



**ANALYSIS OF WELDING STRENGTH BY VARIATION OF VOLTAGE & CURRENT
PARAMETER ON MILD STEEL MATERIAL**

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Abstract: This paper presents a study on the strength of welding joining of hybrid material, between alloy steel and mild steel by electric arc welding. The objective is to analyze the effect of welding on dissimilar plate of alloy steel and mild steel. The finite element model of joining between alloy steel and mild steel by welding was built using a structural three-dimensional (3D) solid modeling element. In this case variation of voltage and type of cooling will give the strength variation. Impact testing using hammer excitation and accelerometer response measuring techniques was used to measure strength properties of hybrid parts.

Key Words: - Welding, Strength, Voltage.

Introduction

The introduction of joints promotes the flexibility of the assembled structures and contributes adequately to the damping properties. Engineering structures are generally fabricated using a variety of fasteners such as bolted, riveted, welded joints etc. Joints are an integral part of most of the real structures. However, its behavior under dynamic condition has not yet been fully understood by the researchers. This is an impediment to accurate

modeling. These connections are recognized as a good source of energy dissipation and greatly affect the dynamic behavior in terms of natural frequency and damping [1-3]. This structural damping offering excellent potential for large energy dissipation is associated with the interface shear of the joint. It is thus recognized that the provision of joints can effectively contribute to the damping of all fabricated structures. The damping and its improvement in structural applications poses the biggest challenge to the practicing engineers. The monolithic structures can be used as a replacement, but unfortunately they possess very low inherent material damping and are not cost-effective. One of the techniques used for improving damping is fabricating these structures in layers by means of joints which provide suitable means of energy dissipation.

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Received on: November 2014

Accepted after revision: December 2014

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Usually, such structures possess both low structural weight and damping. This situation calls for use of additional measures to improve the damping characteristics by dissipating more energy. The role of friction is of paramount importance in controlling the dynamic characteristics of engineering structures. In applications where relative motion between surfaces in contact occurs, the effect of frictional forces, whether desirable or not, cannot be ignored. Although most of the inherent damping occurring in real structures arises in the joints, but little effort has been made to study this source of damping because of complex mechanism occurring at the interfaces due to coefficient of friction, relative slip and pressure distribution characteristics. It is therefore important to focus the attention on these parameters for accurate assessment of damping capacity of structures. Generally, the structural problems are divided into two categories i.e., linear and nonlinear systems. In linear systems, the excitation and response are linearly related and their relationship is given by a linear plot. For many cases, this assumption is valid over certain operating ranges. Working with linear models is easier from both an analytical and experimental point of view. For a linear system, the principle of superposition holds which means that doubling the excitation will approximately double the levels of the response. The beam is one of the fundamental elements of an engineering structure and finds wide applications in structural members. These beam-like structures are typically subjected to dynamic loads. The popular beam theories used are:

- Euler-Bernoulli beam theory
- Timoshenko beam theory.

Dynamic analysis of beams is generally based on one of the above beam theories. If the lateral dimensions of the beam are less than one-tenth of its length, then the effects of shear deformation and rotary inertia are neglected for the beams vibrating at low frequency. The no-transverse-shear assumption means that the rotation of cross section is due to bending alone. A beam based on such conditions is called Euler-Bernoulli beam or thin beam.

Modeling of a Structure

It is essential to have a theoretical model to represent the damping mechanism of jointed structures. Theoretical modeling of the present problem considers two approaches using the Euler-Bernoulli beam theory: continuous and finite element models. Both these approaches are used in the present investigation. A continuous model is characterized by a partial differential equation with respect to spatial and time coordinates which is often used for studying simple structures such as a uniform beam. Exact solutions of such equations are possible only for a limited number of problems with simple geometry, boundary conditions and material properties. The damping model of jointed structures is also developed based on the experimental data. In the present work, response surface methodology has also been adopted to develop the damping models of layered and jointed welded structures. Response surface methodology is a new statistical approach in which the experimental results of damping capacity are statistically analyzed considering the various factors affecting the damping. For this experiment, 30-50 mode shapes were analysed and there is no loading and boundary condition were imposed on the test specimen. The free boundary condition was simulated by supporting the structure with soft material such as sponge. The mesh structure for joining aluminium alloy and stainless steel with weld bead is shown in Fig. 1. The simulation was done part by part so that it can be compared to the experimental analysis later.

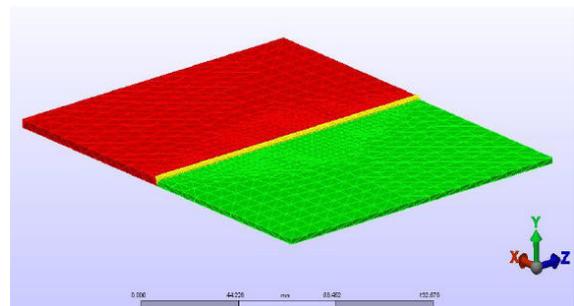


Fig 1 Meshing Structure

Background of Work

Such requirements necessitated the use of layered and welded cantilever beams as

structural members. Alternatively, cast cantilever beams can be used, but unfortunately, these are more expensive to manufacture. As a result, the deployment of welded layered beams is becoming increasingly common in the machine tool industry and fabricated construction. Many structures are made by connecting structural members through joints. Due to very low material damping of built-up structures, sufficient damping has to come from the joints. Damping in built-up structures is often caused by energy dissipation due to micro-slip along frictional interfaces (e.g., at welded joints), which provides a beneficial damping mechanism and plays an important role in the vibration behavior of such structures. Telescopic beam is one of the important parts in the spreader. It is a box shaped beam with four welds joining the two webs and two flanges of different grades of high strength steels.

Hardness Testing

Hardness is the resistance of a material to permanent indentation. It is not a material property but an empirical test. Vickers hardness test was developed in 1924 by Smith and Sandland at Vickers Ltd to measure hardness of the materials. A pyramid shaped indenter is used to make the indentation by applying a test force F and then hardness of the material is measured by measuring the length of the diagonal of the indentation made on the material surface [6].

Vickers test is applicable for all metals and has a wide range among the hardness tests. The unit of hardness given by the test is known as Vickers Pyramid Number (HV). Other mechanical properties are usually computed using hardness number and change in the properties due to heat treatment or welding.

Tensile Testing

Tensile test is the most fundamental type of mechanical test. It can be either force controlled or displacement controlled experiments. In force controlled experiments, a material is being pulled and its behavior to react to the forces applied in tension is determined, while in displacement controlled experiments a constant increasing displacement is applied as a load. The stress and strains are determined from the cross sectional area and length. After

performing tensile test a curve is obtained which tells about the behavior of the material. Properties of the material like elongation, ultimate tensile strength and ductility are computed. The relation between stress and strain is observed to be linear for small strains while for large strains it is no longer linear. Elongation in the specimen can be expressed as a relative measurement called 'strain'. Strain can be expressed as 'engineering strain' or 'true strain'. Engineering strain is the ratio of change in length to the original length while true strain is based on the instantaneous length of the specimen.

Butt welds

Full penetration butt welds are formed when the parts are connected together within the thickness of the parent metal. For thin parts, it is possible to achieve full penetration of the weld. There are nine different types of butt joints: square, single V, double V, single U, double U, single J, double J, single bevel and double bevel. They are shown in Fig. 2. In order to qualify for a full penetration weld, there are certain conditions to be satisfied while making the welds.

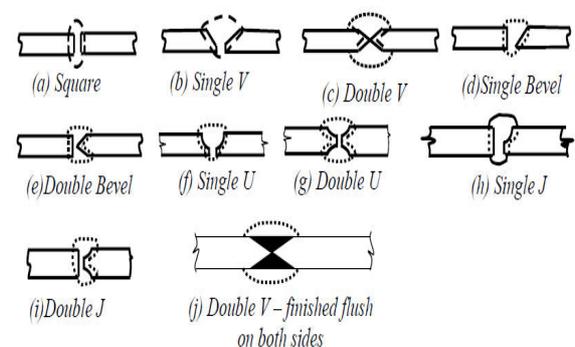


Fig 2 Butt Joints

Discussions

Design strength value is often taken the same as the parent metal strength. For design purposes, the effective area of the butt-welded connection is taken as the effective length of the weld times with voltage variation. Effective length of the butt weld is taken as the length of the continuous full size weld. The electrode is specified by the effective welding strength. For a full penetration butt weld, the throat

dimension is usually assumed as the thickness of the thinner part of the connection. Even though a butt weld may be reinforced on both sides to ensure full cross-sectional areas, its effect is neglected while estimating the throat dimensions. If the stresses are uniform across the welding thickness, the average stress concept may be applied to determine its strength. Connections with partial penetration welds with welding on only one side is generally avoided under tensile load due to the eccentric loading involved.

Conclusions

The necessity and methods of providing beam and column splices are described. Truss connections are presented. Types of beam-to-beam and beam-to-column welded connections are described. Practical methods of providing welded connections are also presented. Worked examples are included for clarity.

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