ANALYSIS EFFECT OF UNDERCUT ON THE STRESS INTENSITY FACTOR TO BUTT WELDED JOINT ASTM A36 PLATE USING FINITE ELEMENT METHOD

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ABSTRACT

A numerical method is developed to predict the effect of undercut on the fatigue strength and fatigue life of butt welded joints. Linear Elastic Fracture Mechanics (LEFM) and Finite Element Analysis (FEA) approaches have been used for the modeling. Evaluation of fatigue life of structures (aircraft, ship, railways, bridges, offshore structures, etc.) is important to ensure the public safety, environmental protection, and economical consideration. Catastrophic failure of any structure can be avoided if precaution is taken appropriately.

It has been found that the effect of undercut geometry is significant on the stress intensity factor and crack growth rate of butt welded joints. The investigation to butt welded joints ASTM A36 plate at 10, 15, and 20 mm of thickness at various undercut depth, obtained that in every increasing undercut depth 3% of plate thickness, the stress intensity factor on the crack front increase 1.7% and the crack growth rate increase 3000% for thickness 10 mm. For the 15 mm thickness, stress intensity factor on the crack front increase 2.2% and the crack growth rate increase 4800%. For 20 mm thickness is obtained that stress intensity factor on the crack front increase 2.5% and the crack growth rate increase 7900%.

The weld metal and HAZ area of butt welded joint have different mechanical properties with base metal. Assuming that weld metal and HAZ have mechanical properties, modulus elasticity are same to base metal, is obtained that the increasing 10% modulus elasticity of weld metal and HAZ will decrease 6% of stress intensity factor and crack growth rate decrease 22.1% for thickness 10 mm. On the 15 and 20 mm plate thickness stress intensity factor decrease 5.5% and crack growth rate decrease 20.4%.

Keywords : undercut, stress intensity factor, crak growth rate