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Bethesda, Maryland 20084

EFFECT OF THE LONGITUDINAL LOCATION OF A PAIR OF OUTER HULLS ON RESISTANCE FOR THE 4300 TON O'NEILL HULLFORM CONCEPT (OHF) SHIP REPRESENTED BY DTNSRDC MODEL 5355-1

by

James E. Wood

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SHIP PERFORMANCE DEPARTMENT
DEPARTMENTAL REPORT

AUGUST 1985

DTNSRDC/SPD-1147-01

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	UNCLASSIFIED
1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
3. DISTRIBUTION / AVAILABILITY OF REPORT	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	DTNSRDC/SPD-1147-01
5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION	David Taylor Naval Ship R&D Ctr
6b. OFFICE SYMBOL (If applicable)	Code 1522
7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code)	Bethesda, Md 20084
7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	Naval Sea Systems Command
8b. OFFICE SYMBOL (If applicable)	05R12
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)	Department of the Navy Washington, D.C. 20363

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
	SF 43-411	4B	1-1204-530

11. TITLE (Include Security Classification)
EFFECT OF THE LONGITUDINAL LOCATION OF A PAIR OF OUTER HULLS ON RESISTANCE FOR THE 4300 TON O'NEILL HULLFORM CONCEPT (OHF) SHIP REPRESENTED BY DTNSRDC MODEL 5355-1

12. PERSONAL AUTHOR(S)
James E. Wood

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
R&D (Final)	FROM ______ TO ______	August 1985	v+25

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Resistance experiments were conducted with a model representing the O'Neill Hullform Concept (OHF). The purposes of the experiments were to investigate the effect on resistance caused by the addition of a pair of strut-like outer hulls to DTNSRDC model 5355 and to determine the sensitivity of the outer hull longitudinal location on resistance. This information will be used to assess the merits of the OHF concept. The residuary resistance coefficient based on model data is lower over most of the speed range than the analytical prediction, but the trends are similar. The experimental results show that the outer hulls produce about fifty percent of the total resistance of the OHF. The total resistance of the OHF, however, compares favorably with that of SWATH III, a typical conventional SWATH hullform of similar size. Thus, the concept shows merit for further investigation. Resistance was lowest with the struts located at the forward position at several speeds below 22 knots, and at all speeds above 25 knots.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT	☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS
21. ABSTRACT SECURITY CLASSIFICATION	UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL	James E. Wood
22b. TELEPHONE (Include Area Code)	(202) 227-1638
22c. OFFICE SYMBOL	Code 1522

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

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NOTATION

Symbol	Computer Code Symbol	Definition
C_A	CA	Correlation Allowance
C_F		Frictional Resistance Coefficient
C_R	CR	Residuary Resistance Coefficient
F_n	FN	Froude Number
g	G	Acceleration due to gravity
L		Length
P_E	PE	Effective Power
R_n	RN	Reynolds Number
V_M	VM	Model Speed
V_S	VS	Ship Speed
$V/\sqrt{L}$	VRTL	Speed-Length Ratio
WS	S	Wetted Surface

ENGLISH/SI EQUIVALENTS

ENGLISH	SI
1 foot	0.3048 m (metres)
1 foot per second	0.3048 m/s (metres per second)
1 knot	0.5144 m/s (metres per second)
1 horsepower	0.7457 kw (kilowatts)
1 long ton	1.0160 t (tonnes)

ABSTRACT

Resistance experiments were conducted with a model representing the O'Neill Hullform Concept (OHF). The purposes of the experiments were to investigate the effect on resistance caused by the addition of a pair of strut-like outer hulls to DTNSRDC model 5355 and to determine the sensitivity of the outer hull longitudinal location on resistance. This information will be used to assess the merits of the OHF concept. The residuary resistance coefficient based on model data is lower over most of the speed range than the analytical prediction, but the trends are similar. The experimental results show that the outer hulls produce about fifty percent of the total resistance of the OHF. The total resistance of the OHF, however, compares favorably with that of SWATH III, a typical conventional SWATH hullform of similar size. Thus, the concept shows merit for further investigation. Resistance was lowest with the struts located at the forward position at several speeds below 22 knots, and at all speeds above 25 knots.

ADMINISTRATIVE INFORMATION

This work was performed at the David Taylor Naval Ship R&D Center (DTNSRDC), Bethesda, Md. 20084. The project was funded by the Naval Sea Systems Command (NAVSEA) Ship and Submarine Technology Program, Concept Assessment of Platform Systems (CAPS) Subproject SF 43-411, Task 4B, Systems Integration Department Work Unit Number 1-1204-530.

INTRODUCTION

As part of the CAPS program at DTNSRDC, the Ship Performance Department was requested by the SWATH Ship Development Office of the Systems Integration Department (Code 1235) to predict the resistance characteristics of a novel hullform concept, referred to as the "O'Neill Hullform (OHF)". This hullform was developed for possible use as a Frigate. With a displacement of approximately 4300 long tons (4369 tonnes) at an even keel draft of 32.17 ft (9.81 m), this ship was designed for superior damaged roll stability and protection of the inner hull against anti-ship missiles. In addition, it was expected that the OHF would have lower resistance than a comparable SWATH ship at 25 to 30 knots.

A model experimental program was carried out to determine the resistance increase due to the outer hulls and to determine if the longitudinal location of the outer hulls has a significant effect on resistance.

For this initial assessment of the concept, an existing ship model was modified for use in the experiments, which were performed in the fixed zero sinkage and trim condition. Data obtained using a captive model may be used to assess the relative performance of the ship and to explore the effect of different longitudinal outer hull locations on resistance. The fixed model condition also allows a direct comparison of the results with the Chapman Resistance Program[1]* prediction,** which assumes that the ship does not sink and trim while underway. It should be noted that P_E values in a sinkage and trim condition would be higher than for the captive model.

DESCRIPTION OF MODEL

DTNSRDC Model 5355-1, representing the O'Neill Hullform Concept, was constructed to a linear scale ratio of 25.23 by modifying the existing Model 5355. The principal hull dimensions and wetted surface areas for both model and full scale are presented in Table 1. Sketches of the O'Neill Hullform Concept are shown in Figures 1 and 2.

Modifications to Model 5355 involved the construction of two strut-like outer hulls attached to the upper hull at an angle of 10 degrees outboard from the vertical. These outer hulls were removable allowing them to be positioned in several different longitudinal locations. No other appendages were attached to the model. The canted stabilizer fins shown in the sketch were not included on the model.

DESCRIPTION OF EXPERIMENTS AND DATA REDUCTION

The experiments were performed using standard DTNSRDC procedures for resistance experiments for surface ship-models. Table 2 presents the experimental program.

The model was rigidly attached to the floating girder of DTNSRDC Towing Carriage One. Tripwires of 0.025 inch diameter were attached at five percent of the chord length aft of the leading edge of each of the struts, and at five percent aft of the nose of the lower hull to stimulate turbulence. The tripwires were secured to the model surface with uniformly spaced wire staples.

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* References are listed on page 7.
** A recently modified version of the original Chapman Program was used here.

The experiments were performed on the model to represent four different configurations - without outer hulls; with outer hulls in the baseline position (longitudinally centered relative to the center strut); with outer hulls in the forward position (leading edge at the same longitudinal location as the leading edge of the center strut); and with outer hulls in the aft position (trailing edge at the same longitudinal location as the trailing edge of the center strut).

The model experimental data were extrapolated to full scale for calm, deep sea water at a temperature of 59 degrees Farenheit (15 degrees Celsius). A correlation allowance of C_A = 0.0005 was used in conjunction with the 1957 ITTC ship-model correlation line. No allowance was made for still air drag.

The frictional resistance calculations for both the model and ship were based on the length Reynolds number of each portion of the hull (lower hull, center strut, and outer struts). For the model, laminar flow was assumed to exist from the leading edge to the location of the tripwires. In this region, the Blasius line was used to determine the frictional resistance coefficient. Aft of the tripwire to the trailing edge of each portion of the hull, turbulent flow was assumed and the ITTC 1957 ship model correlation line was applied.

The residuary resistance of the model was calculated by subtracting the sum of the frictional resistance of each component and the parasitic drag of the tripwires from the total measured resistance of the model. The parasitic drag was calculated using a computer program documented in Reference 2.

The analytical prediction was derived by running a modified version of the Chapman computer program[1] for SWATH resistance predictions. To include the effects of all resistance components of the ship, the OHF was modeled in three parts for the analytical prediction. First, the lower hull and center strut were modeled as a demi-hull. Second, the outer hulls were modeled as a twin-hulled ship. The residuary resistance coefficient was derived from these components. Third, the spacing between the center strut and the outer hulls was modeled to derive the interference drag coefficient. The resistance coefficient from each component was normalized by multiplying the coefficient by the wetted surface of its respective component and dividing this product by the total wetted surface of the ship. The normalized residuary resistance coefficients were added to the normalized interference coefficient and a constant form drag coefficient of 0.0005 to obtain the total residuary resistance coefficient for the O'Neill Hullform. The form drag coefficient was assumed to be the same for the OHF as for conventional SWATH hullforms (in lieu of historical data) in the calculations.

PRESENTATION OF RESULTS

Figure 3 presents the residuary resistance coefficients from the Chapman prediction and the model experiments for the model with the outer hulls. Figure 4 presents the residuary resistance coefficients form the Chapman prediction and the model experiments for the model without the outer hulls. Table 3 presents the Chapman predicted residuary resistance coefficients. Tables 4 through 7 present the experimental predictions for the four different model configurations.

Figure 5 and Tables 4 through 7 present the effective power predictions derived from the model experiments for all the model configurations.

Figure 6 and Table 8 show a comparison of P_E of the OHF with the outer hulls located at the forward and aft positions relative to P_E with the outer hulls at the baseline location.

Figure 7 and Table 9 present a comparison of P_E per ton for SWATH III[3] and the OHF with the outer hulls in the three different longitudinal positions. Table 10 and 11 list the principal dimensions and the effective power data of SWATH III, respectively.

DISCUSSION OF RESULTS

As shown in Figures 3 and 4, the residuary resistance coefficients calculated from the experimenta data are, in general, less than those predicted by the Chapman program. However, the trends are predicted well both for the model without the outer hulls (which is essentially a demi-hull SWATH model) and the model with the outer hulls.

The experiments were carried out with and without the outer hulls in place. The resistance with the outer hulls is about fifty percent greater than without them throughout the speed range (see Figure 5). Up to 24 knots, frictional resistance accounts for most of the increase in total resistance.

In order to indicate the merit of the OHF concept relative to a conventional SWATH ship from a resistance point of view, a comparison is made with the 3800 ton SWATH III[3] in Figure 7. The data plotted in Figure 7 are listed in Table 9. As shown in Figure 7, P_E per ton of the OHF is about the same as that of SWATH III at ship speeds below 20 knots and it is lower at speeds above 20 knots. Overall, the resistance of the OHF is comparable to that of a conventional SWATH.

An effective ship length was used in the OHF calculations. This length is obtained from:

$$\text{effective length} = \frac{L_{\text{Ctr. strut}} \times (WS) + L_{\text{Lower Hull}} \times (WS) + L_{\text{Outer Hull}} \times (WS)}{\text{total Wetted Surface}}$$

A similarly derived effective length was used in the SWATH III calculations.

The predicted effective power of the OHF ship with the outer hulls in the forward position is lowest at several speeds below 22 knots and at all speeds above 25 knots, among the three positions tested (See Figure 6). Over the speed range tested, P_E for the various outer hull positions varies from less than two percent to as much as eighteen percent. The forward outer hull location appears to be the best overall position from the resistance point of view, especially at the higher speeds. However, with the outer hulls in the forward position their wave trains crossed the plane of the propeller at certain speeds; it is possible that this would degrade the propeller acoustic performance.

CONCLUSIONS

1. Using the results of the resistance experiments with Model 5355-1, lower values of C_R are predicted for the OHF than the Chapman analytical prediction. However, the trends of the residuary resistance curves are predicted well by the Chapman program.

2. The magnitude of the resistance due to the two strut-like outer hulls was found to be about fifty percent of the total resistance of the OHF concept. The total resistance of the OHF, however, compares favorably with that of SWATH III, a typical conventional SWATH. At 30 knots, the EHP/ton for the OHF is about 7 percent lower than that for SWATH III. Thus, the concept shows merit for further investigation.

3. The difference in predicted effective power for the OHF with the outer hulls in the three longitudinal positions varied from less than two percent to as much as eighteen percent. The forward location required the least power between 17 and 21 knots and above 25 knots. This indicates that the forward position is the best of the three longitudinal outer hull locations in terms of resistance.

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1. Chapman, R.B., "Hydrodynamic Drag of Semi-Submerged Ships," Trans. ASME, Journal of Basic Engineering, Vol 94, p 878, 1972.

2. Hansen, A.G., "A Computer Program for Evaluation of the Effective Power of Submarines from Model Experiment Data", Scientex Report TSC-18-1, March 1981.

3. Pemberton, T.M., and C.J. Wilson, "Resistance and Propulsion Characteristics for a Series of Small Waterplane Area Twin Hull (SWATH) Forms Represented by Models 5276,5276B, C, D, and E", Ship Performance Department Evaluation Report 396-H-07, December 1972.

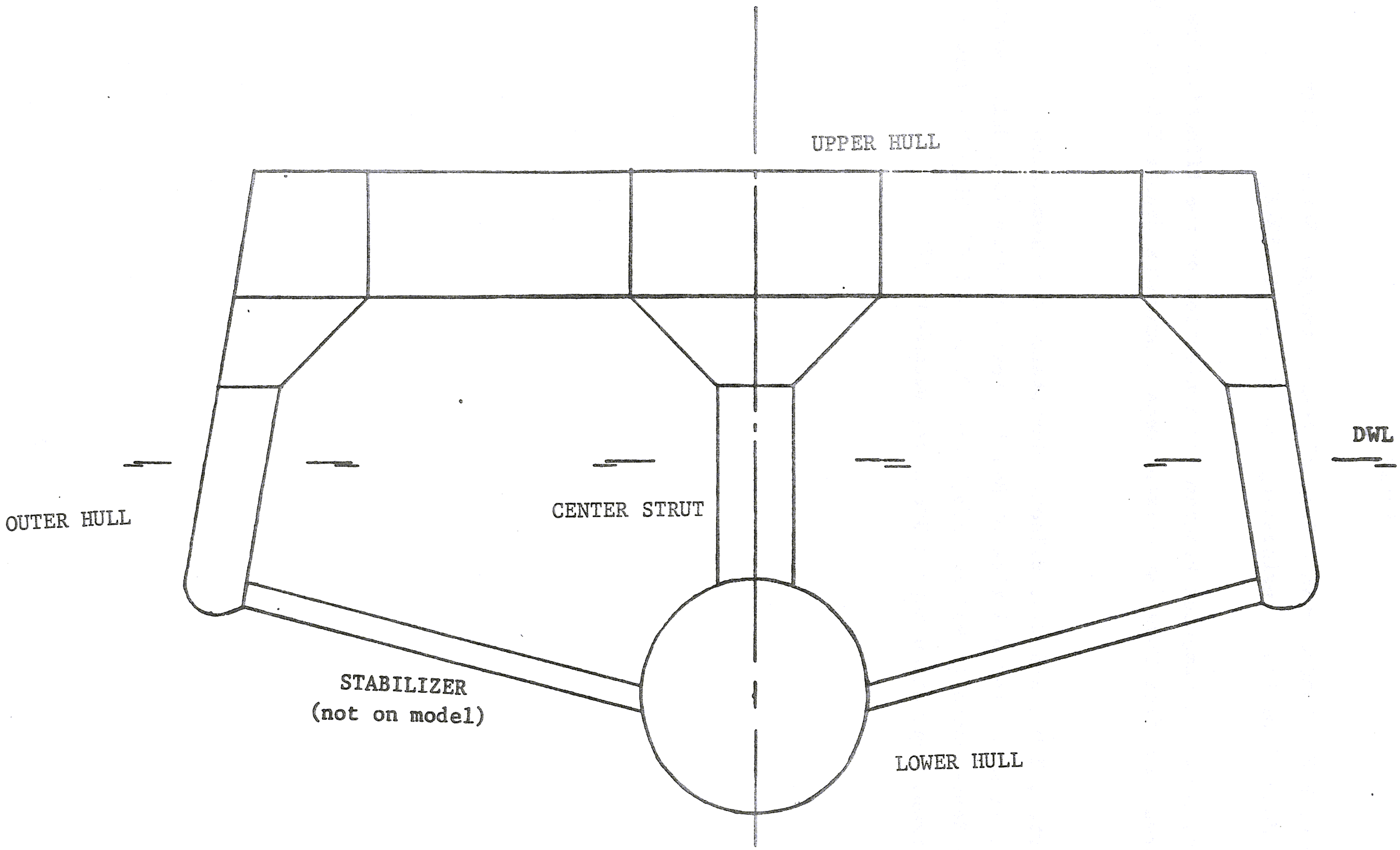
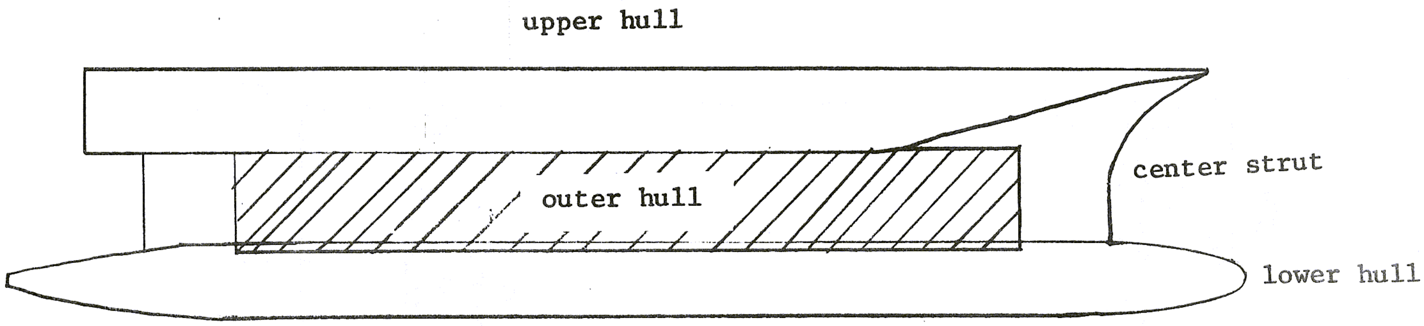
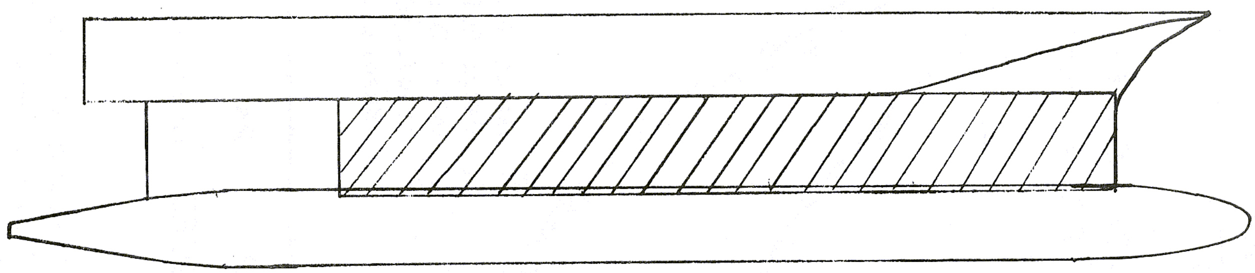


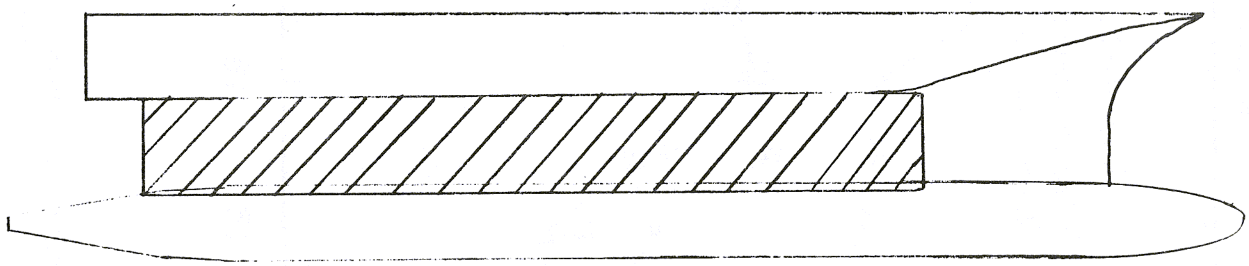
FIGURE 1 - FRONTAL SKETCH OF THE O'NEILL HULLFORM CONCEPT



a) Baseline Position (longitudinally centered relative to center strut)



b) Forward Position (leading edge at same longitudinal location as the leading edge of the center strut)



c) Aft Position (trailing edge at the same longitudinal location as the trailing edge of the center strut)

FIGURE 2 - SIDE VIEW SKETCH OF THE O'NEILL HULLFORM CONCEPT

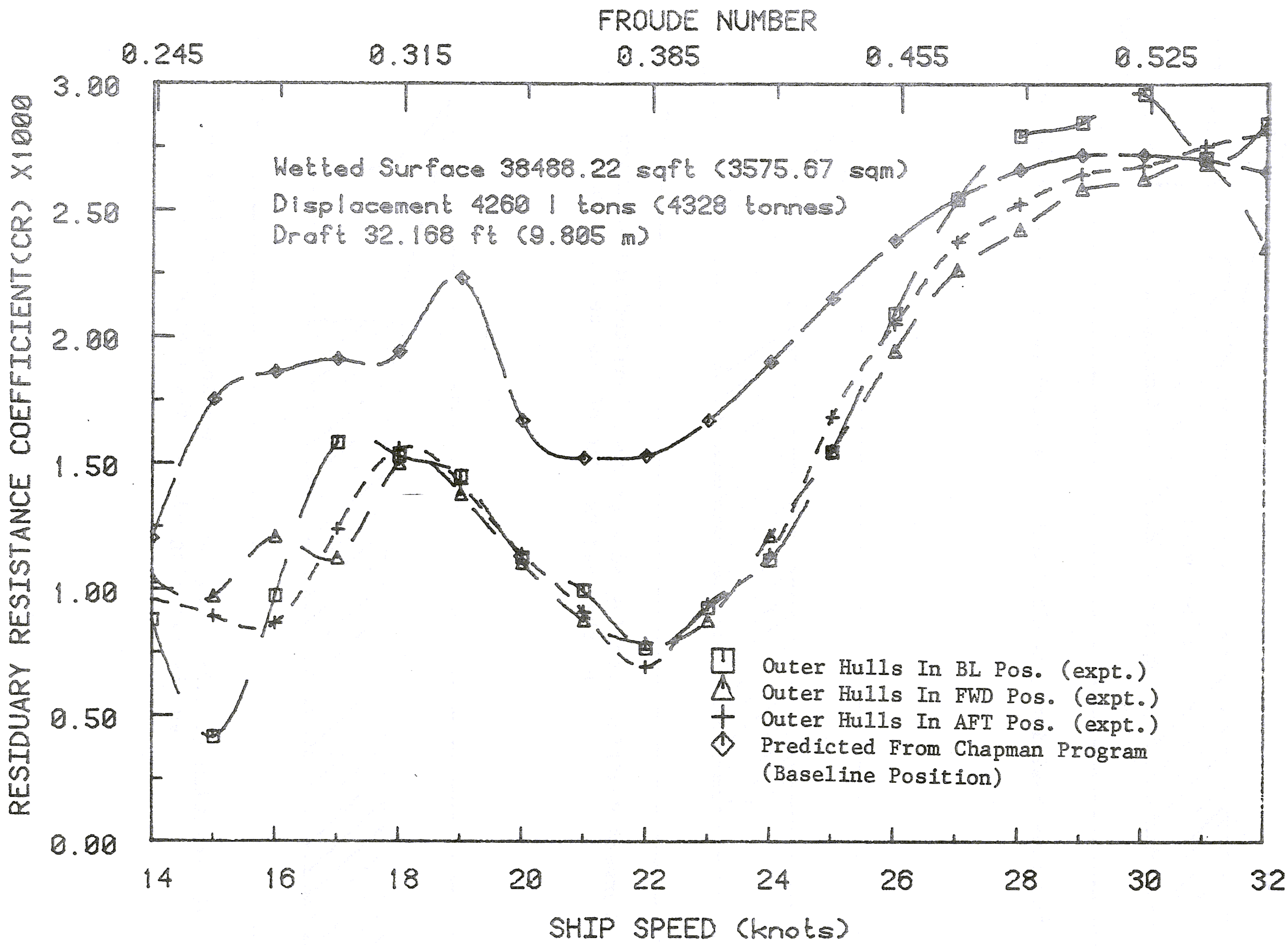


FIGURE 3 - COMPARISON OF RESIDUARY RESISTANCE COEFFICIENTS FOR OHF DETERMINED FROM EXPERIMENTS WITH MODEL 5355-1 AND PREDICTIONS FROM THE CHAPMAN PROGRAM

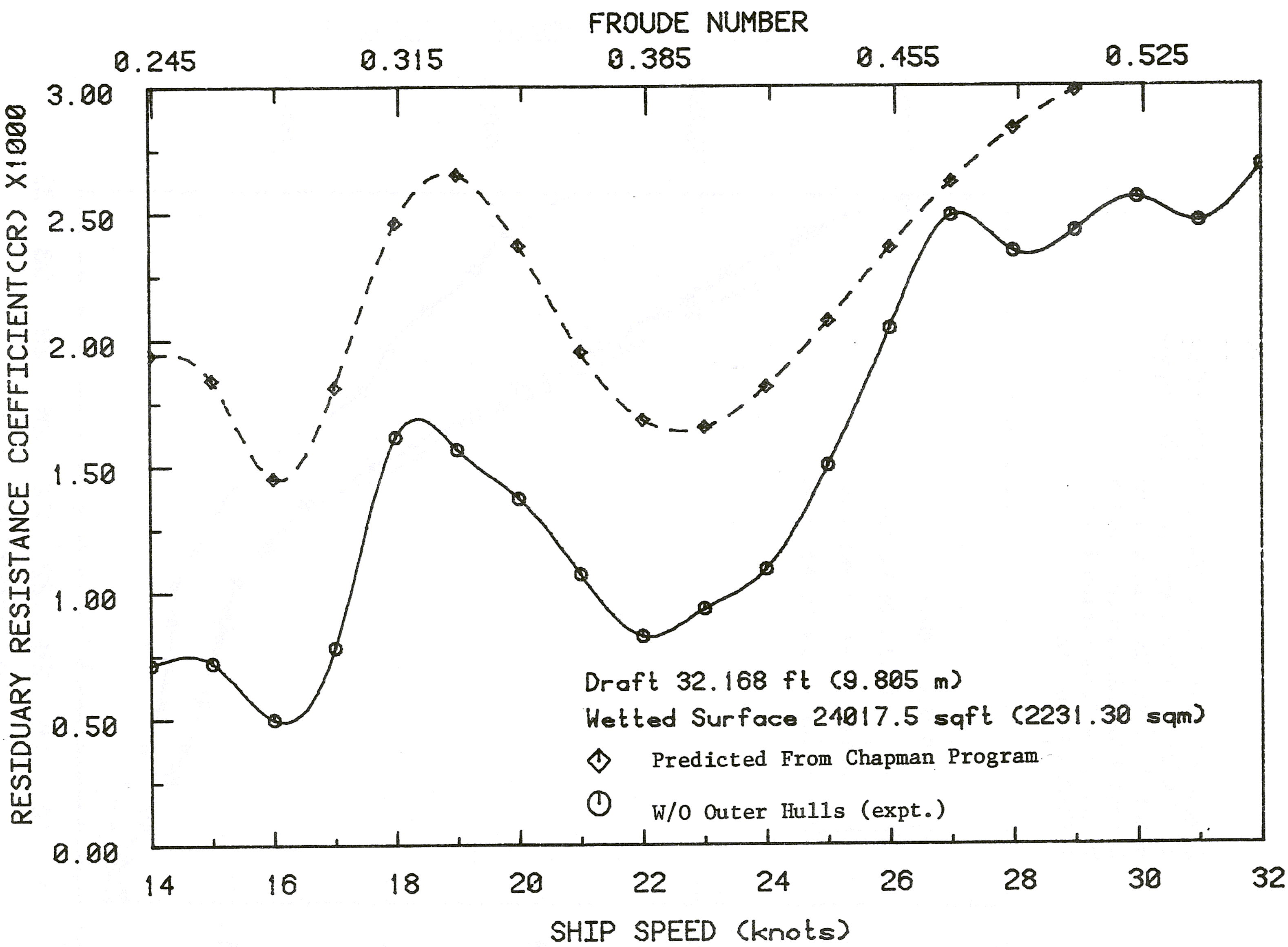


FIGURE 4 - RESIDUARY RESISTANCE COEFFICIENTS FOR OHF DETERMINED FROM EXPERIMENTS WITH MODEL 5355 AND PREDICTIONS FROM THE CHAPMAN PROGRAM

Length of Lower Hull 354.99 ft(108.20 m)
Displacement 4260 long tons (4328 tonnes)
Model Held At Fixed Zero Trim
Correlation Allowance .0005
Turbulence Stimulation Used
ITTC Friction Line

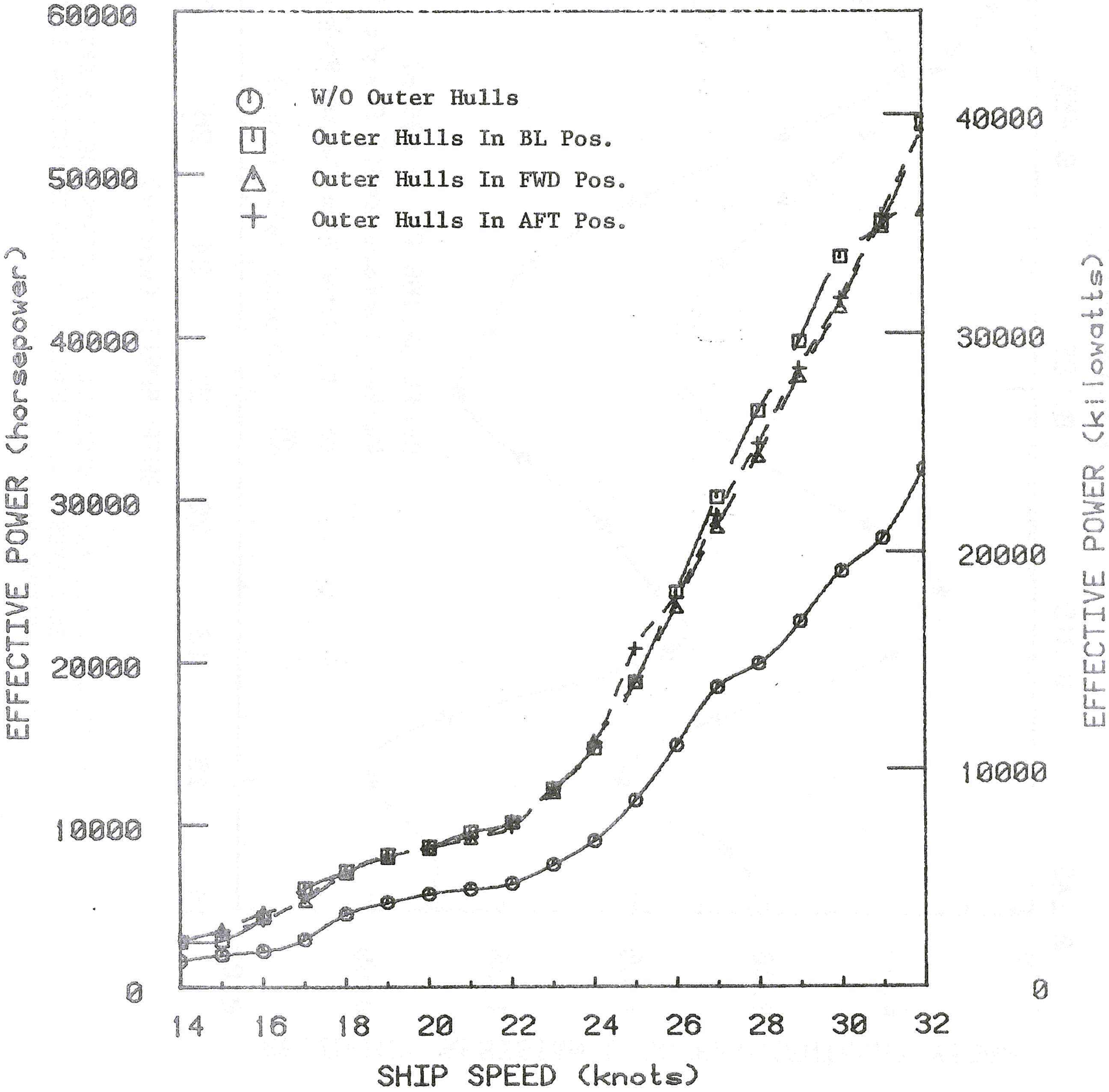


FIGURE 5 - EFFECTIVE POWER PREDICTION FOR OHF

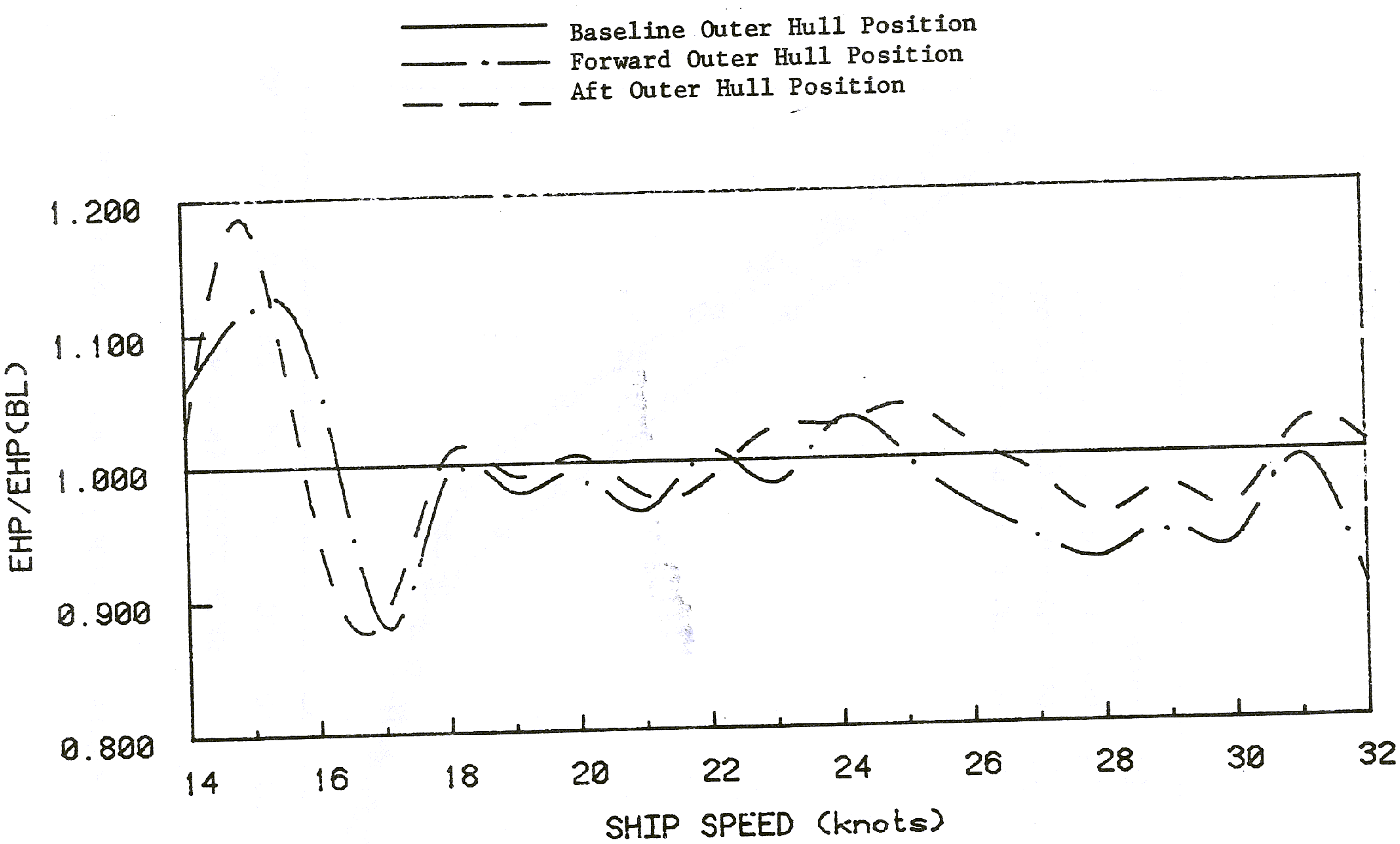


FIGURE 6 - EFFECT OF OUTER HULL LONGITUDINAL POSITON ON EFFECTIVE POWER, AS DETERMINED FROM EXPERIMENTS

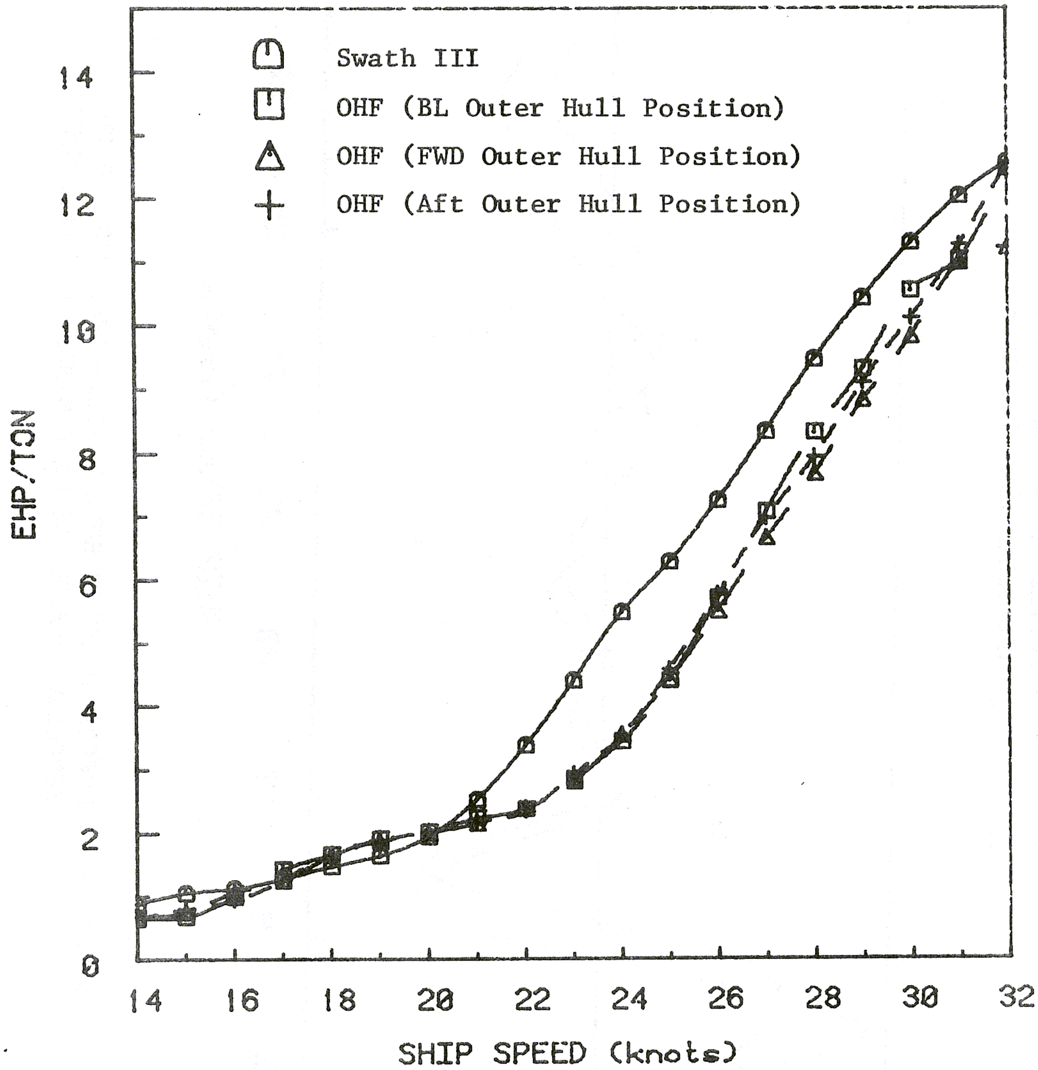


FIGURE 7 - P_E/TON FOR SWATH III AND THE OHF

TABLE 1 - THE O'NEILL HULLFORM CONCEPT DIMENSIONS

Scale Ratio = 25.23 = L_S/L_M

DIMENSION	SHIP	MODEL
Draft	32.168 ft (9.805 m)	1.275 ft (.389 m)
Displacement	4260 t (4328 tonnes)	
Total Wetted Surface	38488.22 sq ft (3575.67 sq m)	60.464 sq ft (5.62 sq m)
Effective Length	291.31 ft (88.79 m)	11.55 ft (3.519 m)
Lower Hull Length	354.99 ft (108.20 m)	14.07 ft (4.289 m)
Center Strut Length	280.05 ft (85.359 m)	11.099 ft (3.383 m)
Upper Hull Length	322.69 ft (98.356 m)	12.789 ft (3.898 m)
Max. L.H. Diameter	21.45 ft (6.538 m)	0.85 ft (0.259 m)
Ctr. Strut Max. Width	9.84 ft (2.999 m)	0.39 ft (0.119 m)
Maximum Beam Overall	106.0 ft (32.309 m)	4.20 ft (1.280 m)
L.H. Wetted Surface	16607.05 sq ft (1542.85 sq m)	26.09 sq ft (2.42 sq m)
Center Strut WS	7410.45 sq ft (688.45 sq m)	11.64 sq ft (1.08 sq m)
Outer Hull Length	224.0 ft (68.28 m)	8.878 ft (2.706 m)
Outer Hull Max. Width	5.5 ft (1.676 m)	.218 ft (.066 m)
Single Outer Hull WS	7235.36 sq ft (672.19 sq m)	11.366 sq ft (1.06 sq m)

TABLE 2 - MODEL 5355-1 O'NEILL HULLFORM CONCEPT (OHF) EXPERIMENTAL PROGRAM

Experiment Number	Date	Model Configuration
1	3/21/85	Outer Hulls in aft position
2	3/22/85	Outer Hulls in aft position
3	3/22/85	Outer Hulls in baseline position
4	3/23/85	Outer Hulls in forward position
5	3/23/85	Outer Hulls in aft position
6	3/25/85	Outer Hulls in aft position
7	3/25/85	Outer Hulls in baseline position
8	3/26/85	Without Outer Hulls

TABLE 3 - RESIDUARY RESISTANCE PREDICTION FOR MODEL 5355-1

USING THE CHAPMAN PROGRAM

V_S (knots)	$C_R (X10^3)$
14	1.20
15	1.75
16	1.86
17	1.91
18	1.94
19	2.23
20	1.67
21	1.52
22	1.53
23	1.67
24	1.90
25	2.15
26	2.38
27	2.55
28	2.66
29	2.72
30	2.72
31	2.70
32	2.65

TABLE 4 - EFFECTIVE POWER PREDICTION FOR OHF AS DETERMINED FROM EXPERIMENTS WITH MODEL 5355-1 (WITHOUT OUTER HULLS)

SHIP SPEED (knots)	F_n	VRTL	C_R $\times 10^3$	P_E hp	P_E kw	C_F model $\times 10^3$	C_F ship $\times 10^3$
14	0.244	0.820	0.713	1630	1220	3.311	1.630
15	0.262	0.879	0.720	2000	1490	3.270	1.616
16	0.279	0.937	0.497	2230	1660	3.232	1.602
17	0.296	0.996	0.781	2950	2200	3.197	1.590
18	0.314	1.055	1.614	4501	3360	3.164	1.579
19	0.331	1.113	1.565	5210	3890	3.134	1.568
20	0.349	1.172	1.371	5730	4270	3.106	1.558
21	0.366	1.230	1.069	6040	4510	3.079	1.548
22	0.384	1.289	0.825	6370	4750	3.054	1.539
23	0.401	1.348	0.932	7540	5620	3.030	1.531
24	0.418	1.406	1.088	8990	6700	3.008	1.523
25	0.436	1.465	1.500	11480	8560	2.987	1.515
26	0.453	1.523	2.041	14870	11090	2.967	1.508
27	0.471	1.582	2.488	18470	13770	2.947	1.501
28	0.488	1.641	2.346	19910	14850	2.929	1.494
29	0.506	1.699	2.427	22500	16780	2.911	1.488
30	0.523	1.758	2.558	25610	19100	2.895	1.482
31	0.540	1.816	2.463	27640	20610	2.878	1.476
32	0.558	1.875	2.686	31890	23780	2.863	1.470

TABLE 5 - EFFECTIVE POWER PREDICTION FOR OHF AS DETERMINED FROM EXPERIMENTS WITH MODEL 5355-1 (WITH OUTER HULLS IN BASELINE POSITION)

SHIP SPEED (knots)	F_n	VRTL	C_R $\times 10^3$	P_E hp	P_E kw	C_F model $\times 10^3$	C_F ship $\times 10^3$
14	0.244	0.820	0.876	2790	2080	3.404	1.661
15	0.262	0.879	0.414	2900	2160	3.361	1.647
16	0.279	0.937	0.974	4260	3080	3.321	1.633
17	0.296	0.996	1.580	6090	4540	3.285	1.620
18	0.314	1.055	1.527	7100	5300	3.251	1.609
19	0.331	1.113	1.447	8140	6070	3.219	1.598
20	0.349	1.172	1.126	8610	6420	3.190	1.587
21	0.366	1.230	0.994	9530	7110	3.162	1.577
22	0.384	1.289	0.766	10110	7540	3.136	1.568
23	0.401	1.348	0.927	12170	9080	3.111	1.560
24	0.418	1.406	1.118	14670	10940	3.088	1.551
25	0.436	1.465	1.546	18780	14000	3.066	1.543
26	0.453	1.523	2.093	24300	18120	3.045	1.536
27	0.471	1.582	2.544	30140	22480	3.025	1.529
28	0.488	1.641	2.796	35420	26410	3.006	1.522
29	0.506	1.699	2.849	39730	29630	2.987	1.515
30	0.523	1.758	2.960	44920	33500	2.970	1.509
31	0.540	1.816	2.708	47000	35050	2.953	1.503
32	0.558	1.875	2.843	53110	39600	2.937	1.497

TABLE 6 - EFFECTIVE POWER PREDICTION FOR OHF AS DETERMINED FROM EXPERIMENTS WITH MODEL 5355-1 (WITH OUTER HULLS IN FORWARD POSITION)

SHIP SPEED (knots)	F_n	VRTL	C_R $\times 10^3$	P_E hp	P_E kw	C_F model $\times 10^3$	C_F ship $\times 10^3$
14	0.244	0.820	1.044	2950	2200	3.404	1.661
15	0.262	0.879	0.970	3520	2630	3.361	1.647
16	0.279	0.937	1.209	4580	3420	3.321	1.633
17	0.296	0.996	1.135	5360	3990	3.285	1.620
18	0.314	1.055	1.497	7040	5250	3.251	1.609
19	0.331	1.113	1.373	7970	5940	3.219	1.598
20	0.349	1.172	1.105	8550	6380	3.190	1.587
21	0.366	1.230	0.882	9180	6850	3.162	1.577
22	0.384	1.289	0.786	10180	7590	3.136	1.568
23	0.401	1.348	0.872	11950	8910	3.111	1.560
24	0.418	1.406	1.209	15090	11250	3.088	1.551
25	0.436	1.465	1.551	18810	14020	3.066	1.543
26	0.453	1.523	1.943	23420	17460	3.045	1.536
27	0.471	1.582	2.266	28310	21110	3.025	1.529
28	0.488	1.641	2.426	32700	24380	3.006	1.522
29	0.506	1.699	2.585	37580	28020	2.987	1.515
30	0.523	1.758	2.624	41890	31230	2.970	1.509
31	0.540	1.816	2.686	46780	34880	2.953	1.503
32	0.558	1.875	2.355	47760	35610	2.937	1.497

TABLE 7 - EFFECTIVE POWER PREDICTION FOR OHF AS DETERMINED FROM EXPERIMENTS WITH MODEL 5355-1 (WITH OUTER HULLS IN AFT POSITION)

SHIP SPEED (knots)	F_n	VRTL	C_R $x10^3$	P_E hp	P_E kw	C_F model $x10^3$	C_F ship $x10^3$
14	0.244	0.820	0.950	2860	2130	3.404	1.661
15	0.262	0.879	0.891	3430	2560	3.361	1.647
16	0.279	0.937	0.822	4050	3020	3.321	1.633
17	0.296	0.996	1.168	5410	4030	3.285	1.620
18	0.314	1.055	1.554	7150	5330	3.251	1.609
19	0.331	1.113	1.415	8070	6020	3.219	1.598
20	0.349	1.172	1.139	8650	6450	3.162	1.587
21	0.366	1.230	0.918	9290	6930	3.162	1.577
22	0.384	1.289	0.726	9970	7430	3.136	1.568
23	0.401	1.348	0.998	12460	9290	3.111	1.560
24	0.418	1.406	1.199	15050	11220	3.088	1.560
25	0.436	1.465	1.685	19510	11220	3.088	1.551
26	0.453	1.523	2.133	24540	18300	3.045	1.536
27	0.471	1.582	2.477	29700	22150	3.025	1.529
28	0.488	1.641	2.573	33780	25190	3.006	1.522
29	0.506	1.699	2.734	38790	28920	2.987	1.515
30	0.523	1.758	2.762	43130	32160	2.970	1.509
31	0.540	1.816	2.804	47950	35760	2.953	1.503
32	0.558	1.875	2.868	53390	39810	2.937	1.497

TABLE 8 - EFFECT OF OUTER HULL LONGITUDINAL POSITION ON EFFECTIVE POWER RELATIVE TO BASELINE POSITION, AS DETERMINED FROM EXPERIMENTS

SHIP SPEED (knots)	$\frac{EHP(fwd)}{EHP(bl)}$	$\frac{EHP(aft)}{EHP(bl)}$
14	1.057	1.025
15	1.121	1.183
16	1.075	0.951
17	0.880	0.888
18	0.992	1.007
19	0.979	0.991
20	0.993	1.005
21	0.963	0.975
22	1.007	0.986
23	0.982	1.024
24	1.029	1.026
25	1.002	1.039
26	0.964	1.010
27	0.939	0.985
28	0.923	0.954
29	0.946	0.976
30	0.933	0.960
31	0.995	1.020
32	0.899	1.005

TABLE 9 - P_E/TON FOR SWATH III AND THE OHF

SHIP SPEED (knots)	SWATH III	OHF (baseline)	OHF (forward)	OHF (aft)
14	0.886	0.655	0.692	0.671
15	1.061	0.681	0.763	0.805
16	1.130	1.000	1.075	0.951
17	1.286	1.430	1.258	1.270
18	1.476	1.667	1.653	1.678
19	1.640	1.911	1.871	1.894
20	1.947	2.021	2.007	2.031
21	2.532	2.237	2.155	2.181
22	3.381	2.373	2.390	2.340
23	4.399	2.857	2.805	2.925
24	5.481	3.444	3.542	3.533
25	6.278	4.408	4.415	4.580
26	7.254	5.704	5.498	5.761
27	8.339	7.075	6.646	6.972
28	9.474	8.315	7.676	7.930
29	10.434	9.326	8.822	9.106
30	11.299	10.545	9.833	10.124
31	12.034	11.033	10.981	11.258
32	12.571	12.467	11.211	12.533

TABLE 10 - SWATH III PRINCIPAL DIMENSIONS

Scale Ratio = 20.4 = L_S/L_M

DIMENSION	SHIP	MODEL
Draft	28 ft (8.53 m)	1.373 ft (0.418 m)
Displacement	3760 t (3820 tonnes)	
Total WS	34710 sq ft (3224.66 sq m)	83.405 sq ft (7.749 sq m)
Effective Length	266.0 ft (81.1 m)	13.039 ft (3.974 m)
Body Length	287.03 ft (87.5 m)	14.07 ft (4.289 m)
Strut Length	226.42 ft (69.0 m)	11.099 ft (3.383 m)
Hull Spacing	75.0 ft (22.86 m)	3.676 ft (1.121 m)

TABLE 11 - EFFECTIVE POWER OF SWATH III FROM EXPERIMENT WITH MODEL 5276[3]*

Turbulence Stimulation Used
Model Held Fixed At Zero Sinkage And Trim
Correlation Allowance = 0.0004
ITTC Friction Line

SHIP SPEED (knots)	F_n	VRTL	P_E hp	P_E kw
14	0.255	0.858	3350	2500
15	0.274	0.920	4010	2990
16	0.292	0.981	4270	3180
17	0.310	1.042	4860	3620
18	0.328	1.104	5580	4160
19	0.347	1.165	6200	4260
20	0.365	1.226	7360	5490
21	0.383	1.288	9570	7140
22	0.401	1.349	12780	9530
23	0.420	1.410	16630	12400
24	0.438	1.472	20720	15450
25	0.456	1.533	23730	17700
26	0.474	1.594	27420	20450
27	0.493	1.655	31520	23500
28	0.511	1.717	35810	26700
29	0.529	1.778	39440	29410
30	0.547	1.839	42710	31850
31	0.566	1.901	45490	33920
32	0.584	1.962	47520	35440

* Data taken from Reference 3, Figure 12, Test 10.

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