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# Experimental Study & Simulation of Double Shear Stress Analysis in Shackles Chain Link

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**Abstract**— The main object of this work calculate and compare the privies results with Finite element analysis (F.E.A) result and reduce the stress by design manipulation of mechanical shackles chain link component the Finite Element Method (FEM) and Finite element analysis (FEA) is best mathematical numerical solution for find the strength and stress of mechanical components

**Keywords**— fine mashing Stress Calculation, double shear Stress, Finite Element analysis

# I. INTRODUCTION

Shackles chain link is U shape type chain link its is very useful for support the structure and heavy weight or a hinged metal loop secured with a quick-release and connected locking pin mechanism, more using Shackles chain link in industry and support to marine, submarine. Shackles chain link are failure due to the double shear failure and there are some critical areas that are more sensible to the removal process. It is very useful linkage use in mechanical side, the failure function of Shackles chain link we apply finite element method (FEM) and calculate the maximum double shear strength under the condition of water wave current and dead load.

# II. EXPERIMENTAL PROCEDURE

Tensile tests of the chain links were performed using instron servohydrolic UTM machine according to ASTM A391 "Standard Specification for Grade-80 alloy steel chain". Each test specimen consists of seven links, excluding those engaged in the testing fixture diameter as specified by ASTM A391. Fig. 2 shows the geometry of a chain link. For the given diameter size, the working load limit, i.e. maximum load applied to an undamaged straight length of chain, is equal to 80.5 kN which is closer to the working load limit and is 25% of the specified break load limit. On the other hand, the chain was tested in tension to a proof load of 161 kN, which is approximately equal 50% of the minimum break load limit. Hardness test was also carried out on base metal and weld samples. The results were used to characterize the mechanical behavior of the weld compared to the base metal.

Nevertheless, some of the alloying elements such as Ni, Cr and Mo are present at lower concentrations than those specified in ASTM Standard A391 for Grade-80 steel alloy. The combination of Cr and Ni commonly enhances toughness and hardness through increasing strength and maintaining ductility, while Mo is important to produce hard structure after quenching.



Fig. 2.1: Link Failure At The Weld During Towing Service.



Fig. 2.2: weld fins located at the inner side of the link and







Fig. 2.4: Geometry and dimensions of Grade-80 alloy steel chain used in this study (d = 16 mm, li = 48.8 mm and wi = 25.9 mm).

#### III. RESULTS & DISCUSSION-



Fig. 3.2: Equivalent Stress

# IV. CONCLUSION

The base metal and the weld were also examined by tensile testing, showing strength of nearly 800 MPa. Unlike the ductile base metal sample, the weld sample failed in a brittle manner at a very low strain value of 0.05. The weld brittleness is explained by metallographic examination, which indicated that welding defects are present in the weld, consisting of internal and external cracks, where the latter are found in the weld fins near the weld interface. Weld inhomogeneity was demonstrated by the presence of two modes of final fracture; namely ductile fracture at the weld center, and brittle behavior at the outer circumference of the weld indicating improper post welding heat treatment.

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