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# A REVIEW ON DESIGN AND ANALYSIS OF MECHANICAL PRESS FRAME

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**Abstract :**This paper present a review on design and analysis of mechanical press frame.Its deals with the analytical method and corresponding design and analysis of mechanical press frame.Modeling of press frame has created by the CAD software and according to the modeling structure failure analysis done by FEA tool.Stress distributions in press frame have been find out by the analytical and simulation methods.Reference data are used for the new design for modification of a new press structure. With regard to design specification, stress distribution, deflection, optimization, ergonomics, stiffness and rigidity is focused on recent design and development in press frame obtained from structural components of press machine frame.

**Keyword**: press frame, material, stress analysis, FEA, stiffness, rigidity,optimization

## I. INTRODUCTION

### *1.1 BACKGROUND*

Press working techniques utilizing large quantities of economical tooling equipment design and it quickly, accurately and economically cold working of mild steel and other ductile materials. The component produced range over an extremely wide field and is used throughout industry for economical production of quantities of pressing; consideration has to be given to the rate of production. The cost of the press tool to be employed [1-2].Press may be defined as the chip less manufacturing process by which various components are made from sheet. Mostly press use fabricated parts of incite shape with thin walls. It uses large force by press tools far short time interval which results in cutting a shaping the sheet metal [3].In the early days, metal forming press use simple crank and lever mechanism that convert rotating motion into linear motion with the help of punch/ram. The rotating motion achieved by motor and linear motion achieved by punch or ram, punch applied on workpiece[4-6].

In the most function of press frame is absorb the force which generated by rotating parts and processing, to provide a precision guidance of other part and support the main drive system and other necessary auxiliary system. In press machine larger area of press frame and also it's higher weight of all among parts. Press machine total area of frame 60-70%. So the more importance of press frames and it's design parameter.

### *1.2 CLASSIFICATION OF PRESS*

According to IS 8064:2002 standard [7], press classified into two principle categories as hydraulic presses which operate on the principle of hydrostatic pressure.Mechanical press which utilized kinematic linkage of elements to transmit power. Mechanical press can be also classified into basis of the design of the frame.

 

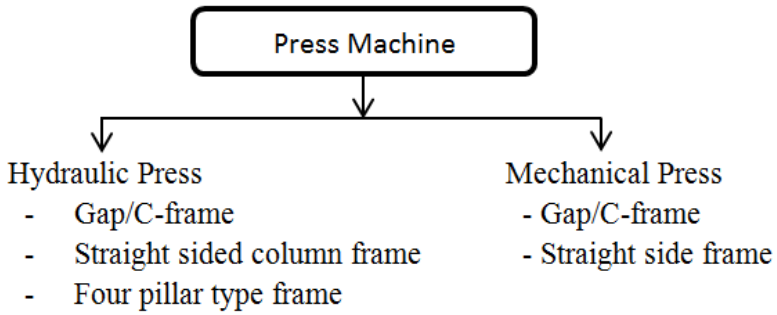


Fig.1.1 Classification of press frame

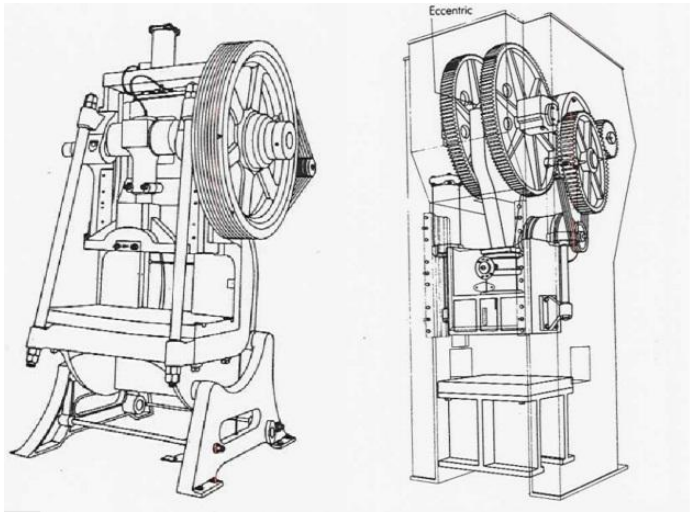


Fig.1.2: Press frame[8]

***1.3 DESIGNATION OF PRESSFRAMES***

Method of designation of mechanical press as gap frame G1-100-1000×630-EI. As left to first order code shows gap type press frame, one point suspension, 100 tone capacity, L to R dimensions of bed, F to B dimensions of bed, eccentric gear drive mechanism, inclinable or fixed inclined lay frame. straight frame S2-1000+630-1800×1600-A as left order straight sided two point suspension, 1000 tonnes capacity,600 tonnes capacity of blank holder, L to R dimension of the bed, F to B dimensions of the bed, accelerated press [7].

In industry mostly used gap frame press a gap press has got open throat arrangement in the press frame open throat provides excellence clearance around the dies and permits larger area far work piece. C-shaped press a provide adequate working clearance for the tools and the press may be approached from three sides.Typically c-type press consists of a single column at the back of work table and other possibly is two columns at the top and the bed. These presses similar to the used in mechanical press most power presses are operated by electrical motor driven mechanical energy. However, gravity drop hummer and foot power kick press are also used. In other drive system, brakes, Dai, clutches, feature are use similar in other presses.

The major advantages of aframe press are economy of a frame press are economy of constitution and provide a rigid constitution. This press design permits good visibility a ready access to the tooling area from all the four sides and also accessible fan discharging finished parts and scrap as well as feeding stock. In the most industry c-frame presses ranging in capacity 5, 10, 20, 30…100

 

tonesaremostly used in the shop work. In press force capacity approximately 250 tones and larger than a straight side press.

## II. MATERIALS FOR PRESSFRAME

Press frames were produced of gray cast iron. Proceeding of welding technology allowed thick plate metal to be jointed with each other, it degree of design flexibility high. Thus, presses made from welded frames can be constructed highly precisely require for individual part requirement.

Generally press frames material used in performing frames are cast iron frames, 80% of the press weight made of gray cast iron, Cast steel frame and welded frames for mild steel or structural steel plates. Cast iron has a low modulus of elasticity and gray cast iron having minimum tensile strength [9]. According to mechanical typification rules used AISI-SAE 4140, AISI-SAE 1045,AISI-SAE 6150, steel casting Fc 250…Fc350class for cast frames. And steel type OL 37, OL42.2k, OL 44.2k and OL 52.2k for welded frame of plates [12].

## III. DESIGNS AND ANALYSIS

### *3.1 ANALYTICAL DESIGN*

In analytical design use for stress concentration at the frame of press.This method use for determination of stress and strains that occur at the full load by applying nominal force on press frame. Also determination of the deflection of frame [10].

This analytical calculation is presented through a numerical example, **H.N.Chauhan** [11] presented by c-type press frame, types SNX-63 and its nominal force is 630 kN, analytical design in his research work and compare with FEA. In **Catalin Iancu** [12] shows analytical calculation in his research work. Considering different cross-section at 15˚ to 15˚in press frame, to providing maximum value of stress and distribution of stress concentration.(Figure-3.1). The different stress value get in different section which in represent on graph.(Figure-3.2)

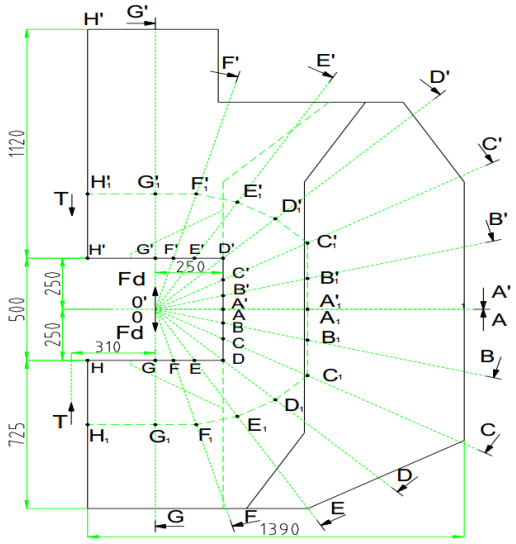


Fig.3.1 cross section of press frame.

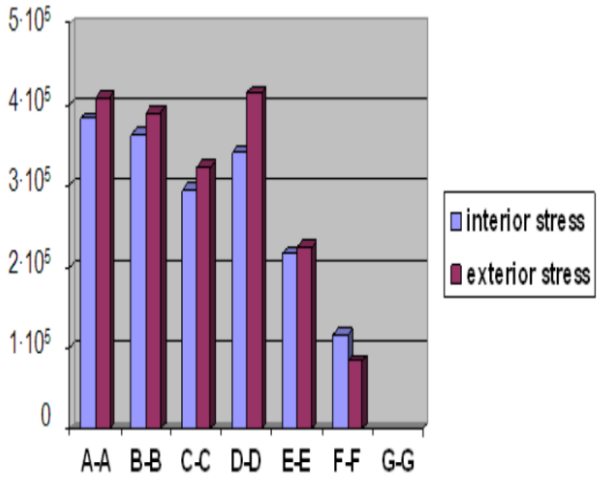


Fig. 3.2 stress distribution on frame

### *3.2 USING FEA SOFWARE*

The software offers comprehensive range of stress analysis and other capability of this larger-scale and complex structural problems. In modeling various range of modeling software through create the model of press. In modeling software use as pro-Engineering wildfire 4.0, CATIA V5, Ansys APDL,COSMOS/M etc.It must be realized a geometric model most accuracy of the press, using dedicated CAD software. A model 3D of press was elaborated rigorously observing the real model that's purpose the pro-E wildfire 4.0 environment use. Base on FEM, FEM technique for numerically

 

modeling a component to give the value of a designerunknown quantity at any location of that component this method requires larger quantities of data which are manipulated by matrix techniques.

### 3.2.1 FEA (FINITE ELEMENT ANALYSIS) FOR STRESS ANALYSIS

Finite element analysis is a computer simulation techniques used in engineering analysis. It uses a numerical technique called finite element method. The finite element method is one of the most used methods in engineering [11-14].This method having various sub steps involves and that through solve geometry. In FEA analysis carried out with help of the FEA software like as Ansys, catia, COSMOS/M, pro-engineering wildfire, etc. In FEM various steps as:

Step 1: create model
Step 2: import the model in simulation software.
Step 3: selection of element.
Step 4: discretization of variants.
Step 5: define meshing.
Step 6: apply boundary condition & loading condition.
Step 7: result

In above software directly solve the given geometry and give solution of the geometry. Display maximum and minimum value of stress and deflection.

**Zhicheng Huang et al** [14] present contact analysis on the frame of 32.8 MN press. Contact analysis carried out with the help of finite element software for stress and strain distribution on the press frame. It verified with the pretension element method.

**S. P. Sinha et al** [15] present the computer aided design of hydraulic presses on 3D complex structures for analytical method of stress and deformation analysis is time consuming. A simplified plan stress FEM model for press structure for its analysis. PS model of analysis for behavior of the structure.

### 3.4.2 OPTIMIZATION

In press machine working with high nominal force so it's weight and the design must be reliable with operation. In weight and cost more so it's optimized with various parameter like as drive mechanism, structure.

In **Muni Prabaharan et al** [21] present in his research work structural optimization on 5-ton press machine. Consider various parameters and focus on press frame, use shape optimization method change in thickness of frame and 26.36 % volume reduce of press machine.**A. G. Naik et al** [22] present the shape optimization on press machine. Consider press frame and optimized weight of press frame, after analyzed 13% weight reduced by the optimization and also 15% cost reduced.

### 3.2.3FATIGUE ANALYSIS

In press machine during operation impact loading continuously applies on frame. Due to continuously impact loading press machine deal with the stress and due to rotating part also be stress developed in press machine. Stress level mainly produces on the press frame, the probabilistic fatigue analysis method use in this respect.

**M. Fulland et al** [16] present the fatigue crack propagation on press frame. Crack growth analyze by the ADAPCRACK3D crack simulation program which is developed in Institute of Applied Mechanics at University Paderborn. These programs develop for measuring crack growth in press frame.(Figure-3.3)

 

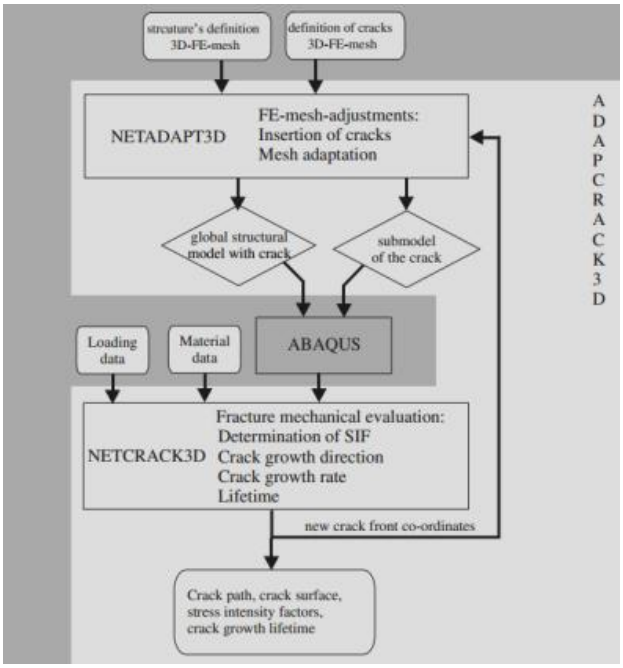


Fig.3.3Functionality scheme of the program ADAPCRACK3D.

3.2.4VIBRATION AND ACOUSTIC

During operation of press machine due to its weight and moving part vibration produce. And some noise sound generated during operation. This vibration depends on frequency generated by the press machine. **L. L. Koss et al** [17] presented study on vibration and acoustic data on 173 kN punch press. Mode shape, radiation ratio and damping data consider from tone vibration shaker test on press machine. Experimental data obtain by two method first acoustic efficiency data obtained for flat plate and second same data for 173 kN punch press. Its data depends on the structural mode shape and air transmission path through the machine. Frame vibration reduced by the tuned absorbers, damper, etc.

3.2.5STIFFNESS AND RIGIDITY

According to EP 2 255 960 B1[18] pre-stress frame use to increasing stiffness and rigidity. First pattern registered for increasing stiffness and rigidity. In press frame rigidity and stiffness are particularly important ensuring the adequate accuracy of item produced on machine. Beside inaccuracy of manufacturer, elastic depression of the joint during machine causes vibration. Press machine consumes energy consumption increase and also appears elastic deformation in the resistance structure. It depends on press stiffness the durability of the machine tool and quality of processing are influenced by rigidity of the machine.

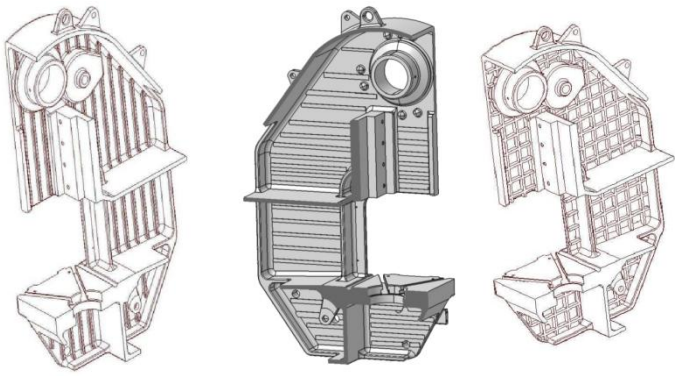

Fig. 3.4 Ribbing of the side wall of press frame

 

In **Ioan dan et al**[19] given best solution for increasing press stiffness. When Stiffness increase also increase its rigidity alternative solution as Pre-tensioning of the front pillar of the machine frame. Pre-tensioning through overall tension on the frame is considerably improved by constructive solution. **Romeo CIOARA et al**[20] presented increasing rigidity of the c-type press frame. In his research increasing stiffness of frame and also increase rigidity. Rigidity increasing with the constructive solution as ribbing of the side wall of the press frame.(Figure-3.4)

## IV. ERGONOMICS

In present manufacturing of press machine most considering thepress machinemany features related to press design were in disagreement with ergonomics criteria. The majority press machine design old and appraisal its dimension and forces involved in their operation.

**R.W. Tomlinson et al** [23] present ergonomics of c-frame presses. In experimental taken on press guard and after studied change in chair height and adjusting to a height to suit the individual operator. The changes have caused an improvement in output and operator comfort.

## V. CONCLUSIONS

Based on a review of published information on design and analysis of mechanical press frame structuresand supporting experimental data, the following conclusions can be drawn:

A) Mechanical press failure most of the sharp corner of press frame and crack initiate at junction of two plate.
B) Analytical method through get where is stress concentration more and deflection of frame.
C) FEA Analysis the best solution method for stress analysis and shape optimization of frame structure. FEA analysis through get accurate result.
D) Increasing rigidity and stiffness increasing by the pre-tensioning of press frame.
E) Optimization technique through decreasing material cost and weight.

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