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A REVIEW ON HYDRAULIC PRESS DESIGN AND ITS OPTIMISATION

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Abstract - Metal forming is a process which is done by deforming metal work pieces to the desired shape and size using pressing or hammering action. Hydraulic presses are being used for forming and pressing operations with wide range of capacities. Hydraulic press machine works under continuous impact load. Because of this continuous load, tensile and compressive stresses are experienced in various parts of machine. These stresses cause permanent deformation in some parts of machine. This work is based on optimization of a 250-ton four pillar type hydraulic press considering constraints like design, weight and cost. The work is focused on design and optimization of top plate of the press machine. Top plate holds the hydraulic cylinder and is one of the most critical parts of the machine. The design is based on sizing optimization method and the results are validated by Finite Element method with proper boundary conditions. The CAD modelling has been carried out by PTC CREO and for FEA, ANSYS software is used. Design Optimization of Hydraulic Press Plate using Finite Element analysis.

Keywords: CAD, Finite Element Analysis, Hydraulic press, Optimization.

I. INTRODUCTION

Press work is a method of mass production involving the cold working of metals, usually in the form of thin sheet or strip. Press working is one of the extensively employed methods of fabricating parts of intricate shapes with thin walls. Press working processes make use of large forces by press tools for a short time interval which results in cutting or shaping the sheet metal. Since, press working does not involve heating of the parts, close tolerances and high surface finish can be obtained on the part. Since presses can produce components at fairly fast rates, the unit cost of labour for operating the press is fairly low.

A hydraulic press produces a great deal of force from the application of a small amount of force to the small piston. A hydraulic press is a press that uses liquid pressure to make a small force applied to a small piston produce a large force on a larger piston.

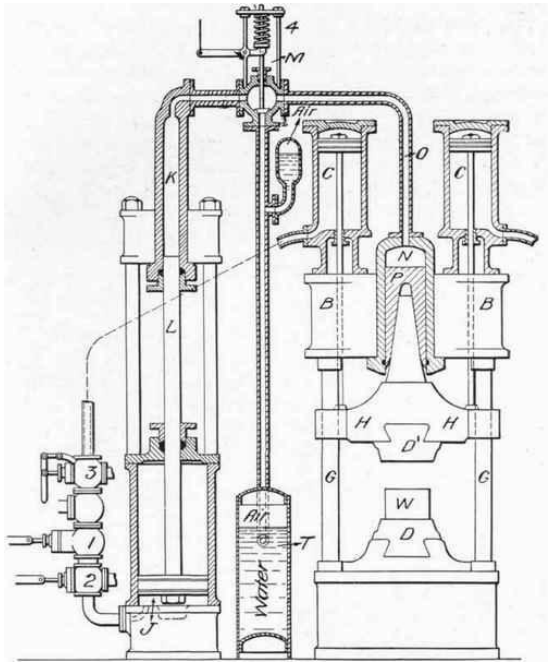

Figure 1.1 hydraulic press

II. System Model

The working drive of press has evolved from Mechanical to Hydraulic and even Pneumatic. With the advancement in

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technology, integration of electronics and electrical devices with mechanical devices has now been possible. These new Hydraulic and Pneumatic presses have better capacity and are far more reliable and easy to maintain [1]. Mainly due to high working capacity of these presses, they are ubiquitous and preferred over mechanical presses. Also maintainability is one of the key factors behind the proper functionality of these presses.

Hydraulic press works on Pascal's law according to this law "In a fluid at rest in a closed container, a pressure change in one part is transmitted without loss to every portion of the fluid and to the walls of the container".

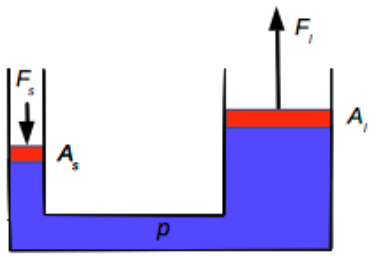

Figure 2.1 Pascal's law

This can be calculated using the following relation.

$$F = PA \quad \text{…….. (1)}$$

Where,

F -is the force applied
P -is the pressure transmitted
A -is the cross sectional area

III. PREVIOUS WORK

1. **Akshay Vaishnav (2016)** explain the metal forming is a process which is done by deforming metal work pieces to the desired shape and size using pressing or hammering action. Hydraulic presses are being used for forming and pressing operations with wide range of capacities. Hydraulic press machine works under continuous impact load. Because of this continuous load, tensile and compressive stresses are experienced in various parts of machine. These stresses cause permanent deformation in some parts of machine. This work is based on optimization of a 250-ton four pillar type hydraulic press considering constraints like design, weight and cost. The work is focused on design and optimization of top plate of the press machine. Top plate holds the hydraulic cylinder and is one of the most critical parts of the machine. The design is based on sizing optimization method and the results are validated by Finite Element method with proper boundary conditions. The CAD modelling has been carried out by PTC CREO and for FEA, ANSYS software is used.

2. **Gebremichael Tasew (2018)** describe Hydraulic bending machine is a common tool in the machine shop that is used to bend a piece of plate. Bending machines in different type found in a small and large scale industries which have limitation on utilizing cylinder force, all those machine lost cylinder force without any function The main objective of this project to develop one hydraulic cylinder driven 5mm thickness stainless steel plate bending machine with low cost and light weight. For reducing the weight and the cost of the machine use only one hydraulic cylinder and maximize the hydraulic cylinder bending load by the help of right angle lever. In this paper generate an innovative idea for handling loss of cylinder force. As a result the machine become low in cost and light in weight simple operation and high competitive marketable machine. The main component of the machine is lever, lower die, punch, frame, table and double acting hydraulic cylinder.

3. **G. C. Mekalke (2017)** focuses on automation of a press tool for production of sheet metal components. The operation of press tool consisted of sequences of operations. This sequence of operations had to automate for increase in productivity. For that purpose, PLC is used from Bosch Rexroth, Germany made. With the help of DTMF module it was made possible to operate the press by using mobile calling from remote locations. In this article, the press thus designed served for the purpose with 73% reduction in production time, with enhanced quality and helped in enabling mass production by eliminating several processes such as marking, cutting done with the help of a cutter, shaping, and so on.

4. **N. A. Anjum (2017)** explain different mechanical presses used to deform or press the material through dies to convert into useful product by applying different conditions like temperature, pressure, speed of ram etc. These material deformation techniques not only used to produce finished products but also to increase the strength of the material by introducing severe plastic deformation. Equal channel angular pressing (ECAP) is a technique used to increase the strength of materials by introducing severe plastic deformation through grains refinement. The ECAP die consisting of two channels intersecting at 90 degree was designed and manufactured to perform angular extrusion.

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The load was calculated through mathematical modelling. A hydraulic press equipped with conventional temperature control furnace, sensor based limit switches, pressure controlled mechanism and with variable speed control was designed, fabricated and manufactured at UET Taxila. The material used for the fabrication purposes is mild steel. The major designing parameters included stroke length, maximum load, pressure, cylinder bore, sealing mechanism and volume flow rate of working fluid.

5. **Bhushan V.Golechha, (2017)** said also cold stamping process. The machine used for press working is known as press. This Project work deals with the Design, Finite element analysis and structural optimization of 10 Ton Pneumatic Press Machine. The aim is to reduce the Wight and cost of the Pneumatic press without reducing the quality of the output. Using the best possible resources in design can affect decrease in the weight and cost of the press machine. One way of doing, it will be the optimizing the volume of material utilized for building the complete structure of machine .Here we have consider an industrial application project consisting of mass minimization of a Pneumatic press. For analysis Purpose ANSYS Software has been used.

6. **Gourav Suresh Kanhe (2017)** Bending of plates and sheets are extensively use to produces the parts such as flanges, angles etc. In bending operation a flat sheet metal is formed into a curved by the applying the bending stress. By the help of die and punch sheet get bend plastically without change in thickness. This project is rooted on the urge of Daulat Industries, Nagpur. The aim of the project is to design a sheet bending machine which is capable of bending 5mm thick stainless steel sheets of 8ft wide and 4 ft length in size. In this research we will develop a CAD model of sheet bending machine and optimization of machine using FEA. This paper is majorly based on the literature review, and also contains needs to design, research methodology of the project. Of the present study is the validation and application of a CFD-based methodology to quantify the hydrodynamic roughness produced by any surface, including viscous oil coatings and befouled surfaces.

IV. OBJECTIVE

1. Hydraulic press plate is design using size optimization method.
2. Comparing all design by using ANSYS software.
3. The new design is more durable, equivalent stress and deformation is very low comparing other design.
4. The weight of hydraulic plate is low by using same material.
5. The cost of hydraulic plate is reducing.

V. PROPOSED METHODOLOGY

Create the CAD model of hydraulic press machine top plate and bottom plate. The ANSYS software is used to design analysis and compare all the design and select best design for manufacturing and results will be discussed and design will be finalized.

The parameter and equation are used for design is fulfill the design constraint. Calculate the suitable parameter according to stress theory.

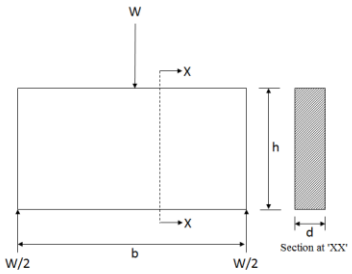

Figure 4.1 Load case

When a static or dynamic load acts on any part of hydraulic press, then along with simple, tensile, compressive, shear stress, it also develops bending stress.

Consider a beam subjected to a bending moment M,

The bending equation is given by,

$$\frac{M}{I} = \frac{\sigma b}{Y} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

M = Bending moment at the given section
σ_b =Bending stress
I = Moment of inertia of the cross-section about the neutral axis.
y = Distance from the neutral surface to the extreme fiber
The following methodology steps are,

1. Collecting information and data related to the hydraulic press plate.
2. A fully parametric model of the hydraulic press plate is generated using catiav5
3. Model obtained in Step 2 is analyzed using ANSYS 15.
4. Manual calculations are done.
5. Finally, we compare the results obtained from ANSYS

VI. EXPECTED RESULTS

For solution of the above problem statement the Finite Element Analysis method is used and comparing all the result and select one of the best result.

The proposed new design is batter then tradition design, and fulfils all design constraint.

VII. FUTURE SCOPES

Hydraulic plate are used in all industries, the new design is more durable, light weight and also cost effective.

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