Conceptual Design of Blanking Tool for Washer Special

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***Abstract*— The aim of this paper is to present a conceptual design of blanking tool to manufacture washer special component. The approach is made to study the process to be followed to obtain an accurate blank part to manufacture a washer special component. The approach is applied to the DIN 1624 sheet metal of 1.5mm in thickness. The results are observed for the stress and the deformation on the punch and die in the blanking tool. On the basis of the results the D2 material taken for the design is said to be as the best suitable material for the punch and die.**

***Keywords*— Blanking; D2; Washer Special; Tool**

I. INTRODUCTION

Blanking is a process of producing a flat piece part from sheet metal. In this process the entire periphery is cut and the cut piece is called blank. The blanking process is occurred by the force applied by the punch on the sheet metal which causes shearing action of the sheet metal. In the blanking process the cut piece is the work piece. The two dimensional illustration below shows the blanking punch when applied force, the punch is forced into the die. On application of force on the metal sheet, the sheet metal exceeds its fracture zone and the sheet is sheared. The blank or the work piece falls down is collected.

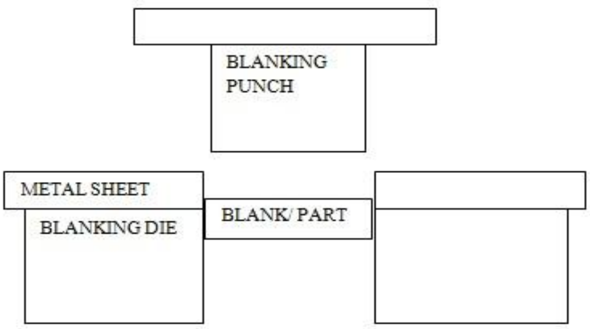

Fig. 1:2D view of blanking process

Today's competitive world there is a demand for the modern technology and techniques to produce quality products at affordable price to overcome the competitor's, sheet metal blanking plays a major role for the manufacture of parts. The design and analysis of the press tools using the modern technology and the technique is needed, the computerized designing and simulations will be helpful to analyze the capabilities of the tool and the analysis helps to reduce the maintenance cost of the tool.

II. DESIGN OF COMPONENT

The washer special is a component used in an automobile part assembly. The component has to be designed to meet its application. So the manufacturing process of the component has to be taken care for the dimensions of the part. The material used for the manufacture of the part is DIN 1624 (under German standard).

TABLE: 1

Mechanical Properties [1]	
Tensile Stress	270 MPa
Yield Stress	210 MPa

TABLE: 2

Chemical Composition [1]	
Carbon	0.08% Max
Silicon	0.025% Max
Manganese	0.40% Max
Sulphur	0.025% Max
Phosphorus	0.025% Max

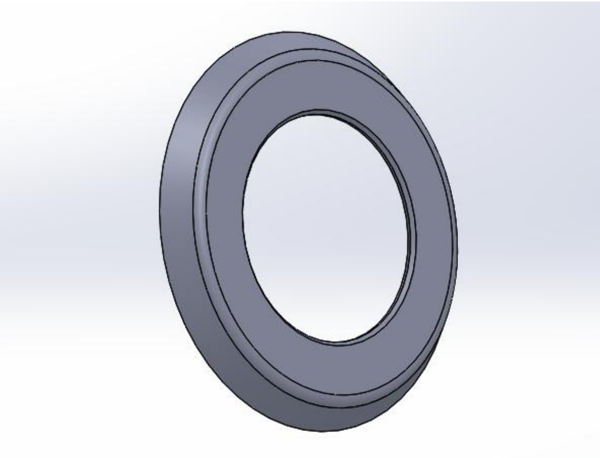

Fig. 2:3D model of component

III. TOOL DESIGN

Before designing the tool, there are certain design points to be followed. Component study, Thickness of the component, Material, Machine to accommodate the process, Critical dimensions of the component. On the bases of the study made some important design concepts should be followed to obtain the component with the accurate dimensions, usefulness, durability, functional, quality, economy and appropriateness of the production process.

A. Material Selection

On the bases of the study made, tool steels are taken as the material for the tooling. These tool steels have high wear resistance with good hardening properties. These characteristics are observed due to high presence of chromium and carbon. After hardening processes these tools steels have low dimensional changes and have medium resistance to hot softening. The material recommended for the designing tool parts is D2 material. D2 material is air hardening high carbon high chromium tool steel having extremely high wear resistance properties. Deep hardening can be done on the D2 material, which is practically free from size changes under high usage of the tool. D2 tool steel high content of chromium gives mild corrosion resisting properties in the hardened condition.

TABLE: 3

Chemical Composition of D2				
C	SI	Cr	Mo	V
1.50%	0.30%	12.00%	0.80%	0.90%

B. Blank Part

Fig 3 shows the dimension of the blank part to be obtained, on the bases of the developed length of the component the shape of the blank part should be in the form of a disk.

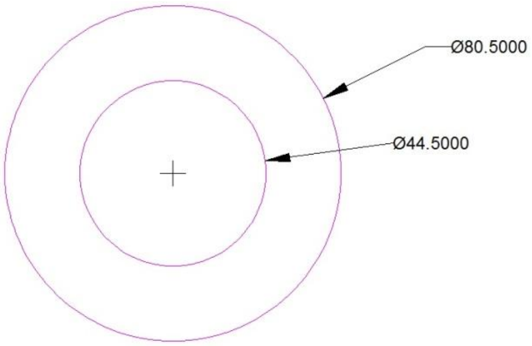

Fig. 3:2D view of Blank Part

C. Design of Strip Layout

Strip layout designing plays a vital role in the final costing of the part and in the blanking process. Strip layout designing is an art of utilizing maximum area of the strip in the blanking process and reducing the scrap in the strip. While designing the strip layout certain considerations should be made, to meet the manufacturing feasibility for the selected strip layout. Since the blanking of the disk shaped sheet has to be made in the manufacture of the washer special as shown in fig 3. So the strip layout planned is as below.

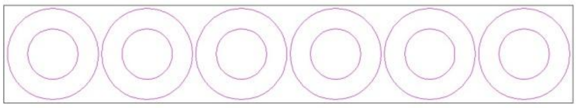

Fig. 4: Strip layout feed

IV. TOOL CALCULATIONS

Shear force

F_s= L x S x T_{max} (1)

= 141.37 x 1.5 x 216

= 45803.88N/mm^2 (shear force for Ø45)

= 254.47 x 1.5 x 216

= 82448.28N/mm^2 (shear force for Ø81)

L – length of cut L = 141.37mm

S – Thickness of sheet S = 1.5mm

T_{max} – shear strength T_{max} = 216N/mm^2

Stripping Force

Stripping Force = 20% of total shear force (2)

= 128252.16 x (20/100)

= 25650.43 KN

Total Shear Force = 128252.16KN

Press Capacity

Total Press Capacity

= Total Shear Force + Stripping Force (3)

= 128252.16 + 25650.432

= 153902.592 KN

Press Tonnage

=(Total ShearForce + Stripping Force)/70% (4)

(The efficiency of the machine is taken as 70%)

= 153902.592/0.7

= 219860.8457KN

Clearance

Clearance = C x t x $\sqrt{T_{max}}$ (5)

= 0.01 x 1.5 x $\sqrt{216}$

= 0.2204mm (per side clearance)

C = 0.01 constant

t = thickness of sheet   t = 1.5mm

T_{max} = Shear strength T_{max}= 216N/mm^2

V. TOOL MODELING

Tool is modeled using Solid Works 2013 software

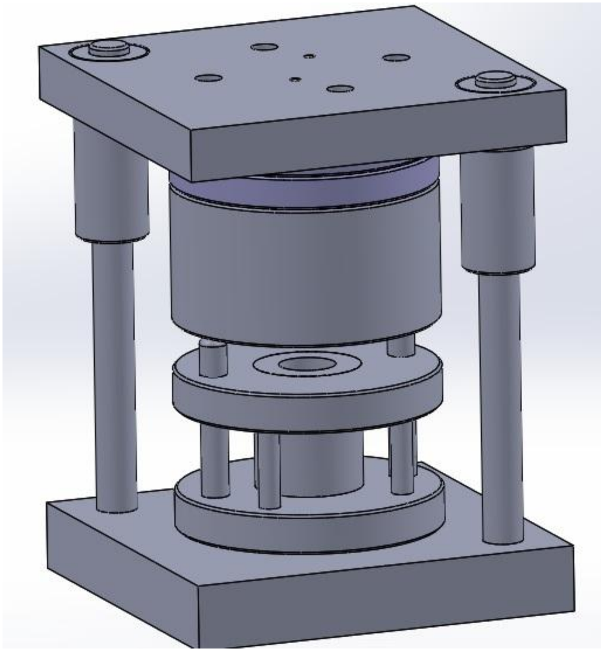

Fig. 5:3D Isometric view modeled tool

VI. PUNCH AND DIE ANALYSIS

The punch and die analysis is carried out using the SOLID WORK 2013 software. Static analysis is done to find out the stress distribution and the displacement on the punch and die.

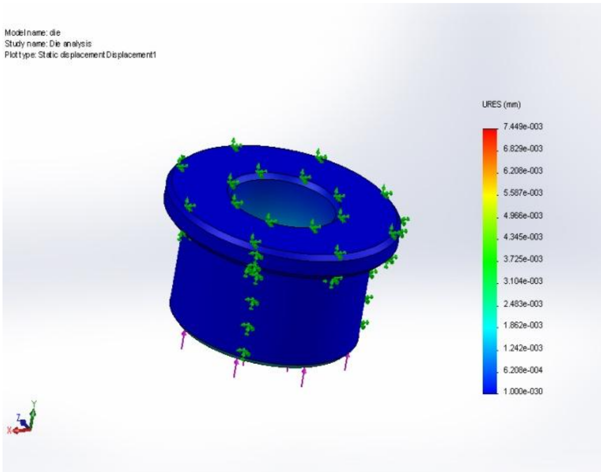

Fig. 6: Die Displacement Analysis

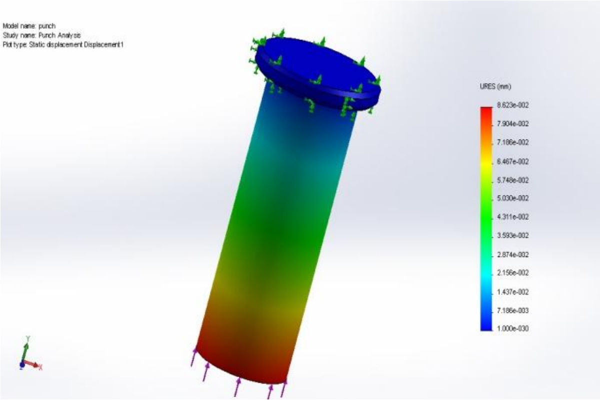

Fig. 7: Punch Displacement Analysis

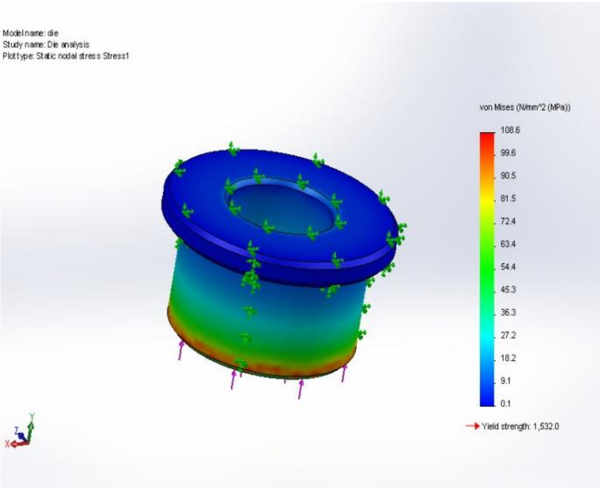

Fig. 8: Die Stress Analysis

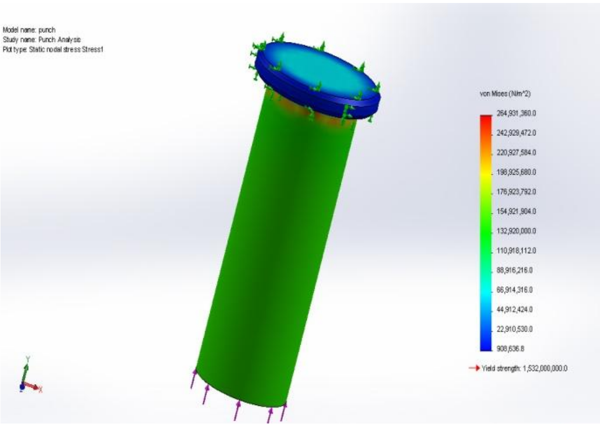

Fig. 9: Punch Stress Analysis

VII. STRESS ANALYSIS RESULT

TABLE: 4

Sl No	Type	Observed Limit	Limit Value	Units
1	Die	108.6	1532	N/mm^2
2	Punch	264.9	1532	N/mm^2

From the analysis results the graph scale on the right end of the figure showed the deformations result of the die and the punch which are less than the limit value, and the displacement value of the punch and the die is small value for the material to deform under load.

VIII. CONCLUSION

1. The results were observed that the maximum available sheet area is utilized for the blanking process.
2. The results show the material used for the tooling increases the life of the tool.
3. Analysis results show the stress values in the blanking process are less than the allowable or the limit values.
4. Analysis results show the design is safe.

REFERENCES

[1] ArcelorMittal South Africa Limited, Data sheet: B3.1, Year 2010.
[2] N B Suresh, A Learners Guide To Press Tools, Pannaga International Academy, Bangalore. Year 2009.
[3] Prakash H. Joshi, Press Tool Design & Construction, Wheeler Publishing. Year 2012.
[4] GT&TC Standard Data Handbook.
[5] Jutz-Scharkus, Westermann Tables, Revised second edition, new age international(P) limited, publisher. Year 2006