

Stevenson
Projects, L.L.C.

THE SPORTFOIL

To make the SportFoil light we made use of the fact that plywood is amazingly strong for its weight when bent and then stressed against this bend. The top decking is bent over and down at the sides, and the bottom sheet is bent up at the end, making a strong monocoque frame as a base for the wings weighing in at under a hundred pounds.

The shape is obviously a simple one, functional and easy to build, requiring no involved jigs or difficult patterns to work with in order to make sure things come out straight. It takes about one weekend to build up the hull, and another to shape and attach the wings from the clear, straight-grained douglas fir stock—using the shaping tricks shown in the plans. Once the standard engine controls are hooked up and a smooth, glossy paint surface is on the hull and wings, you're ready for a "test flight."

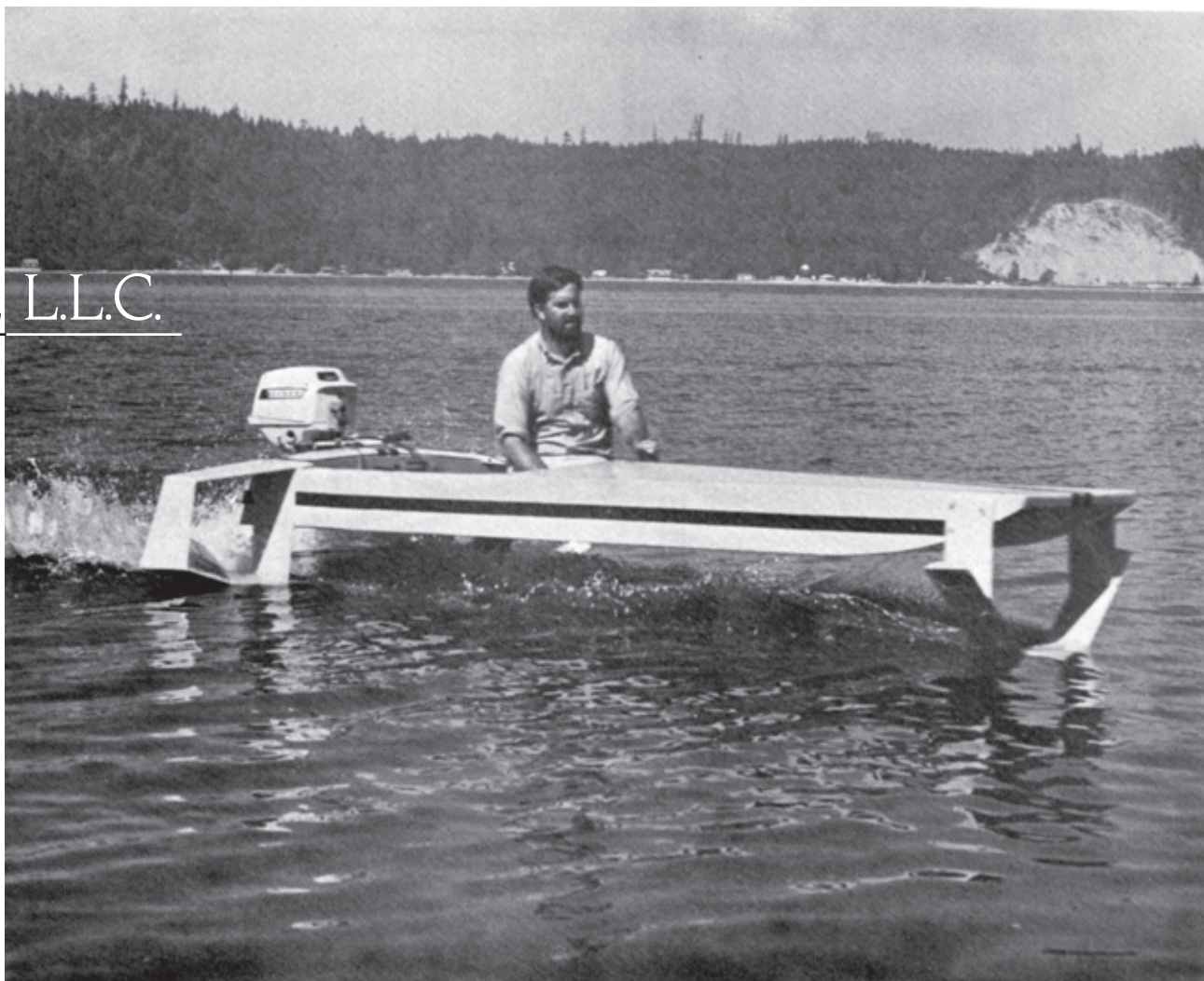
WHAT'S IT LIKE TO FLY A BOAT?

Taxiing along before take-off, the SportFoil rides and handles like a boat much larger than its size. This is

caused by the submerged wings which steady the boat against pitch and roll even at rest (but also make the steering a little more sluggish than you're probably used to in a boat this size). It feels more like you're handling a twenty-four foot boat than a twelve footer. All that changes, however, once she gets in her element—the air.

Increase the gas a bit and you'll start to feel the bow slapping against the chop. Next, you begin to hear the waves drumming on the hull directly beneath you, and then, before you have time to digest it, there is a sudden push of acceleration and everything smooths

out like glass. You're up free of the waves! You can ease off the gas a little, once the drag has dropped off, and as you look ahead to try to gauge how fast you're skimming along over the waves, you slowly start to absorb the fact that you're not feeling the waves that you see coming. After years of learning to prepare yourself for what's coming up next in a boat, you find it doesn't make much difference anymore. Head straight into a wake from another boat and it is translated into only a slow, easy up and down motion by the SportFoil. Put her into a turn and the SportFoil banks through like a plane. The faster you run, the smoother and flatter she takes them, but it's a little



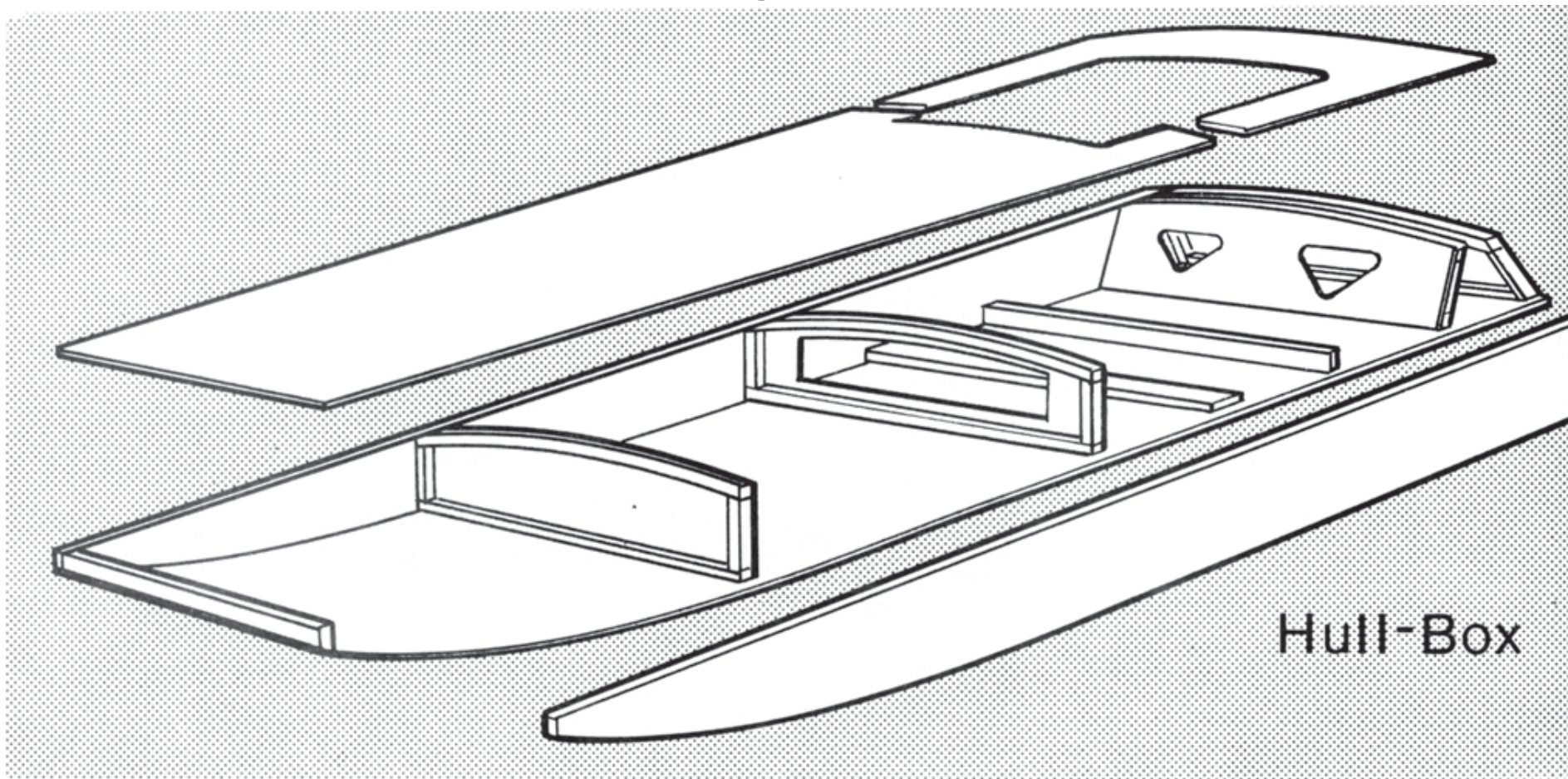
hard to get used to giving it more gas in the turns at first. To make a smooth, graceful landing, ease off gradually on the throttle, and she'll settle down slowly; and you'll feel a curious surprise of being on water again, even though you've never really left it. Cut the power completely in mid-flight, and she'll slow to stalling speed and then drop you down with a splash.

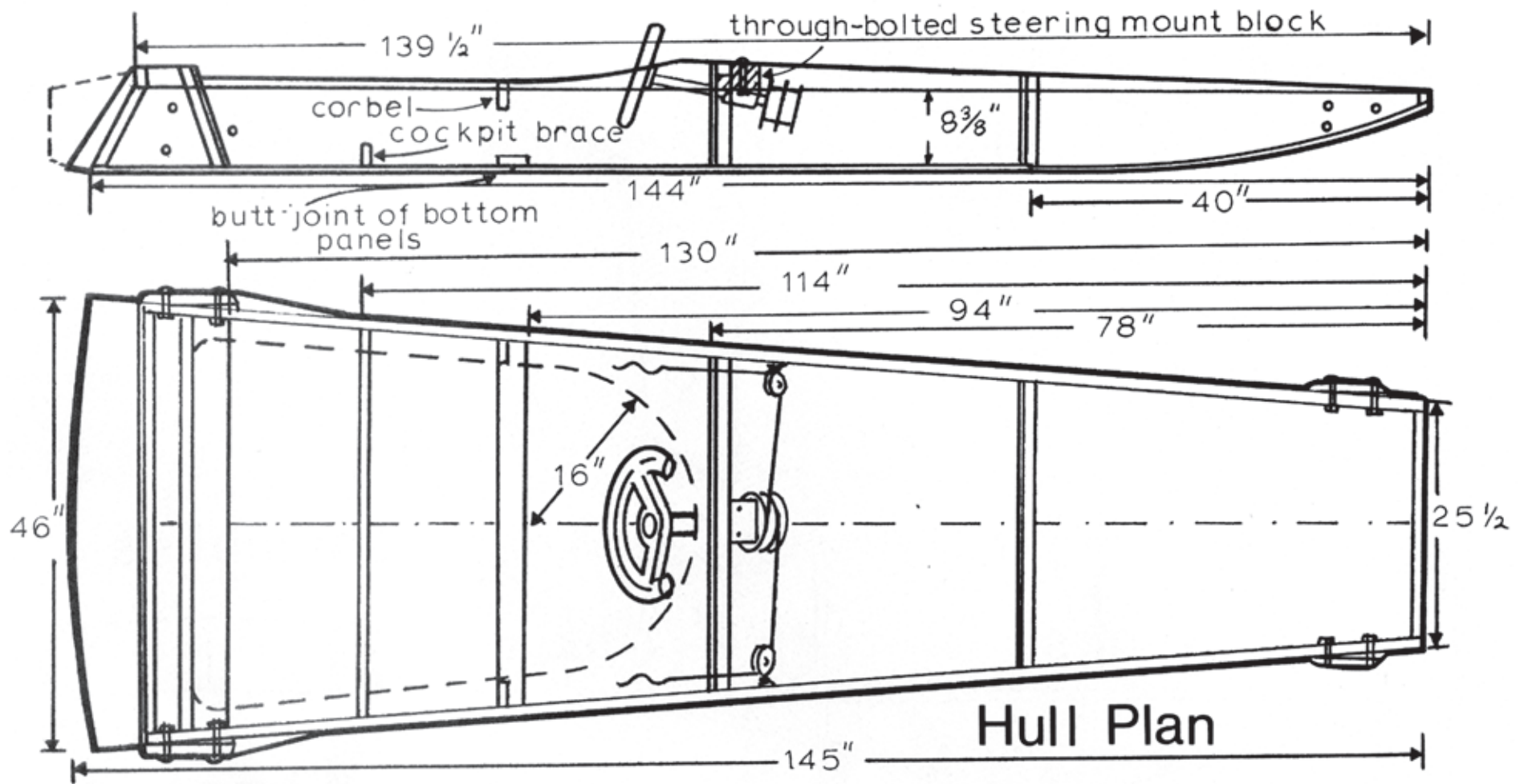
We've had the SportFoil up and flying with as little as 4 horse power. But for sporting around, you want something over 5 horses (7.5 to 15 h.p. range is ideal). Long-shaft engines have a slight advantage for this sort of work. But the standard engines pictured in action here will still provide ample altitude for that feeling of free flight over the water.

BUILDING THE SPORTFOIL— THE HULL

To get your SportFoil under way, begin building the Hull-Box by laying two sheets of 1/4" DFPA Exterior or marine grade plywood end to end on a flat surface (better side down). Draw a centerline lengthwise down both panels, and then mark the width of the boat at the bow on one end of the pair of panels (12 3/4" to either side of the centerline) Measure back from end along the centerline 145 1/2" (1 1/2" longer than the projected overall length shown in the plans) and then use a framing square to mark a line across the centerline at right angles at this point. Mark the 46" width of the stern on this line, 23" out to each side from the centerline. Now, draw straight lines connecting the right corner of the stern with the right corner of the bow, and repeat on the left side.

- The next step is to cut out the hull sides from two 12-ft lengths of clear, straight grained 1x10" fir stock. Set the circular saw at 5 degrees of tilt so that the top line of the sides will angle down to the outside of both side pieces and cut the top line with the aid of the rip guide. Mark the angled transom cut at the stern and then use a thin batten bent into position to mark a smooth curve up under the bow, on one side piece only. Cut the transom line, then reset the saw to a vertical cut, and cut the bow line. Use this side piece as a template to mark the end cuts on the other piece. (The circular saw with the blade set at 1" cutting depth will cut a curve like the one seen at the bow much more smoothly than will a saber saw).





- Now flip the cut plywood panels over and mark line around all sides, 3/8" in from edge. Space marks for screw holes along this line at 4" intervals. Place both side pieces top edge down, and begin to attach one side of the front bottom panel to the curved bottom edge of one of the side pieces.

- Spread waterproof glue on the joining surfaces from the bow point to about 18" back, position the bottom panel in place over the edge of the side piece, drill through with a 1" screw-mate (an inexpensive combination drill/countersink) at the places marked for screw holes on the panel, and then drive the first two or three screws starting at front and working back. Use

1", No. 8 flathead plated or brass wood screws and waterproof glue throughout the hull construction. If you can find a Yankee, push-screwdriver to use, the construction will progress noticeably faster. When all the screws are in place and the glue drips have been wiped dry, repeat the process to attach the other side piece to the front bottom panel. Next position the back bottom panel in place with its front edge butted up against the back edge of the front panel, and attach this to the side pieces in the same way. Cut the 2 1/2" wide fir strip that is mounted over the butt joint, spread glue on its bottom side, and drive the screws up through the bottom panels and into the strip.

- To lay out the bulkheads, mark the sides and bottoms as shown, and then mark the midpoint of the curved top line on a centerline drawn at right angles to the bottom. Drive small nails into the plywood at the tops of the sides and at the midpoint of the top curve, and then push a thin batten up against the nails to shape the curve over the top. Use a hole cutter at all corners of the access holes cut into the seatback and dash panel as starter holes for cutting the shapes.

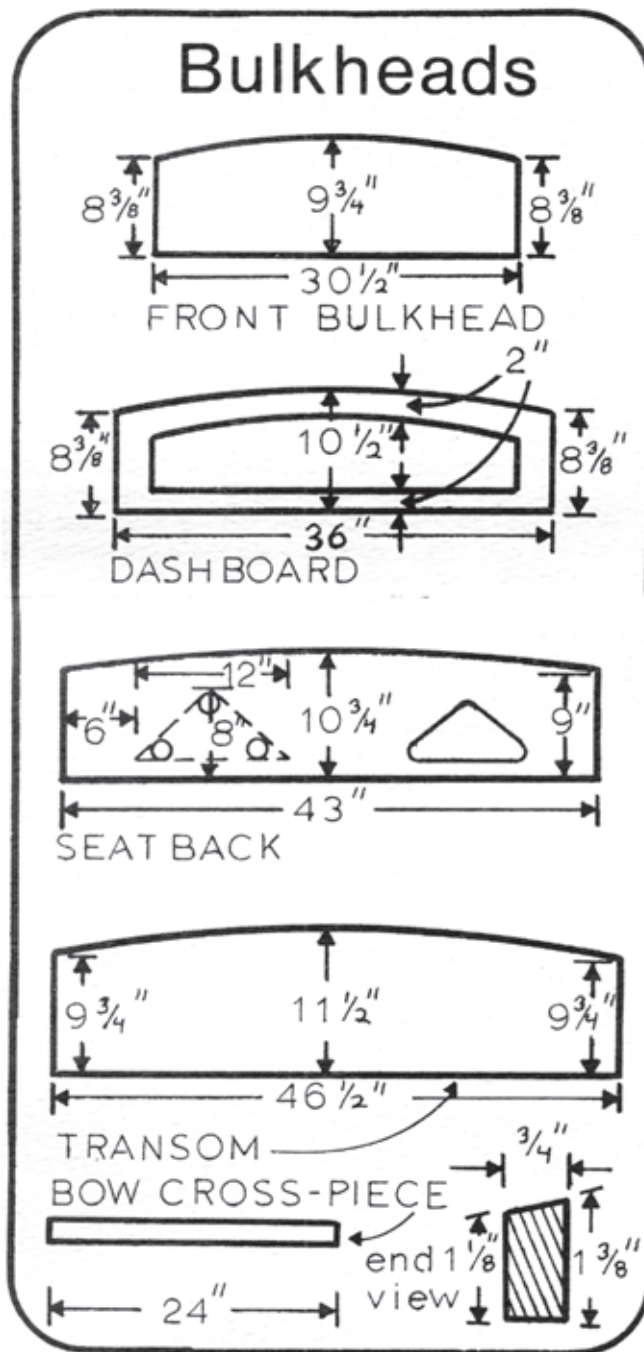
Mark lines along all four sides of each bulkhead, 3/8" in from each edge, and then space marks for screw bores at 4" intervals along these lines (for attaching the stringers to the backsides of the bulkheads). Space

screwholes at the bulkhead ends about 3" apart to prevent splits at the ends of the short stringers. Rip 1"x3/4" stringers from straight grained fir (the long scraps from the side pieces are good for this) and then attach the separate stringers to the bulkheads. If any stringer seems to be too stiff to bend without cracking, cut 1/2" deep kerfs across the side forming the inside of the curve (kerfing between screwholes).

- After the stringers are attached to the bulkheads, use a serrated wood shaper to smooth down the edges of the completed assemblies before positioning them in the hull. Place each bulkhead in position, as shown in the plans, and draw around it marking its outline on the inside of the hull. Space 1/8" screw holes between the positioning lines on the hull bottom so that the screws will come up through the hull bottom and sink into the centers of the stringers. Then flip the boat on its side and countersink the screw holes before spreading glue on the bulkhead stringer edges and fixing it in place. Drive the screws at the two ends of the bottom stringer first, and then drive the others in place. To attach the side stringers to the hull sides, countersink the screw holes into the stringers about halfway through so that the screws will get a firm bite on the hull sides. When attaching the bulkheads, start with the front bulkheads and work back toward the transom in order. Attach the bow cross piece by the driving screws up through the bottom and into the bottom of the cross-piece. Drive two 2" No. 12 screws in through the side pieces and into each end of the cross-piece, using 3/16" counter-sunk screw holes through the side pieces.

- After the top edges of the sides and bulkheads have been faired off with a shaper, fill all gaps and corners along the joint of the hull bottom to the sides with a good caulking compound.

Drill the three 5/16" holes for each front wing strut near the front end of both side pieces in the following positions: drill the front holes 2" down from the top of the side piece and 5" back from the bow front; drill the



top back holes 2" down from the top and 10" back from the front; and drill the bottom back holes 5" down from the top of the sides, and 10" back from the front of the hull. Insert 2"x5/16" bolts (threaded to the

heads) through the holes, sticking out to both sides of the boat. Run nuts onto these bolts and tighten securely, caulking around the bolt heads inside the hull.

ATTACHING THE DECKING-

To attach the front panel of decking to the top of the hull, lay an uncut sheet of 1/4" plywood over the front of the boat, better side up, centered, with one end flush with the front edge of the bow. Drive small nails down through the panel and into the top edge of one hull side at the front, back and midpoint of the side. Lift up the free side of the decking and mark the positions of the tops of the bulkheads and hull sides onto the bottom of the decking. Next, nail the free side of the decking down to the top of the opposite hull side, and then remove the nails on the first side. Mark the positions of the side and bulkheads on the bottom of the decking. Remove the decking panel, flip it over, and space 1/8" screw holes at 4" intervals between the lines marking the positions of the bulkheads and sides.

- When you're ready for an uninterrupted session of driving screws, paint the bulkhead and side-piece markings with glue. Then spread glue onto the tops of the bulkheads and hull sides, replace the front panel of decking in place, redrive the nails into EXACTLY the same holes as before, and finally, with the decking in correct position, countersink all screw holes with the 1" screwmate as you drive all screws in place. When the decking is fastened in place, simply trim off the overhang on both sides.

- The rear decking panel (a 4' x 4' sheet of plywood) is attached in exactly the same manner as the front panel. After it has been attached and trimmed, mark a centerline down the decking. Mark the cockpit side cuts 3" in from the sides of the boat, as shown. To mark the curved front line of the cockpit, drill two little holes in a batten 16" apart, insert a nail through

one hole and a pencil through the other and then, by placing the nail on the centerline, draw an arc with the pencil extending from one cockpit side line to the centerline about two inches behind the dashboard, and from there back to the other side line of the cockpit.

Continue the front curve cut back down the sides of the cockpit to about 4" in front of the seat back. Cut across the back of the cockpit (using the seatback as a guide) to about 4" from the cockpit side lines. Mark a 2" diameter circle with this arc joining the cockpit sideline to the seatback line on both sides, and then cut out the arced corners, joining the cockpit cuts.

- Cut and attach the corbels mounted just beneath the butt joint of the decking panels on both sides of the cockpit, and then cut and attach the 1x2" mounted vertically across the cockpit aft of the panel joints and forward of the seatback.

- Cut a steering mounting block from a 4" length of 4x4" scrap and mount by driving screws down through the deck and forward through the dashboard, as shown. The steering wheel mount flange is then screwed or through-bolted to the angled bottom of this block.

THE MOTOR MOUNT-

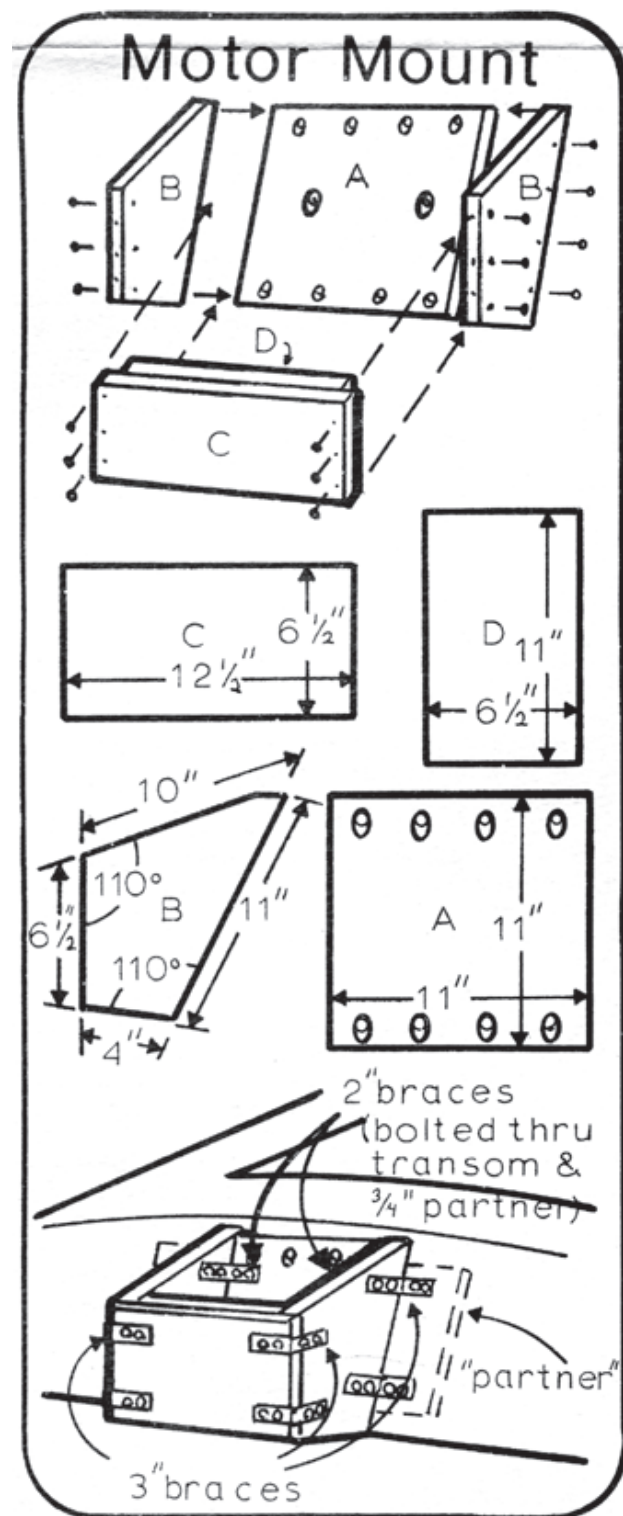
Cut the pieces as shown to build the motor mount from 3/4" exterior or marine grade plywood. Attach the side pieces marked "B" to the side edges of "A" using glue and 2" No. 10 screws (after drilling 3/16" countersunk screw holes, of course). Next, attach part "A" to the boat transom, angling the four top screws up into the top stringer of the transom, and the bottom screws down into the bottom stringer, with glue and the 2" screws. Now attach "C" and "D" to the sides of the mount by driving 2" screws through the sides and into the edge-grain of "D" and through "C" and into the edge-grain of the side pieces.

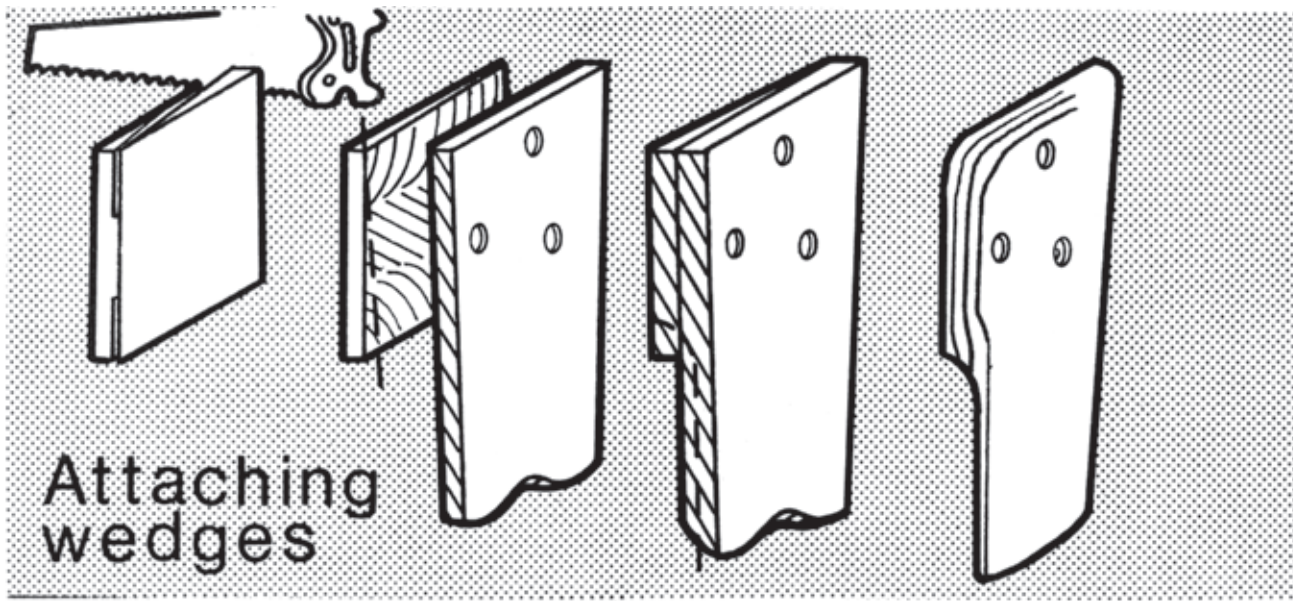
- It's essential to reinforce this mount with 3" steel corner braces mounted as shown in the sketch. These braces are attached in pairs with 2" and 2 1/2X 1/4" bolts extending through both braces, sandwiching the wood in between. It's necessary in most cases (when drilling through the holes provided in the braces and on through the wood) to drill new holes in the 2" inner brace. The corner braces attaching the mount to the transom are through-bolted in pairs through the sides of the mount with the transom side arms bolted through the transom and on through two 7 x 8 inch plywood back-up "partners" mounted on the forward side of the transom. The 2 1/2" bolts are used to bolt through "A", through the transom, and on through the partners.

Cut two 6"x10" pieces of 1/4" thick ply (or one piece of 1/2") to fit up against "C" to bring the overall thickness of the mount to 2".

THE WING STRUTS—

To give the boat wings, start out by cutting the front struts to the rough length shown in the plans, hold each strut in the position shown (against the bolt ends) and tap the strut against the bolts to mark the hole positioning (when the strut is at right angles to the top line of the hull side). Drill these holes with a 5/16" bit and then mount the strut over the bolts. After the nuts have been tightened down, use a framing square to make certain the struts are solidly mounted at right angles to the bottom line of the hull side. Next, unbolt the struts, cut the 5"x7 1/2" wedges (aligning the struts parallel) which fit on the inside of the struts (fat end forward, tapering from 1/2" down to a point at the aft end) and then screw these to the insides of the struts, flush at the top. Re-drill the strut holes on through the wedges and then trim off the excess wedge at the edges of the strut. Countersink the strut holes on the inboard side of the struts so that they will mount over the mounting nuts of the strut bolts, allowing the sides of the struts to lie firmly against the sides of the hull.





- To mount the rear inboard struts drill the mounting holes through the hull sides near the seatback in the following positions: drill the front mounting holes 14" forward of the bottom, back corner of the hull side, and 4" up from the bottom; drill the top mounting holes 10" forward of the back corner of the hull side and 7" up from the bottom; and drill the back mounting hole 7" in front of the bottom back corner of the hull side and 2" up from the hull bottom—all with the 5/16" drill bit.

Cut out the rear outboard struts and hold (or nail) them in place with their center lines at right angles to the hull bottom, and mark the position of the mounting holes. Drill these holes, and then cut the 8 1/2x11" wedges used to align the struts with a handsaw, as shown. These wedges are placed fat end forward, tapering from 3/4" down to a point at the aft end. Screw these to the insides of the struts, trim off the excess at the side edges, re-drill the mounting holes, and then mount the struts solidly in place.

- Next, cut the horizontal strut, arching over the top of the hull from 1x12" stock and mount to the rear inboard struts by running four 2" screws down through

it and into the top edges of the vertical struts. Cut the rear outboard struts from the 1x12" stock, being careful to cut the shorter top end cut at the angle shown in the front view of the rear wing assembly. Mount these to the horizontal strut by running four 2" screws down through this strut and into the top edges of the outboard struts, mounted flush with the ends of the horizontal strut. Glue is used at all joints in the wing systems except, of course, where the struts lie against the hull. Leave these joining surfaces unglued so the wings can be unbolted from the hull.

BUILDING THE WINGS—

An efficient hydrofoil shape is different than an airfoil cross section, more closely resembling the wings of a supersonic plane. The bottom is absolutely flat while the top is a symmetrical arc, ending in a very sharp trailing and leading edge. An airfoil shape used underwater will cavitate and lose lift altogether.

The wings are cut from dry, straight-grained, clear fir. Cut a 53" length of 1x8" stock (actually 3/4 x 7 1/2") for the front wings (leaving the two wings in one piece for the time being for ease of uniform shaping). Cut a

48" length of 1x8" stock for the rear take-off wing, and a 70" length of 1x12" stock for the two rear flying wings.

To shape all of the wings, use a batten to draw an arc on each end of the boards that starts in one lower corner of the cross-section and arcs over, touching the opposite surface of the board at the centerline and then curving back down to the original surface at the opposite lower corner, as shown. The front wings will be slightly fatter in proportion than the rear wings. Bear in mind while shaping the wings that research has shown that the surface condition of the foils, along with the condition of the leading edge, has more to do with the lifting power than the actual cross-section of the wing — as long as it is reasonably close to the foil section shown. So remember that it's better to have a slightly varying cross-section than to have a rough leading edge, or a wing that doesn't have a smooth, glossy paint finish.

- Set the rip guide and the blade depth of your circular saw (hand or table) so that you can cut the kerfs used as shaping guides lengthwise down the wings. After cutting the first kerf, turn the board around and cut it down the other side of the same surface. Then reset the saw for a shallower cut, nearer the center line of the board, and cut the board twice again, and so on, creating a symmetrical shaping guide. The same settings can be used for the front wings and rear take-off wing.

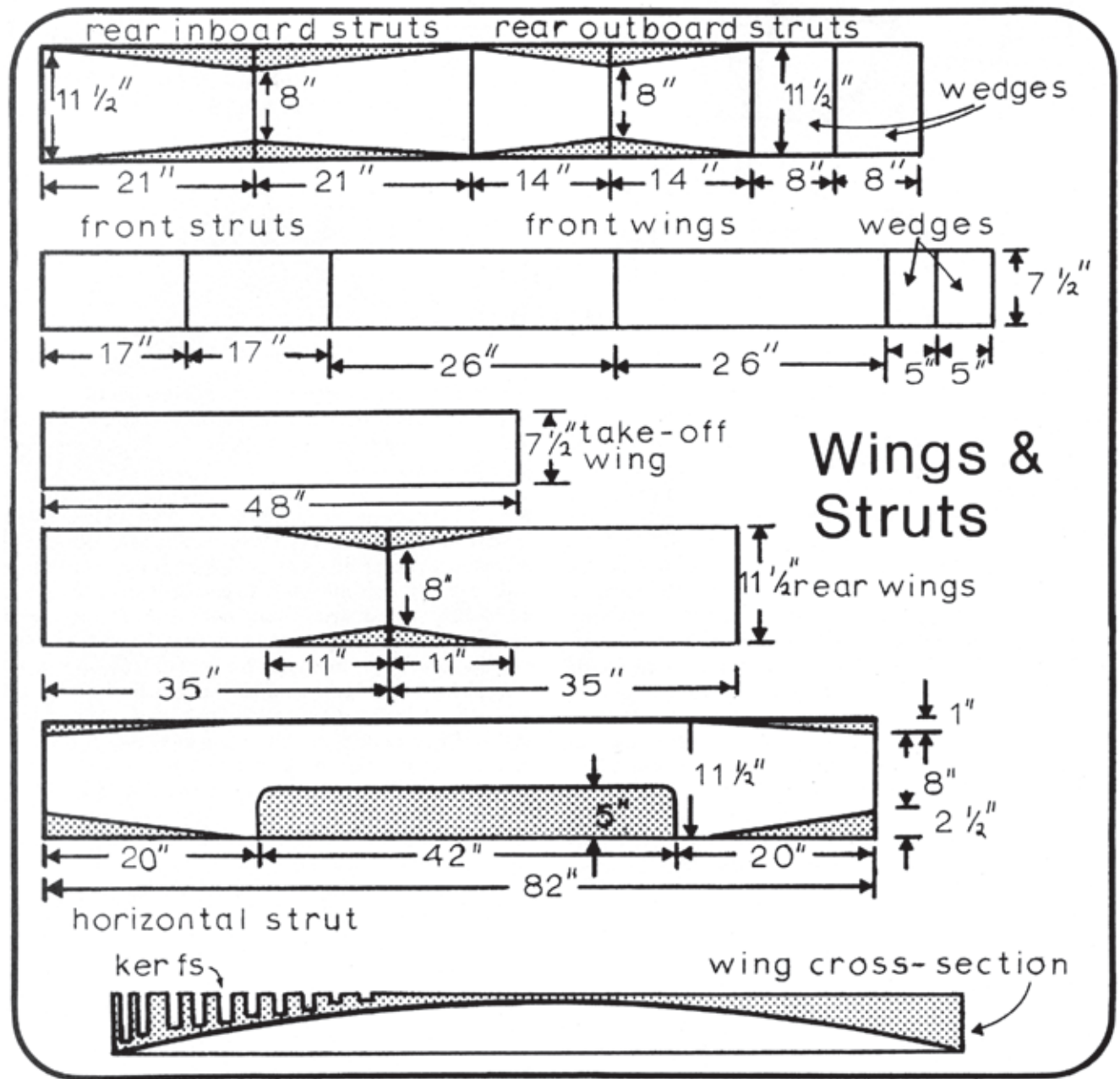
After the boards have been kerfed, use a rotary rasp to remove the wood above the bottoms of the cuts. Then switch to a serrated wood shaper (hand powered) to smooth this rough form into a uniform foil shape. When the foils are ready for first sanding, cut the individual wings to shape (tapering the arcs of the inboard ends of the rear flying wings). The front wings are butted together at right angles in the center, meaning that one of the wings has to be cut to a concave shape at the joining end in order to fit over the arc of the other. Use the arc of the other wing as a

template for this cut and then (after drilling screw guide holes carefully) drive four 2" No. 12 screws through the uncut wing and into the end grain of the concave wing end. Lay the assembly (trailing or leading edge down) on a flat surface and make certain that both wings lie at right angles to the surface. Then back the screws out, spread on glue and reset the screws firmly.

- Setting the angle of attack (the amount of rise toward the front on the bottom surface of the wings) is very important. The angle is figured on all wings by using the flat part of the hull bottom (and the parallel line along the tops of the hull sides) as a line of reference. The front wings are set at five degrees of upward tilt toward the front, the rear flying wings are set at three degrees, and the rear take-off wing is set at five degrees.

To mount the wings on the struts, draw lines across the front struts that line up exactly with the line of the flat part of the hull bottom. Next, draw lines across these struts parallel to these lines, but 4" below them. And finally, angle a line up at five degrees from the back ends of these lines. Figuring a strut width of 7 1/2", the line should be 5/8" above the horizontal line at the leading edge of the strut.

- Trim the outboard ends of the wings so that the end cuts will be vertical when the wings are mounted, and then use these angled end cuts as a template to draw the concave end cuts on the bottoms of the struts. To do this, align the flat bottom edge of the angled cut end exactly on the 5 degree angle of attack line, and then draw over the top of the end cut onto the side of the strut. Set the sabre saw at 45 degree tilt, and cut both strut ends, angling down toward the center. Position the wings in place with their center join directly below the centerline of the boat, and mark the positions of the struts on the tops of the wings. Drill 3/16 screw holes through the wings (countersunk on the bottom side) so that four 2", No. 12 screws pass up through the wings and squarely into the ends of both

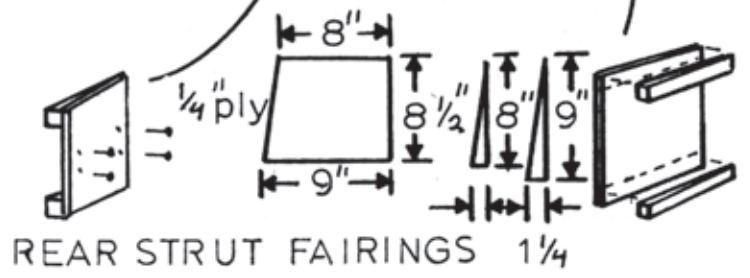
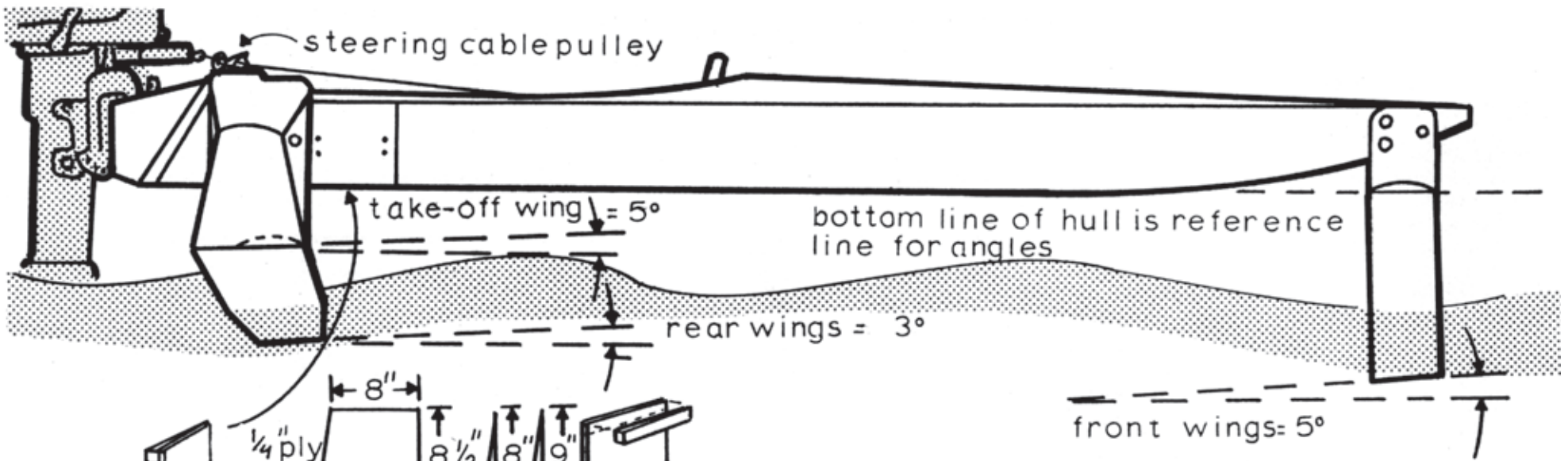
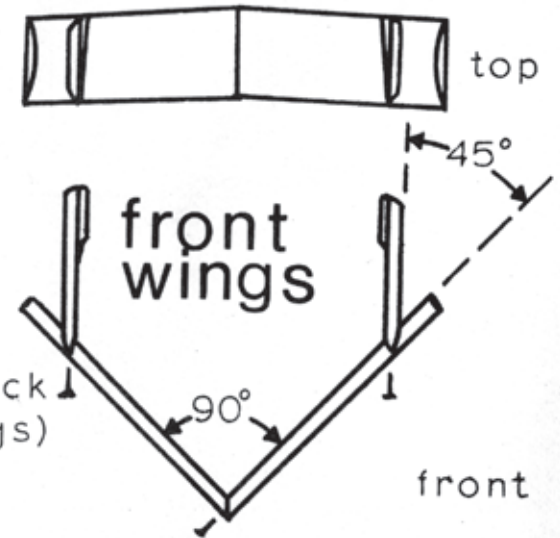
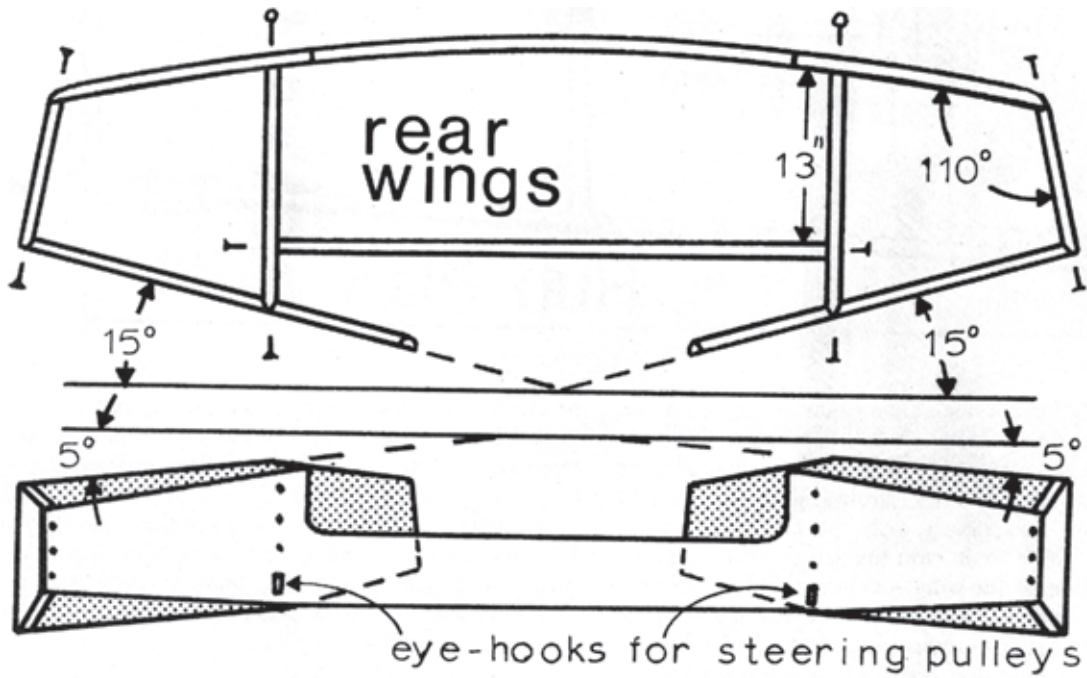


struts. Position the wings in place again, and drill 1/8" starter holes for the screws up through the wing holes and into the center line of the strut ends (about 1"). Attach the wings in place, and alter the end cuts if necessary with a wood shaper to get the right angle of attack. After final checking, back off the screws,

letting the wings down again, spread glue on the joining surfaces, and drive the screws tight one last time.

The rear wings are mounted in much the same way: draw horizontal reference lines across the inboard rear struts 12" below the hull bottom; start the 3-degree

Wing Assemblies



Wing angles of attack

angle of attack lines at the back ends of these lines; use the wing ends (with wings up against the bottom of the outboard strut) to mark the curved strut bottom when the flat bottom of the wing is aligned with the angle of attack line; set the saw at 15 degrees tilt and cut the ends. To mark the outboard struts, place the wing up against the cut of the inboard strut and use the wing-end to draw the curve on the inside of the strut. Then cut with the saw set at 2 degrees tilt.

- Mount the rear wings to the strut bottoms in the same manner as the front wings; mark placement of strut bottoms; drill four vertical 3/16" screw holes to guide the screws into the center lines of the struts; replace the wing and drill 1/8" screw starter holes up into the struts; attach wings with 2" No. 12 screws; test angles of attack; then glue and mount the wings permanently.

The take-off wing (providing extra lift at take-off only) is simply cut to fit between the two inboard rear struts. Mark horizontal lines 6" below the hull bottom, then mark 5 degree angle of attack lines, position wing in place, mark end positions on the struts, drill and mount with glue, driving the screws in through the struts and into the ends of the wing.

- To streamline the vertical struts, draw a line down the centers of the leading and trailing edges, and then smooth the struts to a tapered point along these lines on both edges with a rotary rasp and hand shaper. Spread a good plastic wood filler or catalysed resin filler into all the corners where strut and wing meet, rounding this corner into a smooth curve (your forefinger is a perfect tool to shape this arc). Make the wedge-shaped fairings which fit on the side of the boat just forward of the inboard rear struts from scraps. These fairings prevent a splashing into the cockpit on landing and should be mounted with screws, but no glue to the hull sides to permit removal so that the rear wing assembly can be slipped off the front of the boat. Sand all struts and wings as smooth as you can get them, and then remove the wing assemblies from the boat for painting. The front wings are flexed

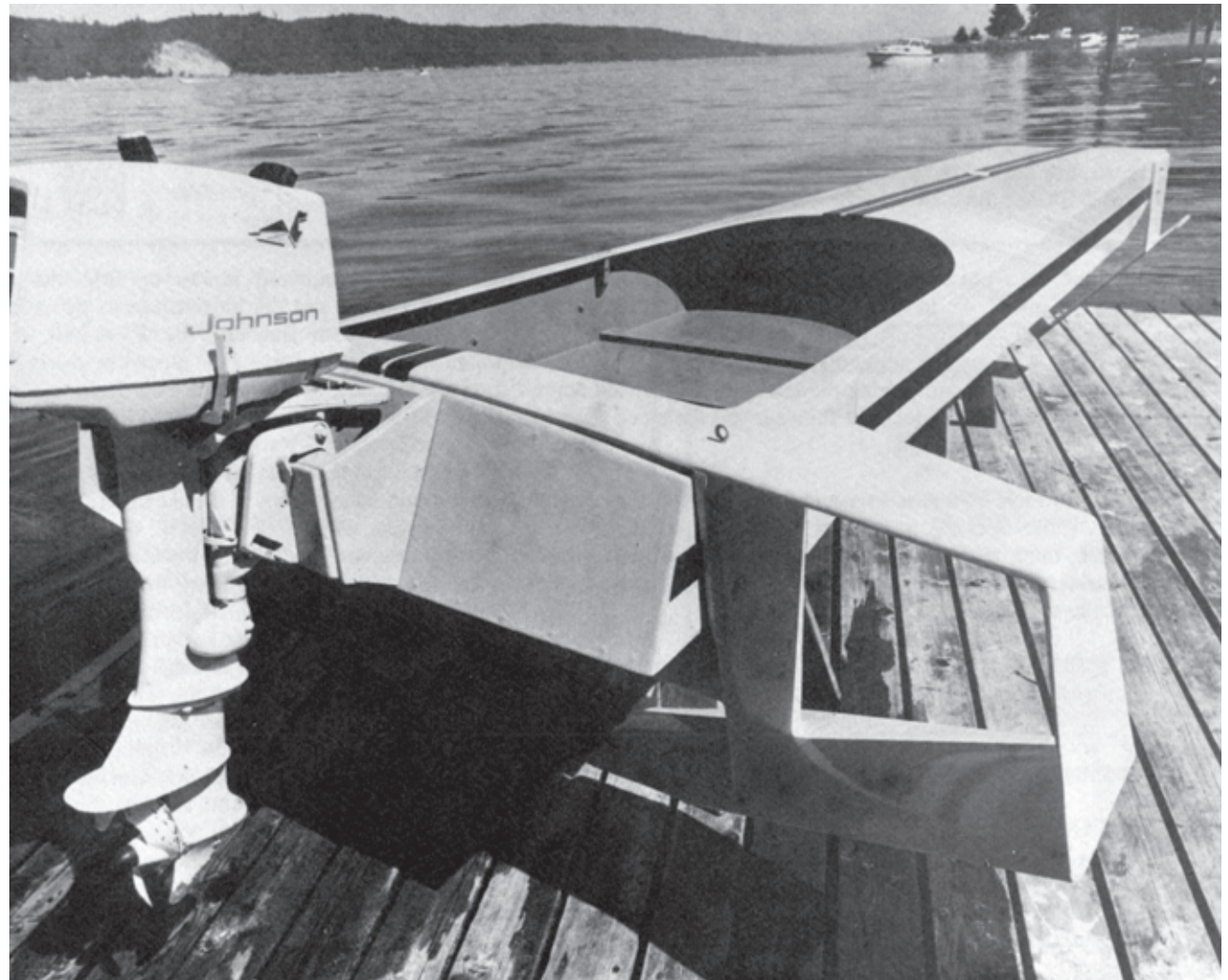
slightly to enable the struts to slip off the bolts.

PAINTING HINTS—

It's important to end up with a smooth, glossy finish on the wings for good flying performance, and here are some of the tricks we've learned to achieve this: always paint the wing surfaces on a horizontal surface, and leave them flat until the paint is tacky enough not to run before turning the wing assemblies to paint other surfaces; always use thinned paint (preferably a good marine paint thinned with water-seal); and use many thinned coats, rather than a couple of thick coats

to cover (it takes a little more patience for the added drying times, but you'll find that the actual painting will proceed much more easily). Sand between the first few coats to remove the little hair-like fibres left after sanding.

If you intend to hot things up with an engine over 15 horsepower, we recommend a general beefing up of the wing assemblies and engine mount. Use a tougher hardwood for the struts and wings, and/or cover all surfaces with a layer or two of fibreglass cloth, finishing off with a "hot coat" of resin for a smooth finish.



FLYING YOUR SPORTFOIL—

When you set off on your first test flights, you may want to squat down, remaining on your feet in order to be able to shift your weight while you get the feel of the controls. Always take off in a straight line and once flying, try to bear in mind that the drag increases in the turns, so you may want to turn the power up rather than easing it off when cornering. This is a little hard to get used to at first, but you'll soon learn that the faster you take the turns, the smoother they go. If you're like most beginners, you'll find that there's more fun than fluster from your first solo onward with the SportFoil!

Because the construction of a SportFoil is dependent on factors of materials used and craftsmanship that are beyond the control of the designer and the magazine publisher, neither the designer nor other contributors can accept responsibility for the performance of the boat as actually constructed.

Publisher's Note:

We think you'll find the old Sportfoil plans to be a good starting point for your own hydrofoil project. We say starting point, as these plans were drawn originally nearly thirty-three years ago. Time has had its way with hydrofoil design, as with everything, and these plans must now be considered merely as a basis for your own hydrofoil design, and are presented as a starting point for the beginning hydrofoil-builder's education. As each builder finds his or her own parts and components, they each will be building a unique machine, tailored to their own needs. This personalization is one of the most rewarding and essential parts of building projects yourself.

The builder/designer/experimenter should make a thorough study of the more current journals and technical publications to learn what advancements have been made in the past one-third-century.

LUMBER LIST—

DFPA Exterior or Marine grade plywood:

3 — 4'x8'x 1/4" panels.

1 — 4'x4'x 1/4" panel.

1 — 2'x4'x 3/4" panel.

Clear, straight-grained Douglas Fir stock:

1—1"x8", 12-ft long.

1—1"x10", 6-ft long.

2 — 1"x 10", 12-ft long.

1 — 1"x12", 8-ft long.

1 — 1"x12", 12-ft long.

HARDWARE LIST—

300 - 1", No. 8 brass or plated flathead wood screws.

100 - 2", No. 12 brass or plated flathead wood screws.

8 - 3" iron corner braces.

4 - 2" iron corner braces.

18 - 2"x 1/4" carriage bolts & nuts (with washers).

4 - 2 1/2"x 1/4" carriage bolts & nuts (with washers).

6 - 2" x 5/16" carriage bolts & double nuts & washers.

6 - 3"x 5/16" carriage bolts & double nuts & washers.

2 - 4"x 1/4" screw eyes.

1 — Outboard steering assembly.

In the Weekender plans we paraphrase Capt. Eddie Rickenbacker's famous line: "Anything that moves is dangerous". This is certainly true of hydrofoils and should be kept in mind if you build your own. The plans show how we built ours, but you'll most likely end up having to change a few things here and there to accommodate your own needs, or to make different parts fit. Just make sure you take the time to consider the loads and ramifications of your work.

Some Thought on the Old Sportfoil Plans:

In the original text the possibility of using engines larger than 15 horsepower is mentioned. We now think this should be unnecessary. If you want to go faster, experiment with prop pitch first. No more than fifteen horsepower should be required to go quite fast enough, given the right pitch or a variable-pitch prop.

When these plans were drawn up, epoxies and better wood filling materials were not well known. Neither were the more modern composite materials available. Nowadays things could be changed to make the foils smoother and stronger. Keep this in mind and incorporate more modern methods and materials if you have the experience.

Good Spruce could be used in place of the Fir for the wings and struts.

Have fun with the process, and we hope you have many safe and exciting "flights."

Stevenson Projects, LLC

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