15th World Congress on Computational Mechanics (WCCM-XV)
8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)
31 July – 5 August 2022, Yokohama, Japan

Proposal of Crack Propagation Criterion Considered Constraint Effect under Extremely Low Cycle Fatigue; Evaluation by 1.5T-CT Specimen

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Key Words: *Extremely low cycle fatigue, Fracture criterion, Constraint effect, Finite element analysis, Stress triaxiality, Equivalent plastic strain increment*

The prediction of fracture behavior under extremely low cycle fatigue due to excessive loading is necessary for the life assessment of structures. ΔJ criterion has been used to assess the life under low cycle fatigue. However, the applicability of this method is not well confirmed under extremely low cycle fatigue. Fracture toughness is dependent on the loading conditions and geometry due to the constraint effect.

In the previous study [2], a crack propagation criterion was proposed for a 1T-CT specimen of SUS316, focusing on the physical quantities near the crack tip. These are the stress triaxiality and the equivalent plastic strain increment. The former is a parameter related to the growth of voids in ductile fracture, while the latter is a parameter that indicates the degree of plastic deformation. However, no comparison has been performed for specimens of different shapes or materials, and more detailed verification is required.

The objective of this study is to evaluate the validity of the crack propagation criterion proposed in the previous study [2] by applying it to CT specimens of different thicknesses and materials.

In this study, two types of crack propagation simulations were performed on a 1.5T-CT specimen of SGV410 under extremely low cycle fatigue fracture tests using the finite element code, ANSYS. The first one is generation phase simulation. In the simulation, the physical quantities near the crack tip were obtained and the parameters of the crack propagation criterion were identified. The second one is the validation phase simulation, in which the crack propagation criterion is used as the crack propagation criterioin to evaluate whether the experimental crack propagation behavior can be reproduced.

The results of both the generation phase simulation and the validation phase simulation are in good agreement with the experimental results.

We'd like to disscuss the accuracy of prediction by the proposed crack propagation criterion under extremely low cycle fatigue.

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