

Design, Analysis and Optimization of 10 Ton Hydraulic Pressing Machine

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ABSTRACT: The hydraulic machine is used to convert the shape of any material into required form by pressing operation. A hydraulic is a machine using hydraulic cylinder to generate a compressive force. The top and bottom segment has to resist the force generate while pressing operation and it is significance to calculate the mechanical properties like total deformation and stress developed on the machine. The mechanism of this application of the machine is used for the manufacturing of car dashboard. The machine is designed and fabricated for this special purpose only the load capacity of 10 Ton. Structural analysis to become a part to identified the product design. The frame and cylinder are model by using CATIAV5. In this 10 Ton hydraulic pressing machine we observed that the deformation is high and the optimization of cylinder and tie rod are analyzing by using ANSYS software. The objective of this paper is to reduce weight and cost of the pressing machine in the quality of output in the component of machine. We modify the structure and reduce the material in it and the factor of safety is obtained from the modified structure is within the limit of the machine.

KEYWORDS: Cylinder, Hydraulic pressing machine, Optimization, Structural analysis, Tie rod.

I. INTRODUCTION

Hydraulics plays a very important part in almost all section of industry. Hydraulics is a study of liquids at rest and in motion, specially under pressure, and application of that knowledge in design and control of machine. Hydraulic system is a transmission system in which uses the pressure applied in fluid to power the hydraulic machine.

We design the model of 4 column hydraulic pressing machine in which used to modelling in catiav5. The objective of this paper is do a structural analysis of main components in the hydraulic pressing machine and also We consider to modified the dimension of machine parts such as cylinder and Tie rod in a machine.

II. METHODOLOGY

The modelling of machine to design and identified the components of machine. We observe the mechanical data in analysis of the model in the machine. We are model and assembly of the part has specification in the design to create by the modelling of the specimen. In this paper used the optimization method to modified machine components such as cylinder and Tie rod.

2.1 Material properties of C45 for cylinder

C45 is a medium carbon steel is used when impact strength and hardness is required in the "as rolled" condition.

Table 1

QUANTITY	VALUE	UNIT
Density	7700	Kg/m ³
Young's modulus	200000	Mpa
Tensile Strength	650-880	Mpa
Yield strength	350	Mpa
Elongation	8-25	%

2.2 Material properties of En8 for Tie rod

EN8 is a very popular grade and is readily machinable in any condition. It can be further surface-hardened to produce components with enhanced wear resistance.

Table 2

QUANTITY	VALUE	UNIT
Density	7850	Kg/m ³
Young's modulus	200000	Mpa
Tensile Strength	700-850	Mpa
Yield strength	465	Mpa
Elongation	16	%

III. MODELING AND ANALYSIS

3.1 Modelling and Analysis of cylinder

In the cylinder parts took the original dimensions of model from the company. The dimension of cylinder and material properties to taken data to be create the model and assemble of the part in the machine in Catiav5. We analysed model in ANSYS Workbench software. In the process the file to be imported the model and its applied the required geometric data to the processing. We mesh the model parts in the surface and applied the boundary condition in the necessary area of the model. Then finally to put solve the solution we get the required result.

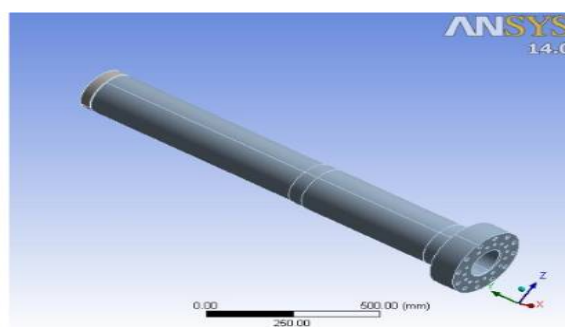


Fig1. Modelling diagram

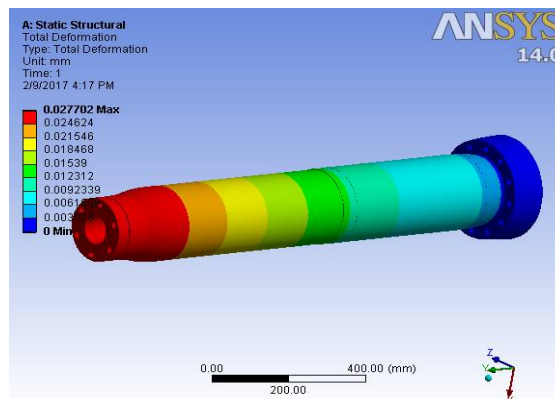


Fig 2.Total Deformation

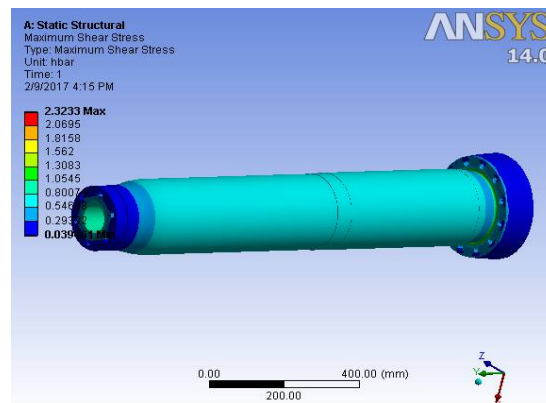


Fig 3.Maximum shear stress

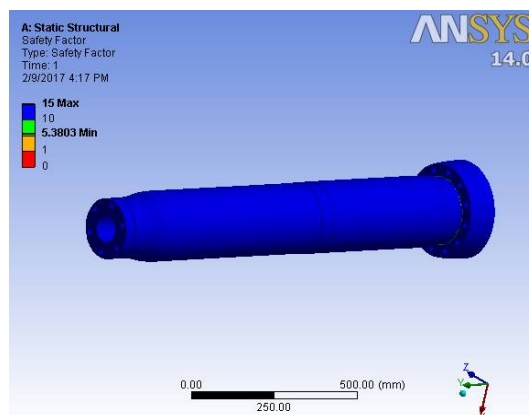


Fig 4.Factor of safety

3.2 Modelling and analysis of Tie rod

In this paper used tie rod frame in the hydraulic machine i.e. 4 columns support frame. The tie rod to withstand the load capacity under the hard chroming after the machining and the model and assembly of the part in modelling create in CatiaV5. We analysed model in ANSYS Workbench software. In the process the file to be imported the model and its

applied the required geometric data to the processing. We meshing the model parts in the surface and applied the boundary condition in the necessary area of the model. Then finally to put solve the solution we get the required result.

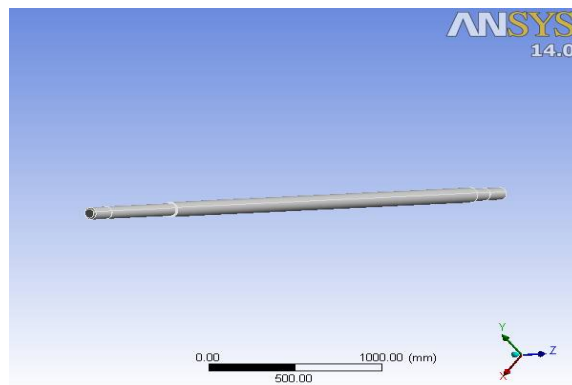


Fig 5. Modelling diagram

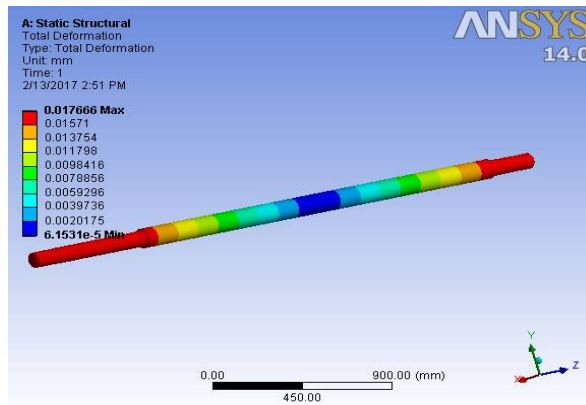


Fig 6. Total Deformation

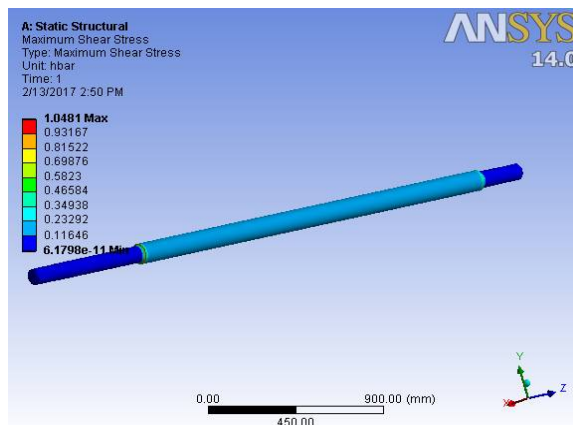


Fig 7. Maximum shear stress

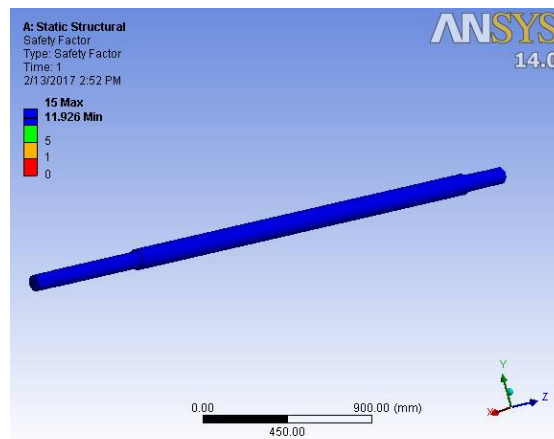


Fig 8.factor of safety

IV. OPTIMIZATION OF MACHINE COMPONENTS

4.1 Modification of cylinder

The optimization and analysis of cylinder in reduce the thickness in the original dimension. In the required dimension to modified the size and shape of the components such as cylinder. In this modification of cylinder to reduce outer diameter, $D_o=170\text{mm}$ and inner diameter $D_i=125\text{mm}$ in analysis the modified part to observe the required quality and reduce weight in the modified model.

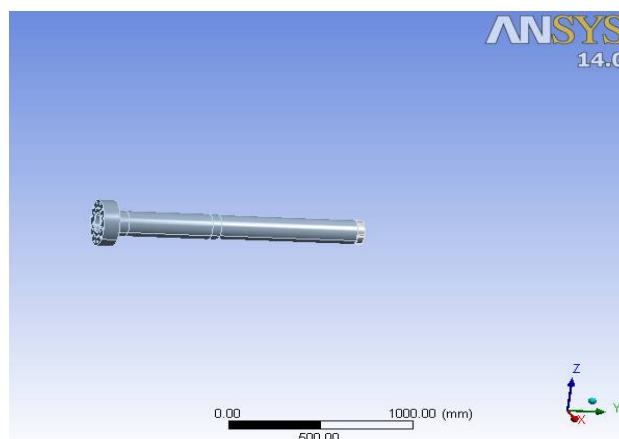


Fig 9.Modelling diagram

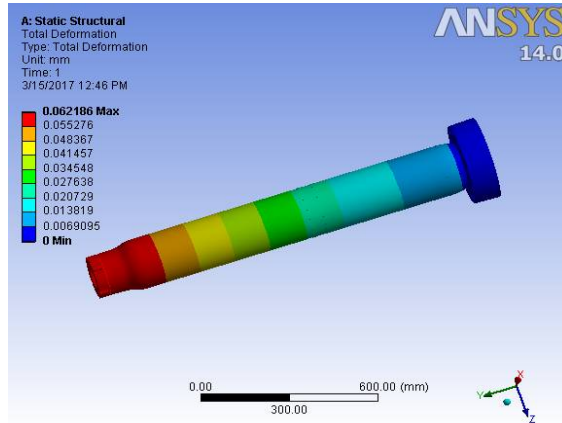


Fig 10.Total Deformation

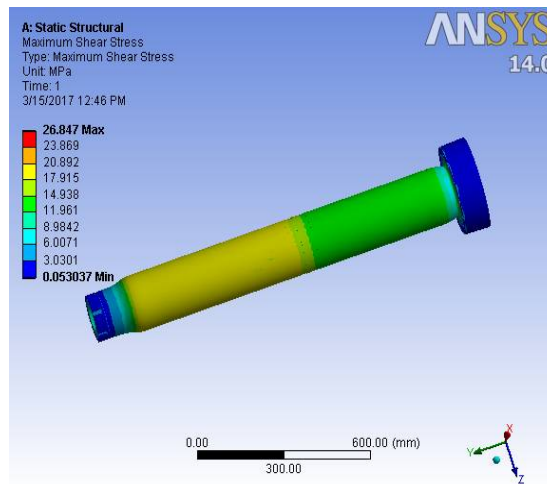


Fig 11.Maximum shear stress

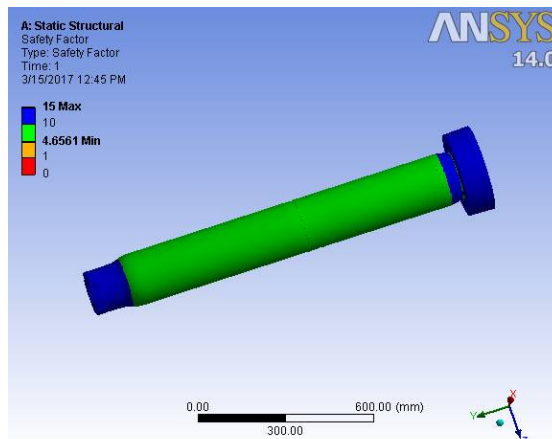


Fig 12.factor of safety

4.2 Modification of Tie rod

The modification of tie rod is used to reduce material on cross section from the original dimension in which to reduce diameter $D=106\text{mm}$ in the component with model and analysis to required quality in purpose of the machine.

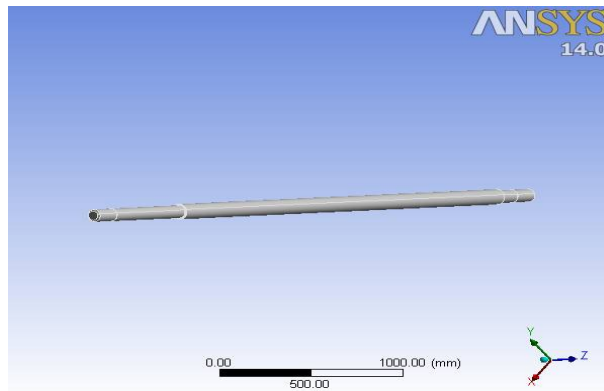


Fig 13. Modelling diagram

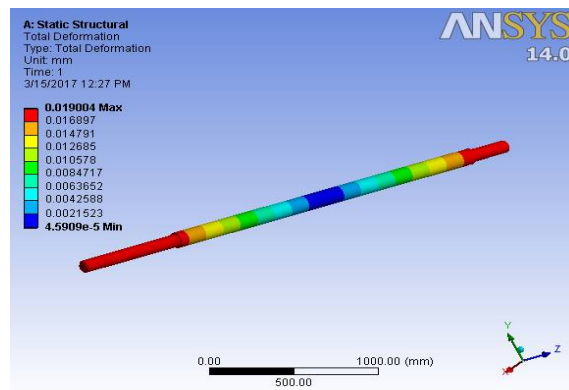


Fig 14. Total Deformation

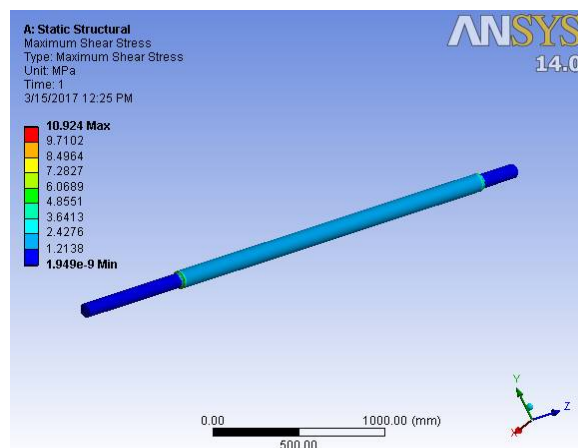


Fig 15. Maximum shear stress

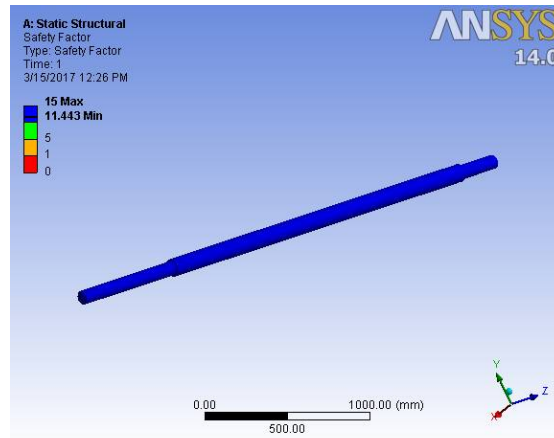


Fig 16.Factor of safety

As shown in above Fig maximum shear stress of cylinder and Tie rod are 26.84Mpa and 10.92Mpa respectively and which has safe limits. So, design is safe.

Here shown in above Fig the total deflection of cylinder and Tie rod are 0.062mm and 0.019mm

V. RESULT

5.1 COMPARISON OF CYLINDER

TABLE3

S.NO	PARAMETER	EXISTING DIMENSION	MODIFICATION DIMENSION
1.	Maximum shear stress	23.2Mpa	26.84Mpa
2.	Total deflection	0.027mm	0.062 mm
3.	Weight	945kg	710kg

5.2 COMPARISON OF TIE ROD

TABLE4

S.NO	PARAMETER	EXISTING DIMENSION	MODIFICATION DIMENSION
1.	Maximum shear stress	10.45Mpa	10.92Mpa
2.	Total deflection	0.017mm	0.019mm
3.	Weight	1916kg	1779kg

VI. CONCLUSION

The above result of comparison between existing and modification method of the cylinder and Tie rod is used to get weight reduce. In the modified structure in maximum shear stress and deflection of the cylinder and Tie rod respectively in which does not cross safe limits. In cylinder we observe the modified dimension compare to 25% of



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existing dimension. In Tie rod the modified dimension compare to 7.2% of existing dimension. The modified dimension of components structure is safe under working condition.

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