SSC-246

(SL-7-4)

THEORETICAL ESTIMATES OF WAVE LOADS ON THE SL-7 CONTAINER SHIP IN REGULAR AND IRREGULAR SEAS

SHIP STRUCTURE COMMITTEE

1974

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This report is one of a group of Ship Structure Committee Reports which describes the SL-7 Instrumentation Program. This program, a jointly funded undertaking of Sea-Land Service, Inc., the American Bureau of Shipping and the Ship Structure Committee, represents an excellent example of cooperation between private industry, regulatory authority and government. The goal of the program is to advance understanding of the performance of ships' hull structures and the effectiveness of the analytical and experimental methods used in their design. While the experiments and analyses of the program are keyed to the SL-7 Containership and a considerable body of data will be developed relating specifically to that ship, the conclusions of the program will be completely general, and thus applicable to any surface ship structure.

The program includes measurement of hull stresses, accelerations and environmental and operating data on the SS Sea-Land McLean, development and installation of a microwave radar wavemeter for measuring the seaway encountered by the vessel, a wave tank model study and a theoretical hydrodynamic analysis which relate to the wave induced loads, a structural model study and a finite element structural analysis which relate to the structural response, and installation of long term stress recorders on each of the eight vessels of the class. In addition, work is underway to develop the initial correlations of the results of the several program elements.

Results of each of the program elements will be published as Ship Structure Committee Reports and each of the reports relating to this program will be identified by an SL- designation along with the usual SSC- number. A list of all of the SL- reports published to date is included on the back cover of this report.

This report contains the theoretical hydro-dynamic analysis of the vessel.

W. M. Benkert
Rear Admiral, U. S. Coast Guard
Chairman, Ship Structure Committee

SSC-246

(SL-7-4)

Technical Report

on

Project SR-205, "Ship Computer Response"

to the

Ship Structure Committee

THEORETICAL ESTIMATES OF WAVE LOADS ON THE SL-7 CONTAINER SHIP IN REGULAR AND IRREGULAR SEAS

by

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OCEANICS, INC.

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U. S. Coast Guard Headquarters
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1974

ABSTRACT

The computer program SCORES for predicting ship structural response in waves is applied to the SL-7 container ship. The operating conditions considered are 2 displacements, 4 ship speeds, 21 wavelengths, 19 headings and 5 sea states assuming both long-crested and short-crested seas. These results constitute a complete data bank for the SL-7 ship in the form of both frequency responses for regular waves as well as rms and other statistical response measures for irregular seas.

Comparison is made between the computer and model tests of the SL-7 in regular waves in predicting vertical, lateral and torsional moments, and vertical and lateral shears at two sections and heave, pitch and roll. Regions where the theory and model experiment do not agree have been pointed out and some means of correction or extension of the theory is discussed.

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NOTES

INTRODUCTION

As part of a continuing overall study of ship structural loads, work has been carried out for a number of years under support of the Ship Structure Committee [1] covering model tests, theoretical analyses (including computer-program development), and full-scale measurements. A particular program covering all of these facets is presently underway with application to the SL-7 container ship class, which represents the largest and fastest ship of that type presently in operation. This ship is expected to operate at high speed in the North Atlantic Ocean.

The existence of a developed theory for determining ship motions and loads in oblique waves [2], together with the computer program [3] based upon this theory, allows the opportunity of determining via computation the various wave loads that act on this ship. At the same time, results of extensive model-tank tests of this ship in regular waves are also available [4], thereby allowing comparison between theory and experiment. In addition, a program of full-scale measurements on the operating vessels themselves is also being carried out (see [5]). These sources of data obtained by different means allow an opportunity to establish correlation between various approaches, so that better tools for load prediction of future ships can be established (as well as providing data for this important type of ship, as an end product per se).

The successful use of a theoretical prediction of wave loads via computer is very important for this class of ship since the number of wave-induced structural loadings and the various conditions (or parameters) is quite extensive. This is due to the importance of the torsional moments and lateral shear forces, in addition to the vertical and lateral bending moments, as well as the dependence of these quantities on their particular location on the ship. Combining these requirements with that of assessing the dependence upon all possible wave directions, as well as ship speed, indicates the large number of variations necessary for determining the characteristics of the various loads affecting a container ship. The extent of the model tests represented by all possible parametric values for operation of this particular ship, as well as consideration of carrying out model tests of future container ship designs, points out the benefits that can be obtained by application of an efficient computer program for determining the different wave loads for such ships.

The present investigation is aimed at obtaining results from computer computations that can be directly compared with those of the model tests in [4] in order to obtain correlation between theory and experiment, as well as to indicate the extent of any deficiencies in the various methods of determining ship loads and motions. In addition, generalized response data is tabulated for various operating conditions of the SL-7 container ship under different static-weight distributions, different speeds, headings, and sea states.

The scope of the computer study includes all of the model test conditions covered in [4], as well as an extended range of ship operating conditions. The appendix presents data on the amplitudes and phases of ship motions (heave, pitch and roll) and loads (vertical and lateral bending moments and shears, and torsion), covering 4 speeds, 2 displacements, 19 headings, and 21 wavelengths. This information is combined with wave spectra representing 5 long-crested and 5 short-crested irregular sea states in order to provide statistical measures of responses in those sea conditions, which are tabulated in the appendix.

SHIP DESCRIPTION AND LOADING

The specifications of the actual SL-7 ship for purposes of the present investigation are listed below in Table 1, with the designation of "heave" loading corresponding to normal full loading in the North Atlantic, and "light" loading corresponding to initial load of one SL-7 container ship operating in conjunction with a fleet of other ships. The actual information on the distribution of the static loading is given in Tables 2 and 3, which also contain information on the sectional vertical centers and roll inertia that are not ordinarily provided during design studies. All of this information is obtained from [4], where the tabulation was prepared for the ship in the form of 22 loading segments. The relations between these loading segments on the ship, the frame numbers and lines-plans stations (for 20 stations along LBP), and the segments of the model tested in [4], are given in Figure 1. As discussed in [4], the vertical CG position of the ship includes the correction due to free liquid effects on the transverse metacentric height.

The model used in the tests reported in [4] did not exactly reproduce the conditions of loading specified in Tables 2 and 3, but was ballasted to obtain values as close as possible to those values. The results obtained are given, in full-scale units, in Tables 4 and 5, representing the characteristics for the three model segments in regard to the degree of matching obtained with the model.

In order to apply the computer program of [3], it is necessary to establish a distribution of loading over the 20 stations representing the ship in regard to weight, location of sectional CG, roll inertia of each section, etc. that would satisfy the model characteristics if a proper simulation of the model ship, as tested, is to be made. This was done by numerical experimentation that produced results that satisfied the characteristics obtained in the model, although the precise distribution over the 20 stations would

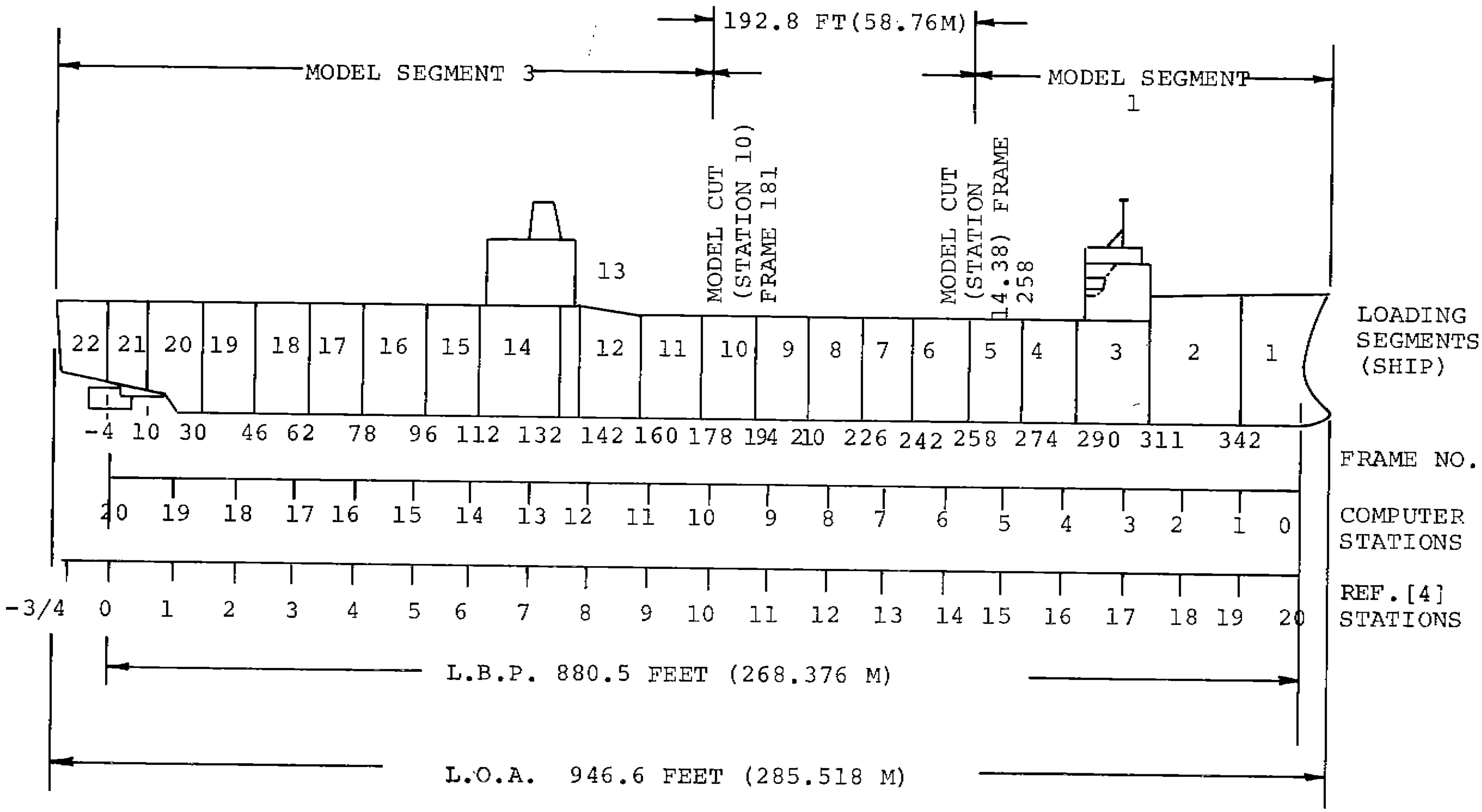

FIG. 1 LONGITUDINAL SEGMENTATION: SL-7 CONTAINERSHIP

not necessarily be the same as that on the model. Since the model distribution over 20 stations is not known, but the total results for each model segment do match, the non-unique distribution of loading obtained to represent the model is considered sufficient for the present purposes of comparison of results for the same case.

At the same time, the design specification for the ship, as presented in Tables 2 and 3, were used to establish the loading distributions for the full-scale ship that will be the base reference conditions for prediction of response data under various operating conditions, as given in the Appendix to the present report. The actual sectional distributions used in the computer program for this purpose are given below in Tables 6 and 7.

TABLE I

SHIP CHARACTERISTICS

Length:	Overall	946.6 Feet (288.518 m.)
Length:	Between Perpendiculars	880.5 Feet (268.376 m.)
Breadth:	Maximum	105.5 Feet (32.156 m.)

Load Designation (for purposes of this study)	"HEAVY"	"LIGHT"
Load Designation: Specified	Normal Full Load (Departure)	Initial Part Load (Departure)
Draft at LCF	32.6 ft. (9.95 m.)	29.1 ft. (8.86 m.)
Trim, by stern	0.14 ft. (42 mm.)	1.83 ft. (.56 m.)
LCG Aft of midship	38.6 ft. (11.75 m.)	37.5 ft. (11.42 m.)
VCG Above baseline	41.7 ft. (12.70 m.)	39.8 ft. (12.14 m.)
$\overline{GM}_t$	3.30 ft. (1.00 m.)	5.79 ft. (1.76 m.)
$\overline{GM}_t$ Corrected for free liquids	2.63 ft. (0.80 m.)	5.32 ft. (1.62 m.)
Displacement	47686 L.T. (48400 M.T.)	41367 L.T. (41900 M.T.)

TABLE II

Estimated Weights, Centers and Gyradii
for "Heavy" Load Condition

SEGMENT	WEIGHT[1]	LCG[2]	VCG[3]	K_{xx}[4]	K_{yy}[5]	K_{zz}[6]
1	765.2	421.25	44.50	23.8	30.5	22.0
2	1847.7	355.93	33.40	24.9	30.0	22.9
3	1205.7	297.07	59.67	35.5	31.2	31.1
4	1613.4	254.73	47.96	30.6	27.6	20.3
5	1943.6	214.75	48.08	33.0	28.3	23.2
6	2379.2	174.71	44.49	34.2	28.6	24.4
7	2305.6	134.72	40.46	36.0	29.3	26.4
8	2610.8	94.72	38.31	37.3	28.7	28.7
9	3148.7	54.73	37.75	38.2	29.2	29.4
10	3343.7	14.74	36.62	38.7	29.2	30.2
11	3299.0	-27.74	31.83	38.7	28.1	31.7
12	3179.2	-72.74	31.07	39.0	28.4	31.7
13	3293.3	-109.75	43.27	41.8	29.5	31.9
14	3039.8	-147.25	45.69	45.7	33.7	36.6
15	2661.3	-194.75	43.48	39.3	26.8	32.3
16	2898.7	-234.10	44.73	37.9	27.3	31.6
17	2116.1	-275.85	50.13	35.9	25.8	29.9
18	1678.3	-316.15	50.57	33.4	25.5	27.6
19	1597.2	-355.30	51.48	32.4	25.4	26.1
20	1244.5	-395.25	50.08	31.9	27.1	24.9
21	897.7	-429.25	44.36	23.8	20.5	18.5
22	691.3	-460.25	51.90	22.0	17.5	18.8
TOTAL	47760.3	-38.61	42.31	37.3	215.1	215.1

1. Long Tons (2240 lb)
2. Feet Forward of Midship
3. Feet Above Baseline
4. Roll Gyradius, Feet
5. Pitch Gyradius, Feet
6. Yaw Gyradius, Feet

TABLE III

Estimated Weights, Centers and Gyradii
for "Light" Load Condition

SEGMENT	WEIGHT[1]	LCG[2]	VCG[3]	K_{xx}[4]	K_{yy}[5]	K_{zz}[6]
1	777.4	421.25	43.40	24.9	31.4	21.8
2	1859.9	355.93	32.88	25.3	30.3	22.8
3	1217.9	297.07	58.52	36.7	32.6	31.0
4	1151.8	254.73	47.36	30.0	25.9	21.7
5	1379.2	214.75	48.67	33.2	27.2	25.1
6	1844.3	174.71	44.99	33.6	26.7	25.7
7	1990.6	134.72	33.36	32.7	25.6	25.9
8	2429.0	94.72	35.89	35.6	26.6	28.5
9	2547.5	54.73	34.42	36.1	26.3	29.4
10	2707.6	14.74	33.81	36.6	26.2	30.4
11	2714.9	-27.74	31.54	37.0	25.6	31.7
12	2697.9	-72.74	31.49	37.0	25.7	31.6
13	3284.9	-109.75	42.97	42.2	30.0	31.9
14	3031.4	-147.25	45.39	46.2	34.2	36.7
15	2726.3	-194.75	41.65	37.9	24.8	32.3
16	2757.4	-234.10	42.03	37.3	26.2	31.8
17	1631.3	-275.85	46.21	36.8	26.1	31.0
18	1217.7	-316.15	47.13	35.1	26.4	29.4
19	982.5	-355.30	41.47	32.7	24.1	28.4
20	901.2	-395.25	40.77	31.2	25.1	27.0
21	889.3	-429.25	44.36	24.3	21.1	18.6
22	682.9	-460.25	52.05	22.5	18.1	18.9
TOTAL	41422.8	-37.43	40.26	36.7	214.8	215.0

1. Long Tons (2240 lb)
2. Feet Forward of Midship
3. Feet Above Baseline
4. Roll Gyradius, Feet
5. Pitch Gyradius, Feet
6. Yaw Gyradius, Feet

TABLE IV

Summary of Model Ballast: "Heavy" Condition
(Model Properties Scaled to Full Size)

Model Segments	1		2		3		Entire Model	
Ship Loading Segments	1 through 5		6 through 10		11 through 22		1 through 22	
	Desired	Achieved	Desired	Achieved	Desired	Achieved	Desired	Achieved
Weight, Long Tons	7375.6	7380.	13788.0	13800.	26596.4	26600.	47760.0	47780.
Longitudinal Center, ft. from	293.74 fwd	293.9 fwd	86.68 fwd	86.8 fwd	195.74 aft	196.7 aft	38.61 aft	39.0 aft
Vertical Center, ft. above	45.90	44.6	39.20	35.2	42.93	42.3	42.31	40.6
Roll Gyradius, K_{xx}, ft.	31.38	28.2	37.23	35.6	38.72	37.8	37.31	36.0
Pitch Gyradius, K_{yy}, ft.	74.61	72.4	63.82	68.4	126.31	123.8	215.09	215.0
Yaw Gyradius, K_{zz}, ft.	72.15	65.1	63.38	66.7	126.80	119.3	215.07	213.0
(Product of Inertia)/Mass, K^2_{xz}, $ft.^2$	-268.72	248.	144.71	-48.2	-719.80	-408.	-383.02	-342.
Angle of Principal Axis, Deg.	-3.6	4.1	3.22	-0.9	-2.8	-1.8	-0.5	-0.4

	Desired	Achieved
Transverse Metacentric Height, $\overline{GM}$, ft.	2.63	2.57
Free Roll Period, seconds, T_r	-	27.8
Apparent Roll Gyradius = $T_r \overline{GM}/1.108$, Feet	-	40.2
(Apparent Roll Gyradius)/(Measured Roll Gyradius)	-	1.11

TABLE V

Summary of Model Ballast: "Light" Condition
(Model Properties Scaled to Full Size)

Model Segments	1		2		3		Entire Model	
Ship Loading Segments	1 through 5		6 through 10		11 through 22		1 through 22	
	Desired	Achieved	Desired	Achieved	Desired	Achieved	Desired	Achieved
Weight, Long Tons	6386.2	6360.	11519.0	11520.	23517.7	23450.	41422.9	41330.
Longitudinal Center, ft. from	303.91 fwd	304.0 fwd	86.80 fwd	78.8 fwd	190.97 aft	190.0 aft	37.43 aft	39.1 aft
Vertical Center, ft. above	45.07	45.4	36.10	32.8	40.99	40.8	40.26	39.3
Roll Gyradius, K_{xx}, ft.	31.64	30.4	35.38	33.3	38.43	38.6	36.74	36.3
Pitch Gyradius, K_{yy}, ft.	74.69	78.2	61.66	59.2	122.99	121.3	214.83	212.6
Yaw Gyradius, K_{zz}, ft.	72.39	66.2	62.42	58.7	123.86	112.2	215.03	209.0
(Product of Inertia)/Mass, K^2_{xz}, ft.^{2}	-315.71	432.	152.79	136.	-454.16	-135.	-218.43	7.8
Angle of Principal Axis, Deg.	-4.2	7.0	3.3	3.3	-1.9	-0.7	-0.3	0.0

	Desired	Achieved
Transverse Metacentric Height, $\overline{GM}$, ft.	5.32	5.60
Free Roll Period, seconds, T_r	-	20.0
Apparent Roll Gyradius - $T_r \sqrt{\overline{GM}}/1.108$, Feet	-	42.8
(Apparent Roll Gyradius)/(Measured Roll Gyradius)	-	1.18

TABLE VI

Weight Properties of the
SL-7 (Heavy) used in the Computer Program

Station	Weight,[1] (long tons)	Vertical center[2] of gravity, ft.	K_{xx}, ft.
0 (FP)	435.19	- 2.0116	23.8
1	900.40	9.0734	25.3
2	1110.55	9.0884	24.9
3	1304.96	-15.5416	35.5
4	1625.78	-10.3496	32.9
5	1973.79	- 5.5316	33.7
6	2323.47	- 4.5676	35.0
7	2709.73	3.3524	35.4
8	3024.64	4.2684	39.0
9	3420.21	5.0194	39.9
10	3421.71	7,4784	38.7
11	3206.49	10.8954	39.7
12	3776.005	7,8594	40.7
13	3526.57	- 2.5356	45.6
14	2837.96	- 2.0016	42.5
15	2893.305	- 1.8436	39.3
16	2491.125	- 5.7896	37.2
17	2056.03	- 7.9736.	34.3
18	1758.175	- 8.8426	33.5
19	1888.51	- 7.6116	32.5
20 (AP)	1075.395	- 6.8986	23.61

1. The ship is divided into 20 segments of 44.025 ft. lengths. The weight at each station is assumed to be uniformly distributed over the segment and centered at the station.

2. The vertical center of gravity of each element is measured, positive downward, with respect to the ship's overall VCG.

TABLE VII

Weight Properties of the
SL-7 (Light) used in the Computer Program

Station	Weight, [1] (long tons)	Vertical center [2] of gravity, ft.	K_{xx}, ft.
0	358.465	- 3.2944	24.90
1	866.42	6,3056	25.26
2	1072.305	7,2256	25.30
3	1229.20	- 9.8944	35.40
4	1273.11	-10.5944	33.50
5	1561.22	- 8.2844	33.20
6	1931.51	- 6.5944	33.60
7	2298.655	5.3056	32.92
8	2613.37	4.5056	35.09
9	2827.715	5.9056	36.33
10	2804.37	7.1056	36.84
11	2671.77	8.6056	37.00
12	3479.65	5.3056	38.65
13	3462.25	- 4.5944	45.50
14	2830.20	- 2.9944	42.57
15	2811.80	- 1.7944	37.90
16	2117.15	- 4.5944	36.98
17	1467.80	- 6.7944	35.64
18	1158.815	- 2.1544	34.10
19	1514.62	- .7944	32.00
20	1072.505	- 9.2944	23.00

1. The ship is divided into 20 segments of 44.025 ft. lengths. The weight at each station is assumed to be uniformly distributed over the segment and centered at the station.

2. The vertical center of gravity of each element is measured, positive downward, with respect to the ship's overall VCG.

EXPERIMENTAL DATA

The experimental data obtained in the model tests in [4] included vertical and lateral bending moments, vertical and lateral shear forces, and torsional moments, measured at both midship and at the forward cut at Frame 258. Measurements were also made of the motions of heave, pitch, and roll, as well as the rudder angle. All results are presented in transfer function form, i.e., amplitude and phase, with the amplitude referred to the wave amplitude tested (response per unit wave amplitude) and the phase referred to the midship vertical bending moment. Positive wave elevation was defined in the experiments to be positive downward which is opposite to the convention used in [2] and [3], and results in some complication in reconciling phases between theory and experiment.

The main regular wave tests were carried out over a speed range of 23-32 kt. covering all headings (based on symmetry considerations) between 0° (following seas) and 180° (head seas), in 30° increments. Insufficient data were obtained for beam seas to characterize the responses for that case, due to experimental difficulties, and hence no comparison between theory and experiment is made for that case. Torsional moments are measured in the model experiments about an axis located 23.3 ft. (full scale) above the baseline in the centerplane. This data, together with data on the lateral shear force (amplitude and phase), can be used to obtain values of the torsional moment about any other axis located at some vertical distance relative to this reference. An application of this procedure would be to obtain the torsional moment about the "center of twist" or shear center, which is normally located below the baseline. Information of this nature can be obtained from the computer program calculations as well, but will be restricted herein to the test measurement reference condition for purposes of comparison of theory and experiment.

Certain special tests were also made (in order to isolate some effects) that are not usually made in the course of experimental studies in order to assist in correlating theory and experiment. These tests included forced rudder oscillations, with measurements of the roll angle, lateral shear and bending moment, and torsional moment (in regard to amplitude and phase relative to the rudder oscillation) in order to isolate the rudder effects on those quantities. Another special test provided roll extinction records, which are the basic data from which linearized roll damping coefficient estimates are made for use in the computer program [3].

The roll extinction records in Figure 4 of [4] for both the heavy and the light configuration, at 28 kt. forward speed, were analyzed in order to obtain values of roll damping for the ship. Results for the light configuration were more linear (i.e. closer to exponential decay with time) than the heavy case, with the heavy configuration being primarily damped in nonlinear fashion. These records were analyzed on the basis of the roll damping being represented as a combination of linear and quadratic nonlinear damping, and the coefficients found for each elemental term (see [6] for illustration of a similar type of analysis). The separate linear and quadratic damping values were combined, in terms of the expected range of roll angles, to produce a final estimate of equivalent linear roll damping for the ship in each of the two displacement conditions. These values were

$\zeta_r = \frac{C}{C_c} = 0.10$ for the light configuration, and $\zeta_r = 0.09$ for the heavy configuration, with the assumption that these same values are applicable over the entire speed range of 23-32 kt. in the regular wave tests of [4]. They are used in the computer program also in carrying out calculations for comparing theory and experiment.

COMPARISON OF THEORY AND EXPERIMENT

All of the comparisons between theory and experiment are made using the sign conventions, etc. of [4] so that the experimental results shown in the accompanying figures are duplicated in this report from those in [4]. Other information presented in this report, in the form of spectral response results given in Table 8 and also in the Appendix, which represent the data bank for SL-7 responses as determined from theory, are presented in terms of the conventions of [2] and [3]. All of the conditions covered by the experimenters in [4], which is then equivalent to about 170-180 different sets of frequency responses (both amplitude and phase) have been theoretically evaluated with the digital computer program. Only a limited number of plots showing representative comparisons between theory and experiment are presented in order to illustrate the results.

The application of the theory of [2] to predict the loads and motions of the SL-7 ship is expected to provide answers that are generally in good agreement with the experimental data. This is based upon the previous successful applications of the theory in [2], the slender fine form of the ship which is closer to the requirements of a long slender body for application of strip theory, and various other (unpublished) applications of the theory and program to different ship forms.

While the major aim of this study is the determination of wave loads, information on the correlation between theory and experiment for the measured ship motions is also useful in providing insight into the capabilities of the basic theory since the motions are significant elements in determining the loads. The measured ship motions in [4] are the heave at Frame 124 (582.5 ft. aft of the forward perpendicular), the pitch angle and the roll angle. To compare the measured heave with the theory, the predicted heave was combined with the predicted pitch to give the resultant heave at Frame 124. Typical heave results are shown in Figures 2 and 3. The agreement, unexpectedly, is not good. On the other hand, typical results showing the very good pitch comparison are displayed in Figures 4 and 5. This level of agreement between theory and experiment in pitch was maintained for all headings, speeds, and displacements.

It thus did not seem reasonable that the heave at Frame 124 was being contaminated by the pitch. To demonstrate this, the measured heave of Frame 124 was combined with the measured pitch to give the measured heave at the ship CG in Figure 6, to which theory was again compared. Again, the theory and experiment are not in agreement. It is commonly accepted in the limit of long waves ($\lambda/L >> 1$) that the ratio of heave amplitude to the wave amplitude approaches 1.0, which is not the case for the present heave measurements. It is impossible to be definitive inasmuch as the SL-7 is operating in a higher speed regime than in the speeds used in the validation of the theory [2], but it appears possible that the heave measurements are in error. This possibility has been acknowledged by the experimenters, and it is their belief that if an experimental error exists it would be a systematic error in heave alone. The possibility was indicated that a factor of two (2) could arise in a dial setting so that all measurements of heave might then be multiplied by a factor of one-half (0.5). If this were the case, the agreement between theory and experiment would then improve.

Typical roll comparisons are shown in Figures 7 and 8, and can be seen to be poor. This may be due primarily to the fact that roll damping is probably nonlinear, and hence it is not properly represented in the present theory of [2] and [3]. These results are for the heavy configuration where the combination of linear and nonlinear roll damping is replaced by a probably too large assumed equivalent linear damping, as discussed in the preceding section of this report. An illustration of the results for the light configuration, where the roll damping was close to linear, is given in Figure 9. In that case it can be seen that better agreement between theory and experiment is obtained, thereby providing further evidence of the significance of nonlinear roll damping on ship response. The limited number of conditions tested for determining roll responses does not allow a complete generalization of these results, but only points to the need for more refined methods of predicting roll motion as well as the various ship wave loads that are significantly influenced by roll.

The comparison between the theory and experiment in predicting the loads on the SL-7 are shown in Figures 10-57. These figures show the variation of particular wave loads as functions of wavelength, for different speeds and headings, and for the two different displacement conditions. The comparisons given there are presented in the following sequence; midship vertical bending moment (Figures 10-21), midship vertical shear (Figures 22-33), midship lateral shear (Figures 34-41), midship torsion (Figures 42-49), and midship lateral bending moment (Figures 50-57). On the whole, the lack of consistent agreement is disappointing, especially in view of the good agreement shown in [2] as well as in several subsequent (but unpublished) applications of the theory and program in [2] and [3]. In the vertical plane, the theoretical results are for the most part lower than the experimental results. An examination was made to see if this difference were due to the influence of higher forward speed (Froude Number effect), as shown in [7] for the case of motion in head seas. The equations used in [7], which are similar to those in [2], also contain some additional terms in the coefficient definitions that could possibly influence the predicted results. Those same coefficient changes were incorporated into the program of [3] and computations repeated for a few different cases. The results obtained with the other theoretical model were almost exactly the same as those found from the original theory and program of [2] and [3].

The situation in regard to the comparison between theory and experiment becomes more evident in the case of following and near following seas, where the theory is considered to be tentative due to the low encounter frequencies. The limitation of present theory is known for this case of low encounter frequencies since the basic strip theory treatment is primarily valid for higher encounter frequencies. As most of the important applications of ship motion and load predictions have generally been associated with head sea operation, little concern was devoted to the following (or near following) sea operating conditions and hence this basic limitation has not been emphasized in ship motion literature.

Some insight was gained into the cause of this lack of agreement by decomposing the midship vertical bending moment into its constituent elements. It was found that the vertical added mass term contribution to the total bending moment is much larger in the case of following seas than in head seas, which was an unexpected result since the added mass term enters the equations of motion in association with an acceleration term and the frequencies are much lower in following seas than in head seas. The explanation is related to the theoretically infinite behavior of the two-dimensional vertical added mass as the frequency approaches zero. Since the added mass should play a minor role for low frequencies, it was decided to set the added mass identically to zero in the program and repeat the calculations for the following seas. The results shown in Figures 58-61 demonstrate that deletion of the vertical added mass term improves the agreement between theory and experiment. The fact that the vertical bending moments and shears are increased with the added mass term deleted is a result of phasing. The results for the motions of heave and pitch were not altered significantly in the computations with this vertical added mass term modification since the encounter frequencies for those cases were low and also far from the natural resonance frequencies for those modes of motion. Similar computations were carried out with the vertical added mass set equal to a constant value, with that constant value corresponding to the value at the limit of infinite frequency, which is easily determined from the section properties. In that case also there was an improvement in the agreement between theory and experiment, although the results were not as satisfactory as in the case where the vertical added mass was identically set equal to zero.

As far as the comparison between theory and experiment in the horizontal plane is concerned, there is no particular known limit condition that is not satisfied which would enable a judgement of consistency in the computed results to be made. Any disagreement might be ascribed to the fact that roll damping is probably nonlinear, and its representation within the computer program (and theory) is not altogether proper. Investigation was made in [4] of the effect of the leeway angle change caused by the rudder, and it was concluded that its effect on the experimental results was too small to be of any significance. Similarly the influence of the rudder on the wave loads in the horizontal plane (lateral bending moment, lateral shear, and torsional moment) was not large enough to affect significantly the experimental values that are used for comparison with theory. Typical results obtained for the various lateral plane wave loads are shown in Figures 34-57, where it is seen that the agreement tends to be fairly good for the case of the light loading condition and not as good for the heavy loading condition. Certain cases for the light loading also showed large differences between theory and experiment, and in all cases where there was a lack of agreement for the loads the same situation was found to be true for the case of roll motion. The particularly large differences occurred in a region corresponding to roll resonant response, which is primarily due to the influence of nonlinearity in the roll damping discussed previously. Thus it appears that an adequate prediction of the various lateral plane wave loads is highly dependent upon the adequate representation of ship roll response with nonlinear roll damping, which is not treated in the present developments in [2] and [3]. The influence of rolling on torsion, for example, has been illustrated in the work of [8] and similarly, the effect of rolling on the lateral bending moment computation is shown in [9]. Both of these cases provide further verification of the significant effect of proper roll motion representation.

Another method of comparison between theory and experiment is by means of determining the rms value of particular motions and loads when assuming the ship to be in various irregular seas. The particular sea states considered are those described by the Pierson-Moskowitz spectra covering a range of significant wave heights from 10 ft. to 50 ft., in steps of 10 ft. The values from experiment that were used in this computation were the Response Amplitude Operators (magnitude of frequency response) which were then squared, multiplied with the assumed wave spectra, and integrated to determine the appropriate rms value by means of the technique of linear superposition [10]. Extrapolation and interpolation of the measured data were performed when necessary, and in addition a cosine-squared spreading law was applied to predict the statistical response for assumed short-crested irregular seas. Since no experimental results were presented in [4] for the case of beam seas, only the responses for head and following conditions in short-crested seas were determined. All of those results using the experimental data to derive the statistical measures for different sea states are considered to be the "measured" values representing the experimental results.

The integration over the heading angle variation for these short-crested sea responses for the experimental data used a spacing of 30° for the heading angle variation, which is generally considered to be somewhat coarse. The theoretical evaluations of rms responses in short-crested irregular seas was carried out using 21 wave lengths and 19 different headings of 10° spacing to determine those results. All of the final rms results for the range of speeds, model configurations, etc. for the two basic headings, head and following, in short-crested irregular seas are presented in Table 8. Examination of the values in this Table shows that the agreement between results from theory and experiment is much better for the head sea conditions than for following seas, when considering all cases. This conclusion holds for all of the various measured quantities presented in Table 8, covering the main responses of interest. The results for the following sea condition show some significant differences, for a number of conditions, which can be ascribed to the effect of the difficulties encountered at low frequencies of encounter for the vertical plane loads and the influence of nonlinear damping and poor roll prediction in regions near roll resonance for lateral plane responses. These influences have been discussed previously. However, in a number of cases, the differences were not as significant when considering rms values as in the case of frequency response, due to the various aspects of integration, smoothing, etc. over ranges of frequency and heading. A possible influence of the more coarse heading variation and the lack of significant experimental data for frequency response in wave conditions for the larger sea states may also have some influence affecting the closeness of this comparison.

Although it is seen from all of the above that the presently developed theory and computer program in [2] and [3] have certain limitations for particular operating conditions (e.g. following seas, nonlinear roll influence, etc.), the existence of the program does allow predictions of motions and loads in different

TABLE VIII

Comparison Between Theoretical and Experimental R.M.S. Responses in Short-Crested Seas

Heading = 0°
Speed = 25 kt.

		Significant Wave Height, ft.				
		10	20	30	40	50
				Pitch - Deg.		
Theory	(Heavy)	.1284	.558	.999	1.369	1.679
	(Light)	.1359	.5760	1.022	1.394	1.704
Experiment	(Heavy)	.1164	.556	.9926	1.284	1.464
	(Light)	.1254	.5594	.9668	1.237	1.403
				Vertical Bending Moment (midship)-ft. tons		
Theory	(Heavy)	2.622E4	.8035E5	1.175E5	1.407E5	1.559E5
	(Light)	2.607E4	.773E5	1.122E5	1.339E5	1.482E5
Experiment	(Heavy)	4.2742E4	1.501E5	2.216E5	2.623E5	2.860E5
	(Light)	4.511E4	1.399E5	1.998E5	2.324E5	2.51E5
				Lateral Bending Moment (midship)-ft. tons		
Theory	(Heavy)	2.139E4	4.195E4	5.243E4	5.860E4	.628E5
	(Light)	1.985E4	4.006E4	5.073E4	5.707E4	6.132E4
Experiment	(Heavy)	3.451E4	7.094E4	8.846E4	9.778E4	1.031E5
	(Light)	2.685E4	5.567E4	6.737E4	7.264E4	7.537E4
				Lateral Shear (midship)-tons		
Theory	(Heavy)	1.247E2	2.204E2	2.617E2	2.829E2	2.955E2
	(Light)	11.8E1	2.046E2	2.415E2	2.602E2	2.711E2
Experiment	(Heavy)	1.312E2	3.057E2	3.945E2	4.398E2	4.650E2
	(Light)	7.707E1	1.794E2	2.248E2	2.455E2	2.563E2
				Vertical Shear (midship)-tons		
Theory	(Heavy)	1.116E2	1.713E2	1.897E2	1.986E2	2.042E2
	(Light)	1.250E2	1.912E2	2.114E2	2.208E2	2.267E2
Experiment	(Heavy)	1.893E2	4.145E2	5.054E2	5.467E2	5.677E2
	(Light)	1.814E2	3.893E2	4.729E2	5.101E2	5.243E2
				Roll - Deg.		
Theory	(Heavy)	1.832	5.324	7.875	9.634	10.854
	(Light)	1.462	3.791	5.149	5.939	6.441
Experiment	(Heavy)	2.201	7.027	9.902	11.468	12.359
		2.221	5.118	6.470	7.111	7.450

TABLE VIII
(Continued)

Comparison Between Theoretical and Experimental
R.M.S. Responses in Short-Crested Seas

Heading = 0°
Speed = 25 kt.

		Significant Wave Height, ft.				
		10	20	30	40	50
		Torsion (about c.g., midship)-ft. tons				
Theory	(Heavy)	3.524E3	9.979E3	14.505E3	1.753E4	1.963E4
	(Light)	3.651E3	8.802E3	11.597E3	13.145E3	14.085E3
Experiment	(Heavy)	1.834E3	6.495E3	9.373E3	1.091E4	1.178E4
	(Light)	2.056E3	5.266E3	6.793E3	7.519E3	7.902E3
		Heave (at c.g.)-ft.				
Theory	(Heavy)	.275	1.641	3.766	6.185	8.748
	(Light)	.289	1.701	3.860	6.298	8.871
Experiment	(Heavy)	.509	2.973	6.014	8.218	9.620
	(Light)	.511	2.976	6.016	8.220	9.622
		Vertical Shear (Frame 258)-tons				
Theory	(Heavy)	1.400E2	3.763E2	5.266E2	.618E3	.678E3
	(Light)	1.410E2	3.693E2	5.124E2	5.124E2	.656E2
Experiment	(Heavy)	1.921E2	6.036E2	8.683E2	1.019E3	1.107E3
	(Light)	1.867E2	5.82E2	8.312E2	9.710E2	1.052E3
		Vertical Bending Moment (Frame 258)-ft. tons				
Theory	(Heavy)	1.949E4	4.541E4	.618E5	.719E5	.785E5
	(Light)	1.947E4	4.409E4	5.920E4	6.849E4	.746E5
Experiment	(Heavy)	2.068E4	7.075E4	1.050E5	1.247E5	1.362E5
	(Light)	1.538E4	5.575E4	8.350E4	9.957E4	1.090E5
		Lateral Shear (Frame 258)-tons				
Theory	(Heavy)	1.028E2	1.916E2	2.334E2	2.563E2	2.708E2
	(Light)	.948E2	1.774E2	2.167E2	2.382E2	2.518E2
Experiment	(Heavy)	1.289E2	2.563E2	3.089E2	3.343E2	3.481E2
	(Light)	1.051E2	2.110E2	2.578E2	2.814E2	2.947E2
		Lateral Bending Moment (Frame 258)-ft. tons				
Theory	(Heavy)	1.235E4	2.7E4	3.537E4	4.051E4	4.401E4
	(Light)	1.241E4	2.766E4	3.632E4	4.153E4	4.502E4
Experiment	(Heavy)	2.043E4	4.678E4	5.711E4	6.155E4	6.381E4
	(Light)	1.308E4	3.336E4	4.267E4	4.698E4	4.924E4

TABLE VIII
(Continued)

Comparison Between Theoretical and Experimental
R.M.S. Responses in Short-Crested Seas

Heading = 0°
Speed = 25 kt.

	Significant Wave Height, ft.				
	10	20	30	40	50
	Torsion (about c.g., Frame 258)-ft. tons				
Theory (Heavy)	4.907E3	1.373E4	1.998E4	2.419E4	2.712E4
(Light)	4.623E3	1.148E4	1.527E4	1.739E4	1.868E4
Experiment (Heavy)	4.513E3	1.572E4	2.234E4	2.587E4	2.786E4
(Light)	4.999E3	1.288E4	1.696E4	1.911E4	2.033E4

TABLE VIII
(Continued)

Comparison Between Theoretical and Experimental
R.M.S. Responses in Short-Crested Seas

Heading = 0°
Speed = 30 kt.

		Significant Wave Height, ft.				
		10	20	30	40	50
		Vertical Bending Moment (midship)-ft. tons				
Theory	(Heavy)	2.158E4	.552E5	.784E5	.935E5	1.037E5
	(Light)	2.148E4	.535E5	.748E5	.885E5	.978E5
Experiment	(Heavy)	4.401E4	1.520E5	2.240E5	2.648E5	2.890E5
	(Light)	5.094E4	1.452E5	2.045E5	2.372E5	2.557E5
		Lateral Bending Moment (midship)-ft. tons				
Theory	(Heavy)	1.924E4	3.948E4	5.086E4	5.800E4	6.301E4
	(Light)	1.856E4	3.844E4	4.962E4	5.657E4	6.139E4
Experiment	(Heavy)	3.428E4	6.537E4	7.767E4	8.372E4	8.71E4
	(Light)	2.247E4	5.486E4	6.990E4	7.703E4	8.080E4
		Torsion (about c.g., midship)-ft. tons				
Theory	(Heavy)	3.948E3	10.218E3	14.199E3	1.679E4	1.857E4
	(Light)	4.071E3	8.471E3	10.691E3	11.921E3	12.681E3
Experiment	(Heavy)	2.288E3	6.860E3	9.766E3	1.139E4	1.232E4
	(Light)	2.791E3	6.127E3	7.704E3	8.455E3	8.852E3
		Lateral Bending Moment (Frame 258)-ft. tons				
Theory	(Heavy)	1.245E4	3.110E4	4.145E4	4.696E4	5.013E4
	(Light)	1.325E4	2.948E4	3.896E4	4.486E4	4.890E4
Experiment	(Heavy)	2.037E4	5.059E4	6.253E4	6.764E4	7.023E4
	(Light)	1.363E4	4.249E4	5.601E4	6.233E4	6.564E4
		Torsion (about c.g., Frame 258)-ft. tons				
Theory	(Heavy)	1.871E3	.417E4	.532E4	.603E4	.662E4
	(Light)	5.218E3	1.115E4	1.419E4	1.589E4	1.695E4
Experiment	(Heavy)	5.103E3	1.660E4	2.395E4	2.822E4	3.074E4
	(Light)	5.927E3	1.523E4	1.983E4	2.217E4	2.347E4
		Vertical Bending Moment (Frame 258)-ft. tons				
Theory	(Heavy)					
	(Light)	3.695E4	8.959E4	11.127E4	1.214E5	1.272E5
Experiment	(Heavy)					
	(Light)	1.712E4	5.887E4	8.738E4	1.038E5	1.133E5

TABLE VIII
(Continued)

Comparison Between Theoretical and Experimental
R.M.S. Responses in Short-Crested Seas

Heading = 180°
Speed = 25 kt.

		Significant Wave Height, ft.				
		10	20	30	40	50
				Pitch - Deg.		
Theory	(Heavy)	.1961	1.077	1.846	2.394	2.801
	(Light)	.1991	1.061	1.811	2.349	2.750
Experiment	(Heavy)	.1904	1.007	1.714	2.157	2.423
	(Light)	.1904	1.007	1.714	2.157	2.423
				Vertical Bending Moment (midship)-ft. tons		
Theory	(Heavy)	$4.173x10^4$	$1.209x10^5$	$1.636x10^5$	$1.871x10^5$	$2.015x10^5$
	(Light)	$4.093x10^4$	$1.104x10^5$	$1.454x10^5$	$1.644x10^5$	$1.710x10^5$
Experiment	(Heavy)	$5.166x10^4$	$1.590x10^5$	$2.255x10^5$	$2.613x10^5$	$2.814x10^5$
	(Light)	$4.617x10^4$	$1.416x10^5$	$2.002x10^5$	$2.316x10^5$	$2.493x10^5$
				Lateral Bending Moment (midship)-ft. tons		
Theory	(Heavy)	$2.486x10^4$	$5.717x10^4$	$7.333x10^4$	$8.170x10^4$	$8.656x10^4$
	(Light)	$2.376x10^4$	$5.300x10^4$	$6.710x10^4$	$7.423x10^4$	$7.827x10^4$
Experiment	(Heavy)	$3.175x10^4$	$6.388x10^4$	$7.646x10^4$	$8.207x10^4$	$8.496x10^4$
	(Light)	$2.639x10^4$	$5.325x10^4$	$6.411x10^4$	$6.898x10^4$	$7.150x10^4$
				Lateral Shear (midship)-tons		
Theory	(Heavy)	$.795x10^2$	$1.313x10^2$	$1.493x10^2$	$1.572x10^2$	$1.614x10^2$
	(Light)	$.756x10^2$	$1.215x10^2$	$1.375x10^2$	$1.445x10^2$	$1.484x10^2$
Experiment	(Heavy)	$1.075x10^2$	$1.807x10^2$	$2.033x10^2$	$2.124x10^2$	$2.169x10^2$
	(Light)	$1.024x10^2$	$1.666x10^2$	$1.858x10^2$	$1.935x10^2$	$1.972x10^2$
				Vertical Shear (midship)-tons		
Theory	(Heavy)	$1.722x10^2$	$4.617x10^2$	$6.005x10^2$	$6.672x10^2$	$7.672x10^2$
	(Light)	$1.918x10^2$	$5.121x10^2$	$6.662x10^2$	$7.410x10^2$	$7.824x10^2$
Experiment	(Heavy)	$2.055x10^2$	$4.240x10^2$	$5.131x10^2$	$5.548x10^2$	$5.770x10^2$
	(Light)	$2.055x10^2$	$4.240x10^2$	$5.131x10^2$	$5.548x10^2$	$5.770x10^2$
				Torsion (about c.g., midship)-ft. tons		
Theory	(Heavy)	$1.481x10^3$	$2.962x10^3$	$3.641x10^3$	$4.052x10^3$	$4.422x10^3$
	(Light)	$1.670x10^3$	$3.028x10^3$	$3.867x10^3$	$5.064x10^3$	$6.604x10^3$
Experiment	(Heavy)	$1.970x10^3$	$3.351x10^3$	$3.795x10^3$	$3.982x10^3$	$4.077x10^3$
	(Light)	$2.062x10^3$	$3.515x10^3$	$3.972x10^3$	$4.161x10^3$	$4.255x10^3$

TABLE VIII
(Continued)

Comparison Between Theoretical and Experimental
R.M.S. Responses in Short-Crested Seas

Heading = 180°
Speed = 25 kt.

		Significant Wave Height, ft.				
		10	20	30	40	50
		Heave (at c.g.)-ft.				
Theory	(Heavy)	.6059	3.491	6.440	9.167	11.828
	(Light)	.6337	3.486	6.390	9.092	11.739
Experiment	(Heavy)	.9415	4.507	7.691	9.710	10.933
	(Light)	.9415	4.507	7.691	9.710	10.933
		Vertical Shear (Frame 258)-tons				
Theory	(Heavy)	1.729E2	4.976E2	.6886E3	.7971E3	.8642E3
	(Light)	1.668E2	4.506E2	6.124E2	.705E3	.763E3
Experiment	(Heavy)	2.344E2	7.313E2	1.048E3	1.218E3	1.314E3
	(Light)	2.213E2	6.877E2	9.853E2	1.146E3	1.236E3
		Vertical Bending Moment (Frame 258)-ft. tons				
Theory	(Heavy)	1.696E4	4.638E4	5.935E4	.655E5	.689E5
	(Light)	1.875E4	5.462E4	7.123E4	7.891E4	8.302E4
Experiment	(Heavy)	2.046E4	6.277E4	9.020E4	1.051E5	1.134E5
	(Light)	1.758E4	5.074E4	7.116E4	8.219E4	8.842E4
		Lateral Shear (Frame 258)-tons				
Theory	(Heavy)	.9404E2	1.999E2	2.506E2	2.765E2	2.915E2
	(Light)	.8981E2	1.867E2	2.313E2	2.537E2	2.664E2
Experiment	(Heavy)	1.166E2	2.205E2	2.546E2	2.685E2	2.754E2
	(Light)	1.064E2	2.072E2	2.406E2	2.542E2	2.609E2
		Lateral Bending Moment (Frame 258)-ft. tons				
Theory	(Heavy)	1.351E4	3.335E4	4.387E4	4.937E4	5.252E4
	(Light)	1.301E4	3.138E4	4.087E4	4.572E4	4.845E4
Experiment	(Heavy)	1.750E4	3.265E4	3.883E4	4.173E4	4.326E4
	(Light)	1.395E4	2.706E4	3.210E4	3.435E4	3.551E4
		Torsion (about c.g. Frame 258)-ft. tons				
Theory	(Heavy)	1.968E3	4.233E3	5.317E3	5.987E3	6.574E3
	(Light)	1.893E3	3.838E3	5.133E3	5.878E3	9.028E3
Experiment	(Heavy)	1.778E3	3.892E3	4.814E3	5.248E3	5.478E3
	(Light)	1.524E3	3.662E3	4.632E2	5.090E3	5.332E3

TABLE VIII
(Continued)

Comparison Between Theoretical and Experimental
R.M.S. Responses in Short-Crested Seas

Heading = 180°
Speed = 30 kt.

	Significant Wave Height, ft.				
	10	20	30	40	50
	Vertical Bending Moment (midship)-ft. tons				
Theory (Heavy)	4.280E4	1.285E5	1.736E5	1.973E5	2.112E5
(Light)	4.260E4	1.203E5	1.581E5	1.772E5	1.883E5
Experiment (Heavy)	6.052E4	1.777E5	2.501E5	2.890E5	3.109E5
(Light)	4.882E4	1.572E5	2.242E5	2.595E5	2.791E5
	Lateral Bending Moment (midship)-ft. tons				
Theory (Heavy)	2.357E4	5.448E4	7.034E4	7.866E4	8.350E4
(Light)	2.257E4	5.051E4	6.429E4	7.132E4	7.531E4
Experiment (Heavy)	3.043E4	6.196E4	7.507E4	8.108E4	8.421E4
(Light)	2.571E4	5.225E4	6.308E4	6.795E4	7.047E4
	Torsion (about c.g., midship)-ft. tons				
Theory (Heavy)	1.416E3	2.863E3	3.559E3	3.976E3	4.335E3
(Light)	1.589E3	2.874E3	3.640E3	4.695E3	6.129E3
Experiment (Heavy)	2.196E3	3.714E3	4.185E3	4.381E3	4.480E3
(Light)	2.150E3	3.635E3	4.097E3	4.287E3	4.381E3
	Heave (at c.g.)-ft.				
Theory (Heavy)	.579	3.783	7.089	9.991	12.716
(Light)	.609	3.755	6.979	9.837	12.542
Experiment (Heavy)	.943	4.507	7.691	9.710	10.933
(Light)	.943	4.507	7.691	9.710	10.933
	Vertical Bending Moment (Frame 258)-ft. tons				
Theory (Heavy)					
(Light)	1.970E4	6.429E4	8.718E4	9.806E4	10.392E4
Experiment (Heavy)					
(Light)	1.976E4	5.678E4	7.859E4	9.027E4	9.685E4
	Torsion (about c.g. Frame 258)-ft. tons				
Theory (Heavy)					
(Light)	1.795E3	3.771E3	5.033E3	6.589E3	8.574E3
Experiment (Heavy)					
(Light)	1.555E3	3.831E3	4.857E3	5.336E3	5.588E3

sea conditions, for different speeds, headings, loadings, etc. of interest for conventional surface ships. On that basis computations were carried out to present a complete "data bank" for the SL-7 ship in the form of both frequency responses for regular waves as well as rms and other statistical response measures for irregular seas. All of this information is presented in the Appendix to this report.

CONCLUDING REMARKS

All of the preceding results represent values obtained from a computer program representing essentially the present state-of-the-art in ship motions and loads computation. The theoretical basis for the computations is a strip theory representation for five degrees of freedom (surge motion neglected), which is consistent with all other available ship motion analyses applicable to wave responses at arbitrary headings and speeds in a seaway. The lack of agreement between theory and experiment in particular cases has been pointed out, and some means of correction or extension of the theory to allow its applicability to these special conditions is also discussed. The particular limitations of the available theory have not been emphasized in many previous studies and only manifest themselves in this case because of the range of operating conditions covered.

The computed results for head and bow seas, as well as a number of results for the light configuration in following seas (for lateral plane responses primarily) are sufficiently close to the model test data that a fair degree of reliability of their values can be accepted. The predicted responses, in statistical form, for the various loads and motions of interest for these conditions are then useful values for comparison with experimental data. The extent of utility of the calculated values for other operating conditions that did not exhibit agreement with the model test data is therefore an unknown factor. However possible errors between measured results and predicted values may not be that extreme when considering realistic values obtained during full-scale tests, where precise sea states, heading variations, etc. are not exactly equivalent to those used in the theoretical prediction. Thus a useful set of values that are anticipated for the SL-7 ship during its operation in realistic seaways can be found by extracting the particular values listed in the data bank provided in the Appendix to the report. These values can be used for correlation between full-scale measurements and theoretical predictions, as well as provide a measure of the expected loads for ships of this type during their operation.

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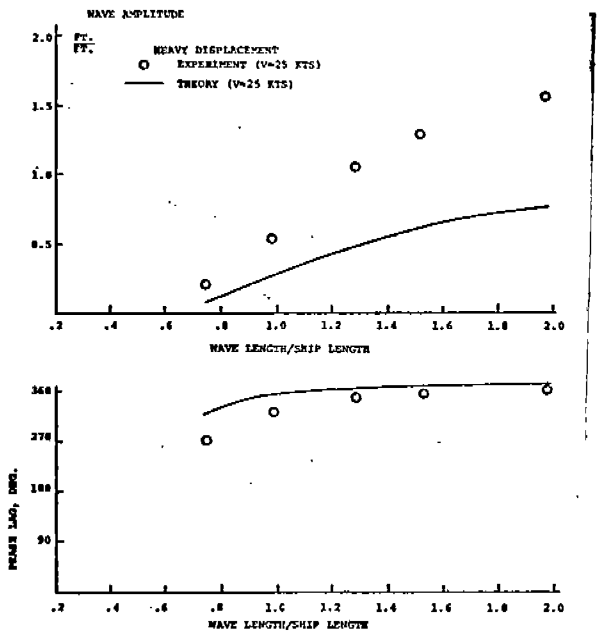

Fig. 2 - Frame 124 Heave & Phase Lag, 0^{o} Heading

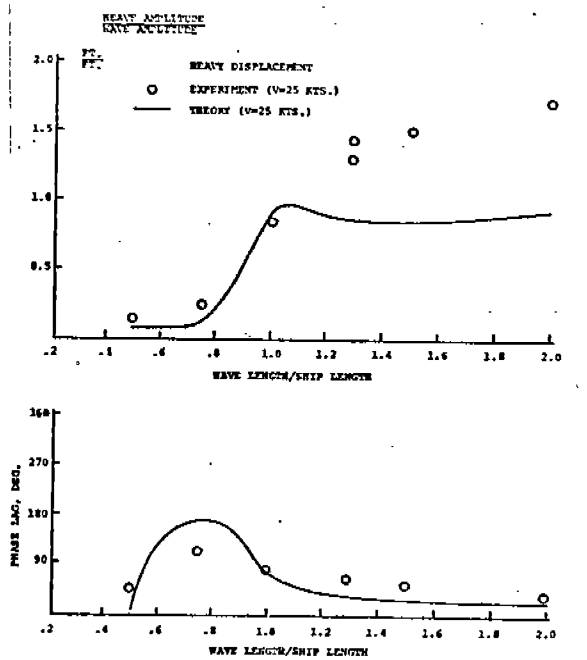

Fig .3 - Frame 124 Heave & Phase Lag, 180^{o} Heading

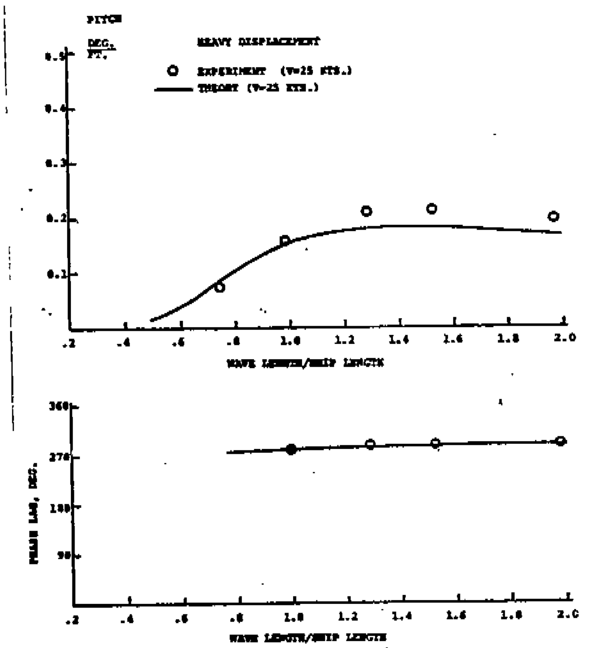

Fig. 4 - Pitch & Phase Lag, 0^{o} Heading

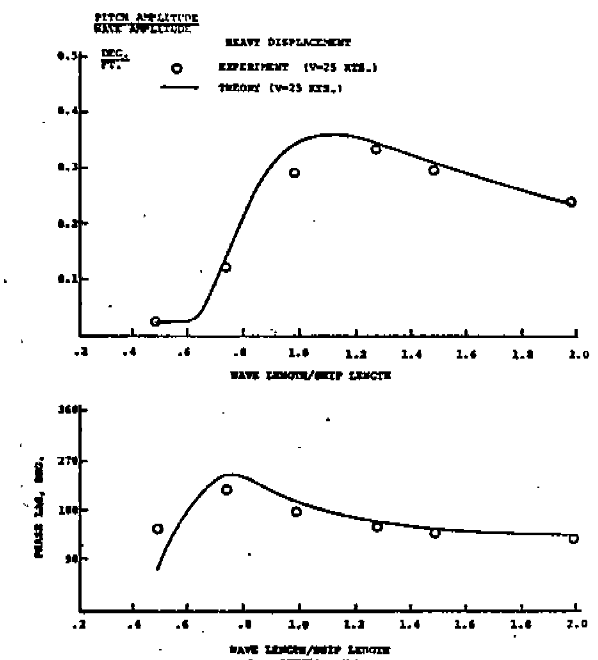

Fig. 5 - Pitch & Phase Lag, 180^{o} Heading

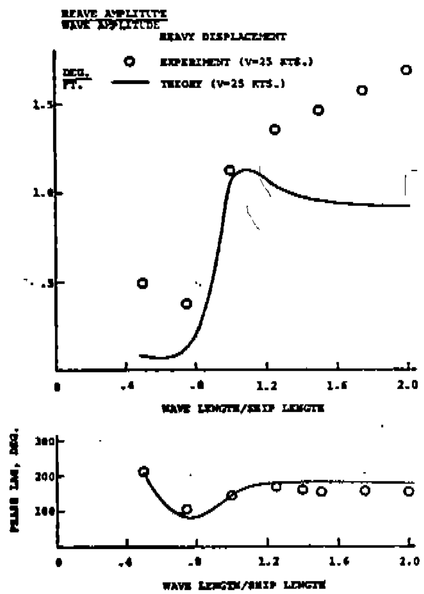

Fig. 6 - C.G. Heave & Phase Lag, 180° Heading

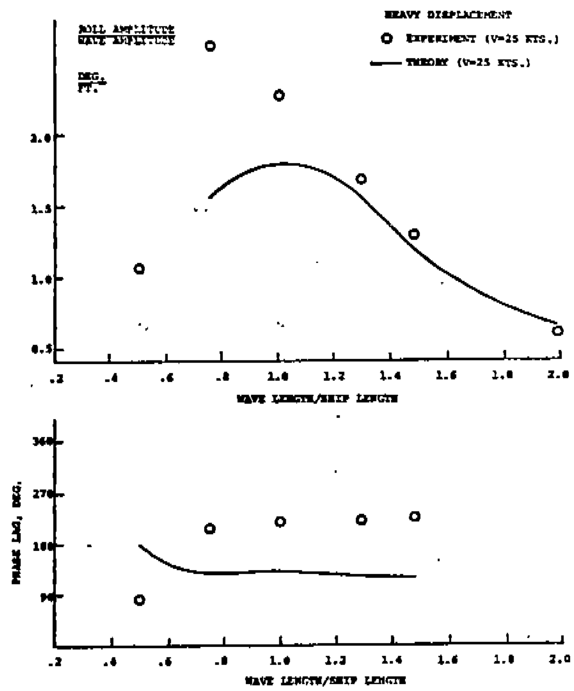

Fig. 7 - Roll & Phase Lag, 30° Heading

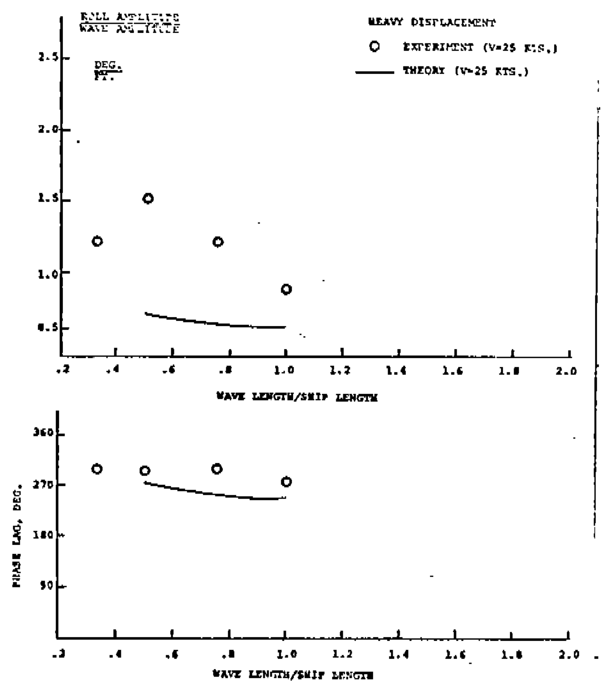

Fig. 8 - Roll & Phase Lag, 60° Heading

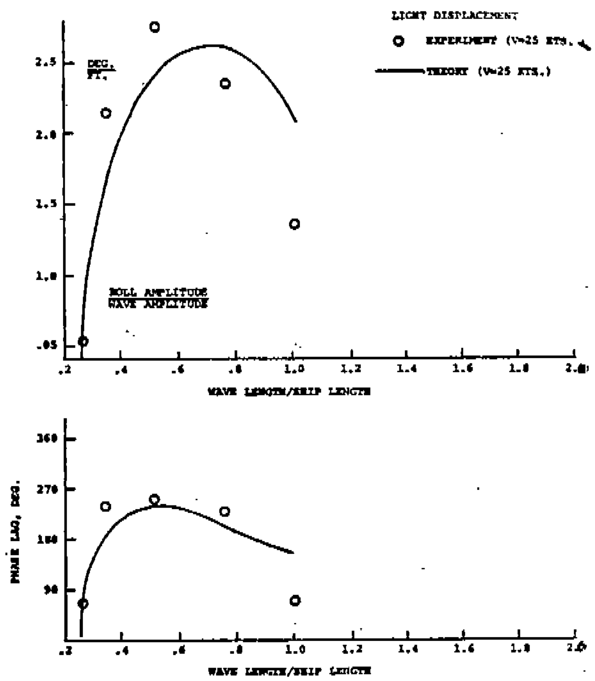

Fig. 9 - Roll & Phase Lag, 60° Heading

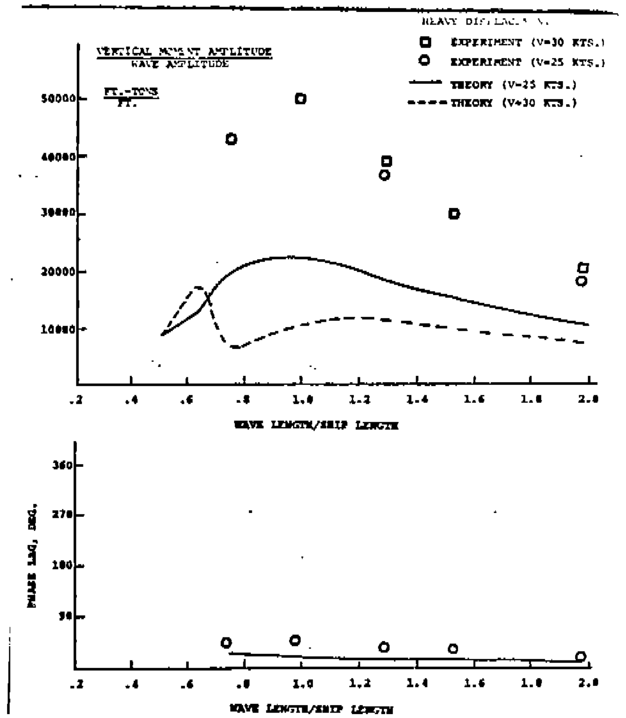

Fig. 10 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 0^{o} Heading

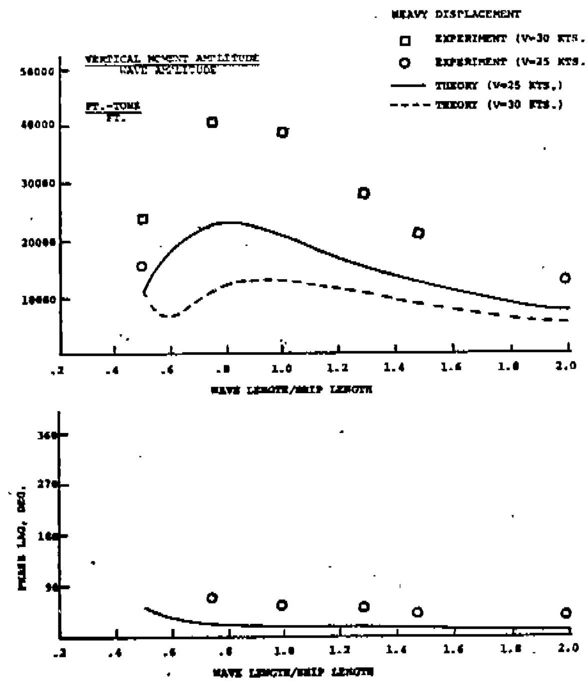

Fig. 11 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 30^{o} Heading

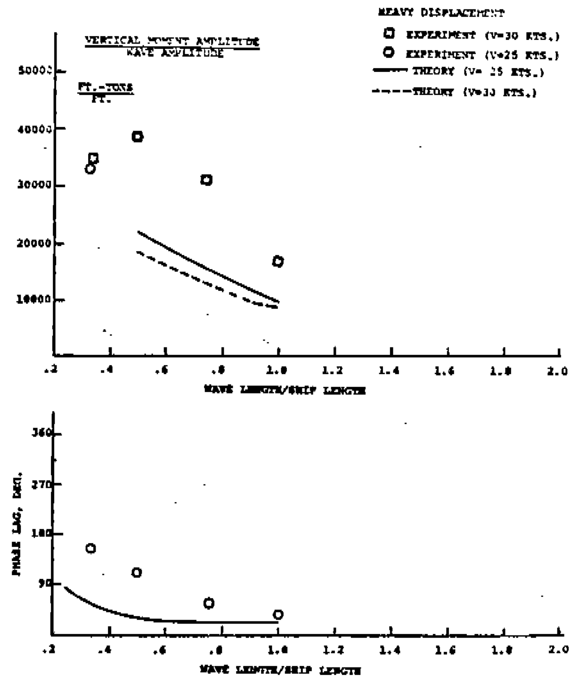

Fig. 12 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 60^{o} Heading

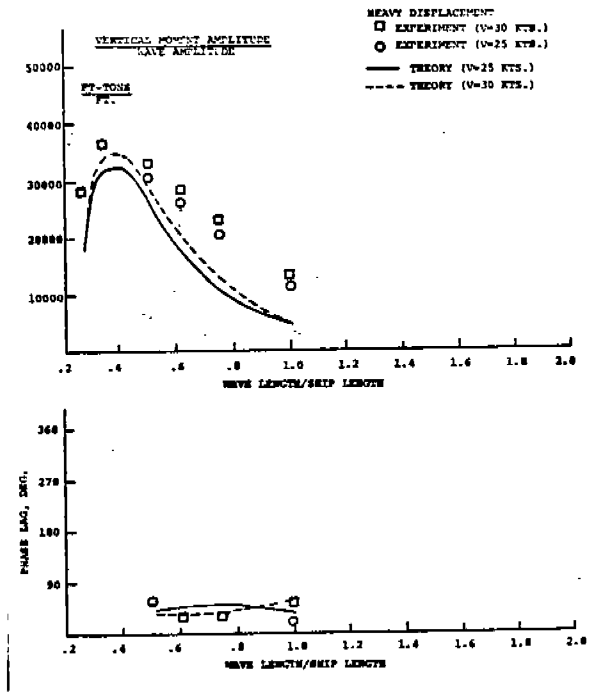

Fig. 13 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 240^{o} Heading

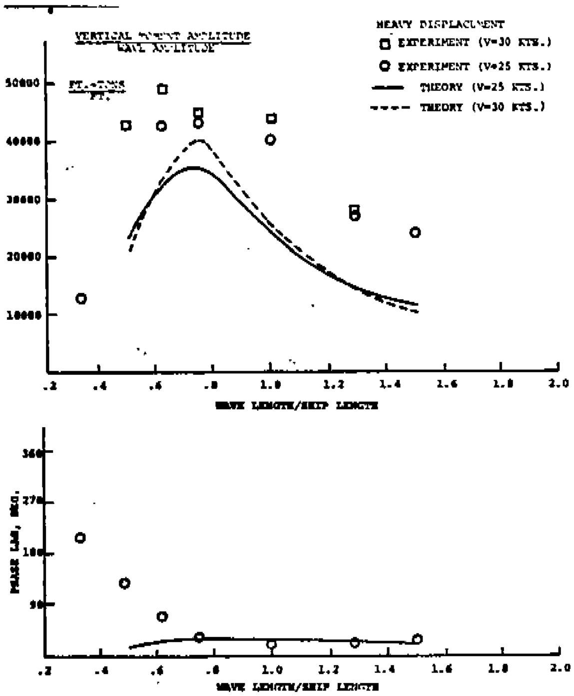

Fig. 14 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 210° Heading

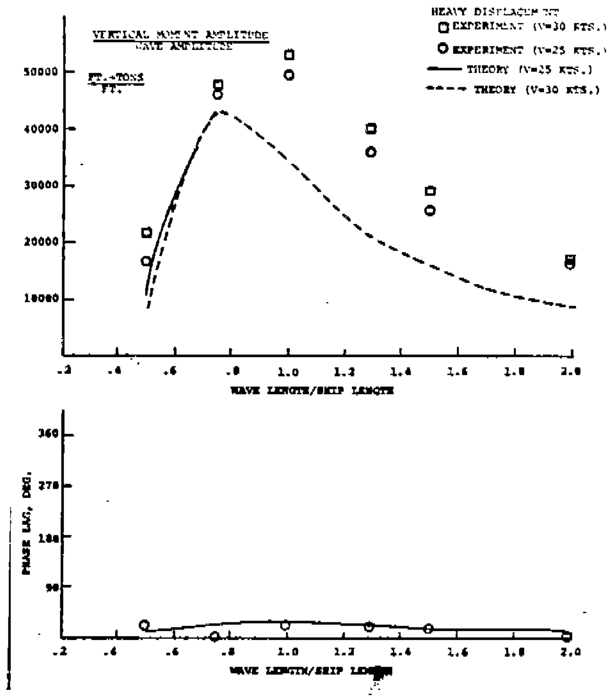

Fig. 15 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 180° Heading

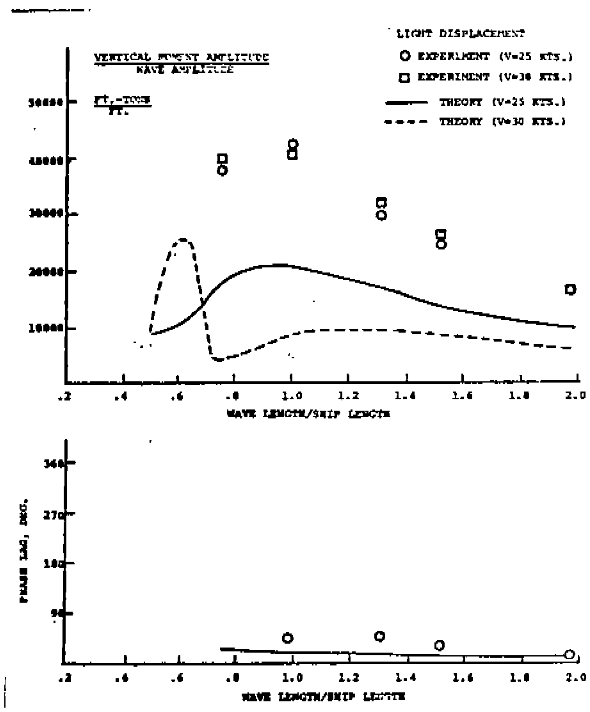

Fig. 16 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 0° Heading

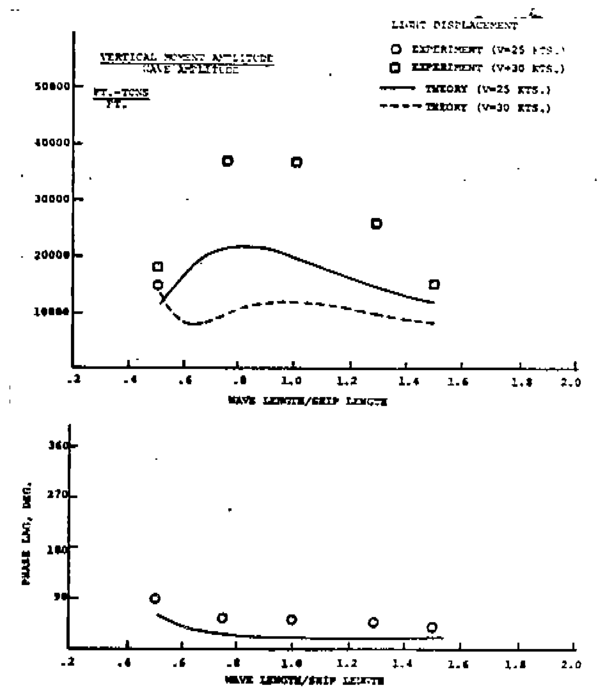

Fig. 17 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 30° Heading

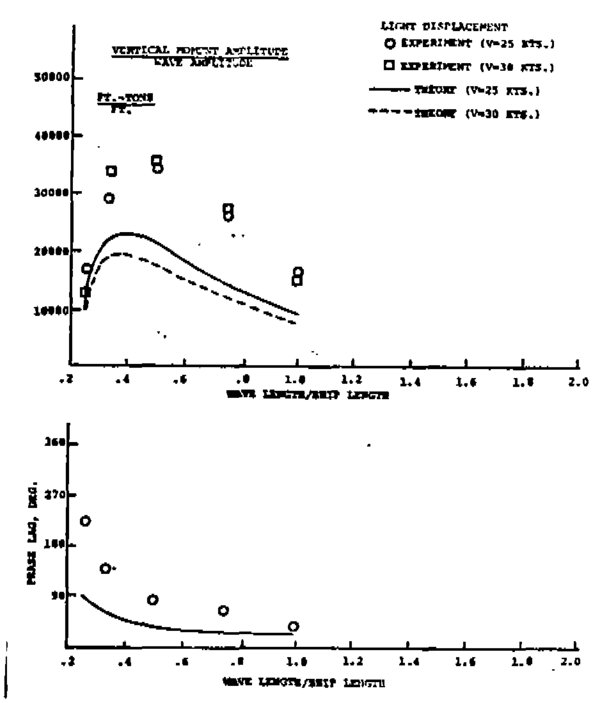

Fig. 18 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 60^0 Heading

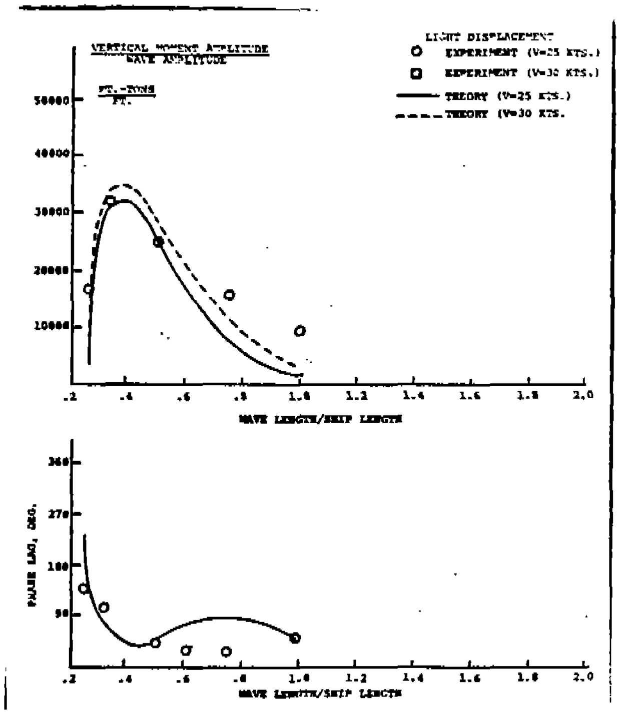

Fig. 19 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 240^0 Heading

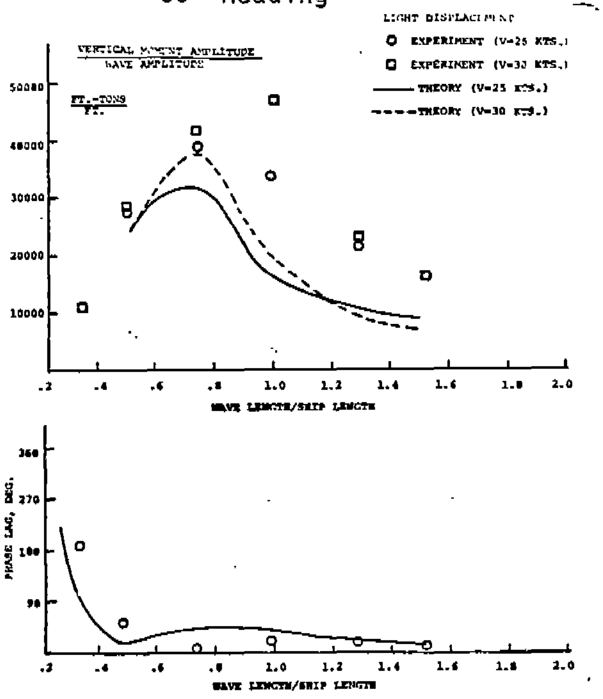

Fig. 20 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 210^0 Heading

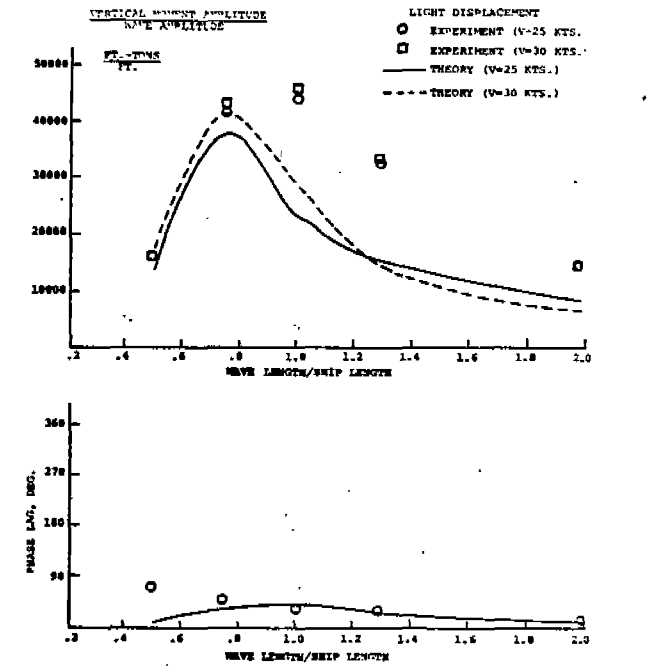

Fig. 21 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 180^0 Heading

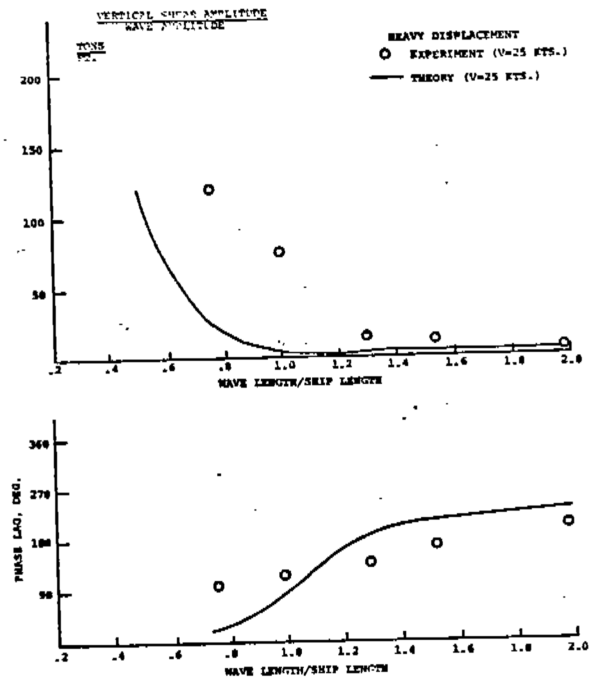

Fig. 22 - Midship Vertical Shear & Phase Lag, 0° Heading

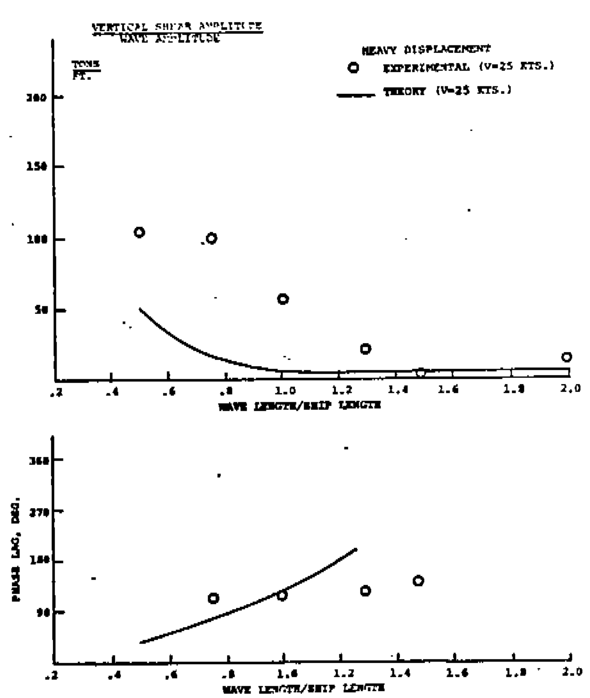

Fig. 23 - Midship Vertical Shear & Phase Lag, 30° Heading

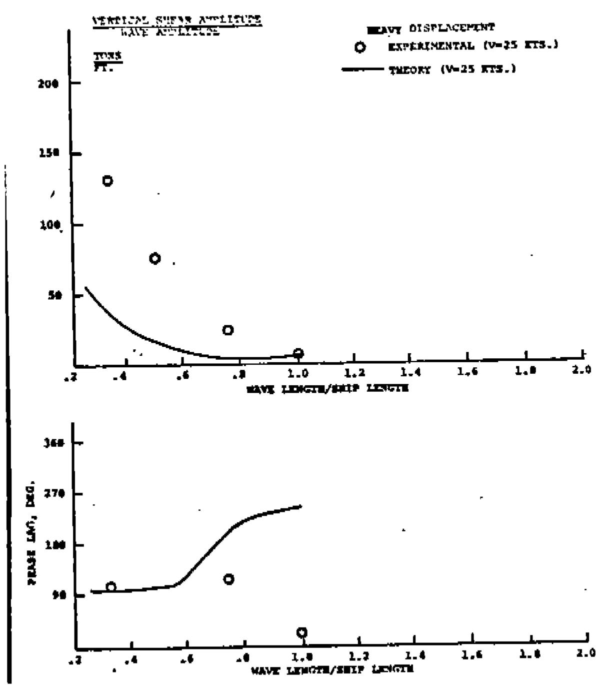

Fig. 24 - Midship Vertical Shear & Phase Lag, 60° Heading

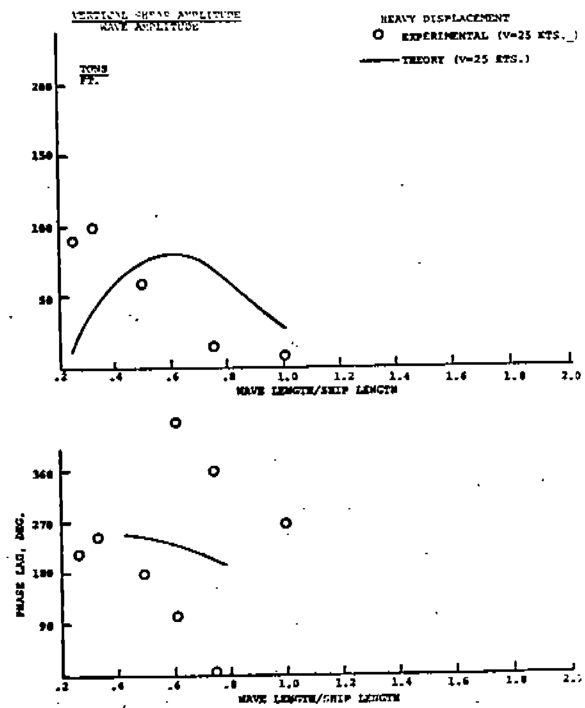

Fig. 25 - Midship Vertical Shear & Phase Lag, 240° Heading

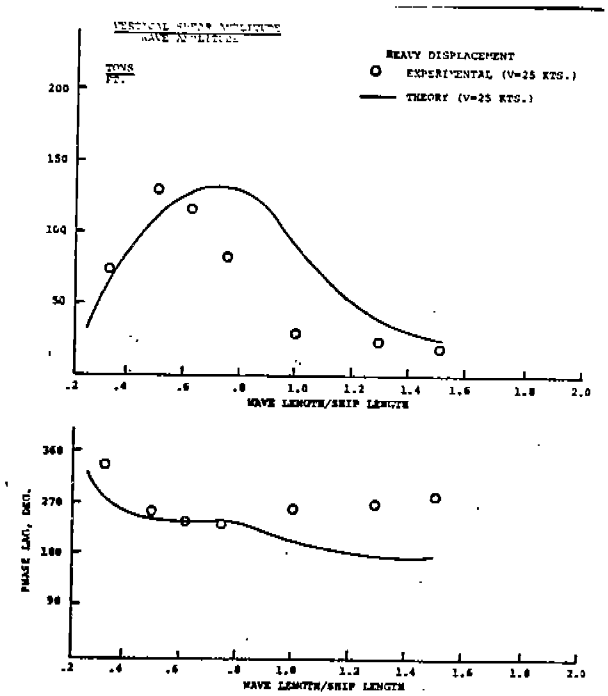

Fig. 26 - Midship Vertical Shear & Phase Lag, 210^{0} Heading

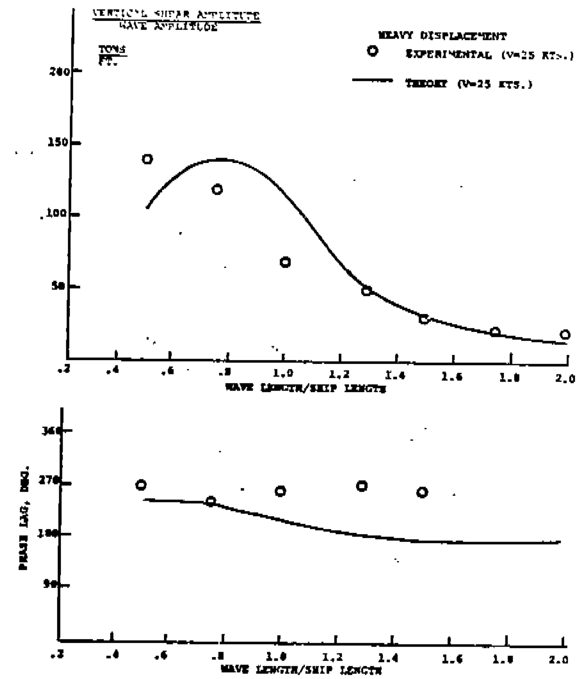

Fig. 27 - Midship Vertical Shear & Phase Lag, 180^{0} Heading

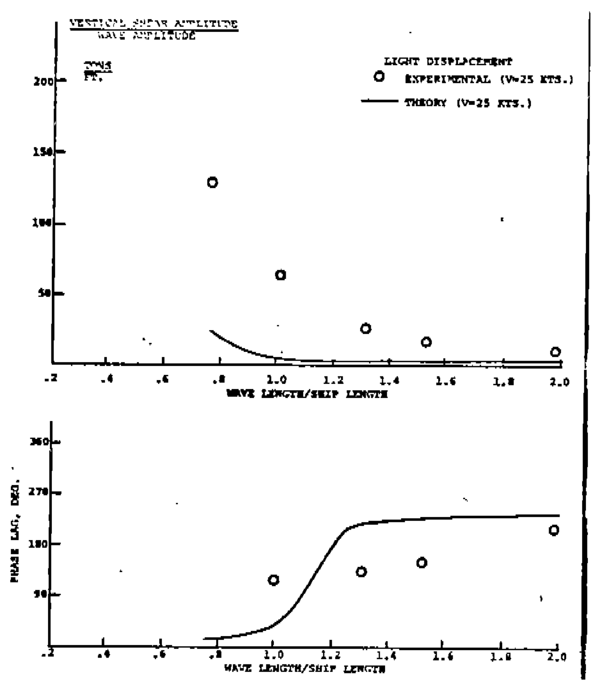

Fig. 28 - Midship Vertical Shear & Phase Lag, 0^{0} Heading

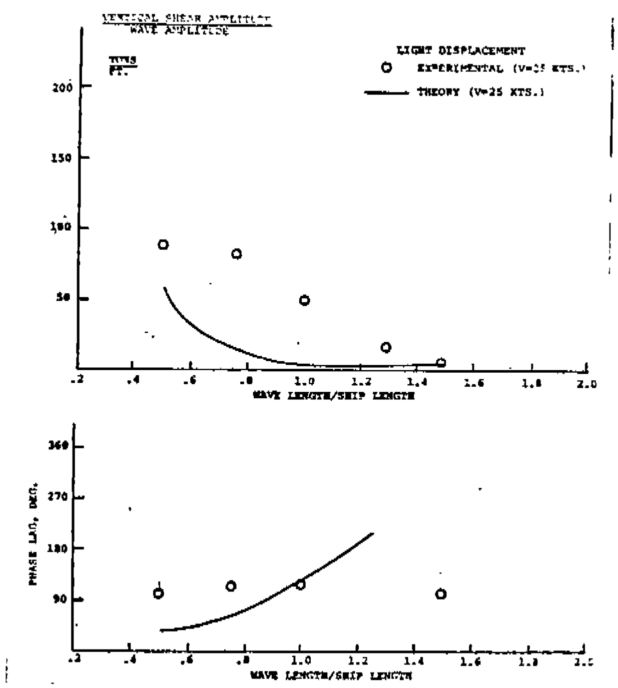

Fig. 29 - Midship Vertical Shear & Phase Lag, 30^{0} Heading

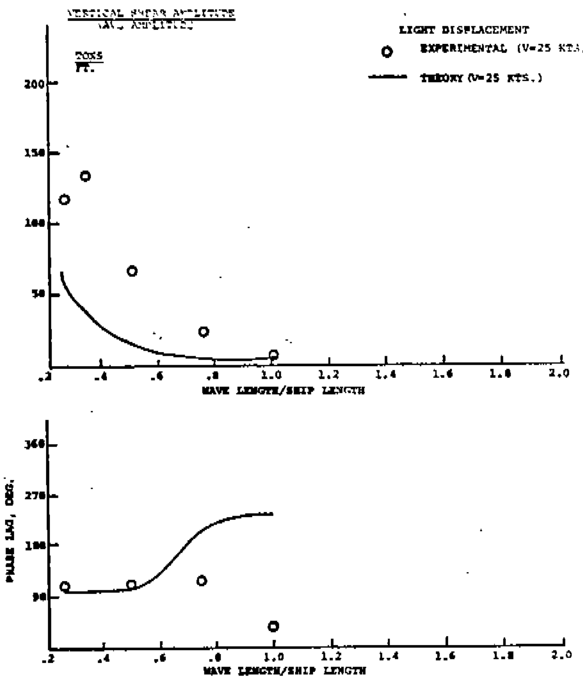

Fig. 30 - Midship Vertical Shear & Phase Lag, 60° Heading

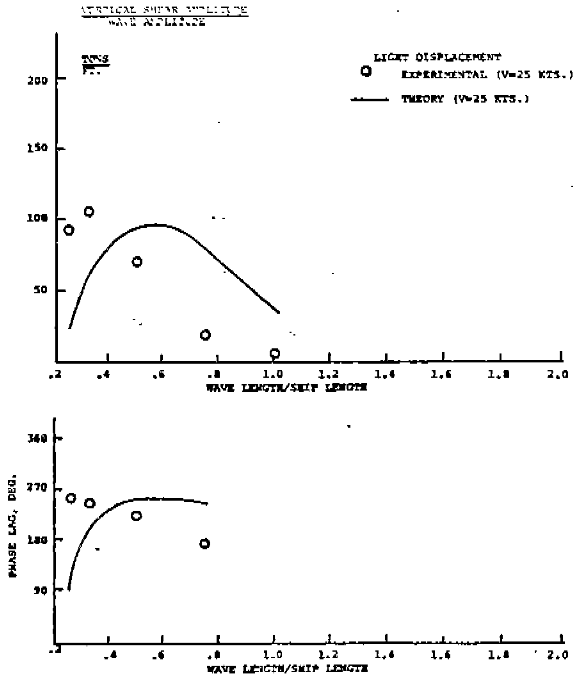

Fig. 31 - Midship Vertical Shear & Phase Lag, 240° Heading

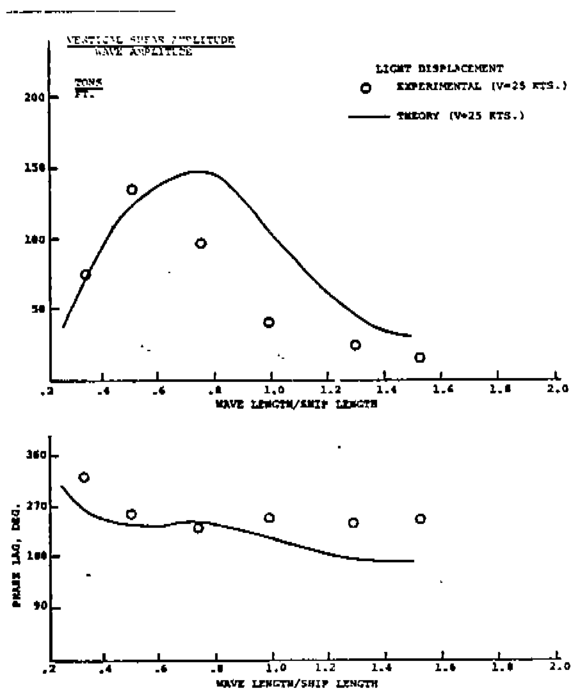

Fig. 32 - Midship Vertical Shear & Phase Lag, 210° Heading

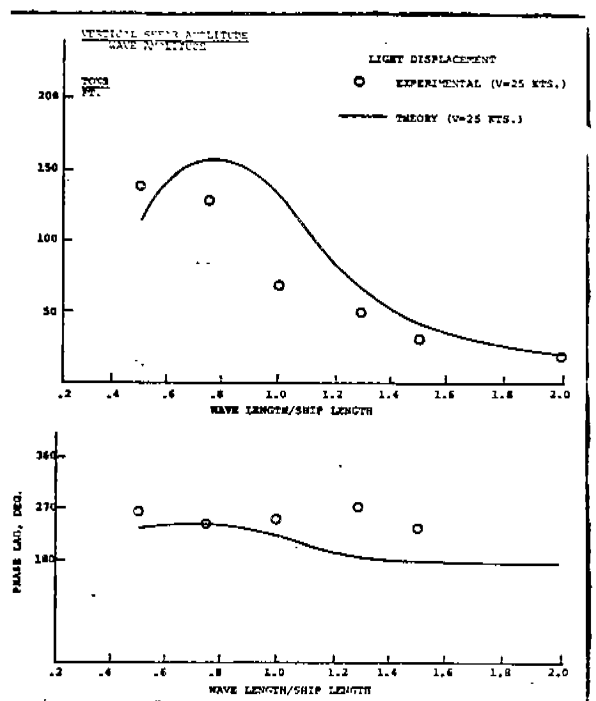

Fig. 33 - Midship Vertical Shear & Phase Lag, 180° Heading

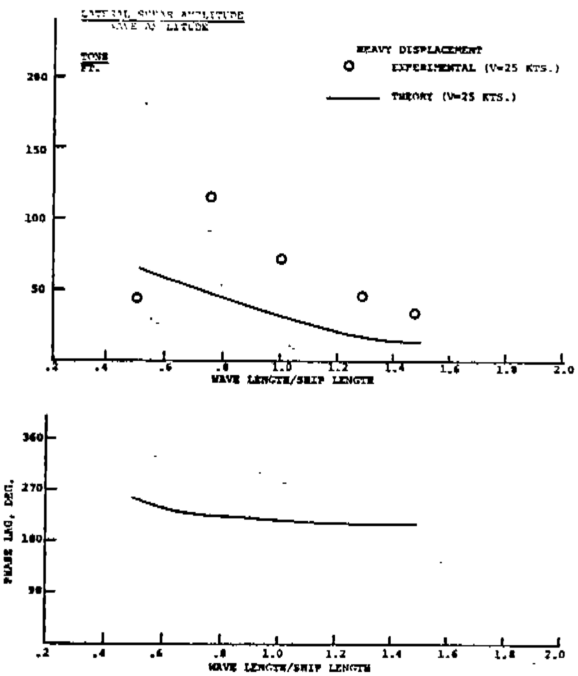

Fig. 34 - Midship Lateral Shear & Phase Lag, 30^{0} Heading

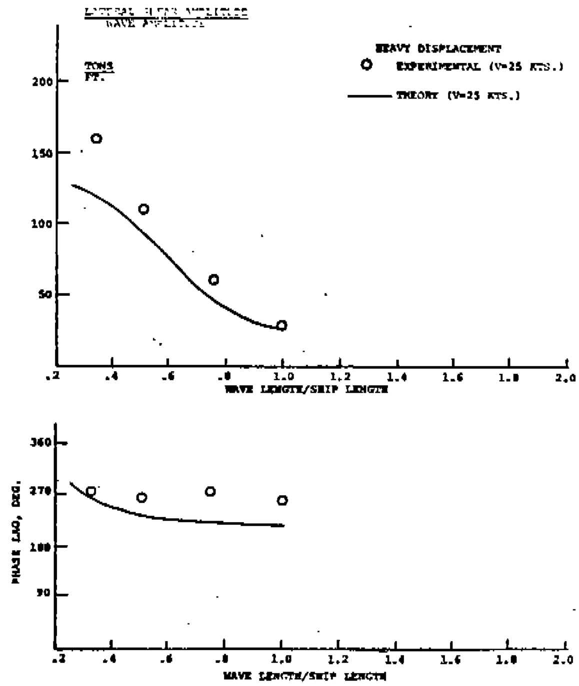

Fig. 35 - Midship Lateral Shear & Phase Lag, 60^{0} Heading

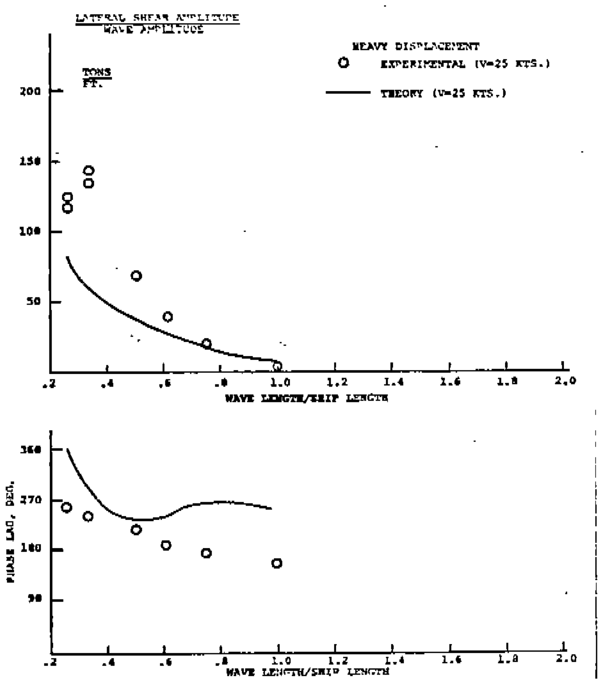

Fig. 36 - Midship Lateral Shear & Phase Lag, 240^{0} Heading

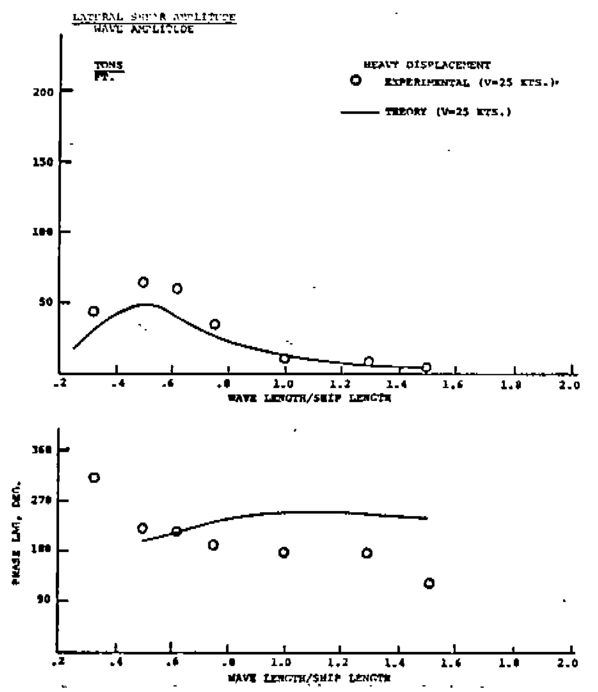

Fig. 37 - Midship Lateral Shear & Phase Lag, 210^{0} Heading

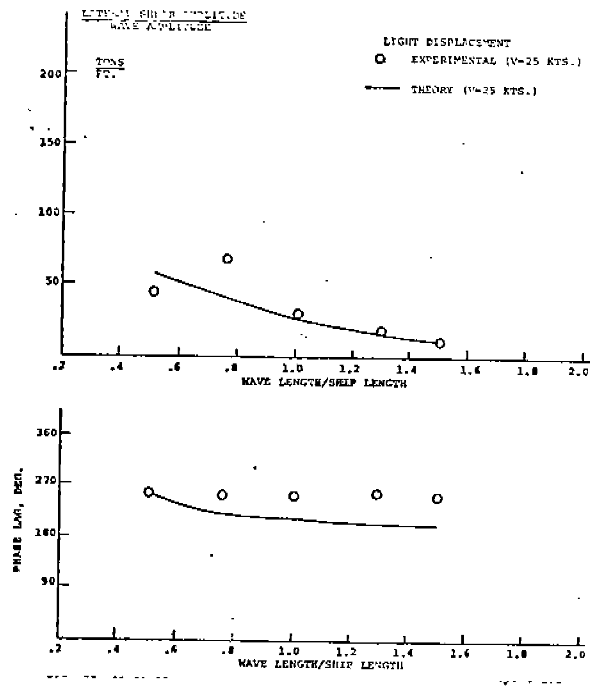

Fig. 38 - Midship Lateral Shear & Phase Lag, 30^0 Heading

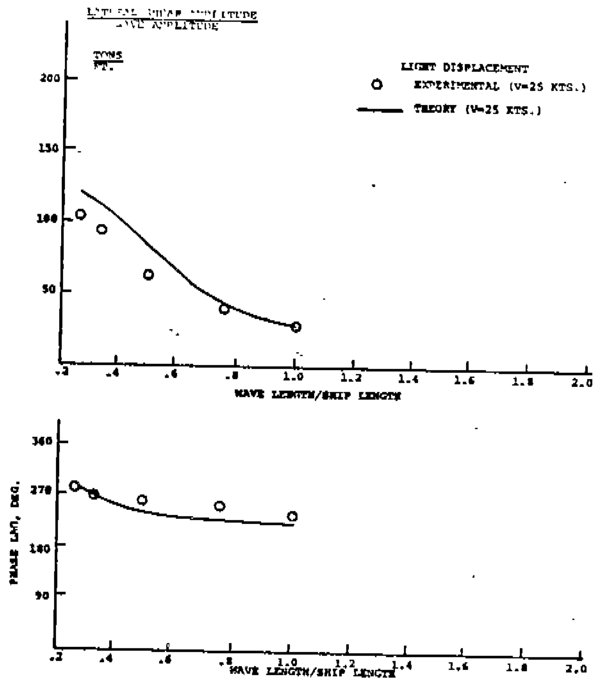

Fig. 39 - Midship Lateral Shear & Phase Lag, 60^0 Heading

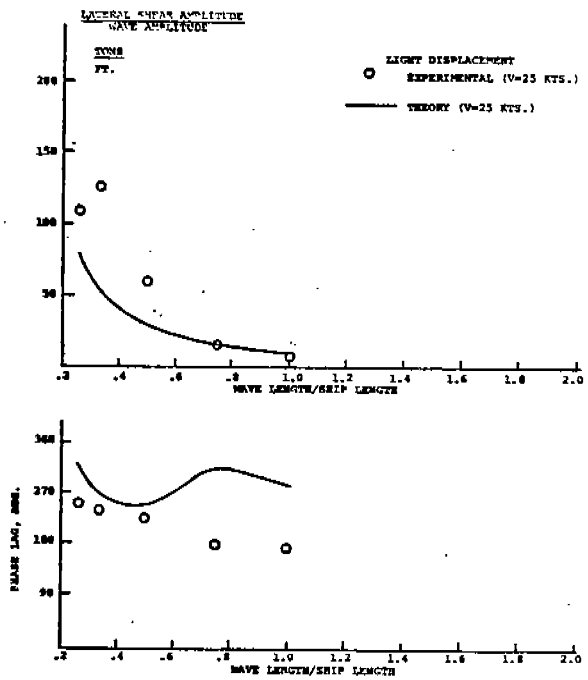

Fig. 40 - Midship Lateral Shear & Phase Lag, 240^0 Heading

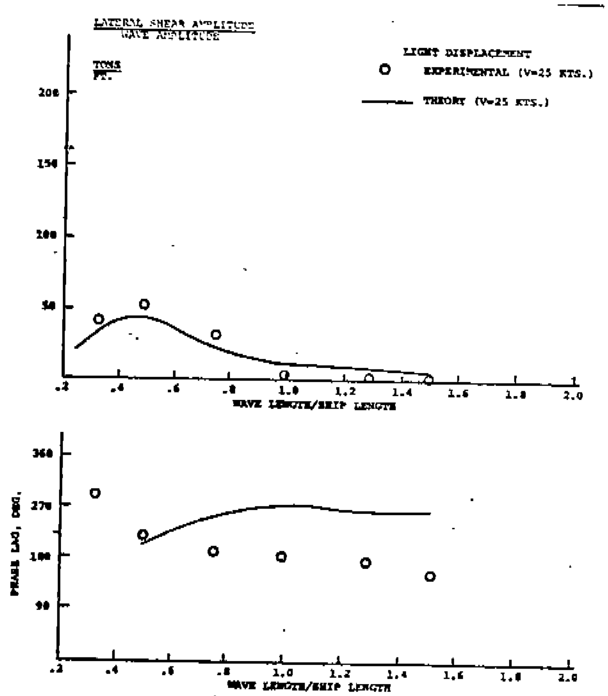

Fig. 41 - Midship Lateral Shear & Phase Lag, 210^0 Heading

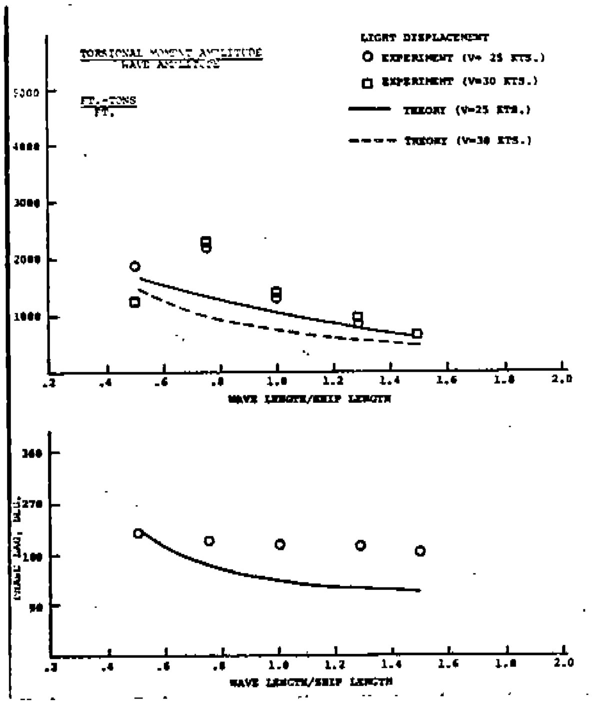

Fig. 42 - Midship Torsional Wave Bending Moments & Phase Lag, 30° Heading

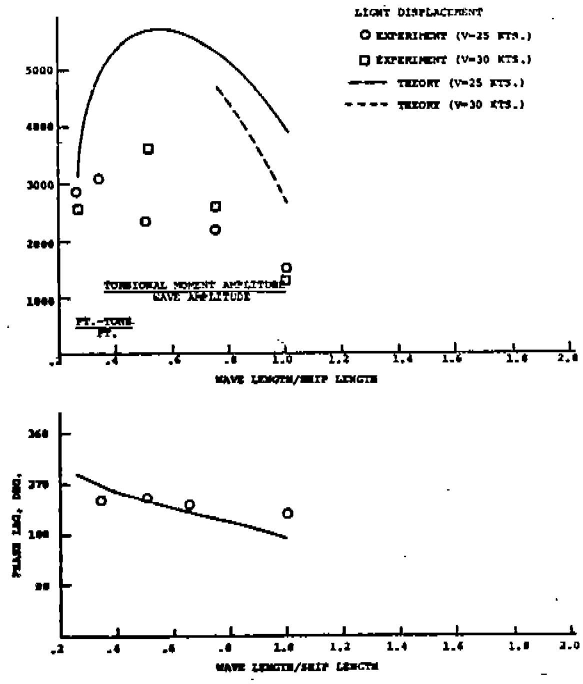

Fig. 43 - Midship Torsional Wave Bending Moments & Phase Lag, 60° Heading

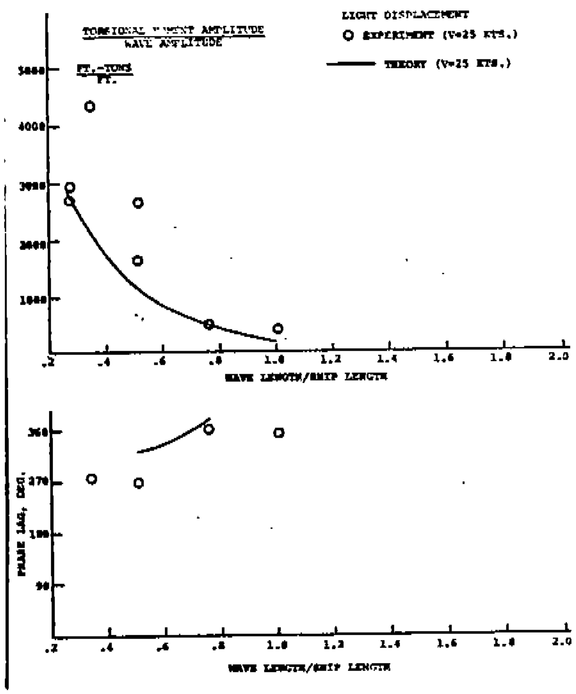

Fig. 44 - Midship Torsional Wave Bending Moments & Phase Lag, 240° Heading

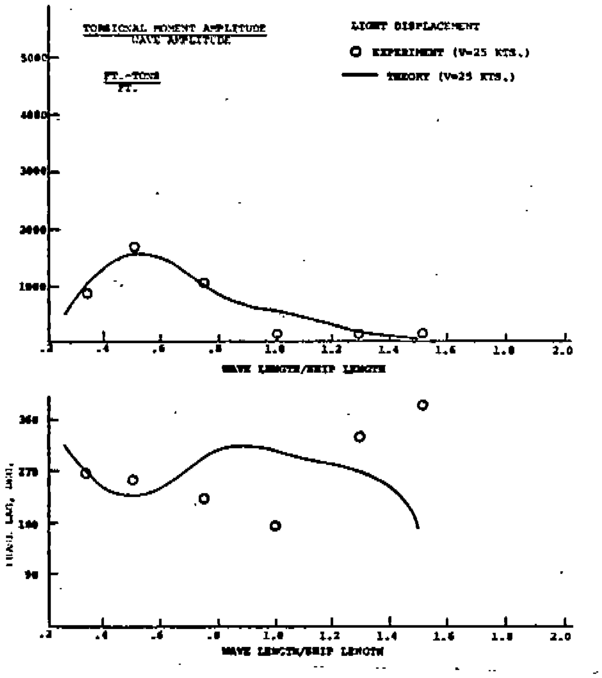

Fig. 45 - Midship Torsional Wave Bending Moments & Phase Lag, 210° Heading

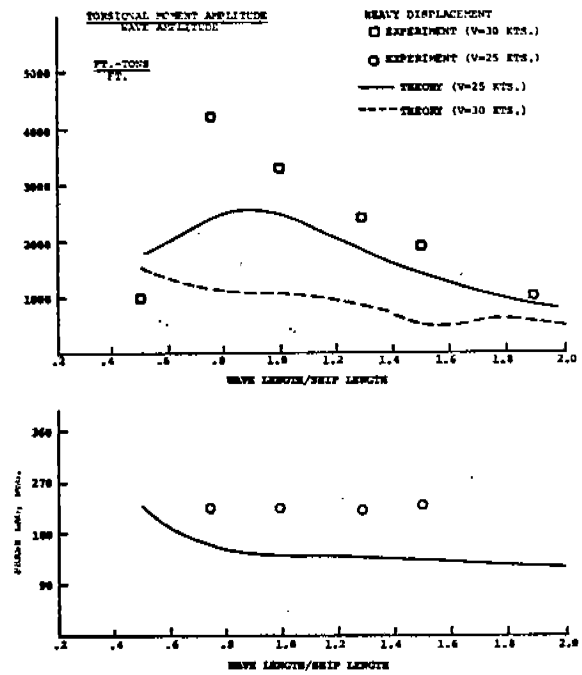

Fig. 46 - Midship Torsional Wave Bending Moments & Phase Lag, 30^{0} Heading

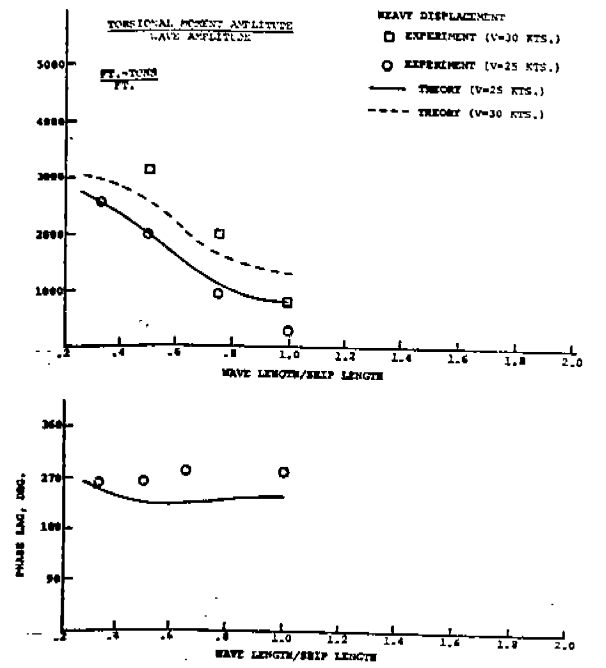

Fig. 47 - Midship Torsional Wave Bending Moments & Phase Lag, 60^{0} Heading

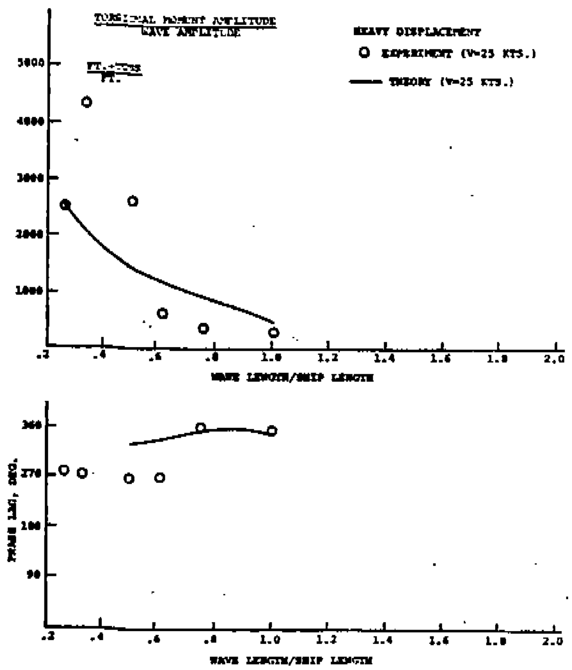

Fig. 48 - Midship Torsional Wave Bending Moments & Phase Lag, 240^{0} Heading

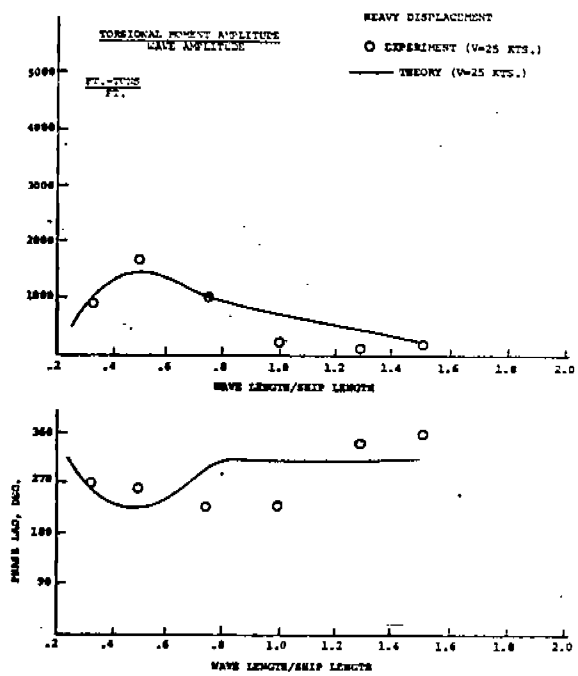

Fig. 49 - Midship Torsional Wave Bending Moments & Phase Lag, 210^{0} Heading

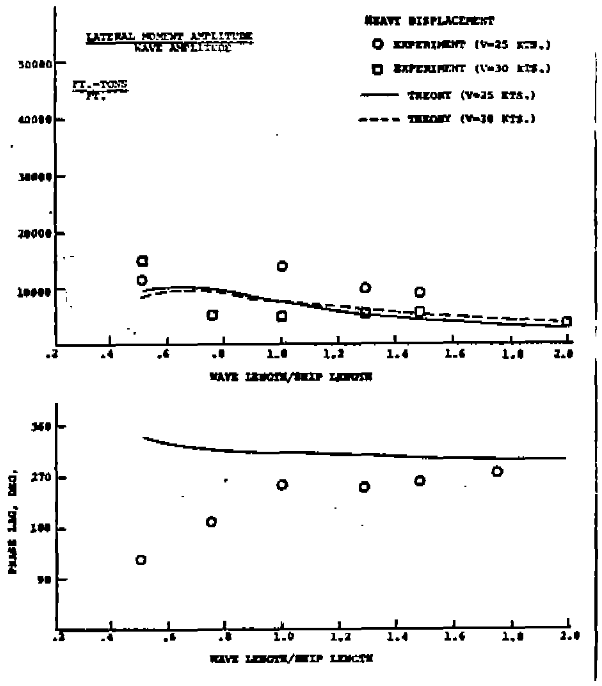

Fig. 50 - Midship Lateral Wave Bending Moments & Phase Lag, 30° Heading

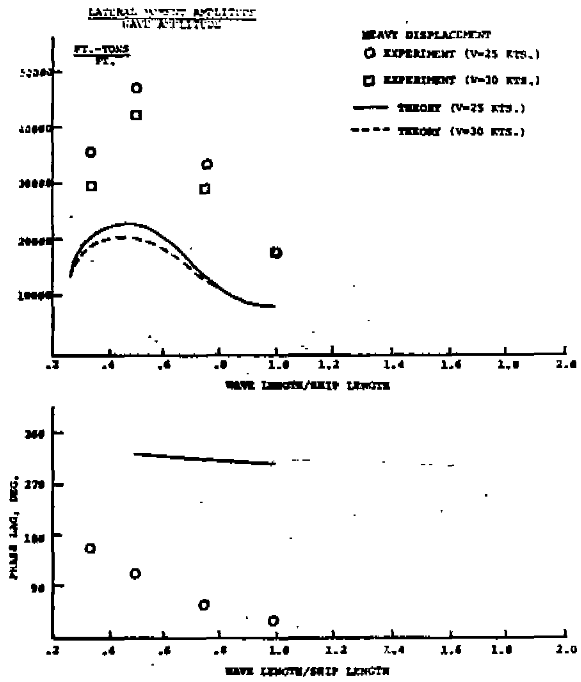

Fig. 51 - Midship Lateral Wave Bending Moments & Phase Lag, 60° Heading

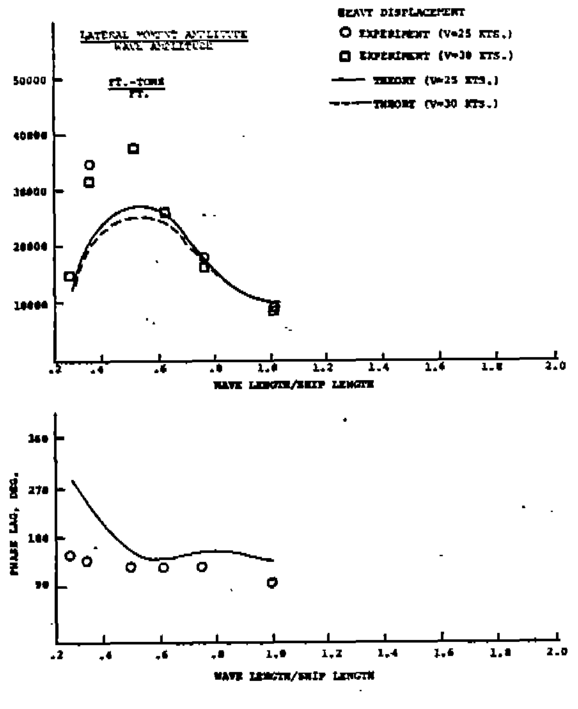

Fig. 52 - Midship Lateral Wave Bending Moments & Phase Lag, 240° Heading

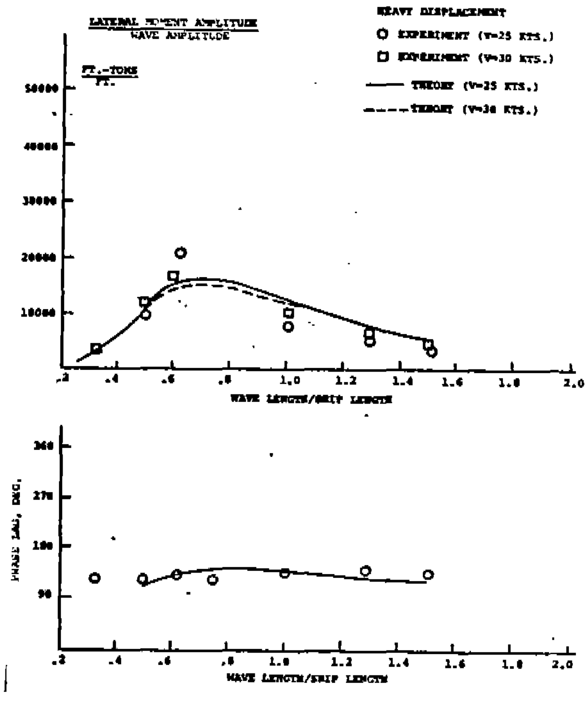

Fig 53 - Midship Lateral Wave Bending Moments & Phase Lag, 210° Heading

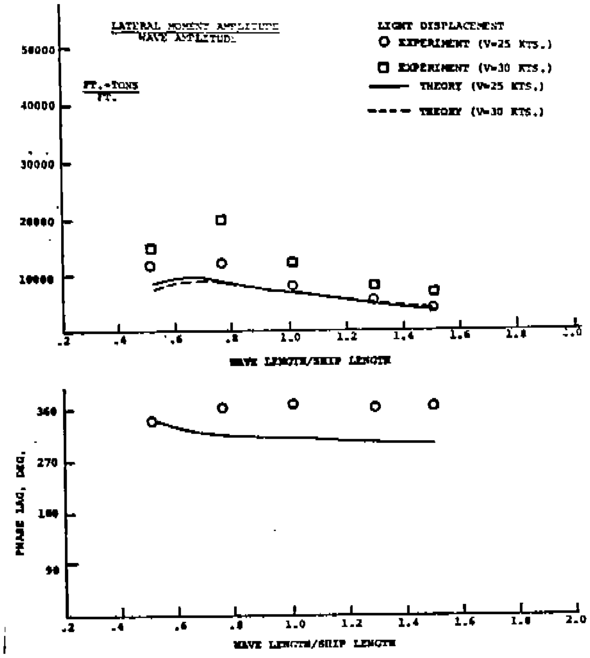

Fig. 54 - Midship Lateral Wave Bending Moments & Phase Lag, 30° Heading

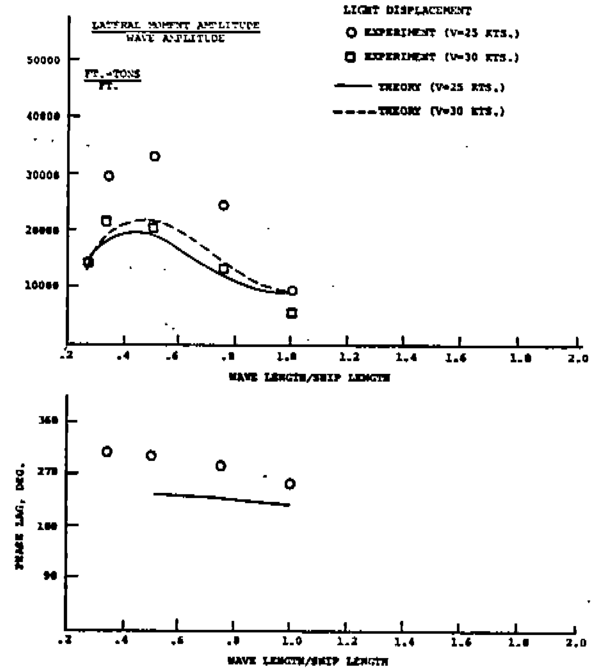

Fig. 55 - Midship Lateral Wave Bending Moments & Phase Lag, 60° Heading

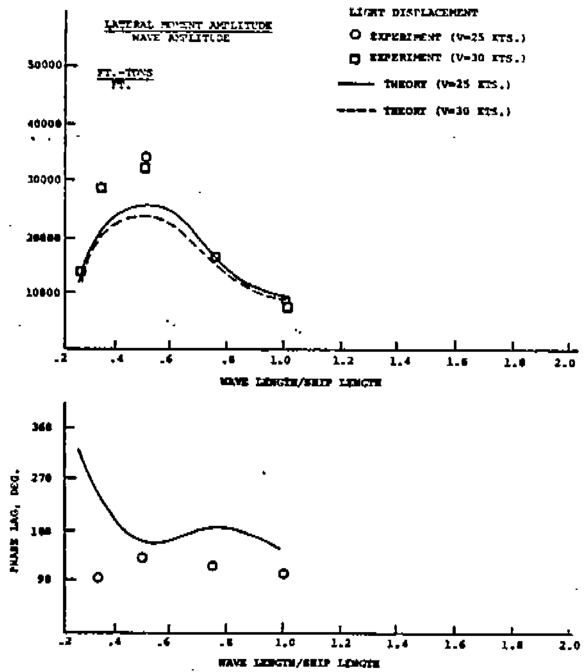

Fig. 56 - Midship Lateral Wave Bending Moments & Phase Lag, 240° Heading

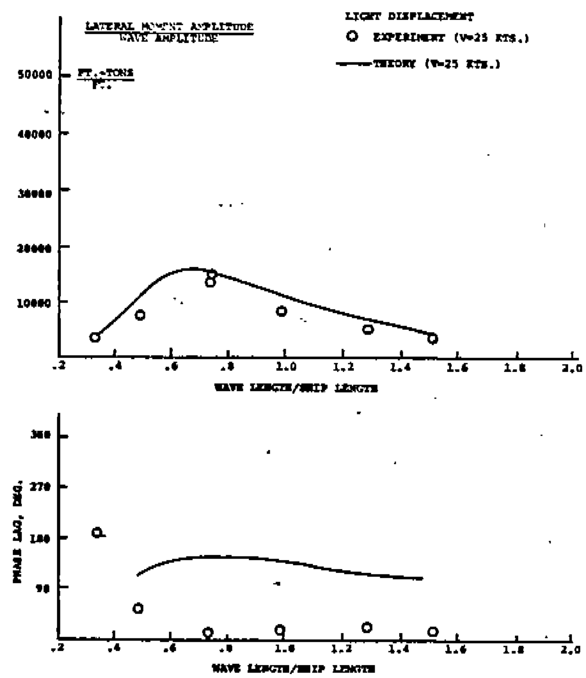

Fig. 57 - Midship Lateral Wave Bending Moments & Phase Lag, 210° Heading

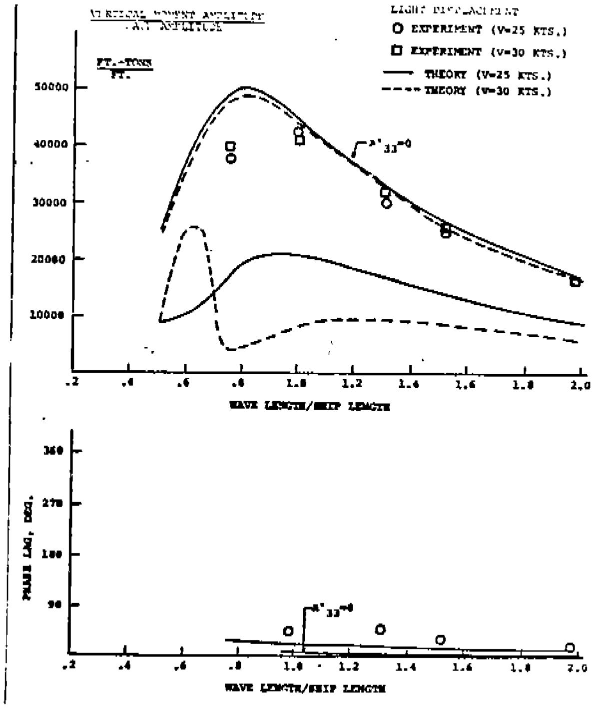

Fig. 58 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 0^{0} Heading, (A'_{33}=0)

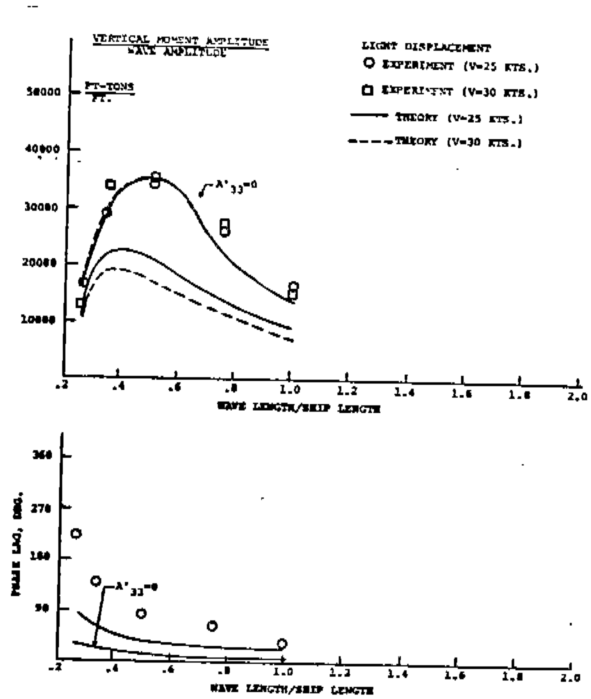

Fig. 59 - Midship Vertical Wave Bending Moments & Wave Phase Lag, 60^{0} Heading, (A'_{33}=0)

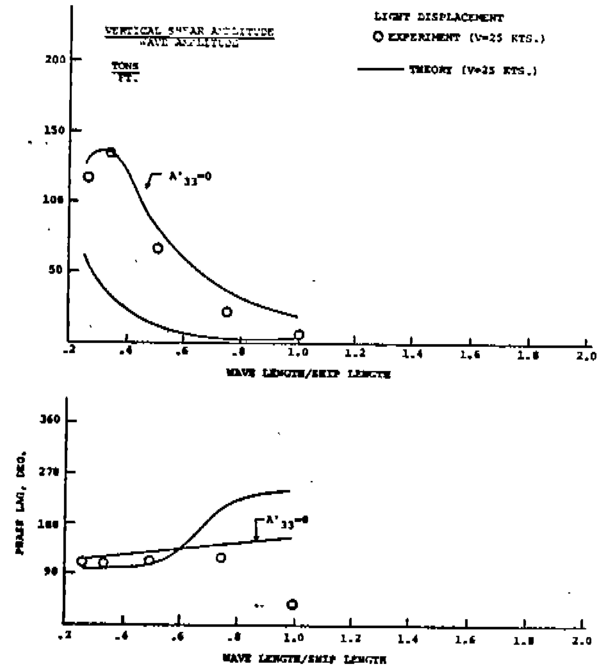

Fig. 60 - Midship Vertical Shear & Phase Lag, 60^{0} Heading, (A'_{33}=0)

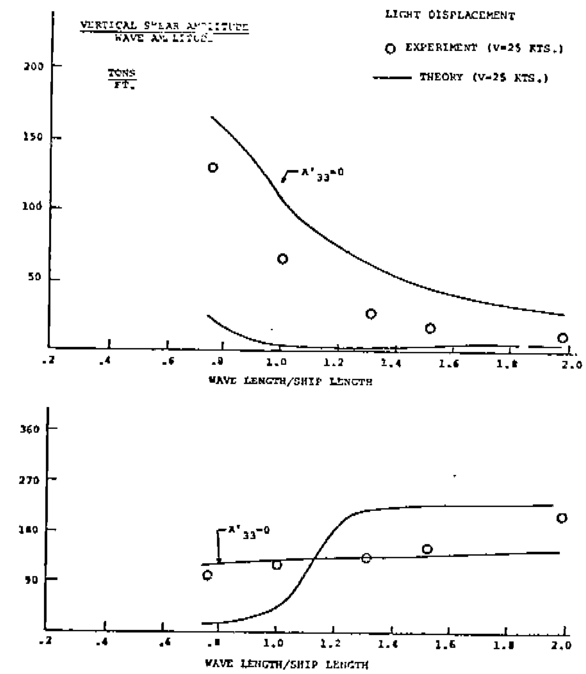

Fig. 61 - Midship Vertical Shear & Phase Lag, 0^{0} Heading, (A'_{33}=0)

This appendix contains a typical set of computer printouts that constitutes the computer data bank for the SL-7 ship. The information presented includes the frequency responses (amplitude and phase) for all of the ship motions and loads considered in this study. This information corresponds to operating conditions covering 4 speeds, viz. 25 kt., 27.5 kt., 30 kt., and 32.5 kt. (denoted as 42.2 ft./sec., 46.42 ft./sec., 50.64 ft./sec. and 54.86 ft./sec. in the tabulations), 2 displacements (Heavy, at 47,760 Tons and Light, 41,422.9 Tons), for 19 headings at 10° intervals from following seas to head seas, for 21 regular wavelengths that cover the spectral energy bands extending from 10-50 ft. significant wave height. In addition to the frequency response information for regular waves, statistical responses are also presented for the SL-7 ship at the same speeds and displacements for 5 long-crested irregular seas and also 5 short-crested irregular seas, with significant wave heights of 10 ft., 20 ft., 30 ft., 40 ft. and 50 ft. The wave spectra corresponding to these significant heights are those of the Pierson-Moskowitz family.

In addition to the motions and loads, vertical and lateral accelerations were determined at four points on the ship. The location of the first pair of points is 166.252 ft. aft of the forward perpendicular, 65.259 ft. up from the keel, and 3.333 ft. port and starboard of the centerline. The location of the second pair of points is 445.502 ft. aft of the forward perpendicular, 37.027 ft. up from the keel, and 0.9583 ft. port and starboard of the centerline. These locations correspond to particular points on the instrumented SL-7 ship where accelerometers are located, thereby presenting information that can be correlated with full-scale measurements.

All of the responses are given in units of feet, long tons, and seconds. The information on the torsional moment corresponds to the evaluation of this quantity about the center of gravity location. All of the computations were carried out for the full-scale ship whose characteristics are presented in Tables 1-3.

SL-7 LIGHT FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 23.44 KNOTS, RESPONSE (AMPLITUD

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M
.20000	.15456	5053.25	6.289E-84	2.414E-86	3.15[illegible]E-84	1.988E-87	1.650E-86	2.914E-78	3.822E-
.24000	.17456	3509.20	5.334E-39	4.236E-41	3.042E-39	5.845E-42	4.035E-41	1.780E-32	8.046E-
.28000	.19093	2578.19	6.181E-20	9.119E-22	4.045E-20	1.873E-22	1.266E-21	9.135E-13	2.205E-
.32000	.20367	1973.93	7.476E-11	1.902E-12	5.660E-11	5.504E-13	3.956E-12	3.765E-03	6.218E-
.36000	.21277	1559.65	3.537E-06	1.477E-07	3.126E-06	5.886E-08	4.636E-07	5.176E+02	6.897E+
.40000	.21823	1263.31	1.152E-03	7.684E-05	1.200E-03	4.[illegible]04E-05	3.609E-04	4.449E+05	5.374E+
.44000	.22006	1044.06	2.590E-02	2.738E-03	3.200E-02	2.084E-03	1.8 5E-02	2.508E+07	2.994E+
.48000	.21826	877.30	1.199E-01	2.059E-02	1.771E-01	2.239E-02	2.060E-01	2.910E+08	3.676E+
.52000	.21282	747.52	1.926E-01	5.784E-02	3.508E-01	9.377E-02	8.277E-01	1.250E+09	1.781E+
.56000	.20374	644.55	1.270E-01	8.141E-02	3.993E-01	2.086E-01	1.665E+00	2.714E+09	4.675E+
.60000	.19103	561.47	2.521E-02	6.582E-02	7.595E-01	2.864E-01	1.9 3E+00	3.489E+09	7.973E+
.64000	.17468	493.48	6.163E-03	3.197E-02	2.131E+00	2.492E-01	1.377E+00	2.854E+09	9.798E+
.68000	.15470	437.13	3.301E-02	1.065E-02	4.185E+00	1.163E-01	5.012E-01	1.635E+09	9.197E+
.72000	.13108	389.91	3.529E-02	5.820E-03	4.983E+00	2.391E-02	4.755E-02	1.107E+09	6.745E+
.76000	.10383	349.95	1.514E-02	5.133E-03	2.908E+00	1.553E-01	1.698E-01	1.511E+09	3.814E+
.80000	.07294	315.83	3.370E-03	2.522E-03	1.034E+01	6.423E-01	4.748E-01	2.705E+08	1.576E+
.84000	.03841	286.47	3.159E-03	3.325E-04	3.999E+02	1.972E+00	5.440E-01	8.861E+07	4.863E+
.88000	.00025	261.02	8.994E-03	3.381E-02	2.825E+11	3.358E+04	3.267E-01	1.785E+07	3.077E+
.92000	-.04154	238.81	7.316E-04	4.857E-04	3.467E+02	1.423E+00	8.880E-02	4.196E+07	4.567E+
.96000	-.08697	219.33	4.457E-05	7.576E-04	5.865E+00	2.092E-01	6.256E-03	3.004E+07	5.786E+
1.00000	-.13604	202.13	3.027E-04	6.565E-04	4.485E-04	1.488E-02	5.887E-02	2.023E+07	4.778E+
		MN. SQ	2.391E-02	1.281E-02	1.130E+10	1.344E+03	3.2 5E-01	6.135E+08	1.921E+
		R.M.S.	1.546E-01	1.132E-01	1.063E+05	3.665E+01	5.740E-01	2.477E+04	1.386E+
		AVG.	1.933E-01	1.415E-01	1.329E+05	4.582E+01	7.1 5E-01	3.096E+04	1.732E+
		SIG.	3.093E-01	2.264E-01	2.126E+05	7.331E+01	1.148E+00	4.954E+04	2.772E+
		AV1/10	3.943E-01	2.886E-01	2.711E+05	9.347E+01	1.4 4E+00	6.316E+04	3.534E+

VERT SHEAR LAT SHEAR (DIMENSIONAL)

MN. SQ 1.809E+04 1.148E+04

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR	(DIMENSIONAL)
MN. SQ	1	2.221E+08	1.218E+06	7.533E+05	.816E+02	1.053E+03	
MN. SQ	2	1.997E+08	8.163E+06	9.315E+05	7.370E+02	1.492E+03	
MN. SQ	3	1.786E+08	1.727E+07	1.321E+06	2.469E+03	1.767E+03	
MN. SQ	4	1.702E+08	2.883E+07	3.008E+06	7.711E+03	2.918E+03	
MN. SQ	5	2.022E+08	4.503E+07	5.193E+06	1.611E+04	4.610E+03	
MN. SQ	6	3.021E+08	6.878E+07	6.809E+06	2.329E+04	6.499E+03	
MN. SQ	7	4.596E+08	1.015E+08	6.904E+06	2.495E+04	8.242E+03	
MN. SQ	8	6.096E+08	1.398E+08	6.123E+06	2.151E+04	9.642E+03	
MN. SQ	9	6.702E+08	1.739E+08	5.352E+06	1.803E+04	1.070E+04	
MN. SQ	10	6.135E+08	1.921E+08	4.424E+06	1.809E+04	1.148E+04	
MN. SQ	11	4.842E+08	1.878E+08	3.449E+06	2.088E+04	1.201E+04	
MN. SQ	12	3.461E+08	1.660E+08	2.699E+06	2.410E+04	1.212E+04	
MN. SQ	13	2.515E+08	1.346E+08	2.285E+06	2.459E+04	1.161E+04	
MN. SQ	14	2.223E+08	1.005E+08	1.673E+06	2.028E+04	1.027E+04	
MN. SQ	15	2.308E+08	6.738E+07	6.932E+05	1.347E+04	8.274E+03	
MN. SQ	16	2.171E+08	3.813E+07	1.287E+05	9.928E+03	5.946E+03	
MN. SQ	17	1.600E+08	1.631E+07	1.031E+05	1.065E+04	3.771E+03	
MN. SQ	18	1.029E+08	3.910E+06	1.152E+05	9.345E+03	1.915E+03	
MN. SQ	19	8.405E+07	2.329E+05	4.304E+04	3.838E+03	5.044E+02	

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	6.340E-04	5.426E-04	1.448E-03
MN. SQ	2	5.064E-05	4.809E-05	4.278E-04

SL-7 LIGHT FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 33.15 KNOTS. RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	3.126E-18	1.200E-20	1.566E-18	9.882E-22	8.202E-21	1.448E-12	1.900E-12	1.241E-14
.24000	.17456	3509.20	2.566E-07	2.038E-09	1.464E-07	2.812E-10	1.9 1E-09	8.564E-01	3.871E-01	4.343E-03
.28000	.19093	2578.19	7.805E-03	1.151E-04	5.108E-03	2.365E-05	1.599E-04	1.154E+05	2.785E+04	4.728E+02
.32000	.20367	1973.93	7.910E-01	2.013E-02	5.988E-01	5.823E-03	4.1 5E-02	3.983E+07	6.578E+06	1.515E+05
.36000	.21277	1559.65	6.409E+00	2.678E-01	5.664E+00	1.067E-01	8.402E-01	9.381E+08	1.250E+08	3.543E+06
.40000	.21823	1263.31	1.471E+01	9.809E-01	1.532E+01	5.367E-01	4.607E+00	5.679E+09	6.861E+08	2.197E+07
.44000	.22006	1044.06	1.651E+01	1.746E+00	2.040E+01	1.329E+00	1.208E+01	1.599E+10	1.909E+09	6.421E+07
.48000	.218[illegible]6	877.30	1.146E+01	1.967E+00	1.692E+01	2.139E+00	1.968E+01	2.780E+10	3.512E+09	1.165E+08
.52000	.21282	747.52	5.275E+00	1.584E+00	9.611E+00	2.569E+00	2.267E+01	3.425E+10	4.877E+09	1.512E+08
.56000	.20374	644.55	1.488E+00	9.540E-01	4.678E+00	2.444E+00	1.9 1E+01	3.181E+10	5.478E+09	1.507E+08
. 0000	.19103	561.47	1.632E-01	4.260E-01	4.916E+00	1.854E+00	1.264E+01	2.258E+10	5.140E+09	1.205E+08
.64000	.17468	493.48	2.608E-02	1.353E-01	9.020E+00	1.055E+00	5.828E+00	1.208E+10	4.147E+09	7.950E+07
.68000	.15470	437.13	1.024E-01	3.305E-02	1.298E+01	3.609E-01	1.555E+00	5.073E+09	2.853E+09	4.561E+07
.72000	.131[illegible]8	389.91	8.685E-02	1.432E-02	1.226E+01	5.885E-02	1.170E-01	2.724E+09	1.660E+09	2.622E+07
.76000	.10[illegible]83	349.95	3.127E-02	1.060E-02	6.006E+00	3.[illegible]07E-01	3.508E-01	3.121E+09	7.878E+08	1.835E+07
.80000	.07294	315.83	6.085E-03	4.555E-03	1.868E+01	1.160E+00	8.572E-01	4.884E+08	2.845E+08	1.467E+07
.84000	.03841	286.47	5.136E-03	5.407E-04	6.503E+02	3.206E+00	8.845E-01	1.441E+08	7.907E+07	1.013E+07
.88000	.00025	261.02	1.347E-02	5.062E-02	4.229E+11	5.028E+04	4.891E-01	2.673E+07	4.607E+07	5.011E+06
.92000	-.04154	238.81	1.026E-03	6.809E-04	4.861E+02	1.995E+00	1.245E-01	5.882E+07	6.403E+07	1.815E+06
.96000	-.08697	219.33	5.926E-05	1.007E-03	7.799E+00	2.782E-01	8.319E-03	3.994E+07	7.694E+07	2.993E+05
1.00000	-.13604	202.13	3.856E-04	8.363E-04	5.713E-04	1.895E-02	7.499E-02	2.577E+07	6.086E+07	8.581E+04
		MN. SQ	2.283E+00	3.279E-01	1.692E+10	2.012E+03	4.093E+00	6.514E+09	1.271E+09	3.322E+07
		R.M.S.	1.511E+00	5.726E-01	1.301E+05	4.486E+01	2.023E+00	8.071E+04	3.566E+04	5.764E+03
		AVG.	1.889E+00	7.158E-01	1.626E+05	5.607E+01	2.529E+00	1.009E+05	4.457E+04	7.204E+03
		SIG.	3.022E+00	1.145E+00	2.601E+05	8.971E+01	4.046E+00	1.614E+05	7.131E+04	1.153E+04
		AV1/10	3.853E+00	1.460E+00	3.317E+05	1.144E+02	5.159E+00	2.058E+05	9.092E+04	1.470E+04

VERT SHEAR LAT SHEAR (DIMENSIONAL)

	VERT SHEAR	LAT SHEAR
MN. SQ	4.311E+04	4.394E+04

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR (DIMENSIONAL)
MN. SQ	1	3.707E+08	1.362E+07	7.390E+06	1.242E+03	1.090E+04
MN. SQ	2	3.352E+08	8.454E+07	8.727E+06	3.959E+03	1.397E+04
MN. SQ	3	3.212E+08	1.762E+08	1.138E+07	2.189E+04	1.347E+04
MN. SQ	4	4.520E+08	2.918E+08	2.480E+07	6.731E+04	1.769E+04
MN. SQ	5	9.813E+08	4.403E+08	4.371E+07	1.272E+05	2.367E+04
MN. SQ	6	2.125E+09	6.261E+08	6.100E+07	1.629E+05	2.994E+04
MN. SQ	7	3.775E+09	8.394E+08	6.464E+07	1.489E+05	3.538E+04
MN. SQ	8	5.423E+09	[illegible].050E+09	5.579E+07	9.948E+04	[illegible].945E+04
MN. SQ	9	6.441E+09	1.209E+09	4.471E+07	5.530E+04	4.215E+04
MN. SQ	10	6.514E+09	1.271E+09	3.322E+07	4.311E+04	4.394E+04
MN. SQ	11	5.777E+09	1.208E+09	2.254E+07	6.017E+04	4.537E+04
MN. SQ	12	4.546E+09	1.044E+09	1.436E+07	9.176E+04	4.587E+04
MN. SQ	13	3.219E+09	8.227E+08	1.044E+07	1.161E+05	4.453E+04
MN. SQ	14	2.155E+09	5.866E+08	6.872E+06	1.130E+05	4.028E+04
MN. SQ	15	1.459E+09	3.727E+08	2.067E+06	8.655E+04	3.297E+04
MN. SQ	16	9.634E+08	2.054E+08	4.614E+05	6.443E+04	2.400E+04
MN. SQ	17	5.284E+08	9.009E+07	1.0 3E+06	5.703E+04	1.619E+04
MN. SQ	18	2.301E+08	2.325E+07	9.492E+05	4.278E+04	9.539E+03
MN. SQ	19	1.329E+08	1.569E+06	3.622E+05	1.551E+04	2.999E+03

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	2.903E-02	2.616E-02	1.983E-02
MN. SQ	2	5.587E-03	5.459E-03	7.225E-03

SL-7 LIGHT FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 40.60 KNOTS. RESPONSE (AMPLITUDE) SPE

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	T
.20000	.15456	5053.25	4.561E-06	1.751E-08	2.284E-06	1.442E-09	1.1[illegible]7E-08	2.113E+00	2.772E+00	1
.24000	.17456	3509.20	1.886E-01	1.498E-03	1.076E-01	2.066E-04	1.426E-03	6.292E+05	2.845E+05	3
.28000	.19093	2578.19	1.145E+01	1.689E-01	7.493E+00	3.469E-02	2.346E-01	1.692E+08	4.085E+07	6
.32000	.20367	1973.93	5.679E+01	1.445E+00	4.299E+01	4.180E-01	3.005E+00	2.860E+09	4.723E+08	1
.36000	.21277	1559.65	9.237E+01	3.859E+00	8.164E+01	1.537E+00	1.211E+01	1.352E+10	1.802E+09	5
.40000	.21823	1263.31	8.471E+01	5.648E+00	8.819E+01	3.090E+00	2.6 3E+01	3.270E+10	3.950E+09	1
.44000	.22006	1044.06	5.457E+01	5.771E+00	6.744E+01	4.392E+00	3.992E+01	5.285E+10	6.310E+09	2
.48000	.21806	877.30	2.665E+01	4.575E+00	3.936E+01	4.975E+00	4.579E+01	6.466E+10	8.169E+09	2
.52000	.21282	747.52	9.737E+00	2.925E+00	1.774E+01	4.741E+00	4.1 5E+01	6.322E+10	9.003E+09	2
.56000	.20374	644.55	2.347E+00	1.505E+00	7.379E+00	3.855E+00	3.078E+01	5.017E+10	8.641E+09	2
.60000	.19103	561.47	2.306E-01	6.020E-01	6.947E+00	2.620E+00	1.786E+01	3.191E+10	7.292E+09	1
.64000	.17468	493.48	3.407E-02	1.767E-01	1.178E+01	1.377E+00	7.613E+00	1.578E+10	5.416E+09	1
.68000	.15470	437.13	1.263E-01	4.075E-02	1.601E+01	4.450E-01	1.917E+00	6.255E+00	3.518E+09	5
.72000	.13108	389.91	1.026E-01	1.692E-02	1.449E+01	6.953E-02	1.383E-01	3.218E+09	1.961E+09	3
.74000	.10383	349.95	3.576E-02	1.213E-02	6.870E+00	3.668E-01	4.012E-01	3.570E+09	9.010E+08	2
.80000	.07294	315.83	6.788E-03	5.081E-03	2.084E+01	1.294E+00	9.564E-01	5.448E+08	3.174E+08	1
.84000	.03841	286.47	5.620E-03	5.916E-04	7.115E+02	3.508E+00	9.678E-01	1.576E+08	8.652E+07	1
.88000	.00025	261.02	1.451E-02	5.455E-02	4.557E+11	5.418E+04	5.271E-01	2.881E+07	4.964E+07	5
.92000	-.04154	238.81	1.092E-03	7.248E-04	5.174E+02	2.124E+00	1.325E-01	6.262E+07	6.817E+07	1
.96000	-.08697	219.33	6.247E-05	1.062E-03	8.222E+00	2.933E-01	8.770E-03	4.210E+07	8.111E+07	3
1.00000	-.13604	202.13	4.033E-04	8.746E-04	5.975E-04	1.982E-02	7.843E-02	2.695E+07	6.365E+07	8
		MN. SQ	1.357E+01	1.072E+00	1.823E+10	2.169E+03	9.231E+00	1.367E+10	2.324E+09	6
		R.M.S.	3.684E+00	1.036E+00	1.350E+05	4.657E+01	3.038E+00	1.169E+05	4.821E+04	8
		AVG.	4.606E+00	1.294E+00	1.688E+05	5.821E+01	3.798E+00	1.461E+05	6.027E+04	1
		SIG.	7.369E+00	2.071E+00	2.700E+05	9.314E+01	6.077E+00	2.338E+05	9.642E+04	1
		AV1/10	9.395E+00	2.641E+00	3.443E+05	1.188E+02	7.748E+00	2.981E+05	1.229E+05	2

	VERT SHEAR	LAT SHEAR	(DIMENSIONAL)
MN. SQ	5.198E+04	6.545E+04	

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR	(DIMENSIONAL)
MN. SQ	1	4.091E+08	2.956E+07	1.576E+07	1.971E+03	2.338E+04	
MN. SQ	2	3.734E+08	1.813E+08	1.836E+07	7.608E+03	2.907E+04	
MN. SQ	3	3.827E+08	3.755E+08	2.330E+07	4.467E+04	2.623E+04	
MN. SQ	4	6.907E+08	6.150E+08	5.003E+07	1.340E+05	3.192E+04	
MN. SQ	5	1.801E+09	9.102E+08	8.812E+07	2.461E+05	4.009E+04	
MN. SQ	6	4.130E+09	1.260E+09	1.241E+08	3.072E+05	4.839E+04	
MN. SQ	7	7.479E+09	1.640E+09	1.327E+08	2.726E+05	5.535E+04	
MN. SQ	8	1.089E+10	1.994E+09	1.142E+08	1.722E+05	6.036E+04	
MN. SQ	9	1.319E+10	2.246E+09	8.968E+07	8.169E+04	6.339E+04	
MN. SQ	10	1.367E+10	2.324E+09	6.427E+07	5.198E+04	6.545E+04	
MN. SQ	11	1.246E+10	2.190E+09	4.116E+07	8.211E+04	6.779E+04	
MN. SQ	12	1.004E+10	1.883E+09	2.395E+07	1.480E+05	6.915E+04	
MN. SQ	13	7.159E+09	1.483E+09	1.647E+07	2.092E+05	6.782E+04	
MN. SQ	14	4.624E+09	1.061E+09	1.064E+07	2.217E+05	6.230E+04	
MN. SQ	15	2.840E+09	6.788E+08	2.948E+06	1.824E+05	5.194E+04	
MN. SQ	16	1.651E+09	3.804E+08	9.085E+05	1.352E+05	3.878E+04	
MN. SQ	17	8.070E+08	1.714E+08	2.178E+06	1.055E+05	2.756E+04	
MN. SQ	18	3.053E+08	4.572E+07	2.022E+06	7.062E+04	1.755E+04	
MN. SQ	19	1.482E+08	3.230E+06	8.188E+05	2.411E+04	5.897E+03	

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	1.088E-01	1.003E-01	5.094E-02
MN. SQ	2	3.018E-02	2.971E-02	3.094E-02

SL-7 LIGHT FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 46.85 KNOTS, RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	S W A Y	Y A W	R O L L	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	7.985E-02	3.065E-04	3.999E-02	2.524E-05	2.0 5E-04	3.700E+04	4.852E+04	3.170E+02
.24000	.17456	3509.20	2.098E+01	1.666E-01	1.197E+01	2.299E-02	1.587E-01	7.000E+07	3.165E+07	3.550E+05
.28000	.19093	2578.19	1.457E+02	2.149E+00	9.532E+01	4.414E-01	2.9 4E+00	2.153E+09	5.197E+08	8.824E+06
.32000	.20367	1973.93	2.522E+02	6.417E+00	1.909E+02	1.856E+00	1.334E+01	1.270E+10	2.097E+09	4.831E+07
.36000	.21277	1559.65	2.343E+02	9.788E+00	2.071E+02	3.899E+00	3.071E+01	3.429E+10	4.569E+09	1.295E+08
.40000	.21823	1263.31	1.560E+02	1.040E+01	1.624E+02	5.691E+00	4.8 5E+01	6.021E+10	7.275E+09	2.329E+08
.44000	.22006	1044.06	8.282E+01	8.758E+00	1.023E+02	6.664E+00	6.059E+01	8.021E+10	9.576E+09	3.221E+08
.48000	.21826	877.30	3.578E+01	6.142E+00	5.283E+01	6.679E+00	6.147E+01	8.680E+10	1.097E+10	3.639E+08
.52000	.21282	747.52	1.206E+01	3.622E+00	2.197E+01	5.871E+00	5.153E+01	7.829E+10	1.115E+10	3.455E+08
.56000	.20374	644.55	2.752E+00	1.764E+00	8.650E+00	4.520E+00	3.608E+01	5.881E+10	1.013E+10	2.787E+08
.60000	.19163	561.47	2.602E-01	6.792E-01	7.838E+00	2.956E+00	2.015E+01	3.600E+10	8.227E+09	1.921E+08
.64000	.17468	493.48	3.739E-02	1.940E-01	1.293E+01	1.512E+00	8.356E+00	1.732E+10	5.945E+09	1.140E+08
.68000	.15470	437.13	1.359E-01	4.384E-02	1.722E+01	4.788E-01	2.063E+00	6.730E+09	3.785E+09	6.051E+07
.72000	.13108	389.91	1.088E-01	1.794E-02	1.536E+01	7.369E-02	1.465E-01	3.411E+09	2.079E+09	3.283E+07
.76000	.10383	349.95	3.748E-02	1.271E-02	7.199E+00	3.844E-01	4.204E-01	3.741E+09	9.442E+08	2.200E+07
.80000	.07294	315.83	7.052E-03	5.279E-03	2.165E+01	1.344E+00	9.936E-01	5.660E+08	3.297E+08	1.701E+07
.84000	.03841	286.47	5.799E-03	6.105E-04	7.342E+02	3.620E+00	9.987E-01	1.627E+08	8.928E+07	1.144E+07
.88000	.00025	261.02	1.489E-02	5.599E-02	4.678E+11	5.561E+04	5.410E-01	2.957E+07	5.095E+07	5.542E+06
.92000	-.04154	238.81	1.116E-03	7.408E-04	5.289E+02	2.171E+00	1.355E-01	6.400E+07	6.967E+07	1.975E+06
.96000	-.08697	219.33	6.363E-05	1.082E-03	8.375E+00	2.987E-01	8.933E-03	4.289E+07	8.262E+07	3.213E+05
1.00000	-.13604	202.13	4.096E-04	8.884E-04	6.069E-04	2.013E-02	7.966E-02	2.737E+07	6.465E+07	9.116E+04
		MN. SQ	3.773E+01	2.009E+00	1.871E+10	2.226E+03	1.359E+01	1.926E+10	3.118E+09	8.752E+07
		R.M.S.	6.142E+00	1.417E+00	1.368E+05	4.719E+01	3.687E+00	1.388E+05	5.584E+04	9.355E+03
		AVG.	7.678E+00	1.772E+00	1.710E+05	5.898E+01	4.609E+00	1.735E+05	6.980E+04	1.169E+04
		SIG.	1.228E+01	2.835E+00	2.736E+05	9.437E+01	7.3 4E+00	2.776E+05	1.117E+05	1.871E+04
		AV1/10	1.566E+01	3.614E+00	3.488E+05	1.203E+02	9.402E+00	3.539E+05	1.424E+05	2.386E+04

VERT SHEAR LAT SHEAR (DIMENSIONAL)

MN. SQ	5.628E+04	7.826E+04

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR (DIMENSIONAL)
MN. SQ	1	4.242E+08	4.260E+07	2.265E+07	2.573E+03	3.362E+04
MN. SQ	2	3.902E+08	2.606E+08	2.621E+07	1.047E+04	4.127E+04
MN. SQ	3	4.192E+08	5.390E+08	3.266E+07	6.237E+04	3.610E+04
MN. SQ	4	8.65[illegible]E+08	8.788E+08	6.945E+07	1.846E+05	4.230E+04
MN. SQ	5	2.419E+09	1.289E+09	1.221E+08	3.351E+05	5.143E+04
MN. SQ	6	5.649E+09	1.764E+09	1.727E+08	4.141E+05	6.053E+04
MN. SQ	7	1.029E+10	2.265E+09	1.850E+08	3.640E+05	6.801E+04
MN. SQ	8	1.508E+10	2.720E+09	1.593E+08	2.259E+05	7.323E+04
MN. SQ	9	1.839E+10	3.033E+09	1.241E+08	1.003E+05	7.615E+04
MN. SQ	10	1.926E+10	3.118E+09	8.752E+07	5.628E+04	7.826E+04
MN. SQ	11	1.775E+10	2.926E+09	5.457E+07	9.543E+04	8. 36E+04
MN. SQ	12	1.444E+10	2.511E+09	3.038E+07	1.882E+05	8.359E+04
MN. SQ	13	1.034E+10	1.980E+09	2.033E+07	2.808E+05	8.251E+04
MN. SQ	14	6.603E+09	1.424E+09	1.309E+07	3.092E+05	7.653E+04
MN. SQ	15	3.907E+09	9.179E+08	3.566E+06	2.622E+05	6.463E+04
MN. SQ	16	2.148E+09	5.205E+08	1.308E+06	1.941E+05	4.911E+04
MN. SQ	17	9.927E+08	2.381E+08	3.073E+06	1.429E+05	3.609E+04
MN. SQ	18	3.518E+08	6.458E+07	2.887E+06	8.983E+04	2.400E+04
MN. SQ	19	1.557E+08	4.668E+06	1.212E+06	2.970E+04	8.330E+03

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	2.178E-01	2.035E-01	8.673E-02
MN. SQ	2	7.492E-02	7.404E-02	6.848E-02

SL-7 LIGHT FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 52.41 KNOTS, RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	7.695E+00	2.954E-02	3.854E+00	2.433E-03	2.019E-02	3.565E+06	4.676E+06	3.055E+04
.24000	.17456	3509.10	1.899E+02	1.508E+00	1.083E+02	2.081E-01	1.437E+00	6.337E+08	2.865E+08	3.214E+06
.28000	.19093	2578.19	4.784E+02	7.057E+00	3.131E+02	1.450E+00	9.800E+00	7.070E+09	1.707E+09	2.898E+07
.32000	.20367	1973.93	5.063E+02	1.288E+01	3.833E+02	3.727E+00	2.679E+01	2.550E+10	4.211E+09	9.699E+07
.36000	.21277	1559.65	3.620E+02	1.512E+01	3.200E+02	6.025E+00	4.746E+01	5.299E+10	7.061E+09	2.001E+08
.40000	.21823	1263.31	2.075E+02	1.384E+01	2.161E+02	7.571E+00	6.499E+01	8.011E+10	9.679E+09	3.099E+08
.44000	.22006	1044.06	1.006E+02	1.064E+01	1.244E+02	8.099E+00	7.3 3E+01	9.748E+10	1.164E+10	3.915E+08
.48000	.21826	877.30	4.106E+01	7.048E+00	6.063E+01	7.665E+00	7.054E+01	9.962E+10	1.259E+10	4.176E+08
.52000	.21282	747.52	1.333E+01	4.003E+00	2.428E+01	6.489E+00	5.728E+01	8.653E+10	1.232E+10	3.818E+08
.56000	.20374	644.55	2.964E+00	1.900E+00	9.318E+00	4.868E+00	3.886E+01	6.335E+10	1.091E+10	3.002E+08
.60000	.19103	561.47	2.753E-01	7.186E-01	8.292E+00	3.127E+00	2.132E+01	3.809E+10	8.704E+09	2.033E+08
.64000	.17468	493.48	3.906E-02	2.026E-01	1.351E+01	1.579E+00	8.728E+00	1.809E+10	6.210E+09	1.191E+08
.68000	.15470	437.13	1.406E-01	4.537E-02	1.782E+01	4.954E-01	2.134E+00	6.964E+09	3.916E+09	6.262E+07
.72000	.13108	389.91	1.116E-01	1.843E-02	1.578E+01	7.573E-02	1.506E-01	3.505E+09	2.136E+09	3.373E+07
.76000	.10383	349.95	3.831E-02	1.299E-02	7.359E+00	3.930E-01	4.2 7E-01	3.824E+09	9.652E+08	2.249E+07
.80000	.07294	315.83	7.179E-03	5.374E-03	2.204E+01	1.368E+00	1.011E+00	5.762E+08	3.357E+08	1.731E+07
.84000	.03841	286.47	5.885E-03	6.195E-04	7.450E+02	3.673E+00	1.013E+00	1.651E+08	9.060E+07	1.161E+07
.88000	.00025	261.02	1.508E-02	5.667E-02	4.735E+11	5.630E+04	5.476E-01	2.993E+07	5.158E+07	5.610E+06
.92000	-.04154	238.81	1.127E-03	7.484E-04	5.343E+02	2.193E+00	1.368E-01	6.466E+07	7.038E+07	1.996E+06
.96000	-.08697	219.33	6.418E-05	1.091E-03	8.447E+00	3.013E-01	9.010E-03	4.326E+07	8.333E+07	3.241E+05
1.00000	-.13604	202.13	4.126E-04	8.949E-04	6.113E-04	2.028E-02	8.025E-02	2.757E+07	6.513E+07	9.183E+04
		MN. SQ	7.627E+01	3.003E+00	1.894E+10	2.254E+03	1.705E+01	2.339E+10	3.720E+09	1.043E+08
		R.M.S.	8.733E+00	1.733E+00	1.376E+05	4.748E+01	4.1 0E+00	1.529E+05	6.099E+04	1.021E+04
		AVG.	1.092E+01	2.166E+00	1.720E+05	5.935E+01	5.1 2E+00	1.912E+05	7.624E+04	1.277E+04
		SIG.	1.747E+01	3.466E+00	2.752E+05	9.496E+01	8.259E+00	3.058E+05	1.220E+05	2.043E+04
		AV1/10	2.227E+01	4.419E+00	3.509E+05	1.211E+02	1.0 3E+01	3.900E+05	1.555E+05	2.605E+04

VERT SHEAR LAT SHEAR (DIMENSIONAL)

MN. SQ 5.903E+04 8.640E+04

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR (DIMENSIONAL)
MN. SQ	1	4.318E+08	5.270E+07	2.803E+07	3.049E+03	4.162E+04
MN. SQ	2	3.997E+08	3.226E+08	3.230E+07	1.260E+04	5.076E+04
MN. SQ	3	4.436E+08	6.671E+08	3.967E+07	7.539E+04	4.359E+04
MN. SQ	4	9.905E+08	1.085E+09	8.372E+07	2.215E+05	4.991E+04
MN. SQ	5	2.868E+09	1.585E+09	1.470E+08	3.993E+05	5.945E+04
MN. SQ	6	6.752E+09	2.155E+09	2.082E+08	4.909E+05	6.887E+04
MN. SQ	7	1.234E+10	2.746E+09	2.238E+08	4.297E+05	7.647E+04
MN. SQ	8	1.812E+10	3.275E+09	1.925E+08	2.646E+05	8.164E+04
MN. SQ	9	2.220E+10	3.631E+09	1.492E+08	1.137E+05	8.432E+04
MN. SQ	10	2.339E+10	3.720E+09	1.043E+08	5.903E+04	8.640E+04
MN. SQ	11	2.167E+10	3.484E+09	6.411E+07	1.044E+05	9.013E+04
MN. SQ	12	1.773E+10	2.987E+09	3.480E+07	2.171E+05	9.311E+04
MN. SQ	13	1.272E+10	2.360E+09	2.292E+07	3.338E+05	9.231E+04
MN. SQ	14	8.075E+09	1.704E+09	1.478E+07	3.753E+05	8.621E+04
MN. SQ	15	4.688E+09	1.104E+09	4.050E+06	3.234E+05	7.348E+04
MN. SQ	16	2.500E+09	6.314E+08	1.636E+06	2.392E+05	5.658E+04
MN. SQ	17	1.119E+09	2.916E+08	3.723E+06	1.704E+05	4.258E+04
MN. SQ	18	3.827E+08	7.992E+07	3.538E+06	1.031E+05	2.911E+04
MN. SQ	19	1.601E+08	5.859E+06	1.523E+06	3.349E+04	1.031E+04

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	3.400E-01	3.205E-01	1.252E-01
MN. SQ	2	1.354E-01	1.341E-01	1.143E-01

WAVE SPECTRAL DENSITY, PIERSON-MOSKOWITZ (1964) SPECTRA

FOR WIND SPEEDS (KNOTS) OF

	23.440	33.150	40.600	46.850	52.410
SPECTRA NO.	1	2	3	4	5
WAVE FREQ.					
.200	.000	.000	.000	.085	8.197
.240	.000	.000	.213	23.739	214.894
.280	.000	.010	14.267	181.502	596.100
.320	.000	1.139	81.788	363.204	729.250
.360	.000	11.378	163.904	415.945	642.727
.400	.003	35.043	201.768	371.580	494.367
.440	.093	59.078	195.205	296.365	360.179
.480	.753	71.982	167.439	224.777	257.958
.520	2.676	73.152	135.024	167.211	184.790
.560	5.720	67.022	105.711	123.923	133.484
.600	8.938	57.851	81.750	92.230	97.581
.640	11.406	48.269	63.049	69.206	72.288
.680	12.746	39.536	48.755	52.453	54.277
.720	13.038	32.089	37.913	40.183	41.291
.760	12.567	25.960	29.603	31.117	31.806
.800	11.635	21.009	23.438	24.350	24.788
.840	10.483	17.046	18.652	19.247	19.531
.880	9.274	13.885	14.963	15.358	15.546
.920	8.106	11.364	12.098	12.365	12.492
.960	7.031	9.349	9.856	10.039	10.126
1.000	6.071	7.733	8.088	8.215	8.275
MN. SQ	4.700	23.961	56.388	101.558	160.068
R.M.S.	2.168	4.895	7.509	10.078	12.652
AVG.	2.655	5.994	9.195	12.340	15.492
SIG.	4.336	9.790	15.018	20.155	25.304
AV1/10	5.518	12.459	19.112	25.649	32.201

SL-7 HEAVY FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 23.44 KNOTS, RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	6.265E-84	2.413E-86	3.035E-84	2. 51E-87	4.419E-86	3.120E-78	4.506E-78	7.598E-80
.24000	.17456	3509.20	5.294E-39	4.227E-41	2.888E-39	6.006E-42	1.615E-40	1.980E-32	9.366E-33	3.677E-34
.28000	.19093	2578.19	6.101E-20	9.073E-22	3.764E-20	1.920E-22	7.820E-21	1.028E-12	2.544E-13	2.098E-14
.32000	.20367	1973.93	7.316E-11	1.884E-12	5.153E-11	5.493E-13	3.710E-11	4.257E-03	7.124E-04	1.092E-04
.36000	.21277	1559.65	3.417E-06	1.454E-07	2.810E-06	5.459E-08	5.9 6E-06	5.654E+02	7.791E+01	1.860E+01
.40000	.21623	1263.31	1.094E-03	7.492E-05	1.084E-03	3.520E-05	5.525E-03	5.016E+05	5.957E+04	1.782E+04
.44000	.22066	1044.06	2.393E-02	2.636E-03	2.917E-02	1.630E-03	3.054E-01	2.813E+07	3.309E+06	1.023E+06
.48000	.21826	877.36	1.064E-01	1.948E-02	1.605E-01	1.761E-02	3.216E+00	3.237E+08	4.156E+07	1.135E+07
.52000	.21282	747.52	1.596E-01	5.343E-02	3.179E-01	7.840E-02	1.109E+01	1.377E+09	2.085E+08	4.224E+07
.56000	.20374	644.55	9.120E-02	7.272E-02	4.362E-01	1.841E-01	1.636E+01	2.954E+09	5.627E+08	6.999E+07
.60000	.19113	561.47	1.026E-02	5.588E-02	1.015E+00	2.532E-01	1.250E+01	3.742E+09	9.728E+08	6.436E+07
.64000	.17468	493.49	1.092E-02	2.499E-02	2.520E+00	2.047E-01	5.372E+00	3.004E+09	1.199E+09	3.911E+07
.68000	.15470	437.13	3.956E-02	7.623E-03	4.193E+00	7.627E-02	1.181E+00	1.626E+09	1.112E+09	1.849E+07
.72000	.13108	389.91	3.487E-02	4.883E-03	4.078E+00	2.446E-02	6.5 6E-01	9.404E+08	7.862E+08	1.068E+07
.76000	.10383	349.95	1.188E-02	4.732E-03	1.919E+00	2.179E-01	1.692E+00	1.198E+09	4.121E+08	1.095E+07
.80000	.07294	315.83	1.693E-03	2.516E-03	1.556E+01	7.224E-01	2.272E+00	2.054E+09	1.484E+08	1.148E+07
.84000	.03845	286.47	2.516E-03	6.221E-04	4.737E+02	2.022E+00	1.788E+00	7.009E+07	4.190E+07	8.579E+06
.88000	.00025	261.02	3.038E-03	1.669E-02	2.868E+11	3.407E+04	8.2 5E-01	9.851E+06	3.404E+07	4.210E+06
.92000	-.04154	238.81	1.252E-03	4.392E-04	3.082E+02	1.387E+00	1.708E-01	7.249E+07	5.685E+07	1.255E+06
.96000	-.08697	219.33	2.900E-04	7.567E-04	3.819E+00	1.664E-01	1.809E-02	5.205E+07	6.971E+07	1.335E+05
1.00000	-.13664	202.13	3.327E-04	6.080E-04	2.163E-02	7.143E-03	2.603E-01	1.647E+07	5.108E+07	7.505E+05
		MN. SQ.	1.994E-02	1.071E-02	1.147E+10	1.363E+03	2.304E+00	6.245E+08	2.270E+08	1.177E+07
		R.M.S.	1.412E-01	1.035E-01	1.071E+05	3.692E+01	1.518E+00	2.499E+04	1.507E+04	3.431E+03
		AVG.	1.765E-01	1.294E-01	1.339E+05	4.615E+01	1.897E+00	3.124E+04	1.883E+04	4.288E+03
		SIG.	2.824E-01	2.070E-01	2.142E+05	7.383E+01	3.036E+00	4.998E+04	3.013E+04	6.861E+03
		AV1/10	3.601E-01	2.639E-01	2.731E+05	9.414E+01	3.870E+00	6.372E+04	3.842E+04	8.748E+03

VERT SHEAR LAT SHEAR (DIMENSIONAL)

MN. SQ	1.406E+04	1.328E+04

	STATION	VERT.B.M.	LAT.B.M.	TORSN.M.	VERT.SHEAR	LAT.SHEAR	(DIMENSIONAL)
MN. SQ	1	2.122E+08	1.121E+06	6.586E+05	3.710E+02	1.111E+03	
MN. SQ	2	1.914E+08	8.614E+06	1.202E+06	7.253E+02	1.840E+03	
MN. SQ	3	1.723E+08	2.043E+07	3.075E+06	2.832E+03	2.332E+03	
MN. SQ	4	1.680E+08	3.633E+07	9.408E+06	8.465E+03	3.692E+03	
MN. SQ	5	2.065E+08	5.821E+07	1.757E+07	1.653E+04	5.659E+03	
MN. SQ	6	3.120E+08	8.817E+07	2.446E+07	2.266E+04	7.839E+03	
MN. SQ	7	4.690E+08	1.265E+08	2.639E+07	2.325E+04	9.880E+03	
MN. SQ	8	6.140E+08	1.696E+08	2.392E+07	1.912E+04	1.149E+04	
MN. SQ	9	6.744E+08	2.073E+08	1.810E+07	1.487E+04	1.255E+04	
MN. SQ	10	6.245E+08	2.270E+08	1.177E+07	1.406E+04	1.328E+04	
MN. SQ	11	5.018E+08	2.220E+08	5.698E+06	1.634E+04	1.380E+04	
MN. SQ	12	3.660E+08	1.969E+08	1.946E+06	1.926E+04	1.389E+04	
MN. SQ	13	2.659E+08	1.611E+08	1.069E+06	2.018E+04	1.324E+04	
MN. SQ	14	2.236E+08	1.220E+08	8.084E+05	1.732E+04	1.172E+04	
MN. SQ	15	2.189E+08	8.337E+07	7.087E+05	1.212E+04	9.570E+03	
MN. SQ	16	1.999E+08	4.806E+07	1.229E+06	9.209E+03	7.116E+03	
MN. SQ	17	1.425E+08	2.083E+07	1.488E+06	1.013E+04	4.698E+03	
MN. SQ	18	8.104E+07	5.089E+06	8.905E+05	9.636E+03	2.451E+03	
MN. SQ	19	5.513E+07	3.164E+05	2.022E+05	4.359E+03	6.564E+02	

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	6.155E-04	7.489E-04	1.749E-03
MN. SQ	2	4.062E-05	4.413E-05	4.270E-04

SL-7 HEAVY FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 33.15 KNOTS. RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	3.114E-18	1.199E-20	1.509E-18	1.019E-21	2.1 6E-20	1.551E-12	2.239E-12	3.776E-14
.24000	.17456	3509.20	2.547E-07	2.034E-09	1.390E-07	2.890E-10	7.771E-09	9.527E-01	4.506E-01	1.769E-02
.28000	.19093	2578.19	7.703E-03	1.146E-04	4.752E-03	2.424E-05	9.875E-04	1.298E+05	3.213E+04	2.649E+03
.32000	.20367	1973.93	7.740E-01	1.994E-02	5.451E-01	5.811E-03	3.925E-01	4.504E+07	7.537E+06	1.156E+06
.36000	.21277	1559.65	6.193E+00	2.635E-01	5.093E+00	9.893E-02	1.085E+01	1.061E+09	1.412E+08	3.370E+07
.40000	.21823	1263.31	1.396E+01	9.564E-01	1.384E+01	4.494E-01	7.0 3E+01	6.403E+09	7.604E+08	2.275E+08
.44000	.22006	1044.06	1.525E+01	1.680E+00	1.859E+01	1.039E+00	1.947E+02	1.793E+10	2.109E+09	6.525E+08
.48000	.21826	877.30	1.017E+01	1.861E+00	1.533E+01	1.682E+00	3.073E+02	3.093E+10	3.970E+09	1.085E+09
.52000	.21282	747.52	4.371E+00	1.464E+00	8.708E+00	2.147E+00	3.037E+02	3.773E+10	5.712E+09	1.157E+09
.56000	.20374	644.55	1.069E+00	8.521E-01	5.111E+00	2.157E+00	1.917E+02	3.461E+10	6.593E+09	8.201E+08
.60000	.19103	561.47	6.642E-02	3.617E-01	6.567E+00	1.639E+00	8.091E+01	2.422E+10	6.296E+09	4.165E+08
.64000	.17468	493.48	4.619E-02	1.058E-01	1.066E+01	8.661E-01	2.2 3E+01	1.271E+10	5.074E+09	1.655E+08
.68000	.15470	437.13	1.227E-01	2.364E-02	1.301E+01	2.366E-01	3.6 4E+00	5.042E+09	3.449E+09	5.736E+07
.72000	.13108	389.91	8.583E-02	1.202E-02	1.004E+01	6.020E-02	1.621E+00	2.315E+09	1.935E+09	2.627E+07
.76000	.10383	349.95	2.453E-02	9.775E-03	3.963E+00	4.502E-01	3.494E+00	2.474E+09	8.513E+08	2.263E+07
.80000	.07294	315.83	2.894E-03	4.543E-03	2.810E+01	1.304E+00	4.103E+00	3.709E+08	2.680E+08	2.074E+07
.84000	.0384	286.47	4.091E-03	1.012E-03	7.702E+02	3.287E+00	2.908E+00	1.140E+08	6.814E+07	1.395E+07
.88000	.00025	261.02	4.549E-03	2.498E-02	4.294E+11	5.100E+04	1.242E+00	1.475E+07	5.097E+07	6.303E+06
.92000	-.04154	238.81	1.755E-03	6.157E-04	4.321E+02	1.044E+00	2.3 5E-01	1.016E+08	7.970E+07	1.759E+06
.96000	-.08697	219.33	3.856E-04	1.006E-03	5.079E+00	2.212E-01	2.406E-02	6.922E+07	9.269E+07	1.775E+05
1.00000	-.13604	202.13	4.238E-04	7.745E-04	2.755E-02	9.099E-03	3.315E-01	2.099E+07	6.506E+07	9.560E+05
		MN. SQ.	2.086E+00	3.057E-01	1.718E+10	2.041E+03	4.801E+01	7.046E+09	1.500E+09	1.883E+08
		R.M.S.	1.444E+00	5.529E-01	1.311E+05	4.518E+01	6.929E+00	8.394E+04	3.873E+04	1.372E+04
		AVG.	1.805E+00	6.911E-01	1.638E+05	5.647E+01	8.601E+00	1.049E+05	4.841E+04	1.715E+04
		SIG.	2.889E+00	1.106E+00	2.621E+05	9.035E+01	1.3 6E+01	1.679E+05	7.745E+04	2.745E+04
		AV1/10	3.683E+00	1.410E+00	3.342E+05	1.152E+02	1.767E+01	2.140E+05	9.876E+04	3.499E+04

	VERT SHEAR	LAT SHEAR	(DIMENSIONAL)
MN. SQ	3.386E+04	5.353E+04	

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR	(DIMENSIONAL
MN. SQ	1	3.451E+08	1.476E+07	8.838E+06	8.369E+02	1.348E+04	
MN. SQ	2	3.126E+08	1.045E+08	1.691E+07	4.727E+03	1.966E+04	
MN. SQ	3	3.086E+08	2.389E+08	4.703E+07	2.638E+04	1.920E+04	
MN. SQ	4	4.735E+08	4.064E+08	1.461E+08	7.617E+04	2.315E+04	
MN. SQ	5	1.074E+09	6.081E+08	2.774E+08	1.359E+05	2.963E+04	
MN. SQ	6	2.311E+09	8.383E+08	4.039E+08	1.670E+05	3.690E+04	
MN. SQ	7	4.047E+09	1.077E+09	4.505E+08	1.483E+05	4.395E+04	
MN. SQ	8	5.768E+09	1.296E+09	3.959E+08	9.667E+04	4.954E+04	
MN. SQ	9	6.877E+09	1.452E+09	3.011E+08	4.987E+04	5.258E+04	
MN. SQ	10	7.046E+09	1.500E+09	1.893E+08	3.386E+04	5.353E+04	
MN. SQ	11	6.355E+09	1.417E+09	8.286E+07	4.846E+04	5.361E+04	
MN. SQ	12	5.108E+09	1.227E+09	1.950E+07	7.930E+04	5.293E+04	
MN. SQ	13	3.690E+09	9.743E+08	5.265E+06	1.068E+05	5.089E+04	
MN. Q	14	2.470E+09	7.040E+08	2.208E+06	1.115E+05	4.602E+04	
MN. SQ	15	1.613E+09	4.583E+08	7.970E+06	9.252E+04	3.776E+04	
MN. SQ	16	1.011E+09	2.601E+08	2.594E+07	7.120E+04	2.823E+04	
MN. SQ	17	5.340E+08	1.169E+08	3.209E+07	6.031E+04	2.007E+04	
MN. Q	18	2.110E+08	3.060E+07	1.884E+07	4.555E+04	1.239E+04	
MN. SQ	19	9.235E+07	2.071E+06	4.192E+06	1.788E+04	3.947E+03	

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	2.872E-02	2.376E-02	1.908E-02
MN. SQ	2	4.892E-03	5.319E-03	8.112E-03

SL-7 HEAVY FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG. WIND SPEED = 40.60 KNOTS. RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	4.544E-06	1.750E-08	2.201E-06	1.487E-09	3.205E-08	2.263E+00	3.268E+00	5.510E-02
.24000	.17456	3509.20	1.872E-01	1.494E-03	1.021E-01	2.123E-04	5.710E-03	7.000E+05	3.311E+05	1.300E+04
.28000	.19093	2578.19	1.130E+01	1.681E-01	6.972E+00	3.556E-02	1.449E+00	1.905E+08	4.713E+07	3.886E+06
.32000	.20367	1973.93	5.557E+01	1.431E+00	3.914E+01	4.172E-01	2.818E+01	3.233E+09	5.411E+08	8.296E+07
.36000	.21277	1559.65	8.926E+01	3.798E+00	7.341E+01	1.426E+00	1.564E+02	1.529E+10	2.035E+09	4.857E+08
.40000	.21823	1263.31	8.038E+01	5.507E+00	7.968E+01	2.587E+00	4.091E+02	3.687E+10	4.378E+09	1.310E+09
.44000	.22006	1044.06	5.042E+01	5.555E+00	6.146E+01	3.435E+00	6.435E+02	5.927E+10	6.973E+09	2.157E+09
.48000	.218-6	877.30	2.365E+01	4.328E+00	3.566E+01	3.913E+00	7.148E+02	7.194E+10	9.235E+09	2.523E+09
.52000	.21282	747.52	8.068E+00	2.701E+00	1.607E+01	3.964E+00	5.605E+02	6.964E+10	1.054E+10	2.136E+09
.56000	.20376	644.55	1.685E+00	1.344E+00	8.062E+00	3.403E+00	3.024E+02	5.459E+10	1.040E+10	1.293E+09
.60000	.191 3	561.47	9.385E-02	5.111E-01	9.280E+00	2.316E+00	1.143E+02	3.423E+10	8.898E+09	5.886E+08
.64000	.17468	493.48	6.034E-02	1.382E-01	1.393E+01	1.131E+00	2.969E+01	1.661E+10	6.628E+09	2.162E+08
.68000	.15470	437.13	1.513E-01	2.916E-02	1.604E+01	2.917E-01	4.519E+00	6.218E+09	4.254E+09	7.076E+07
.72000	.131-8	389.91	1.014E-01	1.420E-02	1.186E+01	7.112E-02	1.915E+00	2.735E+09	2.286E+09	3.104E+07
.76000	.10383	349.95	2.806E-02	1.118E-02	6.533E+00	5.149E-01	3.9?7E+00	2.830E+09	9.737E+08	2.580E+07
.80000	.07294	315.83	3.229E-03	5.069E-03	3.135E+01	1.455E+00	4.577E+00	4.137E+08	2.990E+08	2.313E+07
.84000	.03841	286.47	4.476E-03	1.107E-03	8.427E+02	3.?97E+00	3.182E+00	1.247E+08	7.456E+07	1.526E+07
.88000	.00025	261.02	4.992E-03	2.692E-02	4.627E+11	5.496E+04	1.338E+00	1.589E+07	5.493E+07	6.792E+06
.92000	-.04154	238.81	1.869E-03	6.554E-04	4.600E+02	2.070E+00	2.550E-01	1.082E+08	8.485E+07	1.872E+06
.96000	-.08697	219.33	4.065E-04	1.061E-03	5.354E+00	2.332E-01	2.536E-02	7.297E+07	9.771E+07	1.871E+05
1.00000	-.136-4	202.13	4.432E-06	8.100E-04	2.881E-02	9.516E-03	3.467E-01	2.195E+07	6.805E+07	9.999E+05
		MN. SQ	1.284E+01	1.023E+00	1.851E+10	2.200E+03	1.191E+02	1.498E+10	2.713E+09	4.389E+08
		R.M.S.	3.583E+00	1.011E+00	1.360E+05	4.690E+01	1.091E+01	1.224E+05	5.209E+04	2.095E+04
		AVG.	4.479E+00	1.264E+00	1.701E+05	5.863E+01	1.3 4E+01	1.530E+05	6.511E+04	2.619E+04
		SIG.	7.166E+00	2.023E+00	2.721E+05	9.380E+01	2.1?3E+01	2.447E+05	1.042E+05	4.190E+04
		AV1/10	9.137E+00	2.579E+00	3.469E+05	1.196E+02	2.783E+01	3.121E+05	1.328E+05	5.342E+04

VERT SHEAR LAT SHEAR (DIMENSIONAL)

	VERT SHEAR	LAT SHEAR
MN. SQ	4.118E+06	8.144E+04

	STATION	VERT.B.M.	L.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR
MN. SQ	1	3.783E+08	3.332E+07	2.043E+07	1.244E+03	3.001E+04
MN. SQ	2	3.450E+08	2.327E+08	3.930E+07	9.537E+03	4.231E+04
MN. SQ	3	3.732E+08	5.256E+08	1.101E+08	5.443E+04	3.831E+04
MN. SQ	4	7.54 E+08	8.778E+08	3.414E+08	1.531E+05	4.221E+04
MN. SQ	5	2.023E+09	1.279E+09	6.403E+08	2.664E+05	5.042E+04
MN. SQ	6	4.573E+09	1.706E+09	9.516E+08	3.203E+05	6.007E+04
MN. SQ	7	8.150E+09	2.114E+09	1.066E+09	2.778E+05	6.995E+04
MN. SQ	8	1.178E+10	2.461E+09	9.349E+08	1.731E+05	7.786E+04
MN. SQ	9	1.430E+10	2.681E+09	7.090E+08	7.751E+04	8.149E+04
MN. SQ	10	1.498E+10	2.713E+09	4.389E+08	4.118E+04	8.144E+04
MN. SQ	11	1.382E+10	2.534E+09	1.884E+08	6.767E+04	8.034E+04
MN. SQ	12	1.133E+10	2.181E+09	4.018E+07	1.333E+05	7.892E+04
MN. SQ	13	8.233E+09	1.734E+09	8.379E+06	2.007E+05	7.646E+04
MN. SQ	14	5.361E+04	1.260E+09	2.848E+06	2.267E+05	7.031E+04
MN. SQ	15	3.229E+09	8.303E+08	2.003E+07	2.002E+05	5.862E+04
MN. SQ	16	1.799E+09	4.828E+08	6.485E+07	1.539E+05	4.495E+04
MN. SQ	17	8.462E+08	2.249E+08	7.914E+07	1.160E+05	3.405E+04
MN. SQ	18	2.947E+08	6.104E+07	4.666E+07	7.671E+04	2.305E+04
MN. SQ	19	1.060E+08	4.286E+06	1.054E+07	2.791E+04	7.874E+03

(DIMENSIONAL)

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	1.082E-01	9.346E-02	3.660E-02
MN. SQ	2	2.770E-02	2.910E-02	3.413E-02

SL-7 HEAVY FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 46.85 KNOTS. RESPONSE (AMPLITUDE) SPECTRA

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.	TORSNL.M.
.20000	.15456	5053.25	7.954E-02	3.063E-04	3.854E-02	2.603E-05	5.611E-04	3.961E+04	5.721E+04	9.646E+02
.24000	.17456	3509.20	2.082E+01	1.663E-01	1.136E+01	2.362E-02	6.352E-01	7.788E+07	3.684E+07	1.446E+06
.28000	.19093	2578.19	1.438E+02	2.138E+00	8.869E+01	4.523E-01	1.843E+01	2.423E+09	5.995E+08	4.943E+07
.32000	.20367	1973.93	2.468E+02	6.356E+00	1.738E+02	1.853E+00	1.2 1E+02	1.436E+10	2.403E+09	3.684E+08
.36000	.21277	1559.65	2.264E+02	9.632E+00	1.862E+02	3.617E+00	3.966E+02	3.878E+10	5.161E+09	1.232E+09
.40000	.21823	1263.31	1.480E+02	1.014E+01	1.467E+02	4.765E+00	7.479E+02	6.790E+10	8.063E+09	2.413E+09
.44000	.22006	1044.06	7.652E+01	8.430E+00	9.327E+01	5.213E+00	9.765E+02	8.995E+10	1.058E+10	3.273E+09
.48000	.21826	877.30	3.174E+01	5.810E+00	4.786E+01	5.953E+00	9.5[illegible]5E+02	9.658E+10	1.240E+10	3.387E+09
.52000	.21282	747.52	9.991E+00	3.345E+00	1.991E+01	4.909E+00	6.9 2E+02	8.624E+10	1.306E+10	2.645E+09
.56000	.20374	644.55	1.976E+00	1.575E+00	9.451E+00	3.989E+00	3.545E+02	6.399E+10	1.219E+10	1.516E+09
.60000	.19103	561.47	1.059E-01	5.767E-01	1.047E+01	2.612E+00	1.290E+02	3.861E+10	1.004E+10	6.641E+08
.64000	.17468	493.48	6.623E-02	1.516E-01	1.529E+01	1.242E+00	3.250E+01	1.823E+10	7.275E+09	2.373E+08
.68000	.15470	437.13	1.628E-01	3.137E-02	1.725E+01	3.139E-01	4.862E+00	6.690E+09	4.576E+09	7.610E+07
.72000	.131 8	389.91	1.075E-01	1.505E-02	1.257E+01	7.538E-02	2.030E+00	2.898E+09	2.423E+09	3.290E+07
.76000	.10383	349.95	2.941E-02	1.172E-02	4.750E+00	5.396E-01	4.188E+00	2.965E+09	1.020E+09	2.712E+07
.80000	.07 94	315.83	3.354E-03	5.266E-03	3.256E+01	1.512E+00	4.755E+00	4.298E+08	3.106E+08	2.403E+07
.84000	.03841	286.47	4.619E-03	1.142E-03	8.696E+02	3.712E+00	3.2[illegible]3E+00	1.287E+08	7.693E+07	1.575E+07
.88000	.000[illegible]6	261.[illegible]	5.031E-03	2.763E-02	4.749E+11	5.641E+04	1.3 4E+00	1.631E+07	5.638E+07	6.972E+06
.92000	-.04154	238.81	1.910E-03	6.699E-04	4.701E+02	2.115E+00	2.606E-01	1.106E+08	8.672E+07	1.914E+06
.96000	-.08697	219.33	4.141E-04	1.080E-03	5.459E+00	2.375E-01	2.583E-02	7.432E+07	9.959E+07	1.906E+05
1.00000	-.13604	202.13	4.502E-04	8.227E-04	2.927E-02	9.665E-03	3.522E-01	2.229E+07	6.912E+07	1.016E+06
		MN. SQ	3.626E+01	1.937E+00	1.900E+10	2.258E+03	1.782E+02	2.122E+10	3.620E+09	6.389E+08
		R.M.S.	6.022E+00	1.392E+00	1.378E+05	4.752E+01	1.335E+01	1.457E+05	6.016E+04	2.528E+04
		AVG.	7.527E+00	1.740E+00	1.723E+05	5.940E+01	1.669E+01	1.821E+05	7.520E+04	3.159E+04
		SIG.	1.204E+01	2.783E+00	2.757E+05	9.504E+01	2.670E+01	2.913E+05	1.203E+05	5.055E+04
		AV1/10	1.536E+01	3.549E+00	3.515E+05	1.212E+02	3.404E+01	3.714E+05	1.534E+05	6.645E+04

	VERT SHEAR	LAT SHEAR	(DIMENSIONAL)
MN. SQ	4.485E+04	9.839E+04	

	STATION	VERT.B.M.	LAT.B.M.	TORS.L.M.	VERT.SHEAR	LAT.SHEAR (DIMENSIONAL)
MN. SQ	1	3.913E+08	4.854E+07	3.006E+07	1.579E+03	4.355E+04
MN. SQ	2	3.584E+08	3.377E+08	5.761E+07	1.336E+04	6.058E+04
MN. SQ	3	4.135E+08	7.599E+08	1.608E+08	7.637E+04	5.310E+04
MN. SQ	4	9.641E+08	1.260E+09	4.901E+08	2.121E+05	5.611E+04
MN. SQ	5	2.749E+09	1.817E+09	9.478E+08	3.649E+05	6.474E+04
MN. SQ	6	6.308E+09	2.392E+09	1.302E+09	4.352E+05	7.535E+04
MN. SQ	7	1.130E+10	2.919E+09	1.563E+09	3.747E+05	8.664E+04
MN. SQ	8	1.643E+10	3.350E+09	1.373E+09	2.302E+05	9.574E+04
MN. SQ	9	2.008E+10	3.605E+09	1.036E+09	9.749E+04	9.942E+04
MN. SQ	10	2.122E+10	3.620E+09	6.389E+08	4.485E+04	9.839E+04
MN. SQ	11	1.976E+10	3.365E+09	2.717E+08	7.993E+04	9.635E+04
MN. SQ	12	1.632E+10	2.894E+09	5.571E+07	1.732E+05	9.455E+04
MN. SQ	13	1.189E+10	2.308E+09	1.032E+07	2.743E+05	9.216E+04
MN. SQ	14	7.671E+09	1.688E+09	3.100E+06	3.201E+05	8.580E+04
MN. SQ	15	4.484E+09	1.122E+09	3.008E+07	2.897E+05	7.257E+04
MN. SQ	16	2.376E+09	6.618E+08	9.651E+07	2.225E+05	5.675E+04
MN. SQ	17	1.058E+09	3.136E+08	1.173E+08	1.594E+05	4.464E+04
MN. SQ	18	3.476E+08	8.661E+07	6.946E+07	9.858E+04	3.166E+04
MN. SQ	19	1.132E+08	6.195E+06	1.583E+07	3.445E+04	1.117E+04

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	2.173E-01	1.919E-01	5.262E-02
MN. SQ	2	7.043E-02	7.262E-02	7.369E-02

SL-7 HEAVY FULL SCALE RUNS MAR 24, 1973

SPEED = 42.2000 WAVE ANGLE = 30.00 DEG., WIND SPEED = 52.41 KNOTS. RESPONSE (AMPLITUDE) S

WAVE FREQUENCIES	ENCOUNTER FREQUENCIES	WAVE LENGTH	HEAVE	PITCH	SWAY	YAW	ROLL	VERT.B.M.	LAT.B.M.
.20000	.15456	5053.25	7.666E+00	2.952E-02	3.714E+00	2.509E-03	5.407E-02	3.818E+06	5.513E+06
. 4000	.17456	3509. [illegible]	1.885E+02	1.505E+00	1.028E+02	2.138E-01	5.750E+00	7.050E+08	3.335E+08
.28000	.19093	2578.19	4.721E+02	7.022E+00	2.913E+02	1.486E+00	6.0 2E+01	7.958E+09	1.969E+09
.32000	.20367	1973.93	4.956E+02	1.276E+01	3.490E+02	3.720E+00	2.513E+02	2.883E+10	4.825E+09
.36000	.21277	1559.65	3.498E+02	1.488E+01	2.877E+02	5.588E+00	6.128E+02	5.993E+10	7.976E+09
.40000	.21823	1263.31	1.969E+02	1.349E+01	1.952E+02	6.339E+00	9.9 1E+02	9.034E+10	1.073E+10
.44000	.22006	1044.06	9.299E+01	1.025E+01	1.134E+02	6.335E+00	1.187E+03	1.093E+11	1.286E+10
.48000	.218 6	877.3	3.643E+01	6.668E+00	5.493E+01	6.028E+00	1.101E+03	1.108E+11	1.423E+10
.52000	.21282	747.52	1.104E+01	3.697E+00	2.200E+01	5.425E+00	7.671E+02	9.531E+10	1.443E+10
.56000	.20374	644.55	2.128E+00	1.697E+00	1.018E+01	4.297E+00	3.819E+02	6.893E+10	1.313E+10
.60000	.191 3	561.47	1.120E-01	6.101E-01	1.108E+01	2.764E+00	1.365E+02	4.085E+10	1.062E+10
.64000	.17468	493.48	6.918E-02	1.584E-01	1.597E+01	1.297E+00	3.404E+01	1.904E+10	7.599E+09
.68000	.15474	437.13	1.684E-01	3.246E-02	1.785E+01	3.248E-01	5.041E+00	6.923E+09	4.735E+09
.72000	.131 8	389.91	1.104E-01	1.546E-02	1.291E+01	7.746E-02	2.086E+00	2.978E+09	2.490E+09
.76000	.10383	349.95	3.006E-02	1.198E-02	4.856E+00	5.515E-01	4.281E+00	3.031E+09	1.043E+09
.80000	.07294	315.83	3.415E-03	5.361E-03	3.315E+01	1.539E+00	4.8 1E+00	4.376E+08	3.162E+08
.84000	.03841	286.47	4.687E-03	1.159E-03	8.824E+02	3.766E+00	3.342E+00	1.306E+08	7.807E+07
.88000	.00025	261.02	5.093E-03	2.797E-02	4.808E+11	5.711E+04	1.390E+00	1.651E+07	5.707E+07
.92000	-.04154	238.81	1.929E-03	6.768E-04	4.749E+02	2.137E+00	2.633E-01	1.117E+08	8.761E+07
.96000	-.08697	219.33	4.177E-04	1.090E-03	5.500E+00	2.396E-01	2.606E-02	7.496E+07	1.004E+08
1.00000	-.136 4	202.13	4.536E-04	8.288E-04	2.948E-02	9.736E-03	3.548E-01	2.246E+07	6.962E+07
		MN. SQ	7.399E+01	2.914E+00	1.923E+10	2.286E+03	2.222E+02	2.583E+10	4.306E+09
		R.M.S.	8.60 E+00	1.707E+00	1.387E+05	4.782E+01	1.491E+01	1.607E+05	6.562E+04
		AVG.	1.075E+01	2.134E+00	1.733E+05	5.977E+01	1.8 3E+01	2.009E+05	8.202E+04
		SIG.	1.720E+01	3.414E+00	2.773E+05	9.563E+01	2.981E+01	3.214E+05	1.312E+05
		AV1/10	2.193E+01	4.353E+00	3.536E+05	1.219E+02	3.801E+01	4.098E+05	1.673E+05

VERT SHEAR LAT SHEAR (DIMENSIONAL)

	VERT SHEAR	LAT SHEAR
MN. SQ	4.724E+04	1.092E+05

	STATION	VERT.B.M.	LAT.B.M.	TORSNL.M.	VERT.SHEAR	LAT.SHEAR (DIMENSIONAL)
MN. SQ	1	3.977E+08	.017E+07	3.736E+07	1.846E+03	5.394E+04
MN. SQ	2	3.657E+08	4.182E+08	7.127E+07	1.622E+04	7.453E+04
MN. SQ	3	4.410E+08	9.399E+08	1.978E+08	9.257E+04	6.419E+04
MN. SQ		1.117E+09	1.554E+09	6.119E+08	2.551E+05	6.624E+04
MN. SQ	5	3.279E+09	2.229E+09	1.165E+09	4.364E+05	7.485E+04
MN. SQ	6	7.575E+09	2.916E+09	1.712E+09	5.182E+05	8.581E+04
MN. SQ	7	1.361E+10	3.533E+09	1.924E+09	4.448E+05	9.781E+04
MN. SQ	8	1.983E+10	4.024E+09	1.600E+09	2.717E+05	1.075E+05
MN. SQ	9	2.434E+10	4.306E+09	1.274E+09	1.120E+05	1.111E+05
MN. SQ	10	2.583E+10	4.306E+09	7.836E+08	4.724E+04	1.092E+05
MN. SQ	11	2.416E+10	3.997E+09	3.316E+08	8.852E+04	1.065E+05
MN. SQ	12	2.003E+10	3.438E+09	6.669E+07	2.025E+05	1.046E+05
MN. SQ	13	1.461E+10	2.751E+09	1.158E+07	3.293E+05	1.025E+05
MN. SQ	14	9.381E+09	2.022E+09	3.400E+06	3.908E+05	9.636E+04
MN. SQ	15	5.401E+09	1.352E+09	3.734E+07	3.578E+05	8.248E+04
MN. SQ	16	2.786E+09	8.038E+08	1.193E+08	2.745E+05	6.549E+04
MN. SQ	17	1.204E+09	3.844E+08	1.448E+08	1.914E+05	5.279E+04
MN. SQ	18	3.830E+08	1.071E+08	8.608E+07	1.139E+05	3.846E+04
MN. SQ	19	1.178E+08	7.749E+06	1.975E+07	3.888E+04	1.382E+04

	ACC.PT.	VERT(STBD)	VERT(PORT)	LATERAL
MN. SQ	1	3.397E-01	3.044E-01	7.111E-02
MN. SQ	2	1.291E-01	1.317E-01	1.207E-01

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13. ABSTRACT

The computer program SCORES for predicting ship structural response in waves is applied to the SL-7 container ship. The operating conditions considered are 2 displacements, 4 ship speeds, 21 wavelengths, 19 headings and 5 sea states assuming both long-crested and short-crested seas. These results constitute a complete data bank for the SL-7 ship in the form of both frequency responses for regular waves as well as rms and other statistical response measures for irregular seas.

Comparison is made between the computer and model tests of the SL-7 in regular waves in predicting vertical, lateral and torsional moments, and vertical and lateral shears at two sections and heave, pitch and roll. Regions where the theory and model experiment do not agree have been pointed out and some means of correction or extension of the theory is discussed.

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WAVES						
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