DESIGN & ANALYSIS OF PROGRESSIVE DIE FOR RIM

Kunal V Badgujar[1]
Prof. P. S. Bajaj & K.S. Vishwakarma
Email:badgujarkunal89@gmail.com
Department of Mechanical Engineering
Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal
North Maharashtra University, Jalgaon

Abstract -Rim is one of the most important part in internal expanding brake. It is the part on which brake shoe is mounted. This component is of curved shape, on outer side of this component brake shoe is mounted & on inner side web is mounted. In this project the main task is to design the press tool die which is of progressive type. The component is to be design for two operations i.e. Piercing, Blanking, Slotting, Lancing, Dimpling & Trimming. My role in this project is to design a progressive die which will manufacture a rim in accurate dimension within tolerance limit & should be accepted by customer i.e. BOSCH India Pvt. Ltd. Jalgaon. While designing this tool my aim is to integrate some of processes of sheet metal so that the manpower time & machine required for manufacturing of rim can be reduce. After designing I will prepare Cad model by using NX-CAD software & Analyse is done by using ANSYS for testing failure of each die insert & punch and finally manufactured. Then fabricated die is tested on press machine & manufactured component is compared with standard sample given by Bosch. I am designing this tool for Chinmay engineering Pvt. Ltd. which is a vender company of Bosch & Jain. After designing the die is fabricated in the tool room of Chinmay engineering Pvt. Ltd. & Tested in press shop on Mechanical press machine. The manufactured component (Rim) is then measured & compared with the dimension & sample component given by Bosch India Pvt. Ltd.

Index Terms - Internal Expanding Brake, RIMProgressive die.

I. Introduction

A progressive die performs a series of fundamental sheet metal operations at two or more stations during each press stroke in order to develop a work piece as the strip stock moves through the die. The work piece on progressive dies travels from one station to another, with separate operations being performed at each station. Usually the work piece is retained in the stroke until it reaches the final station, which cuts off the finished piece .All station work simultaneously at different points along the work strip, which advances on station at each stroke of ram. Thus a complete part is produced with each stroke .Progressive dies generally include blanking and piercing operations but a complicated progressive die can do the operation of bending, forming, curling and heading also .Each workstation performs one or more distinct die operation, but the scrip must move from the first through each succeeding station to produce a complete part .One or more idle station may be incorporated in the die ,not to perform work on the metal but to locate the strip, to facilitate inter station strip travel, to provide maximum size die sections or to simplify their construction .

The operation performed in a progressive die could be done individual dies as separate operations but would require individual feeding and producing. In a progressive die the part remains connected to the stock strip, which is fed through the die with automatic feeds and positioned by pilots with speed and accuracy. The linear travel of the strip stock at each press stock is called the progression, advance or pitch and is equal to the interaction distance. The unwanted parts of the strip are cutout as it advances through the die, and one or more tabs are left connected to each partially completed part to carry it through the stations of the die. Sometimes parts are made from individual blanks, neither a part of, nor connected to a strip in such cases mechanical fingers or other devices are employed for

the station to station movement of work piece. The selection of any multi-operation tool, such as progressive die, is justified by the principle that the number of operations achieved with one handling of the stock and produced part is more economical than production by a series of single operation dies and a number of handling for each single die.

Where tool production requirements are high, particularly of production rates are large, totally handling cost is saved by progressive fabrication compared with a series of single operation are frequently greater than the costs of the progressive die. A progressive die should be heavily constructed to withstand the repeated shock and continuous runs to which it is subjected, precision guide post and bushings should be used to maintain accuracy .Lifters should be provided in die cavities to lift up or eject the formed parts and carrier rails or pins should be provided at the last station .When practical, punches should contain shudder or kicker pins to aid in disposal of slugs. Adequate piloting should be provided to ensure proper location of the strip as it advances through the die. The striper plates should engage guides before contacting the strip.

A. INTRODUCTION TO COMPONENT

Brake shoes are typically made of two pieces of steel welded together. The friction material is either riveted to the lining table or attached with adhesive. The crescent-shaped piece is called the Web and contains holes and slots in different shapes for return springs, hold-down hardware, parking brake linkage and self-adjusting components. The brake shoe carries the brake lining, which is riveted or glued to the shoe. When the brake is applied, the shoe moves and presses the lining against the inside of the drum. The friction between lining and drum provides the braking effort. Energy is dissipated as heat.

In designing of rim of brake shoe mainly used press operation like forming, dimpling, lancing, blanking and piercing. Also dimpling operation gives projection for projection welding between rim and web. The operation involving in the manufacturing of rim are listed below,

1. Piercing: Two holes of 5mm dia. having centre distance of 139.12mm.
2. Forming: 6 triangular shape forming & 2 diamond shape forming required specific locations.
3. Piercing: square piercing of length 2.5mm & width 4mm
4. Dimple: 8 Oval shape dimples are required for projection spot welding with Web.
5. Forming: Finally half round shape of 94 mm. rad. is achieved

II. PROBLEM STATEMENT

Rim is the component on which brake liner is to be applies. So I must be more concise while designing the die, following challenges is there in front of me

1. To design a press tool die, this will manufacture the rim in accurate dimension & within tolerance limit so that it should perform its task properly.
2. To design a progressive Die resulting in large production volume at less man & machine power.
3. To do the analyses of Punch & die insert in ANSYS Software.

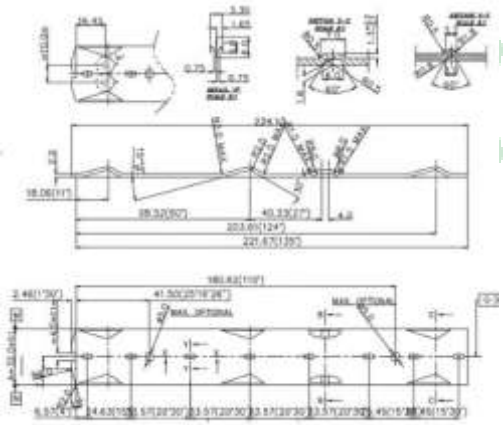


Figure 01

III. Design

A. Layout of component

1. Piercing 1: Two holes of 5mm dia. having centre distance of 139.12mm are pierce first of all because then this hole will maintain position of sheet by supporting pilot punch.
2. Piercing 2: Rectangle holes of 4×2.5mm is pierce at the extreme left edge of sheet.
3. Forming: Forming of 3 triangular shape & 1 Diamond shape are punched on front side of leading component & at the same time 3

triangular shape & 1 Diamond shape are punched on the rear side of trailing component.

4. Dimple: 8 Oval shape dimples are punched on centre line of component. These dimple are used for projection spot welding of two components. (i.e. Web & Rim which together forms base of brake shoe on which brake liner is applied)
5. Piercing 3: there is 5 mm extra material in between two material, this material is removed by this processes of piercing.
6. Blanking: by this processes the unbended final shape of component is removed.
7. Forming: Finally half round shape of 94 mm. rad. is achieved by different die.

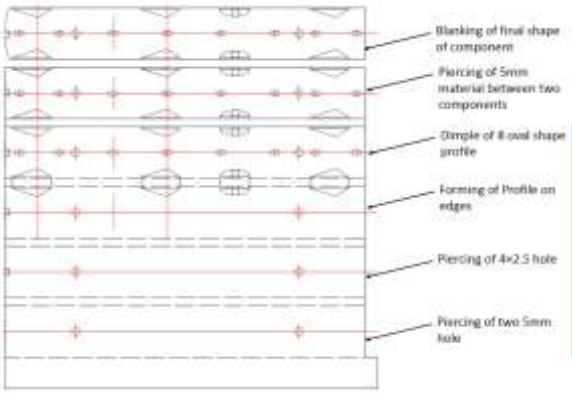


Fig. Layout of component

B. Design of Piercing punch for 4×2.5 mm □ hole

Assuming that the piercing punch as consider as one end is fixed and compressive force is acting on other end. Here for cutting operation (piercing operation) 80% of cutting force is acting on punch as compressive nature. We know that the compressive force on the punch is equal to the shear force on sheet metal.

Cutting force on piercing punch

$$S_{MS} = \frac{P}{A}$$

For rectangular punch

$$P = 2(l + b) \times t \times S_{SH}$$

$$A = l \times b$$

Where

S_{MC}= Mean Compressive stress

S_{SH}= Shear stress of raw material

t=Material thickness

l=length of punch

b=width of punch

∴

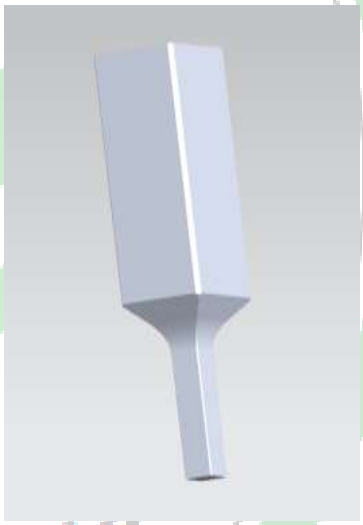
P=2(4+2.5)×2×220= 5720 N

$$A = 4 \times 2.5 = 10mm$$

∴

$$S_{MS} = \frac{5720}{10}$$

S_{MC}= 572 N/mm^2



IV. ANALYSIS

A. Piercing punch

Material Properties:

Density: 0.283lb/in3

Young's modulus: 210 GPa

Poisson's Ratio: 0.3

Boundary condition:

As the piercing punch as consider as one end is fixed and compressive force is acting on other end.

The compressive force = 5720N

The deflection & stress is find out acting on punch

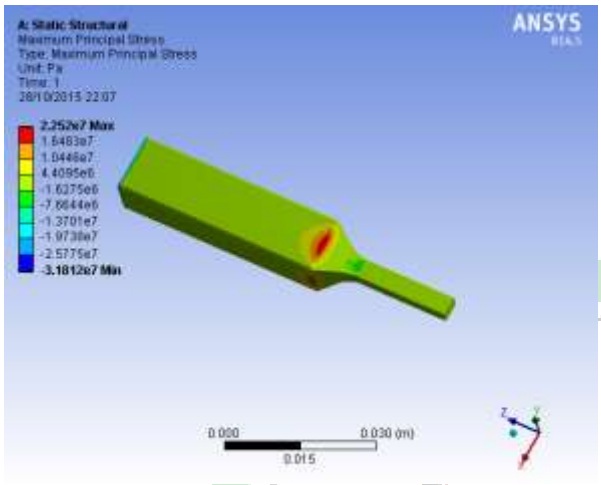


Fig.: Maximum principle stress Piercing punch

V. RESULTS

The below result shows that theoretical stress on punch is 572 N/mm^2 & Ansys shows 22.52 N/mm^2 this means the design of punch is within the stress limit. The punch will not fail while working.

Table: stress values in N/mm^2

Part	Theoretical	Ansys
Piercing punch	**572 N/mm^2**	**22.52N/mm^2**

VI. CONCLUSION

From above study I can conclude that

1. For manufacturing the sheet metal component press tool of progressive type is more benefical because it reduces manufacturing cost, manufacturing time, manpower requirement & machine involved in manufacturing.
2. The design of progressive die is esier by using CAD software like NX-CAD & analysis of the die in ANSYS software gives the strength of die components.
3. By observing the analysis graph I can conclude that all the punches are safe for HCHCr (die Steel) material.

VII. REFRENCES

1. **Design study of the geometry of a punching/blanking tool**
   U.P. Singh(Department of Mechanical and Industrial Engineering, University of Ulster, Jordanstown, UK) A.H. Streppel and H.J.J. Kals (Department of Mechanical Engineering, Twente University, Enschede, Netherlands),Journal of Materials Processing Technology, 33 (1992) 331-345
2. **Progressive Tool Design and Analysis for 49 Lever 5 Stage Tools**
   H. Ameresh[1], P.Hari Shankar[2](Dept. of Mechanical Engineering),
   G. Pulla Reddy Engineering College, Autonomous, Kurnool, IJCTT – volume 4 Issue 7–July 2013
3. **ANALYSIS AND SIMULATION OF PROGRESSIVE DIE**
   Raja ShakarappaAssistant Professor, Dept. of Mechanical Engineering, BKIT, Bhalki, IJRETVolume: 03 Special Issue: 03, May-2014
4. **DESIGN OF PROGRESSIVE DIES**
   K.Kishore Kumar1 , Dr. A.Srinath2 , M.Naveen3 , R.D.pavan kumar4 1,3, Assistant Professor, Research Scholar, Dept.of Mechanical Engg, K L University 2 Professor, Department of Mechanical Engineering, , K L University, 4, Mtech (CAD/CAM) K.L.UNIVERSITY, IJRETVol. 2, Issue 3, May-Jun 2012, pp.2971-2978
5. **Design and Analysis of Progressive Tool**
   Ch.Mastanamma 1, K.Prasada Rao 2,Dr. M.Venkateswara Rao3 1. PG Student, Department of Mechanical Engineering, Bapatla Engineering College, Bapatla, Guntur, India 2. Asst.Professor, Department of Mechanical Engineering, Bapatla Engineering College, Bapatla, Guntur, India 3. Prof. &H.O.D , Department of Mechanical Engineering, Bapatla Engineering College, Bapatla, Guntur, India, IJERT Vol. 1 Issue 6, August - 2012 ISSN: 2278-0181
6. **Progressive Die Strip Layout Optimization for Minimum Unbalanced Moments**
   SerdarTumkor, Kishore Pochiraju of Design and Manufacturing Institute, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ 07030 Manufacturing Engineering Division of ASME APRIL 2010, Vol. 132