

**An engineering calculation method of probability distribution of crack initiation life
for widespread fatigue damage**

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Abstract: An engineering calculation method of predicting probability distribution for crack initiation life of structures susceptible to widespread fatigue damage is proposed. Through a study of the crack initiation mechanism, the incident that crack initiation life of multiple detail structure taking a certain value is transformed into the intersection of three independent incidents. The probability of occurrence of the former incident is the product of the probability of occurrence of the latter three independent incidents, which is derived from the probability distribution function of crack initiation life of single detail structure. Thus, the detailed formulae of probability density functions of initiation lives for cracks appearing in turn in multiple detail structure are obtained. Making use of these detailed formulae, the calculation formula of median rank of initiation life is derived. It is only related to failure order and total number of details. Through the value of median rank, the initiation life with reliability of 50% can be achieved. Thus, an engineering calculation formula of probability distribution of crack initiation life is gotten. Crack initiation test of specimens with a single hole notch and multiple holes notches were carried out. The model is used to estimate crack initiation lives of the multiple holes notched specimens. The predicted results are in good agreement with the testing results, which show that this model is effective.

Key words: *widespread fatigue damage; crack initiation life; probability distribution; intersection of incidents*

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