

FINITE ELEMENT ANALYSIS OF IMPACTS ON WATER AND ITS APPLICATION TO HELICOPTER WATER LANDING AND OCCUPANT SAFETY

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Spring 2001

ABSTRACT

The study of hydrodynamic impact between a body in motion and a free water surface finds applications, in aeronautical fields, in splashdown and ditching problems. The effect of this impact is often prominent in the design phase of the project and, therefore, the importance of studying the event with more accuracy than in the past is imperative. Usually the study of the phenomenon is dealt with experiments, empirical laws, and lately, with finite element simulations. These simulations are performed by means of special codes that allow the fluid-structure coupling; these codes have their origin in Lagrangian finite element programs developed for crash analysis improved with possibility of interfacing with Eulerian spatial description, typical of fluids. Critical points in this kind of modeling are the fluid-structure interaction algorithms, constitutive modeling of the fluid and time efficiency of the computation.

This study describes an effort that focuses on the development of a crash modeling and simulation approach utilizing a non-linear explicit finite-element code (LSDYNA 960) to demonstrate the potential for Helicopter Water Impact analysis in the development of crash design criteria and concepts. Initially, the Water Model shall be validated using default Lagrangian techniques. Subsequently, more accurate ALE-Eulerian analyses will be conducted for finer results for Ball Impact scenario and Helicopter Impact. Finally, the response of an occupant for the above crash test is analyzed using the MADYMO code, utilizing accelerations obtained from the LSDYNA output. Lumbar load, the most crucial mode of injury in these types of crashes will be investigated and discussed.