Design of A Blanking Die

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ABSTRACT

While converting a raw material into a finished product the product should be accurate. In order to require the accurate product the design should be accurate. If the design is not accurate then defects will occur in manufactured product. So while designing the product only we should be very careful. By the implementation of the computers in design field, designing process became easier and the time also has been reduced. The basic fundamental reason for implementing the computer aided design is to increase the productivity, get more accuracy and also for subdividing the parts which we required. There by reducing the time for synthesizing, analyzing and documentation purposes. The purpose of this project is to design and fabricate the blanking die. A blanking die produces a flat piece of material by cutting the desired shape in one operation. The finish part is referred to as a blank. Generally a blanking die may only cut the outside contour of a part, often used for parts with no internal features. Press tools are tools, used to produce a particular component in large quantity, out of sheet metals by using presses. The different types of press tool operations in blanking, piercing, forming, drawing, cutting off, parting off, embossing, coining, extrusion, perforating, trimming, notching, shaving, lancing, dinking, broaching, curling, bulging, swaging, flaring, etc. blanking is a process of producing flat components. The entire periphery is cut. The cut-out piece is called blank. This process is called blanking and tool used is called as blanking tool for producing any type of sheet metal operation, blanking operation is the primary process to be carried out. This can be said to be one of the basic press forming types. This is a type of punch whose size makes it difficult to drill threaded hole or knock holes inside it.

Keywords- Materials, Design, Calculations, Die Block and Modelling.

1. INTRODUCTION

Die is an assemblage of parts used for producing different sheet metal components. The Die is also called press tool as the dies are used on different types of presses based on the cutting forces required for the component Sheet metal is simply a metal formed into thin and flat pieces. The first step in any sheet metal process is to cut the correct shape and sized ‘blank’ from a larger sheet. Generally a blanking die may only cut the outside contour of a part, often used for parts with no internal features. It produces a flat piece of material by cutting the desired shape in one operation. The entire periphery is cut. The cut-out piece is called blank. This process is called blanking and tool used is called as blanking tool. For producing any sheet metal components, blanking operation is the primary process to carry-out. In this project, a real time design of a blanking die and manufacturing of a prototype working model is presented in order to increase Accuracy, Appearance, Flatness by using a press tool. This project is to design and manufacture a blanking die in which a blank of diameter 120mm and thickness 1.2mm is obtained. This blank is used in deep drawing
process with a flat base and straight walls. This is achieved by redrawing the part through a series of dies. The flange region experiences a radial drawing stress and a tangential compressive stress due to the material retention property. 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 Types of press tools 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.

1.1 Procedure
Raw Materials Used: The raw materials used for the manufacturing of the blanking die are:

Mild steel :
Mild steel have been used for majority of the parts, since it is ductile and can be easily machined. Moreover it is economical.

HCHC (High carbon High Chromium Die Steel) :
1. It is used for die and punch we have employed HCHC (High Carbon High Chromium) steel.
2. It is done since the punch and die are the cutting members in the tool, they have to withstand cutting force and resist wear.

A. Purpose of die sets:
1. The purpose of the die set is to utilize the entire die assembly. Some of the advantages realized by assembling die components to a properly selected die sets are:
2. Accuracy of the setup: The die can be installed in the press as a self-contained unit, assuring proper alignment of the various punch and die members.
3. Improved piece-part quality: The quality of the work produced is enhanced by the assured setup accuracy.
4. Increased die life: This is a result of proper alignment.
5. Minimum setup time: Setup time is kept to minimum because the die is installed as a unit. 5. Facilitation of maintenance: Die components can be removed and reassembled without disturbing their relationship to each other. Cutting components can be sharpened in assembly, as units without removing them from die set. This can be distinct advantage over removing the components and sharpening them as separate pieces.
6. Alignment of punch and die members: A die set can be a means of keeping the punch and die members properly during the working process. However, a die set cannot be expected to compensate for a punch press, which is not in good condition. Neither should a die set be expected to operate satisfactorily if heavy, unbalanced work forces exist. Such loads should be compensated for in the design of the die; they should not be transferred to the guide posts and bushing of the die set.
7. Facilitation of storage: On completion of the production run, the die can be stored as a unit ready to be replaced in production again immediately.

Special sets:
A special die set is one, which differs in any way from the standard catalog specifications. Special die sets are made to order. They may be similar to catalog sets, or they may be radically different. Special die sets may have pockets, slots, or cut out areas. These may be rough in or completely finished by the die set manufacturer. Die sets are [through] stress relieved by the manufacturers before finishing rough machining of deep pockets cut outs etc should be done by the die set manufacturer before the stress relieving operation, if residual stresses are not removed, they will be gradually released in service. This can be the source of distortion and dimensional changes, which can have serious consequences.
Generally a blanking die may only cut the outside contour of a part, often used for parts with no internal features. It produces a flat piece of material by cutting the desired shape in one operation.

periphery is cut. The cut-out piece is called blank. This process is called blanking and tool used is called as blanking tool. For producing any sheet metal components, blanking operation is the primary process to carry-out. The blanking tool consists of following major parts.

### Table 1

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BOTTOM PLATE</td>
<td>MILD STEEL</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>BLANKING DIE PLATE</td>
<td>H0HC</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>STRIPPER PLATE</td>
<td>MILD STEEL</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>BLANKING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PUNCH HOLDER</td>
<td>MILD STEEL</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>THRUST PLATE</td>
<td>MILD STEEL</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>TOP PLATE</td>
<td>MILD STEEL</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>GUIDE PILLAR</td>
<td>MILD STEEL</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>GUIDE BUSH</td>
<td>MILD STEEL</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>SHANK</td>
<td>MILD STEEL</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>SCREWS</td>
<td>STD</td>
<td>4</td>
</tr>
</tbody>
</table>

### 1.2 Design And Calculations

**A. Blanking Calculations:**

Shearing force for blanking operation

\[ F = k \times l \times t \times s / 1000 \text{ tonnes} \]

- **K** = 1.2 for normal clearance
- **L** = Perimeter of Blank = 120mm
- **T** = Thickness of stock strip = 1.2mm
- **S** = Shearing strength of mild steel = 21kg/mm²

Shear force \( F = 1.2 \times 120 \times 1.2 \times 21 / 1000 = 3.6 \text{ tonnes} = 35303.94 \text{ N} \)

\[ = 35303.94 \times 9.8 \]

\[ = 3602.44 \text{ kgf} \]

Cutting force = 3602.44kgf

So, a force of 3.6 tonnes is to be applied on the press tool of a blanking die.

### 1.3 Theoretical Deflection and Stress Calculation

**A. Die Block**

\( F = 80\% \) of cutting force = \( 0.8 \times 3602.44 \text{ kgf} = 2881.95 \text{ N} \)

\( d = 205 \text{ mm} \)

\( E = 2.1 \times 105 \text{ N/mm²} \)

\( I = \pi d^4 / 64 \)

\[ = 3.14 \times 2054 / 64 = 86649311.91 \text{ mm}^4 \]

Stress, \( p = F / A = 2881.95 \times 4 / 3.14 \times 2052 \)

So, stress = 8.7 x 104 N/m²

**B. Top Half:**

Top half includes as for calculation and analysis purpose as top plate, punch back plate and punch plate. Assuming that the Top plate is considered to be on parallels. The shoe deflection is calculated using the strength of material formula,

\( \delta = F L^3 / 48 E I \)

Where, \( F = 80\% \) of cutting force

Cutting force = 3.6tons = 35303.94N
=35303.94/9.8 = 3602.44Kgf

Cutting force=3602.44Kgf
F=0.8 x 3602.44kgf=2881.95N
F=2881.95N
L = 355mm,E = 2.1 x 105 N/mm2
b=225mm,h=25mm
I=225 x253/12
I=29296.75mm4
δ =FL3/EI
=2881.951 x 3553/48 x2.11 x105x292968.75
=4.36µm
Stress, p=F/A
=3.24 x106N/m2

C. Blanking Punch:
Scn= cutting force/cross sectional area of punch
Cutting force=2881.95N
Cross sectional area=3.14 x1352/4
A=44922.8mm2
E = 2.1 x 105 N/mm2
Scn=2881.95/44922.8
 =0.0641N/mm2
=64153.9N/m2

E. Stripper Plate:
F = 10% to 20% of cutting force = 0.2 x3602.44
Force =720.488N
D=220mm
I=1.14 x10000
Stress=F/A
Stress=18963.2 N/m

2.2D DRAWINGS OF BLANKING DIE COMPONENTS IN CATIA:

![Fig. 1 Bottom Plate](image-url)
Fig. 3 Top Plate

Fig. 4 Die Block

Fig. 5 Pillar

Fig. 6 Punch Holder

Fig. 7 Stripper Plate
Fig. 8 Knockout Plate

Fig. 9 Punch

Fig. 10 Shank

2.13D ASSEMBLY DRAWING OF BLANKING DIE IN CATIA

Fig: 4.2 Blanking Die Assembly
CONCLUSIONS

Thus a prototype blanking tool is designed and its functions have been demonstrated and explained and is found that a force of 3.6 tonnes capacity of force can be applied on the press tool to obtain a blank of 120mm diameter and thickness of 1.2mm as per design and calculations. The tool could be utilised in mass production to produce identical parts with good geometrical tolerances. By choosing appropriate tool steels for die, punch and other parts, the tool life could be increased for maximum range.

REFERENCES

1. “Tool & Die Maker 2ndYear: Press Tools, Jigs & Fixtures” CIMI (Central Instructional Media Institute), Guindy