Design and Analysis of Press tool for Bracket

Author[1]: Rakesh lilhare, Author[2] Professor Vaibhav Bankar

Author[1]: Rakesh lilhare Department of Mechanical Engineering, Vidarbha Institute Of Technology Nagpur, Maharashtra (INDIA)
Author2: Professor Vaibhav Bankar-Head of Depatment of Mechanical Engineering,Vidarbha Institute Of Technology Nagpur, Maharashtra (INDIA)

ABSTRACT

Design and analysis procedure for developing press tool for Bracket component. The project involves the designing tools for the driving shield of bed clamp. To produce the component in just one go is impossible and thus a gang of press come into frame. Press tool manufacturing is one of the widely emerging trends in production area. sheet metal components are produced using press tools. As the name itself suggests press tool means manufacturing the sheet metal components by applying the predetermined force. bracket is a part which is used in fabrication industry. Sequence of operation is planned initially and then press tool is designed and analyzed. Press tools are special tools custom built to produce a particular component mainly out of sheet metal.Press tools are commonly used in hydraulic, pneumatic and mechanical presses to produce components of high volumes.Generally press tools are categorised by the types of operation performed using the tool, such as blanking, piercing, bending, forming, forging, trimming etc. The purpose of carrying out analysis is to prevent the costly tryouts and thus optimize the quality and rate of production .The design will made in Auto Cad 2016, solid modeling on catiaV6 R18 and analysis of parts in ANSYS software.

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Keyword - *Auto Cad 2016, solid modeling on catiaV6 R18 and analysis of parts in ANSYS 2015 software.*

1. INTRODUCTION

It is a specialised area of manufacturing engineering which comprises the analysis, planning, design, construction and application of tools, methods and procedures necessary to increase manufacturing productivity. It gives industry the machine and special tooling needed for today high speed, high volume production. It does this at a level of quality and economy that will ensure that the cost of the product is competitive. Since no single tool or process can serve all the forms of manufacturing tool designs an ever changing, growing process of creative problem solving. Press tool form a vital and an integral part of our modern production houses. These tool acts as the backbone for the production of stampings which range from the most general items like your wrist watch parts to the most sophisticated and complex items like the skeleton of automobiles, streamlines trains, aircraft, missiles etc. A great knowledge in the theory of design of press tools helps to have a better scientific background instead of using thumb rule. The designs should be more feasible for manufacturing with the available machinery and the equipment. Standardization of tooling element reduces the time and the cost of manufacturing, follow up the action of every stage of manufacturing and working of the tool helps the tool designers considering to application of his knowledge and development of skills .The project involves the designing tools for the driving shield of bed clamp. To produce the component in just one go is impossible and thus a gang of press come into frame.

1.1 INTRODUCTION TO SHEET METAL:-

Sheet metal is metal formed by an industrial process into thin, flat pieces. Sheet metal is one of the fundamental forms used in metal working and it can be cut and bent into variety of shapes. Countless everyday objects are fabricated from sheet metal. These products undergo many rounds of cutting and forming operations till we get the final product in hand .To make such components many varieties manually, hydraulically, pneumatically operated press tools are available.

Sheet metal press tool working:-

These tools are used to make a component by cutting and forming of sheet metal.

Principal components:-

Punch: It is that part of the press tool which enters into the cavity formed in die section.

Die: It is that part of press tool which has an opening or cavity to receive the punch.

Operations:-

Shearing : Piercing, Punching, Perforation, Blanking, Cutting Off, Parting Off.

Bending :Angle Bending, Curling, Forming, pluging

Types of cutting operations:-

Cutting Operations 2. Non-Cutting Operations

Cutting operations:-

Piercing, Louvering ,Blanking, Trimmimg, Notching ,Shaving, Lancing, Parting Off, Cut off, Cropping, Perforating. Nibbling

Non-cutting operations:-

Bending , Embossing, Coining, Hemming, Seaming, Curling ,Bulging ,Drawing.

1.2 DESIGN OF PRESS TOOL

Design of press tools helps to have a better scientific background instead of using thumb rule method. The designs should be feasible for manufacturing with available machinery and equipment. Standardization of tooling element reduces the time and the cost of manufacturing, follow up the action of every stage of manufacturing and working of the tools helps the tool designers considering to arrangement his knowledge and development of skills. A designer has to design and work with the following machines and instruments are as follows:-

Cutting tools, tool holders and cutting fluids.

Machine tools

Jigs and fixtures

Gages and measuring instruments

Dies for sheet metal cutting and forming

Dies for forging, cold finishing and extrusion

Fixtures for welding, riveting and other mechanical fastening

THE TOOL DESIGN PROCESS:-

Statement and analysis of the problem

Analysis of the requirements

Development of initial ideas

Development of design alternatives

Finalization of design ideas

1.3TYPES OF PRESSTOOLS

SIMPLE TOOL

COMPOUND TOOL

COMBINATION TOOL

DRAWING TOOL

BENDING TOOL

PROGRESSIVE TOOL

COMBINATION PRESSTOOL

In a combination tool two or more operations such as bending and trimming will be performed simultaneously. Two or more operations such as forming, drawing, extruding, embossing may be combined on the component with various cutting operations like blanking, piercing, notching and cut-off takes place. It can perform cutting and non-cutting operations in a single tool.

1.4 OBJECTIVES OF TOOL DESIGN:-

- Reduce the overall cost of manufacturing a product by producing acceptable parts at lowest cost.
- Increase the production rate by designing tools that will produce parts as quickly as possible.
- Maintain quality by designing tools which will consistently produce the parts with required precision.
- Reduce the cost of special tooling by making every design as cost effective and efficient as possible.
- Design tools that will be safe and easy to operate.

2 LITERATURE REVIEW

Tool design is one of the most skill full job because almost all the components which are produced using press tool will be demanded high dimensional accuracy therefore at most care should be taken will designing the press tool.Design and Analysis of Blanking and Bending Press Tool to Produce Anchor Bracket Component.The selection of any multi-operation tool, such as progressive die or combination 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.

Mr.Sandeep P V, Mr. C. Vikhnesh In this paper name Design and development of progressive tools for the sheet metal component is one important phase in sheet metal manufacturing. Sheet metal press working process by progressive tools is a highly complex process that is vulnerable to various uncertainties such as variation in progressive tools geometry, stripe layout, die shear, material properties, component and press working equipment position error and process parameters related to its manufacturer. These uncertainties in combination can induce heavy manufacturing losses through premature die failure, final part geometric distortion and production risk. Identification of these uncertainties and quantifying them will facilitates a risk free manufacturing environment, which can be obtained by effective tool design.This project aimed at designing and analyzing a progressive tool for photo frame hook with aid of computer aided design package. The design of the tool is intended both skilled and unskilled labour and mass production of the component, which is cost effective and consumes lesser time for production, The purpose of the present investigation is to study the manufacturing of sheet metals by use of a progressive tool. It is necessary to go through the various stages of designing and finding out the possible failures or errors that would happen at the time of manufacturing. In sheet metal forming when dealing with complicated shapes the process sequence, die geometry, perform shape and process parameters at each stage are designed based on past experiences and trial and error. As a result die and process development may be time consuming and costly. Therefore a computer aided approach is highly desirable for designing robust process sequence to reduce expense.

Gaurav C. Rathod Samadhan Adlinge and Dr. D. N. Raut In this paper name Press tools are used to produce a particular component in large quantity, out of sheet metals where particular component achieved depends upon press tool construction and its configuration. The different types of press tool constructions leads to different operations namely blanking, bending, piercing, forming, drawing, cutting off, parting off, embossing, coining, notching, shaving, lancing, dinking, perforating, trimming, curling etc. Generally metals having thickness less than 6mm is considered as strip. Metals having thickness greater than 6mm is considered as plate. In Piercing and notching the required shape periphery is cut in the work piece material. The press tool used is for Piercing operation is called as Piercing tool .The application of press operations are widely used in many industries like food processing, packing, defense, textile, automobile, aircraft and many apart from manufacturing industry. In this connection an attempt is made on to learn the press tool design, materials, manufacturing used for press tool and calculations involved in it. In this work, a real time design of a simple piercing press tool and manufacturing of a prototype is made along with static analysis of punch where the output is a Pierce hole and notch hole. The press machine is of mechanical type of 200ton. Here the problem statement of project is two combine these two piercing and notching operation. Which is now manufacturing separately two piercing by one punch and two notching operation with another punch.

2.1 FLATENED VIEW, DIMENSIONS & MATERIAL PROPERTIES

Total area: 1558127mm

Total perimeter: 631.28mm

T=360N/mm2

U=Tensile strength=841mpa

THICKNESS=1.8mm

Material=mild steel

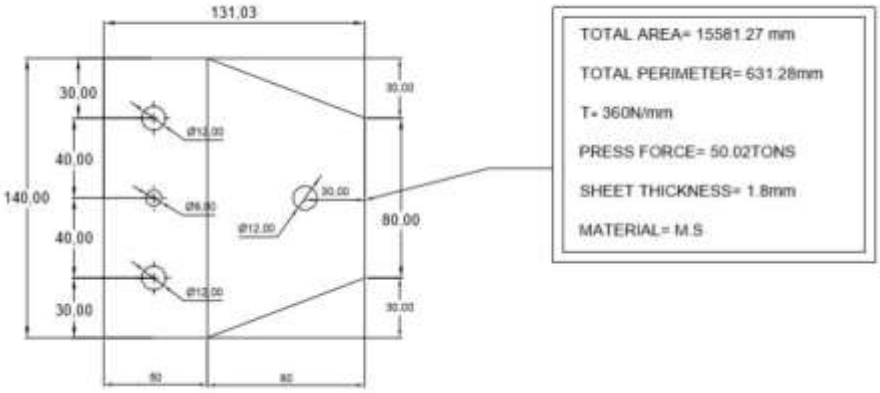

Fig 1 flatened view dimension

2.2STRIP LAYOUT

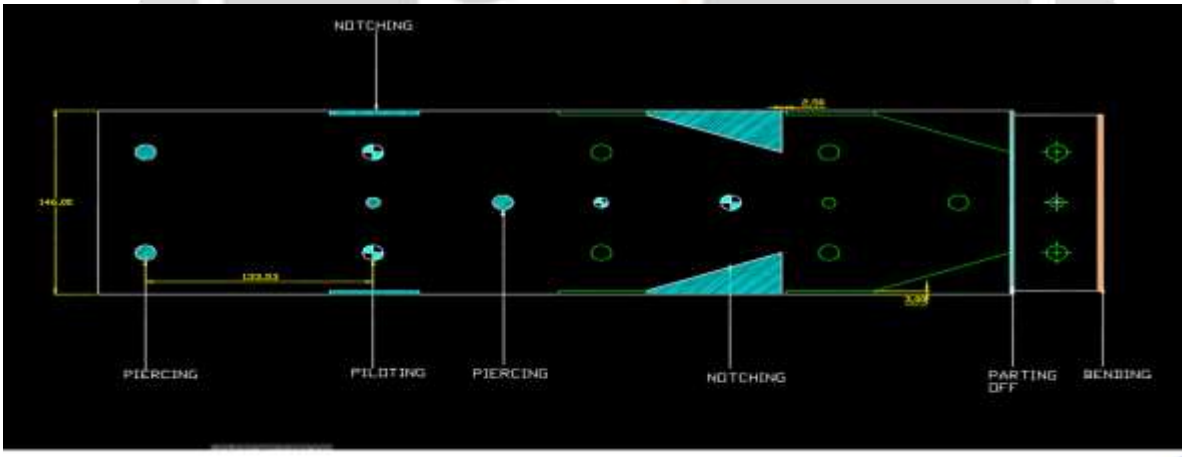

Fig2 Strip Layout

Terms Used In Strip Layout

SCRAP BRIDGE

This is the portion of the material remaining after blanks operation between one edge of the strip and the cutout portion.The portion of material remaining between the two adjacent openings after blanking is also called as the scrap bridge.

Scrap Bridge (B) = (1 to 1.25) T
Choice of the strip lay out method depends on the following factors.
Shape of blank.
Production requirement.
Grain direction.
Burr side.
Stock material.

BURR SIDE

In a blanking operation burr is formed on the face of the blank which comes in direct contact with the punch.
In piercing it appears on the face which comes in direct contact with the die.In some piece parts the burr resulting from either blanking or piercing would be required to appear on a particular face of the blank in relation to details of the blank contour. While deciding the strip layout care must be taken to see that such requirements are met.

STOCK MATERIAL

A comparative study of stock material conservation, tool cost and labor cost is necessary while the strip layout is made.
If the stock material is precious every means to conserve the stock material should be employed.
If double pass is a method of utilizing the stock step by feeding the strip two times into the tool.
After one complete pass of the strip, it is reversed, fed again for maximum utilization of stock strip.
After one complete pass of the strip, it is reversed, fed again for maximum utilization of stock strip.

MATERIALS USED

In material the percentage of C, Mn, Si, P, Cr, Ni, Mo

MATERIAL	C%	Mn%	Si%	S%	P%	Cr%	Ni%	Mo%
M.S.	0.25	0.6-0.9	0.1-0.35	0.055	0.55	0.2-0.35		
EN-8	0.35-0.45	0.6-1.0	0.05-0.35	0.06	0.06			
EN-31	0.9-1.2	0.3-0.75	0.1-0.35	0.05	0.05	1.0-1.6		
OHNS	0.85-0.95	1.0-1.5	0.2-0.4			0.3-0.6		0.3
O.S	0.39	0.4	1.0			5.2		1.4
HCHCR	1.55	0.4	0.3			11.8		0.8

2.2 DESIGN CALCULATIONS

Strip Layout Calculation :-

1} Scrap Bridge (B) = (1 to 1.25) T
= 1.25 x 1.8
= 2.25mm = 2.50mm
2} Margin (M) = (1.25 to 1.5) T
= 1.5x 1.8
= 2.70mm = 3.00 mm
3} Economy Factor = (Area of blank x No of Rows)/ (Width of Strip x Pitch) x 100
= (15581.27 x 1) / (146 x 133.50) x 100 = 80.00 %
Where ,Area of blank = 15581.27 mm
Pitch (P) = 133.50 mm
Width (W) = 146.00 mm

B) Force Calculation :-

1} Cutting Force = (Lx T x Tmax)/9810
= (631.28 x 1.8 x 360)/9810
= 41.69 Tonne
Where, L = Perimeter to cut = 631.28 mm
T = Sheet Thickness = 1.8 mm
Tmax = shear strength in N/mm2 = 360N/mm2

2} A/C Cutting Force = Cutting Force x Factor of Safety
= 41.69 x 1.2
= 50.03 Tonne

3} Stripping Force = 10 to 20% of cutting force
= 0.20 x 41.69
= 8.33 Tonne

4} Bending Force= $(0.333 \times S \times W \times T^2)/(L \times 9810)$
= $(0.333 \times 841 \times 146 \times (1.8)^2)/(2.7 \times 9810)$ = 5.00 Tonnes
Where, S = ultimate tensile strength = 841 N/mm2
w = sheet metal width = 146 mm
L = Span = 2.7mm
T = sheet thickness = 1.8mm

5} Total Force = Cutting Force + Stripping Force+ Bending Force
= 41.69 + 8.33 + 5
= 55.02 Tonne

B) Plate Thickness Calculation :-

1}Thickness of Die Plate (Td) = $\sqrt[3]{}$Cutting Force in Toone = $\sqrt[3]{41.69}$
= 3.47cm
= 34.7mm =35 mm

2} Thickness of Bottom Bolster / plate
= 1.75Td To 2Td
= 1.75x35 To 2x35
= 61.25 To 70 = 70 mm

3} Thickness of Top Bolster / plate
= 1.25Td To 1.5Td
= 1.25x35 To 1.5x35
= 43.75 To 52.5 = 50 mm

4} Thickness of Stripper Plate = 0.75Td
= 0.75 x 35
= 26.25 = 26mm

5} Thickness of Punch Plate = 1.2 Td
= 1.2 x 35
= 42mm

6} Thickness of Thrust Plate = 15 To 20 = 18 mm

7} Cutting Clearance = 0.01 x T x $\sqrt{}$Tmax/10
= 0.01 x 1.8 x $\sqrt{}$360/10
= 0.10 mm per side

3. METHODOLOGY AND PROCESS PLANNING

PROCESS PLANNING:-

As work piece quantities and costs in press work are usually high, considerable economy can be affected by choosing an appropriate sequence of operations and the right type of tooling. The process plan should take into account the total cost: material, tooling, labor (time). Process planning generally includes the following considerations.

Quantity required – total and annual,
Work piece – shape and size,
Work piece – dimensional tolerances,

Work piece – material limitations,
Equipment available for manufacture.
In every tool, the process planning done a vital role and it is followed by above mentioned points. To manufacture the parts of the tool, it is necessary to follow the proper methodology of manufacturing, so that one can get accurate dimensional stability for that particular part within appropriate time.
In Die casting dies also all the parts of the tool are manufactured by considering all above mentioned sequence and choosing of machining sequence. Below mentioned sheet expresses all the view of machining sequence of the tool. Similarly all the parts of the tool are manufactured by the same followed suit.

3.1Manufacturing Processes Planning For Each Part

All the features of the part with dimensions & their references with respect to the assembly.
The part is studies and the plans for sequence of process like conventional, non-conventional & CNC machining, heat treatment in process & stage inspection etc.
Special requirements for the tooling, electrode, and CAD/CAM support for the programs required for the Core & Cavity inserts that are to be machined on the CNC machines etc. are planned in advance to meet the process flow & to maintain the delivery schedule.
Stage drawings of each parts coming & going out from process are made for the convenience of the machine operator showing the references, tolerance analysis, manufacturing allowances using the ordinate dimensioning and inspection methodology.
A continuous follow up for the machine availability is made for the completion of the job in the planned time period to maintain the delivery date.
The above information is applied for all processes related to the part indicating earliest start & finish date of each process with respect to material planning, date of availability of special tooling, electrode, CAD/CAM data, monthly priority list etc. The start & finish date can be taken from the job cards the earliest finish date of assembly can be analysed for the first trial and is communicated to all the interface departments about planning and their support.

3.2 FLOW CHART DESIGN

PART DRAWING RELEASE

↓

RAW MATERIAL

↓

MATERIAL PREPARATION

↓

PREMACHINING

↓

BENCH WORK

↓

PRECISION MACHINING

↓

HEAT TREATMENT

↓

GRINDING

↓

POLISHING

↓

INSPECTION

↓

ASSEMBLY

↓

TRY OUT

Fig3 DESIGN FLOW CHART

3.3 press tool:

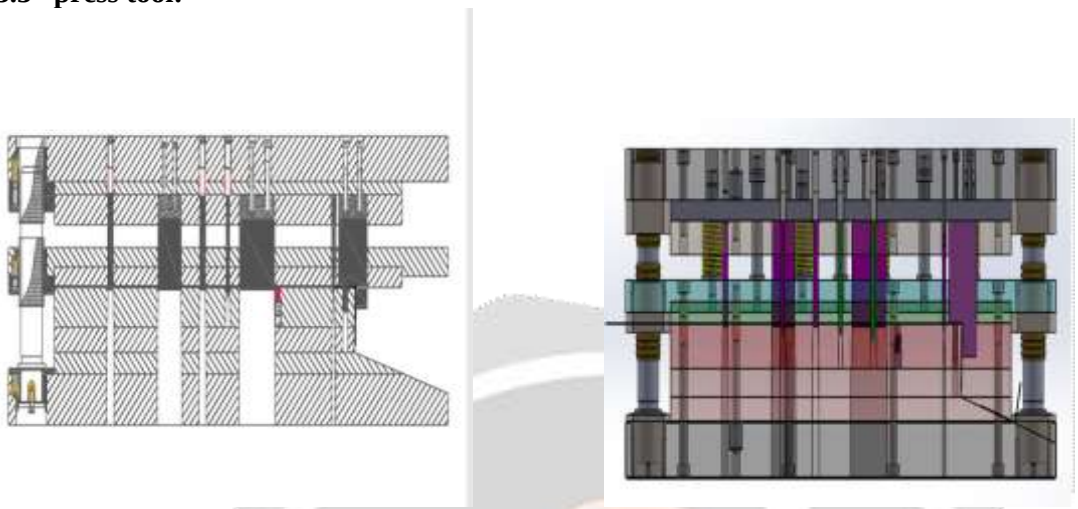

FIG 4 PRESS TOOL

3.4 STRUCTURE ANALYSIS OF CUTTING PUNCHES AND DIE PLATES:-

Structure analysis is an industrial testing method based on calculation of mechanical stress, strain and related deformations. This type of analysis is often performed as a final part of more complicated multi-field of elector-mechanical devices. In an elaborated way, Structure analysis is a computational method for application of load on a structure for determining its resulting response.

ANSYS structural analysis software enables to solve complex engineering problems and make better and faster design decision. With the finite element analysis (FEA) tools available in the suite you can customise and automate solutions for your structural mechanics problems and parameterize them to analyse multiple design scenarios.

STEPS FOR ANALYSIS IN ANSYS:-

Analysis Steps
Geometry
Meshing
Loading
Solve
Reviewing Results
Checking Validity of Solutions
Workshops

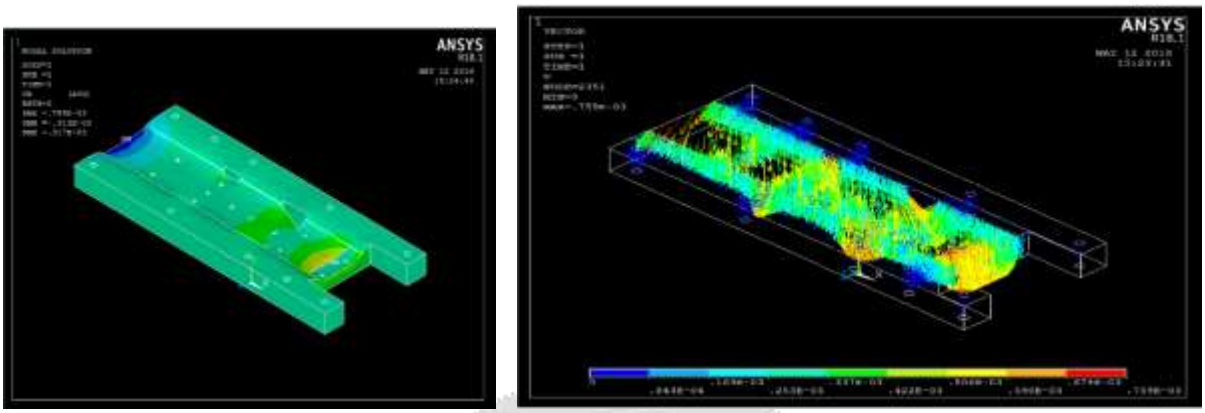

Fig 5 Analysis of Die plate

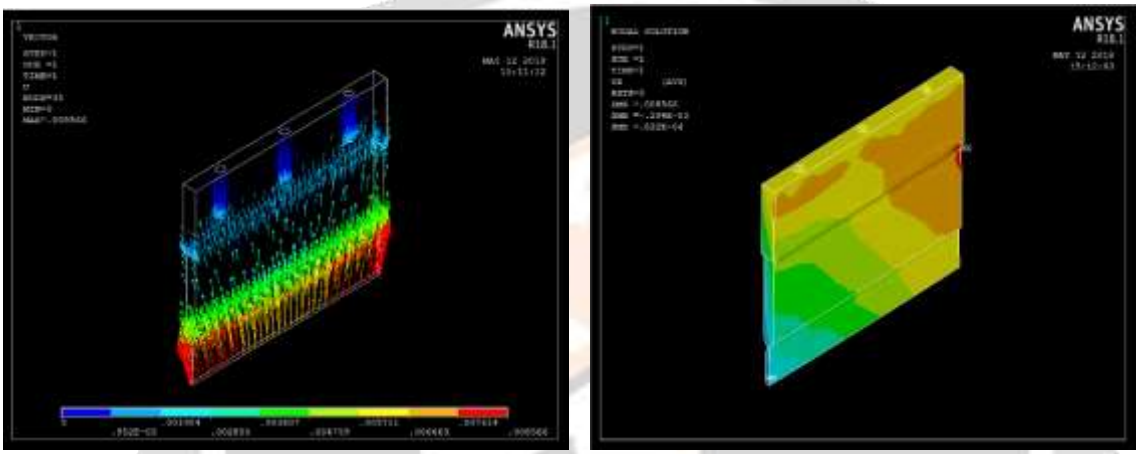

Fig6 analysis of parting off punch

4 Result and discussion

Sl.No	Description	Analysis result		Calculated value	
		Deflection µm	Stress N/m^2	Deflection µm	Stress N/m^2
1	Top half	4.31	6.20×10^6	3.1	5.98×10^6
2	Die plate	22.3	4.32×10^7	26.26	5.62×10^7

5.CONCLUSIONS

- The project was a medium for us to enhance our knowledge in the field of tool design. It helped us lot in better understanding of the concept of press tool.
- During the project, we had to communicate with various departments sand authorities to solve the problems and difficulties around in between. It has helped to improve our abilities to work as a team.

- The project for fluid line was required to be completed in a specific period of time for which we had to work to the best of our abilities to complete the modelling of the component, its 2D drafting and assembly.

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