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THESIS

AN INVESTIGATION INTO THE DAMAGED STABILITY OF A TUMBLEHOME HULL WARSHIP DESIGN

by

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September, 1997

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AN INVESTIGATION INTO THE DAMAGED STABILITY OF A TUMBLEHOME HULL WARSHIP DESIGN

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Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

The objective of this study is to investigate the hydrostatic and damaged stability of a tumblehome hull form by comparing the tumblehome form with one of similar displacement and geometric properties in a wallsided hull form. The data for the comparison is generated by modeling the hull forms in a computer modeling program designed by Creative Systems Incorporated titled General HydroStatics. The objective was achieved by conducting research and computer modeling in 3 parts. 1) Model Development, 2) Intact stability analysis and 3) Damaged stability analysis. This thesis demonstrates both the intact stability and damaged stability problems that will be encountered if the tumblehome hull design is used on a modern warship, as well as the benefits from using an innovative and modern tumblehome hull design.

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I. INTRODUCTION

A. BACKGROUND

The overall purpose of this thesis is to compare two monohulls, wallsided and tumblehome, both with similar dimensions and displacement. The comparison objective is to quantify the stability penalty of using a tumblehome hull form in a modern warship application.

Ship design, since the beginning of time, has evolved a variety of hull forms. For the past 100 years, 3 single (monohull) forms have been used in ship design. These hulls get their name from their appearance from the waterline to the bulkhead deck. They are flared, wallsided, and tumblehome hulls. The body plans of these hull forms are represented in Figure 1. While three general forms of the monohull exist, this thesis will only use the wallsided hull and tumblehome hull to satisfy the objective.

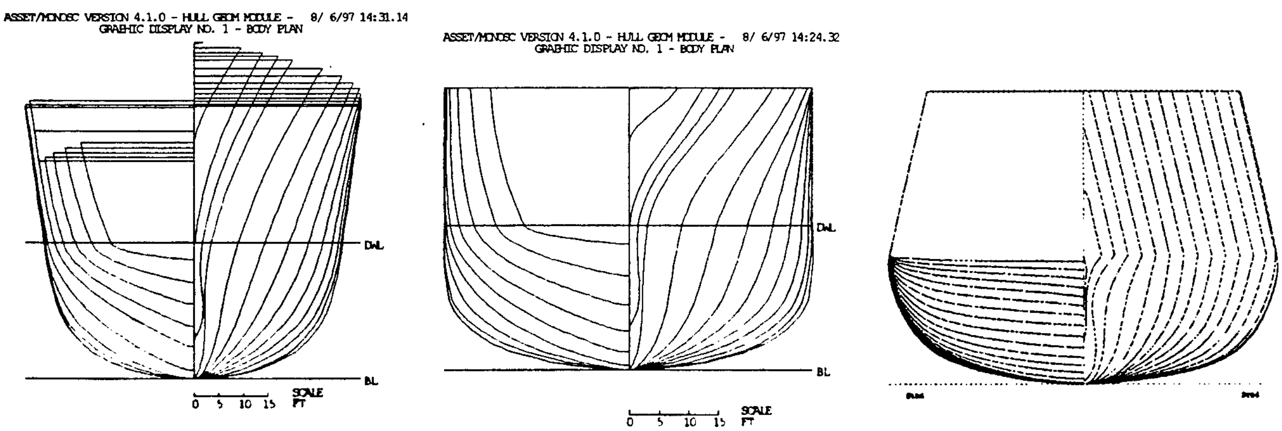


Figure 1. Monohull Body Plans

Due to the geometric shape of tumblehome, its hydrostatic properties are a great concern to the naval architect as well as the operator. The wallsided hull and tumblehome hull were used extensively as a combatant hull forms during the turn of the century. The war record of the tumblehome hull following that period in time was considered extremely poor. During battle and consequently after damage, some tumblehome ships sank very quickly resulting in massive loss of life. For this reason the tumblehome hull form was dropped from the design alternatives list of that period. Recent studies [Ref. 1] of turn of the century tumblehome warships have shown that there may have been other design variables that amplified the rapid sinking and poor combat record of these hull forms, in addition to the hull shape itself. These other design variables were; transverse watertight bulkhead placement, the use of longitudinal watertight bulkheads and low transverse metacentric height.

The location and number of transverse watertight bulkheads is important in that it can determine the degree of flooding containment that can be achieved after damage. Additionally, a consideration for the number of transverse bulkheads is the added weight these bulkheads represent to the vessel's total displacement prior to damage. With a greater knowledge of naval architecture in today's ship design, the number and location of transverse bulkheads within a vessel can be optimized to reduce the rapid deterioration of the vessel's overall stability caused by progressive flooding.

It is apparent from these studies that the greatest design flaw of these early tumblehome warships may have been the use of longitudinal bulkheads along or near the vessel's centerline. After damage along or below the waterline, asymmetric flooding occurred off the centerline on the damaged side. This flooding caused large heeling moments about the centerline and, therefore, is suspected as the cause for rapid capsizing of the vessels. This rapid capsizing is why the sunken vessels had such a high loss of life.

For background concerning the low metacentric heights for these vessels, an understanding of the weapon systems and topside cargo handling gear is required. Early design of this equipment required that most of the weaponry and cargo handling gear that made these combatants effective war-fighters had to be placed on or above the bulkhead deck. This topside equipment and weaponry raised the vessels' center of gravity (CG). The rise in the center of gravity lowered the metacentric height (GM), hence reducing the vessels' stability outright [Ref. 1]. Today's combatants, free of these heavy and high weights, have considerably improved metacentric heights. Primarily, the use of vertical launch missile systems and sonar suites have raised the stability indicator of GM considerably, by lowering CG.

The Tumblehome hull could be found on many of the world's combatants during the turn of the century.

> [Ref. 1] "The advantage of tumblehome, for turn of the century warships, was that it allowed heavy guns to be mounted in turrets (sic. casemates) on each side amidships, where the ship's motions were less than at the ends of the ship, yet still able to fire forward or aft."

Additionally, [Ref. 1] states,

> "It (tumblehome) allowed the ship to have high freeboard at the ends of the ship without the increase in center of gravity of the ship if the hull had been carried to that level with the same beam as at the waterline. The high freeboard prevented sea spray or green water from interfering with the armament that was mounted on the ship centerline. A tumblehome hull also naturally formed a good ram bow that was less likely to be entangled in the rammed enemy ship."

The modern tumblehome warship does not look toward these advantages for its effectiveness in the Navy's future fleet. Instead of side turrets, casemates and a ramming bow in the warship designs of the future, the benefit of the modern tumblehome is its greatly reduced radar cross-section (RCS). Because of the hull's shape above the waterline, its apparent size to a high speed cruise missile skimming parallel to the ocean's surface is greatly reduced. The lack of radar return from enemy missiles makes the tumblehome hull a potentially attractive way to create a truly "stealth" ship using a monohull form.

With each naval architecture advancement over the past 100 years, but especially, the advancements in survivability and susceptibility through reduced radar cross section, it is time to reconsider the tumblehome design as an exciting choice that through evolution, has come of age. This thesis will do just that.

B. DESCRIPTION OF WALLSIDED HULL

The wallsided hull has long been a tried and true ship design. A current program within the U.S. Navy, Surface Combatant for the Twenty First Century (SC-21), was key in recently identifying that a destroyer class hull would be required to replace aging ships and form a part of the navy's future fleet of surface combatants[Ref. 5]. Therefore, the general hull form for the research contained in this thesis was based on the Arliegh Burke Destroyer (DDG-51).

The length between perpendiculars, maximum beam and approximate displacement of the DDG-51 was used to envelop the basic hull forms of both the wallsided and tumblehome hulls for this thesis. The major modifications to the original DDG-51 hull form for this research were made from the waterline up to the bulkhead deck. The modified DDG-51's vertical sides offer a reasonable range of stability throughout operational conditions. The vertical sides of the wallsided hull do not result in an intrinsic increase or decrease in stability as weight is added. This is not the case for the tumblehome or flare hulls, as will be discussed later. In addition to the reasonable range of stability, because of advancements made in the area of compartmentation and modularization the vertical walls of the hull allow the designer and operator to maximize the usable space within the vessel. Table 1 shows the vessel's dimensions and figures as modeled.

Length Between Perpendiculars	476.0 feet
Beam	61.1 feet
Hull Depth	35.7 feet
Design Waterline (DWL)	18.2 feet
Longitudinal Center of Gravity	241 feet
Vertical Center of Gravity	19.63 feet
Design Displacement	8348 long tons

Table 1. Wallsided Hull Dimensions

The determination of the wallsided hull's shape comes from the evaluation of its form coefficients. Three useful coefficients that can be used to describe the hull are: block coefficient, midship section coefficient, and vertical prismatic coefficient. The value of the block coefficient for the wallsided hull is approximately 0.55. This number in comparison to many destroyer class hulls is large, indicating the hull may not perform as well as most destroyers at high speeds. The midship section identifies the fullness of the hull at amidships only. A low value of the midship section coefficient indicates a high rise of floor and a rounded bilge. The model's midship section coefficient is approximately 0.875. This is an average value for destroyer class hulls. Finally, one of the key indicators for this wallsided hull model is the vertical prismatic coefficient. A low value is indicative of V-sections along the hull. The hull as modeled has a vertical prismatic coefficient of

.693, which is typical of a navy destroyer [Ref.4]. A list of these and other relative hull coefficients and ratios is shown in Table 2.

Block Coefficient	0.55
Midship Section Coefficient	0.875
Vertical Prismatic Coefficient	0.693
Longitudinal Prismatic Coefficient	0.629
Waterplane Coefficient	0.789
Displacement to Length Ratio	77.4
Length to Volume Ratio	7.18

Table 2. Wallsided Hull Coefficients

C. DESCRIPTION OF TUMBLEHOME HULL

It was a goal for this comparison to maintain as many as possible of the key dimensions of the tumblehome hull close to those of the wallsided hull. On the outset of this thesis, the primary hull form variables to be held constant between both vessels in the order of their importance were;

1. displacement
2. reserve buoyancy
3. length between perpendiculars
4. maximum beam
5. margin line location
6. compartment permeability

Most importantly from this list are displacement and reserve buoyancy. Equivalent displacements can be representative of similar size and draft of a vessels. Reserve buoyancy is the volume of the watertight hull above the design waterline, converted to the weight of an equal volume of water. It is a measure of a ship's ability to survive flooding. Reference 1 states:

> A tumblehome ship has much less reserve buoyancy in total than a wallsided ship and is especially deficient in the ends of the ship. Having less reserve buoyancy per unit of sinkage than a wallsided ship, it has to sink to a greater draft than a wallsided ship to compensate for the buoyancy lost to damage.

This statement reiterates the importance of maintaining the initial reserve buoyancy between the two compared models. Table 3 shows the tumblehome vessel's dimensions and characteristics as modeled.

Length Between Perpendiculars	475.72 feet
Beam	61.3 feet
Hull Depth	39.3 feet
Design Waterline (DWL)	18.2 feet
Longitudinal Center of Gravity	246 feet
Vertical Center of Gravity	21.6 feet
Design Displacement	8402.86 long tons

Table 3. Tumblehome Hull Dimensions

The tumblehome hull form coefficients are very similar in all respects to the wallsided model. Because hull form coefficients are used extensively by naval architects during the early stages of ship design, Table 4 incorporates an additional column to compare the ratios of the wallsided comparison hull to the tumblehome hull's coefficients. This is important in that it demonstrates that the two hulls are, in fact, comparable.

Coefficient	value	wallside/tumblehome
Block Coefficient	0.554	99.28%
Midship Section Coefficient	0.846	103.4%
Vertical Prismatic Coefficient	0.677	102.2%
Longitudinal Prismatic Coefficient	0.655	96.0%
Waterplane Coefficient	0.846	96.0%
Displacement to Length Ratio	78.1	99.1%
Length to Volume Ratio	7.16	100.3%

Table 4. Tumblehome Hull Coefficients

The degree of tumblehome used for the model was approximately 15 degrees and is kept constant throughout the length of the model This value of the inward slope of the tumblehome hull was based on open literature and is in the correct range to get a reasonable reduction in radar cross section. This value was provided by Mr. James Webster, the author of [Ref. 1].

D. SCOPE OF RESEARCH

This thesis compares the overall intact and damaged stability of the tumblehome hull form to the wallsided hull form under static conditions. This is done by using an advanced computer modeling program called General HydroStatics (GHS) developed by Creative System Incorporated [Ref. 2]. The software is used to solve for stability under certain intact and damaged conditions that will be demonstrated in Chapter III.

II. MODEL DEVELOPMENT

A. WALLSIDED HULL

The wallsided hull model for this comparison thesis was originally created by the author using a ship synthesis module within the program Advanced Surface Ship Evaluation Tool / Monohull Surface Combatant (ASSET/MONOSC) program. The HULGEN MODULE within ASSET/MONOSC created the offsets that would eventually be entered into the Model Converter Module (MC) program within GHS as the wallsided hull. The model's overall dimensions were closely based upon the Arleigh Burke Destroyer DDG-51. The DDG-51 model, as built, is available in the ASSET/MONOSC data bank.

Once the Arleigh Burke class was selected, it was altered within the HULGEN module. The alterations made to the parent ship within ASSET/MONOSC created a slightly longer and, more importantly, a vertical, wallsided DDG-51. The sheer in the bulkhead deck was removed as well as the camber. This was done to more closely resemble what will be a "stealth" tumblehome hull.

After the hull offsets were completed in HULGEN they were exported to GHS and the format of the file was converted to a readable format in the Model Converter (MC) module within GHS. After the hull was read into GHS, all geometric properties were compared between the ships.

After the hull form was finalized attention was turned to how to optimize the transverse bulkhead spacing to ensure that the stability criteria would meet the navy's standards outlined in [Ref. 5]. The determination of the bulkhead spacing was time consuming, but does meet standards set out in [Ref. 5].

In accordance with [Ref. 4] the standard permeabilities were set in each compartment. These permeabilities of a "typical" vessel are suggested to be:

Cargo & stores	0.6
Accommodations & voids	0.95
Machinery spaces	0.85

A list of compartment locations and permeabilities is shown in Table 5.

COMPARTMENT	LOCATION	VOLUME	PERMEABLITY
FOREPEAK.C	28.25f to 10a	4401.1	.95
COMP_A.C	10a to 35a	12166.3	.95
COMP_B.C	35a to 75a	37198.6	.95
COMP_C.C	75a to 110a	46755.8	.95
COMP_CB.C	110a to 150a	40826.1	.60
COMP_DA.C	150a to 185a	39752.0	.60
COMP_E.C	185a to 225a	76040.7	.95
COMP_F.C	225a to 310a	145827.0	.85
COMP_G.C	310a to 350a	63764.0	.85
COMP_H.C	350a to 382a	51649.2	.95
COMP_I.C	382a to 425a	58719.9	.95
COMP_J.C	425a to 476a	44461.8	.85

Table 5. Wallsided Hull Compartments and Permeabilities

The wallsided hull form as modeled for this thesis is shown in Figure 2.

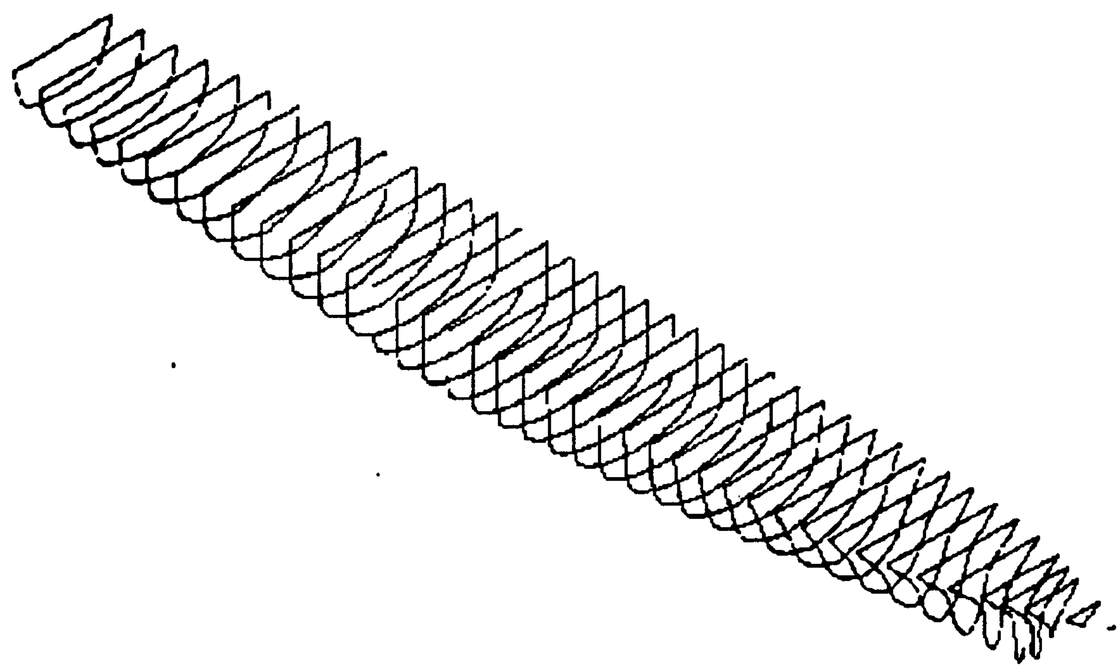


Figure 2. Wallsided Hull Isometric View

B. TUMBLEHOME HULL

The tumblehome model used for this study was created by Naval Sea Systems Command (NAVSEA) naval architects for use in the study listed in [Ref. 1]. The original offsets were created using a ship computer simulator known as Fast Ship and then converted into an exportable output file format known as Ship Hull Characteristics Program (SHCP). These offsets were then entered into GHS and converted into a readable format using MC similar to the process used for the wallsided hull model.

After the model was properly read into GHS, alterations were made to the wave piercing bow in the SE module. These alterations corrected the overall hull length to match the length between perpendiculars of the wallsided hull.

Again, bulkhead spacing was arrived at and entered in the model, in accordance with [Ref. 4], permeabilities were set in each compartment to reflect the permeabilities of a "typical" vessel. A list of compartment locations and permeabilities is shown in Table 6.

COMPARTMENT	LOCATION	VOLUME	PERMEABLITY
FOREPEAK.C	0 to 35a	3815.5	.95
COMP_A.C	35a to72a	19877.4	.95
COMP_B.C	72a to 94	20387.2	.95
COMP_C.C	94a to 122a	34687.2	.95
COMP_CB.C	122a to 144a	21669.4	.60
COMP_DA.C	144a to 166a	25485.1	.60
COMP_E.C	166a to 194a	55511.6	.95
COMP_F.C	194a to 216a	43885.8	.95
COMP_G.C	216a to 288a	128126.0	.85
COMP_H.C	288a to 360a	123405.0	.85
COMP_I.C	360a to 432a	114283.0	.95
COMP_J.C	432a to 475.72a	50104.9	.85

Table 6. Tumblehome Hull Compartments and Permeabilities

The tumblehome hull form as modeled for this thesis is displayed in Figure 3.

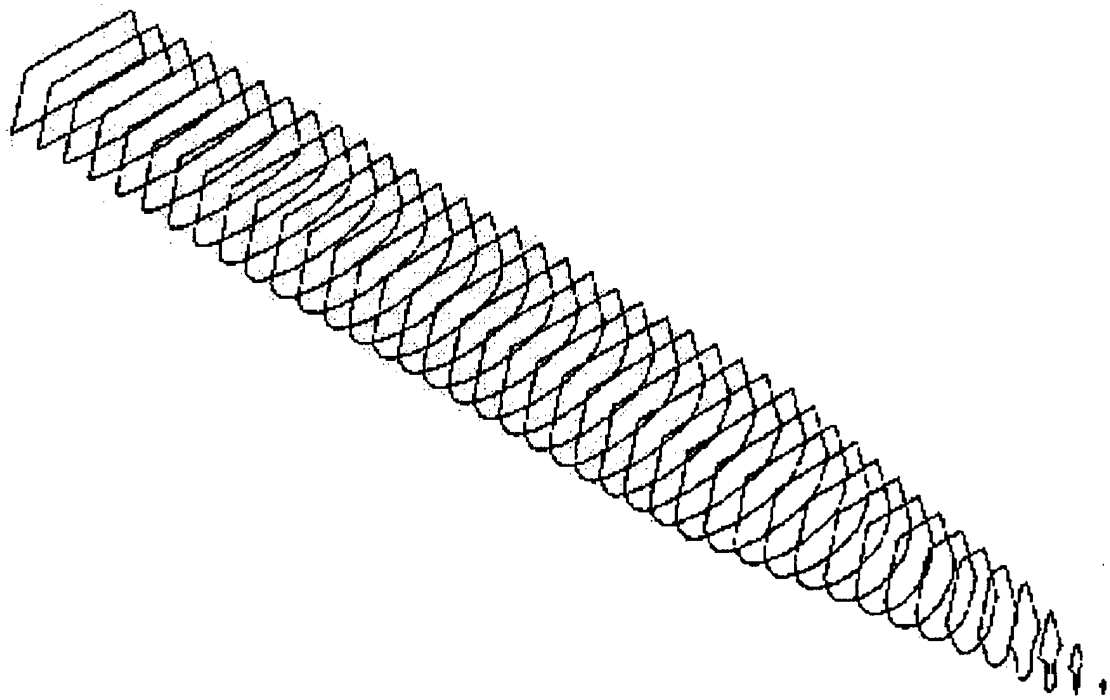


Figure 3. Tumblehome Hull Isometric View

III. INTACT STABILITY

A. WALLSIDED HULL INTACT STABILITY

The wallsided hull was analyzed using data generated by the main GHS program. This data was in the form of a righting arm curve, freeboard status, waterplane area data and transverse metacentric height. These key static stability indicators were generated by reading the model at design conditions listed in Table 1. For each ship, wallsided and tumblehome, this same data was calculated under various conditions. This section will review the results of these computer simulation calculations for the intact ships. Figure 4 is the righting arm curve of the vessel under intact stability conditions.

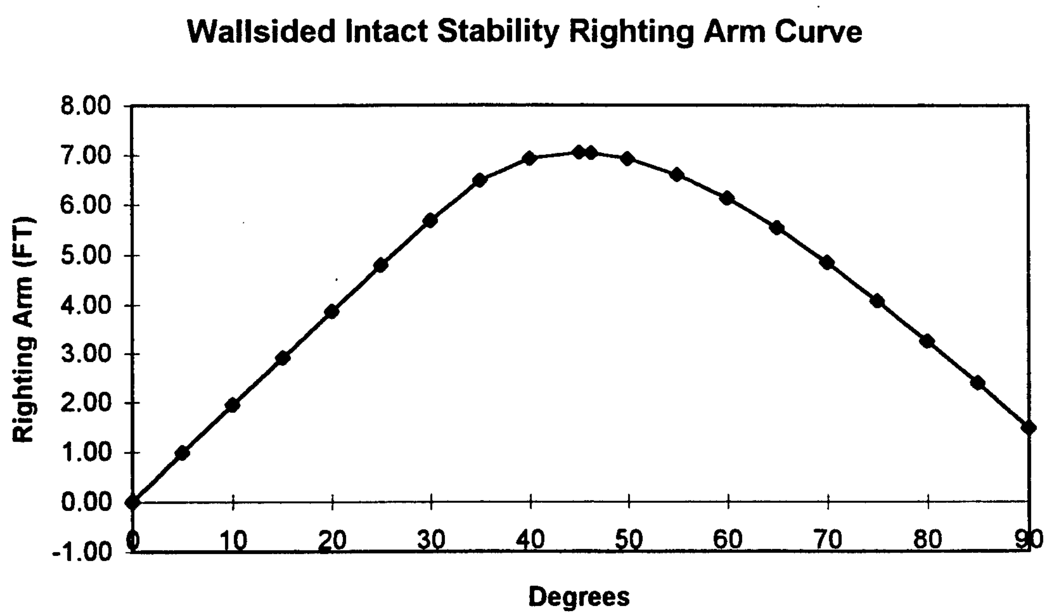


Figure 4. Wallsided Righting Arm Curve (intact)

It can bee seen in this Figure that the righting arm, or distance between the line of force of buoyancy and weight, GZ, remains positive through 90 degrees of inclination. The maximum righting arm occurs at approximately 45 degrees of inclination and has a value of 7.047 feet. This value will become important when comparing the ships. For now, it is noted as being a relatively higher value than the original flared hull DDG-51 with a value of 5.74 feet. This, of course, is affected by the assumed location of the CG that is entered into GHS. A resonable value for the height of CG on Naval combatants is

55 percent of the hull depth and that value was used in this thesis. The actual location of the DDG-51's CG may differ. The GHS data generated for the intact stability analysis is available in appendix (a). Not shown in the figure, but calculated from the data used to create Figure 2, is the value of GM. Metacentric height, as well as many key stability indicators are shown in Table 7.

Waterplane Area at DWL	23186 feet^2
Longitudinal Center of Flotation	262.67 feet
Total Hull Volume	753941 feet^3
Reserve Buoyancy at DWL	454279.5 feet^3
Transverse Metacentric Height (GM)	11.25 feet
Maximum Righting Arm (GZ)	7.047 feet
Least Freeboard	17.5 feet

Table 7. Wallsided Hull Intact Stability Data

The waterplane area is calculated by GHS using the trapezoidal rule. The value of the waterplane area for both models is particularly important due to its relationship to the waterplane moment of inertia as the ship's draft changes in each of the damaged stability scenarios reviewed in Chapter IV. In the intact stability case, the waterplane area is used to calculate the waterplane area's moment of inertia. The waterplane area's moment of inertia, when divided by the ship's displacement volume will give the distance from the transverse center of buoyancy (B) to the metacenter (M), also known as the transverse metacentric radius (BM). This value along with the height of CG from the keel (KG) and the height of the center of buoyancy (KB) can be used to determine the vessel's metacentric height (GM) using the equation:

$$KB+BM-KG=GM$$

With the model floating on an even keel and zero trim, the least freeboard in Table 7 shows the height from the design waterline (DWL) to the bulkhead deck. Originally, the depth of hull was altered in the GHS Section Editor in order to bring the reserve buoyancy values closer together. It is important to note at this point that the intact stability values of reserve buoyancy for the two models are of central interest. A vessel's reserve buoyancy is a significant indicator of its inherent survivability. Without equivalent quantities of reserve buoyancy prior to damage, the comparison of these two hull forms would not be relevant, as they would not have similar reactions to damage in the form of flooding. This will be discussed further in the floodable length section of the following chapter. Additionally, the total hull volumes were also checked closely before attempting any calculations for similar reasons and found to be equivalent.

B. TUMBLEHOME HULL INTACT STABILITY

As in the case of the wallsided hull, the tumblehome hull was analyzed using the data generated by the main GHS program. This data was generated for the model at design conditions shown in Table 3. These calculations provided stability conditions for which the tumblehome was compared to the wallsided baseline.

Figure 5 shows the righting arm curve of the tumblehome hull under those design conditions listed in Table 3.

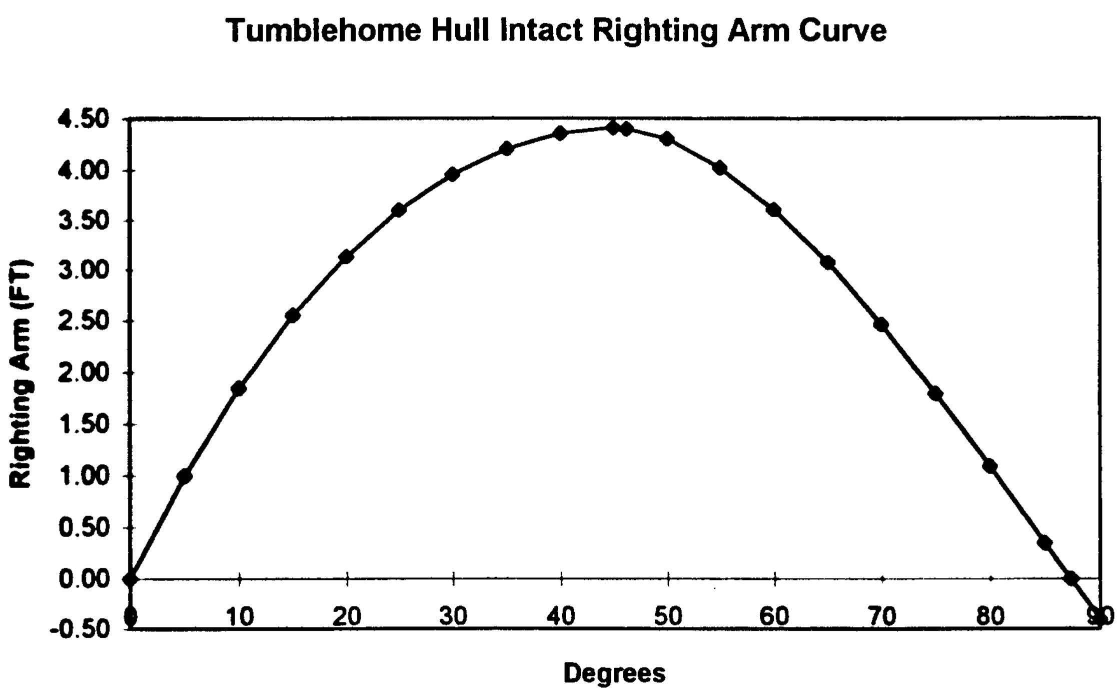


Figure 5. Tumblehome Righting Arm Curve (intact)

The maximum righting arm for the tumblehome hull occurs again at 45 degrees with the value of the righting arm, GZ, at 4.411 feet. While the value of the maximum righting arm is over 2.5 feet less than the wallsided ship, it is only 1.33 feet less than the original DDG-51 at 5.74 feet. The actual value of any ship's righting arm, GZ is considered most important prior to damage. The righting arm curve is especially valuable to ship's operators and naval architects to obtain a general idea of how the vessel will react to damage. It is a fact that the area under the righting arm curve is indicative of the amount of work required to heel the ship to the angle specified. In Figure 5, it can be seen that the area under the curve from zero to 87.3 degrees is the amount of work required to capsize the model. This area is considerably less than the area under the curve in Figure 4 (i.e. work to capsize the wallsided model).

The value of the transverse metacentric height for the tumblehome hull is slightly greater than the wallsided hull. This was not expected and was, therefore analyzed closely to understand this suspected discrepancy. The slope of the righting arm curve for small angles of heel is greater than forthe wallsided hull. The constant beam aft of the wave-piercing bow's apex on the tumblehome hull creates a greater resistance to heel at small angles. Remembering that GM is an indicator of initial stability at small angles, this is the suspected cause for the higher intact stability indicator of GM. These stability indicators, as well as, others are shown in Table 8.

Waterplane Area at DWL	23853 feet^2
Longitudinal Center of Flotation	276 feet
Total Hull Volume	760154 feet^3
Reserve Buoyancy at DWL	458517 feet^3
Transverse Metacentric Height (GM)	11.48 feet
Maximum Righting Arm (GZ)	4.411 feet
Least Freeboard	21.1 feet

Table 8. Tumblehome Hull Intact Stability Data

It is also noted in the table that the longitudinal center of gravity (LCG) is located further aft on the tumblehome hull than on the wallsided hull even though the lengths between perpendiculars are approximately equal. The location is understood when observing the decrease in hull volume in the wave piercing bow of the tumblehome hull.

IV DAMAGED STABILITY

A. WALLSIDED FLOODABLE LENGTH CURVE

A vessel's floodable length is very important when analyzing the basic hull form's resistance to damage. The floodable length of the vessel is the maximum portion of the total length of the vessel, having its center at the point along the hull in question, which can be symmetrically flooded without immersing the margin line. This is calculated at the prescribed permeability for each portion of the ship [Ref. 6]. The floodable length values were calculated in the GHS Floodable Length (FL) module. The method behind the calculations is established in Reference 2:

> All calculations are based on trapezoidal integration using the model (as a geometry file of sections). The accuracy is therefore directly controlled by the extent to which the model surfaces match the real surfaces. Trapezoidal integration is preferred for its reliability, speed and the fact that discontinuities in the model require no special treatment.

Additionally, Reference 2 states;

> Volume integrations are carried out by applying the trapezoidal method to the section properties, which are in turn derived by trapezoidal integration of the points on each section. This entire integration process is repeated for every change in draft, trim and heel. Intermediate abstractions, such as bonjean curves, are not used.

As described in Reference 5, the damaged stability criteria for these two surface combatants is that the vessel must withstand flooding from a shell opening equal to 15 percent of the hull's length between perpendiculars (LBP). This requires that the margin line (located three inches below the bulkhead deck) shall not be submerged as a result of this flooding. Using this criterion, the bulkhead placement was strictly analyzed to ensure all criteria set out by Reference 5 were met. Figure 6 illustrates the final transverse watertight bulkhead arrangement as well as the floodable length curve. Bulkheads for the vessel are located at each v-line intersection along the Flooding Center Location axis in Figure 6. Due to the wallsided hull's geometric shape and subsequent high floodable length, when floating on an even keel at design conditions, the bulkhead placement for a 12 compartment ship was not particularly difficult to identify.

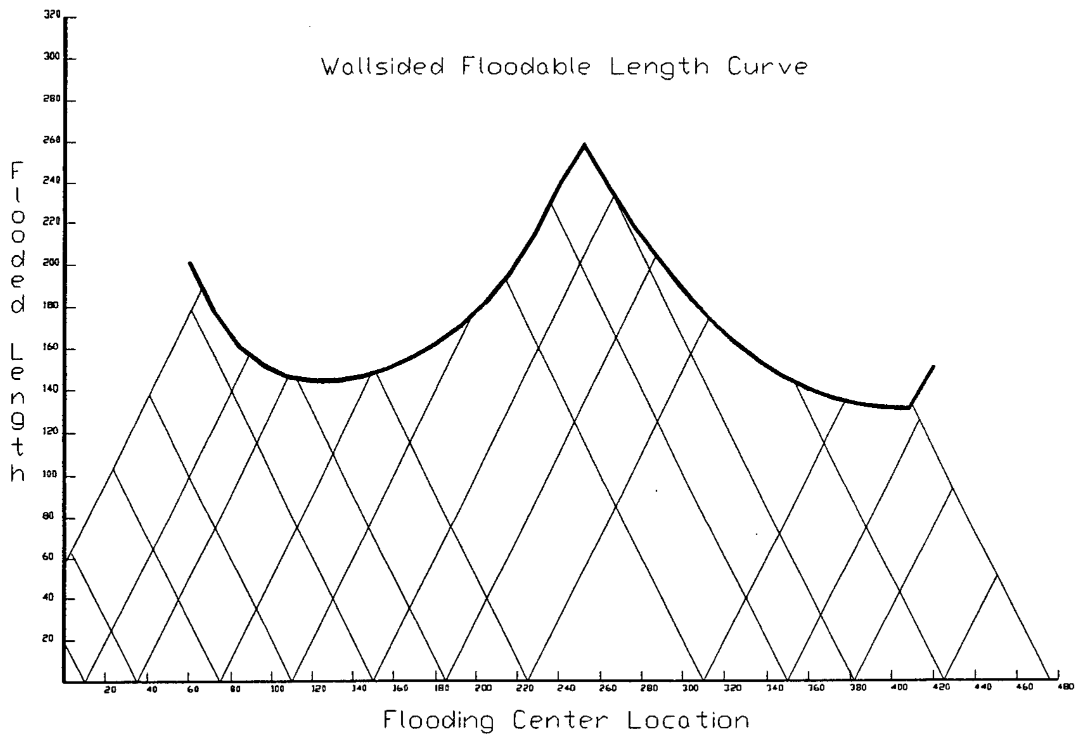


Figure 6. Wallsided Floodable Length Curve

The actual floodable length is at a minimum well aft of amidships. This can be accounted for by the low reserve buoyancy remaining in the rounded stern. The amount of reserve buoyancy forward is surprisingly high when compared to the tumblehome hull.

B. WALLSIDED FLOODING SCENARIO

1. Case I

The forward flooding scenario chosen for the wallsided ship in this case was decided after reviewing the floodable length curve in Figure 6. Here a breach of the hull measures to be 15 percent of the hull length from frame 100 to frame 171. This breach allows compartments COMP_C.C through COMP_DA.C to become flooded. This represents a total of 23 percent of the vessel's LBP flooded to its new waterline. These compartments were chosen to obtain a likely case of forward flooding for the model. The data for this simulated flooding scenario was calculated by GHS's main program. Here a total of 110 feet of the vessel is flooded. The forward draft has increased to 29.49 feet and the trim is measured at 1.76 degrees by the bow. Overall displacement is now 10698.1 LT. The LCG, as expected, has moved forward to 216 ft aft of the forward perpendicular (FP). The amount of freeboard remaining to the bulkhead deck is now 5.34 feet. Table 9 shows these facts and other relevant data.

Displacement	10698 Long Tons
Draft at amidships	22.2 feet
Trim	1.76° forward
Waterplane Area	20049 feet^2
Longitudinal Center of Gravity (LCG)	216.0 feet
Reserve Buoyancy	369911 feet^3
Transverse Metacentric Height (GM)	10.78 feet
Maximum Righting Arm (GZ)	6.29 feet
Least Freeboard	5.34 feet

Table 9. Wallsided Damaged Stability Data (Case I)

In this particular case, the waterplane area has only been reduced by 17.5 percent of the initial intact stability case. The relatively high remaining waterplane is important and is attributed to the wallsided hull form's vertical sides remaining mostly constant throughout the ship as it becomes lower in the water due to parallel sinkage as well as its trim by the bow. GHS was also used to calculate the transverse metacentric height and the righting arm for this case. Illustrated in Figure 7 is the righting arm curve for this particular case of flooding.

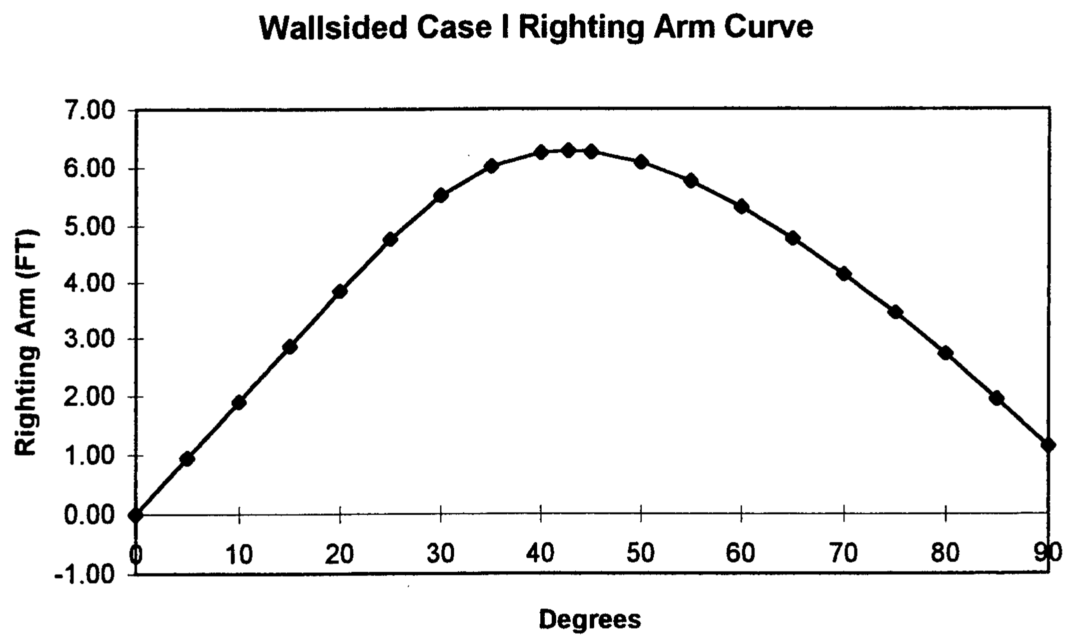


Figure 7. Wallsided Righting Arm Curve (Case I)

The model handles flooding Case I exceptionally well. The righting arm measures 6.29 feet at its peak and while this maximum value is less than intact stability, the curve demonstrates the adequate righting arm through 90 degrees. The model's GM is also measured to be large and positive in this flooding case, indicating that the forward flooding scenario for the wallsided vessel is within the acceptable stability range.

2. Case II

The wallsided model was then subjected to a second flooding scenario (Case II), with midship compartments being damaged. Compartments COMP_DA.C through COMP_F.C were flooded by simulating a breach in the hull from frame 180 to frame 251. While the breach is a total of 15 percent of the hull's LBP, a total of 33.6 percent of the vessel is flooded as a result of this breach. This damage to the vessel and degree of flooding are severe considering the damage location of this case. Key indicators of how the vessel is floating after damage are shown in Table 10.

Displacement	13642.85 Long Tons
Draft at amidships	28 feet
Trim	0.72° forward
Waterplane Area	17524 feet^2
Longitudinal Center of Gravity (LCG)	237.9 feet
Reserve Buoyancy	264203.7 feet^3
Transverse Metacentric Height (GM)	10.88 feet
Maximum Righting Arm (GZ)	5.435 feet
Least Freeboard	6.24 feet

Table 10. Wallsided Damaged Stability Data (Case II)

The waterplane area resulting from this flooded scenario remains at a relatively acceptable level. This becomes important when comparing it to the tumblehome damage scenario, Case II. Here GM is again positive and only reduced by 3.2 percent of the original intact condition. The new displacement is of great concern in this scenario. As expected from this large increase in displacement, reserve buoyancy has been reduced to a minimum of 58 percent of the initial stability. While GZ still remains positive through 90 degrees, Figure 8 shows that the maximum righting arm has been reduced to 5.435 ft at 41 degrees.

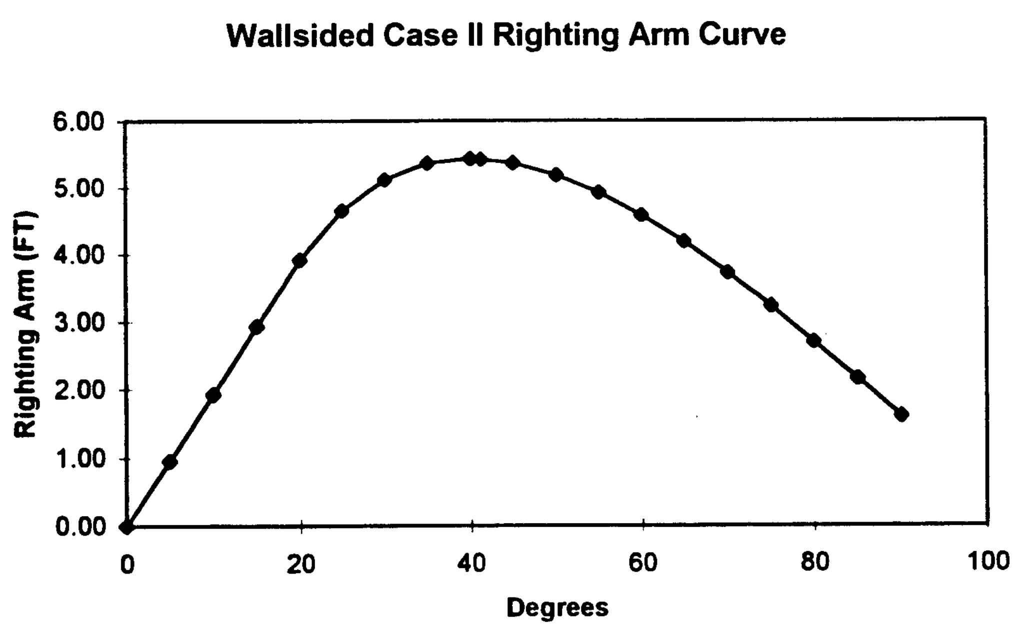


Figure 8. Wallsided Righting Arm Curve (Case II)

It can be seen in this figure how the curve is beginning to change with regards to its initial slope at small angles of heel, representing the metacentric height that is available to the vessel.

3. Case III

The third and final damaged stability scenario simulated in GHS's main program is an aft flooding case. Compartments COMP_H.C through COMP_J.C are flooded due to a breach from frame 360 to 431. The pertinent values of this particular scenario are shown in Table 11.

Displacement	11969 Long Tons
Draft at amidships	22 feet
Trim	3.14° aft
Waterplane Area	17106 feet^2
Longitudinal Center of Gravity (LCG)	291.11 feet
Reserve Buoyancy	129984 feet^3
Transverse Metacentric Height (GM)	8.33 feet
Maximum Righting Arm (GZ)	4.787 feet
Least Freeboard	0.67 feet

Table 11. Wallsided Damaged Stability Data (Case III)

This vessel is in considerable danger of plunging by the stern. As mentioned in the floodable length discussion, the model's stern has only a small portion of the vessel's overall reserve buoyancy located in the stern. This makes its lack of resistance to sinking after damage aft a concern.

Flooding occurs symmetrically in each scenario, the righting arm curve in Figure 9 shows that the righting arm remains positive through 90 degrees, but its maximum value is now only half of the initial intact GZ value.

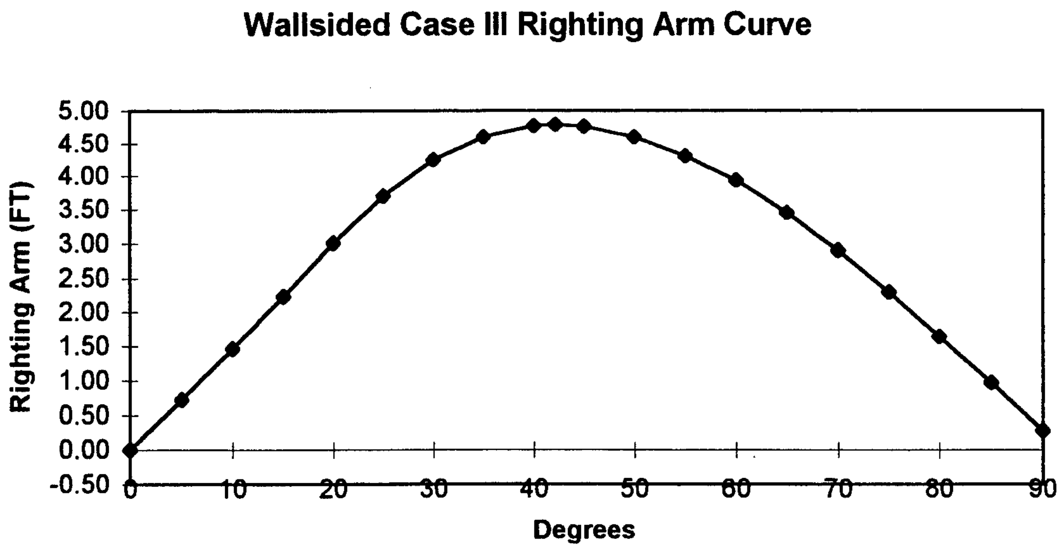


Figure 9. Wallsided Righting Arm Curve (Case III)

C. TUMBLEHOME FLOODABLE LENGTH CURVE

One of the more difficult tasks in completing the objective with regards to the stability penalty of a tumblehome hull was attempting to arrange and optimize the tumblehome model's transverse watertight bulkheads. The arrangement was tedious in attempting to optimize the bulkhead spacing so as to satisfy those requirements listed in [Ref. 5] using criteria and procedures set out by [Ref. 6]. Figure 10 illustrates the floodable length curve and bulkhead placement of the tumblehome hull as modeled.

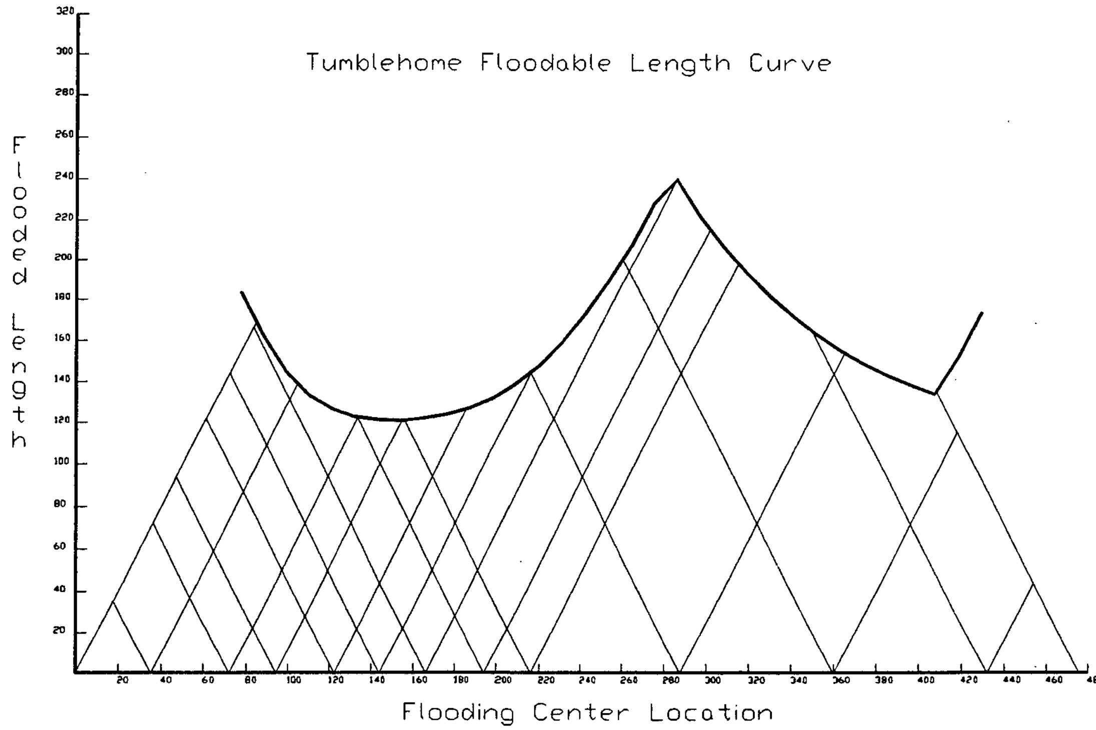


Figure 10. Tumblehome Floodable Length Curve

The placement of the bulkheads to obtain a 12 compartment ship became especially difficult in the forward end of the model. This was due to the lack of volume, and subsequently, reserve buoyancy in the wave piercing bow. The unusual shape of the bow causes a rapid decrease in waterplane are as the bow submerges. While it is possible to arrange and design the forward spaces to have a lower permeability, in order to increase the floodable length in this region, keeping the two models similar prevented this concept from being applied. It is also noted from the illustration in Figure 10, that the floodable length at the stern of the tumblehome model is greater than that of the wallsided ship. This is true because of the increased volume aft due to the constant beam and square transom of the tumblehome model

D. TUMBLEHOME FLOODING SCENARIO

1. Case I

The forward flooding scenario for the tumblehome hull was obtained by breaching the hull from frame 120 to 192 below the design waterline. This represents 15 percent of the hull being open to the sea. Compartments COMP_C.C through COMP_E.C flooded to the new waterline as a result and represent 23 percent of the vessel being flooded. Table 12 shows the important vessels characteristics and damaged stability indicators resulting from the damage. From the GHS data generated in this case, the new waterplane area is calculated to be 72 percent of the initial intact waterplane area. It is the shape of the tumblehome hull that makes the waterplane area drop at a more dramatic rate as flooding occurs than in a wallsided hull. It is this information that must be examined closely when considering a tumblehome hull for a future combatant. The high angle of trim forward is also of concern. Without the high level of reserve buoyancy in the aft section of the vessel the vessel risks plunging by the bow if flooding is not contained within the watertight compartments affected.

Displacement	11246 Long Tons
Draft at amidships	24.3 feet
Trim	2.51° forward
Waterplane Area	17159 feet^2
Longitudinal Center of Gravity (LCG)	221 feet
Reserve Buoyancy	356456 feet^3
Transverse Metacentric Height (GM)	7.33 feet
Maximum Righting Arm (GZ)	3.69 feet
Least Freeboard	6.12 feet

Table 12. Tumblehome Damaged Stability Data (Case I)

The transverse stability of the tumblehome can be evaluated using the righting arm curve shown in Figure 11.

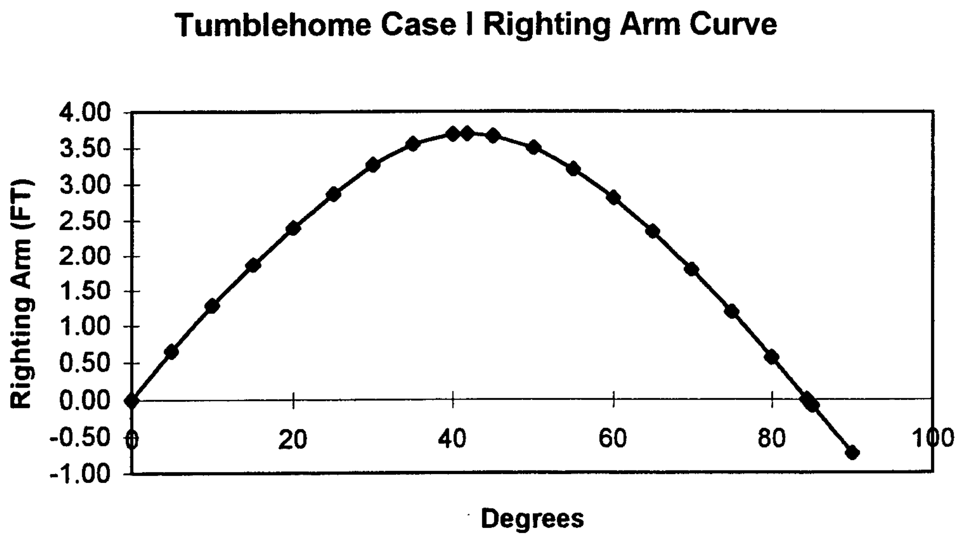


Figure 11. Tumblehome Righting Arm Curve (Case I)

The initial slope of the righting arm is, as always, a good indicator of GM, which has been reduced by 36 percent of initial intact metacentric height. The maximum righting arm is now only 3.69 feet, but more notable is the fact that the righting arm is no longer positive through 90 degrees of heel.

2. Case II

This damaged scenario is based on flooding near amidships. Four compartments, COMP_DA.C through COMP_G.C are affected and subsequently flooded in this particular case. With the tumblehome hull ruptured from frame 160 to frame 232, approximately 30.3 percent of the vessel's LBP is flooded. The slight forward flooded condition, represented by the forward trim at 2.37 degrees, has nearly submerged the wave piercing bow. This is easily done considering the lack of reserve buoyancy forward. This is an extreme case, yet the freeboard remaining is within the requirement detailed in [Ref. 5]. With minimum freeboard at only 2.52 feet, there is no room for continued progressive flooding. Table 13 shows the vessel's key stability indicators for Case II damaged condition.

Displacement	13824.3 Long Tons
Draft at amidships	28.6 feet
Trim	2.37° forward
Waterplane Area	14748 feet^2
Longitudinal Center of Gravity (LCG)	234 feet
Reserve Buoyancy	263904 feet^3
Transverse Metacentric Height (GM)	6.67 feet
Maximum Righting Arm (GZ)	3.28 feet
Least Freeboard	2.52 feet

Table 13. Tumblehome Damaged Stability Data (Case II)

The transverse stability for the vessel in this damaged condition is still within acceptable range. Figure 10 shows the righting arm curve, and the vessel's value of GZ for various angles of heel.

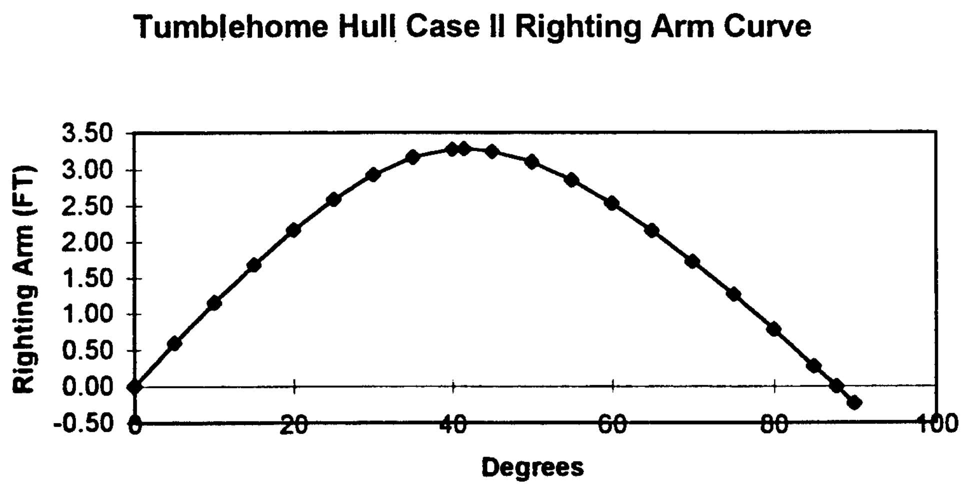


Figure 12. Tumblehome Righting Arm Curve (Case II)

Of particular note is the smaller area beneath the curve which, as discussed previously, is indicative of the amount of work required to capsize the vessel. The righting arm, GZ, remains positive through 87.7 degrees of heel.

3. Case III

This final aft flooding scenario for the tumblehome hull takes place where the vessel is least susceptible to its problem of low reserve buoyancy. The aft hull damage occurs between frame 380 and 451. Compartments COMP_I.C and COMP_J.C are flooded, representing 144 feet or 30.3 percent of the vessel being flooded. The waterplane area has been reduced to only 63.1 percent of the initial intact stability waterplane. As the aft end submerges and the bow draft decreases, the severity of the waterplane area reduction is lessened. Table 14 shows the values of the vessel's key stability indicators.

Displacement	13409 Long Tons
Draft at amidships	24.2 feet.
Trim	2.7° aft
Waterplane Area	15041 feet^2
Longitudinal Center of Gravity (LCG)	288.4 feet
Reserve Buoyancy	179710.4 feet^3
Transverse Metacentric Height (GM)	4.5 feet
Maximum Righting Arm (GZ)	2.69 feet
Least Freeboard	3.93 feet

Table 14. Tumblehome Damaged Stability Data (Case III)

Transverse stability has the lowest value of all the scenarios so far, with GZ at a mere 2.7 feet at 42.66 degrees. The righting arm becomes negative at 86 degrees of heel, shown in Figure 13

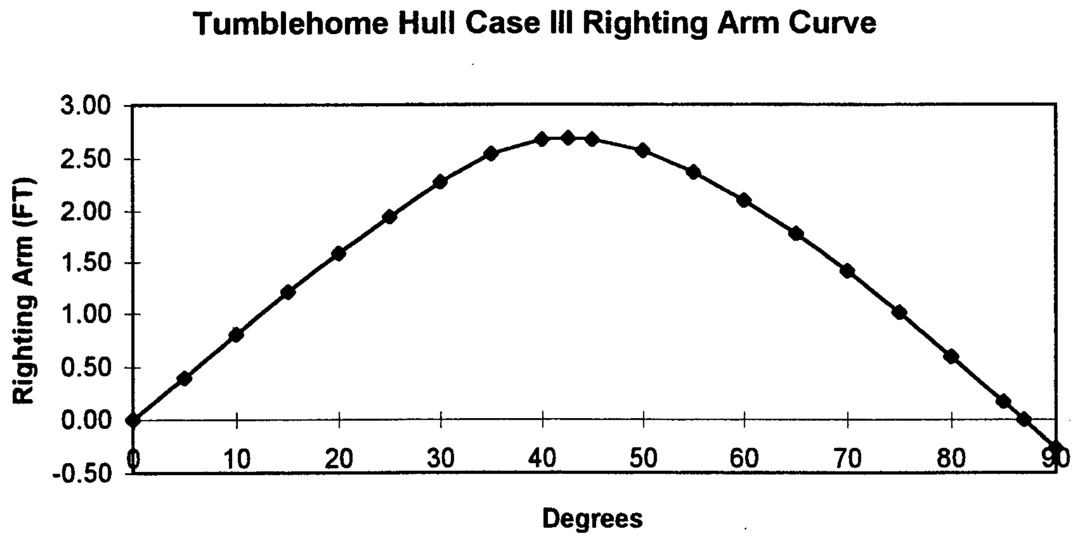


Figure 13. Tumblehome Righting Arm Curve (Case III)

It is noted from both the table and the figure above, that even though the amount of freeboard, reserve buoyancy and displacement are all greater in this scenario, the total GM and righting arm (GZ) are considerably less on the tumblehome hull than on the wallsided vessel. This will be discussed in further detail in Chapter V.

V. RECOMMENDATIONS AND CONCLUSIONS

A. CONCLUSIONS

The tumblehome hull has potential for the U. S. Navy's future surface combatant. This potential can be achieved if the stability considerations are kept in focus from conception to delivery. The considerations for tumblehome stability are presented throughout this thesis. They are in the form of transverse and longitudinal static stability analysis via comparison to a wallsided hull form.

The discussion of the degree of reduced radar cross section for different tumblehome hull angles and hull material properties was outside the scope of this thesis, but, the preliminary results of current studies being conducted on reduced radar cross section for tumblehome hulls are them to be potentially desirable. Tumblehome hulls, if sloped inward properly, are a potentially attractive way to create a truly "stealth" ship using a monohull form..

The transverse static stability penalty can be quantified as a 40 percent reduction in the maximum righting arm when analyzing this tumblehome hull model versus the wallsided hull model. Figure 14 illustrates this point. It is this righting arm reduction problem that leads to the need to analyze the sensitivity of the tumblehome hull's transverse stability. The sensitivity can be further increased by such factors as free surface effects and over-the-side weight handling. In the case of damaged stability criteria, it becomes imperative that only symmetrical flooding, if any, occur with the tumblehome hull.

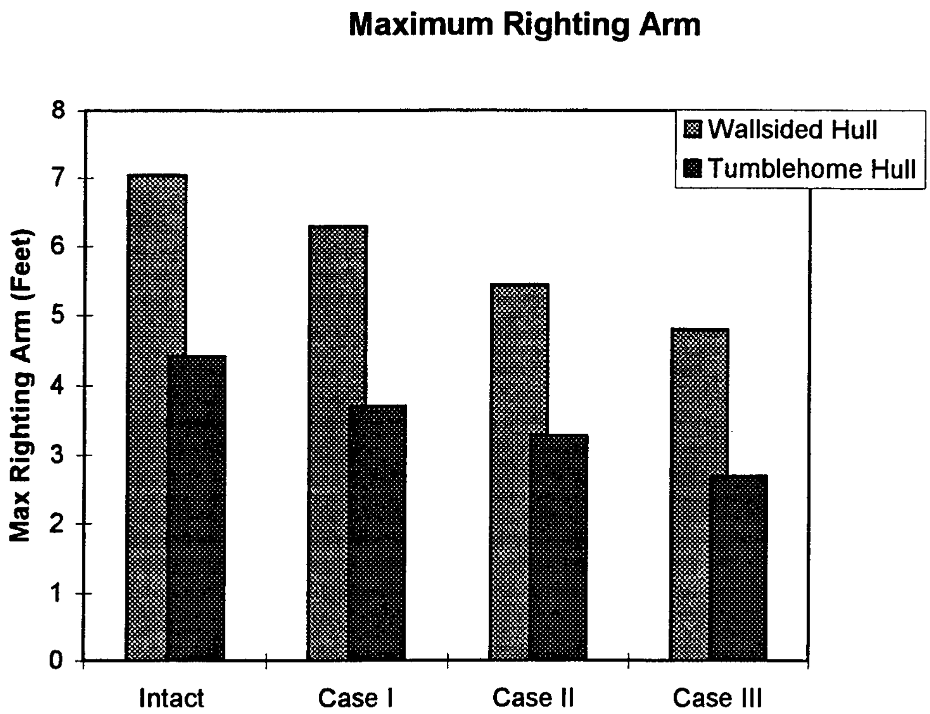


Figure 14. Righting Arm (GZ) Comparison Chart

In considering the longitudinal stability penalty of the tumblehome hull, the tumblehome hull itself is not so much the problem, but the subsequent need to use a wave piercing bow to transition to the tumblehome hull. This bow degrades the tumblehome hull form's longitudinal stability considerably. As seen in Figure 15, the degree of trim in each of the cases of damage has an adverse effect on the vessel's ability to operate after damage. The forward and near amidships damaged cases, Cases I and II respectively, cause serious trim angles for the tumblehome hull. The primary cause for this is the lack of reserve buoyancy located in the bow. While the wallsided hull exhibits moderate angles of trim, the tumblehome hull cannot recover from the significant forward flooding. In addition to this forward trim, a concern is the depth to which the bow sinks below the water's surface. In case II, the depth of the bow at its extreme end is 38.26 feet below the waterline. Forward motion at this draft forward could render the vessel severely unstable. Additionally, due to the problems encountered with forward trim on the tumblehome hull, counter flooding longitudinally may have to be introduced as a measure of damage control. The aft end of the tumblehome has the exact opposite effect. Due to the square transom and constant beam aft of amidships, the reserve buoyancy aft is substantially greater than for the rounded stern of the wallsided hull and hence, less trim in the aft flooding case is apparent.

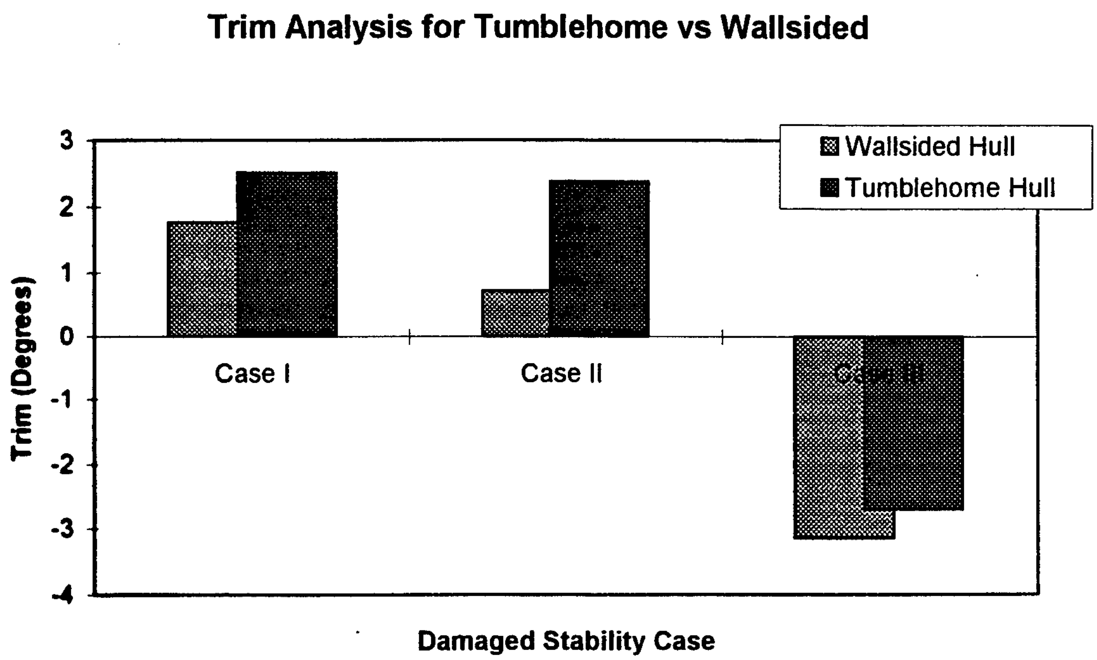


Figure 15. Trim Analysis

It can be seen by Figure 15 that the slightest forward trim brings up the concern for plunging as free surface effects and liquid weight shifts occur within the vessel, similar to the transverse stability penalties.

The tumblehome hull is currently being given serious consideration as the hull form of choice for the U. S. Navy's surface combatant for the 21st century. With the stability penalty in mind, design and delivery of this hull form is certainly possible. Reducing a vessel's radar cross section via a tumblehome hull form has been shown to be an excellent method to reduce the vessel's susceptibility. This, in turn, must be traded off against the increase in vulnerability.

B. RECOMMENDATIONS

This thesis is a new look at a century old concept that may have come of age. A tumblehome hull for the U. S. Navy's 21st century combatant appears inevitable.

Currently, the benefits of tumblehome seem to outweigh the stability penalties. With respect to the tumblehome hull in a modern surface combatant, the following recommendations and suggestions are presented:

- Extensive research is still needed to analyze and determine the dynamic stability penalty of a tumblehome hull form. This is especially applicable in the following areas:
    - Heeling moments caused by beam winds and projected sail area.
    - Heeling moments caused by high speed turns.
    - Lifting of heavy weights off center.
    - Topside icing and water on deck.
- Understanding that the primary interest in the tumblehome hull is because of its low radar cross section potential, additional areas for covertness should be analyzed to minimize the ship's overall signature. These areas include:
    - Infrared (IR) signature due to heat emissions.
    - Wake reduction from both bow and stern.
    - Topside equipment radar cross section including ship's mast.
    - Electronic emissions.

APPENDIX

This appendix includes the following wallsided information and plots:

Plan view
Profile view (with scale)
List of compartments
Isometric view
Body plan
List of offsets, component by component.

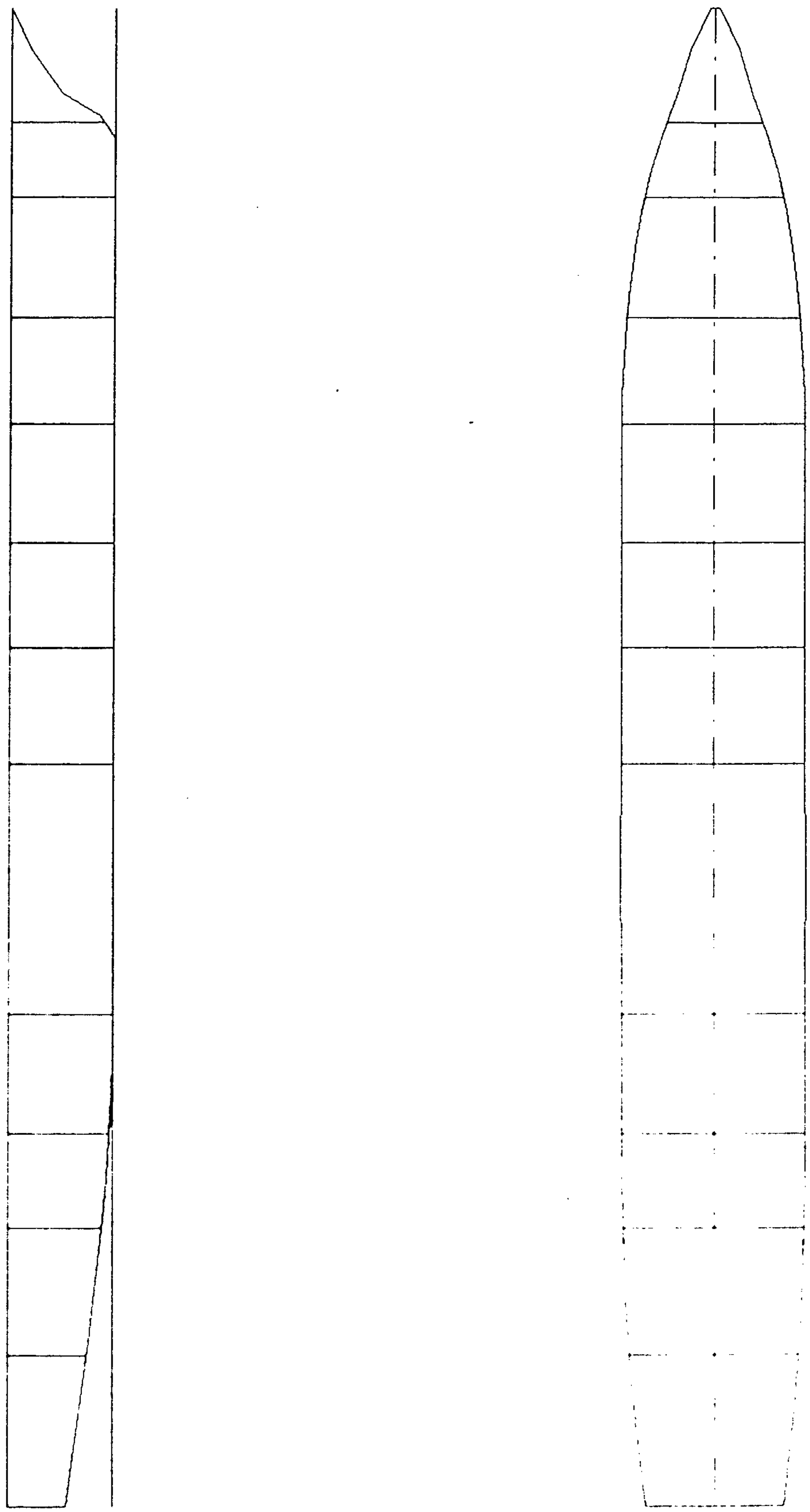
This data is generated as an output report from the GHS program using the "Display Print" command. The actual data values read by GHS for the models are contained in the graphics files ***tumble3.gf*** and ***wallsid4.gf***, but are not legible in text format.

Following these reports in this appendix are the "macro" programs written by the author and executed within GHS for the wallsided and tumblehome hulls to alter the hulls into their final form. These macros are written in a text editor and subsequently executed within the GHS main program. The macros contained herein are the compartmentation, floodable length and stability case macros.

The floodable length macros were written and executed to generate the final floodable length curve data sets that were then analyzed to obtain the optimum locations for bulkhead placement within these two hull forms.

The compartmentation macro was executed to build the twelve compartments within each hull. The permeabilities for each compartment were then entered into the macro for each individual compartment within each hull form..

Following the previous two macros, the stability macros for each ship were written and executed to generate the data sets for each case of damage including the intact stability cases.



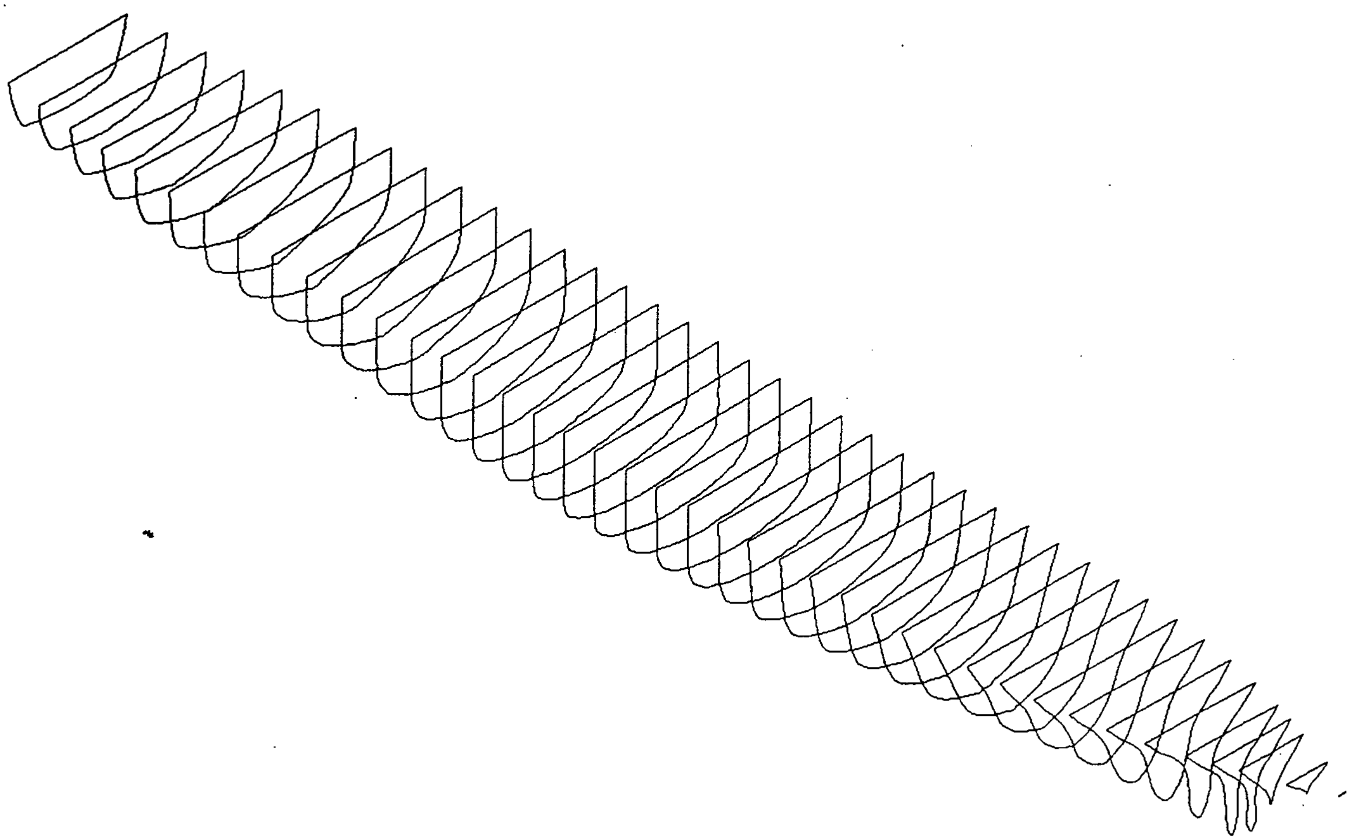
Scale = 1:700

Comments

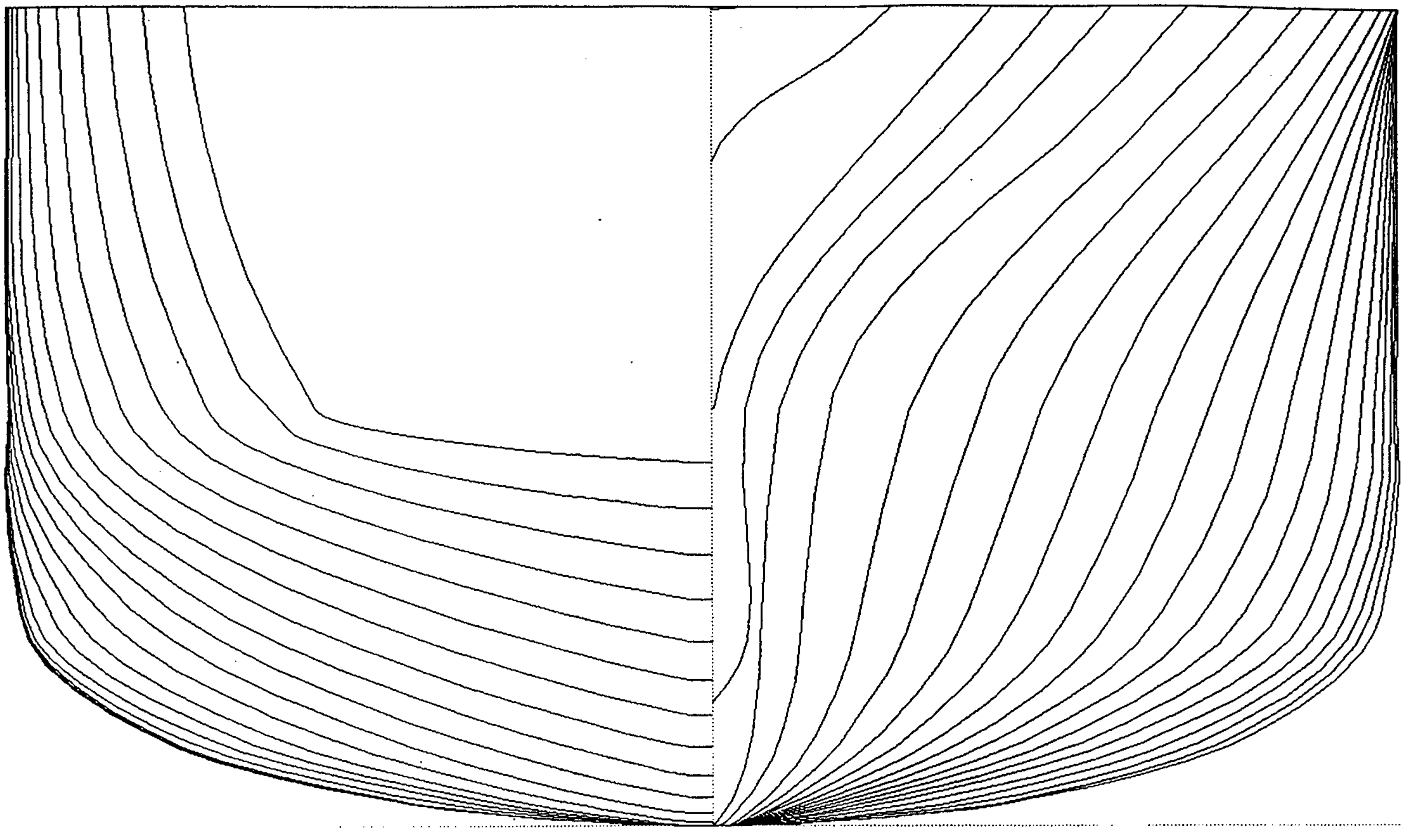
Offsets derived from SHCP data.

Part Name	Class	Description	Location	Volume
HULL	HULL		28.25f to 476.00a	
FOREPEAK.C	TANK		28.25f to 10.00a	4401.10
COMP_A.C	TANK		10.00a to 35.00a	12166.3
COMP_B.C	TANK		35.00a to 75.00a	37198.6
COMP_C.C	TANK		75.00a to 110.00a	46755.8
COMP_CB.C	TANK		110.00a to 150.00a	40826.1
COMP_DA.C	TANK		150.00a to 185.00a	39752.0
COMP_E.C	TANK		185.00a to 225.00a	76040.7
COMP_F.C	TANK		225.00a to 310.00a	145827
COMP_G.C	TANK		310.00a to 350.00a	63764.0
COMP_H.C	TANK		350.00a to 382.00a	51649.2
COMP_I.C	TANK		382.00a to 425.00a	58719.9
COMP_J.C	TANK		425.00a to 476.00a	44461.8

Locations in Feet fwd/aft of the origin. Volumes in cubic Feet.



HULL Isometric Projection



Stbd Stbd

HULL Body Plan (1 component)
Scale = 1:100

Component 1: HULL.C

Offsets in Feet. Read across --->

Section at 28.25 fwd

trans:	0.00	1.50	1.65	0.00
vert:	35.58	35.67	35.70	35.70

Section at 14.13 fwd

trans:	0.00	0.46	1.20	2.22	3.53	5.35	6.87	8.08	0.00
vert:	28.88	29.73	30.59	31.44	32.29	33.43	34.56	35.70	35.70

Section at 0.00

trans:	0.00	0.15	0.52	1.17	2.10	3.32	4.81	8.78	12.51	0.00
vert:	18.20	18.20	19.95	21.70	23.45	25.20	26.95	31.33	35.70	35.70

Section at 7.64 aft

trans:	0.00	0.68	1.25	1.56	1.76	1.65	1.42	1.53	2.22	3.37	4.97	7.03	9.98	12.75
vert:	5.33	6.15	7.13	8.11	10.02	11.92	15.06	18.20	20.39	22.58	24.76	26.95	29.87	32.78
trans:	15.33	0.00												
vert:	35.70	35.70												

Section at 15.27 aft

trans:	0.00	0.19	0.89	1.46	1.81	2.14	2.27	2.51	3.10	3.95	5.24	6.99	9.19	12.31
vert:	0.00	0.15	1.16	2.55	3.93	6.62	9.32	13.76	18.20	20.39	22.58	24.76	26.95	29.87
trans:	15.19	17.84	0.00											
vert:	32.78	35.70	35.70											

Section at 27.52 aft

trans:	0.00	0.32	0.57	1.77	2.73	3.26	3.75	4.00	4.16	4.62	5.47	6.53	8.03	9.98
vert:	0.00	0.00	0.15	1.38	2.92	4.40	6.29	8.15	9.93	14.39	18.78	20.93	23.00	25.15
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vert:	27.26	29.72	32.59	35.70	35.70									

Section at 39.78 aft

trans:	0.00	0.76	1.03	2.40	3.73	4.68	5.54	6.19	6.63	7.62	8.85	9.95	11.43	13.30
vert:	0.00	0.00	0.15	1.16	2.55	3.93	5.73	7.52	9.32	13.76	18.20	20.39	22.58	24.76
trans:	15.54	18.64	21.47	24.03	0.00									
vert:	26.95	29.87	32.78	35.70	35.70									

Section at 52.03 aft

trans:	0.00	0.93	1.25	2.54	3.28	4.67	5.70	6.66	7.84	8.69	9.38	10.78	12.42	13.95
vert:	0.00	0.00	0.15	0.89	1.39	2.49	3.47	4.83	6.67	8.50	10.57	15.01	19.43	21.95
trans:	16.23	18.81	21.47	23.81	26.18	0.00								
vert:	24.79	27.49	30.21	32.81	35.70	35.70								

Section at 64.29 aft

trans:	0.00	1.00	1.37	2.52	3.53	5.10	6.43	7.51	9.15	10.43	11.34	13.10	14.71	16.25
vert:	0.00	0.00	0.15	0.66	1.16	2.09	3.01	3.93	5.73	7.52	9.32	13.76	18.20	21.12
trans:	18.24	20.69	23.27	25.64	27.80	0.00								
vert:	24.03	26.95	29.87	32.78	35.70	35.70								

Section at 76.54 aft

trans:	0.00	1.02	1.45	3.05	4.40	6.69	8.20	9.86	11.47	12.68	13.55	14.29	15.65	16.86
vert:	0.00	0.00	0.15	0.75	1.32	2.49	3.40	4.77	6.34	7.90	9.21	10.63	13.63	16.73
trans:	17.99	19.48	21.23	23.23	26.24	28.97	0.00							
vert:	19.41	22.15	24.83	27.54	31.60	35.70	35.70							

Section at 88.80 aft

trans:	0.00	1.00	1.50	3.12	4.56	6.82	8.73	10.31	12.17	13.72	14.96	15.89	17.49	18.83
vert:	0.00	0.00	0.15	0.66	1.16	2.09	3.01	3.93	5.28	6.62	7.97	9.32	12.28	15.24
trans:	19.88	21.18	22.72	24.51	27.25	29.75	0.00							
vert:	18.20	21.12	24.03	26.95	31.33	35.70	35.70							

Section at 101.06 aft

trans:	0.00	1.00	1.61	3.24	4.74	7.05	9.12	10.71	12.68	14.69	16.00	17.14	19.06	20.54
vert:	0.00	0.00	0.15	0.60	1.04	1.84	2.67	3.39	4.51	5.87	7.00	8.21	11.07	14.00
trans:	21.68	22.80	24.14	25.64	28.00	30.23	0.00							
vert:	17.06	20.09	23.28	26.34	31.05	35.70	35.70							

Section at 113.31 aft

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vert:	0.00	0.00	0.15	0.66	1.16	2.09	3.01	3.93	5.28	6.62	7.97	9.32	12.28	15.24
trans:	23.98	25.43	27.07	30.47	0.00									
vert:	18.20	22.58	26.95	35.70	35.70									

Section at 125.57 aft

trans:	0.00	1.00	1.79	4.53	6.84	9.46	11.63	13.70	15.40	18.09	19.95	21.45	22.41	23.64
vert:	0.00	0.00	0.15	0.73	1.31	2.05	2.75	3.54	4.36	5.88	7.22	8.79	10.18	12.40
trans:	24.56	25.25	25.77	28.07	29.28	30.55	0.00							
vert:	14.43	16.75	18.89	27.28	31.49	35.70	35.70							

Section at 137.83 aft

trans:	0.00	1.00	1.95	4.67	7.00	9.74	12.14	14.20	15.93	18.64	20.82	22.46	23.56	24.85
vert:	0.00	0.00	0.15	0.66	1.16	1.86	2.55	3.24	3.93	5.28	6.62	7.97	9.32	11.54
trans:	25.83	26.52	26.91	28.66	29.55	30.53	0.00							
vert:	13.76	15.98	18.20	26.95	31.33	35.70	35.70							

Section at 150.09 aft

trans:	0.00	1.00	2.23	4.78	6.98	8.49	11.56	14.44	16.41	18.18	20.45	22.33	23.77	24.69
vert:	0.00	0.00	0.15	0.57	1.00	1.33	2.07	2.89	3.57	4.33	5.46	6.61	7.76	8.73
trans:	25.47	26.52	27.29	27.77	28.02	28.66	29.19	29.80	30.52	0.00				
vert:	10.00	12.14	14.30	16.50	18.63	22.90	26.90	31.31	35.70	35.70				

Section at 162.34 aft

trans:	0.00	1.00	2.45	4.87	6.95	8.69	11.83	14.54	16.82	18.67	21.01	22.95	24.49	25.63
vert:	0.00	0.00	0.15	0.49	0.83	1.16	1.86	2.55	3.24	3.93	5.01	6.09	7.16	8.24
trans:	26.38	27.43	28.18	28.63	28.78	29.25	29.62	30.01	30.50	0.00				
vert:	9.32	11.54	13.76	15.98	18.20	22.58	26.95	31.33	35.70	35.70				

Section at 174.60 aft

trans:	0.00	1.00	2.39	4.98	7.05	8.84	12.05	14.60	17.13	19.16	21.48	23.23	24.90	26.16
vert:	0.00	0.00	0.10	0.38	0.66	0.95	1.60	2.19	2.88	3.57	4.60	5.52	6.59	7.67
trans:	27.01	28.11	28.84	29.28	29.37	29.67	29.94	30.19	30.50	0.00				
vert:	8.71	11.08	13.35	15.54	17.86	22.32	26.96	31.25	35.70	35.70				

Section at 186.85 aft

trans:	0.00	1.00	2.28	3.65	6.22	8.37	10.09	11.40	14.65	17.38	19.59	21.28	23.41	25.16
vert:	0.00	0.00	0.05	0.15	0.40	0.66	0.91	1.16	1.86	2.55	3.24	3.93	5.01	6.09
trans:	26.53	27.52	28.13	29.19	29.76	29.83	30.16	30.50	0.00					
vert:	7.16	8.24	9.32	12.28	15.24	18.20	26.95	35.70	35.70					

Section at 199.10 aft

trans:	0.00	1.00	2.38	3.64	4.70	7.32	9.53	11.42	12.69	13.65	16.28	18.54	20.40	21.77
vert:	0.00	0.00	0.04	0.10	0.18	0.42	0.66	0.93	1.15	1.35	1.93	2.51	3.09	3.62
trans:	23.05	25.40	26.97	28.08	28.79	29.62	30.10	30.12	30.50	0.00				
vert:	4.26	5.63	6.86	8.09	9.57	12.23	15.19	18.16	35.70	35.70				

Section at 211.36 aft

trans:	0.00	1.00	2.50	3.62	4.76	7.39	9.61	11.42	12.82	13.82	16.49	18.78	20.68	22.20
vert:	0.00	0.00	0.04	0.07	0.15	0.35	0.55	0.76	0.96	1.16	1.72	2.27	2.82	3.38
trans:	23.34	25.62	27.35	28.53	29.17	29.96	30.34	30.31	30.50	0.00				
vert:	3.93	5.28	6.62	7.97	9.32	12.28	15.24	18.20	35.70	35.70				

Section at 223.62 aft

trans:	0.00	1.00	2.51	3.63	4.80	7.48	9.74	11.59	13.04	14.07	16.83	19.19	21.16	22.99
vert:	0.00	0.00	0.04	0.07	0.14	0.34	0.54	0.73	0.93	1.14	1.69	2.24	2.78	3.46
trans:	24.14	25.96	27.60	28.77	29.29	29.62	30.25	30.51	30.42	30.45	30.47	30.50	0.00	
vert:	4.04	5.09	6.32	7.55	8.43	9.28	12.28	15.24	18.20	22.65	31.35	35.70	35.70	

Section at 235.87 aft

trans:	0.00	1.00	2.50	3.64	4.81	7.52	9.82	11.71	13.19	14.25	17.09	19.52	21.53	23.13
vert:	0.00	0.00	0.04	0.07	0.15	0.35	0.55	0.76	0.96	1.16	1.72	2.27	2.82	3.38
trans:	24.32	26.22	27.74	28.86	29.60	29.95	30.44	30.61	30.47	30.51	30.49	30.47	30.50	0.00
vert:	3.93	5.01	6.09	7.16	8.24	9.32	12.28	15.24	18.20	22.58	26.95	31.33	35.70	35.70

Section at 248.13 aft

trans:	0.00	1.00	2.49	3.60	4.75	7.45	9.73	11.60	13.09	17.02	19.45	21.51	23.07	24.26
vert:	0.00	0.00	0.04	0.07	0.14	0.34	0.54	0.73	0.93	1.69	2.24	2.80	3.33	3.87
trans:	26.19	27.71	28.85	29.65	30.00	30.47	30.64	30.50	30.53	30.50	30.47	30.50	0.00	
vert:	4.96	6.02	7.08	8.21	9.32	12.28	15.24	18.20	22.56	26.94	31.32	35.70	35.70	

Section at 260.38 aft

trans:	0.00	1.00	2.45	3.55	4.69	7.34	9.60	11.46	12.93	13.99	16.83	19.26	21.28	22.89
vert:	0.00	0.00	0.04	0.07	0.15	0.35	0.55	0.76	0.96	1.16	1.72	2.27	2.82	3.38
trans:	24.10	26.04	27.59	28.75	29.52	29.89	30.43	30.63	30.50	30.53	30.50	30.47	30.50	0.00
vert:	3.93	5.01	6.09	7.16	8.24	9.32	12.28	15.24	18.20	22.58	26.95	31.33	35.70	35.70

Section at 272.64 aft

trans:	0.00	1.00	2.31	3.50	4.65	7.27	9.54	11.49	12.83	13.89	16.71	19.12	20.93	22.63
vert:	0.00	0.00	0.04	0.10	0.20	0.43	0.67	0.93	1.15	1.35	1.92	2.49	2.99	3.59
trans:	23.94	25.88	27.44	28.64	29.28	29.73	30.38	30.63	30.50	30.54	30.51	30.48	30.50	0.00
vert:	4.19	5.23	6.28	7.36	8.17	9.26	12.23	15.19	18.20	22.58	26.95	31.33	35.70	35.70

Section at 284.89 aft

trans:	0.00	1.00	2.15	3.46	6.03	8.23	10.05	11.49	15.05	18.05	20.47	22.33	24.64	26.50
vert:	0.00	0.00	0.05	0.15	0.40	0.66	0.91	1.16	1.86	2.55	3.24	3.93	5.01	6.09
trans:	27.92	28.90	29.44	30.24	30.59	30.49	30.55	30.52	30.48	30.50	0.00			
vert:	7.16	8.24	9.32	12.28	15.24	18.20	22.58	26.95	31.33	35.70	35.70			

Section at 297.14 aft

trans:	0.00	1.00	2.04	2.38	5.21	7.42	9.21	12.49	15.07	17.76	19.89	22.10	24.31	26.08
vert:	-0.03	-0.03	0.03	0.07	0.38	0.67	0.96	1.60	2.16	2.85	3.52	4.42	5.49	6.56
trans:	27.45	28.35	29.44	30.14	30.50	30.48	30.58	30.55	30.49	30.50	0.00			
vert:	7.65	8.70	11.07	13.43	15.58	18.17	22.58	26.95	31.33	35.70	35.70			

Section at 309.40 aft

trans:	0.00	1.00	1.98	2.59	5.12	7.28	9.06	12.27	15.06	17.42	19.34	21.82	23.90	25.57
vert:	0.00	0.00	0.07	0.15	0.49	0.83	1.16	1.86	2.55	3.24	3.93	5.01	6.09	7.16
trans:	26.85	27.73	29.00	29.88	30.36	30.45	30.60	30.57	30.50	30.50	0.00			
vert:	8.24	9.32	11.54	13.76	15.98	18.20	22.58	26.95	31.33	35.70	35.70			

Section at 323.29 aft

trans:	0.00	1.00	2.02	2.38	5.02	7.10	8.85	12.01	14.78	16.97	19.08	21.30	23.30	24.93
vert:	0.17	0.17	0.28	0.32	0.76	1.15	1.55	2.33	3.12	3.87	4.72	5.76	6.86	7.96
trans:	26.03	27.08	28.65	29.61	30.18	30.39	30.60	30.59	30.51	30.51	0.00			
vert:	8.89	10.06	12.27	14.24	16.23	18.46	22.54	26.95	31.33	35.70	35.70			

Section at 337.17 aft

trans:	0.00	1.00	2.05	3.88	5.50	6.92	10.36	13.33	15.82	18.88	21.47	23.58	25.23	26.94
vert:	0.54	0.54	0.69	1.01	1.34	1.67	2.57	3.46	4.36	5.66	6.97	8.28	9.58	11.31
trans:	28.30	29.30	29.94	30.22	30.55	30.57	30.49	30.48	0.00					
vert:	13.03	14.75	16.48	18.20	22.58	26.95	31.33	35.70	35.70					

Section at 351.05 aft

trans:	0.00	1.00	1.92	3.85	5.51	8.56	11.20	13.53	16.65	19.26	21.60	23.53	25.62	27.30
vert:	1.23	1.23	1.37	1.77	2.16	2.98	3.78	4.57	5.81	7.01	8.26	9.51	11.20	12.88
trans:	28.57	29.42	29.88	30.25	30.45	30.48	30.41	30.41	0.00					
vert:	14.56	16.19	17.80	20.79	23.80	26.95	31.31	35.70	35.70					

Section at 364.93 aft

trans:	0.00	1.00	1.75	3.76	5.51	8.36	10.93	13.22	16.19	18.82	21.10	23.03	25.16	26.88
vert:	2.17	2.17	2.30	2.75	3.20	4.01	4.82	5.64	6.82	8.01	9.19	10.38	11.94	13.51
trans:	28.18	29.07	29.55	29.99	30.23	30.28	30.25	30.27	0.00					
vert:	15.07	16.64	18.20	21.12	24.03	26.95	31.33	35.70	35.70					

Section at 378.82 aft

trans:	0.00	1.00	1.65	3.48	5.37	8.30	10.63	12.86	15.63	18.55	20.57	22.47	24.62	26.37
vert:	3.36	3.36	3.49	3.91	4.42	5.27	6.02	6.81	7.88	9.14	10.17	11.26	12.71	14.18
trans:	27.68	28.57	29.03	29.54	29.84	29.94	29.96	30.01	0.00					
vert:	15.65	17.15	18.67	21.50	24.34	26.91	31.43	35.70	35.70					

Section at 392.70 aft

trans:	0.00	1.00	1.57	3.17	4.60	8.17	11.37	15.05	18.25	20.98	23.25	25.09	26.52	27.52
vert:	4.77	4.77	4.87	5.25	5.63	6.65	7.67	8.99	10.32	11.65	12.96	14.27	15.58	16.89
trans:	28.11	28.78	29.22	29.42	29.62	0.00								
vert:	18.20	21.12	24.03	26.95	35.70	35.70								

Section at 406.58 aft

trans:	0.00	1.00	1.54	2.97	4.34	7.72	10.46	13.93	16.91	19.54	21.71	23.49	24.87	25.87
vert:	6.35	6.35	6.45	6.77	7.12	8.03	8.85	9.99	11.10	12.24	13.33	14.41	15.42	16.35
trans:	26.67	27.63	28.28	28.65	28.91	29.07	0.00							
vert:	17.49	20.44	23.51	26.56	31.13	35.70	35.70							

Section at 420.47 aft

trans:	0.00	1.00	1.47	2.82	4.07	7.21	10.07	13.41	16.34	18.87	20.98	22.71	24.06	25.02
vert:	8.07	8.07	8.16	8.44	8.72	9.49	10.26	11.26	12.26	13.26	14.25	15.24	16.22	17.21
trans:	25.60	26.57	27.28	27.71	28.10	28.33	0.00							
vert:	18.20	21.12	24.03	26.95	31.33	35.70	35.70							

Section at 434.35 aft

trans:	0.00	1.00	1.23	2.75	3.94	6.89	9.58	12.70	15.69	18.12	20.15	21.83	23.11	23.82
vert:	9.91	9.91	9.95	10.21	10.44	11.07	11.71	12.53	13.44	14.33	15.21	16.11	17.17	18.18
trans:	24.29	25.28	26.02	26.54	27.06	27.37	0.00							
vert:	19.13	21.91	24.64	27.40	31.54	35.70	35.70							

Section at 448.23 aft

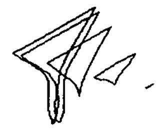
trans:	0.00	1.00	1.41	2.64	3.76	6.56	9.05	11.90	14.37	16.46	18.57	20.18	21.30	21.92
vert:	11.83	11.83	11.88	12.06	12.24	12.72	13.21	13.83	14.46	15.09	15.87	16.64	17.42	18.20
trans:	23.21	24.23	24.98	25.74	26.16	0.00								
vert:	21.12	24.03	26.95	31.33	35.70	35.70								

Section at 462.11 aft

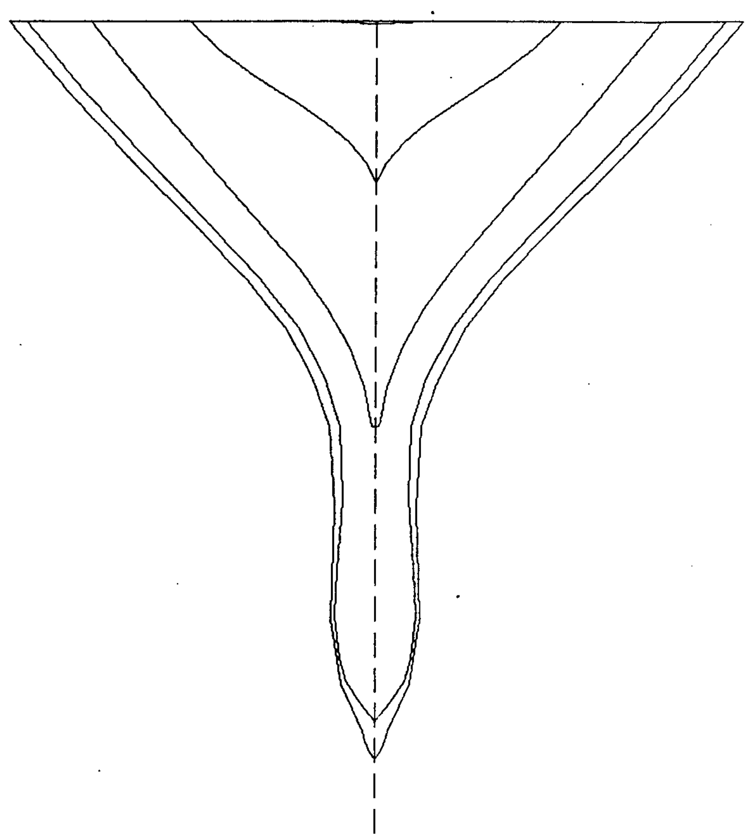
trans:	0.00	0.70	1.22	1.21	2.68	3.72	6.28	8.14	10.48	12.47	13.88	15.73	16.96	17.73
vert:	13.81	13.81	13.81	13.82	13.97	14.09	14.42	14.69	15.08	15.46	15.74	16.21	16.60	16.88
trans:	18.18	20.50	21.91	22.98	23.76	24.31	24.66	0.00						
vert:	17.14	19.54	22.95	26.16	29.34	32.52	35.70	35.70						

Section at 476.00 aft

trans:	0.00	1.00	1.74	1.56	2.81	3.76	6.04	7.96	10.13	11.98	13.51	15.03	16.16	16.90
vert:	15.86	15.86	15.87	15.87	15.94	16.01	16.18	16.36	16.59	16.82	17.06	17.34	17.63	17.91
trans:	17.25	18.85	20.17	21.20	21.99	22.54	22.88	0.00						
vert:	18.20	21.12	24.03	26.95	29.87	32.78	35.70	35.70						



FOREPEAK.C Isometric Projection



FOREPEAK.C Body Plan (1 component)
Scale = 1:100

Component 1: FOREPEAK.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 28.25 fwd

trans:	0.00	1.50	1.65	0.00						
vert:	35.58	35.67	35.70	35.70						

Section at 14.13 fwd

trans:	0.00	0.46	1.20	2.22	3.53	5.35	6.87	8.08	0.00	
vert:	28.88	29.73	30.59	31.44	32.29	33.43	34.56	35.70	35.70	

Section at 0.00

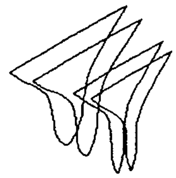
trans:	0.00	0.15	0.52	1.17	2.10	3.32	4.81	8.78	12.51	0.00
vert:	18.20	18.20	19.95	21.70	23.45	25.20	26.95	31.33	35.70	35.70

Section at 7.64 aft

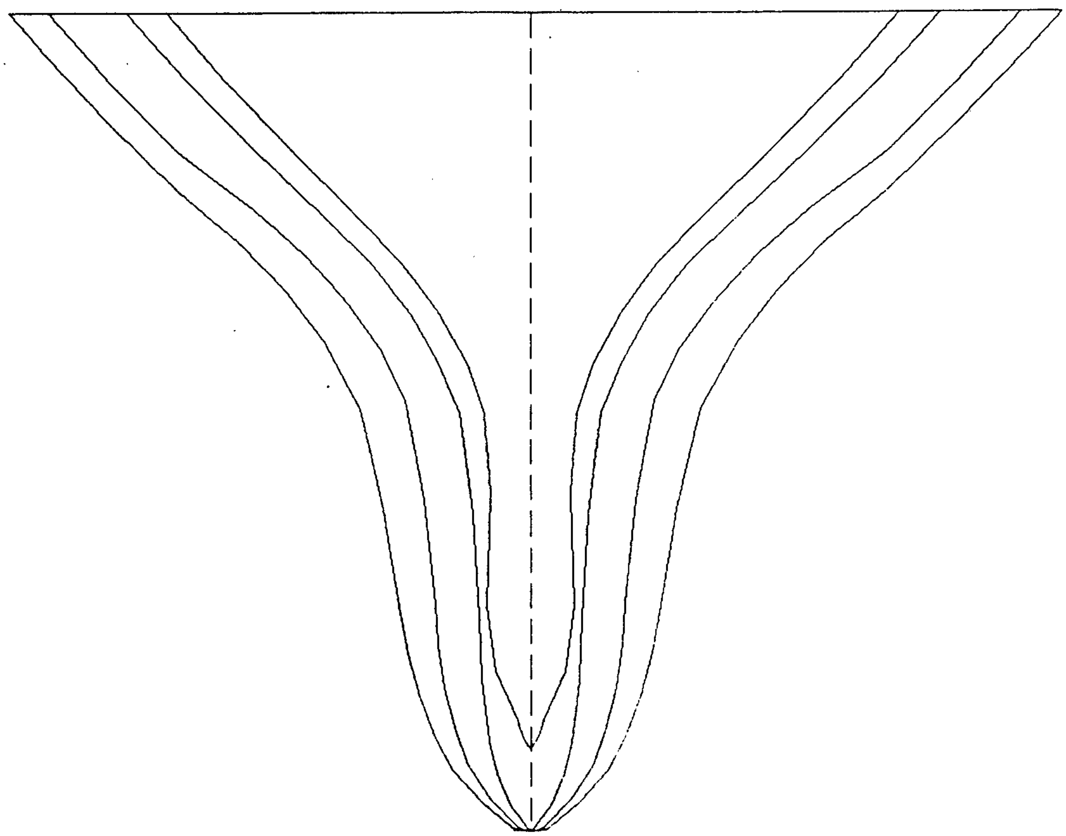
trans:	0.00	0.68	1.25	1.56	1.76	1.65	1.42	1.53	2.22	3.37	4.97	7.03	9.98	12.75
vert:	5.33	6.15	7.13	8.11	10.02	11.92	15.06	18.20	20.39	22.58	24.76	26.95	29.87	32.78
trans:	15.33	0.00												
vert:	35.70	35.70												

Section at 10.00 aft

trans:	0.00	0.06	0.28	0.45	0.56	1.52	1.92	1.76	2.02	2.76	3.95	5.60	7.70	10.70
vert:	3.68	3.73	4.04	4.47	4.90	6.98	9.80	14.66	18.20	20.39	22.58	24.76	26.95	29.87
trans:	13.50	16.10	0.00											
vert:	32.78	35.70	35.70											



COMP_A.C Isometric Projection



COMP_A.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_A.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 10.00 aft

trans:	0.00	0.06	0.28	0.45	0.56	1.52	1.92	1.76	2.02	2.76	3.95	5.60	7.70	10.70
vert:	3.68	3.73	4.04	4.47	4.90	6.98	9.80	14.66	18.20	20.39	22.58	24.76	26.95	29.87

trans:	13.50	16.10	0.00
vert:	32.78	35.70	35.70

Section at 15.27 aft

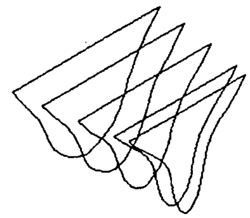
trans:	0.00	0.19	0.89	1.46	1.81	2.14	2.27	2.51	3.10	3.95	5.24	6.99	9.19	12.31
vert:	0.00	0.15	1.16	2.55	3.93	6.62	9.32	13.76	18.20	20.39	22.58	24.76	26.95	29.87
trans:	15.19	17.84	0.00											
vert:	32.78	35.70	35.70											

Section at 27.52 aft

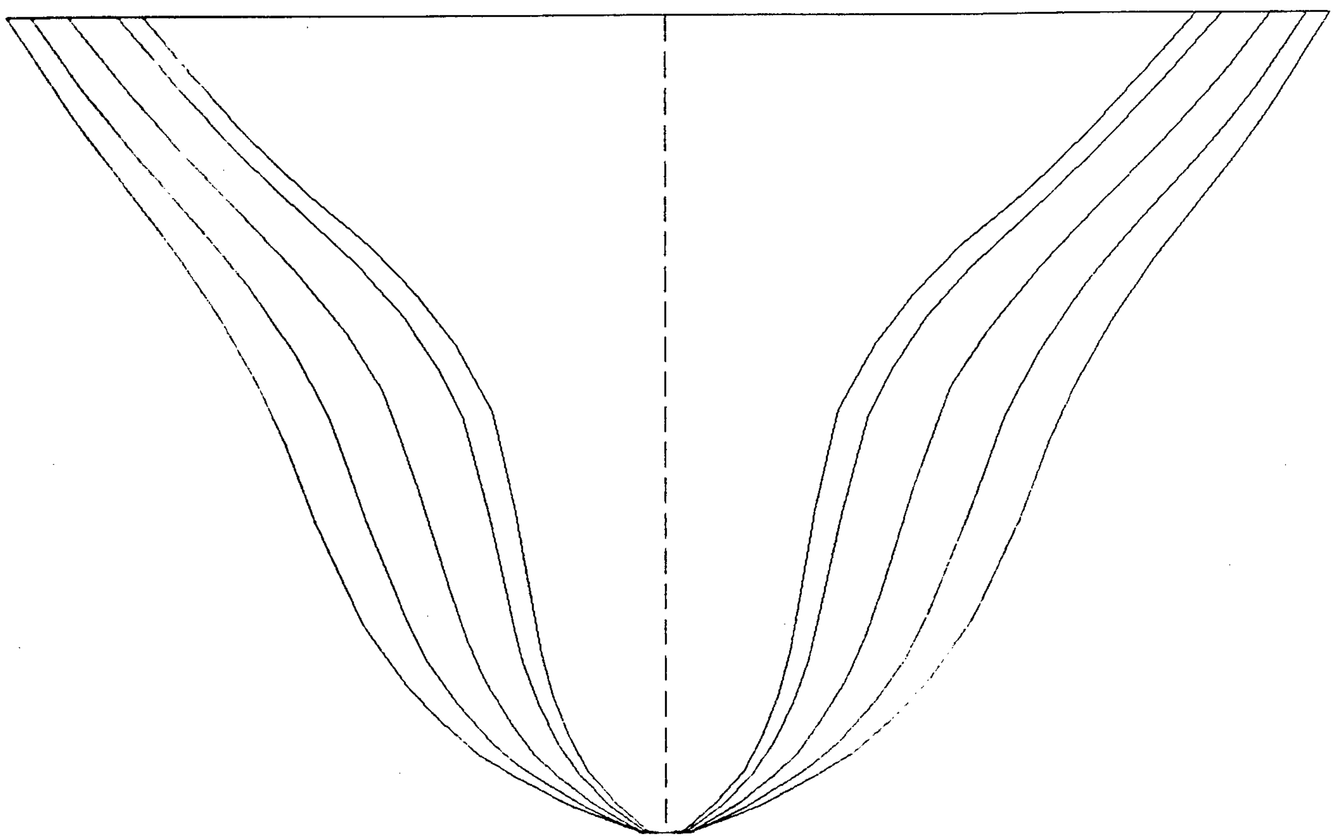
trans:	0.00	0.32	0.57	1.77	2.73	3.26	3.75	4.00	4.16	4.62	5.47	6.53	8.03	9.98
vert:	0.00	0.00	0.15	1.38	2.92	4.40	6.29	8.15	9.93	14.39	18.78	20.93	23.00	25.15
trans:	12.33	15.59	18.46	21.27	0.00									
vert:	27.26	29.72	32.59	35.70	35.70									

Section at 35.00 aft

trans:	0.00	0.69	0.85	2.15	3.34	4.13	4.84	5.34	5.67	6.45	7.53	9.20	10.87	12.92
vert:	0.00	0.06	0.15	1.25	2.69	4.11	5.95	7.77	9.56	14.01	18.43	21.41	23.58	25.74
trans:	15.56	18.57	21.39	22.95	0.00									
vert:	28.03	30.93	33.92	35.70	35.70									



COMP_B.C Isometric Projection



COMP_B.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_B.C 95.00% permeability

Offsets in feet. Read across --->

Section at 35.00 aft

trans:	0.00	0.69	0.85	2.15	3.34	4.13	4.84	5.34	5.67	6.45	7.53	9.20	10.87	12.92
vert:	0.00	0.06	0.15	1.25	2.69	4.11	5.95	7.77	9.56	14.01	18.43	21.41	23.58	25.74
trans:	15.56	18.57	21.39	22.95	0.00									
vert:	28.03	30.93	33.92	35.70	35.70									

Section at 39.78 aft

trans:	0.00	0.76	1.03	2.40	3.73	4.68	5.54	6.19	6.63	7.62	8.85	9.95	11.43	13.30
vert:	0.00	0.00	0.15	1.16	2.55	3.93	5.73	7.52	9.32	13.76	18.20	20.39	22.58	24.76
trans:	15.54	18.64	21.47	24.03	0.00									
vert:	26.95	29.87	32.78	35.70	35.70									

Section at 52.03 aft

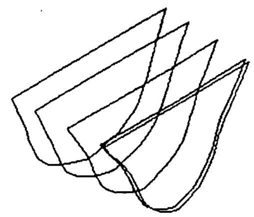
trans:	0.00	0.93	1.25	2.54	3.28	4.67	5.70	6.66	7.84	8.69	9.38	10.78	12.42	13.95
vert:	0.00	0.00	0.15	0.89	1.39	2.49	3.47	4.83	6.67	8.50	10.57	15.01	19.43	21.95
trans:	16.23	18.81	21.47	23.81	26.18	0.00								
vert:	24.79	27.49	30.21	32.81	35.70	35.70								

Section at 64.29 aft

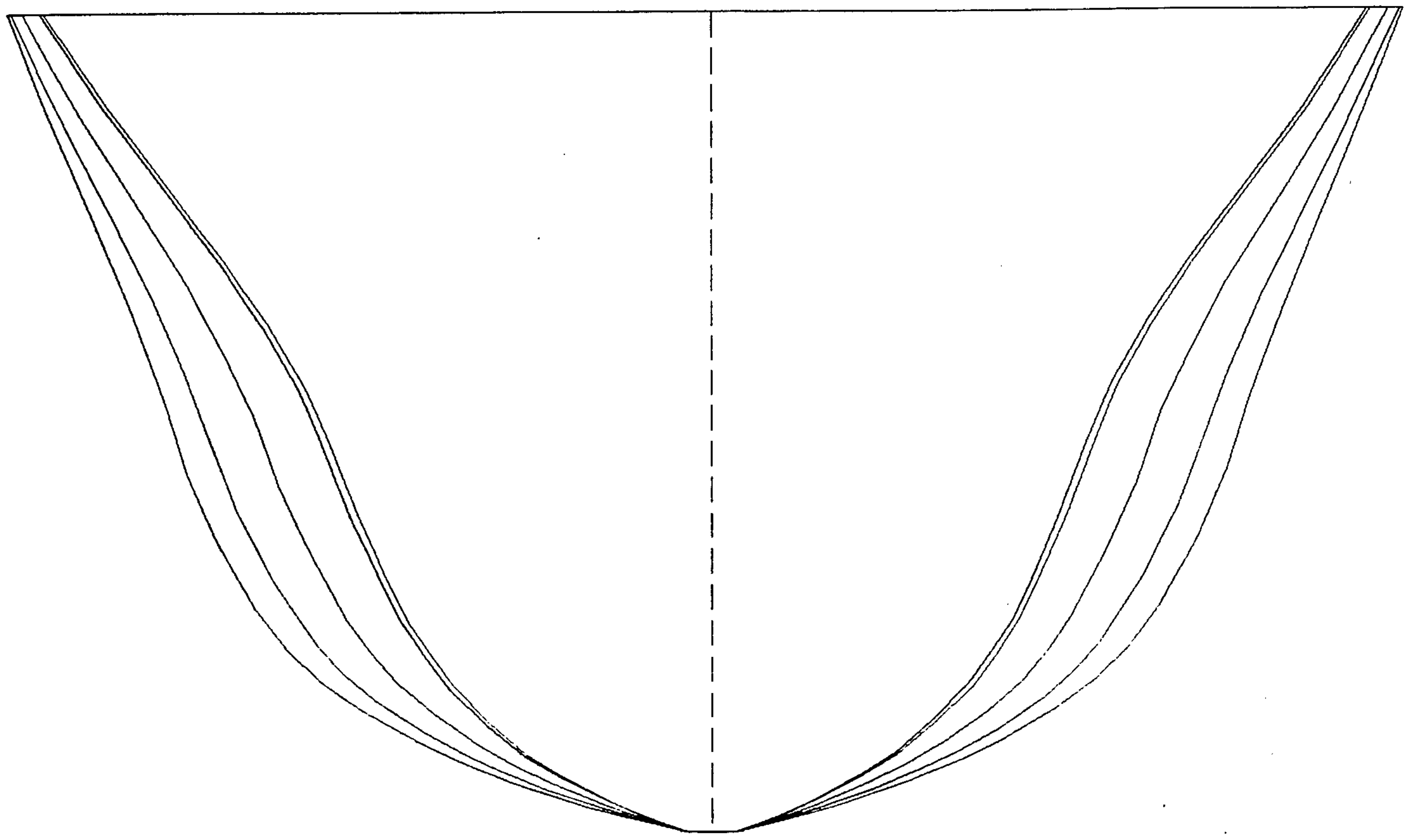
trans:	0.00	1.00	1.37	2.52	3.53	5.10	6.43	7.51	9.15	10.43	11.34	13.10	14.71	16.25
vert:	0.00	0.00	0.15	0.66	1.16	2.09	3.01	3.93	5.73	7.52	9.32	13.76	18.20	21.12
trans:	18.24	20.69	23.27	25.64	27.80	0.00								
vert:	24.03	26.95	29.87	32.78	35.70	35.70								

Section at 75.00 aft

trans:	0.00	1.01	1.44	2.98	4.29	6.65	8.11	9.77	11.34	12.51	13.27	14.14	15.33	16.59
vert:	0.00	0.00	0.15	0.74	1.30	2.55	3.47	4.89	6.49	8.08	9.22	11.02	13.65	16.91
trans:	17.77	19.33	21.16	23.23	26.16	28.82	0.00							
vert:	19.62	22.39	25.10	27.84	31.75	35.70	35.70							



COMP_C.C Isometric Projection



COMP_C.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_C.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 75.00 aft

trans:	0.00	1.01	1.44	2.98	4.29	6.65	8.11	9.77	11.34	12.51	13.27	14.14	15.33	16.59
vert:	0.00	0.00	0.15	0.74	1.30	2.55	3.47	4.89	6.49	8.08	9.22	11.02	13.65	16.91
trans:	17.77	19.33	21.16	23.23	26.16	28.82	0.00							
vert:	19.62	22.39	25.10	27.84	31.75	35.70	35.70							

Section at 76.54 aft

trans:	0.00	1.02	1.45	3.05	4.40	6.69	8.20	9.86	11.47	12.68	13.55	14.29	15.65	16.86
vert:	0.00	0.00	0.15	0.75	1.32	2.49	3.40	4.77	6.34	7.90	9.21	10.63	13.63	16.73
trans:	17.99	19.48	21.23	23.23	26.24	28.97	0.00							
vert:	19.41	22.15	24.83	27.54	31.60	35.70	35.70							

Section at 88.80 aft

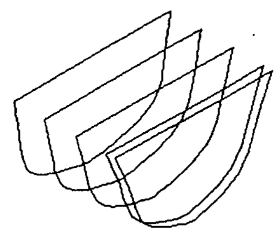
trans:	0.00	1.00	1.50	3.12	4.56	6.82	8.73	10.31	12.17	13.72	14.96	15.89	17.49	18.83
vert:	0.00	0.00	0.15	0.66	1.16	2.09	3.01	3.93	5.28	6.62	7.97	9.32	12.28	15.24
trans:	19.88	21.18	22.72	24.51	27.25	29.75	0.00							
vert:	18.20	21.12	24.03	26.95	31.33	35.70	35.70							

Section at 101.06 aft

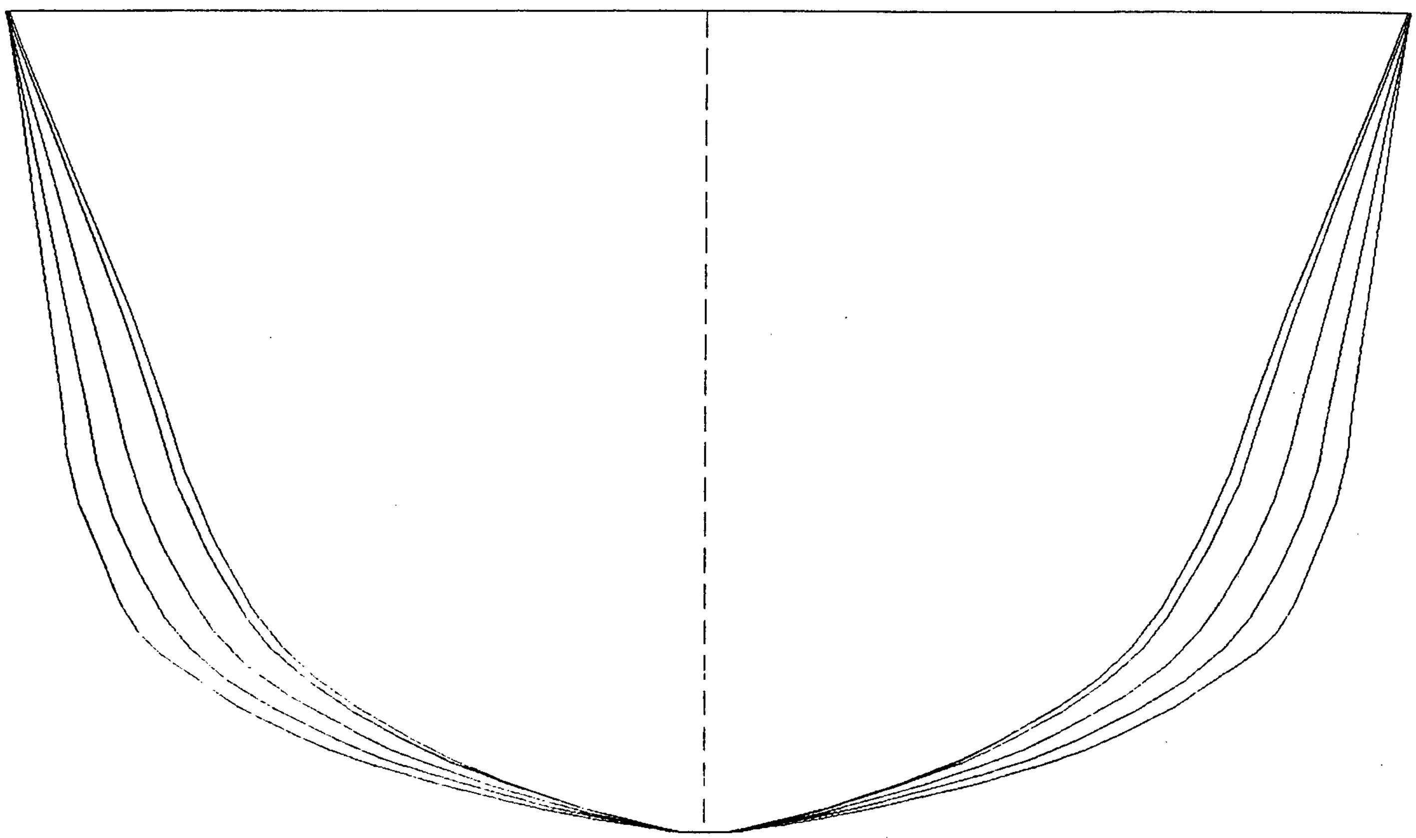
trans:	0.00	1.00	1.61	3.24	4.74	7.05	9.12	10.71	12.68	14.69	16.00	17.14	19.06	20.54
vert:	0.00	0.00	0.15	0.60	1.04	1.84	2.67	3.39	4.51	5.87	7.00	8.21	11.07	14.00
trans:	21.68	22.80	24.14	25.64	28.00	30.23	0.00							
vert:	17.06	20.09	23.28	26.34	31.05	35.70	35.70							

Section at 110.00 aft

trans:	0.00	1.00	1.66	3.65	5.43	8.75	10.99	13.00	15.27	17.03	18.44	19.76	21.44	22.71
vert:	0.00	0.00	0.15	0.64	1.13	2.24	3.11	4.09	5.44	6.73	8.04	9.79	12.74	15.73
trans:	23.66	25.09	26.69	30.40	0.00									
vert:	18.71	22.77	26.78	35.70	35.70									



COMP_CB.C Isometric Projection



COMP_CB.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_CB.C 60.00% permeability

Offsets in Feet. Read across --->

Section at 110.00 aft

trans:	0.00	1.00	1.66	3.65	5.43	8.75	10.99	13.00	15.27	17.03	18.44	19.76	21.44	22.71
vert:	0.00	0.00	0.15	0.64	1.13	2.24	3.11	4.09	5.44	6.73	8.04	9.79	12.74	15.73
trans:	23.66	25.09	26.69	30.40	0.00									
vert:	18.71	22.77	26.78	35.70	35.70									

Section at 113.31 aft

trans:	0.00	1.00	1.68	3.81	5.68	8.62	11.10	13.12	15.48	17.41	18.93	20.01	21.78	23.10
vert:	0.00	0.00	0.15	0.66	1.16	2.09	3.01	3.93	5.28	6.62	7.97	9.32	12.28	15.24
trans:	23.98	25.43	27.07	30.47	0.00									
vert:	18.20	22.58	26.95	35.70	35.70									

Section at 125.57 aft

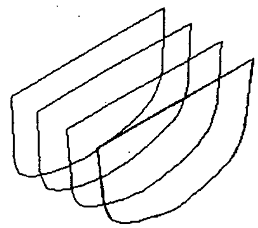
trans:	0.00	1.00	1.79	4.53	6.84	9.46	11.63	13.70	15.40	18.09	19.95	21.45	22.41	23.64
vert:	0.00	0.00	0.15	0.73	1.31	2.05	2.75	3.54	4.36	5.88	7.22	8.79	10.18	12.40
trans:	24.56	25.25	25.77	28.07	29.28	30.55	0.00							
vert:	14.43	16.75	18.89	27.28	31.49	35.70	35.70							

Section at 137.83 aft

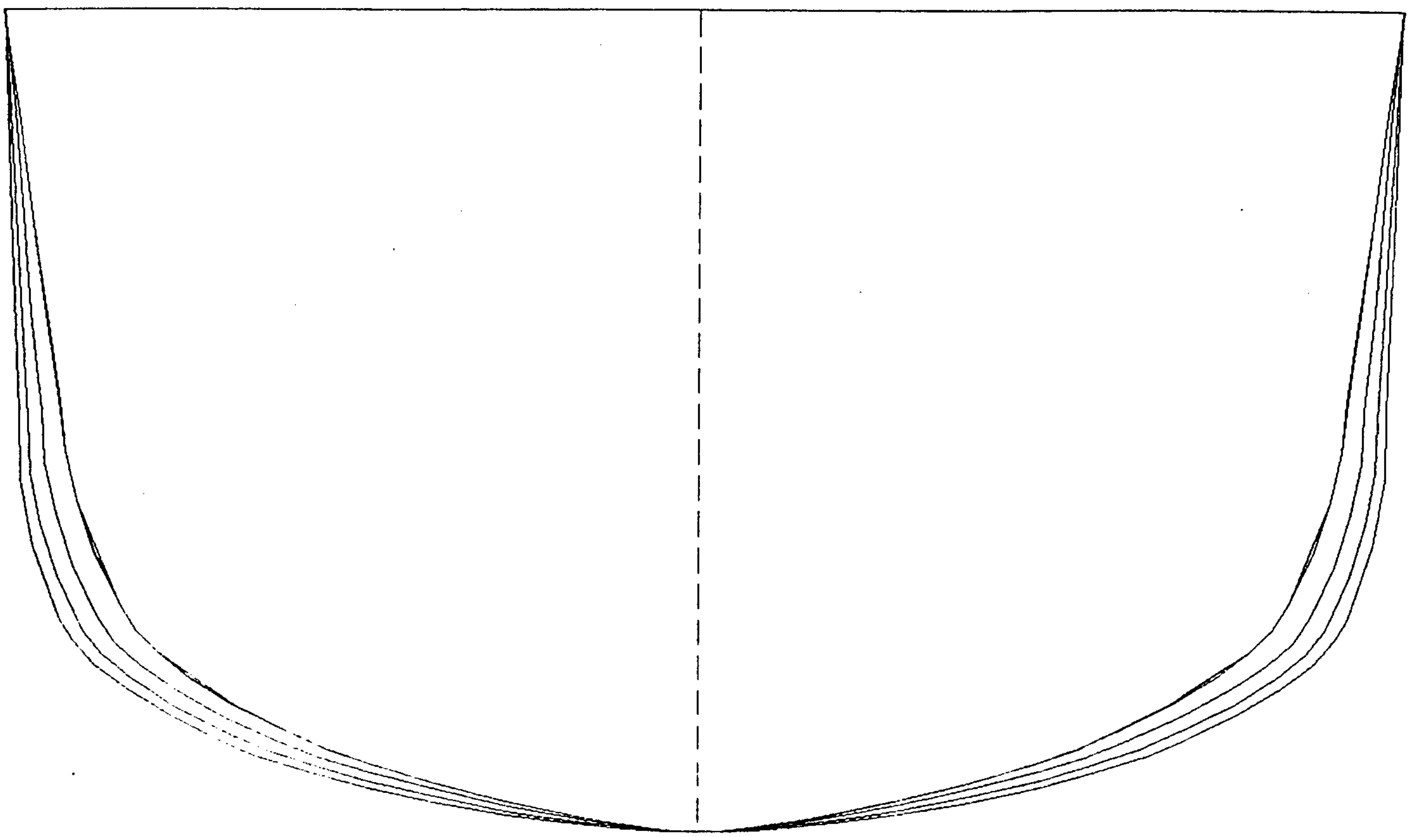
trans:	0.00	1.00	1.95	4.67	7.00	9.74	12.14	14.20	15.93	18.64	20.82	22.46	23.56	24.85
vert:	0.00	0.00	0.15	0.66	1.16	1.86	2.55	3.24	3.93	5.28	6.62	7.97	9.32	11.54
trans:	25.83	26.52	26.91	28.66	29.55	30.53	0.00							
vert:	13.76	15.98	18.20	26.95	31.33	35.70	35.70							

Section at 150.00 aft

trans:	0.00	1.00	2.22	4.77	6.98	8.50	11.56	14.43	16.40	18.18	20.45	23.76	24.69	25.47
vert:	0.00	0.00	0.15	0.57	1.00	1.33	2.08	2.90	3.57	4.34	5.47	7.76	8.73	10.01
trans:	27.28	27.76	28.01	29.18	29.80	30.52	0.00							
vert:	14.30	16.50	18.63	26.90	31.31	35.70	35.70							



COMP_DA.C Isometric Projection



COMP_DA.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_DA.C 60.00% permeability

Offsets in Feet. Read across --->

Section at 150.00 aft

trans:	0.00	1.00	2.22	4.77	6.98	8.50	11.56	14.43	16.40	18.18	20.45	23.76	24.69	25.47
vert:	0.00	0.00	0.15	0.57	1.00	1.33	2.08	2.90	3.57	4.34	5.47	7.76	8.73	10.01
trans:	27.28	27.76	28.01	29.18	29.80	30.52	0.00							
vert:	14.30	16.50	18.63	26.90	31.31	35.70	35.70							

Section at 150.09 aft

trans:	0.00	1.00	2.23	4.78	6.98	8.49	11.56	14.44	16.41	18.18	20.45	22.33	23.77	24.69
vert:	0.00	0.00	0.15	0.57	1.00	1.33	2.07	2.89	3.57	4.33	5.46	6.61	7.76	8.73
trans:	25.47	26.52	27.29	27.77	28.02	28.66	29.19	29.80	30.52	0.00				
vert:	10.00	12.14	14.30	16.50	18.63	22.90	26.90	31.31	35.70	35.70				

Section at 162.34 aft

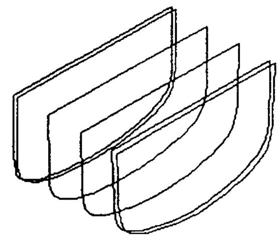
trans:	0.00	1.00	2.45	4.87	6.95	8.69	11.83	14.54	16.82	18.67	21.01	22.95	24.49	25.63
vert:	0.00	0.00	0.15	0.49	0.83	1.16	1.86	2.55	3.24	3.93	5.01	6.09	7.16	8.24
trans:	26.38	27.43	28.18	28.63	28.78	29.25	29.62	30.01	30.50	0.00				
vert:	9.32	11.54	13.76	15.98	18.20	22.58	26.95	31.33	35.70	35.70				

Section at 174.60 aft

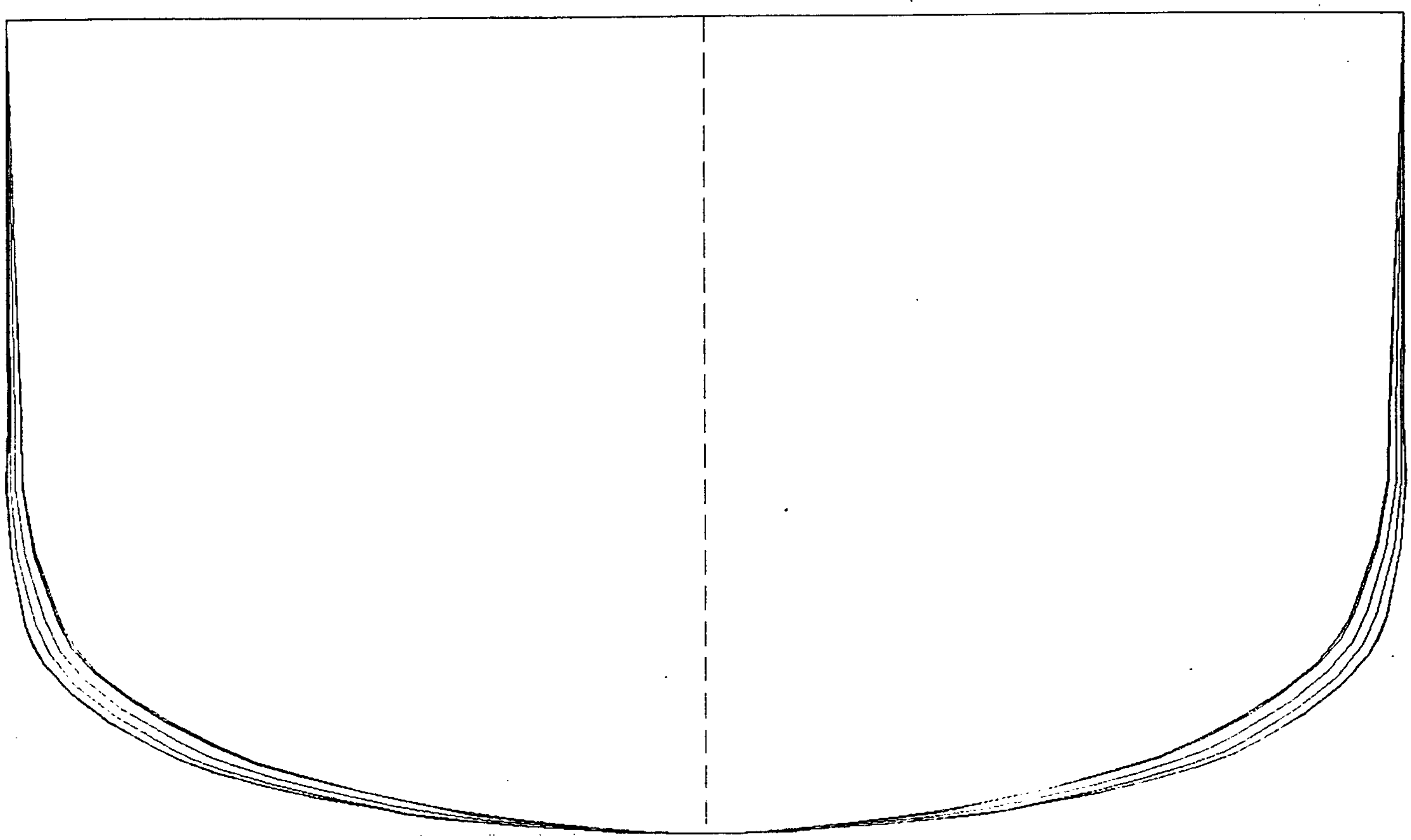
trans:	0.00	1.00	2.39	4.98	7.05	8.84	12.05	14.60	17.13	19.16	21.48	23.23	24.90	26.16
vert:	0.00	0.00	0.10	0.38	0.66	0.95	1.60	2.19	2.88	3.57	4.60	5.52	6.59	7.67
trans:	27.01	28.11	28.84	29.28	29.37	29.67	29.94	30.19	30.50	0.00				
vert:	8.71	11.08	13.35	15.54	17.86	22.32	26.96	31.25	35.70	35.70				

Section at 185.00 aft

trans:	0.00	1.00	2.30	3.85	6.34	8.44	9.90	11.50	14.64	17.35	19.53	21.31	23.38	25.12
vert:	0.00	0.00	0.06	0.18	0.44	0.70	0.92	1.23	1.91	2.60	3.29	4.03	5.09	6.16
trans:	26.48	27.45	27.96	29.14	29.69	29.76	30.13	30.50	0.00					
vert:	7.24	8.31	9.23	12.44	15.29	18.15	26.95	35.70	35.70					



COMP_E.C Isometric Projection



COMP_E.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_E.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 185.00 aft

trans:	0.00	1.00	2.30	3.85	6.34	8.44	9.90	11.50	14.64	17.35	19.53	21.31	23.38	25.12
vert:	0.00	0.00	0.06	0.18	0.44	0.70	0.92	1.23	1.91	2.60	3.29	4.03	5.09	6.16
trans:	26.48	27.45	27.96	29.14	29.69	29.76	30.13	30.50	0.00					
vert:	7.24	8.31	9.23	12.44	15.29	18.15	26.95	35.70	35.70					

Section at 186.85 aft

trans:	0.00	1.00	2.28	3.65	6.22	8.37	10.09	11.40	14.65	17.38	19.59	21.28	23.41	25.16
vert:	0.00	0.00	0.05	0.15	0.40	0.66	0.91	1.16	1.86	2.55	3.24	3.93	5.01	6.09
trans:	26.53	27.52	28.13	29.19	29.76	29.83	30.16	30.50	0.00					
vert:	7.16	8.24	9.32	12.28	15.24	18.20	26.95	35.70	35.70					

Section at 199.10 aft

trans:	0.00	1.00	2.38	3.64	4.70	7.32	9.53	11.42	12.69	13.65	16.28	18.54	20.40	21.77
vert:	0.00	0.00	0.04	0.10	0.18	0.42	0.66	0.93	1.15	1.35	1.93	2.51	3.09	3.62
trans:	23.05	25.40	26.97	28.08	28.79	29.62	30.10	30.12	30.50	0.00				
vert:	4.26	5.63	6.86	8.09	9.57	12.23	15.19	18.16	35.70	35.70				

Section at 211.36 aft

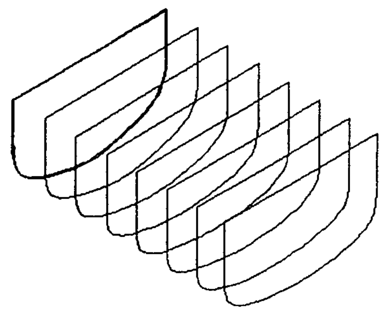
trans:	0.00	1.00	2.50	3.62	4.76	7.39	9.61	11.42	12.82	13.82	16.49	18.78	20.68	22.20
vert:	0.00	0.00	0.04	0.07	0.15	0.35	0.55	0.76	0.96	1.16	1.72	2.27	2.82	3.38
trans:	23.34	25.62	27.35	28.53	29.17	29.96	30.34	30.31	30.50	0.00				
vert:	3.93	5.28	6.62	7.97	9.32	12.28	15.24	18.20	35.70	35.70				

Section at 223.62 aft

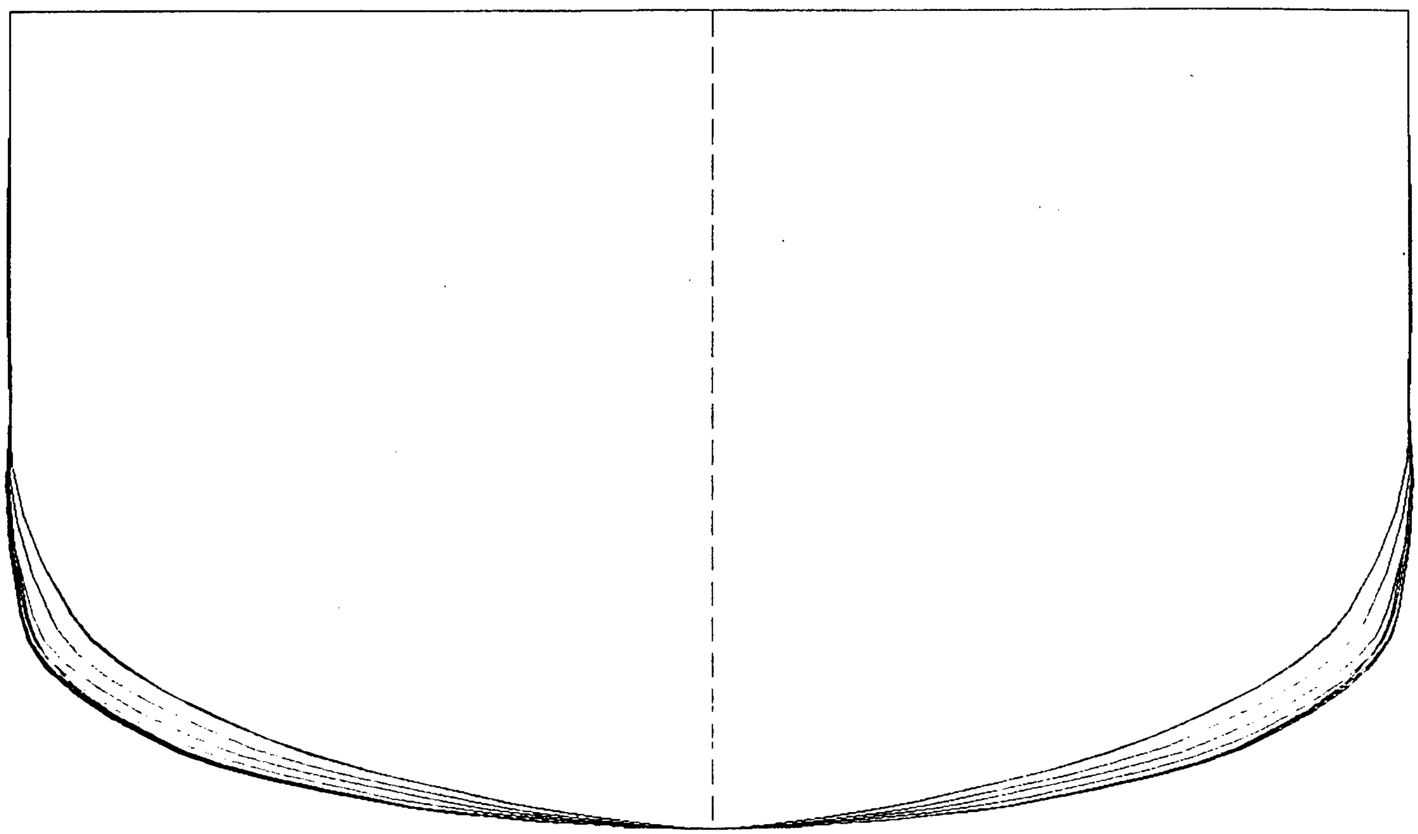
trans:	0.00	1.00	2.51	3.63	4.80	7.48	9.74	11.59	13.04	14.07	16.83	19.19	21.16	22.99
vert:	0.00	0.00	0.04	0.07	0.14	0.34	0.54	0.73	0.93	1.14	1.69	2.24	2.78	3.46
trans:	24.14	25.96	27.60	28.77	29.29	29.62	30.25	30.51	30.42	30.45	30.47	30.50	0.00	
vert:	4.04	5.09	6.32	7.55	8.43	9.28	12.28	15.24	18.20	22.65	31.35	35.70	35.70	

Section at 225.00 aft

trans:	0.00	1.00	2.51	3.63	4.80	7.48	9.75	11.60	13.06	14.09	16.86	19.23	21.20	23.00
vert:	0.00	0.00	0.04	0.07	0.14	0.34	0.54	0.73	0.94	1.14	1.69	2.24	2.79	3.45
trans:	24.16	25.99	27.62	28.78	29.33	29.66	30.27	30.52	30.43	30.46	30.46	30.47	30.50	0.00
vert:	4.03	5.08	6.30	7.51	8.41	9.28	12.28	15.24	18.20	22.64	23.13	31.35	35.70	35.70



COMP_F.C Isometric Projection



COMP_F.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_F.C 85.00% permeability

Offsets in Feet. Read across --->

Section at 225.00 aft

trans:	0.00	1.00	2.51	3.63	4.80	7.48	9.75	11.60	13.06	14.09	16.86	19.23	21.20	23.00
vert:	0.00	0.00	0.04	0.07	0.14	0.34	0.54	0.73	0.94	1.14	1.69	2.24	2.79	3.45
trans:	24.16	25.99	27.62	28.78	29.33	29.66	30.27	30.52	30.43	30.46	30.46	30.47	30.50	0.00
vert:	4.03	5.08	6.30	7.51	8.41	9.28	12.28	15.24	18.20	22.64	23.13	31.35	35.70	35.70

Section at 235.87 aft

trans:	0.00	1.00	2.50	3.64	4.81	7.52	9.82	11.71	13.19	14.25	17.09	19.52	21.53	23.13
vert:	0.00	0.00	0.04	0.07	0.15	0.35	0.55	0.76	0.96	1.16	1.72	2.27	2.82	3.38
trans:	24.32	26.22	27.74	28.86	29.60	29.95	30.44	30.61	30.47	30.51	30.49	30.47	30.50	0.00
vert:	3.93	5.01	6.09	7.16	8.24	9.32	12.28	15.24	18.20	22.58	26.95	31.33	35.70	35.70

Section at 248.13 aft

trans:	0.00	1.00	2.49	3.60	4.75	7.45	9.73	11.60	13.09	17.02	19.45	21.51	23.07	24.26
vert:	0.00	0.00	0.04	0.07	0.14	0.34	0.54	0.73	0.93	1.69	2.24	2.80	3.33	3.87
trans:	26.19	27.71	28.85	29.65	30.00	30.47	30.64	30.50	30.53	30.50	30.47	30.50	0.00	
vert:	4.96	6.02	7.08	8.21	9.32	12.28	15.24	18.20	22.56	26.94	31.32	35.70	35.70	

Section at 260.38 aft

trans:	0.00	1.00	2.45	3.55	4.69	7.34	9.60	11.46	12.93	13.99	16.83	19.26	21.28	22.89
vert:	0.00	0.00	0.04	0.07	0.15	0.35	0.55	0.76	0.96	1.16	1.72	2.27	2.82	3.38
trans:	24.10	26.04	27.59	28.75	29.52	29.89	30.43	30.63	30.50	30.53	30.50	30.47	30.50	0.00
vert:	3.93	5.01	6.09	7.16	8.24	9.32	12.28	15.24	18.20	22.58	26.95	31.33	35.70	35.70

Section at 272.64 aft

trans:	0.00	1.00	2.31	3.50	4.65	7.27	9.54	11.49	12.83	13.89	16.71	19.12	20.93	22.63
vert:	0.00	0.00	0.04	0.10	0.20	0.43	0.67	0.93	1.15	1.35	1.92	2.49	2.99	3.59
trans:	23.94	25.88	27.44	28.64	29.28	29.73	30.38	30.63	30.50	30.54	30.51	30.48	30.50	0.00
vert:	4.19	5.23	6.28	7.36	8.17	9.26	12.23	15.19	18.20	22.58	26.95	31.33	35.70	35.70

Section at 284.89 aft

trans:	0.00	1.00	2.15	3.46	6.03	8.23	10.05	11.49	15.05	18.05	20.47	22.33	24.64	26.50
vert:	0.00	0.00	0.05	0.15	0.40	0.66	0.91	1.16	1.86	2.55	3.24	3.93	5.01	6.09
trans:	27.92	28.90	29.44	30.24	30.59	30.49	30.55	30.52	30.48	30.50	0.00			
vert:	7.16	8.24	9.32	12.28	15.24	18.20	22.58	26.95	31.33	35.70	35.70			

Section at 297.14 aft

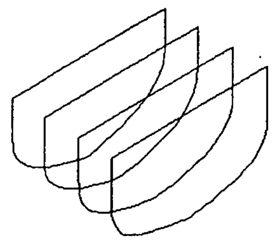
trans:	0.00	1.00	2.04	2.38	5.21	7.42	9.21	12.49	15.07	17.76	19.89	22.10	24.31	26.08
vert:	-0.03	0.03	0.03	0.07	0.38	0.67	0.96	1.60	2.16	2.85	3.52	4.42	5.49	6.56
trans:	27.45	28.35	29.44	30.14	30.50	30.48	30.58	30.55	30.49	30.50	0.00			
vert:	7.65	8.70	11.07	13.43	15.58	18.17	22.58	26.95	31.33	35.70	35.70			

Section at 309.40 aft

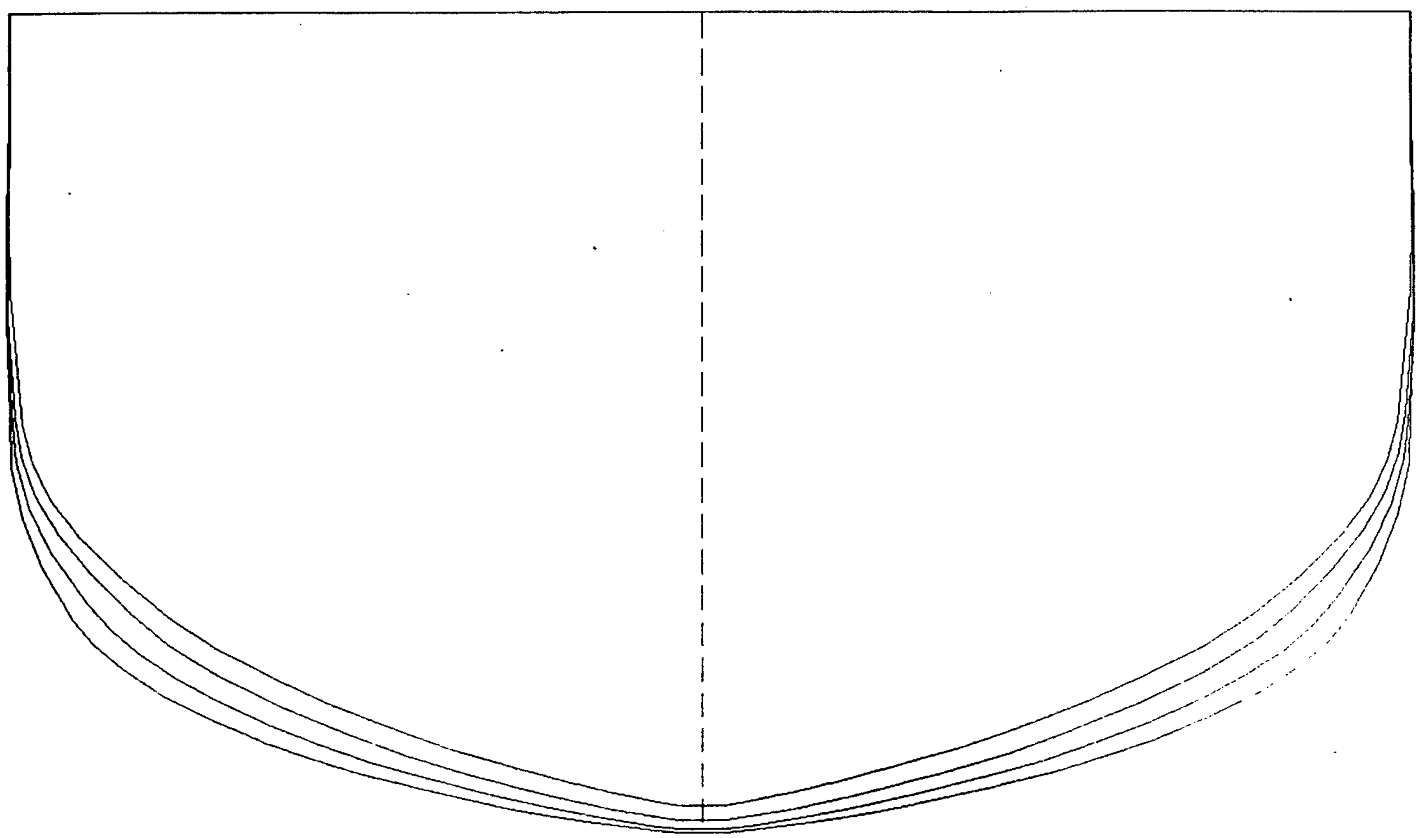
trans:	0.00	1.00	1.98	2.59	5.12	7.28	9.06	12.27	15.06	17.42	19.34	21.82	23.90	25.57
vert:	0.00	0.00	0.07	0.15	0.49	0.83	1.16	1.86	2.55	3.24	3.93	5.01	6.09	7.16
trans:	26.85	27.73	29.00	29.88	30.36	30.45	30.60	30.57	30.50	30.50	0.00			
vert:	8.24	9.3[illegible]	11.54	13.76	15.98	18.20	22.58	26.95	31.33	35.70	35.70			

Section at 310.00 aft

trans:	0.00	1.00	1.98	2.58	5.12	7.27	9.05	12.26	15.05	17.40	19.33	21.80	23.87	25.55
vert:	0.01	0.01	0.08	0.15	0.50	0.84	1.18	1.88	2.57	3.27	3.96	5.04	6.12	7.20
trans:	26.82	27.70	28.99	29.87	30.36	30.45	30.60	30.57	30.50	30.50	0.00			
vert:	8.27	9.35	11.57	13.78	15.99	18.21	22.57	26.95	31.33	35.70	35.70			



COMP_G.C Isometric Projection



COMP_G.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_G.C 85.00% permeability

Offsets in Feet. Read across --->

Section at 310.00 aft

trans:	0.00	1.00	1.98	2.58	5.12	7.27	9.05	12.26	15.05	17.40	19.33	21.80	23.87	25.55
vert:	0.01	0.01	0.08	0.15	0.50	0.84	1.18	1.88	2.57	3.27	3.96	5.04	6.12	7.20
trans:	26.82	27.70	28.99	29.87	30.36	30.45	30.60	30.57	30.50	30.50	0.00			
vert:	8.27	9.35	11.57	13.78	15.99	18.21	22.57	26.95	31.33	35.70	35.70			

Section at 323.29 aft

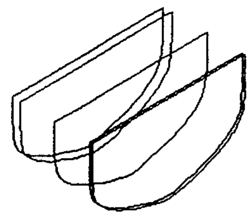
trans:	0.00	1.00	2.02	2.38	5.02	7.10	8.85	12.01	14.78	16.97	19.08	21.30	23.30	24.93
vert:	0.17	0.17	0.28	0.32	0.76	1.15	1.55	2.33	3.12	3.87	4.72	5.76	6.86	7.96
trans:	26.03	27.08	28.65	29.61	30.18	30.39	30.60	30.59	30.51	30.51	0.00			
vert:	8.89	10.06	12.27	14.24	16.23	18.46	22.54	26.95	31.33	35.70	35.70			

Section at 337.17 aft

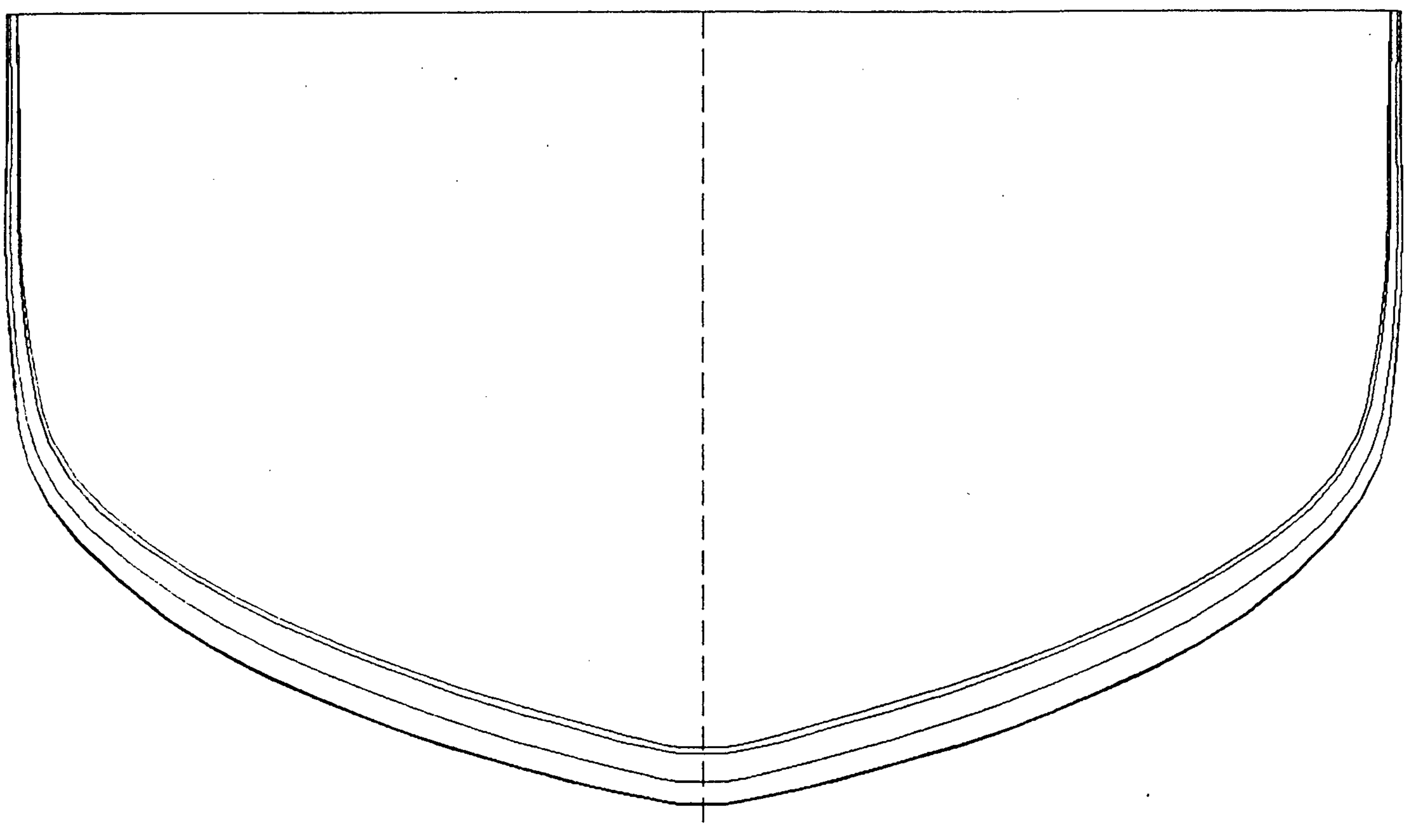
trans:	0.00	1.00	2.05	3.88	5.50	6.92	10.36	13.33	15.82	18.88	21.47	23.58	25.23	26.94
vert:	0.54	0.54	0.69	1.01	1.34	1.67	2.57	3.46	4.36	5.66	6.97	8.28	9.58	11.31
trans:	28.30	29.30	29.94	30.22	30.55	30.57	30.49	30.48	0.00					
vert:	13.03	14.75	16.48	18.20	22.58	26.95	31.33	35.70	35.70					

Section at 350.00 aft

trans:	0.00	1.00	1.93	3.85	5.51	5.62	11.14	13.52	16.59	19.23	21.59	23.54	25.59	25.72
vert:	1.18	1.18	1.32	1.71	2.10	2.12	3.68	4.49	5.70	6.91	8.16	9.42	11.08	11.21
trans:	27.38	28.63	29.46	29.90	30.46	30.49	30.42	30.42	0.00					
vert:	12.89	14.57	16.21	17.83	23.71	26.95	31.31	35.70	35.70					



COMP_H.C Isometric Projection



COMP_H.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_H.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 350.00 aft

trans:	0.00	1.00	1.93	3.85	5.51	5.62	11.14	13.52	16.59	19.23	21.59	23.54	25.59	25.72
vert:	1.18	1.18	1.32	1.71	2.10	2.12	3.68	4.49	5.70	6.91	8.16	9.42	11.08	11.21
trans:	27.38	28.63	29.46	29.90	30.46	30.49	30.42	30.42	0.00					
vert:	12.89	14.57	16.21	17.83	23.71	26.95	31.31	35.70	35.70					

Section at 351.05 aft

trans:	0.00	1.00	1.92	3.85	5.51	8.56	11.20	13.53	16.65	19.26	21.60	23.53	25.62	27.30
vert:	1.23	1.23	1.37	1.77	2.16	2.98	3.78	4.57	5.81	7.01	8.26	9.51	11.20	12.88
trans:	28.57	29.42	29.88	30.25	30.45	30.48	30.41	30.41	0.00					
vert:	14.56	16.19	17.80	20.79	23.80	26.95	31.31	35.70	35.70					

Section at 364.93 aft

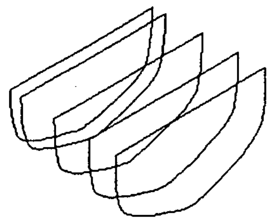
trans:	0.00	1.00	1.75	3.76	5.51	8.36	10.93	13.22	16.19	18.82	21.10	23.03	25.16	26.88
vert:	2.17	2.17	2.30	2.75	3.20	4.01	4.82	5.64	6.82	8.01	9.19	10.38	11.94	13.51
trans:	28.18	29.07	29.55	29.99	30.23	30.28	30.25	30.27	0.00					
vert:	15.07	16.64	18.20	21.12	24.03	26.95	31.33	35.70	35.70					

Section at 378.82 aft

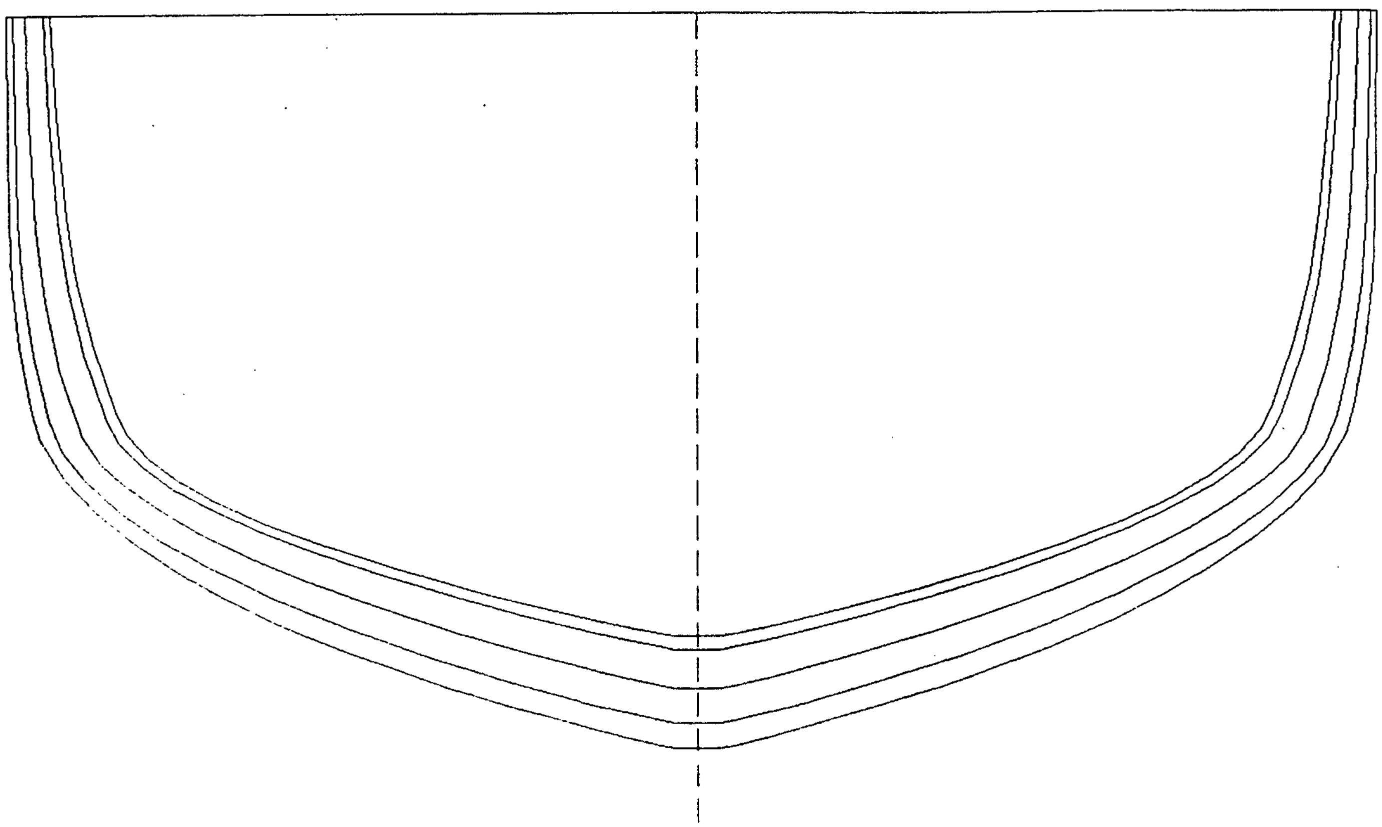
trans:	0.00	1.00	1.65	3.48	5.37	8.30	10.63	12.86	15.63	18.55	20.57	22.47	24.62	26.37
vert:	3.36	3.36	3.49	3.91	4.42	5.27	6.02	6.81	7.88	9.14	10.17	11.26	12.71	14.18
trans:	27.68	28.57	29.03	29.54	29.84	29.94	29.96	30.01	0.00					
vert:	15.65	17.15	18.67	21.50	24.34	26.91	31.43	35.70	35.70					

Section at 382.00 aft

trans:	0.00	1.00	1.63	3.41	5.19	8.27	10.80	12.51	15.49	18.48	20.67	22.13	24.30	26.07
vert:	3.69	3.69	3.80	4.22	4.70	5.59	6.40	7.01	8.13	9.41	10.51	11.35	12.77	14.20
trans:	27.41	28.46	28.82	29.37	29.70	29.82	29.84	29.92	0.00					
vert:	15.63	17.39	18.56	21.41	24.27	26.92	30.40	35.70	35.70					



COMP_I.C Isometric Projection



COMP_I.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_I.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 382.00 aft

trans:	0.00	1.00	1.63	3.41	5.19	8.27	10.80	12.51	15.49	18.48	20.67	22.13	24.30	26.07
vert:	3.69	3.69	3.80	4.22	4.70	5.59	6.40	7.01	8.13	9.41	10.51	11.35	12.77	14.20
trans:	27.41	28.46	28.82	29.37	29.70	29.82	29.84	29.92	0.00					
vert:	15.63	17.39	18.56	21.41	24.27	26.92	30.40	35.70	35.70					

Section at 392.70 aft

trans:	0.00	1.00	1.57	3.17	4.60	8.17	11.37	15.05	18.25	20.98	23.25	25.09	26.52	27.52
vert:	4.77	4.77	4.87	5.25	5.63	6.65	7.67	8.99	10.32	11.65	12.96	14.27	15.58	16.89
trans:	28.11	28.78	29.22	29.42	29.62	0.00								
vert:	18.20	21.12	24.03	26.95	35.70	35.70								

Section at 406.58 aft

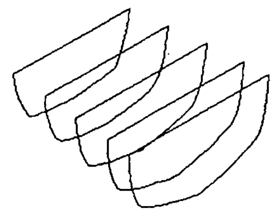
trans:	0.00	1.00	1.54	2.97	4.34	7.72	10.46	13.93	16.91	19.54	21.71	23.49	24.87	25.87
vert:	6.35	6.35	6.45	6.77	7.12	8.03	8.85	9.99	11.10	12.24	13.33	14.41	15.42	16.35
trans:	26.67	27.63	28.28	28.65	28.91	29.07	0.00							
vert:	17.49	20.44	23.51	26.56	31.13	35.70	35.70							

Section at 420.47 aft

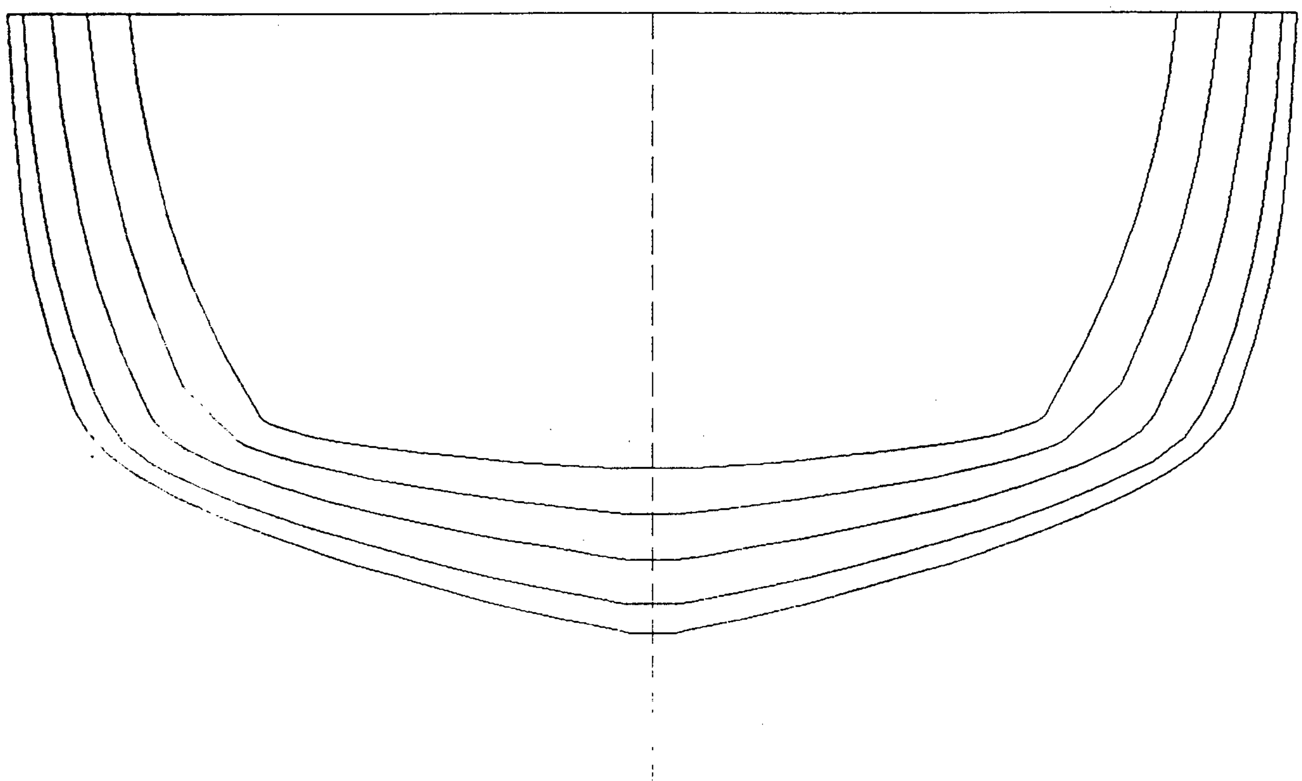
trans:	0.00	1.00	1.47	2.82	4.07	7.21	10.07	13.41	16.34	18.87	20.98	22.71	24.06	25.02
vert:	8.07	8.07	8.16	8.44	8.72	9.49	10.26	11.26	12.26	13.26	14.25	15.24	16.22	17.21
trans:	25.60	26.57	27.28	27.71	28.10	28.33	0.00							
vert:	18.20	21.12	24.03	26.95	31.33	35.70	35.70							

Section at 425.00 aft

trans:	0.00	1.00	1.39	2.80	4.03	7.11	9.91	13.18	16.13	18.63	20.71	22.42	23.75	24.63
vert:	8.67	8.67	8.74	9.02	9.28	10.01	10.74	11.68	12.65	13.61	14.56	15.52	16.53	17.53
trans:	25.17	26.15	26.87	27.33	27.76	28.02	0.00							
vert:	18.50	21.38	24.23	27.10	31.40	35.70	35.70							



COMP_J.C Isometric Projection



COMP_J.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_J.C 85.00% permeability

Offsets in Feet. Read across --->

Section at 425.00 aft

trans:	0.00	1.00	1.39	2.80	4.03	7.11	9.91	13.18	16.13	18.63	20.71	22.42	23.75	24.63
vert:	8.67	8.67	8.74	9.02	9.28	10.01	10.74	11.68	12.65	13.61	14.56	15.52	16.53	17.53
trans:	25.17	26.15	26.87	27.33	27.76	28.02	0.00							
vert:	18.50	21.38	24.23	27.10	31.40	35.70	35.70							

Section at 434.35 aft

trans:	0.00	1.00	1.23	2.75	3.94	6.89	9.58	12.70	15.69	18.12	20.15	21.83	23.11	23.82
vert:	9.91	9.91	9.95	10.21	10.44	11.07	11.71	12.53	13.44	14.33	15.21	16.11	17.17	18.18
trans:	24.29	25.28	26.02	26.54	27.06	27.37	0.00							
vert:	19.13	21.91	24.64	27.40	31.54	35.70	35.70							

Section at 448.23 aft

trans:	0.00	1.00	1.41	2.64	3.76	6.56	9.05	11.90	14.37	16.46	18.57	20.18	21.30	21.92
vert:	11.83	11.83	11.88	12.06	12.24	12.72	13.21	13.83	14.46	15.09	15.87	16.64	17.42	18.20
trans:	23.21	24.23	24.98	25.74	26.16	0.00								
vert:	21.12	24.03	26.95	31.33	35.70	35.70								

Section at 462.11 aft

trans:	0.00	0.70	1.22	1.21	2.68	3.72	6.28	8.14	10.48	12.47	13.88	15.73	16.96	17.73
vert:	13.81	13.81	13.81	13.82	13.97	14.09	14.42	14.69	15.08	15.46	15.74	16.21	16.60	16.88
trans:	18.18	20.50	21.91	22.98	23.76	24.31	24.66	0.00						
vert:	17.14	19.54	22.95	26.16	29.34	32.52	35.70	35.70						

Section at 476.00 aft

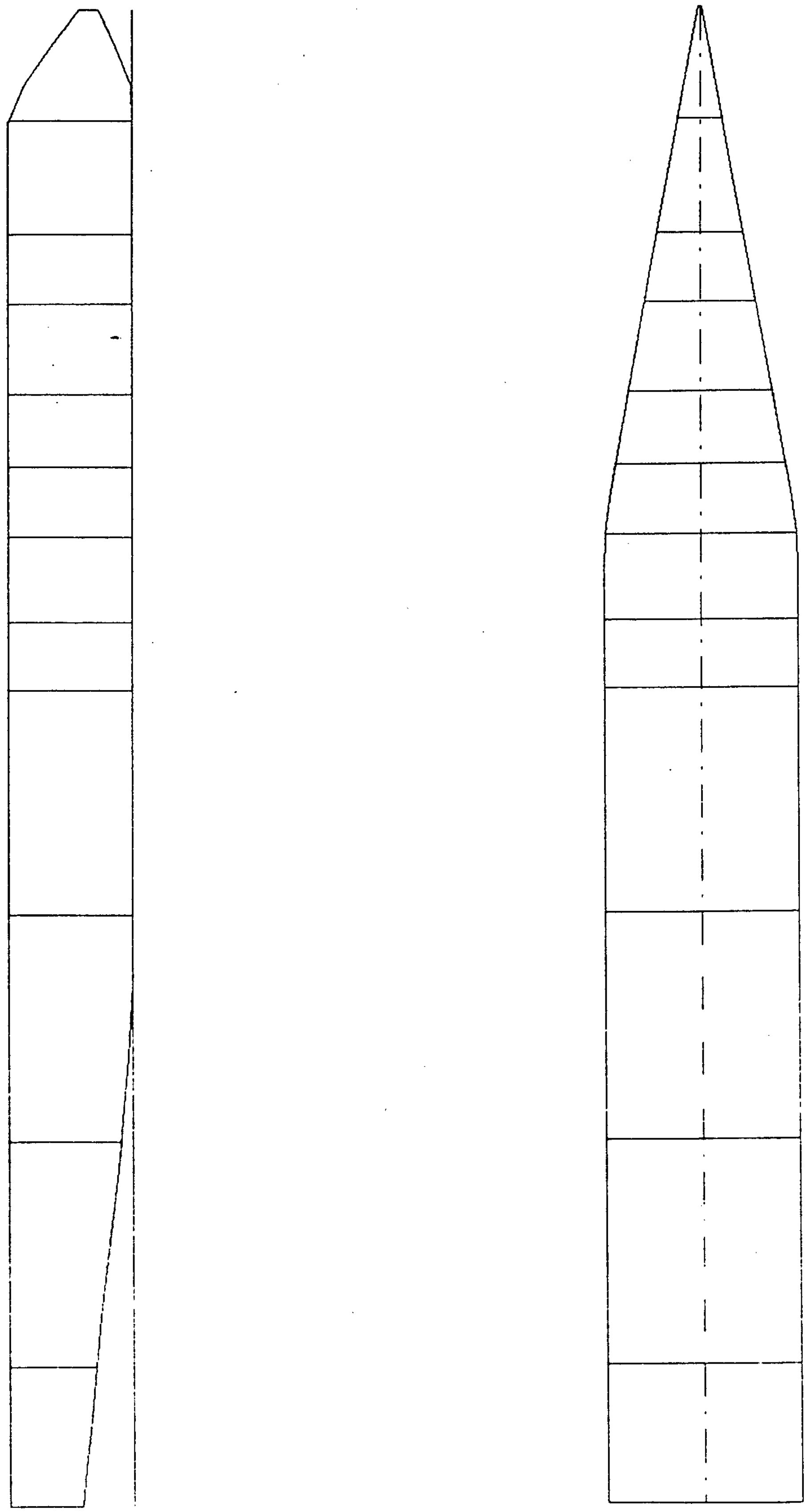
trans:	0.00	1.00	1.74	1.56	2.81	3.76	6.04	7.96	10.13	11.98	13.51	15.03	16.16	16.90
vert:	15.86	15.86	15.87	15.87	15.94	16.01	16.18	16.36	16.59	16.82	17.06	17.34	17.63	17.91
trans:	17.25	18.85	20.17	21.20	21.99	22.54	22.88	0.00						
vert:	18.20	21.12	24.03	26.95	29.87	32.78	35.70	35.70						

```
report WALLFL
CLEAR
enter fl
READ WALLSID4.GF
title WALLSIDE w/ adjusted margin / perm

marg -28.25, .25,  476, .25

perm -28.25, .95, 110, .6, 185, .95, 225, .85, 350, .95, 425, .85, 476, .85


vcg 19.63
fl 18.2
```

```
ENTER PM
CLEAR
READ WALLSID2.GF

DELETE FOREPEAK.C
CREATE FOREPEAK.C
ENDS -28.25, 10
FIT HULL
PERM .95
/

DELETE COMP_A.C
CREATE COMP_A.C
ENDS 10, 35
FIT HULL
PERM .95
/

DELETE COMP_B.C
CREATE COMP_B.C
ENDS 35, 75
FIT HULL
PERM .95
/
DELETE COMP_C.C
CREATE COMP_C.C
ENDS 75, 110
FIT HULL
PERM .95
/
DELETE COMP_CB.C
CREATE COMP_CB.C
ENDS 110, 150
FIT HULL
PERM .60
/
DELETE COMP_DA.C
CREATE COMP_DA.C
ENDS 150, 185
FIT HULL
PERM .60
/
DELETE COMP_E.C
CREATE COMP_E.C
ENDS 185, 225
FIT HULL
PERM .95
/
DELETE COMP_F.C
CREATE COMP_F.C
ENDS 225, 310
FIT HULL
PERM .85
/
```

```
DELETE COMP_G.C
CREATE COMP_G.C
ENDS 310, 350
FIT HULL
PERM .85
/
DELETE COMP_H.C
CREATE COMP_H.C
ENDS 350, 382
FIT HULL
PERM .95
/
DELETE COMP_I.C
CREATE COMP_I.C
ENDS 382, 425
FIT HULL
PERM .95
/
DELETE COMP_J.C
CREATE COMP_J.C
ENDS 425, 476
FIT HULL
PERM .85
/

WRITE WALLSID4.GF
DISP
```

```
proj wallside
read WALLSID4.gf
report
\\\\Damage Stability Wallsided Hull\

lim gm > 3.
lim angle from equ to ra0 > 30 'sets limits in the ra curves

macro dam1    'sets the macro for the type of tank setting
type (comp_c.c, comp_cb.c, comp_da.c) flood    'flood not damage
/
macro dam2    'sets macro for next set of tanks
type (comp_da.c, comp_e.c, comp_f.c) flood    'flood the comp's
/
macro dam3    'sets macro for next set of tanks
type (comp_h.c, comp_i.c, comp_j.c) flood
/

macro case    'case macro for a major status update
page
solve
stat we, di, wp:to, free
page
ra 0,5,...,90 /lim
type (*) intact
/

draft 18.2
vcg 19.63
sol we, lcg
\\-------Intact Stability-------\
.case   'run case macro before damage

.dam1   'run dam1 macro to damage tanks listed
'a SOLVE command general solve finds how the vessel floats
.case   'now run case again to get new status

.dam2
.case

.dam3
.case

view
```



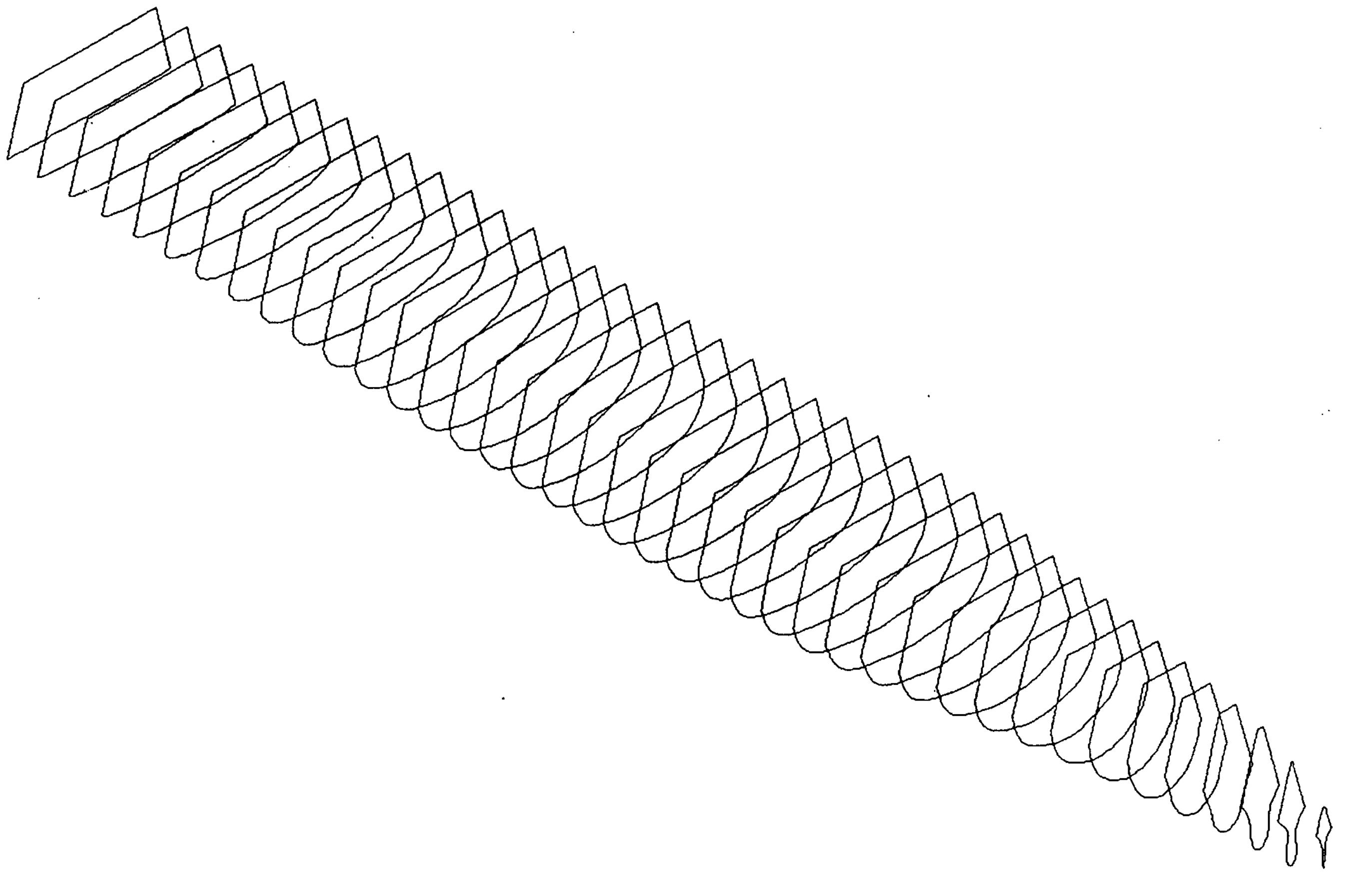
Scale = 1:650

Comments

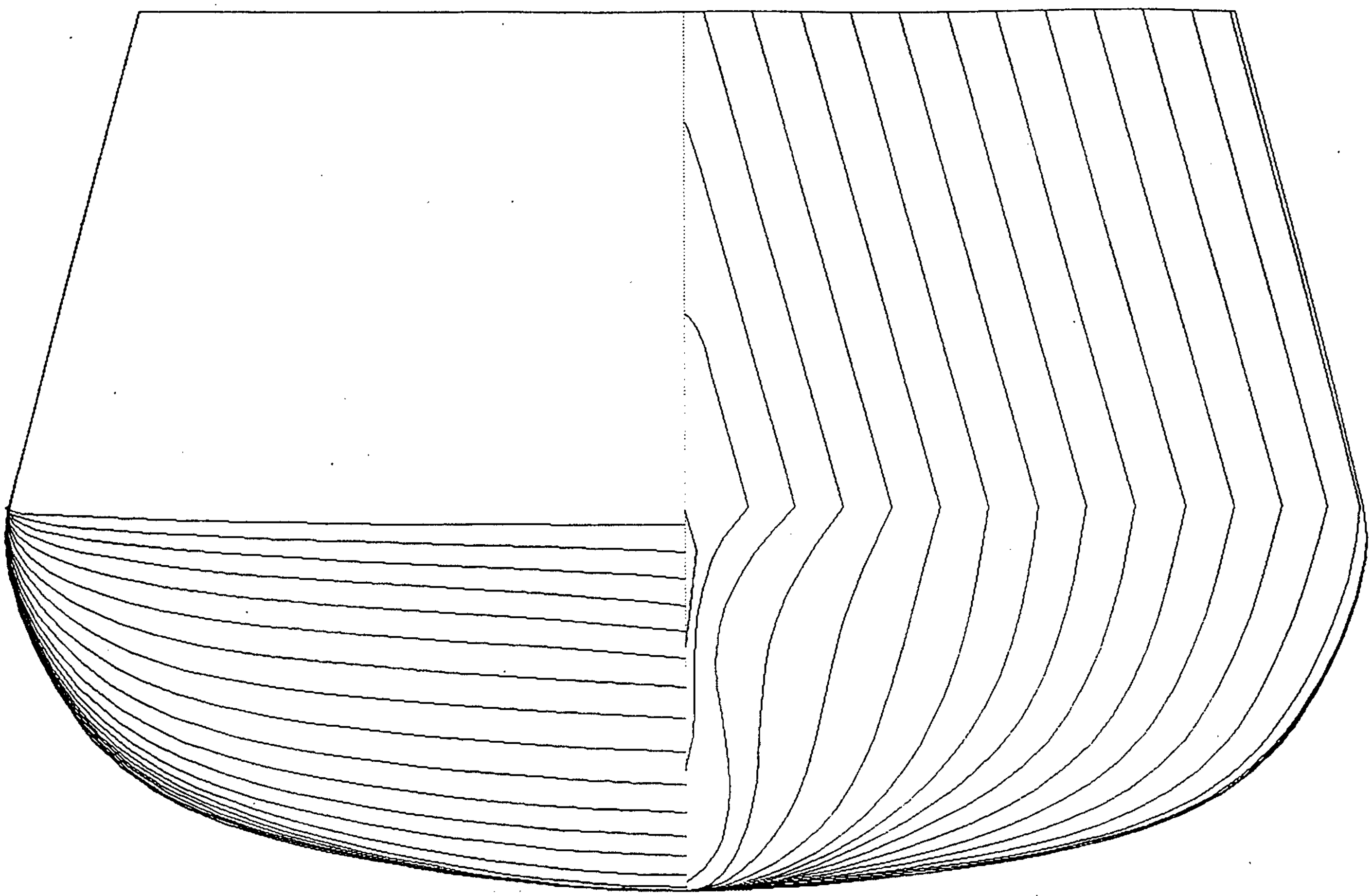
Offsets derived from SHCP data.

Part Name	Class	Description	Location	Volume
HULL	HULL		0.00 to 475.72a	
FOREPEAK.C	TANK		0.00 to 35.00a	3815.56
COMP_A.C	TANK		35.00a to 72.00a	19877.4
COMP_B.C	TANK		72.00a to 94.00a	20387.2
COMP_C.C	TANK		94.00a to 122.00a	34687.2
COMP_CB.C	TANK		122.00a to 144.00a	21669.4
COMP_DA.C	TANK		144.00a to 166.00a	25485.1
COMP_E.C	TANK		166.00a to 194.00a	55511.6
COMP_F.C	TANK		194.00a to 216.00a	43885.8
COMP_G.C	TANK		216.00a to 288.00a	128126
COMP_H.C	TANK		288.00a to 360.00a	123405
COMP_I.C	TANK		360.00a to 432.00a	114283
COMP_J.C	TANK		432.00a to 475.72a	50104.9

Locations in Feet fwd/aft of the origin. Volumes in cubic Feet.



HULL Isometric Projection



Stbd Stbd

HULL Body Plan (1 component)
Scale = 1:100

Component 1: HULL.C

Offsets in Feet. Read across --->

Section at	0.00													
trans:	0.00	0.53	0.00	0.00										
vert:	10.93	15.27	17.03	17.03										
Section at	11.89 aft													
trans:	0.00	0.05	0.34	0.44	0.42	0.53	0.80	1.26	1.74	2.86	1.22	0.96	0.59	0.22
vert:	5.44	5.60	7.02	8.23	10.33	12.23	13.59	14.96	15.82	17.19	23.25	24.22	25.19	25.68
trans:	0.00													
vert:	25.73													
Section at	23.79 aft													
trans:	0.00	0.78	1.32	1.64	1.93	1.96	1.89	1.61	1.44	1.37	1.51	1.79	2.34	3.13
vert:	0.42	1.00	1.69	2.37	3.77	4.55	5.81	7.89	9.06	10.23	11.78	12.80	13.96	15.16
trans:	4.05	4.93	4.44	0.74	0.41	0.19	0.00							
vert:	16.26	17.19	18.96	32.36	33.36	34.05	34.28							
Section at	35.68 aft													
trans:	0.00	0.31	1.10	1.71	2.19	2.73	2.99	3.17	3.25	3.35	3.50	3.56	3.76	4.07
vert:	0.03	0.05	0.32	0.85	1.58	2.90	3.84	4.97	6.09	7.80	9.51	9.97	11.04	12.12
trans:	4.55	5.17	5.88	6.67	7.07	2.36	0.90	0.00						
vert:	13.28	14.44	15.55	16.67	17.19	34.11	39.30	39.30						

Section at 47.57 aft

trans:	0.00	0.86	1.70	2.50	3.24	3.94	4.49	4.99	5.35	5.79	6.40	6.66	6.97	7.41
vert:	0.00	0.11	0.44	0.95	1.62	2.45	3.28	4.28	5.28	6.88	9.60	10.72	11.83	13.13
trans:	7.92	8.55	9.23	3.08	0.00									
vert:	14.43	15.81	17.19	39.30	39.30									

Section at 59.47 aft

trans:	0.00	0.90	1.96	2.99	4.02	5.00	5.89	6.67	7.35	7.90	8.41	8.82	9.20	9.77
vert:	0.00	0.05	0.34	0.75	1.31	2.00	2.80	3.71	4.75	5.79	6.92	8.05	9.21	11.22
trans:	10.56	11.41	9.01	5.26	0.00									
vert:	14.21	17.19	25.83	39.30	39.30									

Section at 71.36 aft

trans:	0.00	0.96	2.23	3.62	4.63	5.80	6.91	7.93	8.84	9.68	10.39	11.03	11.56	12.03
vert:	0.00	0.05	0.29	0.72	1.15	1.77	2.52	3.38	4.33	5.40	6.47	7.64	8.81	10.04
trans:	12.40	12.74	13.03	13.59	7.44	0.00								
vert:	11.26	12.62	13.99	17.19	39.30	39.30								

Section at 83.25 aft

trans:	0.00	1.22	1.63	1.25	2.54	4.03	5.14	6.52	7.66	8.89	9.94	11.01	11.90	12.74
vert:	0.00	0.02	0.05	0.07	0.28	0.70	1.12	1.77	2.42	3.26	4.09	5.10	6.11	7.23
trans:	13.46	14.05	14.56	14.95	15.28	15.54	15.77	9.62	0.00					
vert:	8.43	9.71	11.09	12.47	14.01	15.54	17.19	39.30	39.30					

Section at 95.14 aft

trans:	0.00	1.42	1.47	2.92	4.54	5.76	7.23	8.50	9.89	11.08	12.04	12.86	13.91	14.83
vert:	0.00	0.05	0.08	0.31	0.74	1.16	1.78	2.40	3.17	3.94	4.63	5.33	6.37	7.52
trans:	15.24	15.95	16.53	17.00	17.37	17.95	11.80	0.00						
vert:	8.14	9.47	10.91	12.45	14.00	17.19	39.30	39.30						

Section at 107.04 aft

trans:	0.00	1.01	1.71	3.08	4.18	4.99	6.69	8.10	9.61	11.15	12.49	13.82	15.05	16.16
vert:	0.00	0.06	0.12	0.33	0.54	0.75	1.26	1.77	2.39	3.11	3.83	4.67	5.63	6.71
trans:	17.11	17.90	18.55	19.06	19.49	20.13	13.98	0.00						
vert:	7.94	9.33	10.84	12.44	14.04	17.19	39.30	39.30						

Section at 118.93 aft

trans:	0.00	1.73	3.04	3.91	5.33	6.55	7.58	9.43	11.00	12.69	14.13	15.56	16.86	18.04
vert:	0.00	0.15	0.31	0.46	0.73	0.99	1.26	1.81	2.35	3.02	3.70	4.52	5.46	6.54
trans:	19.05	19.90	20.60	21.17	21.63	22.31	16.16	0.00						
vert:	7.79	9.21	10.77	12.41	14.05	17.19	39.30	39.30						

Section at 130.82 aft

trans:	0.00	1.80	3.32	4.56	6.15	7.54	8.74	10.78	12.52	13.92	15.11	16.64	18.05	19.32
vert:	0.00	0.17	0.33	0.50	0.75	1.01	1.26	1.77	2.27	2.75	3.22	3.95	4.80	5.80
trans:	20.44	20.94	21.84	22.58	23.20	23.71	24.12	24.49	18.34	0.00				
vert:	6.96	7.62	9.08	10.69	12.37	14.05	15.62	17.19	39.30	39.30				

Section at 142.72 aft

trans:	0.00	2.02	3.76	5.22	7.02	8.59	9.93	12.18	14.06	15.53	16.80	18.39	19.83	21.12
vert:	0.01	0.18	0.35	0.52	0.76	1.00	1.24	1.72	2.19	2.63	3.07	3.77	4.60	5.59
trans:	22.26	22.79	23.72	24.52	25.20	25.77	26.65	20.52	0.00					
vert:	6.76	7.44	8.94	10.59	12.32	14.05	17.19	39.30	39.30					

Section at 154.61 aft

trans:	0.00	2.16	4.10	5.83	7.77	9.50	11.02	12.73	14.22	15.49	17.05	18.38	20.03	21.52
vert:	0.01	0.19	0.36	0.54	0.77	0.99	1.22	1.51	1.79	2.08	2.49	2.91	3.58	4.39
trans:	22.85	24.03	24.59	25.59	26.46	27.21	27.85	28.33	28.75	22.69	0.00			
vert:	5.37	6.55	7.24	8.79	10.50	12.27	14.05	15.62	17.19	39.30	39.30			

Section at 166.50 aft

trans:	0.00	3.33	6.36	9.09	11.06	12.78	14.25	16.52	18.21	19.55	21.28	22.84	24.24	25.53
vert:	0.01	0.29	0.56	0.84	1.08	1.31	1.55	1.97	2.37	2.76	3.40	4.19	5.16	6.35
trans:	26.15	27.28	27.81	28.28	28.73	29.13	29.77	30.18	30.33	24.41	0.00			
vert:	7.06	8.65	9.52	10.40	11.32	12.23	14.04	15.73	17.19	39.30	39.30			

Section at 178.40 aft

trans:	0.00	2.34	4.45	6.32	8.46	10.37	12.02	13.89	15.52	16.91	18.64	20.00	21.75	23.32
vert:	0.01	0.17	0.32	0.48	0.69	0.89	1.10	1.37	1.64	1.91	2.31	2.70	3.34	4.14
trans:	24.75	26.06	26.70	27.33	27.89	28.45	28.95	29.40	30.12	30.56	30.65	30.51	30.29	28.76
vert:	5.11	6.31	7.02	7.82	8.61	9.49	10.38	11.30	13.13	14.88	15.73	17.19	18.01	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 190.29 aft

trans:	0.00	2.52	4.65	6.37	8.55	10.49	12.18	14.05	15.71	17.16	18.90	20.28	22.02	23.57
vert:	0.01	0.15	0.28	0.42	0.63	0.83	1.04	1.32	1.60	1.88	2.29	2.70	3.36	4.16
trans:	24.96	26.24	26.86	28.01	28.55	29.03	29.46	30.16	30.57	30.65	30.51	30.29	28.76	24.61
vert:	5.14	6.34	7.06	8.64	9.52	10.41	11.32	13.15	14.89	15.73	17.19	18.01	23.74	39.30
trans:	0.00													
vert:	39.30													

Section at 202.18 aft

trans:	0.00	2.11	3.88	5.31	6.41	8.70	10.66	12.30	14.22	15.91	17.35	18.47	19.47	20.48
vert:	0.01	0.10	0.20	0.29	0.38	0.59	0.81	1.02	1.31	1.60	1.89	2.15	2.41	2.72
trans:	22.24	23.78	25.16	26.42	26.98	28.10	28.62	29.09	29.51	30.19	30.58	30.65	30.51	28.76
vert:	3.40	4.22	5.22	6.44	7.11	8.69	9.57	10.45	11.36	13.18	14.91	15.75	17.19	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 214.07 aft

trans:	0.00	2.20	4.00	5.41	6.43	8.77	10.75	12.37	14.34	16.04	17.47	18.60	19.61	20.61
vert:	0.01	0.10	0.19	0.28	0.37	0.59	0.80	1.02	1.32	1.62	1.92	2.19	2.46	2.78
trans:	22.36	23.91	25.29	26.53	27.07	28.17	28.68	29.55	30.21	30.58	30.65	30.51	30.29	28.76
vert:	3.46	4.29	5.29	6.51	7.18	8.76	9.63	11.41	13.21	14.93	15.76	17.19	18.01	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 225.97 aft

trans:	0.00	2.30	4.14	5.52	8.82	10.82	12.42	14.39	16.10	17.55	18.67	19.70	20.69	22.47
vert:	0.01	0.10	0.18	0.27	0.59	0.81	1.04	1.35	1.67	1.98	2.25	2.53	2.85	3.55
trans:	24.00	25.37	26.59	27.15	28.23	29.17	29.93	30.44	30.65	30.51	30.29	28.76	24.61	0.00
vert:	4.39	5.39	6.61	7.27	8.84	10.58	12.38	14.15	15.79	17.19	18.01	23.74	39.30	39.30

Section at 237.86 aft

trans:	0.00	2.48	4.37	5.69	6.43	8.77	10.77	12.44	14.39	16.11	17.60	19.35	20.78	22.53
vert:	0.01	0.10	0.18	0.27	0.36	0.60	0.83	1.07	1.40	1.73	2.06	2.51	2.96	3.66
trans:	24.06	25.41	26.62	27.21	28.28	29.21	29.95	30.45	30.65	30.51	30.29	28.76	24.61	0.00
vert:	4.49	5.48	6.68	7.38	8.94	10.66	12.45	14.19	15.81	17.19	18.01	23.74	39.30	39.30

Section at 249.75 aft

trans:	0.00	2.46	4.35	5.67	6.42	8.82	10.83	12.44	14.40	16.13	17.64	19.38	20.84	22.60
vert:	0.01	0.10	0.18	0.27	0.36	0.61	0.86	1.11	1.45	1.80	2.14	2.61	3.08	3.79
trans:	24.13	25.49	26.70	27.28	28.33	29.25	29.97	30.45	30.65	30.51	30.29	24.61	0.00	
vert:	4.63	5.63	6.82	7.52	9.07	10.77	12.52	14.24	15.83	17.19	18.01	39.30	39.30	

Section at 261.65 aft

trans:	0.00	1.50	2.53	3.22	5.28	7.01	8.41	9.49	11.69	13.59	15.19	17.68	19.45	20.90
vert:	0.01	0.04	0.07	0.12	0.27	0.41	0.56	0.71	1.03	1.35	1.67	2.24	2.73	3.22
trans:	21.84	23.49	24.95	26.23	27.35	28.39	29.29	30.00	30.47	30.65	30.51	30.29	28.76	24.61
vert:	3.59	4.38	5.31	6.40	7.69	9.21	10.88	12.60	14.29	15.85	17.19	18.01	23.74	39.30
trans:	0.00													
vert:	39.30													

Section at 273.54 aft

trans:	0.00	1.49	2.55	3.20	4.49	5.54	6.37	8.74	10.76	12.44	14.43	16.19	17.71	19.48
vert:	0.00	0.04	0.07	0.11	0.19	0.27	0.35	0.63	0.92	1.20	1.59	1.97	2.36	2.87
trans:	20.96	21.90	23.57	25.01	26.29	27.42	28.45	29.33	30.02	30.48	30.66	30.51	30.29	28.76
vert:	3.38	3.76	4.57	5.51	6.60	7.87	9.37	11.00	12.69	14.34	15.87	17.19	18.01	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 285.43 aft

trans:	0.00	1.36	2.95	3.18	4.45	5.50	6.36	8.07	9.46	11.67	13.59	15.21	17.73	19.50
vert:	0.00	0.03	0.08	0.10	0.19	0.27	0.36	0.56	0.76	1.13	1.49	1.85	2.49	3.02
trans:	21.00	21.96	23.61	25.07	26.34	27.48	28.50	29.37	30.04	30.49	30.66	30.51	24.61	0.00
vert:	3.55	3.94	4.77	5.70	6.79	8.06	9.52	11.12	12.77	14.39	15.89	17.19	39.30	39.30

Section at 297.33 aft

trans:	0.00	1.36	2.95	3.18	4.97	6.35	8.05	9.46	11.63	13.55	15.22	17.75	19.51	21.03
vert:	0.03	0.06	0.11	0.13	0.27	0.41	0.62	0.83	1.22	1.60	1.98	2.65	3.20	3.74
trans:	21.98	23.63	25.10	26.37	27.49	28.51	29.37	30.05	30.49	30.65	30.51	30.25	29.77	24.61
vert:	4.13	4.96	5.90	6.99	8.22	9.67	11.23	12.85	14.43	15.90	17.19	18.17	19.96	39.30
trans:	0.00													
vert:	39.30													

Section at 309.22 aft

trans:	0.00	1.48	2.50	3.19	4.48	5.54	6.37	8.10	9.48	11.69	13.61	15.24	17.76	19.51
vert:	0.20	0.23	0.26	0.31	0.41	0.50	0.60	0.81	1.03	1.42	1.81	2.20	2.88	3.4
trans:	21.03	22.82	24.37	25.73	26.93	27.49	28.50	29.37	30.04	30.48	30.65	30.51	29.77	24.6
vert:	3.96	4.74	5.61	6.60	7.74	8.39	9.80	11.34	12.92	14.47	15.92	17.19	19.96	39.3
trans:	0.00													
vert:	39.30													

Section at 321.11 aft

trans:	0.00	1.61	2.68	4.99	6.42	8.84	10.87	12.50	14.47	16.22	17.77	19.52	21.02	21.9
vert:	0.73	0.77	0.81	0.98	1.12	1.42	1.73	2.03	2.43	2.84	3.24	3.76	4.28	4.6
trans:	23.63	25.08	26.34	27.46	28.48	29.35	30.02	30.47	30.65	30.51	29.77	24.61	0.00	
vert:	5.46	6.36	7.40	8.58	9.96	11.46	13.00	14.52	15.94	17.19	19.96	39.30	39.30	

Section at 333.01 aft

trans:	0.00	2.42	4.31	5.65	6.46	8.83	10.85	12.52	14.47	16.22	17.76	19.50	20.98	21.9
vert:	1.59	1.68	1.78	1.87	1.96	2.22	2.48	2.74	3.09	3.45	3.80	4.27	4.75	5.1
trans:	23.59	25.02	26.30	27.42	28.44	29.32	30.00	30.46	30.64	30.51	27.09	24.61	0.00	
vert:	5.85	6.71	7.70	8.85	10.17	11.62	13.11	14.58	15.96	17.19	29.99	39.30	39.30	

Section at 344.90 aft

trans:	0.00	2.20	4.00	5.42	6.45	8.80	10.81	12.48	14.46	16.20	17.70	19.48	20.92	22.
vert:	2.49	2.58	2.67	2.76	2.85	3.08	3.31	3.54	3.86	4.17	4.49	4.92	5.35	6.
trans:	24.23	25.59	26.80	27.36	28.40	29.28	29.98	30.45	30.64	30.51	30.29	24.61	0.00	
vert:	6.75	7.61	8.62	9.19	10.45	11.82	13.24	14.65	15.99	17.19	18.01	39.30	39.30	

Section at 356.79 aft

trans:	0.00	2.08	3.82	5.22	6.30	8.72	10.73	12.31	14.34	16.09	17.55	19.32	20.79	22.57
vert:	3.53	3.62	3.71	3.79	3.88	4.09	4.29	4.50	4.78	5.06	5.34	5.72	6.11	6.70
trans:	24.12	25.49	26.71	27.28	28.32	29.23	29.94	30.42	30.63	30.51	29.77	24.61	0.00	
vert:	7.39	8.18	9.11	9.64	10.81	12.08	13.42	14.75	16.03	17.19	19.96	39.30	39.30	

Section at 368.68 aft

trans:	0.00	2.01	3.67	5.00	6.00	8.23	10.22	11.98	13.96	15.73	17.29	18.93	20.32	21.47
vert:	4.80	4.88	4.96	5.03	5.11	5.29	5.47	5.65	5.89	6.14	6.38	6.69	6.99	7.30
trans:	23.17	24.66	25.98	27.16	28.23	29.15	29.89	30.39	30.62	30.51	30.29	24.61	0.00	
vert:	7.87	8.53	9.30	10.22	11.27	12.43	13.65	14.88	16.08	17.19	18.01	39.30	39.30	

Section at 380.58 aft

trans:	0.00	2.21	4.07	5.58	7.79	9.77	11.51	13.59	15.40	16.95	18.65	20.07	21.22	22.95
vert:	6.23	6.33	6.42	6.52	6.67	6.83	6.98	7.19	7.39	7.60	7.86	8.12	8.38	8.86
trans:	24.46	25.80	27.01	28.10	29.06	29.82	30.35	30.60	30.60	30.29	24.61	0.00		
vert:	9.43	10.10	10.90	11.82	12.85	13.94	15.05	16.15	16.67	18.01	39.30	39.30		

Section at 392.47 aft

trans:	0.00	3.29	6.22	8.80	11.02	13.07	14.92	16.57	18.29	19.74	20.94	22.39	23.52	24.96
vert:	7.72	7.89	8.06	8.22	8.39	8.56	8.74	8.91	9.12	9.34	9.55	9.87	10.19	10.71
trans:	26.23	26.83	27.95	28.94	29.74	30.30	30.58	30.59	30.51	28.76	24.61	0.00		
vert:	11.32	11.66	12.45	13.33	14.27	15.25	16.23	16.71	17.19	23.74	39.30	39.30		

Section at 404.36 aft

trans:	0.00	5.38	10.59	16.21	17.95	19.42	20.64	21.97	23.08	23.98	25.49	26.62	27.78	28.80
vert:	9.14	9.48	9.82	10.27	10.45	10.62	10.80	11.04	11.27	11.51	12.01	12.50	13.14	13.86
trans:	29.64	30.24	30.55	30.58	30.29	28.76	24.61	0.00						
vert:	14.64	15.47	16.33	16.76	18.01	23.74	39.30	39.30						

Section at 416.26 aft

trans:	0.00	3.07	6.50	10.29	15.91	17.58	19.05	20.34	21.64	22.76	23.70	25.22	26.38	27.66
vert:	10.43	10.69	10.94	11.20	11.62	11.77	11.92	12.07	12.25	12.44	12.62	13.00	13.39	13.91
trans:	28.64	29.53	30.17	30.52	30.56	30.51	24.61	0.00						
vert:	14.43	15.05	15.73	16.44	16.82	17.19	39.30	39.30						

Section at 428.15 aft

trans:	0.00	5.88	15.66	18.06	20.12	21.83	23.48	24.80	26.11	27.42	28.45	29.39	30.09	30.48
vert:	11.64	12.16	12.87	13.06	13.26	13.45	13.69	13.94	14.24	14.62	15.01	15.48	16.00	16.57
trans:	30.56	30.29	28.76	24.61	0.00									
vert:	16.88	18.01	23.74	39.30	39.30									

Section at 440.04 aft

trans:	0.00	1.86	4.07	6.62	9.54	12.80	15.45	17.83	19.90	21.66	23.10	24.63	25.84	27.17
vert:	12.82	13.01	13.20	13.39	13.58	13.77	13.94	14.10	14.26	14.42	14.58	14.78	14.99	15.26
trans:	28.26	29.70	30.29	30.53	30.51	30.29	28.76	24.61	0.00					
vert:	15.54	16.09	16.50	16.94	17.19	18.01	23.74	39.30	39.30					

Section at 451.94 aft

trans:	0.00	1.08	2.42	4.03	5.90	10.64	15.29	17.62	19.66	21.41	22.87	25.62	26.98	28.10
vert:	14.00	14.10	14.21	14.31	14.41	14.64	14.87	14.99	15.11	15.22	15.34	15.62	15.81	16.00
trans:	29.19	30.23	30.51	30.51	28.76	24.61	0.00							
vert:	16.25	16.67	17.01	17.19	23.74	39.30	39.30							

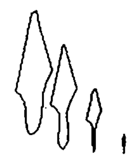
Section at 463.83 aft

trans:	0.00	1.66	3.74	6.26	9.20	15.16	18.07	20.56	22.62	24.25	25.45	26.96	28.15	29.74
vert:	15.19	15.27	15.36	15.44	15.53	15.71	15.80	15.89	15.99	16.08	16.17	16.30	16.43	16.71
trans:	30.42	30.65	30.48	29.77	27.09	24.61	0.00							
vert:	16.97	17.22	17.29	19.96	29.99	39.30	39.30							

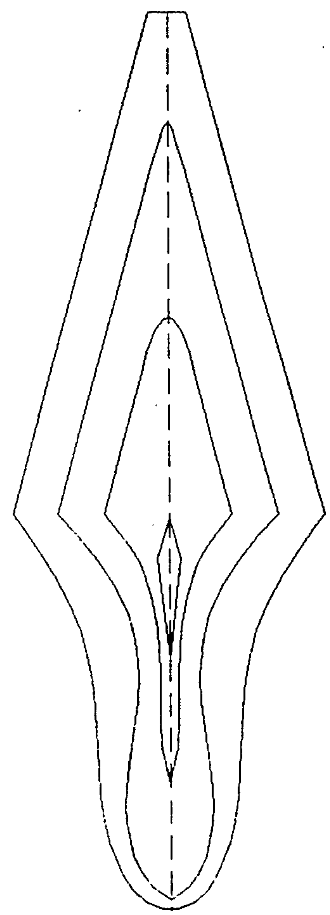
Section at 475.72 aft

trans:	0.00	4.24	7.76	13.28	15.06	18.95	22.27	25.02	27.20	28.81	29.85	30.32	30.50	24.61
vert:	16.41	16.43	16.44	16.47	16.49	16.57	16.65	16.73	16.82	16.90	16.98	17.06	17.19	39.30

trans:	0.00
vert:	39.30



FOREPEAK.C Isometric Projection



FOREPEAK.C Body Plan (1 component)
Scale = 1:100

Component 1: FOREPEAK.C 95.00% permeability

Offsets in Feet. Read across --->

Section at	0.00			
trans:	0.00	0.53	0.00	0.00
vert:	10.93	15.27	17.03	17.03

Section at 11.89 aft

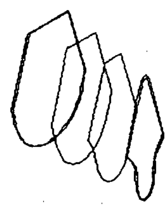
trans:	0.00	0.05	0.34	0.44	0.42	0.53	0.80	1.26	1.74	2.86	1.22	0.96	0.59	0.22
vert:	5.44	5.60	7.02	8.23	10.33	12.23	13.59	14.96	15.82	17.19	23.25	24.22	25.19	25.68
trans:	0.00													
vert:	25.73													

Section at 23.79 aft

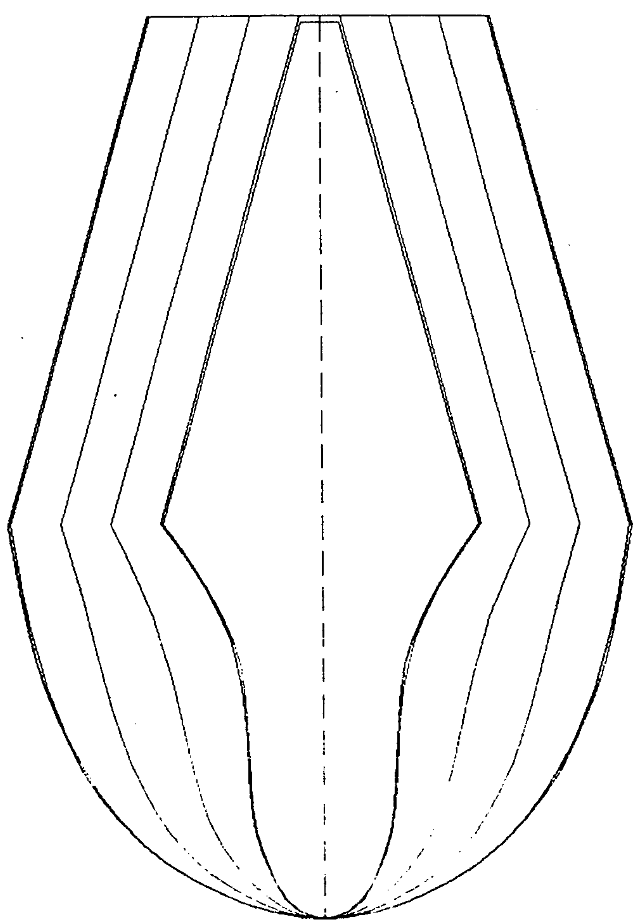
trans:	0.00	0.78	1.32	1.64	1.93	1.96	1.89	1.61	1.44	1.37	1.51	1.79	2.34	3.13
vert:	0.42	1.00	1.69	2.37	3.77	4.55	5.81	7.89	9.06	10.23	11.78	12.80	13.96	15.16
trans:	4.05	4.93	4.44	0.74	0.41	0.19	0.00							
vert:	16.26	17.19	18.96	32.36	33.36	34.05	34.28							

Section at 35.00 aft

trans:	0.00	0.29	1.08	1.69	2.14	2.68	2.93	3.10	3.17	3.25	3.38	3.44	3.63	3.94
vert:	0.05	0.07	0.36	0.90	1.59	2.95	3.84	4.94	6.07	7.80	9.49	9.98	11.09	12.16
trans:	4.42	5.10	5.83	6.57	6.95	2.24	0.85	0.00						
vert:	13.32	14.54	15.65	16.70	17.19	34.11	39.01	39.01						



COMP_A.C Isometric Projection



COMP_A.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_A.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 35.00 aft

trans:	0.00	0.29	1.08	1.69	2.14	2.68	2.93	3.10	3.17	3.25	3.38	3.44	3.63	3.94
vert:	0.05	0.07	0.36	0.90	1.59	2.95	3.84	4.94	6.07	7.80	9.49	9.98	11.09	12.16
trans:	4.42	5.10	5.83	6.57	6.95	2.24	0.85	0.00						
vert:	13.32	14.54	15.65	16.70	17.19	34.11	39.01	39.01						

Section at 35.68 aft

trans:	0.00	0.31	1.10	1.71	2.19	2.73	2.99	3.17	3.25	3.35	3.50	3.56	3.76	4.07
vert:	0.03	0.05	0.32	0.85	1.58	2.90	3.84	4.97	6.09	7.80	9.51	9.97	11.04	12.12
trans:	4.55	5.17	5.88	6.67	7.07	2.36	0.90	0.00						
vert:	13.28	14.44	15.55	16.67	17.19	34.11	39.30	39.30						

Section at 47.57 aft

trans:	0.00	0.86	1.70	2.50	3.24	3.94	4.49	4.99	5.35	5.79	6.40	6.66	6.97	7.41
vert:	0.00	0.11	0.44	0.95	1.62	2.45	3.28	4.28	5.28	6.88	9.60	10.72	11.83	13.13
trans:	7.92	8.55	9.23	3.08	0.00									
vert:	14.43	15.81	17.19	39.30	39.30									

Section at 59.47 aft

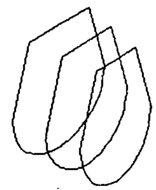
trans:	0.00	0.90	1.96	2.99	4.02	5.00	5.89	6.67	7.35	7.90	8.41	8.82	9.20	9.77
vert:	0.00	0.05	0.34	0.75	1.31	2.00	2.80	3.71	4.75	5.79	6.92	8.05	9.21	11.22
trans:	10.56	11.41	9.01	5.26	0.00									
vert:	14.21	17.19	25.83	39.30	39.30									

Section at 71.36 aft

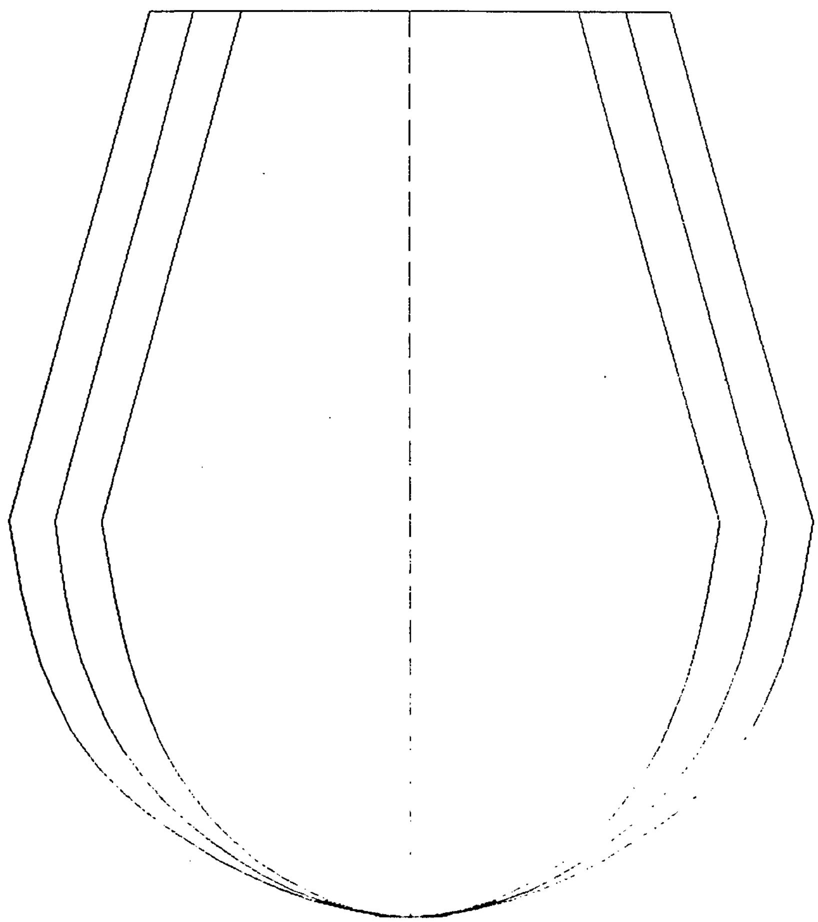
trans:	0.00	0.96	2.23	3.62	4.63	5.80	6.91	7.93	8.84	9.68	10.39	11.03	11.56	12.03
vert:	0.00	0.05	0.29	0.72	1.15	1.77	2.52	3.38	4.33	5.40	6.47	7.64	8.81	10.04
trans:	12.40	12.74	13.03	13.59	7.44	0.00								
vert:	11.26	12.62	13.99	17.19	39.30	39.30								

Section at 72.00 aft

trans:	0.00	0.97	2.20	2.18	2.25	3.64	4.66	5.84	6.95	7.98	8.90	9.75	10.47	11.12
vert:	0.00	0.05	0.28	0.28	0.29	0.72	1.15	1.77	2.52	3.37	4.32	5.39	6.45	7.62
trans:	11.66	12.14	12.52	12.86	13.15	13.70	13.71	7.56	0.00					
vert:	8.79	10.02	11.25	12.62	13.99	17.10	17.19	39.30	39.30					



COMP_B.C Isometric Projection



COMP_B.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_B.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 72.00 aft

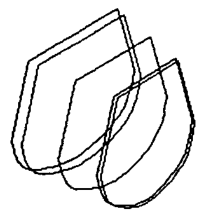
trans:	0.00	0.97	2.20	2.18	2.25	3.64	4.66	5.84	6.95	7.98	8.90	9.75	10.47	11.12
vert:	0.00	0.05	0.28	0.28	0.29	0.72	1.15	1.77	2.52	3.37	4.32	5.39	6.45	7.62
trans:	11.66	12.14	12.52	12.86	13.15	13.70	13.71	7.56	0.00					
vert:	8.79	10.02	11.25	12.62	13.99	17.10	17.19	39.30	39.30					

Section at 83.25 aft

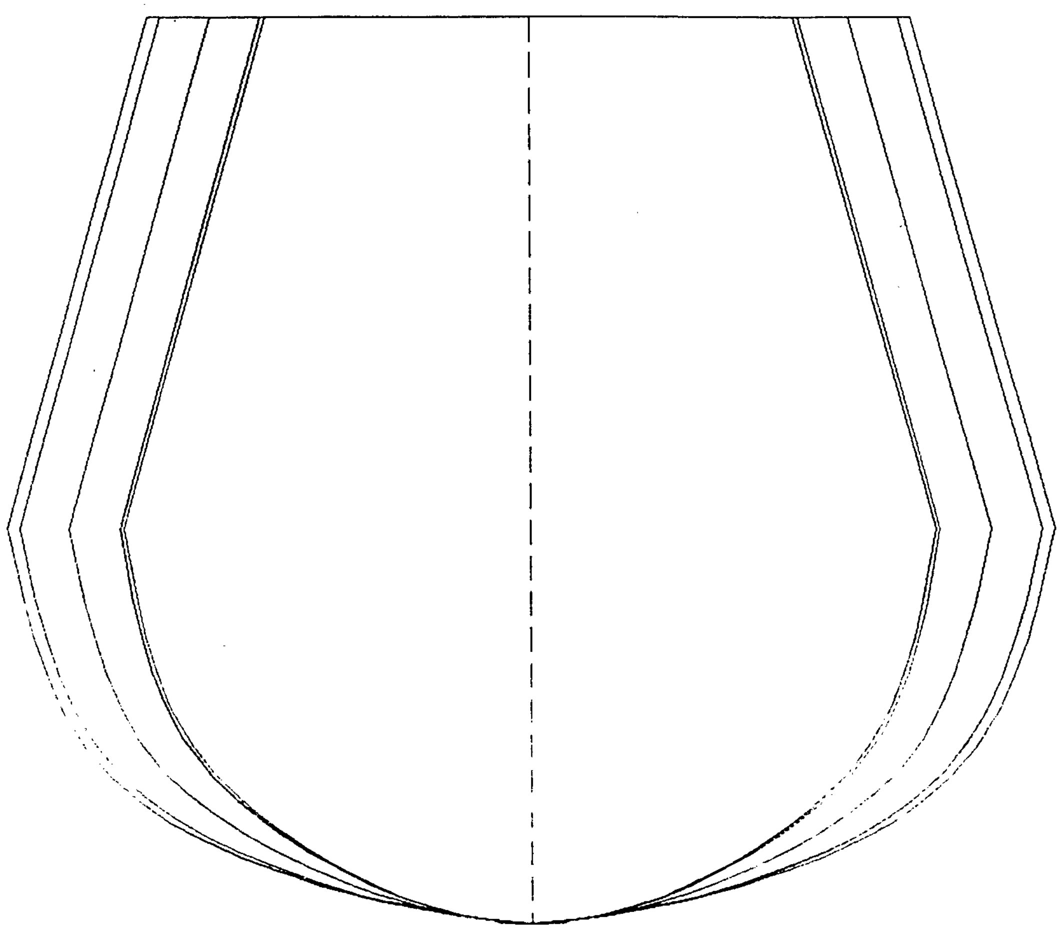
trans:	0.00	1.22	1.63	1.25	2.54	4.03	5.14	6.52	7.66	8.89	9.94	11.01	11.90	12.74
vert:	0.00	0.02	0.05	0.07	0.28	0.70	1.12	1.77	2.42	3.26	4.09	5.10	6.11	7.23
trans:	13.46	14.05	14.56	14.95	15.28	15.54	15.77	9.62	0.00					
vert:	8.43	9.71	11.09	12.47	14.01	15.54	17.19	39.30	39.30					

Section at 94.00 aft

trans:	0.00	1.40	1.45	2.88	4.49	5.70	7.27	8.42	9.89	11.07	11.94	12.77	13.80	14.70
vert:	0.00	0.06	0.08	0.31	0.73	1.16	1.84	2.40	3.26	4.05	4.68	5.40	6.45	7.61
trans:	15.07	15.77	16.34	16.80	17.17	17.74	11.59	0.00						
vert:	8.17	9.49	10.93	12.46	14.00	17.19	39.30	39.30						



COMP_C.C Isometric Projection



COMP_C.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_C.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 94.00 aft

trans:	0.00	1.40	1.45	2.88	4.49	5.70	7.27	8.42	9.89	11.07	11.94	12.77	13.80	14.70
vert:	0.00	0.06	0.08	0.31	0.73	1.16	1.84	2.40	3.26	4.05	4.68	5.40	6.45	7.61
trans:	15.07	15.77	16.34	16.80	17.17	17.74	11.59	0.00						
vert:	8.17	9.49	10.93	12.46	14.00	17.19	39.30	39.30						

Section at 95.14 aft

trans:	0.00	1.42	1.47	2.92	4.54	5.76	7.23	8.50	9.89	11.08	12.04	12.86	13.91	14.83
vert:	0.00	0.05	0.08	0.31	0.74	1.16	1.78	2.40	3.17	3.94	4.63	5.33	6.37	7.52
trans:	15.24	15.95	16.53	17.00	17.37	17.95	11.80	0.00						
vert:	8.14	9.47	10.91	12.45	14.00	17.19	39.30	39.30						

Section at 107.04 aft

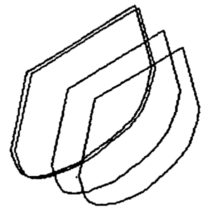
trans:	0.00	1.01	1.71	3.08	4.18	4.99	6.69	8.10	9.61	11.15	12.49	13.82	15.05	16.16
vert:	0.00	0.06	0.12	0.33	0.54	0.75	1.26	1.77	2.39	3.11	3.83	4.67	5.63	6.71
trans:	17.11	17.90	18.55	19.06	19.49	20.13	13.98	0.00						
vert:	7.94	9.33	10.84	12.44	14.04	17.19	39.30	39.30						

Section at 118.93 aft

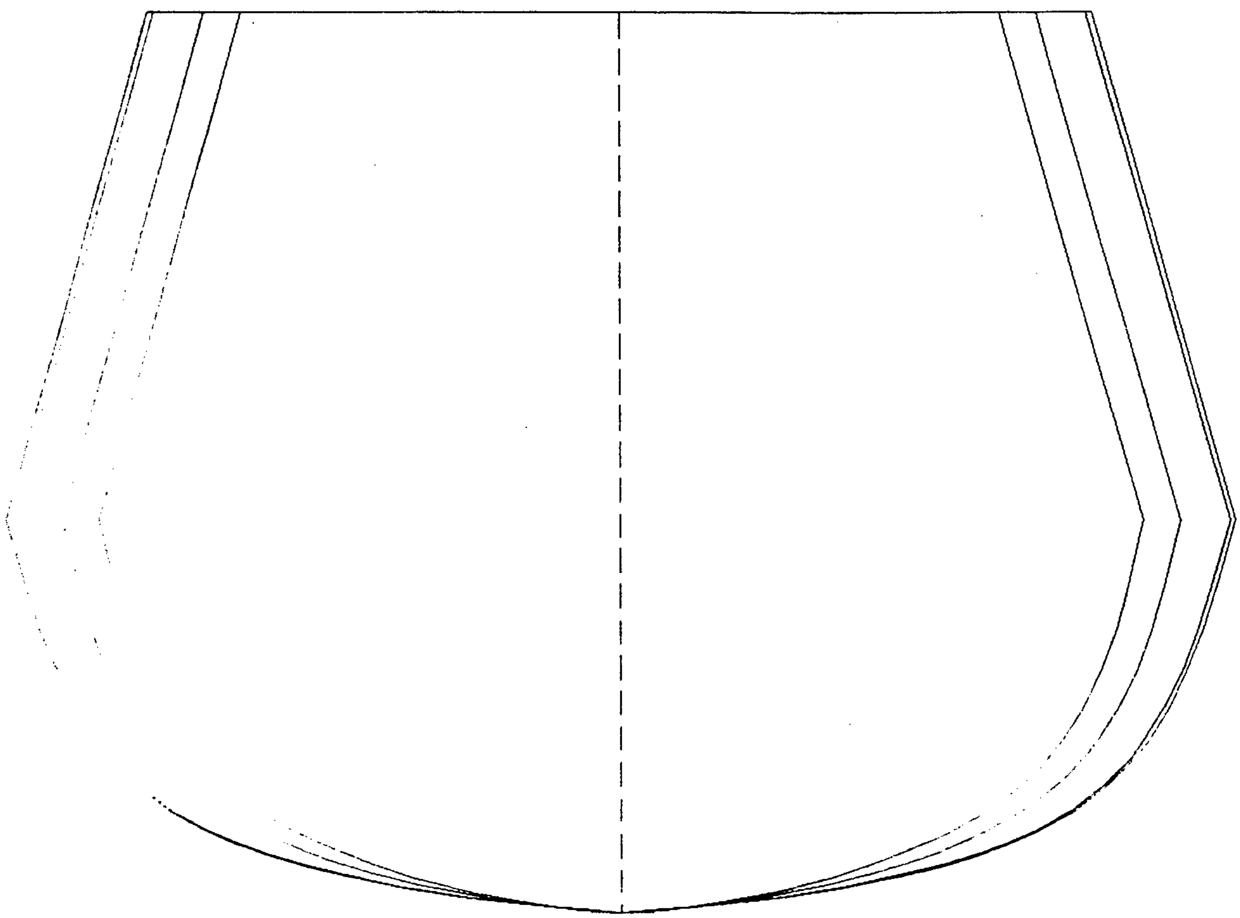
trans:	0.00	1.73	3.04	3.91	5.33	6.55	7.58	9.43	11.00	12.69	14.13	15.56	16.86	18.04
vert:	0.00	0.15	0.31	0.46	0.73	0.99	1.26	1.81	2.35	3.02	3.70	4.52	5.46	6.54
trans:	19.05	19.90	20.60	21.17	21.63	22.31	16.16	0.00						
vert:	7.79	9.21	10.77	12.41	14.05	17.19	39.30	39.30						

Section at 122.00 aft

trans:	0.00	1.75	3.11	4.08	6.45	7.57	9.25	10.94	12.65	14.08	14.38	15.84	17.17	18.37
vert:	0.00	0.16	0.31	0.47	0.93	1.19	1.66	2.20	2.83	3.45	3.58	4.37	5.29	6.35
trans:	19.41	20.17	20.40	21.11	21.70	22.17	22.78	22.87	16.72	0.00				
vert:	7.58	8.80	9.18	10.75	12.40	14.05	16.79	17.19	39.30	39.30				



COMP_CB.C Isometric Projection



COMP_CB.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_CB.C 60.00% permeability

Offsets in feet. Read across --->

Section at 122.00 aft

trans:	0.00	1.75	3.11	4.08	6.45	7.57	9.25	10.94	12.65	14.08	14.38	15.84	17.17	18.37
vert:	0.00	0.16	0.31	0.47	0.93	1.19	1.66	2.20	2.83	3.45	3.58	4.37	5.29	6.35
trans:	19.41	20.17	20.40	21.11	21.70	22.17	22.78	22.87	16.72	0.00				
vert:	7.58	8.80	9.18	10.75	12.40	14.05	16.79	17.19	39.30	39.30				

Section at 130.82 aft

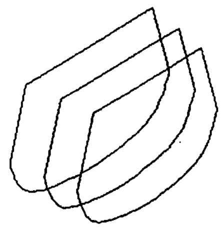
trans:	0.00	1.80	3.32	4.56	6.15	7.54	8.74	10.78	12.52	13.92	15.11	16.64	18.05	19.32
vert:	0.00	0.17	0.33	0.50	0.75	1.01	1.26	1.77	2.27	2.75	3.22	3.95	4.80	5.80
trans:	20.44	20.94	21.84	22.58	23.20	23.71	24.12	24.49	18.34	0.00				
vert:	6.96	7.62	9.08	10.69	12.37	14.05	15.62	17.19	39.30	39.30				

Section at 142.72 aft

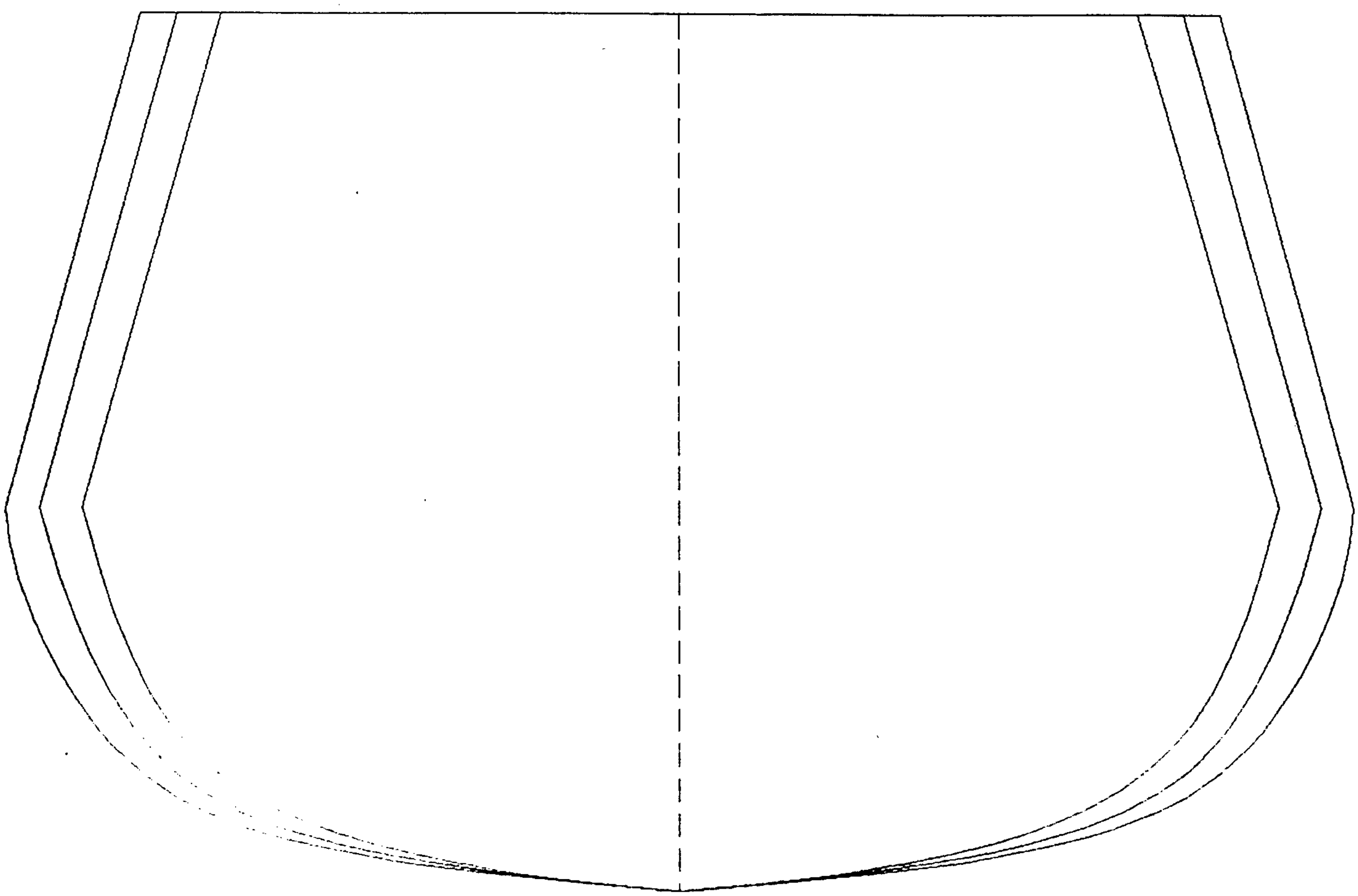
trans:	0.00	2.02	3.76	5.22	7.02	8.59	9.93	12.18	14.06	15.53	16.80	18.39	19.83	21.12
vert:	0.01	0.18	0.35	0.52	0.76	1.00	1.24	1.72	2.19	2.63	3.07	3.77	4.60	5.59
trans:	22.26	22.79	23.72	24.52	25.20	25.77	26.65	20.52	0.00					
vert:	6.76	7.44	8.94	10.59	12.32	14.05	17.19	39.30	39.30					

Section at 144.00 aft

trans:	0.00	2.04	3.80	5.28	7.10	9.88	10.05	12.24	14.08	15.53	16.83	18.39	19.85	21.16
vert:	0.01	0.18	0.35	0.52	0.76	1.21	1.24	1.69	2.15	2.57	3.01	3.68	4.49	5.46
trans:	22.32	22.92	22.98	23.92	24.73	25.42	25.99	26.83	26.88	20.75	0.00			
vert:	6.61	7.34	7.42	8.92	10.58	12.32	14.05	17.02	17.19	39.30	39.30			



COMP_DA.C Isometric Projection



COMP_DA.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_DA.C 60.00% permeability

Offsets in Feet. Read across --->

Section at 144.00 aft

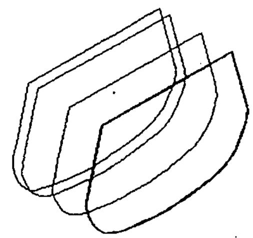
trans:	0.00	2.04	3.80	5.28	7.10	9.88	10.05	12.24	14.08	15.53	16.83	18.39	19.85	21.16
vert:	0.01	0.18	0.35	0.52	0.76	1.21	1.24	1.69	2.15	2.57	3.01	3.68	4.49	5.46
trans:	22.32	22.92	22.98	23.92	24.73	25.42	25.99	26.83	26.88	20.75	0.00			
vert:	6.61	7.34	7.42	8.92	10.58	12.32	14.05	17.02	17.19	39.30	39.30			

Section at 154.61 aft

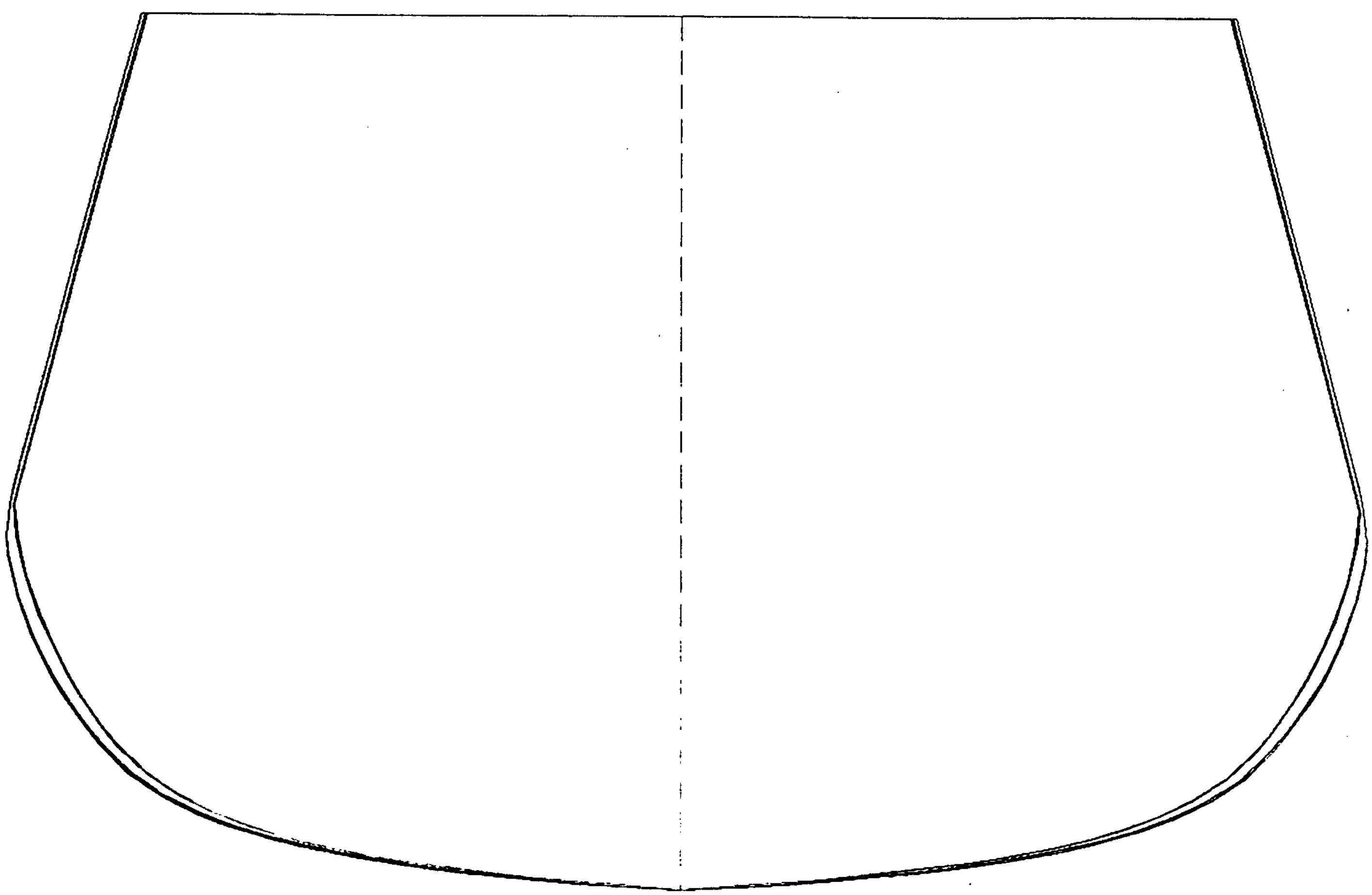
trans:	0.00	2.16	4.10	5.83	7.77	9.50	11.02	12.73	14.22	15.49	17.05	18.38	20.03	21.52
vert:	0.01	0.19	0.36	0.54	0.77	0.99	1.22	1.51	1.79	2.08	2.49	2.91	3.58	4.39
trans:	22.85	24.03	24.59	25.59	26.46	27.21	27.85	28.33	28.75	22.69	0.00			
vert:	5.37	6.55	7.24	8.79	10.50	12.27	14.05	15.62	17.19	39.30	39.30			

Section at 166.00 aft

trans:	0.00	3.36	6.34	9.11	11.06	12.78	14.25	16.54	18.21	19.57	21.29	22.84	24.23	25.49
vert:	0.01	0.29	0.56	0.85	1.08	1.32	1.56	1.99	2.39	2.79	3.44	4.24	5.22	6.39
trans:	26.08	27.21	27.75	28.20	28.66	29.05	29.69	30.10	30.26	24.34	0.00			
vert:	7.07	8.66	9.57	10.40	11.36	12.23	14.04	15.73	17.19	39.30	39.30			



COMP_E.C Isometric Projection



COMP_E.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_E.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 166.00 aft

trans:	0.00	3.36	6.34	9.11	11.06	12.78	14.25	16.54	18.21	19.57	21.29	22.84	24.23	25.49
vert:	0.01	0.29	0.56	0.85	1.08	1.32	1.56	1.99	2.39	2.79	3.44	4.24	5.22	6.39
trans:	26.08	27.21	27.75	28.20	28.66	29.05	29.69	30.10	30.26	24.34	0.00			
vert:	7.07	8.66	9.57	10.40	11.36	12.23	14.04	15.73	17.19	39.30	39.30			

Section at 166.50 aft

trans:	0.00	3.33	6.36	9.09	11.06	12.78	14.25	16.52	18.21	19.55	21.28	22.84	24.24	25.53
vert:	0.01	0.29	0.56	0.84	1.08	1.31	1.55	1.97	2.37	2.76	3.40	4.19	5.16	6.35
trans:	26.15	27.28	27.81	28.28	28.73	29.13	29.77	30.18	30.33	24.41	0.00			
vert:	7.06	8.65	9.52	10.40	11.32	12.23	14.04	15.73	17.19	39.30	39.30			

Section at 178.40 aft

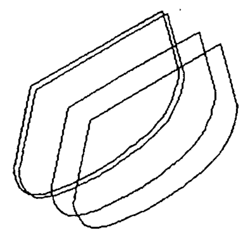
trans:	0.00	2.34	4.45	6.32	8.46	10.37	12.02	13.89	15.52	16.91	18.64	20.00	21.75	23.32
vert:	0.01	0.17	0.32	0.48	0.69	0.89	1.10	1.37	1.64	1.91	2.31	2.70	3.34	4.14
trans:	24.75	26.06	26.70	27.33	27.89	28.45	28.95	29.40	30.12	30.56	30.65	30.51	30.29	28.76
vert:	5.11	6.31	7.02	7.82	8.61	9.49	10.38	11.30	13.13	14.88	15.73	17.19	18.01	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 190.29 aft

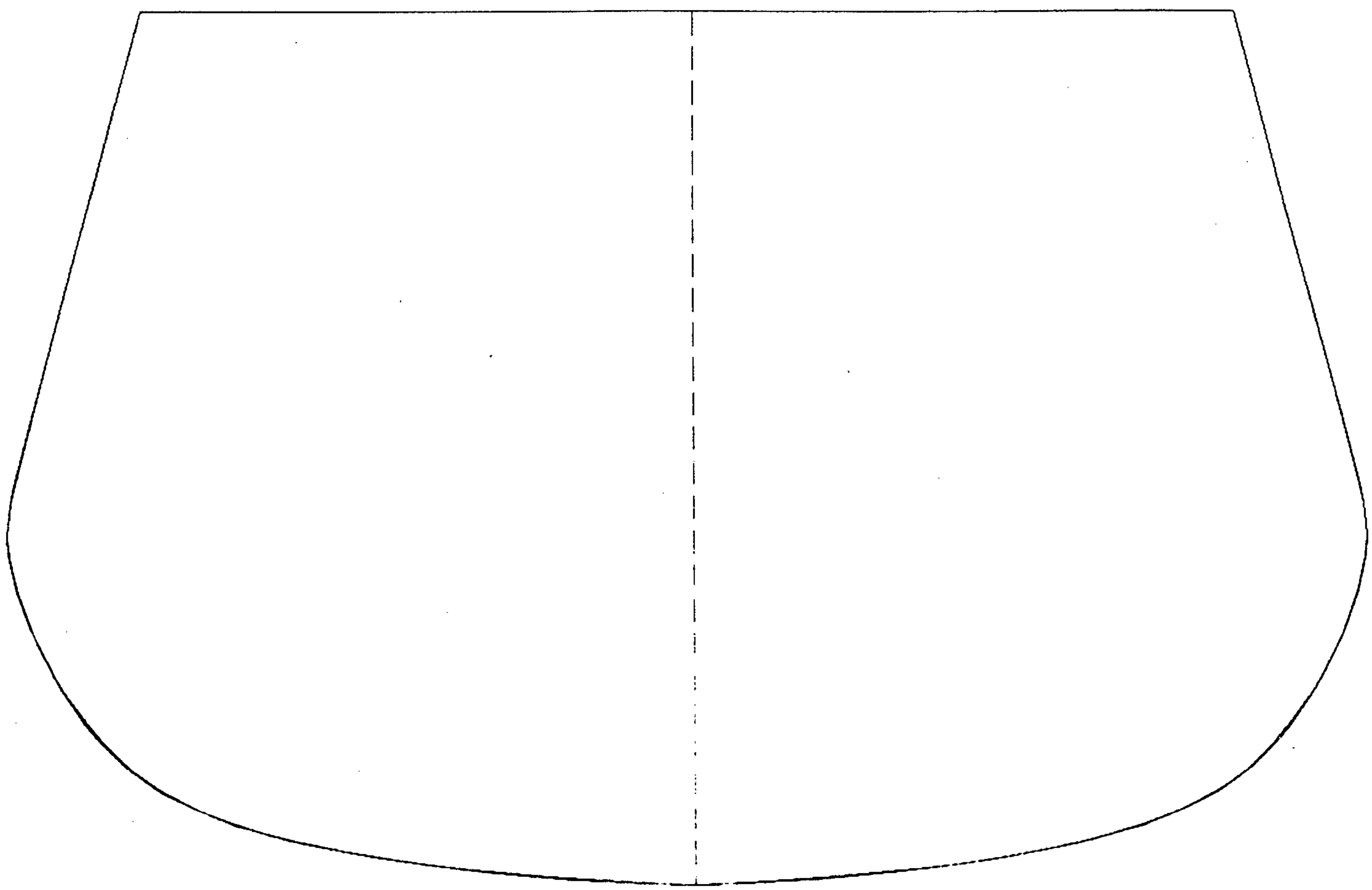
trans:	0.00	2.52	4.65	6.37	8.55	10.49	12.18	14.05	15.71	17.16	18.90	20.28	22.02	23.57
vert:	0.01	0.15	0.28	0.42	0.63	0.83	1.04	1.32	1.60	1.88	2.29	2.70	3.36	4.16
trans:	24.96	26.24	26.86	28.01	28.55	29.03	29.46	30.16	30.57	30.65	30.51	30.29	28.76	24.61
vert:	5.14	6.34	7.06	8.64	9.52	10.41	11.32	13.15	14.89	15.73	17.19	18.01	23.74	39.30
trans:	0.00													
vert:	39.30													

Section at 194.00 aft

trans:	0.00	2.39	4.86	6.38	8.60	10.54	12.22	14.11	15.77	17.22	18.77	20.34	22.09	23.64
vert:	0.01	0.13	0.29	0.41	0.62	0.83	1.03	1.32	1.60	1.88	2.25	2.71	3.37	4.18
trans:	25.02	26.29	26.90	28.04	28.57	29.05	29.48	30.17	30.57	30.65	30.51	30.36	28.76	24.61
vert:	5.16	6.37	7.08	8.66	9.54	10.42	11.34	13.16	14.90	15.74	17.19	17.75	23.74	39.30
trans:	0.00													
vert:	39.30													



COMP_F.C Isometric Projection



COMP_F.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_F.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 194.00 aft

trans:	0.00	2.39	4.86	6.38	8.60	10.54	12.22	14.11	15.77	17.22	18.77	20.34	22.09	23.64
vert:	0.01	0.13	0.29	0.41	0.62	0.83	1.03	1.32	1.60	1.88	2.25	2.71	3.37	4.18
trans:	25.02	26.29	26.90	28.04	28.57	29.05	29.48	30.17	30.57	30.65	30.51	30.36	28.76	24.61
vert:	5.16	6.37	7.08	8.66	9.54	10.42	11.34	13.16	14.90	15.74	17.19	17.75	23.74	39.30
trans:	0.00													
vert:	39.30													

Section at 202.18 aft

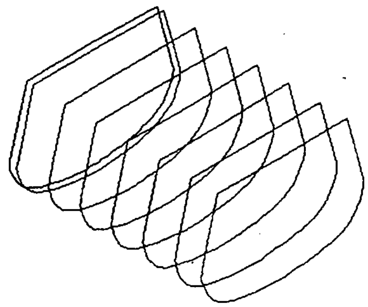
trans:	0.00	2.11	3.88	5.31	6.41	8.70	10.66	12.30	14.22	15.91	17.35	18.47	19.47	20.48
vert:	0.01	0.10	0.20	0.29	0.38	0.59	0.81	1.02	1.31	1.60	1.89	2.15	2.41	2.72
trans:	22.24	23.78	25.16	26.42	26.98	28.10	28.62	29.09	29.51	30.19	30.58	30.65	30.51	28.76
vert:	3.40	4.22	5.22	6.44	7.11	8.69	9.57	10.45	11.36	13.18	14.91	15.75	17.19	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 214.07 aft

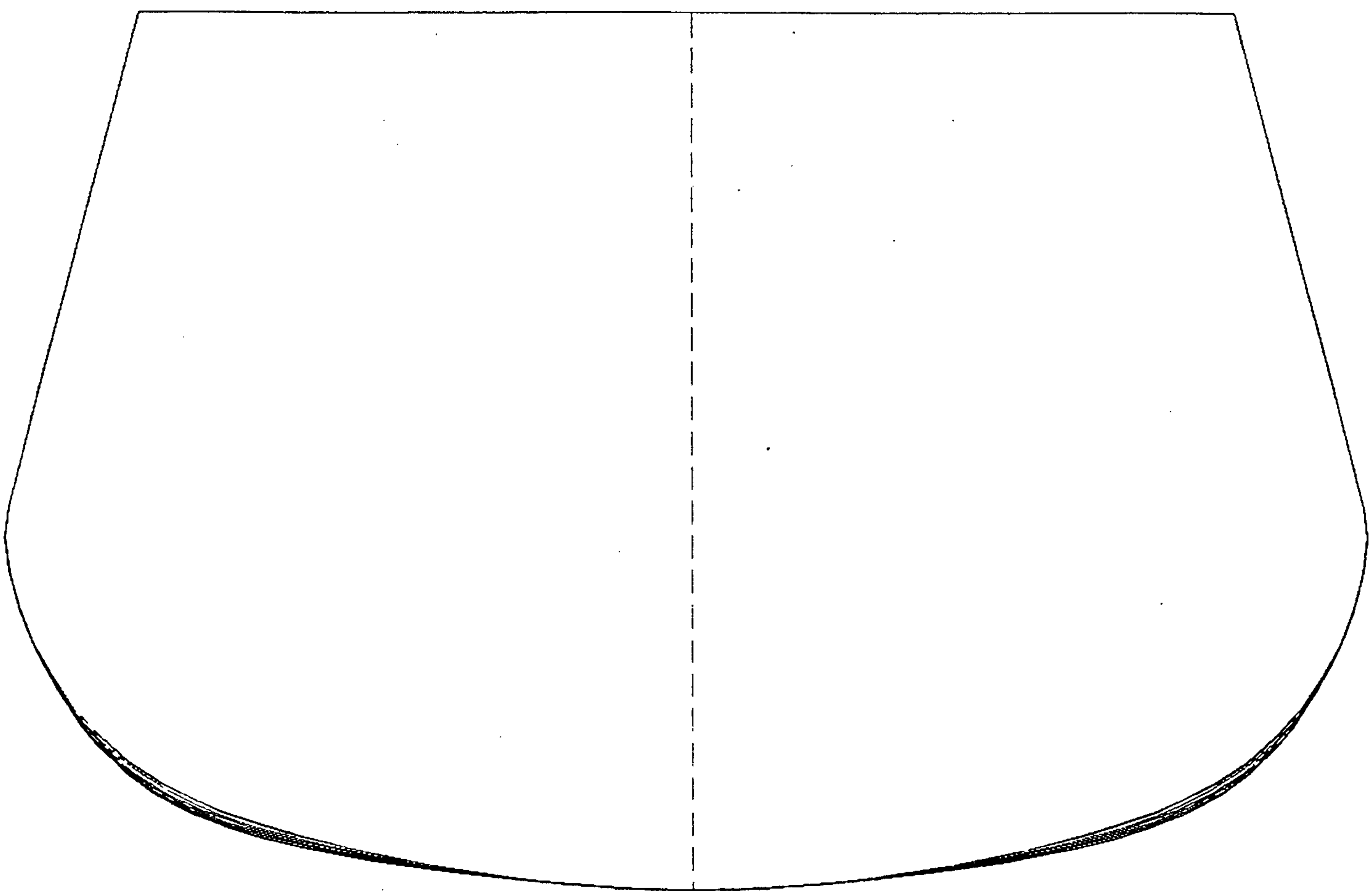
trans:	0.00	2.20	4.00	5.41	6.43	8.77	10.75	12.37	14.34	16.04	17.47	18.60	19.61	20.61
vert:	0.01	0.10	0.19	0.28	0.37	0.59	0.80	1.02	1.32	1.62	1.92	2.19	2.46	2.78
trans:	22.36	23.91	25.29	26.53	27.07	28.17	28.68	29.55	30.21	30.58	30.65	30.51	30.29	28.76
vert:	3.46	4.29	5.29	6.51	7.18	8.76	9.63	11.41	13.21	14.93	15.76	17.19	18.01	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 216.00 aft

trans:	0.00	2.22	4.03	5.43	8.78	10.76	12.38	14.35	16.05	17.48	18.61	19.63	20.62	22.38
vert:	0.01	0.10	0.19	0.28	0.59	0.80	1.02	1.33	1.63	1.93	2.20	2.47	2.79	3.47
trans:	23.93	25.30	26.54	27.08	28.18	29.49	30.16	30.56	30.65	30.51	30.29	28.76	24.61	0.00
vert:	4.30	5.31	6.53	7.20	8.77	11.28	13.08	14.81	15.76	17.19	18.01	23.74	39.30	39.30



COMP_G.C Isometric Projection



COMP_G.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_G.C 85.00% permeability

Offsets in Feet. Read across --->

Section at 216.00 aft

trans:	0.00	2.22	4.03	5.43	8.78	10.76	12.38	14.35	16.05	17.48	18.61	19.63	20.62	22.38
vert:	0.01	0.10	0.19	0.28	0.59	0.80	1.02	1.33	1.63	1.93	2.20	2.47	2.79	3.47
trans:	23.93	25.30	26.54	27.08	28.18	29.49	30.16	30.56	30.65	30.51	30.29	28.76	24.61	0.00
vert:	4.30	5.31	6.53	7.20	8.77	11.28	13.08	14.81	15.76	17.19	18.01	23.74	39.30	39.30

Section at 225.97 aft

trans:	0.00	2.30	4.14	5.52	8.82	10.82	12.42	14.39	16.10	17.55	18.67	19.70	20.69	22.47
vert:	0.01	0.10	0.18	0.27	0.59	0.81	1.04	1.35	1.67	1.98	2.25	2.53	2.85	3.55
trans:	24.00	25.37	26.59	27.15	28.23	29.17	29.93	30.44	30.65	30.51	30.29	28.76	24.61	0.00
vert:	4.39	5.39	6.61	7.27	8.84	10.58	12.38	14.15	15.79	17.19	18.01	23.74	39.30	39.30

Section at 237.86 aft

trans:	0.00	2.48	4.37	5.69	6.43	8.77	10.77	12.44	14.39	16.11	17.60	19.35	20.78	22.53
vert:	0.01	0.10	0.18	0.27	0.36	0.60	0.83	1.07	1.40	1.73	2.06	2.51	2.96	3.66
trans:	24.06	25.41	26.62	27.21	28.28	29.21	29.95	30.45	30.65	30.51	30.29	28.76	24.61	0.00
vert:	4.49	5.48	6.68	7.38	8.94	10.66	12.45	14.19	15.81	17.19	18.01	23.74	39.30	39.30

Section at 249.75 aft

trans:	0.00	2.46	4.35	5.67	6.42	8.82	10.83	12.44	14.40	16.13	17.64	19.38	20.84	22.60
vert:	0.01	0.10	0.18	0.27	0.36	0.61	0.86	1.11	1.45	1.80	2.14	2.61	3.08	3.79
trans:	24.13	25.49	26.70	27.28	28.33	29.25	29.97	30.45	30.65	30.51	30.29	24.61	0.00	
vert:	4.63	5.63	6.82	7.52	9.07	10.77	12.52	14.24	15.83	17.19	18.01	39.30	39.30	

Section at 261.65 aft

trans:	0.00	1.50	2.53	3.22	5.28	7.01	8.41	9.49	11.69	13.59	15.19	17.68	19.45	20.90
vert:	0.01	0.04	0.07	0.12	0.27	0.41	0.56	0.71	1.03	1.35	1.67	2.24	2.73	3.22
trans:	21.84	23.49	24.95	26.23	27.35	28.39	29.29	30.00	30.47	30.65	30.51	30.29	28.76	24.61
vert:	3.59	4.38	5.31	6.40	7.69	9.21	10.88	12.60	14.29	15.85	17.19	18.01	23.74	39.30
trans:	0.00													
vert:	39.30													

Section at 273.54 aft

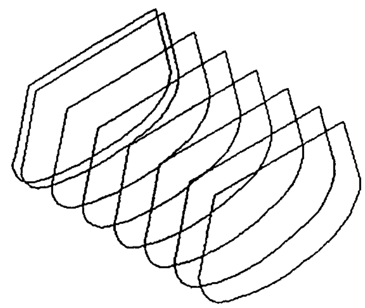
trans:	0.00	1.49	2.55	3.20	4.49	5.54	6.37	8.74	10.76	12.44	14.43	16.19	17.71	19.48
vert:	0.00	0.04	0.07	0.11	0.19	0.27	0.35	0.63	0.92	1.20	1.59	1.97	2.36	2.87
trans:	20.96	21.90	23.57	25.01	26.29	27.42	28.45	29.33	30.02	30.48	30.66	30.51	30.29	28.76
vert:	3.38	3.76	4.57	5.51	6.60	7.87	9.37	11.00	12.69	14.34	15.87	17.19	18.01	23.74
trans:	24.61	0.00												
vert:	39.30	39.30												

Section at 285.43 aft

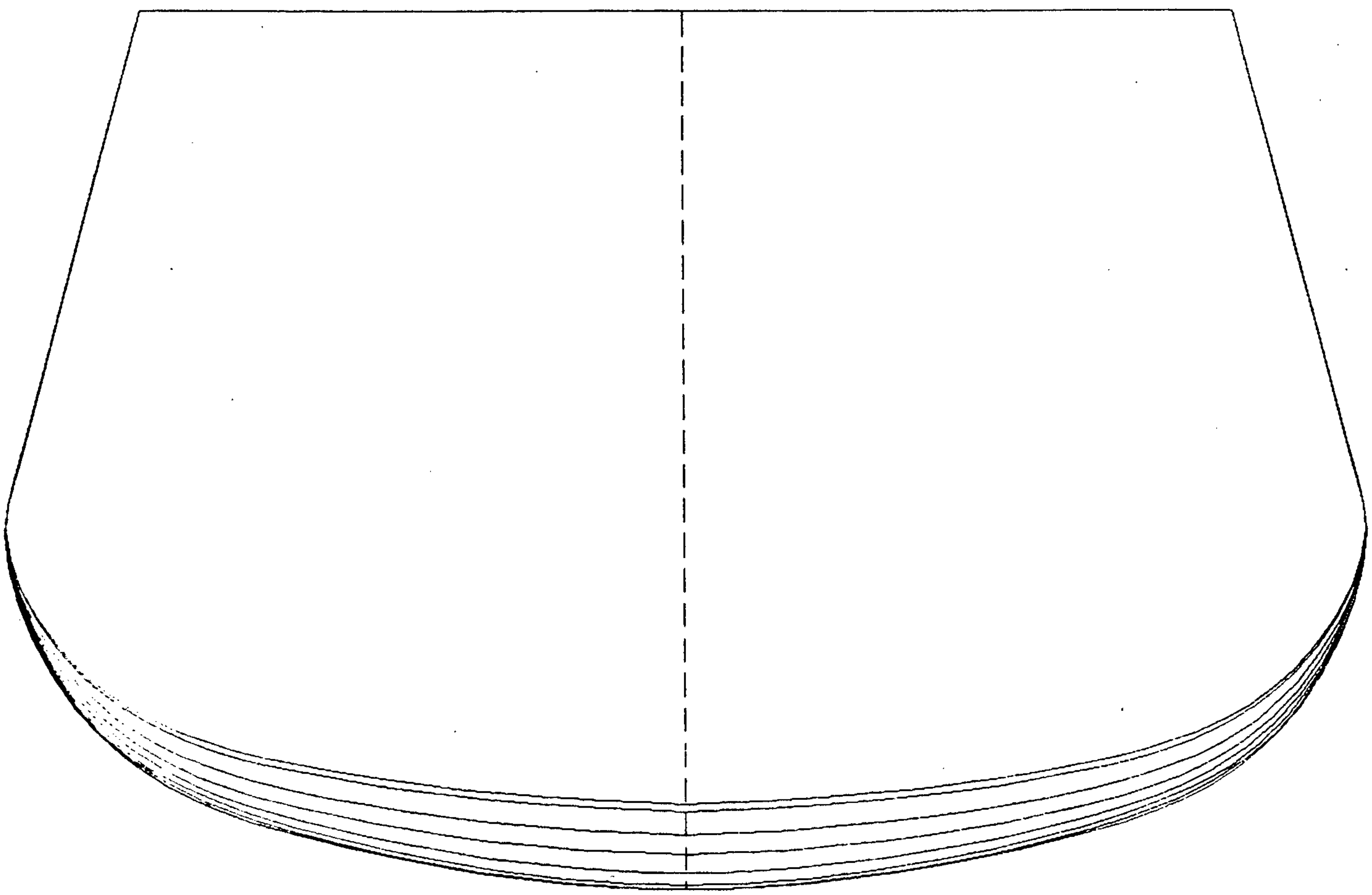
trans:	0.00	1.36	2.95	3.18	4.45	5.50	6.36	8.07	9.46	11.67	13.59	15.21	17.73	19.50
vert:	0.00	0.03	0.08	0.10	0.19	0.27	0.36	0.56	0.76	1.13	1.49	1.85	2.49	3.02
trans:	21.00	21.96	23.61	25.07	26.34	27.48	28.50	29.37	30.04	30.49	30.66	30.51	24.61	0.00
vert:	3.55	3.94	4.77	5.70	6.79	8.06	9.52	11.12	12.77	14.39	15.89	17.19	39.30	39.30

Section at 288.00 aft

trans:	0.00	1.36	2.95	3.18	4.56	5.39	6.36	8.06	9.46	11.66	13.58	15.21	17.73	19.50
vert:	0.01	0.03	0.08	0.11	0.21	0.27	0.37	0.57	0.78	1.14	1.51	1.88	2.52	3.06
trans:	21.01	21.96	23.62	25.08	26.35	27.48	28.50	29.37	30.04	30.49	30.66	30.51	24.61	0.00
vert:	3.59	3.98	4.81	5.75	6.84	8.10	9.55	11.14	12.79	14.40	15.89	17.19	39.30	39.30



COMP_H.C Isometric Projection



COMP_H.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_H.C 85.00% permeability

Offsets in Feet. Read across --->

Section at 288.00 aft

trans:	0.00	1.36	2.95	3.18	4.56	5.39	6.36	8.06	9.46	11.66	13.58	15.21	17.73	19.5
vert:	0.01	0.03	0.08	0.11	0.21	0.27	0.37	0.57	0.78	1.14	1.51	1.88	2.52	3.0
trans:	21.01	21.96	23.62	25.08	26.35	27.48	28.50	29.37	30.04	30.49	30.66	30.51	24.61	0.0
vert:	3.59	3.98	4.81	5.75	6.84	8.10	9.55	11.14	12.79	14.40	15.89	17.19	39.30	39.3

Section at 297.33 aft

trans:	0.00	1.36	2.95	3.18	4.97	6.35	8.05	9.46	11.63	13.55	15.22	17.75	19.51	21.0
vert:	0.03	0.06	0.11	0.13	0.27	0.41	0.62	0.83	1.22	1.60	1.98	2.65	3.20	3.7
trans:	21.98	23.63	25.10	26.37	27.49	28.51	29.37	30.05	30.49	30.65	30.51	30.25	29.77	24.6
vert:	4.13	4.96	5.90	6.99	8.22	9.67	11.23	12.85	14.43	15.90	17.19	18.17	19.96	39.3
trans:	0.00													
vert:	39.30													

Section at 309.22 aft

trans:	0.00	1.48	2.50	3.19	4.48	5.54	6.37	8.10	9.48	11.69	13.61	15.24	17.76	19.51
vert:	0.20	0.23	0.26	0.31	0.41	0.50	0.60	0.81	1.03	1.42	1.81	2.20	2.88	3.42
trans:	21.03	22.82	24.37	25.73	26.93	27.49	28.50	29.37	30.04	30.48	30.65	30.51	29.77	24.61
vert:	3.96	4.74	5.61	6.60	7.74	8.39	9.80	11.34	12.92	14.47	15.92	17.19	19.96	39.30
trans:	0.00													
vert:	39.30													

Section at 321.11 aft

trans:	0.00	1.61	2.68	4.99	6.42	8.84	10.87	12.50	14.47	16.22	17.77	19.52	21.02	21.96
vert:	0.73	0.77	0.81	0.98	1.12	1.42	1.73	2.03	2.43	2.84	3.24	3.76	4.28	4.66
trans:	23.63	25.08	26.34	27.46	28.48	29.35	30.02	30.47	30.65	30.51	29.77	24.61	0.00	
vert:	5.46	6.36	7.40	8.58	9.96	11.46	13.00	14.52	15.94	17.19	19.96	39.30	39.30	

Section at 333.01 aft

trans:	0.00	2.42	4.31	5.65	6.46	8.83	10.85	12.52	14.47	16.22	17.76	19.50	20.98	21.94
vert:	1.59	1.68	1.78	1.87	1.96	2.22	2.48	2.74	3.09	3.45	3.80	4.27	4.75	5.10
trans:	23.59	25.02	26.30	27.42	28.44	29.32	30.00	30.46	30.64	30.51	27.09	24.61	0.00	
vert:	5.85	6.71	7.70	8.85	10.17	11.62	13.11	14.58	15.96	17.19	29.99	39.30	39.30	

Section at 344.90 aft

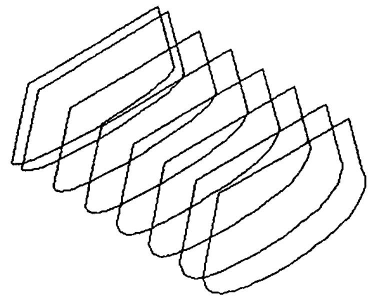
trans:	0.00	2.20	4.00	5.42	6.45	8.80	10.81	12.48	14.46	16.20	17.70	19.48	20.92	22.69
vert:	2.49	2.58	2.67	2.76	2.85	3.08	3.31	3.54	3.86	4.17	4.49	4.92	5.35	6.00
trans:	24.23	25.59	26.80	27.36	28.40	29.28	29.98	30.45	30.64	30.51	30.29	24.61	0.00	
vert:	6.75	7.61	8.62	9.19	10.45	11.82	13.24	14.65	15.99	17.19	18.01	39.30	39.30	

Section at 356.79 aft

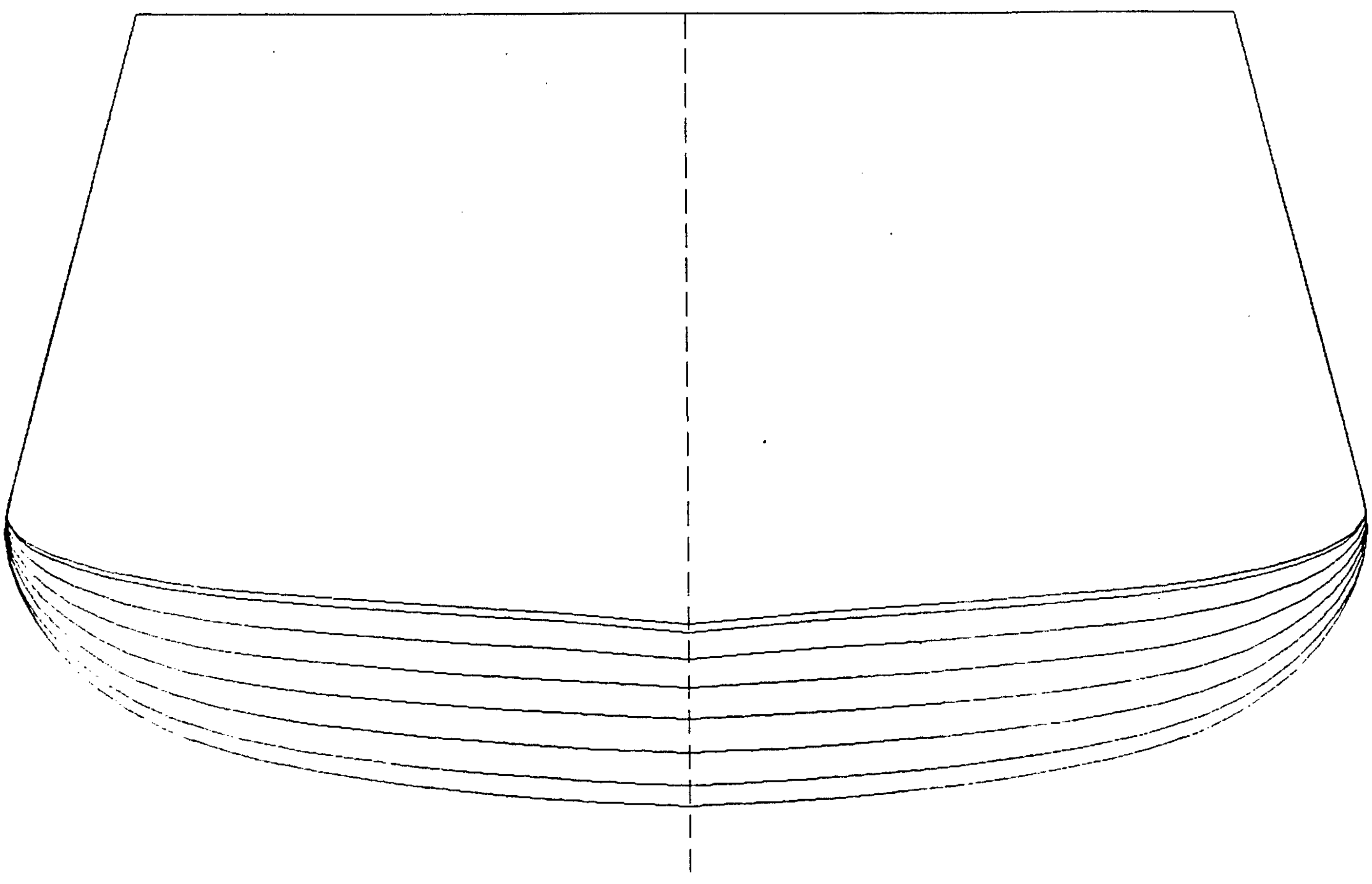
trans:	0.00	2.08	3.82	5.22	6.30	8.72	10.73	12.31	14.34	16.09	17.55	19.32	20.79	22.57
vert:	3.53	3.62	3.71	3.79	3.88	4.09	4.29	4.50	4.78	5.06	5.34	5.72	6.11	6.70
trans:	24.12	25.49	26.71	27.28	28.32	29.23	29.94	30.42	30.63	30.51	29.77	24.61	0.00	
vert:	7.39	8.18	9.11	9.64	10.81	12.08	13.42	14.75	16.03	17.19	19.96	39.30	39.30	

Section at 360.00 aft

trans:	0.00	2.06	3.78	5.16	6.22	8.59	10.59	12.22	14.24	15.99	17.48	19.21	20.66	22.73
vert:	3.87	3.96	4.04	4.13	4.21	4.41	4.61	4.81	5.08	5.35	5.62	5.99	6.35	7.02
trans:	23.86	25.27	26.51	27.25	28.30	29.21	29.93	30.41	30.63	30.51	29.91	24.61	0.00	
vert:	7.52	8.27	9.16	9.80	10.93	12.18	13.48	14.79	16.04	17.19	19.43	39.30	39.30	



COMP_I.C Isometric Projection



COMP_I.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_I.C 95.00% permeability

Offsets in Feet. Read across --->

Section at 360.00 aft

trans:	0.00	2.06	3.78	5.16	6.22	8.59	10.59	12.22	14.24	15.99	17.48	19.21	20.66	22.73
vert:	3.87	3.96	4.04	4.13	4.21	4.41	4.61	4.81	5.08	5.35	5.62	5.99	6.35	7.02
trans:	23.86	25.27	26.51	27.25	28.30	29.21	29.93	30.41	30.63	30.51	29.91	24.61	0.00	
vert:	7.52	8.27	9.16	9.80	10.93	12.18	13.48	14.79	16.04	17.19	19.43	39.30	39.30	

Section at 368.68 aft

trans:	0.00	2.01	3.67	5.00	6.00	8.23	10.22	11.98	13.96	15.73	17.29	18.93	20.32	21.47
vert:	4.80	4.88	4.96	5.03	5.11	5.29	5.47	5.65	5.89	6.14	6.38	6.69	6.99	7.30
trans:	23.17	24.66	25.98	27.16	28.23	29.15	29.89	30.39	30.62	30.51	30.29	24.61	0.00	
vert:	7.87	8.53	9.30	10.22	11.27	12.43	13.65	14.88	16.08	17.19	18.01	39.30	39.30	

Section at 380.58 aft

trans:	0.00	2.21	4.07	5.58	7.79	9.77	11.51	13.59	15.40	16.95	18.65	20.07	21.22	22.95
vert:	6.23	6.33	6.42	6.52	6.67	6.83	6.98	7.19	7.39	7.60	7.86	8.12	8.38	8.86
trans:	24.46	25.80	27.01	28.10	29.06	29.82	30.35	30.60	30.60	30.29	24.61	0.00		
vert:	9.43	10.10	10.90	11.82	12.85	13.94	15.05	16.15	16.67	18.01	39.30	39.30		

Section at 392.47 aft

trans:	0.00	3.29	6.22	8.80	11.02	13.07	14.92	16.57	18.29	19.74	20.94	22.39	23.52	24.96
vert:	7.72	7.89	8.06	8.22	8.39	8.56	8.74	8.91	9.12	9.34	9.55	9.87	10.19	10.71
trans:	26.23	26.83	27.95	28.94	29.74	30.30	30.58	30.59	30.51	28.76	24.61	0.00		
vert:	11.32	11.66	12.45	13.33	14.27	15.25	16.23	16.71	17.19	23.74	39.30	39.30		

Section at 404.36 aft

trans:	0.00	5.38	10.59	16.21	17.95	19.42	20.64	21.97	23.08	23.98	25.49	26.62	27.78	28.80
vert:	9.14	9.48	9.82	10.27	10.45	10.62	10.80	11.04	11.27	11.51	12.01	12.50	13.14	13.86
trans:	29.64	30.24	30.55	30.58	30.29	28.76	24.61	0.00						
vert:	14.64	15.47	16.33	16.76	18.01	23.74	39.30	39.30						

Section at 416.26 aft

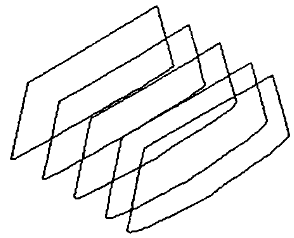
trans:	0.00	3.07	6.50	10.29	15.91	17.58	19.05	20.34	21.64	22.76	23.70	25.22	26.38	27.66
vert:	10.43	10.69	10.94	11.20	11.62	11.77	11.92	12.07	12.25	12.44	12.62	13.00	13.39	13.91
trans:	28.64	29.53	30.17	30.52	30.56	30.51	24.61	0.00						
vert:	14.43	15.05	15.73	16.44	16.82	17.19	39.30	39.30						

Section at 428.15 aft

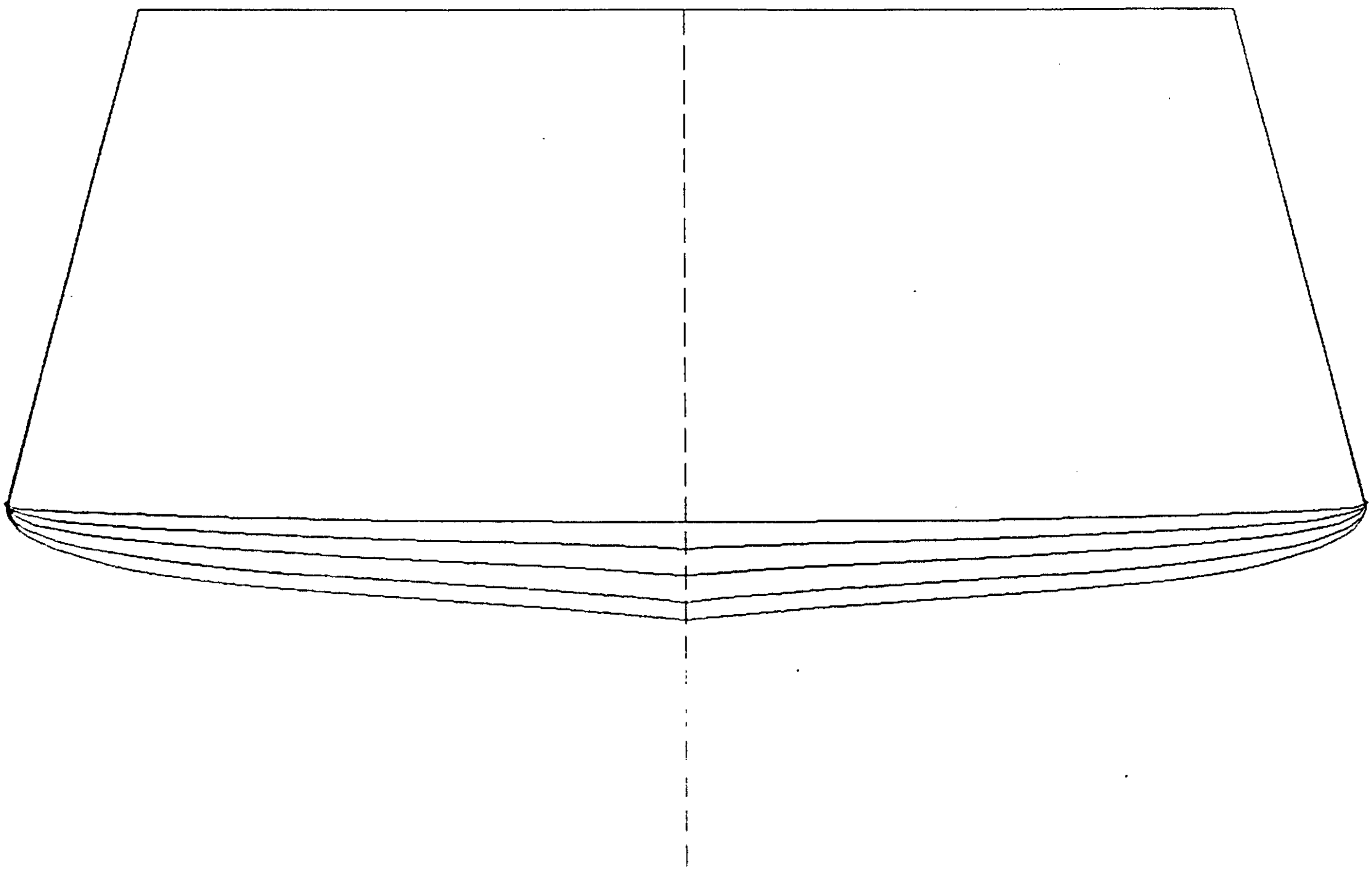
trans:	0.00	5.88	15.66	18.06	20.12	21.83	23.48	24.80	26.11	27.42	28.45	29.39	30.09	30.48
vert:	11.64	12.16	12.87	13.06	13.26	13.45	13.69	13.94	14.24	14.62	15.01	15.48	16.00	16.57
trans:	30.56	30.29	28.76	24.61	0.00									
vert:	16.88	18.01	23.74	39.30	39.30									

Section at 432.00 aft

trans:	0.00	6.12	15.59	17.99	20.05	21.77	23.36	24.75	26.02	27.34	28.39	29.49	29.96	30.42
vert:	12.02	12.56	13.22	13.40	13.58	13.76	13.98	14.21	14.48	14.83	15.18	15.68	16.03	16.55
trans:	30.55	30.29	28.76	24.61	0.00									
vert:	16.90	18.01	23.74	39.30	39.30									



COMP_J.C Isometric Projection



COMP_J.C Body Plan (1 component)
Scale = 1:100

Component 1: COMP_J.C 85.00% permeability

Offsets in Feet. Read across --->

Section at 432.00 aft

trans:	0.00	6.12	15.59	17.99	20.05	21.77	23.36	24.75	26.02	27.34	28.39	29.49	29.96	30.42
vert:	12.02	12.56	13.22	13.40	13.58	13.76	13.98	14.21	14.48	14.83	15.18	15.68	16.03	16.55
trans:	30.55	30.29	28.76	24.61	0.00									
vert:	16.90	18.01	23.74	39.30	39.30									

Section at 440.04 aft

trans:	0.00	1.86	4.07	6.62	9.54	12.80	15.45	17.83	19.90	21.66	23.10	24.63	25.84	27.1
vert:	12.82	13.01	13.20	13.39	13.58	13.77	13.94	14.10	14.26	14.42	14.58	14.78	14.99	15.2
trans:	28.26	29.70	30.29	30.53	30.51	30.29	28.76	24.61	0.00					
vert:	15.54	16.09	16.50	16.94	17.19	18.01	23.74	39.30	39.30					

Section at 451.94 aft

trans:	0.00	1.08	2.42	4.03	5.90	10.64	15.29	17.62	19.66	21.41	22.87	25.62	26.98	28.1
vert:	14.00	14.10	14.21	14.31	14.41	14.64	14.87	14.99	15.11	15.22	15.34	15.62	15.81	16.0
trans:	29.19	30.23	30.51	30.51	28.76	24.61	0.00							
vert:	16.25	16.67	17.01	17.19	23.74	39.30	39.30							

Section at 463.83 aft

trans:	0.00	1.66	3.74	6.26	9.20	15.16	18.07	20.56	22.62	24.25	25.45	26.96	28.15	29.7
vert:	15.19	15.27	15.36	15.44	15.53	15.71	15.80	15.89	15.99	16.08	16.17	16.30	16.43	16.7
trans:	30.42	30.65	30.48	29.77	27.09	24.61	0.00							
vert:	16.97	17.22	17.29	19.96	29.99	39.30	39.30							

Section at 475.72 aft

trans:	0.00	4.24	7.76	13.28	15.06	18.95	22.27	25.02	27.20	28.81	29.85	30.32	30.50	24.6
vert:	16.41	16.43	16.44	16.47	16.49	16.57	16.65	16.73	16.82	16.90	16.98	17.06	17.19	39.3
trans:	0.00													
vert:	39.30													

```
report TUMBFL
CLEAR
enter fl
READ TUMBLE4.GF
title tumble w/ adjusted margin / perm

marg 0, -100, 35.68, .25, 475.72, .25

perm 0, .95, 122, .6, 166, .95, 216, .85, 360, .95, 432, .85, 475.72,
 .85

vcg 21.6
fl 18.2
```

```
ENTER PM
CLEAR
READ TUMBLE2.GF

DELETE FOREPEAK.C
CREATE FOREPEAK.C
ENDS 0, 35
FIT HULL
PERM .95
/

DELETE COMP_A.C
CREATE COMP_A.C
ENDS 35, 72
FIT HULL
PERM .95
/

DELETE COMP_B.C
CREATE COMP_B.C
ENDS 72, 94
FIT HULL
PERM .95
/
DELETE COMP_C.C
CREATE COMP_C.C
ENDS 94, 122
FIT HULL
PERM .95
/
DELETE COMP_CB.C
CREATE COMP_CB.C
ENDS 122, 144
FIT HULL
PERM .60
/
DELETE COMP_DA.C
CREATE COMP_DA.C
ENDS 144, 166
FIT HULL
PERM .60
/
DELETE COMP_E.C
CREATE COMP_E.C
ENDS 166, 194
FIT HULL
PERM .95
/
DELETE COMP_F.C
CREATE COMP_F.C
ENDS 194, 216
FIT HULL
PERM .95
/
```

```
DELETE COMP_G.C
CREATE COMP_G.C
ENDS 216, 288
FIT HULL
PERM .85
/
DELETE COMP_H.C
CREATE COMP_H.C
ENDS 288, 360
FIT HULL
PERM .85
/
DELETE COMP_I.C
CREATE COMP_I.C
ENDS 360, 432
FIT HULL
PERM .95
/
DELETE COMP_J.C
CREATE COMP_J.C
ENDS 432, 475.72
FIT HULL
PERM .85
/

WRITE TUMBLE4.GF
DISP
```

```
proj tumble
read tumble4.gf
report
\\\\Damage Stability Tumblehome Hull\

lim gm > 3
lim angle from equ to ra0 > 30 'sets limits in the ra curves

macro dam1    'sets the macro for the type of tank setting
type (comp_c.c, comp_cb.c, comp_da.c comp_e.c) flood    'flood not damage
/
macro dam2    'sets macro for next set of tanks
type (comp_da.c, comp_e.c, comp_f.c, comp_g.c) flood   'flood the comp's
/
macro dam3    'sets macro for next set of tanks
type (comp_h.c, comp_i.c) flood
/

macro case    'case macro for a major status update
page
solve
stat we, di, wp:to, free
page
ra 0,5,...,90 /lim
type (*) intact
/

draft 18.2
vcg 21.6
sol we, lcg
\\-------Intact Stability-------\
.case   'run case macro before damage

.dam1   'run dam1 macro to damage tanks listed
'a SOLVE command general solve finds how the vessel floats
.case   'now run case again to get new status

.dam2
.case

.dam3
.case

view
```

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