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REVIEW ARTICLE

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A REVIEW ON STATIC ANALYSIS OF ACTUAL AND MODIFIED UPSET PUNCH

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ABSTRACT

The forging industry is facing drastic challenges and growing competition to keep costs down and quality high. The avoidance of conditions that cause internal defects is important from a production and cost containment perspective. It is often difficult to determine the root cause of an internal defect after the material has undergone various heat treatments and deformations. Some problems occur due to material overlapping. we found that material overlapping occur due to some reason. Due to this problem Extra material comes out during Machining operation so part can't get its accurate dimension. Ultimately part rejection will increase.




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I. INTRODUCTION

The forging process, by its nature, produces a superior product, especially in comparison with castings and machined components. Defects can occasionally occur during the forging process, but it should be understood that forging defects are not inherent to the process itself.

By analogy, a world-class athlete will occasionally suffer an injury. How does the athlete respond to this setback? He or she will determine the cause of the injury, take corrective actions to repair any damage and try to prevent the recurrence of the injury in the future.

Similarly, if a forge shop begins to experience defects in their process, they should try to find the root cause of the problem, initiate corrective action and implement procedures to prevent its recurrence.

1.1. ASSUMPTION BEFORE ANALYSIS OF UPSET PUNCH:

- Punch is fixed at lower side by constraint
- 2.5 ton of axial Force is acting on the punch
- Material Assigned as a Steel
- All dimension of Die is in mm. Stress Produced is in MPA.
- Analysis is performed on Single Pass Adaptive Method. Stress is calculated on Max
- Shear Stress Principal.

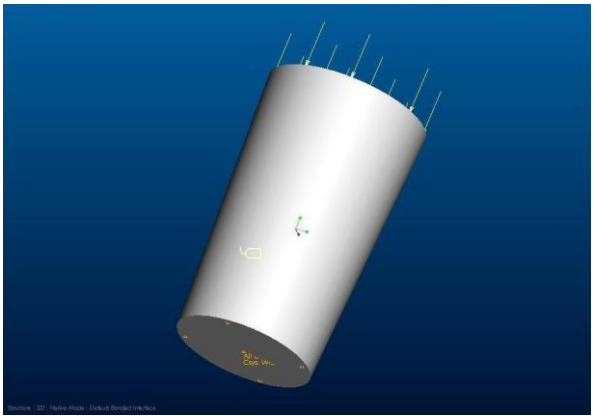

Fig.1.1.Actual upset punch

1.2. STATIC STRESS ANALYSIS OF ACTUAL UPSET PUNCH

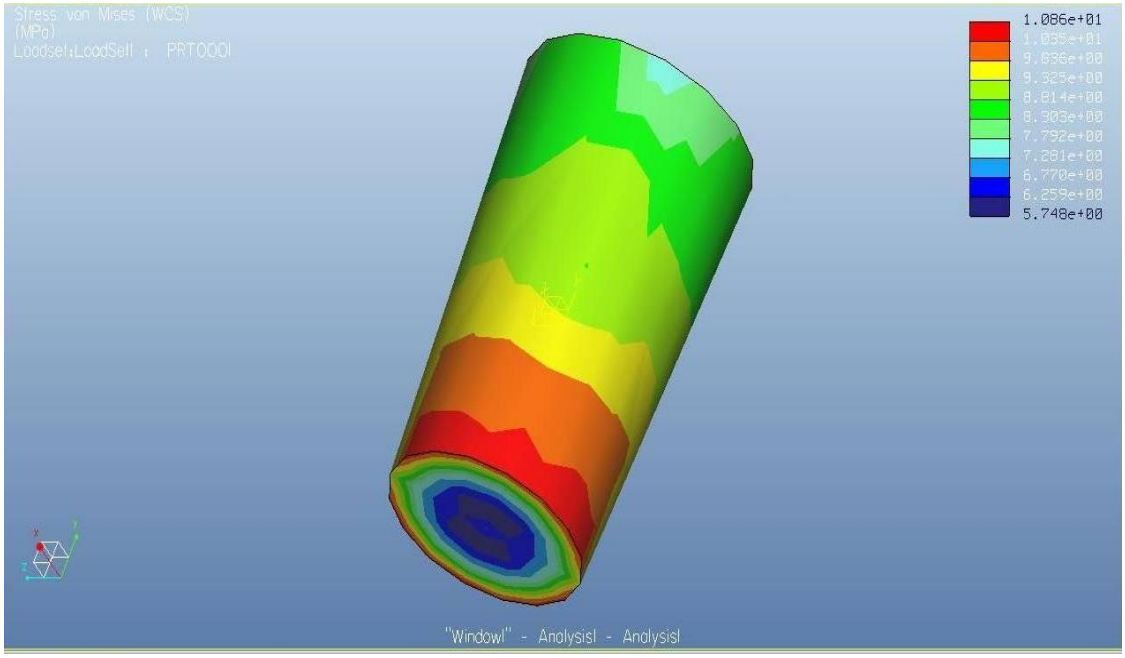

Fig.1.2 Stress distribution in actual upset punch

1.3. SOFTWARE GENERATED STATIC ANALYSIS SHEET

This Static Stress Analysis is performed in Pro Mechanical (Pro-E 5.0).After the completion of Successful the Static Stress Analysis, Pro Mech. Gives Calculated Data sheet of whole Analysis which is as given below…

Principal System of Units: millimeter Newton Second (mmNs)

Length: - mm
Force: - N
Time: - sec
Temperature: - C
Model Type: Three Dimensional
Points: 10
Edges: 29
Faces: 32
Springs: 0
Masses: 0
Beams: 0
Shells: 0
Solids: 12
Elements: 12
Standard Design Study
Convergence Method: Single-Pass Adaptive
Plotting Grid: 4
>> Pass 1 <<
Calculating Element Equations

Total Number of Equations: - 225
Maximum Edge Order: - 3
Solving Equations:-
Post-Processing Solution:-
Checking Convergence:-
Resource Check:-
Elapsed Time (sec): - 0.94
CPU Time (sec):- 0.42
Memory Usage (kb):- 177467
Work Dir Disk Usage (kb): - 0
>> Pass 2 <<
Calculating Element Equations
Total Number of Equations: - 726
Maximum Edge Order: - 5
Solving Equations:-
Post-Processing Solution:-
Checking Convergence:-
Calculating Disp and Stress Results:-
RMS Stress Error Estimates:

Load Set	Stress Error	% of Max Prin Str
LoadSet1	**7.28e-01**	**4.7% of 1.56e+01**

Resource Check:-
Elapsed Time (sec): 1.31
CPU Time (sec): 0.58
Memory Usage (kb): 178803
Work Dir Disk Usage (kb): 0
Total Mass of Model: 1.897556e-03
Total Cost of Model: 0.000000e+00
Mass Moments of Inertia about WCS Origin:
Ixx: 1.95335e+00
Ixy: 9.47940e-08 Iyy: 7.38564e-01
Ixz: 1.19115e-07 Iyz: 4.44752e-07
Izz: 1.95335e+00
Principal MMOI and Principal Axes Relative to WCS Origin:

Max Prin	Mid Prin	Min Prin
1.95335e+00	1.95335e+00	7.38564e-01
WCS X: 7.49981e-01	-6.61459e-01	-7.80334e08
WCSY: 3.00694e-07	2.22963e-07	1.00000e+00
WCS Z:6.61459e-01	7.49981e-01	-3.66115e-07

Center of Mass Location Relative to WCS Origin:
(3.37590e-06, 2.69685e+00, 2.45313e-06)
Mass Moments of Inertia about the Center of Mass:
Ixx: 1.93955e+00
Ixy: 1.12070e-07 Iyy: 7.38564e-01
Ixz: 1.19115e-07 Iyz: 4.57306e-07
Izz: 1.93955e+00
Principal MMOI and Principal Axes Relative to COM:

Max Prin	mid Prin	Min Prin
1.93955e+00	1.93955e+00	7.38564e-01
WCS X: 7.49981e-01	-6.61459e-01	-9.33148e08
WCSY: 3.21851e-07	2.23850e-07	1.00000e+00
WCS Z: 6.61459e-01	7.49981e-01	-3.80775e-07

Load Set: LoadSet1: PRT0001
Resultant Load on Model:
In global X direction: 5.734080e-12
In global Y direction: -2.224089e+04
In global Z direction: 6.103562e-12
Measures:
max_beam_bending: 0.000000e+00
max_beam_tensile: 0.000000e+00
max_beam_torsion: 0.000000e+00
max_beam_total: 0.000000e+00
max_disp_mag: 4.661744e-03
max_disp_x: 3.805979e-04
max_disp_y: -4.646180e-03
max_disp_z: -3.718681e-04
max_prin_mag: -1.562753e+01
max_rot_mag: 0.000000e+00
max_rot_x: 0.000000e+00
max_rot_y: 0.000000e+00
max_rot_z: 0.000000e+00
max_stress_prin: 1.012203e+00
max_stress_vm: 1.085840e+01
max_stress_xx: -5.533335e+00
max_stress_xy: 3.255825e+00
max_stress_xz: 4.361824e-01
max_stress_yy: -1.450890e+01
max_stress_yz: 3.252217e+00
max_stress_zz: -5.523848e+00
min_stress_prin: -1.562753e+01
strain_energy: 5.094295e+01

1.4. OBSERVATION FROM RESULT

From all the Result data we can see that the maximum shear stress is produce in punch's lower corner. This Sharp corner produced high shear stress on the upsetting part so due to sharp edge some folds is created in the inner surface of upsetting part and these Folds overlapped during reverse stroke so Material Defect called "Lapping" is produced after forging. That Max.Shear stress zone is shown in graph.

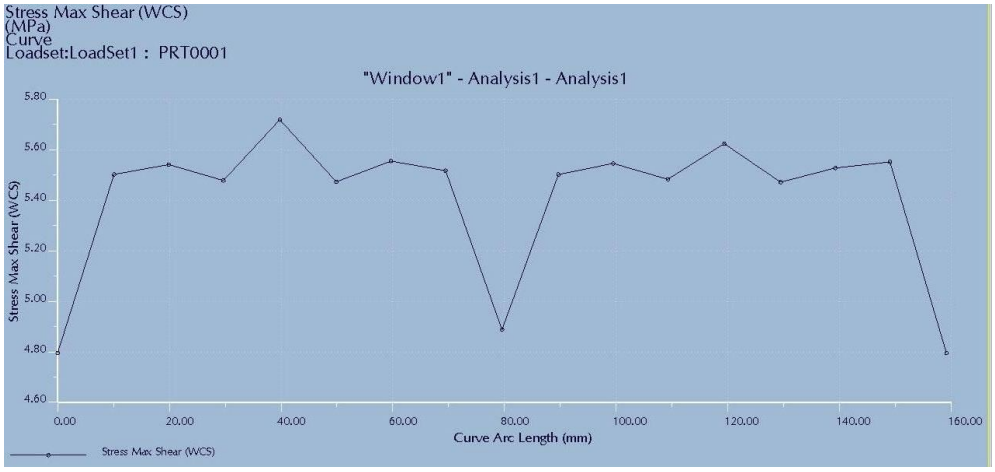

Fig. 1.3. Graph of Max. Shear Zone of upset punch

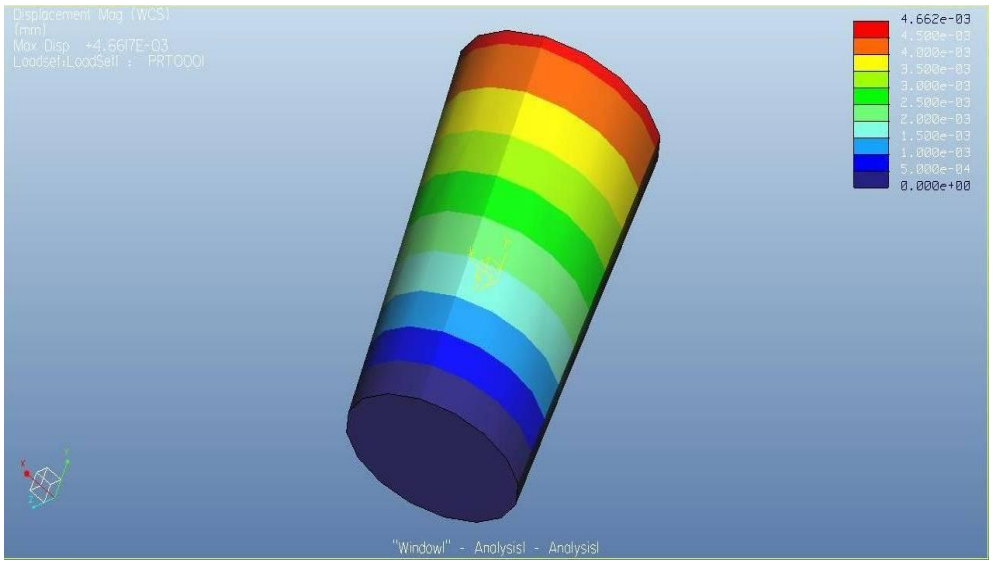

Fig.1.4. Displacement of Actual Upset punch

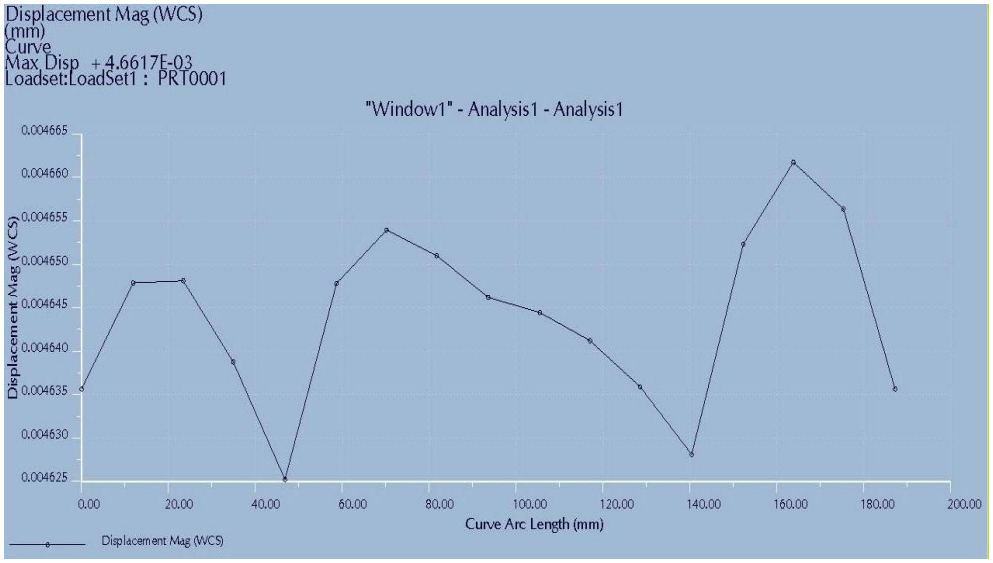

Fig.1.5. Max. Displacement of Actual Upset Punch

II MODIFIED UPSET PUNCH

2.1. ASSUMPTION BEFORE ANALYSIS OF UPSET PUNCH

- Punch is fixed at lower side by constraint. Material Assigned as Steel.
- 2.5 ton of axial Force is acting on the punch. Lower corner has given 3 mm radius.
- Material Assigned as Steel.
- All dimension of Die is in mm. Stress Produced is in MPA.
- Analysis is performed on Single Pass Adaptive Method. Stress is calculated on Max Shear Stress Principal.

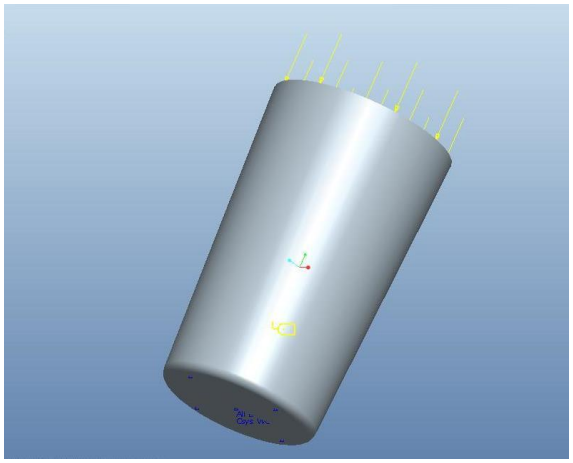

Fig.2.1.Modified Upset Punch

2.2. STATIC STRESS ANALYSIS OF MODIFIED UPSET PUNCH

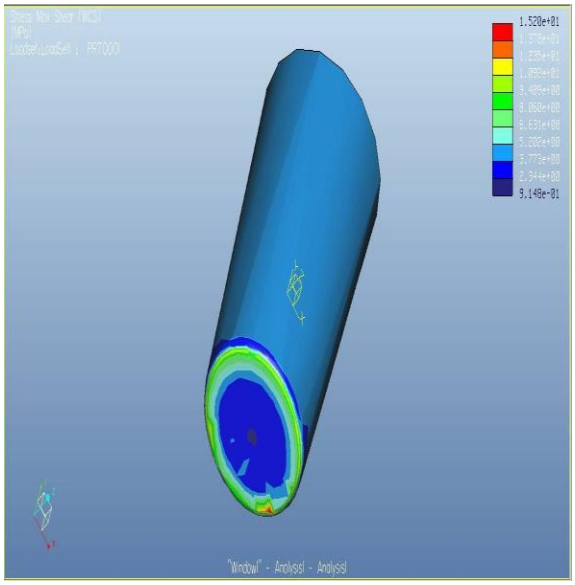

Fig.2.2.Stress distribution in Modified Upset punch

2.3. SOFTWARE GENERATED STATIC ANALYSIS SHEET:-

This Static Stress Analysis is performed in Pro Mechanical (Pro-E 5.0).After the completion of Successful the Static Stress Analysis, Pro Mech. Gives Calculated Data sheet of whole Analysis which is as given below…

Principal System of Units: millimeter Newton Second (mmNs)
Length: mm
Force: N
Time: sec
Temperature: C
Model Type: Three Dimensional
Points: 41
Edges: 169
Faces: 223
Springs: 0
Masses: 0
Beams: 0
Shells: 0
Solids: 94
Elements: 94
Standard Design Study
Static Analysis "Analysis1":
Convergence Method: Single-Pass Adaptive
Plotting Grid: 4

>> Pass 1 <<

Calculating Element Equations:-
Total Number of Equations: - 1641
Maximum Edge Order: - 3
Solving Equations
Post-Processing Solution
Checking Convergence
Resource Check
Elapsed Time (sec):- 1.19
CPU Time (sec):- 0.78
Memory Usage (kb):- 177467
Work Dir Disk Usage (kb):- 1024

>> Pass 2 <<

Calculating Element Equations
Total Number of Equations: - 6264
Maximum Edge Order: - 6
Solving Equations
Post-Processing Solution
Checking Convergence
Calculating Disp. and Stress Results
RMS Stress Error Estimates:
Load Set Stress Error % of Max Prin. Str.

---------- ---------- ----------
LoadSet1 1.11e+00 2.2% of 5.10e+01
Resource Check
Elapsed Time (sec):- 3.42
CPU Time (sec):- 2.55
Memory Usage (kb):- 178803
Work Dir Disk Usage (kb):- 10240
Total Mass of Model: 1.895439e-03
Total Cost of Model: 0.000000e+00
Mass Moments of Inertia about WCS Origin:
Ixx: 1.94752e+00
Ixy: -1.13249e-06 Iyy: 7.37247e-01
Ixz: -1.20537e-07 Iyz: 2.53077e-07
Izz: 1.94752e+00
Principal MMOI and Principal Axes Relative to WCS Origin:

	Max Prin	mid Prin	Min Prin
	1.94752e+00	1.94752e+00	7.37247e-01
WCS X:	-3.44598e-01	9.38750e-01	9.35732e-07
WCS Y:	5.18751e-07	-8.06361e-07	1.0e+00
WCS Z:	9.38750e-01	3.44598e-01 -	2.09107e-07

Center of Mass Location Relative to WCS Origin:
(5.89049e-06, 2.75510e+00, 3.12377e-05)
Mass Moments of Inertia about the Center of Mass:
Ixx: 1.93313e+00
Ixy: -1.10173e-06 Iyy: 7.37247e-01
Ixz: -1.20536e-07 Iyz: 4.16204e-07
Izz: 1.93313e+00
Principal MMOI and Principal Axes Relative to COM:

	Max Prin	mid Prin	Min Prin
	1.93313e+00	1.93313e+00	7.37247e-01
WCS X:	-3.44596e-01	9.38751e-01	9.21268e-07
WCSY:	6.44180e-07	-7.44911e-07	1.00000e+00
WCSZ:	9.38751e-01	3.44596e-01	-3.48031e-07

Constraint Set: ConstraintSet1: PRT0001
Load Set: LoadSet1: PRT0001
Resultant Load on Model:
In global X direction: 6.424083e-12
In global Y direction: -2.224083e+04
In global Z direction: 3.556710e-12
Measures:
Max._beam._bending: 0.000000e+00
max_beam_tensile: 0.000000e+00
max_beam_torsion: 0.000000e+00
max_beam_total: 0.000000e+00
max_disp_mag: 4.748431e-03
max_disp_x: -3.718218e-04
max_disp_y: -4.733333e-03
max_disp_z: -3.745301e-04
max_prin_mag: -5.098778e+01
max_rot_mag: 0.000000e+00
max_rot_x: 0.000000e+00
max_rot_y: 0.000000e+00
max_rot_z: 0.000000e+00
max_stress_prin: 1.296660e+01
max_stress_vm: 3.266390e+01
max_stress_xx: -1.937419e+01
max_stress_xy: -6.746824e+00
max_stress_xz: 3.014349e+00
max_stress_yy: -4.966715e+01
max_stress_yz: 6.978572e+00
max_stress_zz: -1.860328e+01
min_stress_prin: -5.098778e+01
strain_energy: 5.203969e+01

2.4. OBSERVATION FROM RESULT

Mostly Overlapping is occurs due to sharp corner edge of the punch. We take Reference from design consideration and expert opinion from different industry after modified that punch and give 3 mm radius to its sharp corner so it punches hole smoothly in the forging part. Due to this it can't make any Folds in inner Parts of Work piece. Also In the modified the maximum shear stress is reduce in the area of Corner with compare to Actual Punch. The Graph for that

Max. Shear stress zone is shown in fig.

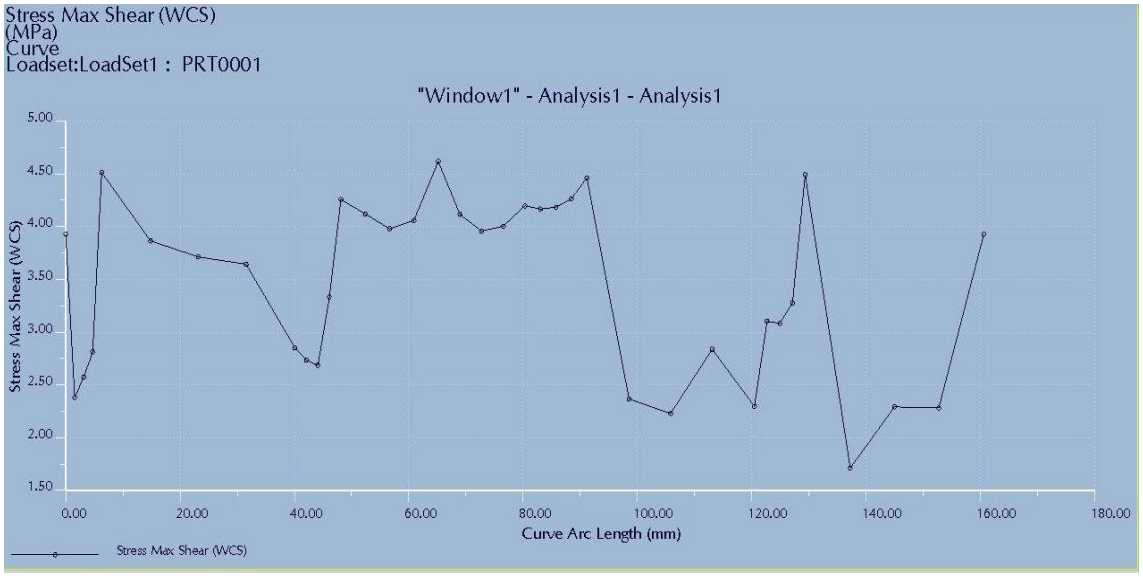

Fig.2.3. Graph of Max Shear Stress of Modified Upset Punch DISPLACEMENT OF MODIFIED UPSET PUNCH

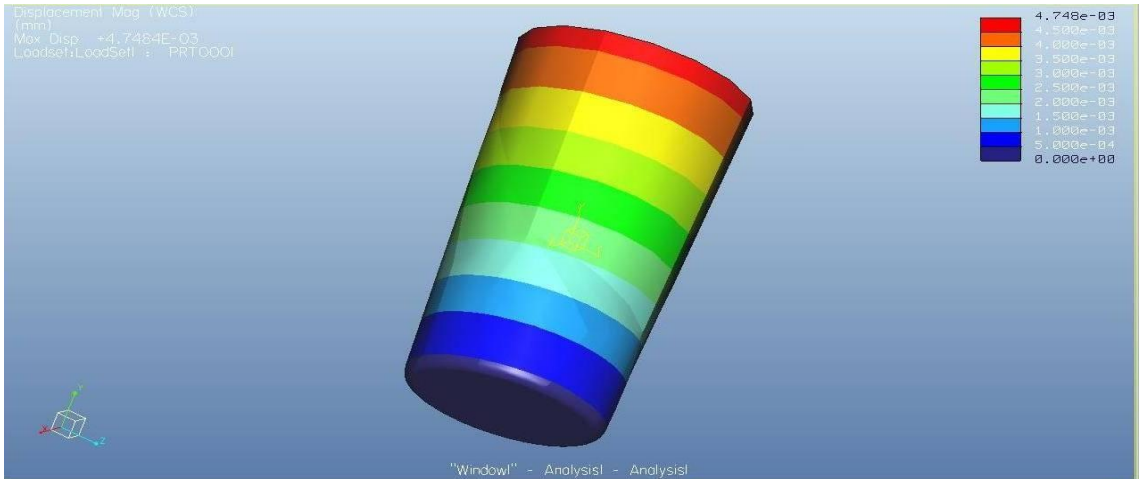

Fig.2.4.Displacement of the Modified Upset Punch

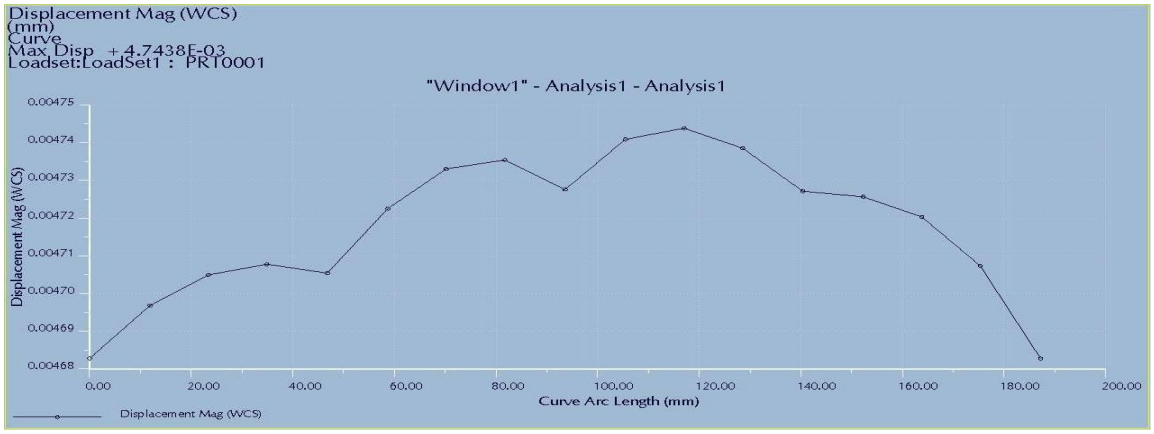

Fig.2.5. Max. Displacement of Modified Upset Punch

III CONCLUSION

Finally we conclude that with the help of static analysis of pump we modified design of punch and this punch design is useful for the problem solution for overlapping which results into consume less power and increase profit for forging base industries

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