Research Paper on Design and Development of Multi-Purpose Machine

(Design & Analysis of Multi -Purpose Cutting, Grinding, Buffing and Drilling Machine)

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ABSTRACT:

Machine design involves the design of a new concept or modification of an existing concept with improved performance. The need to increase productivity has realized many concepts where in the same machine performs two or more similar operations simultaneously, one such operation is cutting off. This operation is performed at the very beginning of the manufacturing cycle though it is essential it does not add any value to the product. Thus it is preferred that this cutting operation be done at a fast rate. Similarly drilling is common operation needed in any work shop. Grinding is needed to sharpen the tools and other finishing operation. Sander is needed to remove the burrs from edges. Buffing operation is needed to improve the surface finish of the work piece. Many designs have been proposed with the idea of operating multiple operations at the same time using a single motor arrangement. Normally these machines have been used with slider crank mechanisms with spring loaded feeding mechanism for cutting operation.

The multi -purpose machine is a novel method where in the cutting is done with hack saws via slider crank mechanism delivering power using a high spur gear pair arrangement. The drilling operation is done via a bevel gear pair powered drill. The grinding wheel is mounted on the same shaft as the sander wheel only that sander wheel is powered by the spiral bevel gear box. The buffing wheel is mounted on the motor extension shaft that also drives the drill machine and grinding sander using an individual belt drive.

The paper discusses work of the theoretical design of the components of machine operation is done and the solid model of the parts is done using Unigraphix Nx whereas the analysis is done using Ansys work bench.

INTRODUCTION:

Today in this world 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 make high productivity rate maintaining the quality and standard of the product at low average cost. In a considerable portion of investment is being made for machinery installation. So in this paper work is proposed where a machine is designed cutting, drilling, grinding, polishing & shaping, some lathe operations at different working centers simultaneously which implies that industrialist will not have to pay for machine performing above tasks individually for operating operation simultaneously.

Economics of manufacturing: According to some economists, manufacturing is a wealth producing sector of an economy, whereas a service sector tends to be wealth consuming.

The project focuses on fabrication of machine which can be used to perform different operations required in small fabrication shops in a single machine. This would not only cut down the cost of operations of three machines but also the cost of setting up a fabrication shop. The primary focus of this research work is to reduce the cost as well as the floor space required by these machines.

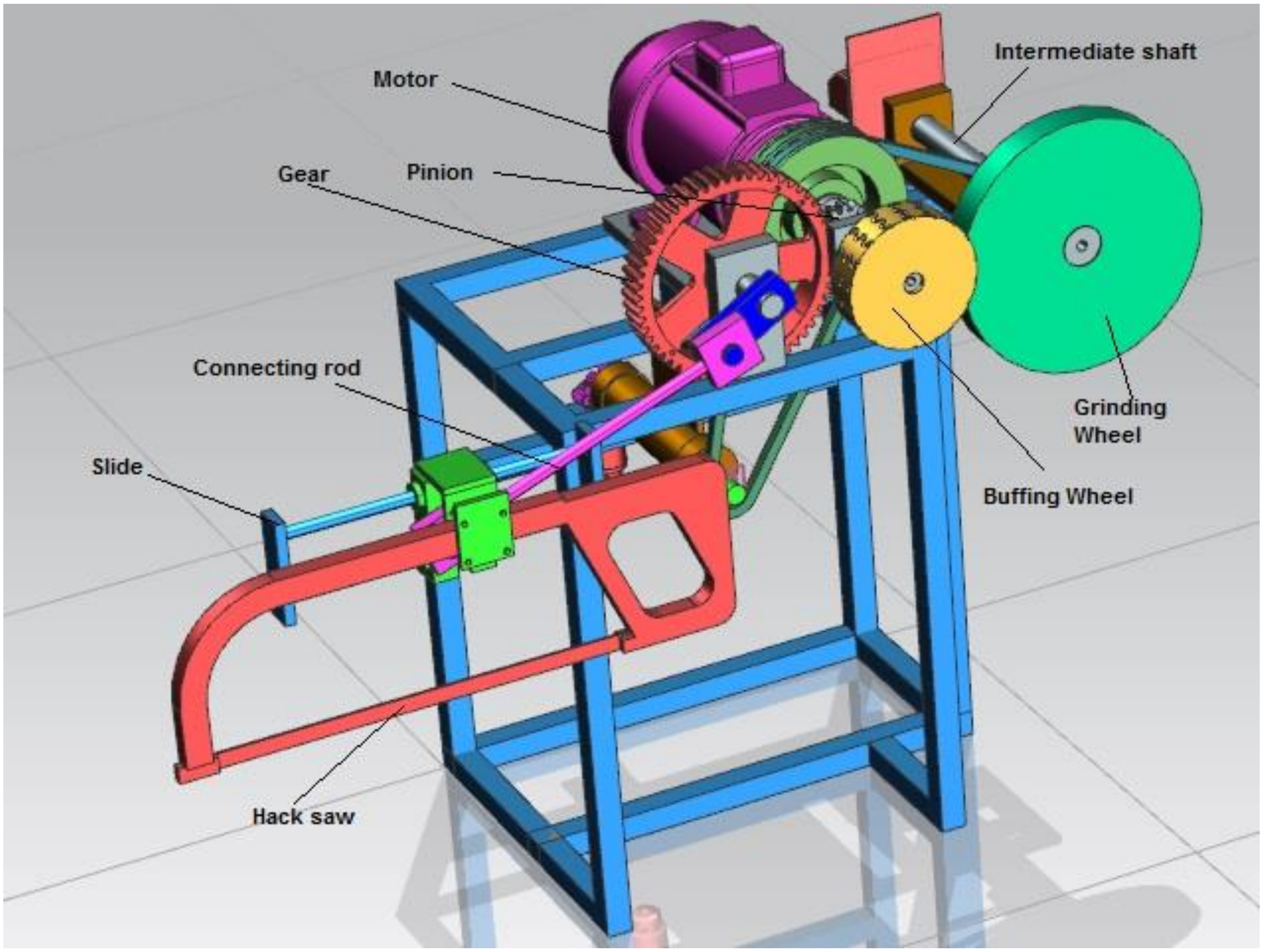
PROBLEM STATEMENT:

- Multiple operations need to be carried out for the manufacturing of certain parts and that too on regular basis.
- This requires the use of different kinds of single purpose machine for the manufacturing.
- Those machines are costlier and consume a lot of space within the workshop.
- Also the single unit of machine is capable of performing single task at a particular time.
- While switching to different machines during the operation change, lot of time gest wasted in handling of parts.

Thus to eliminate the above issues we have introduced a small scale concept named as Multi-Purpose Machine which will be lesser in weight, compact in size, as well as very much capable of performing these operations at single time.

CONSTRUCTION & WORKING

The figure shows the arrangement of machine:



- Main Drive motor, motor shaft,
- Grinding wheel arrangement
- Belt drive between motor shaft and the intermediate shaft
- Belt drive between the motor shaft and drill machine shaft
- Gear box with sander wheel
- Bevel gear pair for drilling
- Spur Pinion & Gear drive for hacksaw
- Hacksaw frame with slider, connecting rod and crank

WORKING:

a) Grinding:

The motor drives the 5-2-A pulley which drives the intermediate shaft which is held in ball bearings and carries the grinding wheel.

b) Sander:

The motor drives the 5-2-A pulley which drives the intermediate shaft which is held in ball bearings and carries the sander spiral bevel gear box on which sander wheel is mounted

c) Buffing:

Buffing wheel is directly mounted on the motor shaft and runs at motor speed.

d) Hack saw:

The pinion on the motor shaft drives the gear which in turn drive the crank which makes the slider carrying the hacksaw frame to reciprocate to attain the cutting action.

e) Drilling:

The motor shaft drives the bevel gear drive shaft via belt drive and the bevel gear drive gives the drill chuck the motion.

DESIGN CALCULATIONS AND

The various components of the system are designed and analysis is carried out.

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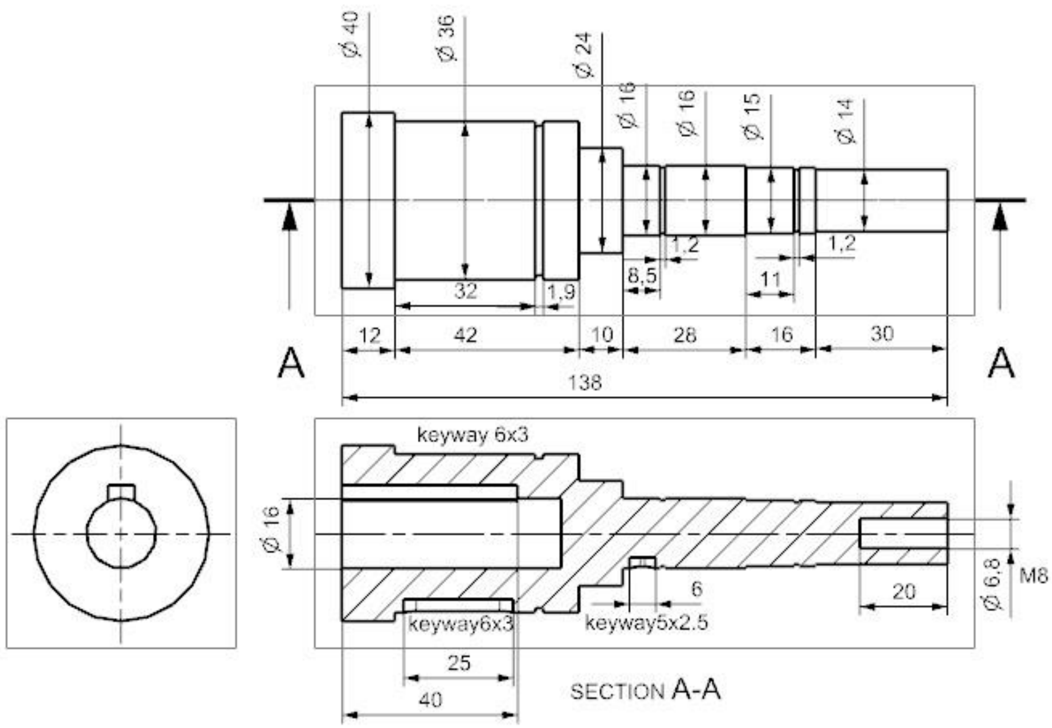
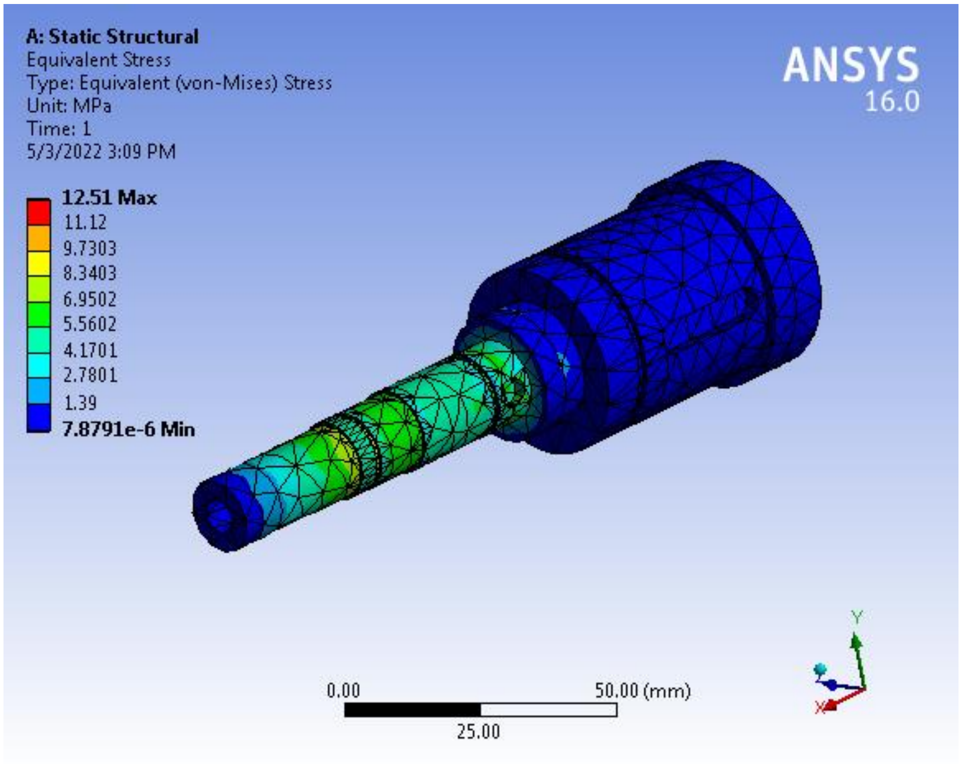
DESIGN OF MOTOR SHAFT



The motor shaft is designed for torsion failure:

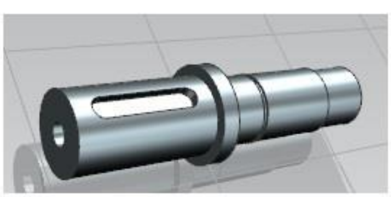
Td = Π/16 x fs act x d3

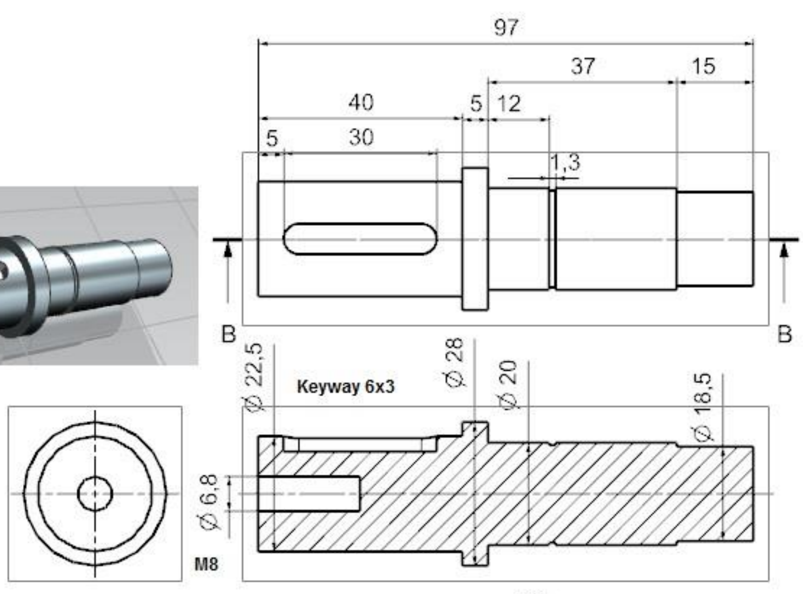
$\Rightarrow$ fs act = 4.6 N/mm2 $\Rightarrow$ Motor shaft is safe under torsional load.



Maximum stress induced in the motor shaft is well below the permissible limit hence it is safe

DESIGN OF CRANK SHAFT





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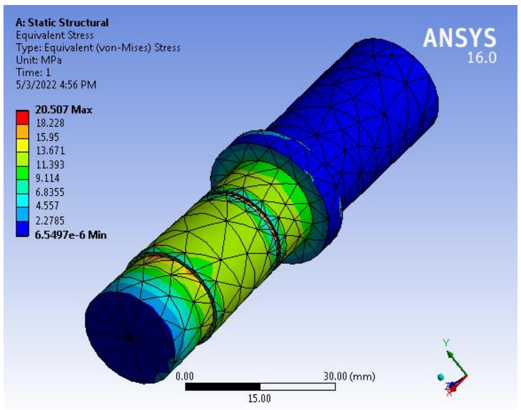
The motor shaft is designed for torsion failure:

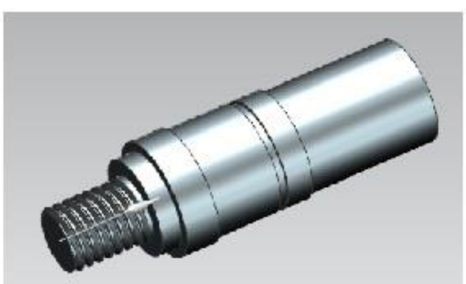
Td = Π/16 x fs act x d3

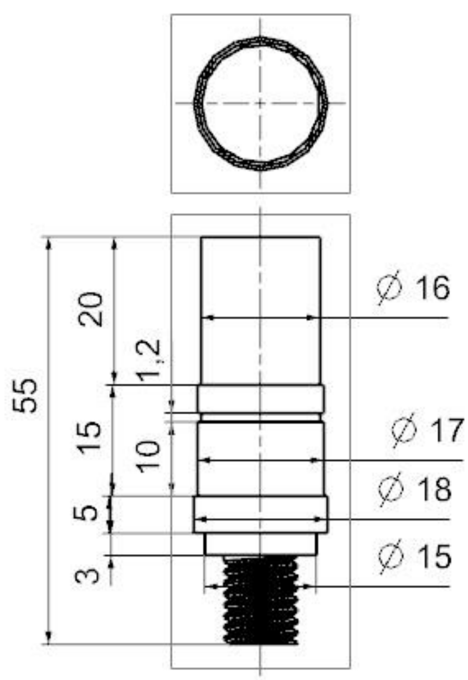
⇒ fs act = 9.13 N/mm2 ⇒ Crank shaft is safe under torsional load.



Maximum stress induced in the crank shaft is well below the permissible limit hence it is safe

DESIGN OF DRILLING MACHINE SHAFT

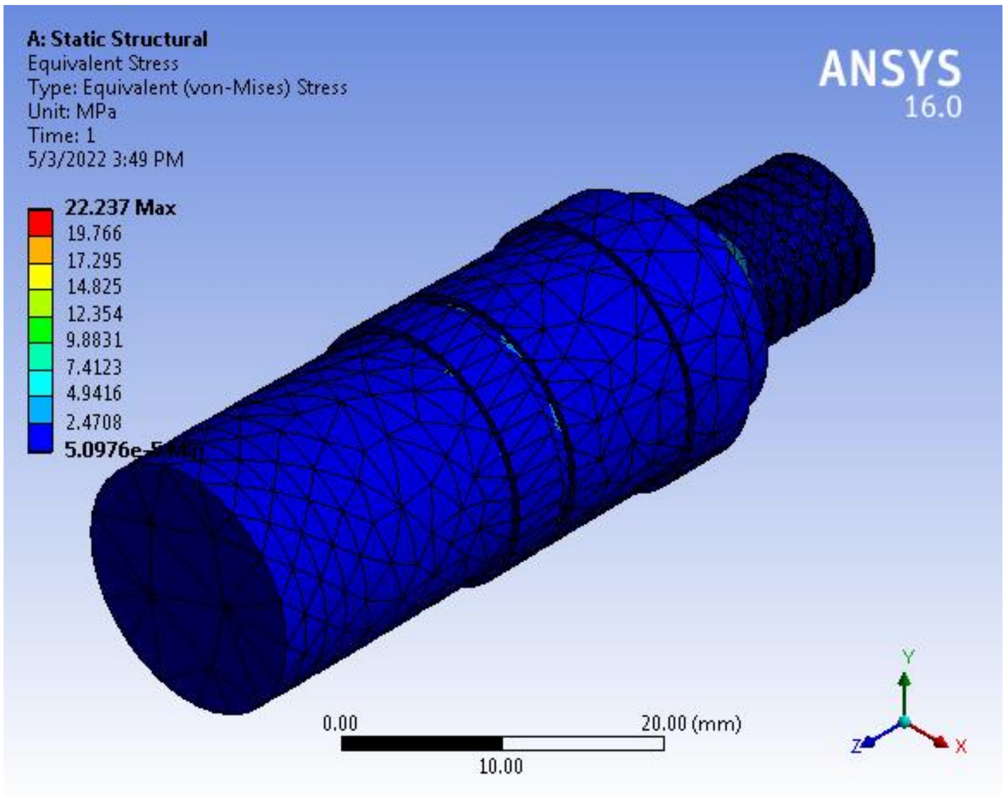




The motor shaft is designed for torsion failure:

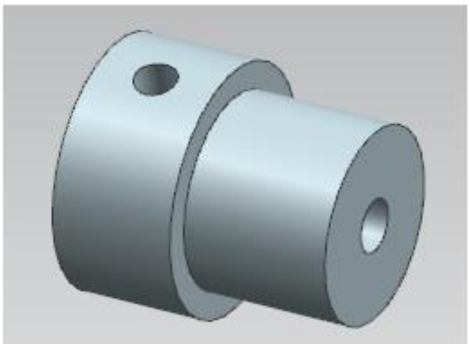
Td = Π/16 x fs act x d3

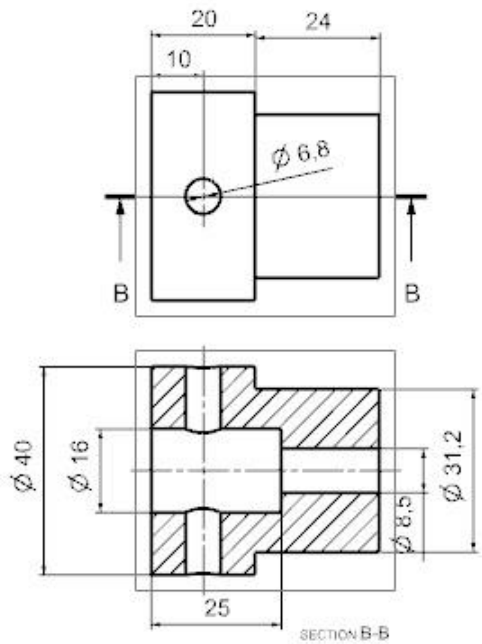
⇒ fs act = 5.04 N/mm2 ⇒ Drill machine shaft is safe under torsional load.



Maximum stress induced in the drill machine shaft is well below the permissible limit hence it is safe

DESIGN OF GRINDING WHEEL SHAFT

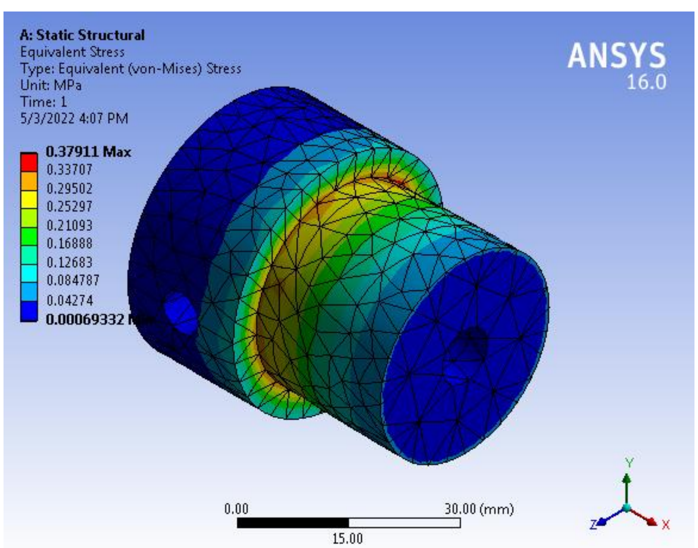




The motor shaft is designed for torsion failure:

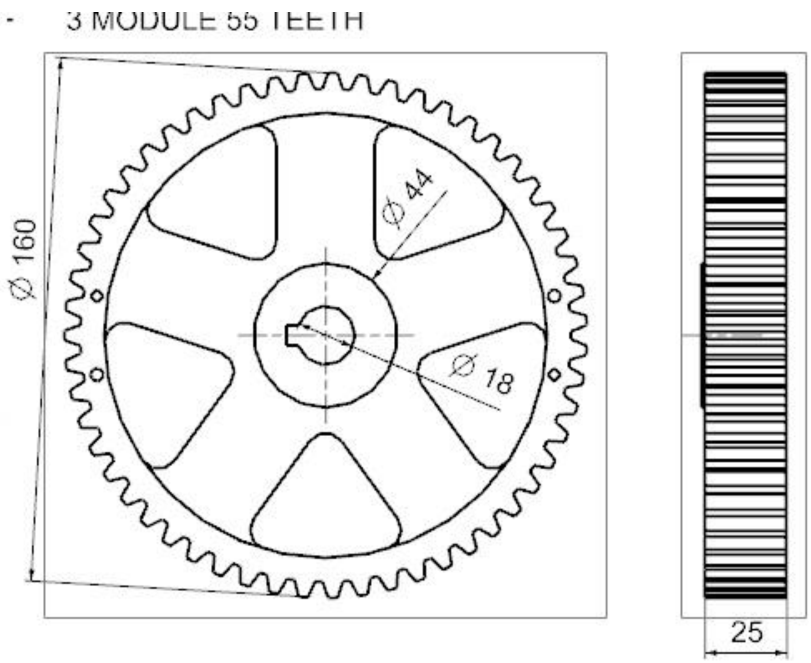
Td = Π/16 x fs act x d3

⇒ fs act = 0.6 N/mm2 ⇒ Grinding wheel shaft is safe under torsional load.



Maximum stress induced in the grinding wheel shaft is well below the permissible limit hence it is safe

Design Analysis of Gear:



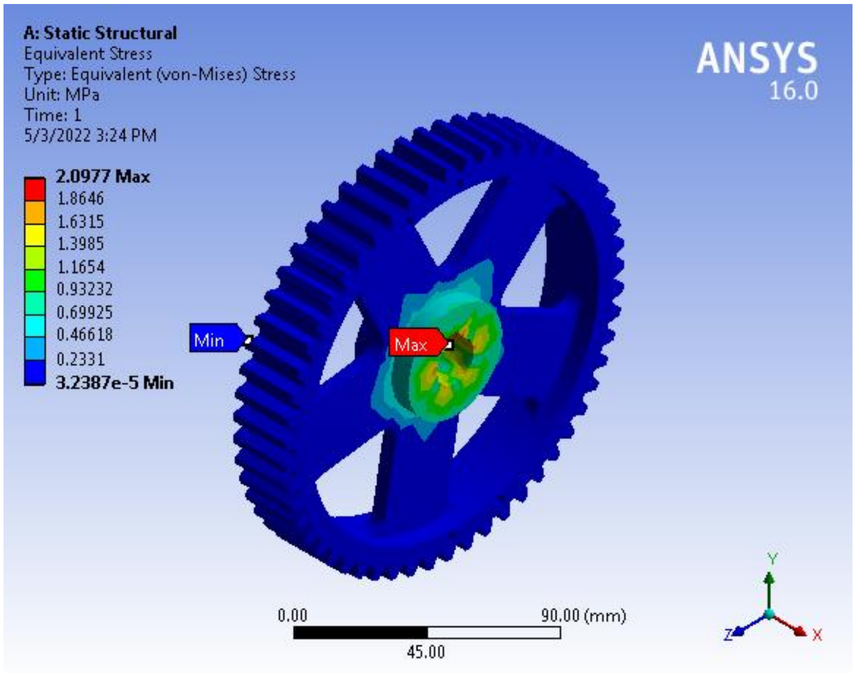
Using Lewis Strength equation

WT = Sbym, module of gear was found to be 3 mm

Checking for torsional strength of gear:

Td = Π/16 x fs act x(D4- d4) /D

⇒ fs act = 0.71/mm2 ⇒Gear is safe under torsional load



The maximum analytical stress is 2.89 Mpa which is far below the permissible limit hence the gear is safe.

Result & Discussion:

The component of the multi-purpose machine is designed using theoretical method and the results are validated using Ansys workbench. The maximum stress in the motor shaft by theoretical method is 4.6 MPa whereas the analytical stress is 12.51 Mpa. The maximum stress in the crank shaft by theoretical method is 9.13 MPa whereas the analytical stress is 26.57 Mpa. The maximum stress in the drill machine shaft by theoretical method is 5.04 MPa whereas the analytical stress is 22.37 Mpa. The maximum stress in the grinding shaft by theoretical method is 0.6 MPa whereas the analytical stress is 8.3 Mpa.

Conclusion:

The multi -purpose machine is an innovative method where in the cutting is done with hack saws via slider crank mechanism delivering power using a high spur gear pair arrangement. The drilling operation is done via a bevel gear pair powered drill. The grinding wheel is mounted on the same shaft as the sander wheel only that sander wheel is powered by the spiral bevel gear box. The buffing wheel is mounted on the motor extension shaft that also drives the drill machine and grinding sander using an individual belt drive.

The paper discusses work of the theoretical design of the components of machine operation is done and the solid model of the parts is done using Unigraphix Nx whereas the analysis is done using Ansys work bench all components were found to be safe by both methods.

Future Scope:

1. We can perform various operations like cutting, drilling, or grinding individually by introducing coupling (engagement & disengagement) between them.
2. We can perform grinding operation by introducing a grinding tool at the main shaft.
3. We can perform boring operation by introducing a boring tool by replacing drilling tool.
4. We can change the speed of motor by regulator.

References:

[1]. Heinrich Arnold1 "The recent history of the machine tool industry and the effects of technological change" University of Munich, Institute for Innovation Research and Technology
Management, November 2001.

[2]. Dr. Toshimichi Moriwaki "Trends in Recent Machine Tool Technologies" Professor Department Mechanical Engineering Kobe University, NTN Technical Review No.74(2006).

[3]. T.Moriwaki "Multi-functional machine tool" , Department of Industrial and Systems Engineering, Setsunan University, Neyagawa, Japan CIRP Annals - Manufacturing Technology
DOI:10.1016/J.cirp.2008.09.004

[5]. Text book of Machine design , RS Khurmi , J K Gupta , S Chand Publications

[6]. Design of Machine Elements , V B Bhandari

[4PSG Design Data handbook.