IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2018

Improving the Rigidity of Sheet Metal by Embossing

B.Yamini[1], V. S. Subramanya[2]

Department of Mechanical Engineering, Raghu Engineering College[1]

Assistant Professor, Department of Mechanical Engineering, Raghu Engineering College[2]

Abstract: Embossing and restoration technique is conducted as a simple method to strengthen sheet metals. Soft aluminum, mild steel and stainless steel sheets of different thickness are subjected to embossing and restoration at different sheet patterns and emboss height. Deflection tests are then conducted to evaluate the effects of the parameters considered on the increase in the rigidity of sheets. Experimental is employed in the investigation. Results show that the restoration technique is effective in increasing the rigidity of thin sheet metals. By taking into considerations several important parameters, improvement in rigidity can be enhanced as shown in this study. Also, it should be emphasized that this technique can be used not only for increasing the rigidity of sheet metals but also for making decorative sheets without any special forming tools.

Keywords: Sheet Metal Forming; Restoration; Embossing; Fem Simulation; Rigidity

1. INTRODUCTION

Sheet metal forming is one of the most important and commonly practiced fabrication processes on the manufacturing industry, ranging from the production of car body, outer panel of electric products and appliances, metal furniture and structural panels. Through the years several efforts have been made in the sheet metal industry to improve efficiency and savings on energy and resource through reduction in weight and cost of the sheet metal product .For instance in the automotive industry the use of lighter gauge high strength steel alloy new density aluminum alloys and tailor welded blanks provided promising opportunities in reducing overall body weight and increasing mileage performance. The use of thinner sheets is practical way for reduction of product cost and product weight. However in utilizing a lighter grade conventional sheet metal during press forming some problems such as increase in deflection due to its low rigidity and strength arise Moreover the formability of the sheet also decreases with decreasing sheet thickness with the objective of overcoming theses drawbacks restoration technique has been proposed to strengthen sheet metal through simple means the sheet metal is bulged by punch and then the embossed sheet is compressed between flat tool.

2. MECHANICS OF SHEET METAL STAMPING

Mechanics of cutting sheet metal should be understood when designing a press working manufacturing process. The work piece in a sheet metal cutting operation is secured to the lower die, whiles the motion of the upper die, (called a punch), and enacts the cutting. Edges of the punch and die do not line up precisely, due to a clearance or space between them. The punch is designed to enter the matching hole in the lower die and is always at least a little smaller. Clearance size, in sheet metal cutting, will vary with different process factors and its selection will affect the quality of the manufactured part as the cutting process begins, force enacted through the punch causes it to move toward the work. The sheet metal is secured to the lower apparatus, it does not move when contacted by the punch. Instead, pressure builds up between the punch and sheet. Plastic deformation of the surface metal occurs. This happens at the top and bottom surfaces, since the bottom cutting die is pushing up with the same force that the punch is pushing down. In manufacturing practice, the plastic deformation occurring at the surfaces of the sheet metal, at this stage in the cutting operation, is referred to as rollover. Penetration occurs next, the actual cutting of sheet metal begins, as the force causes the punch and dies to sink into the work material. This creates a penetration zone, known as the burnish or burnish region. This burnish region may typically occupy 30% to 60% of the total thickness of the sheet. Actual thickness of this straight, smooth surface region is dependent upon several factors. The more ductile the metal, the greater the thickness of the burnish relative to total sheet thickness Increases in clearance or total sheet thickness will decrease the percent of burnish region. Burnish zones on the hole in the sheet metal occur at the top. On the metal removed, (slug or blank), the burnish zone will occur at the bottom. Concern over the edge quality of the metal cut or the hole depends on if the sheared material is a slug or blank

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2018

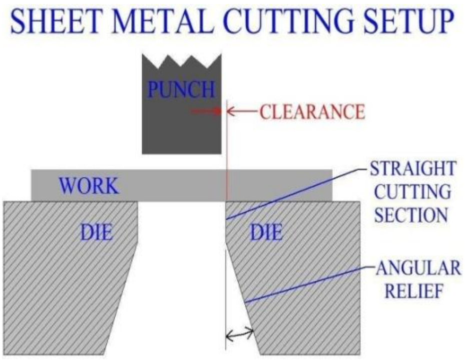


Figure 1: Sheet metal cutting setup

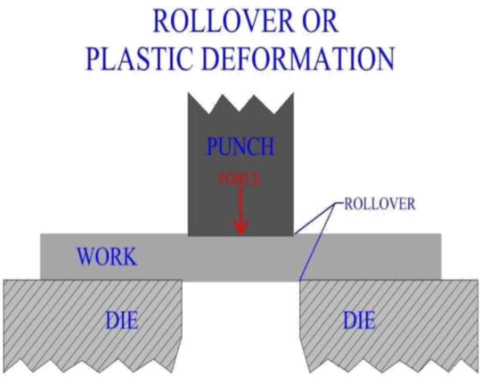


Figure 2: Rollover

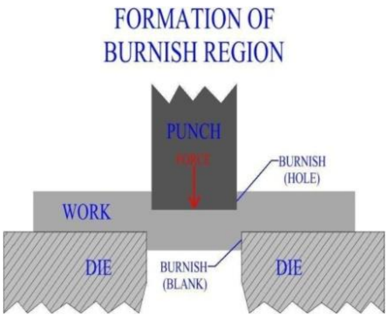


Figure 3: Formation of Burnish Region

At some point during the sheet metal cutting operation, when a certain depth of punch penetration is reached, the forming of the burnish region ends with crack

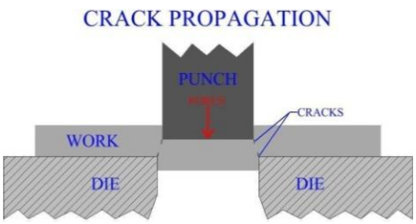


Figure 4: Crack Propagation

In a well designed sheet metal cutting process, the cracks should meet each other and form a continuous break. This break will create the fracture region. The fracture region starts at the end of the burnish region and occupies most of the rest of the thickness of the cut, with exception to the burr. Greater clearance, greater sheet thickness and less ductility of the metal will increase the proportion of the fracture region relative to the total sheet thickness propagation. This occurs from the edges of the punch, on the top, and from the edges of the die, on the bottom.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2018

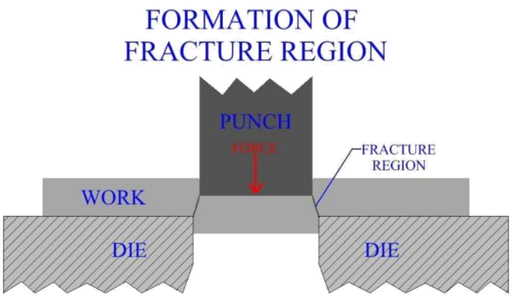


Figure 5: Format of Fracture Region

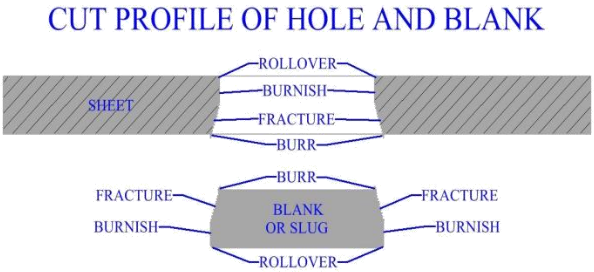
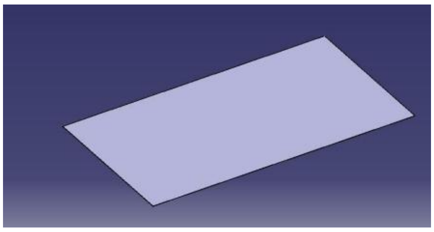


Figure 6: cut profile of whole and blank

3. DESIGN AND ANALYSIS

The parametric nature of a software package is defined as its ability to use its standard properties and parameters in defining the shape and size of a geometry. The main function of this property is to drive the selected geometry to a new size or shape without considering its original dimensions. The shape and size of any feature at any stage of the design process can be changed or modified



Sheet dimensions 1000*500mm
Figure 7: blank sheet

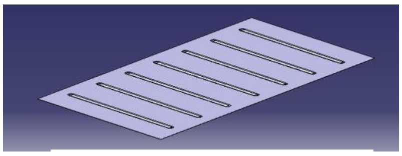


Figure 8: Embossment

Material properties

Table 1: Material properties

Properties	**Al**	**Galvanized steel**	**SS**
Young's modulus (PA)	7.1E+10	4.5E+10	1.93E+11
Passion ratio	0.33	0.35	0.31
Tensile Yield strength	2.8E+08	1.93E+08	2.07E+08
Density	2770	1800	7750

DOI 10.17148/IARJSET.2018.5712

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2018

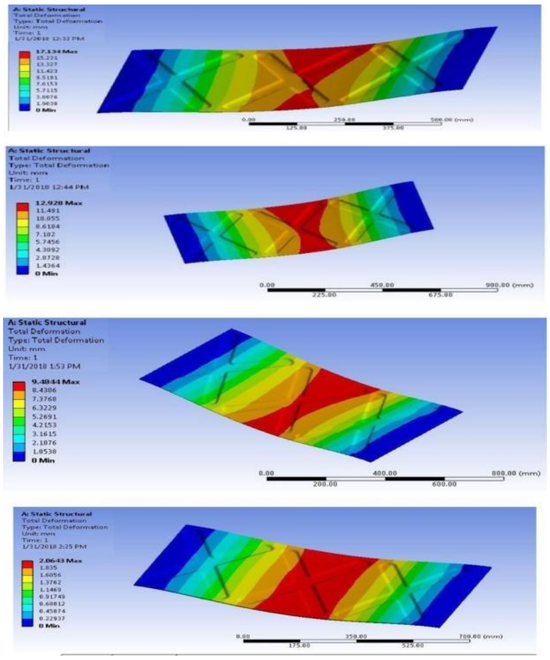


Figure 9 AL SHEET

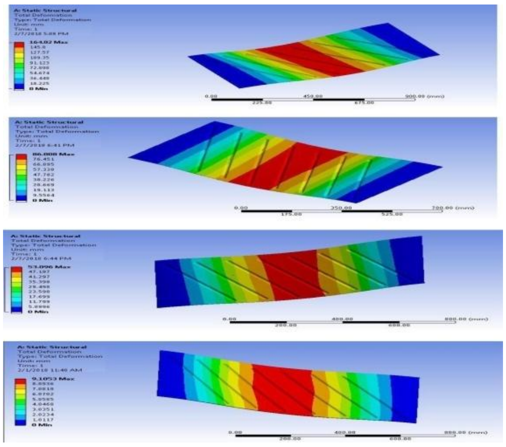


Figure: 10 Stainless steel embossment

4. RESULTS

TABLE 2: OVERALL RESULT

		STAINLESS STEEL			
Gauge	Thickness	Plain sheet	Embossment 1	Embossment 2	Embossment 3
(ga)	mm	Def(mm)	Def(mm)	Def(mm)	Def(mm)
3	6.35	3.04	2.92	2.66	2.06
9	3.96	10.67	9.25	9.91	6.27
11	3.17	24.3	21.3	16.17	9.48
12	2.77	38.9	30.13	21.5	12.92
13	2.38	55.95	45.5	30.9	17.13
		GALVANIZED STEEL			
Gauge	Thickness	Plain sheet	Embossment 1	Embossment 2	Embossment 3
(ga)	mm	Def(mm)	Def(mm)	Def(mm)	Def(mm)
3	0	0	0	0	0
9	3.89	55.02	50.54	41.33	28.3
11	3.13	101.58	89.65	67.08	39.73
12	2.75	164.37	130.6	89.15	64.16
13	2.37	233.72	194.5	123	71.75

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 7, July 2018

		ALUMINIUM			
Gauge	Thickness	Plain sheet	Embossment 1	Embossment 2	Embossment 3
(ga)	mm	Def(mm)	Def(mm)	Def(mm)	Def(mm)
3	5.82	10.59	10.1	9.1	6.9
9	2.9	85.4	74.43	53.99	32.33
11	2.3	171.2	119.96	83.608	48.622
12	1.82	241.7	169.311	125.84	69.145
13	1.42	300.2	185.82	164	110.52

According to this results we can judge rather than using the thickness 3.96 mm of stainless steel you can use the 3.17 thickness with embossment 3 by this you can reduce the weight of the sheet

CONCLUSION

Experimental investigations are conducted to various sheet metals subjected to embossing and restoration .Results show that the proposed technique is an efficient way to improve the rigidity of thinner sheet metals, which leads to the reduction of formed parts. Furthermore, he improvement can be enhanced by taking into consideration several parameter .It should also be emphasized that this technique can be used not only for increasing the rigidity of sheet metals but also for making decorative sheets without any special forming tools.

REFERENCES

[1]C.S. Namoco Jr., T. Iizuka, N. Hatanaka, N. Takakura, and K. Yamaguchi, (2007). Numerical Investigation of Flexural Properties of Sheet Metals Subjected to Embossing and Restoration Process, Key Engineering Materials, 340, 377-382.
[2]C.S. Namoco Jr., T. Iizuka, N. Hatanaka, N. Takakura, and K. Yamaguchi, (2007). Influence of Embossing and Restoration Process on the Mechanical Properties ofAluminum Alloy Sheets, , J. Mater. Process. Technol., 192-193, 18-26.
[3]C.S.Namoco Jr., T. Iizuka, R.C. Sagrado, N. Takakura, and K. Yamaguchi, (2006). Experimental and Numerical Investigation of Restoration Behavior of Sheet Metals Subjected to Bulging Deformation, J. Mater. Process. Technol.,177, 368-372.
[4] J.O. Hallquist, (2003). LS-DYNA Keyword User's Manual, Livermore Software Technology Corporation
[5]K. Yamaguchi and P.B. Mellor, (1976). Thickness and grain size dependence of limit strainsin sheet metal stretching, Int. J. Mech. Sci., 18, 85–90.
[6]K. Yamaguchi, R.C. Sagrado, N. Takakura, and T. Iizuka, (2002). A Simple Method for Strengthening and Decorating of Sheet Metals, Proc. of 22nd IDDRG Biennial Congress, Japan, 9-18
[7]K.Yamaguchi, N. Takakura, and M. Fukuda, (1988). Effect of thickness on Ericksen value of sheet metals, Journal of Japan Society for Technology of Plasticity, 29(334), 1145–1151