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STUDYTHEEFFECTOFWELDINGJOINTLOCATIONONTHE FATIGUESTRENGTHANDFATIGUELIFE FORSTEELWELDMENT

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ABSTRACT: As one of the most time-honored methods of combining metals, welding is examined in this study to determine the impact of welding joint position on steel fatigue strength. Steel samples were joined by electrical arc welding at various places (X/L=0.25, X/L=0.5, and X/L=0.75), where (X) the location of welding zone center and sample subjected to totally reversed bending stress, and then fatigue test results were compared with un-welded sample. The tensile strength and fatigue failure strength of steel are reduced by welding joints, especially for those with (X/L=0.5 and X/L=0.75) and failure at the welding zone, but the sample with (X/L=0.25) had less effect and the failure occurred at the support, not at the welding zone, according to the results of the experiments. When a (S-N) diagram is drawn for each sample, the findings demonstrate that the welding joint has an effect on fatigue life, particularly for samples with (X/L=0.5 and X/L=0.75).

Keywords:S-N diagram and finite element analysis are used to study the fatigue behavior of steel weldments.

Introduction:

Welding fabrication is one of the most frequent methods of combining metal structures. When welded constructions are subjected to fatigue and impact loads, the great majority of component fatigue failures occur at the welded connections. A complex process known as (material subjected to a repetitive fluctuating load and will finally fail at a load far lower than the load required to cause fracture on a single application of the load) is known as (fatigue of materials). When a material is worn out, damage to the crystalline structure occurs first, and plastic deformation, microcracks appearing on slip bands, coalescence of microcracks, and the eventual propagation of a main crack become obvious afterwards.a crack The subject is complicated by a wide range of influences. Extensive research has been done to determine what influences the behavior of different materials. Figure (1) depicts an example of weariness, a common phenomenon studied and further assessed in

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the hopes of having a broader impact. crack surface Weld fatigue is even more complicated than previously thought. As the material is heated and cooled, as well as fused together with extra filler material, welding produces a wide range of distinct materials that are not homogenous. In addition, a weld is frequently far from flawless, comprising inclusions, porosity, cavities, undercuts, and so on and so forth.. High stress is caused by the weld profile and root gaps that are not welded together Clusters with a wide range of morphological characteristics. In addition, welding-related residual stresses and distortions have an impact on fatigue. If you're welding something, you'll notice that the welds are more susceptible to fatigue failures, even if the base metal has notches like apertures or re-entrant corners. For this reason, fatigue assessments are of considerable practical interest for all cyclically loaded welded structures, such as ships, offshore structures, cranes, bridges, vehicles, railcars, and other types of welded components. For such a complex topic and wide range of applications, it is not surprising that fatigue analysis of welded joints is broken down into numerous subfields. But keeping up with the enormous amount of related research on fatigue testing and the creation or use of methodologies that take into account all of the various effect characteristics is nearly impossible. [3] Figure (2.) depicts the schematic of the weld microstructure, which consists of a base material, a heat-affected zone (HAZ), and deposited metal. Solidified weld metal is formed when the filler and part of the base material melt down during welding and create solidified weld metal. In order for the (HAZ) structure to form, anThe movement of the heat source causes a thermal cycle that is necessary to melt the material. As you go away from the fusion line, the heat cycle's effects become less pronounced. The high temperature causes grain development in materials that are close to the weld metal. This causes the production of a coarse-grained microstructure (CGHAZ) near to the fusion line in the so-called coarse-grain heat impacted zone (CGHAZ). Mechanical qualities such as impact toughness and fatigue strength are influenced by the microstructure. [4]

1. **Theaimandscope:**

2.We are trying to determine the ideal site for welding joints in spinning steel shafts in order to improve their fatigue life and fatigue strength. Applied mechanics and welding joint placement design are the focus of this project. Determiningfatigueperformanceofweldedstructures:[5]

3.b) Welds contain intrinsic defects, which serve as the starting point for crack development. c) Welded components are less tolerant to variable loads than their non-welded counterparts for three reasons.

4.b) External stress raisers created by welds serve as the starting point for crack development.

5.When welding, residual stresses are introduced in the weld area, which exacerbates the applied fluctuating stress.

6.According to the type of weld and its orientation with respect to the applied fluctuating loads, fatigue tolerance for welded constructions can be categorized into "detail categories". Structural steel designers employ the AS 4100 and AS 5100 detail categories when working with constructions subject to changing loads. Weld detail category is a number between 36 and 180, which reflects the (MPa) fluctuating load cycles that can be endured for two million (2x106) fluctuating load cycles, figure (3) show the (S-N) diagram for steel.

7. **Stressconcentrationfactor:[6,7]**

A critical cross section with stress concentration is where fatigue fractures of structural features subjected to cyclic stresses are most likely to develop. To reach a final fracture, a fatigue crack begins at the weld toe of a welded joint. There is a substantial variation in fatigue life based on the local weld shape and the welding method because of the stress concentration factor and the creation of crack-like flaws. In addition to the weld, stress concentration parameters should be applied to the source metal. Stress concentration and the overall weld size are often tradeoffs. The strength of a weld increases as the weld size increases, but the stress concentration increases as well, thus the overall strength may not be significantly different.

8.ExperimentalWork:

8.1 Tensiletest:

Thesamplesofexperimentalworkfortensileandfatiguetestswerecuttingfromsteelthathadchemicalcomposition shownin table(1).

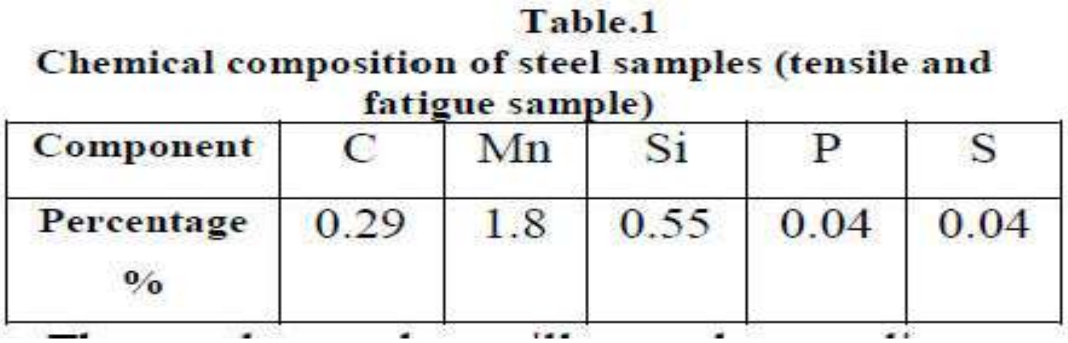

Table.1
Chemical composition of steel samples (tensile and fatigue sample)

Component	C	Mn	Si	P	S
Percentage %	0.29	1.8	0.55	0.04	0.04

The characteristics of the steel samples will be determined by testing them according to DIN 50125.

test specimens such as those depicted in figure (young modulus, yield strength, and ultimate strength) (4). [8]
with the aid of the tensile test

Figure 1 shows the sample being created using a lather machine until it met the 462MPa, and young modulus of 150GPa).

specified dimensions (5).Using a standard American Welding Society weld metal type (AWS E6013) with chemical composition stated in table (2) and mechanical properties of, we cut the tensile sample in the middle to determine the properties of the welded junction (yield strength 380MPa, ultimate strength

8.2 FatigueTest:

9. Figure (6) depicts the results of fatigue testing performed using a fatigue test equipment in accordance with ASTM E467 specifications on the fatigue sample depicted in figure (7). [10]

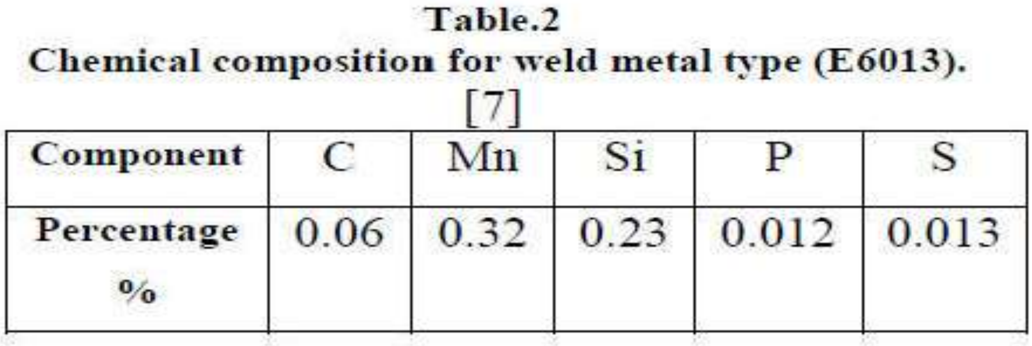

Table.2
Chemical composition for weld metal type (E6013).
[7]

Component	C	Mn	Si	P	S
Percentage %	0.06	0.32	0.23	0.012	0.013

10. Welding and cutting occurred at (X=0.25), (X=0.5L), and (X=0.75L) for all of the fatigue samples, except for one, which didn't cut at all. The samples were subjected to a full reverse bending stress while rotating at a constant speed of 2800 r.p.m., and the number of cycles (fatigue life) were recorded for each sample until failure under a series of loads (60N, 80N, 100N, 120N, and 150N) applied downward at the free end of the samples (diameter 8mm) and fixed at the other end (diameter 12mm). We used two samples for each test and averaged the results.

11. **Calculations:**

The specimen is usually loaded in such a way that stress is cycled between a maximum and minimum tensile stress or between a maximum tensile stress and a predetermined level of compressive stress in most laboratories. The minimal stress is the algebraic minus sign applied to the two letters, each of which is regarded a negative tensile stress.

CONCLUSION:

It is necessary to investigate the influence of varying welding speeds on the tensile energy of butt weld joints at varying groove angles and bevel heights. 1)

2) To study the influence of welding speed on the butt weld's effect power at varied groove angles and bevel heights.

For each unique groove angle and bevel height, determine how different welding speeds affect butt weld joint distortion.

To find out how the exclusive welding velocity affects the toughness of the butt's HAZ at exclusive groove angles and bevel heights.

The purpose of this section is to recommend the best possible welding velocity for plate welding software in order to maximize tensile, impact, and hardness strength and minimize distortion.

Sixth, to recommend an acceptable groove angle for plate welding that will yield the best tensile and effect energy properties with the least amount of hardness and distortion.

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