World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:9, No:01, 2015

Fatigue Life Prediction under Variable Loading Based a Non-Linear Energy Model

Authors : Aid Abdelkrim

Abstract : A method of fatigue damage accumulation based upon application of energy parameters of the fatigue process is proposed in the paper. Using this model is simple, it has no parameter to be determined, it requires only the knowledge of the curve W–N (W: strain energy density N: number of cycles at failure) determined from the experimental Wöhler curve. To examine the performance of nonlinear models proposed in the estimation of fatigue damage and fatigue life of components under random loading, a batch of specimens made of 6082 T 6 aluminium alloy has been studied and some of the results are reported in the present paper. The paper describes an algorithm and suggests a fatigue cumulative damage model, especially when random loading is considered. This work contains the results of uni-axial random load fatigue tests with different mean and amplitude values performed on 6082T6 aluminium alloy specimens. The proposed model has been formulated to take into account the damage evolution at different load levels and it allows the effect of the loading sequence to be included by means of a recurrence formula derived for multilevel loading, considering complex load sequences. It is concluded that a 'damaged stress interaction damage rule' proposed here allows a better fatigue damage prediction than the widely used Palmgren–Miner rule, and a formula derived in random fatigue could be used to predict the fatigue damage and fatigue lifetime very easily. The results obtained by the model are compared with the experimental results and those calculated by the most fatigue damage model used in fatigue (Miner's model). The comparison shows that the proposed model, presents a good estimation of the experimental results. Moreover, the error is minimized in comparison to the Miner's model.

Keywords : damage accumulation, energy model, damage indicator, variable loading, random loading
Conference Title : ICCCE 2015 : International Conference on Civil and Construction Engineering
Conference Location : Jeddah, Saudi Arabia
Conference Dates : January 26-27, 2015