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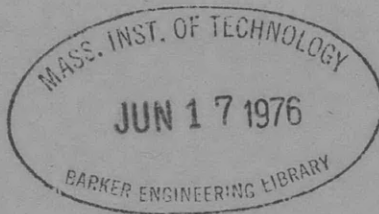
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**NAVY DEPARTMENT**  
**DAVID TAYLOR MODEL BASIN**  
**WASHINGTON, D. C.**

A PHOTOGRAPHIC METHOD OF PRINTING TEMPLATES ON WOOD

by

F. B. Kaye



July 1946

Report R-313

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PERSONNEL

The experimental work described in this report was planned and carried out by F.B. Kaye of the Photographic Development Section, who also wrote the report.

# A PHOTOGRAPHIC METHOD OF PRINTING TEMPLATES ON WOOD

## ABSTRACT

A method is described of transferring body plans of ships to wooden panels by a photographic process, for use as templates in shaping towing models at the David Taylor Model Basin.

## INTRODUCTION

Ship models built and tested at the David Taylor Model Basin are carved from built-up blocks of seasoned pine, by methods which have been described previously (1).\* Much of the early roughing-out of the wood blocks is done by a profiling machine which utilizes templates, sawed from 1/2-inch plywood panels, to cut a number of accurately gaged reference grooves to establish the model contours at a series of stations along the length of a model.

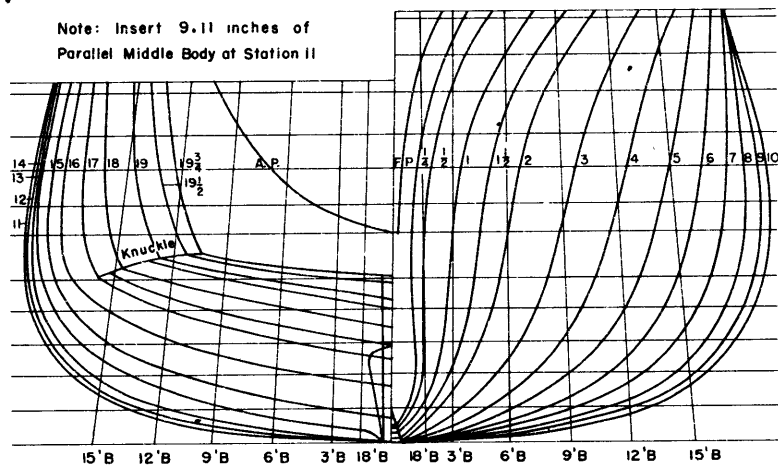


Figure 1 - Sample of Body Plans Used in Making Templates

The body plans of the ship, drawn in half breadth as shown in Figure 1, are at present drawn by the Naval Architecture Section to exact model scale on heavy white paper of high quality. However, this paper has been found to expand, shrink, or warp with changes in humidity, which impairs the accuracy of the templates made by its use. Therefore it was planned to transfer the lines from the paper to the wooden template by photographic means immediately after completion of the drawing. Several methods were tried,\*\* with varying degrees of success, before adoption of the method described in this report.

\* Numbers in parentheses indicate references on page 5 of this report.

\*\* Some of these methods are briefly described in the Appendix.

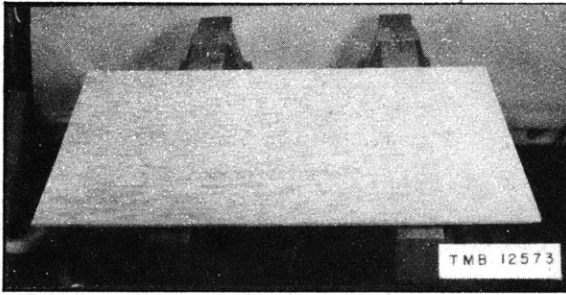


Figure 2a - The Plywood Panel

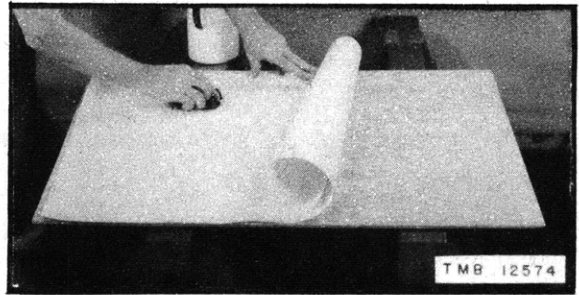


Figure 2b - Applying Water to Dampen Paper

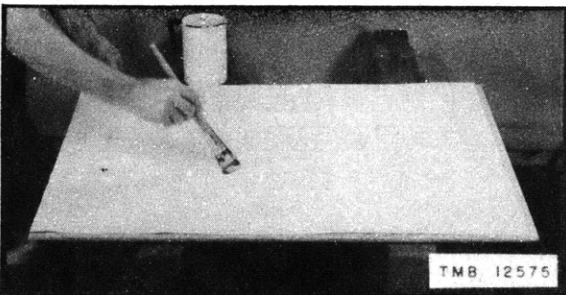


Figure 2c - Applying Paste

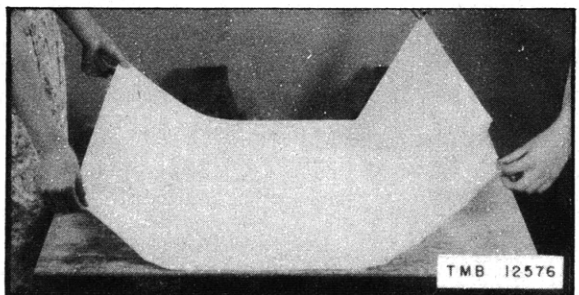


Figure 2d - Lowering Pasted Paper to Panel

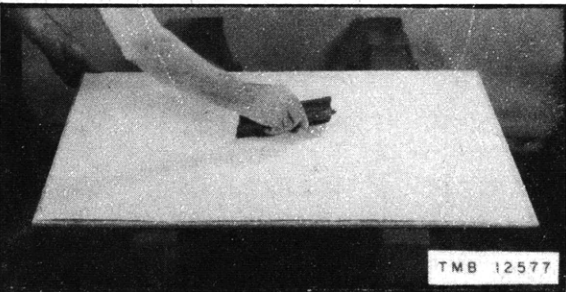


Figure 2e - Smoothing Out Paper with Rubber Squeegee

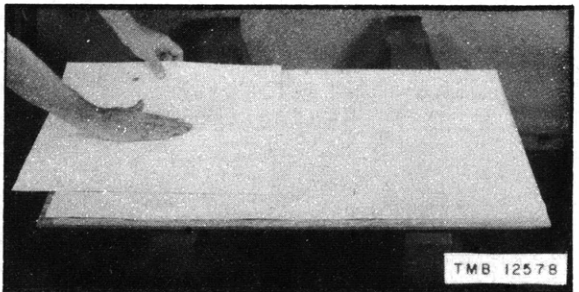


Figure 2f - Blotting off Surplus Moisture

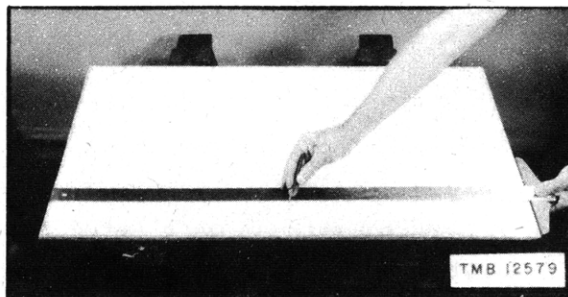


Figure 2g - Inscribing Vertical and Base Line on Paper Coating after Drying

Figure 2 - Steps in Preparing the Panel to Receive the Body Lines

#### PREPARING THE SENSITIZED PANEL

The panel, which is of 1/2-inch plywood, 24 inches wide and 40 inches long, is prepared for sensitizing by pasting to one surface a sheet of white bond paper; see Figures 2a and 2b. To avoid chemical action between the sensitizing solution and the preservatives usually contained in prepared adhesives, a fresh starch paste, made by heating laundry starch in water, is used. This paste is applied smoothly to the sheet of paper, which has been dampened with water and laid out on a flat surface. The wooden panel may be used to support the paper while the paste is being applied; see Figure 2c.

The pasted surface is then turned over on the panel and smoothed out with a rubber squeegee to work out all the trapped air bubbles. The surface water is removed by blotting and the remaining water is allowed to evaporate; see Figures 2d, 2e, and 2f. When the paper is completely dried, it is ready for the sensitizing solution.

Normal blueprint solution is used for sensitizing. This consists of 80 grams of potassium ferricyanide and 180 grams of green citrate of iron and ammonia dissolved in 1000 cubic centimeters of water. This quantity of sensitizer will coat six boards. The solution is applied to the boards in a darkroom with no more than a 60-watt lamp for illumination. The solution is applied with a swab of absorbent cotton, with due care to have a completely uniform coating over the entire surface. The boards are allowed to dry in the dark and are stored in the dark until required for use.

#### TRANSFER OF LINES TO WOOD PANEL

The body plans are drawn as indicated earlier; see Figure 1. The lines on the right side of the perpendicular give the contours of the forward body, and those on the left side the contours of the afterbody. The forward section must be duplicated in reverse on the left side of the wooden template in order to produce a symmetrical forward body in the model. The same is true of the afterbody, except that the left side is printed direct and the right side is duplicated in reverse.

The lines are traced on sheets of matt cellulose acetate, designed originally for topographical drafting in which scale is a highly important factor. These drawings are then transferred to the photographically sensitized panels.

A base line with a perpendicular at its midpoint is inscribed on the sensitized panel, Figure 2g. The drawing of either the forward or aft lines is so placed on the board that its base line and perpendicular coincide with those on the panel, and is tacked in place by means of pushpins through the

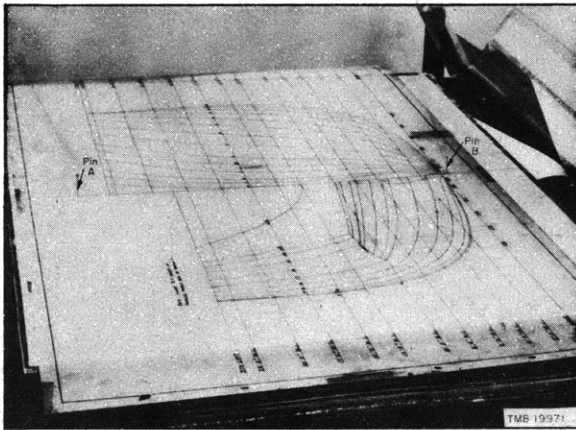


Figure 3a - Panel in Vacuum Frame over Which Half-Breadth Drawing Has Been Placed, with Pins A and B Inserted for Register

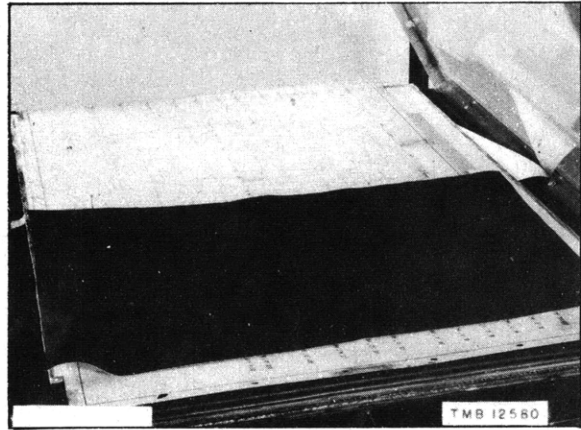


Figure 3b - Opaque Paper in Place to Protect the Part of the Panel That the Reverse Image Is to Occupy

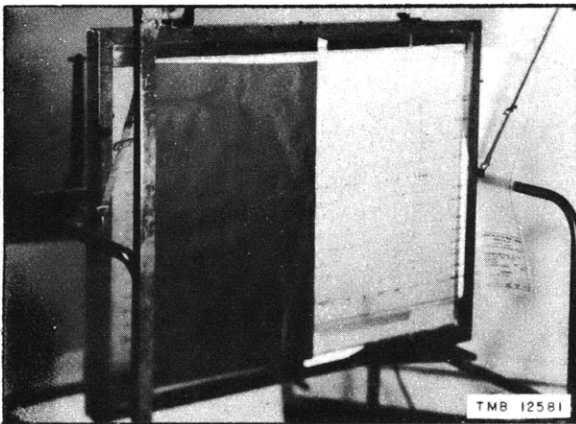


Figure 3c - Closed Vacuum Frame, with Protecting Paper in Position for Printing

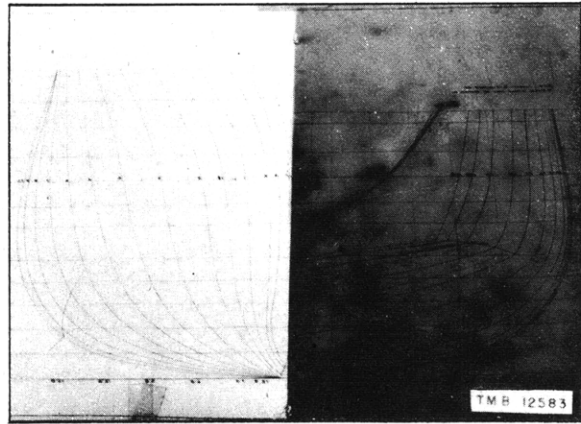


Figure 3d - Opaque Paper Covering Left Side of Drawing in Reverse Position

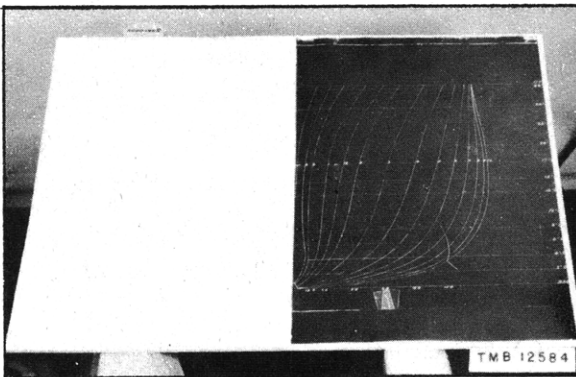


Figure 3e - Printed Right Side of Panel

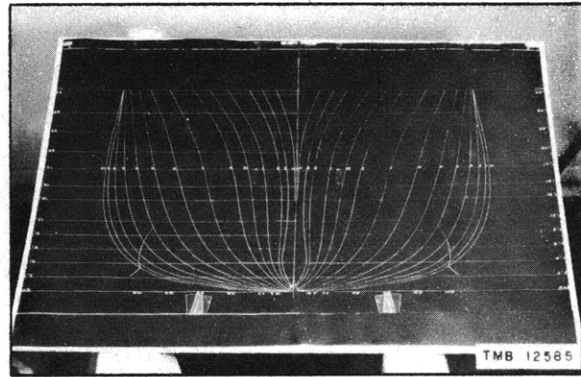


Figure 3f - Completed Panel

Figure 3 - Steps in Printing Body Lines on Sensitized Panel

extreme ends of the perpendicular; see Figure 3a. Held in exact position by the pushpins, the drawing is covered with black paper from the centerline out, to prevent printing on that side while the other side is exposed to the light of an arc lamp, Figure 3b.

#### PRINTING THE BODY LINES

The image is best transferred to the sensitized board in a vacuum frame where absolute contact is ensured between the drawing and the sensitized surface; see Figure 3c. The cellulose acetate drawing sheet is placed on the board, as previously described in this report, and is exposed to the light of a high-intensity arc lamp. Exposure time will vary with lamp voltage, frame-to-lamp distance, and character of the drawing, but as a general rule it will be about 10 minutes. The drawing is then reversed, with due care to match the pinholes, the black paper is shifted to the other side of the centerline, and the second half of the board is exposed; see Figure 3d.

When the exposure has been completed all that is required to develop and fix the image is washing in clean water. The result is a white-line print on a blue background; see Figures 3e and 3f. Care should be taken to keep the edges and back of the board dry to avoid warping.

A weak solution of potassium bichromate, 1/2 ounce per gallon of water, applied to the print after a short preliminary wash in water, will hasten developing and reduce the washing time. Five minutes is the maximum time that will be required for normal developing and washing.

After it has been washed, the board is allowed to dry and is ready for use as a model template.

#### REFERENCES

- (1) "Building Wood Towing Models at the U.S. Experimental Model Basin, Washington," EMB Report 323, March 1932.
- (2) "The Manufacture of Model Propellers at the U.S. Experimental Model Basin, Washington," by R.E. Frisby, EMB Report 290, March 1932.
- (3) "Photography and Plate Making," by I.H. Sayre, Lithographic Text Book Publishers, 45 State Street, Chicago, 1939.
- (4) "Process Photography and Plate Making," by J.S. Mertle, published by G. Cramer Dry Plate Company, St. Louis, Missouri.

APPENDIX  
PRELIMINARY EXPERIMENTS

It was originally intended to adapt photographic methods long in use for the preparation of model-propeller templates at the Model Basin (2) to the present requirements. In these methods the lines are photographed on process film and printed on the sensitized material, which for propeller templates is zinc.

To permit printing on wood, it was first necessary to prepare a panel of that material to receive the sensitizing solution. A smooth panel was given a coat of white lacquer and allowed to dry thoroughly. It was then coated with a solution of egg albumen and ammonium bichromate, such as is used in photolithographic practice (3) (4), and again allowed to dry.

After exposure, in which a vacuum frame was used to ensure close contact, developing ink was spread on the board, which was then sponged lightly with cold water. This removed both the basic coating of albumen and the ink from the unexposed areas, leaving a black image of the lines on a white background.

Blueprint coating was also tried on wood previously covered with various fillers, such as watercolor paints, whiting and glue, whiting and albumen, and several commercial white water paints. Satisfactory images were obtained on some of these coatings. Difficulty in achieving an adequately smooth surface, and subsequent softening of the material, however, rendered these methods too uncertain. They were therefore discarded in favor of the method described in this report.

The method illustrated was carried out on a somewhat smaller scale than that used in practice, owing to the lack of a vacuum frame of adequate size.

To put this method into production would require a frame of adequate size and floor space approximately 8 by 10 feet.

Boards could be prepared in quantities and stored.

An enclosed dark drying cabinet for the sensitized panels would be necessary.







