

Studies about the Utilisation of the Aircraft Cargo Compartment as Additional Passenger Cabin by Use of Numerical Crash Simulation

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Abstract

The worldwide growth in air transportation as well as the need of further reductions in the specific fuel consumption requires a more efficient use of aircraft. One of the ideas – the increase of the passenger capacity – is to use portions of the cargo compartment of wide-body aircraft as additional passenger cabin. Airbus and Boeing have both patented lower deck seating concepts in recent years.

The DLR Institute of Structures and Design participated in the project 'Innovative Cabin Technologies' within the German aeronautical research programme 'LuFo III'. In the project, DLR investigated options to equip the cargo compartment in the front part of the fuselage with passenger seats by means of different numerical crash simulation methods (hybrid and FE). This paper concentrates on the crash simulation studies which were carried out with the hybrid simulation program DRI-KRASH. These studies were used to select the most promising fuselage design concept.

The primary aspect of 'Lower Deck Seating' (LDS) is the safety of the passengers, which – in case of a crash landing – should be comparable to the passenger safety in conventional aircraft. DLR developed an innovative concept for the assessment of occupant safety. The safety potential of each seat is judged on the basis of a point scheme, which assesses the following 4 criteria: Accelerations, preservation of a living space, injury risk from falling objects (e.g. overhead bins or hand luggage) and preservation of an escape route. The evaluation scheme therefore includes the entire occupant environment and also covers important aspects of crash certification.

Different crash models of the fuselage section, the seats and the occupants were set up in a parametric way. Crash simulation calculations with numerous configurations were carried out in an extensive parametric study and in each case evaluated according to the described assessment scheme. Thus, it was possible to develop important design rules, which in case of their implementation should contribute to a possible use of the cargo compartment as passenger cabin in the future.

Keywords

Aircraft, Lower Deck Seating, Crash Simulation, DRI-KRASH, Passenger, Occupant Safety, Injury Criteria, Eiband