# CARBON FIBER IN FF SCALE MODELS

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The more you play with this stuff, the better it becomes! We left off last time talking about a form of CF called a "laminate" and its uses in our low tech airplanes. Since then, I've been introduced to not only more and better forms but also a very accommodating supplier who runs a very prompt mail order service. For a list of their products along with descriptions of them send a SASE to:
Aerospace Composite Products P.O. Box 16621
Irvine, CA 927t4
(714) 250-1107
or go to their website at http://www.acp-composites.com

Going through the product descriptions, the forms of CF we are most interested in are:

Laminate: This is the form described in the last article. The actual carbon fibers are all laid in precise parallel orientation and the whole sheet is bonded to tissue paper by some medium. The stuff is similar to a sheet of thin, stiff, black, typing paper. By nicking the edge, you can peel off long, springy strips down to the width of 1/64 easily. The 007 thickness Is the best.

Braided Carbon Cord: Imagine a long, tiny, tiny, 3 braid pigtail and that's CF cord. The cord is the size, literally, of 1/32 wire. It also is soft and flexible just like hair.

Carbon Fiber Tape: This form is an expanded version of the ribbon, only to keep the 1" width of the hair from tangling up it is lightly mounted on a strip of tissue paper.

Ribbon: This looks (and feels) exactly like a long, fine lock of my daughter's jet black hair! It is a soft, limp, lock about 1/8” wide that is held together by a "sizing" or something like hairspray that keeps the "hair" together. However, you can spread the fibers apart and split it into narrower "locks" if you wish. In fact, you can tangle the whole thing up just like hair if you really get clumsy fingers. It’s also called 'tow" in the composite industry.

While Aerospace Composites have a good 60+ more products, these are the ones I experimented with. For the purposes of free flight scale, the laminate (.007 thickness) is the most useful as for strength vs. weight just because of the exact linear orientation of the carbon fibers and the varieties of sizes that can be stripped off. Next comes the ribbon as its flexibility and small width can allow you to lay it around corners to strengthen balsa. It can be twisted to form a small cord, wrapped around joints, and run in 3 axis to strengthen joints. Once in place, a soaking with CYA glue gives you "instant metal” almost (without the weight). You'll find that when failure does occur, the balsa will split off a patch of itself that is glued to the CF. In other words, the strength of the balsa itself is the limiting factor which is the way it should be.

The braided carbon cord also can be used in the same manner without the worry of getting any fibers needlessly tangled and its main advantage is its ease of handling. However, its cost is a lot higher relative to the ribbon. (They've got to pay Tinkerbelle & her friends to braid the stuff at night and Union wages are outta sight).

The carbon fiber tape has the least practicality as far as our small airplanes are concerned mostly because it's just so much. The RC and big plane modelers would find a number of uses though. As a for instance, laying a spanwise strip of the tape, top and bottom of a foam wing and bonding it into place is a great and strong instant spar. Doubler reinforcing and such comes to mind too. Essentially, it's like the ribbon only on a grander scale. However, it is also the most for your money but trying to break it down into smaller width is a bear. The ribbon is far superior for handling ease.

The main thing to remember in any use of CF is that it is strongest in tension and compression directed in a straight line parallel to the fibers. The more you deviate from that ideal situation, the weaker the CF layup becomes. However, even in its most convoluted layups, it's still very strong for our purposes and will do the job.

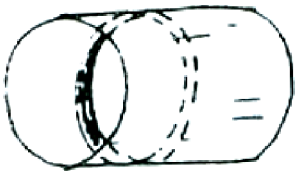
The second factor to always consider is that the layup must be kept from buckling to have that strength. Your glue bonds have got to be good and the CF needs to be snuggled up tight to the balsa. I lined a bunch of fuselage formers with 1/16" CF strips recently and thanks to my sloppy gluing (I know, I know, but I was in a hurry), they popped out halfway after the stringers had been put on. Jeez, what a zoo it was, too, trying to reattach them!

The illustrations are mainly concerned with uses of the ribbon and I will say that they all have not been tried (but will be) so take them as suggestions for right now. A little philosophy might be in order here. I realize that there is a strong tree lobby in free flight scale (“if it don't come from wood, it ain't no good"), but wait!! Hear me out. First off, we are trying to replicate a lot of times in wood what was originally built in metal. Metal is a lot stronger than wood and designers really had a field day when they were finally freed from trying to haul a lumberyard through the air. Planes got stronger, faster, wing loadings dropped (yes, they did—until engines got more power), and designers could follow the laws of aerodynamics instead of fighting them. Junctions of nacelles and wings got impossibly skinny, flying surfaces became thinner, noses got longer, landing gear moved to the wings, for just a few examples. That’s tough enough to replicate in wood & tissue but now put a flailing snake called a rubber motor right through the middle of the fuselage or nacelle. What little strength you had just disappeared. Ever build an F4F wildcat? Wasn't it great to pick it up after it did a cartwheel and feel thaI wobbly wing? It probably didn't even hit too hard or maybe it did. Whatever, it's always a thrill to stand in the hot sun with sweat drippings off your nose trying to glue a mass of shattered formers and stringers via long distance through the nose opening.

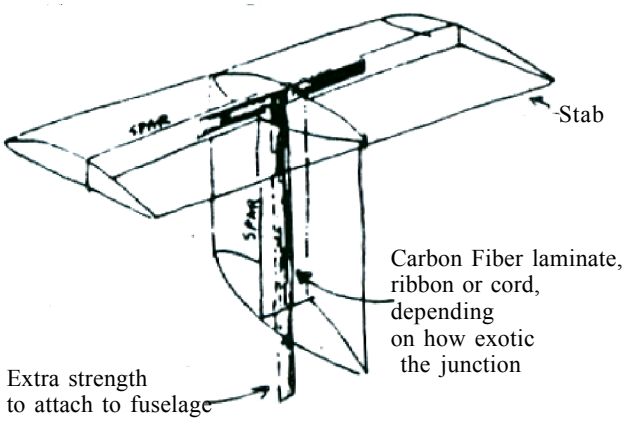
We cry for lightness and strive for low wing loadings so our models will give those soul satisfying slow circles overhead, so why should we be reluctant to use “something" light and strong to achieve that? We cut balsa formers as narrow as we

dare, eliminate stringers with a heavy heart, and shave every possible gram we can get away with and yet not want to use a strip of CF that would allow us to cut even more weight? Hobby shop owners must love us the way we paw over their balsa stock pinching, nicking, holding up to the light, weighing and then sniffing that they don't have any decent light stuff. The road we travel for lightness and strength is only exceeded by the indoor crowd. Now, at last, science has sympathized with us and given us something to bring more joy to the flying field ... and here's the best part: trees have carbon.

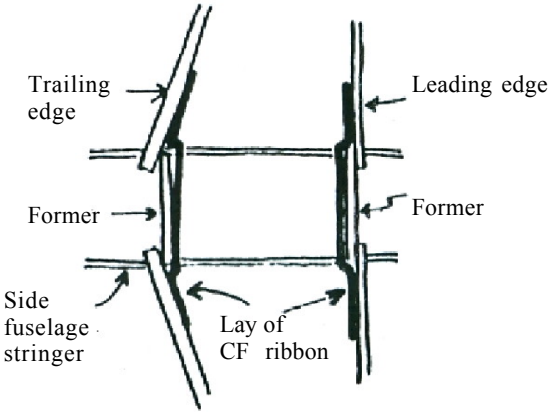
Note that a strip of 1/16" wide CF laminate (.007" thick) weighs the same as a 1/16" square strip of 6.2# balsa.

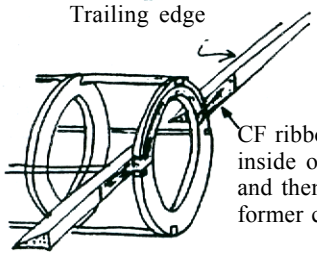


Strengthen balsa tubes or cowls with a band of laminate deletes need for a former



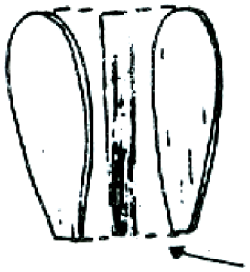

Nacelle & mid-wing mounting top view



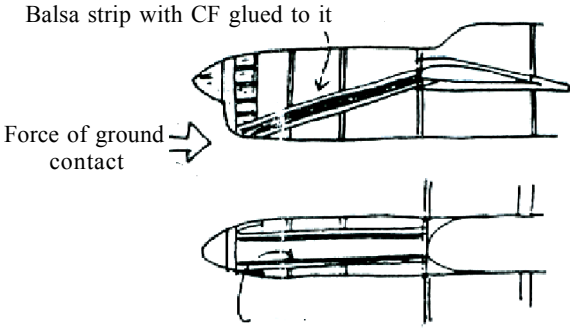

Note that former is designed to be placed ahead of the trailing edge. CF can also be laid up around the bottom of the former. Same procedure for the leading edge. See top view sketch

Balsa prop blades with wide CF laminate strip glued betweeen pieces



Note laminate strip is as wide as the prop "throat" to inhibit breakage at this narrow point

Bracing of long nose or nacelle




Brace may be place inside or outside of formers