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Fe Analysis of Sheet Metal Body in White (BIW) Part

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ABSTRACT
In this Project we are going to analyze the BIW (Body In White) using ANSYS software under the static loading. The BIW consist mainly two part i.e. top hat and flat plate which are joint together by using resistance spot weld. Spot welds made by resistance spot welding are used extensively in automotive engineering. However, owing to increasing demands in the use of advanced and lightweight materials, resistance spot welding has become a popular alternative for producing spot welds. Because of the complexity and uncertainties of resistance spot welds and thus formed structures, the finite-element (FE) modeling of the welds for Dyanamics analysis is a research issue. In this project first outlines some of the existing modeling of top hat and analyzed by using ANSYS software for different materials and positions of spot welds. SOLID 185 (Tetrahedral 4 node 185) elements is used FE modeling. In this work by using ANSYS V 14.5 software we going to generate mesh BIW part and model generated by using CATIA V5 software.
***Keywords* -** Resistance spot welding, CATIA V5,ANSYS V 14.5& FEA.

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I. INTRODUCTION

Resistance welding is the most commonly used method for joining steel sheets. No filler metal is needed and the heat required for the weld pool is created by means of resistance when a high welding current is directed through the welded work pieces. An electro-conductive contact surface is created between the work pieces by pressing them together. Contact is made using the shape of either the welded surfaces of the work pieces or the shape of the electrodes. Water-cooled electrodes made of alloyed copper are used in resistance welding. Electrodes convey a pressing force to the joint and direct the welding current to the joint in the appropriate manner. After welding, the electrodes rapidly cool down the welded joint .Work stages in resistance welding are very fast. The surfaces to be welded do not usually need to be cleaned before welding, in addition to which the weld does not usually require grinding or post heating. The Resistance welding process can be easily automated. Resistance welding is a highly efficient production method that is particularly well-suited for automated production lines and mass production.

Therefore there is scope for changing the position of spot weld in BIW part and Analyze static structural analysis in BIW part and to find out the suitable materials and best position of the spot weld in BIW part.

II. OBJECTIVES

The literature review on strength and ductility of sheet metal BIW part shows that behavior of while static loading under different position of spot weld is of interest to many and varied aspects & parameters for analysis.

The design of sheet metal BIW part while static loading has to choose the variety of parameters which include geometrical parameters, different types of sheet materials, size of sheet etc. Hence it is of interest to analyze some of the sheet metal BIW part for different materials and different position of spot weld varying some all of the parameters like plate thickness, various sheet material , sizes of sheet compare to the different spot weld position analysis on various loading condition, finding the suitable materials and the best position of spot in BIW part.

III. SCOPE & METHODOLOGY

The proposed work include following step.

1) Study of literature review on various work reported.
2) Selecting some of BIW part are available.
3) The geometrical model shall be prepared for the varied position of spot on BIW part
4) CAD Model is prepared using various tool – catia version-5

i.e. extrude, revolve, mirror etc .
5) The analysis results obtained shall help to identify the region of stress concentration and best position of spot in BIW part.

MODELING OF BIW PART

FLATE PLATE

Plate length – 564 mm

Width- 110 mm

Thickness of the plate t= 1.5 mm

TOP HAT

Length- 110 mm

Height- 29 mm

length of TOP HAT = 564 mm

IV. SHEET METAL PLATE (BIW PART) VIEW NOMENCLATURE

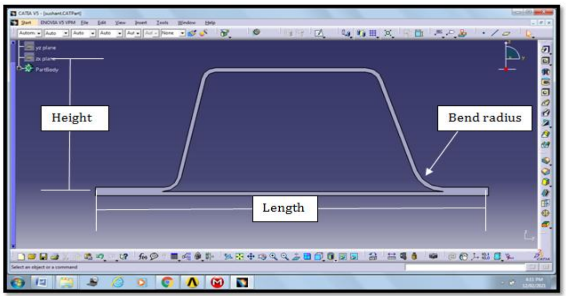


Figure 1: BIW part assembly view Nomenclature

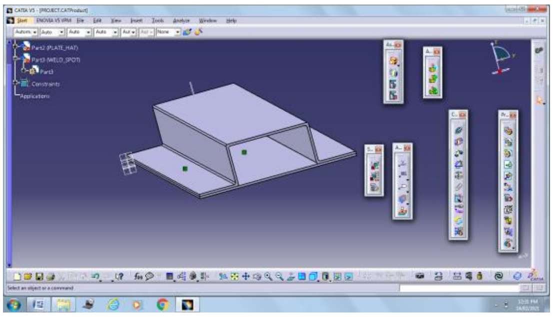


Figure:2 Complete model of BIW Part

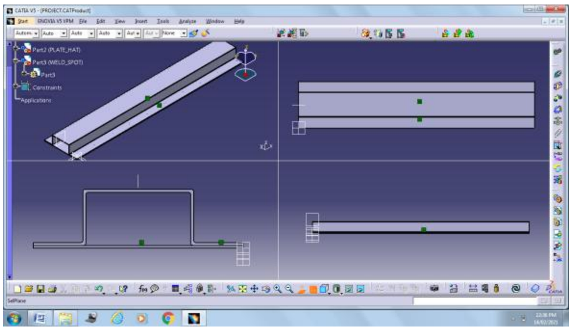


Figure :3. various views of assembly of BIW part.

V. MATERIALS SELECTION

SR. NO.	MATERIALS NAME	DENSITY (ρ) Kg/m^3	YOUNGS MODULUS (E) Pa	POISSONS RATIO (1/m)
1	STRUCTURAL STEEL	7850	$2*10^{11}$	0.3
2	ALUMINUM ALLOY	2770	$7.1*10^{10}$	0.33
3	MAGNESIUM ALLOY	1800	$4.5*10^{10}$	0.35

VI. FINITE ELEMENT ANALYSIS FOR SPOT WELDS IN A STRUCTURE

Meshing of model

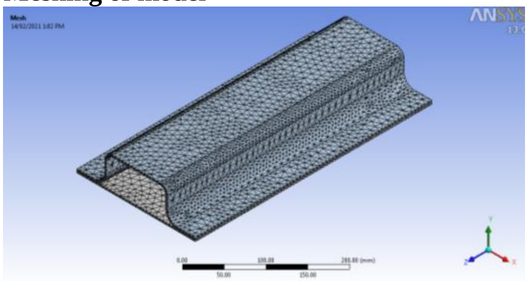


Fig4: Meshing of BIW Part

The element used is tetrahedran elements

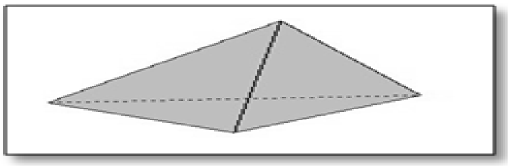


Fig 5: Tetrahedron Element

SUPPORT OF SHEET METAL (BIW PART)

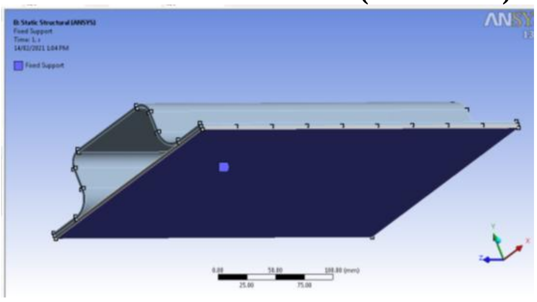


Figure 6: Constraints on a Flat Plate

DIFFERENT POSITION OF SPOT WELD

SPOT AT CORNER POSITION

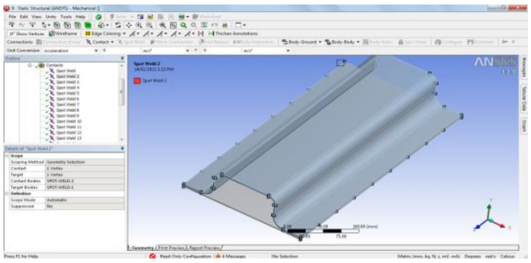


Figure 7: Spot at corner

SPOT NEAR TO BEND POSITION

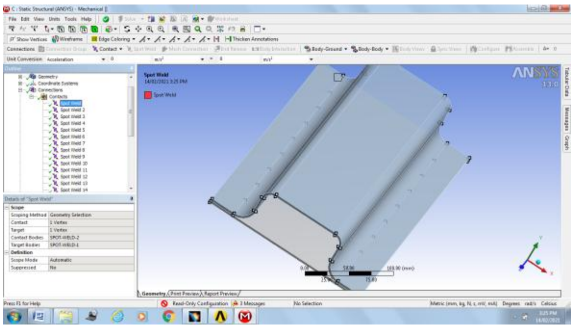


Figure 8: Spot at near bend position

SPOT AT MIDDEL POSITION

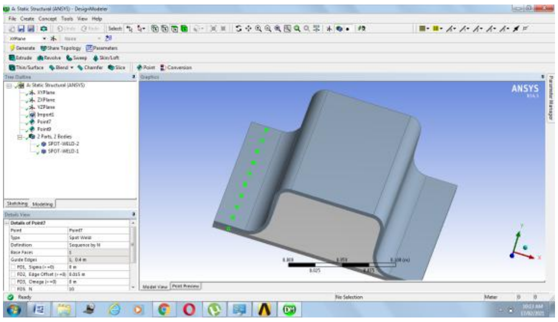


Figure 9: Spot at middle position

All the Boundary condition fixed support and force are applied in combine manner on sheet metal BIW part assembly as shown in figure 10

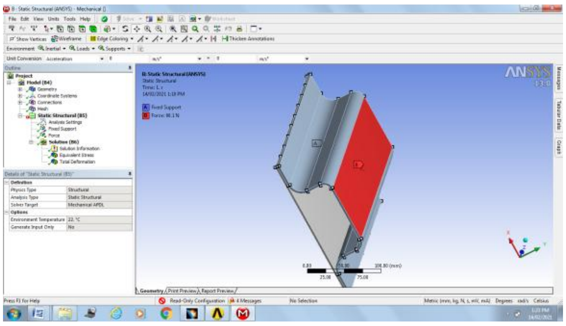


Figure10: Combination of all the Boundary condition.

The first doing the analysis setting and time setting find out the total deformation, directional deformation for different materials and position of spot weld in BIW Part.

TOTAL DEFORMATION SHEET METAL (BIW PART) PLATE

I.RESULT WHEN SPOT AT CORNER

i) Material structural steel

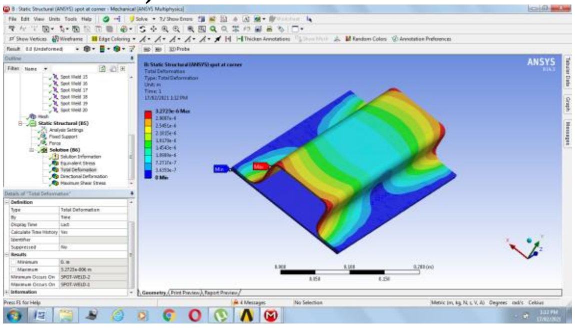


Figure 11:-Total Deformation when spot at corner(ST)

ii) Material aluminum alloy

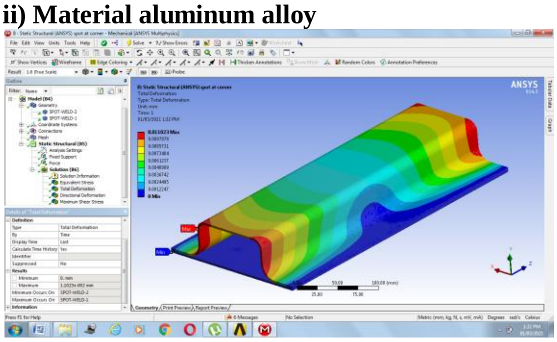


Figure12:-Total Deformation when spot at corner(AL)

iii) Material magnesium alloy

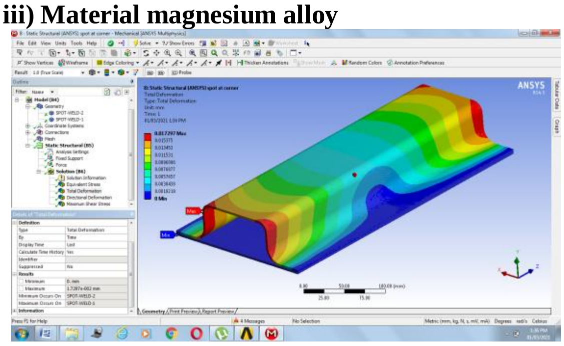


Figure 13:-Total Deformation when spot at corner(MG)

II) RESULT WHEN SPOT WELD AT NEAR TO BEND

i) Material structural steel

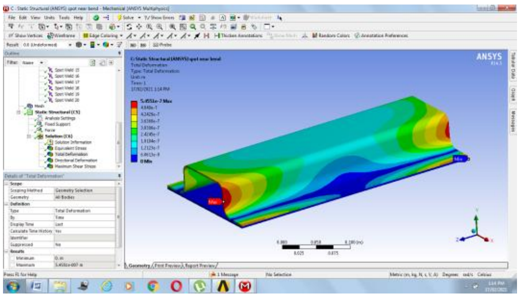


Figure 14:-Total Deformation spot weld at near to curve (ST)

ii) Material aluminum alloy

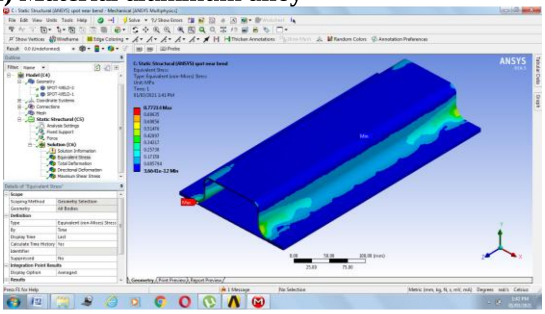


Figure 15:-Total Deformation spot weld at near to curve (AL)

iii) Material magnesium alloy

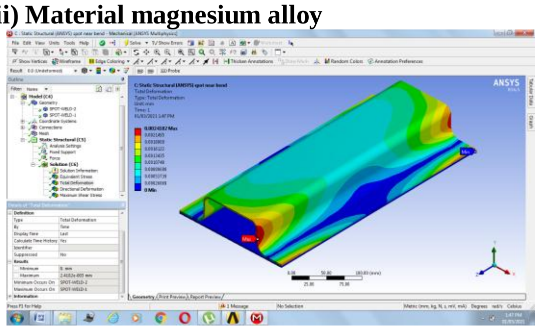


Figure16:-Total Deformation spot weld at near to curve (MG)

III) RESULT WHEN SPOT AT MIDDLE POSITION

i) Material structural steel

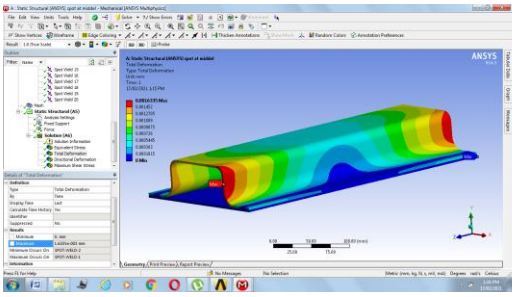


Figure 17:-Total Deformation when spot at middle position (ST)

ii) Material aluminum alloy

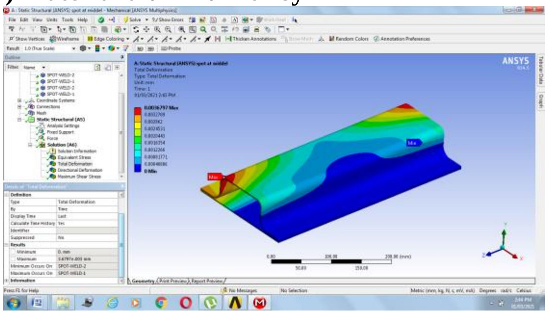


Figure 18:-Total Deformation when spot at middle position (AL)

iii) Material magnesium alloy

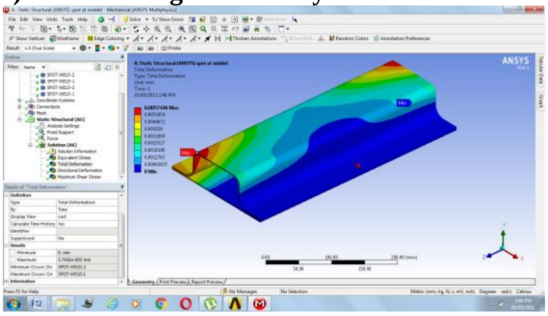


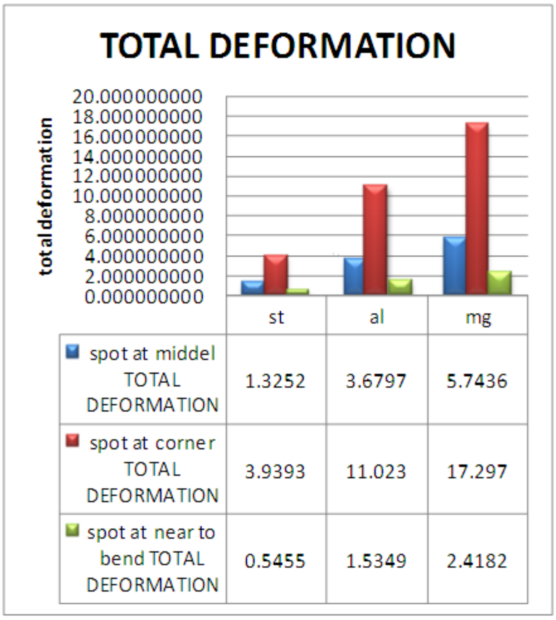
Figure 19:-Total Deformation when spot at middle position (MG)

VI COMPARISON OF RESULT BY USING CHART.

MATERIALS	spot at middel total deformation	spot at corner total deformation	spot at near to bend total defromation
STEEL	1.3252e-003 mm	3.9393e-003 mm	5.4551e-004 mm
ALUMINIUM	3.6797e-003 mm	1.1023e-002 mm	1.5349e-003 mm
MAGNESIUM	5.7436e-003 mm	1.7297e-002 mm	2.4182e-003 mm

VI COMPARISON OF RESULT BY USING CHART.

Table 1: Total Deformation at different materials and position of spot weld.



Graph 1: Variation in Total Deformation due to change in position of spot weld and different materials.

DIRECTIONAL DEFORMATION OF SHEET METAL PLATE (BIW PART) Z- DIRECTION

I) RESULT WHEN SPOT AT CORNER

i) Material structural steel

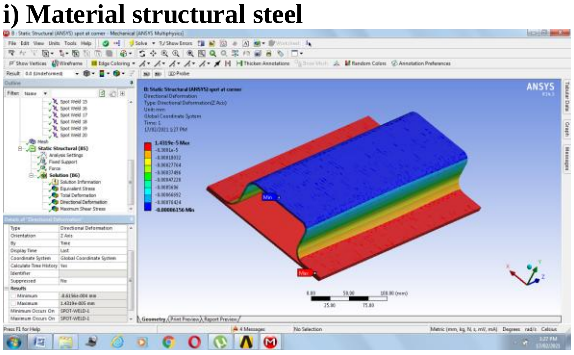


Fig.20:- Directional Deformation Spot weld at corner (ST)

ii) Material aluminum alloy

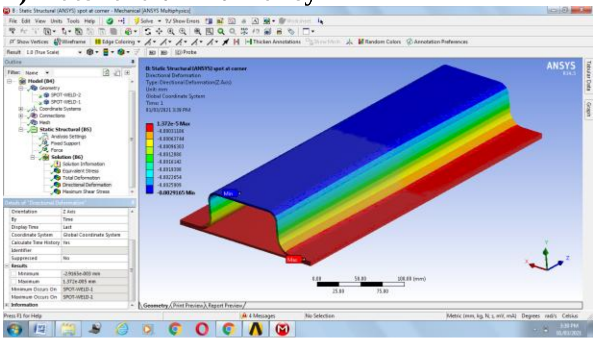


Fig.21:- Directional Deformation Spot weld at corner (AL)

iii) Material magnesium alloy

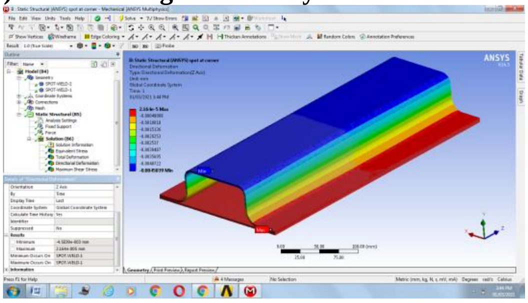


Fig.22:- Directional Deformation Spot weld at corner (MG)

II) RESULT WHEN SPOT WELD AT NEAR TO BEND

i) Material structural steel

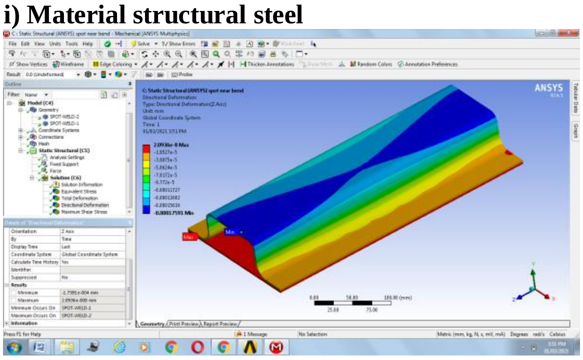


Fig.23:- Directional Deformation Spot weld at corner (ST)

ii) Material aluminum alloy

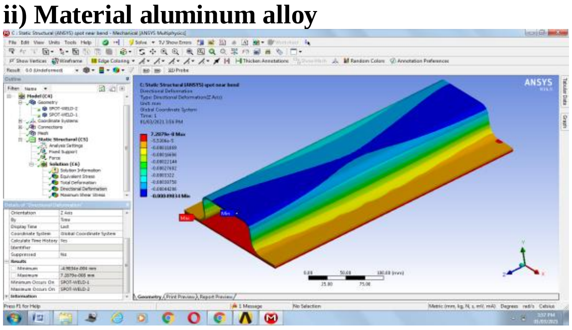


Fig.24 :- Directional Deformation Spot weld at corner (AL)

iii) Material magnesium alloy

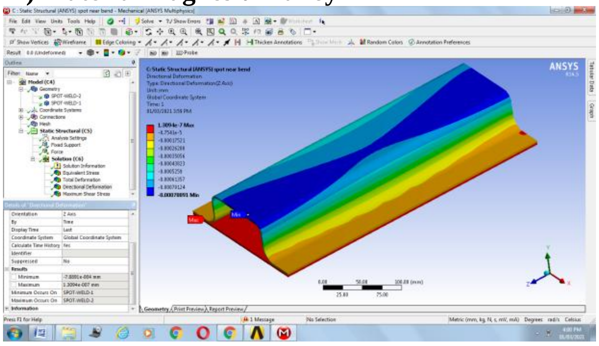


Fig.25:- Directional Deformation Spot weld at corner (MG)

III) RESULT WHEN SPOT AT MIDDLE POSITION

i) Material structural steel

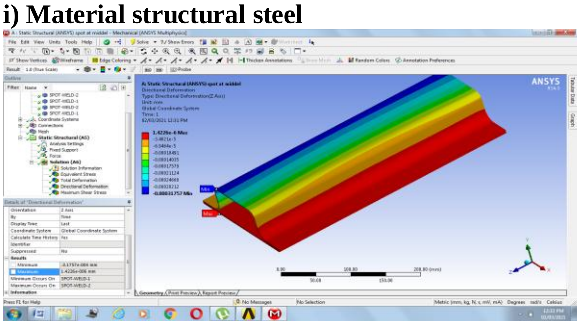


Fig.26:- Directional Deformation Spot weld at middle position (ST)

ii) Material aluminum alloy

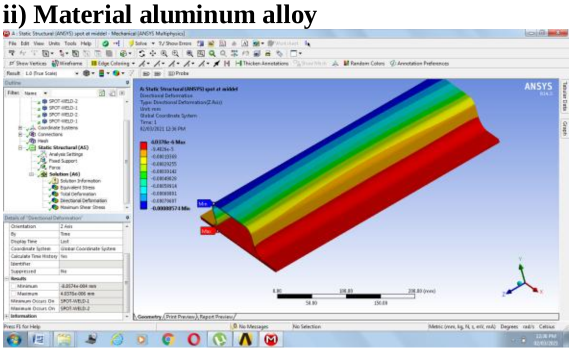


Fig.27:- Directional Deformation Spot weld at middle position (AL)

iii) Material magnesium alloy

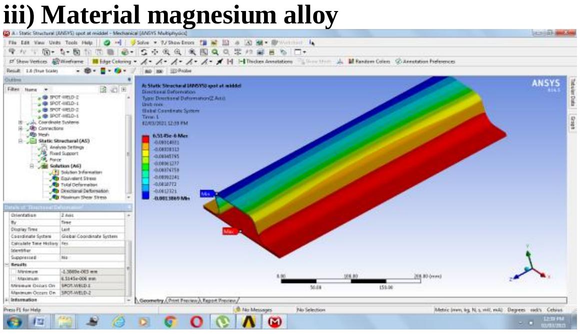
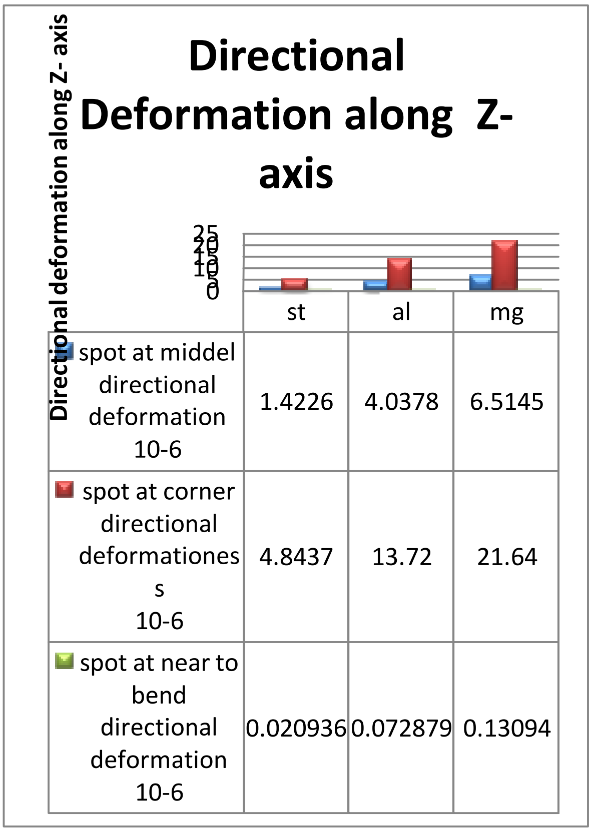


Fig.28:- Directional Deformation Spot weld at middle position (MG)

COMPARISON OF RESULT BY USING CHART.

MATERIALS	spot at middel directional deformation 10^{-6}	spot at corner directional deformation 10^{-6}	spot at near to bend directional deformation 10^{-6}
st	1.4226	4.8437	0.020936
al	4.0378	13.72	0.072879
mg	6.5145	21.64	0.13094

Table 2: Variation in Directional Deformation (mm) of different materials and position of spot weld



Graph 2: Variation in Directional Deformation due to change in position of spot weld.

VII. CONCLUSION

CAD model of the BIW part of sheet metal plate assemblies is generated in CATIA V5 and this model is imported to ANSYS 14.5 for processing work. For different position of spot weld by static structural analysis.

Following are the conclusions from the above results obtained:

1. Total deformation in BIW part is minimum for steel when the position of spot weld at middle compared to other materials and position of spot.

2. Directional deformation in BIW part minimum for steel when spot weld at middle compared to other materials and position of spot weld.

FUTURE SCOPE

Following work may form the scope for future work
i) Fatigue analysis by varying the position of spot weld of BIW part of sheet metal plate.
ii) Further work on different shape of BIW part of sheet metal plate, analyzed by using experimental data.

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