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DESIGN PROGRESSIVE DIE USING FUNCTIONALLY GRADED MATERIAL (FGAS)

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ABSTRACT

***A** progressive tool-die perform series of sheet-metal operations in a single tool (die) at two or more workstations. During each of press or stroke in order to develop a work-piece and the strip stock or moves through the die. The main advantage of progressive die design using CAD, CAM, and machining is an ability to build precision tooling with lows time-consuming. Simulation Software gives the designer to perform and freedom to take risky free decisions.*

Functionally graded materials (FGMs) are composite materials, the composition or microstructure is locally varied, that a certain variation of the local material properties is achieved. FGMs materials can be used for specific function or applications as per a requirement.
In this project, main steps are CAD parts Design, Manufacturing, and Analysis. This progressive die is designed for Fleet gaskets India Pvt. Ltd. which are further used in the automobile sector. Required modeling is done on Solid works software.

Keywords: - Progressive die forces for punching and blanking, Materials, Design analysis.

INTRODUCTION

DESIGN of sheet metal parts, related tools and dies is a large division of tooling design engineering, the technique used in manufacturing industries like automobile, electronic, electrical industries. There is high accuracy achieved by the help of cad & cam software and new ideas for design and construction applied on press tool designer, the coupled latest development made in related fields made more or more productive, economical and durable. This design is an optimal design. We can use the design and the productivity accuracy for real part will be height. Press Tools are special tools custom built to perform high productivity and produce a particular component mainly out of sheet metal component. The principal operations of sheet metal stampings include cutting operations (Blanking, Piercing, Shearing, etc.) and forming operations (drawing, bending etc.). Sheet metal items such as automobile parts (roofs, caps, fenders, etc.).Sheet metal parts of electronic equipment's, precision parts required for the homological industry they are manufactured by press tools. Commonly used tools which are major components of press working are punches and dies.

In the Punch operation, manly important parts are the system which is fastened to the ram and forced into the tool where work-piece to be processed fully supported. Die is a work holding device or designed specifically for a particular product design.

Die is rigidly supported on the base of the press machine. It carries an opening which is perfectly parallel aligned with the punch and its movement. Both die and punch work together as a unit or set and this is called a die set or tool-die set. Die and Punch both are made of functionally graded materials (FGMs).

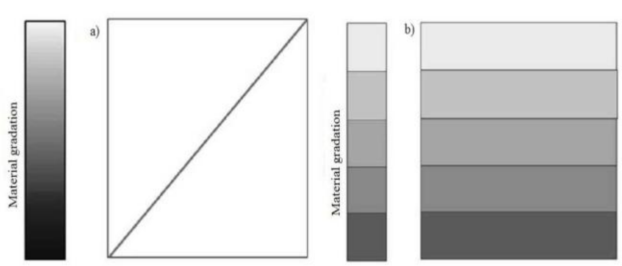
Die and Punch both parts where strength and wear resistant both properties are required. Normally working surface of the die-tool is made commonly used tools which are major components of press working are punches and dies.

Punch is an important part of the system which is fastened to the ram and forced into the die-tool where work-piece to be processed and supported. Die is a work holding contrivance, designed categorically for a particular design of a product. Die is rigidly held on the base of the press machine and load. Die carries an aperture which is impeccably working and aligned with the punch and its forms of kineticism. Both die and punch collaborate as a unit set and this is called a die set. Punch and die both are composed of different material like functionally graded material (FGMs), EN-31 with hardening, high-speed steel. Normally working surface of the Die and Punch is made Materials with changing composition, microstructure, or porosity across the volume of the material are referred to as the functionally graded material (FGMs).

Functionally graded materials (FGMs) to be designed with changing properties over the volume of the bulk material, with the aim of performing a set of specified functions for a long time.

The properties of the material in functionally graded materials (FGMs) are not uniform across the entire material, and the properties depend on the spatial position of the material in the bulk structure of the material. FGMs are designed with varying properties that include changing chemical properties, mechanical, thermal, magnetic, thermal and electrical properties. There are FGMs that are designed as stepwise-graded structures, and some designed to be continuously graded structures, depending on the areas of application and function. There are very different types of areas, in which FGMs material are now being used that are different from the initial area of applications, for which the material was invented In this paper, the different types of FGMs and their areas of application or used written below. The different types of FGMs including porosity and pore size gradient structured.

FGMs, chemical gradient structured FGMs, and micro-structural gradient-structured FGMs both functionally similar types but not same. These different types of functionally graded materials (FGMs) are presented in the next sections below.



ADVANTAGES OF FGM

Some of the advantages of functionally graded materials (FGMs).

- FGMs as an interface layer to connect two incompatible materials can greatly enhance the bond strength.
- FGMs coating and interface can be used to reduce the residual stress and thermal stress.
- FGMs coating can be used to connect the materials to eliminate the stress at the interface and end-point stress singularity.
- FGM coating not only enhances the strength of the connections but can also reduce the crack driving force.
- FGM has the ability to control deformation, dynamic response, wear, corrosion etc.
- FGM also provides the opportunities to take the benefits of different material systems e.g., ceramics and metals. The ceramic part has good thermal resistance, wear and oxidation (rust) resistance whereas metallic part has superior fracture toughness, high strength, and bonding capability.
- FGM has a wide range of applications in dental and orthopedic applications for teeth and bone replacement.
- FGM is used in energy conversion devices. They also provide a thermal barrier and used as a protective coating on turbine blades in a gas turbine engine.

PROCEDURES FOR A PAPER SUBMISSION

In the manufacturing assembling procedure, press tools are designed in two. Punching tool and bending tool. Punching tool is a dynamic device or progressive tool which is having three stages, lancing, blanking, and forming. Bending tool is used only bending purpose.

Progressive dies generally include blanking and perforating operations but a perplexed progressive die can do the operation of bending, composing, curling and heading additionally. Each and every workstation performs one and more distinct die operation, but the script must peregrinate from the first through each prospering station to engender a consummate part.One or more idle station may be incorporated in the die, not to perform work on the metal but to locate the divest, to facilitate inter-station divest peregrinate, to provide maximum size die sections or to simplify their construction. The operation performed in a progressive die could be done individual dies as discrete operations but would require individual victualing and engendering. In a progressive die, the component remains connected to the stock divest, which is victualed through the die with automatic aliments and situated by pilots with speed and precision. The linear peregrinate of the divest stock at each press stock is called the progression, advance or pitch and is equipollent to the interaction distance. The unwanted components of the divest are cutout as it advances through the die, and one or more tabs are left connected to each partially consummated part to carry it through the stations of the die. Sometimes components are made from individual blanks, neither a component of nor connected to a divest in

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such cases mechanical fingers or other contrivances are employed for the station to station kineticism of work-piece. The cull of any multi-operation implement, such as a progressive die, is justified by the principle that the number of operations achieved with one handling of the stock and engendered part is more economical than engendered by a series of single operation dies and a number of handling for every single die.

Where implement engenderment requisites are high, categorically of engenderment rates are sizably voluminous, consummately handling cost is preserved by progressive fabrication compared with a series of single operation are frequently more preponderant than the costs of the progressive die. A progressive die should be heavily constructed to withstand the reiterated shock and perpetual runs to which it is subjected, precision guide post and bushings should be acclimated to maintain precision. Lifters should be provided in die cavities to hoist up or eject the composed components and carrier rails or pins should be provided at the last station.When practical, punches should contain shudder or kicker pins to avail in the 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 afore contacting the divest. The dropping of the work-pieces through the die is the most desirable method of part ejection, but cannot always be obtained. Cutting the scrap into minuscule section simplifies the material handling quandaries and engenders a more preponderant price and return when sold as scrap metal. In the present project, the progressive die set is utilized to engender a component that is washer the designation are as follows Stock divest material is mild steel.

The thickness of strip: 1.6mm Outer diameter: 26mm Inner diameter: 12.5 mm

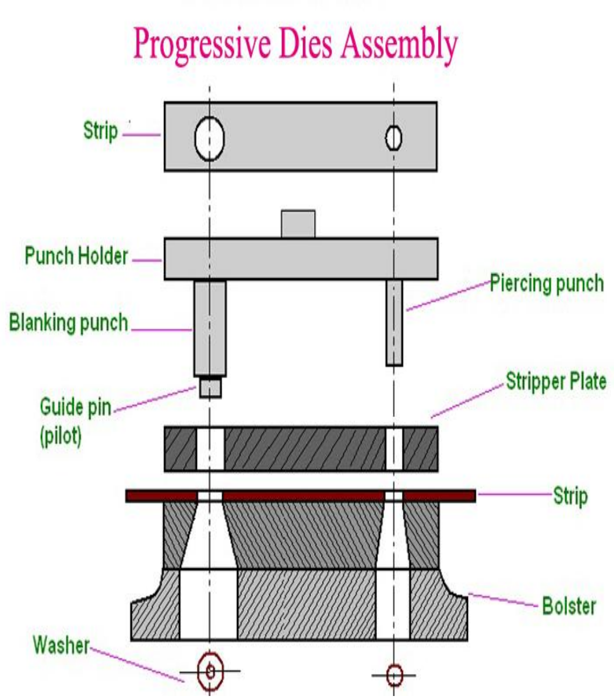

Fig. 1 Blanking punch and die

1. Plain blanking.

The material used is called the stock and is generally a ferrous or nonferrous divest. During the working stroke the punch goes through the material, and on the return stroke the material is hoisted with the punch and is abstracted by the disrober plate. The cessation pin is a gage for the operator. In practice, he victuals the stock by hand and locates the apertures to be punched as shown. The component that is abstracted from the divesting is always the work-piece (blank) in a blanking operation. Fig.2 shows a simple operation of this type.

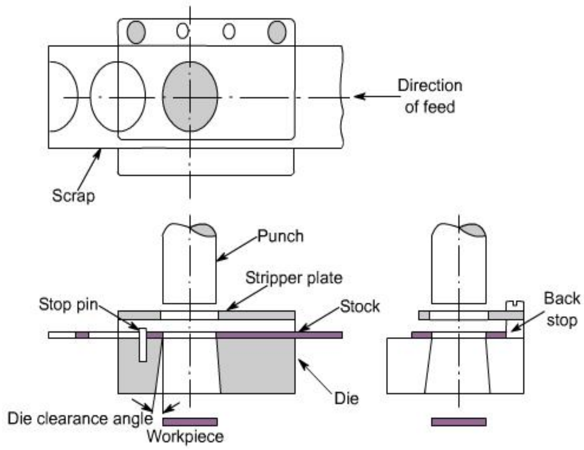

Fig. 2 Blanking punch and die.

2. Piercing.

This operation consists of simple whole punching. It differs from blanking in that the punching (or material cut from stock) is the scrap and the divest is the work-piece. Perforating is proximately always accompanied by a blanking operation afore, after, or concurrently. Fig. 2.1shows a typical perforating die assembly.

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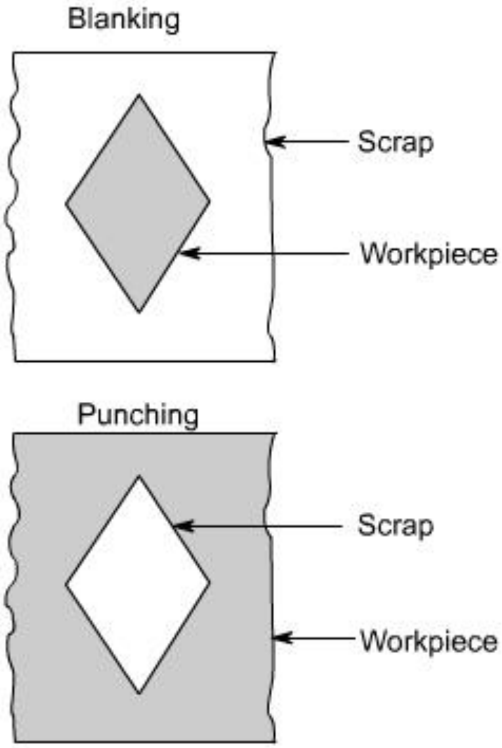

Fig.2.1 shows a blanking and punching operation.

3. Cutting action punch and die operations.

The cutting action that occurs in blanking or piercing is quite similar to that of chip formation ahead of a cutting tool. The punch contacts the work material supported by the die and a pressure buildup occurs. When the elastic limit of the work material is exceeded, the material begins to flow plastically (plastic deformation). The punch penetrates the work material, and the blank, or slug, is displaced into the die opening a corresponding amount. A radius is formed on the top edge of the hole and the bottom edge of the slug, or blank, as shown in Fig: 3. the radius is often referred to as rollover and its magnitude depends upon the ductility of the work material. Compression of the slug material against the walls of the die opening burnishes a portion of the edge of the blank, as shown in Fig. 4-11b. At the same time, the plastic flow pulls the material around the punch, causing a corresponding burnished area in the work material. Further continuation of the punching pressure then starts fractures at the cutting edge of the punch and dies as shown in Fig. 3.

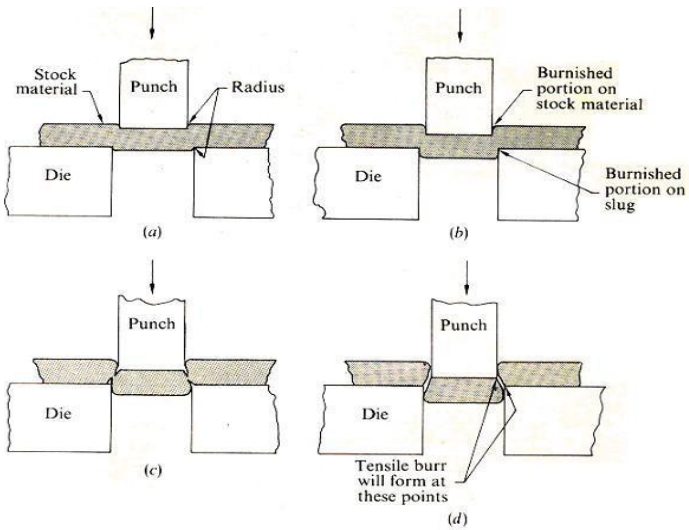

Fig. 3.2 Cutting action progression when blanking and Piercing metal.

4. Die Clearance.

Clearance is defined as the intentional space between the punch cutting edge and dies cutting edge. Clearance is always expressed as the amount of clearance per side. Theoretically, clearance is necessary to allow the fractures to meet when break Occurs; the amount of clearance depends upon the kind, thickness, and hardness of the work material. The excessive clearance allows a large edge radius (rollover) and excessive plastic deformation. The edges of the material tend to be drawn or pulled in the direction of the working force, and the break is not smooth. Large burrs are present at the broken edge. Insufficient cutting clearance caused the fractures to miss and prevents a clean break, a partial break occurs, and a secondary break connects the original or main fractures. This is often referred to as secondary shear. The secondary break does not allow separation of the material without interference, and a second burnished ring is formed. The burnished ring may appear as a slight step around the outside edge of the blank or around the inside edge of the hole. Insufficient clearance increase pressure on the punch and dies edge and has a marked effect on dying life.

5. Press tonnage.

The tonnage of a press is the force that the press ram is able to exert safely. Press slides exert forces greater than the rated tonnage because of the built-in safety factor, but this is not a license to overload. The tonnage of hydraulic presses is the piston area multiplied by the oil pressure in the cylinder. Changing the oil pressure varies the tonnage. The tonnage of mechanical presses is determined by the size of the bearings for the crankshaft or eccentric and is approximately equal to the shear strength of the crankshaft metal multiplied by the area of the crankshaft bearings. The tonnage of a mechanical press is always given when the slide is near the bottom of its stroke because it is greatest at this point.

6. Shut height.

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The shut height of a press is the distance from the top of the bed to the bottom of the slide with the stroke down and the adjustment up. The thickness of the bolster plate must always be taken into consideration when determining the maximum die height. The shut height of the die must be equal to or less than the shut height of the press. The shut height of a press is always given with the adjustment up. Lowering the adjustment of the slide may decrease the opening of the press from the shut height down, but it does not increase the shut height. Thus the shut height of a die must not be greater than the shut height of the press. It may be less because lowering the adjustment can reduce the die opening in the press.

PROCEDURE FOR PROGRESSIVE DIE DESIGN

1. Die placement Make sure that the die is set so that the material feeds parallel to the tool. The parallel feed can be achieved several ways, such as stop pins, keyways, and conical locaters. Only one type of locator is necessary. Avoid "sighting in" the tool as this process is difficult to repeat and inaccurate. When possible, try to place the center of the estimated tonnage in the center of the press and not the centerline of the die in the center of the bolster.
2. Pitch and progression make sure the feed pitch and progression are set correctly. Overfeeding or underfeeding most likely will result in a miss feed and die damage.
3. Material thickness, type, mechanical properties, verify the metal thickness and when possible, verifies that it is the right type to be used in the die.
4. Scrap ejection Make sure that all slug belts and shakers are in place and functioning properly.
5. Shut height Ensure that the shut height of the die is set correctly. Avoid using press counters to establish the finish shut height. Avoid hitting setup blocks. Because a press defects, it may be necessary to calibrate the finished shut height after the die is fully loaded.
6. The first-hit line, this is a very important step and requires careful attention. Starting the material in the wrong spot can cause half-hits of half-forms. Unbalanced cutting or forming can cause the upper and lower dies to misalign and shear. Also, incorrectly starting the material can leave loose scrap in the die. If the scrap is not removed, double metal results and is fed into the tool. This condition can cause severe die damage. A good die designer establishes a distinct first-hit line by placing a positive spring-loaded stop at this point, rather than a simple line with a message: Start strip here.
7. Bolts and fasteners Double-check all of the bolts securing the die in the press, making sure that they are tightened and secure. Make no assumptions. Despite the fact that this seems obvious, it still helps to have a checklist reminder.
8. Counterbalance Make sure the press counterbalance pressure is set properly with respect to the upper-die weight. Not doing so can cause poor ram-to-bolster parallelism, unnecessary press loading, as well as excessive wear, die shearing, a tonnage loss, and a press energy loss.

Progressive die

PRINCIPLE OF METAL CUTTING

The metal is brought to the plastic stage by pressing the sheet between two shearing blades so that fracture is initiated with the movement of the upper shear, finally result in the separation of the slug from the parent strip. The metal under the upper shear is subjected to both compressive and tensile stresses. In an ideal shearing operation. The upper shear pushes the metal to a depth equal to about the third of its thickness. Because of pushing the material into the lower shear the area of the cross-section of the metal between the cutting edge of the shear decreases and causes the initiation of the fracture. The portion of the metal which is forced into the lower shear is lightly burnished and would appear as a bright band around the blank lower portion. The fractures which are initiated at both the cutting points would progress further with the movement of the upper shear and if the clearance is sufficient, would meet, thus completing the shearing action. The two shearing elements of the press tool are the hardened punch and the die plate having sharp edges and a certain shearing clearance. Both the shapes of the punch and the die opening conform to the required shape of the component. The punch is connected to the ram of the power press and while descending contacts the stock, exerts pressure over the stock around the cutting edges and shears it through. Exactly the same phenomenon that takes place wherein blanking (or) in piercing (or) in any other shearing operation. In the process of shearing four important stages are usually distinguished according to the observation.

STAGE me: Plastic Deformation The stock material has been placed on the die and the punch is driven towards the die. The punch contacts the stock material and exerts pressure upon it. When the elastic limit of the stock material is exceeded, plastic deformation takes place.

STAGE II: Penetration As the driving force of the ram continues, the punch is forced to penetrate the stock material and the blank or slug is displaced into the die opening a corresponding amount. This is true shearing part in of the cutting cycle, from which the term “shearing action” is derived.

STAGE III Fracture Further continuation of the punching pressure that causes fractures to start at the cutting edges of the punch and the die. Under proper cutting conditions, the fractures extended toward each other and meet. When this occurs, the fracture is complete and the blank or slug is separated from the original stock material. The punch then enters the die opening, pushing the blank or slug slightly below the die cutting edge.

STAGE IV: As the punch completes the downstroke up to the lower point, the component of the slug is pushed through the die opening. Strictly speaking, this action is a consequence of the dynamic fracture at stage III and only in certain case the push through takes place where the punch takes place where the punch travels beyond the land of the die. This is the simplest approach to the shearing action. Before dealing with the details of the phenomenon, the attention is drawn on the same other allied factors which call for deeper deliberations on the shearing process.

THE AMOUNT OF SHEARING CLEARANCE PER SIDE

At a certain value of shearing clearance, which depends on the thickness, kind and its heat treated conditions of the stock, the crack line meet, resulting in easy action, low vertical force, low horizontal

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force, low stripping, low wear high die life but fairly distorted sheared contour. At narrower clearance, secondary cracks develop that is the two cracks do not meet, resulting in an unfavorable increase in forces but some improvement is found in the quality of the cut contour, due to some burnishing of the shaped secondary cracks.

Importance of cutting clearance Proper cutting clearance is necessary to the life of the die and the quality of the piece part. Excessive cutting clearance results in objectionable piece part characteristics, insufficient cutting clearance causes undue stress and wear on the cutting members of the tool because of greater punching effort required. If the amount of clearance is optimum, then the two fracture lines meet and a clean edge is obtained after the operation. If the clearance is too small then the fracture lines miss each other and a secondary deformation took place resulting in an unclear edge. When the amount of clearance is too large obvious that significant amount of drawing action takes place and the quality of the work-piece is again quite poor. Importance of angular clearance Angular clearance is of vital importance in any die where blanks or slugs pass through the die opening. Like cutting clearance, angular clearance is a “per side” measurement. A clearance of ¼ per side is suggested for die work of good quality when the stock material is less than 1.5mm thick. All die-opening walls should have smoothly finished surfaces throughout. Owing to the lessening of the back pressure from blanks or slugs, small or delicate punches will also benefit from slightly increased angular clearance in the die opening. (4)...

FORCE CALCULATIONS

Punching and Blanking

The punching and blanking process cannot strictly speak grouped under forming operations. In these processes, a finite volume of sheet metal is removed by using a die and a punch. The shape and size of the portion removed are determined by the geometry of the die and the punch. If the final product happens to the removed portion, then the operation is termed as blanking. On the other hand, if the pierced sheet metal is the final product then the operation is called punching.

Blanking It is a process in which the punch removes a portion of material from the stock which is a strip of sheet metal of the necessary thickness and width. The removed portion called a blank and is usually further processed to be of some use**.**

Piercing:- This operation consists of simple hole punching is piercing is making holes in a sheet it is identical to blanking except if the fact that the punched out portion coming out through the die in piercing is scrap .piercing is always accompanied by the blanking operation either before , after(or) at the same time.

Punching Force The force required to be exerted by the punch in order to shear out the blank from the stock can be estimated from the actual shear area and shear strength of the material using formula.

$\mathbf{P = L \times T \times \tau}$. $\tau \rightarrow$ shear strength (mm)

$L \rightarrow$ perimeter of cut (mm)

$T \rightarrow$ stock thickness (mm)

Shearing force (Fsh)

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Fsh =L×T×τ L=Length of cutting edge.
T=Thickness of the stock strip
τ =shear strength of the material Newton/sq.mm Force
Required for piercing operation
F1=L ×T× τ ==π×18×0.8×125 =319654N
The force required for blanking operation:
F2=L ×T×τ =π×140×0.8×125 =43998N
Total shearing force
F=F1+F2 =75963N
Taking a factor of safety=1.5
The capacity of press required is 111.21KN

Blank Holding Force:
Blank holding force or stripping force is the force, which controls the metal flow.It is the force applied by the blank holder on the blank to control the flow of the metal into the die cavity. An important consideration in tooling for sheet metal forming wrinkling of the sheet as it is being formed. Hold down can best be provided by hold down ring.However, by using mechanical spring or an auxiliary air cylinder, hold down can be provided in a single action press.
Stripping force required =k×L×T×τ
K=stripping constant =0.0207(for low carbon steels above 1.5 mm thickness)
=0.0207×π× (140+18) ×0.8×390 =3206.18N =0.3206KN
Total force=shearing force + stripping force =111.21+0.3206 =111.50KN
The capacity of press required for punching operation=111.5KN
SPRING DESIGN Spring is used to obtain the required blank holding forces, spring has to take up the total force and it should be designed for this load.
Pmax=Shearing force+blank holding force =113700N
Springs has to be designed for this force δ/n= (8×W×D3)/ (Gd4)
δ=deflection of spring n=number of active coils
W=axial load in spring
D=mean diameter
G=modules of rigidity for spring material
d =diameter of spring wire in the present project
δ=10mm D=22mm
W=111500N
10/n= (8×111500×223)/ (84000×d4) -------------- (1)
We also know that free length of spring
Lf=Solid length + maximum compression +clearance between adjacent coils =n|×d+C+0.15×C
Where n|=n C=max compression Lf=35mm 35=nd+10+0.15×10---------------- (2)
Solving (1) & (2) n=3turns d =12.00mm D=22mm.

DESIGN OF DIE ELEMENTS USING SOLIDWORKS

(5a)DIE BLOCK DESIGN: A tool-steel block which is bolted to the bed of a punch press and into which the desired impressions are machined. The part of an extrusion mold dies holding the forming bushing and core. The die block constitutes the female half of the two mated tools, which carry the cutting edges. A vertical opening extending through the block determines the size and outline of the blank. The exact opening is provided in the die to obtain a predetermined clearance between the punch and the die. The amount of angular clearance and vertical land in the die opening is necessary in order to prevent the possibility of a blank or slug jamming in the passage. The overall dimensions should be obtained by having minimum die wall thickness required for strength and the space needed for mounting screws, dowels, and stripper plate. The material to be used in manufacturing is HCHC and to be heattreated60-62HRC. Using SolidWorks software a new file is opened in part mode. The sequence of commands is used. Select the plane→front→ ok

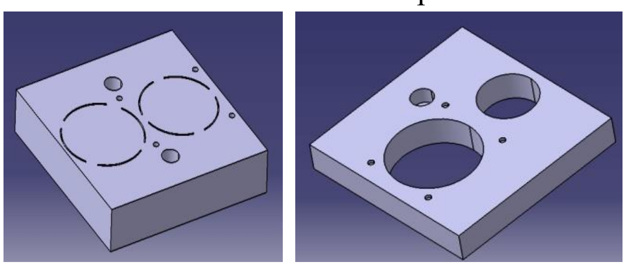

Fig 1) 3-D Model of Die Block

After completion of this command, a proper sketching plane is selected to draw the sketch as shown in the drawings and depth is given to the 2-D sketch such that solid model is obtained. Change PRO/E default units to user-specified units from menu manager.

Select a plane to give the direction of sketching plane a new window sketcher arises on the screen. Toggle off the grid and refresh, draw a rectangle with given dimensions specify the depth of the die plate (rectangle) Select the part -> extrude -> done Select a proper plane and give the direction of cut specify dimensions for the cutting portions. Give Thru all -> done -> ok for creating a hole in die plate of specified dimensions. Feature->sketch->circle->ok For standard hole set ISO standards and select proper screw size to add thread surface click on thru all, thru thread, select primary reference plane select linear reference plane1 and plane2 with given distances check the preview and ok A signal standard hole is created. Feature->copy->mirror->dependent->done Select a feature to be mirrored, select a plane to mirror, the standard hole using copy command created, four standard holes using cut command remove material up to a specified depth to have a step. Feature->extrude->remove->thru all Draw rectangle on the top surface of the die plate highlighted entities be aligned. Specify step depth, die plate of 3D progressive die plate with specified dimensions is created. FIA 1: 3DMODEL the similar steps are repeated for stripper plate, punch plate, top and bottom plates.

5b) DESIGN OF STRIPPER PLATE The primary purpose of a stripper is to remove the stock from the punch after a blanking or piercing operation. However, the stripper serves two other secondary

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functions also. Firstly it guides the strip is fixed to the die block surfaces. Secondly, it holds the blank under pressure before the punch descends fully if the stripper is of spring-loaded type. The thickness of stripper is 14.3mm and the material used is EN 8.

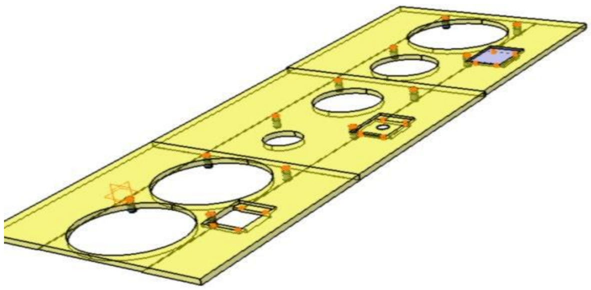

Fig 2) 3D Model of Stripper Plate

After completion of this command, a proper sketching plane is selected to draw the sketch as shown in the drawings and depth is given to the 2-D sketch such that solid model is obtained. Change PRO/E default units to user-specified units from menu manager.

Select a plane to give the direction of sketching plane a new window sketcher arises on the screen. Toggle off the grid and refresh, draw a rectangle with given dimensions specify the depth of the die plate (rectangle) Select the part -> extrude -> done Select a proper plane and give the direction of cut specify dimensions for the cutting portions. Give Thru all -> done -> ok for creating a hole in die plate of specified dimensions. Feature->sketch->circle->ok For standard hole set ISO standards and select proper screw size to add thread surface click on thru all, thru thread, select primary reference plane select linear reference plane1 and plane2 with given distances check the preview and ok A signal standard hole is created. Feature->copy->mirror->dependent->done Select a feature to be mirrored, select a plane to mirror, the standard hole using copy command created, four standard holes using cut command remove material up to a specified depth to have a step. Feature->extrude->remove->thru all Draw rectangle on the top surface of the die plate highlighted entities be aligned. Specify step depth, die plate of 3D progressive die plate with specified dimensions is created. FIA 1: 3DMODEL the similar steps are repeated for stripper plate, punch plate, top and bottom plates.

5b) DESIGN OF STRIPPER PLATE The primary purpose of a stripper is to remove the stock from the punch after a blanking or piercing operation. However, the stripper serves two other secondary functions also. Firstly it guides the strip is fixed to the die block surfaces. Secondly, it holds the blank under pressure before the punch descends fully if the stripper is of spring-loaded type. The thickness of stripper is 14.3mm and the material used is EN 8.

5c) DESIGN OF PUNCH PLATE Punch plate is essentially sheet metal with regularly spaced holes and is used to classify material in applications from dredges to trammels and everything in between. Classification is obviously dependent on the size of the holes and that is dependent on the application. Punch plates hold and support piercing, notching, and cut-off punches. They are usually made of machined steel, but can also be made of tool steel that has been left soft for high grade dies. Punch plates range from small simple blocks for holding single piercing punches to large, precision- machined plates for holding hundreds of perforators the thickness of punch plate is 15mm and the material to be used in manufacturing is EN8. The upper part of the punch plate is provided with a shank equal in diameter to the ram hole. The shank is locked in position with a side screw. This part which is dowelled together with the top plate retains or holds the punches. The center distances are picked up or transferred from the hardened die block to eliminate the possibility of misalignment of punches and die openings due to dimensional changes during heat treatment. Holes to receive the body of punches are provided with H7 fit in order to bare a light press fitting.

5d) DESIGN OF STOCK GUIDES: The size of stock guides are dependent upon the size of the strip and the size of the die block. Two stock guides (front gage and back gage) of the same size 2’21’83 mm are used. Both the front back games are separate units assembled in the die block. Both are extended and provided with strip rest to aid in aligning the strip for starting and feeding.\

5e) DESIGN OF PUNCHES:

The exact dimensions of pitch diameter are determined by providing clearance between the punch and die. The punch is usually designed with a wide shoulder to facilitate mounting and to prevent deflection under load In case of smaller punches the punch may be held in a retainer which in turn is a mounted against the punch holder. The exact length of a punch can be found out by laying the whole assembly drawing only as the sheet height as to be made up from the die block, die shoe, punch, punch holder. Punches of diameter less than the stock thickness must be designed carefully because unit compressive stress in punches rises 4 times the unit shear stress of the material when punch diameter is equal to stock thickness. The height for these punches are 90mm, the material used for manufacturing in HCHC heat treated to 60-62 HRC. The clearance between the punch and die is 0.06mm is selected from the table which is equal to 5-7%.

5f) DESIGN OF TOP PLATE

The top plate (upper shoe) holds the upper half component of the die, clamped to the ram by means of the shank being screwed on its top surface where the center of pressure is located.The thickness of the top plate is determined the product of 0.9 times of the thickness of the die block which is equal to 19mm.The material to be used for manufacturing this part is EN8.

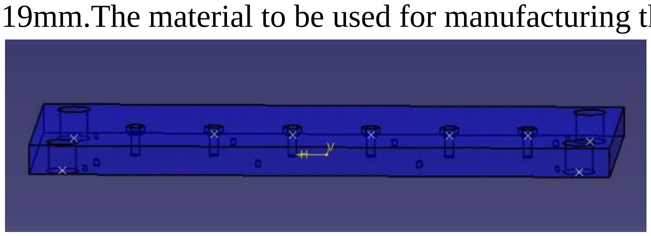

Fig 4) 3D Model of Top Plate

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5g) DESIGN OF BOTTOM PLATE The function of the bottom or lower shoe primarily as a base for the complete die assembly and in turn, is bolted or clamped to the bolster plate over the press bed. The thickness of the bottom plate is 16.8mm. Openings are made with respect to the die openings plus allowance, to allow stamped components to fall freely. The material to be used for manufacturing this part is EN8.

5h) GUIDE PILLERS AND GUIDE BUSHES These elements of the die are responsible for the alignment of the lower and upper part of the die. It should withstand deflection during continuous production. Standard dimensions of these parts are used so that manufacturing would not be a problem when these are available in the market

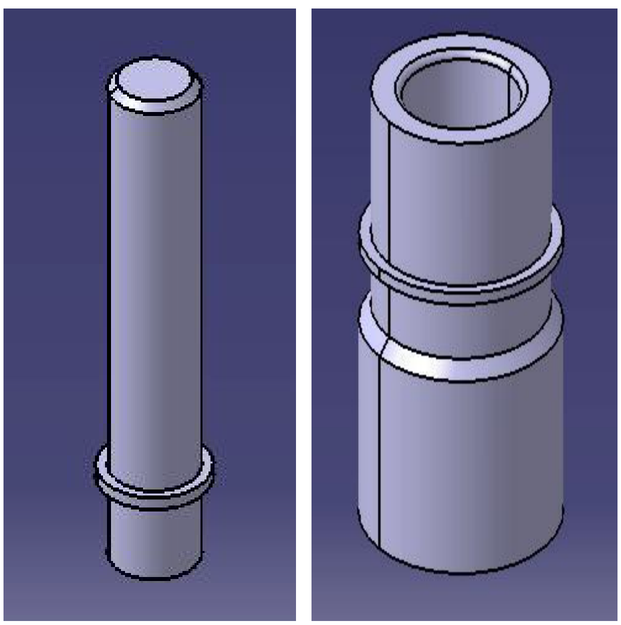

Fig 5) 3D Model of Guide Pillars, Guide Bush.

CONCLUSION

By the implementation of the computer in design field accuracy of design is improved and design field accuracy of design is improved and design process time is reduced drastically than by traditional method. In the process of creating the documentation for the product design, much of required database to manufacture the product is also created. Many design problems which are complicated to estimate by traditional methods are eliminated by using CAD system. As the designs have more standardization they can be imported into any other software and also CAD provide better functional analysis to reduce prototype testing regarding progressive die design of progressive die is simple. The advantage of the progressive die is it perform two or more operations simultaneously by a single stroke. A progressive die is used for high rate of production this design procedure can also be extended to manufacturing

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washers for M-series bolts by modifying the punches and die plate dimension.

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