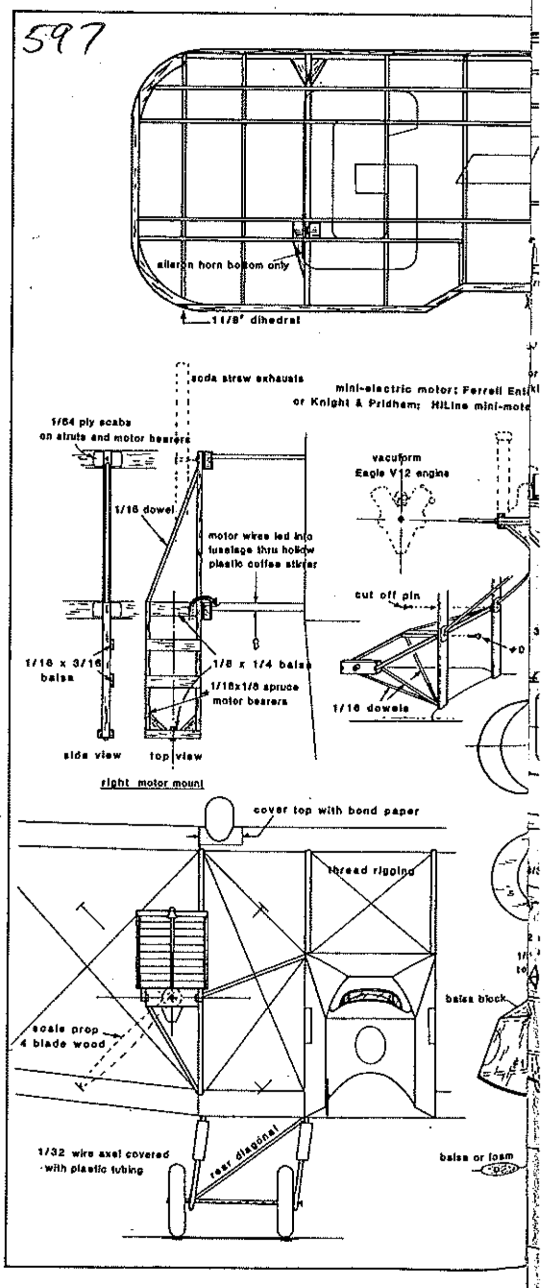
Handley Page W8b

Many aircraft designs haven't been modeled in small size because of shapes and moments that are difficult to balance without adding much ballast. Mini-electric power is helping to open up this new frontier.

■Don Srull



THIS AIRCRAFT of 1922 was one of the first relatively successful British post-WW I transports which was not simply a converted bomber. Seven of the W8b planes were built and used during the period of 1922 to 1932. Power was provided by two 350-hp Rolls-Royce Eagle VIII V-12 engines. Span was 75 ft. and gross weight 12,000 lb. It carried 12 to 14 passengers at a speed of about 104 mph between major cities throughout Britain and the European continent.

The model design presented here was inspired by Dave Stott's beautiful little rubber-powered W8f (a three-engine version of the W8) which he flew in 1982.

Construction is pretty much the same as a typical stick-and-tissue Rubber model. Use lightweight balsa except where noted on the plans. Keep the model as light as possible. Don't reinforce or beef up the structure. Save the heavy RC-grade balsa for RC projects.

Make sure all the structure is straight and well sanded before covering. While uncovered, fit the wing temporarily to the fuselage. Line up both wings very carefully, then fit and size all of the interplane struts. Do not permanently glue the struts in place; just get snug placements at all the strut fittings. When all is lined up, glue and reinforce the strut plug-sockets with balsa gussets at each of the rib locations.

Several of the commercial motor units can be used. In all cases at least the wiring harness will have to be discarded. Rewire the system to place the battery, switch, and charge-plug in the fuselage nose. The FE motor and Knight and Purdham unit can be used pretty much as is, although both will have to be mounted fairly close to the front of the nacelle and against the radiator because of their short prop shafts. The VL and MRC units can be used, though even more adaptation will be required. The units shown on the plans and used in the prototype model were from the HiLine Ltd. Mini-Electric tinkerer's kit.

Fit the motor mount/nacelle frame with the motors attached at this time. Use Ambroid (or equivalent removable model ce-

Top: The Handley Page is a stable and majestic flier. Three 150 mAh cells provide consistent flights of over 1 min. Above: This model would be a difficult Free Flight subject for any other form of power. Mini-electric motors do the trick due to their small size and synchronization.

ment) to tack-glue in place. Drill and fit the small wood screws and pins that anchor the nacelles to the struts. Make sure the motor thrust lines are 0° down in the left nacelle and 3° down in the right nacelle. No side thrust is needed.

Drill a hole in the fuselage where the front brace (hollow plastic drink stirrer) attaches, and thread motor wires into the fuselage. Hook up the parallel wiring harness to the switch, charging jack, and battery. I used three Sanyo 270 mAh cells for my model, although three 150 mAh cells would probably be adequate and save several grams.

Attach the 4-in. plastic props, and check out the propulsion system prior to covering to assure smooth operation and proper direction of prop rotation. The nacelles may seem a little flimsy at this point, but in the final assembly the scale $\frac{1}{16}$ dowel braces stiffen the motor mounts enormously.

Covering and finishing. Disassemble the

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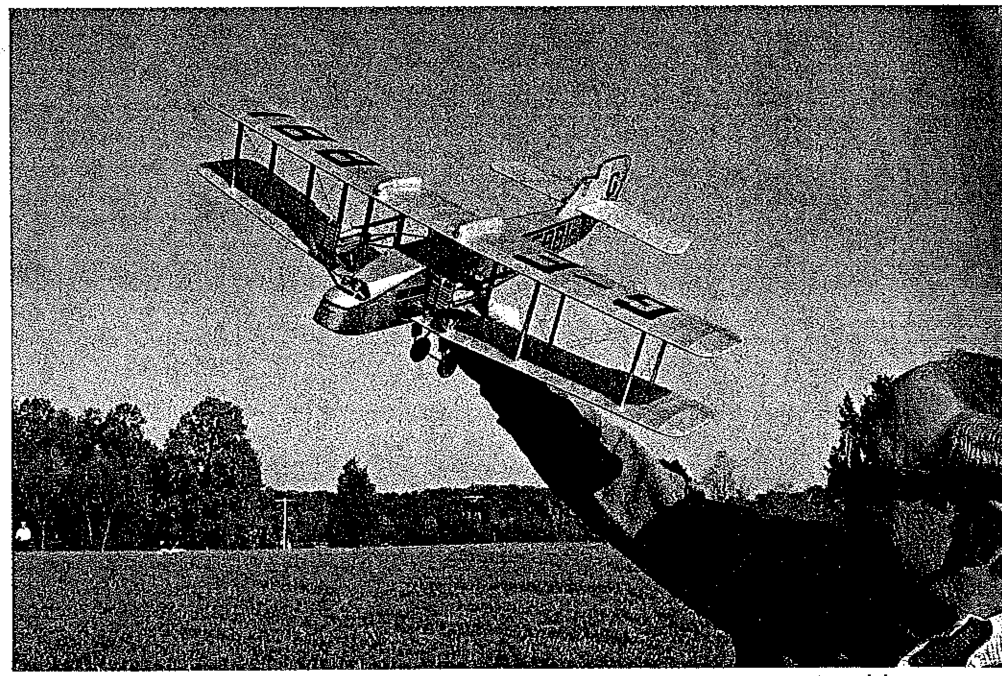
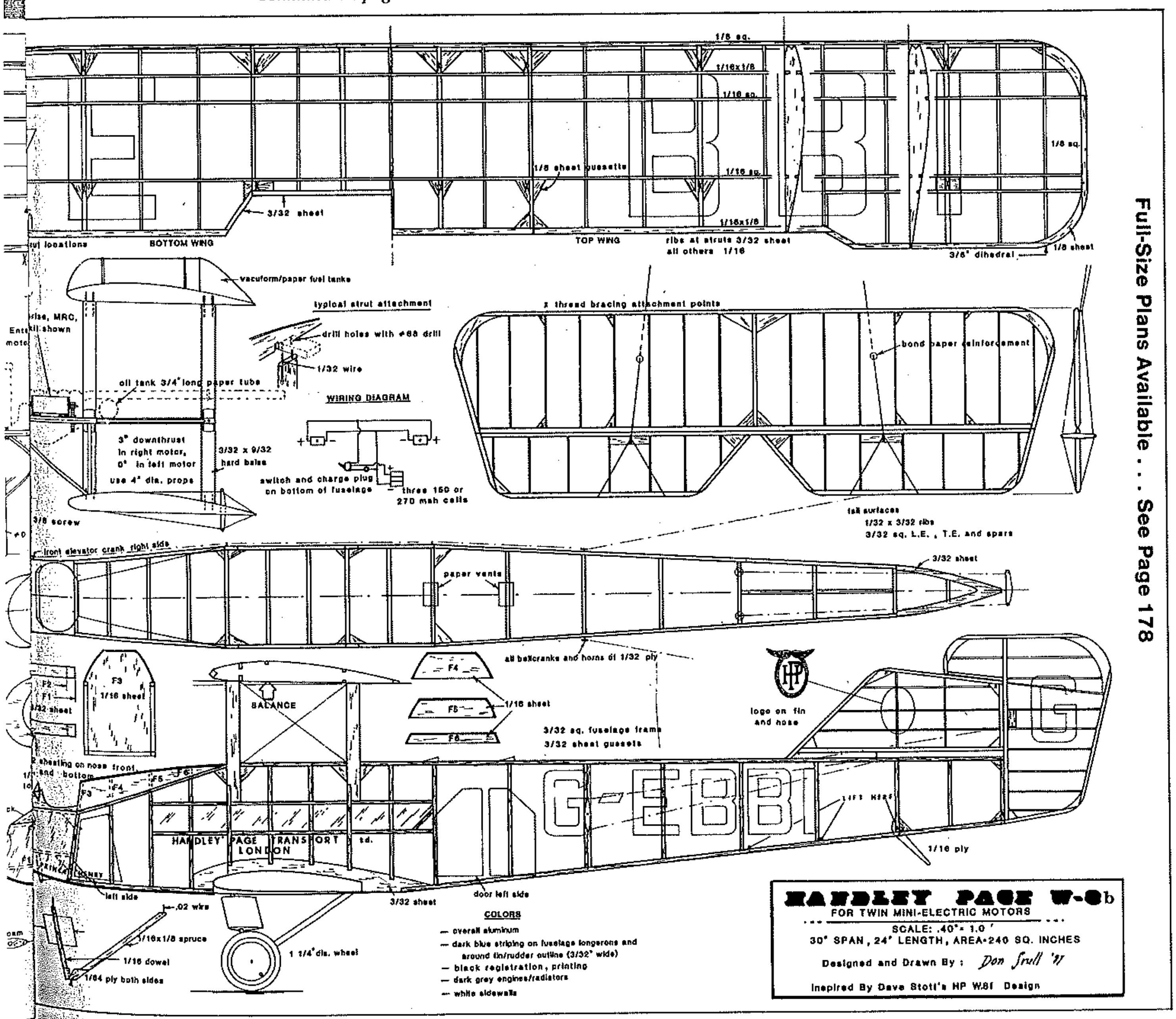


A span of about 30 in. and a flying weight of 6 oz. results in the HP being a compact model—but one big enough to detail. Construction uses the traditional stick-and-tissue methods.



Full-Size Plans Available . . . See Page 178

tom motors, which tells you it can't be all that difficult. Two custom motor combinations we have found to work well:

a) Rewind with #30 wire: 3:1 gear ratio with 6-in. Peck-Polymers prop and two 100 mAh cells.

b) Rewind with #32 wire: 6:1 gear ratio with 7-in. Peck-Polymers prop and three 100 mAh cells.

The latter motor system powers a 26-in.-span Curtiss OC-2 biplane. With 150 sq. in. area and 4½ oz. weight, it flies great. The three 100 mAh cells routinely provide beautiful flights of 1 or 2 min.

If you want to try your hand at making a couple of custom mini-motors (and don't mind rewinding your own), a new company called HiLine Ltd. (P.O. Box 1283, Bethesda, MD 20817) sells a tinkerer's double mini-motor kit for $12.95 plus $1.50 postage. It contains three Kodak motors (in case you goof up one), rewind wire, two sets of gears and shafts, etc., plus rewinding/assembly instructions. HiLine also sells a parts kit for the hand-held field charger described earlier (without the timer) for $19.95 plus $2.00 shipping. Send a pre-addressed, stamped envelope for a price list of all their items.

A way of doubling the power of mini-electric motors, of course, is to gang two (or more) of the motors to a single spur gear. The photos show one such dual motor system which couples two rewound HiLine motors to a 6:1-ratio spur gear. Power with three 150 mAh cells and an 8-in. Peck prop is enough for a 250 sq. in. model weighing 8 to 10 oz. Total weight of the illustrated dual motor system is 60 grams. Dual motors, of course, will draw twice the power from a flight battery as does a single motor.

Multi-mini-motor systems are ideal for multi-engined Free Flight Scale models. Scale subjects that heretofore were unthinkable for Free Flight are now no big deal. To demonstrate this point to ourselves, we built and flew a 42-in.-span Do-X! Here are a few tips on typical multi-engine models to be powered by Mini-Electrics.

The wing area for a multi should be scaled up roughly by the number of motors. That is, for two-cell twin motors, try for a model with wing area between 150 and 240 sq. in. For three-cell twin motors go for 200 to 280 sq. in. Wing loading should be kept between three and five ounces per square foot (the lower the better).

Prop diameter on multis is often limited. For this reason the lower gear ratio motors are usually more suitable. In some cases, even lower gear ratios than those found on commercial units will be beneficial. That's one advantage to customizing your own motors. Suitable plastic props for multis with diameters of 4 in. to 5 in. are made by Kaysun (Oldtimer Models carries these), North Pacific (from Peck-Polymers), and Williams Brothers. Of course you can also make your own props, even to scale—like three- and four-bladers.

Rule one in wiring a multimotor is that the motors should be wired together. Otherwise one of the primary advantages of multi-electrics would be lost: almost perfect, automatic synchronization. Basically we can wire multis together in parallel or in series.

Let's take an example. Say we have a twin using two three-cell motors, each drawing 2½ amperes current. One of the illustrations shows the two possible arrangements. In either case we need double the battery energy of the single motor system. The series arrangement would use a battery of six cells of, say, 70 mAh capacity and draw 2½ amps current. In the parallel arrangement we would use three cells of 150 mAh capacity and draw five amps current from the battery.

The advantage of the series setup with higher voltage is lower losses in the battery because of the lower current. The advantages of the parallel setup include easier charging (with three cells we still can use our standard field charger). The second advantage of parallel wiring is that you will use a much more reliable, robust battery (less chance for a single cell to go bad, less problem of cell "balance," etc.) Overall I prefer the parallel system for its simplicity and reliability.

For four-motor and six-motor airplanes (even eight, 10, 12, etc.), these same principles apply, although many more options are available. The basic requirement is to pair up opposite-side motors (for example outboard left and outboard right) on the same cells. Another drawing illustrates enough of the various alternatives to give you the idea.

For parallel-wired multis, the cells used in the flight battery pack have to be of higher capacity than those commonly used for the conventional single-motor Mini-Electric. Cells of 150, 270, and even higher capacity may be necessary. For twins, 150 mAh- and 270 mAh-capacity cells are about the correct size. Radio Shack sells a 150 mAh "N" size in packages of two for $4.99 (catalog #23-121). Ace RC sells Sanyo 270 mAh cells for $3.90 each. SR Batteries carries high quality cells of 150 mAh, 300 mAh, and higher capacity.

If you would like to give twins a try, and don't mind building two wings, the Handley Page W8b construction article illustrates one example of the new breed of Mini-Electric Free Flight Scale models. Remember, a Free Flight Dornier Do-X is now a practical reality. Let's cut balsa!

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pieces and cover them with lightweight white Japanese tissue. Lightly water spray the tissue for shrinkage, and when dry brush on three or four thin coats of non-shrinking dope such as Sig Lite Coat butyrate or clear brushing lacquer. When you are sure all paper and wood surfaces are sealed, spray on a couple very fine coats of silver dope or lacquer. There's no need to load up with a thick opaque finish; a light uniform coverage is adequate.

The particular aircraft modeled, G-EBBI, has a somewhat tricky but attractive trim. A dark blue stripe edges the fuselage longerons as well as outlines the vertical fin/rudder assembly. I marked in the stripes with a drafting pen filled with thinned blue enamel, then brushed on the interior of the stripes with a fine brush. Doing this was somewhat tedious, but it looks pretty good.

Registration letters can be masked and sprayed on—or cut from black tissue. The other fuselage lettering is from rub-on dry transfers or drawn with pen and ink and lettering guide. The Handley Page logos on the fin and nose were inked onto a piece of silver-doped tissue which was then stuck on

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with double-sided tape.

Wait until after the initial test flights before permanently attaching the $\frac{1}{16}$ dowel motor nacelle braces (lightly glue them with Ambroid at first) and adding the radiators and vacuformed engines. This will enable you to make minor thrust adjustments, if needed, more easily.

Lastly, carve some foam pilot figures and add as much of the rigging and control cables as you like.

Flying. Make sure all the surfaces are unwarped and the balance point is as shown on the plans. The first test flights should be in very calm weather and over the softest surface you can find (green grass is ideal). Test charge the flight battery several times to get a feel for how long a charge is needed to get an 8- to 10-sec. motor run. Since we really can't test glide this model, we will use short runs to sort things out initially.

Put in a tweak (about $\frac{1}{16}$ in.) of right rudder. Charge the motor for an 8- to 10-sec. run, and carefully launch the model. Remove any noticeable turn, dive, or stall tendency with the rudder and elevator. These surfaces are large, so only make small changes at any one time. Shoot for a straight power glide or almost level flight with no tendency to slow down and hang on the props.

When the short hops are satisfactory, begin to lengthen the charge to get five to 10 additional seconds of power. Remember that as you lengthen the charge, the initial power level will increase somewhat. By the time you reach 20 to 30 seconds of power, you should be getting a very slight initial climb and then a level cruise. Keep the turns very wide and gentle. When power is exhausted the model will descend in a slow but steep glide (this isn't a thermal soarer!).

Do not allow the model to climb nose-high and near a stall—especially in gusty weather. Trim for a relatively shallow, penetrating climb. When you are satisfied with the short power runs, charge up and enjoy one of the prettiest Free Flight sights you're ever likely to see.

Dihedral/Beron-Rawdon

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it will roll at 15/10 x 20/30 = 1.00, or the same roll rate! Going to the plot in Figure 4 for 80-in.-span planes, we find that the roll rate should be about 26 degrees per second. (Good thing the plots agree!)

Figure 5 also contains the same information, but for three EDAs as a function of yaw angle.

Prototypical dihedral arrangements. Although different dihedral schemes with the same Equivalent Dihedral Angle will roll at the same rate, the actual localized flow of the air over the wing will vary considerably.

For the sake of illustrating the behavior with less rudder (yaw) near stall, or to fly with more speed margin from stall when rapid maneuvers are required.

Polyhedral. Breaking the wing up into four sections, instead of two as in V-dihedral, reduces the range of angle of attack variations across the wing during a steady-state roll. This is illustrated in Figure 9 as the sawtooth line. This reduces the possibility of leaving the drag bucket during maneuvers. You can imagine that as the number of wing panels is increased, the sawtooth becomes progressively finer until the equivalent of an elliptical wing is reached.

Discussion. We see from the above that the designer of a rudder-elevator airplane has a few options to play with in order to control the maximum roll rate of his plane. In most RC Sailplane applications, the desire is to achieve a high roll rate—more is almost always better.

Span and airspeed are powerful variables but are usually determined by higher priority requirements, such as glide ratio and