YMF-5 WACO: A GOLDEN AGE BEAUTY

Nobody doesn't like a biplane, and when it comes to full-size machines, the classic Waco YMF-5 is about as pretty as they come. Here's a .25 size replica in the author's unique EEE-Z-FLI style of construction.

BY AL WHEELER

During its heyday the Waco Aircraft Company of Troy, Ohio turned out many outstanding aircraft, the Taperwing being one of the most famous. In the talented hands of early airshow stars the Taperwing's exceptional aerobatic potential was exploited to the fullest, thrilling spectators from coast to coast.

In 1930 Waco introduced the F series of three-place, open-cockpit, sport/business aircraft. The first of the series were the INF (Kinner powered) and the RNF (Warner powered) models. Next came the F-2, a slightly larger aircraft powered by a 165-hp Continental. Many F-2s were later modified to accept the 220-hp R670 Continental.

One such aircraft was flown on the northeast airshow circuit by Howard Dutton of Haverill, Massachusetts, an aircraft the writer had the pleasure of flying. Quite a machine for a kid in his 20s! The last of the F series was produced in the late 1930s and were designated the MF-3 and the MF-5. Few F-3s were produced due to a directional control problem resulting from too-small vertical surfaces; these were enlarged and the revised version designated the F-5, the subject of this article.

The Jacobs-powered YMF-5 would probably be considered the most beautiful of the Waco open-cockpit biplanes by today's Waco enthusiasts. The actual subject of our construction efforts, NC15241, is an F-5 that was owned for many years by the writer.

The model follows the EEE-Z-FLI concept of a basic fuselage box with formers and stringers added to produce the desired shape. Wing construction also follows the method of building the entire wing on a 1/16-inch thick sheet balsa bottom skin. The materials are common stock items with no exotics employed. Important to a biplane, the rigging is built in and if the dimensions are maintained during construction, she should fly right off the board.

The model, like the full-scale F-5, cruises with the nose down, giving it a fast look. Takeoff requires some right rudder, with the tail coming up by itself; liftoff requires a tad of up elevator. Stalls indicate an honest airplane; straight ahead with the nose coming back up with a little speed. Glide is steady, slightly nose down and the flair and landing are without incident. Rolls, loops and any combination of the two are easily performed, as are spins and snaps. This is an all-around fun airplane, not difficult to build and not too large to carry around, and the O.S. .25 engine won't eat up all your fuel in one outing to the field. The prototype draws favorable comment wherever it is flown, particularly regarding its realistic looks.

So, if you like classic bipes and want one that looks good and flies well, scratch out an EEE-Z-FLI YMF-5 and keep in touch with the Golden Age!

STAB AND FIN

Tail surfaces are 3/16 medium balsa. The elevators are joined with a dowel as shown.

Keep the tail surfaces as light as possible. Slot the stabilizer, elevators, fin and rudder for hinges, and install hinges in the stab and fin only. When the tail assembly is fitted to the fuselage, a bottom rudder hinge into the fuselage tailpost will also be installed.

LOWER WING

Prior to starting the wing you must choose the aileron configuration; four ailerons are scale, but two are easier to build and, depending on the amount of travel, just as effective as four.

Edge-join the bottom skins; note that they extend full chord and from the root to the tip. Mark the locations of the ribs and spar directly on the bottom skins so that the entire wing may be built on them.

The 3/8x1-3/4 inch trailing edge stock will later become both the ailerons and the trailing edge strip at the hinge line when the ailerons are cut loose. The R1 ribs are flush with the top of the spar and 1/16 inch below the top of the trailing edge; the R2s are 1/16 inch above the top of the spar and flush with the top of the trailing edge. The strips between the R1 ribs at the front face of the trailing edge, flush with the top of the ribs, provide support for the rear edge of the center section skin. The R3 ribs are all the same and are notched for the leading edge dowel only after they are installed. Use a 5/16-inch rat-tail file to do this, keeping the file in contact with the bottom skin so the dowel will seat on its top surface. Add the 3/16-inch balsa tips and tip doublers.

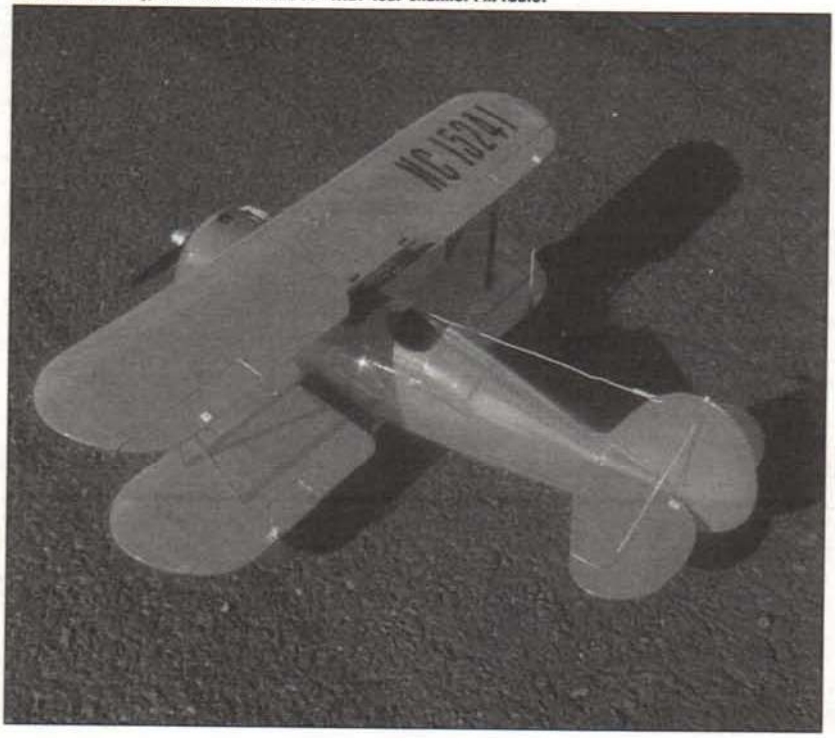
The upper center section skin is fitted from the face of the trailing edge to the *centerline* of the spar. The leading edge sheeting is one piece from the root to the tip rib and fits from the rear face of the spar to the leading edge dowel. You will need to cut a notch to fit the center section skin, which extends to the spar midpoint. When dry, the top and bottom skins can be blended smoothly into the leading edge dowel.

Sand the root ribs of both panels to form a good joint with a straight leading edge and with both tips elevated 1/4 inch above the board. Starting at the root, cut off the entire trailing edge section 1-1/2 inches in from the trailing edge. Mark and cut off the ailerons as required (short for four ailerons, long for two).

The two wing halves can now be joined (with epoxy) with both tips elevated 1/4 inch. On the trailing edge piece from the center out to the aileron gap, provide a slot for the aileron control rod housings (pieces of Nyrod). With the finished aileron controls in place, carefully align the trailing edge sections with the wing and cement in place, making sure they are parallel with the bottom wing skin. Hinge and trial-fit the ailerons to the wing. Install a 2-inch band of glass tape around the wing at the center section.

Not a very good photo, we know, but this is the author's full-size Waco YMF-5 photographed at Bridgeport, Connecticut, circa 1959. It's one of several classic and homebuilt aircraft he's owned over the years.

With the Waco you have the option of using two or four ailerons and making one or two cockpit openings. Model is powered by an O.S. .25 with a 9x6 Master Airscrew prop, is covered with Super MonoKote (the author's favorite), and uses a Futaba FP-4NBF four-channel FM radio.



UPPER WING

Construction of the top wing is the same as the bottom, except that the trailing edge is left attached and only the ailerons are cut out and hinged. They are driven by a slave pushrod from the lower ailerons. Also, the wing has no dihedral and may be built in one piece on a flat surface. Prior to skinning the center section and the leading edge, install 4-40 blind nuts in the 1/8-inch plywood wing support pads. For extra strength, skin the center section with one piece of wood between the outboard R1 ribs.

FUSELAGE

The two FS1 fuselage sides are 1/8-inch balsa. Doublers D1 through D4 are glued to one FS1 with spaces in between to accommodate the firewall and bulkheads. Install the firewall and bulkheads B1 through B4 on one FS1, then place the remaining FS1 on the building table (doublers up) and cement the bulkheads into the slots.

The verticals and cross members at the F5 former location are installed after the fuselage sides are pulled together and glued at the tail post. When installing the top formers, note that the F-2 behind the cockpit is double; the rear one is notched for the turtledeck stringers.

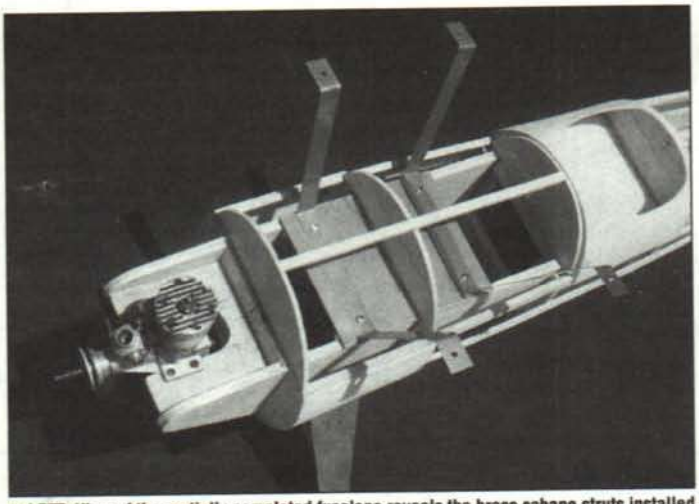
Between formers F-3, F-4 and F-5, back to the rearmost F2, glue in fillers of 1/8 balsa at the upper edge of FS1 to provide support for the bottom edge of the top skin. The 1/16 side skins go from the firewall back to the first F3 on each side. The aft bottom of the fuselage is covered cross grain with 1/16 balsa. Cement a piece of 1/16 ply to the bottom at the tail post, extending far enough forward to attach the tail wheel bracket.

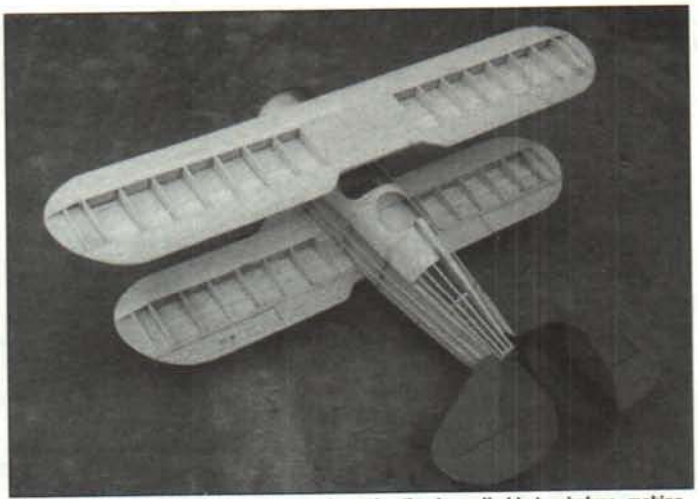
The center section struts are bent from .032 brass or aluminum—your choice. The prototypes all use K&S brass because it is available here in Hawaii

EEE-Z-FLI WACO YMF-5

Designed by Al Wheeler

WINGSPAN	40 in.(top), 35 in.(bottom)
WING AREA	Approx. 500 sq. in.
WEIGHT	68 oz.
WING LOADING	19.6 oz./sq. ft.
LENGTH	32 in.
POWER	O.S. .25 used in prototype
RADIO	Four channels required





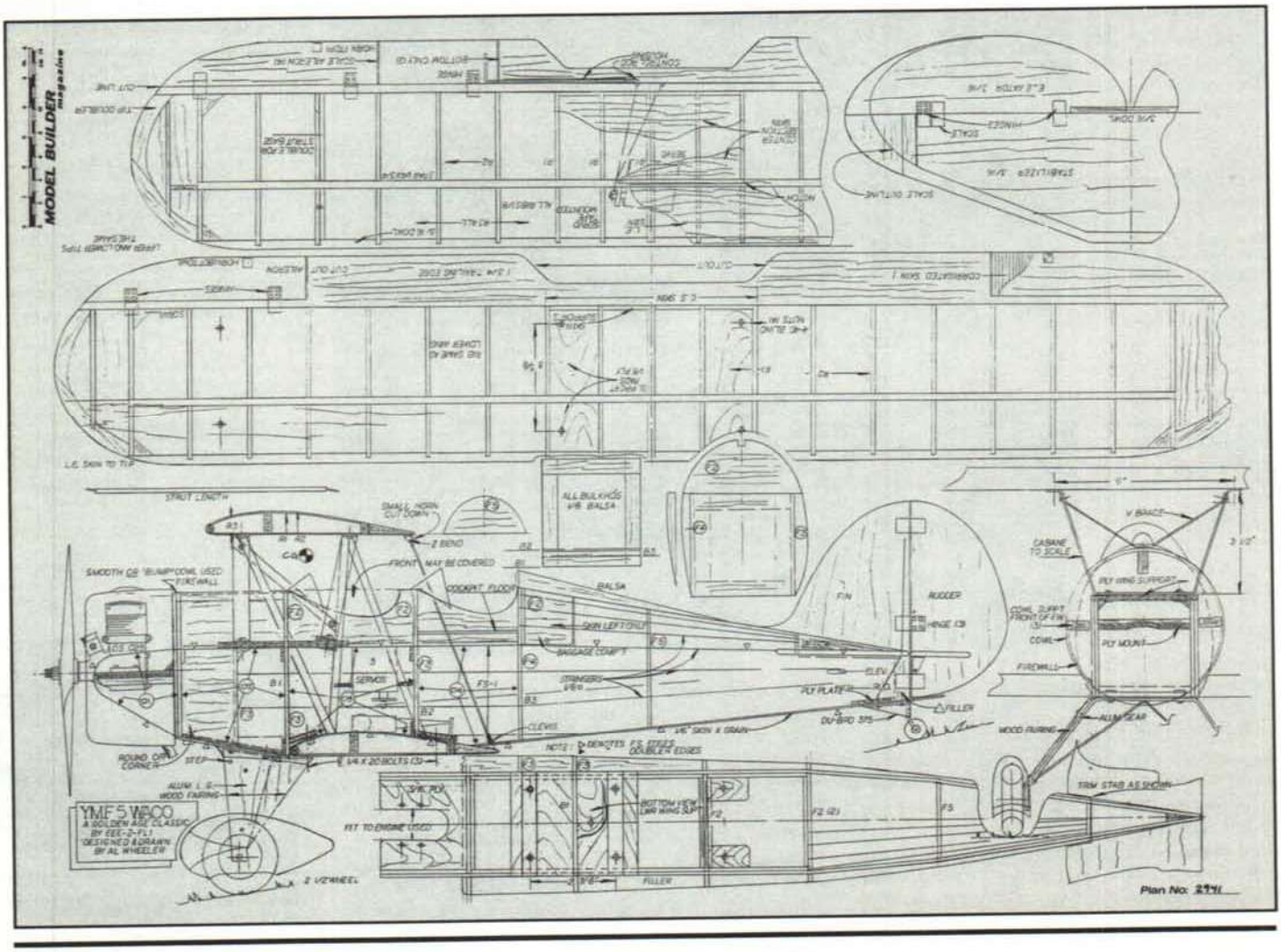
■ **LEFT: View of the partially completed fuselage reveals the brass cabane struts installed on the 3/16-inch plywood plates. Upper fuselage sheeting is applied in two halves, making it simple to put on with the cabanes in place.** ■ **RIGHT: Al couldn't wait to get started covering and actually had the stab done when he remembered to take a bare-bones photo. Here you can see the typical EEE-Z-FLI wing structure—fully sheeted on the bottom, full-depth spar, sheeted on the top from the spar forward. Ailerons have yet to be cut out of the solid balsa trailing edge on the top wing.**

and the writer likes the way it bends. When bending the struts, keep the dimensions as close to the plan as possible, as they establish your basic rigging. Attach the struts *permanently* with 4-40 hex socket screws, using CA or Loctite on the threads. The prototype has many aerobatic flights on it and nothing has come loose.

Because the upper fuselage skin is done in two pieces, joined at the top stringer, getting it on with the cabanes in place is no problem. Make the slots a little longer than the strut width and about 1/4 inch wide with rounded ends. Assure a good glue bond on all edges. The front cockpit may be cut open or left covered; Waco YMF-5s are seen in both configurations.

The 3/16 plywood engine mounting plate is epoxied in place between the forward fuselage sides—assure a good fit against the front of the firewall and be sure to install the triangular reinforcements on the bottom side. Be sure to drill the plate to fit your engine and install blind nuts prior to epoxying it to the fuselage.

continued on page 82



MODEL PLAN SERVICE

Plan prices subject to change without notice.

ORDERING INSTRUCTIONS: U.S. orders, including APO and FPO, add 20% of total order for shipping and handling. Overseas orders (includes Canada and Mexico) add 50%of total order. Remit payment by International Money Order or U.S. funds, drawn on U.S. bank. Please, no cash or C.O.D.'s. Mastercard or Visa include card number, expiration date, and signature. California residents add 7.75% sales tax. Allow 4-6 weeks for delivery. **Illustrated Plans Catalog, 50 pages, 8.5 X 11", $2.00 ppd.**

All Full-Size plans purchased from MODEL BUILDER Magazine include a reprint of the construction article, if building instructions were part of the article.

No. 2941 WACO YMF-5 **$14.00**
Another classic standoff scale aerobatic bipe from prolific designer Al Wheeler, done in his unique all-wood EEE-Z-FLI style of construction. Spans 40", 500 squares, prototype is powered with an O.S. .25. Build it with one or two cockpits and two or four ailerons. Easy to build, looks and flies great.

No. 2942 MINI MAVERICK **$5.00**
Inspired by Tom Hutchinson's Maverick competition free flight, Dennis Weatherly came up with this simple and great flying Pee Wee 30 model. Designed for a hot Cox Pee Wee .020 (would also make a fun sport flier with an .010), the model spans 30" and has a two-wheel gear, pylon-supported polyhedral wing, elliptical stab and wingtips, and an all-balsa fuselage.

No. 1941 LAZY-H **$18.00**
What better way to get involved in larger electrics than with a simple, quick building, great flying biplane? Noted electric designer Scott Hartman's Lazy-H is just that. Powered with an Astro 25 on 14 cells, this 49-1/2 inch span, 810 square inch, 5 pound bipe requires only a basic three-channel radio for rudder, elevator and throttle. All-wood construction. Two sheets.

No. 12931 SCHNEIDER SPORT ELECTRIC **$14.00**
Top electric model designer Bob Benjamin reengineered the Stream, Inc. "Schneider Sport" RC floatplane for electric power, the result being an easy-building ship that strongly resembles a late-20s Schneider Trophy racer and delivers excellent performance on 14 to 18 cell geared electric systems such as the Astro 25 or 40. Equally at home on wheels or floats, the model spans 62-3/4", weighs 7 to 8-1/2 pounds and covers 664 squares.

No. 11931 WET 'R DRY **$16.00**
Noted designer Al Wheeler adapts his unique all-wood "EEE-Z-FLI" construction techniques to this scale-like amphibian, for four-channel RC and .35-.40 power. Looks sort of like a Grumman Widgeon with a single pylon-mounted engine. Landing gear can be manually retracted for water flying. Span 63", wing area 530 squares. Two sheets.

No. 10931 ZOOMSLOT **$10.00**
Innovative designer Roy L. Clough, Jr. adapted his 1955 slot saucer concept to RC, using a Cox reed-valve .049 and Cox FailSafe single-channel radio, ingeniously set up to provide rudder and elevator controls. The oval-shaped saucer itself is 3/4-inch foam with only a few balsa parts added.

MINIMUM ORDER: $10.00 • SEND TO: Model Plan Service • P.O. Box 2459 • Capistrano Beach, CA 92624-0459 • 714/ 496-5411

YMF-5 WACO

continued from page 54

COVERING

Don't spare the sandpaper or the vacuum! A covering job is no better than the preparation. Tiny specks on the surface emerge as big ugly lumps when covered by an iron-on film. For ease of application, excellent shrinking properties and lasting color, the writer recommends Super MonoKote. Colors and trim are the builder's choice. The subject of the prototype model was a Waco YMF-5, NC15241, owned by the writer in the 1950s. After covering, trim the MonoKote from any glue joint areas to assure a good wood-to-wood bond.

ASSEMBLY

Install the stabilizer and fin, assuring that they are both level and square with the fuselage centerline. Install the landing gear and the tail wheel assembly. Bend up the V brace between the front center section struts so that it maintains the 6-inch dimension between the wing mounting holes and just touches the top of the fuselage. To install the V brace, first bolt the top and bottom wings in place, and bolt the V brace to the cabanes only. Note that the model can now be rocked from side to side on the center section struts. Support the model so that the gap between the wings is equal on both sides. Mark the fuselage top through the hole in the V brace. Remove the top wing and install a screw into the fuselage top, back it out and harden the wood with CA, then reinstall the screw. Install the diagonal braces between the front and rear struts. This cabane strut design has been used on several EEE-Z-FLI biplanes and will stand up to any amount of tough aerobatics. The Great Lakes (September '93 *MB*) has been slammed into the ground pretty hard, inverted, and the struts held up with only minor bending.

At this point, check the incidence angles. Using an incidence meter, level the model so that the top of the stabilizer reads 1 degree positive. The lower wing should read 0 degrees and the top wing 1-1/2 degrees positive. The top wing incidence can be changed by adding washers between the wing and the center section struts; the bottom wing can be changed by using various thicknesses of wing seating tape. When the wings are in their final positions, the N struts can be made and installed.

FLYING

Assuming the airplane balances properly, the engine is broken in and has been test-run in the model, the radio range checks OK, the controls all move in the right direction, the model tracks straight when rolled on the ground, etc.—in other words, all of the normal pre-flight checks show the model to be airworthy—it's time to fly. Acceleration is fairly rapid, so line up and add throttle slowly, keeping the tail wheel on the ground until you track in a straight line, easily apply full throttle and right rudder as needed. The tail will come up by itself and a little up elevator will give you a smooth liftoff.

Make a circuit of the flying area, throttle back a bit if it is more comfortable and adjust the trim as required. You will find the Waco to be stable in pitch and roll and capable of loops and rolls from level flight.

Adjust the control surface travels to your liking. Just rudder and elevator alone will produce clean snap rolls and spins. Spin recovery is quick by just releasing the controls. Check the glide characteristics prior to landing—a slight nose down attitude produces a good glidepath. The landing roll is easily controlled with a bit of rudder waggling. Enjoy your Golden Age creation and be sure to send a photo to the writer—Al Wheeler, 525 Kumulani Dr., Kihei, HI 96753. You might win an EEE-Z-FLI T-shirt! **MB**