

# Design of Variable Pitch Punching Tool

Venkatareddy Chilakala, Poliseti Lakshmi Manikanta, Samuel Eda, Medikonda Girija Prasad

**Abstract:** Punching tool is used to cut and create blanks in a sheet metal with a certain pitch. The present day punching machine consists of a punching tool with constant pitch. The idea of this paper is to design variable punching tool with pitch varying from min to max pitch (40-180mm) using die with guidelines. The above design solves the problem of installing new tool for different pitches. Due to the variable punching tool the productivity of the company increases drastically and the setup time for the different punching tool to the machine also decreases. The initial cost of installation decreases to a maximum extent.

**Keywords:** compound/combination die ;Progressive die ;punch ;die setdie- shoe ;guide plate; shank holder; punch holder ;guide rails; stripper pilot; guidepost/bush ; screw; knock-out ; dowel ;backing plateblank holder

## I. INTRODUCTION

Punch die which is used for cutting pieces in different methods have abundant diversity in the cases of shape, dimension and type of them, hence their designing necessitate so much time mean while their cost is very much and on the other hand various design of dies more often are used only for one time, thereby these dies will be useless for other cases therefore because of these, warehousing them vastly get increases whereas the occupied space of the warehouses turns to the big problem for manufactures which it needs so much money therefore it seems necessary to use a method to design dies consist of a few parts that be useable in different dies or in the other word, propose a method to make uniformity between common parts of dies.

### Types of dies:

- Progressive dies: Parts produced with multiple operations such as, punching, blanking and notching are made at high production rates in progressive dies
- Compound Dies: Several operations on the same strip performed in one stroke at one station with a compound die.
- Transfer Dies: Sheet metal undergoes different operations at different stations in a straight line or circular path.

### Die common parts:

Common part in punch metal dies consist of many members such top and bottom bolster, guide pillar, guide bush and shank, nevertheless there are some various cases that these are the same in some characteristics such as material, type and dimensions. Effective parameters on proper material selection for the die common part are as follow:

Manuscript published on 30 May 2013.

\*Correspondence Author(s)

Venkatareddy Chilakala, Department Of Mechanical Engineering, K.L.University, Guntur, Andhra Pradesh, India.

Poliseti Lakshmi Manikanta, Department Of Mechanical Engineering, K.L.University, Guntur, Andhra Pradesh, India.

Samuel Eda, Department Of Mechanical Engineering, K.L.University, Guntur, Andhra Pradesh, India.

Medikonda Girija Prasad, Department Of Mechanical Engineering, K.L.University, Guntur, Andhra Pradesh, India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

- price and preparing possibility
- Mechanical specification
- Thermal operation ability
- Production capacity

In designing die common parts, some specifications of members, dies and presses are used as the fundamental input data for their calculations. This information in each member is as follows:

## II. BOLSTER:

A punch tool consists of two bolsters which all parts of die set up on it. Required mechanical specifications for this part are high hardness and durability, moreover it must be absorb the vibration and easily machining. Thereby cast iron bolsters are more common than steel or aluminium bolsters. However for manufacturing big pieces which need high rigidity and must be stronger under impact loads, mostly steel bolster are used in this cases. Required information for design and selection of bolster with considering type and dimensions of them are some parameters such as press table dimensions, die work area, shape of piece, press capacity and method of feeding plate into the die space.

## III. GUIDE PILLAR:

Guide pillar is used to conduct the punch accurately while it gets through matrix thereby it sets up on the bolster however it must be symmetric about the major axes of die to be able to distribute the equal loads on the both side. Wear resistance, easily machining, thermal operation ability and high module of elasticity are required mechanical specifications for guide pillars. Necessary information for design and selecting the type and dimension of pill are thickness of bolsters, weight of bolsters and the distance between punch and matrix in the case that the die be open so that called stroke.

## IV. GUIDE BUSH:

Guide bushes are used in order to lead the guide pillars on the dies and their material depends on the material of guide pillar and it must be made of such a material that is softer than the guide pillar. These members must be strong enough in front of wear and has proper thermal operation ability. In designing these parts the die stroke, bolster thickness and the guide pillar diameter are important.

## V. SHANK:

Shank is a pipe that is installed on the upper bolster and gets inter the hole which is designed for it in the press. Shanks are available in two groups welded and screwed. Mechanical specifications which are required for determining the material of shanks are easy machining, wear resistance, high hardness, impact resistance and high toughness.



For designing the shanks of common dies a designer should follow some procedures which are depicted in

## VI. DIE STRUCTURE:

### Guiding:

Stock guide, guide rails, guide pins (elastic and solid), pilots

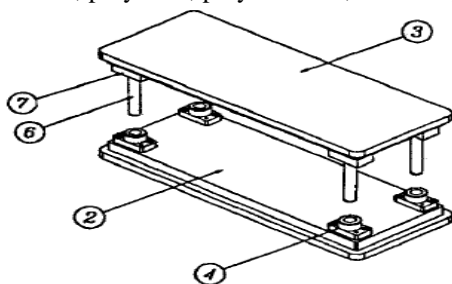
**Stripper:** movable elastic and solid

**Stop pin:** solid and elastic,

**Finger stops:** adjustable and fixed

### Die material

Carbide, rubber, polyester, polyurethane, zinc alloy, etc.



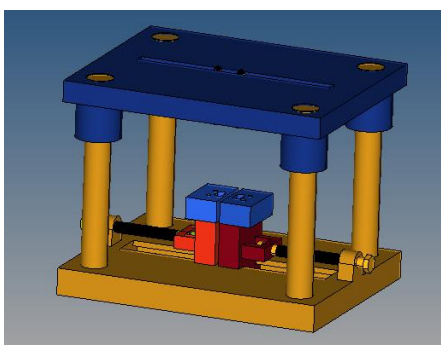
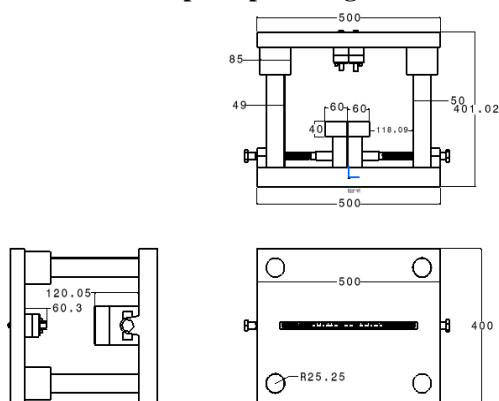
Assembled die

Table of die specifications

ITEM	QTY	NAME	MATERIAL
1	1	REC.FOUR PILLAR	Cast iron
2	1	LOWER SHOE	Cast iron
3	1	UPPER SHOE	Cast iron
4	4	BUSH	Steel
5	4	GUIDE PILLARE	Steel
6	4	GUIDE	Steel
7	4	FLANGE	Steel

Three dimensional view of die in the assembly environment

### Variable pitch punching tool:



## VII.PROCEDURE:

Punching tool consists of two dies top die and bottom die. In this paper we divided the two dies in two parts. The movement of both the dies are done by the guide way and T slot which are controlled by using lead screw. The top die is calibrated by arranging it to bottom die the tool bits are placed in exact positions in the given holes in the bottom die. The Lead Screw is now fixed to the slots and the top die is moved. The required pitch is obtained by aligning the lead screw and pitch calculated using the washers provided just like markings at a distance of 5mm each on both the sides of the guideway. The bottom die is fixed to the frame using bolts and for maximum accuracy Dowell pins are used in tightening the bolts to the frame. Huge vibrations are produced when the machine in operation so these vibrations are controlled using the high tension springs.

## VIII. LIMITATIONS:

- Operator should operate accurately while changing the pitch values. He should identify the how many rounds he need to rotate the screw in order to get the required pitch.
- Operator should change the die pitches (i.e bottom die, top die ) at a time so he can operate accurately.
- While changing the dies for different slots operator should be careful and he should operate safely.
- Operator should check pitch randomly while punching.
- Operator should insert the sections without disturbing the tension springs in common tool.
- Tool has to be firmly fit to the punching press.

## IX. CONCLUSION

Standardizing of common tools for punch metal die is so important in industry and moreover, using this purpose has some benefits such as:

- 1- Minimize the designing time of mechanical pieces
- 2- The possibility of designing and drawing of pieces and three dimensional viewing them in as a single or as an assembled one in the complex is possible.
- 3- Using this method makes the same appearance for all the common parts of various dies.
- 4- Using this method standardize more the manufacturing cycle of common dies.

## REFERENCES

1. Metals Handbook (Forming), ASM, Vol. 14, 1988.
2. C.W. Wegst, Stahlshl Ussel, Verlag stahlschlusssel wegst GmbH, 1989.
3. C. Donaldson, G. H. Lecain and V.C. Goold, Tool Design, McGraw-Hill, 1943.
4. F. W. Wilson, P. D. Harvey and C. B. Gump, Die Design Handbook, McGraw-Hill, 1955.
5. J.R. Paquin, Die Design Fundamentals, Industrial Press INC., 1962.
6. D. wolff, Mechanical Desktop 6.0 Quick Reference, McGraw-Hill, 2000.
7. R. Cheng, Master Mechanical Desktop, Auto Desk Press, 1997.