INVESTIGATION OF TRIMARAN INTERFERENCE EFFECTS

by

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A thesis submitted in partial fulfillment of
the requirements for the Bachelor of Science Degree in
Naval Architecture and Marine Engineering

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ACKNOWLEDGMENTS

The authors would like to thank Professor Richard A. Royce for his support throughout this project. We would also like to thank Patrick Doherty for all of his help with our tank testing. Professor Neil Gallagher helped immensely with the model cutting process. Additionally, we would like to thank Cameron Baker, Brian Petersen, and Matthew O'Leary for their help with various items. The authors also thank their thesis editors, Professor John Lutz and Professor Richard Harris, and thesis readers, Professor George Petrie and Dean Roger Compton.

ABSTRACT

Increased interest in trimarans in the last decade has spurred a need for trimaran model testing to understand better the interference effects between the hulls. For this thesis project, a trimaran model was constructed and tested in the Robinson Model Basin at Webb Institute, where the effect of varying the side-hulls transversely and longitudinally was analyzed. The objective of this thesis project was to determine the optimum position of the side-hulls for the specified hull form at a variety of speeds. The results showed that the resistance characteristics of a trimaran are complex and no one configuration was better than the others over the entire speed range. A distinctive feature of this thesis project was the separate resistance testing of the side-hull when it is a part of the trimaran configuration.

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NOMENCLATURE

C_F -	Frictional Resistance Coefficient, $C_F = \frac{0.075}{\left(\log_{10}\left(R_n\right) - 2\right)^2}$
C_{FMain} -	Frictional Resistance Coefficient for the Main Hull
C_{FSide} -	Frictional Resistance Coefficient for the Side-Hull
C_R -	Residuary Resistance Coefficient
C_{RSide} -	Residuary Resistance Coefficient for the Side-Hull
C_{RMain} -	Residuary Resistance Coefficient for the Main Hull
$C_{RTrimaran}$ -	Residuary Resistance Coefficient for the Trimaran
C_T -	Total Resistance Coefficient, $C_T = C_R + C_F$
$C_{TCenter}$ -	Total Resistance Coefficient when the Main Hull is Tested Separately
C_{TSide} -	Total Resistance Coefficient when the Side-Hull is Tested Separately
$C_{TTrimaran}$ -	Total Resistance Coefficient when Tested as a Trimaran
$C_{TMainInTrimaran}$ -	Total Resistance Coefficient of Main Hull when Tested as Part of the Trimaran Configuration
$C_{TMainSeparate}$ -	$C_{TCenter}$
$C_{TSideInTrimaran}$ -	Total Resistance Coefficient of Side-Hull when Tested as Part of the Trimaran Configuration
$C_{TSideSeparate}$ -	C_{TSide}
ΔC_T -	Interference Resistance Coefficient
$\%C_T$ -	Percentage Interference Coefficient
$\%C_{TMain}$ -	Percent Difference of the Main Hull as Part of a Trimaran and Main Hull Separately
$\%C_{TSide}$ -	Percent Difference of the Side-Hull as Part of a Trimaran and Side-Hull Separately
CFD -	Computational Fluid Dynamics
CFDSHIP-IOWA -	Unsteady Reynolds-Averaged Navier-Stokes CFD Code
F_n -	Froude Number, Non-Dimensional Coefficient, $F_n = \frac{V}{\sqrt{gL}}$
g -	Gravitational Constant
L/B -	Length to Beam Ratio
LVDT -	Linear Variable Differential Transformer
NSWCCD -	Naval Surface Warfare Center: Carderock Division
ONR -	Office of Naval Research
ρ -	Density
R_{AA} -	Air Resistance
R_{AP} -	Appendage Resistance
R_{EDDY} -	Eddy Resistance
R_{FORM} -	Form Resistance
R_F -	Frictional Resistance, $R_F = C_F \cdot \frac{1}{2} \cdot \rho \cdot S \cdot V^2$
R_n -	Reynolds Number

R_R -	Residuary Resistance, $R_R = R_T - R_F$
R_T -	Total Resistance
R_W -	Wave-Making Resistance
R_{WB} -	Wave-Breaking Resistance
RVDT -	Rotary Variable Differential Transformer
S -	Wetted Surface Area
S_{SIDE} -	Wetted Surface Area of Side-Hull
S_{MAIN} -	Wetted Surface Area of Main Hull
S_{TOTAL} -	Wetted Surface Area of Trimaran
SWPE -	Sea Wave Pattern Evaluation
TEU -	Twenty Foot Equivalent Unit
UCL -	University College London
USNA -	United States Naval Academy
V -	Velocity

INTRODUCTION

Webb Institute, Stevens Institute of Technology, University College London (UCL), and the United States Naval Academy (USNA) are taking part in an Office of Naval Research (ONR) sponsored joint project to increase the amount of experimental research in the area of trimarans; specifically, the resistance and powering of such vessels. There have been several papers written on trimarans, but the amount of experimental data on the interference effects between the hulls is limited. With the specialized focus of this joint project, more results will be added to the database on trimarans. Select data from this effort will be compared to Stevens' results.

The interaction of waves created from multi-hull vessels such as trimarans is an important factor to consider when designing such a vessel. These interactions can cause an increase or decrease in the overall wave-making resistance. With the added wetted surface area of multi-hull vessels, minimizing resistance where possible is of paramount importance. One advantage of a trimaran is its slender hulls, which generate smaller waves, and, therefore, reduce residuary resistance. These reductions allow a lower powering requirement for high speeds as opposed to a monohull; however, if the trimaran is not designed properly, even this advantage is eliminated. Although the pure interaction of waves generated by the hulls is the main component of interference effects studied, the flow along and between the hulls has recently been studied. From computational fluid dynamics (CFD) modeling using CFDSHIP-IOWA, it was seen that vortices were being formed at the stern of the hulls. Although these vortices have not been seen in experimental tests, there has been no dedicated research in this area.

BACKGROUND

PREVIOUS WORK COMPLETED

Some of the most complete sets of experimental data on interference effects for trimarans are from two Webb Institute senior theses. The first one, Landen *et al.*, in 1996, had a premise very similar to that of this thesis project: testing a trimaran model with an apparatus able to change the side-hull spacing both longitudinally and transversely. A standard FFG-7 main hull with generic side-hulls was used in their thesis project. They found several arrangements of the side-hulls that had negative interference effects; that is, the total resistance was found to be lower than that of the three hulls tested separately and summed. Three different configurations of side-hulls were tested because they had a set of both symmetric and asymmetric side-hulls, with the asymmetric set tested both ways. However, their selections for the positions of the side-hulls may have been too broad. Some of the side-hull locations tested were close to the bow, which may not be a desired design feature. This configuration causes difficulties with coursekeeping (maneuvering) and reduces visibility.

The second Webb thesis, Ackers *et al.*, in 1997, built on the Landen thesis. Using the same models, they added purposefully imposed angles of attack to the side-hulls and also tested several displacements for the side-hulls. This thesis used the same testing matrix as the previous thesis, having side-hull locations which may be viewed as non-realistic.

A 1995 paper entitled "Trimaran Ships: The Configuration of the Frigate of the Future," by Andrews and Zhang explores the usefulness of trimarans. When explaining trimarans' potential for the future, they presented designs created at UCL for a large

variety of trimarans, ranging from ferries to frigates. When incorporating interference effects into their design decisions, Andrews and Zhang cited interference tests performed by a UCL student in 1992 on the Advanced Technology Anti-Submarine Warfare (ASW) Frigate. Those results were from model tests conducted at the Defense Research Agency (DRA) Haslar tank facilities, which resulted in only positive (detrimental) interference effects for the entire speed range tested. The benefits of stability and increased deck space of a trimaran took precedence over powering reduction. On the contrary, Andrews and Zhang found that the slenderness of the trimaran hulls, a feature that decreases wave-making resistance, allowed for lower powering at higher speeds as compared to non-trimaran hulls. The powering for the trimarans was calculated using Taylor data and did not use direct model tests or CFD programs. They assumed an additional 10% resistance caused by wave interference effects. These were basic calculations since properly designed trimarans could have a beneficial wave interaction between the main and side-hulls. Based on this assumption, it seems that there is an advantage of the slender main hull of trimarans. Figure 1 below compares the effective horsepower for high-speed ships of various hull types to two trimaran designs based on rough predictions.

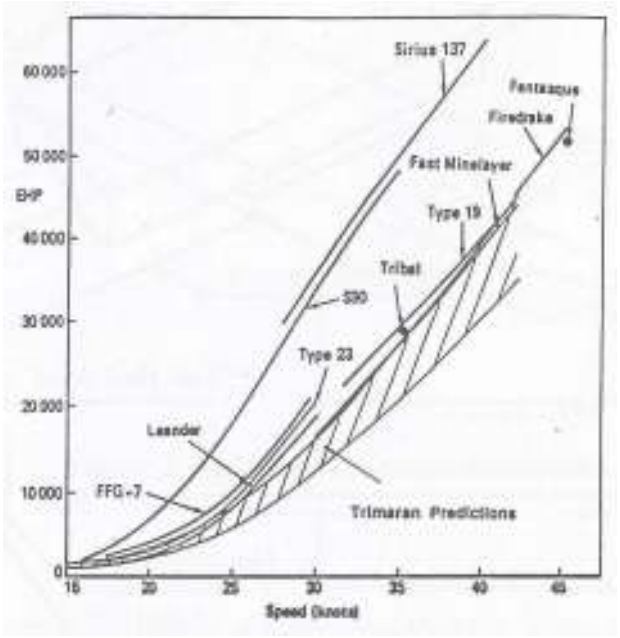

Figure 1. Comparison of EHP at a Displacement of 2642 Tonne
(Source: Andrews & Zhang 1995)

The 1997 UCL doctorate thesis by Zhang explores the feasibility and sea-keeping characteristics of trimarans, and describes possible configurations for different industries. For the thesis project, a twenty-three foot self-propelled trimaran model was constructed and tested at DRA Haslar in 1995. This model was tested for both resistance and sea-keeping with the side-hulls able to move longitudinally and vertically. The testing matrix for this model consisted of five longitudinal locations that were spaced along a large portion of the main hull. In the conclusion of the resistance portion of the thesis, Zhang states, "the results show that the resistance advantages of trimaran ships over conventional monohull ships particularly at top speed could be enhanced if the side-hulls are positioned to achieve maximum wave cancellation effects." He also goes on to state that the wave-making resistance can be decreased at the maximum design speed of 30 knots for the model by moving the side-hulls to the stern.

Lawrence Doctors' paper, "The Optimization of Trimaran Side-Hull Position for Minimum Resistance", (2003, with Robert Scrace) used the data from DRA Haslar in 1996 that involved testing two different sets of side-hulls on a single main hull with five different longitudinal positions for the side-hulls. Using these data, he attempted to see if theoretical calculations for resistance matched the experimental data. He proved that the theory could be very accurate and useful for predicting resistance. One very interesting conclusion was that the side-hulls can influence the total residuary resistance by $\pm 40\%$; this large margin shows the importance of side-hull placement optimization. The premise of this paper was to see if classic linearized theory could be used to predict the resistance for novel modern hull forms, not to create an efficient trimaran hull form.

An experimental study performed in 2001 by graduate students at the Universita degli Studi di Napoli resulted in the paper entitled "Experimental Study on the Efficiency of Trimaran Configuration for High-Speed Very Large Ships." For this study, a 1500 TEU, 40-knot trimaran containership was designed. Through trial and error, they managed to decrease the wave-making resistance by 20%, as compared to the sum of the hulls tested individually. This is a great reduction, showing the potential benefits of trimarans.

APPROACH

This thesis project builds upon previous experimentation and improves on it in several ways. The hull is specifically designed for a trimaran; most, if not all, previous experiments relied on standard hull forms, mostly Series 64 or Wigley hulls. The side-hull location matrix is refined to include the most likely locations for the side-hulls, allowing smaller increments of side-hull placement. Based upon Froude's scaling (see

Appendix A), a large speed range exists to observe critical areas (humps and hollows) of the resistance curve. The size of the test matrix is large, adding significant data to the field of trimaran research. An innovative feature of this thesis project is the separate resistance testing of the side-hull while it is a part of the trimaran. These data will shed light on whether the interference effects are influencing the main hull or side-hull's resistance more.

OBJECTIVE

The primary objective of this thesis project is to determine the optimum position of the side-hulls for the specified hull form, both transversely and longitudinally, at a variety of speeds. The test matrix includes a large range of speeds in an attempt to define accurately all of the humps and hollows in the complex resistance curve of a trimaran. In addition, the test matrix will consist only of locations that are considered the most realistic positions for the side-hulls. This thesis project will expand the limited database of trimaran experimental data. This model will also be used by Stevens Institute and the USNA to compare the results and further augment the database. Lastly, the thesis project will support the Atlantic Center for Innovative Design and Control of Small Ships (ACCSS) project.

THEORY

Principles of Naval Architecture (PNA), Volume II states, "the resistance of a ship at a given speed is the force required to tow the ship at that speed in smooth water, *assuming no interference from the towing ship*." For obvious reasons of practicality, this

is rarely, if ever, done full-scale. Model tests are helpful in this regard because of their significantly lower cost compared to full-scale testing.

The total resistance of a hull operating in calm water consists of four main components: frictional, residuary, air, and appendage resistance. The following equation for total resistance is then:

$$R_T = R_F + R_R + R_{AA} + R_{AP} \qquad \text{(Eq. 1)}$$

where R_T is the total resistance, R_F is the frictional resistance, R_R is the residuary resistance, R_{AA} is the air resistance, and R_{AP} is the appendage resistance.

Frictional resistance is caused by the viscous drag of water molecules as the ship moves through the water. The friction causes a boundary layer that increases in thickness to the stern of the ship where separation occurs. Frictional resistance can be approximated by standard equations for flat plates. Equation 2 shows the calculation of the frictional resistance, and Equation 3 shows the calculation of the frictional resistance coefficient using the International Towing Tank Conference of 1957 (ITTC '57) model correlation line:

$$R_F = C_F \cdot \frac{1}{2} \cdot \rho \cdot S \cdot V^2 \qquad \text{(Eq. 2)}$$

$$C_F = \frac{0.075}{\left(\log_{10}\left(R_n\right) - 2\right)^2} \qquad \text{(Eq. 3)}$$

The residuary resistance consists primarily of wave-making resistance, which is the result of the ship's imparting energy to the surrounding water. It also consists of wave-breaking resistance, eddy resistance, and form resistance. The total residuary resistance can be calculated using Equation 4:

$$R_R = R_W + R_{WB} + R_{Eddy} + R_{Form} = R_T - R_F \qquad \text{(Eq. 4)}$$

where R_R is the residuary resistance, R_W is the wave-making resistance, R_{WB} is the wave-breaking resistance, R_{Eddy} is the eddy resistance, and R_{Form} is the form resistance.

Wave-breaking resistance arises from the energy required to create a breaking bow wave from a ship of full form. The slender hulls of trimarans reduce the breaking waves, so this resistance can be considered negligible.

Form resistance, a name for all unaccounted-for resistances, results from the particular shape of the hull. It is the summed effect of the pressure fields that develop on the hull as a result of separation that occurs in the flow around the hull. Because of the difference in the Reynolds number between the model and the actual vessel, scaling this resistance is difficult.

Air resistance is caused by the ship moving through the air. The air is moved out of the way and therefore increases the energy required to move the ship. Although the density of air is nearly 800 times less than the density of water, high-speed vessels need to include this resistance. Air resistance is a function of the cross-sectional area of the hull and superstructure above the water line.

Appendage resistance results from the total drag caused by anything in the water besides the bare hull. Appendages can include rudders, bilge keels, active stabilizers, and any other protrusions from the hull. For the purpose of this thesis project, appendage drag is ignored because only the bare hull was tested.

At lower speeds, generally below a Froude number of 0.30, frictional resistance is the majority of the total resistance. However, as speed increases, the wave-making resistance begins to dominate, becoming an increasingly larger portion of the total resistance until planing occurs. The frictional resistance cannot easily be reduced.

Reducing the wetted surface area is difficult because the main way to reduce it is to increase the bilge radius. When the bilge radius is increased while the beam is held constant, internal volume is lost.

Reducing wave-making resistance can be accomplished in two ways. First, the hull can be designed to cancel out the crests and hollows along the hull. However, this is feasible only to a certain extent and useful only at a specified speed. The other way to reduce wave-making resistance is to make the hulls more slender since a fuller hull has more wave-making resistance. Slender hulls usually decrease the wave-making resistance over the entire speed range. Normal monohulls usually have a slenderness ratio (L/B) of nine or less. A slenderness ratio greater than nine would produce a hull with poor stability, resulting in the tendency to roll excessively. With the side-hulls offering a good deal of transverse stability, the center hull of a trimaran can have a slenderness ratio in excess of 15.

INTERFERENCE EFFECTS

When testing a multi-hulled vessel such as a catamaran or a trimaran, the resistance of all of the hulls towed together varies from the sum of the resistances when towed individually. Equation 5 was used to calculate this difference in resistance:

$$\Delta C_T = C_{T_{Trimaran}} - (C_{T_{Center}} + 2C_{T_{Side}}) \qquad \text{(Eq. 5)}$$

where ΔC_T is the interference resistance coefficient, $C_{T_{Trimaran}}$ is the total resistance coefficient when tested as a trimaran, $C_{T_{Center}}$ is the total resistance coefficient when the center hull is tested separately, and $C_{T_{Side}}$ is the total resistance coefficient when the side-hull is tested separately.

The hulls affect each other in several ways. These effects are called interference effects and can either be beneficial or detrimental to the resistance of the vessel. Creating beneficial interference effects, or at least minimizing detrimental ones, is important when designing a multi-hull vessel. There are several aspects of interference effects. The first is the interaction of the Kelvin waves created by each hull (see Figure 2).

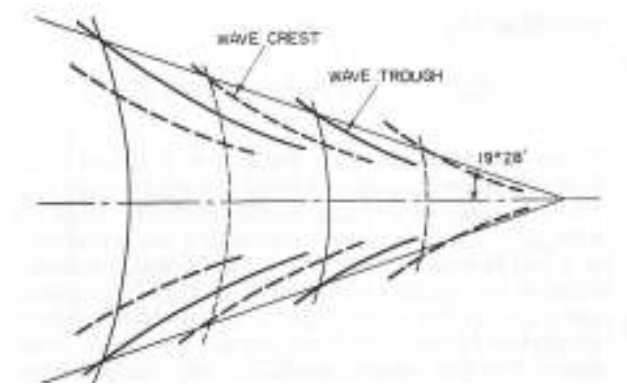

Figure 2. Kelvin Wave Pattern
(Source: Lewis 1988)

The interaction of Kelvin waves can be constructive, when the waves build on each other at the crest or trough, or destructive, when the waves cancel each other out either partially or fully. For the purpose of reducing resistance, destructive wave patterns are preferable because they minimize the wave energy imparted to the water by the vessel. Since the side-hulls and main hull of a trimaran create waves at different longitudinal positions, the science, or more appropriately, the art of designing for destructive interference effects is a difficult task. Another aspect of interference effects is the change in the wetted surface areas of the individual hulls. The wave patterns created by each hull can change the wetted surface area of the other hulls, disturbing the gravity wave created by each hull and destroying the still water assumption used in resistance tests. When multiple hulls are involved, the change in wetted surface area is further exacerbated from that of a

monohull. The third aspect of interference effects is the pressure gradient created on each hull by the others. With the hulls in such close proximity, the water rushing between them can have restricted channel and blockage effects that change the viscous effects, or frictional resistance, on the model (Lawyer 2006).

Currently, interference effects are combined into the residuary resistance category because the technology to separate their effects on the frictional resistance does not exist. The approach for multi-hull model testing is to attempt to reduce the wave-making resistance by adjusting the side-hull spacing. The pressure gradient and wetted surface area differences are difficult, if not impossible, to determine at this point. With the inclusion of vortices identified with CFDSHIP-IOWA software, another aspect of the interference effects is added. Regardless, the only true method naval architects currently have to reduce the resistance of a given trimaran moving through the water at a certain speed is to adjust the side-hull spacing to find the point of least resistance.

TESTING MATRIX

Three transverse and three longitudinal side-hull locations were tested. The apparatus constructed for this thesis project allows for infinite adjustment of the side-hulls to accommodate future tests. Each configuration was tested at approximately thirty different speeds, depending on the results obtained. If higher definition of the resistance curve was needed, more tests were performed. The testing matrix was decided upon after consultation with Professor Richard Royce. This matrix may cover only a small section of the possible configurations, but locations from amidships aft are the most likely positions for the side-hulls on an actual ship. The distance from the stem of the main hull to amidships of the side-hull was varied from 71.5% to 81.5% of the length of the main

hull at evenly spaced increments of 5%, which corresponds to 4.2 inches. The transverse distance from the side-hull to the main hull (clearance from the extreme side of main hull to the inboard side of side-hull) was varied at 30.9%, 50%, and 70% at increments of about 20%, which corresponds to 1.6 inches. (The 30.9% spacing is not exactly 30% because this was the original configuration provided by NSWCCD.) Therefore, a total of nine different configurations were tested. Additionally, the center hull and side-hulls were tested independently to obtain the interference resistance. See Figure 3 for the transverse and longitudinal positions of the side-hulls.

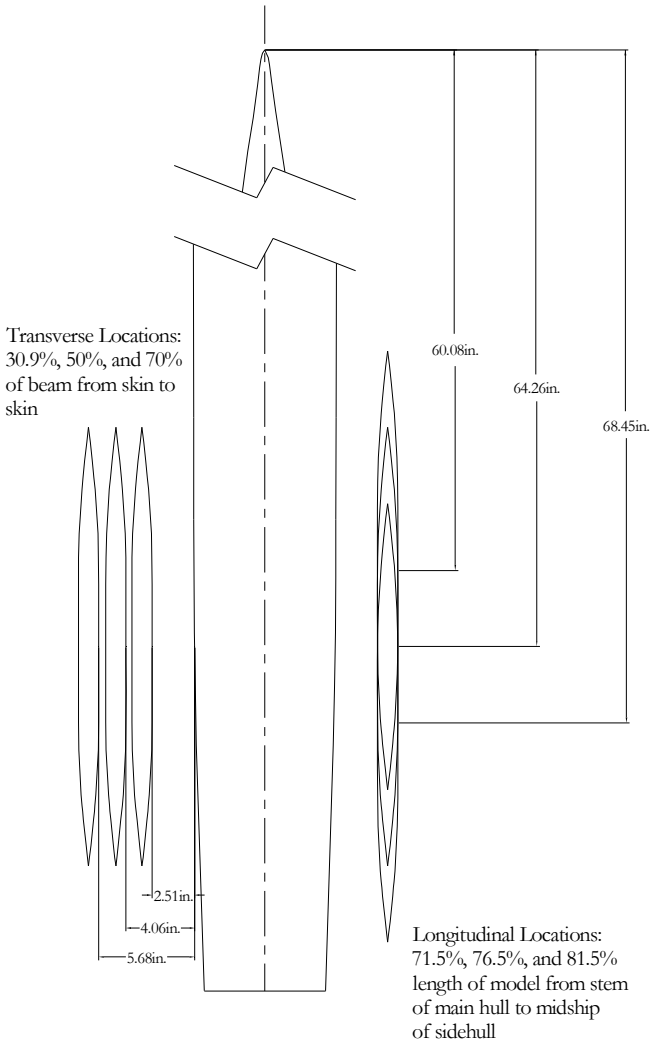

Figure 3. Side-Hull Locations

The tests were run at a speed range of 1.501 ft/s to 7.507 ft/s, with a minimum of twenty-six data points per side-hull configuration. Most configurations were tested at more speeds to investigate the "humps" and "hollows" in the complex trimaran resistance curve.

DESIGN AND CONSTRUCTION

MODEL

A Rhinoceros 3D (Rhino) file of the model was obtained from Dr. Colen Kennel at the Center for Innovation in Ship Design at NSWCCD. (See Figure 4.) However, the 3D model was not fair, so construction could not begin immediately.

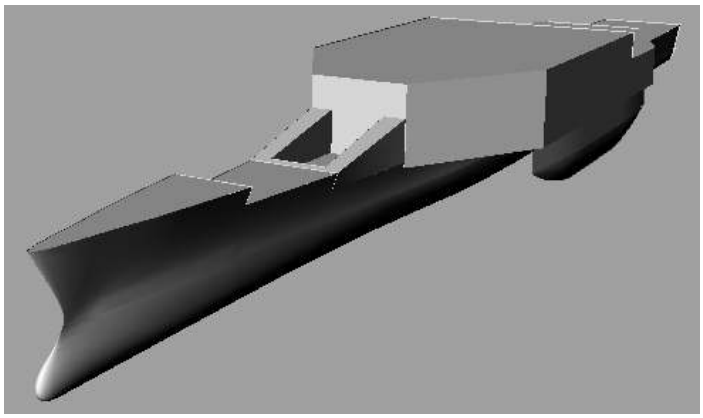

Figure 4. Original Trimaran Design (Screenshot from Rhino)

The model consists of a main hull and two side-hulls. Each side-hull's displacement is approximately 3% of the main hull's displacement, and their lengths are approximately 30% of the main hull's, which is consistent with other trimaran designs. The main hull has a bulbous bow and a transom stern designed to accommodate waterjets. The length to beam ratio for the main hull is 10.4 and 20.1 for the side-hull. The beam to draft ratio for the main hull is 2.86 and 0.54 for the side-hull.

In order to create a physical model, several steps were followed. First, Rhino was used to obtain contours from the unfair model, and then the contours were imported into FastShip. FastShip was used to start anew because it was desirable to use single surfaces to recreate the fair hull. The end result can be seen below in Figures 5 and 6.

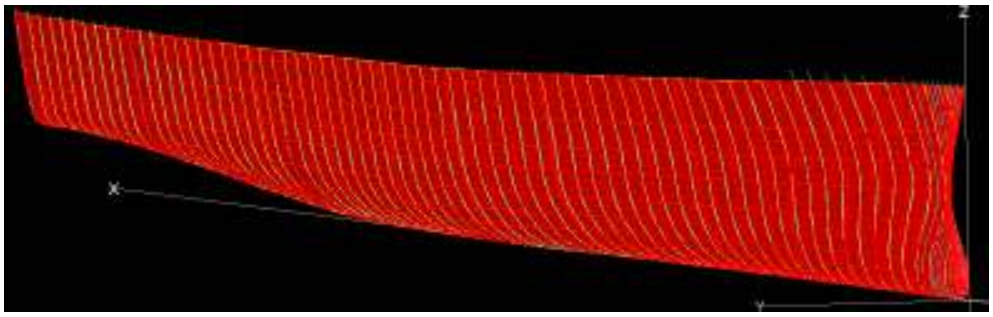

Figure 5. FastShip - Main Hull

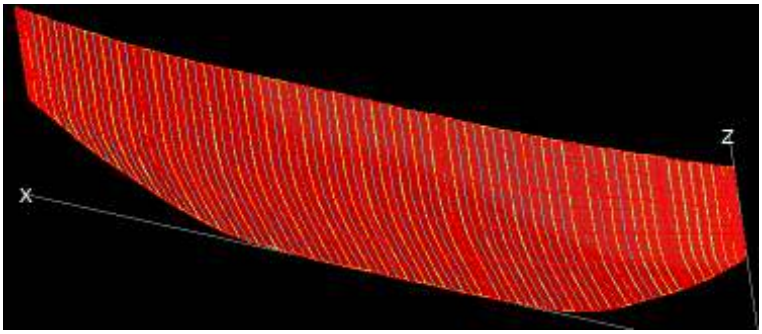

Figure 6. FastShip – Side-Hull

Since the trimaran given by NSWCCD was not fair, the hulls created are not exactly the same; however, the differences are negligible. Fairing the hulls was a necessary step to create hydrodynamically efficient hulls.

Subsequently, the FastShip models for the main hull and side-hulls were imported into MasterCAM. This program created tool paths for the model cutter to follow in order to cut the hull (see Figure 7).

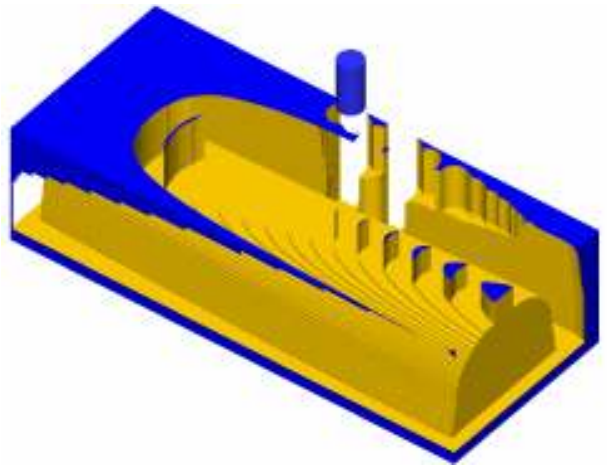

Figure 7. Aft Section of Main Hull in MasterCAM

The next task was to cut pieces of foam that would later be shaped by the model cutter. Since the main hull is seven feet long, it was divided into two sections because of the model cutter length limitation of five feet. The bulbous bow was also cut separately since it has reverse curvature, which cannot be accommodated on Webb's model cutter. The bulb has a point of inflection on each side, so it had to be cut using the buttock lines as guides, while all of the other pieces were cut using the waterlines as guides.

The model cutter was used to create the two sections of the main hull and the two side-hulls. The bulbous bow required the use of the Bridgeport milling machine to accommodate the small radii along the buttocks. The model cutter and Bridgeport cut individual waterlines and buttock lines, respectively, not the area in between. Thus, the hulls consisted of a series of stepped curves as shown below in Figure 8.

Figure 8. Aft Section of Main Hull from Model Cutter

In order to fair the hulls, they were spray painted and sanded until the paint disappeared along the waterlines. After sanding, the pieces of the main hull had to be connected. Since this model will be used by other institutions in other configurations, the different components of the hull were made detachable. The aft and forward sections of the main hull are attached by two bolts, and the bulbous bow is screwed into the forward section. Next, the hulls were coated with polyester resin to seal the foam.

The resin was then sanded, wet-sanded, and spray-painted yellow, thus completing the hulls. See Table 1 for the dimensions of the model. The full-scale characteristics are seen in Table 2.

Table 1. Model Characteristics

Center Hull			
	Length	84	in
	Beam	8.10	in
	Depth	5.45	in
	Draft	2.83	in
	L/B	10.4	
	B/T	2.86	
	$L/Vol^{1/3}$	8.61	
Side-Hull			
	Length	24.1	in
	Beam	1.20	in
	Depth	3.59	in
	Draft	2.23	in
	L/B	20.1	
	B/T	0.54	
	$L/Vol^{1/3}$	7.79	

Table 2. Full-Scale Principal Characteristics

	Center Hull	**Side-Hull**
Length	268.3 m (880.4 ft)	77 m (252.6 ft)
Beam	25.9 m (85.0 ft)	3.8 m (12.6 ft)
Draft	9 m (29.5 ft)	7.1 m (23.4 ft)
Displacement	32,200 MT	
Design Speed	32 knots	

APPARATUS

An apparatus to vary the side-hull transverse and longitudinal positions was designed and constructed (see Figure 9). The apparatus needed to be strong, light, and easy to adjust. Aluminum bar (80/20) and plywood coated with resin (for water-proofing) were used to construct the apparatus. One reason for using 80/20 was to allow for infinite adjustment of the side-hull positions because no holes had to be drilled for preset spacing. The design of the apparatus also had to allow for a force block to measure the side-hull force directly (see Figure 9).

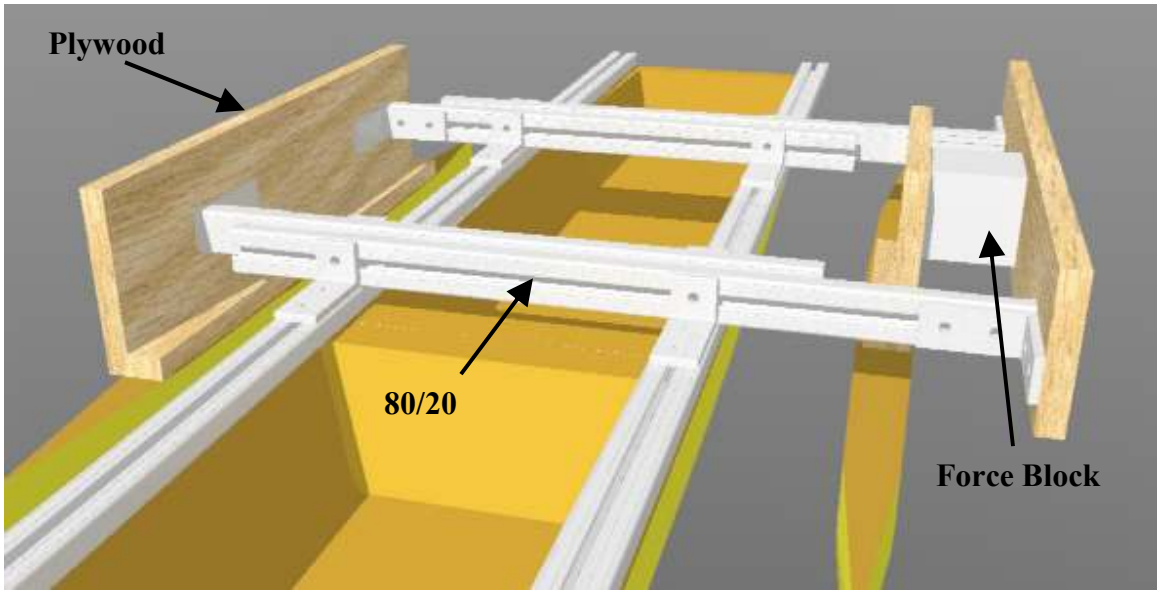

Figure 9. Apparatus for Varying Transverse and Longitudinal Side-Hull Locations

TESTING PROCEDURE

Tank testing was performed in the Robinson Model Basin at Webb Institute. Each configuration of the side-hulls was carefully measured to ensure that the side-hulls were symmetric in the transverse and longitudinal directions. Before each configuration was tested, the main hull resistance, trim, heave, and side-hull resistance were calibrated and then calibrated again after the testing was completed. The values presented in this thesis project are based on the average of the two calibrations. A tare, or 'zero' reading was taken before each run to account for the slight fluctuations in the instruments. This tare value was subtracted from the reading during the test.

Calculations were performed to investigate blockage, restricted channel, and shallow water effects (see Appendix B). These effects were seen to be negligible as the trimaran utilizes slender hulls.

Air resistance tests were performed, but the results were errant and negligible (see Appendix C). Some negative air resistance was seen, which is impossible given the added frontal area. This added area should increase the resistance slightly. These discrepancies can be attributed to the lack of precision of the instruments.

The side-hull monohull testing was performed on the starboard side-hull for all of the speeds and select speeds on the port side-hull. These were found to correlate well, so no further testing of the port side-hull was done (see Appendix C).

When the side-hulls were tested separately, the five-pound force block was used. This may not have been sensitive enough to detect the small changes in the resistance that were found, which may explain some of the anomalies in the side-hull resistance data.

TURBULENCE STIMULATION AND TESTING INSTRUMENTATION

The model was fitted with turbulence stimulators. Hama strips were made from four layers of electrical tape, providing a thickness of 0.028 inches. Triangles roughly ¾" on each side were cut and aligned vertically 3.75" aft of the stem, in keeping with standard practices at the Robinson Model Basin.

There were several different test instruments used for this thesis study. A five-pound and a two-pound Hydronautics force block were used for resistance measurements for the trimaran and side-hull, respectively. A Schaevitz LVDT (type 2002XS-D) measured heave variations with an average sample standard error of +/- 0.039 inches. A Schaevitz RVDT (type 1589) measured trim variations with an average sample standard error of +/- 0.033 degrees. The data were sampled at 200 Hz. LabView software recorded all of the data and made time-averaged measurements of the data. Also, the starting and stopping transient data were truncated.

EXPANSION OF DATA TO FULL-SCALE

After the testing was completed, data analysis began. An average calibration was found by combining the calibration readings before and after testing. When calibrating, a force was applied at an angle to the model, and only the horizontal component of this force was desired. This angle correction was made after the average calibration correction.

Once the resistance of the model was found, (after the average calibration and angle correction were taken into account), the full-scale resistance was computed. The frictional resistance was recalculated using the ITTC ’57 correlation line for the full-scale dimensions and Reynolds number. A correlation allowance of $C_A = 0.0004$ was used in these calculations. A second method, using a Prohaska plot, was used for calculating the full-scale resistance. This method uses a form factor, (1+k), to modify the frictional resistance coefficient slightly to represent the viscous resistance of a shaped hull. See Appendix D for the model data reduction and expansion of these data to full-scale.

SWPE CALCULATIONS

A resistance prediction program, Sea Wave Pattern Evaluation (SWPE) from NSWCCD, was also used to analyze the data. The SWPE output can be used to compare the results only on an order of magnitude basis. The experimental results are more reliable and this program was used to check trends. See Appendix E for the experimental results versus the SWPE output.

ANALYSIS OF RESULTS

The resistance characteristics of trimarans are complex. No single configuration was better for all speeds tested. To analyze the results, the percentage interference was calculated using Equation 6. Negative percentage interference means the resistance of the trimaran configuration was less than that of the three hulls tested separately and summed.

$$\%C_T = \frac{C_{T_{Trimaran}} - (C_{T_{Center}} + 2C_{T_{Side}})}{C_{T_{Trimaran}}} \qquad \text{(Eq. 6)}$$

The best configuration out of the nine tested was the one with the side-hulls located farthest aft and farthest outboard. Generally, when the side-hulls were located outboard, decreased interference effects were observed. When the Froude number exceeded approximately 0.35, the resistance was usually less than for the hulls tested separately and summed (See Figures 10-15).

There were several spots common throughout all of the configurations where there were negative interference effects. For example, at Froude numbers around 0.13, 0.22, and 0.26, almost all configurations exhibited minimum interference effects (see Figures 10-15). See Appendix F for a complete set of the results.

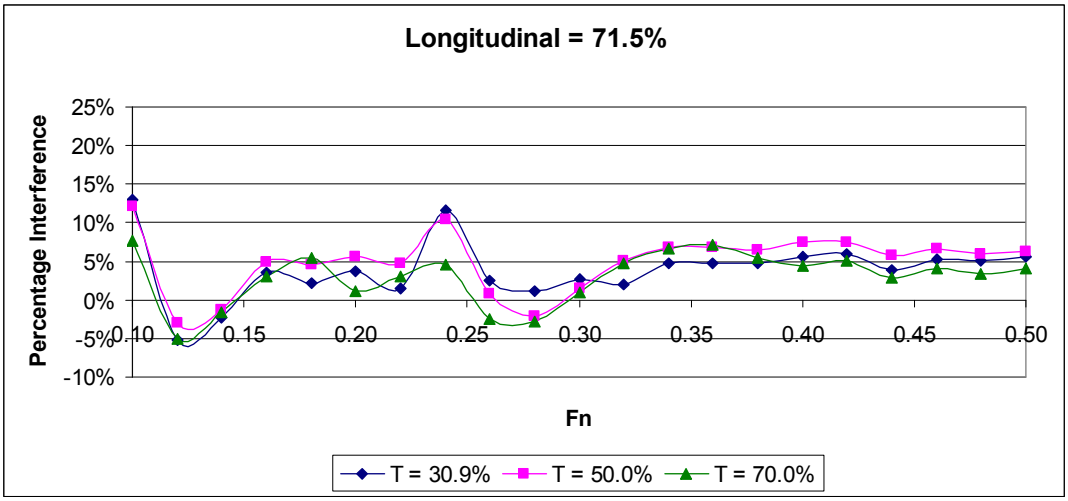

Figure 10. Effect of Transverse Position on Interference, L = 71.5%

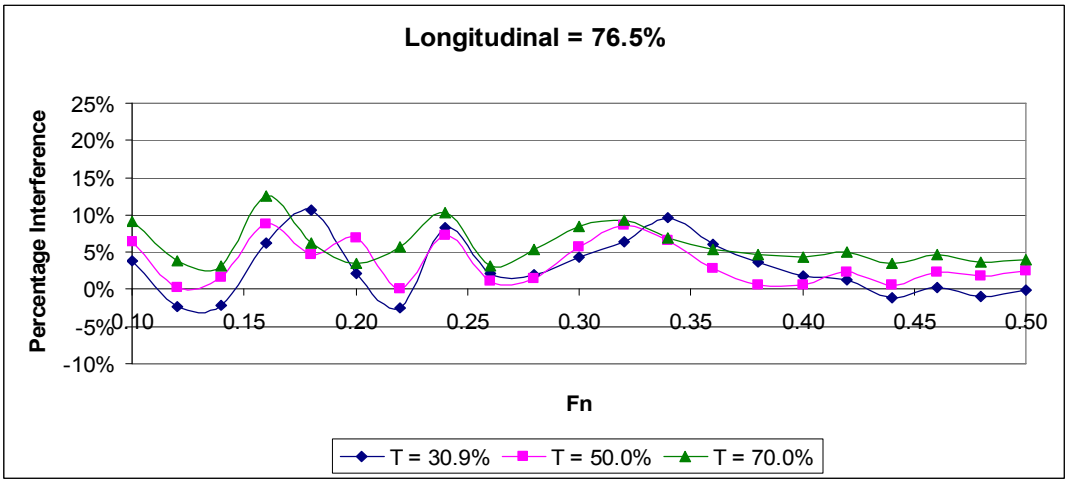

Figure 11. Effect of Transverse Position on Interference, L = 76.5%

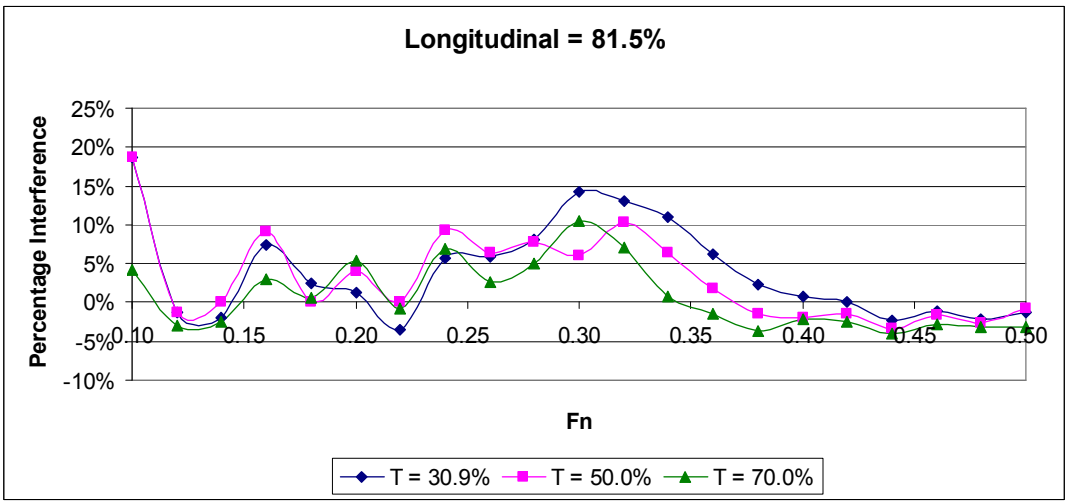

Figure 12. Effect of Transverse Position on Interference, L = 81.5%

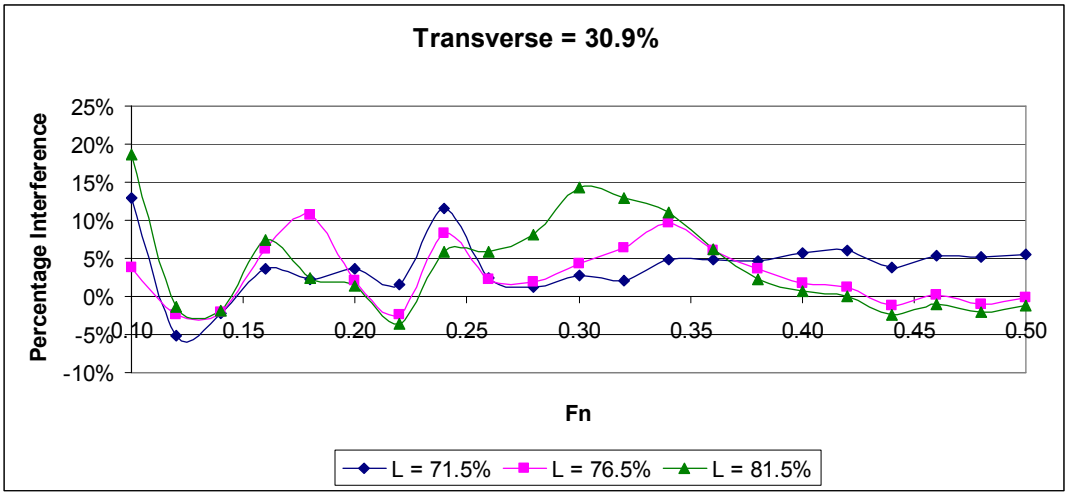

Figure 13. Effect of Longitudinal Position on Interference, T = 30.9%

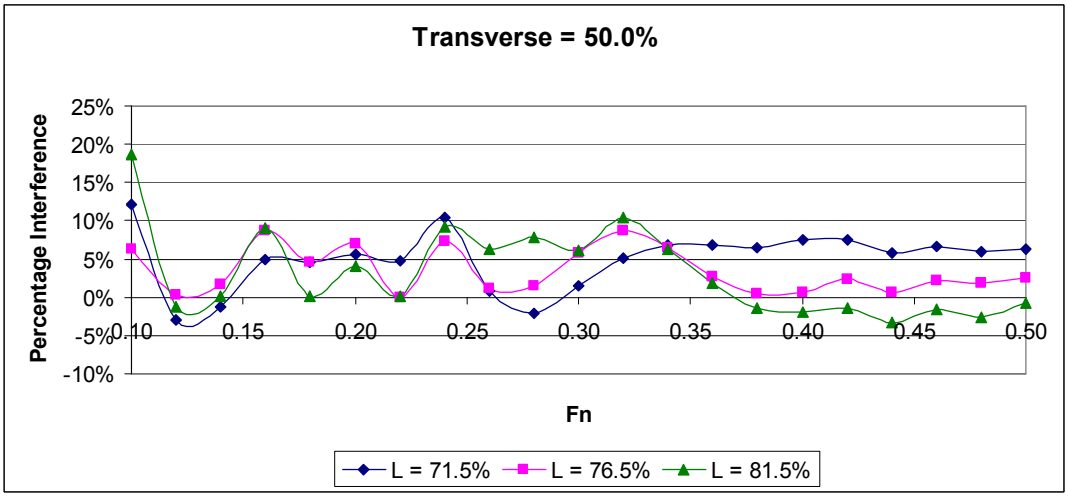

Figure 14. Effect of Longitudinal Position on Interference, T = 50.0%

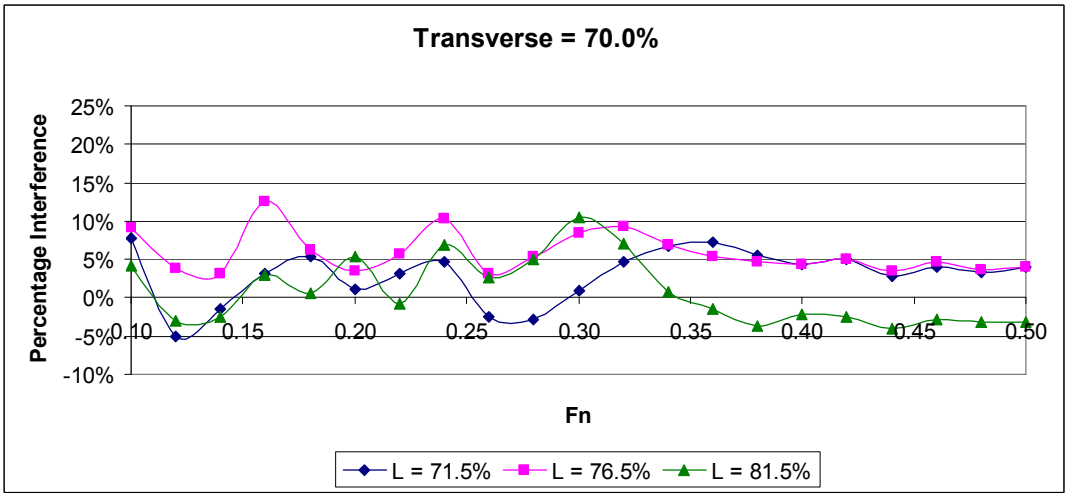

Figure 15. Effect of Longitudinal Position on Interference, T = 70.0%

The total resistance coefficients were plotted for the different configurations (see Figure 16). Also shown in Figure 16 is the total resistance coefficient for the three hulls tested separately and summed. For the spacings shown below (constant longitudinal position of 81.5%), the trimaran exhibited higher resistance, regardless of transverse spacing, for the range of Froude numbers from 0.23 to 0.34.

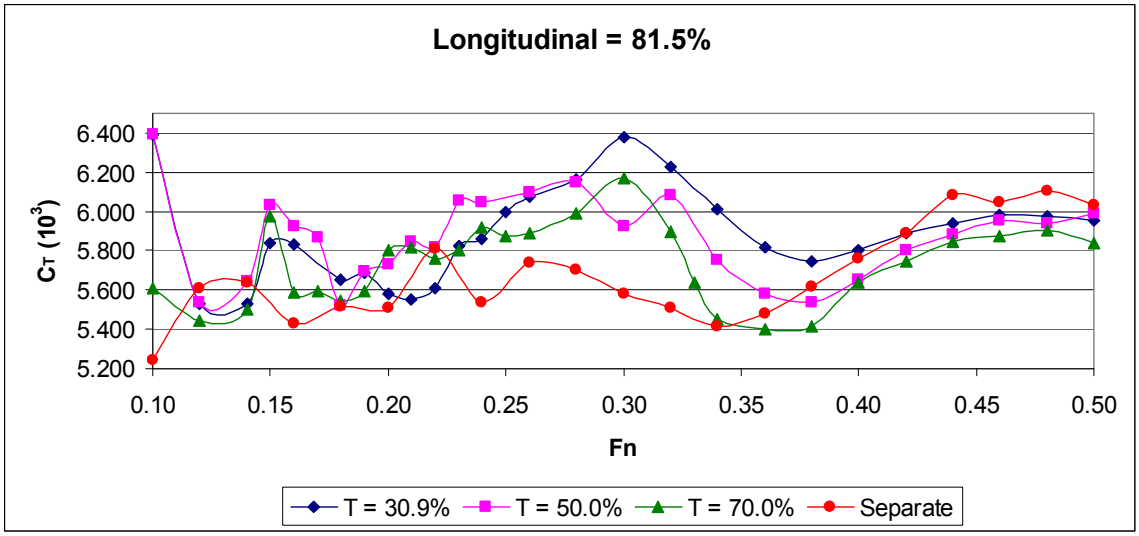

Figure 16. Effect of Transverse Position on Total Resistance Coefficient

Next, the residuary resistance coefficients were plotted (see Figure 17). Again, the residuary resistance coefficient for the three hulls tested separately and summed was plotted using Equation 7. The residuary resistance coefficient of the trimaran was found using Equation 8.

$$C_R = 2C_{R_{Side}}\left(\frac{S_{Side}}{S_{Total}}\right) + C_{R_{Main}}\left(\frac{S_{Main}}{S_{Total}}\right) \qquad \text{(Eq. 7)}$$

$$C_{RTrimaran} = C_{TTrimaran} - 2C_{F_{Side}}\left(\frac{S_{Side}}{S_{Total}}\right) - C_{F_{Main}}\left(\frac{S_{Main}}{S_{Total}}\right) \qquad \text{(Eq. 8)}$$

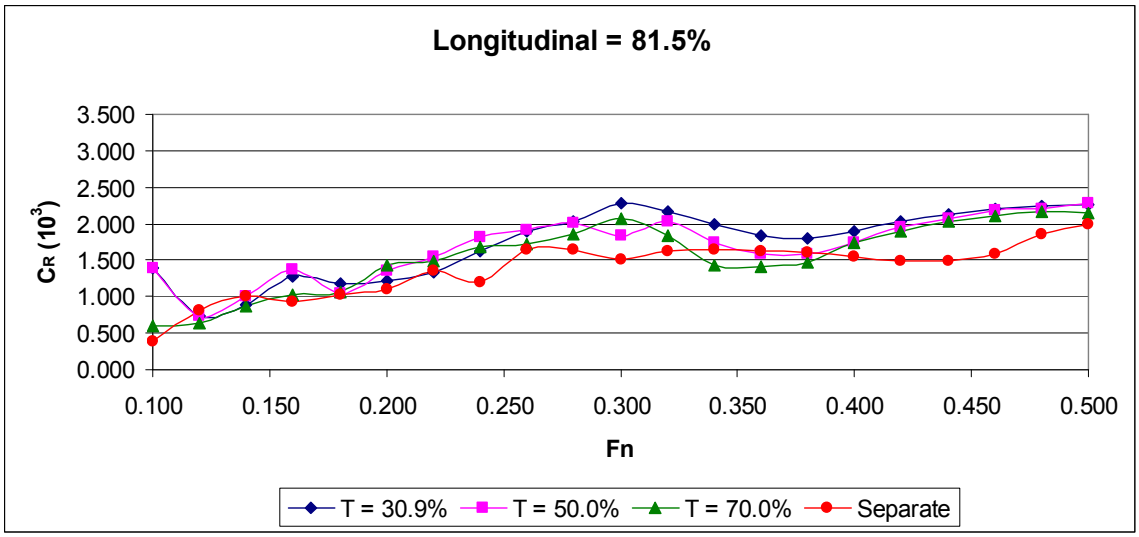

Figure 17. Effect of Transverse Position on Residuary Resistance Coefficient

The range of interference effects obtained from the testing was -5% to +19%. This shows the impact side-hull placement has on total resistance.

The resistance for a trimaran is generally higher than the resistance of the three hulls summed. In addition, the residuary resistance for a trimaran is usually greater than the residuary resistance of the three hulls summed. This is expected because the wave interference causes an increase in both the total and residuary resistance. There are, however, some points at which the resistance for the trimaran is lower than that for the three hulls summed. When designing a trimaran, care should be taken to have a point of reduced resistance corresponding to the design speed.

COMPARISON OF CONFIGURATIONS

The optimal configuration at each speed was found. There seemed to be quite a variation of the optimum configuration at lower speeds. This may have been caused by the small differences in resistance and the imprecision of the instruments. At the higher

Froude numbers, two configurations seemed to dominate, both with the side-hulls positioned farthest outboard.

For Froude numbers of 0.14, 0.16, and range from 0.34 to 0.50, the configuration with the fewest interference effects has the side-hulls positioned farthest aft (81.5%) and outboard (70%). For 11 out of the 21 speeds tested, this configuration had the least percentage interference.

The configuration farthest forward (71.5%) and outboard (70%) had the least percentage interference for Froude numbers of 0.12, 0.20, and of the range from 0.24 to 0.30. This configuration was better for 6 of the 21 speeds tested.

For the lowest speed tested, $F_n = 0.10$, the configuration given by NSWCCD, with the side-hulls at a location of 30.9% transversely and 76.5% longitudinally, had the least percentage interference.

At a Froude number of 0.12, two configurations had the lowest percentage interference: the location most forward (71.5%) at transverse positions of 30.9% and 70%, most inboard and most outboard.

The configuration located farthest aft (81.5%) and 50% transversely had the lowest percentage interference for a Froude number of 0.18. When the side-hulls are moved inboard (30.9%) and kept aft, the smallest percentage interference was seen at a Froude number of 0.22.

For the Froude number 0.32, the design speed of the vessel, the minimal interference was found with the side-hulls positioned farthest forward (71.5%) and farthest inboard (30.9%).

For 17 out of the 21 speeds tested, the farthest outboard transverse location was optimal. When the side-hulls were positioned inboard, the minimal interference was seen for only four speeds. The farthest aft location was optimal for 13 speeds. When moved farthest forward, lower interference was observed for seven speeds. The intermediate positions for both the longitudinal and transverse spacing only saw one speed each for which resistance was decreased.

SINKAGE

As the side-hulls were moved aft, the negative heave decreased; in other words, the hull squatted less. Also, as the side-hulls are moved aft, the slope of the heave becomes more gradual. The transverse location of the side-hulls did not affect the heave greatly. In Figure 18, the graphs are arranged with the transverse spacing increasing to the right and longitudinal spacing increasing downward. The heave oscillates slightly for the configuration with a transverse spacing of 30.9% and longitudinal spacing of 76.5%. This may have been caused by the testing being conducted on two different days.

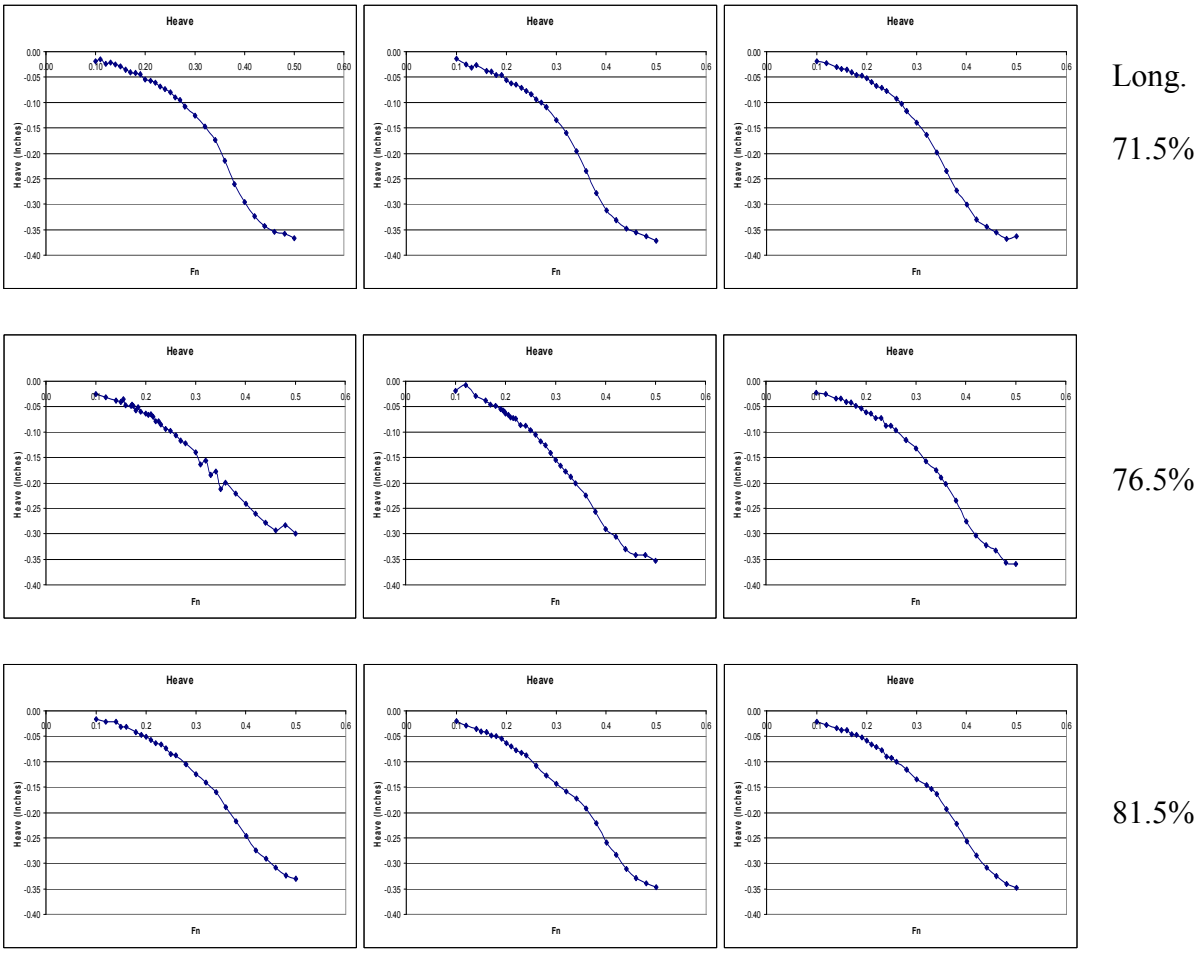

Figure 18. Heave Graphs

TRIM

The trim was affected by the side-hull position. The closer to the main hull the side-hulls were, the greater the effect on the trim. When the side-hulls were positioned at the 30.9% transverse location, the trim increased as the side-hulls were moved forward. As the side-hulls were moved outboard, their effect on the trim decreased. When the side-hulls were positioned in the 70% transverse location, the maximum trim was essentially constant for all longitudinal locations. As the side-hulls were moved aft, a hump seemed to develop around a Froude number of 0.3. In addition, as the side-hulls were moved outboard at the same time, the hump became more pronounced. In Figure 19, below, the

graphs are arranged with the transverse spacing increasing to the right and longitudinal spacing increasing downward.

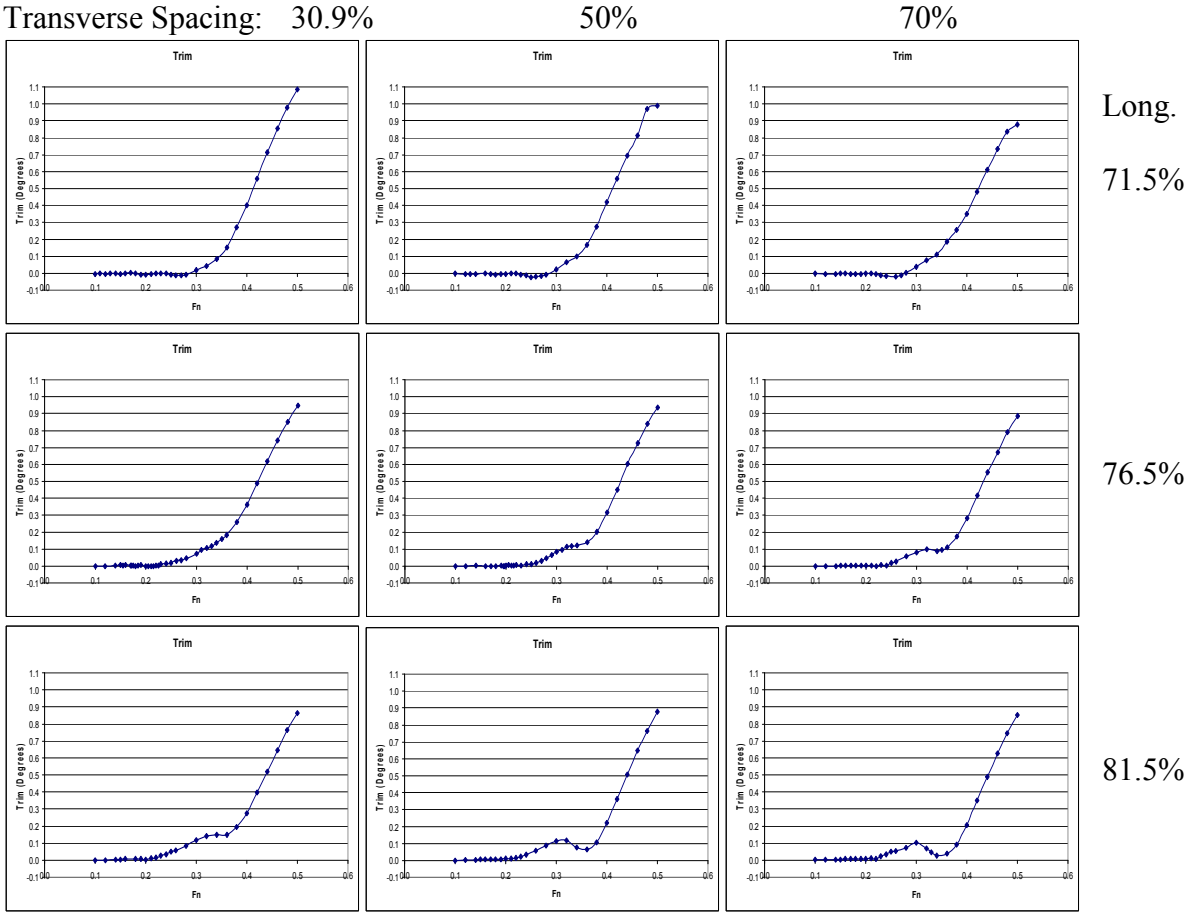

Figure 19. Trim Graphs

SIDE-HULL RESISTANCE

The apparatus designed for this thesis project has a unique feature. It allows the testing of the side-hull resistance while it is a part of the trimaran configuration. The separate resistances of the main hull and side-hulls can be found when the model is in the trimaran configuration. The influence of the interference effects on the main hull and side-hulls can then be seen. These data may prove useful for structural calculations in the design of the cross-deck.

This side-hull resistance data were analyzed by obtaining the percentage difference between the trimaran tests and monohull tests of the main hull and side-hull using Equations 9 and 10.

$$\%C_{TMain} = \frac{C_{TMainInTrimaran} - C_{TMainSeparate}}{C_{TMainSeparate}} \qquad \text{(Eq. 9)}$$

$$\%C_{TSide} = \frac{C_{TSideInTrimaran} - C_{TSideSeparate}}{C_{TSideSeparate}} \qquad \text{(Eq. 10)}$$

The percentage difference for the residuary resistance coefficient was found using equations similar to those above.

From the graphs of the percent differences in total resistance coefficient, it can be seen that in the range of Froude numbers from 0.25 to 0.35, the side-hull's percent difference decreases as the main hull's increases (see Figures 20 and 21). In addition, from 0.35 to 0.50, the side-hull's percent difference increases as the main hull's percent difference decreases. This means the main hull is affected more by the interference in the range from 0.25 to 0.35, and the side-hull is influenced more at the higher speed range. Similar trends are seen with the residuary resistance coefficient. These results can be seen in Appendix G.

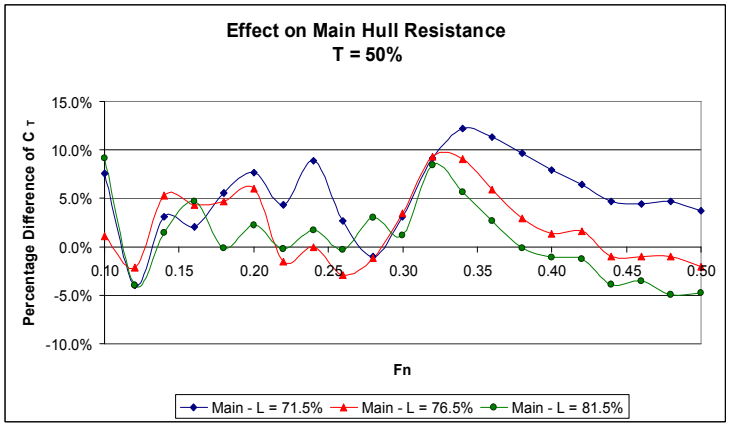

Figure 20. Percent Difference of Total Resistance Coefficient for Main Hull

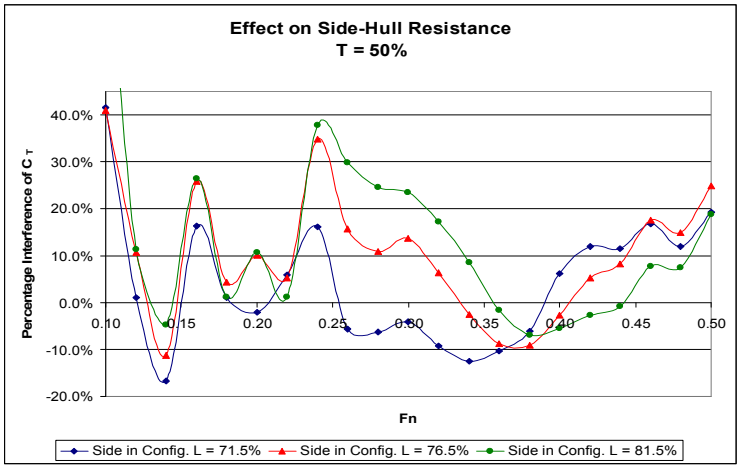

Figure 21. Percent Difference of Total Resistance Coefficient for Side-Hull

CONTOUR PLOTS

Tecplot was used to create contour plots of the interference effects for various speeds. The dark blue indicates lower (beneficial) interference effects, and red indicates higher (detrimental) interference effects (see Figures 22-24). Each contour plot is scaled separately.

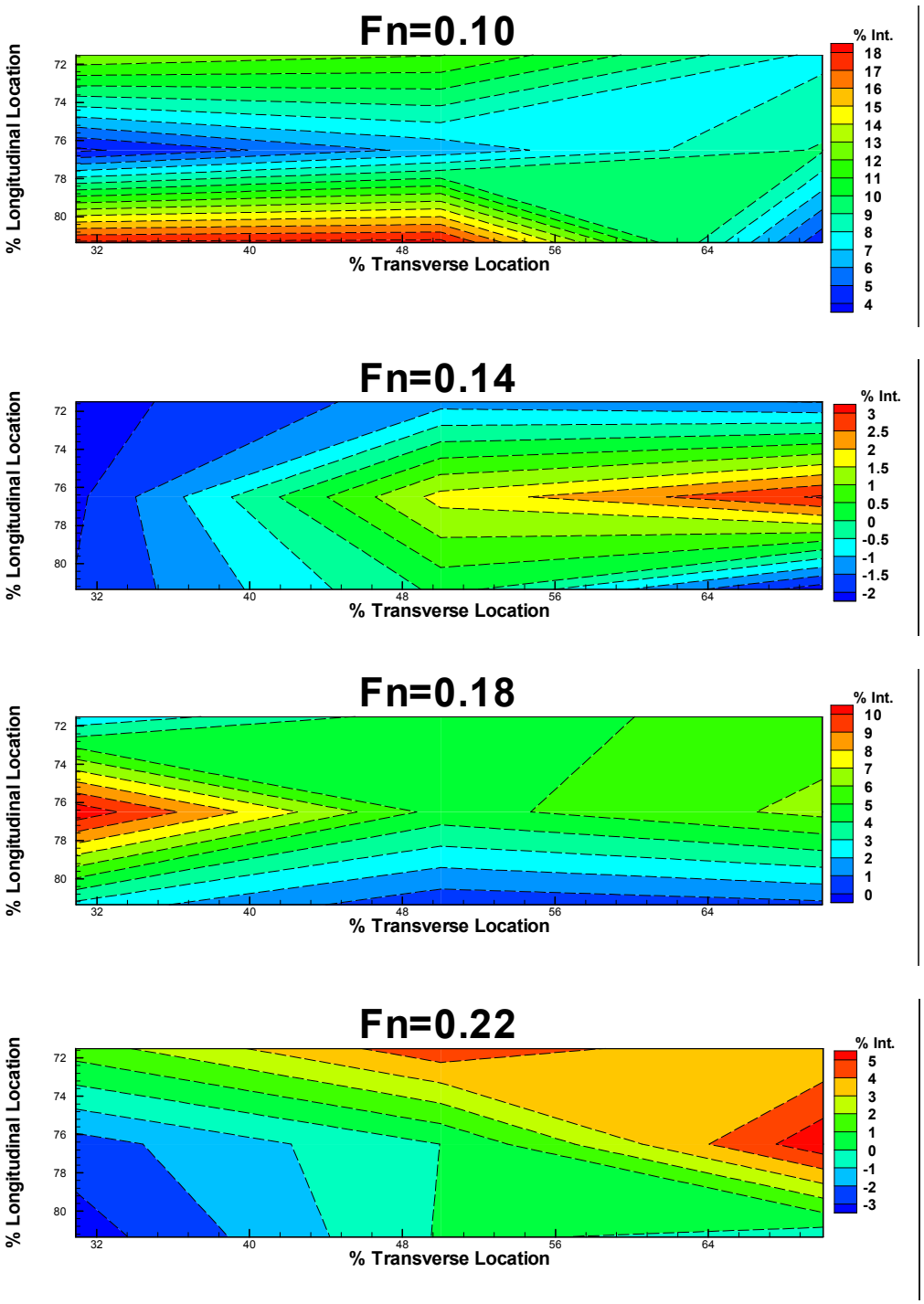

Figure 22. Contour Plots for Low Speeds

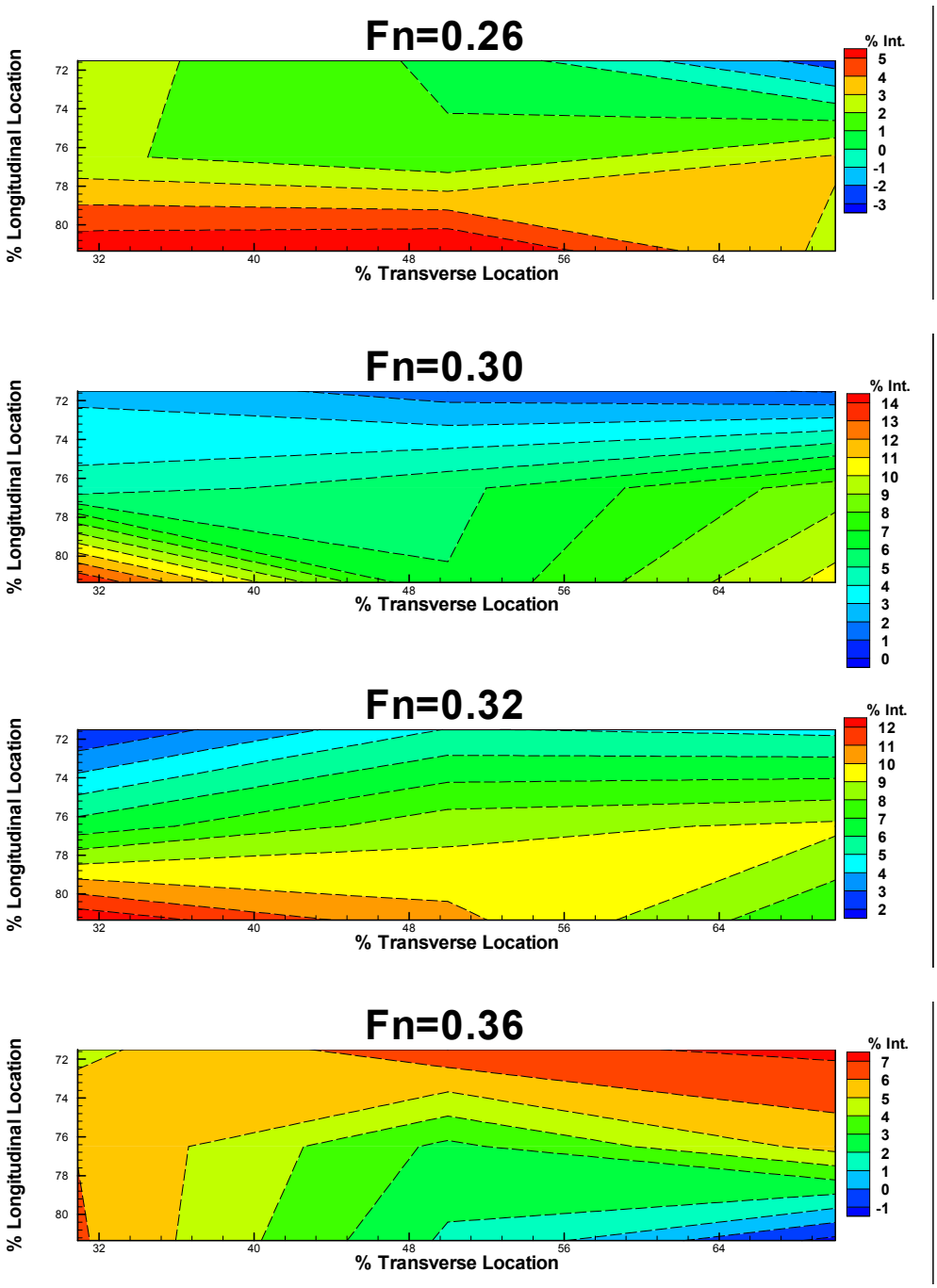

Figure 23. Contour Plots for Intermediate Speeds

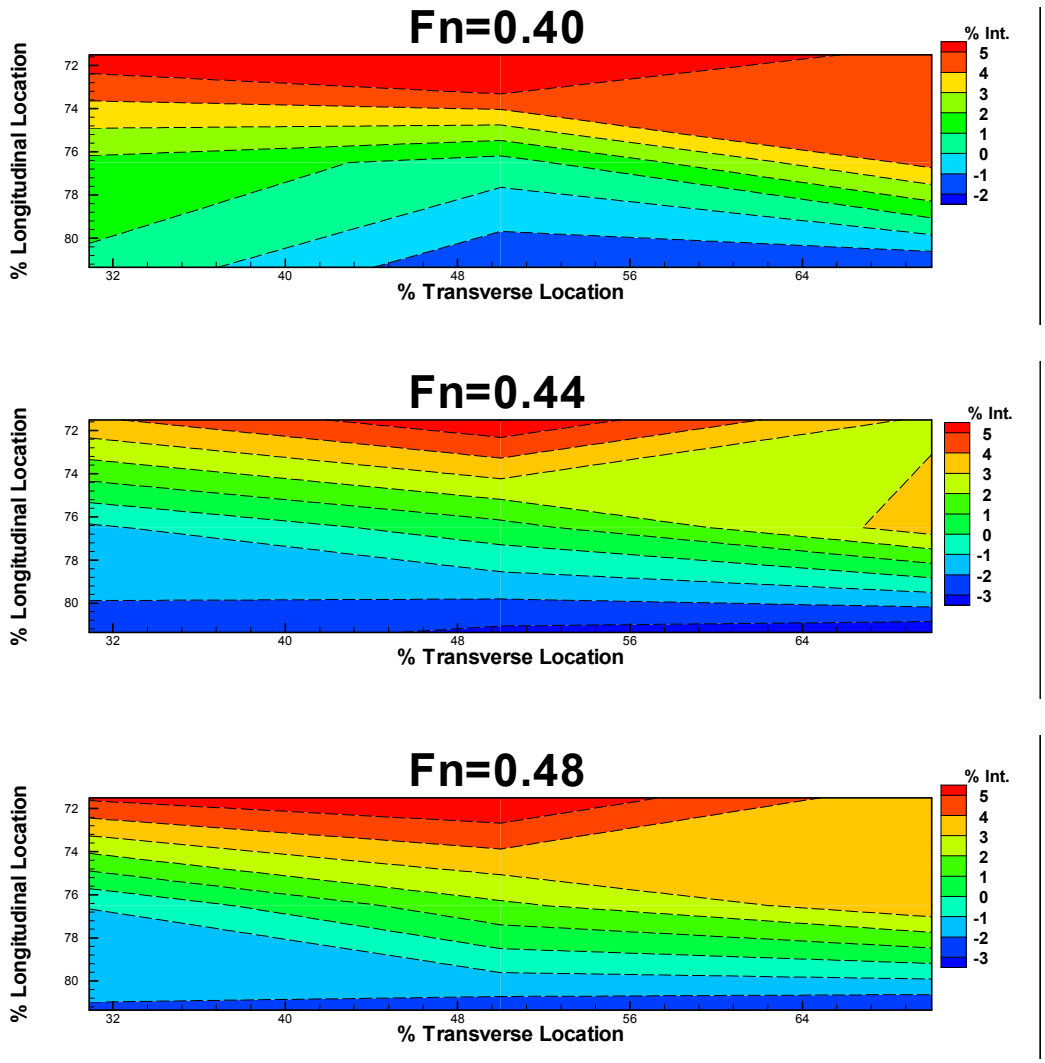

Figure 24. Contour Plots for High Speeds

CONCLUSIONS

There are several factors that influence trimaran resistance but the effects of these are not fully known. Speed and side-hull spacing, both transverse and longitudinal, were the variables this thesis project explored, adding much needed experimental data to the field. No particular configuration had better resistance characteristics for the entire speed range. There were, however, decreases in total resistance for most of the configurations in some portions of the speed regime. Nonetheless, at the design speed of 32 knots, all of the configurations had an increase in resistance from 2% to 13%. The unique design employed in this thesis project yielded interesting results. The main hull's drag varied from the monohull testing results because of the close proximity of the side-hulls. The largest impact the interference effects had on the main or side-hull depended on the speed range. The main hull was influenced more than the side-hull in Froude number ranges of 0.25 to 0.35, and the side-hull was affected more in the range from 0.35 to 0.50.

This thesis project supported the project from the Atlantic Center for Innovative Design and Control of Small Ships. Lastly, a model that will be used by others in subsequent months was constructed and tested.

PLANNED FUTURE WORK

Stevens Institute will test the trimaran model in its towing-tank in order to compare the results of both tanks. Furthermore, more configurations of the side-hulls may be tested as time restraints limited the size of the side-hull location matrix. Additionally, a UCL student may make a more in-depth analysis of the flow visualization around the hulls. The USNA may test even more configurations, encompassing the full range of side-hull locations. Furthermore, a larger version of the model may be constructed at

Stevens Institute to analyze scaling effects, and Stevens may also design and test a different stern section.

Lawrence Doctors will be performing computational tests on this hull and will compare the code's results with the experimental results. The experimental results will be added to his parametric database of trimaran model testing to increase the accuracy of his computational code.

RECOMMENDATIONS FOR FUTURE WORK

Several related studies could be undertaken. Wave probes could be used to perform an analysis of the best and worst configurations. The model could be tested with different displacements and different bulb or stern designs. Other future work may entail constructing larger side-hulls, increasing the side-hull displacement from 3% to 5%, or even 10% of the total displacement.

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APPENDIX A

FROUDE SCALING CALCULATIONS

$L_{Ship} = 268.3\,m$ Length of Full Scale Ship

$L_{Ship} = 880.4\,ft$

$V_S := 32knots$ Ship Design Speed

$Fn := \frac{V_S}{\sqrt{g \cdot L_{Ship}}}$ Froude Number at Design Speed

$Fn = 0.321$

$\Delta_{Design} := 32200tonne$ Full Scale Design Displacement

$\Delta_{Arrival} := 24200tonne$ Full Scale Arrival Displacement

$\Delta_{Light} := 19800tonne$ Full Scale Lightship Displacement

$\rho_{SW} := 1025 \frac{kg}{m^3}$ Density of Salt Water at 20C

$\rho_{FW} := 1000 \frac{kg}{m^3}$ Density of Fresh Water at 20C

$Vol_{SDesign} := \frac{\Delta_{Design}}{\rho_{SW}}$ Underwater Volume for Design Displacement

$Vol_{SDesign} = 3.141 \times 10^4\,m^3$

$L_{Model} := 7ft$ Length of the Model

$L_{Model} = 84.0\,in$

$\lambda := \frac{L_{Ship}}{L_{Model}}$ Linear Scale Ratio

$\lambda = 125.8$

$V_M := 14.5 \frac{ft}{s}$ Maximum Model Speed Limitation of Tank

Given

$$V_M = \frac{V_S}{\sqrt{\lambda}}$$ Froude's Law

$Results := Find(V_S)$

$V_S := Results$

$V_S = 96.3\,knots$

Thus the maximum speed of the carriage corresponds to a maximum ship speed of 96 knots which allows a large speed range to be covered.

Next, the displacement and underwater volume of the model were found.

$$Vol_{MDesign} := \frac{Vol_{SDesign} \cdot \rho_{SW}}{\lambda^3 \cdot \rho_{FW}}$$ Scaled Underwater Volume

$Vol_{MDesign} = 0.016\,m^3$

$Vol_{MDesign} = 987.64\,in^3$

$Vol_{MDesign} \cdot \rho_{FW} = 16.2\,kg$ Weight of Model

$Vol_{MDesign} \cdot \rho_{FW} = 35.7\,lb$

The waterline was then found to be 2.83 inches above the baseline for the center hull. This translated into a draft of 2.23 inches for the side-hull since the center hull and side-hulls aren't on the same plane.

$Vol_{MCenter} := 929.85in^3$ Volume of Center Hull

$Vol_{MCenter} \cdot \rho_{FW} = 15.2\,kg$ Weight of Center Hull

$Vol_{MCenter} \cdot \rho_{FW} = 33.6\,lb$

$Vol_{MSide} := 29.6in^3$ Volume of Side-Hull

$Vol_{MSide} \cdot \rho_{FW} = 1.1\,lb$ Weight of Side-Hull

$Vol_{Total} := \left(Vol_{MCenter} + 2 \cdot Vol_{MSide}\right) \cdot \rho_{FW}$ Check of Total Weight of Model

$Vol_{Total} = 35.7\,lb$

APPENDIX B

SHALLOW WATER, RESTRICTED CHANNEL, AND BLOCKAGE CALCULATIONS

Shallow Water and Restricted Channel Effects

$A_{Tank} := 10ft \cdot 5ft$ Cross-Sectional Area of the Tank

$A_{Model} := 21.2in^2$ Cross-Sectional Area of the Model

$P_{Tank} := 10ft + 5ft + 5ft$ Wetted Perimeter of the Tank

$R_H := \frac{A_{Tank}}{P_{Tank}}$ Hydraulic Radius of the Channel

$R_H = 30.0\,in$

Rectangular Channel of Width b and Depth h

$b := 10ft$

$h := 5ft$

$A_X := A_{Model}$ Maximum Cross-Sectional Area of Hull

$p_s := 4.66in$ Wetted Girth of Side-Hull

$p_m := 10.78in$ Wetted Girth of Main Hull

$p_{Tot} := 2p_s + p_m$ Total Wetted Perimeter of Model

$p_{Tot} = 20.1\,in$

$R_H := \frac{(b \cdot h - A_X)}{b + 2 \cdot h + p_{Tot}}$ Hydraulic Radius when Model is in a Rectangular Channel

$R_H = 27.6\,in$

$\frac{\sqrt{A_X}}{R_H} = 0.167$ Ratio of Cross-Sectional Area to Hydraulic Radius

$\frac{\sqrt{A_X}}{h} = 0.077$ Ratio of Cross-Sectional Area to Height of Channel

$\frac{V_h}{V_I} = 0.999$ Landweber's Method

$\frac{V_h}{V_I} = 1$ Schlichting's Method

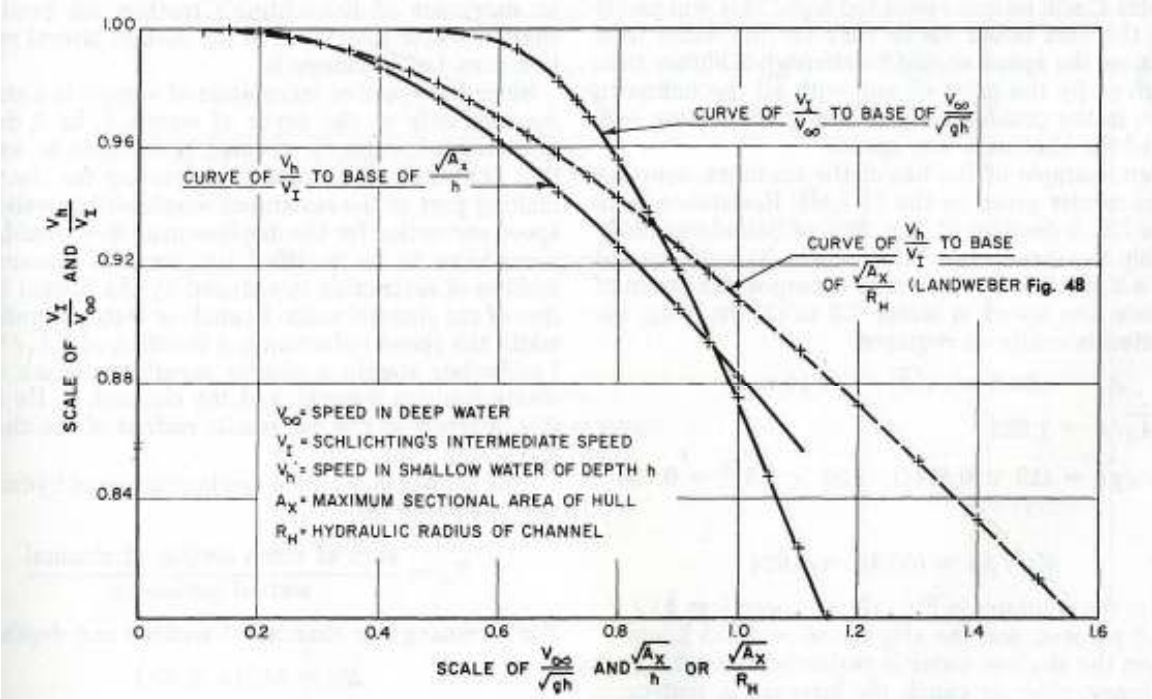


Fig. 46 Curves of velocity ratios for calculating resistance in shallow water (Schlichting)

Source: PNA Volume II, Page 45

Blockage Calculations

$$\frac{A_{Model}}{A_{Tank}} = 0.0029 \qquad < 0.01$$

$$0.7\sqrt{g \cdot h} = 8.88 \frac{ft}{s} \qquad \text{70\% of the Critical Wave Velocity}$$

Maximum Towing Velocity = 7.507 ft/s

Recommendations from Fassardi adapted from DeBord

Submerged Model Cross Section should be less than 1/100 of the tank's cross-section
Towing Velocities not greater than 0.7 of the critical wave velocity.

to minimize blockage effects.

Also, the United States Naval Academy uses the submerged cross section ratio less than 0.005 to minimize blockage effects, which our model meets.

In summary, all of these effects are negligible and no corrections need to be made.

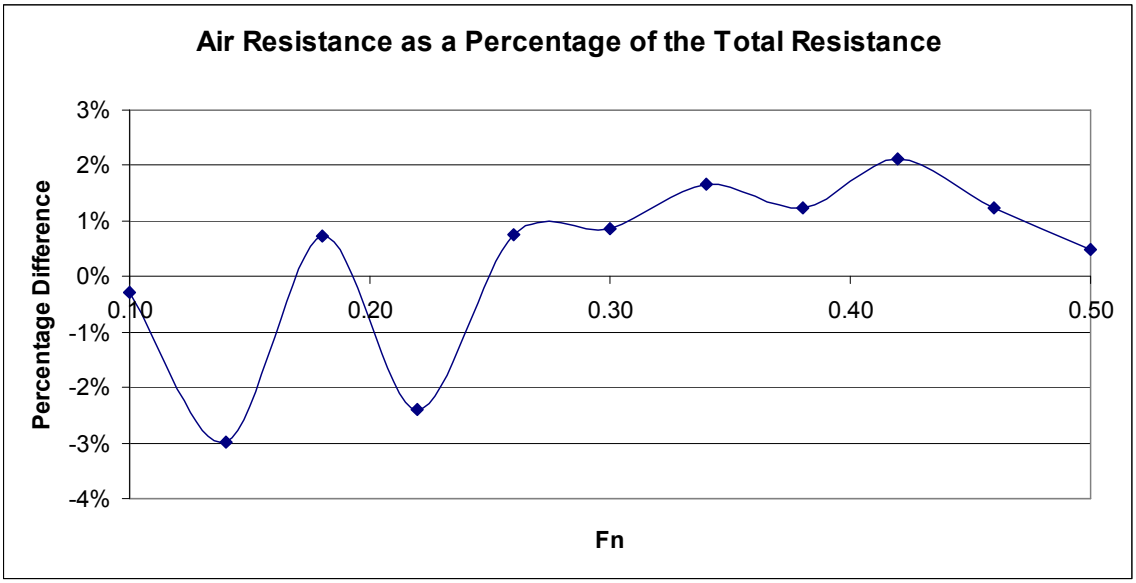
APPENDIX C

AIR RESISTANCE AND SIDE-HULL MONOHULL TESTING

This section shows the results from the air resistance tests and the side-hull monohull tests. The air resistance was determined by testing the main hull with and without the apparatus. These two resistances were compared to obtain the effect of air resistance. The results of these tests and calculations are shown below.

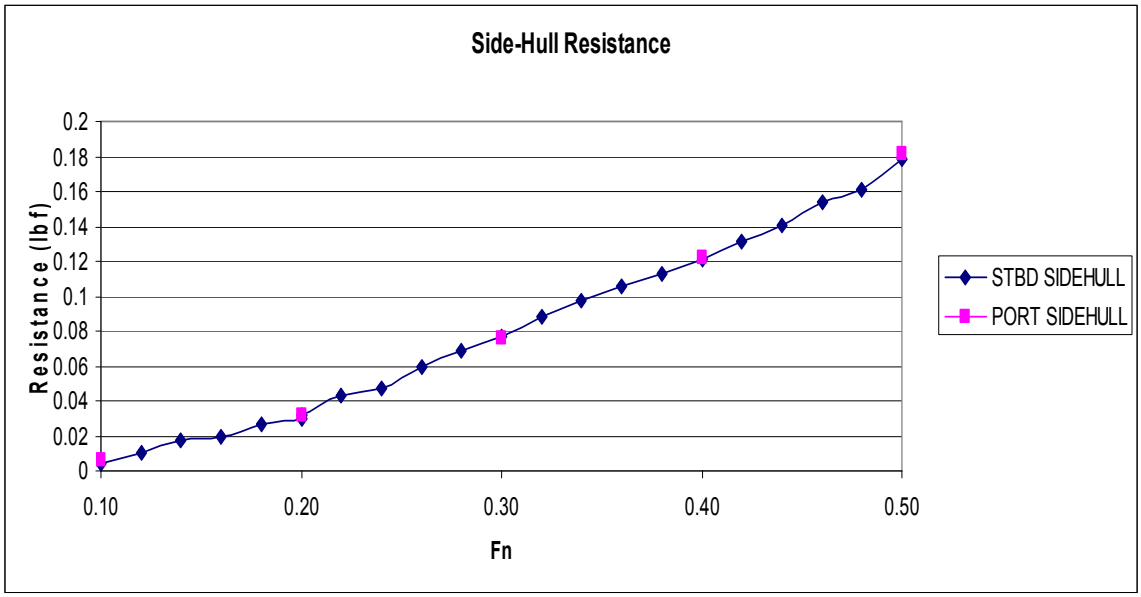
AIR RESISTANCE TESTS

F_n	V_M (ft/s)	Re	C_F	R_F (lbf)	R_T (Hull Only) (lbf)	R_T (Hull w/ Apparatus) (lbf)	Air Res. (lbf)	% of Resist.
0.10	1.501	998986	0.00469	0.052	0.065	0.065	0.000	-0.29%
0.14	2.102	1398580	0.00436	0.096	0.120	0.117	-0.003	-2.99%
0.18	2.702	1798174	0.00414	0.150	0.195	0.196	0.001	0.73%
0.22	3.303	2197768	0.00398	0.215	0.306	0.299	-0.007	-2.39%
0.26	3.903	2597363	0.00385	0.291	0.420	0.423	0.003	0.76%
0.30	4.504	2996957	0.00374	0.377	0.546	0.551	0.005	0.87%
0.34	5.105	3396551	0.00365	0.473	0.678	0.689	0.011	1.66%
0.38	5.705	3796146	0.00358	0.578	0.904	0.915	0.011	1.23%
0.42	6.306	4195740	0.00351	0.693	1.185	1.210	0.026	2.12%
0.46	6.906	4595334	0.00345	0.817	1.474	1.492	0.018	1.23%
0.50	7.507	4994928	0.00340	0.951	1.744	1.753	0.009	0.50%



SIDE-HULL MONOHULL TESTS

	STBD SIDE-HULL	PORT SIDE-HULL		
F_n	Resistance (lbf)	Resistance (lbf)	Difference (lbf)	% Difference
0.10	0.004	0.006	0.002	50.00%
0.12	0.01			
0.14	0.017			
0.16	0.02			
0.18	0.027			
0.20	0.03			
0.20	0.032	0.032	0	0.00%
0.22	0.043			
0.24	0.047			
0.26	0.06			
0.28	0.069			
0.30	0.077	0.076	-0.001	-1.30%
0.32	0.088			
0.34	0.097			
0.36	0.106			
0.38	0.113			
0.40	0.121	0.122	0.001	0.83%
0.42	0.131			
0.44	0.141			
0.46	0.154			
0.48	0.161			
0.50	0.178	0.182	0.004	2.25%



APPENDIX D

DATA REDUCTION AND FULL-SCALE RESISTANCE

This section summarizes all of the testing data for resistance, heave, trim, and side-hull resistance. Several corrections were made to the data after the testing was completed. The calibration and decalibration readings were combined to obtain an average calibration that was used to reduce the data. In addition, when calibrating, a force was applied at an angle to the model, and only the horizontal component is desired. This angle correction was used after the average calibration correction had been made. The reduction of data and expansion to full-scale is summarized below.

TRANSVERSE = 30.9%, LONGITUDINAL = 76.5%

Note: Yellow Highlighted Data Obtained on April 18

Trimaran, T = 30.9%, L = 76.5% | Correct Tow Point | Water Temp 20 C
17-Apr-07 ++++++ No appendages ++++++ Calibration Angle 5.168
18-Apr-07

Hama Thickness = 0.028 in

Total Disp 35.70 lbf

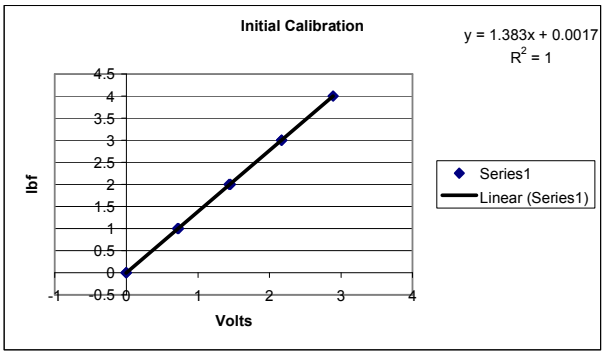
Calibrations

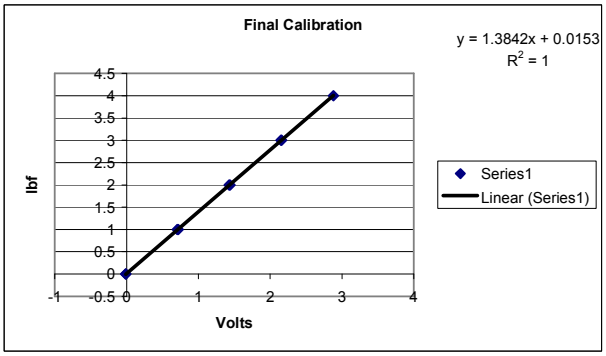
17-Apr-07

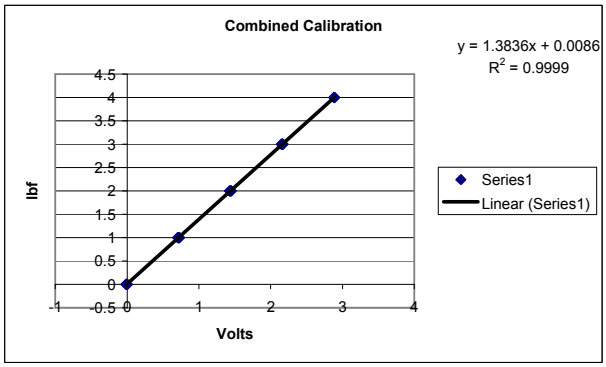
	Volts	lbf
Initial	-0.004	0
	0.717	1
	1.435	2
	2.167	3
	2.891	4
	2.169	3
	1.453	2
	0.73	1
	0	0
Final	-0.013	0
	0.708	1
	1.428	2
	2.15	3
	2.881	4
	2.158	3
	1.439	2
	0.719	1
	-0.011	0

18-Apr-07

	Volts	lbf
Initial	-0.008	0
	0.71	1
	1.432	2
	2.154	3
	2.874	4
	2.158	3
	1.436	2
	0.719	1
	-0.007	0
Final	-0.007	0
	0.711	1
	1.425	2
	2.151	3
	2.87	4
	2.153	3
	1.442	2
	0.72	1
	-0.004	0







Transverse = 30.9% Longitudinal = 76.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.383
B1	0.0017
A2	1.3836
B2	0.0086

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.015	0.063	0.078	0.056	0.078	0.078
2	1.802	-0.018	0.092	0.110	0.080	0.110	0.110
3	2.102	-0.019	0.132	0.151	0.109	0.151	0.150
4	2.252	-0.02	0.16	0.180	0.130	0.180	0.179
5	2.327	-0.002	0.187	0.189	0.136	0.189	0.188
6	2.402	-0.02	0.186	0.206	0.149	0.206	0.205
7	2.552	-0.021	0.215	0.236	0.171	0.236	0.235
8	2.590	-0.002	0.251	0.253	0.182	0.253	0.252
9	2.627	0	0.259	0.259	0.187	0.259	0.258
10	2.702	-0.019	0.257	0.276	0.200	0.276	0.275
11	2.777	-0.003	0.285	0.288	0.208	0.288	0.287
12	2.853	-0.021	0.273	0.294	0.213	0.294	0.293
13	3.003	-0.02	0.294	0.314	0.227	0.314	0.313
14	3.078	-0.002	0.325	0.327	0.236	0.327	0.326
15	3.153	-0.002	0.343	0.345	0.249	0.345	0.344
16	3.228	-0.002	0.363	0.365	0.263	0.365	0.364
17	3.303	-0.022	0.361	0.383	0.277	0.383	0.382
18	3.378	-0.002	0.409	0.411	0.296	0.412	0.410
19	3.453	-0.021	0.418	0.439	0.317	0.439	0.437
20	3.603	-0.02	0.462	0.482	0.349	0.482	0.480
21	3.753	-0.019	0.502	0.521	0.377	0.521	0.519
22	3.903	-0.02	0.533	0.553	0.400	0.553	0.551
23	4.054	-0.002	0.588	0.590	0.425	0.591	0.588
24	4.204	-0.021	0.615	0.636	0.460	0.636	0.634
25	4.504	-0.02	0.712	0.732	0.529	0.732	0.729
26	4.654	-0.002	0.782	0.784	0.565	0.785	0.782
27	4.804	-0.02	0.818	0.838	0.606	0.838	0.835
28	4.954	0	0.888	0.888	0.640	0.889	0.885
29	5.105	-0.02	0.937	0.957	0.692	0.957	0.954
30	5.255	-0.002	0.993	0.995	0.717	0.996	0.992
31	5.405	-0.02	1.03	1.050	0.759	1.050	1.046
32	5.705	-0.021	1.153	1.174	0.849	1.175	1.170
33	6.005	-0.021	1.287	1.308	0.946	1.309	1.303
34	6.306	-0.017	1.45	1.467	1.061	1.468	1.462
35	6.606	-0.019	1.606	1.625	1.175	1.626	1.619
36	6.906	-0.019	1.77	1.789	1.294	1.790	1.783
37	7.206	-0.019	1.924	1.943	1.405	1.944	1.936
38	7.507	-0.015	2.086	2.101	1.519	2.102	2.093

Model

FULL LOAD

LWL =	7	ft
BWL Center =	0.675	ft
Draft =	0.235833	ft
Displ, # =	35.70	
Displ, LT =	0.0	
WS =	6.36	ft^2

CONSTANTS

g=	32.17
ρ=	1.9334
ν=	1.05E-05

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0056	9.99E+05	0.0047	0.0009
1.802	0.0055	1.20E+06	0.0045	0.0010
2.102	0.0055	1.40E+06	0.0044	0.0012
2.252	0.0058	1.50E+06	0.0043	0.0015
2.327	0.0057	1.55E+06	0.0043	0.0014
2.402	0.0058	1.60E+06	0.0042	0.0015
2.552	0.0059	1.70E+06	0.0042	0.0017
2.590	0.0061	1.72E+06	0.0042	0.0019
2.627	0.0061	1.75E+06	0.0042	0.0019
2.702	0.0061	1.80E+06	0.0041	0.0020
2.777	0.0061	1.85E+06	0.0041	0.0019
2.853	0.0059	1.90E+06	0.0041	0.0018
3.003	0.0056	2.00E+06	0.0041	0.0016
3.078	0.0056	2.05E+06	0.0040	0.0016
3.153	0.0056	2.10E+06	0.0040	0.0016
3.228	0.0057	2.15E+06	0.0040	0.0017
3.303	0.0057	2.20E+06	0.0040	0.0017
3.378	0.0058	2.25E+06	0.0040	0.0019
3.453	0.0060	2.30E+06	0.0039	0.0020
3.603	0.0060	2.40E+06	0.0039	0.0021
3.753	0.0060	2.50E+06	0.0039	0.0021
3.903	0.0059	2.60E+06	0.0038	0.0020
4.054	0.0058	2.70E+06	0.0038	0.0020
4.204	0.0058	2.80E+06	0.0038	0.0020
4.504	0.0058	3.00E+06	0.0037	0.0021
4.654	0.0059	3.10E+06	0.0037	0.0022
4.804	0.0059	3.20E+06	0.0037	0.0022
4.954	0.0059	3.30E+06	0.0037	0.0022
5.105	0.0060	3.40E+06	0.0037	0.0023
5.255	0.0058	3.50E+06	0.0036	0.0022
5.405	0.0058	3.60E+06	0.0036	0.0022
5.705	0.0058	3.80E+06	0.0036	0.0023
6.005	0.0059	4.00E+06	0.0035	0.0023
6.306	0.0060	4.20E+06	0.0035	0.0025
6.606	0.0060	4.40E+06	0.0035	0.0026
6.906	0.0061	4.60E+06	0.0035	0.0026
7.206	0.0061	4.80E+06	0.0034	0.0026
7.507	0.0060	4.99E+06	0.0034	0.0026

Ship

FULL LOAD

LWL =	880.4	ft
BWL Center	84.92	ft
Draft =	29.66	ft
Displ, # =	70987840	
Displ, LT =	31691.0	
WS =	100591	ft^2

CONSTANTS

g=	32.17
ρ=	1.9905
ν=	1.28E-05

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.8	0.0009	1.16E+09	0.0015	0.0004	8.013E+04	0.100	15324	7.581E+04
12.0	20.2	0.0010	1.39E+09	0.0015	0.0004	1.167E+05	0.120	15324	1.102E+05
14.0	23.6	0.0012	1.62E+09	0.0014	0.0004	1.679E+05	0.140	15324	1.589E+05
15.0	25.3	0.0015	1.74E+09	0.0014	0.0004	2.096E+05	0.150	15324	1.991E+05
15.5	26.1	0.0014	1.80E+09	0.0014	0.0004	2.192E+05	0.155	15324	2.079E+05
16.0	26.9	0.0015	1.85E+09	0.0014	0.0004	2.443E+05	0.160	15324	2.322E+05
16.9	28.6	0.0017	1.97E+09	0.0014	0.0004	2.863E+05	0.170	15324	2.725E+05
17.2	29.0	0.0019	2.00E+09	0.0014	0.0004	3.164E+05	0.173	15324	3.022E+05
17.4	29.5	0.0019	2.03E+09	0.0014	0.0004	3.237E+05	0.175	15324	3.090E+05
17.9	30.3	0.0020	2.09E+09	0.0014	0.0004	3.479E+05	0.180	15324	3.323E+05
18.4	31.1	0.0019	2.14E+09	0.0014	0.0004	3.625E+05	0.185	15324	3.459E+05
18.9	32.0	0.0018	2.20E+09	0.0014	0.0004	3.637E+05	0.190	15324	3.462E+05
19.9	33.7	0.0016	2.32E+09	0.0014	0.0004	3.829E+05	0.200	15324	3.633E+05
20.4	34.5	0.0016	2.38E+09	0.0014	0.0004	3.988E+05	0.205	15324	3.782E+05
20.9	35.4	0.0016	2.43E+09	0.0014	0.0004	4.242E+05	0.210	15324	4.025E+05
21.4	36.2	0.0017	2.49E+09	0.0014	0.0004	4.535E+05	0.215	15324	4.307E+05
21.9	37.0	0.0017	2.55E+09	0.0014	0.0004	4.780E+05	0.220	15324	4.539E+05
22.4	37.9	0.0019	2.61E+09	0.0014	0.0004	5.238E+05	0.225	15324	4.986E+05
22.9	38.7	0.0020	2.67E+09	0.0014	0.0004	5.682E+05	0.230	15324	5.418E+05
23.9	40.4	0.0021	2.78E+09	0.0014	0.0004	6.312E+05	0.240	15324	6.022E+05
24.9	42.1	0.0021	2.90E+09	0.0013	0.0004	6.852E+05	0.250	15324	6.536E+05
25.9	43.8	0.0020	3.01E+09	0.0013	0.0004	7.242E+05	0.260	15324	6.899E+05
26.9	45.5	0.0020	3.13E+09	0.0013	0.0004	7.737E+05	0.270	15324	7.364E+05
27.9	47.1	0.0020	3.24E+09	0.0013	0.0004	8.388E+05	0.280	15324	7.985E+05
29.9	50.5	0.0021	3.48E+09	0.0013	0.0004	9.771E+05	0.300	15324	9.304E+05
30.9	52.2	0.0022	3.59E+09	0.0013	0.0004	1.055E+06	0.310	15324	1.004E+06
31.9	53.9	0.0022	3.71E+09	0.0013	0.0004	1.133E+06	0.320	15324	1.079E+06
32.9	55.6	0.0022	3.82E+09	0.0013	0.0004	1.205E+06	0.330	15324	1.148E+06
33.9	57.2	0.0023	3.94E+09	0.0013	0.0004	1.312E+06	0.340	15324	1.251E+06
34.9	58.9	0.0022	4.06E+09	0.0013	0.0004	1.359E+06	0.350	15324	1.294E+06
35.9	60.6	0.0022	4.17E+09	0.0013	0.0004	1.436E+06	0.360	15324	1.367E+06
37.9	64.0	0.0023	4.40E+09	0.0013	0.0004	1.620E+06	0.380	15324	1.543E+06
39.9	67.3	0.0023	4.64E+09	0.0013	0.0004	1.822E+06	0.400	15324	1.736E+06
41.9	70.7	0.0025	4.87E+09	0.0013	0.0004	2.073E+06	0.420	15324	1.977E+06
43.9	74.1	0.0026	5.10E+09	0.0013	0.0004	2.318E+06	0.440	15324	2.213E+06
45.9	77.5	0.0026	5.33E+09	0.0013	0.0004	2.574E+06	0.460	15324	2.458E+06
47.9	80.8	0.0026	5.56E+09	0.0013	0.0004	2.806E+06	0.480	15324	2.679E+06
49.8	84.2	0.0026	5.79E+09	0.0012	0.0004	3.044E+06	0.500	15324	2.906E+06

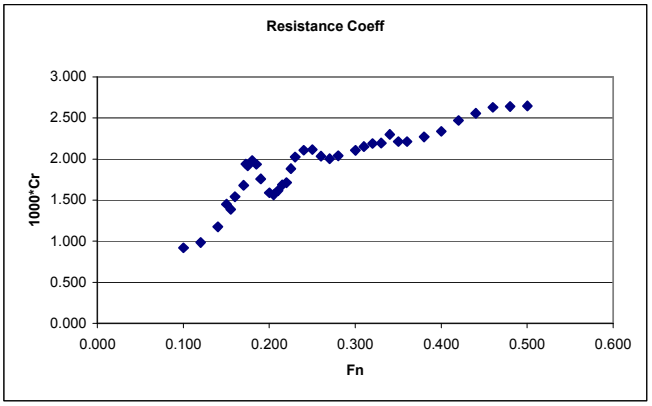
Transverse = 30.9%

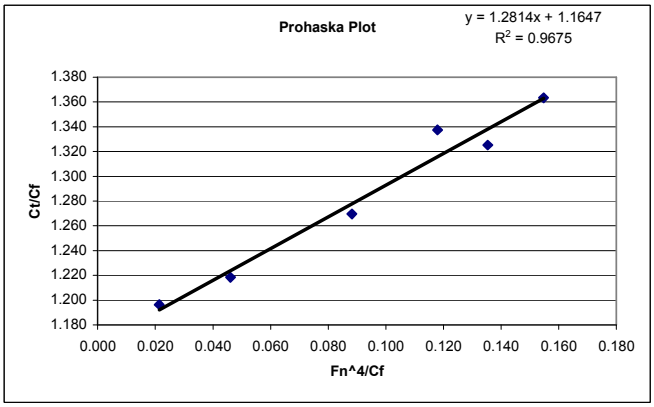
Longitudinal = 76.5%

Transverse = 30.9% Longitudinal = 76.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	0.920	0.021	1.196
0.120	0.985	0.046	1.218
0.140	1.176	0.088	1.270
0.150	1.451	0.118	1.337
0.155	1.389	0.135	1.325
0.160	1.542	0.155	1.363
0.170	1.681	0.200	1.401
0.173	1.940	0.212	1.464
0.175	1.920	0.226	1.461
0.180	1.983	0.254	1.479
0.185	1.936	0.285	1.470
0.190	1.759	0.319	1.429
0.200	1.590	0.395	1.392
0.205	1.565	0.439	1.388
0.210	1.615	0.485	1.402
0.215	1.686	0.536	1.422
0.220	1.712	0.590	1.430
0.225	1.882	0.648	1.475
0.230	2.024	0.711	1.513
0.240	2.108	0.850	1.539
0.250	2.116	1.009	1.546
0.260	2.034	1.190	1.529
0.270	2.004	1.394	1.525
0.280	2.040	1.624	1.538
0.300	2.106	2.169	1.563
0.310	2.152	2.488	1.579
0.320	2.189	2.843	1.592
0.330	2.194	3.234	1.597
0.340	2.300	3.665	1.630
0.350	2.212	4.139	1.609
0.360	2.213	4.657	1.612
0.380	2.270	5.841	1.635
0.400	2.337	7.242	1.660
0.420	2.471	8.883	1.704
0.440	2.557	10.794	1.735
0.460	2.629	13.002	1.762
0.480	2.641	15.537	1.772
0.500	2.646	18.432	1.779





17-Apr-07

Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.004	0	0.00	-0.0031	9.02E-06
0.717	1	1.00	-0.0006	3.35E-07
1.435	2	1.99	0.0059	3.60E-05
2.167	3	3.01	-0.0069	4.62E-05
2.891	4	4.01	-0.0086	7.27E-05
2.169	3	3.01	-0.0096	9.15E-05
1.453	2	2.02	-0.0190	3.58E-04
0.73	1	1.02	-0.0186	3.45E-04
0	0	0.01	-0.0086	7.29E-05
-0.013	0	-0.01	0.0094	8.93E-05
0.708	1	0.99	0.0118	1.41E-04
1.428	2	1.98	0.0156	2.46E-04
2.15	3	2.98	0.0167	2.80E-04
2.881	4	3.99	0.0052	2.82E-05
2.158	3	2.99	0.0056	3.20E-05
1.439	2	2.00	0.0004	2.13E-07
0.719	1	1.00	-0.0034	1.12E-05
-0.011	0	-0.01	0.0066	4.46E-05

Gain	Bias			
1.383	0.0017	***Mean***	-6.23E-05	
1.3836	0.0086	***Std Dev***		0.0106 lbf
		Uncertainty		0.0075 lbf

18-Apr-07

Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.008	0	0.00	0.0025	6.41E-06
0.71	1	0.99	0.0090	8.29E-05
1.432	2	1.99	0.0101	1.03E-04
2.154	3	2.99	0.0111	1.25E-04
2.874	4	3.99	0.0149	2.25E-04
2.158	3	2.99	0.0056	3.20E-05
1.436	2	2.00	0.0046	2.13E-05
0.719	1	1.00	-0.0034	1.12E-05
-0.007	0	0.00	0.0011	1.32E-06
-0.007	0	0.00	0.0011	1.32E-06
0.711	1	0.99	0.0077	5.96E-05
1.425	2	1.98	0.0198	3.93E-04
2.151	3	2.98	0.0153	2.35E-04
2.87	4	3.98	0.0205	4.21E-04
2.153	3	2.99	0.0125	1.58E-04
1.442	2	2.00	-0.0038	1.36E-05
0.72	1	1.00	-0.0048	2.24E-05
-0.004	0	0.00	-0.0031	9.02E-06

Gain	Bias			
1.3877	0.0095	***Mean***	6.70E-03	
1.3894	0.0079	***Std Dev***		0.0106 lbf
		Uncertainty		0.0075 lbf

Calibration Angle 2.917

Trim Run	*Speed*	*Zero*	*deg*	*Zero Corrected*	*Combined Calibration*
1	1.501	-0.093	-0.092	0.001	0.001
2	1.802	-0.089	-0.089	0	0.000
3	2.102	-0.085	-0.083	0.002	0.002
4	2.252	-0.071	-0.065	0.006	0.006
5	2.327	-0.019	-0.015	0.004	0.004
6	2.402	-0.085	-0.078	0.007	0.007
7	2.552	-0.069	-0.065	0.004	0.004
8	2.590	-0.017	-0.015	0.002	0.002
9	2.627	-0.017	-0.015	0.002	0.002
10	2.702	-0.076	-0.076	0	0.000
11	2.777	-0.019	-0.017	0.002	0.002
12	2.853	-0.072	-0.066	0.006	0.006
13	3.003	-0.070	-0.070	0	0.000
14	3.078	-0.016	-0.016	0	0.000
15	3.153	-0.016	-0.015	0.001	0.001
16	3.228	-0.017	-0.017	0	0.000
17	3.303	-0.072	-0.069	0.003	0.003
18	3.378	-0.018	-0.013	0.005	0.005
19	3.453	-0.070	-0.059	0.011	0.011
20	3.603	-0.073	-0.058	0.015	0.015
21	3.753	-0.070	-0.053	0.017	0.017
22	3.903	-0.077	-0.048	0.029	0.029
23	4.054	-0.016	0.016	0.032	0.032
24	4.204	-0.071	-0.025	0.046	0.046
25	4.504	-0.067	0.005	0.072	0.072
26	4.654	-0.017	0.076	0.093	0.093
27	4.804	-0.068	0.037	0.105	0.105
28	4.954	-0.019	0.098	0.117	0.117
29	5.105	-0.069	0.067	0.136	0.136
30	5.255	-0.020	0.139	0.159	0.159
31	5.405	-0.070	0.114	0.184	0.184
32	5.705	-0.074	0.186	0.26	0.260
33	6.005	-0.074	0.288	0.362	0.362
34	6.306	-0.075	0.414	0.489	0.489
35	6.606	-0.081	0.537	0.618	0.618
36	6.906	-0.087	0.655	0.742	0.743
37	7.206	-0.092	0.760	0.852	0.853
38	7.507	-0.090	0.857	0.947	0.948

Heave Run	*Speed*	*Zero*	*inch*	*Zero Corrected*	*Combined Calibration*
1	1.501	-0.043	-0.068	-0.025	-0.025
2	1.802	-0.044	-0.076	-0.032	-0.032
3	2.102	-0.044	-0.082	-0.038	-0.038
4	2.252	-0.049	-0.09	-0.041	-0.041
5	2.327	0.017	-0.018	-0.035	-0.035
6	2.402	-0.045	-0.092	-0.047	-0.047
7	2.552	-0.05	-0.098	-0.048	-0.048
8	2.590	0.016	-0.029	-0.045	-0.045
9	2.627	0.021	-0.027	-0.048	-0.048
10	2.702	-0.045	-0.102	-0.057	-0.057
11	2.777	0.019	-0.032	-0.051	-0.051
12	2.853	-0.049	-0.109	-0.06	-0.060
13	3.003	-0.047	-0.111	-0.064	-0.064
14	3.078	0.019	-0.047	-0.066	-0.066
15	3.153	0.016	-0.049	-0.065	-0.065
16	3.228	0.015	-0.055	-0.07	-0.070
17	3.303	-0.048	-0.127	-0.079	-0.079
18	3.378	0.018	-0.06	-0.078	-0.078
19	3.453	-0.049	-0.134	-0.085	-0.085
20	3.603	-0.047	-0.141	-0.094	-0.094
21	3.753	-0.051	-0.149	-0.098	-0.098
22	3.903	-0.049	-0.156	-0.107	-0.107
23	4.054	0.018	-0.098	-0.116	-0.116
24	4.204	-0.051	-0.173	-0.122	-0.122
25	4.504	-0.049	-0.189	-0.14	-0.140
26	4.654	0.016	-0.147	-0.163	-0.164
27	4.804	-0.048	-0.204	-0.156	-0.156
28	4.954	0.017	-0.166	-0.183	-0.184
29	5.105	-0.046	-0.224	-0.178	-0.178
30	5.255	0.016	-0.195	-0.211	-0.212
31	5.405	-0.047	-0.246	-0.199	-0.199
32	5.705	-0.047	-0.268	-0.221	-0.221
33	6.005	-0.048	-0.289	-0.241	-0.241
34	6.306	-0.044	-0.304	-0.26	-0.261
35	6.606	-0.041	-0.319	-0.278	-0.279
36	6.906	-0.042	-0.335	-0.293	-0.294
37	7.206	-0.054	-0.337	-0.283	-0.284
38	7.507	-0.041	-0.34	-0.299	-0.300

Side-Hull Resistance Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.011	-0.006	0.005	0.005	0.005
2	1.802	-0.017	-0.008	0.009	0.009	0.009
3	2.102	-0.019	-0.005	0.014	0.014	0.014
4	2.252	-0.017	0	0.017	0.017	0.017
5	2.327	-0.004	0.015	0.019	0.019	0.019
6	2.402	-0.016	0.007	0.023	0.023	0.023
7	2.552	-0.016	0.009	0.025	0.025	0.025
8	2.590	-0.008	0.019	0.027	0.027	0.027
9	2.627	-0.004	0.024	0.028	0.028	0.028
10	2.702	-0.015	0.013	0.028	0.028	0.028
11	2.777	-0.006	0.023	0.029	0.029	0.029
12	2.853	-0.017	0.012	0.029	0.029	0.029
13	3.003	-0.014	0.017	0.031	0.031	0.031
14	3.078	-0.007	0.025	0.032	0.032	0.032
15	3.153	-0.007	0.026	0.033	0.033	0.033
16	3.228	-0.008	0.028	0.036	0.036	0.036
17	3.303	-0.014	0.025	0.039	0.039	0.039
18	3.378	-0.006	0.039	0.045	0.045	0.045
19	3.453	-0.016	0.034	0.05	0.050	0.050
20	3.603	-0.014	0.046	0.06	0.060	0.060
21	3.753	-0.017	0.049	0.066	0.067	0.066
22	3.903	-0.016	0.056	0.072	0.073	0.072
23	4.054	-0.007	0.068	0.075	0.075	0.075
24	4.204	-0.018	0.063	0.081	0.082	0.082
25	4.504	-0.016	0.073	0.089	0.090	0.090
26	4.654	-0.008	0.085	0.093	0.093	0.093
27	4.804	-0.017	0.079	0.096	0.097	0.097
28	4.954	-0.004	0.095	0.099	0.099	0.099
29	5.105	-0.018	0.08	0.098	0.099	0.099
30	5.255	-0.005	0.095	0.1	0.100	0.100
31	5.405	-0.014	0.085	0.099	0.100	0.100
32	5.705	-0.014	0.091	0.105	0.106	0.106
33	6.005	-0.015	0.101	0.116	0.117	0.117
34	6.306	-0.014	0.115	0.129	0.130	0.130
35	6.606	-0.015	0.128	0.143	0.144	0.144
36	6.906	-0.018	0.142	0.16	0.161	0.161
37	7.206	-0.023	0.155	0.178	0.179	0.179
38	7.507	-0.012	0.184	0.196	0.198	0.197

Transverse = 30.9%

Longitudinal = 76.5%

Transverse = 30.9%

Trim 17-Apr-07

Error Analysis

Volts	*deg*	*Predicted*	*Difference*	*Dev. ^2*
-0.001	0	-0.06984	0.06984	0.00489
0.316	-0.5	-0.46819	-0.03181	0.00101
0.489	-0.7	-0.68558	-0.01442	0.00021
0.681	-1	-0.92684	-0.07316	0.00534
-0.387	0.4	0.41520	-0.01520	0.00023
-0.57	0.7	0.64516	0.05484	0.00301
-0.951	1.1	1.12393	-0.02393	0.00057
-1.462	1.7	1.76605	-0.06605	0.00435
-0.028	0	-0.03592	0.03592	0.00129
0.288	-0.4	-0.43300	0.03300	0.00109
0.463	-0.7	-0.65291	-0.04709	0.00221
0.663	-0.9	-0.90423	0.00423	0.00002
-0.415	0.5	0.45039	0.04961	0.00247
-0.6	0.7	0.68286	0.01714	0.00030
-0.975	1.2	1.15409	0.04591	0.00211
-1.52	1.8	1.83893	-0.03893	0.00151

Gain	Bias			
		Mean	-6.8375E-06	
-1.2557	-0.0834	***Std Dev***	0.0452	Degrees
-1.2566	-0.0711	***Uncertainty***	0.0339	Degrees

Heave 17-Apr-07

Error Analysis

Volts	*inch*	*Predicted*	*Difference*	*Dev. ^2*
0.021	0.000	-0.01006	0.01006	0.00010
-2.001	0.183	0.19800	-0.01500	0.00022
-3.266	0.305	0.32817	-0.02367	0.00056
-4.667	0.427	0.47233	-0.04583	0.00210
-5.824	0.550	0.59139	-0.04189	0.00175
2.567	-0.293	-0.27204	-0.02096	0.00044
4.665	-0.543	-0.48793	-0.05507	0.00303
0.188	0	-0.02725	0.02725	0.00075
-1.822	0.212	0.17958	0.03242	0.00105
-3.103	0.342	0.31140	0.03060	0.00094
-6.554	0.694	0.66651	0.02749	0.00076
-5.603	0.576	0.56865	0.00735	0.00005
1.463	-0.099	-0.15844	0.05944	0.00354
4.195	-0.432	-0.43957	0.00757	0.00006

Gain	Bias			
		Mean	-1.78E-05	
-0.1027	-0.0351	***Std Dev***	0.0344	Inches
-0.1029	-0.0079	***Uncertainty***	0.0275	Inches

Side-Hull Resistance 17-Apr-07

Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.001	0	-0.00780	0.00780	0.00006
-0.395	0.25	0.03275	0.21725	0.04723
-0.786	0.5	0.07298	0.42702	0.18240
-1.172	0.75	0.11270	0.63730	0.40623
-1.56	1	0.15262	0.84738	0.71815
-1.175	0.75	0.11301	0.63699	0.40584
-0.796	0.5	0.07401	0.42599	0.18152
-0.415	0.25	0.03480	0.21520	0.04634
-0.009	0	-0.00697	0.00697	0.00005
0.064	0	-0.01449	0.01449	0.00021
-0.31	0.25	0.02400	0.22600	0.05110
-0.682	0.5	0.06228	0.43772	0.19166
-1.067	0.75	0.10189	0.64811	0.42012
-1.455	1	0.14182	0.85818	0.73658
-1.075	0.75	0.10272	0.64728	0.41906
-0.705	0.5	0.06464	0.43536	0.18959
-0.326	0.25	0.02565	0.22435	0.05036
0.038	0	-0.01181	0.01181	0.00014

Gain	Bias			
		Mean	0.384733	
-0.6438	-0.0069	***Std Dev***	0.4879	lbf
-0.6491	0.0180	***Uncertainty***	0.3450	lbf

Longitudinal = 76.5%

Trim 18-Apr-07

Error Analysis

Volts	*deg*	*Predicted*	*Difference*	*Dev. ^2*
-0.009	0	-0.05979	0.05979	0.00358
0.304	-0.4	-0.45311	0.05311	0.00283
0.484	-0.6	-0.67929	0.07929	0.00630
0.685	-0.9	-0.93187	0.03187	0.00102
-0.396	0.5	0.42651	0.07349	0.00541
-0.591	0.8	0.67155	0.12845	0.01652
-0.963	1.2	1.13901	0.06099	0.00373
-1.697	2.1	2.06135	0.03865	0.00150
-0.007	0	-0.06230	0.06230	0.00389
0.305	-0.4	-0.45436	0.05436	0.00296
0.482	-0.6	-0.67678	0.07678	0.00590
0.685	-0.9	-0.93187	0.03187	0.00102
-0.397	0.5	0.42777	0.07223	0.00523
-0.588	0.8	0.66778	0.13222	0.01750
-0.962	1.2	1.13775	0.06225	0.00388
-1.692	2.1	2.05507	0.04493	0.00202

Gain	Bias			
		Mean	0.066412113	
-1.2588	-0.006	***Std Dev***	0.0745	Degrees
-1.2601	-0.0056	***Uncertainty***	0.0559	Degrees

Heave 18-Apr-07

Error Analysis

Volts	*inch*	*Predicted*	*Difference*	*Dev. ^2*
0	0.000	-0.00790	0.00790	0.00006
-2.498	0.257	0.24914	0.00736	0.00006
-3.775	0.383	0.38055	0.00245	0.00001
-6.716	0.730	0.68318	0.04682	0.00220
-5.682	0.607	0.57678	0.03022	0.00092
2.67	-0.223	-0.28264	0.05964	0.00356
4.693	-0.472	-0.49081	0.01931	0.00038
0.021	0	-0.01006	0.01006	0.00010
-2.461	0.245	0.24534	-0.00034	0.00000
-3.759	0.3815	0.37890	0.00260	0.00001
-5.66	0.6085	0.57451	0.03399	0.00116
-6.702	0.73	0.68174	0.04826	0.00234
0.887	-0.064	-0.09917	0.03517	0.00124
4.161	-0.4055	-0.43607	0.03057	0.00094

Gain	Bias			
		Mean	0.023859	
-0.1027	0.0172	***Std Dev***	0.0316	Inches
-0.1031	0.0156	***Uncertainty***	0.0253	Inches

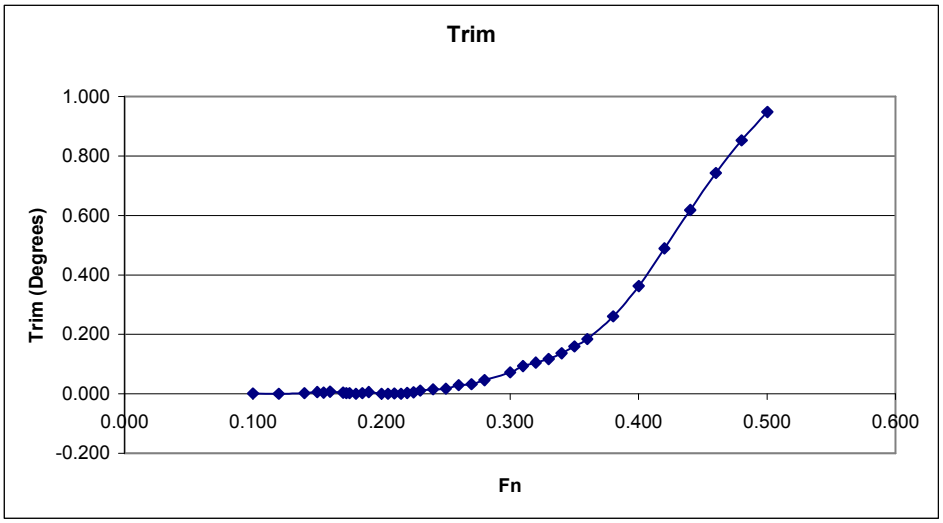
Side-Hull Resistance 18-Apr-07

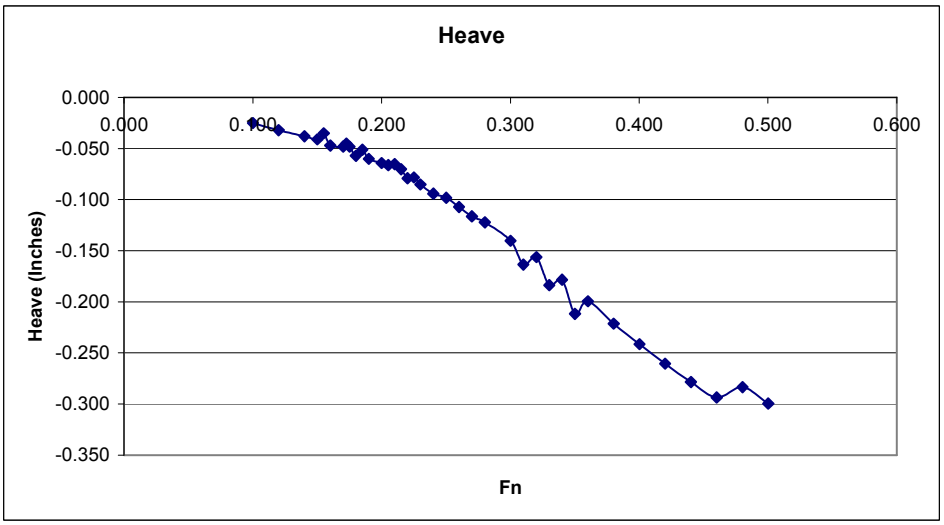
Error Analysis

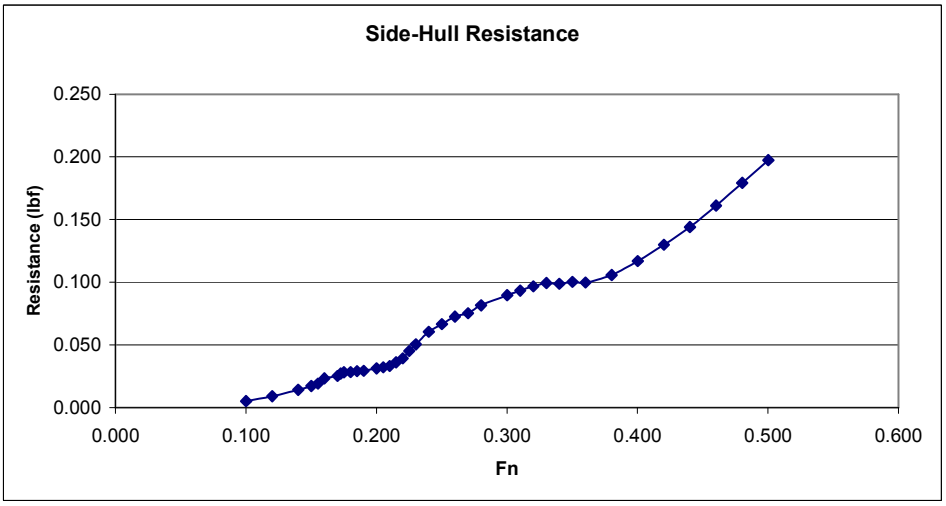
Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.003	0	-0.00759	0.00759	0.00006
-0.387	0.25	0.03192	0.21808	0.04759
-0.783	0.5	0.07267	0.42733	0.18266
-1.163	0.75	0.11177	0.63823	0.40741
-1.551	1	0.15170	0.84830	0.71972
-1.169	0.75	0.11239	0.63761	0.40663
-0.782	0.5	0.07257	0.42743	0.18275
-0.389	0.25	0.03213	0.21787	0.04750
-0.008	0	-0.00708	0.00708	0.00005
0.004	0	-0.00831	0.00831	0.00007
-0.382	0.25	0.03141	0.21859	0.04781
-0.768	0.5	0.07113	0.42887	0.18399
-1.152	0.75	0.11064	0.63936	0.40886
-1.545	1	0.15108	0.84892	0.72077
-1.166	0.75	0.11208	0.63792	0.40702
-0.783	0.5	0.07267	0.42733	0.18266
-0.394	0.25	0.03264	0.21736	0.04727
-0.024	0	-0.00543	0.00543	0.00003

Gain	Bias			
		Mean	0.381201	
-0.6458	-0.003	***Std Dev***	0.4846	lbf
-0.6484	-0.0038	***Uncertainty***	0.3427	lbf

Transverse = 30.9% Longitudinal = 76.5%







TRANSVERSE = 50%, LONGITUDINAL = 76.5%

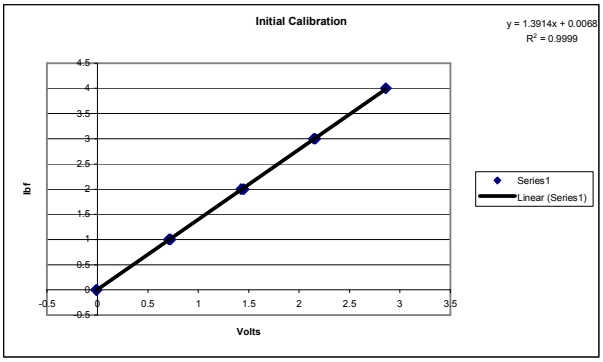
Trimaran, T = 50.0%, L = 76.5% | Correct Tow Point | Water Temp 20 C
18-Apr-07 ++++++ No appendages ++++++ Calibration Angle 5.168

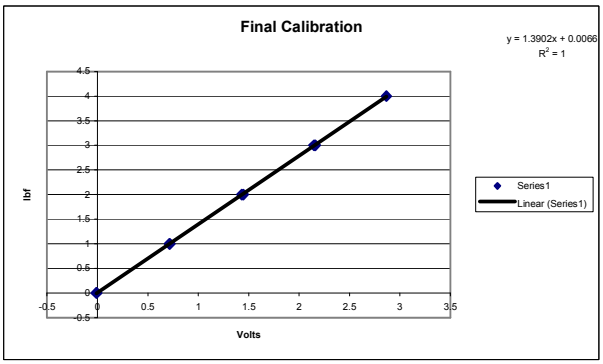
Hama Thickness = 0.028 in

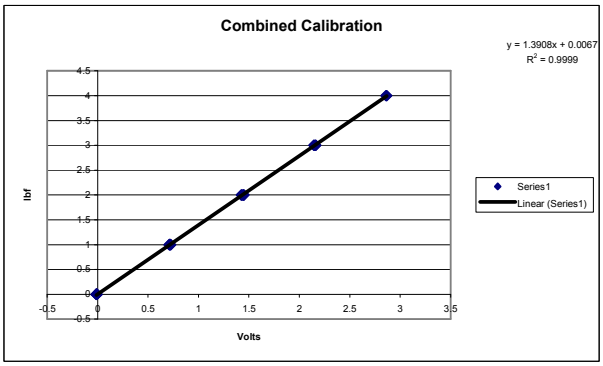
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.013	0
	0.711	1
	1.425	2
	2.147	3
	2.86	4
	2.16	3
	1.449	2
	0.723	1
	-0.007	0
Final	-0.01	0
	0.714	1
	1.432	2
	2.148	3
	2.865	4
	2.16	3
	1.447	2
	0.719	1
	-0.008	0







Transverse = 50% Longitudinal = 76.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3914
B1	0.0068
A2	1.3908
B2	0.0067

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.014	0.066	0.080	0.057	0.080	0.080
2	1.802	-0.01	0.103	0.113	0.081	0.113	0.112
3	2.102	-0.008	0.149	0.157	0.113	0.157	0.156
4	2.402	-0.009	0.202	0.211	0.152	0.211	0.210
5	2.552	-0.004	0.233	0.237	0.170	0.237	0.236
6	2.702	-0.008	0.253	0.261	0.188	0.261	0.260
7	2.853	-0.005	0.28	0.285	0.205	0.285	0.284
8	2.928	-0.006	0.294	0.300	0.216	0.300	0.299
9	2.965	-0.007	0.301	0.308	0.221	0.308	0.307
10	3.003	-0.007	0.322	0.329	0.236	0.329	0.328
11	3.078	-0.006	0.324	0.330	0.237	0.330	0.329
12	3.153	-0.007	0.345	0.352	0.253	0.352	0.350
13	3.228	-0.005	0.36	0.365	0.262	0.365	0.363
14	3.303	-0.007	0.386	0.393	0.282	0.393	0.391
15	3.453	-0.006	0.437	0.443	0.318	0.443	0.441
16	3.603	-0.007	0.471	0.478	0.344	0.478	0.476
17	3.753	-0.007	0.513	0.520	0.374	0.520	0.518
18	3.903	-0.006	0.542	0.548	0.394	0.548	0.546
19	4.054	-0.007	0.574	0.581	0.418	0.581	0.578
20	4.204	-0.007	0.627	0.634	0.456	0.634	0.631
21	4.354	-0.006	0.674	0.680	0.489	0.680	0.677
22	4.504	-0.004	0.738	0.742	0.533	0.742	0.739
23	4.654	-0.006	0.788	0.794	0.571	0.794	0.790
24	4.804	-0.007	0.849	0.856	0.615	0.856	0.852
25	4.954	-0.006	0.889	0.895	0.643	0.895	0.891
26	5.105	-0.007	0.924	0.931	0.669	0.931	0.927
27	5.405	-0.005	1.014	1.019	0.732	1.019	1.014
28	5.705	-0.007	1.132	1.139	0.819	1.139	1.134
29	6.005	-0.005	1.289	1.294	0.930	1.293	1.288
30	6.306	-0.007	1.477	1.484	1.067	1.483	1.477
31	6.606	-0.008	1.648	1.656	1.190	1.655	1.649
32	6.906	-0.006	1.821	1.827	1.313	1.826	1.819
33	7.206	-0.01	1.989	1.999	1.437	1.998	1.990
34	7.507	-0.013	2.146	2.159	1.552	2.158	2.149

Model

FULL LOAD

LWL =	7	ft
BWL $_{Center}$	0.675	ft
Draft =	0.235833	ft
Displ, # =	35.70	
Displ, LT =	0.0	
WS =	6.36	ft^2

CONSTANTS

g=	32.17
ρ=	1.9334
ν=	0.00001052

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0058	9.99E+05	0.0047	0.0011
1.802	0.0056	1.20E+06	0.0045	0.0011
2.102	0.0058	1.40E+06	0.0044	0.0014
2.402	0.0059	1.60E+06	0.0042	0.0017
2.552	0.0059	1.70E+06	0.0042	0.0017
2.702	0.0058	1.80E+06	0.0041	0.0016
2.853	0.0057	1.90E+06	0.0041	0.0016
2.928	0.0057	1.95E+06	0.0041	0.0016
2.965	0.0057	1.97E+06	0.0041	0.0016
3.003	0.0059	2.00E+06	0.0041	0.0019
3.078	0.0056	2.05E+06	0.0040	0.0016
3.153	0.0057	2.10E+06	0.0040	0.0017
3.228	0.0057	2.15E+06	0.0040	0.0017
3.303	0.0058	2.20E+06	0.0040	0.0019
3.453	0.0060	2.30E+06	0.0039	0.0021
3.603	0.0060	2.40E+06	0.0039	0.0021
3.753	0.0060	2.50E+06	0.0039	0.0021
3.903	0.0058	2.60E+06	0.0038	0.0020
4.054	0.0057	2.70E+06	0.0038	0.0019
4.204	0.0058	2.80E+06	0.0038	0.0020
4.354	0.0058	2.90E+06	0.0038	0.0020
4.504	0.0059	3.00E+06	0.0037	0.0022
4.654	0.0059	3.10E+06	0.0037	0.0022
4.804	0.0060	3.20E+06	0.0037	0.0023
4.954	0.0059	3.30E+06	0.0037	0.0022
5.105	0.0058	3.40E+06	0.0037	0.0021
5.405	0.0056	3.60E+06	0.0036	0.0020
5.705	0.0057	3.80E+06	0.0036	0.0021
6.005	0.0058	4.00E+06	0.0035	0.0023
6.306	0.0060	4.20E+06	0.0035	0.0025
6.606	0.0061	4.40E+06	0.0035	0.0027
6.906	0.0062	4.60E+06	0.0035	0.0028
7.206	0.0062	4.79E+06	0.0034	0.0028
7.507	0.0062	5.00E+06	0.0034	0.0028

Ship

FULL LOAD

LWL =	880.4	ft
BWL $_{Cer}$	84.92	ft
Draft =	29.66	ft
Displ, #	70987840	
Displ, L	31691.0	
WS =	100591	ft^2

CONSTANTS

g=	32.17
ρ=	1.9905
ν=	1.28E-05

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0011	1.16E+09	0.0015	0.0004	84103	0.100	15900	81684
12.0	20.21	0.0011	1.39E+09	0.0015	0.0004	122551	0.120	15900	118781
14.0	23.57	0.0014	1.62E+09	0.0014	0.0004	179883	0.140	15900	174436
15.9	26.94	0.0017	1.85E+09	0.0014	0.0004	254118	0.160	15900	246657
16.9	28.62	0.0017	1.97E+09	0.0014	0.0004	287927	0.170	15900	279329
17.9	30.30	0.0016	2.09E+09	0.0014	0.0004	316830	0.180	15900	307009
18.9	32.00	0.0016	2.20E+09	0.0014	0.0004	344777	0.190	15900	333634
19.4	32.84	0.0016	2.26E+09	0.0014	0.0004	364634	0.195	15900	352801
19.7	33.25	0.0016	2.29E+09	0.0014	0.0004	375580	0.198	15900	363398
19.9	33.68	0.0019	2.32E+09	0.0014	0.0004	412840	0.200	15900	400294
20.4	34.52	0.0016	2.38E+09	0.0014	0.0004	403751	0.205	15900	390471
20.9	35.36	0.0017	2.43E+09	0.0014	0.0004	437288	0.210	15900	423250
21.4	36.20	0.0017	2.49E+09	0.0014	0.0004	452277	0.215	15900	437459
21.9	37.04	0.0019	2.55E+09	0.0014	0.0004	497659	0.220	15900	482039
22.9	38.73	0.0021	2.67E+09	0.0014	0.0004	575609	0.230	15900	558315
23.9	40.41	0.0021	2.78E+09	0.0014	0.0004	622210	0.240	15900	603150
24.9	42.09	0.0021	2.90E+09	0.0013	0.0004	682329	0.250	15900	661411
25.9	43.77	0.0020	3.01E+09	0.0013	0.0004	713154	0.260	15900	690285
26.9	45.47	0.0019	3.13E+09	0.0013	0.0004	753254	0.270	15900	728325
27.9	47.15	0.0020	3.25E+09	0.0013	0.0004	833583	0.280	15900	806514
28.9	48.83	0.0020	3.36E+09	0.0013	0.0004	898914	0.290	15900	869610
29.9	50.51	0.0022	3.48E+09	0.0013	0.0004	996153	0.300	15900	964520
30.9	52.19	0.0022	3.59E+09	0.0013	0.0004	1072290	0.310	15900	1038231
31.9	53.88	0.0023	3.71E+09	0.0013	0.0004	1168114	0.320	15900	1131534
32.9	55.56	0.0022	3.82E+09	0.0013	0.0004	1216338	0.330	15900	1177140
33.9	57.25	0.0021	3.94E+09	0.0013	0.0004	1257537	0.340	15900	1215604
35.9	60.62	0.0020	4.17E+09	0.0013	0.0004	1370923	0.360	15900	1323268
37.9	63.98	0.0021	4.40E+09	0.0013	0.0004	1546854	0.380	15900	1493082
39.9	67.35	0.0023	4.64E+09	0.0013	0.0004	1791484	0.400	15900	1731200
41.9	70.72	0.0025	4.87E+09	0.0013	0.0004	2104599	0.420	15900	2037381
43.9	74.09	0.0027	5.10E+09	0.0013	0.0004	2378651	0.440	15900	2304122
45.9	77.45	0.0028	5.33E+09	0.0013	0.0004	2648096	0.460	15900	2565853
47.8	80.81	0.0028	5.56E+09	0.0013	0.0004	2917043	0.480	15900	2826680
49.8	84.19	0.0028	5.79E+09	0.0012	0.0004	3158725	0.500	15900	3059806

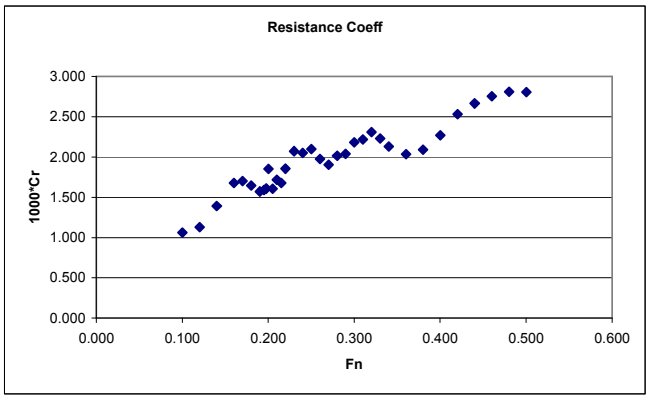
Transverse = 50%

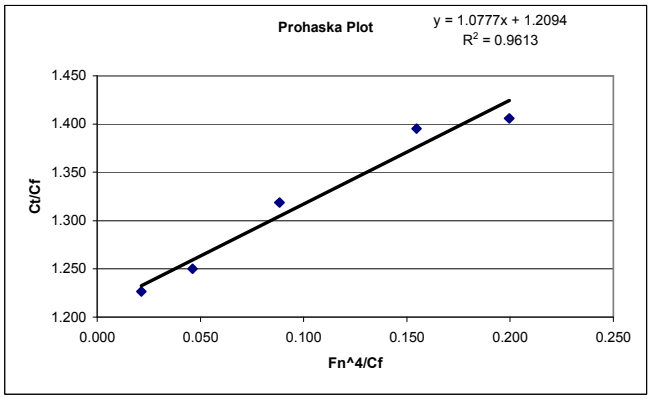
Longitudinal = 76.5%

Transverse = 50% Longitudinal = 76.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.062	0.021	1.226
0.120	1.127	0.046	1.250
0.140	1.391	0.088	1.319
0.160	1.678	0.155	1.395
0.170	1.702	0.200	1.406
0.180	1.646	0.254	1.397
0.190	1.573	0.319	1.384
0.195	1.591	0.356	1.390
0.198	1.608	0.375	1.396
0.200	1.853	0.396	1.457
0.205	1.606	0.439	1.398
0.210	1.719	0.485	1.428
0.215	1.676	0.536	1.419
0.220	1.855	0.590	1.466
0.230	2.074	0.711	1.526
0.240	2.053	0.850	1.525
0.250	2.100	1.009	1.542
0.260	1.977	1.189	1.514
0.270	1.905	1.394	1.499
0.280	2.016	1.624	1.532
0.290	2.042	1.881	1.542
0.300	2.181	2.169	1.583
0.310	2.218	2.488	1.596
0.320	2.311	2.842	1.625
0.330	2.232	3.233	1.607
0.340	2.132	3.666	1.584
0.360	2.035	4.658	1.563
0.380	2.091	5.841	1.585
0.400	2.269	7.240	1.641
0.420	2.534	8.886	1.722
0.440	2.666	10.795	1.766
0.460	2.753	13.001	1.798
0.480	2.811	15.534	1.821
0.500	2.807	18.436	1.826





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.013	0	-0.01138	0.0113804	0.00013
0.711	1	0.995559	0.0044412	2E-05
1.425	2	1.98859	0.01141	0.000131
2.147	3	2.992748	0.0072524	5.3E-05
2.86	4	3.984388	0.015612	0.000245
2.16	3	3.010828	-0.010828	0.000117
1.449	2	2.021969	-0.0219692	0.000481
0.723	1	1.012248	-0.0122484	0.000149
-0.007	0	-0.00304	0.0030356	9.39E-06
-0.01	0	-0.00721	0.007208	5.24E-05
0.714	1	0.999731	0.0002688	8.85E-08
1.432	2	1.998326	0.0016744	2.9E-06
2.148	3	2.994138	0.0058616	3.47E-05
2.865	4	3.991342	0.008658	7.55E-05
2.16	3	3.010828	-0.010828	0.000117
1.447	2	2.019188	-0.0191876	0.000367
0.719	1	1.006685	-0.0066852	4.43E-05
-0.008	0	-0.00443	0.0044264	1.98E-05

Mean	-2.87556E-05	
Std Dev		0.0110 lbf
Uncertainty		0.0078 lbf

Transverse = 50%

Longitudinal = 76.5%

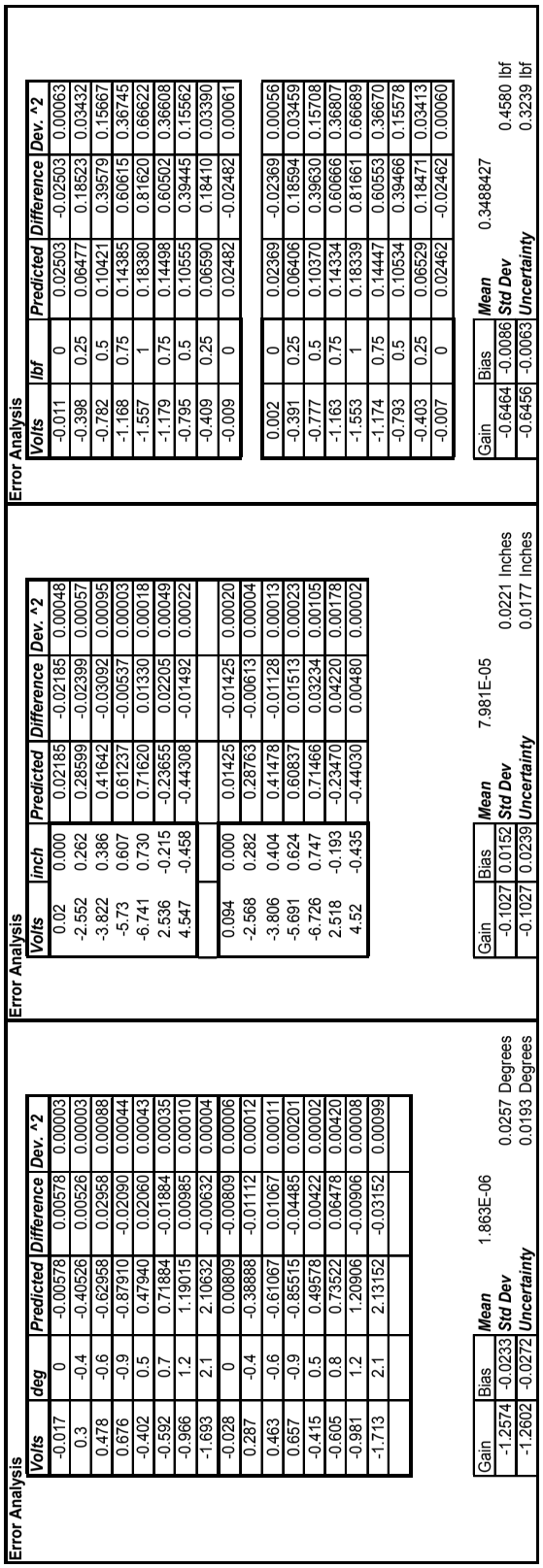
Trim Run	Speed	Zero	deg	Zero Corrected	Combined Calibration
1	1.501	-0.018	-0.019	-0.001	-0.001
2	1.802	-0.027	-0.026	0.001	0.001
3	2.102	-0.024	-0.021	0.003	0.003
4	2.402	-0.021	-0.021	0	0.000
5	2.552	-0.021	-0.021	0	0.000
6	2.702	-0.021	-0.021	0	0.000
7	2.853	-0.023	-0.020	0.003	0.003
8	2.928	-0.018	-0.017	0.001	0.001
9	2.965	-0.020	-0.019	0.001	0.001
10	3.003	-0.023	-0.018	0.005	0.005
11	3.078	-0.025	-0.019	0.006	0.006
12	3.153	-0.020	-0.016	0.004	0.004
13	3.228	-0.021	-0.018	0.003	0.003
14	3.303	-0.025	-0.019	0.006	0.006
15	3.453	-0.018	-0.014	0.004	0.004
16	3.603	-0.027	-0.018	0.009	0.009
17	3.753	-0.023	-0.011	0.012	0.012
18	3.903	-0.024	-0.006	0.018	0.018
19	4.054	-0.018	0.013	0.031	0.031
20	4.204	-0.025	0.022	0.047	0.047
21	4.354	-0.019	0.045	0.064	0.064
22	4.504	-0.023	0.060	0.083	0.083
23	4.654	-0.016	0.080	0.096	0.096
24	4.804	-0.024	0.090	0.114	0.114
25	4.954	-0.022	0.096	0.118	0.118
26	5.105	-0.025	0.096	0.121	0.121
27	5.405	-0.028	0.111	0.139	0.139
28	5.705	-0.029	0.171	0.2	0.200
29	6.005	-0.024	0.291	0.315	0.316
30	6.306	-0.020	0.431	0.451	0.452
31	6.606	-0.023	0.578	0.601	0.602
32	6.906	-0.024	0.701	0.725	0.727
33	7.206	-0.027	0.811	0.838	0.840
34	7.507	-0.021	0.911	0.932	0.934

Heave Run	Speed	Zero	inch	Zero Corrected	Combined Calibration
1	1.501	0.018	-0	-0.019	-0.019
2	1.802	0.016	0.008	-0.008	-0.008
3	2.102	0.016	-0.01	-0.029	-0.029
4	2.402	0.015	-0.02	-0.038	-0.038
5	2.552	0.013	-0.03	-0.046	-0.046
6	2.702	0.015	-0.03	-0.048	-0.048
7	2.853	0.011	-0.04	-0.054	-0.054
8	2.928	0.011	-0.05	-0.057	-0.057
9	2.965	0.009	-0.05	-0.06	-0.060
10	3.003	0.014	-0.05	-0.064	-0.064
11	3.078	0.008	-0.06	-0.066	-0.066
12	3.153	0.013	-0.06	-0.071	-0.071
13	3.228	0.01	-0.06	-0.073	-0.073
14	3.303	0.014	-0.06	-0.074	-0.074
15	3.453	0.013	-0.07	-0.086	-0.086
16	3.603	0.014	-0.07	-0.088	-0.088
17	3.753	0.008	-0.09	-0.097	-0.097
18	3.903	0.012	-0.09	-0.105	-0.105
19	4.054	0.011	-0.11	-0.118	-0.118
20	4.204	0.012	-0.11	-0.126	-0.126
21	4.354	0.011	-0.13	-0.141	-0.141
22	4.504	0.013	-0.14	-0.155	-0.155
23	4.654	0.013	-0.15	-0.166	-0.166
24	4.804	0.014	-0.16	-0.178	-0.178
25	4.954	0.011	-0.18	-0.188	-0.188
26	5.105	0.012	-0.19	-0.2	-0.200
27	5.405	0.013	-0.21	-0.225	-0.225
28	5.705	0.013	-0.24	-0.256	-0.256
29	6.005	0.015	-0.28	-0.291	-0.291
30	6.306	0.016	-0.29	-0.306	-0.306
31	6.606	0.017	-0.31	-0.33	-0.330
32	6.906	0.018	-0.32	-0.342	-0.342
33	7.206	0.015	-0.33	-0.341	-0.341
34	7.507	0.018	-0.34	-0.353	-0.353

Calibration Angle 2.917

Side-Hull Resistance Run	Speed	Zero	lbf	Zero Corrected	Combined Calibratior	Angle Corrected
1	1.501	-0.005	0.002	0.007	0.007	0.007
2	1.802	-0.007	0.004	0.011	0.011	0.011
3	2.102	-0.007	0.008	0.015	0.015	0.015
4	2.402	-0.008	0.017	0.025	0.025	0.025
5	2.552	-0.008	0.017	0.025	0.025	0.025
6	2.702	-0.008	0.02	0.028	0.028	0.028
7	2.853	-0.008	0.023	0.031	0.031	0.031
8	2.928	-0.009	0.024	0.033	0.033	0.033
9	2.965	-0.009	0.025	0.034	0.034	0.034
10	3.003	-0.008	0.027	0.035	0.035	0.035
11	3.078	-0.009	0.027	0.036	0.036	0.036
12	3.153	-0.009	0.029	0.038	0.038	0.038
13	3.228	-0.009	0.032	0.041	0.041	0.041
14	3.303	-0.008	0.037	0.045	0.045	0.045
15	3.453	-0.009	0.047	0.056	0.056	0.056
16	3.603	-0.008	0.055	0.063	0.063	0.063
17	3.753	-0.009	0.058	0.067	0.067	0.067
18	3.903	-0.008	0.061	0.069	0.069	0.069
19	4.054	-0.009	0.063	0.072	0.072	0.072
20	4.204	-0.008	0.068	0.076	0.076	0.076
21	4.354	-0.009	0.073	0.082	0.082	0.082
22	4.504	-0.009	0.078	0.087	0.087	0.087
23	4.654	-0.009	0.082	0.091	0.091	0.091
24	4.804	-0.008	0.085	0.093	0.093	0.093
25	4.954	-0.008	0.085	0.093	0.093	0.093
26	5.105	-0.008	0.086	0.094	0.094	0.094
27	5.405	-0.008	0.088	0.096	0.096	0.096
28	5.705	-0.008	0.094	0.102	0.102	0.102
29	6.005	-0.008	0.109	0.117	0.117	0.117
30	6.306	-0.008	0.129	0.137	0.137	0.137
31	6.606	-0.008	0.15	0.158	0.158	0.158
32	6.906	-0.007	0.173	0.18	0.180	0.180
33	7.206	-0.007	0.194	0.201	0.201	0.200
34	7.507	-0.006	0.215	0.221	0.221	0.220

Transverse = 50% Longitudinal = 76.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.017	0	-0.00578	0.00578	0.00003
0.3	-0.4	-0.40526	0.00526	0.00003
0.478	-0.6	-0.62958	0.02958	0.00088
0.676	-0.9	-0.87910	-0.02090	0.00044
-0.402	0.5	0.47940	0.02060	0.00043
-0.592	0.7	0.71884	-0.01884	0.00035
-0.966	1.2	1.19015	0.00985	0.00010
-1.693	2.1	2.10632	-0.00632	0.00004
-0.028	0	0.00809	-0.00809	0.00006
0.287	-0.4	-0.38888	-0.01112	0.00012
0.463	-0.6	-0.61067	0.01067	0.00011
0.657	-0.9	-0.85515	-0.04485	0.00201
-0.415	0.5	0.49578	0.00422	0.00002
-0.605	0.8	0.73522	0.06478	0.00420
-0.981	1.2	1.20906	-0.00906	0.00008
-1.713	2.1	2.13152	-0.03152	0.00099

Gain	Bias
-1.2574	-0.0233
-1.2602	-0.0272

Mean	1.863E-06
Std Dev	
Uncertainty	

0.0257 Degrees
0.0193 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
0.02	0.000	0.02185	-0.02185	0.00048
-2.552	0.262	0.28599	-0.02399	0.00057
-3.822	0.386	0.41642	-0.03092	0.00095
-5.73	0.607	0.61237	-0.00537	0.00003
-6.741	0.730	0.71620	0.01330	0.00018
2.536	-0.215	-0.23655	0.02205	0.00049
4.547	-0.458	-0.44308	-0.01492	0.00022
0.094	0.000	0.01425	-0.01425	0.00020
-2.568	0.282	0.28763	-0.00613	0.00004
-3.806	0.404	0.41478	-0.01128	0.00013
-5.691	0.624	0.60837	0.01513	0.00023
-6.726	0.747	0.71466	0.03234	0.00105
2.518	-0.193	-0.23470	0.04220	0.00178
4.52	-0.435	-0.44030	0.00480	0.00002

Gain	Bias
-0.1027	0.0152
-0.1027	0.0239

Mean	7.981E-05
Std Dev	
Uncertainty	

0.0221 Inches
0.0177 Inches

Side-Hull Resistance

Error Analysis

Volts	lbf	Predicted	Difference	Dev. ^2
-0.011	0	0.02503	-0.02503	0.00063
-0.398	0.25	0.06477	0.18523	0.03432
-0.782	0.5	0.10421	0.39579	0.15667
-1.168	0.75	0.14385	0.60615	0.36745
-1.557	1	0.18380	0.81620	0.66622
-1.179	0.75	0.14498	0.60502	0.36608
-0.795	0.5	0.10555	0.39445	0.15562
-0.409	0.25	0.06590	0.18410	0.03390
-0.009	0	0.02482	-0.02482	0.00061

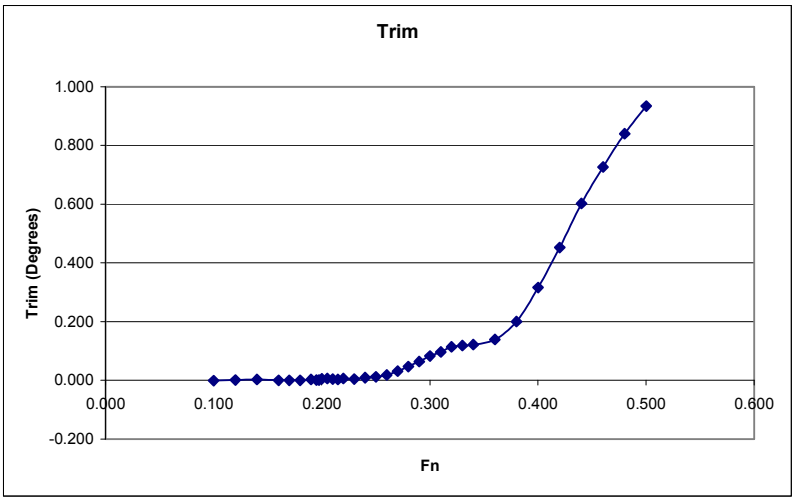
0.002	0	0.02369	-0.02369	0.00056
-0.391	0.25	0.06406	0.18594	0.03459
-0.777	0.5	0.10370	0.39630	0.15708
-1.163	0.75	0.14334	0.60666	0.36807
-1.553	1	0.18339	0.81661	0.66689
-1.174	0.75	0.14447	0.60553	0.36670
-0.793	0.5	0.10534	0.39466	0.15578
-0.403	0.25	0.06529	0.18471	0.03413
-0.007	0	0.02462	-0.02462	0.00060

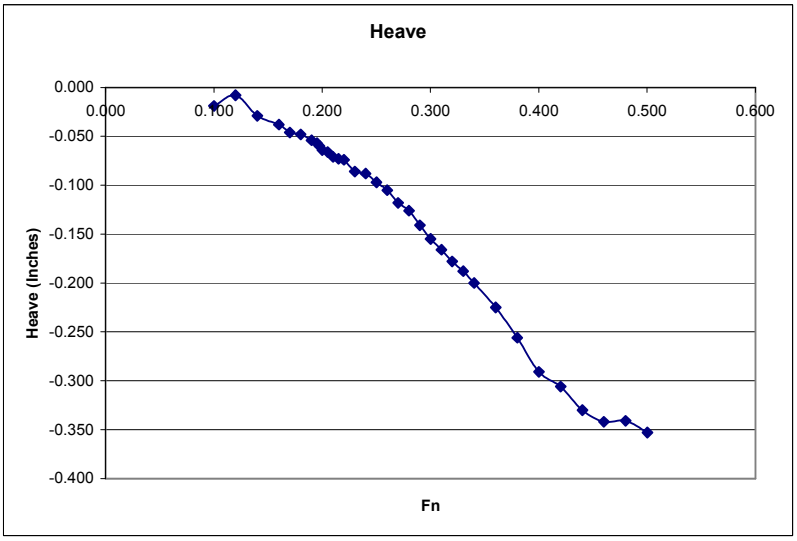
Gain	Bias
-0.6464	-0.0086
-0.6456	-0.0063

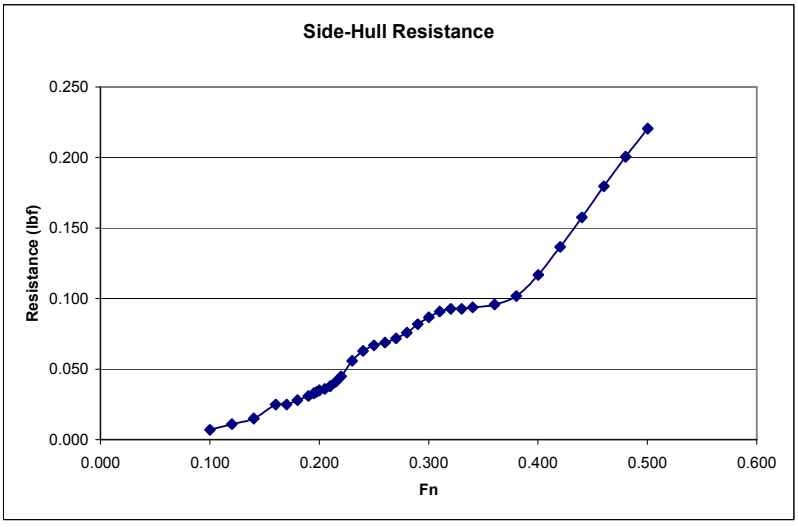
Mean	0.3488427
Std Dev	
Uncertainty	

0.4580 lbf
0.3239 lbf

Transverse = 50% Longitudinal = 76.5%







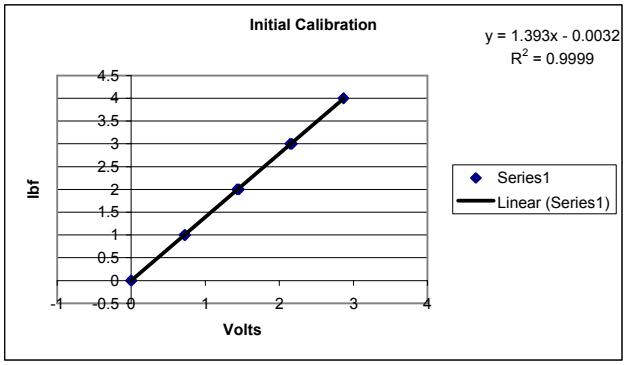
TRANSVERSE = 70%, LONGITUDINAL = 76.5%

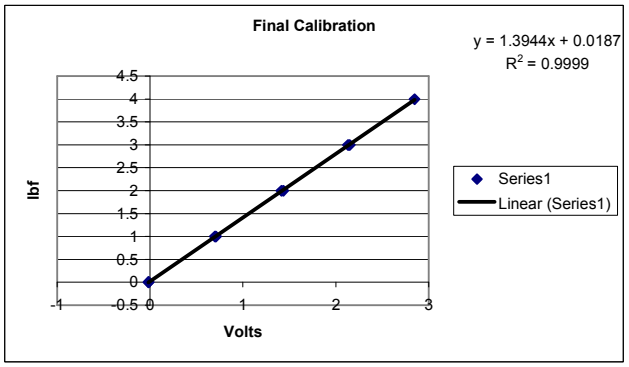
Trimaran, T = 70.0%, L = 76.5% | Correct Tow Point | Water Temp 20 C
19-Apr-07 ++++++ No appendages ++++++ Calibration Angle 5.168
Hama Thickness = 0.028 in

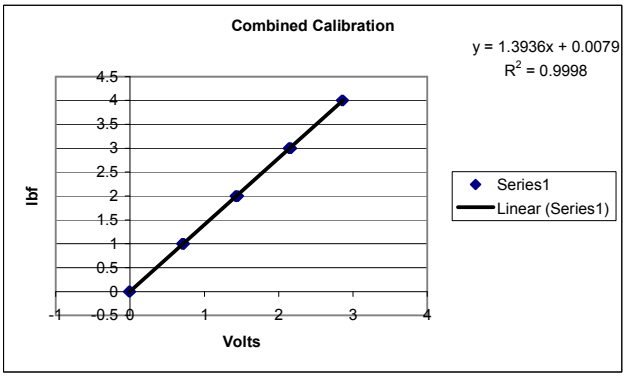
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.001	0
	0.717	1
	1.429	2
	2.146	3
	2.867	4
	2.169	3
	1.454	2
	0.727	1
	-0.001	0
Final	-0.017	0
	0.697	1
	1.415	2
	2.132	3
	2.847	4
	2.149	3
	1.436	2
	0.71	1
	-0.015	0







Transverse = 70% Longitudinal = 76.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.393
B1	-0.0032
A2	1.3936
B2	0.0079

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.018	0.064	0.082	0.059	0.082	0.082
2	1.802	-0.031	0.086	0.117	0.084	0.117	0.117
3	2.102	-0.034	0.125	0.159	0.114	0.159	0.158
4	2.252	-0.028	0.155	0.183	0.131	0.183	0.182
5	2.402	-0.033	0.185	0.218	0.156	0.218	0.217
6	2.552	-0.027	0.222	0.249	0.179	0.249	0.248
7	2.702	-0.033	0.232	0.265	0.190	0.265	0.264
8	2.853	-0.027	0.265	0.292	0.210	0.292	0.291
9	3.003	-0.032	0.286	0.318	0.228	0.318	0.317
10	3.153	-0.027	0.337	0.364	0.261	0.364	0.363
11	3.303	-0.03	0.385	0.415	0.298	0.415	0.413
12	3.453	-0.026	0.438	0.464	0.333	0.464	0.462
13	3.603	-0.029	0.462	0.491	0.352	0.491	0.489
14	3.753	-0.028	0.5	0.528	0.379	0.528	0.526
15	3.903	-0.028	0.53	0.558	0.401	0.558	0.556
16	4.204	-0.029	0.628	0.657	0.472	0.657	0.655
17	4.504	-0.03	0.731	0.761	0.546	0.761	0.758
18	4.804	-0.029	0.831	0.860	0.617	0.860	0.857
19	5.105	-0.029	0.904	0.933	0.670	0.933	0.930
20	5.255	-0.026	0.956	0.982	0.705	0.982	0.978
21	5.405	-0.03	1.014	1.044	0.749	1.044	1.040
22	5.705	-0.032	1.153	1.185	0.851	1.186	1.181
23	6.005	-0.031	1.31	1.341	0.963	1.342	1.336
24	6.306	-0.032	1.49	1.522	1.093	1.523	1.516
25	6.606	-0.033	1.668	1.701	1.221	1.702	1.695
26	6.906	-0.034	1.836	1.870	1.342	1.871	1.863
27	7.206	-0.033	2.002	2.035	1.461	2.036	2.028
28	7.507	-0.02	2.17	2.190	1.572	2.191	2.182

Model

FULL LOAD

LWL =	7	ft
BWL $_{Center}$	0.675	ft
Draft =	0.235833	ft
Displ, # =	35.70	
Displ, LT =	0.0	
WS =	6.36	ft^2

CONSTANTS

g=	32.17
ρ=	1.9334
ν=	1.05E-05

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0059	9.99E+05	0.0047	0.0012
1.802	0.0058	1.20E+06	0.0045	0.0013
2.102	0.0058	1.40E+06	0.0044	0.0015
2.252	0.0058	1.50E+06	0.0043	0.0015
2.402	0.0061	1.60E+06	0.0042	0.0019
2.552	0.0062	1.70E+06	0.0042	0.0020
2.702	0.0059	1.80E+06	0.0041	0.0017
2.853	0.0058	1.90E+06	0.0041	0.0017
3.003	0.0057	2.00E+06	0.0041	0.0017
3.153	0.0059	2.10E+06	0.0040	0.0019
3.303	0.0062	2.20E+06	0.0040	0.0022
3.453	0.0063	2.30E+06	0.0039	0.0024
3.603	0.0061	2.40E+06	0.0039	0.0022
3.753	0.0061	2.50E+06	0.0039	0.0022
3.903	0.0059	2.60E+06	0.0038	0.0021
4.204	0.0060	2.80E+06	0.0038	0.0022
4.504	0.0061	3.00E+06	0.0037	0.0023
4.804	0.0060	3.20E+06	0.0037	0.0023
5.105	0.0058	3.40E+06	0.0037	0.0021
5.255	0.0058	3.50E+06	0.0036	0.0021
5.405	0.0058	3.60E+06	0.0036	0.0022
5.705	0.0059	3.80E+06	0.0036	0.0023
6.005	0.0060	4.00E+06	0.0035	0.0025
6.306	0.0062	4.20E+06	0.0035	0.0027
6.606	0.0063	4.40E+06	0.0035	0.0028
6.906	0.0064	4.60E+06	0.0035	0.0029
7.206	0.0064	4.79E+06	0.0034	0.0029
7.507	0.0063	5.00E+06	0.0034	0.0029

Ship

FULL LOAD

LWL =	880.4	ft
BWL $_{Center}$	84.92	ft
Draft =	29.66	ft
Displ, # =	70987840	
Displ, LT =	31691.0	
WS =	100591	ft^2

CONSTANTS

g=	32.17
ρ=	1.9905
ν=	1.28E-05

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0012	1.16E+09	0.0015	0.0004	88325.2	0.100	25067	86733.5
12.0	20.21	0.0013	1.39E+09	0.0015	0.0004	130913.8	0.120	25067	128308.9
14.0	23.57	0.0015	1.62E+09	0.0014	0.0004	184241.2	0.140	25067	180351.3
15.0	25.26	0.0015	1.74E+09	0.0014	0.0004	215711.2	0.150	25067	211072.4
15.9	26.94	0.0019	1.85E+09	0.0014	0.0004	268775.4	0.160	25067	263315.1
16.9	28.62	0.0020	1.97E+09	0.0014	0.0004	312834.8	0.170	25067	306479.4
17.9	30.30	0.0017	2.09E+09	0.0014	0.0004	325453.0	0.180	25067	318128.0
18.9	32.00	0.0017	2.20E+09	0.0014	0.0004	359564.5	0.190	25067	351187.1
19.9	33.68	0.0017	2.32E+09	0.0014	0.0004	390968.2	0.200	25067	381468.6
20.9	35.36	0.0019	2.43E+09	0.0014	0.0004	462397.7	0.210	25067	451698.7
21.9	37.04	0.0022	2.55E+09	0.0014	0.0004	543249.6	0.220	25067	531273.3
22.9	38.73	0.0024	2.67E+09	0.0014	0.0004	619247.4	0.230	25067	605915.0
23.9	40.41	0.0022	2.78E+09	0.0014	0.0004	649582.0	0.240	25067	634814.0
24.9	42.09	0.0022	2.90E+09	0.0013	0.0004	699571.0	0.250	25067	683287.3
25.9	43.77	0.0021	3.01E+09	0.0013	0.0004	734527.1	0.260	25067	716647.0
27.9	47.15	0.0022	3.25E+09	0.0013	0.0004	881638.7	0.280	25067	860309.1
29.9	50.51	0.0023	3.48E+09	0.0013	0.0004	1036235.2	0.300	25067	1011137.2
31.9	53.88	0.0023	3.71E+09	0.0013	0.0004	1177782.8	0.320	25067	1148582.4
33.9	57.25	0.0021	3.94E+09	0.0013	0.0004	1263255.4	0.340	25067	1229599.4
34.9	58.93	0.0021	4.06E+09	0.0013	0.0004	1330572.0	0.350	25067	1294567.4
35.9	60.62	0.0022	4.17E+09	0.0013	0.0004	1423737.9	0.360	25067	1385299.0
37.9	63.98	0.0023	4.40E+09	0.0013	0.0004	1642738.4	0.380	25067	1599171.8
39.9	67.35	0.0025	4.64E+09	0.0013	0.0004	1889681.9	0.400	25067	1840639.7
41.9	70.72	0.0027	4.87E+09	0.0013	0.0004	2184762.5	0.420	25067	2129873.7
43.9	74.09	0.0028	5.10E+09	0.0013	0.0004	2473403.8	0.440	25067	2412333.6
45.9	77.45	0.0029	5.33E+09	0.0013	0.0004	2739067.9	0.460	25067	2671460.0
47.8	80.81	0.0029	5.56E+09	0.0013	0.0004	2994030.5	0.480	25067	2919526.1
49.8	84.19	0.0029	5.79E+09	0.0012	0.0004	3225789.8	0.500	25067	3144002.8

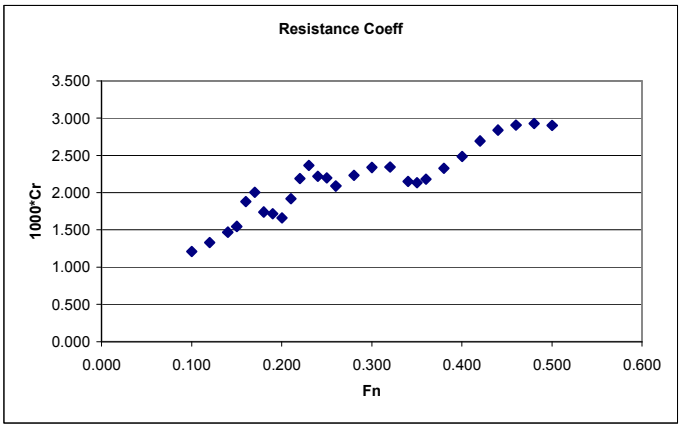
Transverse = 70%

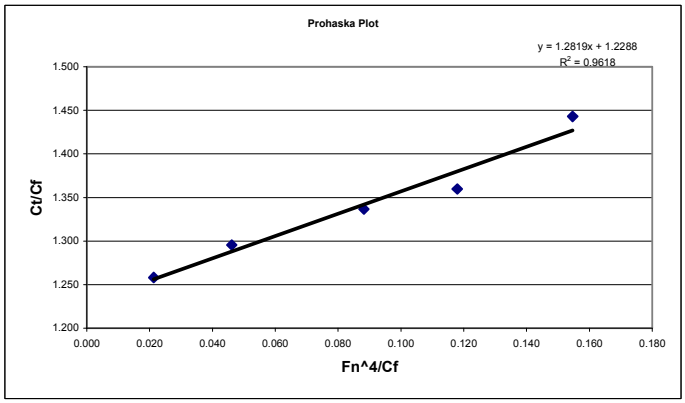
Longitudinal = 76.5%

Transverse = 70% Longitudinal = 76.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.210	0.021	1.258
0.120	1.332	0.046	1.295
0.140	1.469	0.088	1.337
0.150	1.547	0.118	1.360
0.160	1.880	0.155	1.443
0.170	2.005	0.200	1.478
0.180	1.740	0.254	1.420
0.190	1.717	0.319	1.419
0.200	1.660	0.396	1.409
0.210	1.919	0.485	1.478
0.220	2.187	0.590	1.550
0.230	2.365	0.711	1.600
0.240	2.221	0.850	1.568
0.250	2.198	1.009	1.567
0.260	2.089	1.189	1.543
0.280	2.232	1.624	1.589
0.300	2.338	2.169	1.625
0.320	2.344	2.842	1.634
0.340	2.150	3.666	1.588
0.350	2.131	4.140	1.587
0.360	2.179	4.658	1.603
0.380	2.325	5.841	1.650
0.400	2.486	7.240	1.702
0.420	2.694	8.886	1.768
0.440	2.839	10.795	1.816
0.460	2.905	13.001	1.842
0.480	2.929	15.534	1.856
0.500	2.901	18.436	1.854





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.001	0	0.006506	-0.0065064	4.14E-05
0.717	1	1.007111	-0.0071112	4.96E-05
1.429	2	1.999354	0.0006456	5.14E-07
2.146	3	2.998566	0.0014344	2.27E-06
2.867	4	4.003351	-0.0033512	1.08E-05
2.169	3	3.030618	-0.0306184	0.000933
1.454	2	2.034194	-0.0341944	0.001164
0.727	1	1.021047	-0.0210472	0.00044
-0.001	0	0.006506	-0.0065064	4.14E-05
-0.017	0	-0.01579	0.0157912	0.000252
0.697	1	0.979239	0.0207608	0.000434
1.415	2	1.979844	0.020156	0.000409
2.132	3	2.979055	0.0209448	0.000442
2.847	4	3.975479	0.0245208	0.000605
2.149	3	3.002746	-0.0027464	7.15E-06
1.436	2	2.00911	-0.0091096	8.17E-05
0.71	1	0.997356	0.002644	7.37E-06
-0.015	0	-0.013	0.013004	0.000171

Mean	-7.16444E-05	
Std Dev		0.0173 lbf
Uncertainty		0.0122 lbf

Calibration Angle 2.917

Trim Run	Speed	Zero	deg	Zero Corrected	Combined Calibration
1	1.501	-0.022	-0.021	0.001	0.001
2	1.802	-0.044	-0.043	0.001	0.001
3	2.102	-0.037	-0.036	0.001	0.001
4	2.252	-0.034	-0.031	0.003	0.003
5	2.402	-0.038	-0.036	0.002	0.002
6	2.552	-0.040	-0.038	0.002	0.002
7	2.702	-0.036	-0.034	0.002	0.002
8	2.853	-0.032	-0.030	0.002	0.002
9	3.003	-0.030	-0.026	0.004	0.004
10	3.153	-0.038	-0.034	0.004	0.004
11	3.303	-0.025	-0.024	0.001	0.001
12	3.453	-0.042	-0.036	0.006	0.006
13	3.603	-0.022	-0.017	0.005	0.005
14	3.753	-0.040	-0.023	0.017	0.017
15	3.903	-0.025	0.000	0.025	0.025
16	4.204	-0.027	0.029	0.056	0.056
17	4.504	-0.029	0.052	0.081	0.081
18	4.804	-0.030	0.070	0.1	0.100
19	5.105	-0.026	0.061	0.087	0.087
20	5.255	-0.037	0.057	0.094	0.094
21	5.405	-0.027	0.085	0.112	0.112
22	5.705	-0.029	0.145	0.174	0.174
23	6.005	-0.028	0.254	0.282	0.281
24	6.306	-0.031	0.387	0.418	0.417
25	6.606	-0.037	0.517	0.554	0.553
26	6.906	-0.040	0.634	0.674	0.672
27	7.206	-0.046	0.748	0.794	0.792
28	7.507	-0.058	0.832	0.89	0.888

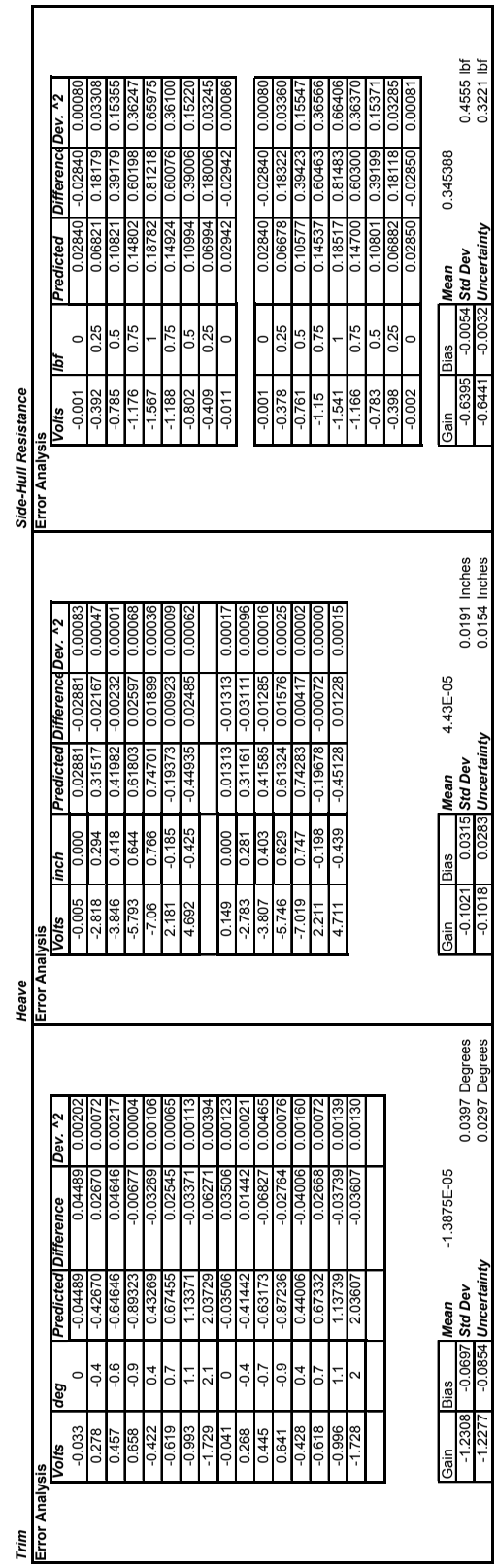
Heave Run	Speed	Zero	inch	Zero Corrected	Combined Calibration
1	1.501	0.001	-0.022	-0.023	-0.023
2	1.802	0	-0.025	-0.025	-0.025
3	2.102	0.002	-0.033	-0.035	-0.035
4	2.252	-0.011	-0.045	-0.034	-0.034
5	2.402	-0.003	-0.044	-0.041	-0.041
6	2.552	-0.01	-0.052	-0.042	-0.042
7	2.702	-0.004	-0.052	-0.048	-0.048
8	2.853	-0.008	-0.062	-0.054	-0.054
9	3.003	-0.002	-0.063	-0.061	-0.061
10	3.153	-0.009	-0.073	-0.064	-0.064
11	3.303	-0.002	-0.075	-0.073	-0.073
12	3.453	-0.013	-0.086	-0.073	-0.073
13	3.603	-0.003	-0.091	-0.088	-0.088
14	3.753	-0.011	-0.099	-0.088	-0.088
15	3.903	-0.008	-0.105	-0.097	-0.097
16	4.204	-0.008	-0.124	-0.116	-0.116
17	4.504	-0.01	-0.142	-0.132	-0.132
18	4.804	-0.006	-0.164	-0.158	-0.158
19	5.105	-0.007	-0.183	-0.176	-0.175
20	5.255	-0.007	-0.197	-0.19	-0.189
21	5.405	-0.006	-0.208	-0.202	-0.201
22	5.705	-0.006	-0.242	-0.236	-0.235
23	6.005	-0.003	-0.279	-0.276	-0.275
24	6.306	-0.002	-0.307	-0.305	-0.304
25	6.606	-0.004	-0.328	-0.324	-0.323
26	6.906	-0.003	-0.337	-0.334	-0.333
27	7.206	0.002	-0.356	-0.358	-0.357
28	7.507	0.001	-0.359	-0.36	-0.359

Side-Hull Resistance Run	Speed	Zero	lbf	Zero Corrected	Combined Calibration	Angle Corrected
1	1.501	0.032	0.039	0.007	0.007	0.007
2	1.802	0.03	0.041	0.011	0.011	0.011
3	2.102	0.029	0.044	0.015	0.015	0.015
4	2.252	0.027	0.046	0.019	0.019	0.019
5	2.402	0.028	0.053	0.025	0.025	0.025
6	2.552	0.027	0.053	0.026	0.026	0.026
7	2.702	0.028	0.057	0.029	0.029	0.029
8	2.853	0.027	0.059	0.032	0.032	0.032
9	3.003	0.028	0.063	0.035	0.035	0.035
10	3.153	0.027	0.065	0.038	0.038	0.038
11	3.303	0.027	0.073	0.046	0.046	0.046
12	3.453	0.027	0.083	0.056	0.056	0.056
13	3.603	0.027	0.09	0.063	0.063	0.063
14	3.753	0.027	0.093	0.066	0.066	0.066
15	3.903	0.027	0.095	0.068	0.068	0.068
16	4.204	0.027	0.101	0.074	0.075	0.074
17	4.504	0.027	0.108	0.081	0.082	0.081
18	4.804	0.027	0.114	0.087	0.088	0.088
19	5.105	0.027	0.121	0.094	0.095	0.095
20	5.255	0.027	0.124	0.097	0.098	0.098
21	5.405	0.027	0.13	0.103	0.104	0.104
22	5.705	0.027	0.145	0.118	0.119	0.119
23	6.005	0.028	0.16	0.132	0.133	0.133
24	6.306	0.028	0.175	0.147	0.148	0.148
25	6.606	0.028	0.188	0.16	0.161	0.161
26	6.906	0.029	0.203	0.174	0.175	0.175
27	7.206	0.03	0.222	0.192	0.193	0.193
28	7.507	0.032	0.243	0.211	0.213	0.212

Transverse = 70%

Longitudinal = 76.5%

Transverse = 70% Longitudinal = 76.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.033	0	-0.04489	0.04489	0.00202
0.278	-0.4	-0.42670	0.02670	0.00072
0.457	-0.6	-0.64646	0.04646	0.00217
0.658	-0.9	-0.89323	-0.00677	0.00004
-0.422	0.4	0.43269	-0.03269	0.00106
-0.619	0.7	0.67455	0.02545	0.00065
-0.993	1.1	1.13371	-0.03371	0.00113
-1.729	2.1	2.03729	0.06271	0.00394
-0.041	0	-0.03506	0.03506	0.00123
0.268	-0.4	-0.41442	0.01442	0.00021
0.445	-0.7	-0.63173	-0.06827	0.00465
0.641	-0.9	-0.87236	-0.02764	0.00076
-0.428	0.4	0.44006	-0.04006	0.00160
-0.618	0.7	0.67332	0.02668	0.00072
-0.996	1.1	1.13739	-0.03739	0.00139
-1.728	2	2.03607	-0.03607	0.00130

Gain	Bias
-1.2308	-0.0697
-1.2277	-0.0854

Mean	-1.3875E-05
Std Dev	0.0397 Degrees
Uncertainty	0.0297 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
-0.005	0.000	0.02881	-0.02881	0.00083
-2.818	0.294	0.31517	-0.02167	0.00047
-3.846	0.418	0.41982	-0.00232	0.00001
-5.793	0.644	0.61803	0.02597	0.00068
-7.06	0.766	0.74701	0.01899	0.00036
2.181	-0.185	-0.19373	0.00923	0.00009
4.692	-0.425	-0.44935	0.02485	0.00062
0.149	0.000	0.01313	-0.01313	0.00017
-2.783	0.281	0.31161	-0.03111	0.00096
-3.807	0.403	0.41585	-0.01285	0.00016
-5.746	0.629	0.61324	0.01576	0.00025
-7.019	0.747	0.74283	0.00417	0.00002
2.211	-0.198	-0.19678	-0.00072	0.00000
4.711	-0.439	-0.45128	0.01228	0.00015

Gain	Bias
-0.1021	0.0315
-0.1018	0.0283

Mean	4.43E-05
Std Dev	0.0191 Inches
Uncertainty	0.0154 Inches

Side-Hull Resistance

Error Analysis

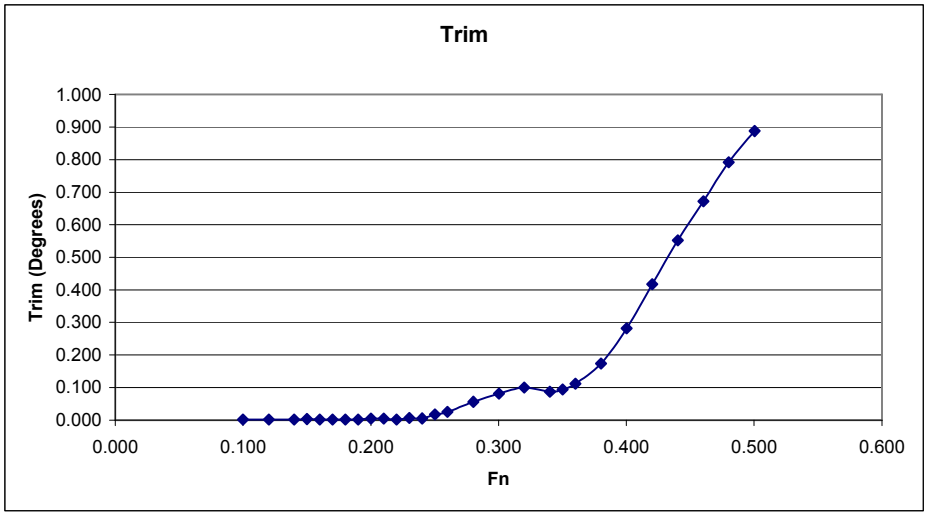
Volts	lbf	Predicted	Difference	Dev. ^2
-0.001	0	0.02840	-0.02840	0.00080
-0.392	0.25	0.06821	0.18179	0.03308
-0.785	0.5	0.10821	0.39179	0.15355
-1.176	0.75	0.14802	0.60198	0.36247
-1.567	1	0.18782	0.81218	0.65975
-1.188	0.75	0.14924	0.60076	0.36100
-0.802	0.5	0.10994	0.39006	0.15220
-0.409	0.25	0.06994	0.18006	0.03245
-0.011	0	0.02942	-0.02942	0.00086

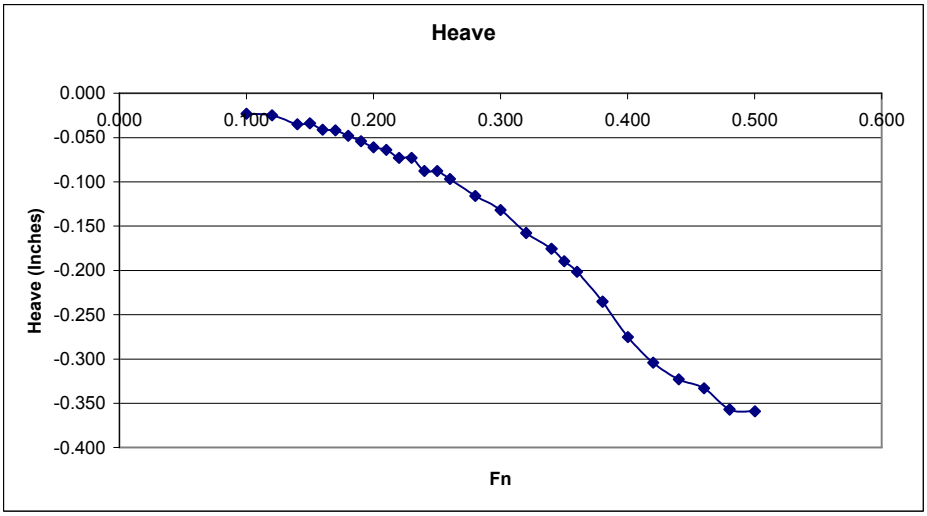
Volts	lbf	Predicted	Difference	Dev. ^2
-0.001	0	0.02840	-0.02840	0.00080
-0.378	0.25	0.06678	0.18322	0.03360
-0.761	0.5	0.10577	0.39423	0.15547
-1.15	0.75	0.14537	0.60463	0.36566
-1.541	1	0.18517	0.81483	0.66406
-1.166	0.75	0.14700	0.60300	0.36370
-0.783	0.5	0.10801	0.39199	0.15371
-0.398	0.25	0.06882	0.18118	0.03285
-0.002	0	0.02850	-0.02850	0.00081

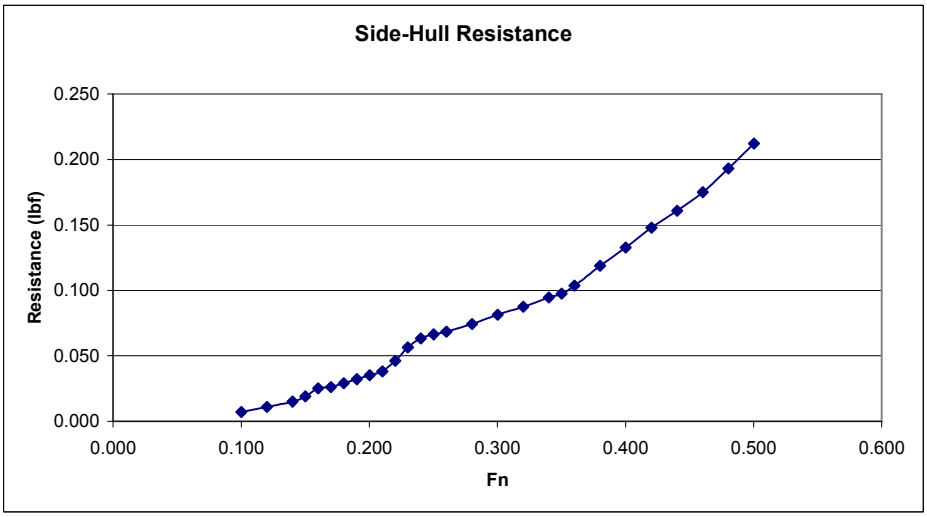
Gain	Bias
-0.6395	-0.0054
-0.6441	-0.0032

Mean	0.345388
Std Dev	0.4555 lbf
Uncertainty	0.3221 lbf

Transverse = 70% Longitudinal = 76.5%


Trim
Trim (Degrees)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.000
0.100
0.200
0.300
0.400
0.500
0.600
Fn


Heave
Heave (Inches)
0.000
-0.050
-0.100
-0.150
-0.200
-0.250
-0.300
-0.350
-0.400
0.000
0.100
0.200
0.300
0.400
0.500
0.600
Fn


Side-Hull Resistance
Resistance (lbf)
0.250
0.200
0.150
0.100
0.050
0.000
0.000
0.100
0.200
0.300
0.400
0.500
0.600
Fn

TRANSVERSE = 70%, LONGITUDINAL = 81.5%

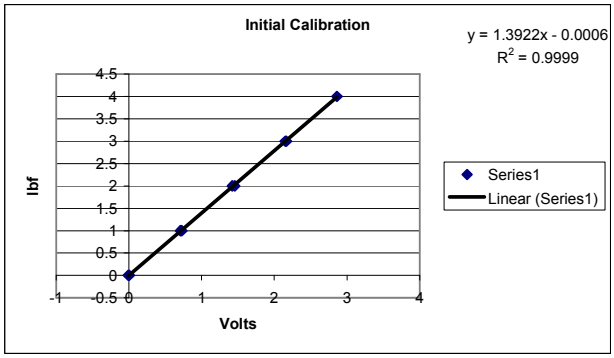
Trimaran, T = 70.0%, L = 81.5% | Correct Tow Point | Water Temp 20 C
19-Apr-07 ++++++ No appendages ++++++ Calibration Angle 5.168

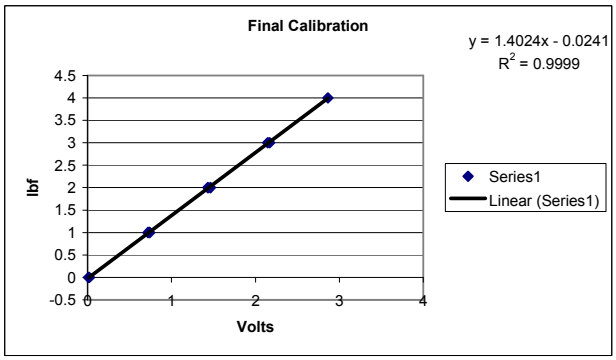
Hama Thickness = 0.028 in

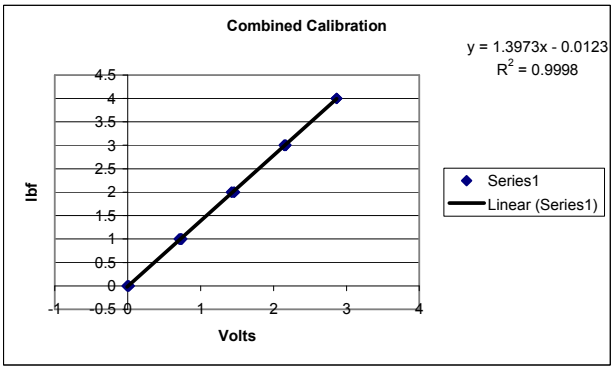
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.008	0
	0.708	1
	1.424	2
	2.152	3
	2.864	4
	2.167	3
	1.456	2
	0.728	1
	0.005	0
Final	0.011	0
	0.722	1
	1.432	2
	2.146	3
	2.864	4
	2.168	3
	1.463	2
	0.739	1
	0.019	0







Transverse = 70% Longitudinal = 81.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3922
B1	-0.0006
A2	1.3973
B2	-0.0123

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.002	0.076	0.078	0.056	0.078	0.078
2	1.802	-0.005	0.104	0.109	0.078	0.109	0.109
3	2.102	-0.004	0.146	0.150	0.108	0.151	0.150
4	2.252	0.016	0.203	0.187	0.134	0.188	0.187
5	2.402	-0.002	0.197	0.199	0.143	0.200	0.199
6	2.552	0.02	0.245	0.225	0.162	0.226	0.225
7	2.702	-0.004	0.246	0.250	0.180	0.251	0.250
8	2.853	0.017	0.298	0.281	0.202	0.282	0.281
9	3.003	-0.004	0.319	0.323	0.232	0.324	0.323
10	3.153	0.016	0.373	0.357	0.256	0.358	0.357
11	3.303	0.003	0.391	0.388	0.279	0.389	0.388
12	3.453	0.019	0.446	0.427	0.307	0.429	0.427
13	3.603	-0.001	0.473	0.474	0.340	0.476	0.474
14	3.753	0.017	0.528	0.511	0.367	0.513	0.511
15	3.903	0.007	0.561	0.554	0.398	0.556	0.554
16	4.204	0.008	0.661	0.653	0.469	0.655	0.653
17	4.504	0.014	0.786	0.772	0.555	0.775	0.772
18	4.804	0.011	0.851	0.840	0.603	0.843	0.840
19	4.954	0.019	0.873	0.854	0.613	0.857	0.854
20	5.105	0.021	0.898	0.877	0.630	0.880	0.877
21	5.405	0.01	0.983	0.973	0.699	0.977	0.973
22	5.705	0.009	1.096	1.087	0.781	1.091	1.087
23	6.005	0	1.254	1.254	0.901	1.259	1.253
24	6.306	0.002	1.411	1.409	1.012	1.414	1.408
25	6.606	0.001	1.575	1.574	1.131	1.580	1.573
26	6.906	0.003	1.732	1.729	1.242	1.735	1.728
27	7.206	-0.004	1.889	1.893	1.360	1.900	1.892
28	7.507	0.002	2.032	2.030	1.458	2.037	2.029

Model

FULL LOAD		CONSTANTS	
LWL =	7 ft	g=	32.17
BWL $_{Center}$	0.675 ft	ρ=	1.9334
Draft =	0.235833 ft	ν=	1.05E-05
Displ, # =	35.70		
Displ, LT =	0.0		
WS =	6.36 ft^2		

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0056	9.99E+05	0.0047	0.0009
1.802	0.0055	1.20E+06	0.0045	0.0010
2.102	0.0055	1.40E+06	0.0044	0.0012
2.252	0.0060	1.50E+06	0.0043	0.0017
2.402	0.0056	1.60E+06	0.0042	0.0014
2.552	0.0056	1.70E+06	0.0042	0.0014
2.702	0.0056	1.80E+06	0.0041	0.0014
2.853	0.0056	1.90E+06	0.0041	0.0015
3.003	0.0058	2.00E+06	0.0041	0.0018
3.153	0.0058	2.10E+06	0.0040	0.0018
3.303	0.0058	2.20E+06	0.0040	0.0018
3.453	0.0058	2.30E+06	0.0039	0.0019
3.603	0.0059	2.40E+06	0.0039	0.0020
3.753	0.0059	2.50E+06	0.0039	0.0020
3.903	0.0059	2.60E+06	0.0038	0.0021
4.204	0.0060	2.80E+06	0.0038	0.0022
4.504	0.0062	3.00E+06	0.0037	0.0024
4.804	0.0059	3.20E+06	0.0037	0.0022
4.954	0.0057	3.30E+06	0.0037	0.0020
5.105	0.0055	3.40E+06	0.0037	0.0018
5.405	0.0054	3.60E+06	0.0036	0.0018
5.705	0.0054	3.80E+06	0.0036	0.0019
6.005	0.0057	4.00E+06	0.0035	0.0021
6.306	0.0058	4.20E+06	0.0035	0.0023
6.606	0.0059	4.40E+06	0.0035	0.0024
6.906	0.0059	4.60E+06	0.0035	0.0024
7.206	0.0059	4.79E+06	0.0034	0.0025
7.507	0.0059	5.00E+06	0.0034	0.0025

Ship

FULL LOAD		CONSTANTS	
LWL =	880.4 ft	g=	32.17
BWL $_{Center}$	84.92 ft	ρ=	1.9905
Draft =	29.66 ft	ν=	1.28E-05
Displ, # =	70987840		
Displ, LT =	31691.0		
WS =	100591 ft^2		

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0009	1.16E+09	0.0015	0.0004	80676.0	0.100	24562	77596.1
12.0	20.21	0.0010	1.39E+09	0.0015	0.0004	115305.3	0.120	24562	110603.0
14.0	23.57	0.0012	1.62E+09	0.0014	0.0004	166862.3	0.140	24562	160171.2
15.0	25.26	0.0017	1.74E+09	0.0014	0.0004	225108.0	0.150	24562	217280.5
15.9	26.94	0.0014	1.85E+09	0.0014	0.0004	231310.5	0.160	24562	222250.4
16.9	28.62	0.0014	1.97E+09	0.0014	0.0004	265336.8	0.170	24562	254947.3
17.9	30.30	0.0014	2.09E+09	0.0014	0.0004	296488.1	0.180	24562	284671.4
18.9	32.00	0.0015	2.20E+09	0.0014	0.0004	338967.6	0.190	24562	325614.6
19.9	33.68	0.0018	2.32E+09	0.0014	0.0004	403302.7	0.200	24562	388323.9
20.9	35.36	0.0018	2.43E+09	0.0014	0.0004	450465.5	0.210	24562	433760.9
21.9	37.04	0.0018	2.55E+09	0.0014	0.0004	490703.8	0.220	24562	472172.6
22.9	38.73	0.0019	2.67E+09	0.0014	0.0004	546549.7	0.230	24562	526090.7
23.9	40.41	0.0020	2.78E+09	0.0014	0.0004	618012.4	0.240	24562	595523.6
24.9	42.09	0.0020	2.90E+09	0.0013	0.0004	668245.3	0.250	24562	643624.4
25.9	43.77	0.0021	3.01E+09	0.0013	0.0004	730016.8	0.260	24562	703160.7
27.9	47.15	0.0022	3.25E+09	0.0013	0.0004	877781.2	0.280	24562	846127.0
29.9	50.51	0.0024	3.48E+09	0.0013	0.0004	1063776.1	0.300	24562	1026921.2
31.9	53.88	0.0022	3.71E+09	0.0013	0.0004	1142504.0	0.320	24562	1100027.2
32.9	55.56	0.0020	3.82E+09	0.0013	0.0004	1139866.7	0.330	24562	1094419.8
33.9	57.25	0.0018	3.94E+09	0.0013	0.0004	1154748.0	0.340	24562	1106203.7
35.9	60.62	0.0018	4.17E+09	0.0013	0.0004	1285250.0	0.360	24562	1230230.1
37.9	63.98	0.0019	4.40E+09	0.0013	0.0004	1449897.8	0.380	24562	1387971.6
39.9	67.35	0.0021	4.64E+09	0.0013	0.0004	1720392.5	0.400	24562	1651127.0
41.9	70.72	0.0023	4.87E+09	0.0013	0.0004	1963431.7	0.420	24562	1886364.6
43.9	74.09	0.0024	5.10E+09	0.0013	0.0004	2224588.4	0.440	24562	2139306.8
45.9	77.45	0.0024	5.33E+09	0.0013	0.0004	2462702.0	0.460	24562	2368765.6
47.8	80.81	0.0025	5.56E+09	0.0013	0.0004	2716705.2	0.480	24562	2613671.7
49.8	84.19	0.0025	5.79E+09	0.0012	0.0004	2912631.6	0.500	24562	2800024.0

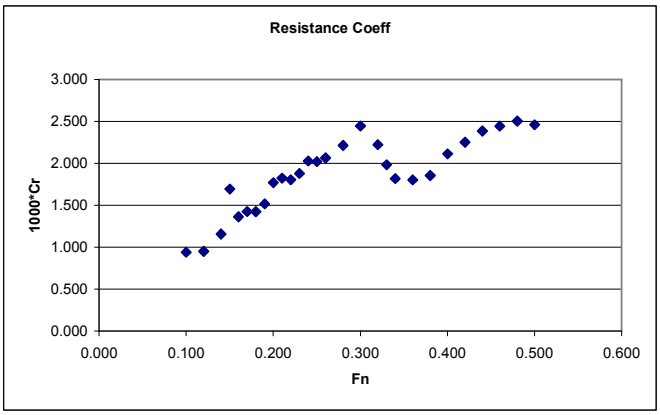
Transverse = 70%

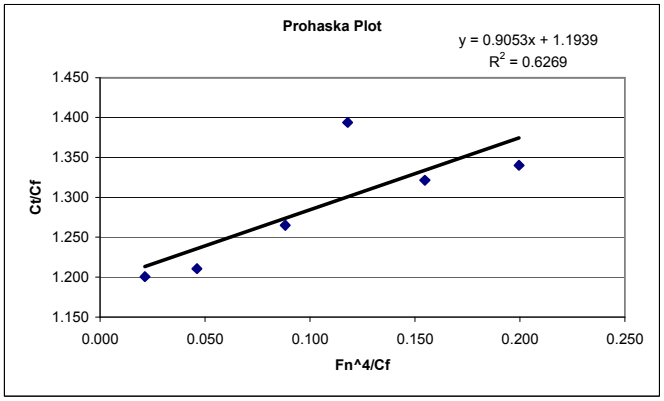
Longitudinal = 81.5%

Transverse = 70% Longitudinal = 81.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	0.941	0.021	1.201
0.120	0.950	0.046	1.211
0.140	1.157	0.088	1.265
0.150	1.694	0.118	1.394
0.160	1.364	0.155	1.321
0.170	1.426	0.200	1.340
0.180	1.425	0.254	1.344
0.190	1.516	0.319	1.370
0.200	1.769	0.396	1.436
0.210	1.824	0.485	1.454
0.220	1.805	0.590	1.454
0.230	1.880	0.711	1.477
0.240	2.027	0.850	1.519
0.250	2.021	1.009	1.521
0.260	2.065	1.189	1.537
0.280	2.215	1.624	1.584
0.300	2.446	2.169	1.654
0.320	2.222	2.842	1.601
0.330	1.984	3.233	1.540
0.340	1.819	3.666	1.498
0.360	1.802	4.658	1.499
0.380	1.854	5.841	1.518
0.400	2.113	7.240	1.596
0.420	2.252	8.886	1.642
0.440	2.386	10.795	1.686
0.460	2.445	13.001	1.709
0.480	2.505	15.534	1.732
0.500	2.460	18.436	1.724





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.008	0	-0.02348	0.0234784	0.000552
0.708	1	0.976988	0.0230116	0.00053
1.424	2	1.977455	0.0225448	0.000509
2.152	3	2.99469	0.0053104	2.84E-05
2.864	4	3.989567	0.0104328	0.000109
2.167	3	3.015649	-0.0156491	0.000244
1.456	2	2.022169	-0.0221688	0.000491
0.728	1	1.004934	-0.0049344	2.42E-05
0.005	0	-0.00531	0.0053135	2.84E-05
0.011	0	0.00307	-0.0030703	9.31E-06
0.722	1	0.996551	0.0034494	1.2E-05
1.432	2	1.988634	0.0113664	0.00013
2.146	3	2.986306	0.0136942	0.000188
2.864	4	3.989567	0.0104328	0.000109
2.168	3	3.017046	-0.0170464	0.00029
1.463	2	2.03195	-0.0319499	0.00102
0.739	1	1.020305	-0.0203047	0.000412
0.019	0	0.014249	-0.0142487	0.000202

Mean	-1.87778E-05	
Std Dev		0.0170 lbf
Uncertainty		0.0120 lbf

Transverse = 70%

Longitudinal = 81.5%

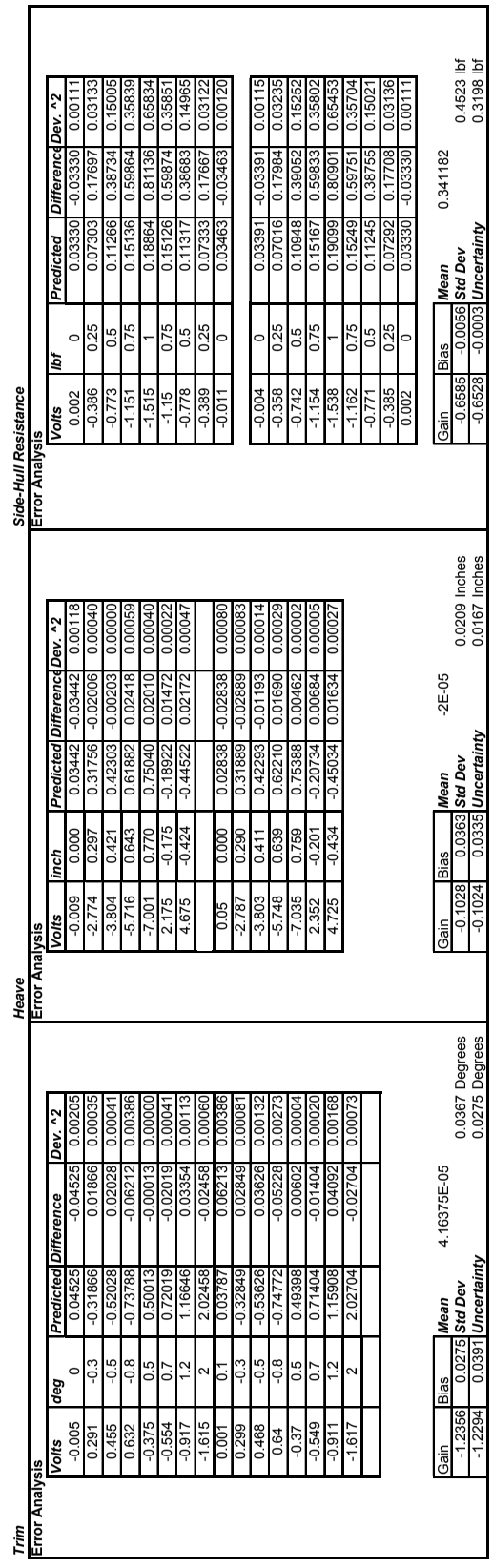
Calibration Angle 4.733

Trim Run	Speed	Zero	deg	*Zero Corrected*	*Combined Calibration*
1	1.501	0.043	0.045	0.002	0.002
2	1.802	0.043	0.045	0.002	0.002
3	2.102	0.039	0.041	0.002	0.002
4	2.252	0.030	0.035	0.005	0.005
5	2.402	0.037	0.045	0.008	0.008
6	2.552	0.028	0.035	0.007	0.007
7	2.702	0.035	0.042	0.007	0.007
8	2.853	0.029	0.035	0.006	0.006
9	3.003	0.035	0.041	0.006	0.006
10	3.153	0.027	0.037	0.01	0.010
11	3.303	0.035	0.041	0.006	0.006
12	3.453	0.028	0.050	0.022	0.022
13	3.603	0.031	0.065	0.034	0.034
14	3.753	0.029	0.077	0.048	0.048
15	3.903	0.034	0.088	0.054	0.054
16	4.204	0.033	0.104	0.071	0.071
17	4.504	0.031	0.133	0.102	0.101
18	4.804	0.030	0.098	0.068	0.068
19	4.954	0.028	0.074	0.046	0.046
20	5.105	0.031	0.056	0.025	0.025
21	5.405	0.029	0.065	0.036	0.036
22	5.705	0.036	0.129	0.093	0.093
23	6.005	0.033	0.241	0.208	0.207
24	6.306	0.035	0.389	0.354	0.352
25	6.606	0.038	0.529	0.491	0.489
26	6.906	0.034	0.664	0.63	0.627
27	7.206	0.038	0.786	0.748	0.744
28	7.507	0.040	0.896	0.856	0.852

Heave Run	Speed	Zero	inch	*Zero Corrected*	*Combined Calibration*
1	1.501	0.039	0.017	-0.022	-0.022
2	1.802	0.039	0.011	-0.028	-0.028
3	2.102	0.038	0.004	-0.034	-0.034
4	2.252	0.035	-0.003	-0.038	-0.038
5	2.402	0.034	-0.004	-0.038	-0.038
6	2.552	0.034	-0.012	-0.046	-0.046
7	2.702	0.032	-0.015	-0.047	-0.047
8	2.853	0.03	-0.022	-0.052	-0.052
9	3.003	0.034	-0.025	-0.059	-0.059
10	3.153	0.032	-0.034	-0.066	-0.066
11	3.303	0.032	-0.04	-0.072	-0.072
12	3.453	0.032	-0.046	-0.078	-0.078
13	3.603	0.037	-0.054	-0.091	-0.091
14	3.753	0.033	-0.06	-0.093	-0.093
15	3.903	0.035	-0.066	-0.101	-0.101
16	4.204	0.034	-0.082	-0.116	-0.116
17	4.504	0.035	-0.1	-0.135	-0.134
18	4.804	0.034	-0.112	-0.146	-0.145
19	4.954	0.034	-0.12	-0.154	-0.153
20	5.105	0.035	-0.13	-0.165	-0.164
21	5.405	0.034	-0.16	-0.194	-0.193
22	5.705	0.036	-0.187	-0.223	-0.222
23	6.005	0.032	-0.225	-0.257	-0.256
24	6.306	0.033	-0.253	-0.286	-0.285
25	6.606	0.037	-0.273	-0.31	-0.309
26	6.906	0.034	-0.292	-0.326	-0.325
27	7.206	0.038	-0.304	-0.342	-0.341
28	7.507	0.036	-0.313	-0.349	-0.348

Side-Hull Resistance Run	Speed	Zero	lbf	*Zero Corrected*	*Combined Calibration*	*Angle Corrected*
1	1.501	0.003	0.01	0.007	0.007	0.007
2	1.802	0.001	0.011	0.01	0.010	0.010
3	2.102	0	0.015	0.015	0.015	0.015
4	2.252	-0.003	0.018	0.021	0.021	0.021
5	2.402	0	0.022	0.022	0.022	0.022
6	2.552	-0.003	0.024	0.027	0.027	0.027
7	2.702	-0.001	0.025	0.026	0.026	0.026
8	2.853	-0.002	0.029	0.031	0.031	0.031
9	3.003	-0.002	0.035	0.037	0.037	0.037
10	3.153	-0.003	0.037	0.04	0.040	0.040
11	3.303	-0.001	0.043	0.044	0.044	0.043
12	3.453	-0.003	0.053	0.056	0.056	0.055
13	3.603	-0.002	0.066	0.068	0.067	0.067
14	3.753	-0.004	0.071	0.075	0.074	0.074
15	3.903	-0.002	0.076	0.078	0.077	0.077
16	4.204	-0.003	0.082	0.085	0.084	0.084
17	4.504	-0.003	0.093	0.096	0.095	0.095
18	4.804	-0.003	0.096	0.099	0.098	0.098
19	4.954	-0.003	0.095	0.098	0.097	0.097
20	5.105	-0.002	0.096	0.098	0.097	0.097
21	5.405	-0.001	0.101	0.102	0.101	0.101
22	5.705	-0.001	0.111	0.112	0.111	0.111
23	6.005	-0.001	0.128	0.129	0.128	0.127
24	6.306	-0.001	0.148	0.149	0.148	0.147
25	6.606	0	0.169	0.169	0.168	0.167
26	6.906	0.001	0.186	0.185	0.183	0.183
27	7.206	0	0.202	0.202	0.200	0.200
28	7.507	0.002	0.224	0.222	0.220	0.219

Transverse = 70% Longitudinal = 81.5%



Trim

Error Analysis

Volts	*deg*	*Predicted*	*Difference*	*Dev. ^2*
-0.005	0	0.04525	-0.04525	0.00205
0.291	-0.3	-0.31866	0.01866	0.00035
0.455	-0.5	-0.52028	0.02028	0.00041
0.632	-0.8	-0.73788	-0.06212	0.00386
-0.375	0.5	0.50013	-0.00013	0.00000
-0.554	0.7	0.72019	-0.02019	0.00041
-0.917	1.2	1.16646	0.03354	0.00113
-1.615	2	2.02458	-0.02458	0.00060
0.001	0.1	0.03787	0.06213	0.00386
0.299	-0.3	-0.32849	0.02849	0.00081
0.468	-0.5	-0.53626	0.03626	0.00132
0.64	-0.8	-0.74772	-0.05228	0.00273
-0.37	0.5	0.49398	0.00602	0.00004
-0.549	0.7	0.71404	-0.01404	0.00020
-0.911	1.2	1.15908	0.04092	0.00168
-1.617	2	2.02704	-0.02704	0.00073

Gain	Bias
-1.2356	0.0275
-1.2294	0.0391

Mean	4.16375E-05
Std Dev	
Uncertainty	

0.0367 Degrees
0.0275 Degrees

Heave

Error Analysis

Volts	*inch*	*Predicted*	*Difference*	*Dev. ^2*
-0.009	0.000	0.03442	-0.03442	0.00118
-2.774	0.297	0.31756	-0.02006	0.00040
-3.804	0.421	0.42303	-0.00203	0.00000
-5.716	0.643	0.61882	0.02418	0.00059
-7.001	0.770	0.75040	0.02010	0.00040
2.175	-0.175	-0.18922	0.01472	0.00022
4.675	-0.424	-0.44522	0.02172	0.00047
0.05	0.000	0.02838	-0.02838	0.00080
-2.787	0.290	0.31889	-0.02889	0.00083
-3.803	0.411	0.42293	-0.01193	0.00014
-5.748	0.639	0.62210	0.01690	0.00029
-7.035	0.759	0.75388	0.00462	0.00002
2.352	-0.201	-0.20734	0.00684	0.00005
4.725	-0.434	-0.45034	0.01634	0.00027

Gain	Bias
-0.1028	0.0363
-0.1024	0.0335

Mean	-2E-05
Std Dev	
Uncertainty	

0.0209 Inches
0.0167 Inches

Side-Hull Resistance

Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
0.002	0	0.03330	-0.03330	0.00111
-0.386	0.25	0.07303	0.17697	0.03133
-0.773	0.5	0.11266	0.38734	0.15005
-1.151	0.75	0.15136	0.59864	0.35839
-1.515	1	0.18864	0.81136	0.65834
-1.15	0.75	0.15126	0.59874	0.35851
-0.778	0.5	0.11317	0.38683	0.14965
-0.389	0.25	0.07333	0.17667	0.03122
-0.011	0	0.03463	-0.03463	0.00120

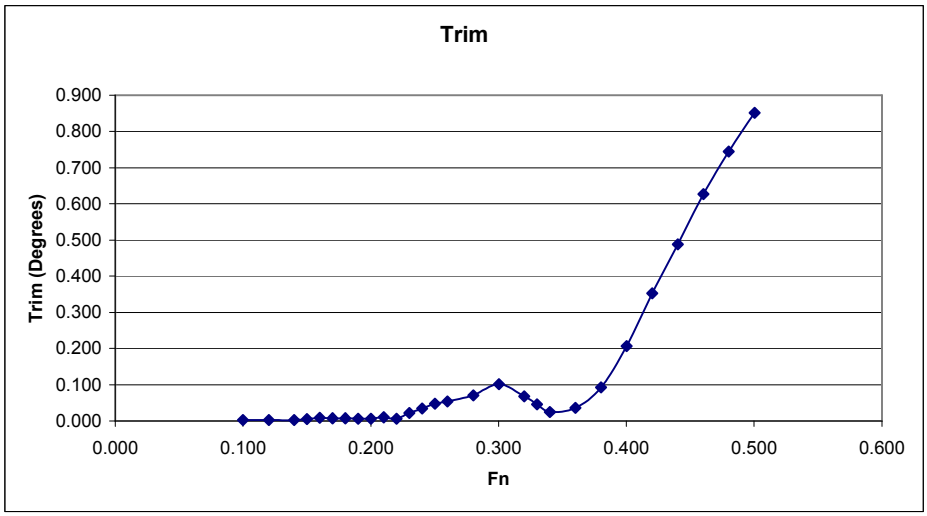
-0.004	0	0.03391	-0.03391	0.00115
-0.358	0.25	0.07016	0.17984	0.03235
-0.742	0.5	0.10948	0.39052	0.15252
-1.154	0.75	0.15167	0.59833	0.35802
-1.538	1	0.19099	0.80901	0.65453
-1.162	0.75	0.15249	0.59751	0.35704
-0.771	0.5	0.11245	0.38755	0.15021
-0.385	0.25	0.07292	0.17708	0.03136
0.002	0	0.03330	-0.03330	0.00111

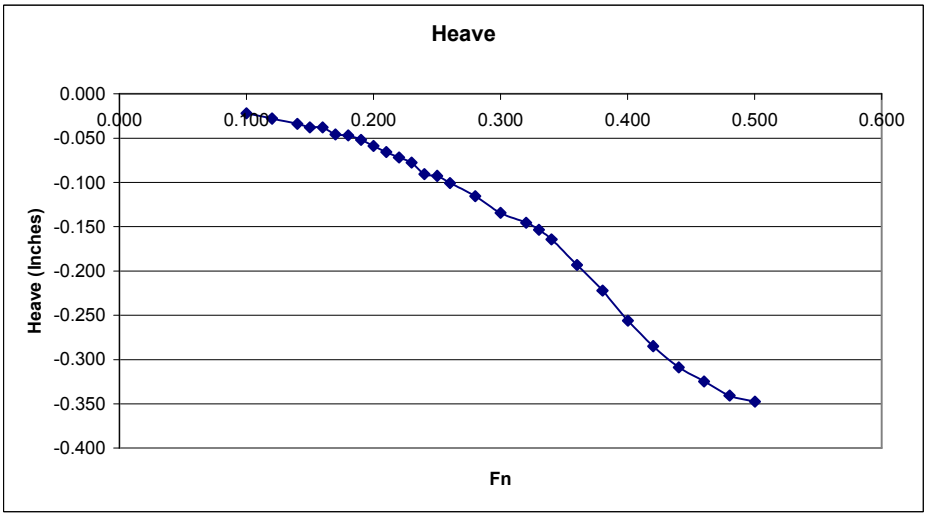
Gain	Bias
-0.6585	-0.0056
-0.6528	-0.0003

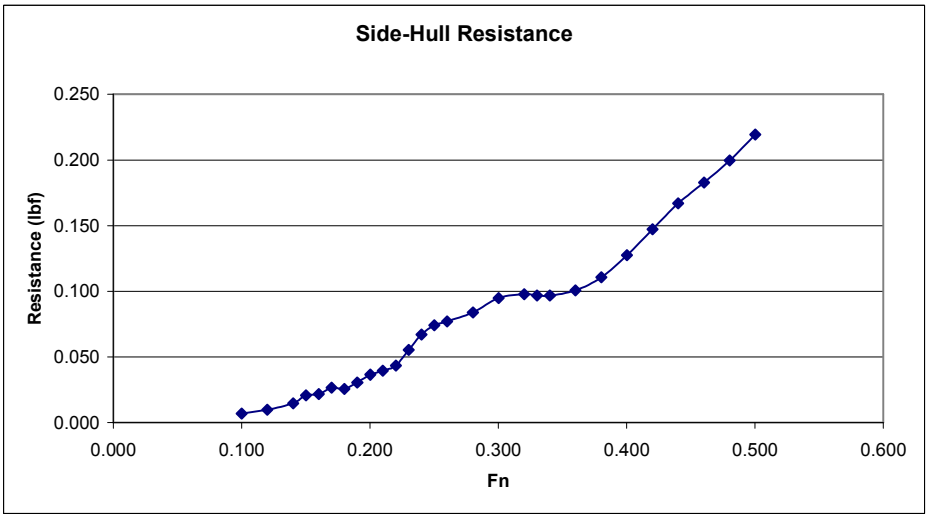
Mean	0.341182
Std Dev	
Uncertainty	

0.4523 lbf
0.3198 lbf

Transverse = 70% Longitudinal = 81.5%







TRANSVERSE = 50%, LONGITUDINAL = 81.5%

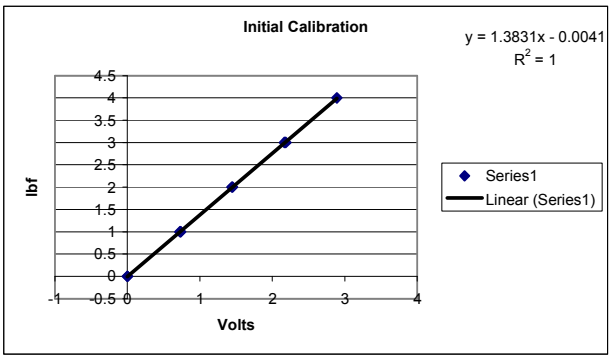
Trimaran, T = 50.0%, L = 81.5% | Correct Tow Point | Water Temp 20 C
22-Apr-07 ++++++ No appendages ++++++ Calibration Angle 5.168

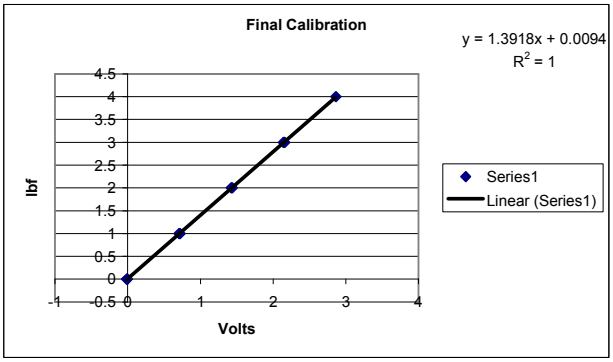
Hama Thickness = 0.028 in

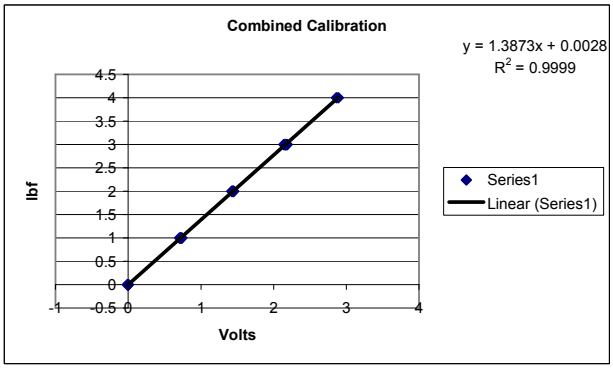
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.002	0
	0.724	1
	1.443	2
	2.167	3
	2.89	4
	2.185	3
	1.449	2
	0.736	1
	0.003	0
Final	-0.011	0
	0.708	1
	1.426	2
	2.141	3
	2.863	4
	2.159	3
	1.437	2
	0.719	1
	-0.007	0







Transverse = 50% Longitudinal = 81.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3831
B1	-0.0041
A2	1.3873
B2	0.0028

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	0.006	0.095	0.089	0.064	0.089	0.089
2	1.802	0.001	0.112	0.111	0.080	0.111	0.111
3	2.102	-0.011	0.143	0.154	0.111	0.154	0.154
4	2.252	-0.022	0.167	0.189	0.137	0.190	0.189
5	2.402	-0.015	0.196	0.211	0.153	0.212	0.211
6	2.552	-0.021	0.215	0.236	0.171	0.237	0.236
7	2.702	-0.019	0.23	0.249	0.180	0.250	0.249
8	2.853	-0.02	0.266	0.286	0.207	0.287	0.286
9	3.003	-0.022	0.297	0.319	0.231	0.320	0.319
10	3.153	-0.02	0.339	0.359	0.260	0.360	0.359
11	3.303	-0.021	0.371	0.392	0.283	0.393	0.392
12	3.453	-0.019	0.427	0.446	0.322	0.447	0.446
13	3.603	-0.021	0.464	0.485	0.351	0.486	0.484
14	3.903	-0.021	0.553	0.574	0.415	0.576	0.573
15	4.204	-0.021	0.65	0.671	0.485	0.673	0.670
16	4.504	0.02	0.762	0.742	0.536	0.744	0.741
17	4.804	-0.02	0.847	0.867	0.627	0.870	0.866
18	5.105	-0.022	0.904	0.926	0.670	0.929	0.925
19	5.405	-0.022	0.984	1.006	0.727	1.009	1.005
20	5.705	-0.021	1.092	1.113	0.805	1.116	1.112
21	6.005	-0.021	1.237	1.258	0.910	1.262	1.257
22	6.306	-0.019	1.405	1.424	1.030	1.428	1.423
23	6.606	-0.013	1.572	1.585	1.146	1.590	1.583
24	6.906	-0.01	1.743	1.753	1.267	1.758	1.751
25	7.206	0.001	1.905	1.904	1.377	1.910	1.902
26	7.507	0.002	2.085	2.083	1.506	2.089	2.081

Model

FULL LOAD

LWL =	7 ft		g=	32.17
BWL Center	0.675 ft		ρ=	1.9334
Draft =	0.235833 ft		ν=	1.05E-05
Displ, # =	35.70			
Displ, LT =	0.0			
WS =	6.36 ft^2			

CONSTANTS: g= 32.17; ρ= 1.9334; ν= 1.05E-05

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0064	9.99E+05	0.0047	0.0017
1.802	0.0056	1.20E+06	0.0045	0.0010
2.102	0.0057	1.40E+06	0.0044	0.0013
2.252	0.0061	1.50E+06	0.0043	0.0018
2.402	0.0059	1.60E+06	0.0042	0.0017
2.552	0.0059	1.70E+06	0.0042	0.0017
2.702	0.0055	1.80E+06	0.0041	0.0014
2.853	0.0057	1.90E+06	0.0041	0.0016
3.003	0.0057	2.00E+06	0.0041	0.0017
3.153	0.0059	2.10E+06	0.0040	0.0019
3.303	0.0058	2.20E+06	0.0040	0.0019
3.453	0.0061	2.30E+06	0.0039	0.0021
3.603	0.0061	2.40E+06	0.0039	0.0022
3.903	0.0061	2.60E+06	0.0038	0.0023
4.204	0.0062	2.80E+06	0.0038	0.0024
4.504	0.0059	3.00E+06	0.0037	0.0022
4.804	0.0061	3.20E+06	0.0037	0.0024
5.105	0.0058	3.40E+06	0.0037	0.0021
5.405	0.0056	3.60E+06	0.0036	0.0020
5.705	0.0056	3.80E+06	0.0036	0.0020
6.005	0.0057	4.00E+06	0.0035	0.0021
6.306	0.0058	4.20E+06	0.0035	0.0023
6.606	0.0059	4.40E+06	0.0035	0.0024
6.906	0.0060	4.60E+06	0.0035	0.0025
7.206	0.0060	4.79E+06	0.0034	0.0025
7.507	0.0060	5.00E+06	0.0034	0.0026

Ship

FULL LOAD

LWL =	880.4 ft		g=	32.17
BWL Center	84.92 ft		ρ=	1.9905
Draft =	29.66 ft		ν=	1.28E-05
Displ, # =	70987840			
Displ, LT =	31691.0			
WS =	100591 ft^2			

CONSTANTS: g= 32.17; ρ= 1.9905; ν= 1.28E-05

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0017	1.16E+09	0.0015	0.0004	103084.7	0.100	23362	103561.0
12.0	20.21	0.0010	1.39E+09	0.0015	0.0004	119258.4	0.120	23362	119568.2
14.0	23.57	0.0013	1.62E+09	0.0014	0.0004	174855.4	0.140	23362	174858.3
15.0	25.26	0.0018	1.74E+09	0.0014	0.0004	228961.4	0.150	23362	228753.9
15.9	26.94	0.0017	1.85E+09	0.0014	0.0004	255610.8	0.160	23362	255153.0
16.9	28.62	0.0017	1.97E+09	0.0014	0.0004	287557.6	0.170	23362	286808.4
17.9	30.30	0.0014	2.09E+09	0.0014	0.0004	294122.3	0.180	23362	293039.3
18.9	32.00	0.0016	2.20E+09	0.0014	0.0004	348839.5	0.190	23362	347376.5
19.9	33.68	0.0017	2.32E+09	0.0014	0.0004	394704.9	0.200	23362	392819.8
20.9	35.36	0.0019	2.43E+09	0.0014	0.0004	454101.6	0.210	23362	451748.8
21.9	37.04	0.0019	2.55E+09	0.0014	0.0004	498392.7	0.220	23362	495525.7
22.9	38.73	0.0021	2.67E+09	0.0014	0.0004	584882.1	0.230	23362	581453.4
23.9	40.41	0.0022	2.78E+09	0.0014	0.0004	639914.9	0.240	23362	635876.3
25.9	43.77	0.0023	3.01E+09	0.0013	0.0004	770233.1	0.260	23362	764826.9
27.9	47.15	0.0024	3.25E+09	0.0013	0.0004	913778.5	0.280	23362	906796.9
29.9	50.51	0.0022	3.48E+09	0.0013	0.0004	1001402.5	0.300	23362	992642.9
31.9	53.88	0.0024	3.71E+09	0.0013	0.0004	1196678.2	0.320	23362	1185927.9
33.9	57.25	0.0021	3.94E+09	0.0013	0.0004	1253891.8	0.340	23362	1240925.7
35.9	60.62	0.0020	4.17E+09	0.0013	0.0004	1351531.6	0.360	23362	1336135.1
37.9	63.98	0.0020	4.40E+09	0.0013	0.0004	1501710.0	0.380	23362	1483657.4
39.9	67.35	0.0021	4.64E+09	0.0013	0.0004	1726974.4	0.400	23362	1706036.1
41.9	70.72	0.0023	4.87E+09	0.0013	0.0004	1992324.0	0.420	23362	1968256.1
43.9	74.09	0.0024	5.10E+09	0.0013	0.0004	2245084.8	0.440	23362	2217660.9
45.9	77.45	0.0025	5.33E+09	0.0013	0.0004	2509601.1	0.460	23362	2478581.6
47.8	80.81	0.0025	5.56E+09	0.0013	0.0004	2736793.8	0.480	23362	2701935.9
49.8	84.19	0.0026	5.79E+09	0.0012	0.0004	3018486.4	0.500	23362	2979530.4

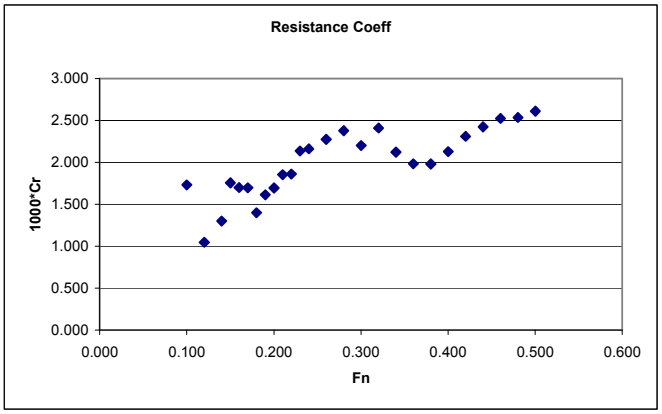
Transverse = 50%

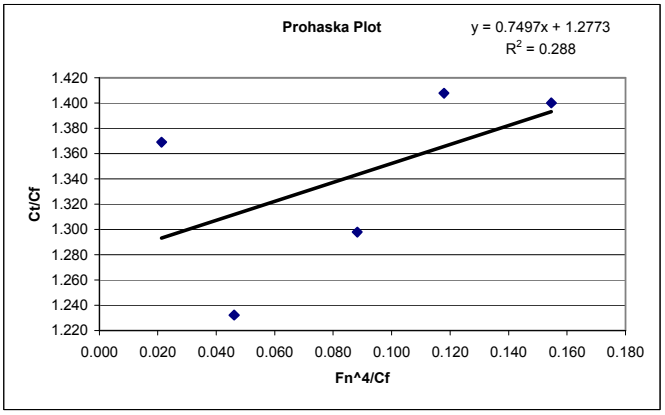
Longitudinal = 81.5%

Transverse = 50% Longitudinal = 81.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.731	0.021	1.369
0.120	1.047	0.046	1.232
0.140	1.300	0.088	1.298
0.150	1.755	0.118	1.408
0.160	1.699	0.155	1.400
0.170	1.697	0.200	1.405
0.180	1.399	0.254	1.338
0.190	1.613	0.319	1.394
0.200	1.693	0.396	1.418
0.210	1.853	0.485	1.461
0.220	1.861	0.590	1.468
0.230	2.136	0.711	1.542
0.240	2.161	0.850	1.553
0.260	2.275	1.189	1.591
0.280	2.377	1.624	1.627
0.300	2.202	2.169	1.588
0.320	2.409	2.842	1.652
0.340	2.121	3.666	1.581
0.360	1.983	4.658	1.549
0.380	1.981	5.841	1.554
0.400	2.127	7.240	1.601
0.420	2.310	8.886	1.658
0.440	2.423	10.795	1.697
0.460	2.523	13.001	1.731
0.480	2.535	15.534	1.741
0.500	2.609	18.436	1.768





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.002	0	2.54E-05	-2.54E-05	8.94E-10
0.724	1	1.007205	-0.0072052	5.2E-05
1.443	2	2.004674	-0.0046739	2.19E-05
2.167	3	3.009079	-0.0090791	8.25E-05
2.89	4	4.012097	-0.012097	0.000146
2.185	3	3.034051	-0.0340505	0.00116
1.449	2	2.012998	-0.0129977	0.000169
0.736	1	1.023853	-0.0238528	0.000569
0.003	0	0.006962	-0.0069619	4.85E-05
-0.011	0	-0.01246	0.0124603	0.000155
0.708	1	0.985008	0.0149916	0.000225
1.426	2	1.98109	0.0189102	0.000357
2.141	3	2.973009	0.0269907	0.000728
2.863	4	3.97464	0.0253601	0.000643
2.159	3	2.997981	0.0020193	4.06E-06
1.437	2	1.99635	0.0036499	1.33E-05
0.719	1	1.000269	-0.0002687	7.46E-08
-0.007	0	-0.00691	0.0069111	4.77E-05

Mean	4.5E-06	
Std Dev		0.0161 lbf
Uncertainty		0.0114 lbf

Transverse = 50%

Longitudinal = 81.5%

Trim

Run	*Speed*	*Zero*	*deg*	*Zero Corrected*	*Combined Calibration*
1	1.501	0.078	0.076	-0.002	-0.002
2	1.802	0.068	0.070	0.002	0.002
3	2.102	0.061	0.064	0.003	0.003
4	2.252	0.032	0.038	0.006	0.006
5	2.402	0.052	0.060	0.008	0.008
6	2.552	0.033	0.040	0.007	0.007
7	2.702	0.028	0.034	0.006	0.006
8	2.853	0.038	0.045	0.007	0.007
9	3.003	0.029	0.038	0.009	0.009
10	3.153	0.037	0.046	0.009	0.009
11	3.303	0.034	0.047	0.013	0.013
12	3.453	0.044	0.067	0.023	0.023
13	3.603	0.032	0.066	0.034	0.034
14	3.903	0.030	0.087	0.057	0.057
15	4.204	0.028	0.115	0.087	0.087
16	4.504	0.028	0.140	0.112	0.112
17	4.804	0.031	0.148	0.117	0.117
18	5.105	0.030	0.106	0.076	0.076
19	5.405	0.030	0.094	0.064	0.064
20	5.705	0.032	0.140	0.108	0.108
21	6.005	0.032	0.253	0.221	0.221
22	6.306	0.025	0.385	0.36	0.361
23	6.606	0.050	0.558	0.508	0.509
24	6.906	0.033	0.679	0.646	0.647
25	7.206	0.069	0.832	0.763	0.764
26	7.507	0.079	0.956	0.877	0.879

Heave

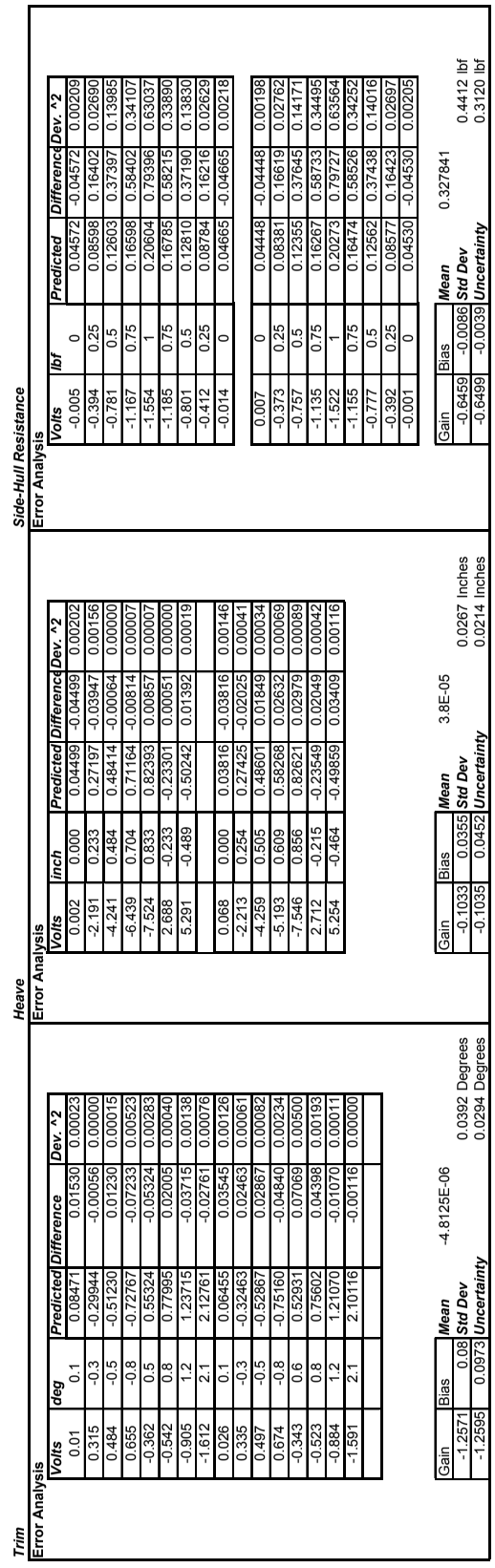
Run	*Speed*	*Zero*	*inch*	*Zero Corrected*	*Combined Calibration*
1	1.501	0.034	0.014	-0.02	-0.020
2	1.802	0.036	0.007	-0.029	-0.029
3	2.102	0.035	0	-0.035	-0.035
4	2.252	0.032	-0.008	-0.04	-0.040
5	2.402	0.032	-0.01	-0.042	-0.042
6	2.552	0.031	-0.017	-0.048	-0.048
7	2.702	0.031	-0.018	-0.049	-0.049
8	2.853	0.026	-0.028	-0.054	-0.054
9	3.003	0.032	-0.031	-0.063	-0.063
10	3.153	0.03	-0.04	-0.07	-0.070
11	3.303	0.032	-0.045	-0.077	-0.077
12	3.453	0.027	-0.056	-0.083	-0.083
13	3.603	0.026	-0.061	-0.087	-0.087
14	3.903	0.031	-0.077	-0.108	-0.108
15	4.204	0.032	-0.095	-0.127	-0.127
16	4.504	0.03	-0.113	-0.143	-0.143
17	4.804	0.028	-0.13	-0.158	-0.158
18	5.105	0.03	-0.142	-0.172	-0.172
19	5.405	0.03	-0.162	-0.192	-0.192
20	5.705	0.03	-0.19	-0.22	-0.220
21	6.005	0.032	-0.227	-0.259	-0.260
22	6.306	0.03	-0.253	-0.283	-0.284
23	6.606	0.034	-0.277	-0.311	-0.312
24	6.906	0.034	-0.294	-0.328	-0.329
25	7.206	0.031	-0.308	-0.339	-0.340
26	7.507	0.036	-0.31	-0.346	-0.347

Calibration Angle 4.733

Side-Hull Resistance

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.01	-0.001	0.009	0.009	0.009
2	1.802	-0.011	0	0.011	0.011	0.011
3	2.102	-0.012	0.004	0.016	0.016	0.016
4	2.252	-0.013	0.008	0.021	0.021	0.021
5	2.402	-0.012	0.013	0.025	0.025	0.025
6	2.552	-0.013	0.014	0.027	0.027	0.027
7	2.702	-0.012	0.015	0.027	0.027	0.027
8	2.853	-0.013	0.017	0.03	0.030	0.030
9	3.003	-0.012	0.023	0.035	0.035	0.035
10	3.153	-0.013	0.025	0.038	0.038	0.038
11	3.303	-0.012	0.031	0.043	0.043	0.043
12	3.453	-0.013	0.04	0.053	0.053	0.053
13	3.603	-0.012	0.052	0.064	0.064	0.064
14	3.903	-0.012	0.065	0.077	0.077	0.077
15	4.204	-0.013	0.072	0.085	0.086	0.085
16	4.504	-0.013	0.081	0.094	0.095	0.094
17	4.804	-0.013	0.089	0.102	0.103	0.102
18	5.105	-0.013	0.091	0.104	0.105	0.104
19	5.405	-0.013	0.09	0.103	0.104	0.103
20	5.705	-0.012	0.092	0.104	0.105	0.104
21	6.005	-0.012	0.101	0.113	0.114	0.113
22	6.306	-0.012	0.114	0.126	0.127	0.126
23	6.606	-0.012	0.132	0.144	0.145	0.144
24	6.906	-0.012	0.152	0.164	0.165	0.164
25	7.206	-0.012	0.175	0.187	0.188	0.188
26	7.507	-0.011	0.198	0.209	0.210	0.210

Transverse = 50% Longitudinal = 81.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
0.01	0.1	0.08471	0.01530	0.00023
0.315	-0.3	-0.29944	-0.00056	0.00000
0.484	-0.5	-0.51230	0.01230	0.00015
0.655	-0.8	-0.72767	-0.07233	0.00523
-0.362	0.5	0.55324	-0.05324	0.00283
-0.542	0.8	0.77995	0.02005	0.00040
-0.905	1.2	1.23715	-0.03715	0.00138
-1.612	2.1	2.12761	-0.02761	0.00076
0.026	0.1	0.06455	0.03545	0.00126
0.335	-0.3	-0.32463	0.02463	0.00061
0.497	-0.5	-0.52867	0.02867	0.00082
0.674	-0.8	-0.75160	-0.04840	0.00234
-0.343	0.6	0.52931	0.07069	0.00500
-0.523	0.8	0.75602	0.04398	0.00193
-0.884	1.2	1.21070	-0.01070	0.00011
-1.591	2.1	2.10116	-0.00116	0.00000

Gain	Bias
-1.2571	0.08
-1.2595	0.0973

Mean	-4.8125E-06
Std Dev	0.0392 Degrees
Uncertainty	0.0294 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
0.002	0.000	0.04499	-0.04499	0.00202
-2.191	0.233	0.27197	-0.03947	0.00156
-4.241	0.484	0.48414	-0.00064	0.00000
-6.439	0.704	0.71164	-0.00814	0.00007
-7.524	0.833	0.82393	0.00857	0.00007
2.688	-0.233	-0.23301	0.00051	0.00000
5.291	-0.489	-0.50242	0.01392	0.00019
0.068	0.000	0.03816	-0.03816	0.00146
-2.213	0.254	0.27425	-0.02025	0.00041
-4.259	0.505	0.48601	0.01849	0.00034
-5.193	0.609	0.58268	0.02632	0.00069
-7.546	0.856	0.82621	0.02979	0.00089
2.712	-0.215	-0.23549	0.02049	0.00042
5.254	-0.464	-0.49859	0.03409	0.00116

Gain	Bias
-0.1033	0.0355
-0.1035	0.0452

Mean	3.8E-05
Std Dev	0.0267 Inches
Uncertainty	0.0214 Inches

Side-Hull Resistance

Error Analysis

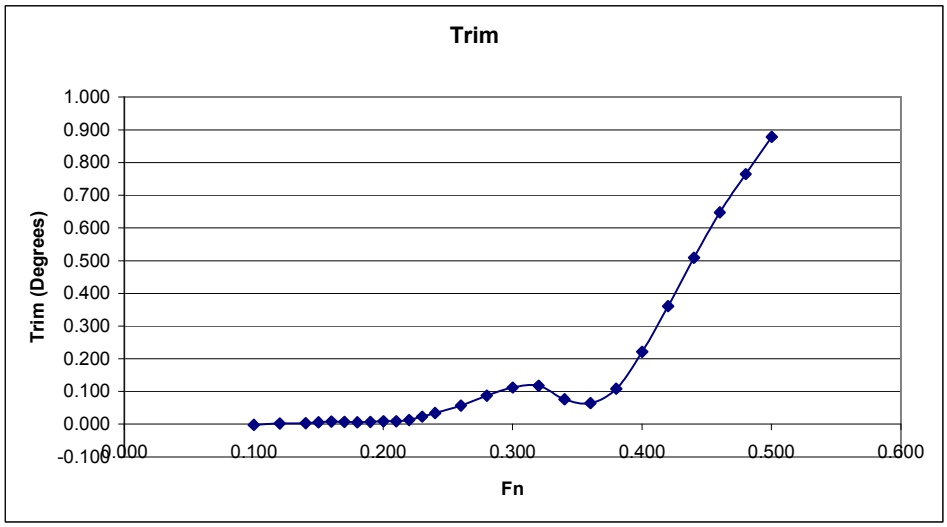
Volts	lbf	Predicted	Difference	Dev. ^2
-0.005	0	0.04572	-0.04572	0.00209
-0.394	0.25	0.08598	0.16402	0.02690
-0.781	0.5	0.12603	0.37397	0.13985
-1.167	0.75	0.16598	0.58402	0.34107
-1.554	1	0.20604	0.79396	0.63037
-1.185	0.75	0.16785	0.58215	0.33890
-0.801	0.5	0.12810	0.37190	0.13830
-0.412	0.25	0.08784	0.16216	0.02629
-0.014	0	0.04665	-0.04665	0.00218

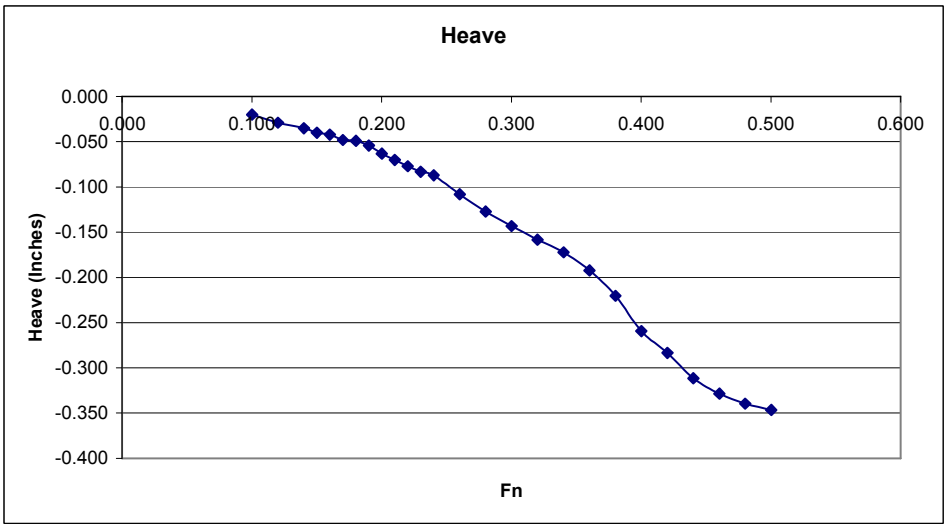
0.007	0	0.04448	-0.04448	0.00198
-0.373	0.25	0.08381	0.16619	0.02762
-0.757	0.5	0.12355	0.37645	0.14171
-1.135	0.75	0.16267	0.58733	0.34495
-1.522	1	0.20273	0.79727	0.63564
-1.155	0.75	0.16474	0.58526	0.34252
-0.777	0.5	0.12562	0.37438	0.14016
-0.392	0.25	0.08577	0.16423	0.02697
-0.001	0	0.04530	-0.04530	0.00205

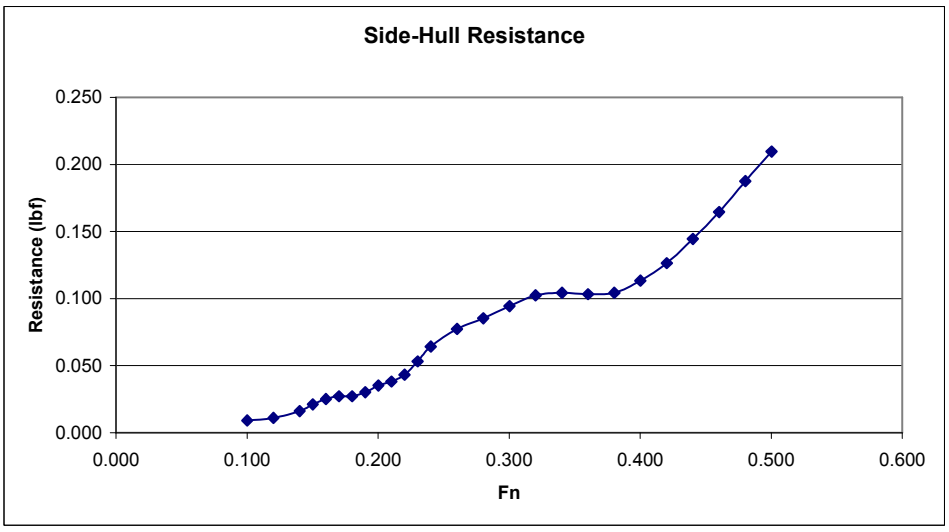
Gain	Bias
-0.6459	-0.0086
-0.6499	-0.0039

Mean	0.327841
Std Dev	0.4412 lbf
Uncertainty	0.3120 lbf

Transverse = 50% Longitudinal = 81.5%







TRANSVERSE = 30.9%, LONGITUDINAL = 81.5%

Trimaran, T = 30.9%, L = 81.5%
23-Apr-07 ++++++
Hama Thickness = 0.028 in

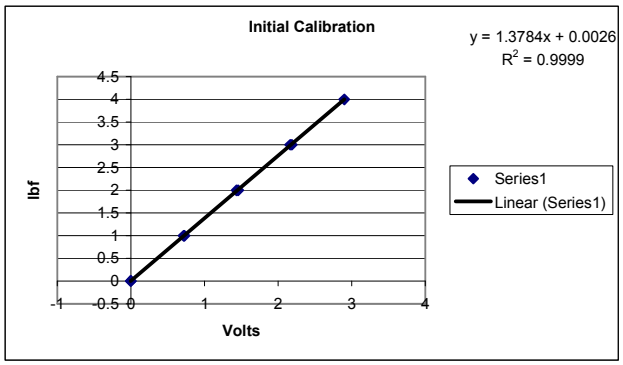
Correct Tow Point
No appendages ++++++

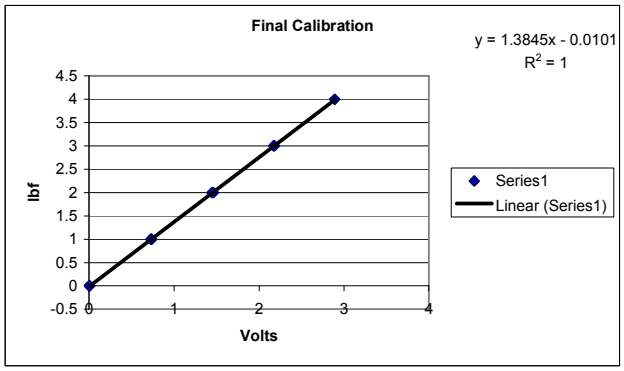
Water Temp 20 C
Calibration Angle 5.168

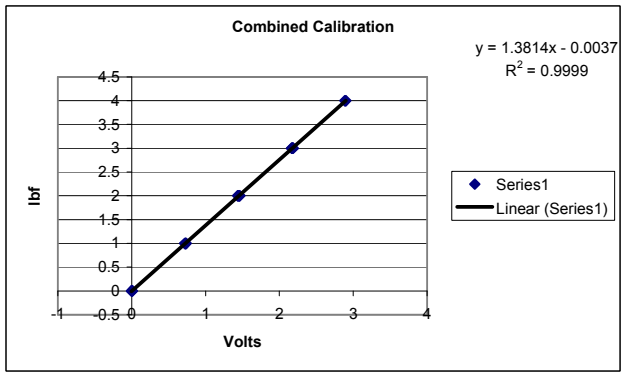
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.003	0
	0.718	1
	1.436	2
	2.166	3
	2.9	4
	2.186	3
	1.458	2
	0.729	1
	0.001	0
Final	0.002	0
	0.726	1
	1.446	2
	2.172	3
	2.89	4
	2.18	3
	1.463	2
	0.736	1
	0.007	0







Transverse = 30.9% Longitudinal = 81.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3784
B1	0.0026
A2	1.3814
B2	-0.0037

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	0.001	0.09	0.089	0.065	0.089	0.089
2	1.802	0.003	0.114	0.111	0.081	0.111	0.111
3	2.102	0.002	0.153	0.151	0.110	0.151	0.151
4	2.252	0.007	0.19	0.183	0.133	0.183	0.183
5	2.402	0.003	0.211	0.208	0.151	0.208	0.208
6	2.702	0.003	0.258	0.255	0.185	0.256	0.255
7	2.853	0.007	0.293	0.286	0.207	0.287	0.285
8	3.003	0.005	0.316	0.311	0.226	0.312	0.310
9	3.153	0.008	0.349	0.341	0.247	0.342	0.340
10	3.303	0.005	0.383	0.378	0.274	0.379	0.377
11	3.453	0.0006	0.43	0.429	0.312	0.430	0.429
12	3.603	0.006	0.476	0.470	0.341	0.471	0.469
13	3.753	0.006	0.528	0.522	0.379	0.523	0.521
14	3.903	0.006	0.578	0.572	0.415	0.573	0.571
15	4.204	0.006	0.679	0.673	0.488	0.674	0.672
16	4.504	0.007	0.807	0.800	0.580	0.802	0.798
17	4.804	0.007	0.895	0.888	0.644	0.890	0.886
18	5.105	0.006	0.974	0.968	0.702	0.970	0.966
19	5.405	0.007	1.057	1.050	0.762	1.052	1.048
20	5.705	0.005	1.161	1.156	0.839	1.159	1.154
21	6.005	0.005	1.298	1.293	0.938	1.296	1.291
22	6.306	0.004	1.452	1.448	1.050	1.451	1.445
23	6.606	0.004	1.606	1.602	1.162	1.605	1.599
24	6.906	0.004	1.767	1.763	1.279	1.767	1.760
25	7.206	0.002	1.919	1.917	1.391	1.921	1.913
26	7.507	0.003	2.077	2.074	1.505	2.079	2.070

Transverse = 30.9%

Longitudinal = 81.5%

Model

FULL LOAD			CONSTANTS	
LWL =	7	ft	g=	32.17
BWL $_{Center}$	0.675	ft	ρ=	1.9334
Draft =	0.235833	ft	ν=	1.05E-05
Displ, # =	35.70			
Displ, LT =	0.0			
WS =	6.36	ft^2		

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0064	9.99E+05	0.0047	0.0017
1.802	0.0056	1.20E+06	0.0045	0.0010
2.102	0.0055	1.40E+06	0.0044	0.0012
2.252	0.0059	1.50E+06	0.0043	0.0016
2.402	0.0059	1.60E+06	0.0042	0.0016
2.702	0.0057	1.80E+06	0.0041	0.0015
2.853	0.0057	1.90E+06	0.0041	0.0016
3.003	0.0056	2.00E+06	0.0041	0.0015
3.153	0.0056	2.10E+06	0.0040	0.0016
3.303	0.0056	2.20E+06	0.0040	0.0016
3.453	0.0058	2.30E+06	0.0039	0.0019
3.603	0.0059	2.40E+06	0.0039	0.0020
3.753	0.0060	2.50E+06	0.0039	0.0021
3.903	0.0061	2.60E+06	0.0038	0.0022
4.204	0.0062	2.80E+06	0.0038	0.0024
4.504	0.0064	3.00E+06	0.0037	0.0027
4.804	0.0062	3.20E+06	0.0037	0.0026
5.105	0.0060	3.40E+06	0.0037	0.0024
5.405	0.0058	3.60E+06	0.0036	0.0022
5.705	0.0058	3.80E+06	0.0036	0.0022
6.005	0.0058	4.00E+06	0.0035	0.0023
6.306	0.0059	4.20E+06	0.0035	0.0024
6.606	0.0060	4.40E+06	0.0035	0.0025
6.906	0.0060	4.60E+06	0.0035	0.0026
7.206	0.0060	4.79E+06	0.0034	0.0026
7.507	0.0060	5.00E+06	0.0034	0.0026

Ship

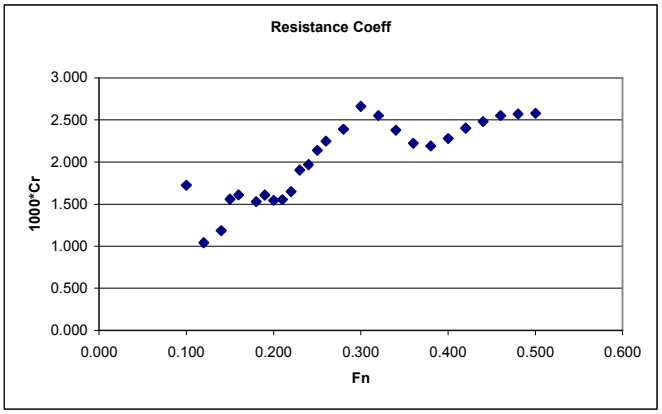
FULL LOAD			CONSTANTS	
LWL =	880.4	ft	g=	32.17
BWL $_{Center}$	84.92	ft	ρ=	1.9905
Draft =	29.66	ft	ν=	1.28E-05
Displ, # =	70987840			
Displ, LT =	31691.0			
WS =	100591	ft^2		

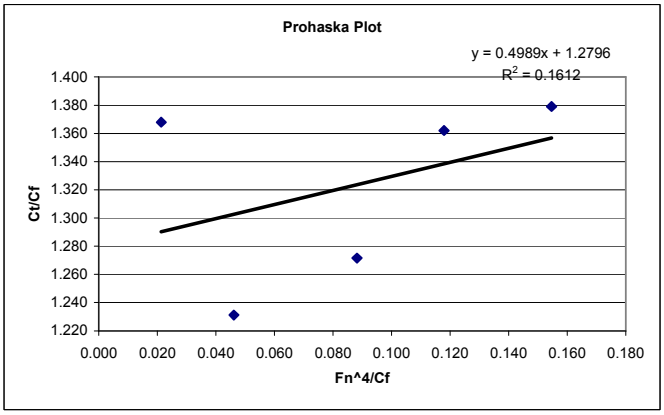
Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0017	1.16E+09	0.0015	0.0004	102928.5	0.100	15190	103502.9
12.0	20.21	0.0010	1.39E+09	0.0015	0.0004	119063.6	0.120	15190	119511.7
14.0	23.57	0.0012	1.62E+09	0.0014	0.0004	168451.7	0.140	15190	168639.2
15.0	25.26	0.0016	1.74E+09	0.0014	0.0004	216362.9	0.150	15190	216365.6
15.9	26.94	0.0016	1.85E+09	0.0014	0.0004	249107.1	0.160	15190	248886.5
17.9	30.30	0.0015	2.09E+09	0.0014	0.0004	305952.1	0.180	15190	305165.1
18.9	32.00	0.0016	2.20E+09	0.0014	0.0004	348337.6	0.190	15190	347202.5
19.9	33.68	0.0015	2.32E+09	0.0014	0.0004	377789.4	0.200	15190	376265.4
20.9	35.36	0.0016	2.43E+09	0.0014	0.0004	416671.2	0.210	15190	414714.2
21.9	37.04	0.0016	2.55E+09	0.0014	0.0004	469082.3	0.220	15190	466647.2
22.9	38.73	0.0019	2.67E+09	0.0014	0.0004	550161.3	0.230	15190	547202.2
23.9	40.41	0.0020	2.78E+09	0.0014	0.0004	608396.8	0.240	15190	604867.0
24.9	42.09	0.0021	2.90E+09	0.0013	0.0004	689184.5	0.250	15190	685036.5
25.9	43.77	0.0022	3.01E+09	0.0013	0.0004	765136.9	0.260	15190	760322.2
27.9	47.15	0.0024	3.25E+09	0.0013	0.0004	916689.9	0.280	15190	910388.8
29.9	50.51	0.0027	3.48E+09	0.0013	0.0004	1118679.5	0.300	15190	1110694.7
31.9	53.88	0.0026	3.71E+09	0.0013	0.0004	1238090.6	0.320	15190	1228215.2
33.9	57.25	0.0024	3.94E+09	0.0013	0.0004	1338134.4	0.340	15190	1326149.5
35.9	60.62	0.0022	4.17E+09	0.0013	0.0004	1439722.7	0.360	15190	1425419.0
37.9	63.98	0.0022	4.40E+09	0.0013	0.0004	1587669.0	0.380	15190	1570826.3
39.9	67.35	0.0023	4.64E+09	0.0013	0.0004	1796323.2	0.400	15190	1776717.6
41.9	70.72	0.0024	4.87E+09	0.0013	0.0004	2038892.2	0.420	15190	2016286.0
43.9	74.09	0.0025	5.10E+09	0.0013	0.0004	2277059.3	0.440	15190	2251231.0
45.9	77.45	0.0026	5.33E+09	0.0013	0.0004	2526969.5	0.460	15190	2497685.1
47.8	80.81	0.0026	5.56E+09	0.0013	0.0004	2760030.6	0.480	15190	2727052.8
49.8	84.19	0.0026	5.79E+09	0.0012	0.0004	2996430.8	0.500	15190	2959506.0

Transverse = 30.9% Longitudinal = 81.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.725	0.021	1.368
0.120	1.042	0.046	1.231
0.140	1.185	0.088	1.272
0.150	1.557	0.118	1.362
0.160	1.609	0.155	1.379
0.180	1.528	0.254	1.369
0.190	1.608	0.319	1.392
0.200	1.544	0.396	1.381
0.210	1.554	0.485	1.387
0.220	1.647	0.590	1.414
0.230	1.904	0.711	1.483
0.240	1.969	0.850	1.503
0.250	2.139	1.009	1.551
0.260	2.248	1.189	1.584
0.280	2.390	1.624	1.630
0.300	2.661	2.169	1.711
0.320	2.551	2.842	1.690
0.340	2.378	3.666	1.651
0.360	2.222	4.658	1.615
0.380	2.190	5.841	1.612
0.400	2.280	7.240	1.644
0.420	2.403	8.886	1.685
0.440	2.481	10.795	1.713
0.460	2.552	13.001	1.740
0.480	2.571	15.534	1.751
0.500	2.578	18.436	1.759





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.003	0	-0.00784	0.0078442	6.14E-05
0.718	1	0.988145	0.0118548	0.00014
1.436	2	1.97999	0.0200096	0.0004
2.166	3	2.988412	0.0115876	0.000134
2.9	4	4.00236	-0.00236	5.61E-06
2.186	3	3.01604	-0.0160404	0.000258
1.458	2	2.010381	-0.0103812	0.000108
0.729	1	1.003341	-0.0033406	1.12E-05
0.001	0	-0.00232	0.0023186	5.33E-06
0.002	0	-0.00094	0.0009372	8.62E-07
0.726	1	0.999196	0.0008036	6.31E-07
1.446	2	1.993804	0.0061956	3.83E-05
2.172	3	2.996701	0.0032992	1.08E-05
2.89	4	3.988546	0.011454	0.000131
2.18	3	3.007752	-0.007752	6.02E-05
1.463	2	2.017288	-0.0172882	0.000299
0.736	1	1.01301	-0.0130104	0.00017
0.007	0	0.00597	-0.0059698	3.57E-05

Mean	8.98889E-06	
Std Dev		0.0105 lbf
Uncertainty		0.0074 lbf

Transverse = 30.9%   Longitudinal = 81.5%

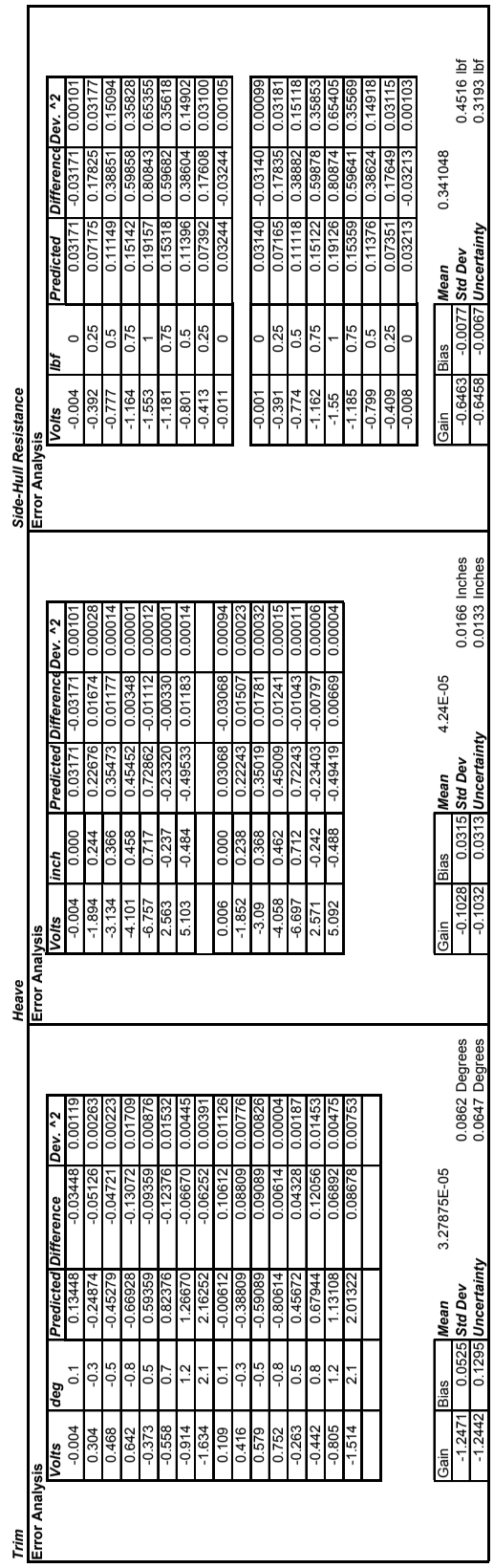
Trim					
Run	*Speed*	*Zero*	*deg*	*Zero Corrected*	*Combined Calibration*
1	1.501	0.036	0.037	0.001	0.001
2	1.802	0.037	0.038	0.001	0.001
3	2.102	0.007	0.012	0.005	0.005
4	2.252	-0.077	-0.074	0.003	0.003
5	2.402	0.002	0.009	0.007	0.007
6	2.702	-0.004	0.003	0.007	0.007
7	2.853	-0.079	-0.071	0.008	0.008
8	3.003	-0.023	-0.018	0.005	0.005
9	3.153	-0.082	-0.072	0.01	0.010
10	3.303	-0.033	-0.017	0.016	0.016
11	3.453	-0.079	-0.053	0.026	0.026
12	3.603	-0.052	-0.018	0.034	0.034
13	3.753	-0.084	-0.036	0.048	0.048
14	3.903	-0.073	-0.015	0.058	0.058
15	4.204	-0.077	0.008	0.085	0.085
16	4.504	-0.073	0.047	0.12	0.120
17	4.804	-0.074	0.067	0.141	0.141
18	5.105	-0.075	0.072	0.147	0.147
19	5.405	-0.073	0.076	0.149	0.149
20	5.705	-0.040	0.153	0.193	0.193
21	6.005	-0.029	0.247	0.276	0.275
22	6.306	-0.028	0.369	0.397	0.396
23	6.606	-0.004	0.518	0.522	0.521
24	6.906	0.005	0.651	0.646	0.644
25	7.206	0.024	0.788	0.764	0.762
26	7.507	0.035	0.901	0.866	0.864

Heave					
Run	*Speed*	*Zero*	*inch*	*Zero Corrected*	*Combined Calibration*
1	1.501	0.034	0.018	-0.016	-0.016
2	1.802	0.034	0.013	-0.021	-0.021
3	2.102	0.03	0.008	-0.022	-0.022
4	2.252	0.033	0.002	-0.031	-0.031
5	2.402	0.032	0.001	-0.031	-0.031
6	2.702	0.033	-0.009	-0.042	-0.042
7	2.853	0.033	-0.014	-0.047	-0.047
8	3.003	0.033	-0.017	-0.05	-0.050
9	3.153	0.033	-0.024	-0.057	-0.057
10	3.303	0.03	-0.033	-0.063	-0.063
11	3.453	0.03	-0.036	-0.066	-0.066
12	3.603	0.032	-0.041	-0.073	-0.073
13	3.753	0.035	-0.05	-0.085	-0.085
14	3.903	0.03	-0.057	-0.087	-0.087
15	4.204	0.033	-0.072	-0.105	-0.105
16	4.504	0.032	-0.092	-0.124	-0.124
17	4.804	0.031	-0.109	-0.14	-0.141
18	5.105	0.031	-0.128	-0.159	-0.160
19	5.405	0.035	-0.153	-0.188	-0.189
20	5.705	0.032	-0.184	-0.216	-0.217
21	6.005	0.032	-0.214	-0.246	-0.247
22	6.306	0.031	-0.242	-0.273	-0.274
23	6.606	0.033	-0.257	-0.29	-0.291
24	6.906	0.033	-0.275	-0.308	-0.309
25	7.206	0.033	-0.289	-0.322	-0.323
26	7.507	0.035	-0.294	-0.329	-0.330

Calibration Angle 4.733

Side-Hull Resistance						
Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.005	0.005	0.01	0.010	0.010
2	1.802	-0.005	0.006	0.011	0.011	0.011
3	2.102	-0.005	0.01	0.015	0.015	0.015
4	2.252	-0.006	0.015	0.021	0.021	0.021
5	2.402	-0.005	0.019	0.024	0.024	0.024
6	2.702	-0.005	0.025	0.03	0.030	0.030
7	2.853	-0.006	0.025	0.031	0.031	0.031
8	3.003	-0.006	0.027	0.033	0.033	0.033
9	3.153	-0.006	0.028	0.034	0.034	0.034
10	3.303	-0.006	0.034	0.04	0.040	0.040
11	3.453	-0.006	0.043	0.049	0.049	0.049
12	3.603	-0.006	0.055	0.061	0.061	0.061
13	3.753	-0.006	0.065	0.071	0.071	0.071
14	3.903	-0.006	0.072	0.078	0.078	0.078
15	4.204	-0.006	0.083	0.089	0.089	0.089
16	4.504	-0.006	0.095	0.101	0.101	0.101
17	4.804	-0.006	0.105	0.111	0.111	0.111
18	5.105	-0.006	0.107	0.113	0.113	0.113
19	5.405	-0.006	0.104	0.11	0.110	0.110
20	5.705	-0.006	0.11	0.116	0.116	0.116
21	6.005	-0.006	0.117	0.123	0.123	0.122
22	6.306	-0.006	0.127	0.133	0.133	0.132
23	6.606	-0.005	0.141	0.146	0.146	0.145
24	6.906	-0.005	0.155	0.16	0.160	0.159
25	7.206	-0.005	0.171	0.176	0.176	0.175
26	7.507	-0.004	0.189	0.193	0.193	0.192

Transverse = 30.9% Longitudinal = 81.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.004	0.1	0.13448	-0.03448	0.00119
0.304	-0.3	-0.24874	-0.05126	0.00263
0.468	-0.5	-0.45279	-0.04721	0.00223
0.642	-0.8	-0.66928	-0.13072	0.01709
-0.373	0.5	0.59359	-0.09359	0.00876
-0.558	0.7	0.82376	-0.12376	0.01532
-0.914	1.2	1.26670	-0.06670	0.00445
-1.634	2.1	2.16252	-0.06252	0.00391
0.109	0.1	-0.00612	0.10612	0.01126
0.416	-0.3	-0.38809	0.08809	0.00776
0.579	-0.5	-0.59089	0.09089	0.00826
0.752	-0.8	-0.80614	0.00614	0.00004
-0.263	0.5	0.45672	0.04328	0.00187
-0.442	0.8	0.67944	0.12056	0.01453
-0.805	1.2	1.13108	0.06892	0.00475
-1.514	2.1	2.01322	0.08678	0.00753

Gain	Bias
-1.2471	0.0525
-1.2442	0.1295

Mean	3.27875E-05
Std Dev	0.0862 Degrees
Uncertainty	0.0647 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
-0.004	0.000	0.03171	-0.03171	0.00101
-1.894	0.244	0.22676	0.01674	0.00028
-3.134	0.366	0.35473	0.01177	0.00014
-4.101	0.458	0.45452	0.00348	0.00001
-6.757	0.717	0.72862	-0.01112	0.00012
2.563	-0.237	-0.23320	-0.00330	0.00001
5.103	-0.484	-0.49533	0.01183	0.00014
0.006	0.000	0.03068	-0.03068	0.00094
-1.852	0.238	0.22243	0.01507	0.00023
-3.09	0.368	0.35019	0.01781	0.00032
-4.058	0.462	0.45009	0.01241	0.00015
-6.697	0.712	0.72243	-0.01043	0.00011
2.571	-0.242	-0.23403	-0.00797	0.00006
5.092	-0.488	-0.49419	0.00669	0.00004

Gain	Bias
-0.1028	0.0315
-0.1032	0.0313

Mean	4.24E-05
Std Dev	0.0166 Inches
Uncertainty	0.0133 Inches

Side-Hull Resistance

Error Analysis

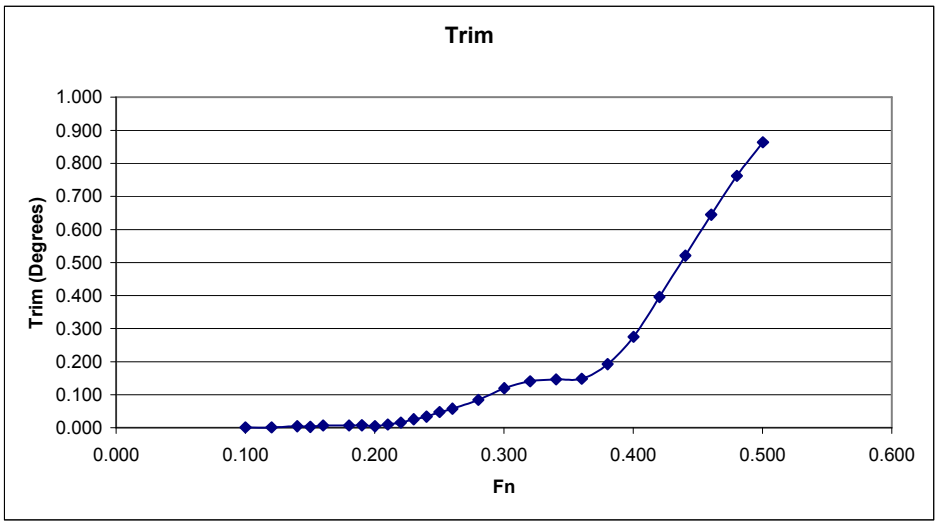
Volts	lbf	Predicted	Difference	Dev. ^2
-0.004	0	0.03171	-0.03171	0.00101
-0.392	0.25	0.07175	0.17825	0.03177
-0.777	0.5	0.11149	0.38851	0.15094
-1.164	0.75	0.15142	0.59858	0.35828
-1.553	1	0.19157	0.80843	0.65355
-1.181	0.75	0.15318	0.59682	0.35618
-0.801	0.5	0.11396	0.38604	0.14902
-0.413	0.25	0.07392	0.17608	0.03100
-0.011	0	0.03244	-0.03244	0.00105

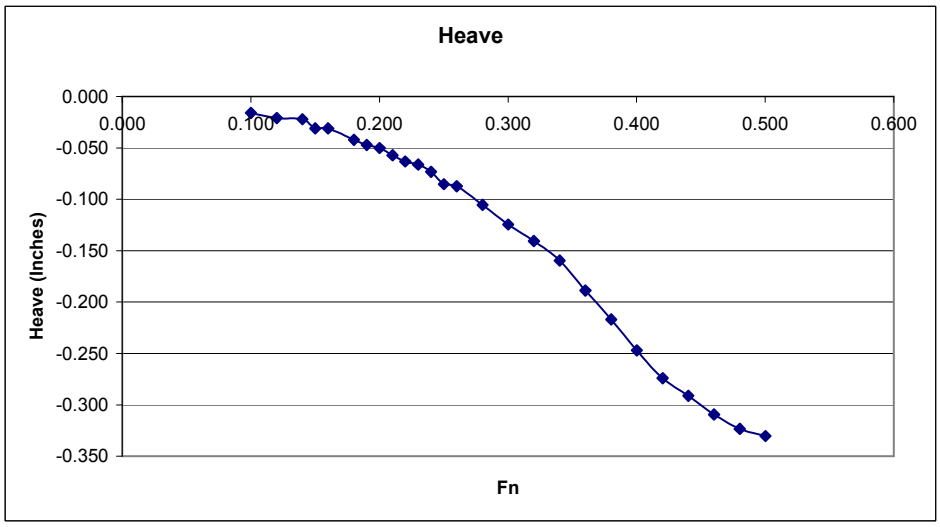
-0.001	0	0.03140	-0.03140	0.00099
-0.391	0.25	0.07165	0.17835	0.03181
-0.774	0.5	0.11118	0.38882	0.15118
-1.162	0.75	0.15122	0.59878	0.35853
-1.55	1	0.19126	0.80874	0.65405
-1.185	0.75	0.15359	0.59641	0.35569
-0.799	0.5	0.11376	0.38624	0.14918
-0.409	0.25	0.07351	0.17649	0.03115
-0.008	0	0.03213	-0.03213	0.00103

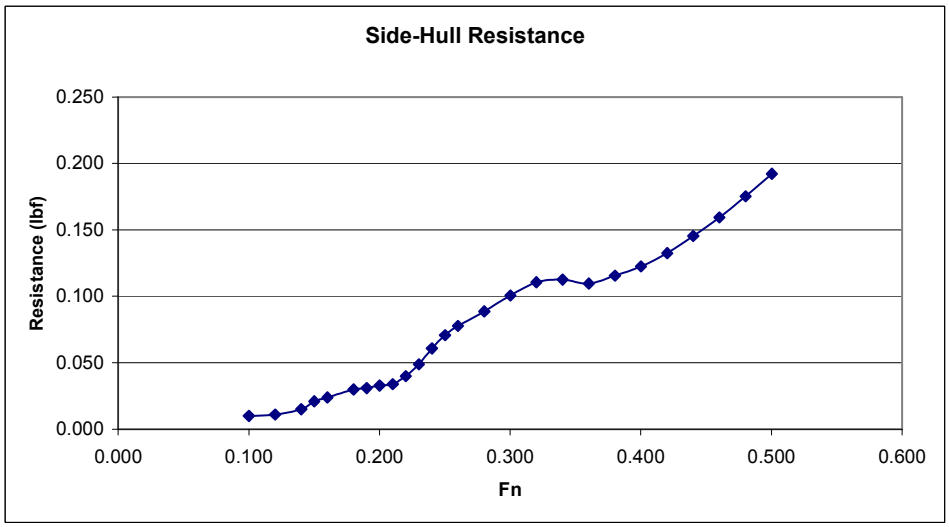
Gain	Bias
-0.6463	-0.0077
-0.6458	-0.0067

Mean	0.341048
Std Dev	0.4516 lbf
Uncertainty	0.3193 lbf

Transverse = 30.9% Longitudinal = 81.5%







TRANSVERSE = 30.9%, LONGITUDINAL = 71.5%

Trimaran, T = 30.9%, L = 71.5%
24-Apr-07 ++++++
Hama Thickness = 0.028 in

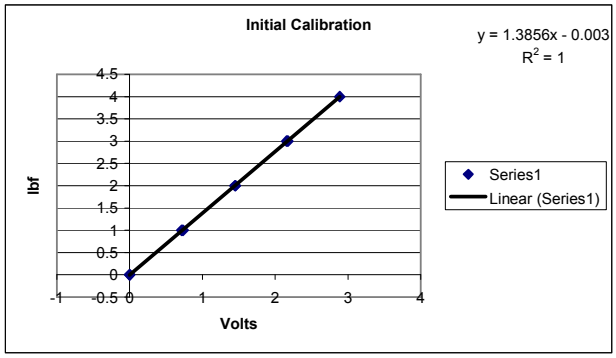
Correct Tow Point
No appendages ++++++

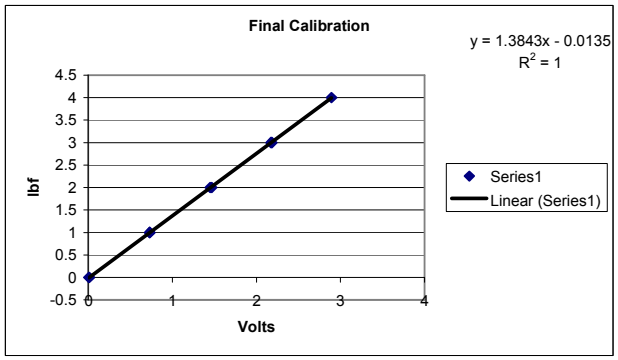
Water Temp 20 C
Calibration Angle 5.168

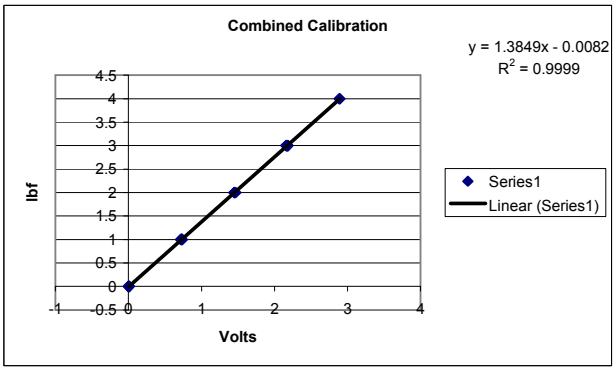
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.002	0
	0.715	1
	1.447	2
	2.158	3
	2.887	4
	2.173	3
	1.453	2
	0.734	1
	0.002	0
Final	0.007	0
	0.728	1
	1.449	2
	2.173	3
	2.894	4
	2.184	3
	1.468	2
	0.732	1
	0.011	0







Transverse = 30.9% Longitudinal = 71.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3856
B1	-0.003
A2	1.3849
B2	-0.0082

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.007	0.078	0.085	0.061	0.085	0.085
2	1.651	0.006	0.104	0.098	0.071	0.098	0.098
3	1.802	0	0.107	0.107	0.077	0.107	0.107
4	1.952	0.008	0.138	0.130	0.094	0.130	0.129
5	2.102	0.004	0.155	0.151	0.109	0.151	0.150
6	2.252	0.003	0.18	0.177	0.128	0.177	0.176
7	2.402	0.004	0.205	0.201	0.145	0.201	0.200
8	2.552	0.008	0.239	0.231	0.167	0.231	0.230
9	2.702	0.002	0.257	0.255	0.184	0.255	0.254
10	2.853	0.004	0.299	0.295	0.213	0.295	0.294
11	3.003	0.003	0.322	0.319	0.230	0.319	0.318
12	3.153	0.005	0.359	0.354	0.255	0.354	0.352
13	3.303	0.005	0.404	0.399	0.288	0.399	0.397
14	3.453	0.009	0.459	0.450	0.325	0.450	0.448
15	3.603	0.004	0.501	0.497	0.359	0.497	0.495
16	3.753	0.004	0.537	0.533	0.385	0.533	0.531
17	3.903	0.005	0.56	0.555	0.401	0.555	0.552
18	4.054	0.008	0.599	0.591	0.427	0.591	0.588
19	4.204	0.009	0.641	0.632	0.456	0.632	0.629
20	4.504	0.008	0.729	0.721	0.520	0.721	0.718
21	4.804	0.009	0.813	0.804	0.580	0.804	0.800
22	5.105	0.005	0.921	0.916	0.661	0.916	0.912
23	5.405	0.003	1.042	1.039	0.750	1.038	1.034
24	5.705	0.006	1.193	1.187	0.857	1.186	1.182
25	6.005	0.003	1.363	1.360	0.982	1.359	1.354
26	6.306	0.004	1.541	1.537	1.109	1.536	1.530
27	6.606	0.005	1.714	1.709	1.233	1.708	1.701
28	6.906	0.006	1.888	1.882	1.358	1.881	1.873
29	7.206	-0.002	2.063	2.065	1.490	2.064	2.056
30	7.507	-0.002	2.222	2.224	1.605	2.223	2.214

Model

FULL LOAD

LWL =	7 ft	g=	32.17
BWL $_{Center}$	0.675 ft	ρ=	1.9334
Draft =	0.235833 ft	ν=	1.05E-05
Displ, # =	35.70		
Displ, LT =	0.0		
WS =	6.36 ft^2		

CONSTANTS (g, ρ, ν)

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0061	9.99E+05	0.0047	0.0014
1.651	0.0058	1.10E+06	0.0046	0.0012
1.802	0.0053	1.20E+06	0.0045	0.0008
1.952	0.0055	1.30E+06	0.0044	0.0011
2.102	0.0055	1.40E+06	0.0044	0.0012
2.252	0.0057	1.50E+06	0.0043	0.0014
2.402	0.0056	1.60E+06	0.0042	0.0014
2.552	0.0057	1.70E+06	0.0042	0.0016
2.702	0.0057	1.80E+06	0.0041	0.0015
2.853	0.0059	1.90E+06	0.0041	0.0018
3.003	0.0057	2.00E+06	0.0041	0.0017
3.153	0.0058	2.10E+06	0.0040	0.0018
3.303	0.0059	2.20E+06	0.0040	0.0019
3.453	0.0061	2.30E+06	0.0039	0.0022
3.603	0.0062	2.40E+06	0.0039	0.0023
3.753	0.0061	2.50E+06	0.0039	0.0022
3.903	0.0059	2.60E+06	0.0038	0.0021
4.054	0.0058	2.70E+06	0.0038	0.0020
4.204	0.0058	2.80E+06	0.0038	0.0020
4.504	0.0058	3.00E+06	0.0037	0.0020
4.804	0.0056	3.20E+06	0.0037	0.0019
5.105	0.0057	3.40E+06	0.0037	0.0020
5.405	0.0058	3.60E+06	0.0036	0.0021
5.705	0.0059	3.80E+06	0.0036	0.0023
6.005	0.0061	4.00E+06	0.0035	0.0026
6.306	0.0063	4.20E+06	0.0035	0.0027
6.606	0.0063	4.40E+06	0.0035	0.0029
6.906	0.0064	4.60E+06	0.0035	0.0029
7.206	0.0064	4.79E+06	0.0034	0.0030
7.507	0.0064	5.00E+06	0.0034	0.0030

Ship

FULL LOAD

LWL =	880.4 ft	g=	32.17
BWL $_{Center}$	84.92 ft	ρ=	1.9905
Draft =	29.66 ft	ν=	1.28E-05
Displ, # =	70987840		
Displ, LT =	31691.0		
WS =	100591 ft^2		

CONSTANTS (g, ρ, ν)

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0014	1.16E+09	0.0015	0.0004	94285.6	0.100	15846	92843.1
11.0	18.52	0.0012	1.27E+09	0.0015	0.0004	106887.2	0.110	15846	105002.8
12.0	20.21	0.0008	1.39E+09	0.0015	0.0004	110300.4	0.120	15846	107905.8
13.0	21.89	0.0011	1.51E+09	0.0015	0.0004	141446.7	0.130	15846	138478.8
14.0	23.57	0.0012	1.62E+09	0.0014	0.0004	167625.7	0.140	15846	164016.7
15.0	25.26	0.0014	1.74E+09	0.0014	0.0004	203127.8	0.150	15846	198808.8
15.9	26.94	0.0014	1.85E+09	0.0014	0.0004	233696.2	0.160	15846	228596.9
16.9	28.62	0.0016	1.97E+09	0.0014	0.0004	275657.4	0.170	15846	269706.6
17.9	30.30	0.0015	2.09E+09	0.0014	0.0004	304557.1	0.180	15846	297682.5
18.9	32.00	0.0018	2.20E+09	0.0014	0.0004	365124.0	0.190	15846	357245.5
19.9	33.68	0.0017	2.32E+09	0.0014	0.0004	392400.0	0.200	15846	383449.9
20.9	35.36	0.0018	2.43E+09	0.0014	0.0004	441312.7	0.210	15846	431216.1
21.9	37.04	0.0019	2.55E+09	0.0014	0.0004	509833.3	0.220	15846	498514.4
22.9	38.73	0.0022	2.67E+09	0.0014	0.0004	589815.5	0.230	15846	577197.8
23.9	40.41	0.0023	2.78E+09	0.0014	0.0004	660878.5	0.240	15846	646884.8
24.9	42.09	0.0022	2.90E+09	0.0013	0.0004	708757.8	0.250	15846	693310.3
25.9	43.77	0.0021	3.01E+09	0.0013	0.0004	727344.7	0.260	15846	710364.8
26.9	45.47	0.0020	3.13E+09	0.0013	0.0004	773556.4	0.270	15846	754953.9
27.9	47.15	0.0020	3.25E+09	0.0013	0.0004	829409.3	0.280	15846	809115.2
29.9	50.51	0.0020	3.48E+09	0.0013	0.0004	953222.3	0.300	15846	929303.4
31.9	53.88	0.0019	3.71E+09	0.0013	0.0004	1061956.9	0.320	15846	1034088.0
33.9	57.25	0.0020	3.94E+09	0.0013	0.0004	1226811.1	0.340	15846	1194648.1
35.9	60.62	0.0021	4.17E+09	0.0013	0.0004	1411549.6	0.360	15846	1374773.6
37.9	63.98	0.0023	4.40E+09	0.0013	0.0004	1644553.8	0.380	15846	1602828.5
39.9	67.35	0.0026	4.64E+09	0.0013	0.0004	1925862.4	0.400	15846	1878848.3
41.9	70.72	0.0027	4.87E+09	0.0013	0.0004	2212441.5	0.420	15846	2159776.9
43.9	74.09	0.0029	5.10E+09	0.0013	0.0004	2486468.0	0.440	15846	2427825.9
45.9	77.45	0.0029	5.33E+09	0.0013	0.0004	2759965.4	0.460	15846	2694997.9
47.8	80.81	0.0030	5.56E+09	0.0013	0.0004	3051315.0	0.480	15846	2979671.7
49.8	84.19	0.0030	5.79E+09	0.0012	0.0004	3290934.3	0.500	15846	3212238.2

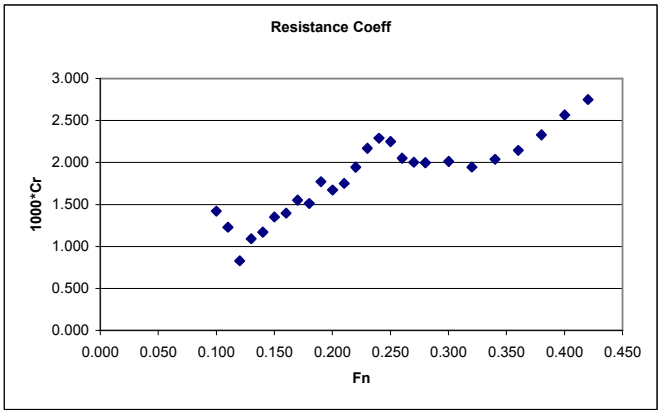
Transverse = 30.9%

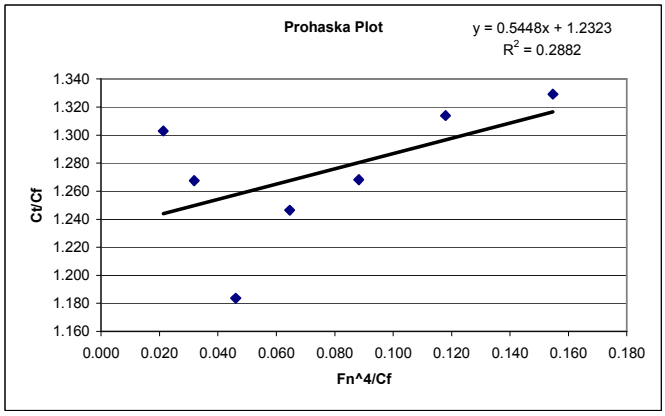
Longitudinal = 71.5%

Transverse = 30.9% Longitudinal = 71.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.420	0.021	1.303
0.110	1.229	0.032	1.267
0.120	0.828	0.046	1.184
0.130	1.093	0.065	1.246
0.140	1.170	0.088	1.268
0.150	1.350	0.118	1.314
0.160	1.397	0.155	1.329
0.170	1.552	0.200	1.370
0.180	1.513	0.254	1.365
0.190	1.771	0.319	1.432
0.200	1.673	0.396	1.413
0.210	1.751	0.485	1.436
0.220	1.944	0.590	1.489
0.230	2.168	0.711	1.550
0.240	2.290	0.850	1.586
0.250	2.249	1.009	1.580
0.260	2.051	1.189	1.533
0.270	2.003	1.394	1.524
0.280	1.998	1.624	1.527
0.300	2.013	2.169	1.538
0.320	1.945	2.842	1.526
0.340	2.039	3.666	1.558
0.360	2.146	4.658	1.594
0.380	2.329	5.841	1.651
0.400	2.565	7.240	1.724
0.420	2.749	8.886	1.783
0.440	2.863	10.795	1.823
0.460	2.940	13.001	1.852
0.480	3.017	15.534	1.881
0.500	2.993	18.436	1.881





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.002	0	-0.01097	0.0109698	0.00012
0.715	1	0.982004	0.0179965	0.000324
1.447	2	1.99575	0.0042497	1.81E-05
2.158	3	2.980414	0.0195858	0.000384
2.887	4	3.990006	0.0099937	1E-04
2.173	3	3.001188	-0.0011877	1.4E-06
1.453	2	2.00406	-0.0040597	1.64E-05
0.734	1	1.008317	-0.0083166	6.91E-05
0.002	0	-0.00543	0.0054302	2.95E-05
0.007	0	0.001494	-0.0014943	2.22E-06
0.728	1	1.000007	-7.2E-06	6.5E-12
1.449	2	1.99852	0.0014799	2.2E-06
2.173	3	3.001188	-0.0011877	1.4E-06
2.894	4	3.999701	0.0002994	9.24E-08
2.184	3	3.016422	-0.0164216	0.00027
1.468	2	2.024833	-0.0248332	0.000616
0.732	1	1.005547	-0.0055468	3.07E-05
0.011	0	0.007034	-0.0070339	4.94E-05

Mean	-4.65E-06	
Std Dev		0.0109 lbf
Uncertainty		0.0077 lbf

Transverse = 30.9%

Longitudinal = 71.5%

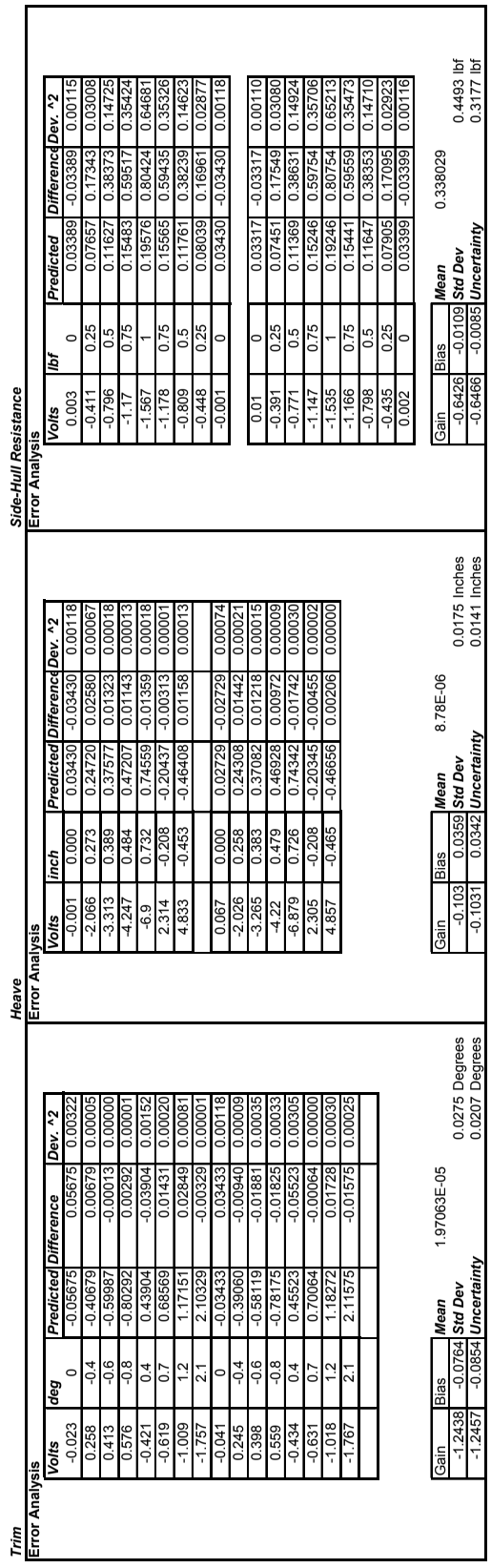
Trim Run	*Speed*	*Zero*	*deg*	*Zero Corrected*	*Combined Calibration*
1	1.501	-0.039	-0.042	-0.003	-0.003
2	1.651	-0.036	-0.037	-0.001	-0.001
3	1.802	-0.038	-0.042	-0.004	-0.004
4	1.952	-0.034	-0.036	-0.002	-0.002
5	2.102	-0.042	-0.043	-0.001	-0.001
6	2.252	-0.030	-0.033	-0.003	-0.003
7	2.402	-0.040	-0.041	-0.001	-0.001
8	2.552	-0.034	-0.032	0.002	0.002
9	2.702	-0.039	-0.041	-0.002	-0.002
10	2.853	-0.029	-0.036	-0.007	-0.007
11	3.003	-0.040	-0.047	-0.007	-0.007
12	3.153	-0.030	-0.036	-0.006	-0.006
13	3.303	-0.038	-0.039	-0.001	-0.001
14	3.453	-0.035	-0.037	-0.002	-0.002
15	3.603	-0.044	-0.044	0	0.000
16	3.753	-0.031	-0.040	-0.009	-0.009
17	3.903	-0.035	-0.048	-0.013	-0.013
18	4.054	-0.034	-0.047	-0.013	-0.013
19	4.204	-0.035	-0.043	-0.008	-0.008
20	4.504	-0.037	-0.019	0.018	0.018
21	4.804	-0.034	0.008	0.042	0.042
22	5.105	-0.035	0.048	0.083	0.083
23	5.405	-0.033	0.119	0.152	0.152
24	5.705	-0.038	0.233	0.271	0.271
25	6.005	-0.043	0.358	0.401	0.402
26	6.306	-0.036	0.519	0.555	0.556
27	6.606	-0.040	0.673	0.713	0.714
28	6.906	-0.042	0.811	0.853	0.854
29	7.206	-0.042	0.935	0.977	0.978
30	7.507	-0.043	1.039	1.082	1.084

Heave Run	*Speed*	*Zero*	*inch*	*Zero Corrected*	*Combined Calibration*
1	1.501	0.038	0.019	-0.019	-0.019
2	1.651	0.03	0.015	-0.015	-0.015
3	1.802	0.038	0.014	-0.024	-0.024
4	1.952	0.034	0.012	-0.022	-0.022
5	2.102	0.034	0.009	-0.025	-0.025
6	2.252	0.034	0.005	-0.029	-0.029
7	2.402	0.037	0.002	-0.035	-0.035
8	2.552	0.038	-0.003	-0.041	-0.041
9	2.702	0.035	-0.007	-0.042	-0.042
10	2.853	0.033	-0.011	-0.044	-0.044
11	3.003	0.037	-0.017	-0.054	-0.054
12	3.153	0.035	-0.022	-0.057	-0.057
13	3.303	0.033	-0.028	-0.061	-0.061
14	3.453	0.035	-0.034	-0.069	-0.069
15	3.603	0.035	-0.039	-0.074	-0.074
16	3.753	0.034	-0.046	-0.08	-0.080
17	3.903	0.036	-0.054	-0.09	-0.090
18	4.054	0.034	-0.061	-0.095	-0.095
19	4.204	0.036	-0.072	-0.108	-0.108
20	4.504	0.036	-0.089	-0.125	-0.125
21	4.804	0.037	-0.11	-0.147	-0.147
22	5.105	0.034	-0.14	-0.174	-0.174
23	5.405	0.036	-0.178	-0.214	-0.214
24	5.705	0.035	-0.225	-0.26	-0.260
25	6.005	0.033	-0.262	-0.295	-0.295
26	6.306	0.035	-0.289	-0.324	-0.324
27	6.606	0.036	-0.306	-0.342	-0.342
28	6.906	0.037	-0.317	-0.354	-0.354
29	7.206	0.035	-0.323	-0.358	-0.358
30	7.507	0.037	-0.329	-0.366	-0.366

Calibration Angle 3.463

Side-Hull Resistance Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.019	-0.01	0.009	0.009	0.009
2	1.651	-0.017	-0.01	0.007	0.007	0.007
3	1.802	-0.018	-0.009	0.009	0.009	0.009
4	1.952	-0.018	-0.007	0.011	0.011	0.011
5	2.102	-0.017	-0.003	0.014	0.014	0.014
6	2.252	-0.018	-0.001	0.017	0.017	0.017
7	2.402	-0.018	0.005	0.023	0.023	0.023
8	2.552	-0.017	0.009	0.026	0.026	0.026
9	2.702	-0.018	0.012	0.03	0.030	0.030
10	2.853	-0.018	0.011	0.029	0.029	0.029
11	3.003	-0.018	0.011	0.029	0.029	0.029
12	3.153	-0.017	0.016	0.033	0.033	0.033
13	3.303	-0.018	0.024	0.042	0.042	0.042
14	3.453	-0.018	0.032	0.05	0.050	0.050
15	3.603	-0.019	0.037	0.056	0.056	0.056
16	3.753	-0.018	0.04	0.058	0.058	0.058
17	3.903	-0.018	0.042	0.06	0.060	0.060
18	4.054	-0.017	0.046	0.063	0.063	0.063
19	4.204	-0.018	0.05	0.068	0.068	0.068
20	4.504	-0.018	0.06	0.078	0.078	0.078
21	4.804	-0.018	0.065	0.083	0.084	0.083
22	5.105	-0.019	0.068	0.087	0.088	0.087
23	5.405	-0.019	0.075	0.094	0.095	0.094
24	5.705	-0.018	0.084	0.102	0.103	0.102
25	6.005	-0.019	0.099	0.118	0.119	0.119
26	6.306	-0.019	0.116	0.135	0.136	0.136
27	6.606	-0.018	0.135	0.153	0.154	0.154
28	6.906	-0.017	0.158	0.175	0.176	0.176
29	7.206	-0.018	0.179	0.197	0.198	0.198
30	7.507	-0.017	0.203	0.22	0.221	0.221

Transverse = 30.9% Longitudinal = 71.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.023	0	-0.05675	0.05675	0.00322
0.258	-0.4	-0.40679	0.00679	0.00005
0.413	-0.6	-0.59987	-0.00013	0.00000
0.576	-0.8	-0.80292	0.00292	0.00001
-0.421	0.4	0.43904	-0.03904	0.00152
-0.619	0.7	0.68569	0.01431	0.00020
-1.009	1.2	1.17151	0.02849	0.00081
-1.757	2.1	2.10329	-0.00329	0.00001
-0.041	0	-0.03433	0.03433	0.00118
0.245	-0.4	-0.39060	-0.00940	0.00009
0.398	-0.6	-0.58119	-0.01881	0.00035
0.559	-0.8	-0.78175	-0.01825	0.00033
-0.434	0.4	0.45523	-0.05523	0.00305
-0.631	0.7	0.70064	-0.00064	0.00000
-1.018	1.2	1.18272	0.01728	0.00030
-1.767	2.1	2.11575	-0.01575	0.00025

Gain	Bias
-1.2438	-0.0764
-1.2457	-0.0854

Mean	1.970636-05
Std Dev	
Uncertainty	

0.0275 Degrees
0.0207 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
-0.001	0.000	0.03430	-0.03430	0.00118
-2.066	0.273	0.24720	0.02580	0.00067
-3.313	0.389	0.37577	0.01323	0.00018
-4.247	0.484	0.47207	0.01143	0.00013
-6.9	0.732	0.74559	-0.01359	0.00018
2.314	-0.208	-0.20437	-0.00313	0.00001
4.833	-0.453	-0.46408	0.01158	0.00013
0.067	0.000	0.02729	-0.02729	0.00074
-2.026	0.258	0.24308	0.01442	0.00021
-3.265	0.383	0.37082	0.01218	0.00015
-4.22	0.479	0.46928	0.00972	0.00009
-6.879	0.726	0.74342	-0.01742	0.00030
2.305	-0.208	-0.20345	-0.00455	0.00002
4.857	-0.465	-0.46656	0.00206	0.00000

Gain	Bias
-0.103	0.0359
-0.1031	0.0342

Mean	8.78E-06
Std Dev	
Uncertainty	

0.0175 Inches
0.0141 Inches

Side-Hull Resistance

Error Analysis

Volts	lbf	Predicted	Difference	Dev. ^2
0.003	0	0.03389	-0.03389	0.00115
-0.411	0.25	0.07657	0.17343	0.03008
-0.796	0.5	0.11627	0.38373	0.14725
-1.17	0.75	0.15483	0.59517	0.35424
-1.567	1	0.19576	0.80424	0.64681
-1.178	0.75	0.15565	0.59435	0.35326
-0.809	0.5	0.11761	0.38239	0.14623
-0.448	0.25	0.08039	0.16961	0.02877
-0.001	0	0.03430	-0.03430	0.00118

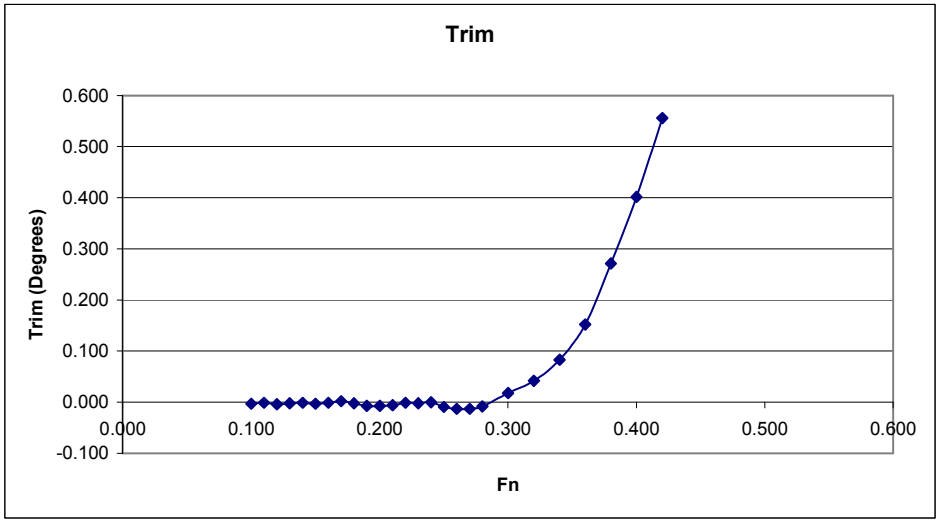
0.01	0	0.03317	-0.03317	0.00110
-0.391	0.25	0.07451	0.17549	0.03080
-0.771	0.5	0.11369	0.38631	0.14924
-1.147	0.75	0.15246	0.59754	0.35706
-1.535	1	0.19246	0.80754	0.65213
-1.166	0.75	0.15441	0.59559	0.35473
-0.798	0.5	0.11647	0.38353	0.14710
-0.435	0.25	0.07905	0.17095	0.02923
0.002	0	0.03399	-0.03399	0.00116

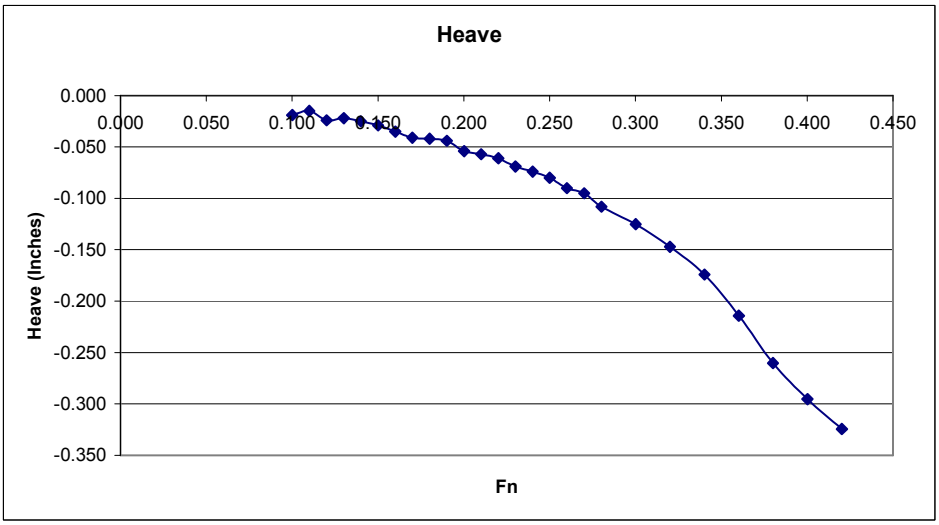
Gain	Bias
-0.6426	-0.0109
-0.6466	-0.0085

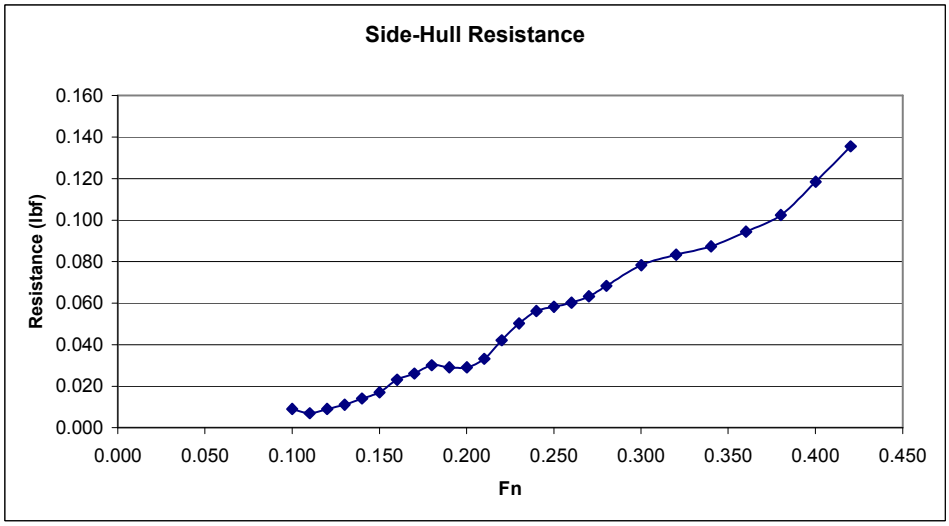
Mean	0.338029
Std Dev	
Uncertainty	

0.4493 lbf
0.3177 lbf

Transverse = 30.9% Longitudinal = 71.5%







TRANSVERSE = 50%, LONGITUDINAL = 71.5%

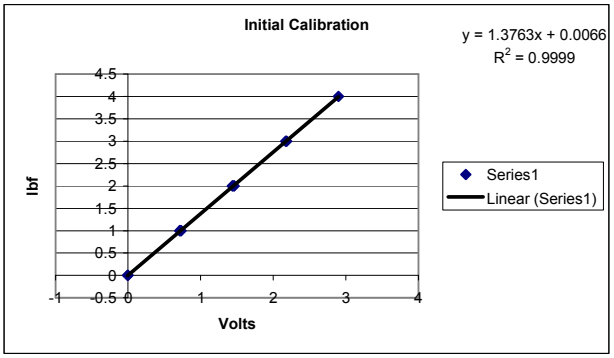
Trimaran, T = 50.0%, L = 71.5% | Correct Tow Point | Water Temp 20 C
26-Apr-07 ++++++ No appendages ++++++ Calibration Angle 5.168

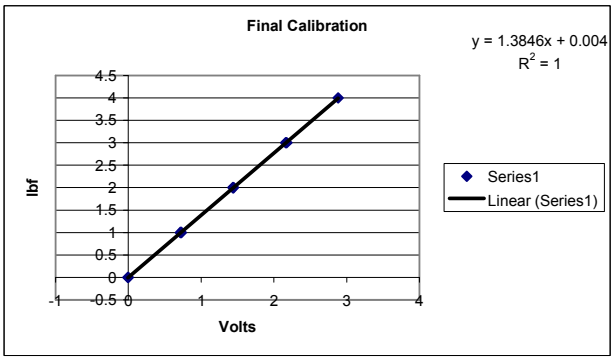
Hama Thickness = 0.028 in

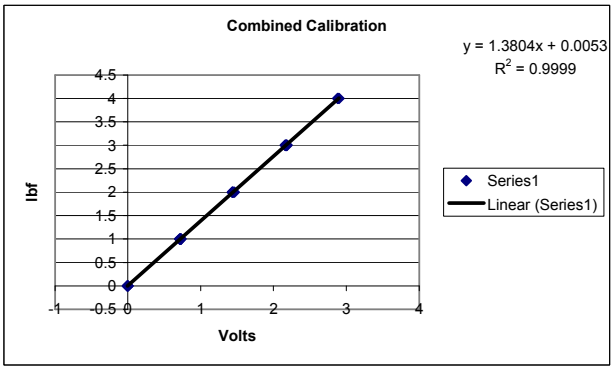
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.006	0
	0.713	1
	1.437	2
	2.17	3
	2.898	4
	2.185	3
	1.46	2
	0.728	1
	-0.003	0
Final	-0.006	0
	0.714	1
	1.434	2
	2.161	3
	2.881	4
	2.176	3
	1.444	2
	0.727	1
	-0.001	0







Transverse = 50% Longitudinal = 71.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3763
B1	0.0066
A2	1.3804
B2	0.0053

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	0.001	0.085	0.084	0.061	0.084	0.084
2	1.802	0.001	0.11	0.109	0.079	0.109	0.109
3	1.952	-0.004	0.127	0.131	0.095	0.131	0.131
4	2.102	-0.001	0.151	0.152	0.110	0.152	0.152
5	2.402	-0.001	0.202	0.203	0.147	0.204	0.203
6	2.552	-0.002	0.231	0.233	0.169	0.234	0.233
7	2.702	-0.001	0.259	0.260	0.189	0.261	0.260
8	2.853	0	0.295	0.295	0.214	0.296	0.295
9	3.003	-0.001	0.323	0.324	0.235	0.325	0.324
10	3.153	-0.001	0.36	0.361	0.262	0.362	0.361
11	3.303	-0.001	0.409	0.410	0.298	0.411	0.410
12	3.453	0	0.46	0.460	0.334	0.461	0.459
13	3.603	-0.002	0.488	0.490	0.356	0.491	0.489
14	3.753	0	0.513	0.513	0.373	0.515	0.512
15	3.903	-0.001	0.543	0.544	0.395	0.546	0.543
16	4.054	-0.003	0.565	0.568	0.413	0.570	0.567
17	4.204	0	0.609	0.609	0.442	0.611	0.608
18	4.504	0	0.71	0.710	0.516	0.712	0.709
19	4.804	-0.001	0.824	0.825	0.599	0.827	0.824
20	5.105	0	0.93	0.930	0.676	0.933	0.929
21	5.405	-0.004	1.051	1.055	0.767	1.058	1.054
22	5.705	-0.001	1.202	1.203	0.874	1.207	1.202
23	6.005	-0.001	1.378	1.379	1.002	1.383	1.377
24	6.306	-0.001	1.552	1.553	1.128	1.558	1.551
25	6.606	-0.001	1.735	1.736	1.261	1.741	1.734
26	6.906	-0.001	1.897	1.898	1.379	1.904	1.896
27	7.206	-0.001	2.073	2.074	1.507	2.080	2.072
28	7.507	0.001	2.233	2.232	1.622	2.239	2.230

Model

FULL LOAD

LWL =	7	ft	g=	32.17
BWL $_{Center}$	0.675	ft	ρ=	1.9334
Draft =	0.235833	ft	ν=	1.05E-05
Displ, # =	35.70			
Displ, LT =	0.0			
WS =	6.36	ft^2		

CONSTANTS (g, ρ, ν above)

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0061	9.99E+05	0.0047	0.0014
1.802	0.0055	1.20E+06	0.0045	0.0009
1.952	0.0056	1.30E+06	0.0044	0.0012
2.102	0.0056	1.40E+06	0.0044	0.0012
2.402	0.0057	1.60E+06	0.0042	0.0015
2.552	0.0058	1.70E+06	0.0042	0.0016
2.702	0.0058	1.80E+06	0.0041	0.0016
2.853	0.0059	1.90E+06	0.0041	0.0018
3.003	0.0058	2.00E+06	0.0041	0.0018
3.153	0.0059	2.10E+06	0.0040	0.0019
3.303	0.0061	2.20E+06	0.0040	0.0021
3.453	0.0063	2.30E+06	0.0039	0.0023
3.603	0.0061	2.40E+06	0.0039	0.0022
3.753	0.0059	2.50E+06	0.0039	0.0020
3.903	0.0058	2.60E+06	0.0038	0.0020
4.054	0.0056	2.70E+06	0.0038	0.0018
4.204	0.0056	2.80E+06	0.0038	0.0018
4.504	0.0057	3.00E+06	0.0037	0.0019
4.804	0.0058	3.20E+06	0.0037	0.0021
5.105	0.0058	3.40E+06	0.0037	0.0021
5.405	0.0059	3.60E+06	0.0036	0.0023
5.705	0.0060	3.80E+06	0.0036	0.0024
6.005	0.0062	4.00E+06	0.0035	0.0027
6.306	0.0063	4.20E+06	0.0035	0.0028
6.606	0.0065	4.40E+06	0.0035	0.0030
6.906	0.0065	4.60E+06	0.0035	0.0030
7.206	0.0065	4.79E+06	0.0034	0.0031
7.507	0.0064	5.00E+06	0.0034	0.0030

Ship

FULL LOAD

LWL =	880.4	ft	g=	32.17
BWL $_{Center}$	84.92	ft	ρ=	1.9905
Draft =	29.66	ft	ν=	1.28E-05
Displ, # =	70987840			
Displ, LT =	31691.0			
WS =	100591	ft^2		

CONSTANTS (g, ρ, ν above)

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0014	1.16E+09	0.0015	0.0004	92843.7	0.100	16556	91213.6
12.0	20.21	0.0009	1.39E+09	0.0015	0.0004	115153.1	0.120	16556	112494.2
13.0	21.89	0.0012	1.51E+09	0.0015	0.0004	144416.8	0.130	16556	141141.6
14.0	23.57	0.0012	1.62E+09	0.0014	0.0004	170745.1	0.140	16556	166782.9
15.9	26.94	0.0015	1.85E+09	0.0014	0.0004	239217.1	0.160	16556	233664.0
16.9	28.62	0.0016	1.97E+09	0.0014	0.0004	281391.6	0.170	16556	274932.2
17.9	30.30	0.0016	2.09E+09	0.0014	0.0004	316600.1	0.180	16556	309159.3
18.9	32.00	0.0018	2.20E+09	0.0014	0.0004	367220.8	0.190	16556	358715.0
19.9	33.68	0.0018	2.32E+09	0.0014	0.0004	404897.9	0.200	16556	395257.1
20.9	35.36	0.0019	2.43E+09	0.0014	0.0004	458151.6	0.210	16556	447297.8
21.9	37.04	0.0021	2.55E+09	0.0014	0.0004	535176.5	0.220	16556	523031.2
22.9	38.73	0.0023	2.67E+09	0.0014	0.0004	613475.1	0.230	16556	599958.9
23.9	40.41	0.0022	2.78E+09	0.0014	0.0004	650088.4	0.240	16556	635121.3
24.9	42.09	0.0020	2.90E+09	0.0013	0.0004	671624.2	0.250	16556	655125.5
25.9	43.77	0.0020	3.01E+09	0.0013	0.0004	708782.5	0.260	16556	690670.9
26.9	45.47	0.0018	3.13E+09	0.0013	0.0004	730696.7	0.270	16556	710878.7
27.9	47.15	0.0018	3.25E+09	0.0013	0.0004	786841.1	0.280	16556	765245.3
29.9	50.51	0.0019	3.48E+09	0.0013	0.0004	935839.9	0.300	16556	910438.8
31.9	53.88	0.0021	3.71E+09	0.0013	0.0004	1110639.9	0.320	16556	1081097.1
33.9	57.25	0.0021	3.94E+09	0.0013	0.0004	1261967.3	0.340	16556	1227927.4
35.9	60.62	0.0023	4.17E+09	0.0013	0.0004	1451672.4	0.360	16556	1412805.9
37.9	63.98	0.0024	4.40E+09	0.0013	0.0004	1685728.5	0.380	16556	1641688.5
39.9	67.35	0.0027	4.64E+09	0.0013	0.0004	1974405.1	0.400	16556	1924841.4
41.9	70.72	0.0028	4.87E+09	0.0013	0.0004	2256104.0	0.420	16556	2200643.2
43.9	74.09	0.0030	5.10E+09	0.0013	0.0004	2553860.2	0.440	16556	2492165.6
45.9	77.45	0.0030	5.33E+09	0.0013	0.0004	2806080.1	0.460	16556	2737793.3
47.8	80.81	0.0031	5.56E+09	0.0013	0.0004	3084407.7	0.480	16556	3009167.5
49.8	84.19	0.0030	5.79E+09	0.0012	0.0004	3323111.0	0.500	16556	3240529.3

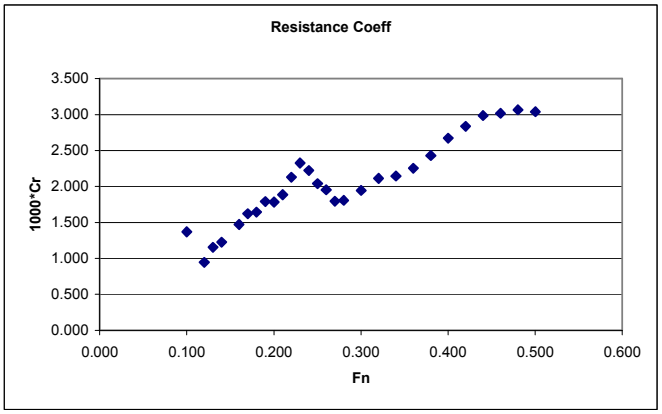
Transverse = 50%

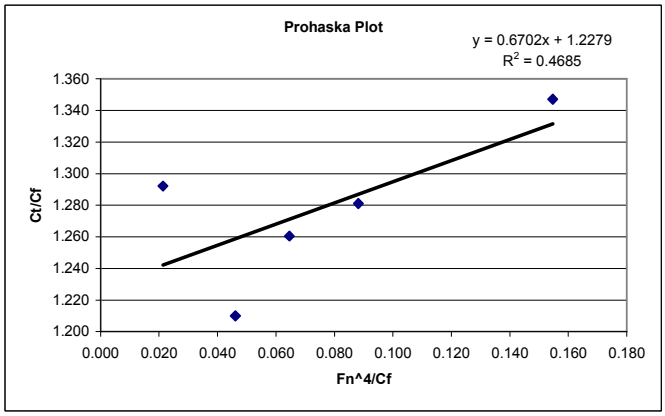
Longitudinal = 71.5%

Transverse = 50% Longitudinal = 71.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.370	0.021	1.292
0.120	0.947	0.046	1.210
0.130	1.154	0.065	1.260
0.140	1.226	0.088	1.281
0.160	1.473	0.155	1.347
0.170	1.622	0.200	1.387
0.180	1.644	0.254	1.397
0.190	1.792	0.319	1.437
0.200	1.783	0.396	1.440
0.210	1.885	0.485	1.470
0.220	2.129	0.590	1.535
0.230	2.326	0.711	1.590
0.240	2.224	0.850	1.569
0.250	2.040	1.009	1.526
0.260	1.954	1.189	1.508
0.270	1.796	1.394	1.470
0.280	1.806	1.624	1.476
0.300	1.945	2.169	1.520
0.320	2.113	2.842	1.572
0.340	2.146	3.666	1.587
0.360	2.255	4.658	1.624
0.380	2.430	5.841	1.679
0.400	2.672	7.240	1.754
0.420	2.837	8.886	1.808
0.440	2.985	10.795	1.858
0.460	3.016	13.001	1.874
0.480	3.067	15.534	1.896
0.500	3.039	18.436	1.894





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.006	0	-0.00298	0.0029824	8.63E-06
0.713	1	0.989525	0.0104748	0.000109
1.437	2	1.988935	0.0110652	0.000121
2.17	3	3.000768	-0.000768	6.6E-07
2.898	4	4.005699	-0.0056992	3.3E-05
2.185	3	3.021474	-0.021474	0.000463
1.46	2	2.020684	-0.020684	0.00043
0.728	1	1.010231	-0.0102312	0.000106
-0.003	0	0.001159	-0.0011588	1.45E-06
-0.006	0	-0.00298	0.0029824	8.63E-06
0.714	1	0.990906	0.0090944	8.19E-05
1.434	2	1.984794	0.0152064	0.00023
2.161	3	2.988344	0.0116556	0.000135
2.881	4	3.982232	0.0177676	0.000314
2.176	3	3.00905	-0.0090504	8.27E-05
1.444	2	1.998598	0.0014024	1.84E-06
0.727	1	1.008851	-0.0088508	7.91E-05
-0.001	0	0.00392	-0.0039196	1.57E-05

Mean	4.41778E-05	
Std Dev		0.0114 lbf
Uncertainty		0.0081 lbf

Transverse = 50%

Longitudinal = 71.5%

Trim

Run	Speed	Zero	deg	Zero Corrected	Combined Calibration
1	1.501	-0.090	-0.092	-0.002	-0.002
2	1.802	-0.094	-0.099	-0.005	-0.005
3	1.952	-0.139	-0.143	-0.004	-0.004
4	2.102	-0.100	-0.103	-0.003	-0.003
5	2.402	-0.104	-0.106	-0.002	-0.002
6	2.552	-0.139	-0.142	-0.003	-0.003
7	2.702	-0.107	-0.115	-0.008	-0.008
8	2.853	-0.136	-0.141	-0.005	-0.005
9	3.003	-0.111	-0.116	-0.005	-0.005
10	3.153	-0.132	-0.133	-0.001	-0.001
11	3.303	-0.120	-0.122	-0.002	-0.002
12	3.453	-0.132	-0.140	-0.008	-0.008
13	3.603	-0.132	-0.146	-0.014	-0.014
14	3.753	-0.130	-0.153	-0.023	-0.023
15	3.903	-0.134	-0.154	-0.02	-0.020
16	4.054	-0.139	-0.154	-0.015	-0.015
17	4.204	-0.133	-0.141	-0.008	-0.008
18	4.504	-0.134	-0.113	0.021	0.021
19	4.804	-0.137	-0.072	0.065	0.065
20	5.105	-0.132	-0.032	0.1	0.099
21	5.405	-0.134	0.034	0.168	0.167
22	5.705	-0.131	0.147	0.278	0.276
23	6.005	-0.113	0.309	0.422	0.419
24	6.306	-0.107	0.455	0.562	0.558
25	6.606	-0.104	0.594	0.698	0.693
26	6.906	-0.104	0.713	0.817	0.811
27	7.206	-0.097	0.881	0.978	0.971
28	7.507	-0.088	0.909	0.997	0.990

Heave

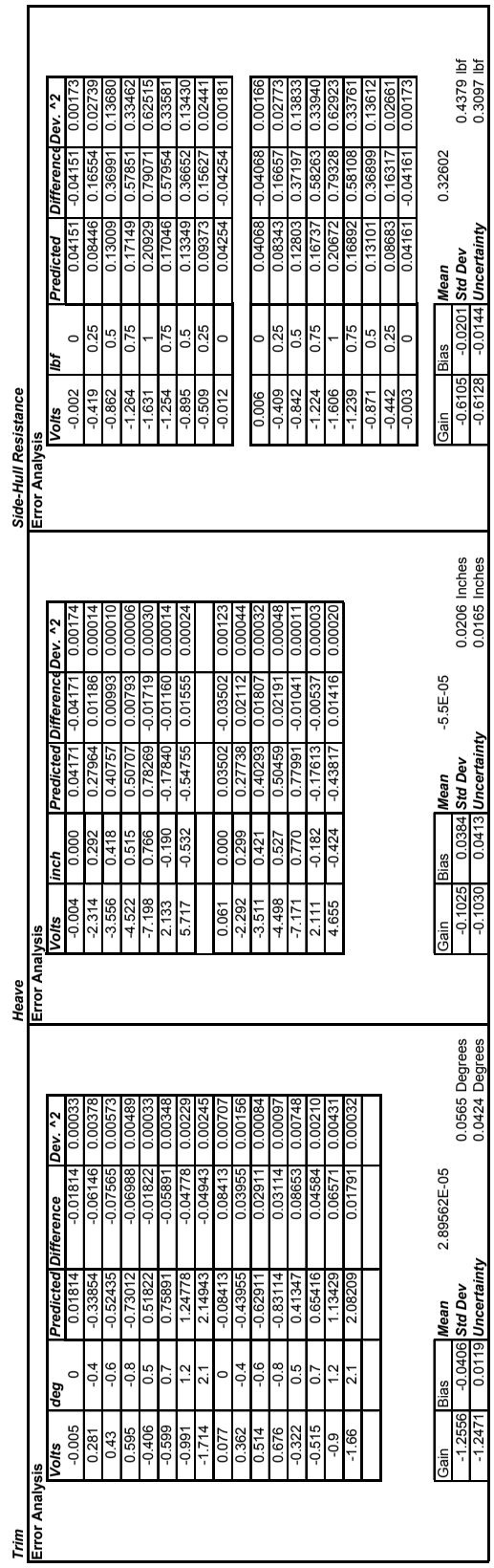
Run	Speed	Zero	inch	Zero Corrected	Combined Calibration
1	1.501	0.036	0.022	-0.014	-0.014
2	1.802	0.041	0.016	-0.025	-0.025
3	1.952	0.039	0.008	-0.031	-0.031
4	2.102	0.038	0.011	-0.027	-0.027
5	2.402	0.041	0.003	-0.038	-0.038
6	2.552	0.035	-0.004	-0.039	-0.039
7	2.702	0.039	-0.006	-0.045	-0.045
8	2.853	0.032	-0.013	-0.045	-0.045
9	3.003	0.041	-0.015	-0.056	-0.056
10	3.153	0.037	-0.025	-0.062	-0.062
11	3.303	0.038	-0.027	-0.065	-0.065
12	3.453	0.035	-0.036	-0.071	-0.071
13	3.603	0.038	-0.039	-0.077	-0.077
14	3.753	0.036	-0.048	-0.084	-0.084
15	3.903	0.04	-0.053	-0.093	-0.093
16	4.054	0.034	-0.066	-0.1	-0.100
17	4.204	0.035	-0.074	-0.109	-0.110
18	4.504	0.038	-0.096	-0.134	-0.135
19	4.804	0.036	-0.123	-0.159	-0.160
20	5.105	0.039	-0.156	-0.195	-0.196
21	5.405	0.039	-0.195	-0.234	-0.235
22	5.705	0.044	-0.233	-0.277	-0.278
23	6.005	0.043	-0.268	-0.311	-0.313
24	6.306	0.038	-0.292	-0.33	-0.332
25	6.606	0.038	-0.308	-0.346	-0.348
26	6.906	0.037	-0.317	-0.354	-0.356
27	7.206	0.037	-0.325	-0.362	-0.364
28	7.507	0.042	-0.328	-0.37	-0.372

Calibration Angle 3.463

Side-Hull Resistance

Run	Speed	Zero	lbf	Zero Corrected	Combined Calibration	Angle Corrected
1	1.501	-0.021	-0.014	0.007	0.007	0.007
2	1.802	-0.022	-0.012	0.01	0.010	0.010
3	1.952	-0.024	-0.012	0.012	0.012	0.012
4	2.102	-0.022	-0.008	0.014	0.014	0.014
5	2.402	-0.022	0.001	0.023	0.023	0.023
6	2.552	-0.024	0.001	0.025	0.025	0.025
7	2.702	-0.022	0.005	0.027	0.027	0.027
8	2.853	-0.024	0.005	0.029	0.029	0.029
9	3.003	-0.023	0.008	0.031	0.031	0.031
10	3.153	-0.024	0.012	0.036	0.036	0.036
11	3.303	-0.023	0.022	0.045	0.045	0.045
12	3.453	-0.024	0.028	0.052	0.052	0.052
13	3.603	-0.023	0.031	0.054	0.054	0.054
14	3.753	-0.024	0.031	0.055	0.055	0.055
15	3.903	-0.023	0.033	0.056	0.056	0.056
16	4.054	-0.024	0.035	0.059	0.059	0.059
17	4.204	-0.023	0.041	0.064	0.064	0.064
18	4.504	-0.023	0.05	0.073	0.073	0.073
19	4.804	-0.024	0.055	0.079	0.079	0.079
20	5.105	-0.023	0.061	0.084	0.084	0.084
21	5.405	-0.023	0.071	0.094	0.094	0.094
22	5.705	-0.023	0.082	0.105	0.105	0.105
23	6.005	-0.023	0.104	0.127	0.127	0.127
24	6.306	-0.023	0.122	0.145	0.146	0.145
25	6.606	-0.022	0.14	0.162	0.163	0.162
26	6.906	-0.022	0.156	0.178	0.179	0.178
27	7.206	-0.022	0.173	0.195	0.196	0.195
28	7.507	-0.021	0.189	0.21	0.211	0.210

Transverse = 50% Longitudinal = 71.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.005	0	0.01814	-0.01814	0.00033
0.281	-0.4	-0.33854	-0.06146	0.00378
0.43	-0.6	-0.52435	-0.07565	0.00573
0.595	-0.8	-0.73012	-0.06988	0.00489
-0.406	0.5	0.51822	-0.01822	0.00033
-0.599	0.7	0.75891	-0.05891	0.00348
-0.991	1.2	1.24778	-0.04778	0.00229
-1.714	2.1	2.14943	-0.04943	0.00245
0.077	0	-0.08413	0.08413	0.00707
0.362	-0.4	-0.43955	0.03955	0.00156
0.514	-0.6	-0.62911	0.02911	0.00084
0.676	-0.8	-0.83114	0.03114	0.00097
-0.322	0.5	0.41347	0.08653	0.00748
-0.515	0.7	0.65416	0.04584	0.00210
-0.9	1.2	1.13429	0.06571	0.00431
-1.66	2.1	2.08209	0.01791	0.00032

Gain	Bias
-1.2556	-0.0406
-1.2471	0.0119

Mean	2.89562E-05
Std Dev	0.0565 Degrees
Uncertainty	0.0424 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
-0.004	0.000	0.04171	-0.04171	0.00174
-2.314	0.292	0.27964	0.01186	0.00014
-3.556	0.418	0.40757	0.00993	0.00010
-4.522	0.515	0.50707	0.00793	0.00006
-7.198	0.766	0.78269	-0.01719	0.00030
2.133	-0.190	-0.17840	-0.01160	0.00014
5.717	-0.532	-0.54755	0.01555	0.00024
0.061	0.000	0.03502	-0.03502	0.00123
-2.292	0.299	0.27738	0.02112	0.00044
-3.511	0.421	0.40293	0.01807	0.00032
-4.498	0.527	0.50459	0.02191	0.00048
-7.171	0.770	0.77991	-0.01041	0.00011
2.111	-0.182	-0.17613	-0.00537	0.00003
4.655	-0.424	-0.43817	0.01416	0.00020

Gain	Bias
-0.1025	0.0384
-0.1030	0.0413

Mean	-5.5E-05
Std Dev	0.0206 Inches
Uncertainty	0.0165 Inches

Side-Hull Resistance

Error Analysis

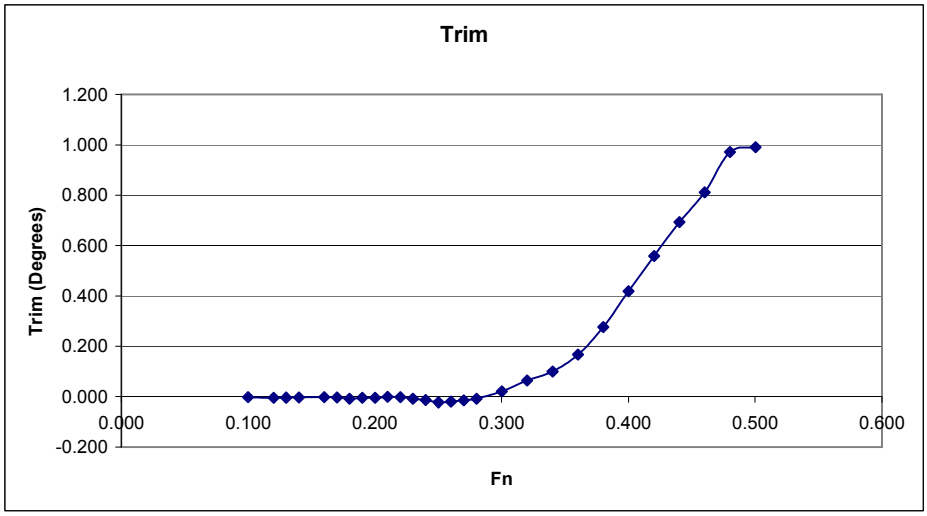
Volts	lbf	Predicted	Difference	Dev. ^2
-0.002	0	0.04151	-0.04151	0.00173
-0.419	0.25	0.08446	0.16554	0.02739
-0.862	0.5	0.13009	0.36991	0.13680
-1.264	0.75	0.17149	0.57851	0.33462
-1.631	1	0.20929	0.79071	0.62515
-1.254	0.75	0.17046	0.57954	0.33581
-0.895	0.5	0.13349	0.36652	0.13430
-0.509	0.25	0.09373	0.15627	0.02441
-0.012	0	0.04254	-0.04254	0.00181

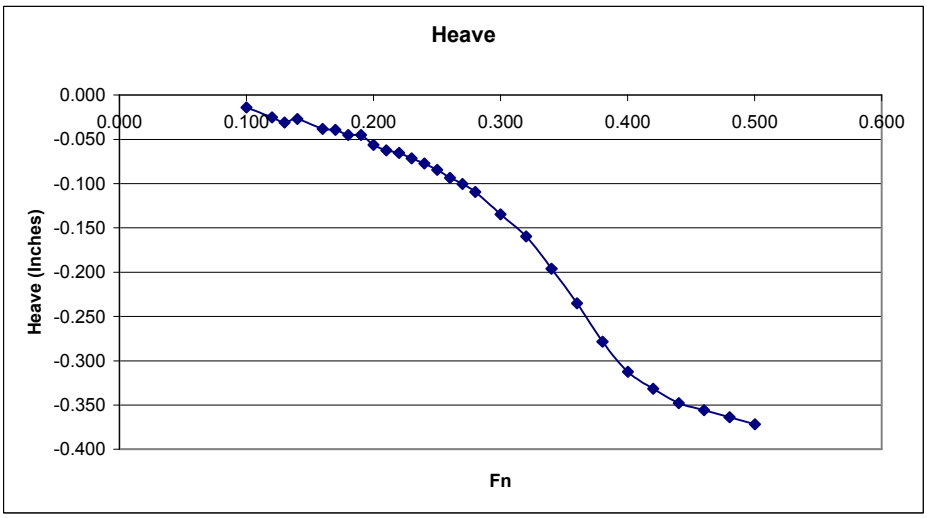
0.006	0	0.04068	-0.04068	0.00166
-0.409	0.25	0.08343	0.16657	0.02773
-0.842	0.5	0.12803	0.37197	0.13833
-1.224	0.75	0.16737	0.58263	0.33940
-1.606	1	0.20672	0.79328	0.62923
-1.239	0.75	0.16892	0.58108	0.33761
-0.871	0.5	0.13101	0.36899	0.13612
-0.442	0.25	0.08683	0.16317	0.02661
-0.003	0	0.04161	-0.04161	0.00173

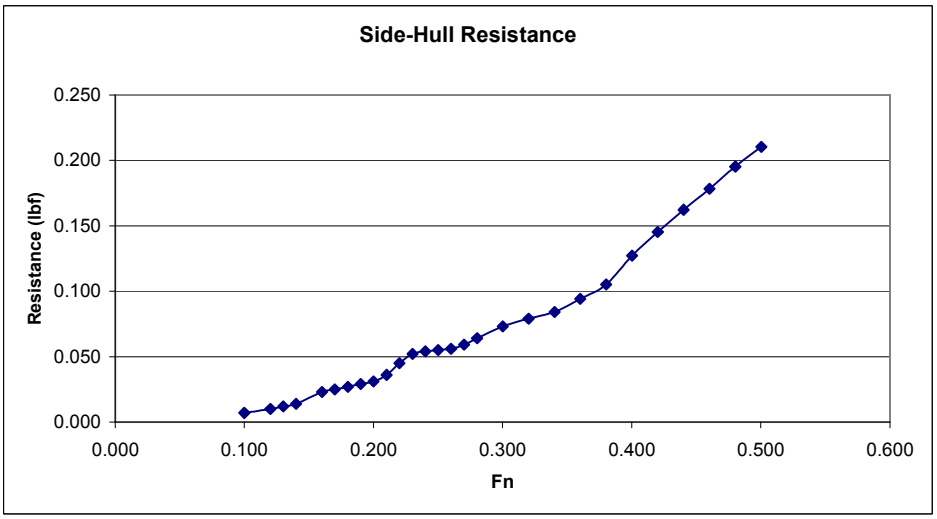
Gain	Bias
-0.6105	-0.0201
-0.6128	-0.0144

Mean	0.32602
Std Dev	0.4379 lbf
Uncertainty	0.3097 lbf

Transverse = 50% Longitudinal = 71.5%







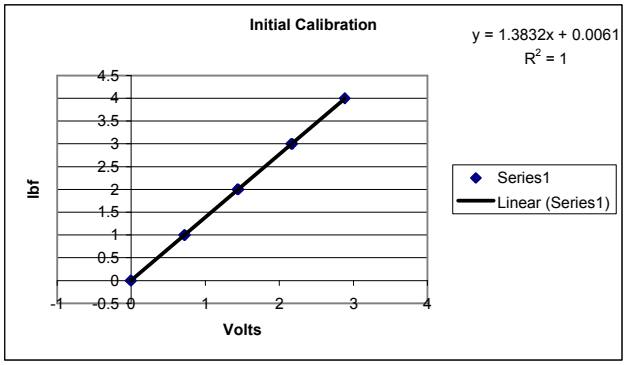
TRANSVERSE = 70%, LONGITUDINAL = 71.5%

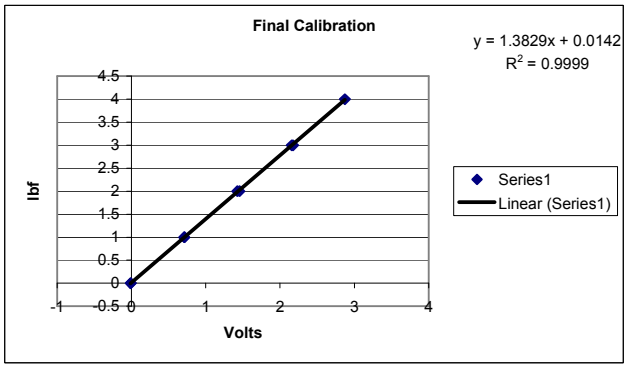
Trimaran, T = 70.0%, L = 71.5% | Correct Tow Point | Water Temp 20 C
27-Apr-07 ++++++ | No appendages ++++++ | Calibration Angle 5.168
Hama Thickness = 0.028 in

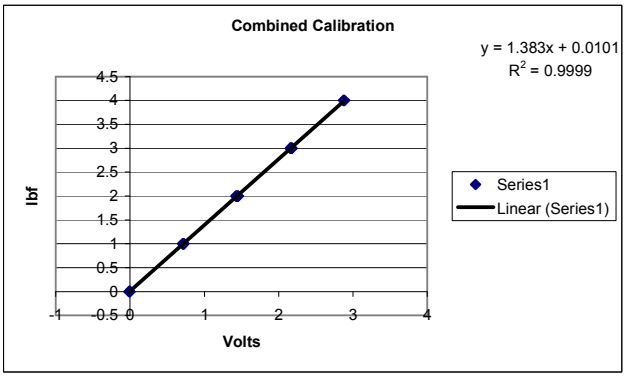
Total Disp 35.70 lbf

Calibrations

	Volts	lbf
Initial	-0.007	0
	0.714	1
	1.435	2
	2.16	3
	2.883	4
	2.175	3
	1.447	2
	0.725	1
	-0.004	0
Final	-0.013	0
	0.709	1
	1.423	2
	2.156	3
	2.872	4
	2.174	3
	1.454	2
	0.712	1
	-0.009	0







Transverse = 70% Longitudinal = 71.5%

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3832
B1	0.0061
A2	1.383
B2	0.0101

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.007	0.074	0.081	0.059	0.081	0.081
2	1.802	-0.007	0.1	0.107	0.077	0.107	0.107
3	2.102	-0.008	0.144	0.152	0.110	0.152	0.151
4	2.252	-0.01	0.166	0.176	0.127	0.176	0.175
5	2.402	-0.011	0.189	0.200	0.145	0.200	0.199
6	2.552	-0.012	0.222	0.234	0.169	0.234	0.233
7	2.702	-0.012	0.251	0.263	0.190	0.263	0.262
8	2.853	-0.011	0.277	0.288	0.208	0.288	0.287
9	3.003	-0.015	0.296	0.311	0.225	0.311	0.310
10	3.153	-0.01	0.349	0.359	0.260	0.359	0.357
11	3.303	-0.019	0.386	0.405	0.293	0.405	0.403
12	3.453	-0.01	0.437	0.447	0.323	0.447	0.445
13	3.603	-0.018	0.448	0.466	0.337	0.466	0.464
14	3.903	-0.016	0.512	0.528	0.382	0.528	0.526
15	4.054	-0.01	0.558	0.568	0.411	0.568	0.566
16	4.204	-0.013	0.594	0.607	0.439	0.607	0.604
17	4.504	-0.011	0.697	0.708	0.512	0.708	0.705
18	4.804	-0.013	0.812	0.825	0.596	0.825	0.822
19	5.105	-0.013	0.919	0.932	0.674	0.932	0.928
20	5.405	-0.018	1.045	1.063	0.769	1.063	1.059
21	5.705	-0.017	1.178	1.195	0.864	1.195	1.190
22	6.005	-0.014	1.328	1.342	0.970	1.342	1.336
23	6.306	-0.012	1.511	1.523	1.101	1.523	1.517
24	6.606	-0.012	1.679	1.691	1.223	1.691	1.684
25	6.906	-0.009	1.85	1.859	1.344	1.859	1.851
26	7.206	-0.006	2.022	2.028	1.466	2.028	2.019
27	7.507	-0.006	2.184	2.190	1.583	2.190	2.181

Model

FULL LOAD

			CONSTANTS	
LWL =	7	ft	g=	32.17
BWL Center	0.675	ft	ρ=	1.9334
Draft =	0.235833	ft	ν=	1.05E-05
Displ, # =	35.70			
Displ, LT =	0.0			
WS =	6.36	ft^2		

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0058	9.99E+05	0.0047	0.0011
1.802	0.0053	1.20E+06	0.0045	0.0008
2.102	0.0056	1.40E+06	0.0044	0.0012
2.252	0.0056	1.50E+06	0.0043	0.0013
2.402	0.0056	1.60E+06	0.0042	0.0014
2.552	0.0058	1.70E+06	0.0042	0.0016
2.702	0.0058	1.80E+06	0.0041	0.0017
2.853	0.0057	1.90E+06	0.0041	0.0016
3.003	0.0056	2.00E+06	0.0041	0.0015
3.153	0.0058	2.10E+06	0.0040	0.0018
3.303	0.0060	2.20E+06	0.0040	0.0020
3.453	0.0061	2.30E+06	0.0039	0.0021
3.603	0.0058	2.40E+06	0.0039	0.0019
3.903	0.0056	2.60E+06	0.0038	0.0018
4.054	0.0056	2.70E+06	0.0038	0.0018
4.204	0.0056	2.80E+06	0.0038	0.0018
4.504	0.0057	3.00E+06	0.0037	0.0019
4.804	0.0058	3.20E+06	0.0037	0.0021
5.105	0.0058	3.40E+06	0.0037	0.0021
5.405	0.0059	3.60E+06	0.0036	0.0023
5.705	0.0059	3.80E+06	0.0036	0.0024
6.005	0.0060	4.00E+06	0.0035	0.0025
6.306	0.0062	4.20E+06	0.0035	0.0027
6.606	0.0063	4.40E+06	0.0035	0.0028
6.906	0.0063	4.60E+06	0.0035	0.0029
7.206	0.0063	4.79E+06	0.0034	0.0029
7.507	0.0063	5.00E+06	0.0034	0.0029

Ship

FULL LOAD

			CONSTANTS	
LWL =	880.4	ft	g=	32.17
BWL Center	84.92	ft	ρ=	1.9905
Draft =	29.66	ft	ν=	1.28E-05
Displ, # =	70987840			
Displ, LT =	31691.0			
WS =	100591	ft^2		

Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0011	1.16E+09	0.0015	0.0004	86189.2	0.100	17417	83015.6
12.0	20.21	0.0008	1.39E+09	0.0015	0.0004	110379.1	0.120	17417	105544.6
14.0	23.57	0.0012	1.62E+09	0.0014	0.0004	169776.5	0.140	17417	162908.8
15.0	25.26	0.0013	1.74E+09	0.0014	0.0004	201218.3	0.150	17417	193189.8
15.9	26.94	0.0014	1.85E+09	0.0014	0.0004	231804.3	0.160	17417	222517.4
16.9	28.62	0.0016	1.97E+09	0.0014	0.0004	281946.6	0.170	17417	271302.8
17.9	30.30	0.0017	2.09E+09	0.0014	0.0004	321062.5	0.180	17417	308962.7
18.9	32.00	0.0016	2.20E+09	0.0014	0.0004	351062.9	0.190	17417	337396.2
19.9	33.68	0.0015	2.32E+09	0.0014	0.0004	376316.8	0.200	17417	360992.6
20.9	35.36	0.0018	2.43E+09	0.0014	0.0004	451771.8	0.210	17417	434688.5
21.9	37.04	0.0020	2.55E+09	0.0014	0.0004	522365.2	0.220	17417	503420.8
22.9	38.73	0.0021	2.67E+09	0.0014	0.0004	584027.4	0.230	17417	563119.1
23.9	40.41	0.0019	2.78E+09	0.0014	0.0004	598012.4	0.240	17417	575036.9
25.9	43.77	0.0018	3.01E+09	0.0013	0.0004	672680.3	0.260	17417	645258.3
26.9	45.47	0.0018	3.13E+09	0.0013	0.0004	727077.3	0.270	17417	697258.7
27.9	47.15	0.0018	3.25E+09	0.0013	0.0004	778880.9	0.280	17417	746575.9
29.9	50.51	0.0019	3.48E+09	0.0013	0.0004	927236.2	0.300	17417	889640.3
31.9	53.88	0.0021	3.71E+09	0.0013	0.0004	1105382.8	0.320	17417	1062069.1
33.9	57.25	0.0021	3.94E+09	0.0013	0.0004	1260120.6	0.340	17417	1210637.8
35.9	60.62	0.0023	4.17E+09	0.0013	0.0004	1461267.5	0.360	17417	1405202.4
37.9	63.98	0.0024	4.40E+09	0.0013	0.0004	1661744.9	0.380	17417	1598661.4
39.9	67.35	0.0025	4.64E+09	0.0013	0.0004	1890147.7	0.400	17417	1819607.4
41.9	70.72	0.0027	4.87E+09	0.0013	0.0004	2185015.9	0.420	17417	2106550.7
43.9	74.09	0.0028	5.10E+09	0.0013	0.0004	2451010.0	0.440	17417	2364202.2
45.9	77.45	0.0029	5.33E+09	0.0013	0.0004	2714436.1	0.460	17417	2618840.0
47.8	80.81	0.0029	5.56E+09	0.0013	0.0004	2977364.0	0.480	17417	2872532.1
49.8	84.19	0.0029	5.79E+09	0.0012	0.0004	3223219.5	0.500	17417	3108669.0

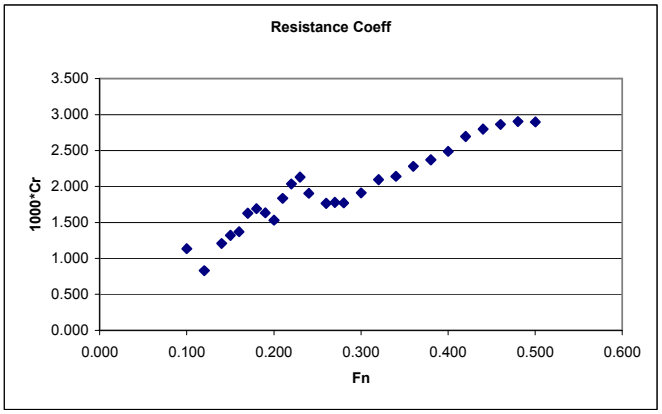
Transverse = 70%

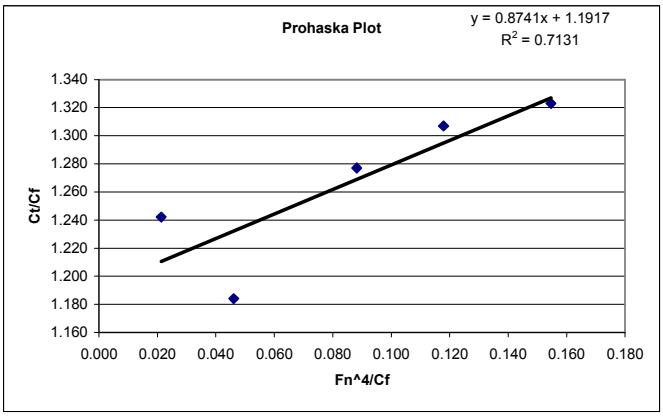
Longitudinal = 71.5%

Transverse = 70% Longitudinal = 71.5%

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.135	0.021	1.242
0.120	0.830	0.046	1.184
0.140	1.209	0.088	1.277
0.150	1.320	0.118	1.307
0.160	1.371	0.155	1.323
0.170	1.629	0.200	1.389
0.180	1.692	0.254	1.409
0.190	1.634	0.319	1.399
0.200	1.531	0.396	1.378
0.210	1.834	0.485	1.457
0.220	2.035	0.590	1.512
0.230	2.130	0.711	1.540
0.240	1.905	0.850	1.487
0.260	1.766	1.189	1.459
0.270	1.778	1.394	1.466
0.280	1.771	1.624	1.467
0.300	1.911	2.169	1.511
0.320	2.095	2.842	1.567
0.340	2.140	3.666	1.586
0.360	2.281	4.658	1.631
0.380	2.371	5.841	1.663
0.400	2.487	7.240	1.702
0.420	2.695	8.886	1.768
0.440	2.798	10.795	1.804
0.460	2.864	13.001	1.830
0.480	2.903	15.534	1.848
0.500	2.898	18.436	1.853





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.007	0	0.000419	-0.000419	2.2E-07
0.714	1	0.997562	0.002438	5.7E-06
1.435	2	1.994705	0.005295	2.75E-05
2.16	3	2.99738	0.00262	6.6E-06
2.883	4	3.997289	0.002711	7.08E-06
2.175	3	3.018125	-0.018125	0.00033
1.447	2	2.011301	-0.011301	0.000129
0.725	1	1.012775	-0.012775	0.000164
-0.004	0	0.004568	-0.004568	2.13E-05
-0.013	0	-0.00788	0.007879	6.13E-05
0.709	1	0.990647	0.009353	8.65E-05
1.423	2	1.978109	0.021891	0.000477
2.156	3	2.991848	0.008152	6.56E-05
2.872	4	3.982076	0.017924	0.000319
2.174	3	3.016742	-0.016742	0.000282
1.454	2	2.020982	-0.020982	0.000442
0.712	1	0.994796	0.005204	2.66E-05
-0.009	0	-0.00235	0.002347	5.28E-06

Mean	5.01111E-05	
Std Dev		0.0120 lbf
Uncertainty		0.0085 lbf

Transverse = 70%

Longitudinal = 71.5%

Trim

Run	Speed	Zero	deg	Zero Corrected	Combined Calibration
1	1.501	-0.120	-0.122	-0.002	-0.002
2	1.802	-0.179	-0.182	-0.003	-0.003
3	2.102	-0.172	-0.176	-0.004	-0.004
4	2.252	-0.145	-0.147	-0.002	-0.002
5	2.402	-0.169	-0.169	0	0.000
6	2.552	-0.150	-0.154	-0.004	-0.004
7	2.702	-0.166	-0.172	-0.006	-0.006
8	2.853	-0.151	-0.157	-0.006	-0.006
9	3.003	-0.165	-0.167	-0.002	-0.002
10	3.153	-0.148	-0.148	0	0.000
11	3.303	-0.158	-0.162	-0.004	-0.004
12	3.453	-0.142	-0.153	-0.011	-0.011
13	3.603	-0.158	-0.175	-0.017	-0.017
14	3.903	-0.156	-0.177	-0.021	-0.021
15	4.054	-0.143	-0.155	-0.012	-0.012
16	4.204	-0.156	-0.154	0.002	0.002
17	4.504	-0.150	-0.113	0.037	0.037
18	4.804	-0.157	-0.081	0.076	0.076
19	5.105	-0.157	-0.045	0.112	0.112
20	5.405	-0.156	0.030	0.186	0.186
21	5.705	-0.159	0.097	0.256	0.256
22	6.005	-0.162	0.190	0.352	0.352
23	6.306	-0.164	0.317	0.481	0.481
24	6.606	-0.169	0.442	0.611	0.611
25	6.906	-0.175	0.559	0.734	0.733
26	7.206	-0.174	0.664	0.838	0.837
27	7.507	-0.152	0.726	0.878	0.877

Heave

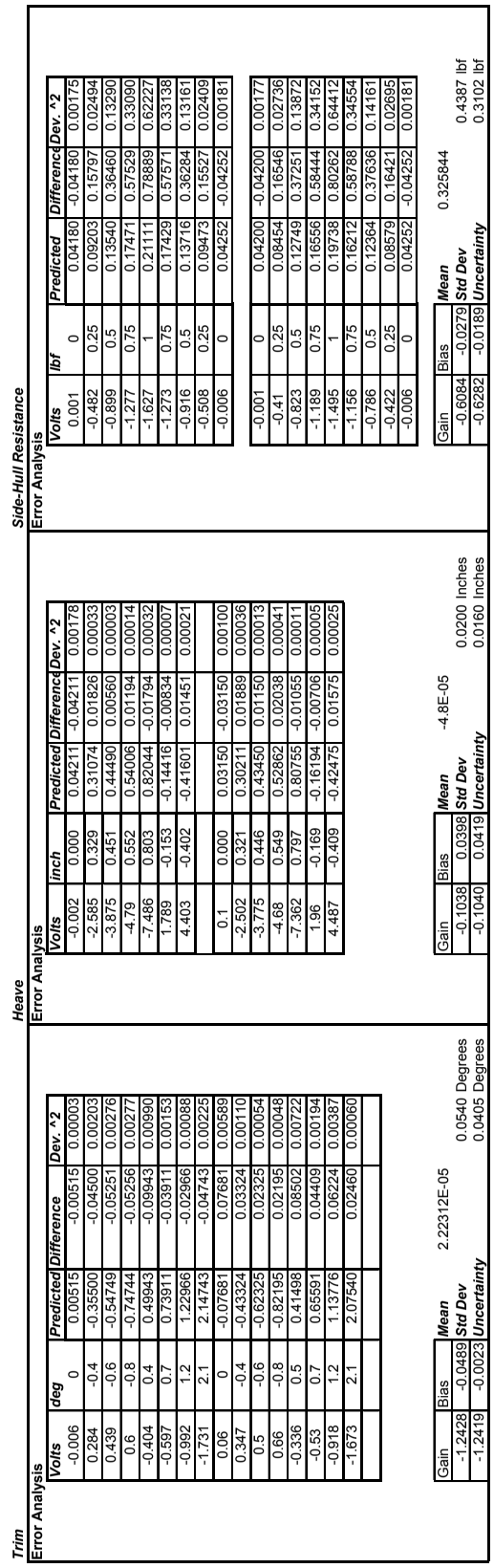
Run	Speed	Zero	inch	Zero Corrected	Combined Calibration
1	1.501	0.041	0.022	-0.019	-0.019
2	1.802	0.04	0.017	-0.023	-0.023
3	2.102	0.043	0.013	-0.03	-0.030
4	2.252	0.037	0.003	-0.034	-0.034
5	2.402	0.039	0.004	-0.035	-0.035
6	2.552	0.036	-0.004	-0.04	-0.040
7	2.702	0.04	-0.006	-0.046	-0.046
8	2.853	0.034	-0.013	-0.047	-0.047
9	3.003	0.037	-0.015	-0.052	-0.052
10	3.153	0.034	-0.025	-0.059	-0.059
11	3.303	0.04	-0.027	-0.067	-0.067
12	3.453	0.036	-0.035	-0.071	-0.071
13	3.603	0.039	-0.038	-0.077	-0.077
14	3.903	0.038	-0.055	-0.093	-0.093
15	4.054	0.036	-0.067	-0.103	-0.103
16	4.204	0.037	-0.08	-0.117	-0.117
17	4.504	0.038	-0.102	-0.14	-0.140
18	4.804	0.034	-0.129	-0.163	-0.163
19	5.105	0.037	-0.161	-0.198	-0.198
20	5.405	0.036	-0.198	-0.234	-0.234
21	5.705	0.039	-0.233	-0.272	-0.273
22	6.005	0.038	-0.263	-0.301	-0.302
23	6.306	0.039	-0.291	-0.33	-0.331
24	6.606	0.039	-0.304	-0.343	-0.344
25	6.906	0.041	-0.314	-0.355	-0.356
26	7.206	0.041	-0.326	-0.367	-0.368
27	7.507	0.044	-0.319	-0.363	-0.364

Calibration Angle 3.463

Side-Hull Resistance

Run	Speed	Zero	lbf	Zero Corrected	Combined Calibration	Angle Corrected
1	1.501	-0.025	-0.02	0.005	0.005	0.005
2	1.802	-0.025	-0.016	0.009	0.009	0.009
3	2.102	-0.026	-0.013	0.013	0.013	0.013
4	2.252	-0.027	-0.01	0.017	0.018	0.018
5	2.402	-0.027	-0.005	0.022	0.023	0.023
6	2.552	-0.027	-0.004	0.023	0.024	0.024
7	2.702	-0.027	-0.001	0.026	0.027	0.027
8	2.853	-0.027	0	0.027	0.028	0.028
9	3.003	-0.027	0.002	0.029	0.030	0.030
10	3.153	-0.027	0.008	0.035	0.036	0.036
11	3.303	-0.027	0.016	0.043	0.044	0.044
12	3.453	-0.027	0.024	0.051	0.053	0.053
13	3.603	-0.027	0.027	0.054	0.056	0.056
14	3.903	-0.027	0.026	0.053	0.055	0.055
15	4.054	-0.027	0.03	0.057	0.059	0.059
16	4.204	-0.027	0.034	0.061	0.063	0.063
17	4.504	-0.027	0.045	0.072	0.074	0.074
18	4.804	-0.027	0.058	0.085	0.088	0.088
19	5.105	-0.027	0.069	0.096	0.099	0.099
20	5.405	-0.027	0.079	0.106	0.109	0.109
21	5.705	-0.026	0.09	0.116	0.120	0.120
22	6.005	-0.026	0.099	0.125	0.129	0.129
23	6.306	-0.026	0.109	0.135	0.139	0.139
24	6.606	-0.026	0.126	0.152	0.157	0.157
25	6.906	-0.026	0.144	0.17	0.176	0.175
26	7.206	-0.025	0.164	0.189	0.195	0.195
27	7.507	-0.025	0.186	0.211	0.218	0.217

Transverse = 70% Longitudinal = 71.5%



Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.006	0	0.00515	-0.00515	0.00003
0.284	-0.4	-0.35500	-0.04500	0.00203
0.439	-0.6	-0.54749	-0.05251	0.00276
0.6	-0.8	-0.74744	-0.05256	0.00277
-0.404	0.4	0.49943	-0.09943	0.00990
-0.597	0.7	0.73911	-0.03911	0.00153
-0.992	1.2	1.22966	-0.02966	0.00088
-1.731	2.1	2.14743	-0.04743	0.00225
0.06	0	-0.07681	0.07681	0.00589
0.347	-0.4	-0.43324	0.03324	0.00110
0.5	-0.6	-0.62325	0.02325	0.00054
0.66	-0.8	-0.82195	0.02195	0.00048
-0.336	0.5	0.41498	0.08502	0.00722
-0.53	0.7	0.65591	0.04409	0.00194
-0.918	1.2	1.13776	0.06224	0.00387
-1.673	2.1	2.07540	0.02460	0.00060

Gain	Bias
-1.2428	-0.0489
-1.2419	-0.0023

Mean	2.22312E-05
Std Dev	
Uncertainty	

0.0540 Degrees
0.0405 Degrees

Heave

Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
-0.002	0.000	0.04211	-0.04211	0.00178
-2.585	0.329	0.31074	0.01826	0.00033
-3.875	0.451	0.44490	0.00560	0.00003
-4.79	0.552	0.54006	0.01194	0.00014
-7.486	0.803	0.82044	-0.01794	0.00032
1.789	-0.153	-0.14416	-0.00834	0.00007
4.403	-0.402	-0.41601	0.01451	0.00021
0.1	0.000	0.03150	-0.03150	0.00100
-2.502	0.321	0.30211	0.01889	0.00036
-3.775	0.446	0.43450	0.01150	0.00013
-4.68	0.549	0.52862	0.02038	0.00041
-7.362	0.797	0.80755	-0.01055	0.00011
1.96	-0.169	-0.16194	-0.00706	0.00005
4.487	-0.409	-0.42475	0.01575	0.00025

Gain	Bias
-0.1038	0.0398
-0.1040	0.0419

Mean	-4.8E-05
Std Dev	
Uncertainty	

0.0200 Inches
0.0160 Inches

Side-Hull Resistance

Error Analysis

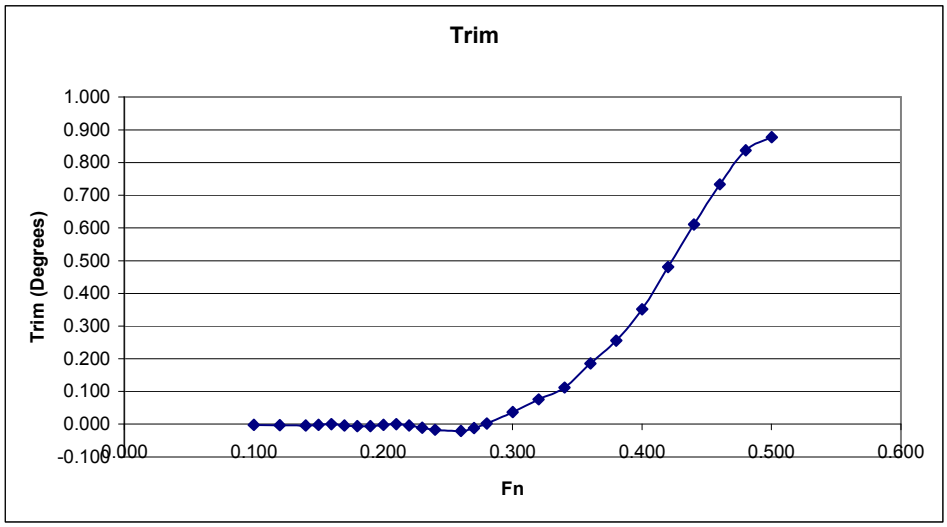
Volts	lbf	Predicted	Difference	Dev. ^2
0.001	0	0.04180	-0.04180	0.00175
-0.482	0.25	0.09203	0.15797	0.02494
-0.899	0.5	0.13540	0.36460	0.13290
-1.277	0.75	0.17471	0.57529	0.33090
-1.627	1	0.21111	0.78889	0.62227
-1.273	0.75	0.17429	0.57571	0.33138
-0.916	0.5	0.13716	0.36284	0.13161
-0.508	0.25	0.09473	0.15527	0.02409
-0.006	0	0.04252	-0.04252	0.00181

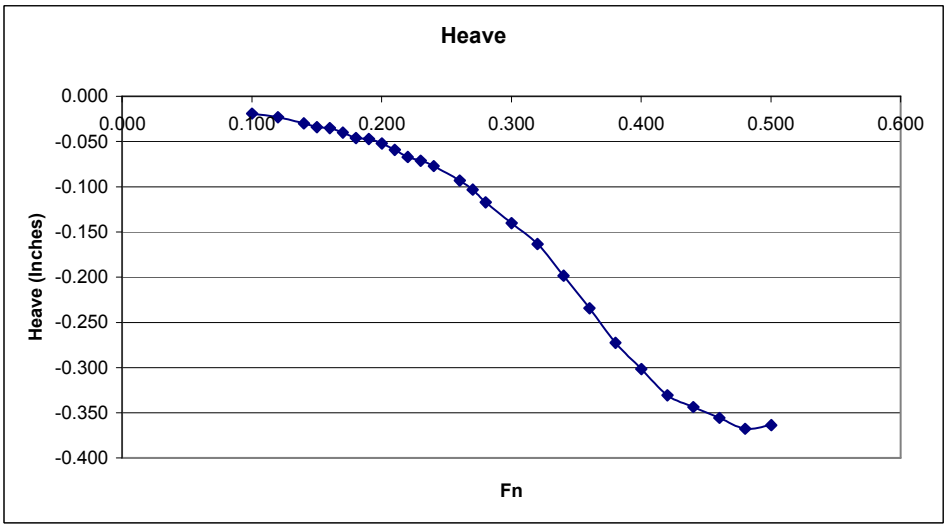
-0.001	0	0.04200	-0.04200	0.00177
-0.41	0.25	0.08454	0.16546	0.02736
-0.823	0.5	0.12749	0.37251	0.13872
-1.189	0.75	0.16556	0.58444	0.34152
-1.495	1	0.19738	0.80262	0.64412
-1.156	0.75	0.16212	0.58788	0.34554
-0.786	0.5	0.12364	0.37636	0.14161
-0.422	0.25	0.08579	0.16421	0.02695
-0.006	0	0.04252	-0.04252	0.00181

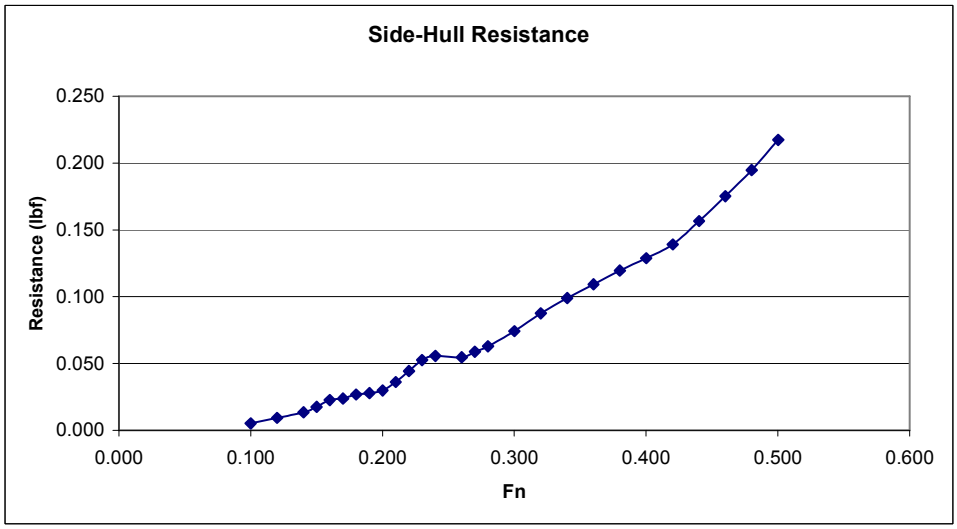
Gain	Bias
-0.6084	-0.0279
-0.6282	-0.0189

Mean	0.325844
Std Dev	0.4387 lbf
Uncertainty	0.3102 lbf

Transverse = 70% Longitudinal = 71.5%







CENTER HULL

Trimaran, Center Only
28-Apr-07 ++++++
Hama Thickness = 0.028 in

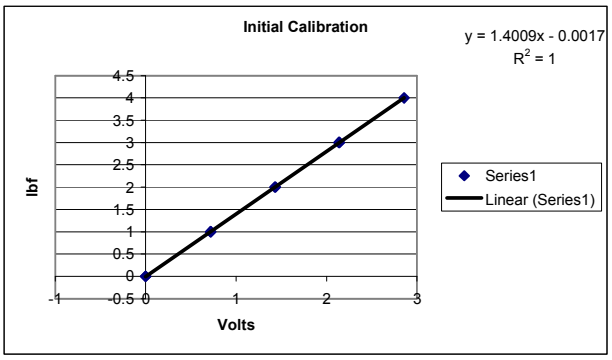
Correct Tow Point
No appendages ++++++

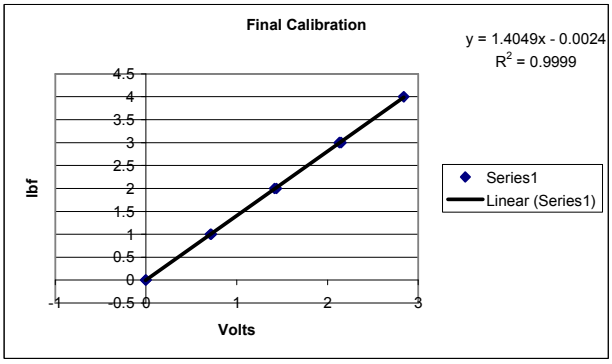
Water Temp 20 C
Calibration Angle 10.739

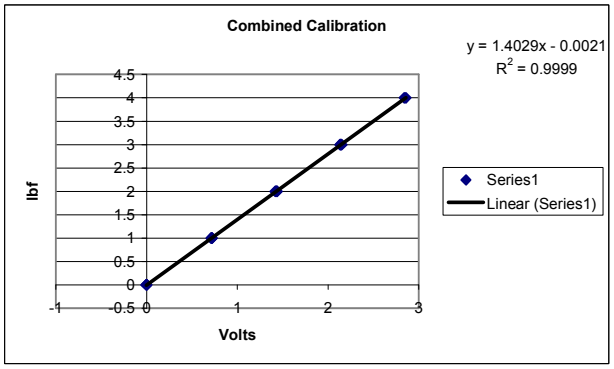
Total Disp 33.60 lbf

Calibrations

	Volts	lbf
Initial	-0.003	0
	0.717	1
	1.426	2
	2.137	3
	2.857	4
	2.143	3
	1.435	2
	0.72	1
	0	0
Final	-0.003	0
	0.71	1
	1.418	2
	2.13	3
	2.84	4
	2.151	3
	1.438	2
	0.72	1
	0	0







Center Hull

*Calibration Coefficients lbf = A*Volts + B*

A1	1.4009
B1	-0.0017
A2	1.4029
B2	-0.0021

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.012	0.054	0.066	0.047	0.066	0.065
2	1.802	-0.011	0.083	0.094	0.067	0.094	0.092
3	2.102	-0.014	0.108	0.122	0.087	0.122	0.120
4	2.252	-0.009	0.13	0.139	0.099	0.139	0.137
5	2.402	-0.02	0.136	0.156	0.111	0.156	0.153
6	2.702	-0.018	0.18	0.198	0.141	0.198	0.195
7	3.003	-0.022	0.225	0.247	0.176	0.247	0.243
8	3.153	-0.01	0.255	0.265	0.189	0.265	0.261
9	3.303	-0.021	0.29	0.311	0.222	0.311	0.306
10	3.453	-0.008	0.33	0.338	0.241	0.338	0.333
11	3.603	-0.014	0.342	0.356	0.254	0.357	0.350
12	3.753	-0.009	0.385	0.394	0.281	0.395	0.388
13	3.903	-0.01	0.417	0.427	0.305	0.428	0.420
14	4.054	-0.008	0.449	0.457	0.326	0.458	0.450
15	4.204	-0.008	0.485	0.493	0.352	0.494	0.485
16	4.504	-0.007	0.548	0.555	0.396	0.556	0.546
17	4.804	-0.005	0.615	0.620	0.443	0.621	0.610
18	5.105	-0.007	0.682	0.689	0.492	0.690	0.678
19	5.405	-0.011	0.779	0.790	0.564	0.791	0.777
20	5.705	-0.017	0.902	0.919	0.656	0.920	0.904
21	6.005	-0.022	1.036	1.058	0.755	1.060	1.041
22	6.306	-0.016	1.188	1.204	0.859	1.206	1.185
23	6.606	-0.018	1.351	1.369	0.977	1.371	1.347
24	6.906	-0.015	1.483	1.498	1.069	1.500	1.474
25	7.206	-0.011	1.621	1.632	1.165	1.634	1.606
26	7.507	-0.008	1.765	1.773	1.266	1.776	1.744

Model

FULL LOAD

LWL =	7	ft
BWL_{Center}	0.675	ft
Draft =	0.235833	ft
Displ, # =	33.60	
Displ, LT =	0.0	
WS =	5.12	ft^2

CONSTANTS

g=	32.17
ρ=	1.9334
ν=	1.05E-05

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0058	9.99E+05	0.0047	0.0011
1.802	0.0058	1.20E+06	0.0045	0.0012
2.102	0.0055	1.40E+06	0.0044	0.0011
2.252	0.0054	1.50E+06	0.0043	0.0011
2.402	0.0054	1.60E+06	0.0042	0.0011
2.702	0.0054	1.80E+06	0.0041	0.0012
3.003	0.0054	2.00E+06	0.0041	0.0014
3.153	0.0053	2.10E+06	0.0040	0.0013
3.303	0.0057	2.20E+06	0.0040	0.0017
3.453	0.0056	2.30E+06	0.0039	0.0017
3.603	0.0055	2.40E+06	0.0039	0.0015
3.753	0.0056	2.50E+06	0.0039	0.0017
3.903	0.0056	2.60E+06	0.0038	0.0017
4.054	0.0055	2.70E+06	0.0038	0.0017
4.204	0.0055	2.80E+06	0.0038	0.0018
4.504	0.0054	3.00E+06	0.0037	0.0017
4.804	0.0053	3.20E+06	0.0037	0.0016
5.105	0.0053	3.40E+06	0.0037	0.0016
5.405	0.0054	3.60E+06	0.0036	0.0018
5.705	0.0056	3.80E+06	0.0036	0.0020
6.005	0.0058	4.00E+06	0.0035	0.0023
6.306	0.0060	4.20E+06	0.0035	0.0025
6.606	0.0062	4.40E+06	0.0035	0.0028
6.906	0.0062	4.60E+06	0.0035	0.0028
7.206	0.0062	4.79E+06	0.0034	0.0028
7.507	0.0063	5.00E+06	0.0034	0.0029

Ship

FULL LOAD

LWL =	880.4	ft
BWL_{Center}	84.92	ft
Draft =	29.66	ft
Displ, # =	70987840	
Displ, LT =	31691.0	
WS =	80980	ft^2

CONSTANTS

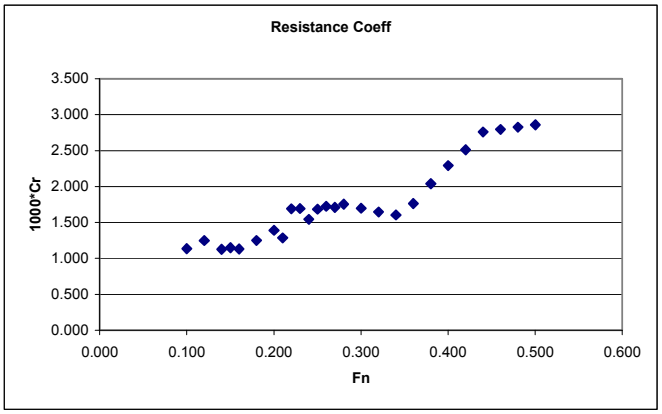
g=	32.17
ρ=	1.9905
ν=	1.28E-05

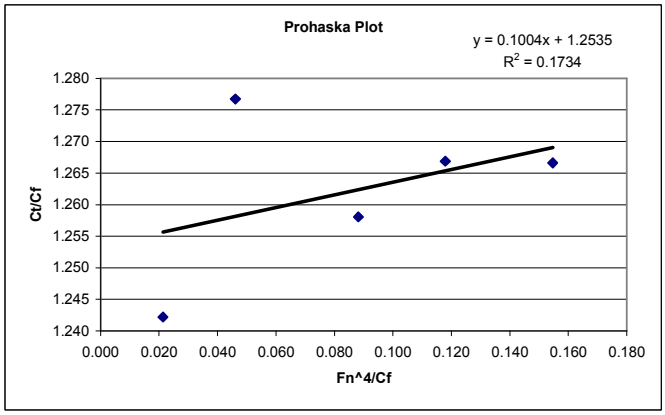
Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0011	1.16E+09	0.0015	0.0004	69398.4	0.100	14113	68964.8
12.0	20.21	0.0012	1.39E+09	0.0015	0.0004	102611.2	0.120	14113	101709.1
14.0	23.57	0.0011	1.62E+09	0.0014	0.0004	132968.2	0.140	14113	131432.7
15.0	25.26	0.0011	1.74E+09	0.0014	0.0004	153133.3	0.150	14113	151215.6
15.9	26.94	0.0011	1.85E+09	0.0014	0.0004	172609.4	0.160	14113	170264.6
17.9	30.30	0.0012	2.09E+09	0.0014	0.0004	225664.7	0.180	14113	222326.9
19.9	33.68	0.0014	2.32E+09	0.0014	0.0004	290084.7	0.200	14113	285559.0
20.9	35.36	0.0013	2.43E+09	0.0014	0.0004	308288.0	0.210	14113	303096.7
21.9	37.04	0.0017	2.55E+09	0.0014	0.0004	382294.4	0.220	14113	376387.7
22.9	38.73	0.0017	2.67E+09	0.0014	0.0004	417385.4	0.230	14113	410712.7
23.9	40.41	0.0015	2.78E+09	0.0014	0.0004	433722.8	0.240	14113	426232.9
24.9	42.09	0.0017	2.90E+09	0.0013	0.0004	489761.8	0.250	14113	481403.0
25.9	43.77	0.0017	3.01E+09	0.0013	0.0004	535122.6	0.260	14113	525842.6
26.9	45.47	0.0017	3.13E+09	0.0013	0.0004	573695.4	0.270	14113	563434.6
27.9	47.15	0.0018	3.25E+09	0.0013	0.0004	623915.2	0.280	14113	612626.6
29.9	50.51	0.0017	3.48E+09	0.0013	0.0004	702456.6	0.300	14113	688950.3
31.9	53.88	0.0016	3.71E+09	0.0013	0.0004	784754.5	0.320	14113	768811.4
33.9	57.25	0.0016	3.94E+09	0.0013	0.0004	872690.0	0.340	14113	854078.1
35.9	60.62	0.0018	4.17E+09	0.0013	0.0004	1023071.6	0.360	14113	1001573.8
37.9	63.98	0.0020	4.40E+09	0.0013	0.0004	1227704.9	0.380	14113	1203092.4
39.9	67.35	0.0023	4.64E+09	0.0013	0.0004	1450342.9	0.400	14113	1422384.2
41.9	70.72	0.0025	4.87E+09	0.0013	0.0004	1684766.1	0.420	14113	1653214.6
43.9	74.09	0.0028	5.10E+09	0.0013	0.0004	1955585.0	0.440	14113	1920215.6
45.9	77.45	0.0028	5.33E+09	0.0013	0.0004	2151780.1	0.460	14113	2112353.8
47.8	80.81	0.0028	5.56E+09	0.0013	0.0004	2356009.4	0.480	14113	2312284.9
49.8	84.19	0.0029	5.79E+09	0.0012	0.0004	2572097.4	0.500	14113	2523815.7

Center Hull

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.136	0.021	1.242
0.120	1.248	0.046	1.277
0.140	1.126	0.088	1.258
0.150	1.148	0.118	1.267
0.160	1.132	0.155	1.267
0.180	1.249	0.254	1.302
0.200	1.391	0.396	1.343
0.210	1.284	0.485	1.320
0.220	1.690	0.590	1.425
0.230	1.693	0.711	1.429
0.240	1.543	0.850	1.395
0.250	1.683	1.009	1.434
0.260	1.725	1.189	1.448
0.270	1.709	1.394	1.447
0.280	1.753	1.624	1.462
0.300	1.697	2.169	1.454
0.320	1.645	2.842	1.445
0.340	1.603	3.666	1.439
0.360	1.763	4.658	1.488
0.380	2.038	5.841	1.570
0.400	2.292	7.240	1.647
0.420	2.510	8.886	1.715
0.440	2.758	10.795	1.793
0.460	2.795	13.001	1.810
0.480	2.826	15.534	1.825
0.500	2.858	18.436	1.841





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.003	0	-0.00631	0.0063087	3.9E-05
0.717	1	1.003779	-0.0037793	1.48E-05
1.426	2	1.998435	0.0015646	2.25E-06
2.137	3	2.995897	0.0041027	1.63E-05
2.857	4	4.005985	-0.0059853	3.66E-05
2.143	3	3.004315	-0.0043147	1.92E-05
1.435	2	2.011062	-0.0110615	0.000124
0.72	1	1.007988	-0.007988	6.49E-05
0	0	-0.0021	0.0021	4.14E-06
-0.003	0	-0.00631	0.0063087	3.9E-05
0.71	1	0.993959	0.006041	3.57E-05
1.418	2	1.987212	0.0127878	0.000162
2.13	3	2.986077	0.013923	0.000192
2.84	4	3.982136	0.017864	0.000317
2.151	3	3.015538	-0.0155379	0.000243
1.438	2	2.01527	-0.0152702	0.000235
0.72	1	1.007988	-0.007988	6.49E-05
0	0	-0.0021	0.0021	4.14E-06

Mean 6.53111E-05

Std Dev 0.0097 lbf

Uncertainty 0.0069 lbf

Center Hull

Trim

Run	Speed	Zero	deg	Zero Corrected	Combined Calibration
1	1.501	-0.099	-0.103	-0.004	-0.004
2	1.802	-0.099	-0.105	-0.006	-0.006
3	2.102	-0.105	-0.112	-0.007	-0.007
4	2.252	-0.073	-0.082	-0.009	-0.009
5	2.402	-0.090	-0.102	-0.012	-0.012
6	2.702	-0.097	-0.113	-0.016	-0.016
7	3.003	-0.082	-0.101	-0.019	-0.019
8	3.153	-0.073	-0.094	-0.021	-0.021
9	3.303	-0.092	-0.117	-0.025	-0.025
10	3.453	-0.074	-0.100	-0.026	-0.026
11	3.603	-0.086	-0.111	-0.025	-0.025
12	3.753	-0.073	-0.097	-0.024	-0.024
13	3.903	-0.085	-0.113	-0.028	-0.028
14	4.054	-0.073	-0.100	-0.027	-0.027
15	4.204	-0.087	-0.112	-0.025	-0.025
16	4.504	-0.089	-0.110	-0.021	-0.021
17	4.804	-0.084	-0.112	-0.028	-0.028
18	5.105	-0.085	-0.125	-0.04	-0.040
19	5.405	-0.085	-0.096	-0.011	-0.011
20	5.705	-0.093	-0.026	0.067	0.067
21	6.005	-0.079	0.101	0.18	0.180
22	6.306	-0.093	0.234	0.327	0.327
23	6.606	-0.089	0.372	0.461	0.461
24	6.906	-0.106	0.496	0.602	0.602
25	7.206	-0.097	0.607	0.704	0.704
26	7.507	-0.070	0.730	0.8	0.800

Heave

Run	Speed	Zero	inch	Zero Corrected	Combined Calibration
1	1.501	0.052	0.03	-0.022	-0.022
2	1.802	0.051	0.026	-0.025	-0.025
3	2.102	0.049	0.022	-0.027	-0.027
4	2.252	0.043	0.015	-0.028	-0.028
5	2.402	0.047	0.014	-0.033	-0.033
6	2.702	0.049	0.007	-0.042	-0.042
7	3.003	0.048	-0.003	-0.051	-0.051
8	3.153	0.047	-0.011	-0.058	-0.058
9	3.303	0.048	-0.016	-0.064	-0.064
10	3.453	0.046	-0.024	-0.07	-0.070
11	3.603	0.046	-0.027	-0.073	-0.073
12	3.753	0.044	-0.036	-0.08	-0.080
13	3.903	0.047	-0.042	-0.089	-0.089
14	4.054	0.044	-0.053	-0.097	-0.097
15	4.204	0.044	-0.062	-0.106	-0.106
16	4.504	0.047	-0.084	-0.131	-0.132
17	4.804	0.047	-0.111	-0.158	-0.159
18	5.105	0.047	-0.138	-0.185	-0.186
19	5.405	0.047	-0.169	-0.216	-0.217
20	5.705	0.05	-0.208	-0.258	-0.259
21	6.005	0.048	-0.244	-0.292	-0.293
22	6.306	0.049	-0.266	-0.315	-0.316
23	6.606	0.049	-0.289	-0.338	-0.339
24	6.906	0.049	-0.305	-0.354	-0.355
25	7.206	0.048	-0.317	-0.365	-0.366
26	7.507	0.052	-0.326	-0.378	-0.379

Trim

Error Analysis

Volts	deg	Predicted	Difference	Dev. ^2
-0.005	0	-0.05864	0.05864	0.00343
0.268	-0.4	-0.39522	-0.00478	0.00002
0.422	-0.6	-0.58508	-0.01492	0.00022
0.58	-0.8	-0.77988	-0.02012	0.00041
-0.43	0.5	0.46535	0.03465	0.00120
-0.637	0.7	0.72056	-0.02056	0.00043
-1.043	1.2	1.22111	-0.02111	0.00045
-1.833	2.2	2.19511	0.00489	0.00002
-0.004	0	-0.05987	0.05987	0.00358
0.277	-0.4	-0.40631	0.00631	0.00004
0.429	-0.6	-0.59371	-0.00629	0.00004
0.586	-0.8	-0.78728	-0.01272	0.00016
-0.423	0.4	0.45672	-0.05672	0.00322
-0.628	0.7	0.70946	-0.00946	0.00009
-1.035	1.2	1.21125	-0.01125	0.00013
-1.826	2.2	2.18648	0.01352	0.00018

Gain	Bias			
-1.2335	-0.0629	**Mean**	-2.2375E-06	
-1.2329	-0.0648	**Std Dev**	0.0301	Degrees
		Uncertainty	0.0226	Degrees

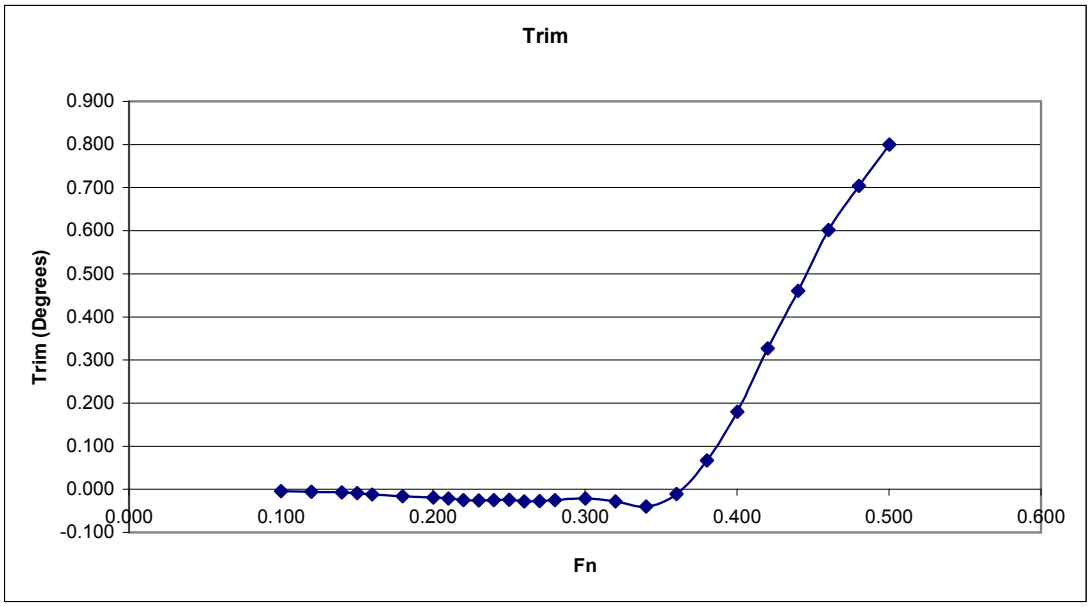
Heave

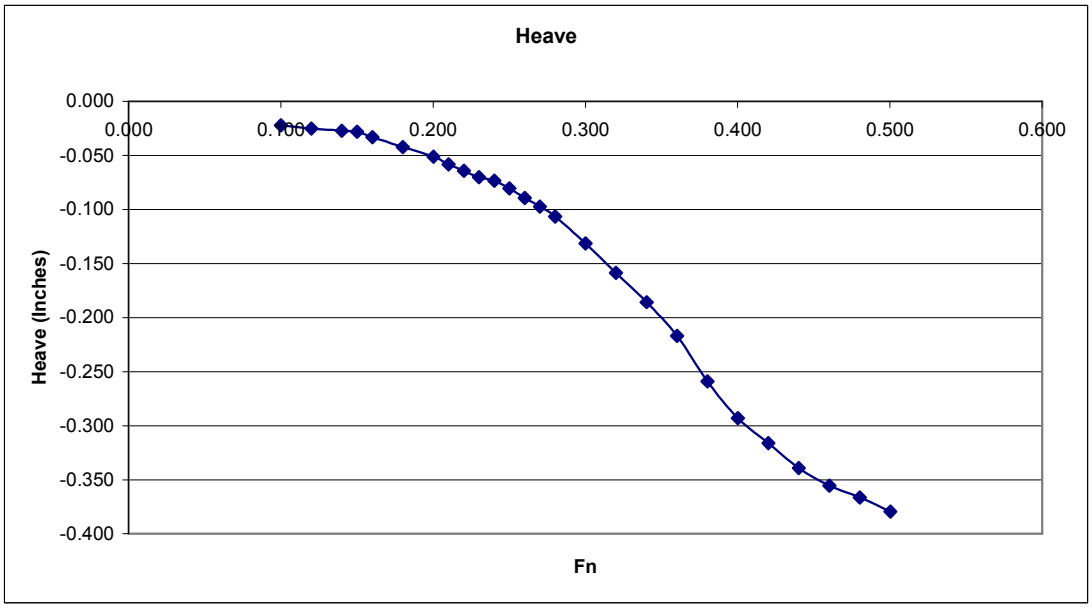
Error Analysis

Volts	inch	Predicted	Difference	Dev. ^2
0.021	0.000	0.04261	-0.04261	0.00182
-2.59	0.339	0.31494	0.02456	0.00060
-3.884	0.470	0.44990	0.02060	0.00042
-4.808	0.573	0.54627	0.02623	0.00068
-7.501	0.817	0.82715	-0.01065	0.00011
1.758	-0.138	-0.13856	0.00106	0.00000
4.354	-0.379	-0.40932	0.03082	0.00095
0.107	0.000	0.03364	-0.03364	0.00114
-2.554	0.320	0.31118	0.00832	0.00007
-3.828	0.445	0.44406	0.00044	0.00000
-4.755	0.551	0.54075	0.00975	0.00009
-7.436	0.801	0.82037	-0.01937	0.00038
1.849	-0.168	-0.14805	-0.01995	0.00040
4.401	-0.410	-0.41422	0.00422	0.00002

Gain	Bias			
-0.1039	0.0526	**Mean**	-1.6E-05	
-0.1043	0.0448	**Std Dev**	0.0227	Inches
		Uncertainty	0.0182	Inches

Center Hull


Trim
Trim (Degrees)
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
0.000
0.100
0.200
0.300
0.400
0.500
0.600
Fn


Heave
Heave (Inches)
0.000
-0.050
-0.100
-0.150
-0.200
-0.250
-0.300
-0.350
-0.400
0.000
0.100
0.200
0.300
0.400
0.500
0.600
Fn

CENTER HULL WITH APPARATUS (AIR RESISTANCE)

Trimaran, Center - Air Resistance
9-May-07 ++++++
Hama Thickness = 0.028 in

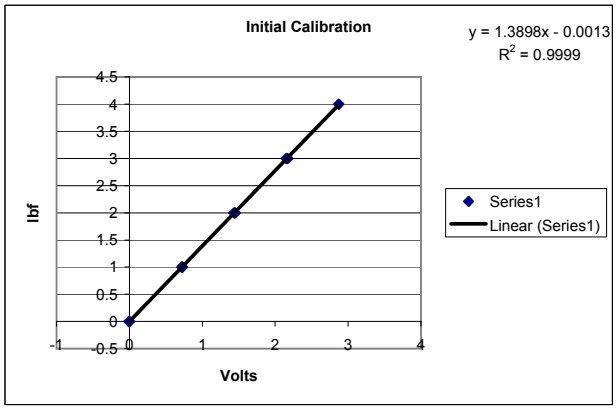
Correct Tow Point
No appendages ++++++

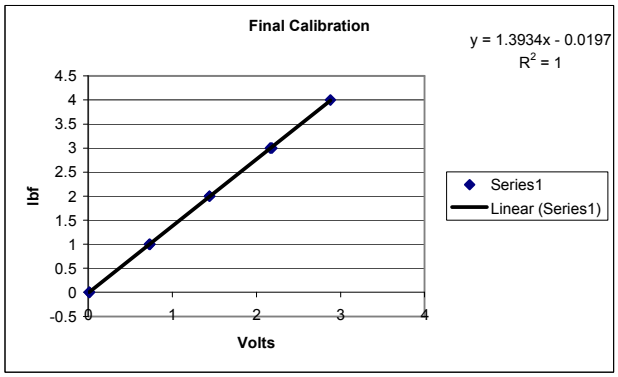
Water Temp 20 C
Calibration Angle **5.819**

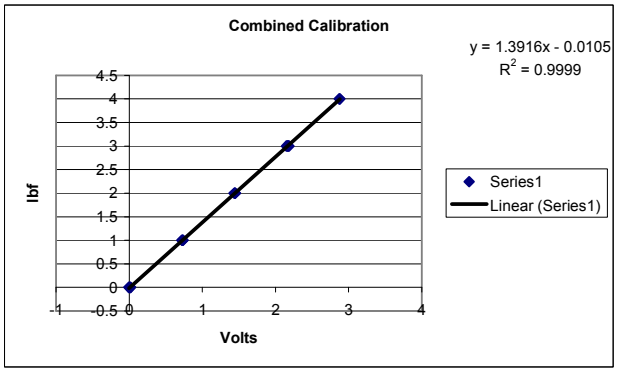
Total Disp 33.60 lbf

Calibrations

	Volts	lbf
Initial	-0.004	0
	0.721	1
	1.435	2
	2.151	3
	2.873	4
	2.17	3
	1.451	2
	0.726	1
	-0.002	0
Final	0.014	0
	0.729	1
	1.442	2
	2.166	3
	2.88	4
	2.183	3
	1.444	2
	0.735	1
	0.017	0







Center Hull with Apparatus (Air Resistance)

*Calibration Coefficients lbf = A*Volts + B*

A1	1.3898
B1	-0.0013
A2	1.3916
B2	-0.0105

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.01	0.055	0.065	0.047	0.065	0.065
2	2.102	-0.004	0.113	0.117	0.084	0.117	0.117
3	2.702	0.002	0.199	0.197	0.142	0.197	0.196
4	3.303	0.009	0.309	0.300	0.216	0.300	0.299
5	3.903	0.011	0.436	0.425	0.306	0.426	0.423
6	4.504	0.011	0.564	0.553	0.398	0.554	0.551
7	5.105	0.011	0.703	0.692	0.498	0.693	0.689
8	5.705	0.01	0.929	0.919	0.661	0.920	0.915
9	6.306	0.008	1.223	1.215	0.874	1.217	1.210
10	6.906	0.001	1.499	1.498	1.078	1.500	1.492
11	7.507	-0.007	1.753	1.760	1.266	1.762	1.753

Model

FULL LOAD			CONSTANTS	
LWL =	7	ft	g=	32.17
BWL_{Center}	0.675	ft	ρ=	1.9334
Draft =	0.235833	ft	ν=	1.05E-05
Displ, # =	33.60			
Displ, LT =	0.0			
WS =	5.12	ft^2		

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0058	9.99E+05	0.0047	0.0011
2.102	0.0053	1.40E+06	0.0044	0.0010
2.702	0.0054	1.80E+06	0.0041	0.0013
3.303	0.0055	2.20E+06	0.0040	0.0016
3.903	0.0056	2.60E+06	0.0038	0.0018
4.504	0.0055	3.00E+06	0.0037	0.0017
5.105	0.0053	3.40E+06	0.0037	0.0017
5.705	0.0057	3.80E+06	0.0036	0.0021
6.306	0.0062	4.20E+06	0.0035	0.0026
6.906	0.0063	4.60E+06	0.0035	0.0029
7.507	0.0063	5.00E+06	0.0034	0.0029

Ship

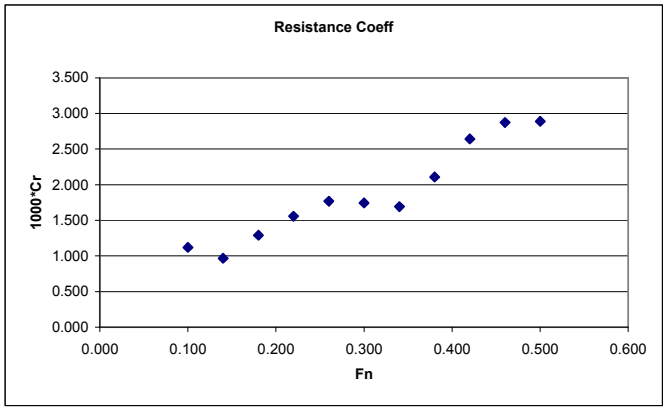
FULL LOAD			CONSTANTS	
LWL =	880.4	ft	g=	32.17
BWL_{Center}	84.92	ft	ρ=	1.9905
Draft =	29.66	ft	ν=	1.28E-05
Displ, # =	70987840			
Displ, LT =	31691.0			
WS =	80980	ft^2		

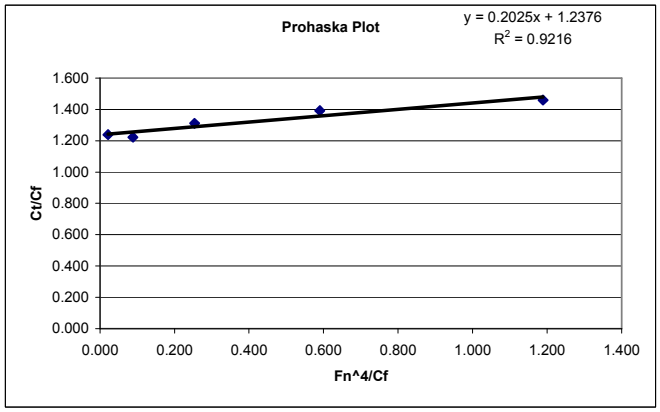
Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	0.0011	1.16E+09	0.0015	0.0004	69013.6	0.100	17522	68034.2
14.0	23.57	0.0010	1.62E+09	0.0014	0.0004	125826.1	0.140	17522	123263.2
17.9	30.30	0.0013	2.09E+09	0.0014	0.0004	228591.4	0.180	17522	223606.2
21.9	37.04	0.0016	2.55E+09	0.0014	0.0004	367650.5	0.220	17522	359339.7
25.9	43.77	0.0018	3.01E+09	0.0013	0.0004	541753.7	0.260	17522	529181.5
29.9	50.51	0.0017	3.48E+09	0.0013	0.0004	712298.8	0.300	17522	694480.4
33.9	57.25	0.0017	3.94E+09	0.0013	0.0004	896096.6	0.340	17522	872024.2
37.9	63.98	0.0021	4.40E+09	0.0013	0.0004	1250759.9	0.380	17522	1219413.7
41.9	70.72	0.0026	4.87E+09	0.0013	0.0004	1737416.9	0.420	17522	1697731.1
45.9	77.45	0.0029	5.33E+09	0.0013	0.0004	2189360.5	0.460	17522	2140277.7
49.8	84.19	0.0029	5.79E+09	0.0012	0.0004	2590049.6	0.500	17522	2530464.0

Center Hull with Apparatus (Air Resistance)

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.100	1.119	0.021	1.239
0.140	0.967	0.088	1.222
0.180	1.289	0.254	1.311
0.220	1.557	0.590	1.391
0.260	1.767	1.189	1.459
0.300	1.745	2.169	1.466
0.340	1.692	3.666	1.463
0.380	2.107	5.841	1.589
0.420	2.641	8.886	1.753
0.460	2.872	13.001	1.832
0.500	2.889	18.436	1.850





Error Analysis

Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.004	0	-0.01607	0.0160664	0.000258
0.721	1	0.992844	0.0071564	5.13E-05
1.435	2	1.986446	0.013554	0.000184
2.151	3	2.982832	0.0171684	0.000295
2.873	4	3.987567	0.0124332	0.000155
2.17	3	3.009272	-0.009272	8.59E-05
1.451	2	2.008712	-0.0087116	7.58E-05
0.726	1	0.999802	0.0001984	4.16E-08
-0.002	0	-0.01328	0.0132832	0.000177
0.014	0	0.008982	-0.0089824	8.06E-05
0.729	1	1.003976	-0.0039764	1.58E-05
1.442	2	1.996187	0.0038128	1.46E-05
2.166	3	3.003706	-0.0037056	1.37E-05
2.88	4	3.997308	0.002692	7.28E-06
2.183	3	3.027363	-0.0273628	0.000748
1.444	2	1.99897	0.0010296	1.07E-06
0.735	1	1.012326	-0.012326	0.000152
0.017	0	0.013157	-0.0131572	0.000173

Mean	-5.53333E-06	
Std Dev		0.0121 lbf
Uncertainty		0.0086 lbf

SIDE-HULL

Trimaran, STBD Side Only
11-May-07 ++++++
Hama Thickness = 0.028 in

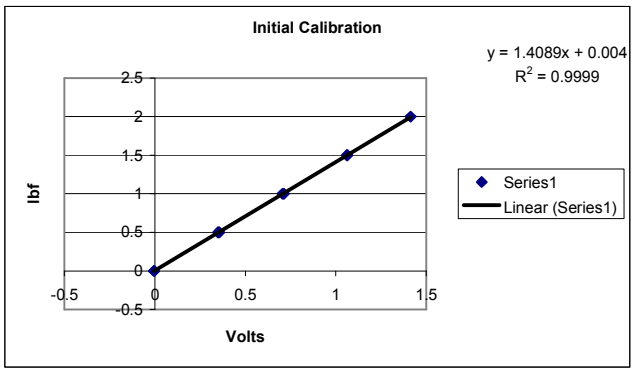
Correct Tow Point
No appendages ++++++

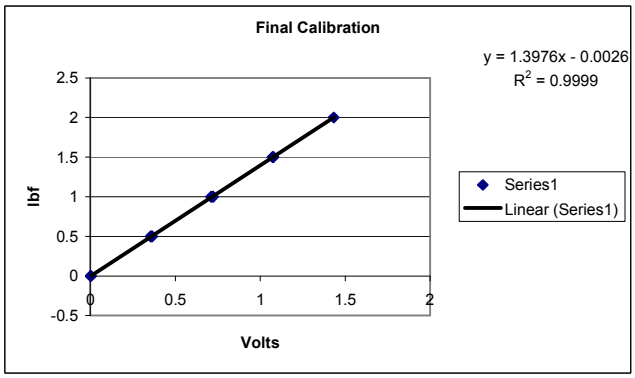
Water Temp 19 C
Calibration Angle 5.594

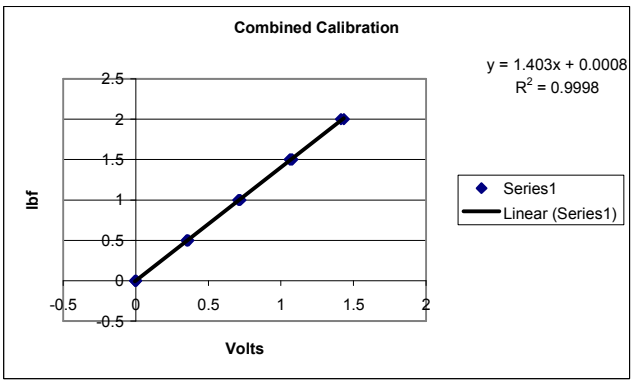
Total Disp 1.07 lbf

Calibrations

	Volts	lbf
Initial	-0.005	0
	0.349	0.5
	0.705	1
	1.061	1.5
	1.413	2
	1.064	1.5
	0.714	1
	0.356	0.5
	-0.004	0
Final	0.001	0
	0.355	0.5
	0.712	1
	1.073	1.5
	1.433	2
	1.078	1.5
	0.722	1
	0.363	0.5
	0.004	0







Side-Hull

*Calibration Coefficients lbf = A*Volts + B*

A1	1.4089
B1	0.004
A2	1.403
B2	0.0008

Run	*Speed*	*Zero*	*lbf*	*Zero Corrected*	*Volts*	*Combined Calibration*	*Angle Corrected*
1	1.501	-0.007	-0.003	0.004	0.003	0.004	0.004
2	1.802	0.004	0.014	0.010	0.007	0.010	0.010
3	2.102	0.005	0.022	0.017	0.012	0.017	0.017
4	2.402	0.006	0.026	0.020	0.014	0.020	0.020
5	2.702	0.007	0.034	0.027	0.019	0.027	0.027
6	3.003	0.007	0.039	0.032	0.023	0.032	0.032
7	3.303	0.006	0.049	0.043	0.031	0.043	0.043
8	3.603	0.005	0.052	0.047	0.033	0.047	0.047
9	3.903	0.005	0.065	0.060	0.043	0.060	0.059
10	4.204	0.005	0.074	0.069	0.049	0.069	0.068
11	4.504	0.005	0.082	0.077	0.055	0.077	0.076
12	4.804	0.005	0.093	0.088	0.062	0.088	0.087
13	5.105	0.005	0.102	0.097	0.069	0.097	0.096
14	5.405	0.006	0.112	0.106	0.075	0.106	0.105
15	5.705	0.007	0.12	0.113	0.080	0.113	0.112
16	6.005	0.007	0.128	0.121	0.086	0.120	0.120
17	6.306	0.007	0.138	0.131	0.093	0.130	0.130
18	6.606	0.006	0.153	0.147	0.104	0.146	0.146
19	6.906	0.006	0.16	0.154	0.109	0.153	0.153
20	7.206	0.005	0.181	0.176	0.125	0.175	0.174
21	7.507	-0.007	0.171	0.178	0.126	0.177	0.176

Model

FULL LOAD

LWL =	2	ft
BWL_{Center}	0.1	ft
Draft =	0.185833	ft
Displ, # =	1.07	
Displ, LT =	0.0	
WS =	0.62	ft^2

CONSTANTS

g=	32.17
ρ=	1.9334
ν=	1.05E-05

Speed (ft/s)	*Ct*	*Re*	*Cf*	*Cr*
1.501	0.0037	2.85E+05	0.0063	-0.0026
1.802	0.0051	3.43E+05	0.0060	-0.0009
2.102	0.0064	4.00E+05	0.0058	0.0006
2.402	0.0057	4.57E+05	0.0056	0.0001
2.702	0.0061	5.14E+05	0.0054	0.0007
3.003	0.0059	5.71E+05	0.0053	0.0006
3.303	0.0065	6.28E+05	0.0052	0.0013
3.603	0.0060	6.85E+05	0.0051	0.0009
3.903	0.0065	7.42E+05	0.0050	0.0015
4.204	0.0065	7.99E+05	0.0049	0.0015
4.504	0.0063	8.56E+05	0.0048	0.0014
4.804	0.0063	9.13E+05	0.0048	0.0015
5.105	0.0062	9.71E+05	0.0047	0.0014
5.405	0.0060	1.03E+06	0.0047	0.0013
5.705	0.0057	1.08E+06	0.0046	0.0011
6.005	0.0055	1.14E+06	0.0046	0.0010
6.306	0.0054	1.20E+06	0.0045	0.0009
6.606	0.0056	1.26E+06	0.0045	0.0011
6.906	0.0053	1.31E+06	0.0044	0.0009
7.206	0.0056	1.37E+06	0.0044	0.0012
7.507	0.0052	1.43E+06	0.0043	0.0009

Ship

FULL LOAD

LWL =	252.6	ft
BWL_{Center}	12.57	ft
Draft =	23.37	ft
Displ, # =	2128000	
Displ, LT =	950.0	
WS =	9808	ft^2

CONSTANTS

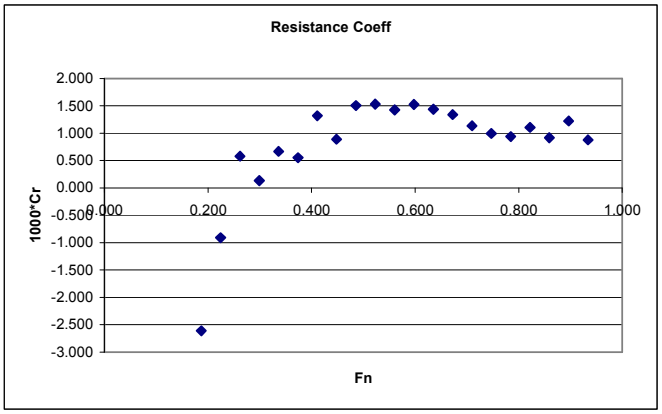
g=	32.17
ρ=	1.9905
ν=	1.28E-05

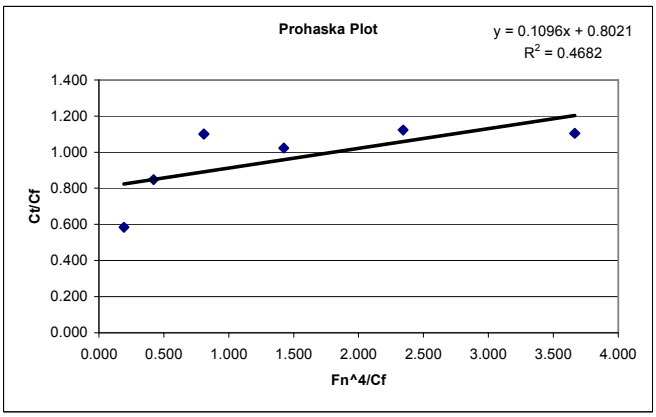
Speed Knots	*Speed (ft/s)*	*Cr*	*Re*	*Cf*	*Ca*	*Resist lbf*	*Fn*	*Random Error*	*Resist Prohaska lbf*
10.0	16.83	-0.0026	3.32E+08	0.0018	0.0004	-1240.6	0.187	13032	-2307.5
12.0	20.21	-0.0009	3.99E+08	0.0017	0.0004	4827.4	0.224	13032	3288.3
14.0	23.57	0.0006	4.66E+08	0.0017	0.0004	14469.0	0.262	13032	12373.2
15.9	26.94	0.0001	5.32E+08	0.0017	0.0004	15511.4	0.299	13032	12773.1
17.9	30.30	0.0007	5.98E+08	0.0016	0.0004	24213.4	0.336	13032	20746.6
19.9	33.68	0.0006	6.65E+08	0.0016	0.0004	28388.2	0.374	13032	24104.0
21.9	37.04	0.0013	7.32E+08	0.0016	0.0004	44329.3	0.411	13032	39144.3
23.9	40.41	0.0009	7.98E+08	0.0016	0.0004	45637.0	0.448	13032	39465.0
25.9	43.77	0.0015	8.64E+08	0.0016	0.0004	64803.5	0.486	13032	57558.5
27.9	47.15	0.0015	9.31E+08	0.0015	0.0004	75419.6	0.523	13032	67011.6
29.9	50.51	0.0014	9.98E+08	0.0015	0.0004	83634.8	0.560	13032	73981.3
31.9	53.88	0.0015	1.06E+09	0.0015	0.0004	97552.2	0.598	13032	86567.1
33.9	57.25	0.0014	1.13E+09	0.0015	0.0004	106997.9	0.635	13032	94590.1
35.9	60.62	0.0013	1.20E+09	0.0015	0.0004	116097.0	0.672	13032	102185.0
37.9	63.98	0.0011	1.26E+09	0.0015	0.0004	120766.2	0.710	13032	105263.8
39.9	67.35	0.0010	1.33E+09	0.0015	0.0004	127101.3	0.747	13032	109922.4
41.9	70.72	0.0009	1.40E+09	0.0015	0.0004	137102.8	0.785	13032	118155.0
43.9	74.09	0.0011	1.46E+09	0.0015	0.0004	158964.3	0.822	13032	138167.2
45.9	77.45	0.0009	1.53E+09	0.0015	0.0004	162204.3	0.859	13032	139471.7
47.8	80.81	0.0012	1.60E+09	0.0014	0.0004	195550.7	0.896	13032	170796.2
49.8	84.19	0.0009	1.66E+09	0.0014	0.0004	187912.6	0.934	13032	161043.0

Side-Hull

Plot Data

Fn	1000Cr	Fn^4/Cf	Ct/Cf
0.187	-2.612	0.194	0.584
0.224	-0.910	0.421	0.848
0.262	0.580	0.809	1.100
0.299	0.132	1.424	1.024
0.336	0.668	2.344	1.123
0.374	0.553	3.666	1.104
0.411	1.318	5.484	1.253
0.448	0.889	7.920	1.174
0.486	1.506	11.104	1.301
0.523	1.532	15.196	1.311
0.560	1.427	20.329	1.294
0.598	1.524	26.687	1.319
0.635	1.437	34.485	1.304
0.672	1.340	43.875	1.288
0.710	1.135	55.097	1.246
0.747	0.993	68.381	1.218
0.785	0.939	84.030	1.208
0.822	1.106	102.202	1.248
0.859	0.917	123.222	1.207
0.896	1.222	147.382	1.279
0.934	0.877	175.089	1.202





Error Analysis

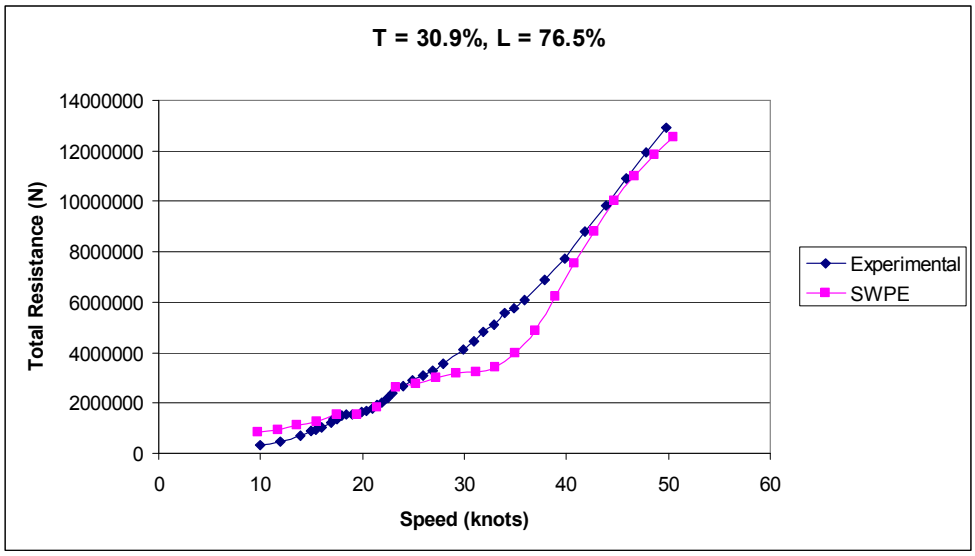
Volts	*lbf*	*Predicted*	*Difference*	*Dev. ^2*
-0.005	0	-0.00622	0.006215	3.88E-05
0.349	0.5	0.490447	0.009553	9.15E-05
0.705	1	0.989915	0.010085	0.000102
1.061	1.5	1.489383	0.010617	0.000113
1.413	2	1.983239	0.016761	0.000281
1.064	1.5	1.493592	0.006408	4.12E-05
0.714	1	1.002542	-0.002542	6.41E-06
0.356	0.5	0.500268	-0.000268	6.65E-08
-0.004	0	-0.00481	0.004812	2.33E-05
0.001	0	0.002203	-0.002203	4.81E-06
0.355	0.5	0.498865	0.001135	1.31E-06
0.712	1	0.999736	0.000264	7.51E-08
1.073	1.5	1.506219	-0.006219	3.86E-05
1.433	2	2.011299	-0.011299	0.000127
1.078	1.5	1.513234	-0.013234	0.000175
0.722	1	1.013766	-0.013766	0.000189
0.363	0.5	0.510089	-0.010089	0.000102
0.004	0	0.006412	-0.006412	4.1E-05

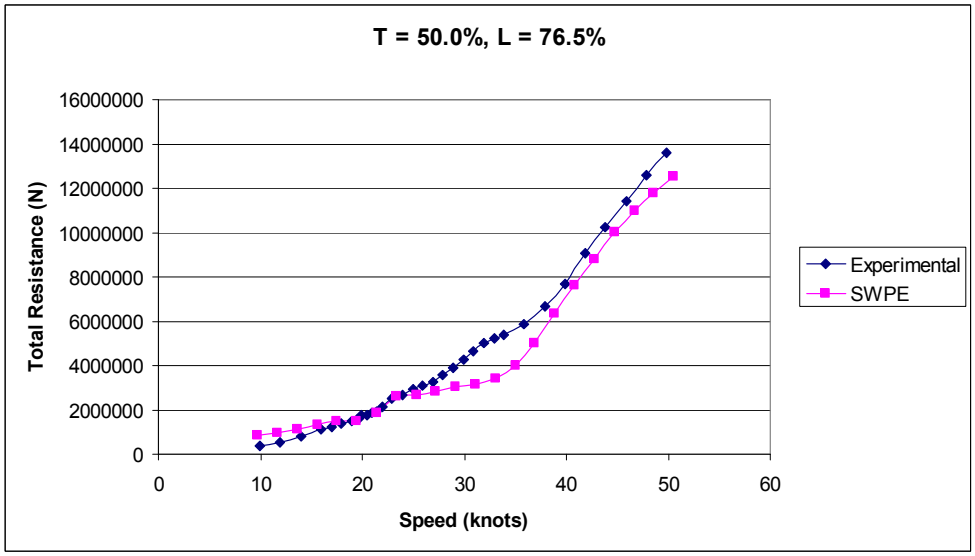
Mean	-1.01111E-05	
Std Dev		0.0090 lbf
Uncertainty		0.0064 lbf

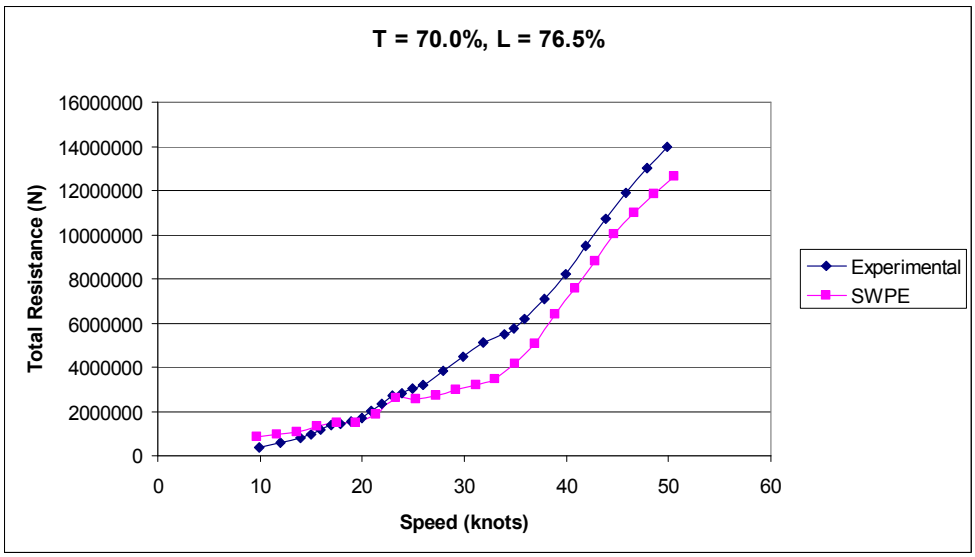
APPENDIX E

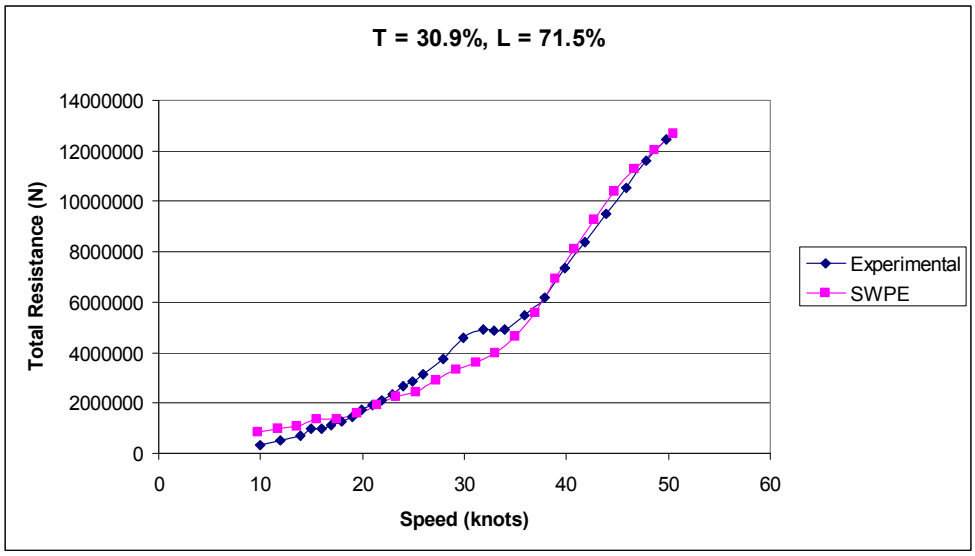
SWPE RESULTS

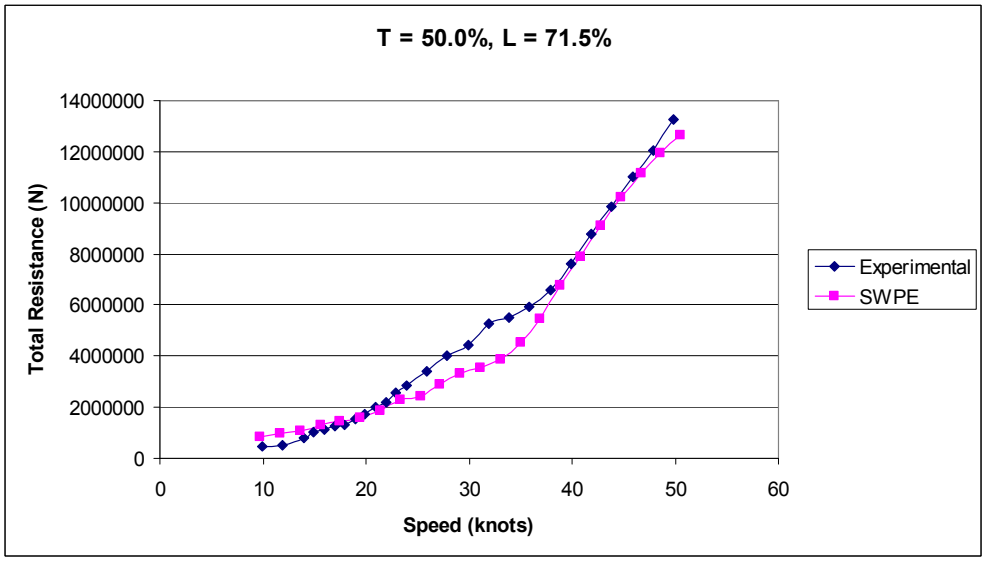
The following graphs compare the experimental results with the results using the SWPE program. In the speed range of 25 knots to 40 knots, SWPE underestimates the resistance by 20 – 35%. However, there is good agreement at the other speeds. The SWPE input files and program can be found on the CD.

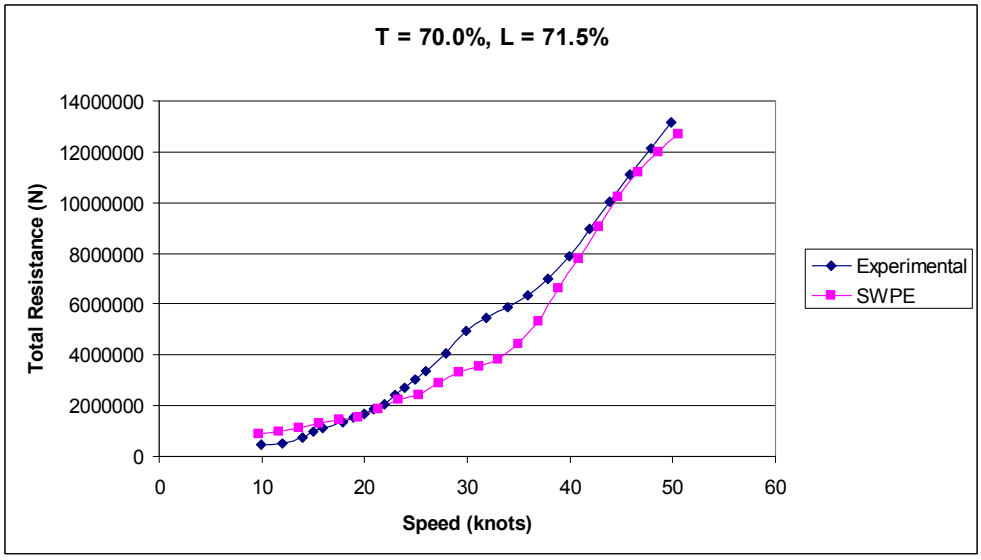

T = 30.9%, L = 76.5%
Total Resistance (N)
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE

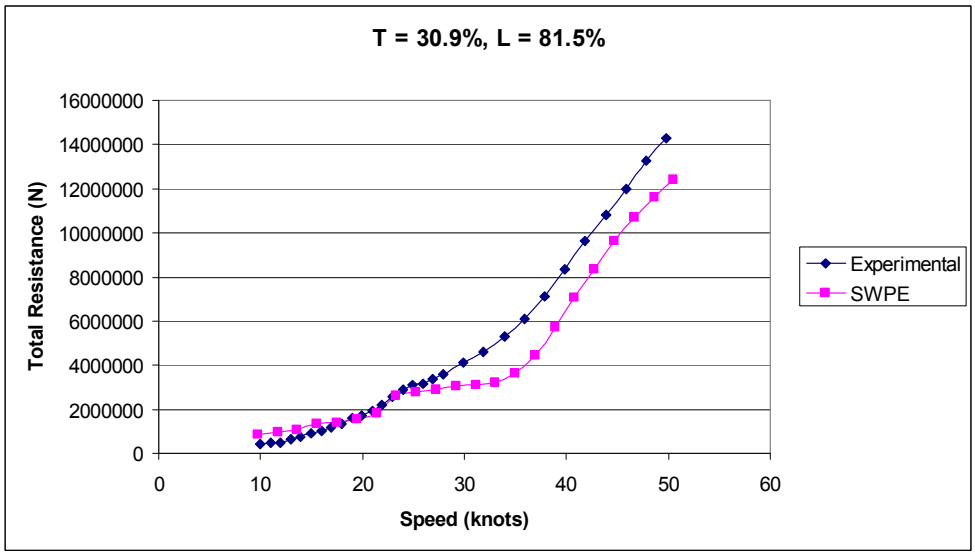

T = 50.0%, L = 76.5%
Total Resistance (N)
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE

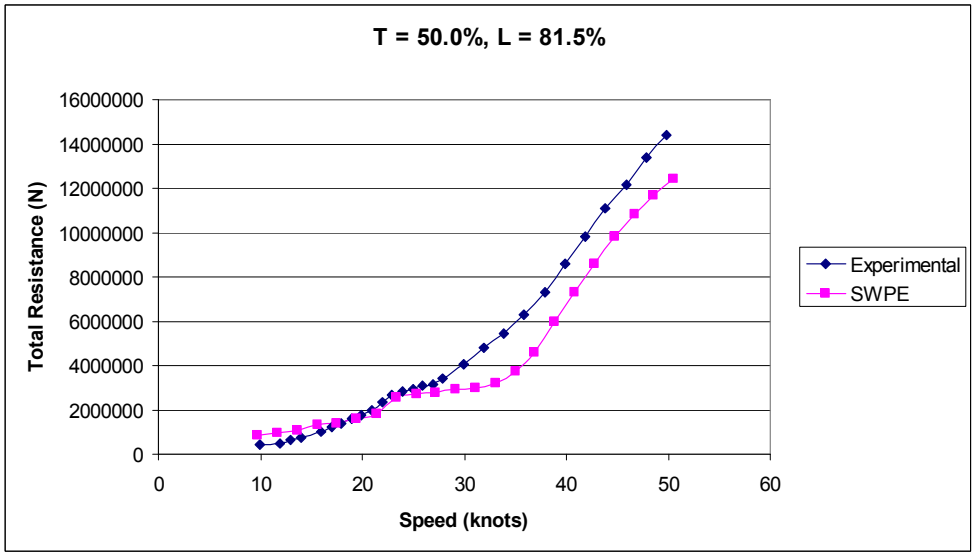

T = 70.0%, L = 76.5%
Total Resistance (N)
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE

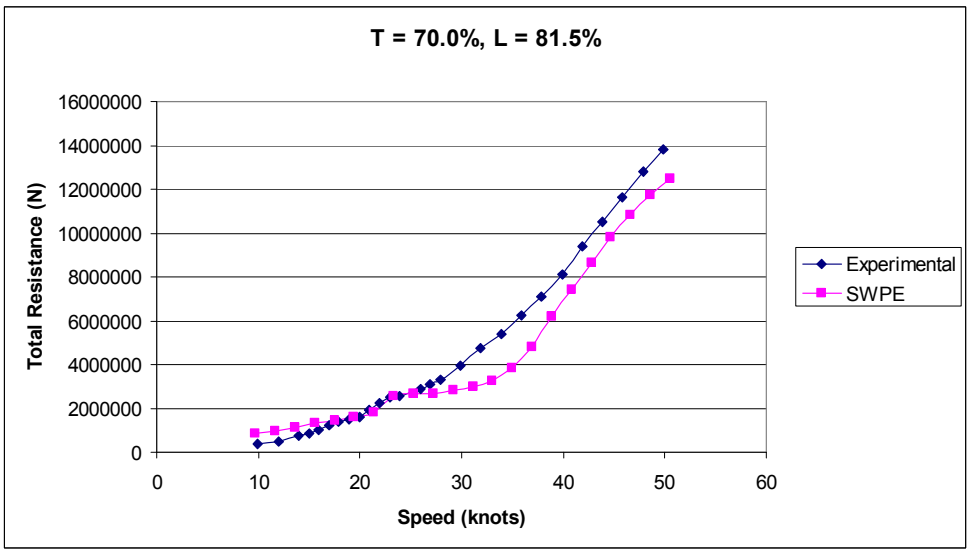

T = 30.9%, L = 71.5%
Total Resistance (N)
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE

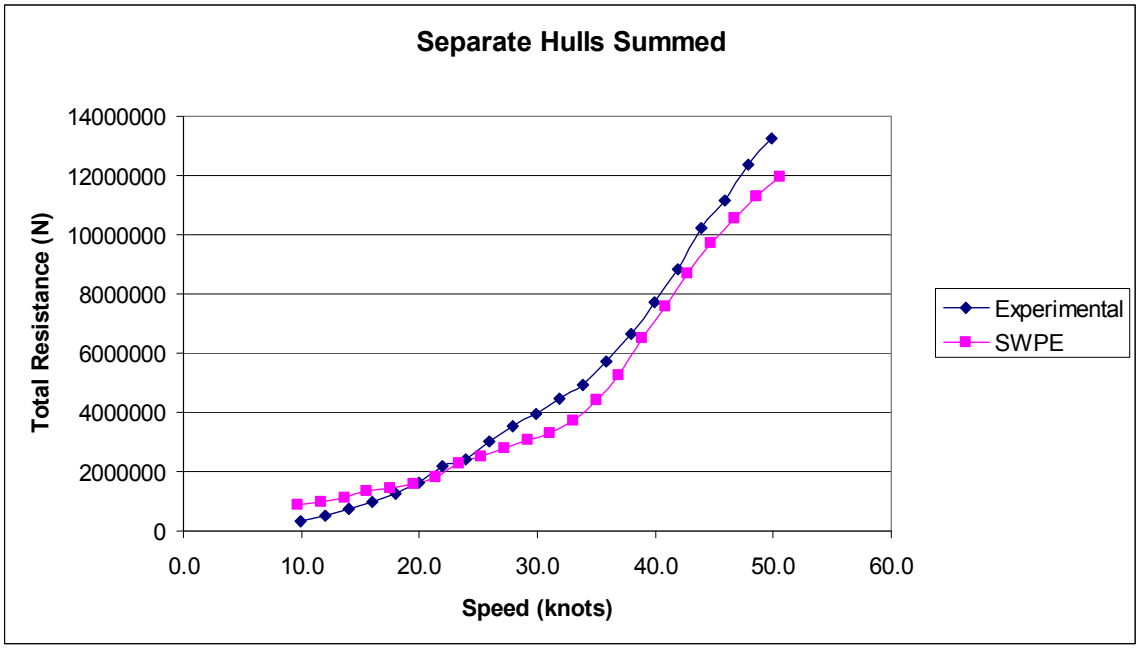

T = 50.0%, L = 71.5%
Total Resistance (N)
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE


T = 70.0%, L = 71.5%
Total Resistance (N)
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE


T = 30.9%, L = 81.5%
Total Resistance (N)
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE


T = 50.0%, L = 81.5%
Total Resistance (N)
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE


T = 70.0%, L = 81.5%
Total Resistance (N)
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0
10
20
30
40
50
60
Speed (knots)
Experimental
SWPE


Separate Hulls Summed
Total Resistance (N)
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Speed (knots)
Experimental
SWPE

APPENDIX F

TESTING RESULTS

This section shows the plots of percentage interference, total resistance coefficient, and residuary resistance coefficient for all of the configurations plus the hulls tested separately and summed.

Hulls Tested Separately and Summed

Fr	C_T	C_R
	(10^3)	(10^3)
0.10	5.386	0.387
0.12	5.607	0.809
0.14	5.641	1.001
0.16	5.427	0.931
0.18	5.514	1.022
0.20	5.509	1.094
0.22	5.814	1.358
0.24	5.538	1.189
0.26	5.737	1.634
0.28	5.704	1.642
0.30	5.584	1.500
0.32	5.511	1.632
0.34	5.413	1.648
0.36	5.479	1.618
0.38	5.620	1.614
0.40	5.758	1.541
0.42	5.888	1.489
0.44	6.086	1.489
0.46	6.048	1.580
0.48	6.102	1.859
0.50	6.033	1.996

Total Resistance Coefficient and Percentage Interference at a Constant Transverse Location

L =	71.5%		76.5%		81.5%	
T =	30.9%		30.9%		30.9%	
Fr	C_T	% Inter	C_T	% Inter	C_T	% Inter
	(10^3)		(10^3)		(10^3)	
0.10	6.086	13.0%	5.590	3.8%	6.389	18.6%
0.12	5.320	-5.1%	5.474	-2.4%	5.534	-1.3%
0.14	5.516	-2.2%	5.521	-2.1%	5.531	-2.0%
0.16	5.622	3.6%	5.767	6.3%	5.833	7.5%
0.18	5.635	2.2%	6.105	10.7%	5.650	2.5%
0.20	5.710	3.6%	5.626	2.1%	5.582	1.3%
0.22	5.902	1.5%	5.671	-2.5%	5.607	-3.6%
0.24	6.178	11.6%	5.997	8.3%	5.858	5.8%
0.26	5.878	2.5%	5.863	2.2%	6.074	5.9%
0.28	5.772	1.2%	5.814	1.9%	6.163	8.0%
0.30	5.736	2.7%	5.829	4.4%	6.381	14.3%
0.32	5.622	2.0%	5.865	6.4%	6.225	13.0%
0.34	5.673	4.8%	5.933	9.6%	6.011	11.1%
0.36	5.740	4.8%	5.806	6.0%	5.816	6.1%
0.38	5.885	4.7%	5.826	3.7%	5.747	2.3%
0.40	6.086	5.7%	5.859	1.7%	5.801	0.8%
0.42	6.238	5.9%	5.960	1.2%	5.893	0.1%
0.44	6.320	3.8%	6.015	-1.2%	5.940	-2.4%
0.46	6.368	5.3%	6.059	0.2%	5.981	-1.1%
0.48	6.417	5.2%	6.044	-1.0%	5.973	-2.1%
0.50	6.369	5.6%	6.023	-0.2%	5.956	-1.3%

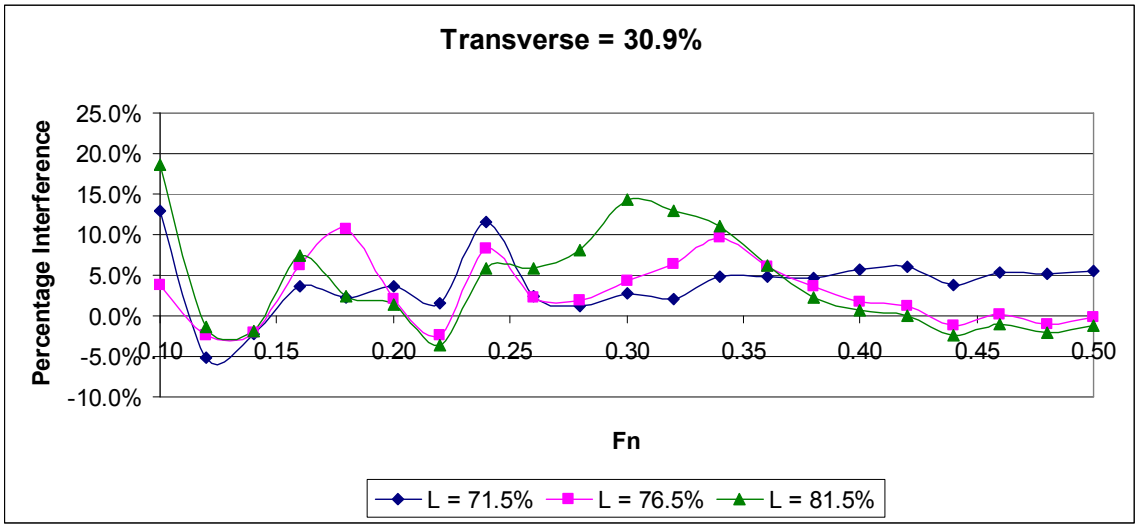
Total Resistance Coefficient and Percentage Interference at a Constant Transverse Location

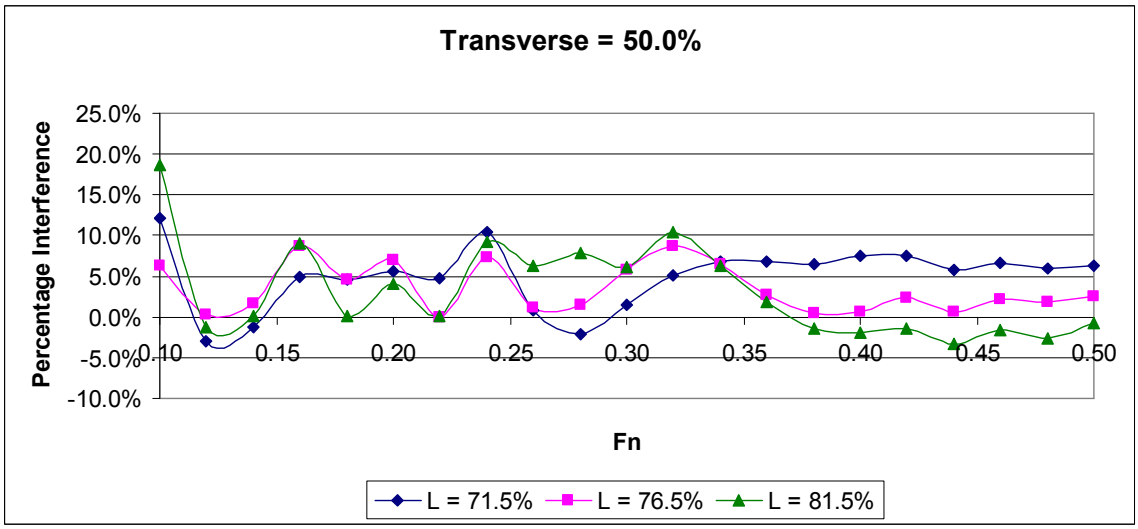
L =	71.5%		76.5%		81.5%	
T =	50.0%		50.0%		50.0%	
Fr	C_T	% Inter	C_T	% Inter	C_T	% Inter
	(10^3)		(10^3)		(10^3)	
0.10	6.035	12.1%	5.728	6.4%	6.395	18.7%
0.12	5.438	-3.0%	5.619	0.2%	5.539	-1.2%
0.14	5.572	-1.2%	5.736	1.7%	5.645	0.1%
0.16	5.697	5.0%	5.902	8.8%	5.922	9.1%
0.18	5.765	4.6%	5.768	4.6%	5.522	0.1%
0.20	5.820	5.6%	5.889	6.9%	5.730	4.0%
0.22	6.086	4.7%	5.814	0.0%	5.819	0.1%
0.24	6.112	10.4%	5.942	7.3%	6.050	9.2%
0.26	5.782	0.8%	5.804	1.2%	6.101	6.3%
0.28	5.581	-2.2%	5.790	1.5%	6.149	7.8%
0.30	5.668	1.5%	5.903	5.7%	5.924	6.1%
0.32	5.788	5.0%	5.986	8.6%	6.083	10.4%
0.34	5.780	6.8%	5.767	6.5%	5.756	6.3%
0.36	5.849	6.7%	5.630	2.7%	5.577	1.8%
0.38	5.986	6.5%	5.648	0.5%	5.538	-1.5%
0.40	6.192	7.5%	5.791	0.6%	5.649	-1.9%
0.42	6.325	7.4%	6.024	2.3%	5.800	-1.5%
0.44	6.442	5.9%	6.125	0.6%	5.882	-3.4%
0.46	6.444	6.6%	6.182	2.2%	5.953	-1.6%
0.48	6.467	6.0%	6.212	1.8%	5.938	-2.7%
0.50	6.414	6.3%	6.184	2.5%	5.987	-0.8%

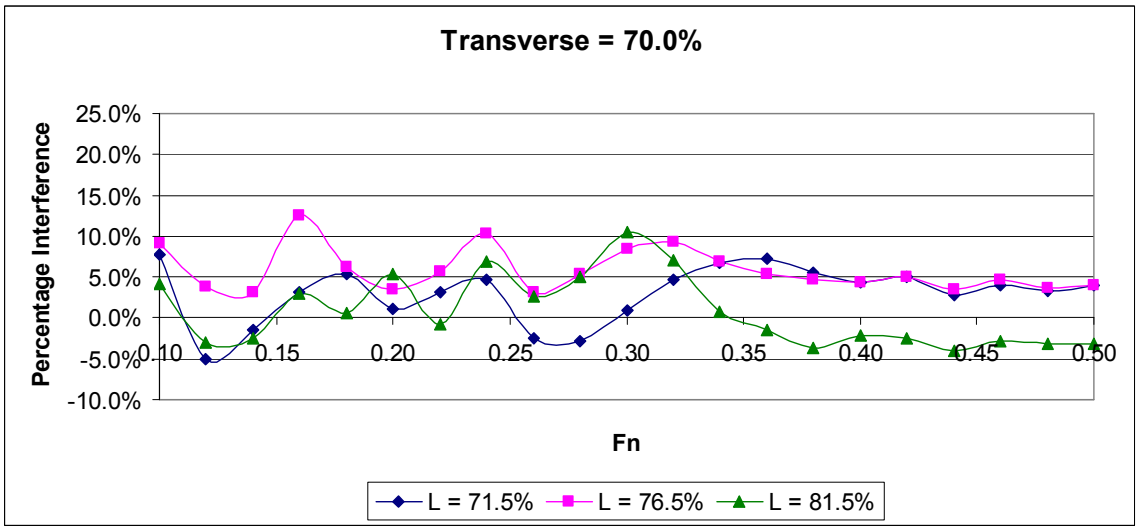
Total Resistance Coefficient and Percentage Interference at a Constant Transverse Location

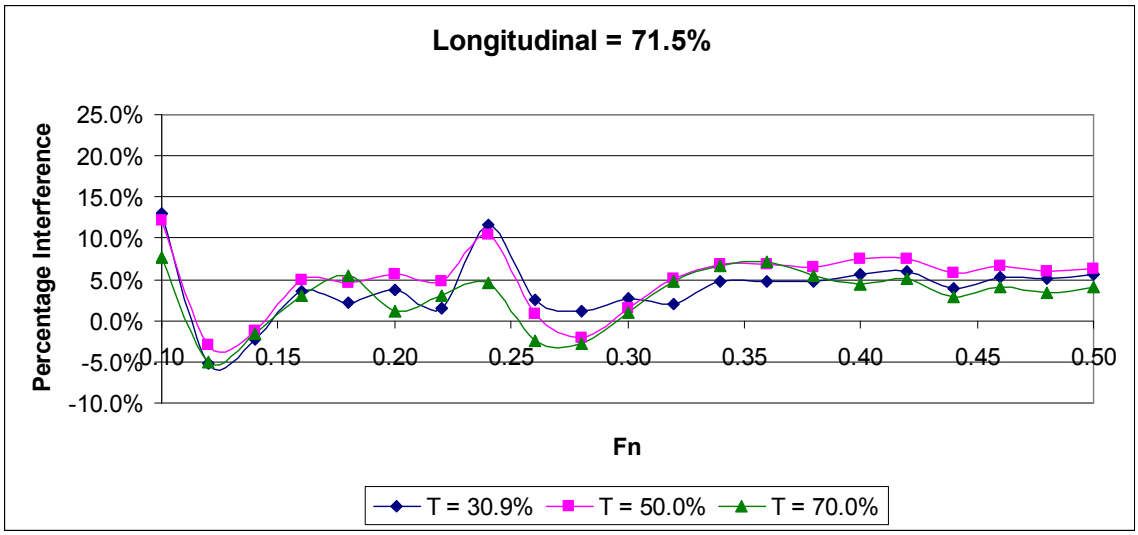
L =	71.5%		76.5%		81.5%	
T =	70.0%		70.0%		70.0%	
Fr	C_T	% Inter	C_T	% Inter	C_T	% Inter
	(10^3)		(10^3)		(10^3)	
0.10	5.801	7.7%	5.876	9.1%	5.608	4.1%
0.12	5.322	-5.1%	5.823	3.8%	5.442	-2.9%
0.14	5.554	-1.5%	5.814	3.1%	5.502	-2.5%
0.16	5.596	3.1%	6.103	12.5%	5.589	3.0%
0.18	5.814	5.4%	5.861	6.3%	5.548	0.6%
0.20	5.569	1.1%	5.697	3.4%	5.806	5.4%
0.22	5.993	3.1%	6.145	5.7%	5.764	-0.9%
0.24	5.795	4.6%	6.109	10.3%	5.916	6.8%
0.26	5.594	-2.5%	5.915	3.1%	5.892	2.7%
0.28	5.545	-2.8%	6.006	5.3%	5.988	5.0%
0.30	5.634	0.9%	6.060	8.5%	6.167	10.4%
0.32	5.770	4.7%	6.019	9.2%	5.898	7.0%
0.34	5.774	6.7%	5.784	6.9%	5.454	0.8%
0.36	5.875	7.2%	5.773	5.4%	5.398	-1.5%
0.38	5.927	5.5%	5.881	4.7%	5.412	-3.7%
0.40	6.007	4.3%	6.006	4.3%	5.635	-2.1%
0.42	6.184	5.0%	6.183	5.0%	5.743	-2.5%
0.44	6.256	2.8%	6.297	3.5%	5.845	-4.0%
0.46	6.292	4.0%	6.333	4.7%	5.875	-2.9%
0.48	6.304	3.3%	6.330	3.7%	5.907	-3.2%
0.50	6.274	4.0%	6.278	4.1%	5.838	-3.2%

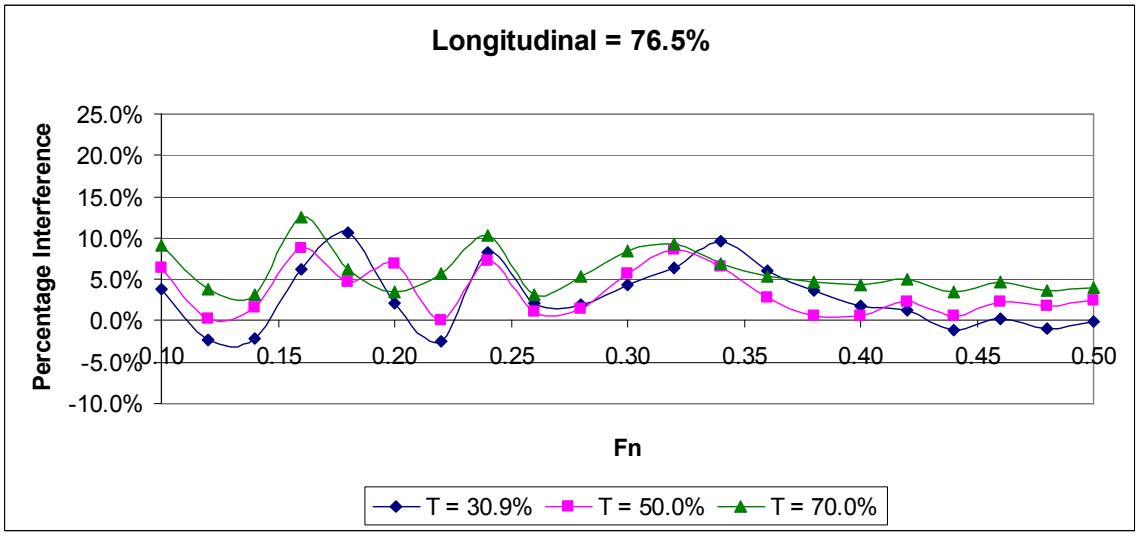
PERCENTAGE INTERFERENCE

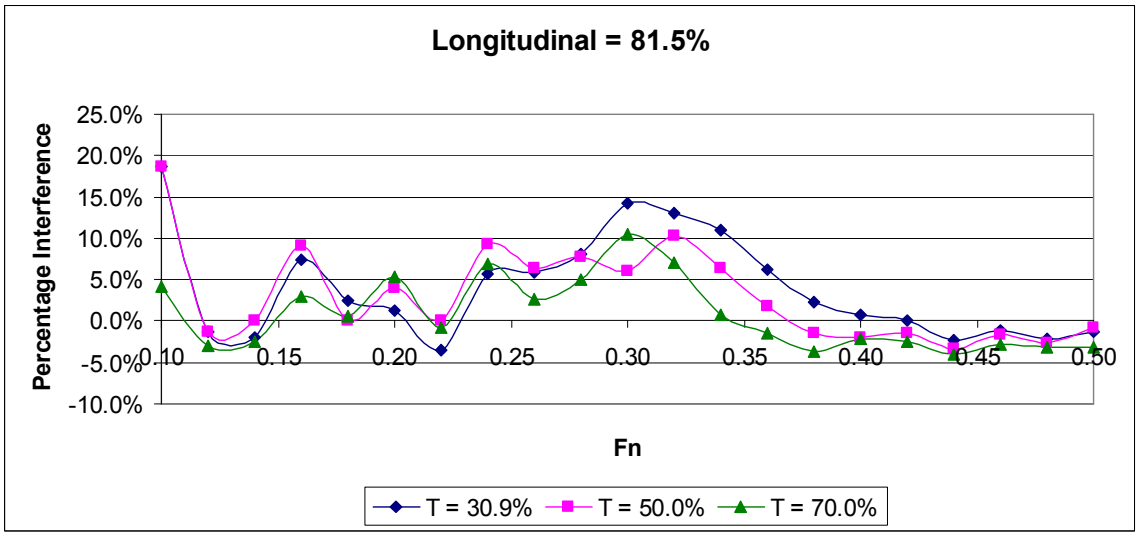




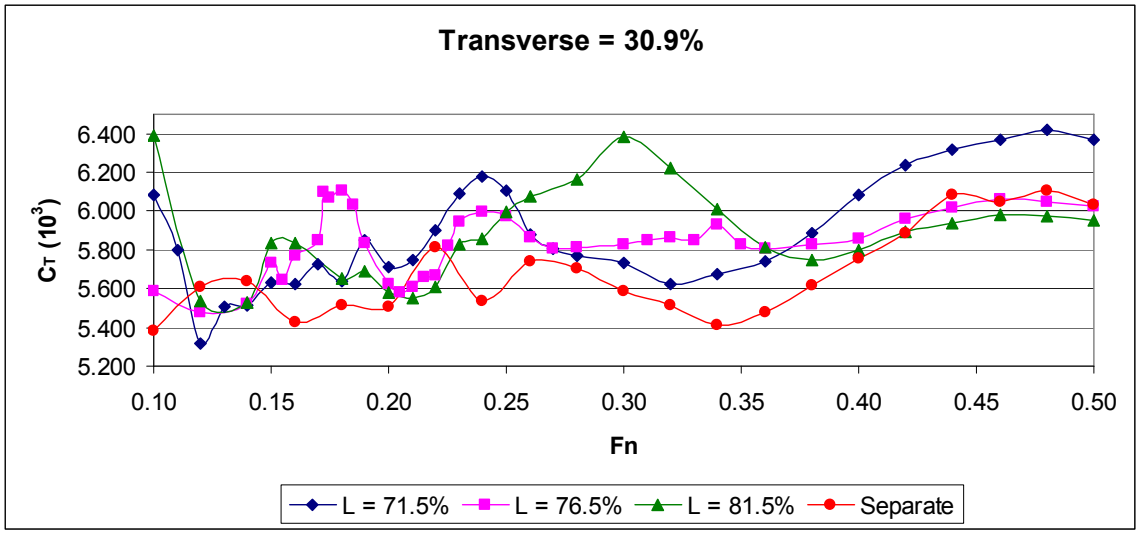


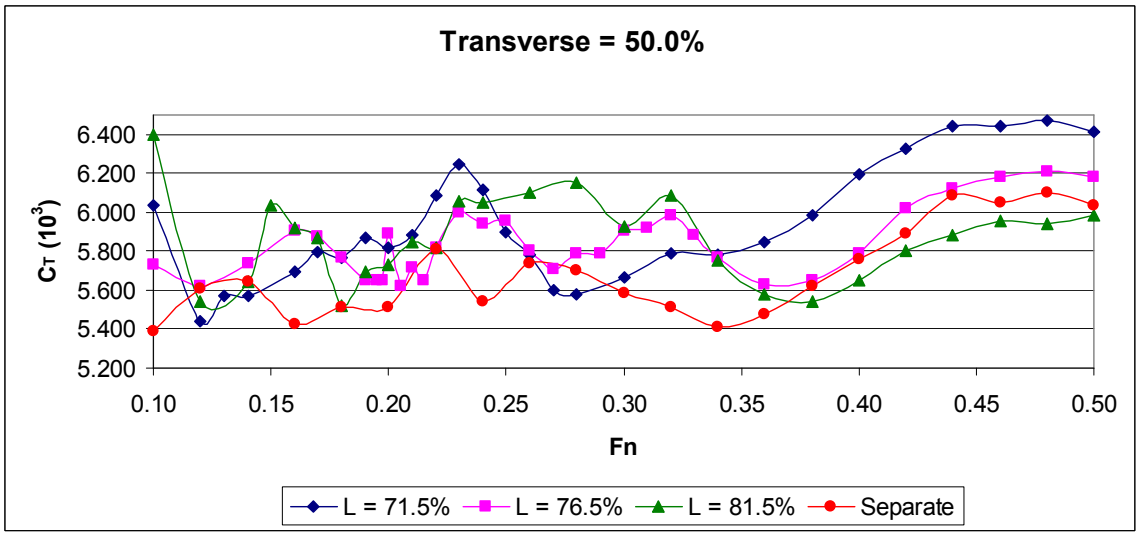

Longitudinal = 71.5%
Percentage Interference
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%

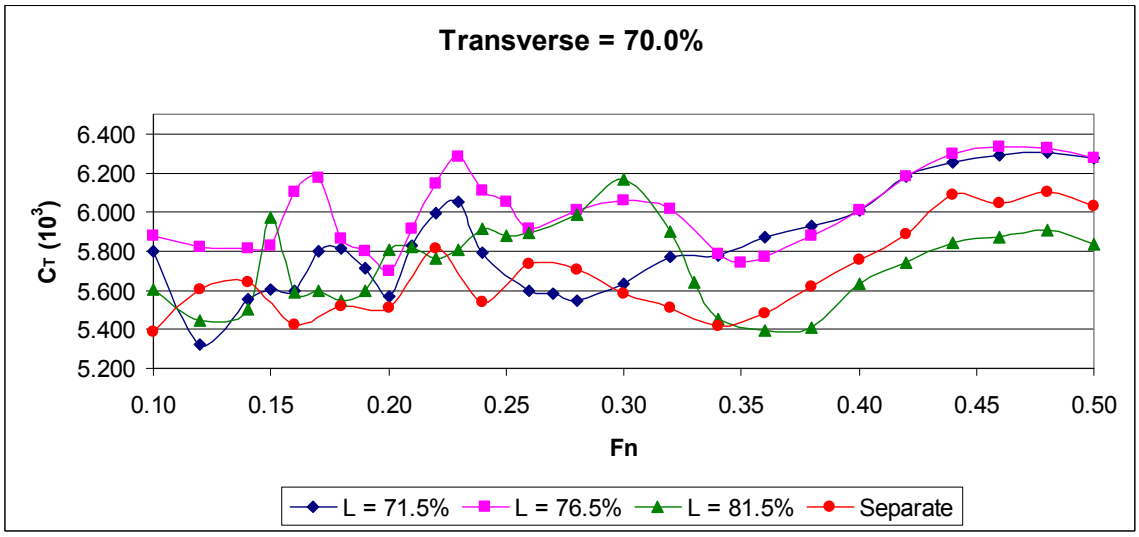

Longitudinal = 76.5%
Percentage Interference
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%

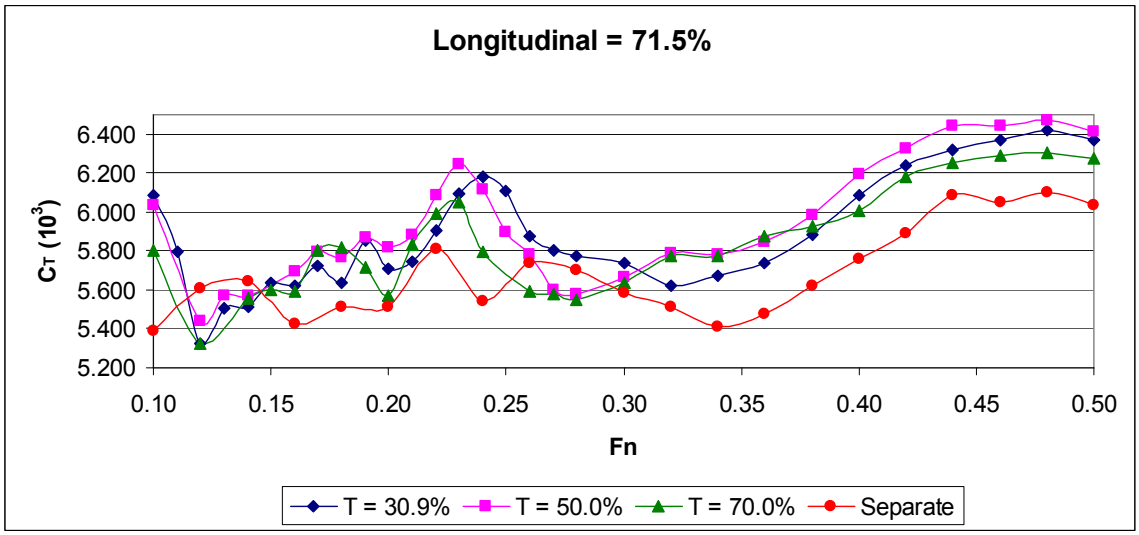

Longitudinal = 81.5%
Percentage Interference
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%

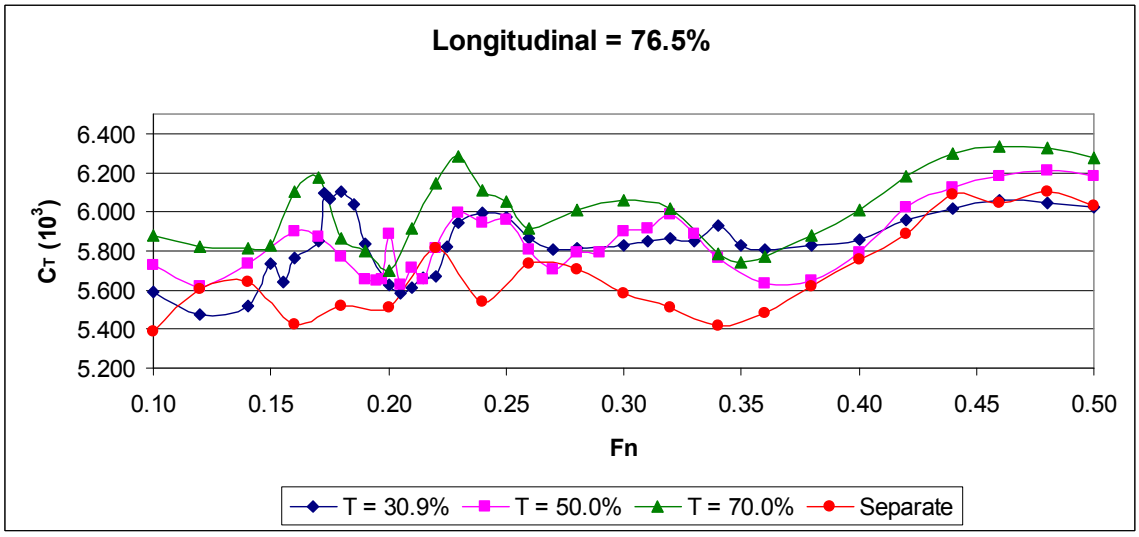
TOTAL RESISTANCE COEFFICIENT

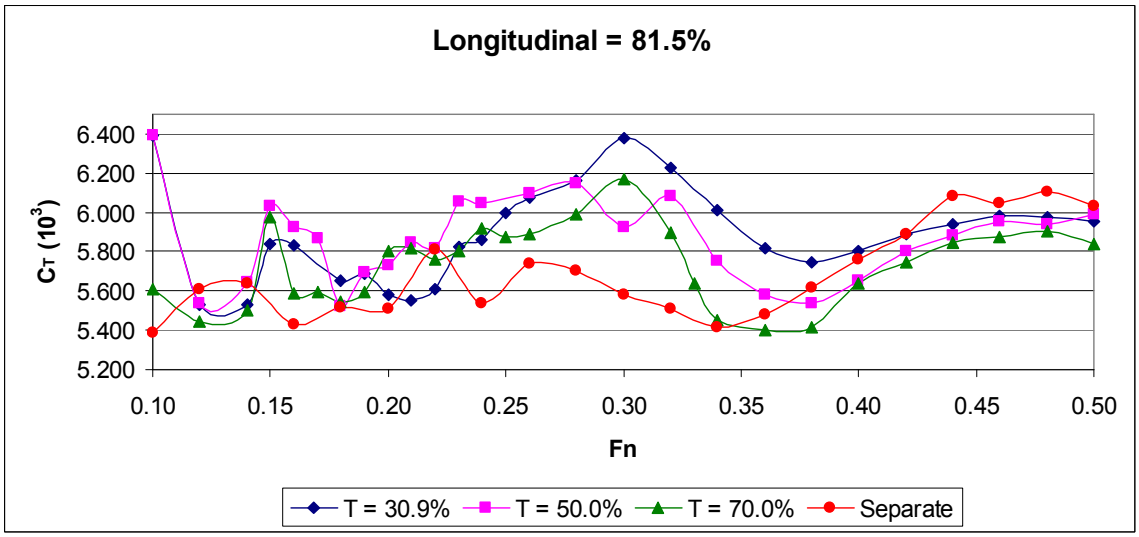







Longitudinal = 71.5%
6.400
6.200
6.000
5.800
5.600
5.400
5.200
C_T (10^3)
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%
Separate

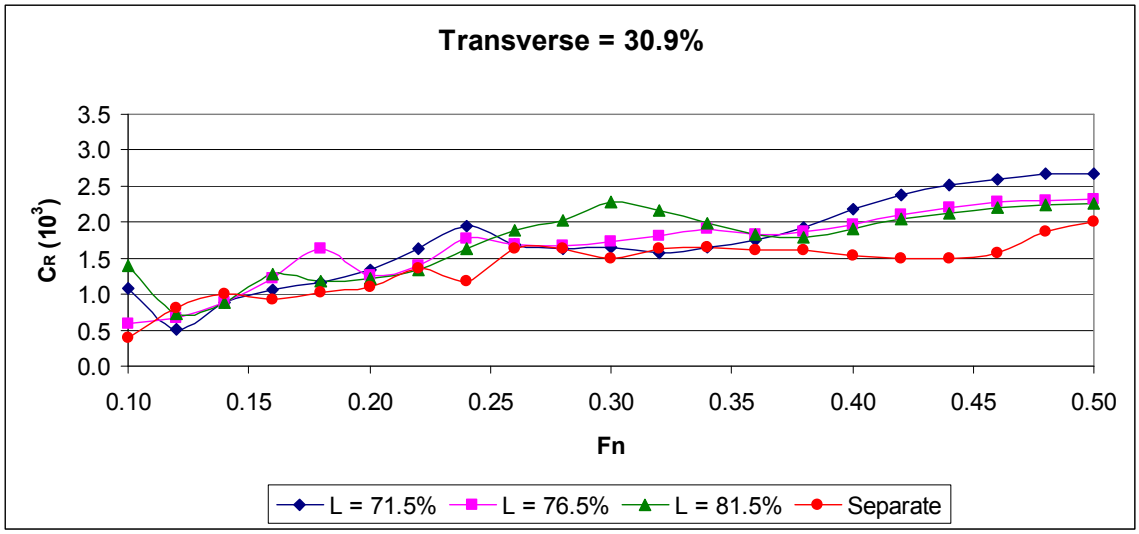

Longitudinal = 76.5%
6.400
6.200
6.000
5.800
5.600
5.400
5.200
C_T (10^3)
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%
Separate

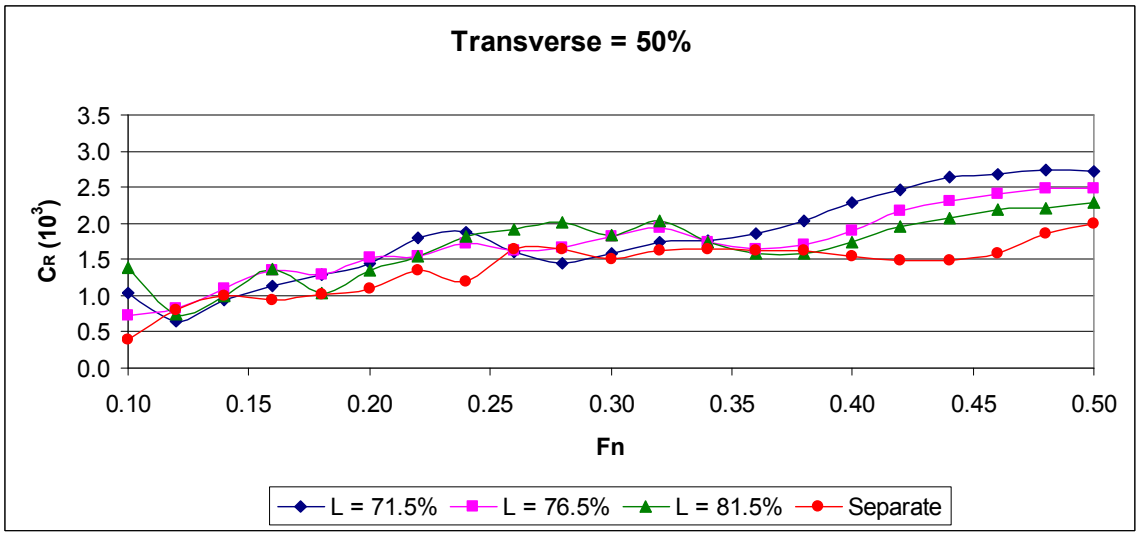

Longitudinal = 81.5%
6.400
6.200
6.000
5.800
5.600
5.400
5.200
C_T (10^3)
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%
Separate

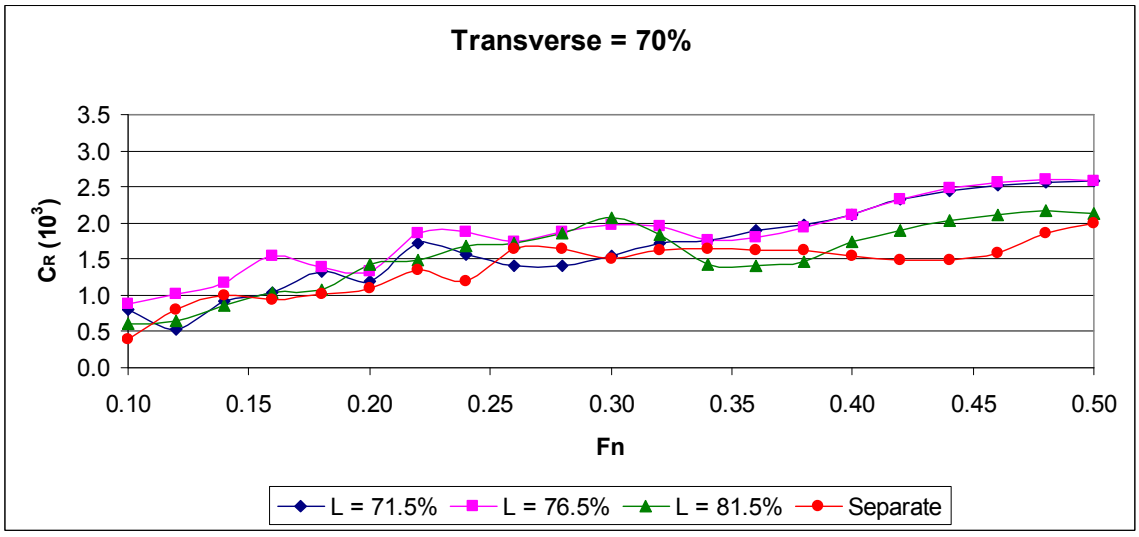
Residuary Resistance Coefficients for all Configurations

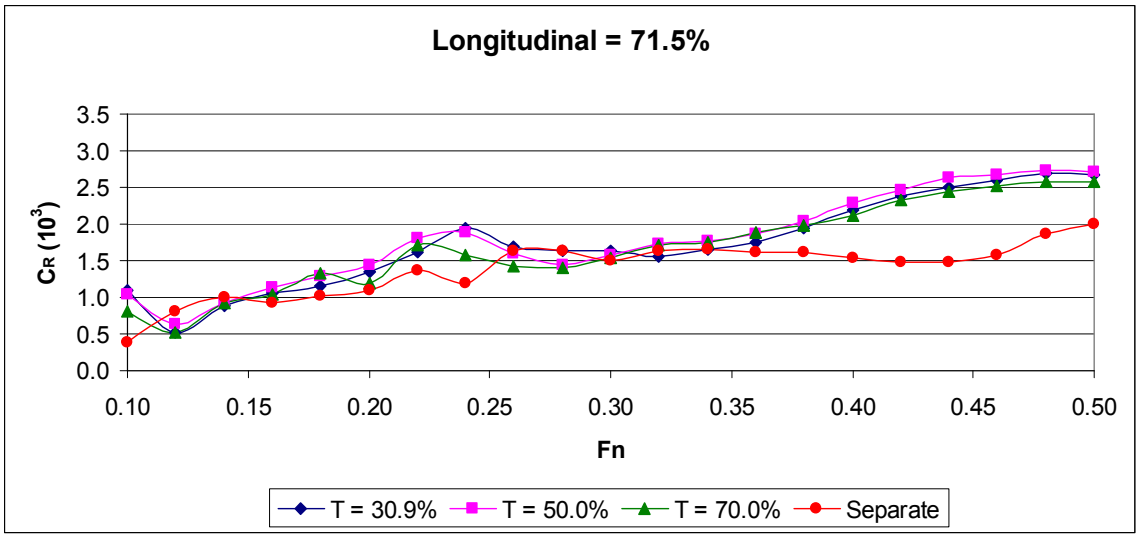
L =	71.5%	76.5%	81.5%	71.5%	76.5%	81.5%	71.5%	76.5%	81.5%
T =	30.9%	30.9%	30.9%	50.0%	50.0%	50.0%	70.0%	70.0%	70.0%
Fr	C_R	C_R	C_R	C_R	C_R	C_R	C_R	C_R	C_R
	(10^3)	(10^3)	(10^3)	(10^3)	(10^3)	(10^3)	(10^3)	(10^3)	(10^3)
0.10	1.087	0.591	1.390	1.036	0.729	1.396	0.802	0.877	0.609
0.12	0.520	0.675	0.734	0.639	0.819	0.739	0.522	1.023	0.642
0.14	0.876	0.881	0.890	0.931	1.095	1.005	0.914	1.173	0.862
0.16	1.067	1.212	1.278	1.143	1.347	1.367	1.041	1.548	1.034
0.18	1.156	1.626	1.171	1.287	1.289	1.043	1.335	1.383	1.069
0.20	1.339	1.254	1.210	1.448	1.518	1.359	1.197	1.326	1.434
0.22	1.624	1.393	1.328	1.808	1.536	1.541	1.715	1.866	1.485
0.24	1.951	1.770	1.631	1.885	1.716	1.823	1.568	1.882	1.690
0.26	1.699	1.684	1.896	1.603	1.626	1.922	1.416	1.737	1.713
0.28	1.637	1.679	2.028	1.447	1.656	2.015	1.411	1.871	1.854
0.30	1.643	1.736	2.288	1.575	1.810	1.831	1.541	1.967	2.074
0.32	1.567	1.810	2.171	1.734	1.931	2.029	1.716	1.964	1.843
0.34	1.655	1.915	1.993	1.762	1.749	1.737	1.756	1.766	1.436
0.36	1.756	1.822	1.832	1.865	1.646	1.593	1.891	1.789	1.414
0.38	1.934	1.875	1.796	2.034	1.696	1.587	1.976	1.930	1.461
0.40	2.185	1.958	1.901	2.291	1.890	1.748	2.106	2.105	1.734
0.42	2.384	2.106	2.039	2.471	2.169	1.946	2.329	2.329	1.888
0.44	2.509	2.204	2.129	2.631	2.313	2.071	2.445	2.485	2.034
0.46	2.597	2.288	2.210	2.673	2.411	2.181	2.521	2.562	2.104
0.48	2.683	2.310	2.239	2.734	2.479	2.204	2.571	2.596	2.173
0.50	2.671	2.324	2.257	2.716	2.485	2.288	2.576	2.579	2.139

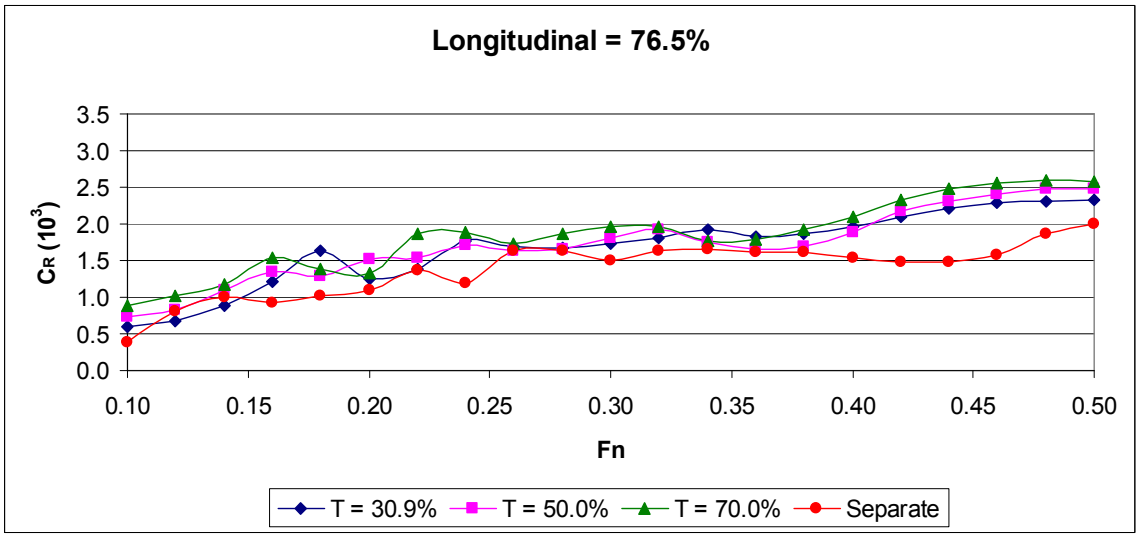
RESIDUARY RESISTANCE COEFFICIENT

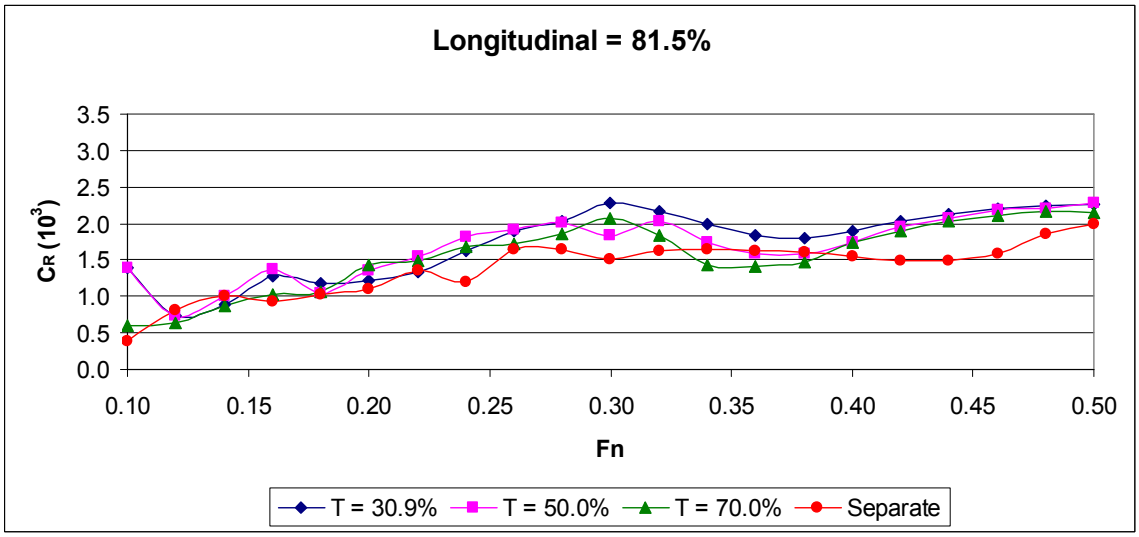







Longitudinal = 71.5%
CR (10^3)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%
Separate


Longitudinal = 76.5%
CR (10^3)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%
Separate


Longitudinal = 81.5%
CR (10^3)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
T = 30.9%
T = 50.0%
T = 70.0%
Separate

APPENDIX G

SIDE-HULL RESISTANCE TESTING RESULTS

This section shows the plots of the percent difference between the main hull resistances in the trimaran configuration and the monohull configuration. In addition, the side-hull percent difference is shown. The total resistance coefficient and residuary resistance coefficient were compared.

Side-Hull Separate		
R_T	C_T	C_R
(lbf)	(10^3)	(10^3)
0.005	3.670	-2.612
0.010	5.075	-0.928
0.017	6.341	0.559
0.020	5.712	0.112
0.027	6.094	0.648
0.032	5.848	0.533
0.043	6.495	1.296
0.047	5.966	0.869
0.059	6.491	1.484
0.068	6.434	1.510
0.076	6.255	1.406
0.087	6.284	1.503
0.096	6.134	1.416
0.105	5.979	1.319
0.112	5.721	1.116
0.120	5.530	0.974
0.130	5.429	0.921
0.146	5.551	1.087
0.153	5.321	0.899
0.174	5.586	1.203
0.176	5.205	0.860

Main Hull Separate		
R_T	C_T	C_R
(lbf)	(10^3)	(10^3)
0.065	5.802	1.113
0.092	5.739	1.230
0.120	5.472	1.108
0.153	5.357	1.113
0.195	5.372	1.229
0.243	5.428	1.373
0.306	5.649	1.671
0.350	5.433	1.523
0.420	5.553	1.704
0.485	5.528	1.735
0.546	5.421	1.679
0.610	5.323	1.627
0.678	5.240	1.586
0.777	5.359	1.745
0.904	5.595	2.018
1.041	5.813	2.271
1.185	6.000	2.491
1.347	6.216	2.737
1.474	6.223	2.773
1.606	6.227	2.804
1.744	6.235	2.837

Frictional Coefficient of Resistance for Main and Side-Hull Separate Using ITTC '57

Equations

Fr	V_M	C_{FMain}	C_{FSide}
	(ft/s)	(10^3)	(10^3)
0.10	1.501	4.689	6.282
0.12	1.802	4.508	6.003
0.14	2.102	4.364	5.782
0.16	2.402	4.244	5.600
0.18	2.702	4.143	5.447
0.20	3.003	4.055	5.315
0.22	3.303	3.978	5.200
0.24	3.603	3.910	5.098
0.26	3.903	3.849	5.007
0.28	4.204	3.793	4.924
0.30	4.504	3.742	4.850
0.32	4.804	3.696	4.781
0.34	5.105	3.653	4.718
0.36	5.405	3.613	4.660
0.38	5.705	3.576	4.606
0.40	6.005	3.542	4.556
0.42	6.306	3.510	4.508
0.44	6.606	3.479	4.464
0.46	6.906	3.450	4.422
0.48	7.206	3.423	4.383
0.50	7.507	3.397	4.345

Longitudinal Spacing = 71.5%											
Transverse Spacing = 30.9%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.009	0.085	6.09	0.07	5.95	6.67	2.5%	82.4%	1.26	0.39	13.0%	-114.9%
0.009	0.107	5.32	0.09	5.48	4.63	-4.4%	-8.8%	0.98	-1.37	-20.6%	48.1%
0.014	0.150	5.52	0.12	5.57	5.29	1.8%	-16.5%	1.21	-0.49	8.8%	-187.7%
0.023	0.200	5.62	0.15	5.37	6.66	0.3%	16.5%	1.13	1.06	1.3%	841.1%
0.030	0.254	5.63	0.19	5.34	6.86	-0.6%	12.6%	1.20	1.42	-2.6%	118.6%
0.029	0.318	5.71	0.26	5.79	5.37	6.7%	-8.2%	1.74	0.06	26.4%	-89.5%
0.042	0.397	5.90	0.31	5.77	6.43	2.2%	-1.0%	1.80	1.23	7.5%	-5.1%
0.056	0.495	6.18	0.38	5.93	7.20	9.1%	20.7%	2.02	2.11	32.6%	142.5%
0.060	0.552	5.88	0.43	5.71	6.58	2.8%	1.3%	1.86	1.57	9.2%	5.9%
0.068	0.629	5.77	0.49	5.61	6.43	1.5%	-0.1%	1.82	1.50	4.9%	-0.5%
0.078	0.718	5.74	0.56	5.57	6.42	2.7%	2.7%	1.83	1.57	8.8%	11.8%
0.083	0.800	5.62	0.63	5.53	6.01	3.9%	-4.4%	1.83	1.23	12.7%	-18.5%
0.087	0.912	5.67	0.74	5.70	5.58	8.7%	-9.1%	2.04	0.86	28.8%	-39.4%
0.094	1.034	5.74	0.85	5.83	5.37	8.8%	-10.1%	2.21	0.71	26.9%	-45.9%
0.102	1.182	5.89	0.98	6.04	5.23	8.0%	-8.5%	2.47	0.63	22.2%	-43.7%
0.119	1.354	6.09	1.12	6.24	5.47	7.3%	-1.2%	2.70	0.91	18.7%	-6.6%
0.136	1.530	6.24	1.26	6.38	5.67	6.3%	4.4%	2.87	1.16	15.1%	26.2%
0.154	1.701	6.32	1.39	6.43	5.86	3.5%	5.5%	2.95	1.39	7.9%	28.0%
0.176	1.873	6.37	1.52	6.43	6.13	3.3%	15.2%	2.98	1.71	7.3%	89.8%
0.198	2.056	6.42	1.66	6.44	6.34	3.4%	13.4%	3.01	1.95	7.5%	62.4%
0.221	2.214	6.37	1.77	6.33	6.52	1.6%	25.3%	2.93	2.17	3.4%	152.9%

Longitudinal Spacing = 76.5%											
Transverse Spacing = 30.9%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.005	0.078	5.59	0.07	6.05	3.72	4.2%	1.6%	1.36	-2.57	22.0%	-1.8%
0.009	0.110	5.47	0.09	5.67	4.64	-1.1%	-8.6%	1.17	-1.36	-5.3%	46.8%
0.014	0.150	5.52	0.12	5.57	5.31	1.9%	-16.3%	1.21	-0.48	9.1%	-185.3%
0.023	0.205	5.77	0.16	5.55	6.67	3.5%	16.8%	1.30	1.07	17.1%	856.1%
0.028	0.275	6.10	0.22	6.03	6.42	12.2%	5.4%	1.89	0.97	53.5%	50.5%
0.031	0.313	5.63	0.25	5.59	5.76	3.0%	-1.6%	1.54	0.44	12.0%	-17.3%
0.039	0.382	5.67	0.30	5.59	5.99	-1.0%	-7.9%	1.62	0.79	-3.2%	-39.4%
0.060	0.480	6.00	0.36	5.58	7.74	2.6%	29.7%	1.67	2.64	9.4%	204.0%
0.072	0.551	5.86	0.41	5.37	7.91	-3.4%	21.9%	1.52	2.91	-10.9%	95.9%
0.082	0.634	5.81	0.47	5.36	7.67	-3.0%	19.3%	1.57	2.75	-9.6%	82.1%
0.090	0.729	5.83	0.55	5.46	7.35	0.7%	17.4%	1.72	2.50	2.4%	77.6%
0.097	0.835	5.86	0.64	5.60	6.96	5.2%	10.8%	1.90	2.18	17.0%	45.3%
0.099	0.954	5.93	0.76	5.84	6.30	11.5%	2.6%	2.19	1.58	38.1%	11.5%
0.100	1.046	5.81	0.85	5.84	5.67	8.9%	-5.1%	2.22	1.01	27.4%	-23.2%
0.106	1.170	5.83	0.96	5.93	5.40	6.0%	-5.6%	2.35	0.80	16.6%	-28.7%
0.117	1.303	5.86	1.07	5.97	5.39	2.8%	-2.6%	2.43	0.83	7.1%	-14.7%
0.130	1.462	5.96	1.20	6.09	5.43	1.5%	0.0%	2.58	0.92	3.5%	0.3%
0.144	1.619	6.02	1.33	6.14	5.49	-1.2%	-1.2%	2.66	1.02	-2.7%	-5.9%
0.161	1.783	6.06	1.46	6.17	5.62	-0.9%	5.6%	2.72	1.19	-2.1%	32.9%
0.179	1.936	6.04	1.58	6.12	5.74	-1.8%	2.8%	2.69	1.36	-3.9%	12.8%
0.197	2.093	6.02	1.70	6.07	5.82	-2.6%	11.9%	2.67	1.48	-5.8%	71.9%

Longitudinal Spacing = 81.5%											
Transverse Spacing = 30.9%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.010	0.089	6.39	0.07	6.16	7.35	6.1%	101.0%	1.47	1.07	32.2%	-140.9%
0.011	0.111	5.53	0.09	5.51	5.61	-3.9%	10.5%	1.00	-0.39	-18.4%	-57.6%
0.015	0.151	5.53	0.12	5.51	5.62	0.7%	-11.3%	1.14	-0.16	3.2%	-128.7%
0.024	0.208	5.83	0.16	5.58	6.89	4.1%	20.6%	1.33	1.29	19.9%	1046.0%
0.030	0.255	5.65	0.19	5.37	6.80	0.0%	11.6%	1.23	1.36	0.0%	109.6%
0.033	0.310	5.58	0.24	5.46	6.06	0.7%	3.6%	1.41	0.74	2.6%	39.7%
0.040	0.377	5.61	0.30	5.49	6.07	-2.7%	-6.5%	1.52	0.87	-9.3%	-32.7%
0.061	0.469	5.86	0.35	5.39	7.78	-0.8%	30.4%	1.48	2.68	-2.7%	208.9%
0.078	0.571	6.07	0.42	5.49	8.48	-1.1%	30.6%	1.65	3.47	-3.5%	133.9%
0.089	0.672	6.16	0.49	5.63	8.34	1.9%	29.6%	1.84	3.41	6.1%	126.2%
0.101	0.798	6.38	0.60	5.93	8.24	9.4%	31.8%	2.19	3.39	30.3%	141.5%
0.111	0.886	6.23	0.67	5.81	7.96	9.1%	26.7%	2.11	3.18	29.7%	111.8%
0.113	0.966	6.01	0.74	5.73	7.18	9.3%	17.1%	2.07	2.46	30.7%	73.9%
0.110	1.048	5.82	0.83	5.71	6.23	6.6%	4.3%	2.10	1.57	20.4%	19.4%
0.116	1.154	5.75	0.92	5.71	5.90	2.1%	3.1%	2.13	1.30	5.7%	16.1%
0.122	1.291	5.80	1.05	5.84	5.65	0.4%	2.1%	2.30	1.09	1.2%	12.1%
0.132	1.445	5.89	1.18	5.98	5.54	-0.4%	2.0%	2.47	1.03	-0.9%	11.9%
0.145	1.599	5.94	1.31	6.04	5.54	-2.9%	-0.2%	2.56	1.08	-6.5%	-1.0%
0.159	1.760	5.98	1.44	6.08	5.55	-2.2%	4.4%	2.63	1.13	-5.0%	26.0%
0.175	1.913	5.97	1.56	6.06	5.61	-2.7%	0.5%	2.64	1.23	-5.9%	2.2%
0.192	2.070	5.96	1.69	6.02	5.67	-3.4%	8.9%	2.63	1.33	-7.4%	54.2%

Longitudinal Spacing = 71.5%											
Transverse Spacing = 50.0%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.007	0.084	6.04	0.07	6.25	5.18	7.6%	41.5%	1.56	-1.11	39.9%	-57.7%
0.010	0.109	5.44	0.09	5.51	5.13	-3.9%	1.1%	1.00	-0.87	-18.6%	-6.0%
0.014	0.152	5.57	0.12	5.64	5.28	3.1%	-16.7%	1.28	-0.50	15.3%	-190.0%
0.023	0.203	5.70	0.16	5.47	6.64	2.1%	16.3%	1.23	1.04	10.1%	826.7%
0.027	0.260	5.77	0.21	5.67	6.16	5.5%	1.1%	1.53	0.71	24.4%	10.3%
0.031	0.324	5.82	0.26	5.84	5.73	7.6%	-2.1%	1.79	0.41	30.0%	-22.6%
0.045	0.410	6.09	0.32	5.90	6.87	4.4%	5.8%	1.92	1.67	14.8%	29.1%
0.054	0.489	6.11	0.38	5.91	6.93	8.8%	16.2%	2.00	1.83	31.6%	111.0%
0.056	0.543	5.78	0.43	5.70	6.12	2.6%	-5.6%	1.85	1.12	8.7%	-24.7%
0.064	0.608	5.58	0.48	5.47	6.03	-1.0%	-6.2%	1.68	1.11	-3.3%	-26.6%
0.073	0.709	5.67	0.56	5.59	6.00	3.1%	-4.2%	1.85	1.15	10.0%	-18.5%
0.079	0.824	5.79	0.67	5.81	5.70	9.1%	-9.2%	2.11	0.92	30.0%	-38.7%
0.084	0.929	5.78	0.76	5.88	5.37	12.2%	-12.5%	2.22	0.65	40.2%	-54.0%
0.094	1.054	5.85	0.87	5.97	5.36	11.3%	-10.3%	2.35	0.70	34.8%	-46.9%
0.105	1.202	5.99	0.99	6.13	5.37	9.6%	-6.1%	2.56	0.77	26.7%	-31.1%
0.127	1.377	6.19	1.12	6.27	5.87	7.9%	6.1%	2.73	1.31	20.2%	34.7%
0.145	1.551	6.33	1.26	6.38	6.07	6.4%	11.9%	2.88	1.57	15.4%	70.2%
0.162	1.734	6.44	1.41	6.50	6.18	4.6%	11.4%	3.03	1.72	10.5%	58.3%
0.178	1.896	6.44	1.54	6.50	6.22	4.4%	16.9%	3.05	1.80	10.0%	99.7%
0.195	2.072	6.47	1.68	6.52	6.26	4.7%	12.0%	3.10	1.87	10.4%	55.8%
0.210	2.230	6.41	1.81	6.46	6.21	3.7%	19.3%	3.07	1.86	8.1%	116.7%

Longitudinal Spacing = 76.5%											
Transverse Spacing = 50.0%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.007	0.080	5.73	0.07	5.87	5.15	1.1%	40.9%	1.18	-1.13	6.2%	-56.8%
0.011	0.112	5.62	0.09	5.62	5.62	-2.1%	10.7%	1.11	-0.38	-10.0%	-58.6%
0.015	0.156	5.74	0.13	5.76	5.63	5.3%	-11.2%	1.40	-0.15	26.0%	-127.0%
0.025	0.210	5.90	0.16	5.59	7.19	4.4%	25.8%	1.35	1.59	21.0%	1312.0%
0.028	0.260	5.77	0.20	5.63	6.36	4.7%	4.4%	1.48	0.91	20.7%	41.2%
0.035	0.328	5.89	0.26	5.75	6.44	6.0%	10.1%	1.70	1.12	23.8%	110.6%
0.045	0.391	5.81	0.30	5.56	6.84	-1.5%	5.3%	1.59	1.64	-5.0%	26.7%
0.063	0.476	5.94	0.35	5.43	8.05	0.0%	34.9%	1.52	2.95	-0.1%	239.8%
0.069	0.546	5.80	0.41	5.39	7.51	-2.9%	15.7%	1.54	2.51	-9.4%	68.8%
0.076	0.631	5.79	0.48	5.46	7.13	-1.1%	10.9%	1.67	2.21	-3.7%	46.3%
0.087	0.739	5.90	0.57	5.61	7.11	3.5%	13.7%	1.87	2.26	11.3%	61.0%
0.093	0.852	5.99	0.67	5.82	6.68	9.3%	6.4%	2.12	1.90	30.4%	26.6%
0.094	0.927	5.77	0.74	5.71	5.98	9.1%	-2.5%	2.06	1.26	29.8%	-10.7%
0.096	1.014	5.63	0.82	5.67	5.45	5.9%	-8.8%	2.06	0.79	18.0%	-40.1%
0.102	1.134	5.65	0.93	5.76	5.20	2.9%	-9.2%	2.18	0.59	8.0%	-46.9%
0.117	1.288	5.79	1.05	5.89	5.38	1.3%	-2.7%	2.35	0.83	3.4%	-15.2%
0.137	1.477	6.02	1.20	6.10	5.71	1.6%	5.3%	2.59	1.21	3.9%	31.0%
0.158	1.649	6.12	1.33	6.15	6.01	-1.0%	8.2%	2.67	1.54	-2.3%	41.7%
0.180	1.819	6.18	1.46	6.16	6.26	-1.0%	17.6%	2.71	1.84	-2.1%	104.4%
0.200	1.990	6.21	1.59	6.16	6.42	-1.0%	14.9%	2.74	2.04	-2.3%	69.4%
0.220	2.149	6.18	1.71	6.11	6.50	-2.1%	25.0%	2.71	2.16	-4.6%	151.1%

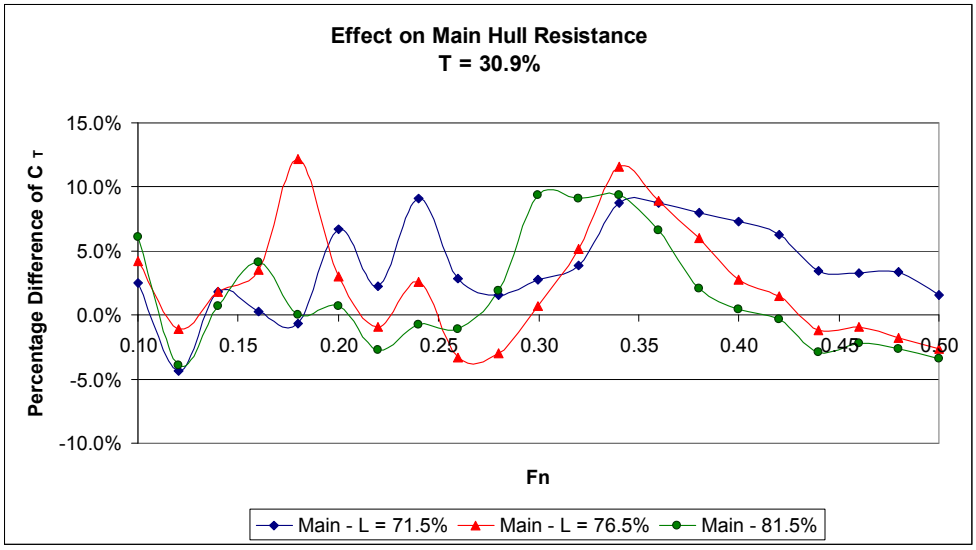
Longitudinal Spacing = 81.5%											
Transverse Spacing = 50.0%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.009	0.089	6.39	0.07	6.33	6.66	9.1%	82.1%	1.65	0.38	47.8%	-114.5%
0.011	0.111	5.54	0.09	5.51	5.65	-4.0%	11.3%	1.00	-0.35	-18.7%	-61.8%
0.016	0.154	5.65	0.12	5.55	6.04	1.4%	-4.8%	1.19	0.26	7.0%	-54.1%
0.025	0.211	5.92	0.16	5.61	7.22	4.7%	26.5%	1.36	1.62	22.5%	1345.9%
0.027	0.249	5.52	0.19	5.37	6.17	-0.1%	1.2%	1.22	0.72	-0.4%	11.1%
0.035	0.319	5.73	0.25	5.55	6.47	2.2%	10.7%	1.49	1.16	8.8%	117.0%
0.043	0.392	5.82	0.31	5.64	6.57	-0.2%	1.2%	1.66	1.37	-0.7%	5.9%
0.064	0.484	6.05	0.36	5.53	8.22	1.7%	37.8%	1.62	3.12	6.0%	259.5%
0.077	0.573	6.10	0.42	5.54	8.43	-0.3%	29.8%	1.69	3.42	-0.8%	130.5%
0.085	0.670	6.15	0.50	5.70	8.02	3.0%	24.6%	1.90	3.09	9.7%	105.0%
0.094	0.741	5.92	0.55	5.49	7.73	1.2%	23.5%	1.74	2.88	3.9%	104.7%
0.102	0.866	6.08	0.66	5.77	7.37	8.4%	17.3%	2.08	2.59	27.7%	72.3%
0.104	0.925	5.76	0.72	5.54	6.65	5.7%	8.5%	1.88	1.94	18.7%	36.7%
0.103	1.005	5.58	0.80	5.50	5.88	2.7%	-1.7%	1.89	1.22	8.3%	-7.6%
0.104	1.112	5.54	0.90	5.59	5.33	-0.1%	-6.9%	2.01	0.72	-0.3%	-35.3%
0.113	1.257	5.65	1.03	5.75	5.23	-1.0%	-5.5%	2.21	0.67	-2.6%	-31.3%
0.126	1.423	5.80	1.17	5.92	5.28	-1.2%	-2.7%	2.42	0.77	-3.0%	-15.8%
0.144	1.583	5.88	1.29	5.97	5.50	-3.9%	-0.9%	2.50	1.04	-8.8%	-4.5%
0.164	1.751	5.95	1.42	6.01	5.73	-3.5%	7.7%	2.56	1.31	-7.8%	45.9%
0.188	1.902	5.94	1.53	5.92	6.00	-4.9%	7.5%	2.50	1.62	-10.9%	34.8%
0.210	2.081	5.99	1.66	5.94	6.18	-4.7%	18.8%	2.54	1.84	-10.4%	113.8%

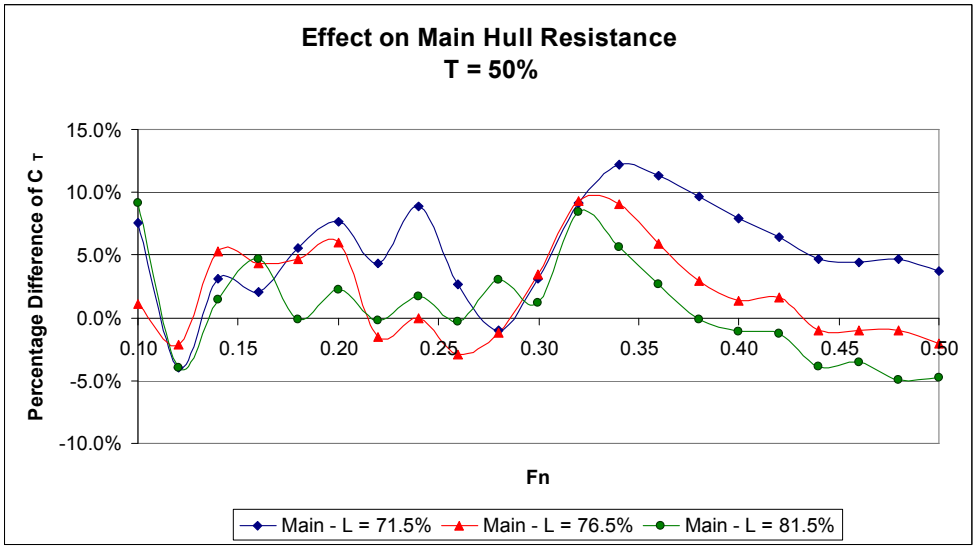
Longitudinal Spacing = 71.5%											
Transverse Spacing = 70.0%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.005	0.081	5.80	0.07	6.29	3.80	8.3%	4.0%	1.60	-2.48	43.7%	-5.1%
0.009	0.107	5.32	0.09	5.46	4.75	-4.9%	-6.4%	0.95	-1.25	-22.8%	35.0%
0.013	0.151	5.55	0.12	5.68	5.04	3.8%	-20.5%	1.31	-0.74	18.6%	-232.3%
0.023	0.199	5.60	0.15	5.37	6.53	0.2%	14.4%	1.12	0.93	1.1%	731.8%
0.027	0.262	5.81	0.21	5.75	6.10	6.9%	0.1%	1.60	0.66	30.4%	1.3%
0.030	0.310	5.57	0.25	5.58	5.51	2.8%	-5.8%	1.53	0.20	11.1%	-63.1%
0.044	0.403	5.99	0.31	5.81	6.75	2.8%	4.0%	1.83	1.56	9.6%	20.0%
0.056	0.464	5.79	0.35	5.47	7.13	0.7%	19.5%	1.56	2.03	2.5%	133.8%
0.055	0.526	5.59	0.42	5.51	5.96	-0.9%	-8.1%	1.66	0.96	-2.7%	-35.6%
0.063	0.604	5.55	0.48	5.45	5.92	-1.3%	-8.1%	1.66	0.99	-4.2%	-34.4%
0.074	0.705	5.63	0.56	5.53	6.08	1.9%	-2.8%	1.78	1.23	6.2%	-12.3%
0.088	0.822	5.77	0.65	5.64	6.31	6.0%	0.4%	1.94	1.53	19.5%	1.9%
0.099	0.928	5.77	0.73	5.64	6.31	7.7%	2.9%	1.99	1.59	25.4%	12.7%
0.109	1.059	5.87	0.84	5.79	6.22	8.1%	4.0%	2.18	1.56	24.8%	18.1%
0.120	1.190	5.93	0.95	5.88	6.11	5.2%	6.8%	2.31	1.50	14.3%	34.6%
0.129	1.336	6.01	1.08	6.02	5.94	3.6%	7.4%	2.48	1.39	9.3%	42.2%
0.139	1.517	6.18	1.24	6.27	5.82	4.5%	7.2%	2.76	1.31	10.9%	42.3%
0.157	1.684	6.26	1.37	6.33	5.97	1.8%	7.5%	2.85	1.51	4.0%	38.5%
0.175	1.851	6.29	1.50	6.34	6.11	1.8%	14.8%	2.89	1.69	4.1%	87.6%
0.195	2.019	6.30	1.63	6.32	6.24	1.5%	11.7%	2.90	1.85	3.4%	54.2%
0.217	2.181	6.27	1.75	6.24	6.42	0.1%	23.3%	2.84	2.07	0.2%	140.9%

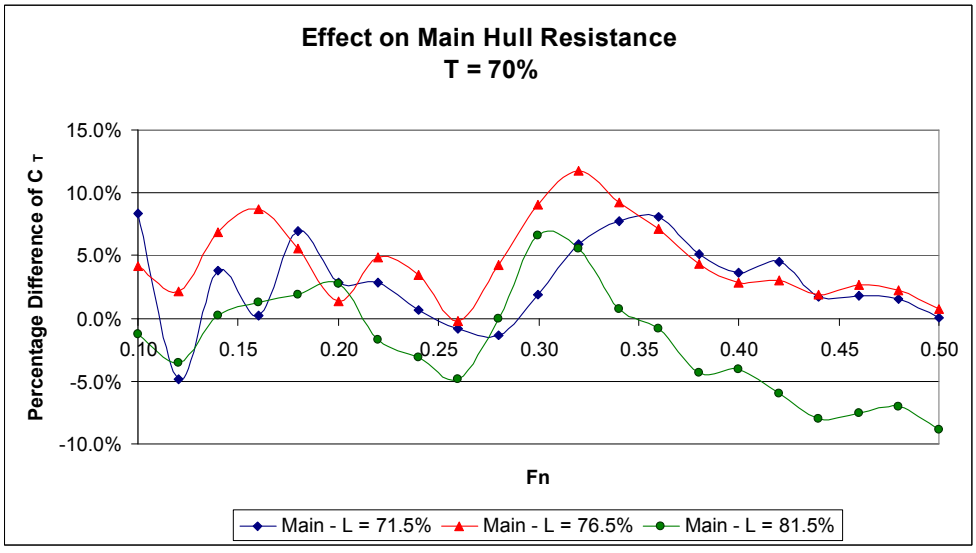
Longitudinal Spacing = 76.5%											
Transverse Spacing = 70.0%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.007	0.082	5.88	0.07	6.04	5.20	4.1%	42.1%	1.36	-1.08	21.8%	-58.5%
0.011	0.117	5.82	0.09	5.86	5.67	2.1%	11.6%	1.35	-0.34	9.7%	-63.7%
0.015	0.158	5.81	0.13	5.85	5.68	6.8%	-10.4%	1.48	-0.10	33.7%	-118.5%
0.025	0.217	6.10	0.17	5.83	7.25	8.7%	26.9%	1.58	1.65	42.2%	1366.0%
0.029	0.264	5.86	0.21	5.67	6.64	5.6%	9.0%	1.53	1.20	24.6%	84.8%
0.035	0.317	5.70	0.25	5.50	6.49	1.4%	11.0%	1.45	1.18	5.5%	120.8%
0.046	0.413	6.14	0.32	5.92	7.05	4.9%	8.6%	1.95	1.85	16.5%	43.0%
0.063	0.489	6.11	0.36	5.62	8.12	3.5%	36.0%	1.71	3.02	12.5%	247.6%
0.068	0.556	5.92	0.42	5.54	7.47	-0.2%	15.0%	1.69	2.46	-0.7%	65.7%
0.074	0.655	6.01	0.51	5.76	7.00	4.3%	8.8%	1.97	2.08	13.5%	37.7%
0.081	0.758	6.06	0.60	5.91	6.68	9.0%	6.8%	2.17	1.83	29.1%	30.1%
0.088	0.857	6.02	0.68	5.95	6.31	11.8%	0.3%	2.25	1.52	38.6%	1.4%
0.095	0.930	5.78	0.74	5.72	6.03	9.2%	-1.6%	2.07	1.31	30.4%	-7.1%
0.104	1.040	5.77	0.83	5.74	5.90	7.2%	-1.4%	2.13	1.24	22.0%	-6.2%
0.119	1.181	5.88	0.94	5.84	6.06	4.3%	6.0%	2.26	1.46	12.0%	30.7%
0.133	1.336	6.01	1.07	5.98	6.12	2.8%	10.7%	2.44	1.57	7.3%	60.9%
0.148	1.516	6.18	1.22	6.18	6.18	3.1%	13.9%	2.67	1.67	7.3%	81.9%
0.161	1.695	6.30	1.37	6.34	6.13	1.9%	10.5%	2.86	1.67	4.4%	53.5%
0.175	1.863	6.33	1.51	6.39	6.10	2.7%	14.7%	2.94	1.68	6.0%	86.9%
0.193	2.028	6.33	1.64	6.37	6.18	2.2%	10.7%	2.94	1.80	5.0%	49.8%
0.212	2.182	6.28	1.76	6.28	6.26	0.8%	20.3%	2.88	1.92	1.6%	123.0%

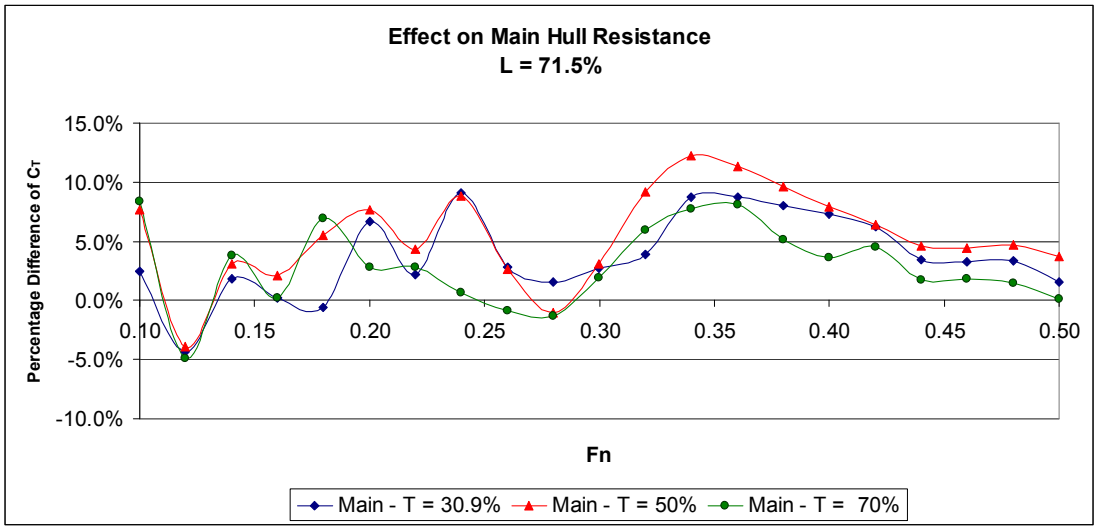
Longitudinal Spacing = 81.5%											
Transverse Spacing = 70.0%											
						%Diff	%Diff			%Diff	%Diff
Side-Hull	$R_{TTrimaran}$	$C_{TTrimaran}$	R_{Main}	C_{TMain}	C_{TSide}	C_T	C_T	C_{RMain}	C_{RSide}	C_R	C_R
(lbf)	(lbf)	(10^3)	(lbf)	(10^3)	(10^3)	(Main)	(Side)	(10^3)	(10^3)	(Main)	(Side)
0.007	0.078	5.61	0.06	5.73	5.10	-1.2%	39.6%	1.04	-1.18	-6.2%	-54.9%
0.010	0.109	5.44	0.09	5.53	5.06	-3.6%	-0.3%	1.02	-0.94	-16.8%	1.7%
0.015	0.150	5.50	0.12	5.48	5.58	0.2%	-12.0%	1.12	-0.20	1.0%	-136.6%
0.022	0.199	5.59	0.16	5.43	6.26	1.3%	9.7%	1.18	0.66	6.2%	490.9%
0.026	0.250	5.55	0.20	5.48	5.85	1.9%	-4.0%	1.33	0.40	8.5%	-37.7%
0.037	0.323	5.81	0.25	5.58	6.74	2.8%	15.3%	1.52	1.43	10.9%	167.5%
0.043	0.388	5.76	0.30	5.55	6.63	-1.7%	2.0%	1.58	1.43	-5.6%	10.1%
0.067	0.474	5.92	0.34	5.27	8.61	-3.1%	44.2%	1.36	3.51	-11.0%	303.8%
0.077	0.554	5.89	0.40	5.28	8.41	-4.9%	29.6%	1.44	3.40	-15.8%	129.4%
0.084	0.653	5.99	0.48	5.52	7.90	-0.1%	22.8%	1.73	2.98	-0.2%	97.2%
0.095	0.772	6.17	0.58	5.78	7.77	6.6%	24.3%	2.04	2.92	21.2%	108.1%
0.098	0.840	5.90	0.64	5.62	7.05	5.6%	12.1%	1.92	2.27	18.3%	50.8%
0.097	0.877	5.45	0.68	5.28	6.18	0.8%	0.7%	1.62	1.46	2.4%	3.1%
0.101	0.973	5.40	0.77	5.32	5.74	-0.8%	-4.1%	1.70	1.08	-2.5%	-18.5%
0.111	1.087	5.41	0.87	5.35	5.65	-4.3%	-1.2%	1.78	1.05	-11.9%	-6.1%
0.127	1.253	5.63	1.00	5.58	5.88	-4.1%	6.3%	2.04	1.32	-10.4%	35.6%
0.147	1.408	5.74	1.11	5.64	6.16	-6.0%	13.4%	2.13	1.65	-14.4%	78.9%
0.167	1.573	5.85	1.24	5.72	6.36	-8.0%	14.6%	2.24	1.90	-18.1%	74.6%
0.183	1.728	5.87	1.36	5.75	6.37	-7.5%	19.8%	2.30	1.95	-16.9%	116.9%
0.200	1.892	5.91	1.49	5.79	6.39	-7.0%	14.4%	2.37	2.01	-15.6%	66.9%
0.219	2.029	5.84	1.59	5.68	6.47	-8.8%	24.3%	2.29	2.13	-19.4%	147.3%

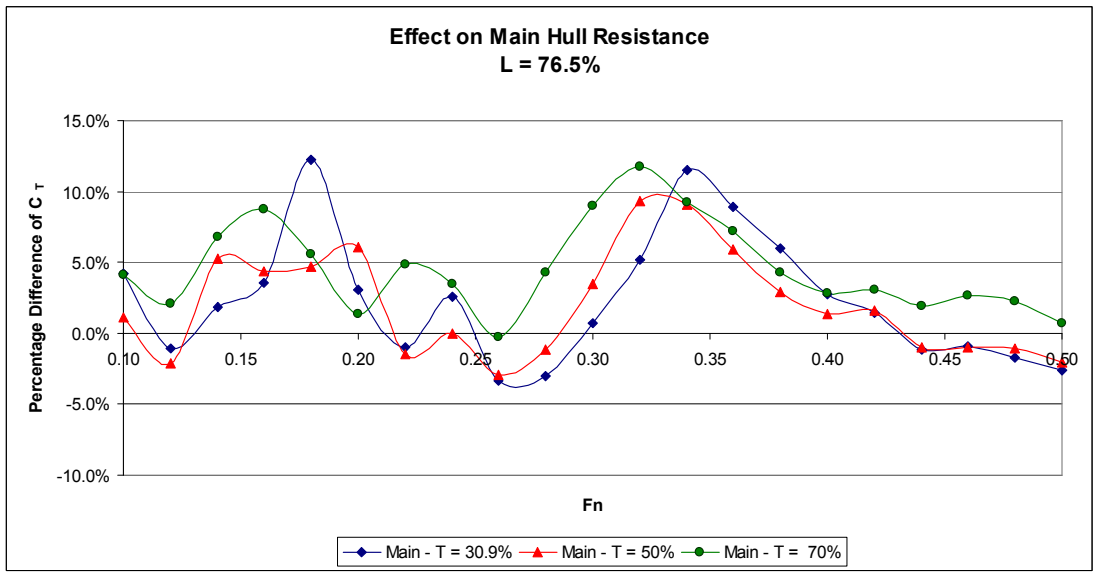
TOTAL RESISTANCE COEFFICIENT – MAIN HULL

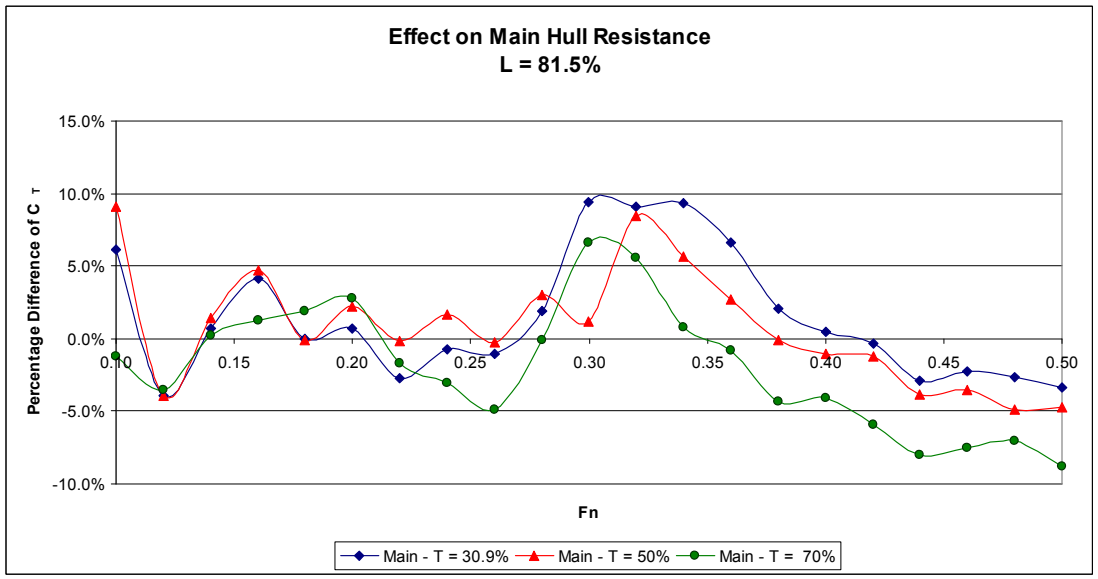




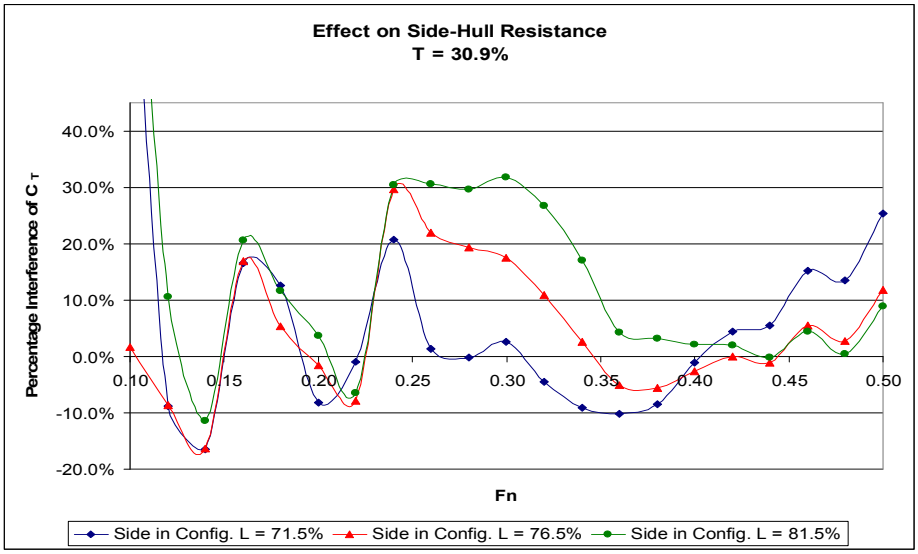


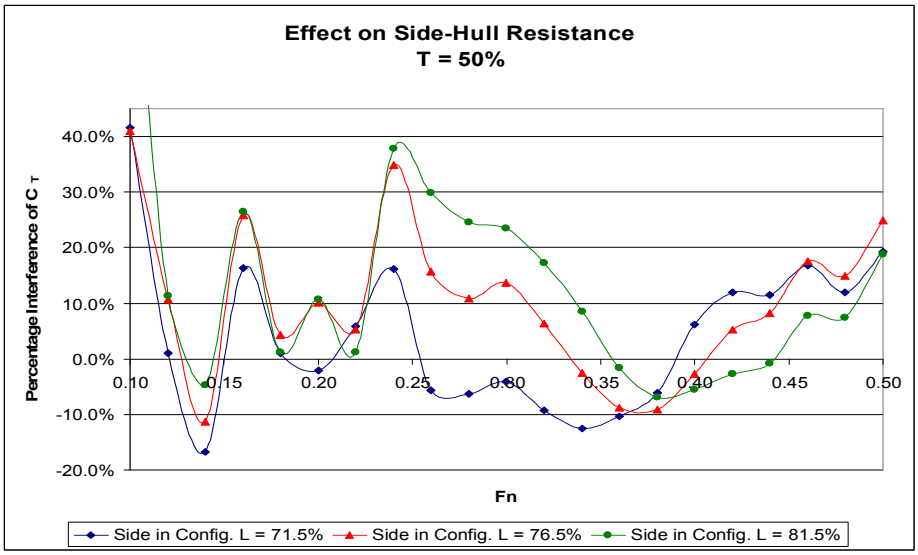

Effect on Main Hull Resistance
L = 71.5%
Percentage Difference of C_T
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Main - T = 30.9%
Main - T = 50%
Main - T = 70%

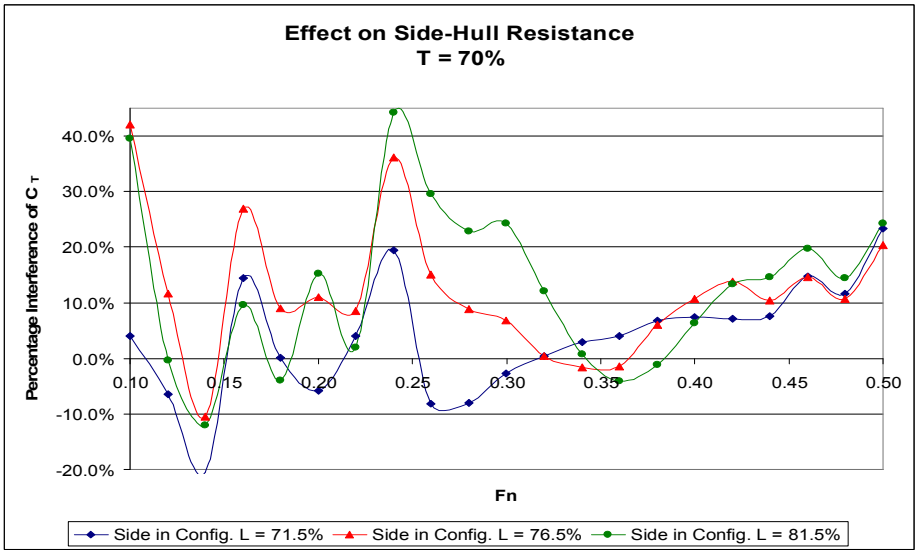

Effect on Main Hull Resistance
L = 76.5%
Percentage Difference of C_T
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Main - T = 30.9%
Main - T = 50%
Main - T = 70%

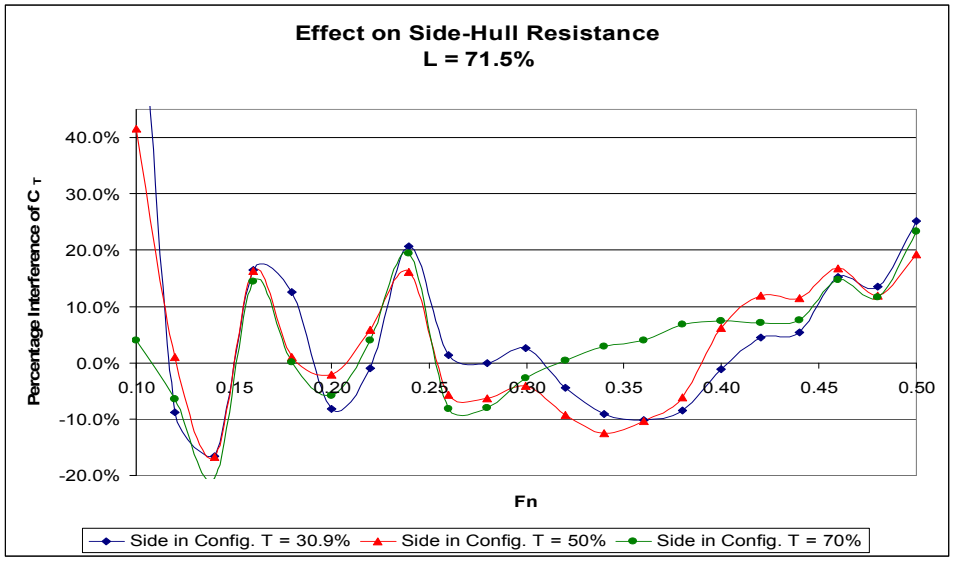

Effect on Main Hull Resistance
L = 81.5%
Percentage Difference of C_T
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Main - T = 30.9%
Main - T = 50%
Main - T = 70%

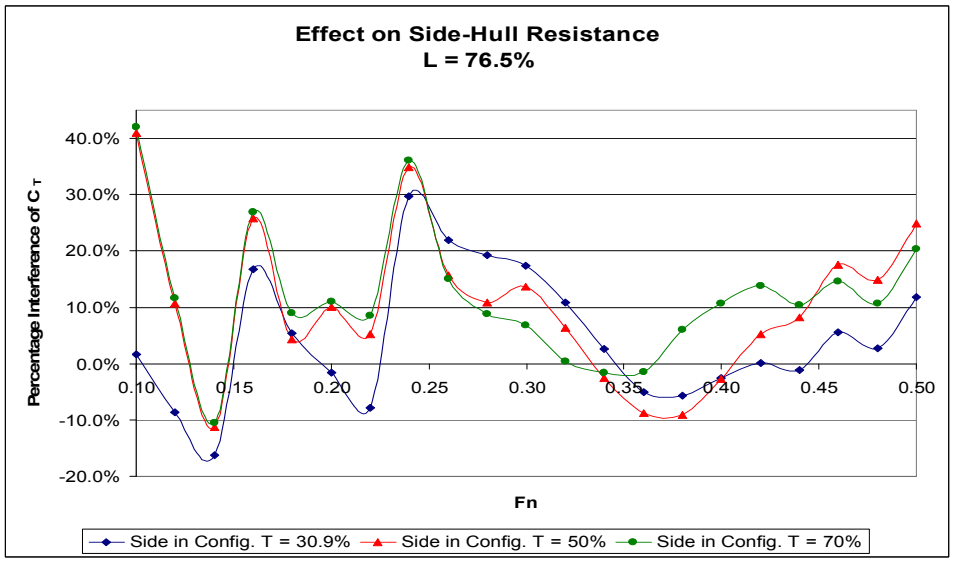
TOTAL RESISTANCE COEFFICIENT – SIDE-HULL

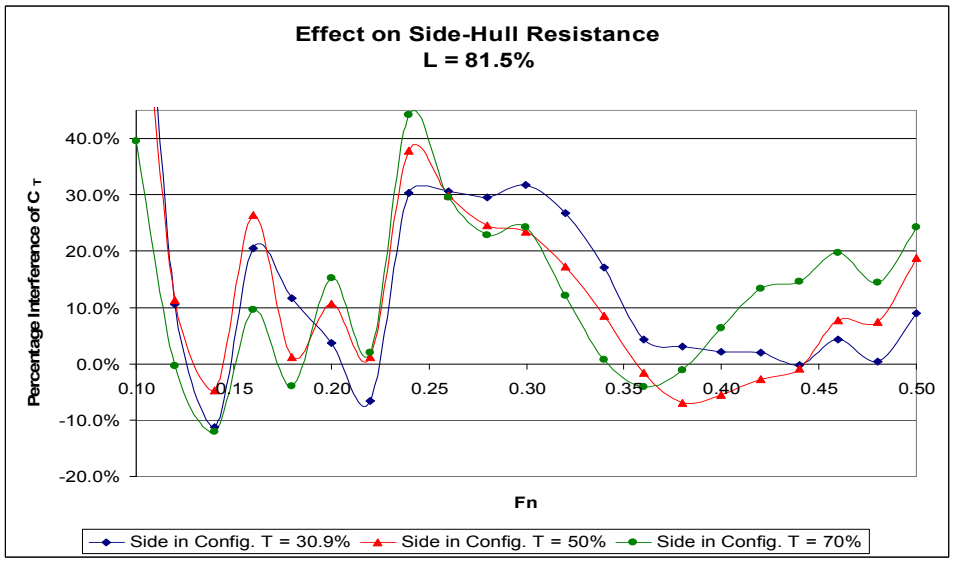




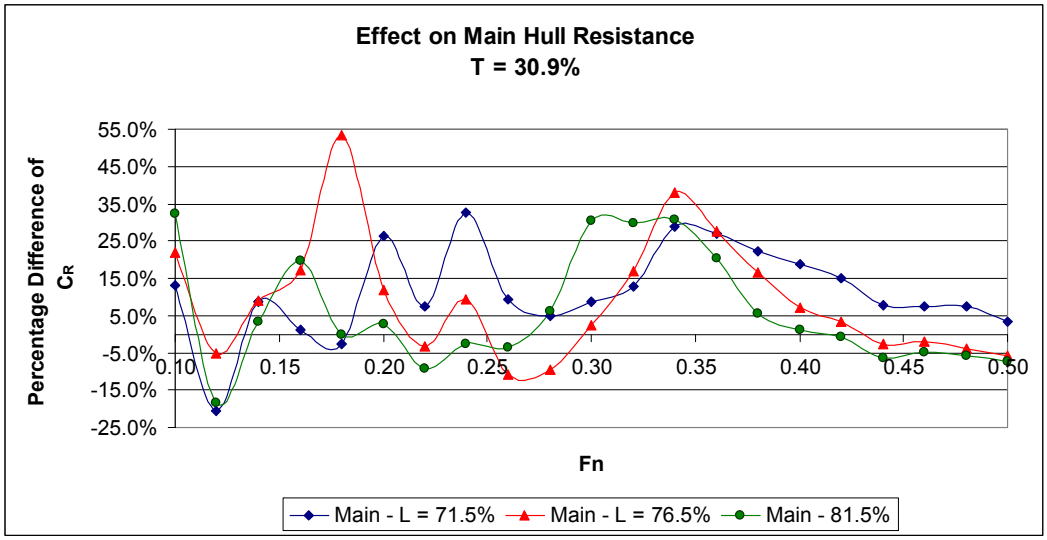


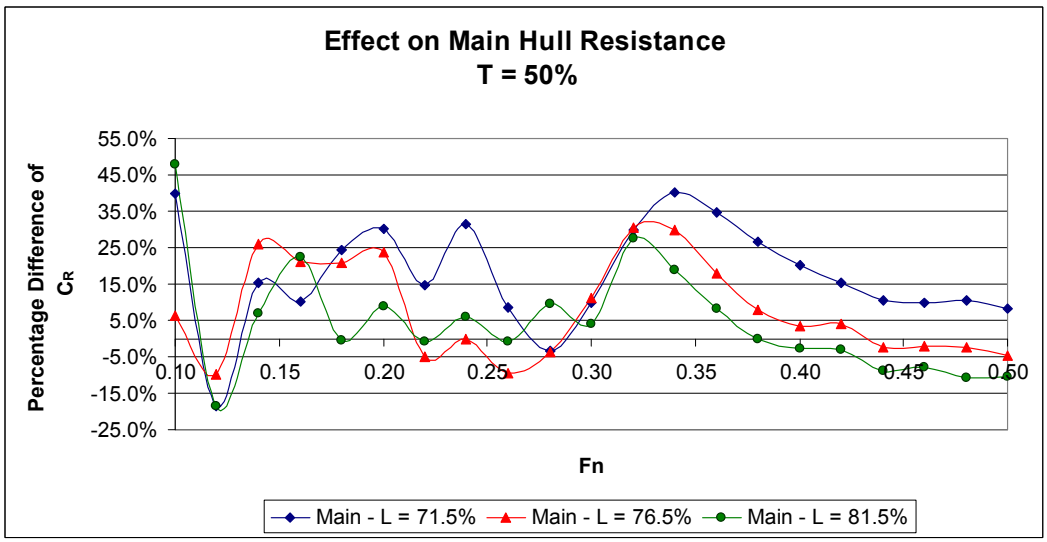

Effect on Side-Hull Resistance
L = 71.5%
Percentage Interference of C T
40.0%
30.0%
20.0%
10.0%
0.0%
-10.0%
-20.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Side in Config. T = 30.9%
Side in Config. T = 50%
Side in Config. T = 70%

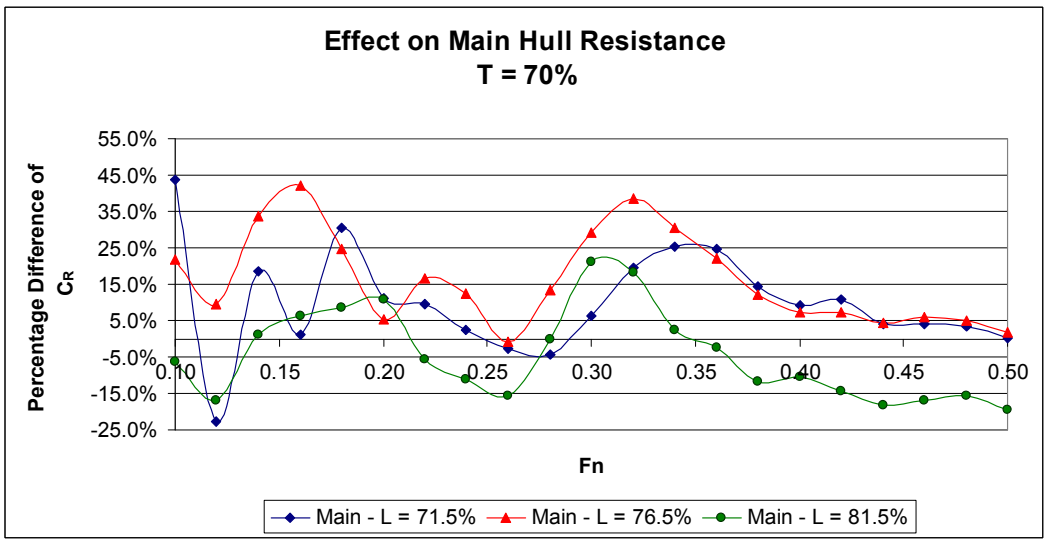

Effect on Side-Hull Resistance
L = 76.5%
Percentage Interference of C T
40.0%
30.0%
20.0%
10.0%
0.0%
-10.0%
-20.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Side in Config. T = 30.9%
Side in Config. T = 50%
Side in Config. T = 70%

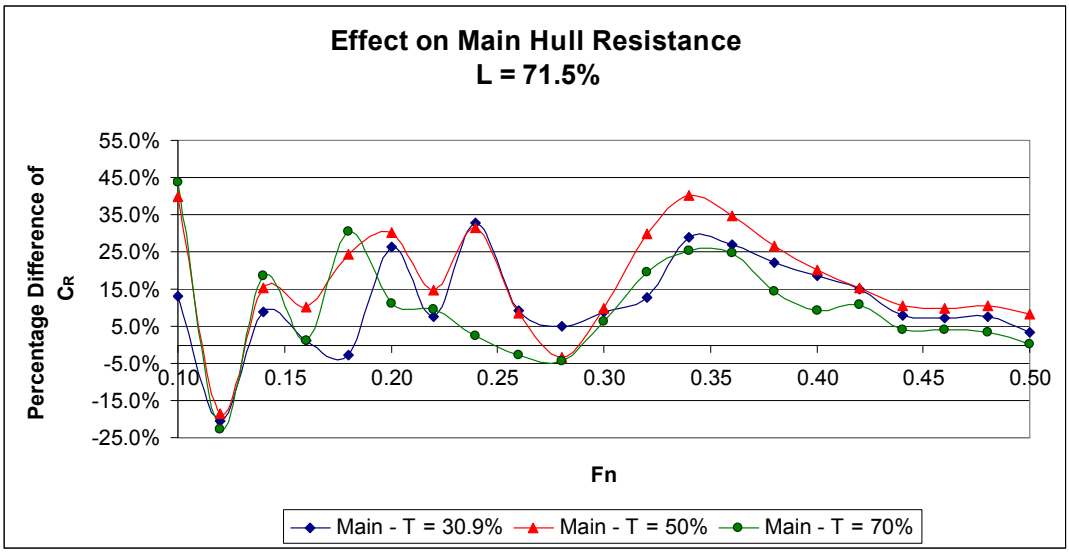

Effect on Side-Hull Resistance
L = 81.5%
Percentage Interference of C T
40.0%
30.0%
20.0%
10.0%
0.0%
-10.0%
-20.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Side in Config. T = 30.9%
Side in Config. T = 50%
Side in Config. T = 70%

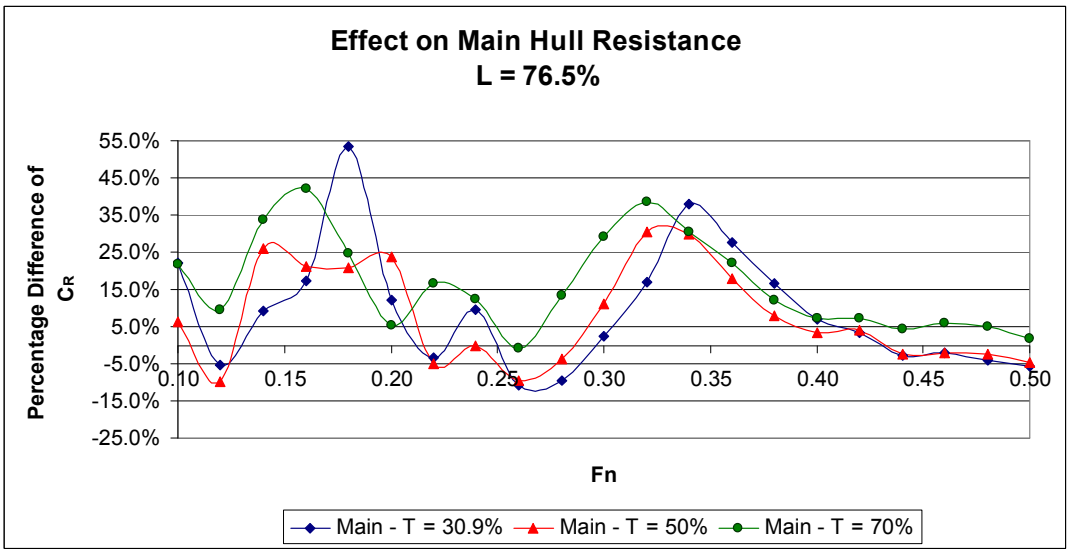
RESIDUARY RESISTANCE COEFFICIENT – MAIN HULL

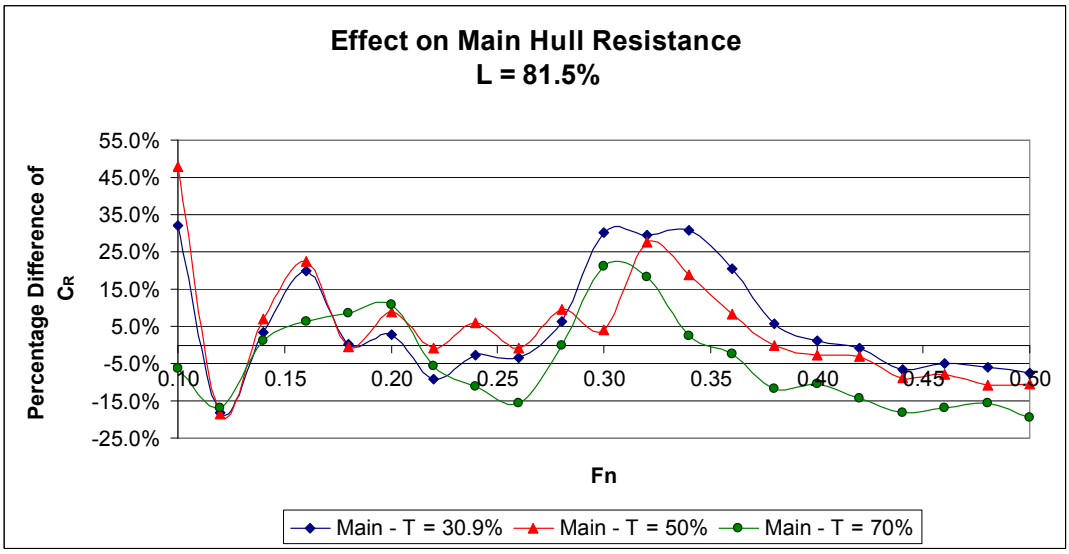




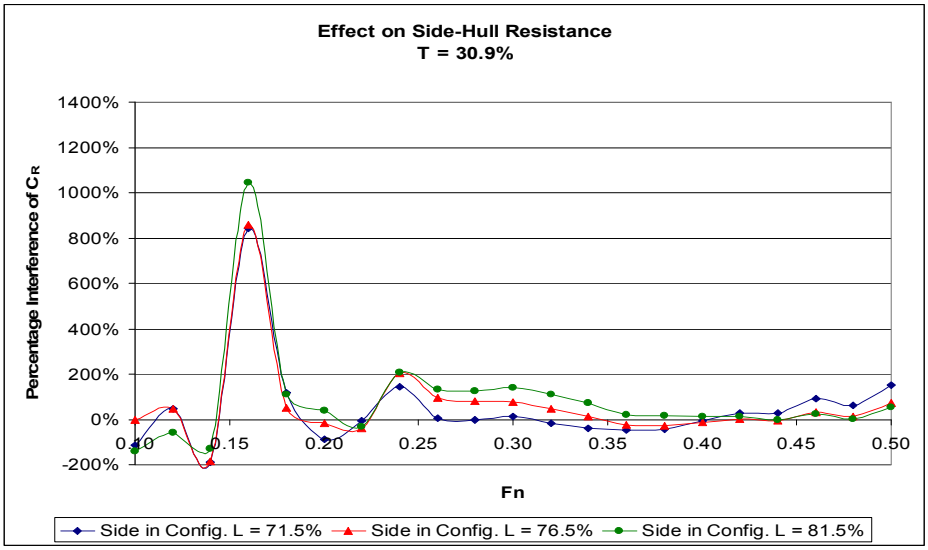


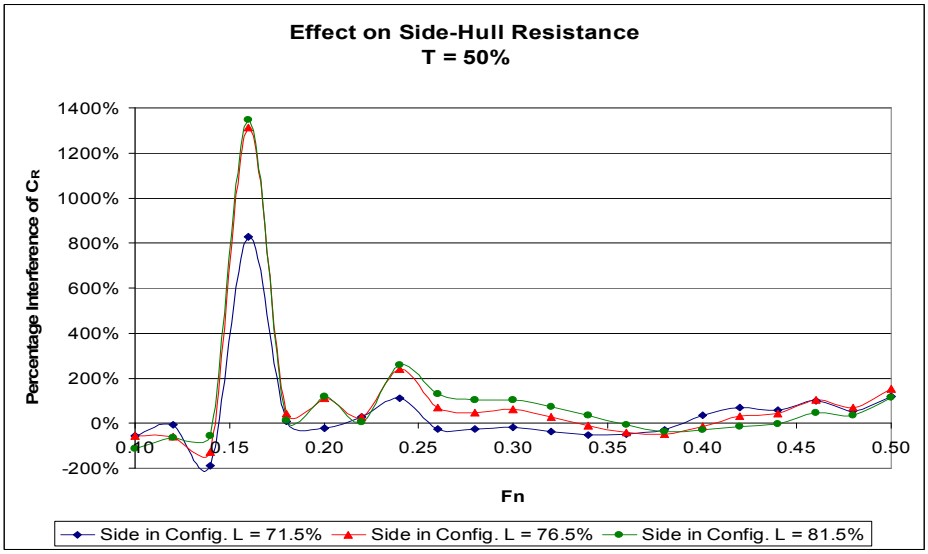

Effect on Main Hull Resistance
L = 71.5%
Percentage Difference of CR
55.0%
45.0%
35.0%
25.0%
15.0%
5.0%
-5.0%
-15.0%
-25.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Main - T = 30.9%
Main - T = 50%
Main - T = 70%

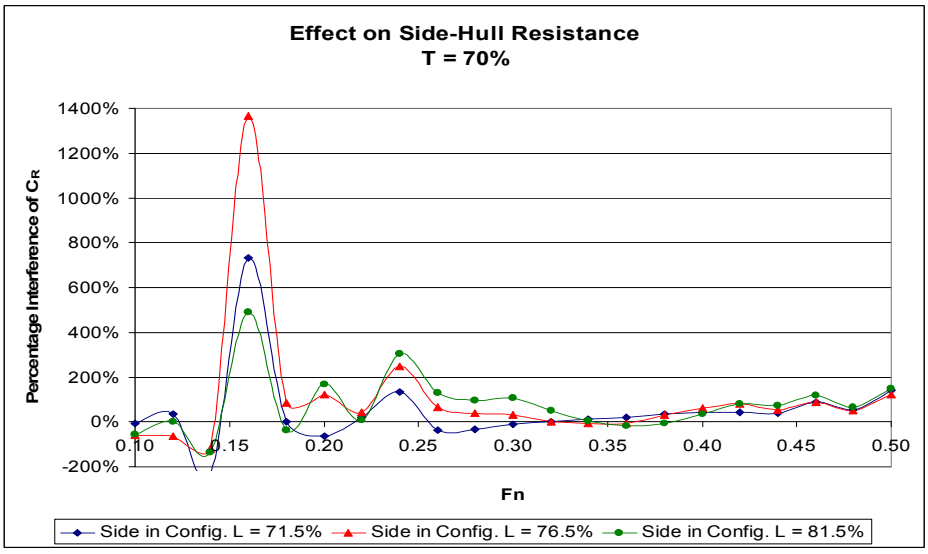

Effect on Main Hull Resistance
L = 76.5%
Percentage Difference of CR
55.0%
45.0%
35.0%
25.0%
15.0%
5.0%
-5.0%
-15.0%
-25.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Main - T = 30.9%
Main - T = 50%
Main - T = 70%

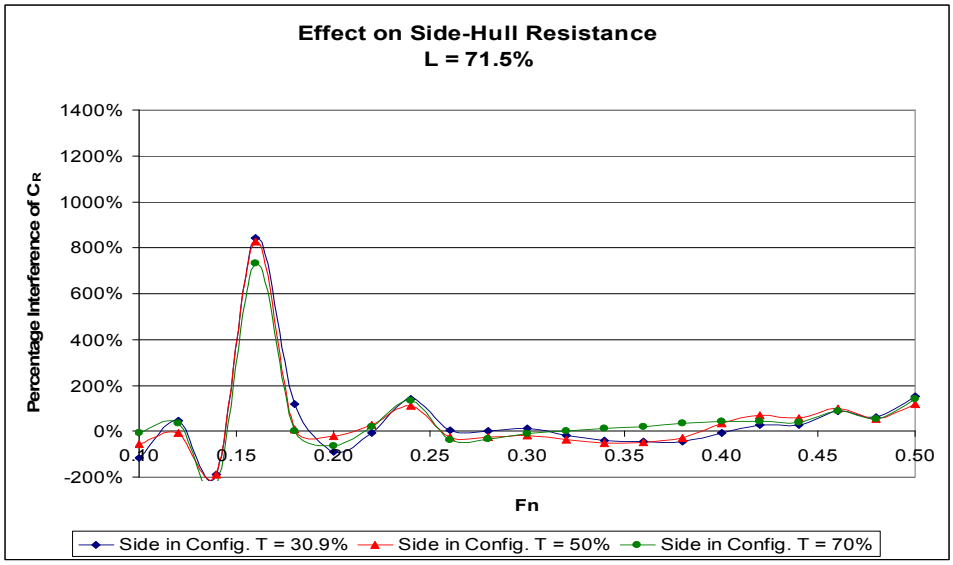

Effect on Main Hull Resistance
L = 81.5%
Percentage Difference of CR
55.0%
45.0%
35.0%
25.0%
15.0%
5.0%
-5.0%
-15.0%
-25.0%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Main - T = 30.9%
Main - T = 50%
Main - T = 70%

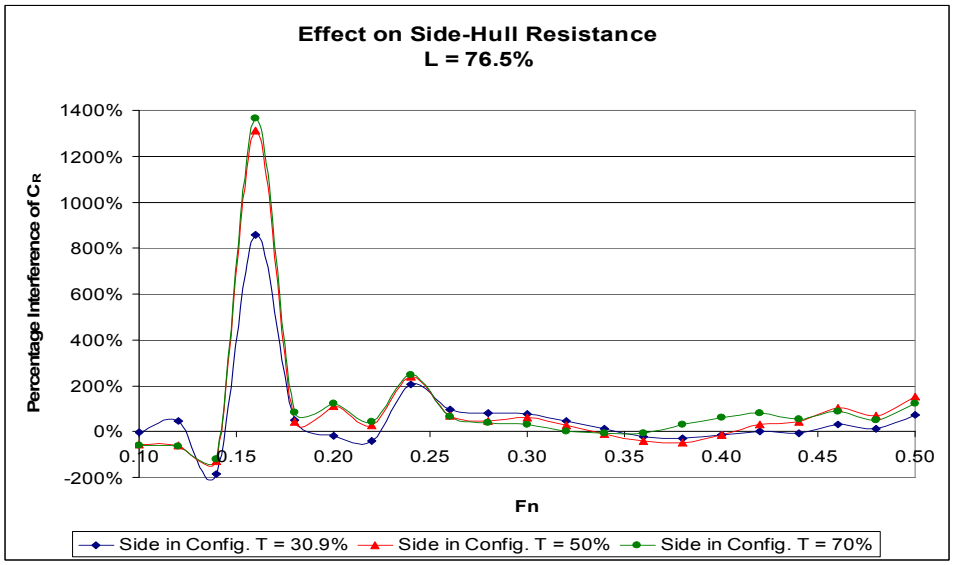
RESIDUARY RESISTANCE COEFFICIENT – SIDE-HULL

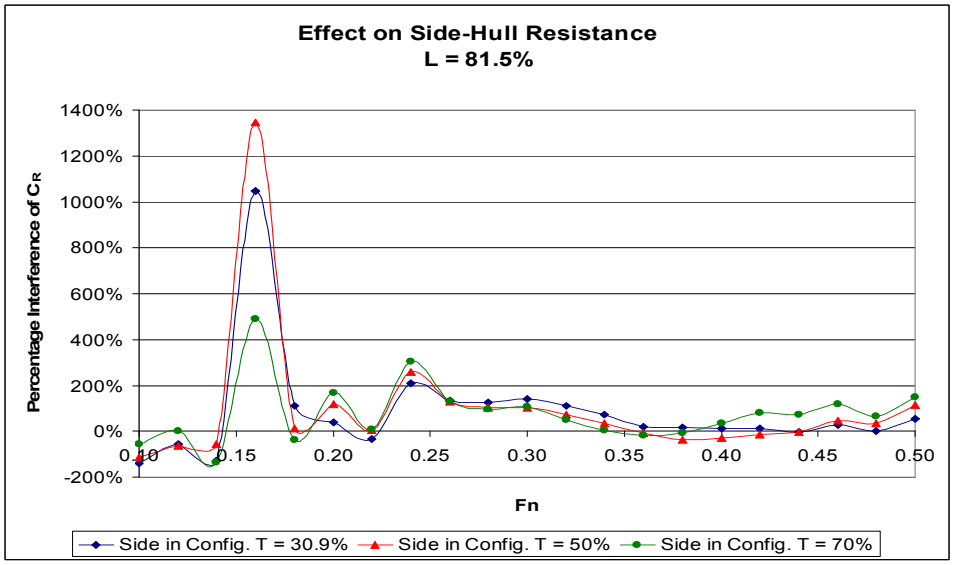







Effect on Side-Hull Resistance
L = 71.5%
Percentage Interference of C_R
1400%
1200%
1000%
800%
600%
400%
200%
0%
-200%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Side in Config. T = 30.9%
Side in Config. T = 50%
Side in Config. T = 70%


Effect on Side-Hull Resistance
L = 76.5%
Percentage Interference of C_R
1400%
1200%
1000%
800%
600%
400%
200%
0%
-200%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Side in Config. T = 30.9%
Side in Config. T = 50%
Side in Config. T = 70%


Effect on Side-Hull Resistance
L = 81.5%
Percentage Interference of C_R
1400%
1200%
1000%
800%
600%
400%
200%
0%
-200%
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Fn
Side in Config. T = 30.9%
Side in Config. T = 50%
Side in Config. T = 70%