ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

# Design and Analysis of Press Tool Assembly

Raveendra
M.Tech Student
Ellenki Institute of Engineering and Technology.

Ch.Nagaraju
Assistant Professor
Ellenki Institute of Engineering and Technology.

## ABSTRACT

***Press working may be defined as a chip less manufacturing process by which various components are made from sheet metal. This process is also termed as cold stamping. The machine used for press working is called press. The main features of a press are a frame which supports a ram or a slide and a bed. A source of mechanism for operating the ram is in line with and normal to the bed. The ram is equipped with suitable punch/punches and a die block is attached to the bed. A stamping is produced by the downward stroke of the ram when the punch moves towards and into the die block. The punch and the die block assembly are generally termed as die set and press working operations are usually done at room temperature.***

## 1. INTRODUCTION

Press working may be defined as a chip less manufacturing process by which various components are made from sheet metal. This process is also termed as cold stamping. The machine used for press working is called press. The main features of a press are a frame which supports a ram or a slide and a bed. A source of mechanism for operating the ram is in line with and normal to the bed. The ram is equipped with suitable punch/punches and a die block is attached to the bed. A stamping is produced by the downward stroke of the ram when the punch moves towards and into the die block. The punch and the die block assembly are generally termed as die set and press working operations are usually done at room temperature.

### 1.1 PRESS OPERATIONS

The operations done on the sheet metal can be classified into two types, cutting operations and forming operations. In cutting operations the work piece is stressed beyond its ultimate strength. The stress caused in the metal by the applied forces will be shearing stresses. In forming operations, the stresses are bellow the ultimate strength of the metal. In this operation there is no cutting of the metal but only the contour of the work piece is changed to get the desired product. The cutting operations include: blanking, notching, piercing, perforating, trimming, shaving, slitting, lancing etc. The forming operations include: bending, drawing, redrawing, squeezing etc.

### 1.2 various press operations

**Blanking:**

Blanking is the operation of cutting a flat shape from sheet metal. The article punched out is called the blank and is required product of the operation. The hole and metal left behind is discarded as waste.

**Piercing:**

It is the cutting operation by which various shaped holes are made in sheet metal. piercing is similar to the blanking except that in piercing hole produced is the desired product, the material punched out from the hole being waste.

**Swaging:**

It is a process of reducing or thinning the portion of a work-piece or cross- section of the work-piece. This is also called Up- setting process.

**Planishing:**

It is a process of flattening the work-piece between the flat face of the die and punch to remove wrinkles or burrs.

**Coining:**

It is a process of producing a design on a piece of thick metal on one side or both sides when brought in between a contact die and punch.

**Embossing:**

It is a process of forming a design or letters on one side of metal piece and the impressions are visible on both sides.

**Bending:**

In this operation, the material in the form of flat sheet or strip is uniformly strained around a linear axis which lies in the neutral plane and perpendicular to the lengthwise direction of the sheet or metal.

**Drawing:**

This is a process of forming a flat work piece into a hallow shape by means of a punch which causes the blank to flow into the die cavity.

## 1.3 PRESS WORKING EQUIPMENTS

Press working equipment includes different types of presses and tools, known as dies or press tools. Presses used for metal stamping are classified in various ways. They classified according to:

1. Sources of power.
2. Method of actuation of ram/rams (slide/slides).
3. Number of slides.
4. Type of frame.
5. The type of work for which the press has been designed.

## 1.4 TYPES OF PRESS

- Fly press.
- Open back inclinable press.
- Straight side single crank press.
- Eccentric press.
- Double action crank press.
- One point press.
- Two point press.
- Double and triple action press.
- Friction screw press.
- Hydraulic press.

## 1.5 PRESS TOOL COMPONENTS

The press tool components may be generally divided into the following types:

- Working components, which participate in the shaping of parts: dies, punches and their sections.
- Structural components, which serve for joining the working components to one another and to the press: Upper shoe (punch holder), lower shoe (die holder) and shanks.
- Guiding components, which ensure accurate alignment of the upper shoe with the shoe in operation guide posts and bushings. Guide posts also facilitate tryout of the press tool in a press. Feeding component, which feed the stock strip or blank to the stamping station
- Locating and locking components, which provide for an accurate positioning of the stock or blank in the die and fix it in place while the operation is performed?
- Stripping components, which strip and remove the blank and scrap form the working components after the operation is over: strippers, push off pins, knockouts.

## 1.6 FACTORS affecting the strip layout

1. Economy of material.
2. Direction of material grain or fiber
3. Strip or coiled stock.
4. Direction of burr.
5. Press used.
6. Production required.
7. Die cost.

## LITERATURE SURVEY

E. N. Duarte et.al emphasized the material flow into the die cavity. In order to achieve better part quality in sheet metal forming the rate of the material flow into the die cavity must be efficiently controlled. This control is obtained using a restraining force supplied either by the blank holder tool, draw beads or both. When the restraining force required is too high, the use of draw beads is necessary, although excessive blank deformation may be produced. Some other disadvantages such as adjustment difficulties during

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

die try-outs to determine the actual Draw bead Restraining Force (DBRF) may also be encountered.

## 3. PRESS SELECTION

Press tool designer has to make proper selection of the type of the press to be used and also the kind of the press tool to be provided. It is more economical to use a tool, which will complete a number of cheaper and simple tests to perform the same work in a series of operation. The design of the tool should be simplest possible and the method of operation the most efficient one.

- Force required to cut metal
- Size and type of die
- Stock length
- Method of feeding and size of sheet blank
- Shunt height
- Type of operation.

### 3.1 GENERAL PRESS INFORMATION:

The tool designer must know certain fundamental of press operation before he successfully design a press tool

**Press Tonnage:**

The tonnage of the press is the force that the press ram is able to deliver safely. Press slides exert greater than the rated tonnage because of built in safety factor the tonnage of mechanical presses is determined by the size of the bearing for the crank shaft.

**Stroke:**

The stroke of a press is the reciprocating motion of a press slide, usually specified as the number of inches between terminal points of the motion.

**Shunt Height:**

The shunt height of a press is the distance from the top of the bed to the bottom of the slide with the stroke down and the adjustment up. The thickness of the bolster plate must always taken into consideration to determine the maximum die height.

## 4. DESIGN CALCULATIONS

Before starting a project work its planning must be done, planning for a project is a very important task and should be taken up with a great care as efficiency of the whole project largely depends upon its planning. While planning project each and every detail should be worked out in anticipation and should be consider carefully, all the relevant provision in advance.

- Quantity required.
- Work piece - shape and size, dimensional tolerances, material limitations.
- Equipment available for manufacturing.

### 4.1 TECHNICAL SPECIFICATIONS:

**FORCE CALCULATIONS:**

Shear force:

$$F_{sh}= (KLtS_{sh}/1000)$$

Where,

K= 1.1 to 1.5 [Normal (Narrow clearance) profiles] =1.5

= 1.25 to 1.75 when d/t < 2

L = Length of cut in mm =351mm

t= Thickness of stock mm =2.5

$S_{sh}$= Shear strength of material =40 Kg / mm$^2$

**Note:**

- 15% Striping forces to be added to total tons.
- 30% for machine safety /machine efficiency.

**Note:**

- Actual tonnage 52.65 tons. Tool to be loaded on 60 ton press

**Horizontal force:**

Horizontal force = vertical force x die clearance

= 60× 0.05 = 3 ton's

**DIE CLEARANCE:**

Minimum die clearance per side = 2.5/100 1.5 =0.0375 mm

**Note:**

- Maximum die clearance per side = 5/100 mm

For M. S. metal die clearance is given between 2.55%

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

### THICKNESS OF DIE PLATE:

$t_d = \sqrt[3]{f_{sh}}$

Note= $F_{sh}$ should be taken on working force only i.e. 52.65 tons

$= \sqrt[3]{52.65} = 3.743$ cm

= 37.43 mm

(As per shut height we are taking 45mm)

### THICKNESS OF PUNCH HOLDER:

$t_d$ =0.5t for guided punch =0.5X45 = 22.5 mm

($t_d$= thickness of the die)

(As per calculations we are taking 25mm)

### THICKNESS OF THE TOP BOLSTERS:

Thickness of the top bolster=1.25$t_d$=1.25 X 45=56.25 mm

(As per calculations we are taking 55 mm)

($t_d$ =thickness of the die)

### THICKNESS OF THE BOTTOM BOLSTERS:

Thickness of the bottom bolster=1.75

$t_d$=1.75 X 45=78.75 mm

(As per calculations we are taking 80 mm)

($t_d$ =thickness of the die)

### THICKNESS OF STRIPPER PLATE:

Thickness of the stripper plate= 0.5

$t_d$ =0.5 X 45 =22.5mm

(As per calculations we are taking 25mm)

($t_d$ =thickness of the die)

### TOTAL LENGTH OF THE PUNCH:

I,>$t_g$+$t_s$+$t_h$+S+b=20+25+25+2.5+25=97.5 mm

Where

$t_g$ =Distance between the stripper and die plate (thickness of guide)

$t_s$ =Thickness of stripper plate

t = Thickness of punch holder plate

S = Sharpening allowance

b = minimum distance between the stripper and punch holder 0-2025 mm

### NUMBER OF SCREWS AND DOWELS:

Stripping load is 10% of vertical force dies clearance 5% per side vertical force 22.Stem's

Stripping load =0.10/22.5 X 9807 =22065.75 Newton's

Root area of metric screws can be found from the following formula

$A=0.7854(0-1.227\ P)^2$

D= Outer diameter of the thread (mm)

P= Pitch of the thread (mm)

For M 12 X 1.75 screws

$A = 0.7854(12-1 \times 1.75)^2 = 0.7854(97.076) = 76.24\ mm^2$

Load capacity at 80 $N/mm^2$ L = 76.24 X 80

= 6100 N/screw

If two dowels are used,

(Note: for one screw of M121.75, safe load is 5950 N.)

We can use six screws of M12 size

Vertical force (V) =22590.54 N/screw

If two dowels are used,

(Note: for one screw of M121.75, safe load is 5950 N.)

We can use six screws of M12size

Vertical force(V)=22590.54 N

Die clearance X V=0. .0522590.54 =1129.579 N

### PRO- ENGINEER

**Component Drawing**

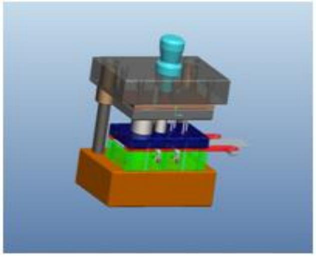


Figure 6.1 Assembly model

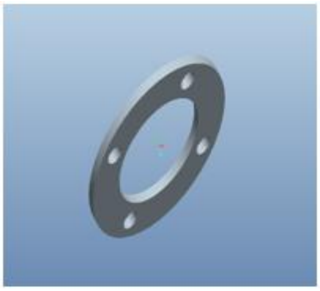


Figure 6.2 Washer

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
*A Peer Reviewed Open Access International Journal*

Figure 6.3 Top bolster

Figure 6.4 Bottom bolster

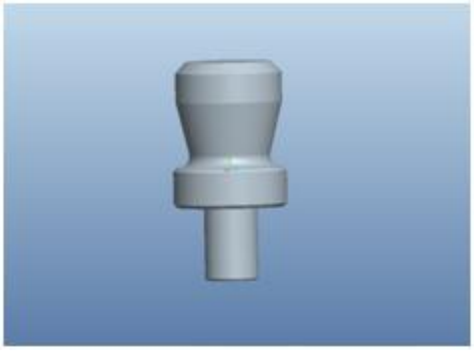
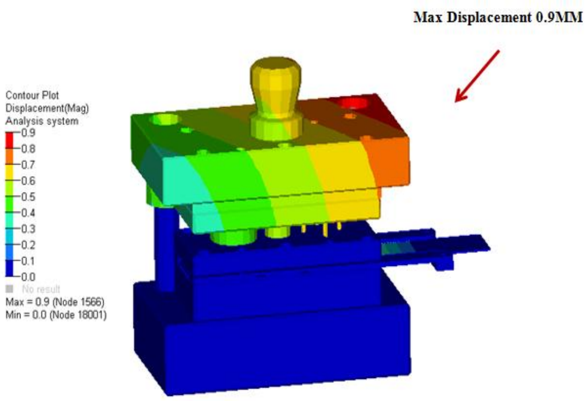


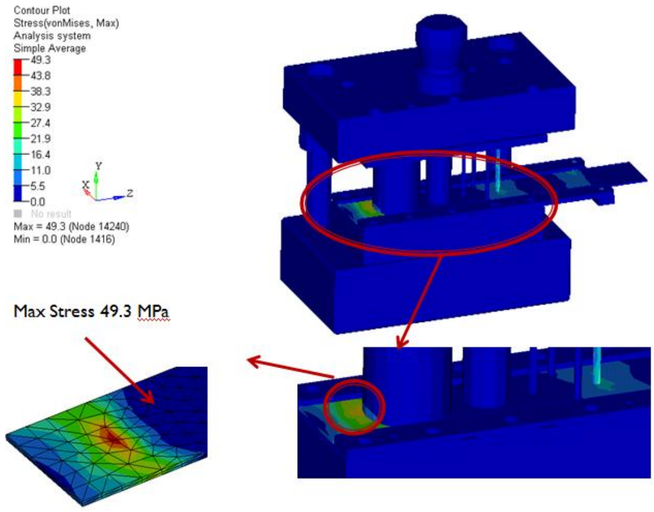
Figure 6.14 Shank

## STRUCTURAL ANALYSIS OF PROGRESSIVE PRESS TOOL ASSEMBLY

### Static Analysis Results

### Maximum Displacement Plot in MM




## CONCLUSIONS

The proposed design in press tool results to achieve high output, economy in the use of material, a long life of working parts of the tools, convenient and safe operation and minimum cost of manufacture.

From the conceptual stage to design, analysis and manufacturing is done. This helps in cutting down cycle time, so that new jobs can be taken up quickly. Better tool designing and drafting with greater number of design proposals within time schedule can be obtained and quality manufacture, accuracy of tooling and product can be achieved.

It is observed that implementation of HCHCr steel is more advantageous over the other material as its hardness varies between 60-62 HRC which when subjected to loads deform less and give safer stress concentration values. The sheet metal component can be manufactured with very close tolerances, and low manufacturing cost thereby increasing profitability of industry. The use of component based metal for design, analysis and manufacture is thus an effective means of increasing the quality and productivity.

For the given loading and boundary conditions, displacement and stresses developed in the structure are within acceptance range for the respective materials.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

## REFERENCES

1. Duarte E. N., Oliveira S. A. G., Weyler R. Neamtu L. (2010), "A hybrid approach for estimating the draw bead restraining force in sheet metal forming", Journal of the Brazilian Society of Mechanical Sciences and Engineering, Vol.32 No.3.

2. Ajay D. Yadav M.S (2008), "Process Analysis and Design in stamping and sheet hydro forming", Dissertation Ohio State University.

3. Ostergaard D.E. (1974). "Basic Die making" McGraw Hill, U.S.A.

4. Ostergaard D.E. (1974). "Advanced Die making" McGraw Hill, U.S.A.

5. ASTME, (1975) "Die Design Handbook" McGraw Hill, U.S.A.

6. John V.B., (1983) "Introduction to Engineering Materials" MacMillan, UK.

7. Donaldson, Le Cain, Goold, (1973) "Tool Design" McGraw Hill, U.S.A.

8. Pollack H.W. (1976) "Tool Design" Prentice Hall, U.S.A.

9. Dallas D. (1976) "Progressive Dies – Design and Manufacture" McGraw Hill.

## Author Details

**Raveendra**
M.Tech Student
Ellenki Institute of Engineering and Technology.

**Ch.Nagaraju**
Assistant Professor
Ellenki Institute of Engineering and Technology.