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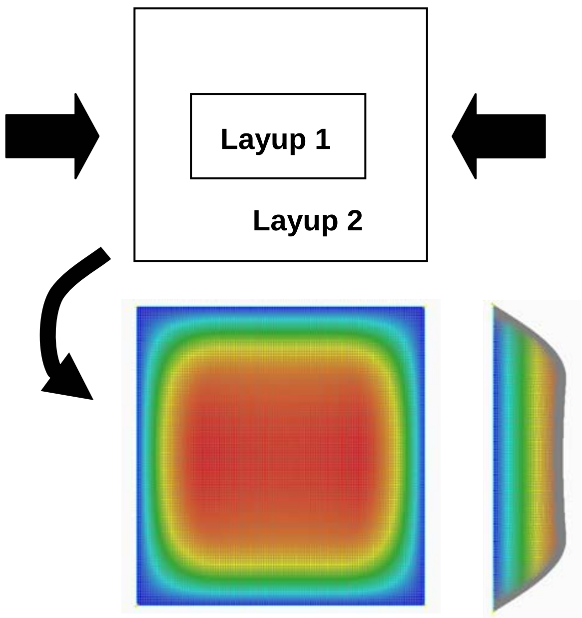
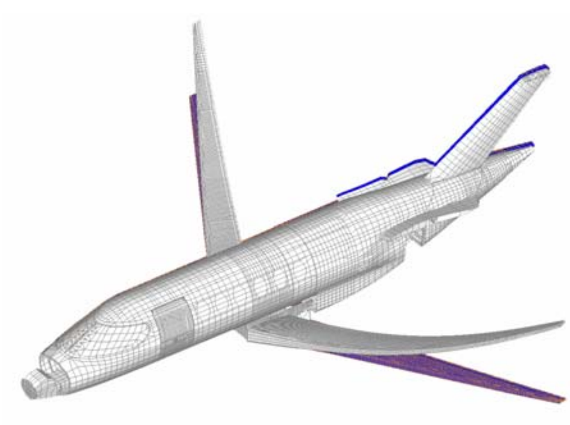
# Aerospace Case Study (Composites Analysis – Concentric Layups)



Christos Kassapoglou, Composites Analysis, Greece, performed studies to improve the performance of rectangular composite panels under compression.

The use of composites has led to significant decreases in weight in various aerospace applications. In particular, optimum design of rectangular panels where the layup and material(s) are selected so that the weight is minimized under a given set of loads has led to very efficient designs for fuselage and wing skin applications. As the performance requirements become more stringent, additional weight savings beyond these optimized designs are necessary. This requires the use of innovative concepts that open up more possibilities. One such concept is the use of multiple concentric layups in the same rectangular panel. This added tailoring leads to further improvements in performance.

In order to further reduce the weight of such skin panels it is necessary to have reliable and accurate analysis methods especially when the panel is under compression, which, for most applications, is more critical than other loadings. A study was undertaken in order to develop such an analysis method. NEi Nastran was used to complement other analytical methods in order to examine their accuracy and to help explain the meaning of some of the results, in particular the buckling mode shape.

The first step was to understand the performance of panels with two concentric layups under compression. Emphasis was placed on determining the buckling load (and mode) and the stress distribution prior to buckling throughout the panel. The design of such panels requires that no stress exceed the allowable stress for the material prior to buckling anywhere in the panel and that the buckling load is no lower than the applied load. Using NEi Nastran composites capabilities and the buckling analysis option led to the determination of the stacking sequences of the two concentric layups and the dimensions of the center layup so that the weight of the entire panel equals the weight of a panel with a single layup but the strength and buckling capability are now improved. Improvements of at least 15% were demonstrated using simple optimizing concepts. This means a 15% increase in load capacity for the same weight or the potential for decreasing the weight by up to 15% for the same applied load. Further improvements are expected when the approach is coupled with a powerful optimization algorithm.

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