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Author: Dr. Davide Nardi
University of Rome "La Sapienza", Italy, davide.nardi@uniroma1.it

NUMERICAL SIMULATION OF DELAMINATIONS INDUCED BY DROP-WEIGHT IMPACT IN COMPOSITE SPACE STRUCTURES AND CORRELATION WITH EXPERIMENTS

Abstract

The present paper proposes a numerical simulation parametric study to predict the delaminated areas in a composite material element subjected to a drop-weight impact and correlate the numerical results with data from experiments. First, some results taken by previous experiences reported in literature have been reproduced in order to validate the approach then the same analysis has been applied to a CFRP (Carbon Fiber Reinforced Plastic) produced in the laboratory of the Mechanical and Aerospace Engineering Department of University of Rome La Sapienza and impacted as the ASTM Normative prescribes. The analysis is based on a finite element approach that includes the use of the Cohesive Zone Model (CZM) constitutive model for describing the delamination onset and propagation , when the composite sample is subjected to a drop-weight impact. A preliminary investigation about the evaluation of the contact conditions during the impact has been performed and a correlation between numerical and experimental results has been also done to tune the cohesive zone parameters. Static and dynamic analysis on both experimental results illustrated in the recent literature and the produced by the authors numerical models are presented. The results demonstrate the capability of better reproducing the position, the extension and the shape of the delaminated area with respect to the approaches of the recent literature. Moreover an improvement in the computational cost of the analysis has also be obtained. The joint combination of the use of the cohesive zone model and of appropriate finite element modeling has been demonstrated as successful elements of the proposed procedure. The use of a dynamic analysis as compared to the static ones of the recent literature has also produced the capability of observing the time at which delamination occur. From experimental evidence has been found that the first delamination occurs after about 0.5 msec. The numerical simulation, according to the experimental result, says that after 0.449 sec each interface has been delaminated, a value that is very close to the experimental evidence.