THE UNIVERSITY OF MICHIGAN

College of Engineering
Department of Naval Architecture and Marine Engineering
Ship Hydrodynamics Laboratory

Results of Still Water Resistance Tests of a 1/48 Scale Model of a 605'-0" Cargo Ship With and Without a Large Bulbous Bow

J. L. Moss

Department of Naval Architecture
and Marine Engineering
University of Michigan
450 West Engineering Building
Ann Arbor, Michigan

For:

J.J. Henry Co., Inc.
21 West Street
New York 6, N.Y.

Administered through:

January 1966

OFFICE OF RESEARCH ADMINISTRATION • ANN ARBOR

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Under the authorization from J.J. Henry Co., Inc. still water resistance tests of a cargo ship model were run to investigate the effects of a large bulbous bow. The work was originally begun in the sping of 1965 but was stopped at the sponsor's request to facilitate alterations in hull design including changes in basic dimensions. Although a model of the earlier design was constructed, no tests were run. The model designation of the earlier hull was U of M Model 1058. In the fall of 1965, lines of the updated design were supplied and a new model, designated U of M 1080, was built to J.J. Henry drawings 5033-331 and 5033-331A. A large bulbous bow modification to the forebody was designed by laboratory personnel and was designated U of M 1080-B1 lines of which were forwarded to the sponsor on December 3, 1965. Contained in this report are the results of resistance tests in still water of models 1080 and 1080-B1.

Generally, the effect of a large bulb is to cancel bow waves created by the main hull by creating an opposing system of waves. The size of the surface waves created by the bulb is a function of bulb size (volume or cross-sectional area), depth of submergence and ship speed. The phase relation between the opposing sets of waves is largely controlled by the longitudinal position of the bulb. For the cargo ship case, it is difficult to achieve optimum cancellation in all conditions since the ship may commonly operate at a number of forward drafts. Hence, the bulb is located nearer to the surface in light or ballast conditions than in fully loaded conditions and the amplitudes of the waves generated by the main hull are not subject to the same changes with varying draft as

are those created by the bulb. Also, the changes in ship speed with varying load conditions may adversely effect the wave cancellation process. Therefore, to obtain the best overall results, taking into consideration different load conditions, the bulb design is necessarily a compromise.

In the present case, the following table shows the speed differential caused by the bulb design tested in a number of load conditions. The values of speed are taken at a constant predicted EHP of 12,000.

H ft.	V_k without bulb (model 1080)	V_k with bulb (model 1080-B1)	δV_k
23.0	21.05	21.25	0.20
26.6	20.65	21.25	0.35
33.0	20.00	20.15	0.15

That is, the bulb caused an average of about 1/4 knot speed increase over a range of conditions. It is doubtful that significant variations from this value could be affected by bulb design changes. However, the distribution of the speed increments versus draft could be altered with changes in bulb size, etc.

Figure 1 is the predicted full scale EHP for all tests run. Extrapolation was made by means of the 1947 A.T.T.C. turbulent flow flat plate friction coefficient line with a correlation allowance of $\Delta C_f = 0.0002$. Turbulence was stimulated in the tests by a 0.036 inch diameter girth wire located 5% LBP aft of the F.P. Additionally, small studs were located on the bulb in the case of model 1080-B1 in keeping with turbulence inducement in fundamental experimentation on spheres.

Table 1 gives the geometric particulars for the test conditions for the ship and model 1080 and Table 2 for ship and model 1080-B1.

TABLE 1

For:	J.J. Henry Co., Inc.
Ship:	C5-S-75a, American Mail Line Ltd., Cargo Vessel
Model No:	U of M 1080
Linear Scale Ratio:	48
Appendages:	None

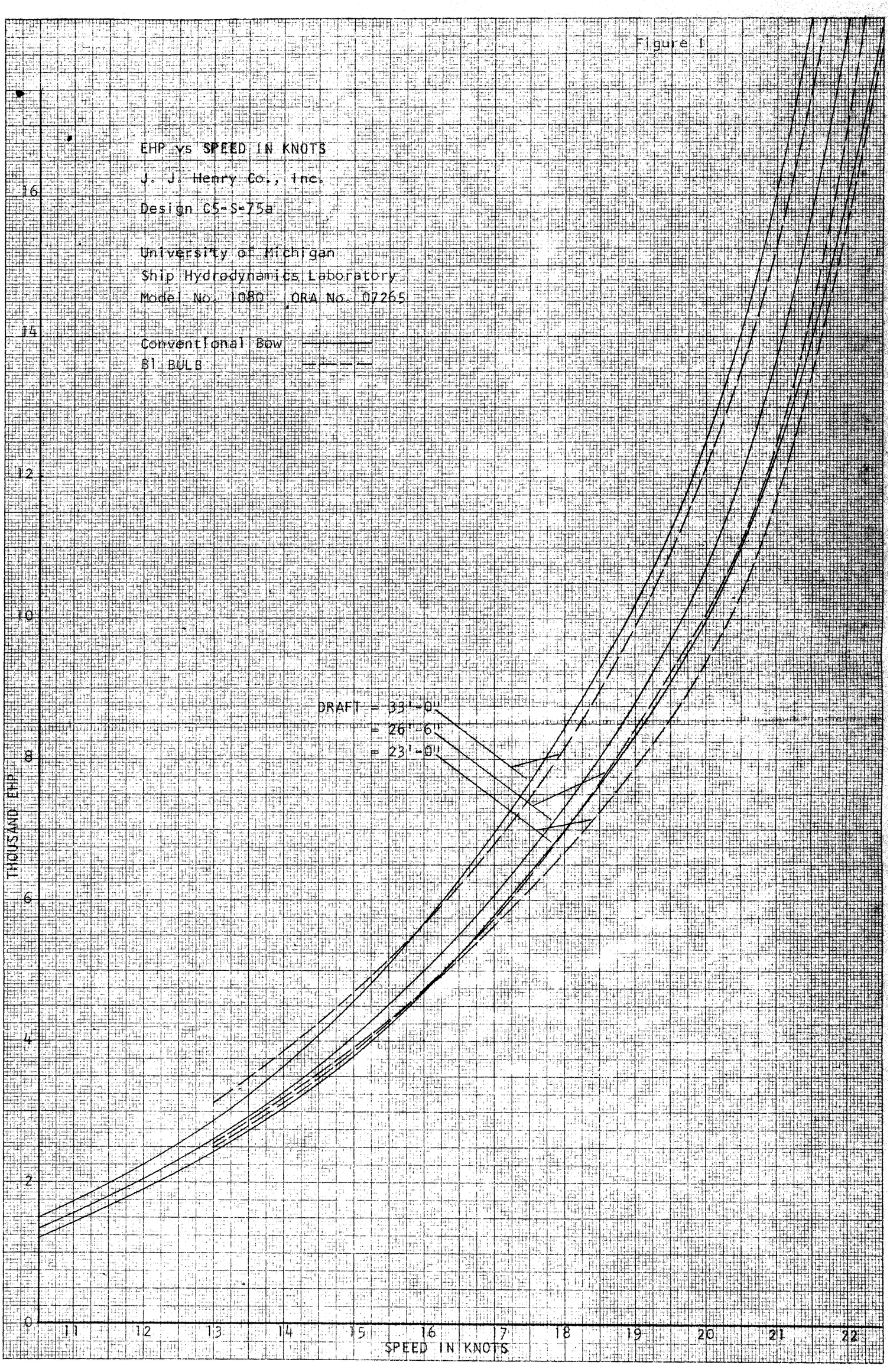
	MODEL	SHIP
LOA	12.604 ft.	605 ft. 0 in.
LBP	12.135 ft.	582 ft. 6 in.
Beam	1.708 ft.	82 ft. 0 in.
Full Load Condition		
LWL	12.340 ft.	592 ft. 4 in.
H (even keel)	0.688 ft.	33 ft. 0 in.
W.S.	28.05 sq. ft.	64,627 sq. ft.
Δ	587.6 lbs.@72°F.F.W.	29,820 L.T.@59°F.S.W.
Intermediate Load Condition		
LWL	11.872 ft.	569 ft. 10 in.
H (even keel)	0.552 ft.	26 ft. 6 in.
W.S.	24.31 sq. ft.	56,010 sq. ft.
Δ	456.5 lbs.@72°F.F.W.	23,170 L.T.@59°F.S.W
Light Load Condition		
LWL	11.707 ft.	561 ft. 11 in.
H (even keel)	0.479 ft.	23 ft. 0 in.
W.S.	22.44 sq. ft.	51,702 sq. ft.
Δ	387.4 lbs.@72°F.F.W.	19,660 L.T.@59°F.S.W.

TABLE 2

For:	J.J. Henry Co., Inc
Ship:	C5-S-75a, American Mail Line Ltd., Cargo Vessel
Model No:	U of M 1080-B1
Linear Scale Ratio:	48
Appendages:	None

	MODEL	SHIP
LOA	12.608 ft.	605 ft. 2 in.
LBP	12.135 ft.	582 ft. 6 in.
Beam	1.708 ft.	82 ft. 0 in.
Full Load Condition		
LWL	12.337 ft.	592 ft. 2 in.
H (even keel)	0.688 ft.	33 ft. 0 in.
W.S.	28.73 sq. ft.	66,194 sq. ft.
Δ	591.3 lbs.@70°F.F.W.	30,000 L.T.@59°F.S.W.
Intermediate Load Condition		
LWL	11.887 ft.	570 ft. 7 in.
H (even keel)	0.552 ft.	26 ft. 6 in.
W.S.	24.97 sq. ft.	57,531 sq. ft.
Δ	460.1 lbs.@70°F.F.W.	23,350 L.T.@59°F.S.W.
Light Load Condition		
LWL	11.753 ft.	564 ft. 2 in.
H (even keel)	0.479 ft.	23 ft. 0 in.
W.S.	23.07 sq. ft.	53,153 sq. ft.
Δ	391.0 lbs.@70°F.F.W.	19,840 L.T.@F.S.W.

Figure 1


EHP vs SPEED IN KNOTS
J. J. Henry Co., Inc.
Design C5-S-75a
University of Michigan
Ship Hydrodynamics Laboratory
Model No. 1080 ORA No. 07265
Conventional Bow
BI BULB
DRAFT = 33'-0"
= 26'-6"
= 23'-0"
THOUSAND EHP
SPEED IN KNOTS
0
2
4
6
8
10
12
14
16
11
12
13
14
15
16
17
18
19
20
21
22