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Design and Analysis of the Deep Draw Tool

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Abstract

Deep drawing is one of the important sheet metal forming process. This process can be used to produce the complex shapes. In deep drawing process various parameters are identified and controlled so that an effective final product with desired mechanical properties can be obtained. This study evaluates the formability of different metal sheets using deep drawing process. Various methods work adopted by designing the deep draw tool. Also the numerical simulation was performed for the deep drawing of cylindrical cups. Punch forces and dome height are evaluated for various metals. In this study the formability of different metals was observed angular geometries of deep drawing tools.

Keywords: Deep Draw; Formability; Simulation; ANSYS; Mild Steel

1. Introduction

Press tools are used to perform various metal forming operations. Different metal forming operations are shearing. Blanking, piercing, bending, deep drawing etc, Raw material is converted into finished product. Some of the important factors must be considered during the designing like type of material, length of the draw, cutting area clearance between die and punch. A hard material is used for dies and punches to enhance the life of tooling. Initial cost of tooling is high, but manufacturing and running cost is low depends on batch size.

The traditional procedure for design for deep draw tool normally used in industry is experimental and expensive. By using analytical method by using various design parameter and forces can be calculated by using COMPUTER AIDED DESIGN such as PROE, CATIA, SOLID WORKS, and FINITE ELEMENT ANALYSIS by using ANSIS which will result in reducing in the time for development of dies. In deep drawing process a flat metal piece is formed drawn with the help of punch into die. During this process sometime shape and thickness of the part may change. The material is drawn beyond its elastic limit.

1.1 Deep Draw Process

Modern industries already have deep drawn products of complicated shapes that require number of stages to be achieved. In first stage a sheet metal undergoes is usually blanking, the shaping of the sheet metal to optimal size followed by deep drawing process. Finally trimming operation is done to remove the extra material to ensure uniformity of the flange shape. This extra material is wrinkled shape along the edge of the flange or end of the wall of the cup.

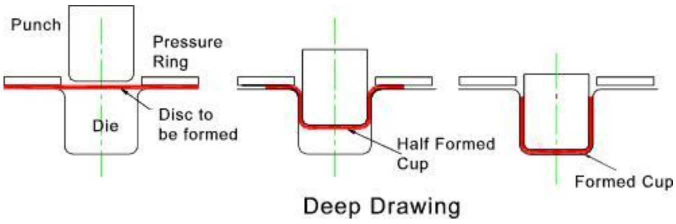


Figure1. Deep Drawing

1.2 Types of Press Tool

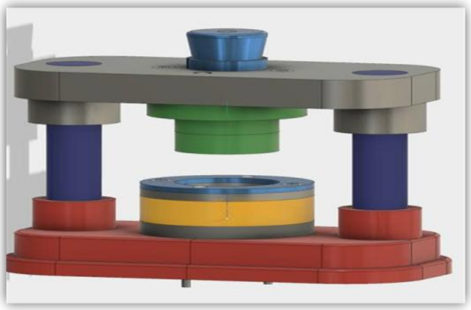
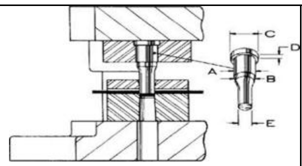
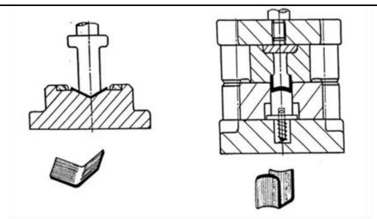
		
1. Drawing Tool	**2. Piercing Tool**	**3. Bending tool**

Figure2. Types of Press Tool

2. Parameters to be considered

1. Blank holder force
2. Punch velocity and punch force
3. Forming Limits
4. Blank shape
5. Stress and Strain Distribution
6. Thickness variation
7. Wrinkling
8. Some other defects

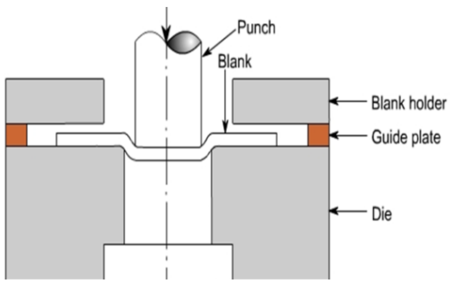


Figure 3. Traditional Process

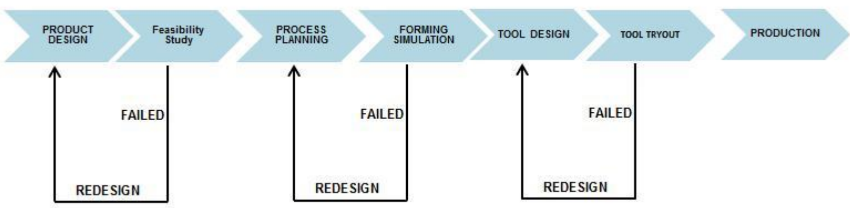


Figure 3. Conventional Processes

As shown the traditional process and effective conventional process can be shown as shown in the Figure 3 and Figure 4

2.1. Other factor that affect cost effectiveness of deep drawing:

1. Location of parts features.
2. Direction of part features.
3. Producing part feature.
4. Part size.
5. Material Thickness
6. Number of part features.

2.2. Defects in deep drawing process wrinkling in the flange and wall:

Several factors can cause wrinkles in drawn parts, including:

1. Blank holder pressure
2. Die cavity depth and radius.
3. Friction between the blank , blank holder and die cavity.
4. Clearance between the blank , blank holder, punch and die cavity
5. Blank shape and thickness.
6. Final part geometry
7. Punch speed.

The blank holder, however does not hold the edges of the blank rigidly in place if this were the case, tearing could occur in the cup wall, The blank holder allows the blank to side somewhat by providing frictional force between the blank holder and the blank itself. Blank holder can be applied hydraulically with the pressure feedback, by using an air or nitrogen cushion or a numerically controlled hydraulic cushion.

The radii degree of the punch and die cavity edges control the flow of blank material into the die cavity. Wrinkling in the cup wall occur if the punch and die cavity edges are too large. If the radii are too small, the blank is prone to tearing because of the high stresses

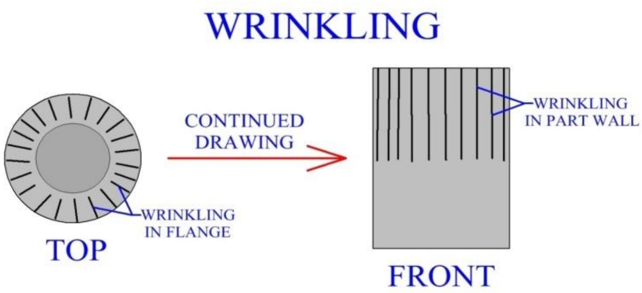


Figure 4. Wrinkling

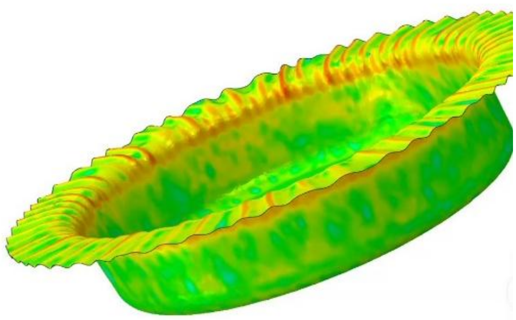


Figure 5. Wrinkling

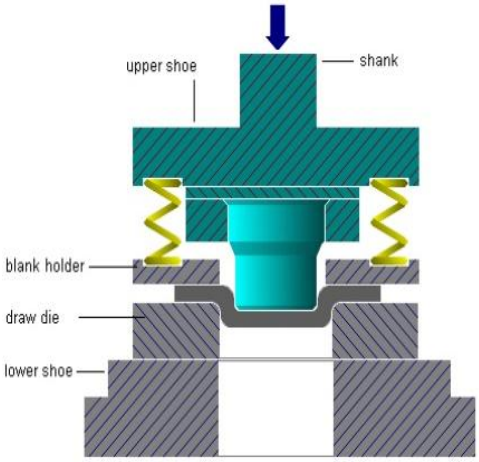
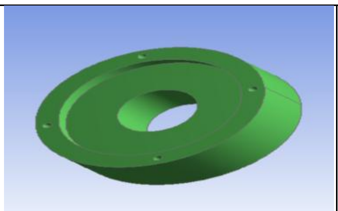
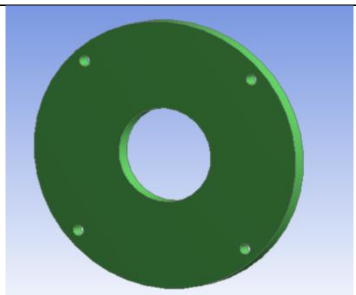
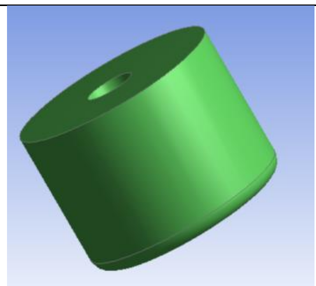
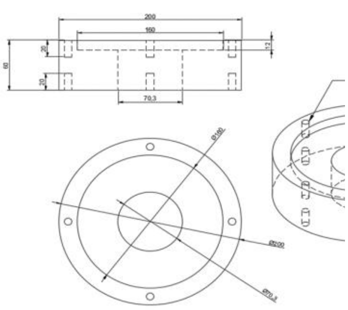
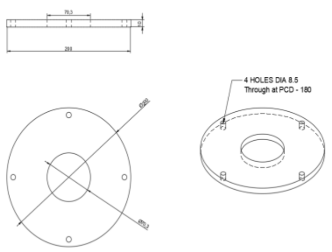
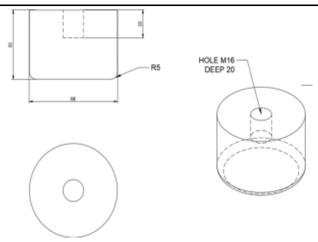


Figure 6. Deep draw tool setup

2.3. Deep drawing design

Parts of deep draw tool

1. Shank
2. Blank holder
3. Punch first stage
4. Punch holder
5. Die first stage
6. Die holder
7. Rubber pad oblique spring
8. Punch second stage
9. Punch holder
10. Guide for blank
11. Die

		
		
Die	Blank Holder	Punch

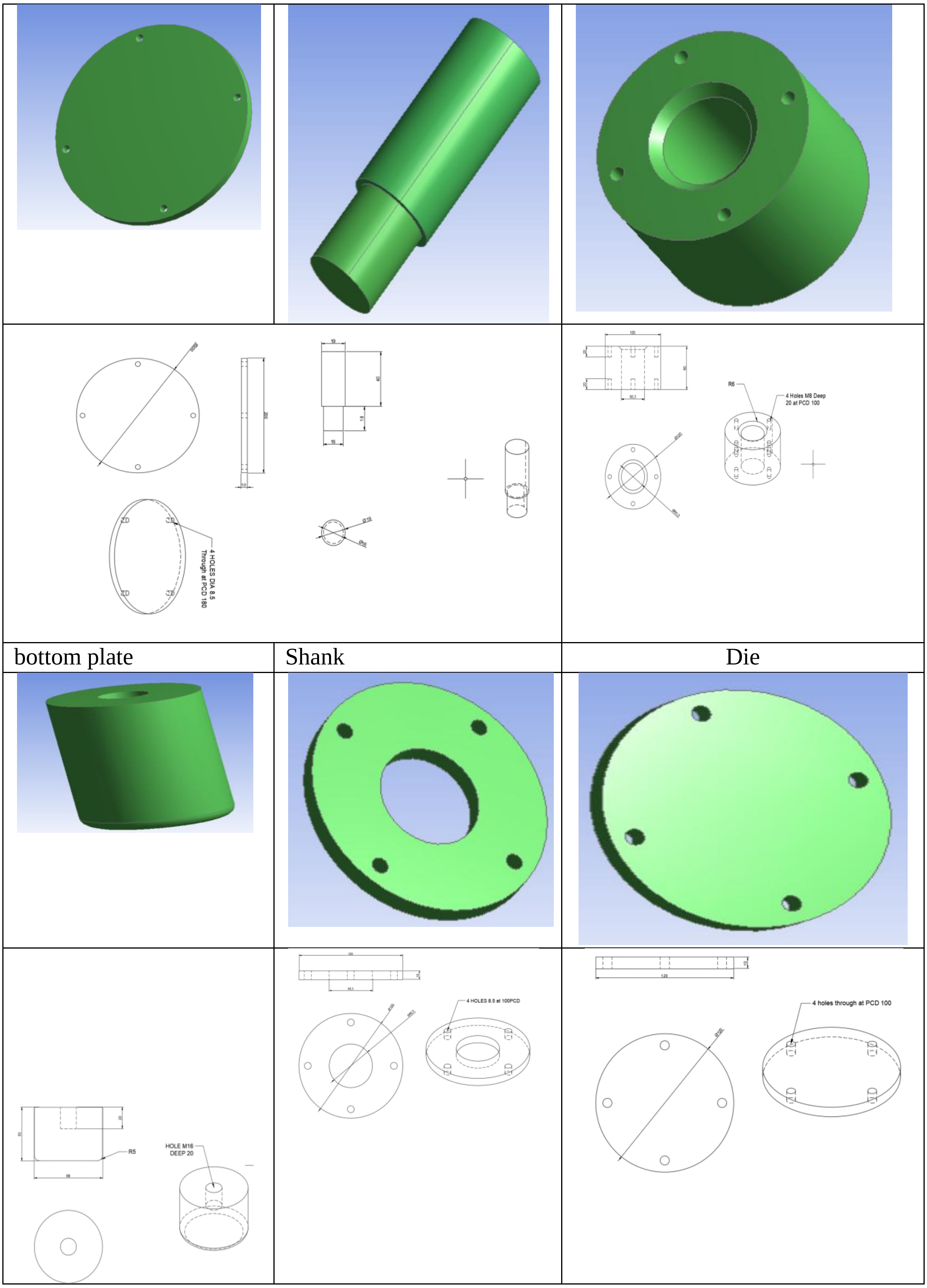


Figure 7. Components of Tool

3.1 Assembly of Deep Drawing Tool

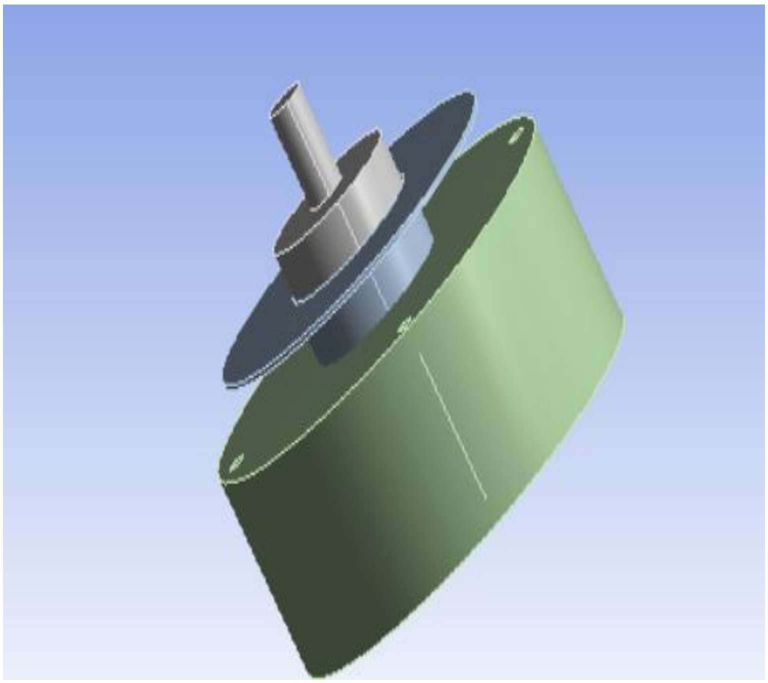


Figure 8 Assembly of deep drawing tool

3.2 Meshing of Components

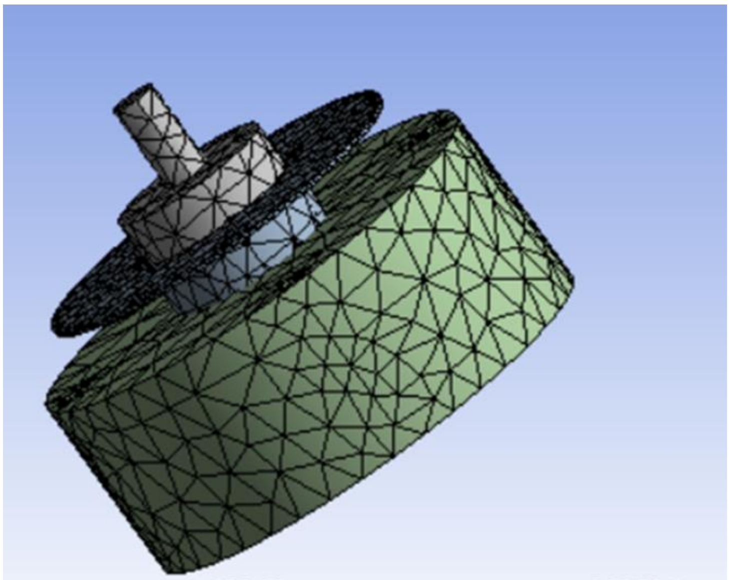


Figure 9.Meshing of components

3.3 Deformation

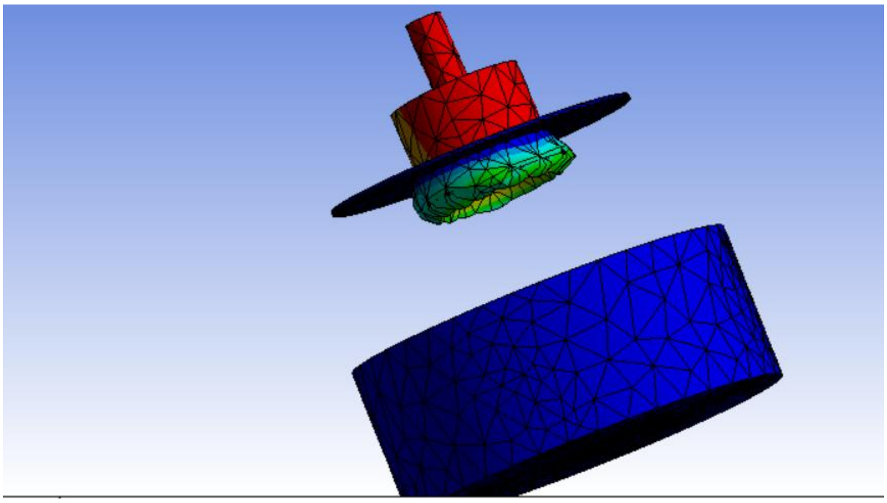
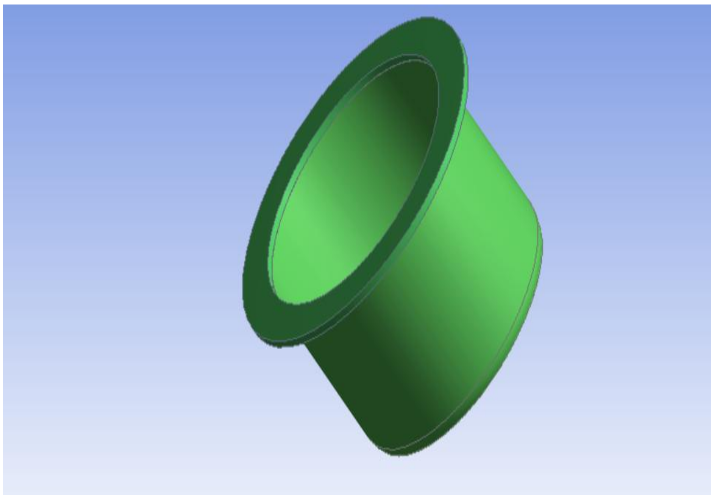


Figure 10. Deformation after force

STAGE -1



STAGE-2

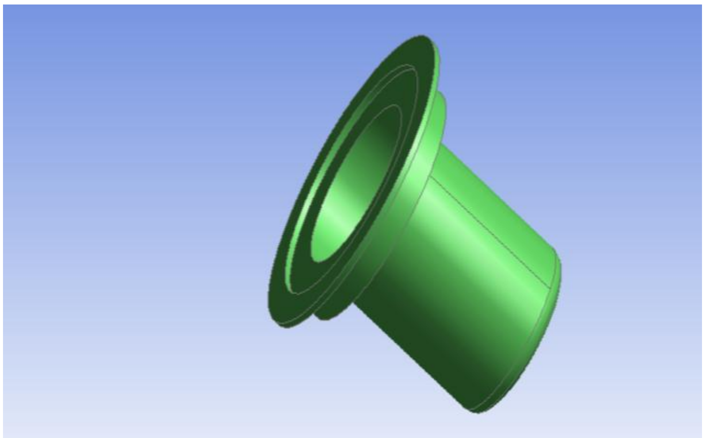


Figure 11. Stages of deformation

4. Conclusion

In This study design have been carried out on the Deep Drawing Tool for Aluminum cup and Structural analysis is done and results are shown above. It has done stress, strain and the maximum deflection analysis using ANSYS on deep drawing tool made up of MILD STEEL.As the result show, Mild steel has more Strength to with stand higher loads. An Analysis is carried out on Mild steel and is suitable for mass Production.

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