Enter Trainer

Written and designed by Fred Randall

I am not an accomplished RC pilot. My hands shake and my knees want to buckle whenever I have a model in the air. Perhaps it's something to do with "an old dog, and new tricks". At 75, I can most certainly be considered an old dog, and so "ARF" in my case might be a salutation, rather than meaning "almost ready to fly!"

While sketching some ideas for a new airplane on an art tablet I decided to get back to basics and design a model that I could relax with at the flying field. The result was an airplane originally conceived as a conventional trainer.

I tend to have occasional lapses of reason, but the realization finally came to me that I didn't need a trainer; what I needed was an aerobatic model to help me improve my meager flying skills without taxing them beyond reason. This realization resulted in the airplane that I call the EnterTrainer, which is the subject of this construction article.

Design considerations

The airplane's configuration is that of the familiar stick model, with the wings and empennage altered to suit the purpose of this design—that of a stable platform from which to learn the basics of RC model aerobatics.

I didn't design this model with any intention of 3-D capability. While cognizant of the piloting skills needed for this mode of operation and the dedication required to attain them, I'm afraid the art is lost on me. I like airplanes that fly like airplanes, not marionettes!

The model can be powered using a .46- to .60-class glow engine, or with an electric motor of similar power rating. It can use a tricycle landing gear or be configured as a tail-dragger; these options are shown on the plans.

The power plant chosen should be dictated by the type of flying you intend to do. At roughly 6.5 pounds, this is not a super lightweight aircraft, and unlimited vertical performance will require power greater than that previously stated for sports use.

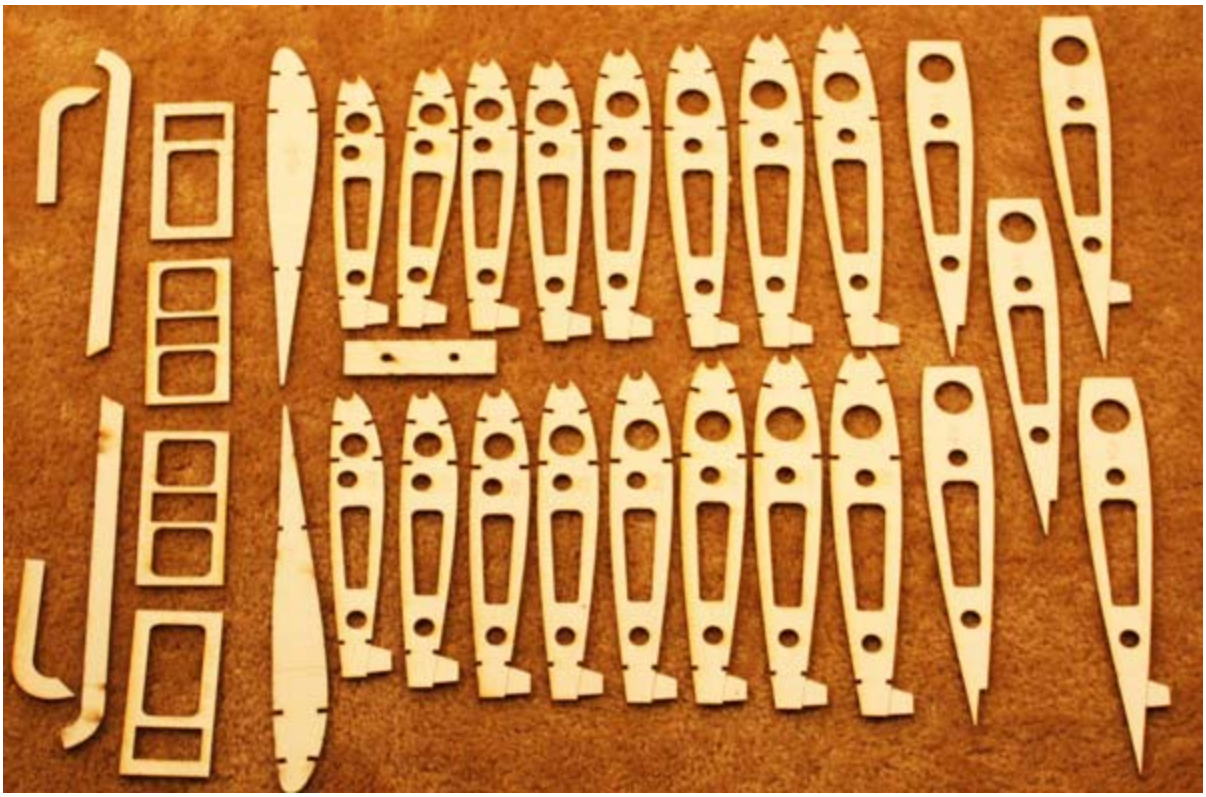
A further option is the extended wing. If you are looking for a model with a wing loading of less than 20 ounces per square foot, the extended wing set provides this. The standard wing is just the ticket for spirited sport flying, while the lighter loading of the extended wing might be better for those with 3-D aspirations, or those desiring a slower-flying model.

In either option the wing uses a thick symmetrical the National Advisory Committee for Aeronautics (NACA) 0016 airfoil at the root, tapering to an almost flat-bottomed NACA 25014 at the tip. This creates wings with a flat top, but with roughly 1/4 inch of dihedral on the bottom under each tip. The total configuration is meant to enhance stability in upright flight, while paying only a slight penalty when flying inverted.

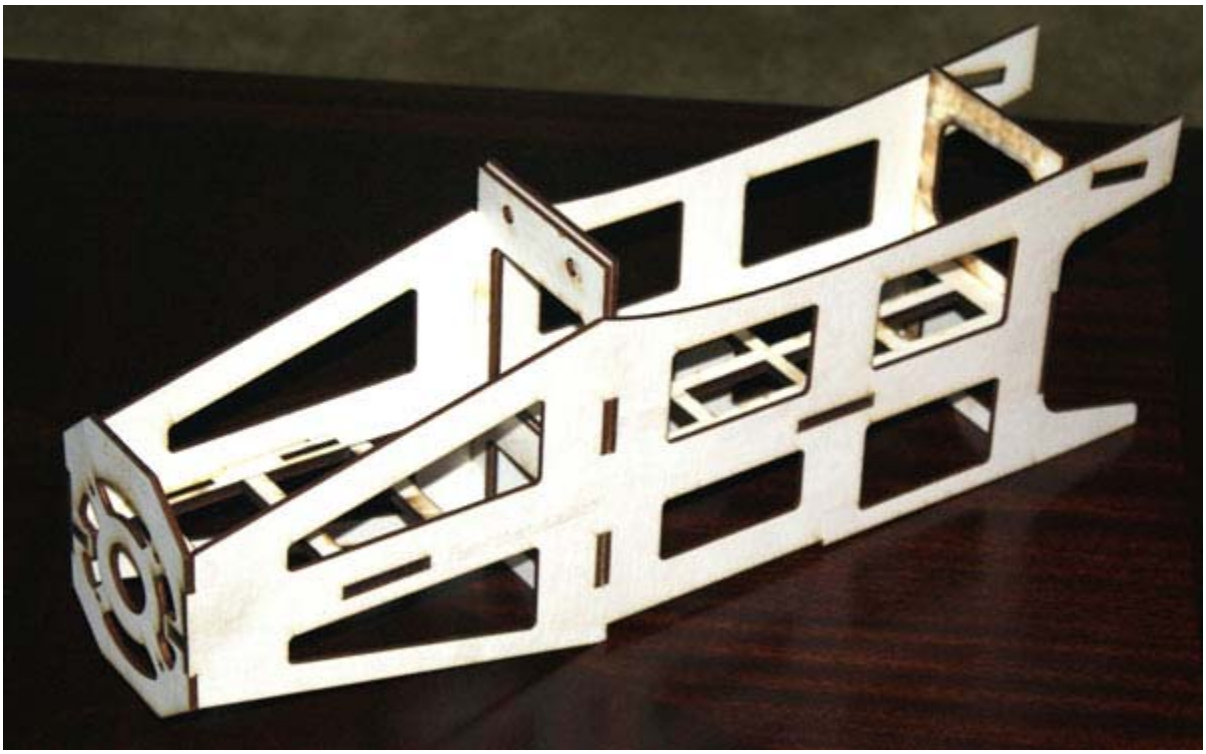
Both flaps and ailerons are provided. The bottom hinged flaps can be eliminated and the ailerons extended to full span if desired. However, I suggest including the flaps as an additional learning tool. The flaps of the extended wing are center hinged for those who would engage in creative transmitter programming.

The empennage is designed to allow maximum deflection of the control surfaces without conflict between the rudder and elevators. Both have dynamic balancers to reduce strain on the servos.

In any version, EnterTrainer is a gentle flyer that can adapt to the pilot’s growing skills by the simple expedient of increasing the throws of the generous (dare I say 3-D rated) control surfaces.



A preformed aluminum main gear is available, as is a laser-cut short kit with either or both wing options from Creative Hobbies. Full-size plans are available at the end of this article. Source information for these and other building materials can be found at the end of this article.



The laser-cut fuselage construction uses a snap-together tab-and-slot box, consisting of the forward fuselage doublers and several formers. These assembled to a tray for the servos, and either a battery or a fuel tank. This arrangement, besides being immensely strong, helps ensure alignment of the fuselage.

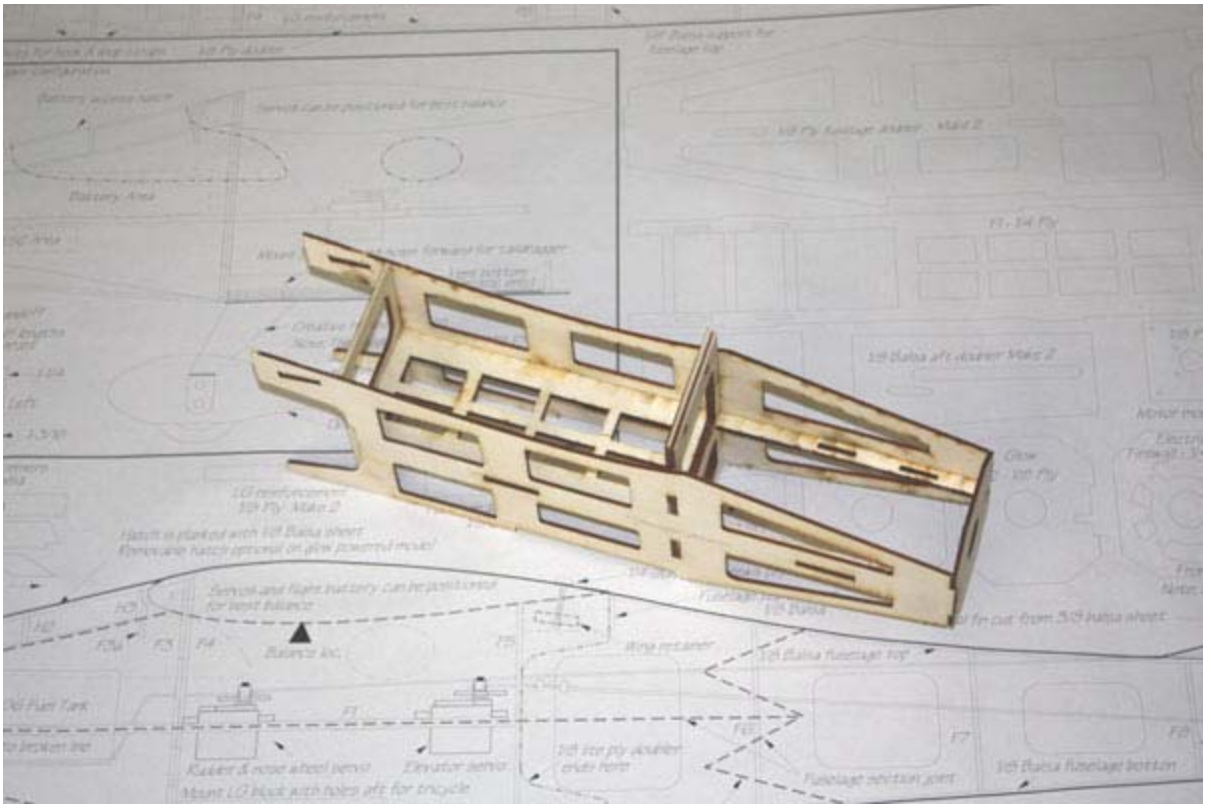
This construction article assumes that the builder has at least a minimum of hand tools, including a model knife, long and short sanding blocks, a razor plane, and a coping or scroll saw to fabricate light plywood parts. An electric drill and a Dremel-type rotary tool are also helpful. You should have an assortment of clamps or spring-loaded clothespins can be substituted.

If you're not using the short kit, it's best to fabricate all necessary parts before starting construction. Many of the parts used to build this model contain lightening holes, as well as tabs and slots that are easily made with a laser cutter. This isn't as easy if you're fabricating your own.

If duplicating these parts is daunting, then by all means simplify them. Use a rotary tool or hole saw to make lightening holes and eliminate the tabs and slots. Use clamps and squares to produce a straight airplane.

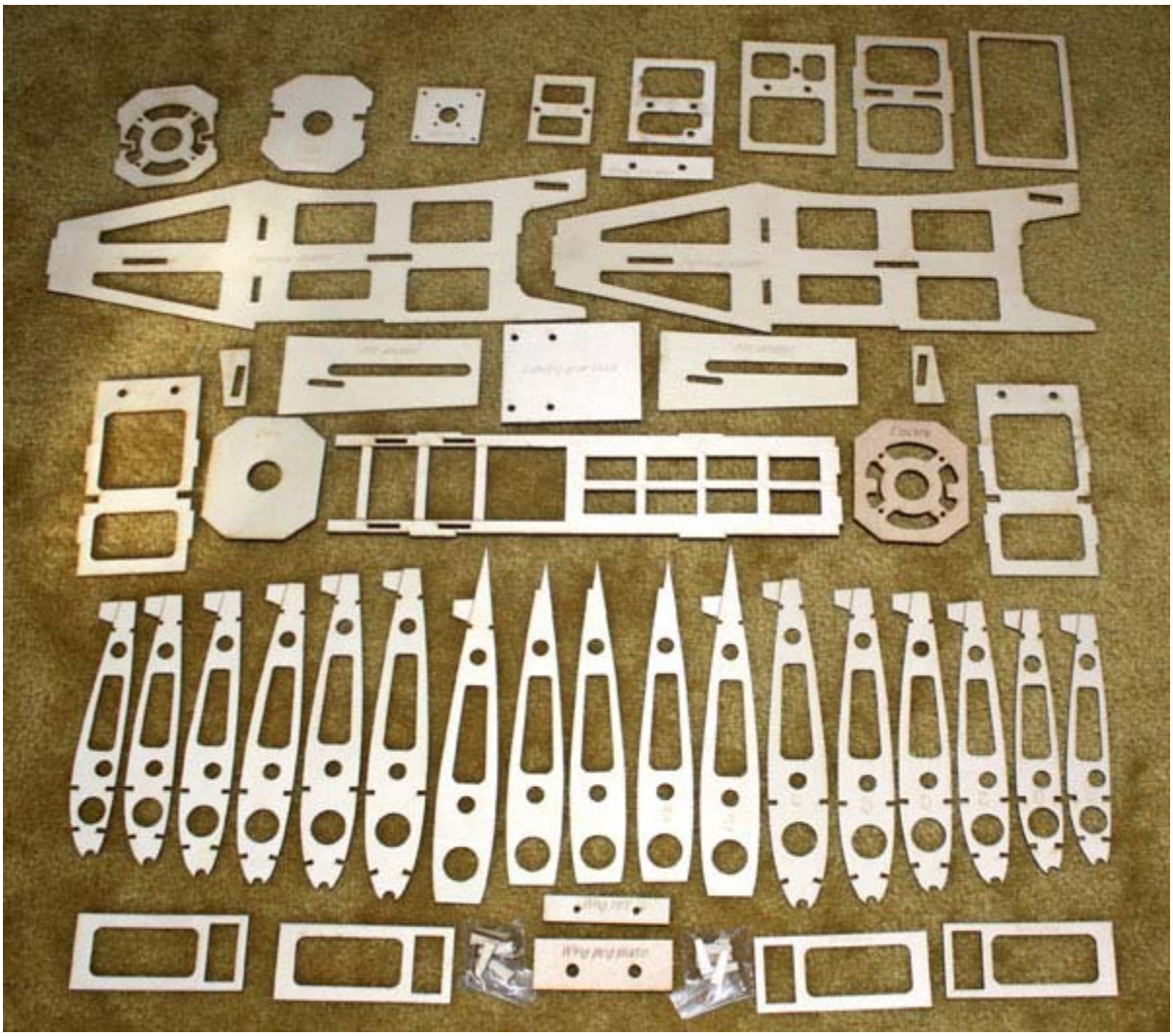
Several sizes of balsa strip are used during construction. I generally cut most of my balsa strips from 3/8 balsa sheet stock, rather than ordering it to size. I encourage modification and experimentation. I always learn something new from those building their own versions of my models.

Construction



This model is for an intermediate builder, and I would not recommend it as a first construction project, because some careful carving and shaping is involved. I suggest building the fuselage first, because it is the more complex of the assemblies involved in building EnterTrainer.

The following applies to the laser-cut short kit:



Depending on whether you will be using glow power or an electric system, you will need to select which firewall and former F2 to use. Those for the electric contain the necessary slots for proper cooling.

If you are building the glow version, the forward crosspieces on F1 should be removed to allow for tank mounting. Otherwise, apply thin CA adhesive to the perforations because the crosspieces will be used as a battery support. Check the fuselage sub assembly parts for fit. Some sanding or filing may be necessary for the tabs to fit properly.

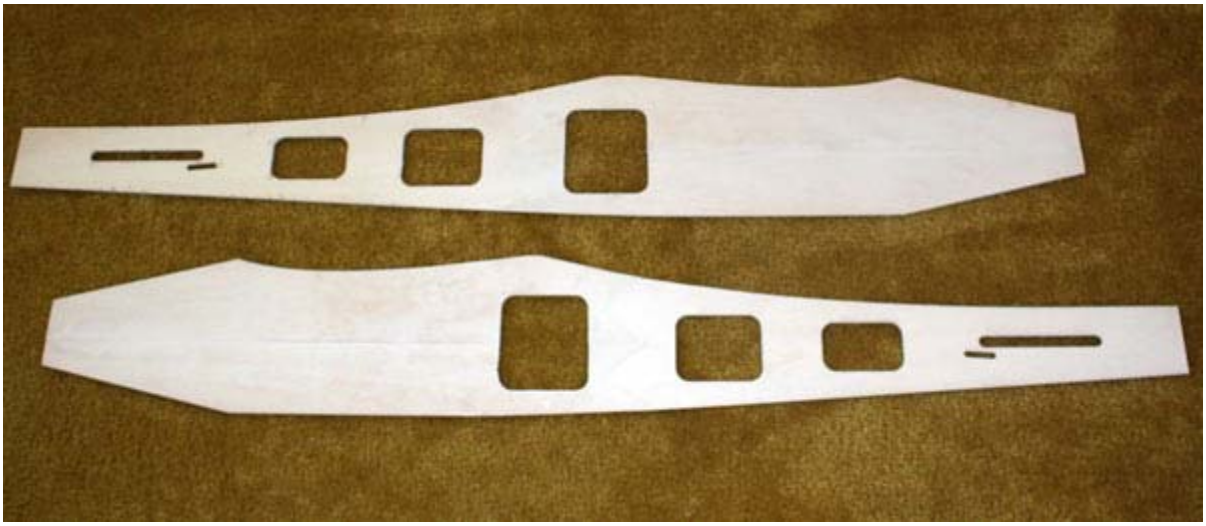
Fuselage

As a preliminary step, use medium CA (cyanoacrylate) adhesive to bond F3 (shorter) and F4 together. The fuselage subassembly consists of F1, F2, F3/F4, F5, and the front fuselage doublers as well as the rear wing retainer reinforcement, the landing gear (LG) plate and reinforcement, and the balsa top support.

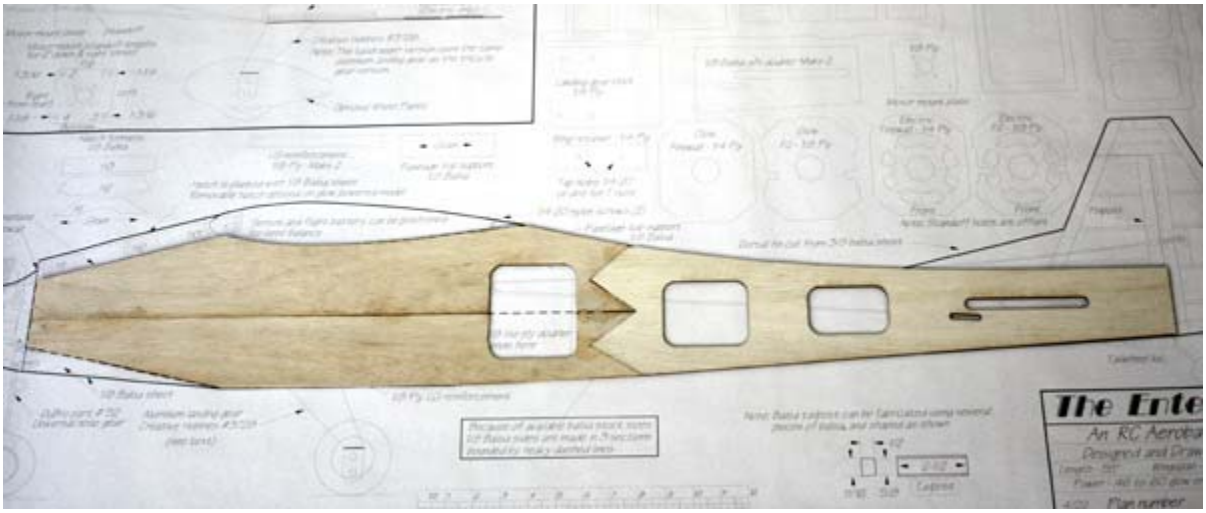
Assemble the formers to F1 and then attach the doublers. Short kit users can assemble the formers and fuselage doublers before applying medium CA to bond them together.

Assemble the 1/8 plywood wing mount reinforcement to the fuselage doublers, and then secure the balsa top support between them. The top of this piece should be 1/8 inch down to allow for the thickness of the rear fuselage planking. Use medium CA to adhere the landing gear plate reinforcement to the fuselage doubler.

Mix a batch of 30-minute epoxy and adhere the 1/4 plywood firewall and landing gear mount to the fuselage inner assembly. Epoxy should also be applied to the juncture of F1, F2, and the 1/8 plywood fuselage doublers. Clamps should be used to secure the firewall and landing gear mount while the epoxy cures. Remember that the holes in the landing gear mount should be aft for trike gear, and forward for a tail dragger.



Because of available sheet-balsa sizes, the fuselage sides are assembled in three pieces. Use suitably matched 1/8 balsa sheet material. Secure the fuselage plans to the building board. Affix a translucent transfer medium, such as shelf paper or vellum over it, and carefully trace the three-piece fuselage side outlines. Transfer the traced images to the balsa sheets and make two copies of each section.



With the fuselage side sections available, cover the plans with waxed paper and pin the balsa sections for one side in position over it. Use medium CA adhesive to bond the sections together. Put another layer of waxed paper over the completed fuselage side and repeat the procedure with the remaining balsa sections. This method ensures that the sides come out identical and true to the plans.

With the two sides removed from the plans, check them for match and make sure that the sections are securely bonded to each other. After choosing a right and a left side, mark the insides with the positions of F6, F7, and F8. Use medium CA to secure the balsa joint reinforcements and aft fuselage doublers in position.

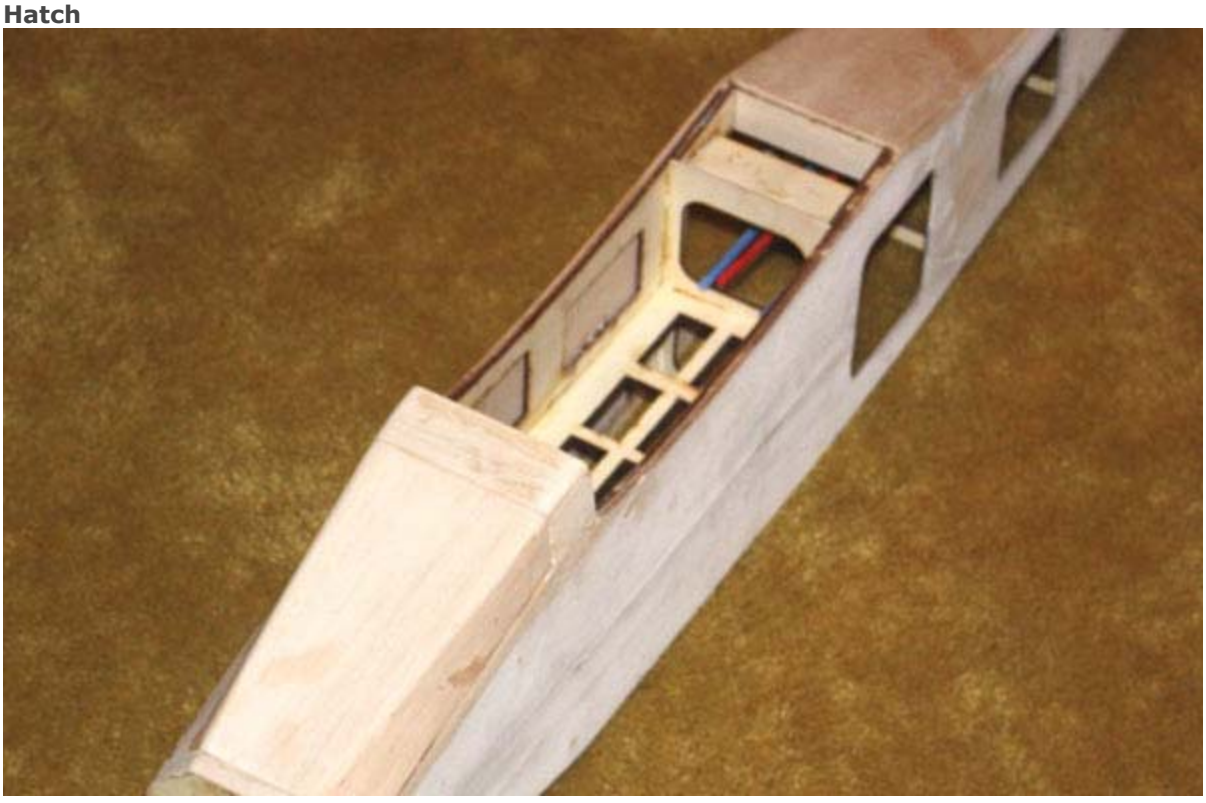
Using clamps, carefully secure the fuselage sides to the ply doublers. Align the sides with the inner structure, and ensure that when the aft portions of the sides are pressed together they match horizontally and vertically. Temporarily pin the fuselage sides together at the rear.

Ensure that everything is aligned properly, and then apply a small amount of medium CA adhesive at several points inside the doubler lightening holes to anchor the balsa sides to the inner structure.

Remove the clamps and gently bend the outer part of the fuselage sides away from the doubler and allow medium CA to flow in and permanently secure the fuselage sides to the doublers. Use only enough adhesive to secure the perimeter of the fuselage sides. After it sets, apply more adhesive inside around the lightening holes.

Remove the pins and clamps and install the remaining formers and fabricated tailpost. Recess the tailpost 1/2 inch to allow for insertion of the fin post later on. Apply a skim coat of balsa filler to the joints on the outer fuselage sides. When hardened, sand the area smooth.

Hatch



The hatch is optional on the glow-powered version, but it is worth considering anyway, because it

gives great access to the tank and the captive nuts that retain the motor mounts and the nose gear retainers, if used. It also provides a place for a remote fuel fitting and glow-plug jack. More on this later.

The hatch and adjacent structures require care in assembly. Refer to the plans and photos as a guide in order to obtain a proper fit. Use a file or a sanding block to bevel the firewall/F2 and the F3/F4 assemblies, ensuring a smooth transition between the firewall and the hatch.

Install 1/8-square balsa hatch supports as shown on the plans. These should be 1/8 inch down from the top of the hatch opening. Former H2a should be installed next. Use the 1/8 plywood hatch base as a guide to position it. H2a should be tilted slightly back from vertical to facilitate easy removal of the hatch.

With the hatch base placed down on the support rails, Use medium CA to adhere H1 and H2 to the hatch base (only). They should fit snugly against their counterparts.

Apply 1/8 balsa planking to the hatch sides (which have a slight twist), and then to the top. Apply 1/8 balsa planking to the firewall/F2 and the section between H2a and F3/F4. Carefully sand with a long sanding block to obtain a proper fit. Follow the plans and the photos. When complete, the hatch should fit flush with a minimum of gap.

The hatch can be retained using dowels and rare earth magnets; the method is up to the builder.

I used a 1/8-inch dowel to secure the front, and three rare earth magnets purchased from Easy Built Models to retain the rear. The magnets engage three flathead screws that protrude from a bracket

cemented across the fuselage below the hatch side rails. The screws assemble to captive nuts adhered to the bottom of the installed bracket. This system permits fine magnet contact adjustment.

Fuselage Completion
Using the plans top view (or the fuselage itself) as a guide, cut the 1/8 balsa fuselage top to shape and fit it flush between the fuselage sides. Use medium CA to adhere it.

This is a good time to install two pushrod guide tubes for the elevators and one for the rudder. Run them through the holes in the formers and out through the fuselage sides and top respectively. Secure them to the formers with medium CA, and then cut the tubes off flush with the fuselage. Use balsa filler on the gaps and when hardened, sand the area smooth.

Cut a piece of 1/8 balsa sheet for the fuselage bottom. It should extend from the rear of the model to the front of the landing gear mounting plate. When it is cemented in place, make four holes to match the bolt holes in the landing gear plate.

If you are building the glow-powered version, drill the firewall for motor mounts, and install T-nuts to retain them. Remember to offset the mounts if using side and/or down thrust. If you are using tricycle gear, drill the holes for the nose gear mounting bracket. Locate and drill a hole for the throttle pushrod. Mount ¼-20 T-nuts on the inside of the landing gear plate. I like to epoxy these in to keep them in place.

While building the prototype, I made a late decision to mount the four-stroke engine inverted. This necessitated mounting the nose gear bracket on the inside of the firewall, rather than outside as shown on the plans. Because of this, the tank had to be lowered and mounted rearward. My choice of providing the hatch paid dividends in this case, permitting access to the nose gear mechanism.

The following is an important step for fuel proofing; don't omit it if you are building the glow version. Liberally apply epoxy finishing resin to the firewall outside and inside as well as to all openings in it.

Mount the fuel tank using your favorite method and install the motor mounts. Locate and install the nose gear pushrod.

For electric version builders: Assemble the 1/8 plywood motor mount using aluminum or brass tubing and machine screws. The tubing length is shown on the plans.

The front bottom portion of the fuselage can now be planked. Because my model has the nose gear mounted inside the firewall, I left an access opening in the planking. This completes the basic fuselage build.

Empennage
The empennage is constructed from balsa strip stock, and is completely conventional; simply build the components over the plans. When construction is complete bevel the moveable surfaces for hinging.

This might be a good time to make the hinge slots or holes, depending what type of hinges you are using. My model uses simple CA hinges. Actual hinging takes place after the covering is applied.

Wings
As with most of my models, I used fiberglass composite (Glaspar) leading edges (LEs) and main spars. The material is light, strong, and inexpensive; it should not be substituted. It is available from suppliers listed in the addendum.

The wings and wing center section are assembled upside down over the plans. The break-off stubs ensure that the wing will be straight and flat, without any twist. The wing taper and transition from

symmetrical to flat-bottomed creates a small amount of dihedral on the bottom of the wing.

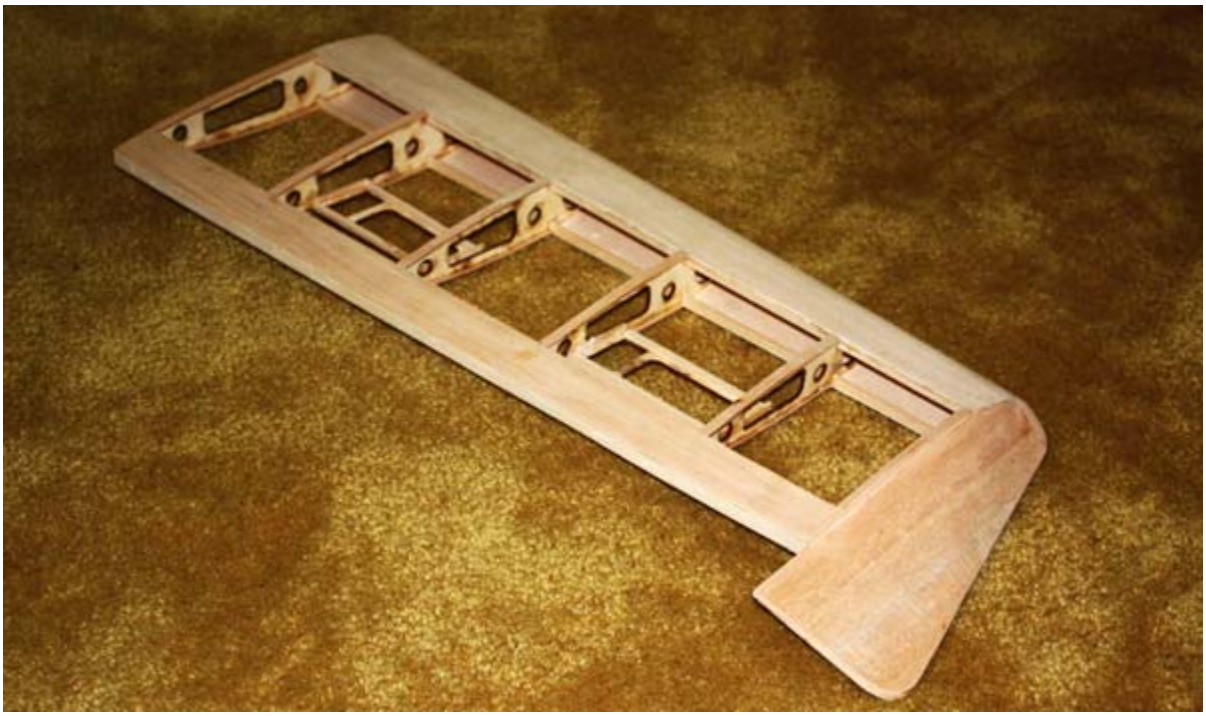
Make the wing center section first. When completed, install 1/4-inch diameter mounting pegs, and the 6-inch long section of .505 diameter composite tubing that functions as a rear locator for the wings.

The center section should mount to the fuselage flush when the pegs inserted in the holes in F3/F4. This would be a good time to tap the holes in the rear wing retainer for ¼ x 20 nylon bolts. Remember to harden the threads with thin CA. The holes should be re-tapped after the CA sets up. After that, plank the top of the center section with 1/16 balsa sheet. Be sure to make holes through the planking for the ¼-20 nylon wing-mounting bolts.

The following instructions apply to both wings and both wing sets. Secure the centermost top spar to the plans. Using it as a guide, use medium CA to adhere the ribs. Ensure that they are square, and that the break-off stubs are flat on the building board. When complete, assemble the bottom 1/8 x 1/4 basswood front and center spars, as well as the 1/8-inch square rear spar to the ribs. Cut the .317 diameter composite LE to size and snap it in place. Use medium CA to secure it.

Cement the servo plates with their 1/8 x 1/4 basswood stiffeners to the wings at this time. Remember that the wings are inverted on the plans and the plates should be assembled flush with what will be the bottom of the wings.

Remove the wing half from the plans. Install the remaining spars. Cut the 1/4 x 1/2 balsa trailing edge (TE) to length and secure it in place using medium CA. Lay the wing on a flat surface and ensure that the break-off stubs are flush on it.



The wingtip parts are cut according to the detail on the upper right of the wing and empennage plan. They are assembled as shown, giving the tips a 1-inch droop. They should be planked entirely with 1/32 balsa for strength. When complete, bond them to the wings using medium CA.

Cut a length of 3/8 x 1/2 balsa aileron/flap LE edge stock to full length, and pin it flush to the wing TE. With the ribs as a guide, sand diagonally across the ribs and the two pieces of balsa with a long sanding block to shape them as shown in the inset detail on the plans. This ensures a smooth transition between the wings and the flaps and ailerons. When complete, cut the aileron and flap LE stock to length.

Construct the ailerons and flaps using 1/16 balsa sheet and TE stock as shown on the plans. Bevel the LEs and slot them for hinging. Note that the flaps are bottom hinged unless you are using the extended-wing option. I used pinned hinges on the flaps and ailerons that I had on hand.

Wing planking

The 1/16 balsa planking wraps around the wing's LE. I soaked the wood with window cleaner (my usual method) to soften it for bending. After I split one wing skin while attempting to make the bend, I made a call.

The helpful folks at BALSA USA suggested that I use household ammonia as a softener. Balsa USA also supplied replacement wing skins at no cost (wow!).

The ammonia worked beautifully! The soaked balsa became so soft I could almost tie it in knots! As a bonus, the ammonia leaves no residue as window cleaner does. When working with ammonia, be sure to do so in a well-ventilated space!

Remove the rib break-off stubs and sand the area sanded. Apply the planking between the aft spars and the TE as shown on the plans, as well as the rib cap strips. I chose to cover the wings before assembling them to the center section, but that is a builder's option.

The completed wings should be assembled to the wing center section using 30-minute epoxy. Use

clamps or tape to hold them tightly together while the epoxy cures. The ailerons (and flaps if used) should be test-fitted and trimmed if necessary.

Cowl

 The cowl is a simple structure made from 3/8 balsa sheet, and is specific to the power plant used. A chin scoop should be present for an electric-powered model to ensure proper motor cooling.

For construction methods, refer to articles appearing in Model Aviation and other publications. The cowl was finished with Hangar 9 UltraCote as was the rest of the model.

I decided on an orange-and-white scheme with black for striping and the faux windshield. Call me a curmudgeon if you will, but I'm not a fan of "flying clown" airplanes. I find the multicolor Op Art schemes found on many of today's ARFs not to my liking, so the conservative old-school color scheme is indicative of my taste. Feel free to cover yours in any way you deem appropriate.

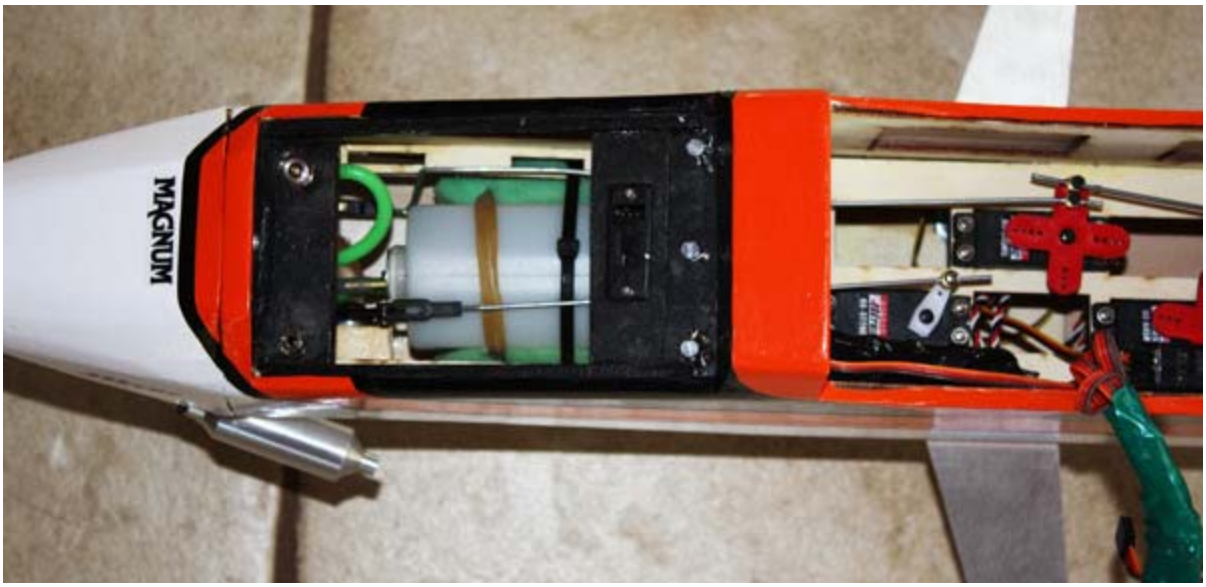
I made some strips of the matching covering material and covered in the hinge joints. It's a good practice and well worth the few minutes that it takes, because it looks neat and it stops control-surface flutter.

Using water slide decal paper and my inkjet printer, I made the AMA logo seen on the left wing, and the name I gave the model on the right wing. The printer ink is not waterproof, so I applied several coats of clear Krylon to seal the decals. I also sealed the edges after application with clear Krylon applied with a small brush.

Hardware
I used an 8-ounce Sullivan tank and Du-Bro hardware. I like single hole mounting control horns with height adjusting flags for clevis attachment. These give fine throw adjustment and are rugged enough for heavy use. In some cases, such as flaps that require extreme deflection, it's necessary to shorten the flags and drill new holes.

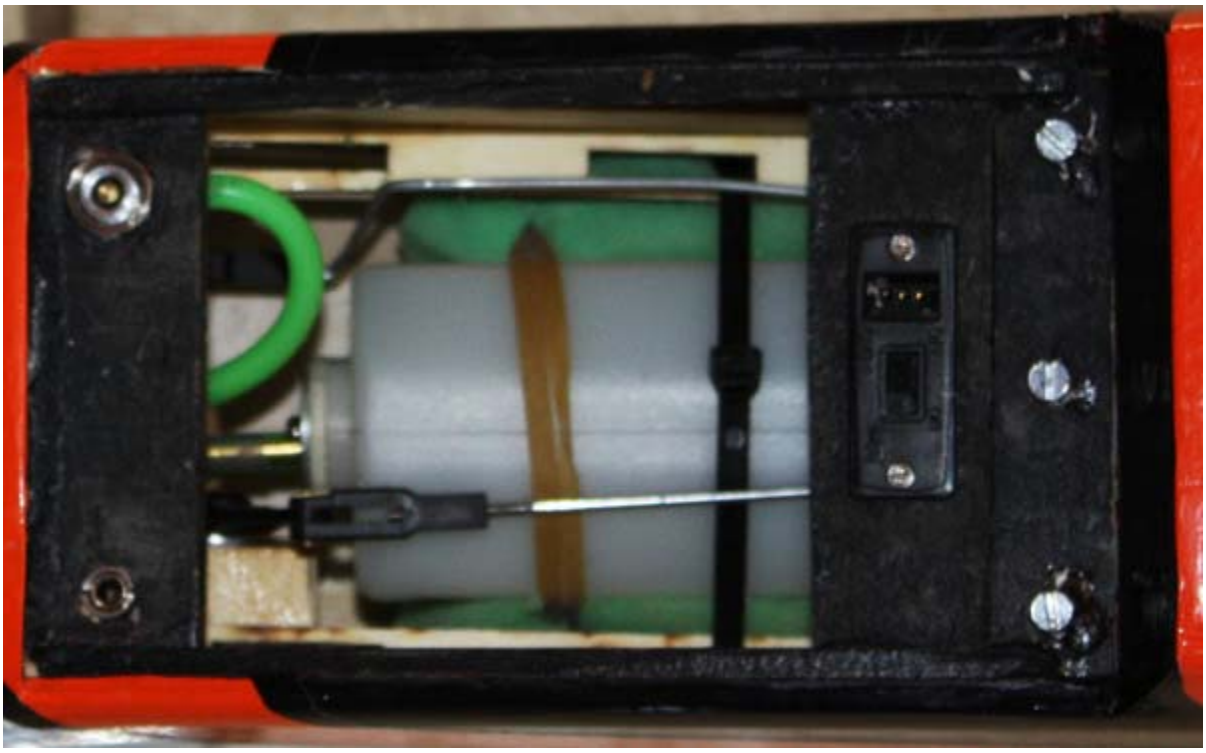
Four Hitec HS-645MG servos are used for the rudder, elevator, and ailerons, while HS-322 HD units are used for the throttle and flaps. I bought a servo-reversing Y harness from BP Hobbies to actuate the flaps. The model is equipped with my usual Spektrum radio equipment; the receiver is a seven-channel AR-7000. The flight battery I used is a five-cell JR Extra 2300 mAh NiMh.

The engine in my model is a Magnum .52 four-stroke, which is mounted inverted.



The inclusion of the hatch on my glow-powered EnterTrainer prompted a few additions. The inverted engine makes it awkward to connect the glow plug, and the cowl prevents easy access to the fuel tubing.

The removable hatch allowed me to mount a remote Hangar 9 glow plug jack and a Du-Bro Kwik Fill remote fueling fixture. I simply added a 1/8 balsa crosspiece cemented to the bottom of the hatch support rails. This provided a mounting place for the aforementioned fixtures.



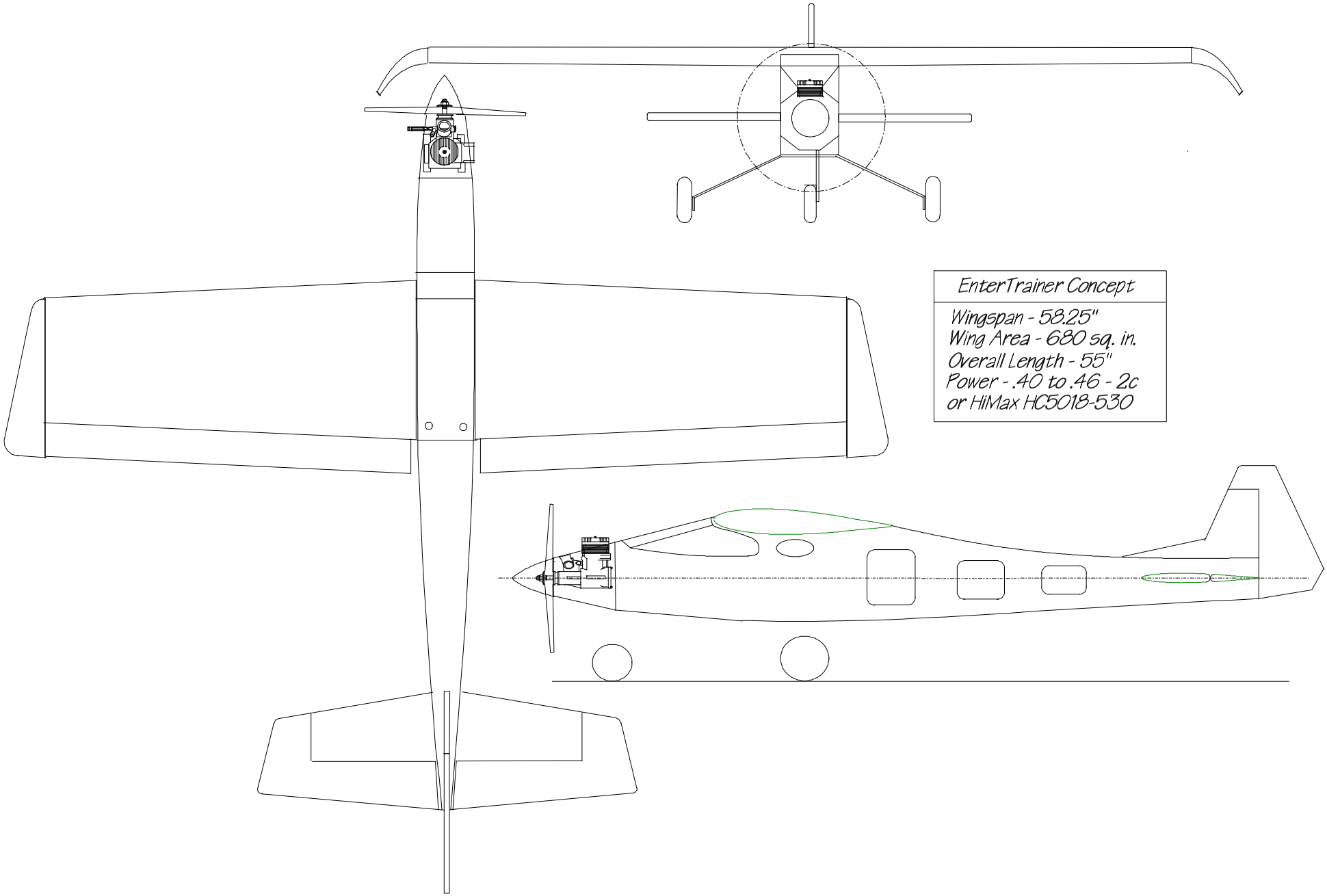
I added another crosspiece and mounted the MPi power switch/charging jack to it. The decision to include the hatch has paid dividends.

Setup
The wing/stabilizer angle of incidence should be 0°. If your model is built according to the plan, it will be so.

I recommend using a computer transmitter. If you're not an expert RC pilot, it's best to start with modest throws of the generous control surfaces. About 1/2-inch up and down is good for the ailerons and elevators, while 3/4-inch left and right is good for the rudder. The flaps can be deflected to 45°.

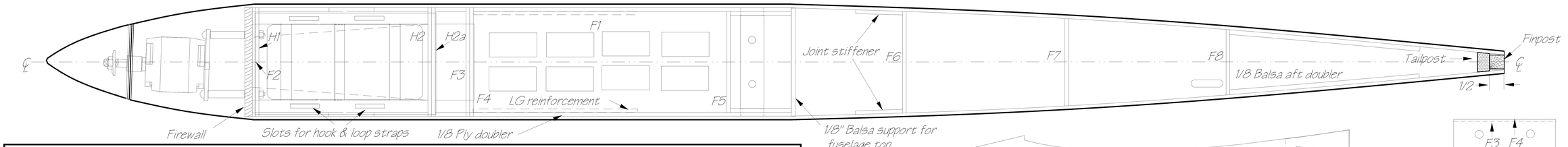
If you're using dual rates, the high rates can be set up to about 45° of deflection for all surfaces. I would recommend using plenty of exponential because of the size of the control surfaces.

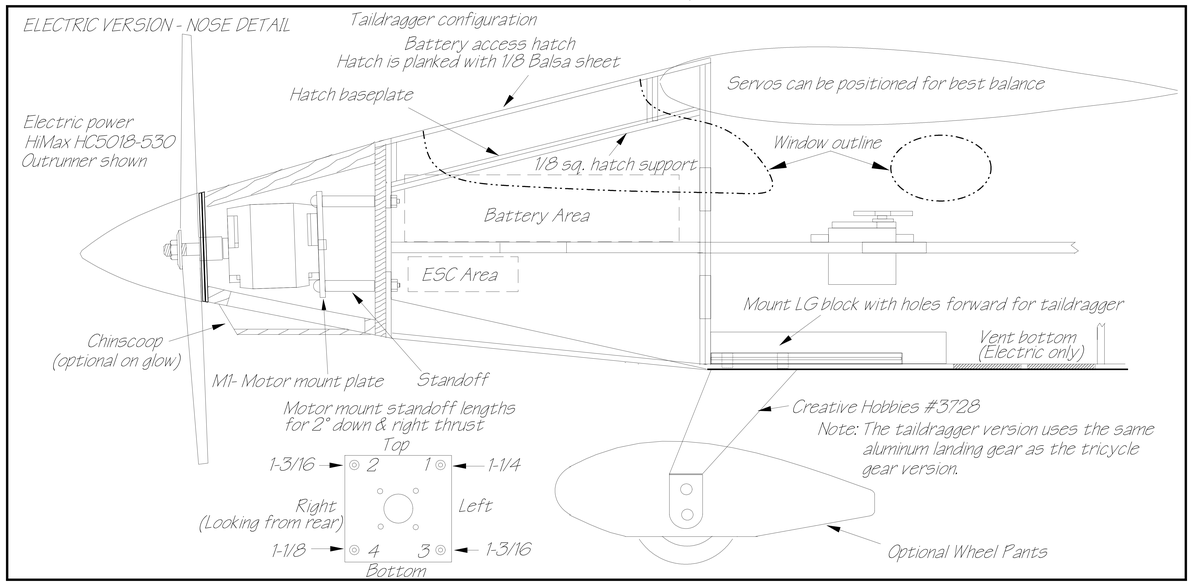
The balance point for first flights should be no more than 3-1/2 inches back from the wing's LE at the fuselage. After the model is trimmed out, the balance can be adjusted farther aft if you want more control sensitivity.

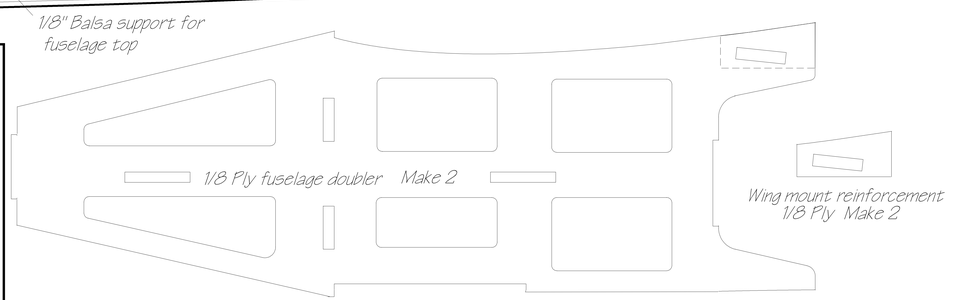


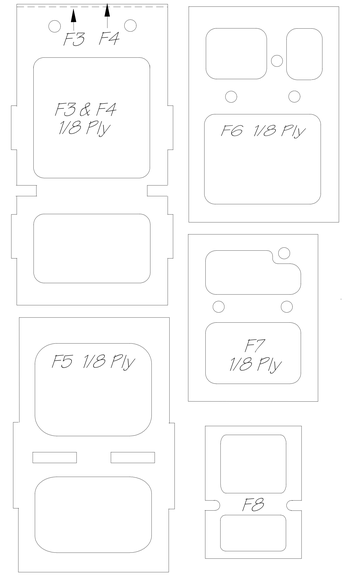
EnterTrainer Concept

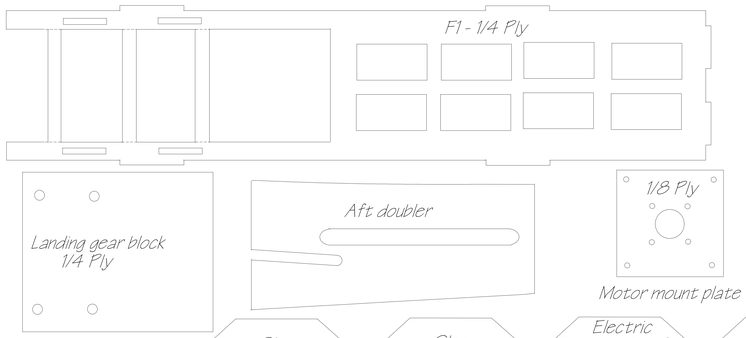
Wingspan - 58.25"
Wing Area - 680 sq. in.
Overall Length - 55"
Power - .40 to .46 - 2c
or HiMax HC5018-530

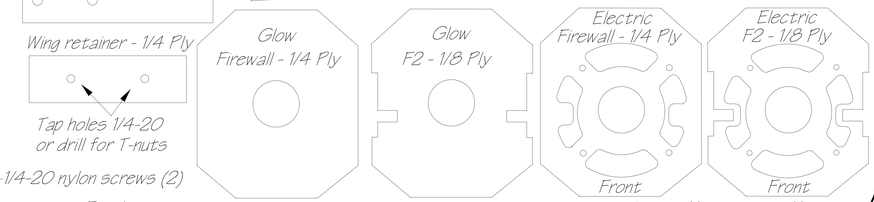












All dimensions are in inches except when in decimal notation

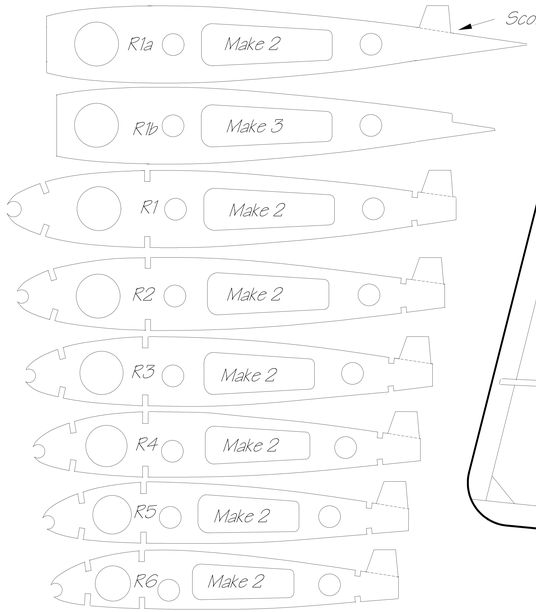
GLOW VERSION SHOWN

Tricycle gear configuration

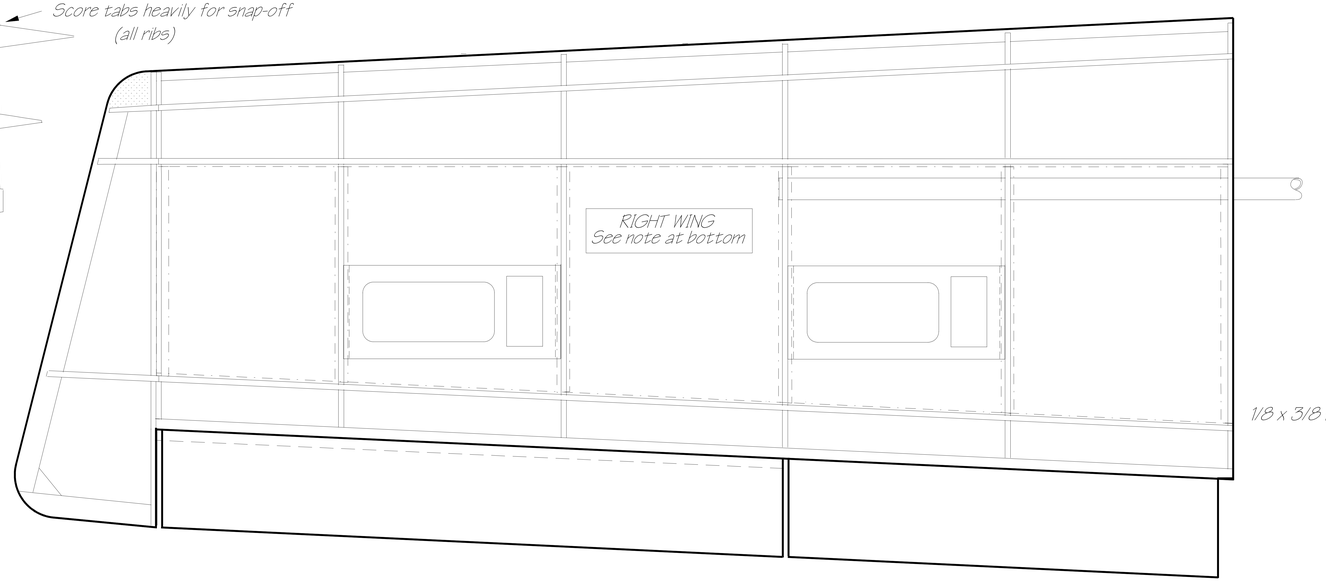
The EnterTrainer

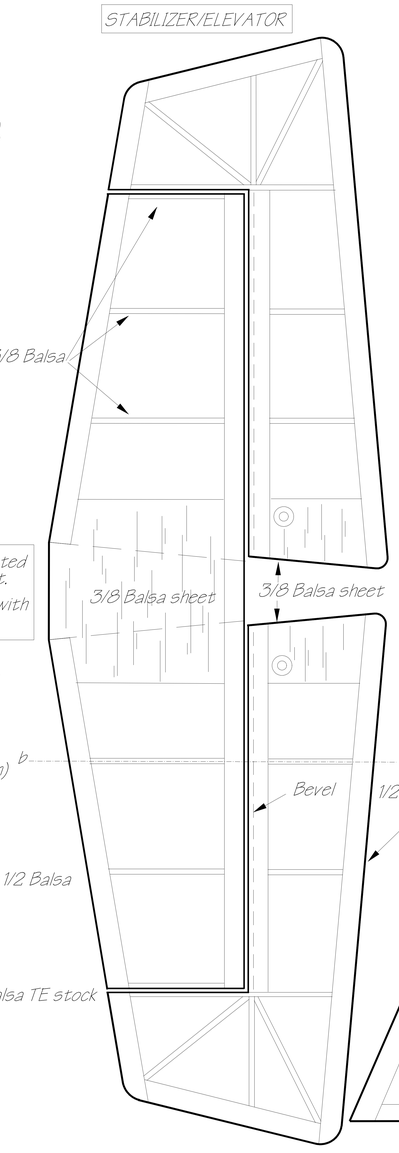
Designed and Drawn by Fred Randall

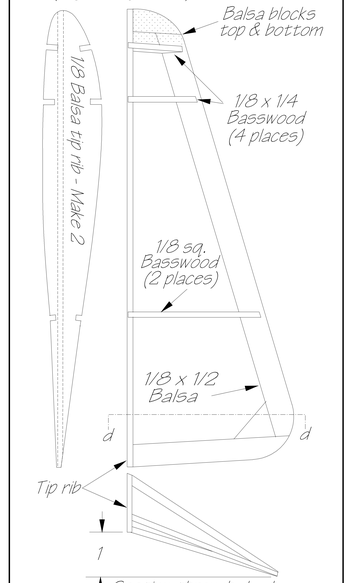
v 10/19 Plan number



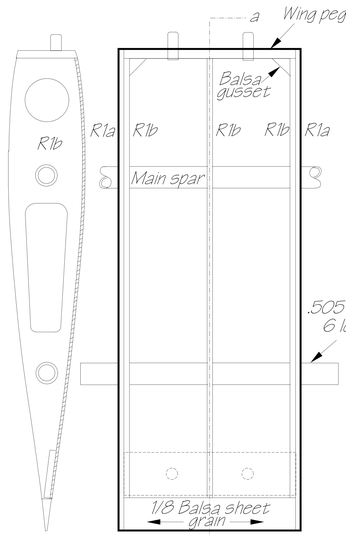
Score tabs heavily for snap-off (all ribs)



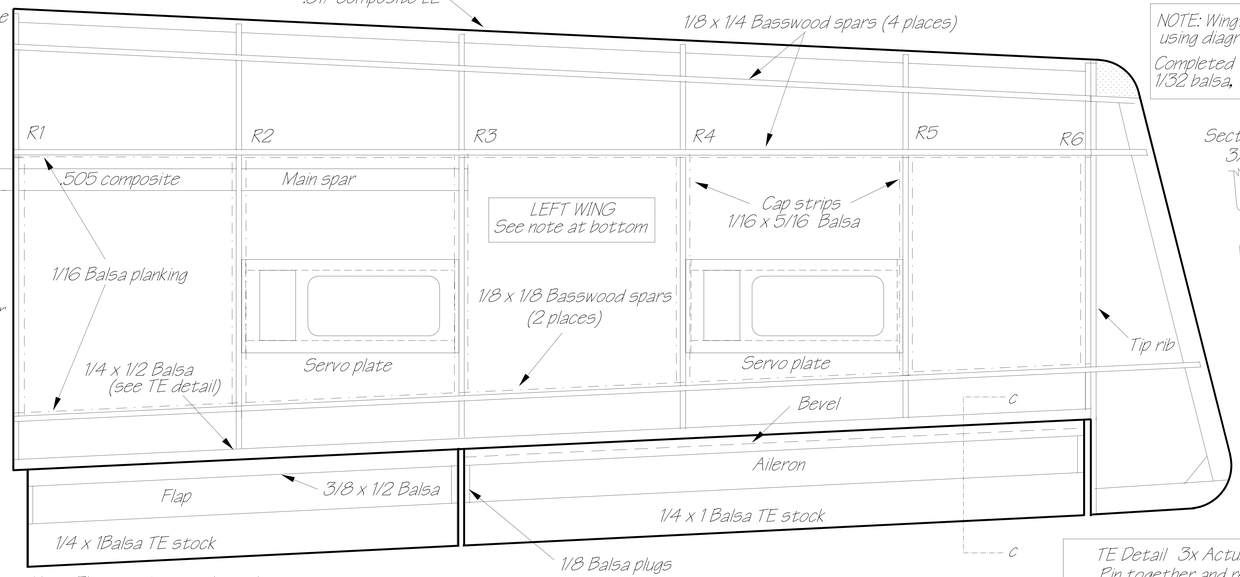




Notice: The short kit contains 1/8 lite ply tip components instead of balsa

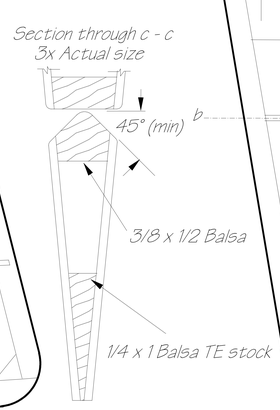


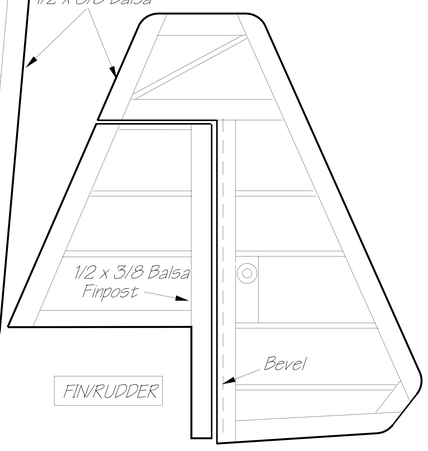
WING CENTER SECTION
Top (only) is planked



Note: Flaps are bottom hinged

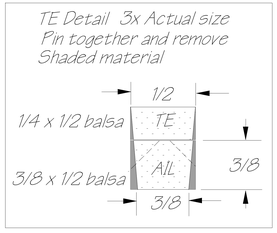
NOTE: Wingtips are constructed using diagram at upper right.
Completed tips are planked with 1/32 balsa, top and bottom

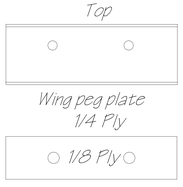




FIN/RUDDER

Note: empennage is constructed of 3/8 x 1/2 and 1/8 x 3/8 balsa strip stock except as noted





Wing anchor (top of wing center)

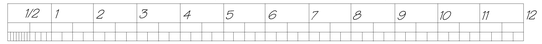
Flap panel 1/16 Balsa - Make 4

Aileron panel 1/16 Balsa - Make 4

Dashed lines are 1/8 x 1/4 Basswood reinforcement

NOTE: WINGS AND WING CENTER SECTION ARE BUILT UPSIDE DOWN OVER PLAN (SEE TEXT)

All 1/4 & 1/8 plywood is light poplar ply



All dimensions are in inches except when in decimal notation

The EnterTrainer

Designed and Drawn by Fred Randall

v10/19 Plan number Panel 2 of 3

RIGHT WING
(see note bottom)

R1 Make 2
R2 Make 2
R3 Make 2
R4 Make 2
R5 Make 2
R6 Make 2
R7 Make 2
R8 Make 2

Score tabs heavily for snap-off
(all ribs)

STABILIZER/ELEVATOR

3/8 Balsa sheet
3/8 Balsa sheet

Construct wingtip frames from this plan
(Right wing shown)

Balsa blocks
top and bottom

1/8 Balsa tip rib - Make 2

1/8 x 1/4
Basswood
(4 places)

1/8 sq.
Basswood
(2 places)

1/8 x 1/2
Balsa

d
d

Tip rib

1

Section through d - d

Tips are planked with 1/32 Balsa

Notice: The short kit contains 1/8 lite ply
tip components instead of balsa

Wing peg plate

a

.317 composite LE

1/8 x 1/4 Basswood spars
4 places

See wingtip detail - Upper right

c

R1b
R1a
R1b
Balsa
gusset
R1b
R1a

R1
R2
R3
R4
R5
R6
R7
R8

Main spar

.505 composite spar

.505 composite spar
6 long

Servo plate

LEFT WING
(see note bottom)

Broken lines indicate
planking & capstrips
1/16 Balsa

Servo plate

1/8 sq. Basswood spars
2 places

1/4 x 1/2 Balsa
(see TE detail)

1/8 balsa plugs

3/8 x 1/2 Balsa

3/8 x 1/2 Balsa

Bevel

1/4 x 1 Balsa TE stock

1/8 Balsa sheet
grain

a

Section through
a - a

b
b

Bevel

1/8 x 3/8 Balsa

TE

45°

3/8 x 1/2 Balsa

1/16 Balsa

c

1/4 x 1 Balsa TE stock

Section through c - c
3x Actual size

Section through b-b

1/2 x 3/8 Balsa
Finpost

Bevel

FIN/RUDDER

Note: empennage is constructed of
3/8 x 1/2 and 1/8 x 3/8 Balsa
strip stock except as noted

WING CENTER SECTION
Top (only) is planked

Top

Wing peg plate
1/4 Ply

1/8 Ply

Wing anchor (top of wing center)

R1a Make 2

R1b Make 3

Dorsal fin
Cut from 3/8 sheet balsa

Servo plates 1/8 ply
Make 2 each

Dashed lines are 1/8 x 1/4 Basswood reinforcement

NOTE: WINGS AND WING CENTER SECTION ARE BUILT
UPSIDE DOWN OVER PLAN (SEE TEXT)

TE Detail 3x Actual size
Pin together and remove
Shaded material

1/4 x 1/2 balsa
3/8 x 1/2 balsa
1/2
TE
AIL
3/8
3/8

All 1/4 & 1/8 plywood is light poplar ply

1/2 1 2 3 4 5 6 7 8 9 10 11 12

All dimensions are in inches except when in decimal notation

The EnterTrainer

EXTENDED WING OPTION

Designed and Drawn by Fred Randall

v 10/19 Plan number Panel 3 of 3