THE EFFECT OF HULL FORM AND WEIGHT DISTRIBUTION ON STRUCTURAL LOADING

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by

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ABSTRACT

The purpose of this thesis is to study the effect varying hull form and weight distribution has on structural loading with the goal of presenting the results in a form that would be useful in preliminary design for considering structural loading when selecting hull form and ship arrangements. Values of hull form parameters are selected from Saunders' design lanes for minimum resistance and weight distribution parameters are derived by averaging data collected for typical cargo ships; these determine "standard" ships. Structural loading is estimated by the vertical longitudinal bending moment in still water plus that caused by the ship travelling at design speed in an irregular sea. Each of the hull form and weight distribution parameters is then systematically varied and the bending moment for the new ship is compared with the bending moment for the standard ship.

The wave bending moment is calculated using an equation that estimates the wave bending moment in an irregular sea; the moment due to the ship's own wave system and the change in the mean of the wave bending moment due to the seaway are included. The significant wave height of the seastate is selected so that the wave bending moment agrees with a design value from ABS rules. The still water bending moment is calculated using an approximate method and a weight distribution is selected that approximates actual weight distributions and results in a still water bending moment that is probably close to the design value that

would be calculated for the standard ships.

The following parameters are varied: waterplane coefficient, block coefficient, length, beam, design speed, machinery location, deadweight location, fraction of the deadweight aft of amidships, the moment of inertia of the weight forward of amidships and aft of amidships, and the speed of the ship in a seaway. The results are presented in the form of marginal factors (see Table VI) which show the fractional change in the total hogging bending moment for a fractional change in one of the hull form or weight distribution parameters.

Generally, the still water bending moment is 50% of the total hogging moment. In most cases, the total sagging moment is only 30% to 40% of the total hogging moment so the hogging moment is used for analyzing all of the results. The hull form and weight distribution parameters that should be of the most concern to the designer interested in reducing structural loading are: waterplane coefficient, block coefficient, length, beam, machinery location, and the location of weights forward of amidships. Since the designer has the most control over the still water bending moment and significant reductions in the total moment may be possible by reducing the still water moment, the still water bending moment should be given more attention than it probably now receives in most design work.

It is most important that bending moment predictions based entirely upon model test results or theoretical analyses consider the effect of a speed reduction in the seaway and the effect of the ship's own wave system and the change in the mean of the wave bending moment due to the seaway. Although the total hogging moment can be satisfactorily estimated without including the effect of the ship's own wave and the effect of the seaway on the wave bending moment mean, the sagging bending moment cannot be satisfactorily calculated without including these effects.

The entire analysis is done for typical dry cargo ships that have a hogging still water bending moment of sufficient magnitude to make the total hogging moment the one of primary interest to the designer. Although the equations and the method of analysis would apply to other types of ships, the results can only be reliably applied to dry cargo ships with hull forms and weight distributions similar to those used in the analysis.

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NOMENCLATURE

Notes:

1) All centers of gravity are measured from amidships. (+) is forward.

2) The expression "y = f(x)" means y is a function of x.

3) "ℓn" indicates the natural logorithm.

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a - tons/ft. of deadweight in parallel midbody portion of ship

a_o - SWBM integral factor for the magnitude of the buoyancy integral

a_1 - SWBM integral factor for the magnitude of the hull weight integral

A_i - coefficients for wave bending moment (i = 0 to 6)

A_i' - coefficients for shift of the wave bending moment mean (i = 0 to 3)

b_o - SWBM integral factor for lever of buoyancy

b_1 - SWBM integral factor for lever of hull weight

B - beam (ft.)

BM - vertical longitudinal bending moment at amidships (ft-tons)

$\overline{BM}^{1/3}$ - significant value of BM from response spectrum = average of 1/3 highest expected moments

C_b - block coefficient = $35\Delta/LBT$

C_m - midship section area coefficient = midship section area/BT

C_p - longitudinal prismatic coefficient = C_B/C_m

C_w	-	waterplane area coefficient = waterplane area/LB
DWT	-	total deadweight (tons)
DWTA	-	deadweight aft of amidships (tons)
F_n	-	Froude number = $v/\sqrt{gL}$ = .298 $V/\sqrt{L}$
g	-	acceleration of gravity = 32.174 ft/sec^2
H_s	-	significant wave height (ft) = average of 1/3 highest expected waves
I_A	-	second moment of weight aft of amidships about an axis through amidships (tons-ft^2)
I_F	-	second moment of weight forward of amidships about an axis through amidships
I_T	-	second moment of total weight of ship about an an axis through amidships
K_{yy}	-	radius of gyration of total ship weight about an axis through LCG (ft)
K_{yy}'	-	radius of gyration of weights forward of amidships about an axis through the center of those forward weights (ft)
L	-	ship length = length between perpendiculars (ft)
LCB	-	longitudinal center of buoyancy of entire ship; expressed as % of L; (+) is forward
LCG	-	longitudinal center of gravity of entire ship from amidships; expressed as % of L; (+) is forward
m	-	factor for the bending moment due to the ship's own wave system. Moment = $\rho g L^3 BM$
M	-	center of gravity of propulsion machinery (ft) from amidships; (+) is forward
r	-	coefficient of determination for fit of regression analyses

SWBM	-	still water vertical longitudinal bending moment (ft-tons)
T	-	draft (ft)
T_z	-	zero crossing period of bending moment response in a seaway
$\overline{T}_z$	-	dimensionless representation of T_z; $\overline{T}_z = T_z\sqrt{g/L}$
v	-	ship speed (ft/sec); $v = 1.6889\ V$
V	-	ship speed (knots)
W_A	-	weight of ship aft of amidships (tons)
W_F	-	weight of ship forward of amidships (tons)
W_h	-	distributed hull weight (tons)
W_2	-	propulsion machinery weight (tons)
X_o	-	difference between actual LCG and standard LCG for SWBM integral factors
x_D	-	center of gravity of hull weight measured from amidships; expressed as % of L; (+) is forward
β	-	longitudinal center of gravity of total deadweight from amidships (ft)
β_A	-	longitudinal center of gravity of deadweight aft of amidships measured from amidships (ft)
Δ	-	total displacement (tons)
δa	-	factor for LCB correction for a_o
δb	-	factor for LCB correction for b_o
μ	-	seakeeping table dimensionless representation of wave bending moment. Wave moment = $4\mu\rho g L^4 \times 10^{-7}$
μ_s	-	Murdey's dimensionless representation of wave bending moment. Wave moment = $\mu_s (H_s/L)\rho g L^3 B$

$\overline{\mu}_s$ - factor for shift of wave bending moment mean due to speed in a seaway.
shift of mean = $\overline{\mu}_s \rho g L^3 B(H_s/L)$

ρ - density of seawater = 1.9905 slugs/ft^3

I. MOTIVE FOR THE ANALYSIS

Some of the most important tools available to a ship designer are the relations between the gross geometry of the ship and other important characteristics of the ship, such as hull and machinery weights, resistance, stability, cargo volume, etc. Relations between hull form and resistance (Taylor's series, Series 60, etc.) that are based on physical principles and model test results have been a basic design tool for many years. Relations for stability, weights, and cargo volume that are based on trends observed in ships that have actually been built have also been used in design for many years. Using these tools, the most common design procedure used today starts with a given payload, or a required cargo capacity, and a speed and range requirement.

Using payload/displacement fractions for the type of ship being designed, the designer would get a first estimate of displacement and a rough length range would be evident based on past ships of this type and size. With the first estimates of displacement and length in mind, the designer would next select B, T, C_p, C_m, etc. to optimize the hull form in the following manner. Several different lengths within some reasonable range might be investigated. Each length would determine a speed length ratio and a displace-

ment length ratio; using these ratios, L/B, B/T, C_p, etc. would be selected from "design lanes" that give a hull with minimum resistance and adequate stability. Any remaining coefficients of form would be selected as functions of the coefficients selected in the optimization process; e.g. $C_w = f(C_p)$.

The foregoing design procedure is based on the philosophy that the "best" ship is the one with minimum resistance at the design speeds. Of course, there may be some constraints in internal volume, deck area, etc. or complications due to more than one "design speed" as in naval ships, but the basic process and philosophy stay the same.

Once the gross dimensions and underwater hull form are selected by the above process and space arrangements are completed, the results are given to the structural designer to determine the loads on the hull and the structure required to carry those loads. Except for some length/depth restrictions to limit hull flexure, hull bending moment is not considered when selecting hull gross dimensions and underwater hull form.

In recent years considerable progress has been made in predicting the wave bending moment from hydrodynamic principles and applying these predictions to the design

process. Relations, varying from simple gross estimates to more complicated equations suitable for hand calculations to sophisticated and expensive computer programs, are given in the literature to predict vertical bending moment due to waves for a given hull form and weight distribution. It was decided to search the literature for a method of predicting bending moment that was detailed and accurate enough to show the effects of varying hull form and weight distribution yet simple enough to allow calculating the bending moment for many hull forms at a reasonable cost. The method would then be used to calculate the bending moment for a series of systematically varied hull forms and the results analyzed and presented in a form that would be useful in preliminary design for determining the effects of hull form variations on structural loading.

These results, the effect of hull form and weight distribution on structural loading, would be the first step in developing a tool that would allow the consideration of structural loading in the selection of hull form. Meaningful trade-off decisions between structural load and resistance (or cargo volume or some other ship characteristic) would be based on structural weight, not just on structural loading; e.g. the designer could not trade off 50,000 ft. tons of bending moment for a 550 SHP increase or

a .5 knot speed reduction; such a trade-off must consider the structural weight saved. This thesis does not consider relations between structural weight and hull form or structural weight and structural load; it does develop and present relations that would be useful in preliminary design for analyzing the effect of hull form and weight distribution on structural loading.

II. HISTORY AND PRESENT TRENDS

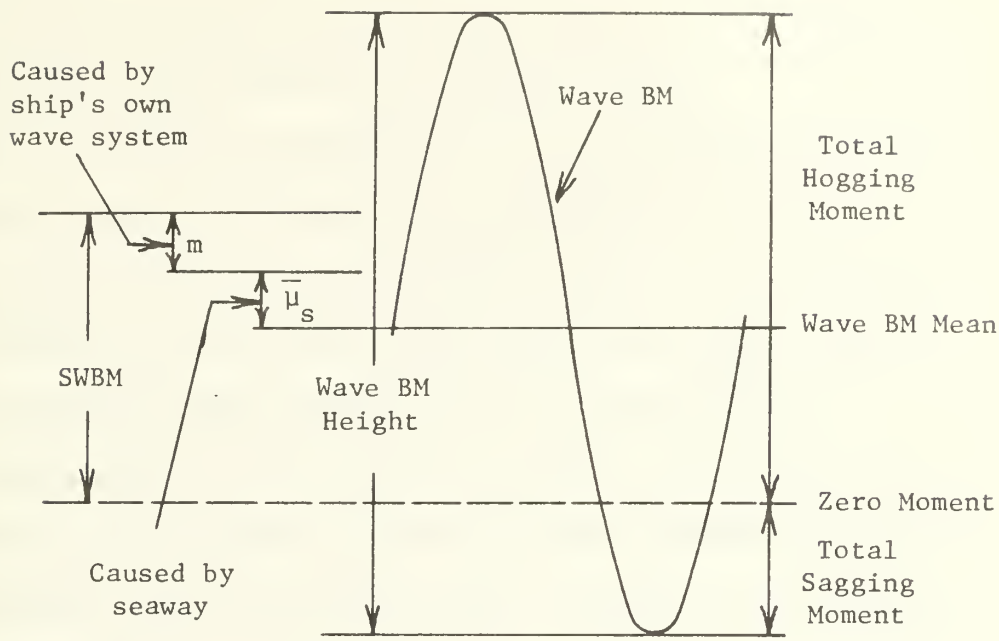
A. Predicting Structural Loads

The most familiar method, and until very recently the most commonly used method, of calculating bending moment is to poise the ship on a troichoidal wave and do a static calculation; the result is a design value of the vertical bending moment. The wave length is equal to the ship length and the wave height is a function of the ship length as is the allowable stress in the midship section. There has been a considerable amount of work in determining the required wave height and the allowable stress (references 1, 2, and 3). Some work was done to show that the maximum stresses actually experienced by a ship at sea and experienced in model tests were the same as those predicted by the static calculation (references 1, 4, and 5).

The more recent approach to predicting structural loads is reflected in the ABS and Lloyd's 1976 shipbuilding rules, in which the total bending moment is divided into a still water bending moment and a wave bending moment. The still water bending moment is found by a straightforward static calculation with the ship in calm water. The wave bending moment is then added to or subtracted from the SWBM to get the total moment. For example, if the SWBM is hogging, then the wave bending moment amplitude (or 1/2

FIGURE I

ILLUSTRATION OF BENDING MOMENT DEFINITIONS



In this illustration:

1) Still water bending moment is hogging.
2) m, the time invariant moment caused by the ship's own wave system, is sagging.
3) $\bar{\mu}_s$, the time invariant shift of the wave BM mean, is sagging.
4) The wave BM varies with time about its mean.

The total hogging or sagging moment is what is approximated by the static balancing of the ship on an L/20 or $1.1\sqrt{L}$ high wave.

the wave BM height) is added to the SWBM to get the total hogging moment and the wave BM amplitude is subtracted from the SWBM to get the total sagging moment.

It is important to distinguish the difference between the wave BM found by the more recent methods and the bending moment found by poising the ship on a troichoidal wave. Poising the ship on a wave gives the total (still water plus wave) bending moment and is essentially a static approximation of a dynamic process. The wave BM calculated by more recent methods is the dynamic variation of the bending moment from its mean. Figure I illustrates this difference.

The older, empirical, static calculation has the advantage that it is consistent and can be relied upon for comparing hulls that have performed satisfactorily with those that have not, so long as the hulls are of similar type in similar service. Unfortunately, the empirical approach is of questionable validity when applied to unusual ship types or weight distributions or when applied to ships with new materials (since the allowable stress for mild steel is a variable when using this approach), and the static calculation does not lend much insight into the physical processes that cause the bending moment. The drawbacks of the static calculation and the development of

the application of hydrodynamic theory to the point where reliable predictions can be made are leading to the acceptance of the newer method in calculating a design bending moment. However, the newer method has its disadvantages, the chief one being that a deterministic solution is not obtainable so one must work with probability and statistics to obtain design loadings; this requires one to make the unpleasant selection of an acceptable probability of failure. In addition, the designer is forced to admit that he cannot say exactly what the loading on the structure will be.

Considering the above factors, it was decided to base the analysis for the effect of hull form on bending moment on the more recent methods rather than predict the bending moment by poising the ship on a static wave. The major advantage of using the newer approach is the separation of the still water and wave bending moments so that one can analyze the effect of form and weight parameters on each.

B. Structural Loading and Hull Form Selection

Although several references were found that discuss structural design philosophy, very few even suggest that structural loading considerations might influence hull form selection or ship arrangements. Reference 1 and the

1976 International Ship Structures Congress, Reference 6, consider the hull form and ship arrangement a given factor in their discussions on design philosophy and are concerned primarily with reliable, complete predictions of loadings on the structure, with accurate calculation of stresses resulting from those loadings, and with how to obtain the least weight structure.

Reference 7, which is concerned only with the effect of the local form of the bow on slamming, is the only reference found that suggests hull form might be influenced by structural loads in cargo ships. In References 4 and 8, Murray discusses some of the effects of hull gross dimensions and tank arrangement on bending moment in tankers and suggests that it would be good design practice to try to minimize the still water bending stresses in a ship. Many of the references mention the qualitative trend of an increasing wave bending moment and a decreasing hogging still water bending moment as the block coefficient is increased; none of the references provide any quantitative information regarding this trend.

Other than those sources mentioned above, the literature search revealed no references that suggested structural loading be considered during the selection of hull form and arrangement of the ship. Even though a

considerable amount of work has been done on predicting structural loads for a given hull form, no one has taken the step of suggesting how the hull form should be modified and the ship arranged so that the structural loading might be minimized or at least reduced.

III. ESTIMATING STRUCTURAL LOADING

A. Factors That Contribute to Structural Loading

For design purposes the stresses on a ship's structure are usually divided into three categories: primary, secondary, and tertiary. Primary stresses are developed by the entire ship acting as a beam with the buoyancy supporting the beam and the ship's weight loading the beam. Secondary stresses are developed in a panel supported by transverse bulkheads or web frames and loaded by pressure forces or cargo loads. Tertiary stresses are developed in a particular member by local loads. When actually designing structural members, it is necessary to include all three categories of stresses. However, when comparing the loading on different hulls and for initial sizing of the ship's structure during preliminary design, it is necessary to include only the primary stresses.

Primary stresses can be caused by longitudinal bending in the vertical and horizontal planes, by transverse bending, and by torsion along a longitudinal axis. For normally shaped cargo ships of average size only the longitudinal bending develops stresses that need be considered in preliminary design. Torsion is usually significant in ships with large hatches, such as container ships. Transverse bending and torsion may be important in

a ship such as a catamaran. In detail design of any ship all three should be considered. However, only longitudinal bending need be considered in this analysis.

Because horizontal bending and vertical bending are out of phase, it is common practice in preliminary design to consider only vertical longitudinal bending (references 1 and 10). Considering only vertical bending is certainly valid for comparing different ships and for initial sizing of the ship's structure. So, to consider the effects of hull form and weight distribution on structural loading, it is necessary to consider only the factors that contribute to the vertical longitudinal bending moment.

B. <u>Factors That Contribute to the Total Bending Moment</u>

References 10 and 11 give a good summary of the loads and the relative importance of the loads that cause vertical bending stresses: residual stresses from construction, thermal strains due to temperature differences over the hull, dynamic stresses due to propeller and machinery induced vibrations, weight and still water buoyancy distribution differences (SWBM), and wave loads subdivided as follows:

(1) The ship riding on its own wave system when running in calm water.

(2) Direct sea loads acting on the ship as a rigid body:

(a) Change in the mean value of the wave BM.

(b) Variation of the wave BM about the mean.

(3) Indirect sea loads developed by the vibratory response of the flexible ship to the direct sea loads:

(a) Springing, a two node, low frequency mode of response to continuing wave loads; the flexing of the hull is assumed to have no effect on the magnitude of the direct wave loads.

(b) Whipping, a high frequency response to slamming and other wave induced transient loads.

Even though residual stresses may be an important factor in brittle fracture, they are usually neglected in preliminary design and are not measured in either full scale or model tests of the ship. Thermal strains are not related to any of the other loads and are usually not

considered during preliminary design and are rarely measured in full scale or model tests. Propeller and machinery induced vibrations usually are not considered in preliminary design and cannot be measured in model tests due to scaling problems. Because they are usually neglected, difficult or impossible to calculate, and contribute only a small amount to the total load on the structure, the residual, thermal, and dynamic vibratory stresses will not be considered further.

The still water bending moment will be included in the analysis. This is a major portion of the total load in many ships, yet it is not measured in either model or full scale tests; measurements are usually made with the zero value being the ship at rest in still water. The calculation of the still water bending moment is theoretically straightforward and the buoyancy distribution is usually well defined. However, in most cases the weight distribution can only be approximated; therefore, the value of the still water bending moment is only as precise as the estimate of weight distribution.

The load due to the ship's own wave system and the change in the BM mean due to the seaway are components of the wave loads that do not change with time. These are measured in model tests and probably could be, but are not,

measured in full scale tests. These can be added to or subtracted from the SWBM to get the time invariant portion of the bending moment or the mean of the bending moment. Most references agree that it is valid to assume the SWBM is the mean and neglect the moment due to the ship's own wave and the time invariant portion of the seaway moment. Nevertheless, these two factors will be included in the analysis. See Figure I for an illustration of these factors.

The variation of the wave BM about the mean, usually called the "wave bending moment", is the second major factor (SWBM being the first) in the total moment. The wave BM is what is commonly measured in full scale and model tests and predicting this value from basic theory has received considerable attention. Of course, the wave BM will be included in the analysis.

Springing and whipping may make a contribution to the total moment that is worth considering and they are certainly affected by hull form and weight distribution (see references 7 and 12). Unfortunately, the prediction of these loads has not yet developed to the point where they are commonly included in a design analysis and there is not enough information available to include them in this analysis. It should be valid to assume that springing and

whipping do not have enough of an effect on the total bending moment to influence the results of the analysis.

In summary, the following factors will be included in the analysis: still water bending moment, wave bending moment, and the change in the bending moment mean due to the ship's own wave system and the seaway. These factors are certainly sufficient for comparing the structural loading on different hulls and would be sufficient for preliminary sizing of the ship's structure for normally shaped ships.

C. Methods for Predicting the Wave Bending Moment

Methods for predicting the wave bending moment can be divided into two categories: methods based on a combination of empirical and theoretical analysis that are used to get a design value for the wave BM, and methods based on hydrodynamic theory and/or model test results to get the wave BM in a given seastate. Empirical methods that produce a design value for BM were not used in the analysis because they do not explicitly consider each major hull form and weight distribution parameter; these methods give a BM value to be used in design that is based on the assumption that once the gross hull geometry (L, B, C_b) is defined, the other parameters will be close to those of

past ships. Some of these empirical methods are presented in the Results for comparison purposes.

Methods derived strictly from theory produce a significant wave BM value in a specific sea state. It is necessary to use extreme value statistics to get a design value (Reference 16). A considerable amount of work has been done in developing these methods and validating their results (see References 5, 11, 13, 14, and 15). Several problems arise in validating predictions; as presented in the previous section, several factors contribute to the total vertical bending moment and only some of these can be measured in model tests, while others are measured in full scale tests. Unfortunately, it is not always clear whether the test results are for only the wave bending moment, which is what is predicted, or whether other BM factors are erroneously included. In full scale tests there is the additional complication that it is practically impossible to accurately measure the seastate while measuring the ship's response to that seastate; because of this and the frequency of instrument errors, the references generally agree that one should not have much faith in full scale test results. Despite these problems, the more recently developed theoretical methods produce results that agree quite well with model tests and reliable full scale

tests and most references agree that these theoretical methods produce results upon which the designer can rely. Two methods were investigated for use in predicting wave BM for the analysis: Loukakis' and Chryssostomidis' seakeeping tables in Reference 14, and Murdey's bending moment equations in Reference 15.

Loukakis and Chryssostomidis analyzed many hulls with an extended series 60 hull form using a computer program based on strip theory. Bending moment is calculated considering hydrodynamic loads and ship mass inertia forces due to ship motions. Hydrodynamic loads are calculated with the strip theory and hydrodynamic coefficients for idealized sections in regular waves. Inertia forces are calculated using the moments of inertia of the mass of the forward and aft halves of the ship and the motions computed from the rest of the program. The results for regular waves are then integrated to get a response amplitude operator curve which is applied to a Pierson-Moskowitz sea spectrum for fully developed seas using linear superposition.

The following parameters must be defined to use the seakeeping tables: Froude number, significant wave height/L, L/B, B/T, and C_b. The tables give the dimensionless response for a wide range of these values and one can

interpolate for the response of a ship with different input parameters. There is little doubt that the seakeeping tables will produce a reliable prediction of bending moment; however, there are a few characteristics of the tables that make them the less desirable of the two alternatives for predicting wave BM.

First, the seakeeping tables give only the root mean square of the BM height due to direct sea loads with an assumed zero mean. The only way to get a total hogging or sagging BM is to add or subtract 1/2 the wave BM from the SWBM. This makes it impossible to analyze the effects of the change in the BM mean due to the ship's own wave system and due to the seaway.

Second, some important hull form and weight distribution parameters were made a function of block coefficient so that it is impossible to use the tables for analyzing the effect of independent variations of these parameters. Details are in Appendix I.

Because Murdey's equations explicitly included each important hull form and weight distribution parameter as an independent variable, it was decided to use them for the analysis. Murdey used the results of model tests in regular waves to develop a response amplitude operator curve for each model which was applied to the sea spectrums

recommended by the 1969 International Towing Tank Conference. A regression analysis was done with the final results to get equations of bending moment as a function of hull form coefficients, weight distribution, Froude number, and sea state. The final equations were checked with 43 model tests done by Murdey and with all model test data available at the time that had the ship and results described in enough detail to give the required input to the equations; agreement between the equations and the model tests is quite good.

Murdey's equations, from Reference 15, are:

m = factor for shift of BM mean due to the ship's own wave in calm water,

$\bar{\mu}_s$ = factor for shift of BM mean due to irregular sea,

μ_s = factor for significant height of wave bending moment response (average of the 1/3 highest wave bending moments experienced in the sea state),

H_s = signficant wave height of the sea state,

T_z = average zero crossing period of the wave BM response

$\bar{T}_z$ = dimensionless T_z

$$m = 10^{-4} F_n^{\;2} (116.3\ C_B^{\;2} - 3.46\ C_B \frac{L}{T} + 3.04 \frac{L}{T}$$

$$- 20.6\ C_w - 2.01 \frac{L}{B} + .6\ LCB - 39.5)$$

$$\overline{\mu}_s = 10^{-2} F_n^{\;2} (A_0' + A_1' C_B + A_2' \frac{L}{T} + A_3' \frac{L}{B})$$

$$\mu_s = 10^{-2} (A_0 + A_1 C_w + A_2 \frac{L}{T} + A_3 LCG + A_4 \frac{I_A}{L^2 \Delta}$$

$$+ A_5 \frac{I_F}{L^2 \Delta} + A_6 F_n)$$

Significant Hogging BM due to waves:

$$\rho g L^3 B (\frac{1}{2}\ \mu_s \frac{H_s}{L} + \overline{\mu}_s \frac{H_s}{L} + m)$$

Significant Sagging BM due to waves:

$$\rho g L^3 B (\frac{1}{2}\ \mu_s \frac{H_s}{L} - \overline{\mu}_s \frac{H_s}{L} - m)$$

The above values are the bending moment caused by direct sea loads and the ship's own wave system. If the ship has a hogging SWBM, the total hogging moment is the SWBM + significant hogging BM due to waves and the total sagging moment is the SWBM - significant sagging BM due to waves; if the total sagging moment is positive, then there

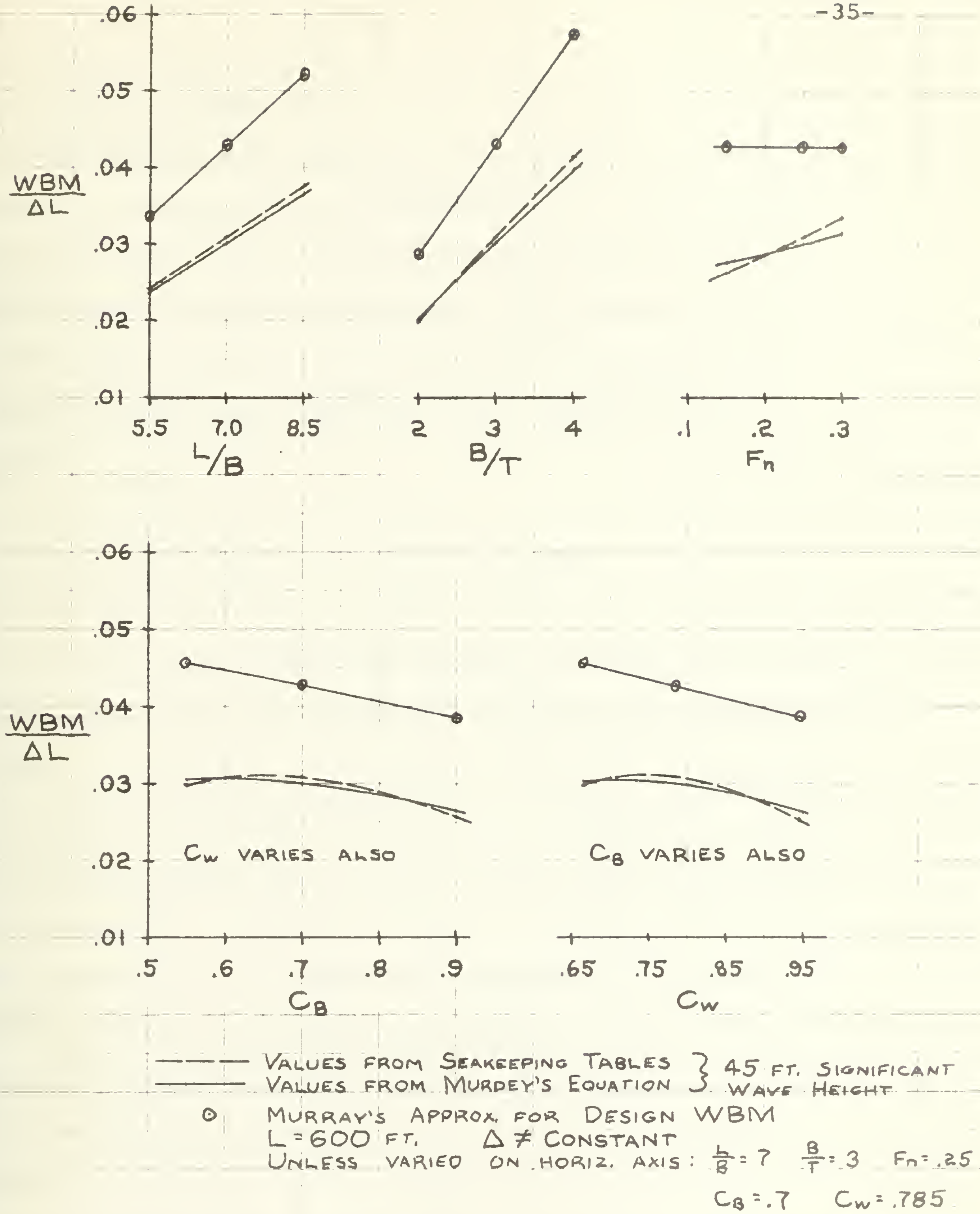


FIGURE II
Comparison of Methods for Calculating Wave Bending Moment

is no sagging moment.

The coefficients (A's) are a function of $\bar{T}_z$ and are listed in the beginning of Appendix VIII. If an actual sea spectrum is known, one can use the average zero crossing period for that spectrum. The analysis was done for the approximate zero crossing period suggested by Murdey for use when a particular sea spectrum is not known:

$$T_z = 3.23 \sqrt[3]{H_s} \qquad \bar{T}_z = T_z \sqrt{g/L}$$

To check the validity of Murdey's equations, the wave bending moment was calculated for several ships and several parameter variations using Murdey's equation, the seakeeping tables, and Murray's formula for an approximate design wave BM from Reference 1. The details of the calculations are in Appendix I and the results are shown in Figure II. The calculations were done for a constant ship length of 600 ft. and a significant wave height of 45 ft. The following parameters were varied: L/B, B/T, F_n, C_b, and C_w. These calculations were not done to see the effect of parameter variations but to compare the results of different methods of calculating the wave BM and the parameters were not varied in the same manner or with the

same constraints that were used for the final analysis.

As expected, the design values of bending moment are consistently higher than the values of bending moment in the 45 ft. sea. Generally, Murdey's wave BM values are within -5% to +7% of the values from the seakeeping tables. Murdey's equation and the seakeeping tables give the same trends as the parameters are varied and, with the exception of Froude number which is not included in Murray's design equation, the trends as the parameters are varied are the same with Murray's design equation. Based on these results, Murdey's equation was used with a high degree of confidence in its prediction of the wave BM in a particular seastate.

D. Methods for Predicting the Still Water Bending Moment

There is a distinct dearth of information concerning the still water bending moment in the literature. Reference 17 from the 1964 International Ship Structures Congress Proceedings suggests the possible importance of the SWBM, mentions the fact that some classification rules put limits on the SWBM stress, and describes the lack of good methods for quickly estimating the SWBM. With the exception of Faresi's paper (Reference 18), little has been done to shed more light on this subject in the last thirteen years.

Although the calculation of the SWBM is theoretically simple, the straightforward numerical integration of weights and buoyancy is quite laborious. Because of the time and/or the expense for computer time involved, and the requirement for developing a weight and buoyancy distribution for each ship in the analysis, it was decided to look for an easier method of calculating the SWBM.

Two methods for approximating the SWBM were found: Murray's method in Reference 1 and Faresi's method in Reference 18. The approach taken in each of these is the same. The SWBM at amidships is essentially the difference between the second integral of the weights and the second integral of the buoyancy over either the forward or aft half of the ship. Murray gives a short table of factors for a range of block coefficients that can be used to estimate the results of the buoyancy integration. Faresi gives plots of factors as a function of block coefficient that can be used to estimate the results of the buoyancy integration. In addition, Faresi gives plots of factors to make corrections for the position of the center of buoyancy and for trim.

Murray's method requires the user to know the weight distribution so the user can calculate the weight integration. Faresi analyzed the hull weights of many ships and

developed plots of factors as a function of block coefficient that can be used to easily calculate the results of the hull weight integration; there is a set of plots for tankers and bulk carriers and a set of plots for cargo ships. It is necessary for the user to calculate the moment of "concentrated" weights such as machinery, deadweight, rudders, propellers, etc.

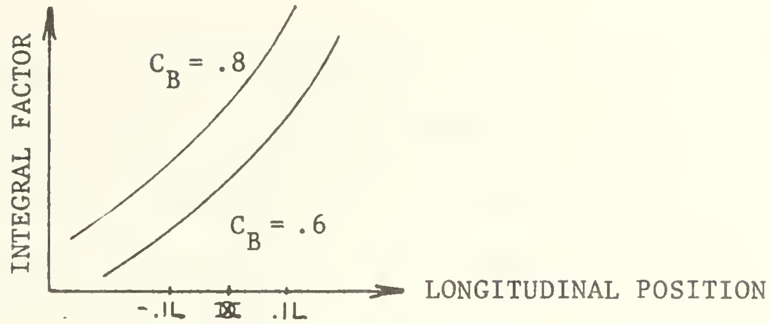
It was decided to use Faresi's method because it does not require knowing the hull weight distribution and because it probably gives more accurate results. Although only the SWBM at amidships is needed for this thesis, it is worth noting that an additional advantage of Faresi's method is that it can give the SWBM at any point along the length of the ship. Faresi's "integral factors" are defined as follows:

a_o = factor for the magnitude of buoyancy,
b_o = factor for the lever of buoyancy,
a_1 = factor for the magnitude of hull weight,
b_1 = factor for the lever of hull weight.

δa and δb are applied to a_o and b_o respectively when the actual LCB is different from the standard LCB used by Faresi. Each factor is given in a set of curves that have

the form shown in Figure III below; only the value at amidships is of interest in this analysis.

FIGURE III



The factors for each value of C_b are listed at the beginning of Appendix VIII. The factors are used to estimate the results of the following integrations:

$$\int_{AP}^{\text{⊄}}\!\!\int \text{Buoyancy} = (b_o + X_o \delta b) L (a_o + X_o \delta a) \Delta$$

$$\int_{AP}^{\text{⊄}}\!\!\int \text{Hull weight} = (b_1 L)(a_1 W_h)$$

$$LCB_{std} = 20\ C_b - 13.5$$

$$X_o = LCB_{std} - LCB_{actual}$$

$$W_h = \text{total hull weight}$$

Note that these factors give the moment about amidships of the buoyancy and hull weight from the after perpendicular to amidships.

Faresi also uses a trim correction similar to the LCB corrections shown above. It was assumed that for the ships to be used in this analysis, the LCG would be close enough to the standard LCB that the hull lines could be adjusted so the ship would ride on an even keel. Since all of the calculated LCG's were well within the design lane limits for LCB, this assumption should be valid and only the LCB correction need be used.

Finally, the moment due to "concentrated" weights must be calculated. This is the moment about amidships of all weights aft of amidships but the distributed hull weight. To simplify the analysis only the propulsion machinery and deadweight (cargo, stores, fuel, etc.) were included. Moments due to omitted items such as the rudder, shafting, and propeller should have a negligible effect on the total; especially when comparing the differences between two hulls.

Therefore, using the approximation that displacement = deadweight + machinery weight + hull weight, the still water bending moment is estimated by the relation:

$$\frac{SWBM}{\Delta L} = \underbrace{b_1 a_1 \left(1 - \frac{DWT}{\Delta} - \frac{W_2}{\Delta}\right)}_{\text{Hull Wt. Moment}} - \underbrace{(a_o + X_o \delta a)(b_o + X_o \delta b)}_{\text{Buoyancy Moment}}$$

$$+ \underbrace{\left|\frac{M}{L}\right| \left(\frac{W_2}{\Delta}\right)}_{\text{Machinery Moment}} + \underbrace{\left|\frac{\beta_A}{L}\right| \left(\frac{DWT_{aft}}{\Delta}\right)}_{\text{Deadweight Moment}}$$

E. Summary of Information Required to Calculate Total Bending Moment

A glance at the equations for predicting bending moment shows that the following parameters that describe the ship are needed to calculate bending moment factors:

Hull form: C_b, C_w, L/T, L/B, LCB, and F_n

Weight Distribution: LCG, $I_a/L^2\Delta$, $I_f/L^2\Delta$, DWT/Δ, $DWTA/\Delta$, W_2/Δ, M/L, and β_A/L.

In addition, the significant height of the seastate and the ship length are needed to define the wave bending moment coefficients and the ship length and displacement are needed to calculate an actual bending moment value. Therefore, the following are also needed: H_s, L, and Δ.

Before bending moment values can be calculated, it remains to determine values for the above parameters that will represent reasonable hull forms and weight distributions. To determine the hull form parameters, the only investigation required is to select the most suitable of the many published relations for selecting hull form; these are usually in the form of design lanes or empirical equations that define design lanes. The hull form parameters for any particular ship would be required to satisfy the definition of the block coefficient.

Determining the weight distribution parameters is more difficult. There are no relations for most of the weight distribution parameters and many of the parameters are not mentioned in summaries of ship characteristics. Therefore, it was necessary to search for information to determine reasonable values of the weight distribution parameters.

It was assumed that the ship would ride on an even keel and that the LCG would equal the LCB so that in the analysis it was necessary to calculate only the LCG from the weight information.

The significant wave height of the seaway was selected so that the wave bending moment values that resulted from Murdey's equations would be close to those that would be

used for design values.

Length and displacement would be varied to cover the range that would produce reasonably shaped and sized hulls typical of today's dry cargo ships.

TABLE I

CHARACTERISTICS OF TYPICAL CARGO SHIPS

Δ Tons	LBP ft.	L/B	C_B	$\frac{DWT}{\Delta}$	$\frac{I_{TOT}}{L^2\Delta}$	$\frac{I_A}{L^2\Delta}$	$\frac{I_F}{L^2\Delta}$	I_{TOT} $10^6 ft^2 ton$	I_A $10^6 ft^2 ton$	I_F $10^6 ft^2 ton$	M/L	β/L
17509	470	6.8	.628	.625	.0451	.0240	.0211	174.4	92.8	81.6	-.178	N/A
20070	520	6.9	.573	.636	.0622	.0322	.0300	337.6	174.7	162.8	-.133	N/A
21013	528.6	7.0	.612	.638	.0600	.0307	.0293	352.3	180.3	172.0	-.044	N/A
26819	600	7.06	.634	N/A	.0587	.0334	.0253	566.7	322.5	244.3	N/A	N/A
24385	530	7.65	.794	N/A	.0419	.0185	.0234	287.0	126.7	160.3	N/A	N/A
19625	500	6.49	.594	N/A	.0623	.0353	.0270	305.7	173.2	132.5	N/A	N/A
13859	435	6.90	.683	.695	N/A	N/A	N/A	N/A	N/A	N/A	-.133	.0271
21093	528	6.95	.624	.636	N/A	N/A	N/A	N/A	N/A	N/A	-.097	0.00
22630	528	6.94	.612	.607	N/A	N/A	N/A	N/A	N/A	N/A	-.144	.0184
21235	544.5	6.95	.539	.609	N/A	N/A	N/A	N/A	N/A	N/A	-.232	.0098

NOTES: 1) I's are about axis through amidships.

2) N/A = Information Not Available.

IV. DETERMINING PARAMETERS REQUIRED TO DESCRIBE THE SHIP

A. Weight Distribution Relations

Since no published relations for determining values of the weight distribution parameters were found, it was necessary to analyze the characteristics of existing ships. References 19 and 20 presented summaries of the more commonly used ship characteristics for several ships; data was obtained from these concerning the location of the total deadweight, and the machinery weight and location, and is summarized in Table I. Plots were made of total deadweight location as a function of deadweight/displacement, as a function of length, and as a function of C_b; the resulting scattered points indicated the lack of any relation; a regression analysis similar to that described below for the moments of inertia was done and yielded no usable relation for deadweight location. Plots and a regression analysis showed no relation between machinery location and length or C_b. Therefore, it was decided to use the average of the actual ship values collected for M/L as a standard and investigate the variation of M/L within the limits of the data collected. For a standard, M/L = -.137 was used. The effects of varying M/L from -0.44 to -.232 was analyzed. A standard for β/L of .0139 was selected from the approximate

weight distribution in Figure IV. β/L was varied from 0.0 to 0.271.

A useful relation was found for the machinery weight, W_2, as a function of displacement and design speed. On page 9 of reference 20, D'Arcangelo gives a plot of shaft horsepower versus displacement for a wide range of speeds and ship sizes. On page 22 he gives a plot of machinery weight versus shaft horsepower for steam plants. Together these plots give a value of machinery weight for each speed and each displacement; the actual values are listed in Appendix II. A least squares fit regression analysis shows that the following function and parameters are in excellent agreement with the data:

$W_2 = aV^b$ where a and b are a function of displacement

Displacement 1,000 Tons	a	b
10	4.132	1.591
12	4.754	1.557
14	6.237	1.493
18	2.142	1.896
20	2.257	1.890
22	2.266	1.900
26	2.278	1.919

The coefficients of determination for the regression analysis

are shown in Appendix II. The above relation was used to determine the machinery weight for each ship.

Data on the moments of inertia of the weights was obtained from M.I.T. Ocean Engineering files and from Murdey's paper, Reference 15, for actual ships and is listed in Table I. Several references give moments of inertia for models; since there was no evidence that the model weight distribution reflected actual ships, model data was not included. A least squares fit regression analysis was done to determine if there might be some relation between hull form and weight moment of inertia. The following functions were tested:

Linear: $y = m_1x + m_o$

Exponential: $y = m_1e^{mx}$

Log: $y = m_1 + m(\ln x)$

Power: $y = m_1x^m$

Each of these functions were tested for possible relations between the following parameters:

$I_{tot}/L^2\Delta$, $I_a/L^2\Delta$, and $I_f/L^2\Delta$ as a function of either C_b or L/B.

I_{tot}, I_a, and I_f as a function of L.

All variations of possible functions and parameter combinations resulted in a poor fit except for the actual moments of inertia being a linear function of length. The results are:

$$I_a = (1.6504L - 687.69) \times 10^6 \text{ ft -tons} \qquad r^2 = .83$$

$$I_f = (1.2156L - 478.98) \times 10^6 \text{ ft -tons} \qquad r^2 = .98$$

A value of the coefficient of determination, r^2, equal to one indicates a perfect fit. Details are Appendix II.

Even though the results of the regression analysis indicate that the moment of inertia may be a function of length, it was decided that to make it a function of length would confuse the effect of a length variation with the effect of a weight distribution variation. So, the analysis was done with the average of the data collected used as a standard and the variation of the moments of inertia over the range of the data collected was analyzed separately.

References 21 and 22 gave long established relations that are in close agreement for the deadweight/displacement as a function of the speed length ratio. An average line through the design lane from Reference 22 results in the following equation which was used in the analysis:

$$DWT/\Delta = -.677/\sqrt{L} + 1.211$$

The design lane shows that DWT/Δ may vary as much as ±.035 from the average line.

The information obtained to date is sufficient to calculate the LCG of the ship. The three weight components involved are the deadweight, machinery weight, and hull weight. Everything required is known except the center of the hull weight which can be found from Faresi's curves for a_1, the integral factor for the magnitude of the hull weight. Reading the curves where $a_1 = .5$ gives the position of the center of the hull weight for each value of C_b. X_d, the center gravity of the hull weight measured from amidships expressed as a percentage of ship length, is listed at the beginning of Appendix VIII for each block coefficient. Using all the above information, the LCG is:

$$LCG = 100 \left[\frac{M}{L} \left(\frac{W_2}{\Delta} \right) + \frac{\beta}{L} \left(\frac{DWT}{\Delta} \right) \right] + X_D \left(1 - \frac{W_2}{\Delta} - \frac{DWT}{\Delta} \right)$$

where LCG is the center of gravity of the total ship as a percentage of ship length from amidships, (+) is forward.

The fraction of deadweight aft of amidships and the center of the deadweight aft of amidships are the only

FIGURE IV
APPROXIMATE DEADWEIGHT AND MACHINERY WEIGHT DISTRIBUTION

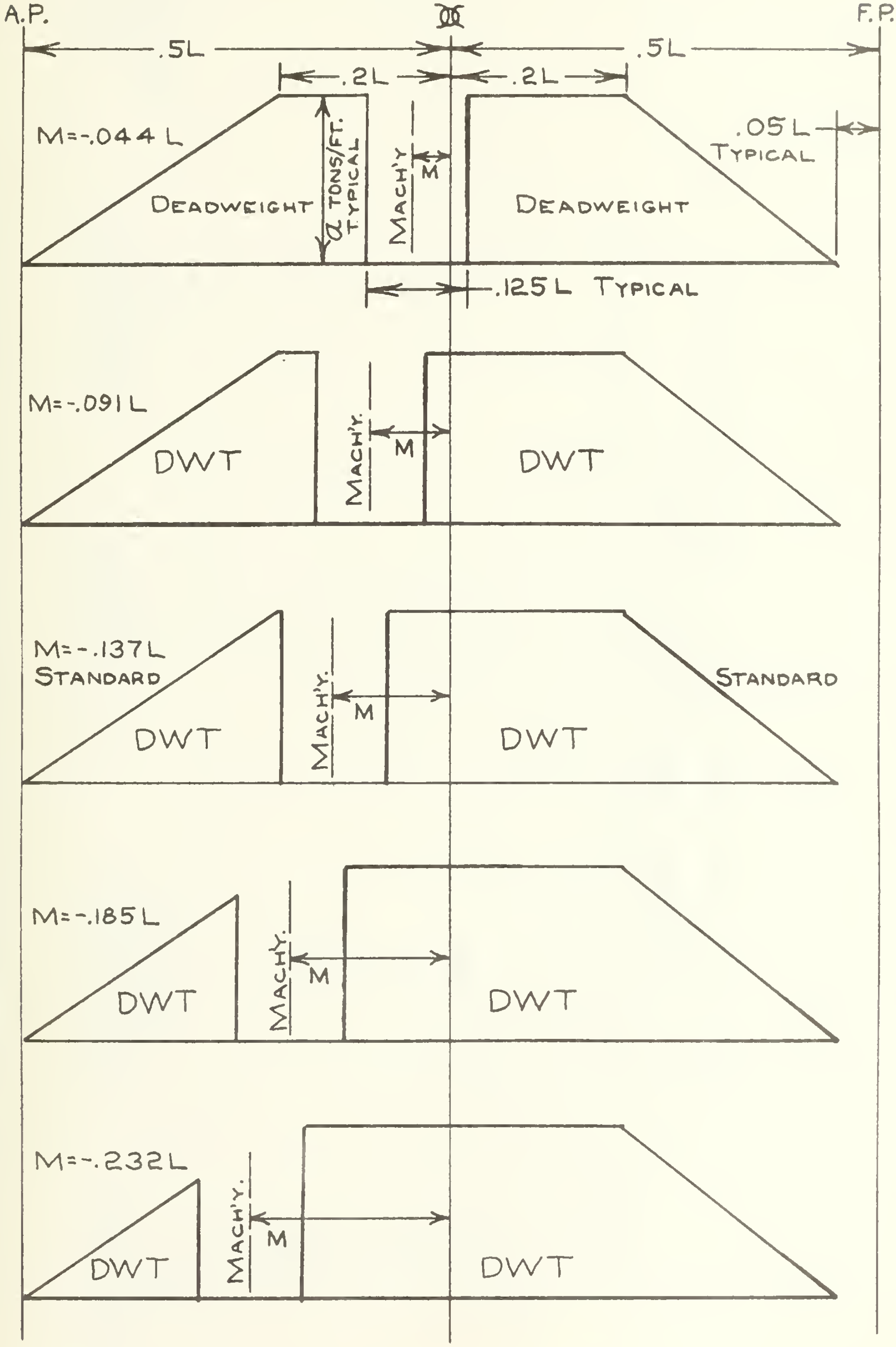


TABLE II

CHARACTERISTICS OF APPROXIMATE WEIGHT DISTRIBUTION

MACHINERY LOCATION M/L	FRACTION OF DEADWEIGHT AFT DWTA/DWT	TOTAL DEADWEIGHT LOCATION β/L	LOCATION OF DEADWEIGHT AFT β_A/L	CHANGE IN DWT DWT/DWT_{STD}
-.044	.443	-.0074	-.244	1
-.091	.410	+.0036	-.238	1
-.137*	.410*	+.0139*	-.213*	1
-.185	.415	+.0230	-.187	1.007
-.232	.426	+.0279	-.166	1.026

Notes: 1) Given M/L determines remainder of characteristics.

2) * = "Standard" ship characteristics.

3) For all cases machinery box length/ship length = .125

weight distribution parameters that have not yet been determined. Because there was no information in the literature concerning these parameters, several weight distributions were reviewed and a standard was adopted for the analysis. This standard weight distribution relates the machinery location, the total deadweight/displacement, the fraction of deadweight aft, and the centers of the total deadweight and the deadweight aft of the amidships. Several unsuccessful attempts at developing a standard weight distribution resulted in either still water bending moments that were unreasonably high or in values of parameters that did not agree with published data. The weight distribution in Figure IV, which was used in the analysis, gives reasonable still water bending moments and gives values of the weight parameters that agree well with published data. Reviewing the ship arrangements in References 19 and 20, it was concluded that machinery length remained fairly constant regardless of machinery location. It was also concluded that for average sized cargo ships a value of machinery box length/ship length of 0.125 would be valid.

Reviewing typical weight distributions showed that Figure IV would be a good straight line approximation of the weight per foot of length (excluding hull weight); i.e., the available volume is used for either machinery

TABLE III

SIGNIFICANT VALUES FROM SAUNDERS' DESIGN LANES

$V/\sqrt{L}$		.7	.8	.9	1.0	1.1
C_p	Min.	.700	.638	.588	.560	.550
	Opt.	.733	.670	.620	.561	.539
	Max.	.765	.702	.651	.612	.593
C_m	Min.	.960	.950	.938	.918	.883
	Opt.	.984	.978	.970	.958	.940
	Max.	1	1	1	1	.996
C_B	Min.	.672	.606	.552	.514	.486
	Opt.	.721	.655	.601	.561	.539
	Max.	.765	.702	.651	.612	.593
C_w	Min.	.781	.729	.687	.664	.655
	Mid.	.809	.756	.714	.685	.675
	Max.	.835	.783	.740	.707	.693
$\frac{\Delta}{(L/100)^3}$	Min.	145.	125.	102.	81.	61.
	Mid.	168.	150.	128.	106.	84.
	Max.	190.	174.	153.	131.	107.

For L/B: $L/B = -3.24 + 1.684 \ln(L)$

Design Lane allows beam to vary ±15 feet from average line.

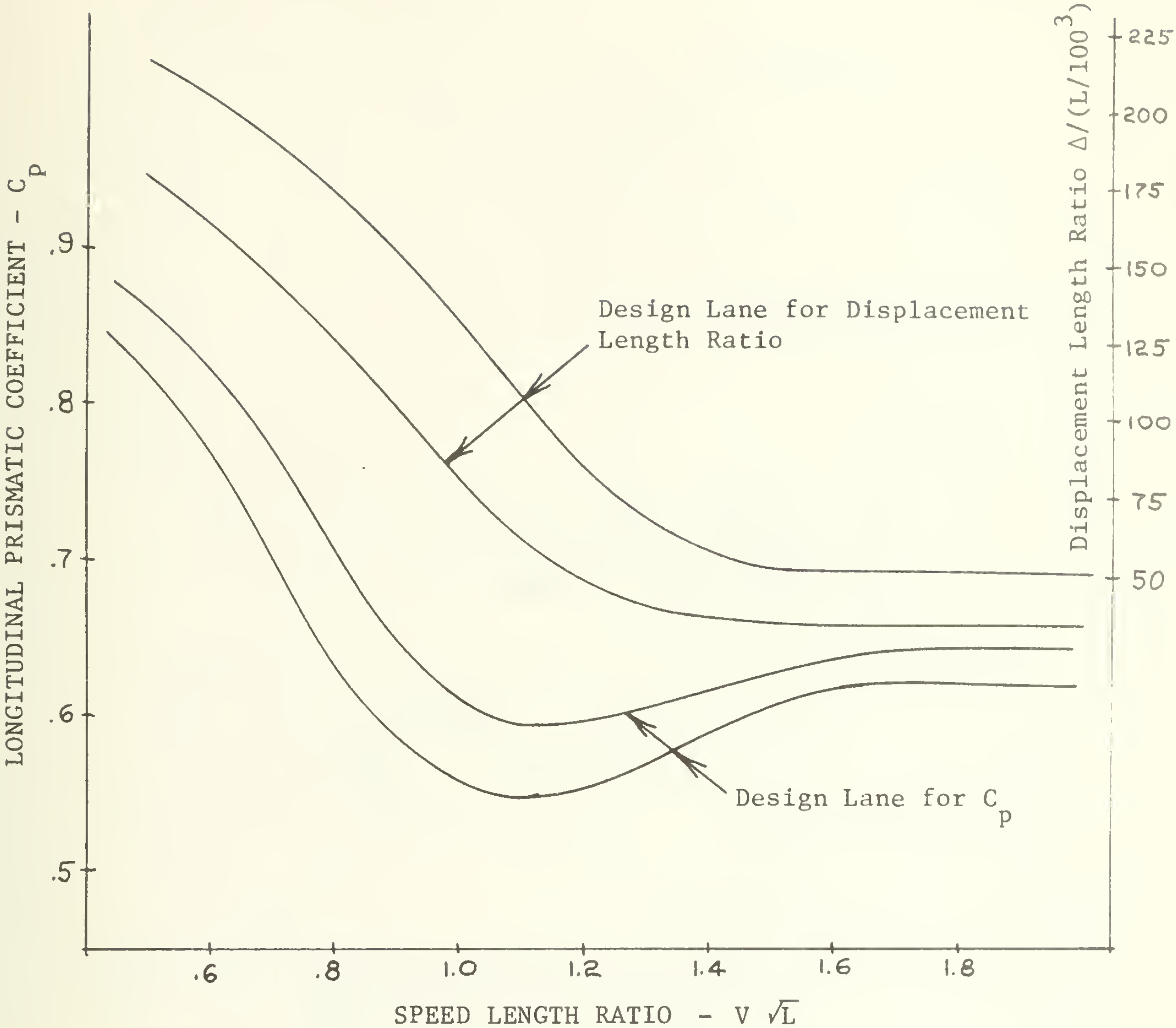


Figure shows approximate design lane; see Table III for precise values.

FIGURE V.A

SAUNDERS' DESIGN LANES FOR C_p and $\Delta/(L/100)^3$

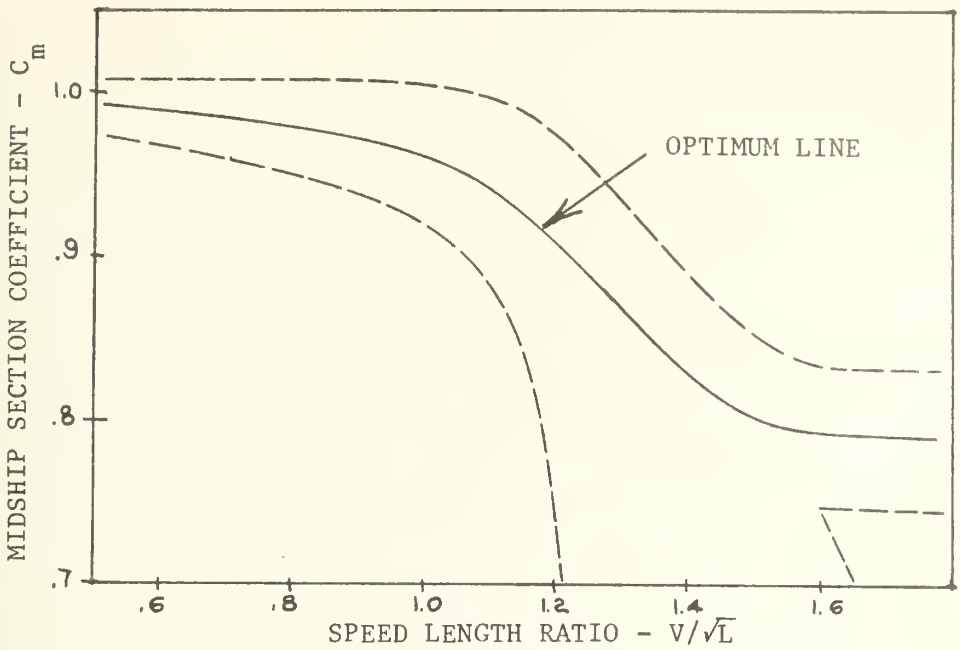


FIGURE V.B - SAUNDERS' DESIGN LANE FOR C_m

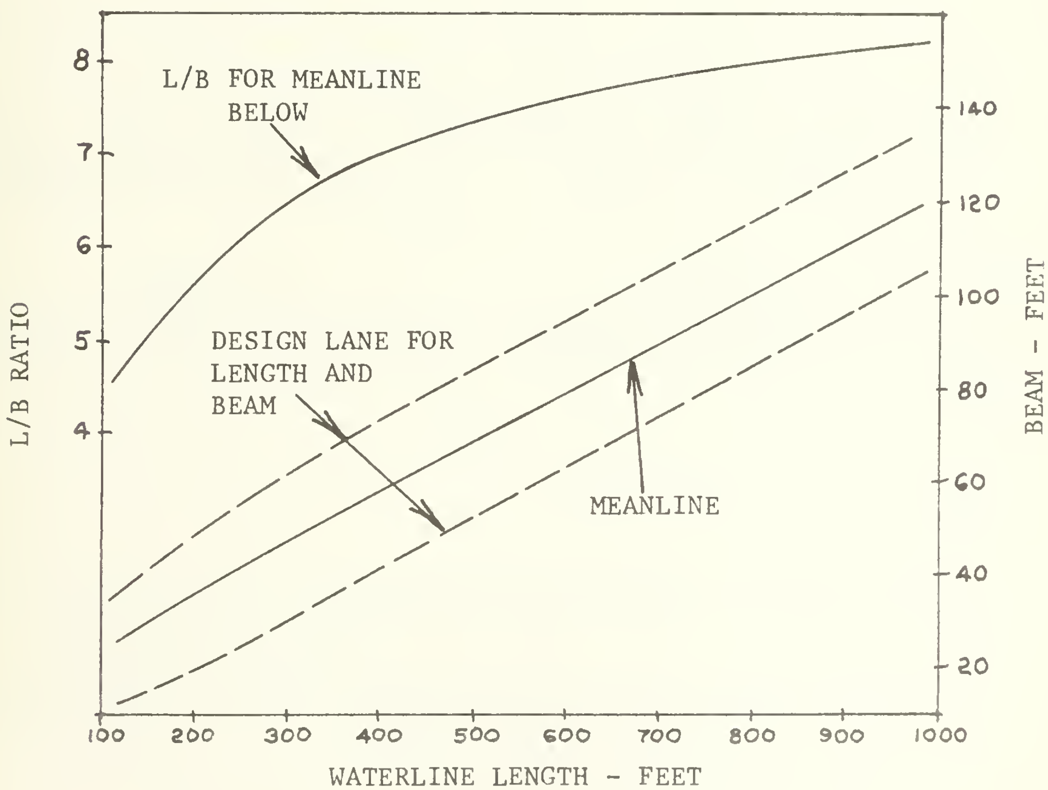


FIGURE V.C - SAUNDERS' DESIGN LANE FOR BEAM

Figures show approximate design lanes; see Table III for precise values.

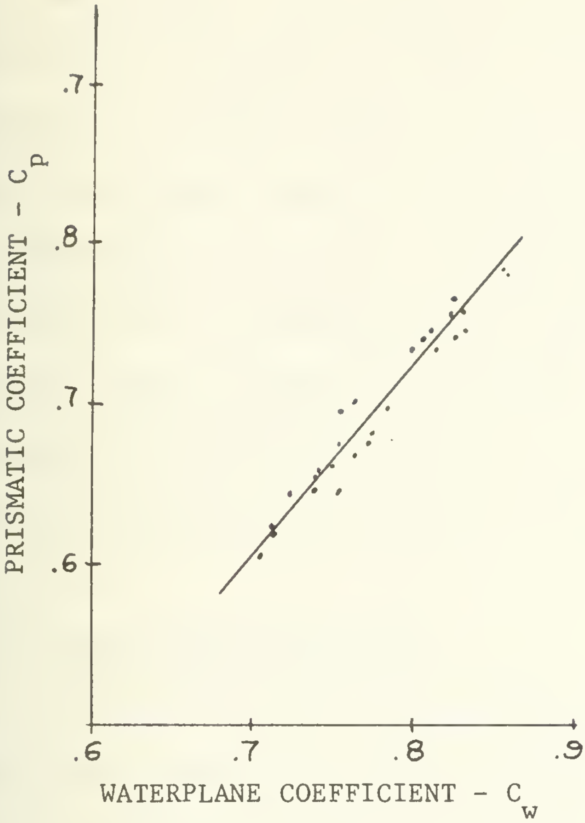


FIGURE V.D

Saunders' Design Lane for C_w

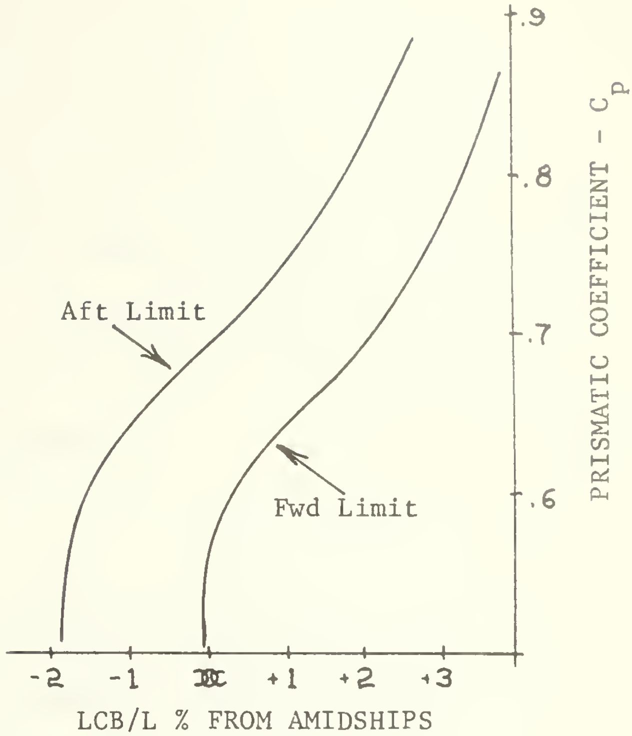


FIGURE V.E

Saunders' Design Lane for LCB

Notes: 1) Figures show approximate design lanes; see Table III for precise values.

2) Points are actual ship data for C_p vs. C_w.

3) Equation for C_p vs. C_w is: $C_w = .837C_p + .195$

or deadweight. The machinery box was kept a constant fraction of the ship length and moved so that the machinery center of gravity covered the range of typical ships. For each machinery location the resulting values of deadweight/displacement, fraction of deadweight aft, and the centers of the total deadweight and the aft deadweight were calculated using simple geometry relations. Figure IV illustrates the geometry and Table II summarizes the results of the machinery move on each of the affected parameters.

B. Hull Form Relations

Relations for determining hull form parameters have been standard tools of the naval architect for years and are available in many references. References 22, 23, and 24 each have information on all of the major parameters. Saunders, Reference 23, was used for this analysis because his information is probably the most complete and his design lanes were definitely developed to produce a ship with minimum resistance. Figure V illustrates the form of Saunders' design lanes and Table III lists the values of the parameters from the design lanes that are of interest in this analysis. The procedure for selecting a hull form is as follows:

1. Start with a particular speed length ratio and select an optimum value of C_p and $\Delta/(L/100)^3$ from

Figure V-A and an optimum value of C_m from Figure V-B.

2. Use the value of C_p to enter Figure V-D and obtain C_w or use $C_w = .837C_p + .195$. And use the value of C_p to obtain LCB limits from Figure V-E; the LCG limits were used only as a check to see that the calculated LCB was within the limits for a reasonable hull form without trim.

3. Calculate C_b using $C_b = C_pC_m$.

The steps up to this point determine the dimensionless coefficients that would be used to define a ship of any size with the design speed length ratio used in Step 1. To proceed further it is necessary to use a particular size (either length or displacement) of ship. Since ships are typically sized by their displacement, it was decided to start with a particular displacement. Therefore, the remaining steps are:

4. Given a particular displacement, use the $\Delta/(L/100)^3$ from Step 1 to calculate an optimum length.

5. Use the optimum length from Step 4 to enter Figure V-C and obtain L/B.

6. The block coefficient can be defined using

$$C_B = \frac{35\Delta}{LBT} .$$

Rearranging the terms gives what is called the "buoyancy constraint":

$$\frac{L}{T} = \frac{C_B}{35\left(\frac{L}{B}\right)} \cdot \frac{10^6}{\left[\frac{\Delta}{(L/100)^3}\right]}$$

which is used to determine L/T using the parameters from the above steps.

With the relations presented in this and the previous sections, a hull form and weight distribution can be selected to define a particular ship given the speed length ratio and displacement of the ship. The hull form will be designed for minimum resistance and adequate transverse stability. The weight distribution will be an average of typical cargo ships that were analyzed.

For consistency of the standard ships the same average value of L/B was used for all of the standard ships. This average value is well within the design lane for each of the ships.

V. CALCULATION METHOD

A. Dimensionless versus Absolute Value for Bending Moment

It is common practice in the literature, especially when reporting research results, to present values in dimensionless form; this has the advantage of allowing a wide range of ship characteristics to be covered in a fairly small amount of space. It is also common practice to discuss the effects of varying certain dimensionless parameters on the dimensionless representation of bending moment, or some other ship characteristic; when concerned with designing a particular ship this latter practice can be quite misleading.

For example, Murdey (Reference 15) uses the dimensionless coefficient μ_s to represent bending moment, where:

$$\mu_s = \frac{\overline{BM}^{1/3}}{(\frac{H}{L}s)\,\rho g L^3 B}$$

while in the seakeeping tables (Reference 14), Loukakis uses μ, where:

$$\mu = \frac{\overline{BM}^{1/3} \times 10^7}{4\rho g L^4}$$

Figure VI shows the values of these dimensionless coefficients as L/B and C_b are varied for a 600 ft. ship in

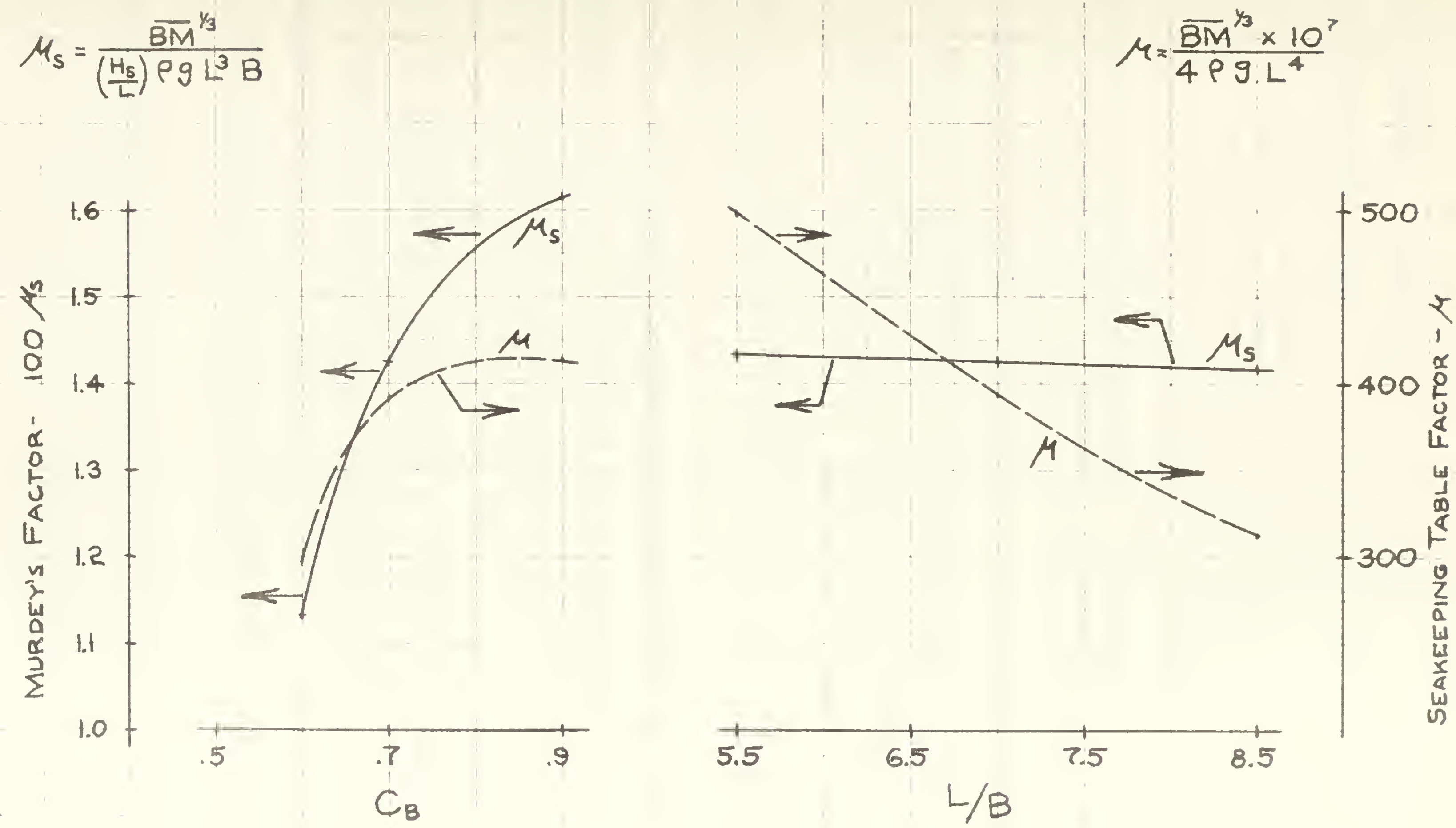


FIGURE VI
COMPARISON OF DIMENSIONLESS
REPRESENTATIONS OF BENDING MOMENT

a 45 ft. seaway. There were no constraints on displacement and all other parameters in the bending moment relations were held constant; details of the calculations are in Appendix I. As seen in Figure VI, one might draw considerably different conclusions regarding the effect of varying L/B or C_b on bending moment, depending on whether μ or μ_s was used for the analysis. This difference exists even though, for a particular ship, the two references will predict the same value for bending moment. The reason for the difference is that the dimensionless coefficients for bending moment contain different parameters and these parameters vary as well as the value of the bending moment.

Trends from dimensionless parameters can be even more misleading when one is concerned with working with a constant displacement and the constraint of satisfying the definition of C_b, as would be the case in an actual design situation. Because it is desired to produce results that are of direct use in preliminary design, it was decided to present results as the absolute value of bending moment rather than represent the bending moment in dimensionless form.

Furthermore, the method for deriving the hull form and weight distribution parameters requires that a particular

size ship be known to get values for W_2/Δ. So, the calculation method requires that actual ships be derived rather than using the dimensionless description of the hull form.

B. Basic Approach to Calculations

Considering the factors in the previous section, it was decided that the analysis would be done as a series of "experiments". First, a standard hull form, typical of today's cargo ships, would be selected. This hull form would be used to define several ships that would cover a practical range of displacements and the bending moment would be calculated for each of the ships. Next, each of the major parameters that affect bending moment would be systematically varied and a new ship would be defined for each variation; each of the new ships would have a displacement equal to that of the standard ships. Last, the bending moment for each of the variations would be compared with the bending moment for each standard to see what effect the variation had on the moment. A few general comments are in order.

A range of displacements was covered because it was felt that the effect of a parameter variation might be different at different displacements. The range was

limited by the input data available for calculating machinery weight from 10,000 tons to 26,000 tons.

In preliminary design, it is customary to be concerned with a ship of a particular size or displacement. In doing the calculations, it would have been convenient to let the displacement vary as the hull form parameters were varied; however, it was felt that this would not reliably predict the effect of varying a hull form parameter on a ship of a certain size. Therefore, to keep the results in a form useful for design purposes, displacement was held constant at the values chosen for the "standard" ships.

To keep the hull forms and weight distributions within reasonable limits, the hull form parameters were not varied much beyond Saunders' design lanes and the weight distribution parameters were kept within the limits of the data collected on actual ships. Going beyond the design lanes would only result in ships that have inadequate stability or have such high resistance that they would not be practical.

C. Deriving the Standard Ships

Four "standard" ships were derived using the weight distribution and hull form relations presented in sections IV.A and B. Displacements of 10,000 tons, 14,000 tons,

TABLE IV

Standard Hull Form and Weight Distribution

Hull Form:

$V/\sqrt{L} = .90$ Fr. No. $= .268$

$C_B = .60$ $C_W = .714$

$L/B = 7.28$ $L/T = 18.47$

$$\frac{\Delta}{(L/100)^3} = 128$$

Weight Distribution:

$M/L = -.137$ $\beta/L = .0139$ $\beta_A/L = -.2130$

$\frac{DWT}{\Delta} = .611$ $\frac{DWTA}{\Delta} = .2505$ $\frac{DWTA}{DWT} = .41$

$\frac{I_A}{L^2\Delta} = .0290$ $\frac{I_F}{L^2\Delta} = .0260$

Particular Hulls:

						Bending Moments Ft.-Tons			
						Wave BM		Total BM	
Δ-Tons	V-Knots	L-Ft.	B-Ft.	T-Ft.	SWBM	HOG	SAG	HOG	SAG
10,000	18.6	427	58.9	23.1	49,297	50,401	-90,157	99,698	-40,860
14,000	19.7	478	65.9	25.9	78,499	75,342	-136,514	153,841	-58,015
20,000	20.9	539	74.3	29.2	127,440	114,676	-211,359	242,116	-83,919
26,000	21.8	588	81.1	31.8	182,369	155,698	-290,840	388,067	-108,471

TABLE IV (continued)

Δ	SWBM / Total BM %	Total SAG BM / Total HOG BM %	Total HOG BM / ΔL	Wave HOG BM / ΔL	SWBM / ΔL
10,000	49	41	.0233	.0118	.0115
14,000	51	38	.0230	.0113	.0117
20,000	53	35	.0225	.0106	.0118
26,000	54	32	.0221	.0102	.0119

20,000 tons, and 26,000 tons were selected to cover the range of input data available to determine machinery weight. A speed length ratio (knots/$\sqrt{\text{feet}}$) of 0.90 was selected as typical of today's dry cargo ships. Using Saunders' design lanes for $V/L^{1/2} = 0.90$ and the definition of C_B, the following parameters were selected as the optimum from a resistance standpoint for all of the hulls (see section IV.B, Figure V, and Table III):

$C_p = 0.620$	$C_m = 0.968$
$C_w = 0.714$	$\Delta/(L/100)^3 = 128.0$
$L/B = 7.25$	$L/T = 18.47$
$C_b = 0.60$	

The above parameters determine the hull form of each of the standard ships, which is shown in Table IV. If Saunders' design procedure were strictly followed, each of the standard ships would have a different L/B, because L/B is a function of length. However, the L/B design lane is wide enough so that the average L/B of 7.25 stays within the design lane for all of the standard ships. Since L/B is one of the parameters in the bending moment equations, it was felt that using the same value for all of the standard ships would make the results more consistent.

The standard weight distribution parameters were obtained as described in section IV.A. DWT/Δ was obtained from the equation for the design lane average for $V/\sqrt{L} = 0.90$. M/L, $I_a/L^2\Delta$, and $I_f/L^2\Delta$ were obtained from the average of the data collected for typical cargo ships. β/L, β_A/L, and DWTA/DWT were obtained from the standard weight distribution shown in Figure IV. The resulting standard values are given in Table IV. The value of β/L obtained from the approximate distribution used in Figure IV is very close to the value of .0184 obtained from the average of the data collected on actual ships.

Table IV also gives the resulting bending moments for the standard ships. The method of calculating these will be presented later in the paper.

D. Variation of Hull Form and Weight Distribution Parameters

Each of the parameters in the still water and wave bending moment equations was systematically varied over a range that would result in reasonable hull forms. Naturally, it is desirable to vary only one parameter at a time so that its effect can be analyzed independently of all other parameters. Unfortunately, in order to satisfy the definition of C_b and to keep displacement constant, it was necessary to vary two parameters at once in many cases.

TABLE V

Ranges of Input Parameters

Parameter	Actual Ship Limits or From Design Lanes for $V/\sqrt{L}$ = .90	Input Data/ Relations Limits	Used in Calculations
C_W	.712 to .716 (2)	None	.710 to .718
C_B	.55 to .65	.6 to .75 for SWBM Integral Factors	.6 to .75
$\frac{\Delta}{(L/100)^3}$	102 to 153	None	102 to 154
L/B	So Beam Varies ± 15 ft.	None	6.00 to 9.00
$V/\sqrt{L}$	N/A	None	.75 to 1.05
LCB	+ .7% to - 1.3%	None	Only to Check LCG
M/L	- .044 to - .232	None	- .044 to - .232
β/L	0 to .0271	None	0 to .0271
$\frac{DWT}{\Delta}$	.576 to .646	None	.576 to .646
$\frac{DWTA}{DWT}$	None	None	.37 to .45
$\frac{I_A}{L^2\Delta}$	.0185 to .0353	None	.0185 to .0353
$\frac{I_F}{L^2\Delta}$	.0211 to .0300	None	.0211 to .0300

NOTES: (1) Hull form parameter limits from Saunder's design lanes. Weight distribution parameter limits from actual ship data.

(2) C_W is closely related to C_B.

The ranges over which the parameters were varied is summarized in Table V. The parameters were varied as follows:

<u>Waterplane coefficient</u> was varied independently of all other parameters. All of the references concerned with hull form agree that C_w is closely related to C_p (see Figure V); therefore, only a small variation of C_w from the standard was considered practical without varying other parameters. Figure V also shows that there is considerable latitude in the choice of C_m so that it should be possible to let C_m vary with C_w so that as C_p varies with C_w the block coefficient can be held constant. The range of the C_w variation was determined by looking at the scatter in the plotted data for Saunders' design lane for C_w.

<u>Block coefficient</u> cannot be varied independently of the other parameters while keeping displacement constant, i.e. the buoyancy constraint must be satisfied:

$$\frac{L}{T} = \frac{C_b}{35(\frac{L}{B})} \cdot \frac{10^6}{[\Delta/(L/100)^3]}$$

It was decided to keep length constant by keeping the displacement length ratio constant and to do one series of variations of C_B and L/T with L/B constant and to do a

second series of variations of C_B and L/B with L/T constant. The foregoing variations would provide information to a designer who is interested in the effect of varying C_b on a particular ship.

However, in analyzing typical ship characteristics it is evident that many other parameters seem closely related to C_b, so that it is common practice to compare ships and analyze trends by considering just ship size, speed, and block coefficient. It is often taken for granted that ships of equal block coefficient have equal values of other important parameters such as C_w; this is particularly true of past qualitative analyses of the effect of C_b on bending moment and of the classification rules. Therefore, a series of variations was done in which C_w was varied with C_b according to Saunders' design lanes to reflect trends that would be seen when studying past typical ships. To satisfy the buoyancy constraint in this series, L/T was varied and L/B was held constant.

In each of the C_b variations it was possible to study only increases in C_b from the standard of 0.60 because Faresi's curves for still water bending moment factors do not go below this value. Also, since C_b is usually closely related to speed and ship type, the range over which C_b was varied, up to 0.75, is larger than the prac-

tical range over which the standard ship could be varied, which is from 0.55 to 0.65. The increased range was used only to see what the trend might be, not because it was felt a particular ship would be varied over this range.

Length is varied by varying the value of the displacement length ratio; the limits of the variation are selected from the design lane for displacement length ratio (see Figure V and Table III). Length affects the buoyancy constraint so two variations were done as in the C_b series; one with L/T varying and one with L/B varying.

Since the speed length ratio is held constant, speed also varies with length. So, a third series was done with speed held constant and the speed length ratio varied as length varies; in this series L/T was varied. With a constant speed length ratio, as length increases, speed increases and machinery weight should increase, causing a decrease in hull weight. With constant speed, as length increases, the speed length ratio decreases and the deadweight will increase, causing a decrease in hull weight.

Beam and draft were varied together because of the buoyancy constraint. Saunders' design lane (Figure V) for L/B shows that for the range of ship lengths of concern, the beam can vary approximately ±15 feet from the standard; L/B was varied so that this approximate range would be

covered.

Design speed was varied by varying the speed length ratio. A fairly wide range was covered to see what trend might develop. Actually, only small variations in design speed would be made in any particular ship without varying other important parameters, such as C_p and C_b. As the design speed varies, the deadweight/displacement was varied; all other input parameters were held constant.

Machinery location was varied over the range of data collected on typical cargo ships from roughly amidships to the aft quarter. Several other important parameters are a function of machinery location, all of which were varied with the machinery location. The parameters are: center of the deadweight aft of amidships, center of the total deadweight, deadweight/displacement, and fraction of deadweight aft. The input values of these are listed in Table IV. It is worth noting that as the machinery moves aft into the region of decreasing weight/foot of length that the amount of deadweight that can be carried on the ship increases if machinery length is held constant.

The remaining weight distribution parameters - the center of the total deadweight, deadweight/displacement, fraction of deadweight aft, and the forward and aft moments of inertia - were all varied independently of each other

and of any other parameter. Deadweight/displacement was varied up to the limits of the design lane, ±.035 from the standard. There was no data on or design lane for the fraction of deadweight aft which was varied from 0.37 to 0.45. The center of the total deadweight and the moments of inertia were varied within the limits of the data collected for typical ships.

In addition to the variations in the hull form and weight distribution of the ship considered above, the effect of a speed reduction in a seaway was analyzed. For each of the standard ships the bending moment at speed length ratios of 0.6, 0.3, and 0.0 was calculated. All other parameters were held constant. These calculations were done by hand and the details are in Appendix VII.

E. <u>Calculation Algorithm</u>

The following algorithm was used for all of the bending moment calculations. The algorithm is suitable for either hand calculations or computer calculations. Appendix IV is a sample of the calculation sheet that could be used for hand calculations; this format was used for preliminary calculations only; with the exception of the speed reduction, all of the final calculations were done by computer.

Appendix V is the computer program and input data. Appendix VIII lists the computer output which is formatted and labelled so that all of the pertinent data for each ship can be easily found by someone who is not familiar with the computer program. Basically, the computer program is set up so that the displacement and dimensionless hull form and weight distribution parameters are input; the program calculates: length, speed, machinery weight, L/T, LCG, SWBM, wave BM, and the change in the wave BM mean due to the ship's own wave and due to the seaway. The calculations are repeated for as many input ships as desired with a loop counter which prevents unintentional repetition of the calculations. Faresi's integral factors for still water bending moment, Murdey's coefficients (A's) for the wave bending moment, and the coefficients for machinery weight are input as data at the beginning of the program.

The following dimensionless hull form and weight distribution parameters are input to the program; these are the same for each of the four displacements analyzed (10,000, 14,000, 20,000, and 26,000 tons) and are selected from Saunders' design lanes for a minimum resistance ship and from weight distribution data (see section V.C) or determined by the variation of parameters (see section V.D):

- speed length ratio, $V/\sqrt{L}$
- waterplane coefficient, C_w
- displacement length ratio, $\Delta/(L/100)^3$
- deadweight aft/displacement, DWTA/Δ
  (DWTA/DWT)$\cdot$(DWT/Δ)
- center of deadweight aft, β_A/L
- aft moment of inertia, $I_a/L^2\Delta$
- significant wave height, H_s
- block coefficient, C_b
- deadweight/displacement, DWT/Δ
- length/beam ratio, L/B
- center of total deadweight, β/L
- machinery location, M/L
- forward moment of inertia, $I_f/L^2\Delta$

The displacement is input and the calculations are done for that displacement; the values of the coefficients for machinery weight, still water bending moment integral factors, and wave bending moment coefficients are obtained when needed by linear interpolation using the following formula:

$$\hat{y} = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1) + y_1$$

The algorithm is:

CALCULATE LENGTH

$$L = 100\left[\frac{\Delta}{\Delta/(L/100)^3}\right]^{1/3}$$

CALCULATE SPEED

$$V = (V/\sqrt{L})\sqrt{L}$$

CALCULATE MACHINERY WEIGHT

INTERPOLATE TO GET VALUES OF "P" AND "Q" FOR INPUT DISPLACEMENT

$$\frac{W_2}{\Delta} = \left(\frac{P}{\Delta}\right)V^Q$$

CALCULATE L/T

$$\frac{L}{T} = \frac{C_B}{35(L/B)} \cdot \frac{10^6}{[\Delta/(L/100)^3]}$$

CALCULATE FROUDE NUMBER

$$F_n = .298\frac{V}{\sqrt{L}}$$

CALCULATE LCG

INTERPOLATE TO GET VALUE OF X_D FOR PARTICULAR C_b

$$LCG = 100\left[\frac{M}{L}\left(\frac{W_2}{\Delta}\right) + \frac{\beta}{L}\left(\frac{DWT}{\Delta}\right)\right] + X_D\left(1 - \frac{W_2}{\Delta} - \frac{DWT}{\Delta}\right]$$

CALCULATE DIFFERENCE BETWEEN FARESI'S STANDARD LCB AND ACTUAL LCG

$$X_o = 20C_b - 13.5 - LCG$$

CALCULATE STILL WATER BENDING MOMENT

INTERPOLATE TO GET VALUES OF a_1, b_1, a_o, b_o, δa, and δb FOR PARTICULAR C_b

$$\frac{SWBM}{\Delta L} = b_1 a_1 \left(1 - \frac{DWT}{\Delta} - \frac{W_2}{\Delta}\right) - (a_o + X_o \delta a)(b_o + X_o \delta b) + \left|\frac{M}{L}\right| \left(\frac{W_2}{\Delta}\right) + \left|\frac{\beta_A}{L}\right| \left(\frac{DWTA}{\Delta}\right)$$

CALCULATE DIMENSIONLESS ZERO CROSSING PERIOD

$$\bar{T}_z = 18.32 [\left(\frac{H_s}{L}\right) \sqrt{1/L}^{1/3}$$

CALCULATE WAVE BENDING MOMENT

INTERPOLATE TO GET VALUES OF A's FOR A PARTICULAR $\overline{T}_z$

$$m = \frac{F_n^2}{10^4}\left[116.3C_B^2 - 3.46C_B\frac{L}{T} + 3.04\frac{L}{T} - 20.6C_w - 2.01\frac{L}{B} + .6LCG - 39.5\right]$$

$$\overline{\mu}_s = \frac{F_n^2}{10^2}\left[A_o' + A_1'C_B + A_2'\frac{L}{T} + A_3'\frac{L}{B}\right]$$

$$\mu_s = 10^{-2}\left[A_o + A_1C_w + A_2\frac{L}{T} + A_3LCG + A_4\frac{I_A}{L^2\Delta} + A_5\frac{I_F}{L^2\Delta} + A_6F_n\right]$$

$$\frac{\text{Hogging Wave BM}}{\Delta L} = \frac{L/T}{C_B}\left[\frac{1}{2}\mu_s\frac{H_s}{L} + \overline{\mu}_s\frac{H_s}{L} + m\right]$$

$$\frac{\text{Sagging Wave BM}}{\Delta L} = \frac{L/T}{C_B}\left[\frac{1}{2}\mu_s\frac{H_s}{L} - \overline{\mu}_s\frac{H_s}{L} - m\right]$$

CALCULATE TOTAL BENDING MOMENT

$$\text{BM HOG} = \left[\frac{\text{SWBM}}{\Delta L} + \frac{\text{HOGGING WBM}}{\Delta L}\right]\Delta L$$

$$\text{BM SAG} = \left[\frac{\text{SWBM}}{\Delta L} - \frac{\text{SAGGING WBM}}{\Delta L}\right]\Delta L$$

When the calculations for a particular ship are completed, the results are printed and then the input parameters and displacement for the next ship are read.

The significant wave height (H_s = 50 ft.) was selected based on preliminary calculations so that the wave bending moment would be close to a design value of wave bending moment and so that the resulting nondimensional zero crossing period, $\overline{T}_z$, would be within the range of data presented by Murdey for calculating the wave bending moment coefficients.

VI. ANALYSIS OF COMPUTER OUTPUT

Several different ways of presenting the results of the calculations were investigated. The motive for the entire analysis is to provide information useful in preliminary design for analyzing the effect of varying hull form and weight distribution on bending moment. In keeping with the motive, it is desired to present the results in a concise form that can be easily applied to a particular ship and from which qualitative trends as well as quantitative information can be readily distinguished without many intermediate calculations.

The computer output was purposely formatted so that detailed information concerning any particular variation could easily be found; see Appendix VIII. But, the computer output is too detailed for preliminary design purposes, and it is difficult to see any apparent trends from looking at the output.

Some plots were made of bending moment versus displacement and of $BM/\Delta L$ for each of the parameter variations and the standard ship. These provided nice looking smooth plots that may have been useful for getting a first estimate of bending moment for some design but it was still not easy to see the effect of varying parameters or to see qualitative trends.

Finally, it was decided to calculate marginal factors

for bending moment for each parameter. The marginal factor was defined so that one could see the fractional change in bending moment that would occur for a given fractional change in the parameter:

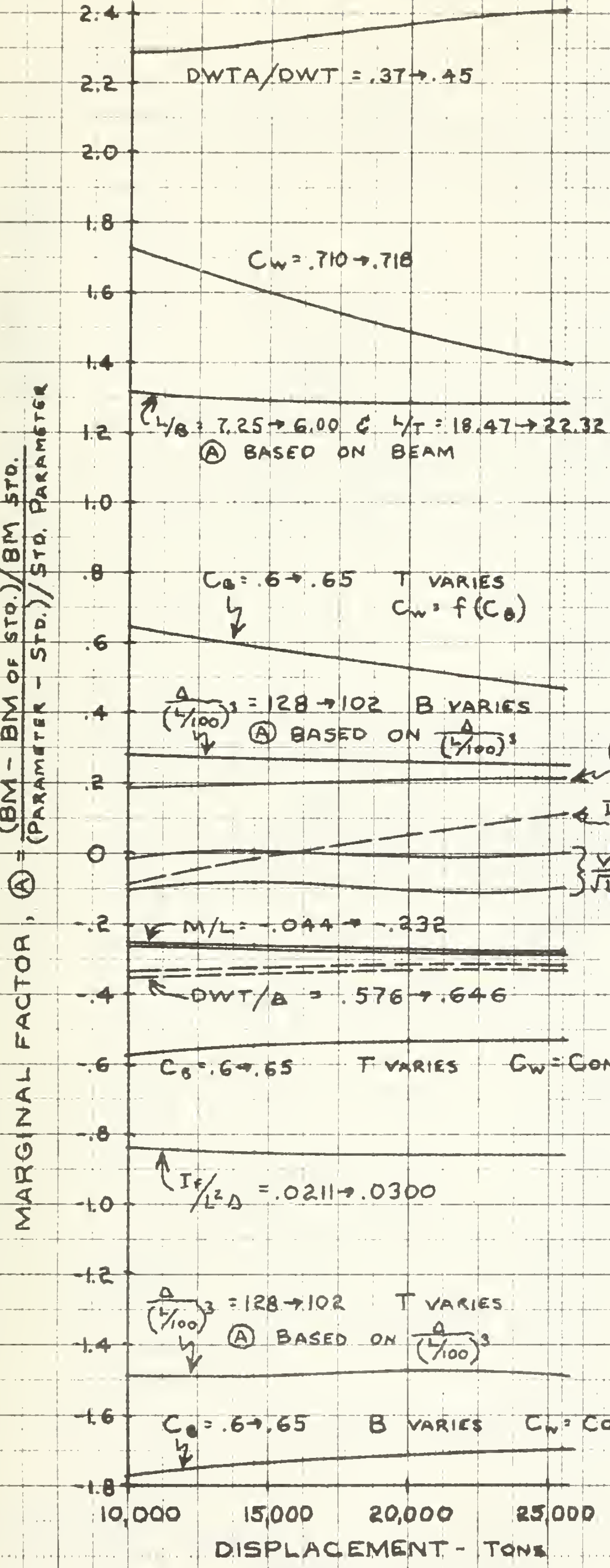
$$\text{marginal factor} = (A) = \frac{(\text{BM for new parameter} - \text{BM for standard ship}) / \text{BM Standard}}{(\text{new parameter} - \text{standard value of parameter}) / \text{Standard Parameter}}$$

The calculation sheet for the marginal factor is in Appendix VI and the factors are shown in Figure VII and the marginal factors averaged over displacement and over each value of the parameter are listed in Table VI.

Because the marginal factors do not vary significantly over the displacement range or over the parameter range (e.g., the average marginal factor for L/B variations is +1.23; from 10,000 to 26,000 tons this factor varies only about $\pm$ 0.017; from an L/B of 6.0 to 9.0 this factor varies only + 0.070) the average value can easily be used to estimate how much bending moment will change given a fractional change in one of the parameters. For example, a 1% increase in beam will result in a 1.23% increase in total bending moment. In addition, qualitative trends can very easily be seen by comparing values of the marginal factors; for example, the marginal factor for a C_b variation holding beam constant is

-0.68 while the marginal factor for a C_b variation holding draft constant is -1.85. Because the marginal factor is negative, it is desirable to use the maximum possible C_b for a particular ship if one wants to reduce bending moment and one can obtain the greatest reduction in bending moment by holding draft constant and reducing beam as C_b is increased.

Besides calculating the marginal factor for the total bending moment, the contribution of the still water bending moment to the total and a comparison of the total sagging moment with the total hogging moment are calculated in Appendix VI. The qualitative trends shown by these calculations are discussed in the Results section.



NOTES: 1) RANGES OF PARAMETER VARIATIONS SHOWN ON EACH CURVE. FOR OTHER RANGES OF L, L/B ¢ C_B VARIATIONS SEE FIGURE VII B.
2) SEE TABLE VI FOR AVERAGE VALUES OF Ⓐ. Ⓐ FOR LENGTH BASED ON $\Delta/(L/100)^3$ IN FIGURE VII. ¢ ON L IN TABLE VI.
3) SEE APPENDIX VI FOR NUMERICAL VALUE OF EACH POINT.

FIGURE VII A
BENDING MOMENT MARGINAL FACTORS vs. DISPLACEMENT

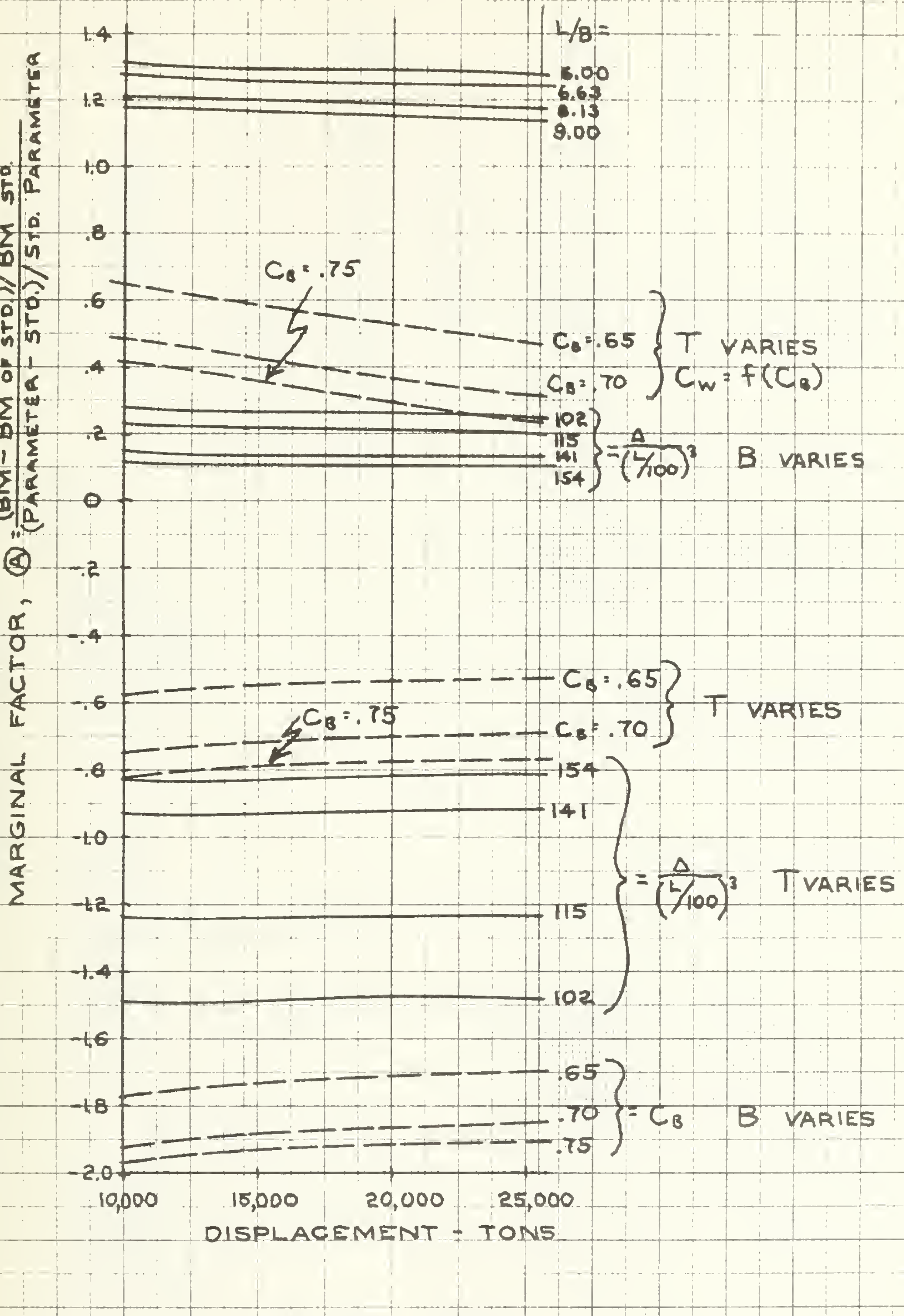


FIGURE VII B

BENDING MOMENT MARGINAL FACTORS VS. DISPLACEMENT

TABLE VI

SUMMARY OF RESULTS

Para-Meter	Parameter Range (Approximate)	$\frac{\text{Change in BM}}{\text{Change in Param.}}$ (A)	Variation of (A) Over Parameter Range	Comments Trends in Magnitude of (A)
C_W	± .6%	+ 1.56	0	(A) Decreases Slightly as Δ Increases
C_B (T)	+ 25.%	- .68	-.52 to -.83	Beam = Constant; (A) Decreases as Δ Increases (A) Increases as C_B Increases
C_B (B)	+ 25.%	- 1.85	-1.70 to -1.97	Draft = Constant; trends as above
C_B&C_W (T)	+ 25.%	+ .43	.24 to .64	C_W = Function of C_B; (A) Decreases as Δ Increases (A) Decreases as C_B Increases
L (L/T)	± 7.%	+ 3.25	2.71 to 3.85	L/B = Constant (A) Decreases as Δ Increases (A) Increases as L Increases
L (L/T)	± 7.%	+ 3.26	2.79 to 3.78	L/B & Speed = Constant (A) Increases as L Increases
L (L/B)	± 7.%	- .53	-.36 to -.72	L/T = Constant (A) Increases as L Increases

TABLE VI (continued)

Para-Meter	Parameter Range (Approximate)	$\frac{\text{Change in BM}}{\text{Change in Param.}}$ (A)	Variation of (A) Over Parameter Range	Comments Trends in Magnitude of (A)
B (L/T)	± 20.%	+ 1.23	1.14 to 1.32	(A) Decreases as Δ Increases (A) Increases as B Increases
V	± 17.%	- .05	-.11 to +.01	Vary Design Speed (A) Increases as V Increases
M/L	± 68.%	- .27	-.25 to -.29	β_A/L, β/L, $\frac{DWT}{\Delta}$, $\frac{DWTA}{DWT}$ all = Function of M/L (A) Increases as Δ Increases
β/L	± 95.%	+ .20	.19 to .21	(A) Increases as Δ Increases (A) Decreases as β/L Increases
$\frac{DWT}{\Delta}$	± 6.%	- .33	-.31 to -.35	(A) Decreases as Δ Increases
$\frac{DWTA}{DWT}$	± 10.%	+ 2.35	2.28 to 2.42	(A) Increases as Δ Increases

TABLE VI (continued)

Para-Meter	Parameter Range (Approximate)	$\frac{\text{Change in BM}}{\text{Change in Param.}}$ (A)	Variation of (A) Over Parameter Range	Comments Trends in Magnitude of (A)
$I_A/L^2\Delta$	-36.% to +22.%	+ .01	-.09 to +.10	(A) < 0 for Δ = 10K & 14K (A) < 0 for Δ = 20K & 26K
$\frac{I_F}{L^2\Delta}$	$\pm$ 17.%	- .85	-.84 to -.86	(A) Increases as Δ Increases

NOTES: (1) All values listed are based on independent parameter shown. Dependent parameter in ( ) was varied as necessary to satisfy buoyancy constraint.

(2) $\text{Range} = \frac{\text{Value - Standard}}{\text{Standard}} \times 100$

(3) $(A) = \frac{(\text{BM - BM Standard})/\text{BM Standard}}{(\text{Parameter Value - Standard})/\text{Standard}}$

(4) Ranges of parameters are within limits for practical hull forms except for C_B. For C_B, actual variation of only $\pm$ 1% or 2% are possible without varying C_W. C_B not varied below standard due to lack of data for still water bending moment calculation.

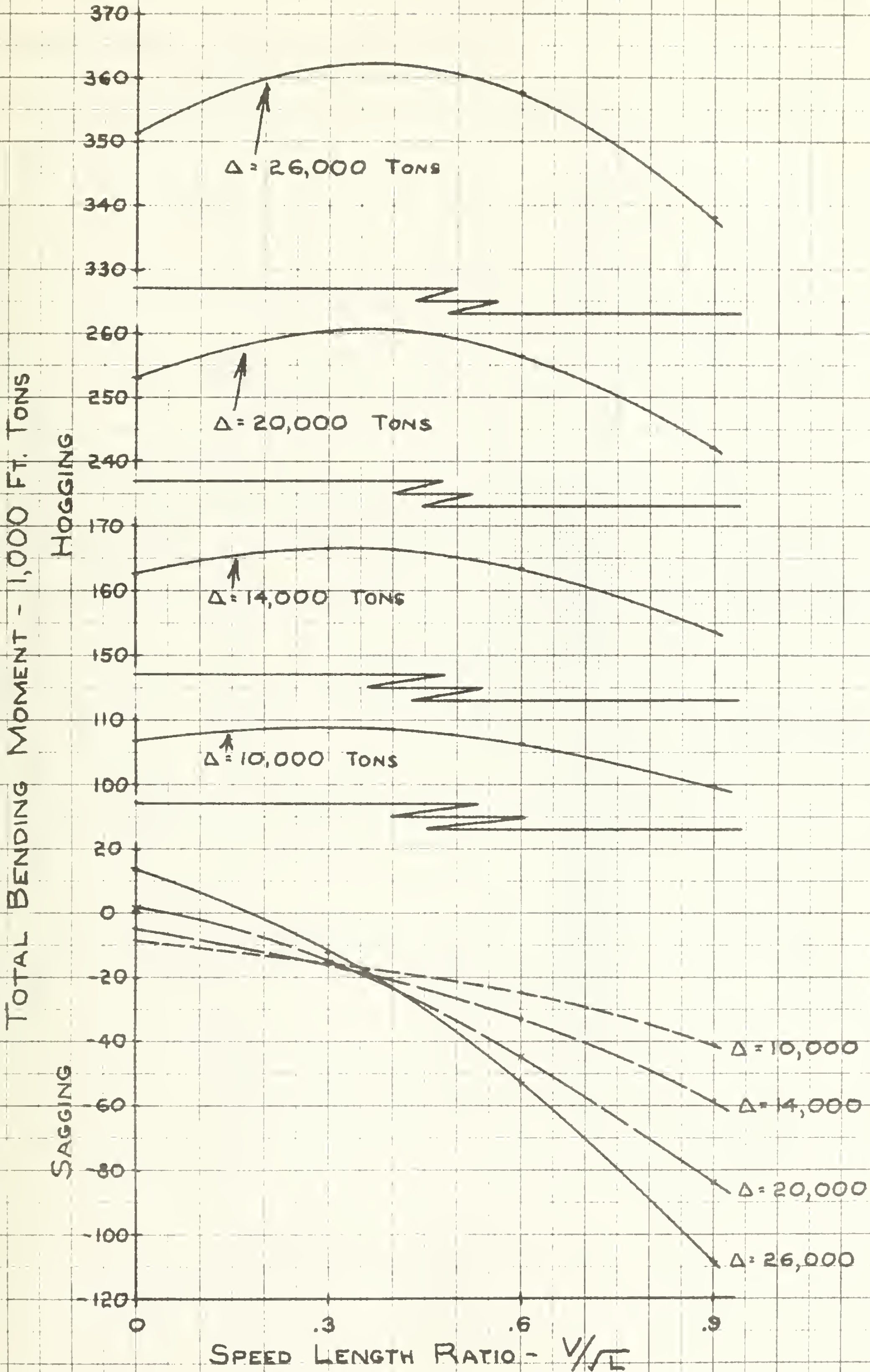


FIGURE VIII

BENDING MOMENT vs. SPEED LENGTH RATIO

TABLE VII

Effect of Decrease of Speed in a Seaway
(All Other Parameters Constant)

	$V/\sqrt{L} = .60$			$V/\sqrt{L} = .30$			$V/\sqrt{L} = 0$	
Δ Tons	V (knots)	δ HOG	δ SAG	V (knots)	δ HOG	δ SAG	δ HOG	δ SAG
10,000	12.4	.07	-.38	6.2	.09	-.64	.07	-.80
14,000	13.1	.06	-.42	6.5	.08	-.72	.06	-.90
20,000	13.9	.06	-.47	6.9	.07	-.81	.04	-1.02
26,000	14.6	.06	-.51	7.2	.07	-.89	.04	-1.13

$$\delta = \frac{\text{BM at Reduced Speed} - \text{BM Standard}}{\text{BM Standard}} \quad \text{for Total Bending Moment}$$

VII. RESULTS

A. Review of Method of Varying Parameters

While evaluating the results of the calculations, it is important to keep the method of varying the parameters in mind. A speed length ratio of 0.90 was considered typical of today's dry cargo ships and was used for most of the calculations. To see the effect that ship size might have on the results, four displacements were investigated for each condition: 10,000, 14,000, 20,000, and 26,000 tons. Each ship must satisfy the definition of the block coefficient, or the "buoyancy constraint":

$$\Delta = \frac{C_B LBT}{35} \quad \text{which gives} \quad \frac{L}{T} = \frac{C_B}{35(\frac{L}{B})} \cdot \frac{10^6}{[\Delta/(L/100)^3]}$$

The "standard" ships were selected as follows:

1) For $V/\sqrt{L} = .9$, select the following from the optimum or middle of Saunders' design lanes (Reference 23): C_p, C_m, C_w, L/B, $\Delta/(L/100)^3$.
2) Using the results from above, calculate $C_b = C_p \cdot C_m \quad DWT/\Delta = f(V/\sqrt{L})$.
3) Use the average of the data collected for existing cargo ships to get the

standard weight distribution parameters:
M/L, β/L, β_A/L, DWTA/DWT, $I_a/L^2\Delta$, $I_f/L^2\Delta$.

4) The parameters from the above 3 steps are the same for all displacements; using them, calculate the following for each displacement: L, V, W_2/Δ, L/T.

5) Calculate LCG, still water bending moment, wave bending moment, and the shift of the wave bending moment mean.

The method described above will produce a ship quite similar to that which would be designed using standard practice today with the philosophy that the "best" hull form is the one with adequate stability and cargo carrying capacity, and minimum resistance.

To analyze how the hull form or weight distribution might be changed to reduce structural loading, each parameter that effects bending moment was varied and the bending moment was calculated for the new ship for each displacement. So that the ships would have a reasonable hull form and weight distribution, the hull form parameters were kept inside or slightly beyond the design lane limits determined by the speed length ratio and the weight parameters were not varied beyond the limits of the actual

ship data collected.

Ideally, each parameter should be varied while all the others are kept constant; unfortunately, this is not possible if the buoyancy constraint is to be satisfied. So, for some parameter variations, such as displacement length ratio and block coefficient, it was necessary to vary either beam or draft as well to satisfy the buoyancy constraint. Obviously, in such cases, the end result is due to the effect of both of the parameters varied and not just the one of prime interest at the time. An alternative solution to this dilemma would have been to let the displacement of the ship vary so that beam and draft could be held constant. However, it was felt that this would be inconsistent with the common design procedure of starting with a certain displacement and designing the ship from that point. More important is the fact that the desired end result is whether the bending moment is reduced or increased for a given size of ship. If, during the analysis, the size of the ship (size is reflected by displacement) is varied as well as the parameter of interest, the results will not tell a designer how the bending moment will change, for example, on a 20,000 ton ship, as the parameter is varied.

Therefore, the parameters were varied as follows:

<u>Waterplane coefficient</u>: independent of all others.

<u>Block coefficient</u>: a) beam constant and draft decreasing as C_b increases.

b) draft constant and beam decreasing as C_b increases.

Note that C_b was increased over a fairly wide range to see what the trend would be. In an actual ship, C_b could be varied only 1% or 2% while holding C_w constant. Unfortunately, only increases in C_b could be analyzed due to limitations of the relations for calculating still water bending moment.

<u>Block and waterplane coefficients</u>: the two were varied together following the design line for $C_w = f(C_p)$ and $C_p = C_b/C_m$ with C_m constant. Beam is constant with draft varying to satisfy the buoyancy constraint. This variation was done primarily for comparison with established trends and classification rules.

<u>Length</u>: varied by varying $\Delta/(L/100)^3$; as $\Delta/(L/100)^3$ increases, L decreases.

a) beam constant and draft decreasing as length increases.

b) draft constant and beam decreasing as length increases.

c) beam and speed constant with draft varying.

Design speed: as speed increases, machinery weight increases and deadweight decreases.

Machinery location: affects β/L, β_A/L, DWT/Δ, DWTA/DWT. As machinery moves aft, the center of the deadweight aft and the total deadweight move forward, deadweight/displacement increases, and the fraction of deadweight aft increases, then decreases.

All other weight parameters were varied independently of any other parameter.

A summary of the standard hull form and weight distribution with the resulting hull dimensions and bending moments is presented in Table IV. A summary of the ranges over which the parameters were varied is presented in Table V.

B. Qualitative Trends in the Effect of Parameters on Bending Moment

1. Analysis of Bending Moment Equations

An analysis of the equations and coefficients for

calculating the bending moments yields the following trends. The details of the analysis are in Appendix VI.

(a) Still Water Bending Moment

$$\frac{SWBM}{\Delta L} = \underbrace{b_1 a_1 (1 - \frac{DWT}{\Delta} - \frac{W_2}{\Delta})}_{\text{Hull Weight}} - \underbrace{(a_o + X_o \delta a)(b_o + X_o \delta b)}_{\text{Buoyancy}}$$

$$+ \underbrace{|\frac{M}{L}| (\frac{W_2}{\Delta})}_{\text{Machinery}} + \underbrace{|\frac{\beta_A}{L}| (\frac{DWTA}{\Delta})}_{\text{Deadweight}}$$

A still water bending moment arises when the weights are not distributed exactly the same as the buoyancy. In the above equation for SWBM at amidships, the weight moments are positive and the buoyancy is negative. For normally shaped cargo ships, the SWBM is hogging and about 42% of the total weight moment is due to the hull weight, about 53% of the total weight moment is due to the deadweight, and about 5% is due to propulsion machinery.

Block coefficient: as C_B increases, the SWBM becomes less hogging. For the standard weight distributed the SWBM is practically zero at $C_B = .75$. The change in SWBM is due to a decrease in the hull weight moment and an

increase in the magnitude of the buoyancy moment as C_B increases.

Length: for constant displacement, SWBM is directly proportional to length, neglecting secondary effects of length on other parameters.

Design speed: speed increase will increase W_2, increasing SWBM, and it will decrease DWT/Δ, the effect of which is explained below.

Machinery location: alone, it has a small effect due to the small machinery moment. However, the machinery location affects the center of the deadweight aft which has a significant effect on SWBM. Machinery location also affects DWT/Δ and the center of the total deadweight so that the net effect of a machinery move is not apparent from looking at the equation.

Total deadweight location: as deadweight moves forward, LCG of the ship moves forward, which decreases the magnitude of the buoyancy moment and results in an increase in SWBM.

Location of deadweight aft of amidships: as it moves aft, SWBM increases due to the increase in the deadweight moment.

Deadweight/displacement: since an increase in

DWT will increase the DWTA, the deadweight moment will increase. Also, a DWT increase will move the total LCG forward which tends to increase SWBM. But, as deadweight increases, hull weight decreases which tends to decrease the SWBM. Therefore, the net effect of a deadweight increase cannot be determined from looking at the equation.

Fraction of deadweight aft: moving more of the deadweight aft will increase the deadweight moment and increase the SWBM; assuming that the total LCG of the ship is unchanged.

Other parameters have no direct effect on the SWBM. Several parameters affect the total LCG; as the LCG moves forward, the magnitude of the buoyancy moment decreases, causing the hogging SWBM to increase.

(b) Wave Bending Moment

$$m = 10^{-4}F_n^{\,2}(116.3C_B^{\,2} - 3.46C_B\frac{L}{T} + 3.04\frac{L}{T} - 20.6C_W - 2.01\frac{L}{B} + .6LCB - 39.5)$$

$$\bar{\mu}_s = 10^{-2} F_n^{\,2} (A_o' + A_1' C_B + A_2' \frac{L}{T} + A_3' \frac{L}{B})$$

$$\mu_s = 10^{-2} (A_o + A_1 C_w + A_2 \frac{L}{T} + A_3 LCG + A_4 \frac{I_A}{L^2 \Delta}$$

$$+ A_5 \frac{I_F}{L^2 \Delta} + A_6 F_n)$$

$$\text{Hogging Wave BM} = \Delta \frac{L/T}{C_B} (\frac{1}{2} \mu_s H_s + \bar{\mu}_s H_s + mL)$$

$$\text{Sagging Wave BM} = \Delta \frac{L/T}{C_B} (\frac{1}{2} \mu_s H_s - \bar{\mu}_s H_s - mL)$$

Coefficients (A's) = $f(\bar{T}_z)$

$$\bar{T}_z = 18.32 [(\frac{H_s}{L}) \sqrt{1/L}]^{1/3}$$

μ_s = significant height of wave bending moment response.

m = shift in wave bending moment mean due to the ship's own wave.

$\bar{\mu}_s$ = shift in the wave bending moment mean due to the seaway.

$\bar{T}_z$ = nondimensional zero crossing period of the response.

The calculations were done with a constant significant

wave height (H_s) of 50 feet; therefore, the coefficients (A's) are different for each length ship.

<u>Waterplane coefficient</u>: has a significant effect on the WBM amplitude. Increasing C_w will increase the amplitude and will tend to make the WBM more sagging.

<u>Block coefficient</u>: has no effect on the WBM amplitude. May make the mean more hogging or sagging depending on the ship and seaway characteristics.

<u>Length</u>: affects the value of the coefficients with no particular trend evident from looking at the equations. Increasing the length will increase the amplitude of the WBM because it increases the "m" term in both the hogging and sagging equations. It is interesting to note that different forms of the WBM equations have the length in different positions, with different powers of length, which may lead to different conclusions about the qualitative effect of a length variation. However, it is clear that, no matter what the form of the equation, the resulting WBM calculations for a particular ship will be the same.

L/B and L/T: L/B has no effect on the WBM amplitude; an increase in L/B makes the WBM more sagging. (A decrease in beam makes the WBM more sagging.) An increase in L/T will decrease the WBM amplitude factor slightly and may affect the mean either way. (A decrease in draft will decrease the WBM amplitude slightly.) L/T has a significant effect on the final wave BM since it multiplies the sum of the factors.

Design speed: A speed increase will increase the WBM amplitude. A speed increase will affect the magnitude of the shift of the mean but not the direction of the shift.

Machinery and deadweight location: these affect the LCG of the total ship. As the LCG moves forward, the WBM amplitude is increased slightly and the WBM becomes more hogging.

Moment of inertia of weight aft of amidships: has a small effect on the amplitude of the WBM. In a high sea, relative to ship length, an increase in I_a will decrease the WBM amplitude. In a low sea, an increase in I_a will increase the WBM amplitude.

Moment of inertia of weight forward of amidships: has a significant effect on the WBM amplitude; an increase in I_f will decrease the WBM amplitude.

2. Analysis of Calculation Results

Besides looking for qualitative trends in the equations for bending moment, the results of the calculations were analyzed for qualitative trends. Of primary interest here is the relative contribution of the still water and wave bending moments to the total hogging bending moment and the relative magnitude of the hogging and sagging bending moments. A quantitative analysis of the effect of each hull form and weight distribution parameter on bending moment is presented in the next section.

For the standard ships: The SWBM is from 49% to 54% of the total. As displacement increases, the SWBM becomes more important. The total sagging bending moment is from 41% to 32% of the hogging bending moment. As displacement increases, the sagging bending moment becomes less important.

Waterplane coefficient: As C_W is increased, the SWBM contribution decreases slightly and the sagging bending moment becomes slightly more important.

Block coefficient: has a significant effect on SWBM. For the case in which beam is constant and draft is decreased as C_b is increased, at C_b = .75 the SWBM is pratically zero and the sagging BM exceeds the hogging BM. For other cases, the SWBM is still practically zero at C_b = .75 and for large C_b the sagging BM is almost as large as the hogging BM.

Length: When beam is held constant and draft is decreased as length is increased, the relative contribution of SWBM to the total is decreased as length increases; this trend is reversed when draft is held constant and beam is varied with length. The relative importance of the hogging and sagging bending moments is essentially unchanged as length is varied.

Design speed: as beam is decreased and draft is increased, the SWBM becomes more important and the sagging BM becomes more important.

Machinery location: as the machinery is moved aft, the SWBM becomes less important and the sagging BM becomes more important. Note that this is for a constant block coefficient of .6; for ships with a high block coefficient (greater than about .75) and machinery somewhat aft the SWBM would be sagging and the total sagging BM would be the one of primary interest to the designer, in such a case

moving the machinery further aft may increase the importance of the SWBM.

Deadweight location: as the center of the total deadweight is moved forward, the SWBM becomes more important and the sagging BM decreases considerably.

Deadweight/displacement: an increase in deadweight decreases the importance of the SWBM and increases the importance of the sagging BM.

Fraction of deadweight aft: as more of the deadweight is moved aft, the SWBM becomes more important and the sagging BM decreases considerably, assuming the center of the total deadweight is unchanged.

Moment of inertia of weight aft of amidships: has a negligible effect.

Moment of inertia of weight forward of amidships: an increase in I_a increases the importance of the SWBM and decreases the sagging BM.

C. Quantitative Effect of Hull Form and Weight Distribution on Total Bending Moment

Table VI and Figure VII summarize the results of the calculations. In addition to the calculations explained so far, the effect of a speed reduction in a seaway was analyzed for each of the standard ships; these results are summarized in Table VII and Figure VIII. The results in

Table VI are given as marginal factors; for instance, a 1% increase in C_w would increase the total design hogging bending moment approximately 1.56%. This factor is the same over the practical range of C_w variation, but varies slightly with displacement. For a more precise value of the marginal factor, one can look at the plot of marginal factors versus displacement for each value of C_w in Figure VII, or one could look at the detailed calculations in Appendix VI.

For dry cargo ships with cruiser type sterns, the marginal factors should prove to be a useful design tool. An example of their application is presented later in the paper. The following is a discussion of the results for each parameter:

Waterplane coefficient: Increasing C_w will increase the total bending moment.

a) Has no effect on SWBM.

b) An increase in C_w makes more of the wave BM sagging; however, this effect is overridden by the increase in the wave BM amplitude.

c) Even though C_w has a noticeable effect on bending moment, the designer probably could not achieve significant reductions in bending moment by reducing C_w, since C_w is very closely related to block and prismatic coefficients

and cannot be varied much for a given block coefficient. Much of a C_w reduction would probably result in inadequate transverse stability.

Block coefficient: The effect of C_b depends on how beam and draft are handled since displacement is held constant; if C_w is held constant, increasing C_b will decrease the total BM. If C_w is varied with C_b (as would be necessary for large C_b variations), increasing C_b will increase the total BM. All C_b variations were done for the standard weight distribution.

a) In each case increasing C_b significantly decreases the SWBM.

b) In each case as the block coefficient is increased the total LCG moves forward, which increases the wave BM amplitude and makes the WBM more hogging.

i) Beam is constant and L/T increases as C_b increases (draft decreases): For this case, the shift towards a more hogging wave BM is most pronounced. Also, since L/T affects the wave BM amplitude while L/B does not, holding beam constant results in less of an increase in the amplitude than holding draft constant. The net effect is that, when beam is held

constant, the hogging wave bending moment increases quite noticeably with C_b and tends to counteract the decrease in SWBM. However, the SWBM decrease is the most significant, resulting in a decrease in the total hogging bending moment as C_b increases.

ii) Draft is constant and L/B increases as C_b increases (beam decreases): For this case there is only a moderate shift towards a more hogging wave BM. So, even though the wave BM amplitude is increased more than in the above case, the net effect is a negligible increase in the hogging wave BM. Therefore, the decrease in SWBM is even more effective in reducing the total hogging BM as C_b is increased.

iii) C_w increases with C_b and beam is held constant: Here there is a pronounced shift of the mean to give a more hogging wave BM; however, the C_w increase decreases the magnitude of the shift somewhat from case (i). The C_w increase

causes a significant increase in the wave BM amplitude. The net effect is that the increase in the hogging wave BM overrides the decrease in the SWBM so that the total hogging bending moment increases slightly as C_b is increased.

c) Selection of the block coefficient is an area over which the designer has some latitude and can effect noticeable reductions in bending moment. Clearly, for a reduced bending moment, the block coefficient should be as high as possible, holding the waterplane coefficient constant and holding draft constant and letting beam reduce as C_b is increased. Such a variation would be limited by the need to maintain adequate transverse stability. As mentioned previously, C_b and C_w are closely related; however, C_w is actually considered a function of C_p in most references; therefore, as C_b is increased it would be desireable to let the midship section coefficient decrease so that C_p may remain constant. Unfortunately, increasing C_b may lead to increased ship resistance, but according to many references resistance is more directly related to C_p so that the method described above may not lead to a noticeable resistance increase. In summary, to reduce bending moment, once a ship is selected from the usual

design lanes, the hull form should then be modified to obtain a high C_b by reducing beam and C_m while other parameters are held constant until the limit of adequate transverse stability is reached.

It must be remembered that the procedure described above is applicable to dry cargo ships designed with a speed length ratio of around 0.9 and a block coefficient of less than about 0.75 so that there is a hogging still water bending moment and the total hogging bending moment is the one of primary concern to the designer. For ships with a higher block coefficient and/or a sagging still water bending moment in which the total sagging moment would be of primary concern, a reduction of design bending moment would probably be obtained by modifying the hull form in a direction opposite to that described above.

Length: Here also, how beam and draft are handled as length is varied has a significant effect on the end result. If beam is held constant so that draft decreases as length is increased, the bending moment is increased as length is increased; whether or not the design speed is held constant or the speed length ratio is held constant has a negligible effect. If draft is held constant and beam reduced as length is increased, the bending moment is reduced as length is increased.

a) For a constant speed length ratio the effect of length on SWBM is the same whether beam or draft are held constant; SWBM increases as length is increased. However, the increase in SWBM is slightly less than it would be if SWBM were directly proportional to length because as speed varies the machinery and hull weight fractions vary.

When speed is held constant and the speed length ratio is varied, SWBM increases even less with length because the deadweight and hull weight fractions vary.

b) i) Holding the speed length ratio constant causes speed to increase as length is increased, which in turn causes the machinery weight to increase and the hull weight fraction to decrease. It seems likely that as length is increased the hull weight fraction would increase even though either beam or draft are decreased to compensate for the length increase; this did not happen because the traditional relations used give deadweight as a function of $V/\sqrt{L}$ and machinery weight as a function of speed and displacement with hull weight being whatever is left over. It may be more

exact to increase the hull weight with length by decreasing the deadweight; this refinement was not added to the relations used and would probably have a negligible effect on the results, since the effect of the machinery and hull weight variations is overridden by other effects.

So, as length and speed increase the total LCG moves aft, which would tend to decrease the wave BM amplitude slightly and make the wave BM more sagging.

a) Holding beam constant and decreasing draft as length increases would tend to make the wave BM amplitude factor smaller and may affect the mean either way. But, the dominating factor is that as length changes, the coefficients (A's) change so that as length increases the wave BM amplitude increases slightly and there is a considerable shift of the wave BM towards more hogging. In addition,

increasing length increases the wave BM height and the associated L/T increase causes an additional increase in the wave BM height. The net result is a significant increase in both the hogging and sagging wave bending moments and in the total hogging and sagging bending moments.

b) Holding draft constant and decreasing beam as length increases yields considerably different results. The shift in the mean makes the wave BM considerably more sagging so that even though the wave BM amplitude increases with length, the hogging wave BM decreases. The net result is a slight decrease in the total hogging bending moment as length is increased and a considerable increase in the total sagging bending moment. (The sagging moment is still only about half the hogging moment.)

ii) Holding speed constant while length is varied results in a slight forward shift in the total LCG as length increases for reasons previously explained. This variation was done with beam held constant and the results are quite similar to those already explained above.

c) Length is a hull form parameter over which the designer has considerable control. The traditional reasoning is that as length is increased, resistance and therefore machinery weight is decreased, while hull weight is increased due to a larger bending moment. Given a constant displacement ship and holding C_b and other important parameters constant, it is clear that if the length increase is accompanied by a draft decrease, there is a significant increase in bending moment. But, if the length increase is accompanied by a beam decrease, it may be possible to actually achieve a slight reduction in bending moment; as always, this approach would be limited by stability constraints.

Beam and draft: A beam increase along with an associated draft decrease will result in a reduced hogging bending moment.

a) Beam and draft changes alone have no effect

on SWBM.

b) An increase in beam and decrease in draft cause a slight decrease in the wave BM amplitude and the wave BM is considerably more hogging. The net result is an increase in the total hogging moment and a slight decrease in the total sagging moment.

c) Obviously, beam and draft variations had some effect on the results obtained when block coefficient or length were the parameters of prime interest. It is clear that to reduce bending moment the designer should strive for minimum beam and maximum draft. Note that the marginal factor in Table VI is based on beam and not draft. Unlike the other hull form parameters, selecting beam for minimum bending moment is consistent with selecting beam for minimum resistance. Also, an increased draft will probably lead to a more efficient midship section regarding weight and moment of inertia of the section.

<u>Design speed</u>: Increases in <u>design</u> speed result in a decrease in total hogging bending moment which is practically negligible. Changes in a ship's speed in a seaway without changing the form or weight distribution of the ship will be discussed later.

a) For reasons explained in previous sections, an increase in design speed moves the total LCG aft and causes

a slight increase in SWBM.

b) As previously explained, a speed increase causes a decrease in hogging wave BM and an increase in the sagging wave BM. The net result is a slight decrease in the total hogging moment and a slight increase in the total sagging moment.

c) The effect of changes in design speed on bending moment are probably not worth consideration during preliminary design.

Machinery location: Moving machinery aft reduces the total hogging bending moment and increases the total sagging moment.

a) The effect of a machinery move on other parameters is explained in the summary of variations. The result is that as the machinery is moved aft, the total LCG moves forward because the machinery is replaced by heavier deadweight. Note that the analysis was done for a constant machinery length rather than constant volume because a constant length seems to be the trend for the ships analyzed; considering machinery arrangements for steam plants, this trend makes sense. SWBM decreases as machinery moves aft.

b) The effect of the LCG move on the wave BM is consistent with the qualitative explanation.

c) Machinery location is certainly under the control of the designer and should be carefully considered. Clearly, significant reductions in bending moment can be achieved by moving machinery aft. Assuming that the ship under consideration has a weight/volume distribution similar to the "standard" used in the analysis, moving the machinery aft has the added advantage of giving more room for deadweight. Of course, there is the disadvantage of trimming the ship in the light load condition. Care should be exercised during this variation since with machinery aft, the maximum bending moment may not occur at amidships.

The result of varying deadweight location is consistent with the qualitative explanations and need not be addressed further. To reduce bending moment the center of the deadweight should be as far forward as possible.

Deadweight/displacement: Increasing the deadweight fraction will decrease the total hogging bending moment slightly.

a) As explained in the qualitative analysis of the SWBM equation, increasing the deadweight has several opposing effects. The result is that as deadweight is increased, there is a decrease in SWBM.

b) The effect of a deadweight increase on wave BM is

due to the forward movement of the total LCG and the results follow the qualitative trends presented earlier. Obviously, the SWBM is affected the most since the total hogging bending moment decreases and the sagging moment increases with a deadweight increase.

c) The net effect of a deadweight increase is small and this marginal factor may not be of much use to the designer. Nevertheless, it is nice to know that having the deadweight fraction as high as possible will lead to a reduction of total hogging moment.

Fraction of deadweight aft: Moving more of the deadweight aft, without moving the center of the total deadweight, causes a significant increase in the total hogging bending moment. Only the still water bending moment is affected. Since the location of deadweight in a dry cargo ship is usually not varied much (except by moving the machinery location), this variation was done primarily for analytical purposes.

Moment of inertia of weights aft of amidships: This has a negligible effect on bending moment and need not be considered during preliminary design.

Moment of inertia of weights forward of amidships: Increasing I_f can lead to useful reductions in bending moment.

a) I_f has no effect on SWBM.

b) As seen in the qualitative analysis, increasing I_f has no effect on the wave BM mean and reduces the wave BM amplitude.

c) The designer may have some control over I_f and should keep its definition in mind when considering any changes in the design; I_f is the moment of inertia of weights forward of amidships about an axis through amidships. Therefore, I_f can be increased by either moving the weights further from the center of the forward weights or by moving the center of the forward weights further from amidships. This means that weight should be kept to a minimum at the forward quarter of the vessel and that, given a choice, it would be better to put a weight near the bow than near amidships.

<u>Speed reduction in a seaway</u>: In Reference 4 Murray suggests that when a ship reduces speed in a seaway, the bending moment may actually increase and he mentions that some ships have experienced structural failures when hove to. At the time, 1958, theory had not advanced to the point where the effect of speed on BM was understood and Murray's suggestion could not be supported by an analysis. It is clear from the equations that as speed is reduced the SWBM will not be affected, the wave BM amplitude will

be slightly reduced, and the wave BM will become more hogging until the SWBM is the true mean of the wave BM. Since ships are usually forced to reduced speed in high seas and because reduced or even zero speed in a high sea is certainly not an unreasonable design condition, the effect of a speed reduction was analyzed. Note that this is not a change in the design speed. In the analysis that follows, all parameters except speed were held constant. Detailed calculations are in Appendix VII.

As can be seen in Table VII and Figure VIII, as speed is reduced, the total hogging bending moment increases to a maximum about 8% higher than the standard at around 7 knots and then decreases to a value about 6% higher than the standard at zero speed. Clearly, if a designer is using an analysis based on hydrodynamic theory, including the shift of the wave BM mean, the analysis should be done at reduced speed to obtain the maximum hogging bending moment.

It is considerably more important that any analysis to obtain a design value for the sagging bending moment be done at the maximum speed attainable in the seaway. Sagging bending moments are considerably reduced at lower speeds and in larger ships where the SWBM dominates, there may be no sagging bending moment at zero speed. This is an

important consideration for failure modes such as buckling of the main deck or tensile failure of the bottom.

Clearly, speed reductions in high seas may not always be advisable. Unfortunately, violent ship motions, slamming, etc. may force one to reduce speed and when considering dynamic stresses from transient loads such as slamming, it is no longer clear whether or not a speed reduction will result in a lower total stress.

One must remember that the foregoing analysis is for a ship with a hogging SWBM and a hull form that shifts the wave BM to more sagging with speed increases. The analysis certainly applies to dry cargo ships with normal hull forms and weight distributions.

D. Comparison of Standard Ship Bending Moments With Classification Rules and Other Sources

The results of bending moment calculations using Lloyd's and ABS rules and Murray's equation [3] and the seakeeping tables [14] are compared with the standard used in the calculations from Faresi's method [18] and Murdey's method [15] for the 20,000 ton ship in Figure IX. Calculations for other displacements yielded similar results and are presented in Appendix VII.

The seakeeping tables do not give any correction for the wave BM mean and the uncorrected wave BM from the

FIGURE IX

Comparison of Calculated Values and Trends
with Rules and Other Sources

For the "Standard" Ship with 20,000 Ton Displacement

L = 539 Ft. B = 74.3 Ft. C_B = .60

Wave Hogging Bending Moment - Ft. Tons

"Calculated" values are those used in thesis calculations derived from Murray's eq.

Calculated w/ Mean Correction	Calculated w/o Mean Correction	Sea Keeping Tables	Murray's Eq.	Lloyd's	ABS
114,676	163,018	160,253	166,745	235,374	146,491
Calc. w/ Mean Corr. / Other Source		N/A	.69	.49	.78
Calc. w/o Mean Corr. / Other Source		1.02	.98	.69	1.11

Relative Effect of L,B,C_B Variation:

$$\frac{(\text{Wave HOG BM} - \text{Standard BM})/\text{Standard BM}}{(\text{Parameter Value} - \text{Standard})/\text{Standard}}$$

Parameter	Calc. w/ Mean Corr.	Calc. w/o Mean Corr.	Murray's Eq.	Lloyd's	ABS
C_B=.6 to .65	4.69	1.77	2.04	.46	.45 (1)

FIGURE IX (continued)

Parameter	Calc. w/ Mean Corr.	Calc. w/o Mean Corr.	Murray's Eq.	Lloyd's	ABS
C_B=.6 to .70	--	--	--	.48	2.36 (1)
L	6.48	3.69	2.45	2.53	2.52
B	2.63	.93	1.00	1.00	1.00

NOTE: (1) Difference is because ABS must use C_B = .64 in equations for any ship with actual C_B less than .64.

thesis calculations compares quite well with the seakeeping table results. This means that the equations used for the calculations gave a good prediction of the wave BM for the sea state used.

Equations for wave BM are also given in the 1976 Lloyd's Rules and the 1976 ABS Rules. It should be noted that the wave BM in the new rules is the moment due only to waves and must be added to a SWBM to get the total moment; the total would be what is calculated by poising the ship on a static wave and doing a traditional calculation for bending moment (of course, the method used in the new rules and the traditional method may not give the same numerical results). In Reference 3, Murray also gives an equation for wave BM. Unlike the seakeeping tables and Murdey's equations, which give the significant value of wave BM in a given seaway, the rules and Murray's equation give design values for the bending moment. One would expect the design values to be higher than the significant values (average of the 1/3 highest) in a particular seaway.

As can be seen in Figure IX, correcting the wave BM mean and using a 50 ft. significant wave height gave a wave BM lower than that given by the other methods. Without correcting the mean, Murdey's equations and a 50 ft.

significant wave height gave a wave bending moment quite close to Murray's results, a bit higher than ABS, and still lower than Lloyd's. So, the relations used for predicting wave BM give results that are close to what would be used as a design value for wave BM.

Lloyd's rules result in a section modulus that is considerably more conservative than the ABS rules. The following summarizes the rules requirements for the 20,000 ton standard ship.

	Lloyd's	ABS
Wave BM (ft-tons)	235,374	146,491
Allowable Stress ($tons/in^2$)	11.53	10.26
SWBM (ft-tons) (from standard calcs., not rules)	127,440	127,440
Section Modulus (in^2-ft)	$\frac{127,440 + 235,374}{11.53}$	$\frac{127,440 + 1.08(146,491)}{10.26}$
	31,467	27,841
$\frac{\text{"Wave BM"}}{\text{Allowable Stress}}$	$\frac{235,374}{11.53}$	$\frac{1.08(146,491)}{10.26}$
	20,414	14,278

$$\frac{\text{ABS Section Modulus}}{\text{Lloyd's Section Modulus}} = .88$$

$$\frac{\text{ABS } \dfrac{\text{Wave BM}}{\text{Allowable Stress}}}{\text{Lloyd's } \dfrac{\text{Wave BM}}{\text{Allowable Stress}}} = .70$$

As seen in the above calculations, when just the wave BM is considered, Lloyd's is considerably more conservative. Adding the SWBM makes Lloyd's and ABS comparable, although Lloyd's is still more conservative, requiring a heavier structure; most of the difference is due to Lloyd's using a higher wave bending moment. Clearly, this relatively new method of calculating structural loading has some important unsolved problems.

Besides comparing actual bending moment values, the effect of varying C_b, length, and beam were analyzed and compared in Figure IX. Murray's equation and the rules all show practically the same effect for a length variation; since length has long been considered a major factor in determining bending moment, this result is expected. It seems that the relations used in the thesis calculations overestimate the effect of length, especially if the correction of the wave BM mean is included.

The rules and Murray's equation show wave BM proportional to beam. Without the mean correction, Murdey's equation gives a similar result. Including the mean correction results in beam having a greater effect on wave BM.

The effect of block coefficient shows considerable variation between the different estimating methods;

including block coefficient in the bending moment calculations is a recent addition to the rules. Lloyd's and ABS give similar results only if C_b is varied from some value slightly below .64 to some value slightly above .64 because ABS does not allow a value of less than .64 to be used in the equations. For other ranges of C_b variations, ABS, Murray's equation, and Murdey's equations without the mean correction give results that are somewhat similar. Lloyd's shows C_b to be considerably less important. Including the mean correction in Murdey's equations shows C_b to be considerably more important.

For SWBM the only other estimating equation found is in the 1976 ABS rules. ABS explicitly states that their equation is to be used only for preliminary estimates and that final design values are to be obtained from conventional calculations for SWBM. The ABS equation gives a SWBM of 156,671 ft. tons for the 20,000 ton standard ship. Faresi's method used in the thesis gives 127,440 ft. tons (see Appendix VII for details). It is interesting to note that the ABS equation shows SWBM increasing with C_b which contradicts the trend given in all other references. It seems that the ABS equation may not give reliable results; however, the ABS results and Faresi's results are close enough so that it is safe to assume that for the purposes

of comparison of different hulls, Faresi's method should give satisfactory results.

It is interesting to compare the calculated results for total bending moment with the traditional standard of $\Delta L/35$. The standard gives $BM/\Delta L = .0286$ for all ships. The relations used in this thesis give values of $BM/\Delta L$ that range from .0233 for small ships to .0221 for large ships. Some other comparisons that yield results quite similar to those already presented are in Appendix VII.

VIII. CONCLUSIONS

1) The object of the calculations is to obtain marginal factors for the effects of hull form and weight distribution on bending moment. The marginal factors were obtained by comparing the differences in bending moment for various hulls. To obtain satisfactory results, it is not necessary to have exact design values for bending moment since the differences between various values are of primary interest.

Nevertheless, it is important to have still water and wave bending moment values that are close to the design values, especially when varying a parameter tends to increase the SWBM and decrease the wave BM, or vice versa. In such a case, the effect of the parameter on the total bending moment (in the final analysis this is the value of interest to the designer) depends very much on the relative contribution of the SWBM and wave BM to the total. The comparisons given in the results indicate that, even though the relations used in the calculations may be a bit lower than design values, the relative contribution of the wave and still water bending moments is quite close to what it would be for the type of ships investigated.

Marginal factors from other sources, rules, and Murray's equations could only be calculated for the wave BM

for C_b, length, and beam. Although the actual marginal factors are not exactly the same as those obtained using Murdey's equations, the qualitative trends are the same.

Therefore, the calculated values of bending moment used in this thesis are probably slightly lower than design values but the marginal factors for the effect of hull form and weight distribution on bending moment should prove to be valid for dry cargo ships. The marginal factors are simple to apply and should prove useful in preliminary design if one is interested in making tradeoffs to obtain a reduced structural loading. The factors for C_w, C_b, L, B, machinery location, and weight distribution forward of amidships are of particular importance to the designer.

2) It is important to remember the type of ship for which the analysis was done; dry cargo ships with a block coefficient less than .75 and a hogging still water bending moment. Any radical departures from the hull form and weight distribution used may change the effect of various parameters.

For example, tankers with a large block coefficient and machinery aft typically have a sagging SWBM. This would obviously change the way in which some parameters should be varied to reduce the total design bending moment

which would now be a sagging rather than a hogging moment. It is interesting to note that for a large block coefficient the change in the mean of the wave BM tends to make the wave BM more hogging, thereby reducing the design value of bending moment and that for low block coefficient ships the wave bending moment tends to be more sagging, which reduces the design value (hogging) of bending moment. In each case, a reduction in speed would tend to increase the value of the bending moment of interest to the designer.

Waterplane coefficient is another important parameter; it probably actually represents the longitudinal moment of inertia of the waterplane area of the ship. The analysis is based on Murdey's equations for ships with cruiser type sterns. Therefore, the results would probably not apply to ships with transom sterns, which would have a different longitudinal distribution of the waterplane area.

3) All of the references that talk about using the analytical, hydrodynamic approach to determining a design value of the wave bending moment say that it is safe to assume that the SWBM is the mean of the wave BM. The total bending moment is found by adding half of the wave BM height to the SWBM to get the total hogging BM and subtract-

ing half of the wave BM height from the SWBM to get the total sagging BM. In a typical cargo ship where the hogging bending moment is by far the largest and of primary concern to the designer, the foregoing approach seems quite safe. However, it seems quite possible that some of the major members in the ship may be sized by failure modes caused by the sagging bending moment, such as buckling of the main deck or tensile failure of the bottom.

A quick comparison of total bending moment values with and without the wave BM mean correction shows some worthwhile results. For example, the 20,000 ton ship at design speed has a wave BM amplitude (1/2 height) of 163,018 ft. tons. With the SWBM of 127,440 ft. tons as the mean, there is a total hogging BM of 290,458 ft. tons and a total sagging BM of -35,578 ft. tons. Correcting the wave BM mean for the effect of the ship's own wave and the effect of speed in the seaway gives a total hogging BM of 242,116 ft. tons and a total sagging BM of -83,919 ft. tons. The hogging moment obtained without the mean correction would be acceptable as a conservative design value since it overestimates the more accurate value. However, the sagging BM without the mean correction is less than half of the more accurate value. Obviously, neglecting the change in the mean of the wave BM would lead to serious undersizing

of members that fail due to the sagging moment.

The simple alternative of using the total hogging moment as the design value for sagging would be overestimating by a factor of more than three and would lead to overdesign in members sized primarily by failure modes caused by sagging moments.

Therefore, for a design based completely on the results of hydrodynamic theory, it is important to include the change in the mean of the wave bending moment and as noted earlier, it is important to investigate the bending moment that occurs when the ship's speed is reduced in a seaway.

4) When first starting to investigate the effects of hull form on bending moment, primary emphasis was on the wave bending moment. As the work progressed, it became clear that the still water bending moment was equally important. The fact that in recent years considerable work has been done on predicting wave bending moments, with still water bending moment barely mentioned, and that the traditional bending moment calculation statically poised the ship on a wave (the fact that the SWBM is automatically included in such a "wave" BM calculation is sometimes forgotten) seem to have lead to a neglect of the importance of the still water bending moment. By selection

of the block coefficient and control of the weight distribution (machinery location in particular), the designer has considerable control over the SWBM while the designer's ability to affect significant changes in the wave BM is somewhat limited. So, despite the fact that calculating the SWBM is theoretically simple, this area probably deserves more attention during the ship design than it now receives.

5) It should be remembered that parameters that are not shown directly in the bending moment equations or in the analysis may still indirectly affect bending moment and should therefore be carefully selected. For instance, the midship section coefficient relates C_p and C_b. And, C_w is related to C_p. Therefore, the midship section coefficient relates C_w and C_b, both of which have a significant impact on bending moment.

6) All of the analysis was done for the bending moment at amidships. For most ships this is close to the area of maximum bending moment. However, for ships with machinery far aft, the maximum bending moment may be located closer to the quarter points of the ship and predictions of the bending moment amidships may not give

valid design values. Therefore, care should be taken in applying the results of this thesis to ships which have unusual loadings that may result in the maximum bending moment being somewhere other than amidships (machinery far aft, empty spaces at the ends or middle of the ship, etc.). Unfortunately, there is very little data on the wave bending moment at places other than amidships and the only way seen to calculate it is by using an expensive seakeeping computer program.

7) The selection of the 50 ft. significant wave height and using the resulting significant value of bending moment response has yielded results that compare satisfactorily with other methods of estimating a design value for wave bending moment. However, there is an alternate approach which may yield improved results: investigation of typical shipping routes would give a reasonable design seastate; using the significant wave height for this seastate, calculate a bending moment response, and use extreme value statistics to get a design value for bending moment. Since the coefficients (A's) in the bending moment equations depend on the seastate and the relative effect of the ship's own wave system depends on the seastate, using the foregoing procedure may yield different results

(however, important trends would probably not change).

8) Several references give general qualitative trends in the variation of bending moment with hull form and weight distribution; these are that the wave bending moment increases with increasing C_b and the still water bending moment decreases with increasing C_b and that the wave bending moment decreases as weight is moved away from amidships. These trends agree with the results obtained. It is important to remember that the results and the marginal factors are for the total hogging moment.

9) In an actual ship design the standard hull form would be the one with minimum resistance. As the hull form is modified to reduce bending moment, the resistance will probably increase which would lead to an increase in machinery weight. This increase in W_2 was not included in the analysis; i.e., W_2 was held constant unless speed was changed. The change in machinery weight would have a negligible effect on bending moment. Of course, the increased resistance would be important in the overall design.

IX. SUGGESTIONS FOR FURTHER WORK

The method used in this analysis produces satisfactory results that may be quite useful. With a few changes, the analysis would be quite accurate and could easily be extended to cover other ships. The following suggestions apply to this method of analysis:

1) The first improvement would be to do the analysis with a value of significant wave height typical of actual shipping routes and apply extreme value statistics to get a design value as discussed in paragraph 7 of the Conclusions. This change would make the method more theoretically correct but probably would not change the results significantly.

2) By extending the displacement range for which machinery weight can be calculated, the analysis can be extended to dry cargo ships with displacements greater than 26,000 tons. This addition should be fairly simple to accomplish.

3) The same method could be used to analyze the effect of hull form and weight distribution on bending moment in tankers. It would be necessary to develop weight distribu-

tion information and to include the still water bending moment integral factors for tankers which Faresi has developed.

4) The analysis should be repeated for standard ships with hull form selected for minimum resistance at a higher and a lower speed length ratio than the speed length ratio of 0.90 used for this thesis. Such an analysis would produce marginal factors for bending moment for "low speed" and "high speed" ships. It is likely that the marginal factors would be different than those for the average speed length ratio of 0.90 but the general trends would probably be the same.

5) Once the above changes and additions are completed, all of which would not require extensive research or computer time, it would be worthwhile to check the bending moment values obtained for several of the key ships in the analyses by using a seakeeping computer program similar to the one used by Chryssostomidis in Reference 14 and by actually deriving a weight distribution and calculating a still water bending moment. An important part of this analysis would be checking the total bending moment along the entire length of the ship to ensure that using the

moment at amidships valid for comparison purposes.

Doing this analysis has also brought to mind several areas in the field of predicting structural loads in which further investigation may be worthwhile. These are:

6) More information needs to be collected on weight distributions. Information should be collected on at least the parameters used in the bending moment equations and attempts should be made to develop design lanes similar to those used for hull form relations. With this information, a reliable and fairly accurate prediction of structural loading could be made quickly while hull form and arrangements are being developed during preliminary design.

7) Some full scale tests on still water bending moment would provide some assurance that prediction methods are accurate and the estimates of weight distribution used in the prediction are satisfactory.

8) Faresi's method for predicting still water bending moment is quite useful and should be extended to ships with lower block coefficients than 0.60. As the separation of

the total bending moment into a still water and wave component becomes the standard method of predicting the total moment (rather than statically poising the ship on a trochoidal wave), methods such as Faresi's for quickly and accurately predicting the still water bending moment will become a useful design tool.

9) The importance of still water bending moment is not yet fully appreciated. Lloyd's rules include a requirement that the ship's section modulus be increased if the still water bending moment is more than the wave bending moment. The reasoning is probably that the still water stress is similar to a mean stress in fatigue analysis. As the mean stress is increased, the magnitude of allowable excursions from that mean is reduced to avoid failure. This is, of course, consistent with fatigue theory. However, there is no benefit given to ships that are designed to minimize or possibly eliminate the still water bending moment. Allowing a higher wave stress for ships with close to a zero still water bending stress would be consistent with fatigue theory. Since the designer has some control over the still water bending moment, this is an area that is certainly worth investigating.

When considering the still water bending moment in

design, it is vital to remember that normal variations of ship loading can cause considerable changes in the still water bending moment. Of course, the worst case should be selected for design purposes. Additionally, changes in the still water bending moment can cause changes in the longitudinal position on the ship at which the maximum moment occurs.

In conclusion, the method presented in this thesis provides a means of easily determining the effect of hull form and weight distribution variations on structural loading. This method should prove useful and reliable for considering structural loading during hull form selection.

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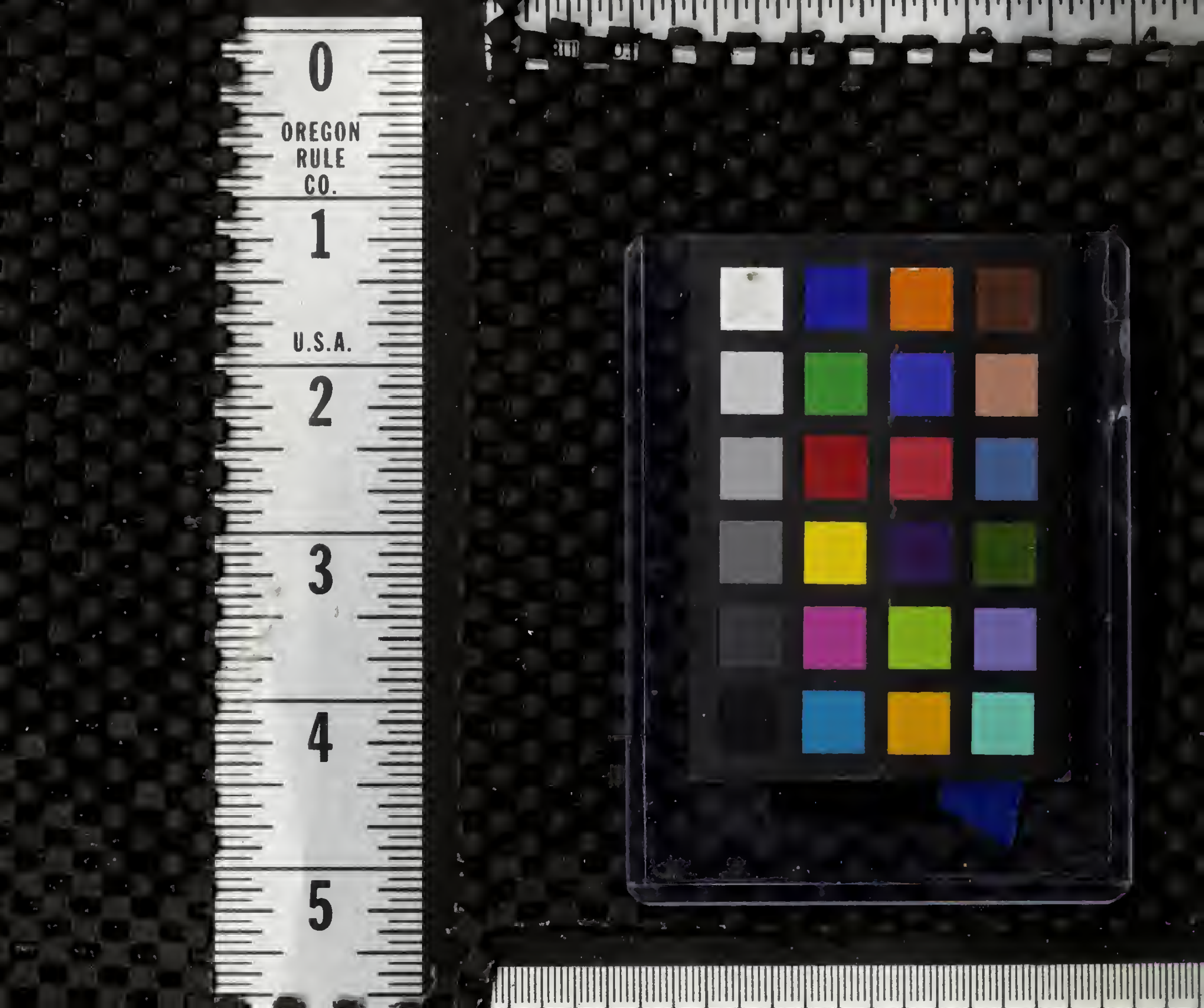
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THE EFFECT OF HULL FORM AND WEIGHT
DISTRIBUTION ON STRUCTURAL
LOADING

v.2

Eric Runnerstrom

THE EFFECT OF HULL FORM AND WEIGHT DISTRIBUTION ON STRUCTURAL LOADING

by

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B.S., Webb Institute of Naval Architecture
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[v.2]

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OF THE REQUIREMENTS FOR THE

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APPENDIX I

COMPARISON OF VARIOUS WAVE BENDING MOMENT PREDICTION METHODS

SELECT WAVE HEIGHT.

FROM PNA, PG. 622, FOR $L \approx 600$ FT.

MAX. $H_S \approx 45$ FT.

TYPICAL SHIP FOR COMPARISON:

$L = 600'$ $F_n = .25$

CONVERT RMS BM TO $\overline{BM}^{1/3}$, REF.

$$\overline{BM}^{1/3} \approx 4\left[1 - \frac{\epsilon^2}{2}\right]^{1/2} (\text{RMS BM})$$

USE $\epsilon = .5$

$$\overline{BM}^{1/3} \approx 3.7417 \, (\text{RMS BM})$$

μ = RMS BM FACTOR FROM SEAKEEPING TABLES REF.

$$\overline{BM}^{1/3} = 3.7417 \, \mu \, \rho \, g \, L^4 \times 10^{-7} \quad \text{FT-LBS.}$$

$$\frac{\overline{BM}^{1/3}}{\Delta L} = \frac{3.7417}{10^7} \, \frac{(L/B)^2 (B/T)}{C_B} \, \mu \qquad \text{Eq. (I-1)}$$

BM DUE TO WAVES FROM SEAKEEPING TABLES

WAVE BM FROM MURRAY, REF. (1).

$1.1\sqrt{L}$ WAVEHEIGHT

$BM = b' B L^{5/2} \times 10^{-4}$ FT-TONS

$$BM = b' \frac{L^{7/2}}{(L/B)} \times 10^{-4} \quad \text{FT.-TONS} \qquad \text{Eq. (I-2)}$$

C_B	b' SAGGING	b' HOGGING
.6	4.47	3.90
.7	5.31	4.70
.8	6.16	5.50

WAVE BM FROM MURDEY, REF.

$$\bar{T}_z = 3.23 \sqrt[3]{H_s} \sqrt{g/L}$$

FOR $H_s = 45'$ & $L = 600'$ $\bar{T}_z = 2.66$

$$100\mu_s = -.442 + 3.719 C_w - .0013 \frac{L}{T} + .0651\, LCG + 10.84\, I_a/L^2\Delta - 61.54\, I_f/L^2\Delta + 1.19\, F_n \qquad \text{Eq (I-3)}$$

$$\frac{\overline{BM}^{1/3}}{\Delta L} = \mu_s \left(\frac{H_s}{L}\right) \frac{(L/T)}{C_B}$$

INCLUDE BROADNESS FACTOR FROM REF.

$H_s/L = .075$

$$\frac{\overline{BM}^{1/3}}{\Delta L} = \frac{.075\,(3.7417)}{4} \cdot \frac{(L/T)}{C_B}\, \mu_s \qquad \text{Eq. (I-4)}$$

USE WEIGHT DISTRIBUTION FROM SEAKEEPING TABLES

$K_{yy}/L = .24$ $K'_{yy}/L = .125$

$W_F/\Delta = .2C_B + .36$ $\frac{LCG \text{ of } W_F}{L} = .1\,C_B + .13$

ABOVE GIVES:

$$\frac{I_f}{L^2\Delta} = (.2C_B + .36)\left[(.125)^2 + (.1C_B + .13)^2\right]$$

$$\frac{I_a}{L^2\Delta} = (.24)^2 - I_f/L^2\Delta$$

USE ABOVE IN EQ. (I-3)

USE LCG = LCB FROM SEAKEEPING TABLES.
VARY L/B, B/T, F_n, C_B, C_w AMONG VALUES GIVEN IN SEAKEEPING TABLES. $C_w = f(C_B)$.
L/B, B/T, C_B, F_n ARE INDEPENDENT.

CALCULATIONS FOR FIGURES II & VI

L/B		5.5	7.0	8.5	7.0	→	→	→	→	7.0
B/T		3	3	3	2	4	3	→	→	3
C_B		.7	→	→	→	→	→	.7	.55	.90
C_W		.785	→	→	→	→	→	.785	.664	.942
LCB		+1.0	→	→	→	→	→	+1.0	-1.5	+2.5
F_n		.25	→	→	→	.25	.15	.30	.25	.25
Δ		47,634	29,407	19,944	44,111	22,055	29,407	29,407	23,106	37,809
μ	FROM SKT	497	393	323	378	394	332	426	298	414
$\frac{\overline{BM}^{1/3}}{\Delta L}$	EQ. I-1	.0241	.0309	.0374	.0198	.0413	.0261	.0335	.0298	.0253
$100/\mu_s$	EQ. I-3	1.4308	1.4249	1.4191	1.4340	1.4158	1.3059	1.4844	1.1307	1.6143
$\frac{\overline{BM}^{1/3}}{\Delta L}$	EQ. I-4	.0237	.0300	.0363	.0201	.0398	.0275	.0313	.0303	.0264
$\frac{BM}{\Delta L}$	MURRAY EQ. I-2	.0337	.0429	.0521	.0286	.0572	.0429	.0429	.0456	.0389

APPENDIX II
WEIGHT DISTRIBUTION RELATIONS

GENERAL REGRESSION ANALYSIS:

$y = f(x)$

GIVEN SEVERAL POINTS (x_i, y_i), WANT TO FIND "f".

USE PROGRAMS IN "HEWLETT-PACKARD HP-25 APPLICATIONS PROGRAMS".

TEST FOR FIT OF LINEAR, EXPONENTIAL, LOG, OR POWER FUNCTION.

r^2 = COEFFICIENT OF DETERMINATION

$$r^2 = \frac{\left[\Sigma x_i y_i - \frac{\Sigma x_i \Sigma y_i}{n}\right]^2}{\left[\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}\right]\left[\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}\right]}$$

FOR n GIVEN POINTS

$r^2 = 1$ INDICATES PERFECT FIT

$0 \le r^2 \le 1$

MACHINERY WEIGHT - W_2

USE POWER FUNCTION $W_2 = a V^b$

INPUT DATA POINTS FROM D'ARCANGELO

GIVEN Δ & V GET SHP FROM FIG. 14

GIVEN SHP GET W_2 FROM FIG. 26

GIVEN Δ, V, W_2 WANT TO USE REGRESSION ANALYSIS PROGRAM TO FIND "a" & "b"

COEFFICIENTS FOR $W_2 = aV^b$

Δ 1,000 TONS	V KTS.	SHP 100 H.P.	W_2 TONS	a	b	r^2
10	10	13	171	4.132	1.591	.973
	12	18	207			
	14	26	256			
	16	41	333			
	18	66	439			
12	10	14	179	4.754	1.557	.974
	12	21	226			
	14	28	267			
	16	44	347			
	18	71	458			
14	10	19	214	6.237	1.493	.961
	12	24	244			
	14	32	289			
	16	50	374			
	18	76	476			
	20	110	590			
18	14	38	319	2.142	1.896	1.000
	16	58	407			
	18	88	518			
	20	122	626			
	22	169	756			
	24	219	879			
20	14	41	333	2.257	1.890	1.000
	16	61	419			
	18	93	535			
	20	130	650			
	22	178	779			
	24	234	913			

COEFF. FOR W_2

Δ	V	SHP	W_2	a	b	r^2
22	14	42	338	2.266	1.900	.999
	16	67	443			
	18	100	558			
	20	137	670			
	22	189	807			
	24	249	946			
26	20	153	714	2.278	1.919	1.000
	22	210	858			
	24	280	1013			

VALUES OF r^2 FOR WEIGHT DISTRIBUTION DATA IN TABLE I REGRESSION ANALYSIS.

FUNCTION - "f" →	LINEAR	EXPONENTIAL	LOG	POWER
$I_a/L^2\Delta = f(C_B)$	.70	.76	.70	.76
$I_f/L^2\Delta = f(C_B)$	.31	.29	.33	.31
$I_{TOT}/L^2\Delta = f(C_B)$	.65	.66	—	.67
$I_a/L^2\Delta = f(L/B)$	.54	.57	.53	.56
$I_f/L^2\Delta = f(L/B)$	.06	.01	.06	.06
$I_{TOT}/L^2\Delta = f(L/B)$	—	—	—	—
$I_a = f(L)$	.83	.78	.81	.78
$I_f = f(L)$	.98	.89	.98	.91
$I_{TOT} = f(L)$	.93	.88	.92	.89
$M/L = f(C_B)$	.32	.23	.20	.25
$M/L = f(L)$	0	0	0	0
$\beta = f(C_B)$	.27	N/A	.16	N/A
$\beta = f(\frac{DWT}{\Delta})$	.25	N/A	.23	N/A
$\beta = f(L)$	.56	N/A	.56	N/A

APPENDIX III
HULL FORM RELATIONS

SPEED & C_B OR C_P

D'ARCANGELO : $V/\sqrt{L} = 2\,(1.05 - C_B)$

WEBB DATA : $V/\sqrt{L} = f\,(C_P)$ DESIGN LANE

SCHOKKER : $V/\sqrt{L} = f\,(C_B)$ DESIGN LANE.

DEADWEIGHT - DISPLACEMENT

WEBB DESIGN LANE : $-.677\frac{V}{\sqrt{L}} + 1.171 \le \frac{DWT}{\Delta} \le -.677\frac{V}{\sqrt{L}} + 1.251$

SCHOKKER & D'ARCANGELO DESIGN LANE FOR

$DWT/\Delta = f\,(V/\sqrt{L})$

DISPLACEMENT LENGTH RATIO

SCHOKKER : $L/\Delta^{1/3} = 15$ FOR $V/\sqrt{L} = .4$

$L/\Delta^{1/3} = 29$ FOR $V/\sqrt{L} = 1.8$

USE LINEAR INTERPOLATION.

WEBB : DESIGN LANE FOR V, L, Δ, EHP

C_m : SCHOKKER : $C_m = f\,(C_p)$

C_w : WEBB DATA : $C_w = .889\,C_p + .165$

L/B : WEBB DESIGN LANE : B OR $L/B = f\,(L)$

APPENDIX IV

FORMAT FOR HAND CALCULATIONS

$\frac{V}{\sqrt{L}}$	C_p	C_m	C_B	C_w	$\frac{\Delta}{(L/100)^3}$	$\frac{DWT}{\Delta}$	F_n	LCB LIMITS
.90	.62	.968	.60	.714	128	.611	.268	-1.3% → +.7%

Δ	10,000
L	427
V	18.6
$\frac{W_2}{\Delta}$	.043
L/B	6.96
L/T	19.24
$\frac{I_a}{L^2\Delta}$	.0093
$\frac{I_f}{L^2\Delta}$	.0221

x_0 %	LCG%	x_0	a_1	b_1	a_0	b_0	δa	δb	$\frac{SWBM}{\Delta L}$	SWBM
-2.1	-.19	1.31	.5279	.2245	.5260	.1782	.0199	.0026	.0212	90,621

	A_0	A_1	A_2	A_3	A_4	A_5	A_6		$\bar{\mu}_s \times 10^2$	$\mu_s \times 10^2$		$F \times 10^4$	$\frac{WBM}{\Delta L}$	WBM	TOTAL $\frac{BM}{\Delta L}$	TOTAL BM
$\frac{H_s}{L}$ → .05	-.936	3.716	-.0001	.0776	14.64	-65.49	1.31		-.0832	1.2405	HOG	2.1179	.0068	28,999	.0280	119,523
$\bar{T}_z$ → 2.46								$m \times 10^4$ →	-.5672		SAG	4.0843	-.0131	-55,924	.0081	34,600
A'_i →	-5.12	6.40	.159	-.422												
$\frac{H_s}{L}$ → .10									-.0636	1.1817	HOG	4.7055	.0151	64,430	.0363	154,954
$\bar{T}_z$ → 3.10	-.401	3.496	-.0038	.0244	-1.06	-46.34	.740	$m \times 10^4$ →	-.5672		SAG	7.1119	-.0228	-97,379	-.0016	-6,855
A'_i →	-3.20	4.50	.112	-.365												

NOTE: 1) VALUES SHOWN ARE FOR ILLUSTRATION ONLY.

2) HOGGING $F = \frac{1}{2}\mu_s(H_s/L) + \bar{\mu}_s(H_s/L) + m$

SAGGING $F = \frac{1}{2}\mu_s(H_s/L) - \bar{\mu}_s(H_s/L) - m$

APPENDIX V
COMPUTOR PROGRAM AND INPUT DATA

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COMPUTOR PROGRAM AND INPUT DATA COMMON TO ALL SHIPS
      IMPLICIT REAL (L,M)
      DIMENSION A(11,18), AB(2,7), BLK(7), C(11), D(7), F(7,4), G(7),
     1 TZ(18), Y(13)
      K=0
C
C READ IN COEFFICIENT ARRAYS
C
      READ (5,45) (D(I),I=1,7), (AB(1,I),AB(2,I),I=1,7)
   45 FORMAT (7F10.0/10F6.3/4F6.3)
      WRITE (6,50)
   50 FORMAT ('1'/////47X,'INPUT COEFFICIENTS')
      WRITE (6,6) (D(I),I=1,7),((AB(J,I),I=1,7),J=1,2)                *****
    6 FORMAT ('0'/42X,'FACTORS FOR W2=(A/DISP)*V**K'/22X,
     1'DISPLACEMENT',7F8.0/33X,'A',7F8.3/33X,'K',7F8.3)
      READ (5,47) (BLK(I),I=1,4), ((F(J,I),I=1,4),J=1,7)
   47 FORMAT (4F4.2/2(4F6.4/),2(4F7.5/),2(4F6.4/),4F5.1)
      WRITE (6,7) (BLK(I),(F(J,I),J=1,7),I=1,4)
    7 FORMAT ('0'/45X,'SWBM INTEGRAL FACTORS'/27X,'CB',5X,'A0',6X,'B0',
     17X,'DA',7X,'DB',6X,'A1',6X,'B1',5X,'XD'/(25X,F5.2,2F8.4,2F9.5,
     22F8.4,F6.1))
      READ (5,49)(TZ(I),I=1,18), ((A(I,J),J=1,18),I=1,11)
   49 FORMAT (18F4.1/2(13F6.2/),10F6.2/6(11F7.3/),6F7.3/3(10F8.4/),
     16F8.4/3(11F7.2/),3F7.2/11F7.3/7F7.3)
      WRITE (6,8)                                                     *****
    8 FORMAT ('0'/46X,'WAVE BM COEFFICIENTS'/19X,'TZ',3X,5HA0'  ,
     15HA1'  ,3HA2',4X,3HA3',5X,'A0',5X,'A1',5X,'A2',6X,'A3',6X,'A4',
     25X,'A5',5X,'A6')
      WRITE (6,9) (TZ(I),(A(J,I),J=1,11),I=1,18)
    9 FORMAT (16X,F5.1,F6.2,F5.2,F6.3,3F7.3,2F8.4,2F7.2,F7.3)
C
C READ IN PARAMETERS FOR A PARTICULAR SHIP
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C
    1 READ (5,2) DISP
    2 FORMAT (F10.0)
      K=K+1
C ****** IF DISPLACEMENT .LT. 9000. OR .GT. 30000., CHANGE TEST LIMITS ******
      IF (DISP.LT.9000.) GO TO 900
      IF (DISP.GT.30000.) GO TO 900
      READ(5,3) SL,CB,CW,DLR,LOB,DWT,DWTA,CGD,CGDA,CGM,MOMA,MOMF,HS
    3 FORMAT (F5.2,F4.2,F5.3,F5.0,F6.2,F5.3,3F6.4,F5.3,2F6.4,F5.1)
C
C CALCULATE FORM OF SHIP
C
      L=100.*(DISP/DLR)**.3333
      V=SL*SQRT(L)
C
      DO 10 I=1,7
      J=I
      IF (D(I)-DISP) 10,18,20
   10 CONTINUE
   18 P=AB(1,J)
      Q=AB(2,J)
      GO TO 22
   20 P=  ((AB(1,J-1)-AB(1,J))/(D(J-1)-D(J)))*(DISP-D(J))  + AB(1,J)
      Q=  ((AB(2,J-1)-AB(2,J))/(D(J-1)-D(J)))*(DISP-D(J))  + AB(2,J)
   22 W2=(P/DISP)*V**Q
C
      LOT=(CB*10.**6.)/(35.*LOB*DLR)
      FN=.298*SL
C
C CALCULATE LCG AND SWBM OF SHIP
C
      DO 110 I=1,4
      J=I
      IF (BLK(I)-CB) 110,118,120
  110 CONTINUE
  118 DO 119 I=1,7
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  119 G(I)=F(I,J)
      GO TO 135
  120 DO 130 I=1,7
  130 G(I)=((F(I,J-1)-F(I,J))/(BLK(J-1)-BLK(J)))*(CB-BLK(J)) + F(I,J)
  135 LCG=100.*((CGM*W2) + CGD*DWT) + G(7)*(1.-W2-DWT)
C
      X0=20.*CB-13.5-LCG
      S=  G(5)*G(6)*(1.-DWT-W2) - (G(1)+X0*G(3))*(G(2)+X0*G(4))
     1-CGM*W2 - CGDA*DWTA
      SWBM=S*DISP*L
C
C CALCULATE WAVE BM OF SHIP
C
      T=18.32*((HS/L)*SQRT(1/L))**.3333
      IF (T.LT.0.6) GO TO 910
      IF (T.GT.4.0) GO TO 910
C
      DO 210 I=1,18
      J=I
      IF (TZ(I)-T) 210,218,220
  210 CONTINUE
  218 DO 219 I=1,11
  219 C(I)=A(I,J)
      GO TO 235
  220 DO 230 I=1,11
  230 C(I)=((A(I,J-1)-A(I,J))/(TZ(J-1)-TZ(J)))*(T-TZ(J)) + A(I,J)
  235 M=  (116.3*CB*CB-3.46*CB*LOT+3.04*LOT-20.6*CW-2.01*LOB+.6*LCG-39.5
     1    )*FN*FN/10000.
C
      MUMN= (C(1)+C(2)*CB+C(3)*LOT+C(4)*LOB)*FN*FN/100.
      MUW= (C(5)+C(6)*CW+C(7)*LOT+C(8)*LCG+C(9)*MOMA+C(10)*MOMF+C(11)*
     1     FN)/100.
      BWH= (.5*MUW*HS/L+MUMN*HS/L+M)*LOT/CB
      BWS= (.5*MUW*HS/L-MUMN*HS/L-M)*LOT/CB
      BH=S+BWH
      BS=S-BWS
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      BMH=BH*DISP*L
      BMS=BS*DISP*L
C
C WRITE RESULTS
C
      HOL=HS/L
      MR=M*10000.
      MUMNR=MUMN*100.
      MUWR=MUW*100.
      IF (DISP.GT.10500.) GO TO 280
      READ (5,270) (Y(I),I=1,13)
  270 FORMAT (13A4)
      WRITE (6,275)  (Y(I),I=1,13)
  275 FORMAT ('1'/////27X,13A4)
      GO TO 290
  280 IF (DISP.LT.24000.) GO TO 290
      WRITE (6,275)  (Y(I),I=1,13)
  290 WRITE (6,300)  SL,FN,CB,CW,DLR,LOB,LOT
      WRITE (6,310)  DWT,DWTA,CGD,CGDA,W2,CGM,MOMA,MOMF,LCG
      WRITE (6,320)  DISP,L,V,HS,HOL,SWBM,BMH,BMS
      WRITE (6,330)  MR,MUMNR,MUWR,S,BWH,BWS,BH
  300 FORMAT ('0'//27X,'V/SQRT(L)   FR.NO.   CB      CW   DISP/L   L/B
     1  L/T'/27X,F6.2,F10.3,F7.2,F8.3,F7.0,2F8.2)
  310 FORMAT ('0',14X,'DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP
     1W2-LCG   I AFT    I FWD    LCG'/11X,2F10.4,F11.4,F9.4,2F9.3,2F9.4,
     2F7.2)
  320 FORMAT ('0',19X,'DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWB
     1M     BM HOG   BM SAG'/18X,2F10.0,2F8.1,F8.2,2F10.0,F9.0)
  330 FORMAT ('0',14X,'BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/
     1  WVBM HOG/  WVBM SAG/   BM HOG/'/28X,'*10**4    *100        *100
     2  DISP-L   DISP-L      DISP-L      DISP-L'/24X,3F10.4,F9.4,F10.4,
     3F11.4,F10.4)
C ****** CHANGE 'X' TO NO. OF SHIPS IN .LT.'X'  ******
      IF (K.LT.250) GO TO 1
  900 STOP
  910 WRITE (6,915) DISP, T
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  915 FORMAT ('0','  FOR DISP=',F7.0,' ENCOUNTER PERIOD =',F5.1,
     1 ' IS OUTSIDE RANGE OF INPUT DATA')
      GO TO 1
      END
C
C  FOLLOWING IS INPUT DATA FOR COEFFICIENTS COMMON TO ALL DRY CARGO SHIPS
C
10000.    12000.    14000.    18000.    20000.    22000.    26000.
 4.132 1.591 4.754 1.557 6.237 1.493 2.142 1.896 2.257 1.890
 2.266 1.900 2.278 1.919
 .60 .65 .70 .75
 .5260 .5077 .4921 .4795
 .1782 .1822 .1874 .1919
 .01990 .01800 .01650 .01520
 .00260 .00324 .00373 .00419
 .5279 .5181 .5055 .4930
 .2245 .2245 .2245 .2245
 -2.1 -1.4 -0.4  0.6
 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0
  0.07  0.21  0.35 -0.40 -2.36 -4.39 -5.63 -5.94 -5.75 -5.29 -4.71 -4.09 -3.49
 -2.90 -2.41 -2.01 -1.67 -1.40  0.00  0.04  0.37  1.90  4.23  6.18  7.21  7.37
 7.08  6.58  5.98  5.36  4.79  4.21  3.74  3.36  3.01  2.73
  0.001  0.005  0.018  0.057  0.112  0.155  0.178  0.183  0.176  0.163  0.148
  0.133  0.119  0.105  0.094  0.085  0.076  0.069 -0.014 -0.050 -0.135 -0.284
 -0.403 -0.454 -0.464 -0.464 -0.448 -0.428 -0.408 -0.390 -0.373 -0.357 -0.345
 -0.333 -0.320 -0.307  0.133  0.436  0.815  0.684  0.268 -0.044 -0.223 -0.335
 -0.401 -0.434 -0.442 -0.430 -0.414 -0.388 -0.362 -0.338 -0.315 -0.295 -0.083
 -0.269 -0.383  0.189  1.159  2.109  2.841  3.329  3.602  3.714  3.719  3.655
  3.557  3.435  3.306  3.178  3.052  2.933
 0.0005  0.0017  0.0038  0.0079  0.0125  0.0130  0.0099  0.0060  0.0028  0.0004
-0.0013 -0.0026 -0.0035 -0.0041 -0.0046 -0.0049 -0.0051 -0.0053  0.0033  0.0117
 0.0347  0.0619  0.0853  0.1033  0.1128  0.1108  0.0995  0.0829  0.0651  0.0473
 0.0313  0.0175  0.0055 -0.0045 -0.0130 -0.0197
   0.51    1.93    6.90   14.93   22.68   27.10   28.06   25.92   21.66   16.27   10.84
   5.55    0.92   -3.04   -6.43   -9.20  -11.55  -13.34   -2.31   -7.81  -19.31  -32.58
 -46.34  -59.42  -68.75  -72.49  -71.43  -67.18  -61.54  -55.25  -49.15  -43.53  -38.39
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-33.86	-29.83	-26.41								
-0.006	-0.022	0.058	0.421	0.803	1.129	1.389	1.510	1.486	1.362	1.190
1.002	0.823	0.657	0.512	0.387	0.281	0.190				

INPUT DATA FOR SPECIFIC SHIPS: FORM VARIATION

Δ / $\frac{V}{\sqrt{L}}$	C_B	C_W	$\frac{\Delta}{(L/100)^3}$	L/B	$\frac{DWT}{\Delta}$	$\frac{DWTA}{\Delta}$	$\frac{\beta}{L}$	$\frac{\beta_A}{L}$	$\frac{M}{L}$	$\frac{I_a}{L^2\Delta}$	$\frac{I_f}{L^2\Delta}$	H_s
10000.												
.9	.6	.714	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
STANDARD HULL FORM & WEIGHT DISTRIBUTION												
14000.												
.9	.6	.714	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
20000.												
.9	.6	.714	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
26000.												
.9	.6	.714	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
10000.												
.9	.6	.710	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
VARIATION OF WATERPLANE COEFFICIENT												
14000.												
.9	.6	.710	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
20000.												
.9	.6	.710	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
26000.												
.9	.6	.710	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
10000.												
.9	.6	.712	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
VARIATION OF WATERPLANE COEFFICIENT												
14000.												
.9	.6	.712	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
20000.												
.9	.6	.712	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
26000.												
.9	.6	.712	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
10000.												
.9	.6	.716	128.	7.25	.611	.2505	.0139	-.213	-.137	.029	.026	50.
VARIATION OF WATERPLANE COEFFICIENT												
14000.												

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 .9  .6  .716 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .716 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .716 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .718 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
        VARIATION OF WATERPLANE COEFFICIENT
14000.
 .9  .6  .718 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .718 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .718 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .65 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
       VARIATION OF BLOCK COEFFICIENT & L/T
14000.
 .90 .65 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .65 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .65 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .70 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
       VARIATION OF BLOCK COEFFICIENT & L/T
14000.
 .90 .70 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .70 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .70 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .75 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
       VARIATION OF BLOCK COEFFICIENT & L/T
14000.
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 .90 .75 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .75 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .75 .714 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .65 .714 128.  7.85 .611 .2505 .0139-.213 -.137 .029  .026  50.
       VARIATION OF BLOCK COEFFICIENT & L/B
14000.
 .90 .65 .714 128.  7.85 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .65 .714 128.  7.85 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .65 .714 128.  7.85 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .70 .714 128.  8.46 .611 .2505 .0139-.213 -.137 .029  .026  50.
       VARIATION OF BLOCK COEFFICIENT & L/B
14000.
 .90 .70 .714 128.  8.46 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .70 .714 128.  8.46 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .70 .714 128.  8.46 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .75 .714 128.  9.06 .611 .2505 .0139-.213 -.137 .029  .026  50.
       VARIATION OF BLOCK COEFFICIENT & L/B
14000.
 .90 .75 .714 128.  9.06 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .75 .714 128.  9.06 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .75 .714 128.  9.06 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .65 .756 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
     DESIGN VARIATION OF BLOCK COEFFICIENT & L/T
14000.
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 .90 .65 .756 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .65 .756 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .65 .756 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .70 .799 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
    DESIGN VARIATION OF BLOCK COEFFICIENT & L/T
14000.
 .90 .70 .799 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .70 .799 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .70 .799 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .75 .842 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
    DESIGN VARIATION OF BLOCK COEFFICIENT & L/T
14000.
 .90 .75 .842 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .75 .842 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .75 .842 128.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 102.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/T
14000.
 .90 .6  .714 102.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 102.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 102.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 115.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/T
14000.
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 .90 .6  .714 115.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 115.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 115.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 141.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/T
14000.
 .90 .6  .714 141.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 141.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 141.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 154.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/T
14000.
 .90 .6  .714 154.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 154.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 154.  7.25 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .87 .60 .714 102.  7.25 .633 .2595 .0139-.213 -.137 .029  .026  50.
   DESIGN VARIATION OF DISP. LENGTH RATIO & L/T
14000.
 .87 .60 .714 102.  7.25 .633 .2595 .0139-.213 -.137 .029  .026  50.
20000.
 .87 .60 .714 102.  7.25 .633 .2595 .0139-.213 -.137 .029  .026  50.
26000.
 .87 .60 .714 102.  7.25 .633 .2595 .0139-.213 -.137 .029  .026  50.
10000.
 .88 .60 .714 115.  7.25 .622 .2550 .0139-.213 -.137 .029  .026  50.
   DESIGN VARIATION OF DISP. LENGTH RATIO & L/T
14000.
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 .88 .60 .714 115.  7.25 .622 .2550 .0139-.213 -.137 .029  .026  50.
20000.
 .88 .60 .714 115.  7.25 .622 .2550 .0139-.213 -.137 .029  .026  50.
26000.
 .88 .60 .714 115.  7.25 .622 .2550 .0139-.213 -.137 .029  .026  50.
10000.
 .91 .60 .714 141.  7.25 .601 .2464 .0139-.213 -.137 .029  .026  50.
   DESIGN VARIATION OF DISP. LENGTH RATIO & L/T
14000.
 .91 .60 .714 141.  7.25 .601 .2464 .0139-.213 -.137 .029  .026  50.
20000.
 .91 .60 .714 141.  7.25 .601 .2464 .0139-.213 -.137 .029  .026  50.
26000.
 .91 .60 .714 141.  7.25 .601 .2464 .0139-.213 -.137 .029  .026  50.
10000.
 .93 .60 .714 154.  7.25 .593 .2431 .0139-.213 -.137 .029  .026  50.
   DESIGN VARIATION OF DISP. LENGTH RATIO & L/T
14000.
 .93 .60 .714 154.  7.25 .593 .2431 .0139-.213 -.137 .029  .026  50.
20000.
 .93 .60 .714 154.  7.25 .593 .2431 .0139-.213 -.137 .029  .026  50.
26000.
 .93 .60 .714 154.  7.25 .593 .2431 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .60 .714 102.  9.10 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/B
14000.
 .90 .60 .714 102.  9.10 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .60 .714 102.  9.10 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .60 .714 102.  9.10 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .60 .714 115.  8.07 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/B
14000.
```

```
 .90 .60 .714 115.  8.07 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .60 .714 115.  8.07 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .60 .714 115.  8.07 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .60 .714 141.  6.58 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/B
14000.
 .90 .60 .714 141.  6.58 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .60 .714 141.  6.58 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .60 .714 141.  6.58 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .60 .714 154.  6.03 .611 .2505 .0139-.213 -.137 .029  .026  50.
   VARIATION OF DISPLACEMENT LENGTH RATIO & L/B
14000.
 .90 .60 .714 154.  6.03 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .60 .714 154.  6.03 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .60 .714 154.  6.03 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 128.  6.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
      VARIATION OF LENGTH/BEAM & LENGTH/DRAFT
14000.
 .90 .6  .714 128.  6.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 128.  6.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 128.  6.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 128.  6.63 .611 .2505 .0139-.213 -.137 .029  .026  50.
      VARIATION OF LENGTH/BEAM & LENGTH/DRAFT
14000.
```

```
 .90 .6  .714 128.  6.63 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 128.  6.63 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 128.  6.63 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 128.  8.13 .611 .2505 .0139-.213 -.137 .029  .026  50.
      VARIATION OF LENGTH/BEAM & LENGTH/DRAFT
14000.
 .90 .6  .714 128.  8.13 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 128.  8.13 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 128.  8.13 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .90 .6  .714 128.  9.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
      VARIATION OF LENGTH/BEAM & LENGTH/DRAFT
14000.
 .90 .6  .714 128.  9.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
20000.
 .90 .6  .714 128.  9.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
26000.
 .90 .6  .714 128.  9.00 .611 .2505 .0139-.213 -.137 .029  .026  50.
10000.
 .75 .60 .714 128.  7.25 .711 .2915 .0139-.213 -.137 .029  .026  50.
      DESIGN VARIATION OF SPEED LENGTH RATIO
14000.
 .75 .60 .714 128.  7.25 .711 .2915 .0139-.213 -.137 .029  .026  50.
20000.
 .75 .60 .714 128.  7.25 .711 .2915 .0139-.213 -.137 .029  .026  50.
26000.
 .75 .60 .714 128.  7.25 .711 .2915 .0139-.213 -.137 .029  .026  50.
10000.
 .83 .60 .714 128.  7.25 .657 .2694 .0139-.213 -.137 .029  .026  50.
      DESIGN VARIATION OF SPEED LENGTH RATIO
14000.
```

```
 .83 .60 .714 128.  7.25 .657 .2694 .0139-.213 -.137 .029  .026  50.
20000.
 .83 .60 .714 128.  7.25 .657 .2694 .0139-.213 -.137 .029  .026  50.
26000.
 .83 .60 .714 128.  7.25 .657 .2694 .0139-.213 -.137 .029  .026  50.
10000.
 .98 .60 .714 128.  7.25 .557 .2284 .0139-.213 -.137 .029  .026  50.
      DESIGN VARIATION OF SPEED LENGTH RATIO
14000.
 .98 .60 .714 128.  7.25 .557 .2284 .0139-.213 -.137 .029  .026  50.
20000.
 .98 .60 .714 128.  7.25 .557 .2284 .0139-.213 -.137 .029  .026  50.
26000.
 .98 .60 .714 128.  7.25 .557 .2284 .0139-.213 -.137 .029  .026  50.
10000.
1.05 .60 .714 128.  7.25 .511 .2095 .0139-.213 -.137 .029  .026  50.
      DESIGN VARIATION OF SPEED LENGTH RATIO
14000.
1.05 .60 .714 128.  7.25 .511 .2095 .0139-.213 -.137 .029  .026  50.
20000.
1.05 .60 .714 128.  7.25 .511 .2095 .0139-.213 -.137 .029  .026  50.
26000.
1.05 .60 .714 128.  7.25 .511 .2095 .0139-.213 -.137 .029  .026  50.
```

INPUT DATA FOR SPECIFIC SHIPS: WEIGHT VARIATION

Δ / $\frac{V}{\sqrt{L}}$	C_B	C_W	$\frac{\Delta}{(L/100)^3}$	L/B	$\frac{DWT}{\Delta}$	$\frac{DWTA}{\Delta}$	$\frac{\beta}{L}$	$\frac{\beta_A}{L}$	$\frac{M}{L}$	$\frac{I_a}{L^2\Delta}$	$\frac{I_f}{L^2\Delta}$	H_s
10000.												
.9	.6	.714	128.	7.25	.611	.2707	-.0074	-.244	-.044	.029	.026	50.
DESIGN VARIATION OF MACHINERY LOCATION												
14000.												
.9	.6	.714	128.	7.25	.611	.2707	-.0074	-.244	-.044	.029	.026	50.
20000.												
.9	.6	.714	128.	7.25	.611	.2707	-.0074	-.244	-.044	.029	.026	50.
26000.												
.9	.6	.714	128.	7.25	.611	.2707	-.0074	-.244	-.044	.029	.026	50.
10000.												
.9	.6	.714	128.	7.25	.611	.2505	.0036	-.238	-.091	.029	.026	50.
DESIGN VARIATION OF MACHINERY LOCATION												
14000.												
.9	.6	.714	128.	7.25	.611	.2505	.0036	-.238	-.091	.029	.026	50.
20000.												
.9	.6	.714	128.	7.25	.611	.2505	.0036	-.238	-.091	.029	.026	50.
26000.												
.9	.6	.714	128.	7.25	.611	.2505	.0036	-.238	-.091	.029	.026	50.
10000.												
.9	.6	.714	128.	7.25	.615	.2552	.0230	-.187	-.185	.029	.026	50.
DESIGN VARIATION OF MACHINERY LOCATION												
14000.												
.9	.6	.714	128.	7.25	.615	.2552	.0230	-.187	-.185	.029	.026	50.
20000.												
.9	.6	.714	128.	7.25	.615	.2552	.0230	-.187	-.185	.029	.026	50.
26000.												
.9	.6	.714	128.	7.25	.615	.2552	.0230	-.187	-.185	.029	.026	50.
10000.												
.9	.6	.714	128.	7.25	.627	.2671	.0279	-.166	-.232	.029	.026	50.
DESIGN VARIATION OF MACHINERY LOCATION												
14000.												

```
 .9   .6   .714 128.  7.25 .627 .2671 .0279-.166 -.232 .029  .026  50.
20000.
 .9   .6   .714 128.  7.25 .627 .2671 .0279-.166 -.232 .029  .026  50.
26000.
 .9   .6   .714 128.  7.25 .627 .2671 .0279-.166 -.232 .029  .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0000-.213 -.137 .029  .026  50.
           VARIATION OF DEADWEIGHT LOCATION
14000.
 .9   .6   .714 128.  7.25 .611 .2505 .0000-.213 -.137 .029  .026  50.
20000.
 .9   .6   .714 128.  7.25 .611 .2505 .0000-.213 -.137 .029  .026  50.
26000.
 .9   .6   .714 128.  7.25 .611 .2505 .0000-.213 -.137 .029  .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0092-.213 -.137 .029  .026  50.
           VARIATION OF DEADWEIGHT LOCATION
14000.
 .9   .6   .714 128.  7.25 .611 .2505 .0092-.213 -.137 .029  .026  50.
20000.
 .9   .6   .714 128.  7.25 .611 .2505 .0092-.213 -.137 .029  .026  50.
26000.
 .9   .6   .714 128.  7.25 .611 .2505 .0092-.213 -.137 .029  .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0228-.213 -.137 .029  .026  50.
           VARIATION OF DEADWEIGHT LOCATION
14000.
 .9   .6   .714 128.  7.25 .611 .2505 .0228-.213 -.137 .029  .026  50.
20000.
 .9   .6   .714 128.  7.25 .611 .2505 .0228-.213 -.137 .029  .026  50.
26000.
 .9   .6   .714 128.  7.25 .611 .2505 .0228-.213 -.137 .029  .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0271-.213 -.137 .029  .026  50.
           VARIATION OF DEADWEIGHT LOCATION
14000.
```

```
 .9  .6  .714 128.  7.25 .611 .2505 .0271-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .611 .2505 .0271-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .611 .2505 .0271-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .611 .2261 .0139-.213 -.137 .029  .026  50.
      VARIATION OF FRACTION OF DEADWEIGHT AFT
14000.
 .9  .6  .714 128.  7.25 .611 .2261 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .611 .2261 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .611 .2261 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .611 .2383 .0139-.213 -.137 .029  .026  50.
      VARIATION OF FRACTION OF DEADWEIGHT AFT
14000.
 .9  .6  .714 128.  7.25 .611 .2383 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .611 .2383 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .611 .2383 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .611 .2627 .0139-.213 -.137 .029  .026  50.
      VARIATION OF FRACTION OF DEADWEIGHT AFT
14000.
 .9  .6  .714 128.  7.25 .611 .2627 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .611 .2627 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .611 .2627 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .611 .2750 .0139-.213 -.137 .029  .026  50.
      VARIATION OF FRACTION OF DEADWEIGHT AFT
14000.
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```
 .9  .6  .714 128.  7.25 .611 .2750 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .611 .2750 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .611 .2750 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .576 .2362 .0139-.213 -.137 .029  .026  50.
      VARIATION OF DEADWEIGHT/DISPLACEMENT
14000.
 .9  .6  .714 128.  7.25 .576 .2362 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .576 .2362 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .576 .2362 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .594 .2435 .0139-.213 -.137 .029  .026  50.
      VARIATION OF DEADWEIGHT/DISPLACEMENT
14000.
 .9  .6  .714 128.  7.25 .594 .2435 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .594 .2435 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .594 .2435 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .629 .2579 .0139-.213 -.137 .029  .026  50.
      VARIATION OF DEADWEIGHT/DISPLACEMENT
14000.
 .9  .6  .714 128.  7.25 .629 .2579 .0139-.213 -.137 .029  .026  50.
20000.
 .9  .6  .714 128.  7.25 .629 .2579 .0139-.213 -.137 .029  .026  50.
26000.
 .9  .6  .714 128.  7.25 .629 .2579 .0139-.213 -.137 .029  .026  50.
10000.
 .9  .6  .714 128.  7.25 .646 .2649 .0139-.213 -.137 .029  .026  50.
      VARIATION OF DEADWEIGHT/DISPLACEMENT
14000.
```

```
 .9   .6   .714 128.  7.25 .646 .2649 .0139-.213 -.137 .029  .026  50.
20000.
 .9   .6   .714 128.  7.25 .646 .2649 .0139-.213 -.137 .029  .026  50.
26000.
 .9   .6   .714 128.  7.25 .646 .2649 .0139-.213 -.137 .029  .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0185 .026  50.
        VARIATION OF AFT MOMENT OF INFRTIA
14000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0185 .026  50.
20000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0185 .026  50.
26000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0185 .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0227 .026  50.
        VARIATION OF AFT MOMENT OF INFRTIA
14000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0227 .026  50.
20000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0227 .026  50.
26000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0227 .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0311 .026  50.
        VARIATION OF AFT MOMENT OF INERTIA
14000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0311 .026  50.
20000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0311 .026  50.
26000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0311 .026  50.
10000.
 .9   .6   .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0353 .026  50.
        VARIATION OF AFT MOMENT OF INERTIA
14000.
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```
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0353 .026  50.
20000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0353 .026  50.
26000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0353 .026  50.
10000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0211 50.
        VARIATION OF FWD MOMENT OF INERTIA
14000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0211 50.
20000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0211 50.
26000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0211 50.
10000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0233 50.
        VARIATION OF FWD MOMENT OF INERTIA
14000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0233 50.
20000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0233 50.
26000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0233 50.
10000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0278 50.
        VARIATION OF FWD MOMENT OF INERTIA
14000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0278 50.
20000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0278 50.
26000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0278 50.
10000.
 .9  .6  .714 128.  7.25 .611 .2505 .0139-.213 -.137 .0290 .0300 50.
        VARIATION OF FWD MOMENT OF INERTIA
14000.
```

```
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0290 .0300 50.
20000.
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0290 .0300 50.
26000.
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0290 .0300 50.
10000.
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0093 .0220 50.
     MOMENT OF INERTIA AS A FUNCTION OF LENGTH
14000.
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0316 .0319 50.
20000.
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0347 .0303 50.
26000.
 .9   .6   .714 128.   7.25 .611 .2505 .0139-.213 -.137 .0315 .0262 50.
```

APPENDIX VI
ANALYSIS OF COMPUTOR OUTPUT

FOR EACH PARAMETER VARIATION CALCULATE:
Ⓐ, SWBM/TOT, SAG/HOG

IF X = VALUE OF PARAMETER
BM = TOTAL HOGGING MOMENT

$$Ⓐ = \frac{(BM - BM_{STD})/BM_{STD}}{(X - X_{STD})/X_{STD}}$$

$$\frac{SWBM}{TOT} = \frac{\text{STILL WATER MOMENT}}{\text{TOTAL HOGGING MOMENT}}$$

$$\frac{SAG}{HOG} = \frac{\text{TOTAL SAGGING MOMENT}}{\text{TOTAL HOGGING MOMENT}}$$

e.g. FOR Δ = 10,000 TON SHIP
STANDARD: C_W = .714 SWBM = 49,297 FT-TONS
TOT. HOGGING MOMENT = 99,698 FT.-TONS
TOT. SAGGING MOMENT = −40,860 FT-TONS

C_{W_1} VARIATION: C_{W_1} = .710 SWBM = 49,297 FT.-TONS
TOT. HOGGING MOMENT = 98,732 FT.-TONS
TOT. SAGGING MOMENT = −39,737 FT.-TONS

SO, FOR C_{W_1} VARIATION:

$$Ⓐ = \frac{(98,732 - 99,698)/99,698}{(.710 - .714)/.714} = 1.73$$

$$\frac{SWBM}{TOT} = \frac{49,297}{98,732} = .50$$

$$\frac{SAG}{HOG} = \frac{39,737}{98,732} = .40$$

INPUT VALUES IN APPENDIX VIII
RESULTS FOLLOW: NC ≡ NOT CALCULATED

Parameter Varied	Δ = 10,000 Tons Ⓐ	SWBM/TOT	SAG/HOG	Δ = 14,000 Tons Ⓐ	SWBM/TOT	SAG/HOG	Δ = 20,000 Tons Ⓐ	SWBM/TOT	SAG/HOG	Δ = 26,000 Tons Ⓐ	SWBM/TOT	SAG/HOG
C_W = .710	1.73	.50	.40	1.61	.51	.37	1.49	.53	.34	1.40	.54	.31
↓ .712	↓	NC	NC	↓	NC	NC	↓	.53	.34	↓	NC	NC
↓ .716	↓	NC	NC	↓	NC	NC	↓	.52	.35	↓	NC	NC
C_W = .718	1.73	.49	.42	1.61	.51	.38	1.49	.52	.35	1.40	.54	.33
C_B varies C_W & B Constant												
C_B = .65	-.576	.38	.48	-.549	NC	NC	-.531	.40	.42	-.524	NC	NC
↓ .70	-.750	.22	.60	-.718	.23	.57	-.699	.23	.54	-.691	.25	.52
C_B = .75	-.829	NC	NC	-.794	.04	.71	-.775	NC	NC	-.768	NC	NC
C_B varies C_W & T Constant												
C_B = .65	-1.775	NC	NC	-1.735	NC	NC	-1.711	.45	.46	-1.696	NC	NC
↓ .70	-1.923	.28	.79	-1.884	.29	.75	-1.863	.31	.71	-1.850	.32	.68
C_B = .75	-1.968	NC	1.25	-1.932	NC	1.18	-1.915	.06	1.14	-1.905	NC	1.10
C_B varies $C_W = f(C_B)$ B = Constant												
C_B = .65	+.642	.34	.54	+.588	NC	NC	+.521	.37	.48	+.464	NC	NC
↓ .70	+.484	.17	.71	+.432	.19	.68	+.365	.20	.65	+.308	.21	.63
C_B = .75	+.412	NC	NC	+.361	NC	NC	+.293	.03	.83	+.236	NC	NC
L varies L/B & $V/\sqrt{L}$ constant Ⓐ based on $\Delta/(L/100)^3$												
$\frac{\Delta}{(L/100)^3}$ = 102	-1.486	NC	NC	-1.487	NC	NC	-1.477	.43	.34	-1.481	NC	NC
↓ 115	-1.238	NC	NC	-1.240	NC	NC	-1.234	.48	.35	-1.235	NC	NC
↓ 141	-.930	.53	.39	-.928	.55	.36	-.921	.56	.33	-.916	.58	.30
$\frac{\Delta}{(L/100)^3}$ = 154	-.826	NC	NC	-.823	NC	NC	-.817	.60	.31	-.811	NC	NC

Parameter Varied	Δ = 10,000 Tons Ⓐ	Δ = 10,000 Tons SWBM/TOT	Δ = 10,000 Tons SAG/HOG	Δ = 14,000 Tons Ⓐ	Δ = 14,000 Tons SWBM/TOT	Δ = 14,000 Tons SAG/HOG	Δ = 20,000 Tons Ⓐ	Δ = 20,000 Tons SWBM/TOT	Δ = 20,000 Tons SAG/HOG	Δ = 26,000 Tons Ⓐ	Δ = 26,000 Tons SWBM/TOT	Δ = 26,000 Tons SAG/HOG
L VARIES — L/T & $V/\sqrt{L}$ CONSTANT — Ⓐ BASED ON $\frac{\Delta}{(L/100)^3}$												
$\frac{\Delta}{(L/100)^3} = 102$	.280	NC	NC	.264	NC	NC	.261	.59	.48	.248	NC	NC
115	.226	NC	NC	.210	NC	NC	.206	.56	.40	.195	NC	NC
141	.151	.47	.36	.138	.49	.33	.136	.50	.30	.132	.52	.28
$\frac{\Delta}{(L/100)^3} = 154$	.117	NC	NC	.105	NC	NC	.104	.49	.27	.102	NC	NC
L VARIES — L/B & V CONSTANT — Ⓐ BASED ON $\frac{\Delta}{(L/100)^3}$												
$\frac{\Delta}{(L/100)^3} = 102$	-1.477	NC	NC	-1.458	NC	NC	-1.453	.43	.34	-1.456	NC	NC
115	-1.250	NC	NC	-1.246	NC	NC	-1.244	.48	.35	-1.244	NC	NC
141	-.921	.54	.40	-.918	.55	.36	-.913	.57	.33	-.907	.58	.30
$\frac{\Delta}{(L/100)^3} = 154$	-.849	NC	NC	-.844	NC	NC	-.840	.61	.32	-.833	NC	NC

L VARIES AS ABOVE EXCEPT Ⓐ BASED ON L

	Δ = 10,000 Tons CONSTANT: $\frac{L}{B}, \frac{V}{\sqrt{L}}$	$\frac{L}{T}, \frac{V}{\sqrt{L}}$	$\frac{L}{B}$, V	Δ = 14,000 Tons CONSTANT: $\frac{L}{B}, \frac{V}{\sqrt{L}}$	$\frac{L}{T}, \frac{V}{\sqrt{L}}$	$\frac{L}{B}$, V	Δ = 20,000 Tons CONSTANT: $\frac{L}{B}, \frac{V}{\sqrt{L}}$	$\frac{L}{T}, \frac{V}{\sqrt{L}}$	$\frac{L}{B}$, V	Δ = 26,000 Tons CONSTANT: $\frac{L}{B}, \frac{V}{\sqrt{L}}$	$\frac{L}{T}, \frac{V}{\sqrt{L}}$	$\frac{L}{B}$, V
$\frac{\Delta}{(L/100)^3} = 102$	3.793	-.716	3.768	3.799	-.679	3.723	3.850	-.680	3.786	3.848	NC	3.784
115	3.363	-.614	3.389	3.346	-.558	3.373	3.574	-.596	3.574	3.500	-.639	3.528
141	3.088	-.493	3.088	2.995	-.446	2.964	2.815	-.419	2.785	2.878	NC	2.847
$\frac{\Delta}{(L/100)^3} = 154$	2.869	-.410	2.955	2.851	-.358	2.919	2.711	-.343	2.793	2.772	-.402	2.839

Parameter Varied	Δ = 10,000 Tons (A)	Δ = 10,000 Tons SWBM/TOT	Δ = 10,000 Tons SAG/HOG	Δ = 14,000 Tons (A)	Δ = 14,000 Tons SWBM/TOT	Δ = 14,000 Tons SAG/HOG	Δ = 20,000 Tons (A)	Δ = 20,000 Tons SWBM/TOT	Δ = 20,000 Tons SAG/HOG	Δ = 26,000 Tons (A)	Δ = 26,000 Tons SWBM/TOT	Δ = 26,000 Tons SAG/HOG
$V/\sqrt{L}$ = .75	-.011	NC	NC	+.009	NC	NC	-.006	.48	.32	+.002	NC	NC
↓ .83	-.048	↓	↓	-.024	↓	↓	-.043	.50	.33	-.034	↓	↓
.98	-.074	↓	↓	-.055	↓	↓	-.079	.55	.37	-.067	↓	↓
$V/\sqrt{L}$ = 1.05	-.107	NC	NC	-.082	NC	NC	-.109	.58	.40	-.100	NC	NC
L/B = 6.00	1.318	NC	NC	1.293	NC	NC	1.292	.41	.27	1.285	NC	NC
↓ 6.63	1.276	↓	↓	1.254	↓	↓	1.244	.47	.31	1.241	↓	↓
8.13	1.206	↓	↓	1.200	↓	↓	1.189	.60	.39	1.168	↓	↓
L/B = 9.00	1.178	NC	NC	1.167	NC	NC	1.156	.68	.41	1.137	NC	NC
M/L = -.044	-.251	NC	NC	-.259	NC	NC	-.264	.62	.10	-.270	NC	NC
↓ -.091	-.259	↓	↓	-.269	↓	↓	-.274	.58	.21	-.281	↓	↓
-.185	-.262	↓	↓	-.273	↓	↓	-.280	.46	.52	-.288	↓	↓
M/L = -.232	-.254	NC	NC	-.267	NC	NC	-.276	.39	.70	-.285	NC	NC
B/L = 0.0	.190	NC	NC	NC	NC	NC	.209	.43	.65	.215	NC	NC
↓ .0092	.189	↓	↓	.198	↓	↓	.208	.50	.43	.214	↓	↓
.0228	.188	↓	↓	.196	↓	↓	.206	.57	.21	.213	↓	↓
B/L = .0271	.187	NC	NC	.196	NC	NC	.206	.58	.16	.212	NC	NC

Parameter Varied	Δ = 10,000 (A)	Δ = 14,000 (A)	Δ = 20,000 (A)	Δ = 20,000 SWBM/TOT	Δ = 20,000 SAG/HOG	Δ = 26,000 (A)
$\frac{DWT}{\Delta}$ = .576	-.350	-.341	-.335	.54	.32	-.333
↓ .594	-.333	-.323	-.317	.53	.33	-.314
.629	-.337	-.327	-.321	.52	.36	-.319
$\frac{DWT}{\Delta}$ = .646	-.335	-.326	-.320	.51	.38	-.317
$\frac{DWTA}{DWT}$ = .37	2.284	NC	2.370	.38	.75	2.408
.39	2.284	2.318	2.370	.46	.52	2.408
.43	2.284	2.318	2.370	.58	.21	2.408
$\frac{DWTA}{DWT}$ = .45	2.293	NC	2.379	.62	.09	2.418
$\frac{I_a}{L^2\Delta}$ = .0185	-.093	-.016	+.056	.54	.33	+.102
.0227	↓	↓	↓	.53	.34	↓
.0311	↓	↓	↓	.52	.35	↓
$\frac{I_a}{L^2\Delta}$ = .0353	-.093	-.016	+.056	.52	.35	+.102
$\frac{I_f}{L^2\Delta}$ = .0211	-.840	-.851	-.858	.45	.44	-.858
.0233	↓	↓	↓	.48	.40	↓
.0278	↓	↓	↓	.56	.31	↓
$\frac{I_f}{L^2\Delta}$ = .0300	-.840	-.851	-.858	NC	NC	-.858

NOTE: SWBM/TOT & SAG/HOG NOT CALCULATED FOR Δ = 10,000; 14,000; & 26,000 TONS.

APPENDIX VII
MISCELLANEOUS ANALYSES

SWBM EQUATION

$$\frac{SWBM}{\Delta L} = a_1 b_1 \left(1 - \frac{DWT}{\Delta} - \frac{W_2}{\Delta}\right) - (a_0 + X_0 \delta a)(b_0 + X_0 \delta b)$$
$$+ \left|{}^{M}/_{L}\right| \left({}^{W_2}/_{\Delta}\right) + \left|{}^{\beta a}/_{L}\right| \left({}^{DWTA}/_{\Delta}\right)$$

$$LCG\% = \left[\frac{M}{L}\left(\frac{W_2}{\Delta}\right)\right]100 + \frac{\beta}{L}\left(\frac{DWT}{\Delta}\right)100 + x_0\left(1 - \frac{W_2}{\Delta} - \frac{DWT}{\Delta}\right)$$

$X_0 = 20\, C_B - 13.5 - LCG\%$

FOR STANDARD SHIPS:

$^{M}/_{L} = -.137$ $\quad \frac{DWT}{\Delta} = .611$ $\quad \frac{DWTA}{DWT} = .41$ $\quad ^{\beta}/_{L} = .0139$

$^{\beta a}/_{L} = .213$ $\quad C_B = .6$

$\Delta =$	10,000	14,000	20,000	26,000
$^{W_2}/_{\Delta}:$	.043	.038	.035	.032

FOR C_B VARIATION:

READ FOLLOWING FROM PLOTS OR TABLE AT BEGINNING OF APPENDIX VIII AS $f(C_B)$:

C_B	a_1	b_1	a_0	b_0	δa	δb	X_0
.6	.5279	.2245	.5260	.1782	.0199	.0026	-2.1
.65	.5181	.2245	.5077	.1822	.0180	.00324	-1.4

SAMPLE CALCULATION FOR $\Delta = 20{,}000$ & $C_B = .6$

$LCG = -13.7(.035) + 1.39(.611) - 2.1(1 - .035 - .611) = -.374$

$X_0 = 20(.6) - 13.5 - (-.374) = -1.13$

$\frac{SWBM}{\Delta L}$ DUE TO: HULL WT. $= .5279(.2245)(1 - .035 - .611) = .0420$

MACH'Y. $= .137(.035) = .0048$

DWT $= .213(.611)(.41) = .0534$

BOUYANCY $= -(.526 + (-1.13)(.0199))(.1782 + (-1.13)(.0026))$

$= -.0882$

TOTAL WT. FACTOR $= .0420 + .0048 + .0534$

$= .1002$

CONTRIBUTION OF: HULL WT $= \frac{.0420}{.1002} = .42$

MACH'Y. $= \frac{.0048}{.1002} = .05$

DWT $= \frac{.0534}{.1002} = .53$

REPEATING CALCULATION FOR $C_B = .6$ & $.65$ FOR EACH Δ GIVES:

$\Delta \rightarrow$	10,000		14,000		20,000		26,000	
$C_B \rightarrow$	.6	.65	.6	.65	.6	.65	.6	.65
$\frac{SWBM}{\Delta L}$ FOR:								
HULL	.0410	.0402	.0416	.0408	.0420	.0412	.0423	.0415
MACH.	.0059	.0059	.0052	.0052	.0048	.0048	.0044	.0044
DWT	.0534	→						.0534
Σ WTS.	.1003	.0995	.1002	.0994	.1002	.0994	.1001	.0993
BOUYANCY	-.0887	-.0912	-.0884	-.0908	-.0882	-.0907	-.0881	-.0905
NET	.0116	.0083	.0118	.0086	.0120	.0087	.0120	.0088

CONCLUSIONS:

↑ ≡ INCREASE ↓ ≡ DECREASE

1) AS Δ ↑: NET $\frac{SWBM}{\Delta L}$ ↑

HULL ↑, BOUY. ↓ ∴ NET ↑

MACH'Y. ↓ ∴ NET ↓ SLIGHTLY

2) AS C_B ↑: NET $\frac{SWBM}{\Delta L}$ ↓ DUE TO:

HULL ↓, BOUY ↑

3) FOR EACH CASE: @ $C_B = .6$ Σ WTS. ≈ .1002

@ $C_B = .65$ Σ WTS. ≈ .0994

@ $C_B = .6$, CONTRIBUTION TO TOTAL WT. MOMENT (Σ WTS.) IS: HULL ≈ 42 %

MACH'Y. ≈ 4% - 6%

DWT ≈ 53 %

ABS SWBM - REF. # 29

$$SWBM \approx C_{st} L^{2.5} B (C_B + .5) \qquad C_B \text{ MUST BE } \geq .64$$

FOR $360' < L \leq 525'$, $C_{st} = \left[.285 + \frac{525 - L}{6100}\right] \times 10^{-3}$

FOR $525' < L \leq 690'$, $C_{st} = \left[.275 + \frac{690 - L}{16400}\right] \times 10^{-3}$

RESULTS OF ABS CALCS. FOR SWBM: $C_B = .6$

L	C_{st}	B	SWBM	SWBM/ΔL
427	$.3011 \times 10^{-3}$	58.9	76,173	.0178
478	.2927	65.9	109,846	.0164
539	.2842 ↓	74.3	162,364	.0151
588	$.2812 \times 10^{-3}$	81.1	217,964	.0143

NOTE: ABOVE FOR STANDARD SHIPS.

COMPARE THESIS SWBM & ABS SWBM

Δ	THESIS SWBM / ABS SWBM
10,000	.0116/.0178 = .65
14,000	.0118/.0164 = .72
20,000	.0120/.0151 = .79
26,000	.0120/.0143 = .84

OTHER METHODS FOR WAVE BM

SEAKEEPING TABLE CALCS. FOR Δ = 20,000 TON STANDARD SHIP.

STD. $C_B = .6$ $\quad H_s/L = \frac{50}{539} = .093 \quad F_n = .268 \quad \frac{B}{T} = 2.55 \quad \frac{L}{B} = 7.25$

VALUES OF μ FROM TABLES GIVEN L/B, B/T, Hs/L, Fn

	$\frac{L}{B}=7, \frac{B}{T}=2$		$\frac{L}{B}=7, \frac{B}{T}=3$		$\frac{L}{B}=8.5, \frac{B}{T}=2$		$\frac{L}{B}=8.5, \frac{B}{T}=3$	
Hs/L →	.075	.1	.075	.1	.075	.1	.075	.1
$F_n = .25$	327	356	342	368	274	296	279	297
.30	349	383	371	401	294	317	302	323

INTERPOLATE USING $\hat{y} = y_1 + \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

INTERPOLATE IN FOLLOWING ORDER: Hs/L, Fn, B/T, L/B

L/B →	7	7	7	7.25	8.5	8.5	8.5
B/T →	2	2.55	3	2.55	2	2.55	3
$F_n = .25$	348		361		290		292
↓ .268	357	366	373	355	298	300	301
$F_n = .30$	373		393		311		317

Hs/L = .093 FOR ALL VALUES ABOVE.

$\mu = 355$

$$\overline{BM}^{1/3} = \frac{3.7417}{2240 \times 10^7} \mu \rho g L^4 = \frac{3.7417}{2240 \times 10^7} (355)(1.9905)(32.174)(539)^4$$

$\overline{BM}^{1/3} = 320{,}506$ FT.-TONS HOGGING BM = 160,253

MURRAY'S EQUATION FOR DESIGN BM, REF. # 3

$$\text{Hogging Wave BM} = 55.5(1.6\, C_B - .49) L^3 B e^{-L/900} \times 10^{-6}$$

FOR STAND. SHIPS, $C_B = .6$

Δ	14,000	20,000	26,000
L	478	539	588
B	65.9	74.3	81.1
WBM × 10^{-5}	1.104	1.667	2.238

LLOYD'S EQUATION FOR DESIGN BM, REF. # 30

NOTE: LLOYD'S CALCS. DONE IN METRIC UNITS THEN CONVERTED TO ENGLISH UNITS.

FT. = 3.281 × M   LB = .2248 × N

FT-TONS = .3293 × kN-M

$$BM = \sigma_w C_1 L^2 B (C_B + .7) \times 10^{-3} \; [kN\text{-}M]$$

$\sigma_w = 98.1$

L [M]	100	125	150	150-300
C_1	8.040	8.473	8.913	$10.75 - \left(\frac{300-L}{100}\right)^{1.5}$

USE LINEAR INTERPOLATION FOR C_1

FOR STANDARD SHIPS: $C_B = .6$

L FT	427	478	539	588
L M	130.1	145.7	164.3	179.2
C_1	8.563	8.837	9.169	9.422
B FT	58.9	65.9	74.3	81.1
B M	18.0	20.1	22.6	24.7
BM kN-M	332,710	480,875	713,375	953,078
BM FT-TONS	109,561	158,352	234,914	313,849

ABS EQUATION FOR DESIGN BM, REF. # 29

$BM = C_h L^2 B H_e$

$C_h = [12.04\, C_B - 4.51] \times 10^{-4}$

$H_e = .0171\, L + 11.98$ FOR $200' < L \le 490'$

$H_e = .018\, L + 11.535$ FOR $490' < L \le 720'$

FOR STD. SHIPS $C_B = .6$

L	427	478	539	588
B	58.9	65.9	74.3	81.1
He	19.28	20.15	21.24	22.12
BM	66,172	96,974	146,491	198,195

OTHER ESTIMATES OF WAVE BM

OLD STANDARD: $BM = \Delta L/35 \Rightarrow \frac{BM}{\Delta L} = .0286$

FOR TOTAL BM

FROM PNA: WAVE $BM/\Delta L \approx .0247$ FOR ALL SHIPS

COMPARISON OF L, B, C_B VARIATION

USE $\Delta = 20{,}000$ TONS, STANDARD IS BASE.

$L = 539'$ $B = 74.3'$ $C_B = .6$

C_B VARIATION: USE $C_B = .65$ $C_W = .756$

"DESIGN VARIATION OF C_B AND L/T"

L VARIATION: USE $L = 558$ FT. $C_B = .6$ $L/B = 7.25$

"VARIATION OF DISPLACEMENT LENGTH RATIO & L/T"

B VARIATION: USE $B = 81.3$ $\therefore L/B = 6.63$

"VARIATION OF L/B & L/T"

USE EQUATIONS ABOVE & COMPUTOR OUTPUTS MENTIONED ABOVE TO GET:

BENDING MOMENTS

	STANDARD	B = CONS'T. $C_B = .65$	L/B = CONST. L = 558	B = 81.3
COMPUTOR OUTPUT	114,676	159,477	140,881	143,057
" w/o MN. CORR.(1)	163,018	187,043	184,211	177,364
MURRAY	166,745	195,127	181,142	182,454
LLOYD'S	235,374	244,427	255,014	257,549
ABS	146,491	152,011	159,529	160,293
		$C_B = .70$		
LLOYD'S		253,479		
ABS		179,607		

NOTE: 1) COMPUTOR OUTPUT WITHOUT INCLUDING EFFECT OF SHIP'S OWN WAVE & SEASTATE ON WAVE BM MEAN.

REQUIRED SECTION MODULUS FROM ABS & LLOYD'S

USE $\Delta = 20,000$ TON STD. SHIP.

$L = 539'$ $B = 74.3'$ $T = 29.2'$ $C_B = .6$

SWBM = 127,440 FT-TONS = 387,003 [kN-m]

LLOYD'S : WBM = 713,375 [kN-M] = 234,914 [FT-TONS]

STRESS : $\sigma_c = 178.0$ N/mm² MAX. ALLOWABLE TOTAL

$\sigma_w = 98.1$ N/mm² ALLOWABLE WAVE STRESS

$\sigma_s = 79.9$ N/mm² " SWBM STRESS

$$\text{S.M. DUE TO WAVE ONLY} = \frac{713,375}{178} \times 10^3 = 4,007,924 \text{ cm}^3$$
$$= 244,570 \text{ IN}^3$$

$$\text{S.M. TOTAL} = \frac{713,375 + 387,003}{178} \times 1000 = 6,181,900 \text{ cm}^3$$
$$= 377,243 \text{ IN}^3$$

ABS : WBM = 146,491 FT-TONS

ALLOWABLE STRESS = 10.26 TON/IN²

$$\text{S.M. DUE TO WAVE ONLY} = \frac{146,491}{10.26}(1.08) = 15,420 \text{ FT-IN}^2$$
$$= 185,040 \text{ IN}^3$$

$$\text{S.M. TOTAL} = \frac{146,491 + 127,440}{10.26}(1.08) = 28,835 \text{ FT-IN}^2$$

ABS S.M. TOTAL = 346,018 IN^3

COMPARE ALLOW. STRESS

178 N/mm^2 = 11.53 TON/IN^2

ABS/LLOYD'S : ALLOW. STRESS = $\frac{10.26}{11.53}$ = .89

WAVE BM = $\frac{146,491\ (1.08)}{239,914}$ = .67

SM DUE TO WAVES = $\frac{185,040}{244570}$ = .76

SM TOTAL = $\frac{346,018}{377,243}$ = .92

SPEED REDUCTION IN SEAWAY

USE MURDEY'S EQUATIONS TO CALCULATE

Δ	$V/\sqrt{L}$	V	Fn	m x 10^4	$\bar{\mu}_s$ x 10^2	μ_s x 10^2	HOGGING WBM	SAGGING WBM
10	0	0	0	0	0	.7482	57,580	57,580
14	↓	↓	↓	↓	↓	.7808	84,125	84,125
20						.8158	125,565	125,565
26	0	0	0	0	0	.8435	168,777	168,777
10	.3	6.2	.089	-.0744	-.0079	.8021	59,534	63,922
14	↓	6.5	↓	-.0741	-.0085	.8474	87,998	94,603
20		6.9		-.0739	-.0094	.8963	132,610	143,301
26	.3	7.2	.089	-.0738	-.0099	.9344	179,531	194,401
10	.6	12.4	.179	-.3009	-.0318	.8567	57,080	74,780
14	↓	13.1	↓	-.2997	-.0346	.9147	84,922	112,181
20		13.9		-.2991	-.0379	.9776	128,877	172,061
26	.6	14.6	.179	-.2984	-.0399	1.0263	175,344	235,365

SEE NEXT PAGE FOR VALUES OF COEFFICIENTS (A's) REQUIRED TO CALCULATE m, $\bar{\mu}_s$, μ_s

Δ 1,000 TONS	L	H_s/L	$\bar{T}_z$	A_0'	A_1'	A_2'	A_3'
10	427	.117	3.27	-2.73	4.05	.101	-.353
14	478	.105	3.09	-3.23	4.53	.113	-.366
20	539	.093	2.91	-3.76	5.05	.125	-.381
26	588	.085	2.78	-4.15	5.42	.135	-.392

	A_0	A_1	A_2	A_3	A_4	A_5	A_6
10	-.379	3.390	-.0043	.0133	-4.227	-41.73	.606
14	-.402	3.502	-.0038	.0251	-.862	-46.62	.748
20	-.421	3.601	-.0031	.0385	3.00	-51.90	.904
26	-.431	3.661	-.0025	.0491	6.08	-55.88	1.021

TOTAL BM = SWBM $\pm$ WBM (+) FOR HOG (−) FOR SAG

Δ	$V/\sqrt{L}$ = .60 HOG	$V/\sqrt{L}$ = .60 SAG	$V/\sqrt{L}$ = .30 HOG	$V/\sqrt{L}$ = .30 SAG	$V/\sqrt{L}$ = 0.0 HOG	$V/\sqrt{L}$ = 0.0 SAG
10,000	106,377	-25,483	108,831	-14,625	106,877	-8283
14,000	163,421	-33,682	166,497	-16,104	162,624	-5626
20,000	256,317	-44,621	260,050	-15,861	253,005	+1875
26,000	357,713	-52,996	361,900	-12,032	351,146	+13,592

APPENDIX VIII COMPUTOR OUTPUT

FACTORS FOR W2=(A/DISP)*V**K

DISPLACEMENT	10000.	12000.	14000.	18000.	20000.	22000.	26000.
A	4.132	4.754	6.237	2.142	2.257	2.266	2.278
K	1.591	1.557	1.493	1.896	1.890	1.900	1.919

SWBM INTEGRAL FACTORS

CB	A0	B0	DA	DB	A1	B1	XD
0.60	0.5260	0.1782	0.01990	0.00260	0.5279	0.2245	-2.1
0.65	0.5077	0.1822	0.01800	0.00324	0.5181	0.2245	-1.4
0.70	0.4921	0.1874	0.01650	0.00373	0.5055	0.2245	-0.4
0.75	0.4795	0.1919	0.01520	0.00419	0.4930	0.2245	0.6

WAVE BM COEFFICIENTS

TZ	A0'	A1'	A2'	A3'	A0	A1	A2	A3	A4	A5	A6
0.6	0.07	0.0	0.001	-0.014	0.133	-0.083	0.0005	0.0033	0.51	-2.31	-0.006
0.8	0.21	0.04	0.005	-0.050	0.436	-0.269	0.0017	0.0117	1.93	-7.81	-0.022
1.0	0.35	0.37	0.018	-0.135	0.815	-0.383	0.0038	0.0347	6.90	-19.31	0.058
1.2	-0.40	1.90	0.057	-0.294	0.684	0.189	0.0079	0.0619	14.93	-32.58	0.421
1.4	-2.36	4.23	0.112	-0.403	0.268	1.159	0.0125	0.0853	22.68	-46.34	0.803
1.6	-4.39	6.18	0.155	-0.454	-0.044	2.109	0.0130	0.1033	27.10	-59.42	1.129
1.8	-5.63	7.21	0.178	-0.464	-0.223	2.841	0.0099	0.1128	28.06	-68.75	1.389
2.0	-5.94	7.37	0.183	-0.464	-0.335	3.329	0.0060	0.1108	25.92	-72.49	1.510
2.2	-5.75	7.08	0.176	-0.448	-0.401	3.602	0.0028	0.0995	21.66	-71.43	1.486
2.4	-5.29	6.58	0.163	-0.428	-0.434	3.714	0.0004	0.0829	16.27	-67.18	1.362
2.6	-4.71	5.98	0.148	-0.408	-0.442	3.719	-0.0013	0.0651	10.84	-61.54	1.190
2.8	-4.09	5.36	0.133	-0.390	-0.430	3.655	-0.0026	0.0473	5.55	-55.25	1.002
3.0	-3.49	4.79	0.119	-0.373	-0.414	3.557	-0.0035	0.0313	0.92	-49.15	0.823
3.2	-2.90	4.21	0.105	-0.357	-0.388	3.435	-0.0041	0.0175	-3.04	-43.53	0.657
3.4	-2.41	3.74	0.094	-0.345	-0.362	3.306	-0.0046	0.0055	-6.43	-38.39	0.512
3.6	-2.01	3.36	0.085	-0.333	-0.338	3.178	-0.0049	-0.0045	-9.20	-33.86	0.387
3.8	-1.67	3.01	0.076	-0.320	-0.315	3.052	-0.0051	-0.0130	-11.55	-29.63	0.281
4.0	-1.40	2.73	0.069	-0.307	-0.295	2.933	-0.0053	-0.0197	-13.34	-26.41	0.190

STANDARD HULL FORM & WEIGHT DISTRIBUTION

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	99698.	-40860.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9131	0.0115	0.0118	0.0211	0.0233

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	153841.	-58015.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9830	0.0117	0.0113	0.0204	0.0230

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	242116.	-83919.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0590	0.0118	0.0106	0.0196	0.0225

STANDARD HULL FORM & WEIGHT DISTRIBUTION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I APT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	338067.	-108471.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.1157	0.0119	0.0102	0.0190	0.0221

VARIATION OF WATERPLANE COEFFICIENT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.710	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	98732.	-39737.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6693	-0.0714	0.8995	0.0115	0.0116	0.0208	0.0231

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.710	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-C.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	152453.	-56382.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6667	-0.0776	0.9690	0.0117	0.0110	0.0201	0.0228

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.710	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-C.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	240095.	-81504.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6653	-0.0847	1.0446	0.0118	0.0105	0.0194	0.0223

VARIATION OF WATERPLANE COEFFICIENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.710	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	335416.	-105263.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6639	-0.0901	1.1010	0.0119	0.0100	0.0188	0.0219

VARIATION OF WATERPLANE COEFFICIENT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.712	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	99215.	-40298.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6722	-0.0714	0.9063	0.0115	0.0117	0.0210	0.0232

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.712	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	153147.	-57199.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6696	-0.0776	0.9760	0.0117	0.0112	0.0203	0.0229

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.712	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	241105.	-82712.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6682	-0.0847	1.0518	0.0118	0.0106	0.0195	0.0224

VARIATION OF WATERPLANE COEFFICIENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.712	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	336742.	-106867.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6668	-0.0901	1.1083	0.0119	0.0101	0.0189	0.0220

VARIATION OF WATERPLANE COEFFICIENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.716	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	100181.	-41421.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6782	-0.0714	0.9199	0.0115	0.0119	0.0212	0.0234

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.716	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	154535.	-58831.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6756	-0.0776	0.9900	0.0117	0.0114	0.0205	0.0231

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.716	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	243127.	-85126.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6741	-0.0847	1.0662	0.0118	0.0107	0.0197	0.0226

VARIATION OF WATERPLANE COEFFICIENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.716	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	598.	21.8	50.0	0.09	182369.	339392.	-110076.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6728	-0.0901	1.1230	0.0119	0.0103	0.0191	0.0222

VARIATION OF WATERPLANE COEFFICIENT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.718	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	100665.	-41982.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6811	-0.0714	0.9266	0.0115	0.0120	0.0214	0.0236

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.718	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	155229.	-59647.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6785	-0.0776	0.9970	0.0117	0.0115	0.0206	0.0232

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.718	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	244137.	-86333.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6771	-0.0847	1.0734	0.0118	0.0108	0.0198	0.0227

VARIATION OF WATERPLANE COEFFICIENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.718	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	340718.	-111680.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6757	-0.0901	1.1303	0.0119	0.0104	0.0192	0.0223

VARIATION OF BLOCK COEFFICIENT & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.25	20.01

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.23

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	35613.	94883.	-45171.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.2842	-0.0456	0.9098	0.0083	0.0139	0.0189	0.0222

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.25	20.01

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.16

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	57144.	146806.	-65141.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.2815	-0.0488	0.9834	0.0085	0.0134	0.0183	0.0219

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.25	20.01

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.13

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	93150.	231405.	-96108.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.2799	-0.0527	1.0638	0.0086	0.0128	0.0176	0.0215

VARIATION OF BLOCK COEFFICIENT & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.25	20.01

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.09

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	133810.	323311.	-126550.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.2785	-0.0558	1.1240	0.0088	0.0124	0.0170	0.0212

200

VARIATION OF BLOCK COEFFICIENT & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	0.12

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	18848.	87200.	-52568.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1148	-0.0198	0.9079	0.0044	0.0160	0.0167	0.0204

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	0.19

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	30996.	135430.	-77182.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1178	-0.0200	0.9865	0.0046	0.0156	0.0162	0.0202

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	0.23

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	51177.	213909.	-116342.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1194	-0.0206	1.0727	0.0048	0.0151	0.0156	0.0199

VARIATION OF BLOCK COEFFICIENT & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	0.26

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	74389.	299117.	-156150.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1210	-0.0215	1.1375	0.0049	0.0147	0.0151	0.0196

VARIATION OF BLOCK COEFFICIENT & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-ICG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	0.46

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	1544.	79024.	-60457.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.5173	0.0061	0.9061	0.0004	0.0181	0.0145	0.0185

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-ICG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	0.54

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	4011.	123290.	-89988.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.5205	0.0089	0.9896	0.0006	0.0178	0.0140	0.0184

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	0.58

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	7863.	195188.	-137801.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.5223	0.0114	1.0816	0.0007	0.0174	0.0135	0.0181

VARIATION OF BLOCK COEFFICIENT & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	0.62

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	13074.	273196.	-187478.

BM FACOTPS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.5240	0.0128	1.1510	0.0009	0.0170	0.0131	0.0179

VARIATION OF BLOCK COEFFICIENT & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.85	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.23

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	35613.	84951.	-45325.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4580	-0.0720	0.9163	0.0083	0.0115	0.0189	0.0199

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.85	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.16

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	57144.	131600.	-65292.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4552	-0.0770	0.9892	0.0085	0.0111	0.0183	0.0197

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.85	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.13

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	93150.	207592.	-96231.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4537	-0.0829	1.0685	0.0086	0.0106	0.0176	0.0193

VARIATION OF BLOCK COEFFICIENT & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.714	128.	7.85	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.09

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	133810.	290281.	-126608.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4523	-0.0874	1.1278	0.0088	0.0102	0.0170	0.0190

VARIATION OF BLOCK COEFFICIENT & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	8.46	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	0.12

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	18848.	67751.	-53759.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.1972	-0.0730	0.9211	0.0044	0.0114	0.0170	0.0159

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	8.46	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	0.19

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	30996.	105546.	-78799.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.1942	-0.0768	0.9981	0.0046	0.0111	0.0164	0.0158

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	8.46	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	0.23

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	51177.	166947.	-118583.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.1926	-0.0316	1.0822	0.0048	0.0107	0.0158	0.0155

VARIATION OF BLOCK COEFFICIENT & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.714	128.	8.46	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	0.26

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	74389.	233830.	-158964.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.1910	-0.0853	1.1452	0.0049	0.0104	0.0153	0.0153

VARIATION OF BLOCK COEFFICIENT & L/B

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	9.06	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	0.46

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	1544.	50637.	-63401.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1080	-0.0736	0.9257	0.0004	0.0115	0.0152	0.0118

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	9.06	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	0.54

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	4011.	79525.	-94137.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1111	-0.0763	1.0070	0.0006	0.0113	0.0147	0.0119

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	9.06	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	0.58

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	7863.	126196.	-143781.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1129	-0.0798	1.0958	0.0007	0.0110	0.0141	0.0117

VARIATION OF BLOCK COEFFICIENT & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.714	128.	9.06	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	0.62

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	13074.	177084.	-195249.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.1146	-0.0826	1.1625	0.0009	0.0107	0.0136	0.0116

DESIGN VARIATION OF BLOCK COEFFICIENT & L/T

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          V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
            0.90      0.268   0.65   0.756   128.    7.25   20.01

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.043   -0.137   0.0290   0.0260  -0.23

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       427.    18.6    50.0    0.12    35613.   105033.  -56959.

BM FACOTPS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100      *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.3464   -0.0456   1.0523   0.0083    0.0162     0.0217     0.0246


          V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
            0.90      0.268   0.65   0.756   128.    7.25   20.01

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.038   -0.137   0.0290   0.0260  -0.16

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       478.    19.7    50.0    0.10    57144.   161381.  -82282.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100      *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.3437   -0.0488   1.1306   0.0085    0.0156     0.0208     0.0241


          V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
            0.90      0.268   0.65   0.756   128.    7.25   20.01

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.035   -0.137   0.0290   0.0260  -0.13

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       539.    20.9    50.0    0.09    93150.   252627. -121458.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100      *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.3422   -0.0527   1.2150   0.0086    0.0148     0.0199     0.0235
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DESIGN VARIATION OF BLOCK COEFFICIENT & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.65	0.756	128.	7.25	20.01

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.09

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	133810.	351145.	-160241.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3407	-0.0558	1.2777	0.0088	0.0142	0.0192	0.0230

DESIGN VARIATION OF BLOCK COEFFICIENT & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.799	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	0.12

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	19.6	50.0	0.12	18848.	107741.	-76424.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.0112	-0.0198	1.1963	0.0044	0.0208	0.0223	0.0252

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.799	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	0.19

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	30996.	164928.	-111872.

BM FACOTPS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.0082	-0.0200	1.2844	0.0046	0.0200	0.0213	0.0246

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.799	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	0.23

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	51177.	256859.	-167646.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.0065	-0.0206	1.3788	0.0048	0.0191	0.0203	0.0238

DESIGN VARIATION OF BLOCK COEFFICIENT & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.70	0.799	128.	7.25	21.55

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	0.26

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	74389.	355449.	-224333.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.0050	-0.0215	1.4486	0.0049	0.0184	0.0195	0.0233

DESIGN VARIATION OF BLOCK COEFFICIENT & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.842	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	0.46

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	1544.	109957.	-96382.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.3276	0.0061	1.3404	0.0004	0.0254	0.0229	0.0257

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.842	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	0.54

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	4011.	167710.	-142227.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.3308	0.0089	1.4381	0.0006	0.0245	0.0218	0.0251

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.842	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	0.58

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	7863.	259867.	-215058.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.3326	0.0114	1.5426	0.0007	0.0234	0.0207	0.0241

DESIGN VARIATION OF BLOCK COEFFICIENT & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.75	0.842	128.	7.25	23.09

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	0.62

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	13074.	358026.	-290154.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	0.3343	0.0128	1.6195	0.0009	0.0226	0.0198	0.0234

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.046	-0.137	0.0290	0.0260	-0.50

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	461.	19.3	50.0	0.11	52711.	129791.	-51778.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3500	-0.0387	0.9399	0.0114	0.0167	0.0227	0.0282

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.040	-0.137	0.0290	0.0260	-0.44

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	516.	20.4	50.0	0.10	84075.	200305.	-73683.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3472	-0.0410	1.0131	0.0116	0.0161	0.0218	0.0277

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	581.	21.7	50.0	0.09	136331.	314757.	-107508.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3460	-0.0445	1.0929	0.0117	0.0154	0.0210	0.0271

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.37

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	634.	22.7	50.0	0.08	195207.	439800.	-139267.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3445	-0.0458	1.1529	0.0118	0.0148	0.0203	0.0267

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.045	-0.137	0.0290	0.0260	-0.48

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	443.	18.9	50.0	0.11	50883.	112230.	-46326.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5310	-0.0576	0.9254	0.0115	0.0138	0.0219	0.0253

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.039	-0.137	0.0290	0.0260	-0.42

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	496.	20.0	50.0	0.10	81086.	173222.	-65922.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5283	-0.0620	0.9969	0.0117	0.0133	0.0212	0.0250

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.036	-0.137	0.0290	0.0260	-0.39

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	558.	21.3	50.0	0.09	131570.	272451.	-95970.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5270	-0.0676	1.0751	0.0118	0.0126	0.0204	0.0244

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.034	-0.137	0.0290	0.0260	-0.36

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	609.	22.2	50.0	0.08	188331.	380477.	-124281.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5256	-0.0712	1.1330	0.0119	0.0121	0.0197	0.0240

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.042	-0.137	0.0290	0.0260	-0.46

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	414.	18.3	50.0	0.12	47903.	90285.	-35662.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7928	-0.0817	0.9012	0.0116	0.0102	0.0202	0.0218

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.037	-0.137	0.0290	0.0260	-0.40

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	463.	19.4	50.0	0.11	76227.	139336.	-50421.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7903	-0.0892	0.9699	0.0119	0.0097	0.0195	0.0215

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.034	-0.137	0.0290	0.0260	-0.36

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	521.	20.6	50.0	0.10	123807.	219458.	-72379.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7888	-0.0976	1.0442	0.0119	0.0092	0.0188	0.0210

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.33

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	569.	21.5	50.0	0.09	177127.	306615.	-93248.

BM FACOTPS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7874	-0.1043	1.1005	0.0120	0.0088	0.0183	0.0207

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	7.25	15.35

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.041	-0.137	0.0290	0.0260	-0.45

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	402.	18.0	50.0	0.12	46661.	82980.	-30884.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8904	-0.0895	0.8899	0.0116	0.0090	0.0193	0.0206

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	7.25	15.35

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.036	-0.137	0.0290	0.0260	-0.39

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	450.	19.1	50.0	0.11	74208.	128115.	-43399.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-I	BM HOG/ DISP-L
	-0.8880	-0.0980	0.9575	0.0118	0.0086	0.0187	0.0204

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	7.25	15.35

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.033	-0.137	0.0290	0.0260	-0.35

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	506.	20.3	50.0	0.10	120572.	201960.	-61729.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8864	-0.1074	1.0304	0.0119	0.0080	0.0180	0.0199

VARIATION OF DISPLACEMENT LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	7.25	15.35

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.031	-0.137	0.0290	0.0260	-0.32

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	553.	21.2	50.0	0.09	172463.	282402.	-79131.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8851	-0.1151	1.0868	0.0120	0.0077	0.0175	0.0197

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

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              V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B    L/T
                0.90     0.268   0.60   0.714   102.    9.10   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.046   -0.137   0.0290   0.0260  -0.50

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       461.   19.3    50.0    0.11   52711.    94026.  -53482.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100      *100    DISP-L   DISP-L     DISP-L     DISP-L
             -0.9443   -0.1237   0.9584   0.0114    0.0090     0.0230    0.0204


              V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B    L/T
                0.90     0.268   0.60   0.714   102.    9.10   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.040   -0.137   0.0290   0.0260  -0.44

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       516.   20.4    50.0    0.10   84075.   145586.  -76129.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100      *100    DISP-L   DISP-L     DISP-L     DISP-L
             -0.9415   -0.1319   1.0290   0.0116    0.0085     0.0222    0.0202


              V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B    L/T
                0.90     0.268   0.60   0.714   102.    9.10   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.038   -0.137   0.0290   0.0260  -0.41

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       581.   21.7    50.0    0.09  136331.   229278. -110919.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100      *100    DISP-L   DISP-L     DISP-L     DISP-L
             -0.9402   -0.1414   1.1052   0.0117    0.0080     0.0213    0.0197
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VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	102.	9.10	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.37

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	634.	22.7	50.0	0.08	195207.	321059.	-143731.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9388	-0.1472	1.1615	0.0118	0.0076	0.0206	0.0195

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	8.07	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.045	-0.137	0.0290	0.0260	-0.48

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	443.	18.9	50.0	0.11	50883.	97410.	-46360.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7945	-0.0944	0.9340	0.0115	0.0105	0.0220	0.0220

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	8.07	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.039	-0.137	0.0290	0.0260	-0.42

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	496.	20.0	50.0	0.10	81086.	150555.	-65910.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7918	-0.1014	1.0045	0.0117	0.0100	0.0212	0.0217

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	8.07	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.036	-0.137	0.0290	0.0260	-0.39

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	558.	21.3	50.0	0.09	131570.	237043.	-95781.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7904	-0.1097	1.0811	0.0118	0.0094	0.0204	0.0212

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	115.	8.07	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.034	-0.137	0.0290	0.0260	-0.36

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	609.	22.2	50.0	0.08	188331.	331385.	-123906.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7890	-0.1152	1.1376	0.0119	0.0090	0.0197	0.0209

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	6.58	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.042	-0.137	0.0290	0.0260	-0.46

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	414.	18.3	50.0	0.12	47903.	101226.	-36390.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5775	-0.0528	0.8937	0.0116	0.0129	0.0204	0.0245

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	6.58	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.037	-0.137	0.0290	0.0260	-0.40

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	463.	19.4	50.0	0.11	76227.	155997.	-51642.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5750	-0.0583	0.9632	0.0118	0.0123	0.0197	0.0241

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	6.58	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.034	-0.137	0.0290	0.0260	-0.36

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	521.	20.6	50.0	0.10	123807.	245452.	-74365.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5735	-0.0644	1.0385	0.0119	0.0117	0.0190	0.0235

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	141.	6.58	18.48

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.33

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	569.	21.5	50.0	0.09	177127.	342588.	-96122.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5721	-0.0695	1.0958	0.0120	0.0112	0.0185	0.0232

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	6.03	18.46

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.041	-0.137	0.0290	0.0260	-0.45

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	402.	18.0	50.0	0.12	46661.	102071.	-32671.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4986	-0.0377	0.8759	0.0116	0.0138	0.0197	0.0254

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	6.03	18.46

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.036	-0.137	0.0290	0.0260	-0.39

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	450.	19.1	50.0	0.11	74208.	157134.	-46371.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4962	-0.0428	0.9449	0.0118	0.0132	0.0192	0.0250

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	6.03	18.46

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.033	-0.137	0.0290	0.0260	-0.35

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	506.	20.3	50.0	0.10	120572.	247214.	-66480.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4946	-0.0481	1.0196	0.0119	0.0125	0.0185	0.0244

VARIATION OF DISPLACEMENT LENGTH RATIO & L/B

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	154.	6.03	18.46

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.031	-0.137	0.0290	0.0260	-0.32

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	553.	21.2	50.0	0.09	172463.	345064.	-85985.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4933	-0.0528	1.0777	0.0120	0.0120	0.0180	0.0240

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.87	0.259	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6330	0.2595	0.0139	-0.2130	0.044	-0.137	0.0290	0.0260	-0.40

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	461.	18.7	50.0	0.11	51644.	129306.	-51480.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3229	-0.0361	0.9358	0.0112	0.0168	0.0224	0.0280

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.87	0.259	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6330	0.2595	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	516.	19.8	50.0	0.10	82285.	199416.	-73427.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3204	-0.0383	1.0088	0.0114	0.0162	0.0216	0.0276

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.87	0.259	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6330	0.2595	0.0139	-0.2130	0.036	-0.137	0.0290	0.0260	-0.30

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	581.	21.0	50.0	0.09	133602.	313580.	-107124.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3191	-0.0415	1.0889	0.0115	0.0155	0.0207	0.0270

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.87	0.259	0.60	0.714	102.	7.25	23.18

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6330	0.2595	0.0139	-0.2130	0.033	-0.137	0.0290	0.0260	-0.27

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	634.	21.9	50.0	0.08	191240.	438029.	-139011.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.3178	-0.0428	1.1489	0.0116	0.0150	0.0200	0.0266

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.88	0.262	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6220	0.2550	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.43

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	443.	18.5	50.0	0.11	50430.	112350.	-45706.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5054	-0.0551	0.9225	0.0114	0.0140	0.0217	0.0254

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.88	0.262	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6220	0.2550	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.37

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	496.	19.6	50.0	0.10	80302.	173314.	-65064.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5029	-0.0593	0.9937	0.0116	0.0134	0.0210	0.0250

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.88	0.262	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6220	0.2550	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.33

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	558.	20.8	50.0	0.09	130400.	272714.	-94585.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5015	-0.0646	1.0718	0.0117	0.0128	0.0202	0.0244

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.88	0.262	0.60	0.714	115.	7.25	20.56

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6220	0.2550	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.30

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	609.	21.7	50.0	0.08	186613.	380766.	-122466.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5002	-0.0681	1.1296	0.0118	0.0123	0.0195	0.0240

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.91	0.271	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6010	0.2464	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.50

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	414.	18.5	50.0	0.12	48383.	90370.	-35751.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8124	-0.0836	0.9025	0.0117	0.0101	0.0203	0.0218

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.91	0.271	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6010	0.2464	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.44

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	463.	19.6	50.0	0.11	77012.	139495.	-50495.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8098	-0.0912	0.9711	0.0119	0.0096	0.0197	0.0215

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.91	0.271	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6010	0.2464	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	521.	20.8	50.0	0.10	125033.	219654.	-72480.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8083	-0.0998	1.0452	0.0120	0.0091	0.0189	0.0211

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.91	0.271	0.60	0.714	141.	7.25	16.77

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6010	0.2464	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	569.	21.7	50.0	0.09	178894.	306909.	-93313.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8069	-0.1066	1.1015	0.0121	0.0087	0.0184	0.0207

DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

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          V/SQRT(L)  FR.NO.   CB     CW   DISP/L   L/B     L/T
            0.93      0.277  0.60  0.714   154.    7.25   15.35

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.5930    0.2431     0.0139  -0.2130    0.043   -0.137   0.0290   0.0260  -0.53

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       402.    18.6    50.0    0.12   47354.    82499.  -31893.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100      *100     DISP-L  DISP-L     DISP-L     DISP-L
             -0.9549   -0.0956   0.8940    0.0118   0.0087     0.0197    0.0205


          V/SQRT(L)  FR.NO.   CB     CW   DISP/L   L/B     L/T
            0.93      0.277  0.60  0.714   154.    7.25   15.35

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.5930    0.2431     0.0139  -0.2130    0.038   -0.137   0.0290   0.0260  -0.47

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       450.    19.7    50.0    0.11   75387.   127470.  -44838.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100      *100     DISP-L  DISP-L     DISP-L     DISP-L
             -0.9521   -0.1046   0.9619    0.0120   0.0083     0.0191    0.0203


          V/SQRT(L)  FR.NO.   CB     CW   DISP/L   L/B     L/T
            0.93      0.277  0.60  0.714   154.    7.25   15.35

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.5930    0.2431     0.0139  -0.2130    0.035   -0.137   0.0290   0.0260  -0.44

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       506.    20.9    50.0    0.10  122359.   200814.  -64058.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100      *100     DISP-L  DISP-L     DISP-L     DISP-L
             -0.9506   -0.1147   1.0351    0.0121   0.0077     0.0184    0.0198
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DESIGN VARIATION OF DISP. LENGTH RATIO & L/T

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.93	0.277	0.60	0.714	154.	7.25	15.35

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5930	0.2431	0.0139	-0.2130	0.033	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	553.	21.9	50.0	0.09	175075.	280869.	-82266.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9491	-0.1229	1.0916	0.0122	0.0074	0.0179	0.0195

VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

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              V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
                0.90      0.268   0.60   0.714  128.    6.00   22.32

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.043   -0.137   0.0290   0.0260  -0.47

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       427.    18.6    50.0    0.12   49297.   126918.  -39871.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.2276   -0.0116    0.8967   0.0115    0.0182     0.0209     0.0297


              V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
                0.90      0.268   0.60   0.714  128.    6.00   22.32

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.038   -0.137   0.0290   0.0260  -0.41

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       478.    19.7    50.0    0.10   78499.   195510.  -56713.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.2250   -0.0134    0.9685   0.0117    0.0175     0.0202     0.0292


              V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
                0.90      0.268   0.60   0.714  128.    6.00   22.32

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.035   -0.137   0.0290   0.0260  -0.38

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       539.    20.9    50.0    0.09  127440.   307377.  -82158.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.2236   -0.0158    1.0471   0.0118    0.0167     0.0195     0.0285
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VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	6.00	22.32

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	428605.	-106311.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.2222	-0.0178	1.1060	0.0119	0.0161	0.0189	0.0280

VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

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            V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
              0.90      0.268   0.60   0.714  128.    6.63   20.20

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.043   -0.137   0.0290   0.0260  -0.47

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       427.    18.6    50.0    0.12   49297.   111577.  -40885.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100        *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.4658   -0.0431     0.9057   0.0115    0.0146     0.0211     0.0261


            V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
              0.90      0.268   0.60   0.714  128.    6.63   20.20

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.038   -0.137   0.0290   0.0260  -0.41

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       478.    19.7    50.0    0.10   78499.   171995.  -58142.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100        *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.4632   -0.0472     0.9765   0.0117    0.0140     0.0204     0.0257


            V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
              0.90      0.268   0.60   0.714  128.    6.63   20.20

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.035   -0.137   0.0290   0.0260  -0.38

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       539.    20.9    50.0    0.09  127440.   270497.  -84230.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100        *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.4618   -0.0522     1.0536   0.0118    0.0133     0.0197     0.0251
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VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	6.63	20.20

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	377392.	-109014.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4604	-0.0560	1.1113	0.0119	0.0128	0.0191	0.0247

VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	8.13	16.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	86637.	-39877.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9411	-0.1083	0.9216	0.0115	0.0087	0.0209	0.0203

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	8.13	16.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	133948.	-56422.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9385	-0.1170	0.9905	0.0117	0.0083	0.0202	0.0200

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	8.13	16.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	211121.	-81320.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9371	-0.1269	1.0651	0.0113	0.0078	0.0194	0.0196

VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	8.13	16.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	295220.	-104767.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9357	-0.1342	1.1207	0.0119	0.0074	0.0188	0.0193

VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	9.00	14.88

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	76763.	-38362.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-1.1773	-0.1421	0.9284	0.0115	0.0064	0.0205	0.0180

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	9.00	14.88

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	118964.	-54043.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-1.1747	-0.1528	0.9965	0.0117	0.0060	0.0198	0.0178

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	9.00	14.88

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	187861.	-77531.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-1.1733	-0.1650	1.0701	0.0118	0.0056	0.0190	0.0174

VARIATION OF LENGTH/BEAM & LENGTH/DRAFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	9.00	14.88

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I APT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACFMENT	LENGTH	SPFED	WAVF HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	263149.	-99457.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVF HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-1.1719	-0.1740	1.1246	0.0119	0.0053	0.0184	0.0172

DESIGN VARIATION OF SPEED LENGTH RATIO

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             V/SQRT(L)   FR.NO.    CB       CW    DISP/L    L/B      L/T
               0.75      0.223    0.60    0.714    128.     7.25    18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I APT    I FWD    LCG
0.7110    0.2915     0.0139  -0.2130    0.032   -0.137   0.0290   0.0260   0.01

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       427.    15.5    50.0    0.12   44826.    99887.  -37470.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L      DISP-L      DISP-L
             -0.4546   -0.0496    0.8923   0.0105    0.0129     0.0193     0.0234


             V/SQRT(L)   FR.NO.    CB       CW    DISP/L    L/B      L/T
               0.75      0.223    0.60    0.714    128.     7.25    18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I APT    I FWD    LCG
0.7110    0.2915     0.0139  -0.2130    0.029   -0.137   0.0290   0.0260   0.04

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       478.    16.4    50.0    0.10   71029.   153620.  -53480.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L      DISP-L      DISP-L
             -0.4535   -0.0539    0.9609   0.0106    0.0123     0.0186     0.0229


             V/SQRT(L)   FR.NO.    CB       CW    DISP/L    L/B      L/T
               0.75      0.223    0.60    0.714    128.     7.25    18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I APT    I FWD    LCG
0.7110    0.2915     0.0139  -0.2130    0.025   -0.137   0.0290   0.0260   0.09

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       539.    17.4    50.0    0.09  115877.   242346.  -76802.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L      DISP-L      DISP-L
             -0.4521   -0.0588    1.0366   0.0108    0.0117     0.0179     0.0225
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DESIGN VARIATION OF SPEED LENGTH RATIO

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.75	0.223	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.7110	0.2915	0.0139	-0.2130	0.023	-0.137	0.0290	0.0260	0.12

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	18.2	50.0	0.09	165560.	337943.	-99376.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.4513	-0.0626	1.0926	0.0108	0.0113	0.0173	0.0221

DESIGN VARIATION OF SPEED LENGTH RATIO

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.83	0.247	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6570	0.2694	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.25

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	17.2	50.0	0.12	47324.	100055.	-39007.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5661	-0.0607	0.9034	0.0111	0.0123	0.0202	0.0234

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.83	0.247	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6570	0.2694	0.0139	-0.2130	0.034	-0.137	0.0290	0.0260	-0.20

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	18.1	50.0	0.10	75178.	154139.	-55491.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5643	-0.0660	0.9727	0.0112	0.0118	0.0195	0.0230

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.83	0.247	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6570	0.2694	0.0139	-0.2130	0.030	-0.137	0.0290	0.0260	-0.16

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	19.3	50.0	0.09	122352.	242915.	-79907.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5628	-0.0721	1.0485	0.0114	0.0112	0.0188	0.0226

DESIGN VARIATION OF SPEED LENGTH RATIO

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.83	0.247	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6570	0.2694	0.0139	-0.2130	0.028	-0.137	0.0290	0.0260	-0.13

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	20.1	50.0	0.09	174957.	338976.	-103259.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.5618	-0.0766	1.1049	0.0114	0.0107	0.0182	0.0222

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                    DESIGN VARIATION OF SPEED LENGTH RATIO


             V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
               0.98     0.292   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.5570    0.2284     0.0139  -0.2130    0.050   -0.137   0.0290   0.0260  -0.73

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       427.    20.3   50.0    0.12    51644.    99023.  -43226.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.8139   -0.0847    0.9241   0.0121    0.0111     0.0222     0.0232


             V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
               0.98     0.292   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.5570    0.2284     0.0139  -0.2130    0.043   -0.137   0.0290   0.0260  -0.66

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       478.    21.4   50.0    0.10    82464.   153117.  -61243.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.8102   -0.0920    0.9946   0.0123    0.0106     0.0215     0.0229


             V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
               0.98     0.292   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.5570    0.2284     0.0139  -0.2130    0.041   -0.137   0.0290   0.0260  -0.64

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       539.    22.7   50.0    0.09   133430.   240465.  -89122.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/    WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.8091   -0.1005    1.0705   0.0124    0.0099     0.0207     0.0223
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DESIGN VARIATION OF SPEED LENGTH RATIO

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.98	0.292	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5570	0.2284	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.60

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	23.8	50.0	0.09	191100.	335998.	-115265.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.8072	-0.1068	1.1275	0.0125	0.0095	0.0200	0.0220

DESIGN VARIATION OF SPEED LENGTH RATIO

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
1.05	0.313	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5110	0.2095	0.0139	-0.2130	0.055	-0.137	0.0290	0.0260	-0.96

DISPLACEMENT	LENGTH	SPFED	WAVF HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	21.7	50.0	0.12	53486.	97918.	-45814.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9477	-0.0972	0.9337	0.0125	0.0104	0.0232	0.0229

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
1.05	0.313	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5110	0.2095	0.0139	-0.2130	0.048	-0.137	0.0290	0.0260	-0.87

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	23.0	50.0	0.10	85628.	151717.	-64845.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9427	-0.1056	1.0049	0.0128	0.0099	0.0225	0.0227

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
1.05	0.313	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5110	0.2095	0.0139	-0.2130	0.047	-0.137	0.0290	0.0260	-0.86

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	24.4	50.0	0.09	138090.	237690.	-95004.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9422	-0.1153	1.0806	0.0128	0.0092	0.0216	0.0221

DESIGN VARIATION OF SPEED LENGTH RATIO

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
1.05	0.313	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5110	0.2095	0.0139	-0.2130	0.044	-0.137	0.0290	0.0260	-0.82

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	25.5	50.0	0.09	197926.	332329.	-123069.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.9398	-0.1226	1.1378	0.0130	0.0088	0.0210	0.0217

DESIGN VARIATION OF MACHINERY LOCATION

V/SORT(L)	FR.NO.	CB	CW	DISF/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2707	-0.0074	-0.2440	0.043	-0.044	0.0290	0.0260	-1.37

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	67705.	116654.	-22022.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7140	-0.0714	0.9008	0.0158	0.0115	0.0210	0.0273

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2707	-0.0074	-0.2440	0.038	-0.044	0.0290	0.0260	-1.36

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	109011.	180929.	-25764.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7135	-0.0776	0.9591	0.0163	0.0107	0.0201	0.0270

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2707	-0.0074	-0.2440	0.035	-0.044	0.0290	0.0260	-1.35

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	178025.	285524.	-28943.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7132	-0.0847	1.0214	0.0165	0.0100	0.0192	0.0265

DESIGN VARIATION OF MACHINERY LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-ICG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2707	-0.0074	-0.2440	0.032	-0.044	0.0290	0.0260	-1.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	256178.	400111.	-26957.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7129	-0.0901	1.0670	0.0168	0.0094	0.0185	0.0262

DESIGN VARIATION OF MACHINERY LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0036	-0.2380	0.043	-0.091	0.0290	0.0260	-0.90

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	58675.	108381.	-31276.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6938	-0.0714	0.9072	0.0137	0.0116	0.0210	0.0254

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0036	-0.2380	0.038	-0.091	0.0290	0.0260	-0.86

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	94026.	167726.	-41654.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6922	-0.0776	0.9715	0.0140	0.0110	0.0203	0.0251

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0036	-0.2380	0.035	-0.091	0.0290	0.0260	-0.84

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	153167.	264400.	-56084.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6913	-0.0847	1.0409	0.0142	0.0103	0.0194	0.0245

DESIGN VARIATION OF MACHINERY LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0036	-0.2380	0.032	-0.091	0.0290	0.0260	-0.82

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	219889.	369937.	-67251.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6905	-0.0901	1.0923	0.0144	0.0098	0.0188	0.0242

DESIGN VARIATION OF MACHINERY LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6150	0.2552	0.0230	-0.1870	0.043	-0.185	0.0290	0.0260	-0.10

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	39556.	90547.	-50776.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6594	-0.0714	0.9180	0.0093	0.0119	0.0211	0.0212

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6150	0.2552	0.0230	-0.1870	0.038	-0.185	0.0290	0.0260	-0.02

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	62355.	139110.	-74876.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6557	-0.0776	0.9929	0.0093	0.0115	0.0205	0.0208

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6150	0.2552	0.0230	-0.1870	0.035	-0.185	0.0290	0.0260	0.03

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	100678.	218336.	-112504.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6537	-0.0847	1.0746	0.0093	0.0109	0.0198	0.0203

DESIGN VARIATION OF MACHINERY LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6150	0.2552	0.0230	-0.1870	0.032	-0.185	0.0290	0.0260	0.07

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	143323.	303937.	-150739.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6518	-0.0901	1.1360	0.0094	0.0105	0.0192	0.0199

DESIGN VARIATION OF MACHINERY LOCATION

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          V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
            0.90     0.268   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6270    0.2671     0.0279  -0.1660    0.043   -0.232   0.0290   0.0260   0.05

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       10000.       427.    18.6    50.0    0.12   30895.    82139.  -59513.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100       *100    DISP-L  DISP-L     DISP-L     DISP-L
             -0.6527   -0.0714    0.9202   0.0072   0.0120     0.0212    0.0192


          V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
            0.90     0.268   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6270    0.2671     0.0279  -0.1660    0.038   -0.232   0.0290   0.0260   0.16

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       14000.       478.    19.7    50.0    0.10   47924.   125334.  -89639.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100       *100    DISP-L  DISP-L     DISP-L     DISP-L
             -0.6479   -0.0776    0.9975   0.0072   0.0116     0.0205    0.0187


          V/SQRT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
            0.90     0.268   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6270    0.2671     0.0279  -0.1660    0.035   -0.232   0.0290   0.0260   0.22

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG   BM SAG
       20000.       539.    20.9    50.0    0.09   76691.   195781. -137368.

BM FACOTRS:  OWN WAVE  WAVE MN   WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/  BM HOG/
              *10**4    *100       *100    DISP-L  DISP-L     DISP-L     DISP-L
             -0.6453   -0.0847    1.0821   0.0071   0.0111     0.0199    0.0182
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DESIGN VARIATION OF MACHINERY LOCATION

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6270	0.2671	0.0279	-0.1660	0.032	-0.232	0.0290	0.0260	0.28

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	108237.	271292.	-187423.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6428	-0.0901	1.1461	0.0071	0.0107	0.0193	0.0178

VARIATION OF DEADWEIGHT LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0	-0.2130	0.043	-0.137	0.0290	0.0260	-1.32

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	31687.	80717.	-58063.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7119	-0.0714	0.9015	0.0074	0.0115	0.0210	0.0189

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0	-0.2130	0.038	-0.137	0.0290	0.0260	-1.26

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	50954.	123226.	-84000.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7093	-0.0776	0.9615	0.0076	0.0108	0.0202	0.0184

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0	-0.2130	0.035	-0.137	0.0290	0.0260	-1.23

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	83154.	191570.	-124374.

BM FACOTPS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7078	-0.0847	1.0262	0.0077	0.0101	0.0193	0.0178

VARIATION OF DEADWEIGHT LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0	-0.2130	0.032	-0.137	0.0290	0.0260	-1.19

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	119580.	265278.	-164712.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.7065	-0.0901	1.0743	0.0078	0.0095	0.0186	0.0174

VARIATION OF DEADWEIGHT LOCATION

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0092	-0.2130	0.043	-0.137	0.0290	0.0260	-0.76

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	43379.	93316.	-46641.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6876	-0.0714	0.9092	0.0101	0.0117	0.0211	0.0218

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	C.2505	0.0092	-0.2130	0.038	-0.137	0.0290	0.0260	-0.70

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	69241.	143545.	-66746.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6850	-0.0776	0.9758	0.0103	0.0111	0.0203	0.0214

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0092	-0.2130	0.035	-0.137	0.0290	0.0260	-0.66

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	112556.	225115.	-97508.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6836	-0.0847	1.0479	0.0105	0.0105	0.0195	0.0209

VARIATION OF DEADWEIGHT LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0092	-0.2130	0.032	-0.137	0.0290	0.0260	-0.63

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	161266.	313582.	-127360.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6822	-0.0901	1.1017	0.0106	0.0100	0.0189	0.0205

VARIATION OF DEADWEIGHT LOCATION

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0228	-0.2130	0.043	-0.137	0.0290	0.0260	0.07

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	60405.	111684.	-30012.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6517	-0.0714	0.9205	0.0141	0.0120	0.0212	0.0261

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0228	-0.2130	0.038	-0.137	0.0290	0.0260	0.13

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	95873.	173181.	-41639.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6491	-0.0776	0.9968	0.0143	0.0115	0.0205	0.0259

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0228	-0.2130	0.035	-0.137	0.0290	0.0260	0.17

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	155373.	274058.	-58437.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6477	-0.0847	1.0799	0.0144	0.0110	0.0199	0.0254

VARIATION OF DEADWEIGHT LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/I	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0228	-0.2130	0.032	-0.137	0.0290	0.0260	0.20

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	221974.	384073.	-73061.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6463	-0.0901	1.1421	0.0145	0.0106	0.0193	0.0251

VARIATION OF DEADWEIGHT LOCATION

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0271	-0.2130	0.043	-0.137	0.0290	0.0260	0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	65725.	117428.	-24818.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6404	-0.0714	0.9240	0.0154	0.0121	0.0212	0.0275

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0271	-0.2130	0.038	-0.137	0.0290	0.0260	0.40

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	104194.	182452.	-33801.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6378	-0.0776	1.0034	0.0156	0.0117	0.0206	0.0273

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0271	-0.2130	0.035	-0.137	0.0290	0.0260	0.43

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	168751.	289373.	-46244.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6364	-0.0847	1.0901	0.0157	0.0112	0.0200	0.0269

VARIATION OF DEADWEIGHT LOCATION

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0271	-0.2130	0.032	-0.137	0.0290	0.0260	0.46

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	240940.	406133.	-56121.

BM FACOTPS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6350	-0.0901	1.1549	0.0158	0.0108	0.0194	0.0266

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5760	0.2362	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.59

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	51495.	101698.	-38604.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6805	-0.0714	0.9114	0.0120	0.0117	0.0211	0.0238

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5760	0.2362	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.53

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	81945.	156846.	-54344.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6779	-0.0776	0.9799	0.0122	0.0112	0.0204	0.0234

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5760	0.2362	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.50

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	132990.	246766.	-77818.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6765	-0.0847	1.0543	0.0123	0.0106	0.0196	0.0229

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5760	0.2362	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	190250.	344509.	-99649.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6751	-0.0901	1.1097	0.0125	0.0101	0.0190	0.0225

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5940	0.2435	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.53

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	50316.	100621.	-39813.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6778	-0.0714	0.9123	0.0118	0.0118	0.0211	0.0235

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5940	0.2435	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	80097.	155224.	-56308.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0776	0.9815	0.0120	0.0112	0.0204	0.0232

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5940	0.2435	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.44

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	130013.	244252.	-81078.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6737	-0.0847	1.0567	0.0121	0.0106	0.0196	0.0227

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.5940	0.2435	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.40

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	186023.	341022.	-104360.

BM PACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6724	-0.0901	1.1128	0.0122	0.0101	0.0190	0.0223

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6290	0.2579	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	48206.	98708.	-41981.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6725	-0.0714	0.9139	0.0113	0.0118	0.0211	0.0231

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6290	0.2579	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.35

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	76787.	152357.	-59842.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6699	-0.0776	0.9846	0.0115	0.0113	0.0204	0.0228

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6290	0.2579	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.31

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	124684.	239824.	-86957.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6685	-0.0847	1.0614	0.0116	0.0107	0.0197	0.0223

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6290	0.2579	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.28

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	178456.	334893.	-112870.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6671	-0.0901	1.1187	0.0117	0.0102	0.0191	0.0219

VARIATION OF DEADWEIGHT/DISPLACEMENT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6460	0.2649	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.35

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	47185.	97782.	-43031.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6699	-0.0714	0.9147	0.0110	0.0118	0.0211	0.0229

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6460	0.2649	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.29

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	75184.	150968.	-61554.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6673	-0.0776	0.9861	0.0112	0.0113	0.0204	0.0226

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6460	0.2649	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.25

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	122103.	237680.	-89806.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6659	-0.0847	1.0637	0.0113	0.0107	0.0197	0.0221

VARIATION OF DEADWEIGHT/DISPLACEMFNT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6460	0.2649	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.22

DISPLACEMENT	LENGTH	SPEED	WAVF HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	174791.	331927.	-116992.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6645	-0.0901	1.1216	0.0114	0.0103	0.0191	0.0217

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	C.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2261	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	27083.	77484.	-63074.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9131	0.0063	0.0118	0.0211	0.0181

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2261	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	43708.	119050.	-92806.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9830	0.0065	0.0113	0.0204	0.0178

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2261	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	71464.	186140.	-139894.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0590	0.0066	0.0106	0.0196	0.0173

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2261	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	102951.	258649.	-187890.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.1157	0.0067	0.0102	0.0190	0.0169

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2383	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	38190.	88591.	-51967.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9131	0.0089	0.0118	0.0211	0.0207

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2383	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	61103.	136446.	-75410.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9830	0.0091	0.0113	0.0204	0.0204

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2383	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	99452.	214128.	-111907.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0590	0.0092	0.0106	0.0196	0.0199

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2383	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	142660.	298358.	-148181.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.1157	0.0093	0.0102	0.0190	0.0195

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2627	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	60405.	110805.	-29753.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9131	0.0141	0.0118	0.0211	0.0259

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2627	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	95894.	171237.	-40619.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9830	0.0143	0.0113	0.0204	0.0256

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2627	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	155427.	270104.	-55931.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0590	0.0144	0.0106	0.0196	0.0251

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I APT	I FWD	LCG
0.6110	0.2627	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	222079.	377776.	-68762.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.1157	0.0145	0.0102	0.0190	0.0247

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2750	0.0139	-0.2130	0.043	-0.137	0.0290	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	71603.	122004.	-18554.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9131	0.0168	0.0118	0.0211	0.0285

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2750	0.0139	-0.2130	0.038	-0.137	0.0290	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	113432.	188775.	-23081.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9830	0.0169	0.0113	0.0204	0.0282

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2750	0.0139	-0.2130	0.035	-0.137	0.0290	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	183645.	298321.	-27714.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0590	0.0171	0.0106	0.0196	0.0277

VARIATION OF FRACTION OF DEADWEIGHT AFT

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2750	0.0139	-0.2130	0.032	-0.137	0.0290	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	262113.	417810.	-28728.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.1157	0.0172	0.0102	0.0190	0.0273

VARIATION OF AFT MOMENT OF INERTIA

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             V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
               0.90     0.268   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.043   -0.137   0.0185   0.0260  -0.47

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG    BM SAG
       10000.       427.    18.6    50.0    0.12   49297.   103046.  -44208.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.6752   -0.0714    0.9566   0.0115   0.0126     0.0219     0.0241


             V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
               0.90     0.268   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.038   -0.137   0.0185   0.0260  -0.41

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG    BM SAG
       14000.       478.    19.7    50.0    0.10   78499.   154750.  -58924.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.6726   -0.0776    0.9914   0.0117   0.0114     0.0205     0.0231


             V/SORT(L)  FR.NO.   CB      CW   DISP/L   L/B     L/T
               0.90     0.268   0.60   0.714   128.    7.25   18.47

DWT/DISP  DWTA/DISP  DWT-LCG  DWTA-LCG  W2/DISP  W2-LCG   I AFT    I FWD    LCG
0.6110    0.2505     0.0139  -0.2130    0.035   -0.137   0.0185   0.0260  -0.38

     DISPLACEMENT  LENGTH  SPEED  WAVE HT. HS/L    SWBM     BM HOG    BM SAG
       20000.       539.    20.9    50.0    0.09  127440.   237220.  -79023.

BM FACOTRS:  OWN WAVE  WAVE MN    WAVE HT.  SWBM/   WVBM HOG/  WVBM SAG/   BM HOG/
              *10**4    *100       *100    DISP-L   DISP-L     DISP-L      DISP-L
             -0.6712   -0.0847    1.0272   0.0118   0.0102     0.0192     0.0220
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VARIATION OF AFT MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0185	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	325541.	-95946.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.0531	0.0119	0.0094	0.0182	0.0213

VARIATION OF AFT MOMENT OF INERTIA

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0227	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	101707.	-42869.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9392	0.0115	0.0123	0.0216	0.0238

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0227	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	154386.	-58560.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9881	0.0117	0.0113	0.0205	0.0231

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0227	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	239179.	-80981.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0399	0.0118	0.0104	0.0194	0.0222

VARIATION OF AFT MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0227	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	330551.	-100956.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.0781	0.0119	0.0097	0.0185	0.0216

VARIATION OF AFT MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0311	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	99028.	-40190.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.9044	0.0115	0.0116	0.0209	0.0232

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0311	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	153659.	-57833.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9813	0.0117	0.0112	0.0204	0.0230

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0311	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	243095.	-84898.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0653	0.0118	0.0107	0.0197	0.0226

VARIATION OF APT MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I APT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0227	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	330551.	-100956.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.0781	0.0119	0.0097	0.0185	0.0216

VARIATION OF AFT MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0353	0.0260	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	97689.	-38851.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.8870	0.0115	0.0113	0.0206	0.0229

V/SQRT(L)	FR.NO.	CB	CW	DISP/I	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0353	0.0260	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	153296.	-57469.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.9780	0.0117	0.0112	0.0203	0.0229

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0353	0.0260	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	245054.	-86856.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.0780	0.0118	0.0109	0.0199	0.0228

VARIATION OF AFT MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0353	0.0260	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	345582.	-115987.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.1532	0.0119	0.0107	0.0195	0.0226

VARIATION OF FWD MOMENT OF INERTIA

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0211	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	115485.	-56647.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	1.1182	0.0115	0.0155	0.0248	0.0270

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0211	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	178502.	-82675.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	1.2119	0.0117	0.0149	0.0241	0.0267

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0211	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	281286.	-123089.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.3134	0.0118	0.0143	0.0233	0.0261

VARIATION OF FWD MOMENT OF INERTIA

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0211	-0.34

DISPLACEMENT	LENGTH	SPFED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	392724.	-163129.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.3888	0.0119	0.0138	0.0226	0.0257

VARIATION OF FWD MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0233	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	108397.	-49559.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	1.0261	0.0115	0.0138	0.0231	0.0254

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0233	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	167430.	-71603.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	1.1091	0.0117	0.0133	0.0224	0.0250

V/SORT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0233	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	263700.	-105502.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	1.1992	0.0118	0.0127	0.0216	0.0245

VARIATION OF FWD MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0233	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	368184.	-138589.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.2662	0.0119	0.0122	0.0210	0.0241

VARIATION OF FWD MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0278	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	93899.	-35060.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.8377	0.0115	0.0104	0.0197	0.0220

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0278	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	144782.	-48956.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.8989	0.0117	0.0099	0.0190	0.0216

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.035	-0.137	0.0290	0.0278	-0.38

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
20000.	539.	20.9	50.0	0.09	127440.	227727.	-69530.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6712	-0.0847	0.9655	0.0118	0.0093	0.0183	0.0211

VARIATION OF FWD MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.032	-0.137	0.0290	0.0278	-0.34

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
26000.	588.	21.8	50.0	0.09	182369.	317989.	-88393.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6698	-0.0901	1.0153	0.0119	0.0089	0.0177	0.0208

VARIATION OF FWD MOMENT OF INERTIA

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.043	-0.137	0.0290	0.0300	-0.47

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
10000.	427.	18.6	50.0	0.12	49297.	86811.	-27972.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6752	-0.0714	0.7456	0.0115	0.0088	0.0181	0.0203

V/SQRT(L)	FR.NO.	CB	CW	DISP/L	L/B	L/T
0.90	0.268	0.60	0.714	128.	7.25	18.47

DWT/DISP	DWTA/DISP	DWT-LCG	DWTA-LCG	W2/DISP	W2-LCG	I AFT	I FWD	LCG
0.6110	0.2505	0.0139	-0.2130	0.038	-0.137	0.0290	0.0300	-0.41

DISPLACEMENT	LENGTH	SPEED	WAVE HT.	HS/L	SWBM	BM HOG	BM SAG
14000.	478.	19.7	50.0	0.10	78499.	133710.	-37884.

BM FACOTRS:	OWN WAVE *10**4	WAVE MN *100	WAVE HT. *100	SWBM/ DISP-L	WVBM HOG/ DISP-L	WVBM SAG/ DISP-L	BM HOG/ DISP-L
	-0.6726	-0.0776	0.7962	0.0117	0.0082	0.0174	0.0200

Thesis
R88
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171195
The effect of hull form and weight distribution on structural loading.