Investigation of Progressive Die Tool for Electrical Appliances

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Abstract-Nowadays, progressive dies have a special role in various methods of sheet metal production. Progressive dies have a unique role in different techniques for sheet metal generation. A progressive die performs a series offundamental sheet-metal operations at two or morestations during each press stroke in order to develop a workpiece as the strip stock moves through the die.The most important of this paper is the progressive die design software application in unigraphics guides you through all of these stages required to develop a progressivedie. The design procedure however requires a less time and lower mastery. They are likewise especially reasonable for creating small and fragile parts, for example, the connectors utilized in phone items or lead outlines for the IC Industry. Unigrahics progressive die design is a comprehensive solution for quality die design, supporting associatively with the part design at every stage of die development and including a variety of functions specific to automotive progressive dies.

IndexTerms **-**Progressive Die, 3D software, ICindustry, Sheet metal generation.

I. INTRODUCTION

Design of sheet metal dies is a large division of tool engineering, used in varying degree in manufacturing industries like automobile, electronic, house hold wares and in furniture.There is no doubt that accuracy achieved by the new ideas in design and construction applied by the press tool designer, coupled latest development made in related fields made more productive, durable and economical. Progressive tool performs two or more operations at different stages in each stroke.

The stock strip is advanced through a series of stations that form one or more distinct press working operations on the strip to get the component.

PROBLEM STATEMENT

In traditional manufacturing Process there was high loss of time, money, material and labor. The safety of the labor was compromised while undergoing different operations on different dies.

OBJECTIVE

The analysis of progressive die we can suggests the changes that can be done in tooling material and the die itself to improve the productivity. This can be done by knowing the stress acting on each part of die as well as on tools which are used in die. Another main objective of this project is we can also calculate increase in productivity in progressive die than normal compound die. This can be done by comparing the time taken in operation of a sheet metal between progressive die and normal die.

SCOPE

In progressive die the difficulties are eliminated such as burr formation on the edges, the accuracy achieved is much higher and the time consumption on product cycle is reduced much times. Human safety is a well considered factor in the progressive die.

METHODOLOGY

1) Designing of part / component as per dimension provided.

2) Reverse engineering on part / component up to raw strip material.

3) Preparing strip layout with operation stages.

4) Trial and error for maximum strip utilization with strength consideration.

5) Force calculation for plates.

6) Selection of capacity of press.

7) Design of plates and parts.

8) Assembly

II. LITERATURE REVIEW

K.Shirai and H.Murakami[1] introduces the increasing demand for press tools, a compact and practical CAD/CAM system for progressive dies. The features of this system are: (1) designing can be easily accomplished just by inputting the geometrical data of the strip and die layouts, and (2) CAM information can be directly extracted from the CAD information.

S. Kumar, R.Singh [2] studied on an intelligent system for selection of materials for progressive die components. The proposed system SMPDC comprises of two knowledge base modules, namely DIEMAT and SELHRD. The module DIEMAT is designed for selection of materials for both active and inactive components of progressive die. The module SELHRD is developed for determination of hardness range of materials for active components of progressive die. Knowledge for both the modules of the proposed system is acquired, analyzed, tabulated and incorporated into a set of production rules of IF-THEN variety. The system is coded in the Auto LISP language and loaded into the prompt area of AutoCAD.

S. Kumar, R. Singh [3] introduces an automated design system developed for design of progressive die. The proposed system is organized in 27 knowledge-base modules. The production rule based knowledge-base system (KBS) approach is utilized for constructing the system modules. Modules are user interactive and designed to be loaded into the prompt area of AutoCAD.The system is capable of automating all major activities of design of progressive die such as checking the design features of sheet metal parts, design of strip-layout, selection of progressive die components, modeling of die components and die assembly, and selection of materials for progressive die components.

M. Ghatrehnaby and B. Arezoo[4] introduces mathematical model based on Medial Axis Transform (MAT).This model is applicable to parts without suitable circular holes for direct piloting. The model analyzes the part geometry in order to find the best position for semi-direct and indirect pilots. It also optimizes the piloting system using minimum scrap strategy. A prototype software is also developed to automatically design auxiliary holes on the scrap part of the strip for piloting purposes.

H. Ameresh and P.Hari Shankar[5]worked on manufacturing 49 lever 5 stage tool, manufacturing process is press tool design.Two tools are to be designed i.e. Punching tool and Bending tool. Punching tool is a progressive tool which is having five stages, Lancing, blanking, forming.This design is the optimal design. By using this designwe can produce accurate components.

III. CONSIDERATION FOR DESIGN OF PROGRESSIVE DIE

Strip Layout Design

The preparation of the strip is the setup work of the entire research, including first searching the bend line and bend plate from the 3D CAD model of the sheet metal part, and saving information about associated geometries and features in a proper format, then unfolding the sheet metal part and designing the punches corresponding to the bending and shearing features.

Material for Die Components

The whole press tool is not required high strength material. Because all parts of press tool does not involve in operation. Here the more important members are die, punch, and hitting pad. These parts are required more strengthful material.The main principle while selecting the material for that part is given-

i. The tool material have more wear, abrasive or adhesive resistance than the part material. Also its friction force is more than part material.

ii. The hardness of material is more than the part material.

iii. Fatigue, shear, compressive strength is more than part material strength and plastic or elastic deformation strength is less than the part material strength.The material steel is used for punch and die. Steels are originally soft and machinable .Also 20MnCr5, MS materials are used where the more wear and deformation occur; such as guide pillar& Limit sleeve.

Modeling of die components and die assembly

Modeling of plate elements requires the dimensional data of die block, die gages, stripper plate, punch plate and back plate. The dimensions of plate elements as recommended by an intelligent system and stored in various output data files can be

utilized for their modeling.

Drawing on AutoCAD such as LINE, PLINE, CIRCLE, FILLET, LAYER etc. can be invoked for modeling of plate elements. Further for automatic modeling of plate elements, one may recall the strip-layout stored in a file and may insert it appropriately in the plan view of plate elements.

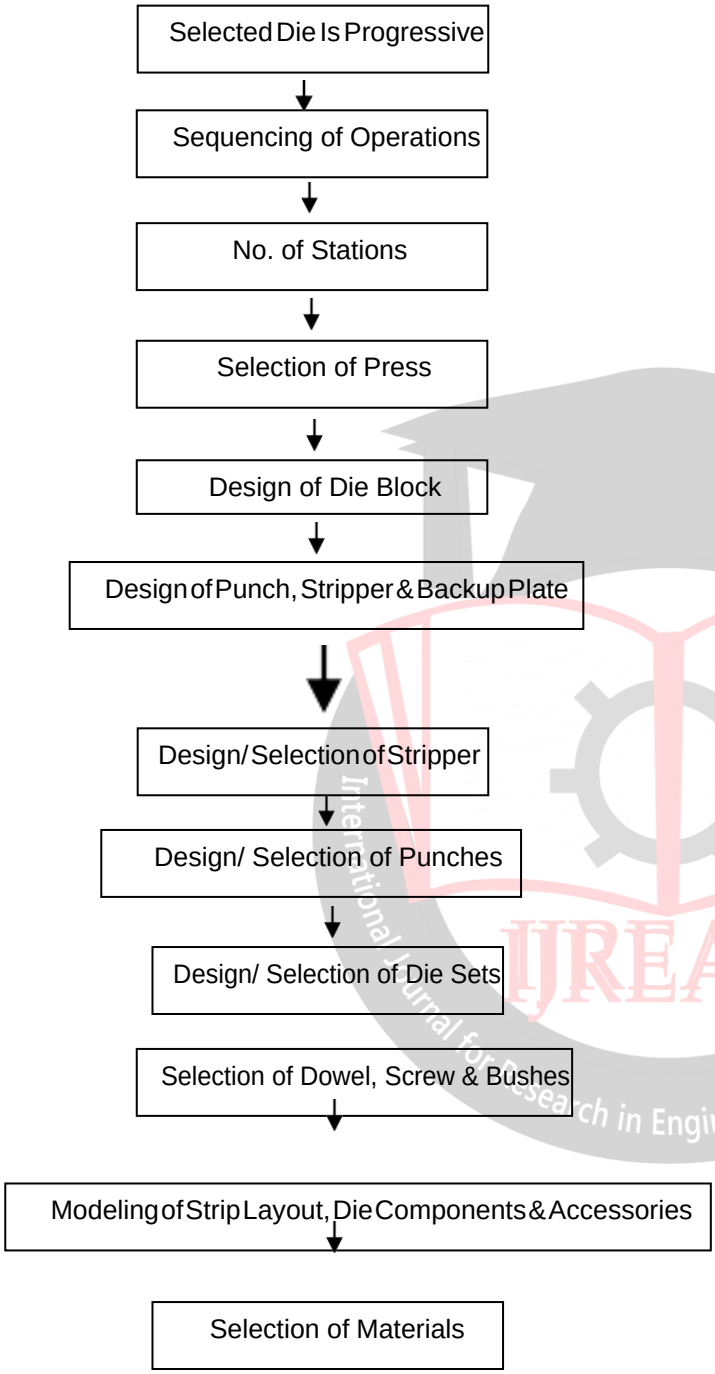


Fig: - Flowchart of Progressive Die

IV. DESIGNING PROCESS

Progressive dies perform a series of fundamental cutting and forming operations typically on continuous sheet metal strip, or coil, stock. These operations are performed simultaneously at two or more stations during

each press stroke as the strip progresses through the die to produce a part. Positioning of the stock at each station is accomplished by pilot holes or slots. As the stock advances through the die stations, unwanted material is cut out leaving one or more tabs, ribbons, or bridges to connect the partially completed part to the strip until completion. By combining stock material transfer, along with cutting and forming operations within a single progressive die arrangement, significant cost savings are realized especially on high volume production runs.

1. The initial operations such as side cuts or cropping, which do not directly affect the shape of the final product should be made in the first stage.
2. Pierced holes may be distributed over several stages, if they are closely located and functionally not related.
3. Holes with high position accuracy requirement should be punched in one station
4. If the external profile of the blank is complex, then the profile may be split into simple sections by projecting all the vertices of the blank vertically up to the edge of the strip.
5. Idle stations may be used to avoid crowding of punches and die blocks together.
6. Bending should preferably be done in the last station or prior to the parting stage.
7. Finally blanking operations and internal holes used as semi-piloting holes should be staged.

V. Strip Layout

A strip layout represents the sequence of the logical,workable operations, which is to say a sequence od idea. Factors to be considered while designing the layout are.
1.Shape of blank 2.Production of requirement 3.Burr side
4.Stock material

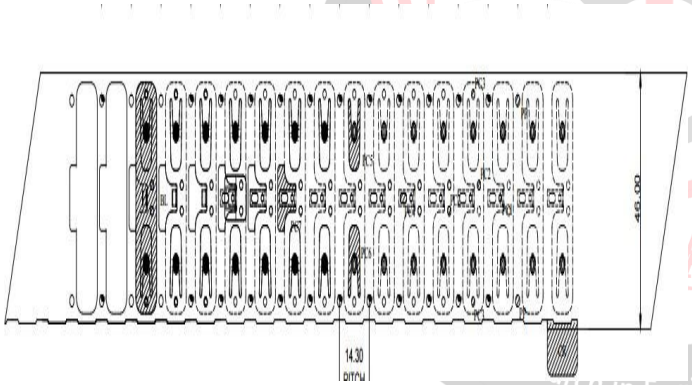


Fig:- Strip Layout

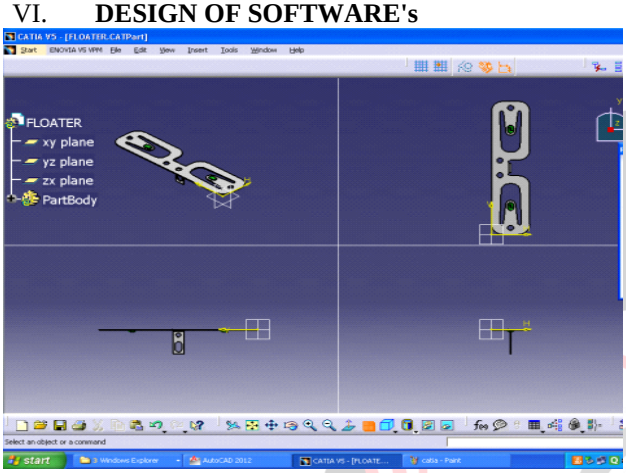
Sr.No	Description	Strip Layout
1.	Material	Copper
2.	Thickness	0.3 mm
3.	Strip Width	46.00 mm
4.	Pitch	14.30

Operations-

Sr.No	**Strip Layout**
1	Cropping
2	Pilot piercing
3	Piloting and profile piercing

4	Piloting and profile piercing
5	Piloting and profile piercing
6	Piloting and profile piercing
7	piloting
8	Piloting and profile piercing
9	Piloting and embossing
10	Piloting and profile piercing
11	Piloting
12	Down ARD Bending
13	Piloting
14	IDLE
15	Blanking
16	Piloting

VI. DESIGN OF SOFTWARE's



VII. DESIGN AND CALCULATIONS Force Calculations:

Shearing Force = (L x S x T max) L=length of the periphery to be cut in mm S=Stock thickness in mm

T max= Maximum Shear strength in N/mm Shear Force = L x S x T max

[1]Blank Area=398.67 mm*2 Cutting Area=41.9 mm*2

=398.67-41.9-41.9-2.01-2.01-1.33-2.01-

Cutting force=307.55*0.3*200

=1.88tonn=2tonn L=Cut length in mm

S=Sheet metal thickness in mm

T max =Maximum shear strength of sheet metal MPa Stripping Force-

Stripping Force=10 to 20% of C.F

=2.1*0.15

=0.315tonn Considering =15

Bending Force=Bending length.S.T max

=7.2*0.2*200

=432N=0.044tonn

Total force=Cutting force +Bending force

=2tonn+0.044tonn

=2.1 tonn

Press Tonnage=Cutting Force+Stripping Force

+Bending Force+ 20% total

=2.1+0.315+(0.2*0.044)

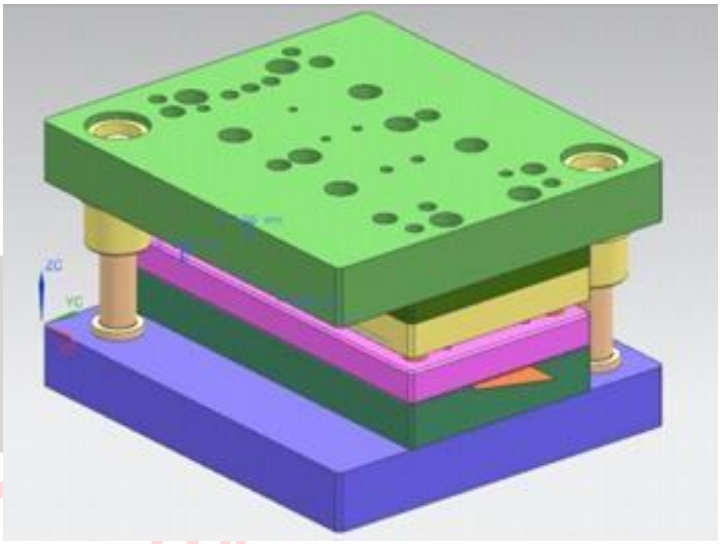
=2.898tonn

=3tonn

VIII. ASSEMBLY OF PROGRESSIVE DIE

2.01-5.06

[Actual blank area=300.44 mm*2]



Strip Utilization=Blank area/strip width*pitch

=300.44/46*10.30*100

=45.67

% Scrap=100-

45.67=54.33%

[3]Cutting Force

Cutting Force =L.S.T

max T max =200MPa

[170-240 MPa]range for copper

L=(46.86*2)+(5.03*4)+(4.08*1)+(8.45)+(6.44*2)+52

. 46+ 17.99+ 97.85

=307.55 mm

Sr.No.	Type of Plate	Material
1	TOP PLATE	C45
2	THRUST PLATE	EN31
3	PUNCH PLATE	C45
4	STRIPPER PLATE	HCHCr
5	DIE PLATE	K110
6	BASE PLATE	C45

IX. RESULT

By using the progressive die the strip utilization is more i.e. 45.67% as compared to compound die i.e. 39.73%.Also we reduced cost of desired component.

X. CONCLUSION

By using the progressive die we concluded that progressive dies not only increases the production rate but also reduces man power. Progressive dies also can bring quality and consistency in bringing quality by continues production. Progressive die increases productivity and it is very beneficial for workers as per their safety issues. Progressive die reduces cost as well as time. Using the progressive die we can perform two or more operations.

XI. FUTURE SCOPE

In the progressive die there should be some error of burr problem on blank. So there is some problem in die clearance. Also there is problem in guiding the strip over the die surface.

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