Composite Engineer's Viewpoint

Rik Heslehurst PhD, MEng, BEng(Aero)
FIEAust, FRAeS, CPEng

Designing with Composite Materials
Part 10 – Detailed Design

In this article, we undertake the detailed design of the structure. This step is a culmination of all the previous steps undertaken in the design of composite structures.

The final composite structural component has been designed to meet specific requirements. Some of these requirements may have been conflicting, but in the end we have resolved conflicting requirements to satisfy the overall performance as best we can. What have we done to achieve our composite structure?

- We have chosen the type of fibre/resin system that best meets our performance, operational and/or manufacturing needs within a weight/cost design space.
- In combination with our constituent materials selection and fabrication capabilities, we have selected a manufacturing process. This will impact the development of our engineering properties through the resulting fibre volume ratio achieved.
- The choice of fibre orientations were obtained based on the structural performance needs. In association with a forward understanding of the other requirements, variations of the fibre patterns have been considered.
- The ply stacking sequence was then determined, and for the first time we can calculate the complete structural performance of the component.
- Analysis of the design details, such as attachments to other components and if flexural stiffening is appropriate can be done. Likewise the need to remove and add plies at discrete location is examined, particularly where stress concentrations are considered.
- We again check our design against the specifications and requirements to confirm the appropriateness of the performance of the structure.
- A series of ply changes and stacking sequences variations is undertaken to optimize the cost, weight and/or performance of the structure.
- Now a prototype of the structure can be fabricated and tested to confirm that the physical design goals have been meet.

Congratulations, you have successfully designed a composite structure and it should have taken only a couple of days (depending on the complexity of the structure of course). Now you can commit resources to building your structure with peace of mind.

In the next article, we look at the issue of volume ratio versus weight ratio in the design and fabrication of composite structures. Are they not the same thing? What is the relationship between volume ratios and weight ratios? I also welcome questions, comments and your point of view. Feel free to contact me via r.heslehurst@adfa.edu.au. I may publish your questions and comments, and my response in future newsletter.