On the ’Wing... #173

Diva, Part 2

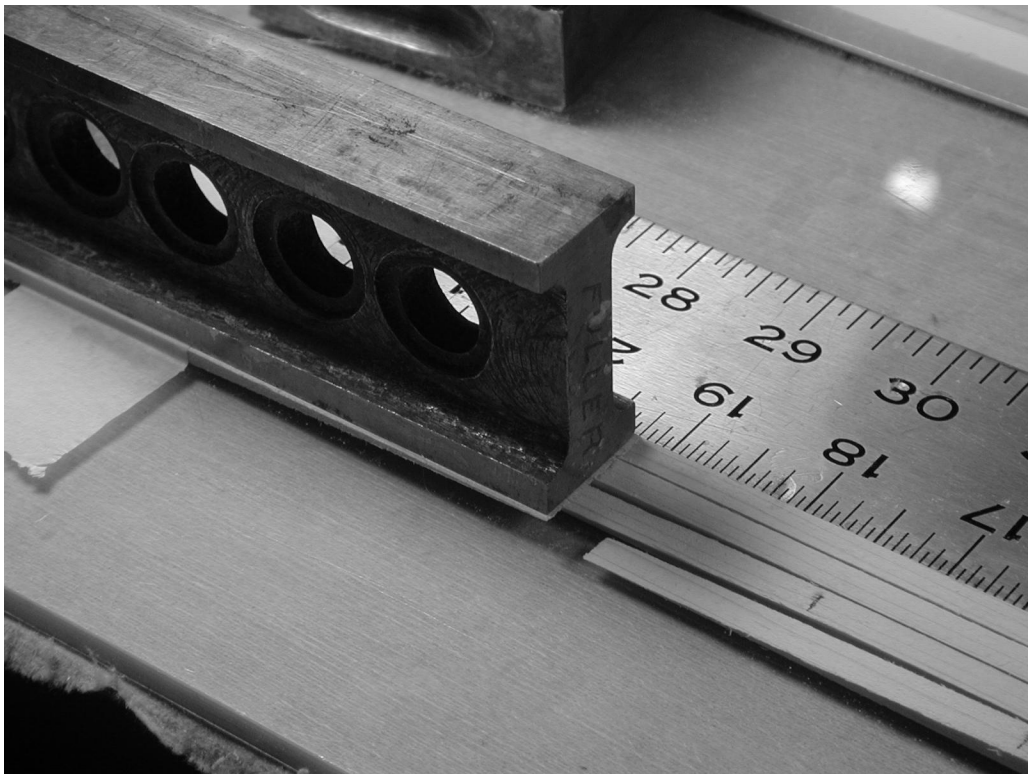
Changes, changes, changes...

Plans for Diva are now fairly complete, but several changes have had to be made as construction has progressed. This month’s column will be devoted to examining the major changes which have been made.

Spar details

The spar location was chosen with structural considerations at the forefront. The leading edge of the wing is a straight line which comes off the fuselage perpendicular to the centerline. The triple taper of the trailing edge, together with the geometry of the leading edge, forces the quarter chord line to sweep forward at incrementally smaller angles toward the wing tip.

We placed the rear edge of the main spar at the 25% chord location at the root and the tip. The rear edge of the spar is a straight line, so the location of the rear edge goes back to 30% chord at the



This photo shows the 12 inch spar extensions being glued on to the main spar. Both the main spar and the extension have been tapered over the last three inches to form a scarf joint. Thick CA is applied to the extension, and it’s slid under the steel block to exactly fit against the end of the main spar.

This photo shows the wing upside down with both spars in place. The upper surface of the leading edge D-tube is already bonded to the upper spar. This image has been retouched so the joints between the three spar components are more sharply defined.

first taper break, and to 31% chord at the second break. This is an acceptable compromise as the leading edge D-tube follows the same line and all shear webbing is at the rear of the spar. This arrangement has the benefit of strengthening the wing at the taper breaks without producing unacceptable local focused stress risers.

Additionally, it must be kept in mind that while the spar is swept forward, the wing rod is not. To allow enough fore and aft space for the wing rod, the spar width must be expanded in the forward direction. This additional piece is tapered so that the local spar leading edge is parallel to the wing rod and covers two wing bays. Another spar addition is located behind the main spar piece. It's tapered across three bays so it does not end in unison with the front spar addition.

Aileron servo location and mounting

Alyssa's idea involved placing the servo near the wing root and running a music wire pushrod out the wing to a bellcrank at the inner edge of the aileron. Unfortunately, this servo location is directly within an area which is fully sheeted, top and bottom.

We engineered a lockable sliding platform to allow access to the servo for maintenance or exchange. The servo slides out through the wing root on a drawer fixture which is held in place by pressure from the fuselage wing root fitting. Such a mounting method, however, requires a large number of wood pieces which need to be cut to close tolerances.

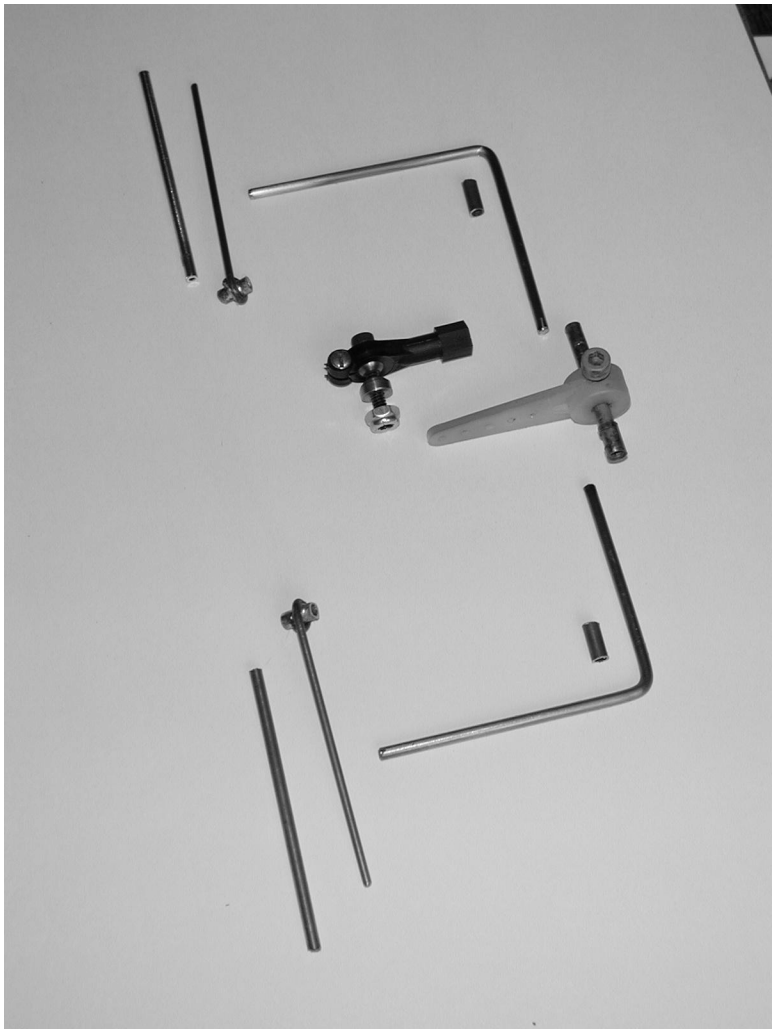
If the servo is moved out to the third bay, which is open, it can be glued to a piece of plywood mounted between the two wing ribs. There's enough vertical area in this bay, so we're almost certain our decision will be to move the servos to this more outboard location. If, at some time in the future, we need to access the servo for replacement, we'll simply cut through the covering material.

Elevator control linkage

In Part 1, we described a nifty little fixture made by Sullivan Products which is designed for use in aerobatic aircraft with stabilizer anhedral and other situations where separate elevator halves are necessary. We've reconsidered this option and have instead decided to use what was originally designed to operate flap systems on conventional sailplanes.

The mechanism consists of two L-shaped pieces of 3/32nd inch music wire which are connected by soldered brass tubing within the fuselage. A special nylon control horn is slipped over the brass tubing and held in place with a set screw. These rods extend outward through the fuselage and angle to the rear, and are then connected to the elevator halves by means of 1/16th inch wire pins which are inserted into brass tubing receptacles in the elevators. Because these pins must be free to slide along the 3/32nd inch music wire rods as the elevator moves up and down, they encircle and are soldered to brass tubing sleeves.

Brass tubing bearings which are epoxied to the fuselage sides keep the elevator control horn from sliding side to side within the fuselage.



The elevator control system. The two small brass tubes at the left will be placed in the elevator halves. The 1/16th inch music wire pins will fit into those receptacles and be free to move along the actuating arms by means of the brasss tubing sleeves to which they're attached. The L-shaped actuating arms will be soldered to the brass tubing and the control horn will be locked in position with its set screw. The two small brass tubing bushings will be epoxied to the fuselage sides and hold the mechanism in place side to side. The heavy duty ball link will be mounted on the left side of the control horn so it's slightly to the left of the fuselage centerline.

Right wing nearly completed, left wing being glued together. The balsa blocks at the left wing root have been cut to the dihedral angle so the rib will be exactly square with the center section of the wing which is an integral part of the fuselage.

Fuselage construction

The fuselage will be constructed according to our standard practice. The forward fuselage sides are of 1/8th inch plywood, spliced to 1/8th inch sheet balsa rear panels. Triangle stock will be used to connect the plywood sides to the balsa sheet bottom and balsa block canopy.

The wing center section, which houses the main wing rod bearing and includes the generous filleting at the trailing edge, is to be epoxied to the fuselage wing saddle, using the tow hook mounting block as additional mating surface.

The elevator and rudder servos are to be located directly in front of the wing center section. The forward elevator servo is mounted at the same height as the rudder servo which is behind it.

The rudder pushrod crosses the fuselage as it traces back to the rudder so that the rudder pushrod servo connection is on the right side and the rudder connection is on the left. The pushrod can exit the fuselage side at a more rearward point, and at a steeper angle, making for a more streamlined installation.

The elevator pushrod is connected to the servo arm on the left side of the fuselage and to the elevator control horn just off center by means of a heavy duty universal joint.

Wing tips

We had originally considered some sort of framework for the wing tips, much like those on our version of Dave Jones' R-2. Because Diva's tips are of a different shape, more like those of Dave's Blackbird, the decision has been made to construct them in similar fashion. Duplicates of Rib#19 will be made and glued to the existing tips. Upper and lower tip surfaces of 1/16th inch balsa will then be shaped to conform to the added rib, and brought to the outline where they will be laminated with a 1/64th inch plywood rim. There's not much weight difference either way, so we've chosen what we believe will be an easier construction process.

Construction progress thus far

We started construction with the wings. The 21 wing ribs were cut out using templates made from aluminum flashing material. All of the tapered trailing edge pieces were cut from 1/16th inch balsa sheet at the same time to assure uniformity.

The main spar was extended by addition of 12 inch lengths of spruce of the same cross-sectional dimensions. This joint was made by tapering the ends of the two pieces over a length of three inches and then joining the two pieces with thick CA while using heavy steel blocks to weight the complete assembly. Once this joint was cured, the outer portion of the spar was tapered to the proper width (1/8th inch) with a heavy duty "razor" plane and a PermaGrit sanding bar. The additional front and rear spars were then glued on using thick CA.

Both left and right wings and control surfaces have all ribs in place; the spars are glued in position and the shear webbing has been added; all trailing edge sheeting is installed; the upper surface of the leading edge D-tube has been glued to the spar; and the control surfaces are cut away from the main wing and are nearly complete.

We still need to get the main wing rod system and aileron servos installed, along with the aileron pushrods and the elevator pin receptacles. We'll get into more detail concerning the wing construction process in Part 3.

Readers with topics for future "On the 'Wing..." columns can always contact us at P.O. Box 975, Olalla WA 98359-0975, or at <bsquared@appleisp.net>.