Design And Analysis Of Punch And Die For Cropping Tool Of Bridge Frame Component

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***Abstract*— The aim of this paper is to introduce a Design and analysis of punch and die of cropping tool to produce a bridge frame component. The approach is made to examine the procedure to be taken after to acquire a precise cropping part to produce a bridge frame. This approach is connected to the Cold Rolled Closed Annealed (CRCA) material which is in the form of tube of minimum thickness. The outcomes are watched for the stress and the displacement on the punch and die in the cropping tool. On the premise of the outcomes, the D2 material is taken for the outline is said to be as the best suitable for the punch and die.**

Keywords—Bridge Frame; CRCA; Cropping Tool; Stress; Displacement etc…

I. INTRODUCTION

Cropping is a procedure that when the state of the component is such that a single line shearing creates a part from a strip already measured to the component width, the operation is called cropping. In this procedure the tube fringe is cut at a desired length and at a desired angle. The cropping procedure is happened by the force applied by the punch on the sheet metal tube which causes shearing activity of the sheet metal tube. The two dimensional outline underneath demonstrates the cropping punch when applied force, the punch is constrained into the die. On the application of force on the sheet metal tube, the sheet metal tube exceeds its fracture zone and the tube is sheared.

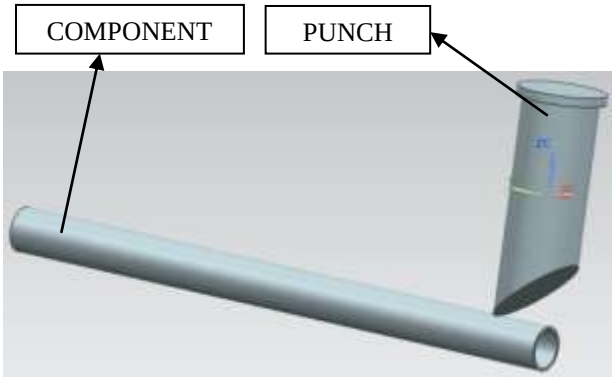

Fig. 1: 3D view of cropping process

In today's focused world there is an interest for the current innovation and systems to deliver quality items at moderate cost to conquer the competitor's. The design and analysis of the press tools utilizing the present day innovation and the procedure is required, the automated outlining what's more, reproductions will be useful to investigate the capacities of the tool and the examination serves to lessen the support expense of the tool.

II. DESIGN OF COMPONENT

The bridge frame is a component utilized as a part of a bike part get together. The part must be intended to meet its application. The assembling procedure of the component must be taken watch over the measurements of the part. A suitable material utilized for the assembling of the part is CRCA.

TABLE: 1

CHEMICAL COMPOSITION [1]	
Carbon	0.12max.
Silicon	0.25-0.75
Manganese	0.20-0.50
Phosphorus	0.07-0.15
Sulphur	0.040max.
Copper	0.25-0.60
Nickel	0.65max.
Chromium	0.31-1.25

TABLE: 2

MECHANICAL PROPERTIES [1]	
Shearstress (N/mm^2)	310
Yield point (N/mm^2)	350

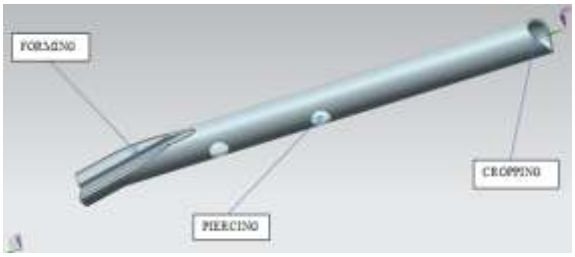

Fig. 2: 3D component model

III. TOOL DESIGN

Before planning the tool, there are certain design points to be followed. Part think about, Thickness of the part, Material, Machine to oblige the procedure, Critical measurements of the part on the basis of the study made a few essential design

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ideas ought to be taken after to acquire the component with the precise measurements, helpfulness, strength, useful, quality, economy what's more, suitability of the creation process.

A. Material Selection

On the basis of the study made, tool steels are taken as the material for the tooling. These tool steels have high wear resistance with great solidifying properties. These attributes are seen because of high nearness of chromium and carbon. After solidifying forms these tool steels have low dimensional changes and have medium imperviousness to hot softening. The material prescribed for the designing tool parts is D2 material. D2 material is air solidifying high carbon high chromium tool steel having to great degree high wear resistance properties. Deep solidifying should be possible on the D2 material, which is for all intents and purposes free from size changes under high utilization of the tool. D2 tool steel high substance of chromium gives mellow (mild) consumption opposing properties in the solidified condition.

TABLE: 3

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

B. Cropped Part

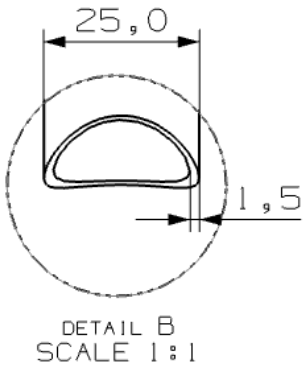

Fig. 3:2D view of Cropped Part

Figure 3 shows the dimension of the cropping part to be obtained.

IV. TOOL CALCULATIONS

Shear force

$F_s = L \times S \times T_{max}$ (1)

$= (\pi \times 25) \times 3 \times 310$

= 73042.0292 N (shear force for Ø25)

L – length of cut L = 78.539mm
S – Thickness of sheet S = 3mm
T_{max} – shear strength T_{max} = 310N/mm2

Total Shear Force = 73042.0292 N

Stripping Force

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

= 73042.0292 × (20/100)

= 14608.4058 N

Press Capacity

Total Press Capacity

= Total Shear Force + Stripping Force (3)

= 73042.0292 + 14608.4058

= 87650.43504 N

Press Tonnage

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

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

= 87650.43504 /0.7

= 125214.9072 N

= 125.2149 KN

= 125.2149/9.81

= 12.76 Tons, 12.76 × 0.25 = 15.9 Tons ≃ 20 tons

IV. TOOL MODELING

Tool is modeled using Uni Graphics 7.5 software.

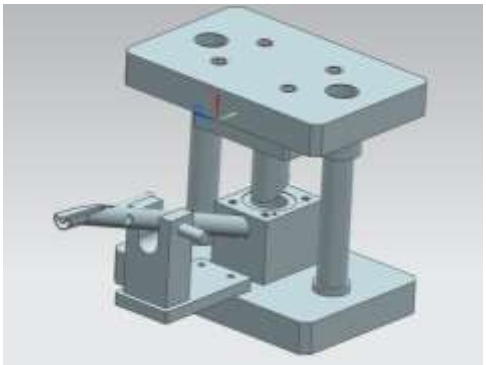

Fig. 4:3D Isometric view modeled tool

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VI. PUNCH AND DIE ANALYSIS

The punch and die analysis is completed utilizing the SOLID WORKS 2015 CAD programming. Static analysis is finished to discover the stress dissemination and the displacement on the punch and die.

MESHED VIEW OF PUNCH

Fig. 5: Punch In Mesh View

MESHED VIEW OF DIE

Fig.6: Die In Mesh View

1) Stress analysis for punch at 20 Tons

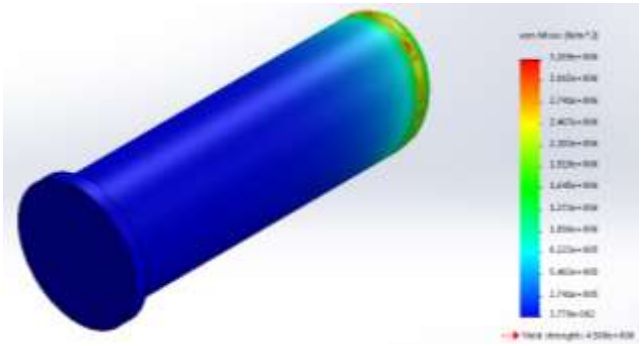

Fig. 7: Punch Displacement Analysis

2) Stress analysis for die at 20 Tons

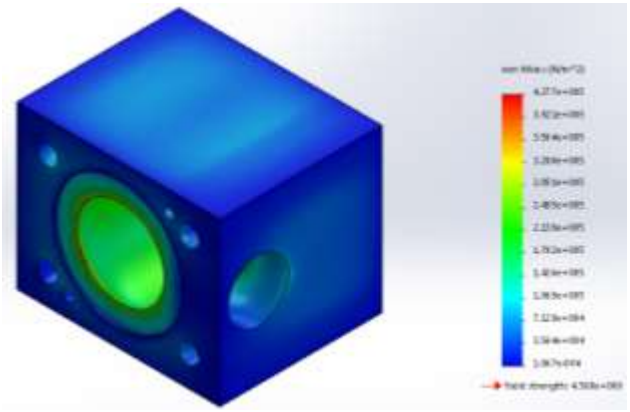

Fig. 8: Punch Displacement Analysis

3) Displacement analysis for punch at 20 Tons

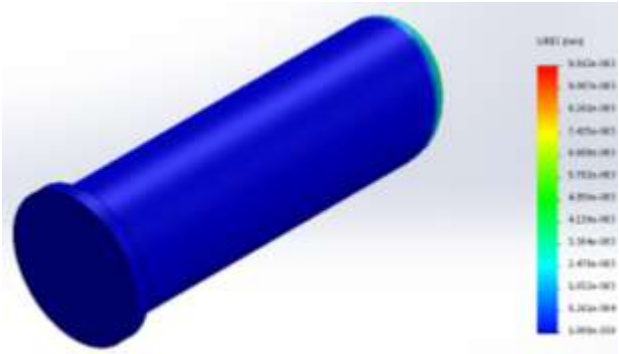

Fig. 9: Punch Displacement Analysis

2. Displacement occurs in the punch and die is negligible in the material so the design of the punch and die is safe.

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VIII. CONCLUSION

1. The results show the material used for the tooling increases the life of the tool.

2. Analysis results show the stress value in the cropping process are less than the allowable or the limit values.

3. Analysis results show the design is safe.

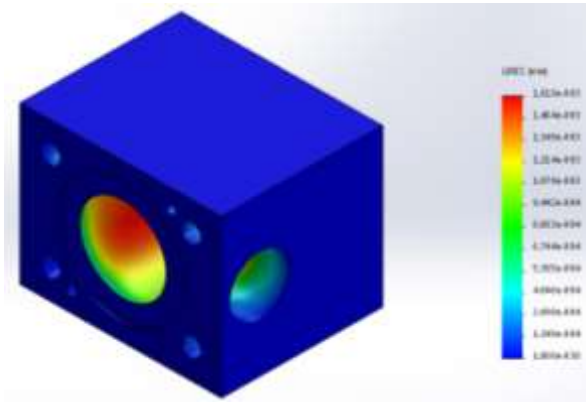

Fig. 10: Die Displacement Analysis

VII. ANALYSIS RESULTS

1. STRESS ANALYSIS RESULTS

SL NO.	TYPE	OBSERVED LIMIT	LIMIT	UNIT
1.	PUNCH	3.28×10^{3}	4.50×10^{5}	N/mm^2
2.	DIE	4.27×10^{2}	4.50×10^{5}	N/mm^2

2. DISPLACEMENT ANALYSIS RESULTS

SL NO.	TYPE	DISPLACEMENT	UNIT
1.	PUNCH	0.001618	mm
2.	DIE	0.009912	mm

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