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FEM Study of a CNC Slanted bed – A Review

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Abstract : In the realm of engineering, we encounter numerous complicated issues whose resolution is time-consuming and frequently impractical using analytical techniques. In this situation, numerical techniques must be used. The numerical technique known as "Finite Element Analysis" is incredibly effective for solving complex issues. In this project, ribs are added at the appropriate places to the machine bed in order to minimize weight without compromising structural strength or tool accuracy. The 3D CAD model for the design and base line in this work was made using the 3D modelling program CREO.

***Keywords* - Finite element analysis, creo,3d modelling, ANSYS,CNC machine.**

I. INTRODUCTION

Perhaps the most widely used numerical method for resolving engineering issues is the finite element method. Every complicated shape or geometry, any material attributes, any boundary condition, and any loading condition can be handled by the approach because it is sufficiently generic. Because it is so general, the finite element approach is a good fit for the analysis needs of today's complex engineering systems and designs, where it is frequently impossible to find a closed-form solution to the governing equilibrium equations. Also, it is a useful design tool that enables designers to carry out parametric design studies by taking into account a variety of design instances (including multiple shapes, materials, loads, etc.), assessing them, and selecting the best design. A numerical analytical method known as the finite element method can be used to generate an approximative solution to a number of engineering issues.

Let's use the Stress Analysis of a body under specific loading conditions as an example. Normally, a very small box element of dimensions would be used in the analysis (dx, dy, dz). Putting down the equilibrium and compatibility equations for this element as each tends to zero. Then, utilizing integration techniques over the entire body, we would attempt to find a solution for the Stress Distribution in the body under the given boundary conditions.

II. LITERATURE SURVEY

Malleswara Swami et al [1], In this paper By placing ribs in the appropriate places, the machine bed's weight is reduced without compromising its structural strength or the precision of the tool. In this work, CATIA, a commercial 3D modelling programme, has been used to build the 3D CAD models for the optimised design and the baseline. HYPERMESH was used to create the 3D FE model. ANSYS was used for the analyses, while Optistruct was employed for design optimization.

S. Syath Abuthakeer et al. [2], with the use of structural adjustments made to the CNC machine tool bed, these studies seek to provide diverse form designs of machine tool structures. Finite element simulation was used to confirm the lighting effect before fast prototyping was used to create scaled-down versions of an original bed and vertical ribs with hollow bed models. Experimental analysis was done on the dynamic properties of the various bed shape designs.

The conclusions of a numerical analysis were verified by experimental findings. The cross and horizontal rib with hollow bed, according to the results, may boost specific stiffness by 8% with a 4% weight decrease, and its dynamic performance also improves with higher first natural frequencies. High speed machine tools' static and dynamic structural performances are effectively enhanced by the redesigned design.

N. Ashwin Kumar et al [3] , This project's goal is to use finite element analysis to conduct an analysis and validate the real load carrying capacities of the company's new machine bed design and the machine bed's original design. The author proposed an optimal bed design as part of the analysis for this project to withstand the load carrying capability of 14000 kg.

Analysis was done on the machine's bed, which had more ribs put to it so it could support a bigger capacity. The software is used, among other things, to do finite element analysis. Three steps of FEA were completed, first for the original bed, then for the company's revised bed, and finally for the author's optimized bed design.

B.V. Subrahmanyam et al [4], this work attempts to evaluate the three machine tool structures—milling, shaping, and lathe—both statically and dynamically. All machines have large strains in the x-direction, which is a direction perpendicular to the longitudinal axis. In milling machines, the deflection is shown to be more prominent. Further analysis reveals that the deflection is rising along with frequency.

S.S. Abuthakeer et al [5], the goal of this study is to use a composite material made of welded steel and polymer concrete to increase the machine tool bed's stiffness, natural frequency, and damping capacity. First-mode results revealed a 24.7% improvement in natural frequency and a damping ratio that was 2.7 times greater than cast iron. The results of this study suggested a hybrid welded steel bed as an alternative to cast iron for machine tool beds, and they revealed that the hybrid steel bed's static and dynamic properties were superior to those of cast iron.

A.M.Joshi et al [6], the machine tool is a device that gives a work piece the desired shape while removing metal in the form of chips from the work piece with the desired accuracy. In a machine tool, beds, columns, bases, and head stock are referred to as "structures". In a machine tool, the framework accounts for 70 to 80 percent of the machine's overall weight. In this study, the headstock is subjected to FE analysis for the turning operation, a particular cutting condition. In this case, we prepared a headstock model using pro-E 4.0. Values for cutting forces and thrust forces are calculated mathematically and used in FE analysis. For the FE study of the head stock in this case, we used the ANSYS WORK BENCH 11.0 programme (Machine tool structure). We obtain the result of this study in terms of stresses and deformation, and this result is within acceptable bounds.

III. CONCLUSION

Following the research report mentioned above, it is determined that the machine bed has ribs placed strategically to save weight while maintaining structural integrity and tool precision.

IV. ACKNOWLEDGEMENT

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