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Design and Manufacturing of Progressive Die

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***Abstract*—Progressive die performs a series of operations in a single die at two or more workstations. There is given finish part at eachstroke of press machine. Design and development of progressive die is one of the important phase in sheet metal manufacturing. Thesmall error at any work station can induce heavy manufacturing losses through die failure, part geometry distortion and productionrisk. This research deals with designing a progressive die, simulating the blanking and piercing process. By using this die we canproduce accurate component. In this work authors have designed a progressive die which have two work stations. The former operationis piercing and is followed by blanking. It is the material removing tool. This progressive die is designed for Seva Engineers Pvt. Ltd. which is further used in agricultural sector. There is no of workstation gives the no of operation formed on thepart. Required modeling is done with CATIA.**

***Index Terms*— Progressive dies, forces for punching and blanking, Materials, Design.**

I. INTRODUCTION

Press Tools are special tools custom built to produce a particular component mainly out of sheet metal. The principal operations of sheet stampings include cutting operations (Shearing, Blanking, Piercing etc.) and forming operations (bending, drawing, etc.). Sheet metal items such as a automobile parts (roofs, fenders, caps, etc). Components of aircraft, parts of business machines, household appliances ,sheet metal parts of electronic equipment's, precision parts required for homological industry etc. are manufactured by press tools.

Commonly used tools which are major components of press working are punches and dies.

Punch is an important part of the system which is fastened to the ram and forced into the die where work piece to be processed is supported. Die is a work holding device, designed specifically for a particular design of a product. Die is rigidly held on the base of the press. Die carries an opening which is perfectly aligned with the punch and its movement. Both die and punch work together as a unit and this is called a die set. Punch and die both are made of high speed steel. Die is the part where strength and wear resistant both properties are required. So normally working surface of the die is made of satellite or cemented carbide.

Press tools are commonly used in hydraulic, pneumatic, and mechanical presses to produce components at high volumes. Generally press tools are categorized by the types of operation performed using the tool, such as blanking, piercing, bending, forming, forging, trimming etc. The press tool will also be specified as a blanking tool, piercing tool, bending tool etc.

II. FORCE CALCULATIONS PUNCHING AND BLANKING

The punching and blanking process cannot strictly speaking grouped under forming operations. In these processes a finite volume of sheet metal is removed by using a die and a punch. The shape and size of the portion removed are determined by the geometry of the die and the punch. If the final product happens to the removed portion, then the operation is termed as blanking. On the other hand if the pierced sheet metal is the final product then the operation is called punching.

A. *Blanking*

It is a process in which the punch removes a portion of material from the stock which is a strip of sheet metal of the necessary thickness and width. The removed portion called a blank and is usually further processed to be of somese.

B. Piercing

This operation consist of simple hole punching is piercing is making holes in a sheet it is identical to blanking except if the fact that the punched out portion coming out through the die in piercing is scrap. Piercing is always accompanied by the blanking operation either before, after (or) at the same time.

C. Punching Force

The force required to be exerted by the punch in order to shear out the blank from the stock can be estimated from the actual shear area and shear strength of the material using formulae

$$P = L \times T \times \tau$$

$\tau \rightarrow$ shearstrength(mm)
$L \rightarrow$ perimeter of cut(mm)

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T →stock thickness(mm)

Shearing force (Fsh):
Fsh =L×T×τ
L=Length of cutting edge
T=Thickness of the stock strip
τ =shear strength of the material Newton/sq.m
Force required for piercing operation :
F1=L ×T× τ
=π×21.5×3×390
=79026.76 N
Force required for blanking operation:
F2=L ×T×τ
=π×21.5×3×390
=79026.76 N
Totalshearing force :
F=F1+F2
=158053.53 N
Taking factor of safety=1.5
The capacity of press required is 237.08 KN

III. MATERIALS USED IN DIE

The die set is made up of Aluminium – Silicon alloy by replacing the tool steel material which enhance the high ductility and high hardness level. This material is suggested for light weight of the die and it tends to deforms while the thrust force is applied, regain its original shape. However it is good corrosion resistance.

Table 1: Materials Used in Die

Sr No.	Die Parts	Material Used	Hardness
1	Bottom Plate	MS	----
2	Top Plate	MS	-----
3	Die Plate	WPS	60-62
4	Stripper Plate	OHNS	50-55
5	Punch Plate	MS	-----
6	Setting Block	MS	----
7	Guide Ways	OHNS	50-55
8	Side Block	WPS	50-52

IV. DESIGN OF DIE ELEMENTS USING AUTOCAD

A. Bottom Plate

The function of the bottom or lower shoe primarily as a base for the completedie assembly and in turn is bolted or clamped to the bolster plate over the press bed.

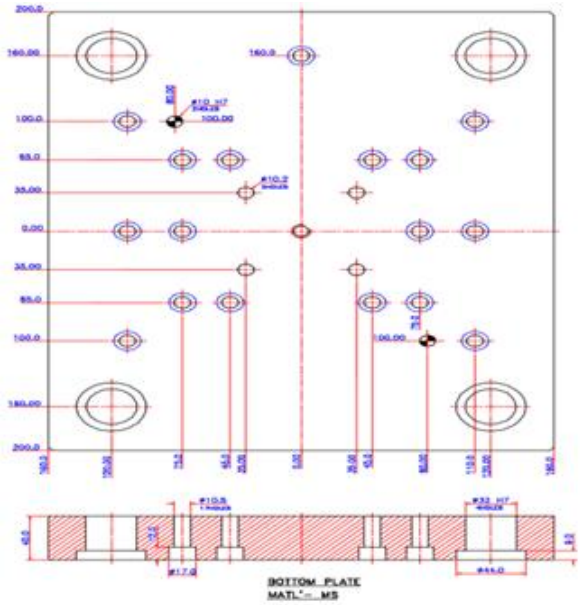

Fig 1: Bottom Plate

B. Top Plate

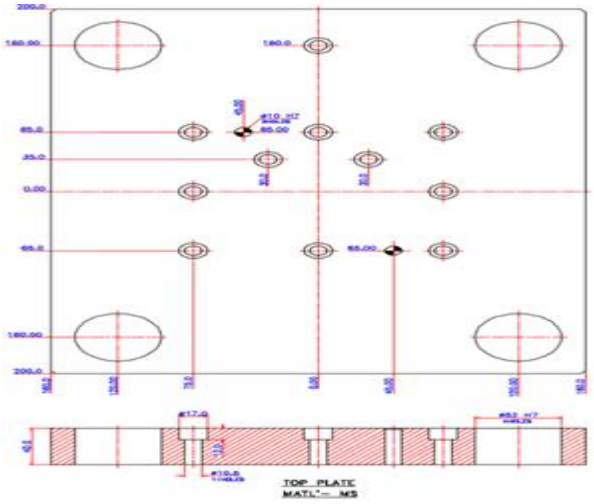

Fig 2: Top Plate

Top plate (upper shoe) holds the upper half component of the die, clamped to the ram by means of the shank being screwed on its top surface where the center of pressure is located .

C. Die Plate

The die block constitutes the female half of the two mated tools, which carry the cutting edges. A vertical opening extending through the block determines the size and outline of the blank. The exact opening is provided in the die to obtain a predetermined clearance between punch and the die. The amount of angular clearance and vertical land in the die opening is necessary in order to prevent the possibility of a blank or slug jamming in the passage.

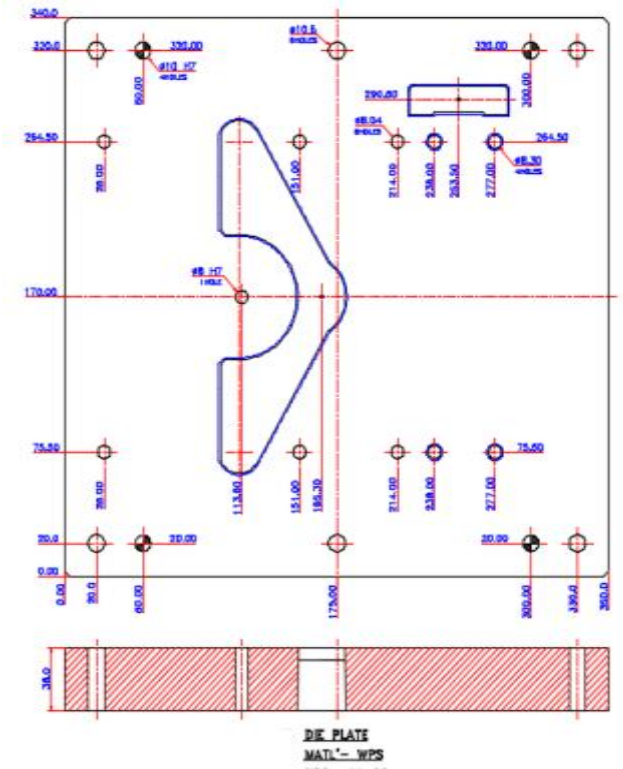

Fig 3: Die Plate

D. Stripper Plate

The primary purpose of a stripper is to remove the stock from the punch after ablanking or piercing operation. However the stripper serves two other secondaryfunctions also. Firstly it guides the strip if fixed to the die block surfaces. Secondly, itholds the blank under pressure before the punch descends fully if the stripper is ofspring loaded type.

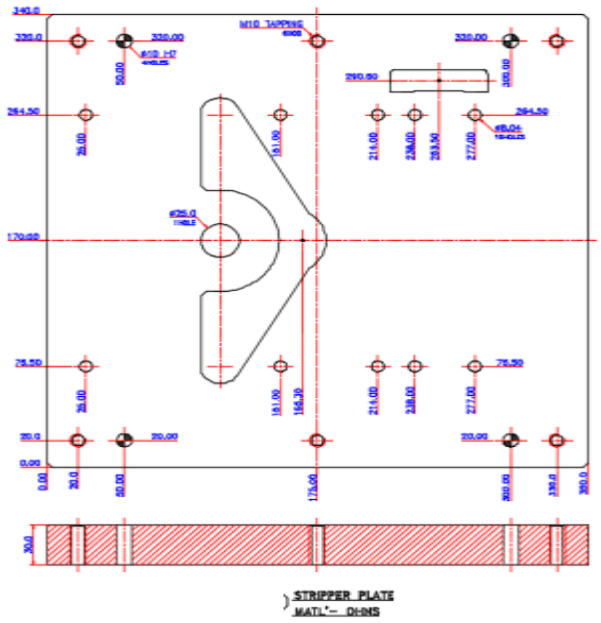

Fig 4: Stripper Plate

E. Punch Plate

Punch plates hold and support piercing, notching, and cut-off punches. They are usually made of machine steel, but can also be made of tool steel that has been left soft for high grade dies. Punch plates range from small simple blocks for holding singlepiercing punches to large, precision- machined plates for holding hundreds ofperforators

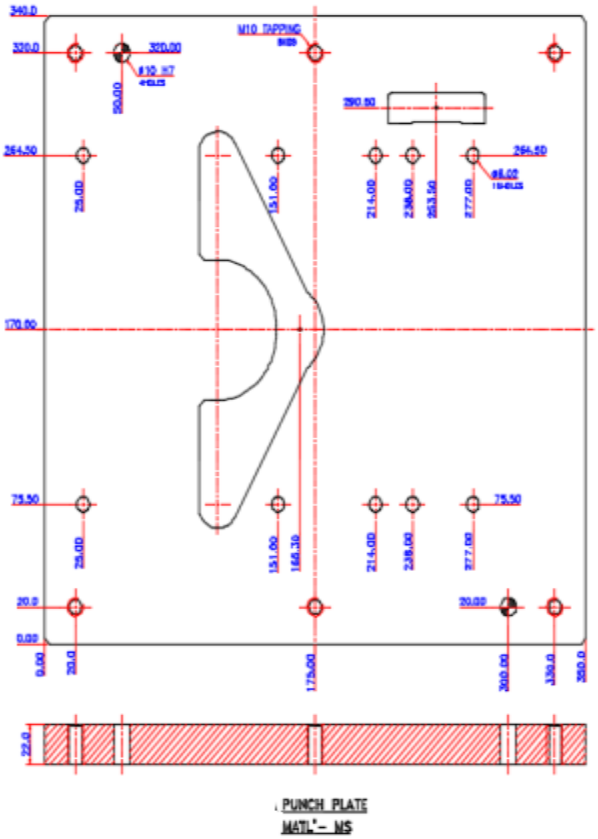

Fig 5:Punch Plate

F. Guide ways

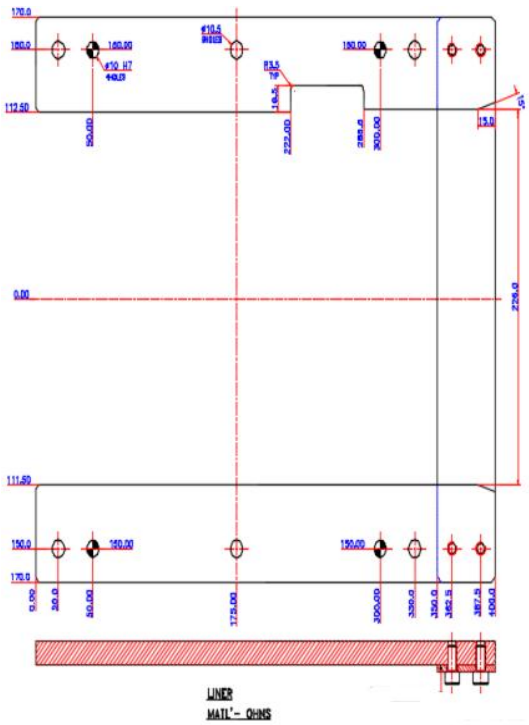

Fig 6:Guide Way

Guide ways are used to guide the raw material strip, so that it does not get deflect from position.

V. ASSEMBLY OF DIE

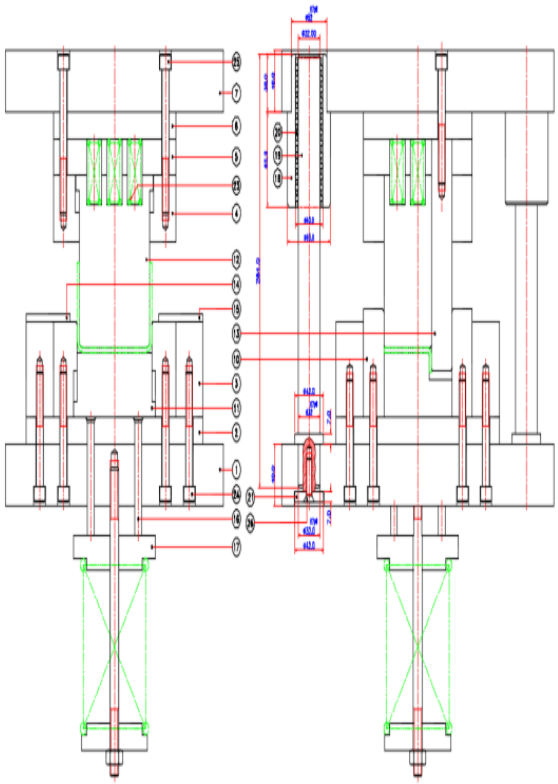

Fig 7: Assembly of Die

VI. CONCLUSION

The total capacity required to manufacture die holder is 237.08 KN including 1.25 factor of safety. And the existing hydraulic press machine in seva engineers industry has the capacity of 250 KN, which meets the requirement of press capacity to manufacture the part. Hence, the company can use all the results and manufacture the die.

Regarding progressive die design of progressive die is simple. Advantage of progressive die is it perform two or more operations simultaneously by a single stroke. Progressive die is used for high rate of production.

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