

Multi- Purpose Machine Tool: A Key to Increased Productivity, Decreased Cost and Saving in Power Consumption and Floor Area Requirement

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ABSTRACT

The project aims at designing and developing a multipurpose machine tool which is capable of performing multiple tasks simultaneously. The machine is operated by giving drive to the main shaft to which worm gear mechanism is directly attached; worm gear mechanism is used for sawing operation. On the main shaft bevel gear mechanism was used for transmitting power. These bevel gears are used to transmit motion in the radial direction and drives drilling centre. The Grinding wheel is directly connected to the motor shaft. This model facilitates to complete three operations simultaneously with a single power source.

The machine was designed by using Solid works software. Various tests were performed on the designed model using Ansys software (Version 13). The tests were carried out with regards to deformation, stress and weight carrying capacity. Finally, the designed model was fabricated. The objectives of the model developed are conservation of electricity (power supply), reduction in cost of manufacturing, increase in productivity and reduced floor space requirement.

Keywords: Multipurpose machine tool, Productivity, Power Consumption, Floor Area Requirement, Manufacturing Cost.

INTRODUCTION

Industries are basically meant for production of useful goods and services at low production cost, machinery cost and low inventory cost. Nowadays, every task has been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure. Every industry desires to increase the productivity rate maintaining the quality of the product at comparatively low cost. In any industry considerable portion of investment is being made for machinery installation.

The present work mainly focuses on designing and developing a new machine which can perform three different operations viz. Drilling, Grinding and Cutting. Lathe is a versatile machine tool which can perform any operation desired. However, some of them are to be carried out at different working centers where as with the present machine this need is eliminated due to the fact that the operations were performed simultaneously.

According to some economists, manufacturing is a wealth-producing sector of an economy, whereas a service sector tends to be wealth-consuming. Emerging technologies have provided some new growth in advanced manufacturing, employment opportunities in the Manufacturing sector. Manufacturing provides important materials support for national infrastructure and for national defense also.

LITERATURE REVIEW

Heinrich Arnold conducted a study with more than 100 decision makers and industry experts who have witnessed the development of the industry over the last forty years. The study establishes a connection between radical technological change, industry structure, and competitive environment. It reveals a number of important occurrences and interrelations that have so far gone unnoticed.

Dr.ToshimichiMoriwaki focused on recent trends in the machine tool technologies. He conducted a survey from the view points of high speed and high performance machine tools, combined multifunctional machine tools, ultra precision machine tools and advanced and intelligent control technologies.

Frankfurt-am Main states that selling machinery remains a tough business. Machine tools nowadays have to be veritable “jack of all trades”, able to handle all kinds of materials, to manage without any process materials as far as possible, and be capable of adapting to new job profiles with maximized flexibility.

Two highly respected experts on machining and forming from Dortmund and Chemnitz report on what’s in store for machine tool manufacturers and users. Multi-purpose machines are the declarations of independence. The trend towards the kind of multi- purpose machining centres that are able to cost efficiently handle a broad portfolio of products with small batch sizes accelerated significantly during the crisis. “With a multi-purpose machine, you’re less dependent on particular products and sectors”, explains Biermann.

MULTI-PURPOSE MACHINE TOOL

The basic components of a multi- purpose machine tool are motor, gear box, bevel gears, bearings, drill chuck, pulleys, V-belt, grinding wheel, and hack saw blade with frame.



Figure1. *Multi – Purpose Machine Tool*

Operations Carried Out by the Multi- Purpose Machine

Drilling

Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called drill. The machine used for drilling is called drilling machine. The drilling operation can also be accomplished in lathe, in which the drill is held in tailstock and the work is held by the chuck. The most common drill used is the twist drill.

Grinding

Grinding is a semi finishing process which is primarily meant for bringing the component for desired shape and size. Grinding results in less volume of metal removal.

Cutting

Cutting is a process of separating the component / material from the given stock. It is a primary manufacturing process and it calls for subsequent operations to be carried out to bring it to the final shape and size.

Model Development

The model was developed by Solid Works software and is imported to ANSYS software for carrying out further analysis and is shown below:

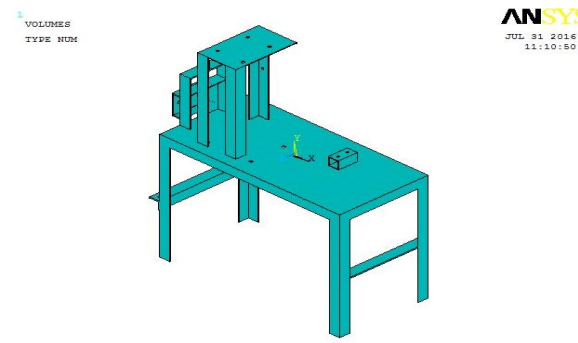


Figure2. Model of Multi Purpose Machine

METHODOLOGY

The methodology followed in the present work is described in the flow chart given below:

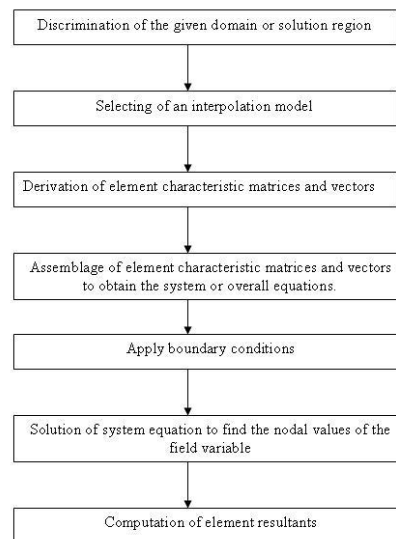


Figure3. Methodology Adopted

Steps in Ansys

To solve any problem in ANSYS it mainly follows the following steps. These are common steps to all problems except material properties and type of analysis used.

Preliminary decisions: Analysis type, Model, Element type.

Pre processing: Material, Create or import the model geometry, Mesh the geometry.

Solution: Apply loads and solve.

Post processing: Review the results, Check the validity of the solution.

Force Analysis of Multi Purpose Machine Tool

The following steps were followed to analyze the various forces acting on the multi-purpose machine tool.

- Set the title.
- Importing the model.
- Define the element type.
- Define material properties.
- Mesh the model.
- Define the solution type.
- Apply convection loads.
- Solve the model.
- Review the deformed results.

RESULTS

Stress Distribution: The following figure shows the stress distribution on the multi –purpose machine tool obtained from ANSYS software.

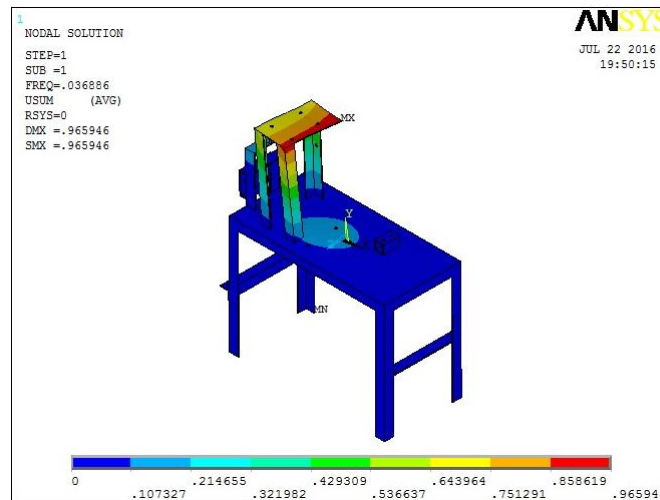


Figure4. Stress Distribution

Deformation: The following sketches shows the deformation on the multipurpose machine tool obtained from ANSYS software.

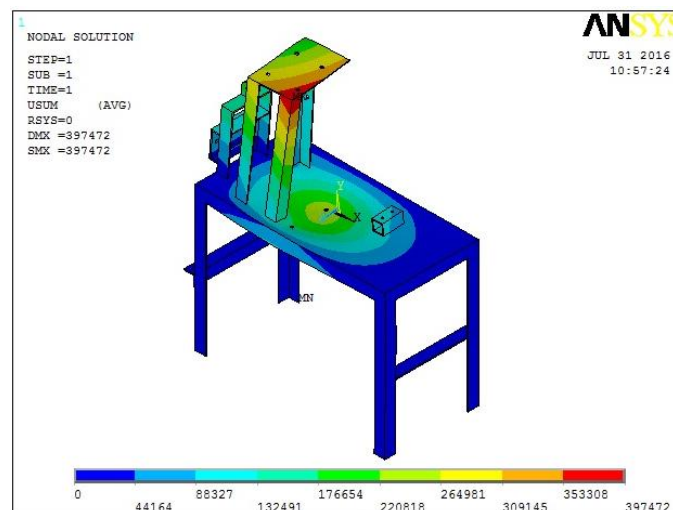
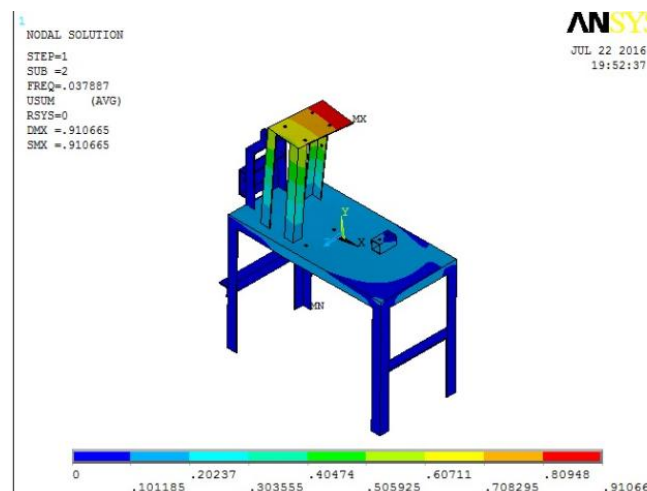


Figure5. Deformation



Weight Carrying Capacity: The following sketch shows the weight carrying capacity of the model developed and is portrayed in ANSYS as given below:

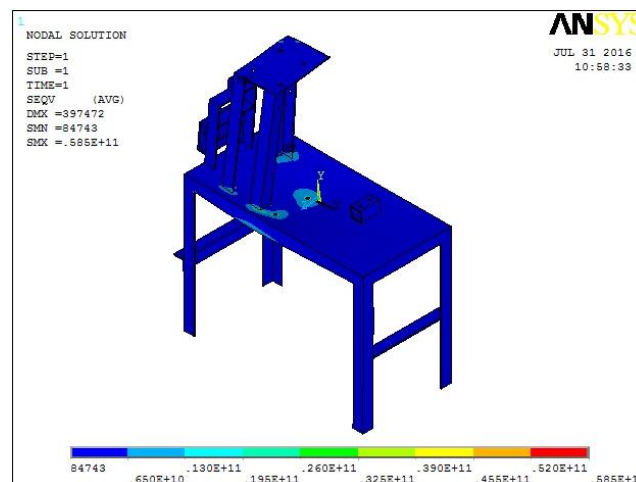


Figure6. Weight Carrying Capacity

Comparison between Individual and Multi Purpose Machines

The following comparisons can be drawn from the work carried out.

Table1. Individual Vs Multi-Purpose Machine

| S.No. | Type of Machine | Cost Range of Basic Individual Machines with Multi-Machine |
|-------|--------------------|---|
| 1 | Individual Machine | Drilling Machine: Rs. 8,000-10,000 Power hacksaw cutting machine: Rs.5000-7000 Grinding Machine: Rs. 4500-5500 |
| 2 | Multi Machine | Cost of Multi Purpose Machine: Rs. 16,000 |

So that we can ultimately reduce the overall manufacturing cost compared to individual cutting, grinding and drilling machines. This also reduces the floor space when compared to Individual Machines. The overall power consumption is also reduced by the replacement of Individual Machines with Multi-machines.

CONCLUSION

The following conclusions can be drawn

- The machine is useful particularly for small scale industries.
- Workers movements can be minimized.
- Number of operations can be carried out on the single machine.
- Power consumption is reduced.
- Floor area required is reduced.
- Cost of manufacturing is also reduced.
- Three different operations viz. drilling, grinding and cutting.

FUTURE SCOPE

- Other operations can also be incorporated in to the machine.
- The machine can be made more portable.
- Cost can also be reduced to some extent by manufacturing it on a mass scale.

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