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Design of Blanking Punch and Die for Cam Head Washer Component using Finite Element Analysis

Dr D Ramegowda[1],
[1] Principal,
Department of PG Studies,
GTTC Mysuru, Karnataka,
India

Madhusudhana. M[2]
[2] M Tech Student,
Tool Engineering, GTTC Mysuru,
Karnataka, India

Abstract: **The concept in this paper deals with design of blanking punch and die for cam head washer component using Finite element analysis. The designing of blanking punch and die is a very precision, complex and knowledge based process. Sheet metal blanking is a very significant and powerful tool for manufacturing process a variety of parts for automobiles, aerospace, and marine products. Therefore the press process has identified as one of the important manufacturing process. Designing of punch and die plays an important role in sheet metal process. The highly précised and complex punch and die structure need very accurate and reliable work throughout the work.**

The analysis of punch and die performed using the computer aided engineering software has been successfully executed for the evaluation of maximum transverse deflection and stresses. The results taken by this analysis will be very useful to the designers and thereby saving lot of time and avoiding costly tryouts.

Key words: Punch, Die, Analysis, Material, Design concepts

1. INTRODUCTION

Press tool is a device which the sheet metal can be converted into required shape by various press operations. It can also be defined as device used for punching out sheet metal components from the strip by a device called press. Various cutting and non-cutting tools will be loaded between fixed table and moving ram of a press. The pressure when exerted from top and bottom sides by the press. The component is produced according to the punch and dies profiles in the tool. The component is produced from a press tool is applicable in different aspects like automobile parts. All most all products like television, tape-record, radio, refrigerator, car, watch, computer etc. which consists number of components made of either plastic or sheet metal. Sheet metal components are produced by a device called Press Tool. Generally these tools are cold working and manufactured to improve the productivity of the components qualitatively and quantitatively.

Press tool are mainly manufactured for high rate of production of components. If the requirement of a sheet metal components is less (less than 1000 numbers) these devices are not economical. Hence press tools are categorized according to the requirement such as simple press tools, medium production press tools, horogical press tools(watch components),spherical purpose press tools (cantilever press tools, side cam press tools) and in types of operation such as cutting press tools, non-cutting press tools and hybrid press tools (cutting and non-cutting operation).

2. STUDY OF THE COMPONENT

The component study is an important and basic step in any manufacturing process and it plays an important role. The component drawing is studied to know the important features, its geometry, special and important features of the component.

2.1 COMPONENT AND ITS DETAILS

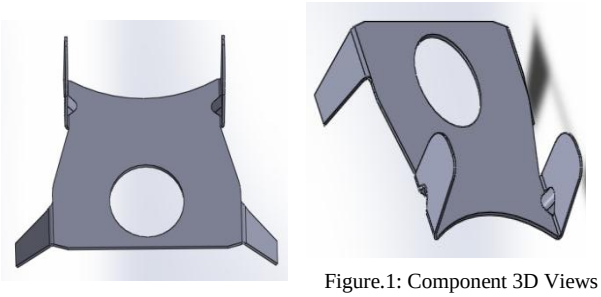

Figure.1: Component 3D Views

The 3D models of the component is as shown in figure 1

The component details of the cam head washer is listed below:

Name of the component: Cam Head Washer
Thickness: 1.25 mm
Component application: used in Ashok Leyland vehicles

2.2 COMPONENT MATERIAL

Material: Cold Rolled Carbon Steel Sheet
Designation: IS: 513 Grade D
Chemical composition: C%: 0.10, Mn%: 0.60, P%: 0.04, Si%: 0.06%, Su%: 0.04, Fe%: 98,38

3. DESIGN CONCEPTS OF PUNCH AND DIE

Designing of punch and die is the first step in the press tool design and by considering this design other parameters are decided. Hence designing press punch and die is a vital step in the development of press processes, therefore 3D solid model of punch and die is similar to real product. Use of this concept in punch and die design to avoid any interference and to facilitate design and modification, which in turn reduces the designing time.

In this punch and die is designed to carry out both blanking and piercing operation in a single shot.

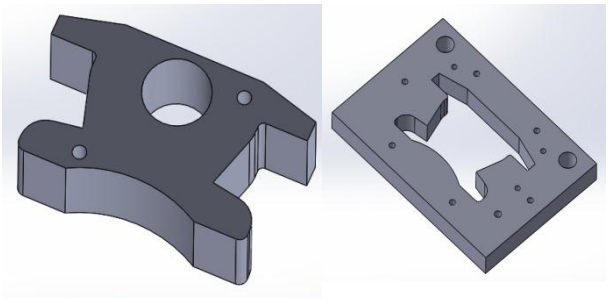

Figure 2: Blanking and Piercing die

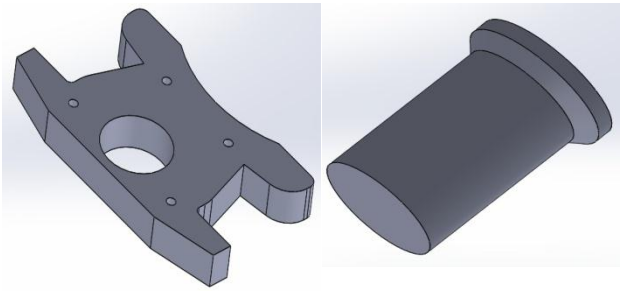

Figure 3: Blanking and Piercing punch

3.1. SELECTION OF TOOLING MATERIAL

The material is subjected to vacuum heat treatment process and hardened up to 50-60 HRC and then used for punch and die. Primary machining operations such as wire cutting and CNC machining are performed to get required profile.

The selected material for punch and die is D2. D2 is high carbon high chromium tool steel, its used when greater toughness is required. It offers good wear resistance and high compressive strength.

4. ANALYSIS OF PUNCH AND DIE

Finite Element Analysis is a simulation technique which evaluates the behavior of components, equipment's and structures for various loading conditions including applied forces, pressure and temperature. Finite element analysis is a computerized method for predicting how a real object will react to forces, heat, vibration, etc. by mesh of simpler interlocking structures, the simpler structures or finite elements being amenable to mathematical analysis. The analysis of whole structure is obtained by simultaneously analysis the individual finite elements, having due regard to their individual positions within the mesh and being totally dependent upon the assistance of an automatic computer. Numerical modeling of metal forming processes has now gained the industrial stage, and it became possible to simulate metal deformation and to calculate stress and strain states for complex processes.

Nowadays, the finite element method (FEM) has proven its efficiency and usefulness simulating steady and non-steady metal forming processes. When the modeling approaches are deterministic requiring the introduction of several input data such as geometry, mesh, non-linear material behavior laws, loading cases, friction laws, thermal laws, then the computation of process evolution and final results is called a direct problem.

4.1 Analysis of Punch

Component: Punch
Load: 40.11 Tons
Mesh: Fine Mesh
Analysis Type: Static Analysis
Software: Solid Works 2013

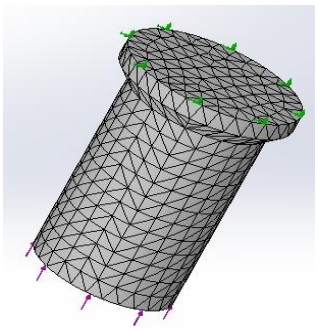

Figure 4: Solid Mesh

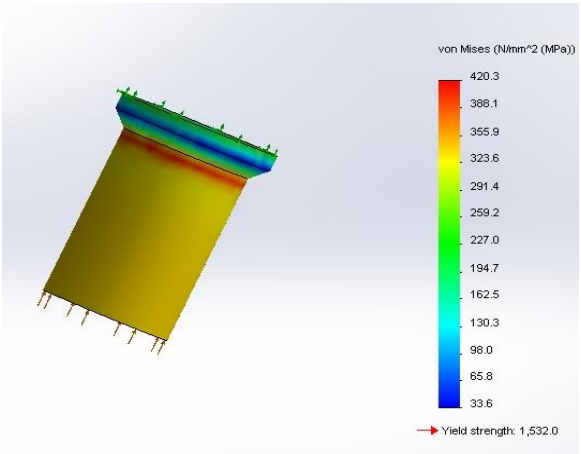

Figure 5: Von Mises Stress of Punch

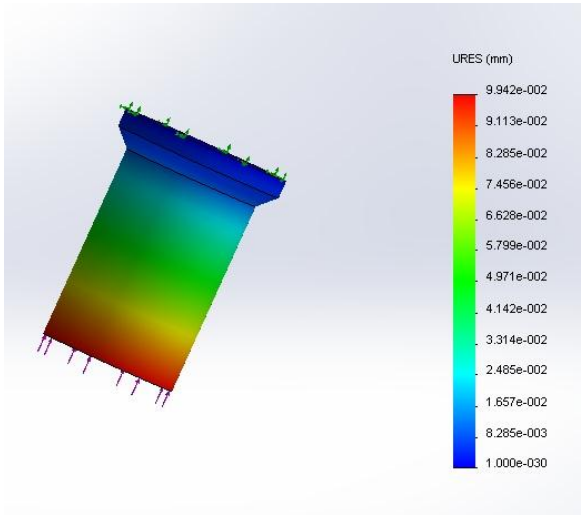

Figure 6: Static Displacement of Punch

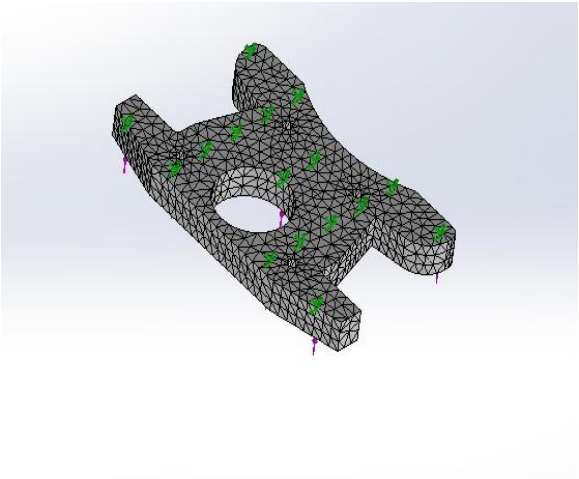

Figure 7: Solid Mesh

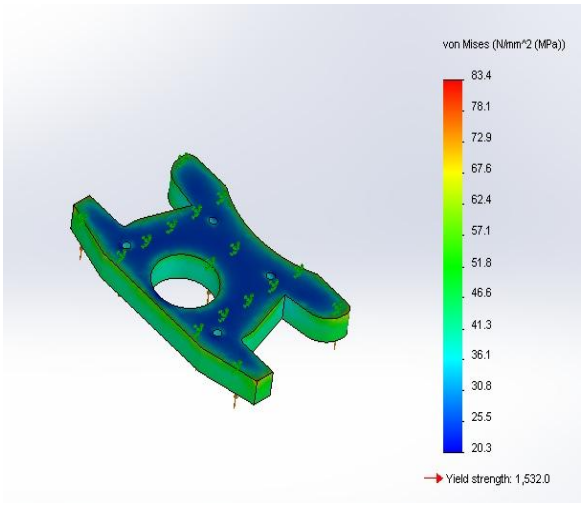

Figure 8: Von Mises Stress of Punch

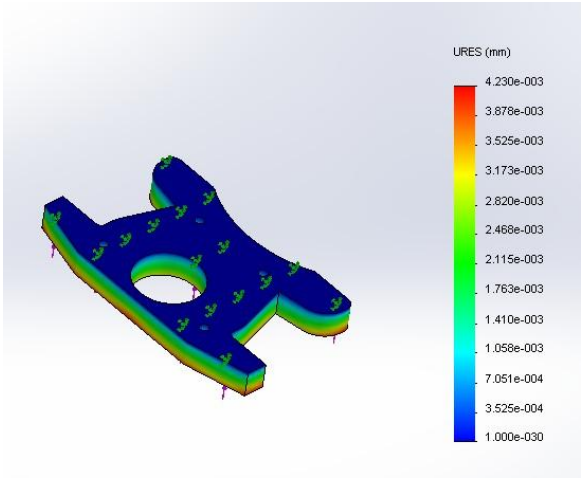

Figure 9: Static Displacement of Punch

Table 1: Analysis Result of Piercing Punch

Type	Static Stress	Static Displacement
Minimum	33.4 N/mm^2	0.001mm
Maximum	420.3 N/mm^2	0.09mm

Table 2: Analysis Result Blanking

Type	Static Stress	Static Displacement
Minimum	20.3 N/mm^2	0.001mm
Maximum	83.4 N/mm^2	0.004mm

4.2 Analysis of Die

Component: Die
Load: 40.11 Tons
Mesh: Fine Mesh
Analysis Type: Static Analysis
Software: Solid Works 2013

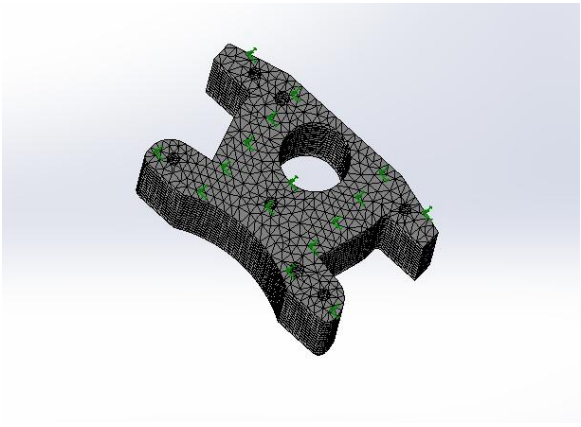

Figure 10: Solid Mesh

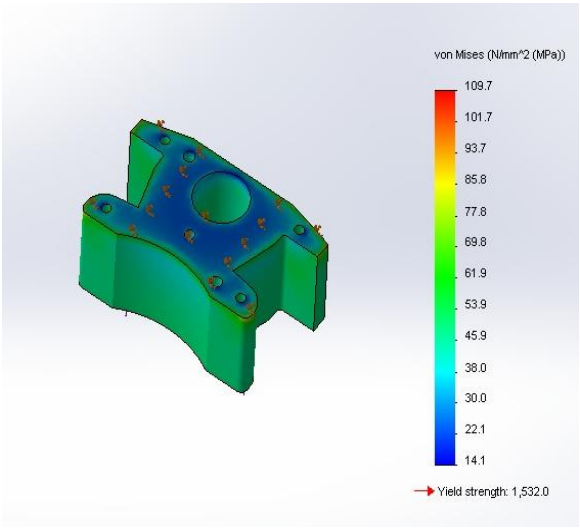

Figure 11: Von Mises Stress of Die

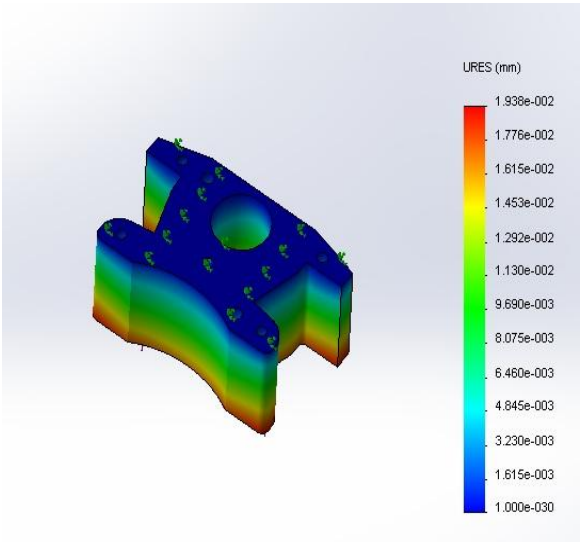

Figure 12: Static Displacement of Die

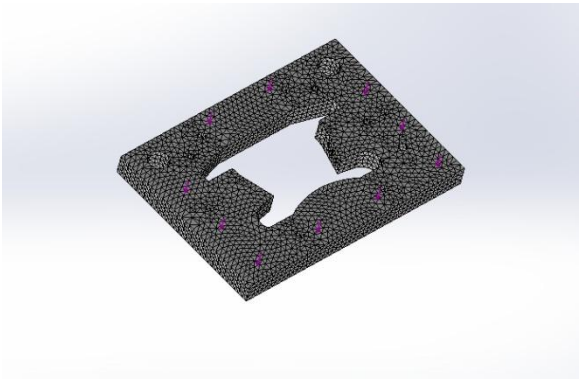

Figure 13: Solid Mesh

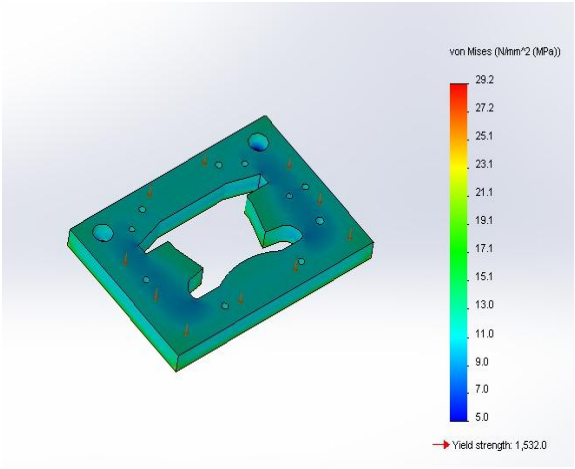

Figure 14: Von Mises Stress of Die

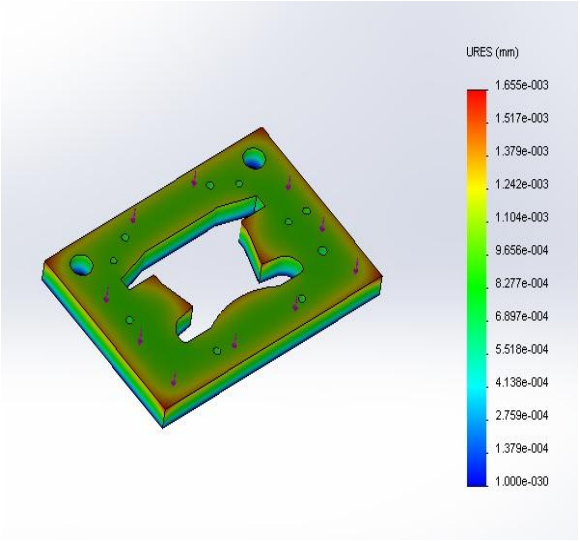

Figure 15: Static Displacement of Die

Table 3: Analysis result of Piercing Die

Type	Static Stress	Static Displacement
Minimum	14.1 N/mm^2	0.019mm
Maximum	100.7 N/mm^2	0.09mm

Table 4: Analysis result of Blanking Die

Type	Static Stress	Static Displacement
Minimum	5 N/mm^2	0.0016mm
Maximum	29.2 N/mm^2	0.09mm

5. CONCLUSION

In this paper, an integrated approach for design and analysis of punch and die was introduced for the blanking process by using CAD and CAE software. By applying this knowledge based systems significant result was achieved.

Several imperfections in the design of punch and die for the manufacture of components by stamping of sheet metal was decided upon primarily on a critical examination. Finally significantly shorter lead time, better product quality and cost effective design and manufacturing was obtained by this integrated approach.

And finally analyze the analysis result the design of die and punch is safe for sheet metal blanking process

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