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STUDY THE EFFECT OF WELDING JOINT LOCATION ON THE FATIGUE STRENGTH AND FATIGUE LIFE FOR STEEL WELDMENT

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ABSTRACT

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that is usually stronger than the base material. Pressure may also be used in conjunction with heat, or by itself, to produce a weld.In this project ,A welding joint is a point or edge where two or more pieces of metal or plastic are joined together. They are formed by welding two or more work pieces (metal or plastic) according to a particular geometry. three types of joints referred to by the American Welding Society: butt, corner and tee.3d modeling done in Creo. analysis done in ANSYS.

Key words: Finite element analysis, welded joint.

I. INTRODUCTION

The problem of connecting plates was first solved through riveted connections but the development that occurred during World War-II saw the welded joints replace riveted joints in most applications. The ship building industry was perhaps in the fore front and large ships in excess of 10,000 in number were build with welded structures welding technology, indeed provided several advantages. The ease of processing and weight reduction were the identifiable advantages in the beginning. The automation and variety of welding processes have now become the most obvious advantages the technological developments have included several steels and even non-ferrous metals in the lists of weldable materials.Fabrication of structural components inherently involves the cases when repairs are necessary. This is due to the prolonged time of structure operation, and the effect of various phenomena, like corrosion, fatigue, or theology. Quite often repairs are caused by the events of random nature, but even so, the outcome can be invariably the failure of structure. If this is the case, then the best remedy is to replace the element that has failed with a new one, but due to economic factors and complicated nature of this operation, it is often far easier to fix the problem locally. This study describes a truss that has suffered failure. One of the means used to fix the problem was replacement of the damaged plates and fabrication of a welded joint composed of five plates. To better evaluate this solution, the properties of the joint were examined.

OBJECTIVES

- describe types of welded joints,
- understand strength of welding joint,
- describe modes of failure of welded joint, and
- design welded joints under different load conditions including eccentric loading.

WELDING AND WELDED CONNECTIONS

Welding is the process of joining two pieces of metal by creating a strong metallurgical bond between them by heating or pressure or both. It is distinguished from other forms of mechanical connections, such as riveting or bolting, which are formed by friction or mechanical interlocking. It is one of the oldest and reliable methods of joining. Welding offers many advantages over bolting and riveting. Welding enables direct transfer of stress between members eliminating gusset and splice plates necessary for bolted structures. Hence, the weight of the joint is minimum. In the case of tension members, the absence of holes improves the efficiency of the section. It involves less fabrication cost compared to other methods due to handling of fewer parts and elimination of operations like drilling, punching etc. and consequently less labour leading to economy. Welding offers air tight and water tight joining and hence is ideal for oil storage tanks, ships etc. Welded structures also have a neat appearance and enable the connection of complicated shapes. Welded structures are more rigid compared to structures with riveted and bolted connections. A truly continuous structure is formed by the process of fusing the members together. Generally welded joints are as strong or stronger than the base metal, thereby placing no restriction on the joints. Stress concentration effect is also considerably less in a welded connection. Some of the disadvantages of welding are that it requires skilled manpower for welding as well as inspection. Also, non-destructive evaluation may have to be carried out to detect defects in welds. Welding in the field may be difficult due to the location or environment. Welded joints are highly prone to cracking under fatigue loading. Large residual stresses and distortion are developed in welded connections.

II.LITERATUREREVIEW

Fatigue of Steel WeldmentsThe literature dealing with the fatigue of steel weldments has been reviewed and the effect on fatigue strength of testing conditions, weld geometry, weld metal soundness, residual stress and the microstructure of the weld

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metal and heat-affected zone has been examined. It has been clearly shown that weld geometry is the most important factor in determining the fatigue properties of a weld. For a given weld geometry, the fatigue strength is determined by the severity of the stress concentration at the weld toe or, with the weld reinforcement removed, by the stress concentration at weld metal defects. Different welding processes influence fatigue strength by producing welds with different degrees of surface roughness and weld metal soundness. Residual stress due to welding only affects fatigue strength for alternating loading and under such conditions a moderate increase in fatigue strength is obtained by thermal stress relief. Larger increases in fatigue strength may be obtained by postweld treatments which produce compressive residual stresses, in place of the original tensile stresses, at the weld toe. The microstructures of the weld metal and heat-affected zone have only a minor effect upon the fatigue strength of welds and are usually masked by the much greater effects of weld geometry and weld defects.Fatigue of Aluminum Alloy Welded JointsA study of aluminum alloy butt, lap and tee welded joints under axial-stress loading and of butt welds under repeated-bending loading (all of thin-gage plate materials) revealed that their fatigue strengths were affected foremost by the geometric characteristics of the joints. The degree of stress concentration and of symmetry with respect to the load axis both contribute to the following order of decreasing axial-stress fatigue strength for the joints investigated: 1. Butt, bead on. 2. Butt, bead off. 3. Tee, double fillet. 4. Lap, double fillet. 5. Lap, single fillet. 6. Tee, single fillet. Only small differences were found between the last three joints listed, all of which had substantially lower fatigue strengths than the three joints rated above them. The base metal and filler metal alloys apparently had less effect on fatigue strength than the geometric factors. For any given type joint (butt, lap or tee), the weld size and shape were prime factors affecting their fatigue strengths (except bead-off butt welds). The highest fatigue strength for bead-on butt joints was obtained from welds with low-profile reinforcements and high tensile strength. Fillet welds with a convex shape produced lower fatigue strengths for both lap and tee joints. Tee joints with fillet welds substantially oversize and with the welds blending smoothly into base metals had the highest fatigue strength for that type joint.

IV. INTRODUCTION TO CAD/CAE:

Computer-aided design (**CAD**), also known as **computer-aided design and drafting** (**CADD**), is the use of computer technology for the process of design and design-documentation.

INTRODUCTION TO PRO-ENGINEER

Pro/ENGINEER Wildfire is the standard in 3D product design, featuring industry-leading productivity tools that promote best practices in design while ensuring compliance with your industry and company standards. Integrated Pro/ENGINEER CAD/CAM/CAE solutions allow you to

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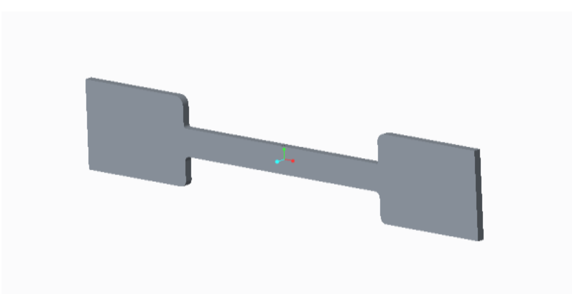
design faster than ever, while maximizing innovation and quality to ultimately create exceptional products.**Different modules in pro/engineer**Part design, Assembly, Drawing& Sheet metal.

INTRODUCTION TO FINITE ELEMENT METHOD: Finite Element Method (FEM) is also called as Finite Element Analysis (FEA). Finite Element Method is a basic analysis technique[5][6] for resolving and substituting complicated problems by simpler ones, obtaining approximate solutions Finite element method being a flexible tool is used in various industries to solve several practical engineering problems. In finite element method it is feasible to generate the relative results.

V. RESULTS AND DISCUSSIONS:

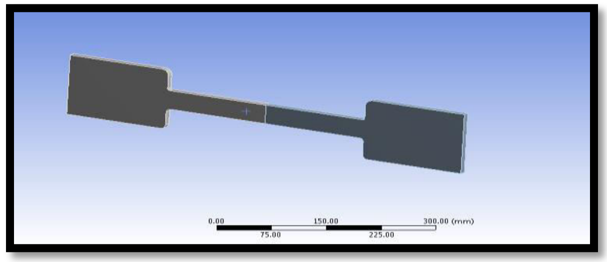
Models of welded joint done in pro-e wildfire 5.0



STATIC ANALYSIS USED MATERIALS

Used software for this project work bench Open work bench in Ansys 14.5

Select static structural>select geometry>import IGES model>OK



Click on model>select EDIT

Select model >apply materials to all the objects (different materials also)

Mesh> generate mesh>ok

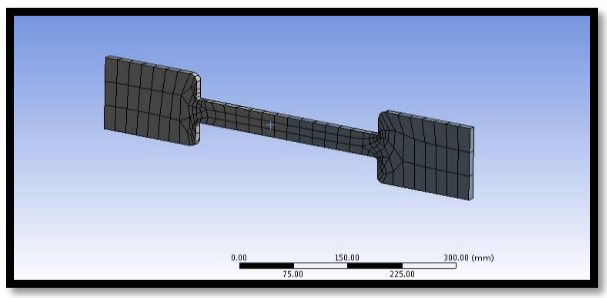


Fig7: meshed model

Static structural A5>insert>select .displacement>select fixed areas>ok >Select pressure>select pressure areas> enter pressure value

Solution A6>insert>total deformation>right click on total deformation>select evaluate all results. Insert>stress>equivalent (von misses)>right click on equivalent >select evaluate all results

Insert>strain>equivalent (von misses)>right click on equivalent >select evaluate all results Deformation

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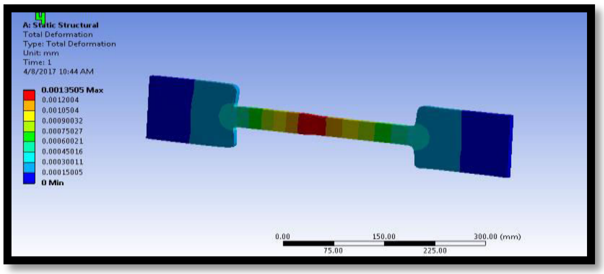
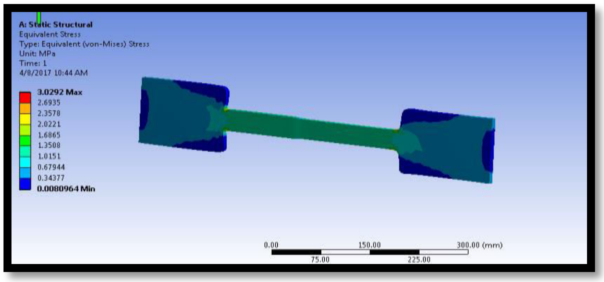
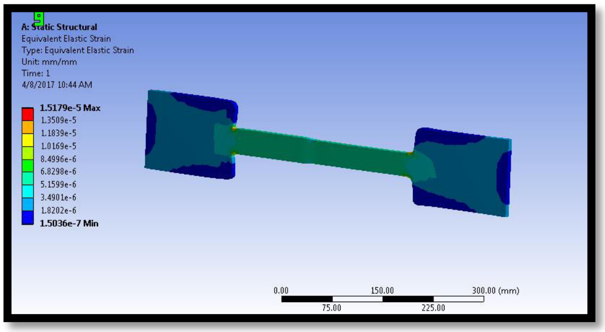


Stress

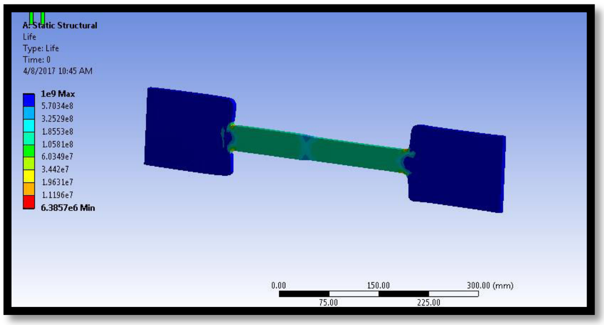


Strain

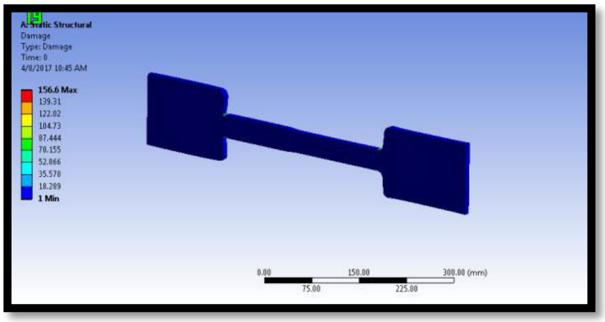


FATIGUE ANALYSIS

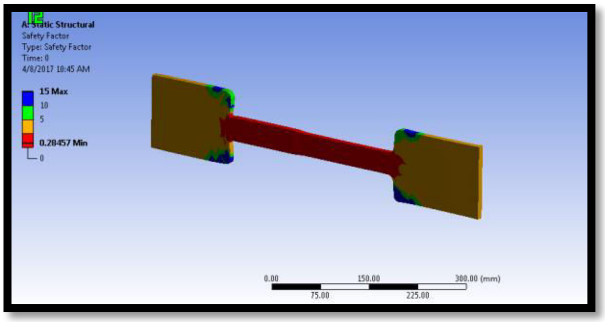
Life



Damage



Safety factor



CONCLUSION

1)To study the effect of different welding speed on tensile strength ofbutt weld joint at different groove angles and bevel heights.

2)To find out the effect of different welding speed on impact strength of butt weld at different groove angles and bevel heights.

3)To find out the effect of different welding speed on distortion of butt weld joint at different groove angles and bevel heights.

4)To find out the effect of the different welding speed on toughness of HAZ of butt at different groove angles and bevel heights.

5)To suggest the best suitable welding speed for maximum tensile, impact strength and for minimum hardness of HAZ and distortion for plate welding application.

6)To suggest the best suitable groove angle for maximum tensile, impact strength and for minimum hardness of HAZ and distortion for plate welding application.

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