Delft University of Technology

Aerospace Structures & Computational Mechanics
Ph.D. Seminar Series

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Damage creation and evolution during impact

The introduction of composite materials in aerospace has led to a paradigm shift when it comes to performance over weight efficiency of structures. The possibility of manipulating the material behavior by altering the composite layup architecture expands the design space, which in theory should lead to more efficient designs. In practice however, this is often not the case. The complex behavior of composite materials, especially in terms of damage behavior, due to the combination of different constituents leads to larger uncertainties, which lead to larger reserve factors and therefore result in a reduction in the efficiency of composite structures. Especially impact loading is a big concern since it leads to significant reduction of the strength of composite structures. On top of this, impact induced damages could result in subsurface delaminations which are not visible or are barely visible to the naked eye, making them hard to detect during inspections. These load cases are usually probabilistic in nature and can occur during the entire life-cycle of the structure, starting with tool dropping during the production process up to impact by foreign objects during service like impact by runway debris or by hail.

The goal of this research is to increase the understanding of impact behavior of composite structures for low-speed impact loads.
Although there are no clear definitions for low-speed impact, we are in general interested in impact loads which lead to indentations which are barely visible (barely visible impact damage BVID). These type of damages usually lead to matrix cracks and subsurface delaminations, which reduce the strength of composite laminates especially in compression.

An elasticity solution will be presented that allows accurate determination of stresses during impact. This is coupled with a fracture mechanics approach that allows determination of the extent of delaminations at different ply interfaces of an impacted laminate. On the basis of these, a damage index is defined that allows comparison of the residual strength of different laminates and can be used for optimization. Analytical predictions and comparisons with finite element results and experiments will be presented.

time: **Tuesday, May 7th, 2013, 16:00**

location: **FeIS-Instructiezaal 5 (1.25) (Fellowship)**

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