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FUTURE STRUCTURAL STABILITY DESIGN FOR COMPOSITE SPACE AND AIRFRAME STRUCTURES

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European space and aircraft industry demands for reduced development and operating costs. Structural weight reduction by exploitation of structural reserves in composite space and aerospace structures contributes to this aim, however, it requires accurate and experimentally validated stability analysis of real structures under realistic loading conditions. This paper presents different advances from the area of structural stability analysis of composite aerospace structures which contribute to that field.

For stringer stiffened panels, as used in aerospace main results of the finished EU project COCOMAT (Improved MATerial Exploitation at Safe Design of COmposite Airframe Structures by Accurate Simulation of COllapse) and selected achievements of the running EU project MAAXIMUS (More Affordable Aircraft Structure through eXtended, Integrated, and Mature nUmerical Sizing) are given. Aim is the exploitation of reserves in primary fibre composite fuselage structures through an accurate and reliable simulation of postbuckling and collapse.

For unstiffened and highly imperfection sensitive cylindrical composite shells as more used in space applications, a proposal for a new and efficient design method is presented. It takes the advantages of composite materials in an efficient way into account within stability analysis

Thin-walled light weight structures endangered by buckling can be mainly divided into two groups: imperfection tolerant and imperfection sensitive structures. For both groups design guidelines for composites structures are still under development. This paper gives a short state-of-the-art and presents proposals for future design guidelines.

Imperfection tolerant structures are for instance stiffened panels as used in aeronautic applications (e.g. fuselage or wing). They are characterised by a relatively large postbuckling area (load carrying capacity between maximum load and first, in most cases local buckling) which may be usually used for design. The maximum load is quite insensitive with respect geometrical or loading imperfections. The finished EU project COCOMAT investigated the postbuckling and collapse behaviour of this kind of structures. The running EU project

MAAXIMUS builds up on these results and goes one step further to consider loads directly obtained from fuselage barrel level. This paper presents an overview about main COCOMAT results which demonstrates the potential of the postbuckling behaviour of stiffened CRFP panels and gives the strategy of the running MAAXIMUS project.

Imperfection sensitive structures are for instance unstiffened structures or stiffened structures with a rather dominant skin compared to the stiffeners. For such structures the maximum load is equal or close to the first buckling load and is imperfection sensitive. These types of structures are commonly used in space applications. The currently applied design guidelines with respect to structural stability were developed only for metallic structures and are from 1968. For composites structures no guidelines exist. To fill this gap DLR developed a promising "Single Pertubation Approach" which promises high potential for a future application. The paper presents the approach, results as well as the challenges for the future.

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