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Research Paper

STRESS AND THERMAL ANALYSIS OF SPOT WELD ON DISSIMILAR MATERIALS

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Resistance spot welding is the process of joining sheet metal this welding process is fusion welding process where both heat and pressure are applied on the joint. There is no filler metal or flux is added. The heat necessary for the melting of the joint is obtained by the heating effect of the electrical resistance. Resistance spot welding applications are automobile industries, rail coach manufacturing, aerospace and nuclear sectors, electric and electronic industries. In the present work the peel test is carried to know the strength of the spot weld experimentally and also using finite element analysis for different combination of dissimilar materials to evaluate the stresses. Thermal analysis is also carried out to know temperature distribution.

Keywords: Resistance spot welding, Dissimilar metals, Stainless steel, Peel test

INTRODUCTION

Resistance spot welding is simplest form of resistance welding process in which overlapping plates are held between two copper electrodes. A low voltage with high amperage current is passed for short time (0.06 to 3 seconds).The time of the electric current supply should be such that the heat released is just sufficient to melt the joint interface and subsequently the joint is formed under pressure. At interface, heat is generated by the resistance offered to the current flow, and after attaining the welding temperature, the pressure between electrodes squeezes the plates together to complete weld taken Miller (2012). The current is switched off while pressure is still on. This enables the metal to regain strength by cooling. Dissimilar materials copper and stainless steel are taken. They are joined with spot weld and peel test is performed to know the spot weld strength done by Mohd Zaim Bin Din (2008). Finite element analysis is carried out for combination of dissimilar materials to evaluate the stresses done by Thaku (2010). Ahmet Akkus (2009) used variation of sheet metal thickness and temperature distribution in resistance spot welding and also thicker sheet having higher temperatures in weld zones In 2008.

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EXPERIMENTAL PROCEDURE FOR PEEL TEST

Welds are broken apart in the peel test by clamping one of the welded sheets, typically in a vice. The other welded sheet is gripped. And force is applied in such a way that the weld is loaded perpendicular to its original orientation thus peeling the weld open.

The materials used copper and stainless steel of 150 x 50 x 1 mm and they are bending in to L shape having size of 100 x 50 x 1 mm. The two dissimilar materials copper and stainless steel are joined by Spot weld using spot welding machine as shown in below Figure 1. And peel test is performed by using UTM machine as shown in Figure 2. The cooper plate is fixed in the fixed jaw and stainless steel is fixed in movable jaw and load is applied hydraulically using UTM and get breaking load is 0.5 KN are taken experiment tally. Similarly we perform the peel test for stainless steel and mild steel with different thickness and get the breaking load is 0.4 KN.

Figure 1: Copper and Stainless Steel Spot Weld

Figure 2: UTM Machine

Finite Element Analysis

In finite element analysis the weld joint model is designed in PROE and export into ansys by using igs file. Analysis is completed for different combination of dissimilar materials and their stress values are evaluated as shown in Figures 3 to 6. The combinations of materials are

- Copper-stainless steel
- Stainless steel-mild steel
- Copper-aluminum
- Aluminum-stainless steel

Table 1 is indicate the simulation values for different combination of materials load applied at 300 N.

Von Misses Stresses for Different Combination of Dissimilar Materials are Shown Below:

Figure 3: Von Misses Stress of Copper and Aluminum

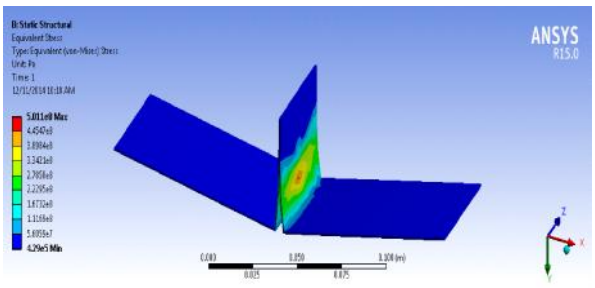

Figure 4: Von Misses Stress of Stainless Steel and Copper

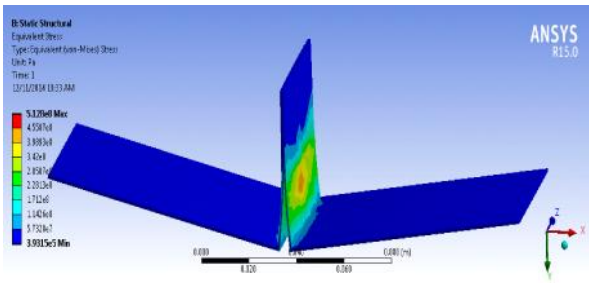

Figure 5: Von Misses Stress of Stainless Steel and Copper

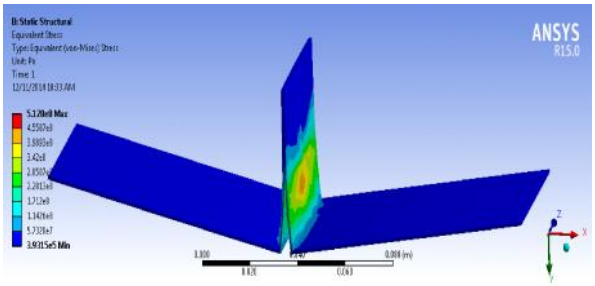

Figure 6: Von Misses Stresses of Stainless Steel and Mild Steel

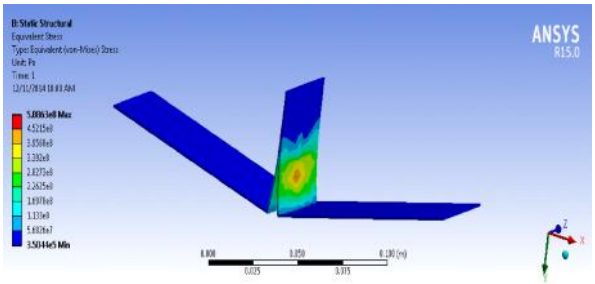

Table 1: Simulation Values for Different Combinations of Dissimilar Materials Stress Values

Combination of Materials	**Stress (Pa)**
Copper-aluminum	5.011e8
Stainless steel-aluminum	4.9264e8
Stainless steel-copper	5.128e8
Stainless steel-mild steel	5.0863e8

Thermal Analysis

During resistance spot welding the temperature distributions for different combination materials as showed in below Figures 7 to 10. Temperature changes during the different combinations temperature at the ends are shown in Table 2.

Figure 7: Copper and Aluminum

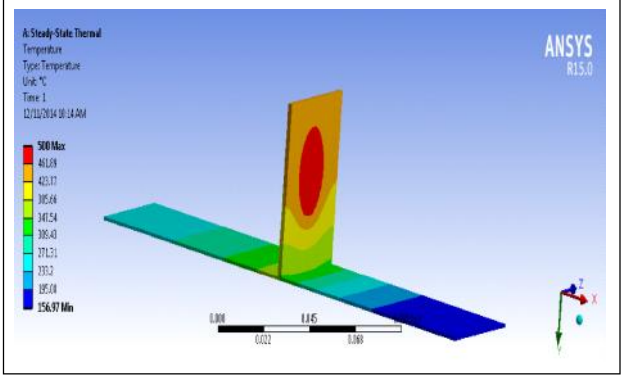

Figure 8: Stainless Steel and Aluminum

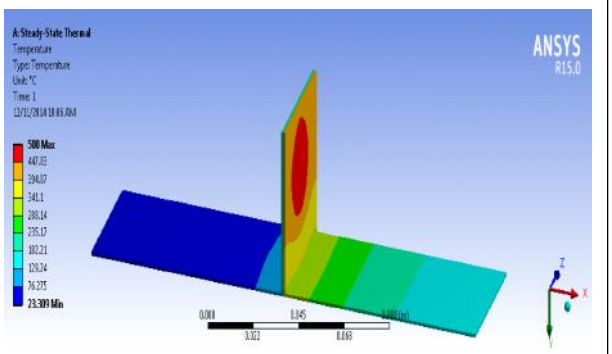

Figure 9: Stainless Steel and Copper

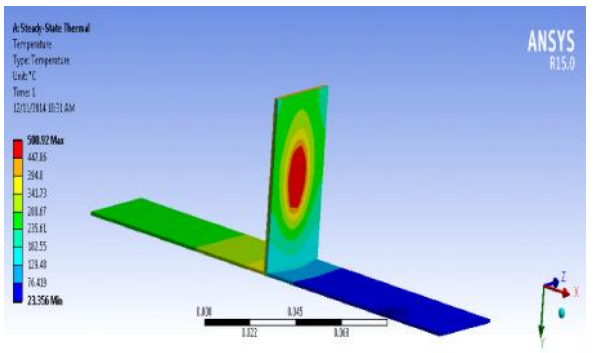

Figure 10: Stainless Steel and Mild Steel

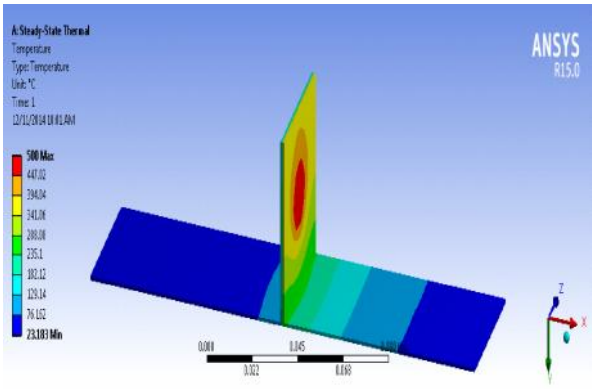

Table 2: Simulation Values for Temperature Distribution

Combination of Materials	Temperature at the Ends (°C)
Copper-aluminum	156.97
Stainless steel-aluminum	23.309
Stainless steel-copper	23.356
Stainless steel-mild steel	23.183

CONCLUSION

In this work the peel test is performed to know the spot weld strength and finite element analysis is done for different combination of dissimilar materials (copper-aluminum, stainless steel-aluminum, stainless steel-copper, stainless steel-mild steel) stress values are obtained .stainless steel-aluminum have low stress value. From the thermal analysis stainless steel-mild steel have low temperature as shown in Table 2.

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