Design, Development and Analysis of A 20 Ton Hydraulic Press

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Abstract: **Hydraulic Press is one of the oldest basic machine tools. In its modern form, is well adapted to press work ranging from coining jewelry to forging aircraft parts. Hydraulic Deep Drawing Presses are widely used for industrial sheet metal forming today. Small manufacturers of drawn parts and suppliers of the automotive industry especially appreciate these machines because of their high flexibility in process design. As wide range in shapes of products manufactured. In the present review paper an effort is made to study the previous investigations that have been made in the different structural analysis and optimization techniques of hydraulic press. Metal forming is one of the manufacturing processes which is mainly done on hydraulic press. Hydraulic press machine works under impact load condition. Because of continues impact load some parts of machine experience the compressive stress and some parts experience tensile stress. To overcome this problem optimization of machine frame is required which can be done using CAD tool and analyzed in FEA tool such as ANYSYS**

Keywords: **Optimization, Analysis,**

I. INTRODUCTION

A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force. Frames and column and cylinder are the main components of the hydraulic press[2]. Typical hydraulic press consists of a pump which provides the motive power for the fluid, the fluid itself which is the medium of power transmission through hydraulic pipes and connectors, control devices and the hydraulic motor which converts the hydraulic energy into useful work at the point of load resistance [2].In this project hydraulic press frame and column are designed by the design procedure. Press frame and column are analyzed to improve its performance and quality for press working operation. Structural analysis has become an integral part of the product design [2]. The performance of a hydraulic press depends, largely, upon the behavior of its structure during operation. However, these welded structures are becoming complicated and their accurate analysis under given loading conditions is quite important to the structural designer [1].Structural analysis has been applied on frame hydraulic press structure by using analyzing software ANSYS. An integrated approach has been developed to verify the structural performance and stress strain distributions are plotted by using ANSYS software. According to the structural value the dimensions of the frame andcolumn are modified to perform the functions satisfactory [2].

II. EXISTING H FRAME HYDRAULIC PRESS

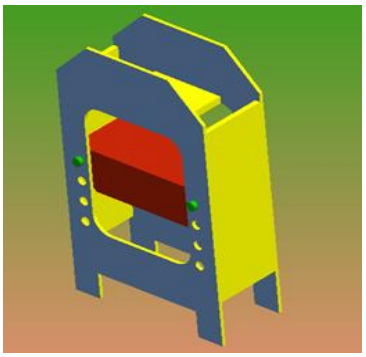


Fig.no.1.Structure of Existing Hydraulic press

A 20 ton Hydraulic press machines are commonly used for forging, molding, blanking, punching, deep drawing, and metal forming process. Due to such operations hydraulic press machine always work under impact load condition. Because of continuous impact load, the existing hydraulic press machine always experience continuous stress. Some part of machine experience compressive stresses and some experience tensile stresses. Different parts of machine are subjected to different types of loading. Press machine continuously deals with stress and because of that there are frequent structural failure problems in machine. To overcome these problems detailed design analysis and optimization of hydraulic press is carried out. Costs play an important role for every industry for small scale industry as well as large industry.The cost of Existing press is Rs.45, 000/- in the market, this cost is not affordable to small scale industry or small scale workshop. To overcome the

problem of cost it is necessary to optimize the existing press and reduce the cost

III. RESEARCH PROBLEM DEFINITION

To design a 20 ton hydraulic press by using suitable geometric modeling software followed by detailed analysis and optimization of its critical components and thereby reducing the manufacturing cost of hydraulic press.

IV. NEED FOR OPTIMIZATION

To optimize geometric structure of columns, frame and other components of 20 ton hydraulic press machine. To reduce the unwanted stresses causing failure of frame and other components. To reduce the cost and improve the safety.

V. METHODOLOGY

5.1 To study the designs of existing 20 ton hydraulic press in geometric modeling software.

5.2 To carry out analysis of existing 20 ton hydraulic press in finite element analysis software

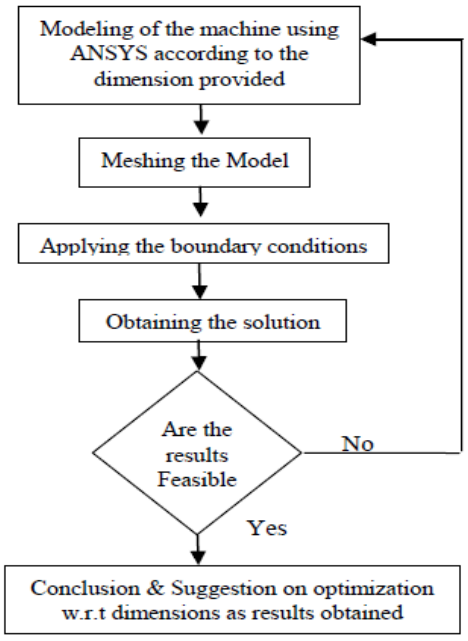
5.3 To analyze the problems present in existing press.

5.4 To design the critical components of the hydraulic press using geometric modeling software.

5.5 To analyze and optimize the critical areas of 20 ton hydraulic press.

5.6 To finalize the design of 20 ton hydraulic press.

5.7 To manufacture the 20 ton hydraulic press



Flow chart to indicate stage of the methodology

VI. DESIGN AND ANALYSIS PROCEDURE

[6.1] The first step is to study the design of the existing press, in the existing press it has been observed that the designing of the critical components of press is very difficult work and the hydraulic press is manufactured by using the laser cutting operation due to which increases the cost of press, and is not affordable for the small industry and small workshops so there is need to change the design of existing to reduce the cost of hydraulic press

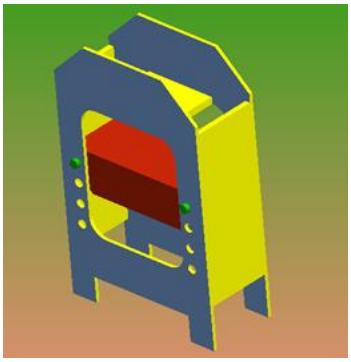


Fig.no.2.Structure of Existing Hydraulic press

[6.2**]** The analysis result of the existing press for Maximum shear stress and Total deformation is given below in the figure. It shows that blue color at safe region and red is for critical region. The Maximum shear stress is 166.15MPa and total deformation is 1.901mm

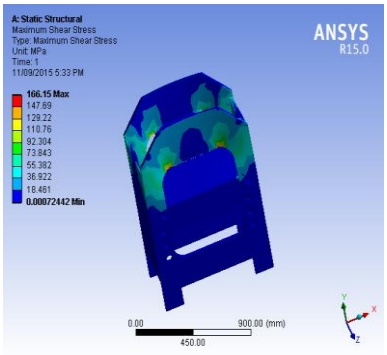


Fig.no.3.Maximum shear stress for Existing Hydraulic press

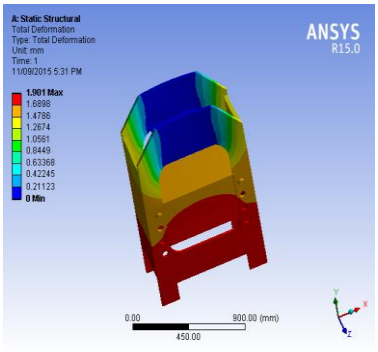


Fig.no.4.Total deformation of Existing Hydraulic press

[6.3] In the design of the New Hydraulic Press, the total design of the press is changed in order to reduce the weight of the press. The new press is manufactured by using the standard components such as C channel and I section channel, due to which cost of the manufacturing is reduced

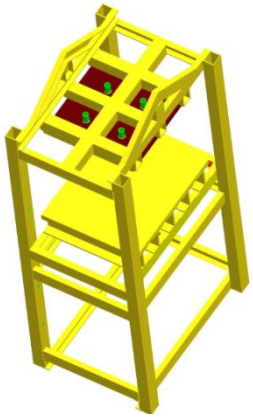


Fig.no.5.Structure of New Hydraulic press

[6.4] After the design Modification of existing press the analysis results for Maximum shear stress is 298.14 MPa and the Total Deformation is 2.0642mm is obtained

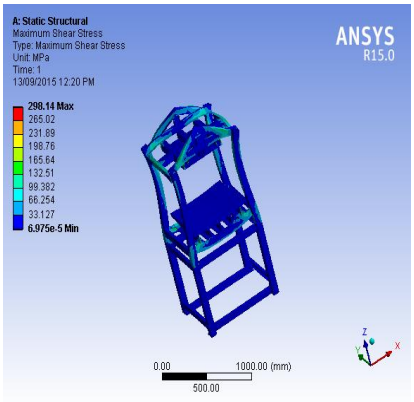


Fig.no.6.Maximum shear stress for New Hydraulic press

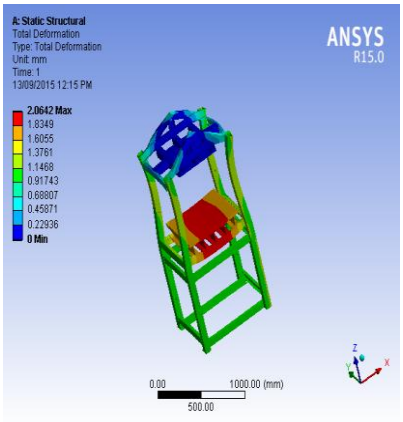


Fig.no.6.Total deformation of New Hydraulic press

VII. RESULT COMPARISON

Component	Weight in kg	
	Existing press	Structure 5
Vertical column	414	69
Top frame	54	68
Press pin	13	5
Working table	151	151
Total weight	**632**	**294**

Sr. No.	Type		Existing Press	Structure No. 5
1	Stress	Maximum equivalent stress	**15**	**15**
2	Deformation	Total deformation (mm)	**1.90**	**2.064**
3	Strain	Equivalent von-mises (mm/mm)	**0.0019**	**0.0034**
4		Maximum shear (mm/mm)	**0.0021**	**0.0038**
5	Stress	Equivalent von-mises (MPa)	**308.62**	**572.02**
6		Maximum shear (MPa)	**166.15**	**298.14**

VIII. CALCULATION OF COST REDUCTION FOR NEW HYDRAULIC PRESS

[I] Total cost before optimization
Material cost per kg = Rs.60
Fabrication cost per kg = Rs.32
Material cost for 632 kg = Rs.37920
Fabrication cost for 632 kg = Rs.20224
Total = Rs.58144

[II] Total cost after optimization
Material cost per kg = Rs.60
Fabrication cost per kg = Rs.32
Material cost for 294kg = Rs.17640
Fabrication cost for 294 kg = Rs.9408
Total = Rs.27048

[III] Cost reduction of hydraulic press
Percentage of material cost reduction
= (58144-27048) / 58144 * 100

= 53.48%

Percentage of cost reduction we got up to **53.48%**

IX. CONCLUSION

In this paper attempt has been made to analyze and optimize the existing press by using Finite Element Software. After the Design and Analysis the New Hydraulic press it has been observed that, The weight of New Hydraulic Press is reduced up to 50% and cost reduced up to 53.48%. These have been achieved by changing the design ofExisting Hydraulic Press and by using the standard components to manufacture. The stresses induced in the New Hydraulic press in within the limit. So the New hydraulic press is safe to manufacture and use in industries

X. REFERENCES

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