DESIGN, ANALYSIS AND OPTIMAZATION OF 10 TON PNEUMATIC PRESS MACHINE : A REVIEW

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Abstract

Power press working is defined as chip less manufacturing process. We can also say as cold stamping process. The machine used for press working is known as press. This Project work deals with the Design, analysis and optimization of Pneumatic 10 Ton 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 reduction of volume of material Forming operation is consider. For analysis Purpose ANSYS has been used.

Key Words: *FEA, Structural optimization, Wight reduction, Forming operation.*

I. Introduction

Power press are used for producing large quantities of articles quickly, accurately and economically from the cold working of mild steel and other ductile materials. A Press Machine is a machine that supplies force to die used to form, blank or shape metal or non-metallic materials. The Metal forming manufacturing process is almost chip less. Press tools are used to carry out this operation. Deformation of work piece to desired size is done by applying pressure. In this Project Work Pneumatic Press Machine are mainly used for sheet metal Forming Operation. It consists of bed, frame or bolster plate, Pillar. The ram exert force upon sheet metal or working material through unique tools mounted on the bed or ram. The Energy supplied by a pneumatic cylinder in a pneumatic press is transferred to the ram to provide straight movement. Presses are considered best and most capable way to form a sheet metal into final finished products. Pneumatic presses are commonly used for punching, forging, molding, clinching, blanking, deep drawing and metal forming operation. Pneumatic press is used for producing huge quantities of articles economically, quickly and accurately. The components which are produced range over a very wide field and are used all over industry. By means of particularly designed press tools and combination of operations, most of the sheet parts of any shape are produced. The selection of the proper press and design of die or tool to be mounted on it is very important for any operation to be carried out on the Press Machine.

II. Power press working

We know that there are mainly three types of power presses: mechanical, hydraulic, and pneumatic. Their control systems may be mechanical or electro-mechanical. Through these three major types of power presses share some common features, the mechanical power press is the most commonly used and researched. In power press two major are stationary bed and a moving ram. Mechanical power press works on the principle of reciprocating motion and the main components for power transmission are the flywheel, and crankshaft, clutch. A motor gives the rotation motion to flywheel and clutch is used for couple the rotation flywheel to the crankshaft. The crankshaft converts the rotary motion of the flywheel to the downward and upward motions of the press ram. A work piece is fed into the lower die, either automatically or manually, and the machine cycle is initiated. On the down stroke, the ram (with an upper die) moves toward the area of operation. When the upper and lower dies press together on the stock material, a re-formed piece is produced. Once the down stroke is completed, the formed work piece is removed and a new work piece fed to the machine and process repeated.

III. Terminology of Power Press

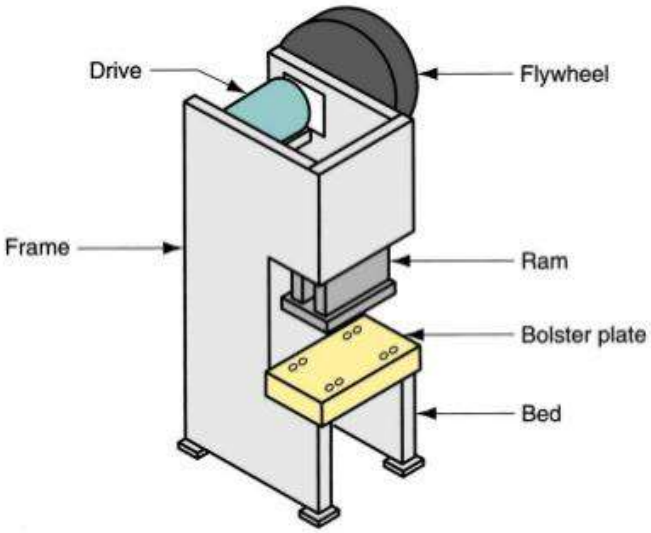

Figure 1: Terminology of Power Press

Frame

It is a main body of the power press. It supports ram, driving mechanism and control mechanisms.

Ram

Main operating part of the press is RAM which works directly during processing of a work-piece. Motion of Ram is to and fro within its guide ways with predefined stroke length and power. It can be adjusted as per the requirements and Punch attached at bottom end of RAM.

Flywheel

In most of the presses driven gear or driven pulley is made of the shape of flywheel, which is used for storing the energy reserve wire of energy for maintaining constant speed of ram when punch is pressed against the work-piece. Flywheel is placed in the driving mechanism just before the clutch is sequence of power transmission.

Base (Bed)

Base is the main supporting member for work-piece holding dies and different controlling mechanisms of press. The size of the work pieces depend on the table limits.

Bolster plate

Bolster plate is a thick plate which is attached to the bed and it is also used to clamp the die assembly.

Drive

In the power press different types of driving mechanisms like cylinder and piston arrangement in hydraulic press, crankshaft and eccentric mechanisms in mechanical press have been used and Ram driven by these mechanism which transferring the power from motor to ram.

IV. Press Applications

A. Mechanical Engineering
B. Sheet Metal Products, Components, Assemblies
C. Automotive Industry and Its Suppliers
D. Heating, Ventilation, Air Conditioning
E. Steel and Aluminium Construction
F. Precision Engineering
G. Aero Space
H. Ship Building

V. C-Frame Type Power Press

Basically in this, work is on the C-frame type Pneumatic press machine but we know that the presses fall into two types
one is gap frame and straight side presses. The frame used in Pneumatic presses is similar to those used in many mechanical presses. Main advantages of an open frame press design are economy of construction and unhindered access to the die area. Inclinable models and those with moveable beds or tables also offer a great deal of versatility, making them particularly useful for short run production or job shop applications. The drawback of the open frame design is the fact that such presses are generally limited in practice to the use of single dies. This is a result of several factors including the lack of stiffness and the typically small force capacity and die area of open frame presses.

This is conventional frame structure design of power presses and due to open from 3 sides; also known as open front press. Key advantages of C Frame are operator can work from 3 sides as well as use maximum area of Press Bed or Bolster also convenient for progressive tooling. C Frame presses are economical with compare to Ring Frame and H Type Box Frame Presses and disadvantage of frame deflection after long time.

VI. Work Methodology

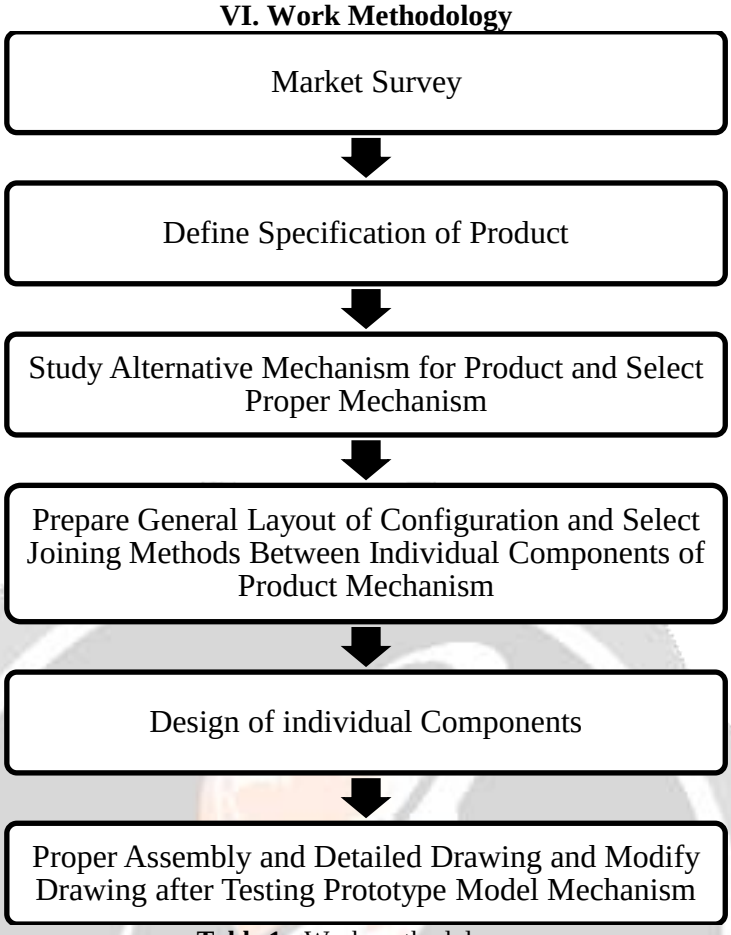

Table 1 : Work methodology

VII. Literature Survey

A. G. Naik and et al [1] incorporated design process successfully into a structural shape optimization problem. The aim of their work was reduction of bending stresses causing bending of frame of a hydraulic cotton lint bailing press by optimizing the Top & Bottom frame. Reduction of cost and Improvement in safety was another aim of their work. Software ANSYS was used for this work. Due to new design a reduction in weight of frame was 13%.

H.N.Chauhan and et al [2] designed & analyzed frame of a 63 tonne power press machine using Finite Element method. Due to the impact loading at the end of the bolster plate there was development of a crack at the corner and stress generated was more due to continuous loading and stress concentration. Modifications were done by introducing the fillets of proper size. Also plate thickness was reduced which saved material.

Ankit H Parmar and et al [3] performed optimization of a hydraulic press structure to decrease total mass of structure while assuring adequate stiffness. A method of structure optimization for hydraulic press was proposed in order to reduce mass while assuring adequate stiffness. Key geometric parameters of plates which have relatively larger impacts on mass and stiffness were extracted as design variables. In order to research relationship between stiffness, mass and design variables, common batch file was built by CREO and analysis was done in ANSYS. Top plate, movable plate and column design and analysis were done. A reduction of weight was 42 % keeping the stresses & deflection within limit.

B. Parthiban and et al [4] designed a 'C' type hydraulic press structure and cylinder. They analyzed press frame and cylinder to improve its performance and quality of press working operation. The frame and cylinder were modeled by using software CATIA. Structural analysis was done using analysis software ANSYS. An integrated approach was developed to verify the structural performance and stress strain distributions were plotted by using ANSYS software. According to the structural values the dimensions of the frame and cylinder were modified to perform the functions satisfactory.

D. Ravi and et al [5] analyzed a power press of 10 tone capacity under static condition. The modeling of the C- frame power press was done using Pro/E software. The 3D model of the power press was analyzed in static condition to find the stresses and deflections in the structure. Later part involved the reduction in weight of the power press by varying or reducing the thickness of frame and bed and the press was analyzed in static condition to find the results. The result obtained from analysis package is within the limit.

Santoshkumar S. Malipatil and et al [6] made an attempt with the objective to reduce the volume of material of a press. They considered an industrial application project consisting of mass minimization of H-frame type hydraulic press. ANSYS software was used for this analysis the main aim was to reduce the cost of the Hydraulic presses without compromising on the quality of the output. With regarding to design specification, stress distribution, deflection, and cost, were focused on optimized design. The methodology followed in this work was comparison of stresses induced in machine for different thickness used for construction of frame and column of the H-frame type hydraulic press.

Rajdipsinh G. Vaghela and et.al. [7] Incorporated design process successfully into a structural shape optimization problem. The aim of their work was reduction of bending stresses causing bending of frame of a C-Frame 40 ton pneumatic press. Reduction of cost and Improvement in safety was another aim of their work. Software Creo-2.0 was used for this work. Due to new design a reduction in thickness of frame was 20%..

Rangraj S. More and et al [8] made an attempt to reduce the cost of hydraulic presses without reducing the quality of the output. They deals with the analysis method and optimize the 200 ton hydraulic press. Software ANSYS was used for this work. Due to new design a reduction in weight of frame was 12.62%.

VIII. Assumption considered

Following are the assumptions had been made for frame structure.

1. The load is consider as a perfectly vertical.
2. Frame material is homogeneous and isotropic.
3. The base is bolted to a solid foundation so all the deflections of the base plate are zero.
4. As the frame is having the symmetrical cross section area, one side is to be consider for the purpose of analysis.

IX. Design Procedure of C Frame Press

The frame is the base machine element in press. It is designed by the following steps.

1. Function

The main function of the frame is to withstand the force developed by the RAM. Frame is used for mounting and housing the press accessories like ram, die block, motor, flywheel, gears etc.

2. Determination of forces

The capacity of the press determines the major forces acting on the frame structure.

3. **Material Specifications**

Specification of Material
Designation: St 42 W.
Tensile strength: 420 to 540 MPa.
Density: 7850 kgf/m^3.
Young's Modulus: 2.1 x 10^5 N/mm^2.
Poisons Ratio: 0.3.
Factor of Safety: 4.
For impact loading
Stress Concentration Factor: 1.25

4. Design.

Design of C-frame has been be done in solid works software.

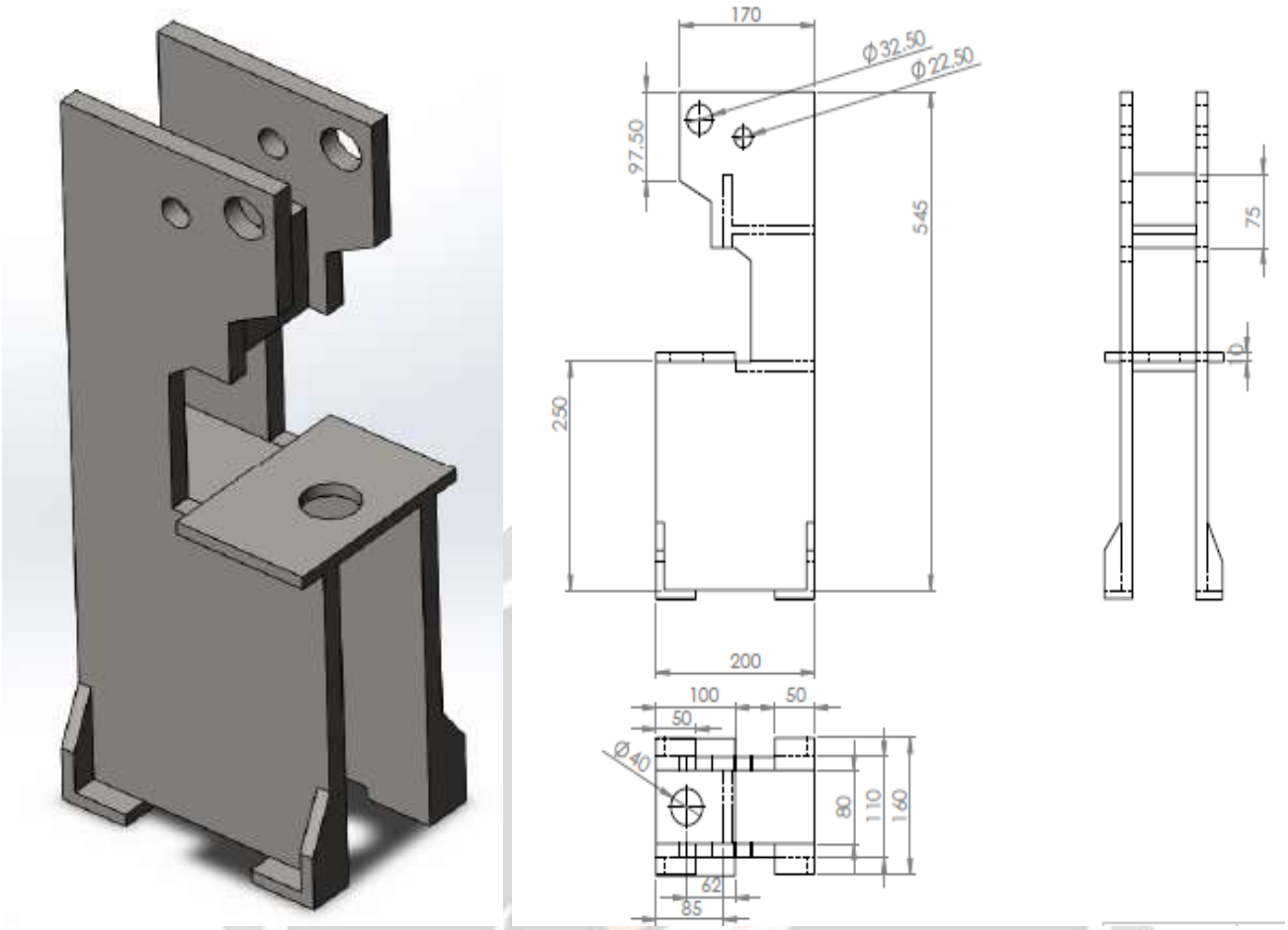

Figure 2: Design of C-frame

X. Specification of 10 Ton Press Machine

Capacity	10
Diameter of Crankshaft	32.5
Stroke Adjustment	06 -50
Max. Dist Bolster to Ram (SUAU)	195
Side Adjustment	25
Side Face FB X LR	1100 X 2000
Size of Table (FB X LR)	1000 X 1600
Bolster Thickness	100
Flywheel Diameter	700
Stroke per minute	70
Weight Approximate (kg.)	550

Electric Motor (H.P./R.P.M.)	1/1440

XI. Conclusions

In this paper an effort is made to review the previous investigations that have been made on the design and analysis of various frame structures of press machine. An attempt has been made in the present article to give an overview of various techniques developed for the analysis and optimization of frames. Majority of researchers have carried out work to reduce the unwanted stresses in the frame of Press Machine and number of work is carried out to optimize the structure of hydraulic press frame. The techniques of Design, analysis and optimization are going to be used for the current project of Design Analysis and optimization of a 10 Ton Pneumatic Press Machine.The human safety is a part of this project.

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