Elua Mika Mark 6B

By JIM MARTIN. . .This is the sixth in a series of R/C gliders by the author, each an improvement over the predecessor. The name is Hawaiian, and translates to "two meter." Airfoil is author's own design.

• Flying. . .thermals. . .cloudbase. . . Now that I have your attention, let me tell you about the glider that lets you touch the cloudbase. The Elua Mika series was designed for the conditions of light slope and small thermals found on the slopes of Mt. Haleakala, Maui. These small thermals are 20 to 60 feet in diameter. The design criteria called for low wing loading, high maneuverability, and quick response to control commands. The resulting design occurred through a development of seven variants, each with definite changes in airfoil, fuselage construction, and rudder areas. I consider the Mark 6B to be the best all-around performer of the series. Elua Mika is from the Hawaiian language meaning two-meter.

Note the long nose moment to carry the radio components in tandem, eliminating the need for any weight in the nose. The effective wing area is 625 square inches, generous for a two-meter ship. The large rudder area allows for control correction in rough air. The stabilator is 18 percent of the wing area and is flat with no curvature, allowing for small changes in decalage as well as pitch control when needed.

To obtain lightness, the selection of building material is important. Each piece of balsa is selected for strength and lightness. The use of laminates saves on weight. The laminated bows on tail surfaces again gives rigidity for weight-to-strength ratio.

There has not been any in-flight structural failure. No wings have come undone on a gasoline power winch. I have bounced the Mark 6B off the ground a few times, including cartwheels. But I must admit it does not fly too well through barbed-wire fence, if that can be called flight structural failure.

The airfoil is an original creation with sufficient Phillips entry for wind penetration and a continuous curvature lessening toward the trailing edge for a broad speed envelope. Nose down for high speed, and nose up for slow speeds brought about by a change in decalage. On a go-around, lower the nose, and the flying speed is increased, and this is in your favor. Slowly bring the nose up; this can be as effective as flaps. It takes a little experience, but it is all the fun of it. The drawing are for two functions; pitch and yaw. However, if you have miniature equipment, spoilers can be added without any weight penalty. At the local contest, the Mark 6B scores well within 90 percent of the high score.

The author launches the Elua from the 4,000-foot mark of Poli Poli, on Mt. Haleakala. The South Shore of Maui lies in the distance. Elua grabbed a small thermal, good for a hundred feet of lift.

CONSTRUCTION NOTES

Construction techniques for the Elua Mika varies from the general two-meter glider in that laminated 1/16-inch sheet

balsa is used in place of 1/8-inch sheet balsa. The strength by laminating is far stronger than a single sheet. Fuselage sides are laminated with the grain running in the same direction. Bulkheads are cross-grain laminates. Vertical fin rudder and stabilator leading and trailing edges are three-ply balsa laminates to obtain strength as well as the required curvature. Repair of damaged laminated portions take a little care, the trick is to remove a laminate and glue another laminate with sufficient overlap.

For adhesives I use aliphatic glues for general construction, cyanoacrylate where a short setting time is a factor, and epoxy for wing and stabilator tubes and rods. Use whatever adhesive equivalent that you are comfortable with.

VERTICAL FIN AND RUDDER

Lay out both vertical fin and rudder together. The vertical fin post and rudder post are made of 1/4-inch square hard balsa. Cut posts to length and relief slots for the hinges. Place post on drawing and pin to position. Then lay out respective size balsa, as called out by symbols. See symbol balsa size chart on the drawing.

The stabilator control box is built into the vertical fin. Place T-1, made of 1/16-inch ply, into position; over-laid T-2, made of 1/8-inch ply, into position; and then add the 1/16 x 1/8-inch filler pieces. Next, close the stabilator control box with the second T-1.

Leading and trailing edges are laminates made up of three pieces of 1/16 x 1/4-inch strip balsa. You may strip your own out of a flexible sheet of 1/16-inch balsa. The trailing edge is made of three laminates of 10 inches in length. Glue the laminates together with aliphatic glue, form the laminate while the glue is still viscous, and bend to the required curvature. Use pins to hold the curvature until the glue cures. The leading laminate is of 15 inches in length. Glue the laminates together with aliphatic glue, form the laminates to the curvature, and pin to hold the position. Start at the lower end of the vertical fin and work the laminate to curvature terminating the laminate at the top of the rudder post.

STABILATOR

Stabilator construction is started by laying out the internal braces as called out on drawing. Individually glue each stick, and pin into position on the drawing. Cut root plates out of 1/4-inch sheet balsa, and glue. Note that the right and left stabilator panels are not identical.

Stabilator leading and trailing edges are laminates made up of three pieces of 1/16 x 1/4-inch strip balsa. The leading edge laminate is 12-1/2 inches in length. Laminate and form to the required curvature using the same technique as done for the vertical fin and rudder. The trailing edge laminate is 14 inches in length. Again, use the technique as mentioned. Work the curvature from the root block to the stabilator tip.

Remove the right stabilator off the drawing when the glue is cured. Drill a 1/16-inch hole through the right stabilator root block lined up to the inside edge of the leading edge doubler. Cut a 1/16-inch music wire 3-1/2 inches long. Insert the 1/16-inch wire 1-1/2 inches into the 1/16 hole of the right stabilator panel. Do not glue in the 1/16-inch wire at this time. Drill a 3/32-inch hole into the right stabilator root block at the center of the notch lining up to the front edge of the 1/4-inch square spar. Cut a 3/32-inch music wire 7-1/2 inches long. Insert 3/32-inch wire 3-3/8 inches into the 3/32-inch hole. Do not glue the 3/32-inch wire at this time.

Remove the left stabilator off the drawing. Drill a 3/32 hole through the left stabilator panel root block lined up with the inside edge of the leading edge doubler. Cut a brass tubing with a 3/32-inch diameter to the length of 1-3/4 inches. Crimp one end and solder, so epoxy will not flow into the tubing. Insert tubing into the 3/32-inch hole with the crimped end facing inward into the stabilator.

Drill a 1/8-inch hole into the left stabilator root block at the center of the notch lining up to the front edge of the 1/4-inch spar. Cut a piece of brass tubing with a 1/8-inch diameter to a length of 3-1/3 inches. Next, drill a 3/32 wheel collar to an 1/8-inch hole. Notch the brass half way by filling about 1/4 inch from one end. Solder the wheel collar over the notch in such a manner that the set screw is over the notch permitting the locking of the 3/32 music wire. With a small piece of sheet brass, solder close the end of the tubing at the collar end. When solder is cooled, file wheel collar to within an 1/32 inch of the tubing. Do not file around the set screw. Insert the tubing into the stabilator into the left stabilator panel with the closed and set screw end facing outbroad.

Pin the stabilator panels back over the drawing with the spring steel wire in the right panel and the tubing in the left panel. Do not forget to insert the spring steel wire into the tubing. Glue the 1/4-inch square balsa doubler as shown on drawing. Epoxy the spring steel wire to the right panel and the tubing to the left panel. Fill in with epoxy between the 1/4-inch spar and doubler for both stabilator panels.

When epoxy cures, remove stabilator from drawing and trim off excess epoxy. Sand the stabilator flat on both sides and round the leading and trailing edges.

FUSELAGE

Fuselage sides are cut from four, 1/16-inch balsa sheets to size, as shown on the drawing. Laminate two sets of fuselage sides using weight to obtain gluing pressure, or pin laminates over waxpaper to work table with about four pins per square inch. When glue is set, mark the bulkhead positions on the fuselage sides. Be sure that they are left and right side assemblies. Glue 1/4-inch triangle stock to lower fuselage edge and rear upper fuselage edge as shown.

Cut from 1/16-inch sheet balsa two sets of bulkheads; B, C, D, F, and G. One set, the grain runs vertical; and the other set, the grain runs horizontal. Laminate the bulkheads and cut out for Gold-n-Rods as shown. Bulkhead "D" is made out of 1/8-inch plywood with relief for Gold-n-Rods.

Join the rear of the fuselage sides by a common 1/4-inch square medium hard balsa 1/4-inch forward of the rear edge. Be certain that the bulkhead markings face inward. Then pin the fuselage sides to the drawing in the inverted position. Be sure that the sides are square to the building table. Next, glue the bulkheads in position to the marks on the fuselage sides starting with bulkhead "G" and working forward. For added strength, glue 1/4-inch triangle stock supporting bulkhead "C" in the rear and bulkhead "D" in the front where the bulkheads meet the fuselage sides.

As you may note, the nose block is bulkhead "A." Shape the nose block about 1/16-inch over sized on the external dimensions only. This allows sanding material when shaping fuselage on the final sanding. Glue and pin the nose block to the fuselage.

The stabilator control rod assembly provides rigidity for the sharp turn of the Gold-n-Rods in the limited space at the rear of the fuselage. First cut out T-3 out of 1/8-inch ply and drill 1/16-inch holes as shown. Heat Gold-n-Rod (flex, red) in hot water and bend to fit curvature of T-3 and bind and tie with unwaxed dental floss. Glue the dental floss binding with cyanoacrylate. Now attach the stabilator control rod assembly to the vertical fin as shown on the drawing.

Set the vertical fin on fuselage and run the stabilator control rod assembly through the bulkheads on the left side of the fuselage. Set a 1/16-inch balsa spacer between the fuselage top and vertical fin. Check alignment and glue to position. Once the glue is set, remove the spacers.

Drill outlets for rudder and antenna Gold-n-Rods with a brass tubing equal to the diameter of the red rod. Chuck the brass tubing on an electric drill and drill into the fuselage sides as shown. Install rudder and antenna Gold-n-Rod in position and glue with cyanoacrylate. When glue is set, trim flush with fuselage sides.

Attach the tow hook mounting plate. The mounting plate is made out of 1/8-inch ply. Either pre-drill the holes for tow hook now or do it when fuselage is complete.

The fuselage planking on the top and bottom goes on next. First plank from bulkhead "D" back to the vertical fin and between vertical fin and fuselage with 1/16-inch sheet balsa. Be sure that the grain runs crosswise. Second, planking the underside of the fuselage ahead of the tow hook mounting plate with a laminate of 1/16-inch sheet balsa of two-ply with the grain running 90 degrees to each other. The crossgrain of the laminate should be glued to the fuselage. Third, plank back of the tow mounting plate with a two-ply laminate for 2-1/2 inches and the remainder back to the rudder post plank with 1/16-inch sheet balsa with grain running crosswise.

The wing center section is built as an integral part of the fuselage. Install the wing crush panel between bulkhead "C" and "D." The wing crush panel is a laminate of 1/16-inch ply and 1/16-inch sheet balsa. The 1/16-inch ply faces inward. Now, glue in laminate W-1 contour ribs from bulkhead "D" to bulkhead "E." Next install the center section doubler as shown on the drawing. The doubler is made out of 1/16-inch ply and ties the center section to the fuselage sides as well as the wing support assembly.

Build up the wing support assembly as shown on the drawing. Assemble with epoxy. When epoxy cures remove excess epoxy and install into fuselage on the back of bulkhead "D" with epoxy. Cut holes into fuselage center section lined up with wing support assembly hole. Cut a square hole to be filled with epoxy when installing wing tube. Next, cut out a 7/16-inch hole in W-1 ribs of the center section as located on the drawing. Now insert a 7/16 diameter paper tube into the 7/16 hole. This hole is for the rubber band that holds the wing panels against the fuselage center section.

CANOPY

The canopy assembly is made up of balsa blocks. Trace canopy sides from fuselage drawing and cut to shape, then glue blocks together. Check illustration of canopy block detail before shaping. When glue is cured rough shape. Install 1/8-inch dowel on inner side center rear of canopy. Next, install key hole lock to the top side of the nose block. Be sure the nose block is recessed and grooved to receive the head of a #3 sheet metal screw for the canopy. Fit canopy to fuselage and mark the position that the 1/8-inch dowel makes contact with bulkhead "D." Drill a 1/8-inch hole into bulkhead "D" to receive the 1/8-inch dowel. Now install canopy to fuselage and sand canopy to contour with fuselage.

WINGS

Take your time in building the wing panels. Start by cutting the ribs out of 1/16-inch sheet balsa. The following are the number of ribs required: fourteen W-1, twelve W-2, and two of each for ribs W-3 to W-8. Stack and pin the same numbered ribs together and sand lightly.

Assembly of the wing starts with pinning the trailing edges and lower spar stringer. Next set in the lower rib caps and the undersheeting of the inner panels. Glue ribs W-2 to W-8 in position. Do not glue in W-1 ribs at this time. Now fit the upper spar stringers to ribs and glue.

Glue in the rear spar webs between the W-2 ribs and between all ribs from W-3 to W-8. Be sure that the grain runs vertical. Next, glue in the rear 1/16-inch ply spar webs to the inner wing panels. Now glue in the rear portion of W-1 ribs. Do not install the W-1 root ribs at this time.

Install and glue in the trailing edge filler webs. This takes a little time, but the reward is a stronger trailing edge.

Glue the 3/8-inch square balsa leading edge. When the glue is cured, contour the leading edge with rib curvature to receive the 1/16-inch sheet balsa from spar to leading edge. Remove wing panels from work table and install the lower leading edge 1/16-inch sheeting to the inner and outer wing panels from the front edge of the lower spar stringer to leading edge.

Pin down the inner wing panels. Mate the outer wing panels to inner wing panels with wing tips elevated to 3-3/4 inches. Use an emery board to sand both ends of the leading edges and spar stringers to the correct dihedral angle. Install and glue the rear dihedral gussets. Next fit and glue in the front dihedral gussets. Be sure that the gussets fit in tight. The front and rear dihedral gussets are of 1/16-inch ply, and the internal gussets are of hard balsa. Next, install a 1/16-inch ply doubler to the back side of the leading edge.

Install the front and rear laminated W-1 sections to the dihedral joint. Fit in and glue the filler spar webs between the spar stringer between all W-2 ribs, and between ribs W-3 and W-4 use 1/4-inch soft balsa. Next, glue trailing edge fill webs between W-2 and the rear W-1 ribs and also between rear W-1 and W-3 ribs. Now install dihedral gussets to the back edges of the spar stringers on the inner wing panel.

Sand the lower trailing edge sheet to receive the top trailing edge sheet. Install the outer wing panel top leading and trailing edge sheeting.

Cut a piece of brass tubing with 1/4-inch outside diameter and of 10-1/2 inches in length. Cap the ends of the tubing with hard balsa plugs. Cut a piece of brass tubing with a 3/32 diameter and of 3-1/2 inches in length. Crimp the ends and solder the ends.

Insert the center of the 1/4-inch brass tubing through the center section. Install the 3/32 diameter brass tubing through the center section so that it will line up with the inner surface of the wing sheeting and just ahead of the wing trailing edge sheeting.

Set the fuselage on a flat surface and check for squareness. Set the wing panels to the fuselage, and set the dihedral angle by blocking wing with equal height blocks. Doublecheck the dihedral angle and angle of incidence. Use 1/4-inch square pine block taper to fit between the 1/4-inch brass tubing and the top and lower spar stringers.

Remove wing panels, remove brass tubings from fuselage, and epoxy around brass tubing and reinstall tubing through the fuselage. Then bring the wing panels back to position. Double check the dihedral angle and angle of incidence. Epoxy and install 1/4-inch square tapered blocks between the 1/4-inch brass tubing and top and lower spar stringers. Laminate two sets of W-1 root ribs and install flush to the fuselage center section. Do not glue root ribs to fuselage center section. Next, glue 3/8-inch square pine wing hook supports.

When the adhesive cures, cut the brass tubings between the fuselage center section and root ribs. Fill in additional epoxy to any opening in the fuselage wing support assembly line center section.

Cut a 7/32-inch music wire to 10 inches in length and cut the 1/16-inch music wire to 3-1/2 in length. Round the ends of the wire. Insert the steel wire into the center section and install the wing panels and check alignment. Remove wing panels, and sheet with 1/16-inch sheet balsa and leading and trailing edges of the wing inner panel. Also install the inner sheet as shown on the drawing as well center section top sheeting. Next, glue 1/2-inch square balsa block to W-8, then carve and sand blocks to form wing tips. Shape both wing tips together and follow the section as shown on drawing. Sand in preparation for covering.

Place fuselage on a flat surface and install the wing panels; check for fit. Shim the wing panels with block making the fuselage square to flat surface. Next, insert a piece of brass tubing with a 1/8-inch outside diameter and a length of one inch through the stabilator box and center. Now place the hardwood buttons on the 1/8-inch brass tubing on each side of the vertical fin. Install the stabilator and level by shimming each side with equal height blocks. Push the button against the vertical fin and with cyanoacrylate glue the bottoms to vertical fin. This type of stabilator bearing gives more than enough support and is easy to setup.

Carefully sand the entire airframe with 320 sandpaper. The type of covering material used is your choice. My choice is clear Micafilm. It is light and strong and carries the structure loads alone with the air frame.

The tow hook may be installed at this time. Install the rudder to the vertical fin. I use the hingeless type. Now install the radio gear and control rods. Check controls and surfaces for maximum travel. The rudder should have the maximum travel within a half an inch from the stabilator. The stabilator deflection measure at the leading should be 3/8 inch up and 1/2 inch down. Note that the measurements of half an inch down means the up travel. The wing may need one degree washout.

FLYING

The CG should be just back of the spar. Test glides are made off small rise. Get the feel of this new air machine. It was designed to be highly maneuverable to work small thermals. It is a responsive air machine that can turn on a dime, and give you a few pennies change. It is a fun and challenging glider to fly and is not the docile Sunday flyer. Put the Mark 6B on a high start, pull up steep, release, feel for the first small thermal, and up and away to the cloudbase. Enjoy! •

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