On the ’Wing... # 174

Diva, Part 3

This has been an exciting series of weeks for us because Diva construction has progressed rapidly. As this column is being written, the entire framework is complete and all radio gear has been temporarily installed. The airframe, minus covering and painting, weighs 1300g, a bit under 46 ounces, which is right on target.

Finishing the wing

The most critical part of wing construction is the D-tube formation. Once the upper and lower sheeting is bonded to the spars, ribs, and leading edge, it’s nearly impossible to take out or put in any wing twist. Because the Diva wing uses a triple reverse taper, we set up three separate sets of jigging fixtures. As we had made templates for all of the wing ribs, getting heights and angles for the various fixture pieces was a simple, but time consuming, matter.

After getting all of the ribs glued into place on the spar and adding all of the trailing edge pieces, the wing was jigged into position right side up and the upper surface leading edge sheeting was glued onto the structure, along with all of the upper surface rib cap strips. This procedure was performed on both wings.

The wings were then inverted and aligned again. Using the rib templates, we made sure there was no twist built in. Because the rear upper surface of the wing is very slightly concave, it’s possible to set up the wing so that it is self aligning. Once assured everything lined up properly, the lower surface leading edge sheeting was attached to the spar and ribs. The leading edge stock was then glued on with the wing still in place in the jig, followed by the lower surface rib cap strips.

The aileron bellcrank is mounted on a piece of 1/16th plywood which is attached to two adjacent ribs. See Photo 1. The pushrod from the bellcrank to the aileron comes out of the bottom of the wing. Since this is in an open bay, the covering must have some sort of attached substrate. We

Photo 1: Aileron bellcrank mount.

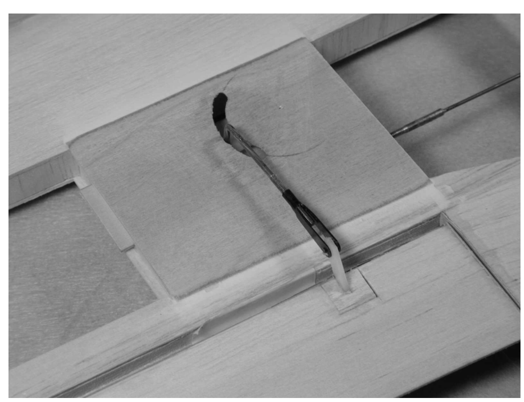

Photo 2: Aileron pushrod.

used a large piece of specially cut 1/64th plywood for this purpose. The pushrods come straight out of the cutout from the bellcrank, and then bend back to the control surface through a 90 degree angle. Photo 2, taken before covering was applied, shows the aileron linkage and wing cutout to good effect.

Vertical fin and rudder

Choice of an airfoil for the vertical fin and rudder was dependent upon the aft fuselage taper and the need for an airfoil which could also be used for the sub-fin. To make the transition from the fin and rudder to the ventral fin easier to configure, we looked for an airfoil with flat sides for most of the aft portion. We selected the BTP8 section from our archives. This section was originally designed for use in model rockets, but in the past has also been used with success for tail surfaces on conventional tailed RC models. We've included a coordinate table for this section along with a low res plot. The maximum thickness point of the BTP8 is just ahead of 20% chord and the surfaces are straight lines from about 30% chord to the trailing edge. The trailing edge itself lends itself well to sheet balsa construction, as it a very thin and blunt.

Some mathematical skills were required to get the templates for the diagonal ribs printed out, as the percent thickness of these ribs changes slightly along the rib length. We started cutting balsa once we were sure each of the ribs matched the width of the fin trailing edge. Fin construction consisted of blocking the leading and trailing edge off the table and adding ribs at 90 degrees to the spruce fin trailing edge. The base rib was then oriented to match the top of the fuselage and glued into place, as was the end rib. The rough cut tip block was then glued in place.

Rudder construction was fairly straightforward as the entire structure has a triangular cross-section. The forward edge is a square C-shape structure, the trailing edge is simply two sheets of 1/16th balsa laminated to a central core of 1/64th plywood. The triangular rudder ribs were easy to make as all that was needed was the leading edge width and total length.

The tip block was shaped in outline and cross-section, and all exterior surfaces were sanded to accept plastic shrink covering material.You can see the completed fin and rudder, along with the ventral fin discussed next, in Photo 3.

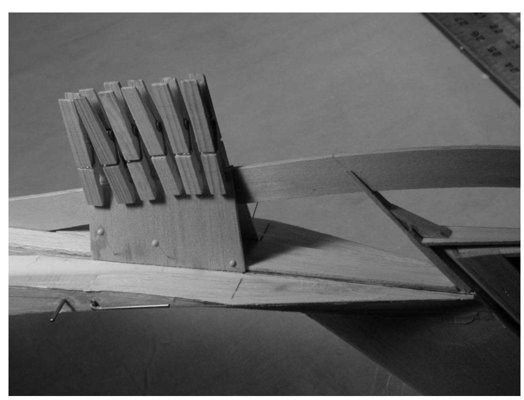

Photo 4: Sub fin construction.

Photo 3: Completed fin and rudder.

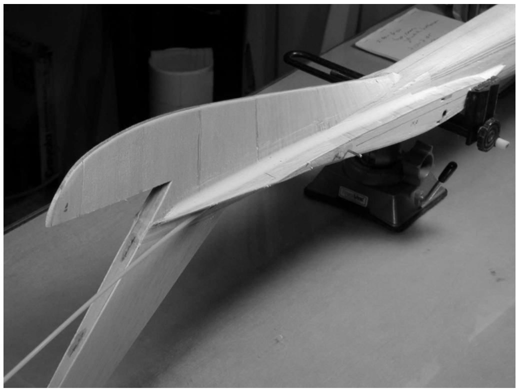

Photo 5: Completed fin and sub fin.

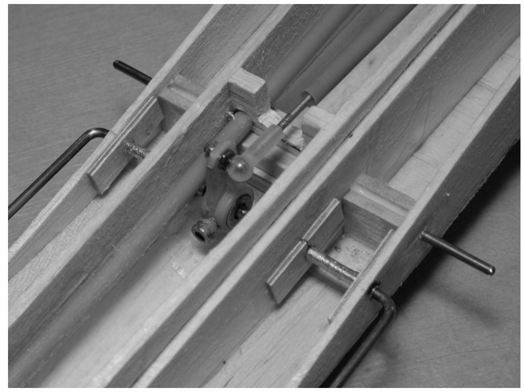

Photo 6: Elevator control system.

Ventral fin

Because the vertical tail tends to get blanketed when the wing is at higher angles of attack, we've always made sure there is substantial ventral fin area. The ventral fin was designed to drive the wing to below its zero lift angle upon touchdown, preventing ballooning following a bounce. This surface, while of extremely low aspect ratio, must also be able to absorb potentially large side loads which may be imposed during touchdown.

The ventral fin core consists of a 1/8th plywood rim mounted on a balsa base rib which maintains the vertical tail airfoil. 1/16th hard balsa sheeting is then edged to match both the base rib and fuselage surface on one edge and create a large gluing surface against the plywood rim. The initial pieces of sheeting must be carefully positioned in order to keep this fin precisely aligned with the fuselage. We used the method shown in Photo 4.

The completed ventral fin, as shown in Photo 5, will eventually receive a layer of one and a half ounce fiberglass along the edge which comes in contact with the ground. Additional 'glass cloth will then be applied to tie the lower portion of the fuselage into the structure and strengthen the balsa sides against those side loads.

Elevator control system

The elevator control system described in Part 2 was installed in the fuselage before the top sheeting was glued on. Photo 6 shows the installed internal system and pushrod. This is a no slop system which is both rigid and free moving.

The elevator halves were cut free of the main wing panels and set aside until the control mechanism was installed in the fuselage. Once we knew where the control arms exited the fuselage, placement of the brass tubes in the elevator was undertaken. This involved taping the elevators to the wing in the neutral position and sliding the wing into position. We marked the elevators using a 48 inch straightedge, then drilled out the ribs by hand to acept the brass tubing receptacles. Some plywood pieces were glued to the balsa ribs and within the trailing edge to spread stresses across larger surfaces.

At the field, the wing slides along the main wing rod a short distance and the elevator drive rods are then inserted into the brass tubing receptacles in the elevators. The servo wiring is plugged in while the gap is relatively large. As the wing is set against the wing-fuselage fillet, the incidence pin plugs into a brass tube in the wing near the elevator hinge line.

The future

Next month's column will focus on the fuselage and the wing-fuselage filleting. A consistent line of questioning at the flying field starts with something like, "How do you shape such a sleek rounded fuselage from a bunch of balsa and plywood?" For this reason, particular attention will be paid to transforming the fuselage from its original primitive square cross-section into a much more aerodynamic shape. Additionally, we'll share some photos of the completed airframe.

Since we're so close to finishing Diva, we're already trying to choose our next construction project. Potential builds include an R-2 enlarged to XC size, a Raven S of either 100 inch span or enlarged to XC, and a Raven FF adapted to RC, but we're open to other suggestions. Go to the RCSoaringDigest Yahoo! group page <http://groups.yahoo.com/group/RCSoaringDigest/> and click on "Polls." Let us know what you think we should tackle next!

Don't forget, we're always available at P.O. Box 975, Olalla WA 98359-0975 or through <bsquared@appleisp.net>.

<u>BTP8</u>

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