TWICE AS EASY EEE-Z-FLI

BY AL WHEELER

A twin seemed the logical outgrowth of the original EEE-Z-FLI series *(Model Builder,* September 1989); particularly when so many of the Maui RC pilots are nervous about being surrounded by so much water. After all, twins are safer, right?

Development of the twin followed the basic concepts of the earlier EEE-Z-FLI series. Ease of construction without exotic material requirements and good flight characteristics were prime considerations. A reasonable basic appearance and ease of repair were also felt to be important. In order to keep both size and cost within the acceptable range of a first-time twin builder, the aircraft was designed to use a pair of .25 size engines.

Flight testing with a pair of O.S. 25FPs has been a joy from the first takeoff. The initial flight was no less than "text book," requiring only one notch of down elevator. Ground handling and tracking are good, ease of rotation indicates proper main gear location, and all phases of normal flight indicate excellent stability with no slow flight problems. With reduced power, approaches are normal, and flare and touchdown on the mains can best be described as routine. The aircraft is fast, the roll rate is exciting and the climb is most satisfactory.

The most frequent comments from bystanders regard the sound—even on the ground a twin has a sound quite unlike anything else. The area of most concern tc the writer was the loss of one engine and its resulting directional control effect. It was not possible to shut one down as both engines operate from the same throttle servo, so . . . fly it and someday one will quit! When that did happen it pointed out one of the most gratifying flight characteristics of all. TWICE AS EASY handles single engine flight with ease. Reduce power on the remaining engine, retaining sufficient power to keep flying, and there is no wing drop or yaw problem beyond what is easily controlled. Loss of the left engine on a climb out for a left-hand pattern was no problem; a reduction in power to about half throttle and the left pattern was continued with no problems in turning into the dead engine. Approach and landing are normal on one engine, either right or left, but you cannot taxi, except in circles into the dead engine.

In summary, TWICE AS EASY is an ideal first twin. It's easy and inexpensive to build and its flight envelope doesn't seem to have any "hidden corners." So, if the sound of twin engines stirs your imagination, clean off the workbench and start cutting wood, it's TWICE AS EASY!

GENERAL NOTES

1. It is recommended that all parts be cut out prior to the start of construction, the same as a kit.

2. It is important that the wing be built flat, as this type of construction is quite rigid and resists corrective warping.

3. Numerous choices are left up to the builder, such as engine brand, covering material, fuel tank make and general hardware selection. Selections used on the prototype will be noted in the appropriate section of the instructions.

CONSTRUCTION

Fuselage

Select matched sheets of 1/8 medium hard balsa and cut FS-1 and FS-2. Edge join them on a flat surface. Cut FD-1 and FD-2 and cement them to the sides, starting with FD-1. Position FD-1 1/8 of an inch back from the front end of the fuselage side. Using a piece of scrap, position FD-2 1/8 of an inch behind the aft edge of FD-1. This provides a slot for the installation of B-2. Install the vertical 1/2x/8 pieces in the aft fuselage. Mark and cut the pushrod slots. Install B-2 in the slot on one fuselage side and B-3 flush against the aft side of FD-2. Join the fuselage sides by cementing B-2 and B-3 to the remaining side. Do this on a flat surface and use a square to align the sides at the aft end. Install FD-3 and FD-4. Align and install BI in the slots at the forward end of the fuselage. Install the triangular vertical braces.

Pull the aft ends of the fuselage together, assure good alignment, secure with clothespins, and cement. Install the top and bottom braces in the aft fuselage. Install the filler block at the aft end of the fuselage and the mounting pad under the stabilizer attachment point. The bottom of the fuselage aft of B-4 may be covered with 1/16 balsa. Install the 1/2x1/8 cross brace at the top of the cabin area and cover the top of the fuselage from the base of the windshield back to the stab cutout with 1/16 balsa. Servo support rails may now be installed on the top face of FD-2. Position the aft support against the forward face of B-3 and the forward support to accommodate the servos to be used. The installation shown is Futaba. Golden Rod or wood pushrods may be used; the prototype used wood pushrods for less flex. The nose gear support may be installed on the aft side of B-1 and the nose block supports cemented to the front side. The nose block is carved from a blank laminated from 1/2-inch soft balsa as shown. The hatch and retainer tongue are made from 1/8 medium balsa and secured with two screws in the front corners. Cover the forward fuselage bottom from B-1 to B-2 with 1/8 balsa and provide a slot in the front edge to clear the nose landing gear. Install the hardwood skid at the aft bottom end of the fuselage. The fuselage may now be sanded and put aside for covering.

Tail Surfaces

All surfaces are 3/16 medium hard balsa. Elevators are joined with 3/16 dowel as shown. Join them on a flat surface and be sure the leading edge is straight and that both elevator trailing edges are aligned. Cut hinge slots and cement the hinges into the stab only. Join the fin and dorsal. Cut hinge slots and install hinges in the fin and fuselage only. Trial fit the stabilizer and fin to the fuselage and trim if required. Do not attach the fin to the stab yet. Sand all edges round and put the tail surfaces aside for covering.

Wings

Select four matched sheets of 1/16x4 medium hard balsa and, working on the plans, cut and edge join the bottom wing sheets. Working on the plan, mark the spar and rib locations with a ballpoint pen. Cement the spars to the bottom sheets, assuring that the sides are vertical. Cut the preformed trailing edge material to length, mark its location and cement it to the bottom sheets. Now install the R-3 ribs between the aft face of the spar and the trailing edge. Assure that they are flush with the top of the spar and 1/16 inch below the top of the trailing edge. Install filler strips between the R-3 ribs at the forward face of the T.E. flush with the top of the ribs. This provides an attaching surface for the top skin. NOTE: Angle the butt ribs to accommodate the dihedral angle.

Now install the R-2 ribs. Assure that they are flush with the top face of the T.E. and 1/16 inch above the top of the spar. Bevel the ends of the R-4 ribs for a good fit and install, also 1/16 inch above the top of the spar and flush with the top of the T.E. On the R-1 ribs, be sure that the round cutouts for the leading edge allow it to seat on the bottom sheet, even with the front edge of the sheet. The rear edges of the ribs should be flush with the top of the spar. Install the R-1 ribs and cut the

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leading edge dowel to length. Cement it in place, assuring a good joint with the bottom sheet and the front of all ribs. Cut holes in the two ribs outboard of the inboard end rib to accommodate the engine control flex cable. Cut two lengths of cable housing and push it through the ribs. The top of the center section between the end R-3 ribs may be planked with 1/16 sheet, ending the planking at the center line of the spar. Cut a length of 1/16 sheet for the leading edge, trimmed as required to match the center section sheeting. Wet the top side and install flush with the rear face of the spar. Be sure to apply adequate cement on the spar top, the top of all ribs and the leading edge dowel. Tape around the leading edge as required to assure a tight joint.

The ailerons may now be cut from the trailing edge as shown. Trim the inboard ends and bevel the leading edges. Cut hinge slots in the wing T.E. and the ailerons, trial fit, and cement the hinges in the trailing edge only. Install actuating hardware as shown. Trim and sand the bottom sheets and top planking at the leading edge dowel to a round contour.

The wing halves may now be joined. With a 1-1/2 inch block under *one* wingtip, sand the butt ends to obtain a good fit, assuring that the leading edge is straight. When you're satisfied with the fit, punch small holes in both butt ribs to provide for better epoxy penetration. Recheck alignment and then join the panels with 5-minute epoxy. When the joint has cured the entire wing and aileron assemblies may be sanded. Install the glass reinforcement tape, double in the area of aileron servo mount. Fit and epoxy the landing gear support pad to the bottom of the center section, but do not drill the pad yet. Cut out the top skin at the center section to provide access to the throttle servo. Assuming your throttle arms will be on the right side of the engines, mark off a line denoting the inboard face of the right hand nacelle side, both right and left nacelles. Mark the appropriate exit point for the throttle cable and cut an elongated slot and fish the cable housing out. Make and install the throttle servo mounts. The center rib(s) will have to be trimmed to accommodate the servo. This will not weaken the wing due to the additional support provided by the landing gear support pad and the landing gear itself. Wing tips or tip plates may be fitted at this time.

Nacelles

Cut out four nacelle sides and four doublers. Make two firewall from 3/16 plywood, drill to match your engine mount(s) and install blind nuts as required. Assure that the thrust line is centered with the center of the firewall. Fuel, vent and throttle openings should remain the same regardless of the engine mount used. Cement the doublers to the nacelle sides to make two left and two right. Attach the firewalls against the front face of the doublers with 5-minute epoxy. Install the cross braces behind the firewall top and at the rear bottom of the nacelle sides. *Keep everything square.* Cement in the triangular braces both front and back of the firewall. Cover the top of the nacelles from the top of the firewall to the rear bottom edge with 1/16 balsa. Select a right and left nacelle and carefully fit them to the top of the wing, right and left sides. Sullivan 6 oz. flex tanks may now be trial fitted into the nacelles and removed for covering and fuel proofing. When fitting the nacelles to the wing top contours, slide the throttle cable housing through the firewall and check for fit against the right inside of the nacelles. Elongate the hole in the upper wing skin as required. The nacelles may now be sanded and fuel proofed, prior to covering.

Covering

Sand all surfaces a final time. Covering may be done in the builder's choice of materials. The prototypes were covered and trimmed in Super MonoKote. Mark and cut the covering away from all assembly joints to assure a wood-to-wood cement joint.

Assembly

Cement the stabilizer to the fuselage, checking for proper alignment. Using a square to assure it is vertical, and be sure the dorsal is centered on the top of the fuselage. The elevators may now be installed and the hinges cemented, followed by the rudder. Mark the nacelle positions on the wings and remove all covering at the joint area. The base of the firewalls should be flush against the leading edge dowel and the nacelles aligned *straight* fore and aft. No knock-kneed pidgeon-toed assembly at this point, we want both engines pulling straight ahead! When satisfied with the alignment, cement both nacelles to the wing after installing the fuel tanks and lines and feeding the throttle controls through the firewalls. Install the nose gear, servos and control rods, and push the throttle cables through from the firewall end and into the connectors (Hobby Lobby HLH819) on the servo wheel; right cable to the top of the wheel and left to the bottom. This may be easier to do with the wheel off the servo due to limited working space. Now the housings may be positioned to end about a half-inch from the servo wheel when it is actuated toward the housing being positioned. Cement the housing at the forward face of the firewall but do not cut until after the engine installation.

The engines may now be installed and the fuel lines connected. With the throttle open (servo open position) and the control link and threaded coupler attached to the carb throttle arm, measure the point on the cable where it will bottom in the threaded coupler, then cut and solder the coupler to the cable. For final adjustments to the throttle system, use the threaded connector at the throttle arm. Initial settings should be made for full throttle on each engine. You will find that the idle pretty much falls in where you want it.

Hang everything on the aircraft it will be flown with (props, spinners, receiver, battery, etc.). Place the main landing gear under the aircraft and move it fore and aft until you find the point where, when you push the tail to the ground, it will hesitate for a fraction of a second and then come up. Mark the point, drill the holes in the fuselage and attach the gear. You now have a properly balanced aircraft as far as good ground handling is concerned. Balance it for flight on the mark shown by moving the battery location and, if required, adding weight to the inside of the nose block. It should balance slightly nose down with the fuel tanks empty.

The wing saddle should seat the wing at +1-1/2 degrees with the stabilizer at 0. Also, with the stab at 0 the thrust line should be 3 degrees down. Rig the controls for the throws shown on the drawings and rig the ailerons for neutral with the bottom surface parallel to the bottom of the wing. Roll the aircraft on the ground to check alignment of the nose wheel; it should track in a straight line.

Flying

The prototype models were flown with O.S. 25FP engines turning Master Airscrew 9x6 props—a satisfactory combination. To properly adjust the engines and match their performance, the following is recommended:

1. With the throttle full open, adjust both carbs to open fully.

2. Start one engine and adjust the mixture for desired operation at full throttle. Check and set idle operation as required. Use a tach to measure max rpm.

3. Stop the first engine and start the second, following the same procedures. Again, check max rpm. If the top rpm differs from the first by more than 100 rpm, adjust as required.

Double check all control throws for proper amount of deflection and proper direction. Fill both fuel tanks and start both engines, with someone holding the aircraft. Check full throttle operation. A badly out-of-synch condition will be quite audible. Do a series of taxi and acceleration checks. Expect *rapid* responses to power application. If you feel that you and the airplane arc both ready, GO DO IT! Add throttle slowly; directional control with rudder is excellent and in the case of one engine coming in quicker than the other, a little rudder will keep the model straight. By the time you get the throttle open and take a deep breath, a bit of back pressure will give you rotation and an easy liftoff. You will find pitch stability to be excellent, roll control quite positive and yaw (rudder only) good. The prototype is an excellent flight pattern airplane at half throttle. Approaches are easy and stable, however TWICE AS EASY is a slippery aircraft and throttle must be brought back close to idle to slow it down. Flare and touchdown are easy. If you lose an engine, don't panic, reduce power and just keep truckin' on around the pattern.

In Summary

TWICE AS EASY, the newest member of the EEE-Z-FLI clan, is a good choice for a first twin, as its ease of construction, moderate cost and gentle flight characteristics make it hard to beat with anything in the marketplace today. So, as we said earlier, if you like the sound of twins and want something new in your stable, saddle up and start building, it's TWICE AS EASY! **MB**