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To: Dr. Briggs

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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TANK TESTS OF TWO FLOATS FOR HIGH-SPEED SEAPLANES

By Joe W. Bell
Langley Memorial Aeronautical Laboratory

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SUMMARY

At the request of the Bureau of Aeronautics, Navy Department, a study of the design of floats especially suitable for use on high-speed seaplanes was undertaken in the N.A.C.A. tank. This note gives the results obtained in tests of one-quarter full-size models of two floats for high-speed seaplanes. One was a float similar to that used on the Macchi high-speed seaplane which competed in the 1926 Schneider Trophy races, and the other a float designed at the N.A.C.A. tank in an attempt to improve on the water performance of the Macchi float. The model of the latter showed considerably better water performance than the model of the Macchi float.

INTRODUCTION

The high speeds that can be obtained with the towing carriage of the N.A.C.A. tank make it especially suited for testing large models of floats for high-speed seaplanes. Consequently, one of the first items of work for the tank, in response to request of the Bureau of Aeronautics, Navy Department, was the improvement of the water performance of floats for high-speed seaplanes. Information was first required concerning the performance in the tank of a float representative of good practice and having good all-round performance. This information being available, floats could be designed to use in determining which features affected performance.

The Bureau of Aeronautics was requested to provide a set of lines of a float which had good water performance and which was considered representative of good practice in service. The Bureau accordingly furnished the Committee with the lines of the floats used on the 1926 Macchi high-speed seaplane and with data on the water performance as determined by the Experimental Model Basin, Washington Navy Yard. A one-quarter full-size model (N.A.C.A. tank model no. 2) of this float was made and tested as a single float.

From observation of the behavior of this model and the study of data on other floats which were made available by the Bureau of Aeronautics, it was concluded that an improved float could be designed having the same general dimensions as the Macchi, but incorporating certain changes in shape. The lines for such a float were prepared at the tank and a one-quarter full-size model (N.A.C.A. tank model no. 6) was constructed.

Although model no. 2 was first tested in November 1931, the tests on model no. 6 were delayed until January 1933 by more pressing work. The present note makes available the data that have been obtained on this subject to date.

DESCRIPTION OF MODELS

Model no. 2 is of the single-step deeply concave V-bottom type. The outboard profile shows that the bottom curves up sharply at the bow. The length of the forebody is 50 percent of the over-all length and the station of maximum beam is located at the step. The deck is curved to the chine in the transverse sections and is straight for almost the entire length in profile, with only a slight downward curvature at the bow.

Model no. 6 is of the same general type as no. 2, with several quite noticeable differences. The bottom rises at the bow with a long sweeping curve instead of a sharp curve and the bow is lower. The length of the forebody is 52.5 percent of the over-all length and the station of maximum beam is located at 30 percent of the length from the bow. Transversely the deck curves to a vertical side for quite a length amidships while longitudinally it curves down quite sharply on the forebody and slopes down slightly on the afterbody.

The maximum beam of model no. 6 was brought considerably farther forward than usual because of the distribution of the volume given to the float. The distribution follows as closely as possible that of the hull of the U.S. Navy C-Class airships. The distribution of volume was selected because it was believed that the air drag of a float might be reduced if the volume were suitably distributed and it was known that the hull of the C-Class airships had low drag. Volume-distribution curves of model no. 6 and of the C-Class hull are shown in figure 1.

All the data given herein are for the one-quarter full-size models, a size selected as giving a get-away speed of the model well within the speed range of the towing carriage.

Both models were made of laminated mahogany, were worked to a tolerance of ±0.02 inch, and were painted with several coats of gray pigmented varnish.

Outline drawings of the models are given in figures 2 and 3 and photographs are given in figures 4 and 5.

Particulars of the models are as follows:

	Model no.2	Model no. 6
Length	5 ft.	5 ft.
Maximum beam	7 in.	7 in.
Distance from bow to section of maximum beam	30 in.	18 in.
Depth	7.0 in.	7.5 in.
Depth of step	0.75 in.	0.75 in.
Dead rise at step (Dead rise is measured to the chine)	29.7°	29.7°
Angle of afterbody keel	7°36'	7° 0'
Initial trim by stern	3°	3°
Load displacement	25.8 lb.	25.8 lb.
Reserve buoyancy	76.5 percent	90.0 percent
Longitudinal metacentric height	6.65 ft.	5.16 ft.

APPARATUS AND METHOD

Both models were tested under the same conditions of load, get-away speed, and trim angle. The gross load for each model was 25.8 pounds and the get-away speed was 59.1 feet per second. Both models were towed free-to-trim and at various fixed-trim angles.

A lift, simulating wing lift, was applied to the model by the hydrovane method. In the use of the hydrovane method, wing lift is assumed to vary with the square of the speed at all speeds up to the get-away speed of the model. The hydrovane was kept at a constant angle of attack throughout the tests regardless of variations of the trim angle of the model. A description of the hydrovane method as used in the N.A.C.A. tank is given in reference 1.

The interference between twin floats being small at the spacings used in practice, the data given here are assumed to be directly applicable to twin floats.

RESULTS

As no method has been found for separating air and water resistance of a model, the resistances given include the air drag. The loads used in computing the load/resistance ratios were determined by deducting hydrovane lift from the gross load of the model. This lift was assumed to be proportional to the square of the speed of the model.

The pull for towing each model was applied at a point above the model corresponding to the center of gravity of the complete Macchi seaplane. This point was also used as the pivot point for varying the trim angle and as the center of moments for measuring the moments required to hold the model at fixed trim. As the center of gravity of the model was below this point there was a gravity moment tending to bring the model to its initial trim at all times. The trimming moments for fixed-trim runs were corrected for this gravity moment. The moment curves for the free-to-trim tests show the gravity moments which influenced the trim throughout the tests. Because of the difference in gravity moments the free-to-trim angles for the two models are not strictly comparable. Moments caused by water forces tending to raise the bow of the model are considered positive.

Figures 6 to 9 give the curves plotted with resistance, trim angle, rise, moment, and load/resistance ratio of each model as ordinates, and model speed as the abscissa.

PRECISION

The precision of the results is as follows:

Speed	±0.1 f.p.s
Resistance	±.1 lb.
Trim angle	±.1°
Trimming moment	±.5 lb.-ft.
Rise	±.1 in.

A few test points failed to fall within these limits because the model was running under unsteady conditions which could not be duplicated.

DISCUSSION OF RESULTS

The water resistance of model no. 6 is less than that of model no. 2 at most of the speeds and angles tested, and particularly at the hump and in the planing range.

Model no. 2 porpoised at speeds above 20 feet per second when towed free-to-trim and at speeds between 25 and 30 feet per second at 6° fixed trim. No tendency to porpoise was noticed in model no. 6.

The spray of the two models was almost identical. The sides of the models were wet at speeds below 10 feet per second. At higher speeds the sides were dry. A "roach" about 14 inches high followed both models about 3 feet aft of the stern at speeds around 15 feet per second. The spray did not seem to be of such a nature as to endanger the propellers or tail surfaces at any speed and trim.

Observations indicated that the low bow of model no. 6 would be satisfactory for racing conditions as the model showed no tendency to dive at any speed.

CONCLUSIONS

The tests showed model no. 6 to have lower water resistance than model no. 2 through most of the speed range at all trim angles at which the models were towed.

It is expected that model no. 6 will have the lower air drag of the two models because of the shape of the bow and the distribution of volume, but this cannot be known definitely until wind-tunnel tests are made.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., October 4, 1933.

REFERENCE

1. Truscott, Starr: The N.A.C.A. Tank. T.R. No. 470, N.A.C.A., 1933.

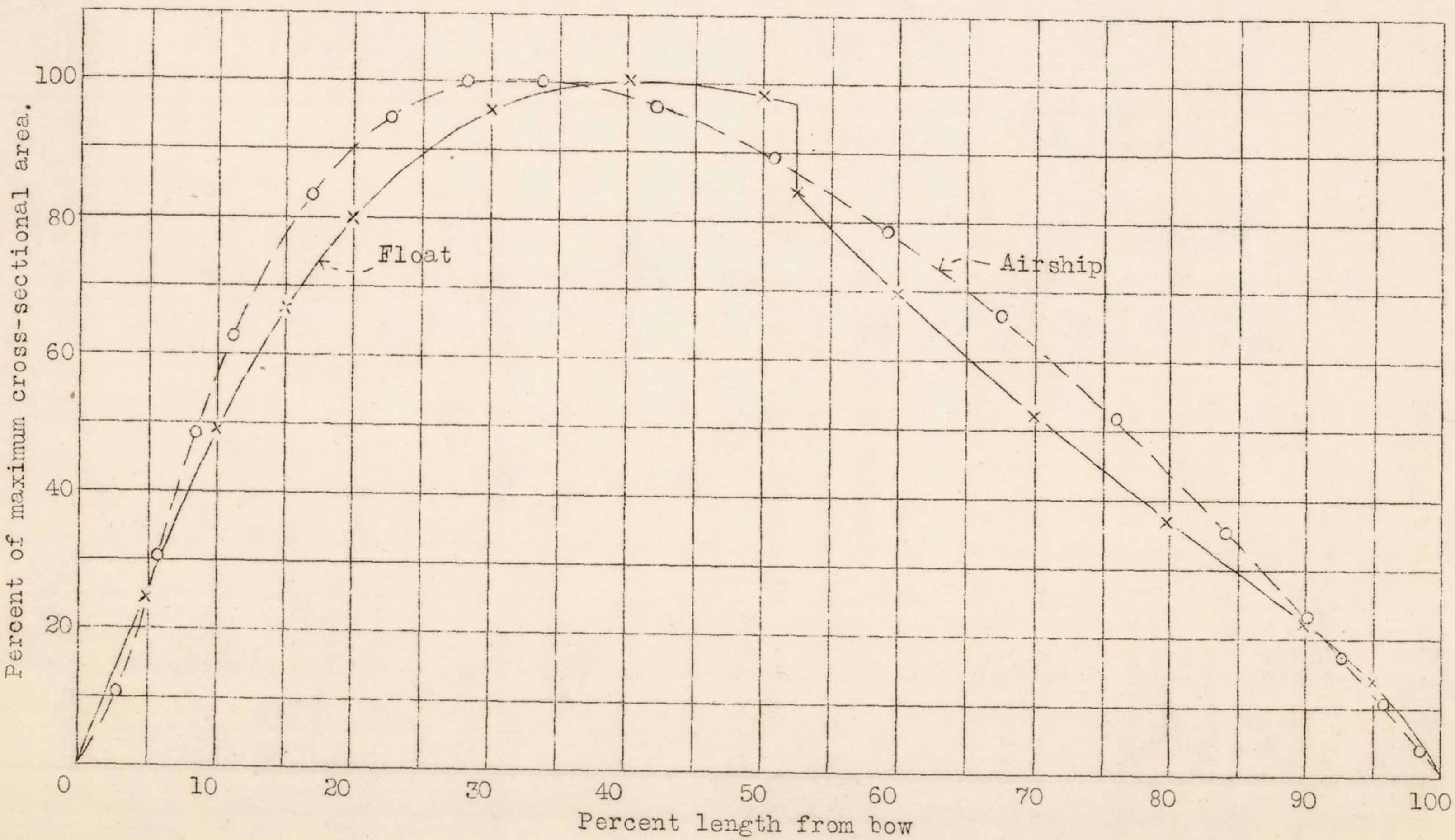

Figure 1.- Volume distribution of N.A.C.A. float No.6 and U.S. Navy C - class airship.

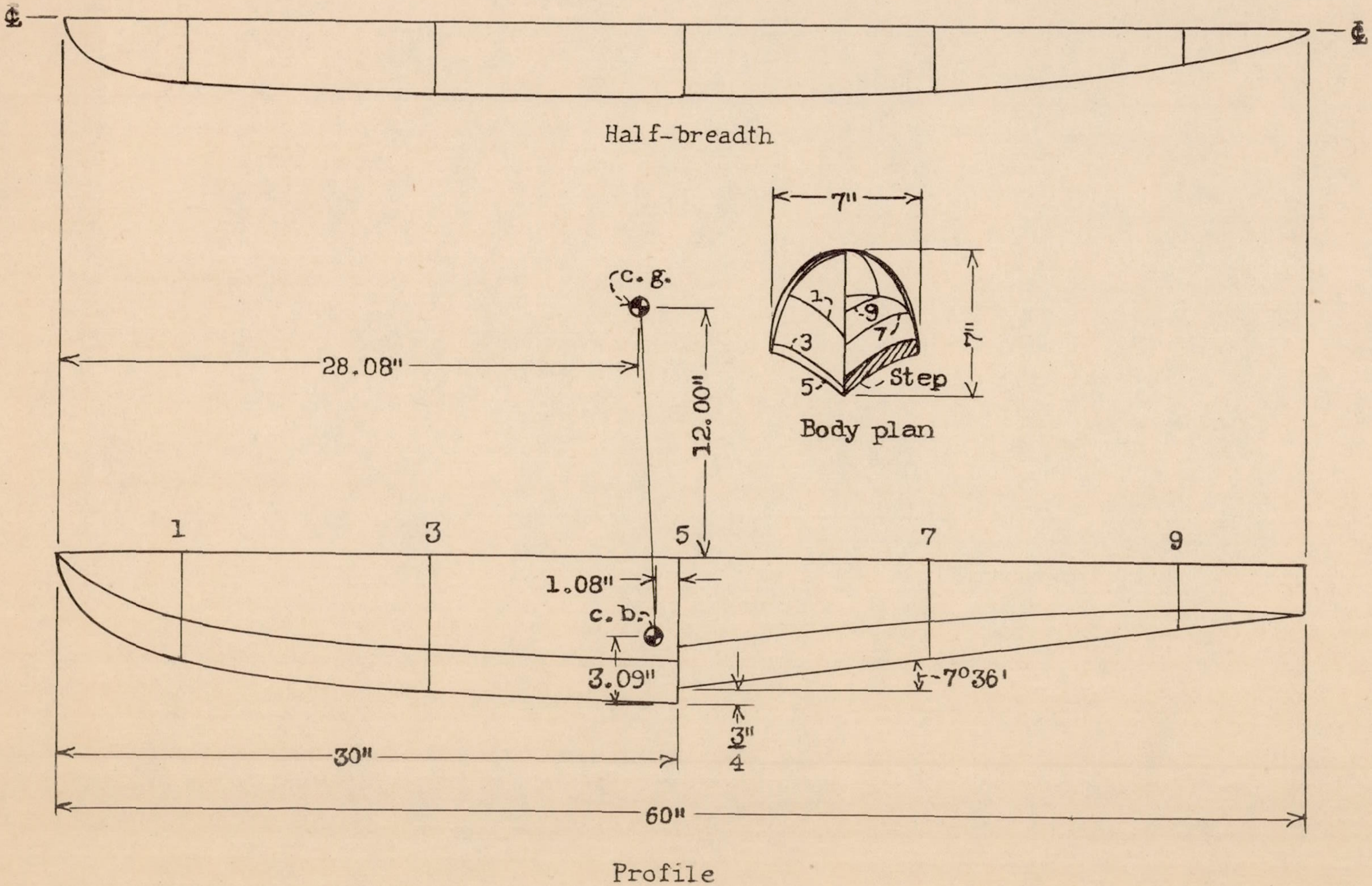

Figure 2.-N.A.C.A. tank, model No.2 .

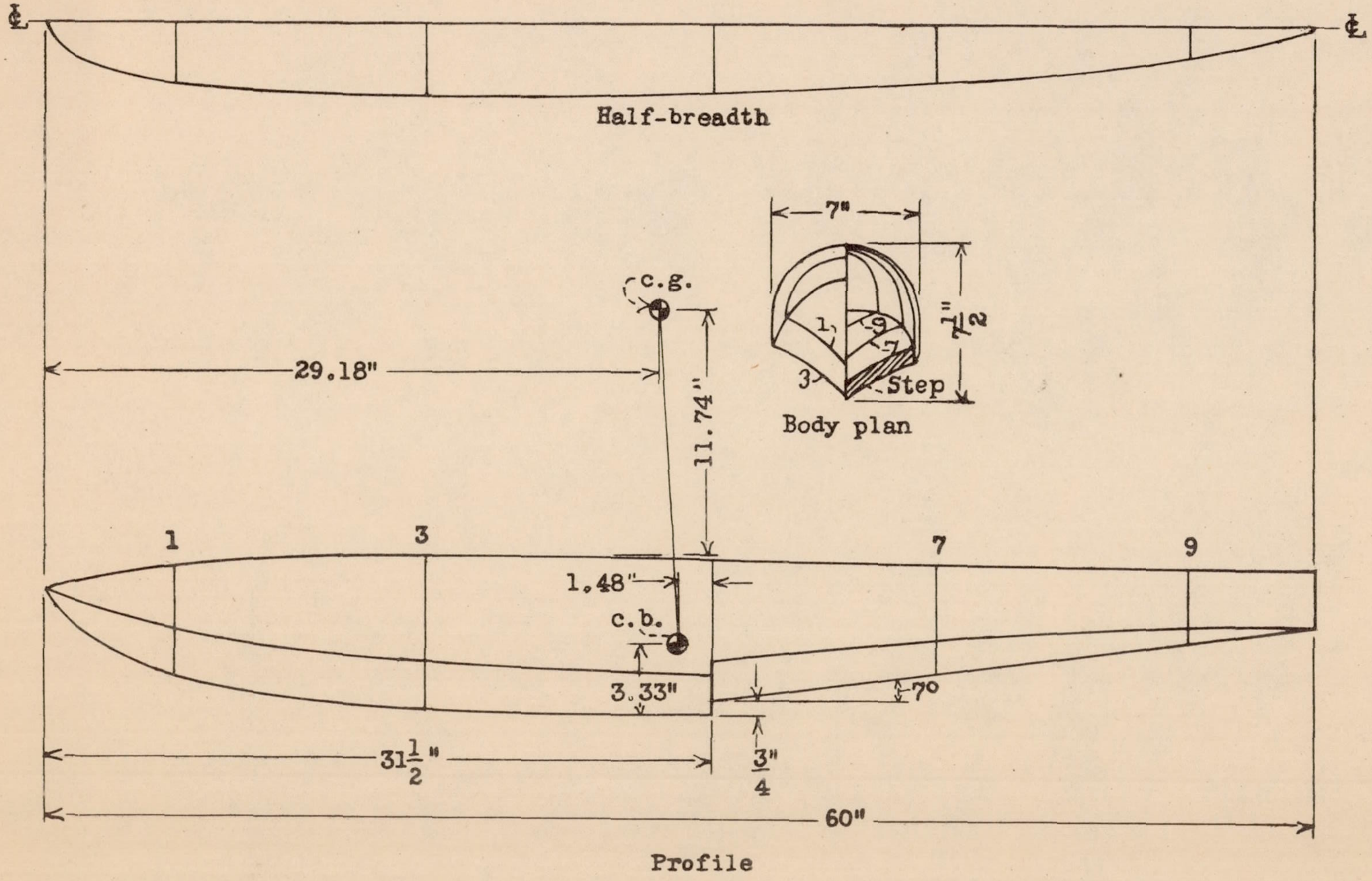

Figure 3.-N.A.C.A. tank, model No.6 .

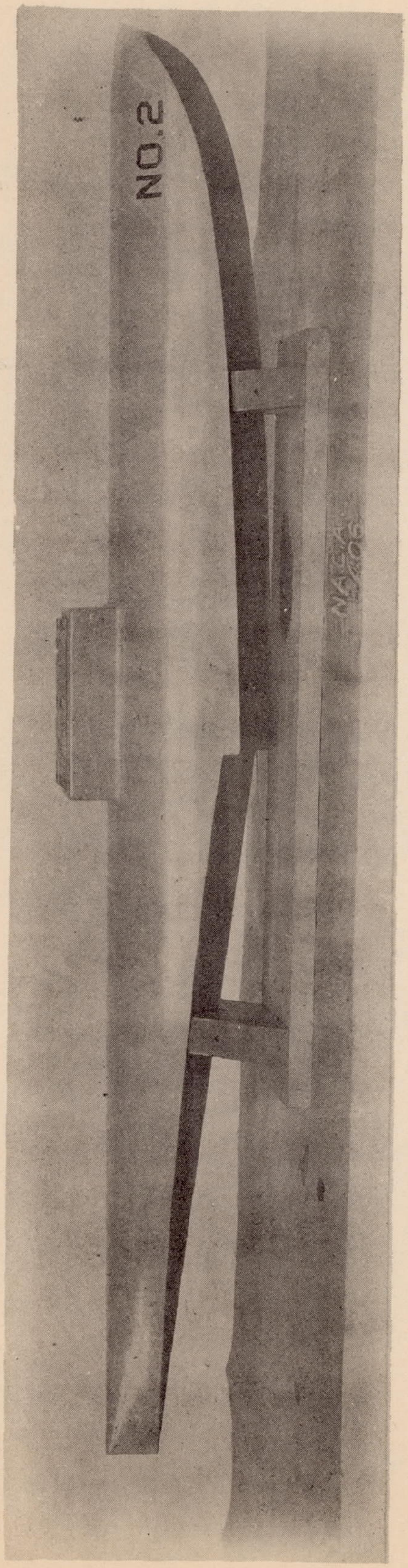

Figure 4

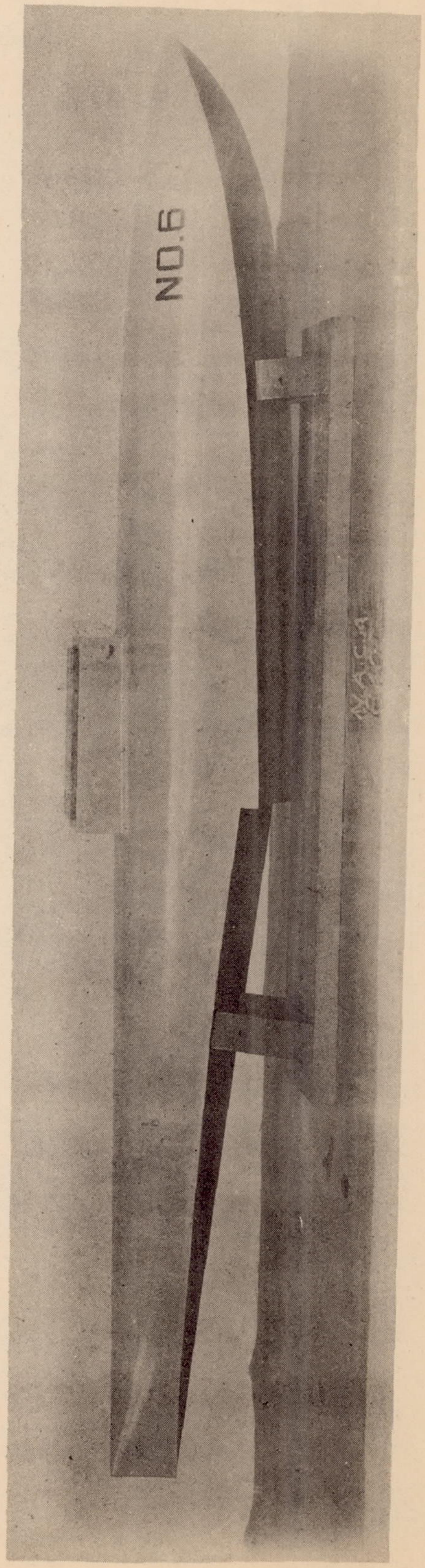

Figure 5

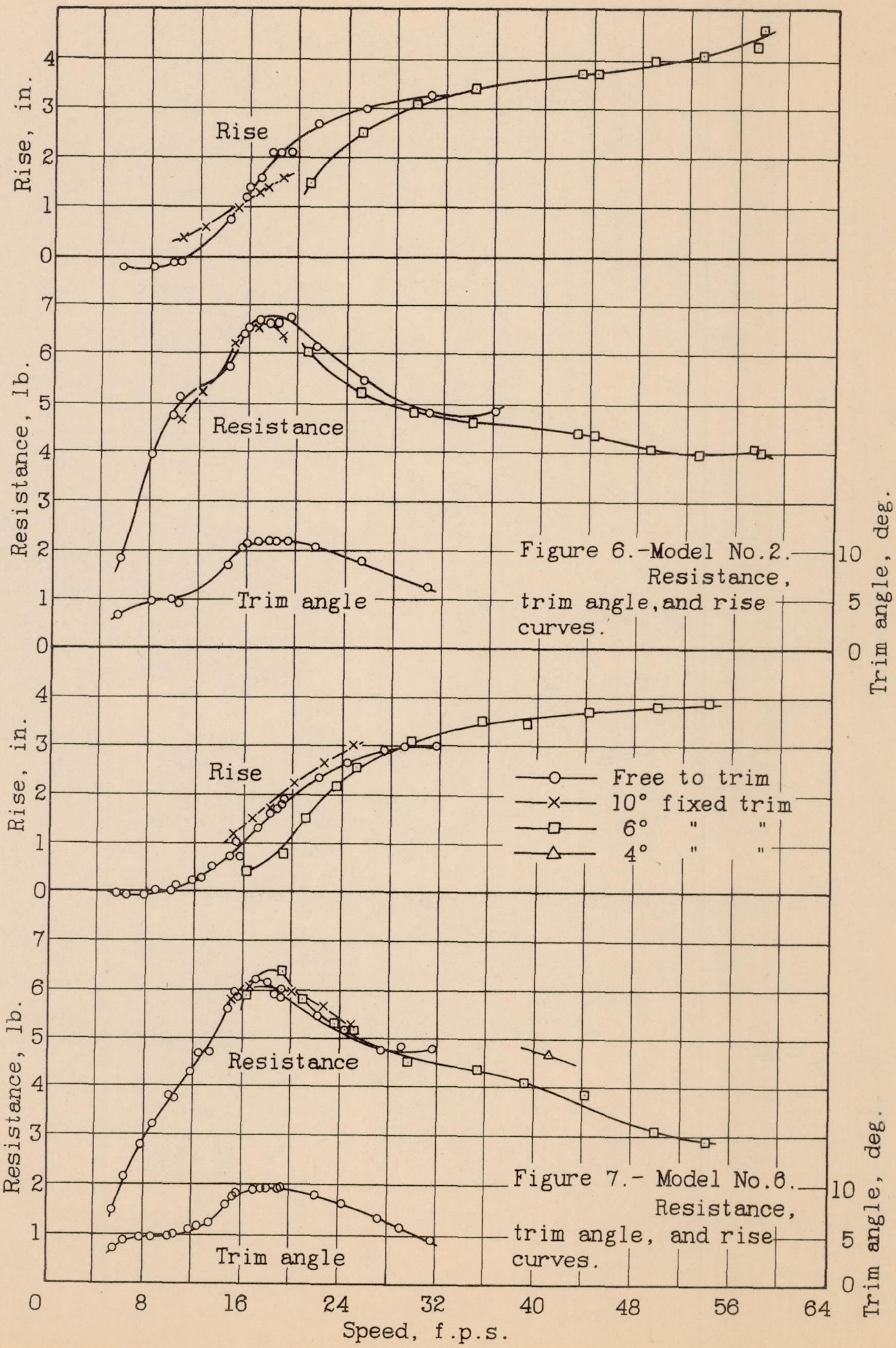

Figure 6.-Model No.2. Resistance, trim angle, and rise curves.

Figure 7.- Model No.6. Resistance, trim angle, and rise curves.

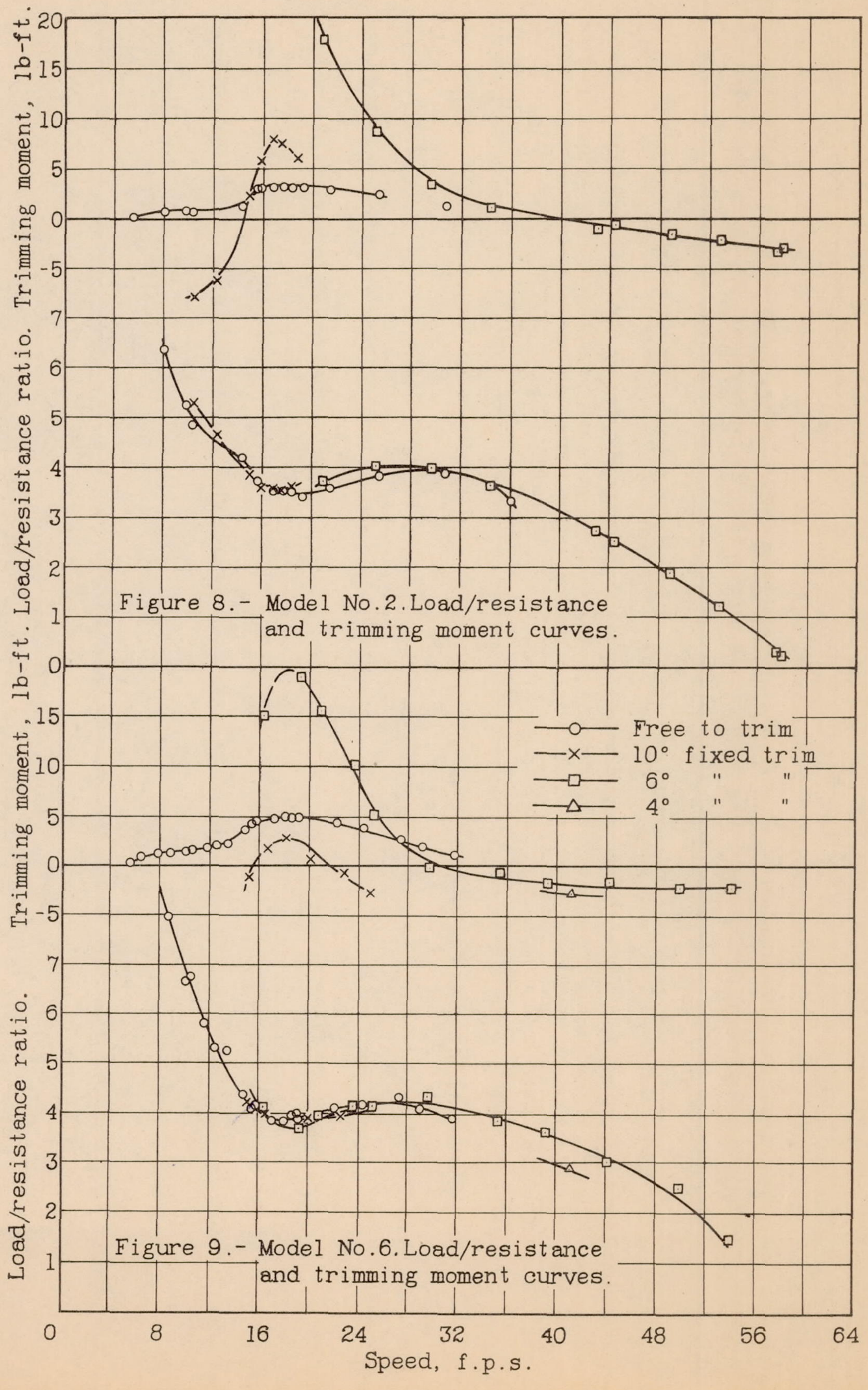

Figure 8.- Model No.2. Load/resistance and trimming moment curves.

Figure 9.- Model No.6. Load/resistance and trimming moment curves.