*R Venkat Reddy * et al.*
(IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH
Volume No.5, Issue No.6, October - November 2017, 7684-7691.

Effect Of Various Process Parameters On Punch And Die Design In Deep Drawing Process

Dr. R . VENKAT REDDY
Professor and Head of Department, Department of Mechanical Engineering, Anurag Group of Institutions

V. MOUNIKA
PG Student, Department of Mechanical Engineering, Anurag Group of Institutions

Dr. P. RAVIKANTH RAJU
Associate Professor, Department of Mechanical Engineering, Anurag Group of Institutions

Abstract: **The model is designed in CREO software. Analysis is done in ANSYS software for different materials. In this work static analysis is done for cup and punch to determine the deformation, stress and strain at different load conditions and for different materials by changing the geometry thickness. In this work the stress have been calculated theoretically and as well as using ansys and both results are compared. Modal analysis is done for cup to determine the deformation and frequency for different materials by changing the geometry thicknesses. Random vibration analysis is done for cup to determine the directional deformation, shear stress and shear strain for different materials by changing the geometry thickness.In this work the shear stress have been calculated theoretically and as well as using ansys and both results are compared.Transient analysis is done for cup to determine the deformation, stress and strain for different materials by changing the geometry thickness with respect to time.**

Keywords: **Cup; Punch;Static Analysis; Random Analysis ; CREO Parametric;ANSYS;**

I. INTRODUCTION

Deep drawing is a sheet metal forming process in which a sheet metal blank is radially drawn into a forming die by the mechanical action of a punch. It is thus a shape transformation process with material retention. The process is considered "deep" drawing when the depth of the drawn part exceeds its diameter. This is achieved by redrawing the part through a series of dies. The flange region (sheet metal in the die shoulder area) experiences a radial drawing stress and a tangential compressive stress due to the material retention property. These compressive stresses (hoop stresses) result in flange wrinkles (wrinkles of the first order). Wrinkles can be prevented by using a blank holder, the function of which is to facilitate controlled material flow into the die radius as shown in Fig 1.1.

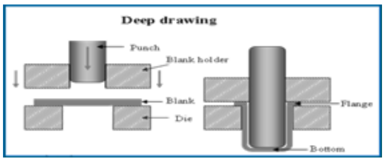


Fig 1.1 A Typical Deep Drawing Operation

1.2 Process of Deep Drawing

Commercial applications of this metal shaping process often involve complex geometries with straight sides and radii. In such a case, the term stamping is used in order to distinguish between the deep drawing (radial tension-tangential compression) and stretch-and-bend (along the straight sides) components. Deep drawing is always accompanied by other forming techniques within the press. These other forming methods include:

a. Beading: Material is displaced to create a larger, or smaller, diameter ring of material beyond theoriginal body diameter of a part, often used to create O-ring seats.

b. Bottom Piercing: A round or shaped portion of metal is cut from the drawn part.

c. Bulging: In the bulging process a portion of the part's diameter is forced to protrude from the surrounding geometry.

d. Coining: Material is displaced to form specific shapes in the part. Typically coining should not exceed a depth of 30% of the material thickness**.**

e. Curling: Metal is rolled under a curling die to create a rolled edge**.**

f. Extruding: After a pilot hole is pierced, a larger diameter punch is pushed through, causing the metal to expand and grow in length.

g. Ironing / Wall Thinning: Ironing is a process to reduce the wall thickness of parts. Typically ironing should not exceed a depth of 30% of the material thickness.

h.Necking: A portion of the part is reduced in diameter to less than the major diameter.

i.Notching: A notch is cut into the open end of the part. This notch can be round, square, or shaped.

j. Rib Forming: Rib forming involves creating an inward or outward protruding rib during the drawing process.

k. Side Piercing: Holes are pierced in the side wall of the drawn part. The holes may be round or shaped according to specifications.

l.Stamping / Marking: This process is typically used to put identification on a part, such as a part number or supplier identification.

m.Threading: Using a wheel and arbor, threads are formed into a part. In this way threaded parts can be produced within the stamping press.

n. Trimming: In the Trimming process, excess metal that is necessary to draw the part is cut away from the finished part.

II. LITERATURE REVEIW

Some journal papers were selectively studied which have direct relevance with my work. A brief discussion is presented belowJay N.Mistri, K.D.Kothari,Gaurav, Kumar Sharma all[1], are discussed about Deep drawing is part of forming process in which sheet metal drawn into die cavity by action of a punch. So, due to action of punch desired shape can be achieved. For reduce various defects in deep drawing process it is essential to control or vary physical and geometric parameters of deep drawing process. Sheet-metal drawing is a more complex operation than cutting or bending, and more things can go wrong. Nowadays composite material is extensively used in manufacturing industries due to its better strength.

INTRODUCTION TO CAD

Computer-aided design (CAD) is using laptop structures (or workstations) to aid within the advent, change, analysis, or optimization of a layout. CAD software is used to increase the productiveness of the clothier, improve the great of layout, improve communications via documentation, and to create a database for production. CAD output is frequently within the form of digital documents for print, machining, or other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used.

INTRODUCTION TO CREO

Pro/ENGINEER Wildfire is the equal old in 3-d product layout, presenting employer-main productiveness equipment that sell outstanding practices in design on the identical time as making sure compliance together with your agency and business enterprise requirements. Integrated Pro/ENGINEER CAD/CAM/CAE answers can help you format quicker than ever, even as maximizing innovation and extraordinary to in the end create great merchandise.

Customer necessities might also additionally alternate and time pressures may additionally continue to mount, but your product layout desires remain the same - irrespective of your challenge's scope, you need the powerful, smooth-to-use, much less costly answer that Pro/ENGINEER provides.

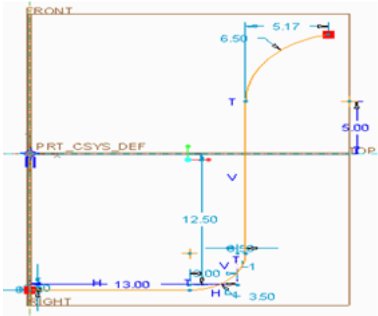


Fig 3.1 2D Sketch of Cup

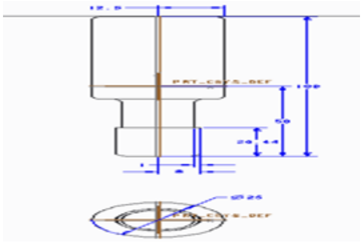


Fig 3.2 2D Sketch of Punch

By using PTC CREO Software, 3D Model of Cup and punch is developed. It is shown in Fig 3.3

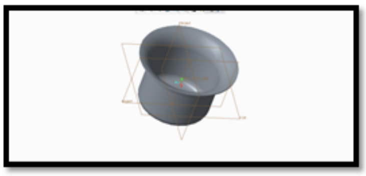


Fig 3.3 3D Model of Cup

Fig 3.4 3D Model of Punch

INTRODUCTION TO FEA

Finite element evaluation is a technique of solving, normally approximately, certain problems in engineering and science. It is used specially for troubles for which no precise solution, expressible in a few mathematical shape, is available. As such, it is a numerical in preference to an analytical technique. Methods of this type are wanted due to the fact analytical strategies cannot cope with the real, complicated troubles which can be met with in engineering. For instance, engineering electricity of substances or the mathematical principle of elasticity may be used to calculate analytically the stresses and lines in a bent beam, but neither will be very successful in locating out what's going on in a part of a car suspension device for the duration of cornering.

3.2 THEORETICAL CALCULATIONS TO FIND THE STRESS OF CUP

F= $(\frac{2}{\sqrt{3}}) \times \pi \times UTS \times D \times t$
..... (Eq 3.1)

Where,

t_O = thickness (mm)

UTS =ultimate tensile strength (MPa)

Do = die diameter (mm)

Blank diameter =26

Punch diameter =25

Blank thickness =0.5,0.7,0.9

Radial clearance between punch and die radius =1.1

Punch nose radius =0.52

Parameters obtained from Sandeeppatil[29]

$\boldsymbol{\sigma}$=F/A
-----(Eq 3.2)

A=333.923 mm^2

Where,

σ = stress (N/mm^2)

P = maximum load (N)

A =area (mm^2)

CASE 1-MATERIAL- STAINLESS STEEL

At t=0.5 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 513.61 \times 26 \times 0.5/333.923$

=62.5 MPa

At t=0.7 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 513.61 \times 26 \times 0.7/333.923$

=54.4 MPa

At t=0.9 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 513.61 \times 26 \times 0.9/333.923$

=40.5 MPa

CASE 2-MATERIAL- AL 5083

At t=0.5 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 26 \times 0.5/333.923$

=46 MPa

At t=0.7 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 26 \times 0.7/333.923$

=45.07 MPa

At t=0.9 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 26 \times 0.9/333.923$

=32.199 MPa

CASE 3-MATERIAL- AL 7475

At t=0.5 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 345 \times 26 \times 0.5/333.923$

=63.2 MPa

At t=0.7 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 26 \times 0.7/333.923$

=62 MPa

At t=0.9 mm, D$_o$=26 mm

$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 26 \times 0.9/333.923$

=48.7MPa

III. INTRODUCTION

ANSYS is wellknown-reason finite detail evaluation (FEA) software bundle. Finite Element Analysis is a numerical method of deconstructing a complicated system into very small pieces (of person-exact length) called factors. The software implements equations that govern the behaviour of these factors and solves all of them; creating a comprehensive clarification of ways the machine acts as a whole. These outcomes then can be offered in tabulated, or graphical forms. This kind of analysis is typically used for the layout and optimization of a machine some distance too complex to analyze by hand. Systems that may match into this category are too complicated due to their geometry, scale, or governing equations.

STATIC ANALYSIS OF CUP

Static structural analysis for deformationand stress are shown in Figure 3.5 and 3.6 respectively.

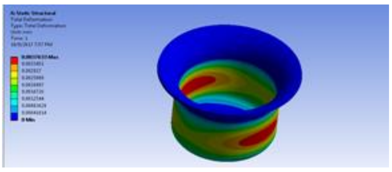


Fig 3.5 Deformation Contours of Cup

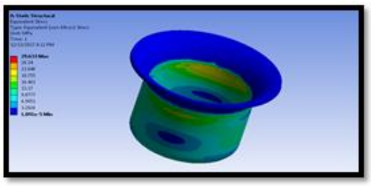
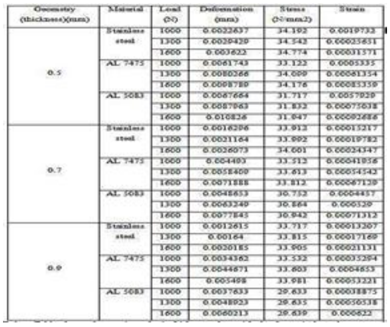


Fig 3.6 Stress Contours of Cup

From the Table 3.2 it can be seen that the stress value increases with increasing the load and decreases with increasing the thickness. The stress value occurred minimum for the material AL 5083 at 0.9 mm thickness for 1000N load.

Table 3.2 The Static Analysis Results Of Cup



Geometry (thickness)(mm)	Material	Load (N)	Deformation (mm)	Stress (N/mm2)	Strain
0.5	Stainless steel	1000	0.0022637	34.192	0.00019732
		1300	0.0029420	34.542	0.00025651
		1600	0.003622	34.774	0.00031571
	AL 7475	1000	0.0061743	33.122	0.0005335
		1300	0.0080266	34.099	0.00081354
		1600	0.0098789	34.176	0.00085339
	AL 5083	1000	0.0067664	31.717	0.0057929
		1300	0.0087963	31.832	0.00075638
		1600	0.010826	31.947	0.00092686
0.7	Stainless steel	1000	0.0016296	33.912	0.00015217
		1300	0.0021164	33.992	0.00019782
		1600	0.0026073	34.001	0.00024347
	AL 7475	1000	0.004403	33.512	0.00041956
		1300	0.0058400	33.613	0.00054542
		1600	0.0071888	33.812	0.00067129
	AL 5083	1000	0.0048653	30.752	0.0004457
		1300	0.0063240	30.864	0.000529
		1600	0.0077845	30.942	0.00071312
0.9	Stainless steel	1000	0.0012615	33.717	0.00013207
		1300	0.00164	33.815	0.00017169
		1600	0.0020185	33.905	0.00021131
	AL 7475	1000	0.0034362	33.532	0.00035294
		1300	0.0044671	33.603	0.0004653
		1600	0.005498	33.981	0.00053221
	AL 5083	1000	0.0037633	29.633	0.00038875
		1300	0.0048923	29.635	0.00050538
		1600	0.0060213	29.639	0.000622

Below Table shows that static analysis fairly matches with the theoretical results

Table 3.3 Comparison of Theoretical Stress And ANSYS Stress

Materials	Thickness (mm)	ANSYS stress (MPa)	Theoretical stress (MPa)
Stainless steel	0.5	55.938	62.53
	0.7	46.736	54.4
	0.9	36.789	40.56
AL 7475	0.5	57.736	63.2
	0.7	56.206	62.02
	0.9	42.852	48.7
AL 5083	0.5	39.994	46
	0.7	38.925	45.07
	0.9	29.633	32.199

Summary:

According to the contours plot, the maximum stress at inside of the cup because of force acting on the area due to punch applied and the minimum stress at upside,down side and around the cup because of fixed the cup.

The stress value occurred minimum for the material AL 5083 at 0.9 mm thickness for 1000N load.

3.5 THEORETICAL CALCULATIONS TO FIND THE STRESS OF PUNCH

F= $\left(\frac{2}{\sqrt{3}}\right) \times \pi \times UTS \times D \times t$

$\boldsymbol{\sigma}$=F/A, A=333.923 mm2

Stainless Steel

At t=0.5 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 513.61 \times 25 \times 0.5/333.923$$

=59.74 MPa

At t=0.7 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 513.61 \times 25 \times 0.7/333.923$$

=48.6 MPa

At t=0.9 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 513.61 \times 25 \times 0.9/333.923$$

=42.54 MPa

AL 5083

At t=0.5 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 25 \times 0.5/333.923$$

=45.23 MPa

At t=0.7 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 25 \times 0.7/333.923$$

=42.4 MPa

At t=0.9 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 25 \times 0.9/333.923$$

=41.11 MPa

AL 7475

At t=0.5 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 345 \times 25 \times 0.5/333.923$$

=55.23 MPa

At t=0.7 mm, Dp=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 25 \times 0.7/333.923$$

=52.5 MPa

At t=0.9 mm, D_p=25 mm

$$=\left(\frac{2}{\sqrt{3}}\right) \times \pi \times 228 \times 25 \times 0.9/333.923$$

=46.84 MPa

3.6 STATIC ANALYSIS OF PUNCH

Static structural analysis of punch for deformation and stress are shown in Figure 3.7 and 3.8 respectively.

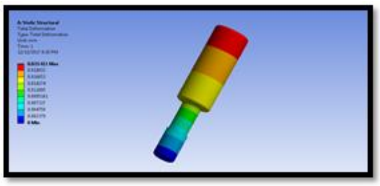


Fig 3.7 Deformation contours of Punch

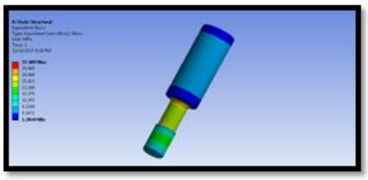
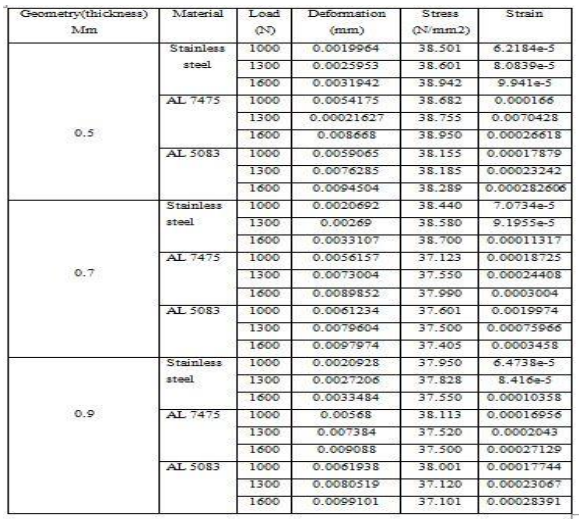


Fig 3.8 Stress contours of Punch

From the Table 3.4 it can be seen that the stress value increases with increasing the load and decreases with increasing the thickness.



Geometry(thickness) Mm	Material	Load (N)	Deformation (mm)	Stress (N/mm2)	Strain
0.5	Stainless steel	1000	0.0019964	38.501	6.2184e-5
		1300	0.0025953	38.601	8.0839e-5
		1600	0.0031942	38.942	9.941e-5
	AL 7475	1000	0.0054175	38.682	0.000166
		1300	0.00021627	38.755	0.0070428
		1600	0.008668	38.950	0.00026618
	AL 5083	1000	0.0059065	38.155	0.00017879
		1300	0.0076285	38.185	0.00023242
		1600	0.0094504	38.289	0.000282606
0.7	Stainless steel	1000	0.0020692	38.440	7.0734e-5
		1300	0.00269	38.580	9.1955e-5
		1600	0.0033107	38.700	0.00011317
	AL 7475	1000	0.0056157	37.123	0.00018725
		1300	0.0073004	37.550	0.00024408
		1600	0.0089852	37.990	0.0003004
	AL 5083	1000	0.0061234	37.601	0.0019974
		1300	0.0079604	37.500	0.00075966
		1600	0.0097974	37.405	0.0003458
0.9	Stainless steel	1000	0.0020928	37.950	6.4738e-5
		1300	0.0027206	37.828	8.416e-5
		1600	0.0033484	37.550	0.00010358
	AL 7475	1000	0.00568	38.113	0.00016956
		1300	0.007384	37.520	0.0002043
		1600	0.009088	37.500	0.00027129
	AL 5083	1000	0.0061938	38.001	0.00017744
		1300	0.0080519	37.120	0.00023067
		1600	0.0099101	37.101	0.00028391

Material	Thickness (mm)	Theoretical Stress MPa	ANSYS Stress MPa
Stainless Steel	0.5	59.74	45.125
	0.7	48.6	40.123
	0.9	42.54	38.001
AL 5083	0.5	45.23	38.177
	0.7	42.4	38.152
	0.9	41.11	37.489
AL 7475	0.5	55.23	49.433
	0.7	52.5	46.233
	0.9	46.84	37.880

Summary:

According to the counters plot, the maximum stress at down side of the cup because of force acting on the area due to punch applied and the minimum stress at upside.

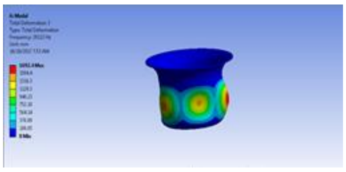
The stress value occurred minimum for the material AL 5083 at 0.9 mm thickness for 1000N load

IV. MODAL ANALYSIS OF CUP

The goal of modal analysis in structural mechanics is to determine the natural mode shapes and frequencies of an object or structure during free vibration. It is common to use the finite element method (FEM) to perform this analysis because, like other calculations using the FEM, the object being analyzed can have arbitrary shape and the results of the calculations are acceptable. The types of equations which arise from modal analysis are those seen in eigen systems. The physical interpretation of the eigen values and eigen vectorswhich come from solving the system are that they represent the frequencies and corresponding mode shapes. Sometimes, the only desired modes are the lowest frequencies because they can be the most prominent modes at which the object will vibrate, dominating all the higher frequency modes.

According to the counters plot, the maximum total deformation at around the cup because of force acting on the area due to punch applied and the minimum directional deformation at up and down side of the cup because of fixed the cup.

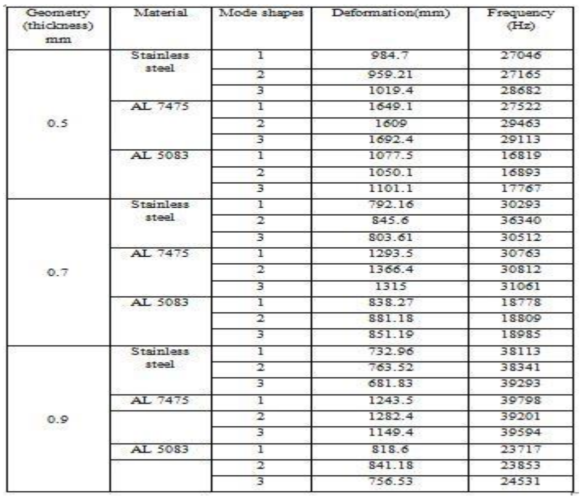
Modal analysis of cup for total deformation it is shown in Figure 4.1



4.1 Total Deformation contours

Here,Table 4.1 showndeformationof AL5083,AL7475 and stainless steel, it canbeseenthatthe maximumdeflection1692.4 mm for AL7475andcorresponding deflectioninAL5083andStainless steel are 1101mm,1019.4mm.

Table 4.1 Modal analysis results of cup



Geometry (thickness) mm	Material	Mode shapes	Deformation(mm)	Frequency (Hz)
0.5	Stainless steel	1	984.7	27046
		2	959.21	27165
		3	1019.4	28682
	AL 7475	1	1649.1	27522
		2	1609	29463
		3	1692.4	29113
	AL 5083	1	1077.5	16819
		2	1050.1	16893
		3	1101.1	17767
0.7	Stainless steel	1	792.16	30293
		2	845.6	36340
		3	803.61	30512
	AL 7475	1	1293.5	30763
		2	1366.4	30812
		3	1315	31061
	AL 5083	1	838.27	18778
		2	881.18	18809
		3	851.19	18985
0.9	Stainless steel	1	732.96	38113
		2	763.52	38341
		3	681.83	39293
	AL 7475	1	1243.5	39798
		2	1282.4	39201
		3	1149.4	39594
	AL 5083	1	818.6	23717
		2	841.18	23853
		3	756.53	24531

V. RANDOM VIBRATIONAL ANALYSIS OF CUP

The Random Vibration analysis uses the results from a modal analysis, specify which design scenario in the current model has the modal results with the Use modal results from Design Scenario field.The Model Units of the random vibration analysis must be identical to the Model Units of the modal results.According to the counters plot, the maximum shear stress at inside of the cup because of force acting on the area due to punch applied and the minimum shear stress at upside ,down side and around the cup because of fixed the cup.

Random Vibration analysis of cup for Shear stress it is shown in Figure 5.1

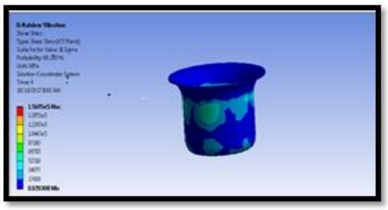
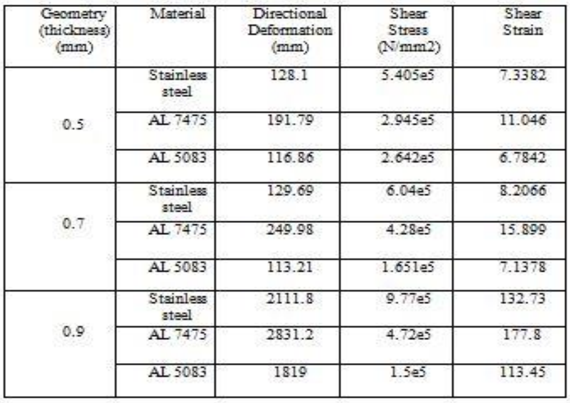


Fig 5.1 Shear Stress contour

Here,Table5.1shownShearstressof AL5083,AL7475 and stainless steel, it can be seen that the minimum shear stress1.5e^{5}N/mm2for AL5083 and corresponding shear stress in AL7475 and Stainless steel are 2.94e^{5}N/mm2, 5.405e^{5}N/mm2

The Shear stress value occurred minimum for the material AL 5083 at 0.9mm thickness

Table 5.1 Random Vibration Analysis Results



Geometry (thickness) (mm)	Material	Directional Deformation (mm)	Shear Stress (N/mm2)	Shear Strain
0.5	Stainless steel	128.1	5.405e5	7.3382
	AL 7475	191.79	2.945e5	11.046
	AL 5083	116.86	2.642e5	6.7842
0.7	Stainless steel	129.69	6.04e5	8.2066
	AL 7475	249.98	4.28e5	15.899
	AL 5083	113.21	1.651e5	7.1378
0.9	Stainless steel	2111.8	9.77e5	132.73
	AL 7475	2831.2	4.72e5	177.8
	AL 5083	1819	1.5e5	113.45

5.1 THEORETICAL CALCULATIONS FOR SHEAR STRESS

Shear stress (N/m^2)

τ=$4\mu u/(h-t)$,
----- (Eq 5.1)

u=Negligible

Stainless Steel---$\mu = 0.3$

At t=0.5 mm, h=25.0484 mm

τ=$4 \times 0.3/(25.0484 - 0.5)$

=49.8 N/m^2

At t=0.7 mm, h=25.0484 mm

τ=$4 \times 0.3/(25.0484 - 0.7)$

=49.6 N/m^2

At t=0.9 mm, h=25.0484 mm

τ=$4 \times 0.3/(25.0484 - 0.9)$

=48.8 N/m^2

AL 5083---$\mu = 0.129$

At t=0.5 mm, h=25.0484 mm

τ=$4 \times 0.129/(25.0484 - 0.5)$

=21.3 N/m^2

At t=0.7 mm, h=25.0484 mm

τ=$4 \times 0.129/(25.0484 - 0.7)$

=21.1 N/m^2

At t=0.9 mm, h=25.0484 mm

τ=$4 \times 0.129/(25.0484 - 0.9)$

=21 N/m^2

AL 7475---$\mu = 0.257$

At t=0.5 mm, h=25.0484 mm

τ=$4 \times 0.257/(25.0484 - 0.5)$

=42.2 N/m^2

At t=0.7 mm, h=25.0484 mm

τ=$4 \times 0.257/(25.0484 - 0.7)$

=42 N/m^2

At t=0.9 mm, h=25.0484 mm

τ=$4 \times 0.257/(25.0484 - 0.9)$

=41.8 N/m^2

Below Table shows that theoretical results fairly matches with the ANSYS results

Table 5.2 Comparison of Theoretical and ANSYS Shear Stress Values

Materials	Thickness(mm)	Ansys shear stress(MPa)	Theoretical shear stress(MPa)
Stainless steel	0.5	5.405×e^5	4.9800×e^5
	0.7	2.945×e^5	4.9600×e^5
	0.9	1.5×e^5	4.8800×e^5
AL 5083	0.5	6.04×e^5	2.1300×e^5
	0.7	4.28×e^5	2.1100×e^5
	0.9	1.651×e^5	2.1000×e^5
AL 7475	0.5	9.77×e^5	4.2340×e^5
	0.7	4.72×e^5	4.2200×e^5
	0.9	2.642×e^5	4.1800×e^5

Summary:

The Shear stress value occurred minimum for the material AL 5083 at 0.9mm thickness

VI. TRANSIENT ANALYSIS OF CUP

A transient dynamic analysis is used to determine the response of a structure subjected to a time-dependent loading considering inertia and damping effects. It is often referred to as a time-history analysis. The full method in ANSYS uses the full system matrices to calculate the transient response at each solution point. The model-superposition method scales the mode shapes and sums them to capture the dynamic response.

Below Figures 6.1 to 6.3 shows the deformation of the cup at 10, 20 and 30 sec respectively for the given load.

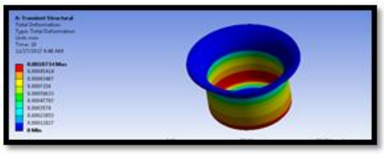


Fig 6.1 Deformation of cup at 10 seconds.

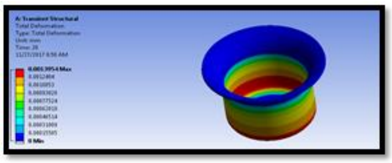


Fig 6.2 Deformation of cup at 20seconds

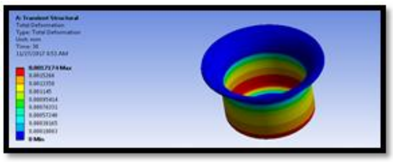


Fig 6.3 deformation of cup at 30sec

Below Figure from 6.4 to 6.6 shows the maximum stress evaluated in cup at 10,20 and 30 sec for a given load.

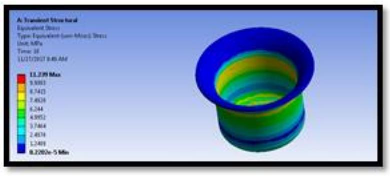


Fig.6.4 Maximum stress of cup at 10 seconds.

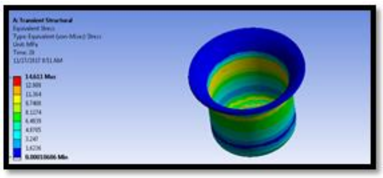


Fig 6.5 Maximum stress of cup at 20 seconds.

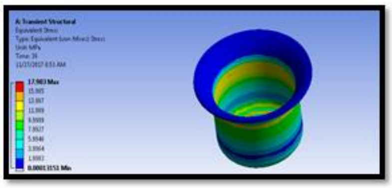
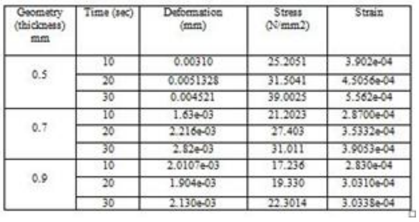


Fig 6.6 Maximum stress of cup at 30 seconds.

Below Tables 6.1 to 6.3 shows the transient analysis results of cup. From the results table it can be seen that the deformation increases with respect to time and the difference in deformation value reduces with respect to time. Also the stress value increases with respect to the time and the difference in stress value decreases with respect to the time.

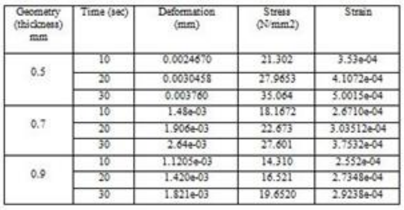
The stress value occurred minimum for the material AL 5083 at 0.9 mm, at 10sec.

Table 6.1 Transient Analysis of Stainless Steel



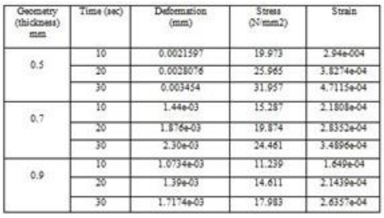
Geometry (thickness) mm	Time (sec)	Deformation (mm)	Stress (N/mm2)	Strain
0.5	10	0.00310	25.2051	3.902e-04
	20	0.0051328	31.5041	4.5056e-04
	30	0.004521	39.0025	5.562e-04
0.7	10	1.63e-03	21.2023	2.8700e-04
	20	2.216e-03	27.403	3.5332e-04
	30	2.82e-03	31.011	3.9053e-04
0.9	10	2.0107e-03	17.236	2.830e-04
	20	1.904e-03	19.330	3.0310e-04
	30	2.130e-03	22.3014	3.0338e-04

6.2 Transient Analysis of AL 7475



Geometry (thickness) mm	Time (sec)	Deformation (mm)	Stress (N/mm2)	Strain
0.5	10	0.0024670	21.302	3.53e-04
	20	0.0030458	27.9653	4.1072e-04
	30	0.003760	35.064	5.0015e-04
0.7	10	1.48e-03	18.1672	2.6710e-04
	20	1.906e-03	22.673	3.03512e-04
	30	2.64e-03	27.601	3.7532e-04
0.9	10	1.1205e-03	14.310	2.552e-04
	20	1.420e-03	16.521	2.7348e-04
	30	1.821e-03	19.6520	2.9238e-04

6.3 Transient Analysis of AL 5083



Geometry (thickness) mm	Time (sec)	Deformation (mm)	Stress (N/mm2)	Strain
0.5	10	0.0021597	19.973	2.94e-004
	20	0.0028076	25.965	3.8274e-04
	30	0.003454	31.957	4.7115e-04
0.7	10	1.44e-03	15.287	2.1808e-04
	20	1.876e-03	19.874	2.8352e-04
	30	2.30e-03	24.461	3.4896e-04
0.9	10	1.0734e-03	11.239	1.649e-04
	20	1.39e-03	14.611	2.1439e-04
	30	1.7174e-03	17.983	2.6357e-04

According to plot the maximum Shear stress of material at 0.9mm,Material Stainless Steel, minimum at 0.9 mm Material AL-5083, Here Material Thickness Increasing To Shear Stress Will Be Increasing it shown in Fig 6.7

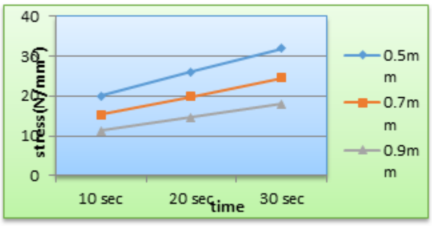


Fig 6.7 Time Vs Stress

VII. CONCLUSIONS AND FUTURE SCOPE OF WORK

Conclusions

- From the static analysis results of Cup, Punch it is seen that the stress values are increases by increasing the load and decreases with increasing the thickness and deformation values are increases by decreasing the loads at geometry thickness 0.9mm for AL 5083 material when we compare stainless steel and AL7475
- From the static analysis results of cup AL5083 material having minimum stress value 29.633N/mm^2 compared to AL7475 is 42.852N/mm^{2}and stainless steel is 36.789N/mm^2
- The static analysis of punch the stress values are increases by increasing and deformation values are increases by decreasing the loads at geometry thickness 0.9mm for AL 5083 material when we compare stainless steel and AL7475.
- From the static analysis results of punch AL5083 material having minimum stress value 37.489N/mm^2 compared to AL7475 is 37.880N/mm^{2}and stainless steel is 38.001N/mm^2
- The stress values are calculated using ansys as well as using theoretically for cup and punch.
- The modal analysis the deformation values are increases by decreasing the loads. The deformation increases by increasing the mode shapes of the die. The maximum deformation at geometry thickness 0.5mm for AL 7475.
- The random vibration analysis the shear strain value are increases by increasing the geometry thickness at 0.9 AL5083.
- The shearstress values are calculated using ansys as well as theoretically forcup.
- The transient analysis of cup the stress values are increases by increasing and deformation values are increases by decreasing the time at geometry thickness 0.9mm for AL 5083 material when we compare stainless steel and AL 7475.
- So it can be concluded the geometry thickness is 0.9mm and material is AL 5083 is best and punch material AL 5083 is the better material.

FUTURE SCOPE OF WORK

- Finite element analysis based simulation has been done using ANSYS for the single stage drawing process.
- The effect of parameters on the wrinkles, thinning and formability quality characteristics of single stage drawing process has been done.
- Further research is needed to study and develop predictive models for the other responses, such as bend allowance and residual stress for AL sheets.

VIII. REFERENCES

[1] Jay N.Mistri, K.D.Kothari,Gaurav, Kumar Sharma,Experimental and Simulation study of Deep drawing process-A review Journal of Advance Engineering and Research Development,Volume1,June,2014

[2] Krupal T. Shah, Sandip Chaudhary, Darshan K.Bhatt, Analysis of the Effect of process parameters in Deep drawing Journal of Advance Engineering and Research Development,Volume1,May,2014

[3] Chandra Pal Singh,GeetaAgnihotri of the Study of Deep drawing process parameter:A Review Journal of Mechanical Engineering Volume5,Feb 2015

[4] P. Venkateshwar Reddy, Perumalla Janaki Ramulu, G. Sandhya Madhuri, Dasari Govardhan and PVS Ram Prasad ,Design and Analysis of Deep Drawing Process on angular Deep Drawing Dies for Different Anisotropic Materials Journal of Technical Analyst, CurlVeeTechnolabs, Hyderabad, India, Materials Science and Engineering 2016

[5] Kopanathi Gowtham, K.V.N.S. Srikanth and K.L.N. Murty ,Simulation of the effect of Die Radius on Deep Drawing process Journal of CAD-CAM, Dept. of Mechanical Engineering, Godavari Institute of Engg. & Tech., Rajahmundry, India International Journal of Applied Research in Mechanical Engineering (IJARME) ISSN: 2231 –5950, Volume-2, Issue-1, 2012. april ,2008.