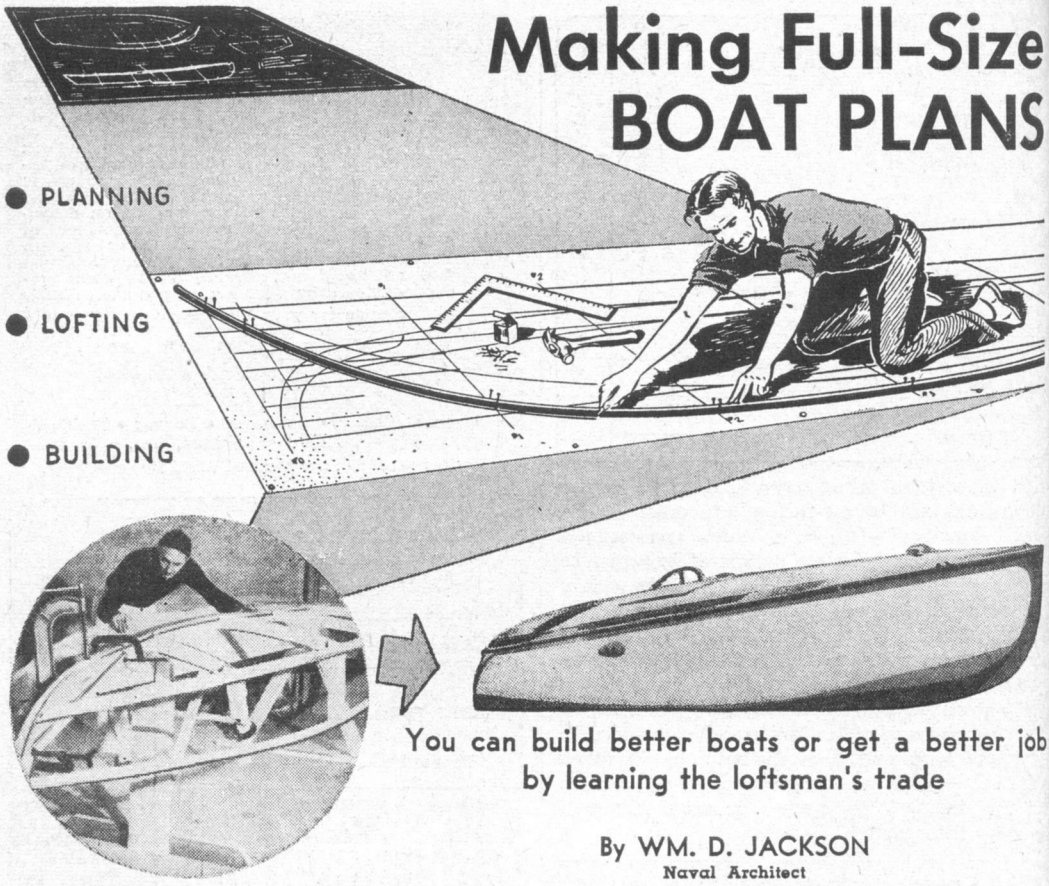
Making Full-Size BOAT PLANS

- PLANNING
- LOFTING
- BUILDING



You can build better boats or get a better job by learning the loftsman's trade

By WM. D. JACKSON
Naval Architect

IF YOU can do a good job of laying down boat design lines full size, you can qualify as a *mold loftsman,* which, incidentally, is a well-paid profession. The job of the mold loftsman is to enlarge to full size and *fair* certain portions of the naval architect's drawings (basic designs known as the lines), so that templates and patterns can be made and the actual form of the boat obtained with true fair lines. (A line is *fair* when it makes a smooth curve with no abrupt change in shape, and is pleasing to the eye.) Making full-size layouts also serves to avoid the errors that occur when dimensions taken are scaled directly from the architect's small scale blue-prints and applied to the actual construction. To show you how mold loftsmen work, let's take the plan of the 15 ft. inboard hydroplane boat, *Rocket,* which appeared in the Feb. '46 issue of SCIENCE AND MECHANICS. Note that the line drawings in Fig. 1 show three views drawn to small scale as they would be specified by the naval architect. They are: *profile, half breadths plan,* and *body plan.* The profile drawing shows the basic lines of the boat as viewed from the side. From this drawing all the dimensions from the base lines to the keel lines, chine line, water lines and deck line at the various frame stations can be obtained; sometimes these dimensions are given on the profile drawing.

The half breadths drawing is half of the basic lines of the boat as viewed from above; (since both sides of the boat are symmetrical, only one side is drawn). From this drawing all the dimensions outward from the longitudinal centerline to the chine line, deck line and various water lines at each frame station are obtained. Here again these dimensions are sometimes given on the half breadths drawing.

The body plan drawings show half of the cross sections at the frame stations as viewed from the bow or stern. In this drawing, those vertical and horizontal distances in both the profile and half breadths which apply are shown together at each frame station.

These three lines drawings clearly define all the basic lines of the boat and act as a check on each other in determining the shape of the hull. From the original lines drawing the architect obtains the list of dimensions called the Table of Offsets. The Table of Offsets gives all the distances projected from the centerlines and base line which establish the shape of the hull.

All three views in the lines drawings are generally shown separately although occasionally the

body plan is drawn in the center of the profile view. When the full-size drawings are made, half breadths and profile plans are drawn together to save space and labor. To prevent confusion, draw profile first with black pencil, and half breadths next with red or blue pencil.

Now let's take a look at the list of dimensions known as the Table of Offsets; these are points of measurement out from the centerline on the half breadths plan, up from the base line on the profile drawing. The fore and aft measurements are usually given directly on the plans. Ordinarily, all dimensions in a table of offsets are expressed in feet, inches and eighths of an inch, and are usually given to the outside of the planked hull, unless otherwise stated. After drawing full size plans from Offsets given to outside of planking, the thickness of planking at each frame station is

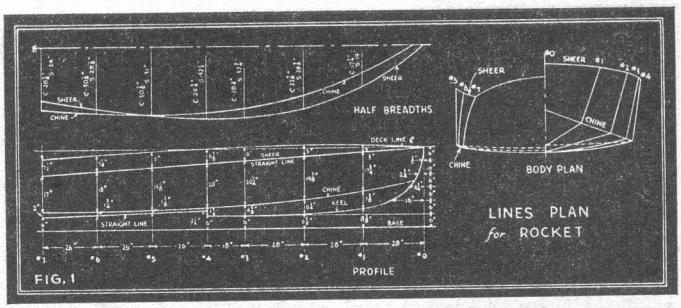


FIG. 1

TABLE OF OFFSETS FOR "ROCKET"—15 Ft. Hydroplane*

HEIGHTS ABOVE BASE IN INCHES AND EIGHTHS OF AN INCH

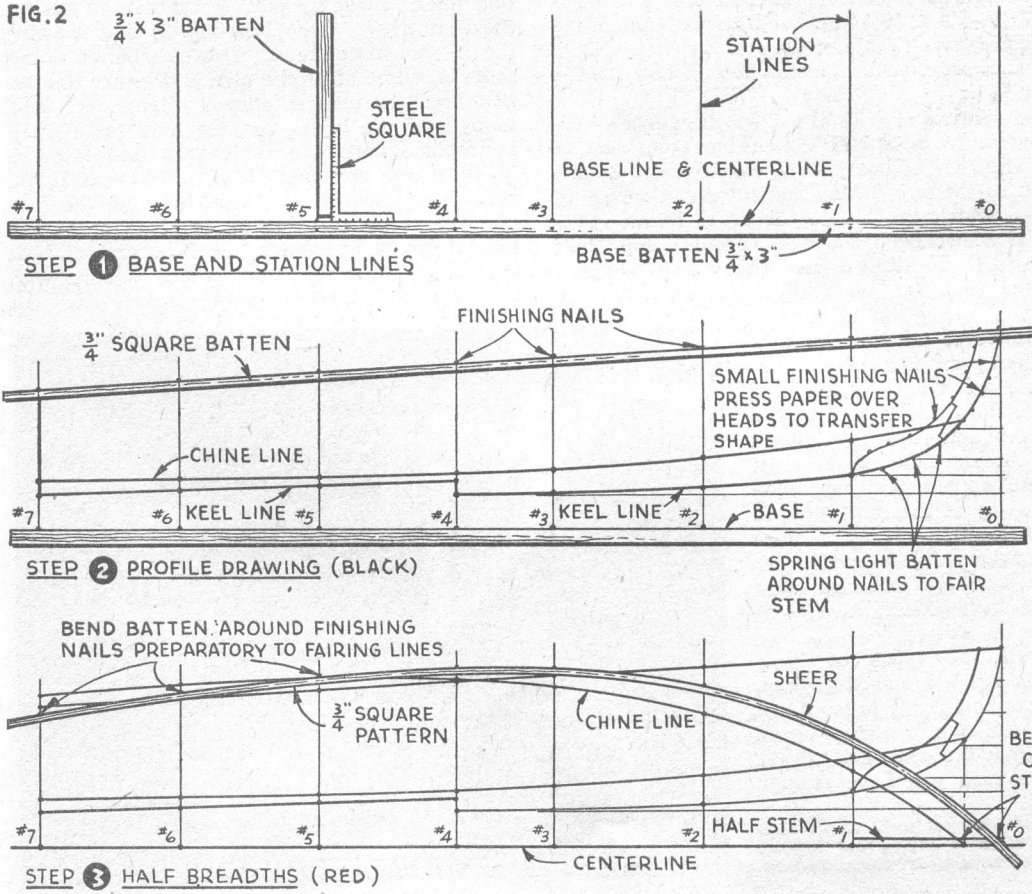
STATION	0	1	2	3	4	5	6	7
KEEL		8-7	6-3	6-0	6-0	7-6	6-7	6-0
CHINE	21-4	16-4	12-5	10-5	9-6	9-1	8-5	8-0
DECK LINE OR SHEER	36-0	34-2	32-4+	30-7—	29-6	28-2—	26-4+	25-0

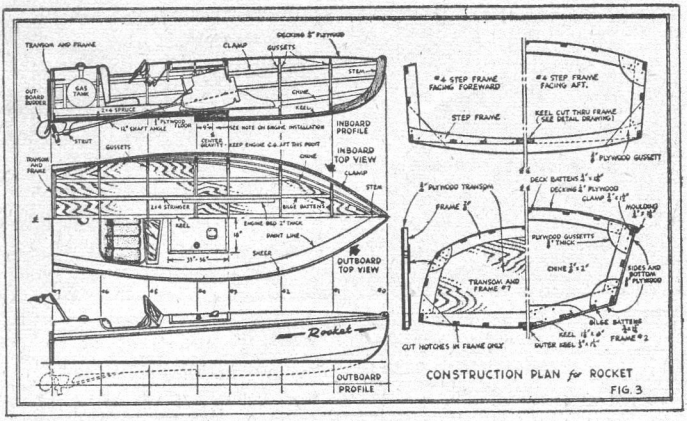
HALF BREADTHS

DECK LINE OR SHEER	0-2	19-0	28-5	32-3	32-4	31-0	28-1	24-0
CHINE		12-2	22-7	28-2	29-6	30-3	30-1	28-5

*All dimensions to outside of frames

FIG. 2



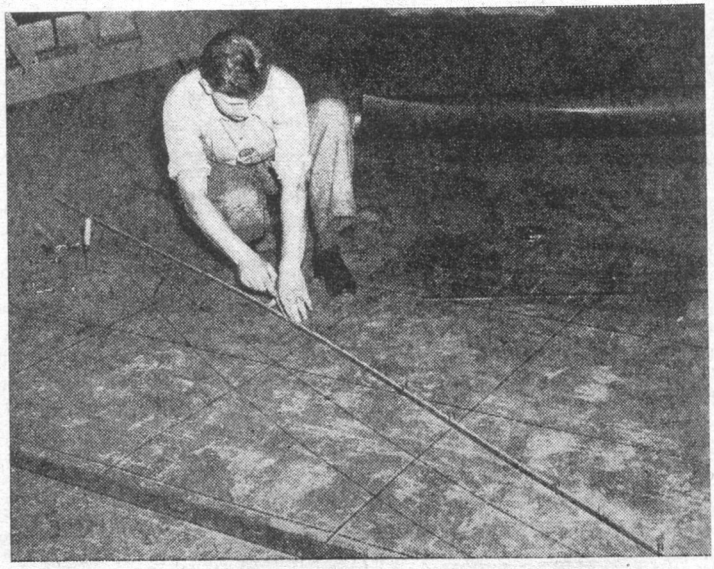


deducted to secure actual frame dimensions. The best way to correct frame dimensions is to fair the lines to outside of planking and then deduct for thickness of planking on body plan only. The dimensions shown in the offset table for *Rocket* are given in inches and eighths of an inch to the outside of the framework, therefore no deductions are necessary for planking thickness. For instance, in heights above the base (see Table of Offsets and profile lines drawing) on frame station No. 1, distance from baseline to chine is 16-4 (16-4/8 or 16½ in). Another example in the half breadths (Table of Offsets) on frame No. 4, distance from centerline to chine is 29-6 (29-6/8 or 29¾ in.).

As contrasted with the *lines* drawings which show *basic* lines and dimensions, *construction* drawings of a boat show construction details such as the size, fitting and interrelationship of parts, which the builder needs to know. Sectional views from the side (profile), top (half breadths) and front or rear (body plan) are presented (Fig. 3). In addition, an outside profile view showing the actual appearance of the finished boat is often presented. For an example of what construction plans show, an inboard profile construction drawing shows the builder the boat as it would appear with one side cut away at the centerline, to show location and appearance of various frame parts, i.e., stem, keel, etc., and how these parts fit together, as viewed from the side.

With the types of basic views defined and explained, we are now ready to lay down our full-size drawings from the lines drawings and offsets. Make sure you have enough unobstructed or surface space to do this job; if an even floor area is lacking, sheets of plywood laid end to end on the ground will provide a level surface on which to lay out the lines. For small boats under 25 ft. long, if you put building paper on the floor and lay out the hull design on the paper, you can then cut out the various parts of the design and use them as accurate templates for the stem, knees, and other parts. For laying out larger boats, you can paint the workshop floor with cold water paint (which dries quickly) and draw your designs on the painted surface; this insures more legible lines to work from.

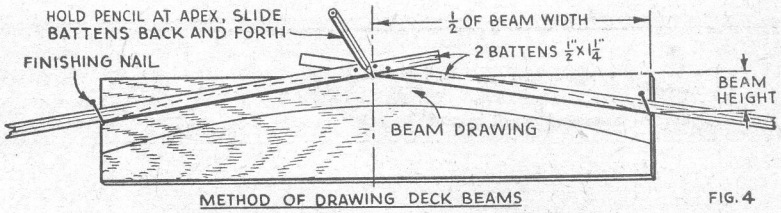
Tools needed for full-size layout work are: a square, a hammer, a handful of 2 in. finishing nails, and two or three battens. For drawing profile and half breadth lines, use a batten ¾ in. square and at least as long as the boat to be drawn. For stem profiles or curved transoms, use a thin ¼ x ⅜ in. batten which can be easily bent to assume a fair curve. Use ¾ x 3 in. batten conjunction with a steel square to erect station lines. Start by placing the square against the base batten (step 1 in Fig. 2) and drawing the various station lines. This base batten represents base line of profile plan and center line for half breadths plan as shown. Remember that, though we are laying out the lines for a small hydroplane here, the same basic procedure is identical for any boat from a rowboat to an ocean-going schooner. Begin drawing the full-size layout by marking an ordinate or station line at No. 0 at forward or bow end of boat drawing. Mark this line exactly square with the base or centerline. Now measure back the



A professional mold loftsman is shown here laying out full-size plans for a Coast Guard lifeboat.

distance specified for each frame station, from No. 0 to No. 7, and draw each ordinate or station line exactly square with the base line. Then beginning with No. 0 mark in all dimensions for the proposed stem outline, drive a finishing nail lightly into each point marked on the stem, and bend the light batten around nails. If any portion of stem fails to line up properly, simply remove nails from this portion and move batten back and forth until it makes a smooth curve without any abrupt changes. Then outline the stem by marking with a pencil along inside edge of batten. Next, at each station, measure off points indicated for keel, chine and sheer lines. Drive a finish nail at each point along the keel and spring the ¾ in. square batten around all the nails. Make certain all points line up with fair, even curves. If they don't, check back over the table of offsets for errors and if none have been made, adjust the batten until you have a faired line on the full-size drawing; then mark the outline in pencil. Lay out and mark the chine and sheer lines similarly (Fig. 2, step 2 and 3).

With profile and half breadth plans drawn and faired, if the plans indicate that lines and dimensions are to outside of planking, deduct thickness of planking at each station. Remember to show corrected frame dimensions, minus planking thickness, on body plan drawing which you will now draw on a separate sheet of building paper. Take all dimensions from the corrected and faired, full-size drawings. This body plan sums up all the faired drawings and provides patterns for the frames. The frame material is laid down upon this body plan, marked and cut to shape and then frame parts are fastened together. The full-size drawing of the boat indicates the correct planes in which to mark the rabbet for cutting in the stem, and by drawing keels, stems, and knees right on the full-size drawing, you'll have patterns of these parts that fit exactly. To secure patterns of any part of the full-size drawing, drive a series of small finishing nails in the floor along the outline of the part wanted. Then press a piece of paper lightly over the nail-outlined part wanted, and the outline is transferred to your paper. Next complete the outline on the nail-perforated paper and use paper pattern or transfer it to plywood for a permanent pattern.



METHOD OF DRAWING DECK BEAMS FIG. 4

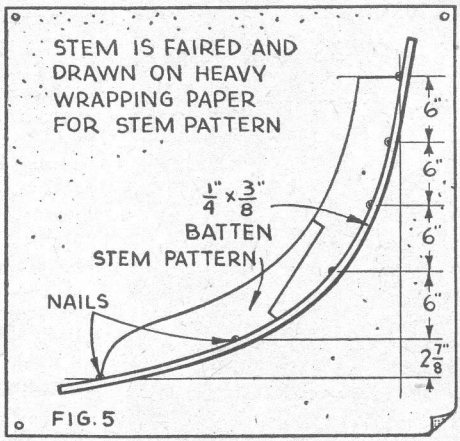


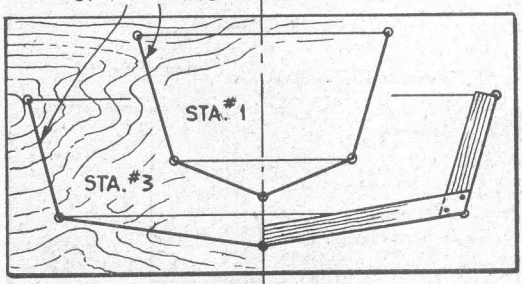
FIG. 5

To draw deck beam curves and curved or convex bottom frames so that they are fair and even regardless of length or height of beam or its position, select the board from which beam will be cut, and indicate points at the ends and the exact center of the beam with a pencil (Fig. 4). Then insert a finishing nail at the extreme ends of the beam to be drawn and lay two ½ in. x 1¼ in. battens on the board so that they touch the finishing nails and overlap at the center point as shown in Fig. 4. Fasten the overlapping ends together with screws or finishing nails. Hold a lead pencil at the center or vertex of the angle, rotate these battens from one nail to the other and the pencil will scribe a perfect arc of a circle.

To lay out a building form secure a ¾ in. square batten and with the building form plank selected make the measurements on the plank which are shown in the drawings you are following. Then drive a nail at each of these points, spring a batten around the nails and mark and cut the form to shape. Finally, lay stem in position at end of form, and mark and saw stem recess out with a keyhole saw.

As another example of the use of full-size plans, to lay out the centerboards on sailboats, make a cardboard pattern and try it in its approximate position inside the centerboard trunk (the lines for which should be drawn in full-size profile view). Cut cardboard to exact shape necessary. When it fits to your satisfaction, remove it and use as template for metal centerboard.

LINE DRAWINGS WITH THICKNESS OF PLANKING DEDUCTED FIG. 6



LAY OUT BOAT FRAMES ON PLYWOOD