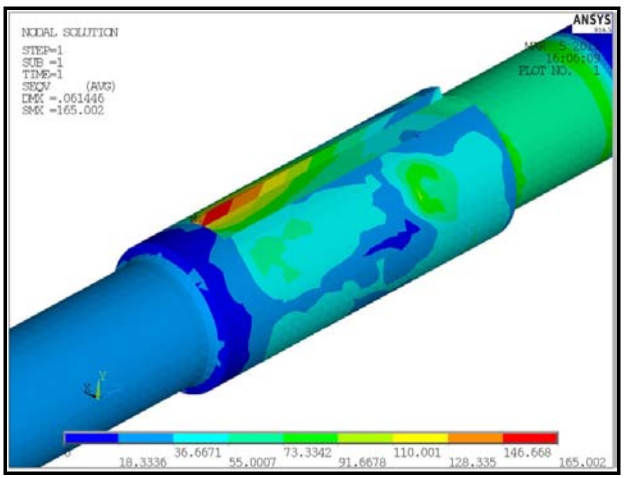

Fig.5 Analysis for st52 (whiz image)

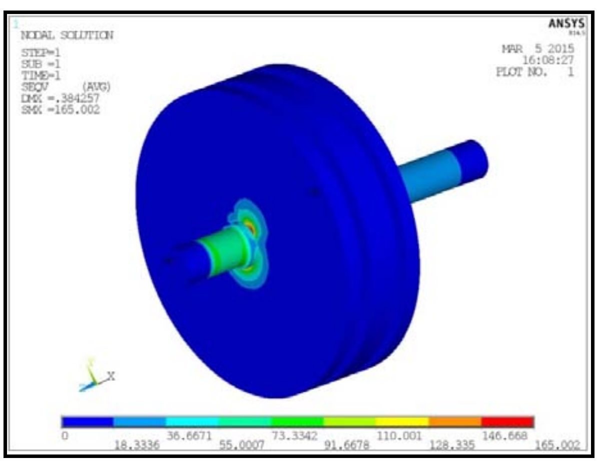

Fig.6 Analysis for st52 on assembly

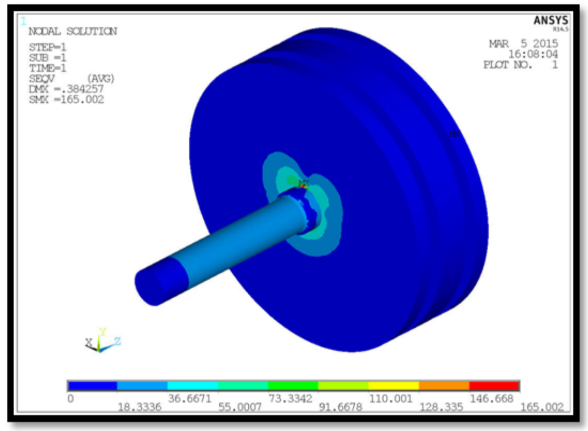

Fig.7 Analysis on assembly (Rare view)

A. Boron Material

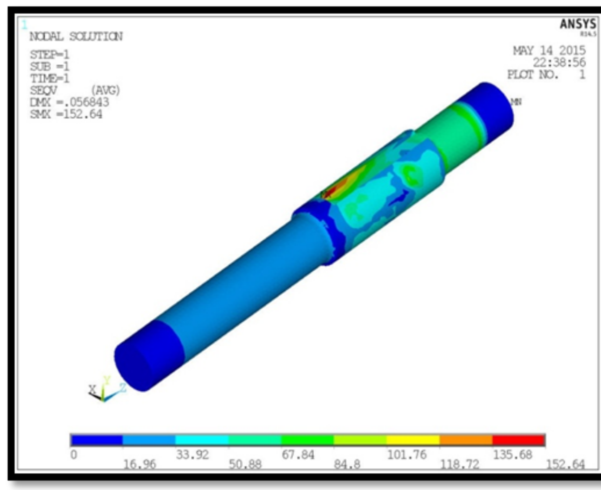

Fig 8 Von mises stress for boron (153Mpa)

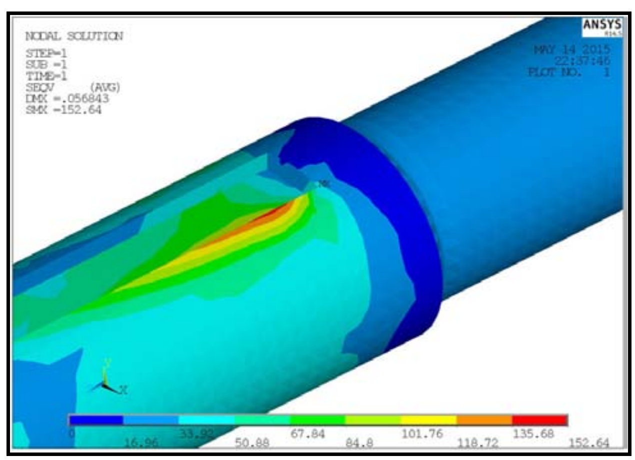

Fig.9 Analysis for boron (whiz image)

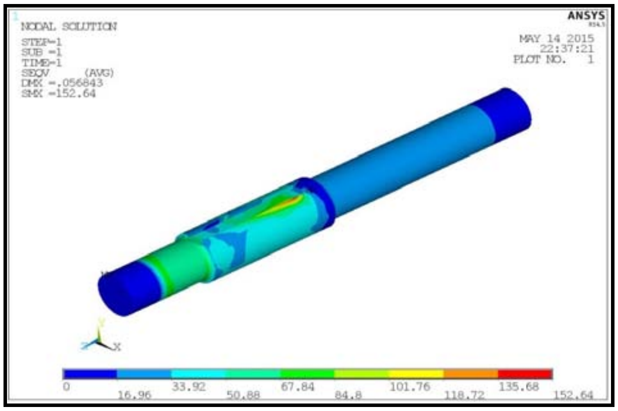

Fig.10 Analysis for boron rear view

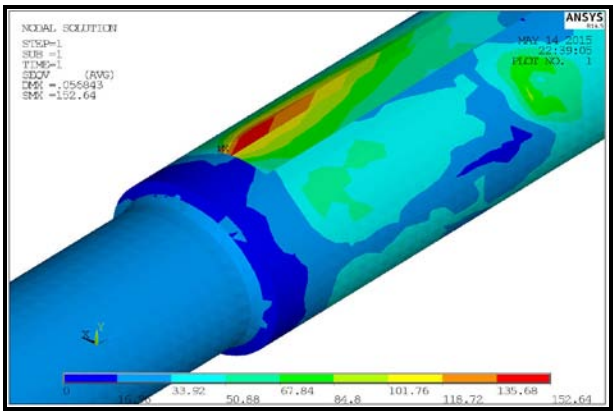

Fig.11 Analysis of boron face outlook

Discussions

Table III Represents correlating results table

Material	Utmost Von mises stress	Least Von mises stress	Number of cycles to failure
st52	165Mpa	18Mpa	8.37e5
Boron	153Mpa	17Mpa	2.8e6

From the above table III. The similarity of both the materials that is st52 and boron material is done. The utmost von mises stress in st52 material is 165Mpa & least stress is 18Mpa and cycles to faiure are 8.37e5. In boron material utmost von mises stress is 153Mpa & least stress is 17Mpa. By comparing all these values by the 2 different materials, we conclude boron is preferable than steel.

1V. CONCLUSION

- Comparative study has been made between st52 and boron material & stresses are found analytically and cycles to failure is calculated theoretically.
- Stresses obtained for st52 material are higher than boron material.
- The number of cycles to failure in st52 material is less than boron material.
- Thus concluding that the composite material that is boron is better material than of steel material.

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