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Design of C Frame for Assembly Press

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***Abstract*—The objective is to fabricate the model for assembly operation known as hydraulic press machine. Using the concept of reverse engineering the C-frame has been designed keeping in mind the design specification, stress distribution, deflection. The objective of this study is to investigate the finite element modeling of 'C' frame power press of 1 ton capacity and to analyze the assembly press under static condition. Press is comprised of a frame a base plate and a reciprocating piston which exerts force upon component through special tool mounted on the piston. The first stage involves the modeling of the C- frame for assembly press in Unigraphics software. The 3D model of the power press is analyzed in static condition to find the stresses and deflections in the structure. The optimum resources possible in designing the hydraulic presses frame can effect reduction in the cost of the hydraulic presses. By optimizing the weight of material utilized for building the structure an attempt has been made in this direction to reduce the volume of material. So here we consider an industrial application project consisting of mass minimization of C-frame type assembly press. HYPERMESH has been used for this analysis aim is to reduce the cost of the system, stresses, material and deflection without compromising on the quality of the output.**

Keywords— Analysis of Assembly Press; Modelling; Reduction in Material Weight; Optimisation; Analysis in Static Condition)

INTODUCTION

Fluid transmission system is a power transmission system in which transmission of power takes place through fluid medium. This is most convenient and highly efficient. Present conventional power transmission systems are being replaced and being changed over to fluid power based systems.

In this system mechanical energy is supplied to the system by prime mover is converted to pressure energy by pump and stored in fluid. This pressurized fluid is transmitted to different parts of system through pipes or tubes .The mechanical energy supplied is recovered back in a convenient form and required operations are carried out.

Pascal law is the basis of all hydraulic systems. It states that "Pressure applied to a confined fluid at any point is transmitted undiminished throughout the fluid in all directions and acts up on every part of the confining vessel at right angles to its interior surface and equally up on equal areas." Modern machine tools make use of such systems in majority applications. Hydraulic press is one such application.

Hydraulic Press

One of the earliest applications of hydrostatic system is the hydraulic press. A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force. Frames, column and cylinder are the main components of the hydraulic press. A hydraulic press consists of a pump which provides the energy to the fluid, the fluid 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 requirement. The main advantages of hydraulic presses are that they compatible to changes in input pressure, the force and pressure can accurately be controlled, and the entire magnitude of the force is available during the entire working stroke of the ram travel. Hydraulic presses can be easily designed for large values of forces with minimum moving parts.

Applications

In its modern form hydraulic press is well adapted to press work of

- Forging presses
- Stamping machines
- Rolling presses
- Riveting machines
- Blanking and punching machines

Structure

Depending on application different frame structures are available while performing the operation

1. 'H' TYPE OR fabricated 4-column type
2. 'C' type
3. 4-pillars (Hard chrome pillars type)

C- frame presses
These presses have a 'C' like shape, which is specifically designed to maximize the floor space for the workers in order to move around easily at the workplace. Unlike other presses that have multi-processes, the C- frame presses only include a single press application. Its application includes straightening, drawing and mostly includes assembling work. C-frame presses come in a variety of weights. The C- frame presses are also available with extra features such as wheel stands and pressure gauges.

H- frame presses
These presses have a 'H' shape and are capable of handling more than one press application

Source of the Project:
The source of the project is from CALEO ENGINEERING.CO Pune. The dimensions and specifications of a 1 ton capacity are provided by the company.

Need of the Project:
The operation of assembly was initially carried out by hand operated power press. To reduce the manpower required for this operation from three to one the hydraulic press was taken into consideration. The C frame was considered for support of the press as standard C-frame presses are precise and easy to control to most pressroom applications including punching, blanking, coining, forming, bending, drawing and assembly work. The C frame press is considered because of its high rigid frame construction and also the maintenance cost of the press is less compared to other. In most of the presses there are some waste materials where no stress is acting there. This increases the material weight and cost. So these materials should be removed to reduce the material usage to increase the profit and reduce wastage.

Methodology
The dimensions and specifications for a C frame assembly press are provided by manufacturer. Using the specifications and dimensions a C framed assembly press is modeled in NX and then the model is tested in Hypermesh for stress analysis. The static load condition is considered for analysis. As per the specifications the load is applied on the frame and the deflections and stresses acting on the structure are calculated. The design of the frame is further modified to reduce material required without compromising the design specifications. The objective is to make use of minimum available resources, to maximize profit without affecting the quality, durability, operation of the system.

Design Specifications
Outer diameter of the Ram - 55mm
Inner diameter of the Ram - 43mm
Stroke Length - 260mm

Design Check for Top Plate

INPUT DATA

Outer diameter of piston rod = 55mm
Inner diameter of piston rod = 43mm

Material selection:

Designation	Tensile Strength N/mm^2	Yield Strength N/mm^2
EN24	800	680

Direct Tensile or Compressive stress due to an axial load:-

$$fc_{act} = \frac{W}{A}$$

$$fc_{act} = \frac{1000}{\Pi \times (55^2-43^2)}$$

$$\underline{fc_{act} = 0.2706 \ N/mm^2}$$

$$\underline{fc_{all}} = \frac{\underline{S_{UT}}}{\text{Factor of Safety}}$$

$$= \frac{800}{4}$$

$$\underline{fc_{all} = 200 \ N/mm^2}$$

As $fc_{act} < fc_{all}$

$0.2706 < 200$

Piston rod is safe in compression.

Hence material selected is Mild Steel.

Material used : Mild Steel
Young's Modulus : 2.1×105 N/mm2
Poisson's Ratio : 0.3
Density : 7860Kg/meters cube
Thermal expansion : 0.000017

Component List

	COMPONENTS	DIMENSIONS
1	C Channel	100*50*5
2	Rib 1	180*130*8
3	Rib 2	150*100*8
4	Top Plate	550*150*10
5	Base Plate 1	550*450*10
6	Base Plate 2	550*300*10
7	Fixture Plate	150*8*8
8	Supporting Plates	350*10*10
9	Bottom Plates	180*180*10

Hydraulic Circuit
The counter balance valve is used. This a pressure control valve. Counterbalance or back-pressure is used to keep the vertically mounted hydraulic cylinder in upward position while pump is idling. It prevents the vertical cylinder from descending due to weight of its load.

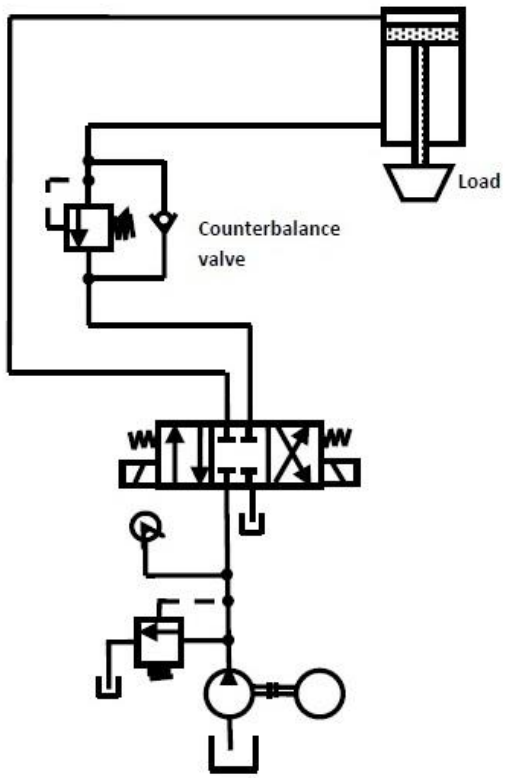

Fig.1 Hydraulic circuit with Counterbalance valve

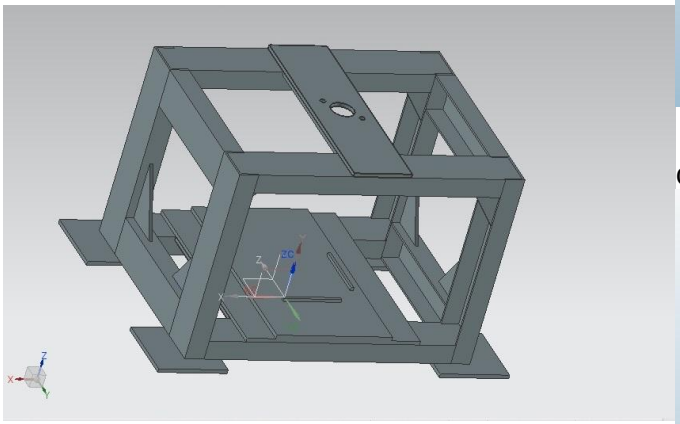

Fig.2 Model in Unigraphics

Case 1:

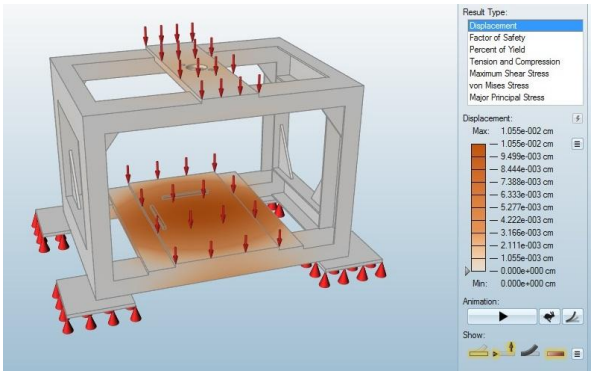

Fig.3 Result: Safe against Displacement

Case 2:

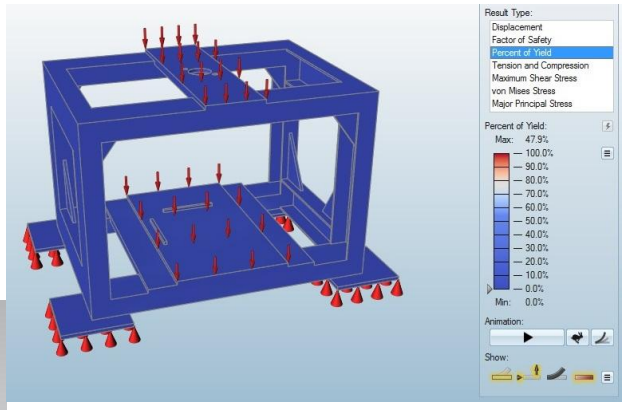

Fig.4 Result: Safe against Yield Stress

Case3:

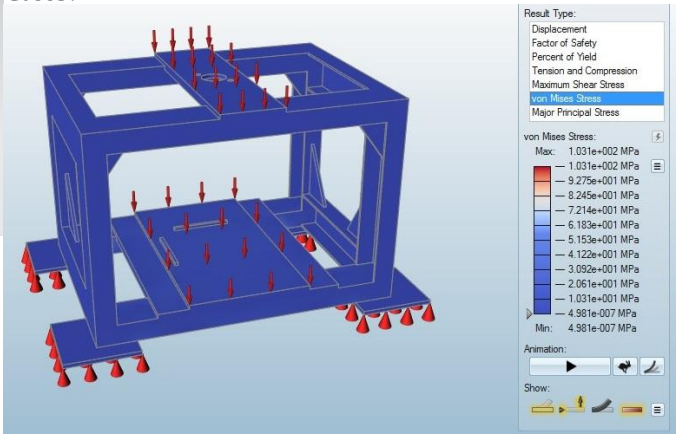

Fig.5 Result: Safe against Von Mises stress

CONCLUSION

In this project the Assembly Press is studied and the design of the C frame is done as per the requirements by following the process of Reverse engineering. The modeling of the C frame was done in Unigraphics software. The analysis of the assembly press is carried out using Hypermesh software. Analysis was done for the C frame by reducing its material used, without causing wastage of material.

The positions where the stresses were not acting the extra material was removed thus optimizing the design without compromising. The result obtained from analysis software is within the limit.

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