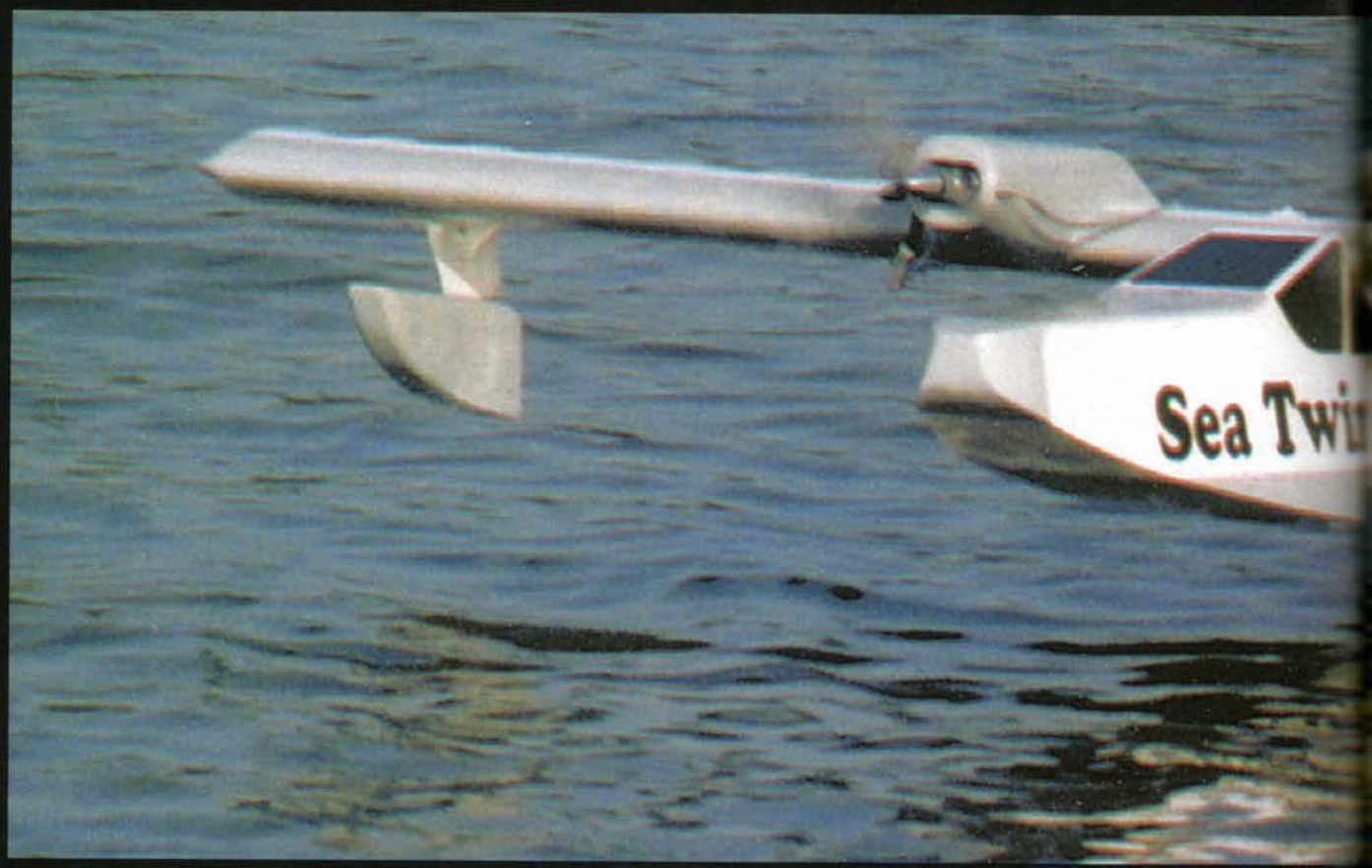
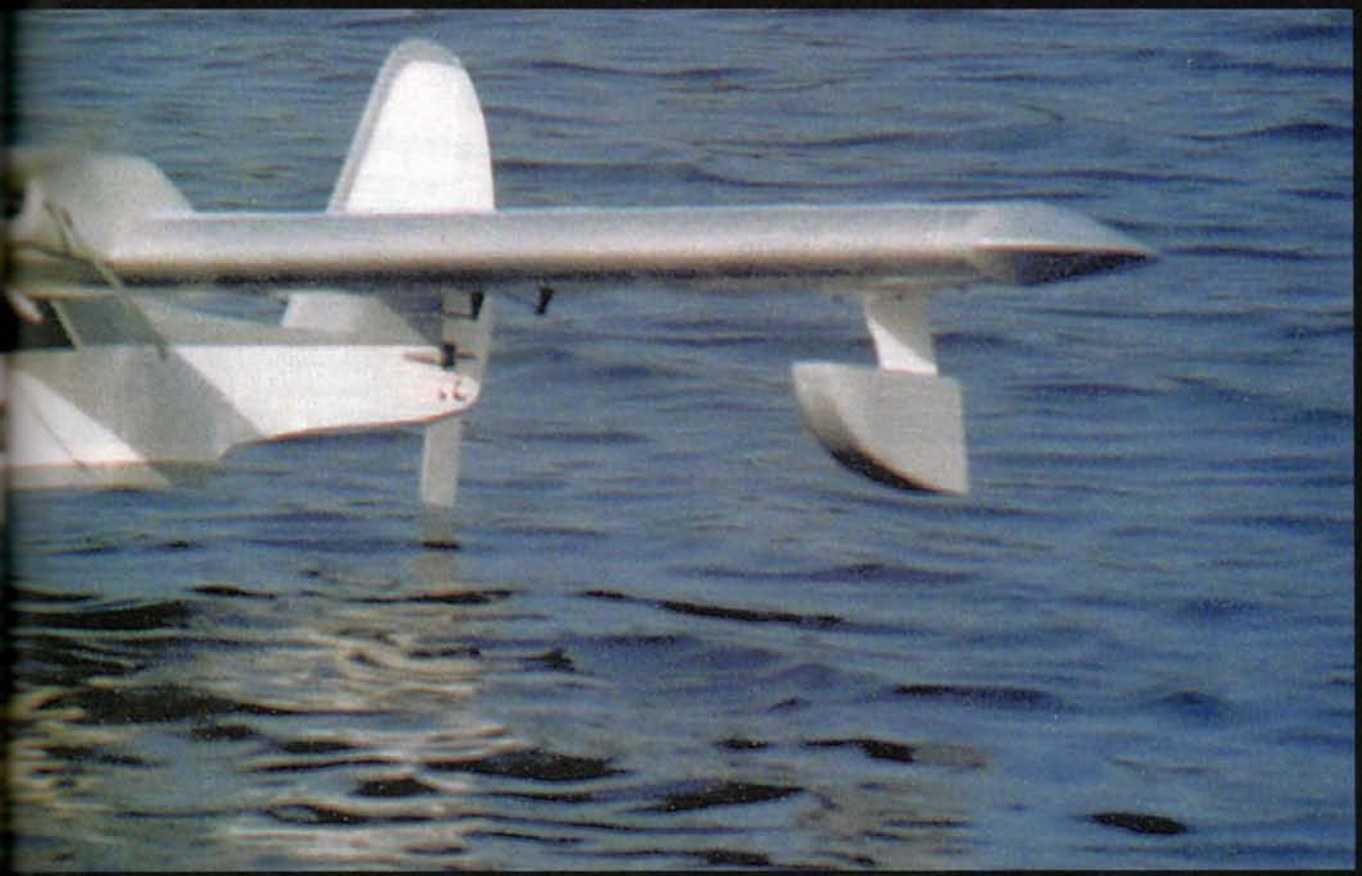


Sea Twin



Sport Seaplane Twin

For Two .40-.52 2-Stroke or .52-.70 4-Stroke Engines

By Richard H. Leavitt

"Rudder-Only" touch and go. Seaplanes are fun. Twins are awesome. The Sea Twin is awesome fun!

Sea Twin

Here is a project that is so much fun that it is probably against the law in several states. While you're at it, you might even gain a new experience or two. Three things that many modelers have not done, but always plan to do, are (1) scratch-build a plane from plans, (2) build a sea plane, and (3) build a twin. Here is your opportunity to do all three at once. The Sea Twin is easy to build and flies so realistically that it always draws a crowd. Two 56 size 4-stroke engines pull the 16 pounder around with authority for gorgeous take-offs and splash-and-goes. It very nicely performs mild aerobatics such as loops and rolls, but it is mainly built for full-scale-like flight.

Inspired by the great little Ace Seamaster 40, ten years ago I scratch-built a similar airplane with an 8-1/2" wing, powered by a single Super Tiger 3000 mounted on a pylon. I used 1/8" mahogany plywood door-skin for the fuselage and ribs, basswood spars in the wing, and happily flew it for a number of years. Three years ago, my good friend Butch Mallam offered the loan of two O.S. 91 4-strokes that were not in use, so I sawed off the pylon and built nacelles. A twin was born. The twin flew so well that there have been three copies made by friends. However, the 100" one-piece wing is hard to get into my van, so this new Sea Twin is a 90% copy with further updates.

I have been accused of building heavy (and strong) so I'm sure that lighter material and finishing choices could save a pound or two. This model uses door-skin for much of the hull and some of the ribs. The door-skin can be ordered from your local home-improvement store. You want the 2.5mm birch and mahogany ply, which goes for about $20.00 for a 4'x8' sheet, but probably will have to be special ordered. In place of the door-skins, you can use lite-ply, which is lighter but a bit more expensive. Lite-ply is available in sizes up to 12" x 48" from the balsa supply houses that advertise in this magazine. If you are going to build big airplanes in the future using plywood and basswood spars, the two handiest tools in the world are a small 9" bandsaw and a small bench sander with a 1" belt and 5" disk. These sell at the home improvement store or the Harbor Freight Catalog and I make 90% of my cut-and-fits with them rather than blades and razor saws.

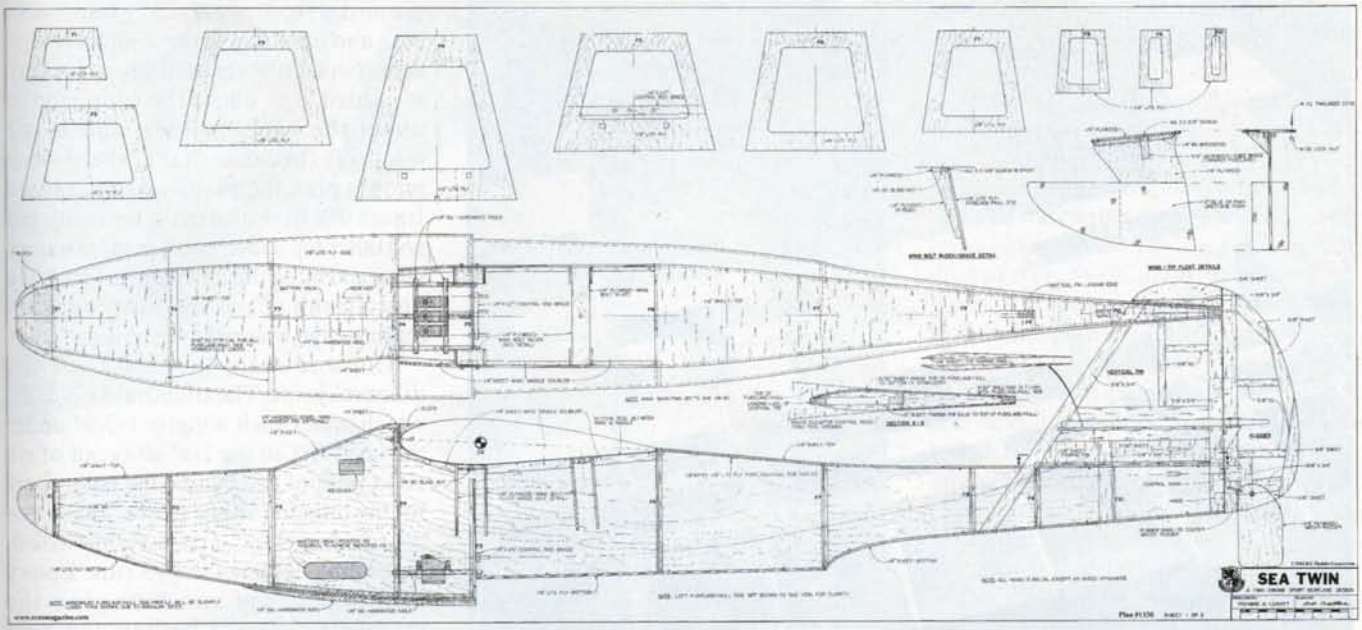
The author with his pride and joy.

CONSTRUCTION

The Wing

The wing ribs are all identical, 8 of plywood, and 17 of 1/8" balsa. Stack, bolt together, and cut out all of the plywood ribs at one time on your bandsaw and sand them smooth. You can notch the ribs for the spars with multiple cuts of the bandsaw, but keep a tight fit for the spars. Repeat for the stack of balsa ribs. 14 of the balsa ribs will have 2-1/2" of the trailing edge cut off where the ailerons mount.

Cover one wing plan with wax paper, pin down the bottom main spar on the plan and position the aft lower sub-spar, raised up on 7/16" scrap blocks. The first couple of ribs will set the angle of the sub-spar. Note that all spars are basswood, and the LE and TE are balsa. Glue the #2 rib to the two spars, and at the same time, glue on the wing web going to rib #3. On rib #2, don't glue it to the front and back of the main spars, as you will need to cut away some of that rib later on when you are inserting the dihedral splice plates. Glue in #3 rib and



PLAN #1330

FULL SIZE PLANS AVAILABLE SEE PAGE 171

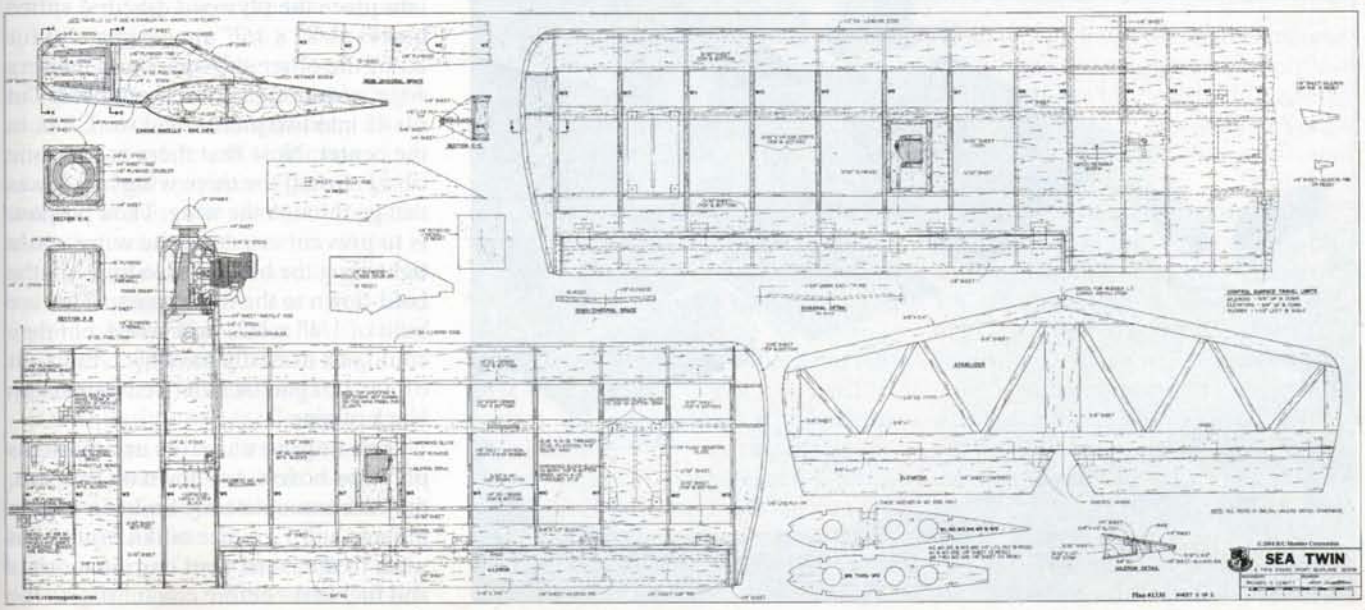
Designed by:
Richard Leavitt
TYPE AIRCRAFT
Sea Plane
WINGSPAN
87 Inches
WING CHORD
14-3/8 Inches (Avg.)
TOTAL WING AREA
1235 Sq. In.
WING LOCATION
Top of Fuselage
AIRFOIL
Symmetrical
WING PLANFORM
Constant Chord
DIHEDRAL, EACH TIP
1-7/8 Inches
OVERALL FUSELAGE LENGTH
72 Inches
RADIO COMPARTMENT SIZE
Ample

STABILIZER SPAN
32-1/2 Inches
STABILIZER CHORD (inc. elev.)
10 Inches
STABILIZER AREA
320 Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
2" Above Fuselage
VERTICAL FIN HEIGHT
10 Inches
VERTICAL FIN WIDTH (inc. rud.)
11-1/2 Inches
REC. ENGINE SIZE
.46-.61 or .52-.70 4-Stroke
FUEL TANK SIZE
(2) 12 Oz.
LANDING GEAR
None
REC. NO. OF CHANNELS
4

CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.
C.G. (from L.E.)
4-1/2 Inches
ELEVATOR THROWS
3/4" Up — 3/4" Down
AILERON THROWS
5/8" Up — 5/8" Down
RUDDER THROWS
1-1/2" Left — 1-1/2" Right
SIDETHRUST
—
DOWNTHRUST/UPTHRUST
—

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage Lite Ply (or Door Skin), & Balsa
Wing ..... Hardwood & Balsa
Empennage ..... Balsa
Wt. Ready To Fly ..... 240-256 Oz. (15-16 Lbs.)
Wing Loading ..... 28-30 Oz./Sq. Ft.



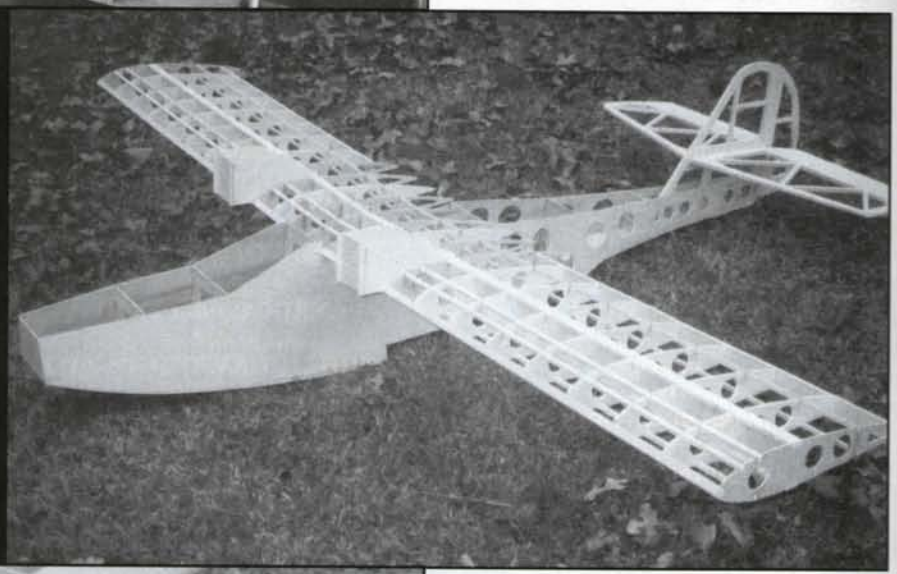
the next web, then the next rib and web, etc., and continue to the end. Note that the plywood ribs are used where strength is needed, e.g., above the wing saddle, under the nacelle sides, and at the wingtips (because that's where most people pick the plane up to help you launch it!). Now glue in the top main spar and other top sub-spars. Remove the first wing and build the other wing. Finish the bottom sub spars, leading edge and trailing edge where the ailerons go.

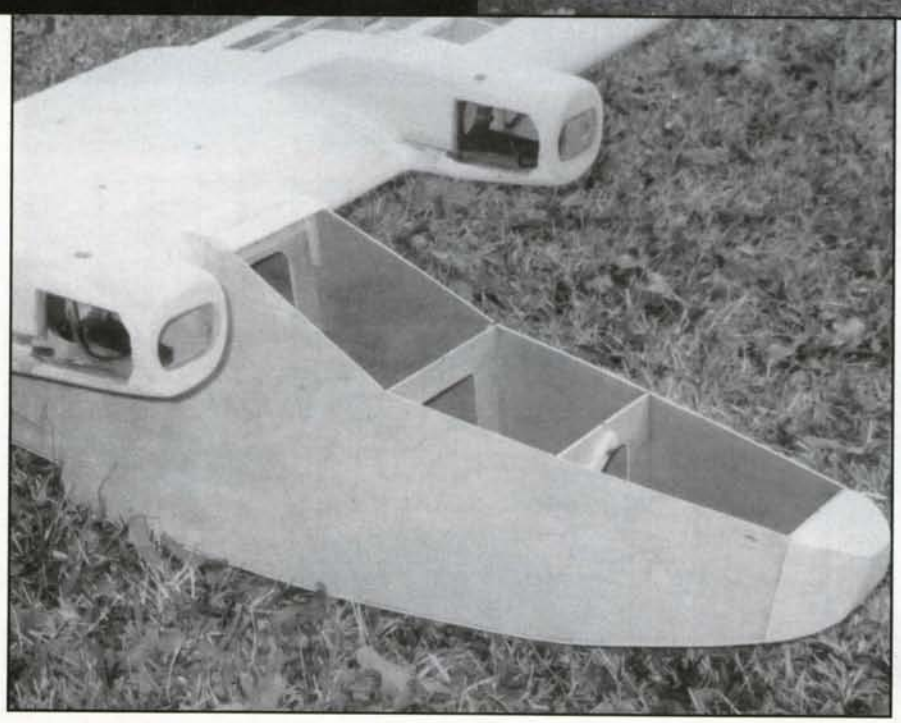
Cut and mate the spars for the dihedral joint. The dihedral is 2-1/2°, which raises each wingtip 1-7/8" under the last rib. Cut the 1/8" slots out of rib #2 in front of and behind the main spars for the dihedral splice plates. These two plates are 1/8" aircraft plywood, extending between the #3 ribs. Epoxy into place. You can butt-glue the remaining spar together, the real

ABOVE: Wing with nacelles under construction. Note the top two small spars are cut away to allow fuel tank installation. A single servo and bellcranks drive the throttles. Note wing splice plates. The plans show a slightly different trailing edge.

RIGHT: The basic airframe with lots of lightening holes. The top sheeting is added after the servos and pushrods have been installed.

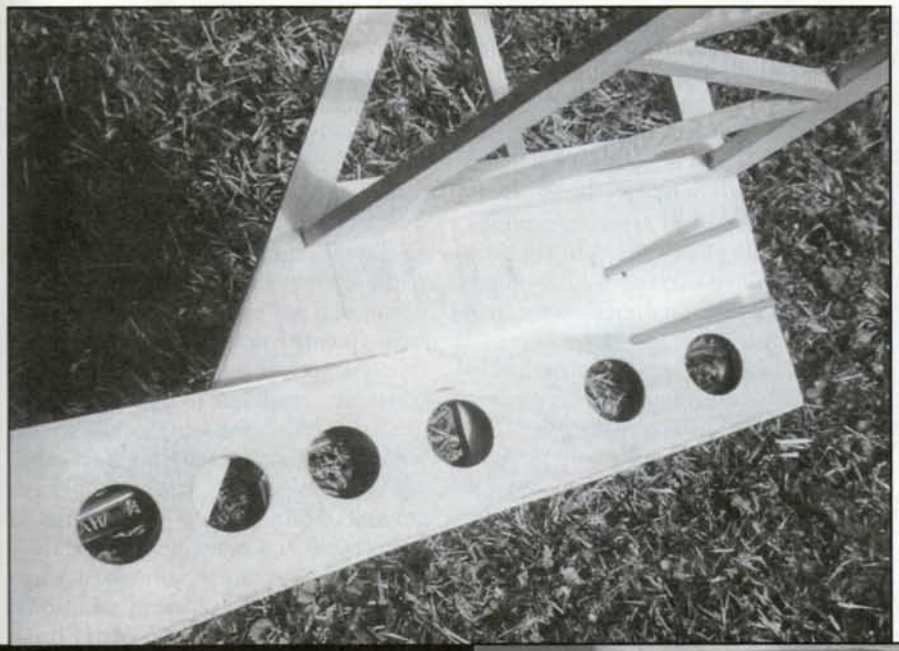
BELOW: Engine nacelles are square at rear, and round at front. Round fiberglass cowls could also be used. The fuselage formers are cut away to allow access to nose for battery placement.

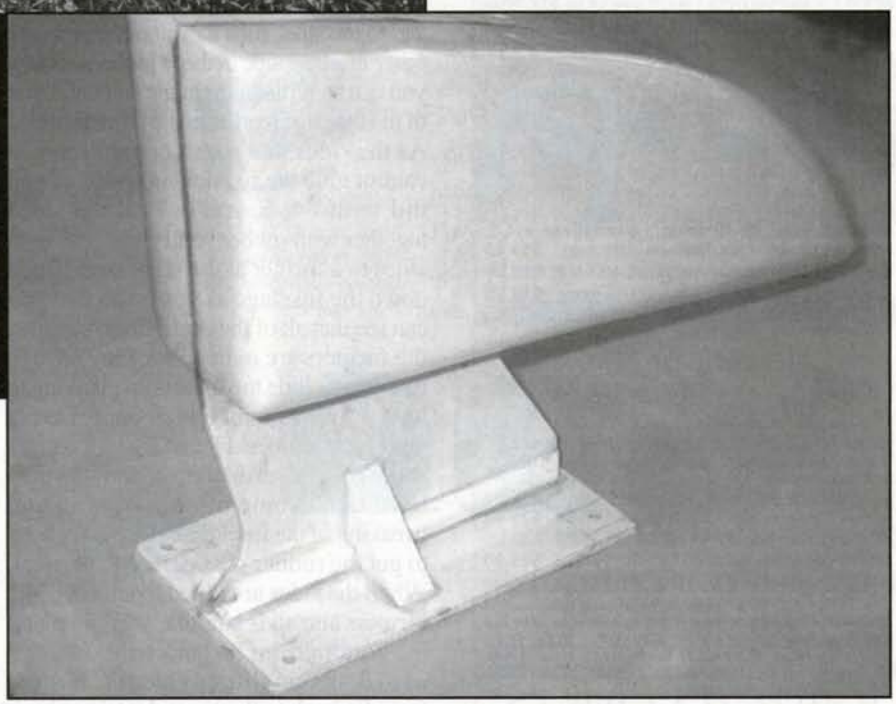




strength is going to come from the additional splice braces. Make and glue into place the plywood dihedral splice braces (1/8" x 1/2" approximately) for all of the other sub-spars and leading edge, notching the ribs as required. Cut rib #1 into two pieces, and work it in to the center. Note that there is only one rib #1. Install the three wing bolt boxes that go through the wing. Their purpose is to prevent crushing the wing while tightening the bolts, and to transmit the hold-down to the main spars. Mine are built of 1/4" x 1/2" bass wood, but they could just as easily have been built out of hard balsa, or a drilled-out scrap block of pine.

The engine nacelles are made as plywood boxes. As shown on the plan, they accommodate my Saito 56 engine mounts and 12 ounce tanks. You might wish to measure your engine mounts and fuel tanks before committing to the





ABOVE: Tear drop planking under the stab greatly stiffens the tail section. The leading edges of the stab and fin were rounded after this picture was taken.

RIGHT: The tip floats are cut from 2" pink foam and then covered with fiberglass. The strut is made of aircraft plywood. The mounting plate screws to blocks at the main and rear spars. Expect a lot of side-load on the tip floats.

exact location of ribs #4 and #5. On the original 100" plan, the engines were mounted upright, and the nacelles were slab-sided. On this one, the engines are side-mounted and the nacelles more streamlined. Keep in mind the necessity to have the needle valve at or above the centerline of the tank.

The ply nacelle sides are notched to fit the leading edge, the two top sub-spars and the top main spar. They extend down into the wing 1/2" to epoxy to the side of the plywood ribs #4 and #5, and the various spars they fasten to. Epoxy the firewall to the box sides as shown, and reinforce with triangular stock. Cut away the two 1/4" top sub-spars that run through the box, as that is where the fuel tanks have to go. Put balsa floors in the nacelles and fuelproof them. If you ever have a leaky fuel tank, you won't want raw fuel running around in your wing!

Drill and temporarily mount the engine mounts to the firewall, assemble your fuel tanks and set them in place on top of their foam padding, and drill the holes for the fuel lines. This avoids kinks in the fuel lines later. Also, figure the routing of the throttle cable, which may affect the balsa sides to be added later. Remove the engine mounts and tanks, then fuelproof all the holes that you have drilled. Install the Tee nuts for the engine mounts. You can now add the 1/8" plywood top, but first be sure you can slide the fuel tank in and out past the main spar.

You should now plank the wing before finishing the nacelles. All planking and rib caps are 3/32" balsa. I planked the entire top of the wing out past the nacelles to rib #6, but the bottom only out to rib #3. The leading edge planking is 3" wide material, a bit skimpy on the fit, so be careful. Split one 3" piece into two 1-1/2" pieces for the planking on the wing in front of the ailerons (top and bottom). All exposed ribs are capped with 3/32" x 1/4" strips. The capstrips run right over the spars, and the covering does not come in contact with the spars.

Now to finish the nacelles. Glue the 1/4" balsa sides to the plywood boxes, and install the 1/4" balsa bottom for the engine compartment. Temporarily reinstall the engine mount, and add 3/4" triangular stock inside the engine compartment on all four sides and fronts. Cut the hole for the engine in the right-hand wall, and install the engine through that hole. Glue on the top 1/4" balsa, check the length of the nacelle and design a rounded nose ring of 1/4" balsa for your engine. Remove the engine and carve, rasp, hack, hew and sand away until you have a nacelle that is square but streamlined at the rear around the fuel tank and almost round at the front around the engine. The photo will give you the idea. Of course, if you can find a couple of fiberglass cowls, you don't have to build anything forward of the firewall. (Stan's Fibertech has a 5-3/8" diameter round cowl that might work.)

The tip floats are made up of 2" thick pink (or blue) foam. I cut a slot with my band saw to accommodate the 1/8" plywood support, which is epoxied in place. The covering is lightweight fiberglass cloth and finishing epoxy (check for compatibility), then spray painted. Expect heavy side-loads on the floats at times, and don't skimp on the mounting.

The Fuselage (Hull)

The sides as shown are full-size patterns, and should be copied to cut out

the sides. Be sure you identify which piece is for plywood side, and which is top and bottom planking. Because the sides slope inward, the drawing makes the fuselage appear as tall as the sloped sides of the formers, rather than the vertical height of the formers. The completed fuselage will not be quite as tall as the picture. Rather than cut up the plans, you could draw a horizontal line down the middle of the fuselage, and transfer dimensions at the formers to your plywood.

Mark all former locations on the inside of the fuselage sides and mark the vertical centerline on all formers, on both sides. You will use the marks as aiming points later. Glue 1/4" or 3/8" square balsa to the fuselage sides at each former location to give something for the formers to align to and hold them in place while gluing.

Lay one side of the fuselage flat and glue on formers F4, F5, and F6 so they are 90° to the side. Turn it over and glue to the other fuselage side at those locations. Now you can start pinching in the front and rear of the fuselage to glue in the other formers. As the sides there are not parallel, you cannot glue the formers in at 90° as you did with F4, 5, and 6. Pull the sides together with rubber bands, and glue both sides to a former at the same time. Sight down the fuselage as you go so that you can see that all of the centerlines drawn on the formers are in line. You may have to tack-glue a little top or bottom planking to hold it straight until it is all done. Do not glue in the formers F9 and F10 yet, as F11 is the rudder vertical post, and you may have to do some minor twisting and tweaking of the fuselage before you glue it to get the rudder post perfectly vertical. When the sides are glued together by the formers and all is straight, you can plank the bottom from F1 back to about F8. I used doorskin (lite-ply) for the bottom from F1 back to the second step to give it more strength for running up on the beach. The rest is cross-grain 1/8" balsa.

The Tail

The horizontal stab is built out of 3/8" thick balsa. After it was built I used my orbital sander to taper the thickness from 3/8" in the center down to 1/4" at the ends. The vertical stab is done the same way. The vertical stabilizer is built in two pieces — the lower half which goes under the stab, and the upper half which goes above the stab. The upper half includes **all** of the leading edge, which goes from the top of the stabilizer to the bottom of the fuselage.

Lay the horizontal stab at the edge of your building board so that you can glue on the top half of the vertical stab, while letting the leading edge hang off of the table. Get that glued on perfectly square! You have to notch the leading edge of the horizontal stab for the rudder LE, so the trailing edges will line up. When that has cured, turn it upside-down, let the vertical part hang off of the table, weight it down to hold it on the table, and epoxy on the bottom part.

Now you have the entire tail as a sub-assembly. Clamp the tail into the fuselage without glue, and twist and tweak until you have it perfectly straight. "Straight" means pointing down the centerline of the fuselage, not leaning left nor right, and the stab is 0° incidence to the wing! Put a yardstick across the wing saddle so that you can see if the tail and wing are parallel. When all is square, wick a generous amount of thin CA into the rear joint of rudder post and fuselage sides. Before removing any clamps, glue in fuselage formers F9 and F10 and any additional blocking you think you need. Finish planking the bottom of the fuselage.

Do not plank the top until you absolutely have to, as you will first want to install your NyRod housing, antennae housing, servo mounting rails, wing bolt blocks, wood dowel alignment pins for the wing, etc., and waterproofing for at least the lower half of the hull (clear polyurethane works fine). It is inevitable that you will end up with some water in the hull someday, and you don't need soggy wood.

Later, after you have routed the flexible NyRods through the lower vertical stab, plank around that lower part in a teardrop shape from the fuselage up to the horizontal stab. This really stiffens up the stab/rudder connection to the fuselage. Some variations on the stab/rudder which have been made on other Sea Twins include mounting the horizontal stab directly on the fuselage with a little dihedral, or halfway up the rudder like a PBY, and one copy has twin rudders, and is painted like a Pan Am Clipper!

It now begins to look like an airplane. Make a final check of wing angle-of-incident, install wing saddle, wing bolt blocks, close up the hull, and get ready to cover. On the original 100" airplane, built ten years ago, I used Super Coverite on the hull, painted with epoxy paint, and MonoKote on the wings and tail. Unfortunately, epoxy paint seems to be out of supply in the hobby shops these days. So on this airplane I covered the plywood bottom of the hull with fiberglass and finishing-epoxy (and paint), and used Worldtex iron-on fabric on everything else, trimmed with hobby shop spray paint. Then all is sprayed with an automotive "clear coat," which is a three-part paint. (The "clear coat" was thanks to my friend Forrest Garb who has

a paint shop for his antique cars.) You can gain a pound of weight if you get heavy-handed with the spray gun, but it does seal things up nicely, and helps to keep it clean. Spray-can "clear coat" would be just fine, I'm sure. Iron-on film would be fine for everything but the bottom of the fuselage and save even more weight. Use 1/8" wing saddle tape around all four sides to make a good seal for the wing-to-fuselage joint.

Radio

All servos are standard duty, and I use a 5-cell 1400 mA receiver battery pack with my trusty old Airtronics. Be sure to keep all of the electronics off the bottom of the fuselage. I mounted three servos (rudder and two elevators) low in the hull, just ahead of the step. The receiver and the on-board glow driver are both mounted high up in front of Former F4, which means that they are in front of the opening for the wing, and fairly immune to dripping water. The on-board glow driver has two 4500 mA cells in series, and the two identical glow plugs are likewise in series. That may sound like a lot of overkill for the glow plugs, but I spend a lot of time at low throttle shooting splash-and-goes, plus I needed the weight in the nose anyway.

There are two aileron servos inside the wing, mounted on plywood plates that are part of the bottom of the wing. The plates are held on with screws, but covered over with the iron-on covering. If I ever need to get to the servos, I will have to cut the covering around the plate and around the screw heads. I used one servo in the middle of the wing for both throttles, but two servos may be used to simplify the installation process. Mount the receiver switch and on-board glow switch inside the hull, and use pushrods to operate them. (Hint: small toggle switches generally have chrome-plated brass handles, which can be flattened and drilled to receive a pushrod clevis. Likewise, the receiver switch handle can be carefully drilled for threaded pushrod.) For scale-like turns I recommend quite a bit of rudder mixing with the aileron, if your radio will do it, as it does not take much aileron to control this airplane. Flaperons are fun and make for short landings, but they are certainly not required.

Flying

The control throws are really quite mild, and yet you have a lot of authority. I have 5/8" both directions on ailerons, 3/4" on elevators, and 1-1/2" on the rudder (a lot for taxiing purposes). If you can train yourself to fly with both thumb and finger pinching the stick (as opposed to thumb on top of stick) and apply control inputs gently, this airplane will fly very smoothly and realistically. Banging the sticks around with nervous thumbs is not going to look good.

I recommend the following start-up procedure for safety reasons. Assuming you are right-handed, start the right engine (the engine on your left) first, warm it up and set the needle valve. Idle back, shut off the engine, and start the left-hand engine (the engine on your right). When it is ready, come back to a fast idle and re-start the other engine. Give them a good full power and idle check, and you are ready to go. NEVER tweak one needle valve while both engines are running. If something doesn't sound right, shut down the "good" engine and adjust the offending one. The engines do not need to be in sync at full throttle, 500 rpm is close enough. And never attempt to sync the engine by adjusting the one of the needle valves. Flying this airplane is a piece of cake! Apply full "up" elevator long enough for it to hop up on the step, and then relax the back-pressure. The ailerons work right away, so keep the tip floats out of

the water and it will fly right off. Do not let it smack back in the water and porpoise, but establish a shallow realistic climb. Beautiful. But remind yourself over and over — if an engine quits on take-off, cut the throttle and land straight ahead. If you are in level flight and lose an engine, throttle back to about half power and lower the nose to keep the airspeed up while setting up to land. If you start to lose control while flying on one engine, CUT THE THROTTLE, and it will glide just fine to a landing.

This is a very forgiving airfoil, and it slow-flights very well. To check out the stall characteristics, I climbed up two-mistakes-high, went to idle and slowly added full up. It just mushed straight ahead, and was easy to control. My first try at a landing resulted in a very low, very slow pass. I had to reduce the idle to get it to come down. It will fly around at half power, and the sound of the twin 4-stroke engines is very realistic.

My favorite thing is making splash-and-goes, and I always get in a dozen per flight. It doesn't mind taking off and landing up-wind, down-wind or cross-wind, but keep in mind where you would land if you lost power.

Landings are neat. I generally add back 1 or 2 clicks of throttle after I pull the power, and fly it all the way in. Close the throttle and try to make the water rudder touch first. The Sea Twin is not like your trike gear plane at the grass field, where you can get within a foot above ground and then give up controlling it (or worse, land "hot"). If you do that, I guarantee that you will porpoise down the lake. You should keep flying this airplane even after touchdown, until it comes off of the step. In fact, you can add 1/4 throttle and make great high-speed taxi turns with aileron and rudder, with the inside tip float throwing a rooster-tail.

Some of the accessories I used successfully include:

- Robart single hinge points for ailerons.
- Radio South 1/4 scale hinges (glue-in w/CA type, thin plastic) on the tail.
- Du-Bro EZ connectors on the throttle servo arms.
- Sullivan Gold-N-Cable semi flex throttle cable.
- Du-Bro large scale T Horns on all control surfaces.

Have fun and e-mail me with comments and questions (no attachments please) at:

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