Design of Dies in Pneumatic Press for Ring Sizing, Bending and Forming

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Abstract: In highly competitive manufacturing industries now-a-days, ultimate goals of the manufactures are to produce high quality product with less cost and time constraints. To achieve these goals, one of the considerations is by optimizing one or more parameters through the process of finding the conditions that give the maximum or minimum value of a function. A Pneumatic Press machine is used to various press operations like Ring Sizing, Bending and forming. Ii has very good advantages than to use mechanical power press.

The objective of this project is to design and development of Pneumatic Press for Ring Sizing, Bending and forming to minimize the product cost As well as energy analysis of Pneumatic Press compares to Mechanical power press. Objective function is reducing the product cost by design and development of Pneumatic Press. The results show that the design is safe and it has low cost compared to the mechanical press.

Keywords: Optimization, Pneumatic Press machine, Mechanical power press, Pneumatic press, Energy Analysis, Cost, weight reduction.

Introduction:

Mechanical power press requires electrical power consumption, safety and maintenance, heavy flywheel, drive arrangement and their control unit, Also requires Proper orientation, die setting, die material to withstand that much load to work without failure so it is having higher initial cost. The Pneumatic presses are most suitable options available for the replacement of the conventional mechanical press. In this study a FEA analysis of the different components of the pneumatic press are conducted. Though pneumatic presses are suitable due to its light weight and high capacity, the selection and construction of the press is dependent on the on the types of work performed also Smith & Associates et al[1] given the few guide lines for press selection.

For selection of pneumatic press as a replacement of mechanical press there is a need to study the different aspects of the mechanical and pneumatic systems. Peter Croser et.al.[2] have studied the information regarding the characteristics and applications of pneumatic system and David Alkire Smith.[3] has supplied information on the different aspects of the mechanical press design.

There are also some researchers who are working in the field of design of pneumatic press components, Rajdipsinh G. Vaghela et.al.[4] have carried out research work is to design and analyze the C shape frame of pneumatic power press. Results of this study showed that the stresses in the frame are within permissible limit and can be further optimized using hyper mesh optistruct solver.John R. Groot et.al.[5] also studied the pneumatic systems and he described the transmission and control of pressure switch, safety relief valve, pressure regulator. A. K. Gupta et.al.[6] also has presented investigation, design and fabrication of blanking of thin sheet (0.1-2 mm) of different sheet material. The study helped to evaluate the influence of tool clearance, burr formation, sheet thickness, punch/die size and blanking layout on the sheet deformation.

Gaurav P. Sonawane et.al.[7] studied hydro-pneumatic press and its design and manufacturing is conducted for pressing sleeve bearing into the circular casting part. This work provides the concept development, design, analysis and manufacturing of press machine.

Here the study of different stresses developed in the components of the pneumatic presses are observed and compared to the maximum permissible limits. The analysis of dies used for different operations is conducted in this research work.

Model Analysis For Ring sizing Operation :

Following is the FEM analysis of the different components of the pneumatic press. The stress and deformation of the components can be observed in these figures under loading condition.

a. Top Die:

Equivalent Stresses:

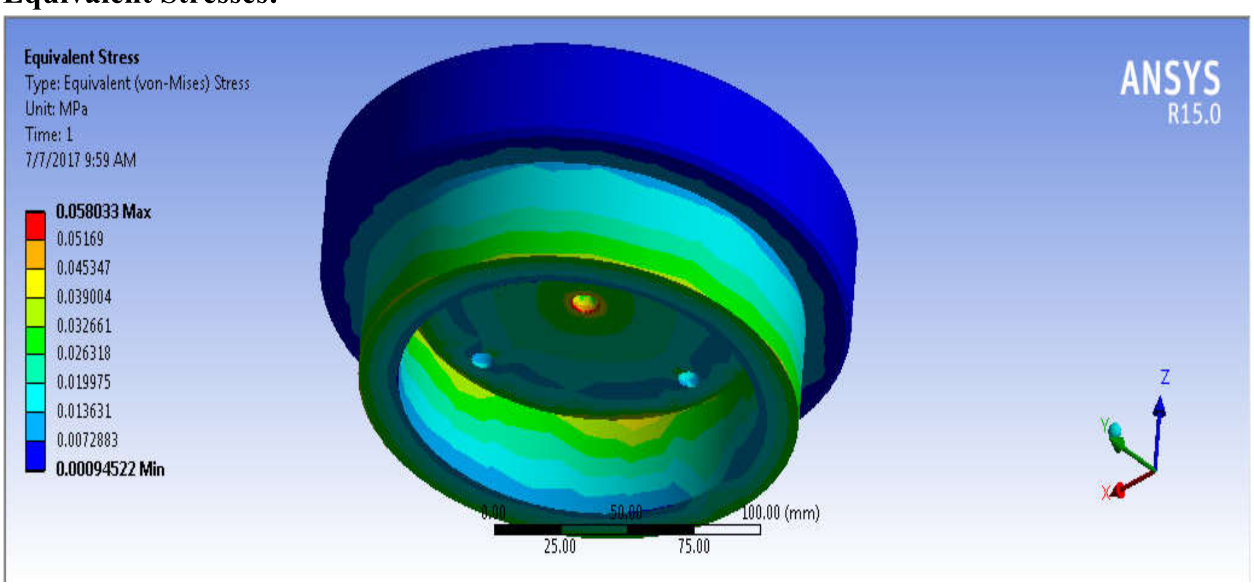

Fig .1 Equivalent stresses of top die for ring sizing operations

Deformation:

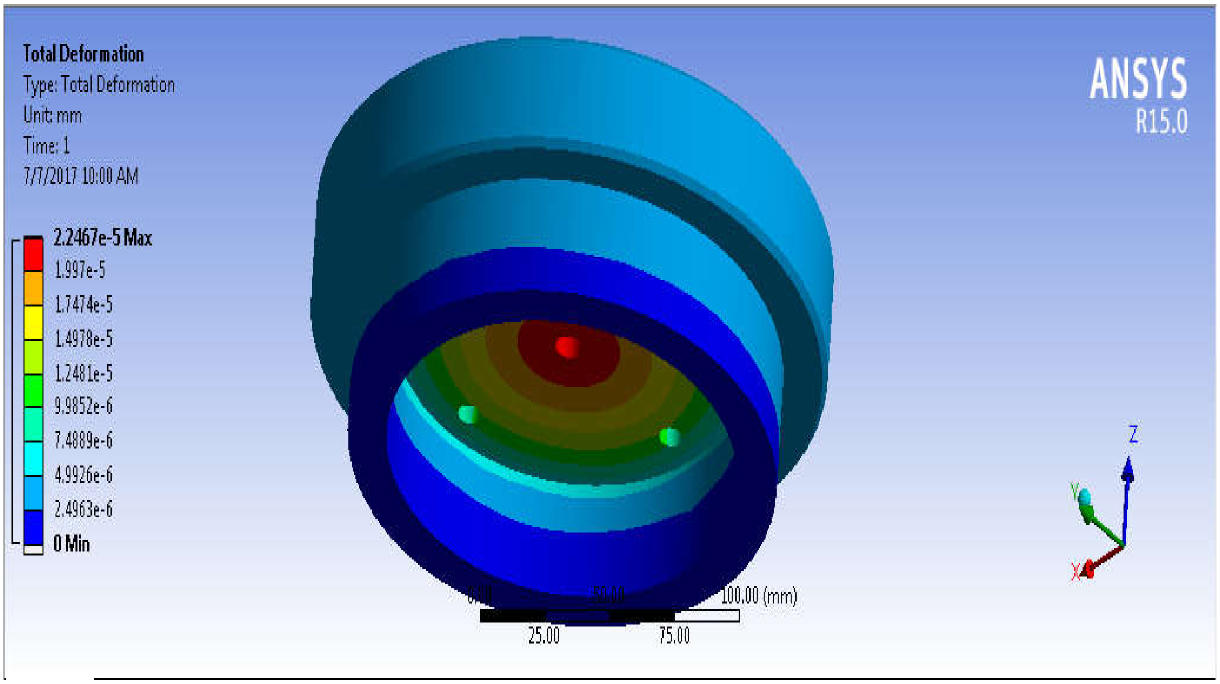

Fig.2 Total Deformation of top die for ring sizing operations

Fig 1 and 2 shows the FEA analysis of top die used in the Ring sizing Operation. The red color region values shows the maximum stresses and deformation points and values.

b. Bottom Die:

Equivalent Stresses:

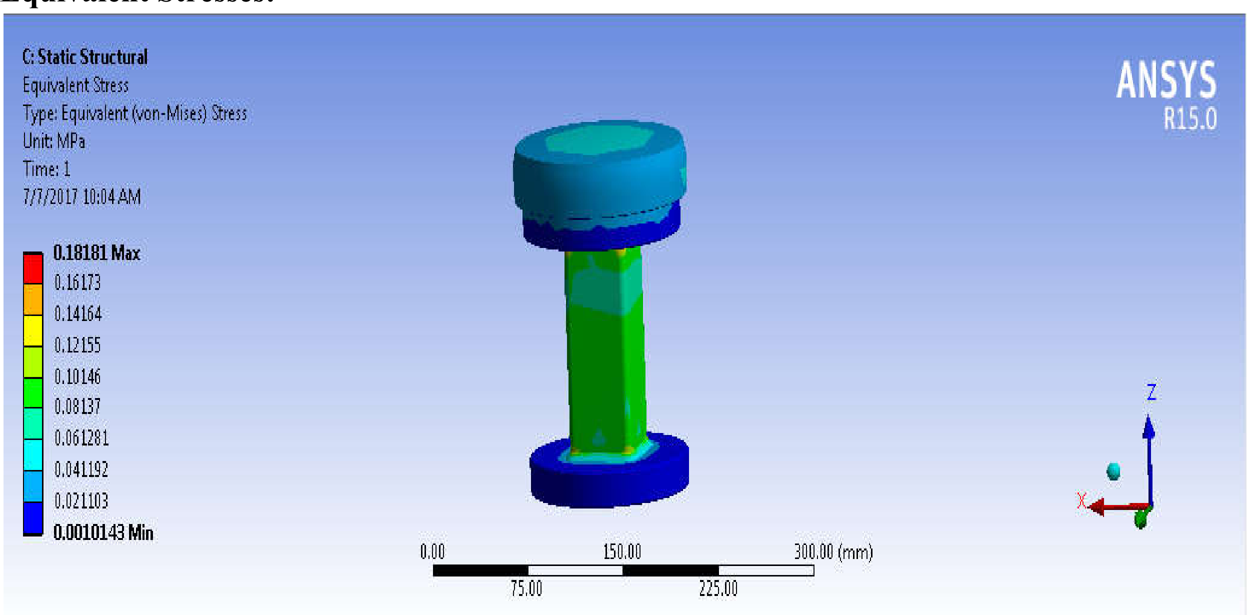

Fig 3 Equivalent stresses of Bottom die for ring sizing operations

Deformation:

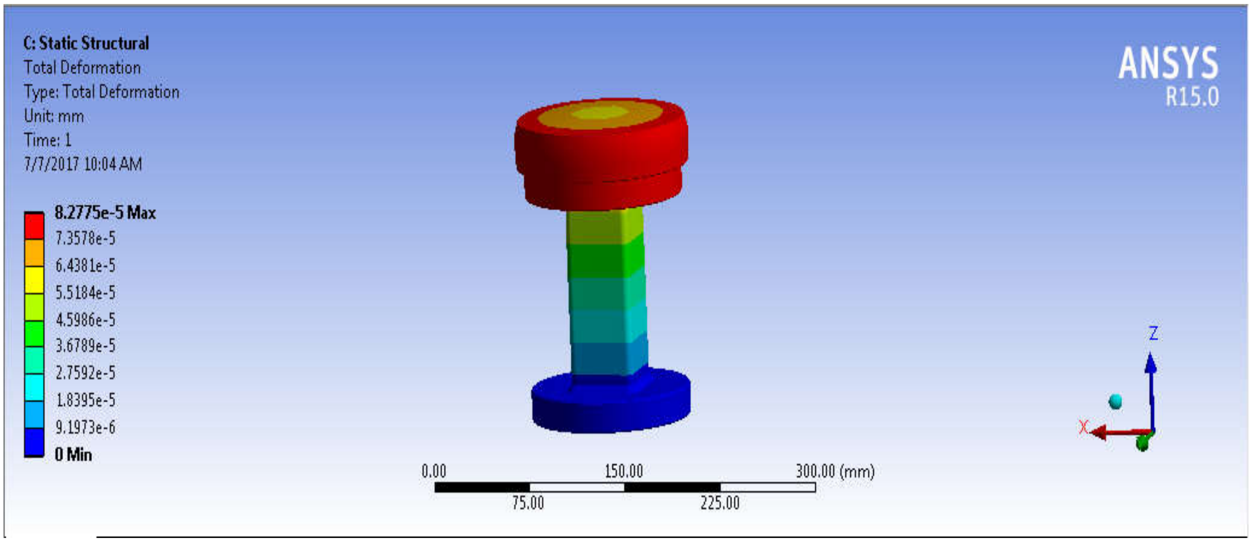

Fig 4 Total Deformation of Bottom die for ring sizing operations

Model Analysis For Wire bending Operation
a. Top Die
Equivalent Stresses

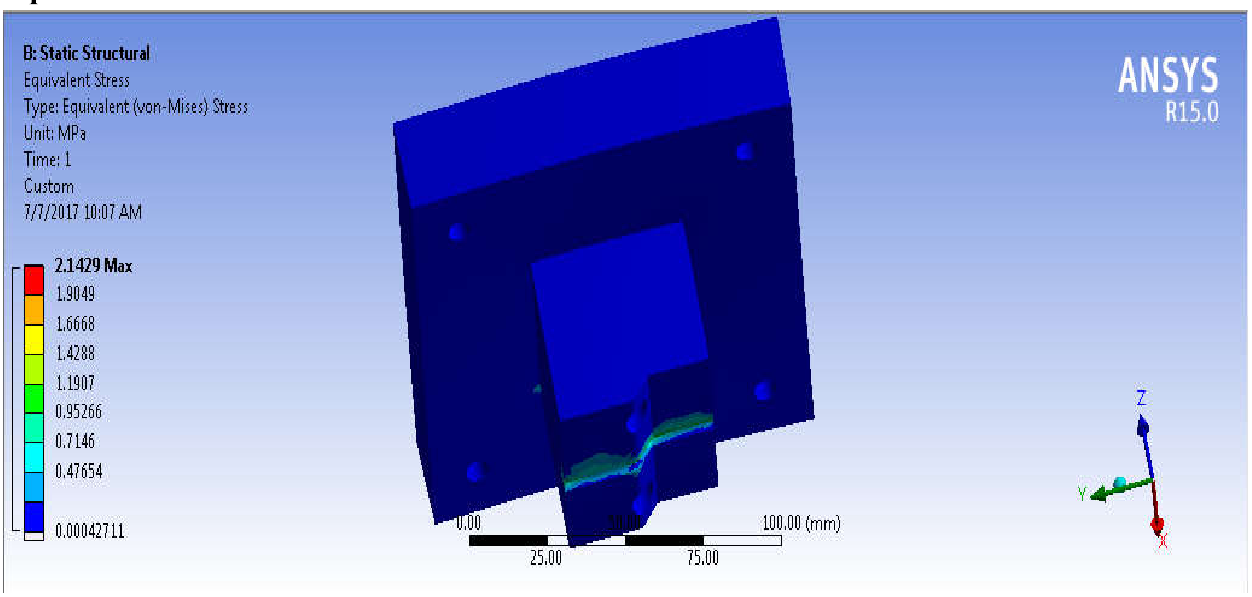

Fig.5 Equivalent stresses of Top die for Wire bending operations

Deformation

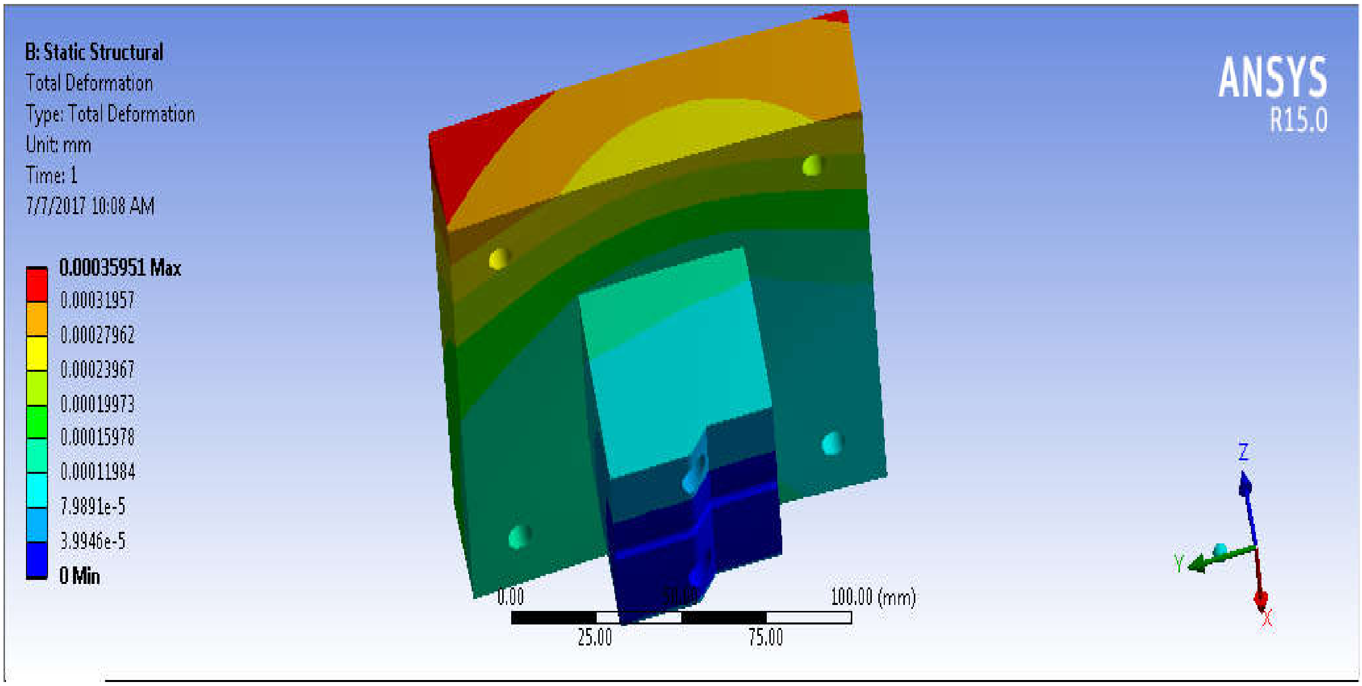

Fig.6 Total deformations of Top die for Wire bending operations

b. Bottom Die

Equivalent Stresses

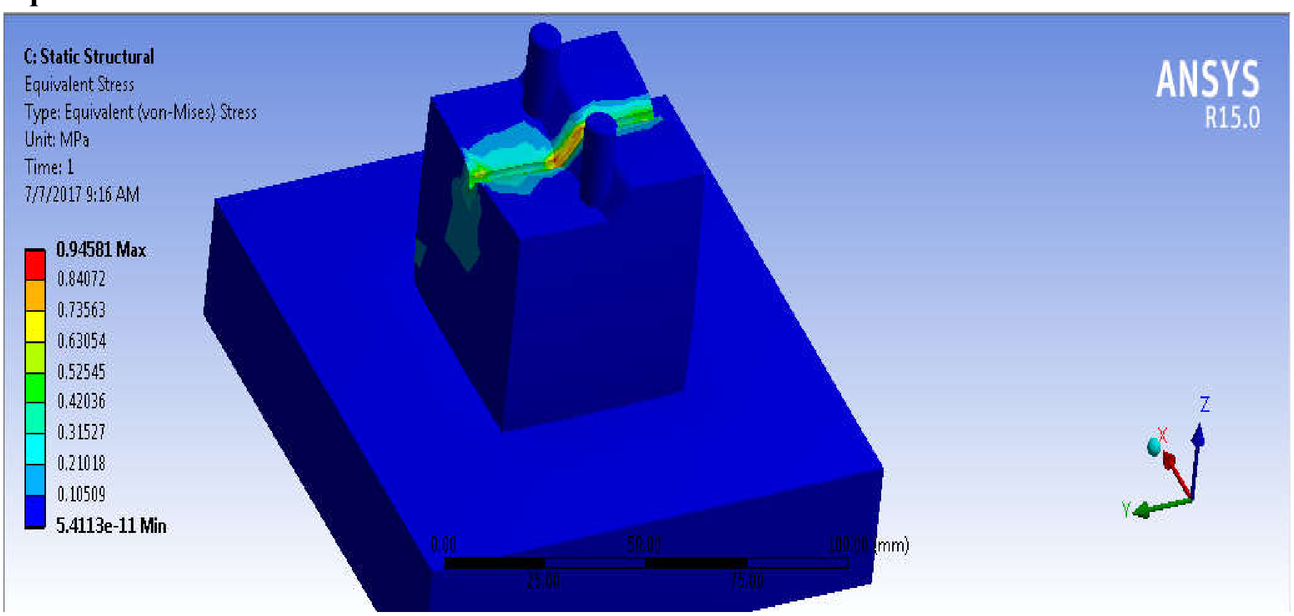

Fig.7 Equivalent stresses of Bottom die for Wire bending operations

Deformation

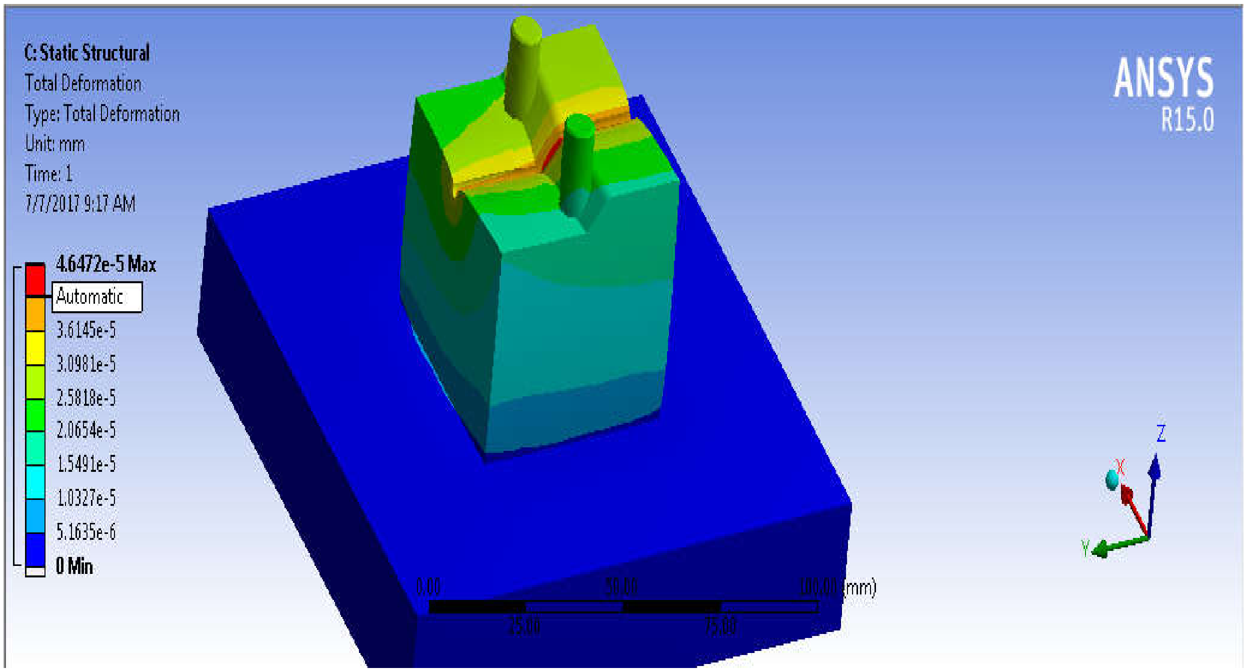

Fig.8 Total Deformation of Bottom die for Wire bending operations

Model Analysis For Forming Operation:

a. Top Die

Equivalent Stresses

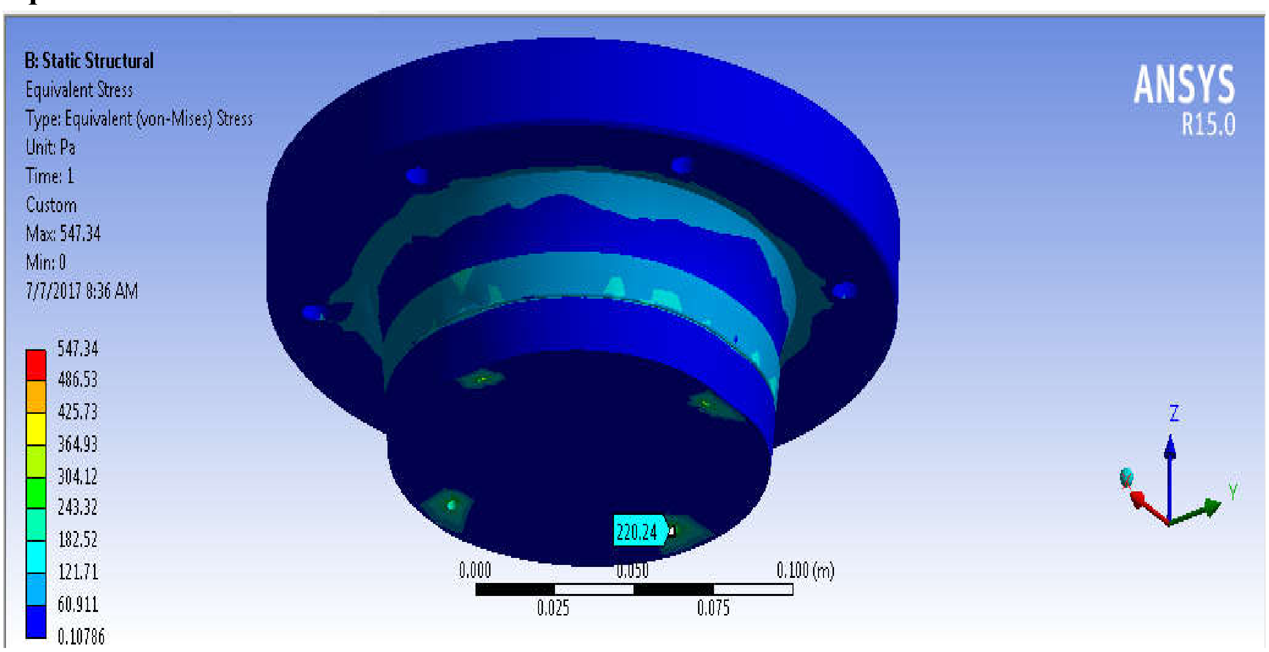

Fig.9 Equivalent Stress of Top die for Forming operations

Deformation

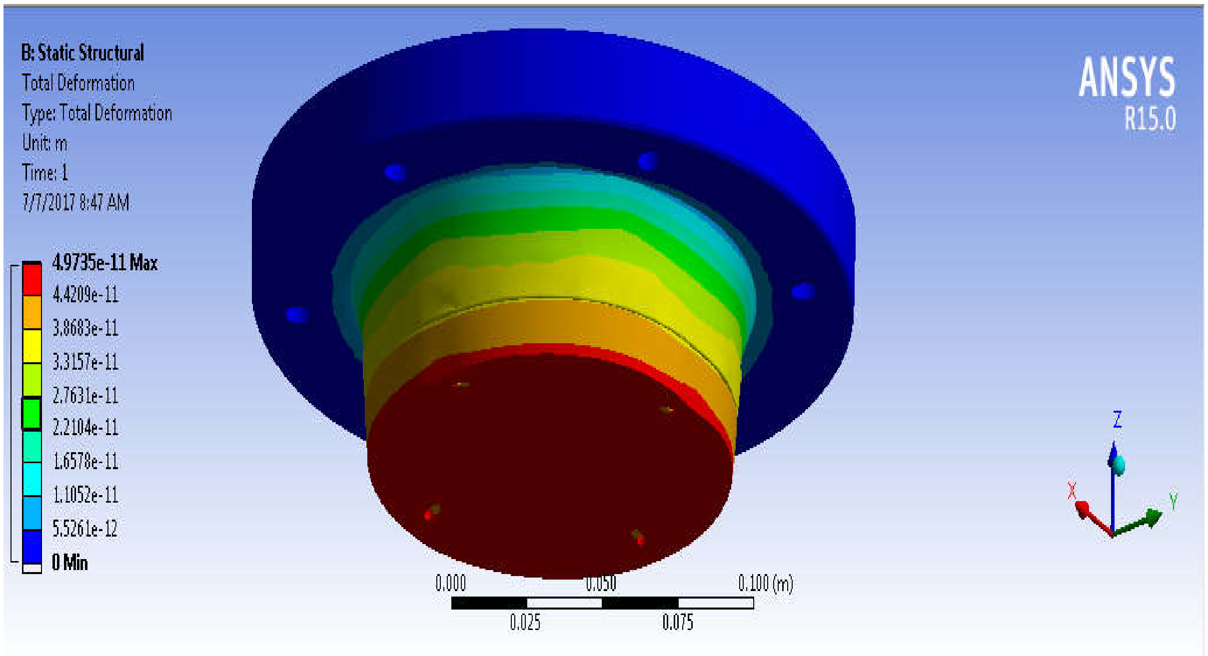

Fig.10 Total Deformation of Top die for Forming operations

b. Bottom Die

Equivalent Stresses

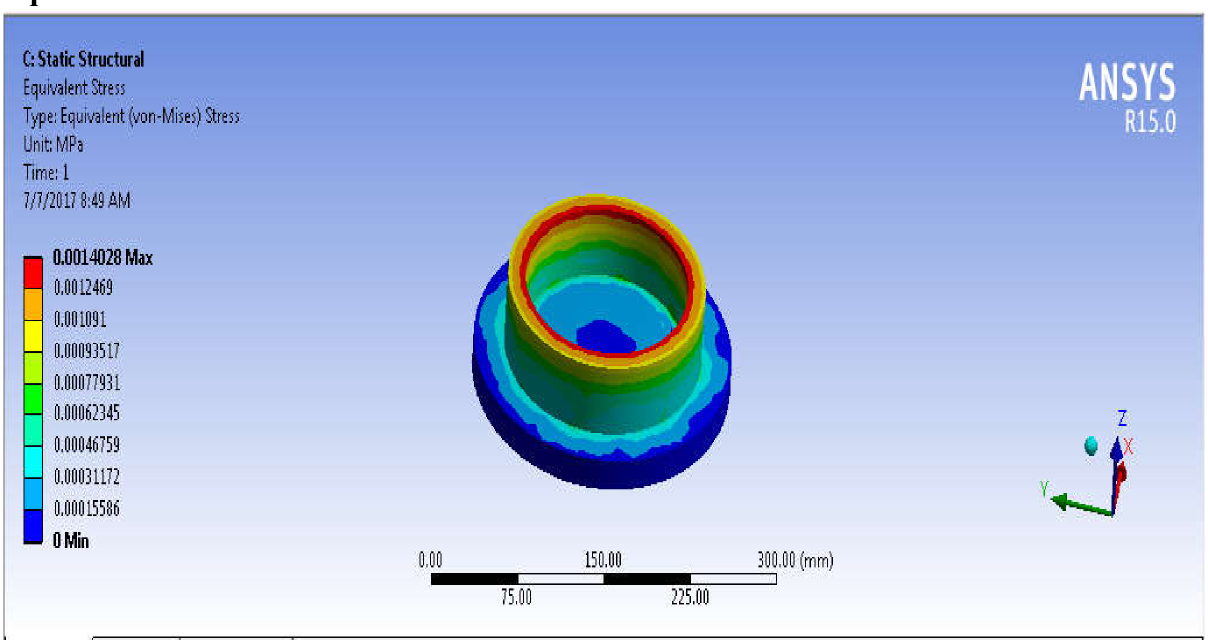

Fig.11 Equivalent Stress of Bottom die for Forming operations

Deformation

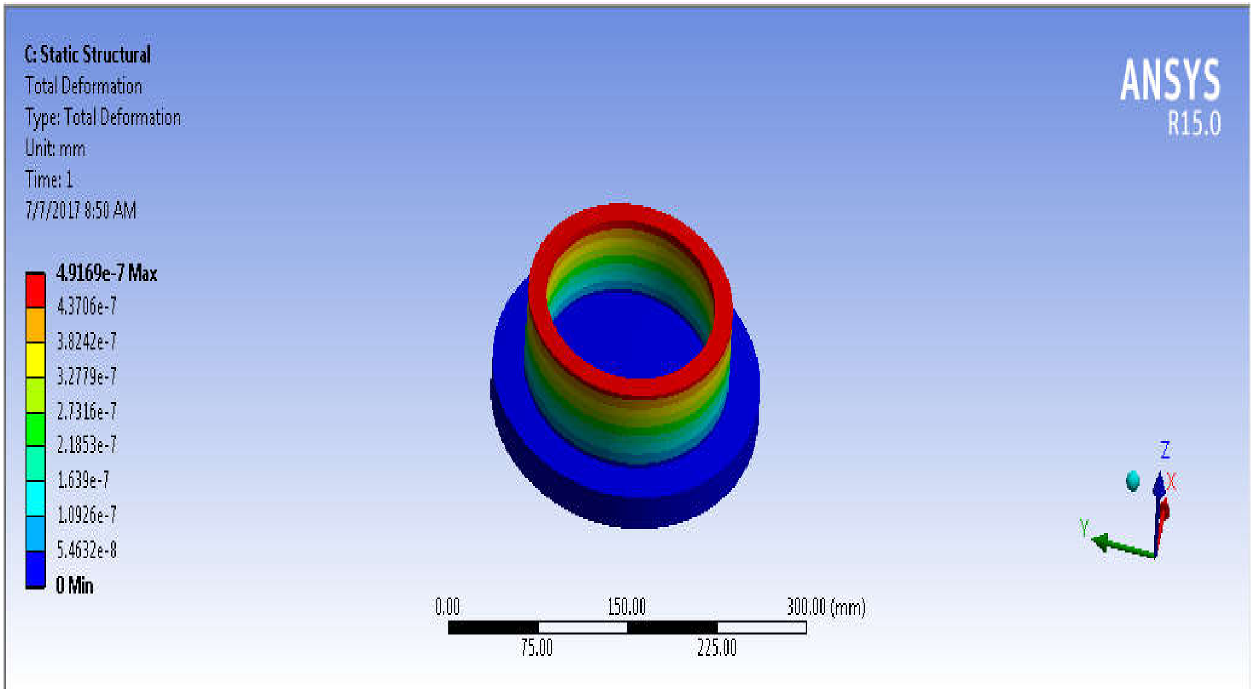

Fig.12 Total Deformation of Bottom die for Forming operations

Fig 3 to 12 shows the values and regions of obtained stress and deformations in dies for Ring Sizing, Wire Bending and Forming operations, the values of maximum stress and deformation can also be observed from these figures. All these values are in permissible limits hence these designs of these dies can be considered as safe.

Collected Data of Results Obtained at various Operations

Table 1 Collected Data of Results

Sr.No	Operations	Die Type	Equivalent Stresses (Von Misses Stress) in MPa	Equivalent Elastic Strain in mm/mm	Total Deformation in mm
1	Ring Sizing	Top Die	0.058033	3.0075 $\times 10^{-7}$	2.2467 $\times 10^{-5}$
		Bottom Die	0.1881	9.7965 $\times 10^{-7}$	8.2775 $\times 10^{-5}$
2	Wire Bending	Top Die	0.214299	100715 $\times 10^{-5}$	3.5951 $\times 10^{-5}$
		Bottom Die	0.94581	4.7336 $\times 10^{-6}$	4.647 $\times 10^{-5}$
3	Forming	Top Die	0.547	2.836 $\times 10^{-5}$	4.9735 $\times 10^{-11}$
		Bottom Die	0.0014028	7.274 $\times 10^{-9}$	4.916 $\times 10^{-7}$

The results obtained from the analysis software are presented in the table 1. It shows the equivalent stresses, equivalent elastic strain and deformation in the different components of the hydraulic press, the obtained results of the stress values of the components are below permissible safe limit. From these results it seems that the design is safe.

Conclusion:

In this work FEA is conducted using Ansys software is used to analyze the dies used for different operations on pneumatic die. The result shows that the design of all these dies is safe from the strength and deformation point of view. These dies can be used on the pneumatic press and these can sustain the operations conducted on pneumatic press.

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