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Finite Element Analysis of CNC Lathe

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ABSTRACT

Lathe is a machine tool used in the manufacturing industry; lathe is the mother of all machines. When a machine is manufactured it may fail due to stress acting of the lathe, the manufactured part may fail due to vibration. This paper analysis the various stresses acting on the machine tool, using finite element analysis .The analyzed data helps to understand the behavior of the machine tool, it helps to redesign the machine tool structures.

KEY WORDS: Finite element analysis, machine tool structures

1. INTRODUCTION

Functions of machine tool structures and their Requirements: Machine tool parts, such as beds, columns, box; type housings, over arms, a carriages, tables, etc. are known as structures. The structures, depending upon their function, may be broadly divided into the following three groups.

Group 1: beds and bases, upon which the various subassemblies are mounted.

Group 2: box type housing in which individual units are assembled, e.g., speed box housing, spindle head, etc.; and

Group 3: parts that serve for supporting and moving the work piece and cutting tool, e.g., table, carriage, knee, tail stock, etc.

Machine toll structures must satisfy the following requirements:

- All important mating surfaces of the structures should be machined with a high degree of accuracy to provide the desired geometrical accuracy.
- The initial geometrical accuracy of the structures should be maintained during the whole service life of the machine tool.
- The shapes and sizes of the structures should not only provide safe operation and maintenance of the machine tool but also ensure that working stresses and deformations do not exceed specific limits, it should noted that the stresses and deformations are due to mechanical loading.

Basic Design Procedure of Machine Tool Structures: In order to a particular machine tool structure, it is first essential to draw up its design diagram. Machine tool structures have, as a rule, highly complicated profiles. The structure is therefore, first simplified by making assumptions, which however, should not distort the actual picture .In the next step the forces acting on the structure are marked. The following force most be taken into account. Cutting force: The cutting force depends upon the work piece material, machining parameters, wear of cutting tool, etc. To a designer a knowledge about the nature and direction of the force and the point where it acts on the structure is often more important than a very precise knowledge of its magnitude. The cutting force is represented by three mutually perpendicular components.

Forces of reaction: These forces are determined with the help of equilibrium equations. If the structure is statically indeterminate, then additional deformation equations are written, as required in the general solution of such structures. If the support surface is not very large, the reactive force may be concentrated force acting at the centre of the supporting surface. Force due to the mass of the structure, work piece fixtures and clamping Devices. In ertial forces due to vibration and transient processes.

Design for strength: If a beam subjected to bending in two perpendicular planes and torsion, the design for strength is done on the basis of principal stress. The principal stress may be determined if the normal stresses due to bending and shear stresses due to torsion are known.

Finite Element Analysis of CNC Lathe:

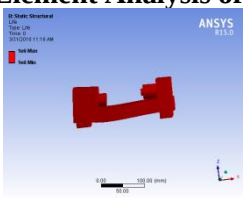

Figure.1. Fatigue life

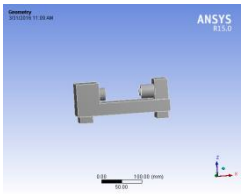

Figure.2. Geomentry CNC

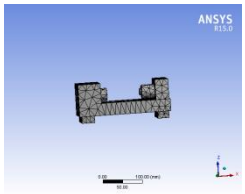

Figure.3.Mesh CNC Lathe

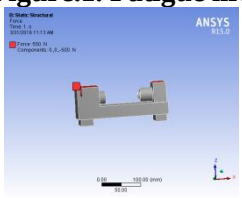

Figure.4. Force CNC Lathe

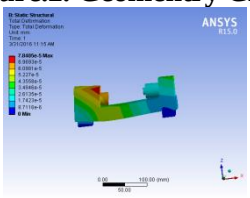

Figure.5. Total deformation

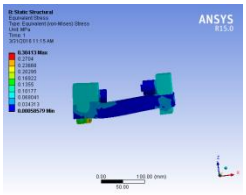

Figure.6. Equivalent strress

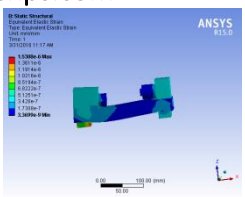

Figure.7.Equivalent Elastic Strain

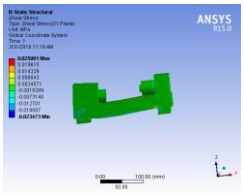

Figure.8. Shear Stress

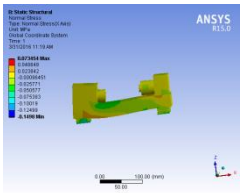

Figure.9. Normal Stress

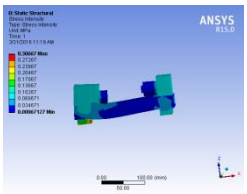

Figure.10. Stress Intensity

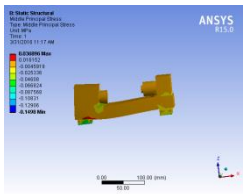

Figure.11. Middle Principle stress

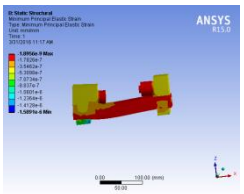

Figure.12. Minimum principle Elastic strain

Finite element analysis was carried out on the CNC Lathe, the finite element software ANSYS Work Bench 15 was used in the modelling and analysis of the CNC Lathe. The lathe was meshed, then forces were applied, then solved using a solver, the various parameters were analysed

2. CONCLUSION

The design calculation were made using standard formulae and using data books .The lathe machine was Modelled using ANSYS Workbench package. The Lathe machine was designed using ANSYS Work Bench software package .Many parameters were analysed, the results from the analysis, shear stress, shear strain, Normal Stress, Stress, Minimum principle Elastic strain intensity, Shear Elastic strain, Minimum principle Elastic strain Maximumshear stress,were useful for designing the lathe .

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