LASER SPOT WELD ANALYSIS USING ANSYS SOFTWARE

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ABSTRACT

In this project we are going to study laser spot weld, and give the appropriate to optimize BIW which joint by laser 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, laser welding has become a popular alternative for producing spot welds. Because of the complexity and uncertainties of laser welds and thus formed structures, the finite-element (FE) modeling of the welds for dynamic analysis is a research issue. This article first outlines some of the existing modelling works of spot welds. Then, a hat-plate structure used for this study is described and its FE representations are explained. Also, by using ANSYS V 11.0 software we going to generate model and mesh. Also we going to study thermal aspect for weld by using research papers.

Keywords: *Welding Process, Laser Welding, Finite Element Analysis, ANSYS Software.*

1. INTRODUCTION

1.1 Introduction of Welding Process-

Parts to be joined so that on solidification of the weld metal the parts become united. The common processes of this type are grouped as fusion welding. Heat must be supplied to cause the melting of the filler Modern welding technology started just before the end of the 19th century with the development of methods for generating high temperature in localized zones. Welding generally requires a heat source to produce a high temperature zone to melt the material, though it is possible to weld two metal pieces without much increase in temperature. There are different methods and standards adopted and there is still a continuous search for new and improved methods of welding. As the demand for welding new materials and larger thickness components increases, mere gas flame welding which was first known to the welding engineer is no longer satisfactory and improved methods such as Metal Inert Gas welding.

1.2 Introduction to Laser Spot Welding-

Laser spot welding is receiving increasing attention as a high speed technique to replace the resistance spot welding method for joining metal sheets in automotive industry. To ensure the reliability of the spot welds during vehicle lifetime, weld quality should be improved. In this investigation laser spot welding was used to join low carbon steel sheets. The relationship between the joint quality and laser spot welding parameters was studied using.

Taguchi analysis was made to determine the most effective parameters in the investigated range on the quality of laser welded joints. To address this issue, tensile- shear tests were performed on laser spot welded joints. Joint quality and mechanical behavior are evaluated by energy absorption capability of weld before crack initiation. In these experiments, three overload failure modes were observed; pullout failure is the desirable one which is the ductile mode. Load carrying capacity and energy absorption capability for those welds which fail under the overload pullout mode are more than those welds which fail under the other modes. Optimum process parameters in the studied range were found which would ensure the desirable pullout failure mode and thus maximum failure energy.

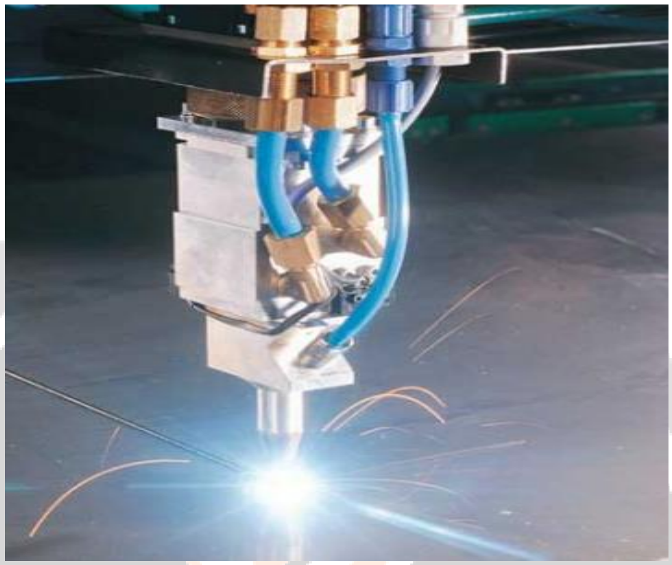

Figure 1 Laser Welding Process

1.3 New Method of Laser Spot Weld Analysis-

New advances in computer technology have made finite element stress analysis a routine tool in design process has given rise to computer-aided design (CAD) using solid-body modeling. Some benefits of CAD are productivity improvement in design, shorter lead times in design, more logical design process & analysis, fewer design errors, greater accuracy in design calculations, standardization of design, more understand ability and improved procedures for engineering changes.

2 Finite Element Analysis (FEA)-

It is widely accepted method of accessing product performance without the need for physical building and testing. It also shortens prototype development cycle times & facilitates quicker product launch. FEA consists of a computer model of a material or design that is loaded and analyzed for specific results. It is used in new product design, and existing product refinement.

2.1 Advantages of FEA-

The inherent advantages of finite element analysis are as under:

- Easy to model irregular shapes
- Possible to evaluate different materials
- Can apply general load conditions
- Large numbers and kinds of boundary conditions are possible in FEA

- Different sizes of elements can be used where necessary
- Cheap and easy
- Dynamic effects, nonlinear behaviors and nonlinear materials can be examined
- Reduce the number of prototypes required in the design process

2.2 About ANSYS Software-

ANSYS AUTODYN release 11.0 is the first release of the ANSYS AUTODYN software within the ANSYS Workbench framework. ANSYS Workbench brings many new possibilities to the ANSYS AUTODYN user in terms of CAD geometry import, complex geometry generation, meshing and ease of use. To complement the significantly enhanced model generation capabilities, a range of new solver, material modeling and post-processing features enable larger simulations to be solved in a faster time.

The main new features of the ANSYS AUTODYN 11.0 release are –

• ANSYS AUTODYN and ANSYS Workbench.

Meshing (for each ANSYS AUTODYN-3D licensee)

3 LITERATURE REVIEW

There are great deal of researches and number literatures on laser spot weld analysis using ANSYS software. Laser welding has been studied well for various metals and alloys in different configurations. Understanding the physical processes that take place during welding which affect the weld material properties and the around regions is essential. The analysis of dissimilar metal joint offers a number of challenges, arising out of complexities such as dissimilar metal properties, asymmetric weld pool shape, mixing of the molten metal's, segregation and formation of inter metallic compound [1]. In order to achieve a satisfactory study of the laser welding process, it is first of all necessary to know the temperature distribution resulting from the irradiation of the laser beam [3], to stand with some of these challenges, to know the temperature field in and around the melt pool, where the mechanical properties of the weld metal and around the Heat Affected Zone (HAZ) region, are highly dependent on the cooling rate of work piece. It is also essential for the understanding and modeling of the welding process [3]. Joining between dissimilar metals are used in many industries, mainly automotive, electronics,

HAT-PLATE COMPONENTS AND FE REPRESENTATIONS

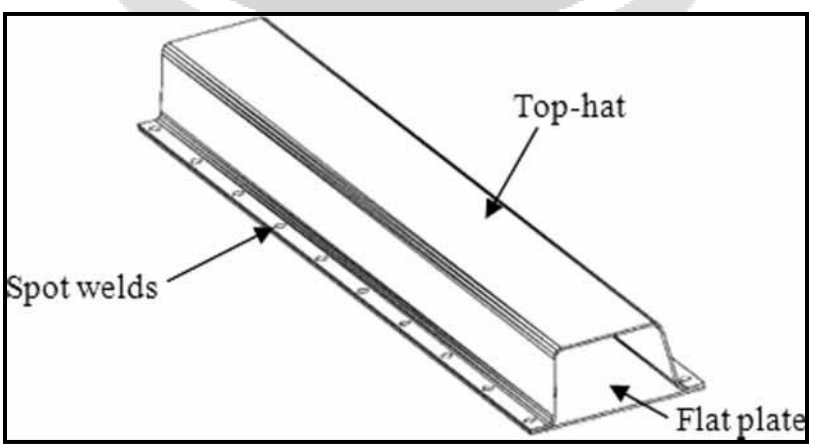

Figure 2 The hat structure [1]

A hat-plate structure shown in Figure 2 is used in this work. The structure, which consists of a flat plate and a formed hat-like shell (or 'top-hat') joined together by spot welds at the flanges, is designed to represent common structures used in the construction of a car BIW. The spot welds, which are produced by LW, are 5mm in diameter and 60 mm apart in the longitudinal.

The overall dimensions of the hat plates are as 564mm long and110mmwide.The plates,of thickness 1.5 mm,are made of cold rolled mild steel sheet metal. A set of nine identical pairsof the Nominal values for the material properties of mild steel are used for both models,withYoung's modulusE = 210GPa, Poisson's ratioν= 0.3,anddensityρ = 7860kg/m3.

It is essential to high light that FE model updating can only correct the errors that originated from the uncertainties of modelling parameters in a geometrically well-defined model.Therefore, manual tuning of the initial model, based on trial and error and or engineering judgement,must be carried out first.The manual tuning procedure involves manual alterations of the model geometry to bring the FE model closerto the physical structure.

It usually includes a small number of key parameters from the FE model that can be controlled manually.In this work, the outcome of the numerical modelis found to be sensitive to the top-hat's fold radiiand the thicknesses of the flat plate and the top-hat.Therefore, the thicknesses of all the plates are measured at different places and a mean value of 1.45mm is incorporated in the FE models of both components.Furthermore,acloserinspectionofthetop-hats reveals that the fold radii are approximately 4mm,which is 1mm smaller than the specified radii. The radius corrections are then incorporated in the manual tuning of the top-hat. Solution103 in MSC/NASTRAN is used to compute the modal data of the components.

4.0 PLANNING FOR PROJECT STAGE II

4.1 Optimization of weld parameter

Selecting the updating parameters is an important aspect of the FE model updating process and any parameters for material and geometric properties (such as area, inertia, thickness, diameter, density, Young's modulus, etc.) can be considered. However, the parameters selected should be justified by engineering understanding of the structure and the number of parameters should be kept to a minimum to avoid ill-conditioning problems. Therefore, it is necessary to compute the eigen values sensitivities beforehand, so that only the most parameters can be chosen. Two parameters are selected for the flat plate and four parameters are chosen for the top-hat, as follows [1]:

(a) Young's modulus of the flat plate, *E*flatplate;

(b)Shear modulus of the flat plate, *G*flatplate;

€ Thickness of the folds for the top-hat, *t*1;

(d) Thickness of the flanges for the top-hat, *t*2;

€ Thickness of the sidewalls for the top-hat, *t*3;

(f) Thickness of the top for the top-hat, *t*4.

The FEA simulates the loading conditions of a design and determines the design response in those conditions. It can be used in new product design as well as in existing product refinement. A model is divided into a finite number of regions/divisions called elements. These elements can be of predefined shapes, such as triangular, quadrilateral, hexahedron, tetrahedron, and so on. The predefined shape of an element helps define the equations that describe how the element will respond to certain loads. The sum of the responses of all elements in a model gives the total response of the complete model.

Work to be done in Stage II:-Following path is followed for the proceeding project work for project stage II. Which starts from modeling of desired top hat and flat plate such a way that further simulation or analysis is to be carried out. Followings are the steps which followed in stage II.

Table 1 Project stage II Planning

Sr. No.	Month	Task to be done
1	November 2017	Modelling of top hate and flat plate
2	December 2017	Design calculation for BIW part as per given loading conditions.
3	January 2018	FEA analysis and simulation with the design.
4	February 2018	Final research paper proceeding and paper publication on project stage II
5	March 2018	Report writing under guidance of project guide
6	April 2017	Report writing with guidance from project guide and final presentation preparation.

5.0 REFERENCES

[1]N A Husain,H H Khodaparast, A Snaylam, S James,Gdearden, and H Ouyang Department of Engineering, University of Liverpool, Liverpool, UK.The manuscript was received on 16 June 2009 and was accepted after revision for publication on 2 October 2009.

[2]JOHN C. Ion. Laser Processing of Engineering Materials. First Published, Elsevier Butterworth Heinemann, 2005, pp.155-156.

[3]JOSE Roberto Berretta; WANGER de Rossi; MAURICIO David; MARTINS das Nevens; IVAN Alves de Almeida ; NILSON Dias Vieira Junior. Pulsed Nd:YAG Laser Welding of AISI 304 to AISI 420 Stainless Steels. Optics and Lasers in Engineering [J] 45 (2007) 960–966

[4]EZZEDDIN Mohamed Hassan. Feasibility and Optimization of Dissimilar Laser Welding Components. Ph.D. Thesis, Dublin City University, (2008).

[5]Cho, Y., Hu, S. J., and Li,W. Resistance spot welding of aluminum and steel: a comparative experimental study.*J. Eng.Manuf.*, 2003, 217, 1355–1363.

[6] www.freefullpdf.com

6. BIOGRAPHY

	Mr. Ugale Mayuresh, student of the SND Collage of Engineering & Research Center Yeola, Nashik-423401, Maharashtra, India.in the year 2017-18. In the mechanical Engineering. Work on the project “LASER SPOT WELD ANALYSIS USING ANSYS SOFTWARE”. Email id- mayureshugale01@gmail.com

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