COST-EFFICIENT TOOLS FOR COMPOSITE STRUCTURAL DESIGN

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ABSTRACT

The paper presents cost-efficient design methods which have been successfully applied to various composite structures in the industry. The key focus is on overall time-reduction of the design process as well as on enhancement of design quality.

In a typical industrial project, there are various challenges from the first preliminary design through the finalized structural analysis. Some are more time-consuming for the designer than others. Modern design tools however allow speeding up the design process at various stages.

The paper describes cost-efficient product development and design approaches to composite structure for a few different applications.

In the first project stages, ESAComp, an analysis and design software dedicated to layered composite structures, is typically used as a stand-alone tool for conceptual design, material selection, preliminary laminate design, and analyses of critical details at that stage. The material data bank, including data from many different suppliers of reinforcement and sandwich core materials, ensures that correct and consistent input values are used throughout the design process.

Typically, the preliminary dimensioning of the structure is based on beams, panels or stiffened panel fields. Due to the built-in FE-solver, these analyses can be done extremely quickly under virtually any loads and boundary conditions, including eigenfrequencies and buckling. In various cases critical details can be already assessed already in this stage using special analysis capabilities, for instance for bolted and adhesively bonded joints.

FE-analyses of the structure are usually started at later stages. Considerably time is saved by using laminate and material export capabilities of ESAComp, again ensuring consistent data during the whole project. ESAComp is enhancing productivity of the design process also at later stages. Even though exhaustive FE-analyses are carried out during the project, certain well-known shortcomings of FE-methods are overcome by the synergy of using ESAComp with the FE-software in parallel. The design time is substantially reduced by assessing structural discontinuities, such as holes, bonded and bolted joints or free-edge effects with ESAComp, by exporting relevant structural loadings from the solution of the FE-model.

Depending on the FE-code, the time needed for the assessing all the stress results for a failure analysis can be shortened using the interface modules between ESAComp and the FE-software. This allows not only to specify modern, ply dependent failure criteria, not usually available in standard FE-codes, but also to get all relevant failure related data (failure index, critical ply number and failure mode) in one picture instead of having to assess failure indices through various laminate plies and core layers.

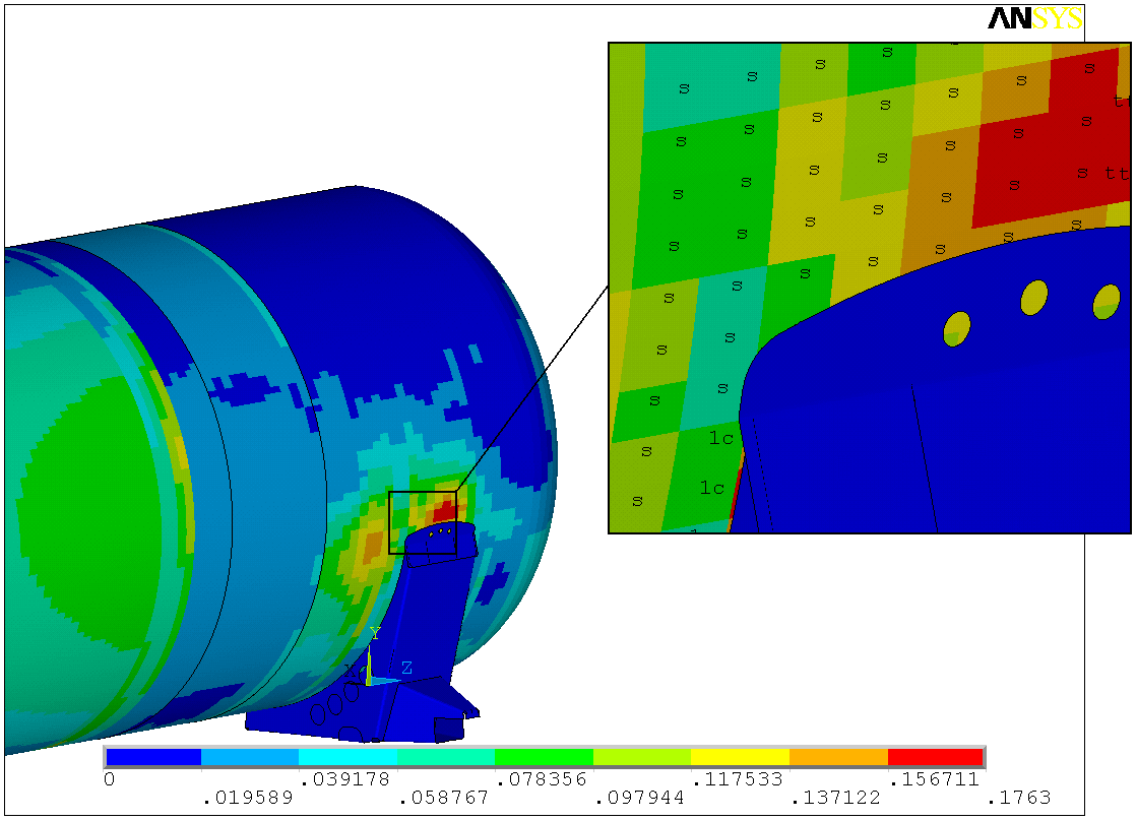

Fig. 1: ESAComp post-processed results shown in ANSYS. The plot shows 1/reserve factor as well as failure mode in the most critical layer.