CARBON FIBER — HIGH TECH STUFF FOR LOW TECH AIRPLANES

By Tom Arnold, Editor of Scale Staffel in 1991

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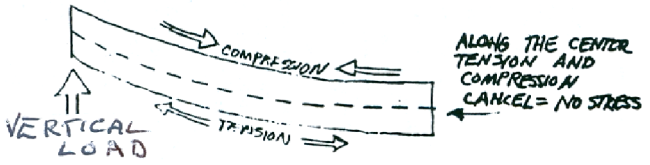
You guys who don't go to the FAC NATS back in Geneseo really miss out on some terrific flying. both on the field and in the hangar, so to speak. Last summer while perched on a dormitory bunk bed, the editor was talking shop with Don Srull of the DC Maxecuters. Don related some uses he hod developed with that exotic stuff—carbon fiber. I say 'exotic' because it wasn't made from trees like most of the ingredients of our models. As a dedicated stick and tissue type, it seemed always one ot those expensive things made for RC and not us. After examining the stuff. I can honestly say its made exclusively for us—we just have ignored it!!

First off, carbon fiber is **not** Boron fiber. Boron fiber is a pretty bad actor that supposedly shatters and little whiskers get into your bloodstream that lodge in your brain, heart, family jewels or whatever. Carbon fiber is bound into a matrix in a sheet that ties it together. It pulls off the matrix in nice even strips like celery string and acts like a springy piece of 1/32' music wire. You can break and bend it but to tell you the truth, razor blades and dope fumes have damaged more of my body than carbon fiber ever could. The stuff is sold in 3"x24" sheets of varying thickness and I found some at a local RC hobby shop put out by Bob Violett Models. (Ed. Note: .007" thickness is probably best)

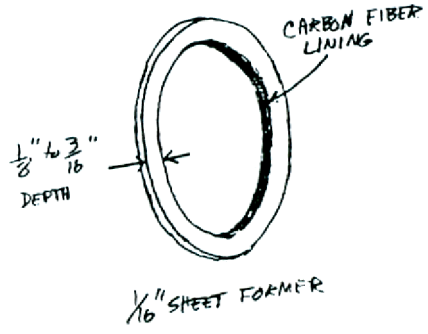
Carbon fiber is tremendously strong in tension and, to a slightly lesser degree, compression. The difference between the two is insignificant for our purposes. That means any place you need compressive/tension strength, such as a spar, this stuff is super. To give an example, by gluing a 1/16" strip on the top and bottom edges of a 1/16 sheet spar you have on incredibly rigid member to vertical loads. Put a strip on the front and back and you have the some results for horizontal loads. The thing to remember is to separate the 2 CF strips as far as possible for the most strength. For those unfamiliar, see the sketch below showing the loads placed on a wing spar.

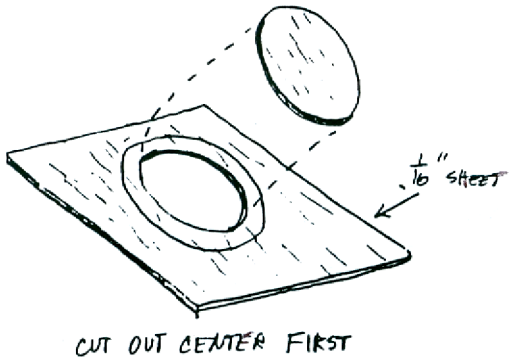


The top and bottom edges take the most stress, the middle none at all. In fact, you can eliminate the center of the spar quite safely. (This would give you stringers for spars and what is often done in the past is to glue a vertical web between the two of a very light material to keep the stringers from buckling while under stress).

In times past, the challenge was to build the spar with the strength needed but without any excess weight. Of course, everybody would guess wrong somewhere along the line as balsa is only so strong. The famous 1/16" sheet spar was easy to make and was strong enough in the heavier grades but a few outdoor cartwheels and it would break too. Now enter some carbon fiber. Take a very light 1/16" sheet spar that normally would not take any abuse and CYA a 1/16" or 1/32" strip of CF to the top and bottom edge. You have a tremendously strong spar for a lot less weight. As long as you can keep the CF from buckling, you are in fat city.

Now back to Don Srull and his experiments using CF to line the inner ring of a fuselage former. By doing this he could get a former depth of l/8" to 3/16" and have a rigid ring that far exceeded any laminated or sheet ring. After making up a few samples, the editor got quite excited at how stiff they were and promptly plunged into a model utilizing them. While I made no weight measurements, I feel the weight saved is a function of the size of the former and the glue used to attach the CF (both CYA and Titebond work). In some cases, you'll save weight for the same strength and in other cases, you'll break even. What it does give you in all cases though is a tremendously open fuselage or nacelle to handle a flailing rubber motor.

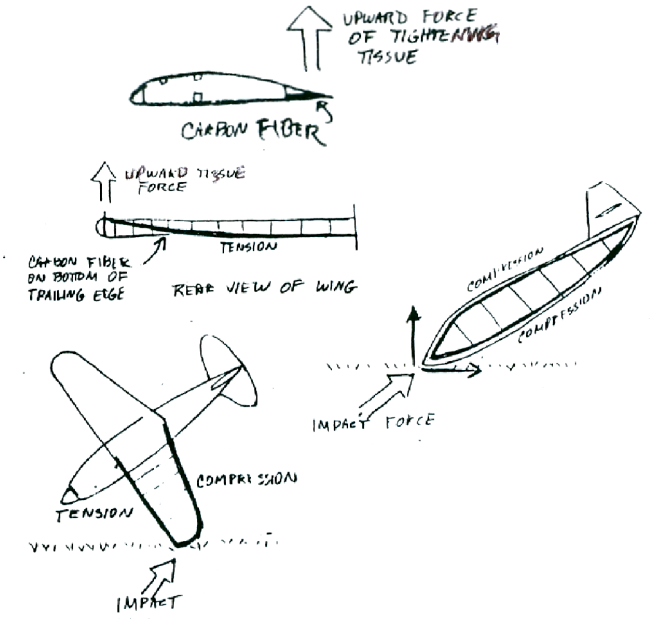




The construction of the formers is a little backwards and Don suggested working from the inside out. What this means is to draw your former outlines on a sheet of balsa. Cut the inside out first and pin it down on your workbench with a sheet of wax paper under the 'holed' former. Now line the inner edge with a strip of CF and glue in place. I found CYA worked fine after I slipped the CF strip in place. It's really springy and will fight going in—sort of like thin music wire would. Using some small patches of wax paper to rub the CF against the balsa as the CYA glue set helped to keep the fingers from getting stuck. After the glue is set, cut out the outside outline and there you have It. You'll be amazed at how tough those formers are and if you are like the editor, you'll play around and finally destroy one as you try to see just how rigid it is!

Needless to say, the half-former-and-shell method of fuselage construction can't be used with these new formers. The external "picture frame" jig as outlined in a previous newsletter would be most likely be utilized. (Ed. Note: The jig sold by Rocky Top Models will do this quite well)

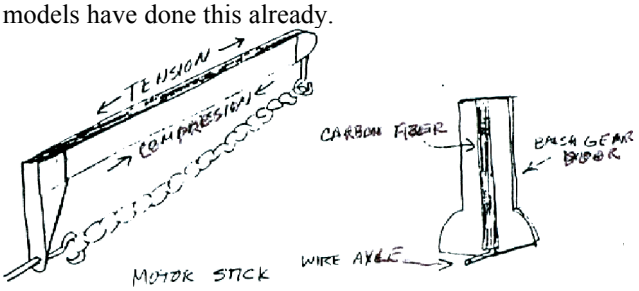
Other places to use the CF strips is along any balsa that regularly buckles under stress such as on top and bottom or side keels—or all of them, a backing for wing leading edges, a backing for wing tips, and along a trailing edge. Al Lawton of Portland, CT, in discussions, felt a strip along the bottom of a trailing edge would counteract the doped tissue on a wing from warping progressively greater washout in a wingtip.

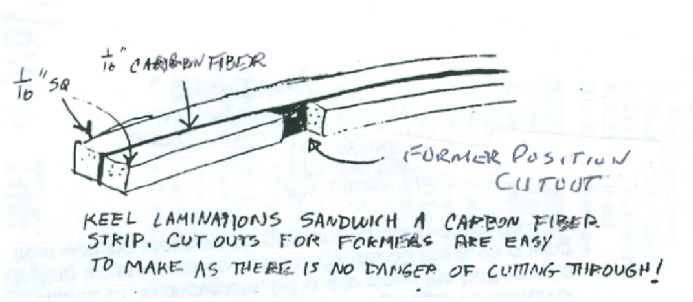


A strip of CF inside the outline of a vertical stab would protect it during a hit-the-nose-flop-over-on-the-back landing. Same thing would apply to horizontal stabs., Even just a strip along the central stabilizer spar may be enough.

Motor sticks could be made lighter by allowing the CF to take the compression/tension force of a fully wound motor.

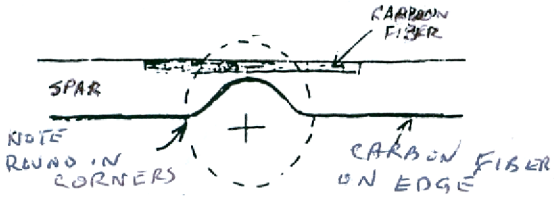
Landing gear could dispense with music wire and rely on the landing gear door reinforced with a strip of CF. Some indoor models have done this already.



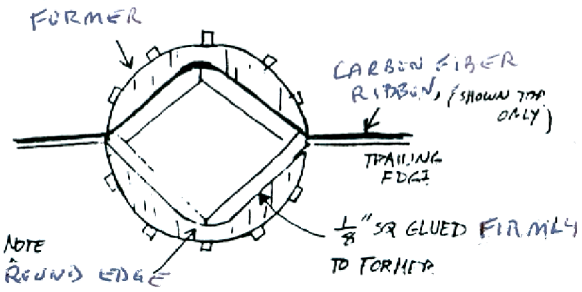


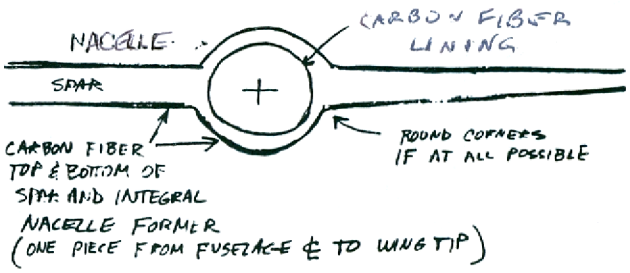
Dihedral joints can be faced with strips.

Spars can be cut out in a nacelle to allow greater room for a rubber motor.



While the ideal situation is a flat, straight run of CF, you can cheat a little and bend the CF as long as it's bonded to something to prevent it from buckling. Here's an example of a mid-wing aircraft and how the trailing edge could be mated to a former. Note, there are no sharp bends. Think of the stress as water flowing through a pipe. Sharp kinks cause it to rupture and squirt out.





In cases where it's a tough joint, a patch will work fine although at a weight increase. .

There are also some aircraft that visually can benefit from any strip of balsa reinforced with CF. Two which immediately

come to mind are the Westland Lysander and Fieseler Storch with their bird cage cockpits mated to the wing. A lot of the Early Bird aircraft and WWI types also have impossibly delicate structures that suffer rough and tumble outdoor flying poorly.

Propellers take a bodacious beating and strips laid up along the L.E. and TE. would seem to delay if not prevent the loss of a blade on ground impact. In fact, a CF patch may be the ideal thing to back a blade with at its narrow throat near the hub. In cases of a twin where a weighty propeller is not wanted, a balsa prop with strips of CF laid spanwise may serve as both strength and a

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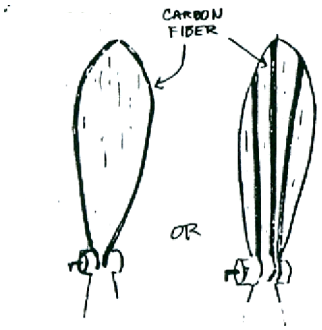

These are some ideas the editor will pursue in his upcoming models. My apologies for not having more hard data. For those who do get intrigued with CF and use it, do send in your results and we'll publish it to prevent the wheel from getting reinvented a hundred times over. (Actually. this is a plea so the editor doesn't reinvent the wheel!! Being basically a sloth, he sucks up on every good idea he hears.)