Design and Fabrication of Strip Cutting and Bending Machine

Mamta Pawar[1], Shivam Vishwakarma[2], Pooja Nagpure[3], Mukul Masram[4], Aparna Jogwe[5], Sneha Payak[6], Sumedh Raut[7]
[1]*Assistant Professor, Mechanical Engineering, DBACER, Nagpur*
[2,3,4,5,6,7] *Student, Mechanical Engineering, DBACER, Nagpur*

***Abstract*- This paper reports the synopsis of design simulation and analysis of strip cutting and bending machine. It is a small fraction of a bigger study. Analysis of various components that make up the final design was done in order to establish the forces, stresses and dimensions. This is an era of automation, because of some basic reasons like accuracy, production rate, requirement of identical parts, working conditions, reduced labor work. Automation is now getting its roots in every form of industry, it can be production, finishing, transport, etc. It is a necessity for all to increase their production rate while increasing the ease of working. Automation in any sort of industry results in increasing of capital of the industry. Thus, research was about designing and construction of a machine that gives high quality product with less manual work and more accuracy. In this era of expensive capital, cheap alternatives are of immense need because the ascending level of capital is resulting in doom production. To descend the production cost and increase the production rate we chose this endeavor to meet the goals set up for the betterment of automated future.**

I. INTRODUCTION

Bending and shearing is required in most of the manufacturing industries. Bending and shearing machine allows the producer to obtain the desired product in as less time as possible. The motive behind making of this machine was to increase the production rate and decrease the labour cost and manual fatigue. The bending and shearing machine will provide the producer with the customized capacity and product specifications required. This prevents the producer from buying the high capacity and high cost machines that are not necessarily required. As the producer may need identical products, the bending and cutting machine would reduce the human errors and increases the accuracy of the product.

The cutting and bending machine comprises of various parts that are, the frame, pneumatic cylinder, punch and die set up and additional metal strip feeding mechanism.

The machine works on the basic principle of shearing and bending which includes application of force with clearance been taken into consideration. This allows the punch to shear the strip and bend it down. The punch reciprocates with help of pneumatic cylinder which in turn is attached with the dovetail guide ways. These dovetail guide ways allows the punch to get the straight line motion.

The feeding mechanism comprises of series of rollers which will be handled manually to allow the specified feed. The rollers help to straighten the metal strip that is to be fed. The controlled motion of the punch is foot operated.

Thus the optimum available solution was to go for the manufacturing of the customized machine either than buying the over expensive machines and importing it.

II. LITERATURE REVIEW

Shearing and bending of strip demanded the study of various parameters like clearances, fixing the degree of freedom of reciprocating punch and the amount of force required. For literature review extensive data is collected from various journals and books EXPERIMENTAL ANALYSIS OF DIE CLEARANCE DISTRIBUTION IN A PRESSTOOL ASSEMBLY, gave the idea about die clearance being important parameter in sheet metal manufacturing, it gives the comparison of percentage die clearance and its results and analysis Chapter 10, machine tool design AMT Certification Program Study guide, gives the knowledge about the different types and shape of the guide way design that can be used for

restricting the motion and it also gives the knowledge about guide way installation, alignment and design criteria.

Bending and Forming Tools by Nageswara Rao Posinasetti gives the information about the bending process, bending radius and the percentage clearance required.

An Overview of effect of Punch Tool Wear Radius on Burr Formation In Sheet Metal Blanking studies the effect of burr formation in comparison thickness, clearance, and wear radius.

III. METHODS AND MATERIAL

Methods

- Attach the required punch and die setup in the machine as per the required product
- Fix the strip in the feeding mechanism
- Check all the electrical and pressure line connections
- Feed the strip by rotating the roller as per the required length
- Press the foot pedal to bring down the punch
- Collect the strip in the bottom pan

Material

- Frame of machine is made of mild steel
- Punch and die are made of high carbon high chromium steel (HCHCR)
- Strip material of strip to be fed NiCr44

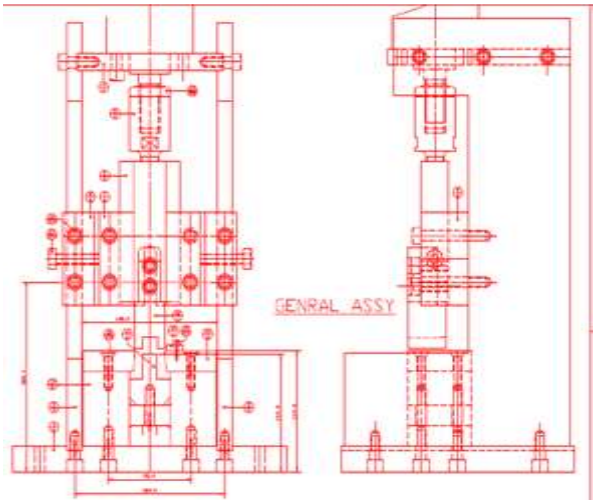

Fig 1. General Assembly

IV. CALCULATIONS

Fig 2. Raw Material Dimension

Cross section area for shear = 0.8×2.5 mm^2

$= (0.0314) \times (0.0984) = 0.00308$ inch^2

$\because$ (1 mm = 0.03937 inch)

Now,

Force required = 0.0032×25

$= 0.08$ ton

$= 80$ kg

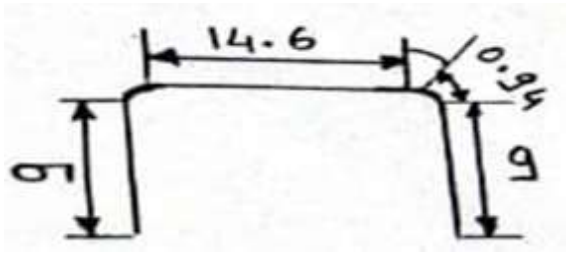

Fig 3. Product Dimensions

Total length = $14.6 + (0.94) \times 2 + 2(9)$

$= 34.48$mm

0.8 mm = 0.0315”

2.5 mm = 0.0984”

Area of cross section = $0.0315 \times (009840$

$= 0.0331$ inch^2

$S_{ut} = 25$ ton/ inch$^2 \approx 380.13$ MPa

$\therefore S_{ut} = F/A$

$\therefore F = S_{ut} \times A$

$\therefore F = 25 \times (0.031)$

$\therefore F = 0.0077$ Ton

$\therefore F \approx 7.8$ Kg

Optimum clearance for shearing

$C = 0.0032 + \sqrt{S_{ut}}$

$= 0.0032\ 1\ (0.8) \times \sqrt{388.13}$

$C \approx 6.05$ mm

Now,

Shearing clearance = 6% of thickness = 0.06×0.8

$\therefore$ $= 0.048$ mm

Bend radius R = 0.8 ------ (For hard material)

Bend radius R = 0.5 ------ (For soft material)

Bend allowances = $\alpha (R + Kt)$

Where, $\alpha = 90° = 1.570^c$

$R = 0.4,\ 2t = 2 \times 0.8 = 1.6$

$\therefore R < 2t$

$\therefore k > 0.33$

$\therefore B = 1.570\ (0.4 + 0.33 \times 0.8)$

= 1.04

∴ Bending allowance = 0.8mm

∵ standard formulae is given by

Bending allowance = thickness

∴ bending allowance = 0.8 mm

Avg no. of strokes per minute = 30

V. RESULTS AND DISCUSSION

According to the requirement of Shanti Engineering Pvt. Ltd. We designed a machine in such a way that it will increase the production rate and reduce labour cost.

Salient features of machine are as follows:-

- Compact in size: Compact size of machine helps us to install more no. of machine in plant layout.
- Increase in production rate: Due to the possibilities of installation of more no. of machines in same plant layout results in higher production of product.
- Reduction in time consumption: As the cutting and bending operation has been done simultaneously in one stroke at single station.
- Easy to handle: There in no requirement of skilled worker to operate these machines.
- Portable: Assembly and disassembly is easy due the compact design.

Fig 4. Assembled Machine

Fig 5. Side View of Machine

Fig 6. Testing Phase

VI. CONCLUSION

In the era of automation we came across an idea of design and fabrication of strip cutting and bending machine by using pneumatic cylinder which is compact in size as compared to the other machines available in market.

By considering the factors such as compact size, easy handling, precise and accurate product, increase in production, reduction in labour cost, affordable price of machine our machine is more preferable for the particular product compared to the other machines available in the, market.

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