To Determine Stress and Displacement of Solid Shaft and Hollow Shaft using FEA and Validate Analytically

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Abstract— The paper is based on FEA analysis which uses creo parametric 2.0 for modelling and analysis 15.0 for ansys. The paper prepared to find stresses and displacement between solid and hollow shaft. To validate the solution of analysis results, we use analytical method.
Key words: CAD, FEA, etc

I. INTRODUCTION

To determine the stresses and displacements between solid and hollow shaft. First of all, we design the solid and hollow shaft in creo parametric 2.0 which is 3-d modelling software. Then with the help of ansys software, we apply force and constraints will be provided and find the result.

The value which we obtain from ansys software is validates by analytical method so that we obtain the perfect analysis. Then we decide which shaft is used in the design.

II. OBJECTIVE

1) To determine stress and displacement of both the solid and hollow shaft.
2) Validate with analytical method.

III. RESEARCH METHODOLOGY

A. For Solid Shaft-

1) First of all, we design the solid and hollow shaft in creo parametric which is shown in fig. 1 of d=30mm and l=600mm.

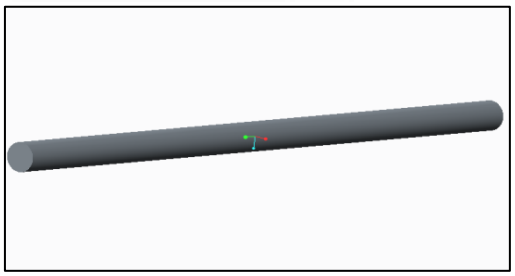

Fig. 1: solid shaft model

2) Then we go the analysis part which we done in Ansys. First meshing process is completed which is seen in fig 2 so that model is discretized into finite element. Then after apply load on shaft i.e. F=100 N and constraints on other side seen in fig 3

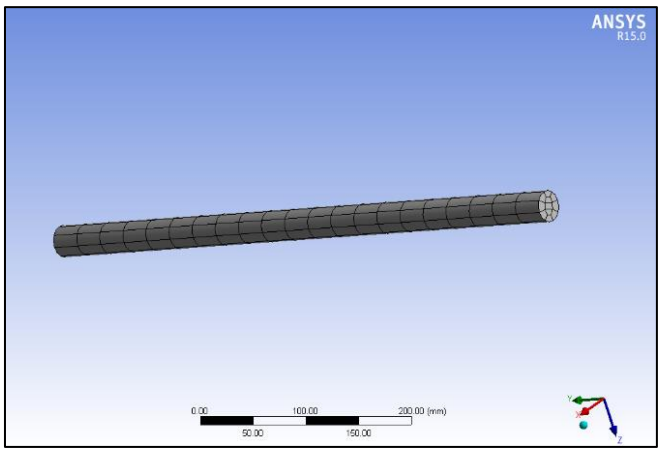

Fig. 2: Meshing of solid shaft

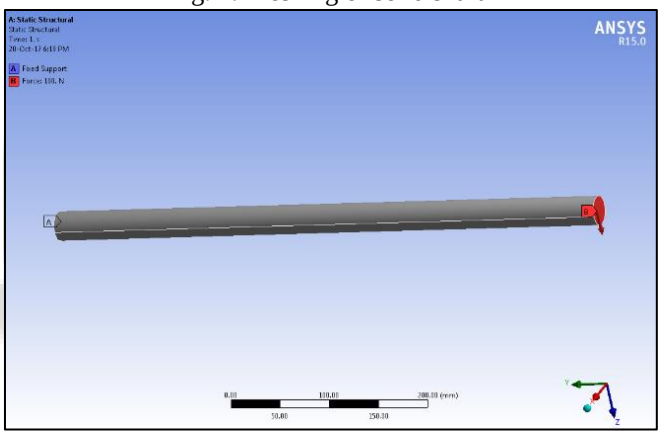

Fig. 3: force and constraint

3) All the process is done using material –Structural Steel. And after that we got results in the form of stress and displacement shown in fig 4 & 5.

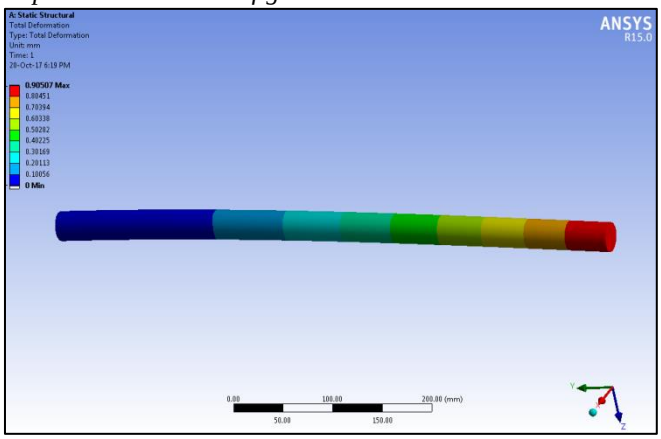

Fig. 4: Total deformation

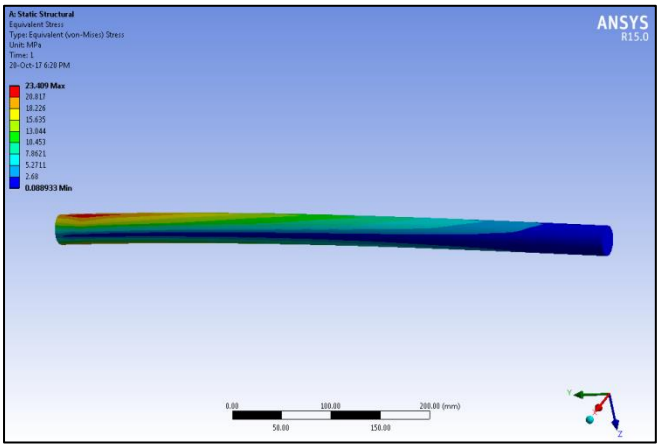

Fig. 5: Stresses

The same procedure which is explaining in research methodology is repeated from point A to C for hollow shaft. And find out the stress and displacement values.

B. For Hollow Shaft-

First of all, we design hollow shaft in creo parametric which is shown in fig. 6 of

1) d=30mm, l=600mm.

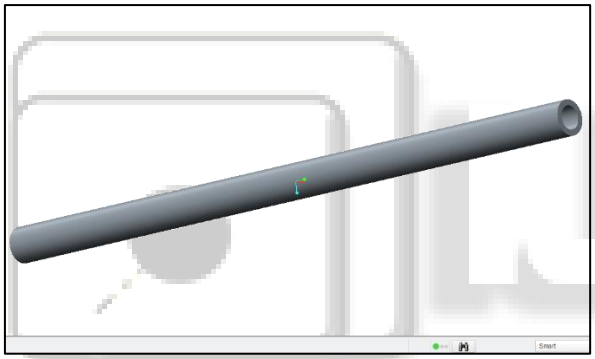

Fig. 6: hollow shaft model

2) Then we go the analysis part which we done in Ansys. First meshing process is completed which is seen in fig 7 so that model is discretized into finite element. Then after apply load on shaft i.e. F=100 N and constraints on other side seen in fig 8

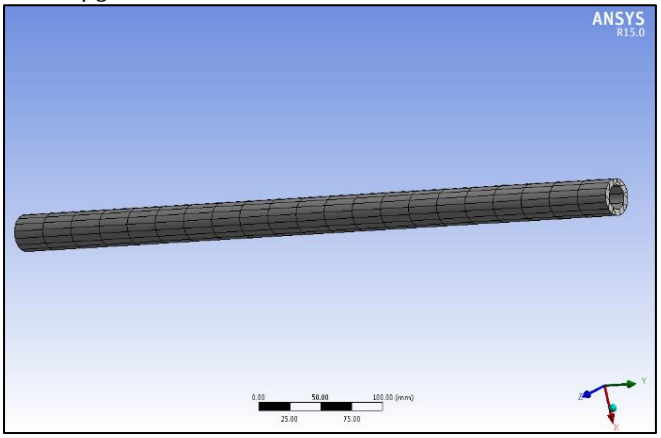

Fig. 7: Meshing of hollow shaft

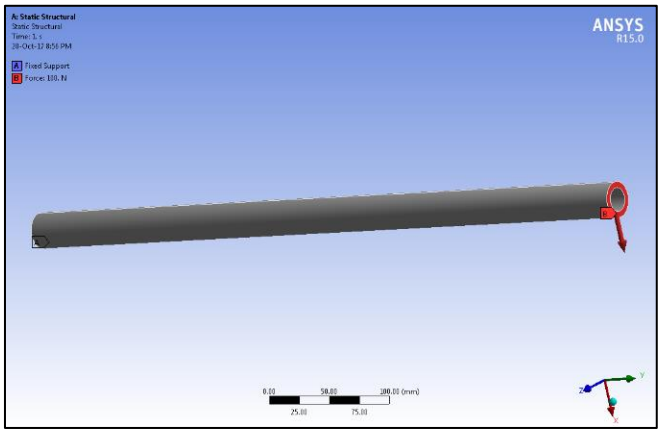

Fig. 8: force and constraint

3) All the process is done using material –Structural Steel. And after that we got results in the form of stress and displacement shown in fig 9 & 10.

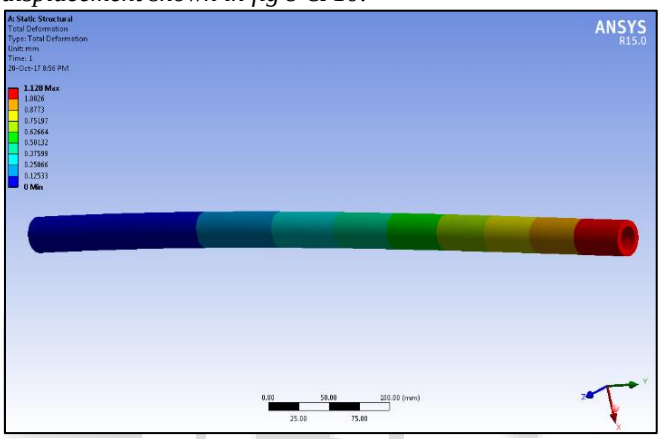

Fig. 9: Total deformation

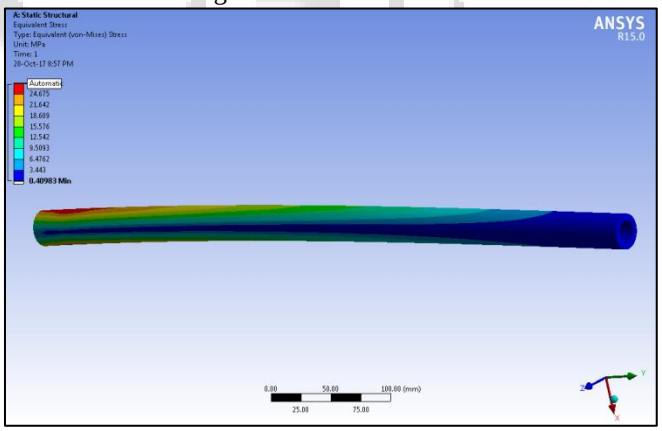

Fig. 10: Stresses

The table no. 1 shows the comparing results between two shafts are as follows,

	σ (MPa)	δ (mm)
Solid Shaft	23.409	0.905
Hollow Shaft	27.708	1.128

Table 1:

IV. CALCULATIONS

A. For Solid Shaft-

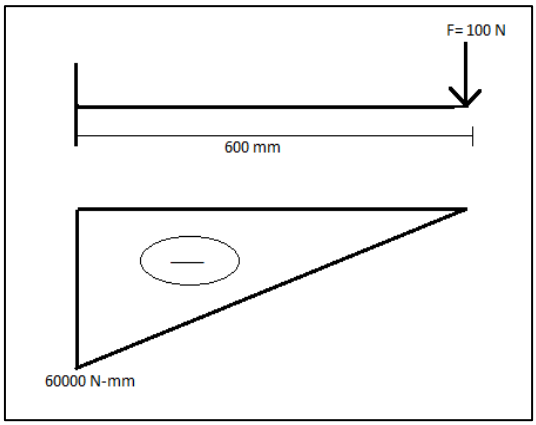

Fig. 11: Bending Moment dig.

$$\frac{M}{I} = \frac{\sigma}{Y}$$

$$\frac{60000}{\frac{\pi}{64} * 30^4} = \frac{\sigma}{\frac{30}{2}}$$ Type equation here.

σ =22.635 MPa

For Hollow Shaft-

$$\frac{M}{I} = \frac{\sigma}{Y}$$

$$\frac{60000}{\frac{\pi}{64} * (30^4 - 20^4)} = \frac{\sigma_1}{\frac{30}{2}}$$ Type equation here.

σ=28.207 MPa

B. Comparing Results

	σ (MPa)-Ansys	σ (MPa)-Analytical
Solid Shaft	23.409	22.635
Hollow Shaft	27.708	28.207

Table 2:

V. CONCLUSION

The present work clearly says that the Solid shaft is much safe than the hollow shaft in this particular diameter and length used. We use solid shaft according to changing application and need of work.

Also. Table no. 2 clearly validate the value which came from the ansys software and analytical calculations.

