A Review on Welding Failure in Fly Ash Brick Machine

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Abstract— Welding is a process of joining metals by application of heat with or without application of pressure and addition of filler material. All mechanical structural assemblies have to be joined in some way either by bolting, welding or riveting. Out of the above welding is widely used. Also there is various type of welding i.e. Arc welding, Gas welding, Resistance welds, Energy Beam Welding and Solid State welding. But out of the above Shielded Metal Arc welding is extensively used in fabrication process in industry. In Arc welding the source of heat is electric are. Since welding process relies intensively on localised heat input, it results in generation of undesired residual stress and deformation in welded structures. Since residual stress has a strong influence on welded deformation, fatigue stress, fracture toughness and buckling so many research has been made regarding the effect of process parameters of electric arc on formation of residual stress. This paper aims to study various methods for determining residual stress which are proposed by various research papers. Finite element analysis will be used for finding out residual stress in Arc welding. In this paper an effort is made to review the investigation that have been made to find out the impact of residual stress on fatigue life on various types of welded joint in Arc welding.

Key words: Arc Welding, Finite Element Method, Residual Stress, Deformation and Fatigue

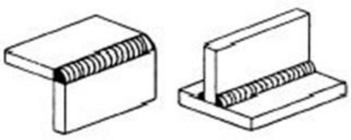
I. INTRODUCTION

Welding is a fabrication process used to join materials, usually metals or thermoplastics, together. During welding, the pieces to be joined (the workpieces) are melted at the joining interface and usually a filler material is added to form a pool of molten material (the weld pool) that solidifies to become a strong joint. In Arc welding, a welding power supply is used to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. In such welding processes the power supply could be AC or DC, the electrode could be consumable or non-consumable and a filler material may or may not be added.

In welding there are basically five types of joint are welded.

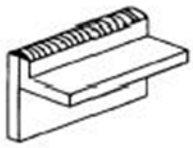
1) Butt Joint:

2) Corner and Tee Joints:



3) Lap Joint:

4) Edge Joint:



In arc welding processes since there is rapid heating and cooling of workpiece it results in uneven expansion and contrast in all the direction. This results in distortion in different direction of workpiece and also formation of residual stress. Residual stress has a strong influence on weld deformation, fatigue strength, fractures toughness and bucklingstrength.

The finite element analysis has become a powerful tool for the numerical solution of a wide range of deformation and stress analysis of automotive, aircraft, building, bridge structures and in many general fabrication structures.

Thus the objective of this paper is to study the impact of residual stress on fatigue life in Arc weld with the help of FEM.

II. LITERATURE REVIEW

D.H. Bae, I.S.Sohn and J.K. Hong investigate the effect of residual stress on the fatigue strength of spot weld. In this study residual stress was calculated using nonlinear finite element analysis. The calculated residual stress was compared to those measured by X-ray diffraction. Then stress analysis was performed under tensile loading in order to evaluate the fatigue strength. They concluded that the residual stress calculated by nonlinear FEA method show reasonably agreement between calculation and measurements. In this study it is shown that the proposed stress amplitude can provide a systematic and accurate evaluation of fatigue strength of spot weld.

Anil Kumar and J.Venu Murali performed fatigue analysis of welded joints. In this process stress concentration at the welded joints is analyzed. The type of joints considered is Tee Joint, Butt Joint and Lap Joint. Structural and fatigue analysis is done in on the welded joints in Ansys. In this research stress distribution in different welded joints is investigated with a computer modelling technique. The finite element analysis is used for the analysis of joints in the plane stress condition under static load. Modelling is done in Pro/Engineer and analysis is done in Ansys. They conclude that fatigue usage is more for Butt Joint, so the life of Butt Joint is less the other two joints.

M.Venkatasudhahar, N. Dlilipraja and K. Lokesh investigated the Finite element analysis of fatigue life of spot weld joint and the influence of sheet thickness and spot diameter. In this paper the impact of sheet metal thickness and spot weld diameter on the fatigue life of sheet metals is discussed. Pro-E was used for designing the specimen and Ansys was used for analysis of fatigue life. They concluded that for a joint to have higher fatigue life, the criterion required is sheet metal thickness should be high, weld spot diameter should be high and applied load should be low.

Z. Barsoum and I. Barsoum investigate the residual stress effect on welded structures using Linear Elastic Fracture Mechanics (LEFM). In this paper a welding simulation procedure is developed using the FE-software ANSYS in order to predict the residual stress. The objective of this paper is to investigate fatigue test results from special designed test bars from the frame box where all test failed from the non-penetrated weld root. They concluded that compressive residual stresses are found at weld roots will enhance the fatigue life. The fatigue life prediction using the developed LEFM subroutine and the mapping procedure confirms teh fatigue life enhancement for the welded specimens compared with the stress relived.

Djan Eirik and Erik Strande investigate the fatigue failure analysis of fillet welded joints used in offshore structures. In this they studied the various fatigue assessment methods for welded structure such as Nominal stress approach, Structural stress approach and Effective notch stress approach in which Effective notch approach found to be more useful. Also they discuss various fatigue life improvement methods. After doing analysis of different weld sizes they conclude that increase in weld size leads to a higher fatigue life in the weld root.

Rajlazmi N. Mhetre and S.G. Jadhav perform the finite element analysis of welded joints. The aim of this paper is to develop an efficient and reliable method of assimilation of the welding process using the Finite Element Method. Moving heat source and element death and birth technique is used to simulate the welding process. The analysis result help us to understand the phenomena governing the welding of the joint thus offering insight on the mechanism and mechanical aspect particular to the welding process.

Swapnil S. Ingle and Dr. Rejendra S. Dalu perform the Thermo-Mechanical analysis in TIG welding of Aluminium Alloy 6082. The objective of this research is to study the variation of temperature in TIG welded plate of 5mm thickness. Since the result obtained from Thermo-Mechanical analysis is close to the experiment result data, hence they conclude that this is more reliable method of finding out temperature distribution.

K. Ashok Kumar performed the Thermo-Mechanical analysis of a copper welded joint by Finite Element Method. The simulation is carried out in Ansys. The FEM is carried out in two stages. In the first stage the pure thermal analysis is carried out to estimate the time dependent temperature. The temperature obtained in thermal analysis is given as input in the second stage i.e. the structural analysis. He concluded that the obtained thermal stresses are in good agreement with theoretical values.

Vishnu V.S., Nadeera M. and Joy Varghese performed the numerical analysis of effect of process parameters on residual stress in a double side TIG welded low carbon steel plate. In this a 3D thermo-mechanical simulation model was developed to predict to predict the distribution of temperature and residual stress during TIG welding. An uncoupled thermal-mechanical finite element analysis is performed using Ansys. The simulated result concluded that residual stresses are tensile at the weld pool region and as the distance from the weld line increase it tends to compressive.

Dragi Stamenkovic performed the finite element analysis of residual stress in butt welding two similar plates. This analysis includes a finite element model for the thermal and mechanical welding simulation in Ansys. The finite element analysis and the element birth and death method is employed. The results show that the present results are very close to experimental result.

K. Ashok Kumar, T.N. Charulu, Dr. C.H. Srinivasa Rao and P. Surendra Babu performed the free expansion and thermal stress analysis of a corner welded joint by finite element method. This paper deals with the simulation of arc welding process for the study of stress due to free expansion and temperature rise. It is observed that the stress is more for fixed condition due to fin effect and heat loss through the exposed surface due to convection.

Mr. Harshal K. Chavan, Mr. Gunwanat D. Shelake and Dr. M.S. Kadam investigated the residual stress in MIG welding. The objective of this research is to simulate the complex arc welding in Ansys in which the effects of varying welding process parameters on thermo-mechanical is studied. This paper concluded that as the heat input increases temperature generation in the plate increases and thus the stress generation decreases.

J Shivakumar , Dr.G.R. Jinu and Dr. Kumaresan investigated the analysis of residual stress and distortion in welding. In this paper cirseam welding of aluminium alloy is simulated in Ansys. This analysis includes a finite element model for thermal welding simulation. The element birth and death technique is employed folr simulation of filler metal depositions. The temperature distribution pattern is obtained which is used for estimation of residual stress and distortion. This paper concludes that the axial stress varies with respect to angle because of unsymmetrical loading of heat source.

A.V. Damale and Dr. K.N.Nandurkar performed thermo-mechanical analysis for determination of weld induced angular distortion in MMAW Butt welded plates. In the present study 3D transient thermal analysis and non linear structural analysis is done for predicting angular distortion. This paper concluded that the predicted angular distortion can be used for pre-setting the specimen to compensate the angular distortion.

M.N.Buradkar, Dr. D.V. Bhope and S.D. Khamankar performed experimental and photoelastic analysis of Arc welded Lap-joint. This research work deals with the stresses in the weldment of an arc welded lap-joint under static load condition. The stresses in the weldment are evaluated by varying the gap between the parent plates which may occur during welding. The breaking strength of the weldment is also determined. This paper observed that the magnitude of stress in the weldment varies with respect to gap between parent plates.

G. Hanumantharao, S. Vijay and Dr. M.Venkateswara Rao performed the transient heat transfer analysis for optimum temperature distribution to reduce thermal stresses. The project investigated the thermal stresses of aluminium plate welded by gas tungsten arc welding. A model was generated in Ansys using solid 98. The nonlinear material properties are fed for the heat flow solution to get the thermal stress. This paper present the analysis method to calculate thermal gradient thereby reduce the thermal stress for the optimum temperature distribution in aluminium welded joints.

G. Janakiram, S. Vijay and Dr. M. Venkateswara Rao investigates the temperature distribution of welded joints in ship building. A model was generated in Ansys using Solid Tet 10 node 87. The non linear material properties are feed for the heat flow solution to get the thermal stress. The variation in temperature with time and thermal stress is obtained. This paper concludes that temperature distribution and thermal flux distribution of aluminium and cast iron is uniform throughout the entire length of weld.

III. Discussion and conclusion

Residual stresses and distortion are two major concerns in welded parts. Residual Stress are the stresses which remain within in the welded part when all external load or reactions are removed which are developed in heat affected zone. So measurement of residual stress in very important in order to predict service life, analyze distortion and determining reason of failure.

Since in Fly Ash Brick Machine there is cyclic loading hence research should be done by incorporating Finite Element Analysis technique and should proceed in following way- first with the help of thermo-mechanical analysis the residual stress should be determined. Second the impact of residual stress on fatigue life should be calculated. Research should be done in Tee Joint as it is widely used in Fly Ash Brick Machine.

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