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DESIGN OF PIERCING DIE FOR INDUSTRIAL PART

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Abstract: The project titled "Design of Piercing Die" aims to create a die that can pierce 18 holes simultaneously in a sheet metal workpiece. This die will be designed and used by Prakash Technoplast located in Ambad, Nashik for manufacturing a cover plate. The current process of piercing 9 holes in the cover plate using an indexing machine is time-consuming and produces low accuracy. The new piercing die will help improve the efficiency and accuracy of the manufacturing process.

***KEYWORDS:* - Piercing die, Indexing machine, Die Design.**

I. INTRODUCTION

The Piercing Die design and modelling process for sheet metal operations is quite systematic and involves various activities such as checking of part design features from a manufacturability point of view, choice of manufacturing operations, selection of the type of die, selection of the press machine and selection of the dimensions of the die components.

One of the most practical methods in metalworking is sheet metal, which can be repaired and cut into a variety of forms and sizes. Sheet metal is used in the production of a broad variety of products, making it a crucial component of the modern world. The thickness of sheet metal differs. Its gauge, a measurement, is used to determine how wide it is. If the gauge number is higher, the metal will be thinner. Also available is sheet metal in the shape of foil. The two common forms of sheet metal on the market are flat pieces and coiled segments. Sheet metal is continuously fed into a roll slitter to create the bundles.

[1] In today's practical and cost-conscious world, sheet-metal components have already largely replaced many pricey casts, forged, and machined items. The relative affordability of these techniques, or other mass-produced components, as well as tighter control over their technical and aesthetic specifications, are undoubtedly the determining factors. Press working is typically described as a chip less manufacturing method that uses sheet metal to create a variety of components. Press tools are employed to create a specific component in huge quantities. Metals with a thickness of less than 6 mm are typically referred to as strips. Metals that are thicker than 6mm are referred to as plates. The needed strip portion in this operation must, per organizational requirements, have semi-circular ends on both ends.

[2] The sheet metal working processes are widely used in almost all industries like automotive, defence, medical, and mechanical industries. The major advantage of using a metalworking process is to improve the production rate and reduce the cost per piece. Nowadays many people are working for developing die punches with innovative ideas. This project is also based on a new design for die punch. The project mainly focuses on different operations done on the single setup of die punch in a single stroke, presently these operations are done on three separate setups which lead to reduced production rate and increased cycle time with cost as well. The theoretical calculations were done for calculating cutting force, tonnage required, Von-Mises stresses, fatigue life, buckling load, and total deformation.

[3] An accurate design of the product and data required for manufacturing is a must before converting raw materials to a finished product. If the design is not accurate then defects will occur in the manufactured product. This paper presents a design of a die by combining the blanking and two piercing operations for an industrial part in a single die. Compound die generally consists of blanking and piercing operations which are performed in single press stroke. This design tool is manufactured by the company and used in cargo load body.

I. PROBLEM STATEMENT

Design a die which will pierce 9 pairs of holes i.e. 18 HOLES at a time so as to reduce cycle time as compare to regular indexing method.

Material grade to be used for die: Grade D, IS 513
Material thickness: 4mm
PCD of piercing holes: 147mm
Diameter of piercing hole on
PCD : 6.18mm

Previously this operation was done by using indexing but there were many disadvantages for this process in mass production.

•It requires more time to pierce all 18 holes
•After piercing each hole, operator has to rotate the workpiece.
•Accuracy is not maintained.
•More labour cost is involved.

II. SELECTION OF TOOL STEEL AND DIE COMPONENT MATERIALS

[3] The die components are constructed from Tool steels used in a variety of press working operations which is subject to wear. As If these tool steels are heat-treated develop a high level of hardness and abrasion resistance. The important in all industrial manufacturing processes is that the production runs are trouble-free during cutting operations of sheet metal parts. It is important to achieve good productivity and tooling economy, and selecting appropriate tool steel is crucial. As some standard items are involved, the whole system may not require high-strength material. It could be made from less expensive materials; the researchers categorize the selection of materials into three groups. Tool steels are used to construct the die components subject to wear. They are used in a variety of press working operations. These steels are designed specially to develop high hardness levels and abrasion resistance when heat-treated. The selection of tool steel for a specific operation must be based on two major considerations:

i. for an application Predicting the performance of the steel and

ii. The limitations associated with the manufacturing of tools and dies analysis.

A high-carbon, high-chromium tool steel alloyed AISI D2 with molybdenum and vanadium characterized by: high wear resistance, high compressive strength, and high stability in hardening and good resistance to tempering back. In most worldwide AISI D2 material is the most widely used tool steel. It also fulfils the requirements of the manufacturing of piercing and bending punches and dies plate. The remaining parts can be manufactured by structural steel St-42 a less expensive material suite for structural parts.

IV. DIE DESIGN CALCULATIONS

A. Die clearance and tool life

The standard clearance among the die and punch cutting edges depend upon the material properties. To avoid the drawn out of soft metal from gap, usually the die clearance for ductile material is less. Otherwise the for hard material large clearance is required. To reduce the burr, die clearance need to be less. But the blunting of the cutting edges of dies and punches gets accelerates. The recommended Die clearance is 2.5% to 5.0%of thickness. That is :- 0.04 mm and 0.08 mm is the Minimum and maximum die clearance is to be taken.

From this,Size of Die hole = diameter of punch + 2*(per side clearance of die)

To increase the tool life the die clearance must be doubled from 2.5% to 5% (for sheet of mild steel) so that the tool life doubles.

B. Calculation of Force required

1. Sheets and strips of CR2, CR3, CR4 and CR5 grade shall be supplied in annealed and skin passed condition. Grade CR0 shall be supplied in hard condition. Sheets and strips of CR1 grade may be supplied in any of the following condition.

2. CR0 and CR1 grade sheets and strips may be supplied rimmed, semi-killed, killed or as agreed between the purchaser and the manufacturer. However, other grades shall be supplied only in fully killed condition. CR4 and CR5 grade sheets and strips shall be supplied only in fully aluminum killed condition. [4]

Table.1 Chemical Composition of Grade D, IS513 2008 [4]

QUALITY			CONSTITUTE, %max			
Sr. no	**Designation**	**Name**	**Carbon**	**Manganese**	**Sulphur**	**Phosphorus**
1	**2**	**3**	**4**	**5**	**6**	**7**
2	CRO	Hard	0.25	1.7	0.045	0.05
3	CR1	Commercial	0.15	0.6	0.04	0.05
4	CR2	Drawing	0.12	0.5	0.035	0.04
5	CR3	Deep Drawing	0.1	0.45	0.03	0.025
6	CR4	Extra deep drawing	0.08	0.4	0.03	0.02

Table.2 Mechanical Properties of Grade D, IS 513 (2008) [4]

Sr. no	QUALITY		Yield stress	Tensile strength
	Designation	**Grade**	**MPA**	**MPA**
1	2	3	4	5
A	CRO	H	-	-
B	CR1	O	-	-
C	CR2	D	240	370
D	CR3	DD	220	350
E	CR4	EDD	210	350

The **cutting force** is as follows,

$$F = P \times t \times S_{SY}$$

Where, F= Cutting force, N
P= Perimeter of component, mm
t= Stock thickness, mm
$S_{SY=}$ Shear strength of stock material, MPA
Initially we calculate the perimeter if pierced parts:
Perimeter = π × diameter of hole
=3.14 × 6.18
=19.415mm
Thickness of plate= 4mm
Shear strength = 0.8 × ultimate tensile strength
= 0.8 × 370 … (From above Chart)
= 296 MPA
Punch Force (kN) = Perimeter (mm) × Plate Thickness (mm) × Shear Strength (kN / mm^2)
= 19.415 × 4 × 296
= 22987.36 N
(Round off to 25KN)
Thus,
Cutting force for piercing 18 holes
= 18 × 25
= 450KN

Punch Force =F/g = 450/9.81
= 45.871 tons
i.e. 50 tons
Therefore, Total = 50+12.50 = 62.5 tons

τ = 370 N/mm²
Clearance (C) = 0.0032 t $\sqrt{\tau}$
= 0.0032 × 4 × √370
= 0.24mm

Hence, we have to punch hole having diameter of 6.18mm. So, we have to consider all allowances and clearances to calculate actual size of punch.

Punch size = hole size + 2*ERA
= 6.18 + (2 × 0.05)
= 6.28 mm
Actual hole size = Punch size + clearance
= 6.28 + 0.24

Punch calculations:
Minimum length of punch (L):
= {(Л × d) / 8} × √ [(E × d)/(S × t)] (c)

Where,
d = punch diameter
E= modulus of elasticity (210*10^3 MPA)
S= shear strength of material = (0.8 × SUT) = 0.8 × 650 = 520 MPA t = thickness of work piece (4 mm)

But it also includes the stripping force while reverse stroke of ram to avoid the stick if work piece which always 25% of cutting force.

Stripping force = 25% × cutting force
= 0.25 × 50000
= 12.50 tons

Where,
L= selected length of punch.
I= mass moment of inertia = $(M^* r^2) / 2$

= $(0.600 \times 3.14^2) /2$
= 2.95788 kg-mm^2

A= cross sectional area = (Л / 4) * d2
= (Л / 4) × 6.282
= 30.97mm

Put all values in (d); = 30 / √ (2.9578/30.97)
= 97.07 > 90

Hence condition satisfied, selected value of length of punch (L) = 30 mm

Stripper plate thickness (T_s):

T_S = (D/3) + 2×t
Where,
TS = stripper plate thickness
D= diameter of work piece = 110 mm t = thickness of work piece = 4 mm
Put all values in (e):
= (110/3) + (2×4)
= 44.66 ~ = 45 mm
Hence the thickness of stripper plate (Ts) = 45 mm.

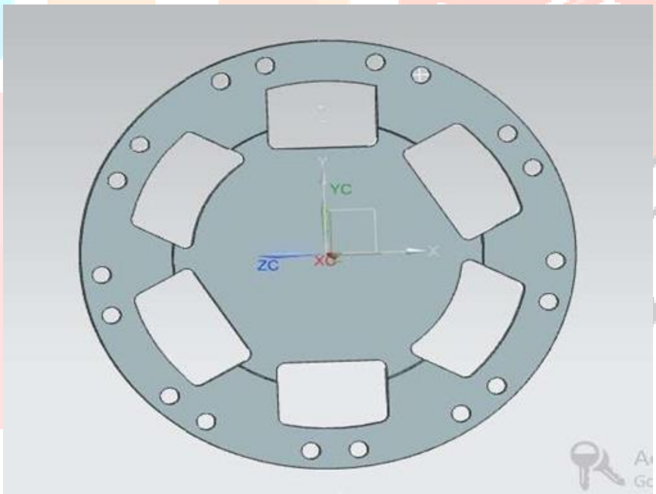

Fig.1.

CONCLUSION

Previously, the cover plate was machined using an indexing operation which took 4-5 minutes to pierce all 9 holes. To improve the manufacturing process, alternative methods such as gang drilling and press working were evaluated. It was observed that by designing the process characteristics and minimizing rejection, the machining time can be significantly reduced by using a mechanical press to pierce the holes.

Therefore, the proposed project model aims to implement this concept of press working to manufacture the cover plate. This will result in several benefits such as cost and time savings, increased production rate, improved flexibility in production, ease of forming and cutting, and overall simplification of the work process.

REFERENCES

[1]. Tool and Die Design for a Piercing Operation of Strip S. R. Dheringe, Prof. (Dr.) S. N. Shelke Department of Mechanical Engineering, SVIT, Nashik, Maharashtra, India DOI https://doi.org/10.32628/IJSRSET19669

[2]. Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072 © 2017, IRJET | Impact Factor value: 5.181 | ISO 9001:2008 Certified Journal | Page 2760 Design and Analysis of Blanking and Piercing die punch

[3]. Design of Die for Industrial Part Rahul A. Patil1 , Avinash T. Panchal 2 1 Assistant Professor, 2Assistant Professor, G.H.RAISONI Institute of G.H.RAISONI Institute of Engineering and Management, Jalgaon Engineering and Management, Jalgaon http://doi.one/10.1727/IJCRT.17139

[4]. AMENDMENT NO. 1 JULY 2010 TO IS 513: 2008 COLD REDUCED LOW CARBON STEEL SHEET AND STRIP (Fifth Revision)