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Design and Analysis of Spindle for Special Purpose Machine Using ANSYS

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Abstract- The present interest in increasing a manufacturing ability at the mixed scales is important to a number of investigations afraid by the progress of special purpose machine tools. Competition permanently insists the machine tool manufacturers to progress the working accuracy with the dynamical behavior of their machines while reducing both product developments time and costs. The difficulty with most special purpose machines be the amount of vibration that is transmitted through the spindle, which affects the quality of surface finish and the dimensional accuracy imparted to the work piece being machined. Owing to the way the spindle is mounted at the end of a cantilevered structure, little resonant frequencies can happen to easily excited. SPM is a special purpose machine completely used in two wheeler automobiles. The core objective of this paper is to design and perform finite element analysis of the SPM.

Index Terms- Machine tool manufacturers, Special purpose machine, Work accuracy, Design calculations

1. INTRODUCTION

Special purpose machines are designed and manufactured for definite jobs and as such never formed in bulk. Such machines are finding rising use in industries. The method for designing such machines would clearly be quite different from those under for mass produced machines. A very keen judgment is essential for success of such machines. Generally the special purpose machine tools could be classified as those in which job remains set in one position and job moves from one station to other transfer machines. In first case perform the machine either only one operation or more. In the second case, the product may be either moving always (as in the case of spraying, sanding, polishing etc.) or irregularly (the most usual case in machining operation). Rotary irregular motion transfer machine is very trendy production machine and is described in brief. Such a machine comprises a turret, on periphery several heads are mounting to accept and locate the components for working. The tower rotates intermittently about its central axis and is provided with fine and complicated mechanisms to manage its motion before stopping, it is correctly decelerated and desired positioning accuracy is attain. At stationary positions around the turret, usual mounted on a table, are the some tools and units which present the machining operation. Synchronized in order to obtain chosen product, All tools and units must have done their operation and be withdrawn clear of the turret by it starts to index. Also the turret must index specifically and accurately and come to rest, before tools and units start their work.

1.1 Introduction To Surface Polishing

Polishing and buffing are finishing processes for smoothing a work piece’s surface using an abrasive and a work wheel or a leather strop. Technically polishing refers to processes that use an abrasive that is glued to the work wheel, while buffing uses a loose abrasive applied to the work wheel. Polishing is a more aggressive process while buffing is less harsh, which leads to a smoother, brighter finish. A common misconception is that a polished surface has a mirror bright finish, however most mirror bright finishes are actually buffed.

1.2 Objectives

- Spindle with only belt loads is considered. The deflections and stresses due to belt loads are plotted. The boundary conditions applied for the analysis due to tensioning of belt.
- The mode shape of the different natural frequencies. From the modal analysis different frequencies analysis are calculated.

2. MODELING AND ANALYSIS OF SPINDLE

- **Dimensions of spindle**

Following dimension are used to draw the solid model.
Outer diameter of a spindle - 50 mm
Length of a spindle - 1000 mm
Outside step - 70 mm x 25 mm
Middle Step (pulley mounting) – 70 mm

2.1 Analysis Of Spindle

- **Preprocessing:**

- Create the solid model.
- Choose the element type.

- **Element Type - spindle**

Young's modulus : 2.1×10^5MPa
Poisson's Ratio : 0.3
Density : 7.850×10^{-3} tons/mm^3.
- Mesh the model.

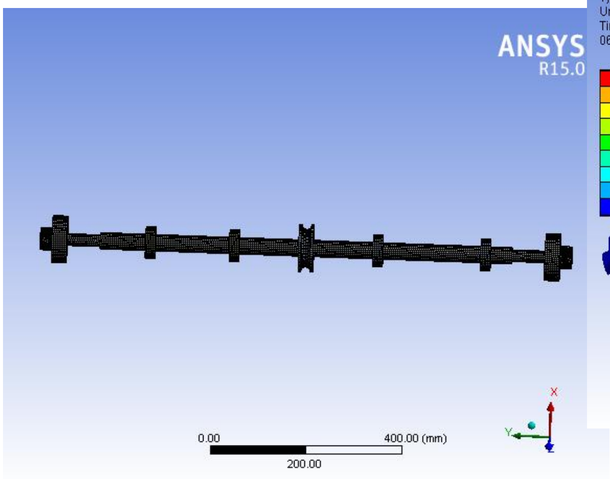

Fig. 1 spindlemodel

1. Load: 200 N

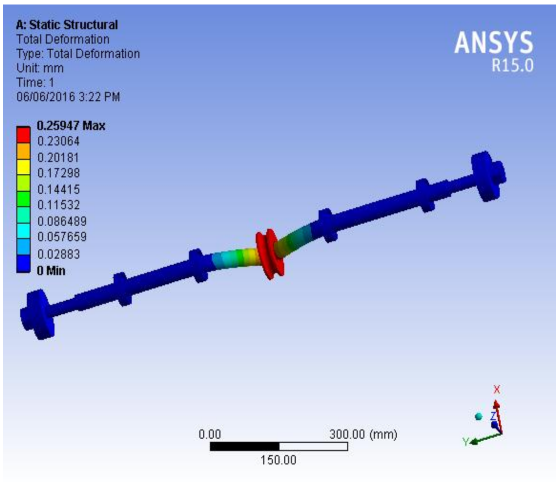

Fig. 2 analysis on spindle at load 200 N

RESULT:

- LOAD APPLY: 200 N
- Deformation:
  - Min = 0 mm
  - Maximum = 0.25 mm

1.1 Equivalent Von-Mises Stress At 200 N

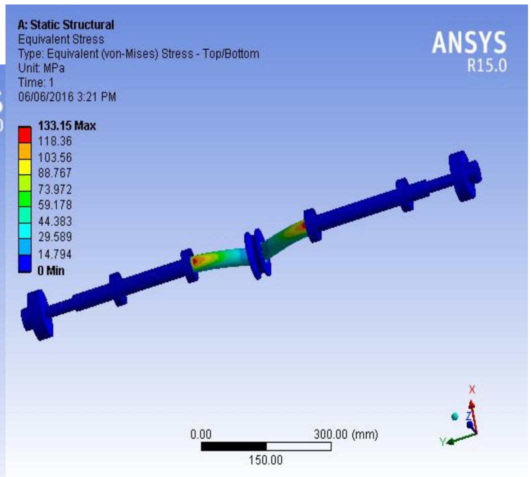

Fig. 3 analysis on spindle Equivalent Von-Mises Stress at 200 N

2. LOAD: 400 N

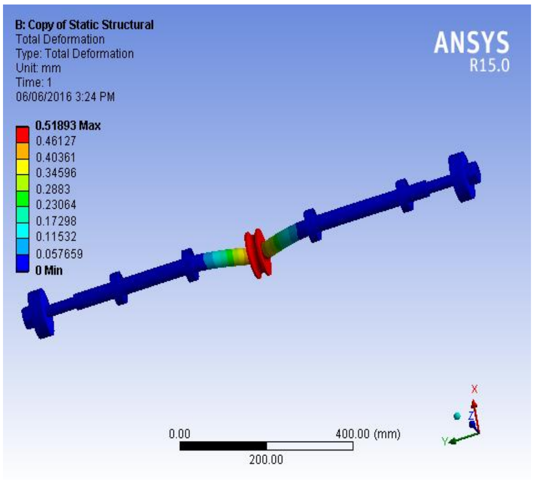

Fig. 4. analysis on spindle at load 400 N

RESULT:

- LOAD APPLY: 400 N
- Deformation:
  - Min = 0 mm
  - Maximum = 0.5183 mm

2.1 *Equivalent Von-Mises Stress At 400 N*

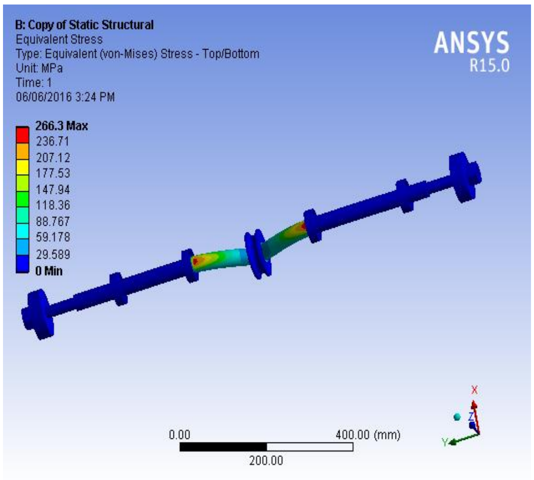

Fig. 5 analysis on spindle Equivalent Von-Mises

Stress at 400 N

3. STATIC ANALYSIS RESULT

The stress analysis of existing roller and modified roller is done. The Load value for existing spindle is 200 N, 400 N these two loads are applied to the spindle and there deformation is analyzed and results are mentioned below in tabular form.

Table 3.1: Applied Load vs. Deformation

SR. NO.	APPLIED LOAD	DEFORMATION	
		MIN (mm)	MAX (mm)
1.	200 N	0	0.25
2.	400 N	0	0.5163

4. CONCLUSION

3d model of the SPM assembly is done using pro-E and Finite element analysis is carried out using ANSYS. Design calculations are performed to calculate the operating loads. Finite element analysis was done to validate the design Based on analysis the spindle deflections.

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