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Prediction of Fatigue Crack Propagation in Bulb Stiffeners by Experimental and Numerical Methods

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Abstract: Fatigue crack propagation in bulb stiffeners, which are widely used in ship and bridge structures, is one of the basic problems for structures' fatigue life prediction. This paper proposes a method to calculate the fatigue crack propagation in bulbs, which provides a method for defining the failure criterion for bulb stiffeners. The shape of a three dimensional surface crack in a full-scale bulb stiffener fatigue test was measured and estimated by the Nominalization Crack Opening Displacement method. Then the obtained crack shape was used to predict the fatigue crack propagation in the bulb stiffener based on the two dimensional Paris' law and the Linear Finite Element Analysis method. Moreover, the predicted fatigue crack propagation has been verified by the full-scale fatigue test on a typical ship structure detail.

Key words: bulb stiffener; crack opening displacement; fatigue crack growth; fatigue test

0. Nomenclature

COD	Crack Opening Displacement
σ	tensile stress for Model I crack
E	Young's modulus
L	the length of crack opening measured from structure surface
NCOD	Nominalization Crack Opening Displacement
ε_n	nominal strain
d	crack depth
T	structure thickness
V	function related to d/T
α	proportional factor
δ	crack mouth opening displacement
ε_c	strain around the crack opening
l_c	the length of the crack affected area
l_e	effective length of strain gauge
$\bar{\varepsilon}$	strain measured by strain gauge
ε_r	reference strain
s	perpendicular distance from crack to measurement points ε

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