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Progressive damage modeling in laminate composites under slamming impact water for naval applications

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Abstract – The use of composite materials begin to normalize in various sectors, however, these structures are very susceptible to degradation of their properties and consequently a catastrophic failure. The response of deformable composite subjected to water-entry impact can cause a phenomenon called hydro-elastic effect due to water-flexible laminate interaction. This phenomenon may be large enough to cause the damage in composite panels. This paper employs the finite element method to simulate the behavior of composite wedges under slamming impact with presence of damage. To investigate this situation, the hydro-elastic influence has been analysis as both kinematic effect due to deflection of the composite panel and dynamic effect caused by the interaction between the water and the structure. On the other hand, damage modeling was formulated based on continuum damage mechanics for intra-laminar damage. A user-defined material subroutine VUMAT has been incorporated into explicit Abaqus FE software to enhance the damage simulation, which includes Hashin criteria for degradation of the panel stiffness with failure onset criteria and fracture mechanics. To reinforce the methodology adopted, numerical results are compared with the previous experimental data. A good agreement was observed. Effects of impact velocity and the panels flexibility on the damage have been investigated.

Keyword: Laminate composites, Impact behaviour, Damage mechanics, Finite element analysis, Slamming impact.

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