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DESIGN AND DEVELOPMENT OF PNEUMATIC DRILL JIG

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ABSTRACT:

Mechanical industries always use the jigs and fixtures for betterment of manufacturing. Mechanical parts are passing through various processes such as turning, drilling, shaping etc. Sometimes the final finishing of mechanical parts needs to work on such parts to remove the unwanted sharp corners etc. Holding the part in a particular position makes it easy to work with such parts. Accurate shaping of each part is necessary in mechanical industries. As these small parts are going to be the part of bigger machines or processes, their dimensions must be very accurate and finishing must be proper. The support helps in better grip on the parts during cutting operations. Authors have developed a jig design from point of view of Indian workshops.

KEYWORDS: Drilling, Drill Jig, Fixtures, Mechanical Industries, etc.

INTRODUCTION:

Manufacturing process has passed through many revisions and modifications for betterments. Several supporting tools and structures are produced to support the manufacturing of various products. Mechanical tool manufacturing needs to operate on heavy machines and operations where there is need of accuracy. Jig will be useful for drilling on multiple parts at a time. This helps in improving the time consumption of and reduces the cost of operation.

The time taken by drill machine to settle on work piece will be reduced with the help of jig. With development of India and the initiatives by government of India such as make in India, the industries are developing fast. We are on the verge of industry 4.0 revolution. Many small scale industries are still struggling with the availability of technology. Mechanical industries are always looking for the innovative initiatives in betterment of manufacturing processes. Many small scale industries as on today are practicing the manual finishing and processing of the product. This will be useful for enhancement in the quality of product. Product quality can be considered as a final outcome of the manufacturing process.

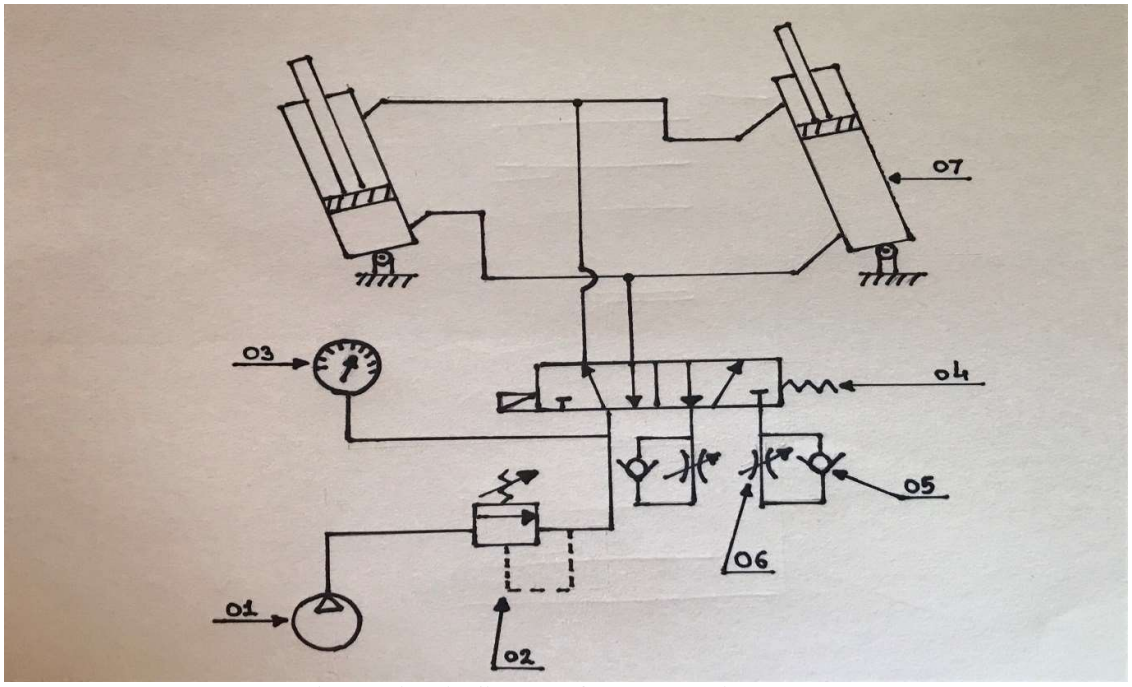

Fig.1: Circuit diagram for pneumatic system

The above pneumatic circuit is used in the drill jig. This pneumatic circuit will operate the leaf of the drill jig. Because of which the jig operation is made easier. This circuit consists of number of components such as compressor, pressure relief valve, pressure gauge, direction control valve, flow control valve and pneumatic cylinder.

OBJECTIVES OF WORK:

Objectives of the work carried out are:

- Improving accuracy of the drilling on work piece.
- Reducing manual errors in drilling operations of mechanical parts.
- Reduce the time taken for drilling.

SYSTEM DESIGN:

We have developed the CAD design in CATIA V5 21 software for the system as below:

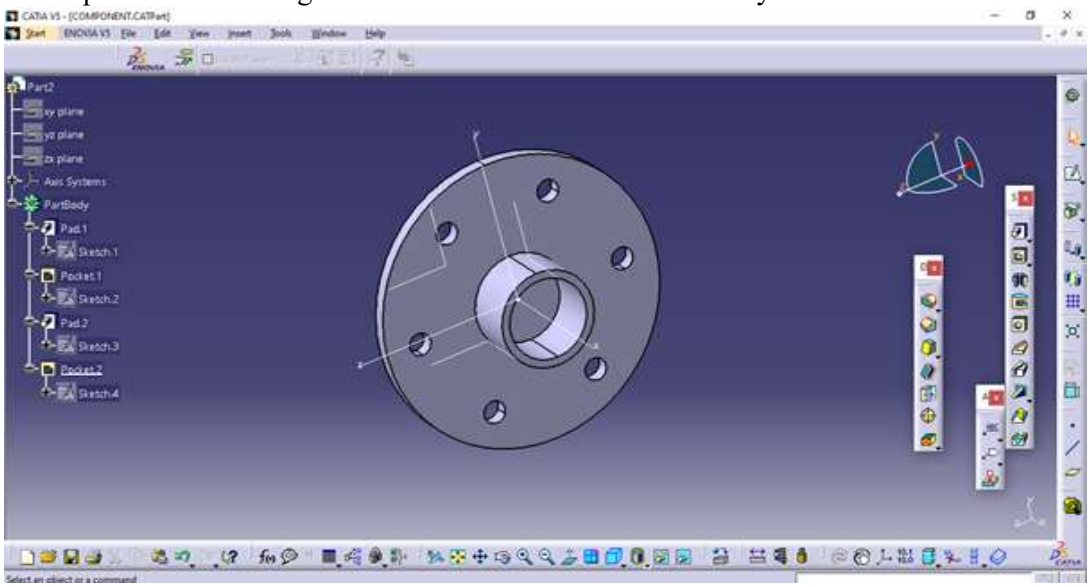

Fig.2: CAD Design of work piece model

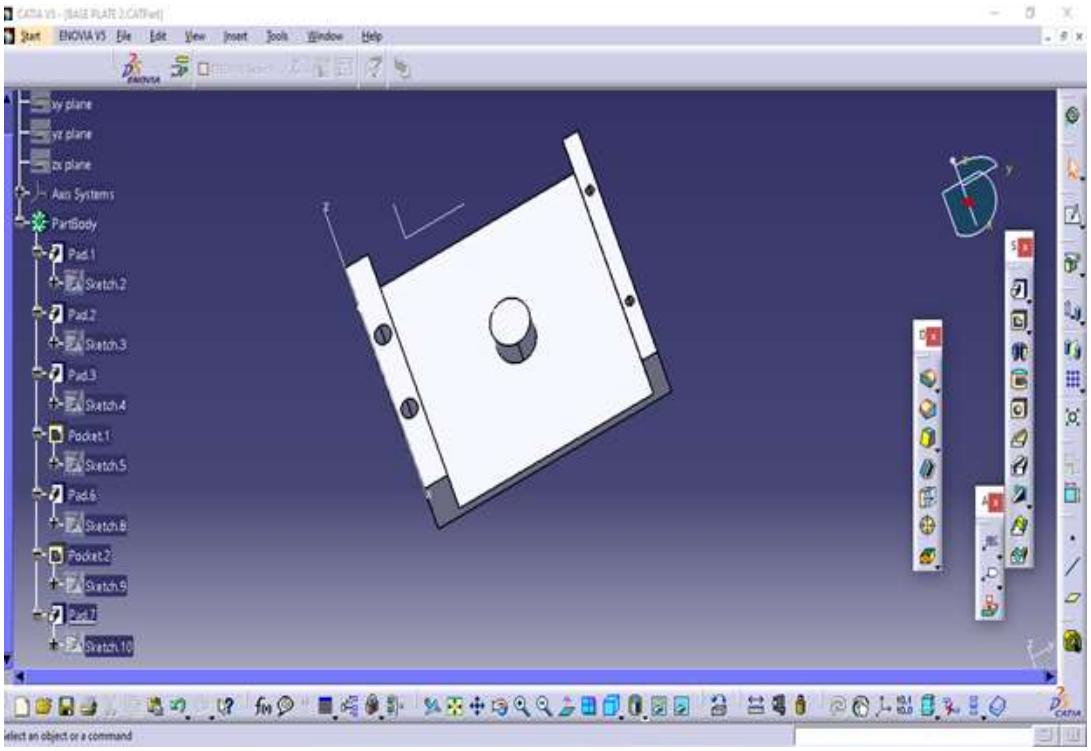

Fig. 3: CAD Model of Base Plate

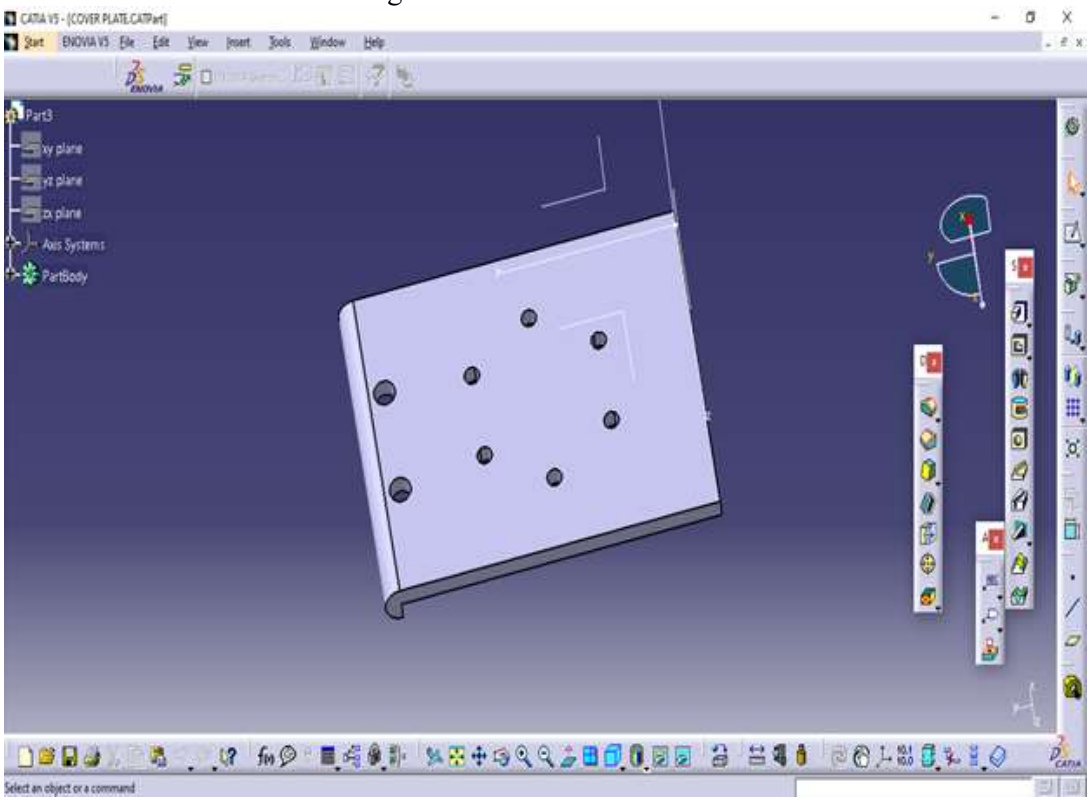

Fig.4: CAD Modeling of Cover plate

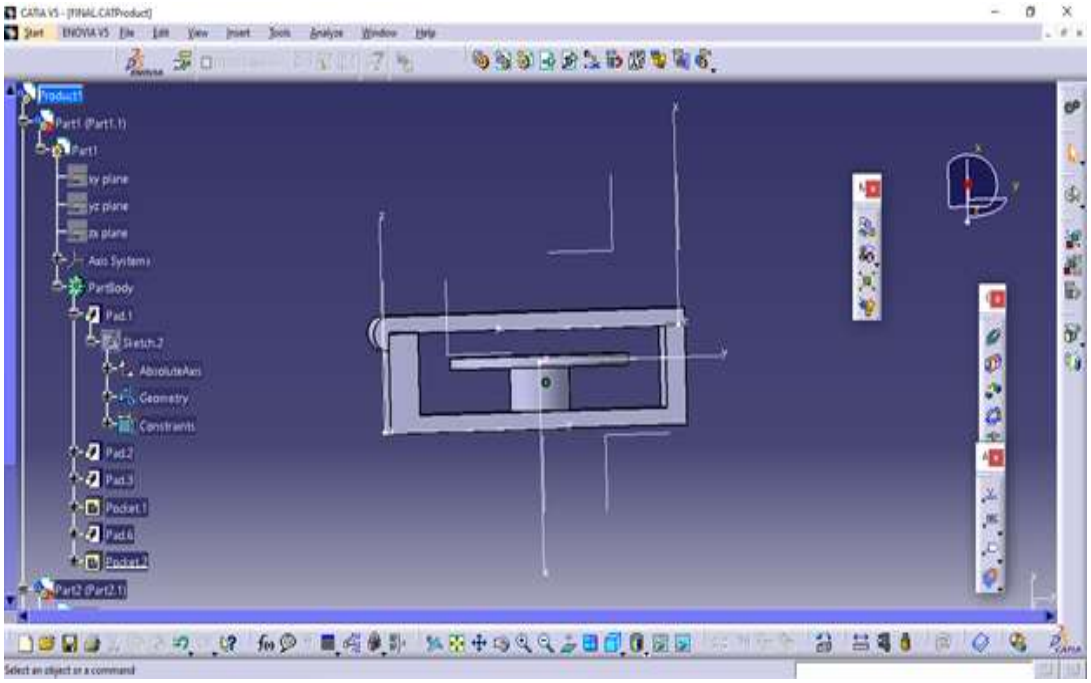

Fig.5: CAD Assembly

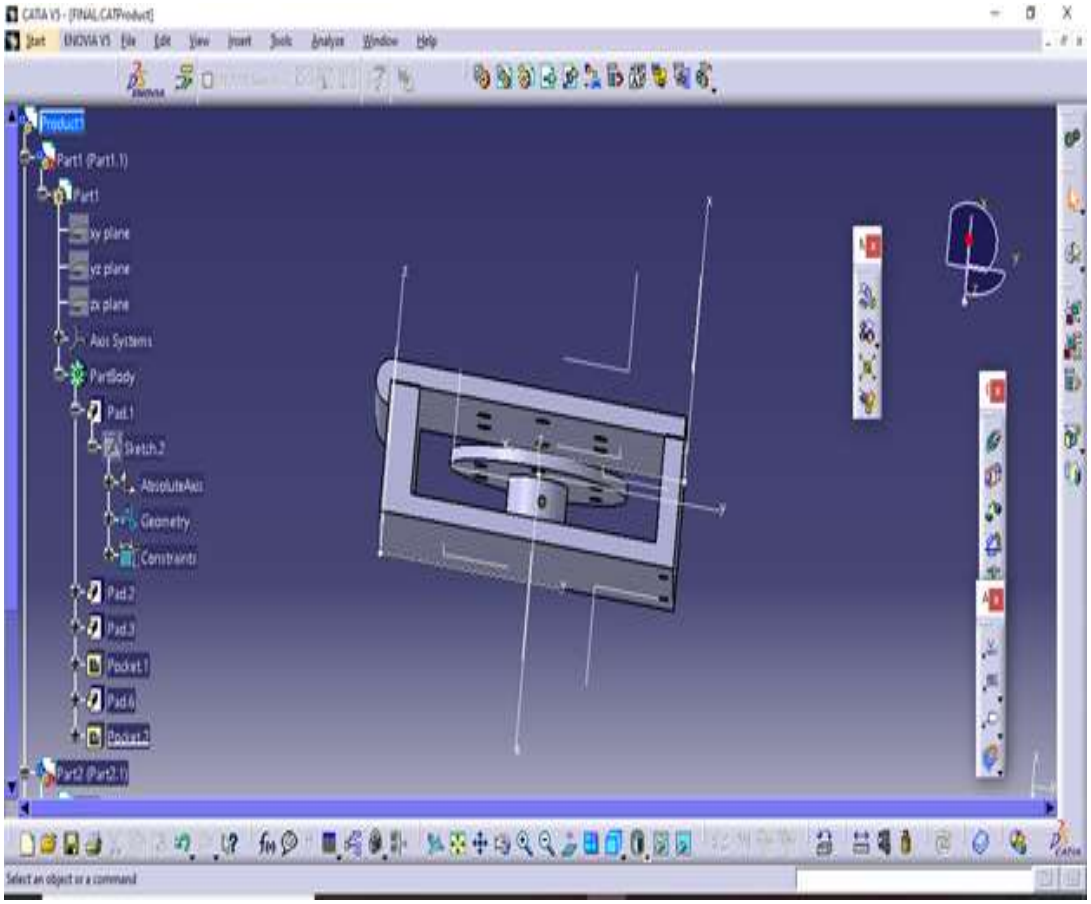

Fig.6: CAD Assembly Side View

ANALYSIS OF COMPONENT:

The analysis of the components designed is carried out in ANSYS.

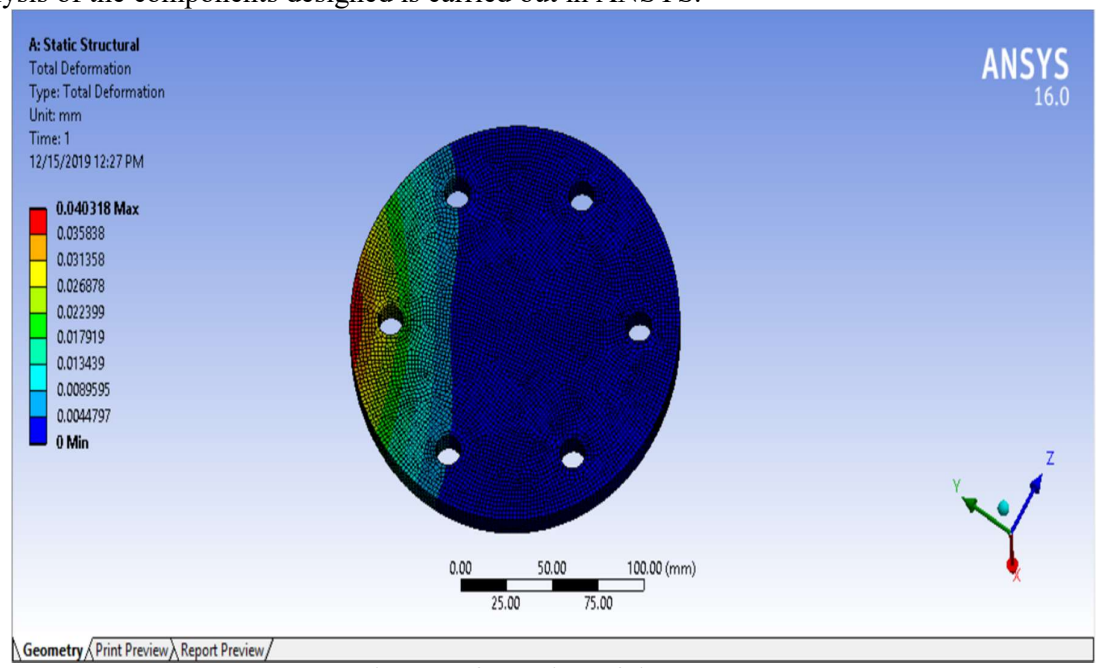

Fig.7: Deformation of the component

The analysis of the component has to be done so that it can understand even before practical operation that the component is safe or not when stress is applied. The analysis is done on the ANSYS workbench software where the different stresses and strain can be understood. If the design is not safe necessary changes have to be done. The different colour coding gives the idea of the parts where the component might fail as follows:

Red Color: It indicates at what stress the part will damage.

Blue Color: It indicates safe stress limit for the part.

The color indication helps in understanding the stress present on different point of the part when actual load is applied on the part.

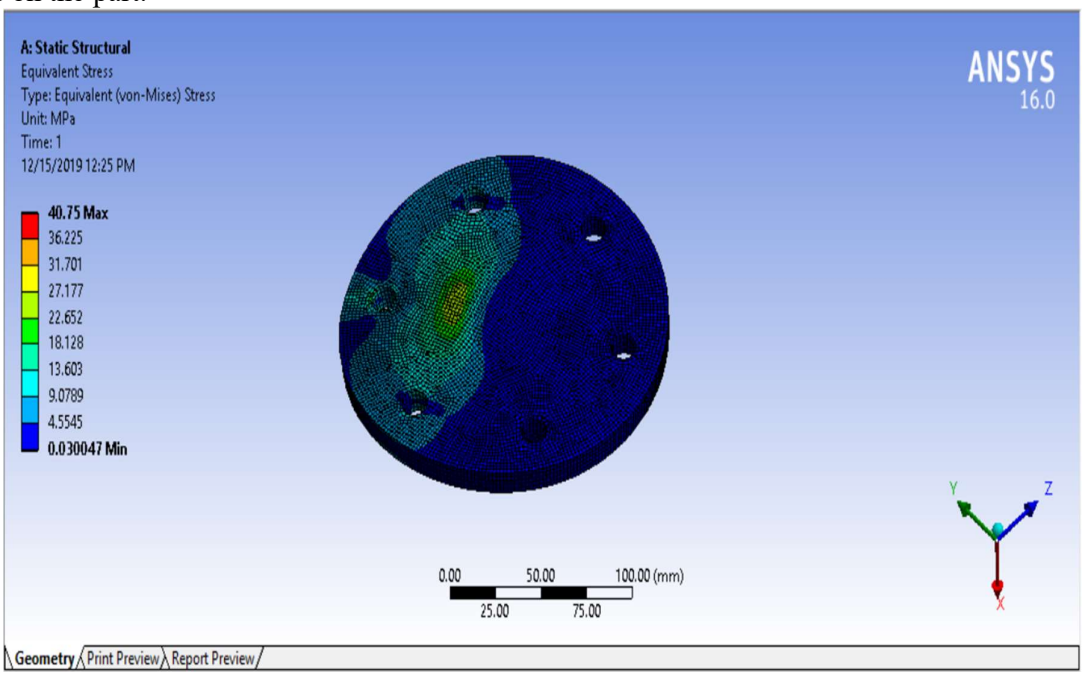

Fig.8: Stress on the component

The maximum stress obtained from the analysis is 40.75Mpa and the minimum stress obtained is 0.03004Mpa.

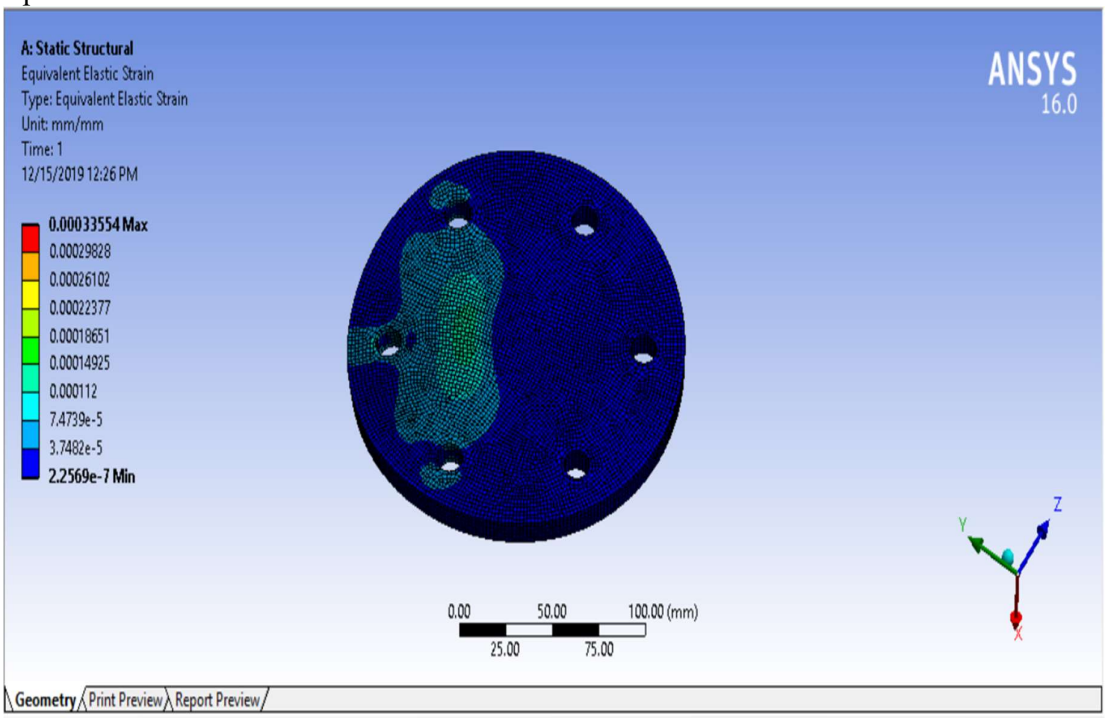

Fig.9: Strain in the component

The strain in the component obtained is very less. That can be seen using the colour coding system in the software. The maximum strain in the given component is 0.0035.

APPROVAL OF DESIGN:

Table 1: Observation Table

Material used	Stress (Mpa)	Strain	Total Deformation (mm)
Mild steel (MS)	40.75	0.0035	0.040

- Drill bit used 8mm.
- Force applied by the drill on the component is 990.1 N.
- As the yield strength of mild steel is 247Mpa and its factor of safety is considered to be 1.5.
- Syt = stress/FOS
- 247=40.75/FOS
- Calculated FOS= 6.061

The factor of safety of the component is greater than the given FOS 1.5. Hence the component is safe in design.

CONCLUSION:

Drill jig is basic component used to improve the drilling on mechanical parts. Mild steel is suitable to use for drill jig. The design validation is done and found suitable for development of hardware. It can also be concluded that the work is reduced by using a pneumatic system instead of doing the clamping manually. We have developed a jig for application in small scale industries of India. The advantage of using cylinder is to reduce the efforts of operator. The cost of operation is reduced with reducing the waste motion of drill machine. The operation is smooth with higher productivity as the speed is high than regular operation.

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