Cedar-Strip CANOE

The beauty of wood and the strength of fiberglass come together in this build-it-yourself family canoe.

Our photo-packed three-part series guides you through every step.

By BRUCE KIEFFER

PART ONE:
Assembling the wooden form on which your canoe will be built.

We know what you're thinking: "I'd love to own one, and I'd love to build one, but this is just too big and too difficult for me."

Well, we think you're in for a pleasant surprise. True, this *is* a large project, and it *is* time-consuming. But it's like painting your house — lots of time and lots of work, but not all that difficult. Unlike most forms of boat-building, a cedar-strip canoe is very forgiving in its construction. A first-time canoe builder with modest tool skills can build an excellent craft.

To ensure your success, we've gone all out with this story: Almost 50 how-to photos and plenty of drawings that'll guide you through every step. We're spreading it out over this and the next two issues, but if you're fired up to start, go right ahead; don't wait for all three installments. You'll find that they keep pace nicely with your work.

Our canoe is 18 ft. long, and designed as a general-purpose family touring craft for camping and flatwater paddling. It's stable, moderately fast, carries plenty of weight, has no keel, and is easy to portage. The one we built for this story weighed in at 54 lbs., though your canoe may end up a pound or two different.

In this issue, we'll assemble the "strongback," which is basically a long sawhorse on which to work. We then attach the molds, which are curved plywood pieces that the hull will be built on. The plans show clearly what the strongback and molds look like.

WHAT IS A CEDAR-STRIP CANOE, ANYWAY?

The basic idea behind a cedar-strip canoe is to make a hull of narrow wood strips, each one glued to the next with ordinary carpenter's glue, and then cover the hull with fiberglass, inside and out. The wooden hull by itself is weak, but the two layers of fiberglass make the canoe extremely strong, lightweight and

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waterproof. No ribs are needed, no canvas covering, and no caulking.

This "sandwich" construction, with the fiberglass as bread and wood as the filling, is also why this type of canoe is very forgiving to a novice builder — the wooden strips don't have to be fitted very exactly, because the fiberglass covers all the gaps.

WHAT IT TAKES TO BUILD

You don't need the skills (or the fussiness) of an expert woodworker to make a cedar-strip canoe. If you can operate a table saw or radial arm saw, you can do it. You do need patience and persistence, however. There are a lot of wooden strips to put on, and there's plenty of surface area to sand. You should count on it taking about 150 - 175 hours to finish the canoe. In addition, the materials will cost around $485.

A garage is the best place for building, because you need 12 - 16 ft. of clearance in front of and behind your saw for cutting the long strips. Furthermore, sanding the glued-up hull produces clouds of sawdust, and applying the fiberglass produces noxious fumes. You could work in a basement shop, but be sure you can get the finished canoe out, and install a powerful fan to exhaust dust and fumes. The tools you will need are listed on p. 88.

If you're ready, take a deep breath, and let's get started.

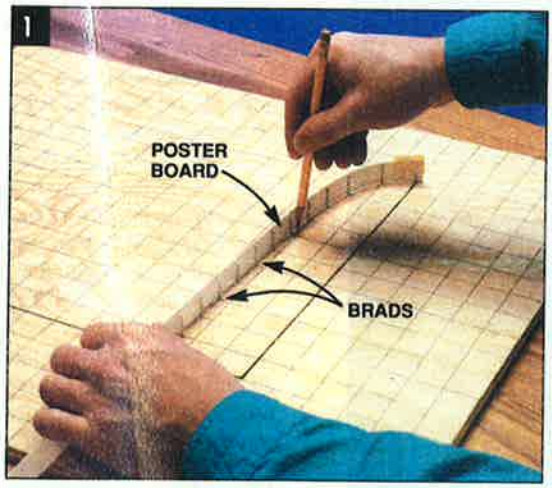
CUT STRONGBACK PIECES TO SIZE

Begin by cutting all the plywood pieces A - M to the dimensions given in the Cutting List. Then cut the leg supports (M) to their finished shapes.

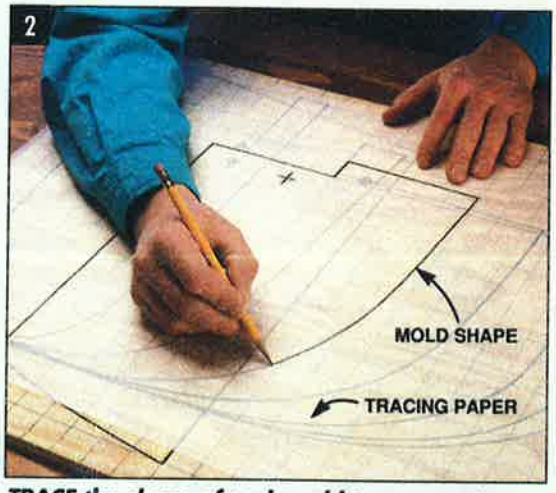
Cut the pine pieces N - U to their finished dimensions, then cut the tapered ends of the top pieces (U).

THE GRID LAYOUT BOARD

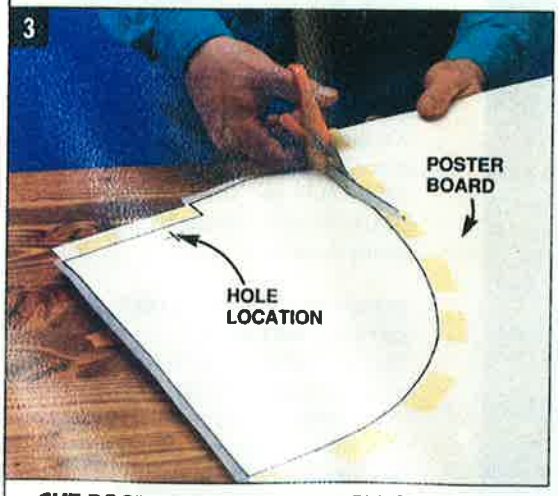
The grid layout board is used for drawing all the mold shapes to their full size. The shapes are then transferred to poster board templates, and then to the



TRANSFER MOLD SHAPES from our drawing to a piece of plywood using brads and a thin piece of poster board.

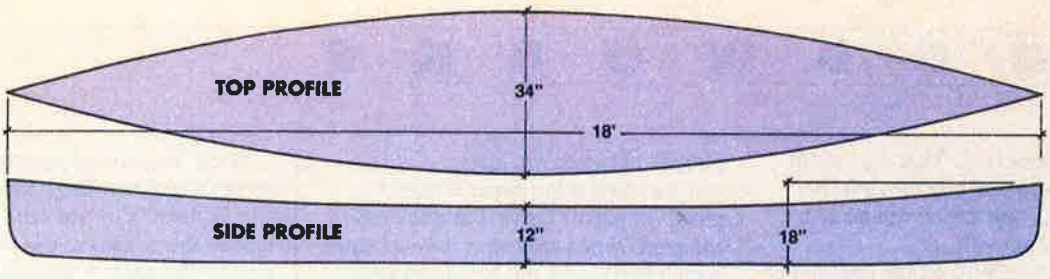


TRACE the shape of each mold to a separate sheet of tracing paper, taping it securely to the plywood layout board for accuracy.



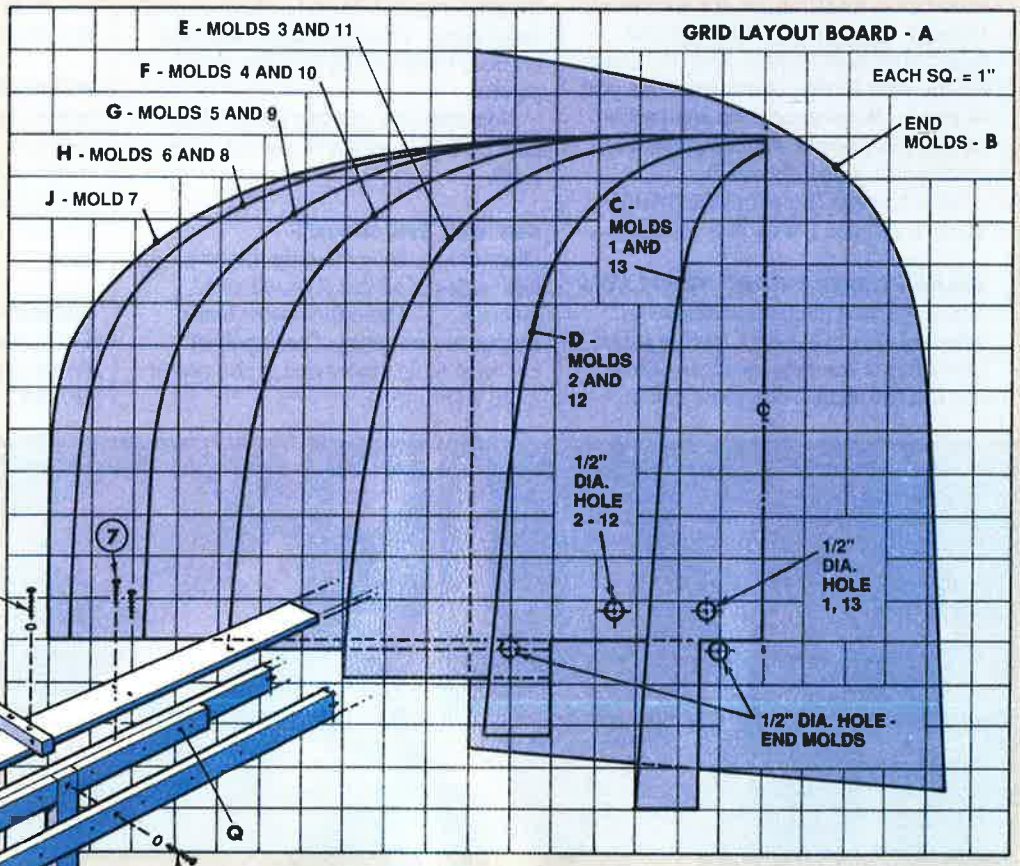
CUT POSTER BOARD TEMPLATES from each tracing paper pattern, again taping the tracing paper down for accuracy.

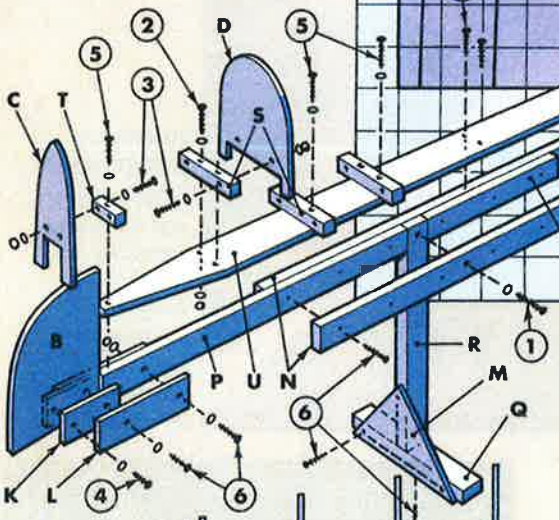
ALIGN the poster board templates to the center lines on the plywood mold pieces. Mark the mold shapes on the plywood.

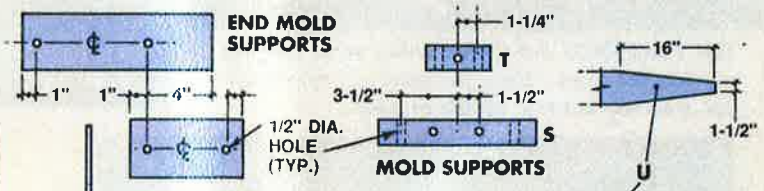


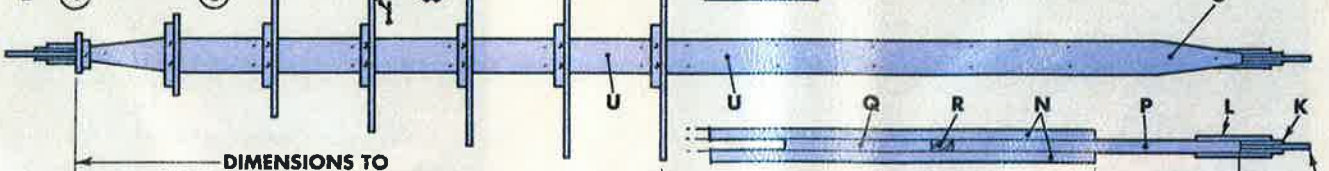
HARDWARE LEGEND

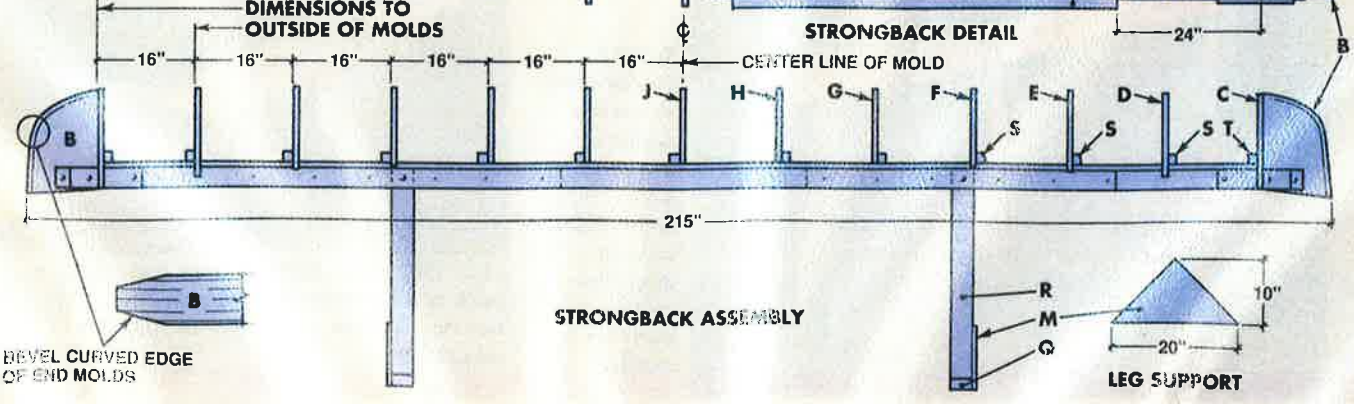
1. 1/4 X 5" HEX HEAD BOLT WITH WASHER AND NUT (2 REQD.)
2. 1/4 X 3" HEX HEAD BOLT WITH WASHER AND NUT (8 REQD.)
3. 1/4 X 2-1/2" HEX HEAD BOLT WITH WASHER AND NUT (26 REQD.)
4. 1/4 X 2" HEX HEAD BOLT WITH WASHER AND NUT (2 REQD.)
5. 1/4 X 3" LAG BOLT WITH WASHER (20 REQD.)
6. #6 X 2-1/2" DRYWALL SCREW (34 REQD.)
7. #6 X 1-1/2" DRYWALL SCREW (18 REQD.)











plywood pieces B - J. This may seem like a cumbersome process, but the payoff is that your canoe will be symmetrical and smooth.

Draw the 1-in. grid on the grid layout board (A). To eliminate any confusion, transfer one set of mold shapes at a time. Start with molds 1 and 13. Transfer the intersecting points from our grid to yours. Draw the curves joining the intersecting points and complete the mold half's shape (Photo 2).

Now transfer the remaining mold shapes, and the 1/2-in. hole locations.

MAKE POSTER BOARD TEMPLATES

Trace the individual mold shapes to separate sheets of heavy tracing paper. Don't forget the hole locations (Photo 2). Cut the shapes out about 1/2 in. outside of the drawn lines.

Tape the tracing paper shapes to pieces of poster board, but don't cover the pencil lines with tape. Use a center punch to transfer the hole locations to the poster board, then carefully cut out the shapes. Then check the accuracy of these templates against the grid pattern.

Note that you can buy printed templates from us, ready to cut out. See p. 89.

CUT OUT THE MOLDS

Draw center lines dividing the width on both sides of all the plywood mold pieces C - J. Trace the poster board shapes to one piece of each pair of plywood mold pieces and to the center mold 7 (Photo 4).

Stack the pairs of plywood mold pieces and screw them together with 1-in. screws. Cut and sand them as a unit so the shapes of the two molds are exactly the same (Photo 5). Drill the 1/2-in. holes, then separate the screwed-together pieces.

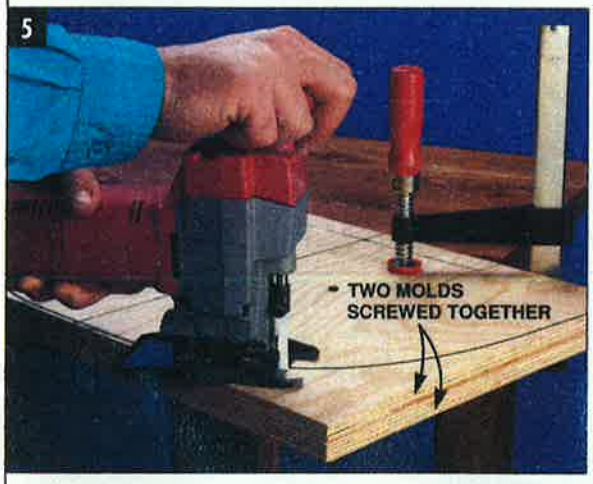
ASSEMBLE THE STRONGBACK

Screw the pine strongback pieces N - Q together (Photo 6).

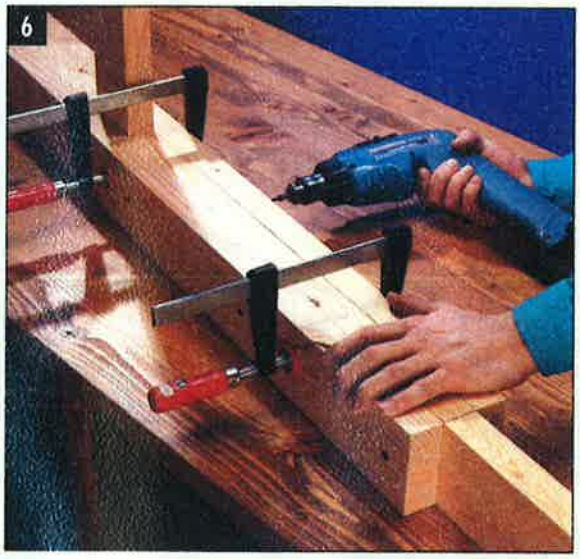
Screw the strongback top (U) to the strongback. Assemble the legs (Q, R, M) and then bolt the legs to the strongback.

MOUNT THE MOLD SUPPORTS

Use a chalk line to snap a center line down the length of the strongback top (Photo 7). Mark the locations of the

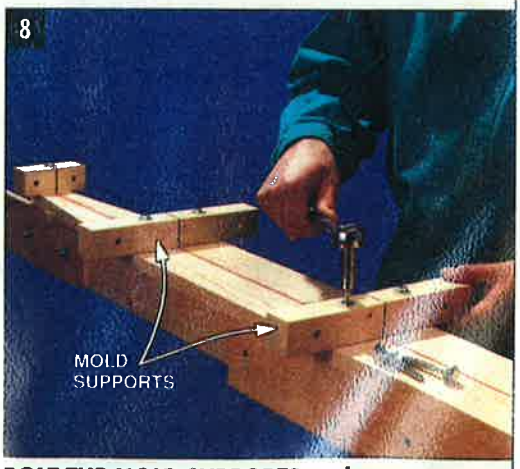


***CUT THE MOLDS** out with a saber saw, staying outside the lines. Since the canoe is symmetrical, you can cut two molds at once.*



***ASSEMBLE THE STRONGBACK**, aligning the pieces carefully. Work on a long, flat surface to keep the strongback straight.*

***SNAP A CHALK LINE** down the center of the strongback. This line will be used to align the mold supports and molds.*

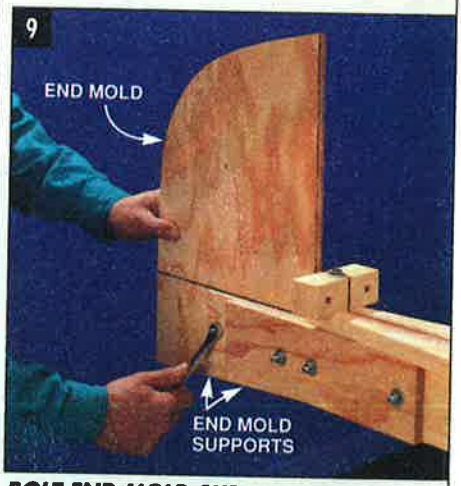


***BOLT THE MOLD SUPPORTS** to the strongback so the center lines match. The oversize holes leave you plenty of room for adjustment.*

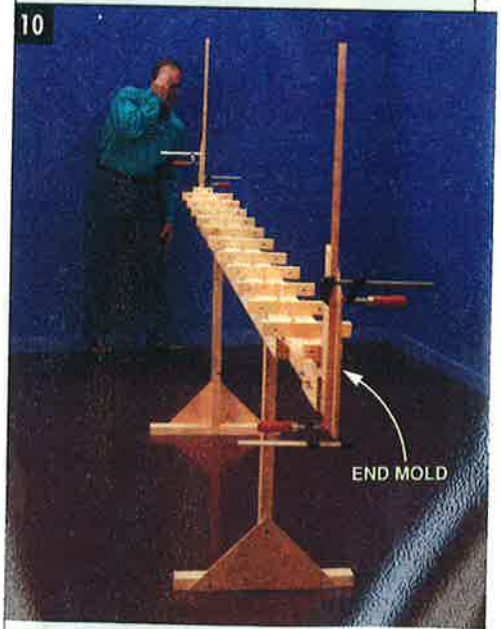
WOODWORKS

molds on the strongback top. The spaces between the molds are equal except for those between molds 6 and 7 and molds 8 and 7, which are 1/4 in. less than the rest.

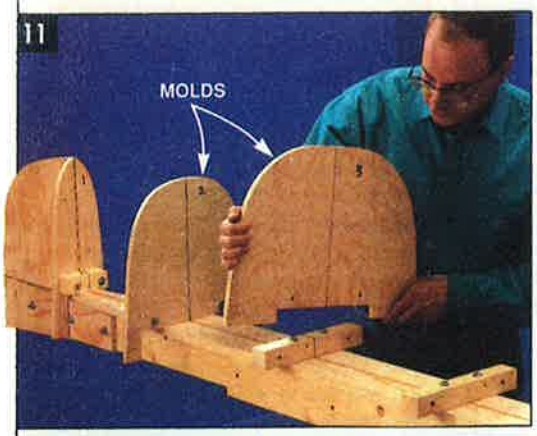
Draw center lines dividing the length on all sides of the mold supports (S, T). Drill the bolt holes in the mold supports and end mold supports (K, L). Drill the holes in the ends of the strongback for the end mold supports (L), then bolt them in place. Bolt the mold supports to the strongback (Photo 8).



***BOLT END MOLD SUPPORTS** to the end molds through the front hole, then slide the end molds into the strongback and bolt them down.*

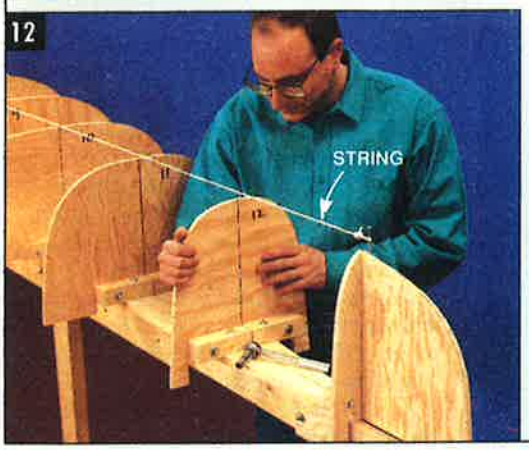


***ALIGN THE END MOLDS.** Long, straight pieces of wood clamped to the end molds will allow you to do it accurately by eye.*



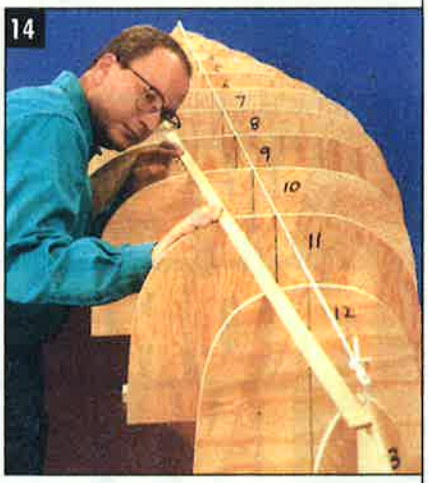
***PLACE THE MOLDS** on the strongback with the center lines of the molds and mold supports aligned, then bolt them in place.*

***CUT THE CEDAR STRIPS** that will form the hull of the canoe out of ordinary cedar lumber. A thin-kerf saw blade will reduce waste.*



***ALIGN THE MOLDS,** using a string pulled taut from end mold to end mold, then tighten the bolts holding the molds to the supports.*

***CHECK THE MOLDS** with a cedar strip, and shift them if needed, to be sure that all the strips will lie flat against each mold.*



MOUNT AND ALIGN THE MOLDS

Bolt the end mold supports (K) to the end molds, and then to the strongback (Photo 9).

Align the end molds so they're parallel to each other and in a straight line (Photo 10). Place poster board shims under the end mold supports to adjust the end molds.

Bolt the molds to the mold supports (Photo 11).

Screw a screw to the top edge of each end mold and tie a string between the screws. Align the center lines of the molds to the string (Photo 12). Be fussy about this step, because the canoe won't paddle straight if all the molds aren't in a straight line.

CHECK THE FAIRNESS OF THE MOLDS

"Fair" is a boat-building term that describes a curve that is smooth, without bumps or hollows. To ensure that your canoe hull is fair, you must carefully align the molds.

Start by cutting the cedar strips (V) that will be used to build the hull (Photo 13), and choose one of the strips as a fairing strip. First, lay it across the last couple of molds and the end mold. Bevel the edges of the end mold at about a 15-degree angle with a rasp so the strip lies flat on it.

Lay the fairing batten across the molds at different positions and look along it to see if it's flat against the molds (Photo 14). Check one area on one side and then the same area on the other side. The batten should lie similarly on both sides. Check all the molds in many places and make any necessary adjustments by shifting the molds slightly on the strongback or by trimming or shimming.

When it looks like the cedar strips will lie smoothly on the molds, you're ready to start Part 2.

TOOL LIST

Power tools: table saw or radial arm saw, jigsaw, electric drill, belt sander, orbital sander and router.
Hand tools: wrenches, chalk line, ten 2-in. spring clamps, four 6-in. clamps, two staple guns, Surform file, hand plane, two 7-in. or 9-in. paint rollers and three trays, two paint scrapers, coping saw, combination square.
Miscellaneous: church-key can opener or small tack puller, 20 clothespins, cartridge-type respirator, safety goggles, dust masks and rubber gloves.

COMING UP NEXT MONTH

In our next issue, the fun starts — actually building the canoe. We'll glue cedar strips together on top of the molds to form the wooden hull, and put fiberglass on it.

SHOPPING LIST: PART 1

ITEM	QUANTITY
22" x 28" poster board	3 sheets
19" x 24" tracing paper	5 sheets
1/2" x 4' x 8' exterior fir plywood	2 sheets
2" x 4" x 12' pine	7
1" x 6" x 8' pine	2
1/4" x 5" hex head bolts with nuts and washers	2
1/4" x 3" hex head bolts with nuts and washers	8
1/4" x 2-1/2" hex head bolts with nuts and washers	26
1/4" x 2" hex head bolts with nuts and washers	2
1/4" x 3" lag bolts	20
#6 x 2-1/2" drywall screws	50
#6 x 1-1/2" drywall screws	46
1" brads	50
1" x 10" x 16' cedar	3 pieces

Materials for our canoe cost $485.

CUTTING LIST

KEY	PCS.	SIZE & DESCRIPTION
A	1	1/2" x 20" x 24" fir plywood (grid layout board)
B	2	1/2" x 12" x 18-1/2" fir plywood (end molds)
C	2	1/2" x 6-1/4" x 16" fir plywood (molds 1 and 13)
D	2	1/2" x 13-1/2" x 14-1/4" fir plywood (molds 2 and 12)
E	2	1/2" x 13-1/4" x 20" fir plywood (molds 3 and 11)
F	2	1/2" x 12-1/2" x 25" fir plywood (molds 4 and 10)
G	2	1/2" x 12" x 30" fir plywood (molds 5 and 9)
H	2	1/2" x 12" x 33-1/4" fir plywood (molds 6 and 8)
J	1	1/2" x 12" x 34-1/4" fir plywood (mold 7)
K	4	1/2" x 3-1/2" x 7" fir plywood (end mold supports)
L	4	1/2" x 3-1/2" x 12" fir plywood (end mold supports)
M	2	1/2" x 10" x 20" fir plywood (leg supports)
N	2	1-1/2" x 3-1/2" x 12' pine (strongback sides)
P	2	1-1/2" x 3-1/2" x 48" pine (strongback ends)
Q	4	1-1/2" x 3-1/2" x 24" pine (strongback centers and feet)
R	2	1-1/2" x 3-1/2" x 36" pine (strongback legs)
S	11	1-1/2" x 1-1/2" x 10" pine (mold supports)
T	2	1-1/2" x 1-1/2" x 4" pine (mold supports)
U	2	3/4" x 5-1/2" x 8' pine (strongback top)
V	70	1/4" x 3/4" x 16' cedar (hull)

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TEMPLATE OFFER

We've printed a set of seven templates for the molds of this canoe. They're full-size, ready to cut out, will save you several hours of work and help ensure accuracy. The set costs $10, and can be ordered from Canoe Templates, The Family Handyman, 7900 International Drive, Minneapolis, MN 55425. Offer good while supplies last. *TFH*

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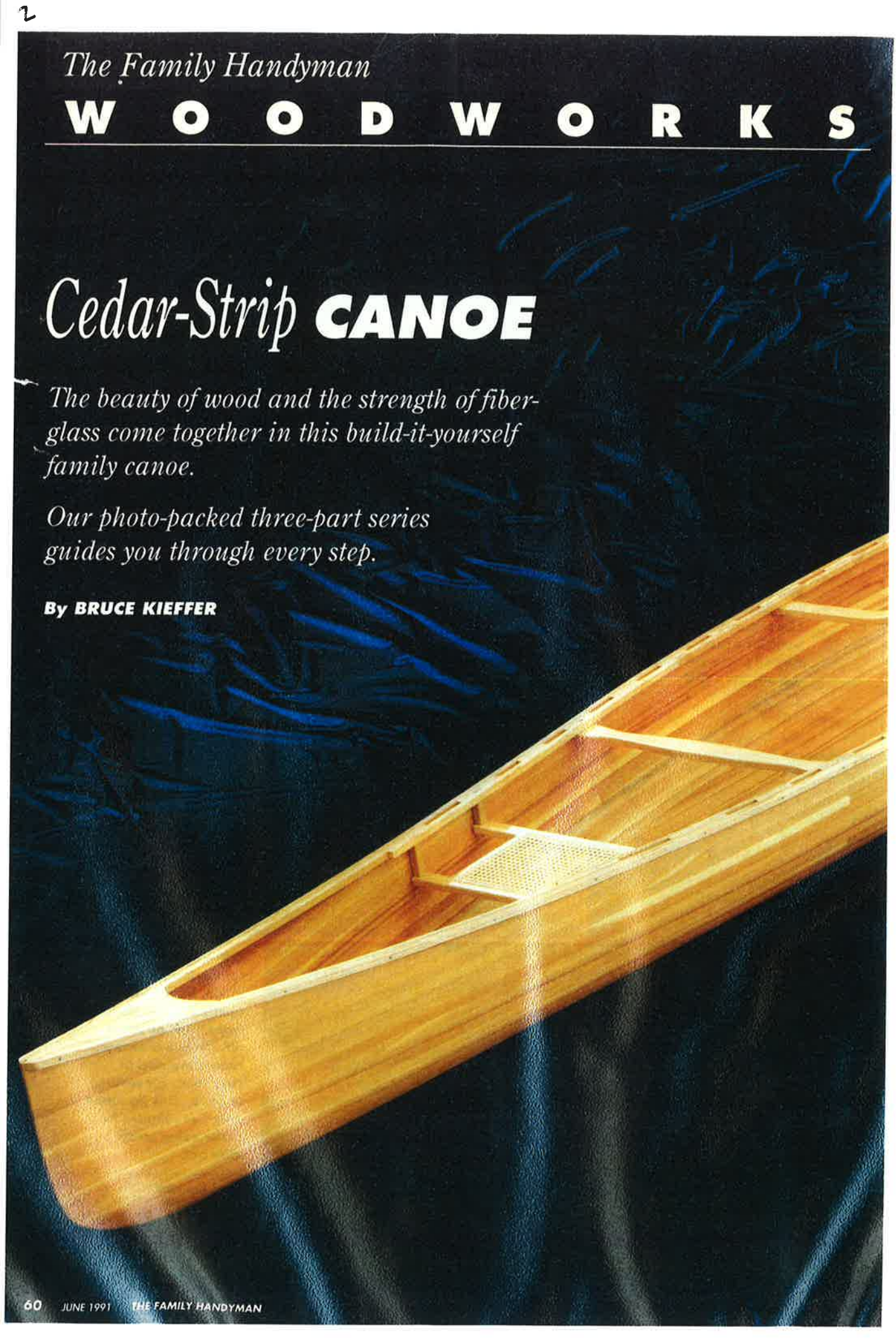

PART TWO:

The fun begins — building the cedar hull and covering it with fiberglass.

Last month, we did tedious but necessary groundwork, building the wooden form on which to make the canoe. Now the exciting part begins — the actual canoe building. In this second part of our three-part series, we'll be gluing cedar strips together to form the hull, and applying fiberglass to the outside surface.

(Note: To make it easier for you, all the fiberglassing supplies you'll need are available as a complete package. See the Shopping List for details.)

BASIC STRIPPING TECHNIQUE

Cedar strips are stapled to the molds to form the hull, with the edge of each strip glued to the edge of the previous strip with yellow carpenter's glue. Use 9/16-in. staples to attach the strips to the molds, and 1/4-in. staples between the molds to hold the edges of the strips tight to each other as the glue cures. Once the hull is complete, the staples are removed.

Begin by checking again that the

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molds are in the right position (Photo 14, Part 1, May '91), by holding a cedar strip along the molds in various places all over the canoe. The strip should lie across them without gaps or bulges. Move the molds slightly, trim them with a sander, or build them up with a thin strip until they're perfect.

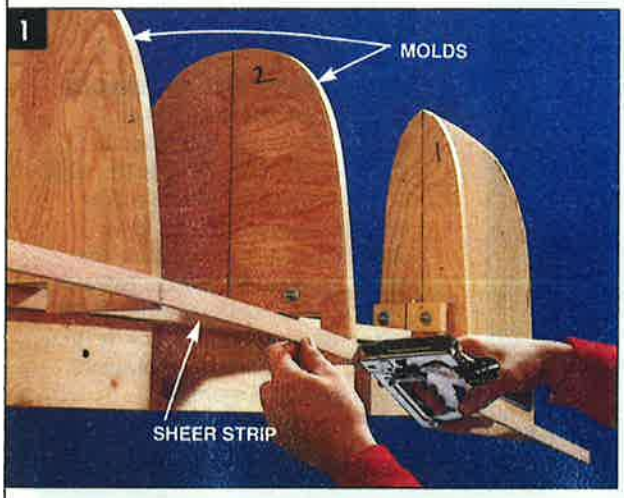
Now cover the edges of the molds with two layers of masking tape and a heavy coat of paste wax. This keeps the glue from sticking to the molds. Choose the cedar strips you plan to use. Keep color variations to a minimum by tossing out strips that are too light. To eliminate problems, attach the cedar strips in the order we describe. For the sheer strip (Photo 1) and all the subsequent horizontal strips, staple first at the center mold (No. 7) then staple out toward the ends. Staple all the tapered strips at their tapered ends first.

Since none of the cedar strips is long enough to cover the entire length of the canoe, you'll need to join the ends of strips together in a butt joint (Photo 3). Keep the positions of the butt joints the same on each side of the canoe so they're mirror images of each other, and stagger the joints up the sides to help conceal them. Apply a small amount of yellow glue to the ends of the strips at each joint.

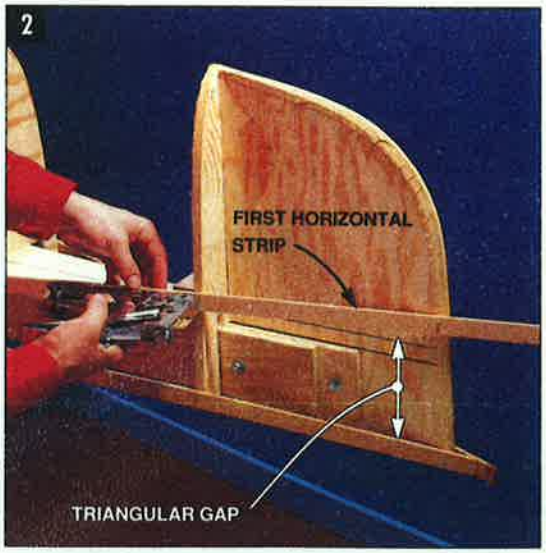
Here are the details:

THE SHEER STRIP AND HORIZONTAL STRIPS

Join two strips over mold 7, and staple them along the bottom edges of the molds (Photo 1). This is the sheer strip. Do one side of the canoe first, then cut off the ends of the strips at



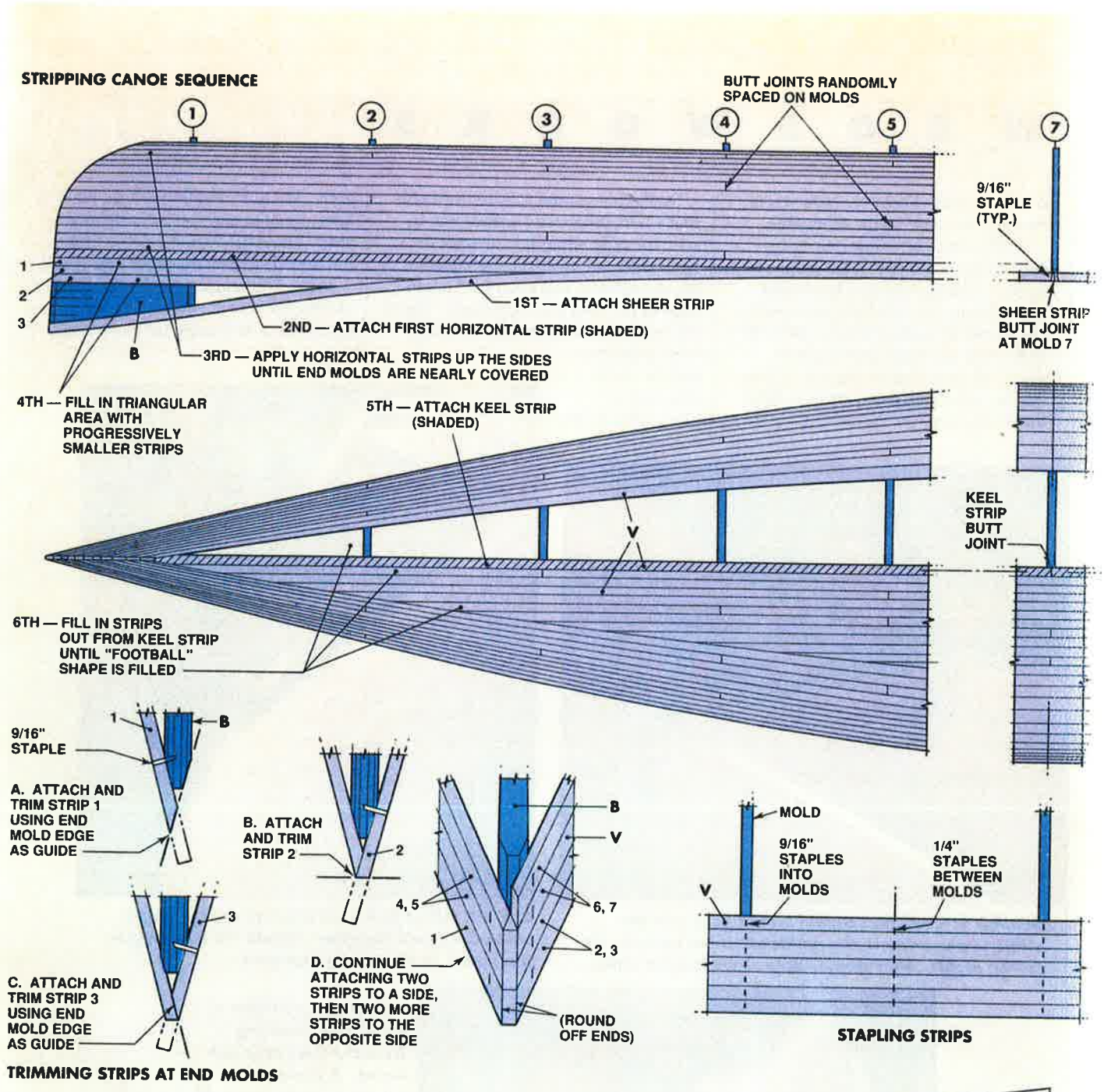
STAPLE THE FIRST CEDAR STRIP to the bottom corner of the molds, bending it smoothly to the ends. This is the "sheer strip."

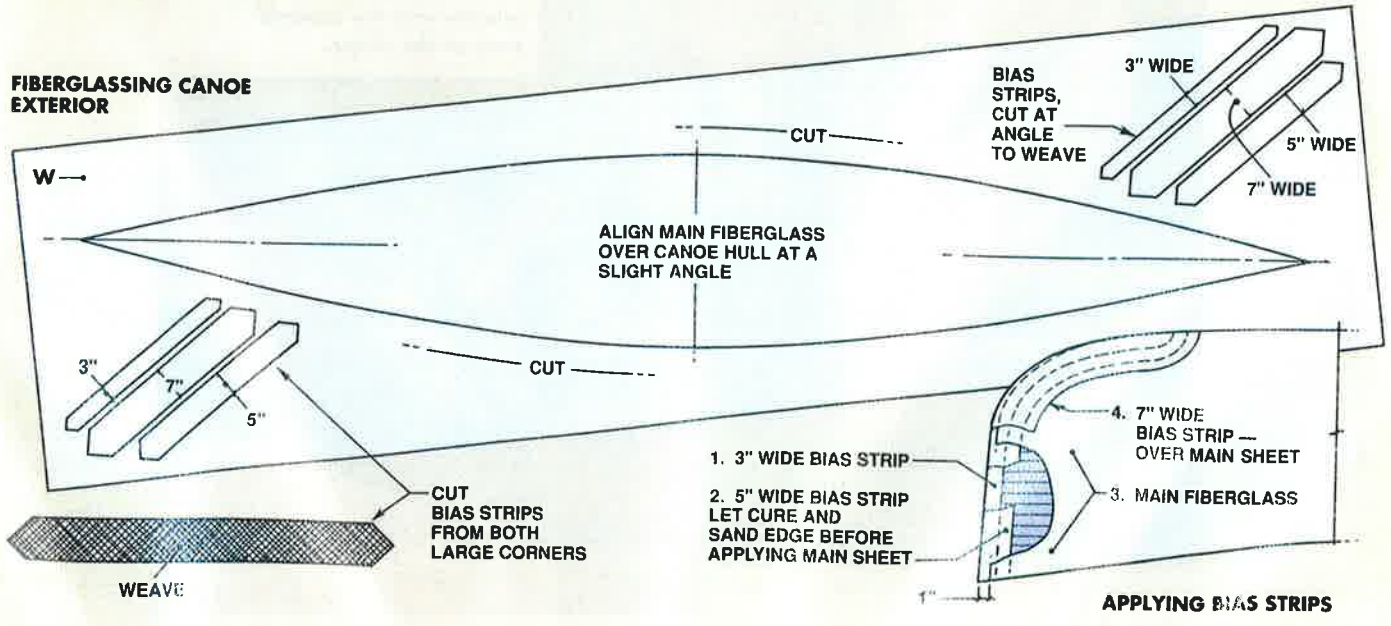


STAPLE THE SECOND STRIP horizontally, just above the sheer strip. Strips are edge-glued with regular carpenter's glue and stapled to the molds to hold them in place. Short strips are cut later to fill the triangular gaps.

JOIN CEDAR STRIPS end-to-end, always putting the joint over a mold and keeping the joints spread randomly over the surface of the canoe.

USE A COPING SAW to trim the ends of the strips. Note how the ends of strips on opposite sides of the canoe overlap. Temporarily laying a strip on the other side will allow you to mark the strips for cutting.


STRIPPING CANOE SEQUENCE
BUTT JOINTS RANDOMLY SPACED ON MOLDS
1
2
3
4
5
7
9/16" STAPLE (TYP.)
SHEER STRIP BUTT JOINT AT MOLD 7
1ST — ATTACH SHEER STRIP
2ND — ATTACH FIRST HORIZONTAL STRIP (SHADED)
3RD — APPLY HORIZONTAL STRIPS UP THE SIDES UNTIL END MOLDS ARE NEARLY COVERED
4TH — FILL IN TRIANGULAR AREA WITH PROGRESSIVELY SMALLER STRIPS
5TH — ATTACH KEEL STRIP (SHADED)
KEEL STRIP BUTT JOINT
6TH — FILL IN STRIPS OUT FROM KEEL STRIP UNTIL "FOOTBALL" SHAPE IS FILLED
9/16" STAPLE
A. ATTACH AND TRIM STRIP 1 USING END MOLD EDGE AS GUIDE
B. ATTACH AND TRIM STRIP 2
C. ATTACH AND TRIM STRIP 3 USING END MOLD EDGE AS GUIDE
TRIMMING STRIPS AT END MOLDS
D. CONTINUE ATTACHING TWO STRIPS TO A SIDE, THEN TWO MORE STRIPS TO THE OPPOSITE SIDE
(ROUND OFF ENDS)
MOLD
9/16" STAPLES INTO MOLDS
1/4" STAPLES BETWEEN MOLDS
STAPLING STRIPS


FIBERGLASSING CANOE EXTERIOR
W
CUT
BIAS STRIPS, CUT AT ANGLE TO WEAVE
3" WIDE
5" WIDE
7" WIDE
ALIGN MAIN FIBERGLASS OVER CANOE HULL AT A SLIGHT ANGLE
CUT
3"
7"
5"
CUT BIAS STRIPS FROM BOTH LARGE CORNERS
WEAVE
1. 3" WIDE BIAS STRIP
2. 5" WIDE BIAS STRIP LET CURE AND SAND EDGE BEFORE APPLYING MAIN SHEET
4. 7" WIDE BIAS STRIP — OVER MAIN SHEET
3. MAIN FIBERGLASS
APPLYING BIAS STRIPS

the end molds (Photo 4). Now staple on the sheer strip on the other side.

Apply a bead of yellow glue to the edge of the sheer strip from mold 5 to mold 9. Arrange the first horizontal strip (Photo 2) so the butt joints will be over mold 10, push it down against the sheer strip at mold 7, and staple it down. Between the molds, put 1/4-in. staples across the glued strips to hold them together.

Staple this second strip to the molds so it's horizontal. The easiest way to keep the strip straight is to mark the end molds 3/4 in. above the top edge of the strongback, and align the bottom edge of the strip with that mark. There will be triangular gaps between this horizontal strip and the sheer strip as you move toward the ends (Photo 2), but they will be filled in later. Cut the ends of the horizontal strip (Photo 4), then attach the first horizontal strip on the other side.

Make 10 clamping blocks like the one shown in Photo 5, with a 3/8-in. slot in them. Glue and staple the remaining

***SPRING CLAMPS** and slotted blocks help hold the strips in place where the molds are more curved. Between molds, short staples hold strips to each other.*

***CUT THE KEEL STRIP** to fit after all the horizontal strips are glued together. Staple the keel strip to the molds so it's exactly centered.*

***FILL IN THE BOTTOM** of the canoe, working from the keel strip outward. A hand plane quickly cuts the tapered ends of the strips.*

horizontal strips up the sides (Photo 5), using the clamping blocks to help hold the strips down when necessary. You can add strips continuously, without waiting for the glue on previous strips to dry.

Stop attaching horizontal strips when the next one will cover the top of the end molds and molds 1 and 13.

FILL IN THE TRIANGULAR END SPACES

Unbolt and remove the end mold holders (see Photo 9, Part 1), but don't disturb the end molds.

Use a small hand plane to taper short cedar strips to fill in the four triangular gaps between the sheer strips and the horizontal strips.

ATTACH THE KEEL STRIP

Use a chisel to flatten the remaining exposed top of the end molds and molds 1 and 13 so the keel strip (Photo 6) has a flat spot to rest on, then reapply masking tape to the exposed plywood edges.

Make the keel strip by tapering the ends of two long strips to fit on top of molds 1 and 13 (Photo 6). Set the strips in place, then mark and cut the butt joint so it rests on mold 7. Staple the strips down, using a little glue at the joints.

FILL IN THE CANOE BOTTOM

Work down from the keel strip now, tapering the ends of the strips so they fit against the horizontal strips (Photo 7). Glue and staple the strips. For appearance's sake, be careful to cut the tapered edges so they fit tightly on the inside of the hull as well as the outside.

The final strips on both sides are the most difficult to cut. They may be little more than slivers, so make sure they fit well before you glue them.

SHAPE AND SAND THE HULL

Once the glue has dried, remove all the staples with a sharpened bottle opener or tack puller (Photo 9). Scrape off the dried glue with a paint scraper and a Surform file (Photo 10). Dab hot water on the hull to help close up the staple holes and lift any dents, then sand the outside of the hull with a finish sander. Start with 40-grit, then work up to 100-grit, making sure there are no flats or depressions in the surface. Round the ends (Photo 11) and sand them, too.

Apply one coat of polyurethane sanding sealer to the hull. Lightly sand it after it's dry.

CUT THE FIBERGLASS FOR THE HULL

Cut the large sheet of fiberglass cloth to 240 in., drape it over the canoe at as much of an angle as you can, and trim off the excess (Photo 12). Save the cut-off pieces. At the curved ends of the canoe, cut the cloth so it is 1 in. short of the ends (i.e., 1 in. of wood is exposed). When the cloth is cut, roll it back from the ends a few inches without moving the rest of the cloth.

CUT THE BIAS STRIPS

Strips of fiberglass cloth are used to build up a thicker layer on the ends of the canoe for protection. These strips are cut at a 45-degree angle to the weave (cut on the bias) so they lie easily over the curved ends. Cut two 3-in. wide strips, two 5-in. wide strips and two 7-in. wide strips (Photo 13).

MIX THE POLYESTER RESIN AND CATALYST

The polyester resin, which soaks into the glass cloth and glues it to the hull, requires the addition of a catalyst to make it harden. Measure the resin and catalyst by volume, and always work with pint batches so you have plenty of time to apply the catalyzed resin before it starts to set up. Apply the resin when it, the air and the canoe are at about 70 degrees, and don't work in direct sunlight, which would cause the hull to heat up unevenly.

Caution: This stuff is *not* good to breathe or touch. Wear rubber gloves and a respirator with activated carbon filters (see Buyers Guide). The catalyst can blind you if it gets in your eyes, so wear goggles, too. You'll feel like Darth Vader (Photo 14), but it's worth it.

The resin has wax in it to make it sand easily, so shake the can every time you pour from it to make sure the wax is evenly distributed.

Pour 1 pint (16 oz.) of resin in a mixing cup, add 1/2 tablespoon of catalyst, and stir for one minute. You'll have about 20 minutes to work with the catalyzed resin before it starts to set up.

APPLY THE BIAS STRIPS

Hold a 3-in. strip on the end of the canoe and brush on the resin, using a

disposable brush (Photo 15). Wear all safety equipment and have plenty of ventilation — even if you're wearing a respirator, you shouldn't let the fumes accumulate in your house. Apply the 5-in. strips on top of the 3-in. strips while the 3-in. strips are still wet. Allow the catalyzed resin to cure overnight, then sand with 80-grit sandpaper.

APPLY THE FIBERGLASS TO THE HULL

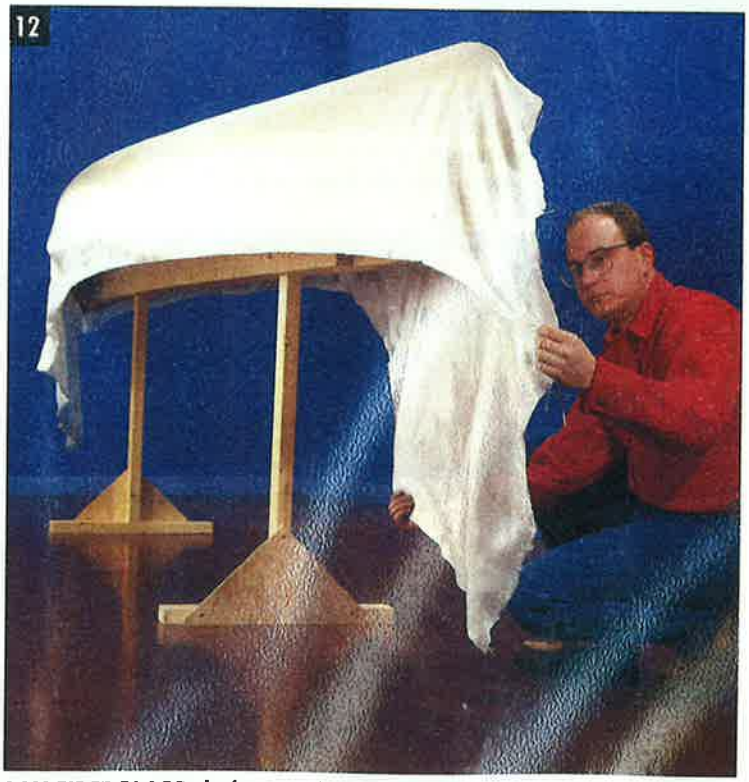
Align the main sheet of fiberglass on the hull, then have a helper mix resin while you apply it. Pour a 1 pint batch of catalyzed resin into the roller tray and apply it to the fiberglass with a paint roller (Photo 16). Have a spare roller and tray ready, in case the resin sets up in the tray before you use it all.

Work out any wrinkles in the fiber-

***PULL THE STAPLES** out when all the strips are in place and the glue is dry. A bottle opener with the tip ground or filed flat is the perfect tool.*

***SCRAPE OFF THE DRY GLUE** with a Surform file and paint scraper, then sand the hull smooth with a power sander and coarse sandpaper.*

***SHAPE THE ENDS** of the canoe with a rasp so the edge is about the diameter of a pencil. Sand the entire hull smooth, then coat it with a polyurethane sanding sealer.*



***LAY FIBERGLASS** cloth over the hull so the weave is at an angle to the keel, then trim off the overhanging pieces. Trim the cloth an inch or so short of the ends of the canoe.*

glass with the paint roller while applying the first coat of resin to the hull. Now apply the 7-in. wide bias strips that cover the ends. Apply a second coat of catalyzed resin to the entire hull immediately after you complete the first coat.

Allow the resin to cure for about one hour, then use a sharp utility knife to carefully cut the overhanging edges flush with the edges of the sheer strips.

Let the resin cure overnight, then sand the hull with 80-grit sandpaper in a finish sander to smooth out the surface. Don't sand into the fiberglass cloth.

Apply a third and final coat of catalyzed resin to the hull to give it a smooth finish. Let the resin cure overnight, then sand the hull smooth with 120-grit sandpaper. The outside of the hull is now done.

Next month, we'll put fiberglass on the inside of the hull (which is a bit different), and then put on the finishing touches — seats, decks and trim. ***TFH***

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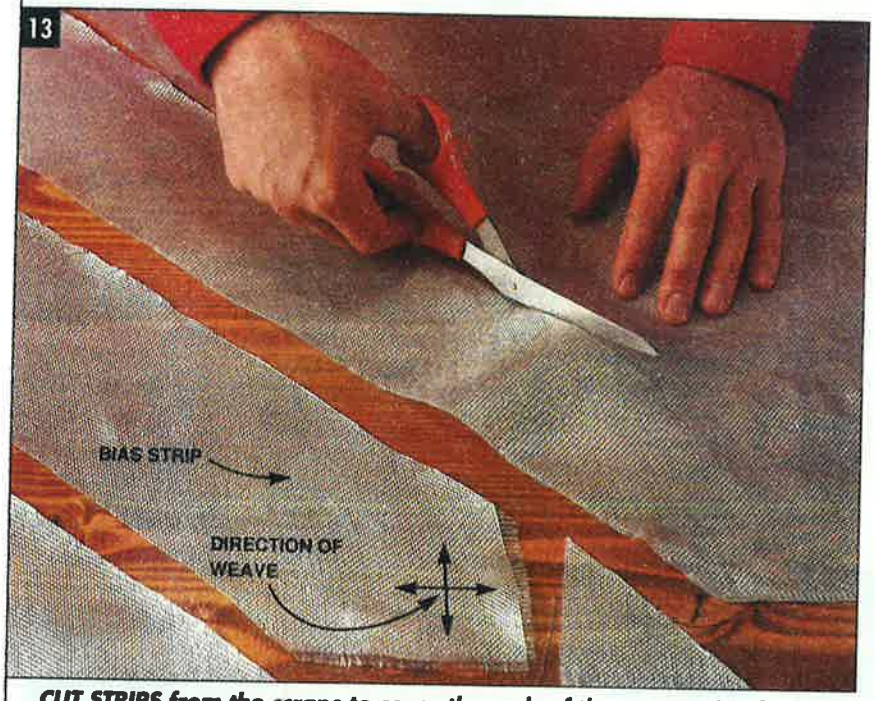
13



***CUT STRIPS** from the scraps to cover the ends of the canoe. Cut them at 45 degrees to the weave (on the bias) and make the ends pointed.*

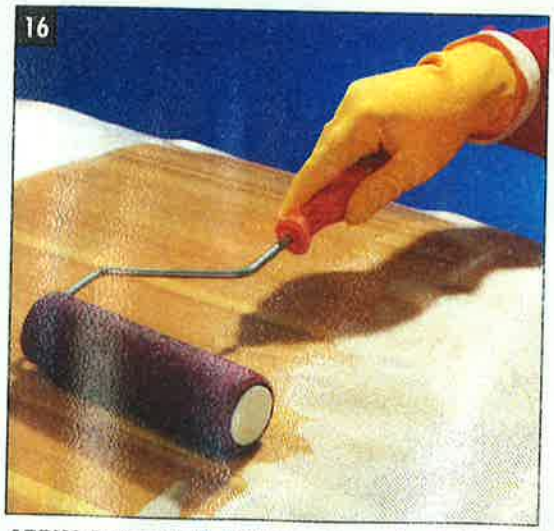
14

***SAFETY FIRST!** The resin that goes on the fiberglass cloth and its catalyst are both dangerous. Wear a carbon-filter respirator, goggles and rubber gloves.*

15

***START WITH THE END STRIPS**, laying down the dry cloth, then applying resin with a disposable brush. These strips (two under and one over the main cloth layer) provide extra strength in this critical area.*

16



***APPLY CLOTH AND RESIN** to the entire hull. Lay the dry cloth on the hull, and apply the resin with a paint roller. Work out from the center in 2-ft. sections. Let it cure, sand and it's done.*

3

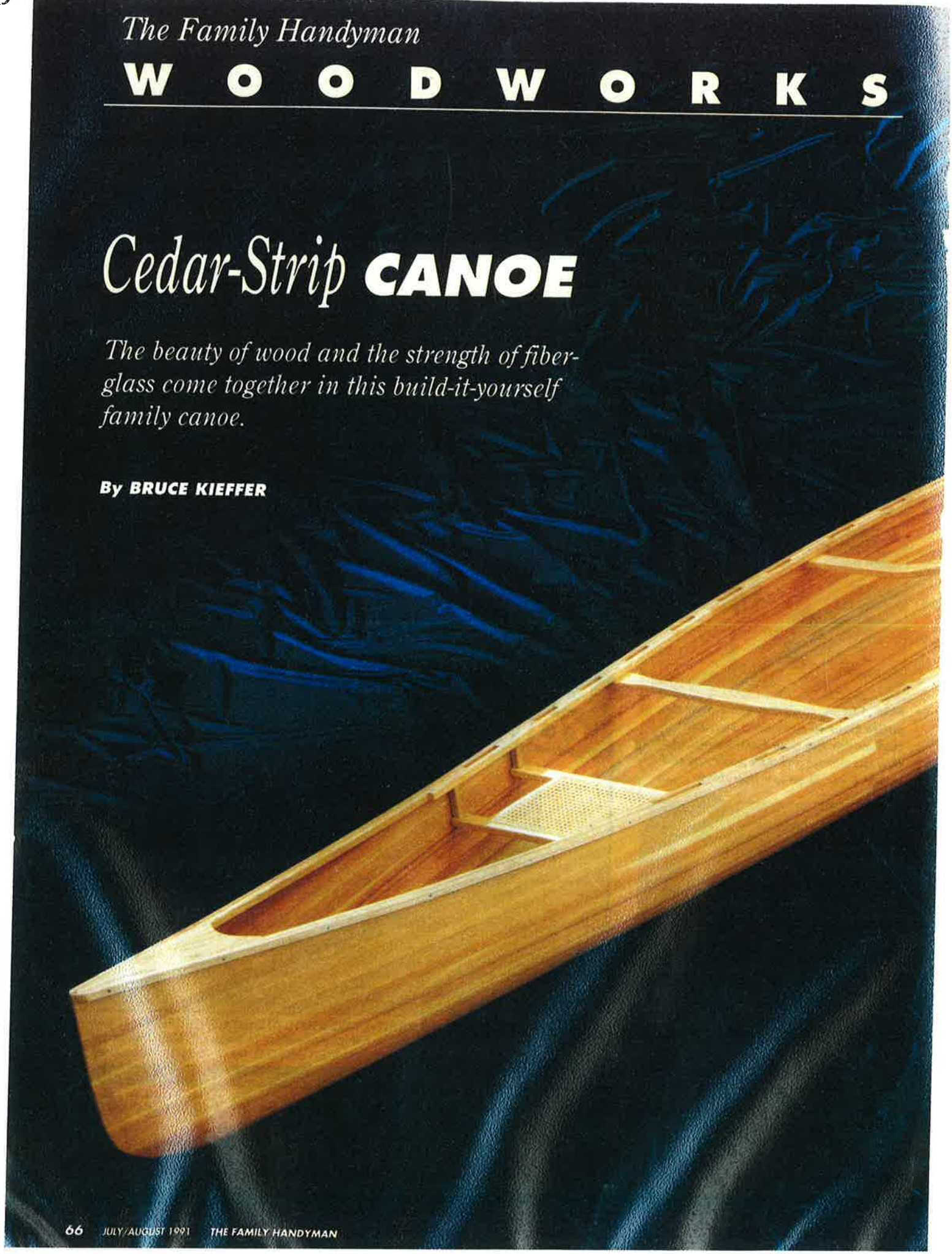
The Family Handyman

WOODWORKS

Cedar-Strip CANOE

The beauty of wood and the strength of fiberglass come together in this build-it-yourself family canoe.

By BRUCE KIEFFER



PART THREE:

The home stretch — fiberglassing the inside and attaching the trim.

This month, in the last of our three-part series, we'll complete our cedar-strip canoe.

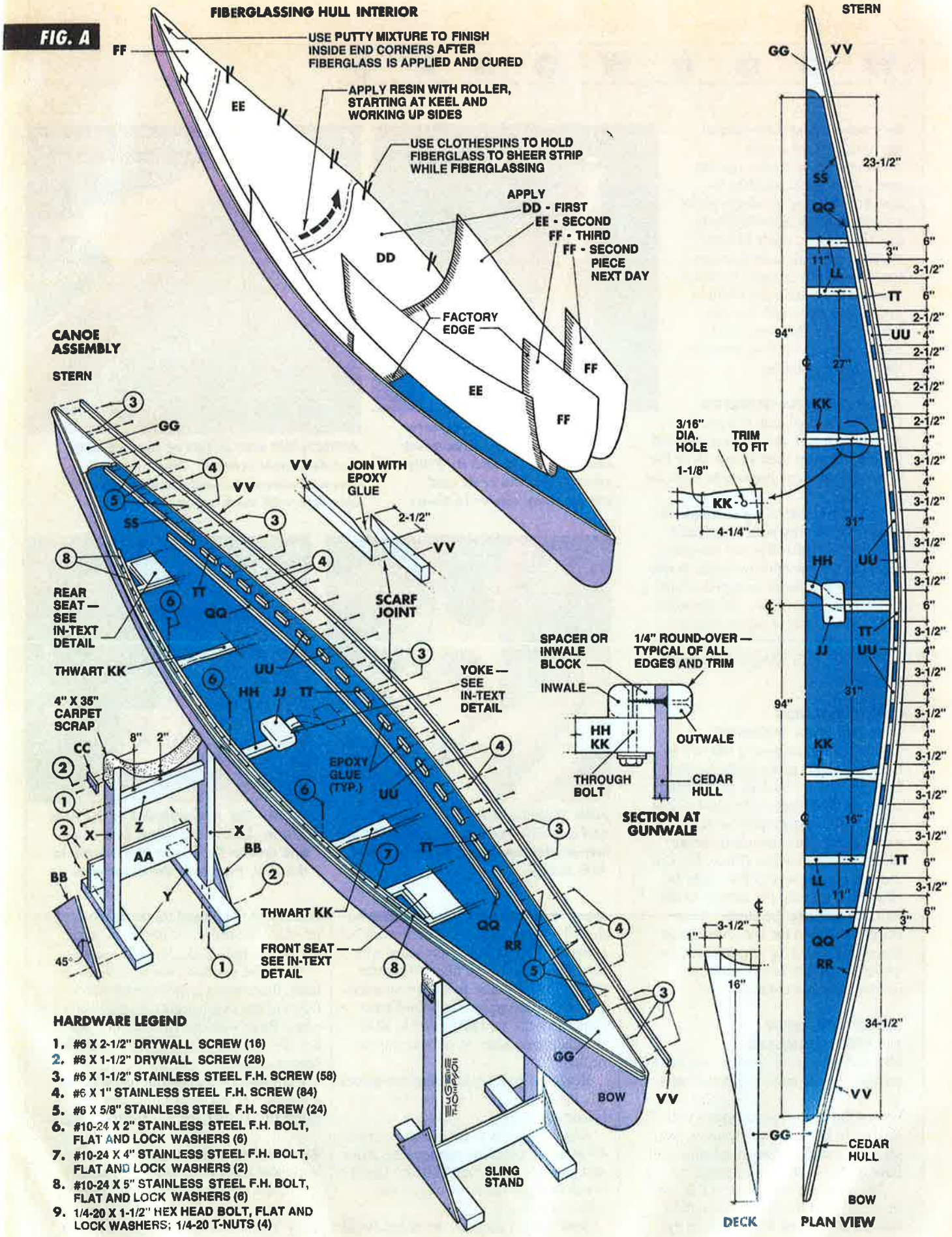
In our last two issues (May and June, '91), we constructed the form on which the canoe is built, then we stapled the cedar strips together to make the hull and put fiberglass on the outside of it. (If you need copies of Parts 1 and 2, see the Shopping List on p. 74.)

Now that the outside is covered with fiberglass, we can flip the canoe over, cover the interior with fiberglass, and build the seats, decks and other trim.

Fiberglassing the inside of the canoe is like doing the outside. However, instead of a single large sheet, which would be difficult to apply without wrinkles, the fiberglass is laid in sections. The interior fiberglass is also left a little rough so you're less likely to slip, and to reduce glare.

The trim is made from ash instead of cedar. The "gunwales" (the upper edges of the hull) are

FIG. A



HARDWARE LEGEND

1. #6 X 2-1/2" DRYWALL SCREW (16)
2. #6 X 1-1/2" DRYWALL SCREW (28)
3. #6 X 1-1/2" STAINLESS STEEL F.H. SCREW (58)
4. #6 X 1" STAINLESS STEEL F.H. SCREW (84)
5. #6 X 5/8" STAINLESS STEEL F.H. SCREW (24)
6. #10-24 X 2" STAINLESS STEEL F.H. BOLT, FLAT AND LOCK WASHERS (6)
7. #10-24 X 4" STAINLESS STEEL F.H. BOLT, FLAT AND LOCK WASHERS (2)
8. #10-24 X 5" STAINLESS STEEL F.H. BOLT, FLAT AND LOCK WASHERS (6)
9. 1/4-20 X 1-1/2" HEX HEAD BOLT, FLAT AND LOCK WASHERS; 1/4-20 T-NUTS (4)

Cedar-Strip CANOE

the most important part of the trim — they protect the edge of the hull, they stiffen and strengthen the entire boat, and they provide a place to attach the seats and thwarts. The gunwales consist of a three-part sandwich: a strip of ash on the inside (the "inwale"), then the fiberglassed hull, then a strip of ash on the outside (the "outwale"). The inwale has openings in it so water can drain out when the canoe is upside down.

The seats are simply ash frames with prewoven cane in the middle, and the decks and thwarts are simpler yet — just shaped pieces of ash. All are simply screwed or bolted on.

Here are the details.

MAKE THE SLING STANDS

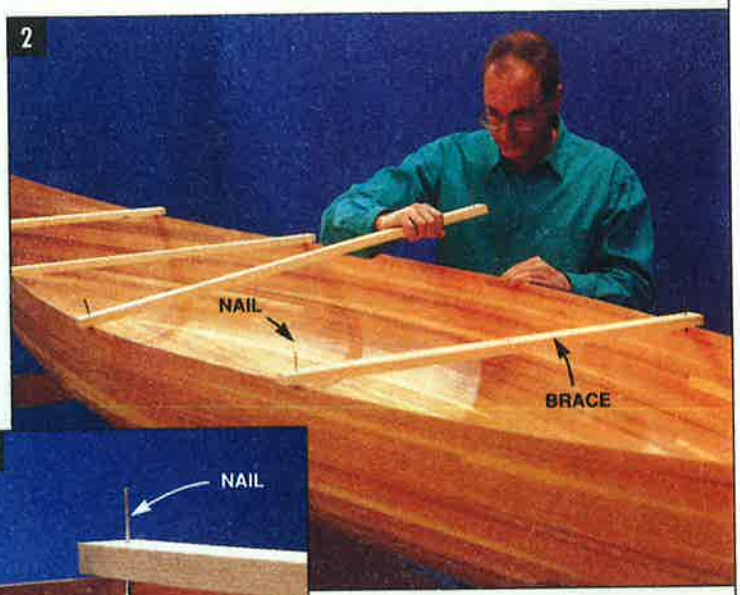
Sling stands hold the canoe once it's off the strongback, so you can work on the interior. They're also good for holding the canoe in the winter. Cut pieces X - CC to the finished dimensions shown in the Cutting List, and assemble the sling stands as shown in Fig. A.

REMOVE THE HULL FROM THE STRONGBACK

Unbolt molds 2 - 6 and 8 - 12 from their mold supports. Use a rubber mallet to tap these molds free from the hull. Unbolt the remaining molds from their mold holders and remove the hull and molds from the strongback (Photo 1). Place the hull in the sling stands.

Tap the remaining molds free from the hull. If you have trouble removing the end molds, free them by hammering a stick against their top corners at

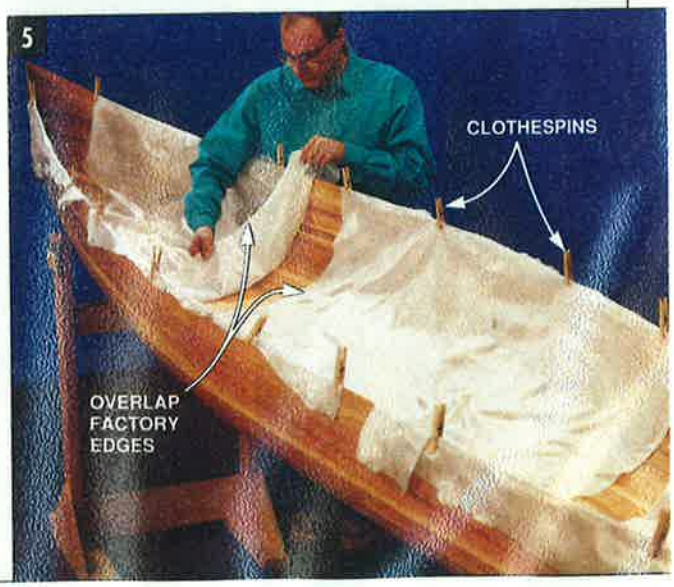
***REMOVE THE CANOE** from the strongback and place it on sling stands, which support it while you work on the inside of the hull and the trim.*



***WOOD BRACES** with nails at the ends keep the hull from bowing in when you're not working on it. Use the molds to determine the nail spacing.*

***SAND THE INSIDE** using an orbital sander. Place carpet pad between the sander's pad and the sandpaper so it conforms to the canoe's shape.*

***FIBERGLASS THE INSIDE** with overlapping pieces, starting at the center and working out. Clothespins hold the fabric in place as you apply the resin.*



the ends, forcing them toward the middle of the canoe.

Make a set of braces, one for every other mold position, to maintain the canoe's shape while you're not working on it (Photo 2). They can be made of scrap wood strips, with nails through the ends so the distance between the nails is equal to the width of the appropriate mold. Set the braces across the canoe so the nails are inside the hull, preventing it from bowing in.

SAND THE HULL INTERIOR

Grind or file the blade of a paint scraper to match the tightest curve of the hull interior; then scrape away the dried glue and any high spots from the hull.

Sand the inside of the hull smooth (Photo 4), starting with 40-grit and going through 60-, 80- and 100-grit. Sand the narrow ends by hand. A thin stick with sandpaper wrapped around it will help you sand deep into the ends.

Apply one coat of polyurethane sanding sealer to the hull interior and sand lightly with 120-grit sandpaper after it's dry.

CUT FIBERGLASS FOR THE HULL INTERIOR

Cut the fiberglass pieces DD - FF to the dimensions given in the Cutting List. Make sure the two overlapping edges are both factory-finished edges.

Lay the fiberglass pieces DD and EE in position in the canoe and secure them with clothespins (Photo 5). Cut the inside end pieces FF to their finished shape, using the outside of the hull as a guide to the shape. Allow enough material for 1-in. overlaps at the seams. Save the scrap pieces for use as repair patches (I know, it's unthinkable, but even so . . .).

APPLY THE RESIN TO THE FIBERGLASS

Mix pint batches of resin so you have enough time to apply it before it sets up. Apply the resin with a paint roller. Follow the safety precautions we described in Part 2 — wear gloves, goggles and a carbon-filter respirator, and have plenty of cross ventilation.

Start with the center piece DD. Roll the resin onto the fiberglass in the bottom of the boat first; work up the sides, removing the clothespins as you near the sheer strips; and then work out toward the ends. Apply pressure with the roller to force the fiberglass onto the hull. Make sure there are no areas where the fiberglass has pulled away from the hull. You may need to slide the fiberglass down to remove any air pockets.

Realign the adjacent fiberglass pieces EE, lap their edges 1 in. over DD, then roll on the resin.

Align and apply resin to *one* end piece FF at each end of the canoe. The other end pieces will be applied later. Use a brush to apply the resin where the roller can't reach.

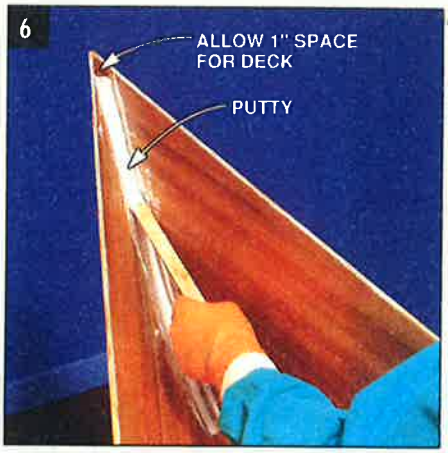
Now apply a second coat of catalyzed resin to all the fiberglass on the hull interior. Set the wood braces in place across the hull while the resin cures.

Allow the resin to cure for about one hour, then, using a utility knife, carefully cut the overhanging fiberglass edges flush with the sheer strips. Allow the resin to cure overnight with the braces in place.

Complete the inside fiberglassing by applying the final two end pieces FF. Allow this resin to cure overnight, too.

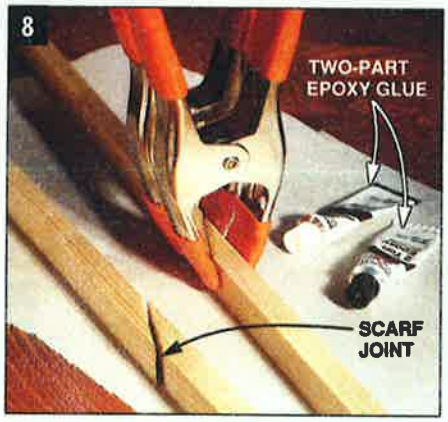
FINISH THE INSIDE ENDS

Polyester resin putty is used to seal and finish the inside ends and protect them from water damage. You mix the putty from the same resin you used for

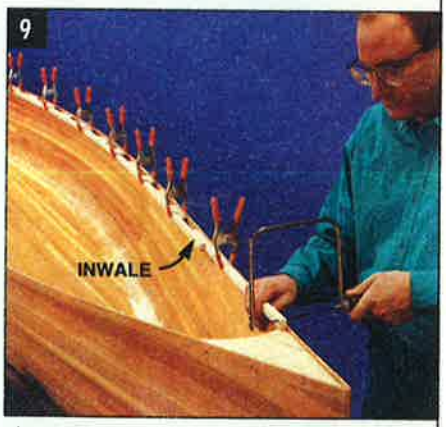


***FILL THE ENDS** with polyester resin putty, using a rounded-end stick to smooth it. Putty strengthens the ends and makes them easier to clean.*

***ATTACH THE ASH DECKS** to the hull with stainless steel screws. Offset the two screws nearest the ends so they don't interfere with each other.*



***JOIN STRIPS** of ash for the inwales and outwales with a "scarf joint," a low-angled lap joint. Glue the joint with epoxy.*



***CLAMP THE ASH INWALE** to the hull 1/4 in. below the edge, and trim one end to fit. Screw the inwale to the hull, then trim the other end.*

fiberglassing, plus a silica thickener and glass micro bubbles (see Shopping List, Part 2, June '91). The thickener keeps the resin from running, and the glass micro bubbles make it stronger.

Measure the putty components by volume: Thoroughly mix one cup (8 oz.) of the glass micro bubbles into one cup (8 oz.) of resin. Add 5 oz. of the silica thickener to the resin and micro bubbles and mix together thoroughly. Complete the mixture by adding 1 teaspoon of catalyst and stir for one minute. Apply the putty in the ends with a rounded stick (Photo 6), and let it cure overnight. Be sure to avoid putting putty in the top 1 in. of the end, where the deck will fit.

Lightly sand the interior fiberglass with 120-grit sandpaper, then apply two coats of clear exterior polyurethane.

INSTALL THE DECKS

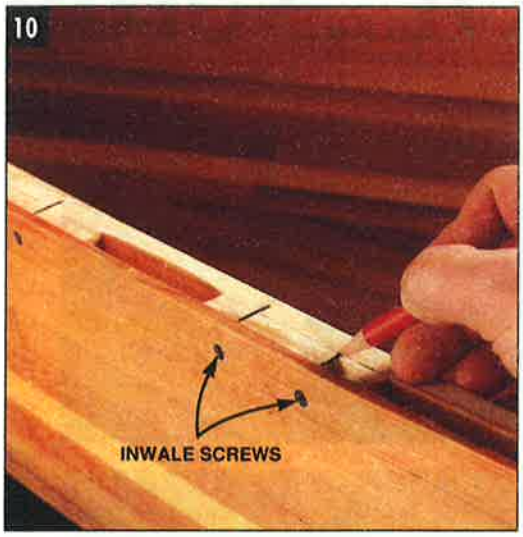
Cut the decks (GG) to size, finish-sand them, and round over the back edges. Screw each deck to the hull with stainless steel screws (Photo 7). Offset the two screws at the end of each deck so they don't interfere with each other. The deck is attached so that 1/4 in. of the hull protrudes above it — this excess will be sanded off later.

ATTACH THE GUNWALES

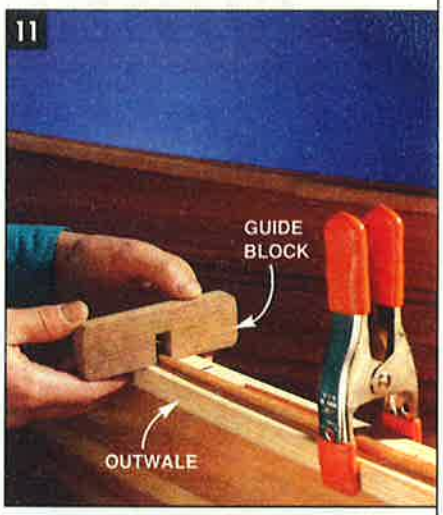
Cut out the inwales (QQ) and outwales (VV), which together will form the gunwales of the canoe. To get pieces long enough, you may need to "scarf join" the ends of two shorter pieces (Photo 8). Use epoxy glue.

Align and glue together the inwale pieces QQ - UU to make the inwales. Glue the blocks (TT, UU) to QQ with epoxy glue and clamp them with spring clamps. Allow the glue to cure overnight, then sand. Round over the inside edges of the inwales and the outside edges of the outwales.

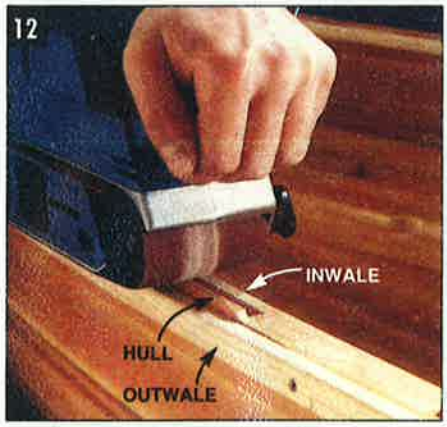
The inwales and outwales are screwed, not glued, to the hull and set 1/4 in. below the top edge of the sheer strip. That's so they hide the messy area where the tapered ends of horizontal strips butt up against the sheer strip. The 1/4 in. of sheer strip that protrudes will be sanded down flush with the gunwales later (Photo 12).



***MARK THE LOCATION** of the screws that hold the inwales and decks to the hull so you can screw the outwales on without screws hitting each other.*



***CLAMP ON THE OUTWALE** and get it aligned, then screw it on. A notched block of wood helps get the outwale and inwale lined up evenly.*



***SAND THE GUNWALES FLUSH** with a belt sander, removing the 1/4 in. of hull that protrudes. Hold the sander as flat as possible while you sand.*

***MARK THE THWARTS** so they fit the angle of the hull, cut them, then bolt them on underneath the inwales with stainless steel bolts.*

Align and clamp one inwale to the hull. Trim one end so it fits tightly against the edge of the deck (Photo 9). Screw the inwale to the hull starting at the trimmed end and working down to the untrimmed end. Countersink the screw holes in the hull and drill pilot holes into the inwale to avoid splitting. As you near the other end, trim the inwale to fit against the deck, and finish screwing it to the hull. Repeat this procedure for the other inwale.

Mark the locations of the screws that attach the inwales and decks to the hull (Photo 10). Screw the outwales to the hull (Photo 11) just as you did for the inwales. Sand the hull flush with the decks and gunwales (Photo 12).

MOUNT THE THWARTS

Cut the thwarts (KK) and yoke (HH) to the dimensions given in the Cutting List, shape them according to the plans, and sand the edges smooth.

Temporarily clamp the yoke under the inwales in the center of the canoe to hold the canoe at its finished width. Don't bolt it on yet. Set the thwarts on top of the gunwales, centered on their inwale mounting blocks. Mark and cut them to length (Photo 13). Clamp the thwarts under the inwales, countersink and drill their bolt holes, then bolt them in place.

ATTACH THE SEATS

Cut the seat stiles (LL) and seat rails (MM) to the Cutting List dimensions, then assemble them with dowels and epoxy glue to make the seat frame (Fig. B). The prewoven cane seat is attached as follows: (1) Rout a 1/4 x 1/4-in. groove in the tops of the seat frame, using a straightedge to guide the router when cutting the rails (Photo 14); (2) lay the woven cane sheet on top of the seat; and (3) wedge the seat material tightly down in the groove with a thin wooden strip ("spline"). Detailed instructions are supplied with the prewoven cane seat.

The seat stiles must be slightly shorter than the hull width at the gunwales. This is necessary because the seats hang down and the hull narrows as you go down. Start by cutting the seat stiles to length at the gunwales, just like the thwarts. Slowly trim the stile lengths, equally on both sides, until the seats fit where they hang without being forced against the hull. Use the seat

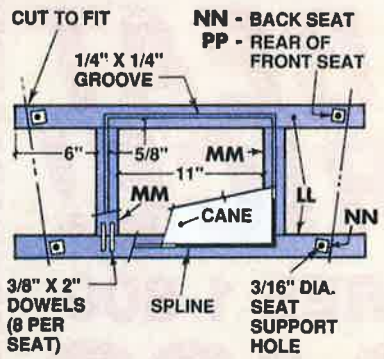
CUTTING LIST

KEY	PCS.	SIZE & DESCRIPTION
X	4	1-1/2" x 3-1/2" x 38" pine (sling stand legs)
Y	4	1-1/2" x 3-1/2" x 24" pine (sling stand feet)
Z	2	1-1/2" x 3-1/2" x 21" pine (sling stand braces)
AA	2	1/2" x 6" x 24" fir plywood (sling stand braces)
BB	4	1/2" x 10" x 20" fir plywood (sling stand leg supports)
CC	4	1/2" x 2" x 3-1/2" fir plywood (sling stand carpet cleats)
DD	1	52" x 60" fiberglass (inside center)
EE	2	48" x 60" fiberglass (inside)
FF	4	20" x 30" fiberglass (inside ends)
GG	2	3/4" x 7" x 16" ash (decks)
HH	1	3/4" x 5-1/2" x 34" ash (yoke)
JJ	2	3/4" x 4" x 8" ash (yoke pads)
KK	2	3/4" x 2-1/2" x 30" ash (thwarts)
LL	4	3/4" x 1-1/2" x 26" ash (seat stiles)
MM	4	3/4" x 1-1/2" x 8" ash (seat rails)
NN	6	3/4" x 3/4" x 2-7/8" ash (seat supports)
PP	2	3/4" x 3/4" x 2" ash (seat supports)
QQ	2	1/2" x 3/4" x 130" ash (inwales)
RR	2	1/2" x 3/4" x 40-1/2" ash (bow inwales)
SS	2	1/2" x 3/4" x 29-1/2" ash (stern inwales)
TT	6	1/2" x 3/4" x 6" ash (inwale blocks)
UU	22	1/2" x 3/4" x 4" ash (inwale blocks)
VV	2	1/2" x 3/4" x 240" ash (outwales)

supports (NN, PP) as guides. For comfort, be sure the front edge of each seat is hung lower than the back.

When the seat fits, clamp it to the gunwale on one side, and drill the mounting holes through the seat and inwale. Drill the bolt holes at an angle to match the angle of the hull. Repeat on the other side. Drill the bolt holes through the seat supports, then bolt the seat in place (Photo 15).

FIG. B SEAT DETAIL



APPLY THE FINISH AND MOUNT THE YOKE

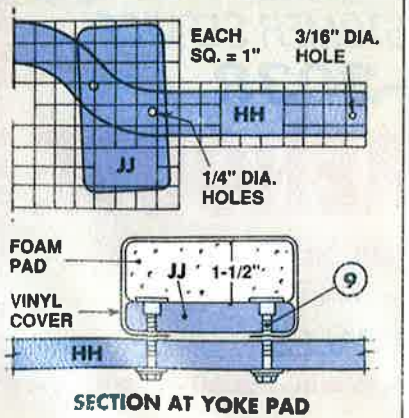
Unbolt the seats and thwarts and remove the yoke so they can be varnished separately. Apply two coats of polyurethane to all the trim and to the outside of the hull (Photo 16), then remount the seats and thwarts. Be sure to varnish under the decks.

If you want to put portaging pads on the yoke (Fig. C), drill holes for the bolts that join the yoke and yoke pads (HH and JJ). Hammer the T-nuts into the yoke pads, upholster them and then bolt them to the yoke.

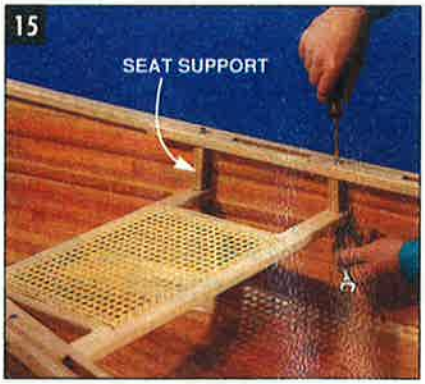
Clamp the yoke to the undersides of the inwales with two small C-clamps. Set the canoe on your shoulders and see how it balances. Adjust the yoke forward or backward on the inwale until the canoe balances perfectly, then drill the yoke bolt holes and bolt it in place.

That's it — you're done! What a job, and what a beautiful canoe. Here are a few tips on keeping it that way.

FIG. C YOKE DETAIL



BUILD THE SEATS from ash frames with grooves routed in them to hold the prewoven cane. A wood strip, called a "spline," is jammed in the groove to hold the cane tightly.



HANG THE SEATS from the gunwales with long bolts and seat support blocks. The front edge of each seat is hung lower for paddling comfort.

APPLY TWO COATS of clear exterior polyurethane to the hull and to all the ash trim. Then break out the paddles — you're finished!

MAINTENANCE

To avoid cracking the hull, always load and unload the canoe while it's in the water. When the polyurethane starts to peel, clean it thoroughly, wash it with mineral spirits, and sand with 120-grit sandpaper. Apply another coat of polyurethane. If the hull becomes damaged, let it dry; sand the damaged area; put a layer of fiberglass cloth over it, then three coats of resin, just as you did when building the canoe. After the first two coats of resin are dry, sand the edges of the patch out to a feather edge. Then apply the third coat of resin and varnish. ***TFH***

SHOPPING LIST: PART 3

ITEM	QUANTITY
#20 - 1/4" x 1-1/2" hex head bolts with lock and flat washers	4
#20 - 1/4" T-nuts #26054*	4
Two-part epoxy glue	1 set
#6 - 1-1/2" flat head stainless steel screws	58
#6 - 1" flat head stainless steel screws	84
#6 - 5/8" flat head stainless steel screws	24
#10 - 24 x 5" flat head bolts with nuts, lock and flat washers	2
#10 - 24 x 4" flat head bolts with nuts, lock and flat washers	6
#10 - 24 x 2" flat head stainless steel bolts with nuts, lock and flat washers	6
3/8" x 2" dowel pins	16
12" x 36" conventional weave cane #41012*	1 piece
1/4" x 10' cane spline, #41103*	1 piece
1-1/2" x 4" x 8" high-density foam rubber	2
10" x 14" vinyl upholstery fabric	2
Satin exterior polyurethane	2 quarts

*Available from The Woodworkers' Store, Dept. TFH, 21801 Industrial Blvd., Rogers, MN 55374; (612) 428-2199.

If you need copies of Parts 1 and 2 of this project, send for our May and June '91 issues. Write to Handyman Back Issues Dept., P.O. Box 1917, Marion, OH 43305. The cost is $3.50 each. A set of full-size templates is also available to help you build the molds. Write to Canoe Templates, The Family Handyman, 7900 International Drive, Suite 950, Minneapolis, MN 55425. The cost is $10.

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