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# DESIGN AND ANALYSIS OF A PUNCH TO MANUFACTURE A SHEET METAL PART

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**Abstract:** *Sheet Metal is used to make everything from hinges to automobile parts in presswork ,this technology has emerged with the development of the steel industry .The importance of software developments in the manufacturing industry can seen by a recent emphasis of CAD software developers on the production of high level systems aimed at the complete automation of design processes. A recent trend by manufacturing companies has been their use of large-scale parametric software suitable for integration into existing design methods. . Development of software in the manufacturing industry can be seen by a recent emphasis in CAD software developers on the production of high level systems aimed at the complete automation of processes, which reduces error and inaccuracy. This paper consist design of punch for sheet metal by getting support of CAD Modeling and undergoes Analysis, shows the behavior and characteristics of a Punch prior to manufacturing. CATIA uses Finite Element analysis, which solve all the steps used in Finite element method automatically. Many tool engineers had worked in designing press tools without getting software support, while many CAD/CAM engineers are working for the software developments of different mechanical field, both had achieved success in their individual field. But combining Tool design with software will give more success to a tool engineer/designer.*

**Keywords:** *Punch, Sheet metal, CATIA, Nodes, Elementsie, Punch, CAD, Modelling*

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## INTRODUCTION

The technology of sheet metal presswork emerged with the development of the steel industry, and to large degree we owe our present standard of living to the production of stamped metal parts. This needs a design of Press tools (Punch and Die) by an tool designer carries a personal knowledge base granted upon a life time experience is mostly based upon a rule of thumb that are gathered through trial and error. This method of work may be a tedious job and may cause inaccuracy. To overcome this, introduction of software to this field becomes essential. Development of software in the manufacturing industry can be seen by a recent emphasis in CAD software developers on the production of high level systems aimed at the complete automation of processes, which reduces error and inaccuracy. [1]

The use of finite element simulation technology for stamping applications is growing rapidly these days. This technology was already becoming common for R&D purposes (such as car crash analysis), its real industrialization did not start until around 1990. By that time, a considerable effort has been made on making the finite element technology accessible enough for industry to use these technology in common complex industrial problems.[5] Today, such a case could be analyzed in less than one week including the die face generation, the formability analysis and the springback. This dramatic reduction in the total simulation time came not only from the rapidly improving computer technology, but was more influenced by the introduction of new tools in the finite element world, such as adaptive meshing (1994), automatic discretization/meshing of CAD models (1995), easier and more standardized input (1996) and the introduction of new implicit algorithms for a rapid and qualitative forming evaluation (1998). [7]

## 2. DESIGN OF PRESS TOOL

**Component under study:-** Component taken of sheet metal is' Locking latch'.

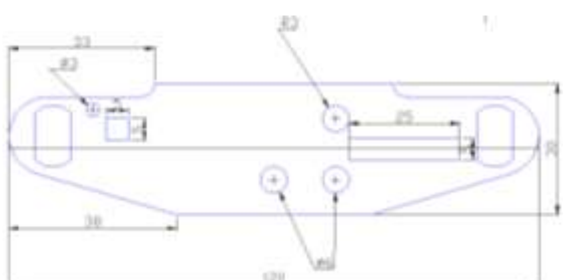


**Fig. 1 component sketch-Locking latch**.

**Cutting force calculation**

Cutting force,

F = S p t where

F= cutting force

S = shear strength of stock material is 3.875tonns/$cm^2$

p = perimeter or length of cutting edge

t = thickness of material the cutting force formula is give as 2mm

So first find out perimeter for component

p = 4(π X 8) + (π X 8)X2 + (π X 6)3 + 2(5+5) +(1.5Xπ)+(58X2)2

+((5Xπ)+(10X2))2+41+37.117+(9Xπ)/2+(3Xπ)/4+(1Xπ)/2+(5X2) +5+(9Xπ)/8

≅ **705.71mm** by manual

F=38.75 X 705.71 X 2

= 54692.5.5 kg

***Cutting force = 54.70 tonns***

So we have taken **60tonns** press for the for blanking

**Punch dimensioning**

The determination of punch dimension has been generally based on practical experience. When the diameter of a pierced round hole equals stock thickness, the unit compressive stress on the punch is four times the unit shear stress on the cut area of the stock, from the formula.

$$\frac{4S_s}{S_c} \frac{t}{d} = 1$$

**Where**

**$S_c$ = unit compressive stress on the punch kgs / $mm^2$**

**$S_s$ = unit shear stress on the stock, psi kgs / $mm^2$.**

***t* = stock thickness mm**

***d* = diameter of punched hole, mm.**

The diameter of most holes is gr

recommended. The maximum all

$$L = \frac{\pi d}{8}\left(\frac{E}{S_s} \frac{a}{t}\right)^{1/2}$$

**where**

**d / t = 1.1 or higher**

***E* = modulus of elasticity**

$$L = \frac{\pi X 8}{8}\left(\frac{2.7X10^5}{0.85X10^5} \frac{8}{2}\right)^{1/2}$$

***L* = 125.6637mm maximum**

But we take length as 45mm, which is desired and applicable without bending for all punch considering 3 mm as grinding allowance. Because of 15 mm length of punch is used in punch plate 15 mm in stripper and remaining is utilize for cutting action in die.

Using above length we will find out deflection

From the above Calculation

P = Pressure in kg =60000Kg

L = length of punch is taken 45mm

A = Cross section area of all punches is 3060 $mm^2$

E = For HcHCr material is about 2.7E+5 Kg/ $mm^2$

$$\delta l = \frac{P \, X \, L}{A \, X \, E}$$

$$\delta l = \frac{60000 X \, 45}{3060 \, X \, 2.7E{+}5}$$

The deformation of punch is **0.003267mm**

**3. PART MODELING**

In computer-aided design, geometric modeling is concerned with the computer-compatible mathematical description of the geometry of an object. The mathematical description allows the image of the object to be displayed and manipulated on a graphics terminal through signals from the CPU of the CAD system. The software that provides geometric modeling capabilities must be designed for efficient use both by the computer and the human designer.[8]

**II. ANALYSIS OF PUNCH USING CATIA SOFTWARE**

The basic steps discussed for finite element analysis are solved automatically by using the commands of General structural Analysis in Static case which are given in Appendix D. [11]

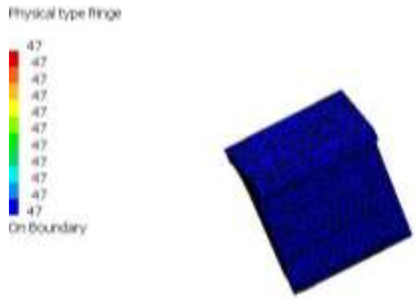
- **Static Case : Make description**
- **Boundary Conditions Nodes and Elements : Make description**
- **MESH:**

| Entity | Size |
|---|---|
| Nodes | 2298 |
| Elements | 9404 |

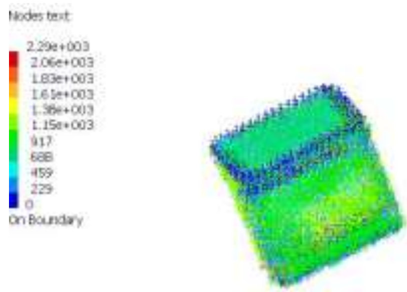
- **ELEMENT TYPE:**

| Connectivity | Statistics |
|---|---|
| TE4 | 9404 ( 100.00% ) |

- **Nodes and Elements - Physical type fringe**

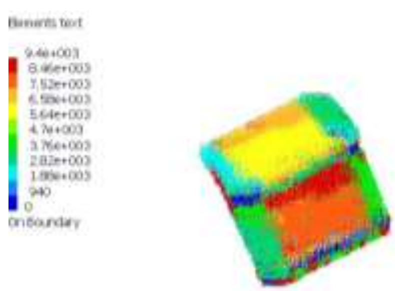



- **Nodes and Elements - Nodes text**

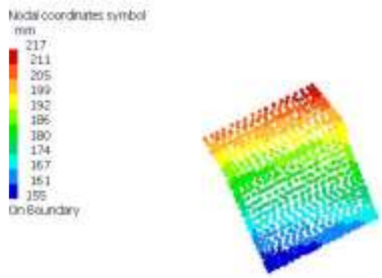



- **Nodes and Elements - Mesh**

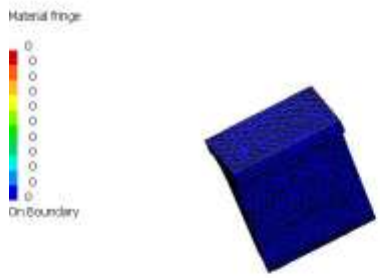
- **Nodes and Elements - Elements text**




- **Nodes and Elements - Nodal coordinates symbol**




- **Solid Property.1 - Material fringe**




- **Properties.1 : Make description**
- **Material apply to**

Part2 - OCTREE Tetrahedron Mesh.1 : Part2

| | |
|---|---|
| Material | Steel : Structural ( ASTM-A36 ) |
| Young Modulus | 2.7e+05Kg mm2 |
| Poisson Ratio | 0.3 |
| Density | 7860kg_m3 |
| Thermal Expansion | 0.0000117 |
| Yield Strength | 2.5e+03N_mm2 |

- **Restraints.1 : Make description**

Name: RestraintSet.1

Number of S.P.C : 372

- **Restraints.1 : Computation summary**
- **STRUCTURE Computation**

Number of nodes : 2298

Number of elements : 9404

Number of D.O.F. : 6894

Number of Contact relations : 0

Number of Kinematic relations : 0

Linear tetrahedron : 9404

- **RESTRAINT Computation**

Name: RestraintSet.1

Number of S.P.C : 372

- **Loads.1 : Make description**

Name: LoadSet.1

Applied load resultant :

Fx = 3 . 407e+000 N

Fy = -5 . 740e-018 N

Fz = -2 . 186e-017 N

Mx = -1 . 576e-018 Nxm

My = 5 . 042e-001 Nxm

Mz = -3 . 436e-001 Nxm

- **LOAD Computation**

Name: LoadSet.1

Applied load resultant :

Fx = 3 . 407e+000 N

Fy = -5 . 740e-018 N

Fz = -2 . 186e-017 N

Mx = -1 . 576e-018 Nxm

My = 5 . 042e-001 Nxm

Mz = -3 . 436e-001 Nxm

- **Static Case Solution.1 - Deformed Mesh**

Display On Boundary ---- Over all the Model

The mean deformation computed form the above is **0.00619mm**

- **CONCLUSION**

Press tool is never ending and very widely and unavoidably used tool in the manufacturing industry. Using CAD the designing of the press tool is not quite so simple tool is made simpler and its modeling and simulation has been effectively shown in this project. Appealing pictorial 3-D views have been added in the report, which are quite esy understandable. CATIA has given complete project solution using Modeling, and Simulation. It is very easy to operate CATIA because of limited tool on desktop and its high graphic resolution and its multifunctional and multi-application Hybrid category software which provides convenience to do all the task using same software.

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