A REVIEW PAPER ON LASER WELD PARAMETER FEA ANALYSIS

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ABSTRACT

In this paper we are going to analyze the BIW (Body In White) using ANSYS software .The BIW consist mainly two part i.e. top hat and flat plate which are joint together by using laser spot weld. Spot welds made by resistance spot welding are used extensively in automotive engineering. More recent material, equipment and welding process developments to extend electrode-life, enhance weld quality and reduce power consumption are making this process increasingly attractive to automakers [1].. In this work firstly outlines some of the existing modeling of top hat and analyzed by using ANSYS software for different static load and validate by using free hammer test. SOLID 285 (Tetrahedral 4 node 285) elements is used FE modeling. In this work, we are using LVDT accelerometer to calculate the modal frequency of the different BIW part at given static load. Also, by using ANSYS V 12.0 software we going to generate mesh BIW part and model generated by using PRO-E software.

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

I. 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[1].

II. 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. ANSYS AUTODYN release 18.0 is the latest release by ANSYS.

III. ABOUT BIW

A hat-plate structure shown in Fig.1 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 564 mm long and 110 mm wide. The plates, of thickness 1.5 mm, are made of cold rolled mild steel sheet metal. The overall dimension of top hat and flat plate shown in fig 4.2 by using Pro-E software. A set of nine identical pairs of the structures are built in-house, each having the same nominal dimensions .Nominal values for the material properties of mild steel are used for both models, with Young's modulus E = 210GPa, Poisson's ratio ν= 0.3,anddensityρ = 7860kg/m3[1]

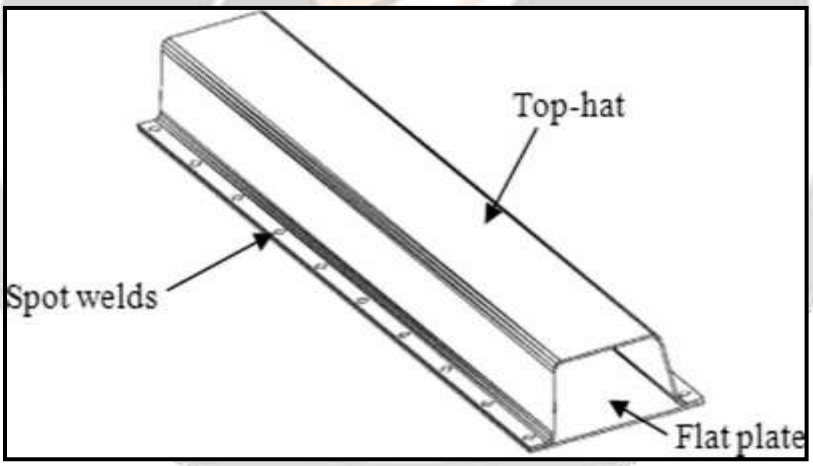

Fig. 1 Top hat and flat plate structure

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. Here,for FE modelling the top hate,flate plate and there assembly is created by using Pro-E software and it is import in ANSYS Autodyne 12.0 for furthe analysis.Fig 2 and 3 is gives overall diemention and structure of top hate respectively.

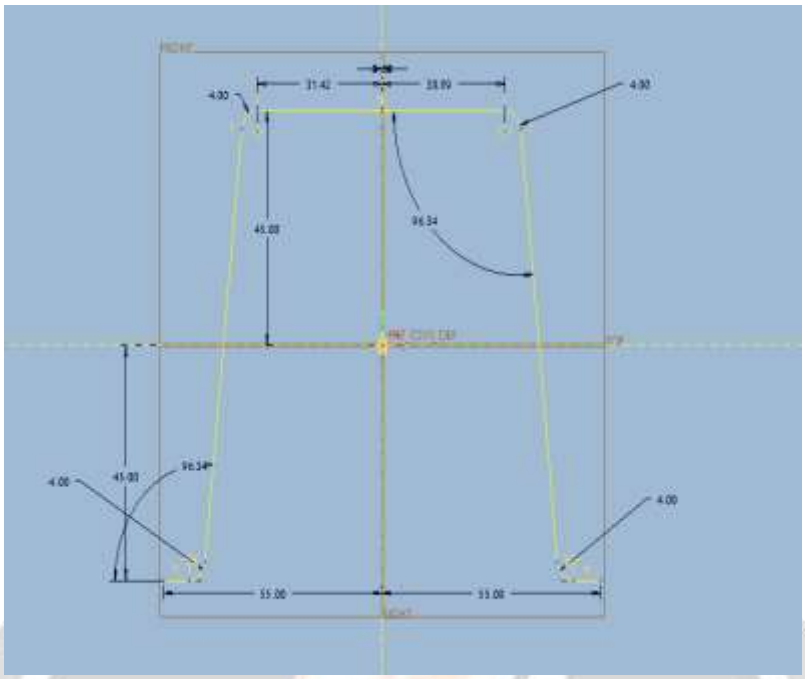

Fig. 2 The overall dimension of top hate(All diemension in mm)

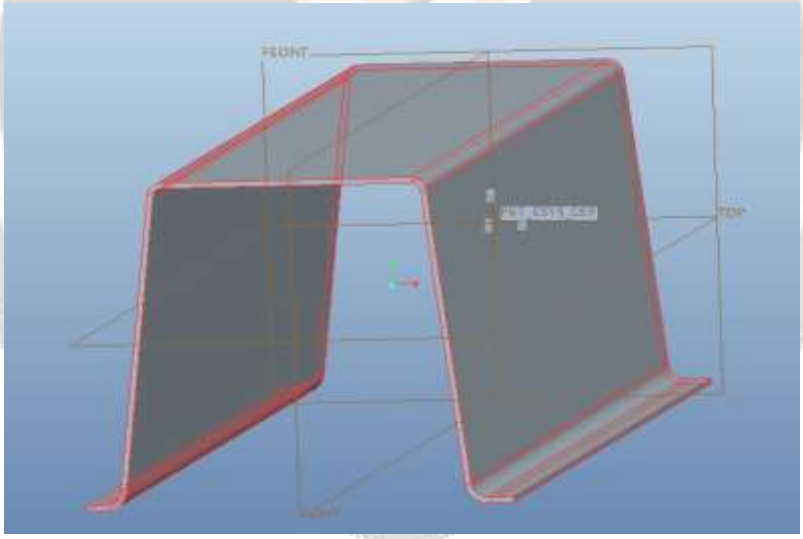

Fig. 3 The top hate structure.

Also, fig 4 and 5 is gives overall diemention and structure of flat plate respectively.

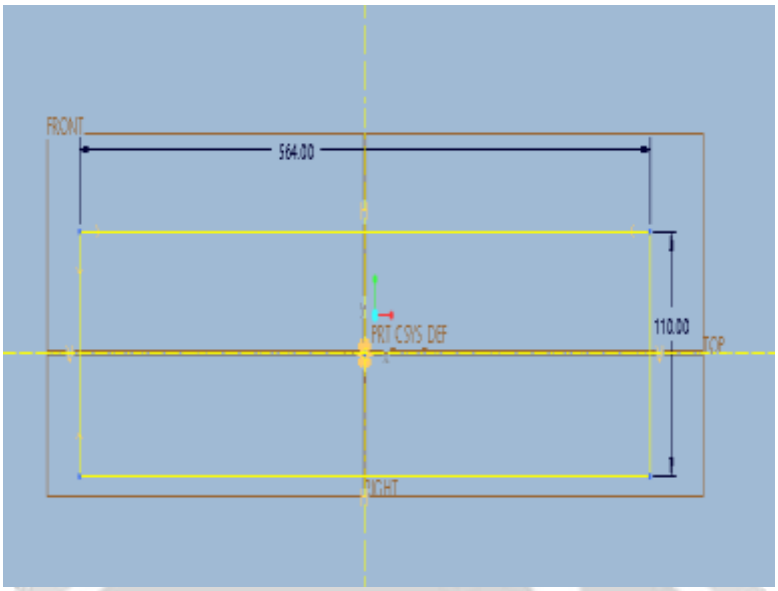

Fig. 4 The overall dimension of flat plate(All diemension in mm)

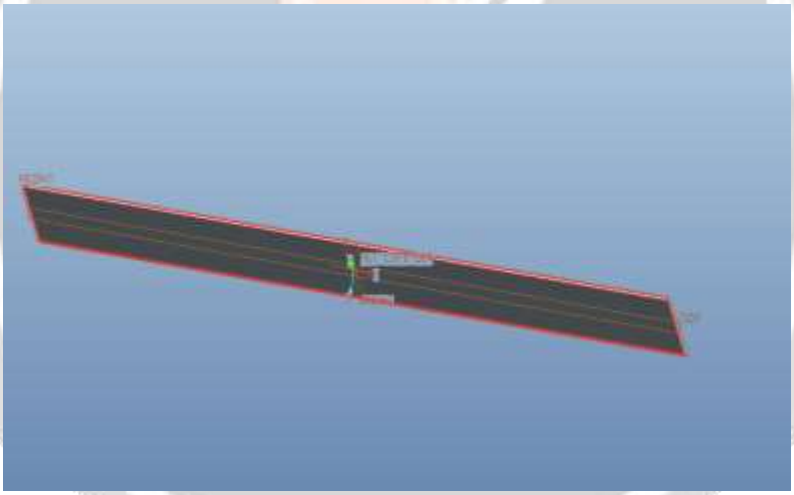

Fig. 5 The flat plate structure.

IV.SOLID 285

For analysis the BIW part i.e. top hat SOLID 285 element (Tetrahedral 4 node) is used for FE modeling. The reason as below-

1. Convergence of solution is better in tetrahedral element compare other element. If we select the tetrahedral with more than 4 node i.e.8 nodes, 10 nodes, etc. So, it will take more time for analysis because number of nodal point is increases. SOLID 285 is the nomenclature for 4 nodes quadrilateral element according to NAFEMS (National Agencies For Finite Element Method And Standards, London).Less number of nodes are taken to reduce computational time (Reduce number of equation and number of boundaries. The element description as shown in fig 6 as

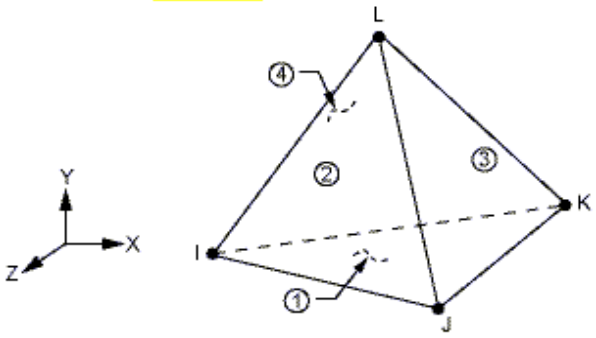

Fig. 6 SOLID 285 Geometry

V. FE MODELING USING ANSYS 18.0

Here we used SOLID 285 element i.e. (Tetrahedral 4 node 285).The total number of mesh division is 25 i.e. each division of 22.56 mm distance .Total number of node taken in this type of element is 5965. Now, we are going to model i.e. top hate of BIW parts by using ANSYS software. Meshed element as shown in fig 7

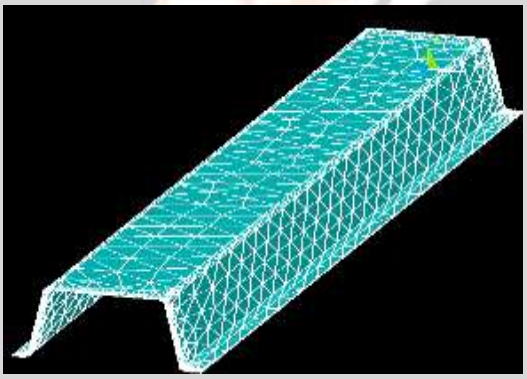

Fig. 7 Meshing of Top hat structure

The impact load is varies from 0.7 kg to 1.1 kg. But, in analysis this load acting like a static load so it varies from 1.5-2 times impact load. So, we assume according to impact theory of a load taken this load as 2 times impact load as 1.4 kg to 2.2 kg i.e. from 13.734 N to 21.582 N. Following are the stress shapes observed for the load 13.73N to 21.582N as

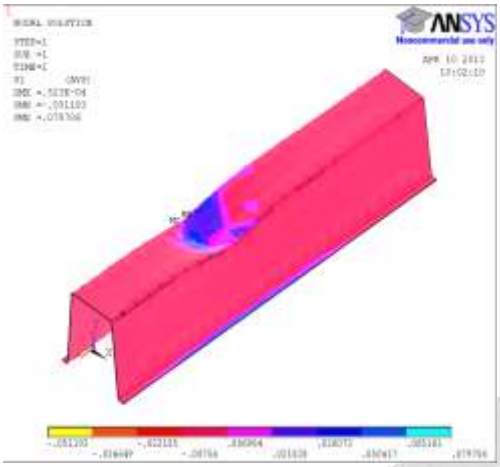

Fig. 8 Stress after applying 13.73 N

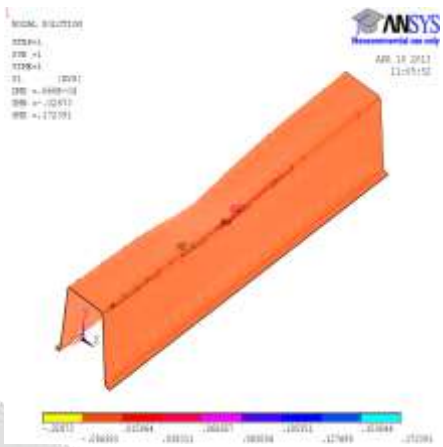

Fig. 9 Stress after applying 15.696 N

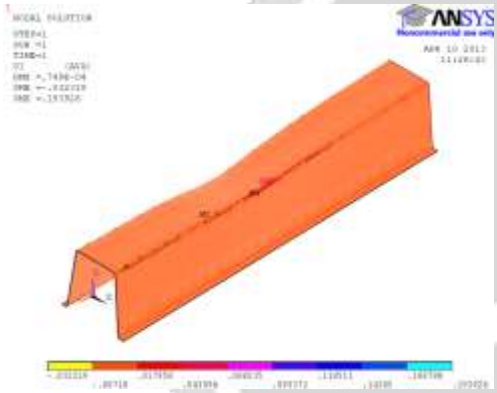

Fig. 10 Stress after applying 17.658 N

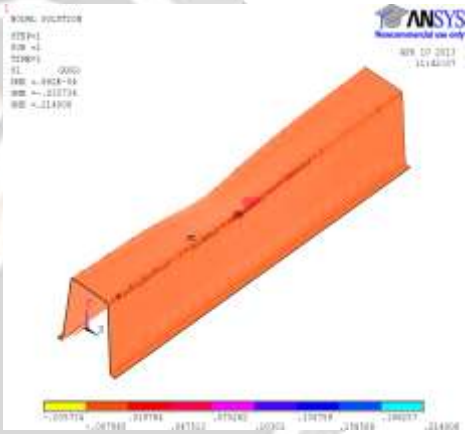

Fig. 11 Stress after applying 19.62 N

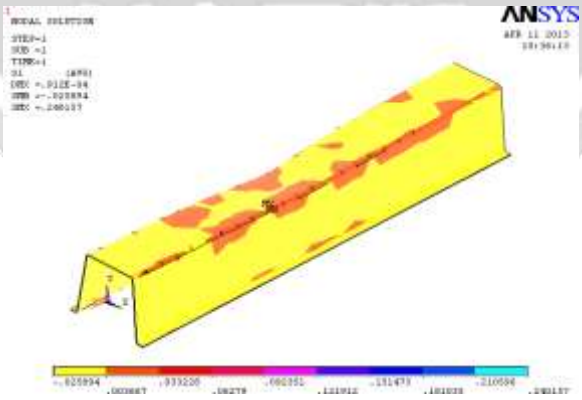

Fig. 12 Stress after applying 19.62 N

VI. CONCLUSION

FE modeling we know that failure of model is by means of the loading i.e. by impact loading. Because the laser spot weld is failure under action of heat treatment only. In case of BIW part the heat generation at the junction is negligible. This work has reviewed some of the FE models developed to represent spot welds normally produced by RSW in the past. Amongst all these models, SOLID 285 is selected to modeling and different static load analysis and mode generation at that respective static load most importantly, it is essential to have an appropriate mesh in the FE model since it will influence the size of the patch used in the FE model. The maximum stress is 0.20184 N/mm^2 at a static load of 21.582 N i.e. at a 1.1 kg weight of accelerometer in free hammer test for complete structure. The minimum stress is 0.12844 N/mm^2 a static load of 13.734 N i.e. at a 0.7 kg weight of accelerometer in free hammer test for structure. Variation of maximum and minimum stress are shown in fig 13 and 14 respectively.

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