Repairing a Hollow Molded Supra's Wing

Got your attention, didn't it?

This was my first time doing this type of repair and I experimented with it a little. You should take that as a disclaimer that anything shown here has any value for builders/rebuilders other than purely humorous.

There are just too many pictures documenting this repair to stuff in this newsletter, so check out the full compliment in the Repairing a Supra Wing photo gallery online. Those pictures have more detail than you'll find here, because these newsletter pictures have been reduced, so the newsletter doesn't become huge.

This is Bob Anderson's Supra sailplane that I've attempted to repair. I have to say “attempted”, because it still hasn't been flown with its new repairs at the time of this writing. It will be a couple of weeks until it is. In the meantime I'm hopeful that the repair will be fine. I tried bending it over my knee to flex the spar and the repair and didn't hear any funny sounds. Hmmm … that didn't quite sound right or very encouraging for Bob to do the fuselage repairs. I hope Bob isn't reading this.

Stopped by the spar

The damage you see in the pictures and a broken fuselage came about from two sailplanes colliding when coming in for landings near each other during the June ESL Unlimited contest.

This wing is hollow molded, so it's basically a flying eggshell filled with air and a spar on the inside. From the pictures, after I've removed the damaged material and exposed the layers, you can see, going from outside to inside, are what looks like a paper thin layer of paint with something like a very open mesh of Kevlar under it sitting on less that an eight inch of foam and a final open layer of Kevlar mesh and then a lot of air. A “mesh”, in this case, is the opening or space enclosed by the threads of a net. You can see the net in the pictures. It looks like blades of dried grass woven together.

Some part of the other sailplane in the accident was hard enough to crush the leading edge of Bob's wing back as far as the spar. So the damage to the wing was spread out from the point of impact, because the wing's leading edge was crushed back and folded in on itself like an accordion for the length of about a foot on the bottom and only seven or eight inches on the top; not insubstantial.

Removing damaged material. Look closely and you can see how coarse the Kevlar netting is and the creases in the wing.

So the order of repairs were:

- Slowly remove damaged material while checking for more damage
- Whittle out blue foam plugs to the inside shape of the airfoil
- Glue the blue foam plugs to the spar
- Slide a fiberglass layer between the blue foam plugs and the inside surface of the wing
- Remove about 3/16th's inch of foam from the edges of the top and bottom holes to expose the inside Kevlar mesh layer
- Using a thin layer of epoxy, laminate the fiberglass to the blue foam plugs and to the edges of the hole. The fiberglass patch replaces the removed inside section of Kevlar mesh to give the wing back some strength. Some of the epoxy was allowed to soak into the foam, stiffening it where it had cracks. The excess epoxy was blotted off to keep weight down and sanding to a minimum.
- Epoxy carbon fiber cloth over the leading edge to form a D-channel connecting the top and bottom layers of fiberglass over the blue foam making the wing more rigid.
- Apply a tin layer of Gorilla Glue over the blue foam and carbon fiber D-channel and moisten it to create a light layer of foam, building the repaired section up in thickness. The bubbles were inconsistent in size. I got the idea of using Gorilla Glue from looking

at Herb Schaefer's repairs of his Thermal Dancer wings.

- Using a mixture of ten drops Gorilla Glue, five drops vinegar and a small amount of baking soda to bring the mixture to the consistency of toothpaste, form the leading edge. The foam bubbles are smaller, more consistent and they can be sanded after only 45 minutes of cure time. Check out the YouTube video on How to Fast Cure Gorilla Glue. The whole point of this was to keep the repair light by incorporating air into the repair. Putting Saran Wrap over the leading edge and shaping it with a ruler saved me a lot of sanding. This stuff is hard to sand even with 80 weight sandpaper. Too bad I didn't take more pictures at this stage.
- Finally, cover up the whole ugly mess with layers of Bondo while sanding between them. If I were going to paint this repair right away I would put on one more paper thin layer of Bondo and break out the really fine 1200 grit sandpaper.

Fiberglass is inserted between the blue foam plugs and the inside of the wing. The outside layer of the wing's yellow foam is being cut away at the edges so that the fiberglass can be epoxied to the Kevlar netting at the same time the fiberglass is laminated to the blue foam plugs.

Carbon fiber epoxied around the leading edge creates a D-channel to give the wing some strength and make it more rigid. The blue foam is two foam pieces that are slid into each side of the hole and then butted and glued together.

Foaming action of the glue is used to build up a light, but strong layer over the repairs and form a leading edge in line with the rest of the wing. This glue is tough to sand, but still way easier and less smelly than epoxy.

Saran Wrap and rolling a steel ruler over the leading edge forms the foaming glue into a shaped leading edge and really cuts back on sanding after it hardens.

Sanded between applications of thin layers of Bondo. Yup, the carbon fiber layer was a tad high in one spot of the D-channel, but not anymore. It's okay; it has fiberglass underneath. The black edge in the rear of the repair is where the paint was feathered down to the carbon cap on the spar.

A straight leading edge, for a given value of straight. In this case a ruler was used.

One of those rare instances in life where bigger isn't necessarily better.

The repair itself blends well with the wing's airfoil. What seems like long straight lines at first glance is really a bunch of complex curves, especially near the wing root. Also the thickness of the wing isn't constant, further complicating the task of blending everything together. The solution: sand, measure, repeat, repeat, repeat.

The damaged center wing weighed 23 ounces. Damaged material weighing 0.25 ounces was removed from it, bringing its weight down to 22.75 ounces. After repairing the damaged section the wing weighed 24.6 ounces. Fortunately, the repair was near the center of the wing, so adding 0.23 ounces near the joiner on the opposite end of the wing balanced the center wing laterally and brought the overall weight to 24.83 ounces. Considering that the repair on the bottom of the wing is a foot long and the top is seven or eight inches, that seems reasonable to me.

If I had to do this repair over again the only thing I'd do differently is to be neater. This type of repair covers a large area and already uses the minimum amount of epoxy I could get way with. The only place left to try and save a little weight is by reducing the thickness of Bondo used for finishing by increasing the thickness of the Gorilla Glue foam That means sanding the foam to just under the thickness of the wing, compound curves and all. I think that approach to cutting weight would rapidly turn into diminishing returns considering effort versus weight savings.

If anyone has done composite repairs and could turn them into an article(s), with pictures, and they make what I've done seem hefty, I wouldn't feel bad at all if it was submitted for the newsletter. Mine could be referred back to as the bad example. In the meantime, I don't want to do another repair for a good long time. Even something as simple as this was too much of a time sink.

Update: Per Herb Schaefer, Gorilla Glue now comes in three types. The latest that he has used is clear and dries white and foamed after about 20 minutes, hard in about 45 min.