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Crashworthiness of Fuselage Hybrid Structure

D. Hachenberg[*)] • V. Lavigne[**)] • A. Larran[**)] • M. Mahé[**)]

[*)] Airbus Operations GmbH, Hamburg, Germany
[**)] Airbus Operations SAS, Toulouse, France

Abstract

This paper deals with the application of dynamic numerical analysis for proof of crashworthiness all along aircraft development and certification.
The selection of hybrid materials and appropriate design principles has led to several technical challenges with respect to fuselage crash performance. The increased use of composites in the design of fuselage lower shell architecture requires demonstration of equivalency of crashworthiness compared to a conventional pure metallic aircraft of the same size.
To cope with these special conditions, virtual testing has been selected for investigations on fuselage crashworthiness behavior. The development of predictive virtual testing capabilities for crash by following consequently a crashworthiness building block approach is presented.
Experimental testing at coupon and detail level allowed identification of failure mechanisms and definition of physically based damage models and failure criteria which are key enabler for predictions at higher levels of testing (overall kinematics, sequence of events, energy absorption capability). Through intensive use of validated dynamic simulations the design process could be supported in the selection of materials, technologies and the definition of design principles in case of unconventional airframe architecture.
Evidences of predictive capabilities of selected modelling technology have allowed bringing high level of confidence, selecting “Analysis supported by tests” as a mean of compliance for crashworthiness demonstration and thereby allowing minimized full scale testing requirements. Predictive virtual testing has also offered the opportunity to proof a given crash design for robustness regarding range of impact velocity and various loading conditions.

Keywords: fuselage ▪ hybrid structure ▪ transport aircraft ▪ crashworthiness ▪ dynamic simulation ▪ building block approach

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D. Hachenberg(✉)
Airbus Operations GmbH, Kreetslag 10, 21129 Hamburg, Germany
e-mail: dieter.hachenberg@airbus.com / phone: +49 40 7437-6897 / fax: +49 40 7437-6598