Analysis of Innovative Composite Aircraft Structures

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Abstract: Innovative composite structures are increasingly being used in the aircraft industry. A critical point of these new composite parts is the attachment to the surrounding aircraft structure. In cooperation between different EADS Business Units, a new advanced composite load introduction rib is developed to minimize weight and manufacturing costs. The new design of the flap focuses on the load introduction rib and drive fitting including the integrated lugs for the attachment to the flap support structure. The calculation of composite load introduction requires the implementation of 3D elements for an accurate analysis of all stress components. This is achieved by the use of 3D continuum shell elements, which provide all stress components with an enhanced formulation for the transversal shear stresses (fig. 1). Since delamination is a common type of failure for composite load introduction, the transversal shear and peel stresses are of high interest. The load introduction rib (modelled with 3D elements) is attached to the surrounding structure (2D elements) with rivets. These rivets are implemented as elastic connectors in connection with rigid body elements..

Keywords: Aircraft, Composites, Connectors, Design Optimization.

1. Introduction

Innovative composite structures are increasingly being used in the aircraft industry. A critical point of these new composite parts is the attachment to the surrounding aircraft structure. Current composite high lift structures usually have metal load introduction structures, which have been designed as Fail Safe structures. This leads to high weights, high manufacturing costs and an increased assembly effort. Additional thermal loads may occur due to the different thermal expansion between metals and composites.

The aim of new innovative load introduction structures is to reduce structural complexity by an integrated design reducing weight and costs. The use of composite in load introduction structures permits a damage tolerance design instead of a fail safe structure, since a failure of one ply is compensated by the surrounding intact plies. This further eliminates additional thermal loads, since the high lift structure as the load introduction structure are made of the same material..

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