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Design and Manufacture of Prograssive Tool by Cad/Cam Technique

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Abstract- "Sheet Metal forming in modern industry deal with complicated shapes and the forming processs consists of several successive operations, until the final shape is formed. The process sequence, die geometry ,perform shape/ blank shape and process parameter at each stage are designed based on past experience and trial and error.

Conventional computer aided design (CAD) system have dramatically reduced the workload of the human design and reduced the duration of product design cycle.

This paper presents integration of CAD/CAM technology, maximize productivity through automated industry specific process in progressive die design software, streamlining complex processes and automating tasks for remarkable time savings.

The objective behind the implementation of integrated design and manufacturing system using CAD/CAM technique is an integrated approach ,complete design tool to assist the designer in all phases is ability to build precision tooling in less time and at lower cost, relatively easy to implement and well suited to industry."

I. Introduction

The progressive die perform a series of fundamental cutting and forming operation typically on continuous sheet metal strip or stock.

These operations are performed simultaneously at two a or more stations during each press stroke as the strip progresses through the die to produce a part.

The decision to produce a part progressively is determined by two factors:

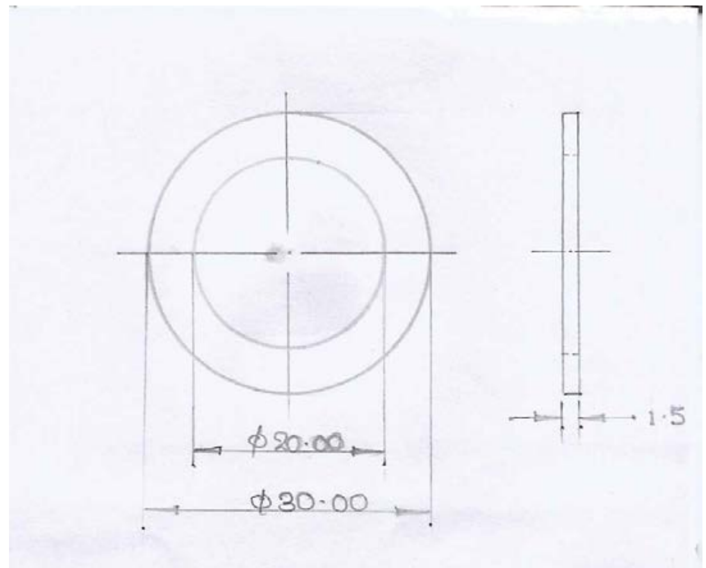
- The production volume and part complexity.
- Strip development to address factors contribute to part quality, tool maintenance, tool life and ultimately tool cost.

These factors are instrumental in design and construction of tooling.

II. Component Analysis

Component name	: Washer
Material	: Mild Steel
Thickness	: 1.5
Shearing Stress	: 110 N /sq mm.

Component Diagram:



III. Layout of the Stock Strip

The components are to be ultimately blanked out of a stock strip, hence precaution is to be taken while designing the dies for utilizing as much as stock as possible.

It is also necessary in progressive dies, to ensure continuous handling of the scrap on the die block which means that the scrap strip should have sufficient strength.

- Allowance for Multi blank die:
  - Between the blanks with pitch ….. T min.
  - Between the blanks diagonally ….. T min.
  - Blank to the edge of the material… 0.5 T min
  - (because if there were a problem, the width of the material used could easily be increased)

Optimum utilization of the stock strip (or)

Economic factor efficiency = Area of the component x 100 x No. of rows / pitch x width of the strip.

Optimum utilization of stock strip should be above 60%.

Stock strip layout:

Area of the component = 0.78 x (30x30)
Thickness of the strip (t) = 1.5mm
Strap bridge = 1.2 t =1.2*1.5 =1.8 mm
Where,
t = thickness of the stock strip.mm

Pitch (stock advance) = 31.8.mm

No. of rows = 04
Strip width = 112.2.mm

Economic factor efficiency =
{Area of the component x 100 x number of rows / pitch x strip width}= {0.78 x 30 x 30 x 100 x 4 / 30.8 x112.2} = 78 per cent.

IV. Establish Centre Line of Pressure:

(Finding the centre of pressure of blanking section)
Blanking die is too large; it would better be positioned on the same axis as the ram of press.

This way the centre of the press force and the centre of its distribution throughout the blanking section will coincide.

To position a powerful blanking station slightly off the center may result in greater than usual wear of t die bushing, caused by the dies inclination in the direction of the lesser support. In order to place a complicated shape dead on centre, first the centre must be located.

Method of calculating centre of pressure:
X (centre) = L_1 x X_1 + L_2 x X_2 + … LN x XN / L_1 + l2 + … LN.
Y (centre) = L1 x Y_1 + L_2 X Y_2 + … + LN X YN / L_1 + L_2 + … + LN
Centre of pressure (c.p) of Die block from x,y(Ref)
= (88, 64)

V. Design of Progressive Die Elements:

All the punches and dies are assembled within their respective blocks. The blocks themselves are firmly and with great precision attached to their supporting backup plates and to their die shoes.

For mounting of blocks, socket head cap screws are most often utilized.

The precision alignment is achieved by at least two dowel pins per block.

Smaller blocks, four screws and two dowel pins will suffice.

Die Block

The Die block is made of high- quality steel hardened and precision ground to exact size.

Die blocks, running in dies with a stationery stripper, would not contain tapped holes for screws, with counter bores in the stripper plate ,relief holes through all the blocks and a final tapped hole in the bottom die shoe.

The Distances between various openings, especially those of die(punch) and dowel pin holes, are of the utmost importance ,and their precise locations cannot be over emphasized.

According to Oehler findings, the thickness of the die block can be made equal to

T_d = 3 x Square root of F_{sh} …mm.

Where,
T_d = thickness of the die blocks in mm
F_{sh} = total shearing force in N /sq.mm

Calculation for thickness of Die Blocks(Td) :
Thickness of die block t_d= 3 Sq. root of $F_{sh.}$ …mm

Total shearing force (F_{sh}) = piercing force + blanking force.
Piercing force = L X T X $T_{sheer….N}$
Where,
L = length of cutting edge (or) Peheripery to be cut in mm
T = Thickness of the stock strip in mm
T shear = Shearing strength of material in Kg/mm^2

Piercing force = L x T x T_{SHEAR} =0.78 *20*20*1.5*110 =51480 N

Blanking force = L x T x T_{shear} =0.78*30*30*1.5*110 =115830 N

Total shearing force F_{sh} =51480 +115830 =167310 N.

Stationery Stripper:

Strippers as used in the die work, are either stationery or (non-moving) or floating.

Stationery strippers are low in cost ,when stationery stippers are provided with milled channel made to accommodate the strip material.

It retains the strip in a fixed location, preventing it from moving anywhere, up, down or sideways.

The stationery strippers is attached to the die block and it can be using the same screws and dowel pins necessary for attaching the die block to the die shoe. This way, a single set of dowel pins provides for the alignment between all plates, and a single set of screws is used for their attachment.

Thickness of stripper plates = 0.5 x Td …mm
=0.5*3 sq.root of Fsh.

Punch Plate:

The punch plate is designed, dimensioned and manufactured similarly to the die block.

Purpose of accuracy, when using NC block cutting equipment provision, both of these plates should be viewed and manufactured from the same location from the top view of the die.

The punch plate, since it provides the support for all punch shanks, must be adequately thick but not in excess of what is necessary, in order not to increase the weight of a die.

The upper back up plate has only clearance opening for them.

Thickness of punch plate (p) = 0.5 x T_d in mm.
= 0.5 * 3 sq.root of F sh.

Back up plates:

Back up plates are made of hardened steel, 9.5mm thick For general work, 12.5mm thick for heavy duty jobs.

Blanking / piercing punch:

The ratio of the punch diameter to the stock thickness Must satisfy the condition (d/t)= 1.10 min.

The maximum length of the punch is calculated by the Formula = (3.18 x d / 8) Sq. root of E x d / s x t

Where L = Maximum length of the punch in mm
d = Punch diameter in mm
t = thickness of the stock material
E = Modulus of Elasticity in N / sq.mm.
s = Shearing stress of the material N/ sq.mm

Blanking and piercing punch calculations:

Cutting clearance (c) : 4% of stock thickness
: 0.04 *1.5 =0.06 mm per side.

Blanking punch dimensions:
Blanking punch = size of the blanking die - 2 x C
Where , C = Cutting Clearance per side in mm.
Blanking punch = 30 – 2*0.06 =29.88 mm.
Blanking Die = Dia 30.00 mm.
Piercing punch Dimensions
Piercinng die = size of the piercing punch - 2 C
= 20 -2 *0.06 =19.88 mm.

Piercing punch = Dia 20.00 mm.

VI. Tool Specification:

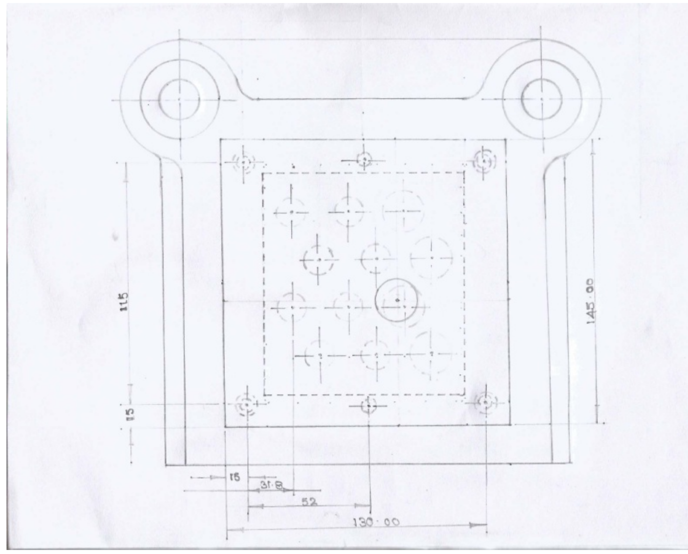
Press capacity	:23 Ton.
Type of stroke	: Fixed
Type of Press	: Mechanical
No. of slides	:Single
Method of feeding	: Manual
Type of Die set	: Rear piller

Press capacity $P_{t\,=}$ 1.2 x Total shearing force.
= 1.2 x 184041
= 220849.2 N
= 22.5 TON.

Total Shear Fsh total = shearing force (F1) + stripping force (F2).
=167310 + 16731 =184041 N

Shearing force (F1) = 167310 N
Stripping for(F2) = 10% of shearing force.
=10 *167310/100=16731N

VII. Tool Assembly:



VIII. VIII Die Cost Estimation:

Designing a Die to produce a part and build a tool, amount of cost:

1) Die Design : USD 3,500.00
2) Die Manufacture : USD 40,000.00

IX. CONCLUSION

The tool and die industry is facing three service challenges. First the increasing competitive market has forced Companies to push out new products more frequently to attract customers. Second – Consumer Expectations becomes more sophisticated, the product quality demands invariably requiring the use of new materials with high standards of accuracy and finish.

Third - The newly industrialized and industrializing countries, use of conventional CAD/CAM system has helped to automate the drafting, NC programming in design and manufacturing. This has partly helped to alleviate the problem posed by the challenges identified above.

A long term solution is to introduce integrated CAD/CAM practices to the die making industry to help it meet with the challenges for the planning designing and manufacturing .

References

[1] Dallas .D .B .Progressive die design and Manufacturing, Mc Graw –Hill Book Companey, New York,1962.

[2] Donalson, Goold, lecaian. 'Tool Design' Tata Mc Graw-Hill publishing Companey,New York,1988.

[3] Fundamentals of Tool Design Study Guide,dvo7pub4- Sme.

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