Composite Engineer's Viewpoint  
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Scarf Repair  
Is it best to have the big ply down first or the little ply down first?

There are basically two different configurations used to repair composite structures with an adhesively bonded scarf repair. The two fundamental adhesively bonded scarf repair schemes are described as either the little ply down first (aerospace) or big ply down first (marine). Which is strongest - the aerospace or the marine approach to scarf repair ply lay-up?

The two scarf repair schemes are shown below. The aerospace repair method uses the same repair ply orientation to over-lap the parent plies, whereas the marine plies will still have the same ply orientation, but the base ply covers all of the scarfed parent plies.

Several tests have shown that the average strength of the two configurations are not that dissimilar. However, failure behaviour has shown some distinctive differences between the two scarf joint configurations.

The aerospace configuration always failed just outside the actual bondline through the repair adherend and run parallel with the scarf angle. The marine configuration always failed eventually through the bondline, but often started as a delamination in the surface repair ply exposed interfaces. Generally the failure path was dissimilar over the many specimens tested.

The results of a statistical analysis of one set of tests are shown below. The results of the testing that are most notable are that the aerospace configuration has a low scatter of test results when compared with the marine configuration. The effect of this is that the design allowable strength of the joint can be considerably different. Because of the failure mode
consistency of the aerospace configuration the B-basis allowable strength is greater. This can result in a marked reduction of the joint weight.

Also, the aerospace configuration has additional benefits associated with environmental sealing. The outer ply of the aerospace configuration covers the repair site and all the other repair interfaces, whereas the marine configuration leaves the bondline and the repair ply interfaces exposed to the environment. For longevity and best strength advantages, the aerospace scarf repair joint configuration is better than the marine scarf repair joint configuration.

In the next article we will look at impact of the ply direction on the bonding surface strength. Whilst the in-plane homogeneous properties of the composite may not change, the local effects of the ply on the faying surface at the bondline interface can be a significant cause of reduced joint strength. 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.