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A simulation study on the interaction between sloping marine structure and level ice based on cohesive element model

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Abstract: The interaction between sloping marine structure and level ice is a complex process, which contains local crushing and flexural failure. The ice fragments fallen from ice sheet will continuously experience rotation, sliding and accumulation processes. These processes interfere with each other and give rise to difficulty to determine accurately the ice loads on structure. The issue is solved by using cohesive element model (CEM) in this paper. In the condition of a cone icebreaking against level ice, the elastoplastic linear softening constitutive model is introduced to the regular tri-prism bulk elements to present the microscopic crushing of ice sheet, while the bending failure of ice sheet is caused by the failure of cohesive elements. The proposed models are incorporated into the LS-DYNA finite element code. The mesh dependency study and a series of parametric analysis on the main parameters of models are conducted. The numerical results are compared with available model test data in literature, and good agreements are achieved. Then a series of simulations in terms of invasion velocity, cone angle and cone waterline diameter are performed. Effects of these parameters on the ice loads and contributions of breaking module are discussed.

Keywords: structure-ice interaction; elastoplastic constitutive model; cohesive element model; parametric analysis; ice loads

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