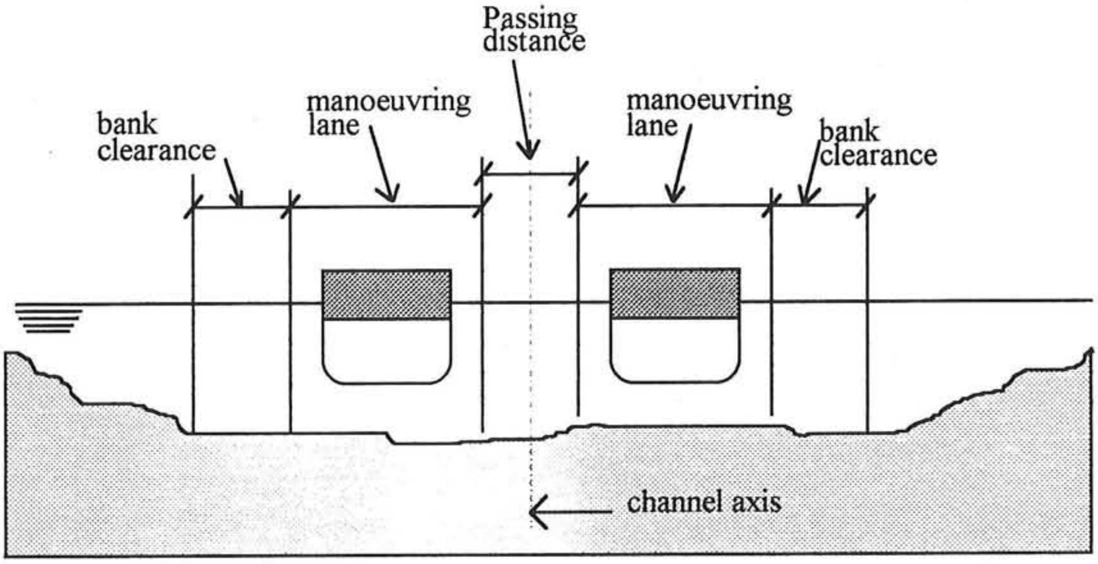
A Study on the Concept Design Rules for Approach Channels

The Final Report



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Report Chronology

Version	Reason for updating
June 1994	First Report on the study results
October 1994	Supplementary Report, as a result of: - the review on the calculation process - the new data from supplementary sources
November 1994	Supplementary Results (results only), reviewed results based on new data from the Supplementary Questionnaire (limited distribution)
January 1995	Final Report on the study results (concept)
February 1995	Supplementary Results (first revision)
February 1995	Final Report on the study results (first revision)
April 1995	Supplementary Results (second revision)
October 1995	Final Report on the study results (second revision)

ABSTRACT

The "Guide for Concept Design" is prepared by the Working Group 30 (WG30) in order to provide practical guidelines for the design of approach channels and fairways. WG30 is a joint working group formed by the Permanent International Association of Navigation Congresses (PIANC) and International Association of Ports and Harbours (IAPH). As part of the preparation, a study was assigned to verify the guidelines using information from/of existing channels around the world. As a result of the study, the Concept Design has proven to closely meet the expectations for ONE WAY channels (where only one ship can pass at a given time). However, for the majority of the TWO WAY channels (where two ships can pass from opposite directions at a given time) the Concept Design Rules showed larger widths. One of the causes for these results is the discrepancy in information concerning the dimensions of ships passing the channels.

KEY WORDS: approach channels, Concept Design, fairways, guidelines channel design.

SUMMARY

Results:

1. The questionnaire used to gain information from ports and harbours world-wide was not adequate to generate enough data for Concept Design calculations. Additional information from available sources on ports and harbours has been very useful in providing extra data. Furthermore, a supplementary questionnaire finally provided even more accurate information. All these data were used to carry out this study.
2. For One-Way channels, the Concept Design Rules (CDR):
   a. overestimated 44% of the channels
   b. underestimated 52% of the channels
3. For Two-Way channels, the CDR:
   a. overestimated 56% of the channels
   b. underestimated 28% of the channels

Conclusions:

1. The results of the CDR calculations for One-Way channels are much closer to the reality than the results for the Two-Way channels.
2. The overestimation may have been caused by: (1) the differences between the dimensions of the largest ship nowadays allowed to enter and the dimensions of the design ship used for the original design of the channel; (2) the Concept Design takes into account the risks of certain cargo types on the environment which probably were not considered when the channel was designed; (3) the change in the policy for permitting a ship to enter a channel; and (4) higher safety standards of the CDR.
3. On the other hand, the underestimation may have been caused by: (1) the relatively large width of the channels, and (2) the discrepancy in the channel widths.

Recommendations:

1. The future questionnaires should be set up in such a way that it would provide specific and accurate information which can directly be used for the CDR.
2. When using the Concept Design it is crucial to consider things that may possibly lead to either overestimation or underestimation; for instance the fact that the largest vessel allowed to enter nowadays is larger (or even smaller) than the design ship.
3. An in-depth study on the channels is recommended to discover the local physical and environmental conditions and explain their effects on the CDR calculations. This study may include, among other things: research on the policy of permitting ship to enter and pass the channel; adjustments or changes in the existing channel; and changes in the sizes and types of ships. This in-depth study can be beneficial in developing better insight into the effectiveness of the Concept Design Rules.

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1. INTRODUCTION

In the past 10 to 15 years changes have taken place in the sea transportation world. New channels have been designed and vessel traffic managements (VTS-systems) of existing channels have changed. Ship sizes and types, traffic densities and mix have changed too. There is now a greater awareness of marine and environment risk.

All these factors have led to the decision to review good modern practice for determination of approach channel width. Since 1980 a PIANC publication has served as the practical guidance for designers. PIANC is now working together with IAPH (International Association of Ports and Harbours) on a new guide for concept design for approach channels.

In August 1993 IAPH has sent a questionnaire to its members world-wide on behalf of the Joint PIANC/IAPH Working Group Nr. 30 (WG30). The objective of the questionnaire was to gain information on the local entrance channel(s) to ports and harbours. This information is essential for WG30 in verifying the guidelines for dimensioning approach channels. These guidelines are formulated in WG30's "Guide for Concept Design for the Approach Channels".

2. PROBLEM DEFINITION

The objective of this study is to compare the channel widths determined by using the Concept Design Rules with the actual width of existing chanels; to quantify the differences and to identify the causes.

3. THE CONCEPT DESIGN RULES

The Concept Design Rules consist of two basic parts:

(1) The basic manoeuvring lane or basic manoeuvring width. That is the minimum width required by a vessel in order to pass a channel safely under very favourable environment and operational conditions. This basic manoeuvring width w_{BM} is expressed as a multiple of the design ship's beam B (Table 3.1).

TABLE 3.1

BASIC MANOEUVRING LANE		**Outer Channel**	**Inner Channel**
Ship Manoeuvrability			
0	good	1.3 B	1.3 B
1	moderate	1.5 B	1.5 B
2	poor	1.8 B	1.8 B

(2) The additional widths are introduced to allow for the effects of wind, current, and other environmental conditions. The additional widths are added to the basic manoeuvring width (w_{BM}). The other kinds of additional width are (1) to provide safety zones between the ship and the edges of the channel (called the "bank clearance") and (2) to provide a safety zone between two ships passing in opposite directions (called "passing distance"). This additional widths are given in Tables 3.2, 3.3 (for passing distance), and 3.4 (for bank clearance). See Figure 3.1 for illustration.

FIGURE 3.1
Elements of Channel Width

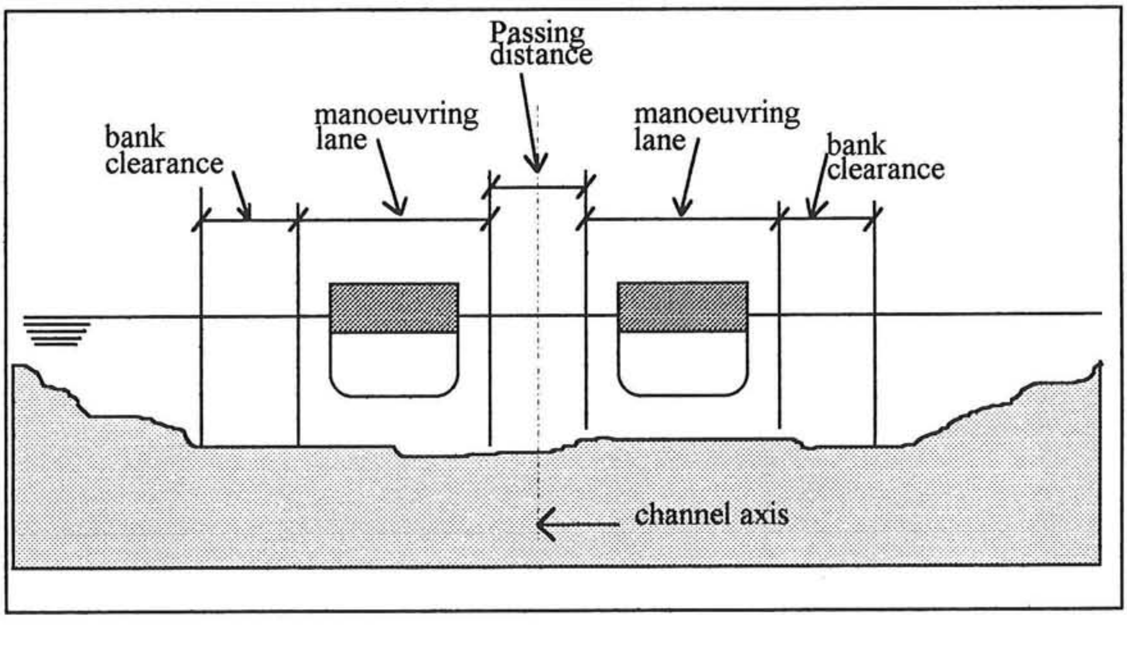


TABLE 3.2

ADDITIONAL WIDTH			Outer Channel	Inner Channel
Add. width due to vessel speed				
0	fast (V > 12 kn.)		0.1 B	0.1 B
1	moderate (8 kn. < V < 12 kn.)		0.0	0.0
2	slow (5 kn. < V < 8 kn.)		0.0	0.0
Add. width due to prevailing cross wind		**speed**		
0	mild (<15 kn or Beaufort 4)	all	0.0	0.0
1	moderate (15-33 kn or Beaufort 4-7)	fast	0.3 B	--
		moderate	0.4 B	0.4 B
		slow	0.5 B	0.5 B
2	severe (33-48 kn or Beaufort 7-9)	fast	0.6 B	--
		moderate	0.8 B	0.8 B
		slow	1.0 B	1.0 B
Add. width due to prevailing cross current		**speed**		
0	negligible (< 0.2 kn.)	all	0.0	0.0
1	low (0.2 kn - 0.5 kn)	fast	0.1 B	--
		moderate	0.2 B	0.1 B
		slow	0.3 B	0.2 B
2	moderate (0.5 kn - 1.5 kn)	fast	0.5 B	--
		moderate	0.7 B	0.5 B
		slow	1.0 B	0.8 B
3	strong (1.5 kn - 2 kn)	fast	0.7 B	--
		moderate	1.0 B	--
		slow	1.3 B	--
Add. width due to prevailing longitudinal current		**speed**		
0	low (<1.5 kn)	all	0.0	0.0
1	moderate (1.5 kn - 3 kn)	fast	0.0	--
		moderate	0.1 B	0.1 B
		slow	0.2 B	0.2 B
2	strong (> 3 kn)	fast	0.1 B	--
		moderate	0.2 B	0.2 B
		slow	0.4 B	0.4 B
Add. width due to sig. wave height and length		**speed**		
0	Hs<=1 and wave length <= L	all	0.0	0.0
1	1 < Hs < 3 and wave length = L	fast	appr. 2.0 B	--
		moderate	appr. 1.0 B	--
		slow	appr. 0.5 B	--
2	Hs > 3 and wave length > L	fast	appr. 3.0 B	--
		moderate	appr. 2.2 B	--
		slow	appr. 1.5 B	--

TABLE 3.2 (*continued*)

	WIDTH	Outer Channel	Inner Channel
Add. width due to navigational aids			
0	excellent with shore traffic control	0.0	0.0
1	good	0.1 B	0.1 B
2	ordinary, visual and ship board, infrequent poor visibility	0.2 B	0.2 B
3	ordinary, visual and ship board, frequent poor visibility	>= 0.5 B	>= 0.5 B
Add. width due to bottom surface			
0	if depth/draught (D/T) >= 1.5	0.0	0.0
	if depth/draught (D/T) < 1.5 then:		
1	smooth and soft bottom surface	0.1 B	0.1 B
2	smooth/sloping and hard bottom surface	0.1 B	0.1 B
3	rough and hard bottom surface	0.2 B	0.2 B
Add. width due to the depth of waterway			
0	D >= 1.5 T	0.0	0.0
1	1.25 T < D < 1.5 T	0.1 B	0.2 B
2	D < 1.25T	0.2 B	0.4 B
Add. width due to cargo hazard level			
0	low (dry bulk, break bulk, containers, passengers, general freight, trailer freight)	0.0	0.0
1	medium (Oil in bulk)	>= 0.5 B	>= 0.4 B
2	high (Aviation spirit, LPG, LNG, chemicals of all classes)	>= 1.0 B	>= 0.8 B

TABLE 3.3

ADDITIONAL WIDTH for Two-Way Traffic			
PASSING DISTANCE (Wp)		**Outer Channel**	**Inner Channel**
Passing distance due to the vessel speed			
0	fast (V > 12 kn)	2.0 B	--
1	moderate (8kn < V < 12 kn)	1.6 B	1.4 B
2	slow (5 kn < V 8 kn)	1.2 B	1.0 B
Passing distance due to encounter traffic density			
0	light (0 - 1 vessel/hour)	0.0	0.0
1	moderate (1.0 - 3.0 vessels/hour)	0.2 B	0.2 B
2	heavy (> 3.0 vessels/hour)	0.5 B	0.4 B

TABLE 3.4

ADDITIONAL WIDTH for Bank Clearance			
WIDTH for BANK CLEARANCE		**Outer Channel**	**Inner Channel**
Sloping channel edges and shoals:			
0	Vessel speed: fast (V > 12 kn)	0.7 B	--
1	Vessel speed: moderate (8 kn < V < 12 kn)	0.5 B	0.5 B
2	Vessel speed: slow (5 kn < V < 8 kn)	0.3 B	0.3 B
Steep and hard embankments, structures:			
0	Vessel speed: fast (V > 12 kn)	1.3 B	--
1	Vessel speed: moderate (8 kn < V < 12 kn)	1.0 B	1.0 B
2	Vessel speed: slow (5 kn < V < 8 kn)	0.5 B	0.5 B

FIGURE 3.2
Sloping Channel Edges and Shoals

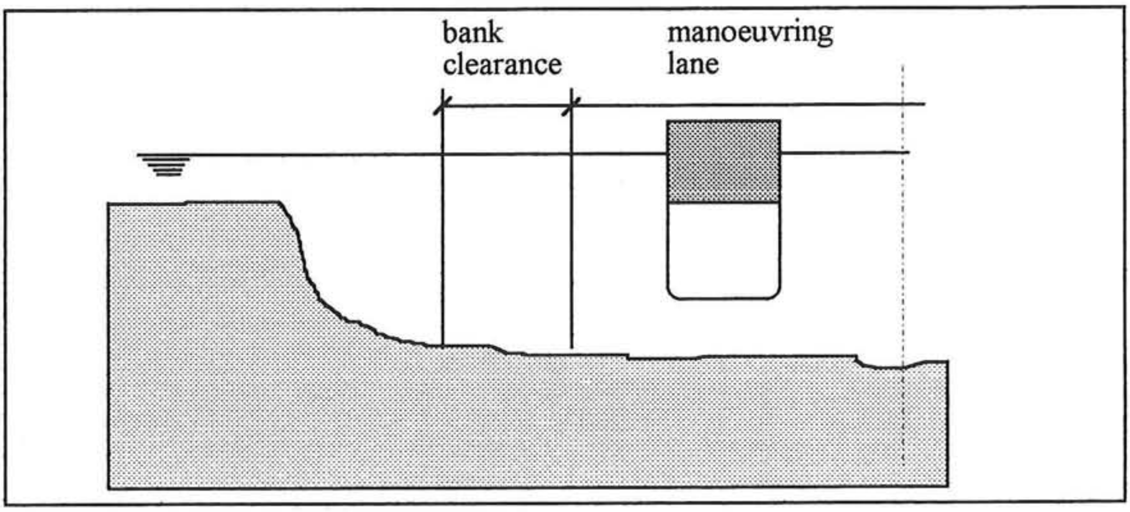
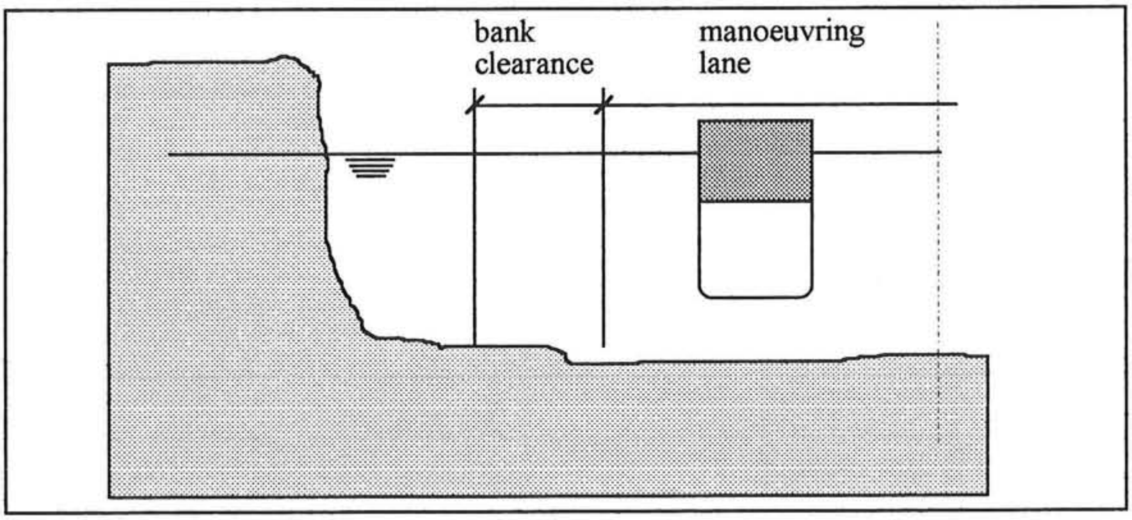


FIGURE 3.3
Steep and Hard Embankments and Structures



The Concept Design results in the bottom width of a channel (see Figure 3.1), instead of the width on the water level; for now on the bottom width is referred to as the "width". The water-level width is not used in the calculations at all. The design width is given by the following:

a. For ONE WAY Channel :

$$\boxed{W = w_{BM} + \text{total } w_i + w_{Br} + w_{Bg} \qquad (3.1)}$$

b. For TWO WAY Channel :

$$\boxed{W = 2*(w_{BM} + \text{total } w_i) + w_{Br} + w_{Bg} + w_P \qquad (3.2)}$$

Wherein :

TABLE 3.7

	Description	**Function of**
W	the bottom width of the waterway	
w_{BM}	the basic manoeuvring lane	vessel's manoeuvrability
w_{Br}	the bank clearance RED (left/port)	type of channel edges, vessel speed
w_{Bg}	the bank clearance GREEN (right/starboard)	type of channel edges, vessel speed
w_P	the passing distance	vessel speed, traffic density
w_i	environmental-dependent factor, i.e. :	
	a. vessel speed	vessel speed only
	b. prevailing cross wind	wind velocity, vessel speed
	c. prevailing cross current	current velocity, vessel speed
	d. prevailing longitudinal current	current velocity, vessel speed
	e. significant wave height and length	wave height & length, vessel speed
	f. available aids to navigation	level of technology
	g. bottom surface	depth, type of surface
	h. cargo hazard level	type cargo transported

4. THE QUESTIONNAIRE

The Concept Design Rules (CDR) have to be evaluated by (1) carrying out Concept Design calculations using data on existing approach channels and then (2) comparing the results (the so-called design widths) with the actual widths. In order to obtain the information, IAPH has distributed up to three different versions of the questionnaire to its members in the past. There has been, however, no proper follow-up due to several reasons, such as the complexity and the comprehensiveness of the questionnaire, the lack of response, and the lack of information. Therefore, to avoid the same problems, the latest version, distributed in August 1993, was concise and compact. As a result it did prompt a quick and large response. In fact, over 130 ports and harbours have responded.

This questionnaire is focused on the following factors that are crucial to dimensioning an approach channel:

a. Whether the width of the navigable channel limits the size of the entering vessel;
b. The width and depth of the most critical section of the channel;
c. The dimensions of the largest vessel which to pass;
d. Other limiting factors;
e. Environmental conditions, such as cross currents, winds, wave conditions, and the tides.

All submitted information is presented in list ... of Appendix A.

4.1 Missing information

Although through the questionnaire a large amount of useful information was obtained, a considerable amount of information was still missing. Reasons are:

(1) The questionnaire simply did not request some of the needed information. In order to keep the questionnaire concise and compact, it excluded a number of elements that are also needed for the CDR.
(2) There was absence of (specific) answers to the questions because the port/harbour was not in the position to provide them.

The information obtained through questionnaire must be complemented with a considerable extra quantity of information. This extra information is crucial: (1) to form a clear picture of the local conditions and (2) to gain higher accuracy. The following ways have been used to obtain additional information:

(1) By sending a follow-up questionnaire to a selected number of ports, July 1994.
(2) By collecting supplementary data from other sources.

4.2 Information obtained from supplementary sources

The supplementary sources are:

1. **Guide to Port Entry 1993/1994**, Shipping Guides Limited;
2. **Lloyd's Ports of the World 1994**, Lloyd's of London Press Ltd;
3. **Fairplay World Port Directory**, Fairplay, 1994;
4. **Shipping Statistics Yearbook 1994**,
   Institute of Shipping, Economics & Logistics;
5. **Hans Gade's American Harbour Pilot**, Hans Gade, 1983.

These sources provide, among others, information on:

a. whether it concerns an OUTER or an INNER channel,
b. the traffic density in the channel,
c. the types of cargo transported to and from the ports/harbour,
d. the ship manoeuvrability,
e. the navigational aids.

4.3 Information obtained from the supplementary questionnaire

The supplementary questionnaire requested the following information:

a. the channel: ONE WAY or TWO WAY,
b. the location of the most critical section(s),
c. the longitudinal current,
d. the traffic density,
e. the ship manoeuvrability,
f. the pemitted vessel speed in the channel,
g. the cargo hazard level.

A total 24 ports and harbours responded by returning the supplementary questionnaire. The returned questionnaire provided additional information on 26 channels. See Table 4.1.

TABLE 4.1

Information gained through the supplementary questionnaire

No.	Port	Country	Type of channel	Loc. most crit.	Long. current	Traffic density	Ship man.	Vessel speed allowed	Cargo hazard level
			A:one B:two	A:outer B:inner	A:low B:mod. C:str.	A:light B:mod. C:poor	A:good B:mod. C:poor	A:fast B:mod. C:slow	A:low B:med. C:high
2	AARHUS	Denmark	B	A	A	A	B	B	C
8	BLUFF	New Zealand	A	B	C	A	B	C	B
16	CAIRNS	Australia	A	A	B	B	B	B	C
29	ESBJERG	Denmark	B	A	B	B	B	B	n.s.
31	FRASER Port	Canada	B	B	C	A	B	B	A
32	FREEMANTLE (1)	Australia	A	A	A	A	A	B	C
	FREEMANTLE (2)	Australia	A	B	A	A	B	C	C
33	GEELONG, Victoria	Australia	A	B	A	A	A	B	B&C
34	GHENT	Belgium	B	A	A	C	A	B	C
51	HOUSTON, Texas	U.S.A.	B	B	A	C	B	B	C
66	LE HAVRE	France	A	A	B	C	A	A	C
73	MARSEILLE (1)	France	B	A	A	B	A	A	C
	MARSEILLE (2)	France	A	B	A	B	B	A	C
78	MONTREAL, Quebec	Canada	B	B	B	B	B	B	A
83	NEWCASTLE, NSW	Australia	A	B	A	A	B	C	A
85	OAKLAND, Cal.	U.S.A.	A	B	C	B	B	C	A
90	PORT HEDLAND	Australia	A	A&B	B	A	A&B	B	A
92	PORT LOUIS	Mauritius	A	A	A	B	A	C	C
111	SHUWAIKH	Kuwait	B	A	A	A	A	A	A
113	SINGAPORE	Singapore	B	B	B	C	A	B	B
118	TAURANGA	New Zealand	B	B	C	A	B	B	B
129	WHANGAREI	New Zealand	A	B	B	A	B	B	A&B
	Total : 22 channels	12 countries							

Notes:

Marseille (1) : access channel to the Gulf of Fos
Marseille (2) : dredged channel of the Gulf of Fos
Fremantle (1) : Success/Parnelia Channel
Fremantle (2) : Stirling/Calista Channel
Whangarei (NZ) : Whangarei Harbour - Marsden point oil terminal & Port Whangarei Cargo Port
n.s. : not specified

Channels	where two channels are mentioned, the one with the worse combination of conditions is chosen
Cargo hazard level	where two levels are mentioned, the higher one is chosen
Ship manoeuvrab.	where two conditions are mentioned, the worse one is chosen
Most critical sect.	where two locations are mentioned, A (outer/open water) is chosen

5. EVALUATION OF THE RESULTS FROM THE QUESTIONNAIRE

Before any calculation using the Concept Design Rules (CDR) can be carried out, it is necessary to make a number of selections and assumptions first. They are inevitable since not all the needed information is available or known. The selections are needed to limit the number of channels applicable for the calculations. As a result, the calculations can be limited to a number of applicable ports. The assumptions are useful to fill the gap caused by the pieces of information that so far have remained unknown.

5.1 Selection Criterias

The following selection criterias were applied:
Criteria 1: The present channel width must limit the size of the vessels
Criteria 2: The beam of the largest vessel must be known
Criteria 3: The existing channel width must be known

Based on these criterias, 45 applicable channels were selected (from a total of 130+) to be used in this study.

5.2 Assumptions

The following assumptions are made since the information from the questionnaire was sometimes not quite clear or it didn't provide all the necessary data. These assumptions are needed to make it possible to calculate the channel widths according to CDR.

5.2.1 Assumption #1: The channel has sloping edges and shoals

The Concept Design makes a distinction between (a) sloping channel edges and shoals, and (b) steep and hard embankments (see Table 3.6). For this study it was assumed that the channels have sloping edges and shoals.

5.2.2 Assumption #2: All speeds are present in the channel

When the permitted vessel speed in the channel is not known, it is then assumed that all speeds mentioned in the CDR are possible. The CDR split the range into three classes of speed: LOW, MODERATE, and FAST. Although this assumption does not imply that all speeds are actually allowed, it does mean that when the allowable speed is unknown a calculation is to be carried out for each class of speed.

5.2.3 Assumption #3: The most critical part is located in the straight section

It is hardly known where exactly the "most critical section" of the channel is located. Almost no indication can be found whether it is in a straight section or in a bend. The Concept Design itself is based on straight channel sections. In case of a bend, additional factors will have to be added. Therefore, for this study it was assumed that the most critical part is located in the straight section.

5.3 One-way or Two-way?

Although the type of a channel--either One-Way or Two-Way--is crucial for this study, the information is not always at hand. The first source of data--the questionnaire--did not indicate the type of the channels. It didn't explicitly set a limit of what the minimum width of a one-way and a two-way channel should be. This might have been useful in categorising a channel. The supplementary sources of information do not provide an explicit answer either. The third source--the supplementary questionnaire--did provide this information, but only on 20 out of the applicable 45 channels. For the remaining channels the channel type still has to be determined. For this study a 3-step method is employed is order to determine or categorise a channel.

5.3.1 Step #1: Calculate all CDR widths for both types for all applicable channels and select the lowest and the highest values

For this step it was assumed that, as long as the type (One-Way of Two-Way) remains unknown, a channel can be either One-Way or Two-Way. For each channel, calculations were carried out for both One-Way and Two-Way variation. Afterwards, the lowest and the highest values of the widths were selected, for each variation.

5.3.2 Step #2: Determine the absolute minimum and maximum CDR widths

All the CDR calculation results were then categorised in either One-Way or Two-Way. For each category, the absolute minimum width (the lowest value in the category) and the absolute maximum width (the highest value in the category) are selected. These became the absolutes for each category. The difference of between these two absolute CDR widths in the category is the absolute range. Table 5.1 shows a set of: the absolute minimum width, the absolute maximum width, and the absolute range for each channel type.

5.3.3 Step #3: Determine the "border value"

Table 5.1 also shows an overlap between the ranges for One-Way and Two-Way channel. In other words, some One-Way channels might as well be categorised as Two-Way. In fact, nearly 80% of the One-Way range overlaps with the Two-Way range and more than 40% of the Two-Way range overlaps with One-Way. This is illustrated in Figure 5.1.

TABLE 5.1
THE ABSOLUTE WIDTHS

	Questionnaire + additional data			
	Abs. minimum	Abs. maximum	Abs. Range	Avg. Range
ONE-WAY	2.8 B	8.7 B	5.9 B	0.7 B
TWO-WAY	4 B	15.1 B	11.1 B	1.3 B

Notes :

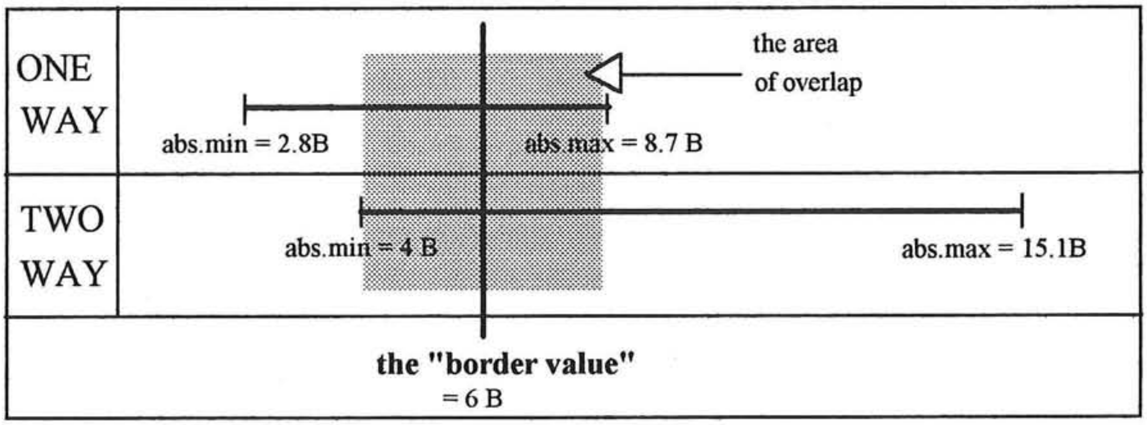
(1) the calculated absolute minimum (the minimum of all calculated CDR widths);
(2) the calculated absolute maximum (the maximum of all calculated CDR widths);
(3) the absolute range (the difference between the abs. maximum and abs. minimum); and
(4) the average range of all channel types (the average of all calculated ranges);
(5) All results are presented as a multiple of the design vessel beam B.

The following assumption is made in order to determine the type of a channel:

> When the Wactual (W/B) is larger than the minimum CDR width (W_{min}) for a Two-Way channel, the channel may then be wide enough to be categorised as a Two-Way channel.

A "border value" must then be determined to clearly mark the point where One-Way ends and Two-Way starts. One possible way to do this is by conveniently choosing a point "halfway" between the absolute maximum for One-Way ($W_{ONE,abs.max}$= 8.7 B) and the absolute minimum for Two-Way ($W_{TWO,abs.min}$= 4B). After rounding off the value, it results in the "border value" of 6 B. See Figure 5.1. This value proves to be in line with the generally used design theory.

FIGURE 5.1
The "border value" between One and Two-WAY



5.4 **The rule-of-thumb** (Step #4: Determine the channel type)

The supplementary questionnaire provides information on the type of 20 channels. For the remaining 25 channels, the type had to be determined using the following rule-of-thumb from the previous step:

0.0 B < W < 6 B : ONE-WAY CHANNEL
W >= 6 B : TWO-WAY CHANNEL

As a result, 27 channels are categorised as One-Way and 12 channels as Two-Way. See Table 5.4.

5.5 Exceptions on the rule-of-thumb

The rule-of-thumb may be the right way of distinguishing one type of channel from the other. However, it has its weak points too.

The CDR specifically require the dimensions of the design ship, the questionnaire, however, asked for the dimensions of the largest design ship. This may have led to discrepancies in the results of the calculations, especially in cases where the largest ship is not necessarily the design ship. A channel may normally have a Two-Way traffic for ships whose dimensions fit the design ships. Only as a matter of exception when the "largest" ship enters or leaves, the channel allows one-way traffic only. Using the beam of the largest ship in the rule-of-thumb will indeed lead to the conclusion the channel is a One-Way channel.

As a matter of fact, 6 channels were categorised by the rule-of-thumb as One-Way while they are in reality (according to the data from the supplementary questionnnaire) Two-Way. In other words, information on the dimensions of the largest vessel will not necessarily reflect the actual situation.

Therefore, information on both (1) the type of the channel and (2) the beam of the design vessel is crucial. On one hand, no CDR width can be calculated without knowing the size of the beam. On the other hand, without explicit information about the channel type, a considerable uncertainty will exist when it comes to analysing the results of the calculation.

5.6 The Methodology for Estimating Channel Widths According to the Concept Design Rules (CDR)

In this section the methodology of evaluating the CDR is presented. The selected channels (see 5.3) were categorised into One-Way and Two-Way channels.

5.6.1 Step #1: Select the applicable channels

Using the selection strategy presented in 5.1, a group of channels is selected to which the CDR can be applied. Selection #1 results in a group of 57 out of more than 130 channels. Selections #2 and #3 altogether reduce the group to 45 channels. These channels are applicable for this study. That is less than 35% of the submitted cases.

5.6.2 Step #2: When not known, determine the type of channel

As already mentioned in Chapter 3, each channel type is to be treated differently. Therefore it is crucial to determine the type first. For 25 out of 45 channels the type had to be determined using the rule-of-thumb (see 5.3).

5.6.3 Step #3: Select the suitable additional widths

The CDR starts with the basic manoeuvring lane (w_{BM}), depending on the ship's manoeuvrability. Then 12 possible additional widths (or "addition") can be added to the w_{BM}. These additional widths are formulated depending on the channel conditions and use, such as: (1) the location of the channel (open water or protected water), (2) the permissible vessel speed in the channel, and (3) the traffic density. Most of the additions depend heavily on the location of the channel (in protected water or in open sea) and on the vessel speed (low, medium, or fast).

The more channel conditions and use are known, the more accurate the additional width can be determined. In general, the questionnaire did not provide an explicit information on the location of the channel nor on the allowable vessel speed. Since most of the additional width are both location-dependent and speed-dependent, it is crucial to collect the unavailable information.

The supplementary sources were useful in providing this information. Among other things, the location of a channel (whether it is exposed to open water [outer] or whether it is in protected water [inner]) can be derived from maps. However, the location of the most critical section of the channel can not be accurately determined that way.

The supplementary questionnaire, on the contrary, did provide accurate information. Among other things, it specified the location of the most critical section and the permissible vessel speed. However, the supplementary questionnaire provided this piece of information of only 20 out of a total of 45 applicable channels. That is less than one half of the total.

Therefore the following approach is used in order to calculate the CDR widths.

Step 1 : When the location of the critical section of the channel is not clear, assume that the channel is located in open water (outer channel).
Step 2 : Choose one class of manoeuvrability (or example: good)
Step 3 : Choose one class of speed (for example: fast).
Step 4 : * For each speed-dependent addition, select the additional width belonging to the chosen class of speed
(for example : the additional width that belongs to "fast").
* For not speed-dependent addition, select the suitable additional width.
Step 5 : Total all additional widths.
(This will be, for instance, the additional widths for fast-speed only)
Step 6 : If the vessel speed is unknown, repeat the process from Step 3 for the remaining speed-classes (for example, one for "moderate" and another one for "slow").
Step 7 : If the manoevrability is unknown, repeat the process from Step 2 for the remaining manoeuvrability-classes (for example, one for "moderate" and another one for "poor")

The result of the calculations using CDR, depending on whether the ship manoeuvrability or vessel speed is known, is a number of widths (between 1 and 9). See Table 5.2. Out of these CDR widths, the minimum and the maximum width can be selected. Except when both the manoeuvrability and speed are known, there will be only one CDR width. This process is illustrated in Figure 5.2.

TABLE 5.2
TOTAL NUMBER OF CDR WIDTHS

The total number of channel widths resulted from CDR calculations		**SHIP MANOEUVRABILITY**	
		known (1basic man. lane)	**unknown** (3 basic man. lanes)
VESSEL SPEED	**known** (1set add. widths)	1 x 1 = **1 CDR width**	3 x 1 = **3 CDR widths**
	unknown (3sets add. widths)	1 x 3 = **3 CDR widths**	3 x 3 = **9 CDR widths**

For those 45 applicable channels the additions are listed in the following tables.

TABLE 5.3

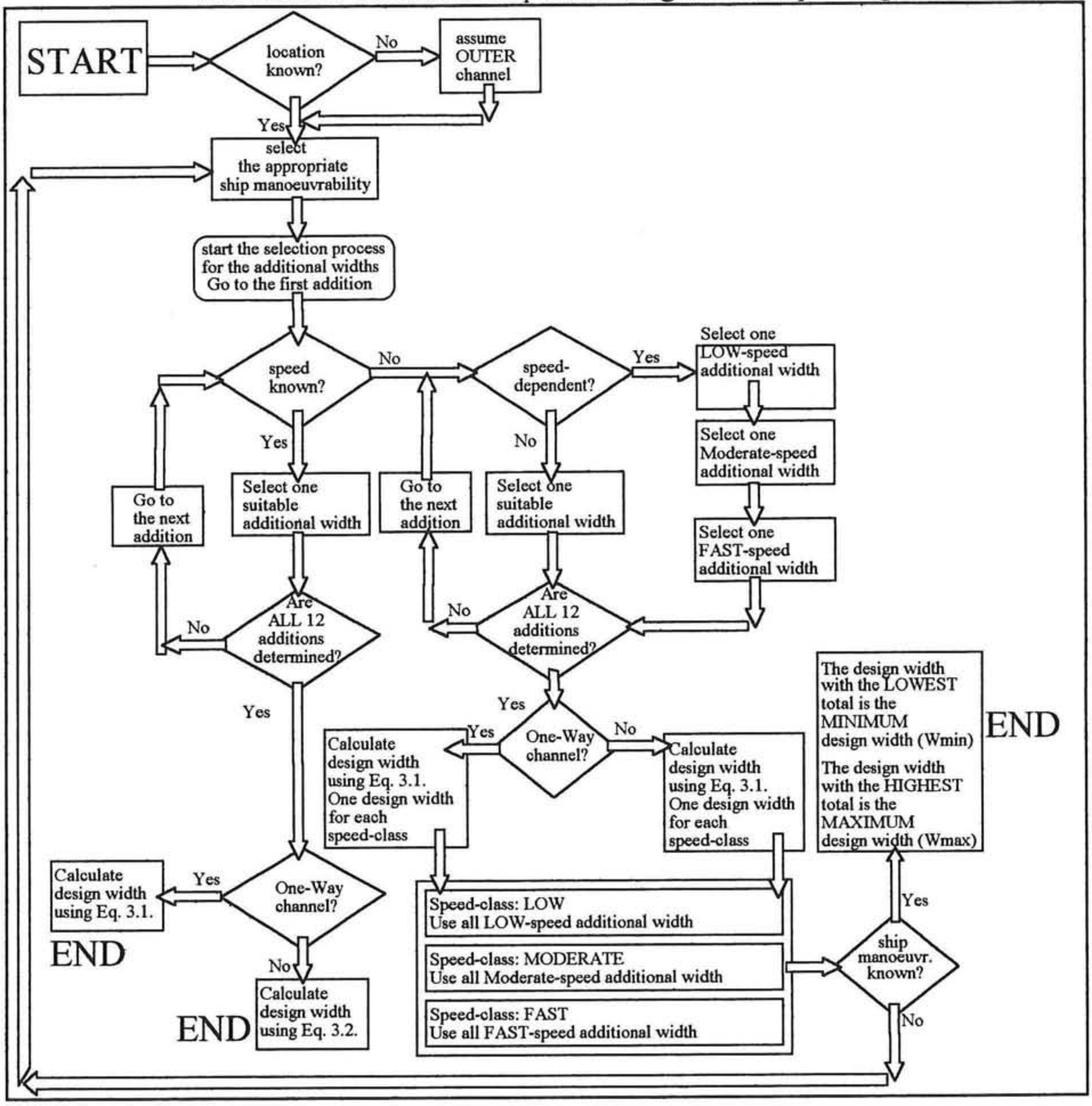
Table	Page	Type Channel	Condition
B1	App-1	ONE WAY	minimum CDR width
B2	App-2	TWO WAY	minimum CDR width
B3	App-3	ONE WAY	maximum CDR width
B4	App-4	TWO WAY	maximum CDR width

5.7 Results analysis

The results of the calculation using CDR are then to be evaluated. The evaluation process and its results will be discussed in Chapter 6.

FIGURE 5.2

Flowchart of the calculation process using the Concept Design Rules



6. ANALYSING THE RESULTS

This section discusses the results of the calculations using the Concept Design Rules (CDR). In the first place, it highlights the benefit of having the information on the permissible vessel speed. When the speed is known it makes a considerable difference in the results and their accuracy. Further, the term "Difference" (always with a capital D, or further to be referred simply as DIFF) and its use will be explained. Difference has been useful to express overestimation, underestimation and accuracy. Last but not least, possible causes of overestimation and underestimation will be presented and analysed.

6.1 The results of the Concept Design Rules calculations

The results of the calculations using the CDR are presented in Tables 6.1.1 (for One-Way channels) and 6.1.2 (for Two-Way channels). In column (2) the locations of the most critical section (in open water [outer] or in protected water [inner]) are listed.

Columns (3) and (4) present the dimensions of the channels. The width of the largest vessel allowed to pass in a channel is to be found in column (5). Dividing the channel width (W) in column (3) by the vessel beam (B) in column (5) resulted in a ratio (W/B) called W.actual (or W.act.). See column (6). W.act. is a relative unit that makes it possible to compare one channel width with another.

The CDR calculations, as already discussed in 5.4, resulted first in three widths. From these three widths, the lowest width, which the result of calculations using favourable (environmental) conditions, is the minimum width (W_{min}). The highest width, on the other hand, is the result of calculations using unfavourable (environmental) conditions and is the maximum width (W_{max}). These two widths are further to be referred as "CDR widths". These CDR widths and the actual width ($W_{act.}$) are presented in Figures 6.1.1 (for One-Way channels) and 6.1.2 (for Two-Way channels). The difference between the minimum and maximum widths is the Range (W_{range}), see column (11). W_{range} is also a relative unit.

Another relative unit is to be found in column (12), that is the Difference (DIFF). DIFF shows the difference between the actual channel width (W.actual) and the CDR widths. The use of DIFF is to be discussed later in this chapter. DIFF is calculated according to the equations in 6.2.

For ports and harbours that received the supplementary questionnaire, the calculations resulted in equal minimum and maximum CDR widths ($W_{max} = W_{min}$). As a result, the range (W_{range}) is nil (zero-range), see column (11) of Tables 6.1.1 and 6.1.2. In other words, the calculations result in only one CDR width when all channel conditions and use for CDR calculations were available.

TABLE 6.1.1

OVERVIEW OF EXISTING AND DESIGN WIDTHS

ONE-WAY CHANNEL ONLY

No.	Loc.	Existing channel width in m	Exist. channel depth in m	Width of largest vessel in m	Existing channel Width in B	Min.[1] CDR width in B	Ratio[2] of Wmin/W	Max.[3] CDR width in B	Ratio[2] of Wmax/W	Range[4] CDR widths in B	Difference[5] in B
		W	**D**	**B**	$W_{act.}$[6]	W_{min}	$W_{min.rat.}$	W_{max}	$W_{max.rat.}$	W_{range}	**DIFF**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	outer	200	14	60	3.3	3.4	1.03	3.9	1.2	0.5	-0.1
2	inner	100	8.5	24	4.2	3.6	0.9	4.2	1.0	0.6	0.0
3	inner	87	8.2	34	2.6	3.5	1.4	3.5	1.4	0	-0.9
4	inner	150	7	40	3.8	4.2	1.1	4.7	1.3	0.5	-0.4
5	inner	200	12.2	41	4.9	3.6	0.7	4.3	0.9	0.7	0.6
6	inner	76	7.6	32	2.4	4.2	1.8	4.8	2.0	0.6	-1.8
7	outer	90	8.5	32	2.8	4.4	1.6	4.4	1.6	0	-1.6
8	inner	78	10	35	2.2	2.9	1.3	3.8	1.7	0.9	-0.7
9	outer	200	9.3	42	4.8	3.9	0.8	5.4	1.1	1.5	0.0
10	outer	152	13.7	46	3.3	4.1	1.2	4.1	1.2	0	-0.8
11	inner	122	10.5	45.7	2.7	3.7	1.4	3.7	1.4	0	-1.0
12	inner	150	13.5	34	4.4	3.7	0.8	3.7	0.8	0	0.7
13	inner	140	8.6	34	4.1	3.3	0.8	4	1.0	0.7	0.1
14	inner	250	13.5	58	4.3	3.6	0.8	4.3	1.0	0.7	0.0
15	outer	100	12	27.1	3.7	3	0.8	5.7	1.5	2.7	0.0
16	inner	91	11	44.2	2.1	3.8	1.8	3.8	1.8	0	-1.7
17	inner	200	10.5	34	5.9	3.3	0.6	4.3	0.7	1	1.6
18	outer	300	15	52	5.8	4.8	0.8	4.8	0.8	0	1.0
19	outer	180	12.8	40	4.5	6.6	1.5	8.7	1.9	2.1	-2.1
20	inner	100	10	30	3.3	4.5	1.4	4.6	1.4	0.1	-1.2
21	inner	152	12	28	5.4	2.9	0.5	3.9	0.7	1	1.5
22	inner	180	15.2	55	3.3	4	1.2	4	1.2	0	-0.7
23	inner	183	11.6	39.6	4.6	3	0.6	3	0.6	0	1.6
24	outer	183	14.6	55	3.3	3.4	1.0	3.4	1.0	0	-0.1
25	outer	185	12.2	32	5.8	5.6	1.0	5.6	1.0	0	0.2
26	outer	183	12	34	5.4	3.3	0.6	4.7	0.9	1.4	0.7
27	outer	150	7	37	4.1	4.2	1.0	4.2	1.0	0	-0.1
28	inner	90	8.1	32.2	2.8	3.6	1.3	3.6	1.3	0	-0.8
29	outer	200	12	55	3.6	3.7	1.0	6.2	1.7	2.5	-0.1

NOTES:

[1] = Minimum width according to the Concept Design Rules (CDR), using favourable conditions for the variables of the additional widths. Abbreviated by **Wmin**. Presented as a multiple of B.

[2] = Ratio (Abbreviated by **Wmin.rat.** or **Wmax.ratio.**) is determined as follows:

For Wmin **Wmin.rat. = Wmin/Wactual** (8)=(7)/(6)

For Wmax **Wmax.rat. = Wmax/Wactual** (10)=(9)/(6)

[3] = Maximum width according to CDR, using unfavourable conditions for the variables of the additional widths. Abbreviated by **Wmax**. Presented as a multiple of B.

[4] = Range (Abbreviated by **Wrange**. Presented as a multiple of B) is the difference between the minimum and maximum CDR width.

Wrange = Wmax-Wmin or (11)=(9)-(7)

[5] = Difference (Abbreviated by **DIFF**. Presented as a multiple of B.) determined as follows:

If Wactual < Wmin [or col. (6)<(7)] then **DIFF = Wactual - Wmin** (12)=(6)-(7)

If Wactual > Wmax [or col. (6)>(9)] then **DIFF = Wactual - Wmax** (12)=(6)-(9)

If Wmin<Wactual<Wmax then **DIFF = 0**

[6] = **Wactual** is the ratio of existing channel width W and the vessel's beam B. **(Wactual=W/B)**

FIGURE 6.1.1

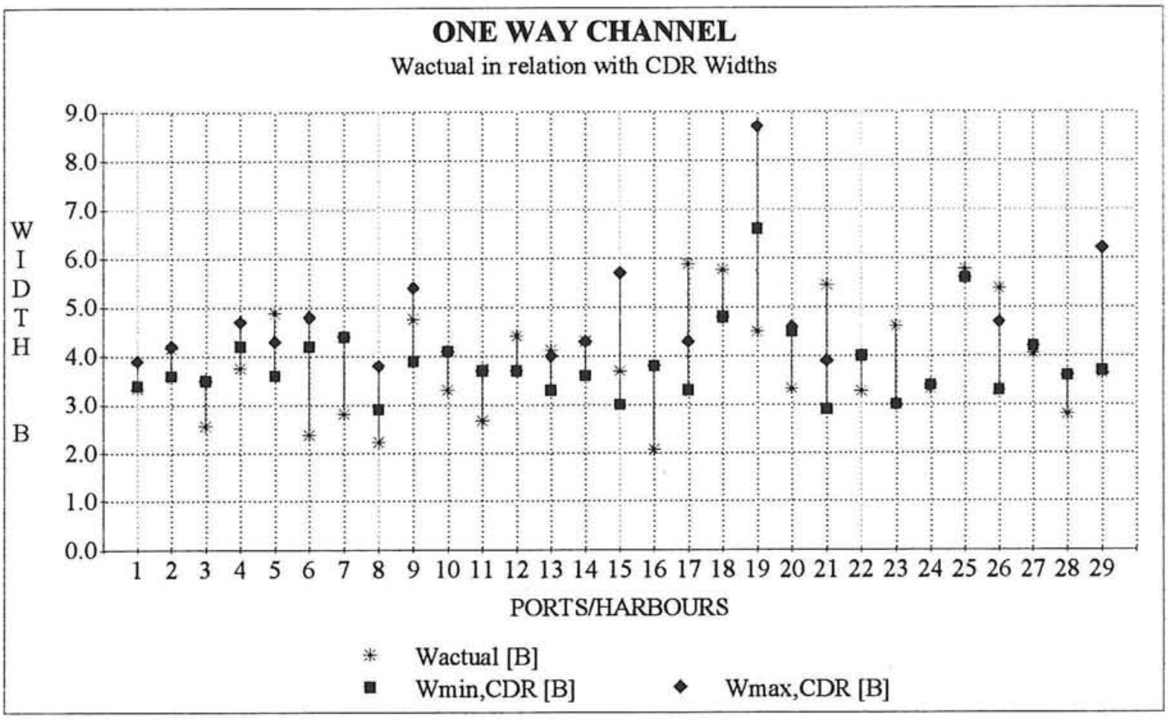


FIGURE 6.1.2

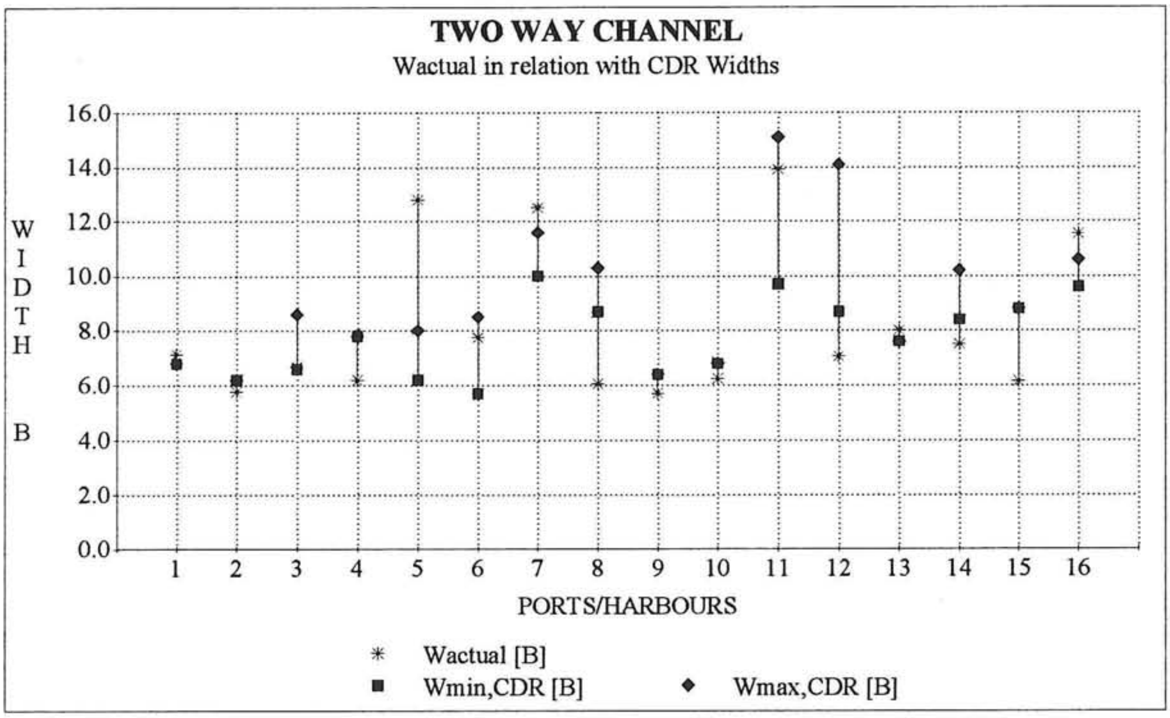


TABLE 6.1.2

OVERVIEW OF EXISTING AND DESIGN WIDTHS

TWO-WAY CHANNEL ONLY

No.	Loc.	Existing channel width in **m**	Exist. channel depth in **m**	Width of largest vessel in **m**	Existing channel Width in **B**	Min.[1] CDR width in **B**	Ratio[2] of Wmin/W	Max.[3] CDR width in **B**	Ratio[2] of Wmax/W	Range[4] CDR widths in **B**	Difference[5] in **B**
		W	**D**	**B**	$W_{act.}$[6]	W_{min}	$W_{min.rat.}$	W_{max}	$W_{max.rat.}$	W_{range}	**DIFF**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	inner	200	9.1	28	7.1	6.8	0.95	6.8	0.95	0	0.3
2	inner	150	9.5	26	5.8	6.2	1.1	6.2	1.1	0	-0.4
3	inner	300	13.5	45	6.7	6.6	1.0	8.6	1.3	2	0.0
4	inner	200	10.7	32.3	6.2	7.8	1.3	7.8	1.3	0	-1.6
5	inner	320	13	25	12.8	6.2	0.5	8	0.6	1.8	4.8
6	outer	240	11	31	7.7	5.7	0.7	8.5	1.1	2.8	0.0
7	outer	500	13	40	12.5	10	0.8	11.6	0.9	1.6	0.9
8	outer	200	25	33	6.1	8.7	1.4	10.3	1.7	1.6	-2.6
9	inner	244	11	42.7	5.7	6.4	1.1	6.4	1.1	0	-0.7
10	inner	200	11	32	6.3	6.8	1.1	6.8	1.1	0	-0.5
11	outer	960	21	69	13.9	9.7	0.7	15.1	1.1	5.4	0.0
12	outer	240	12	34	7.1	8.7	1.2	14.1	2.0	5.4	-1.6
13	inner	360	10.5	45	8.0	7.6	1.0	7.6	1.0	0	0.4
14	inner	150	10.5	20	7.5	8.4	1.1	10.2	1.4	1.8	-0.9
15	inner	200	12.9	32.5	6.2	8.8	1.4	8.8	1.4	0	-2.6
16	inner	150	11	13	11.5	9.6	0.8	10.6	0.9	1	0.9

NOTES:

1) = Minimum width according to the Concept Design Rules (CDR), using favourable conditions for the variables of the additional widths. Abbreviated by **Wmin**. Presented as a multiple of B.

2) = Ratio (Abbreviated by **Wmin.rat.** or **Wma.ratio.**)
is determined as follows:
For Wmin **Wmin.rat. = Wmin/Wactual** (8)=(7)/(6)
For Wmax **Wmax.rat. = Wmax/Wactual** (10)=(9)/(6)

3) = Maximum width according to CDR, using unfavourable conditions for the variables of the additional widths. Abbreviated by **Wmax**. Presented as a multiple of B.

4) = Range (Abbreviated by **Wrange**. Presented as a multiple of B) is the difference between the minimum and maximum CDR width.
Wrange = Wmax-Wmin or (11)=(9)-(7)

5) = Difference (Abbreviated by **DIFF**. Presented as a multiple of B.) determined as follows:
If Wactual < Wmin [or col. (6)<(7)] then **DIFF = Wactual - Wmin** (12)=(6)-(7)
If Wactual > Wmax [or col. (6)>(9)] then **DIFF = Wactual - Wmax** (12)=(6)-(9)
If Wmin<Wactual<Wmax then **DIFF = 0**

6) = **Wactual** is the ratio of existing channel width W and the vessel's beam B. (**Wactual=W/B**)

Notes: * To categorise a channel the following rule is used:

If Wactual < 6.B then **One-Way**
If Wactual > 6.B then **Two-Way**

* The following channels are categorised as One-Way based on that rule inspite of the information obtained from the questionaire and the supplementary questionaire and were removed from Table 2 (Two-Way channels) to Table 1 (One-Way channels):

No. of Table 1	**Location**	**Type according to questionaire**	**Wactual**	**Rule of Category**	**Categorised as**
1.	outer	Two-Way	3.3 B	<6 B	One-Way
9.	outer	Two-Way	4.8 B	<6 B	One-Way
12.	inner	Two-Way	4.4 B	<6 B	One-Way
16.	inner	Two-Way	2.1 B	<6 B	One-Way
27.	outer	Two-Way	4.1 B	<6 B	One-Way

6.2 Influence of Vessel Speed and Manoeuvrability on CDR results

From the two items, the vessel speed is the most important. The Concept Design has 7 speed-dependent additions and only one manoeuvrability-dependent element (which is the basic manoeuvring lane WBM). See Table 6.2.1 below.

TABLE 6.2.1

	Addition's Dependence				
	Manoeuv-rability	**Location**	**Vessel speed**	**Traffic density**	**Other factors**
Basic Man. Lane	✓				
Concept Design Additions					
a. Vessel speed		✓	✓		
b. Prev. cross wind		✓	✓		✓
c. Prev. cross current		✓	✓		✓
d. Pre. long. current		✓	✓		✓
e. Wave height+length		✓	✓		✓
f. Aids to navigation		✓			✓
g. Bottom surface		✓			✓
h. Depth waterway		✓			✓
i. Cargo hazard level		✓			✓
Passing Distance (Wp)		✓	✓	✓	
Bank clearance (Wb)		✓	✓		✓

As far as the manoeuvrability is concerned, the effect is fairly marginal because the difference between the smallest (1.3 B) and largest factor (1.8 B) is just 0.5 B. Furthermore, the effect of manoeuvrability is clearly related with the magnitude of the basic manoeuvring lane (WBM). Poor manoeuvrability, for instance, leads directly to the largest WBM (unfavourable condition), thus contributes to the maximum width; when the manoeuvrability is good, it leads to the minimum width.

The effect of the vessel speed, on the contrary, is not marginal. It is because the total effect is cumulated by all 7 speed-dependent additions, even tough for each addition the difference between the additional widths can be as low as 0.1 B. Furthermore, the effect of speed cannot directly be deducted from the speed. For 3 additions (significant wave height, passing distance, and bank clearance) fast-speed leads to the largest additional width and low-speed to the smallest (see Table 3.2, Chapter 3). For the other 4 speed-dependent additions, it is exactly the opposite: low-speed leads to the largest additional width, fast-speed leads to the smallest. In other words, arbitrary choosing low speed, respectively fast speed, will not necessarily lead to the largest, respectively smallest, width. A great care is demanded when it comes to speed-dependent additions.

Since the effect of the ship speed cannot be neglected and cannot directly be deducted, when the speed is not exactly known, calculations using CDR must be carried out for all three classes of speed. When the ship manoeuvrability is also not known, the CDR calculations will then have a 3x3 combination (3 speed classes and 3 manoeuvrability classes), see Table 6.2.2 below and Table 5.1, in other words: nine CDR widths. In this case, the minimum and the maximum width must be selected from those 9 widths. When either the speed or the manoeuvrability is exactly known, there will only be a 3x1 combination. The minimum and maximum width can then be selected from 3 widths. Finally, when both items are known, for instance LOW-speed and moderate manoeuvrability as shown in Table 6.2.2 with shaded block, there is then only one width.

TABLE 6.2.2
CDR-MATRIX OF WIDTHS

Additional Widths			**Basic Manoeuvring Lane**		
		Speed-dependent additional widths Tables 3.2, 3.4, & 3.6	**Ship Manoeuvrability**		
			good	**moderate**	**poor**
NOT		LOW-speed additional widths			
speed dependent additional widths additions: from Table 3.2: (f), (g), (h), & (i)	+	Moderate-speed additional widths			
		FAST-speed additional widths			

In Table 6.2.4 the total number of CDR widths calculated for each channel are presented. In Table 6.2.3 below, the range of CDR widths and of the ratios are summarised.

TABLE 6.2.3

	ship man.	vessel speed	number of CDR widths	Wrange lies between (Wrange=Wmax-Wmin)	range of ratio (=Wmax.rat-Wmin.rat)
ONE WAY	known	known	1	0	0
	known	unknown	3	0.5 B - 1.0 B	0.1 - 0.4
	unknown	unknown	9	1.4 B - 2.7 B	0.3 - 0.7
TWO WAY	known	known	1	0	0
	known	unknown	3	0.0 B - 2.0 B	0.0 - 0.3
	unknown	unknown	9	0.0 B - 5.4 B	0.0 - 0.8

TABLE 6.2.4
TOTAL NUMBER OF WIDTHS CALCULATED USING CDR

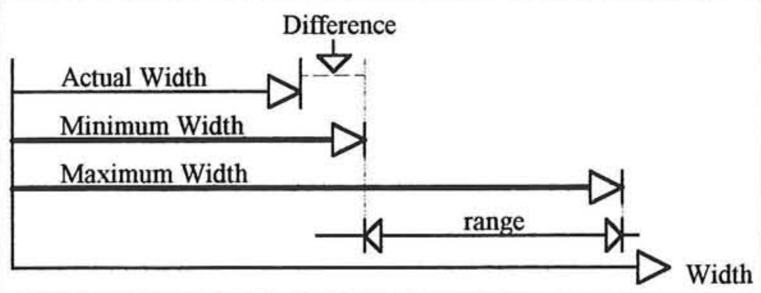
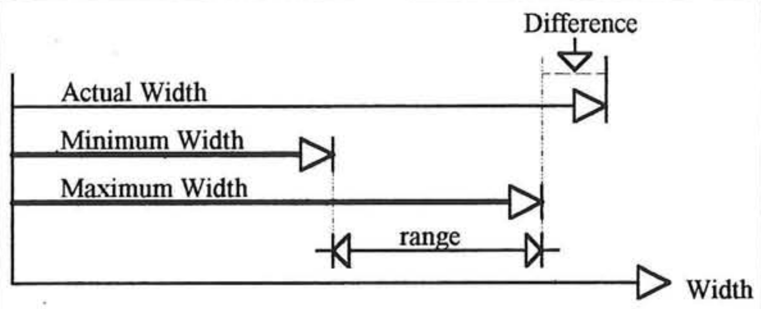
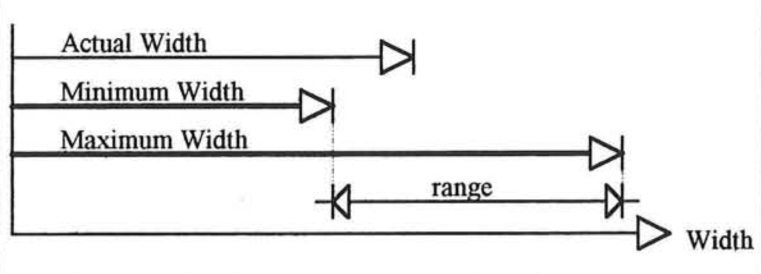
No.	Loc.	Existing channel Width in **B**	Min. CDR width in **B**	Max. CDR width in **B**	Range CDR widths in **B**	Ship Manoeuv.	Vessel speed	Total number CDR width(s)
		$W_{act.}$	W_{min}	W_{max}	W_{range}			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	outer	3.3	3.4	3.9	0.5	known	known	1
2	inner	4.2	3.6	4.2	0.6	known	unknown	3
3	inner	2.6	3.5	3.5	0	known	known	1
4	inner	3.8	4.2	4.7	0.5	known	unknown	3
5	inner	4.9	3.6	4.3	0.7	known	unknown	3
6	inner	2.4	4.2	4.8	0.6	known	unknown	3
7	outer	2.8	4.4	4.4	0	known	known	1
8	inner	2.2	2.9	3.8	0.9	known	unknown	3
9	outer	4.8	3.9	5.4	1.5	known	known	1
10	outer	3.3	4.1	4.1	0	known	known	1
11	inner	2.7	3.7	3.7	0	known	known	1
12	inner	4.4	3.7	3.7	0	known	known	1
13	inner	4.1	3.3	4	0.7	known	unknown	3
14	inner	4.3	3.6	4.3	0.7	known	unknown	3
15	outer	3.7	3	5.7	2.7	unknown	unknown	9
16	inner	2.1	3.8	3.8	0	known	known	1
17	inner	5.9	3.3	4.3	1	known	unknown	3
18	outer	5.8	4.8	4.8	0	known	known	1
19	outer	4.5	6.6	8.7	2.1	unknown	unknown	9
20	inner	3.3	4.5	4.6	0.1	known	known	1
21	inner	5.4	2.9	3.9	1	known	unknown	3
22	inner	3.3	4	4	0	known	known	1
23	inner	4.6	3	3	0	known	known	1
24	outer	3.3	3.4	3.4	0	known	known	1
25	outer	5.8	5.6	5.6	0	known	known	1
26	outer	5.4	3.3	4.7	1.4	unknown	unknown	9
27	inner	4.1	4.2	4.2	0	known	known	1
28	inner	2.8	3.6	3.6	0	known	known	1
29	outer	3.6	3.7	6.2	2.5	unknown	unknown	9
1	inner	7.1	6.8	6.8	0	known	unknown	3
2	nner	5.8	6.2	6.2	0	known	unknown	3
3	inner	6.7	6.6	8.6	2	known	unknown	3
4	inner	6.2	7.8	7.8	0	known	known	1
5	inner	12.8	6.2	8	1.8	known	unknown	3
6	outer	7.7	5.7	8.5	2.8	unknown	unknown	9
7	outer	12.5	10	11.6	1.6	unknown	unknown	9
8	outer	6.1	8.7	10.3	1.6	unknown	unknown	9
9	inner	5.7	6.4	6.4	0	known	known	1
10	inner	6.3	6.8	6.8	0	unknown	unknown	9
11	outer	13.9	9.7	15.1	5.4	unknown	unknown	9
12	outer	7.1	8.7	14.1	5.4	unknown	unknown	9
13	inner	8.0	7.6	7.6	0	known	known	1
14	inner	7.5	8.4	10.2	1.8	known	unknown	3
15	inner	6.2	8.8	8.8	0	known	known	1
16	inner	11.5	9.6	10.6	1	known	unknown	3

6.3 Comparison of CDR results with the Actual Channel Widths:

6.3.1 The Difference (DIFF)

The Difference (DIFF) is the difference between the actual width from either the minimum design width or the maximum. The Difference is given as follows:

FIGURE 6.3.1
DEFINITION OF DIFFERENCE (DIFF)

Definition	Description
If **Wact < Wmin** or col. (7) < (6) Then **DIFF = Wact-Wmin** or col.(10) = (6) - (7) **>Overestimation<**	
If **Wact > Wmax** or col. (8) < (6) Then **DIFF = Wact-Wmax** or col.(10) = (6) - (8) **>Underestimation<**	
If **Wmin<Wact<Wmax** or col. (7) < (6) < (8) Then **DIFF = 0** or col.(10) = 0	

A negative value of the Difference (DIFF<0) means all calculated CDR widths are larger than the existing width (an overestimation). Conversely, a positive value of the Difference means all calculated CDR widths are smaller than the existing width (an underestimation). All values of Difference are listed in column (10) of Tables 6.1.1 and 6.1.2. Just as the widths, the Difference is also in units of the vessel beam B.

When the actual width does fall between the minimum and maximum CDR width, the value of Difference is zero. However, it does not express the position of the actual width in relation to the design widths. Therefore, when a zero-Difference occurs a closer examination of the case is highly advisable.

The distribution of the Differences are presented in Figures 6.4.2 and 6.5.2 for resp. One and Two Way channels. Figures 6.4.1 and 6.5.1 are the expanded versions of Figures 6.1.1 and 6.1.2 with the Difference presented in bars. They are ranked according to the Difference.

6.3.2 The Ratio

A ratio is determined as follows:

$$W_{min,ratio} = W_{min}/W_{actual} \qquad (6.3.1)$$

$$W_{max,ratio} = W_{max}/W_{actual} \qquad (6.3.2)$$

A ratio is then a relative value of a CDR width in relations to the existing width. The ratios are presented in Figures 6.4.3 and 6.5.3 for respectively One-Way and Two-Way. Tables 6.4.1 and 6.5.1 list all ratios for the channels.

As already mentioned in 6.3.1, when there is a zero-Difference (DIFF=0), a closer examination is needed. Example, One-Way channel nr. 14 (Table 6.1.1 and Figure 6.4.3) has a zero-Difference. The ratios, however, show that the minimum width is slightly smaller than the existing width ($W_{min.ratio}$ =0.8), but the maximum width is 50% larger than the existing width. This means, although the existing width falls within the range of CDR widths, the CDR widths themselves can be far apart from one another. In other words, the CDR widths in this case are far from exact.

Ratio also shows the significance of a Difference. For example One-Way channel nr. 7 (from Table 6.1.1 and Figure 6.4.3) has a Difference value of 1 B. Although the Difference doesn't seem large, the minimum width is 40% larger than the existing and the maximum is nearly two times larger than the existing width. Furthermore, based on the value of Difference, this channel was overestimated (DIFF<0) by 1 B. The ratios provide information on the rate of the overestimation (or otherwise: underestimation). In this case, the minimum width is 40% overestimated, while the maximum width 80%.

The distance between two ratios is the range between the minimum and the maximum CDR widths. Equal ratios means that the CDR calculations resulted in one exact width. The larger the distance between two ratios is, the less exact the results are. This happened due to lack of specific data to be used in the calculations. Example: One-Way channel nr. 14. In a way, the ratios show how specific the datas used in CDR are.

6.4 Comparisons of CDR results for One-Way channels

6.4.1 The Difference

Figure 6.4.1 shows the widths (left Y-axis) and the Difference (Y-axis on the right). The figure shows that for One-Way channels the Differences are fairly distributed on both sides. Four ports (nrs. 2, 9, 14, 15) with zero-DIFF, they fall perfectly within the range. Sixteen channels are overestimated (Difference<0). On the other side, 9 channels are underestimated (Difference>0). The Differences vary between -2.1 B and 1.8 B. This can also be seen in Figure 6.4.2 that shows the cumulative distribution of the Differences.

6.4.2 The Ratio

Figure 6.4.3 shows the ratios. The line of ratio=1 represents the existing width (Wactual). The absolute values of the Ratio for the minimum widths are between 0.5 and 1.8 (See column 7 of Table 6.1.1). It means that for the minimum widths, CDR estimations deviate between 50% under and 80% above the existing width. For the maximum widths, CDR estimations deviate between 40% under and up to 100% above the existing width (see column 9 of Table 6.1.1).

The conclusion can be made based on these results is that on average, for One-Way channels, CDR estimations come close to the actual channel widths.

FIGURE 6.4.1

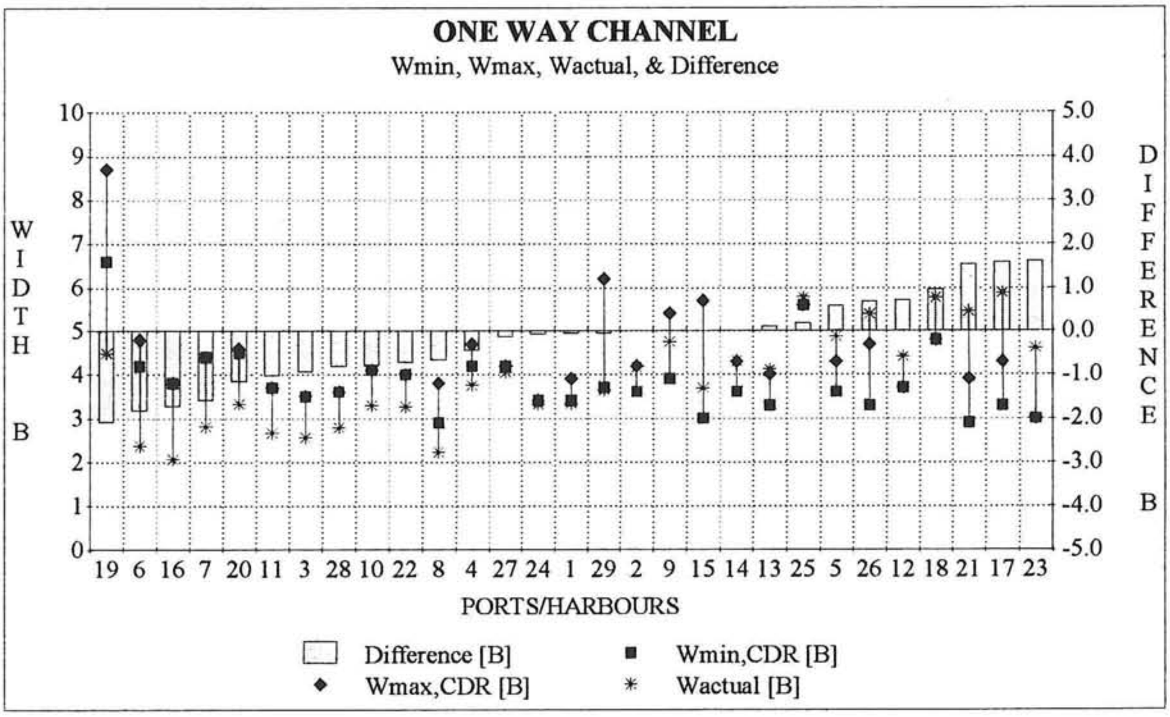


FIGURE 6.4.2

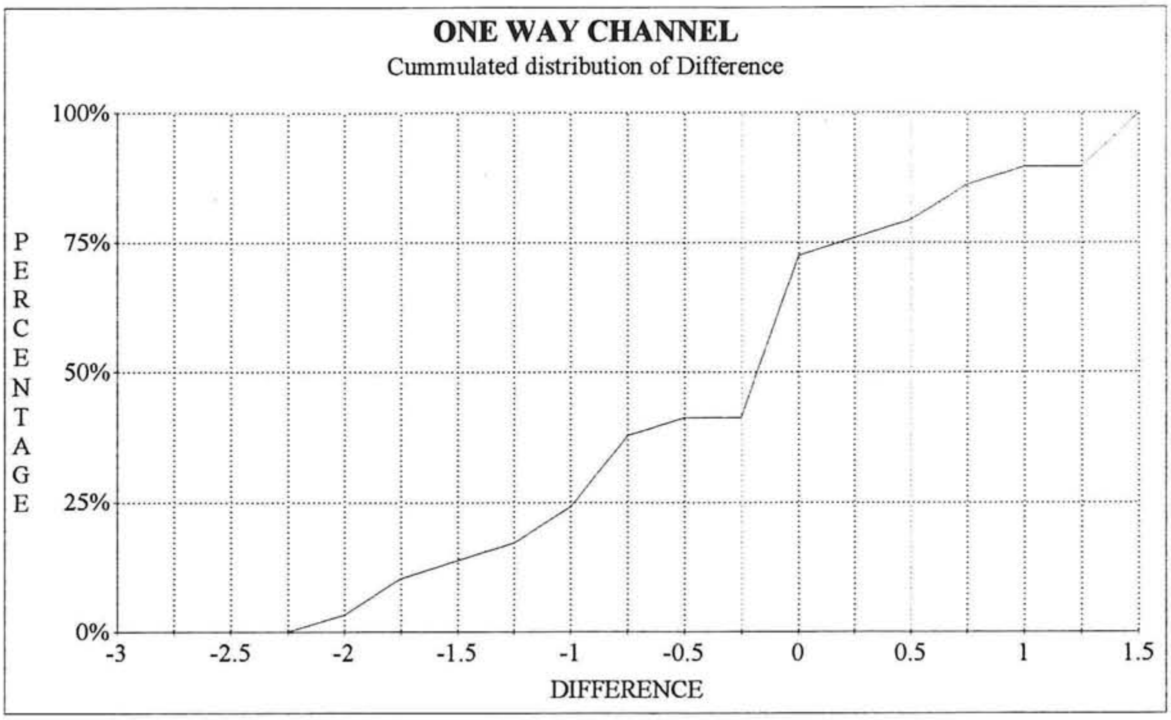
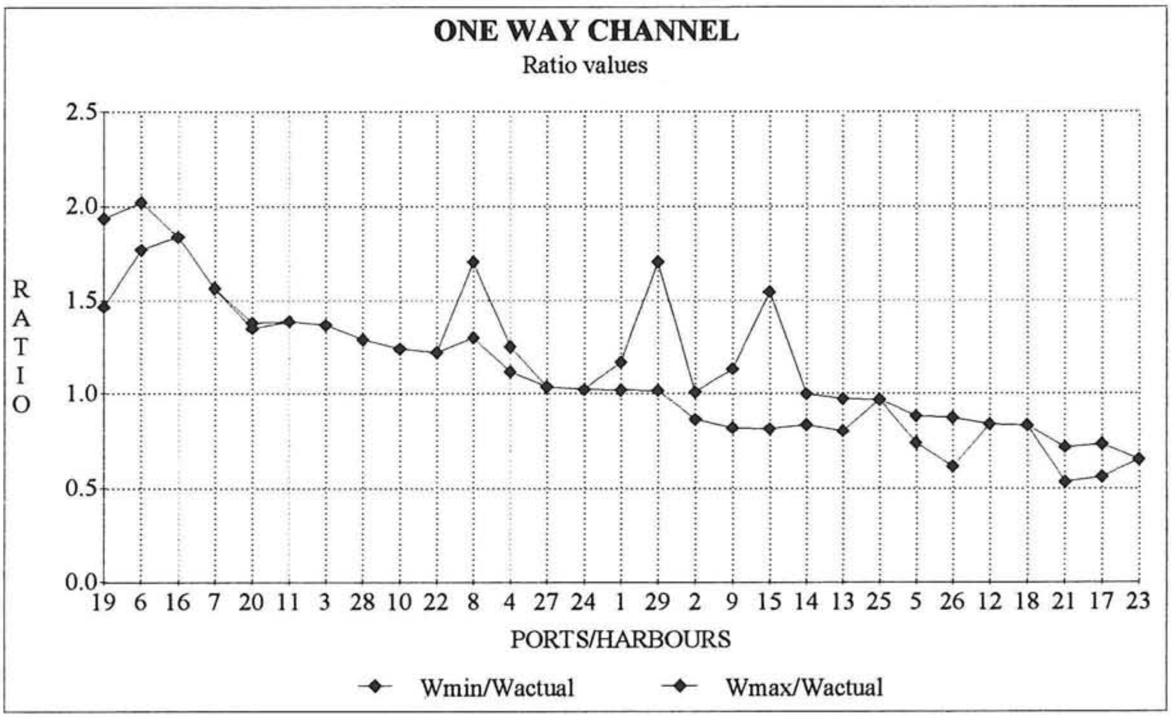


FIGURE 6.4.3



6.5 Comparisons of CDR results for Two-Way channels

6.5.1 The Difference

Figure 6.5.1 shows the Differences for the Two-Way channels. Three ports (nrs. 3, 6, and 11) with zero-DIFF serve as the border; they fall within the range. The cumulative distribution (Figure 6.5.2) shows 50% (8 out of 16) channels are overestimated, while 31% (5 out f 16) underestimated. The Differences as a whole vary from -4 to +5.

6.5.2 The Ratio

Figure 6.5.3 shows the ratios (Y-axis on the right) and the Difference (left Y-axis). The line ratio=1 represents the existing width (Wactual). The absolute values of the ratio for the minimum widths are between 0.5 and 1.4. For the maximum widths, the absolute values are between 0.6 and 2. In other words, for both widths, CDR estimation deviate between 50% under the existing width up to 2 times the existing width.

These results lead to the conclusion that, on average, for Two-Way channels, the Concept Design Rules tend to produce larger widths (overestimation).

FIGURE 6.5.1

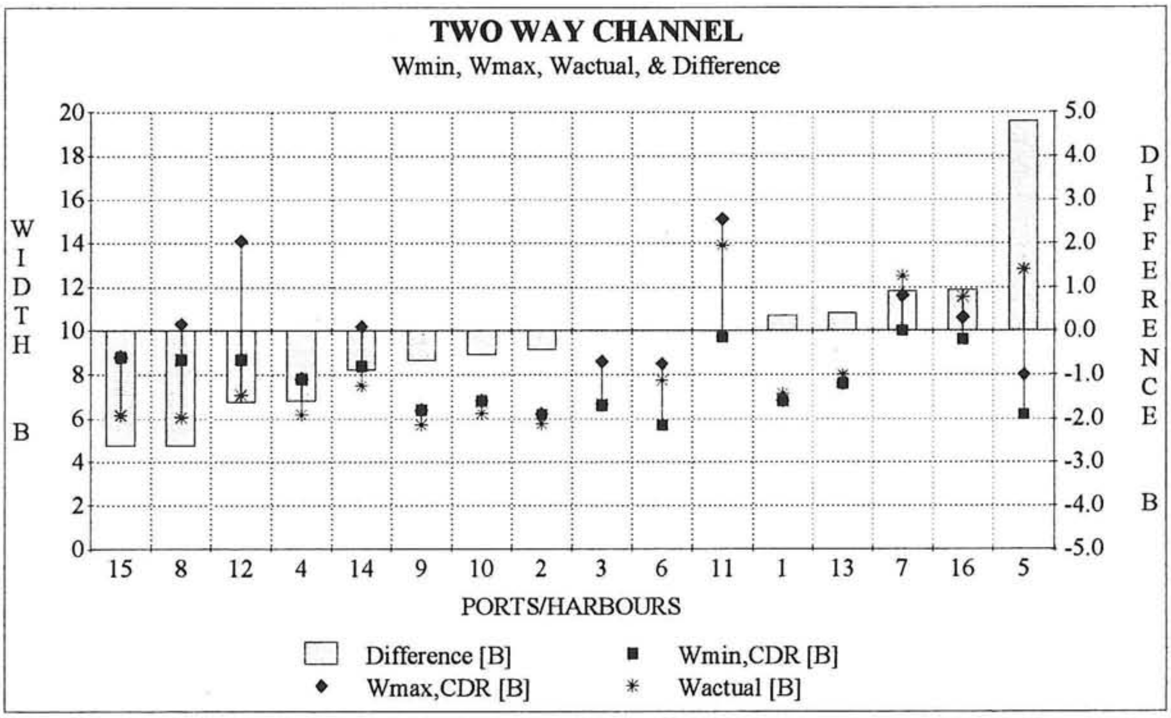


FIGURE 6.5.2

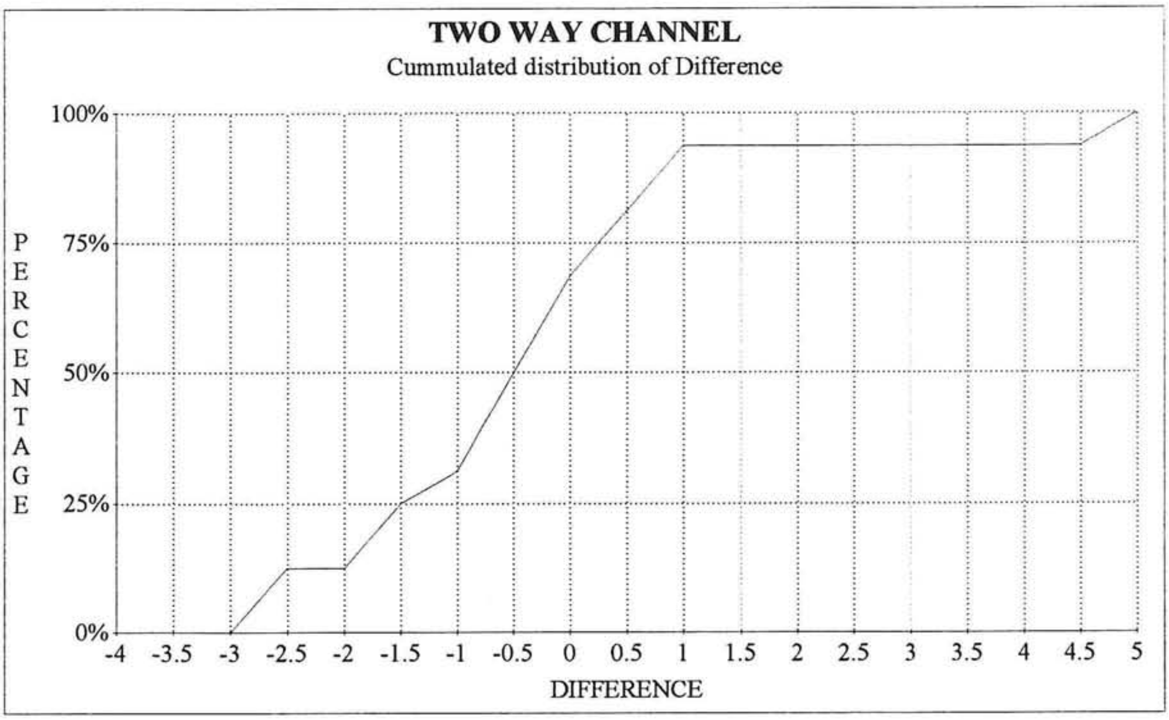
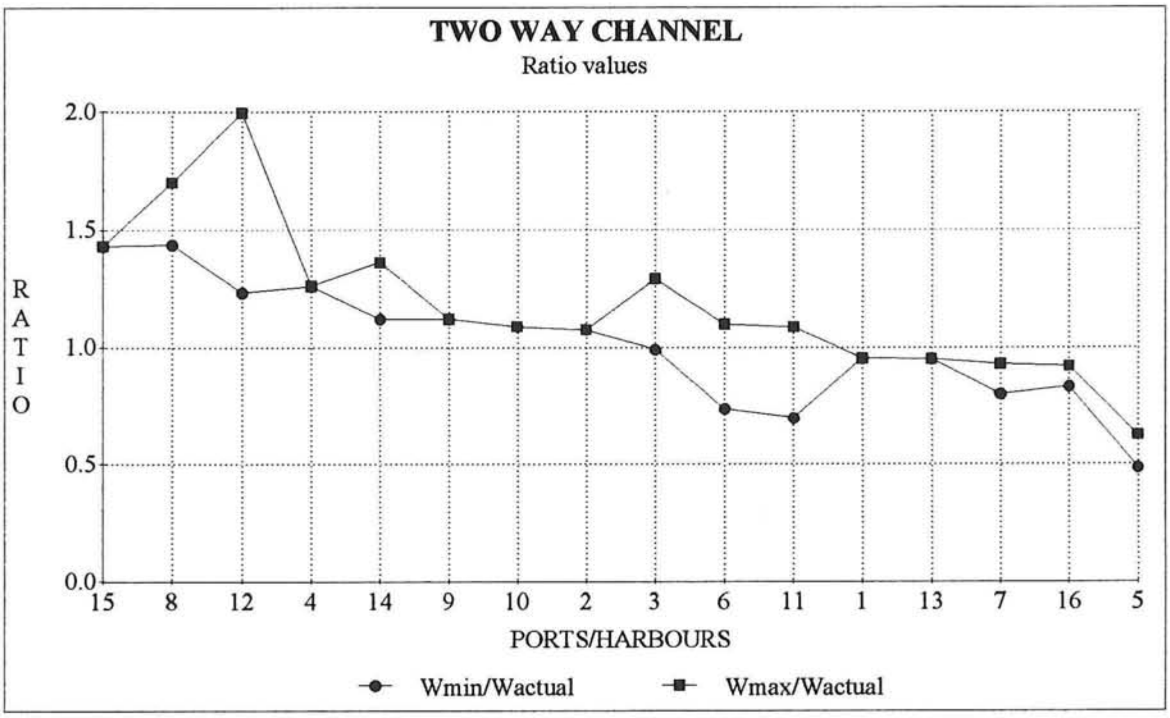


FIGURE 6.5.3



6.6 Overestimation and its causes

There are at least four possible causes for overestimation (the CDR width is larger than the actual one):

(1) The possibility exists that between the time of original design of the channel and the time the questionnaire is filled out the local port authority has changed or adjusted its policy with regard to the size of the ships permitted to enter the channel.

(2) The Concept Design includes variables that might not have been considered when the channel was originally designed.

(3) The Concept Design subscribes to higher safely standards than those adopted and used by the ports and harbours in their original design.

6.6.1 Overestimation caused by a change of policy regarding ship's size

As sea transportation industry has undergone various changes it is not unlikely that the Harbour Master's policy concerning the size of ships to enter the channel has changed too. For instance, it is possible that ships whose dimensions are in agreement with those of the design ship hardly exist nowadays and are replaced by either slightly to much larger ships or smaller ships. This may have caused the change in the policy. See for example the following data from a number of German ports in Table 6.6.1.

TABLE 6.6.1

The beam (B) of the design ship and the largest ship in German ports/harbours

Nr.	Port/Harbour	Design Ship (m)	Largest Ship (m)	Difference (m)
11.	BRAKE	28	44	16
12.	BREMEN	25	26	1
13.	BREMERHAVEN	38	41	3
43.	HAMBURG	40	58	18
84.	NORDENHAM	32	44	12

When, for instance, larger ships are allowed to pass, larger beam B has to be introduced in the calculations and this will lead to smaller W (=actual width/beam), thus larger Difference (= $|W - W_{min}|$).

6.6.2 Overestimation caused by contemporary elements included in the Concept Design

The big difference between designing a channel now and, say, 10 years ago, are (1) the developments towards higher consideration and appreciation for the environment; and (2) the developments in the navigational technology, such as electronic guiding systems. It is then very likely that the original design of a channel did not include at least two of the Concept Design variables: (1) the role of the available navigational aids and (2) the potential danger of certain type of cargos.

These contemporary additions in the Concept Design will automatically lead to additional widths to the basic manoeuvring width, and accordingly a larger CDR width. As the CDR width becomes larger, the Difference, thus the overestimation, will become larger as well.

6.6.3 Overestimation caused by higher safety standards of the Concept Design

Another element of designing an infrastructure in the 90s is the element of safety. Higher, or even much higher, safety standards have been introduced in the recent past; they are to guarantee the safety of both human lives and the environment. These contemporary standards may be much higher than those known when the existing channels were designed.

These higher safety standards are translated into higher (safety) factors introduced in the Concept Design. Consequently, the Concept Design will result in larger additional widths, thus larger CDR width.

6.7 Underestimation and its causes

An underestimation, as opposed to overestimation, is when the calculated maximum CDR width is smaller than the actual width ($W_{max} < W_{actual}$). It may be a result of at least two possible causes that either separately or in combination can lead to an underestimation. They are:

(1) The relatively large channel width

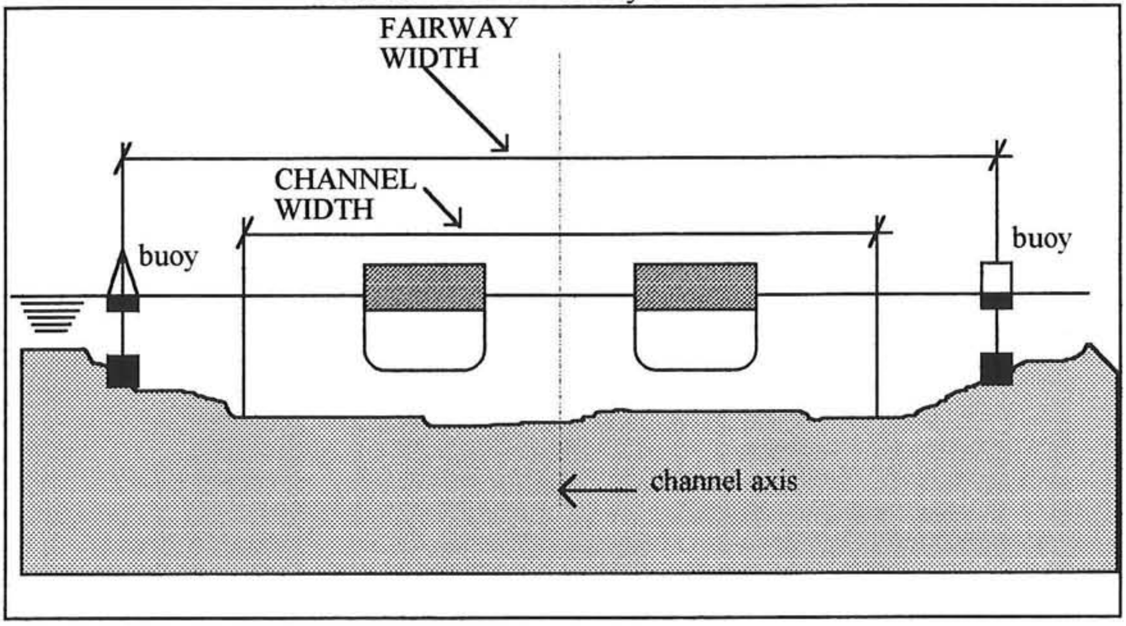
It is possible that, in comparison with the dimensions of the ships, the channel width is relatively large. This may be caused by the fact that the channel is a natural wide, yet not very deep channel. The depth will then limit the size of the ships. An example is the channel nr. 5 in the Two-Way category (Table 6.1.2); its Difference reaches an extreme of 4.8 B. For passing vessels with a beam of 25 m, the channel width of 320 m (nearly 13 times B) is relatively large (see Table 6.1.1). Since B is small, Wactual (=existing width/beam) will be large; the larger Wactual becomes, the greater Difference will be.

(2) The discrepancy in the channel widths

A discrepancy in channel widths may occur, for instance, when the given channel width is actually the fairway width rather than the channel width (See Figure 6.7.1). A fairway is the navigable waterway defined by fairway buoys; it may or may not have a width equal to that of the channel--usually larger than the channel width. This discrepancy will automatically lead to a (sometimes much) larger actual width, therefore larger Difference from the CDR width.

FIGURE 6.7.1

The definition of fairway and channel



6.8 Summary

1. The Concept Design come closer to the reality in estimating the width for One-Way channels than for Two-Way.
2. The overestimation in the Concept Design calculation are possibly caused by:
   a. The change in the harbour's policy regarding the ship's size
   b. The some additions included in the Concept Design Rules were not considered when a channel is designed
   c. The higher safety standards of the Concept Design Rules
3. The underestimation are possibly caused by:
   a. The relatively large actual channel width
   b. The discrepancy in the channel widths

7. CONCLUSIONS AND RECOMMENDATIONS

This section summarises the results and the conclusions of the study on CDR and suggests a number of recommendations.

The process of obtaining information has been a crucial part of the whole study. At the beginning the needed data was provided by the questionnaire submitted by a large number of IAPH members world-wide. In spite of the amount, it soon became clear that the available data was not sufficient for the Concept Design.

Consequently, other sources of information had to be explored; they included references on ports and harbours (see 4.2) and a supplementary questionnaire mailed to selected ports. Hence, this section presents a recommendation regarding questionnaires in the future.

7.1 The Results of Concept Design Rules calculations

1. Many channel widths could not exactly be determined due to the lack of data on:
   a. The ship manoeuvrability
   b. The location of the most critical section of the channel (either in protected or open water)
   c. The type of the channel (One-Way or Two-Way)
   d. The permitted vessel speed in the channel
   e. The dimensions of the design ship

2. For One-Way channels (see Table 7.1):
   a. 55% of the CDR results are overestimation
   b. 31% of the CDR results are underestimation
   c. the range of Difference is between -2.1 B and +1.8 B.

3. For Two-Way channels (see Table 7.1):
   a. 50% of the CDR results are overestimation
   b. 31% of the CDR results are underestimation
   c. the range of Difference is between -4 B and +5 B.

TABLE 7.1
OVERVIEW OF THE DISTRIBUTION OF DIFFERENCES

	Range of DIFF		DIFF < 0 (overestimation)		DIFF = 0		DIFF > 0 (underestimation)		total
	From	to	numb.	perc.	numb.	perc.	numb.	perc.	
ONE WAY	-2.1 B	+1.8 B	16	55%	4	14%	9	31%	29
TWO WAY	-4 B	+5 B	8	50%	3	19%	5	31%	16

7.2 Conclusions

1. The overestimation--negative value of Difference--may be a result of either one or a combination of the following possible causes. (See also 6.6)
    a. The likely possibility that in the recent past these ports and harbours have adjusted their policy in permitting a ship to enter their channels. The adjustment might be in such a way that larger ships are allowed to pass. Result: larger B, therefore a smaller W_{actual}.
    b. The CDR includes additions that might not have been considered when the channels were designed; they are (1) the navigational aids and (2) the cargo hazard level. These additions mean extra additional width to the basic manoeuvring lane (W_{BM}), accordingly a larger design width.
    c. The Concept Design subscribes to higher safety standards than those adopted and used by the ports and harbours in their original design. These higher standards lead to higher additional width, thus a larger CDR width.

2. For Two-Way channels, the effect of the extra additional width (see point 1.c. above) or the larger values of additional widths (see point 1.d.) will become larger because the total CDR width is more than a double of the total width for One-Way channels. As a result, there are two times more overestimated Two-Way channels than those underestimated.

3. The underestimation--positive value of Difference--may have been caused by either one or a combination of the following:
    a. The channels have a natural large width, but a shallow depth. The shallow depth lets only smaller vessels to enter, therefore beam (B) is small. Small B leads to large W_{actual} and thus large Difference.
    b. The discrepancy in the channel widths. The given width may happen to be the width of the fairway rather than of the channel. This leads to large W_{actual}, thus large Difference.

4. The Concept Design give more exact results for One-Way channels than for Two-Way.

5. The Concept Design has proven to be a very practical tool for the preliminary stage of channel design process. Its advantages include: (1) it is quick and easy to use; (2) it provides direct insight in the effect of the environmental and local conditions on the design process; (3) it simplifies the design process that otherwise can be complex; and (4) it can be easily programmed into a computer.

7.3 Recommendations

1. In order to make sure that channel width can exactly be determined using CDR it is of great importance to have information on:
   a. Ship manoeuvrability
   b. The location of the most critical section (in protected or open water)
   c. The permitted vessel speed in the channel

2. The experience in determining the type of a channel (either One-Way or Two-Way), underscores the need for:
   a. Explicit information on the channel type
   b. An explicit border where one channel type ends and the other starts
   c. The dimensions of the design ship

3. The ability of CDR to exactly determine a channel width depends heavily on the accuracy of the available data, consequently, taking the trouble to obtain accurate information does pay in the form of more reliable results.

4. As already indicated as possible causes of either overestimation or underestimation, there are elements (such as local physical and environmental conditions) that were not completely visible during this study. These elements, however, may have played a crucial role.
   An in-depth study on the channels is recommended to discover those physical and environmental conditions and explain their effects on the CDR calculations. This study may include, among other things: research on the policy of permitting ship to enter and pass the channel; adjustments or changes in the existing channel; and changes in the sizes and types of ships. This in-depth study can be beneficial in developing better insight into the effectiveness of the Concept Design Rules.

7.4 Recommendations with regard to future questionnaires

One of the most time-consuming activities (and also a potential source of mistakes) in this study was reading and interpreting the information given in the questionnaires. The latter was inevitable since not all datas could directly be translated into an alternative in CDR. The other problem was, as already discussed in Chapter 4, the questionnaire did not provide some important pieces of information needed for CDR. In short, the questionnaire was not compatible with the Concept Design. One of the ways to create or improve the compatibility between a questionnaire and the Concept Design is to use the multiple-choice format, exactly in the same way the Concept Design is presented.

This approach was used in the supplementary questionnaire (see Table 7.2). In this questionnaire the port administrators were asked to circle the most appropriate alternative. The advantages of this format of questionnaire are (1) the information is ready-to-use (there is no need to interpretate or translate the information), therefore (2) shorter processing time and (3) it eliminates a potential source of mistake, and as a result, (4) the channel widths can exactly be determined using CDR.

TABLE 7.2
THE SUPPLEMENTARY QUESTIONNAIRE

Type of Channel: a. ONE WAY b. TWO WAY	Location of the most critical section: a. Exposed to open water (outer channel) b. Protected water (inner channel)
Longitudinal Current: a. Low (<1.5 knots) b. Moderate (1.5 - 3 knots) c. Strong (> 3 knots)	Traffic Density in the channel: a. Light (0 - 1 vessels/hour) b. Moderate (1 - 3 vessels/hour) c. Heavy (> 3 vessels/hour)
Ship Manoeuvrability: a. Good b. Moderate c. Poor	Vessel Speed allowed in the channel: a. Fast (> 12 knots) b. Moderate (8 - 12 knots) c. Slow (5 - 8 knots)
Cargo Hazard Level: a. Low (Dry bulk, break bulk, containers, passengers, general freight, trailer freight) b. Medium (Oil in bulk) c. High (Aviation spirit, LPG, LNG, chemicals of all classes)	

END OF REPORT

A Study on the Concept Design Rules for Approach Channels

The Final Report

Appendix :

Reponses on the PIANC/IAPH Questionnaire

Study by Paul J.B. Siregar
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October 1995

Nr	Port/Harbour	Port Authority	Category	Country	Limit?
1	ANTWERP	Havenbedrijf ANTWERPEN	MARGINAL INTERESTING	BELGIUM	NO
2	AARHUS	Port of ARHUS	VERY INTERESTING	DENMARK	YES
3	AUCKLAND	Ports of AUCKLAND Ltd.	NOT INTERESTING	NEW ZEALAND	NO
4	BANDIRMA	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	NO
5	BANGKOK	Port Authority of Thailand	MARGINAL INTERESTING	THAILAND	YES
6	BANJUL	GAMBIA Ports Authority	NOT INTERESTING	THE GAMBIA, W	NO
7	BARCELONA	Port of BARCELONA	NOT INTERESTING	SPAIN	NO
8	BLUFF, South Island	South Port New Zealand Ltd.	VERY INTERESTING	NEW ZEALAND	YES
9	BORDEAUX	Port Autonome de BORDEAUX	INTERESTING	FRANCE	YES
10	BOTANY BAY, NSW	MSB SYDNEY Ports Authority	VERY INTERESTING	AUSTRALIA	NO
11	BRAKE	Freie Hansestadt BREMEN	MARGINAL INTERESTING	GERMANY	YES
12	BREMEN	Freie Hansestadt BREMEN	MARGINAL INTERESTING	GERMANY	YES
13	BREMERHAVEN	Freie Hansestadt BREMEN	MARGINAL INTERESTING	GERMANY	YES
14	BRISBANE	Port of BRISBANE Authority	MARGINAL INTERESTING	AUSTRALIA	YES
15	BUNDABERG	BUNDABERG Port Authority	VERY INTERESTING	AUSTRALIA	YES
16	CAIRNS	CAIRNS Port Authority	VERY INTERESTING	AUSTRALIA	YES
17	CANAVERAL Port, Florida	CANAVERAL Port Authority	INTERESTING	USA	NO
18	COPENHAGEN	Port of COPENHAGEN	MARGINAL INTERESTING	DENMARK	YES
19	CORK	Port of CORK	INTERESTING	IRELAND	NO
20	CORPUS CHRISTI, Texas	Port CORPUS CHRISTI Authority	INTERESTING	USA	NO
21	DALIAN	Port of DALIAN	NOT INTERESTING	CHINA	NO
22	DAR-ES-SALAAM	Tanzania Harbours Authority	NOT INTERESTING	TANZANIA	NO
23	DELFZIJL	Port Authority of DELFZIJL/EEMSHAVEN	VERY INTERESTING	NETHERLANDS	YES
24	DERINCE	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	NO
25	DEVONPORT, Tasmania	Port of DEVONPORT	NOT INTERESTING	AUSTRALIA	NO
26	DUBAI Emirate (FATEH TERMINAL)	DUBAI Ports Authority	NOT INTERESTING	UAE	NO
27	DUBLIN	Port of DUBLIN Authority	INTERESTING	IRELAND	NO
28	DUNKERQUE	Port Autonome de Dunkerque	MARGINAL INTERESTING	FRANCE	NO
29	ESBJERG	Stathavnsadministrationen ESBJERG	INTERESTING	DENMARK	YES
30	FLUSHING (Vlissingen)		NOT INTERESTING	NETHERLANDS	NO

Nr	Port/Harbour	Width	Depth	Beam	Draught	Length	Other limitations
1	ANTWERP			52	14.95		
2	AARHUS	200	14	60	13	350	
3	AUCKLAND						
4	BANDIRMA	225	12	40	11.5	220	
5	BANGKOK	100	8.5	24	3.96	172	
6	BANJUL			30.54	9.4	249.94	max perm draft for entry 8.3m, anything in excess wait f
7	BARCELONA	370	16	46	14.38	293.5	only restrictions in the draft
8	BLUFF, South Island	87	8.2	34	9.7	225	
9	BORDEAUX	150	7	40	11	250	
10	BOTANY BAY, NSW				14.6		
11	BRAKE	200	9.2	44	11.58	270	
12	BREMEN	150	9	26	10.5	190	
13	BREMERHAVEN	200	12.2	41	13.41	340	
14	BRISBANE	300	13.5	45	11.6	243	Max l.o.a. of vessel : 295m
15	BUNDABERG	76	7.6	32	9.62	185	
16	CAIRNS	90	8.5	32	7.5	240	
17	CANAVERAL Port, Florida	121.92	10.66	33.52	9.75	297.18	
18	COPENHAGEN	35	9	30	9	200	
19	CORK	152	13.2	42	12.5	275	
20	CORPUS CHRISTI, Texas	121.92	13.71	44	12.2	360	
21	DALIAN	8500	20	42	30	340	
22	DAR-ES-SALAAM				6.7	17.5	
23	DELFZIJL	78	10	35	8.7	200	
24	DERINCE			25	11	200	
25	DEVONPORT, Tasmania				10.6	210	
26	DUBAI Emirate (FATEH TERMINAL)	240	15	58	14		
27	DUBLIN	152	7.8	34	10.4	290	
28	DUNKERQUE				20.5		
29	ESBJERG	200	9.3	42	9.5	250	
30	FLUSHING (Vlissingen)				15.2	310	

Nr	Port/Harbour	Cross Current	Winds
1	ANTWERP		
2	AARHUS	NE but moderate	W
3	AUCKLAND	spring flood/ebb tides	SW-NE wind to gale force
4	BANDIRMA	NIL	NIL
5	BANGKOK	3-7km/h	NE (win.) SW (sum.)
6	BANJUL	NONE	moderate
7	BARCELONA		gale
8	BLUFF, South Island	NIL	NIL
9	BORDEAUX	1.5kn	25m/s
10	BOTANY BAY, NSW	NIL	NIL
11	BRAKE	NIL	SW-NW 4-5kn
12	BREMEN		
13	BREMERHAVEN	2kn	SW-NW Max:4-5
14	BRISBANE		
15	BUNDABERG	max:4kn	SE
16	CAIRNS	NO	SW
17	CANAVERAL Port, Florida		30kn
18	COPENHAGEN	N/A	NIL
19	CORK		
20	CORPUS CHRISTI, Texas		
21	DALIAN	2.5kn (SE)	5m/s (win:N, sum:S)
22	DAR-ES-SALAAM	spring tide	N/W
23	DELFZIJL		SW-NW
24	DERINCE	NIL	NE-W-SW
25	DEVONPORT, Tasmania		cross winds above 30kn
26	DUBAI Emirate (FATEH TERMINAL)	max:1.7kn	occasional strong NW
27	DUBLIN		S-SE
28	DUNKERQUE		
29	ESBJERG	0.6-1.0kn	15m/s
30	FLUSHING (Vlissingen)	due to tide	N/A

Nr	Port/Harbour	Wave Conditions	Tidal conditions	Study ever done?	Report Available	Available for Discussion?
1	ANTWERP			YES		
2	AARHUS	mostly calm	max:30m	YES	YES	YES
3	AUCKLAND	slight NE swell in outer channe	MSR:2.6m MNP:1.9m	YES	YES	YES
4	BANDIRMA	NIL	0.5-0.6m	NO		
5	BANGKOK	weak	HHW:2.28m LLW:2.42m	YES	NO	YES
6	BANJUL	heavy swells over bar area	less water over bar	NO	NO	YES
7	BARCELONA		none	NO		?
8	BLUFF, South Island	NIL	high + low water transits only	NO		YES
9	BORDEAUX	Hs:4-5m T:10-12s		YES	YES	YES
10	BOTANY BAY, NSW	NIL	NIL	YES	YES	YES
11	BRAKE	NIL	2-3kn H:3.8m	NO		
12	BREMEN			NO		YES
13	BREMERHAVEN	Max:3m	2-4kn H:2.9-3.8m	NO		
14	BRISBANE		MHWS-MLWS:1.38m	YES	YES	YES
15	BUNDABERG	smooth waters	1-1.5kn	YES	YES	YES
16	CAIRNS	NIL	no vessel 7.7m on ebb tide	YES	YES	YES
17	CANAVERAL Port, Florida			YES	YES	YES
18	COPENHAGEN	0.2m		NO		YES
19	CORK			YES	YES	YES
20	CORPUS CHRISTI, Texas			NO		
21	DALIAN	avg H:0.7m	avg 1.56m	YES	NO	NO
22	DAR-ES-SALAAM	normal	2.9m	YES	YES	YES
23	DELFZIJL	NIL	max:3m	YES	YES	YES
24	DERINCE	NIL	0.4m	NO		
25	DEVONPORT, Tasmania			NO	NO	YES
26	DUBAI Emirate (FATEH TERMINAL)			YES	NO	YES
27	DUBLIN		4m	YES	NO	YES
28	DUNKERQUE		6.5m	NO		NO
29	ESBJERG	2.5m	MLWS+1.3m	YES	YES	YES
30	FLUSHING (Vlissingen)	N/A	due to tide	YES	YES	YES

Nr	Port/Harbour	Contact	Title Contact
1	ANTWERP	Mr. Belmans	
2	AARHUS	Capt. David York Christensen	Port Captain
3	AUCKLAND	Capt. R.L. McKenzie	
4	BANDIRMA		
5	BANGKOK		
6	BANJUL		Harbour Master
7	BARCELONA	Capt. F. Gil de Bernabe	
8	BLUFF, South Island	Capt. J.A. Henderson	
9	BORDEAUX	M. Alain FERAL	Direction de l'Equipement
10	BOTANY BAY, NSW	Capt. R.H. McGee	
11	BRAKE	Capt. J.U. Andersen	
12	BREMEN	Capt. P. Breuer	
13	BREMERHAVEN	Capt. J.U. Andersen	
14	BRISBANE	Dr. W. Tranberg	Manager Port Operations
15	BUNDABERG	D.C. Antrobus	
16	CAIRNS	Chris Boland, CPA	
17	CANAVERAL Port, Florida	Richard Lombroia	
18	COPENHAGEN	Kaj Holm Jorgensen	Technical Manager
19	CORK	J.B. O'Sullivan	
20	CORPUS CHRISTI, Texas	Frank C. Brogan	Director of Engineering Services
21	DALIAN	Liu Gai	
22	DAR-ES-SALAAM		Director of Engineering & Technical Services
23	DELFZIJL	Capt. R.K. Mast	Harbour Master
24	DERINCE		
25	DEVONPORT, Tasmania	Capt. Richard C. O'Neill	Assistant Harbour Master
26	DUBAI Emirate (FATEH TERMINAL)	David Gibbons	Joint Executive Director
27	DUBLIN	Capt. E.P. Connellan	Harbour Master & Pilotage Supt.
28	DUNKERQUE	Capt. J.C. Larrieu	Harbour Master
29	ESBJERG	Erik Clausen	Civil Engineer
30	FLUSHING (Vlissingen)	E.A. van den Berg	

Nr	Port/Harbour	Address of contact person	
1	ANTWERP	Antwerpse Havendienst	Tavernierkaai 3
2	AARHUS	Arhus Port Authority	Europlads 2/P.O. Box 130
3	AUCKLAND	Ports of AUCKLAND Ltd.	Princes Wharf, Quay Street/P.O. Bo 1281
4	BANDIRMA	TCCD Ports Department	
5	BANGKOK	Port Authority of Thailand	Klong Toey, Sunthornkosa Road
6	BANJUL	Gambia Ports Authority	P.O. Box 617
7	BARCELONA		
8	BLUFF, South Island	South Port New Zealand Ltd.	P.O. Box 1
9	BORDEAUX	Port Autonome de BORDEAUX	152 quai de Bacalan
10	BOTANY BAY, NSW	MSB SYDNEY Ports Authority	G.P.O. Box 32
11	BRAKE	Wasser-und Schiffahrtsamt Bremen	Franziuseck 5
12	BREMEN	Wasser-und Schiffahrtsamt Bremen	Franziuseck 5
13	BREMERHAVEN	Wasser-und Schiffahrtsamt Bremen	Franziuseck 5
14	BRISBANE	Port of BRISBANE Authority	G.P.O. Box 1818
15	BUNDABERG	BUNDABERG Port Authority	
16	CAIRNS	Cairns Port Authority	Cnr. Esplanade and Spence Street
17	CANAVERAL Port, Florida	Canaveral Port Authority	P.O. Box 267
18	COPENHAGEN	Port of COPENHAGEN	Postbox 2083
19	CORK	Cork Harbour Commissioners	Custom House Street
20	CORPUS CHRISTI, Texas	Port of Corpus Christi Authority	222 Power Street / P.O. Box 1541
21	DALIAN	Foreign Affairs Office, Port of Dalian Authority	1 Gangwan Street
22	DAR-ES-SALAAM	Tanzania Harbours Authority	P.O. Box 9184
23	DELFZIJL	Port Authority of DELFZIJL/EEMSHAVEN	P.O. Box 20.004
24	DERINCE	TCCD Ports Department	
25	DEVONPORT, Tasmania	Port of Devonport Authority	48 Formby Road, P.O. Box 478
26	DUBAI Emirate (FATEH TERMINAL)	DUBAI Ports Authority	P.O. Box 17000
27	DUBLIN	Port Centre	Alexandra Road
28	DUNKERQUE	Port Autonome de Dunkerque	BP 6-534
29	ESBJERG	Statshavnsadministrationen Esbjerg	Postboks 2
30	FLUSHING (Vlissingen)		

Nr	Port/Harbour	Address of contact	person (continued)	Phone number	Fax number
1	ANTWERP	B-2000 Antwerpen	BELGIUM	+32-3-231 1773	+32-3-231 2062
2	AARHUS	8100 Arhus C	DENMARK		
3	AUCKLAND	Auckland	NEW ZEALAND	+64-9-366 0055	+64-9-307 5822
4	BANDIRMA	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
5	BANGKOK	Bangkok 10110	THAILAND		+66-2-249 0885
6	BANJUL	Banjul	THE GAMBIA, West Africa		+220-22 72 68
7	BARCELONA				
8	BLUFF, South Island	Bluff	NEW ZEALAND		
9	BORDEAUX	33300 Bordeaux	FRANCE	+33-5690 5800	+33-5690 5877
10	BOTANY BAY, NSW	Sydney, 2001	AUSTRALIA	+61-2-364 2111	+61-2-364 2034
11	BRAKE	28199 Bremen	GERMANY		
12	BREMEN	28199 Bremen	GERMANY		
13	BREMERHAVEN	28199 Bremen	GERMANY		
14	BRISBANE	Brisbane QLD 4001	AUSTRALIA	+61-7-833 0833	+61-7-839 3591
15	BUNDABERG	Bundaberg, Queensland 4670	AUSTRALIA	+61-71-59 42 33	+61-71-59 46 55
16	CAIRNS	Cairns, Queensland 4870	AUSTRALIA	+61-70-52 38 88	+61-70-52 14 93
17	CANAVERAL Port, Florida	Cape Canaveral, Florida 32952	USA	+1-407-783 7831	+1-407-784 6223
18	COPENHAGEN	1013 Copenhagen K	DENMARK	+45-3314 4340	+45- 3393 2340
19	CORK	Cork	IRELAND	+353-21-27 31 25	+353-21-27 64 84
20	CORPUS CHRISTI, Texas	Corpus Christi, Texas 78403	USA	+1-512-882 5633	+1-512-882 7110
21	DALIAN	Zhongshan District, Dalian 116	P.R. of CHINA		
22	DAR-ES-SALAAM	Dar-es-Salaam	TANZANIA	+255-51-21 212	
23	DELFZIJL	9930 PA Delfzijl	NETHERLANDS	+31-5960-40400	+31-5960-30424
24	DERINCE	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
25	DEVONPORT, Tasmania	Devonport, Tasmania	AUSTRALIA	+61-004-24 09 11	+61-004-24 64 18
26	DUBAI Emirate (FATEH TERMINAL)	Dubai	UAE	+00-971-84 56578	
27	DUBLIN	Dublin 1	IRELAND		
28	DUNKERQUE	59386 Dunkerque Cedex 1	FRANCE	+33-2829 7070	+33-2829 7106
29	ESBJERG	DK-6701 Esbjerg	DENMARK	+45-7512 4144	+45-7513 4050
30	FLUSHING (Vlissingen)				

Nr	Port/Harbour	Port Authority	Category	Country	Limit?
31	FRASER	FRASER River Harbour Commision	MARGINAL INTERESTING	CANADA	YES
32	FREMANTLE	FREMANTLE Port Authority	VERY INTERESTING	AUSTRALIA	YES
33	GEELONG, Victoria	Port of GEELONG Authority	VERY INTERESTING	AUSTRALIA	YES
34	GHENT	Port of GHENT	INTERESTING	BELGIUM	YES
35	GIJON	Port of GIJON	NOT INTERESTING	SPAIN	NO
36	GIZAN	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	YES
37	GLADSTONE,Queensland	GLADSTONE Port Authority	VERY INTERESTING	AUSTRALIA	NO
38	GLASGOW	Clydeport Limited	NOT INTERESTING	UK (Scotland)	NO
39	GUANGDONG	ZHANJIANG Port Authorities	NOT INTERESTING	CHINA	NO
40	GUANGZHOU	GUANGZHOU Harbour Bureau	INTERESTING	CHINA	YES
41	GUTHENBURG	Port of GUTHENBURG	NOT INTERESTING	SWEDEN	NO
42	HALIFAX	HALIFAX Port Corporation	NOT INTERESTING	CANADA	NO
43	HAMBURG	Freie und Hansestadt HAMBURG	INTERESTING	GERMANY	YES
44	HARWICH	HARWICH Haven Authority	MARGINAL INTERESTING	UK	YES
45	HAYDARPASA, Istanbul	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	YES
46	HELSINKI	Port of HELSINKI	MARGINAL INTERESTING	FINLAND	YES
47	HELSINKI	Port of HELSINKI	MARGINAL INTERESTING	FINLAND	YES
48	HELSINKI	Port of HELSINKI	MARGINAL INTERESTING	FINLAND	YES
49	HIROSHIMA	Port of HIROSHIMA Authority	INTERESTING	JAPAN	YES
50	HONG KONG	Marine Department	MARGINAL INTERESTING	HONG KONG	NO
51	HOUSTON, Texas	Port of HOUSTON Authority	VERY INTERESTING	USA	YES
52	HUALIEN	HUALIEN Harbour Bureau	NOT INTERESTING	TAIWAN	NO
53	HUELVA	Puerto Autonomo de HUELVA	MARGINAL INTERESTING	SPAIN	YES
54	ISKENDERUN	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	NO
55	IZMIR	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	?
56	JEDDIC Islamic Port	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	NO
57	JUBAIL Commercial Port	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	NO
58	KAOHSIUNG	KAOHSIUNG Harbor Bureau	MARGINAL INTERESTING	TAIWAN	YES
59	KING ABDUL AZIZ Port	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	NO
60	KING FAHD Industrial Port	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	NO

Nr	Port/Harbour	Width	Depth	Beam	Draught	Length	Other limitations
31	FRASER	200	10.7	32.3	10.7	243.8	Ship mov. dep. on tidal assist.
32	FREMANTLE	152	13.7	46		293.5	underkeel cl: 13%(sum) 14% (win)
33	GEELONG, Victoria	122	10.5	45.74	10.5	265.2	
34	GHENT	150	13.5	34	12.5	265	bridges to pass
35	GIJON	300	18.5	48	17.4	333	
36	GIZAN	320	13	25	10.5	200	
37	GLADSTONE,Queensland		15.7	55.73	17.9	315	
38	GLASGOW		6.9		9.7	229	
39	GUANGDONG		10.5	40	12	250	
40	GUANGZHOU	140	8.6	34	11.23	257	
41	GUTHENBURG						VCLL : sight min 3nm, wind max 15m/s
42	HALIFAX			60	17.5	362.75	
43	HAMBURG	250	13.5	58	14	351	
44	HARWICH		10	40	13.1	320	
45	HAYDARPASA, Istanbul	240	11	31	11	250	Int. vessel traffic in Bosporus str.
46	HELSINKI		9.6	40	9.6	260	
47	HELSINKI		11	40	11	300	
48	HELSINKI		9	40	9	260	
49	HIROSHIMA	100	12	27.1	15.2	186	
50	HONG KONG		11		11		for large vessels restricted length + draft
51	HOUSTON, Texas	91.44	10.97	44.2	12.192	289	
52	HUALIEN	250	15.5	35	13.5	245	
53	HUELVA	200	10.5	34	11	240	
54	ISKENDERUN	200	12	35	11.3	200	berth lengths + depths
55	IZMIR		10		10		
56	JEDDIC Islamic Port				16		
57	JUBAIL Commercial Port				13.3	280	
58	KAOHSIUNG	80	10	49	14.5	320	
59	KING ABDUL AZIZ Port				13		
60	KING FAHD Industrial Port				30		

Nr	Port/Harbour	Cross Current	Winds
31	FRASER		
32	FREMANTLE	max:1kn	max:30kn
33	GEELONG, Victoria	NIL	
34	GHENT		
35	GIJON	0.2-0.3m/s	15m/s
36	GIZAN	N/S	NW 17-23kn
37	GLADSTONE,Queensland	N/A	winds applies to light draft vessels
38	GLASGOW		
39	GUANGDONG		E-SE, force 2
40	GUANGZHOU		E-SW max:40m/s
41	GUTHENBURG		
42	HALIFAX	NONE	very rarely
43	HAMBURG	NIL	beaufort 12
44	HARWICH	Strong ebb tide	strong+prolonged NE
45	HAYDARPASA, Istanbul	N/A	SW/N
46	HELSINKI	NO	SW
47	HELSINKI	NO	SW
48	HELSINKI	NO	SW
49	HIROSHIMA	0.1-0.4kn	calm
50	HONG KONG	NIL	SW (sum.) NE (win)
51	HOUSTON, Texas	N/A	N/A
52	HUALIEN	0.5-1kn	SSW-4 (sum) NE-6 (win)
53	HUELVA		
54	ISKENDERUN	NIL	S-SW-W
55	IZMIR	NIL	NIL
56	JEDDIC Islamic Port	NIL	NW 25-30kn
57	JUBAIL Commercial Port	NW/SE	NW
58	KAOHSIUNG	Fld:1.5knNW Ebb:1.5knSW	N-NE 3.3-5.4m/s S-SE 3.3-5.4m/s
59	KING ABDUL AZIZ Port	NW/SE	NW 25kn
60	KING FAHD Industrial Port	NIL	NW 35kn

Nr	Port/Harbour	Wave Conditions	Tidal conditions	Study ever done?	Report Available	Available for Discussion?
31	FRASER		Tidal curr. & freshet cond.	YES	YES	YES
32	FREMANTLE	swell		YES	YES	YES
33	GEELONG, Victoria	NIL		NO		NO
34	GHENT			YES	YES	YES
35	GIJON	Hs:1.5-3m	3.5-4.5m	YES		YES
36	GIZAN	normal	1m	NO		YES
37	GLADSTONE,Queensland	N/A	max:4.7m	NO		YES
38	GLASGOW			YES	YES	YES
39	GUANGDONG	normal	2 unregular tides	YES	YES	NO
40	GUANGZHOU	avg:0.2m typh:1.92m	avg:2m max:3.66m	YES	YES	YES
41	GUTHENBURG			NO	NO	YES
42	HALIFAX	of no effect	of no effect	YES	YES	YES
43	HAMBURG	NIL	max:4kn	YES	YES	YES
44	HARWICH	swell	2.3-3.6m	YES	NO	NO
45	HAYDARPASA, Istanbul	NIL	0.4m	?		
46	HELSINKI	NO	NO	YES	YES	YES
47	HELSINKI	NO	NO	YES	YES	YES
48	HELSINKI	NO	NO	YES	YES	YES
49	HIROSHIMA	Ho:2.2m	LWL:0.15m HWL:3.8m	NO	NO	NO
50	HONG KONG	1m		YES	NO	
51	HOUSTON, Texas	N/A	N/A	NO	NO	NO
52	HUALIEN	0.5-1m	1.6m	NO		?
53	HUELVA			YES	YES	YES
54	ISKENDERUN	N/A	Max:0.61m	NO		
55	IZMIR	NIL	0.3m	NO		
56	JEDDIC Islamic Port	2m	NIL	NO		YES
57	JUBAIL Commercial Port	moderate	2.1m	NO		YES
58	KAOHSIUNG		MHW:1.1m HW:0.88m LW:0.49m	NO		
59	KING ABDUL AZIZ Port	slight	2m	NO		YES
60	KING FAHD Industrial Port	2m	NIL	NO		YES

Nr	Port/Harbour	Contact	Title Contact
31	FRASER	Capt. Allen Domaas	
32	FREMANTLE	Capt. E.J. Atkinson	Shipping Services Manager/Harbour Master
33	GEELONG, Victoria	Capt. I.S. Edwards	
34	GHENT	Capt. P. van Driessche	Port Commander
35	GIJON	Mr. Vindel	
36	GIZAN		
37	GLADSTONE,Queensland	Mr. Reg Tanna	General Manager
38	GLASGOW	Capt. W.D. Gillespie	General Manager Marine
39	GUANGDONG	Mr. Xie Jian-Ming	Vice Managing Director
40	GUANGZHOU	Cheng Zhi Ping	
41	GUTHENBURG	Capt. Hans Lind	Harbour Master
42	HALIFAX	Capt. Claude L. Ball	Senior Vice President & COO
43	HAMBURG	Dr.Ing. Heinz Giszas	Hafenbaudirektor
44	HARWICH	Mr. J. Jenkinson, M.V.O.	Chief Executive
45	HAYDARPASA, Istanbul		
46	HELSINKI	Eve Tuomola-Oinonen	
47	HELSINKI	Eve Tuomola-Oinonen	
48	HELSINKI	Eve Tuomola-Oinonen	
49	HIROSHIMA		Port & Harbour Division of Public Works & Construction
50	HONG KONG		Director of Marine, Senior Marine Officer/Port Operations
51	HOUSTON, Texas	H. Thomas Kornegay	
52	HUALIEN		
53	HUELVA	Jaime Lobo	Doctor Ingeniero de Caminos, Canales y Puertos
54	ISKENDERUN		
55	IZMIR		
56	JEDDIC Islamic Port		Director General
57	JUBAIL Commercial Port		
58	KAOHSIUNG	Mr. Yeh Yun-Hsiang	Director
59	KING ABDUL AZIZ Port		Director General
60	KING FAHD Industrial Port		Director General

Nr	Port/Harbour	Address of contact person	
31	FRASER		
32	FREMANTLE	FREMANTLE Port Authority	1 Cliff Street
33	GEELONG, Victoria	Port of Geelong Authority	P.O. Box 344
34	GHENT		
35	GIJON	Harbour Management Dept Port of Gijon	Claudio/Alvargonzalez 32
36	GIZAN	Gizan Port Management	P.O. Box 16
37	GLADSTONE,Queensland	GLADSTONE Port Authority	P.O. Box 259
38	GLASGOW	Clydeport Limited, Clydeport Estuary Control Tower	Campbell Street
39	GUANGDONG	ZHANJIANG Port Authorities	1 You Yi Road
40	GUANGZHOU	GuangZhou Harbour Channel Administration Institute	40 Tong Fu Road (west)
41	GUTHENBURG	Port of Guthenburg AB	
42	HALIFAX	HALIFAX Port Corporation	P.O. Box 336
43	HAMBURG	Strom- und Hafenbau	Dalmannstr. 1
44	HARWICH	HARWICH Haven Authority	Harbour House, The Quay,
45	HAYDARPASA, Istanbul	TCCD Ports Department	
46	HELSINKI	Port of HELSINKI	PL 193
47	HELSINKI	Port of HELSINKI	PL 193
48	HELSINKI	Port of HELSINKI	PL 193
49	HIROSHIMA	Departmen of Hiroshima Prefectural Government	10-52 Motomati Nakaku
50	HONG KONG	Marine Department	Harbour Building
51	HOUSTON, Texas	Port of Houston Authority	P.O. Box 2562
52	HUALIEN		
53	HUELVA	Autoridad Portuaria de Huelva	Real Sociedad Colombina Onubense s/no
54	ISKENDERUN	TCCD Ports Department	
55	IZMIR	TCCD Ports Department	
56	JEDDIC Islamic Port	Jeddah Islamic Port	P.O. Box 9285
57	JUBAIL Commercial Port	King Fahd Industrial Port Management	P.O. Box 276
58	KAOHSIUNG	KAOHSIUNG Harbor Bureau	No. 62 Lin Hai 2nd Road
59	KING ABDUL AZIZ Port	King Abdul Aziz Port	P.O. Box 28062
60	KING FAHD Industrial Port	King Fahd Industrial Port	P.O. Box 30325

Nr	Port/Harbour	Address of contact	person (continued)	Phone number	Fax number
31	FRASER				
32	FREMANTLE	Freemantle, WA 6160	AUSTRALIA	+61-0-430 4911	+61-9-336 1391
33	GEELONG, Victoria	Geelong, Victoria 3220	AUSTRALIA	+61-52-22 16 44	+61-52-21 68 83
34	GHENT				
35	GIJON	33201 Gijon	SPAIN		
36	GIZAN	Gizan	SAUDI ARABIA		
37	GLADSTONE,Queensland	Gladstone, Queensland 4680	AUSTRALIA	+61-79-76 13 33	+61-79-72 30 45
38	GLASGOW	Greenock PA16 8AW	UK (Scotland)		+44-41-248 3167
39	GUANGDONG	Zhanjiang 524027, Guangdong	P.R. of CHINA		
40	GUANGZHOU	GuangZhou	P.R. of CHINA		
41	GUTHENBURG	S-40338 Guthenburg	SWEDEN	+46-31-63 20 00	+46-31-63 22 51
42	HALIFAX	Halifax, Nova Scotia B3J 2P6	CANADA	+1-902-426 3642	
43	HAMBURG	20457 Hamburg	GERMANY		+49-40-3285 2881
44	HARWICH	Harwich, Essex CO12 3HH	UK	+44-255-24 30 30	
45	HAYDARPASA, Istanbul	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
46	HELSINKI	SF-00141 Helsinki	FINLAND	+358-0-1733 3205	
47	HELSINKI	SF-00141 Helsinki	FINLAND	+358-0-1733 3205	
48	HELSINKI	SF-00141 Helsinki	FINLAND	+358-0-1733 3205	
49	HIROSHIMA	Hiroshimashi	JAPAN		
50	HONG KONG	38 Pier Road	HONG KONG	+852-852 4541	+852-544 9241
51	HOUSTON, Texas	Houston, Texas 77252-2562	USA	+1-713-670 2400	+1-713-670 2429
52	HUALIEN				
53	HUELVA	21001 Huelva	SPAIN	+34-955-21 31 00	+34-955-21 31 01
54	ISKENDERUN	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
55	IZMIR	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
56	JEDDIC Islamic Port	Jeddah 21188	SAUDI ARABIA		
57	JUBAIL Commercial Port	Jubail 31951	SAUDI ARABIA		
58	KAOHSIUNG	Kaohsiung	TAIWAN	+886-7-561 2311	+886-7-561 1694
59	KING ABDUL AZIZ Port	Dammam 31437	SAUDI ARABIA		
60	KING FAHD Industrial Port	Yanbu Al Sinaiyah	SAUDI ARABIA		

Nr	Port/Harbour	Port Authority	Category	Country	Limit?
61	KITAKYUSHU	Port of KITAKYUSHU	NOT INTERESTING	JAPAN	YES
62	KELANG,Selangor State	KLANG Port Authority	NOT INTERESTING	MALAYSIA	NO
63	KUANTAN	Lembaga Pelabuhan KUANTAN	NOT INTERESTING	MALAYSIA	NO
64	LAEM CHABANG	Port Authority of Thailand	MARGINAL INTERESTING	THAILAND	NO
65	LARNACA Port	Cyprus Ports Authority	NOT INTERESTING	CYPRUS	NO
66	LE HAVRE		MARGINAL INTERESTING	FRANCE	YES
67	LE HAVRE-ANTIFER		MARGINAL INTERESTING	FRANCE	NO
68	LIBREVILLE	Office de Ports et Rades du GABBON	NOT INTERESTING	GABON	NO
69	LIMASSOL	Cyprus Ports Authority	NOT INTERESTING	CYPRUS	NO
70	LISBON	Administracao do Porto de Lisboa	NOT INTERESTING	PORTUGAL	YES
71	LONDON	Port of LONDON Authority	MARGINAL INTERESTING	UK	NO
72	MAKASSAR,Ujung Pandang	PT. Pelabuhan Indonesia IV	INTERESTING	INDONESIA	YES
73	MARSEILLE	Port Autonome de MARSEILLE	INTERESTING	FRANCE	YES
74	MELBOURNE	Port of MELBOURNE Authority	MARGINAL INTERESTING	AUSTRALIA	NO
75	MERSIN	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	NO
76	MIAMI, Florida	Port of MIAMI	MARGINAL INTERESTING	USA	NO
77	MOMBASA	Kenya Ports Authority	MARGINAL INTERESTING	KENYA	YES
78	MONTREAL, Quebec	Port of MONTREAL	MARGINAL INTERESTING	CANADA	YES
79	NAGOYA	NAGOYA Port Authority	NOT INTERESTING	JAPAN	NO
80	NANTES SAINT-NAZARE	Port Autonome de NANTES SAINT NAZARE	MARGINAL INTERESTING	FRANCE	NO
81	NAPIER, North Island	Port of NAPIER Ltd.	NOT INTERESTING	NEW ZEALAND	NO
82	NEW ORLEANS, Louisiana	The Port of NEW ORLEANS	INTERESTING	USA	YES
83	NEWCASTLE, NSW	Maritime Services Board NSW	VERY INTERESTING	AUSTRALIA	YES
84	NORDENHAM	Freie Hansestadt BREMEN	MARGINAL INTERESTING	GERMANY	YES
85	OAKLAND,California	Port of OAKLAND	INTERESTING	USA	YES
86	OSAKA	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?
87	OSAKA	Port & Harbour Bureau City of OSAKA	NOT INTERESTING	JAPAN	NO
88	PAPEETE	Port of PAPEETE	MARGINAL INTERESTING	TAHITI	NO
89	PORT ALBERNI	Port ALBERNI Harbour Commission	MARGINAL INTERESTING	CANADA	NO
90	PORT HEDLAND	PORT HEDLAND Port Authority	VERY INTERESTING	AUSTRALIA	YES

Nr	Port/Harbour	Width	Depth	Beam	Draught	Length	Other limitations
61	KITAKYUSHU	500	13	40	11	325	
62	KELANG,Selangor State	210	11.3	35	13.2	300	one-way traffic only
63	KUANTAN		11.5		11.5	245	turning circle : 480m
64	LAEM CHABANG		14				
65	LARNACA Port						
66	LE HAVRE	300	15	52	20	350	
67	LE HAVRE-ANTIFER	550	25	71	28.5	414	
68	LIBREVILLE						draft of 11m during low tide
69	LIMASSOL						
70	LISBON		11	50	11	414	air draft 57m (LW)
71	LONDON			60	14	370	
72	MAKASSAR,Ujung Pandang	180	12.8	40	12	200	
73	MARSEILLE	100	10	30	8	170	
74	MELBOURNE				11.9		
75	MERSIN	250	14	40			
76	MIAMI, Florida	152.4	12.8	23	11.88	150	large ships : one way only
77	MOMBASA	200	25	33	13.25	275	Max draft:13.25m
78	MONTREAL, Quebec	243.84	11	42.67		266.7	water fluctuations in river dep. from outflow Great Lakes
79	NAGOYA						Navig. chn. no.2 length restr. 230m
80	NANTES SAINT-NAZARE	150	5.1	32	10	200	Nantes: turning zone ,max length 220m
81	NAPIER, North Island	180	11	34	10.4	250	dim. swinging basin 300x300m
82	NEW ORLEANS, Louisiana	152.4		28	11.5	198.1	
83	NEWCASTLE, NSW	180	15.2	55	15.65	315	
84	NORDENHAM	200	11	44	13	270	
85	OAKLAND,California	182.88	11.58	39.62	11.58	274.32	
86	OSAKA	120	10	33			
87	OSAKA						principle limiting factor : depth
88	PAPEETE	110	10.9	32.3	10.36	294	
89	PORT ALBERNI	400	32	36.57	11.58	213.36	
90	PORT HEDLAND	183	14.6	55	18.7	325	

Nr	Port/Harbour	Cross Current	Winds
61	KITAKYUSHU	E:3kn W:5kn	
62	KELANG,Selangor State	max:3kn	
63	KUANTAN	apprach chn to breakwater ma 3.2kn	inside breakwater : 0 bft; monsoonal NE max:3-4 bft, NNE:5-7bft
64	LAEM CHABANG	NIL	NIL
65	LARNACA Port	NIL	SSW force 5-7 (winter)
66	LE HAVRE		max:45kn
67	LE HAVRE-ANTIFER	max:1.5kn	max:40kn
68	LIBREVILLE		
69	LIMASSOL	NIL	SSW force 5-7 (winter)
70	LISBON	aligned with channel	SW (win) NNW (sum)
71	LONDON	generally river current	SW
72	MAKASSAR,Ujung Pandang	2kn	30kn
73	MARSEILLE	NIL	>60kn
74	MELBOURNE		
75	MERSIN	NIL	NIL
76	MIAMI, Florida	NIL	NIL
77	MOMBASA	4-6kn	SW monsoon
78	MONTREAL, Quebec	NO	NO
79	NAGOYA	0.1-0.2kn	NW-NNW 26.3% exceeds 10m/s
80	NANTES SAINT-NAZARE	2-5kn	W-SW
81	NAPIER, North Island		strong W
82	NEW ORLEANS, Louisiana		
83	NEWCASTLE, NSW	1-2kn	NE-NW-SE:35kn
84	NORDENHAM	2kn	SW-NW 4-5kn
85	OAKLAND,California	NIL	NIL
86	OSAKA	0.5-1kn	2.6m/s (NNE)
87	OSAKA	weak	avg:3.9m/s dir:WSW
88	PAPEETE	W 2kn	E 15-20kn
89	PORT ALBERNI	max:1kn	strong SW
90	PORT HEDLAND		NW:20-25kn (sum) SE:20-25kn (win)

Nr	Port/Harbour	Wave Conditions	Tidal conditions	Study ever done?	Report Available	Available for Discussion?
61	KITAKYUSHU			YES	YES	NO
62	KELANG,Selangor State		strong ebbs due cause considerably leeway	YES	YES	YES
63	KUANTAN	monsoonal max (NE)	normal avg 6hrs internal	NO	NO	NO
64	LAEM CHABANG	NIL	NIL	NO	NO	NO
65	LARNACA Port		MSL:0.3m	YES	YES	YES
66	LE HAVRE		high slack for VLCC	NO		YES
67	LE HAVRE-ANTIFER	max:3m		YES	YES	YES
68	LIBREVILLE			YES	YES	YES
69	LIMASSOL		MSL:0.3m	YES	YES	YES
70	LISBON	SW (some danger) SE	aligned with channel	YES	YES	YES
71	LONDON	moderate-rough	5-7m	YES		YES
72	MAKASSAR,Ujung Pandang	Hs:5m T:9s	1.7m	YES	YES	YES
73	MARSEILLE	NIL	NIL	YES	YES	YES
74	MELBOURNE			NO		YES
75	MERSIN	NIL	NIL	NO		
76	MIAMI, Florida	NIL	NIL	YES	YES	YES
77	MOMBASA	MIN	MIN	NO	NO	YES
78	MONTREAL, Quebec	NO	85% of time 1m abv chart datum	YES	YES	YES
79	NAGOYA		2.57m	NO	NO	NO
80	NANTES SAINT-NAZARE	H:1-3m	6m	YES	YES	NO
81	NAPIER, North Island	swell from east or strong east	1.5m	NO		YES
82	NEW ORLEANS, Louisiana			?		
83	NEWCASTLE, NSW		MHWS:2m	YES	YES	YES
84	NORDENHAM	NIL	2-3kn H:3.8m	NO		
85	OAKLAND,California	N/A	NIL	YES		
86	OSAKA			NO		YES
87	OSAKA	max:2.8m		NO		YES
88	PAPEETE	N swell increase very fast	Max:0.3m	NO		
89	PORT ALBERNI	0.91m	1.5kn	NO	YES	YES
90	PORT HEDLAND	minimal	Fld:1-2kn (45deg)	YES		YES

Nr	Port/Harbour	Contact	Title Contact
61	KITAKYUSHU	Mr. Shuji Yamamoto	Assistant Manager Planning
62	KELANG,Selangor State	Capt. Abdul Rahin Abd Aziz	Assistant General Manager (Regulatory)
63	KUANTAN		Marine Manager
64	LAEM CHABANG		
65	LARNACA Port		General Manager
66	LE HAVRE	Mr. J. Smagghe	
67	LE HAVRE-ANTIFER		
68	LIBREVILLE	Mr Onio Menie Joseph	Technical Adviser
69	LIMASSOL		General Manager
70	LISBON	Ana Cristina dos Reis e Cunha	Head of the Commercial Dept.
71	LONDON	Capt. G.S. Varney	Chief Harbour Master
72	MAKASSAR,Ujung Pandang	Ir. Sumardi	
73	MARSEILLE		Port Master
74	MELBOURNE	Capt. M.G. Leslie	Navigation Services Superintendent
75	MERSIN		
76	MIAMI, Florida	Carmen J. Lunetta	Director
77	MOMBASA	Capt. A.J. Ketoyo	Manager Marine Operations
78	MONTREAL, Quebec	Capt. Jean-Luc Bedard	Harbour Master
79	NAGOYA	Mr. Hidetoshi Yokochi	Port Promotion Manager
80	NANTES SAINT-NAZARE	B. Gallenne	Head of Hydraulic & Environmental Dept.
81	NAPIER, North Island	John Roil	Port Operations Manager
82	NEW ORLEANS, Louisiana	David A. Wagner	Managing Director
83	NEWCASTLE, NSW	Capt. John McTavish	Nagivation Services Manager
84	NORDENHAM	Capt. J.U. Andersen	
85	OAKLAND,California		
86	OSAKA	Shinji Kataoka	Division Director
87	OSAKA	Masakazu Yamaoka	Manager
88	PAPEETE		Capitainerie du Port de Papeete
89	PORT ALBERNI	Capt. Brian Stansbury	Harbour Master
90	PORT HEDLAND	Capt. Ian de C.F. Baird	General Manager

Nr	Port/Harbour	Address of contact person	
61	KITAKYUSHU	Kitakyushu Port & Harbor Bureau	
62	KELANG,Selangor State	KLANG Port Authority	Mail Bag Service 202, Jalan Pelabuhan
63	KUANTAN	Kuantan Port Authority	Tanjung Gelang P.O. Box 161
64	LAEM CHABANG	The Laem Chabang Port	Chonburi Province
65	LARNACA Port	Office de Ports et Rades du GABBON	23, Crete Str./P.O. Box 2007
66	LE HAVRE	Port Autonome du HAVRE	Terre Plein de la Barve, B.P. 1413
67	LE HAVRE-ANTIFER		
68	LIBREVILLE	Office de Ports et Rades du GABBON	B.P. 1051
69	LIMASSOL	Office de Ports et Rades du GABBON	23, Crete Str./P.O. Box 2007
70	LISBON	Administracao do Porto de Lisboa	Rua da Junqueira, 94
71	LONDON	Port of LONDON Authority, London River House	Royal Pier Road
72	MAKASSAR,Ujung Pandang	Indonesia Port Corporation IV	Jl. Soekarno No. 1
73	MARSEILLE	Port Autonome de MARSEILLE	
74	MELBOURNE	Port of Melbourne Authority	P.O. Box 4721
75	MERSIN	TCCD Ports Department	
76	MIAMI, Florida	Port of MIAMI	1015 North America Way, Suite #210
77	MOMBASA	Kenya Ports Authority	P.O. Box 95001
78	MONTREAL, Quebec	Port of MONTREAL, Port of Montreal Building - Wing #1	Cite du Havre
79	NAGOYA	Nagoya Port Authority	8-21, Irifune 1-Chome, Minato-Ku
80	NANTES SAINT-NAZARE	Port Autonome de NANTES SAINT NAZARE	18 Quai Ernest Renaud BP 3139
81	NAPIER, North Island	Port of Napier Ltd.	P.O. Box 947
82	NEW ORLEANS, Louisiana	Board of Commissioners of the Port of New Orleans	P.O. Box 60046
83	NEWCASTLE, NSW	Hunter Ports Authority	P.O. Box 663
84	NORDENHAM	Wasser-und Schiffahrtsamt Bremen	Franziuseck 5
85	OAKLAND,California	Port of Oakland	530 Water Street, Jack London's Waterfront
86	OSAKA	Planning & Design Standard Div.	Port & Harbour Research Institute
87	OSAKA	Port & Harbour Bureau, City of OSAKA	2-8-24 Chikko Minato-ku
88	PAPEETE		BP 9164
89	PORT ALBERNI	Port ALBERNI Harbour Commission	P.O. Box 99
90	PORT HEDLAND	PORT HEDLAND Port Authority	P.O. Box 2

Nr	Port/Harbour	Address of contact	person (continued)	Phone number	Fax number
61	KITAKYUSHU				
62	KELANG,Selangor State	42005 Port Klang	MALAYSIA	+60-603-368 6171	+60-603-367 0211
63	KUANTAN	25720 Kuantan	PAHANG MALAYSIA		
64	LAEM CHABANG	Sukumvit Road	THAILAND		
65	LARNACA Port	Nicosia	CYPRUS	+357-2-45 01 00	+357-2-36 54 20
66	LE HAVRE	76067 LE HAVRE CEDEX	FRANCE		
67	LE HAVRE-ANTIFER				
68	LIBREVILLE	Libreville	GABON		
69	LIMASSOL	Nicosia	CYPRUS	+357-2-45 01 00	+357-2-36 54 20
70	LISBON	1300 Lisboa	PORTUGAL	+351-1-363 7151	+351-1-64 69 00
71	LONDON	Gravesend, Kent DA12 2BG	UK	+44-474-56 22 31	+44-474-56 22 77
72	MAKASSAR,Ujung Pandang	Ujung Pandang	INDONESIA	+62-411-32 47 97	+62-411-31 90 44
73	MARSEILLE			+33-9139 4000	+33-9139 4140
74	MELBOURNE	Melbourne 3001	AUSTRALIA	+61-3-611 1777	+61-3-611 1905
75	MERSIN	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
76	MIAMI, Florida	Miami, Florida 33132	USA	+1-305-371 7678	
77	MOMBASA	Mombasa	KENYA	+254-11-31 22 11/22 12 11	+254-11-31 18 67
78	MONTREAL, Quebec	Montreal (Quebec) H3C 3R5	CANADA	+1-514-283 7011	+1-514-283 0829
79	NAGOYA	Nagoya 455	JAPAN	+81-52-654 7840	+81-52-654-7995
80	NANTES SAINT-NAZARE	44031 Nantes Cedex 04	FRANCE	+33-4044 2020	+33-4044 2130
81	NAPIER, North Island	Napier	NEW ZEALAND		
82	NEW ORLEANS, Louisiana	New Orleans, Louisiana 70160	USA	+1-504-522 2551	+1-504-524 4156
83	NEWCASTLE, NSW	Newcastle, NSW 2300	AUSTRALIA		
84	NORDENHAM	28199 Bremen	GERMANY		
85	OAKLAND,California	Oakland, Ca. 94604	USA	+1-510-272 1100	+1-510-272 1172
86	OSAKA	Ministry of Transport	JAPAN		
87	OSAKA	Osaka 552	JAPAN	+81-6-572 5121	+81-6-572 0554
88	PAPEETE	Motu Uta	TAHITI - French Polinesia		+689-43 36 12
89	PORT ALBERNI	Port Alberni, B.C.	CANADA	+1-604-723 5312	+1-604-723 1114
90	PORT HEDLAND	Port Hedland, WA 6721	AUSTRALIA	+61-91-73 14 00	+61-91-73 1760

Nr	Port/Harbour	Port Authority	Category	Country	Limit?
91	PORT KEMBALA, NSW	MSB ILLAWARA Port Authority	VERY INTERESTING	AUSTRALIA	NO
92	PORT LOUIS Harbour	Mauritius Marine Authority	MARGINAL INTERESTING	MAURITIUS	YES
93	PORT-OF-SPAIN	Port Authority of Trinida & Tobago	MARGINAL INTERESTING	TRINIDAD, WI	NO
94	PULAU PENANG	Suruhanjaya Pelabuhan PULAU PINANG	MARGINAL INTERESTING	MALAYSIA	YES
95	QUEBEC	Port of QUEBEC Corp.	MARGINAL INTERESTING	CANADA	NO
96	RAJANG, Serawak	Lembaga Pelabuhan RAJANG	MARGINAL INTERESTING	MALAYSIA	YES
97	RAS AL KHAFJI	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	NO
98	RAS TANURA	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	YES
99	RIJEKA	Port of RIJEKA	NOT INTERESTING	CROATIA	
100	ROTTERDAM	Port of ROTTERDAM	MARGINAL INTERESTING	NETHERLANDS	NO
101	SAMSUN	General Directorate of Turkish State Railways	MARGINAL INTERESTING	TURKEY	NO
102	SAN DIEGO, California	Port of SAN DIEGO	MARGINAL INTERESTING	USA	NO
103	SAN JUAN	Maritime Bureau	NOT INTERESTING	PUERTO RICO	YES
104	SARAWAK	Lembaga Pelaguhan MIRI	NOT INTERESTING	MALAYSIA	
105	SEATTLE, Washington	Port of SEATTLE	NOT INTERESTING	USA	NO
106	SETO Island Sea	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?
107	SETO Island Sea	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?
108	SETO Island Sea	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?
109	SHAHID RAJAEE, Bandar	Ports & Shipping Organization	NOT INTERESTING	IRAN	YES
110	SHUAIBA	KUWAIT Ports Authority	MARGINAL INTERESTING	KUWAIT	YES
111	SHUWAIKH	Ports Public Authority	MARGINAL INTERESTING	KUWAIT	YES
112	SINES	Administracao do Porto de SINES	NOT INTERESTING	PORTUGAL	
113	SINGAPORE	Port of SINGAPORE Authority	MARGINAL INTERESTING	SINGAPORE	YES
114	ST. LAWRENCE Ship Channel	Canadian Coast Guard	MARGINAL INTERESTING	CANADA	
115	STAVANGER	STAVANGER Interkommunale Havnevesen	NOT INTERESTING	NORWAY	NO
116	SYDNEY Harbour, NSW	MSB SYDNEY Ports Authority	VERY INTERESTING	AUSTRALIA	NO
117	TANJUNG PRIOK, Jakarta	PT. Pelabuhan Indonesia II	MARGINAL INTERESTING	INDONESIA	YES
118	TAURANGA, South Island	Port of TAURANGA Ltd.	MARGINAL INTERESTING	NEW ZEALAND	YES
119	TIANJIN	Port of TIANJIN	MARGINAL INTERESTING	CHINA	YES
120	TOKYO	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?

Nr	Port/Harbour	Width	Depth	Beam	Draught	Length	Other limitations
91	PORT KEMBALA, NSW	150	15.25	55.7	15.25	315	
92	PORT LOUIS Harbour	185	12.2	32	11	225	
93	PORT-OF-SPAIN	106.68	9.75	20	9	130	
94	PULAU PENANG	183	12	34	13	230	Draft, min 10%
95	QUEBEC	305	12.5	53.5	15.8	281	non-existing nav. aids during winter
96	RAJANG, Serawak			50	6	155	Hard rock + sharp curves
97	RAS AL KHAFJI				21.34		
98	RAS TANURA	960	21	69	24.44	458.45	
99	RIJEKA						
100	ROTTERDAM				22.5		
101	SAMSUN	225	11	40	10.5	220	
102	SAN DIEGO, California	182.88	10.66	36	12.71	305	
103	SAN JUAN	9660	12.5	49	10.7	305	
104	SARAWAK						
105	SEATTLE, Washington						
106	SETO Island Sea	1400	19				speed limit : 12kn
107	SETO Island Sea	450	14		11.4	220	
108	SETO Island Sea	500	12	33.5	12.4	263	
109	SHAHID RAJAEE, Bandar	240	12	34	12	230	
110	SHUAIBA			32	13	275	Vessel over 250m daylight only
111	SHUWAIKH	150	7	37	9.6	260	
112	SINES						
113	SINGAPORE	360	10.5	45	9.5	350	
114	ST. LAWRENCE Ship Channel						
115	STAVANGER	200	30	33.8	10.5	315.5	
116	SYDNEY Harbour, NSW				13.7		
117	TANJUNG PRIOK, Jakarta	150	10.5	20	10.5	225	
118	TAURANGA, South Island	200	12.9	32.5	13	290	
119	TIANJIN	150	11	13	4	85	
120	TOKYO	300	11				

Nr	Port/Harbour	Cross Current	Winds
91	PORT KEMBALA, NSW	None or very small influence	60kn (win) 25kn (sum)
92	PORT LOUIS Harbour	1-2kn	max:60km/h
93	PORT-OF-SPAIN	2kn	12-15kn
94	PULAU PENANG	18 deg to alignment	NE & SW moonsoon
95	QUEBEC	3-4kn	N/A
96	RAJANG, Serawak		0.6m/s Max:30m/s
97	RAS AL KHAFJI	N/S	NW 39kn
98	RAS TANURA	N/S	NW 30 kn
99	RIJEKA		
100	ROTTERDAM		
101	SAMSUN	NIL	NW-N-NE
102	SAN DIEGO, California	NIL	NIL
103	SAN JUAN	NONE	N/A
104	SARAWAK		
105	SEATTLE, Washington		
106	SETO Island Sea	0.5-1.5kn	
107	SETO Island Sea	0.1kn	
108	SETO Island Sea	0.2-0.5kn	0-5m/s (NNW)
109	SHAHID RAJAEE, Bandar	NONE	max: 30kn, normal 5-15kn
110	SHUAIBA	Max:0.5m/s	N-NW 1-10 Max:40
111	SHUWAIKH	2-3kn	15-20kn
112	SINES		
113	SINGAPORE	0.5kn	15kn
114	ST. LAWRENCE Ship Channel		
115	STAVANGER	max:2kn	sheltered area
116	SYDNEY Harbour, NSW	NIL	NIL
117	TANJUNG PRIOK, Jakarta	NIL	10-20kn
118	TAURANGA, South Island	Max:4kn	Max:4-5kn
119	TIANJIN	Fld:0.8kn Ebb:0.66kn	Norm:SW Str:NE
120	TOKYO	0.5kn	03.-05m/s (N)

Nr	Port/Harbour	Wave Conditions	Tidal conditions	Study ever done?	Report Available	Available for Discussion?
91	PORT KEMBALA, NSW	NIL	max:2m	NO		YES
92	PORT LOUIS Harbour	mild	Max:0.7m	NO		YES
93	PORT-OF-SPAIN	calm		NO		
94	PULAU PENANG	Max: 1m	Diurnal MHWS:2.6 MLWS:0.6	YES	YES	YES
95	QUEBEC	NIL	Max:6.7m	NO		YES
96	RAJANG, Serawak	0.05m/s Max:0.74m/s	2.7kn H:0.5-1m	YES	NO	YES
97	RAS AL KHAFJI	2m	1.75m	NO		YES
98	RAS TANURA	moderate	2m	NO		YES
99	RIJEKA			NO		
100	ROTTERDAM			YES	YES	YES
101	SAMSUN	NIL	0.5-0.6m	NO		
102	SAN DIEGO, California	NIL	NIL	YES		YES
103	SAN JUAN	0-1.5m	1hr6sec	NO	YES	YES
104	SARAWAK			NO		
105	SEATTLE, Washington			?		?
106	SETO Island Sea		1.8m	NO		YES
107	SETO Island Sea		2m	NO		YES
108	SETO Island Sea	0-0.5m	3.1m	NO		YES
109	SHAHID RAJAEE, Bandar	max:5m, normal 0.5-1.5m	EHW:2.4m ELW:2.5m	NO	NO	NO
110	SHUAIBA	Hs:0.5,1,2 N-NW	EHW:+3 MHHW: 2.4 LLW:-0.3	YES	YES	YES
111	SHUWAIKH	3-4 F	H:9.6M	NO		
112	SINES			NO		
113	SINGAPORE	N/A	Max:2.7m	NO		YES
114	ST. LAWRENCE Ship Channel					
115	STAVANGER	max:2m at the achorage	max:2kn	YES	YES	YES
116	SYDNEY Harbour, NSW	NIL	NIL	YES	YES	YES
117	TANJUNG PRIOK, Jakarta	1-2m	Diurnal tide	NO	YES	YES
118	TAURANGA, South Island	Outside appr. only	Max drafts HW:13 LW:111.7	YES	YES	YES
119	TIANJIN	Avg:0.5 Max:3.7	Avg:2.47	YES	YES	YES
120	TOKYO	H(1/3)=0.25-0.5m	2m	NO		YES

Nr	Port/Harbour	Contact	Title Contact
91	PORT KEMBALA, NSW	W. Hoogendorn	Harbour Master
92	PORT LOUIS Harbour	Mr. S. Suntah	Port Engineer
93	PORT-OF-SPAIN	Mr. Harine Singh	Civil Engineer
94	PULAU PENANG	Capt. Ahmed Husni bin Haji Zakwan	Chief Marine Officer
95	QUEBEC		
96	RAJANG, Serawak		General Manager
97	RAS AL KHAFJI		Director
98	RAS TANURA		
99	RIJEKA		
100	ROTTERDAM	Anthony P. Margadant	Director of Shipping/Nautical Affairs
101	SAMSUN		
102	SAN DIEGO, California	Stanley R. Westover	Manager Marine Operations
103	SAN JUAN	Luis de Casenave	Chief Maritime Bureau
104	SARAWAK		
105	SEATTLE, Washington	Keith Christian	Director Marine Planning and Development
106	SETO Island Sea	Shinji Kataoka	Division Director
107	SETO Island Sea	Shinji Kataoka	Division Director
108	SETO Island Sea	Shinji Kataoka	Division Director
109	SHAHID RAJAEE, Bandar		
110	SHUAIBA	Ibrahim Abdul Aziz Al-Fulaij	Director
111	SHUWAIKH		
112	SINES		
113	SINGAPORE	Capt. James Fong	Port Master
114	ST. LAWRENCE Ship Channel		
115	STAVANGER	Edgar Bergsvik	Habour Master
116	SYDNEY Harbour, NSW	Capt. R.H. McGee	MSB SYDNEY Ports Authority
117	TANJUNG PRIOK, Jakarta	Capt. Sjarial Nasution MBA	
118	TAURANGA, South Island	J.I. Mayson	Operations Manager
119	TIANJIN		
120	TOKYO	Shinji Kataoka	Division Director

Nr	Port/Harbour	Address of contact person	
91	PORT KEMBALA, NSW	MSB ILLAWARA Port Authority	P.O. Box 89
92	PORT LOUIS Harbour	Mauritius Marine Authority, Port Administration Building	Mer Rouge
93	PORT-OF-SPAIN	Port Authority of Trinida & Tobago	Dock Road
94	PULAU PENANG	Penang Port Commission	P.O. Box 143
95	QUEBEC	Corporation of Lower St. Lawrence Pilots	240 Dalhousie Street [or P.O. Box 38 - station B]
96	RAJANG, Serawak	Rajang Port Authority	
97	RAS AL KHAFJI	Al-Khafji Port	P.O. Box 366
98	RAS TANURA	Ras Tanura Port Authority	P.O. Box 251
99	RIJEKA		
100	ROTTERDAM	Rotterdam Municipal Port Management	Galvanistraat 15
101	SAMSUN	TCCD Ports Department	
102	SAN DIEGO, California	Port of SAN DIEGO	3165 Pacific Highway/P.O. Box 488
103	SAN JUAN	Port of San Juan Authority	G.O.P. Box 362829
104	SARAWAK		
105	SEATTLE, Washington		
106	SETO Island Sea	Planning & Design Standard Div.	Port & Harbour Research Institute
107	SETO Island Sea	Planning & Design Standard Div.	Port & Harbour Research Institute
108	SETO Island Sea	Planning & Design Standard Div.	Port & Harbour Research Institute
109	SHAHID RAJAEE, Bandar	Ports & Shipping Organization	751 Enghrlab Avenue
110	SHUAIBA	Shuaiba Port	P.O. Box 10099
111	SHUWAIKH	Ports Public Authority, Shuwaikh Port	P.O. Box 3874
112	SINES		
113	SINGAPORE	Port of Singapore Authority, PSA Building	460 Alexandra Road
114	ST. LAWRENCE Ship Channel		
115	STAVANGER	STAVANGER Interkommunale Havnevesen	Nedre Strandgate 51
116	SYDNEY Harbour, NSW		G.P.O. Box 32
117	TANJUNG PRIOK, Jakarta	Pilotage Services Division	Jl. Pasoso No.1, Tanjung Priok
118	TAURANGA, South Island	Port of TAURANGA Ltd.	Post Bag 1
119	TIANJIN		
120	TOKYO	Planning & Design Standard Div.	Port & Harbour Research Institute

Nr	Port/Harbour	Address of contact	person (continued)	Phone number	Fax number
91	PORT KEMBALA, NSW	Port Kembala, NSW 2505	AUSTRALIA		
92	PORT LOUIS Harbour	Port Louis	MAURITIUS	+230-240 0415	+230-240 0856
93	PORT-OF-SPAIN	Port of Spain	Trinidad, W.I.	+809-627 8942	+809-627 2666
94	PULAU PENANG	10710 Penang	MALAYSIA	+60-604-61 22 11	+60-604-61 33 36
95	QUEBEC	Quebec (Quebec) G1K 7A1	CANADA	+1-418-692 0444	+1-418-692 4142
96	RAJANG, Serawak	96000 SIBU, Sarawak	MALAYSIA	+60-???-31 90 09	+60-???-31 87 54
97	RAS AL KHAFJI	Al-Khafji 31971	SAUDI ARABIA		
98	RAS TANURA	Rahima 31941	SAUDI ARABIA		
99	RIJEKA				
100	ROTTERDAM	3002 AP Rotterdam	NETHERLANDS	+31-10-489 7404	+31-10-476 7809
101	SAMSUN	Gar-Ankara	TURKEY	+90-4-311 3083/312 6556	+90-4-312 3215
102	SAN DIEGO, California	San Diego, Ca. 92112	USA	+1-619-291 3900	
103	SAN JUAN	San Juan	PUERTO RICO 00936		
104	SARAWAK				
105	SEATTLE, Washington		USA	+1-206-728 3316	
106	SETO Island Sea	Ministry of Transport	JAPAN		
107	SETO Island Sea	Ministry of Transport	JAPAN		
108	SETO Island Sea	Ministry of Transport	JAPAN		
109	SHAHID RAJAEE, Bandar	Teheran	IRAN		
110	SHUAIBA	Shuaiba, Code-65451	KUWAIT		+965-326 0114/326 3825
111	SHUWAIKH	13039 Safat	KUWAIT	+965-483 3580/481 2622	+965-483 5233/483 7204
112	SINES				
113	SINGAPORE	Singapore 0511	SINGAPORE	+65-274 7111	+65-274 4677
114	ST. LAWRENCE Ship Channel				
115	STAVANGER	4005 Stavanger	NORWAY	+47-04-50 78 00	+47-04-50 78 22
116	SYDNEY Harbour, NSW	Sydney, NSW 2001	AUSTRALIA		
117	TANJUNG PRIOK, Jakarta	Jakarta 14310	INDONESIA	+62-21-430 1080	+62-21-49 13 00/49 51 40
118	TAURANGA, South Island	Mount Maunganui	NEW ZEALAND		
119	TIANJIN				
120	TOKYO	Ministry of Transport	JAPAN		

Nr	Port/Harbour	Port Authority	Category	Country	Limit?
121	TOKYO Bay	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?
122	TOKYO Bay	Port & Harbour Research Institute, Ministry of Transport	NOT INTERESTING	JAPAN	?
123	VALENCIA	Puerto de VALENCIA	NOT INTERESTING	SPAIN	NO
124	VANCOUVER, B.C.	VANCOUVER Port Corp.	NOT INTERESTING	CANADA	NO
125	VENICE	Provveditorato al porto di VENEZIA	MARGINAL INTERESTING	ITALY	YES
126	WHANGAREI Port,	NORTHLAND Port Corp.	VERY INTERESTING	NEW ZEALAND	YES
127	WILMINGTON, N.C.	N.C. State Ports Authority	VERY INTERESTING	USA	YES
128	YANBU Commercial	Kingdom of Saudi Arabia Ports Authority	INTERESTING	SAUDI ARABIA	YES
129		Ports & Harbours Bureau, Ministry of Transport	MARGINAL INTERESTING	JAPAN	
130		Puertos del Estados	NOT INTERESTING	SPAIN	

Nr	Port/Harbour	Width	Depth	Beam	Draught	Length	Other limitations
121	TOKYO Bay	1400	25				speed limit : 12kn
122	TOKYO Bay	700	20		17		speed limit : 12kn
123	VALENCIA	500	17	50	15	350	
124	VANCOUVER, B.C.				16.2		air drafts
125	VENICE	30	9.14	25	9	150	
126	WHANGAREI Port,	90	8.1	32.24	9.45	190	
127	WILMINGTON, N.C.	12.192	11.58	33	9.5	221	
128	YANBU Commercial	200	12	55	10.36	255	
129							
130							

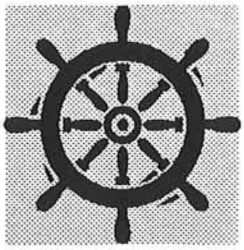
Nr	Port/Harbour	Cross Current	Winds
121	TOKYO Bay	0.3-1kn	
122	TOKYO Bay	0.1kn	
123	VALENCIA		NE
124	VANCOUVER, B.C.		
125	VENICE	NO	NO
126	WHANGAREI Port,	in shell cut area	SW
127	WILMINGTON, N.C.		SW + NE
128	YANBU Commercial	NIL	NW 35kn
129			
130			

Nr	Port/Harbour	Wave Conditions	Tidal conditions	Study ever done?	Report Available	Available for Discussion?
121	TOKYO Bay			NO		YES
122	TOKYO Bay			NO		YES
123	VALENCIA			NO		YES
124	VANCOUVER, B.C.			YES	YES	YES
125	VENICE	NO	NO	YES	YES	YES
126	WHANGAREI Port,	no problem	tight tidal constraints	NO		YES
127	WILMINGTON, N.C.	light to moderate	0.3m	NO		YES
128	YANBU Commercial	2m	NIL	NO		YES
129						
130				NO		

Nr	Port/Harbour	Contact	Title Contact
121	TOKYO Bay	Shinji Kataoka	Division Director
122	TOKYO Bay	Shinji Kataoka	Division Director
123	VALENCIA	Rafael Escutia	Head Planning Dept.
124	VANCOUVER, B.C.	Capt. J. Houston	Harbour Master
125	VENICE	Dr. Alessandro di Cio	Chairman
126	WHANGAREI Port,	Capt. Phil Barling	Port Superintendent
127	WILMINGTON, N.C.		Director
128	YANBU Commercial		Director General
129		Akira Koyama	Deputy Director, International Affairs Office
130			

Nr	Port/Harbour	Address of contact person	
121	TOKYO Bay	Planning & Design Standard Div.	Port & Harbour Research Institute
122	TOKYO Bay	Planning & Design Standard Div.	Port & Harbour Research Institute
123	VALENCIA	Autoridad Portuaria de Valencia	
124	VANCOUVER, B.C.	VANCOUVER Port Corp.	1900-200 Granville St.
125	VENICE	Provveditorato al porto di VENEZIA	
126	WHANGAREI Port,	NORTHLAND Port Corp.	P.O. Box 848
127	WILMINGTON, N.C.	N.C. State Ports Authority	P.O. Box 9002
128	YANBU Commercial	King Fahd Industrial Port	P.O. Box 30325
129		Ports & Harbours Bureau, Ministry of Transport	2-1-3 Kasumigaseki, Chiyoda-ku
130			

Nr	Port/Harbour	Address of contact person (continued)		Phone number	Fax number
121	TOKYO Bay	Ministry of Transport	JAPAN		
122	TOKYO Bay	Ministry of Transport	JAPAN		
123	VALENCIA	46024 Valencia	SPAIN	+34-6-367 4391	+34-6-367 2752
124	VANCOUVER, B.C.	Vancouver, BC.	CANADA V6C 2P9		
125	VENICE			+39-41-533 4111	+39-41-533 4254
126	WHANGAREI Port,	Whangarei	NEW ZEALAND	+64-9-438 1279	+64-9-438 7067
127	WILMINGTON, N.C.	Wilmington, N.C. 28402-9002	USA		
128	YANBU Commercial	Yanbu Al Sinaiyah	SAUDI ARABIA		
129		Tokyo 100	JAPAN	+81-3-3580 6851	+81-3-3580 7961
130					



Towards Fast-time Simulation-based Probabilistic Design of Channel Width

⇒ **Volume I: Main Report**
Appendix A
Volume II: Appendix B
Volume III: Appendix C

by:
Paul J. Siregar
mentors:
Prof. Ir. H. Velsink
Ir. R. Groenveld

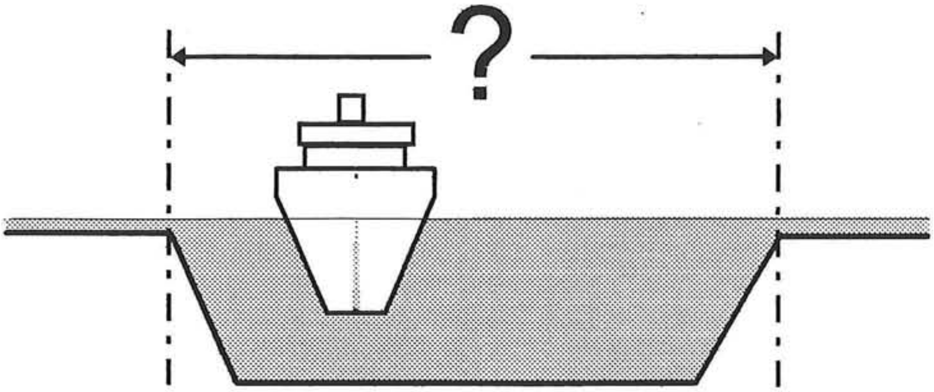
TU Delft

Delft University of Technology
Department of Civil Engineering
Hydraulic and Geotechnical Engineering Division
Hydraulic Engineering Group
December 1995

"To you alone, O LORD,
to you alone, and not to
us, must glory be given
because of your constant
love and faithfulness."

(Psalm 115:1)

Preface



How wide should an access channel be? That is the question that keeps the harbour developers and port authorities busy. A host of methods have been developed to provide a sufficient answer to the question. Most of the methods so far are deterministic, where a set of rules-of-thumb are formulated based on human experience. These methods have been instrumental in dimensioning and maintenance of modern channels. The next generation of methods are based on either real-life or real-time simulations. Most of the time they are applied to test out the design made using a deterministic method.

This study contributes to the third generation of methods: the fast-time simulation methods. The most disturbing shortcoming of these methods is the absence of the human factors. The reason to leaving out the human factors is the unpredictability of human response, something that is too complex to be simplified without losing its essence. This missing link was the main question this study tried to answer: How to include the human factors and to simulate the unpredictability of human response in a fast-time simulation method.

The Introduction of this report sets the scene of the problem. Part I of this report discusses the basic idea of developing and using a computer simulation. A computational model certainly has its advantages, yet it also has its shortcomings. The basic principles and structures three computer simulation programs (COLUMBUS, SHIPMA 4.30, and PROSIM 3.01) are presented briefly.

Part II deals with the approaches designed and tried out in process of developing a sufficient model. Before finally the sufficient model was worked out, two different models were explored. The last Chapter in this part discusses this model, which later to be called the RandSail model.

At last, Part III presents and discusses the results of the RandSail model. They are also compared with the results obtained from calculations using the Concept Design Rules (CDR). The CDR are recently formulated by a joint working group of PIANC[*]/IAPH[†]. Conclusions and recommendations close the report.

Finally, I am deeply indebted to a number of people for all the assistance and guidance they have given to me during this project. First of all, I want to thank Ir. Jos van Doorn and Ir. Dick ten Hove at MSCN[‡] in Wageningen. When the question arose on how to include the element of unpredictability in the model, they came up with various solutions including the idea of using COLUMBUS. Their knowledge and expertise in ship simulation have proven to be imperative.

Second of all, I am also grateful to Mr. Ben Peters and Mr. Piet Kik at the RWS-AVV[§] in Rotterdam. They helped me find my way in using COLUMBUS and produce the crucial input for the RandSail model. They even let me work in their offices as I worked on the Columbus simulations.

Last but certainly not least, there are two people without whom I wouldn't have been able to even get started on this project, let alone finishing it. I want to thank Ir. R. Groenveld, my mentor, for his guidance throughout the whole process and for keeping me motivated until the end. I also thank Prof. Ir. H. Velsink, who is in charge of the project, for the crucial role he played in keeping the process on track.

Delft, December 1995

Paul J.B. Siregar

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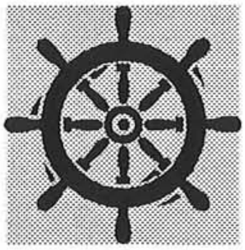
[*] PIANC : Permanent International Association of Navigational Congresses
[†††] IAPH : International Association of Ports and Harbours
[‡] MSCN : Maritime Simulation Centre the Netherlands
[§] RWS-AVV : Transportation and Traffic Engineering Research Department of the Dutch Ministry of Transport and Public Works



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PART III: The Method and Its Results

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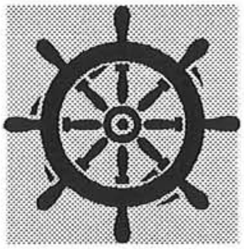
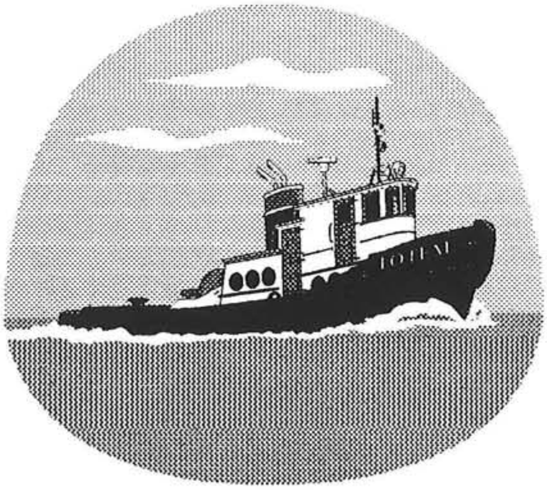


1. Introduction



1.1. General

Determining the suitable width of an entrance channel is a balancing act between cost-efficiency and safety. On one hand, if the channel width is in such a way that there is a total safety guarantee for all ships going to and from the port, the port is highly accessible. A high accessibility leads to high cash-flow. On the other hand, maintaining a channel is very costly. Where it comes down to is: a channel or a fairway must then have a certain dimension that optimises the balance between the income and the maintenance expenditure. This optimisation technique using the total cost basis is, as a matter of fact, applied widely when it comes to designing the dimensions of entrance channels, both for the depth and the width (see [1] and [2]).

In general the following methods used to determine the dimensions of a fairway (see [3] and [4]):

- Deterministic computations
- Simulations
- Scale models

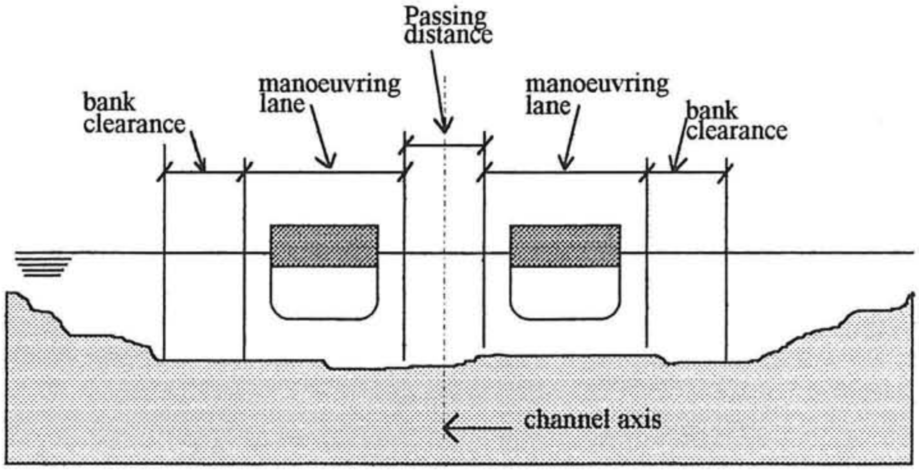
1.1.1 Deterministic Computations

A deterministic computation approach uses rules of thumb guidelines or advanced experimental or numerical techniques. This method uses one ship, the so-called "design ship" to represent a group of ships. Furthermore, it reduces all environmental factors, such as winds, waves, and currents, into a set of deterministic design data. For this factors the probability of occurrence is predetermined based on available data.

The most recent example of these rules of thumb to calculate the width of a channel is the "Concept Design for Approach Channels"[5] prepared y the Joint Working Group 30 of PIANC[*], IAPH[†], and IMPA[‡], in 1993. These rules of thumb is further known as the Concept Design Rules or CDR. The CDR take into account up to 14 factors, such as ship manoeuvrability, cross wind, cross current, wave height, and cargo hazard level.

The CDR were tested in a 1994 study by using them to calculate the channel widths of existing channels. In 1993 IAPH distributed a questionnaire to ports and harbours world-wide to collect data on the most critical part of their entrance channels. This data, along with data from other sources, were used in this study. The conclusion of this study was that the CDR are a good tool for the design stage to estimate a channel width [6].

Figure 1.1 Elements of the horizontal dimension of a fairway as used in the Concept Design Rules



1.1.2 Simulation

When there are a large amount of factors, or variable, or where no proper distribution functions are known, one way to approach the matter is by using simulations. These simulations are done on a ship simulator, a machine upon which a pilot can experience the manoeuvring of a given ship in a given situation. As it is with the better known flight simulator, a ship simulator (also called a manoeuvring simulator) is a substitute for the real ship. As a substitute it functions close to the real ship but costs less and also less risky to operate.
In each manoeuvring simulation, also called a "simulation run", a combination can be made of various factors or variable that are considered to be relevant. A set of runs might be needed to obtain a sufficient amount of data. This data will then be used to determine, for instance, the proper distribution function of a ship's path.

The ship simulator technology has come quite far that the modern simulators are not restricted to the operation of existing channels any

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[*] PIANC : Permanent International Association of Navigation Congresses (Brussels, Belgium)
[†] IAPH : International Association of Ports and Harbours (Tokyo, Japan)
[‡] IMPA : International Maritime Pilots Association (London, United Kingdom)

longer, at it was a decade ago[3]. The most common use of a ship simulator then was to train new skippers or harbour pilots[8]. Maritime research centres, such as MSCN[§] in Holland, now use ship simulator to study, for instance, the navigability of a proposed (expansion of a) channel. This use makes it possible to test a number of channel designs[7]. Another use is to evaluate ship movements during approach to a proposed harbour[8]. These last two uses are probably the most effective use of a simulator.

These ship simulators, where a human pilot is present and manually operates the manoeuvre, work on a natural time scale and widely categorised as a real-time simulator. More on real-time simulators see also [8]. Another type of simulators doesn't need a pilot to be physically present. In fact, the role of the human operator is played entirely by a computer. With the human element practically eliminated, these simulators do not have to work on a natural time scale any longer. They are known as the fast-time simulators. Further discussion on fast-time simulations see in Chapter 2.

1.1.3 Scale Models

Another way of approaching a design problem is to reconstruct the actual proposed situation in a physical scale model. If such a model is large enough, it can reproduce the real hydraulic situation quite accurately. The role of the human pilot, however, cannot possibly be properly reproduced in a physical model. The model distorts his time scale and the scale of his perception.

To get a correct representation of all hydraulic and hydrodynamic influences, it is necessary to apply Froude's law to determine the scaling factors.

The Froude number is: $\mathbf{F} = \frac{V}{\sqrt{gd}}$

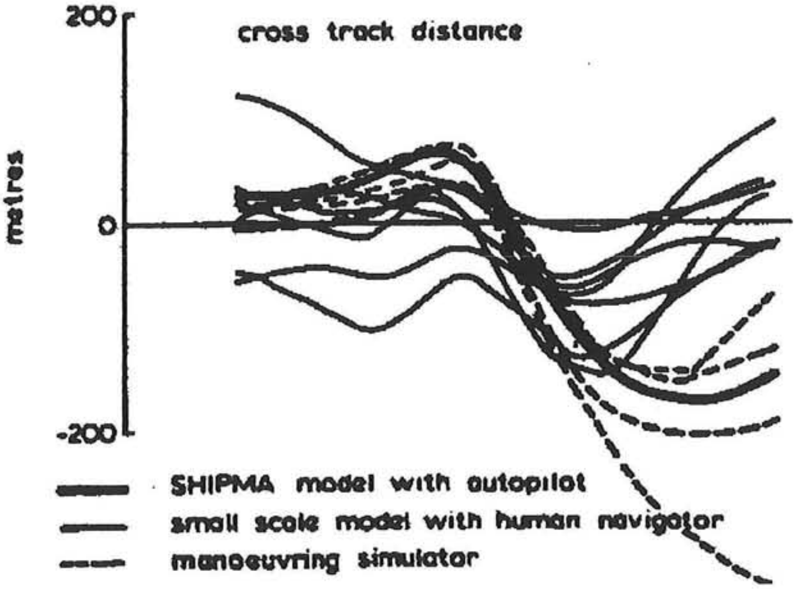
Where:
V = average velocity (m/s)
g = force of gravity (m/s^2)
d = depth (m)

The time element is crucial to the Froude number as they are included in both V and g. According to this equation, the time scale factor equals the square root of linear scaling factor. In other words, in the scale model time will pass much faster than in real-life. This distorts the time scale and perception of the human navigator and therefore this may lead to incorrect representation of the navigator (see also [9] and [10]). As a matter of fact, tests have shown that small scale model with shore-based human navigator leads to poor results, see also Figure 1.2.

[§] MSCN: Maritime Simulation Centre the Netherlands, Wageningen, the Netherlands.

Figure 1.2
Poor results of small scare model with shore-based human navigator

(source: [9])



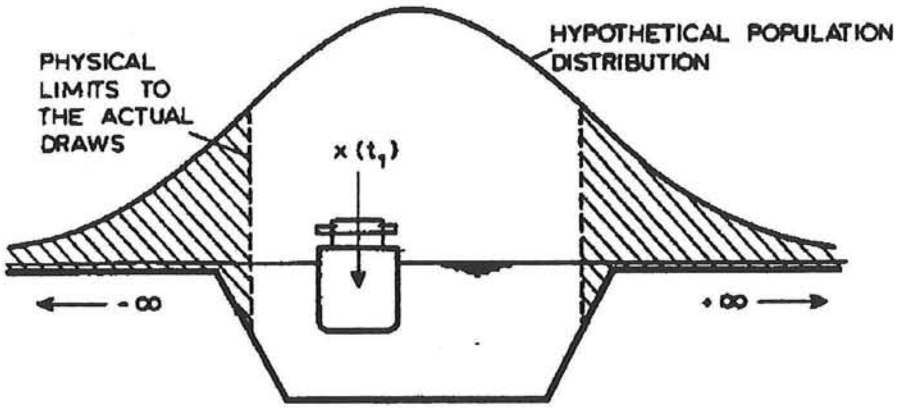
1.2. Probabilistic Computation: Taking Safety into account

When it comes to safety the question of "how safe" a given design is will have to be rephrase in "what is the chance of failure". Since no one can be completely sure that nothing will go wrong, one can only be sure, up to a certain extent, that the chance something will go wrong is very small or negligible. In other words, being concerned with safety means being concerned with the probability of failure. In the case of designing channel width, maximising safety means minimising the chance a ship will exceed the channel boundaries.

The distribution of the chance of exceedance in a cross-section of channel is illustrated in Figure 1.3 below. In this case it is assumed that the chance is normally distributed. This figure also shows the physical boundaries of the channel. The shadowed area on either side of the channel represents the cumulative chance of exceedance at that cross-section. The distribution can only be determined when the samples of ship position, their mean value, and their standard deviation are known. The design process in which the channel dimensions are determined on the ground of an acceptable probability of failure is called the probabilistic dimensioning techniques.

Figure 1.3
The physical and stochastic boundaries of an access channel

(source:[11])



The cornerstone of this technique is the probabilistic computation. The main difference between the deterministic computations and the probabilistic computations is that the latter one includes the stochastic characteristic of both the ships and the physical environment (winds, wave, etc.). The computations will then use the appropriate probability distributions of these parameters. Furthermore it also uses the physical relations between these parameters and the physical processes, for instance the effect of a given wave height on the manoeuvre of a ship sailing on a given speed.

The stochastic variability of the physical environment can be determined using the data collected by local observations. More and more areas in the world are well-observed and therefore the stochastic variability of the environmental elements is the least to worry about.

The stochastic characteristics of ships, in contrary, is probably the most complicated part of this approach. On one hand ship's vertical motions (heave, roll, and pitch) and horizontal motions (surge, sway, and yaw) have been studied extensively. The stochastic variability of the vertical motion can be determined as a function of various factors, such as sea bed roughness and the ship's vertical motions[1]. Despite the variety of factors need to be taken into account, the progress in the field of vertical ship motions is much faster than in the field of horizontal motions[9]. A computer program (TRIAL) to calculate the behaviour of a ship in the vertical direction was already developed more than two decades ago[12].

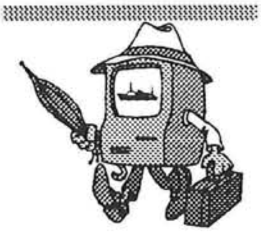
On the other hand, however, when it comes to the horizontal dimension of a channel, it is the ship's position in relation to the channel edges and the desired course that matters most. This position could be expected to follow the normal distribution. If the standard deviation of the ship's path is known the chance that the ship will exceed a given path can be calculated [4]. The only question to answer now is: how to determine the value of the standard deviation.

It is far from simple to determine the value of the standard deviation since it is a function of a lot of factors. Among those factors are: the local traffic density in the channel, the availability and quality of the navigational aids, the physical conditions of the channel itself, and probably most important of all: the human factors.

1.3. The Objective of the Project

The probability of an event, in this case a ship exceeds the boundaries of a channel, can be estimated by either of the following two procedures[13]:

1. **Classical or a priori approach.** If an event can occur in *h* different ways out of a total number of *n* possible ways, all of



which are equally likely, then the probability of the event is h/n. The problem with this approach is the vagueness of the definition "equally likely". It may mean that a distribution should be uniform.

2. **Frequency or a posteriori approach.** If after n repetitions of an experiment, where n is very large, an event is observed to occur in h of these, then the probability of the event is h/n. Another name for this is the *empirical probability* of the event. The problem with this approach is the vagueness of the "large number" involved. When is n large enough before one can estimate the probability accurately?

The first approach, emphasised by the words "equally likely", is more appropriate for a uniform distribution. Since a ship's path is rather a normal distribution than a uniform one, only the second approach is available. However, as mentioned, how often should the manoeuvring simulation be repeated to obtain enough population?

In general there are three ways to do the experiment:

- Registration of data during real-life ship manoeuvre
- Registration of data during real-time simulation using a ship simulator
- Registration of data using a fast-time simulation

Due to the high costs the first two types of experiment are restricted to a relatively small number of n (usually $n = 10$). Furthermore, the first type, using real-life ship, is highly dependent on external factors such as the weather. The second type of experiment, using a ship simulator, is practically independent on weather, yet it is still costly.

A fast-time simulation should be an attractive solution for it is much cheaper than the other two and also much faster. Its low costs make it possible to run a large number of simulations. The problem for the time being is that there is no fast-time simulation program available is capable of simulating the human factors in a ship simulation. The present probabilistic calculations are usually based on data obtained through real-time simulations.

Therefore, the objective of this project is to develop a probabilistic method to determine the width of an entrance channel. The method, however, must be based on fast-time simulations.

1.4. Further in this Report

Part I of this report covers the subject of computational models. Chapter 2 discusses the subject of computer simulations. Although computer simulation models have been widely used for quite a long time, they still have their shortcomings when it comes to replicating a real-life system. Despite these shortcomings, the applicability of a number of available computer simulation programs to develop a fast-time based probabilistic method of design have been studied.

In Chapter 3, the first of three computer simulation programs, COLUMBUS, is described. The description of the second program, SHIPMA 4.30, follows in Chapter 4. The third program, PROSIM 3.01, that later became the umbrella for the first two as well, is presented in Chapter 5.

Part II covers this study. It started with an approach that later appeared to be unsatisfactory. Since this approach has been an important step in the study, it is discussed in Chapter 6. The next chapter, Chapter 7, is dedicated to elaborate on the final approach where the three simulation programs are integrated. The discussions on the results of this study are in Part III, Chapter 8 and Chapter 9. The conclusions and recommendations follow in Chapter 10.

REFERENCES:

[1] Bijker, Prof.Dr.Ir. E.W., Dijk, Ir. J.J. van, Massie, W.W., MSc.PE, Coastal Engineering, Volume II: Harbour and Beach Problems, *Chapter 4: Channel Depth*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, 1986.

[2] Massie, W.W., MSc.PE, Coastal Engineering, Volume II: Harbour and Beach Problems, *Chapter 8: Total Channel Optimization*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, 1986.

[3] Weide, Ir. J. van der, *Design of Navigation Channels*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 2.

[4] Dijk, Ir. J.J. van, Coastal Engineering, Volume II: Harbour and Beach Problems, *Chapter 5: Channel Width*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, 1986.

[5] Joint Working Group 30, *Approach Channels: A Guide for Concept Design*, PIANC/IAPH/IMPA, London, United Kingdom, 1993.

[6] Siregar, P.J.B., *A Study on the Concept Design Rules for Approach Channels*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, October 1995.

[7] Perdok, Drs. J., *Study of Approach Channels to the Demerara and Berbice Rivers, Guyana*, Report No. 06162-1-NS (Guyana Navigability Study ordered by TU Delft), Maritime Research Institute Netherlands (MARIN), Wageningen, the Netherlands, July 1984.

[8] Bijker, Prof.Dr.Ir. E.W., Loo, Ir. L.E. van, Massie, W.W., MSc.PE, Coastal Engineering, Volume II: Harbour and Beach Problems, *Chapter 6: Ship Manoeuvring Models*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, 1986.

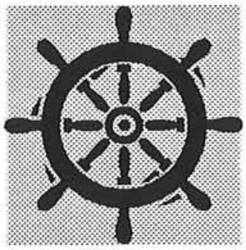
[9] Strating, Ir. J. and Koeman, Ir. J.W., *Dimensioning of Access Channels: Techniques and Research Means*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 4, Section 4.3.1.

[10] Streeter, Victor L. and Wylie, E. Banjamin, *Fluid Mechanics*, McGraw-Hill Book Company, Singapore, 1987, Sections 4.4 and 11.4.

[11] Figure 5.1. of [9]

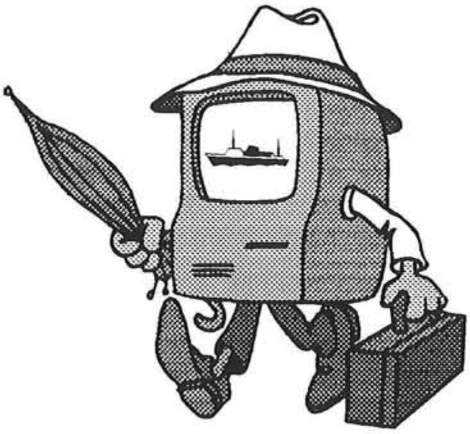
[12] Beukelman, W. and Bijlsma, E.F. (mrs), *Description of a Program to Calculate the Behaviour of a Ship in a Seaway (Named: TRIAL)*, Delft University of Technology, Shipbuilding Laboratory, Delft, the Netherlands, August 1973.

[13] Spiegel, Murray R., *Schaum's Outline of Theory and Problems of Probability and Statistics*, Schaum's Outline Series, McGraw-Hill, Inc., New York, NY, U.S.A., 1994.



2. Computer Simulations

From real-life to fast-time



2.1. Introduction

A simulation is basically a computational model of a natural system. A computational model aims to come as close as possible to the natural system it is modelled on. In other words, a simulation or a computational model is supposed to be a mapping of that part of the real world onto a computer[1]. Ideally, in the mapping the natural system and the model can be mapped onto each other.

However, a computational model can never be considered to be a perfect copy of the reality because:

- A model will never describe every aspect of the natural system in the interest of the study. Due to the enormous amount of elements present in a natural system, a model, with its finite number of variables, will never be a perfect copy.
- A model will include elements that do not occur in the natural system. Mathematics modelling is largely based on axioms. These axioms are simplifications of the real world based on its characteristics. A natural system doesn't work with these axioms or simplifications.

2.2. From Scratch to Simulation Models

Generally speaking, developing a computational model or a simulation model involves the following steps[2] (see also Figure 2.2):

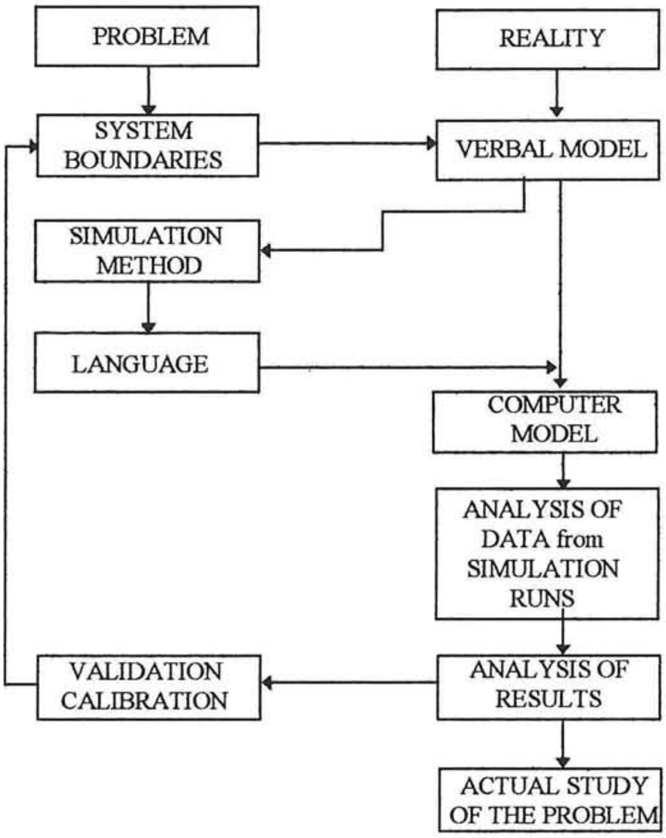
- Determine the boundaries of the system to be modelled.
- Create a verbal description of the model, which is the schematisation of the system within its boundaries.
- Build the simulation model.
- Verify and validate the simulation model.

Verification means making sure that the model, its input parameters, and its logical structure are correctly implemented in the program. Validation means determining whether the model is accurate enough to represent the real system. A crucial part of validation is calibration, which is an interactive process of comparing the model to the actual system behaviour. It uses the discrepancies to improve the model.

The verbal model is the algorithm of the whole simulation model. This algorithm describes how the computation should be accomplished. The grade of complexity of an algorithm depends mainly on the complexity of the system and the objective of the model.
The main question concerning algorithm that keeps researchers in the area of simulation is: What algorithm is the best to describe a specific system. The imperfection of the algorithm, which is its inability to describe every aspect of a system and the presence of unnatural elements (see section 2.1.), is the source of the shortcomings of a simulation model.

Figure 2.1 Simulation process step-by-step

(source: [2])



2.3. Computational Models versus Real Life

Despite the shortcomings, computational models are a welcome answer for the world of science. First of all, research in a natural, real-life situation is time consuming. A computational model, on the other hand, enables the user(s) to isolate a specific element of the system or process in order to study it extensively and therefore it takes up much less time. For instance, for pilots to practice landing approach a couple of times means repeating the whole process of flying (waiting, taking-off, flying, approaching, and landing) from the beginning to the end. In a flight simulator, the pilots and the trainers can easily concentrate on the landing approach and repeat it as often as needed.

Secondly, research in natural situation is costly. For instance, to evaluate an harbour approach, a real ship has to be used. That means operational costs have to be added to the total research budget. Not to mention the costs of risks.

2.4.
Computational Models and the Usage

A popular use of computational models or simulations are to make a prediction. A well-known example is the simulations used by meteorological institutes world-wide to forecast the weather. This technology has come quite far that these institutes are able to make weather forecast with significant accuracy, not only for the next day but also, for a couple of days to come. Harbour development projects have also been known to be effectively using simulations to predict the effects of proposed changes or expansions.

Another use of computational models is to create 3-dimension visual of a surface of which only 2-dimensional graphics are available. Since NASA sent the *Magellan* probe to explore the Planet Venus in 1989, the probe has been transmitting radar images of the planet to the earth[3]. Using computers NASA has been able to create contour images of Venus. The computational models use the technology of flight simulation and therefore is able to simulate "exploration flight above Venus."

The third popular use of computer simulations is indeed the flight simulator. The purpose of this simulator is to train pilots. New pilots or pilots who are moving to a higher class of aircraft have to go through trainings where they practice flying an aircraft in a flight simulator. Beside training to fly a new aircraft, the simulator is also used to help pilots practice making approaches to airports (or airstrips) they have never been to before.
The marine counterpart of the flight simulator is the ship simulator. The ship simulator is also used for training purposes. It's other use is to test out proposed designs for harbour approaches or physical navigational aids (beacons, etc.).

2.5.
Man-Machine Systems

The computational model used by NASA to visualise the surface of Venus is designed to describe a static physical condition. The other examples, in contrary, both the weather simulation program and the ship simulator, are designed to describe dynamic systems or processes. The difference between the two, however, is that the weather process is a natural process, practically without any human interference. On the other hand, the ship simulator describes the interaction between a human operator (a skipper, a pilot) and a machine (a ship). Processes such as steering a ship, flying an aeroplane, or driving a car, are examples of interactive process between a man[*] and a machine. Therefore these processes are called the Man-Machine Systems (MMS).

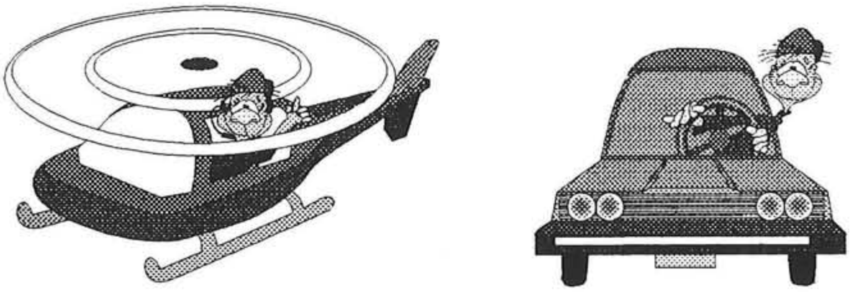


Figure 2.2
Typical Examples
of Man-Machine
Systems (MMS)

An MMS is probably the most complicated system to describe. Natural processes, such as weather or flood-and-ebb motions of the sea-level, can be described using the predictability of the nature itself. This element of predictability is practically absent when it comes to processes where humans play a crucial role. The effects of actions taken by a human operator, or the responses of the machine to the actions, can be accurately calculated. This is possible because a machine (a car, a ship, an aeroplane) is a predictable system. The actions of the human operator, however, cannot be predicted. That makes the whole man-machine system an unpredictable whole. Therefore, MMS functioning is always probabilistic[4].

The safety of a fairway is a function of not only the physical dimensions of the fairway, but also the human factor (the control dimension). This study, therefore, has to deal with the interaction between a human operator (the skipper or pilot) and a machine (the ship). These factors can be modelled either mathematically or physically and therefore there are four basic techniques to create a model[5]:

Table 2.1
Ship manoeuvring
Research methods

		physical effects	
		mathematical	physical
control effects	physical	**simulator (real-time)**	**human controlled model (real-life)**
	mathematical	**mathematical model (fast-time)**	**computer controlled model**

---

[*] "Man" in the context of this report refers to both males and females. The same applies to the terms "human operator", "pilot", etc.

2.6. Simulations: Real-time and Fast-time

There are several possible ways to study an man-machine system. One of them, as already mentioned earlier, is to simulate the process (i.e. the flight simulator). In general there are two types of MMS simulations available:

- **Real-time simulation** (See Table 2.1. Physical effects: mathematical. Control effects: physical) Under this category is the ship simulator. This simulator is equipped with a full-sized ship's bridge. The bridge, as it is the case with the real-life ship's bridge, is equipped with all kinds of instruments and facilities. The second element of the simulator is a computer that is connected to all navigational instruments on the bridge. The computer works using a mathematical model that calculates the effects of all possible changes made on the bridge. The interaction between the controller on the bridge (i.e. the helmsman or the pilot) and the computer takes place through the instruments and the third element of the simulator: surrounding image projector. The image - buoys, coast, navigation lights, etc. - is projected on a large screen that surrounds the bridge (see also [6] and [7]).

- **Fast-time simulation** (See Table 2.1. Physical effects: mathematical. Control effects: mathematical) The basic difference of fast-time simulation from the real-time simulation is that on a fast-time simulator the role of both the controller and the observer is completely played by the computer. A human observer and controller needs time to perceive the situation he is in and his responses will take time too. But when this role is played by a computer, the element of time if practically eliminated. In other words, simulations done entirely on and by a computer can be done much faster. If a real-time ship manoeuvre takes up hours, a fast-time simulation does the manoeuvre in terms of minutes or even seconds.

The differences between these two simulation techniques, and also between them and the real-life ship manoeuvre are presented and summarised in Table 2.1 and Table 2.2. Beside these technical differences there are also financial differences, as mentioned in section 2.1. These three methods are listed in that table in the descending order of costs.

This study is focused on the application of the last type: the fast-time simulations. Real-time simulations have been widely used to obtain stochastic characteristics needed for channel width design. This study is mainly designed to concentrate on the other possibility, that is the application of the fast-time simulations. Further discussions on the advantages and disadvantages of this type and the other types, both the technical and the financial aspects thereof, are left out of consideration of this project.

Table 2.2
Research Method
Overview

Research Method	**Time scale**	**Operator**	**Vessel**	**External factors**
Real-life manoeuvre	Natural	Human operator	Actual ship	Natural factors
Real-time simulation	Natural	Human operator	Computer generated	Computer generated
Fast-time simulation	Simulated	Computer operated	Computer generated	Computer generated

2.7. MMS in Fast-time Simulations

The response of a human operator to a situation is based on his perception of and estimation on the situation. When a pilot thinks that his ship is getting further away from the desired track, then his response will be correcting the course. But when he thinks that his ship is coming closer to the desired track, then his decision may be to keep its present course.

In a real-time simulation, this decision-making or control process will take place on a natural time scale. In other words, on the bridge of a ship simulator the process will basically take the same amount of time as on the bridge of a real ship.
In fast-time simulation, in the contrary, the role of the human operator has to be played by a computer. In other words, a computational model for the computer must be developed. This model, known as the *navigator,* has to describe the close loop control process which is usually done by a human navigator.

Wewerinke (1989[4]) studied this decision-making process in a dynamic man-machine system. Although this study was focused on dynamic systems in general, the research was done at the National Aerospace Laboratory (NLR), in the Netherlands. Wewerinke studied two different approaches: the optimal control model (OCM) approach and the workload model.

Wewerinke sub-divided the role of the human operator in the following functional aspects: (1) perception, (2) information processing, (3) decision making, and (4) controlling. This process of decision making is presented in Figure 2.3.

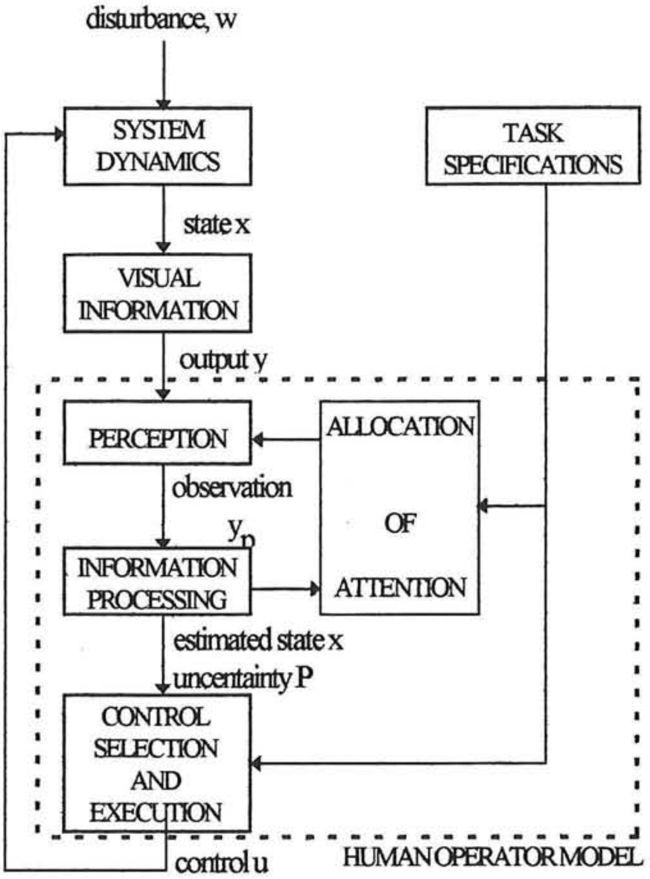


Figure 2.3
Block diagram of the Man-Machine System (MMS) model

(Source: [4])

The perception of the human operator on the bridge is based on what he sees (visual information). The output of this observation will be processed (information processing) while in the meantime he considers his objectives (task specifications). This objective might be: come closer to and follow the desired track.

The result of this process is an estimation on his present state (or position) and a decision on what action(s) to be taken (control selection) in response to that. After a decision is made, an execution follows. This whole process will then start all over again when a new state (or position) is reached. This process is then a closed loop (continuous) manual control system.

As mentioned, Wewerinke studied both the OCM and workload model to develop a mathematical description for a MMS.

- The OCM basically describes only the control task of the human operator, that means that its objective is to minimise the deviation of position to a given reference. In this process OCM, beside the regulator control behaviour, involves the operator's perception, estimation, and prediction of the present state as well.

- Because a human operator has the ability to adapt himself to a variety of workload, the workload is an important variable in the model. For a complete description of human control behaviour and its impact on overall system reliability, it is therefore necessary to assess how hard the human controller has to work to achieve a given performance level. The workload of a human operator can be assessed using the workload model. At the completion of his research, Wewerinke arrived to the conclusion that both models are capable in describing various control tasks.

Short after Wewerinke, Papenhuijzen (1994[8]) did an extensive research to develop a mathematical model for a human navigator. His research led to two different approaches: one is based on linear optimal control theory (or optimal control model - OCM) and the other one is based on the so-called fuzzy set theory.

When it comes to realistically simulating the way in which a human navigator operates rudder control, concluded Papenhuijzen, the fuzzy set model is the better model. The optimal control theory, however, has probably better potential to be developed into a system with complex planning behaviour. The latter includes significant engine speed variations and complex collision avoidance manoeuvres.

The final answer is still out so far. More research is still needed to come closer to a navigator model that resembles the performance the human navigator. The work of Papenhuijzen, nevertheless, did result in two different products.

- The first one is the so-called Complete Compatibility Reconstructor (CCR). CCR is a filter technique to reconstruct sequences of positions (states) based on a sequence of imperfect measurements (or estimations). This filter technique ensures that the estimated sequence of positions (states) is fully compatible with a given model of the system behaviour.
- The second one is an application for a personal computer, a program called COLUMBUS. COLUMBUS is in fact a stripped version of an early navigator model prototype. This computer program can be used to design, evaluate, and optimise the layout(s) of (proposed) aids to navigation (i.e. beacons). COLUMBUS turned out to be useful in the context of this study on probabilistic design of channel width as well (for further description see Chapter 3).

2.8. Scope of this Study

Ever since computers were widely available, which makes calculations of complicated systems easier to execute, research into fast-time modelling of ship's behaviour has made significant progress. In 1973, for instance, the Shipbuilding Laboratory at Delft University of Technology has developed a computer model called TRIAL (written in ALGOL 60 for IBM 360/65-256k) to calculate, among other things, vertical ship motions[9]. Barely six years later, the same Laboratory has developed another computer program, called ROUTE (written in ALGOL). This time the program is designed to calculate the natural speed, the voluntary speed reduction, and the behaviour of the ship at that speed in a seaway with head waves[10]. Less than a decade later, SHIPMA (written in FORTRAN 77 for IBM or IBM-compatibles personal computers with 640 k), which is even more complex than its predecessors, was introduced and used[5].

Despite its capability to simulate a ship manoeuvre, SHIPMA doesn't take (possible) errors in human factors into account. The fact is, 60% of accidents at sea are caused by human failure[11]. A couple of years ago, another computer model was developed, called COLUMBUS (written also for IBM or IBM-compatibles personal computers). This model is developed for RWS-AVV* and mainly focused on the stochastic of errors in human perception of distances and subtended angles between the ship and point(s) of reference (i.e. a buoy) [8/12/13].

So far, there is no mathematical ship manoeuvring model available yet, wherein the stochastic of human factors are incorporated. Therefore, fast-time simulation techniques were never used to generate stochastic to be used in the probabilistic design of channel width. This void was the main reason for this study.

In order to achieve its objective as already formulated in Chapter 1: Introduction, the emphasis of this project lies on the following questions:

- Is it possible to use fast-time simulation programs to generate the needed stochastic for a probabilistic calculation method?
- If it is indeed possible, how does it (suppose to) work?

Reinventing the wheel has never been an objective of this project, therefore attention was focused on applying already available computer models. Three fast-time simulation applications are available to and used in this study. They are:

- COLUMBUS, a simulation program of position estimation by human pilot/skipper (for further description, see Chapter 3),
- SHIPMA 4.30, a simulation program for ship manoeuvring (for further description, see Chapter 4), and
- PROSIM 3.01, a software environment to create simulation models (for further description, see Chapter 5).

Various methods have been tried out in this study (see Chapter 6) before finally a satisfactory method was found (see Chapter 7).

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* RWS-AVV : Directoraat-General Rijkswaterstaat, Adviesdienst Verkeer en Vervoer (Transportation and Traffic Engineering Research Department of the Dutch Ministry of Transportation and Public Works), Rotterdam, the Netherlands.

REFERENCES:

[1] Stelling, G.S., and Booij, N., *Computational Modelling in Open Channel Hydraulics*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, February 1994.

[2] Groenveld, Ir. R., *Service Systems in Ports and Inland Waterways*, Delft University of Technology, Delft, Department of Civil Engineering, the Netherlands, October 1994.

[3] Hunten, Donald M., *Venus (planet)*, Microsoft Encarta '95, Microsoft Corporation, U.S.A., 1994.

[4] Wewerinke, Dr.Ir. P.H., *Models of the Human Observer and Controller of a Dynamic System*, thesis for Ph.D. degree at University of Twente, Enschede, the Netherlands, 1989.

[5] Strating, Ir. J. and Koeman, Ir. J.W., *Dimensioning Access Channels: Techniques and Research Means*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 4, Section 4.

[6] Bijker, Prof.Dr.Ir. E.W., Loo, Ir. L.E. van, Massie, W.W., MSc.PE, Coastal Engineering, Volume II: Harbour and Beach Problems, *Chapter 6: Ship Manoeuvring Models*, Delft University of Technology, Delft, Department of Civil Engineering, the Netherlands, 1986.

[7] Glansdorp, Ir. C.C., *Scheepsmanoevreersimulatoren*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 5.

[8] Papenhuijzen, Dr.Ir. R., *Towards a Human Operator Model of the Navigator*, a thesis for Ph.D. degree, Delft University of Technology, Department of Mechanical Engineering and Marine Technology, Delft, the Netherlands, 1994.

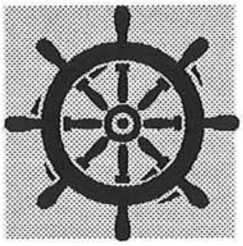
[9] Beukelman, W. and Bijlsma, (mrs) E.F., *Description of a Program to Calculate the Behaviour of a Ship in a Seaway (Named: TRIAL)*, Shipbuilding Laboratory, Delft University of Technology, August 1973, Report nr. 383.

[10] Journée, Ir. J.M.J., *Prediction of Speed and Behaviour of a Ship in a Seaway*, Shipbuilding Laboratory, Delft University of Technology, March 1976, Report nr. 427.

[11] Section 3.1.4 of [5].

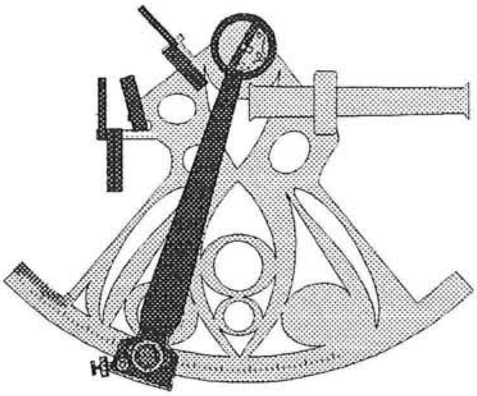
[12] Anonymous, *COLUMBUS: Simulatieprogramma positieschatting van een schipper* (short report) , Direktoraat-Generaal Rijkswaterstaat, Adviesdienst Verkeer en Vervoer, Rotterdam, the Netherlands, December 1993.

[13] Waanders, J. (Simtech BV), *COLUMBUS: Gebruikershandleiding*, RWS-AVV, Rotterdam, the Netherlands, October 1993.



3. COLUMBUS

Aids to Navigation Evaluation Program



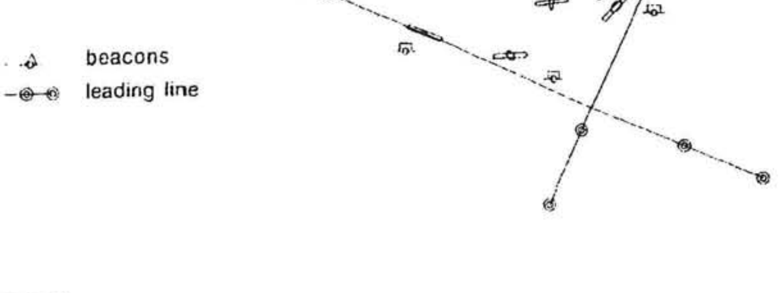
3.1 Introduction

Columbus is a simulation program designed and developed by the Transportation and Traffic Engineering Research Department (RWS-AVV[*]) of the Dutch Ministry of Transport and Public Works.

The program is designed to study the effectiveness of navigational aids, or a configuration thereof, such as buoys and beacons. The effectiveness is measured in terms of the accuracy of the skipper's estimation of the ship's position. The more effective a configuration becomes, the more accurate the skipper's estimation will be. Using information on the environment Columbus simulates the skipper's visual observation and calculates the accuracy of his estimation of the ship's position. See Figure 3.1 for a typical output of Columbus.

Figure 3.1
Typical output of Columbus program

(Source: [1])



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[*] RWS-AVV : Directoraat-Generaal Rijswaterstaat, Adviesdienst Verkeer en Vervoer, Rotterdam.

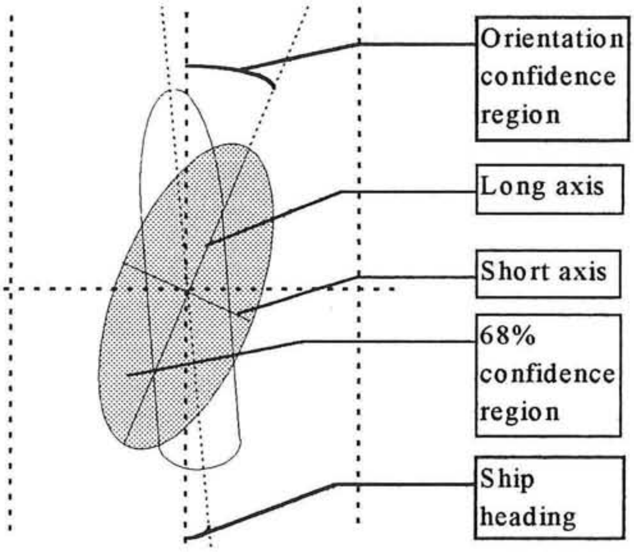
3.2 Method of simulation

In order to achieve its objective, COLUMBUS basically uses two elements: (1) the accuracy with which various navigational aids are perceived under a series of circumstances, and (2) the accuracy of position estimation, based on the result of the first one. The known correlation between the estimation errors is taken into account in determining the mathematical relation between the two elements.

From each element a set of variance of observation errors is gathered. This information is then used to determine the variance of errors in estimating the ship's position.

COLUMBUS presents the result of the calculations as a two-dimensional 68%-confidence region, which is the standard deviation. It is assumed that the distribution is normal, in both long-axis and short-axis, and therefore the area given has an ellipse form. This "egg" form (see Figure 3.2) is the origin of the program's name.

Figure 3.2
The "egg of Columbus"



In accordance to the reality, the program uses a number of so-called "observation types". An observation type is related to one point of reference, for instance a buoy. The number of these observation types is limited to the most essentials. Other person-related or situation-related aspects with marginal significance are excluded. COLUMBUS recognises the following observation types (see also Figure 3.3 and Figure 3.4):

I. determining distance to a buoy, beacon, etc.
II. determining distance to (river) banks, dams, buildings, etc.
III. range and relative bearing to a pre-defined object
IV. subtended angles between beacons on the desired track
V. subtended angles between beacons on other lines of sight
VI. reading from the compass

For each type of observation there is a widely accepted relation between the perceived value and the variance of the observation error. The accuracy of an observation is then defined as the error made in that observation. The error is assumed to be normal and defined as an average observation error with the distribution around it.

COLUMBUS presents the observation error within the 68% confidence interval. In other words, the results are also the values of the standard deviation. The use of the 68% confidence interval is based on experiments by MSCN. See also the last paragraph of this chapter. For detailed description of COLUMBUS see[2] and [3].

3.3 Things to be considered in using COLUMBUS

Before, while, and after using COLUMBUS, the user has to consider the following:

1. COLUMBUS is a static simulation program. It means that COLUMBUS doesn't work with a manoeuvring process, in other words, COLUMBUS doesn't actually have "runs". Therefore, each point is calculated independently from what has been calculated for a previous point. Each calculation is a moment and position-bound snapshot.
   This algorithm resembles the intended usage of the program, which is to simulate the skipper's estimation of the position of the ship in relation to the visible navigational aids. For this estimation, a manoeuvre doesn't seem to necessary.
   The advantage of this approach is that the user can define a roster of points along a certain track and have COLUMBUS calculate the estimation accuracy for all points. The points, however, must be indicated and calculated one at a time. It is not possible to have COLUMBUS calculate more than one point simultaneously.
   The disadvantage of the absence of the so-called *manoeuvring history* is that COLUMBUS produces relatively large values for both the long-axis and the short-axis. This will frequently lead to surprisingly high observation error, for instance 200 m.
2. Except for time (day or night) and visibility-related weather aspects (misty or clear day), COLUMBUS doesn't take into account environmental influences. It doesn't include elements such as winds, waves, and currents. Neither is ship speed.
3. Despite the fact that COLUMBUS does have a contour file, it works only two-dimensional (only on the level of water surface). Other elements, such as depth and underwater contours, are not taken into account.
4. (Potential) users are advised to use the program only in the preliminary stage of design process and to review the results only qualitatively. In other words, the results of COLUMBUS calculations are useful to obtain insight in the effectiveness of navigational aids, but not the definite measurements. The latter has to be obtained, at least for the time being, using real-time and real-life studies.

Figure 3.3
Types of simulated observation in COLUMBUS

(Source: [2])

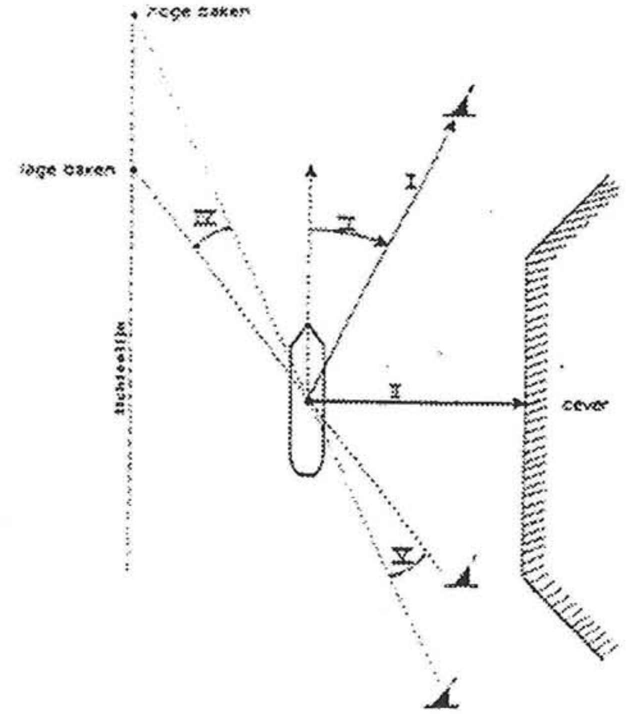
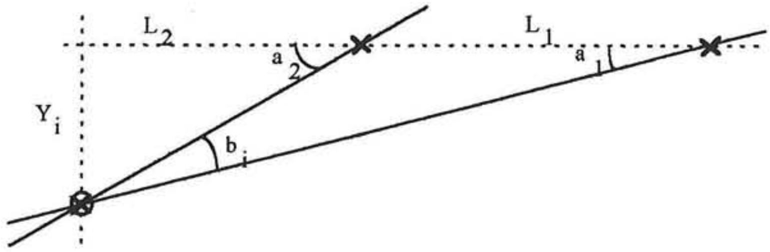


Figure 3.4
Geometry of observation of a pair of buoys



Symbol	Definition
Y_i	the y-distance of object i
L_1	the x-distance between the y-axis and buoy nr. 1
L_2	the x-distance between the y-axis and buoy nr. 2
β_i	the subtended angle to the pair of buoys to be calculated as follows: $\beta_1 = \frac{L_1 / L_2}{L_1 + L_2} . Y_i$ Equation 3.1 See also [4].
α_1	the subtended angle to buoy nr. 1 to be calculated as follows: $\alpha = \tan\left(\frac{Y}{L + L}\right) \approx \frac{Y}{L + L} \quad (\alpha \text{ small})$ Equation 3.2 See also [4]

Symbol	Definition
α_2	the subtended angle to buoy nr. 2 to be calculated in the same way as α_1.

3.4 Structure of COLUMBUS

The structure of COLUMBUS consists of four types of files: the steering file, ship file, object file(s), and contour file(s). The steering file refers to one ship file, one or more object files, and available contour file(s). See Figure 3.5. These files are kept in a working directory (workdir). One working directory can accommodate multiple steering files and ship files. It is the steering file that indicates which ship files, object file(s), and contour file(s) to use in the manoeuvre. For short description of the files, see Table 3.1.

Figure 3.5
The relation between the steering file and other files

(Source: [3])

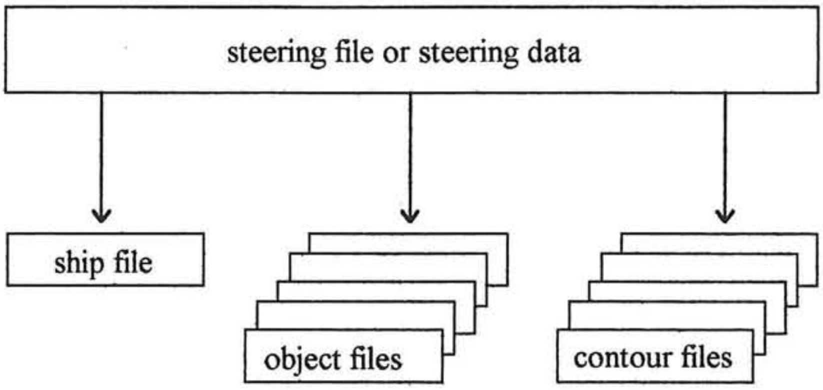


Table 3.1
COLUMBUS files

File type	Description
Steering file or steering data	The steering data's are recorded in this file. Included in the file are: 1. time of manoeuvre (day or night) 2. weather (mist or clear) 3. visibility in mist 4. number of related contour and object files
Ship file	The ship file includes the following information: 1. ship's name 2. ship length 3. ship width 4. the position of the skipper on the ship in relation to the ship's centre of gravity
Object file(s)	There are two types of object file: 1. background this facility enables the user to either enter the scanned map of the manoeuvring area or draw the outlines of the area, or even to just leave the background blank 2. navigational aids with this facility the user can enter various

File type	Description
	information, such as: a. the type and co-ordinates of navigational objects (buoys, beacons) and also the leading line b. the visibility at day, night, and by radar Each manoeuvring procedure can have one or more object files.
Contour file(s)	A scanned map has only meaning to the user. The user has to use the map to draw the so-called contour-lines, such as the river banks, that can be processed by COLUMBUS. While entering the contour-lines, the user can call up and put the scanned map at the background. A colour can be selected by the user. This is useful to distinguish one type of contour line from the other. A contour file is not always necessary, for instance for a manoeuvre in practically open sea.

3.5 Working with COLUMBUS

Before start using COLUMBUS, the user has to create or define a so-called working directory (workdir). This helps keep all related files and calculations in one place. See Figure 3.6.

The next step then is initialising a background. This is optional since the user can choose a blank background, which will be the case in open-sea manoeuvres. See also Table 3.1. The following step is to create or define the object file(s) to be used. Items such as navigational aids are to be defined in one of these files. A multiple of files can be created, especially when the user wants to study a various sets of navigational aids. An object file is compulsory.

The same can be done in the following step, which is creating or defining the contour file(s). As mentioned in Table 3.1, this is optional. A track can be divided in a number of sections, especially when the track doesn't fit well in the screen, and each section can be defined in one contour file.

The following stage is to create or define the ship file where all related information on the ship must be entered. Next is the steering file where information such as the time of simulation (day or night) has to be indicated.

After all these steps have been completed a simulation 'run' can be conducted. These steps are necessary when the project is completely new. For further study, the user can create as many files as needed within the working directory and the order of working is not necessary any more.

COLUMBUS doesn't have a file handling facility. The program can only create and update a file (entering, changing, and deleting data). Deleting, copying, and moving a file can only be done from within DOS environment.

3.6 COLUMBUS Output

COLUMBUS has the following types of output:

1. Graphic on-screen simulation

   This graphic simulation, however, only shows one "egg" at a time. When the user wants to see the graphic presentation of the results for various points along the track, he/she has to create a plot file and update it each time a new set of results, therefore a new "egg", is presented. All information, such as co-ordinates, and the results of the calculations will be presented on the list next to the graphic. The graphic itself will only show the contour, the position of the ship, and the "egg" resulting from the calculations.

2. Plot file

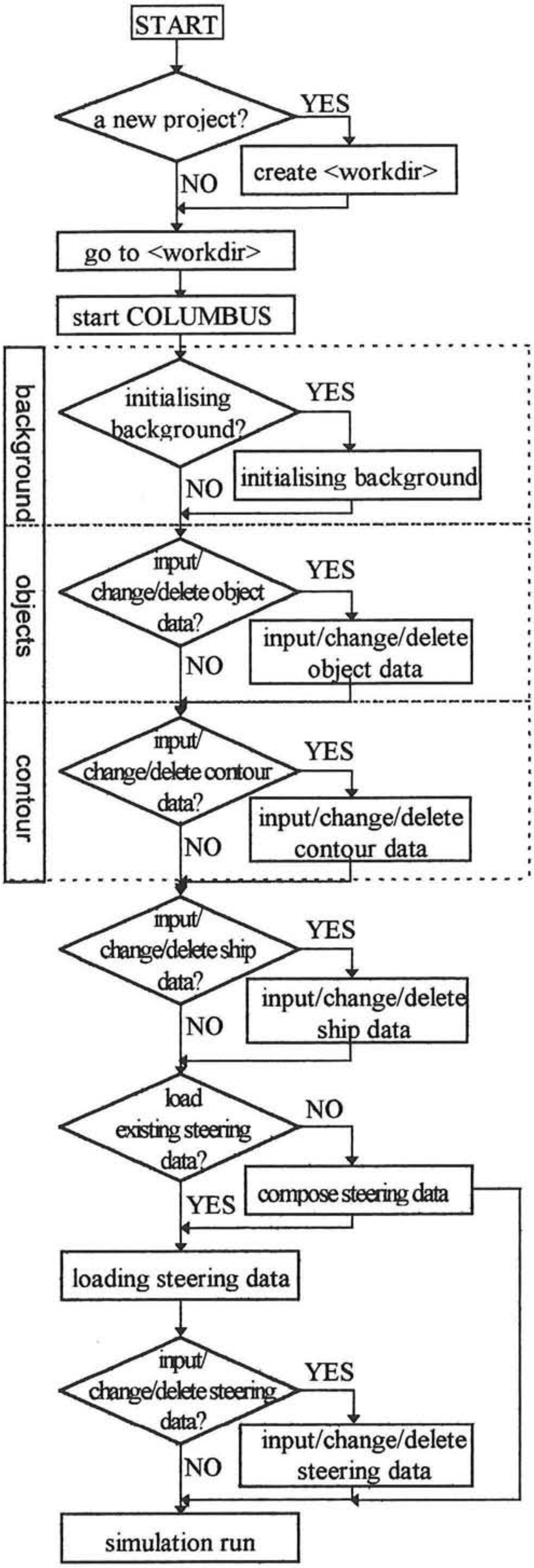
   A plot file comes handy when the user wants to have a hardcopy of the results. The plot, however, will not include any measurement or co-ordinate. It is not possible to print a graphic directly from within the program. The user will have to leave COLUMBUS first and print the plot file from DOS environment. The scanned (background) map will not be printed.

3. Print file

   A print file presents the numbers, as opposed to graphics. A print file has to be created separate from the plot file. Multiple results can be collected in one file, but they will not be presented in a table form. The results, therefore, will be printed according to the order they are sent to the file. It is then advisable that the user keeps a record of the order of calculated points. This will come handy in analysing the printed hardcopy. As it is the case with a plot file, a print file can only be printed from within DOS environment.

Figure 3.6
Flowchart
diagram:
COLUMBUS
working process

(Source: [3])



3.7 Summary of the results of study on COLUMBUS by MSCN

Commissioned by the creator of COLUMBUS, RWS-AVV, Maritime Simulation Centre the Netherlands (MSCN) Consultancy conducted in 1994 a research to quantify the errors in perceiving navigational aids that is crucial in position determination process by skippers (see [4]).

The study is concentrated on the accuracy in perceiving the following fundamental elements:

1. the distance to a bank (i.e. a dike)
2. the distance and the bearing to a single buoy (α in Figure 3.4)
3. the subtended angle of a pair of buoys (β in Figure 3.4)
4. the subtended angle of the leading line

Each element was to be observed from a number positions and angles. Each combination of position and angle is called a condition. For this study, MSCN involved four experienced bargemasters as the experimentals. At each condition, all bargemaster were asked five times to give their estimation of a distance or an angle. This is done in such a way that the estimations are independent.

The bargemasters waited on the lower deck of the ship used in the experiments, therefore they were not able to see where the ship was sailing. Each time the ship arrived to a certain position they were asked to come upstairs, one by one, to the bridge. At the bridge each bargemaster had to give his estimation of a distance or an angle. When he returned, the next bargemaster came upstairs.

To guarantee independent observations, the bargemasters were not given access to other information, such as each other's estimation and radar information. This method of experiments has also been applied by the National Maritime Research Centre, part of the US Department of Commerce's Maritime Administration (see [5]). The experiments by MSCN produced the following results[4]:

Table 3.2

With regard to	Results of the experiments
The distance to a bank	The human experimentals systematically overestimate the distance to bank. The larger the distance becomes, the larger the error gets.
The distance to a single buoy	The human experimentals systematically overestimate the distance to a buoy. The larger the distance becomes, the larger the error gets.
The subtended angle between a pair of buoys	The human experimentals systematically underestimate the subtended angle between a pair of buoys.
The subtended angle to the leading line	The human experimentals systematically underestimate the subtended angle to the leading line.

Based on these results, MSCN suggested a series of new coefficients to be incorporated in the second version of COLUMBUS.

In the contrary to the first version, in which COLUMBUS produced results in the 95%-confidence interval[3], the second version uses 68%-confidence interval and includes the new coefficients. The main reason for this adjustment is the fact that distribution of COLUMBUS numbers, in a 95%-confidence interval, appeared to be asymmetrical. The 68%-confidence interval was selected because within that interval the distribution is symmetrical, as a normal distribution should be. This adjustment was necessary to bring the results closer to the reality (see further [6]).

REFERENCES:

[1] Papenhuijzen, Dr.Ir. R., *Towards a Human Operator Model of the Navigator*, Ph.D. thesis, Delft University of Technology, Department of Mechanical Engineering and Marine Technology, Delft, the Netherlands, February 1994.

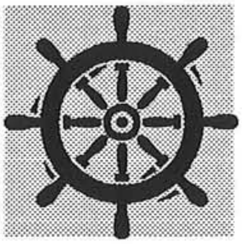
[2] Anonymous, *COLUMBUS: simulatieprogramma positieschatting van een schipper* (short report) , Direktoraat-Generaal Rijkswaterstaat, Adviesdienst Verkeer en Vervoer, Rotterdam, the Netherlands, December 1993. (Presumably by the same authors as [6])

[3] Waanders, J. (Simtech BV), *COLUMBUS: Gebruikershandleiding*, RWS-AVV, Rotterdam, the Netherlands, October 1993.

[4] Wewerinke, Dr.Ir. P.H., and Hove, Ir. D. ten, *Waarnemingsnauwkeurigheid Vaarwegmaarkeringsobjecten*, Maritime Simulation Centre the Netherlands (MSCN), Wageningen, the Netherlands, April 1994.

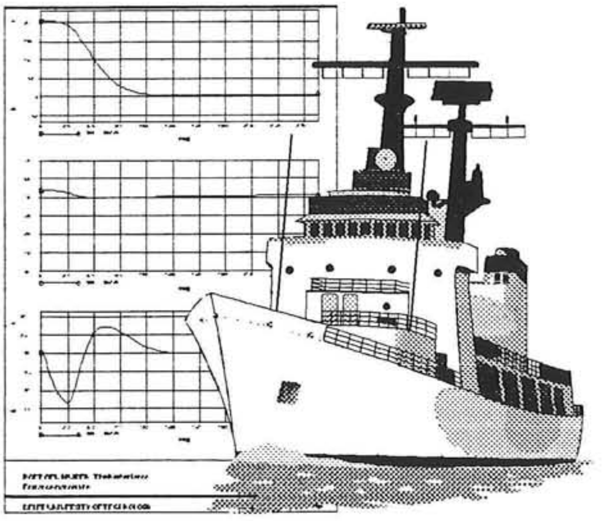
[5] Williams, K., Ph.D., *Mariner Perception of Yaw, Yaw Rate and Bearing as a Function of Ship Size and Mariner Experience*, CAORF Technical Report nr. 60-7904-01, December 1980.

[6] Kik, P. and Peters, B.M., Internal Report on Evaluation of COLUMBUS, Direktoraat-Generaal Rijkswaterstaat, Adviesdienst Verkeer en Vervoer, Rotterdam, the Netherlands, August 17, 1994.



4. Shipma 4.30

A fast time simulation program for ship manoeuvring



4.1 Introduction

SHIPMA (SHIP-Manoeuvring) 4.30 is a fast-time simulation program developed by DELFT HYDRAULICS and designed to simulate the manoeuvring behaviour of ship. For the simulation process SHIPMA involves the following influences:

1. the ship's manoeuvring characteristics,
2. the type of manoeuvre and the desired track,
3. rudder and engine actions,
4. tug assistance,
5. wind, waves, and currents,
6. shallow water and
7. bank suction

The last 4 influences are optional. Rudder, engine, and tug(s) are controlled by a combination of:

- a track keeping autopilot,
- a tug controller and
- input data as defined by the user.

All these aspects, both nautical and ship's physical, are modelled mathematically in SHIPMA. Therefore SHIPMA falls under the category of mathematical model.

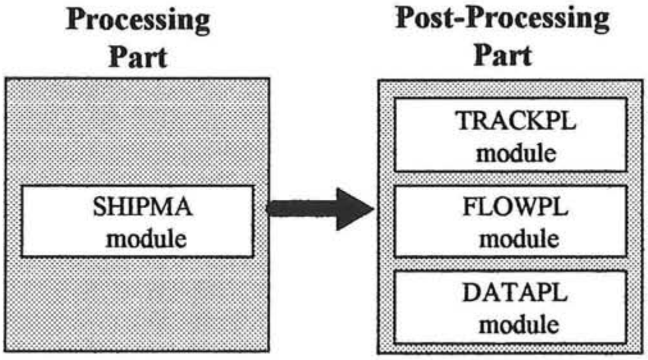
The objective of the autopilot is to manoeuvre the ship along the user-defined track. It responds to deviations from the desired track and course angle and then introduces corrections when needed. In the case of curved tracks and changes in the current-patterns, the autopilot will anticipate these changes, while taking into account a user-defined "anticipation distance".

4.2 Simulation Run

SHIPMA computes the track and course angles of the ship, the required actions for the rudder, the engine and the tugs, on time-step basis during the manoeuvre. All forces acting on the ship, the speeds, rotations, and accelarations of the ship will be determined as well. These influences will then be stored in output files. In addition, the external influences, such as the actual water depths, current velocities, wind velocities, wave heights, and tug forces, are also calculated.

Figure 4.1

Overview SHIPMA simulation process



Basically SHIPMA 4.30 consists of two parts (see Figure 4.1 above: the processing part and the post-processing part. The first part has one module, the SHIPMA module. The post-processing part has three modules: FLOWPL, TRACKPL, and DATAPL.

All four SHIPMA modules are to be operated independently in DOS-platform. It is not possible to go from one module to another without closing the earlier one first due to the fact that it does not have a "main" module from which the loose modules can be activated. The three post-processing modules, however, demand input files created by the SHIPMA module

4.3 SHIPMA Module

The SHIPMA module is the program that actually simulates the ship's manoeuvring behaviour. This module consists of the following files:

Table 4.1
Files of the SHIPMA module

File type	**Description**
*.MAN file	for general input data and description of the desired manoeuvre
*.SHP file	specifies ship dimensions and wind coefficients
*.CFT file	specifies hydrodynamic coefficients used to solve the equations of motions in the module
*.BOT file	specifies the bottom schematisation
*.CUR file	specifies the current-pattern and the water level
*.WIN file	specifies the wind pattern
*.WAV file	specifies the wave patterns and the ship-dependent wave-drift coefficients
*.BNK file	specifies the banks and the ship-dependent bank-suction coefficients
*.TUG file	for all input data for tug assistance
*.PRI file	specifies the contents of the output file, which may be both input data (up to 6 signals) and output data (up to 46 signals)
*.RUN file	a prescription of which files SHIPMA is going to use for a simulation

The *.RUN file is a convenient solution that helps user quickly specify the files SHIPMA is going to use. As shown in Figure 4.2, the *.RUN file controls the use of the other 10 SHIPMA files. Figure 4.3 shows an example of a *.RUN file.

Figure 4.2:

Data Flow in SHIPMA 4.30

(source: [1])

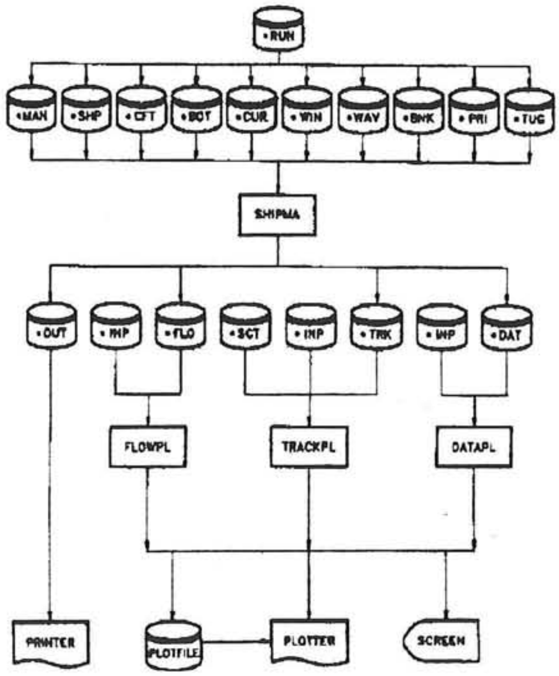


Figure 4.3
An example of a *.RUN file in SHIPMA 4.30

```
******************************************************************
**                    DEFINE INPUT FILES                        **
******************************************************************
**                                                              **
** FILE     : LC03100%.RUN                                      **
** PROJECT  : PORT OF IJMUIDEN, the Netherlands.                **
** CLIENT   : Dept. of Civil Engineering, TU Delft.             **
** COMMENT  : STANDARD .RUN FILE.                               **
**                                                              **
***** DELFT UNIVERSITY OF TECHNOLOGY **** SEPTEMBER 1995 ****
**
MAN,\SHIPWORK\IJBASICS\MANO1085.MAN
SHP,\SHIPMA\SHIPS\BUL242A.SHP
CFT,\SHIPMA\SHIPS\BUL242A.CFT
BOT,\SHIPWORK\OMGEVING\IJGEUL.BOT
CUR,\SHIPWORK\OMGEVING\IJGEUL.CUR
WIN,\SHIPWORK\OMGEVING\NO.WIN
WAV,\SHIPWORK\OMGEVING\LC090100.WAV
BNK,\SHIPMA\INPUT\NO.BNK
TUG,\SHIPMA\INPUT\NO.TUG
PRI,\SHIPWORK\OMGEVING\LOCATE.PRI
******************************************************************
```

SHIPMA 4.30 provides a large degree of freedom when it comes to the usage of files. In the *.RUN file, as shown in Figure 4.3 above, the user can specify which files and in what locations to be used. This freedom, however, demands a great care from the user in writing the *.RUN file.

4.4 The Post-Processing Part: TRACKPL, FLOWPL, and DATAPL

The post-processing modules are for the graphic presentation of the current-pattern (FLOWPL), the sailing track (TRACKPL), and the remaining results of calculations (DATAPL). With the last module a user can determine which output variables to be plotted.

As a result of the simulation the SHIPMA module produces 4 output files, they are *.OUT, *.FLO, *.TRK, and *.DAT files (see also Figure 4.2). Only the *.OUT file is an ASCII file and is directly accessible for the user. The remaining output files are not ASCII files and created to serve as input files for the post-processing modules. One for each module: *.FLO file for FLOWPL, *.TRK file for TRACKPL, and *.DAT file for DATAPL. Beside these files, each module has its own specific *.INP file. The *.INP files are to specify the graphic(s) to plot by the modules.

Next to the two files, *.TRK and *.INP, the TRACKPL module uses a third one, the *.SCT file. This file describes the contour of the ship on the track plot (Figure 4.4). The DATAPL module produces the data plot (Figure 4.5) and the FLOWPL creates the flow plot (Figure 4.6).

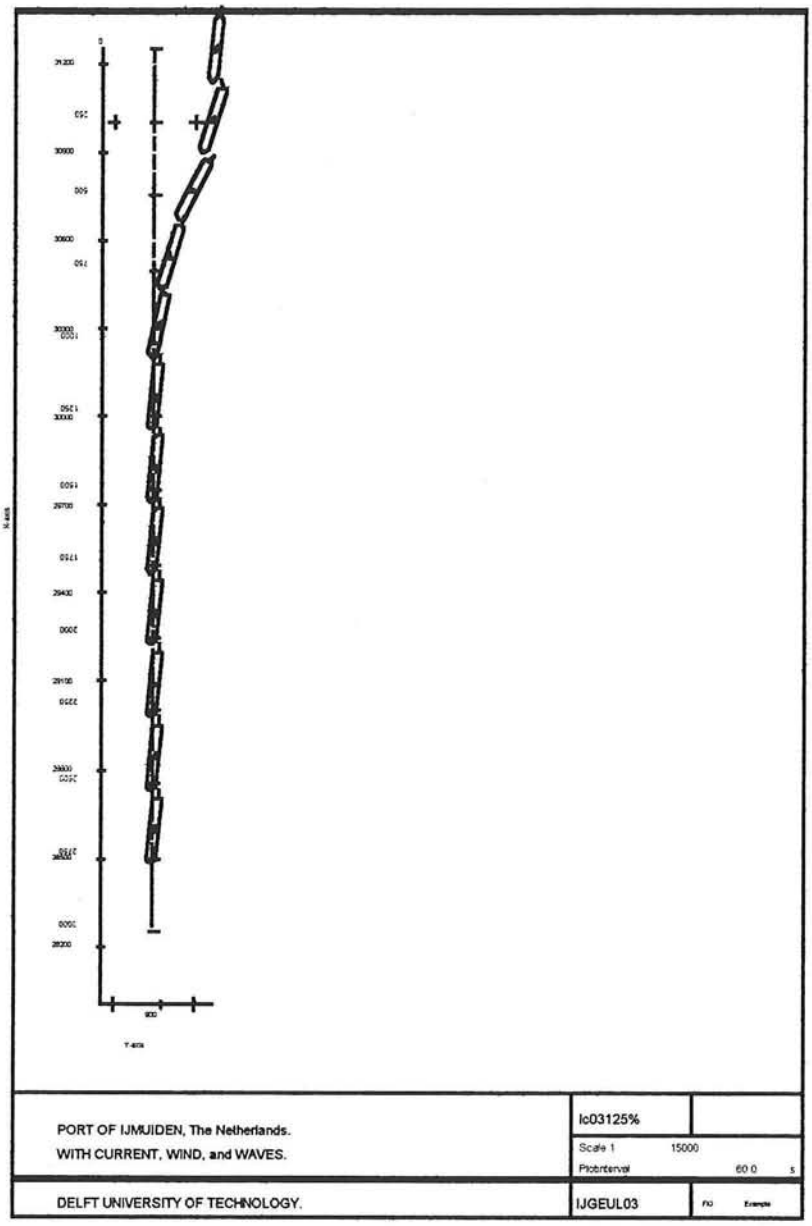


Figure 4.4 Example of a SHIPMA-trackplot

The post-processing modules produce a graphic image in one of the following three forms: (a) on screen display, (b) to a plotter, or (c) as a plot file. The last one can come handy when the user wishes to incorporate the graphic presentation in a text file. It is advisable to have a graphic program, such as Draw Perfect 1.1, to convert the plot file to a high-quality graphic file readable for a word processing program.

It is however not possible to print any output files, either an ASCII file or a plot file, from inside the program. Only when a plotter is available, a hardcopy of a plot file can be made. A user has to leave the program first before printing an output from within DOS environment.

To shortcut this complex procedure of visualising the output, instead of utilising SHIPMA's graphic facility, the user can import the *.OUT file in a spreadsheet application, for instance Quattro Pro. This is a much quicker way to obtain a graph of any SHIPMA output. When a Windows-compatible version of the spreadsheet is used, beside the speed, another advantage is that the user can easily copy and paste (or even manipulate) the graph in his/her own text. This shortcut is extensively used in this study.

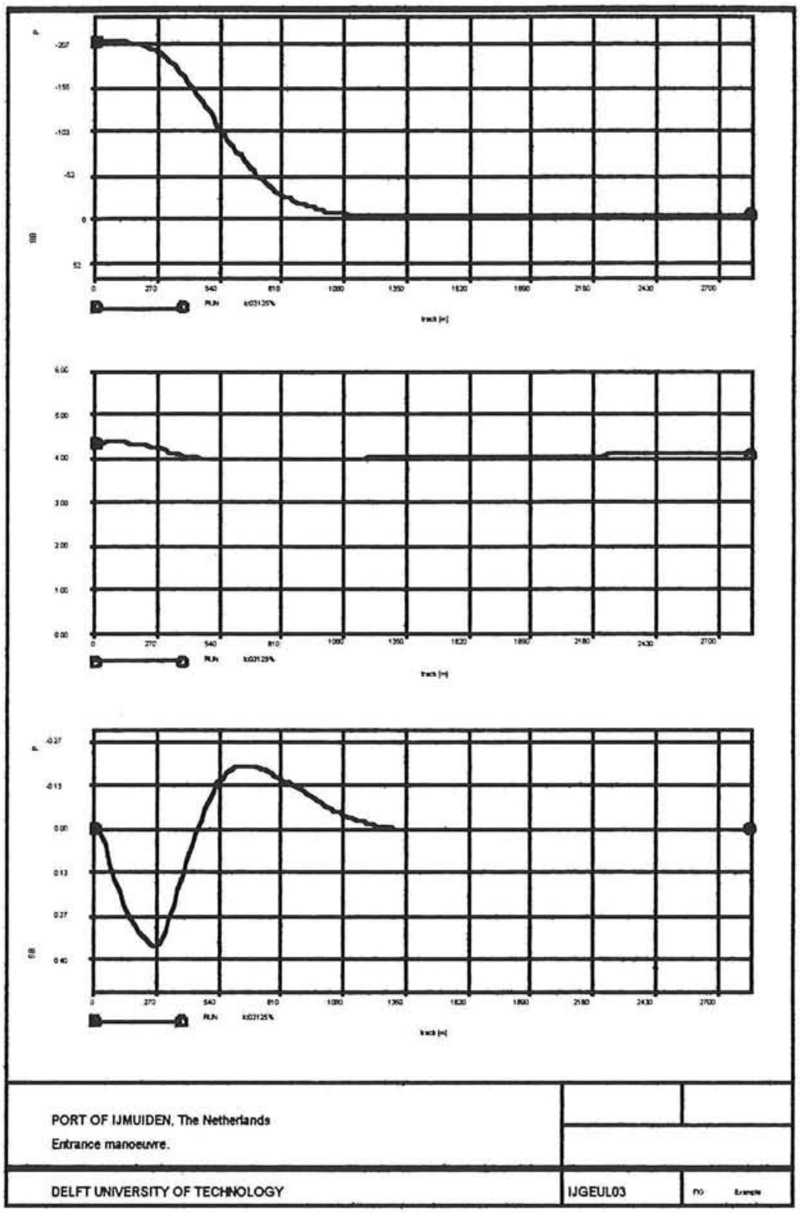
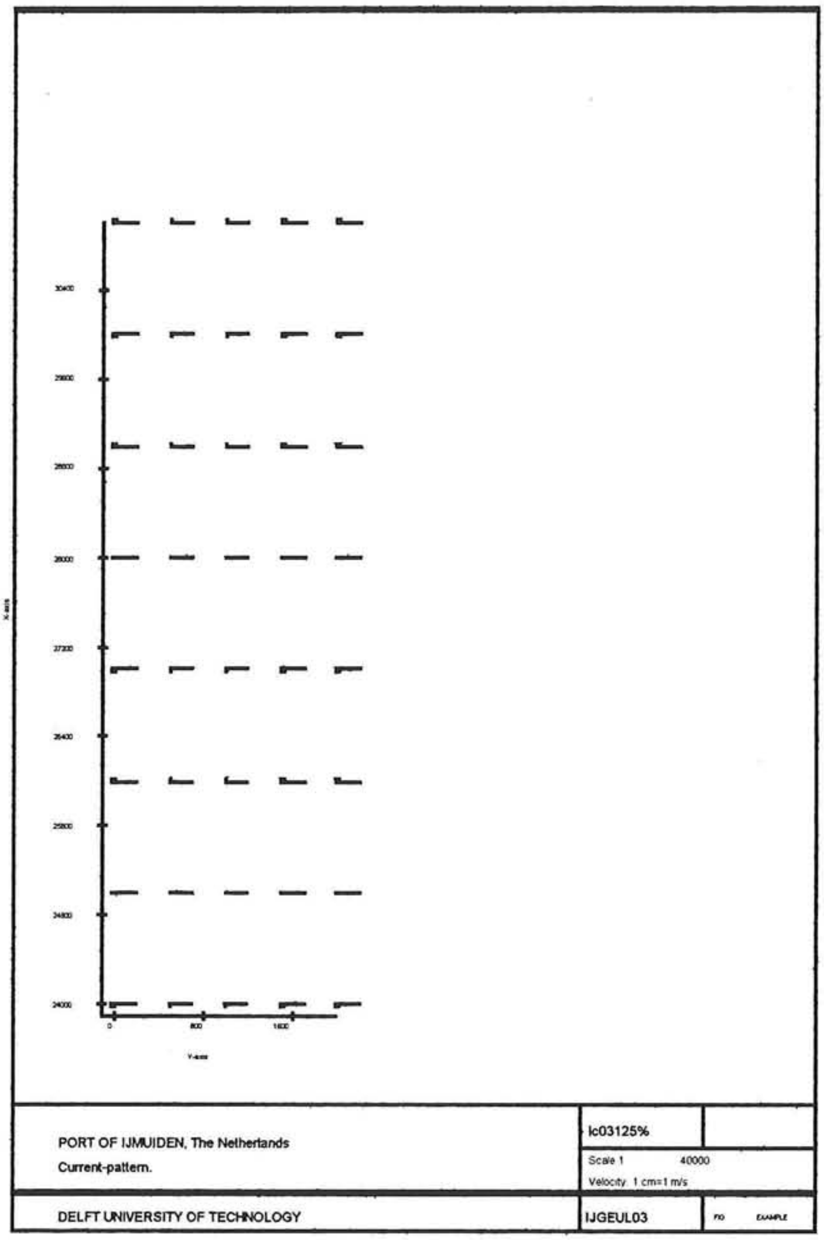


Figure 4.5
Example of SHIPMA-dataplot

Figure 4.6
Example of SHIPMA current-flow plot



4.5 Manoeuvring Control in SHIPMA

The manoeuvring role, which in reality is played by a pilot, a mate, or a skipper, in SHIPMA is shared by:

- an autopilot, which is responsible for the setting of rudder angle and propeller revolution, and
- a tug controller, which calculates desired tug forces when tugs are to be operated.

The autopilot is the main controller. The tug controller submits itself to the control strategy followed by the autopilot.

The autopilot has three different modes:

1. track-keeping
2. turning circle
3. zig-zag manoeuvre

A user can select a mode in the *.MAN file. The remaining of this part will discuss the track-keeping mode.

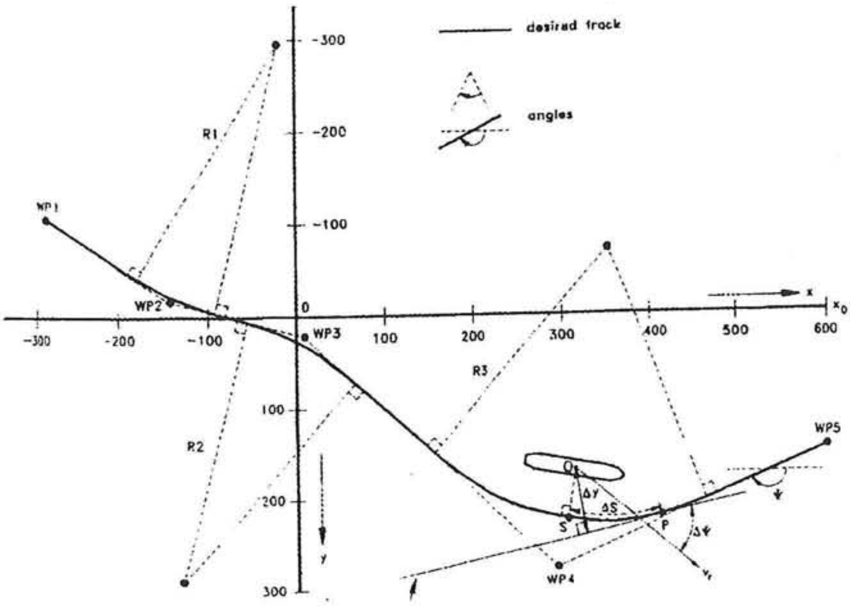
For the track-keeping mode the user has to specify the desired track. The only task of SHIPMA's autopilot is to follow this track as close as possible. The track is to define using the following steps:

1. the definition of a track consisting of straight lines
2. the specification of the radius of the bend for each transition from one straight leg to the next

SHIPMA will then calculate the interconnecting arcs between each pair of subsequent straight legs. The resulting track can be plotted by the TRACKPL module, see example Figure 4.7 below.

Figure 4.7 Definition of the desired track and conventions for autopilot description

(source: [2])



4.5.1 Autopilot

The main task of the track-keeping autopilot is to determine the rudder angle for each time-step in such a way that the deviation from the desired track is minimum.

Figure 4.7 shows an arbitrary part of a desired track and the measures that play a role in the manoeuvring process. All these measures are related to a certain point P on the track. The distance Δs, also called the "anticipation distance", represents the distance between the position of the ship and the position the controller wants to get the ship to. This anticipation distance has to be specified as input for the autopilot in the *.MAN file. The deviations are specified in:

Δψ : the difference between the tangent of the track at P and the actual earth-bound course of the ship (in Figure 4.7 is equivalent to the direction of the vessel's resulting speed)

Δy : the distance of the ship's origin (the point at the center of the ship) perpendicular to the tangent of the desired track at point P.

Furthermore, the deviations are also related to the ship length and speed. The formulation used by SHIPMA is as follows:

$$a\,\delta_d + b\,\dot{\delta}_d = c\,\Delta\psi' + d\,\Delta y' + e\,r' + f\,\Delta v_c' + g\,\dot{r}' + h \qquad \text{Eq. 4.1}$$

where:

symbol	description
a..h	autopilot parameters, specified by the user in the *.MAN file
δ_d	the 'desired' rudder angle in radians [-]
$\dot{\delta}_d$	the rate of change of δ_d [1/s]
$\Delta\psi'$	the course error = $\Delta\psi$
$\Delta y'$	the cross-track error = $\Delta y * 1/L$ with L = ship length
r'	the rate of turn (yaw rate) = $r * L/U_m$ with U_m = forward speed $\lvert u \rvert$, limited downward to $U_s/10$ and U_s = 'service speed': a constant used only for this limitation
$\Delta v_c'$	the difference between the cross-current at the actual position and the cross-current at position P = $\Delta v_c * 1/U_m$
$\dot{r}'$	yaw acceleration = $r * (L/U_m)^2$

For detailed description of the symbols see [3]).

The parameters for track-keeping mode are set as follows:
$\Delta s'$ = 1 to 2 (anticipation distance expressed in ship length)
$a = 1$
$b = 0$
$c = 8.6/(K'\,\Delta s')$
$d = 5.1/(K'\,\Delta s'^2)$
$e = 5/K'$
$f = 8.6/(K'\,\Delta s')$
$g = 0$
$h = 0$

In order to obtain these parameters a model of the dynamic response of the ship, the first order Nomoto model, is used and is defined as:

$$-K\delta = r + T\,\dot{r} \qquad \text{Eq. 4.2}$$

where: K = the gain factor
T = the time constant

From this model the following dimensionless parameters are found, for details see 3):

$$T' = T * u/L$$
$$K' = K * L/u$$

where: u = the ship speed
L = the ship length

4.5.2 Propeller Control

In contrary to the idea that the propeller revolutions are used to maintain a certain forward speed, the propeller revolutions are track related. In the *.MAN file the user has to specify one revolution value for each track section. Therefore the revolutions are kept constant until the next track section is encountered.

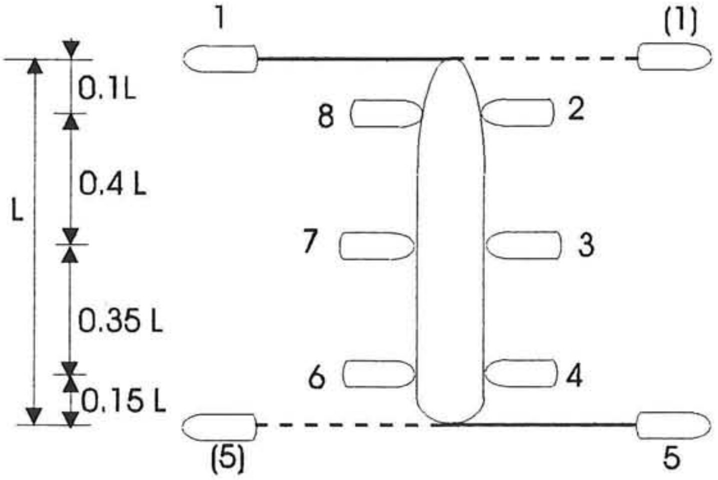
However, the autopilot has the possibility to 'ask for' some assistance from the propeller to perform certain corrections. When the rudder angle which the autopilot, based on its calculations, would like to apply exceeds twice the available maximum, a signal is sent to the propeller control. The propeller control would then set the propeller revolutions to the number of 'revolutions for power burst'. The user can disable this mechanism for the entire run

4.5.3 Tug Controller

The use of tugs is, just as the 'power burst', optional for the manoeuvring operation. The tug assistance in SHIPMA is meant only for track-keeping and not for berthing or turning. Furthermore, in SHIPMA tugs can only apply forces in the direction perpendicular to the ship's centre line. Tugs can be made fast on five positions along the ship's length, including three in the middle on port and starboard side, see Figure 4.8.

Figure 4.8 Definition of tug positions

(source: 4)



When the propeller revolutions are above n_{lim} (as maximum revolutions for tug track-keeping, also specified in the *.TUG file) track-keeping is still the responsibility of the autopilot. When the ship speed is insufficient, tug forces are applied to compensate for wind and wave forces. This compensation will only be activated if it does not counteract the momentary rudder angle.

]

When propeller revolutions decrease to less than n_{lim}, track-keeping will be taken over by the tug controller. The tug controller will then overrule a rudder setting as calculated by the autopilot. The setting, however, will not be adapted in more detail since the rudder will hardly be effective due to the low propeller revolutions.

When the tug controller is in charge, a different criterion for 'power bursts' is applied than when the autopilot is in control. The control function of the tug controller is based on the calculation of the extra yaw moment and side force that would be needed to keep the ship on the desired track. The compensation for other forces, such as wind and wave, will simply be added to those.

4.6 Mathematical Description of SHIPMA

The mathematical model of a manoeuvring ship in SHIPMA consists of a set of equations that constitute a relationship between the ship's position and velocity on two subsequent points in time. The dynamics of the manoeuvring ship are described by the rate of change of the system state, at any time, as a function of the system state itself, rudder and propeller revolution, and external influences, such as current, wind, and waves. See further also [5].

The general equations of motion in the three directions of the horizontal plane can be described as:

$$X = m\,[\dot{u} - r\,v\ - x_g r^2]$$

$$Y = m\,[\dot{v} + r\,u\ + x_g\,\dot{r}]$$

$$N = I_{zz}\,\dot{r} + m\,x_g\,[\dot{v} + r\,u]$$

Eqs. 4.3

where:

symbol	description
X	the total of longitudinal forces acting on the ship [N]
Y	the total of transversal forces acting on the ship [N]
N	the total of the yaw moments of forces acting on the ship [Nm]
m	the mass of the ship [kg]
I_{zz}	the moment of inertia of the ship around the vertical axis [kgm^2]
u	the forward speed of the ship [m/s]
v	the sway velocity of the ship [m/s]
r	the yaw rate of the ship [deg/s]
x_g	the x-position of the ship's centre of gravity [m] and a dot denoting the time derivative of the variable underneath

In the discretised model used in SHIPMA the time derivatives are defined as follows:

$$u(t+\delta t) \approx u(t) + \delta t.\dot{u}(t)$$

$$v(t+\delta t) \approx v(t) + \delta t.\dot{v}(t)$$

$$r(t+\delta t) \approx r(t) + \delta t.\dot{r}(t)$$

Eqs 4.4

These equations represent the mechanism used by SHIPMA to calculate the velocities after each time step. For the position and heading of the ship, using a moving coordinate system, the following equations are applied:

$$x(t+\delta t) \approx x(t) + \delta t.\{u(t)\cos(psi(t)) - v(t)\sin(psi(t))\}$$

$$y(t+\delta t) \approx y(t) + \delta t.\{u(t)\sin(psi(t)) + v(t)\cos(psi(t))\}$$

$$psi(t+\delta t) \approx psi(t) + \delta t.\dot{r}(t)$$

Eqs. 4.5

In SHIPMA all forces working on a ship are divided into the following categories:

Category	Forces
External forces	i.e. wind, waves, and tugs
Control forces	i.e. rudder angle and propeller revolutions
Hull forces	remaining forces when rudder angle and propeller revolution are equal to zero

In order to describe the forces, an approach taken by Abkowitz and others is applied for SHIPMA. In this approach a Taylor series expansion starting from some equilibrium is used. Since all forces related to propulsion and steering are ruled out the only available equilibrium is the ship lying still.

The series expansion reads:

$$\begin{aligned} X = {} & X_{\dot{u}}\dot{u} + X_{\dot{v}}\dot{v} + X_{\dot{r}}\dot{r} + \\ & X_u u + X_v v + X_r r + \\ & \tfrac{1}{2}\,[X_{uu}u^2 + X_{vv}v^2 + \ldots + 2X_{uv}uv + \ldots] + \\ & \tfrac{1}{6}\,[X_{uuu}u^3 + \ldots + 3X_{uuu}u^2v + \ldots + 6X_{uvr}uvr + \ldots\ ] + \text{error} \end{aligned}$$

Eqs 4.6

where a suffix means a partial derivating, e.g., $X_{uv} = \delta^2 X/\ \delta u \delta v$.

The problem of defining the functions to calculate forces is brought down to determining the values of the derivatives in Eqs 4.6 and similar equations for the Y-force and the N-moment The main contribution of Abkowitz is that he selected the most important derivatives from all possible combinations, and gave a guideline for the highest order of terms to be included in the series. In Abkowitz use is made of the following:

- non-lineair acceleration terms are zero
- interaction terms of intertial and viscous forces (e.g. $X^{\cdot}$) are negligible
- some derivatives will be zero because of the symmetrical or anti-symmetrical nature of the force component around the equilibrium state (i.e. the ship 'at rest')

The definite selection of terms depends further on (1) the type of ship, (2) the kind of manoeuvre to be described by the model, and (3) the availability (or measurability)of derivatives.

The control forces (the second category) are to be added to the hull forces to form the left-hand side of equations in Eqs. 4.3. For fixed-pitch propeller the rudder swayforce will include important parts proportional to:

- the rudder angle
- the incoming water velocity squared, yielding terms with the ship speed squared, the propeller revolutions (rpm) squared, and their cross product.

The relations will then be:

$$\boxed{Y_{rudder} = Y\delta_{uu}\delta u^2 + Y\delta_{nn}\delta n^2 + Y\delta_{un}\delta un\ (+\ldots)}$$

Eq. 4.7

where: δ = rudder angle
u = ship speed
n = propeller revolution (rpm)

and similar equations for X_{rudder} and N_{rudder}.

4.6.1 Current

Although the current can be seen as an external influence, for which an additional external force can be calculated, current is treated separately because of the important 'relative motion' concept involved and the mathematically different treatment.

Since a ship is hardly ever on a stationary course due to changes in speed and heading, and to allow not uniform current, the way to account for current is to calculate the additional forces caused by the additional flow of water along the ship. The solution is by taking the velocity relative to the water in equations Eqs 4.6 and Eq. 4.7.

Thus

$$\boxed{X_u u \text{ becomes: } X_u(u - u_c)}$$

Eq. 4.8

Terms with ship accelerations also accurs in the hull force equations and again the rate of change of the velocities relative to the water is to be substitute:

$$\boxed{X_{\dot{u}}\, \dot{u} \text{ becomes: } X_{\dot{u}}\,(\dot{u} - \frac{D}{Dt} u_c)}$$

Eq. 4.9

These current-accelerations can be calculated as follows:
From a given position, heading, and velocities, the position half a time-step backward and half a time-step forward can be easily calculated from equation Eqs. 4.5, assuming that the velocities remain the same during this time interval. At these positions the local current-velocities in the current field can be found. The difference between two corresponding current-velocities, divided by the time interval, is the estimated rate of change of the current-velocity in the middle of the time interval. That is the point for which the current-accelerations are calculated.
For more on the subject of current, see also [6].

4.6.2 Winds

The wind force is calculated based on the apparent wind velocity, which is the vectorial addition of the wind velocity and the opposite of the ship's velocity vector. Therefore even if there is no wind at all, there is always a contribution of the wind force in the manoeuvring equations.

The following describes wind forces:

$$\begin{aligned}
X_{wi} &= \tfrac{1}{2}\rho_a V_{aw}^2\, C_{xwi}(\alpha_{aw})\, A_{wx} \\
Y_{wi} &= \tfrac{1}{2}\rho_a V_{aw}^2\, C_{ywi}(\alpha_{aw})\, A_{wy} \\
N_{wi} &= \tfrac{1}{2}\rho_a V_{aw}^2\, C_{nwi}(\alpha_{aw})\, A_{wy} L
\end{aligned}$$

Eqs. 4.10

with:

ρ_a	the density of air [kg/m^3]
V_{aw}	the apparent wind velocity [m/s]
C_{xwi}, C_{ywi}, C_{nwi}	the air resistance coefficients as specified in the *.SHP file, for a number of angles of incidence α_i
α_{aw}	the angle of incidence of the apparent wind velocity V_{aw}; see Figure 4.9.
A_{wx}	the projected area of the cross-sections of the ship,

	see Figure 4.10.
A_{wy}	the projected area of the length-sections of the ship, see Figure 4.10.
L	the ship length

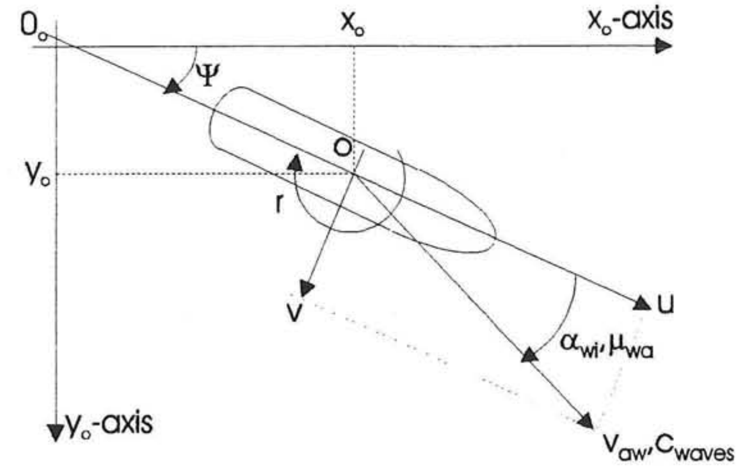


Figure 4.9 Definitions of variables

(source: [7])

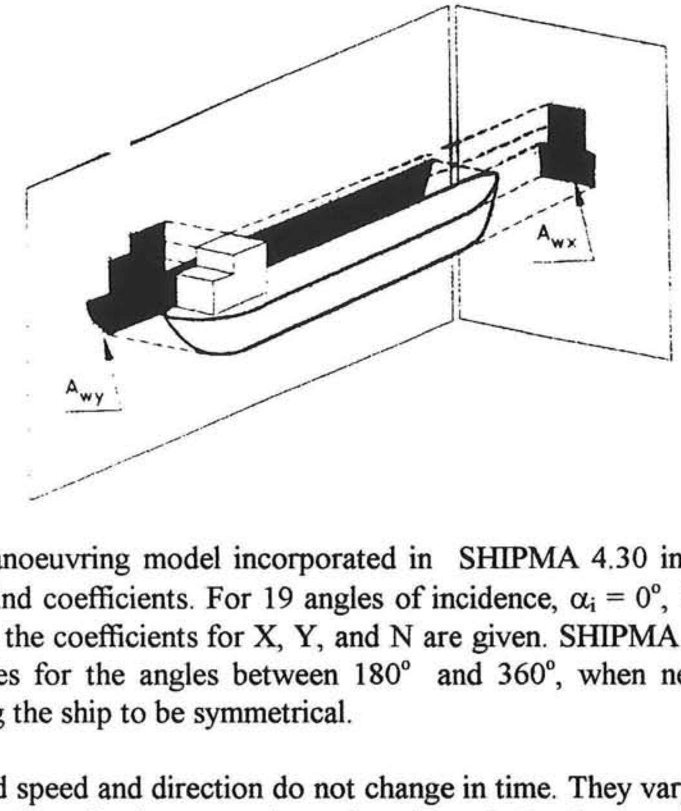


Figure 4.10 Definition of Windage Area

(source: [7])

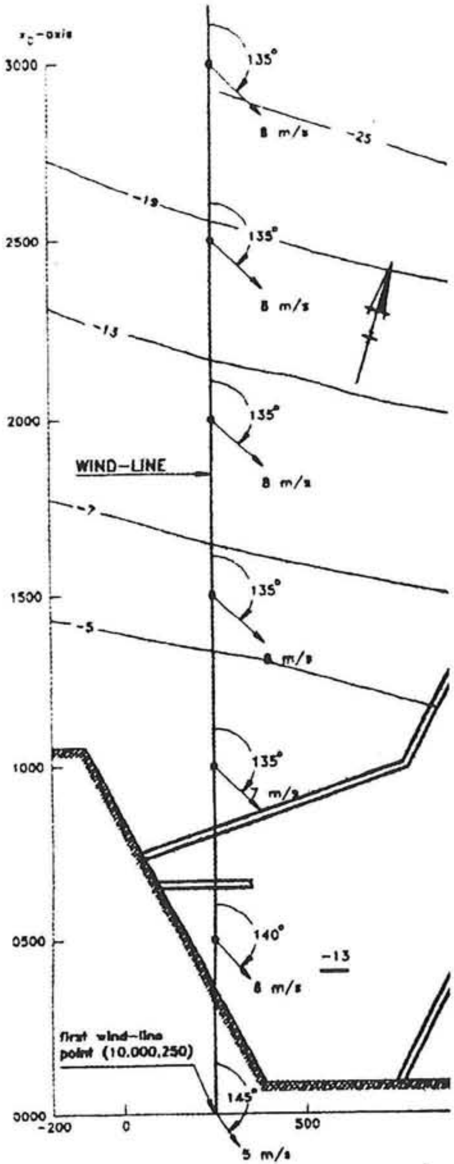
Each manoeuvring model incorporated in SHIPMA 4.30 includes a set of wind coefficients. For 19 angles of incidence, $\alpha_i = 0^{\circ}, 10^{\circ}, 20^{\circ}, \ldots, 180^{\circ}$, the coefficients for X, Y, and N are given. SHIPMA deduces the values for the angles between 180° and 360°, when necessary, assuming the ship to be symmetrical.

The wind speed and direction do not change in time. They vary only in one direction, for instance along the channel. In the perpendicular direction, for instance cross-channel, the winds are uniform. They are to be specified in the *.WIN file as a number of values along the line in the manoeuvring area. Wind speed and direction are constant along lines perpendicular to this wind distribution line, see Figure 4.11.

For more on Winds, see also [8].

Figure 4.11 Wind distribution line

(source: [9])



4.6.3 Waves

Wave forces included in the model are the second-order wave drift forces, which influence the ship's travelled path. The first-order forces averaged over a period, largely compared to the wave period itself, will yield zero. As the periods involved in manoeuvring are generally much larger than the wave periods, the first-order forces are neglected.

The magnitude of the wave drift forces is proportional to the wave height squared. The wave drift forces are defined as follows:

$$X_{wa} = H_{1/3}^{2}\ C_{xwa}(\mu)$$
$$Y_{wa} = H_{1/3}^{2}\ C_{ywa}(\mu)$$
$$N_{wa} = H_{1/3}^{2}\ C_{nwa}(\mu)$$

Eqs. 4.11

with:

$H_{1/3}$	the significant wave height
μ	the wave angle on incidence, see Figure 4.9
C_{waves}	propagation velocity of the waves, see Figure 4.9
C_{xwa}, C_{ywa}, C_{nwa}	the wave coefficients as specified in the *.SHP input file, for a number of angles of incidence μ_i

Each manoeuvring model incorporated in SHIPMA includes a set of wave force coefficients. For 19 angles of incidence, α_i = 0°, 10°, 20°, ..., 180°, the coefficients for X, Y, and N are given. SHIPMA deduces the values for the angles between 180° and 360°, when necessary, assuming the ship to be symmetrical. The actual values for μ are determined by linear interpolation between the nearest μ_i values.

The wave height and direction do not change in time. It varies only in one direction, for instance along the channel. In the perpendicular direction, for instance cross-channel, the wave heights are uniform. They are to be specified in the *.WAV file as a number of values along the line in the manoeuvring area. Wave height and direction are constant along lines perpendicular to this wave distribution line.
For more on Waves, see also [10].

4.6.4 Bank Suction

The presence of banks near the manoeuvring ship will influence the manoeuvring behaviour of the ship. As soon as the ship moves closer towards the channel boundary (the bank), the flow pattern will become asymmetrical. This results in a suction force that pull the ship even closer towards the bank. This phenomena becomes noticeable as soon as the ratio of bank height to channel depth $h_b/d > 0.4$ (see also [11] and Figure 4.13). The influence of banks and shoals is only a local effect and is modelled by adding bank suction forces to the total force acting on the ship.

For the calculation of the bank suction forces usually the distance from the ship's centreline to the isobath for half the ship's draught is taken as the determinative measure, see also Figure 4.12. The schematisation of the fairway is to be specified in the *.BNK input file.

SHIPMA uses the following formulation:

$$\boxed{\begin{aligned} X_{suct} &= X_{uvB/w} uvB / w + X_{uuu/hw} u^3 / hw \\ Y_{suct} &= Y_{uvB} \beta uv\beta + Y\alpha_{uu} \alpha u^2 + Y\alpha\alpha\alpha_{uu} \alpha^3 u^3 + Y\alpha\alpha_{uv} \alpha^2 uv \\ N_{suct} &= \mu\left\{N_{uv} \beta uv\beta + N\alpha_{uu} \alpha u^2 + N\alpha\alpha\alpha_{uu} \alpha^3 u^3 + N\alpha\alpha_{uv} \alpha^2 uv\right\} \end{aligned}}$$

Eqs. 4.12

with:

B	the ship's beam
w	the width of the channel between the bank lines
h	the mean depth of the channel

β	a blockage parameter, defined as: $\beta = .33(1\text{-}w/10B)$ if $w < 10B$, $\beta = 0$ otherwise
α	an a-symmetry parameter, defined as: $\alpha = B/w_{portside} - B/w_{starboardside}$
μ	a moment multiplication factor, specified at input

The additional resistance X is not really a 'bank suction' effect, but is due to the blockage of the channel section.

The bank lines are defined in the *.BNK file by the distance of the bank lines from the SHIPMA track at a number points along the track. SHIPMA uses linear interpolation to calculate the local channel widths. The number of points to be used depends on the geometry of the channel.

The moment multiplication factor μ is used to account for rather sudden changes in the channel geometry. The factor must also be specified in the *.BNK file at a number of points along the track.

For more on bank suction, see also [12].

Figure 4.12 Definitions for the *.BNK file

(source: [13])

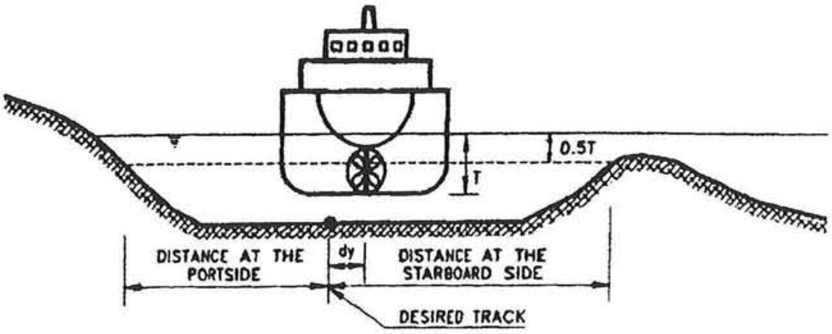
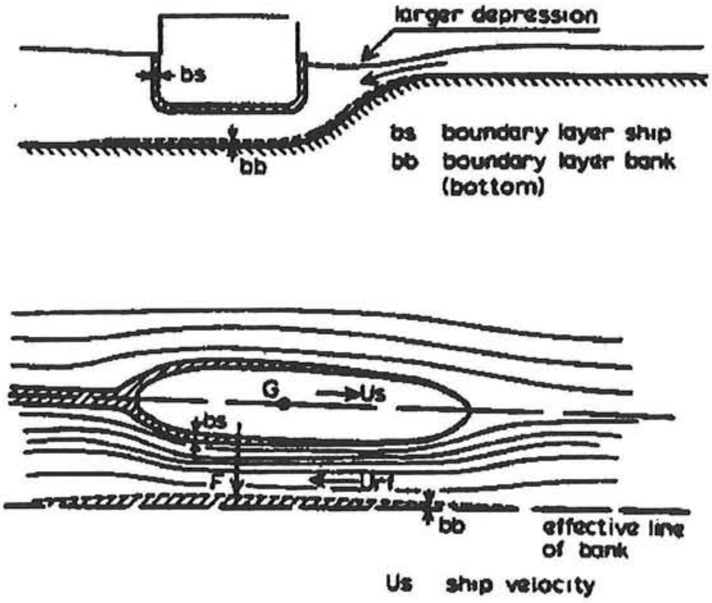


Figure 4.13 Bank-suction: asymmetric flow around a ship in a channel

(source: [14])



4.6.5 Tugs

The other elements of external forces are the tugs forces. The forces applied on the ship by tugs are treated exactly the same was as other external forces. The tug forces can only work perpendicular to the ship's centreline.

For more on tugs, see also [15].

REFERENCES:

[1] Verkerk, Freek S.H. et al, SHIPMA 4.30 User Manual, *Part A: Introduction*, Delft Hydraulics, Delft/Emmeloord, the Netherlands, October 1990.

[2] Part D, Section D.2: *Autopilot* of [1], page 3

[3] Part D, Section D.2: *Autopilot* of [1], pages 2-10

[4] Part C, Section C.2: *SHIPMA Module* of [1], page 32

[5] Part E, Section E.1 *Theoretical Backgrounds* and Section E.2 *Abkowitz' Manoeuvring Model* of [1]

[6] Part E, Section E.3: *Influence of Current* of [1]

[7] Part E, Section E.4: *External Influences on ship's behaviour* of [1], page 10

[8] Part E, Section E.4: *External Influences on ship's behaviour*, pages 9-10, and
Part C, Section C.2: *SHIPMA Module*, pages 22-24 of [1]

[9] Part C, Section C.2: *SHIPMA Module* of [1], page 24

[10] Part E, Section E.4: *External Influences on ship's behaviour*, pages 11-12, and
Part C, Section C.2: *SHIPMA Module*, pages 25-28 of [1]

[11] Strating, Ir. J. and Koeman, Ir. J.W., *Dimensioning of Access Channels: Techniques and Research Means*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 4, Section 3.

[12] Part E, Section E.4: *External Influences on ship's behaviour*, page 12, and
Part C, Section C.2: *SHIPMA Module*, pages 29-30 of [1]

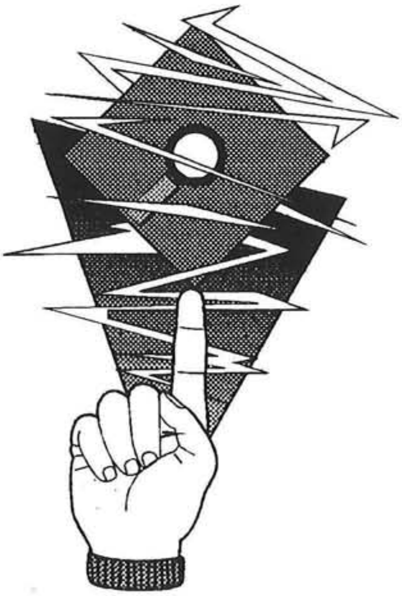
[13] Part C, Section C.2: *SHIPMA Module* of [1], page 17

[14] Figure 3.8 of [11]

[15] Part E, Section E.4: *External Influences on ship's behaviour*, page 14, and
Part D, Section D.3: *Tug Controller*, and
Part C, Section C.2: *SHIPMA Module*, pages 31-33 of [1] .

5. PROSIM 3.01

Modelling and simulation environment



5.1 Introduction

This chapter is the last one in Part I and discusses the third computer simulation program available and used in this study. First the structure of the program is briefly discussed. Then follows a number of specific tools of the program, which have been instrumental in the study.

Different from the previous two programs, COLUMBUS and SHIPMA, PROSIM is not merely a program. PROSIM is a software environment for combined discrete/continuous modelling and simulation using a personal computer. PROSIM can be compared with a programming language, such as Pascal, but it has its own environment. This environment enables the user to remain inside PROSIM to create, run, and analyse simulation models.

Furthermore, Prosim works with random processes and has virtually all widely used types of distribution as its standard functions. This was the reason why PROSIM was selected for this study.

5.2 Applied PROSIM

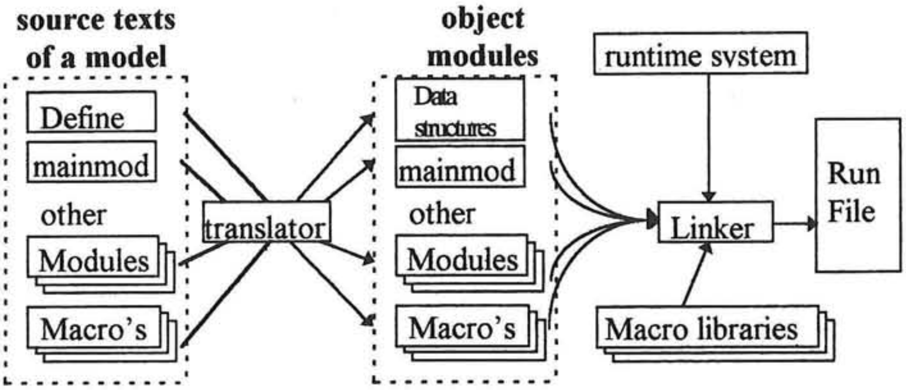
PROSIM, together with COLUMBUS, started to play a role after the first two approaches using only SHIPMA (See Chapter 6: Initial Studies). In the third approach, to be called the RandSail approach (See Chapter 7: The RandSail Approach), PROSIM plays two crucial roles:

1. PROSIM generates random numbers based on distributions produced by COLUMBUS. The random generating facilities of PROSIM will be briefly discussed later in this chapter. The random generating activities will be discussed more in-depth in Chapter 7.

2. PROSIM, thanks to its environment, is also used as the master program. This master program then utilises the information from COLUMBUS and SHIPMA in simulating a ship's manoeuvre. Chapter 7 of this report presents the setup of this combination.

For both roles, a program had to be written and run in PROSIM. For an example of a model written in PROSIM, see [1].

Figure 5.1
PROSIM process
(source: [2])



5.3 Structure of PROSIM 3.01

The PROSIM software environment for simulation consists of the following parts (for more details see [3]):

- **The Maintenance System**
  This system is basically PROSIM's "program manager" and forms the main entry to all PROSIM's subsystems, including the program writing subsystem called the Text Editor. It is also the meeting point for all subsystems where the user can leave one subsystem, say the Text Editor, and go to another subsystem, for instance the Graphics Designer. In the contrary, SHIPMA, doesn't have a maintenance system and therefore the user has to return to DOS first before being able to use another module.

- **The Prosim Translator**
  Every single part of a program written in PROSIM must be translated first before it can be included in a run. The main role of the Translator is to compile module, or a macro, of a PROSIM model into an object module (machine code). See also Figure 5.1. When a syntax error occurs, the user will be alerted and advised on the error.

- **The Text Editor**
  The Text Editor is the subsystem where the user can:
  * create and update a module or a macro of a model
  * create and update a user data file
  (a user-specified input or output file)

- **The PROSIM Linker**
  The Linker links the object modules of a model together with - for the model necessary - parts of the PROSIM Runtime System Library and the Macro Library used in the model. The linking process will then create a run-file that can be executed from within the PROSIM Maintenance System. See also Figure 5.1.

- **The File Handling System**
  This system is accessible from all subsystems within PROSIM. This enables the user to inspect and transform data files. This data handling facilities can simplify a simulation investigation considerably.

- **The PROSIM Runtime System**
  This is the brain or, as its makers call it, the 'artificial intelligence' of PROSIM. Among other things, it also performs all kinds of programming-related facilities and simulation aids, such as: input, output, and mathematical functions.

- **The PROSIM Run Control System**
  With this system the user controls a simulation run.

- **The Graphics Designer**
  The Graphics Designer is to create and update graphical objects, such as drawings and plots.

- **The Animation Designer**
  Beside static plots or drawing, a process can be animated using the Animation Designer.

- **The Statistics System**
  Statistics are a powerful tool, not only when interpreting and comparing simulation results, but also when preparing a simulation model. PROSIM Statistics combines a number of techniques for model preparation and evaluating simulation results.

- **The Regression System**
  This system conducts the regression analysis.

- **The Help Facility**
  Beside the File Handling System, this is one of the two subsystems that can directly be accessed from most subsystems. This Help

Facility consists of a two-parts screen. The one on the right shows a list of related topics and the other shows the information of a selected item from the list.

5.4
Random Generator

Random numbers in PROSIM are generated according to Lehmers method. This means that all random numbers are taken from a cycle 2^{31}-2 of 32 bit long integers. Each integer from 1 to 2^{31}-2 appears just once somewhere in the cycle.

Each number in the cycle can be obtained as a function of its predecessor. Therefore any number in the range 1 to 2^{31}-2 can be used as a starting point for a series of random numbers forming part of the cycle, without any chance of repetition. This starting number is called the *seed* of a randomstream. PROSIM itself has a default seed value. However, the seed value can also be user defined to enhance the random character of the results.

The default randomstream provides uniformly distributed numbers over the interval (0,1). The user can "reshape" the randomstream and therefore customise it to certain needs and preference. This RESHAPE facility can transform a random number to be sampled, according to one of the following distributions:

- UNIFORM
- EXPONENTIAL
- NORMAL
- GAMMASHAPE
- BETASHAPE
- UNKNOWN

For more details on these distributions see also [3].

The application of PROSIM in this study uses exclusively the normal distribution to generate the random numbers. This choice is based on:

1. the fact that the distribution of observation error produced by COLUMBUS is normal and
2. the assumption that the ship's start position is normally distributed as well.

For efficiency reasons, PROSIM draws normally distributed numbers from a standard normal distribution table. The domain of this table is the interval (-4.08,4.08).

5.5
PROSIM Statistics Tool

Using PROSIM Statistics one can run:

* statistical analysis of one series of data (Univariate statistics), or
* statistical comparison of two series of data (Compare variables)

A series of data has to be in the so-called STORESTREAM format and contained in a STORE FILE. A STORESTREAM contains only one pair of data: values of the *dependent* variable (for instance the results of the simulation) versus values of the *independent* variable (usually the simulation time).
A STORESTREAM can be created in two ways. Firstly, it can be created during the simulation by having the program store the result at each point of time in a STORE FILE. It can also be created by converting a USER DATA FILE (UDF) into a STORESTREAM. A UDF can be either an input file or an output file and both are in ASCII format. A STORE FILE is not in ASCII format, however, it can be converted into an ASCII file (a UDF) when needed. For instance when the user wants to reproduce the results in his/her report.

To activate PROSIM Statistics, the user will have to leave the run-mode first, or wherever he/she might be at a given point, and go all the way back to the very first menu, the Principal Selection. From the Principal Selection Menu the user can select Statistics.

In order to run a statistical analysis, a STORESTREAM must be submitted. In case of Univariate Statistics, PROSIM Statistics will then run an analysis on one pair of data and produce statistical information as shown in Figure 5.2 below.

Figure 5.2
An example of statistical information

```
+- PROSIM STATISTICS - FILE RUN20101 - STREAM RAAI  2  -+
+-------------------------------------------------------+
                    == BASIC STATISTICS ==
 Mean           :   47.987896   Number of entries:   100
 St. deviation  :   1.236780
 Mn. deviation  :   1.045647    Minimum :
 Skewness       :   -0.125360   Maximum :
 Alt. Skewness  :   -0.000460   Range   :
 Kurtosis       :   1.988523    Midrange:

Confidence intervals for the mean:
                      90% (  47.782 -   48.194)
                      95% (  47.742 -   48.234)
Correlation according to the independant
        Linear (Pearson): Independant series is constant
        Rank (Spearman) :
        Lags (max=  39) :   20
                      Percentiles
 10.000  46.355713  Median: 47.988464  90.000 49.686340
```

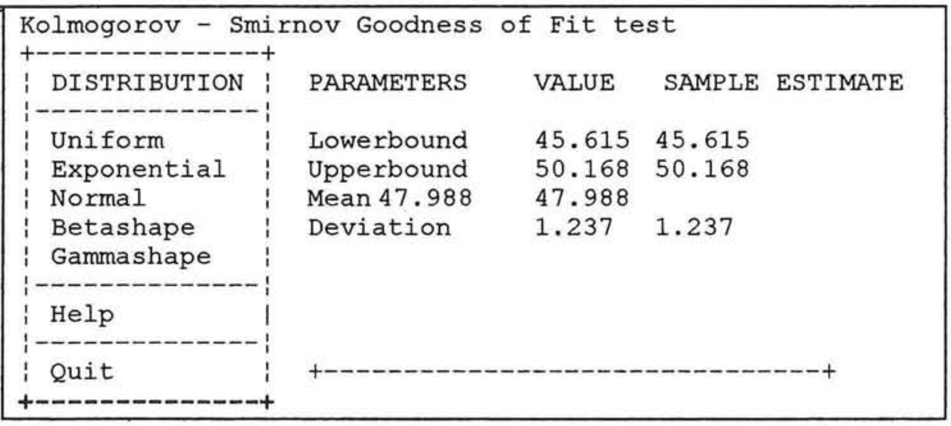
At this point the user can obtain additional information about the STORESTREAM using the following three options (see also [4]):

- CORRELATION: This is to display data on the pseudo auto correlation of the series.
- KOLMOGOROV-SMIRNOV goodness-of-fit test. This is to figure out in what way the data are distributed (For more on this test, see also [5]).

Another goodness-of-fit test is the CHI-square test (see also [6]/[7]/[8]), but it is not included in PROSIM.

- PERCENTILES. This is a handy tool to obtain more insight about the ordering of the data distribution.

Among these options, the Kolmogorov-Smirnov goodness of fit test has been used the most. This test shows in what distribution the results fit best. As the user selects this option, he/she will get to see the following screen (Figure 5.3) and asked to select a distribution.



```
Kolmogorov - Smirnov Goodness of Fit test
+--------------+
¦ DISTRIBUTION ¦   PARAMETERS    VALUE   SAMPLE ESTIMATE
¦--------------¦
¦ Uniform      ¦   Lowerbound    45.615  45.615
¦ Exponential  ¦   Upperbound    50.168  50.168
¦ Normal       ¦   Mean 47.988   47.988
¦ Betashape    ¦   Deviation     1.237   1.237
¦ Gammashape   ¦
¦--------------¦
¦ Help         |
¦--------------¦
¦ Quit         ¦   +------------------------------+
+--------------+
```

Figure 5.3
An example of selection of Kolmogorov-Smirnov

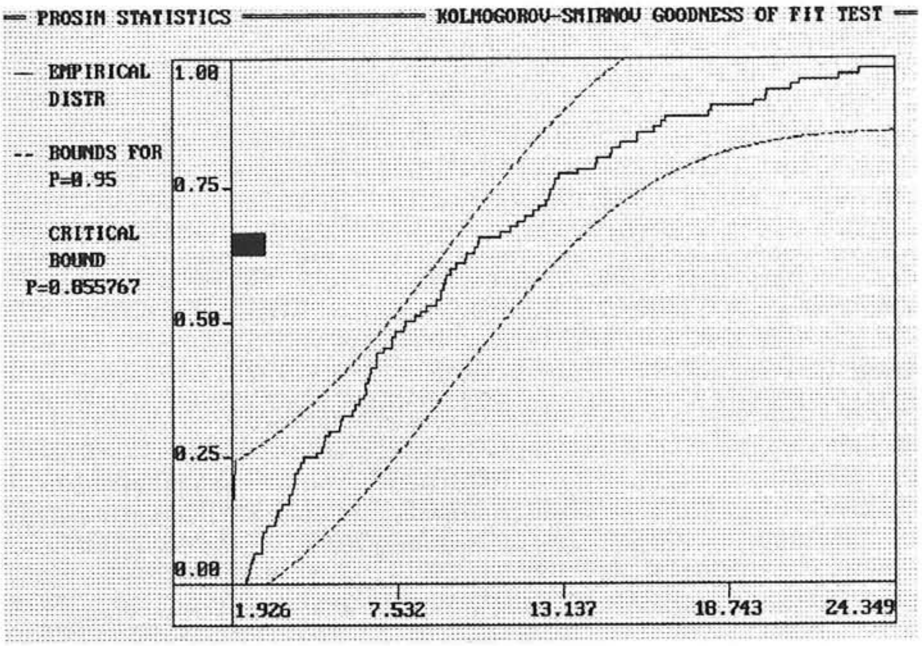
As shown, this goodness of fit test recognises the following five distributions:

- uniform
- exponential
- normal
- betashape
- gammashape

After having selected a specific distribution, in this case the Normal distribution, PROSIM Statistics will show the following graph on-screen (Figure 5.4) to show how well the data fit the selected distribution. This graph shows (on the top left corner):

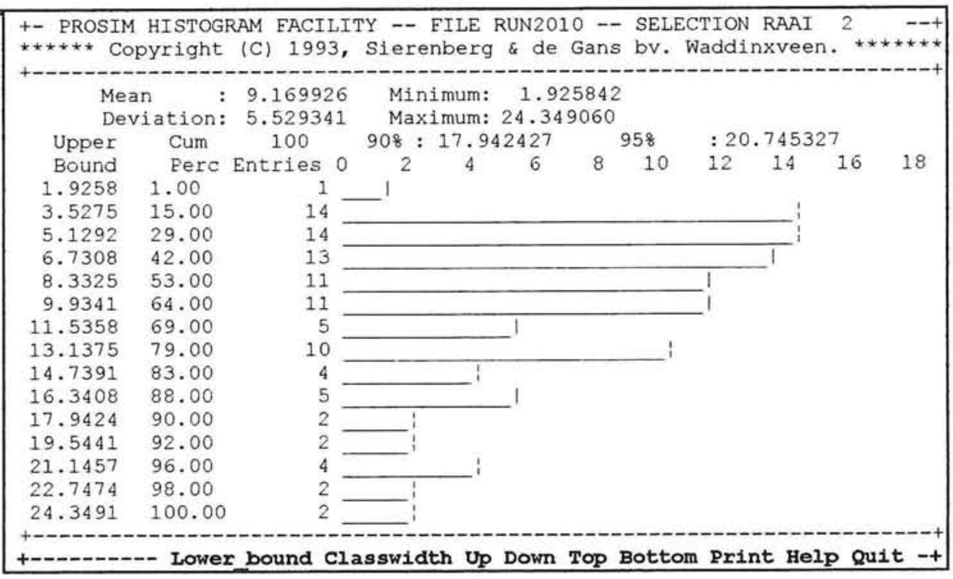
- the empirical cumulative distribution of data (the straight line),
- the upper and lower limit of the 95% confidence interval around the selected distribution (the dotted line), and
- the critical bound p (a value near to zero indicates a good fit)

Figure 5.4
An example of the result of the Goodness-of-Fit test (Kolmogorov-Smirnov)



Beside these statistical tools, a STORESTREAM can be directly analysed after each run is completed. In other words, for this objective the user doesn't have to leave the run-mode. When a STORESTREAM is analysed using the so-called Stream Handling facility, PROSIM will show the cumulative distribution of the data as shown below (Figure 5.5). This figure is a slightly different presentation (rotated 90 degrees clockwise) from the previous one (Figure 5.4).

Figure 5.5
An example of PROSIM Histogram



```
+- PROSIM HISTOGRAM FACILITY -- FILE RUN2010 -- SELECTION RAAI  2     --+
****** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *******
+-----------------------------------------------------------------------+
       Mean      : 9.169926   Minimum:  1.925842
       Deviation: 5.529341   Maximum: 24.349060
   Upper     Cum      100    90% : 17.942427      95%     :20.745327
   Bound     Perc Entries 0    2    4    6    8   10   12   14   16   18
   1.9258   1.00        1 ___|
   3.5275  15.00       14 ___________________________________¦
   5.1292  29.00       14 ___________________________________¦
   6.7308  42.00       13 ________________________________|
   8.3325  53.00       11 ___________________________|
   9.9341  64.00       11 ___________________________|
  11.5358  69.00        5 ____________|
  13.1375  79.00       10 _________________________¦
  14.7391  83.00        4 __________¦
  16.3408  88.00        5 ____________|
  17.9424  90.00        2 _____¦
  19.5441  92.00        2 _____¦
  21.1457  96.00        4 __________¦
  22.7474  98.00        2 _____¦
  24.3491 100.00        2 _____¦
+-----------------------------------------------------------------------+
+---------- Lower_bound Classwidth Up Down Top Bottom Print Help Quit -+
```

5.6 (Im-) Practicalities of PROSIM

When it comes to output, the following might come handy to know:

1. One STOREFILE can only consist of a maximum of one independent and one dependent set. Therefore, it is not possible to directly

create a comparative graph where more than one set of samples (or results) are compared. In order to create a more suitable graphic file, the user must leave the model first, return all the way to the Pincipal Menu. From there the user can select the Animation Designer and then merge the various STOREFILES into one file. The nieuw file will not be suitable for a statistics tool any longer.

2. The statistics tools are quick and magnificent. On any standard PC PROSIM is able to produce statistics in a fraction of a second. Working with a spreadsheet to process PROSIM output in order to generate statistics will certainly provide a much nicer-looking graphs, but it takes too much time. Depending on the size of the samples, it may take at least 10 minutes. The use of spreadsheet is therefore not advisable to create statistics.
   PROSIM Statistics Tools, however, include only one type of goodness-of-fit test (Kolmogorov-Smirnov). When the user wishes to use other type of test, for instance the CHI-square, it is then advisable to use a spreadsheet application.

3. All user-defined-files (UDF), including input-files and output-files, are of ASCII type and therefore can be directly imported to and manipulated in a spreadsheet or word-processing applications. Other type of files, for instance *.sto (STOREFILE) and a macro file, can also be imported to or manipulated in other applications, but they must be transformed into ASCII files first. This possibility is highly recommended towards various ends except for statistical functions covered by PROSIM Statistics Tools.

REFERENCES:

[1] Groenveld, Ir. R., *Service Systems in Ports and Inland Waterways*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, October 1994, Appendix II.

[2] Sierenberg & de Gans bv, *PROSIM User Guide*, Waddinxveen, the Netherlands, 1993, page 2.

[3] Chapter 1, pages 1-5 of [2].

[4] Chapter 11, pages 105-108 of [2].

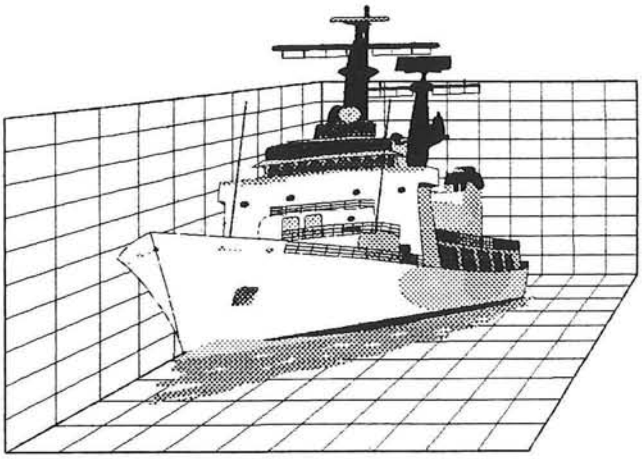
[5] Section 7.3, pages 85-86 of [1].

[6] Section 7.3, pages 84-85 of [1].

[7] Spiegel, Murray R., *Schaum's Outline of Theory and Problems of Probability and Statistics*, Schaum's Outline Series, McGraw-Hill, Inc., New York, NY, U.S.A., 1994, pages 217-219.

[8] Soest, Ir. J. van, *Elementaire Statistiek*, Delftse Uitgevers Maatschappij, Delft, the Netherlands, 1985, pages 166-168.

6. Initial Models



6.1 Introduction

This study aims to develop a method for probabilistic design of the required width of entrance channels using fast-time simulation programs. As it is with simulator studies using human operators, also known as real-time simulations, a sufficient number of runs had to be conducted. They are crucial to obtain insight into the stochastic distribution of ship's positions along the cross-section of the channel. Towards that end it is necessary that the runs, using the fast-time simulation programs, produce arbitrary manoeuvres along the desired track, as it is the case with human operators.

Initially the study is conducted using only SHIPMA 4.30 simulation program to create ship manoeuvres under various conditions. This was the case with the first two approaches, see further paragraphs 2.3 and 2.4. Later on it became apparent that SHIPMA manoeuvres had to be complemented with other programs that would be able to introduce the stochastic aspects of ship manoeuvres.

For the third and last approach, see the next chapter, two other programs were used: COLUMBUS and PROSIM 3.01. The first one is a program that simulates the position estimation by a skipper. The latter is a software environment for combined discrete/continuous modelling and simulation.

6.2 Environmental conditions

For the study, the entrance channel to the Port of IJmuiden, the Netherlands, has been selected as the test case. See map in Figure 6.7. The channel is further also to be referred as IJgeul. This selection is based on the following arguments:

- The entrance channel is basically long and straight which makes it possible to keep the manoeuvres simple. Bends along the track will complicate the manoeuvres.
- The entrance channel has virtually constant depths over a long distance.

The dimensions of the IJgeul are as follows:

Table 6.1
IJgeul dimensions

Source: [1]

	Channel section (distance set from the harbour entrance)		
Dimensions	**section 1** (0-5 km)	**section 2** (5 - 10 km)	**section 3** (10 - 23.2 km)
Length	5000 m	5000 m	13200 m
Width	450 m	450 m	450 m
Depth	18.88 m	18.88 m	19.33 m

The environmental conditions of the IJgeul are as follows:

Table 6.2
IJgeul environment

(June 22, 1994)
(source: [2])

	Direction	**Velocity**
Wind	South West to West	between 6 and 7 Bft (22 to 33 kn or 11 to 17 m/s)
Waves	South West to West	
Current	North to South and v.v.	between -1 to 1 m/s

The wave forces are distributed as follows:

Table 6.3
Wind forces

(source: [3])

Force (% of average.)	**Minimum duration**		
	1 sec.	**30 sec.**	**60 sec.**
50%	2549	1356	946
75%	1950	889	403
100%	1465	368	67
125%	1072	132	0
150%	796	0	0
175%	555	0	0

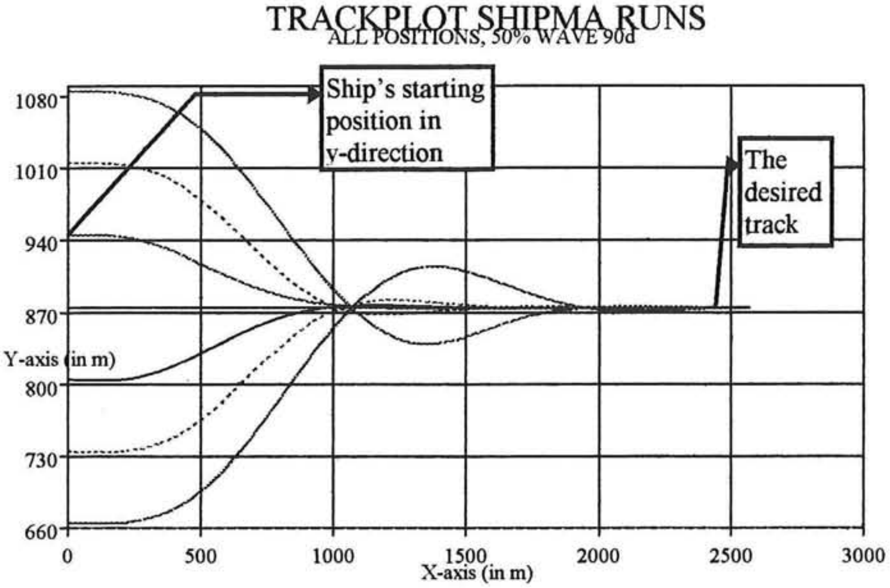
6.3 The Ship

The largest ship, the bulk carrier, to enter the Port of IJmuiden is selected to be the model ship for the study. With the following dimensions [4]:

Length (L_{oa}) : 225.0 m
Beam (B) : 32.2 m
Draught (T) : 12.0 m
DWT : 58750 ton
Service speed (v) : 13.5 kn

Figure 6.1
A trackplot of a variety of SHIPMA runs

W.direction: 90°
W.force: 50%



6.4 Basic Setup

For this study, there are three important variables. They are (1) the starting position of the ship, (2) the direction of the waves, (3) the wave forces, (4) the direction of the wind, and (5) the direction of the current. Based on these three variables, the ship manoeuvring runs are categorised as follows:

1. ship's start position over the channel width
   - y = 665 m (deviation 210 m to the left of the middle line)
   - y = 735 m (deviation 140 m to the left of the middle line)
   - y = 805 m (deviation 70 m to the left of the middle line)
   - y = 875 m (the middle line)
   - y = 945 m (deviation 70 m to the right of the middle line)
   - y = 1015 m (deviation 140 m to the right of the middle line)
   - y = 1085 m (deviation 210 m to the right of the middle line)

   (see also Figure 6.1)

2. variety in waves incoming direction
   - 90° (perpendicular to the middle line)
   - 270° (perpendicular to the middle line)

3. variety in wave forces
   - 0% of wave force
   - 50% of wave force
   - 75% of wave force

   - 100% of wave force
   - 125% of wave force

4. variety in wind's incoming direction
   - 90° (perpendicular to the middle line)
   - 270° (perpendicular to the middle line)

5. variety in current's incoming direction
   - 90° (perpendicular to the middle line)
   - 270° (perpendicular to the middle line)

For the influence of the wind and current, due to the limited available information, the maximum velocity has been selected.

In total there are up to 70 possible run-combinations (Table 6.4).

Table 6.4

List of SHIPMA runs								
Wave		Start position ship in y-direction (in m)						
dir.	force	665	735	805	875	945	1015	1085
90 deg	0%	a0000665	a0000735	a0000805	a0000875	a0000945	a0001015	a0001085
	50%	a0500665	a0500735	a0500805	a0500875	a0500945	a0501015	a0501085
	75%	a0750665	a0750735	a0750805	a0750875	a0750945	a0751015	a0751085
	100%	a1000665	a1000735	a1000805	a1000875	a1000945	a1001015	a1001085
	125%	a1250665	a1250735	a1250805	a1250875	a1250945	a1251015	a1251085
270 deg	0%	b0000665	b0000735	b0000805	b0000875	b0000945	b0001015	b0001085
	50%	b0500665	b0500735	b0500805	b0500875	b0500945	b0501015	b0501085
	75%	b0750665	b0750735	b0750805	b0750875	b0750945	b0751015	b0751085
	100%	b1000665	b1000735	b1000805	b1000875	b1000945	b1001015	b1001085
	125%	b1250665	b1250735	b1250805	b1250875	b1250945	b1251015	b1251085

6.5 Approach 1: Uniform Wave field

In studies on the required channel width, the main concern, most of the time, is to calculate the maximum width in such a way that it is both economical to build and safe for ships. One way to do that is to find out what the most extreme position of a ship can be.

In the first approach, it is assumed that external influences, such as winds, waves, and currents, will all come from the same direction. Therefore the name: uniform wave field.

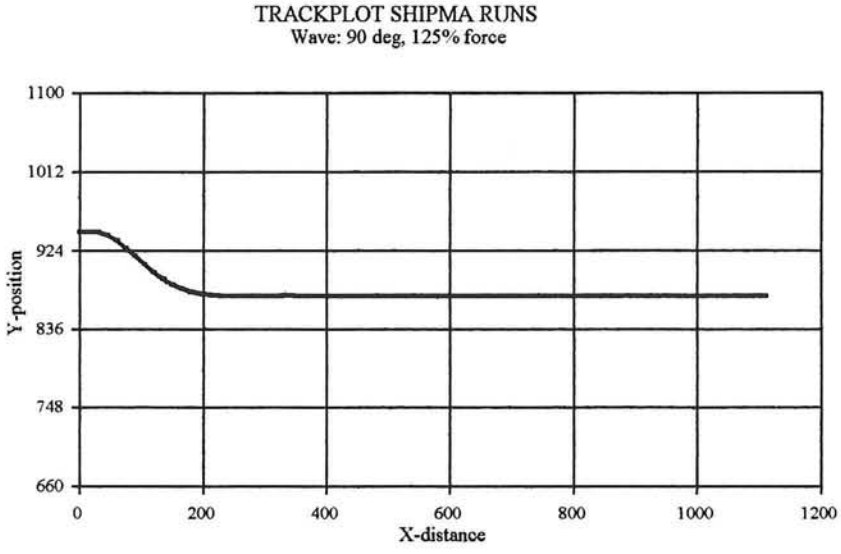
6.5.1 Setup

To begin with, it is assumed that en extreme position along the track is a result of an extreme start position of the ship. The first approach employed in this research is to deliberately put the ship at positions deviating from the desired track, including two extreme positions close to the channel's (underwater) edges. For an example of one extreme position, 210 m deviated from the desired track and 15 m from the edge, see Figure 6.1 and Figure 6.2.

Since a manoeuvre can be strongly affected by external influences such as waves, winds, and currents, it is assumed that the strongest influence will take place when the these three elements are in the same direction, perpendicular to the track (North-South or South-North). For wind and current, the maximum known velocity is selected. For the waves, a variety of 5 wave forces is used. This approach didn't expand the number of possible run-combinations since the influence of the wind and the current is simply added to the basic set (Table 6.4).

Figure 6.2
Example of
trackplot of
SHIPMA run

Direction: 90°
W. force: 125%



6.5.2 Results

The results of this uniform wave field approach are:

1. This approach, however, didn't produce the desired result.
    a. First of all, except for the extreme starting position, the ship has hardly ever come to a position much further from the desired track. The reason is: the main objective of the autopilot to bring the ship towards the desired track, therefore the ship's position will always be brought closer to the track.

    b. In the second place, a SHIPMA manoeuvre is a fixed manoeuvre that depends only on the selected set of input. In other words, the time and the frequency a run is executed will not change the manoeuvre and will only result in a number of identical manoeuvres. It doesn't matter whether the run is conducted today or tomorrow, or whether 10 or 100 runs are conducted, the results are always exactly identical manoeuvres.

2. The results also show that winds and currents appeared to have practically insignificant effect on the manoeuvres. The reasons might be:
    a. the maximum velocity of both wind and current is not high

enough to affect a ship's manoeuvring process
b. the selected ship type, the bulk-carrier, is not sensitive enough to the influences of wind and current

6.5.3 Conclusions

Based on these results, the following conclusions can be made:

1. The only way to diversify the manoeuvres is to alter one input element for every single sun. For instance, using slightly different rudder angles for all runs. This kind of alterations, however, will only result in slightly different manoeuvres.

2. Furthermore, changing an input element, no matter how insignificant it might be, will not create a set of random results. It may be useful for a sensitivity analysis, as to see what effect certain (slight) alterations may have on the results. But without the stochastic character, this approach is not appropriate for this study.

3. The role of wind and current can be excluded for the remainder of this study. This will further simplify the variables.

6.6 Approach 2: Non-uniform wave field

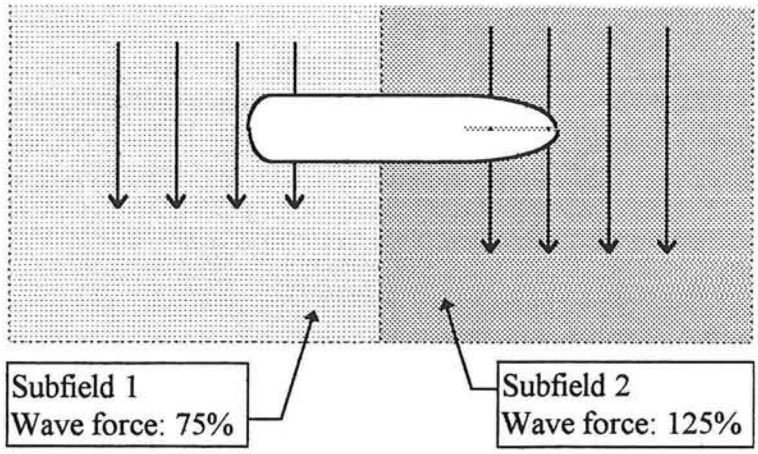
In real-time simulations and in real-life manoeuvres, another element plays a crucial role, beside the external influences. That element is the errors made by skippers in estimation their position. These errors will then create the so-called 'noise' in the manoeuvring process. Therefore a manoeuvre will not be as smooth as it can be seen from the results of the previous approach.

This 'noise' must be seen in a manoeuvre. The question is: in what way can such noise be created. One possible approach is by introducing a non-uniform wave field where waves of different forces can influence a ship's manoeuvre. To enhance the effect, non-uniform also includes introducing waves of opposite directions in one wave field. The latter may not seem to be realistic, however, this may create the right noise effect.

6.6.1 Setup

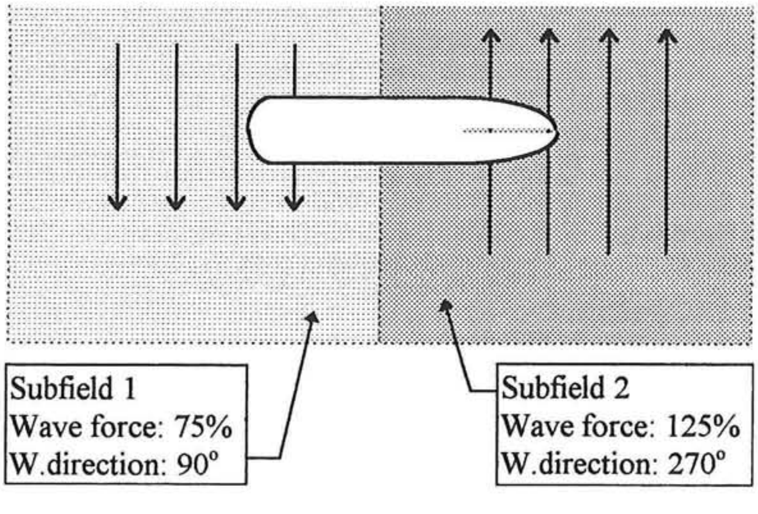
In this approach a use is made of a non-uniform wave field. A non-uniform wave field means the wave field is split into two sub-fields and one type of wave is introduced in each sub-field. One type can mean both in direction and in force magnitude. For instance, waves coming from one direction and vary in forces: 75% wave force in the first sub-field and 125% wave force in the next. See Figure 6.3 below.

Figure 6.3
Non-uniform wavefield: waves from one direction



The combination can also involve two different wave directions: one 90° and the other 270°. When the wave field is split into up to two sub-fields, there will be 90 different possible combinations. See Figure 6.4 below. For an example of the result, see Figure 6.5. It is, however, questionable whether introducing waves of two opposite directions in one wave field is a realistic approach. Yet on the other hand, the effect does resemble the expected noise.

Figure 6.4
Non-uniform wavefield: waves from opposite directions



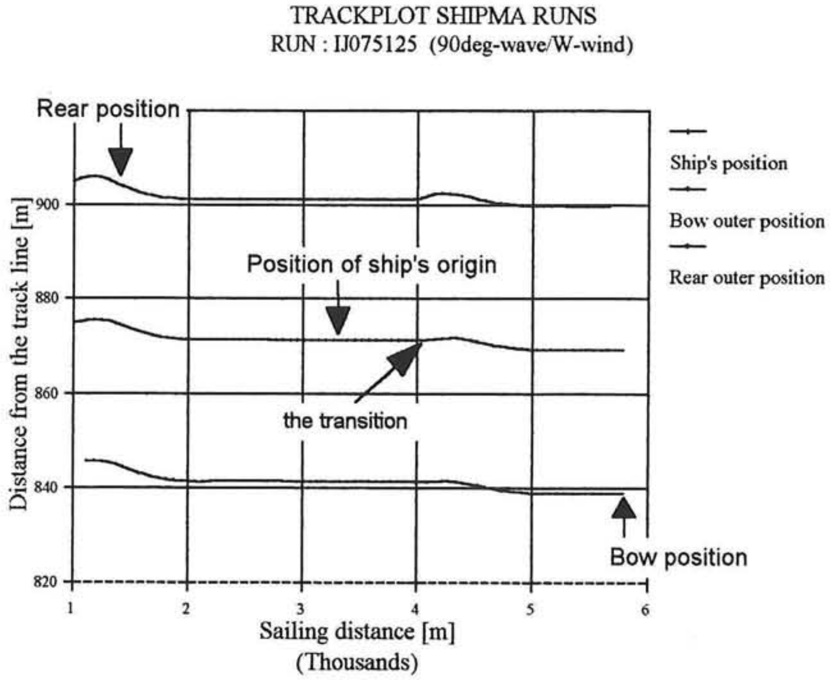
6.6.2 Results

The results of this non-uniform wave field approach are:

1. The effects do resemble the expected noise.
2. The most important result of this approach may be: it shows the effect of changing wave forces (and also wave directions) on the manoeuvre of a vessel. For instance, when the waves are of the same direction, a change from 75% wave force to 125% wave force (see Figure 6.5) will "push" the ship much further in the wave direction. When the order of change is reversed, from 125% to 75%, the result will be a slight relapse as the force is suddenly reduced (see Figure 6.6).

Figure 6.5
Trackplot of
SHIPMA run
with non-uniform
wave field
(75% to 125%)

Direction: 90°
W.force 1: 75%
W.force 2: 125%

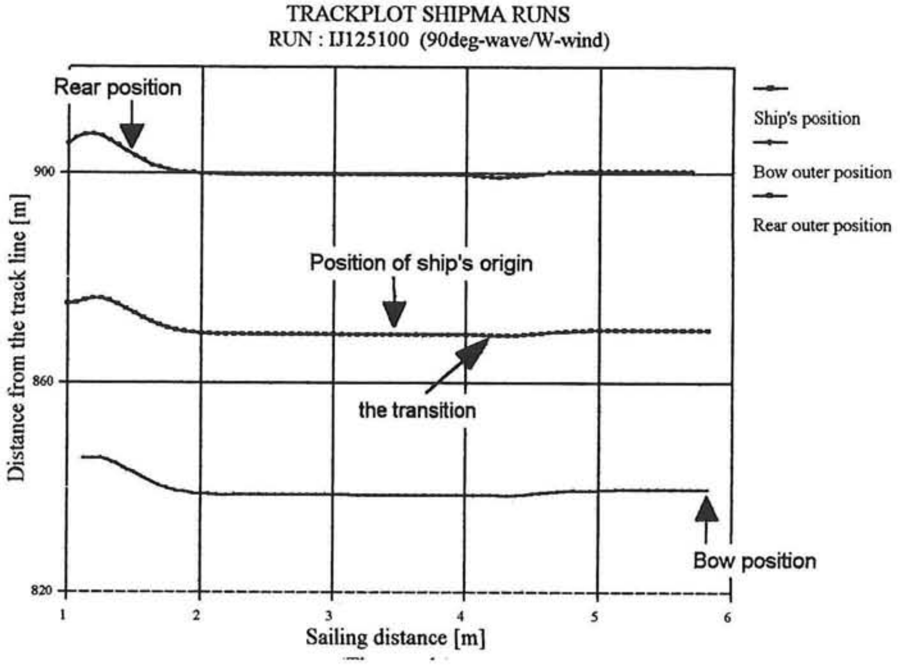


3. As shown in these figures, the deviation caused by fluctuations in wave forces can be considered marginal. For instance in Figure 6.5 is shown that the deviation amounts around 5 m, which is only 1/6 of ship's beam. The same result can also be seen in Figure 6.6 although in this case the wave directions are different.

4. Despite the insight obtained from the results, as it was the case with the first one, this approach only produced identical manoeuvres for each combination.

Figure 6.6
Trackplot of
SHIPMA run
with non-uniform
wave field
(125% to 100%)

Direction: 90°
W.force 1: 125%
W.force 2: 75%



6.6.3
Conclusions

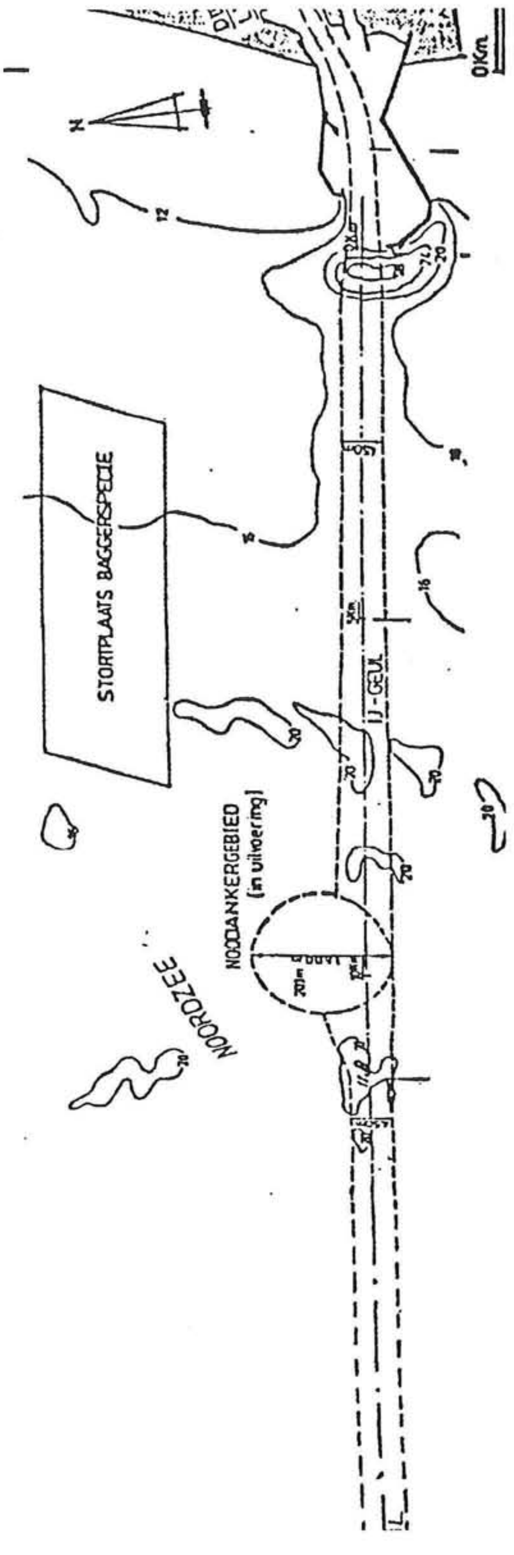
Although the effects do resemble the expected noise, the deviations are marginal. This leads to the conclusion that the non-uniform wave field approach does not deliver the desired results.

6.7
General Conclusions

Up to this point one conclusion can be made with regard to SHIPMA simulation model: a SHIPMA model alone will not result in random manoeuvres. In other words, a SHIPMA model must be complemented with a random generating application.

The question now is not so much how to generate the random outcomes, but on what ground this random generator should be based. The generator must know (1) the distribution to be used, (2) the mean values, and (3) the standard deviation. Therefore, for the next approach, a second additional application is needed to determine the characteristics of the random variable(s).

Figure 6.7 The IJgeul channel to the Port of IJmuiden, Holland



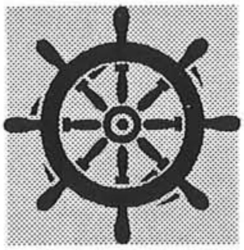
REFERENCES:

[1] Slootweg, H.E., *IJgeul te IJmuiden*, final assignment report (draft version), Haarlem.

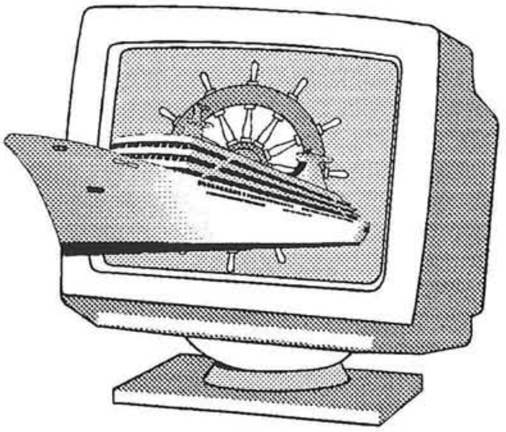
[2] Hydro meteo adviesdienst IJmuiden (Rijkswaterstaat directie noord-holland), tijdpoortinformatie, June 22, 1994.

[3] Doorn, Ir. J.T.M. van, personal communication: letter ref. MO004/94/JD/05480, MSCN, Wageningen, the Netherlands, 1994.

[4] Verkerk, F.S.H. et al, SHIPMA 4.30 User Manual, supplement: *Ship's Description*, Delft Hydraulics, Delft/Emmeloord, the Netherlands, October 1990.



7. RandSail Approach



7.1. Introduction

In the previous chapter it is concluded that in order to create a set of random manoeuvres, SHIPMA simulation program needs to be complemented with two additional applications. The first one is a random generating application and the other application is to determine the random variables.

To perform the random generator activities, PROSIM 3.01 is selected For more details on PROSIM 3.01, see Chapter 5. To determine the random variables, a simulation program called COLUMBUS is selected. For more details, see Chapter 3. This third approach is called the RANDSAIL approach which is derived from the words "random" and "sailing".

In this approach, PROSIM is then used as the master program. Both SHIPMA and COLUMBUS served as input generating applications. SHIPMA provides information on ship's manoeuvres and COLUMBUS provides the stochastic variables of ship's position estimation.

7.2. The State Estimation Behaviour

Each time a position has to be estimated (state estimation), two important activities take place. On the bridge of a real-life ship, these activities are done by a human operator (i.e. the skipper or pilot) that is also to be referred as the *human navigator*. When the word *Navigator* (with capital N) is used, it refers to the computational model of the *human navigator*.

The first one is the evaluation of the present position. For human operator this 'evaluating position' in reality means 'estimating position' since the results will never be entirely exact. Strating and

Koeman[1] used the term *estimator* for this role. In this report, this role is further to be called the *Observer*, in line with the term introduced by Wewerinke (1989, see [2]) and later also used by Papenhuijzen (1994, see [3]).

The second activity is adjusting the manoeuvre in order to reach the desired position. Strating and Koeman called it the "decision making element". Wewerinke uses the term *Controller* and Papenhuijzen the term *Reconstructor*, for this report *controller* is chosen.

The basics of the state estimation behaviour has not been a focus of this study and has already extensively been discussed by both Wewerinke and Papenhuijzen. These studies have laid an important corner stone in the world-wide activity to develop suitable computational model for the Navigator. One of the results of Papenhuijzen's research was the development of computer program COLUMBUS. This program has become an important part of the RandSail model since it is capable of simulation the error made by a human operator in observing, among other things, the distance to a reference point (i.e. a pair of buoys).

7.3. RandSail Approach

With the state estimation behaviour in mind comes the question: in what way can this behaviour be simulated in a fast-time simulation. The RandSail approach simulates the above mentioned state estimation behaviour by distributing the two tasks among three programs.

Basically, RandSail is a top-down approach[4] that is based on goals, functions, and derived behaviour. This all produces an integrated model structure. Two of the fast-time simulation programs integrated in RandSail, COLUMBUS and SHIPMA 4.30, are in the contrary bottom-up approach where detailed task elements are combined to build up a model to describe the whole task. These two bottom-up programs become crucial ground for the top-down RandSail model.

7.3.1 Setup

The basic process starts with a specific *start position*, both in x-direction and in y-direction. At this position a human operator (HO) must perform the state estimation. This state estimation process is illustrated in Figure 7.1.

The mathematical expression for the estimated position is as follows:

$$y_{est.} = y_{actual} + \Delta y_{obsv.}$$

Equation 7.1

Where:
$y_{est.}$: estimated position in y-direction
y_{actual} : actual position in y-direction
$\Delta y_{obsv.}$: error in observed distance

Except for the very first starting point, the actual position is calculated as follows:

$$\Rightarrow y_{actual,new} = y_{est.} + \Delta y_{sail}(y_{est.}) - (y_{est.} - y_{actual,old})$$
$$\Rightarrow y_{actual,new} = y_{actual,old} + \Delta y_{sail}(y_{est.})$$

Equation 7.2

Where:
$y_{actual,new}$: the new actual position in y-direction
$y_{actual,old}$: the old actual position in y-direction
$y_{est.}$: estimated position in y-direction
$\Delta y_{sail}(y_{est.})$: the sailed distance in y-direction, a function of the estimated position

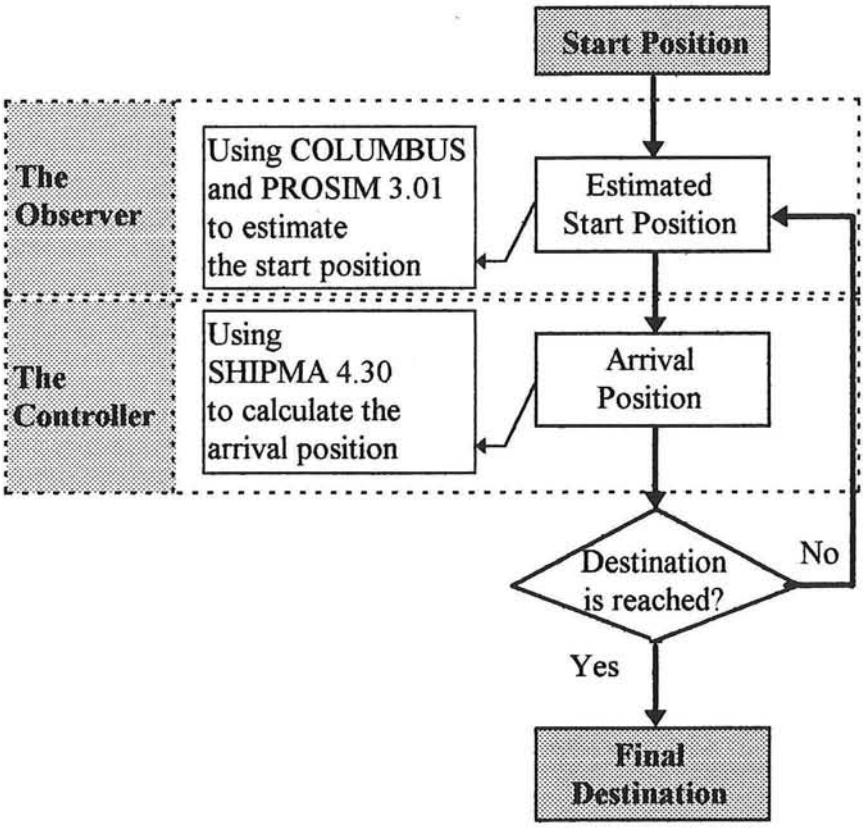


Figure 7.1 The State Estimation Behaviour in RandSail process

First of all, the Navigator must estimate the position of the ship. This task is performed by the Observer (see Table 7.1). Based on available points of reference, COLUMBUS determines the stochastic distribution of error of observation around that position. This distribution is presented in form of 2-dimensional 68%-confidence area (see Chapter 1). PROSIM uses this distribution of error and 'estimates' the ship's position by randomly select a position within the 68%-confidence area. This is the *estimated position*.

The two distributions, the short-axis and the long-axis, are independent from and not correlated to one another. Each distribution, however, is a function of (1) the position and (2) the heading of the observer, and (3) of the position of the point(s) of reference. The argument thereof lies on the setup of the simulation experiments, whose results were later used to determine the coefficients in COLUMBUS (see also [5] and [6]). In other words, one random number generated using one distribution function doesn't have a one-to-one correspondence to a random number generated using the other distribution function. Therefore, the two distributions can be separately used by PROSIM to generate random numbers. One random number will be generated from each distribution and they will form co-ordinates that later to be transformed in xy-axis. More on this method see Section 7.3.3.

The fact that the long-axis and short-axis distributions are not correlated simplifies the algorithm a great deal. Otherwise, there should be a relation between the two functions and this would lead to a 3-dimensional function where $P = f_{XY}(x,y)$ as shown in Figure 7.2. This function is also called the *probability surface*[7]. For more on this subject see also [8]. As for now, RandSail works only on a 2-dimensional area which forms the "egg of Columbus", see Figure 7.6.

Figure 7.2
A 3-dimensional distribution function

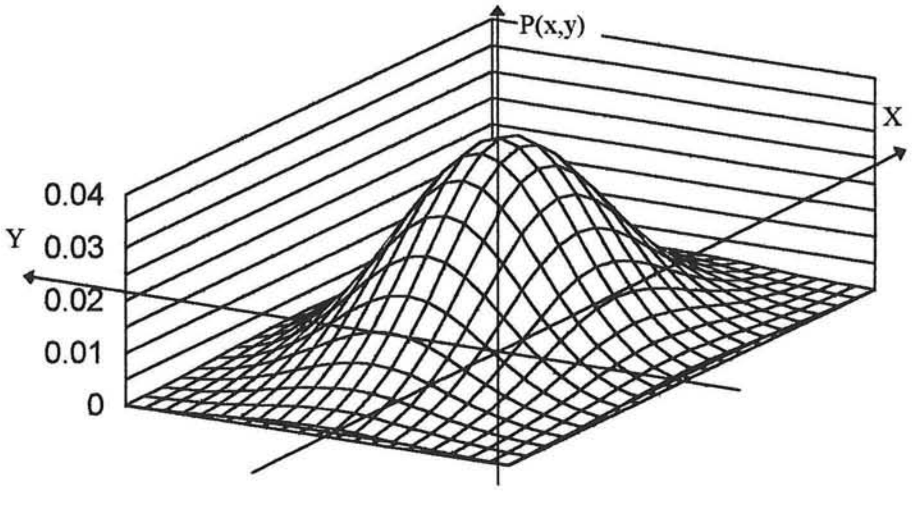


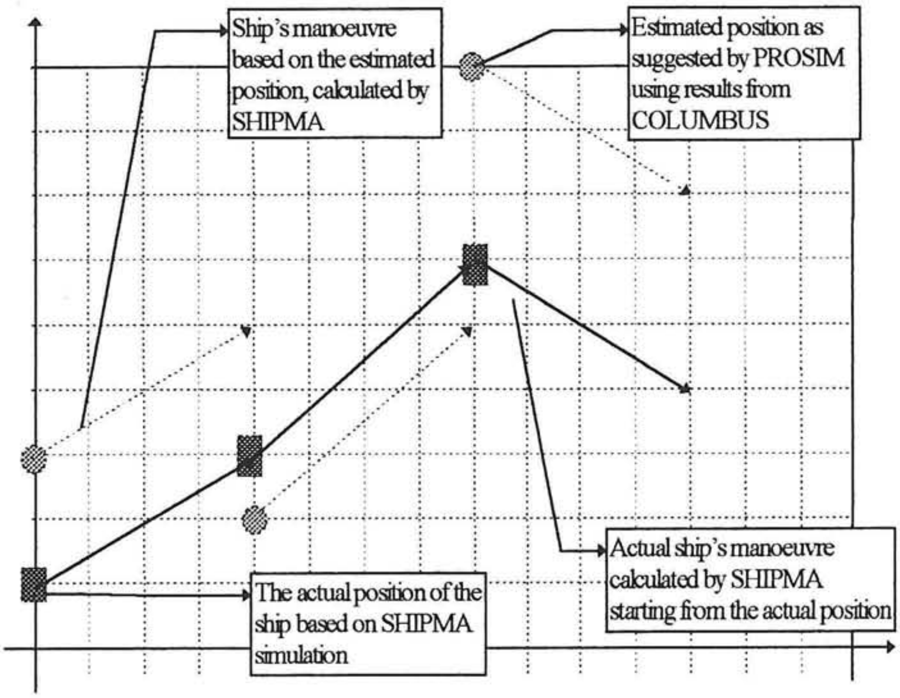
Table 7.1

State Estimation Behaviour Tasks Distribution		
Role	**Task/sub-task**	**Program**
Observer	a. Error definition	COLUMBUS
	b. Position estimation	PROSIM 3.01
Controller	Reconstruction of manoeuvre in order to follow the desired track	SHIPMA 4.30

Afterwards, the Navigator must reconstruct or adjust the manoeuvre in order to minimise the distance to and follow the desired track. This task is performed by the Controller (see also Table 7.1). Based on (1) the estimated position, (2) the ship's heading (in degrees), and (3) the ship's rate of turn (in deg/s) at the start position, SHIPMA simulates the manoeuvre from the estimated position to the desired track (centre-line).

The calculated manoeuvre will then be interpolated on the actual position of the ship, not the estimated position. At the beginning of the process it will be the start position. This process is illustrated in Figure 7.3 below.

Figure 7.3
RandSail approach at work



After a certain number of time-step, say 60 seconds, the manoeuvre will reach an new position, the *arrival position*. As long as the final destination is not reached, the process will repeat itself. This time, the arrival position will be the new start position. See the flowchart of the process in Figure 7.1.

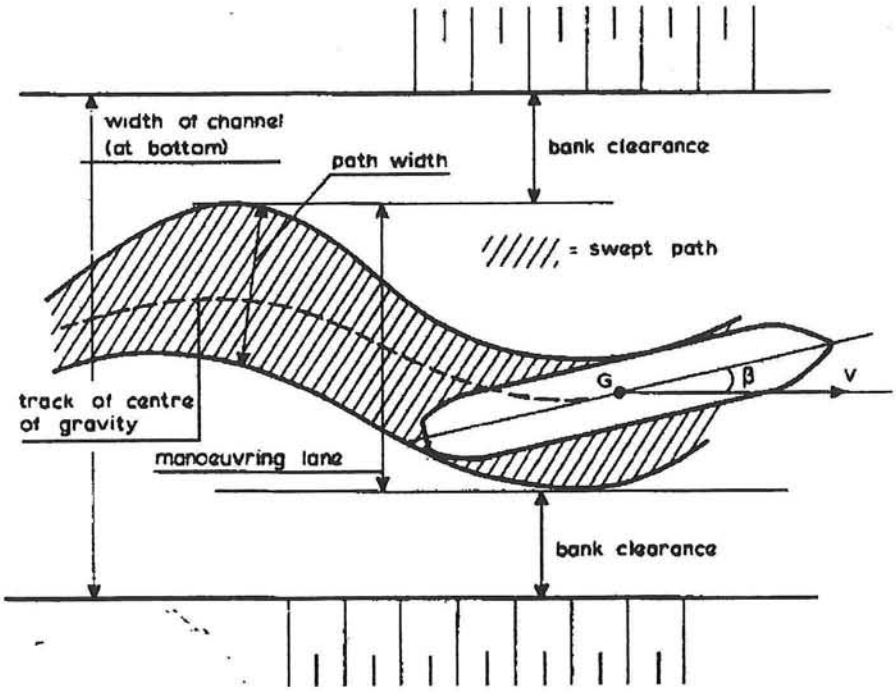
7.3.2 The Swept Path

Up until now, the term position refers to the centre of gravity of a ship. It is, however, not the centre of gravity that matters most when it comes to ship manoeuvre. It is the position of the extremities -- the farthest points of the ship in both the port and starboard sides -- that matter most. During a manoeuvre, a ship will take up an area wider than its own breadth, the so-called swept-path (see Figure 7.4). A swept-path are determined by the extremities of the ship.

RandSail is also able to determine the ship's swept path. RandSail model calculates the position of the farthest points of the ship using the heading. Statistics can then be made of not only the positions of the centre of gravity of the ship, but also of its extremities.

Figure 7.4
A swept-path

(source: [1])



7.3.3 COLUMBUS simulation

Keeping in mind that COLUMBUS simulations are time-invariant and position-bound, the main objective of employing this program in the study is to obtain as much information as possible on the errors made in estimating ship's position. The fact that COLUMBUS doesn't take variables such as winds, waves, or even ship speed, simplifies the data gathering process.

a. Contour and objects

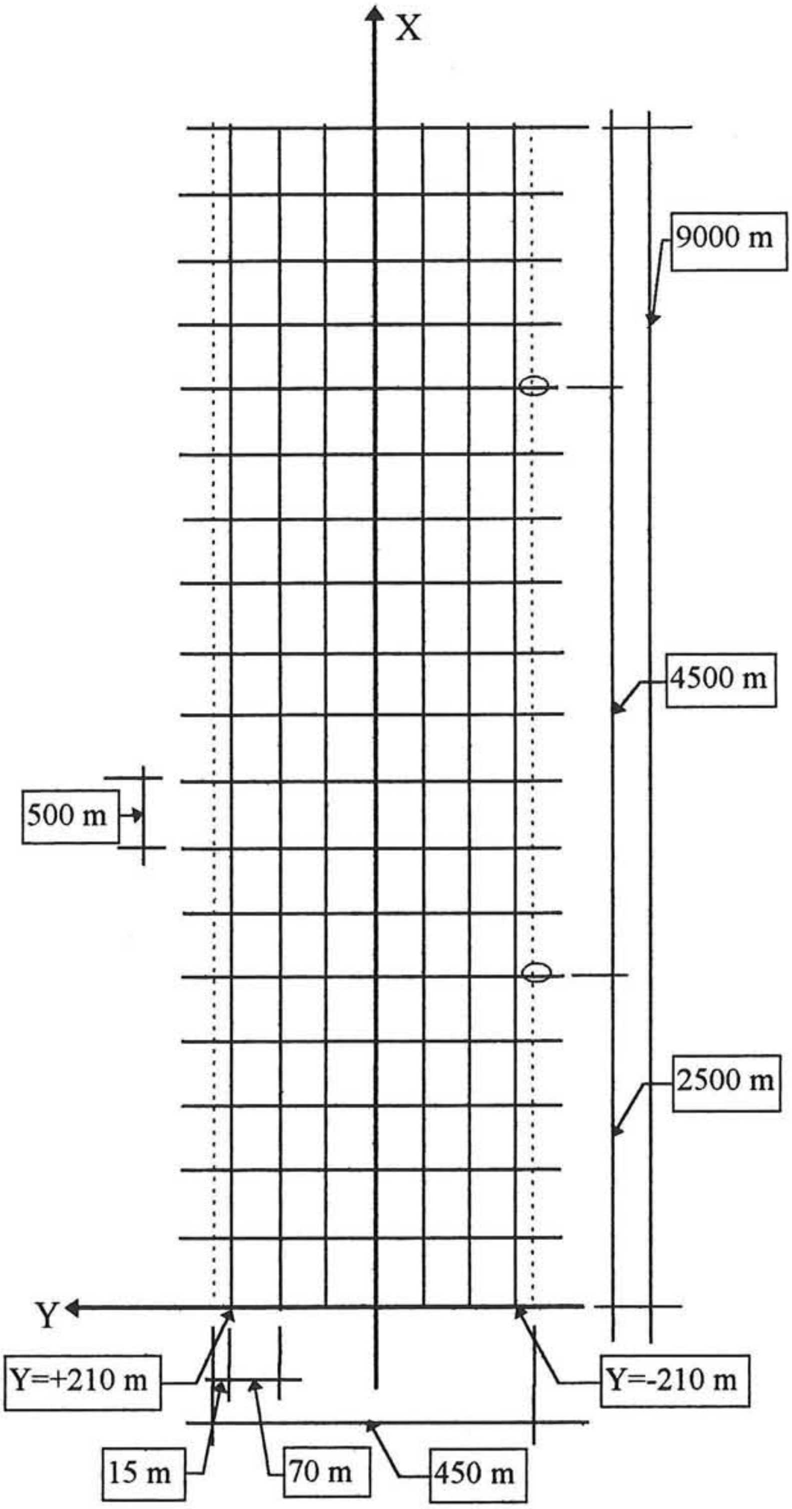
For the contour, it is set to be section 1 of the IJgeul (see Chapter 6, Table 6.1) with a length of 5000 m and 450 m wide (see).
In Section 1 there are two buoys on the starboard side (moving towards the harbour entrance) with a distance of 4500 m in between.

b. Simulation set-up

To set up the COLUMBUS simulation, a 9000m-long straight section of the IJgeul is selected. This section is then divided into a roster network consisting of 7 lines parallel to the x-axis (with an equidistant of 70 m) and 19 lines parallel to the y-axis (with an equidistant of 500m). This roster network is shown in Figure 7.5. The 7 lines parallel to the x-axis correspond with the 7 pre-selected start positions (see Chapter 6).

This roster network has 133 points where the lines cross each other. During the simulations, the estimation errors are collected for all points and by doing that the estimation errors in the whole channel section are obtained.

Figure 7.5 Contour and objects of IJgeul used in COLUMBUS simulation (sub-section a)



c. Simulation results

As a result, a list of output for 133 points is obtained. This list had to be transformed into a readable format, a table, for PROSIM. To this end a spreadsheet program (Quattro Pro) is used. The table presents the co-ordinates of the points, ship heading, and the related 2-dimensional 68%-confidence region of error in position estimation and its orientation.

Visual presentation by COLUMBUS on the monitor of this area may look as shown in Figure 7.6. COLUMBUS prints its output one position at a time using the following format:

```
positie x: 3.459643e+003
positie y: 2.759169e+003
heading (graden): 2.072960e-008
halve lange as ellips: 6.377327e+002
halve korte as ellips: 1.8680593+002
orientatie ellips (graden): 2.242536e+000
```

An output file will then have to be reformatted to produce a form suitable for further processing. An example of reformatted COLUMBUS output, in this case the length of the long-axis, is presented in Table 7.2 and the graphic of this output (the values of the length on three y-positions, along the x-axis) is shown in Figure 7.7.

This table is then transformed (also using the spreadsheet program) into an ASCII input file for further process using PROSIM 3.01.

Table 7.2

COLUMBUS Output: Length of Long-axis (deg)

Position x-axis	Start position along y-axis						
	-210	-140	-70	0	70	140	210
0	687.18	736.67	791.81	850.05	906.29	924.64	977.39
500	642.99	683.67	729.22	776.79	824.73	844.05	881.45
1000	532.21	557.6	585.16	615.26	641.94	661.16	669.86
1500	371.44	375.16	381.54	384.38	391.49	403.27	395.21
2000	236.77	214.7	191.5	165.99	135.51	105.51	82.62
2500	285.58	275.47	266.5	251.71	248.3	243.2	236.1
3000	450.54	465.06	480.97	497.37	513.53	525.18	531.48
3500	590.34	623.86	660.49	698.44	736.11	761.9	781.71
4000	670.32	719.12	767.24	821.29	872.06	893.99	940.5
4500	685.59	735.02	790.55	849.59	834.83	916.45	978.9
5000	639.2	681.3	727.71	777.37	746.76	825.94	879.37
5500	533.57	560.01	587.19	530.64	587.21	641.33	672.88
6000	379.33	383.33	329.6	346.66	365.48	382.03	393.19
6500	252.32	197.06	177.58	156.7	130.2	106.46	85.41
7000	295.8	282.72	270.74	256.46	245.12	236.11	230.95
7500	533.2	536.09	545.95	542.18	544.97	547.16	547.76
8000	851.66	850.79	853.72	853.38	849.64	845.95	852.41
8500	1145.26	1143.69	1145.29	1146.71	1147.86	1139.21	1151.89
9000	1416.18	1415.5	1424.46	1426.36	1405.14	1418.65	1432.14

Figure 7.6
Result of a Columbus simulation: The 68% confidence area/region

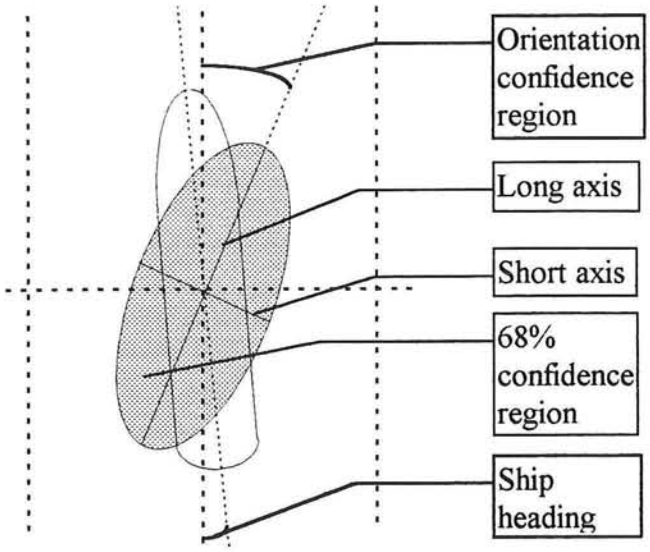
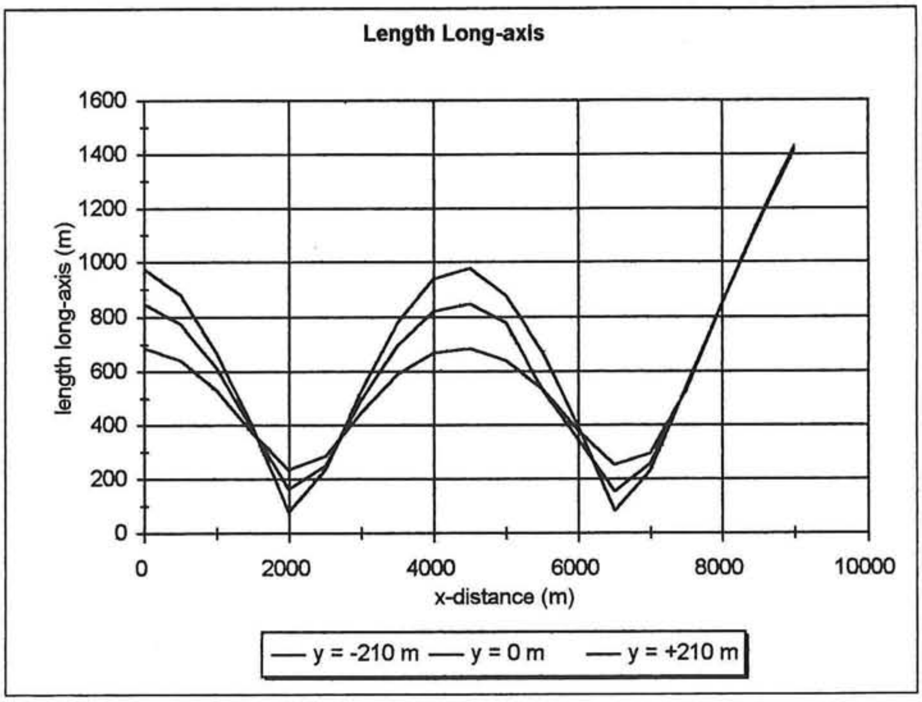


Figure 7.7
Columbus Output: Length of Long-axis

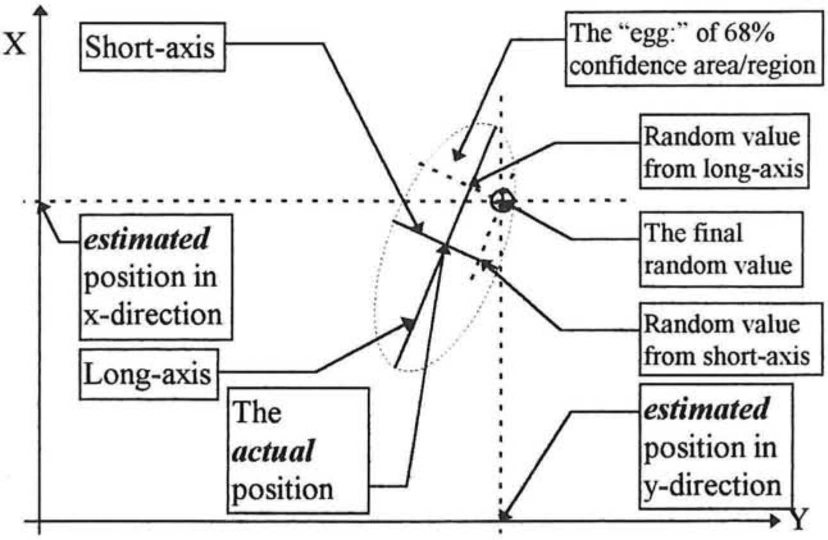


7.3.4 PROSIM simulation

a. Setup

Since COLUMBUS works with normal distribution, the random generator selected for this study is also normal. In PROSIM the error distribution is indicated using one value for the mean and another value for the standard deviation. For RandSail model, the mean value is 0 and the value for the deviation is derived from the COLUMBUS output.

Figure 7.8
Generating the random value



b. Generating the random value

PROSIM activates two random generators: one for the long-axis distribution and the another one for the short-axis distribution. From each axis, one random number will be generated. These two random numbers together form a "co-ordinate" in the long-short co-ordinate system. See Figure 7.8 above.

c. Determining the *estimated position*

In order to determine the estimated position, this "co-ordinate" must be projected first to the earth-fixed co-ordinate system (see Figure 7.8). That projected point is the *estimated position*.

d. Steering the manoeuvre

Beside playing the role of a random generator, PROSIM plays a larger role as the master program. The master program simulates the state estimation behaviour where both the Observer and the Controller are present. Therefore the RandSail manoeuvres are the result of PROSIM simulation using information from COLUMBUS (for the error distribution) and from SHIPMA (for the ship's manoeuvring behaviour). See further Section 7.4: RandSail: Putting it all together.

7.3.5 SHIPMA simulation

a. Basic Setup

Based on the results of the very first approach (see Section 6.4) and the conclusions (Sub-section 6.5.3), the influence of winds and currents are excluded in this application of SHIPMA. Therefore, the variables that finally played a role in this study are:

(1) the start positions,
(2) the ship heading (course angle),
(3) the rate-of-turn,
(4) the direction of the incoming waves, and
(5) the wave forces.

The basic setup as already listed in Table 6.4. is expanded with variables nr. 2 and 3. Therefore, beside the variations in starting points, wave directions, and wave forces, there are also variations in the ship heading and the rate-of-turn.

The new variations are as follows:

Table 7.3

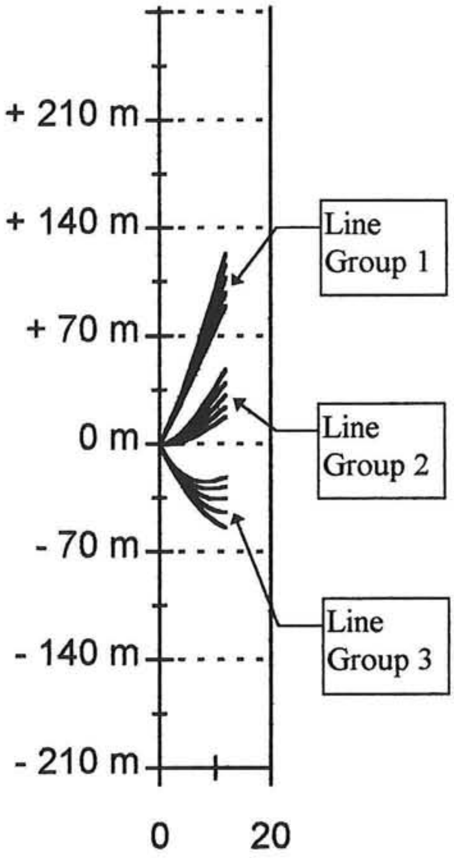
Variable	**Variations**						
	Var 1	Var 2	Var 3	Var 4	Var 5	Var 6	Var 7
Course Angle (degrees)	+15	+10	+5	0	-5	-10	-15
Rate-of-turn (degrees/sec.)	+0.3	+0.15	0	-0.15	-0.3		

This means that there are another (5 x 7 =) 35 sub-variations under the existing 70 variations mentioned in Table 6.4. In other words, there are a total of (35 x 70 =) 2450 SHIPMA-runs to be made.

This expansion of variables is crucial since ship manoeuvre is not only a function of its position in relation to the desired track, but also, among other things, its momentary heading (course angle) and rate-of-turn. Both elements, especially when combined, have considerable effects on the manoeuvring behaviour of a ship. Examples are shown in Figure 7.9.

Basically, beside these two variables, the dynamics of ship manoeuvre is also a function of rudder, propeller revolution, and external influences[9]. For this stage, however, it is decided to limit the expansion by not varying the rudder or the propeller revolution. As far as the external influences are concerned, only the wave varies.

Figure 7.9
Impact of the combinations of ship heading and rate-of-turn on the manoeuvring behaviour



The figure to the right shows examples of the impact of combinations of ship heading and its rate-of-turn on its manoeuvring behaviour. The combinations are as follows:

Group 1

- Heading: -15 degrees
- Rate-of-turn: -0.3, -0.15, 0, +0.15, and +0.3

Group 2

- Heading: 0 degrees
- Rate-of-turn: -0.3, -0.15, 0, +0.15, and +0.3

Group 3

- Heading: +15 degrees
- Rate-of-turn: -0.3, -0.15, 0, +0.15, and +0.3

b. Simulation Runs

For the SHIPMA runs, the following set of input is used:

Table 7.4

Basic Input for SHIPMA manoeuvres		
Variable		**Input**
Starting points		7 points (y = -210 m, -140 m, -70 m, 0 m, +70 m, +140 m, and +210 m)
Desired track	position	the middle line at y = 0 m
	length	3000 m
Course angle		see variations in Table 7.3
Rudder angle		0 deg
Propeller revolutions	initial	1 1/sec.
	maximum	1.4 1/sec.
Longitudinal velocity		5 m/sec.
Transverse velocity		0.5 m/sec.
Rate of turn		see variations in Table 7.3
Time Step		5 sec.
Anticipation distance		2.5 times ship overall length
Waves	Direction	90 deg.
		270 deg.

Table 7.4

Basic Input for SHIPMA manoeuvres

Variable		**Input**	
Waves	Force	0% (no wave)	
		50%	equal to wave height = 1.4 m
		75%	equal to wave height = 1.7 m
		100%	equal to wave height = 2.0 m
		125%	equal to wave height = 2.2 m

As far as wind, current, bank-suction, and tugs are concerned (see also Chapter 5), the following files are used: NO.WIN, NO.CUR, NO.BNK, and NO.TUG.

The input for wave variables are defined in 9 different files, see Table 7.5, including one SHIPMA standard NO.WAV file which is used in two cases. In these input files both the direction and the force of the wind are indicated. Wave force is defined as wave height.

Table 7.5

List of SHIPMA Wave input files

Wave Direction	**Wave Force**				
	0%	**50%**	**75%**	**100%**	**125%**
90°	NO.WAV	lc090050	lc090075	lc090100	lc090125
270°	NO.WAV	lc270050	lc270075	lc270100	lc270125

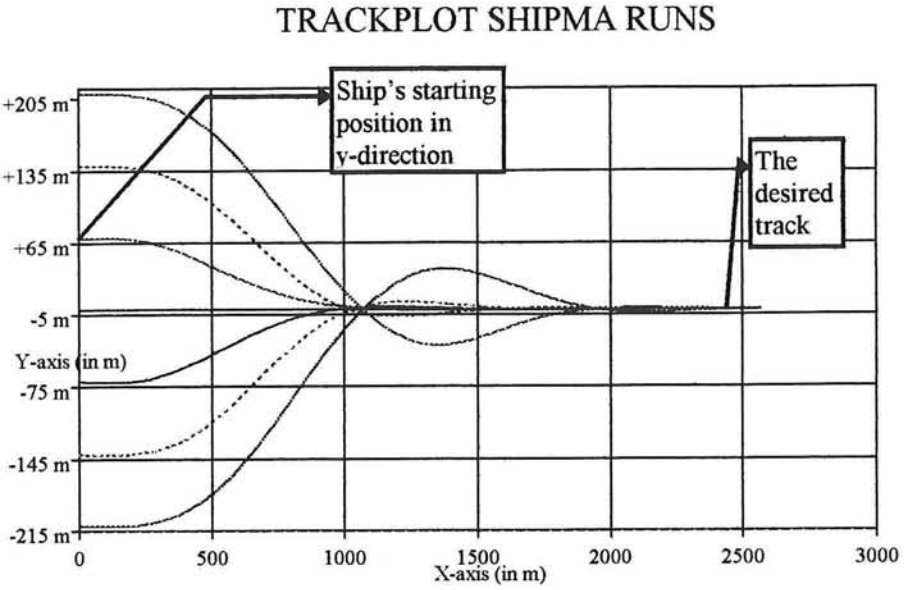
c. Simulation Output

As already mentioned, 2450 SHIPMA runs were made and therefore the same amount of output files.

For RandSail approach the use of these output data is limited to only the time and ship's position in y-direction. These selected output data from 2450 output files are then transformed (and reduced) into 70 input files for further processing by PROSIM. Each input file already includes 35 manoeuvres (one for each start position with one rate-of-turn). For a graphic presentation of such an input file see Figure 7.10.

To simplify the process, it is assumed that the longitudinal speed remains constant (5 m/s) and therefore the ship's position is x-direction can be derived by multiplying the speed (v) with the time-step (Δt), as follows: Δx = Δt*v.

Figure 7.10 Example trackplot of SHIPMA manoeuvres



7.4. RandSail: Putting it all together

A specific approach is needed to create an algorithm that calculates Equation 7.1 and Equation 7.2. RandSail approach works with the so-called "bands". A band is the area between two points over the cross-section of the channel. In Figure 7.11 the top right part of Figure 7.10 is zoomed in. In this figure a band is indicated.

Before further simulation can be run, regardless the program, the location of an actual position in a band must be located first. For instance, point at y = +25 m (see ⊗ in Figure 7.11) is located in the band between the line y = 0 m and y = +70 m. In this figure, the leading line is on y = 0 m.

COLUMBUS will find the nearest line to the point, in the case of a point at y = +25 m (see ⊗ in Figure 7.11), it will be the line at y = 0 m. Furthermore, due to the fact that there are three buoys along the track, COLUMBUS simulations are also a function of x-coordinates. Therefore, COLUMBUS will use the coordinates in both x and y directions to determine the error of observation.

PROSIM generates then a random coordinate of the estimated position (see ⊕ in Figure 7.11). To locate it in one of the bands, PROSIM will use not only the estimated position, but also the heading of the ship (ψ) and its rate-of-turn (ψ'). In this sample case, the estimated coordinate is y = +95 m, which puts it in the band between line y = +70 m and y = +140 m.

PROSIM will then use the output data from SHIPMA simulations. One manoeuvre with starting point y = +70 m and another one with starting point y = +210 m. These two manoeuvres will be interpolated to determine the manoeuvre with the estimated position as the new starting position. These manoeuvre, however, will start from the actual position, not from the estimated position. See Figure 7.3.

After a number of pre-selected time-steps, say 12 steps (equal to 60 secs. or a distance of 300 m, with a speed of v = 5 m/s), the ship will reach an arrival point. At this point, state estimation process must be repeated to determine the next step.

Figure 7.11
Definition of a band

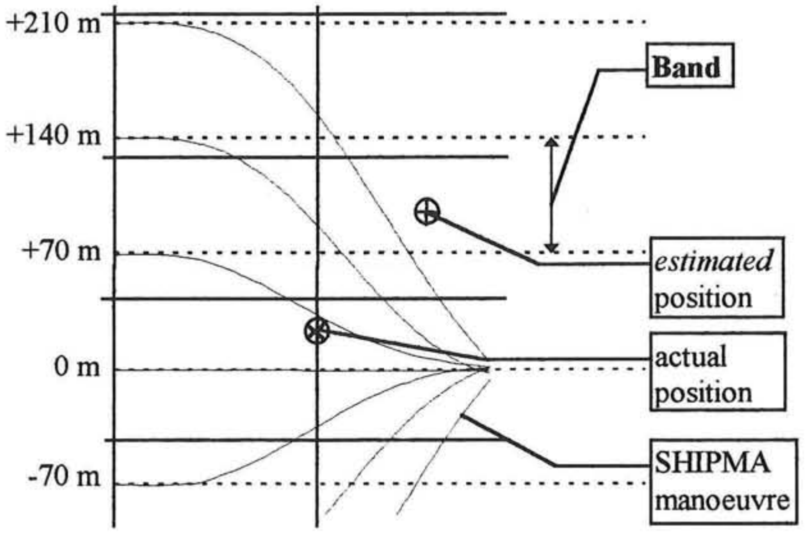
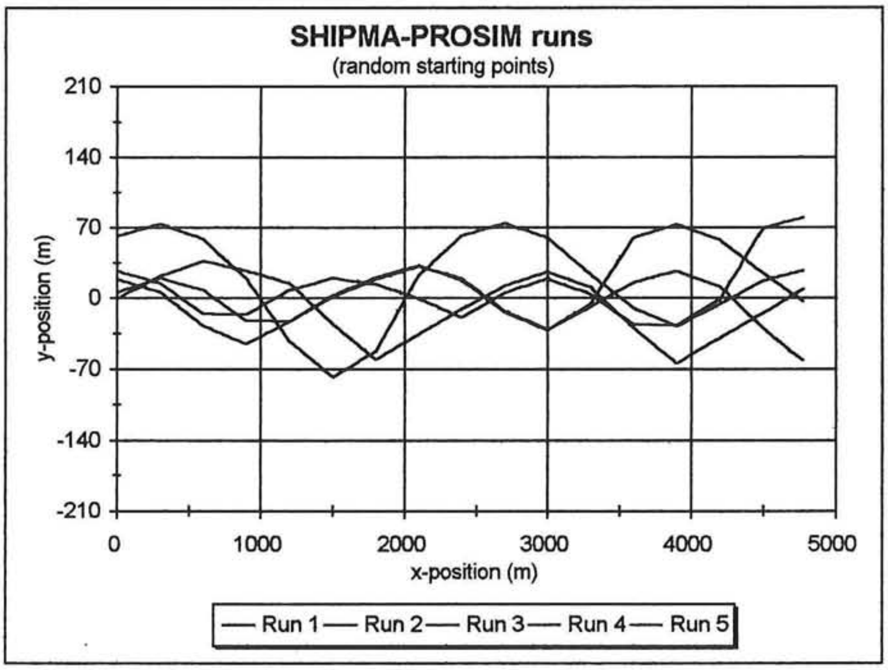


Figure 7.12 shows an example of RandSail runs. To enhance visibility, this graphic only consists of five runs. For the remainder of this study, at least 100 runs were done.

Figure 7.12
Example of
RandSail Runs



REFERENCES:

[1] Strating, Ir. J. and Koeman, Ir. J.W., *Dimensioning of Access Channels: Techniques and Research Means*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB4.

[2] Wewerinke, Dr.Ir. P.H., *Models of the Human Observer and Controller of a Dynamic System*, Ph.D. thesis, University of Twente, Enschede, the Netherlands, May 1989.

[3] Papenhuijzen, Dr.Ir. R., *Towards a Human Operator Model of the Navigator*, Ph.D. thesis, Delft University of Technology, Department of Mechanical Engineering and Marine Technology, Delft, the Netherlands, February 1994.

[4] Introduction of [2].

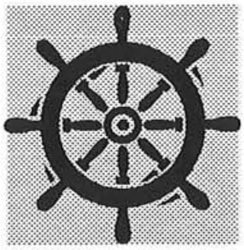
[5] Wewerinke, Dr.Ir. P.H. and Hove, Ir. D. ten, *Waarnemingsnauwkeurigheid Vaarwegmarkeringsobjecten*, MSCN, Wageningen, the Netherlands, April 1994, Appendix A: The Setup of the Experiments (report nr. OD052.10/2).

[6] Williams, Kent, *Mariner Perception of Yaw, Yaw Rate, and Bearing as a Function of Ship Size and Mariner Experience*, National Maritime Research Center, Kings Point, NY 11024, U.S.A., December 1980. CAORF Technical Report nr. 60-7904-01.

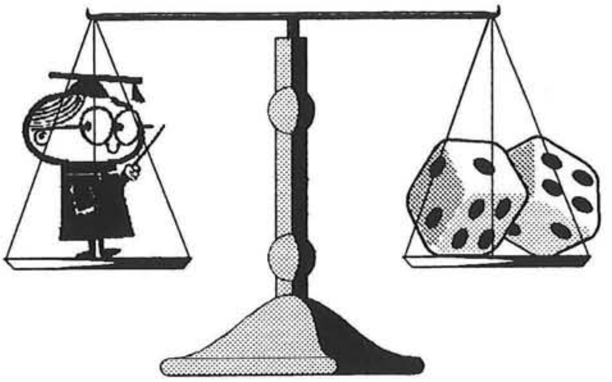
[7] Spiegel, Murray R., *Theory and Problems of Probability and Statistics*, Schaum's Outline Series, McGras-Hill, Inc., New York, NY, U.S.A., 1994, Chapter 2.

[8] Price, W.G. and Bishop, R.E.D., *Probabilistic Theory of Ship Dynamics*, Chapman and Hall Ltd., London, England, 1974, chapter 3.

[9] Bolt, Ernst W., SHIPMA 4.30 User Manual, *Part E: Mathematical Description of SHIPMA*, Delft Hydraulics, Delft/Emmeloord, the Netherlands, October 1990.



8. Deterministic and Probabilistic case study: the IJ-channel



8.1. Introduction

This chapter is to compare the deterministic method, using the Concept Design Rules (CDR) formulated by Joint Working Group 30 of PIANC/IAPH[1], and the probabilistic method, using the RandSail model. For the test case, the entrance channel (the IJgeul) to the Port of IJmuiden, the Netherlands, is used.

8.2. A deterministic method: Concept Design Rules

In order to use the CDR, some crucial information must be at hand. The following is the information available on the IJgeul (sources: [2]/[3]/[4]) to be taken into account in CDR calculations:

Vessel speed	: 4.0 to 6.0 knots
Breadth ship (B)	: 32.2 m
Draught (T)	: 12 m
Cross wind	: 30 to 50 knots (7 to 9 bft)
Cross current	: 1 m/s = 3.6 km/h ≈ 1.8 knots
Significant wave height H_s	: 2 m
Aids to navigation	: excellent, with shore traffic control
Depth waterway (D)	: 18.88 m ≥ 1.5 T
Cargo hazard level	: low (dry bulk)
Traffic	: one-way only
Bank type	: sloping channel edges and shoals

The calculations are as shown in Table 8.1 below. As a result, the CDR calculations suggest a channel width of 4.7 B. With B = 32.2 m, this means a width of 151 m. In the reality the IJgeul is 450 m wide.

Table 8.1
CDR calculations

BASIC MANOEUVRING LANE			
Manoeuvrability		good	**1.3 B**
ADDITIONAL WIDTHS			
a.	Vessel speed	slow	0 B
b.	Prevailing cross wind	severe	1.0 B
c.	Prevailing cross current	strong	1.3 B
d.	Prevailing longitudinal current	low	0 B
e.	significant wave height H_s and wave length λ (m)	moderate	0.5 B
f.	Aids to navigation	excellent	0 B
g.	Bottom surface	depth ≥ 1.5 T	0 B
h.	Depth of waterway	≥ 1.5 T	0 B
i.	Cargo hazard level	low	0 B
	Total Additional Width		**2.8 B**

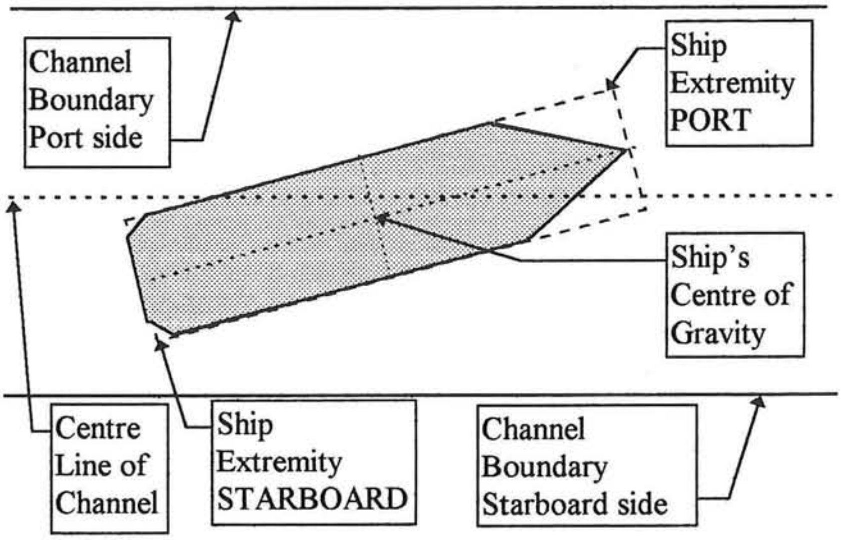
BANK CLEARANCE		
Sloping channel edges and shoals		**0.3 B**

Basic Manoeuvring Lane (BML)		1.3 B
Total ADDITIONAL Width		2.8 B
Bank Clearance (2 x 0.3 B =)		0.6 B
Total CHANNEL WIDTH		**4.7 B**
or equals (4.7 x 32.2 m =)		151.34 m

8.3. A Probabilistic method using the RANDSAIL model

In a probabilistic method, the main objective in determining the width of an entrance channel is to determine the frequency of exceedance -- which is the probability a ship would exceed the boundaries of the channel. The attention should then be focused on the position of the ship's extremities, both on the port and starboard side (see Figure 8.1).

Figure 8.1
Definition of ship's extremities



The RandSail model calculates basically the position of the centre of gravity of the ship. A facility is included, however, to calculate the position of the extremities based on the ship's heading and to include them in the output.

The extremities are calculated as follows (see also Figure 8.2):

$$Y_1 = Y\text{centre} + ½.L*\sin(\alpha) + ½.L*\cos(\alpha)$$
$$Y_2 = Y\text{centre} - ½.L*\sin(\alpha) - ½.L*\cos(\alpha)$$

Equation 8.1

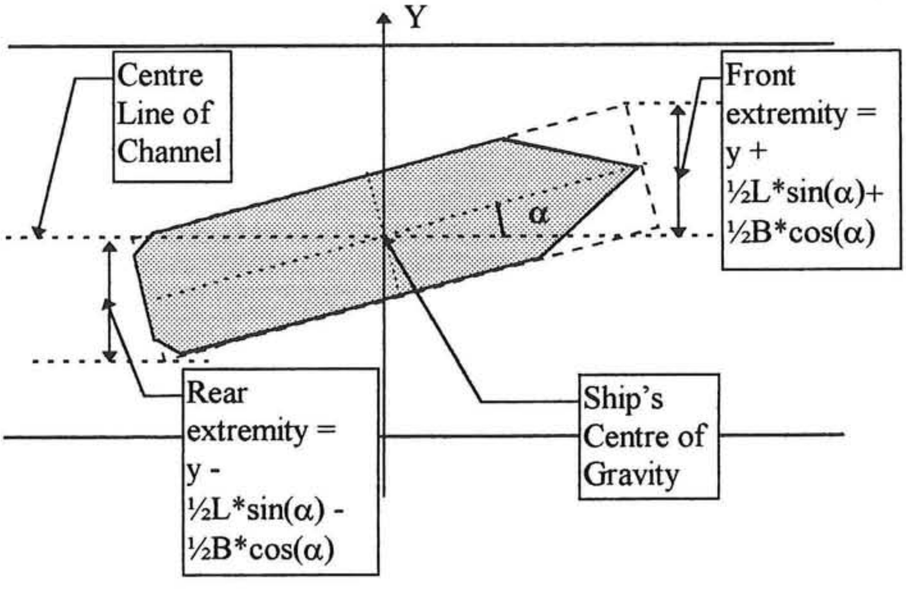
Where:

Y_1 : front extremity (port/starboard) (in m)
Y_2 : rear extremity (port/starboard) (in m)
Y_{centre} : position of ship's centre of gravity (in m)
α : ship heading (in degrees)
L : ship length (in m)
B : ship breadth (in m)

As showed in Figure 8.2, for the calculations a rectangle area is chosen to represent a ship. On one hand it simplifies the calculations and on the other hand it is a safer approach.

Since an extremity, for instance at the front, depending on the heading of the ship, can be either on the port side or the starboard side, RandSail model calculates all four corner points of the rectangle. From these four points, two points are selected. One with the highest value and the other one with the lowest value (the two extremities). In determining the frequency of exceedance, the remaining two points are of less importance. It is also less relevant to know which of the four points the two extremities are.

Figure 8.2 calculating ship's extremities



As it is the case with the ship's centre of gravity (Chapter 7), RandSail model stores for each cross section (a "raai" or a station) the position of both extremities in a STOREFILE. From this STOREFILE, statistics can be made (for an example, see Table 8.2). For the sake of clarity, these extremities are further to be called the port and the starboard extremities. Using the values for the mean and the standard deviation, the density function of the distribution can be determined.

The distribution is normal and the density function is described as follows:

$$P(y) = \sigma \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(\frac{y-\mu}{\sigma})^2}$$

Equation 8.2

Where:
y = a value on the y-axis (cross-section)
μ = mean of all y-values
σ = standard deviation

Table 8.2
Statistics of
Port Extremity
on cross-section
x = 2000 m

```
+- PROSIM STATISTICS --- FILE STO17111 - STREAM RAAI+ 8 +
+-------------------------------------------------------+
        == BASIC STATISTICS ==
  Mean           :  38.488026     Number of entries:    100
  St. deviation :  20.170452
  Mn. deviation :  17.252375     Minimum :     -3.875978
  Skewness       :  -0.341573     Maximum :     67.801476
  Alt. Skewness :  -0.048595     Range   :     71.677454
  Kurtosis       :   1.997104     Midrange:     31.962749

Confidence intervals for the mean:
        90% (  35.135 -    41.841)
        95% (  34.480 -    42.496)

Percentiles
10.000   :      9.273119
Median   :     39.468201
90.000   :     63.625122
```

This density function can then be used to determine the frequency of exceedance for each cross-section of a channel, one for the port extremity and another one for the starboard extremity. Figure 8.4 and Figure 8.5 show the density function of both extremities on two different cross-section of the channel (resp. 2000 m and 4000 m). The two thick lines show the boundaries of the channel as determined using the CDR-calculations.

Figure 8.3
Distribution of
exceedances

——— Port
.... Starboard

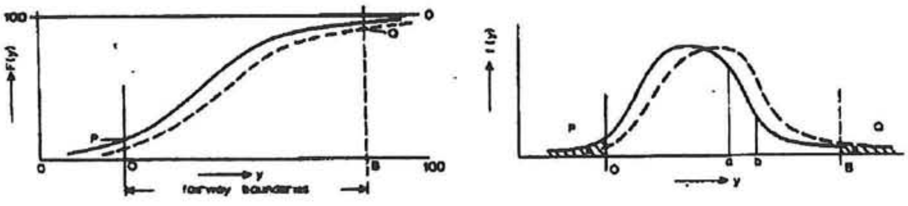


Figure 8.4
Probability
Density Function
of the Port and
Starboard
Extremities
(on x = 2000 m)

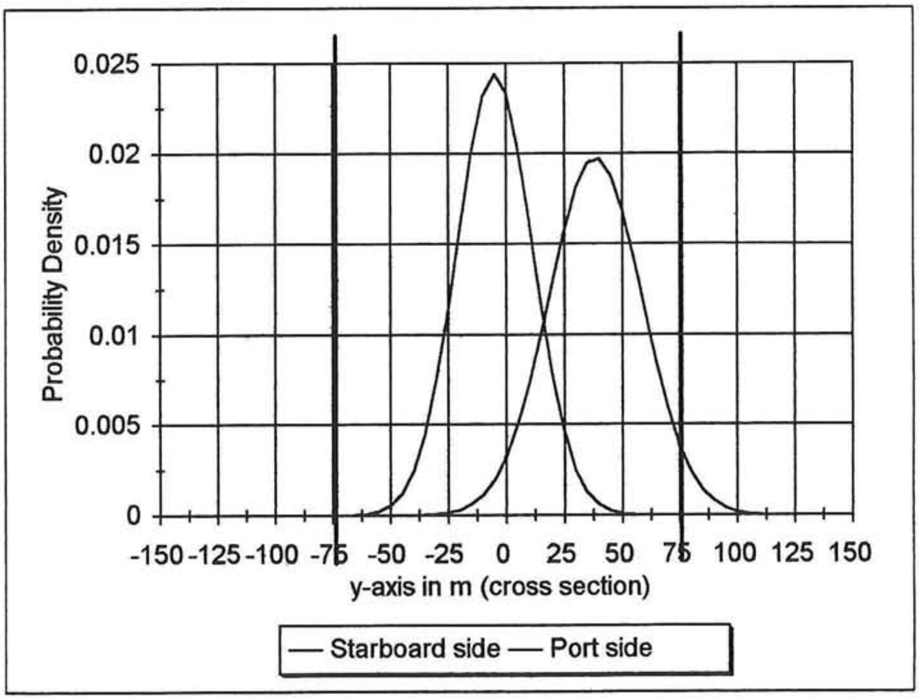


Figure 8.5
Probability
Density Function
of the Port and
Starboard
Extremities
(on x = 4000 m)

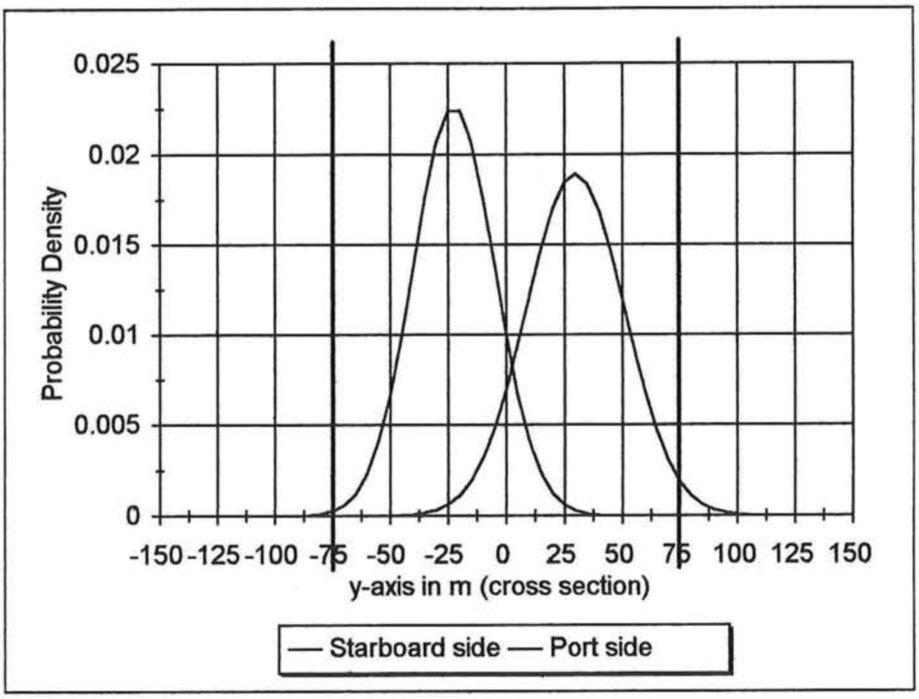
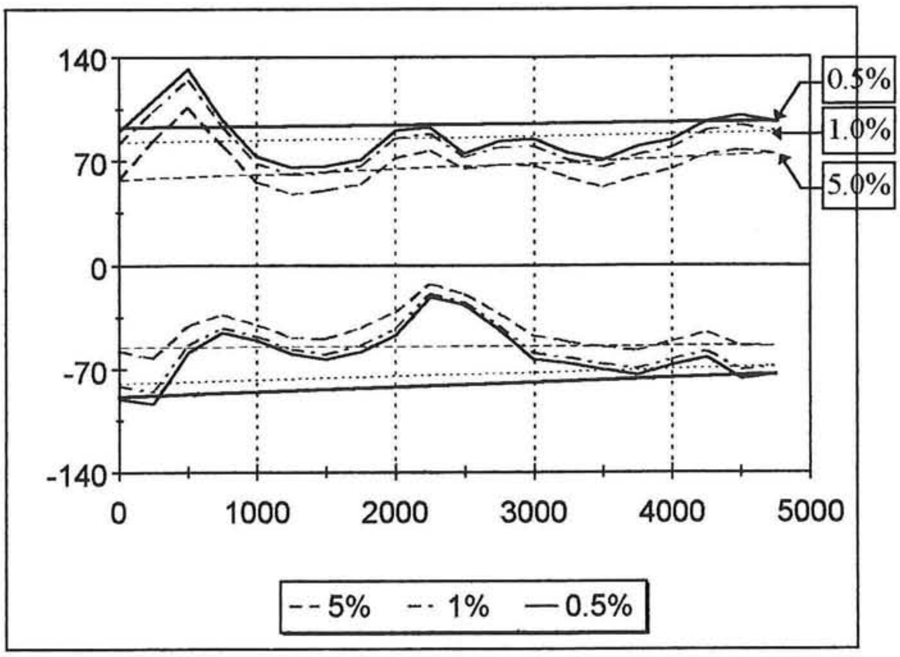


Figure 8.6 shows the position of a variation of exceedance frequencies (5%, 1% and 0.5%) all along the channel. This figure help visualise both the numbers and the "safety boundaries" of the channel. For more on this approach, see [5].

Figure 8.6
Frequency of
exceedance



When a fluctuating line of one frequency, say 5%, is replaced by one straight line, drawn using the average value of means and average value of deviation; and when an area limited by two lines of the same frequency (one on the port side and the other on the starboard side), a certain manoeuvring path can be estimated (see Figure 8.7).

The straight line is drawn using density function described as follows:

$$P(y) = \bar{\sigma} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(\frac{y - \bar{\mu}}{\bar{\sigma}})^2}$$

Equation 8.3

Where:

y = a value on the y-axis (cross-section)

$\bar{\mu}$ = average value of mean of all y-values

$\bar{\sigma}$ = average value of standard deviation

The average values of the means and the deviations are calculated as follows:

$$\bar{\mu} = \frac{\sum \mu}{n}$$

$$\bar{\sigma} = \frac{\sum \sigma}{n}$$

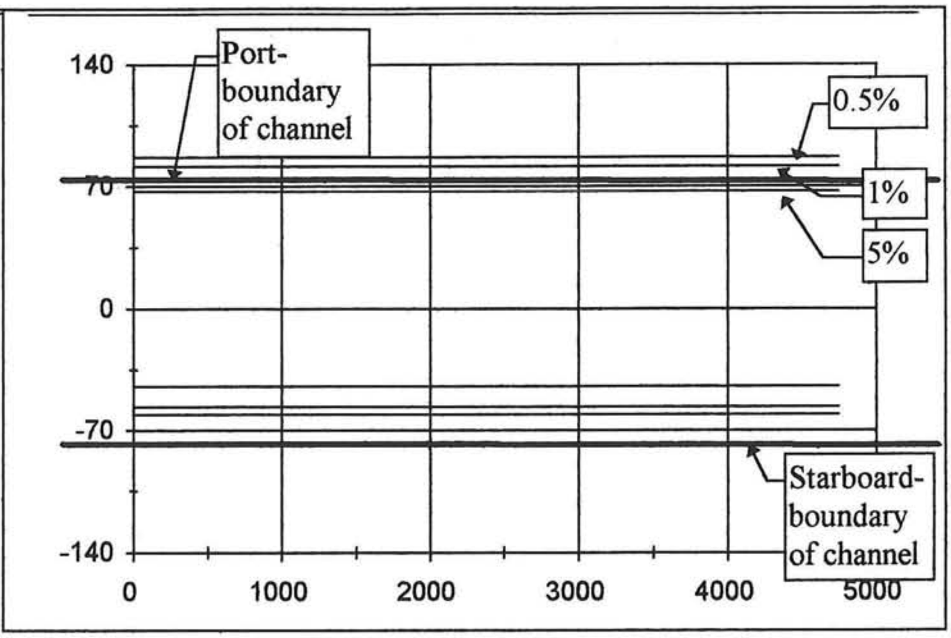
with n = number of data

The thick lines in the figure show the boundaries of the manoeuvring area in the channel as calculated using the Concept Design Rules (CDR-area). The figure shows that the manoeuvring area with 5% chance of exceedance falls nicely within the CDR-calculated areas.

The port side boundary of 1% chance of exceedance falls slightly outside CDR-area.

This leads to the conclusion that the lower the chance of exceedance gets, the wider the manoeuvring path becomes. At the end the result of a probabilistic method is a wider channel than the one calculated using CDR. This is not too surprising. In general, probabilistic calculations lead to larger width than deterministic calculations (see also Figure 8.8 and [6]). Strating and Koeman have even gone much further and made the statement: “Rules of thumb give quick relief, but low satisfaction.”[7].

Figure 8.7
The manoeuvring area



The fluctuating lines, however, make one important point clear. That is the probability that the channel boundaries would be exceeded more than once, on various places, during one channel transit. Therefore, the risk of running aground in a channel transit cannot be calculated by simply adding up the total risks of the channel sections.

The risk of grounding itself can be calculated as follows[5]:

$$\Pr\{g\} \;=\; \frac{n_r}{n_c} \text{ x } \sum (\Pr\{\underline{y}_{\text{port}} < 0\} + \Pr\{\underline{y}_{\text{starboard}} > b\})$$

Equation 8.4

Where:

$\Pr\{\text{ship aground in cross section}\} \;=\; \Pr\{\underline{y}_{\text{port}} < 0 \text{ or } \underline{y}_{\text{starboard}} > b\}$

$\underline{y}_{\text{port}}$ = the distance of ship’s port extremity to the port boundary of the channel

$\underline{y}_{\text{starboard}}$ = the distance of ship’s port extremity to the port boundary of the channel

n_r = the total number of runs in which grounding occurs

n_c = the total number of channel boundary exceedances in the cross-sections

In other words, the risk of grounding is the total of all chance of exceedance on both boundaries times the total number of runs in which grounding occurs (n_r) and divided by the total number of exceedances (n_c).

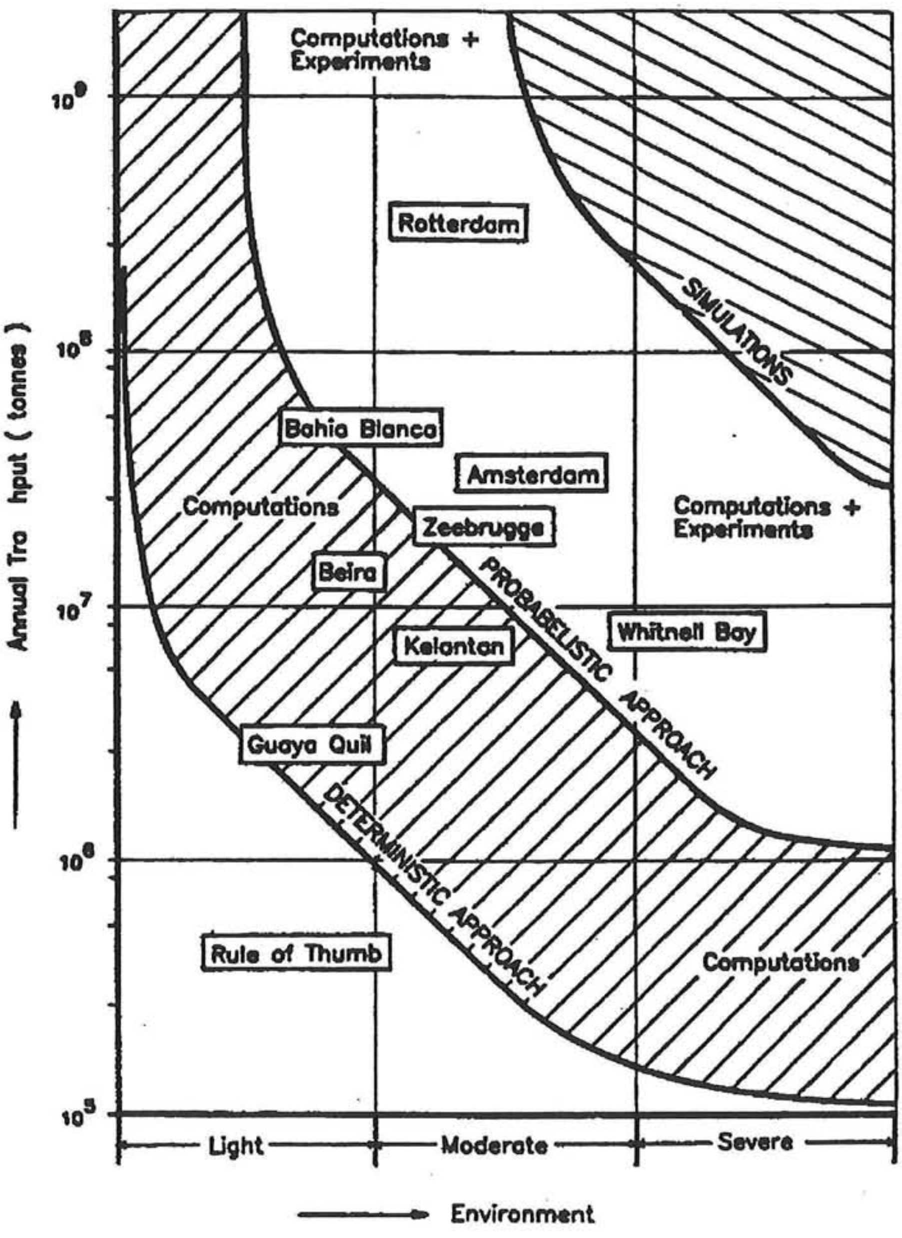


Figure 8.8 Design approach as a function of annual throughput and environmental conditions

(source: [6])

		Light	Moderate	Severe
definiation environment =	wave conditions	0<Hs<1m	1<Hs/3m	Hs>5m
	wind conditions	0<U<10m/s	10<U<17,5m/s	U>17,5m/s
	type of cargo	gen.cargo	oil	lng*
	bottom material	mud	sand	rock

REFERENCES:

[1] Joint Working Group 30, *Approach Channels: A Guide for Concept Design*, PIANC/IAPH/IMPA, London, United Kingdom, 1993.

[2] Slootweg, H.E., *IJgeul te IJmuiden*, final assignment report (draft version), Haarlem.

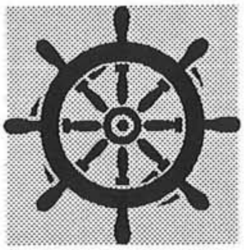
[3] Hydro meteo adviesdienst IJmuiden (Rijkswaterstaat directie noord-holland), tijdpoortinformatie, June 22, 1994.

[4] Doorn, Ir. J.T.M. van, personal communication: letter ref. MO004/94/JD/05480, MSCN, Wageningen, the Netherlands, 1994.

[5] Strating, Ir. J. and Koeman, Ir. J.W., *Dimensioning of access channels: techniques and research means*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 4, pages 56-62.

[6] Weide, Ir. J. van der, *Design of Navigation Channels: General Introduction*, Cursus: Toegangsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 2.

[7] Section 2.1 of [5].



9. Discussion of the Results

9.1. General

This Chapter is to discuss the results involved in this study. First of all, the output from COLUMBUS simulation program will be discussed. This output becomes crucial input for the RandSail model. This model uses the Columbus output to simulate the role of the human observer in estimating distances. Further, the output from SHIPMA simulations will also be discussed. This output is used to simulate the second role of a human navigator, which is controlling the manoeuvre. Last of all, the results of the RandSail model itself will be presented and discussed.

9.2. COLUMBUS Output

As already discussed in Chapter 3, COLUMBUS produces the length of the so-called short-axis and long-axis of the ellipse of the 68%-confidence region. The value of each length is the standard deviation of the distribution. One set of output is already presented in the Chapter 7. The remainder of the output can be found in Appendix A.1.

The lengths of both the long and short axis can be transformed into the possible minimum and maximum estimated distance to the centre line (using the orientation of the ellipse). When transformed, the results will be as presented in Table 9.3 and Table 9.4. Figure 9.2 is the graphic presentation of these results with the ship on y = -210 m and Figure 9.3 with the ship on y = +210 m. For more graphs, see also Appendix A.1.

The following can be said about the output of the COLUMBUS simulations:

1. The lengths of both the short and the long axis get smaller as the ship comes nearer to a beacon. See Figure 9.4. This is in

agreement with the reality. The pilot's estimation of his position in relation with a beacon becomes more accurate as he comes closer to the beacon[1].

2. As shown in Figure 9.2 and Figure 9.3, the actual distance from the ship to the centre line falls within the range of the minimum and maximum estimated distance. The only thing that still matters is the fact that the values can be surprisingly huge (see also the far right part of these figures).
   These values are basically the standard deviation of the distribution. Later in RandSail model these values are used to generate random values for the estimated position. The random values may be even larger than the standard deviation. The value can be much too large to be realistic. Therefore it is crucial to, from time to time, one way or another, reduce the generated random values.

3. After the ship has passed the pair of buoys, the lengths of both the short and the long axis become larger. In the calculations, beside the pair of buoys, the leading line is also included. Although the leading line is present, the results of the COLUMBUS simulations do not show that the estimations become more accurate.
   This may have been caused by the fact that in its calculations, a Columbus navigator doesn't "look back" to the two buoys he just passed. After he passed the buoys, the only reference he has is the leading line and it doesn't help much in estimating his position.

9.3. Adjustments in COLUMBUS Output

The earlier mentioned conclusions lead to a crucial question:
Do the relatively large values of COLUMBUS output have any effect on the results of RandSail calculations that depend for a great deal on them?
In order to answer this question, a series of RandSail runs were executed. The results are as shown in the following listed figures:

Figure nr.	Description
Figure 9.6	RandSail calculation with given Columbus' Standard Deviation
Figure 9.7	RandSail calculation with 1/2 of Columbus' Standard Deviation
Figure 9.8	RandSail calculation with 1/4 of Columbus' Standard Deviation
Figure 9.9	RandSail calculation with 1/8 of Columbus' Standard Deviation

Figure 9.6 shows RandSail simulation runs using the standard deviation values as they are given by COLUMBUS. This figure shows that the resulting simulated manoeuvres deviated significantly from the centre-line. This is not in accordance to the real-life ship manoeuvre. The reality is, as Van Dijk[2] quoted Oldenkamp (1973[3]), ships often

tend to sail *close* and *parallel to* the centre-line. For that matter, SHIPMA simulations have shown the capability of the program to perfectly simulate the real-life manoeuvre.

Therefore, it is clear that the large values of the standard deviation do have serious effect on the results of RandSail. In other words, the values of the standard deviation as produced by COLUMBUS must be adjusted in one way or another.

In order to approach the real-life manoeuvre (sailing *close* and *parallel to* the centre-line) as close as possible attempts have been made to reduce the values of standard deviation to be used by RandSail. The values are reduced first by one half (Figure 9.7) and then by one-fourth (Figure 9.8), and finally by one-eight (Figure 9.9).

These results, as shown in the figure, have led to the conclusion that despite the large magnitude of COLUMBUS output, reducing them by one half is already enough. Therefore, the RandSail model by default reduces the input values from COLUMBUS by 50%.

9.4. Switches for RandSail

The fact that 50% reduction is sufficient doesn't stand on its own. It is also a result of the usage of a number of the so-called switches. When COLUMBUS produces a standard deviation of, say nearly 200 m (see Table 9.3) while the actual distance to the centre-line is merely 70 m, the generated random number can be even larger. The switches are used to basically limit the magnitude of the random number.

Without these switches, a reduction of COLUMBUS standard deviation by one-eight is not enough. See example given in Figure 9.1 below. This figure shows how extremely far the simulated ship can sail from the centre- line.

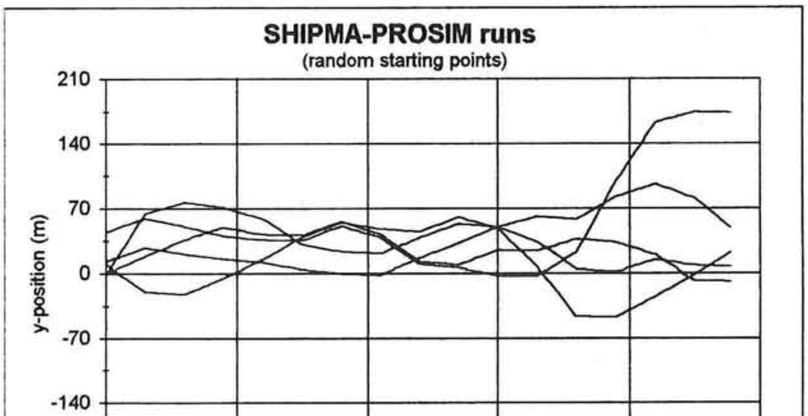


Figure 9.1 Sample results of RandSail calculations using 1/8 of standard deviation, without switches.

The following switches are used:

Table 9.1
Switches in RandSail: description and the argument for using them

Switch nr	Description and Argument for using it
1	On the Port side (positive) of the centre line, the values of the random number must be positive. Similarly, on the Starboard side (negative), the values must be negative. This is essential since a random number generated by PROSIM can be either positive or negative regardless the position of the ship. In reality, when a pilot is steering his ship on one side of the centre-line, it is unlikely that he would estimate his position to be on the other side of the line. This switch makes sure that RandSail model would not make such an estimation either.
2	Estimating a distance by more than two times the ship's breadth (2*B) is, in real-life situation, highly unlikely. Especially because in reality a skipper has the leading-line to his disposal, this kind of error is quite unthinkable. The reality is, once again, a ship tends to sail *close* and *parallel to* the centre-line. Therefore, for all random numbers with a value between 70 m and 140 m (in absolute value), this switch reduces the value by 50%.
3	For the same reason as switch nr. 2, for all random numbers with a value larger than 140 m (in absolute value), this switch reduces the value down to only one-third.

The effects of the switches on the RandSail calculations are shown in figures listed in Table 9.2 below. A variety of combinations is tried out and therefore a variety of results is obtained. These results have led to the conclusion that RandSail calculations work more effective in approaching the real-life situation when all switches are used.

Table 9.2

Figure nr.	Switches used		
	Switch 1	Switch 2	Switch 3
Figure 9.10	yes	yes	yes
Figure 9.11	yes	yes	no
Figure 9.12	yes	no	no
Figure 9.13	no	no	no

Table 9.3
Minimum Estimated Distance to the Leading Line (m)

Position on x-as	Actual Distance to Centre Line (in m)						
	-210	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
0	-313	-240	-167	-95	-23	65	148
500	-343	-267	-191	-113	-34	68	157
1000	-357	-278	-198	-116	-31	55	169
1500	-354	-273	-190	-105	-17	72	164
2000	-331	-249	-166	-82	7	97	190
2500	-344	-263	-180	-94	-6	85	177
3000	-358	-278	-196	-112	-25	63	175
3500	-353	-275	-197	-117	-35	49	164
4000	-331	-256	-182	-107	-31	65	152
4500	-310	-238	-166	-94	-10	67	146
5000	-342	-267	-190	-113	4	75	147
5500	-358	-279	-199	-90	-13	67	149
6000	-358	-276	-174	-94	-11	76	166
6500	-339	-241	-160	-77	9	98	190
7000	-347	-265	-181	-95	-6	86	178
7500	-379	-294	-208	-120	-31	60	182
8000	-419	-329	-239	-149	-58	31	161
8500	-442	-352	-262	-172	-82	48	145
9000	-463	-373	-284	-194	-63	30	128

Table 9.4
Maximum Estimated Distance to the Leading Line (m)

Position on x-as	Actual Distance to Centre Line (in m)						
	-210	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
0	-107	-40	27	95	163	215	272
500	-77	-13	51	113	174	212	263
1000	-63	-2	58	116	171	225	251
1500	-66	-7	50	105	157	208	256
2000	-89	-31	26	82	133	183	230
2500	-76	-17	40	94	146	195	243
3000	-62	-2	56	112	165	217	245
3500	-67	-5	57	117	175	231	256
4000	-89	-24	42	107	171	215	268
4500	-110	-42	26	94	150	213	274
5000	-78	-13	50	113	136	205	273
5500	-62	-1	59	90	153	213	271
6000	-62	-4	34	94	151	204	254
6500	-81	-39	20	77	131	182	230
7000	-73	-15	41	95	146	194	242
7500	-41	14	68	120	171	220	238
8000	-1	49	99	149	198	249	259
8500	22	72	122	172	222	232	275
9000	43	93	144	194	203	250	292

Figure 9.2
Minimum and Maximum Estimated Distance to the Centre Line

ship position:
y = -210 m

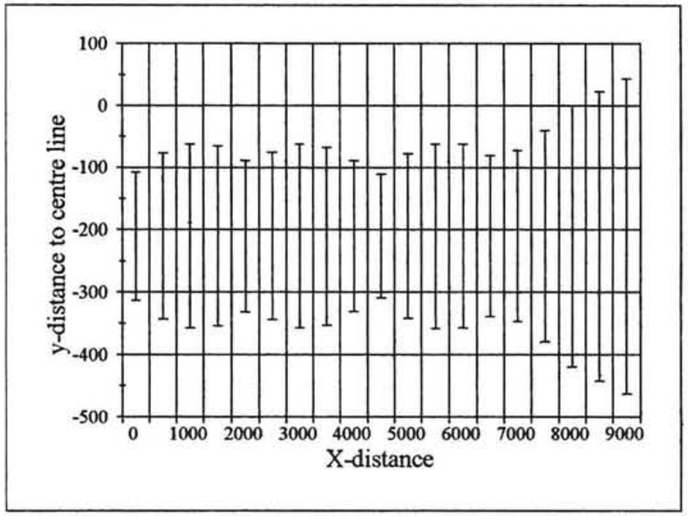


Figure 9.3
Minimum and Maximum Estimated Distance to the Centre Line

Ship position:
y = +210 m

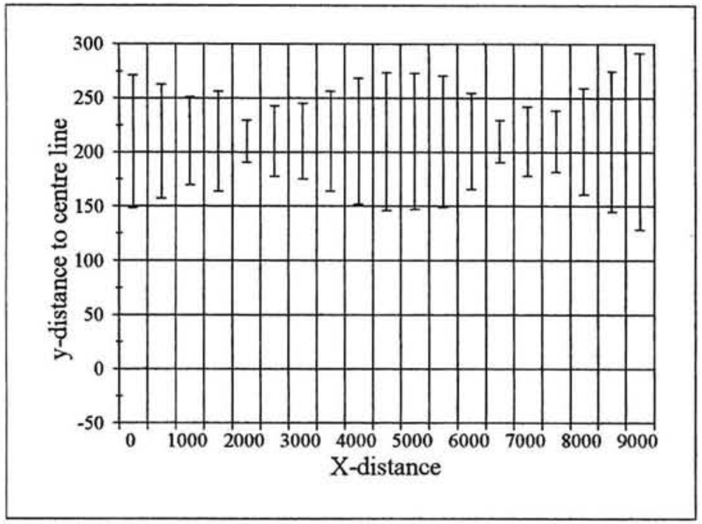


Figure 9.4
Length of the long-axis of the ellipse

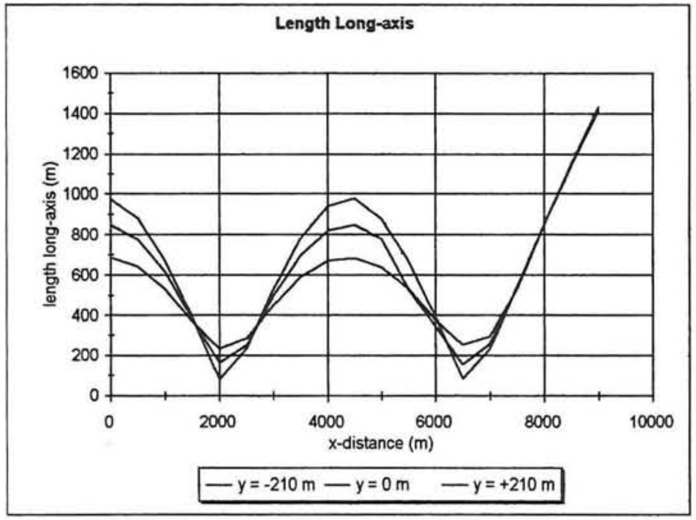


Figure 9.5
Length of the short-axis of the ellipse

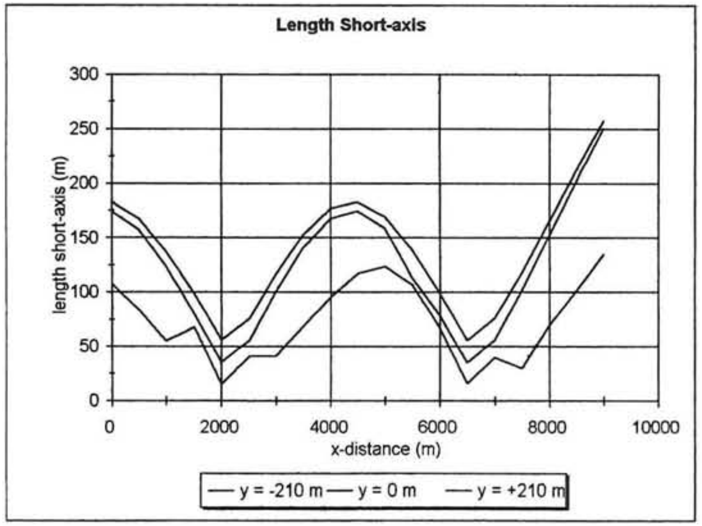


Figure 9.6
RandSail calculation with given COLUMBUS' Standard Deviation

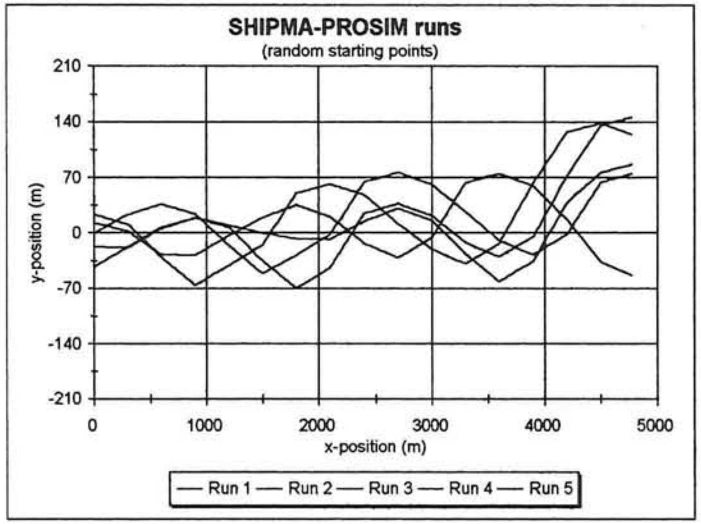


Figure 9.7
RandSail calculation with 1/2 of COLUMBUS' Standard Deviation

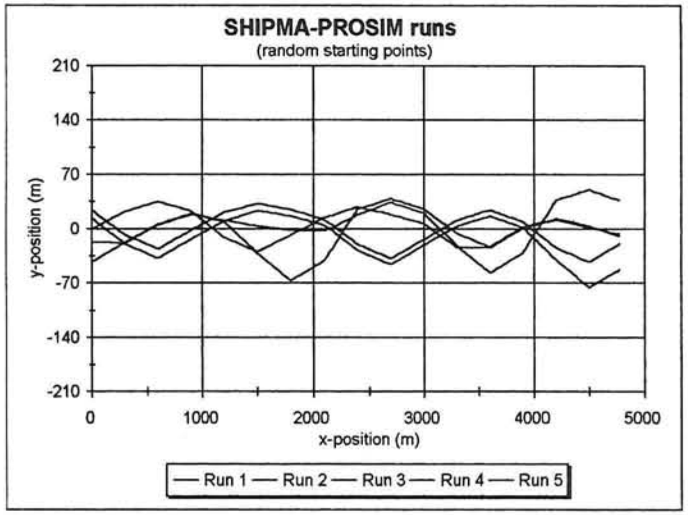


Figure 9.8
RandSail calculation with 1/4 of COLUMBUS' Standard Deviation

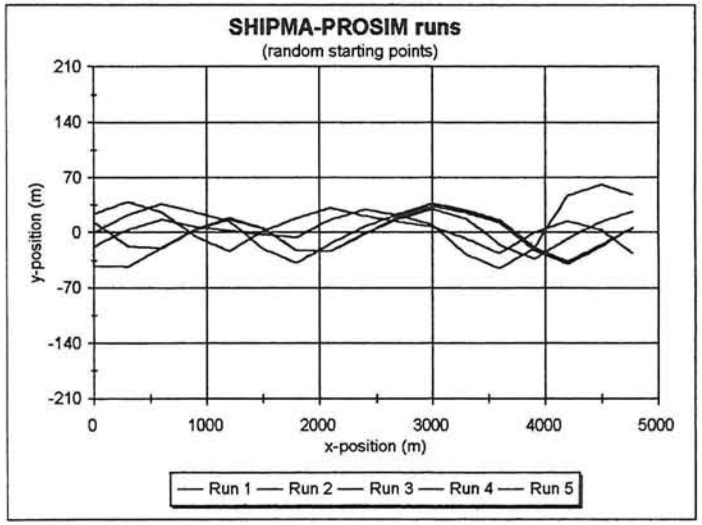


Figure 9.9
RandSail calculation with 1/8 of COLUMBUS' Standard Deviation

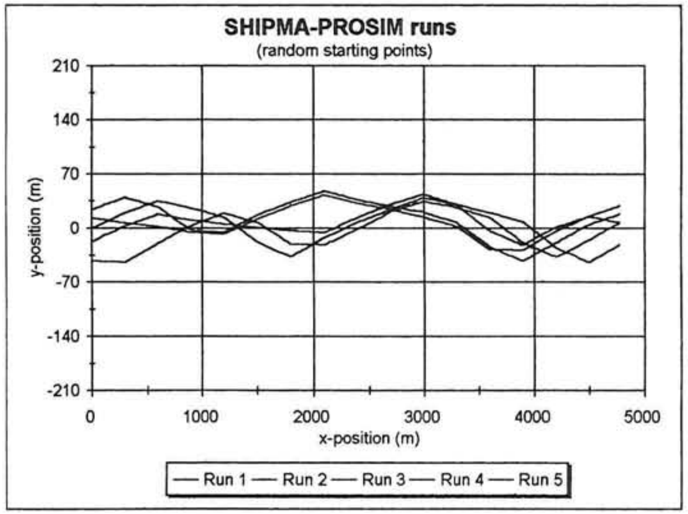


Figure 9.10 RandSail calculation with 50% reduction of COLUMBUS' Standard Deviation and with the complete set of switches

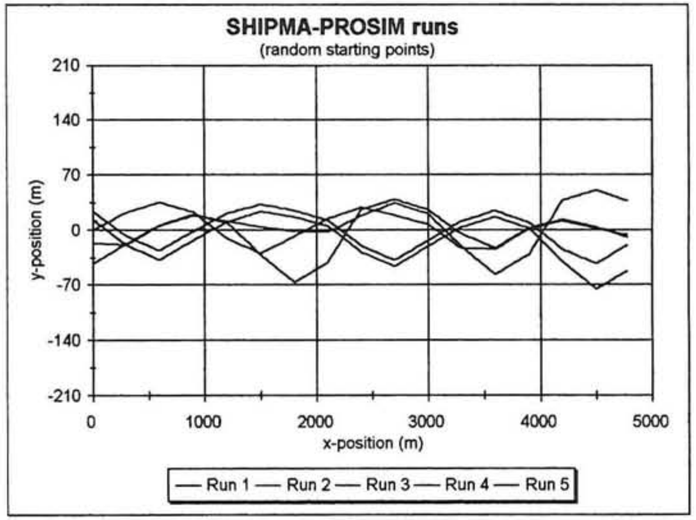


Figure 9.11 RandSail calculation with 50% reduction of COLUMBUS' Standard Deviation and with switches nr. 1 and 2

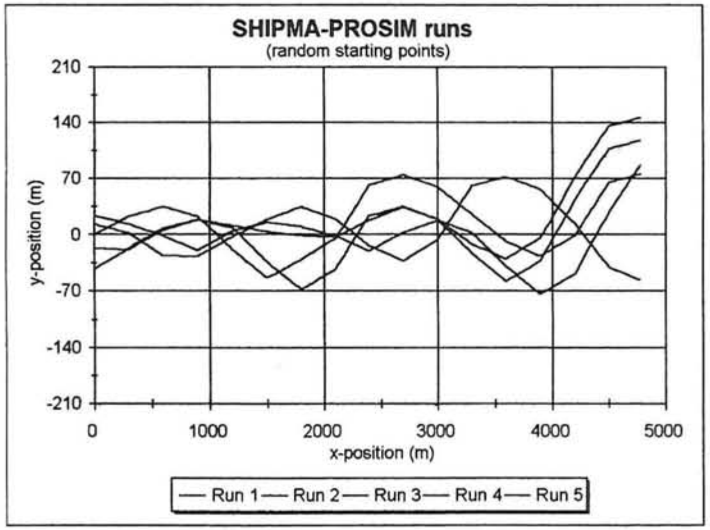


Figure 9.12 RandSail calculation with 50% reduction of COLUMBUS' Standard Deviation and with only switch nr. 1

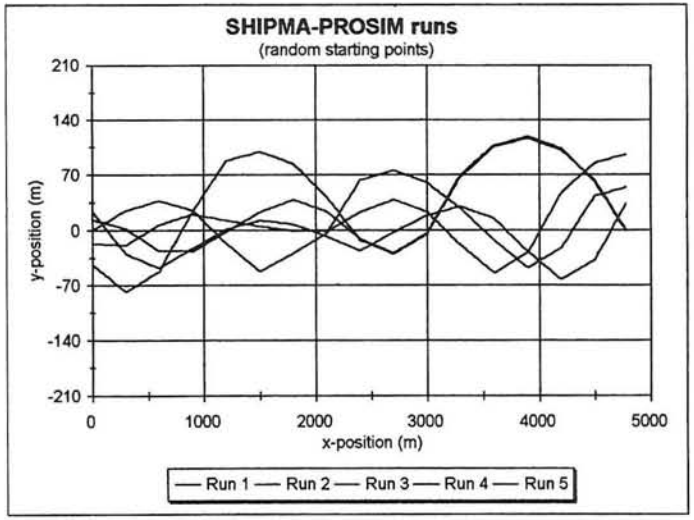
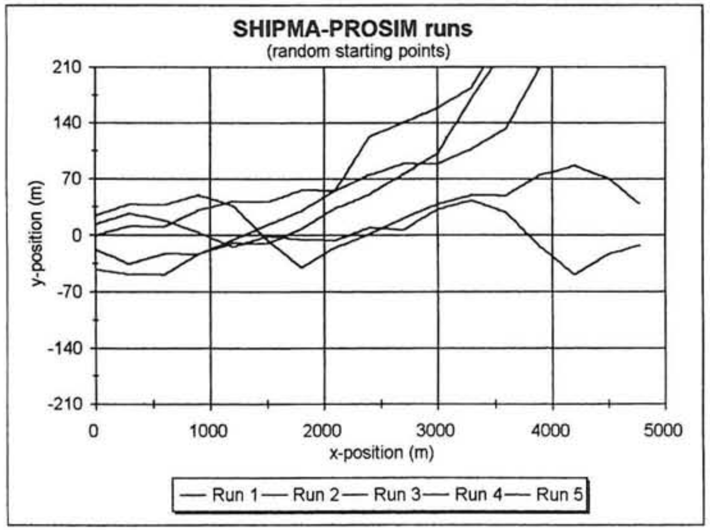


Figure 9.13 RandSail calculation with 50% reduction of COLUMBUS' Standard Deviation and without switches at all



9.5. SHIPMA Output

From 2450 different runs made in SHIPMA, the following can be concluded:

1. Variation in the value of ship's heading makes a significant difference in the ship's manoeuvring behaviour. See the figures in Table 9.5.

2. Each figure in Table 9.5 shows a set of seven manoeuvres with a constant rate-of-turn. Only the ship's heading varies. The line on the top is the manoeuvre with the heading ψ = -15 deg and the one at the bottom has a heading ψ = +15 deg.

   A comparative study on these figures will lead to the following conclusions:

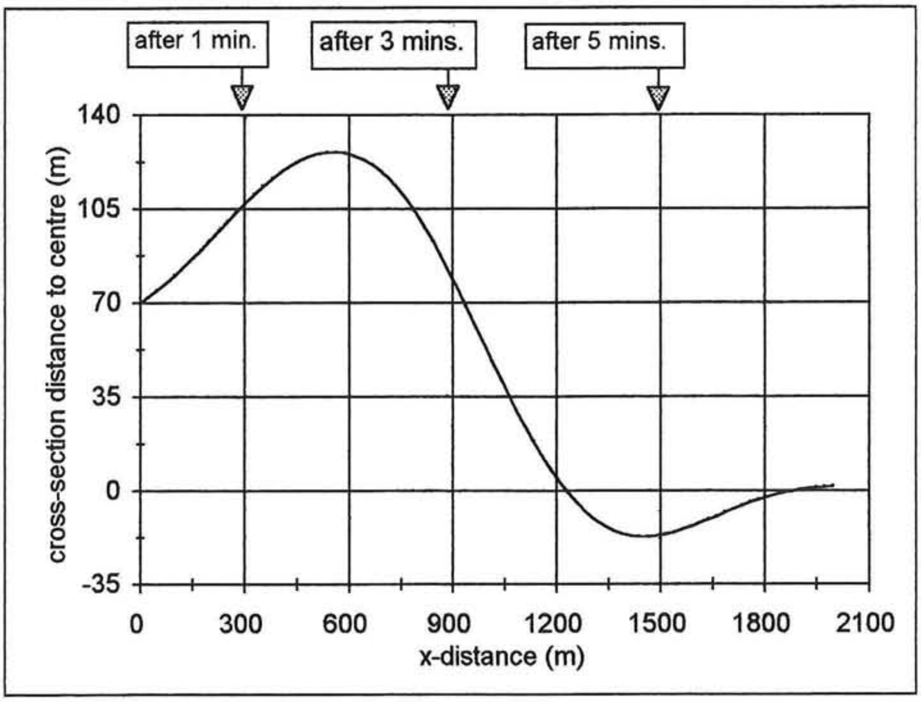
   - In general, starting heading between -15 and 0 degrees ($-15<\psi<0$) will cause the ship to manoeuvre even further from the centre line. In absolute values, the heading also becomes larger. For safety reasons, any heading angle (in relation with the desired track) larger than the absolute value of 15 is not desirable[4].
   - Some starting heading between 0 and +15 degrees ($0<\psi<15$) does cause the ship to manoeuvre closer to the centre line. As a matter of fact, the heading becomes smaller than the initial heading.
   - The larger the absolute value of rate-of-turn in the negative direction gets, the further the ship diverts from desired track. (See also Figure 9.16, Figure 9.17, and Figure 9.18)
   - On the other hand, the larger the rate-of-turn value in the positive direction, the closer the ship comes to the desired track (see also Figure 9.18, Figure 9.19, and Figure 9.20).

   This diverging manoeuvring behaviour as produced by SHIPMA take place in the initial phase of a manoeuvre. It takes SHIPMA a while before it stabilises the manoeuvre and moves in the desired direction. In that initial phase, the "ship" gets the first shock of its environment and needs a few moments before it finally sails properly. It can be compared with the first few minutes when a remote-control boat is just put on water with current. The boat will be pushed in the direction of the current first before it finally utilises its rudder and/or engine thrust to compensate the force of the current in order to sail in the desired direction.

   Due to the fact that the RandSail model uses only the first one minute of a manoeuvre, RandSail only has the first "unstable" phase of SHIPMA manoeuvre to its disposal.

Figure 9.14 below shows a SHIPMA manoeuvre that lasts for 7 minutes (or approximately 2000 m). In the figure, the time lapsed is indicated. As shown, during the first two minutes, the simulated ship moves in the opposite direction from the desired track. The manoeuvre starts to stabilise after 3 minutes when the simulated ship moves as it is supposed to move from the starting point of +70 m from the centre line.

Figure 9.14
Time-phased SHIPMA manoeuvre



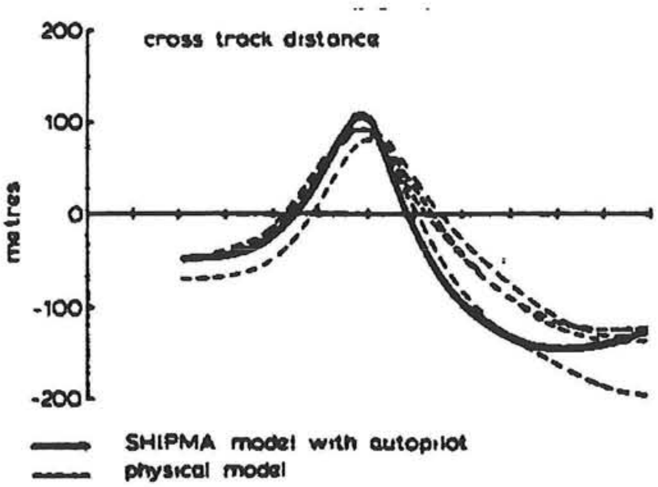
From this figure it can be concluded that using only the first minute of the manoeuvring process is not appropriate. First of all, it is too short to allow SHIPMA manoeuvre to move in the desired direction. Secondly, it is unrealistic as well. In reality, a pilot on a bridge does not evaluate his position every single minute. As a matter of fact, every single change in steering will take more than a couple of minutes before its effects will materialise due to the ship's inertia. Therefore, a pilot simply does not evaluate his position *a la* minute.

Finally, it also should be noticed that SHIPMA manoeuvre is an optimal manoeuvre. In other words, the ship responds as soon as a certain steering action is implemented. Furthermore, the steering action itself is taken at the right timing and in the right proportion. The reality, however, involves the ship's inertia and the delay in and inaccuracy of human response.

Figure 9.15 below shows various manoeuvres of 200,000 dwt tanker[5]. The thick line shows a SHIPMA manoeuvre and the other lines are the real-life manoeuvres.

Figure 9.15
Entrance manoeuvres of 200,000 dwt tanker

(source: [5])



In SHIPMA model, the autopilot corrects the course of the ship much sooner than in reality. This means that a human pilot takes more time than SHIPMA autopilot to judge his position and to respond accordingly.

Table 9.5

Ship's Manoeuvring Behaviour under varying heading and rate-of-turn.

Starting point:
y = 0 m

Ship's Rate-of-turn				
ψ'= -0.3 d/s	ψ'=-0.15 d/s	ψ' = 0 d/s	ψ'= 0.15 d/s	ψ'= 0.3 d/s

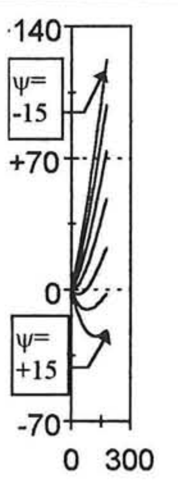
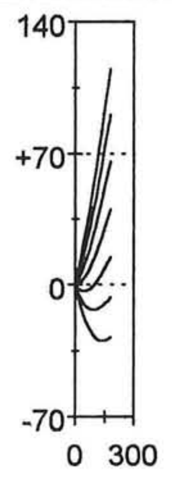
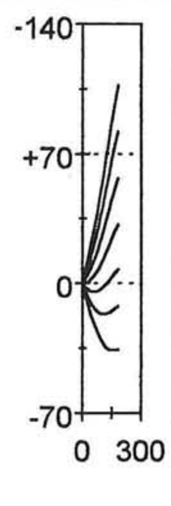
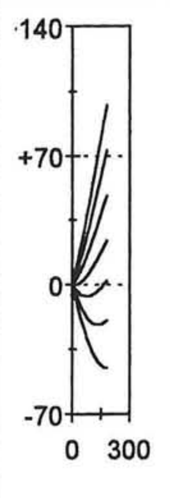
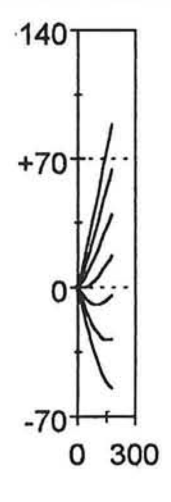

				

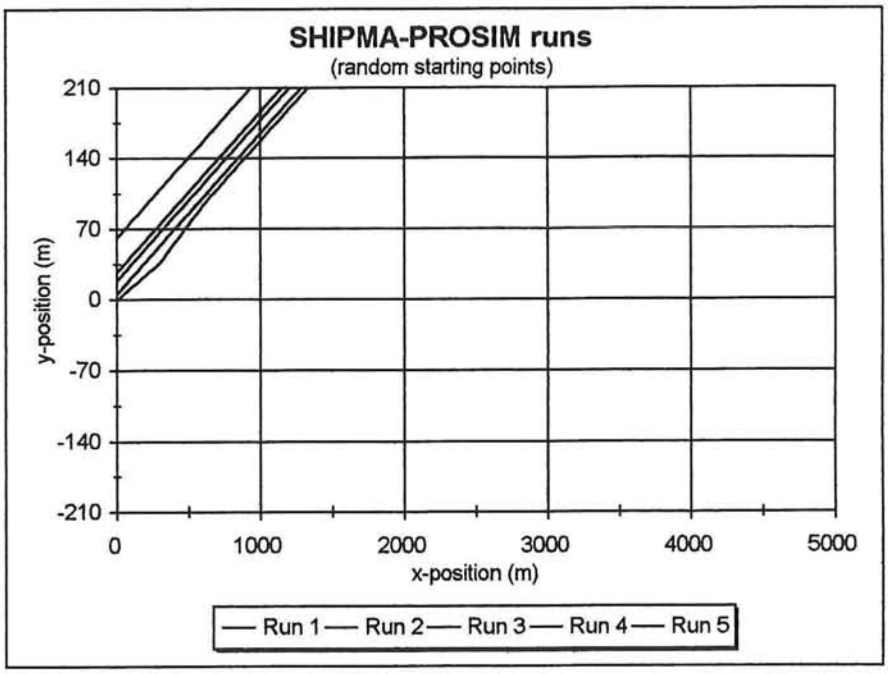
Figure 9.16	Figure 9.17	Figure 9.18	Figure 9.19	Figure 9.20

9.6. RandSail Output

According to the basic algorithm of RandSail, the desired manoeuvre is selected based on (1) the estimated position, (2) the ship's heading and (3) its rate-of-turn at the actual position (see Section 7.4). When this algorithm is followed, the resulted manoeuvre will look as shown in Figure 9.21.

This kind of results are caused by the fact that negative value of ship's heading at the beginning of a manoeuvre will lead to larger absolute values of the heading, as discussed in Section 8.3. As a result, the ship will sail further away from the centre line.

Figure 9.21
An example of RandSail Runs without special facilities



9.7. Extra Facilities in RandSail

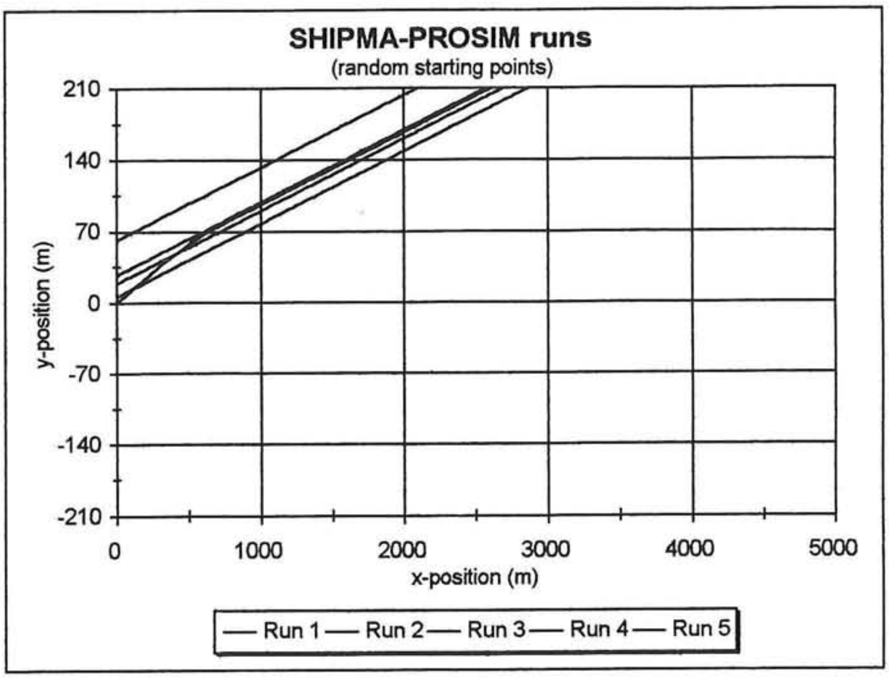
Considering the facts given in Section 8.3, possible solutions can be found in equipping RandSail with facilities that will enable it to select a manoeuvre that is more appropriate rather than the manoeuvre selected according to the basic algorithm. When the ship's heading is negative, say -10 degrees, and the rate-of-turn is also negative, say -0.3 deg.s., then the manoeuvre will be as shown in Figure 9.16. This manoeuvre, however, brings the ship further from the desired track. Another problem is that the resulting heading at the end of the manoeuvre is even larger (in absolute value) than the start heading.

An appropriate manoeuvre must (1) always strive to minimise the distance from the ship to the centre line (or the desired track), and (2) have a heading less than 15 degrees (in absolute value) at the end of the manoeuvre. This manoeuvre is already available in the input sources and the only thing that has to be done is that RandSail has to select it. The objective of the extra facilities is to enable RandSail select the appropriate manoeuvre.

9.7.1 Extra Facility: ship heading adjustment

One of such extra facilities enables RandSail to select a smaller absolute value of heading when the heading appears to be negative. For instance, when the heading is -15 degrees, RandSail will select a manoeuvre with start heading of -10 degrees. The result of this solution is shown in Figure 9.22. Unfortunately, the results are not much better than without this facility.

Figure 9.22
An example of RandSail Runs with only "heading-adjustment" facilities

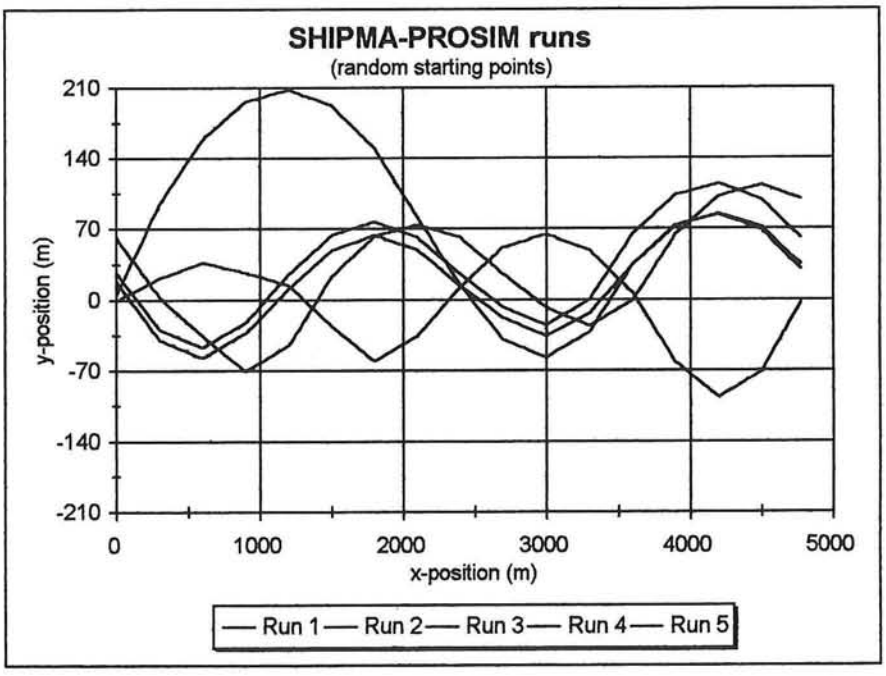


9.7.2 Extra Facility: rate-of-turn adjustment

Another type of facility. This facility is to enable RandSail, when both the heading and the rate-of-turn appear to be negative, to select a manoeuvre with a positive rate-of-turn. For instance, when the rate-of-turn is -0.15 deg/s to select +0.3 deg/s instead.

The result of this approach is shown in Figure 9.23. The manoeuvres start to look like the manoeuvres in reality where a ship will swing about the centre line. The deviation from the centre line, however, can be very large.

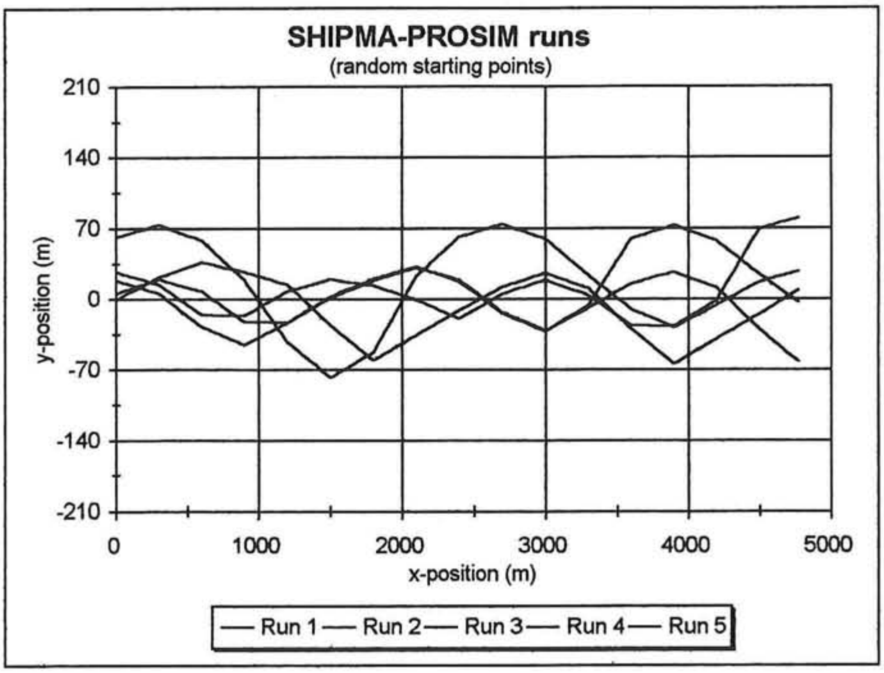
Figure 9.23
An example of RandSail Runs with only "rate-of-turn adjustment" facilities



9.7.3 A combination of extra facilities

In order for RandSail to simulate a real-life manoeuvring situation, the resulted manoeuvre must not deviate too far from the desired track and the ship swings about the desired track. RandSail has come close to this objective using the second extra facility which adjusts the given rate-of-turn. This has led to another solution, which is a combination of both extra facilities. The results look as shown in Figure 9.24 and they look even better.

Figure 9.24
An example of RandSail Runs with complete special facilities (both heading and rate-of-turn adjustments facilities)

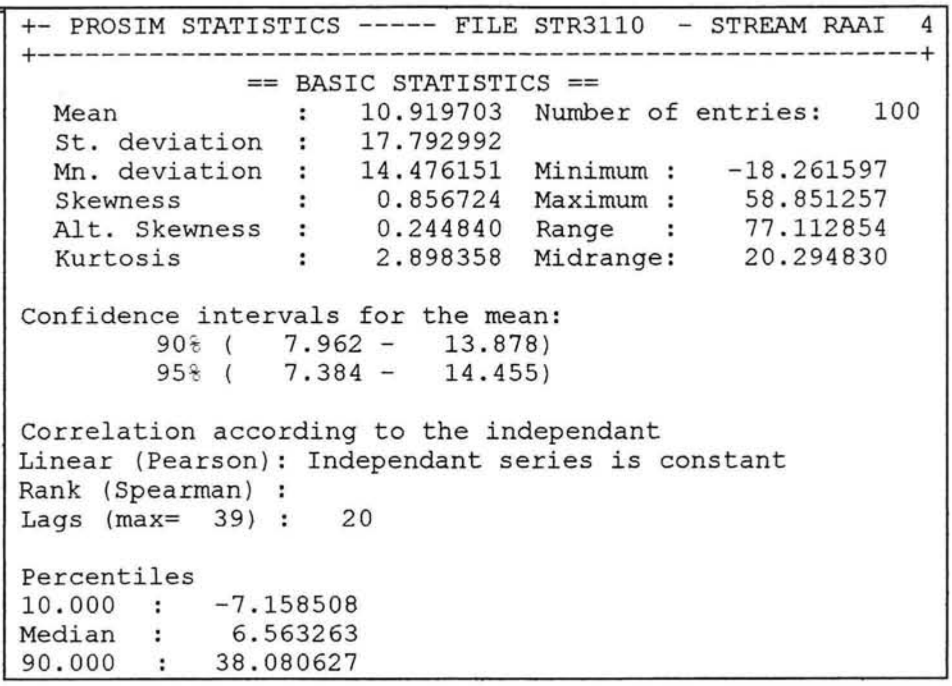


9.8. Final Results of RandSail approach

To analyse the results, RandSail produces statistics at every 250 m. The model simulates the manoeuvres over a distance of 4800 m. There are a total of 19 positions along the track for which statistics are produced.

PROSIM, the environment software in which the RandSail model is written can produces a variety of statistics (see Chapter 5). One of them is the basic statistics of the position of the ship's centre point on the x-distance of 1000 m (see Figure 9.25). This statistics provides a set of data, including the mean of the position, the standard deviation, and the 90% and 95% confidence interval. The same statistics can be presented using a histogram (see Figure 9.26).

The statistics show the mean position of 11 m and standard deviation of 18 m. Considering the ship's dimensions (width = 32.2 m), these numbers are acceptable..



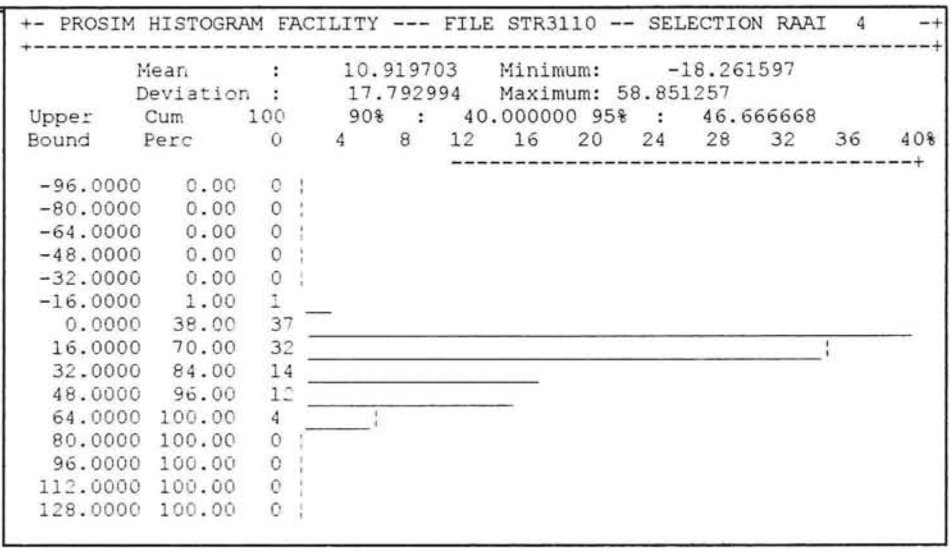
```
+- PROSIM STATISTICS ----- FILE STR3110  - STREAM RAAI  4
+-------------------------------------------------------+
                  == BASIC STATISTICS ==
  Mean            :    10.919703  Number of entries:   100
  St. deviation   :    17.792992
  Mn. deviation   :    14.476151  Minimum :    -18.261597
  Skewness        :     0.856724  Maximum :     58.851257
  Alt. Skewness   :     0.244840  Range   :     77.112854
  Kurtosis        :     2.898358  Midrange:     20.294830

Confidence intervals for the mean:
        90% (    7.962 -    13.878)
        95% (    7.384 -    14.455)

Correlation according to the independant
Linear (Pearson): Independant series is constant
Rank (Spearman) :
Lags (max=   39) :    20

Percentiles
10.000   :    -7.158508
Median   :     6.563263
90.000   :    38.080627
```

Figure 9.25
An example of PROSIM statistics of RandSail runs



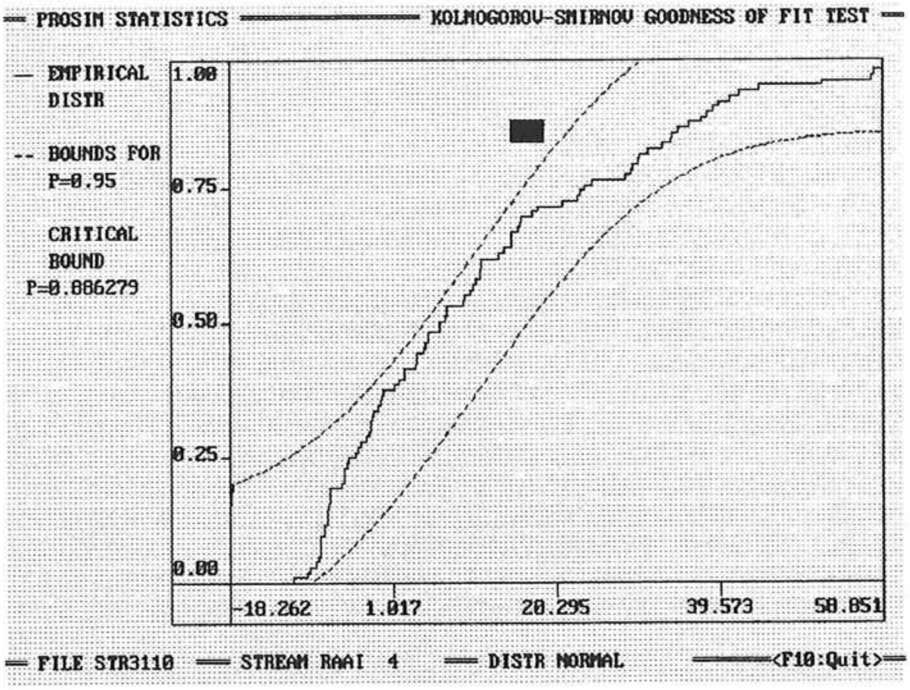
```
+- PROSIM HISTOGRAM FACILITY --- FILE STR3110 -- SELECTION RAAI  4       -+
+-------------------------------------------------------------------------+
              Mean        :      10.919703   Minimum:       -18.261597
              Deviation  :      17.792994   Maximum: 58.851257
Upper      Cum        100       90%   :   40.000000 95%   :   46.666668
Bound      Perc         0     4     8    12    16    20    24    28    32    36    40%
                                         ----------------------------------+
 -96.0000     0.00      0 |
 -80.0000     0.00      0 |
 -64.0000     0.00      0 |
 -48.0000     0.00      0 |
 -32.0000     0.00      0 |
 -16.0000     1.00      1 __
   0.0000    38.00     37 ____________________________________________________
  16.0000    70.00     32 ____________________________________________ |
  32.0000    84.00     14 ____________________
  48.0000    96.00     12 __________________
  64.0000   100.00      4 ______ |
  80.0000   100.00      0 |
  96.0000   100.00      0 |
 112.0000   100.00      0 |
 128.0000   100.00      0 |
```

Figure 9.26
An sample result of PROSIM histogram facility used for RandSail

These results will have to be tested in order to determine the appropriate distribution. PROSIM's Kolmogorov-Smirnov goodness-of-fit test is used towards that end. At the position of x = 1000 m, the goodness-of-fit test shows, see Figure 9.27, that the output data fit the normal distribution well. A "good fit" is when the value of P is close to zero (see also [6] and [7]).

The complete outcome of RandSail approach, including the statistics of all 19 positions along the track, can be found in Appendix A.2.

Figure 9.27
Raai: 4
x = 1000 m



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[1] Wewerinke, Dr.Ir. P.H. and Hove, Ir. D. ten, *Waarnemingsnauwkeurigheid Vaarwegmarkeringsopbjecten*, Project nr. OD052, MSCN, Wageningen, the Netherlands, April 1994.

[2] Dijk, Ir. J.J. van, *Coastal Engineering II: Harbour and Beach Problems*, Department of Civil Engineering, Delft University of Technology, Delft, the Netherlands, January 1986, Chapter 5: Channel Width.

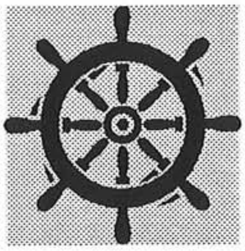
[3] Oldenkamp, I., *Statistical Analysis of Ship's Manoeuvres*, Preprints, Symposium on Ship Handling, Netherlands Ship Model Basin, Wageningen, the Netherlands, 1973 as quoted by Van Dijk in [2].

[4] Bouwmeester, Ir. J., *Binnenscheepvaart en scheepvaartwegen: Havens en scheepvaartwegen I*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, January 1987, Chapter 4.

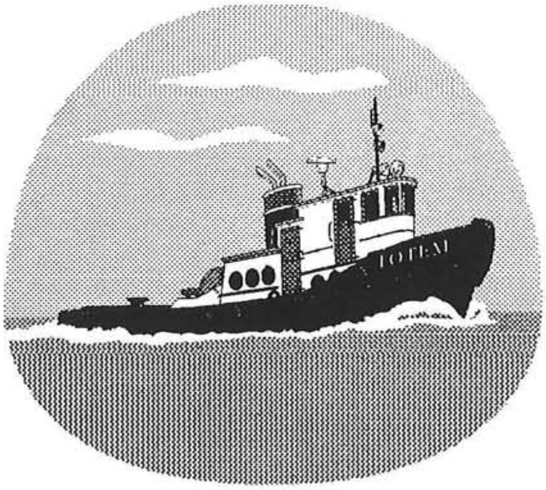
[5] Strating, Ir. J. and Koeman, Ir. J.W., *Dimensioning of Access Channels : Techniques and Research Means*, Cursus: Toeganggsgeulen Havens, PATO, Delft, the Netherlands, 1985, SB 4, page2 51-52.

[6] Sierenberg & de Gans bv, *PROSIM User Guide*, Waddinxveen, the Netherlands, 1993, Chapter 11, page 105-107.

[7] Groenveld, Ir. R., *Service Systems in Ports and Inland Waterways*, Delft University of Technology, Department of Civil Engineering, Delft, the Netherlands, October 1994, Section 7.3.



10. Conclusions and Recommendations



10.1. Conclusions and Recommendations regarding COLUMBUS

As far as COLUMBUS is concerned, the following conclusions can be made:

1. COLUMBUS output has made it possible for the RandSail model to simulate the errors made in human observation of distance.

2. The numbers produced by COLUMBUS, however, are surprisingly large. It has to do with the setup of the program itself, which mainly designed to simulate human observation errors on a given distance to a point of reference. COLUMBUS is a static simulation program as opposed to dynamic.

3. The large numbers have led to certain complications for the RandSail model as discussed in section 9.3 and 9.4. In order to make COLUMBUS output workable for RandSail, a number of switches and adjustments has been devised and implemented. This leads to the conclusion that COLUMBUS' output as it is now, is not suitable enough for an application in a model such as RandSail.

Therefore it is recommended to:

Expand COLUMBUS model with new coefficients to enable COLUMBUS to simulate errors in human observation during a dynamic process of manoeuvring. COLUMBUS itself doesn't have to be a dynamic program. It is thinkable to add a supplementary algorithm for which only elementary variables, such as ship's speed, need to be given. This expansion may bring down the numbers to a more reasonable values. In that case, COLUMBUS output might be directly used in RandSail without using special treatments.

10.2. Conclusions and Recommendations regarding SHIPMA

1. SHIPMA has proven to be a reliable simulation model. Its extensive mathematical model includes a huge number of variables that enable SHIPMA to simulate a manoeuvring process quite precisely.

2. SHIPMA, however, doesn't take the human error in observation into consideration. The result is a perfect manoeuvre. In reality, however, a perfect manoeuvre is not possible due to the errors made by the pilot in estimation his position. These errors effect the way the pilot respond to his present state.

3. The development in the research into the behaviour of a human operator has come quite far and COLUMBUS is basically a mathematical description of such a process resulted from various research. Since the behaviour of the human operator is practically the only thing still missing in SHIPMA model, it may be worth recommending to expand the SHIPMA model with a state-estimation module. This module could be the COLUMBUS model rewritten for SHIPMA.

4. Another shortcoming of the program is the fact that it simulates an optimal system. In a SHIPMA manoeuvre, the autopilot responds promptly and properly to any situation because of its mathematical ability to anticipate and calculate the situation. As a matter of fact, SHIPMA does that, by default, every 5 seconds. In reality, a man-machine system is hardly optimal. The human navigator has a limited capacity to anticipate and calculate a situation. As a result, it takes the human pilot more time and, when an action is finally taken, it is not necessarily sufficient.

5. Beside the perfect autopilot, SHIPMA also simulates a perfect ship that responds promptly to a steering action. In reality, a ship never respond promptly to a steering action due to its inertia. A certain time must have elapsed before the effect of the action materialises.

6. This level of perfection possessed by SHIPMA could be toned down by applying some kind of reducing factors or time-delay in order to simulate human and imperfect manoeuvres.

10.3. Conclusions and Recommendations regarding RANDSAIL

The RandSail model has achieved the following objectives:

1. RandSail model has shown that it is possible to develop a method to generate stochastics using (a number of available) fast-time simulation models.

2. Based on the fact that (a) the manoeuvres produced by the RandSail model have come close to resembling the real-life manoeuvres and that (b) the statistics fit the normal distribution, it can also be concluded that RandSail model has proven to be a sufficient method to generate stochastics needed for probabilistic design of channel width.

Recommendations:

1. At this time, the major area of improvement might be extending the time period between two position-estimating activities. The present RandSail works with a time period of one minute which appeared to be unrealistic. Considering the given SHIPMA manoeuvring behaviour, a more realistic time period should be between 5 and 10 minutes. It is therefore recommended to improve RandSail by using a 5-minute or 10-minute algorithm. This might help eliminate the need for the special facilities.

2. It may be an option to further develop the RandSail model. It is, however, not advisable to continue doing so beyond the suggested improvement. Continuing working on the RandSail model is comparable with trying to reinvent the wheel. As already mentioned in previous sections, suitable models have been developed to simulate the two roles of the human navigator.

   The COLUMBUS model plays the role of the human observer and the SHIPMA model the role of the human controller. RandSail has proven that combining the two models will result in a working model to apply fast-time simulations to generate stochastics. It is therefore highly recommended to combine COLUMBUS and SHIPMA into one model rather than continuing to develop RandSail.

=== End of Report ===

Appendix A: Columbus Output

Figure A. 1
Overview IJgeul

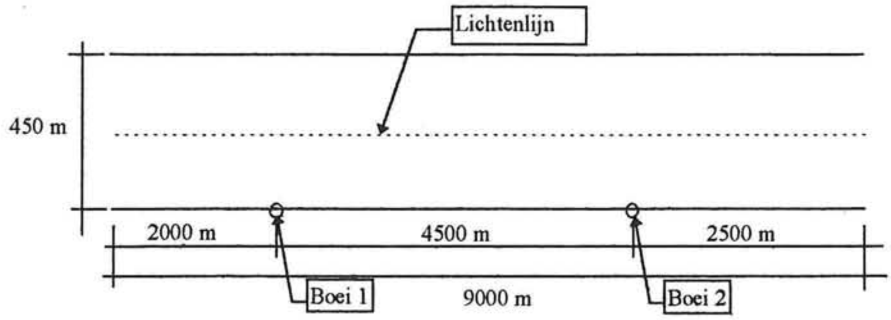


Figure A. 2
Grid system applied in Columbus calculations

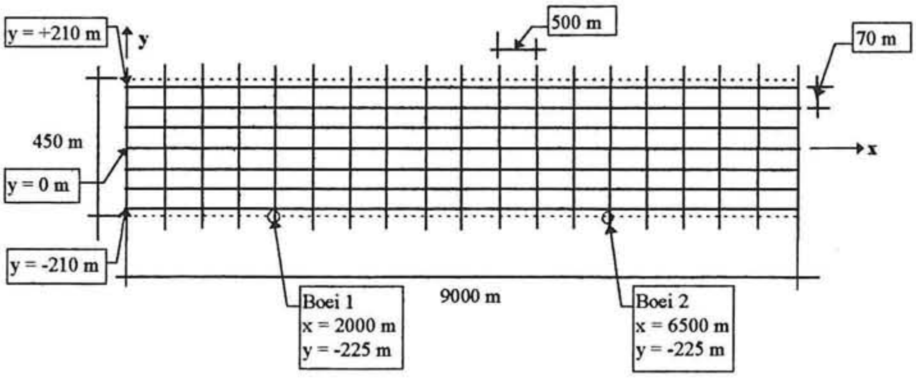


Table A. 1
Columbus Output: Orientation of the ellipse

Positon	Start Position along y-axis						
x-axis	-210	-140	-70	0	70	140	210
0	1.93	1.65	1.36	1.11	0.85	2.56	0.92
500	9	7.81	6.5	5.13	3.67	4.07	1.46
1000	17.95	15.52	12.98	10.24	7.46	4.61	2.22
1500	33.76	29.77	25.16	20.44	14.99	9.1	3.4
2000	7.3	71.5	67.19	62.13	53.35	40.36	17.54
2500	129.47	133.98	139.82	145.76	154.66	164.03	174.06
3000	155.12	158.3	161.72	165.38	169.46	173.31	176.95
3500	166.55	168.37	170.3	172.3	174.41	176.5	178.24
4000	174.38	175.21	175.93	176.78	177.6	176.58	178.72
4500	1.36	1.29	1.08	0.86	177.13	178.21	179.37
5000	8.7	7.57	6.36	5.03	0.54	0.37	0.15
5500	17.98	15.56	13.08	7.32	5.4	3.36	1.25
6000	34.32	30.03	23.44	19.14	14.46	8.9	3.19
6500	73.65	70.74	66.75	61.52	53.99	39.02	16.57
7000	130.44	134.52	139.94	146.19	154.17	163.54	174.02
7500	154.14	157.65	161.43	164.94	168.9	173.04	177.19
8000	162.16	164.82	167.45	170.07	172.73	175.25	178.1
8500	167.04	168.99	170.89	172.83	174.78	175.85	178.58
9000	169.73	171.3	172.86	174.38	174.6	176.51	178.85

Table A. 2
Columbus Output:
Length of the long-axis

Position	Start Position along y-axis						
x-axis	-210	-140	-70	0	70	140	210
0	687.18	736.67	791.81	850.05	906.29	924.64	977.39
500	642.99	683.67	729.22	776.79	824.73	844.05	881.45
1000	532.21	557.6	585.16	615.26	641.94	661.16	669.86
1500	371.44	375.16	381.54	384.38	391.49	403.27	395.21
2000	236.77	214.7	191.5	165.99	135.51	105.51	82.62
2500	285.58	275.47	266.5	251.71	248.3	243.2	236.1
3000	450.54	465.06	480.97	497.37	513.53	525.18	531.48
3500	590.34	623.86	660.49	698.44	736.11	761.9	781.71
4000	670.32	719.12	767.24	821.29	872.06	893.99	940.5
4500	685.59	735.02	790.55	849.59	834.83	916.45	978.9
5000	639.2	681.3	727.71	777.37	746.76	825.94	879.37
5500	533.57	560.01	587.19	530.64	587.21	641.33	672.88
6000	379.33	383.33	329.6	346.66	365.48	382.03	393.19
6500	252.32	197.06	177.58	156.7	130.2	106.46	85.41
7000	295.8	282.72	270.74	256.46	245.12	236.11	230.95
7500	533.2	536.09	545.95	542.18	544.97	547.16	547.76
8000	851.66	850.79	853.72	853.38	849.64	845.95	852.41
8500	1145.26	1143.69	1145.29	1146.71	1147.86	1139.21	1151.89
9000	1416.18	1415.5	1424.46	1426.36	1405.14	1418.65	1432.14

Figure A. 3
Length of the long-axis as function of distance (x-axis)

Starting points:
y= -210 m,
y= 0 m, and
y = +210 m

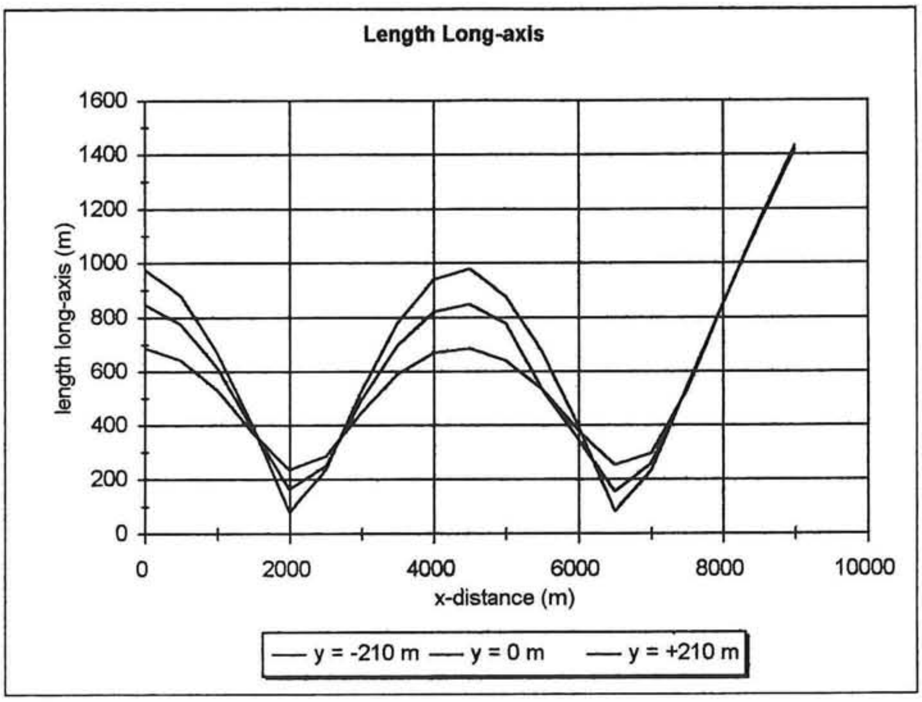


Table A. 3
Columbus Output:
Length of the short-axis

Position	Start Position along y-axis						
x-axis	-210	-140	-70	0	70	140	210
0	182.36	179.04	176.22	173.87	172	108.22	107.75
500	167.31	163.24	159.91	157.16	155.52	84.3	83.69
1000	137.59	131.88	127.28	123.69	120.55	117.96	55.48
1500	98.69	92.26	86.36	80.07	75.31	72.69	68.68
2000	56.16	48.49	41.2	35.72	28.94	22.05	15.27
2500	75.65	69.26	63.17	55.82	50.55	45.31	41.23
3000	117.57	111.65	106.12	101.17	96.87	94.06	41.46
3500	152.59	148.13	144.19	140.87	138.59	136.13	68.81
4000	176.74	173.04	170.05	167.58	165.35	96.29	95.75
4500	182.87	179.44	176.59	174.27	118.63	117.91	117.26
5000	169.16	164.96	161.3	158.46	125.89	124.69	124.05
5500	138.94	133.66	128.57	113.58	110.76	108.78	107.21
6000	99.03	92.86	84.67	78.52	73.7	69.2	67.04
6500	55.85	48.81	41.61	35.34	28.48	22.41	15.7
7000	76.01	69.3	62.89	55.99	49.56	43.84	40.17
7500	118.19	112.16	107.93	102.12	98.14	95.09	29.89
8000	165.68	160.61	156.99	153.44	150.02	147.53	70.1
8500	213.2	208.72	205.56	202.93	200.88	101.75	101.95
9000	257.54	253.83	252.46	250.4	135.06	134.72	135.07

Figure A. 4
Length of the short-axis as function of distance (x-axis)

Starting points:
y= -210 m,
y= 0 m, and
y = +210 m

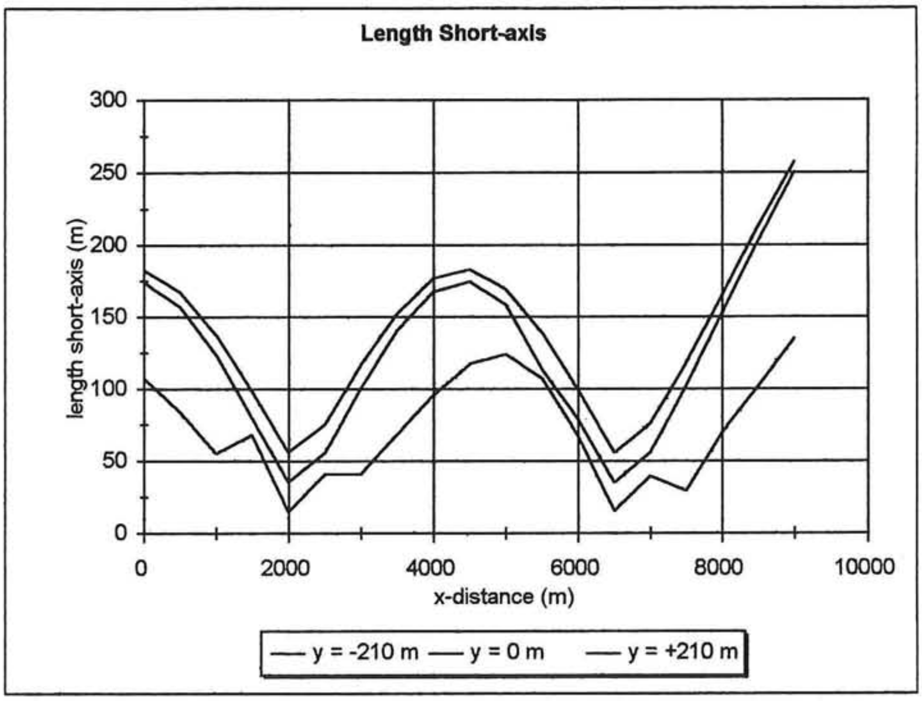


Table A. 4
Minimum
Estimated
Distance to the
Leading Line (m)

Position	**Actual Distance to Centre Line** (in m)						
on x-as	**-210**	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
0	-313	-240	-167	-95	-23	65	148
500	-343	-267	-191	-113	-34	68	157
1000	-357	-278	-198	-116	-31	55	169
1500	-354	-273	-190	-105	-17	72	164
2000	-331	-249	-166	-82	7	97	190
2500	-344	-263	-180	-94	-6	85	177
3000	-358	-278	-196	-112	-25	63	175
3500	-353	-275	-197	-117	-35	49	164
4000	-331	-256	-182	-107	-31	65	152
4500	-310	-238	-166	-94	-10	67	146
5000	-342	-267	-190	-113	4	75	147
5500	-358	-279	-199	-90	-13	67	149
6000	-358	-276	-174	-94	-11	76	166
6500	-339	-241	-160	-77	9	98	190
7000	-347	-265	-181	-95	-6	86	178
7500	-379	-294	-208	-120	-31	60	182
8000	-419	-329	-239	-149	-58	31	161
8500	-442	-352	-262	-172	-82	48	145
9000	-463	-373	-284	-194	-63	30	128

Table A. 5
Maximum
Estimated
Distance to the
Leading Line (m)

Position	**Actual Distance to Centre Line** (in m)						
on x-as	**-210**	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
0	-107	-40	27	95	163	215	272
500	-77	-13	51	113	174	212	263
1000	-63	-2	58	116	171	225	251
1500	-66	-7	50	105	157	208	256
2000	-89	-31	26	82	133	183	230
2500	-76	-17	40	94	146	195	243
3000	-62	-2	56	112	165	217	245
3500	-67	-5	57	117	175	231	256
4000	-89	-24	42	107	171	215	268
4500	-110	-42	26	94	150	213	274
5000	-78	-13	50	113	136	205	273
5500	-62	-1	59	90	153	213	271
6000	-62	-4	34	94	151	204	254
6500	-81	-39	20	77	131	182	230
7000	-73	-15	41	95	146	194	242
7500	-41	14	68	120	171	220	238
8000	-1	49	99	149	198	249	259
8500	22	72	122	172	222	232	275
9000	43	93	144	194	203	250	292

Figure A. 5
Minimum and
Maximum
Estimated
Distance to the
Centre Line

Ship position:
y = -210 m

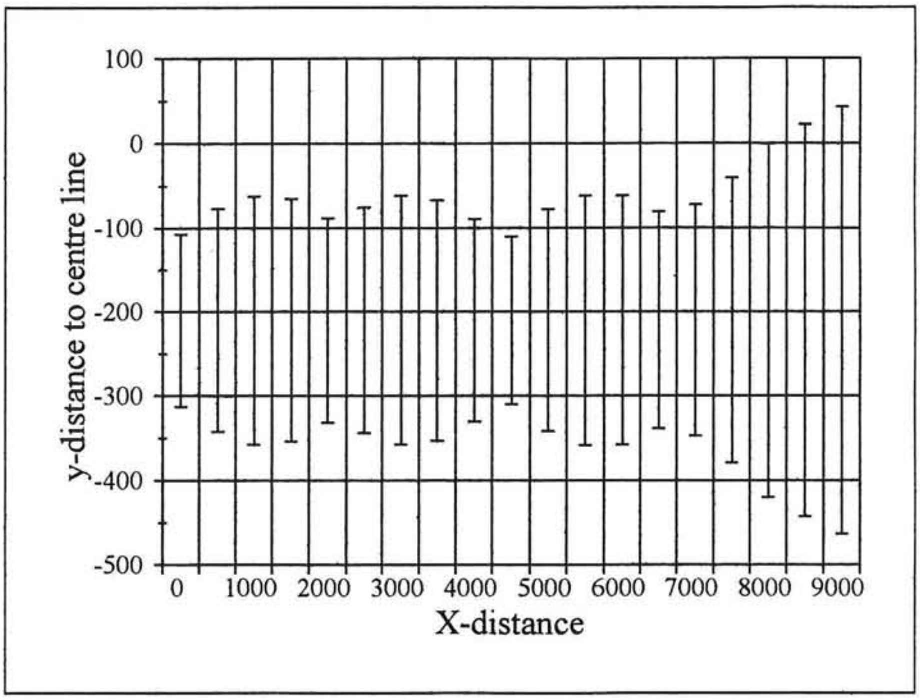


Figure A. 6
Minimum and
Maximum
Estimated
Distance to the
Centre Line

Ship position:
y = -140 m

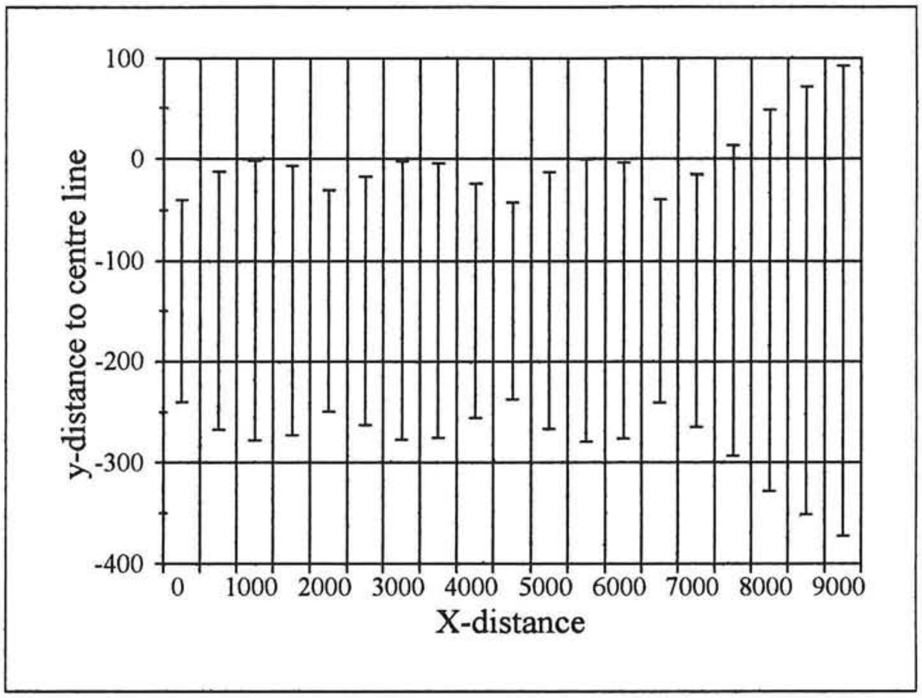


Figure A. 7
Minimum and Maximum Estimated Distance to the Centre Line

Ship position:
y = -70 m

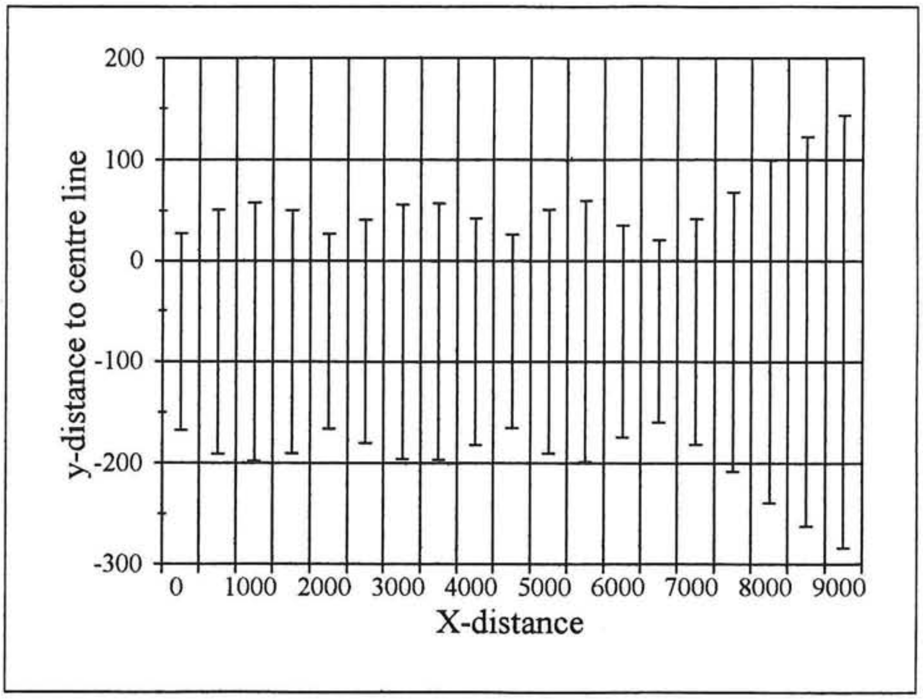


Figure A. 8
Minimum and Maximum Estimated Distance to the Centre Line

Ship position:
y = 0 m

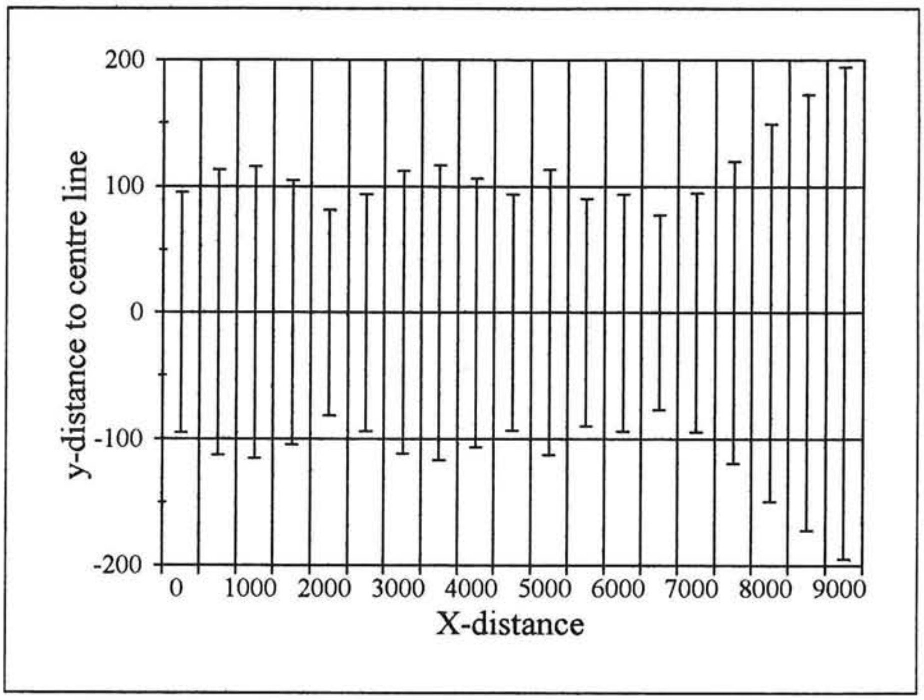


Figure A. 9
Minimum and Maximum Estimated Distance to the Centre Line

Ship position:
y = +70 m

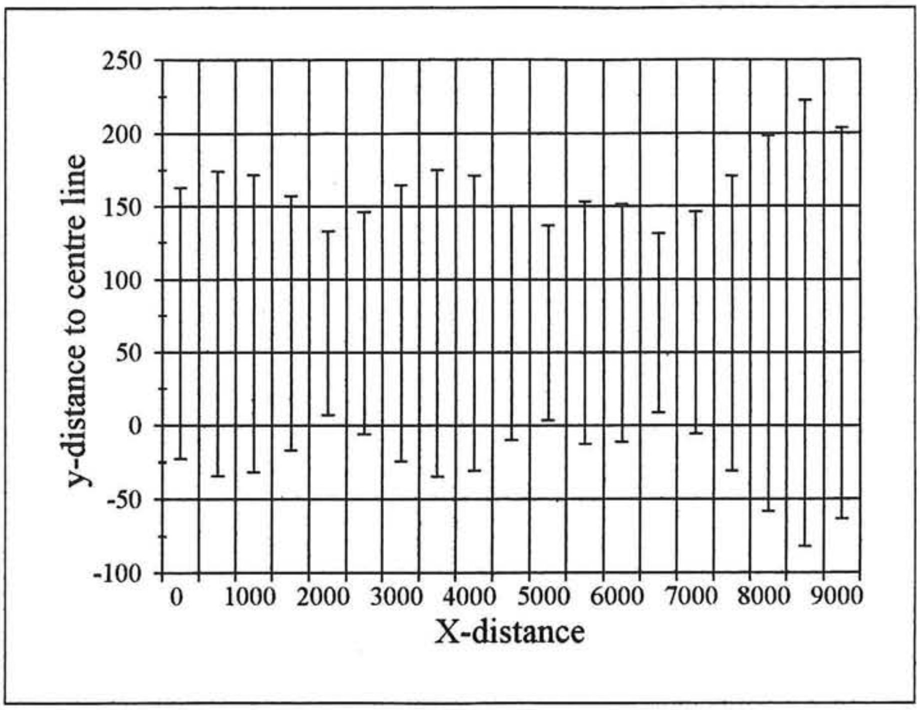


Figure A. 10
Minimum and Maximum Estimated Distance to the Centre Line

Ship position:
y = -140 m

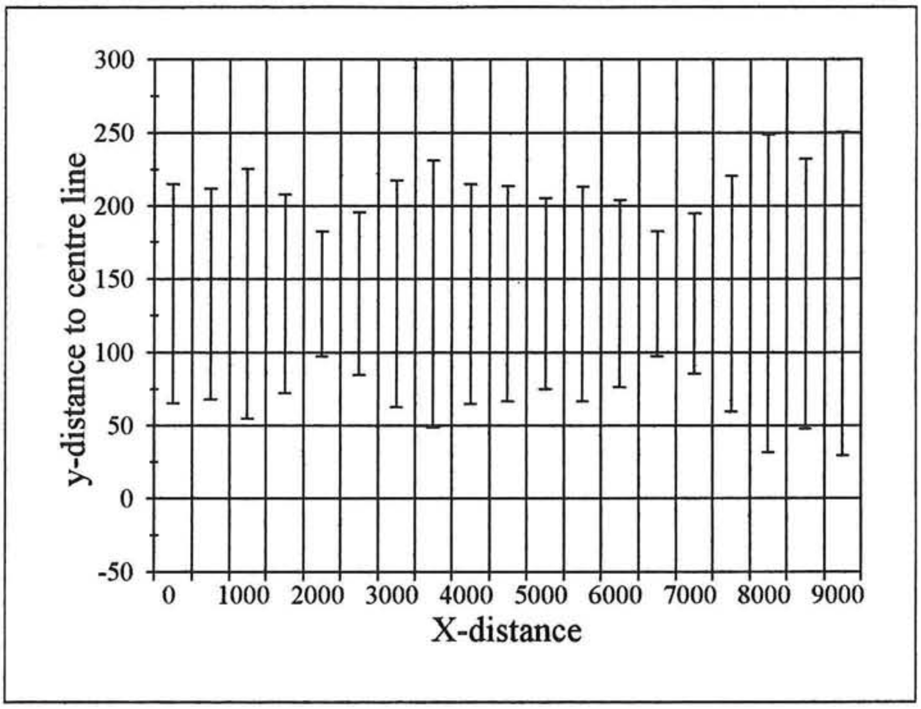
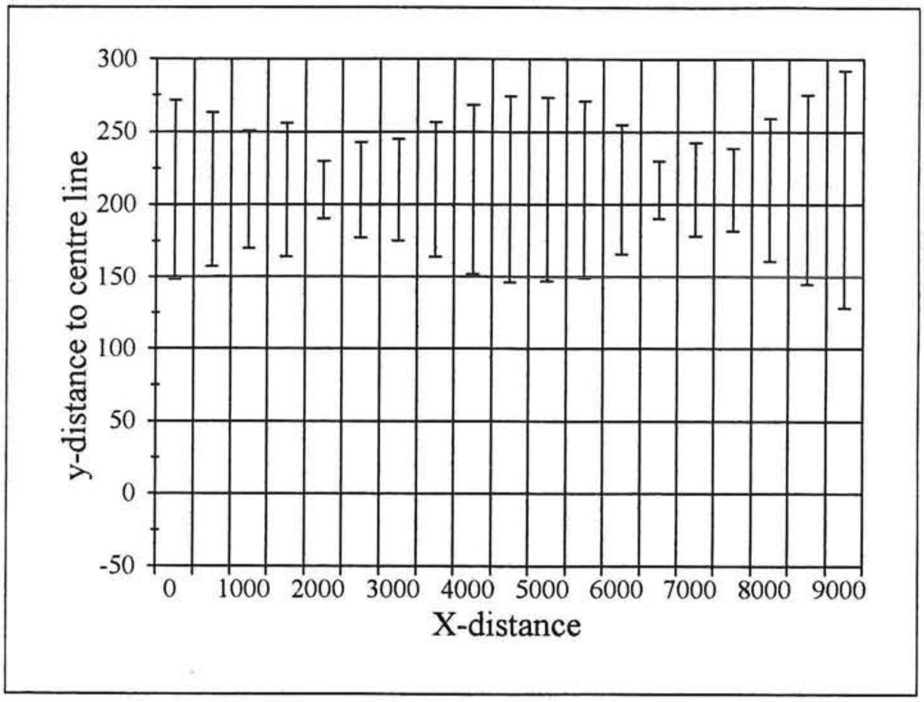
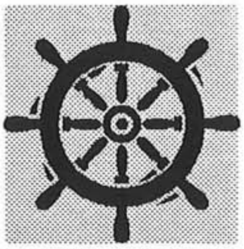


Figure A. 11
Minimum and Maximum Estimated Distance to the Centre Line

Ship position:
y = +210 m





Towards Fast-time Simulation-based Probabilistic Design of Channel Width

Volume I: Main Report
Appendix A
⇒ **Volume II: Appendix B**
Volume III: Appendix C

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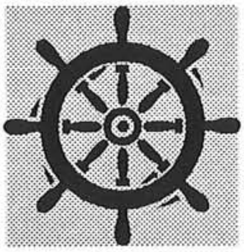
Department of Civil Engineering
Hydraulic and Geotechnical Engineering Division
Hydraulic Engineering Group
December 1995



Appendix B: RandSail Model

List of Contents

Introduction to Appendix B

Appendix B is the second volume of the graduate thesis "Towards fast-time Simulation-based Probabilistic Design of Channel Width". This volume is exclusively compiled to provide insight into the inner-workings of the RandSail simulation model. Its objective, however, is not to play the role of a user's manual. Nevertheless, the necessary has been attempted to provide an easy access to the program itself.

The first part of this volume, "Process Description of the RandSail Model" provides a birds-eye view into the structure of the model. First of all, the role of the modules and macros are described, followed by two flowcharts.

The second part, the "RandSail Model: Step-by-step", describes the basic algorithm of the model in a step-by-step fashion. As it is with its predecessor, this part also provides reference to the line numbers in the program itself. These line numbers, however, are the numbers as provided by the text-processing application used to create this document. The difference from the line numbering in the program, fortunately, is hardly noticeable.

Section B.1 of Appendix B consists of the complete RandSail Model as written in PROSIM 3.01. Section B.2 consists of 70 (seventy) input files generated in SHIPMA 4.30. Section B.3 consists of the remaining 3 (three) input files as generated in COLUMBUS.

Appendix B is not to be used as a stand-alone volume. Although the step-by-step description of the model is included in this volume, the basic thinking is only to be found in the main report (first volume). The third volume, Appendix C, consists of the analysis of the output of the model. The analysis is done using PROSIM Statistics and Quattro Pro release 5.0 (spreadsheet).

Delft, December 1995

Paul J. Siregar

Part I

Process Description of the RandSail Model

Part	Task Description	Module/ Macro	Line number
1	**Variable Definition** The DEFINEMOD-module defines all variables used in the model, the so-called attributes. Each variable can be an integer, a real number, a character, or a logical variable.	DEFINE (a PROSIM standard name)	
2	**Model Algorithm Description** MAINMOD-module describes the algorithm of the process.	MAINMOD (a PROSIM standard name)	
3	**Initialisation**		
	MAINMOD defines the starting values of a number of variables.	MAINMOD	3-8
	INFOGAT-macro requests user-defined values for: (1) the number of runs and (2) the value for the seed of the distribution. INFOGAT limits the number of runs up to a maximum of 300 runs (line 13). This can be altered, when needed.	INFOGAT (Activated on line 19 of MAINMOD)	1-20 22-25
	STARTPOSITION-macro requests user-defined values for: (1) the starting point of the manoeuvring runs (must be between x = 0 m and x = 11250 m) (2) the final point of the manoeuvring runs (must be between x = 0 m and x = 11250 m)	STARTPOSITION (Activated on line 34 of MAINMOD)	1-13 15-27
	YPOSITION defines the starting position of the manoeuvre in the cross-section. The position is randomly determined. By default the value for the standard deviation is 35 (line 34). This can be altered when needed.	YPOSITION (Activated on line 60 of MAINMOD)	33-35

Part	Task Description	Module/ Macro	Line number
	WAVE RandSail provides a selection of ten wave conditions. WAVE-macro requests user to select a wave condition which is a combination of: (1) one wave direction (90 deg or 270 deg) and (2) one wave force (0%, 50%, 75%, 100%, or 125%)	WAVE (Activated on line 1 of WAVEFIELD)	1-13 15-33
	WAVEFIELD Based on the selection made in WAVE-macro, the WAVEFIELD-macro defines an identifier-value of the appropriate input-file	WAVEFIELD (Activated on line 41 of MAINMOD)	
	MANOEUVREDEFINE assigns an identifier value to each input-file	MANOEUVREDEFINE (Activated on line 71 of MAINMOD)	
4	**Simulation**		
	NEWAPPROACH is basically a sub-algorithm of MAINMOD which is completely dedicated to the simulation process. NEWAPPROACH also includes the extra facilities (see section 9.7 of the report). They are listed on lines 46-76.	NEWAPPROACH (Activated on line 79 of MAINMOD)	
	MANOEUVRE mainly reads the input files that describe the manoeuvring behaviour	MANOEUVRE (Activated on line 60 of NEWAPPROACH)	
	COLUMBUSNEW is a sub-algorithm of NEWAPPROACH and exclusively calculates the random *estimated* position based on input from Columbus. COLUMBUSNEW also includes the switches (see section 9.4 of the report). They are listed on lines 131-143.	COLUMBUSNEW (Activated on line 12 of NEWAPPROACH)	
	SELECTING determines the “band” (see section 7.4 of the report) to be used to calculate the manoeuvres. The selection is based on: (1) the ship’s heading, (2) the ship’s rate-of-turn, (3) the ship’s *estimated* position, and (4) the wave condition	SELECTING (Activated on line 59 of NEWAPPROACH)	

Part	Task Description	Module/ Macro	Line number
	COLUMBUSDATAREAD reads the initial data from the input-files generated by Columbus. The data are: (1) the ship's heading (2) the length of the long-axis (3) the length of the short-axis	COLUMBUSDATAREAD (Activated on line 26 of COLUMBUSNEW)	10-17 19-33 35-49
	COLUMBUSDATAREAD2 is the continuation of COLUMBUSDATAREAD and reads the remaining data from the input-files generated by Columbus. The data are: (1) the ship's heading (2) the length of the long-axis (3) the length of the short-axis This process of data-reading has to be split due to technical and practical reasons.	COLUMBUSDATA-READ2 (Activated on lines 25-114 of COLUMBUSNEW)	1-17 19-33 35-49
	COLUMBUSMATRIX selects the appropriate value of the long-axis and short-axis of Columbus' 68%-confidence region (see section 3.2 and section 7.3.3 of the report) based on the *actual* position of the ship	COLUMBUSMATRIX (Activated on line 116 of COLUMBUSNEW)	
	CALCULATOR-macro is the random generator of the RandSail model. Based on the values of the long-axis and short-axis selected in COLUMBUSMATRIX, CALCULATOR-macro (1) determines the random number and (2) translates it into the *estimated* position of the ship By default, CALCULATOR-macro calculates using one-half of the value of the standard variation given by Columbus (see section 9.3 of the report). User can alter this default division by two with other factor on line 27 and 28 of CALCULATOR-macro.	CALCULATOR (Activated on line 118 of COLUMBUSNEW)	6-45 47-95
	NEWAPPRSUB	NEWAPPRSUB (Activated on line 61 of NEWAPPROACH)	
5	**Registering the manoeuvres**		
	STORAGE1	STORAGE1 (Activated on line 74 of NEWAPPROACH)	
	STORAGE2 registering the position of the	STORAGE2	

Part	Task Description	Module/ Macro	Line number
	ship's centre of gravity in an (ASCII) output file	(Activated on line 75 of NEWAPPROACH)	
	STORAGE3A store the position of the ship's centre of gravity during the manoeuvre in a STOREFILE.	STORAGE3A (Activated on line 77 of NEWAPPROACH)	
	STORAGE3B store the position of the ship's extremities (port side and starboard side -- see section 8.3 of the report) during the manoeuvre in a STOREFILE.	STORAGE3B (Activated on line 80 of NEWAPPROACH)	
	UITERWAARDEN calculates the position of the ship's extremities (port side and starboard side) based on the ship's dimensions (length and breadth) and heading (see section 8.3 of the report).	UITERWAARDEN (Activated on line 79 of NEWAPPROACH)	

Figure B.0. 1 First Flowchart of RandSail Model Process

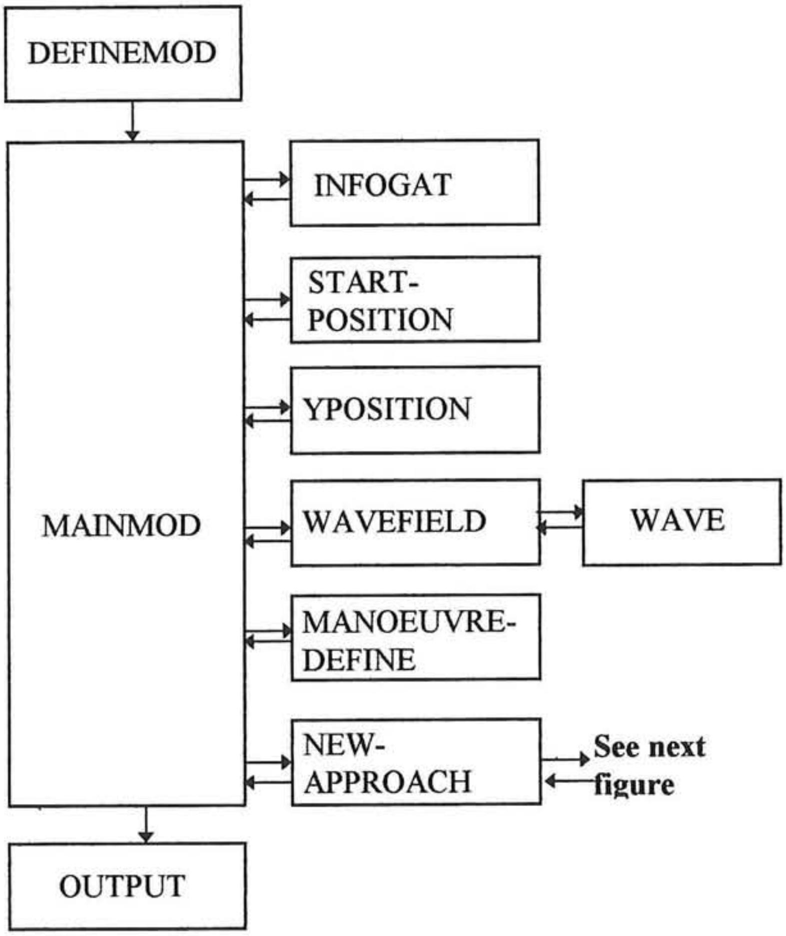
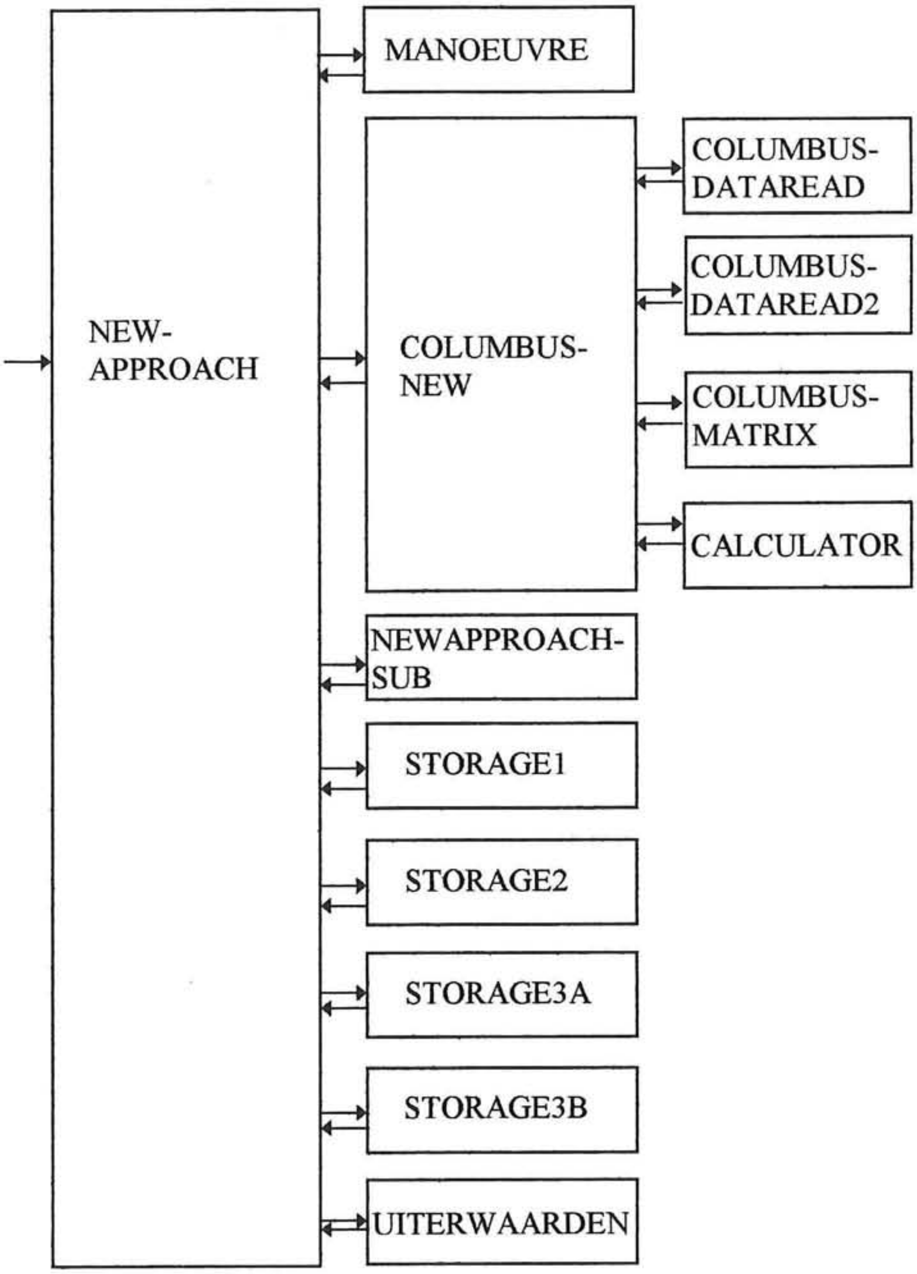


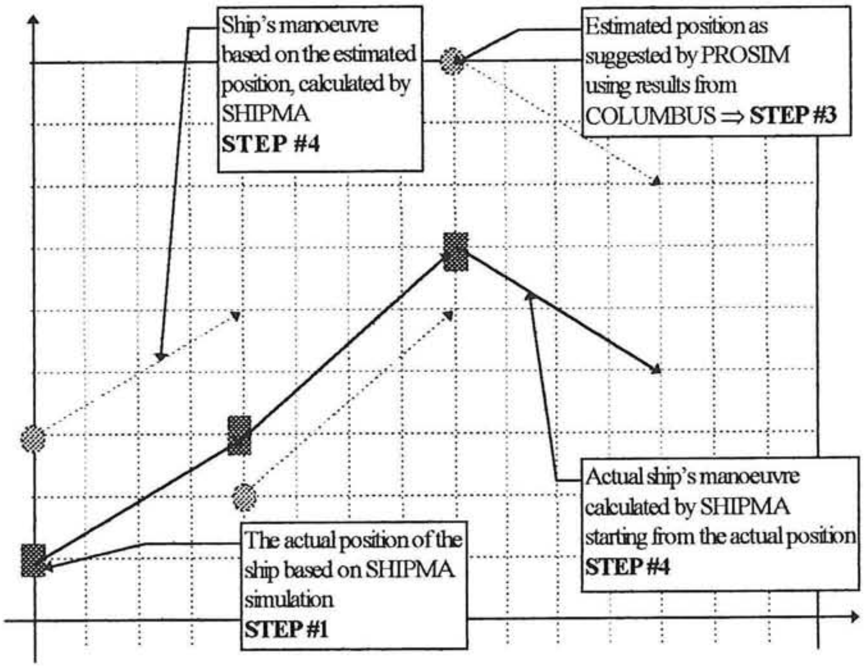
Figure B.0. 2 Second flowchart of RandSail Model process (activated in NEW-APPROACH macro)



Part II
RandSail Model: Step-by-step

		Module/Macro	Line
Step #1	Specify the starting point for the calculations		
	⇒ To start any manoeuvre, RandSail will randomly specify the starting point. Module MAINMOD activates macro YPOSITION to do that.	MAINMOD YPOSITION	60 33-35
	⇒ For the remainder of the process, RandSail uses the arrival point of the previous calculation as the starting point for the next.	NEW-APPROACH	6

Figure B.0. 3
RandSail Model
at work



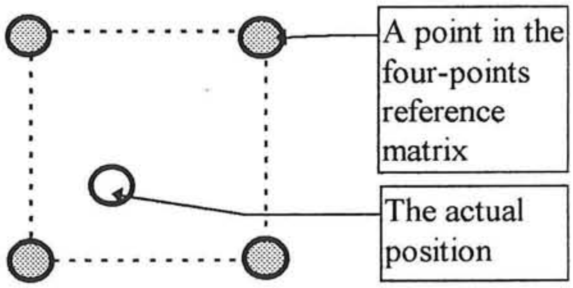
		Module/Macro	Line
Step #2	Select a group of input files that provide information on manoeuvres under a specific wave condition (see Table B.0. 1 below). In order to create an automated selection process, the input files not only have PROSIM Environment names (see list on Table B.0. 2) - which is a standard procedure in PROSIM - but also a "reference names". These names are given in the MANOEUVREDEFINE macro. The "reference names" enable RandSail to select a specific input file based on <u>number</u> only as opposed to name. This simplifies the writing of the model.	MAINMOD MANOEUVRE-DEFINE	71

Table B.0. 1

Wave Direction	Wave Force	Ship Heading						
		-15 deg	**-10 deg**	**-5 deg**	**0 deg**	**+5 deg**	**+10 deg**	**+15 deg**
90 deg	**0%**	Route111	Route112	Route113	Route114	Route115	Route116	Route117
	50%	Route121	Route122	Route123	Route124	Route125	Route126	Route127
	75%	Route131	Route132	Route133	Route134	Route135	Route136	Route137
	100%	Route141	Route142	Route143	Route144	Route145	Route146	Route147
	125%	Route151	Route152	Route153	Route154	Route155	Route156	Route157
270 deg	**0%**	Route211	Route212	Route213	Route214	Route215	Route216	Route217
	50%	Route221	Route222	Route223	Route224	Route225	Route226	Route227
	75%	Route231	Route232	Route233	Route234	Route235	Route236	Route237
	100%	Route241	Route242	Route243	Route244	Route245	Route246	Route247
	125%	Route251	Route252	Route253	Route254	Route255	Route256	Route257

		Module/Macro	Line
Step #3	Determine the (random) estimated position by going through the following procedure:		
	⇒ Find four points in the Columbus roster (see Figure 7.5 of the report) which are the closest to the actual position. This reference points provide the needed data on (1) the long-axis, (2) short-axis, and (3) the orientation of the ellipse. For sample, see also Table 7.2 of the report. The macros COLUMBUSDATAREAD and COLUMBUSDATAREAD2 will then read the data from the following input files: * **Columba1.udf** for the long-axis * **Columba2.udf** for the short-axis * **Columbb1.udf** for the orientation	NEW-APPROACH COLUMBUS-DATAREAD COLUMBUS-DATAREAD2 COLUMBUS-MATRIX	7-114 1-49 1-49 1-151
	⇒ Determine the appropriate lengths for the long-axis and short-axis and the appropriate orientation of the ellipse by interpolation using the four-points reference (see Figure B.0. 4 below).	CALCU-LATOR	1-23

Figure B.0. 4
The four-points reference matrix



		Module/Macro	Line
	⇒Determine the (random) estimated position based on the previously interpolated length of the long-axis and the short-axis and the orientation of the ellipse	CALCU-LATOR	24-95

Table B.0. 2 List of RandSail Input files and their reference names in PROSIM

No.	File Name	PROSIM Environment File name	RandSail File reference name	No.	File Name	PROSIM Environment File name	RandSail File reference name
1	Route111	INADD01	Input[01]	36	Route211	INADD36	Input[36]
2	Route112	INADD02	Input[02]	37	Route212	INADD37	Input[37]
3	Route113	INADD03	Input[03]	38	Route213	INADD38	Input[38]
4	Route114	INADD04	Input[04]	39	Route214	INADD39	Input[39]
5	Route115	INADD05	Input[05]	40	Route215	INADD40	Input[40]
6	Route116	INADD06	Input[06]	41	Route216	INADD41	Input[41]
7	Route117	INADD07	Input[07]	42	Route217	INADD42	Input[42]
8	Route121	INADD08	Input[08]	43	Route221	INADD43	Input[43]
9	Route122	INADD09	Input[09]	44	Route222	INADD44	Input[44]
10	Route123	INADD10	Input[10]	45	Route223	INADD45	Input[45]
11	Route124	INADD11	Input[11]	46	Route224	INADD46	Input[46]
12	Route125	INADD12	Input[12]	47	Route225	INADD47	Input[47]
13	Route126	INADD13	Input[13]	48	Route226	INADD48	Input[48]
14	Route127	INADD14	Input[14]	49	Route227	INADD49	Input[49]
15	Route131	INADD15	Input[15]	50	Route231	INADD50	Input[50]
16	Route132	INADD16	Input[16]	51	Route232	INADD51	Input[51]
17	Route133	INADD17	Input[17]	52	Route233	INADD52	Input[52]
18	Route134	INADD18	Input[18]	53	Route234	INADD53	Input[53]
19	Route135	INADD19	Input[19]	54	Route235	INADD54	Input[54]
20	Route136	INADD20	Input[20]	55	Route236	INADD55	Input[55]
21	Route137	INADD21	Input[21]	56	Route237	INADD56	Input[56]
22	Route141	INADD22	Input[22]	57	Route241	INADD57	Input[57]
23	Route142	INADD23	Input[23]	58	Route242	INADD58	Input[58]
24	Route143	INADD24	Input[24]	59	Route243	INADD59	Input[59]
25	Route144	INADD25	Input[25]	60	Route244	INADD60	Input[60]
26	Route145	INADD26	Input[26]	61	Route245	INADD61	Input[61]
27	Route146	INADD27	Input[27]	62	Route246	INADD62	Input[62]
28	Route147	INADD28	Input[28]	63	Route247	INADD63	Input[63]
29	Route151	INADD29	Input[29]	64	Route251	INADD64	Input[64]
30	Route152	INADD30	Input[30]	65	Route252	INADD65	Input[65]
31	Route153	INADD31	Input[31]	66	Route253	INADD66	Input[66]
32	Route154	INADD32	Input[32]	67	Route254	INADD67	Input[67]
33	Route155	INADD33	Input[33]	68	Route255	INADD68	Input[68]
34	Route156	INADD34	Input[34]	69	Route256	INADD69	Input[69]
35	Route157	INADD35	Input[35]	70	Route257	INADD70	Input[70]
				71	Columba1	AFWIJKLL	
				72	Columba2	AFWIJKKL	
				73	Columbb1	ORIENTA	

		Module/Macro	Line
Step #4	Determine the manoeuvre starting from the estimated position by going through the following procedure		
	⇒ Select the input files that form the "manoeuvring band" (see also Figure 7.11 of the report) based on (1) the wave condition (2) the ship's heading (3) the ship's position (4) the ship's rate-of-turn	SELECTING SELECTING SELECTING SELECTING	1-99 1-99 101-154 101-154
	⇒ Read the input files	MANOEUVRE	1-77
	⇒ Calculate the manoeuvre by interpolating the data from the input files	NEW-APPROACH-SUB	1-43
	⇒ Connect the manoeuvre to the starting point calculated previously	NEW-APPROACH-SUB	45-75

		Module/Macro	Line
Step #5	Register the manoeuvre in the following files:	STORAGE1	
	⇒ Output file named OUTINF1.UDF This output file is created only when the number of requested manoeuvre not higher than 5. The file is handy during programming process to examine the resulting manoeuvre.	STORAGE2	
	⇒ STOREFILES to store the position of the ship's centre of gravity at a pre-defined cross-section. By default the distance between two cross-sections is 250 m. • One STOREFILE consists of all positions at only one cross-section. • This STOREFILE is later to be used for the statistical analysis of the results using PROSIM Statistics. • Before the user can run another set of manoeuvres using RandSail, PROSIM will ask him whether to keep or discard these STOREFILES. When the user wishes to keep them, he will have to give the whole set of STOREFILES a name.	STORAGE3A	
	⇒ Calculate the positions of the ship's extremities (both starboard-side and port-side) based on the ship's dimensions and heading.	UITER-WAARDEN	

	⇒ STOREFILES to store the position of the ship's extremities (both at the starboard-side and port-side) at a pre-defined cross-section. By default the distance between two cross-sections is 250 m. • One STOREFILE consists of all positions at only one cross-section. • This STOREFILE is later to be used for the statistical analysis of the results using PROSIM Statistics. • Before the user can run another set of manoeuvres using RandSail, PROSIM will ask him whether to keep or discard these STOREFILES. When the user wishes to keep them, he will have to give the whole set of STOREFILES a name.	STORAGE3B	

Appendix B.1: RandSail Model in PROSIM 3.01

List of Contents

RandSail Model in PROSIM 3.01: DEFINE module

```
ATTRIBUTES OF MAIN:
  INTEGER           : I K L MCOUNT TIJD WAVEFLD HEADING
  INTEGER           : TEMPCOUNT SELECTIE MULTIPLE SELECTA
  INTEGER           : BANDL BANDH SELECTION XPAST
  REAL              : RUDDER RATETRN RUDD1 RUDD2 RATE1 RATE2 NOMOR
  REAL              : TEMPSTART XSTARTPLUS SPEED VAARTIJD TIJDSTAP DEELTIJD
  REAL              : NUMRUNS RANDGETAL SHORTAXIS LONGAXIS TOTRUNS
  REAL              : ISTART NUMLEFT DEEL AFWIJKL AFWIJKK
  REAL              : HEAD ORIENT GRAD HOEK PHI POSITIE HEADPLUS ORIENTPLUS
  REAL              : XSTART XFINAL YSTART GOLFRICH GOLFKRACHT KRACHT
  REAL              : MANPOST PRESPOST KEUS KEUSR KEUSK
  REAL              : XPOS YPOS DELTAX DELTAY XAXIS YAXIS XLOC YLOC HLOC
  REAL              : XBASE1 XBASE2 XRATIO XDELTA
  REAL              : YBASE1 YBASE2 YRATIO YDELTA
  REAL              : XORIGINAL YORIGINAL VAARPOST
  REAL              : XSHIPMA YSHIPMA XSCHIP YSCHIP Y500
  REAL              : XSHIPMAPLUS YSHIPMAPLUS AFWIJKLPLUS AFWIJKKPLUS
  REAL              : YCOLUML YCOLUMH YPREVIOUS YCOLUMA YCOLUMB
  REAL              : PT01 PT02 PT03 PT04 PT05
  REAL              : PT06 PT07 PT08 PT09 PT10
  REAL              : PT11 PT12 PT13 PT14 PT15
  REAL              : PT16 PT17 PT18 PT19 PT20 PTDELTA
  REAL              : PR01 PR02 PR03 PR04 PR05 PR06 PR07
  REAL              : XPOST XPOS01 XPOS02 XPOS03 XPOS04 XPOS05
  REAL              : XPOS06 XPOS07 XPOS08 XPOS09 XPOS10 XPOS11 XPOS12
  REAL              : PT011 PT021 PT031 PT041 PT051 PT001 PT002
  REAL              : PT061 PT071 PT081 PT091 PT101
  REAL              : PT111 PT121 PT131 PT141 PT151
  REAL              : PT161 PT171 PT181 PT191 PT201
  REAL              : PT012 PT022 PT032 PT042 PT052
  REAL              : PT062 PT072 PT082 PT092 PT102
  REAL              : PT112 PT122 PT132 PT142 PT152
  REAL              : PT162 PT172 PT182 PT192 PT202
  REAL              : PS00 PS01 PS02 PS03 PS04 PS05 PS06 PS07 PS08
  REAL              : PX00 PX01 PX02 PX03 PX04 PX05 PX06 PX07 PX08
  REAL              :  PS012 PS022 PS032 PS042 PS052
  REAL              : PS062 PS072 PS082 PS092 PS102 PS112 PS122
  REAL              : ORDER1 ORDER2 ORDER3 ORDER4 ORDER5 ORDER6 ORDER7
  REAL              : PB011 PB021 PB031 PB041 PB051
  REAL              : PB061 PB071 PB081 PB091 PB101 PB111 PB121
  REAL              : PB012 PB022 PB032 PB042 PB052
  REAL              : PB062 PB072 PB082 PB092 PB102 PB112 PB122
  REAL              : PB01 PB02 PB03 PB04 PB05 PB06
  REAL              : PB07 PB08 PB09 PB10 PB11 PB12
  REAL              : PSB001 PSB011 PSB021 PSB031 PSB041 PSB051
  REAL              : PSB061 PSB071 PSB081 PSB091 PSB101 PSB111 PSB121
  REAL              : PSB00 PSB01 PSB02 PSB03 PSB04 PSB05
  REAL              : PSB06 PSB07 PSB08 PSB09 PSB10 PSB11 PSB12
  REAL              : ORIENT011 ORIENT012 ORIENT013 ORIENT014
  REAL              : ORIENT015 ORIENT016 ORIENT017
  REAL              : ORIENT021 ORIENT022 ORIENT023 ORIENT024
  REAL              : ORIENT025 ORIENT026 ORIENT027
  REAL              : ORIENT01 ORIENT02 ORIENT03 ORIENT04 ORIENTL ORIENTR
```

```
    REAL             : AFWIJKL011 AFWIJKL012 AFWIJKL013 AFWIJKL014
    REAL             : AFWIJKL015 AFWIJKL016 AFWIJKL017
    REAL             : AFWIJKL021 AFWIJKL022 AFWIJKL023 AFWIJKL024
    REAL             : AFWIJKL025 AFWIJKL026 AFWIJKL027
    REAL             : AFWIJKL01 AFWIJKL02 AFWIJKL03 AFWIJKL04
    REAL             : AFWIJKK011 AFWIJKK012 AFWIJKK013 AFWIJKK014
    REAL             : AFWIJKK015 AFWIJKK016 AFWIJKK017
    REAL             : AFWIJKK021 AFWIJKK022 AFWIJKK023 AFWIJKK024
    REAL             : AFWIJKK025 AFWIJKK026 AFWIJKK027
    REAL             : AFWIJKK01 AFWIJKK02 AFWIJKK03 AFWIJKK04
    REAL             : AFWIJKKLFT AFWIJKKRGT AFWIJKLLFT AFWIJKLRGT
    REAL             : PY06 PY05 PY04 PY00 PY01 PY02 PY03
    REAL             : VERHOUD PPAST
    REAL             : CENTERPOINT POINTA POINTB POINTC POINTD EXTMAX EXTMIN
    REAL             : CENTERSUB POINTE POINTF POINTG POINTH EXTMAXA EXTMINA
    LOGICAL          : KEUZE
    CHARACTER(1)     : RUNPROC GOLFCOND LANGUAGE CONTEND
    CHARACTER(1)     : NOTHING DOGHEAD NOTH INTSTEP INTSPEED
    CHARACTER(3)     : INPLAB MANLABL MANLABH
    CHARACTER(20)    : LOCATION ORIGIN
    MACRO            : SELECT
    STREAMREFERENCE  : INPUT[70] PT[10]

  INPUTSTREAM        : ORIENT1
  INPUTSTREAM        : AFWIJKL1
  INPUTSTREAM        : AFWIJKK1

  INPUTSTREAM        : INADD01 INADD02 INADD03 INADD04 INADD05
  INPUTSTREAM        : INADD06 INADD07 INADD08 INADD09 INADD10
  INPUTSTREAM        : INADD11 INADD12 INADD13 INADD14 INADD15
  INPUTSTREAM        : INADD16 INADD17 INADD18 INADD19 INADD20
  INPUTSTREAM        : INADD21 INADD22 INADD23 INADD24 INADD25
  INPUTSTREAM        : INADD26 INADD27 INADD28 INADD29 INADD30
  INPUTSTREAM        : INADD31 INADD32 INADD33 INADD34 INADD35
  INPUTSTREAM        : INADD36 INADD37 INADD38 INADD39 INADD40
  INPUTSTREAM        : INADD41 INADD42 INADD43 INADD44 INADD45
  INPUTSTREAM        : INADD46 INADD47 INADD48 INADD49 INADD50
  INPUTSTREAM        : INADD51 INADD52 INADD53 INADD54 INADD55
  INPUTSTREAM        : INADD56 INADD57 INADD58 INADD59 INADD60
  INPUTSTREAM        : INADD61 INADD62 INADD63 INADD64 INADD65
  INPUTSTREAM        : INADD66 INADD67 INADD68 INADD69 INADD70

  OUTPUTSTREAM       : OUTINF1
  RANDOMSTREAM       : NORM
```

RandSail Model in PROSIM 3.01: MAINMOD module

```
START:

MCOUNT ⇐ 0
ISTART ⇐ 1
PRESPOST ⇐ 0
NUMRUNS ⇐ 0
NUMLEFT ⇐ 0
YORIGINAL ⇐ 0

REWIND OUTINF1

CALL OPENINGTITLE

DISPLAY "    PRESS A KEY TO CONTINUE" AT LINE 18 POSITION 1 WITH IMAGE A
NOTHING ⇐ CHREAD

CALL CLEARSCREEN

CALL INFOGAT

CALL CLEARSCREEN

IF MCOUNT≥1
  IF NUMRUNS>NUMLEFT
    NUMRUNS ⇐ 10
  END
  IF NUMRUNS≤NUMLEFT
    NUMRUNS ⇐ NUMRUNS+PRESPOST
  END
  ISTART ⇐ PRESPOST+1
END

STARTPOSITION:
CALL STARTPOSITION

SPEED ⇐ 5
TIJDSTAP ⇐ 60
DEEL ⇐ SPEED*TIJDSTAP
DEELTIJD ⇐ TIJDSTAP/5

CALL WAVEFIELD
CALL CLEARSCREEN

TOTRUNS ⇐ (XFINAL-XSTART)/DEEL

XORIGINAL ⇐ XSTART

DISPLAY "NUMBER OF RUNS: ";NUMRUNS AT LINE 5 POSITION 50 WITH IMAGE AΔxxxx
DISPLAY "NUMBER SUBRUNS: ";TOTRUNS AT LINE 6 POSITION 50 WITH IMAGE AΔxxxx
DISPLAY "Y START POSIT.: ";YORIGINAL AT LINE 7 POSITION 50 WITH IMAGE AΔxxxx
DISPLAY "LENGTH OF STEP: ";TIJDSTAP AT LINE 8 POSITION 50 WITH IMAGE AΔxxxx
DISPLAY "SAILING SPEED : ";SPEED AT LINE 9 POSITION 50 WITH IMAGE AΔxxxx
DISPLAY "WAVE DIRECTION: ";KEUSR AT LINE 10 POSITION 50 WITH IMAGE AΔxxxx
```

```
DISPLAY "WAVE FORCE    : ";KEUSK AT LINE 11 POSITION 50 WITH IMAGE AΔxxxx

WRITE "RUN ID.: ";YORIGINAL;"/";TIJDSTAP;"/";SPEED;"/";KEUSR;"/";KEUSK TO OUTINF1 WITH
IMAGE AΔxxxxΔAΔxxxΔAΔxΔAΔxΔAΔx

FOR I ⇐ ISTART TO NUMRUNS
  CALL YPOSITION

  ORDER3 ⇐ YSTART
  ORDER4 ⇐ YSTART
  YSCHIP ⇐ 0
  YSHIPMA ⇐ 0
  SELECTION ⇐ 0
  XPAST ⇐ 0
  VAARTIJD ⇐ 0
  VAARPOST ⇐ 0

  CALL MANOEUVREDEFINE

WRITE "RUN NO.    : ";I TO OUTINF1 WITH IMAGE AΔxx
  WRITE " " TO OUTINF1 WITH IMAGE A
  WRITE XPOST;VAARTIJD;YSTART TO OUTINF1 WITH IMAGE xxxxxΔxxxxΔxxxxx.xx

  XSTART ⇐ XORIGINAL

  CALL NEWAPPROACH
WRITE " " TO OUTINF1 WITH IMAGE A
END

CONTINUE:
MCOUNT ⇐ MCOUNT+1
PRESPOST ⇐ NUMRUNS

FINAL:
TERMINATE
```

RandSail Model in PROSIM 3.01: INFOGAT macro

```
KEUZE ⇐ FALSE
WRITE " " WITH IMAGE A
WHILE KEUZE = FALSE
  IF NUMLEFT≠0
    WRITE "    YOU CAN ONLY HAVE ";NUMLEFT;" RUNS" WITH IMAGE AΔxxΔA
    WRITE "    MAKE SURE YOU REQUEST A NUMBER OF RUNS ≤";NUMLEFT WITH IMAGE
AΔxx
    WRITE "    OTHERWISE THIS PROGRAM WILL ONLY EXECUTE ";NUMLEFT;" RUNS" WITH
IMAGE AΔxxΔA
  END
  WRITE "    NUMBER OF RUNS = " WITH IMAGE A
  NUMRUNS ⇐ READ
  KEUZE ⇐ TRUE IF NUMRUNS≤300
  IF NUMLEFT>0
    IF NUMRUNS>NUMLEFT
      WRITE "    THIS PROGRAM WILL EXECUTE ONLY ";NUMLEFT;" RUNS" WITH IMAGE
AΔxxΔA
    END
  END
END

WRITE " " WITH IMAGE A
WRITE "    GIVE SEED OF NORM" WITH IMAGE A
WRITE "    SEED VALUE = " WITH IMAGE A
SEED OF NORM ⇐ READ
```

RandSail Model in PROSIM 3.01: STARTPOSITION macro

```
KEUZE ⇐ FALSE
WRITE " " WITH IMAGE A
WRITE "    STARTING POSITION ship in sailing direction" WITH IMAGE A
WRITE "    MINIMUM X = 0m, MAXIMUM X = 11250m" WITH IMAGE A
WHILE KEUZE = FALSE
  WRITE "    STARTING POSITION SHIP IN X =" WITH IMAGE A
  XSTART ⇐ READ
  IF XSTART≥0
    IF XSTART≤11250
      KEUZE ⇐ TRUE
    END
  END
END

KEUZE ⇐ FALSE
WRITE " " WITH IMAGE A
WRITE "    ARRIVAL POSITION SHIP IN SAILING DIRECTION" WITH IMAGE A
WRITE "    MINIMUM X = 0 m, MAXIMUM X = 11250 m" WITH IMAGE A
WHILE KEUZE = FALSE
  WRITE "    ARRIVAL POSITION SHIP IN X  =" WITH IMAGE A
  XFINAL ⇐ READ
  IF XFINAL≥0
    IF XFINAL≤11250
      KEUZE ⇐ TRUE
    END
  END
END

WRITE " " WITH IMAGE A
WRITE "    STARTING POSITION SHIP IN X =";XSTART;"  m" WITH IMAGE AΔxxxxxxΔA
WRITE "    ARRIVAL  POSITION SHIP IN X =";XFINAL;"  m" WITH IMAGE AΔxxxxxxΔA
WRITE "    STARTING POSITION SHIP IN Y =";YSTART;"  m" WITH IMAGE AΔxxxxxxΔA
```

RandSail Model in PROSIM 3.01: YPOSITION macro

```
RESHAPE NORM AS SAMPLED FROM DISTRIBUTION NORMAL WITH PARAMETERS MEAN(0)
DEVIATION(35)
YSTART ⇐ NORM+875

```

RandSail Model in PROSIM 3.01: WAVEFIELD macro

```
CALL WAVE

CHOICE:
IF KEUSR=1
  WAVEFLD ⇐ 1 IF KEUSK=1
  WAVEFLD ⇐ 2 IF KEUSK=2
  WAVEFLD ⇐ 3 IF KEUSK=3
  WAVEFLD ⇐ 4 IF KEUSK=4
  WAVEFLD ⇐ 5 IF KEUSK=5
END

IF KEUSR=2
  WAVEFLD ⇐ 6 IF KEUSK=1
  WAVEFLD ⇐ 7 IF KEUSK=2
  WAVEFLD ⇐ 8 IF KEUSK=3
  WAVEFLD ⇐ 9 IF KEUSK=4
  WAVEFLD ⇐ 10 IF KEUSK=5
END

```

RandSail Model in PROSIM 3.01: WAVE macro

```
KEUSR ⇐ 0
KEUZE ⇐ FALSE IF KEUSR=0
WRITE " " WITH IMAGE A
WRITE "    SELECT PREFERRED WAVE DIRECTION" WITH IMAGE A
WRITE "    (1) Wave direction = 90 degrees" WITH IMAGE A
WRITE "    (2) Wave direction = 270 degrees" WITH IMAGE A

WHILE KEUZE = FALSE
  WRITE "    YOUR CHOICE IS (1 or 2) =" WITH IMAGE A
  KEUSR ⇐ READ
  KEUZE ⇐ TRUE IF KEUSR=1
  KEUZE ⇐ TRUE IF KEUSR=2
END

KEUSK ⇐ 0
KEUZE ⇐ FALSE IF KEUSK=0
WRITE " " WITH IMAGE A
WRITE "    SELECT PREFERRED WAVE FORCE" WITH IMAGE A
WRITE "    (1) Wave force =   0%" WITH IMAGE A
WRITE "    (2) Wave force =  50%" WITH IMAGE A
WRITE "    (3) Wave force =  75%" WITH IMAGE A
WRITE "    (4) Wave force = 100%" WITH IMAGE A
WRITE "    (5) Wave force = 125%" WITH IMAGE A

WHILE KEUZE = FALSE
  WRITE "    YOUR CHOICE IS (1,2,3,4 or 5)= " WITH IMAGE A
  KEUSK ⇐ READ
  KEUZE ⇐ TRUE IF KEUSK=1
  KEUZE ⇐ TRUE IF KEUSK=2
  KEUZE ⇐ TRUE IF KEUSK=3
  KEUZE ⇐ TRUE IF KEUSK=4
  KEUZE ⇐ TRUE IF KEUSK=5
END
```

RandSail Model in PROSIM 3.01: MANOEUVREDEFINE macro

```
INPUT[1]⇐ INADD01
INPUT[2]⇐ INADD02
INPUT[3]⇐ INADD03
INPUT[4]⇐ INADD04
INPUT[5]⇐ INADD05
INPUT[6]⇐ INADD06
INPUT[7]⇐ INADD07
INPUT[8]⇐ INADD08
INPUT[9]⇐ INADD09
INPUT[10]⇐ INADD10

INPUT[11]⇐ INADD11
INPUT[12]⇐ INADD12
INPUT[13]⇐ INADD13
INPUT[14]⇐ INADD14
INPUT[15]⇐ INADD15
INPUT[16]⇐ INADD16
INPUT[17]⇐ INADD17
INPUT[18]⇐ INADD18
INPUT[19]⇐ INADD19
INPUT[20]⇐ INADD20

INPUT[21]⇐ INADD21
INPUT[22]⇐ INADD22
INPUT[23]⇐ INADD23
INPUT[24]⇐ INADD24
INPUT[25]⇐ INADD25
INPUT[26]⇐ INADD26
INPUT[27]⇐ INADD27
INPUT[28]⇐ INADD28
INPUT[29]⇐ INADD29
INPUT[30]⇐ INADD30

INPUT[31]⇐ INADD31
INPUT[32]⇐ INADD32
INPUT[33]⇐ INADD33
INPUT[34]⇐ INADD34
INPUT[35]⇐ INADD35

INPUT[36]⇐ INADD36
INPUT[37]⇐ INADD37
INPUT[38]⇐ INADD38
INPUT[39]⇐ INADD39
INPUT[40]⇐ INADD40

INPUT[41]⇐ INADD41
INPUT[42]⇐ INADD42
INPUT[43]⇐ INADD43
INPUT[44]⇐ INADD44
INPUT[45]⇐ INADD45
```

```
INPUT[46]⇐ INADD46
INPUT[47]⇐ INADD47
INPUT[48]⇐ INADD48
INPUT[49]⇐ INADD49
INPUT[50]⇐ INADD50

INPUT[51]⇐ INADD51
INPUT[52]⇐ INADD52
INPUT[53]⇐ INADD53
INPUT[54]⇐ INADD54
INPUT[55]⇐ INADD55
INPUT[56]⇐ INADD56
INPUT[57]⇐ INADD57
INPUT[58]⇐ INADD58
INPUT[59]⇐ INADD59
INPUT[60]⇐ INADD60

INPUT[61]⇐ INADD61
INPUT[62]⇐ INADD62
INPUT[63]⇐ INADD63
INPUT[64]⇐ INADD64
INPUT[65]⇐ INADD65
INPUT[66]⇐ INADD66
INPUT[67]⇐ INADD67
INPUT[68]⇐ INADD68
INPUT[69]⇐ INADD69
INPUT[70]⇐ INADD70

```

RandSail Model in PROSIM 3.01: MANOEUVRE macro

```
REWIND INPUT[SELECTION]

NOMOR ⇐ READ FROM INPUT[SELECTION]

WHILE NOMOR+XPAST
  PT001 ⇐ READ FROM INPUT[SELECTION]
  PB011 ⇐ READ FROM INPUT[SELECTION]
  PB021 ⇐ READ FROM INPUT[SELECTION]
  PB031 ⇐ READ FROM INPUT[SELECTION]
  PB041 ⇐ READ FROM INPUT[SELECTION]
  PB051 ⇐ READ FROM INPUT[SELECTION]
  PB061 ⇐ READ FROM INPUT[SELECTION]
  PB071 ⇐ READ FROM INPUT[SELECTION]
  PB081 ⇐ READ FROM INPUT[SELECTION]
  PB091 ⇐ READ FROM INPUT[SELECTION]
  PB101 ⇐ READ FROM INPUT[SELECTION]
  PB111 ⇐ READ FROM INPUT[SELECTION]
  PB121 ⇐ READ FROM INPUT[SELECTION]
  RUDD1 ⇐ READ FROM INPUT[SELECTION]
  RATE1 ⇐ READ FROM INPUT[SELECTION]
  NOMOR ⇐ READ FROM INPUT[SELECTION]
END

PT001 ⇐ READ FROM INPUT[SELECTION]
PB011 ⇐ READ FROM INPUT[SELECTION]
PB021 ⇐ READ FROM INPUT[SELECTION]
PB031 ⇐ READ FROM INPUT[SELECTION]
PB041 ⇐ READ FROM INPUT[SELECTION]
PB051 ⇐ READ FROM INPUT[SELECTION]
PB061 ⇐ READ FROM INPUT[SELECTION]
PB071 ⇐ READ FROM INPUT[SELECTION]
PB081 ⇐ READ FROM INPUT[SELECTION]
PB091 ⇐ READ FROM INPUT[SELECTION]
PB101 ⇐ READ FROM INPUT[SELECTION]
PB111 ⇐ READ FROM INPUT[SELECTION]
PB121 ⇐ READ FROM INPUT[SELECTION]
RUDD1 ⇐ READ FROM INPUT[SELECTION]
RATE1 ⇐ READ FROM INPUT[SELECTION]

IF PT001<1085
  NOMOR ⇐ READ FROM INPUT[SELECTION]
  PT002 ⇐ READ FROM INPUT[SELECTION]
  PB012 ⇐ READ FROM INPUT[SELECTION]
  PB022 ⇐ READ FROM INPUT[SELECTION]
  PB032 ⇐ READ FROM INPUT[SELECTION]
  PB042 ⇐ READ FROM INPUT[SELECTION]
  PB052 ⇐ READ FROM INPUT[SELECTION]
  PB062 ⇐ READ FROM INPUT[SELECTION]
  PB072 ⇐ READ FROM INPUT[SELECTION]
  PB082 ⇐ READ FROM INPUT[SELECTION]
  PB092 ⇐ READ FROM INPUT[SELECTION]
```

```
  PB102 ⇐ READ FROM INPUT[SELECTION]
  PB112 ⇐ READ FROM INPUT[SELECTION]
  PB122 ⇐ READ FROM INPUT[SELECTION]
  RUDD2 ⇐ READ FROM INPUT[SELECTION]
  RATE2 ⇐ READ FROM INPUT[SELECTION]
END

CLOSE INPUT[SELECTION]

IF (YSTART≥1085)|(YSTART<665)
  PT002 ⇐ PT001
  PB012 ⇐ PB011
  PB022 ⇐ PB021
  PB032 ⇐ PB031
  PB042 ⇐ PB041
  PB052 ⇐ PB051
  PB062 ⇐ PB061
  PB072 ⇐ PB071
  PB082 ⇐ PB081
  PB092 ⇐ PB091
  PB102 ⇐ PB101
  PB112 ⇐ PB111
  PB122 ⇐ PB121
  RUDD2 ⇐ RUDD1
  RATE2 ⇐ RATE1
END

```

RandSail Model in PROSIM 3.01: NEWAPPROACH macro

```
FOR K ⇐ 1 TO TOTRUNS
  DISPLAY "THIS IS MAIN-RUN NO. = ";I AT LINE 2 POSITION 6 WITH IMAGE AΔxxx
  DISPLAY "THIS IS SUB-RUN  NO. = ";K AT LINE 3 POSITION 6 WITH IMAGE AΔxxx

  XSTART ⇐ XORIGINAL+DEEL*K
  YPREVIOUS ⇐ YSTART
  Y500 ⇐ 0

  YSCHIP ⇐ YSHIPMA IF YSHIPMA≠0
  YSHIPMA ⇐ YPREVIOUS-875

  CALL COLUMBUSNEW

    ORDER1 ⇐ 1 IF ((YSCHIP/YSHIPMA)<1)&((YSCHIP/YSHIPMA)≥0)
    ORDER1 ⇐ 2 IF (YSCHIP/YSHIPMA)>1
    ORDER1 ⇐ 3 IF ((YSCHIP/YSHIPMA)<0)&(YSHIPMA≥0)
    ORDER1 ⇐ 4 IF ((YSCHIP/YSHIPMA)<0)&(YSHIPMA<0)
    ORDER2 ⇐ 1 IF (ORDER1=2)&(YSHIPMA≥0)
    ORDER2 ⇐ 2 IF (ORDER1=1)&(YSHIPMA≥0)
    ORDER2 ⇐ 3 IF (ORDER1=1)&(YSHIPMA<0)
    ORDER2 ⇐ 4 IF (ORDER1=2)&(YSHIPMA<0)

    ORDER7 ⇐ RATETRN
    ORDER6 ⇐ RUDDER
    ORDER5 ⇐ YSTART-875

    IF ORDER5≥0
      ORDER6 ⇐ ORDER6+10 IF RUDDER≤-17.5
      ORDER6 ⇐ ORDER6+7.5 IF (RUDDER≤-7.5)&(RUDDER>-17.5)
      ORDER6 ⇐ ORDER6+5 IF (RUDDER≤-2.5)&(RUDDER>-7.5)

      IF WAVEFLD>5
        ORDER6 ⇐ ORDER6+7.5 IF (RUDDER<2.5)&(RUDDER>-2.5)
        ORDER6 ⇐ ORDER6+5 IF (RUDDER<7.5)&(RUDDER_2.5)
      END
      RUDDER ⇐ ORDER6

      ORDER7 ⇐ 0.3 IF RUDDER≤-2.5
      ORDER7 ⇐ 0.3 IF (RUDDER<2.5)&(RUDDER>-2.5)
      ORDER7 ⇐ 0.3 IF RUDDER≥2.5
    END
    IF ORDER5<0
      ORDER6 ⇐ ORDER6+5 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
      RUDDER ⇐ ORDER6

      ORDER7 ⇐ 0.3 IF RUDDER≤-2.5
      ORDER7 ⇐ 0.3 IF (RUDDER<2.5)&(RUDDER>-2.5)
      ORDER7 ⇐ 0.3 IF (RUDDER≥2.5)&(RUDDER<7.5)
      IF (RUDDER≥7.5)&(RUDDER<12.5)
        ORDER7 ⇐ 0.15
      END
```

```
      IF (RUDDER≥12.5)
        ORDER7 ⇐ 0
      END
    END

    RATETRN ⇐ ORDER7

    CALL SELECTING
    CALL MANOEUVRE
    CALL NEWAPPRSUB

  PR01 ⇐ PS01
  PR02 ⇐ PS02
  PR03 ⇐ PS03
  PR04 ⇐ PS04
  PR05 ⇐ PS05
  PR06 ⇐ PS06
  PR07 ⇐ PS07

  FOR L ⇐ 1 TO DEELTIJD
    VAARTIJD ⇐ ((K-1)*TIJDSTAP)+(L*5)
    VAARPOST ⇐ VAARTIJD*SPEED
    CALL STORAGE1
    CALL STORAGE2 IF NUMBER ≤5

    CALL STORAGE3A

    CALL UITERWAARDEN
    CALL STORAGE3B
  END
END
```

RandSail Model in PROSIM 3.01: SELECTING macro

```
IF WAVEFLD=1
  SELECTION ⇐ 7 IF RUDDER≥12.5
  SELECTION ⇐ 6 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 5 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 1 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 2 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 3 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 4 IF RUDDER≤-12.5
END

IF WAVEFLD=2
  SELECTION ⇐ 14 IF RUDDER≥12.5
  SELECTION ⇐ 13 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 12 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 8 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 9 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 10 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 11 IF RUDDER≤-12.5
END

IF WAVEFLD=3
  SELECTION ⇐ 21 IF RUDDER≥12.5
  SELECTION ⇐ 20 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 19 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 15 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 16 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 17 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 18 IF RUDDER≤-12.5
END

IF WAVEFLD=4
  SELECTION ⇐ 28 IF RUDDER≥12.5
  SELECTION ⇐ 27 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 26 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 22 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 23 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 24 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 25 IF RUDDER≤-12.5
END

IF WAVEFLD=5
  SELECTION ⇐ 35 IF RUDDER≥12.5
  SELECTION ⇐ 34 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 33 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 29 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 30 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 31 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 32 IF RUDDER≤-12.5
END

IF WAVEFLD=6
```

```
  SELECTION ⇐ 42 IF RUDDER≥12.5
  SELECTION ⇐ 41 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 40 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 36 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 37 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 38 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 39 IF RUDDER≤-12.5
END

IF WAVEFLD=7
  SELECTION ⇐ 49 IF RUDDER≥12.5
  SELECTION ⇐ 48 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 47 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 43 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 44 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 45 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 46 IF RUDDER≤-12.5
END

IF WAVEFLD=8
  SELECTION ⇐ 56 IF RUDDER≥12.5
  SELECTION ⇐ 55 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 54 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 50 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 51 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 52 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 53 IF RUDDER≤-12.5
END

IF WAVEFLD=9
  SELECTION ⇐ 63 IF RUDDER≥12.5
  SELECTION ⇐ 62 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 61 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 57 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 58 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 59 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 60 IF RUDDER≤-12.5
END

IF WAVEFLD=10
  SELECTION ⇐ 70 IF RUDDER≥12.5
  SELECTION ⇐ 69 IF (RUDDER<12.5)&(RUDDER≥7.5)
  SELECTION ⇐ 68 IF (RUDDER<7.5)&(RUDDER≥2.5)
  SELECTION ⇐ 65 IF (RUDDER<2.5)&(RUDDER>-2.5)
  SELECTION ⇐ 66 IF (RUDDER≤-2.5)&(RUDDER>-7.5)
  SELECTION ⇐ 67 IF (RUDDER≤-7.5)&(RUDDER>-12.5)
  SELECTION ⇐ 68 IF RUDDER≤-12.5
END

IF RATETRN≤-0.225
  XPAST ⇐ 1 IF YSTART<665
  XPAST ⇐ 1 IF (YSTART≥665)&(YSTART<735)
  XPAST ⇐ 2 IF (YSTART≥735)&(YSTART<805)
  XPAST ⇐ 3 IF (YSTART≥805)&(YSTART<875)
  XPAST ⇐ 4 IF (YSTART≥875)&(YSTART<945)
```

```
  XPAST ⇐ 5 IF (YSTART≥945)&(YSTART<1015)
  XPAST ⇐ 6 IF (YSTART≥1015)&(YSTART<1085)
  XPAST ⇐ 7 IF YSTART≥1085
END

IF (RATETRN>-0.225)&(RATETRN≤-0.075)
  XPAST ⇐ 8 IF YSTART<665
  XPAST ⇐ 8 IF (YSTART≥665)&(YSTART<735)
  XPAST ⇐ 9 IF (YSTART≥735)&(YSTART<805)
  XPAST ⇐ 10 IF (YSTART≥805)&(YSTART<875)
  XPAST ⇐ 11 IF (YSTART≥875)&(YSTART<945)
  XPAST ⇐ 12 IF (YSTART≥945)&(YSTART<1015)
  XPAST ⇐ 13 IF (YSTART≥1015)&(YSTART<1085)
  XPAST ⇐ 14 IF YSTART≥1085
END

IF (RATETRN>-0.075)&(RATETRN≤0.075)
  XPAST ⇐ 15 IF YSTART<665
  XPAST ⇐ 15 IF (YSTART≥665)&(YSTART<735)
  XPAST ⇐ 16 IF (YSTART≥735)&(YSTART<805)
  XPAST ⇐ 17 IF (YSTART≥805)&(YSTART<875)
  XPAST ⇐ 18 IF (YSTART≥875)&(YSTART<945)
  XPAST ⇐ 19 IF (YSTART≥945)&(YSTART<1015)
  XPAST ⇐ 20 IF (YSTART≥1015)&(YSTART<1085)
  XPAST ⇐ 21 IF YSTART≥1085
END

IF (RATETRN>0.075)&(RATETRN≤0.225)
  XPAST ⇐ 22 IF YSTART<665
  XPAST ⇐ 22 IF (YSTART≥665)&(YSTART<735)
  XPAST ⇐ 23 IF (YSTART≥735)&(YSTART<805)
  XPAST ⇐ 24 IF (YSTART≥805)&(YSTART<875)
  XPAST ⇐ 25 IF (YSTART≥875)&(YSTART<945)
  XPAST ⇐ 26 IF (YSTART≥945)&(YSTART<1015)
  XPAST ⇐ 27 IF (YSTART≥1015)&(YSTART<1085)
  XPAST ⇐ 28 IF YSTART≥1085
END

IF RATETRN>0.225
  XPAST ⇐ 29 IF YSTART<665
  XPAST ⇐ 29 IF (YSTART≥665)&(YSTART<735)
  XPAST ⇐ 30 IF (YSTART≥735)&(YSTART<805)
  XPAST ⇐ 31 IF (YSTART≥805)&(YSTART<875)
  XPAST ⇐ 32 IF (YSTART≥875)&(YSTART<945)
  XPAST ⇐ 33 IF (YSTART≥945)&(YSTART<1015)
  XPAST ⇐ 34 IF (YSTART≥1015)&(YSTART<1085)
  XPAST ⇐ 35 IF YSTART≥1085
END

```

RandSail Model in PROSIM 3.01: COLUMBUSNEW macro

```
@ INVOER VAN POSITIE SCHIP
XLOC ⇐ 0
Y500 ⇐ 0
YAXIS ⇐ 0
@YPREVIOUS ⇐ YSTART

XLOC ⇐ 500 IF (XPOST≥500)&(XPOST<1000)
XLOC ⇐ 1000 IF (XPOST≥1000)&(XPOST<1500)
XLOC ⇐ 1500 IF (XPOST≥1500)&(XPOST<2000)
XLOC ⇐ 2000 IF (XPOST≥2000)&(XPOST<2500)
XLOC ⇐ 2500 IF (XPOST≥2500)&(XPOST<3000)
XLOC ⇐ 3000 IF (XPOST≥3000)&(XPOST<3500)
XLOC ⇐ 3500 IF (XPOST≥3500)&(XPOST<4000)
XLOC ⇐ 4000 IF (XPOST≥_4000)&(XPOST<4500)
XLOC ⇐ 4500 IF (XPOST≥4500)&(XPOST<5000)
XLOC ⇐ 5000 IF (XPOST≥5000)&(XPOST<5500)
XLOC ⇐ 5500 IF (XPOST≥5500)&(XPOST<6000)
XLOC ⇐ 6000 IF (XPOST≥6000)&(XPOST<6500)
XLOC ⇐ 6500 IF (XPOST≥6500)&(XPOST<7000)
XLOC ⇐ 7000 IF (XPOST≥7000)&(XPOST<7500)
XLOC ⇐ 7500 IF (XPOST≥7500)&(XPOST<8000)
XLOC ⇐ 8000 IF (XPOST≥8000)&(XPOST<8500)
XLOC ⇐ 8500 IF (XPOST≥8500)&(XPOST<9000)

IF XPOST=0
  CALL COLUMBUSDATAREAD
  XBASE1 ⇐ 0
  XBASE2 ⇐ 500
END
IF XLOC =500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 500
  XBASE2 ⇐ 1000
END
IF XLOC =1000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 1000
  XBASE2 ⇐ 1500
END
IF XLOC =1500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 1500
  XBASE2 ⇐ 2000
END
IF XLOC =2000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 2000
  XBASE2 ⇐ 2500
END
IF XLOC =2500
  CALL COLUMBUSDATAREAD2
```

```
  XBASE1 ⇐ 2500
  XBASE2 ⇐ 3000
END
IF XLOC =3000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 3000
  XBASE2 ⇐ 3500
END
IF XLOC =3500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 3500
  XBASE2 ⇐ 4000
END
IF XLOC =4000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 4000
  XBASE2 ⇐ 4500
END
IF XLOC =4500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 4500
  XBASE2 ⇐ 5000
END
IF XLOC =5000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 5000
  XBASE2 ⇐ 5500
END
IF XLOC =5500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 5500
  XBASE2 ⇐ 6000
END
IF XLOC =6000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 6000
  XBASE2 ⇐ 6500
END
IF XLOC =6500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 6500
  XBASE2 ⇐ 7000
END
IF XLOC =7000
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 7000
  XBASE2 ⇐ 7500
END
IF XLOC =7500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 7500
  XBASE2 ⇐ 8000
END
IF XLOC =8000
  CALL COLUMBUSDATAREAD2
```

```
  XBASE1 ⇐ 8000
  XBASE2 ⇐ 8500
END
IF XLOC =8500
  CALL COLUMBUSDATAREAD2
  XBASE1 ⇐ 8500
  XBASE2 ⇐ 9000
END

CALL COLUMBUSMATRIX

CALL CALCULATOR

ORDER5 ⇐ YAXIS
IF YSHIPMA>0
  ORDER5 ⇐ (-1)*ORDER5 IF YAXIS<0  @SWITCH 1
  ORDER5 ⇐ 0.5*ORDER5 IF (ORDER5>70)&(ORDER5≤140) @SWITCH 2
  ORDER5 ⇐ ORDER5/3 IF ORDER5>140  @SWITCH 3
END
IF YSHIPMA<0
  ORDER5 ⇐ (-1)*ORDER5 IF YAXIS>0  @SWITCH 1
  ORDER5 ⇐ ORDER5/2 IF (ORDER5<-70)&(ORDER5≥-140) @SWITCH 2
  ORDER5 ⇐ ORDER5/3 IF ORDER5<-140  @SWITCH 3
END

YAXIS ⇐ ORDER5

HLOC ⇐ 1 IF YAXIS≥0
HLOC ⇐ 2 IF YAXIS<0

XSHIPMA ⇐ YAXIS

YLOC ⇐ HLOC

Y500 ⇐ YAXIS

YSTART ⇐ YSTART+Y500

```

RandSail Model in PROSIM 3.01: COLUMBUSDATAREAD macro

```
PPAST ⇐ READ FROM ORIENTA
ORIENT011 ⇐ READ FROM ORIENTA
ORIENT012 ⇐ READ FROM ORIENTA
ORIENT013 ⇐ READ FROM ORIENTA
ORIENT014 ⇐ READ FROM ORIENTA
ORIENT015 ⇐ READ FROM ORIENTA
ORIENT016 ⇐ READ FROM ORIENTA
ORIENT017 ⇐ READ FROM ORIENTA

BANDL ⇐ READ FROM ORIENTA
ORIENT021 ⇐ READ FROM ORIENTA
ORIENT022 ⇐ READ FROM ORIENTA
ORIENT023 ⇐ READ FROM ORIENTA
ORIENT024 ⇐ READ FROM ORIENTA
ORIENT025 ⇐ READ FROM ORIENTA
ORIENT026 ⇐ READ FROM ORIENTA
ORIENT027 ⇐ READ FROM ORIENTA

AFWIJKL011 ⇐ READ FROM AFWIJKLL
AFWIJKL012 ⇐ READ FROM AFWIJKLL
AFWIJKL013 ⇐ READ FROM AFWIJKLL
AFWIJKL014 ⇐ READ FROM AFWIJKLL
AFWIJKL015 ⇐ READ FROM AFWIJKLL
AFWIJKL016 ⇐ READ FROM AFWIJKLL
AFWIJKL017 ⇐ READ FROM AFWIJKLL

AFWIJKL021 ⇐ READ FROM AFWIJKLL
AFWIJKL022 ⇐ READ FROM AFWIJKLL
AFWIJKL023 ⇐ READ FROM AFWIJKLL
AFWIJKL024 ⇐ READ FROM AFWIJKLL
AFWIJKL025 ⇐ READ FROM AFWIJKLL
AFWIJKL026 ⇐ READ FROM AFWIJKLL
AFWIJKL027 ⇐ READ FROM AFWIJKLL

AFWIJKK011 ⇐ READ FROM AFWIJKKL
AFWIJKK012 ⇐ READ FROM AFWIJKKL
AFWIJKK013 ⇐ READ FROM AFWIJKKL
AFWIJKK014 ⇐ READ FROM AFWIJKKL
AFWIJKK015 ⇐ READ FROM AFWIJKKL
AFWIJKK016 ⇐ READ FROM AFWIJKKL
AFWIJKK017 ⇐ READ FROM AFWIJKKL

AFWIJKK021 ⇐ READ FROM AFWIJKKL
AFWIJKK022 ⇐ READ FROM AFWIJKKL
AFWIJKK023 ⇐ READ FROM AFWIJKKL
AFWIJKK024 ⇐ READ FROM AFWIJKKL
AFWIJKK025 ⇐ READ FROM AFWIJKKL
AFWIJKK026 ⇐ READ FROM AFWIJKKL
AFWIJKK027 ⇐ READ FROM AFWIJKKL
```

RandSail Model in PROSIM 3.01: COLUMBUSDATAREAD2 macro

```
PPAST ⇐ BANDL
BANDL ⇐ READ FROM ORIENTA
ORIENT011 ⇐ ORIENT021
ORIENT012 ⇐ ORIENT022
ORIENT013 ⇐ ORIENT023
ORIENT014 ⇐ ORIENT024
ORIENT015 ⇐ ORIENT025
ORIENT016 ⇐ ORIENT026
ORIENT017 ⇐ ORIENT027

ORIENT021 ⇐ READ FROM ORIENTA
ORIENT022 ⇐ READ FROM ORIENTA
ORIENT023 ⇐ READ FROM ORIENTA
ORIENT024 ⇐ READ FROM ORIENTA
ORIENT025 ⇐ READ FROM ORIENTA
ORIENT026 ⇐ READ FROM ORIENTA
ORIENT027 ⇐ READ FROM ORIENTA

AFWIJKL011 ⇐ AFWIJKL021
AFWIJKL012 ⇐ AFWIJKL022
AFWIJKL013 ⇐ AFWIJKL023
AFWIJKL014 ⇐ AFWIJKL024
AFWIJKL015 ⇐ AFWIJKL025
AFWIJKL016 ⇐ AFWIJKL026
AFWIJKL017 ⇐ AFWIJKL027

AFWIJKL021 ⇐ READ FROM AFWIJKLL
AFWIJKL022 ⇐ READ FROM AFWIJKLL
AFWIJKL023 ⇐ READ FROM AFWIJKLL
AFWIJKL024 ⇐ READ FROM AFWIJKLL
AFWIJKL025 ⇐ READ FROM AFWIJKLL
AFWIJKL026 ⇐ READ FROM AFWIJKLL
AFWIJKL027 ⇐ READ FROM AFWIJKLL

AFWIJKK011 ⇐ AFWIJKK021
AFWIJKK012 ⇐ AFWIJKK022
AFWIJKK013 ⇐ AFWIJKK023
AFWIJKK014 ⇐ AFWIJKK024
AFWIJKK015 ⇐ AFWIJKK025
AFWIJKK016 ⇐ AFWIJKK026
AFWIJKK017 ⇐ AFWIJKK027

AFWIJKK021 ⇐ READ FROM AFWIJKKL
AFWIJKK022 ⇐ READ FROM AFWIJKKL
AFWIJKK023 ⇐ READ FROM AFWIJKKL
AFWIJKK024 ⇐ READ FROM AFWIJKKL
AFWIJKK025 ⇐ READ FROM AFWIJKKL
AFWIJKK026 ⇐ READ FROM AFWIJKKL
AFWIJKK027 ⇐ READ FROM AFWIJKKL
```

RandSail Model in PROSIM 3.01: COLUMBUSMATRIX macro

```
IF YSTART≤665
  YBASE1⇐665
  YBASE2⇐665
  ORIENT01 ⇐ ORIENT011
  ORIENT02 ⇐ ORIENT011
  ORIENT03 ⇐ ORIENT021
  ORIENT04 ⇐ ORIENT021

  AFWIJKL01 ⇐ AFWIJKL011
  AFWIJKL02 ⇐ AFWIJKL011
  AFWIJKL03 ⇐ AFWIJKL021
  AFWIJKL04 ⇐ AFWIJKL021

  AFWIJKK01 ⇐ AFWIJKK011
  AFWIJKK02 ⇐ AFWIJKK011
  AFWIJKK03 ⇐ AFWIJKK021
  AFWIJKK04 ⇐ AFWIJKK021
END

IF (YSTART>665)&(YSTART<735)
  YBASE1⇐665
  YBASE2⇐735
  ORIENT01 ⇐ ORIENT011
  ORIENT02 ⇐ ORIENT012
  ORIENT03 ⇐ ORIENT021
  ORIENT04 ⇐ ORIENT022

  AFWIJKL01 ⇐ AFWIJKL011
  AFWIJKL02 ⇐ AFWIJKL012
  AFWIJKL03 ⇐ AFWIJKL021
  AFWIJKL04 ⇐ AFWIJKL022

  AFWIJKK01 ⇐ AFWIJKK011
  AFWIJKK02 ⇐ AFWIJKK012
  AFWIJKK03 ⇐ AFWIJKK021
  AFWIJKK04 ⇐ AFWIJKK022
END

IF (YSTART≥735)&(YSTART<805)
  YBASE1⇐735
  YBASE2⇐805
  ORIENT01 ⇐ ORIENT012
  ORIENT02 ⇐ ORIENT013
  ORIENT03 ⇐ ORIENT022
  ORIENT04 ⇐ ORIENT023

  AFWIJKL01 ⇐ AFWIJKL012
  AFWIJKL02 ⇐ AFWIJKL013
  AFWIJKL03 ⇐ AFWIJKL022
  AFWIJKL04 ⇐ AFWIJKL023

```

```
  AFWIJKK01 ⇐ AFWIJKK012
  AFWIJKK02 ⇐ AFWIJKK013
  AFWIJKK03 ⇐ AFWIJKK022
  AFWIJKK04 ⇐ AFWIJKK023
END

IF (YSTART≥805)&(YSTART<875)
  YBASE1⇐805
  YBASE2⇐875
  ORIENT01 ⇐ ORIENT013
  ORIENT02 ⇐ ORIENT014
  ORIENT03 ⇐ ORIENT023
  ORIENT04 ⇐ ORIENT024

  AFWIJKL01 ⇐ AFWIJKL013
  AFWIJKL02 ⇐ AFWIJKL014
  AFWIJKL03 ⇐ AFWIJKL023
  AFWIJKL04 ⇐ AFWIJKL024

  AFWIJKK01 ⇐ AFWIJKK013
  AFWIJKK02 ⇐ AFWIJKK014
  AFWIJKK03 ⇐ AFWIJKK023
  AFWIJKK04 ⇐ AFWIJKK024
END

IF (YSTART≥875)&(YSTART<945)
  YBASE1⇐875
  YBASE2⇐945
  ORIENT01 ⇐ ORIENT014
  ORIENT02 ⇐ ORIENT015
  ORIENT03 ⇐ ORIENT024
  ORIENT04 ⇐ ORIENT025

  AFWIJKL01 ⇐ AFWIJKL014
  AFWIJKL02 ⇐ AFWIJKL015
  AFWIJKL03 ⇐ AFWIJKL024
  AFWIJKL04 ⇐ AFWIJKL025

  AFWIJKK01 ⇐ AFWIJKK014
  AFWIJKK02 ⇐ AFWIJKK015
  AFWIJKK03 ⇐ AFWIJKK024
  AFWIJKK04 ⇐ AFWIJKK025
END

IF (YSTART≥945)&(YSTART<1015)
  YBASE1⇐945
  YBASE2⇐1015
  ORIENT01 ⇐ ORIENT015
  ORIENT02 ⇐ ORIENT016
  ORIENT03 ⇐ ORIENT025
  ORIENT04 ⇐ ORIENT026

  AFWIJKL01 ⇐ AFWIJKL015
  AFWIJKL02 ⇐ AFWIJKL016
  AFWIJKL03 ⇐ AFWIJKL025
```

```
  AFWIJKL04 ⇐ AFWIJKL026

  AFWIJKK01 ⇐ AFWIJKK015
  AFWIJKK02 ⇐ AFWIJKK016
  AFWIJKK03 ⇐ AFWIJKK025
  AFWIJKK04 ⇐ AFWIJKK026
END

IF (YSTART≥1015)&(YSTART<1085)
  YBASE1⇐1015
  YBASE2⇐1085
  ORIENT01 ⇐ ORIENT016
  ORIENT02 ⇐ ORIENT017
  ORIENT03 ⇐ ORIENT026
  ORIENT04 ⇐ ORIENT027

  AFWIJKL01 ⇐ AFWIJKL016
  AFWIJKL02 ⇐ AFWIJKL017
  AFWIJKL03 ⇐ AFWIJKL026
  AFWIJKL04 ⇐ AFWIJKL027

  AFWIJKK01 ⇐ AFWIJKK016
  AFWIJKK02 ⇐ AFWIJKK017
  AFWIJKK03 ⇐ AFWIJKK026
  AFWIJKK04 ⇐ AFWIJKK027
END

IF YSTART≥1085
  YBASE1⇐1085
  YBASE2⇐1085
  ORIENT01 ⇐ ORIENT017
  ORIENT02 ⇐ ORIENT017
  ORIENT03 ⇐ ORIENT027
  ORIENT04 ⇐ ORIENT027

  AFWIJKL01 ⇐ AFWIJKL017
  AFWIJKL02 ⇐ AFWIJKL017
  AFWIJKL03 ⇐ AFWIJKL027
  AFWIJKL04 ⇐ AFWIJKL027

  AFWIJKK01 ⇐ AFWIJKK017
  AFWIJKK02 ⇐ AFWIJKK017
  AFWIJKK03 ⇐ AFWIJKK027
  AFWIJKK04 ⇐ AFWIJKK027
END

```

RandSail Model in PROSIM 3.01: CALCULATOR macro

```
XDELTA ⇐ XPOS-XBASE1
XRATIO ⇐ XDELTA/500
YDELTA ⇐ YSTART-YBASE1
YRATIO ⇐ YDELTA/70

ORIENTL ⇐ ORIENT01+(XRATIO*(ORIENT03-ORIENT01))
ORIENTR ⇐ ORIENT02+(XRATIO*(ORIENT04-ORIENT02))
AFWIJKLLFT ⇐ AFWIJKL01+(XRATIO*(AFWIJKL03-AFWIJKL01))
AFWIJKLRGT ⇐ AFWIJKL02+(XRATIO*(AFWIJKL04-AFWIJKL02))
AFWIJKKLFT ⇐ AFWIJKK01+(XRATIO*(AFWIJKK03-AFWIJKK01))
AFWIJKKRGT ⇐ AFWIJKK02+(XRATIO*(AFWIJKK04-AFWIJKK02))

IF ORIENTL=ORIENTR
  ORIENT ⇐ ORIENTL
  AFWIJKL ⇐ AFWIJKLLFT
  AFWIJKK ⇐ AFWIJKKLFT
END

IF ORIENTL+ORIENTR
  ORIENT ⇐ ORIENTL+(YRATIO*(ORIENTL-ORIENTR))
  AFWIJKL ⇐ AFWIJKLLFT+(YRATIO*(AFWIJKLLFT-AFWIJKLRGT))
  AFWIJKK ⇐ AFWIJKKLFT+(YRATIO*(AFWIJKKLFT-AFWIJKKRGT))
END

DISPLAY "Y POSITION = ";YSTART AT LINE 9 POSITION 6 WITH IMAGE AΔxxxxx

AFWIJKL ⇐ AFWIJKL/(2)
AFWIJKK ⇐ AFWIJKK/(2)

HEAD ⇐ 0 IF HEADING=1
HEAD ⇐ 4 IF HEADING=2
HEAD ⇐-4 IF HEADING=3

@ BEREKENING DE HOEK
HOEK ⇐ HEAD+ORIENT
GRAD ⇐ HOEK/180
HOEK ⇐ 3.14159*GRAD

@ DEFINITIE VAN DE VERDELING
RESHAPE NORM AS SAMPLED FROM DISTRIBUTION NORMAL WITH PARAMETERS MEAN(0)
DEVIATION(AFWIJKL)
LONGAXIS ⇐ NORM
RESHAPE NORM AS SAMPLED FROM DISTRIBUTION NORMAL WITH PARAMETERS MEAN(0)
DEVIATION(AFWIJKK)
SHORTAXIS ⇐ NORM

@ BEREKENING VAN X EN Y POSITIE
YCOLUMA ⇐ SQRT((SHORTAXIS*SHORTAXIS)+(LONGAXIS*LONGAXIS))
YCOLUMB ⇐ ARCCOS(LONGAXIS/YCOLUMA)

IF HOEK≥0
```

```
  IF (SHORTAXIS≥0)&(LONGAXIS_0)
    HOEK ⇐ HOEK+YCOLUMB
    XAXIS ⇐ YCOLUMA*COS(HOEK)
    YAXIS ⇐ YCOLUMA*SIN(HOEK)
  END
  IF (SHORTAXIS≥0)&(LONGAXIS<0)
    HOEK ⇐ YCOLUMB-HOEK
    XAXIS ⇐ (-1)*YCOLUMA*COS(HOEK)
    YAXIS ⇐ YCOLUMA*SIN(HOEK)
  END
  IF (SHORTAXIS<0)&(LONGAXIS≤0)
    HOEK ⇐ HOEK-YCOLUMB
    XAXIS ⇐ YCOLUMA*COS(HOEK)
    YAXIS ⇐ YCOLUMA*SIN(HOEK)
  END
  IF (SHORTAXIS<0)&(LONGAXIS<0)
    HOEK ⇐ HOEK+YCOLUMB
    XAXIS ⇐ (-1)*YCOLUMA*COS(HOEK)
    YAXIS ⇐ (-1)*YCOLUMA*SIN(HOEK)
  END
END

IF HOEK<0
  IF (SHORTAXIS≥0)&(LONGAXIS≥0)
    HOEK ⇐ YCOLUMB-HOEK
    XAXIS ⇐ YCOLUMA*COS(HOEK)
    YAXIS ⇐ YCOLUMA*SIN(HOEK)
  END
  IF (SHORTAXIS≥0)&(LONGAXIS<0)
    HOEK ⇐ HOEK-YCOLUMB
    XAXIS ⇐ (-1)*YCOLUMA*COS(HOEK)
    YAXIS ⇐ (-1)*YCOLUMA*SIN(HOEK)
  END
  IF (SHORTAXIS<0)&(LONGAXIS≥0)
    HOEK ⇐ HOEK-YCOLUMB
    XAXIS ⇐ YCOLUMA*COS(HOEK)
    YAXIS ⇐ YCOLUMA*SIN(HOEK)
  END
  IF (SHORTAXIS<0)&(LONGAXIS<0)
    HOEK ⇐ HOEK+YCOLUMB
    XAXIS ⇐ (-1)*YCOLUMA*COS(HOEK)
    YAXIS ⇐ (-1)*YCOLUMA*SIN(HOEK)
  END
END
```

RandSail Model in PROSIM 3.01: NEWAPPROACHSUB macro

```
PSB00 ⇐ RUDD1
PSB01 ⇐ RUDD2
PSB00 ⇐(PSB00-180) IF RUDD1≥0
PSB00 ⇐(180+PSB00) IF RUDD1<0
PSB01 ⇐(PSB01-180) IF RUDD2≥0
PSB01 ⇐(180+PSB01) IF RUDD2<0
RUDD1 ⇐ PSB00
RUDD2 ⇐ PSB01

IF PT001=PT002
  PT01 ⇐ PB011
  PT02 ⇐ PB021
  PT03 ⇐ PB031
  PT04 ⇐ PB041
  PT05 ⇐ PB051
  PT06 ⇐ PB061
  PT07 ⇐ PB071
  PT08 ⇐ PB081
  PT09 ⇐ PB091
  PT10 ⇐ PB101
  PT11 ⇐ PB111
  PT12 ⇐ PB121
  RUDDER ⇐ RUDD1
  RATETRN ⇐ RATE1
END

IF PT001+PT002
  VERHOUD ⇐ (YSTART-PT001)/(PT002-PT001)
  PT01 ⇐ PB011+(VERHOUD*(PB012-PB011))
  PT02 ⇐ PB021+(VERHOUD*(PB022-PB021))
  PT03 ⇐ PB031+(VERHOUD*(PB032-PB031))
  PT04 ⇐ PB041+(VERHOUD*(PB042-PB041))
  PT05 ⇐ PB051+(VERHOUD*(PB052-PB051))
  PT06 ⇐ PB061+(VERHOUD*(PB062-PB061))
  PT07 ⇐ PB071+(VERHOUD*(PB072-PB071))
  PT08 ⇐ PB081+(VERHOUD*(PB082-PB081))
  PT09 ⇐ PB091+(VERHOUD*(PB092-PB091))
  PT10 ⇐ PB101+(VERHOUD*(PB102-PB101))
  PT11 ⇐ PB111+(VERHOUD*(PB112-PB111))
  PT12 ⇐ PB121+(VERHOUD*(PB122-PB121))
  RUDDER ⇐ RUDD1+(VERHOUD*(RUDD2-RUDD1))
  RATETRN ⇐ RATE1+(VERHOUD*(RATE2-RATE1))
END

PTDELTA ⇐ PT001-YPREVIOUS IF YSTART≤665
PTDELTA ⇐ PT002-YPREVIOUS IF YSTART≥1085
PTDELTA ⇐ Y500 IF (YSTART>665)&(YSTART<1085)

PT01 ⇐ PT01-PTDELTA
PT02 ⇐ PT02-PTDELTA
PT03 ⇐ PT03-PTDELTA
```

```
PT04 ⇐ PT04-PTDELTA
PT05 ⇐ PT05-PTDELTA
PT06 ⇐ PT06-PTDELTA
PT07 ⇐ PT07-PTDELTA
PT08 ⇐ PT08-PTDELTA
PT09 ⇐ PT09-PTDELTA
PT10 ⇐ PT10-PTDELTA
PT11 ⇐ PT11-PTDELTA
PT12 ⇐ PT12-PTDELTA

ORDER3 ⇐ (PT12-YPREVIOUS)/12

PB01 ⇐ YPREVIOUS+ORDER3
PB02 ⇐ PB01+ORDER3
PB03 ⇐ PB02+ORDER3
PB04 ⇐ PB03+ORDER3
PB05 ⇐ PB04+ORDER3
PB06 ⇐ PB05+ORDER3
PB07 ⇐ PB06+ORDER3
PB08 ⇐ PB07+ORDER3
PB09 ⇐ PB08+ORDER3
PB10 ⇐ PB09+ORDER3
PB11 ⇐ PB10+ORDER3
PB12 ⇐ PT12

```

RandSail Model in PROSIM 3.01: STORAGE1 macro

```
IF L=1
  XPOST ⇐ XPOS01
  YSTART ⇐ PT01
END
IF L=2
  XPOST ⇐ XPOS02
  YSTART ⇐ PT02
END
IF L=3
  XPOST ⇐ XPOS03
  YSTART ⇐ PT03
END
IF L=4
  XPOST ⇐ XPOS04
  YSTART ⇐ PT04
END
IF L=5
  XPOST ⇐ XPOS05
  YSTART ⇐ PT05
END
IF L=6
  XPOST ⇐ XPOS06
  YSTART ⇐ PT06
END
IF L=7
  XPOST ⇐ XPOS07
  YSTART ⇐ PT07
END
IF L=8
  XPOST ⇐ XPOS08
  YSTART ⇐ PT08
END
IF L=9
  XPOST ⇐ XPOS09
  YSTART ⇐ PT09
END
IF L=10
  XPOST ⇐ XPOS10
  YSTART ⇐ PT10
END
IF L=11
  XPOST ⇐ XPOS11
  YSTART ⇐ PT11
END
IF L=12
  XPOST ⇐ XPOS12
  YSTART ⇐ PT12
END
```

RandSail Model in PROSIM 3.01: STORAGE2 macro

```
IF L=1
  WRITE VAARTIJD;VAARPOST;PB01 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=2
  WRITE VAARTIJD;VAARPOST;PB02 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=3
  WRITE VAARTIJD;VAARPOST;PB03 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=4
  WRITE VAARTIJD;VAARPOST;PB04 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=5
  WRITE VAARTIJD;VAARPOST;PB05 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=6
  WRITE VAARTIJD;VAARPOST;PB06 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=7
  WRITE VAARTIJD;VAARPOST;PB07 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=8
  WRITE VAARTIJD;VAARPOST;PB08 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=9
  WRITE VAARTIJD;VAARPOST;PB09 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=10
  WRITE VAARTIJD;VAARPOST;PB10 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=11
  WRITE VAARTIJD;VAARPOST;PB11 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
IF L=12
  WRITE VAARTIJD;VAARPOST;PB12 TO OUTINF1 WITH IMAGE xxxxxΔxxxxxΔxxxxx.xx
END
```

RandSail Model in PROSIM 3.01: STORAGE3A macro

```
IF L=1
  PB01 ⇐ PB01-875
  STORE PB01 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB01 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB01 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB01 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB01 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB01 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB01 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB01 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB01 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB01 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB01 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB01 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB01 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB01 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB01 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB01 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB01 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB01 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB01 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB01 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=2
  PB02 ⇐ PB02-875
  STORE PB02 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB02 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB02 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB02 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB02 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB02 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB02 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB02 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB02 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB02 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB02 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB02 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB02 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB02 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB02 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB02 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB02 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB02 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB02 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB02 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=3
  PB03 ⇐ PB03-875
  STORE PB03 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB03 VERSUS NOW AS "RAAI  2" IF XPOST=500
```

```
  STORE PB03 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB03 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB03 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB03 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB03 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB03 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB03 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB03 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB03 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB03 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB03 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB03 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB03 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB03 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB03 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB03 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB03 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB03 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=4
  PB04 ⇐ PB04-875
  STORE PB04 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB04 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB04 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB04 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB04 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB04 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB04 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB04 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB04 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB04 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB04 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB04 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB04 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB04 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB04 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB04 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB04 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB04 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB04 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB04 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=5
  PB05 ⇐ PB05-875
  STORE PB05 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB05 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB05 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB05 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB05 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB05 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB05 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB05 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB05 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB05 VERSUS NOW AS "RAAI 10" IF XPOST=2500
```

```
  STORE PB05 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB05 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB05 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB05 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB05 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB05 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB05 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB05 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB05 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB05 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=6
  PB06 ⇐ PB06-875
  STORE PB06 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB06 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB06 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB06 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB06 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB06 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB06 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB06 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB06 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB06 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB06 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB06 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB06 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB06 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB06 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB06 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB06 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB06 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB06 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB06 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=7
  PB07 ⇐ PB07-875
  STORE PB07 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB07 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB07 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB07 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB07 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB07 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB07 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB07 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB07 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB07 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB07 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB07 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB07 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB07 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB07 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB07 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB07 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB07 VERSUS NOW AS "RAAI 18" IF XPOST=4500
```

```
  STORE PB07 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB07 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=8
  PB08 ⇐ PB08-875
  STORE PB08 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB08 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB08 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB08 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB08 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB08 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB08 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB08 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB08 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB08 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB08 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB08 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB08 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB08 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB08 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB08 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB08 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB08 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB08 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB08 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=9
  PB09 ⇐ PB09-875
  STORE PB09 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB09 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB09 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB09 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB09 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB09 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB09 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB09 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB09 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB09 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB09 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB09 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB09 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB09 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB09 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB09 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB09 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB09 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB09 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB09 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=10
  PB10 ⇐ PB10-875
  STORE PB10 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB10 VERSUS NOW AS "RAAI  2" IF XPOST=500
```

```
  STORE PB10 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB10 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB10 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB10 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB10 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB10 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB10 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB10 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB10 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB10 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB10 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB10 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB10 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB10 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB10 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB10 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB10 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB10 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=11
  PB11 ⇐ PB11-875
  STORE PB11 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB11 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB11 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB11 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB11 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB11 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB11 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB11 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB11 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB11 VERSUS NOW AS "RAAI 10" IF XPOST=2500
  STORE PB11 VERSUS NOW AS "RAAI 11" IF XPOST=2750
  STORE PB11 VERSUS NOW AS "RAAI 12" IF XPOST=3000
  STORE PB11 VERSUS NOW AS "RAAI 13" IF XPOST=3250
  STORE PB11 VERSUS NOW AS "RAAI 14" IF XPOST=3500
  STORE PB11 VERSUS NOW AS "RAAI 15" IF XPOST=3750
  STORE PB11 VERSUS NOW AS "RAAI 16" IF XPOST=4000
  STORE PB11 VERSUS NOW AS "RAAI 17" IF XPOST=4250
  STORE PB11 VERSUS NOW AS "RAAI 18" IF XPOST=4500
  STORE PB11 VERSUS NOW AS "RAAI 19" IF XPOST=4750
  STORE PB11 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

IF L=12
  PB12 ⇐ PB12-875
  STORE PB12 VERSUS NOW AS "RAAI  1" IF XPOST=250
  STORE PB12 VERSUS NOW AS "RAAI  2" IF XPOST=500
  STORE PB12 VERSUS NOW AS "RAAI  3" IF XPOST=750
  STORE PB12 VERSUS NOW AS "RAAI  4" IF XPOST=1000
  STORE PB12 VERSUS NOW AS "RAAI  5" IF XPOST=1250
  STORE PB12 VERSUS NOW AS "RAAI  6" IF XPOST=1500
  STORE PB12 VERSUS NOW AS "RAAI  7" IF XPOST=1750
  STORE PB12 VERSUS NOW AS "RAAI  8" IF XPOST=2000
  STORE PB12 VERSUS NOW AS "RAAI  9" IF XPOST=2250
  STORE PB12 VERSUS NOW AS "RAAI 10" IF XPOST=2500
```

```
    STORE PB12 VERSUS NOW AS "RAAI 11" IF XPOST=2750
    STORE PB12 VERSUS NOW AS "RAAI 12" IF XPOST=3000
    STORE PB12 VERSUS NOW AS "RAAI 13" IF XPOST=3250
    STORE PB12 VERSUS NOW AS "RAAI 14" IF XPOST=3500
    STORE PB12 VERSUS NOW AS "RAAI 15" IF XPOST=3750
    STORE PB12 VERSUS NOW AS "RAAI 16" IF XPOST=4000
    STORE PB12 VERSUS NOW AS "RAAI 17" IF XPOST=4250
    STORE PB12 VERSUS NOW AS "RAAI 18" IF XPOST=4500
    STORE PB12 VERSUS NOW AS "RAAI 19" IF XPOST=4750
    STORE PB12 VERSUS NOW AS "RAAI 20" IF XPOST=5000
END

```

RandSail Model in PROSIM 3.01: STORAGE3B macro

```
STORE EXTMAXA VERSUS NOW AS "RAAI+ 1" IF XPOST=250
STORE EXTMAXA VERSUS NOW AS "RAAI+ 2" IF XPOST=500
STORE EXTMAXA VERSUS NOW AS "RAAI+ 3" IF XPOST=750
STORE EXTMAXA VERSUS NOW AS "RAAI+ 4" IF XPOST=1000
STORE EXTMAXA VERSUS NOW AS "RAAI+ 5" IF XPOST=1250
STORE EXTMAXA VERSUS NOW AS "RAAI+ 6" IF XPOST=1500
STORE EXTMAXA VERSUS NOW AS "RAAI+ 7" IF XPOST=1750
STORE EXTMAXA VERSUS NOW AS "RAAI+ 8" IF XPOST=2000
STORE EXTMAXA VERSUS NOW AS "RAAI+ 9" IF XPOST=2250
STORE EXTMAXA VERSUS NOW AS "RAAI+10" IF XPOST=2500
STORE EXTMAXA VERSUS NOW AS "RAAI+11" IF XPOST=2750
STORE EXTMAXA VERSUS NOW AS "RAAI+12" IF XPOST=3000
STORE EXTMAXA VERSUS NOW AS "RAAI+13" IF XPOST=3250
STORE EXTMAXA VERSUS NOW AS "RAAI+14" IF XPOST=3500
STORE EXTMAXA VERSUS NOW AS "RAAI+15" IF XPOST=3750
STORE EXTMAXA VERSUS NOW AS "RAAI+16" IF XPOST=4000
STORE EXTMAXA VERSUS NOW AS "RAAI+17" IF XPOST=4250
STORE EXTMAXA VERSUS NOW AS "RAAI+18" IF XPOST=4500
STORE EXTMAXA VERSUS NOW AS "RAAI+19" IF XPOST=4750
STORE EXTMAXA VERSUS NOW AS "RAAI+20" IF XPOST=5000


STORE EXTMINA VERSUS NOW AS "RAAI- 1" IF XPOST=250
STORE EXTMINA VERSUS NOW AS "RAAI- 2" IF XPOST=500
STORE EXTMINA VERSUS NOW AS "RAAI- 3" IF XPOST=750
STORE EXTMINA VERSUS NOW AS "RAAI- 4" IF XPOST=1000
STORE EXTMINA VERSUS NOW AS "RAAI- 5" IF XPOST=1250
STORE EXTMINA VERSUS NOW AS "RAAI- 6" IF XPOST=1500
STORE EXTMINA VERSUS NOW AS "RAAI- 7" IF XPOST=1750
STORE EXTMINA VERSUS NOW AS "RAAI- 8" IF XPOST=2000
STORE EXTMINA VERSUS NOW AS "RAAI- 9" IF XPOST=2250
STORE EXTMINA VERSUS NOW AS "RAAI-10" IF XPOST=2500
STORE EXTMINA VERSUS NOW AS "RAAI-11" IF XPOST=2750
STORE EXTMINA VERSUS NOW AS "RAAI-12" IF XPOST=3000
STORE EXTMINA VERSUS NOW AS "RAAI-13" IF XPOST=3250
STORE EXTMINA VERSUS NOW AS "RAAI-14" IF XPOST=3500
STORE EXTMINA VERSUS NOW AS "RAAI-15" IF XPOST=3750
STORE EXTMINA VERSUS NOW AS "RAAI-16" IF XPOST=4000
STORE EXTMINA VERSUS NOW AS "RAAI-17" IF XPOST=4250
STORE EXTMINA VERSUS NOW AS "RAAI-18" IF XPOST=4500
STORE EXTMINA VERSUS NOW AS "RAAI-19" IF XPOST=4750
STORE EXTMINA VERSUS NOW AS "RAAI-20" IF XPOST=5000
```

RandSail Model in PROSIM 3.01: UITERWAARDEN macro

```
CENTERPOINT ⇐ PT01 IF L=1
CENTERPOINT ⇐ PT02 IF L=2
CENTERPOINT ⇐ PT03 IF L=3
CENTERPOINT ⇐ PT04 IF L=4
CENTERPOINT ⇐ PT05 IF L=5
CENTERPOINT ⇐ PT06 IF L=6
CENTERPOINT ⇐ PT07 IF L=7
CENTERPOINT ⇐ PT08 IF L=8
CENTERPOINT ⇐ PT09 IF L=9
CENTERPOINT ⇐ PT10 IF L=10
CENTERPOINT ⇐ PT11 IF L=11
CENTERPOINT ⇐ PT12 IF L=12

CENTERSUB   ⇐ PB01 IF L=1
CENTERSUB   ⇐ PB02 IF L=2
CENTERSUB   ⇐ PB03 IF L=3
CENTERSUB   ⇐ PB04 IF L=4
CENTERSUB   ⇐ PB05 IF L=5
CENTERSUB   ⇐ PB06 IF L=6
CENTERSUB   ⇐ PB07 IF L=7
CENTERSUB   ⇐ PB08 IF L=8
CENTERSUB   ⇐ PB09 IF L=9
CENTERSUB   ⇐ PB10 IF L=10
CENTERSUB   ⇐ PB11 IF L=11
CENTERSUB   ⇐ PB12 IF L=12

HEADPLUS ⇐ 3.1416*(RUDDER/180)
POINTA ⇐ (112.5*SIN(HEADPLUS))+(16.1*COS(HEADPLUS))
POINTB ⇐ (112.5*SIN(HEADPLUS))-(16.1*COS(HEADPLUS))
POINTC ⇐ (-112.5*SIN(HEADPLUS))-(16.1*COS(HEADPLUS))
POINTD ⇐ (-112.5*SIN(HEADPLUS))+(16.1*COS(HEADPLUS))

IF HEADPLUS≥0
  POINTG ⇐ CENTERSUB+POINTA
  POINTH ⇐ CENTERSUB+POINTB
  POINTE ⇐ CENTERSUB-POINTA
  POINTF ⇐ CENTERSUB-POINTB

  POINTC ⇐ CENTERPOINT+POINTA
  POINTD ⇐ CENTERPOINT+POINTB
  POINTA ⇐ CENTERPOINT-POINTA
  POINTB ⇐ CENTERPOINT-POINTB
END

IF HEADPLUS<0
  POINTE ⇐ CENTERSUB+POINTC
  POINTF ⇐ CENTERSUB+POINTD
  POINTG ⇐ CENTERSUB-POINTC
  POINTH ⇐ CENTERSUB-POINTD

  POINTA ⇐ CENTERPOINT+POINTC
```

```
  POINTB ⇐ CENTERPOINT+POINTD
  POINTC ⇐ CENTERPOINT-POINTC
  POINTD ⇐ CENTERPOINT-POINTD
END

EXTMAX ⇐ MAX(POINTA,POINTB,POINTC,POINTD)
EXTMIN ⇐ MIN(POINTA,POINTB,POINTC,POINTD)
EXTMAXA ⇐ MAX(POINTE,POINTF,POINTG,POINTH)
EXTMINA ⇐ MIN(POINTE,POINTF,POINTG,POINTH)
```

Appendix B.2

List of Contents

Nr.	Wind Direction	Wind Force	Ship Heading	Input file name	Page
1	90 deg	0%	-15 deg	Route 111	App. B.2.1
2		0%	-10 deg	Route 121	App. B.2.2
3		0%	-5 deg	Route 131	App. B.2.3
4		0%	0 deg	Route 141	App. B.2.4
5		0%	+5 deg	Route 151	App. B.2.5
6		0%	+10 deg	Route 161	App. B.2.6
7		0%	+15 deg	Route 171	App. B.2.7
8		50%	-15 deg	Route 112	App. B.2.8
9		50%	-10 deg	Route 122	App. B.2.9
10		50%	-5 deg	Route 132	App. B.2.10
11		50%	0 deg	Route 142	App. B.2.11
12		50%	+5 deg	Route 152	App. B.2.12
13		50%	+10 deg	Route 162	App. B.2.13
14		50%	+15 deg	Route 172	App. B.2.14
15		75%	-15 deg	Route 113	App. B.2.15
16		75%	-10 deg	Route 123	App. B.2.16
17		75%	-5 deg	Route 133	App. B.2.17
18		75%	0 deg	Route 143	App. B.2.18
19		75%	+5 deg	Route 153	App. B.2.19
20		75%	+10 deg	Route 163	App. B.2.20
21		75%	+15 deg	Route 173	App. B.2.21
22		100%	-15 deg	Route 114	App. B.2.22
23		100%	-10 deg	Route 124	App. B.2.23
24		100%	-5 deg	Route 134	App. B.2.24
25		100%	0 deg	Route 144	App. B.2.25
26		100%	+5 deg	Route 154	App. B.2.26
27		100%	+10 deg	Route 164	App. B.2.27
28		100%	+15 deg	Route 174	App. B.2.28
29		125%	-15 deg	Route 115	App. B.2.29
30		125%	-10 deg	Route 125	App. B.2.30
31		125%	-5 deg	Route 135	App. B.2.31
32		125%	0 deg	Route 145	App. B.2.32
33		125%	+5 deg	Route 155	App. B.2.33
34		125%	+10 deg	Route 165	App. B.2.34
35		125%	+15 deg	Route 175	App. B.2.35

Appendix B.2

List of Contents (continued)

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: -15 deg. **Input file: ROUTE111.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.87	679.57	688.1	697.34	707.22	717.64	728.54	739.85	751.5	763.43	775.6	787.94	156.3	0.017
2	735	741.9	749.65	758.19	767.42	777.25	787.62	798.44	809.65	821.2	833.01	845.03	857.21	156.9	0.0236
3	805	811.9	819.65	828.19	837.42	847.25	857.62	868.44	879.65	891.2	903.01	915.03	927.21	156.9	0.0236
4	875	881.9	889.65	898.19	907.42	917.25	927.62	938.44	949.65	961.2	973.01	985.03	997.21	156.9	0.0236
5	945	951.9	959.65	968.19	977.42	987.25	997.62	1008.44	1019.65	1031.2	1043.01	1055.03	1067.21	156.9	0.0236
6	1015	1021.9	1029.65	1038.19	1047.42	1057.25	1067.62	1078.44	1089.65	1101.2	1113.01	1125.03	1137.21	156.9	0.0236
7	1085	1091.9	1099.65	1108.19	1117.42	1127.25	1137.62	1148.44	1159.65	1171.2	1183.01	1195.03	1207.21	156.9	0.0236
8	665	671.77	679.14	687.19	695.94	705.33	715.28	725.71	736.56	747.77	759.27	771.01	782.93	157.2	0.0128
9	735	741.8	749.28	757.42	766.16	775.44	785.18	795.33	805.82	816.6	827.6	838.78	850.07	159.5	0.0403
10	805	811.8	819.28	827.42	836.16	845.44	855.18	865.33	875.82	886.6	897.6	908.78	920.07	159.5	0.0403
11	875	881.8	889.28	897.42	906.16	915.44	925.18	935.33	945.82	956.6	967.6	978.78	990.07	159.5	0.0403
12	945	951.8	959.28	967.42	976.16	985.44	995.18	1005.33	1015.82	1026.6	1037.6	1048.78	1060.07	159.5	0.0403
13	1015	1021.8	1029.28	1037.42	1046.16	1055.44	1065.18	1075.33	1085.82	1096.6	1107.6	1118.78	1130.07	159.5	0.0403
14	1085	1091.8	1099.28	1107.42	1116.16	1125.44	1135.18	1145.33	1155.82	1166.6	1177.6	1188.78	1200.07	159.5	0.0403
15	665	671.67	678.79	686.39	694.58	703.41	712.81	722.71	733.05	743.76	754.78	766.06	777.53	158.3	0.007
16	735	741.67	748.83	756.56	764.81	773.54	782.69	792.2	802.02	812.08	822.34	832.73	843.22	161.7	0.0531
17	805	811.71	818.92	826.65	834.88	843.54	852.59	861.98	871.64	881.52	891.57	901.73	911.96	162.5	0.0631
18	875	881.71	888.92	896.65	904.88	913.54	922.59	931.98	941.64	951.52	961.57	971.73	981.96	162.5	0.0631
19	945	951.71	958.92	966.65	974.88	983.54	992.59	1001.98	1011.64	1021.52	1031.57	1041.73	1051.96	162.5	0.0631
20	1015	1021.71	1028.92	1036.65	1044.88	1053.54	1062.59	1071.98	1081.64	1091.52	1101.57	1111.73	1121.96	162.5	0.0631
21	1085	1091.71	1098.92	1106.65	1114.88	1123.54	1132.59	1141.98	1151.64	1161.52	1171.57	1181.73	1191.96	162.5	0.0631
22	665	671.58	678.42	685.62	693.25	701.42	710.16	719.42	729.13	739.22	749.63	760.3	771.18	159.9	0.0032
23	735	741.58	748.47	755.8	763.57	771.75	780.27	789.1	798.18	807.45	816.88	826.39	835.94	164.3	0.0712
24	805	811.59	818.51	825.81	833.49	841.5	849.8	858.35	867.1	876	884.99	894.03	903.05	165.8	0.089
25	875	881.61	888.55	895.87	903.56	911.57	919.87	928.4	937.13	946	954.96	963.95	972.92	166	0.0915
26	945	951.61	958.55	965.87	973.56	981.57	989.87	998.4	1007.13	1016	1024.96	1033.95	1042.92	166	0.0915
27	1015	1021.61	1028.55	1035.87	1043.56	1051.57	1059.87	1068.4	1077.13	1086	1094.96	1103.95	1112.92	166	0.0915
28	1085	1091.61	1098.55	1105.87	1113.56	1121.57	1129.87	1138.4	1147.13	1156	1164.96	1173.95	1182.92	166	0.0915
29	665	671.48	678.05	684.82	691.92	699.42	707.36	715.81	724.74	734.11	743.83	753.85	764.11	161.1	-0.0118
30	735	741.48	748.05	754.85	762.04	769.65	777.64	785.95	794.53	803.33	812.3	821.38	830.51	165.1	0.0628
31	805	811.48	818.11	825.04	832.25	839.73	847.44	855.34	863.37	871.5	879.67	887.83	895.93	168.3	0.1064
32	875	881.51	888.18	895.08	902.22	909.58	917.12	924.81	932.59	940.43	948.27	956.07	963.77	169.4	0.119
33	945	951.51	958.18	965.08	972.22	979.58	987.12	994.81	1002.59	1010.43	1018.27	1026.07	1033.77	169.4	0.119
34	1015	1021.51	1028.18	1035.08	1042.22	1049.58	1057.12	1064.81	1072.59	1080.43	1088.27	1096.07	1103.77	169.4	0.119
35	1085	1091.51	1098.18	1105.08	1112.22	1119.58	1127.12	1134.81	1142.59	1150.43	1158.27	1166.07	1173.77	169.4	0.119

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: -15 deg. **Input file: ROUTE121.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.88	679.61	688.18	697.47	707.4	717.88	728.84	740.19	751.88	763.83	776	788.32	156.8	0.0364
2	735	741.91	749.69	758.27	767.55	777.44	787.86	798.74	810	821.57	833.4	845.42	857.58	157.4	0.0432
3	805	811.91	819.69	828.27	837.55	847.44	857.86	868.74	880	891.57	903.4	915.42	927.58	157.4	0.0432
4	875	881.91	889.69	898.27	907.55	917.44	927.86	938.74	950	961.57	973.4	985.42	997.58	157.4	0.0432
5	945	951.91	959.69	968.27	977.55	987.44	997.86	1008.74	1020	1031.57	1043.4	1055.42	1067.58	157.4	0.0432
6	1015	1021.91	1029.69	1038.27	1047.55	1057.44	1067.86	1078.74	1090	1101.57	1113.4	1125.42	1137.58	157.4	0.0432
7	1085	1091.91	1099.69	1108.27	1117.55	1127.44	1137.86	1148.74	1160	1171.57	1183.4	1195.42	1207.58	157.4	0.0432
8	665	671.78	679.18	687.27	696.08	705.52	715.52	726.01	736.9	748.14	759.65	771.39	783.29	157.8	0.0324
9	735	741.81	749.32	757.5	766.29	775.63	785.42	795.62	806.15	816.96	827.97	839.13	850.39	160	0.0605
10	805	811.81	819.32	827.5	836.29	845.63	855.42	865.62	876.15	886.96	897.97	909.13	920.39	160	0.0605
11	875	881.81	889.32	897.5	906.29	915.63	925.42	935.62	946.15	956.96	967.97	979.13	990.39	160	0.0605
12	945	951.81	959.32	967.5	976.29	985.63	995.42	1005.62	1016.15	1026.96	1037.97	1049.13	1060.39	160	0.0605
13	1015	1021.81	1029.32	1037.5	1046.29	1055.63	1065.42	1075.62	1086.15	1096.96	1107.97	1119.13	1130.39	160	0.0605
14	1085	1091.81	1099.32	1107.5	1116.29	1125.63	1135.42	1145.62	1156.15	1166.96	1177.97	1189.13	1200.39	160	0.0605
15	665	671.69	678.83	686.47	694.71	703.59	713.05	723	733.39	744.13	755.16	766.43	777.87	158.9	0.0267
16	735	741.68	748.87	756.64	764.94	773.73	782.93	792.49	802.34	812.43	822.69	833.07	843.5	162.2	0.0737
17	805	811.72	818.95	826.73	835.01	843.73	852.83	862.26	871.96	881.86	891.91	902.05	912.22	163.1	0.0838
18	875	881.72	888.95	896.73	905.01	913.73	922.83	932.26	941.96	951.86	961.91	972.05	982.22	163.1	0.0838
19	945	951.72	958.95	966.73	975.01	983.73	992.83	1002.26	1011.96	1021.86	1031.91	1042.05	1052.22	163.1	0.0838
20	1015	1021.72	1028.95	1036.73	1045.01	1053.73	1062.83	1072.26	1081.96	1091.86	1101.91	1112.05	1122.22	163.1	0.0838
21	1085	1091.72	1098.95	1106.73	1115.01	1123.73	1132.83	1142.26	1151.96	1161.86	1171.91	1182.05	1192.22	163.1	0.0838
22	665	671.59	678.46	685.7	693.38	701.6	710.39	719.7	729.45	739.58	750	760.67	771.51	160.4	0.0228
23	735	741.59	748.51	755.88	763.7	771.93	780.51	789.38	798.49	807.79	817.2	826.68	836.17	164.9	0.092
24	805	811.6	818.55	825.89	833.62	841.68	850.04	858.63	867.42	876.33	885.31	894.31	903.26	166.4	0.1097
25	875	881.62	888.59	895.95	903.69	911.75	920.1	928.68	937.44	946.33	955.27	964.23	973.13	166.6	0.1122
26	945	951.62	958.59	965.95	973.69	981.75	990.1	998.68	1007.44	1016.33	1025.27	1034.23	1043.13	166.6	0.1122
27	1015	1021.62	1028.59	1035.95	1043.69	1051.75	1060.1	1068.68	1077.44	1086.33	1095.27	1104.23	1113.13	166.6	0.1122
28	1085	1091.62	1098.59	1105.95	1113.69	1121.75	1130.1	1138.68	1147.44	1156.33	1165.27	1174.23	1183.13	166.6	0.1122
29	665	671.49	678.08	684.91	692.05	699.6	707.6	716.09	725.06	734.45	744.19	754.2	764.43	161.6	0.0073
30	735	741.49	748.08	754.93	762.17	769.84	777.87	786.23	794.84	803.66	812.62	821.67	830.74	165.7	0.0839
31	805	811.49	818.15	825.12	832.38	839.92	847.67	855.61	863.68	871.82	879.97	888.09	896.11	168.9	0.1268
32	875	881.52	888.21	895.16	902.35	909.76	917.35	925.08	932.9	940.75	948.58	956.33	963.95	170	0.1389
33	945	951.52	958.21	965.16	972.35	979.76	987.35	995.08	1002.9	1010.75	1018.58	1026.33	1033.95	170	0.1389
34	1015	1021.52	1028.21	1035.16	1042.35	1049.76	1057.35	1065.08	1072.9	1080.75	1088.58	1096.33	1103.95	170	0.1389
35	1085	1091.52	1098.21	1105.16	1112.35	1119.76	1127.35	1135.08	1142.9	1150.75	1158.58	1166.33	1173.95	170	0.1389

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: -15 deg. **Input file: ROUTE131.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.89	679.63	688.21	697.53	707.49	718	728.98	740.35	752.06	764.02	776.19	788.5	157	0.0457
2	735	741.92	749.71	758.3	767.61	777.53	787.98	798.88	810.16	821.75	833.58	845.6	857.75	157.6	0.0525
3	805	811.92	819.71	828.3	837.61	847.53	857.98	868.88	880.16	891.75	903.58	915.6	927.75	157.6	0.0525
4	875	881.92	889.71	898.3	907.61	917.53	927.98	938.88	950.16	961.75	973.58	985.6	997.75	157.6	0.0525
5	945	951.92	959.71	968.3	977.61	987.53	997.98	1008.88	1020.16	1031.75	1043.58	1055.6	1067.75	157.6	0.0525
6	1015	1021.92	1029.71	1038.3	1047.61	1057.53	1067.98	1078.88	1090.16	1101.75	1113.58	1125.6	1137.75	157.6	0.0525
7	1085	1091.92	1099.71	1108.3	1117.61	1127.53	1137.98	1148.88	1160.16	1171.75	1183.58	1195.6	1207.75	157.6	0.0525
8	665	671.79	679.2	687.31	696.14	705.61	715.64	726.14	737.06	748.31	759.83	771.57	783.45	158	0.0419
9	735	741.82	749.34	757.54	766.36	775.71	785.54	795.76	806.31	817.13	828.15	839.3	850.54	160.3	0.0701
10	805	811.82	819.34	827.54	836.36	845.71	855.54	865.76	876.31	887.13	898.15	909.3	920.54	160.3	0.0701
11	875	881.82	889.34	897.54	906.36	915.71	925.54	935.76	946.31	957.13	968.15	979.3	990.54	160.3	0.0701
12	945	951.82	959.34	967.54	976.36	985.71	995.54	1005.76	1016.31	1027.13	1038.15	1049.3	1060.54	160.3	0.0701
13	1015	1021.82	1029.34	1037.54	1046.36	1055.71	1065.54	1075.76	1086.31	1097.13	1108.15	1119.3	1130.54	160.3	0.0701
14	1085	1091.82	1099.34	1107.54	1116.36	1125.71	1135.54	1145.76	1156.31	1167.13	1178.15	1189.3	1200.54	160.3	0.0701
15	665	671.69	678.84	686.51	694.77	703.68	713.16	723.14	733.54	744.3	755.34	766.61	778.03	159.1	0.0361
16	735	741.68	748.89	756.68	765.01	773.82	783.04	792.62	802.49	812.59	822.85	833.22	843.63	162.5	0.0834
17	805	811.72	818.97	826.77	835.07	843.81	852.94	862.4	872.11	882.02	892.07	902.2	912.34	163.4	0.0935
18	875	881.72	888.97	896.77	905.07	913.81	922.94	932.4	942.11	952.02	962.07	972.2	982.34	163.4	0.0935
19	945	951.72	958.97	966.77	975.07	983.81	992.94	1002.4	1012.11	1022.02	1032.07	1042.2	1052.34	163.4	0.0935
20	1015	1021.72	1028.97	1036.77	1045.07	1053.81	1062.94	1072.4	1082.11	1092.02	1102.07	1112.2	1122.34	163.4	0.0935
21	1085	1091.72	1098.97	1106.77	1115.07	1123.81	1132.94	1142.4	1152.11	1162.02	1172.07	1182.2	1192.34	163.4	0.0935
22	665	671.6	678.48	685.74	693.44	701.69	710.51	719.84	729.61	739.74	750.17	760.84	771.66	160.6	0.0322
23	735	741.6	748.53	755.92	763.77	772.02	780.62	789.51	798.64	807.94	817.36	826.82	836.28	165.2	0.1018
24	805	811.61	818.57	825.93	833.68	841.77	850.15	858.77	867.56	876.48	885.46	894.44	903.36	166.7	0.1193
25	875	881.63	888.61	895.99	903.75	911.84	920.21	928.82	937.59	946.48	955.42	964.36	973.22	166.9	0.1218
26	945	951.63	958.61	965.99	973.75	981.84	990.21	998.82	1007.59	1016.48	1025.42	1034.36	1043.22	166.9	0.1218
27	1015	1021.63	1028.61	1035.99	1043.75	1051.84	1060.21	1068.82	1077.59	1086.48	1095.42	1104.36	1113.22	166.9	0.1218
28	1085	1091.63	1098.61	1105.99	1113.75	1121.84	1130.21	1138.82	1147.59	1156.48	1165.42	1174.36	1183.22	166.9	0.1218
29	665	671.5	678.1	684.94	692.11	699.69	707.71	716.22	725.21	734.62	744.36	754.37	764.58	161.8	0.0165
30	735	741.5	748.1	754.97	762.23	769.92	777.98	786.36	794.99	803.82	812.77	821.8	830.84	166	0.0938
31	805	811.5	818.17	825.16	832.45	840	847.79	855.74	863.82	871.97	880.12	888.21	896.2	169.2	0.1363
32	875	881.53	888.23	895.2	902.41	909.85	917.46	925.22	933.05	940.9	948.73	956.46	964.04	170.3	0.1481
33	945	951.53	958.23	965.2	972.41	979.85	987.46	995.22	1003.05	1010.9	1018.73	1026.46	1034.04	170.3	0.1481
34	1015	1021.53	1028.23	1035.2	1042.41	1049.85	1057.46	1065.22	1073.05	1080.9	1088.73	1096.46	1104.04	170.3	0.1481
35	1085	1091.53	1098.23	1105.2	1112.41	1119.85	1127.46	1135.22	1143.05	1150.9	1158.73	1166.46	1174.04	170.3	0.1481

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: -15 deg. **Input file: ROUTE141.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.89	679.65	688.26	697.61	707.6	718.14	729.15	740.55	752.27	764.25	776.41	788.7	157.3	0.0568
2	735	741.92	749.73	758.35	767.68	777.64	788.12	799.05	810.35	821.96	833.81	845.82	857.95	157.9	0.0637
3	805	811.92	819.73	828.35	837.68	847.64	858.12	869.05	880.35	891.96	903.81	915.82	927.95	157.9	0.0637
4	875	881.92	889.73	898.35	907.68	917.64	928.12	939.05	950.35	961.96	973.81	985.82	997.95	157.9	0.0637
5	945	951.92	959.73	968.35	977.68	987.64	998.12	1009.05	1020.35	1031.96	1043.81	1055.82	1067.95	157.9	0.0637
6	1015	1021.92	1029.73	1038.35	1047.68	1057.64	1068.12	1079.05	1090.35	1101.96	1113.81	1125.82	1137.95	157.9	0.0637
7	1085	1091.92	1099.73	1108.35	1117.68	1127.64	1138.12	1149.05	1160.35	1171.96	1183.81	1195.82	1207.95	157.9	0.0637
8	665	671.79	679.22	687.36	696.21	705.72	715.77	726.31	737.25	748.52	760.05	771.78	783.64	158.3	0.0531
9	735	741.82	749.36	757.58	766.43	775.82	785.67	795.92	806.5	817.33	828.35	839.5	850.71	160.6	0.0815
10	805	811.82	819.36	827.58	836.43	845.82	855.67	865.92	876.5	887.33	898.35	909.5	920.71	160.6	0.0815
11	875	881.82	889.36	897.58	906.43	915.82	925.67	935.92	946.5	957.33	968.35	979.5	990.71	160.6	0.0815
12	945	951.82	959.36	967.58	976.43	985.82	995.67	1005.92	1016.5	1027.33	1038.35	1049.5	1060.71	160.6	0.0815
13	1015	1021.82	1029.36	1037.58	1046.43	1055.82	1065.67	1075.92	1086.5	1097.33	1108.35	1119.5	1130.71	160.6	0.0815
14	1085	1091.82	1099.36	1107.58	1116.43	1125.82	1135.67	1145.92	1156.5	1167.33	1178.35	1189.5	1200.71	160.6	0.0815
15	665	671.7	678.87	686.55	694.85	703.79	713.3	723.31	733.73	744.51	755.56	766.82	778.22	159.4	0.0474
16	735	741.69	748.91	756.72	765.08	773.92	783.18	792.79	802.68	812.79	823.05	833.41	843.78	162.8	0.0949
17	805	811.73	818.99	826.82	835.14	843.92	853.08	862.56	872.29	882.22	892.27	902.38	912.48	163.7	0.105
18	875	881.73	888.99	896.82	905.14	913.92	923.08	932.56	942.29	952.22	962.27	972.38	982.48	163.7	0.105
19	945	951.73	958.99	966.82	975.14	983.92	993.08	1002.56	1012.29	1022.22	1032.27	1042.38	1052.48	163.7	0.105
20	1015	1021.73	1028.99	1036.82	1045.14	1053.92	1063.08	1072.56	1082.29	1092.22	1102.27	1112.38	1122.48	163.7	0.105
21	1085	1091.73	1098.99	1106.82	1115.14	1123.92	1133.08	1142.56	1152.29	1162.22	1172.27	1182.38	1192.48	163.7	0.105
22	665	671.6	678.5	685.78	693.52	701.79	710.64	720	729.79	739.94	750.38	761.04	771.84	160.9	0.0435
23	735	741.6	748.55	755.97	763.84	772.12	780.75	789.67	798.82	808.13	817.54	826.99	836.4	165.5	0.1133
24	805	811.62	818.59	825.98	833.75	841.87	850.28	858.92	867.74	876.67	885.64	894.6	903.48	167	0.1307
25	875	881.63	888.63	896.04	903.82	911.94	920.35	928.97	937.77	946.66	955.6	964.51	973.34	167.2	0.1332
26	945	951.63	958.63	966.04	973.82	981.94	990.35	998.97	1007.77	1016.66	1025.6	1034.51	1043.34	167.2	0.1332
27	1015	1021.63	1028.63	1036.04	1043.82	1051.94	1060.35	1068.97	1077.77	1086.66	1095.6	1104.51	1113.34	167.2	0.1332
28	1085	1091.63	1098.63	1106.04	1113.82	1121.94	1130.35	1138.97	1147.77	1156.66	1165.6	1174.51	1183.34	167.2	0.1332
29	665	671.5	678.13	684.99	692.19	699.79	707.84	716.38	725.4	734.82	744.56	754.57	764.76	162.1	0.0274
30	735	741.5	748.13	755.02	762.31	770.03	778.12	786.52	795.17	804	812.96	821.96	830.96	166.4	0.1056
31	805	811.5	818.19	825.2	832.52	840.11	847.92	855.9	864	872.15	880.29	888.36	896.3	169.5	0.1474
32	875	881.53	888.25	895.24	902.48	909.95	917.6	925.37	933.22	941.08	948.9	956.61	964.15	170.6	0.159
33	945	951.53	958.25	965.24	972.48	979.95	987.6	995.37	1003.22	1011.08	1018.9	1026.61	1034.15	170.6	0.159
34	1015	1021.53	1028.25	1035.24	1042.48	1049.95	1057.6	1065.37	1073.22	1081.08	1088.9	1096.61	1104.15	170.6	0.159
35	1085	1091.53	1098.25	1105.24	1112.48	1119.95	1127.6	1135.37	1143.22	1151.08	1158.9	1166.61	1174.15	170.6	0.159

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: -15 deg. **Input file: ROUTE151.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.9	679.67	688.29	697.67	707.68	718.24	729.27	740.69	752.43	764.42	776.58	788.86	157.6	0.0652
2	735	741.93	749.75	758.39	767.74	777.72	788.22	799.17	810.5	822.12	833.97	845.99	858.1	158.2	0.0721
3	805	811.93	819.75	828.39	837.74	847.72	858.22	869.17	880.5	892.12	903.97	915.99	928.1	158.2	0.0721
4	875	881.93	889.75	898.39	907.74	917.72	928.22	939.17	950.5	962.12	973.97	985.99	998.1	158.2	0.0721
5	945	951.93	959.75	968.39	977.74	987.72	998.22	1009.17	1020.5	1032.12	1043.97	1055.99	1068.1	158.2	0.0721
6	1015	1021.93	1029.75	1038.39	1047.74	1057.72	1068.22	1079.17	1090.5	1102.12	1113.97	1125.99	1138.1	158.2	0.0721
7	1085	1091.93	1099.75	1108.39	1117.74	1127.72	1138.22	1149.17	1160.5	1172.12	1183.97	1195.99	1208.1	158.2	0.0721
8	665	671.8	679.24	687.39	696.27	705.8	715.88	726.44	737.39	748.68	760.21	771.94	783.79	158.6	0.0617
9	735	741.83	749.37	757.62	766.49	775.9	785.78	796.05	806.64	817.48	828.51	839.65	850.84	160.8	0.0901
10	805	811.83	819.37	827.62	836.49	845.9	855.78	866.05	876.64	887.48	898.51	909.65	920.84	160.8	0.0901
11	875	881.83	889.37	897.62	906.49	915.9	925.78	936.05	946.64	957.48	968.51	979.65	990.84	160.8	0.0901
12	945	951.83	959.37	967.62	976.49	985.9	995.78	1006.05	1016.64	1027.48	1038.51	1049.65	1060.84	160.8	0.0901
13	1015	1021.83	1029.37	1037.62	1046.49	1055.9	1065.78	1076.05	1086.64	1097.48	1108.51	1119.65	1130.84	160.8	0.0901
14	1085	1091.83	1099.37	1107.62	1116.49	1125.9	1135.78	1146.05	1156.64	1167.48	1178.51	1189.65	1200.84	160.8	0.0901
15	665	671.7	678.88	686.59	694.9	703.87	713.4	723.43	733.88	744.66	755.72	766.97	778.36	159.7	0.056
16	735	741.69	748.92	756.76	765.14	774	783.28	792.91	802.82	812.94	823.2	833.54	843.9	163.1	0.1036
17	805	811.73	819.01	826.85	835.2	844	853.18	862.68	872.43	882.36	892.41	902.51	912.59	163.9	0.1136
18	875	881.73	889.01	896.85	905.2	914	923.18	932.68	942.43	952.36	962.41	972.51	982.59	163.9	0.1136
19	945	951.73	959.01	966.85	975.2	984	993.18	1002.68	1012.43	1022.36	1032.41	1042.51	1052.59	163.9	0.1136
20	1015	1021.73	1029.01	1036.85	1045.2	1054	1063.18	1072.68	1082.43	1092.36	1102.41	1112.51	1122.59	163.9	0.1136
21	1085	1091.73	1099.01	1106.85	1115.2	1124	1133.18	1142.68	1152.43	1162.36	1172.41	1182.51	1192.59	163.9	0.1136
22	665	671.61	678.52	685.82	693.57	701.87	710.74	720.13	729.93	740.1	750.54	761.19	771.98	161.2	0.0521
23	735	741.61	748.57	756	763.9	772.2	780.85	789.79	798.95	808.27	817.68	827.11	836.5	165.8	0.122
24	805	811.62	818.61	826.01	833.81	841.95	850.38	859.04	867.87	876.81	885.78	894.72	903.57	167.2	0.1393
25	875	881.64	888.65	896.07	903.88	912.02	920.45	929.09	937.9	946.8	955.73	964.63	973.42	167.4	0.1417
26	945	951.64	958.65	966.07	973.88	982.02	990.45	999.09	1007.9	1016.8	1025.73	1034.63	1043.42	167.4	0.1417
27	1015	1021.64	1028.65	1036.07	1043.88	1052.02	1060.45	1069.09	1077.9	1086.8	1095.73	1104.63	1113.42	167.4	0.1417
28	1085	1091.64	1098.65	1106.07	1113.88	1122.02	1130.45	1139.09	1147.9	1156.8	1165.73	1174.63	1183.42	167.4	0.1417
29	665	671.51	678.14	685.02	692.24	699.87	707.94	716.5	725.53	734.96	744.72	754.72	764.9	162.3	0.0356
30	735	741.51	748.14	755.05	762.36	770.11	778.22	786.64	795.3	804.14	813.09	822.09	831.05	166.6	0.1144
31	805	811.51	818.21	825.24	832.58	840.19	848.02	856.02	864.13	872.28	880.42	888.47	896.38	169.7	0.1557
32	875	881.54	888.27	895.28	902.54	910.03	917.7	925.49	933.35	941.22	949.03	956.72	964.23	170.8	0.1671
33	945	951.54	958.27	965.28	972.54	980.03	987.7	995.49	1003.35	1011.22	1019.03	1026.72	1034.23	170.8	0.1671
34	1015	1021.54	1028.27	1035.28	1042.54	1050.03	1057.7	1065.49	1073.35	1081.22	1089.03	1096.72	1104.23	170.8	0.1671
35	1085	1091.54	1098.27	1105.28	1112.54	1120.03	1127.7	1135.49	1143.35	1151.22	1159.03	1166.72	1174.23	170.8	0.1671

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: -10 deg. **Input file: ROUTE112.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.76	675.34	681.75	688.96	696.91	705.57	714.82	724.6	734.82	745.41	756.33	767.5	158.4	-0.0194
2	735	739.79	745.47	751.97	759.18	767.02	775.41	784.27	793.52	803.11	812.98	823.05	833.29	161.7	0.0218
3	805	809.79	815.47	821.97	829.18	837.02	845.41	854.27	863.52	873.11	882.98	893.05	903.29	161.7	0.0218
4	875	879.79	885.47	891.97	899.18	907.02	915.41	924.27	933.52	943.11	952.98	963.05	973.29	161.7	0.0218
5	945	949.79	955.47	961.97	969.18	977.02	985.41	994.27	1003.52	1013.11	1022.98	1033.05	1043.29	161.7	0.0218
6	1015	1019.79	1025.47	1031.97	1039.18	1047.02	1055.41	1064.27	1073.52	1083.11	1092.98	1103.05	1113.29	161.7	0.0218
7	1085	1089.79	1095.47	1101.97	1109.18	1117.02	1125.41	1134.27	1143.52	1153.11	1162.98	1173.05	1183.29	161.7	0.0218
8	665	669.66	674.95	680.91	687.59	694.98	703.07	711.79	721.07	730.83	741	751.51	762.3	159.3	-0.0299
9	735	739.65	745	751.08	757.82	765.14	772.97	781.24	789.89	798.85	808.06	817.46	827.01	163.5	0.0297
10	805	809.69	815.08	821.16	827.86	835.12	842.85	850.99	859.49	868.28	877.29	886.48	895.79	164.3	0.0384
11	875	879.69	885.08	891.16	897.86	905.12	912.85	920.99	929.49	938.28	947.29	956.48	965.79	164.3	0.0384
12	945	949.69	955.08	961.16	967.86	975.12	982.85	990.99	999.49	1008.28	1017.29	1026.48	1035.79	164.3	0.0384
13	1015	1019.69	1025.08	1031.16	1037.86	1045.12	1052.85	1060.99	1069.49	1078.28	1087.29	1096.48	1105.79	164.3	0.0384
14	1085	1089.69	1095.08	1101.16	1107.86	1115.12	1122.85	1130.99	1139.49	1148.28	1157.29	1166.48	1175.79	164.3	0.0384
15	665	669.56	674.57	680.1	686.21	692.95	700.32	708.33	716.94	726.07	735.65	745.6	755.87	160.3	-0.044
16	735	739.56	744.57	750.15	756.35	763.12	770.41	778.13	786.24	794.65	803.33	812.2	821.21	164.8	0.0282
17	805	809.57	814.67	820.31	826.46	833.08	840.09	847.46	855.11	862.99	871.04	879.22	887.46	167.2	0.0587
18	875	879.59	884.7	890.35	896.51	903.12	910.13	917.48	925.1	932.96	940.98	949.11	957.31	167.3	0.061
19	945	949.59	954.7	960.35	966.51	973.12	980.13	987.48	995.1	1002.96	1010.98	1019.11	1027.31	167.3	0.061
20	1015	1019.59	1024.7	1030.35	1036.51	1043.12	1050.13	1057.48	1065.1	1072.96	1080.98	1089.11	1097.31	167.3	0.061
21	1085	1089.59	1094.7	1100.35	1106.51	1113.12	1120.13	1127.48	1135.1	1142.96	1150.98	1159.11	1167.31	167.3	0.061
22	665	669.46	674.19	679.29	684.84	690.91	697.54	704.75	712.56	720.93	729.79	739.07	748.69	161.8	-0.0567
23	735	739.46	744.19	749.28	754.87	761.02	767.7	774.82	782.34	790.19	798.3	806.62	815.09	166	0.0235
24	805	809.46	814.25	819.5	825.17	831.22	837.61	844.29	851.2	858.3	865.51	872.8	880.11	169.7	0.0759
25	875	879.49	884.32	889.54	895.13	901.06	907.28	913.75	920.41	927.21	934.1	941.03	947.93	170.8	0.0891
26	945	949.49	954.32	959.54	965.13	971.06	977.28	983.75	990.41	997.21	1004.1	1011.03	1017.93	170.8	0.0891
27	1015	1019.49	1024.32	1029.54	1035.13	1041.06	1047.28	1053.75	1060.41	1067.21	1074.1	1081.03	1087.93	170.8	0.0891
28	1085	1089.49	1094.32	1099.54	1105.13	1111.06	1117.28	1123.75	1130.41	1137.21	1144.1	1151.03	1157.93	170.8	0.0891
29	665	669.35	673.79	678.46	683.45	688.85	694.73	701.12	708.04	715.52	723.53	732.01	740.89	163.3	-0.0805
30	735	739.35	743.79	748.46	753.45	758.9	764.87	771.31	778.16	785.34	792.81	800.5	808.34	167.5	0.0186
31	805	809.35	813.85	818.64	823.76	829.18	834.86	840.76	846.82	853	859.25	865.5	871.72	172.5	0.0964
32	875	879.36	883.88	888.66	893.71	899	904.5	910.17	915.95	921.81	927.69	933.53	939.29	173.7	0.111
33	945	949.38	953.93	958.71	963.74	968.99	974.42	980.01	985.69	991.43	997.17	1002.86	1008.45	174.2	0.1167
34	1015	1019.38	1023.93	1028.71	1033.74	1038.99	1044.42	1050.01	1055.69	1061.43	1067.17	1072.86	1078.45	174.2	0.1167
35	1085	1089.38	1093.93	1098.71	1103.74	1108.99	1114.42	1120.01	1125.69	1131.43	1137.17	1142.86	1148.45	174.2	0.1167

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: -10 deg. **Input file: ROUTE122.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.77	675.39	681.84	689.1	697.11	705.82	715.12	724.94	735.19	745.81	756.72	767.87	159	-0.0004
2	735	739.8	745.51	752.05	759.32	767.21	775.66	784.56	793.86	803.48	813.35	823.42	833.62	162.3	0.0421
3	805	809.8	815.51	822.05	829.32	837.21	845.66	854.56	863.86	873.48	883.35	893.42	903.62	162.3	0.0421
4	875	879.8	885.51	892.05	899.32	907.21	915.66	924.56	933.86	943.48	953.35	963.42	973.62	162.3	0.0421
5	945	949.8	955.51	962.05	969.32	977.21	985.66	994.56	1003.86	1013.48	1023.35	1033.42	1043.62	162.3	0.0421
6	1015	1019.8	1025.51	1032.05	1039.32	1047.21	1055.66	1064.56	1073.86	1083.48	1093.35	1103.42	1113.62	162.3	0.0421
7	1085	1089.8	1095.51	1102.05	1109.32	1117.21	1125.66	1134.56	1143.86	1153.48	1163.35	1173.42	1183.62	162.3	0.0421
8	665	669.67	674.99	680.99	687.72	695.17	703.31	712.09	721.42	731.21	741.4	751.91	762.68	159.8	-0.0116
9	735	739.67	745.04	751.17	757.96	765.33	773.22	781.54	790.22	799.2	808.42	817.81	827.31	164.1	0.0504
10	805	809.7	815.12	821.25	828	835.31	843.09	851.29	859.82	868.63	877.65	886.82	896.07	164.9	0.0593
11	875	879.7	885.12	891.25	898	905.31	913.09	921.29	929.82	938.63	947.65	956.82	966.07	164.9	0.0593
12	945	949.7	955.12	961.25	968	975.31	983.09	991.29	999.82	1008.63	1017.65	1026.82	1036.07	164.9	0.0593
13	1015	1019.7	1025.12	1031.25	1038	1045.31	1053.09	1061.29	1069.82	1078.63	1087.65	1096.82	1106.07	164.9	0.0593
14	1085	1089.7	1095.12	1101.25	1108	1115.31	1123.09	1131.29	1139.82	1148.63	1157.65	1166.82	1176.07	164.9	0.0593
15	665	669.57	674.61	680.18	686.35	693.14	700.56	708.62	717.27	726.44	736.04	746	756.25	160.8	-0.0262
16	735	739.57	744.61	750.23	756.48	763.31	770.65	778.42	786.56	795	803.68	812.52	821.48	165.4	0.0492
17	805	809.59	814.71	820.39	826.6	833.27	840.34	847.74	855.43	863.33	871.38	879.53	887.71	167.7	0.0799
18	875	879.6	884.74	890.44	896.65	903.31	910.37	917.76	925.43	933.3	941.31	949.42	957.55	167.9	0.0823
19	945	949.6	954.74	960.44	966.65	973.31	980.37	987.76	995.43	1003.3	1011.31	1019.42	1027.55	167.9	0.0823
20	1015	1019.6	1024.74	1030.44	1036.65	1043.31	1050.37	1057.76	1065.43	1073.3	1081.31	1089.42	1097.55	167.9	0.0823
21	1085	1089.6	1094.74	1100.44	1106.65	1113.31	1120.37	1127.76	1135.43	1143.3	1151.31	1159.42	1167.55	167.9	0.0823
22	665	669.47	674.23	679.37	684.97	691.09	697.78	705.04	712.89	721.29	730.17	739.44	749.04	162.3	-0.0394
23	735	739.47	744.23	749.37	755.01	761.21	767.94	775.11	782.67	790.53	798.64	806.94	815.35	166.6	0.0446
24	805	809.47	814.3	819.58	825.3	831.41	837.85	844.58	851.52	858.63	865.84	873.09	880.32	170.3	0.0974
25	875	879.5	884.36	889.62	895.27	901.25	907.52	914.03	920.73	927.54	934.42	941.3	948.12	171.4	0.1104
26	945	949.5	954.36	959.62	965.27	971.25	977.52	984.03	990.73	997.54	1004.42	1011.3	1018.12	171.4	0.1104
27	1015	1019.5	1024.36	1029.62	1035.27	1041.25	1047.52	1054.03	1060.72	1067.54	1074.42	1081.3	1088.12	171.4	0.1104
28	1085	1089.5	1094.36	1099.62	1105.27	1111.25	1117.52	1124.03	1130.72	1137.54	1144.42	1151.3	1158.12	171.4	0.1104
29	665	669.36	673.83	678.54	683.58	689.04	694.97	701.4	708.36	715.85	723.87	732.35	741.22	163.7	-0.0654
30	735	739.36	743.83	748.54	753.58	759.09	765.11	771.59	778.47	785.68	793.15	800.81	808.6	168	0.0397
31	805	809.36	813.89	818.72	823.9	829.37	835.1	841.04	847.13	853.32	859.55	865.76	871.89	173.1	0.1174
32	875	879.37	883.92	888.75	893.85	899.19	904.74	910.45	916.26	922.13	927.99	933.79	939.47	174.3	0.1315
33	945	949.39	953.97	958.79	963.87	969.17	974.66	980.29	986	991.75	997.47	1003.12	1008.63	174.8	0.1369
34	1015	1019.39	1023.97	1028.79	1033.87	1039.17	1044.66	1050.29	1056	1061.75	1067.47	1073.12	1078.63	174.8	0.1369
35	1085	1089.39	1093.97	1098.79	1103.87	1109.17	1114.66	1120.29	1126	1131.75	1137.47	1143.12	1148.63	174.8	0.1369

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: -10 deg. **Input file: ROUTE132.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.78	675.41	681.88	689.16	697.2	705.94	715.27	725.11	735.37	745.99	756.9	768.04	159.2	0.0088
2	735	739.81	745.53	752.09	759.38	767.3	775.77	784.7	794.02	803.65	813.53	823.59	833.77	162.5	0.0517
3	805	809.81	815.53	822.09	829.38	837.3	845.77	854.7	864.02	873.65	883.53	893.59	903.77	162.5	0.0517
4	875	879.81	885.53	892.09	899.38	907.3	915.77	924.7	934.02	943.65	953.53	963.59	973.77	162.5	0.0517
5	945	949.81	955.53	962.09	969.38	977.3	985.77	994.7	1004.02	1013.65	1023.53	1033.59	1043.77	162.5	0.0517
6	1015	1019.81	1025.53	1032.09	1039.38	1047.3	1055.77	1064.7	1074.02	1083.65	1093.53	1103.59	1113.77	162.5	0.0517
7	1085	1089.81	1095.53	1102.09	1109.38	1117.3	1125.77	1134.7	1144.02	1153.65	1163.53	1173.59	1183.77	162.5	0.0517
8	665	669.67	675.01	681.03	687.78	695.26	703.43	712.23	721.58	731.39	741.59	752.1	762.86	160	-0.0027
9	735	739.67	745.06	751.21	758.02	765.42	773.33	781.68	790.38	799.37	808.59	817.97	827.45	164.4	0.0602
10	805	809.7	815.14	821.28	828.06	835.4	843.21	851.42	859.98	868.8	877.82	886.97	896.2	165.1	0.0692
11	875	879.7	885.14	891.28	898.06	905.4	913.21	921.42	929.98	938.8	947.82	956.97	966.2	165.1	0.0692
12	945	949.7	955.14	961.28	968.06	975.4	983.21	991.42	999.98	1008.8	1017.82	1026.97	1036.2	165.1	0.0692
13	1015	1019.7	1025.14	1031.28	1038.06	1045.4	1053.21	1061.43	1069.98	1078.8	1087.82	1096.97	1106.2	165.1	0.0692
14	1085	1089.7	1095.14	1101.28	1108.06	1115.4	1123.21	1131.42	1139.98	1148.8	1157.82	1166.97	1176.2	165.1	0.0692
15	665	669.57	674.63	680.22	686.41	693.23	700.68	708.76	717.43	726.62	736.22	746.19	756.43	161	-0.0176
16	735	739.57	744.63	750.27	756.55	763.4	770.77	778.56	786.72	795.17	803.84	812.68	821.61	165.6	0.0592
17	805	809.59	814.73	820.43	826.66	833.36	840.45	847.88	855.58	863.49	871.54	879.67	887.82	168	0.09
18	875	879.6	884.76	890.48	896.71	903.4	910.49	917.9	925.58	933.46	941.47	949.56	957.66	168.2	0.0923
19	945	949.6	954.76	960.48	966.71	973.4	980.49	987.9	995.58	1003.46	1011.47	1019.56	1027.66	168.2	0.0923
20	1015	1019.6	1024.76	1030.48	1036.71	1043.4	1050.49	1057.9	1065.58	1073.46	1081.47	1089.56	1097.66	168.2	0.0923
21	1085	1089.6	1094.76	1100.48	1106.71	1113.4	1120.49	1127.9	1135.58	1143.46	1151.47	1159.56	1167.66	168.2	0.0923
22	665	669.47	674.25	679.41	685.04	691.18	697.89	705.17	713.02	721.39	730.25	739.51	749.09	162.4	-0.0368
23	735	739.47	744.25	749.41	755.07	761.3	768.05	775.25	782.82	790.69	798.81	807.09	815.48	166.9	0.0546
24	805	809.47	814.31	819.62	825.37	831.5	837.97	844.71	851.67	858.78	865.99	873.22	880.42	170.5	0.1074
25	875	879.5	884.38	889.66	895.33	901.34	907.64	914.17	920.88	927.69	934.57	941.43	948.22	171.7	0.1203
26	945	949.5	954.38	959.66	965.33	971.34	977.64	984.17	990.88	997.69	1004.57	1011.43	1018.22	171.7	0.1203
27	1015	1019.5	1024.38	1029.66	1035.33	1041.34	1047.64	1054.17	1060.88	1067.69	1074.57	1081.43	1088.21	171.7	0.1203
28	1085	1089.5	1094.38	1099.66	1105.33	1111.34	1117.64	1124.17	1130.88	1137.69	1144.57	1151.43	1158.21	171.7	0.1203
29	665	669.37	673.85	678.58	683.65	689.13	695.08	701.53	708.5	716.01	724.03	732.51	741.37	163.9	-0.0581
30	735	739.37	743.85	748.58	753.65	759.18	765.22	771.73	778.63	785.84	793.31	800.95	808.72	168.3	0.0497
31	805	809.37	813.91	818.76	823.96	829.46	835.21	841.17	847.28	853.47	859.7	865.88	871.98	173.4	0.1272
32	875	879.38	883.94	888.78	893.91	899.28	904.86	910.58	916.41	922.28	928.14	933.91	939.55	174.6	0.141
33	945	949.4	953.98	958.83	963.93	969.26	974.78	980.42	986.15	991.9	997.62	1003.24	1008.71	175.1	0.1463
34	1015	1019.4	1023.98	1028.83	1033.93	1039.26	1044.78	1050.42	1056.15	1061.9	1067.62	1073.24	1078.71	175.1	0.1463
35	1085	1089.4	1093.98	1098.83	1103.93	1109.26	1114.78	1120.42	1126.15	1131.9	1137.62	1143.24	1148.71	175.1	0.1463

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: -10 deg. **Input file: ROUTE142.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.78	675.43	681.92	689.24	697.31	706.08	715.44	725.3	735.58	746.22	757.12	768.24	159.5	0.02
2	735	739.82	745.55	752.14	759.46	767.41	775.91	784.87	794.21	803.86	813.74	823.8	833.95	162.8	0.0633
3	805	809.82	815.55	822.14	829.46	837.41	845.91	854.87	864.21	873.86	883.74	893.8	903.95	162.8	0.0633
4	875	879.82	885.55	892.14	899.46	907.41	915.91	924.87	934.21	943.86	953.74	963.8	973.95	162.8	0.0633
5	945	949.82	955.55	962.14	969.46	977.41	985.91	994.87	1004.21	1013.86	1023.74	1033.8	1043.95	162.8	0.0633
6	1015	1019.82	1025.55	1032.14	1039.46	1047.41	1055.91	1064.87	1074.21	1083.86	1093.74	1103.8	1113.95	162.8	0.0633
7	1085	1089.82	1095.55	1102.14	1109.46	1117.41	1125.91	1134.87	1144.21	1153.86	1163.74	1173.8	1183.95	162.8	0.0633
8	665	669.68	675.03	681.08	687.86	695.37	703.57	712.4	721.78	731.61	741.82	752.33	763.08	160.3	0.008
9	735	739.68	745.09	751.25	758.1	765.53	773.47	781.84	790.57	799.58	808.8	818.17	827.61	164.7	0.0719
10	805	809.71	815.16	821.33	828.14	835.5	843.35	851.59	860.16	869	878.02	887.16	896.36	165.5	0.0809
11	875	879.71	885.16	891.33	898.14	905.5	913.35	921.59	930.16	939	948.02	957.16	966.36	165.5	0.0809
12	945	949.71	955.16	961.33	968.14	975.5	983.35	991.59	1000.16	1009	1018.02	1027.16	1036.36	165.5	0.0809
13	1015	1019.71	1025.16	1031.33	1038.14	1045.5	1053.35	1061.59	1070.16	1079	1088.02	1097.16	1106.36	165.5	0.0809
14	1085	1089.71	1095.16	1101.33	1108.14	1115.5	1123.35	1131.59	1140.16	1149	1158.02	1167.16	1176.36	165.5	0.0809
15	665	669.58	674.65	680.27	686.49	693.33	700.82	708.93	717.63	726.83	736.45	746.41	756.64	161.3	-0.0071
16	735	739.58	744.65	750.32	756.62	763.51	770.91	778.73	786.9	795.36	804.04	812.86	821.76	166	0.0711
17	805	809.6	814.75	820.48	826.74	833.46	840.59	848.05	855.77	863.69	871.74	879.85	887.96	168.4	0.1018
18	875	879.61	884.78	890.52	896.79	903.51	910.63	918.07	925.76	933.65	941.66	949.73	957.79	168.5	0.1042
19	945	949.61	954.78	960.52	966.79	973.51	980.63	988.07	995.76	1003.65	1011.66	1019.73	1027.79	168.5	0.1042
20	1015	1019.61	1024.78	1030.52	1036.79	1043.51	1050.63	1058.07	1065.76	1073.65	1081.66	1089.73	1097.79	168.5	0.1042
21	1085	1089.61	1094.78	1100.52	1106.79	1113.51	1120.63	1128.07	1135.76	1143.65	1151.66	1159.73	1167.79	168.5	0.1042
22	665	669.48	674.27	679.46	685.11	691.29	698.03	705.34	713.2	721.6	730.46	739.72	749.29	162.7	-0.0269
23	735	739.48	744.27	749.45	755.15	761.41	768.19	775.41	783	790.89	799	807.27	815.62	167.2	0.0666
24	805	809.48	814.34	819.67	825.44	831.61	838.1	844.87	851.85	858.97	866.17	873.38	880.53	170.9	0.1193
25	875	879.51	884.4	889.71	895.41	901.45	907.77	914.33	921.05	927.88	934.74	941.58	948.32	172	0.132
26	945	949.51	954.4	959.71	965.41	971.45	977.77	984.33	991.05	997.88	1004.74	1011.58	1018.32	172	0.132
27	1015	1019.51	1024.4	1029.71	1035.41	1041.45	1047.77	1054.33	1061.05	1067.88	1074.74	1081.58	1088.32	172	0.132
28	1085	1089.51	1094.4	1099.71	1105.41	1111.45	1117.77	1124.33	1131.05	1137.88	1144.74	1151.58	1158.32	172	0.132
29	665	669.37	673.88	678.63	683.72	689.23	695.21	701.69	708.68	716.19	724.19	732.65	741.49	164.1	-0.0529
30	735	739.37	743.88	748.63	753.72	759.28	765.36	771.89	778.81	786.03	793.5	801.13	808.86	168.6	0.0617
31	805	809.37	813.93	818.81	824.04	829.56	835.35	841.33	847.46	853.66	859.87	866.03	872.07	173.7	0.1387
32	875	879.39	883.96	888.83	893.99	899.39	904.99	910.75	916.59	922.47	928.31	934.06	939.66	174.9	0.1521
33	945	949.41	954.01	958.88	964.01	969.37	974.91	980.58	986.33	992.09	997.79	1003.39	1008.81	175.4	0.1572
34	1015	1019.41	1024.01	1028.88	1034.01	1039.37	1044.91	1050.58	1056.33	1062.09	1067.79	1073.39	1078.81	175.4	0.1572
35	1085	1089.41	1094.01	1098.88	1104.01	1109.37	1114.91	1120.58	1126.33	1132.09	1137.79	1143.39	1148.81	175.4	0.1572

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: -10 deg. **Input file: ROUTE152.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.79	675.45	681.96	689.3	697.4	706.19	715.57	725.45	735.75	746.38	757.29	768.39	159.8	0.0285
2	735	739.82	745.57	752.17	759.51	767.49	776.02	785	794.35	804.01	813.9	823.95	834.09	163.1	0.072
3	805	809.82	815.57	822.17	829.51	837.49	846.02	855	864.35	874.01	883.9	893.95	904.09	163.1	0.072
4	875	879.82	885.57	892.17	899.51	907.49	916.02	925	934.35	944.01	953.9	963.95	974.09	163.1	0.072
5	945	949.82	955.57	962.17	969.51	977.49	986.02	995	1004.35	1014.01	1023.9	1033.95	1044.09	163.1	0.072
6	1015	1019.82	1025.57	1032.17	1039.51	1047.49	1056.02	1065	1074.35	1084.01	1093.9	1103.95	1114.09	163.1	0.072
7	1085	1089.82	1095.57	1102.17	1109.51	1117.49	1126.02	1135	1144.35	1154.01	1163.9	1173.95	1184.09	163.1	0.072
8	665	669.68	675.05	681.12	687.92	695.45	703.67	712.53	721.92	731.77	741.99	752.5	763.24	160.5	0.0162
9	735	739.68	745.1	751.29	758.16	765.61	773.58	781.97	790.71	799.73	808.95	818.31	827.74	164.9	0.0807
10	805	809.71	815.18	821.37	828.2	835.58	843.45	851.72	860.31	869.15	878.17	887.3	896.48	165.7	0.0898
11	875	879.71	885.18	891.37	898.2	905.58	913.45	921.72	930.31	939.15	948.17	957.3	966.48	165.7	0.0898
12	945	949.71	955.18	961.37	968.2	975.58	983.45	991.72	1000.31	1009.15	1018.17	1027.3	1036.48	165.7	0.0898
13	1015	1019.71	1025.18	1031.37	1038.2	1045.58	1053.45	1061.72	1070.31	1079.15	1088.17	1097.3	1106.48	165.7	0.0898
14	1085	1089.71	1095.18	1101.37	1108.2	1115.58	1123.45	1131.72	1140.31	1149.15	1158.17	1167.3	1176.48	165.7	0.0898
15	665	669.58	674.67	680.31	686.54	693.41	700.92	709.05	717.77	726.99	736.61	746.58	756.8	161.5	0.0009
16	735	739.58	744.67	750.35	756.68	763.59	771.01	778.85	787.04	795.51	804.18	812.99	821.87	166.2	0.0801
17	805	809.6	814.77	820.52	826.8	833.55	840.69	848.17	855.91	863.83	871.88	879.98	888.06	168.6	0.1108
18	875	879.61	884.8	890.56	896.85	903.59	910.73	918.19	925.9	933.8	941.81	949.86	957.89	168.8	0.1131
19	945	949.61	954.8	960.56	966.85	973.59	980.73	988.19	995.9	1003.8	1011.81	1019.86	1027.89	168.8	0.1131
20	1015	1019.61	1024.8	1030.56	1036.85	1043.59	1050.73	1058.19	1065.9	1073.8	1081.81	1089.86	1097.89	168.8	0.1131
21	1085	1089.61	1094.8	1100.56	1106.85	1113.59	1120.73	1128.19	1135.9	1143.8	1151.81	1159.86	1167.89	168.8	0.1131
22	665	669.48	674.29	679.49	685.17	691.37	698.13	705.46	713.34	721.75	730.62	739.88	749.44	162.9	-0.0192
23	735	739.48	744.29	749.49	755.21	761.49	768.3	775.54	783.14	791.04	799.15	807.4	815.73	167.5	0.0757
24	805	809.48	814.35	819.71	825.5	831.69	838.21	845	851.99	859.11	866.31	873.5	880.61	171.1	0.1282
25	875	879.51	884.42	889.75	895.47	901.53	907.88	914.45	921.19	928.02	934.88	941.69	948.4	172.3	0.1407
26	945	949.51	954.42	959.75	965.47	971.53	977.88	984.45	991.19	998.02	1004.88	1011.69	1018.4	172.3	0.1407
27	1015	1019.51	1024.42	1029.75	1035.47	1041.53	1047.88	1054.45	1061.19	1068.02	1074.88	1081.69	1088.4	172.3	0.1407
28	1085	1089.51	1094.42	1099.75	1105.47	1111.53	1117.88	1124.45	1131.19	1138.02	1144.88	1151.69	1158.4	172.3	0.1407
29	665	669.38	673.89	678.66	683.78	689.32	695.32	701.81	708.82	716.33	724.34	732.8	741.63	164.3	-0.0462
30	735	739.38	743.89	748.66	753.78	759.36	765.46	772.01	778.95	786.18	793.64	801.26	808.97	168.9	0.0707
31	805	809.38	813.95	818.85	824.09	829.65	835.45	841.45	847.59	853.79	860	866.14	872.15	174	0.1473
32	875	879.39	883.98	888.87	894.04	899.47	905.09	910.87	916.72	922.6	928.44	934.17	939.73	175.2	0.1604
33	945	949.41	954.02	958.91	964.07	969.45	975.01	980.71	986.46	992.22	997.92	1003.5	1008.89	175.6	0.1654
34	1015	1019.41	1024.02	1028.91	1034.07	1039.45	1045.01	1050.71	1056.46	1062.22	1067.92	1073.5	1078.89	175.6	0.1654
35	1085	1089.41	1094.02	1098.91	1104.07	1109.45	1115.01	1120.71	1126.46	1132.22	1137.92	1143.5	1148.89	175.6	0.1654

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: -5 deg. **Input file: ROUTE113.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.62	671.08	675.36	680.45	686.34	692.99	700.39	708.47	717.15	726.34	735.96	745.96	160.4	-0.0666
2	735	737.62	741.1	745.43	750.56	756.4	762.86	769.86	777.33	785.18	793.36	801.81	810.46	165	0.001
3	805	807.65	811.21	815.61	820.75	826.53	832.86	839.67	846.89	854.44	862.26	870.3	878.5	166.7	0.0212
4	875	877.65	881.21	885.61	890.75	896.53	902.86	909.67	916.89	924.44	932.26	940.3	948.5	166.7	0.0212
5	945	947.65	951.21	955.61	960.75	966.53	972.86	979.67	986.89	994.44	1002.26	1010.3	1018.5	166.7	0.0212
6	1015	1017.65	1021.21	1025.61	1030.75	1036.53	1042.86	1049.67	1056.89	1064.44	1072.26	1080.3	1088.5	166.7	0.0212
7	1085	1087.65	1091.21	1095.61	1100.75	1106.53	1112.86	1119.67	1126.89	1134.44	1142.26	1150.3	1158.5	166.7	0.0212
8	665	667.51	670.67	674.52	679.08	684.36	690.37	697.09	704.51	712.57	721.2	730.31	739.83	161.4	-0.0825
9	735	737.51	740.67	744.56	749.18	754.53	760.54	767.13	774.22	781.73	789.59	797.74	806.12	165.6	-0.0095
10	805	807.53	810.78	814.74	819.35	824.51	830.18	836.27	842.71	849.46	856.43	863.58	870.85	169.1	0.0356
11	875	877.54	880.8	884.77	889.37	894.54	900.19	906.26	912.68	919.39	926.33	933.44	940.67	169.2	0.0377
12	945	947.54	950.8	954.77	959.37	964.54	970.19	976.26	982.68	989.39	996.33	1003.44	1010.67	169.2	0.0377
13	1015	1017.54	1020.8	1024.77	1029.37	1034.54	1040.19	1046.26	1052.68	1059.39	1066.33	1073.44	1080.67	169.2	0.0377
14	1085	1087.54	1090.8	1094.77	1099.37	1104.54	1110.19	1116.26	1122.68	1129.39	1136.33	1143.44	1150.67	169.2	0.0377
15	665	667.4	670.28	673.68	677.68	682.32	687.6	693.55	700.17	707.42	715.28	723.69	732.58	162.6	-0.1081
16	735	737.4	740.28	743.68	747.7	752.37	757.7	763.65	770.13	777.07	784.4	792.05	799.95	166.5	-0.0214
17	805	807.4	810.34	813.89	818.01	822.63	827.7	833.14	838.91	844.94	851.17	857.54	863.99	171.2	0.0479
18	875	877.43	880.41	883.93	887.97	892.46	897.36	902.6	908.12	913.86	919.77	925.79	931.87	172.3	0.06
19	945	947.43	950.41	953.93	957.97	962.46	967.36	972.6	978.12	983.86	989.77	995.79	1001.87	172.3	0.06
20	1015	1017.43	1020.41	1023.93	1027.97	1032.46	1037.36	1042.6	1048.12	1053.86	1059.77	1065.79	1071.87	172.3	0.06
21	1085	1087.43	1090.41	1093.93	1097.97	1102.46	1107.36	1112.6	1118.12	1123.86	1129.77	1135.79	1141.87	172.3	0.06
22	665	667.3	669.88	672.83	676.25	680.2	684.72	689.84	695.56	701.96	709.04	716.76	725	164.3	-0.1275
23	735	737.3	739.88	742.83	746.25	750.22	754.77	759.92	765.62	771.83	778.47	785.48	792.78	167.7	-0.0372
24	805	807.3	809.89	812.9	816.44	820.47	824.94	829.77	834.92	840.33	845.93	851.67	857.49	172.6	0.0486
25	875	877.31	879.97	883.05	886.53	890.37	894.53	898.95	903.59	908.39	913.29	918.24	923.18	175.1	0.0814
26	945	947.33	950.01	953.08	956.53	960.32	964.41	968.74	973.26	977.92	982.67	987.44	992.2	175.7	0.0879
27	1015	1017.33	1020.01	1023.08	1026.53	1030.32	1034.41	1038.74	1043.26	1047.92	1052.67	1057.44	1062.2	175.7	0.0879
28	1085	1087.33	1090.01	1093.08	1096.53	1100.32	1104.41	1108.74	1113.26	1117.92	1122.67	1127.44	1132.2	175.7	0.0879
29	665	667.19	669.47	671.97	674.81	678.07	681.82	686.09	690.91	696.3	702.28	708.86	716.01	166	-0.1894
30	735	737.19	739.47	741.97	744.81	748.07	751.83	756.12	760.96	766.34	772.2	778.49	785.12	169	-0.0572
31	805	807.19	809.47	811.98	814.84	818.15	821.93	826.15	830.75	835.67	840.84	846.2	851.7	173	0.0268
32	875	877.19	879.54	882.19	885.14	888.35	891.81	895.45	899.24	903.12	907.04	910.94	914.78	177.9	0.1026
33	945	947.22	949.6	952.22	955.09	958.18	961.45	964.88	968.4	971.97	975.53	979.05	982.46	179.1	0.1156
34	1015	1017.22	1019.6	1022.22	1025.09	1028.18	1031.45	1034.88	1038.4	1041.97	1045.53	1049.05	1052.46	179.1	0.1156
35	1085	1087.22	1089.6	1092.22	1095.09	1098.18	1101.45	1104.88	1108.4	1111.97	1115.53	1119.05	1122.46	179.1	0.1156

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: -5 deg. **Input file: ROUTE123.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.63	671.12	675.45	680.59	686.53	693.24	700.69	708.83	717.54	726.76	736.39	746.38	160.9	-0.0497
2	735	737.63	741.14	745.52	750.69	756.59	763.11	770.16	777.67	785.55	793.74	802.18	810.79	165.6	0.0211
3	805	807.66	811.25	815.69	820.88	826.72	833.11	839.97	847.22	854.8	862.63	870.65	878.8	167.2	0.0419
4	875	877.66	881.25	885.69	890.88	896.72	903.11	909.97	917.22	924.8	932.63	940.65	948.8	167.2	0.0419
5	945	947.66	951.25	955.69	960.88	966.72	973.11	979.97	987.22	994.8	1002.63	1010.65	1018.8	167.2	0.0419
6	1015	1017.66	1021.25	1025.69	1030.88	1036.72	1043.11	1049.97	1057.22	1064.8	1072.63	1080.65	1088.8	167.2	0.0419
7	1085	1087.66	1091.25	1095.69	1100.88	1106.72	1113.11	1119.97	1127.22	1134.8	1142.63	1150.65	1158.8	167.2	0.0419
8	665	667.52	670.71	674.61	679.22	684.55	690.61	697.38	704.82	712.89	721.51	730.61	740.11	161.8	-0.0711
9	735	737.52	740.71	744.64	749.32	754.72	760.79	767.43	774.55	782.08	789.95	798.09	806.44	166.1	0.0105
10	805	807.54	810.82	814.83	819.48	824.71	830.42	836.56	843.04	849.81	856.78	863.91	871.13	169.6	0.0568
11	875	877.55	880.84	884.86	889.51	894.73	900.43	906.55	913.01	919.74	926.68	933.77	940.94	169.8	0.0589
12	945	947.55	950.84	954.86	959.51	964.73	970.43	976.55	983.01	989.74	996.68	1003.77	1010.94	169.8	0.0589
13	1015	1017.55	1020.84	1024.86	1029.51	1034.73	1040.43	1046.55	1053.01	1059.74	1066.68	1073.77	1080.94	169.8	0.0589
14	1085	1087.55	1090.84	1094.86	1099.51	1104.73	1110.43	1116.55	1123.01	1129.74	1136.68	1143.77	1150.94	169.8	0.0589
15	665	667.41	670.32	673.76	677.82	682.5	687.84	693.84	700.49	707.78	715.67	724.09	732.96	163.1	-0.0912
16	735	737.41	740.32	743.76	747.83	752.56	757.94	763.94	770.46	777.43	784.77	792.41	800.28	167	-0.0021
17	805	807.41	810.38	813.97	818.14	822.82	827.93	833.43	839.23	845.27	851.49	857.83	864.21	171.8	0.0693
18	875	877.44	880.45	884.01	888.1	892.65	897.6	902.88	908.44	914.2	920.1	926.09	932.09	172.8	0.0814
19	945	947.44	950.45	954.01	958.1	962.65	967.6	972.88	978.44	984.2	990.1	996.09	1002.09	172.8	0.0814
20	1015	1017.44	1020.45	1024.01	1028.1	1032.65	1037.6	1042.88	1048.44	1054.2	1060.1	1066.09	1072.09	172.8	0.0814
21	1085	1087.44	1090.45	1094.01	1098.1	1102.65	1107.6	1112.88	1118.44	1124.2	1130.1	1136.09	1142.09	172.8	0.0814
22	665	667.31	669.92	672.92	676.39	680.39	684.96	690.12	695.88	702.27	709.26	716.85	725	164.4	-0.1301
23	735	737.31	739.92	742.92	746.39	750.4	755.01	760.2	765.94	772.18	778.83	785.83	793.1	168.2	-0.0186
24	805	807.31	809.93	812.99	816.58	820.66	825.18	830.06	835.24	840.66	846.25	851.95	857.71	173.2	0.0701
25	875	877.32	880.01	883.13	886.66	890.56	894.77	899.24	903.91	908.71	913.6	918.51	923.38	175.7	0.1025
26	945	947.34	950.05	953.17	956.67	960.51	964.65	969.02	973.57	978.24	982.98	987.71	992.38	176.3	0.1089
27	1015	1017.34	1020.05	1023.17	1026.67	1030.51	1034.65	1039.02	1043.57	1048.24	1052.98	1057.71	1062.38	176.3	0.1089
28	1085	1087.34	1090.05	1093.17	1096.67	1100.51	1104.65	1109.02	1113.57	1118.24	1122.98	1127.71	1132.38	176.3	0.1089
29	665	667.2	669.51	672.06	674.95	678.26	682.05	686.37	691.22	696.63	702.61	709.16	716.27	166.4	-0.1834
30	735	737.2	739.51	742.06	744.95	748.26	752.06	756.4	761.27	766.67	772.55	778.82	785.43	169.5	-0.0402
31	805	807.2	809.51	812.06	814.98	818.33	822.17	826.44	831.07	836	841.16	846.49	851.92	173.6	0.0482
32	875	877.2	879.58	882.27	885.27	888.54	892.05	895.73	899.55	903.44	907.34	911.19	914.95	178.5	0.1232
33	945	947.23	949.64	952.31	955.22	958.37	961.69	965.16	968.71	972.28	975.84	979.31	982.64	179.7	0.1355
34	1015	1017.23	1019.64	1022.31	1025.22	1028.37	1031.69	1035.16	1038.71	1042.28	1045.84	1049.31	1052.64	179.7	0.1355
35	1085	1087.23	1089.64	1092.31	1095.22	1098.37	1101.69	1105.16	1108.71	1112.28	1115.84	1119.31	1122.64	179.7	0.1355

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: -5 deg. **Input file: ROUTE133.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.63	671.14	675.49	680.65	686.62	693.36	700.84	708.99	717.73	726.96	736.6	746.58	161.1	-0.0415
2	735	737.63	741.16	745.56	750.76	756.68	763.23	770.31	777.83	785.73	793.92	802.35	810.95	165.8	0.0308
3	805	807.66	811.27	815.73	820.95	826.81	833.22	840.11	847.38	854.97	862.8	870.82	878.94	167.5	0.0518
4	875	877.66	881.27	885.73	890.95	896.81	903.22	910.11	917.38	924.97	932.8	940.82	948.94	167.5	0.0518
5	945	947.66	951.27	955.73	960.95	966.81	973.22	980.11	987.38	994.97	1002.8	1010.82	1018.94	167.5	0.0518
6	1015	1017.66	1021.27	1025.73	1030.95	1036.81	1043.22	1050.11	1057.38	1064.97	1072.8	1080.82	1088.94	167.5	0.0518
7	1085	1087.66	1091.27	1095.73	1100.95	1106.81	1113.22	1120.11	1127.38	1134.97	1142.8	1150.82	1158.94	167.5	0.0518
8	665	667.52	670.73	674.65	679.28	684.64	690.73	697.52	704.99	713.07	721.7	730.81	740.3	162	-0.0633
9	735	737.52	740.73	744.68	749.39	754.81	760.91	767.57	774.71	782.25	790.12	798.25	806.57	166.4	0.0203
10	805	807.55	810.84	814.87	819.54	824.8	830.54	836.7	843.2	849.97	856.95	864.07	871.26	169.9	0.0669
11	875	877.55	880.86	884.89	889.57	894.82	900.55	906.69	913.16	919.91	926.85	933.92	941.06	170.1	0.069
12	945	947.55	950.86	954.89	959.57	964.82	970.55	976.69	983.16	989.91	996.85	1003.92	1011.06	170.1	0.069
13	1015	1017.55	1020.86	1024.89	1029.57	1034.82	1040.55	1046.69	1053.16	1059.91	1066.85	1073.92	1081.06	170.1	0.069
14	1085	1087.55	1090.86	1094.89	1099.57	1104.82	1110.55	1116.69	1123.16	1129.91	1136.85	1143.92	1151.06	170.1	0.069
15	665	667.42	670.33	673.8	677.88	682.59	687.96	693.98	700.65	707.95	715.85	724.27	733.14	163.3	-0.0842
16	735	737.42	740.33	743.8	747.9	752.65	758.06	764.08	770.62	777.6	784.94	792.58	800.43	167.3	0.0073
17	805	807.42	810.4	814.01	818.2	822.91	828.05	833.56	839.38	845.43	851.64	857.96	864.32	172.1	0.0794
18	875	877.45	880.47	884.05	888.17	892.74	897.71	903.02	908.59	914.36	920.26	926.23	932.2	173.1	0.0914
19	945	947.45	950.47	954.05	958.17	962.74	967.71	973.02	978.59	984.36	990.26	996.23	1002.2	173.1	0.0914
20	1015	1017.45	1020.47	1024.05	1028.17	1032.74	1037.71	1043.02	1048.59	1054.36	1060.26	1066.23	1072.2	173.1	0.0914
21	1085	1087.45	1090.47	1094.05	1098.17	1102.74	1107.71	1113.02	1118.59	1124.36	1130.26	1136.23	1142.2	173.1	0.0914
22	665	667.31	669.94	672.95	676.45	680.48	685.07	690.26	696.04	702.43	709.43	717	725.1	164.6	-0.1291
23	735	737.31	739.94	742.95	746.45	750.49	755.12	760.34	766.1	772.34	779	785.99	793.25	168.5	-0.0097
24	805	807.31	809.95	813.03	816.64	820.75	825.29	830.19	835.39	840.81	846.4	852.09	857.81	173.5	0.0802
25	875	877.33	880.03	883.17	886.73	890.65	894.88	899.37	904.05	908.87	913.75	918.64	923.47	176	0.1124
26	945	947.35	950.07	953.21	956.73	960.6	964.76	969.15	973.72	978.4	983.12	987.84	992.47	176.5	0.1187
27	1015	1017.35	1020.07	1023.21	1026.73	1030.6	1034.76	1039.15	1043.72	1048.4	1053.12	1057.84	1062.47	176.5	0.1187
28	1085	1087.35	1090.07	1093.21	1096.73	1100.6	1104.76	1109.15	1113.72	1118.4	1123.12	1127.84	1132.47	176.5	0.1187
29	665	667.21	669.53	672.1	675.01	678.35	682.17	686.5	691.37	696.79	702.78	709.38	716.62	166.6	-0.1606
30	735	737.21	739.53	742.1	745.01	748.35	752.17	756.53	761.42	766.83	772.71	778.98	785.57	169.7	-0.032
31	805	807.21	809.53	812.1	815.04	818.42	822.28	826.57	831.22	836.15	841.31	846.62	852.02	173.9	0.0584
32	875	877.21	879.6	882.31	885.33	888.63	892.16	895.87	899.7	903.59	907.48	911.31	915.03	178.8	0.1327
33	945	947.24	949.66	952.35	955.29	958.46	961.81	965.29	968.85	972.44	975.98	979.43	982.72	179.9	0.1448
34	1015	1017.24	1019.66	1022.35	1025.29	1028.46	1031.81	1035.29	1038.85	1042.44	1045.98	1049.43	1052.72	179.9	0.1448
35	1085	1087.24	1089.66	1092.35	1095.29	1098.46	1101.81	1105.29	1108.85	1112.44	1115.98	1119.43	1122.72	179.9	0.1448

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: -5 deg. **Input file: ROUTE143.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.64	671.16	675.53	680.73	686.73	693.5	701.01	709.19	717.95	727.19	736.84	746.81	161.4	-0.0316
2	735	737.64	741.19	745.6	750.84	756.79	763.37	770.48	778.02	785.94	794.14	802.56	811.13	166.1	0.0424
3	805	807.67	811.29	815.78	821.02	826.92	833.36	840.28	847.57	855.17	863.01	871.01	879.11	167.8	0.0636
4	875	877.67	881.29	885.78	891.02	896.92	903.36	910.28	917.57	925.17	933.01	941.01	949.11	167.8	0.0636
5	945	947.67	951.29	955.78	961.02	966.92	973.36	980.28	987.57	995.17	1003.01	1011.01	1019.11	167.8	0.0636
6	1015	1017.67	1021.29	1025.78	1031.02	1036.92	1043.36	1050.28	1057.57	1065.17	1073.01	1081.01	1089.11	167.8	0.0636
7	1085	1087.67	1091.29	1095.78	1101.02	1106.92	1113.36	1120.28	1127.57	1135.17	1143.01	1151.01	1159.11	167.8	0.0636
8	665	667.53	670.76	674.69	679.36	684.75	690.87	697.69	705.18	713.28	721.93	731.04	740.53	162.2	-0.054
9	735	737.53	740.76	744.73	749.47	754.92	761.05	767.73	774.89	782.45	790.32	798.44	806.73	166.7	0.0321
10	805	807.55	810.86	814.91	819.62	824.9	830.68	836.86	843.39	850.17	857.15	864.25	871.41	170.2	0.0788
11	875	877.56	880.89	884.94	889.65	894.92	900.68	906.85	913.35	920.11	927.05	934.11	941.21	170.4	0.0809
12	945	947.56	950.89	954.94	959.65	964.92	970.68	976.85	983.35	990.11	997.05	1004.11	1011.21	170.4	0.0809
13	1015	1017.56	1020.89	1024.94	1029.65	1034.92	1040.68	1046.85	1053.35	1060.11	1067.05	1074.11	1081.21	170.4	0.0809
14	1085	1087.56	1090.89	1094.94	1099.65	1104.92	1110.68	1116.85	1123.35	1130.11	1137.05	1144.11	1151.21	170.4	0.0809
15	665	667.42	670.36	673.85	677.96	682.7	688.1	694.14	700.83	708.14	716.02	724.43	733.28	163.4	-0.0793
16	735	737.42	740.36	743.85	747.97	752.76	758.2	764.24	770.81	777.8	785.15	792.78	800.61	167.6	0.0186
17	805	807.42	810.42	814.06	818.28	823.01	828.18	833.72	839.56	845.61	851.83	858.12	864.44	172.4	0.0914
18	875	877.46	880.49	884.1	888.24	892.85	897.85	903.18	908.77	914.55	920.44	926.39	932.33	173.4	0.1032
19	945	947.46	950.49	954.1	958.24	962.85	967.85	973.18	978.77	984.55	990.44	996.39	1002.33	173.4	0.1032
20	1015	1017.46	1020.49	1024.1	1028.24	1032.85	1037.85	1043.18	1048.77	1054.55	1060.44	1066.39	1072.33	173.4	0.1032
21	1085	1087.46	1090.49	1094.1	1098.24	1102.85	1107.85	1113.18	1118.77	1124.55	1130.44	1136.39	1142.33	173.4	0.1032
22	665	667.32	669.96	673	676.53	680.58	685.21	690.42	696.22	702.62	709.63	717.19	725.28	164.8	-0.1216
23	735	737.32	739.96	743	746.53	750.6	755.26	760.5	766.28	772.54	779.21	786.19	793.42	168.7	0.0012
24	805	807.32	809.97	813.08	816.72	820.86	825.43	830.35	835.57	841	846.58	852.25	857.92	173.8	0.0922
25	875	877.33	880.05	883.22	886.8	890.75	895.02	899.53	904.23	909.05	913.93	918.79	923.58	176.3	0.124
26	945	947.35	950.09	953.25	956.81	960.71	964.89	969.31	973.9	978.58	983.3	987.99	992.58	176.9	0.1302
27	1015	1017.35	1020.09	1023.25	1026.81	1030.71	1034.89	1039.31	1043.9	1048.58	1053.3	1057.99	1062.58	176.9	0.1302
28	1085	1087.35	1090.09	1093.25	1096.81	1100.71	1104.89	1109.31	1113.9	1118.58	1123.3	1127.99	1132.58	176.9	0.1302
29	665	667.21	669.55	672.14	675.09	678.45	682.3	686.66	691.54	696.97	702.96	709.51	716.63	166.7	-0.1794
30	735	737.21	739.55	742.14	745.09	748.45	752.31	756.68	761.59	767.01	772.9	779.17	785.74	170	-0.0222
31	805	807.21	809.55	812.15	815.12	818.53	822.42	826.73	831.4	836.34	841.49	846.78	852.14	174.2	0.0704
32	875	877.21	879.62	882.36	885.41	888.74	892.3	896.03	899.87	903.77	907.65	911.46	915.13	179.1	0.1439
33	945	947.24	949.68	952.39	955.36	958.56	961.94	965.45	969.03	972.62	976.16	979.58	982.83	-179.7	0.1556
34	1015	1017.24	1019.68	1022.39	1025.36	1028.56	1031.94	1035.45	1039.03	1042.62	1046.16	1049.58	1052.83	-179.7	0.1556
35	1085	1087.24	1089.68	1092.39	1095.36	1098.56	1101.94	1105.45	1109.03	1112.62	1116.16	1119.58	1122.83	-179.7	0.1556

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: -5 deg. **Input file: ROUTE153.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.64	671.18	675.57	680.79	686.81	693.61	701.12	709.28	718.02	727.25	736.89	746.86	161.4	-0.0284
2	735	737.64	741.2	745.64	750.89	756.87	763.48	770.6	778.17	786.1	794.3	802.72	811.27	166.4	0.0513
3	805	807.67	811.31	815.82	821.08	827	833.47	840.4	847.72	855.33	863.17	871.16	879.24	168	0.0726
4	875	877.67	881.31	885.82	891.08	897	903.47	910.4	917.72	925.33	933.17	941.16	949.24	168	0.0726
5	945	947.67	951.31	955.82	961.08	967	973.47	980.4	987.72	995.33	1003.17	1011.16	1019.24	168	0.0726
6	1015	1017.67	1021.31	1025.82	1031.08	1037	1043.47	1050.4	1057.72	1065.33	1073.17	1081.16	1089.24	168	0.0726
7	1085	1087.67	1091.31	1095.82	1101.08	1107	1113.47	1120.4	1127.72	1135.33	1143.17	1151.16	1159.24	168	0.0726
8	665	667.53	670.77	674.73	679.42	684.83	690.97	697.82	705.32	713.44	722.1	731.21	740.7	162.4	-0.0468
9	735	737.53	740.77	744.77	749.52	755.01	761.15	767.86	775.04	782.6	790.47	798.58	806.85	167	0.041
10	805	807.56	810.88	814.95	819.68	824.99	830.78	836.99	843.53	850.32	857.3	864.39	871.52	170.5	0.0878
11	875	877.57	880.9	884.98	889.71	895.01	900.79	906.98	913.49	920.26	927.2	934.24	941.32	170.6	0.0899
12	945	947.57	950.9	954.98	959.71	965.01	970.79	976.98	983.49	990.26	997.2	1004.24	1011.32	170.6	0.0899
13	1015	1017.57	1020.9	1024.98	1029.71	1035.01	1040.79	1046.98	1053.49	1060.26	1067.2	1074.24	1081.32	170.6	0.0899
14	1085	1087.57	1090.9	1094.98	1099.71	1105.01	1110.79	1116.98	1123.49	1130.26	1137.2	1144.24	1151.32	170.6	0.0899
15	665	667.43	670.37	673.89	678.01	682.78	688.2	694.27	700.97	708.29	716.18	724.59	733.45	163.6	-0.0729
16	735	737.43	740.37	743.89	748.03	752.84	758.3	764.37	770.95	777.96	785.31	792.93	800.75	167.8	0.0272
17	805	807.43	810.44	814.1	818.34	823.09	828.29	833.84	839.69	845.75	851.96	858.25	864.53	172.6	0.1004
18	875	877.46	880.51	884.14	888.3	892.93	897.95	903.3	908.91	914.69	920.59	926.52	932.42	173.7	0.1121
19	945	947.46	950.51	954.14	958.3	962.93	967.95	973.3	978.91	984.69	990.59	996.52	1002.42	173.7	0.1121
20	1015	1017.46	1020.51	1024.14	1028.3	1032.93	1037.95	1043.3	1048.91	1054.69	1060.59	1066.52	1072.42	173.7	0.1121
21	1085	1087.46	1090.51	1094.14	1098.3	1102.93	1107.95	1113.3	1118.91	1124.69	1130.59	1136.52	1142.42	173.7	0.1121
22	665	667.32	669.98	673.04	676.58	680.66	685.31	690.54	696.35	702.77	709.78	717.34	725.42	165	-0.1158
23	735	737.32	739.98	743.04	746.58	750.68	755.36	760.62	766.42	772.69	779.36	786.34	793.56	169	0.0095
24	805	807.32	809.99	813.11	816.78	820.94	825.53	830.47	835.7	841.14	846.72	852.37	858.01	174.1	0.1012
25	875	877.34	880.07	883.25	886.86	890.84	895.12	899.65	904.37	909.19	914.06	918.91	923.66	176.6	0.1327
26	945	947.36	950.11	953.29	956.87	960.79	965	969.43	974.03	978.72	983.43	988.1	992.65	177.1	0.1388
27	1015	1017.36	1020.11	1023.29	1026.87	1030.79	1035	1039.43	1044.03	1048.72	1053.43	1058.1	1062.65	177.1	0.1388
28	1085	1087.36	1090.11	1093.29	1096.87	1100.79	1105	1109.43	1114.03	1118.72	1123.43	1128.1	1132.65	177.1	0.1388
29	665	667.22	669.57	672.18	675.14	678.54	682.4	686.78	691.68	697.12	703.1	709.64	716.73	166.9	-0.1771
30	735	737.22	739.57	742.18	745.14	748.54	752.41	756.8	761.72	767.16	773.05	779.32	785.87	170.2	-0.0148
31	805	807.22	809.57	812.19	815.18	818.61	822.52	826.85	831.53	836.48	841.63	846.9	852.23	174.4	0.0796
32	875	877.22	879.64	882.39	885.47	888.82	892.4	896.15	900.01	903.91	907.78	911.57	915.2	179.4	0.1522
33	945	947.25	949.7	952.43	955.42	958.64	962.05	965.57	969.16	972.76	976.29	979.69	982.91	-179.5	0.1637
34	1015	1017.25	1019.7	1022.43	1025.42	1028.64	1032.05	1035.57	1039.16	1042.76	1046.29	1049.69	1052.91	-179.5	0.1637
35	1085	1087.25	1089.7	1092.43	1095.42	1098.64	1102.05	1105.57	1109.16	1112.76	1116.29	1119.69	1122.91	-179.5	0.1637

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: 0 deg. **Input file: ROUTE114.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.45	666.77	668.92	671.9	675.68	680.25	685.58	691.71	698.63	706.25	714.48	723.23	162.8	-0.1237
2	735	735.45	736.77	738.92	741.92	745.75	750.37	755.7	761.65	768.12	775.05	782.35	789.96	166.8	-0.0437
3	805	805.48	806.88	809.15	812.17	815.84	820.08	824.81	829.94	835.41	841.16	847.13	853.25	171.5	0.0195
4	875	875.48	876.9	879.16	882.17	885.83	890.05	894.75	899.85	905.29	911	916.92	922.98	171.7	0.0215
5	945	945.48	946.9	949.16	952.17	955.83	960.05	964.75	969.85	975.29	981	986.92	992.98	171.7	0.0215
6	1015	1015.48	1016.9	1019.16	1022.17	1025.83	1030.05	1034.75	1039.85	1045.29	1051	1056.92	1062.98	171.7	0.0215
7	1085	1085.48	1086.9	1089.16	1092.17	1095.83	1100.05	1104.75	1109.85	1115.29	1121	1126.92	1132.98	171.7	0.0215
8	665	665.34	666.35	668.05	670.48	673.65	677.54	682.16	687.5	693.55	700.3	707.71	715.75	163.7	-0.1663
9	735	735.34	736.35	738.05	740.48	743.67	747.61	752.26	757.58	763.48	769.89	776.72	783.92	167.5	-0.0623
10	805	805.34	806.4	808.22	810.77	813.94	817.67	821.86	826.46	831.39	836.58	841.98	847.53	172.8	0.0221
11	875	875.37	876.48	878.3	880.75	883.78	887.29	891.22	895.5	900.07	904.86	909.81	914.87	174.2	0.038
12	945	945.37	946.48	948.3	950.75	953.78	957.29	961.22	965.5	970.07	974.86	979.81	984.87	174.2	0.038
13	1015	1015.37	1016.48	1018.3	1020.75	1023.78	1027.29	1031.22	1035.5	1040.06	1044.86	1049.81	1054.87	174.2	0.038
14	1085	1085.37	1086.48	1088.3	1090.75	1093.78	1097.29	1101.22	1105.5	1110.06	1114.86	1119.81	1124.87	174.2	0.038
15	665	665.23	665.94	667.18	669.03	671.53	674.69	678.52	683.02	688.2	694.05	700.56	707.7	165.4	-0.2118
16	735	735.23	735.94	737.18	739.03	741.53	744.7	748.56	753.1	758.25	763.98	770.19	776.81	168.5	-0.0826
17	805	805.23	805.94	807.21	809.12	811.69	814.88	818.6	822.79	827.36	832.26	837.41	842.76	172.9	0.0016
18	875	875.24	876.03	877.41	879.32	881.71	884.52	887.7	891.17	894.87	898.75	902.76	906.82	176.7	0.0542
19	945	945.26	946.07	947.43	949.3	951.63	954.37	957.44	960.79	964.36	968.09	971.92	975.8	177.2	0.0603
20	1015	1015.26	1016.07	1017.43	1019.3	1021.63	1024.37	1027.44	1030.79	1034.36	1038.09	1041.92	1045.8	177.2	0.0603
21	1085	1085.26	1086.07	1087.43	1089.3	1091.63	1094.37	1097.44	1100.79	1104.36	1108.09	1111.92	1115.8	177.2	0.0603
22	665	665.12	665.52	666.31	667.56	669.35	671.71	674.68	678.28	682.5	687.35	692.84	698.96	167.6	-0.2654
23	735	735.12	735.52	736.31	737.56	739.35	741.71	744.68	748.3	752.57	757.46	762.92	768.88	169.6	-0.1188
24	805	805.12	805.52	806.31	807.58	809.43	811.86	814.85	818.35	822.27	826.55	831.12	835.92	174	-0.0117
25	875	875.12	875.58	876.49	877.85	879.63	881.77	884.21	886.9	889.78	892.8	895.9	899.02	179	0.0686
26	945	945.15	945.66	946.55	947.82	949.43	951.33	953.47	955.8	958.26	960.8	963.36	965.89	-179.4	0.0881
27	1015	1015.15	1015.66	1016.55	1017.82	1019.43	1021.33	1023.47	1025.8	1028.26	1030.8	1033.36	1035.89	-179.4	0.0881
28	1085	1085.15	1085.66	1086.55	1087.82	1089.43	1091.33	1093.47	1095.8	1098.26	1100.8	1103.36	1105.89	-179.4	0.0881
29	665	665.01	665.11	665.42	666.08	667.16	668.73	670.83	673.49	676.72	680.55	684.98	690.02	170.3	-0.2799
30	735	735.01	735.11	735.42	736.08	737.16	738.73	740.83	743.49	746.73	750.6	755.08	760.15	171.2	-0.171
31	805	805.01	805.11	805.42	806.08	807.18	808.8	810.96	813.66	816.83	820.41	824.33	828.52	175.2	-0.0282
32	875	875.01	875.12	875.5	876.27	877.44	878.96	880.78	882.84	885.09	887.46	889.92	892.39	-179.5	0.0692
33	945	945.02	945.19	945.64	946.38	947.38	948.6	949.99	951.52	953.12	954.75	956.34	957.86	-176.9	0.105
34	1015	1015.04	1015.24	1015.67	1016.34	1017.23	1018.3	1019.52	1020.82	1022.17	1023.51	1024.79	1025.96	-176	0.1157
35	1085	1085.04	1085.24	1085.67	1086.34	1087.23	1088.3	1089.52	1090.82	1092.17	1093.51	1094.79	1095.96	-176	0.1157

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: 0 deg. **Input file: ROUTE124.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.46	666.81	669	672.03	675.87	680.49	685.87	692.02	698.91	706.48	714.67	723.38	162.9	-0.12
2	735	735.46	736.81	739	742.06	745.94	750.62	756	761.99	768.5	775.44	782.74	790.32	167.2	-0.0254
3	805	805.49	806.92	809.23	812.3	816.03	820.33	825.1	830.27	835.77	841.52	847.46	853.53	172	0.0401
4	875	875.49	876.94	879.25	882.31	886.02	890.3	895.04	900.18	905.64	911.35	917.25	923.26	172.2	0.0422
5	945	945.49	946.94	949.25	952.31	956.02	960.3	965.04	970.18	975.64	981.35	987.25	993.26	172.2	0.0422
6	1015	1015.49	1016.94	1019.25	1022.31	1026.02	1030.3	1035.04	1040.18	1045.64	1051.35	1057.25	1063.26	172.2	0.0422
7	1085	1085.49	1086.94	1089.25	1092.31	1096.02	1100.3	1105.04	1110.18	1115.64	1121.35	1127.25	1133.26	172.2	0.0422
8	665	665.35	666.39	668.14	670.62	673.83	677.78	682.45	687.83	693.91	700.67	708.07	716.07	164.1	-0.1591
9	735	735.35	736.39	738.14	740.62	743.85	747.85	752.55	757.91	763.84	770.27	777.11	784.28	167.9	-0.0449
10	805	805.35	806.44	808.31	810.9	814.13	817.91	822.15	826.78	831.73	836.92	842.3	847.79	173.4	0.0428
11	875	875.38	876.52	878.38	880.89	883.96	887.53	891.5	895.82	900.41	905.19	910.12	915.12	174.8	0.059
12	945	945.38	946.52	948.38	950.89	953.96	957.53	961.5	965.82	970.41	975.19	980.12	985.12	174.8	0.059
13	1015	1015.38	1016.52	1018.38	1020.89	1023.96	1027.53	1031.5	1035.82	1040.41	1045.19	1050.12	1055.12	174.8	0.059
14	1085	1085.38	1086.52	1088.38	1090.89	1093.96	1097.53	1101.5	1105.82	1110.41	1115.19	1120.12	1125.12	174.8	0.059
15	665	665.24	665.98	667.27	669.17	671.71	674.92	678.8	683.34	688.55	694.4	700.9	708.01	165.8	-0.2058
16	735	735.24	735.98	737.27	739.17	741.71	744.94	748.85	753.41	758.6	764.34	770.56	777.16	168.9	-0.0668
17	805	805.24	805.98	807.29	809.25	811.88	815.12	818.89	823.11	827.71	832.6	837.73	843.03	173.5	0.0218
18	875	875.25	876.07	877.49	879.45	881.9	884.76	887.98	891.48	895.21	899.08	903.05	907.05	177.3	0.0752
19	945	945.27	946.11	947.51	949.43	951.82	954.61	957.72	961.1	964.69	968.41	972.21	976.02	177.8	0.0813
20	1015	1015.27	1016.11	1017.51	1019.43	1021.82	1024.61	1027.72	1031.1	1034.69	1038.41	1042.21	1046.02	177.8	0.0813
21	1085	1085.27	1086.11	1087.51	1089.43	1091.82	1094.61	1097.72	1101.1	1104.69	1108.41	1112.21	1116.02	177.8	0.0813
22	665	665.13	665.57	666.39	667.69	669.53	671.95	674.96	678.59	682.83	687.69	693.16	699.25	168.1	-0.256
23	735	735.13	735.57	736.39	737.69	739.53	741.95	744.96	748.61	752.9	757.78	763.22	769.15	170	-0.1084
24	805	805.13	805.57	806.39	807.71	809.62	812.1	815.14	818.67	822.61	826.89	831.44	836.19	174.5	0.0079
25	875	875.13	875.62	876.57	877.99	879.82	882.01	884.49	887.21	890.11	893.11	896.17	899.21	179.6	0.0896
26	945	945.16	945.7	946.64	947.96	949.62	951.57	953.75	956.11	958.58	961.11	963.63	966.08	-178.8	0.1087
27	1015	1015.16	1015.7	1016.64	1017.96	1019.62	1021.57	1023.75	1026.11	1028.58	1031.11	1033.63	1036.08	-178.8	0.1087
28	1085	1085.16	1085.7	1086.64	1087.96	1089.62	1091.57	1093.75	1096.11	1098.58	1101.11	1103.63	1106.08	-178.8	0.1087
29	665	665.02	665.15	665.51	666.21	667.35	668.96	671.1	673.79	677.05	680.88	685.28	690.28	170.8	-0.2657
30	735	735.02	735.15	735.51	736.21	737.35	738.96	741.1	743.79	747.05	750.9	755.36	760.38	171.5	-0.1686
31	805	805.02	805.15	805.51	806.21	807.36	809.03	811.24	813.97	817.16	820.75	824.65	828.79	175.7	-0.0098
32	875	875.02	875.16	875.58	876.41	877.63	879.2	881.06	883.15	885.41	887.77	890.18	892.58	-178.9	0.09
33	945	945.03	945.23	945.73	946.52	947.57	948.84	950.27	951.83	953.44	955.05	956.61	958.05	-176.3	0.1248
34	1015	1015.05	1015.28	1015.75	1016.48	1017.42	1018.54	1019.8	1021.13	1022.49	1023.82	1025.06	1026.15	-175.4	0.1349
35	1085	1085.05	1085.28	1085.75	1086.48	1087.42	1088.54	1089.8	1091.13	1092.49	1093.82	1095.06	1096.15	-175.4	0.1349

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: 0 deg. **Input file: ROUTE134.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.47	666.83	669.04	672.1	675.96	680.61	686.01	692.16	699.03	706.57	714.74	723.44	163	-0.1187
2	735	735.47	736.83	739.04	742.12	746.03	750.73	756.14	762.15	768.67	775.62	782.92	790.49	167.5	-0.0166
3	805	805.49	806.94	809.27	812.37	816.12	820.44	825.24	830.43	835.93	841.69	847.62	853.67	172.3	0.0499
4	875	875.5	876.96	879.29	882.37	886.11	890.41	895.18	900.34	905.81	911.52	917.41	923.4	172.5	0.0521
5	945	945.5	946.96	949.29	952.37	956.11	960.41	965.18	970.34	975.81	981.52	987.41	993.4	172.5	0.0521
6	1015	1015.5	1016.96	1019.29	1022.37	1026.11	1030.41	1035.18	1040.34	1045.81	1051.52	1057.41	1063.4	172.5	0.0521
7	1085	1085.5	1086.96	1089.29	1092.37	1096.11	1100.41	1105.18	1110.34	1115.81	1121.52	1127.41	1133.4	172.5	0.0521
8	665	665.35	666.41	668.18	670.68	673.92	677.9	682.59	687.98	694.08	700.85	708.25	716.24	164.3	-0.1532
9	735	735.35	736.41	738.18	740.68	743.94	747.96	752.69	758.07	764.02	770.45	777.29	784.45	168.1	-0.0365
10	805	805.35	806.46	808.35	810.97	814.22	818.02	822.29	826.93	831.89	837.08	842.45	847.91	173.7	0.0527
11	875	875.38	876.54	878.42	880.95	884.05	887.64	891.64	895.97	900.57	905.35	910.27	915.24	175	0.0688
12	945	945.38	946.54	948.42	950.95	954.05	957.64	961.64	965.97	970.57	975.35	980.27	985.24	175	0.0688
13	1015	1015.38	1016.54	1018.42	1020.95	1024.05	1027.64	1031.64	1035.97	1040.57	1045.35	1050.27	1055.24	175	0.0688
14	1085	1085.38	1086.54	1088.42	1090.95	1094.05	1097.64	1101.64	1105.97	1110.57	1115.35	1120.27	1125.24	175	0.0688
15	665	665.24	665.99	667.3	669.23	671.8	675.04	678.94	683.5	688.71	694.58	701.14	708.4	166	-0.1832
16	735	735.24	735.99	737.3	739.23	741.8	745.05	748.98	753.57	758.77	764.52	770.73	777.33	169.1	-0.0592
17	805	805.24	805.99	807.33	809.32	811.97	815.23	819.03	823.26	827.87	832.77	837.89	843.16	173.7	0.0315
18	875	875.26	876.09	877.53	879.51	881.99	884.88	888.12	891.63	895.36	899.24	903.19	907.16	177.5	0.085
19	945	945.28	946.12	947.55	949.5	951.91	954.72	957.86	961.26	964.85	968.57	972.35	976.12	178.1	0.0912
20	1015	1015.28	1016.12	1017.55	1019.5	1021.91	1024.72	1027.86	1031.26	1034.85	1038.57	1042.35	1046.12	178.1	0.0912
21	1085	1085.28	1086.12	1087.55	1089.5	1091.91	1094.72	1097.86	1101.26	1104.85	1108.57	1112.35	1116.12	178.1	0.0912
22	665	665.14	665.58	666.43	667.76	669.62	672.06	675.1	678.74	682.99	687.85	693.32	699.39	168.3	-0.2518
23	735	735.14	735.58	736.43	737.76	739.62	742.06	745.1	748.76	753.06	757.94	763.37	769.29	170.2	-0.1017
24	805	805.14	805.58	806.43	807.78	809.7	812.21	815.27	818.82	822.77	827.05	831.59	836.32	174.8	0.0173
25	875	875.14	875.64	876.61	878.05	879.91	882.12	884.62	887.36	890.26	893.26	896.29	899.3	179.9	0.0995
26	945	945.17	945.72	946.68	948.02	949.71	951.68	953.89	956.26	958.74	961.26	963.76	966.17	-178.5	0.1183
27	1015	1015.17	1015.72	1016.68	1018.02	1019.71	1021.68	1023.89	1026.26	1028.74	1031.26	1033.76	1036.17	-178.5	0.1183
28	1085	1085.17	1085.72	1086.68	1088.02	1089.71	1091.68	1093.89	1096.26	1098.74	1101.26	1103.76	1106.17	-178.5	0.1183
29	665	665.03	665.16	665.55	666.28	667.43	669.07	671.24	673.94	677.2	681.03	685.43	690.4	171	-0.2589
30	735	735.03	735.16	735.55	736.28	737.43	739.07	741.24	743.94	747.2	751.05	755.5	760.5	171.7	-0.1635
31	805	805.03	805.16	805.55	806.28	807.45	809.14	811.37	814.11	817.32	820.91	824.8	828.92	175.9	-0.001
32	875	875.03	875.18	875.62	876.47	877.72	879.31	881.19	883.29	885.56	887.92	890.31	892.67	-178.7	0.0998
33	945	945.03	945.25	945.77	946.58	947.66	948.95	950.41	951.98	953.59	955.2	956.73	958.14	-176	0.134
34	1015	1015.06	1015.3	1015.79	1016.54	1017.51	1018.66	1019.93	1021.28	1022.65	1023.97	1025.18	1026.24	-175.1	0.1439
35	1085	1085.06	1085.3	1085.79	1086.54	1087.51	1088.66	1089.93	1091.28	1092.65	1093.97	1095.18	1096.24	-175.1	0.1439

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: 0 deg. **Input file: ROUTE144.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.47	666.85	669.09	672.17	676.07	680.74	686.18	692.35	699.24	706.8	714.97	723.67	163.2	-0.1099
2	735	735.47	736.85	739.09	742.2	746.14	750.87	756.31	762.34	768.88	775.84	783.14	790.7	167.8	-0.0058
3	805	805.5	806.96	809.32	812.44	816.23	820.58	825.4	830.61	836.13	841.89	847.81	853.83	172.6	0.0617
4	875	875.5	876.98	879.33	882.45	886.22	890.55	895.34	900.52	906.01	911.72	917.59	923.55	172.8	0.0638
5	945	945.5	946.98	949.33	952.45	956.22	960.55	965.34	970.52	976.01	981.72	987.59	993.55	172.8	0.0638
6	1015	1015.5	1016.98	1019.33	1022.45	1026.22	1030.55	1035.34	1040.52	1046.01	1051.72	1057.59	1063.55	172.8	0.0638
7	1085	1085.5	1086.98	1089.33	1092.45	1096.22	1100.55	1105.34	1110.52	1116.01	1121.72	1127.59	1133.55	172.8	0.0638
8	665	665.36	666.43	668.22	670.76	674.03	678.03	682.75	688.17	694.28	701.06	708.47	716.45	164.5	-0.1461
9	735	735.36	736.43	738.22	740.76	744.05	748.1	752.85	758.26	764.22	770.67	777.5	784.65	168.4	-0.0264
10	805	805.36	806.48	808.4	811.04	814.33	818.16	822.45	827.12	832.08	837.28	842.63	848.06	174	0.0645
11	875	875.39	876.56	878.47	881.03	884.16	887.78	891.8	896.16	900.76	905.55	910.44	915.38	175.4	0.0806
12	945	945.39	946.56	948.47	951.03	954.16	957.78	961.8	966.16	970.76	975.55	980.44	985.38	175.4	0.0806
13	1015	1015.39	1016.56	1018.47	1021.03	1024.16	1027.78	1031.8	1036.16	1040.76	1045.55	1050.44	1055.38	175.4	0.0806
14	1085	1085.39	1086.56	1088.47	1091.03	1094.16	1097.78	1101.8	1106.16	1110.76	1115.55	1120.44	1125.38	175.4	0.0806
15	665	665.25	666.02	667.35	669.31	671.91	675.17	679.1	683.68	688.91	694.78	701.3	708.43	166.1	-0.2014
16	735	735.25	736.02	737.35	739.31	741.91	745.18	749.14	753.75	758.96	764.72	770.94	777.53	169.4	-0.0501
17	805	805.25	806.02	807.38	809.39	812.08	815.37	819.19	823.45	828.06	832.96	838.07	843.32	174	0.0431
18	875	875.27	876.12	877.58	879.59	882.09	885.01	888.28	891.82	895.55	899.42	903.36	907.28	177.9	0.0967
19	945	945.28	946.15	947.6	949.57	952.02	954.86	958.02	961.44	965.04	968.75	972.51	976.24	178.4	0.1028
20	1015	1015.28	1016.15	1017.6	1019.57	1022.02	1024.86	1028.02	1031.44	1035.04	1038.75	1042.51	1046.24	178.4	0.1028
21	1085	1085.28	1086.15	1087.6	1089.57	1092.02	1094.86	1098.02	1101.44	1105.04	1108.75	1112.51	1116.24	178.4	0.1028
22	665	665.14	665.61	666.48	667.83	669.73	672.19	675.26	678.92	683.18	688.04	693.5	699.55	168.5	-0.2467
23	735	735.14	735.61	736.48	737.83	739.73	742.19	745.26	748.94	753.25	758.14	763.56	769.46	170.4	-0.0935
24	805	805.14	805.61	806.48	807.85	809.81	812.35	815.43	819	822.96	827.25	831.77	836.47	175.1	0.0287
25	875	875.14	875.66	876.66	878.13	880.01	882.25	884.78	887.54	890.44	893.43	896.45	899.41	-179.8	0.1111
26	945	945.17	945.74	946.72	948.1	949.81	951.82	954.05	956.44	958.92	961.43	963.91	966.28	-178.2	0.1295
27	1015	1015.17	1015.74	1016.72	1018.1	1019.81	1021.82	1024.05	1026.44	1028.92	1031.43	1033.91	1036.28	-178.2	0.1295
28	1085	1085.17	1085.74	1086.72	1088.1	1089.81	1091.82	1094.05	1096.44	1098.92	1101.43	1103.91	1106.28	-178.2	0.1295
29	665	665.03	665.19	665.59	666.35	667.54	669.21	671.39	674.11	677.38	681.21	685.6	690.55	171.3	-0.2506
30	735	735.03	735.19	735.59	736.35	737.54	739.21	741.39	744.11	747.38	751.23	755.67	760.65	171.9	-0.1572
31	805	805.03	805.19	805.59	806.35	807.55	809.27	811.53	814.29	817.51	821.1	824.98	829.08	176.2	0.0096
32	875	875.03	875.2	875.67	876.55	877.83	879.45	881.35	883.47	885.74	888.09	890.46	892.78	-178.3	0.1113
33	945	945.04	945.27	945.81	946.66	947.76	949.09	950.57	952.15	953.78	955.37	956.88	958.25	-175.7	0.1447
34	1015	1015.06	1015.32	1015.84	1016.62	1017.62	1018.79	1020.09	1021.46	1022.83	1024.14	1025.34	1026.35	-174.8	0.1543
35	1085	1085.06	1085.32	1085.84	1086.62	1087.62	1088.79	1090.09	1091.46	1092.83	1094.14	1095.34	1096.35	-174.8	0.1543

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: 0 deg. **Input file: ROUTE154.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.48	666.87	669.13	672.23	676.15	680.85	686.3	692.5	699.4	706.97	715.15	723.84	163.4	-0.1035
2	735	735.48	736.87	739.13	742.25	746.22	750.98	756.43	762.49	769.04	776.01	783.3	790.85	168	0.0024
3	805	805.5	806.98	809.35	812.5	816.31	820.68	825.53	830.75	836.29	842.05	847.96	853.95	172.8	0.0705
4	875	875.51	877	879.37	882.51	886.3	890.65	895.47	900.67	906.16	911.87	917.74	923.67	173	0.0727
5	945	945.51	947	949.37	952.51	956.3	960.65	965.47	970.67	976.16	981.87	987.74	993.67	173	0.0727
6	1015	1015.51	1017	1019.37	1022.51	1026.3	1030.65	1035.47	1040.67	1046.16	1051.87	1057.74	1063.67	173	0.0727
7	1085	1085.51	1087	1089.37	1092.51	1096.3	1100.65	1105.47	1110.67	1116.16	1121.87	1127.74	1133.67	173	0.0727
8	665	665.36	666.45	668.26	670.81	674.11	678.14	682.88	688.31	694.43	701.22	708.63	716.61	164.7	-0.1408
9	735	735.36	736.45	738.26	740.81	744.13	748.2	752.98	758.4	764.38	770.83	777.67	784.81	168.6	-0.0186
10	805	805.36	806.5	808.43	811.1	814.41	818.26	822.57	827.25	832.23	837.42	842.76	848.17	174.2	0.0734
11	875	875.39	876.58	878.5	881.09	884.24	887.88	891.93	896.29	900.91	905.69	910.58	915.48	175.6	0.0895
12	945	945.39	946.58	948.5	951.09	954.24	957.88	961.93	966.29	970.91	975.69	980.58	985.48	175.6	0.0895
13	1015	1015.39	1016.58	1018.5	1021.09	1024.24	1027.88	1031.93	1036.29	1040.91	1045.69	1050.58	1055.48	175.6	0.0895
14	1085	1085.39	1086.58	1088.5	1091.09	1094.24	1097.88	1101.93	1106.29	1110.91	1115.69	1120.58	1125.48	175.6	0.0895
15	665	665.25	666.03	667.39	669.36	671.99	675.27	679.22	683.82	689.05	694.93	701.44	708.56	166.3	-0.1992
16	735	735.25	736.03	737.39	739.36	741.99	745.29	749.26	753.88	759.11	764.88	771.1	777.68	169.6	-0.0431
17	805	805.25	806.03	807.41	809.45	812.16	815.47	819.31	823.59	828.21	833.11	838.21	843.43	174.3	0.0519
18	875	875.27	876.13	877.61	879.65	882.18	885.12	888.4	891.95	895.7	899.57	903.48	907.38	178.1	0.1055
19	945	945.29	946.17	947.63	949.63	952.1	954.96	958.14	961.57	965.18	968.89	972.63	976.34	178.6	0.1116
20	1015	1015.29	1016.17	1017.63	1019.63	1022.1	1024.96	1028.14	1031.57	1035.18	1038.89	1042.63	1046.34	178.6	0.1116
21	1085	1085.29	1086.17	1087.63	1089.63	1092.1	1094.96	1098.14	1101.57	1105.18	1108.89	1112.63	1116.34	178.6	0.1116
22	665	665.15	665.62	666.51	667.89	669.81	672.3	675.38	679.05	683.32	688.19	693.64	699.68	168.7	-0.2501
23	735	735.15	735.62	736.51	737.89	739.81	742.3	745.38	749.07	753.39	758.28	763.71	769.6	170.6	-0.0851
24	805	805.15	805.62	806.51	807.91	809.89	812.45	815.55	819.13	823.11	827.39	831.91	836.59	175.3	0.0373
25	875	875.15	875.68	876.7	878.19	880.1	882.36	884.9	887.67	890.58	893.57	896.56	899.49	-179.5	0.1198
26	945	945.18	945.76	946.76	948.16	949.9	951.92	954.17	956.57	959.06	961.57	964.02	966.36	-177.9	0.1379
27	1015	1015.18	1015.76	1016.76	1018.16	1019.9	1021.92	1024.17	1026.57	1029.06	1031.57	1034.02	1036.36	-177.9	0.1379
28	1085	1085.18	1085.76	1086.76	1088.16	1089.9	1091.92	1094.17	1096.57	1099.06	1101.57	1104.02	1106.36	-177.9	0.1379
29	665	665.04	665.21	665.63	666.41	667.62	669.31	671.51	674.25	677.52	681.35	685.73	690.65	171.5	-0.2443
30	735	735.04	735.21	735.63	736.41	737.62	739.31	741.51	744.25	747.52	751.37	755.79	760.76	172.1	-0.1505
31	805	805.04	805.21	805.63	806.41	807.63	809.38	811.65	814.42	817.63	821.22	825.1	829.2	176.3	0.0133
32	875	875.04	875.22	875.71	876.61	877.91	879.55	881.47	883.6	885.88	888.23	890.58	892.86	-178.1	0.1199
33	945	945.04	945.29	945.85	946.71	947.84	949.19	950.69	952.29	953.91	955.51	957	958.33	-175.5	0.1527
34	1015	1015.07	1015.34	1015.88	1016.67	1017.7	1018.9	1020.21	1021.59	1022.97	1024.28	1025.45	1026.44	-174.6	0.1621
35	1085	1085.07	1085.34	1085.88	1086.67	1087.7	1088.9	1090.21	1091.59	1092.97	1094.28	1095.45	1096.44	-174.6	0.1621

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: +5 deg. **Input file: ROUTE115.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.28	662.43	662.44	663.27	664.92	667.36	670.58	674.55	679.26	684.68	690.82	697.65	165.6	-0.2505
2	735	733.28	732.43	732.44	733.27	734.92	737.36	740.61	744.64	749.38	754.76	760.72	767.17	168.3	-0.1143
3	805	803.28	802.46	802.52	803.43	805.12	807.52	810.52	814.03	817.98	822.3	826.92	831.78	173.7	-0.0156
4	875	873.31	872.56	872.67	873.52	875.02	877.08	879.61	882.54	885.8	889.32	893.04	896.9	176.7	0.0229
5	945	943.31	942.56	942.67	943.52	945.02	947.08	949.61	952.54	955.8	959.32	963.04	966.9	176.7	0.0229
6	1015	1013.31	1012.56	1012.67	1013.52	1015.02	1017.08	1019.61	1022.54	1025.8	1029.32	1033.04	1036.9	176.7	0.0229
7	1085	1083.31	1082.56	1082.67	1083.52	1085.02	1087.08	1089.61	1092.54	1095.8	1099.32	1103.04	1106.9	176.7	0.0229
8	665	663.16	662	661.55	661.81	662.82	664.57	667.06	670.27	674.19	678.81	684.12	690.11	167.5	-0.2866
9	735	733.16	732	731.55	731.81	732.82	734.57	737.06	740.29	744.25	748.9	754.17	760.02	169.3	-0.1463
10	805	803.16	802	801.55	801.85	802.93	804.76	807.26	810.35	813.94	817.97	822.35	827.01	173.9	-0.0364
11	875	873.18	872.11	871.77	872.1	873.01	874.43	876.27	878.48	880.97	883.7	886.6	889.61	178.8	0.0339
12	945	943.19	942.13	941.78	942.06	942.91	944.24	945.98	948.06	950.43	953	955.74	958.56	179.3	0.0395
13	1015	1013.19	1012.13	1011.78	1012.06	1012.91	1014.24	1015.98	1018.06	1020.43	1023	1025.74	1028.56	179.3	0.0395
14	1085	1083.19	1082.13	1081.78	1082.06	1082.91	1084.24	1085.98	1088.06	1090.43	1093	1095.74	1098.56	179.3	0.0395
15	665	663.05	661.58	660.65	660.33	660.65	661.64	663.31	665.66	668.68	672.39	676.76	681.8	169.9	-0.3
16	735	733.05	731.58	730.65	730.33	730.65	731.64	733.31	735.66	738.69	742.42	746.85	751.91	170.7	-0.195
17	805	803.05	801.58	800.65	800.33	800.68	801.73	803.48	805.85	808.79	812.22	816.04	820.21	174.8	-0.054
18	875	873.05	871.64	870.83	870.62	870.94	871.72	872.89	874.39	876.16	878.12	880.23	882.42	-179.3	0.0433
19	945	943.08	941.71	940.89	940.58	940.71	941.24	942.11	943.24	944.58	946.07	947.66	949.28	-177.7	0.0618
20	1015	1013.08	1011.71	1010.89	1010.58	1010.71	1011.24	1012.11	1013.24	1014.58	1016.07	1017.66	1019.28	-177.7	0.0618
21	1085	1083.08	1081.71	1080.89	1080.58	1080.71	1081.24	1082.11	1083.24	1084.58	1086.07	1087.66	1089.28	-177.7	0.0618
22	665	662.94	661.16	659.76	658.82	658.42	658.59	659.38	660.79	662.83	665.51	668.83	672.79	172.6	-0.2903
23	735	732.94	731.16	729.76	728.82	728.42	728.59	729.38	730.79	732.83	735.51	738.84	742.84	172.7	-0.2547
24	805	802.94	801.16	799.76	798.82	798.42	798.59	799.41	800.89	803	805.69	808.89	812.53	175.5	-0.0926
25	875	872.94	871.16	869.79	868.94	868.66	868.9	869.58	870.63	871.99	873.6	875.39	877.3	-178.9	0.0275
26	945	942.95	941.25	939.98	939.13	938.65	938.48	938.59	938.91	939.38	939.96	940.58	941.19	-175.3	0.0783
27	1015	1012.97	1011.29	1010	1009.07	1008.46	1008.14	1008.06	1008.15	1008.36	1008.64	1008.94	1009.19	-174.3	0.0895
28	1085	1082.97	1081.29	1080	1079.07	1078.46	1078.14	1078.06	1078.15	1078.36	1078.64	1078.94	1079.19	-174.3	0.0895
29	665	662.83	660.73	658.86	657.31	656.19	655.55	655.45	655.9	656.93	658.56	660.8	663.64	175.3	-0.2796
30	735	732.83	730.73	728.86	727.31	726.19	725.55	725.45	725.9	726.93	728.56	730.8	733.64	175.3	-0.2796
31	805	802.83	800.73	798.86	797.31	796.19	795.55	795.45	795.9	796.97	798.68	800.97	803.8	176.6	-0.1499
32	875	872.83	870.73	868.86	867.34	866.29	865.77	865.75	866.18	866.99	868.11	869.48	871.03	-178.4	0.0021
33	945	942.83	940.79	939.05	937.62	936.48	935.59	934.9	934.37	933.93	933.55	933.15	932.69	-172.7	0.0962
34	1015	1012.86	1010.87	1009.11	1007.6	1006.3	1005.18	1004.2	1003.31	1002.46	1001.59	1000.67	999.63	-171.1	0.1147
35	1085	1082.86	1080.86	1079.1	1077.56	1076.23	1075.07	1074.05	1073.1	1072.19	1071.26	1070.26	1069.15	-170.9	0.117

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: +5 deg. **Input file: ROUTE125.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.29	662.47	662.52	663.4	665.1	667.6	670.86	674.87	679.61	685.06	691.2	698.02	166	-0.2403
2	735	733.29	732.47	732.52	733.4	735.1	737.6	740.89	744.96	749.73	755.15	761.12	767.57	168.7	-0.0998
3	805	803.29	802.5	802.6	803.56	805.31	807.76	810.8	814.35	818.33	822.65	827.25	832.07	174.3	0.0039
4	875	873.32	872.6	872.75	873.65	875.21	877.32	879.89	882.86	886.14	889.67	893.36	897.17	177.2	0.0432
5	945	943.32	942.6	942.75	943.65	945.21	947.32	949.89	952.86	956.14	959.67	963.36	967.17	177.2	0.0432
6	1015	1013.32	1012.6	1012.75	1013.65	1015.21	1017.32	1019.89	1022.86	1026.14	1029.67	1033.36	1037.17	177.2	0.0432
7	1085	1083.32	1082.6	1082.75	1083.65	1085.21	1087.32	1089.89	1092.86	1096.14	1099.67	1103.37	1107.17	177.2	0.0432
8	665	663.17	662.04	661.63	661.95	663.01	664.81	667.34	670.58	674.53	679.17	684.48	690.45	167.9	-0.2781
9	735	733.17	732.04	731.63	731.95	733.01	734.81	737.34	740.6	744.6	749.26	754.54	760.38	169.7	-0.1309
10	805	803.17	802.04	801.63	801.98	803.14	805.02	807.57	810.68	814.28	818.29	822.62	827.2	174.5	-0.0146
11	875	873.19	872.15	871.86	872.23	873.2	874.66	876.55	878.79	881.31	884.04	886.92	889.87	179.3	0.0542
12	945	943.2	942.17	941.86	942.2	943.09	944.47	946.26	948.38	950.76	953.34	956.04	958.81	179.8	0.0599
13	1015	1013.2	1012.17	1011.86	1012.2	1013.09	1014.47	1016.26	1018.38	1020.76	1023.34	1026.04	1028.81	179.8	0.0599
14	1085	1083.2	1082.17	1081.86	1082.2	1083.09	1084.47	1086.26	1088.38	1090.76	1093.34	1096.04	1098.81	179.8	0.0599
15	665	663.06	661.62	660.73	660.46	660.83	661.87	663.58	665.97	669.02	672.73	677.1	682.11	170.3	-0.2867
16	735	733.06	731.62	730.73	730.46	730.83	731.87	733.58	735.97	739.02	742.76	747.17	752.21	171	-0.1867
17	805	803.06	801.62	800.73	800.46	800.86	801.96	803.75	806.17	809.14	812.57	816.39	820.53	175.2	-0.0369
18	875	873.06	871.67	870.91	870.76	871.13	871.96	873.17	874.71	876.49	878.45	880.53	882.67	-178.7	0.0635
19	945	943.09	941.75	940.97	940.71	940.9	941.48	942.39	943.55	944.91	946.4	947.95	949.5	-177.2	0.0819
20	1015	1013.09	1011.75	1010.97	1010.71	1010.9	1011.48	1012.39	1013.55	1014.91	1016.4	1017.95	1019.5	-177.2	0.0819
21	1085	1083.09	1081.75	1080.97	1080.71	1080.9	1081.48	1082.39	1083.55	1084.91	1086.4	1087.95	1089.5	-177.2	0.0819
22	665	662.95	661.2	659.84	658.95	658.6	658.82	659.65	661.09	663.16	665.84	669.15	673.07	173	-0.2768
23	735	732.95	731.2	729.84	728.95	728.6	728.82	729.65	731.09	733.16	735.84	739.15	743.1	173.1	-0.2499
24	805	802.95	801.2	799.84	798.95	798.6	798.82	799.68	801.2	803.33	806.02	809.19	812.79	175.8	-0.0811
25	875	872.95	871.2	869.87	869.07	868.85	869.13	869.85	870.94	872.32	873.92	875.68	877.53	-178.3	0.0475
26	945	942.96	941.29	940.07	939.26	938.83	938.72	938.87	939.22	939.71	940.28	940.87	941.41	-174.7	0.098
27	1015	1012.98	1011.33	1010.08	1009.2	1008.65	1008.38	1008.33	1008.46	1008.69	1008.96	1009.22	1009.4	-173.8	0.1089
28	1085	1082.98	1081.33	1080.08	1079.2	1078.65	1078.38	1078.33	1078.46	1078.69	1078.96	1079.22	1079.4	-173.8	0.1089
29	665	662.84	660.77	658.94	657.44	656.37	655.78	655.72	656.2	657.25	658.88	661.09	663.89	175.8	-0.2658
30	735	732.84	730.77	728.94	727.44	726.37	725.78	725.72	726.2	727.25	728.88	731.09	733.89	175.8	-0.2658
31	805	802.84	800.77	798.94	797.44	796.37	795.78	795.72	796.2	797.28	798.98	801.26	804.06	177	-0.1429
32	875	872.84	870.77	868.94	867.47	866.48	866	866.02	866.48	867.31	868.43	869.78	871.28	-177.9	0.0213
33	945	942.84	940.83	939.13	937.75	936.66	935.83	935.18	934.68	934.26	933.86	933.43	932.9	-172.1	0.1151
34	1015	1012.87	1010.91	1009.2	1007.73	1006.48	1005.41	1004.48	1003.62	1002.78	1001.91	1000.96	999.85	-170.6	0.1328
35	1085	1082.87	1080.9	1079.18	1077.69	1076.41	1075.31	1074.32	1073.41	1072.52	1071.58	1070.55	1069.37	-170.4	0.1351

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: +5 deg. **Input file: ROUTE135.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.29	662.49	662.55	663.46	665.19	667.71	671	675.03	679.78	685.23	691.38	698.19	166.1	-0.2355
2	735	733.29	732.49	732.55	733.46	735.19	737.71	741.03	745.11	749.9	755.33	761.31	767.75	168.9	-0.0929
3	805	803.29	802.52	802.64	803.63	805.4	807.87	810.94	814.51	818.49	822.82	827.41	832.2	174.5	0.0132
4	875	873.32	872.62	872.79	873.72	875.29	877.43	880.03	883.01	886.31	889.83	893.52	897.3	177.5	0.0528
5	945	943.32	942.62	942.79	943.72	945.29	947.43	950.03	953.01	956.31	959.83	963.52	967.3	177.5	0.0528
6	1015	1013.32	1012.62	1012.79	1013.72	1015.29	1017.43	1020.03	1023.01	1026.31	1029.83	1033.52	1037.3	177.5	0.0528
7	1085	1083.32	1082.62	1082.79	1083.72	1085.29	1087.43	1090.03	1093.01	1096.31	1099.83	1103.52	1107.3	177.5	0.0528
8	665	663.18	662.06	661.66	662.01	663.09	664.92	667.47	670.74	674.7	679.34	684.65	690.62	168	-0.2802
9	735	733.18	732.06	731.66	732.01	733.09	734.92	737.47	740.75	744.76	749.43	754.71	760.54	169.9	-0.1249
10	805	803.18	802.06	801.66	802.05	803.22	805.14	807.7	810.84	814.45	818.46	822.78	827.35	174.8	-0.0057
11	875	873.2	872.17	871.89	872.3	873.28	874.78	876.69	878.95	881.47	884.2	887.06	889.99	179.6	0.0639
12	945	943.21	942.19	941.9	942.26	943.18	944.59	946.39	948.53	950.92	953.5	956.19	958.93	-179.9	0.0695
13	1015	1013.21	1012.19	1011.9	1012.26	1013.18	1014.59	1016.39	1018.53	1020.92	1023.5	1026.19	1028.93	-179.9	0.0695
14	1085	1083.21	1082.19	1081.9	1082.26	1083.18	1084.59	1086.39	1088.53	1090.92	1093.5	1096.19	1098.93	-179.9	0.0695
15	665	663.07	661.64	660.77	660.52	660.92	661.98	663.72	666.12	669.18	672.9	677.26	682.25	170.5	-0.2803
16	735	733.07	731.64	730.77	730.52	730.92	731.98	733.72	736.12	739.18	742.92	747.33	752.35	171.2	-0.1869
17	805	803.07	801.64	800.77	800.52	800.94	802.08	803.88	806.32	809.3	812.74	816.56	820.68	175.4	-0.0287
18	875	873.07	871.69	870.95	870.82	871.21	872.07	873.31	874.86	876.65	878.61	880.68	882.78	-178.5	0.0731
19	945	943.1	941.77	941.01	940.77	940.98	941.59	942.52	943.7	945.07	946.55	948.09	949.61	-176.9	0.0913
20	1015	1013.1	1011.77	1011.01	1010.77	1010.98	1011.59	1012.52	1013.7	1015.07	1016.55	1018.09	1019.61	-176.9	0.0913
21	1085	1083.1	1081.77	1081.01	1080.77	1080.98	1081.59	1082.52	1083.7	1085.07	1086.55	1088.09	1089.61	-176.9	0.0913
22	665	662.96	661.22	659.88	659.01	658.68	658.93	659.78	661.24	663.31	666	669.3	673.21	173.2	-0.2703
23	735	732.96	731.22	729.88	729.01	728.68	728.93	729.78	731.24	733.31	736	739.3	743.23	173.3	-0.245
24	805	802.96	801.22	799.88	799.01	798.68	798.93	799.81	801.35	803.49	806.18	809.34	812.92	176	-0.0762
25	875	872.96	871.22	869.91	869.13	868.93	869.24	869.98	871.08	872.47	874.07	875.82	877.65	-178.1	0.0569
26	945	942.97	941.31	940.1	939.32	938.92	938.83	939	939.37	939.86	940.43	941	941.52	-174.5	0.1071
27	1015	1012.99	1011.35	1010.12	1009.26	1008.73	1008.49	1008.47	1008.6	1008.84	1009.11	1009.35	1009.5	-173.5	0.1179
28	1085	1082.99	1081.35	1080.12	1079.26	1078.73	1078.49	1078.47	1078.6	1078.84	1079.11	1079.35	1079.5	-173.5	0.1179
29	665	662.84	660.79	658.98	657.5	656.46	655.89	655.84	656.34	657.4	659.03	661.23	664.02	176	-0.2593
30	735	732.84	730.79	728.98	727.5	726.46	725.89	725.84	726.34	727.4	729.03	731.23	734.02	176	-0.2593
31	805	802.84	800.79	798.98	797.5	796.46	795.89	795.84	796.34	797.43	799.13	801.4	804.18	177.1	-0.1377
32	875	872.84	870.79	868.98	867.53	866.56	866.11	866.15	866.63	867.47	868.59	869.92	871.4	-177.7	0.0305
33	945	942.84	940.85	939.17	937.81	936.75	935.94	935.31	934.83	934.41	934.01	933.56	933	-171.9	0.1239
34	1015	1012.87	1010.93	1009.23	1007.79	1006.57	1005.53	1004.61	1003.77	1002.94	1002.07	1001.09	999.96	-170.4	0.1413
35	1085	1082.87	1080.92	1079.22	1077.75	1076.5	1075.42	1074.46	1073.56	1072.67	1071.73	1070.69	1069.47	-170.2	0.1435

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: +5 deg. **Input file: ROUTE145.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.3	662.51	662.6	663.54	665.29	667.84	671.16	675.21	679.98	685.45	691.59	698.4	166.3	-0.2301
2	735	733.3	732.51	732.6	733.54	735.29	737.84	741.19	745.29	750.1	755.54	761.53	767.97	169.1	-0.0847
3	805	803.3	802.54	802.69	803.7	805.51	808.01	811.1	814.69	818.69	823.02	827.6	832.36	174.8	0.0245
4	875	873.33	872.64	872.83	873.79	875.4	877.56	880.19	883.2	886.5	890.03	893.7	897.46	177.8	0.0643
5	945	943.33	942.64	942.83	943.79	945.4	947.56	950.19	953.2	956.5	960.03	963.7	967.46	177.8	0.0643
6	1015	1013.33	1012.64	1012.83	1013.79	1015.4	1017.56	1020.19	1023.2	1026.5	1030.03	1033.7	1037.46	177.8	0.0643
7	1085	1083.33	1082.64	1082.83	1083.79	1085.4	1087.56	1090.19	1093.2	1096.5	1100.03	1103.7	1107.46	177.8	0.0643
8	665	663.18	662.08	661.71	662.08	663.2	665.05	667.63	670.92	674.89	679.54	684.85	690.81	168.3	-0.2781
9	735	733.18	732.08	731.71	732.08	733.2	735.05	737.63	740.93	744.95	749.63	754.92	760.74	170.1	-0.1179
10	805	803.18	802.08	801.71	802.12	803.33	805.27	807.86	811.02	814.65	818.66	822.98	827.52	175	0.005
11	875	873.2	872.19	871.94	872.37	873.39	874.91	876.85	879.13	881.67	884.4	887.24	890.14	179.9	0.0753
12	945	943.21	942.21	941.95	942.33	943.29	944.72	946.55	948.71	951.11	953.69	956.37	959.08	-179.6	0.081
13	1015	1013.21	1012.21	1011.95	1012.33	1013.29	1014.72	1016.55	1018.71	1021.11	1023.69	1026.37	1029.08	-179.6	0.081
14	1085	1083.21	1082.21	1081.95	1082.33	1083.29	1084.72	1086.55	1088.71	1091.11	1093.69	1096.37	1099.08	-179.6	0.081
15	665	663.07	661.66	660.82	660.59	661.02	662.11	663.87	666.29	669.37	673.09	677.45	682.43	170.7	-0.2726
16	735	733.07	731.66	730.82	730.59	731.02	732.11	733.87	736.29	739.37	743.11	747.52	752.52	171.4	-0.1809
17	805	803.07	801.66	800.82	800.59	801.05	802.21	804.04	806.5	809.49	812.94	816.76	820.86	175.7	-0.0188
18	875	873.07	871.71	871	870.89	871.32	872.2	873.47	875.04	876.84	878.8	880.85	882.92	-178.2	0.0844
19	945	943.1	941.79	941.05	940.84	941.09	941.72	942.68	943.88	945.25	946.74	948.25	949.74	-176.6	0.1025
20	1015	1013.1	1011.79	1011.05	1010.84	1011.09	1011.72	1012.68	1013.88	1015.25	1016.74	1018.25	1019.74	-176.6	0.1025
21	1085	1083.1	1081.79	1081.05	1080.84	1081.09	1081.72	1082.68	1083.88	1085.25	1086.74	1088.25	1089.74	-176.6	0.1025
22	665	662.96	661.24	659.92	659.08	658.79	659.06	659.94	661.41	663.5	666.18	669.47	673.36	173.4	-0.2625
23	735	732.96	731.24	729.92	729.08	728.79	729.06	729.94	731.41	733.5	736.18	739.47	743.38	173.5	-0.2394
24	805	802.96	801.24	799.92	799.08	798.79	799.06	799.97	801.52	803.68	806.37	809.53	813.09	176.2	-0.0679
25	875	872.96	871.24	869.95	869.21	869.04	869.37	870.14	871.26	872.65	874.25	875.99	877.78	-177.8	0.0682
26	945	942.97	941.33	940.15	939.4	939.02	938.96	939.16	939.54	940.05	940.61	941.16	941.64	-174.2	0.1179
27	1015	1012.99	1011.37	1010.16	1009.33	1008.84	1008.62	1008.63	1008.78	1009.02	1009.29	1009.51	1009.63	-173.2	0.1285
28	1085	1082.99	1081.37	1080.16	1079.33	1078.84	1078.62	1078.63	1078.78	1079.02	1079.29	1079.51	1079.63	-173.2	0.1285
29	665	662.85	660.81	659.02	657.58	656.56	656.02	656	656.51	657.58	659.21	661.4	664.16	176.2	-0.2513
30	735	732.85	730.81	729.02	727.58	726.56	726.02	726	726.51	727.58	729.21	731.4	734.16	176.2	-0.2513
31	805	802.85	800.81	799.02	797.58	796.56	796.02	796	796.51	797.61	799.3	801.57	804.33	177.3	-0.1323
32	875	872.85	870.81	869.02	867.6	866.67	866.24	866.31	866.8	867.65	868.77	870.09	871.53	-177.4	0.0416
33	945	942.85	940.87	939.21	937.89	936.86	936.07	935.47	935	934.59	934.19	933.72	933.13	-171.6	0.1343
34	1015	1012.88	1010.95	1009.28	1007.87	1006.67	1005.66	1004.77	1003.94	1003.12	1002.25	1001.26	1000.09	-170.1	0.1512
35	1085	1082.88	1080.94	1079.26	1077.83	1076.61	1075.55	1074.62	1073.74	1072.86	1071.92	1070.85	1069.6	-169.9	0.1533

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: +5 deg. **Input file: ROUTE155.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.3	662.53	662.64	663.59	665.37	667.94	671.28	675.35	680.14	685.61	691.75	698.55	166.5	-0.2266
2	735	733.3	732.53	732.64	733.59	735.37	737.94	741.31	745.43	750.25	755.7	761.69	768.14	169.3	-0.0783
3	805	803.3	802.56	802.72	803.76	805.59	808.11	811.22	814.83	818.84	823.17	827.74	832.49	175	0.0331
4	875	873.34	872.66	872.87	873.85	875.48	877.67	880.32	883.34	886.65	890.18	893.84	897.57	178	0.073
5	945	943.34	942.66	942.87	943.85	945.48	947.67	950.32	953.34	956.65	960.18	963.84	967.57	178	0.073
6	1015	1013.34	1012.66	1012.87	1013.85	1015.48	1017.67	1020.32	1023.34	1026.65	1030.18	1033.84	1037.57	178	0.073
7	1085	1083.34	1082.66	1082.87	1083.85	1085.48	1087.67	1090.31	1093.34	1096.65	1100.18	1103.84	1107.57	178	0.073
8	665	663.19	662.1	661.75	662.14	663.28	665.15	667.75	671.05	675.04	679.7	685	690.95	168.4	-0.2748
9	735	733.19	732.1	731.75	732.14	733.28	735.15	737.75	741.07	745.1	749.78	755.05	760.85	170.2	-0.1179
10	805	803.19	802.1	801.75	802.18	803.41	805.37	807.99	811.16	814.79	818.81	823.12	827.64	175.3	0.0134
11	875	873.21	872.2	871.97	872.43	873.47	875.01	876.97	879.26	881.81	884.54	887.38	890.25	-179.9	0.084
12	945	943.22	942.23	941.98	942.39	943.36	944.82	946.68	948.85	951.26	953.83	956.5	959.18	-179.4	0.0896
13	1015	1013.22	1012.23	1011.98	1012.39	1013.36	1014.82	1016.68	1018.85	1021.26	1023.83	1026.5	1029.18	-179.4	0.0896
14	1085	1083.22	1082.23	1081.98	1082.39	1083.36	1084.82	1086.68	1088.85	1091.26	1093.83	1096.5	1099.18	-179.4	0.0896
15	665	663.08	661.68	660.85	660.65	661.1	662.21	663.99	666.43	669.51	673.24	677.59	682.56	170.9	-0.2668
16	735	733.08	731.68	730.85	730.65	731.1	732.21	733.99	736.43	739.51	743.26	747.66	752.66	171.5	-0.1741
17	805	803.08	801.68	800.85	800.65	801.13	802.31	804.16	806.62	809.62	813.07	816.89	820.99	175.8	-0.0154
18	875	873.08	871.73	871.03	870.95	871.4	872.3	873.59	875.17	876.98	878.94	880.98	883.02	-177.9	0.0929
19	945	943.11	941.81	941.09	940.9	941.17	941.83	942.8	944.01	945.39	946.87	948.38	949.84	-176.4	0.1108
20	1015	1013.11	1011.81	1011.09	1010.9	1011.17	1011.83	1012.8	1014.01	1015.39	1016.87	1018.38	1019.84	-176.4	0.1108
21	1085	1083.11	1081.81	1081.09	1080.9	1081.17	1081.83	1082.8	1084.01	1085.39	1086.87	1088.38	1089.84	-176.4	0.1108
22	665	662.97	661.26	659.96	659.14	658.87	659.16	660.05	661.54	663.64	666.33	669.61	673.48	173.6	-0.2565
23	735	732.97	731.26	729.96	729.14	728.87	729.16	730.05	731.54	733.64	736.33	739.61	743.5	173.7	-0.2356
24	805	802.97	801.26	799.96	799.14	798.87	799.16	800.08	801.65	803.82	806.51	809.67	813.23	176.4	-0.0615
25	875	872.97	871.26	869.99	869.27	869.12	869.47	870.26	871.39	872.79	874.39	876.11	877.88	-177.6	0.0767
26	945	942.98	941.35	940.18	939.45	939.1	939.06	939.28	939.68	940.19	940.75	941.29	941.73	-173.9	0.126
27	1015	1013	1011.39	1010.2	1009.39	1008.92	1008.72	1008.75	1008.91	1009.16	1009.43	1009.63	1009.72	-173	0.1364
28	1085	1083	1081.39	1080.2	1079.39	1078.92	1078.72	1078.75	1078.91	1079.16	1079.43	1079.63	1079.72	-173	0.1364
29	665	662.85	660.83	659.06	657.63	656.64	656.12	656.11	656.64	657.72	659.34	661.53	664.27	176.4	-0.2453
30	735	732.85	730.83	729.06	727.63	726.64	726.12	726.11	726.64	727.72	729.34	731.53	734.27	176.4	-0.2453
31	805	802.85	800.83	799.06	797.63	796.64	796.12	796.11	796.64	797.74	799.44	801.69	804.44	177.5	-0.1284
32	875	872.85	870.83	869.06	867.66	866.74	866.34	866.43	866.94	867.79	868.91	870.22	871.64	-177.2	0.0499
33	945	942.85	940.89	939.25	937.94	936.93	936.17	935.59	935.13	934.73	934.33	933.84	933.22	-171.3	0.142
34	1015	1012.88	1010.96	1009.31	1007.92	1006.75	1005.76	1004.89	1004.08	1003.27	1002.39	1001.38	1000.19	-169.8	0.1586
35	1085	1082.88	1080.96	1079.3	1077.88	1076.68	1075.65	1074.74	1073.87	1073	1072.05	1070.98	1069.7	-169.7	0.1606

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: +10 deg. **Input file: ROUTE116.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.12	658.11	655.95	654.62	654.11	654.39	655.45	657.27	659.84	663.13	667.13	671.83	170.3	-0.3124
2	735	731.12	728.11	725.95	724.62	724.11	724.39	725.45	727.27	729.84	733.14	737.18	741.9	170.9	-0.2285
3	805	801.12	798.11	795.95	794.62	794.13	794.48	795.61	797.46	799.95	803.01	806.56	810.52	174.7	-0.0853
4	875	871.14	868.22	866.18	864.93	864.37	864.4	864.94	865.91	867.24	868.85	870.68	872.68	-179.3	0.0112
5	945	941.15	938.24	936.18	934.85	934.16	934.02	934.35	935.06	936.09	937.37	938.84	940.44	-178.2	0.0253
6	1015	1011.15	1008.24	1006.18	1004.85	1004.16	1004.02	1004.35	1005.06	1006.09	1007.37	1008.84	1010.44	-178.2	0.0253
7	1085	1081.15	1078.24	1076.18	1074.85	1074.16	1074.02	1074.35	1075.06	1076.09	1077.37	1078.84	1080.44	-178.2	0.0253
8	665	661	657.68	655.05	653.14	651.98	651.55	651.85	652.89	654.64	657.1	660.25	664.09	172.5	-0.3068
9	735	731	727.68	725.05	723.14	721.98	721.55	721.85	722.89	724.64	727.1	730.25	734.12	172.6	-0.2805
10	805	801	797.68	795.05	793.14	791.98	791.55	791.88	792.99	794.82	797.28	800.32	803.86	175.2	-0.1192
11	875	871	867.71	865.16	863.37	862.3	861.87	862	862.59	863.58	864.9	866.47	868.25	-179	-0.0032
12	945	941.03	937.8	935.27	933.37	932.01	931.13	930.65	930.5	930.61	930.93	931.39	931.93	-175.6	0.042
13	1015	1011.03	1007.8	1005.27	1003.37	1002.01	1001.13	1000.65	1000.5	1000.61	1000.93	1001.39	1001.93	-175.6	0.042
14	1085	1081.03	1077.8	1075.27	1073.37	1072.01	1071.13	1070.65	1070.5	1070.61	1070.93	1071.39	1071.93	-175.6	0.042
15	665	660.89	657.25	654.14	651.63	649.76	648.56	648.03	648.18	649.01	650.52	652.71	655.56	174.9	-0.2992
16	735	730.89	727.25	724.14	721.63	719.76	718.56	718.03	718.18	719.01	720.52	722.71	725.56	174.9	-0.2992
17	805	800.89	797.25	794.14	791.63	789.76	788.56	788.03	788.18	789.04	790.63	792.88	795.73	176.1	-0.1728
18	875	870.89	867.25	864.14	861.67	859.9	858.81	858.35	858.43	858.98	859.93	861.2	862.72	-178.7	-0.026
19	945	940.9	937.34	934.37	931.95	929.99	928.46	927.27	926.38	925.7	925.2	924.8	924.45	-173.5	0.0543
20	1015	1010.92	1007.37	1004.37	1001.86	999.78	998.09	996.71	995.59	994.67	993.88	993.18	992.49	-172.6	0.0645
21	1085	1080.92	1077.37	1074.37	1071.86	1069.78	1068.09	1066.71	1065.6	1064.67	1063.88	1063.18	1062.49	-172.6	0.0645
22	665	660.78	656.82	653.23	650.1	647.5	645.46	644.03	643.23	643.05	643.51	644.61	646.36	177.6	-0.2894
23	735	730.78	726.82	723.23	720.1	717.5	715.46	714.03	713.23	713.05	713.51	714.61	716.36	177.6	-0.2894
24	805	800.78	796.82	793.23	790.1	787.5	785.46	784.03	783.23	783.05	783.51	784.64	786.45	177.9	-0.2366
25	875	870.78	866.82	863.23	860.1	857.52	855.57	854.25	853.54	853.38	853.68	854.41	855.48	-178.2	-0.062
26	945	940.78	936.86	933.38	930.35	927.73	925.46	923.49	921.76	920.21	918.78	917.41	916.05	-171.1	0.0523
27	1015	1010.81	1006.96	1003.5	1000.39	997.6	995.09	992.8	990.69	988.69	986.76	984.83	982.85	-169.4	0.0897
28	1085	1080.81	1076.95	1073.46	1070.33	1067.51	1064.95	1062.62	1060.44	1058.38	1056.37	1054.37	1052.3	-169.2	0.0922
29	665	660.66	656.39	652.32	648.58	645.24	642.39	640.05	638.27	637.07	636.46	636.45	637.05	-179.6	-0.2786
30	735	730.66	726.39	722.32	718.58	715.24	712.39	710.05	708.27	707.07	706.46	706.45	707.05	-179.6	-0.2786
31	805	800.66	796.39	792.32	788.58	785.24	782.39	780.05	778.27	777.07	776.46	776.45	777.05	-179.6	-0.2786
32	875	870.66	866.39	862.32	858.58	855.24	852.39	850.08	848.38	847.28	846.75	846.74	847.19	-177.5	-0.1269
33	945	940.66	936.39	932.36	928.72	925.54	922.8	920.47	918.47	916.74	915.22	913.84	912.57	-171.6	0.0359
34	1015	1010.67	1006.49	1002.57	998.9	995.48	992.25	989.18	986.21	983.29	980.38	977.43	974.37	-166.8	0.1086
35	1085	1080.69	1076.52	1072.55	1068.81	1065.25	1061.86	1058.58	1055.37	1052.18	1048.96	1045.66	1042.23	-165.8	0.1195

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: +10 deg. **Input file: ROUTE126.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.13	658.15	656.03	654.75	654.29	654.62	655.73	657.59	660.18	663.49	667.49	672.17	170.7	-0.2997
2	735	731.13	728.15	726.03	724.75	724.29	724.62	725.73	727.59	730.18	733.5	737.53	742.23	171.2	-0.2209
3	805	801.13	798.15	796.03	794.75	794.31	794.71	795.89	797.78	800.3	803.38	806.93	810.88	175.1	-0.0698
4	875	871.15	868.26	866.26	865.06	864.55	864.64	865.22	866.23	867.58	869.2	871.02	872.97	-178.8	0.0303
5	945	941.16	938.28	936.25	934.98	934.34	934.26	934.63	935.38	936.43	937.71	939.16	940.71	-177.7	0.0447
6	1015	1011.16	1008.28	1006.25	1004.98	1004.34	1004.26	1004.63	1005.38	1006.43	1007.71	1009.16	1010.71	-177.7	0.0447
7	1085	1081.16	1078.28	1076.25	1074.98	1074.34	1074.26	1074.63	1075.38	1076.43	1077.71	1079.16	1080.71	-177.7	0.0447
8	665	661.01	657.71	655.13	653.27	652.15	651.77	652.13	653.2	654.97	657.44	660.59	664.41	172.9	-0.294
9	735	731.01	727.71	725.13	723.27	722.15	721.77	722.13	723.2	724.97	727.44	730.59	734.43	172.9	-0.271
10	805	801.01	797.71	795.13	793.27	792.15	791.77	792.16	793.3	795.15	797.62	800.65	804.18	175.5	-0.1095
11	875	871.01	867.74	865.24	863.5	862.48	862.1	862.27	862.9	863.91	865.23	866.79	868.51	-178.5	0.0157
12	945	941.04	937.84	935.35	933.5	932.19	931.36	930.92	930.81	930.94	931.26	931.7	932.19	-175.1	0.0612
13	1015	1011.04	1007.84	1005.35	1003.5	1002.19	1001.36	1000.92	1000.81	1000.94	1001.26	1001.7	1002.19	-175.1	0.0612
14	1085	1081.04	1077.84	1075.35	1073.5	1072.19	1071.36	1070.92	1070.81	1070.94	1071.26	1071.7	1072.19	-175.1	0.0612
15	665	660.9	657.29	654.22	651.76	649.94	648.78	648.3	648.48	649.34	650.86	653.03	655.86	175.3	-0.2863
16	735	730.9	727.29	724.22	721.76	719.94	718.78	718.3	718.48	719.34	720.86	723.03	725.86	175.3	-0.2863
17	805	800.9	797.29	794.22	791.76	789.94	788.78	788.3	788.48	789.37	790.96	793.2	796.02	176.5	-0.1676
18	875	870.9	867.29	864.22	861.8	860.08	859.04	858.62	858.73	859.32	860.28	861.56	863.08	-178.4	-0.0121
19	945	940.91	937.38	934.45	932.07	930.17	928.69	927.55	926.69	926.03	925.53	925.1	924.7	-173	0.0733
20	1015	1010.93	1007.41	1004.45	1001.98	999.96	998.32	996.99	995.9	995	994.21	993.48	992.74	-172.1	0.0833
21	1085	1080.93	1077.41	1074.45	1071.98	1069.96	1068.32	1066.99	1065.9	1065	1064.21	1063.48	1062.74	-172.1	0.0833
22	665	660.79	656.86	653.31	650.23	647.67	645.69	644.3	643.52	643.37	643.83	644.92	646.63	178	-0.2765
23	735	730.79	726.86	723.31	720.23	717.67	715.69	714.3	713.52	713.37	713.83	714.92	716.63	178	-0.2765
24	805	800.79	796.86	793.31	790.23	787.67	785.69	784.3	783.52	783.37	783.83	784.94	786.71	178.3	-0.2303
25	875	870.79	866.86	863.31	860.23	857.7	855.79	854.52	853.84	853.7	854.01	854.73	855.79	-177.9	-0.0557
26	945	940.79	936.9	933.47	930.48	927.91	925.69	923.75	922.04	920.49	919.05	917.63	916.18	-170.6	0.059
27	1015	1010.82	1007	1003.57	1000.52	997.78	995.32	993.08	991	989.02	987.08	985.13	983.09	-168.9	0.1079
28	1085	1080.82	1076.99	1073.54	1070.46	1067.69	1065.18	1062.89	1060.75	1058.71	1056.7	1054.66	1052.55	-168.7	0.1103
29	665	660.67	656.43	652.4	648.7	645.42	642.61	640.32	638.57	637.38	636.77	636.74	637.31	-179.2	-0.2656
30	735	730.67	726.43	722.4	718.7	715.42	712.61	710.32	708.57	707.38	706.77	706.74	707.31	-179.2	-0.2656
31	805	800.67	796.43	792.4	788.7	785.42	782.61	780.32	778.57	777.38	776.77	776.74	777.31	-179.2	-0.2656
32	875	870.67	866.43	862.4	858.7	855.42	852.61	850.32	848.62	847.53	847.01	847.02	847.47	-177.3	-0.1164
33	945	940.67	936.43	932.44	928.85	925.72	923.03	920.74	918.77	917.06	915.53	914.13	912.8	-171.1	0.0388
34	1015	1010.68	1006.53	1002.65	999.03	995.66	992.48	989.45	986.52	983.62	980.71	977.73	974.62	-166.3	0.126
35	1085	1080.7	1076.56	1072.63	1068.94	1065.43	1062.09	1058.86	1055.68	1052.51	1049.29	1045.97	1042.48	-165.3	0.1365

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: +10 deg. **Input file: ROUTE136.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.13	658.17	656.07	654.81	654.37	654.73	655.86	657.74	660.34	663.66	667.66	672.33	170.9	-0.2936
2	735	731.13	728.17	726.07	724.81	724.37	724.73	725.86	727.74	730.34	733.67	737.69	742.39	171.4	-0.2173
3	805	801.13	798.17	796.07	794.81	794.39	794.81	796.02	797.93	800.45	803.53	807.08	811.02	175.2	-0.0665
4	875	871.15	868.27	866.3	865.12	864.63	864.72	865.31	866.3	867.61	869.18	870.94	872.81	-178.4	0.0425
5	945	941.16	938.29	936.29	935.04	934.43	934.37	934.76	935.52	936.59	937.88	939.32	940.84	-177.4	0.0539
6	1015	1011.16	1008.29	1006.29	1005.04	1004.43	1004.37	1004.76	1005.52	1006.59	1007.88	1009.32	1010.84	-177.4	0.0539
7	1085	1081.16	1078.29	1076.29	1075.04	1074.43	1074.37	1074.76	1075.52	1076.59	1077.88	1079.32	1080.84	-177.4	0.0539
8	665	661.01	657.73	655.16	653.33	652.24	651.88	652.25	653.34	655.13	657.61	660.76	664.57	173.1	-0.2879
9	735	731.01	727.73	725.16	723.33	722.24	721.88	722.25	723.34	725.13	727.61	730.76	734.58	173.1	-0.267
10	805	801.01	797.73	795.16	793.33	792.24	791.88	792.28	793.44	795.3	797.79	800.82	804.34	175.7	-0.103
11	875	871.01	867.76	865.28	863.56	862.57	862.21	862.4	863.05	864.07	865.39	866.93	868.64	-178.2	0.0248
12	945	941.05	937.86	935.39	933.56	932.28	931.47	931.06	930.96	931.1	931.42	931.84	932.31	-174.9	0.0703
13	1015	1011.05	1007.86	1005.39	1003.56	1002.28	1001.47	1001.06	1000.96	1001.1	1001.42	1001.84	1002.31	-174.9	0.0703
14	1085	1081.05	1077.86	1075.39	1073.56	1072.28	1071.47	1071.06	1070.96	1071.1	1071.42	1071.84	1072.31	-174.9	0.0703
15	665	660.9	657.3	654.26	651.82	650.02	648.89	648.43	648.63	649.49	651.01	653.18	656	175.5	-0.2801
16	735	730.9	727.3	724.26	721.82	720.02	718.89	718.43	718.63	719.49	721.01	723.18	726	175.5	-0.2801
17	805	800.9	797.3	794.26	791.82	790.02	788.89	788.43	788.63	789.52	791.11	793.35	796.16	176.6	-0.1627
18	875	870.9	867.3	864.26	861.86	860.16	859.15	858.75	858.88	859.48	860.45	861.72	863.22	-178.2	-0.0036
19	945	940.91	937.4	934.49	932.13	930.26	928.8	927.68	926.83	926.19	925.68	925.25	924.82	-172.7	0.0822
20	1015	1010.93	1007.43	1004.48	1002.05	1000.05	998.43	997.12	996.05	995.16	994.37	993.62	992.85	-171.9	0.0922
21	1085	1080.93	1077.43	1074.48	1072.04	1070.05	1068.43	1067.12	1066.05	1065.16	1064.37	1063.62	1062.85	-171.9	0.0922
22	665	660.79	656.88	653.35	650.29	647.76	645.8	644.43	643.67	643.52	643.98	645.07	646.76	178.2	-0.2703
23	735	730.79	726.88	723.35	720.29	717.76	715.8	714.43	713.67	713.52	713.98	715.07	716.76	178.2	-0.2703
24	805	800.79	796.88	793.35	790.29	787.76	785.8	784.43	783.67	783.52	783.98	785.09	786.83	178.4	-0.2273
25	875	870.79	866.88	863.35	860.29	857.78	855.9	854.65	853.99	853.85	854.17	854.88	855.92	-177.8	-0.0586
26	945	940.79	936.92	933.51	930.55	927.99	925.79	923.87	922.17	920.63	919.18	917.74	916.28	-170.5	0.0588
27	1015	1010.82	1007.02	1003.61	1000.58	997.87	995.43	993.21	991.15	989.18	987.24	985.27	983.21	-168.7	0.1163
28	1085	1080.82	1077.01	1073.58	1070.52	1067.77	1065.29	1063.02	1060.9	1058.87	1056.85	1054.81	1052.66	-168.5	0.1187
29	665	660.68	656.45	652.44	648.76	645.51	642.72	640.45	638.71	637.53	636.92	636.88	637.43	-179	-0.2593
30	735	730.68	726.45	722.44	718.76	715.51	712.72	710.45	708.71	707.53	706.92	706.88	707.43	-179	-0.2593
31	805	800.68	796.45	792.44	788.76	785.51	782.72	780.45	778.71	777.53	776.92	776.88	777.43	-179	-0.2593
32	875	870.68	866.45	862.44	858.76	855.51	852.72	850.45	848.76	847.68	847.16	847.16	847.61	-177.1	-0.1119
33	945	940.68	936.45	932.47	928.91	925.8	923.09	920.72	918.63	916.75	915	913.32	911.66	-170.4	0.0293
34	1015	1010.69	1006.55	1002.68	999.09	995.75	992.59	989.59	986.67	983.78	980.87	977.87	974.74	-166	0.1341
35	1085	1080.71	1076.57	1072.67	1069	1065.52	1062.2	1058.99	1055.83	1052.67	1049.45	1046.11	1042.61	-165.1	0.1443

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: +10 deg. **Input file: ROUTE146.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.14	658.19	656.11	654.88	654.47	654.86	656.01	657.92	660.54	663.86	667.86	672.53	171.1	-0.2863
2	735	731.14	728.19	726.11	724.88	724.47	724.86	726.01	727.92	730.54	733.87	737.91	742.63	171.5	-0.2159
3	805	801.14	798.19	796.11	794.88	794.49	794.94	796.18	798.11	800.65	803.74	807.29	811.22	175.4	-0.0576
4	875	871.16	868.3	866.34	865.19	864.73	864.85	865.46	866.48	867.81	869.38	871.13	872.97	-178.1	0.0535
5	945	941.17	938.32	936.34	935.11	934.53	934.5	934.92	935.7	936.78	938.07	939.5	941	-177.2	0.0648
6	1015	1011.17	1008.32	1006.34	1005.11	1004.53	1004.5	1004.92	1005.7	1006.78	1008.07	1009.5	1011	-177.2	0.0648
7	1085	1081.17	1078.32	1076.34	1075.11	1074.53	1074.5	1074.92	1075.7	1076.78	1078.07	1079.5	1081	-177.2	0.0648
8	665	661.02	657.75	655.21	653.4	652.34	652.01	652.41	653.52	655.32	657.8	660.95	664.75	173.3	-0.2806
9	735	731.02	727.75	725.21	723.4	722.34	722.01	722.41	723.52	725.32	727.8	730.95	734.76	173.3	-0.2621
10	805	801.02	797.75	795.21	793.4	792.34	792.01	792.44	793.62	795.49	797.98	801.02	804.54	175.9	-0.0953
11	875	871.02	867.78	865.32	863.64	862.67	862.34	862.56	863.22	864.26	865.58	867.11	868.79	-177.9	0.0357
12	945	941.05	937.88	935.43	933.63	932.38	931.6	931.21	931.13	931.29	931.61	932.02	932.46	-174.6	0.0811
13	1015	1011.05	1007.88	1005.43	1003.63	1002.38	1001.6	1001.21	1001.13	1001.29	1001.61	1002.02	1002.46	-174.6	0.0811
14	1085	1081.05	1077.88	1075.43	1073.63	1072.38	1071.6	1071.21	1071.13	1071.29	1071.61	1072.02	1072.46	-174.6	0.0811
15	665	660.91	657.33	654.3	651.89	650.12	649.02	648.58	648.8	649.68	651.2	653.37	656.16	175.7	-0.2727
16	735	730.91	727.33	724.3	721.89	720.12	719.02	718.58	718.8	719.68	721.2	723.37	726.16	175.7	-0.2727
17	805	800.91	797.33	794.3	791.89	790.12	789.02	788.58	788.8	789.7	791.3	793.53	796.33	176.8	-0.1576
18	875	870.91	867.33	864.3	861.93	860.27	859.28	858.9	859.06	859.67	860.64	861.91	863.38	-177.9	0.0066
19	945	940.92	937.42	934.54	932.21	930.36	928.93	927.84	927.01	926.38	925.87	925.42	924.96	-172.4	0.0928
20	1015	1010.94	1007.45	1004.53	1002.12	1000.15	998.56	997.28	996.23	995.34	994.55	993.79	993	-171.6	0.1026
21	1085	1080.94	1077.45	1074.53	1072.12	1070.15	1068.56	1067.28	1066.23	1065.34	1064.55	1063.79	1063	-171.6	0.1026
22	665	660.8	656.9	653.39	650.36	647.86	645.92	644.58	643.84	643.7	644.17	645.24	646.92	178.5	-0.2628
23	735	730.8	726.9	723.39	720.36	717.86	715.92	714.58	713.84	713.7	714.17	715.24	716.92	178.5	-0.2628
24	805	800.8	796.9	793.39	790.36	787.86	785.92	784.58	783.84	783.7	784.17	785.26	786.98	178.6	-0.2237
25	875	870.8	866.9	863.39	860.36	857.88	856.03	854.8	854.16	854.04	854.37	855.07	856.1	-177.6	-0.0608
26	945	940.8	936.95	933.55	930.62	928.1	925.92	924.02	922.33	920.79	919.33	917.87	916.35	-170.2	0.0629
27	1015	1010.83	1007.04	1003.66	1000.65	997.97	995.56	993.37	991.33	989.37	987.43	985.44	983.35	-168.4	0.1263
28	1085	1080.83	1077.03	1073.62	1070.59	1067.87	1065.43	1063.18	1061.08	1059.05	1057.04	1054.98	1052.8	-168.2	0.1287
29	665	660.68	656.47	652.48	648.84	645.61	642.85	640.6	638.88	637.71	637.1	637.05	637.57	-178.8	-0.2519
30	735	730.68	726.47	722.48	718.84	715.61	712.85	710.6	708.88	707.71	707.1	707.05	707.57	-178.8	-0.2519
31	805	800.68	796.47	792.48	788.84	785.61	782.85	780.6	778.88	777.71	777.1	777.05	777.57	-178.8	-0.2519
32	875	870.68	866.47	862.48	858.84	855.61	852.85	850.6	848.93	847.85	847.34	847.34	847.77	-177	-0.1069
33	945	940.68	936.47	932.52	928.98	925.9	923.22	920.88	918.8	916.93	915.18	913.49	911.81	-170.2	0.0309
34	1015	1010.69	1006.57	1002.73	999.17	995.85	992.72	989.74	986.85	983.97	981.06	978.05	974.88	-165.8	0.1436
35	1085	1080.71	1076.6	1072.72	1069.07	1065.62	1062.33	1059.15	1056.01	1052.86	1049.64	1046.29	1042.76	-164.8	0.1536

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: +10 deg. **Input file: ROUTE156.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.14	658.21	656.15	654.93	654.55	654.96	656.13	658.05	660.69	664.01	668.02	672.67	171.3	-0.2807
2	735	731.14	728.21	726.15	724.93	724.55	724.96	726.13	728.05	730.69	734.02	738.05	742.76	171.7	-0.2133
3	805	801.14	798.21	796.15	794.93	794.57	795.04	796.29	798.24	800.8	803.9	807.45	811.38	175.6	-0.0507
4	875	871.16	868.31	866.38	865.25	864.81	864.95	865.59	866.61	867.96	869.53	871.27	873.1	-177.9	0.0617
5	945	941.17	938.33	936.37	935.17	934.61	934.6	935.04	935.84	936.93	938.22	939.64	941.11	-176.9	0.073
6	1015	1011.17	1008.33	1006.37	1005.17	1004.61	1004.6	1005.04	1005.84	1006.93	1008.22	1009.64	1011.11	-176.9	0.073
7	1085	1081.17	1078.33	1076.37	1075.17	1074.61	1074.6	1075.04	1075.84	1076.93	1078.22	1079.64	1081.11	-176.9	0.073
8	665	661.02	657.77	655.24	653.46	652.41	652.11	652.53	653.65	655.47	657.95	661.1	664.88	173.5	-0.2749
9	735	731.02	727.77	725.24	723.46	722.41	722.11	722.53	723.65	725.47	727.95	731.1	734.89	173.5	-0.2584
10	805	801.02	797.77	795.24	793.46	792.41	792.11	792.55	793.75	795.64	798.13	801.16	804.66	176	-0.0951
11	875	871.02	867.8	865.36	863.69	862.75	862.44	862.68	863.36	864.4	865.72	867.25	868.91	-177.7	0.0439
12	945	941.06	937.9	935.47	933.68	932.46	931.7	931.33	931.27	931.43	931.75	932.16	932.57	-174.4	0.0892
13	1015	1011.06	1007.9	1005.47	1003.68	1002.46	1001.7	1001.33	1001.27	1001.43	1001.75	1002.16	1002.57	-174.4	0.0892
14	1085	1081.06	1077.9	1075.47	1073.68	1072.46	1071.7	1071.33	1071.27	1071.43	1071.75	1072.16	1072.57	-174.4	0.0892
15	665	660.91	657.34	654.33	651.94	650.2	649.12	648.69	648.93	649.82	651.35	653.51	656.29	175.9	-0.2671
16	735	730.91	727.34	724.33	721.94	720.2	719.12	718.69	718.93	719.82	721.35	723.51	726.29	175.9	-0.2671
17	805	800.91	797.34	794.33	791.94	790.2	789.12	788.69	788.93	789.84	791.44	793.67	796.45	177	-0.1538
18	875	870.91	867.34	864.33	861.98	860.34	859.38	859.02	859.19	859.81	860.79	862.05	863.51	-177.7	0.0143
19	945	940.92	937.44	934.57	932.26	930.44	929.03	927.95	927.14	926.52	926.02	925.56	925.07	-172.2	0.1007
20	1015	1010.94	1007.47	1004.56	1002.17	1000.23	998.66	997.4	996.36	995.48	994.7	993.93	993.1	-171.4	0.1105
21	1085	1080.94	1077.47	1074.56	1072.17	1070.23	1068.66	1067.4	1066.36	1065.49	1064.7	1063.93	1063.1	-171.4	0.1105
22	665	660.8	656.92	653.43	650.41	647.93	646.02	644.7	643.97	643.84	644.31	645.37	647.03	178.6	-0.2571
23	735	730.8	726.92	723.43	720.41	717.93	716.02	714.7	713.97	713.84	714.31	715.37	717.03	178.6	-0.2571
24	805	800.8	796.92	793.43	790.41	787.93	786.02	784.7	783.97	783.84	784.31	785.38	787.08	178.7	-0.2253
25	875	870.8	866.92	863.43	860.41	857.96	856.13	854.91	854.29	854.18	854.51	855.22	856.23	-177.4	-0.0542
26	945	940.8	936.96	933.59	930.68	928.17	926.01	924.13	922.46	920.92	919.45	917.96	916.41	-170	0.0645
27	1015	1010.83	1007.06	1003.69	1000.7	998.05	995.66	993.49	991.46	989.51	987.57	985.57	983.46	-168.2	0.1338
28	1085	1080.83	1077.04	1073.66	1070.64	1067.95	1065.52	1063.3	1061.21	1059.2	1057.18	1055.11	1052.91	-168	0.1361
29	665	660.69	656.48	652.52	648.89	645.68	642.94	640.71	639.01	637.85	637.23	637.18	637.68	-178.6	-0.2461
30	735	730.69	726.48	722.52	718.89	715.68	712.94	710.71	709.01	707.85	707.23	707.18	707.68	-178.6	-0.2461
31	805	800.69	796.48	792.52	788.89	785.68	782.94	780.71	779.01	777.85	777.23	777.18	777.68	-178.6	-0.2461
32	875	870.69	866.48	862.52	858.89	855.68	852.94	850.72	849.05	847.98	847.47	847.46	847.89	-176.8	-0.1028
33	945	940.69	936.48	932.55	929.04	925.97	923.32	920.99	918.94	917.07	915.32	913.63	911.95	-170	0.0342
34	1015	1010.7	1006.58	1002.76	999.22	995.93	992.82	989.86	986.98	984.11	981.2	978.18	974.99	-165.6	0.1507
35	1085	1080.72	1076.61	1072.75	1069.13	1065.7	1062.43	1059.27	1056.15	1053.01	1049.79	1046.43	1042.88	-164.6	0.1605

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 0% Heading: +15 deg. **Input file: ROUTE117.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.98	653.84	649.52	646.02	643.33	641.44	640.31	639.95	640.32	641.43	643.25	645.77	175.5	-0.3113
2	735	728.98	723.84	719.52	716.02	713.33	711.44	710.31	709.95	710.32	711.43	713.25	715.77	175.5	-0.3113
3	805	798.98	793.84	789.52	786.02	783.33	781.44	780.31	779.95	780.33	781.48	783.38	785.94	176.3	-0.2127
4	875	868.98	863.84	859.53	856.08	853.5	851.71	850.63	850.18	850.28	850.86	851.84	853.15	-178.7	-0.0585
5	945	939.01	933.96	929.73	926.23	923.34	920.99	919.08	917.55	916.32	915.32	914.49	913.78	-173	0.0287
6	1015	1009.01	1003.96	999.73	996.23	993.34	990.99	989.08	987.55	986.32	985.32	984.49	983.78	-173	0.0287
7	1085	1079.01	1073.96	1069.73	1066.23	1063.34	1060.99	1059.08	1057.55	1056.32	1055.32	1054.49	1053.78	-173	0.0287
8	665	658.87	653.4	648.61	644.53	641.18	638.56	636.66	635.49	635.04	635.28	636.23	637.87	177.6	-0.3056
9	735	728.87	723.4	718.61	714.53	711.18	708.56	706.66	705.49	705.04	705.28	706.23	707.87	177.6	-0.3056
10	805	798.87	793.4	788.61	784.53	781.18	778.56	776.66	775.49	775.04	775.28	776.25	777.93	177.8	-0.2627
11	875	868.87	863.4	858.61	854.53	851.21	848.67	846.89	845.81	845.36	845.46	846.05	847.07	-178.5	-0.0965
12	945	938.88	933.5	928.85	924.85	921.41	918.46	915.92	913.73	911.81	910.1	908.53	907.04	-171.3	0.0116
13	1015	1008.9	1003.52	998.82	994.73	991.17	988.07	985.34	982.93	980.77	978.8	976.95	975.16	-170.4	0.0456
14	1085	1078.9	1073.52	1068.82	1064.73	1061.17	1058.07	1055.34	1052.93	1050.77	1048.8	1046.95	1045.16	-170.4	0.0456
15	665	658.75	652.97	647.7	643.01	638.95	635.54	632.79	630.72	629.33	628.6	628.55	629.17	-179.9	-0.2978
16	735	728.75	722.97	717.7	713.01	708.95	705.54	702.79	700.72	699.33	698.6	698.55	699.17	-179.9	-0.2978
17	805	798.75	792.97	787.7	783.01	778.95	775.54	772.79	770.72	769.33	768.6	768.55	769.17	-179.9	-0.2978
18	875	868.75	862.97	857.7	853.01	848.95	845.54	842.8	840.77	839.47	838.84	838.81	839.32	-178.1	-0.1542
19	945	938.75	933	927.84	923.3	919.4	916.06	913.22	910.81	908.74	906.96	905.4	903.99	-171.6	-0.0001
20	1015	1008.79	1003.11	997.96	993.29	989.05	985.17	981.6	978.27	975.12	972.11	969.16	966.22	-167.6	0.066
21	1085	1078.78	1073.09	1067.91	1063.21	1058.93	1055	1051.38	1047.99	1044.78	1041.69	1038.67	1035.65	-167.4	0.0683
22	665	658.64	652.54	646.78	641.47	636.67	632.42	628.77	625.72	623.3	621.51	620.35	619.83	-177.2	-0.2879
23	735	728.64	722.54	716.78	711.47	706.67	702.42	698.77	695.72	693.3	691.51	690.35	689.83	-177.2	-0.2879
24	805	798.64	792.54	786.78	781.47	776.67	772.42	768.77	765.72	763.3	761.51	760.35	759.83	-177.2	-0.2879
25	875	868.64	862.54	856.78	851.47	846.67	842.42	838.77	835.72	833.3	831.53	830.45	830.03	-176.8	-0.2185
26	945	938.64	932.54	926.78	921.51	916.83	912.74	909.23	906.22	903.66	901.49	899.65	898.1	-171.8	-0.0631
27	1015	1008.66	1002.64	997.03	991.8	986.9	982.29	977.91	973.72	969.65	965.65	961.66	957.62	-165.1	0.0527
28	1085	1078.67	1072.66	1067	1061.68	1056.64	1051.85	1047.27	1042.82	1038.47	1034.16	1029.83	1025.44	-164	0.0961
29	665	658.53	652.1	645.87	639.94	634.41	629.34	624.77	620.75	617.29	614.41	612.13	610.45	-174.5	-0.277
30	735	728.53	722.1	715.87	709.94	704.41	699.34	694.77	690.75	687.29	684.41	682.13	680.45	-174.5	-0.277
31	805	798.53	792.1	785.87	779.94	774.41	769.34	764.77	760.75	757.29	754.41	752.13	750.45	-174.5	-0.277
32	875	868.53	862.1	855.87	849.94	844.41	839.34	834.77	830.75	827.29	824.41	822.13	820.45	-174.5	-0.277
33	945	938.53	932.1	925.87	919.94	914.41	909.38	904.93	901.05	897.71	894.87	892.46	890.43	-171.4	-0.1035
34	1015	1008.53	1002.15	996.02	990.2	984.66	979.37	974.27	969.31	964.45	959.65	954.88	950.15	-164	-0.014
35	1085	1078.56	1072.25	1066.15	1060.24	1054.53	1048.96	1043.5	1038.1	1032.71	1027.28	1021.77	1016.13	-160.9	0.1204

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 50% Heading: +15 deg. **Input file: ROUTE127.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.99	653.87	649.6	646.15	643.51	641.66	640.58	640.25	640.65	641.77	643.59	646.09	175.8	-0.299
2	735	728.99	723.87	719.6	716.15	713.51	711.66	710.58	710.25	710.65	711.77	713.59	716.09	175.8	-0.299
3	805	798.99	793.87	789.6	786.15	783.51	781.66	780.58	780.25	780.66	781.82	783.71	786.26	176.5	-0.2032
4	875	868.99	863.87	859.63	856.27	853.75	852.01	850.97	850.53	850.62	851.18	852.13	853.4	-178.3	-0.0499
5	945	939.02	934	929.81	926.35	923.52	921.21	919.35	917.86	916.65	915.66	914.82	914.06	-172.5	0.0469
6	1015	1009.02	1004	999.81	996.35	993.52	991.21	989.35	987.86	986.65	985.66	984.82	984.06	-172.5	0.0469
7	1085	1079.02	1074	1069.81	1066.35	1063.52	1061.21	1059.35	1057.86	1056.65	1055.66	1054.82	1054.06	-172.5	0.0469
8	665	658.88	653.43	648.69	644.65	641.35	638.78	636.93	635.79	635.36	635.62	636.56	638.17	178	-0.2933
9	735	728.88	723.43	718.69	714.65	711.35	708.78	706.93	705.79	705.36	705.62	706.56	708.17	178	-0.2933
10	805	798.88	793.43	788.69	784.65	781.35	778.78	776.93	775.79	775.36	775.62	776.56	778.22	178.1	-0.2609
11	875	868.88	863.43	858.69	854.65	851.38	848.89	847.16	846.11	845.69	845.81	846.39	847.39	-178.2	-0.0926
12	945	938.89	933.54	928.93	924.97	921.59	918.69	916.19	914.04	912.14	910.43	908.85	907.33	-170.9	0.0155
13	1015	1008.91	1003.56	998.9	994.86	991.35	988.29	985.61	983.24	981.1	979.13	977.26	975.44	-169.9	0.0637
14	1085	1078.91	1073.56	1068.9	1064.86	1061.35	1058.29	1055.61	1053.24	1051.1	1049.13	1047.26	1045.44	-169.9	0.0637
15	665	658.76	653	647.77	643.13	639.12	635.76	633.06	631.02	629.64	628.93	628.87	629.46	-179.6	-0.2856
16	735	728.76	723	717.77	713.13	709.12	705.76	703.06	701.02	699.64	698.93	698.87	699.46	-179.6	-0.2856
17	805	798.76	793	787.77	783.13	779.12	775.76	773.06	771.02	769.64	768.93	768.87	769.46	-179.6	-0.2856
18	875	868.76	863	857.77	853.13	849.12	845.76	843.06	841.07	839.78	839.16	839.14	839.64	-177.8	-0.1433
19	945	938.76	933.04	927.91	923.43	919.57	916.28	913.49	911.11	909.07	907.29	905.71	904.26	-171.2	0.0016
20	1015	1008.8	1003.15	998.04	993.42	989.22	985.4	981.87	978.58	975.46	972.44	969.47	966.49	-167.1	0.0837
21	1085	1078.79	1073.13	1067.99	1063.34	1059.1	1055.23	1051.65	1048.3	1045.11	1042.03	1038.98	1035.92	-166.9	0.086
22	665	658.65	652.57	646.86	641.59	636.84	632.64	629.03	626.01	623.61	621.82	620.65	620.11	-176.9	-0.2757
23	735	728.65	722.57	716.86	711.59	706.84	702.64	699.03	696.01	693.61	691.82	690.65	690.11	-176.9	-0.2757
24	805	798.65	792.57	786.86	781.59	776.84	772.64	769.03	766.01	763.61	761.82	760.65	760.11	-176.9	-0.2757
25	875	868.65	862.57	856.86	851.59	846.84	842.64	839.03	836.01	833.61	831.83	830.71	830.25	-176.5	-0.2153
26	945	938.65	932.57	926.86	921.63	917	912.97	909.49	906.52	903.98	901.82	899.98	898.4	-171.4	-0.0475
27	1015	1008.67	1002.68	997.11	991.92	987.07	982.51	978.18	974.03	969.98	965.99	961.99	957.93	-164.7	0.0567
28	1085	1078.68	1072.7	1067.08	1061.8	1056.82	1052.08	1047.54	1043.14	1038.81	1034.5	1030.15	1025.71	-163.5	0.1131
29	665	658.53	652.14	645.95	640.07	634.58	629.56	625.04	621.04	617.6	614.72	612.43	610.71	-174.1	-0.2647
30	735	728.53	722.14	715.95	710.07	704.58	699.56	695.04	691.04	687.6	684.72	682.43	680.71	-174.1	-0.2647
31	805	798.53	792.14	785.95	780.07	774.58	769.56	765.04	761.04	757.6	754.72	752.43	750.71	-174.1	-0.2647
32	875	868.53	862.14	855.95	850.07	844.58	839.56	835.04	831.04	827.6	824.72	822.43	820.71	-174.1	-0.2647
33	945	938.53	932.14	925.95	920.07	914.58	909.6	905.19	901.35	898.03	895.19	892.77	890.73	-171.1	-0.0976
34	1015	1008.53	1002.19	996.1	990.33	984.84	979.59	974.53	969.59	964.73	959.91	955.11	950.34	-163.6	-0.0092
35	1085	1078.57	1072.29	1066.22	1060.37	1054.71	1049.19	1043.78	1038.42	1033.05	1027.64	1022.11	1016.43	-160.4	0.1364

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 75% Heading: +15 deg. **Input file: ROUTE137.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	659	653.89	649.63	646.21	643.59	641.76	640.7	640.39	640.81	641.93	643.75	646.25	176	-0.2931
2	735	729	723.89	719.63	716.21	713.59	711.76	710.7	710.39	710.81	711.93	713.75	716.25	176	-0.2931
3	805	799	793.89	789.63	786.21	783.59	781.76	780.7	780.39	780.81	781.97	783.86	786.41	176.7	-0.2
4	875	869	863.89	859.67	856.33	853.83	852.12	851.1	850.68	850.78	851.34	852.29	853.56	-178.1	-0.0422
5	945	939.03	934.01	929.85	926.41	923.6	921.32	919.48	918	916.81	915.82	914.97	914.19	-172.3	0.0555
6	1015	1009.03	1004.01	999.85	996.41	993.6	991.32	989.48	988	986.81	985.82	984.97	984.19	-172.3	0.0555
7	1085	1079.03	1074.01	1069.85	1066.41	1063.6	1061.32	1059.48	1058	1056.81	1055.82	1054.97	1054.19	-172.3	0.0555
8	665	658.88	653.45	648.72	644.71	641.43	638.88	637.05	635.93	635.51	635.78	636.71	638.32	178.1	-0.2875
9	735	728.88	723.45	718.72	714.71	711.43	708.88	707.05	705.93	705.51	705.78	706.71	708.32	178.1	-0.2875
10	805	798.88	793.45	788.72	784.71	781.43	778.88	777.05	775.93	775.51	775.78	776.72	778.35	178.2	-0.2591
11	875	868.88	863.45	858.72	854.71	851.46	849	847.28	846.26	845.84	845.97	846.56	847.54	-178.1	-0.0967
12	945	938.9	933.55	928.96	925.03	921.67	918.79	916.32	914.18	912.3	910.59	908.99	907.45	-170.8	0.0184
13	1015	1008.91	1003.57	998.94	994.92	991.43	988.4	985.74	983.39	981.26	979.29	977.41	975.57	-169.7	0.0722
14	1085	1078.91	1073.57	1068.94	1064.92	1061.43	1058.4	1055.74	1053.39	1051.26	1049.29	1047.42	1045.57	-169.7	0.0722
15	665	658.77	653.02	647.81	643.19	639.2	635.86	633.18	631.16	629.79	629.08	629.02	629.59	-179.4	-0.2798
16	735	728.77	723.02	717.81	713.19	709.2	705.86	703.18	701.16	699.79	699.08	699.02	699.59	-179.4	-0.2798
17	805	798.77	793.02	787.81	783.19	779.2	775.86	773.18	771.16	769.79	769.08	769.02	769.59	-179.4	-0.2798
18	875	868.77	863.02	857.81	853.19	849.2	845.86	843.18	841.2	839.93	839.32	839.29	839.79	-177.6	-0.1388
19	945	938.77	933.06	927.95	923.49	919.65	916.39	913.62	911.26	909.23	907.45	905.86	904.37	-171	0.0038
20	1015	1008.8	1003.17	998.07	993.48	989.31	985.5	982	978.72	975.61	972.6	969.63	966.62	-166.9	0.092
21	1085	1078.8	1073.14	1068.03	1063.39	1059.19	1055.34	1051.78	1048.45	1045.27	1042.19	1039.13	1036.04	-166.7	0.0943
22	665	658.65	652.59	646.9	641.65	636.92	632.75	629.15	626.16	623.76	621.98	620.8	620.24	-176.7	-0.2699
23	735	728.65	722.59	716.9	711.65	706.92	702.75	699.15	696.16	693.76	691.98	690.8	690.24	-176.7	-0.2699
24	805	798.65	792.59	786.9	781.65	776.92	772.75	769.15	766.16	763.76	761.98	760.8	760.24	-176.7	-0.2699
25	875	868.65	862.59	856.9	851.65	846.92	842.75	839.15	836.16	833.76	831.98	830.85	830.37	-176.4	-0.2131
26	945	938.65	932.59	926.9	921.69	917.08	913.07	909.62	906.67	904.14	901.98	900.14	898.54	-171.2	-0.0417
27	1015	1008.67	1002.7	997.15	991.98	987.16	982.62	978.31	974.17	970.14	966.15	962.14	958.06	-164.5	0.0603
28	1085	1078.69	1072.72	1067.12	1061.86	1056.9	1052.19	1047.67	1043.28	1038.97	1034.66	1030.3	1025.84	-163.3	0.121
29	665	658.54	652.16	645.98	640.13	634.67	629.66	625.16	621.18	617.75	614.87	612.57	610.83	-173.9	-0.2589
30	735	728.54	722.16	715.98	710.13	704.67	699.66	695.16	691.18	687.75	684.87	682.57	680.83	-173.9	-0.2589
31	805	798.54	792.16	785.98	780.13	774.67	769.66	765.16	761.18	757.75	754.87	752.57	750.83	-173.9	-0.2589
32	875	868.54	862.16	855.98	850.13	844.67	839.66	835.16	831.18	827.75	824.87	822.57	820.83	-173.9	-0.2589
33	945	938.54	932.16	925.98	920.13	914.67	909.71	905.32	901.49	898.18	895.34	892.92	890.87	-171	-0.0947
34	1015	1008.54	1002.2	996.14	990.39	984.92	979.69	974.65	969.73	964.89	960.09	955.33	950.58	-163.5	-0.0059
35	1085	1078.58	1072.31	1066.26	1060.43	1054.79	1049.3	1043.91	1038.57	1033.22	1027.8	1022.27	1016.58	-160.2	0.1438

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 100% Heading: +15 deg. **Input file: ROUTE147.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	659	653.91	649.68	646.27	643.69	641.89	640.86	640.57	641	642.13	643.95	646.43	176.2	-0.2861
2	735	729	723.91	719.68	716.27	713.69	711.89	710.86	710.57	711	712.13	713.95	716.43	176.2	-0.2861
3	805	799	793.91	789.68	786.27	783.69	781.89	780.86	780.57	781	782.16	784.05	786.59	176.8	-0.1961
4	875	869	863.91	859.71	856.4	853.93	852.25	851.25	850.85	850.97	851.53	852.47	853.74	-178	-0.0422
5	945	939.03	934.03	929.89	926.48	923.7	921.45	919.64	918.18	916.99	916.01	915.15	914.35	-172	0.0658
6	1015	1009.03	1004.03	999.89	996.48	993.7	991.45	989.64	988.18	986.99	986.01	985.15	984.35	-172	0.0658
7	1085	1079.03	1074.03	1069.89	1066.48	1063.7	1061.45	1059.64	1058.18	1056.99	1056.01	1055.15	1054.35	-172	0.0658
8	665	658.89	653.47	648.76	644.78	641.53	639.01	637.2	636.1	635.69	635.96	636.9	638.49	178.4	-0.2804
9	735	728.89	723.47	718.76	714.78	711.53	709.01	707.2	706.1	705.69	705.96	706.9	708.49	178.4	-0.2804
10	805	798.89	793.47	788.76	784.78	781.53	779.01	777.2	776.1	775.69	775.96	776.9	778.52	178.4	-0.2558
11	875	868.89	863.47	858.76	854.78	851.56	849.12	847.43	846.43	846.03	846.17	846.76	847.73	-177.9	-0.0889
12	945	938.9	933.58	929.01	925.1	921.77	918.92	916.48	914.36	912.48	910.78	909.16	907.59	-170.6	0.0214
13	1015	1008.92	1003.6	998.98	994.99	991.53	988.53	985.9	983.56	981.45	979.48	977.6	975.72	-169.5	0.0823
14	1085	1078.92	1073.6	1068.98	1064.99	1061.53	1058.53	1055.9	1053.56	1051.45	1049.48	1047.6	1045.72	-169.5	0.0823
15	665	658.77	653.04	647.85	643.26	639.3	635.99	633.33	631.33	629.97	629.27	629.2	629.76	-179.2	-0.2727
16	735	728.77	723.04	717.85	713.26	709.3	705.99	703.33	701.33	699.97	699.27	699.2	699.76	-179.2	-0.2727
17	805	798.77	793.04	787.85	783.26	779.3	775.99	773.33	771.33	769.97	769.27	769.2	769.76	-179.2	-0.2727
18	875	868.77	863.04	857.85	853.26	849.3	845.99	843.33	841.37	840.11	839.5	839.48	839.96	-177.5	-0.1339
19	945	938.77	933.08	927.99	923.56	919.75	916.52	913.77	911.43	909.41	907.64	906.05	904.56	-170.9	0.0053
20	1015	1008.81	1003.19	998.12	993.55	989.41	985.63	982.15	978.9	975.8	972.79	969.81	966.78	-166.6	0.1018
21	1085	1078.8	1073.16	1068.07	1063.47	1059.29	1055.47	1051.93	1048.62	1045.46	1042.38	1039.31	1036.2	-166.4	0.1041
22	665	658.66	652.61	646.94	641.72	637.02	632.87	629.3	626.32	623.94	622.16	620.97	620.39	-176.5	-0.2628
23	735	728.66	722.61	716.94	711.72	707.02	702.87	699.3	696.32	693.94	692.16	690.97	690.39	-176.5	-0.2628
24	805	798.66	792.61	786.94	781.72	777.02	772.87	769.3	766.32	763.94	762.16	760.97	760.39	-176.5	-0.2628
25	875	868.66	862.61	856.94	851.72	847.02	842.87	839.3	836.32	833.94	832.16	831.02	830.52	-176.2	-0.2105
26	945	938.66	932.61	926.94	921.76	917.18	913.2	909.77	906.84	904.33	902.17	900.32	898.71	-171	-0.0365
27	1015	1008.68	1002.72	997.19	992.05	987.26	982.75	978.47	974.35	970.33	966.34	962.32	958.21	-164.3	0.0645
28	1085	1078.69	1072.74	1067.16	1061.93	1057	1052.32	1047.83	1043.46	1039.16	1034.85	1030.49	1026	-163	0.1303
29	665	658.55	652.18	646.03	640.2	634.77	629.79	625.31	621.35	617.93	615.05	612.74	610.98	-173.7	-0.2518
30	735	728.55	722.18	716.03	710.2	704.77	699.79	695.31	691.35	687.93	685.05	682.74	680.98	-173.7	-0.2518
31	805	798.55	792.18	786.03	780.2	774.77	769.79	765.31	761.35	757.93	755.05	752.74	750.98	-173.7	-0.2518
32	875	868.55	862.18	856.03	850.2	844.77	839.79	835.31	831.35	827.93	825.05	822.74	820.98	-173.7	-0.2518
33	945	938.55	932.18	926.03	920.2	914.77	909.83	905.47	901.65	898.35	895.52	893.1	891.03	-170.8	-0.0913
34	1015	1008.55	1002.23	996.19	990.46	985.02	979.82	974.8	969.9	965.09	960.32	955.58	950.84	-163.3	-0.0017
35	1085	1078.58	1072.33	1066.3	1060.5	1054.89	1049.43	1044.07	1038.75	1033.41	1028.01	1022.47	1016.75	-159.9	0.1525

RandSail in PROSIM 3.01 Wave Direction: 90 deg Wave Force: 125% Heading: +15 deg. **Input file: ROUTE157.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	659.01	653.93	649.71	646.33	643.76	641.98	640.97	640.7	641.14	642.28	644.09	646.57	176.4	-0.2807
2	735	729.01	723.93	719.71	716.33	713.76	711.98	710.97	710.7	711.14	712.28	714.09	716.57	176.4	-0.2807
3	805	799.01	793.93	789.71	786.33	783.76	781.98	780.97	780.7	781.14	782.31	784.19	786.73	177	-0.1928
4	875	869.01	863.93	859.74	856.45	854.01	852.34	851.37	850.98	851.11	851.68	852.61	853.86	-177.9	-0.0456
5	945	939.04	934.05	929.92	926.53	923.78	921.55	919.75	918.31	917.14	916.16	915.29	914.48	-171.8	0.0736
6	1015	1009.04	1004.05	999.92	996.53	993.78	991.55	989.75	988.31	987.14	986.16	985.29	984.48	-171.8	0.0736
7	1085	1079.04	1074.05	1069.92	1066.53	1063.78	1061.55	1059.75	1058.31	1057.14	1056.16	1055.29	1054.48	-171.8	0.0736
8	665	658.89	653.49	648.8	644.83	641.61	639.1	637.32	636.23	635.83	636.11	637.04	638.62	178.5	-0.2751
9	735	728.89	723.49	718.8	714.83	711.61	709.1	707.32	706.23	705.83	706.11	707.04	708.62	178.5	-0.2751
10	805	798.89	793.49	788.8	784.83	781.61	779.1	777.32	776.23	775.83	776.11	777.04	778.65	178.6	-0.2519
11	875	868.89	863.49	858.8	854.83	851.64	849.22	847.55	846.56	846.17	846.32	846.91	847.88	-177.7	-0.0823
12	945	938.91	933.59	929.04	925.15	921.84	919.02	916.59	914.49	912.63	910.92	909.31	907.73	-170.4	0.0227
13	1015	1008.92	1003.61	999.01	995.04	991.61	988.63	986.01	983.69	981.59	979.63	977.73	975.84	-169.3	0.0899
14	1085	1078.92	1073.61	1069.01	1065.04	1061.61	1058.63	1056.01	1053.69	1051.59	1049.63	1047.73	1045.84	-169.3	0.0899
15	665	658.78	653.06	647.88	643.31	639.37	636.08	633.44	631.45	630.11	629.41	629.33	629.88	-179	-0.2674
16	735	728.78	723.06	717.88	713.31	709.37	706.08	703.44	701.45	700.11	699.41	699.33	699.88	-179	-0.2674
17	805	798.78	793.06	787.88	783.31	779.37	776.08	773.44	771.45	770.11	769.41	769.33	769.88	-179	-0.2674
18	875	868.78	863.06	857.88	853.31	849.37	846.08	843.44	841.5	840.25	839.64	839.62	840.1	-177.3	-0.1301
19	945	938.78	933.09	928.03	923.61	919.83	916.62	913.89	911.56	909.55	907.79	906.18	904.67	-170.7	0.0083
20	1015	1008.81	1003.2	998.15	993.6	989.48	985.73	982.27	979.03	975.95	972.94	969.95	966.9	-166.4	0.1092
21	1085	1078.81	1073.18	1068.1	1063.52	1059.36	1055.56	1052.05	1048.75	1045.6	1042.52	1039.45	1036.32	-166.2	0.1115
22	665	658.66	652.63	646.97	641.77	637.09	632.97	629.42	626.45	624.08	622.3	621.11	620.51	-176.3	-0.2575
23	735	728.66	722.63	716.97	711.77	707.09	702.97	699.42	696.45	694.08	692.3	691.11	690.51	-176.3	-0.2575
24	805	798.66	792.63	786.97	781.77	777.09	772.97	769.42	766.45	764.08	762.3	761.11	760.51	-176.3	-0.2575
25	875	868.66	862.63	856.97	851.77	847.09	842.97	839.42	836.45	834.08	832.3	831.14	830.63	-176.1	-0.2085
26	945	938.66	932.63	926.97	921.82	917.26	913.3	909.89	906.97	904.47	902.32	900.46	898.83	-170.8	-0.033
27	1015	1008.68	1002.74	997.22	992.11	987.34	982.85	978.59	974.48	970.47	966.48	962.45	958.32	-164.1	0.0669
28	1085	1078.7	1072.75	1067.19	1061.99	1057.08	1052.42	1047.95	1043.6	1039.3	1035	1030.63	1026.12	-162.8	0.1373
29	665	658.55	652.2	646.06	640.25	634.84	629.89	625.42	621.48	618.06	615.19	612.87	611.1	-173.6	-0.2464
30	735	728.55	722.2	716.06	710.25	704.84	699.89	695.42	691.48	688.06	685.19	682.87	681.1	-173.6	-0.2464
31	805	798.55	792.2	786.06	780.25	774.84	769.89	765.42	761.48	758.06	755.19	752.87	751.1	-173.6	-0.2464
32	875	868.55	862.2	856.06	850.25	844.84	839.89	835.42	831.48	828.06	825.19	822.87	821.1	-173.6	-0.2464
33	945	938.55	932.2	926.06	920.25	914.84	909.93	905.58	901.78	898.49	895.66	893.23	891.16	-170.7	-0.0887
34	1015	1008.55	1002.24	996.22	990.51	985.1	979.91	974.91	970.03	965.22	960.44	955.68	950.93	-163.1	0.0003
35	1085	1078.59	1072.34	1066.34	1060.56	1054.97	1049.53	1044.19	1038.89	1033.56	1028.16	1022.62	1016.89	-159.8	0.1581

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: -15 deg. **Input file: ROUTE211.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.87	679.57	688.1	697.34	707.22	717.64	728.54	739.85	751.5	763.43	775.6	787.94	156.3	0.017
2	735	741.9	749.65	758.19	767.42	777.25	787.62	798.44	809.65	821.2	833.01	845.03	857.21	156.9	0.0236
3	805	811.9	819.65	828.19	837.42	847.25	857.62	868.44	879.65	891.2	903.01	915.03	927.21	156.9	0.0236
4	875	881.9	889.65	898.19	907.42	917.25	927.62	938.44	949.65	961.2	973.01	985.03	997.21	156.9	0.0236
5	945	951.9	959.65	968.19	977.42	987.25	997.62	1008.44	1019.65	1031.2	1043.01	1055.03	1067.21	156.9	0.0236
6	1015	1021.9	1029.65	1038.19	1047.42	1057.25	1067.62	1078.44	1089.65	1101.2	1113.01	1125.03	1137.21	156.9	0.0236
7	1085	1091.9	1099.65	1108.19	1117.42	1127.25	1137.62	1148.44	1159.65	1171.2	1183.01	1195.03	1207.21	156.9	0.0236
8	665	671.77	679.14	687.19	695.94	705.33	715.28	725.71	736.56	747.77	759.27	771.01	782.93	157.2	0.0128
9	735	741.8	749.28	757.42	766.16	775.44	785.18	795.33	805.82	816.6	827.6	838.78	850.07	159.5	0.0403
10	805	811.8	819.28	827.42	836.16	845.44	855.18	865.33	875.82	886.6	897.6	908.78	920.07	159.5	0.0403
11	875	881.8	889.28	897.42	906.16	915.44	925.18	935.33	945.82	956.6	967.6	978.78	990.07	159.5	0.0403
12	945	951.8	959.28	967.42	976.16	985.44	995.18	1005.33	1015.82	1026.6	1037.6	1048.78	1060.07	159.5	0.0403
13	1015	1021.8	1029.28	1037.42	1046.16	1055.44	1065.18	1075.33	1085.82	1096.6	1107.6	1118.78	1130.07	159.5	0.0403
14	1085	1091.8	1099.28	1107.42	1116.16	1125.44	1135.18	1145.33	1155.82	1166.6	1177.6	1188.78	1200.07	159.5	0.0403
15	665	671.67	678.79	686.39	694.58	703.41	712.81	722.71	733.05	743.76	754.78	766.06	777.53	158.3	0.007
16	735	741.67	748.83	756.56	764.81	773.54	782.69	792.2	802.02	812.08	822.34	832.73	843.22	161.7	0.0531
17	805	811.71	818.92	826.65	834.88	843.54	852.59	861.98	871.64	881.52	891.57	901.73	911.96	162.5	0.0631
18	875	881.71	888.92	896.65	904.88	913.54	922.59	931.98	941.64	951.52	961.57	971.73	981.96	162.5	0.0631
19	945	951.71	958.92	966.65	974.88	983.54	992.59	1001.98	1011.64	1021.52	1031.57	1041.73	1051.96	162.5	0.0631
20	1015	1021.71	1028.92	1036.65	1044.88	1053.54	1062.59	1071.98	1081.64	1091.52	1101.57	1111.73	1121.96	162.5	0.0631
21	1085	1091.71	1098.92	1106.65	1114.88	1123.54	1132.59	1141.98	1151.64	1161.52	1171.57	1181.73	1191.96	162.5	0.0631
22	665	671.58	678.42	685.62	693.25	701.42	710.16	719.42	729.13	739.22	749.63	760.3	771.18	159.9	0.0032
23	735	741.58	748.47	755.8	763.57	771.75	780.27	789.1	798.18	807.45	816.88	826.39	835.94	164.3	0.0712
24	805	811.59	818.51	825.81	833.49	841.5	849.8	858.35	867.1	876	884.99	894.03	903.05	165.8	0.089
25	875	881.61	888.55	895.87	903.56	911.57	919.87	928.4	937.13	946	954.96	963.95	972.92	166	0.0915
26	945	951.61	958.55	965.87	973.56	981.57	989.87	998.4	1007.13	1016	1024.96	1033.95	1042.92	166	0.0915
27	1015	1021.61	1028.55	1035.87	1043.56	1051.57	1059.87	1068.4	1077.13	1086	1094.96	1103.95	1112.92	166	0.0915
28	1085	1091.61	1098.55	1105.87	1113.56	1121.57	1129.87	1138.4	1147.13	1156	1164.96	1173.95	1182.92	166	0.0915
29	665	671.48	678.05	684.82	691.92	699.42	707.36	715.81	724.74	734.11	743.83	753.85	764.11	161.1	-0.0118
30	735	741.48	748.05	754.85	762.04	769.65	777.64	785.95	794.53	803.33	812.3	821.38	830.51	165.1	0.0628
31	805	811.48	818.11	825.04	832.25	839.73	847.44	855.34	863.37	871.5	879.67	887.83	895.93	168.3	0.1064
32	875	881.51	888.18	895.08	902.22	909.58	917.12	924.81	932.59	940.43	948.27	956.07	963.77	169.4	0.119
33	945	951.51	958.18	965.08	972.22	979.58	987.12	994.81	1002.59	1010.43	1018.27	1026.07	1033.77	169.4	0.119
34	1015	1021.51	1028.18	1035.08	1042.22	1049.58	1057.12	1064.81	1072.59	1080.43	1088.27	1096.07	1103.77	169.4	0.119
35	1085	1091.51	1098.18	1105.08	1112.22	1119.58	1127.12	1134.81	1142.59	1150.43	1158.27	1166.07	1173.77	169.4	0.119

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: -15 deg. **Input file: ROUTE221.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.86	679.53	688.02	697.21	707.02	717.39	728.22	739.47	751.07	762.97	775.1	787.44	155.9	0.0019
2	735	741.89	749.61	758.11	767.28	777.06	787.37	798.13	809.28	820.77	832.54	844.54	856.72	156.5	0.0081
3	805	811.89	819.61	828.11	837.28	847.06	857.37	868.13	879.28	890.77	902.54	914.54	926.72	156.5	0.0081
4	875	881.89	889.61	898.11	907.28	917.06	927.37	938.13	949.28	960.77	972.54	984.54	996.72	156.5	0.0081
5	945	951.89	959.61	968.11	977.28	987.06	997.37	1008.13	1019.28	1030.77	1042.54	1054.54	1066.72	156.5	0.0081
6	1015	1021.89	1029.61	1038.11	1047.28	1057.06	1067.37	1078.13	1089.28	1100.77	1112.54	1124.54	1136.72	156.5	0.0081
7	1085	1091.89	1099.61	1108.11	1117.28	1127.06	1137.37	1148.13	1159.28	1170.77	1182.54	1194.54	1206.72	156.5	0.0081
8	665	671.76	679.11	687.11	695.81	705.14	715.03	725.4	736.19	747.35	758.82	770.53	782.45	156.8	-0.0027
9	735	741.79	749.24	757.34	766.03	775.25	784.94	795.02	805.46	816.19	827.16	838.32	849.62	159	0.0241
10	805	811.81	819.32	827.5	836.29	845.63	855.42	865.62	876.15	886.96	897.97	909.13	920.39	160	0.0605
11	875	881.79	889.24	897.34	906.03	915.25	924.94	935.02	945.46	956.19	967.16	978.32	989.62	159	0.0241
12	945	951.79	959.24	967.34	976.03	985.25	994.94	1005.02	1015.46	1026.19	1037.16	1048.32	1059.62	159	0.0241
13	1015	1021.79	1029.24	1037.34	1046.03	1055.25	1064.94	1075.02	1085.46	1096.19	1107.16	1118.32	1129.62	159	0.0241
14	1085	1091.79	1099.24	1107.34	1116.03	1125.25	1134.94	1145.02	1155.46	1166.19	1177.16	1188.32	1199.62	159	0.0241
15	665	671.67	678.75	686.31	694.45	703.21	712.56	722.4	732.69	743.35	754.34	765.6	777.07	157.9	-0.0087
16	735	741.66	748.79	756.48	764.68	773.36	782.45	791.9	801.66	811.68	821.91	832.3	842.8	161.2	0.0363
17	805	811.7	818.88	826.57	834.75	843.35	852.35	861.68	871.29	881.13	891.15	901.31	911.55	162.1	0.0461
18	875	881.7	888.88	896.57	904.75	913.35	922.35	931.68	941.29	951.13	961.15	971.31	981.55	162.1	0.0461
19	945	951.7	958.88	966.57	974.75	983.35	992.35	1001.68	1011.29	1021.13	1031.15	1041.31	1051.55	162.1	0.0461
20	1015	1021.7	1028.88	1036.57	1044.75	1053.35	1062.35	1071.68	1081.29	1091.13	1101.15	1111.31	1121.55	162.1	0.0461
21	1085	1091.7	1098.88	1106.57	1114.75	1123.35	1132.35	1141.68	1151.29	1161.13	1171.15	1181.31	1191.55	162.1	0.0461
22	665	671.57	678.38	685.54	693.12	701.23	709.91	719.12	728.77	738.82	749.2	759.86	770.74	159.4	-0.0125
23	735	741.57	748.44	755.73	763.44	771.56	780.03	788.8	797.83	807.07	816.48	825.99	835.56	163.8	0.0538
24	805	811.58	818.47	825.73	833.36	841.31	849.56	858.06	866.76	875.62	884.6	893.64	902.7	165.3	0.0715
25	875	881.6	888.51	895.79	903.43	911.38	919.62	928.11	936.79	945.63	954.57	963.56	972.57	165.5	0.0741
26	945	951.6	958.51	965.79	973.43	981.38	989.62	998.11	1006.79	1015.63	1024.57	1033.56	1042.57	165.5	0.0741
27	1015	1021.6	1028.51	1035.79	1043.43	1051.38	1059.62	1068.11	1076.79	1085.63	1094.57	1103.56	1112.57	165.5	0.0741
28	1085	1091.6	1098.51	1105.79	1113.43	1121.38	1129.62	1138.11	1146.79	1155.63	1164.57	1173.56	1182.57	165.5	0.0741
29	665	671.47	678.01	684.75	691.79	699.23	707.12	715.51	724.39	733.72	743.41	753.41	763.68	160.7	-0.0273
30	735	741.47	748.01	754.77	761.91	769.47	777.4	785.66	794.2	802.97	811.92	821	830.17	164.7	0.045
31	805	811.47	818.08	824.96	832.12	839.55	847.2	855.04	863.04	871.14	879.29	887.47	895.61	167.8	0.0888
32	875	881.5	888.14	895	902.09	909.39	916.88	924.51	932.26	940.07	947.9	955.71	963.45	168.9	0.1018
33	945	951.5	958.14	965	972.09	979.39	986.88	994.51	1002.26	1010.07	1017.9	1025.71	1033.45	168.9	0.1018
34	1015	1021.5	1028.14	1035	1042.09	1049.39	1056.88	1064.51	1072.26	1080.07	1087.9	1095.71	1103.45	168.9	0.1018
35	1085	1091.5	1098.14	1105	1112.09	1119.39	1126.88	1134.51	1142.26	1150.07	1157.9	1165.71	1173.45	168.9	0.1018

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: -15 deg. **Input file: ROUTE231.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.86	679.52	687.98	697.15	706.93	717.27	728.07	739.29	750.87	762.74	774.87	787.2	155.7	-0.0052
2	735	741.89	749.59	758.07	767.22	776.97	787.25	797.98	809.11	820.57	832.33	844.31	856.49	156.3	0.0009
3	805	811.89	819.59	828.07	837.22	846.97	857.25	867.98	879.11	890.57	902.33	914.31	926.49	156.3	0.0009
4	875	881.89	889.59	898.07	907.22	916.97	927.25	937.98	949.11	960.57	972.33	984.31	996.49	156.3	0.0009
5	945	951.89	959.59	968.07	977.22	986.97	997.25	1007.98	1019.11	1030.57	1042.33	1054.31	1066.49	156.3	0.0009
6	1015	1021.89	1029.59	1038.07	1047.22	1056.97	1067.25	1077.98	1089.11	1100.57	1112.33	1124.31	1136.49	156.3	0.0009
7	1085	1091.89	1099.59	1108.07	1117.22	1126.97	1137.25	1147.98	1159.11	1170.57	1182.33	1194.31	1206.49	156.3	0.0009
8	665	671.76	679.09	687.07	695.75	705.05	714.91	725.25	736.02	747.15	758.6	770.31	782.23	156.6	-0.0099
9	735	741.79	749.22	757.3	765.97	775.16	784.82	794.88	805.29	816	826.95	838.1	849.4	158.8	0.0164
10	805	811.79	819.22	827.3	835.97	845.16	854.82	864.88	875.29	886	896.95	908.1	919.4	158.8	0.0164
11	875	881.79	889.22	897.3	905.97	915.16	924.82	934.88	945.29	956	966.95	978.1	989.4	158.8	0.0164
12	945	951.79	959.22	967.3	975.97	985.16	994.82	1004.88	1015.29	1026	1036.95	1048.1	1059.4	158.8	0.0164
13	1015	1021.79	1029.22	1037.3	1045.97	1055.16	1064.82	1074.88	1085.29	1096	1106.95	1118.1	1129.4	158.8	0.0164
14	1085	1091.79	1099.22	1107.3	1115.97	1125.16	1134.82	1144.88	1155.29	1166	1176.95	1188.1	1199.4	158.8	0.0164
15	665	671.66	678.73	686.27	694.38	703.12	712.44	722.26	732.52	743.16	754.13	765.38	776.85	157.7	-0.016
16	735	741.65	748.77	756.44	764.62	773.27	782.33	791.75	801.49	811.49	821.71	832.09	842.59	161	0.0283
17	805	811.69	818.86	826.53	834.68	843.27	852.23	861.53	871.12	880.94	890.95	901.11	911.36	161.9	0.038
18	875	881.69	888.86	896.53	904.68	913.27	922.23	931.53	941.12	950.94	960.95	971.11	981.36	161.9	0.038
19	945	951.69	958.86	966.53	974.68	983.27	992.23	1001.53	1011.12	1020.94	1030.95	1041.11	1051.36	161.9	0.038
20	1015	1021.69	1028.86	1036.53	1044.68	1053.27	1062.23	1071.53	1081.12	1090.94	1100.95	1111.11	1121.36	161.9	0.038
21	1085	1091.69	1098.86	1106.53	1114.68	1123.27	1132.23	1141.53	1151.12	1160.94	1170.96	1181.11	1191.36	161.9	0.038
22	665	671.57	678.37	685.5	693.06	701.14	709.8	718.97	728.6	738.63	748.99	759.64	770.52	159.3	-0.0199
23	735	741.57	748.42	755.69	763.38	771.47	779.91	788.67	797.68	806.91	816.3	825.82	835.41	163.6	0.0453
24	805	811.58	818.45	825.7	833.3	841.22	849.44	857.92	866.6	875.44	884.41	893.45	902.53	165.1	0.0632
25	875	881.6	888.5	895.76	903.37	911.29	919.51	927.97	936.63	945.45	954.38	963.38	972.41	165.3	0.0657
26	945	951.6	958.5	965.76	973.37	981.29	989.51	997.97	1006.63	1015.45	1024.38	1033.38	1042.4	165.3	0.0657
27	1015	1021.6	1028.5	1035.76	1043.37	1051.29	1059.51	1067.97	1076.63	1085.45	1094.38	1103.38	1112.4	165.3	0.0657
28	1085	1091.6	1098.5	1105.76	1113.37	1121.29	1129.51	1137.97	1146.63	1155.45	1164.38	1173.38	1182.4	165.3	0.0657
29	665	671.47	677.99	684.71	691.73	699.14	707.01	715.37	724.23	733.53	743.21	753.21	763.47	160.5	-0.0345
30	735	741.47	747.99	754.73	761.85	769.38	777.28	785.52	794.04	802.79	811.73	820.82	830	164.5	0.0366
31	805	811.47	818.06	824.92	832.06	839.46	847.09	854.9	862.88	870.96	879.12	887.3	895.46	167.6	0.0804
32	875	881.5	888.12	894.96	902.03	909.3	916.76	924.38	932.1	939.9	947.73	955.54	963.3	168.7	0.0935
33	945	951.5	958.12	964.96	972.03	979.3	986.76	994.38	1002.1	1009.9	1017.73	1025.54	1033.3	168.7	0.0935
34	1015	1021.5	1028.12	1034.96	1042.03	1049.3	1056.76	1064.38	1072.1	1079.9	1087.72	1095.54	1103.3	168.7	0.0935
35	1085	1091.5	1098.12	1104.96	1112.03	1119.3	1126.76	1134.38	1142.1	1149.9	1157.72	1165.54	1173.3	168.7	0.0935

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: -15 deg. **Input file: ROUTE241.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.85	679.49	687.93	697.07	706.83	717.12	727.9	739.08	750.63	762.48	774.59	786.91	155.5	-0.0136
2	735	741.88	749.57	758.02	767.15	776.86	787.1	797.8	808.9	820.33	832.06	844.03	856.2	156.1	-0.0076
3	805	811.88	819.57	828.02	837.15	846.86	857.1	867.8	878.9	890.33	902.06	914.03	926.2	156.1	-0.0076
4	875	881.88	889.57	898.02	907.15	916.86	927.1	937.8	948.9	960.33	972.06	984.03	996.2	156.1	-0.0076
5	945	951.88	959.57	968.02	977.15	986.86	997.1	1007.8	1018.9	1030.33	1042.06	1054.03	1066.2	156.1	-0.0076
6	1015	1021.88	1029.57	1038.02	1047.15	1056.86	1067.1	1077.8	1088.9	1100.33	1112.06	1124.04	1136.2	156.1	-0.0076
7	1085	1091.88	1099.57	1108.02	1117.15	1126.86	1137.1	1147.8	1158.9	1170.33	1182.06	1194.04	1206.2	156.1	-0.0076
8	665	671.75	679.07	687.02	695.67	704.94	714.76	725.07	735.81	746.92	758.34	770.04	781.95	156.4	-0.0184
9	735	741.78	749.2	757.26	765.89	775.05	784.68	794.7	805.08	815.77	826.7	837.84	849.14	158.6	0.0073
10	805	811.78	819.2	827.26	835.89	845.05	854.68	864.7	875.08	885.77	896.7	907.84	919.14	158.6	0.0073
11	875	881.78	889.2	897.26	905.89	915.05	924.68	934.7	945.08	955.77	966.7	977.84	989.14	158.6	0.0073
12	945	951.78	959.2	967.26	975.89	985.05	994.68	1004.7	1015.08	1025.77	1036.7	1047.84	1059.14	158.6	0.0073
13	1015	1021.78	1029.2	1037.26	1045.9	1055.05	1064.68	1074.7	1085.08	1095.77	1106.7	1117.84	1129.14	158.6	0.0073
14	1085	1091.78	1099.2	1107.26	1115.9	1125.05	1134.68	1144.7	1155.08	1165.77	1176.7	1187.84	1199.14	158.6	0.0073
15	665	671.65	678.71	686.23	694.31	703.02	712.3	722.08	732.31	742.93	753.88	765.12	776.59	157.5	-0.0246
16	735	741.65	748.75	756.39	764.55	773.16	782.19	791.58	801.29	811.27	821.47	831.85	842.35	160.8	0.0189
17	805	811.68	818.84	826.49	834.61	843.16	852.09	861.36	870.92	880.72	890.72	900.87	911.13	161.6	0.0284
18	875	881.68	888.84	896.49	904.61	913.16	922.09	931.36	940.92	950.72	960.72	970.87	981.13	161.6	0.0284
19	945	951.68	958.84	966.49	974.61	983.16	992.09	1001.36	1010.92	1020.72	1030.72	1040.87	1051.13	161.6	0.0284
20	1015	1021.68	1028.84	1036.49	1044.61	1053.16	1062.09	1071.36	1080.92	1090.72	1100.72	1110.87	1121.13	161.6	0.0284
21	1085	1091.68	1098.84	1106.49	1114.61	1123.16	1132.09	1141.36	1150.92	1160.72	1170.72	1180.87	1191.13	161.6	0.0284
22	665	671.56	678.35	685.46	692.98	701.03	709.66	718.8	728.4	738.4	748.75	759.39	770.27	159	-0.0285
23	735	741.56	748.4	755.64	763.31	771.37	779.78	788.5	797.5	806.71	816.1	825.63	835.24	163.3	0.0351
24	805	811.57	818.43	825.65	833.22	841.12	849.3	857.75	866.4	875.23	884.19	893.23	902.32	164.8	0.0532
25	875	881.59	888.47	895.71	903.29	911.19	919.37	927.8	936.44	945.24	954.16	963.16	972.2	165	0.0557
26	945	951.59	958.47	965.71	973.29	981.19	989.37	997.8	1006.44	1015.24	1024.16	1033.16	1042.2	165	0.0557
27	1015	1021.59	1028.47	1035.71	1043.29	1051.19	1059.37	1067.8	1076.44	1085.24	1094.16	1103.16	1112.2	165	0.0557
28	1085	1091.59	1098.47	1105.71	1113.29	1121.19	1129.37	1137.8	1146.44	1155.24	1164.16	1173.16	1182.2	165	0.0557
29	665	671.46	677.97	684.66	691.66	699.04	706.87	715.2	724.03	733.31	742.97	752.96	763.22	160.2	-0.0429
30	735	741.46	747.97	754.69	761.78	769.27	777.15	785.35	793.84	802.58	811.52	820.6	829.8	164.2	0.0266
31	805	811.46	818.04	824.88	831.99	839.36	846.95	854.74	862.69	870.76	878.91	887.09	895.28	167.3	0.0703
32	875	881.49	888.1	894.92	901.95	909.2	916.63	924.21	931.91	939.69	947.51	955.34	963.12	168.4	0.0834
33	945	951.49	958.1	964.92	971.95	979.2	986.63	994.21	1001.91	1009.69	1017.51	1025.34	1033.12	168.4	0.0834
34	1015	1021.49	1028.1	1034.92	1041.95	1049.2	1056.63	1064.21	1071.91	1079.69	1087.52	1095.34	1103.12	168.4	0.0834
35	1085	1091.49	1098.1	1104.92	1111.95	1119.2	1126.63	1134.21	1141.91	1149.69	1157.51	1165.34	1173.12	168.4	0.0834

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: -15 deg. **Input file: ROUTE251.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	671.85	679.48	687.9	697.01	706.74	717.01	727.76	738.92	750.44	762.28	774.37	786.69	155.3	-0.0198
2	735	741.88	749.56	757.99	767.09	776.78	787	797.67	808.74	820.15	831.86	843.82	855.99	155.9	-0.0139
3	805	811.88	819.56	827.99	837.09	846.78	857	867.67	878.74	890.15	901.86	913.82	925.99	155.9	-0.0139
4	875	881.88	889.56	897.99	907.09	916.78	927	937.67	948.74	960.15	971.86	983.82	995.99	155.9	-0.0139
5	945	951.88	959.56	967.99	977.09	986.78	997	1007.67	1018.74	1030.15	1041.86	1053.82	1065.99	155.9	-0.0139
6	1015	1021.88	1029.56	1037.99	1047.09	1056.78	1067	1077.67	1088.74	1100.15	1111.86	1123.82	1135.99	155.9	-0.0139
7	1085	1091.88	1099.56	1107.99	1117.09	1126.78	1137	1147.67	1158.74	1170.15	1181.86	1193.83	1205.99	155.9	-0.0139
8	665	671.75	679.05	686.99	695.61	704.86	714.66	724.94	735.65	746.74	758.15	769.83	781.74	156.2	-0.0247
9	735	741.78	749.18	757.22	765.84	774.97	784.57	794.57	804.93	815.59	826.51	837.64	848.94	158.4	0.0006
10	805	811.78	819.18	827.22	835.84	844.97	854.57	864.57	874.93	885.59	896.51	907.64	918.94	158.4	0.0006
11	875	881.78	889.18	897.22	905.84	914.97	924.57	934.57	944.93	955.59	966.51	977.64	988.94	158.4	0.0006
12	945	951.78	959.18	967.22	975.84	984.97	994.57	1004.57	1014.93	1025.59	1036.51	1047.64	1058.94	158.4	0.0006
13	1015	1021.78	1029.18	1037.22	1045.84	1054.97	1064.57	1074.57	1084.93	1095.59	1106.51	1117.64	1128.94	158.4	0.0006
14	1085	1091.78	1099.18	1107.22	1115.84	1124.97	1134.57	1144.57	1154.93	1165.59	1176.51	1187.64	1198.94	158.4	0.0006
15	665	671.65	678.69	686.19	694.25	702.93	712.19	721.95	732.16	742.76	753.69	764.92	776.39	157.3	-0.031
16	735	741.64	748.73	756.36	764.49	773.08	782.08	791.45	801.14	811.1	821.29	831.66	842.17	160.6	0.0118
17	805	811.68	818.82	826.46	834.55	843.08	851.99	861.23	870.77	880.55	890.54	900.69	910.95	161.4	0.0212
18	875	881.68	888.82	896.46	904.55	913.08	921.99	931.23	940.77	950.55	960.54	970.69	980.95	161.4	0.0212
19	945	951.68	958.82	966.46	974.55	983.08	991.99	1001.23	1010.77	1020.55	1030.54	1040.69	1050.95	161.4	0.0212
20	1015	1021.68	1028.82	1036.46	1044.55	1053.08	1061.99	1071.23	1080.77	1090.55	1100.54	1110.69	1120.95	161.4	0.0212
21	1085	1091.68	1098.82	1106.46	1114.55	1123.08	1131.99	1141.23	1150.77	1160.55	1170.54	1180.69	1190.95	161.4	0.0212
22	665	671.56	678.33	685.42	692.93	700.95	709.55	718.67	728.25	738.23	748.56	759.19	770.08	158.8	-0.035
23	735	741.56	748.38	755.6	763.25	771.29	779.68	788.38	797.36	806.56	815.95	825.48	835.11	163.1	0.0274
24	805	811.57	818.42	825.62	833.17	841.04	849.2	857.62	866.26	875.07	884.02	893.07	902.17	164.6	0.0456
25	875	881.59	888.46	895.68	903.24	911.11	919.27	927.67	936.29	945.08	953.99	963	972.05	164.8	0.0481
26	945	951.59	958.46	965.68	973.24	981.11	989.27	997.67	1006.29	1015.08	1023.99	1033	1042.05	164.8	0.0481
27	1015	1021.59	1028.46	1035.68	1043.24	1051.11	1059.27	1067.67	1076.29	1085.08	1093.99	1103	1112.05	164.8	0.0481
28	1085	1091.59	1098.46	1105.68	1113.24	1121.11	1129.27	1137.67	1146.29	1155.08	1163.99	1173	1182.05	164.8	0.0481
29	665	671.46	677.95	684.63	691.6	698.96	706.76	715.07	723.88	733.14	742.79	752.77	763.03	160.1	-0.0493
30	735	741.46	747.95	754.66	761.72	769.19	777.04	785.23	793.7	802.42	811.35	820.44	829.65	164	0.0191
31	805	811.46	818.02	824.84	831.93	839.28	846.85	854.61	862.54	870.6	878.74	886.94	895.14	167.1	0.0626
32	875	881.49	888.08	894.88	901.9	909.12	916.52	924.09	931.77	939.54	947.36	955.19	962.99	168.2	0.0758
33	945	951.49	958.08	964.88	971.9	979.12	986.52	994.09	1001.77	1009.54	1017.36	1025.19	1032.99	168.2	0.0758
34	1015	1021.49	1028.08	1034.88	1041.9	1049.12	1056.52	1064.09	1071.77	1079.54	1087.36	1095.19	1102.99	168.2	0.0758
35	1085	1091.49	1098.08	1104.88	1111.9	1119.12	1126.52	1134.09	1141.77	1149.54	1157.36	1165.19	1172.99	168.2	0.0758

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: -10 deg. **Input file: ROUTE212.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.76	675.34	681.75	688.96	696.91	705.57	714.82	724.6	734.82	745.41	756.33	767.5	158.4	-0.0194
2	735	739.79	745.47	751.97	759.18	767.02	775.41	784.27	793.52	803.11	812.98	823.05	833.29	161.7	0.0218
3	805	809.79	815.47	821.97	829.18	837.02	845.41	854.27	863.52	873.11	882.98	893.05	903.29	161.7	0.0218
4	875	879.79	885.47	891.97	899.18	907.02	915.41	924.27	933.52	943.11	952.98	963.05	973.29	161.7	0.0218
5	945	949.79	955.47	961.97	969.18	977.02	985.41	994.27	1003.52	1013.11	1022.98	1033.05	1043.29	161.7	0.0218
6	1015	1019.79	1025.47	1031.97	1039.18	1047.02	1055.41	1064.27	1073.52	1083.11	1092.98	1103.05	1113.29	161.7	0.0218
7	1085	1089.79	1095.47	1101.97	1109.18	1117.02	1125.41	1134.27	1143.52	1153.11	1162.98	1173.05	1183.29	161.7	0.0218
8	665	669.66	674.95	680.91	687.59	694.98	703.07	711.79	721.07	730.83	741	751.51	762.3	159.3	-0.0299
9	735	739.65	745	751.08	757.82	765.14	772.97	781.24	789.89	798.85	808.06	817.46	827.01	163.5	0.0297
10	805	809.69	815.08	821.16	827.86	835.12	842.85	850.99	859.49	868.28	877.29	886.48	895.79	164.3	0.0384
11	875	879.69	885.08	891.16	897.86	905.12	912.85	920.99	929.49	938.28	947.29	956.48	965.79	164.3	0.0384
12	945	949.69	955.08	961.16	967.86	975.12	982.85	990.99	999.49	1008.28	1017.29	1026.48	1035.79	164.3	0.0384
13	1015	1019.69	1025.08	1031.16	1037.86	1045.12	1052.85	1060.99	1069.49	1078.28	1087.29	1096.48	1105.79	164.3	0.0384
14	1085	1089.69	1095.08	1101.16	1107.86	1115.12	1122.85	1130.99	1139.49	1148.28	1157.29	1166.48	1175.79	164.3	0.0384
15	665	669.56	674.57	680.1	686.21	692.95	700.32	708.33	716.94	726.07	735.65	745.6	755.87	160.3	-0.044
16	735	739.56	744.57	750.15	756.35	763.12	770.41	778.13	786.24	794.65	803.33	812.2	821.21	164.8	0.0282
17	805	809.57	814.67	820.31	826.46	833.08	840.09	847.46	855.11	862.99	871.04	879.22	887.46	167.2	0.0587
18	875	879.59	884.7	890.35	896.51	903.12	910.13	917.48	925.1	932.96	940.98	949.11	957.31	167.3	0.061
19	945	949.59	954.7	960.35	966.51	973.12	980.13	987.48	995.1	1002.96	1010.98	1019.11	1027.31	167.3	0.061
20	1015	1019.59	1024.7	1030.35	1036.51	1043.12	1050.13	1057.48	1065.1	1072.96	1080.98	1089.11	1097.31	167.3	0.061
21	1085	1089.59	1094.7	1100.35	1106.51	1113.12	1120.13	1127.48	1135.1	1142.96	1150.98	1159.11	1167.31	167.3	0.061
22	665	669.46	674.19	679.29	684.84	690.91	697.54	704.75	712.56	720.93	729.79	739.07	748.69	161.8	-0.0567
23	735	739.46	744.19	749.28	754.87	761.02	767.7	774.82	782.34	790.19	798.3	806.62	815.09	166	0.0235
24	805	809.46	814.25	819.5	825.17	831.22	837.61	844.29	851.2	858.3	865.51	872.8	880.11	169.7	0.0759
25	875	879.49	884.32	889.54	895.13	901.06	907.28	913.75	920.41	927.21	934.1	941.03	947.93	170.8	0.0891
26	945	949.49	954.32	959.54	965.13	971.06	977.28	983.75	990.41	997.21	1004.1	1011.03	1017.93	170.8	0.0891
27	1015	1019.49	1024.32	1029.54	1035.13	1041.06	1047.28	1053.75	1060.41	1067.21	1074.1	1081.03	1087.93	170.8	0.0891
28	1085	1089.49	1094.32	1099.54	1105.13	1111.06	1117.28	1123.75	1130.41	1137.21	1144.1	1151.03	1157.93	170.8	0.0891
29	665	669.35	673.79	678.46	683.45	688.85	694.73	701.12	708.04	715.52	723.53	732.01	740.89	163.3	-0.0805
30	735	739.35	743.79	748.46	753.45	758.9	764.87	771.31	778.16	785.34	792.81	800.5	808.34	167.5	0.0186
31	805	809.35	813.85	818.64	823.76	829.18	834.86	840.76	846.82	853	859.25	865.5	871.72	172.5	0.0964
32	875	879.36	883.88	888.66	893.71	899	904.5	910.17	915.95	921.81	927.69	933.53	939.29	173.7	0.111
33	945	949.38	953.93	958.71	963.74	968.99	974.42	980.01	985.69	991.43	997.17	1002.86	1008.45	174.2	0.1167
34	1015	1019.38	1023.93	1028.71	1033.74	1038.99	1044.42	1050.01	1055.69	1061.43	1067.17	1072.86	1078.45	174.2	0.1167
35	1085	1089.38	1093.93	1098.71	1103.74	1108.99	1114.42	1120.01	1125.69	1131.43	1137.17	1142.86	1148.45	174.2	0.1167

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: -10 deg. **Input file: ROUTE222.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.75	675.31	681.64	688.74	696.62	705.21	714.41	724.16	734.36	744.97	755.92	767.16	157.7	-0.0392
2	735	739.78	745.43	751.89	759.05	766.83	775.16	783.96	793.16	802.71	812.54	822.61	832.85	161.3	0.0054
3	805	809.78	815.43	821.89	829.05	836.83	845.16	853.96	863.16	872.71	882.54	892.61	902.85	161.3	0.0054
4	875	879.78	885.43	891.89	899.05	906.83	915.16	923.96	933.16	942.71	952.54	962.61	972.85	161.3	0.0054
5	945	949.78	955.43	961.89	969.05	976.83	985.16	993.96	1003.16	1012.71	1022.54	1032.61	1042.85	161.3	0.0054
6	1015	1019.78	1025.43	1031.89	1039.05	1046.83	1055.16	1063.96	1073.16	1082.71	1092.54	1102.61	1112.85	161.3	0.0054
7	1085	1089.78	1095.43	1101.89	1109.05	1116.83	1125.16	1133.96	1143.16	1152.71	1162.54	1172.61	1182.85	161.3	0.0054
8	665	669.65	674.91	680.83	687.43	694.75	702.76	711.41	720.63	730.33	740.46	750.94	761.72	158.8	-0.0457
9	735	739.64	744.97	751	757.69	764.95	772.73	780.94	789.54	798.45	807.64	817.04	826.6	163.1	0.0127
10	805	809.68	815.04	821.08	827.73	834.93	842.6	850.69	859.14	867.89	876.88	886.07	895.39	163.9	0.0212
11	875	879.68	885.04	891.08	897.73	904.93	912.6	920.69	929.14	937.89	946.88	956.07	965.39	163.9	0.0212
12	945	949.68	955.04	961.08	967.73	974.93	982.6	990.69	999.14	1007.89	1016.88	1026.07	1035.39	163.9	0.0212
13	1015	1019.68	1025.04	1031.08	1037.73	1044.93	1052.6	1060.69	1069.14	1077.89	1086.88	1096.07	1105.39	163.9	0.0212
14	1085	1089.68	1095.04	1101.08	1107.73	1114.93	1122.6	1130.69	1139.14	1147.89	1156.88	1166.07	1175.39	163.9	0.0212
15	665	669.55	674.53	680.02	686.08	692.76	700.07	708.02	716.58	725.66	735.21	745.14	755.4	159.9	-0.0583
16	735	739.55	744.53	750.06	756.21	762.93	770.16	777.83	785.89	794.27	802.92	811.79	820.82	164.3	0.0109
17	805	809.56	814.63	820.23	826.33	832.89	839.85	847.16	854.76	862.61	870.65	878.83	887.11	166.7	0.0406
18	875	879.58	884.66	890.27	896.38	902.94	909.89	917.18	924.76	932.59	940.59	948.73	956.96	166.9	0.0429
19	945	949.58	954.66	960.27	966.38	972.94	979.89	987.18	994.76	1002.59	1010.59	1018.73	1026.96	166.9	0.0429
20	1015	1019.58	1024.66	1030.27	1036.38	1042.94	1049.89	1057.18	1064.76	1072.59	1080.59	1088.73	1096.96	166.9	0.0429
21	1085	1089.58	1094.66	1100.27	1106.38	1112.94	1119.89	1127.18	1134.76	1142.59	1150.59	1158.73	1166.96	166.9	0.0429
22	665	669.45	674.15	679.2	684.71	690.72	697.29	704.46	712.21	720.55	729.38	738.63	748.25	161.4	-0.0709
23	735	739.45	744.15	749.2	754.74	760.84	767.45	774.53	782	789.81	797.91	806.23	814.73	165.6	0.0059
24	805	809.45	814.22	819.42	825.04	831.03	837.37	844	850.87	857.94	865.15	872.45	879.8	169.2	0.0574
25	875	879.48	884.28	889.46	895	900.87	907.04	913.46	920.08	926.85	933.74	940.68	947.63	170.3	0.0705
26	945	949.48	954.28	959.46	965	970.87	977.04	983.46	990.08	996.85	1003.74	1010.68	1017.63	170.3	0.0705
27	1015	1019.48	1024.28	1029.46	1035	1040.87	1047.04	1053.46	1060.08	1066.85	1073.74	1080.68	1087.63	170.3	0.0705
28	1085	1089.48	1094.28	1099.46	1105	1110.87	1117.04	1123.46	1130.08	1136.85	1143.74	1150.68	1157.63	170.3	0.0705
29	665	669.34	673.76	678.38	683.32	688.67	694.49	700.83	707.71	715.16	723.14	731.6	740.48	162.9	-0.0932
30	735	739.34	743.76	748.38	753.32	758.71	764.63	771.02	777.82	784.98	792.43	800.13	808.01	167	0.0009
31	805	809.34	813.81	818.56	823.63	829	834.63	840.48	846.51	852.68	858.93	865.22	871.51	171.9	0.0771
32	875	879.35	883.84	888.58	893.58	898.82	904.26	909.88	915.63	921.46	927.34	933.21	939.03	173.2	0.0924
33	945	949.37	953.89	958.63	963.6	968.8	974.18	979.72	985.37	991.08	996.82	1002.54	1008.19	173.7	0.0982
34	1015	1019.37	1023.89	1028.63	1033.6	1038.8	1044.18	1049.72	1055.37	1061.08	1066.82	1072.54	1078.19	173.7	0.0982
35	1085	1089.37	1093.89	1098.63	1103.6	1108.8	1114.18	1119.72	1125.37	1131.08	1136.82	1142.54	1148.19	173.7	0.0982

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: -10 deg. **Input file: ROUTE232.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.75	675.29	681.61	688.71	696.56	705.11	714.27	723.95	734.09	744.63	755.51	766.67	157.8	-0.0426
2	735	739.78	745.41	751.85	758.99	766.74	775.04	783.81	792.99	802.52	812.34	822.4	832.64	161.1	-0.0023
3	805	809.78	815.41	821.85	828.99	836.74	845.04	853.81	862.99	872.52	882.34	892.4	902.64	161.1	-0.0023
4	875	879.78	885.41	891.85	898.99	906.74	915.04	923.81	932.99	942.52	952.34	962.4	972.64	161.1	-0.0023
5	945	949.78	955.41	961.85	968.99	976.74	985.04	993.81	1002.99	1012.52	1022.34	1032.4	1042.64	161.1	-0.0023
6	1015	1019.78	1025.41	1031.85	1038.99	1046.74	1055.04	1063.81	1072.99	1082.52	1092.34	1102.4	1112.64	161.1	-0.0023
7	1085	1089.78	1095.41	1101.85	1108.99	1116.74	1125.04	1133.81	1142.99	1152.52	1162.34	1172.4	1182.64	161.1	-0.0023
8	665	669.64	674.9	680.79	687.37	694.66	702.64	711.27	720.46	730.14	740.24	750.71	761.49	158.6	-0.0525
9	735	739.64	744.95	750.96	757.63	764.86	772.61	780.8	789.37	798.27	807.44	816.83	826.4	162.9	0.0048
10	805	809.67	815.02	821.04	827.67	834.84	842.48	850.55	858.98	867.71	876.69	885.87	895.2	163.7	0.0131
11	875	879.67	885.02	891.04	897.67	904.84	912.48	920.55	928.98	937.71	946.69	955.87	965.2	163.7	0.0131
12	945	949.67	955.02	961.04	967.67	974.84	982.48	990.55	998.98	1007.71	1016.69	1025.87	1035.2	163.7	0.0131
13	1015	1019.67	1025.02	1031.04	1037.67	1044.84	1052.48	1060.55	1068.98	1077.71	1086.69	1095.87	1105.2	163.7	0.0131
14	1085	1089.67	1095.02	1101.04	1107.67	1114.84	1122.48	1130.55	1138.98	1147.71	1156.69	1165.87	1175.2	163.7	0.0131
15	665	669.54	674.51	679.98	686.02	692.67	699.96	707.88	716.41	725.47	735	744.92	755.18	159.8	-0.065
16	735	739.54	744.51	750.03	756.15	762.85	770.05	777.69	785.72	794.09	802.73	811.59	820.63	164.1	0.0029
17	805	809.56	814.61	820.19	826.27	832.8	839.73	847.02	854.6	862.44	870.47	878.65	886.94	166.5	0.0321
18	875	879.57	884.64	890.24	896.32	902.85	909.77	917.04	924.6	932.41	940.41	948.55	956.79	166.6	0.0343
19	945	949.57	954.64	960.24	966.32	972.85	979.77	987.04	994.6	1002.41	1010.41	1018.55	1026.79	166.6	0.0343
20	1015	1019.57	1024.64	1030.24	1036.32	1042.85	1049.77	1057.04	1064.6	1072.41	1080.41	1088.55	1096.79	166.6	0.0343
21	1085	1089.57	1094.64	1100.24	1106.32	1112.85	1119.77	1127.04	1134.6	1142.41	1150.41	1158.55	1166.79	166.6	0.0343
22	665	669.44	674.13	679.17	684.64	690.63	697.18	704.32	712.05	720.36	729.18	738.43	748.04	161.3	-0.0775
23	735	739.44	744.13	749.16	754.68	760.75	767.34	774.39	781.84	789.64	797.72	806.05	814.56	165.4	-0.0023
24	805	809.44	814.2	819.38	824.97	830.95	837.26	843.86	850.71	857.76	864.97	872.28	879.65	168.9	0.0486
25	875	879.47	884.26	889.42	894.94	900.78	906.93	913.32	919.92	926.68	933.57	940.52	947.49	170	0.0616
26	945	949.47	954.26	959.42	964.94	970.78	976.93	983.32	989.92	996.68	1003.57	1010.52	1017.49	170	0.0616
27	1015	1019.47	1024.26	1029.42	1034.94	1040.78	1046.93	1053.32	1059.92	1066.68	1073.57	1080.52	1087.49	170	0.0616
28	1085	1089.47	1094.26	1099.42	1104.94	1110.78	1116.93	1123.32	1129.92	1136.68	1143.57	1150.52	1157.49	170	0.0616
29	665	669.34	673.74	678.34	683.26	688.58	694.37	700.69	707.56	714.98	722.95	731.41	740.29	162.8	-0.0992
30	735	739.34	743.74	748.34	753.26	758.62	764.51	770.88	777.66	784.81	792.25	799.95	807.85	166.8	-0.0074
31	805	809.34	813.79	818.52	823.57	828.91	834.52	840.35	846.37	852.53	858.79	865.1	871.42	171.7	0.0678
32	875	879.35	883.82	888.54	893.52	898.73	904.15	909.74	915.47	921.3	927.17	933.05	938.9	172.9	0.0835
33	945	949.37	953.87	958.59	963.54	968.71	974.07	979.58	985.21	990.92	996.66	1002.39	1008.06	173.4	0.0893
34	1015	1019.37	1023.87	1028.59	1033.54	1038.71	1044.07	1049.58	1055.21	1060.92	1066.66	1072.39	1078.06	173.4	0.0893
35	1085	1089.37	1093.87	1098.59	1103.54	1108.71	1114.07	1119.58	1125.21	1130.92	1136.66	1142.39	1148.06	173.4	0.0893

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: -10 deg. **Input file: ROUTE242.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.74	675.26	681.56	688.63	696.45	704.97	714.09	723.74	733.85	744.37	755.23	766.39	157.5	-0.0506
2	735	739.77	745.39	751.8	758.91	766.64	774.9	783.64	792.79	802.29	812.09	822.14	832.39	160.9	-0.0113
3	805	809.77	815.39	821.8	828.91	836.64	844.9	853.64	862.79	872.29	882.09	892.14	902.39	160.9	-0.0113
4	875	879.77	885.39	891.8	898.91	906.64	914.9	923.64	932.79	942.29	952.09	962.14	972.39	160.9	-0.0113
5	945	949.77	955.39	961.8	968.91	976.64	984.9	993.64	1002.79	1012.29	1022.09	1032.14	1042.39	160.9	-0.0113
6	1015	1019.77	1025.39	1031.8	1038.91	1046.64	1054.9	1063.64	1072.79	1082.29	1092.09	1102.14	1112.39	160.9	-0.0113
7	1085	1089.77	1095.39	1101.8	1108.91	1116.64	1124.9	1133.64	1142.79	1152.29	1162.09	1172.14	1182.39	160.9	-0.0113
8	665	669.64	674.87	680.75	687.3	694.55	702.5	711.09	720.25	729.9	739.99	750.44	761.21	158.4	-0.0605
9	735	739.63	744.92	750.92	757.55	764.76	772.47	780.63	789.17	798.05	807.2	816.59	826.16	162.7	-0.0046
10	805	809.67	815	821	827.59	834.73	842.35	850.38	858.78	867.49	876.45	885.63	894.97	163.4	0.0035
11	875	879.67	885	891	897.59	904.73	912.35	920.38	928.78	937.49	946.45	955.63	964.97	163.4	0.0035
12	945	949.67	955	961	967.59	974.73	982.35	990.38	998.78	1007.49	1016.45	1025.63	1034.97	163.4	0.0035
13	1015	1019.67	1025	1031	1037.59	1044.73	1052.35	1060.38	1068.78	1077.49	1086.45	1095.63	1104.97	163.4	0.0035
14	1085	1089.67	1095	1101	1107.59	1114.73	1122.35	1130.38	1138.78	1147.49	1156.45	1165.63	1174.97	163.4	0.0035
15	665	669.54	674.49	679.94	685.94	692.57	699.83	707.75	716.28	725.33	734.84	744.75	755	159.7	-0.0706
16	735	739.54	744.49	749.98	756.08	762.74	769.91	777.52	785.53	793.87	802.5	811.36	820.41	163.9	-0.0066
17	805	809.55	814.59	820.14	826.19	832.69	839.59	846.85	854.41	862.22	870.25	878.43	886.73	166.2	0.022
18	875	879.57	884.62	890.19	896.24	902.74	909.63	916.87	924.41	932.2	940.19	948.34	956.59	166.4	0.0242
19	945	949.57	954.62	960.19	966.24	972.74	979.63	986.87	994.41	1002.2	1010.19	1018.34	1026.59	166.4	0.0242
20	1015	1019.57	1024.62	1030.19	1036.24	1042.74	1049.63	1056.87	1064.41	1072.2	1080.19	1088.34	1096.59	166.4	0.0242
21	1085	1089.57	1094.62	1100.19	1106.24	1112.74	1119.63	1126.87	1134.41	1142.2	1150.19	1158.34	1166.59	166.4	0.0242
22	665	669.44	674.11	679.12	684.57	690.53	697.04	704.15	711.86	720.14	728.94	738.18	747.79	161	-0.0853
23	735	739.44	744.11	749.12	754.6	760.64	767.2	774.22	781.65	789.43	797.5	805.83	814.35	165.1	-0.0119
24	805	809.44	814.18	819.34	824.9	830.84	837.12	843.69	850.52	857.56	864.76	872.08	879.47	168.6	0.0381
25	875	879.47	884.24	889.37	894.86	900.68	906.79	913.15	919.73	926.48	933.36	940.32	947.32	169.8	0.051
26	945	949.47	954.24	959.37	964.86	970.68	976.79	983.15	989.73	996.48	1003.36	1010.32	1017.32	169.8	0.051
27	1015	1019.47	1024.24	1029.37	1034.86	1040.68	1046.79	1053.15	1059.73	1066.48	1073.36	1080.32	1087.32	169.8	0.051
28	1085	1089.47	1094.24	1099.37	1104.86	1110.68	1116.79	1123.15	1129.73	1136.48	1143.36	1150.32	1157.32	169.8	0.051
29	665	669.33	673.72	678.29	683.18	688.47	694.24	700.53	707.37	714.77	722.72	731.17	740.05	162.5	-0.1088
30	735	739.33	743.72	748.29	753.18	758.52	764.38	770.71	777.47	784.6	792.04	799.74	807.65	166.5	-0.0171
31	805	809.33	813.77	818.47	823.49	828.8	834.38	840.2	846.2	852.36	858.62	864.95	871.31	171.3	0.0566
32	875	879.34	883.8	888.5	893.44	898.62	904.01	909.58	915.29	921.1	926.97	932.87	938.75	172.6	0.0727
33	945	949.36	953.85	958.54	963.47	968.6	973.93	979.42	985.03	990.72	996.46	1002.21	1007.91	173.1	0.0786
34	1015	1019.36	1023.85	1028.54	1033.47	1038.6	1043.93	1049.42	1055.03	1060.72	1066.46	1072.21	1077.91	173.1	0.0786
35	1085	1089.36	1093.85	1098.54	1103.47	1108.6	1113.93	1119.42	1125.03	1130.72	1136.46	1142.21	1147.91	173.1	0.0786

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: -10 deg. **Input file: ROUTE252.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	669.74	675.25	681.53	688.57	696.37	704.86	713.96	723.58	733.67	744.17	755.02	766.17	157.4	-0.0567
2	735	739.77	745.38	751.77	758.85	766.55	774.79	783.51	792.63	802.12	811.91	821.95	832.2	160.7	-0.0181
3	805	809.77	815.38	821.77	828.85	836.55	844.79	853.51	862.63	872.12	881.91	891.95	902.2	160.7	-0.0181
4	875	879.77	885.38	891.77	898.85	906.55	914.79	923.51	932.63	942.12	951.91	961.95	972.2	160.7	-0.0181
5	945	949.77	955.38	961.77	968.85	976.55	984.79	993.51	1002.63	1012.12	1021.91	1031.95	1042.2	160.7	-0.0181
6	1015	1019.77	1025.38	1031.77	1038.85	1046.55	1054.79	1063.51	1072.63	1082.12	1091.91	1101.95	1112.2	160.7	-0.0181
7	1085	1089.77	1095.38	1101.77	1108.85	1116.55	1124.79	1133.51	1142.63	1152.12	1161.91	1171.95	1182.2	160.7	-0.0181
8	665	669.63	674.86	680.71	687.24	694.47	702.39	710.96	720.09	729.73	739.79	750.23	761	158.3	-0.0665
9	735	739.63	744.91	750.88	757.5	764.68	772.36	780.5	789.02	797.88	807.02	816.41	825.98	162.5	-0.0116
10	805	809.66	814.99	820.96	827.54	834.65	842.24	850.25	858.63	867.32	876.28	885.45	894.8	163.2	-0.0037
11	875	879.66	884.99	890.96	897.54	904.65	912.24	920.25	928.63	937.32	946.28	955.45	964.8	163.2	-0.0037
12	945	949.66	954.99	960.96	967.54	974.65	982.24	990.25	998.63	1007.32	1016.28	1025.45	1034.8	163.2	-0.0037
13	1015	1019.66	1024.99	1030.96	1037.54	1044.65	1052.24	1060.25	1068.63	1077.32	1086.28	1095.45	1104.8	163.2	-0.0037
14	1085	1089.66	1094.99	1100.96	1107.54	1114.65	1122.24	1130.25	1138.63	1147.32	1156.28	1165.45	1174.8	163.2	-0.0037
15	665	669.53	674.47	679.9	685.89	692.49	699.73	707.62	716.12	725.15	734.65	744.55	754.8	159.5	-0.0765
16	735	739.53	744.47	749.95	756.02	762.66	769.8	777.39	785.38	793.7	802.32	811.18	820.24	163.7	-0.0137
17	805	809.55	814.57	820.11	826.14	832.61	839.49	846.72	854.26	862.06	870.08	878.27	886.58	166	0.0144
18	875	879.56	884.6	890.16	896.19	902.66	909.53	916.75	924.26	932.04	940.02	948.17	956.44	166.2	0.0165
19	945	949.56	954.6	960.16	966.19	972.66	979.53	986.75	994.26	1002.04	1010.02	1018.17	1026.44	166.2	0.0165
20	1015	1019.56	1024.6	1030.16	1036.19	1042.66	1049.53	1056.75	1064.26	1072.04	1080.02	1088.17	1096.44	166.2	0.0165
21	1085	1089.56	1094.6	1100.16	1106.19	1112.66	1119.53	1126.75	1134.26	1142.04	1150.02	1158.17	1166.44	166.2	0.0165
22	665	669.43	674.09	679.09	684.51	690.45	696.94	704.02	711.71	719.98	728.76	737.99	747.6	160.9	-0.0911
23	735	739.43	744.09	749.08	754.55	760.56	767.09	774.09	781.5	789.27	797.33	805.66	814.19	164.9	-0.0191
24	805	809.43	814.16	819.3	824.84	830.76	837.02	843.57	850.38	857.41	864.6	871.93	879.34	168.4	0.0302
25	875	879.46	884.22	889.34	894.81	900.6	906.69	913.03	919.59	926.33	933.2	940.17	947.19	169.5	0.043
26	945	949.46	954.22	959.34	964.81	970.6	976.69	983.03	989.59	996.33	1003.2	1010.17	1017.19	169.5	0.043
27	1015	1019.46	1024.22	1029.34	1034.81	1040.6	1046.69	1053.03	1059.59	1066.33	1073.2	1080.17	1087.19	169.5	0.043
28	1085	1089.46	1094.22	1099.34	1104.81	1110.6	1116.69	1123.03	1129.59	1136.33	1143.2	1150.17	1157.19	169.5	0.043
29	665	669.33	673.7	678.26	683.13	688.39	694.14	700.4	707.23	714.62	722.55	730.99	739.88	162.3	-0.1142
30	735	739.33	743.7	748.26	753.13	758.44	764.27	770.59	777.33	784.45	791.88	799.58	807.51	166.3	-0.0244
31	805	809.33	813.75	818.44	823.43	828.72	834.28	840.08	846.07	852.22	858.49	864.84	871.23	171.1	0.0481
32	875	879.34	883.78	888.46	893.39	898.54	903.91	909.45	915.15	920.95	926.83	932.73	938.63	172.4	0.0645
33	945	949.36	953.83	958.51	963.41	968.53	973.83	979.3	984.89	990.58	996.32	1002.07	1007.8	172.9	0.0705
34	1015	1019.36	1023.83	1028.51	1033.41	1038.53	1043.83	1049.3	1054.89	1060.58	1066.32	1072.07	1077.8	172.9	0.0705
35	1085	1089.36	1093.83	1098.51	1103.41	1108.52	1113.83	1119.29	1124.89	1130.58	1136.32	1142.07	1147.8	172.9	0.0705

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: -5 deg. **Input file: ROUTE213.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.62	671.08	675.36	680.45	686.34	692.99	700.39	708.47	717.15	726.34	735.96	745.96	160.4	-0.0666
2	735	737.62	741.1	745.43	750.56	756.4	762.86	769.86	777.33	785.18	793.36	801.81	810.46	165	0.001
3	805	807.65	811.21	815.61	820.75	826.53	832.86	839.67	846.89	854.44	862.26	870.3	878.5	166.7	0.0212
4	875	877.65	881.21	885.61	890.75	896.53	902.86	909.67	916.89	924.44	932.26	940.3	948.5	166.7	0.0212
5	945	947.65	951.21	955.61	960.75	966.53	972.86	979.67	986.89	994.44	1002.26	1010.3	1018.5	166.7	0.0212
6	1015	1017.65	1021.21	1025.61	1030.75	1036.53	1042.86	1049.67	1056.89	1064.44	1072.26	1080.3	1088.5	166.7	0.0212
7	1085	1087.65	1091.21	1095.61	1100.75	1106.53	1112.86	1119.67	1126.89	1134.44	1142.26	1150.3	1158.5	166.7	0.0212
8	665	667.51	670.67	674.52	679.08	684.36	690.37	697.09	704.51	712.57	721.2	730.31	739.83	161.4	-0.0825
9	735	737.51	740.67	744.56	749.18	754.53	760.54	767.13	774.22	781.73	789.59	797.74	806.12	165.6	-0.0095
10	805	807.53	810.78	814.74	819.35	824.51	830.18	836.27	842.71	849.46	856.43	863.58	870.85	169.1	0.0356
11	875	877.54	880.8	884.77	889.37	894.54	900.19	906.26	912.68	919.39	926.33	933.44	940.67	169.2	0.0377
12	945	947.54	950.8	954.77	959.37	964.54	970.19	976.26	982.68	989.39	996.33	1003.44	1010.67	169.2	0.0377
13	1015	1017.54	1020.8	1024.77	1029.37	1034.54	1040.19	1046.26	1052.68	1059.39	1066.33	1073.44	1080.67	169.2	0.0377
14	1085	1087.54	1090.8	1094.77	1099.37	1104.54	1110.19	1116.26	1122.68	1129.39	1136.33	1143.44	1150.67	169.2	0.0377
15	665	667.4	670.28	673.68	677.68	682.32	687.6	693.55	700.17	707.42	715.28	723.69	732.58	162.6	-0.1081
16	735	737.4	740.28	743.68	747.7	752.37	757.7	763.65	770.13	777.07	784.4	792.05	799.95	166.5	-0.0214
17	805	807.4	810.34	813.89	818.01	822.63	827.7	833.14	838.91	844.94	851.17	857.54	863.99	171.2	0.0479
18	875	877.43	880.41	883.93	887.97	892.46	897.36	902.6	908.12	913.86	919.77	925.79	931.87	172.3	0.06
19	945	947.43	950.41	953.93	957.97	962.46	967.36	972.6	978.12	983.86	989.77	995.79	1001.87	172.3	0.06
20	1015	1017.43	1020.41	1023.93	1027.97	1032.46	1037.36	1042.6	1048.12	1053.86	1059.77	1065.79	1071.87	172.3	0.06
21	1085	1087.43	1090.41	1093.93	1097.97	1102.46	1107.36	1112.6	1118.12	1123.86	1129.77	1135.79	1141.87	172.3	0.06
22	665	667.3	669.88	672.83	676.25	680.2	684.72	689.84	695.56	701.96	709.04	716.76	725	164.3	-0.1275
23	735	737.3	739.88	742.83	746.25	750.22	754.77	759.92	765.62	771.83	778.47	785.48	792.78	167.7	-0.0372
24	805	807.3	809.89	812.9	816.44	820.47	824.94	829.77	834.92	840.33	845.93	851.67	857.49	172.6	0.0486
25	875	877.31	879.97	883.05	886.53	890.37	894.53	898.95	903.59	908.39	913.29	918.24	923.18	175.1	0.0814
26	945	947.33	950.01	953.08	956.53	960.32	964.41	968.74	973.26	977.92	982.67	987.44	992.2	175.7	0.0879
27	1015	1017.33	1020.01	1023.08	1026.53	1030.32	1034.41	1038.74	1043.26	1047.92	1052.67	1057.44	1062.2	175.7	0.0879
28	1085	1087.33	1090.01	1093.08	1096.53	1100.32	1104.41	1108.74	1113.26	1117.92	1122.67	1127.44	1132.2	175.7	0.0879
29	665	667.19	669.47	671.97	674.81	678.07	681.82	686.09	690.91	696.3	702.28	708.86	716.01	166	-0.1894
30	735	737.19	739.47	741.97	744.81	748.07	751.83	756.12	760.96	766.34	772.2	778.49	785.12	169	-0.0572
31	805	807.19	809.47	811.98	814.84	818.15	821.93	826.15	830.75	835.67	840.84	846.2	851.7	173	0.0268
32	875	877.19	879.54	882.19	885.14	888.35	891.81	895.45	899.24	903.12	907.04	910.94	914.78	177.9	0.1026
33	945	947.22	949.6	952.22	955.09	958.18	961.45	964.88	968.4	971.97	975.53	979.05	982.46	179.1	0.1156
34	1015	1017.22	1019.6	1022.22	1025.09	1028.18	1031.45	1034.88	1038.4	1041.97	1045.53	1049.05	1052.46	179.1	0.1156
35	1085	1087.22	1089.6	1092.22	1095.09	1098.18	1101.45	1104.88	1108.4	1111.97	1115.53	1119.05	1122.46	179.1	0.1156

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: -5 deg. **Input file: ROUTE223.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.61	671.04	675.28	680.32	686.15	692.75	700.09	708.11	716.74	725.89	735.49	745.47	160.1	-0.0804
2	735	737.61	741.06	745.35	750.42	756.21	762.61	769.56	776.98	784.8	792.95	801.39	810.06	164.6	-0.0156
3	805	807.64	811.17	815.53	820.61	826.34	832.61	839.37	846.54	854.06	861.86	869.9	878.12	166.2	0.0038
4	875	877.64	881.17	885.53	890.61	896.34	902.61	909.37	916.54	924.06	931.86	939.9	948.12	166.2	0.0038
5	945	947.64	951.17	955.53	960.61	966.34	972.61	979.37	986.54	994.06	1001.86	1009.9	1018.12	166.2	0.0038
6	1015	1017.64	1021.17	1025.53	1030.61	1036.34	1042.61	1049.37	1056.54	1064.06	1071.86	1079.9	1088.12	166.2	0.0038
7	1085	1087.64	1091.17	1095.53	1100.61	1106.34	1112.61	1119.37	1126.54	1134.06	1141.86	1149.9	1158.12	166.2	0.0038
8	665	667.5	670.63	674.44	678.95	684.18	690.13	696.79	704.16	712.18	720.77	729.86	739.36	161.1	-0.0959
9	735	737.5	740.63	744.47	749.05	754.34	760.3	766.83	773.87	781.35	789.19	797.34	805.74	165.2	-0.0259
10	805	807.52	810.74	814.66	819.21	824.33	829.93	835.97	842.38	849.09	856.05	863.21	870.51	168.6	0.0174
11	875	877.53	880.76	884.69	889.24	894.35	899.94	905.96	912.34	919.03	925.95	933.07	940.33	168.8	0.0194
12	945	947.53	950.76	954.69	959.24	964.35	969.94	975.96	982.34	989.03	995.95	1003.07	1010.33	168.8	0.0194
13	1015	1017.53	1020.76	1024.69	1029.24	1034.35	1039.94	1045.96	1052.34	1059.03	1065.95	1073.07	1080.33	168.8	0.0194
14	1085	1087.53	1090.76	1094.69	1099.24	1104.35	1109.94	1115.96	1122.34	1129.03	1135.95	1143.07	1150.33	168.8	0.0194
15	665	667.39	670.24	673.6	677.55	682.13	687.36	693.26	699.83	707.05	714.88	723.27	732.14	162.3	-0.1204
16	735	737.41	740.32	743.76	747.83	752.56	757.94	763.94	770.46	777.43	784.77	792.41	800.28	167	-0.0021
17	805	807.39	810.3	813.81	817.87	822.44	827.46	832.86	838.59	844.6	850.82	857.21	863.71	170.7	0.0288
18	875	877.42	880.37	883.85	887.83	892.27	897.12	902.31	907.79	913.51	919.42	925.46	931.58	171.7	0.0409
19	945	947.42	950.37	953.85	957.83	962.27	967.12	972.31	977.79	983.51	989.42	995.46	1001.58	171.7	0.0409
20	1015	1017.42	1020.37	1023.85	1027.83	1032.27	1037.12	1042.31	1047.79	1053.51	1059.42	1065.46	1071.58	171.7	0.0409
21	1085	1087.42	1090.37	1093.85	1097.83	1102.27	1107.12	1112.31	1117.79	1123.51	1129.42	1135.46	1141.58	171.7	0.0409
22	665	667.29	669.84	672.75	676.12	680.02	684.48	689.55	695.24	701.61	708.68	716.38	724.62	164	-0.1377
23	735	737.29	739.84	742.75	746.12	750.03	754.53	759.63	765.29	771.47	778.09	785.09	792.42	167.3	-0.053
24	805	807.29	809.85	812.82	816.31	820.29	824.7	829.49	834.6	839.99	845.59	851.35	857.23	172.1	0.0292
25	875	877.3	879.93	882.97	886.39	890.18	894.29	898.67	903.27	908.05	912.95	917.93	922.93	174.6	0.0617
26	945	947.32	949.97	953	956.4	960.13	964.17	968.45	972.94	977.58	982.33	987.14	991.96	175.1	0.0681
27	1015	1017.32	1019.97	1023	1026.4	1030.13	1034.17	1038.45	1042.94	1047.58	1052.33	1057.14	1061.96	175.1	0.0681
28	1085	1087.32	1089.97	1093	1096.4	1100.13	1104.17	1108.45	1112.94	1117.58	1122.33	1127.14	1131.96	175.1	0.0681
29	665	667.18	669.43	671.89	674.68	677.89	681.58	685.8	690.59	695.96	701.93	708.52	715.69	165.6	-0.1978
30	735	737.18	739.43	741.89	744.68	747.89	751.59	755.84	760.65	766.02	771.88	778.17	784.81	168.7	-0.069
31	805	807.18	809.43	811.9	814.75	818.09	821.89	826.09	830.63	835.47	840.54	845.78	851.16	173.2	0.0224
32	875	877.18	879.5	882.11	885	888.17	891.57	895.17	898.92	902.79	906.71	910.66	914.56	177.4	0.0827
33	945	947.21	949.56	952.14	954.96	957.99	961.21	964.59	968.08	971.63	975.21	978.76	982.25	178.5	0.0959
34	1015	1017.21	1019.56	1022.14	1024.96	1027.99	1031.21	1034.59	1038.08	1041.63	1045.21	1048.76	1052.25	178.5	0.0959
35	1085	1087.21	1089.56	1092.14	1094.96	1097.99	1101.21	1104.59	1108.08	1111.63	1115.21	1118.76	1122.25	178.5	0.0959

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: -5 deg. **Input file: ROUTE233.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.6	671.02	675.24	680.26	686.06	692.63	699.94	707.94	716.55	725.68	735.26	745.23	159.9	-0.0868
2	735	737.6	741.04	745.31	750.36	756.12	762.5	769.42	776.81	784.61	792.76	801.19	809.86	164.4	-0.0234
3	805	807.63	811.15	815.49	820.55	826.25	832.5	839.23	846.38	853.88	861.67	869.71	877.94	166	-0.0044
4	875	877.63	881.15	885.49	890.55	896.25	902.5	909.23	916.38	923.88	931.67	939.71	947.94	166	-0.0044
5	945	947.63	951.15	955.49	960.55	966.25	972.5	979.23	986.38	993.88	1001.67	1009.71	1017.94	166	-0.0044
6	1015	1017.63	1021.15	1025.49	1030.55	1036.25	1042.5	1049.23	1056.38	1063.88	1071.67	1079.71	1087.94	166	-0.0044
7	1085	1087.63	1091.15	1095.49	1100.55	1106.25	1112.5	1119.23	1126.38	1133.88	1141.67	1149.71	1157.94	166	-0.0044
8	665	667.49	670.62	674.4	678.89	684.09	690.01	696.65	703.99	711.99	720.57	729.64	739.14	160.9	-0.1021
9	735	737.49	740.62	744.44	748.99	754.25	760.18	766.69	773.71	781.17	789	797.14	805.55	164.9	-0.0336
10	805	807.51	810.72	814.62	819.15	824.24	829.82	835.83	842.22	848.91	855.87	863.03	870.35	168.4	0.0089
11	875	877.52	880.75	884.65	889.18	894.26	899.83	905.82	912.18	918.85	925.77	932.9	940.17	168.5	0.0108
12	945	947.52	950.75	954.65	959.18	964.26	969.83	975.82	982.18	988.85	995.77	1002.9	1010.17	168.5	0.0108
13	1015	1017.52	1020.75	1024.65	1029.18	1034.26	1039.83	1045.82	1052.18	1058.85	1065.77	1072.9	1080.17	168.5	0.0108
14	1085	1087.52	1090.75	1094.65	1099.18	1104.26	1109.83	1115.82	1122.18	1128.85	1135.77	1142.9	1150.17	168.5	0.0108
15	665	667.39	670.22	673.56	677.49	682.04	687.25	693.12	699.67	706.87	714.69	723.07	731.93	162.1	-0.1262
16	735	737.39	740.22	743.56	747.5	752.09	757.34	763.21	769.63	776.52	783.81	791.46	799.39	165.9	-0.0452
17	805	807.39	810.28	813.77	817.81	822.35	827.34	832.72	838.44	844.43	850.65	857.05	863.58	170.4	0.0199
18	875	877.42	880.35	883.81	887.77	892.19	897	902.17	907.63	913.34	919.25	925.3	931.44	171.5	0.0318
19	945	947.42	950.35	953.81	957.77	962.19	967	972.17	977.63	983.34	989.25	995.3	1001.44	171.5	0.0318
20	1015	1017.42	1020.35	1023.81	1027.77	1032.19	1037	1042.17	1047.63	1053.34	1059.25	1065.3	1071.44	171.5	0.0318
21	1085	1087.42	1090.35	1093.81	1097.77	1102.19	1107	1112.17	1117.63	1123.34	1129.25	1135.3	1141.44	171.5	0.0318
22	665	667.28	669.82	672.71	676.06	679.93	684.37	689.41	695.09	701.44	708.51	716.21	724.44	163.8	-0.1423
23	735	737.28	739.82	742.71	746.06	749.94	754.42	759.51	765.18	771.37	777.99	784.98	792.29	167.3	-0.0552
24	805	807.28	809.83	812.78	816.25	820.2	824.58	829.35	834.45	839.83	845.43	851.2	857.1	171.9	0.0201
25	875	877.3	879.91	882.93	886.33	890.09	894.17	898.53	903.12	907.88	912.79	917.78	922.81	174.3	0.0522
26	945	947.31	949.95	952.96	956.34	960.05	964.05	968.31	972.78	977.42	982.17	987	991.84	174.9	0.0587
27	1015	1017.31	1019.95	1022.96	1026.34	1030.05	1034.05	1038.31	1042.79	1047.42	1052.17	1057	1061.84	174.9	0.0587
28	1085	1087.31	1089.95	1092.96	1096.34	1100.05	1104.05	1108.31	1112.79	1117.42	1122.17	1127	1131.84	174.9	0.0587
29	665	667.17	669.41	671.85	674.62	677.8	681.47	685.67	690.44	695.79	701.76	708.35	715.54	165.4	-0.2021
30	735	737.17	739.41	741.85	744.62	747.8	751.48	755.7	760.5	765.86	771.71	777.99	784.65	168.5	-0.0759
31	805	807.17	809.41	811.86	814.69	818	821.78	825.96	830.49	835.31	840.38	845.65	851.05	172.9	0.013
32	875	877.17	879.48	882.07	884.94	888.08	891.46	895.03	898.77	902.63	906.56	910.52	914.46	177.1	0.0731
33	945	947.21	949.54	952.1	954.89	957.9	961.1	964.45	967.93	971.48	975.06	978.63	982.14	178.2	0.0864
34	1015	1017.21	1019.54	1022.1	1024.89	1027.9	1031.1	1034.45	1037.93	1041.48	1045.06	1048.63	1052.14	178.2	0.0864
35	1085	1087.21	1089.54	1092.1	1094.89	1097.9	1101.1	1104.45	1107.93	1111.48	1115.06	1118.63	1122.14	178.2	0.0864

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: -5 deg. **Input file: ROUTE243.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.6	671	675.2	680.18	685.95	692.49	699.77	707.74	716.32	725.42	734.99	744.95	159.7	-0.0944
2	735	737.6	741.02	745.26	750.28	756.01	762.36	769.25	776.61	784.39	792.52	800.95	809.63	164.1	-0.0324
3	805	807.63	811.13	815.44	820.48	826.14	832.36	839.06	846.18	853.66	861.45	869.49	877.73	165.7	-0.0139
4	875	877.63	881.13	885.44	890.48	896.14	902.36	909.06	916.18	923.66	931.45	939.49	947.73	165.7	-0.0139
5	945	947.63	951.13	955.44	960.48	966.14	972.36	979.06	986.18	993.66	1001.45	1009.49	1017.73	165.7	-0.0139
6	1015	1017.63	1021.13	1025.44	1030.48	1036.14	1042.36	1049.06	1056.18	1063.66	1071.45	1079.49	1087.73	165.7	-0.0139
7	1085	1087.63	1091.13	1095.44	1100.48	1106.14	1112.36	1119.06	1126.18	1133.66	1141.45	1149.49	1157.73	165.7	-0.0139
8	665	667.49	670.59	674.36	678.81	683.98	689.87	696.48	703.79	711.77	720.32	729.38	738.87	160.7	-0.1095
9	735	737.49	740.59	744.39	748.91	754.14	760.04	766.52	773.52	780.95	788.77	796.91	805.33	164.7	-0.0426
10	805	807.51	810.7	814.57	819.07	824.13	829.68	835.66	842.02	848.7	855.65	862.82	870.15	168.1	-0.0012
11	875	877.52	880.72	884.6	889.1	894.15	899.69	905.66	911.99	918.64	925.56	932.69	939.98	168.3	0.0007
12	945	947.52	950.72	954.6	959.1	964.15	969.69	975.66	981.99	988.64	995.56	1002.69	1009.98	168.3	0.0007
13	1015	1017.52	1020.72	1024.6	1029.1	1034.15	1039.69	1045.66	1051.99	1058.64	1065.56	1072.69	1079.98	168.3	0.0007
14	1085	1087.52	1090.72	1094.6	1099.1	1104.15	1109.69	1115.66	1121.99	1128.64	1135.56	1142.69	1149.98	168.3	0.0007
15	665	667.38	670.19	673.51	677.41	681.94	687.11	692.96	699.48	706.66	714.46	722.82	731.68	161.9	-0.133
16	735	737.38	740.19	743.51	747.43	751.99	757.2	763.04	769.43	776.3	783.59	791.23	799.17	165.6	-0.054
17	805	807.38	810.26	813.72	817.73	822.25	827.21	832.56	838.25	844.24	850.46	856.86	863.41	170.2	0.0093
18	875	877.41	880.33	883.76	887.7	892.08	896.87	902.01	907.45	913.14	919.05	925.1	931.27	171.2	0.021
19	945	947.41	950.33	953.76	957.7	962.08	966.87	972.01	977.45	983.14	989.05	995.1	1001.27	171.2	0.021
20	1015	1017.41	1020.33	1023.76	1027.7	1032.08	1036.87	1042.01	1047.45	1053.14	1059.05	1065.1	1071.27	171.2	0.021
21	1085	1087.41	1090.33	1093.76	1097.7	1102.08	1106.87	1112.01	1117.45	1123.14	1129.05	1135.1	1141.27	171.2	0.021
22	665	667.28	669.8	672.67	675.98	679.82	684.23	689.25	694.9	701.25	708.3	715.99	724.22	163.7	-0.1477
23	735	737.28	739.8	742.67	745.98	749.84	754.28	759.35	765	771.16	777.77	784.77	792.09	167	-0.064
24	805	807.28	809.8	812.74	816.17	820.09	824.45	829.19	834.27	839.64	845.24	851.02	856.95	171.6	0.0093
25	875	877.29	879.89	882.88	886.26	889.99	894.04	898.37	902.93	907.69	912.6	917.6	922.67	174	0.041
26	945	947.31	949.93	952.92	956.26	959.94	963.92	968.15	972.6	977.23	981.98	986.82	991.7	174.6	0.0474
27	1015	1017.31	1019.93	1022.92	1026.26	1029.94	1033.92	1038.15	1042.6	1047.23	1051.98	1056.82	1061.7	174.6	0.0474
28	1085	1087.31	1089.93	1092.92	1096.26	1099.94	1103.92	1108.15	1112.6	1117.23	1121.98	1126.82	1131.7	174.6	0.0474
29	665	667.17	669.39	671.81	674.54	677.7	681.34	685.51	690.26	695.6	701.56	708.15	715.35	165.2	-0.2076
30	735	737.17	739.39	741.81	744.54	747.7	751.34	755.55	760.32	765.66	771.5	777.79	784.45	168.3	-0.0841
31	805	807.17	809.39	811.81	814.61	817.89	821.64	825.8	830.31	835.13	840.2	845.48	850.92	172.6	0.002
32	875	877.17	879.46	882.02	884.86	887.97	891.32	894.87	898.6	902.45	906.38	910.36	914.34	176.8	0.0616
33	945	947.2	949.52	952.06	954.82	957.79	960.96	964.29	967.75	971.29	974.88	978.47	982.03	177.9	0.0749
34	1015	1017.2	1019.52	1022.06	1024.82	1027.79	1030.96	1034.29	1037.75	1041.29	1044.88	1048.47	1052.03	177.9	0.0749
35	1085	1087.2	1089.52	1092.06	1094.82	1097.79	1100.96	1104.29	1107.75	1111.29	1114.88	1118.47	1122.03	177.9	0.0749

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: -5 deg. **Input file: ROUTE253.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	667.59	670.98	675.16	680.12	685.87	692.38	699.64	707.58	716.14	725.23	734.78	744.74	159.5	-0.1001
2	735	737.59	741	745.23	750.23	755.93	762.25	769.12	776.46	784.23	792.35	800.77	809.45	164	-0.0392
3	805	807.62	811.11	815.41	820.42	826.06	832.25	838.93	846.03	853.5	861.28	869.31	877.56	165.6	-0.021
4	875	877.62	881.11	885.41	890.42	896.06	902.25	908.93	916.03	923.5	931.28	939.31	947.56	165.6	-0.021
5	945	947.62	951.11	955.41	960.42	966.06	972.25	978.93	986.03	993.5	1001.28	1009.31	1017.56	165.6	-0.021
6	1015	1017.62	1021.11	1025.41	1030.42	1036.06	1042.25	1048.93	1056.03	1063.5	1071.28	1079.31	1087.56	165.6	-0.021
7	1085	1087.62	1091.11	1095.41	1100.42	1106.06	1112.25	1118.93	1126.03	1133.5	1141.28	1149.31	1157.56	165.6	-0.021
8	665	667.48	670.58	674.32	678.76	683.9	689.77	696.35	703.64	711.6	720.14	729.18	738.67	160.5	-0.1151
9	735	737.48	740.58	744.34	748.82	754.02	759.89	766.34	773.3	780.71	788.52	796.66	805.08	164.5	-0.0502
10	805	807.5	810.68	814.54	819.02	824.05	829.58	835.54	841.88	848.55	855.49	862.65	870	167.9	-0.0087
11	875	877.51	880.71	884.57	889.05	894.07	899.59	905.53	911.85	918.49	925.4	932.53	939.83	168.1	-0.0069
12	945	947.51	950.71	954.57	959.05	964.07	969.59	975.53	981.85	988.49	995.4	1002.53	1009.83	168.1	-0.0069
13	1015	1017.51	1020.71	1024.57	1029.05	1034.07	1039.59	1045.53	1051.85	1058.49	1065.4	1072.53	1079.83	168.1	-0.0069
14	1085	1087.51	1090.71	1094.57	1099.05	1104.07	1109.59	1115.53	1121.85	1128.49	1135.4	1142.53	1149.83	168.1	-0.0069
15	665	667.38	670.18	673.48	677.36	681.86	687.01	692.83	699.34	706.5	714.28	722.64	731.5	161.8	-0.1381
16	735	737.38	740.18	743.48	747.37	751.91	757.1	762.92	769.29	776.14	783.42	791.06	799	165.5	-0.0606
17	805	807.38	810.24	813.69	817.68	822.17	827.11	832.44	838.12	844.09	850.31	856.72	863.29	169.9	0.0014
18	875	877.41	880.31	883.73	887.64	892	896.76	901.88	907.31	912.99	918.89	924.96	931.15	171	0.0129
19	945	947.41	950.31	953.73	957.64	962	966.76	971.88	977.31	982.99	988.89	994.96	1001.15	171	0.0129
20	1015	1017.41	1020.31	1023.73	1027.64	1032	1036.76	1041.88	1047.31	1052.99	1058.89	1064.96	1071.15	171	0.0129
21	1085	1087.41	1090.31	1093.73	1097.64	1102	1106.76	1111.88	1117.31	1122.99	1128.89	1134.96	1141.15	171	0.0129
22	665	667.27	669.78	672.63	675.93	679.74	684.13	689.13	694.76	701.1	708.15	715.83	724.06	163.5	-0.1517
23	735	737.27	739.78	742.63	745.93	749.76	754.18	759.22	764.85	771	777.61	784.6	791.93	166.8	-0.0705
24	805	807.27	809.79	812.7	816.11	820.01	824.35	829.07	834.13	839.49	845.09	850.89	856.84	171.4	0.0012
25	875	877.29	879.87	882.85	886.2	889.91	893.93	898.25	902.8	907.55	912.45	917.47	922.56	173.8	0.0325
26	945	947.3	949.91	952.88	956.2	959.86	963.81	968.03	972.47	977.09	981.84	986.69	991.6	174.3	0.0388
27	1015	1017.3	1019.91	1022.88	1026.2	1029.86	1033.81	1038.03	1042.47	1047.08	1051.84	1056.69	1061.6	174.3	0.0388
28	1085	1087.3	1089.91	1092.88	1096.2	1099.86	1103.81	1108.03	1112.47	1117.08	1121.84	1126.69	1131.6	174.3	0.0388
29	665	667.16	669.37	671.77	674.49	677.62	681.23	685.39	690.12	695.45	701.41	708.01	715.23	165.1	-0.2057
30	735	737.16	739.37	741.77	744.49	747.62	751.24	755.43	760.19	765.51	771.35	777.63	784.3	168.1	-0.0902
31	805	807.16	809.37	811.78	814.55	817.81	821.54	825.68	830.18	834.99	840.07	845.36	850.82	172.4	-0.0062
32	875	877.16	879.44	881.99	884.81	887.89	891.22	894.75	898.46	902.3	906.24	910.24	914.25	176.5	0.0528
33	945	947.2	949.5	952.02	954.76	957.71	960.86	964.17	967.61	971.15	974.74	978.35	981.94	177.7	0.0662
34	1015	1017.2	1019.5	1022.02	1024.76	1027.71	1030.86	1034.17	1037.61	1041.15	1044.74	1048.35	1051.94	177.7	0.0662
35	1085	1087.2	1089.5	1092.02	1094.76	1097.71	1100.86	1104.17	1107.61	1111.15	1114.74	1118.35	1121.94	177.7	0.0662

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: 0 deg. **Input file: ROUTE214.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.45	666.77	668.92	671.9	675.68	680.25	685.58	691.71	698.63	706.25	714.48	723.23	162.8	-0.1237
2	735	735.45	736.77	738.92	741.92	745.75	750.37	755.7	761.65	768.12	775.05	782.35	789.96	166.8	-0.0437
3	805	805.48	806.88	809.15	812.17	815.84	820.08	824.81	829.94	835.41	841.16	847.13	853.25	171.5	0.0195
4	875	875.48	876.9	879.16	882.17	885.83	890.05	894.75	899.85	905.29	911	916.92	922.98	171.7	0.0215
5	945	945.48	946.9	949.16	952.17	955.83	960.05	964.75	969.85	975.29	981	986.92	992.98	171.7	0.0215
6	1015	1015.48	1016.9	1019.16	1022.17	1025.83	1030.05	1034.75	1039.85	1045.29	1051	1056.92	1062.98	171.7	0.0215
7	1085	1085.48	1086.9	1089.16	1092.17	1095.83	1100.05	1104.75	1109.85	1115.29	1121	1126.92	1132.98	171.7	0.0215
8	665	665.34	666.35	668.05	670.48	673.65	677.54	682.16	687.5	693.55	700.3	707.71	715.75	163.7	-0.1663
9	735	735.34	736.35	738.05	740.48	743.67	747.61	752.26	757.58	763.48	769.89	776.72	783.92	167.5	-0.0623
10	805	805.34	806.4	808.22	810.77	813.94	817.67	821.86	826.46	831.39	836.58	841.98	847.53	172.8	0.0221
11	875	875.37	876.48	878.3	880.75	883.78	887.29	891.22	895.5	900.07	904.86	909.81	914.87	174.2	0.038
12	945	945.37	946.48	948.3	950.75	953.78	957.29	961.22	965.5	970.07	974.86	979.81	984.87	174.2	0.038
13	1015	1015.37	1016.48	1018.3	1020.75	1023.78	1027.29	1031.22	1035.5	1040.06	1044.86	1049.81	1054.87	174.2	0.038
14	1085	1085.37	1086.48	1088.3	1090.75	1093.78	1097.29	1101.22	1105.5	1110.06	1114.86	1119.81	1124.87	174.2	0.038
15	665	665.23	665.94	667.18	669.03	671.53	674.69	678.52	683.02	688.2	694.05	700.56	707.7	165.4	-0.2118
16	735	735.23	735.94	737.18	739.03	741.53	744.7	748.56	753.1	758.25	763.98	770.19	776.81	168.5	-0.0826
17	805	805.23	805.94	807.21	809.12	811.69	814.88	818.6	822.79	827.36	832.26	837.41	842.76	172.9	0.0016
18	875	875.24	876.03	877.41	879.32	881.71	884.52	887.7	891.17	894.87	898.75	902.76	906.82	176.7	0.0542
19	945	945.26	946.07	947.43	949.3	951.63	954.37	957.44	960.79	964.36	968.09	971.92	975.8	177.2	0.0603
20	1015	1015.26	1016.07	1017.43	1019.3	1021.63	1024.37	1027.44	1030.79	1034.36	1038.09	1041.92	1045.8	177.2	0.0603
21	1085	1085.26	1086.07	1087.43	1089.3	1091.63	1094.37	1097.44	1100.79	1104.36	1108.09	1111.92	1115.8	177.2	0.0603
22	665	665.12	665.52	666.31	667.56	669.35	671.71	674.68	678.28	682.5	687.35	692.84	698.96	167.6	-0.2654
23	735	735.12	735.52	736.31	737.56	739.35	741.71	744.68	748.3	752.57	757.46	762.92	768.88	169.6	-0.1188
24	805	805.12	805.52	806.31	807.58	809.43	811.86	814.85	818.35	822.27	826.55	831.12	835.92	174	-0.0117
25	875	875.12	875.58	876.49	877.85	879.63	881.77	884.21	886.9	889.78	892.8	895.9	899.02	179	0.0686
26	945	945.15	945.66	946.55	947.82	949.43	951.33	953.47	955.8	958.26	960.8	963.36	965.89	-179.4	0.0881
27	1015	1015.15	1015.66	1016.55	1017.82	1019.43	1021.33	1023.47	1025.8	1028.26	1030.8	1033.36	1035.89	-179.4	0.0881
28	1085	1085.15	1085.66	1086.55	1087.82	1089.43	1091.33	1093.47	1095.8	1098.26	1100.8	1103.36	1105.89	-179.4	0.0881
29	665	665.01	665.11	665.42	666.08	667.16	668.73	670.83	673.49	676.72	680.55	684.98	690.02	170.3	-0.2799
30	735	735.01	735.11	735.42	736.08	737.16	738.73	740.83	743.49	746.73	750.6	755.08	760.15	171.2	-0.171
31	805	805.01	805.11	805.42	806.08	807.18	808.8	810.96	813.66	816.83	820.41	824.33	828.52	175.2	-0.0282
32	875	875.01	875.12	875.5	876.27	877.44	878.96	880.78	882.84	885.09	887.46	889.92	892.39	-179.5	0.0692
33	945	945.02	945.19	945.64	946.38	947.38	948.6	949.99	951.52	953.12	954.75	956.34	957.86	-176.9	0.105
34	1015	1015.04	1015.24	1015.67	1016.34	1017.23	1018.3	1019.52	1020.82	1022.17	1023.51	1024.79	1025.96	-176	0.1157
35	1085	1085.04	1085.24	1085.67	1086.34	1087.23	1088.3	1089.52	1090.82	1092.17	1093.51	1094.79	1095.96	-176	0.1157

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: 0 deg. **Input file: ROUTE224.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.44	666.73	668.84	671.77	675.49	680.01	685.29	691.37	698.26	705.85	714.05	722.77	162.5	-0.1347
2	735	735.44	736.73	738.84	741.79	745.57	750.13	755.4	761.31	767.74	774.64	781.94	789.56	166.3	-0.0592
3	805	805.46	806.84	809.06	812.03	815.65	819.84	824.51	829.61	835.05	840.79	846.77	852.92	171	0.0011
4	875	875.47	876.86	879.08	882.04	885.65	889.81	894.46	899.52	904.93	910.63	916.56	922.67	171.2	0.0031
5	945	945.47	946.86	949.08	952.04	955.65	959.81	964.46	969.52	974.93	980.63	986.56	992.67	171.2	0.0031
6	1015	1015.47	1016.86	1019.08	1022.04	1025.65	1029.81	1034.46	1039.52	1044.93	1050.63	1056.56	1062.67	171.2	0.0031
7	1085	1085.47	1086.86	1089.08	1092.04	1095.65	1099.81	1104.46	1109.52	1114.93	1120.63	1126.56	1132.67	171.2	0.0031
8	665	665.33	666.31	667.97	670.35	673.46	677.3	681.87	687.17	693.18	699.91	707.31	715.34	163.4	-0.1781
9	735	735.33	736.31	737.97	740.35	743.48	747.37	751.97	757.24	763.11	769.49	776.32	783.53	167	-0.0773
10	805	805.33	806.36	808.14	810.63	813.76	817.43	821.58	826.14	831.04	836.23	841.65	847.25	172.3	0.0032
11	875	875.36	876.44	878.21	880.62	883.59	887.05	890.93	895.17	899.72	904.51	909.48	914.6	173.7	0.0186
12	945	945.36	946.44	948.21	950.62	953.59	957.05	960.93	965.17	969.72	974.51	979.48	984.6	173.7	0.0186
13	1015	1015.36	1016.44	1018.21	1020.62	1023.59	1027.05	1030.93	1035.17	1039.72	1044.51	1049.48	1054.6	173.7	0.0186
14	1085	1085.36	1086.44	1088.21	1090.62	1093.59	1097.05	1100.93	1105.17	1109.72	1114.51	1119.48	1124.6	173.7	0.0186
15	665	665.22	665.89	667.1	668.9	671.34	674.45	678.23	682.7	687.85	693.68	700.2	707.35	165.1	-0.2199
16	735	735.22	735.89	737.1	738.9	741.34	744.46	748.28	752.78	757.9	763.6	769.8	776.43	168.1	-0.0964
17	805	805.22	805.89	807.12	808.99	811.5	814.64	818.32	822.47	827.02	831.91	837.08	842.47	172.4	-0.0167
18	875	875.23	875.99	877.32	879.18	881.52	884.28	887.41	890.85	894.54	898.42	902.45	906.58	176.2	0.0339
19	945	945.25	946.03	947.34	949.17	951.44	954.13	957.15	960.47	964.03	967.76	971.62	975.57	176.7	0.0399
20	1015	1015.25	1016.03	1017.34	1019.17	1021.44	1024.13	1027.15	1030.47	1034.03	1037.76	1041.62	1045.57	176.7	0.0399
21	1085	1085.25	1086.03	1087.34	1089.17	1091.44	1094.13	1097.15	1100.47	1104.02	1107.76	1111.62	1115.57	176.7	0.0399
22	665	665.11	665.48	666.22	667.43	669.16	671.48	674.4	677.96	682.16	687.01	692.5	698.66	167.2	-0.2744
23	735	735.11	735.48	736.22	737.43	739.16	741.48	744.4	747.99	752.24	757.12	762.58	768.56	169.2	-0.1316
24	805	805.11	805.48	806.22	807.45	809.24	811.63	814.57	818.03	821.93	826.2	830.79	835.64	173.5	-0.0297
25	875	875.11	875.54	876.41	877.72	879.44	881.53	883.93	886.59	889.46	892.49	895.63	898.82	178.5	0.0477
26	945	945.14	945.62	946.47	947.69	949.24	951.09	953.19	955.48	957.93	960.49	963.09	965.7	-180	0.0671
27	1015	1015.14	1015.62	1016.47	1017.69	1019.24	1021.09	1023.19	1025.48	1027.93	1030.49	1033.09	1035.7	-180	0.0671
28	1085	1085.14	1085.62	1086.47	1087.69	1089.24	1091.09	1093.19	1095.48	1097.93	1100.49	1103.09	1105.7	-180	0.0671
29	665	665	665.07	665.34	665.95	666.98	668.49	670.55	673.18	676.4	680.23	684.68	689.76	169.9	-0.293
30	735	735	735.07	735.34	735.95	736.98	738.49	740.55	743.18	746.41	750.27	754.74	759.8	170.9	-0.1726
31	805	805	805.07	805.34	805.95	806.99	808.56	810.69	813.35	816.5	820.08	824.01	828.24	174.7	-0.0455
32	875	875	875.08	875.42	876.14	877.26	878.73	880.5	882.53	884.77	887.16	889.65	892.2	179.9	0.0479
33	945	945	945.15	945.56	946.25	947.19	948.36	949.71	951.21	952.8	954.45	956.09	957.69	-177.5	0.0841
34	1015	1015.03	1015.2	1015.59	1016.21	1017.04	1018.07	1019.24	1020.51	1021.86	1023.21	1024.54	1025.79	-176.6	0.0951
35	1085	1085.03	1085.2	1085.59	1086.21	1087.04	1088.07	1089.24	1090.51	1091.86	1093.21	1094.54	1095.79	-176.6	0.0951

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: 0 deg. **Input file: ROUTE234.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.43	666.71	668.8	671.7	675.4	679.89	685.15	691.22	698.08	705.66	713.84	722.56	162.4	-0.1399
2	735	735.43	736.71	738.8	741.73	745.48	750.01	755.26	761.14	767.56	774.45	781.74	789.37	166.1	-0.0664
3	805	805.46	806.82	809.03	811.97	815.56	819.72	824.37	829.45	834.88	840.62	846.6	852.77	170.8	-0.0074
4	875	875.47	876.84	879.04	881.98	885.56	889.7	894.32	899.37	904.76	910.46	916.39	922.52	170.9	-0.0055
5	945	945.47	946.84	949.04	951.98	955.56	959.7	964.32	969.37	974.76	980.46	986.39	992.52	170.9	-0.0055
6	1015	1015.47	1016.84	1019.04	1021.98	1025.56	1029.7	1034.32	1039.37	1044.76	1050.46	1056.39	1062.52	170.9	-0.0055
7	1085	1085.47	1086.84	1089.04	1091.98	1095.56	1099.7	1104.32	1109.37	1114.76	1120.46	1126.39	1132.52	170.9	-0.0055
8	665	665.32	666.29	667.93	670.29	673.37	677.19	681.74	687.01	693.03	699.78	707.21	715.27	163.3	-0.1778
9	735	735.32	736.29	737.93	740.29	743.39	747.25	751.83	757.08	762.93	769.31	776.13	783.34	166.8	-0.0843
10	805	805.32	806.34	808.1	810.57	813.67	817.31	821.44	825.98	830.88	836.07	841.5	847.11	172.1	-0.0056
11	875	875.35	876.42	878.17	880.56	883.5	886.93	890.79	895.02	899.56	904.34	909.33	914.46	173.5	0.0095
12	945	945.35	946.42	948.17	950.56	953.5	956.93	960.79	965.02	969.56	974.34	979.33	984.46	173.5	0.0095
13	1015	1015.35	1016.42	1018.17	1020.56	1023.5	1026.93	1030.79	1035.02	1039.56	1044.34	1049.33	1054.46	173.5	0.0095
14	1085	1085.35	1086.42	1088.17	1090.56	1093.5	1096.93	1100.79	1105.02	1109.56	1114.34	1119.33	1124.46	173.5	0.0095
15	665	665.21	665.88	667.06	668.84	671.25	674.34	678.1	682.55	687.68	693.51	700.02	707.19	164.9	-0.2238
16	735	735.21	735.88	737.06	738.84	741.25	744.35	748.15	752.63	757.76	763.47	769.67	776.3	168	-0.1001
17	805	805.21	805.88	807.08	808.92	811.41	814.53	818.18	822.31	826.85	831.74	836.92	842.33	172.2	-0.0252
18	875	875.23	875.97	877.28	879.12	881.43	884.17	887.28	890.7	894.38	898.26	902.31	906.46	175.9	0.0244
19	945	945.24	946.01	947.3	949.1	951.36	954.01	957.02	960.32	963.87	967.6	971.48	975.45	176.4	0.0303
20	1015	1015.24	1016.01	1017.3	1019.1	1021.36	1024.01	1027.02	1030.32	1033.87	1037.6	1041.48	1045.45	176.4	0.0303
21	1085	1085.24	1086.01	1087.3	1089.1	1091.36	1094.01	1097.02	1100.32	1103.87	1107.6	1111.48	1115.45	176.4	0.0303
22	665	665.1	665.47	666.18	667.36	669.07	671.36	674.27	677.81	682	686.85	692.34	698.53	167	-0.2743
23	735	735.1	735.47	736.18	737.36	739.07	741.36	744.27	747.84	752.07	756.96	762.46	768.47	169.1	-0.1344
24	805	805.1	805.47	806.18	807.38	809.15	811.51	814.44	817.88	821.77	826.04	830.64	835.5	173.3	-0.038
25	875	875.1	875.52	876.37	877.66	879.35	881.42	883.8	886.45	889.31	892.35	895.5	898.73	178.2	0.0377
26	945	945.14	945.6	946.43	947.62	949.15	950.98	953.05	955.34	957.78	960.34	962.97	965.61	179.8	0.057
27	1015	1015.14	1015.6	1016.43	1017.62	1019.15	1020.98	1023.05	1025.34	1027.78	1030.34	1032.97	1035.61	179.8	0.057
28	1085	1085.14	1085.6	1086.43	1087.62	1089.15	1090.98	1093.05	1095.34	1097.78	1100.34	1102.97	1105.61	179.8	0.057
29	665	664.99	665.05	665.3	665.88	666.89	668.38	670.42	673.04	676.25	680.08	684.54	689.63	169.7	-0.2991
30	735	734.99	735.05	735.3	735.88	736.89	738.38	740.42	743.04	746.26	750.12	754.61	759.68	170.7	-0.1769
31	805	804.99	805.05	805.3	805.88	806.9	808.45	810.55	813.2	816.34	819.92	823.86	828.11	174.5	-0.0535
32	875	874.99	875.06	875.38	876.08	877.17	878.61	880.37	882.39	884.62	887.02	889.53	892.11	179.6	0.0378
33	945	945	945.13	945.52	946.18	947.1	948.25	949.58	951.06	952.65	954.3	955.97	957.61	-177.8	0.074
34	1015	1015.03	1015.18	1015.55	1016.14	1016.95	1017.95	1019.1	1020.37	1021.71	1023.07	1024.42	1025.71	-176.8	0.0852
35	1085	1085.03	1085.18	1085.55	1086.14	1086.95	1087.95	1089.1	1090.37	1091.71	1093.07	1094.42	1095.71	-176.8	0.0852

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: 0 deg. **Input file: ROUTE244.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.43	666.69	668.75	671.63	675.3	679.75	684.99	691.03	697.87	705.43	713.6	722.3	162.2	-0.146
2	735	735.43	736.69	738.75	741.65	745.37	749.87	755.1	760.95	767.35	774.22	781.51	789.14	165.9	-0.0749
3	805	805.45	806.8	808.98	811.89	815.46	819.59	824.21	829.26	834.68	840.41	846.39	852.59	170.5	-0.0175
4	875	875.46	876.81	878.99	881.9	885.45	889.56	894.16	899.18	904.56	910.25	916.19	922.34	170.7	-0.0156
5	945	945.46	946.81	948.99	951.9	955.45	959.56	964.16	969.18	974.56	980.25	986.19	992.34	170.7	-0.0156
6	1015	1015.46	1016.81	1018.99	1021.9	1025.45	1029.56	1034.16	1039.18	1044.56	1050.25	1056.19	1062.34	170.7	-0.0156
7	1085	1085.46	1086.81	1088.99	1091.9	1095.45	1099.56	1104.16	1109.18	1114.56	1120.25	1126.19	1132.34	170.7	-0.0156
8	665	665.31	666.27	667.89	670.21	673.27	677.05	681.57	686.82	692.84	699.64	707.14	715.26	163.3	-0.1737
9	735	735.31	736.27	737.89	740.21	743.29	747.12	751.67	756.89	762.72	769.08	775.9	783.12	166.6	-0.0925
10	805	805.31	806.31	808.05	810.5	813.56	817.18	821.28	825.8	830.68	835.87	841.31	846.95	171.8	-0.0159
11	875	875.35	876.39	878.13	880.48	883.39	886.8	890.63	894.84	899.36	904.15	909.14	914.31	173.2	-0.0012
12	945	945.35	946.39	948.13	950.48	953.39	956.8	960.63	964.84	969.36	974.15	979.14	984.31	173.2	-0.0012
13	1015	1015.35	1016.39	1018.13	1020.48	1023.39	1026.8	1030.63	1034.84	1039.36	1044.15	1049.14	1054.31	173.2	-0.0012
14	1085	1085.35	1086.39	1088.13	1090.48	1093.39	1096.8	1100.63	1104.84	1109.36	1114.15	1119.14	1124.31	173.2	-0.0012
15	665	665.21	665.85	667.01	668.76	671.15	674.2	677.94	682.37	687.48	693.3	699.81	706.98	164.7	-0.229
16	735	735.21	735.85	737.01	738.76	741.15	744.22	747.99	752.45	757.55	763.24	769.45	776.1	167.8	-0.1101
17	805	805.21	805.85	807.04	808.85	811.31	814.39	818.02	822.13	826.66	831.54	836.73	842.16	171.9	-0.0351
18	875	875.22	875.95	877.24	879.04	881.33	884.03	887.11	890.52	894.19	898.08	902.14	906.33	175.6	0.0131
19	945	945.24	945.98	947.26	949.03	951.25	953.88	956.86	960.14	963.68	967.42	971.32	975.32	176.1	0.0189
20	1015	1015.24	1015.98	1017.26	1019.03	1021.25	1023.88	1026.86	1030.14	1033.68	1037.42	1041.32	1045.32	176.1	0.0189
21	1085	1085.24	1085.98	1087.26	1089.03	1091.25	1093.88	1096.86	1100.14	1103.68	1107.42	1111.32	1115.32	176.1	0.0189
22	665	665.1	665.44	666.14	667.29	668.97	671.23	674.11	677.64	681.81	686.65	692.16	698.38	166.9	-0.2715
23	735	735.1	735.44	736.14	737.29	738.97	741.23	744.12	747.68	751.93	756.84	762.34	768.36	169	-0.1354
24	805	805.1	805.44	806.14	807.31	809.05	811.38	814.28	817.7	821.58	825.85	830.45	835.34	173	-0.0479
25	875	875.1	875.5	876.32	877.58	879.25	881.28	883.64	886.27	889.13	892.17	895.35	898.61	177.9	0.0259
26	945	945.13	945.57	946.38	947.55	949.05	950.84	952.89	955.16	957.6	960.17	962.81	965.5	179.4	0.045
27	1015	1015.13	1015.57	1016.38	1017.55	1019.05	1020.84	1022.89	1025.16	1027.6	1030.17	1032.81	1035.5	179.4	0.045
28	1085	1085.13	1085.57	1086.38	1087.55	1089.05	1090.84	1092.89	1095.16	1097.6	1100.17	1102.81	1105.5	179.4	0.045
29	665	664.99	665.02	665.25	665.81	666.78	668.25	670.27	672.86	676.07	679.9	684.37	689.48	169.4	-0.3063
30	735	734.99	735.02	735.25	735.81	736.78	738.25	740.27	742.86	746.08	749.95	754.44	759.53	170.5	-0.182
31	805	804.99	805.02	805.25	805.81	806.8	808.32	810.4	813.03	816.16	819.73	823.68	827.95	174.2	-0.063
32	875	874.99	875.04	875.33	876	877.06	878.48	880.21	882.21	884.44	886.84	889.38	892.01	179.3	0.0258
33	945	944.99	945.1	945.47	946.11	947	948.11	949.42	950.89	952.47	954.13	955.83	957.51	-178.1	0.0619
34	1015	1015.02	1015.15	1015.5	1016.07	1016.85	1017.82	1018.95	1020.2	1021.53	1022.9	1024.28	1025.62	-177.2	0.0732
35	1085	1085.02	1085.15	1085.5	1086.07	1086.85	1087.82	1088.95	1090.2	1091.53	1092.9	1094.28	1095.62	-177.2	0.0732

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: 0 deg. **Input file: ROUTE254.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	665.42	666.67	668.72	671.57	675.22	679.65	684.86	690.89	697.71	705.25	713.41	722.1	162.1	-0.1506
2	735	735.42	736.67	738.72	741.59	745.29	749.77	754.97	760.8	767.19	774.05	781.33	788.97	165.7	-0.0813
3	805	805.45	806.78	808.94	811.84	815.38	819.48	824.08	829.12	834.53	840.25	846.24	852.45	170.3	-0.025
4	875	875.45	876.8	878.96	881.84	885.37	889.45	894.03	899.04	904.41	910.09	916.04	922.2	170.5	-0.0232
5	945	945.45	946.8	948.96	951.84	955.37	959.45	964.03	969.04	974.41	980.09	986.04	992.2	170.5	-0.0232
6	1015	1015.45	1016.8	1018.96	1021.84	1025.37	1029.45	1034.03	1039.04	1044.41	1050.09	1056.04	1062.2	170.5	-0.0232
7	1085	1085.45	1086.8	1088.96	1091.84	1095.37	1099.45	1104.03	1109.04	1114.41	1120.09	1126.04	1132.2	170.5	-0.0232
8	665	665.31	666.25	667.85	670.15	673.19	676.95	681.45	686.68	692.68	699.48	706.98	715.09	163.1	-0.1778
9	735	735.31	736.25	737.85	740.15	743.21	747.01	751.55	756.75	762.57	768.92	775.73	782.95	166.4	-0.0987
10	805	805.31	806.3	808.02	810.44	813.48	817.08	821.16	825.66	830.54	835.72	841.16	846.82	171.6	-0.0236
11	875	875.34	876.38	878.09	880.42	883.31	886.69	890.51	894.7	899.21	904	909	914.19	173	-0.0092
12	945	945.34	946.38	948.09	950.42	953.31	956.69	960.51	964.7	969.21	974	979	984.19	173	-0.0092
13	1015	1015.34	1016.38	1018.09	1020.42	1023.31	1026.69	1030.51	1034.7	1039.21	1044	1049	1054.19	173	-0.0092
14	1085	1085.34	1086.38	1088.09	1090.42	1093.31	1096.69	1100.51	1104.7	1109.21	1114	1119	1124.19	173	-0.0092
15	665	665.2	665.84	666.98	668.71	671.07	674.1	677.82	682.23	687.33	693.15	699.66	706.85	164.6	-0.2269
16	735	735.2	735.84	736.98	738.71	741.07	744.11	747.87	752.31	757.4	763.08	769.28	775.94	167.6	-0.1159
17	805	805.2	805.84	807	808.79	811.23	814.29	817.9	821.99	826.51	831.39	836.58	842.03	171.7	-0.0426
18	875	875.22	875.93	877.2	878.98	881.25	883.93	886.99	890.38	894.04	897.94	902.01	906.22	175.4	0.0046
19	945	945.23	945.97	947.22	948.97	951.17	953.77	956.74	960.01	963.54	967.28	971.19	975.22	175.9	0.0103
20	1015	1015.23	1015.97	1017.22	1018.97	1021.17	1023.77	1026.74	1030.01	1033.54	1037.28	1041.19	1045.22	175.9	0.0103
21	1085	1085.23	1085.97	1087.22	1088.97	1091.17	1093.77	1096.74	1100.01	1103.54	1107.28	1111.19	1115.22	175.9	0.0103
22	665	665.09	665.43	666.1	667.23	668.89	671.13	673.99	677.5	681.67	686.5	692.02	698.26	166.7	-0.2713
23	735	735.09	735.43	736.1	737.23	738.89	741.13	744	747.55	751.79	756.7	762.2	768.22	168.9	-0.1404
24	805	805.09	805.43	806.1	807.25	808.97	811.29	814.19	817.61	821.47	825.71	830.29	835.15	173	-0.0501
25	875	875.09	875.48	876.28	877.52	879.17	881.18	883.52	886.14	889	892.04	895.23	898.53	177.6	0.0171
26	945	945.13	945.56	946.35	947.49	948.97	950.74	952.77	955.03	957.46	960.03	962.7	965.42	179.2	0.0359
27	1015	1015.18	1015.76	1016.76	1018.16	1019.9	1021.92	1024.17	1026.57	1029.06	1031.57	1034.02	1036.36	-177.9	0.1379
28	1085	1085.13	1085.56	1086.35	1087.49	1088.97	1090.74	1092.77	1095.03	1097.46	1100.03	1102.7	1105.42	179.2	0.0359
29	665	664.98	665.01	665.22	665.75	666.7	668.15	670.15	672.73	675.93	679.76	684.24	689.37	169.3	-0.3117
30	735	734.98	735.01	735.22	735.75	736.7	738.15	740.15	742.73	745.95	749.81	754.32	759.42	170.4	-0.1858
31	805	804.98	805.01	805.22	805.75	806.72	808.22	810.29	812.91	816.03	819.6	823.54	827.8	174.1	-0.0673
32	875	874.98	875.02	875.29	875.94	876.98	878.38	880.09	882.08	884.3	886.71	889.27	891.92	179	0.0168
33	945	944.99	945.09	945.44	946.05	946.92	948.01	949.3	950.76	952.34	954.01	955.72	957.44	-178.4	0.0527
34	1015	1015.01	1015.14	1015.46	1016.01	1016.77	1017.72	1018.83	1020.07	1021.4	1022.78	1024.18	1025.55	-177.4	0.064
35	1085	1085.01	1085.14	1085.46	1086.01	1086.77	1087.72	1088.83	1090.07	1091.4	1092.78	1094.18	1095.55	-177.4	0.064

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: +5 deg. **Input file: ROUTE215.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.28	662.43	662.44	663.27	664.92	667.36	670.58	674.55	679.26	684.68	690.82	697.65	165.6	-0.2505
2	735	733.28	732.43	732.44	733.27	734.92	737.36	740.61	744.64	749.38	754.76	760.72	767.17	168.3	-0.1143
3	805	803.28	802.46	802.52	803.43	805.12	807.52	810.52	814.03	817.98	822.3	826.92	831.78	173.7	-0.0156
4	875	873.31	872.56	872.67	873.52	875.02	877.08	879.61	882.54	885.8	889.32	893.04	896.9	176.7	0.0229
5	945	943.31	942.56	942.67	943.52	945.02	947.08	949.61	952.54	955.8	959.32	963.04	966.9	176.7	0.0229
6	1015	1013.31	1012.56	1012.67	1013.52	1015.02	1017.08	1019.61	1022.54	1025.8	1029.32	1033.04	1036.9	176.7	0.0229
7	1085	1083.31	1082.56	1082.67	1083.52	1085.02	1087.08	1089.61	1092.54	1095.8	1099.32	1103.04	1106.9	176.7	0.0229
8	665	663.16	662	661.55	661.81	662.82	664.57	667.06	670.27	674.19	678.81	684.12	690.11	167.5	-0.2866
9	735	733.16	732	731.55	731.81	732.82	734.57	737.06	740.29	744.25	748.9	754.17	760.02	169.3	-0.1463
10	805	803.16	802	801.55	801.85	802.93	804.76	807.26	810.35	813.94	817.97	822.35	827.01	173.9	-0.0364
11	875	873.18	872.11	871.77	872.1	873.01	874.43	876.27	878.48	880.97	883.7	886.6	889.61	178.8	0.0339
12	945	943.19	942.13	941.78	942.06	942.91	944.24	945.98	948.06	950.43	953	955.74	958.56	179.3	0.0395
13	1015	1013.19	1012.13	1011.78	1012.06	1012.91	1014.24	1015.98	1018.06	1020.43	1023	1025.74	1028.56	179.3	0.0395
14	1085	1083.19	1082.13	1081.78	1082.06	1082.91	1084.24	1085.98	1088.06	1090.43	1093	1095.74	1098.56	179.3	0.0395
15	665	663.05	661.58	660.65	660.33	660.65	661.64	663.31	665.66	668.68	672.39	676.76	681.8	169.9	-0.3
16	735	733.05	731.58	730.65	730.33	730.65	731.64	733.31	735.66	738.69	742.42	746.85	751.91	170.7	-0.195
17	805	803.05	801.58	800.65	800.33	800.68	801.73	803.48	805.85	808.79	812.22	816.04	820.21	174.8	-0.054
18	875	873.05	871.64	870.83	870.62	870.94	871.72	872.89	874.39	876.16	878.12	880.23	882.42	-179.3	0.0433
19	945	943.08	941.71	940.89	940.58	940.71	941.24	942.11	943.24	944.58	946.07	947.66	949.28	-177.7	0.0618
20	1015	1013.08	1011.71	1010.89	1010.58	1010.71	1011.24	1012.11	1013.24	1014.58	1016.07	1017.66	1019.28	-177.7	0.0618
21	1085	1083.08	1081.71	1080.89	1080.58	1080.71	1081.24	1082.11	1083.24	1084.58	1086.07	1087.66	1089.28	-177.7	0.0618
22	665	662.94	661.16	659.76	658.82	658.42	658.59	659.38	660.79	662.83	665.51	668.83	672.79	172.6	-0.2903
23	735	732.94	731.16	729.76	728.82	728.42	728.59	729.38	730.79	732.83	735.51	738.84	742.84	172.7	-0.2547
24	805	802.94	801.16	799.76	798.82	798.42	798.59	799.41	800.89	803	805.69	808.89	812.53	175.5	-0.0926
25	875	872.94	871.16	869.79	868.94	868.66	868.9	869.58	870.63	871.99	873.6	875.39	877.3	-178.9	0.0275
26	945	942.95	941.25	939.98	939.13	938.65	938.48	938.59	938.91	939.38	939.96	940.58	941.19	-175.3	0.0783
27	1015	1012.97	1011.29	1010	1009.07	1008.46	1008.14	1008.06	1008.15	1008.36	1008.64	1008.94	1009.19	-174.3	0.0895
28	1085	1082.97	1081.29	1080	1079.07	1078.46	1078.14	1078.06	1078.15	1078.36	1078.64	1078.94	1079.19	-174.3	0.0895
29	665	662.83	660.73	658.86	657.31	656.19	655.55	655.45	655.9	656.93	658.56	660.8	663.64	175.3	-0.2796
30	735	732.83	730.73	728.86	727.31	726.19	725.55	725.45	725.9	726.93	728.56	730.8	733.64	175.3	-0.2796
31	805	802.83	800.73	798.86	797.31	796.19	795.55	795.45	795.9	796.97	798.68	800.97	803.8	176.6	-0.1499
32	875	872.83	870.73	868.86	867.34	866.29	865.77	865.75	866.18	866.99	868.11	869.48	871.03	-178.4	0.0021
33	945	942.83	940.79	939.05	937.62	936.48	935.59	934.9	934.37	933.93	933.55	933.15	932.69	-172.7	0.0962
34	1015	1012.86	1010.87	1009.11	1007.6	1006.3	1005.18	1004.2	1003.31	1002.46	1001.59	1000.67	999.63	-171.1	0.1147
35	1085	1082.86	1080.86	1079.1	1077.56	1076.23	1075.07	1074.05	1073.1	1072.19	1071.26	1070.26	1069.15	-170.9	0.117

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: +5 deg. **Input file: ROUTE225.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.27	662.4	662.35	663.14	664.73	667.12	670.29	674.23	678.9	684.31	690.48	697.42	165.3	-0.2384
2	735	733.27	732.4	732.35	733.14	734.73	737.13	740.33	744.32	749.04	754.43	760.39	766.85	168	-0.1233
3	805	803.27	802.42	802.44	803.3	804.94	807.28	810.23	813.71	817.64	821.96	826.59	831.49	173.2	-0.0335
4	875	873.3	872.52	872.59	873.39	874.83	876.84	879.33	882.22	885.46	888.98	892.73	896.64	176.2	0.0034
5	945	943.3	942.52	942.59	943.39	944.83	946.84	949.33	952.22	955.46	958.98	962.73	966.64	176.2	0.0034
6	1015	1013.3	1012.52	1012.59	1013.39	1014.83	1016.84	1019.33	1022.22	1025.46	1028.98	1032.73	1036.64	176.2	0.0034
7	1085	1083.3	1082.52	1082.59	1083.39	1084.83	1086.84	1089.33	1092.22	1095.46	1098.98	1102.73	1106.64	176.2	0.0034
8	665	663.15	661.96	661.46	661.68	662.64	664.34	666.78	669.95	673.85	678.46	683.77	689.78	167.1	-0.2946
9	735	733.15	731.96	731.46	731.68	732.64	734.34	736.78	739.97	743.91	748.56	753.85	759.71	169	-0.1546
10	805	803.15	801.96	801.46	801.72	802.75	804.53	806.98	810.03	813.6	817.61	822	826.71	173.4	-0.0534
11	875	873.17	872.07	871.69	871.97	872.83	874.19	875.99	878.16	880.65	883.38	886.31	889.37	178.3	0.0136
12	945	943.18	942.09	941.7	941.93	942.72	944	945.7	947.75	950.1	952.68	955.45	958.34	178.7	0.019
13	1015	1013.18	1012.09	1011.7	1011.93	1012.72	1014	1015.7	1017.75	1020.1	1022.68	1025.45	1028.34	178.7	0.019
14	1085	1083.18	1082.09	1081.7	1081.93	1082.72	1084	1085.7	1087.75	1090.1	1092.68	1095.45	1098.34	178.7	0.019
15	665	663.04	661.54	660.57	660.2	660.47	661.41	663.04	665.35	668.36	672.06	676.44	681.5	169.5	-0.3124
16	735	733.04	731.54	730.57	730.2	730.47	731.41	733.04	735.35	738.37	742.09	746.49	751.54	170.4	-0.1958
17	805	803.04	801.54	800.57	800.2	800.49	801.5	803.2	805.54	808.46	811.87	815.71	819.9	174.4	-0.07
18	875	873.04	871.59	870.75	870.49	870.76	871.49	872.62	874.09	875.84	877.81	879.96	882.21	-179.8	0.0226
19	945	943.07	941.67	940.81	940.44	940.53	941.01	941.83	942.94	944.27	945.77	947.39	949.09	-178.3	0.0407
20	1015	1013.07	1011.67	1010.81	1010.44	1010.53	1011.01	1011.83	1012.94	1014.27	1015.77	1017.39	1019.09	-178.3	0.0407
21	1085	1083.07	1081.67	1080.81	1080.44	1080.53	1081.01	1081.83	1082.94	1084.27	1085.77	1087.4	1089.09	-178.3	0.0407
22	665	662.93	661.12	659.67	658.69	658.24	658.37	659.11	660.49	662.52	665.2	668.55	672.55	172.1	-0.3033
23	735	732.93	731.12	729.67	728.69	728.24	728.37	729.11	730.49	732.52	735.2	738.56	742.59	172.4	-0.2555
24	805	802.93	801.12	799.67	798.69	798.24	798.37	799.15	800.6	802.7	805.38	808.59	812.25	175.1	-0.1065
25	875	872.93	871.12	869.7	868.81	868.48	868.67	869.31	870.33	871.68	873.3	875.12	877.1	-179.4	0.007
26	945	942.94	941.21	939.9	939	938.46	938.25	938.32	938.61	939.08	939.67	940.34	941.03	-175.9	0.0569
27	1015	1012.96	1011.25	1009.91	1008.93	1008.28	1007.91	1007.79	1007.85	1008.06	1008.36	1008.7	1009.04	-174.9	0.0681
28	1085	1082.96	1081.25	1079.91	1078.93	1078.28	1077.91	1077.79	1077.85	1078.06	1078.36	1078.7	1079.04	-174.9	0.0681
29	665	662.82	660.69	658.77	657.18	656.01	655.33	655.18	655.61	656.63	658.27	660.54	663.44	174.9	-0.2932
30	735	732.82	730.69	728.77	727.18	726.01	725.33	725.18	725.61	726.63	728.27	730.54	733.44	174.9	-0.2932
31	805	802.82	800.69	798.77	797.18	796.01	795.33	795.18	795.62	796.69	798.4	800.72	803.59	176.3	-0.1544
32	875	872.82	870.69	868.77	867.21	866.11	865.54	865.48	865.88	866.68	867.81	869.21	870.83	-178.9	-0.0175
33	945	942.82	940.75	938.96	937.49	936.3	935.36	934.63	934.07	933.63	933.27	932.92	932.55	-173.3	0.0748
34	1015	1012.85	1010.83	1009.03	1007.47	1006.11	1004.95	1003.92	1003.01	1002.15	1001.31	1000.44	999.49	-171.7	0.0937
35	1085	1082.85	1080.82	1079.01	1077.43	1076.04	1074.84	1073.77	1072.81	1071.89	1070.98	1070.04	1069.01	-171.5	0.0962

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: +5 deg. **Input file: ROUTE235.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.26	662.38	662.31	663.07	664.64	667.01	670.16	674.07	678.73	684.13	690.31	697.26	165.2	-0.2404
2	735	733.26	732.38	732.31	733.07	734.64	737.02	740.21	744.21	748.94	754.32	760.29	766.74	168	-0.1252
3	805	803.26	802.4	802.4	803.23	804.85	807.17	810.1	813.56	817.48	821.79	826.43	831.35	173	-0.0418
4	875	873.29	872.5	872.55	873.33	874.75	876.73	879.19	882.07	885.3	888.82	892.58	896.52	176	-0.0057
5	945	943.29	942.5	942.55	943.33	944.75	946.73	949.19	952.07	955.3	958.82	962.58	966.52	176	-0.0057
6	1015	1013.29	1012.5	1012.55	1013.33	1014.75	1016.73	1019.19	1022.07	1025.3	1028.82	1032.58	1036.52	176	-0.0057
7	1085	1083.29	1082.5	1082.55	1083.33	1084.75	1086.73	1089.19	1092.07	1095.3	1098.82	1102.58	1106.52	176	-0.0057
8	665	663.15	661.95	661.43	661.62	662.55	664.23	666.65	669.8	673.69	678.29	683.6	689.62	166.9	-0.2986
9	735	733.15	731.95	731.43	731.62	732.55	734.23	736.65	739.82	743.75	748.39	753.68	759.55	168.8	-0.1603
10	805	803.15	801.95	801.43	801.65	802.66	804.41	806.84	809.88	813.44	817.45	821.84	826.56	173.2	-0.0613
11	875	873.16	872.05	871.65	871.91	872.74	874.08	875.86	878.02	880.49	883.23	886.17	889.26	178	0.0042
12	945	943.18	942.07	941.66	941.87	942.64	943.89	945.57	947.61	949.95	952.53	955.31	958.23	178.5	0.0095
13	1015	1013.18	1012.07	1011.66	1011.87	1012.64	1013.89	1015.57	1017.61	1019.95	1022.53	1025.31	1028.23	178.5	0.0095
14	1085	1083.18	1082.07	1081.66	1081.87	1082.64	1083.89	1085.57	1087.61	1089.95	1092.53	1095.31	1098.23	178.5	0.0095
15	665	663.04	661.52	660.53	660.14	660.38	661.3	662.91	665.21	668.21	671.9	676.29	681.36	169.3	-0.3182
16	735	733.04	731.52	730.53	730.14	730.38	731.3	732.91	735.21	738.22	741.94	746.35	751.4	170.3	-0.2
17	805	803.04	801.52	800.53	800.14	800.41	801.39	803.07	805.4	808.3	811.71	815.55	819.75	174.1	-0.0775
18	875	873.04	871.58	870.71	870.43	870.67	871.38	872.49	873.94	875.69	877.67	879.83	882.11	179.9	0.0128
19	945	943.07	941.65	940.77	940.38	940.44	940.9	941.7	942.79	944.12	945.63	947.27	949	-178.6	0.0307
20	1015	1013.07	1011.65	1010.77	1010.38	1010.44	1010.9	1011.7	1012.79	1014.12	1015.63	1017.27	1019	-178.6	0.0307
21	1085	1083.07	1081.65	1080.77	1080.38	1080.44	1080.9	1081.7	1082.79	1084.12	1085.63	1087.27	1089	-178.6	0.0307
22	665	662.93	661.1	659.64	658.63	658.15	658.26	658.99	660.35	662.37	665.06	668.41	672.43	171.9	-0.3094
23	735	732.93	731.1	729.64	728.63	728.15	728.26	728.99	730.35	732.37	735.06	738.42	742.48	172.2	-0.258
24	805	802.93	801.1	799.64	798.63	798.15	798.26	799.02	800.46	802.55	805.23	808.44	812.12	174.9	-0.113
25	875	872.93	871.1	869.66	868.75	868.4	868.56	869.18	870.19	871.54	873.16	875	877.01	-179.7	-0.0025
26	945	942.93	941.19	939.86	938.93	938.37	938.14	938.19	938.47	938.93	939.54	940.22	940.95	-176.1	0.0467
27	1015	1012.96	1011.23	1009.87	1008.87	1008.19	1007.8	1007.66	1007.71	1007.92	1008.23	1008.59	1008.97	-175.2	0.0579
28	1085	1082.96	1081.23	1079.87	1078.87	1078.19	1077.8	1077.66	1077.71	1077.92	1078.23	1078.59	1078.97	-175.2	0.0579
29	665	662.81	660.68	658.74	657.12	655.92	655.22	655.06	655.47	656.49	658.14	660.42	663.34	174.7	-0.2995
30	735	732.81	730.68	728.74	727.12	725.92	725.22	725.06	725.47	726.49	728.14	730.42	733.34	174.7	-0.2995
31	805	802.81	800.68	798.74	797.12	795.92	795.22	795.06	795.49	796.56	798.27	800.57	803.41	176.2	-0.1576
32	875	872.81	870.68	868.74	867.14	866.03	865.43	865.35	865.74	866.53	867.67	869.09	870.73	-179.2	-0.0265
33	945	942.81	940.73	938.92	937.42	936.21	935.25	934.51	933.93	933.49	933.13	932.81	932.48	-173.6	0.0645
34	1015	1012.84	1010.81	1008.99	1007.4	1006.03	1004.83	1003.8	1002.87	1002.01	1001.18	1000.33	999.42	-172	0.0836
35	1085	1082.84	1080.81	1078.97	1077.36	1075.96	1074.73	1073.64	1072.66	1071.75	1070.85	1069.93	1068.94	-171.8	0.0861

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: +5 deg. **Input file: ROUTE245.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.26	662.35	662.27	663	664.54	666.88	670	673.89	678.53	683.93	690.1	697.06	165	-0.2427
2	735	733.26	732.35	732.27	733	734.54	736.89	740.06	744.03	748.74	754.11	760.06	766.51	167.8	-0.1322
3	805	803.26	802.37	802.35	803.16	804.74	807.03	809.94	813.38	817.29	821.59	826.24	831.18	172.7	-0.0515
4	875	873.29	872.48	872.5	873.25	874.64	876.59	879.03	881.89	885.11	888.63	892.4	896.37	175.7	-0.0164
5	945	943.29	942.48	942.5	943.25	944.64	946.59	949.03	951.89	955.11	958.63	962.4	966.37	175.7	-0.0164
6	1015	1013.29	1012.48	1012.5	1013.25	1014.64	1016.59	1019.03	1021.89	1025.11	1028.63	1032.4	1036.37	175.7	-0.0164
7	1085	1083.29	1082.48	1082.5	1083.25	1084.64	1086.59	1089.03	1091.89	1095.11	1098.63	1102.4	1106.37	175.7	-0.0164
8	665	663.14	661.92	661.38	661.55	662.45	664.1	666.49	669.63	673.49	678.09	683.4	689.43	166.7	-0.3034
9	735	733.14	731.92	731.38	731.55	732.45	734.1	736.49	739.65	743.56	748.19	753.48	759.35	168.6	-0.167
10	805	803.14	801.92	801.38	801.58	802.56	804.28	806.69	809.7	813.24	817.25	821.65	826.38	172.9	-0.0706
11	875	873.16	872.03	871.61	871.83	872.63	873.95	875.7	877.84	880.31	883.04	886	889.13	177.7	-0.007
12	945	943.17	942.05	941.61	941.79	942.53	943.76	945.41	947.43	949.76	952.35	955.15	958.1	178.2	-0.0018
13	1015	1013.17	1012.05	1011.61	1011.79	1012.53	1013.76	1015.41	1017.43	1019.76	1022.35	1025.15	1028.1	178.2	-0.0018
14	1085	1083.17	1082.05	1081.61	1081.79	1082.53	1083.76	1085.41	1087.43	1089.76	1092.35	1095.15	1098.1	178.2	-0.0018
15	665	663.03	661.5	660.49	660.06	660.28	661.17	662.75	665.04	668.02	671.71	676.11	681.2	169	-0.325
16	735	733.03	731.5	730.49	730.06	730.28	731.17	732.75	735.04	738.03	741.76	746.17	751.24	170.1	-0.2049
17	805	803.03	801.5	800.49	800.06	800.31	801.26	802.92	805.22	808.11	811.51	815.36	819.58	173.9	-0.0864
18	875	873.03	871.55	870.67	870.36	870.57	871.25	872.33	873.77	875.51	877.49	879.67	882	179.6	0.0013
19	945	943.06	941.63	940.72	940.31	940.34	940.77	941.55	942.62	943.94	945.46	947.12	948.89	-178.9	0.0188
20	1015	1013.06	1011.63	1010.72	1010.31	1010.34	1010.77	1011.55	1012.62	1013.94	1015.46	1017.12	1018.89	-178.9	0.0188
21	1085	1083.06	1081.63	1080.72	1080.31	1080.34	1080.77	1081.55	1082.62	1083.94	1085.46	1087.12	1088.89	-178.9	0.0188
22	665	662.92	661.08	659.59	658.55	658.05	658.13	658.83	660.19	662.2	664.88	668.25	672.29	171.7	-0.3165
23	735	732.92	731.08	729.59	728.55	728.05	728.13	728.83	730.19	732.2	734.88	738.26	742.34	171.9	-0.261
24	805	802.92	801.08	799.59	798.55	798.05	798.13	798.87	800.3	802.38	805.07	808.29	811.97	174.7	-0.1175
25	875	872.92	871.08	869.62	868.67	868.29	868.43	869.03	870.02	871.36	872.99	874.85	876.9	-180	-0.0138
26	945	942.93	941.17	939.82	938.86	938.27	938.01	938.03	938.3	938.76	939.37	940.09	940.86	-176.5	0.0346
27	1015	1012.95	1011.21	1009.83	1008.8	1008.09	1007.67	1007.5	1007.54	1007.75	1008.07	1008.46	1008.88	-175.6	0.0457
28	1085	1082.95	1081.21	1079.83	1078.8	1078.09	1077.67	1077.5	1077.54	1077.75	1078.07	1078.46	1078.88	-175.6	0.0457
29	665	662.81	660.65	658.69	657.04	655.82	655.09	654.91	655.31	656.33	657.97	660.27	663.22	174.4	-0.307
30	735	732.81	730.65	728.69	727.04	725.82	725.09	724.91	725.31	726.33	727.97	730.27	733.22	174.4	-0.307
31	805	802.81	800.65	798.69	797.04	795.82	795.09	794.91	795.33	796.4	798.11	800.42	803.29	176	-0.1635
32	875	872.81	870.65	868.69	867.07	865.92	865.3	865.2	865.57	866.36	867.5	868.93	870.61	-179.5	-0.0372
33	945	942.81	940.71	938.88	937.35	936.11	935.12	934.35	933.77	933.33	932.98	932.69	932.4	-173.9	0.0522
34	1015	1012.84	1010.79	1008.95	1007.33	1005.92	1004.7	1003.64	1002.7	1001.84	1001.02	1000.21	999.35	-172.4	0.0714
35	1085	1082.84	1080.78	1078.93	1077.29	1075.85	1074.6	1073.49	1072.5	1071.58	1070.7	1069.8	1068.87	-172.2	0.0739

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: +5 deg. **Input file: ROUTE255.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	663.25	662.34	662.23	662.94	664.46	666.78	669.88	673.75	678.38	683.76	689.86	696.67	164.8	-0.2592
2	735	733.25	732.34	732.23	732.94	734.46	736.79	739.95	743.95	748.69	754.09	760.05	766.5	167.9	-0.1297
3	805	803.25	802.36	802.31	803.1	804.66	806.93	809.82	813.24	817.14	821.44	826.1	831.05	172.5	-0.0588
4	875	873.28	872.46	872.47	873.19	874.56	876.49	878.91	881.76	884.97	888.49	892.27	896.26	175.5	-0.0243
5	945	943.28	942.46	942.47	943.19	944.56	946.49	948.91	951.76	954.97	958.49	962.27	966.26	175.5	-0.0243
6	1015	1013.28	1012.46	1012.47	1013.19	1014.56	1016.49	1018.91	1021.76	1024.97	1028.49	1032.27	1036.26	175.5	-0.0243
7	1085	1083.28	1082.46	1082.46	1083.19	1084.56	1086.49	1088.91	1091.76	1094.97	1098.49	1102.27	1106.26	175.5	-0.0243
8	665	663.14	661.91	661.34	661.49	662.37	664	666.37	669.49	673.35	677.94	683.25	689.29	166.5	-0.3081
9	735	733.14	731.91	731.34	731.49	732.37	734	736.37	739.51	743.42	748.04	753.32	759.2	168.4	-0.1721
10	805	803.14	801.91	801.34	801.52	802.48	804.18	806.57	809.56	813.1	817.1	821.5	826.25	172.7	-0.0775
11	875	873.15	872.01	871.57	871.78	872.56	873.85	875.58	877.71	880.17	882.9	885.87	889.03	177.5	-0.0152
12	945	943.17	942.03	941.58	941.74	942.45	943.66	945.29	947.3	949.62	952.21	955.02	958	178	-0.0102
13	1015	1013.17	1012.03	1011.58	1011.74	1012.45	1013.66	1015.29	1017.3	1019.62	1022.21	1025.02	1028	178	-0.0102
14	1085	1083.17	1082.03	1081.58	1081.74	1082.45	1083.66	1085.29	1087.3	1089.62	1092.21	1095.02	1098	178	-0.0102
15	665	663.02	661.48	660.45	660.01	660.2	661.07	662.64	664.91	667.88	671.57	675.97	681.07	168.9	-0.3301
16	735	733.02	731.48	730.45	730.01	730.2	731.07	732.64	734.91	737.9	741.62	746.04	751.11	169.9	-0.2086
17	805	803.02	801.48	800.45	800.01	800.23	801.17	802.8	805.09	807.97	811.37	815.21	819.45	173.7	-0.093
18	875	873.02	871.54	870.63	870.3	870.49	871.15	872.22	873.64	875.37	877.36	879.55	881.91	179.4	-0.0073
19	945	943.06	941.61	940.69	940.25	940.26	940.67	941.43	942.49	943.81	945.33	947.01	948.81	-179.1	0.0098
20	1015	1013.06	1011.61	1010.69	1010.25	1010.26	1010.67	1011.43	1012.49	1013.81	1015.33	1017.01	1018.81	-179.1	0.0098
21	1085	1083.06	1081.61	1080.69	1080.25	1080.26	1080.67	1081.43	1082.49	1083.81	1085.33	1087.01	1088.81	-179.1	0.0098
22	665	662.91	661.06	659.55	658.5	657.97	658.03	658.72	660.06	662.07	664.75	668.12	672.18	171.5	-0.3219
23	735	732.91	731.06	729.55	728.5	727.97	728.03	728.72	730.06	732.07	734.75	738.14	742.24	171.8	-0.2643
24	805	802.91	801.06	799.55	798.5	797.97	798.04	798.77	800.2	802.28	804.95	808.15	811.82	174.6	-0.1219
25	875	872.91	871.06	869.58	868.62	868.21	868.33	868.91	869.9	871.23	872.86	874.74	876.81	179.8	-0.0222
26	945	942.92	941.15	939.78	938.8	938.19	937.91	937.92	938.17	938.63	939.25	939.98	940.79	-176.7	0.0254
27	1015	1012.95	1011.19	1009.79	1008.74	1008.01	1007.57	1007.39	1007.42	1007.62	1007.95	1008.36	1008.82	-175.8	0.0364
28	1085	1082.95	1081.19	1079.79	1078.74	1078.01	1077.57	1077.39	1077.42	1077.62	1077.95	1078.36	1078.82	-175.8	0.0364
29	665	662.8	660.64	658.65	656.99	655.74	654.99	654.79	655.19	656.2	657.85	660.16	663.13	174.2	-0.3126
30	735	732.8	730.64	728.65	726.99	725.74	724.99	724.79	725.19	726.2	727.85	730.16	733.13	174.2	-0.3126
31	805	802.8	800.64	798.65	796.99	795.74	794.99	794.79	795.21	796.27	797.99	800.32	803.21	175.9	-0.1635
32	875	872.8	870.64	868.65	867.01	865.85	865.21	865.09	865.44	866.21	867.33	868.75	870.41	-179.6	-0.0425
33	945	942.8	940.69	938.84	937.29	936.03	935.02	934.24	933.64	933.2	932.86	932.59	932.35	-174.2	0.0428
34	1015	1012.83	1010.77	1008.91	1007.27	1005.84	1004.6	1003.53	1002.58	1001.71	1000.91	1000.11	999.29	-172.6	0.0621
35	1085	1082.83	1080.77	1078.89	1077.23	1075.77	1074.5	1073.37	1072.37	1071.45	1070.58	1069.71	1068.81	-172.4	0.0646

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: +10 deg. **Input file: ROUTE216.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.12	658.11	655.95	654.62	654.11	654.39	655.45	657.27	659.84	663.13	667.13	671.83	170.3	-0.3124
2	735	731.12	728.11	725.95	724.62	724.11	724.39	725.45	727.27	729.84	733.14	737.18	741.9	170.9	-0.2285
3	805	801.12	798.11	795.95	794.62	794.13	794.48	795.61	797.46	799.95	803.01	806.56	810.52	174.7	-0.0853
4	875	871.14	868.22	866.18	864.93	864.37	864.4	864.94	865.91	867.24	868.85	870.68	872.68	-179.3	0.0112
5	945	941.15	938.24	936.18	934.85	934.16	934.02	934.35	935.06	936.09	937.37	938.84	940.44	-178.2	0.0253
6	1015	1011.15	1008.24	1006.18	1004.85	1004.16	1004.02	1004.35	1005.06	1006.09	1007.37	1008.84	1010.44	-178.2	0.0253
7	1085	1081.15	1078.24	1076.18	1074.85	1074.16	1074.02	1074.35	1075.06	1076.09	1077.37	1078.84	1080.44	-178.2	0.0253
8	665	661	657.68	655.05	653.14	651.98	651.55	651.85	652.89	654.64	657.1	660.25	664.09	172.5	-0.3068
9	735	731	727.68	725.05	723.14	721.98	721.55	721.85	722.89	724.64	727.1	730.25	734.12	172.6	-0.2805
10	805	801	797.68	795.05	793.14	791.98	791.55	791.88	792.99	794.82	797.28	800.32	803.86	175.2	-0.1192
11	875	871	867.71	865.16	863.37	862.3	861.87	862	862.59	863.58	864.9	866.47	868.25	-179	-0.0032
12	945	941.03	937.8	935.27	933.37	932.01	931.13	930.65	930.5	930.61	930.93	931.39	931.93	-175.6	0.042
13	1015	1011.03	1007.8	1005.27	1003.37	1002.01	1001.13	1000.65	1000.5	1000.61	1000.93	1001.39	1001.93	-175.6	0.042
14	1085	1081.03	1077.8	1075.27	1073.37	1072.01	1071.13	1070.65	1070.5	1070.61	1070.93	1071.39	1071.93	-175.6	0.042
15	665	660.89	657.25	654.14	651.63	649.76	648.56	648.03	648.18	649.01	650.52	652.71	655.56	174.9	-0.2992
16	735	730.89	727.25	724.14	721.63	719.76	718.56	718.03	718.18	719.01	720.52	722.71	725.56	174.9	-0.2992
17	805	800.89	797.25	794.14	791.63	789.76	788.56	788.03	788.18	789.04	790.63	792.88	795.73	176.1	-0.1728
18	875	870.89	867.25	864.14	861.67	859.9	858.81	858.35	858.43	858.98	859.93	861.2	862.72	-178.7	-0.026
19	945	940.9	937.34	934.37	931.95	929.99	928.46	927.27	926.38	925.7	925.2	924.8	924.45	-173.5	0.0543
20	1015	1010.92	1007.37	1004.37	1001.86	999.78	998.09	996.71	995.59	994.67	993.88	993.18	992.49	-172.6	0.0645
21	1085	1080.92	1077.37	1074.37	1071.86	1069.78	1068.09	1066.71	1065.6	1064.67	1063.88	1063.18	1062.49	-172.6	0.0645
22	665	660.78	656.82	653.23	650.1	647.5	645.46	644.03	643.23	643.05	643.51	644.61	646.36	177.6	-0.2894
23	735	730.78	726.82	723.23	720.1	717.5	715.46	714.03	713.23	713.05	713.51	714.61	716.36	177.6	-0.2894
24	805	800.78	796.82	793.23	790.1	787.5	785.46	784.03	783.23	783.05	783.51	784.64	786.45	177.9	-0.2366
25	875	870.78	866.82	863.23	860.1	857.52	855.57	854.25	853.54	853.38	853.68	854.41	855.48	-178.2	-0.062
26	945	940.78	936.86	933.38	930.35	927.73	925.46	923.49	921.76	920.21	918.78	917.41	916.05	-171.1	0.0523
27	1015	1010.81	1006.96	1003.5	1000.39	997.6	995.09	992.8	990.69	988.69	986.76	984.83	982.85	-169.4	0.0897
28	1085	1080.81	1076.95	1073.46	1070.33	1067.51	1064.95	1062.62	1060.44	1058.38	1056.37	1054.37	1052.3	-169.2	0.0922
29	665	660.66	656.39	652.32	648.58	645.24	642.39	640.05	638.27	637.07	636.46	636.45	637.05	-179.6	-0.2786
30	735	730.66	726.39	722.32	718.58	715.24	712.39	710.05	708.27	707.07	706.46	706.45	707.05	-179.6	-0.2786
31	805	800.66	796.39	792.32	788.58	785.24	782.39	780.05	778.27	777.07	776.46	776.45	777.05	-179.6	-0.2786
32	875	870.66	866.39	862.32	858.58	855.24	852.39	850.08	848.38	847.28	846.75	846.74	847.19	-177.5	-0.1269
33	945	940.66	936.39	932.36	928.72	925.54	922.8	920.47	918.47	916.74	915.22	913.84	912.57	-171.6	0.0359
34	1015	1010.67	1006.49	1002.57	998.9	995.48	992.25	989.18	986.21	983.29	980.38	977.43	974.37	-166.8	0.1086
35	1085	1080.69	1076.52	1072.55	1068.81	1065.25	1061.86	1058.58	1055.37	1052.18	1048.96	1045.66	1042.23	-165.8	0.1195

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: +10 deg. **Input file: ROUTE226.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.11	658.07	655.87	654.49	653.93	654.16	655.18	656.97	659.51	662.79	666.8	671.52	169.9	-0.3244
2	735	731.11	728.07	725.87	724.49	723.93	724.16	725.18	726.97	729.51	732.81	736.86	741.6	170.5	-0.2386
3	805	801.11	798.07	795.87	794.49	793.95	794.25	795.34	797.15	799.62	802.66	806.21	810.19	174.3	-0.1
4	875	871.13	868.18	866.1	864.8	864.19	864.17	864.67	865.61	866.91	868.53	870.39	872.44	-179.8	-0.0085
5	945	941.14	938.2	936.09	934.72	933.98	933.79	934.08	934.76	935.78	937.07	938.57	940.23	-178.7	0.0051
6	1015	1011.14	1008.2	1006.09	1004.72	1003.98	1003.79	1004.08	1004.76	1005.78	1007.07	1008.57	1010.23	-178.7	0.0051
7	1085	1081.14	1078.2	1076.09	1074.72	1073.98	1073.79	1074.08	1074.76	1075.78	1077.07	1078.57	1080.22	-178.7	0.0051
8	665	660.99	657.64	654.97	653.01	651.8	651.32	651.59	652.59	654.33	656.78	659.95	663.82	172.1	-0.3192
9	735	730.99	727.64	724.97	723.01	721.8	721.32	721.59	722.59	724.33	726.78	729.95	733.86	172.2	-0.2868
10	805	800.99	797.64	794.97	793.01	791.8	791.32	791.62	792.7	794.51	796.97	800.03	803.59	174.9	-0.1279
11	875	870.99	867.67	865.08	863.24	862.12	861.64	861.73	862.3	863.27	864.6	866.2	868.03	-179.5	-0.0225
12	945	941.02	937.76	935.19	933.24	931.83	930.9	930.38	930.2	930.31	930.64	931.13	931.74	-176.2	0.0212
13	1015	1011.02	1007.76	1005.19	1003.24	1001.83	1000.9	1000.38	1000.2	1000.31	1000.64	1001.13	1001.74	-176.2	0.0212
14	1085	1081.02	1077.76	1075.19	1073.24	1071.83	1070.9	1070.38	1070.2	1070.31	1070.64	1071.13	1071.74	-176.2	0.0212
15	665	660.88	657.21	654.06	651.5	649.59	648.34	647.77	647.89	648.71	650.23	652.43	655.33	174.5	-0.312
16	735	730.88	727.21	724.06	721.5	719.59	718.34	717.77	717.89	718.71	720.23	722.43	725.33	174.5	-0.312
17	805	800.88	797.21	794.06	791.5	789.59	788.34	787.77	787.9	788.76	790.34	792.61	795.48	175.8	-0.1791
18	875	870.88	867.21	864.06	861.54	859.72	858.59	858.08	858.14	858.68	859.62	860.92	862.49	-179.2	-0.0441
19	945	940.89	937.3	934.29	931.82	929.81	928.23	927.01	926.09	925.41	924.92	924.56	924.28	-174	0.0331
20	1015	1010.91	1007.33	1004.29	1001.73	999.6	997.86	996.45	995.31	994.38	993.61	992.94	992.34	-173.2	0.043
21	1085	1080.91	1077.33	1074.29	1071.73	1069.6	1067.86	1066.45	1065.31	1064.38	1063.61	1062.94	1062.34	-173.2	0.043
22	665	660.76	656.78	653.15	649.97	647.32	645.24	643.78	642.95	642.76	643.23	644.37	646.16	177.2	-0.3028
23	735	730.76	726.78	723.15	719.97	717.32	715.24	713.78	712.95	712.76	713.23	714.37	716.16	177.2	-0.3028
24	805	800.76	796.78	793.15	789.97	787.32	785.24	783.78	782.95	782.76	783.23	784.4	786.26	177.5	-0.2427
25	875	870.76	866.78	863.15	859.97	857.35	855.35	854	853.26	853.07	853.38	854.13	855.24	-178.7	-0.0795
26	945	940.76	936.82	933.3	930.22	927.55	925.24	923.24	921.5	919.95	918.55	917.25	915.99	-171.7	0.047
27	1015	1010.8	1006.92	1003.41	1000.26	997.42	994.86	992.54	990.4	988.4	986.49	984.61	982.72	-170	0.068
28	1085	1080.8	1076.91	1073.38	1070.2	1067.32	1064.73	1062.35	1060.16	1058.09	1056.11	1054.15	1052.18	-169.8	0.0705
29	665	660.65	656.35	652.24	648.45	645.07	642.17	639.8	638	636.79	636.2	636.23	636.89	179.9	-0.2925
30	735	730.65	726.35	722.24	718.45	715.07	712.17	709.8	708	706.79	706.2	706.23	706.89	179.9	-0.2925
31	805	800.65	796.35	792.24	788.45	785.07	782.17	779.8	778	776.79	776.2	776.23	776.89	179.9	-0.2925
32	875	870.65	866.35	862.24	858.45	855.07	852.17	849.83	848.11	847.01	846.49	846.51	846.99	-177.9	-0.1377
33	945	940.65	936.35	932.28	928.59	925.36	922.58	920.21	918.18	916.45	914.95	913.63	912.43	-172.2	0.0146
34	1015	1010.66	1006.45	1002.49	998.77	995.3	992.02	988.91	985.92	983.01	980.12	977.22	974.25	-167.4	0.0874
35	1085	1080.68	1076.48	1072.47	1068.68	1065.07	1061.63	1058.31	1055.08	1051.89	1048.69	1045.45	1042.1	-166.4	0.0989

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: +10 deg. **Input file: ROUTE236.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.1	658.06	655.83	654.43	653.84	654.06	655.06	656.83	659.36	662.64	666.64	671.37	169.7	-0.33
2	735	731.1	728.06	725.83	724.43	723.84	724.06	725.06	726.83	729.36	732.65	736.71	741.47	170.4	-0.2372
3	805	801.1	798.06	795.83	794.43	793.87	794.14	795.22	797.01	799.46	802.5	806.05	810.04	174.1	-0.1069
4	875	871.12	868.16	866.06	864.74	864.1	864.06	864.54	865.46	866.76	868.38	870.25	872.33	180	-0.0176
5	945	941.13	938.18	936.06	934.66	933.9	933.69	933.95	934.62	935.63	936.92	938.44	940.12	-178.9	-0.0043
6	1015	1011.13	1008.18	1006.06	1004.66	1003.9	1003.69	1003.95	1004.62	1005.63	1006.92	1008.44	1010.12	-178.9	-0.0043
7	1085	1081.13	1078.18	1076.06	1074.66	1073.9	1073.69	1073.95	1074.62	1075.63	1076.92	1078.44	1080.12	-178.9	-0.0043
8	665	660.98	657.62	654.93	652.95	651.71	651.22	651.47	652.45	654.18	656.63	659.81	663.69	171.9	-0.325
9	735	730.98	727.62	724.93	722.95	721.71	721.22	721.47	722.45	724.18	726.63	729.82	733.74	172	-0.2877
10	805	800.98	797.62	794.93	792.95	791.71	791.22	791.5	792.56	794.35	796.81	799.87	803.45	174.7	-0.136
11	875	870.98	867.65	865.04	863.18	862.03	861.54	861.6	862.16	863.13	864.45	866.07	867.93	-179.7	-0.0315
12	945	941.02	937.74	935.15	933.18	931.75	930.8	930.25	930.06	930.16	930.5	931.01	931.66	-176.4	0.0114
13	1015	1011.02	1007.74	1005.15	1003.18	1001.75	1000.8	1000.25	1000.06	1000.16	1000.5	1001.01	1001.66	-176.4	0.0114
14	1085	1081.02	1077.74	1075.15	1073.18	1071.75	1070.8	1070.26	1070.06	1070.16	1070.5	1071.01	1071.66	-176.4	0.0114
15	665	660.87	657.19	654.02	651.44	649.5	648.23	647.65	647.76	648.57	650.09	652.3	655.21	174.3	-0.318
16	735	730.87	727.19	724.02	721.44	719.5	718.23	717.65	717.76	718.57	720.09	722.3	725.21	174.3	-0.318
17	805	800.87	797.19	794.02	791.44	789.5	788.23	787.65	787.77	788.62	790.21	792.48	795.36	175.7	-0.1835
18	875	870.87	867.19	864.02	861.48	859.64	858.48	857.96	858	858.53	859.48	860.78	862.38	-179.4	-0.0526
19	945	940.88	937.28	934.25	931.75	929.73	928.12	926.88	925.95	925.27	924.78	924.45	924.21	-174.3	0.023
20	1015	1010.9	1007.32	1004.25	1001.66	999.52	997.76	996.32	995.17	994.24	993.48	992.84	992.27	-173.5	0.0328
21	1085	1080.9	1077.32	1074.25	1071.66	1069.52	1067.76	1066.32	1065.17	1064.24	1063.48	1062.84	1062.27	-173.5	0.0328
22	665	660.76	656.76	653.11	649.91	647.24	645.14	643.66	642.81	642.63	643.1	644.25	646.07	177	-0.3091
23	735	730.76	726.76	723.11	719.91	717.24	715.14	713.66	712.81	712.63	713.1	714.25	716.07	177	-0.3091
24	805	800.76	796.76	793.11	789.91	787.24	785.14	783.66	782.81	782.63	783.11	784.29	786.18	177.3	-0.2458
25	875	870.76	866.76	863.11	859.91	857.26	855.24	853.88	853.12	852.93	853.24	853.99	855.11	-178.8	-0.0836
26	945	940.76	936.8	933.26	930.16	927.47	925.14	923.12	921.37	919.83	918.44	917.17	915.95	-172	0.0365
27	1015	1010.79	1006.9	1003.37	1000.19	997.33	994.76	992.41	990.27	988.26	986.36	984.5	982.65	-170.3	0.0577
28	1085	1080.79	1076.89	1073.34	1070.14	1067.24	1064.62	1062.23	1060.02	1057.96	1055.98	1054.05	1052.12	-170.1	0.0602
29	665	660.64	656.33	652.2	648.39	644.98	642.06	639.68	637.87	636.66	636.08	636.13	636.82	179.7	-0.299
30	735	730.64	726.33	722.2	718.39	714.98	712.06	709.68	707.87	706.66	706.08	706.13	706.82	179.7	-0.299
31	805	800.64	796.33	792.2	788.39	784.98	782.06	779.68	777.87	776.66	776.08	776.13	776.82	179.7	-0.299
32	875	870.64	866.33	862.2	858.39	854.98	852.06	849.71	847.98	846.88	846.37	846.4	846.9	-178.1	-0.1432
33	945	940.64	936.33	932.24	928.53	925.27	922.47	920.08	918.05	916.32	914.82	913.52	912.36	-172.5	0.0046
34	1015	1010.66	1006.43	1002.45	998.71	995.21	991.92	988.79	985.79	982.87	980	977.12	974.19	-167.7	0.0772
35	1085	1080.68	1076.46	1072.43	1068.61	1064.99	1061.52	1058.19	1054.95	1051.76	1048.57	1045.35	1042.05	-166.7	0.0888

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: +10 deg. **Input file: ROUTE246.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.1	658.03	655.79	654.36	653.74	653.93	654.9	656.66	659.18	662.45	666.46	671.2	169.5	-0.3367
2	735	731.1	728.03	725.79	724.36	723.74	723.93	724.9	726.66	729.18	732.47	736.52	741.29	170.2	-0.2423
3	805	801.1	798.03	795.79	794.36	793.77	794.02	795.06	796.84	799.29	802.32	805.86	809.85	173.9	-0.1123
4	875	871.12	868.14	866.01	864.66	864	863.93	864.39	865.29	866.58	868.2	870.08	872.19	179.7	-0.0284
5	945	941.13	938.16	936.01	934.59	933.8	933.56	933.8	934.45	935.45	936.75	938.28	940	-179.2	-0.0154
6	1015	1011.13	1008.16	1006.01	1004.59	1003.8	1003.56	1003.8	1004.45	1005.45	1006.75	1008.28	1010	-179.2	-0.0154
7	1085	1081.13	1078.16	1076.01	1074.59	1073.8	1073.56	1073.8	1074.45	1075.45	1076.75	1078.28	1080	-179.2	-0.0154
8	665	660.98	657.6	654.88	652.88	651.61	651.09	651.32	652.29	654	656.45	659.63	663.54	171.6	-0.3319
9	735	730.98	727.6	724.88	722.88	721.61	721.09	721.32	722.29	724	726.45	729.64	733.57	171.8	-0.2866
10	805	800.98	797.6	794.88	792.88	791.61	791.09	791.35	792.4	794.18	796.63	799.69	803.29	174.4	-0.1436
11	875	870.98	867.63	864.99	863.11	861.93	861.41	861.45	861.99	862.95	864.28	865.92	867.8	180	-0.042
12	945	941.01	937.72	935.11	933.1	931.65	930.67	930.1	929.9	929.99	930.34	930.87	931.56	-176.7	-0.0002
13	1015	1011.01	1007.72	1005.11	1003.1	1001.65	1000.67	1000.1	999.9	999.99	1000.34	1000.87	1001.56	-176.7	-0.0002
14	1085	1081.01	1077.72	1075.11	1073.1	1071.65	1070.67	1070.1	1069.9	1069.99	1070.34	1070.87	1071.56	-176.7	-0.0002
15	665	660.87	657.17	653.98	651.37	649.4	648.1	647.5	647.6	648.4	649.92	652.15	655.08	174.1	-0.3251
16	735	730.87	727.17	723.98	721.37	719.4	718.1	717.5	717.6	718.4	719.92	722.15	725.08	174.1	-0.3251
17	805	800.87	797.17	793.98	791.37	789.4	788.1	787.5	787.61	788.46	790.05	792.32	795.22	175.5	-0.1887
18	875	870.87	867.17	863.98	861.41	859.54	858.36	857.81	857.83	858.36	859.31	860.62	862.25	-179.7	-0.0625
19	945	940.88	937.26	934.21	931.68	929.63	928	926.73	925.78	925.1	924.62	924.31	924.11	-174.6	0.0111
20	1015	1010.9	1007.29	1004.2	1001.59	999.42	997.63	996.17	995.01	994.07	993.32	992.71	992.18	-173.8	0.0208
21	1085	1080.9	1077.29	1074.2	1071.59	1069.42	1067.63	1066.17	1065.01	1064.07	1063.32	1062.71	1062.18	-173.8	0.0208
22	665	660.75	656.74	653.07	649.84	647.14	645.01	643.51	642.66	642.47	642.95	644.11	645.96	176.7	-0.3165
23	735	730.75	726.74	723.07	719.84	717.14	715.01	713.51	712.66	712.47	712.95	714.11	715.96	176.7	-0.3165
24	805	800.75	796.74	793.07	789.84	787.14	785.01	783.51	782.66	782.47	782.96	784.16	786.08	177.1	-0.2482
25	875	870.75	866.74	863.07	859.84	857.16	855.12	853.73	852.97	852.77	853.08	853.84	854.97	-179	-0.0885
26	945	940.75	936.78	933.21	930.09	927.37	925.02	922.98	921.22	919.68	918.32	917.08	915.92	-172.4	0.0241
27	1015	1010.79	1006.88	1003.33	1000.12	997.23	994.63	992.27	990.1	988.1	986.21	984.38	982.58	-170.6	0.0453
28	1085	1080.79	1076.87	1073.3	1070.06	1067.14	1064.49	1062.08	1059.86	1057.79	1055.83	1053.93	1052.05	-170.5	0.0478
29	665	660.64	656.31	652.16	648.32	644.88	641.94	639.54	637.72	636.51	635.93	636	636.73	179.4	-0.3067
30	735	730.64	726.31	722.16	718.32	714.88	711.94	709.54	707.72	706.51	705.93	706	706.73	179.4	-0.3067
31	805	800.64	796.31	792.16	788.32	784.88	781.94	779.54	777.72	776.51	775.93	776	776.73	179.4	-0.3067
32	875	870.64	866.31	862.16	858.32	854.88	851.94	849.57	847.83	846.73	846.23	846.26	846.79	-178.2	-0.1393
33	945	940.64	936.31	932.19	928.45	925.17	922.35	919.94	917.89	916.16	914.68	913.4	912.28	-172.8	-0.0071
34	1015	1010.65	1006.41	1002.4	998.64	995.11	991.79	988.64	985.63	982.71	979.85	977	974.13	-168	0.0649
35	1085	1080.67	1076.44	1072.39	1068.54	1064.88	1061.4	1058.04	1054.79	1051.6	1048.42	1045.23	1041.98	-167.1	0.0767

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: +10 deg. **Input file: ROUTE256.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	661.09	658.02	655.75	654.31	653.67	653.83	654.79	656.53	659.04	662.3	666.32	671.06	169.4	-0.3416
2	735	731.09	728.02	725.75	724.31	723.67	723.83	724.79	726.53	729.04	732.32	736.38	741.16	170	-0.2461
3	805	801.09	798.02	795.75	794.31	793.69	793.92	794.95	796.71	799.15	802.17	805.71	809.71	173.8	-0.1185
4	875	871.11	868.12	865.98	864.61	863.92	863.83	864.27	865.16	866.44	868.06	869.96	872.09	179.5	-0.0364
5	945	941.12	938.14	935.98	934.53	933.72	933.46	933.68	934.32	935.32	936.62	938.16	939.91	-179.5	-0.0237
6	1015	1011.12	1008.14	1005.98	1004.53	1003.72	1003.46	1003.68	1004.32	1005.32	1006.62	1008.16	1009.91	-179.5	-0.0237
7	1085	1081.12	1078.14	1075.98	1074.53	1073.72	1073.46	1073.68	1074.32	1075.32	1076.62	1078.16	1079.91	-179.5	-0.0237
8	665	660.97	657.58	654.85	652.83	651.54	651	651.2	652.16	653.87	656.32	659.5	663.42	171.5	-0.337
9	735	730.97	727.58	724.85	722.83	721.54	721	721.2	722.16	723.87	726.32	729.52	733.46	171.7	-0.2887
10	805	800.97	797.58	794.85	792.83	791.54	791	791.24	792.27	794.04	796.49	799.56	803.16	174.3	-0.1493
11	875	870.97	867.61	864.96	863.05	861.86	861.31	861.34	861.86	862.82	864.15	865.8	867.71	179.8	-0.0498
12	945	941	937.7	935.07	933.05	931.57	930.57	929.99	929.77	929.86	930.21	930.76	931.48	-177	-0.0089
13	1015	1011	1007.7	1005.07	1003.05	1001.57	1000.57	999.99	999.77	999.86	1000.21	1000.76	1001.48	-177	-0.0089
14	1085	1081	1077.7	1075.07	1073.05	1071.57	1070.57	1069.99	1069.77	1069.86	1070.21	1070.76	1071.48	-177	-0.0089
15	665	660.86	657.15	653.94	651.31	649.33	648.01	647.39	647.48	648.28	649.79	652.03	654.98	173.9	-0.3305
16	735	730.86	727.15	723.94	721.31	719.33	718.01	717.39	717.48	718.28	719.79	722.03	724.98	173.9	-0.3305
17	805	800.86	797.15	793.94	791.31	789.33	788.01	787.39	787.49	788.35	789.93	792.18	795.05	175.4	-0.1915
18	875	870.86	867.15	863.94	861.35	859.46	858.26	857.7	857.71	858.23	859.18	860.51	862.15	-179.9	-0.07
19	945	940.87	937.24	934.17	931.62	929.55	927.9	926.62	925.66	924.97	924.5	924.21	924.05	-174.9	0.0022
20	1015	1010.89	1007.28	1004.17	1001.54	999.34	997.53	996.06	994.88	993.95	993.2	992.61	992.12	-174	0.0117
21	1085	1080.89	1077.28	1074.17	1071.54	1069.34	1067.53	1066.06	1064.88	1063.94	1063.2	1062.61	1062.12	-174	0.0117
22	665	660.75	656.72	653.03	649.78	647.06	644.92	643.4	642.54	642.34	642.83	644.01	645.88	176.5	-0.322
23	735	730.75	726.72	723.03	719.78	717.06	714.92	713.4	712.54	712.34	712.83	714.01	715.88	176.5	-0.322
24	805	800.75	796.72	793.03	789.78	787.06	784.92	783.4	782.54	782.34	782.85	784.07	786	177	-0.2479
25	875	870.75	866.72	863.03	859.78	857.09	855.03	853.62	852.85	852.64	852.96	853.72	854.86	-179.2	-0.0952
26	945	940.75	936.76	933.18	930.03	927.29	924.92	922.88	921.11	919.57	918.22	917.01	915.89	-172.6	0.0147
27	1015	1010.78	1006.86	1003.29	1000.06	997.15	994.53	992.15	989.98	987.98	986.09	984.29	982.53	-170.9	0.0358
28	1085	1080.78	1076.85	1073.26	1070.01	1067.06	1064.39	1061.97	1059.74	1057.67	1055.72	1053.84	1052	-170.7	0.0383
29	665	660.63	656.29	652.12	648.26	644.81	641.85	639.43	637.6	636.39	635.82	635.91	636.66	179.3	-0.3125
30	735	730.63	726.29	722.12	718.26	714.81	711.85	709.43	707.6	706.39	705.82	705.91	706.66	179.3	-0.3125
31	805	800.63	796.29	792.12	788.26	784.81	781.85	779.43	777.6	776.39	775.82	775.91	776.66	179.3	-0.3114
32	875	870.63	866.29	862.12	858.26	854.81	851.85	849.46	847.72	846.61	846.11	846.16	846.7	-178.4	-0.1458
33	945	940.63	936.29	932.16	928.4	925.09	922.25	919.83	917.77	916.04	914.56	913.31	912.22	-173	-0.0159
34	1015	1010.65	1006.39	1002.37	998.58	995.03	991.69	988.53	985.51	982.59	979.74	976.92	974.08	-168.3	0.0554
35	1085	1080.67	1076.42	1072.35	1068.49	1064.81	1061.3	1057.93	1054.67	1051.47	1048.31	1045.15	1041.94	-167.3	0.0674

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 0% Heading: +15 deg. **Input file: ROUTE217.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.98	653.84	649.52	646.02	643.33	641.44	640.31	639.95	640.32	641.43	643.25	645.77	175.5	-0.3113
2	735	728.98	723.84	719.52	716.02	713.33	711.44	710.31	709.95	710.32	711.43	713.25	715.77	175.5	-0.3113
3	805	798.98	793.84	789.52	786.02	783.33	781.44	780.31	779.95	780.33	781.48	783.38	785.94	176.3	-0.2127
4	875	868.98	863.84	859.53	856.08	853.5	851.71	850.63	850.18	850.28	850.86	851.84	853.15	-178.7	-0.0585
5	945	939.01	933.96	929.73	926.23	923.34	920.99	919.08	917.55	916.32	915.32	914.49	913.78	-173	0.0287
6	1015	1009.01	1003.96	999.73	996.23	993.34	990.99	989.08	987.55	986.32	985.32	984.49	983.78	-173	0.0287
7	1085	1079.01	1073.96	1069.73	1066.23	1063.34	1060.99	1059.08	1057.55	1056.32	1055.32	1054.49	1053.78	-173	0.0287
8	665	658.87	653.4	648.61	644.53	641.18	638.56	636.66	635.49	635.04	635.28	636.23	637.87	177.6	-0.3056
9	735	728.87	723.4	718.61	714.53	711.18	708.56	706.66	705.49	705.04	705.28	706.23	707.87	177.6	-0.3056
10	805	798.87	793.4	788.61	784.53	781.18	778.56	776.66	775.49	775.04	775.28	776.25	777.93	177.8	-0.2627
11	875	868.87	863.4	858.61	854.53	851.21	848.67	846.89	845.81	845.36	845.46	846.05	847.07	-178.5	-0.0965
12	945	938.88	933.5	928.85	924.85	921.41	918.46	915.92	913.73	911.81	910.1	908.53	907.04	-171.3	0.0116
13	1015	1008.9	1003.52	998.82	994.73	991.17	988.07	985.34	982.93	980.77	978.8	976.95	975.16	-170.4	0.0456
14	1085	1078.9	1073.52	1068.82	1064.73	1061.17	1058.07	1055.34	1052.93	1050.77	1048.8	1046.95	1045.16	-170.4	0.0456
15	665	658.75	652.97	647.7	643.01	638.95	635.54	632.79	630.72	629.33	628.6	628.55	629.17	-179.9	-0.2978
16	735	728.75	722.97	717.7	713.01	708.95	705.54	702.79	700.72	699.33	698.6	698.55	699.17	-179.9	-0.2978
17	805	798.75	792.97	787.7	783.01	778.95	775.54	772.79	770.72	769.33	768.6	768.55	769.17	-179.9	-0.2978
18	875	868.75	862.97	857.7	853.01	848.95	845.54	842.8	840.77	839.47	838.84	838.81	839.32	-178.1	-0.1542
19	945	938.75	933	927.84	923.3	919.4	916.06	913.22	910.81	908.74	906.96	905.4	903.99	-171.6	-0.0001
20	1015	1008.79	1003.11	997.96	993.29	989.05	985.17	981.6	978.27	975.12	972.11	969.16	966.22	-167.6	0.066
21	1085	1078.78	1073.09	1067.91	1063.21	1058.93	1055	1051.38	1047.99	1044.78	1041.69	1038.67	1035.65	-167.4	0.0683
22	665	658.64	652.54	646.78	641.47	636.67	632.42	628.77	625.72	623.3	621.51	620.35	619.83	-177.2	-0.2879
23	735	728.64	722.54	716.78	711.47	706.67	702.42	698.77	695.72	693.3	691.51	690.35	689.83	-177.2	-0.2879
24	805	798.64	792.54	786.78	781.47	776.67	772.42	768.77	765.72	763.3	761.51	760.35	759.83	-177.2	-0.2879
25	875	868.64	862.54	856.78	851.47	846.67	842.42	838.77	835.72	833.3	831.53	830.45	830.03	-176.8	-0.2185
26	945	938.64	932.54	926.78	921.51	916.83	912.74	909.23	906.22	903.66	901.49	899.65	898.1	-171.8	-0.0631
27	1015	1008.66	1002.64	997.03	991.8	986.9	982.29	977.91	973.72	969.65	965.65	961.66	957.62	-165.1	0.0527
28	1085	1078.67	1072.66	1067	1061.68	1056.64	1051.85	1047.27	1042.82	1038.47	1034.16	1029.83	1025.44	-164	0.0961
29	665	658.53	652.1	645.87	639.94	634.41	629.34	624.77	620.75	617.29	614.41	612.13	610.45	-174.5	-0.277
30	735	728.53	722.1	715.87	709.94	704.41	699.34	694.77	690.75	687.29	684.41	682.13	680.45	-174.5	-0.277
31	805	798.53	792.1	785.87	779.94	774.41	769.34	764.77	760.75	757.29	754.41	752.13	750.45	-174.5	-0.277
32	875	868.53	862.1	855.87	849.94	844.41	839.34	834.77	830.75	827.29	824.41	822.13	820.45	-174.5	-0.277
33	945	938.53	932.1	925.87	919.94	914.41	909.38	904.93	901.05	897.71	894.87	892.46	890.43	-171.4	-0.1035
34	1015	1008.53	1002.15	996.02	990.2	984.66	979.37	974.27	969.31	964.45	959.65	954.88	950.15	-164	-0.014
35	1085	1078.56	1072.25	1066.15	1060.24	1054.53	1048.96	1043.5	1038.1	1032.71	1027.28	1021.77	1016.13	-160.9	0.1204

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 50% Heading: +15 deg. **Input file: ROUTE227.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.97	653.8	649.44	645.9	643.16	641.22	640.06	639.67	640.03	641.13	642.97	645.52	175	-0.3237
2	735	728.97	723.8	719.44	715.9	713.16	711.22	710.06	709.67	710.03	711.13	712.97	715.52	175	-0.3237
3	805	798.97	793.8	789.44	785.9	783.16	781.22	780.06	779.67	780.05	781.21	783.1	785.67	176	-0.2188
4	875	868.97	863.8	859.45	855.95	853.32	851.49	850.38	849.9	849.98	850.56	851.55	852.91	-179.1	-0.0753
5	945	939	933.92	929.66	926.1	923.17	920.77	918.83	917.26	916.02	915.04	914.25	913.6	-173.5	0.0083
6	1015	1009	1003.92	999.66	996.1	993.17	990.77	988.83	987.26	986.02	985.04	984.25	983.6	-173.5	0.0083
7	1085	1079	1073.92	1069.66	1066.1	1063.17	1060.77	1058.83	1057.26	1056.02	1055.04	1054.25	1053.6	-173.5	0.0083
8	665	658.86	653.36	648.53	644.41	641.01	638.35	636.42	635.22	634.75	635	635.97	637.65	177.2	-0.3183
9	735	728.86	723.36	718.53	714.41	711.01	708.35	706.42	705.22	704.75	705	705.97	707.65	177.2	-0.3183
10	805	798.86	793.36	788.53	784.41	781.01	778.35	776.42	775.22	774.75	775	775.99	777.73	177.4	-0.2682
11	875	868.86	863.36	858.53	854.41	851.04	848.46	846.64	845.54	845.07	845.16	845.76	846.8	-178.9	-0.1108
12	945	938.87	933.46	928.77	924.72	921.24	918.24	915.67	913.45	911.52	909.82	908.3	906.89	-171.8	0.0105
13	1015	1008.89	1003.48	998.75	994.61	991	987.85	985.09	982.66	980.49	978.53	976.72	975	-171	0.0247
14	1085	1078.89	1073.48	1068.75	1064.61	1061	1057.85	1055.09	1052.66	1050.49	1048.53	1046.72	1045	-171	0.0247
15	665	658.74	652.93	647.62	642.89	638.78	635.33	632.55	630.46	629.05	628.34	628.32	628.99	179.6	-0.3109
16	735	728.74	722.93	717.62	712.89	708.78	705.33	702.55	700.46	699.05	698.34	698.32	698.99	179.6	-0.3109
17	805	798.74	792.93	787.62	782.89	778.78	775.33	772.55	770.46	769.05	768.34	768.32	768.99	179.6	-0.3109
18	875	868.74	862.93	857.62	852.89	848.78	845.33	842.58	840.56	839.26	838.63	838.6	839.11	-178.3	-0.1636
19	945	938.74	932.97	927.76	923.18	919.22	915.84	912.97	910.53	908.45	906.68	905.16	903.82	-172.1	-0.0124
20	1015	1008.78	1003.07	997.88	993.17	988.88	984.95	981.35	978	974.85	971.85	968.94	966.08	-168.2	0.0448
21	1085	1078.77	1073.05	1067.84	1063.09	1058.76	1054.79	1051.13	1047.72	1044.51	1041.44	1038.46	1035.51	-168	0.0471
22	665	658.63	652.5	646.71	641.35	636.5	632.21	628.53	625.46	623.04	621.26	620.14	619.68	-177.7	-0.3014
23	735	728.63	722.5	716.71	711.35	706.5	702.21	698.53	695.46	693.04	691.26	690.14	689.68	-177.7	-0.3014
24	805	798.63	792.5	786.71	781.35	776.5	772.21	768.53	765.46	763.04	761.26	760.14	759.68	-177.7	-0.3014
25	875	868.63	862.5	856.71	851.35	846.5	842.21	838.53	835.46	833.04	831.29	830.26	829.89	-177.1	-0.2229
26	945	938.63	932.5	926.71	921.39	916.66	912.54	908.99	905.95	903.38	901.21	899.4	897.9	-172.3	-0.0803
27	1015	1008.65	1002.61	996.95	991.67	986.73	982.07	977.66	973.45	969.37	965.4	961.46	957.53	-165.6	0.0449
28	1085	1078.66	1072.62	1066.93	1061.55	1056.47	1051.64	1047.02	1042.55	1038.2	1033.91	1029.64	1025.32	-164.6	0.0752
29	665	658.51	652.07	645.79	639.82	634.24	629.13	624.53	620.49	617.03	614.18	611.94	610.33	-174.9	-0.2908
30	735	728.51	722.07	715.79	709.82	704.24	699.13	694.53	690.49	687.03	684.18	681.94	680.33	-174.9	-0.2908
31	805	798.51	792.07	785.79	779.82	774.24	769.13	764.53	760.49	757.03	754.18	751.94	750.33	-174.9	-0.2908
32	875	868.51	862.07	855.79	849.82	844.24	839.13	834.53	830.49	827.03	824.18	821.94	820.33	-174.9	-0.2908
33	945	938.51	932.07	925.79	919.82	914.24	909.17	904.7	900.8	897.46	894.62	892.24	890.25	-171.7	-0.1102
34	1015	1008.51	1002.11	995.94	990.07	984.49	979.16	974.03	969.07	964.22	959.46	954.76	950.11	-164.4	-0.0179
35	1085	1078.55	1072.21	1066.07	1060.12	1054.35	1048.74	1043.25	1037.82	1032.43	1027.03	1021.57	1016	-161.5	0.1005

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 75% Heading: +15 deg. **Input file: ROUTE237.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.97	653.78	649.41	645.84	643.08	641.12	639.94	639.53	639.89	640.99	642.83	645.4	174.8	-0.3295
2	735	728.97	723.78	719.41	715.84	713.08	711.12	709.94	709.53	709.89	710.99	712.83	715.4	174.8	-0.3295
3	805	798.97	793.78	789.41	785.84	783.08	781.12	779.94	779.53	779.91	781.07	782.97	785.55	175.8	-0.2225
4	875	868.97	863.78	859.41	855.89	853.24	851.39	850.26	849.77	849.85	850.41	851.39	852.71	-179.2	-0.0764
5	945	939	933.9	929.62	926.04	923.09	920.67	918.7	917.13	915.88	914.9	914.13	913.52	-173.8	-0.0013
6	1015	1009	1003.9	999.62	996.04	993.09	990.67	988.7	987.13	985.88	984.9	984.13	983.52	-173.8	-0.0013
7	1085	1079	1073.9	1069.62	1066.04	1063.09	1060.67	1058.7	1057.13	1055.88	1054.9	1054.13	1053.52	-173.8	-0.0013
8	665	658.85	653.34	648.5	644.35	640.93	638.25	636.3	635.09	634.61	634.87	635.85	637.54	177	-0.3242
9	735	728.85	723.34	718.5	714.35	710.93	708.25	706.3	705.09	704.61	704.87	705.85	707.54	177	-0.3242
10	805	798.85	793.34	788.5	784.35	780.93	778.25	776.3	775.09	774.61	774.87	775.87	777.63	177.2	-0.2707
11	875	868.85	863.34	858.5	854.35	850.96	848.36	846.53	845.41	844.93	845.03	845.63	846.68	-179	-0.1093
12	945	938.87	933.44	928.73	924.66	921.16	918.14	915.55	913.32	911.38	909.69	908.19	906.82	-172	0.0062
13	1015	1008.88	1003.46	998.71	994.55	990.92	987.75	984.97	982.52	980.35	978.4	976.61	974.93	-171.2	0.0148
14	1085	1078.88	1073.46	1068.71	1064.55	1060.92	1057.75	1054.97	1052.52	1050.35	1048.4	1046.61	1044.93	-171.2	0.0148
15	665	658.74	652.91	647.58	642.83	638.7	635.23	632.43	630.33	628.92	628.21	628.21	628.9	179.4	-0.317
16	735	728.74	722.91	717.58	712.83	708.7	705.23	702.43	700.33	698.92	698.21	698.21	698.9	179.4	-0.317
17	805	798.74	792.91	787.58	782.83	778.7	775.23	772.43	770.33	768.92	768.21	768.21	768.9	179.4	-0.317
18	875	868.74	862.91	857.58	852.83	848.7	845.23	842.46	840.44	839.13	838.5	838.48	839	-178.5	-0.1684
19	945	938.74	932.95	927.72	923.12	919.14	915.74	912.85	910.4	908.32	906.55	905.04	903.73	-172.4	-0.0216
20	1015	1008.77	1003.06	997.85	993.11	988.79	984.85	981.23	977.87	974.71	971.72	968.84	966.02	-168.4	0.0348
21	1085	1078.77	1073.03	1067.8	1063.03	1058.68	1054.69	1051.01	1047.59	1044.38	1041.31	1038.36	1035.45	-168.3	0.0371
22	665	658.63	652.48	646.67	641.29	636.42	632.12	628.41	625.34	622.91	621.14	620.04	619.61	-177.9	-0.3077
23	735	728.63	722.48	716.67	711.29	706.42	702.12	698.41	695.34	692.91	691.14	690.04	689.61	-177.9	-0.3077
24	805	798.63	792.48	786.67	781.29	776.42	772.12	768.41	765.34	762.91	761.14	760.04	759.61	-177.9	-0.3077
25	875	868.63	862.48	856.67	851.29	846.42	842.12	838.41	835.34	832.91	831.18	830.16	829.83	-177.3	-0.2253
26	945	938.63	932.48	926.67	921.33	916.58	912.44	908.87	905.83	903.25	901.08	899.28	897.8	-172.5	-0.0777
27	1015	1008.64	1002.59	996.92	991.61	986.65	981.97	977.54	973.32	969.25	965.28	961.37	957.46	-165.9	0.0453
28	1085	1078.66	1072.61	1066.89	1061.49	1056.39	1051.54	1046.9	1042.43	1038.08	1033.8	1029.54	1025.27	-164.9	0.0652
29	665	658.51	652.05	645.76	639.76	634.16	629.03	624.42	620.37	616.91	614.07	611.85	610.27	-175.2	-0.2973
30	735	728.51	722.05	715.76	709.76	704.16	699.03	694.42	690.37	686.91	684.07	681.85	680.27	-175.2	-0.2973
31	805	798.51	792.05	785.76	779.76	774.16	769.03	764.42	760.37	756.91	754.07	751.85	750.27	-175.2	-0.2973
32	875	868.51	862.05	855.76	849.76	844.16	839.03	834.42	830.37	826.91	824.07	821.85	820.27	-175.2	-0.2971
33	945	938.51	932.05	925.76	919.76	914.16	909.08	904.58	900.68	897.34	894.51	892.14	890.17	-171.9	-0.1154
34	1015	1008.51	1002.09	995.9	990.01	984.41	979.06	973.92	968.95	964.09	959.3	954.57	949.89	-164.5	-0.0209
35	1085	1078.55	1072.2	1066.03	1060.06	1054.27	1048.64	1043.13	1037.7	1032.3	1026.91	1021.47	1015.94	-161.7	0.0908

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 100% Heading: +15 deg. **Input file: ROUTE247.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.96	653.76	649.36	645.77	642.99	641	639.8	639.37	639.72	640.82	642.67	645.26	174.6	-0.3363
2	735	728.96	723.76	719.36	715.77	712.99	711	709.8	709.37	709.72	710.82	712.67	715.26	174.6	-0.3363
3	805	798.96	793.76	789.36	785.77	782.99	781	779.8	779.37	779.74	780.9	782.82	785.41	175.6	-0.2219
4	875	868.96	863.76	859.37	855.82	853.15	851.27	850.12	849.61	849.68	850.24	851.23	852.58	-179.4	-0.0857
5	945	938.99	933.88	929.57	925.97	922.99	920.54	918.56	916.97	915.72	914.74	913.99	913.42	-174.1	-0.0125
6	1015	1008.99	1003.88	999.57	995.97	992.99	990.54	988.56	986.97	985.72	984.74	983.99	983.42	-174.1	-0.0125
7	1085	1078.99	1073.88	1069.57	1065.97	1062.99	1060.54	1058.56	1056.97	1055.72	1054.74	1053.99	1053.42	-174.1	-0.0125
8	665	658.85	653.32	648.45	644.28	640.84	638.13	636.16	634.94	634.45	634.71	635.7	637.42	176.8	-0.3313
9	735	728.85	723.32	718.45	714.28	710.84	708.13	706.16	704.94	704.45	704.71	705.7	707.42	176.8	-0.3313
10	805	798.85	793.32	788.45	784.28	780.84	778.13	776.16	774.94	774.45	774.71	775.73	777.51	177	-0.2739
11	875	868.85	863.32	858.45	854.28	850.87	848.24	846.39	845.25	844.77	844.86	845.47	846.53	-179.2	-0.1174
12	945	938.86	933.42	928.69	924.59	921.06	918.02	915.41	913.16	911.22	909.54	908.06	906.73	-172.3	-0.0053
13	1015	1008.88	1003.44	998.67	994.48	990.82	987.63	984.83	982.37	980.19	978.25	976.48	974.84	-171.5	0.0031
14	1085	1078.88	1073.44	1068.67	1064.48	1060.82	1057.63	1054.83	1052.37	1050.19	1048.25	1046.48	1044.84	-171.5	0.0031
15	665	658.73	652.89	647.54	642.76	638.6	635.11	632.3	630.18	628.77	628.07	628.07	628.79	179.2	-0.3242
16	735	728.73	722.89	717.54	712.76	708.6	705.11	702.3	700.18	698.77	698.07	698.07	698.79	179.2	-0.3242
17	805	798.73	792.89	787.54	782.76	778.6	775.11	772.3	770.18	768.77	768.07	768.07	768.79	179.2	-0.3242
18	875	868.73	862.89	857.54	852.76	848.6	845.11	842.33	840.29	838.98	838.36	838.34	838.89	-178.6	-0.1643
19	945	938.73	932.93	927.68	923.05	919.04	915.61	912.67	910.18	908.06	906.26	904.73	903.4	-172.6	-0.0299
20	1015	1008.77	1003.03	997.8	993.04	988.7	984.73	981.09	977.71	974.56	971.58	968.72	965.94	-168.8	0.0228
21	1085	1078.76	1073.01	1067.76	1062.96	1058.58	1054.57	1050.87	1047.44	1044.22	1041.17	1038.24	1035.38	-168.6	0.0251
22	665	658.62	652.46	646.63	641.22	636.33	632	628.28	625.19	622.76	621	619.92	619.53	-178.1	-0.3151
23	735	728.62	722.46	716.63	711.22	706.33	702	698.28	695.19	692.76	691	689.92	689.53	-178.1	-0.3151
24	805	798.62	792.46	786.63	781.22	776.33	772	768.28	765.19	762.76	761	759.92	759.53	-178.1	-0.3151
25	875	868.62	862.46	856.63	851.22	846.33	842	838.28	835.19	832.76	831.04	830.05	829.75	-177.5	-0.2293
26	945	938.62	932.46	926.63	921.26	916.48	912.32	908.73	905.68	903.09	900.92	899.12	897.63	-172.6	-0.0686
27	1015	1008.64	1002.57	996.87	991.54	986.55	981.85	977.4	973.17	969.09	965.14	961.26	957.41	-166.2	0.0416
28	1085	1078.65	1072.59	1066.85	1061.42	1056.29	1051.42	1046.76	1042.28	1037.92	1033.66	1029.43	1025.21	-165.2	0.0532
29	665	658.5	652.03	645.71	639.69	634.07	628.92	624.29	620.23	616.77	613.94	611.74	610.2	-175.4	-0.305
30	735	728.5	722.03	715.71	709.69	704.07	698.92	694.29	690.23	686.77	683.94	681.74	680.2	-175.4	-0.305
31	805	798.5	792.03	785.71	779.69	774.07	768.92	764.29	760.23	756.77	753.94	751.74	750.2	-175.4	-0.305
32	875	868.5	862.03	855.71	849.69	844.07	838.92	834.29	830.23	826.77	823.94	821.74	820.21	-175.4	-0.2986
33	945	938.5	932.03	925.71	919.69	914.07	908.96	904.45	900.54	897.2	894.37	892.01	890.06	-172.1	-0.1228
34	1015	1008.5	1002.07	995.86	989.94	984.32	978.94	973.79	968.81	963.96	959.21	954.51	949.88	-164.8	-0.0226
35	1085	1078.54	1072.17	1065.99	1059.99	1054.18	1048.52	1042.99	1037.54	1032.15	1026.77	1021.36	1015.88	-162.1	0.0791

RandSail in PROSIM 3.01 Wave Direction: 270 deg Wave Force: 125% Heading: +15 deg. **Input file: ROUTE257.UDF**

Line nr.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Pos. 6	Pos. 7	Pos. 8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Heading	R of T
1	665	658.96	653.74	649.33	645.72	642.91	640.91	639.69	639.25	639.59	640.69	642.55	645.15	174.4	-0.3415
2	735	728.96	723.74	719.33	715.72	712.91	710.91	709.69	709.25	709.59	710.69	712.55	715.15	174.4	-0.3415
3	805	798.96	793.74	789.33	785.72	782.91	780.91	779.69	779.25	779.62	780.78	782.7	785.31	175.5	-0.2257
4	875	868.96	863.74	859.33	855.77	853.07	851.18	850.01	849.49	849.55	850.11	851.1	852.47	-179.6	-0.0927
5	945	938.99	933.87	929.54	925.92	922.92	920.45	918.45	916.85	915.59	914.62	913.89	913.34	-174.3	-0.0209
6	1015	1008.99	1003.87	999.54	995.92	992.92	990.45	988.45	986.85	985.59	984.62	983.89	983.34	-174.3	-0.0209
7	1085	1078.99	1073.87	1069.54	1065.92	1062.92	1060.45	1058.45	1056.85	1055.59	1054.62	1053.89	1053.34	-174.3	-0.0209
8	665	658.84	653.31	648.42	644.23	640.76	638.04	636.05	634.82	634.33	634.59	635.59	637.33	178.3	-0.3366
9	735	728.84	723.31	718.42	714.23	710.76	708.04	706.05	704.82	704.33	704.59	705.59	707.33	178.3	-0.3366
10	805	798.84	793.31	788.42	784.23	780.76	778.04	776.05	774.82	774.33	774.59	775.62	777.42	178.3	-0.2773
11	875	868.84	863.31	858.42	854.23	850.79	848.15	846.28	845.14	844.64	844.73	845.34	846.41	-178.7	-0.1235
12	945	938.86	933.41	928.66	924.54	920.99	917.93	915.3	913.04	911.1	909.42	907.96	906.66	-172.4	-0.0138
13	1015	1008.87	1003.43	998.63	994.43	990.75	987.53	984.72	982.25	980.07	978.13	976.38	974.78	-171.7	-0.0056
14	1085	1078.87	1073.43	1068.63	1064.43	1060.75	1057.53	1054.72	1052.25	1050.07	1048.13	1046.38	1044.78	-171.7	-0.0056
15	665	658.73	652.87	647.51	642.71	638.53	635.02	632.19	630.07	628.65	627.95	627.97	628.71	179	-0.3296
16	735	728.73	722.87	717.51	712.71	708.53	705.02	702.19	700.07	698.65	697.95	697.97	698.71	179	-0.3296
17	805	798.73	792.87	787.51	782.71	778.53	775.02	772.19	770.07	768.65	767.95	767.97	768.71	179	-0.3296
18	875	868.73	862.87	857.51	852.71	848.53	845.02	842.22	840.18	838.87	838.24	838.24	838.79	-178.8	-0.169
19	945	938.73	932.91	927.65	923	918.97	915.51	912.57	910.06	907.94	906.15	904.62	903.33	-172.8	-0.038
20	1015	1008.76	1003.02	997.77	992.99	988.63	984.64	980.98	977.6	974.44	971.47	968.63	965.88	-169	0.0137
21	1085	1078.76	1073	1067.72	1062.91	1058.51	1054.47	1050.76	1047.32	1044.1	1041.06	1038.15	1035.32	-168.8	0.016
22	665	658.62	652.44	646.59	641.17	636.25	631.91	628.18	625.08	622.65	620.9	619.83	619.46	-178.3	-0.3207
23	735	728.62	722.44	716.59	711.17	706.25	701.91	698.18	695.08	692.65	690.9	689.83	689.46	-178.3	-0.3207
24	805	798.62	792.44	786.59	781.17	776.25	771.91	768.18	765.08	762.65	760.9	759.83	759.46	-178.3	-0.3207
25	875	868.62	862.44	856.59	851.17	846.25	841.91	838.18	835.08	832.66	830.94	829.97	829.69	-177.7	-0.2316
26	945	938.62	932.44	926.59	921.21	916.41	912.23	908.63	905.56	902.97	900.79	898.97	897.44	-172.6	-0.0683
27	1015	1008.63	1002.55	996.84	991.49	986.48	981.76	977.3	973.05	968.98	965.03	961.18	957.36	-166.4	0.0324
28	1085	1078.65	1072.57	1066.81	1061.37	1056.22	1051.33	1046.65	1042.16	1037.81	1033.55	1029.35	1025.16	-165.5	0.044
29	665	658.5	652.01	645.68	639.64	634	628.83	624.19	620.12	616.67	613.84	611.66	610.15	-175.6	-0.3107
30	735	728.5	722.01	715.68	709.64	704	698.83	694.19	690.12	686.67	683.84	681.66	680.15	-175.6	-0.3107
31	805	798.5	792.01	785.68	779.64	774	768.83	764.19	760.12	756.67	753.84	751.66	750.15	-175.6	-0.3107
32	875	868.5	862.01	855.68	849.64	844	838.83	834.19	830.12	826.67	823.84	821.66	820.17	-175.6	-0.2951
33	945	938.5	932.01	925.68	919.64	914	908.87	904.35	900.44	897.09	894.27	891.92	889.98	-172.3	-0.1282
34	1015	1008.5	1002.05	995.82	989.89	984.24	978.85	973.69	968.71	963.87	959.13	954.47	949.88	-164.9	-0.0241
35	1085	1078.54	1072.16	1065.95	1059.94	1054.1	1048.43	1042.88	1037.43	1032.04	1026.66	1021.28	1015.83	-162.3	0.0702

Appendix B.3

List of Contents

Nr	Creating Software	File Name	Description	Page
1	Columbus	Columba1.udf	Length of Columbus Long-axis	App.B.3.1
2	Columbus	Columba2.udf	Length of Columbus Short-axis	App.B.3.1
3	Columbus	Columbb1.udf	Heading of Columbus axis	App.B.3.2

RandSail Input from COLUMBUS

RandSail in PROSIM 3.01	**Long-axis**
Input file: Columba1.udf	**Heading: 0 deg**

Position	**Start position along y-axis**						
x-axis	**-210**	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
0	687.18	736.67	791.81	850.05	906.29	924.64	977.39
500	642.99	683.67	729.22	776.79	824.73	844.05	881.45
1000	532.21	557.6	585.16	615.26	641.94	661.16	669.86
1500	371.44	375.16	381.54	384.38	391.49	403.27	395.21
2000	236.77	214.7	191.5	165.99	135.51	105.51	82.62
2500	285.58	275.47	266.5	251.71	248.3	243.2	236.1
3000	450.54	465.06	480.97	497.37	513.53	525.18	531.48
3500	590.34	623.86	660.49	698.44	736.11	761.9	781.71
4000	670.32	719.12	767.24	821.29	872.06	893.99	940.5
4500	685.59	735.02	790.55	849.59	834.83	916.45	978.9
5000	639.2	681.3	727.71	777.37	746.76	825.94	879.37
5500	533.57	560.01	587.19	530.64	587.21	641.33	672.88
6000	379.33	383.33	329.6	346.66	365.48	382.03	393.19
6500	252.32	197.06	177.58	156.7	130.2	106.46	85.41
7000	295.8	282.72	270.74	256.46	245.12	236.11	230.95
7500	533.2	536.09	545.95	542.18	544.97	547.16	547.76
8000	851.66	850.79	853.72	853.38	849.64	845.95	852.41
8500	1145.26	1143.69	1145.29	1146.71	1147.86	1139.21	1151.89
9000	1416.18	1415.5	1424.46	1426.36	1405.14	1418.65	1432.14

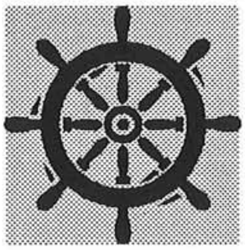
RandSail in PROSIM 3.01	**Short-axis**
Input file: Columba2.udf	**Heading: 0 deg**

Position	**Start position along y-axis**						
x-axis	**-210**	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
0	182.36	179.04	176.22	173.87	172	108.22	107.75
500	167.31	163.24	159.91	157.16	155.52	84.3	83.69
1000	137.59	131.88	127.28	123.69	120.55	117.96	55.48
1500	98.69	92.26	86.36	80.07	75.31	72.69	68.68
2000	56.16	48.49	41.2	35.72	28.94	22.05	15.27
2500	75.65	69.26	63.17	55.82	50.55	45.31	41.23
3000	117.57	111.65	106.12	101.17	96.87	94.06	41.46
3500	152.59	148.13	144.19	140.87	138.59	136.13	68.81
4000	176.74	173.04	170.05	167.58	165.35	96.29	95.75
4500	182.87	179.44	176.59	174.27	118.63	117.91	117.26
5000	169.16	164.96	161.3	158.46	125.89	124.69	124.05
5500	138.94	133.66	128.57	113.58	110.76	108.78	107.21
6000	99.03	92.86	84.67	78.52	73.7	69.2	67.04
6500	55.85	48.81	41.61	35.34	28.48	22.41	15.7
7000	76.01	69.3	62.89	55.99	49.56	43.84	40.17
7500	118.19	112.16	107.93	102.12	98.14	95.09	29.89
8000	165.68	160.61	156.99	153.44	150.02	147.53	70.1
8500	213.2	208.72	205.56	202.93	200.88	101.75	101.95
9000	257.54	253.83	252.46	250.4	135.06	134.72	135.07

RandSail Input from COLUMBUS

RandSail in PROSIM 3.01	**Orientation of axis**
Input file: Columbb1.udf	**Heading: 0 deg**

Cross	**Start position along y-axis**						
Section	**-210**	**-140**	**-70**	**0**	**+70**	**+140**	**+210**
1	1.93	1.65	1.36	1.11	0.85	2.56	0.92
2	9	7.81	6.5	5.13	3.67	4.07	1.46
3	17.95	15.52	12.98	10.24	7.46	4.61	2.22
4	33.76	29.77	25.16	20.44	14.99	9.1	3.4
5	73	71.5	67.19	62.13	53.35	40.36	17.54
6	-50.53	-46.02	-40.18	-34.24	-25.34	-15.97	-5.94
7	-24.88	-21.7	-18.28	-14.62	-10.54	-6.69	-3.05
8	-13.45	-11.63	-9.7	-7.7	-5.59	-3.5	-1.76
9	-5.62	-4.79	-4.07	-3.22	-2.4	-3.42	-1.28
10	1.36	1.29	1.08	0.86	-2.87	-1.79	-0.63
11	8.7	7.57	6.36	5.03	0.54	0.37	0.15
12	17.98	15.56	13.08	7.32	5.4	3.36	1.25
13	34.32	30.03	23.44	19.14	14.46	8.9	3.19
14	73.65	70.74	66.75	61.52	53.99	39.02	16.57
15	-49.56	-45.48	-40.06	-33.81	-25.83	-16.46	-5.98
16	-25.86	-22.35	-18.57	-15.06	-11.1	-6.96	-2.81
17	-17.84	-15.18	-12.55	-9.93	-7.27	-4.75	-1.9
18	-12.96	-11.01	-9.11	-7.17	-5.22	-4.15	-1.42
19	-10.27	-8.7	-7.14	-5.62	-5.4	-3.49	-1.15



Towards Fast-time Simulation-based Probabilistic Design of Channel Width

Volume I: Main Report
Appendix A
Volume II: Appendix B
⇒ **Volume III: Appendix C**

by:
Paul J. Siregar
mentors:
Prof. Ir. H. Velsink
Ir. R. Groenveld

TU Delft

Delft University of Technology
Department of Civil Engineering
Hydraulic and Geotechnical Engineering Division
Hydraulic Engineering Group
December 1995

Appendix C: RandSail Output Analysis

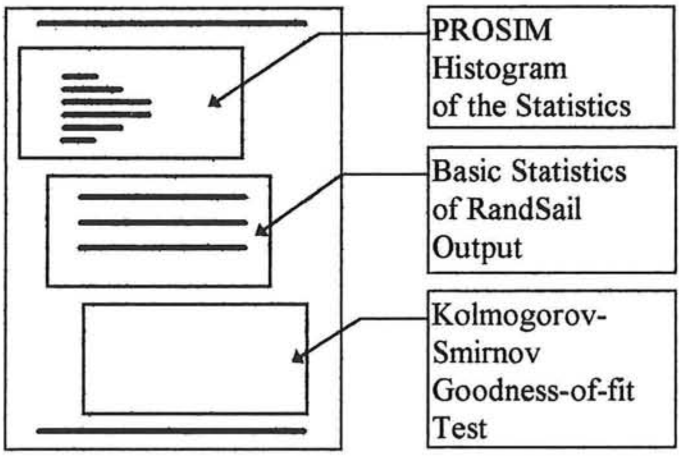
List of Contents

			Results of PROSIM Statistics on the position of		
Cross-section nr	position x-direction	graph on page	centre of gravity	port-side extremity	starboard-side extremity
1	250 m	App. C.4.1	App. C.1.1	App. C.2.1	App. C.3.1
2	500 m	App. C.4.1	App. C.1.2	App. C.2.2	App. C.3.2
3	750 m	App. C.4.2	App. C.1.3	App. C.2.3	App. C.3.3
4	1000 m	App. C.4.2	App. C.1.4	App. C.2.4	App. C.3.4
5	1250 m	App. C.4.3	App. C.1.5	App. C.2.5	App. C.3.5
6	1500 m	App. C.4.3	App. C.1.6	App. C.2.6	App. C.3.6
7	1750 m	App. C.4.4	App. C.1.7	App. C.2.7	App. C.3.7
8	2000 m	App. C.4.4	App. C.1.8	App. C.2.8	App. C.3.8
9	2250 m	App. C.4.5	App. C.1.9	App. C.2.9	App. C.3.9
10	2500 m	App. C.4.5	App. C.1.10	App. C.2.10	App. C.3.10
11	2750 m	App. C.4.6	App. C.1.11	App. C.2.11	App. C.3.11
12	3000 m	App. C.4.6	App. C.1.12	App. C.2.12	App. C.3.12
13	3250 m	App. C.4.7	App. C.1.13	App. C.2.13	App. C.3.13
14	3500 m	App. C.4.7	App. C.1.14	App. C.2.14	App. C.3.14
15	3750 m	App. C.4.8	App. C.1.15	App. C.2.15	App. C.3.15
16	4000 m	App. C.4.8	App. C.1.16	App. C.2.16	App. C.3.16
17	4250 m	App. C.4.9	App. C.1.17	App. C.2.17	App. C.3.17
18	4500 m	App. C.4.9	App. C.1.18	App. C.2.18	App. C.3.18
19	4750 m	App. C.4.10	App. C.1.19	App. C.2.19	App. C.3.19

Introduction to Appendix C

Appendix C, the third volume of the graduate thesis "Towards Fast-time Simulation-based Probabilistic Design of Channel Width", presents the results of the analysis on the output of the RandSail Model.

This volume consists of four main parts. The first three parts are the results of the analysis done using PROSIM Statistics facilities of the output of the RandSail manoeuvres. These parts, as illustrated below, have a uniform layout where (1) a histogram, (2) the statistics, and (3) goodness-of-fit test are presented.



The last part shows the graphs of the normal-distribution of the three crucial points of the ship: the centre-of-gravity, the starboard-side extremity and the port-side extremity. These graphs are calculated and drawn using Quattro Pro release 5.0 spreadsheet based on the results of PROSIM Statistics. A graph is drawn for each cross-section.

Appendix C is to be used in combination with the other volumes of the report. The inner-workings of the RandSail Model are compiled in Appendix B (the second volume of the report). Appendix A is integrated with the main part of the report in the first volume.

Delft, December 1995

Paul J. Siregar

List of Mean and Standard Deviation

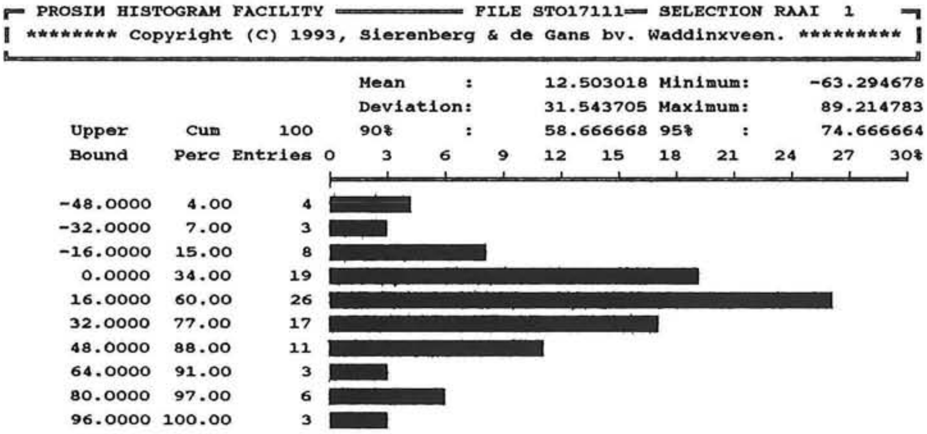
of the normal-distribution of the positions fo ship's centre-of-gravity and extremities

Position of ship's centre-of-gravity			
Cross-section nr.	position in x-dir	Mean	Standard Deviation
1	250	18.11	36.84
2	500	40.12	27.15
3	750	35.19	20.34
4	1000	10.92	17.79
5	1250	-9.16	13.93
6	1500	-15.26	12.16
7	1750	-6.37	15.72
8	2000	-0.58	10.09
9	2250	1.97	11.69
10	2500	1.03	13.43
11	2750	-2.81	14.93
12	3000	-7.22	15.18
13	3250	-6.59	15.74
14	3500	-0.82	18.57
15	3750	2.82	14.52
16	4000	3.32	17.04
17	4250	2.62	27.55
18	4500	2.44	27.97
19	4750	2.01	18.25

Position of ship's starboard-side extremity			
Cross-section nr.	position in x-dir	Mean	Standard Deviation
1	250	33.22	30.18
2	500	60.65	27.66
3	750	49.00	19.22
4	1000	25.43	18.54
5	1250	16.76	18.94
6	1500	20.49	18.04
7	1750	25.32	17.68
8	2000	38.49	20.17
9	2250	48.34	17.33
10	2500	47.11	10.82
11	2750	40.31	16.52
12	3000	34.71	19.45
13	3250	29.08	17.96
14	3500	19.80	19.77
15	3750	22.61	22.24
16	4000	29.77	21.03
17	4250	35.04	23.75
18	4500	35.31	25.32
19	4750	36.56	23.00

Position of ship's port-side extremity			
Cross-section nr.	position in x-dir	Mean	Standard Deviation
1	250	-8.22	33.14
2	500	-9.46	19.11
3	750	-11.62	13.16
4	1000	-21.43	11.30
5	1250	-29.08	11.90
6	1500	-25.35	14.94
7	1750	-13.90	17.25
8	2000	-4.85	16.33
9	2250	3.42	9.75
10	2500	-6.04	8.12
11	2750	-12.79	11.91
12	3000	-18.38	17.56
13	3250	-26.51	15.49
14	3500	-27.73	16.66
15	3750	-28.02	17.98
16	4000	-22.46	17.61
17	4250	-14.99	18.49
18	4500	-14.73	24.00
19	4750	-21.81	19.92

PROSIM STATISTICS: Position centre-of-gravity on cross-section 1 ($\chi = 250$ m)



```
┌─ PROSIM HISTOGRAM FACILITY ════════════ FILE STO17111══ SELECTION RAAI  1    ─┐
| ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└───────────────────────────────────────────────────────────────────────────────┘
                              Mean      :        12.503018 Minimum:      -63.294678
                              Deviation:         31.543705 Maximum:       89.214783
   Upper     Cum      100     90%       :        58.666668 95%     :      74.666664
   Bound     Perc  Entries 0     3     6     9     12    15    18    21    24    27    30%

  -48.0000   4.00        4
  -32.0000   7.00        3
  -16.0000  15.00        8
    0.0000  34.00       19
   16.0000  60.00       26
   32.0000  77.00       17
   48.0000  88.00       11
   64.0000  91.00        3
   80.0000  97.00        6
   96.0000 100.00        3
```

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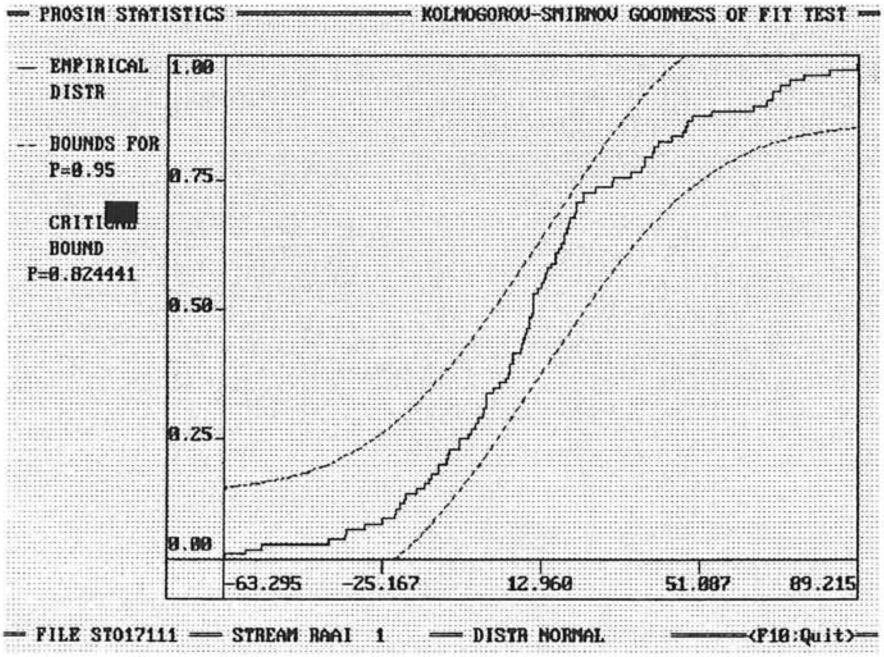
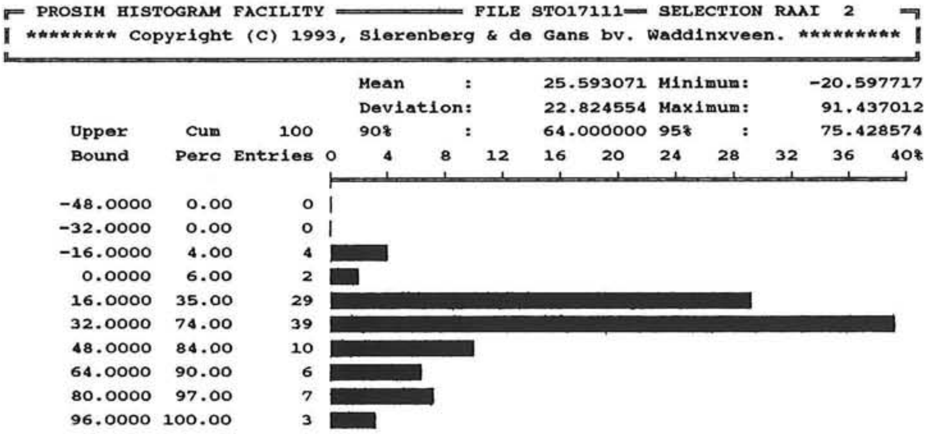
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  1    -+
+-----------------------------------------------------------------------+
                              == BASIC STATISTICS ==
   Mean             :          12.503016        Number of entries:    100
   St. deviation    :          31.543701
   Mn. deviation    :          23.293957        Minimum :       -63.294678
   Skewness         :           0.199630        Maximum :        89.214783
   Alt. Skewness    :           0.053073        Range   :       152.509460
   Kurtosis         :           3.292179        Midrange:        12.960052

   Confidence intervals for the mean:     90% (    7.259 -    17.747)
                                          95% (    6.235 -    18.771)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000     -22.017822
   Median:      10.828888
   90.000      63.833984
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 2 (x = 500 m)



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╒═ PROSIM HISTOGRAM FACILITY ════════════ FILE STO17111═ SELECTION RAAI  2    ═╕
│ ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└───────────────────────────────────────────────────────────────────────────────┘
                                  Mean        :       25.593071 Minimum:       -20.597717
                                  Deviation:          22.824554 Maximum:        91.437012
   Upper      Cum       100       90%         :       64.000000 95%     :       75.428574
   Bound      Perc Entries 0    4    8    12   16   20   24   28   32   36   40%

  -48.0000    0.00       0
  -32.0000    0.00       0
  -16.0000    4.00       4
    0.0000    6.00       2
   16.0000   35.00      29
   32.0000   74.00      39
   48.0000   84.00      10
   64.0000   90.00       6
   80.0000   97.00       7
   96.0000  100.00       3
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  2     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean            :           25.593069        Number of entries:   100
   St. deviation   :           22.824558
   Mn. deviation   :           16.708523        Minimum :        -20.597717
   Skewness        :            0.933315        Maximum :         91.437012
   Alt. Skewness   :            0.240428        Range   :        112.034729
   Kurtosis        :            3.931471        Midrange:         35.419647

   Confidence intervals for the mean:     90% (  21.798 -    29.388)
                                          95% (  21.058 -    30.128)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000        5.740112
   Median:      20.105408
   90.000      67.451721
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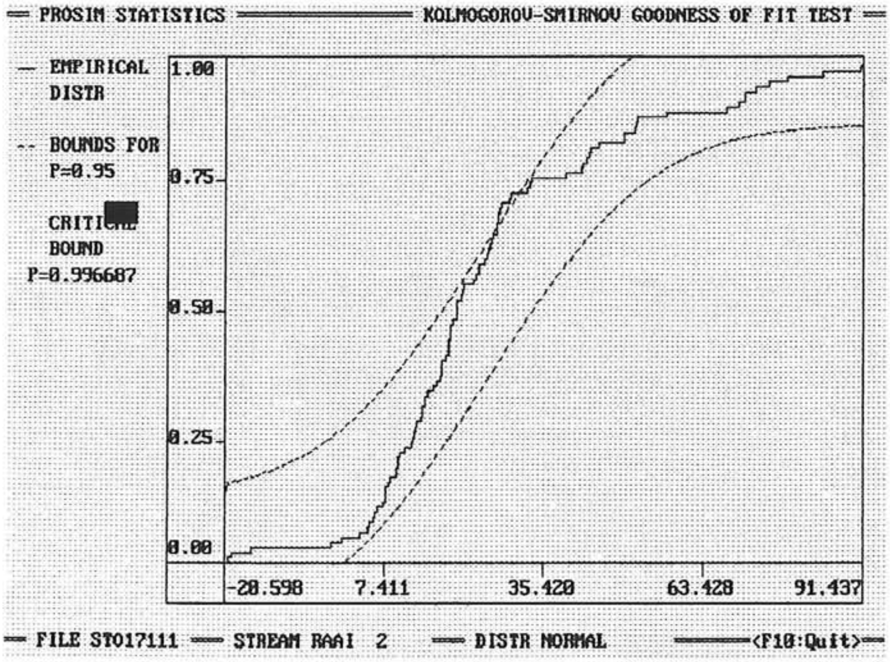
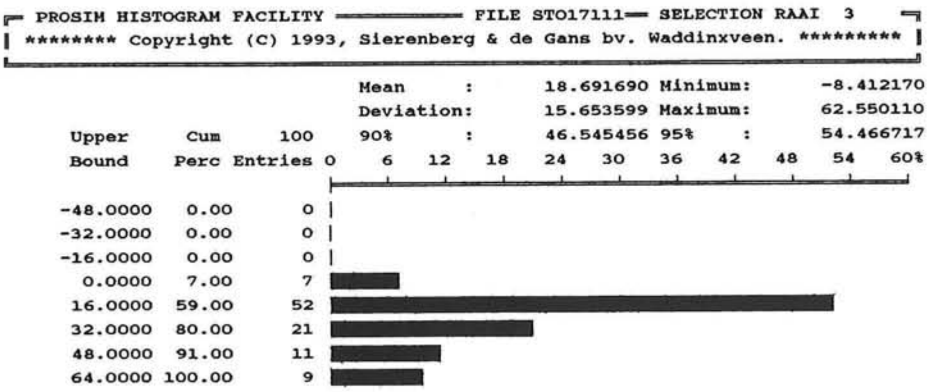


PROSIM STATISTICS: Position centre-of-gravity on cross-section 3 (x = 750 m)



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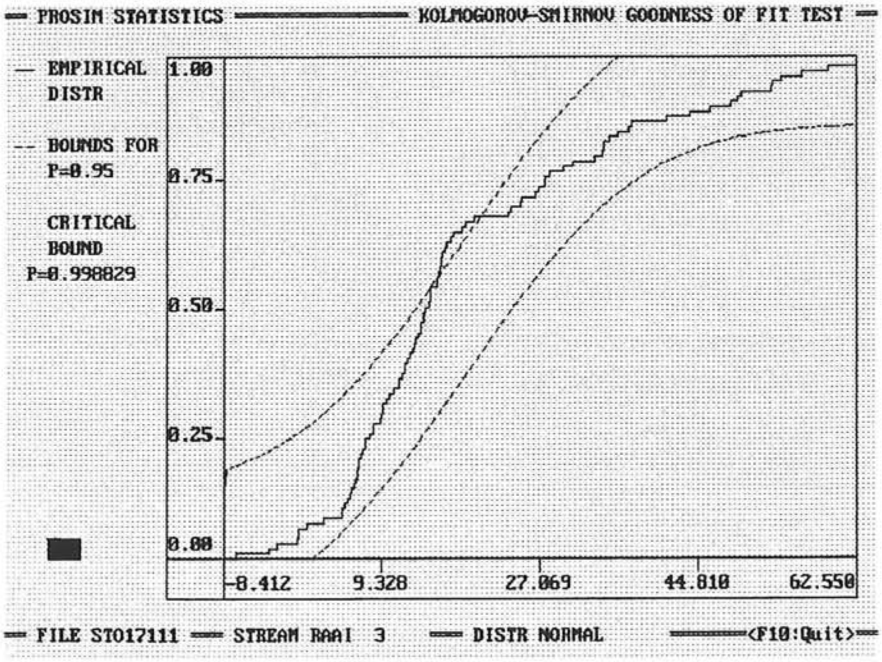
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                             Mean      :        18.691690 Minimum:      -8.412170
                             Deviation:         15.653599 Maximum:      62.550110
  Upper       Cum      100   90%       :        46.545456 95%    :      54.466717
  Bound      Perc Entries 0    6    12    18    24    30    36    42    48    54    60%

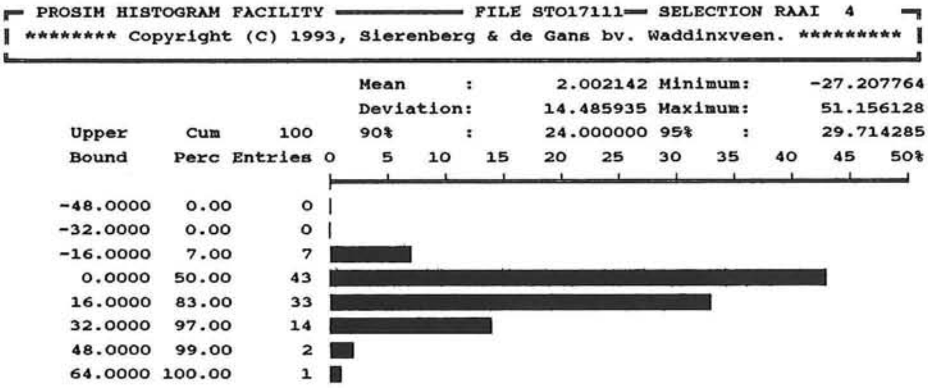
 -48.0000    0.00      0 |
 -32.0000    0.00      0 |
 -16.0000    0.00      0 |
   0.0000    7.00      7
  16.0000   59.00     52
  32.0000   80.00     21
  48.0000   91.00     11
  64.0000  100.00      9
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  3    -+
+-----------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean           :          18.691689        Number of entries:    100
   St. deviation  :          15.653600
   Mn. deviation  :          12.289707        Minimum :         -8.412170
   Skewness       :           0.996373        Maximum :         62.550110
   Alt. Skewness  :           0.286665        Range   :         70.962280
   Kurtosis       :           3.332978        Midrange:         27.068970

   Confidence intervals for the mean:      90% (  16.089 -    21.294)
                                           95% (  15.581 -    21.802)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        4.950745
   Median:       14.204346
   90.000       46.188843
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 4 (χ = 1000 m)



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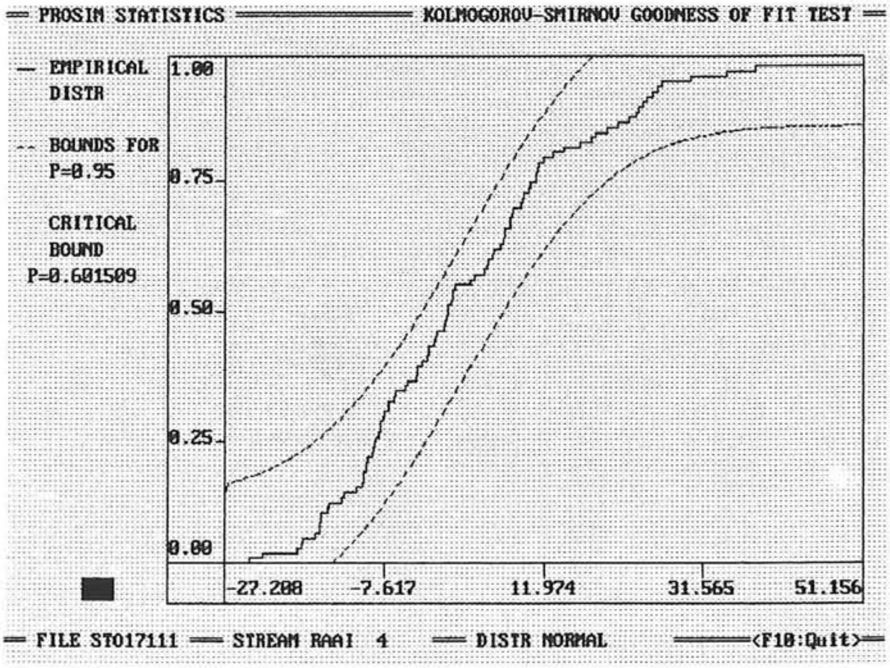
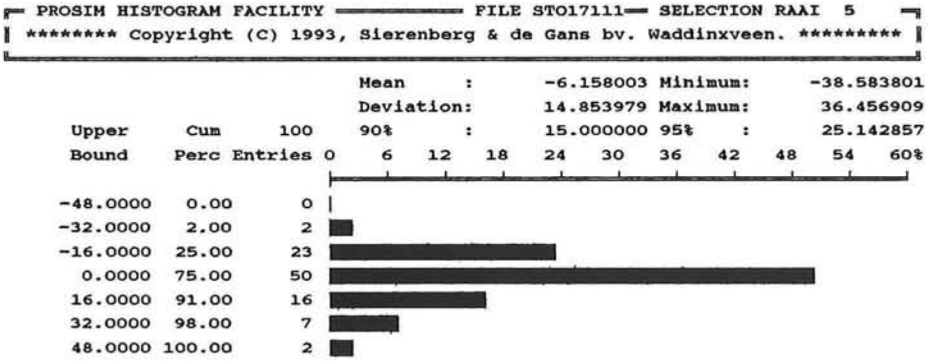
┌─ PROSIM HISTOGRAM FACILITY ──────────── FILE STO17111── SELECTION RAAI  4      ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                 Mean       :        2.002142 Minimum:      -27.207764
                                 Deviation:         14.485935 Maximum:       51.156128
  Upper        Cum       100     90%        :       24.000000 95%     :      29.714285
  Bound        Perc Entries 0     5    10    15    20    25    30    35    40    45   50%
                            |----|----|----|----|----|----|----|----|----|----|
 -48.0000     0.00        0 |
 -32.0000     0.00        0 |
 -16.0000     7.00        7 |
   0.0000    50.00       43 |
  16.0000    83.00       33 |
  32.0000    97.00       14 |
  48.0000    99.00        2 |
  64.0000   100.00        1 |
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  4     -+
+------------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean              :        2.002142        Number of entries:    100
   St. deviation     :       14.485934
   Mn. deviation     :       11.549572        Minimum :      -27.207764
   Skewness          :        0.655545        Maximum :       51.156128
   Alt. Skewness     :        0.133525        Range   :       78.363892
   Kurtosis          :        3.409495        Midrange:       11.974182

   Confidence intervals for the mean:     90% (  -0.406 -    4.411)
                                          95% (  -0.876 -    4.880)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -15.344910
   Median:  0.067902
   90.000       23.677734
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 5 (χ = 1250 m)



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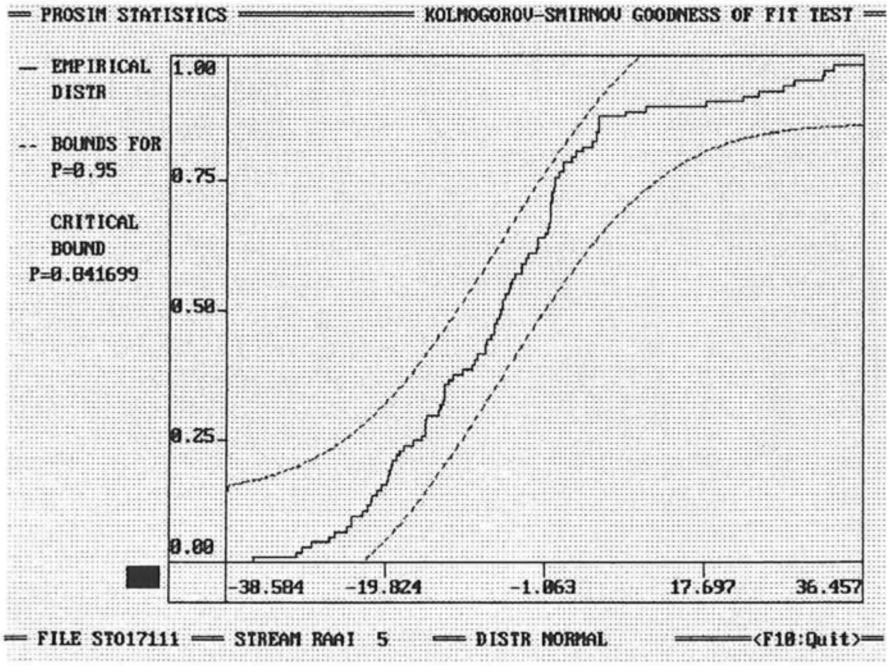
PROSIM HISTOGRAM FACILITY ════════════ FILE ST017111══ SELECTION RAAI  5
 ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                 Mean       :       -6.158003 Minimum:      -38.583801
                                 Deviation:         14.853979 Maximum:       36.456909
   Upper      Cum      100       90%        :       15.000000 95%     :      25.142857
   Bound     Perc Entries 0    6    12    18    24    30    36    42    48    54    60%

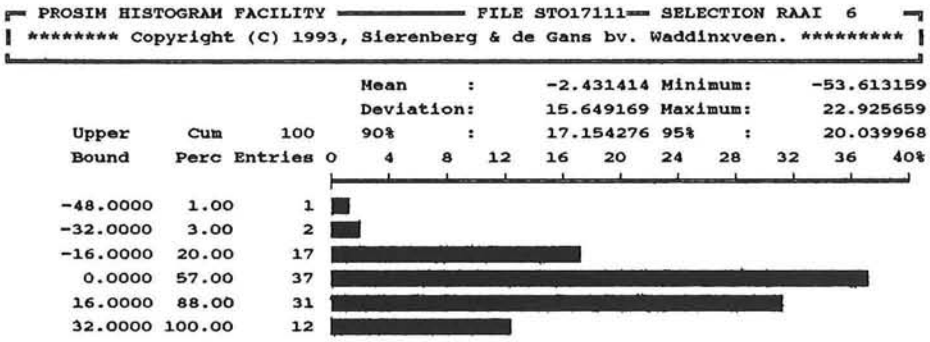
  -48.0000   0.00       0
  -32.0000   2.00       2
  -16.0000  25.00      23
    0.0000  75.00      50
   16.0000  91.00      16
   32.0000  98.00       7
   48.0000 100.00       2
```

```
+- PROSIM STATISTICS --------------- FILE ST017111 - STREAM RAAI  5     -+
+------------------------------------------------------------------------+
                                       == BASIC STATISTICS ==
   Mean             :        -6.158003         Number of entries:   100
   St. deviation    :          14.853979
   Mn. deviation    :          11.027414         Minimum :       -38.583801
   Skewness         :          0.717767          Maximum :        36.456909
   Alt. Skewness    :          0.010867          Range   :        75.040710
   Kurtosis         :          3.813560          Midrange:        -1.063446

   Confidence intervals for the mean:     90% (  -8.628 -    -3.688)
                                          95% (  -9.109 -    -3.207)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000     -22.594666
   Median:      -6.319427
   90.000      10.711914
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 6 ($\underline{x}$ = 1500 m)



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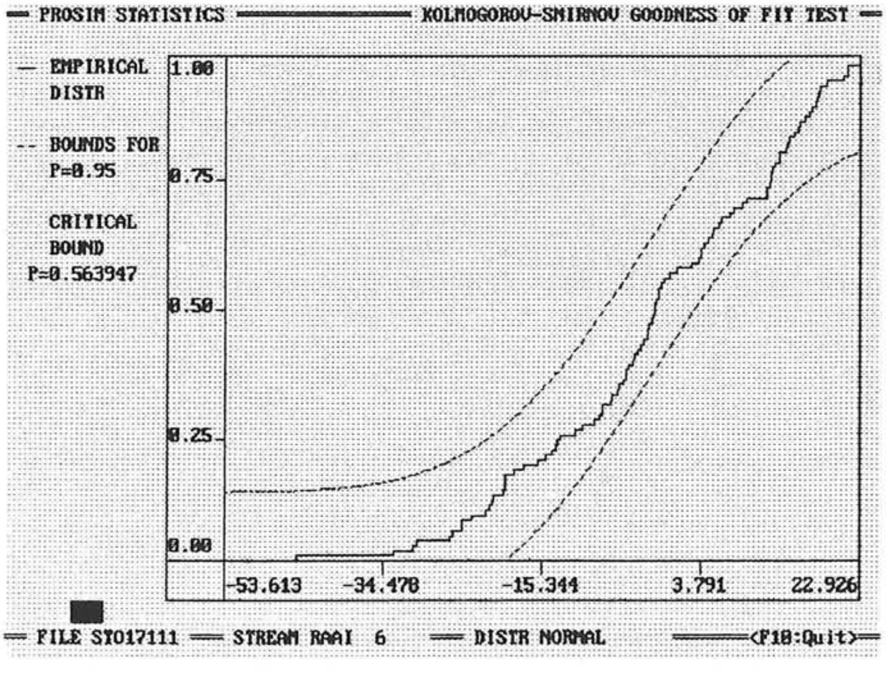
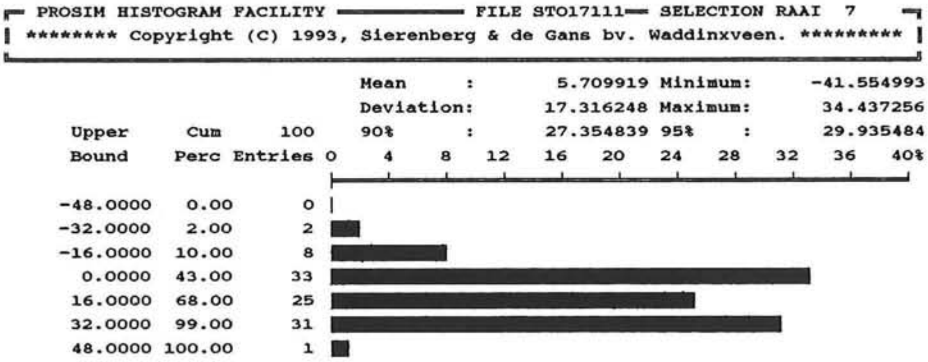
┌─ PROSIM HISTOGRAM FACILITY ──────────── FILE STO17111── SELECTION RAAI  6    ─┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                              Mean       :       -2.431414 Minimum:      -53.613159
                              Deviation:         15.649169 Maximum:       22.925659
   Upper      Cum      100    90%        :       17.154276 95%     :      20.039968
   Bound      Perc Entries 0    4     8    12   16   20   24   28   32   36   40%
                           |----|-----|----|----|----|----|----|----|----|----|
  -48.0000   1.00        1
  -32.0000   3.00        2
  -16.0000  20.00       17
    0.0000  57.00       37
   16.0000  88.00       31
   32.0000 100.00       12
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI  6    -+
+----------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean              :            -2.431414     Number of entries:   100
   St. deviation     :            15.649169
   Mn. deviation     :            12.393174     Minimum :       -53.613159
   Skewness          :            -0.587832     Maximum :        22.925659
   Alt. Skewness     :            -0.032474     Range   :        76.538818
   Kurtosis          :                3.112568  Midrange:       -15.343750

   Confidence intervals for the mean:      90% (  -5.033 -     0.170)
                                           95% (  -5.541 -     0.678)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -22.134766
   Median:       -1.923218
   90.000       17.151550
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 7 (χ = 1750 m)



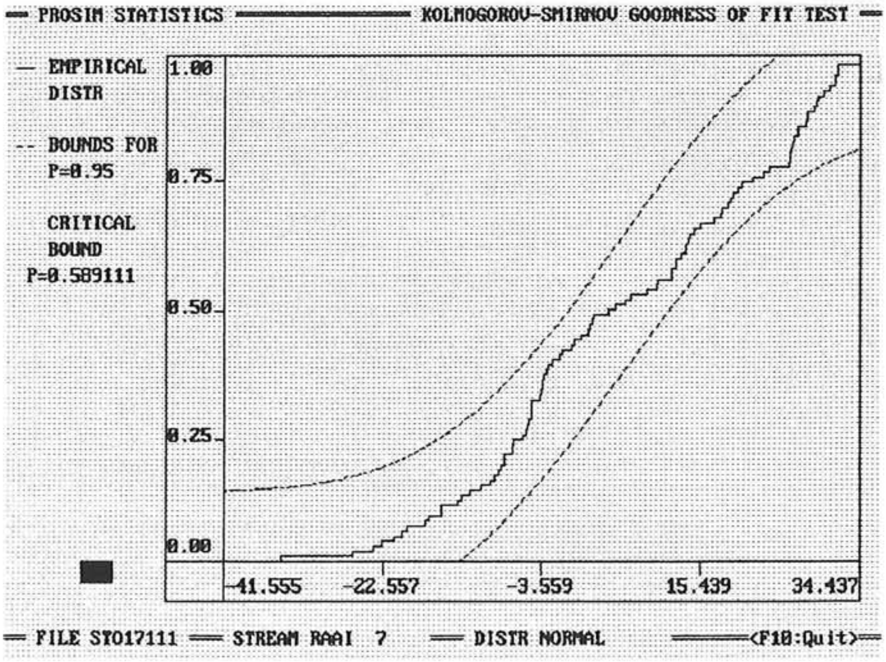
```
PROSIM HISTOGRAM FACILITY ───────── FILE STO17111── SELECTION RAAI  7
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |

                                 Mean      :        5.709919 Minimum:      -41.554993
                                 Deviation:        17.316248 Maximum:       34.437256
  Upper      Cum       100       90%       :       27.354839 95%     :      29.935484
  Bound      Perc Entries 0    4    8   12   16   20   24   28   32   36   40%

 -48.0000    0.00        0
 -32.0000    2.00        2
 -16.0000   10.00        8
   0.0000   43.00       33
  16.0000   68.00       25
  32.0000   99.00       31
  48.0000  100.00        1
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  7     -+
+-----------------------------------------------------------------------+
                                     == BASIC STATISTICS ==
  Mean            :         5.709919         Number of entries:    100
  St. deviation   :        17.316250
  Mn. deviation   :        14.826455         Minimum :        -41.554993
  Skewness        :        -0.204727         Maximum :         34.437256
  Alt. Skewness   :         0.125661         Range   :         75.992249
  Kurtosis        :         2.282070         Midrange:         -3,558868

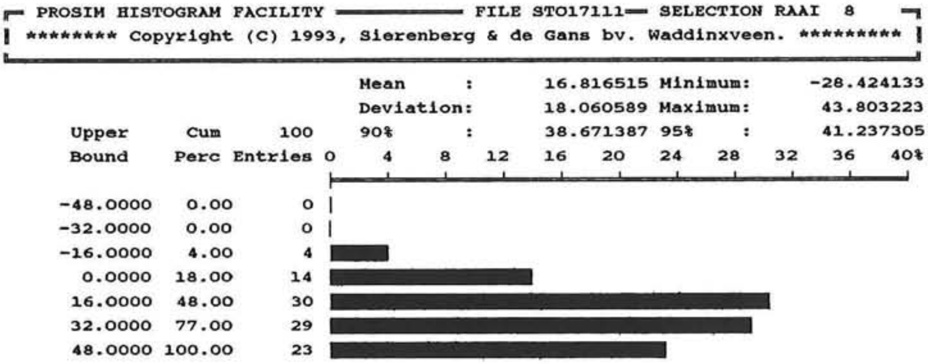
  Confidence intervals for the mean:      90% (    2.831 -     8.589)
                                          95% (    2.269 -     9.151)
  Correlation according to the independant
  Linear (Pearson): Independant series is constant
  Rank (Spearman) :
  Lags (max=  39) :    20
  Percentiles
  10.000      -15.567932
  Median:  3.533936
  90.000      28.989624
```



PROSIM STATISTICS ─────── KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

= FILE STO17111 = STREAM RAAI 7 = DISTR NORMAL ═══<F10:Quit>

PROSIM STATISTICS: Position centre-of-gravity on cross-section 8 (χ = 2000 m)



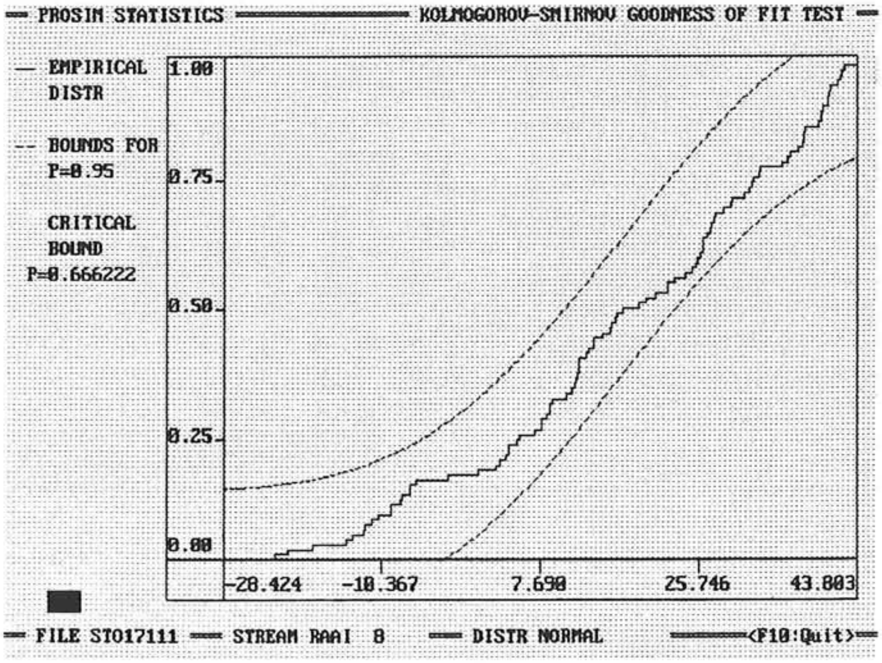
```
PROSIM HISTOGRAM FACILITY ──────── FILE STO17111── SELECTION RAAI  8
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean       :         16.816515 Minimum:       -28.424133
                              Deviation:           18.060589 Maximum:        43.803223
   Upper      Cum      100    90%        :         38.671387 95%     :       41.237305
   Bound     Perc  Entries 0    4    8   12   16   20   24   28   32   36   40%

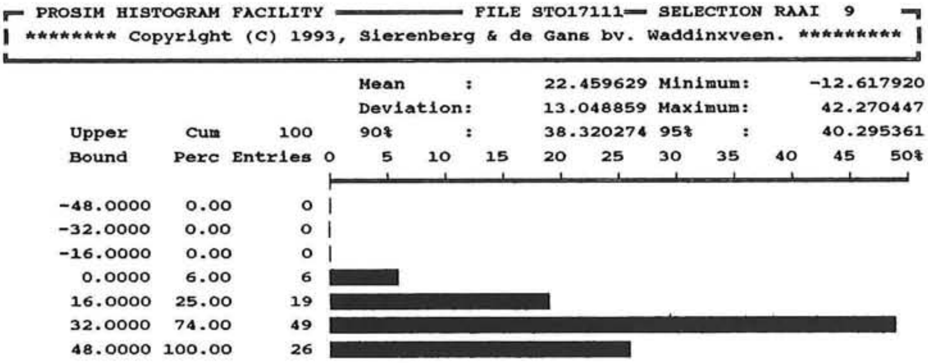
 -48.0000    0.00        0 |
 -32.0000    0.00        0 |
 -16.0000    4.00        4
   0.0000   18.00       14
  16.0000   48.00       30
  32.0000   77.00       29
  48.0000  100.00       23
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  8     -+
+-----------------------------------------------------------------------+
                                        == BASIC STATISTICS ==
   Mean            :          16.816515        Number of entries:   100
   St. deviation   :          18.060589
   Mn. deviation   :          15.032080        Minimum :        -28.424133
   Skewness        :          -0.432834        Maximum :         43.803223
   Alt. Skewness   :           0.005785        Range   :         72.227356
   Kurtosis        :           2.290730        Midrange:          7.689545

   Confidence intervals for the mean:       90% (  13.814 -    19.819)
                                            95% (  13.228 -    20.405)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -9.331055
   Median:       16.712036
   90.000       39.919922
```



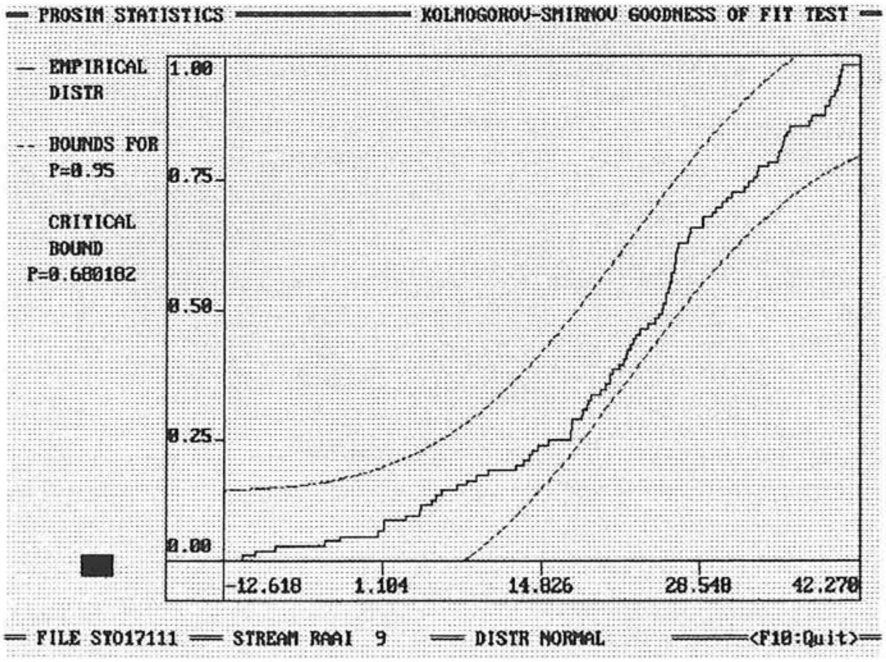
PROSIM STATISTICS: Position centre-of-gravity on cross-section 9 (χ = 2250 m)



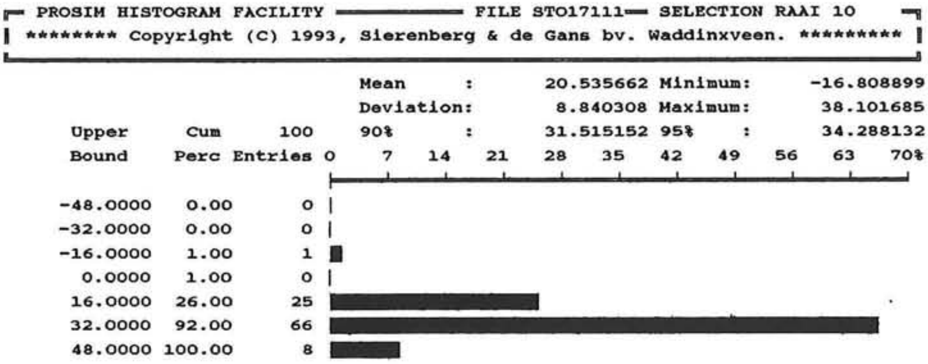
```
┌─ PROSIM HISTOGRAM FACILITY ─────────── FILE STO17111── SELECTION RAAI  9     ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                   Mean      :       22.459629 Minimum:       -12.617920
                                   Deviation:        13.048859 Maximum:        42.270447
  Upper        Cum      100        90%       :       38.320274 95%     :       40.295361
  Bound        Perc  Entries 0     5    10    15    20    25    30    35    40    45   50%
                               |----+-----+-----+-----+-----+-----+-----+-----+-----+----|
 -48.0000      0.00        0 |
 -32.0000      0.00        0 |
 -16.0000      0.00        0 |
   0.0000      6.00        6 ██████
  16.0000     25.00       19 ███████████████████
  32.0000     74.00       49 █████████████████████████████████████████████████
  48.0000    100.00       26 ██████████████████████████
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI  9    -+
+-----------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean             :         22.459633        Number of entries:    100
   St. deviation    :         13.048858
   Mn. deviation    :         10.192301        Minimum :       -12.617920
   Skewness         :         -0.712657        Maximum :        42.270447
   Alt. Skewness    :         -0.203395        Range   :        54.888367
   Kurtosis         :          2.990487        Midrange:        14.826263

   Confidence intervals for the mean:      90% (  20.290 -    24.629)
                                           95% (  19.867 -    25.052)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        4.325439
   Median:       25.113708
   90.000       39.297180
```



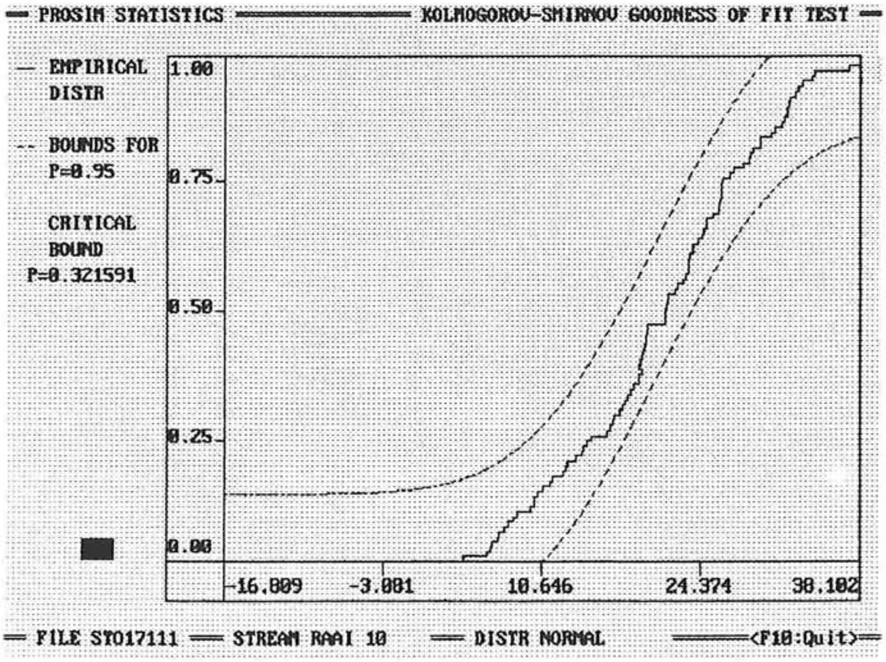
PROSIM STATISTICS: Position centre-of-gravity on cross-section 10 ($\chi = 2500$ m)



```
┌─ PROSIM HISTOGRAM FACILITY ─────────── FILE STO17111── SELECTION RAAI 10     ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                  Mean       :       20.535662 Minimum:       -16.808899
                                  Deviation:          8.840308 Maximum:        38.101685
  Upper        Cum       100      90%        :       31.515152 95%     :        34.288132
  Bound        Perc  Entries 0     7     14     21    28    35    42    49    56    63    70%
                             ├─────────────────────────────────────────────────────────────┤
 -48.0000      0.00        0 |
 -32.0000      0.00        0 |
 -16.0000      1.00        1 |
   0.0000      1.00        0 |
  16.0000     26.00       25 |
  32.0000     92.00       66 |
  48.0000    100.00        8 |
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 10     -+
+------------------------------------------------------------------------+
                                == BASIC STATISTICS ==
   Mean              :         20.535654         Number of entries:   100
   St. deviation     :          8.840307
   Mn. deviation     :          6.865344         Minimum :       -16.808899
   Skewness          :         -0.753520         Maximum :        38.101685
   Alt. Skewness     :         -0.089457         Range   :        54.910583
   Kurtosis          :          4.749203         Midrange:        10.646393

   Confidence intervals for the mean:      90% (  19.066 -    22.005)
                                           95% (  18.779 -    22.292)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000        8.473755
   Median:       21.326477
   90.000       31.798828
```



= PROSIM STATISTICS ═══════════ KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST =

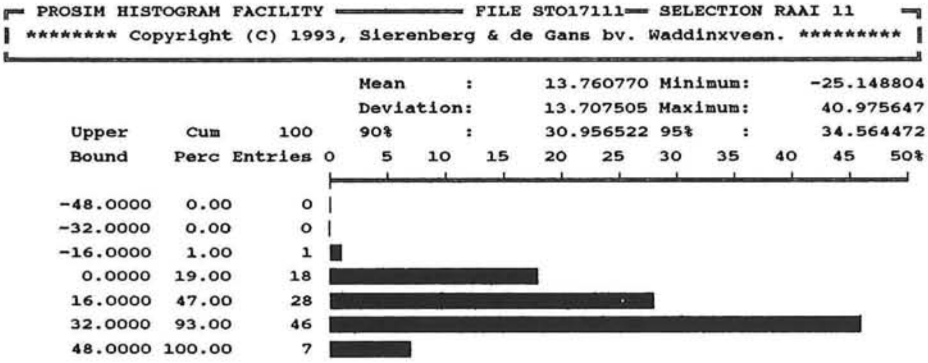
— EMPIRICAL DISTR

-- BOUNDS FOR P=0.95

CRITICAL BOUND P=0.321591

= FILE STO17111 = STREAM RAAI 10 = DISTR NORMAL ═══<F10:Quit>=

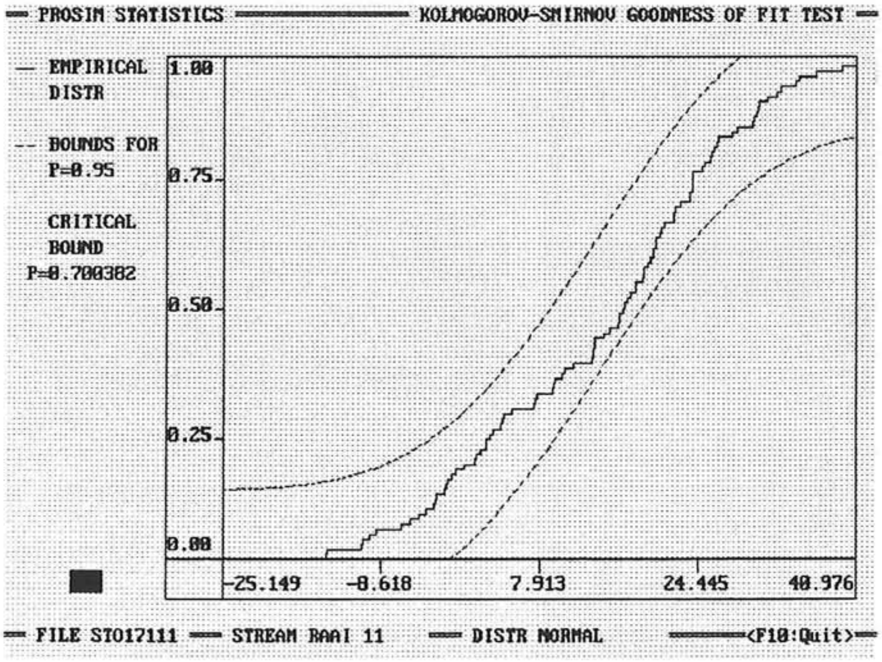
PROSIM STATISTICS: Position centre-of-gravity on cross-section 11 (χ = 2750 m)



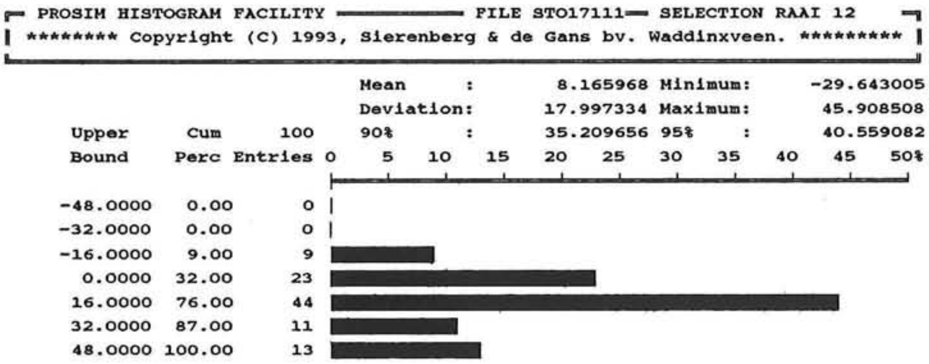
```
┌─ PROSIM HISTOGRAM FACILITY ═══════════ FILE STO17111── SELECTION RAAI 11      ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                            Mean       :      13.760770 Minimum:      -25.148804
                            Deviation:        13.707505 Maximum:       40.975647
    Upper      Cum      100 90%        :      30.956522 95%     :      34.564472
    Bound     Perc Entries 0    5   10   15   20   25   30   35   40   45   50%
                           ├────┴────┴────┴────┴────┴────┴────┴────┴────┴────┤
 -48.0000     0.00       0 |
 -32.0000     0.00       0 |
 -16.0000     1.00       1 █
   0.0000    19.00      18 ██████████████████
  16.0000    47.00      28 ████████████████████████████
  32.0000    93.00      46 ██████████████████████████████████████████████
  48.0000   100.00       7 ███████
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 11     -+
+-----------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean            :         13.760769        Number of entries:   100
   St. deviation   :         13.707504
   Mn. deviation   :         11.341942        Minimum :       -25.148804
   Skewness        :         -0.358331        Maximum :        40.975647
   Alt. Skewness   :         -0.193672        Range   :        66.124451
   Kurtosis        :          2.514576        Midrange:         7.913422

   Confidence intervals for the mean:      90% (  11.482 -    16.040)
                                           95% (  11.037 -    16.484)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000       -3.965454
   Median:       16.415527
   90.000       30.756714
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 12 ($\chi = 3000$ m)

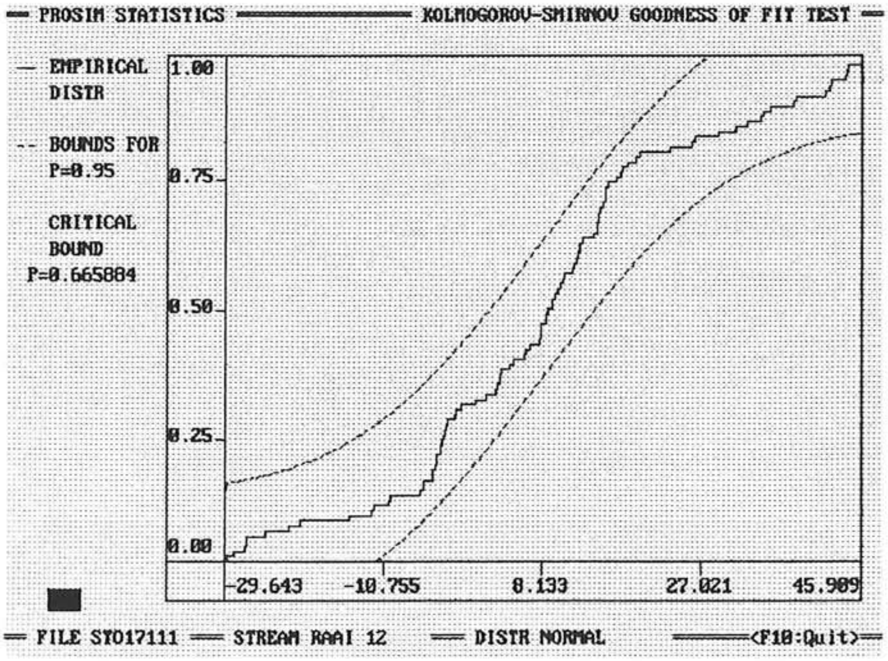


```
┌─ PROSIM HISTOGRAM FACILITY ──────────── FILE STO17111── SELECTION RAAI 12     ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                               Mean      :       8.165968 Minimum:     -29.643005
                               Deviation:       17.997334 Maximum:      45.908508
     Upper      Cum      100   90%       :      35.209656 95%     :     40.559082
     Bound      Perc Entries 0    5   10   15   20   25   30   35   40   45   50%

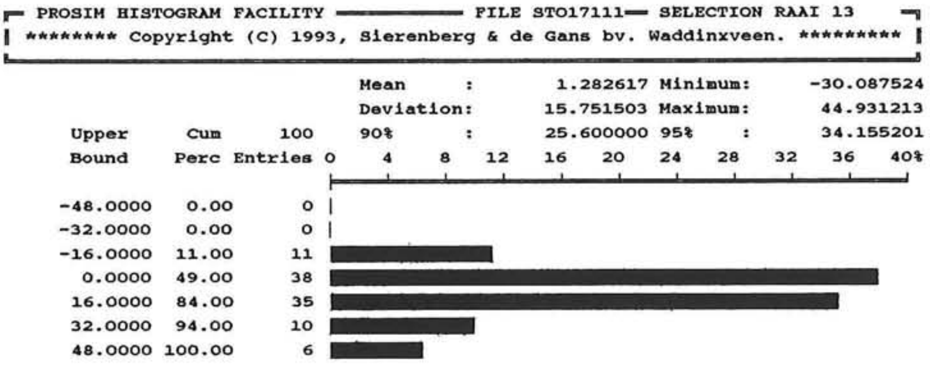
  -48.0000     0.00        0
  -32.0000     0.00        0
  -16.0000     9.00        9
    0.0000    32.00       23
   16.0000    76.00       44
   32.0000    87.00       11
   48.0000   100.00       13
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI 12      -+
+------------------------------------------------------------------------+
                                     == BASIC STATISTICS ==
   Mean             :          8.165968        Number of entries:    100
   St. deviation    :         17.997332
   Mn. deviation    :         13.676714        Minimum :       -29.643005
   Skewness         :          0.047550        Maximum :        45.908508
   Alt. Skewness    :         -0.033145        Range   :        75.551514
   Kurtosis         :          2.859345        Midrange:         8.132751

   Confidence intervals for the mean:      90% (    5.174 -     11.158)
                                           95% (    4.590 -     11.742)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -12.194458
   Median:  8.762482
   90.000       35.127991
```



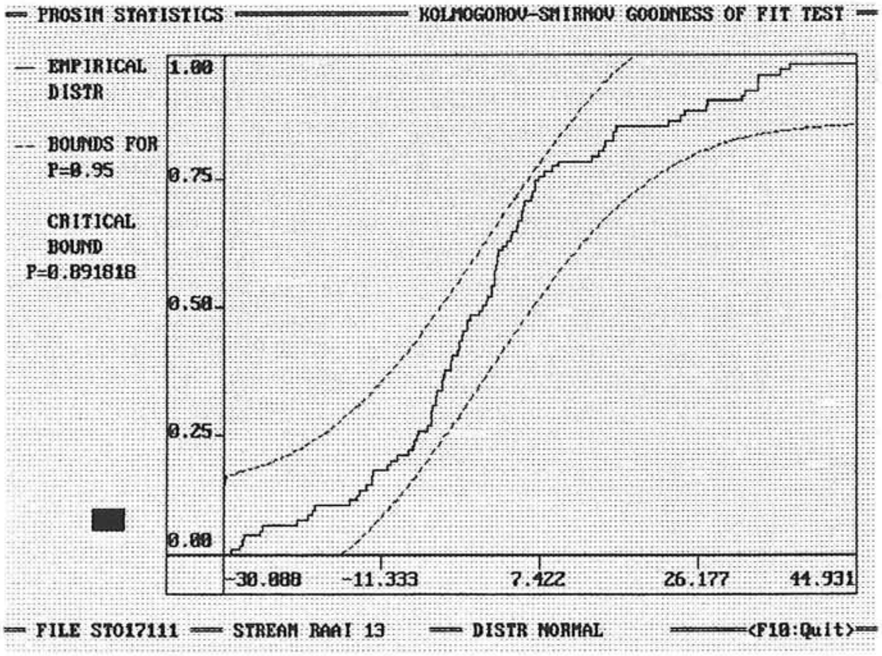
PROSIM STATISTICS: Position centre-of-gravity on cross-section 13 (χ = 3250 m)



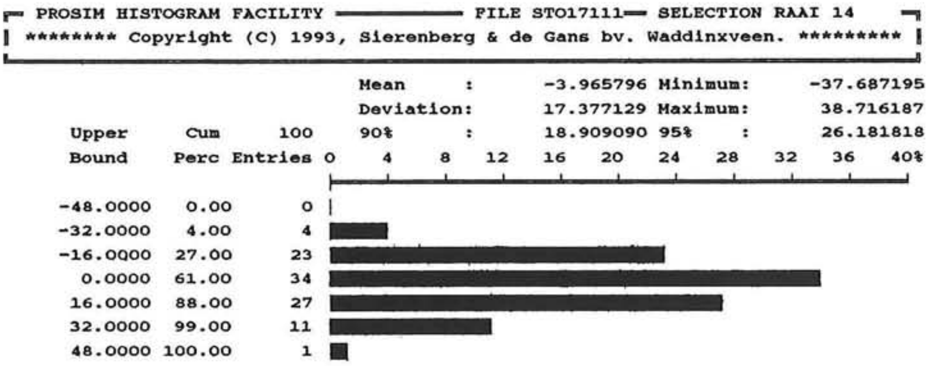
```
┌─ PROSIM HISTOGRAM FACILITY ────────── FILE ST017111── SELECTION RAAI 13   ─┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└─────────────────────────────────────────────────────────────────────────────┘
                                 Mean       :       1.282617 Minimum:     -30.087524
                                 Deviation:        15.751503 Maximum:      44.931213
  Upper        Cum      100      90%        :      25.600000 95%     :     34.155201
  Bound       Perc  Entries 0     4     8    12    16    20    24    28    32    36   40%
                            |
 -48.0000     0.00        0 |
 -32.0000     0.00        0 |
 -16.0000    11.00       11 |
   0.0000    49.00       38 |
  16.0000    84.00       35 |
  32.0000    94.00       10 |
  48.0000   100.00        6 |
```

```
+- PROSIM STATISTICS -------------- FILE ST017111 - STREAM RAAI 13      -+
+-----------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean                :          1.282617          Number of entries:   100
   St. deviation       :         15.751504
   Mn. deviation       :         11.588637          Minimum :       -30.087524
   Skewness            :          0.443835          Maximum :        44.931213
   Alt. Skewness       :          0.050557          Range   :        75.018738
   Kurtosis            :          3.248408          Midrange:         7.421844

   Confidence intervals for the mean:        90% (  -1.336 -     3.901)
                                             95% (  -1.847 -     4.412)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -19.234131
   Median:  0.486267
   90.000       27.223816
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 14 (χ = 3500 m)



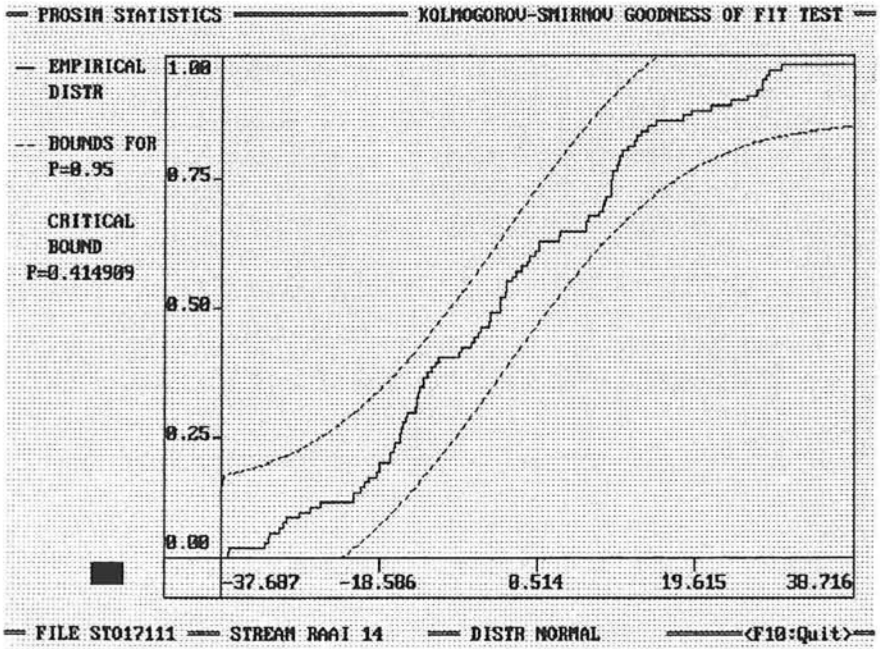
```
PROSIM HISTOGRAM FACILITY ———————— FILE STO17111—— SELECTION RAAI 14
********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. **********

                              Mean       :      -3.965796 Minimum:    -37.687195
                              Deviation:        17.377129 Maximum:     38.716187
  Upper       Cum      100    90%        :      18.909090 95%    :     26.181818
  Bound      Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

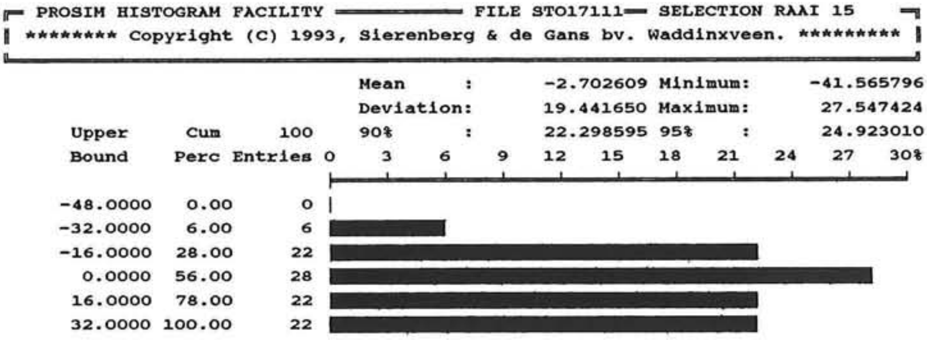
 -48.0000    0.00        0 |
 -32.0000    4.00        4
 -16.0000   27.00       23
   0.0000   61.00       34
  16.0000   88.00       27
  32.0000   99.00       11
  48.0000  100.00        1
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 14     -+
+------------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean             :        -3.965796          Number of entries:   100
   St. deviation    :          17.377129
   Mn. deviation    :          14.234706          Minimum :       -37.687195
   Skewness         :          0.195742           Maximum :        38.716187
   Alt. Skewness    :          0.041395           Range   :        76.403381
   Kurtosis         :          2.401271           Midrange:        0.514496

   Confidence intervals for the mean:      90% (  -6.855 -     -1.077)
                                           95% (  -7.419 -     -0.513)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -26.939514
   Median:         -4.685120
   90.000        21.503174
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 15 (χ = 3750 m)

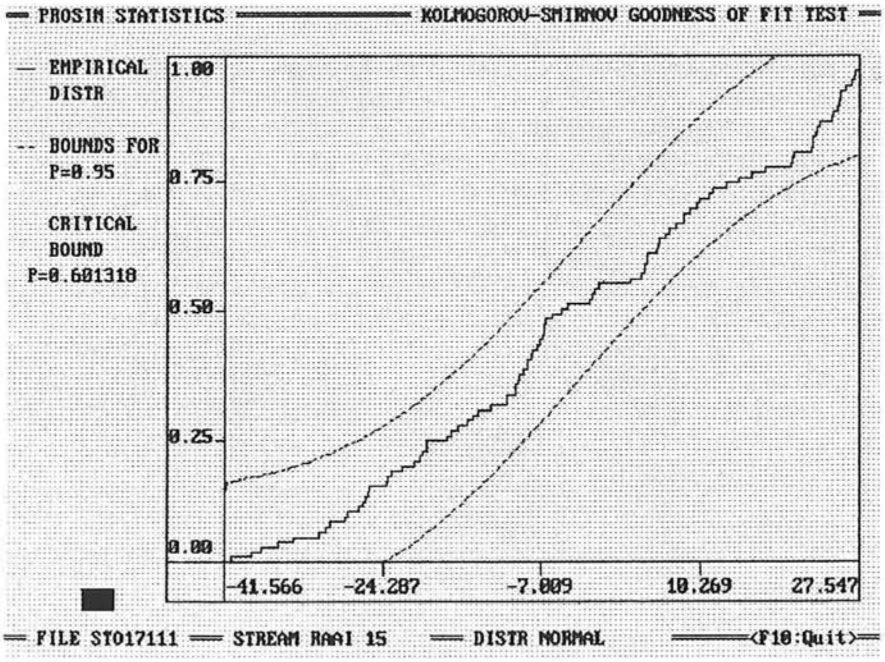


```
┌─ PROSIM HISTOGRAM FACILITY ─────────── FILE STO17111── SELECTION RAAI 15   ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                    Mean       :      -2.702609 Minimum:      -41.565796
                                    Deviation:        19.441650 Maximum:       27.547424
   Upper        Cum       100       90%        :      22.298595 95%    :       24.923010
   Bound        Perc Entries 0    3     6     9    12    15    18    21    24    27    30%

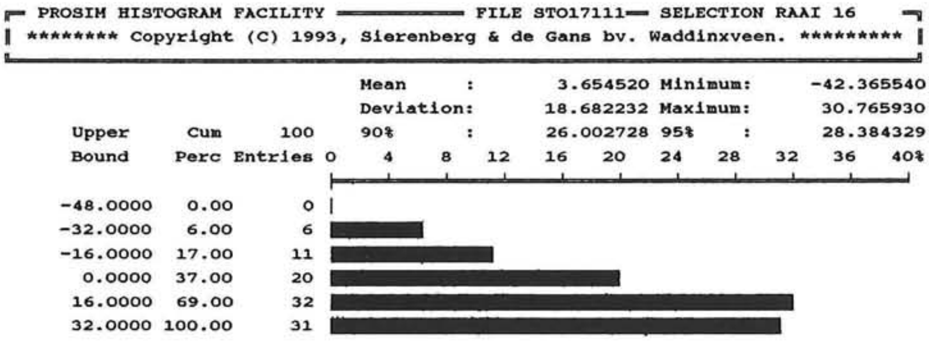
  -48.0000      0.00       0
  -32.0000      6.00       6
  -16.0000     28.00      22
    0.0000     56.00      28
   16.0000     78.00      22
   32.0000    100.00      22
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 15    -+
+-----------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
  Mean             :       -2.702609        Number of entries:   100
  St. deviation    :         19.441650
  Mn. deviation    :         16.500759      Minimum :       -41.565796
  Skewness         :       -0.066122        Maximum :        27.547424
  Alt. Skewness    :         0.130594       Range   :        69.113220
  Kurtosis         :         1.947078       Midrange:        -7.009186

  Confidence intervals for the mean:      90% (  -5.935 -    0.530)
                                          95% (  -6.566 -    1.160)
  Correlation according to the independant
  Linear (Pearson): Independant series is constant
  Rank (Spearman) :
  Lags (max=  39) :   20
  Percentiles
  10.000      -28.112976
  Median:       -5.241577
  90.000       25.101074
```



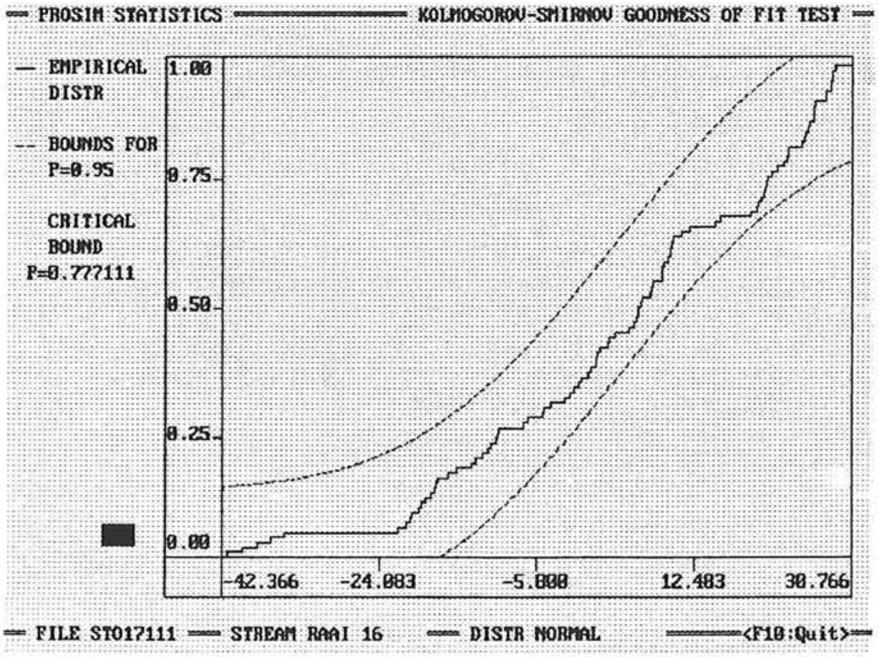
PROSIM STATISTICS: Position centre-of-gravity on cross-section 16 (χ = 4000 m)



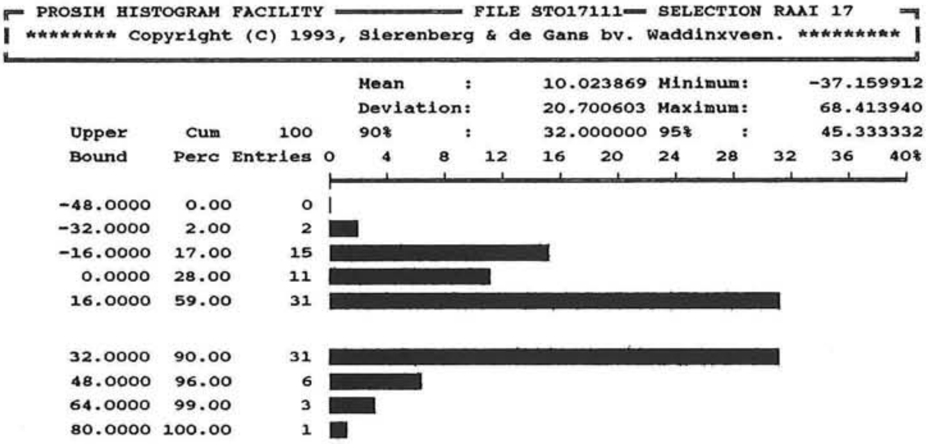
```
┌─ PROSIM HISTOGRAM FACILITY ──────────── FILE STO17111── SELECTION RAAI 16     ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                Mean        :        3.654520 Minimum:      -42.365540
                                Deviation:          18.682232 Maximum:       30.765930
    Upper       Cum       100   90%         :       26.002728 95%     :      28.384329
    Bound      Perc Entries 0    4     8    12    16    20    24    28    32    36    40%
                            |----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
  -48.0000     0.00       0 |
  -32.0000     6.00       6 
  -16.0000    17.00      11 
    0.0000    37.00      20 
   16.0000    69.00      32 
   32.0000   100.00      31 
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 16     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean              :          3.654520          Number of entries:   100
   St. deviation     :         18.682232
   Mn. deviation     :         15.217881          Minimum :      -42.365540
   Skewness          :         -0.534793          Maximum :       30.765930
   Alt. Skewness     :         -0.117509          Range   :       73.131470
   Kurtosis          :          2.571441          Midrange:       -5.799805

   Confidence intervals for the mean:      90% (    0.549 -     6.761)
                                           95% (   -0.058 -     7.367)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -19.570068
   Median:   5.849854
   90.000       26.340088
```



PROSIM STATISTICS: Position centre-of-gravity on cross-section 17 (χ = 4250 m)

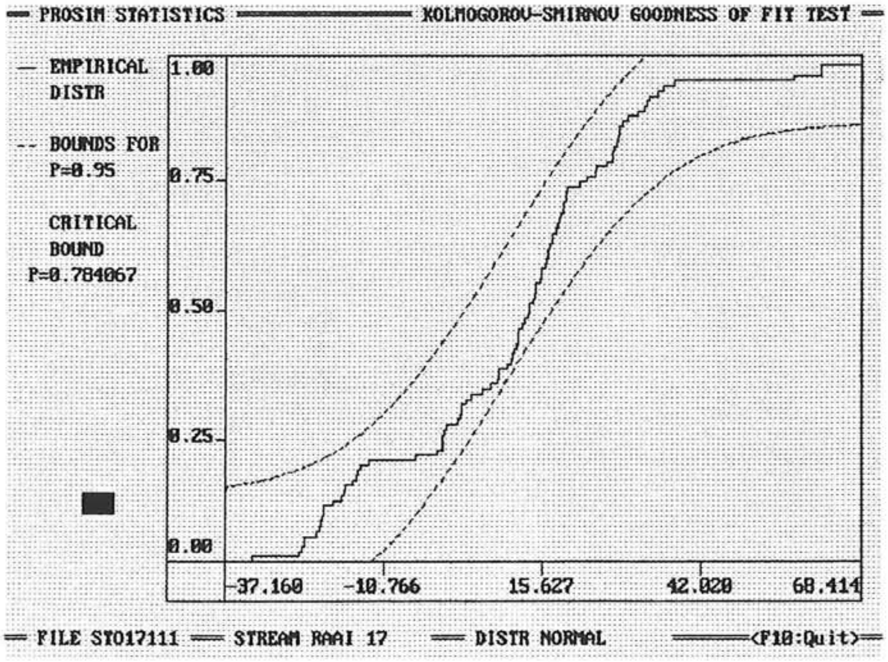


```
┌─ PROSIM HISTOGRAM FACILITY ──────── FILE STO17111── SELECTION RAAI 17   ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                            Mean       :      10.023869 Minimum:      -37.159912
                            Deviation:        20.700603 Maximum:       68.413940
   Upper       Cum     100  90%        :      32.000000 95%    :       45.333332
   Bound       Perc Entries 0     4     8    12    16    20    24    28    32    36    40%
                            ├─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘
   -48.0000    0.00      0  |
   -32.0000    2.00      2  █
   -16.0000   17.00     15  ███████████████
     0.0000   28.00     11  ███████████
    16.0000   59.00     31  ███████████████████████████████

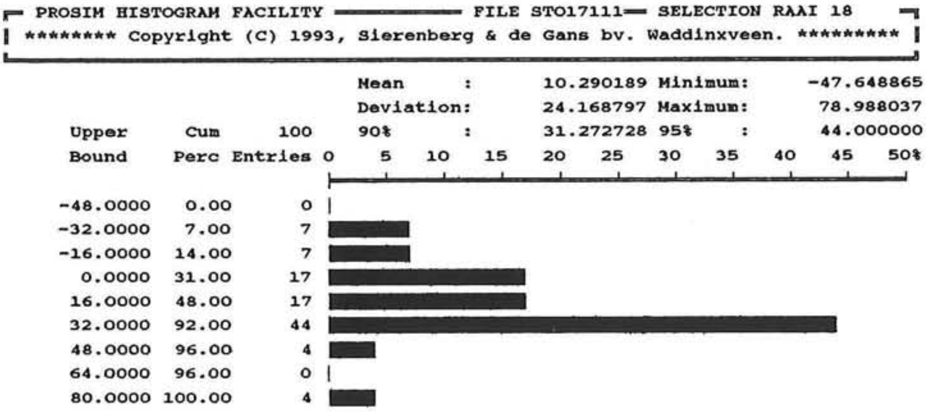
    32.0000   90.00     31  ███████████████████████████████
    48.0000   96.00      6  ██████
    64.0000   99.00      3  ███
    80.0000  100.00      1  █
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 17      -+
+-------------------------------------------------------------------------+
                                          == BASIC STATISTICS ==
   Mean            :          10.023869          Number of entries:   100
   St. deviation   :          20.700602
   Mn. deviation   :          15.820800          Minimum :        -37.159912
   Skewness        :           0.057917          Maximum :         68.413940
   Alt. Skewness   :          -0.156362          Range   :        105.573853
   Kurtosis        :           3.230288          Midrange:         15.627014

   Confidence intervals for the mean:      90% (    6.582 -     13.465)
                                           95% (    5.911 -     14.137)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -20.791565
   Median:        13.260651
   90.000        32.406555
```



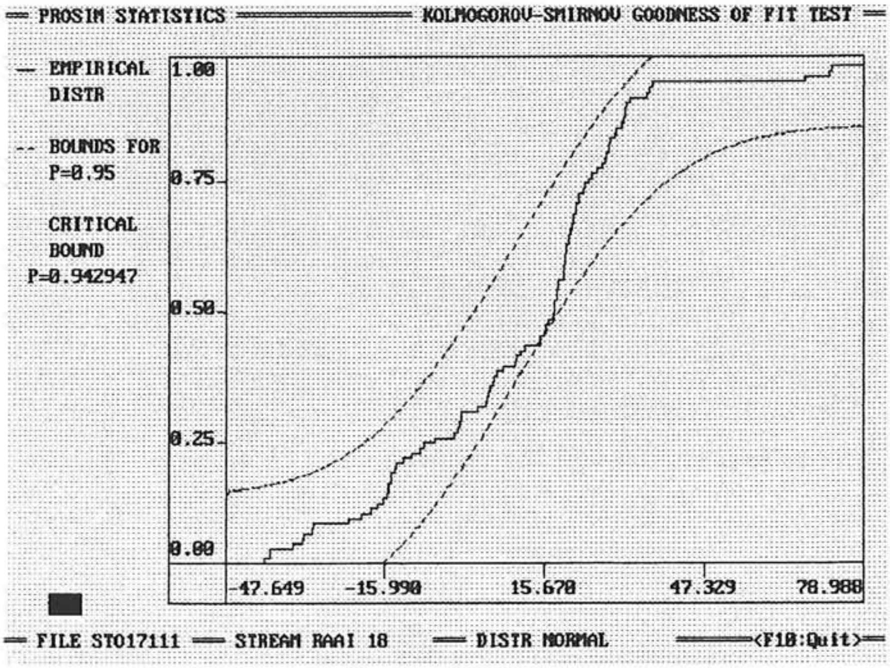
PROSIM STATISTICS: Position centre-of-gravity on cross-section 18 ($\chi = 4500$ m)



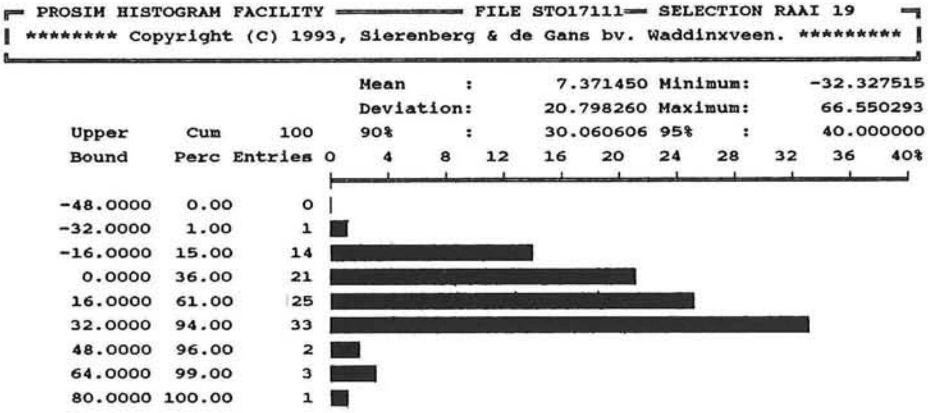
```
┌─ PROSIM HISTOGRAM FACILITY ──────── FILE STO17111── SELECTION RAAI 18     ─┐
| ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********** |
└──────────────────────────────────────────────────────────────────────────────┘
                                 Mean      :      10.290189 Minimum:      -47.648865
                                 Deviation:       24.168797 Maximum:       78.988037
 Upper      Cum      100         90%       :      31.272728 95%     :      44.000000
 Bound      Perc  Entries 0    5    10    15    20    25    30    35    40    45    50%
                          |----+-----+-----+-----+-----+-----+-----+-----+-----+-----|
 -48.0000   0.00        0 |
 -32.0000   7.00        7 
 -16.0000  14.00        7 
   0.0000  31.00       17 
  16.0000  48.00       17 
  32.0000  92.00       44 
  48.0000  96.00        4 
  64.0000  96.00        0 |
  80.0000 100.00        4 
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 18      -+
+-------------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean            :          10.290189         Number of entries:    100
   St. deviation   :          24.168795
   Mn. deviation   :          18.813063         Minimum :        -47.648865
   Skewness        :          -0.023975         Maximum :         78.988037
   Alt. Skewness   :          -0.297677         Range   :        126.636902
   Kurtosis        :           3.540302         Midrange:         15.669586

   Confidence intervals for the mean:        90% (    6.272 -     14.308)
                                             95% (    5.488 -     15.093)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -20.756836
   Median:        17.484680
   90.000        31.580994
```



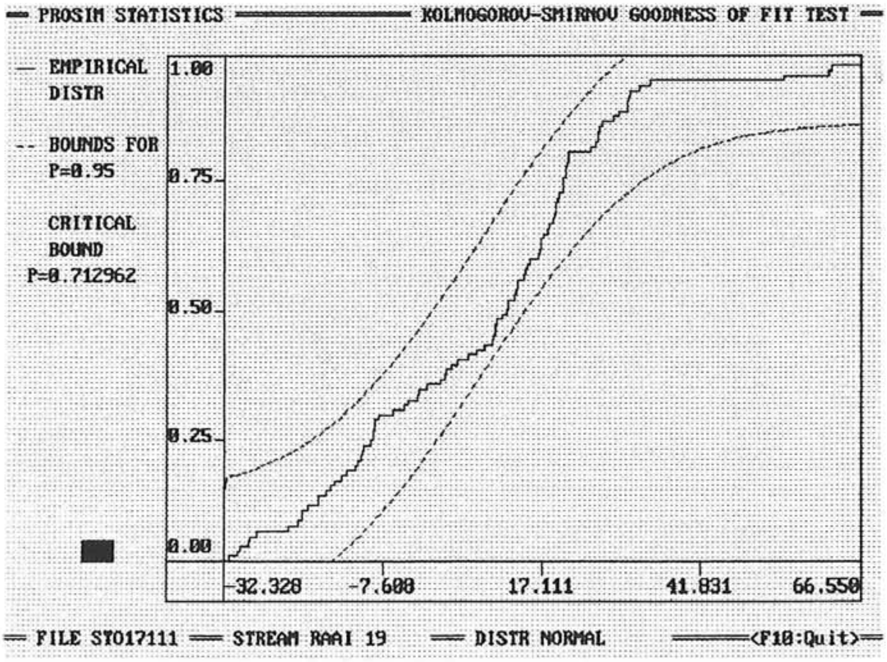
PROSIM STATISTICS: Position centre-of-gravity on cross-section 19 (χ = 4750 m)



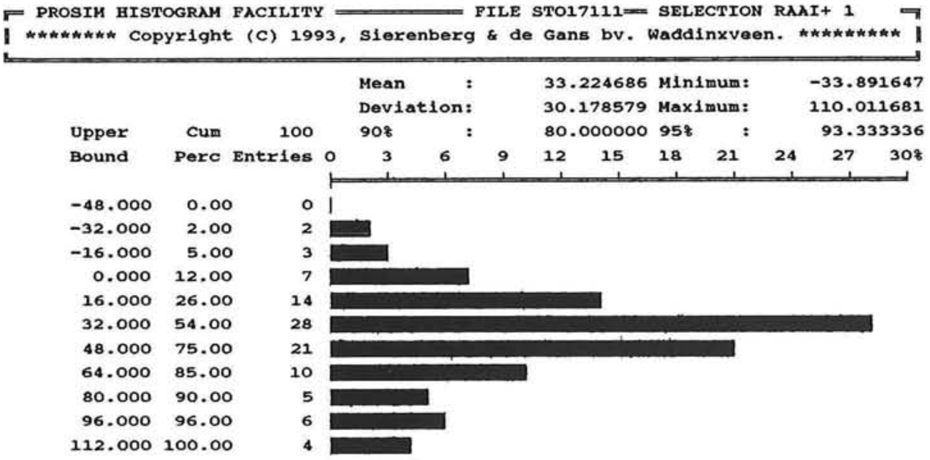
```
┌─ PROSIM HISTOGRAM FACILITY ──────── FILE STO17111── SELECTION RAAI 19     ─┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└─────────────────────────────────────────────────────────────────────────────┘
                                 Mean       :      7.371450 Minimum:      -32.327515
                                 Deviation:       20.798260 Maximum:       66.550293
   Upper        Cum       100    90%        :     30.060606 95%      :      40.000000
   Bound       Perc Entries 0     4     8    12    16    20    24    28    32    36   40%
                             |
  -48.0000      0.00       0 |
  -32.0000      1.00       1 |
  -16.0000     15.00      14 |
    0.0000     36.00      21 |
   16.0000     61.00      25 |
   32.0000     94.00      33 |
   48.0000     96.00       2 |
   64.0000     99.00       3 |
   80.0000    100.00       1 |
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI 19    -+
+-----------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean             :         7.371450          Number of entries:    100
   St. deviation    :        20.798256
   Mn. deviation    :        16.807762          Minimum :        -32.327515
   Skewness         :         0.218344          Maximum :         66.550293
   Alt. Skewness    :        -0.189972          Range   :         98.877808
   Kurtosis         :         3.131578          Midrange:         17.111389

   Confidence intervals for the mean:      90% (    3.914 -     10.829)
                                           95% (    3.239 -     11.504)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -20.152283
   Median:      11.322540
   90.000       30.250732
```



PROSIM STATISTICS: Port-side extremity on cross-section 1 (x = 250 m)



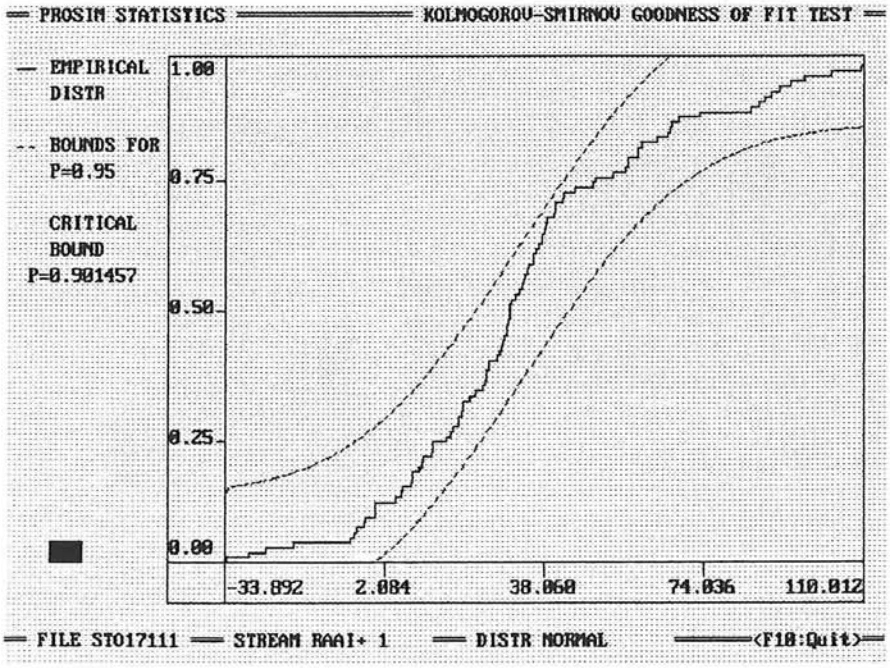
```
PROSIM HISTOGRAM FACILITY ========== FILE STO17111== SELECTION RAAI+ 1
********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                Mean      :      33.224686 Minimum:      -33.891647
                                Deviation:       30.178579 Maximum:      110.011681
  Upper      Cum      100       90%       :      80.000000 95%     :      93.333336
  Bound      Perc Entries 0     3     6     9    12    15    18    21    24    27   30%

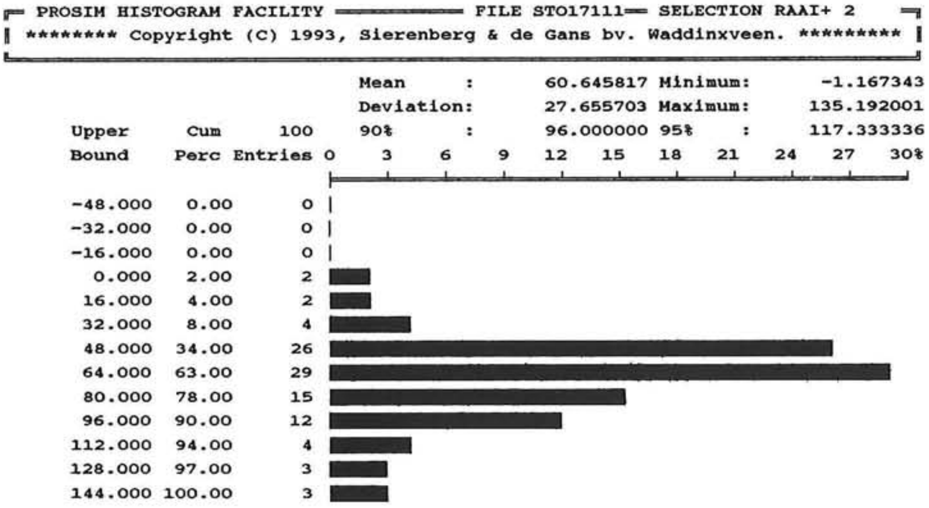
  -48.000    0.00      0
  -32.000    2.00      2
  -16.000    5.00      3
    0.000   12.00      7
   16.000   26.00     14
   32.000   54.00     28
   48.000   75.00     21
   64.000   85.00     10
   80.000   90.00      5
   96.000   96.00      6
  112.000  100.00      4
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 1     -+
+-----------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean             :        33.224709          Number of entries:    100
   St. deviation    :        30.178583
   Mn. deviation    :        22.334837          Minimum :       -33.891647
   Skewness         :         0.423188          Maximum :        110.011681
   Alt. Skewness    :         0.100130          Range   :        143.903328
   Kurtosis         :         3.276760          Midrange:        38.060017

   Confidence intervals for the mean:       90% (  28.207 -    38.242)
                                            95% (  27.228 -    39.221)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000       -0.091719
   Median:       30.202921
   90.000       84.630882
```



PROSIM STATISTICS: Port-side extremity on cross-section 2 (x = 500 m)



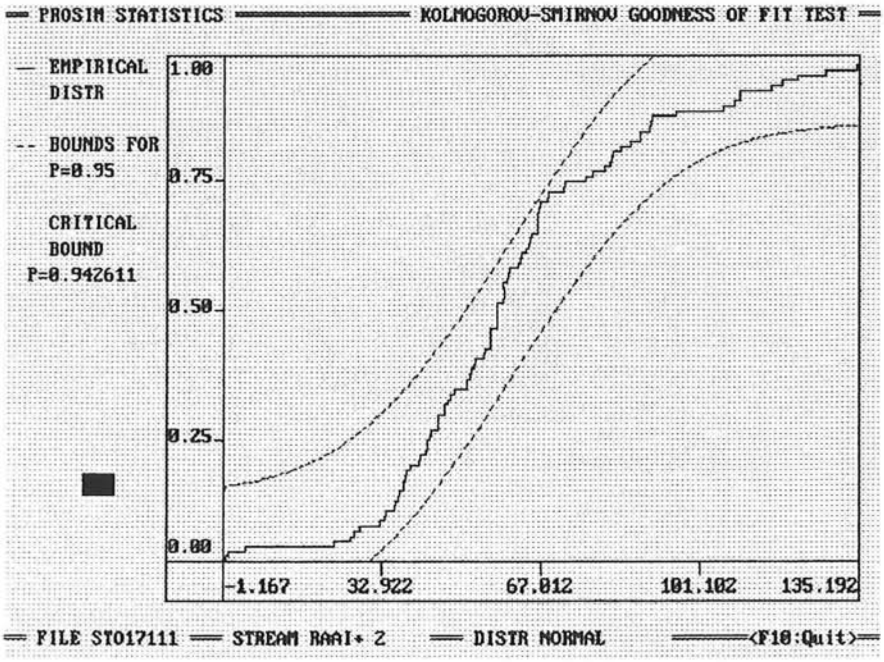
```
PROSIM HISTOGRAM FACILITY ============ FILE ST017111== SELECTION RAAI+ 2
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean       :        60.645817 Minimum:        -1.167343
                              Deviation:          27.655703 Maximum:        135.192001
 Upper      Cum      100      90%        :        96.000000 95%     :       117.333336
 Bound     Perc  Entries 0    3     6     9    12    15    18    21    24    27    30%

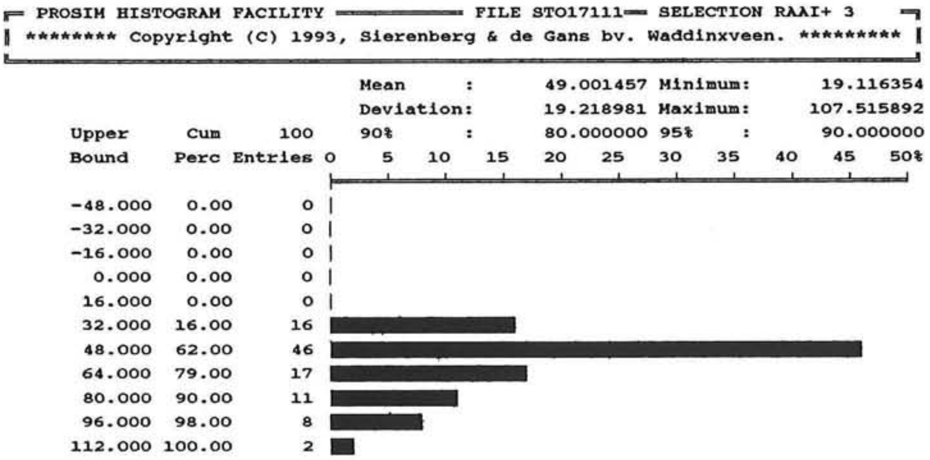
 -48.000    0.00       0 |
 -32.000    0.00       0 |
 -16.000    0.00       0 |
   0.000    2.00       2
  16.000    4.00       2
  32.000    8.00       4
  48.000   34.00      26
  64.000   63.00      29
  80.000   78.00      15
  96.000   90.00      12
 112.000   94.00       4
 128.000   97.00       3
 144.000  100.00       3
```

```
+- PROSIM STATISTICS -------------- FILE ST017111 - STREAM RAAI+ 2      -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean              :        60.645802        Number of entries:    100
   St. deviation     :        27.655701
   Mn. deviation     :        20.405384        Minimum :         -1.167343
   Skewness          :         0.532482        Maximum :        135.192001
   Alt. Skewness     :         0.106138        Range   :        136.359344
   Kurtosis          :         3.608224        Midrange:         67.012329

   Confidence intervals for the mean:      90% (  56.048 -     65.244)
                                           95% (  55.151 -     66.141)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        33.895897
   Median:        57.710476
   90.000       106.217346
```



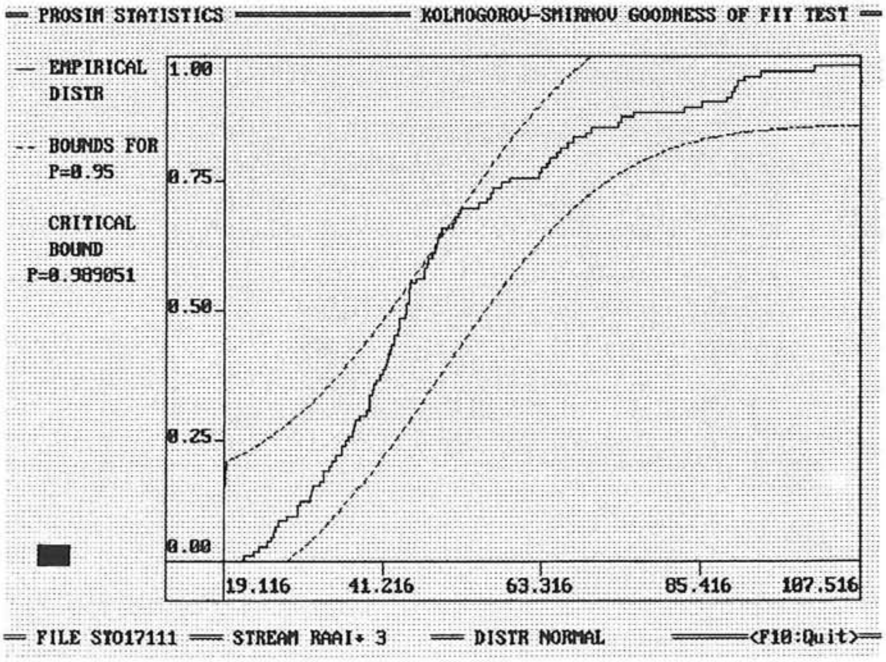
PROSIM STATISTICS: Port-side extremity on cross-section 3 (x = 750 m)



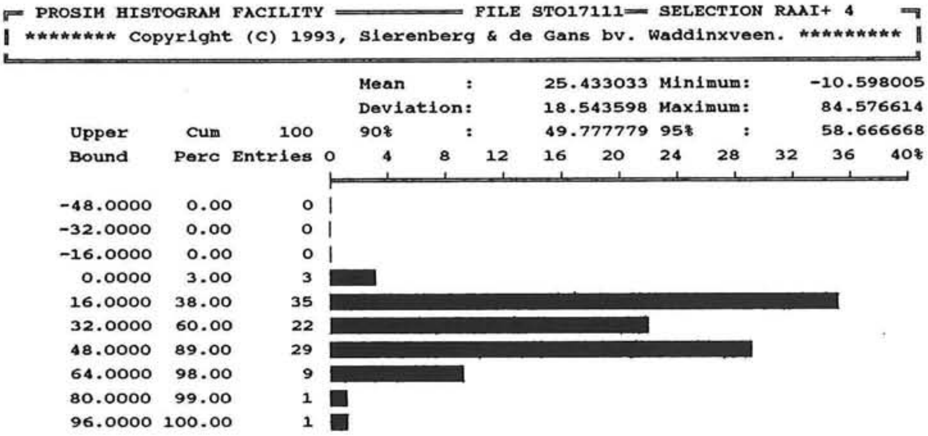
```
╒═ PROSIM HISTOGRAM FACILITY ═════════ FILE ST017111═ SELECTION RAAI+ 3    ═╕
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                            Mean      :      49.001457 Minimum:       19.116354
                            Deviation:       19.218981 Maximum:      107.515892
  Upper      Cum     100    90%       :      80.000000 95%     :      90.000000
  Bound      Perc Entries 0    5   10   15   20   25   30   35   40   45   50%
                          |----+----+----+----+----+----+----+----+----+----+
  -48.000    0.00      0 |
  -32.000    0.00      0 |
  -16.000    0.00      0 |
    0.000    0.00      0 |
   16.000    0.00      0 |
   32.000   16.00     16 ████████████████
   48.000   62.00     46 ██████████████████████████████████████████████
   64.000   79.00     17 █████████████████
   80.000   90.00     11 ███████████
   96.000   98.00      8 ████████
  112.000  100.00      2 ██
```

```
+- PROSIM STATISTICS -------------- FILE ST017111 - STREAM RAAI+ 3     -+
+-----------------------------------------------------------------------+
                                     == BASIC STATISTICS ==
   Mean               :          49.001469         Number of entries:   100
   St. deviation      :          19.218981
   Mn. deviation      :          14.725525         Minimum :        19.116354
   Skewness           :           1.057937         Maximum :        107.515892
   Alt. Skewness      :           0.240771         Range   :        88.399538
   Kurtosis           :           3.570237         Midrange:        63.316123

   Confidence intervals for the mean:       90% (   45.806 -    52.197)
                                            95% (   45.183 -    52.820)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        29.412006
   Median:        44.374096
   90.000        83.102234
```



PROSIM STATISTICS: Port-side extremity on cross-section 4 (x = 1000 m)

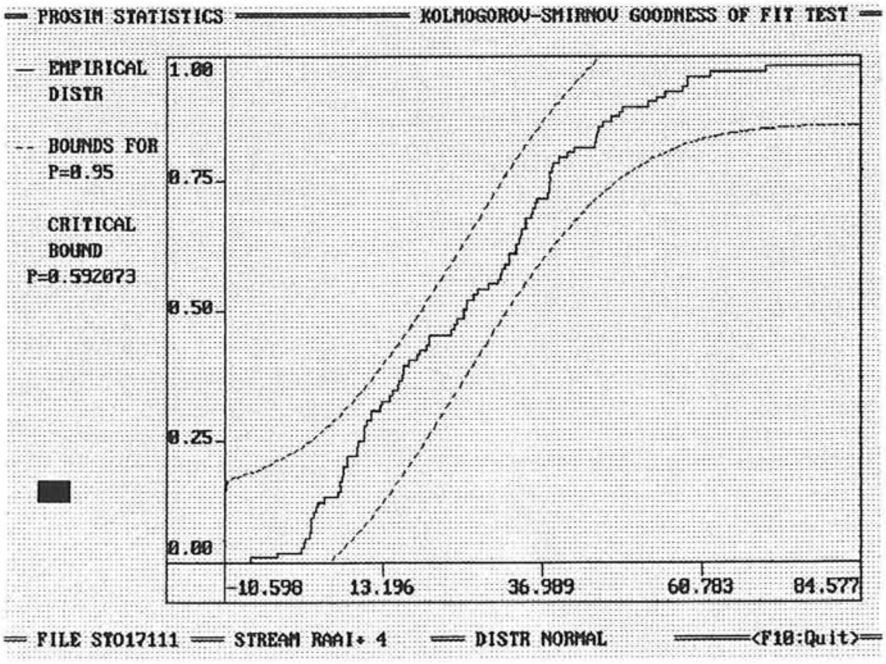


```
┌─ PROSIM HISTOGRAM FACILITY ══════════ FILE STO17111══ SELECTION RAAI+ 4    ═┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└─────────────────────────────────────────────────────────────────────────────┘
                              Mean       :     25.433033 Minimum:      -10.598005
                              Deviation:       18.543598 Maximum:       84.576614
  Upper       Cum     100     90%        :     49.777779 95%      :     58.666668
  Bound      Perc Entries 0    4    8    12   16   20   24   28   32   36   40%

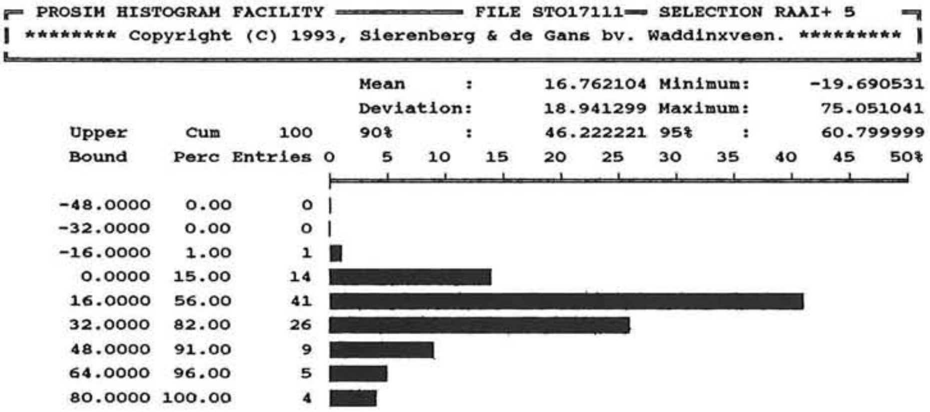
 -48.0000    0.00       0 |
 -32.0000    0.00       0 |
 -16.0000    0.00       0 |
   0.0000    3.00       3
  16.0000   38.00      35
  32.0000   60.00      22
  48.0000   89.00      29
  64.0000   98.00       9
  80.0000   99.00       1
  96.0000  100.00       1
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 4      -+
+-------------------------------------------------------------------------+
                                       == BASIC STATISTICS ==
   Mean               :        25.433035         Number of entries:    100
   St. deviation      :        18.543600
   Mn. deviation      :        15.393968         Minimum :        -10.598005
   Skewness           :         0.482311         Maximum :         84.576614
   Alt. Skewness      :         0.007208         Range   :         95.174620
   Kurtosis           :         2.879643         Midrange:         36.989305

   Confidence intervals for the mean:        90% (  22.350 -    28.516)
                                             95% (  21.748 -    29.118)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000       2.812689
   Median:      25.299379
   90.000      48.869598
```



PROSIM STATISTICS: Port-side extremity on cross-section 5 (x = 1250 m)



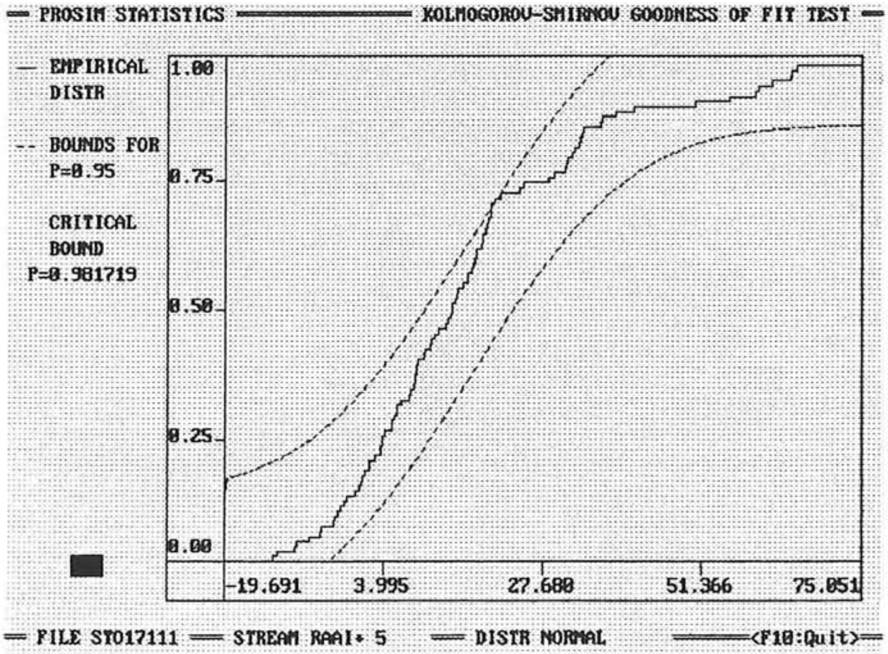
```
PROSIM HISTOGRAM FACILITY ────────── FILE STO17111── SELECTION RAAI+ 5
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                 Mean       :      16.762104 Minimum:      -19.690531
                                 Deviation:        18.941299 Maximum:       75.051041
   Upper        Cum      100     90%        :      46.222221 95%     :      60.799999
   Bound        Perc Entries 0     5    10    15    20    25    30    35    40    45    50%

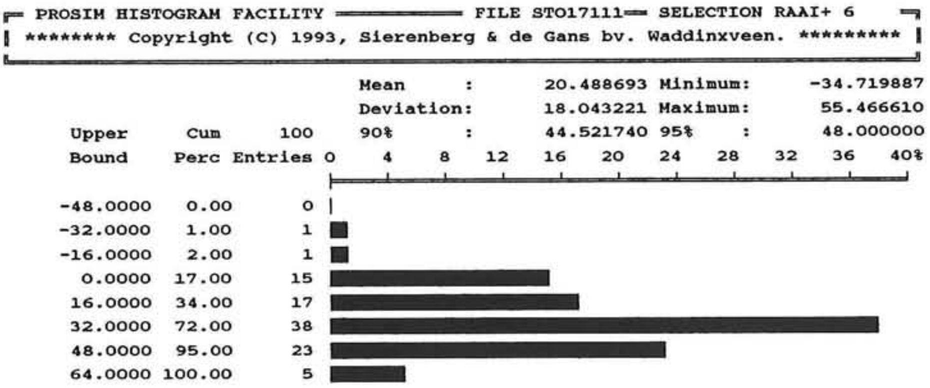
  -48.0000     0.00        0
  -32.0000     0.00        0
  -16.0000     1.00        1
    0.0000    15.00       14
   16.0000    56.00       41
   32.0000    82.00       26
   48.0000    91.00        9
   64.0000    96.00        5
   80.0000   100.00        4
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 5     -+
+-------------------------------------------------------------------------+
                                == BASIC STATISTICS ==
   Mean              :        16.762100        Number of entries:   100
   St. deviation     :        18.941299
   Mn. deviation     :        14.090729        Minimum :       -19.690531
   Skewness          :         1.027796        Maximum :        75.051041
   Alt. Skewness     :         0.136837        Range   :        94.741571
   Kurtosis          :         3.904764        Midrange:        27.680255

   Confidence intervals for the mean:      90% (  13.613 -    19.911)
                                           95% (  12.998 -    20.526)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -2.780069
   Median:       14.170223
   90.000       41.062420
```

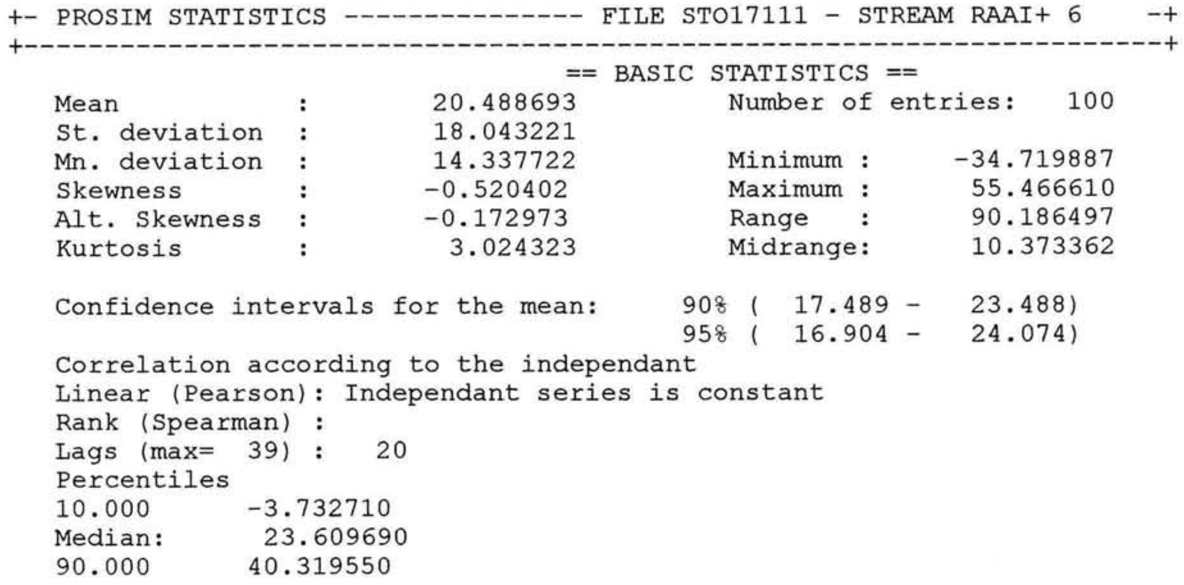


PROSIM STATISTICS: Port-side extremity on cross-section 6 (x = 1500 m)



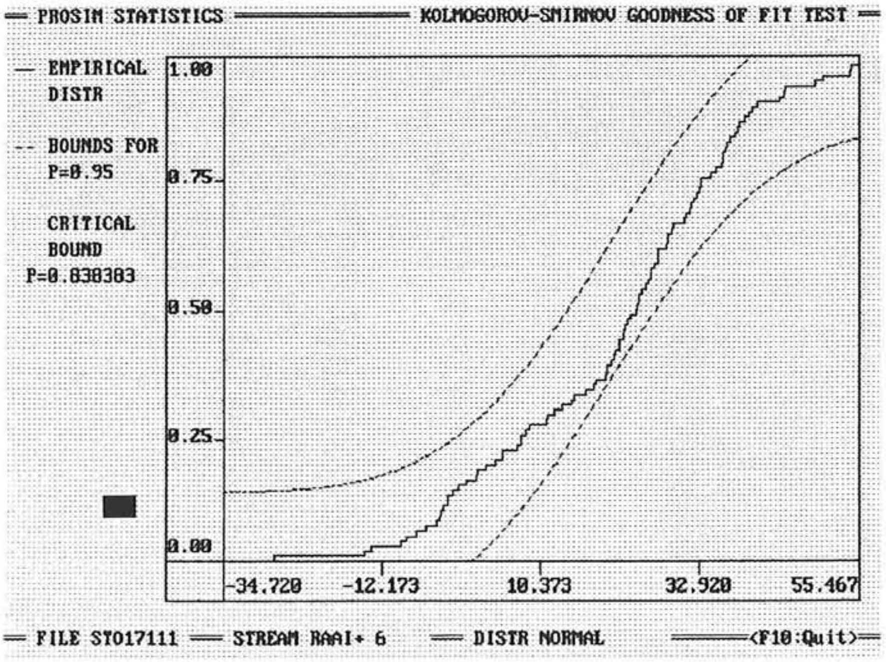
```
┌─ PROSIM HISTOGRAM FACILITY ========== FILE STO17111== SELECTION RAAI+ 6    ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                               Mean      :      20.488693 Minimum:      -34.719887
                               Deviation:       18.043221 Maximum:       55.466610
 Upper      Cum      100       90%       :      44.521740 95%    :       48.000000
 Bound      Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

 -48.0000   0.00       0
 -32.0000   1.00       1
 -16.0000   2.00       1
   0.0000  17.00      15
  16.0000  34.00      17
  32.0000  72.00      38
  48.0000  95.00      23
  64.0000 100.00       5
```

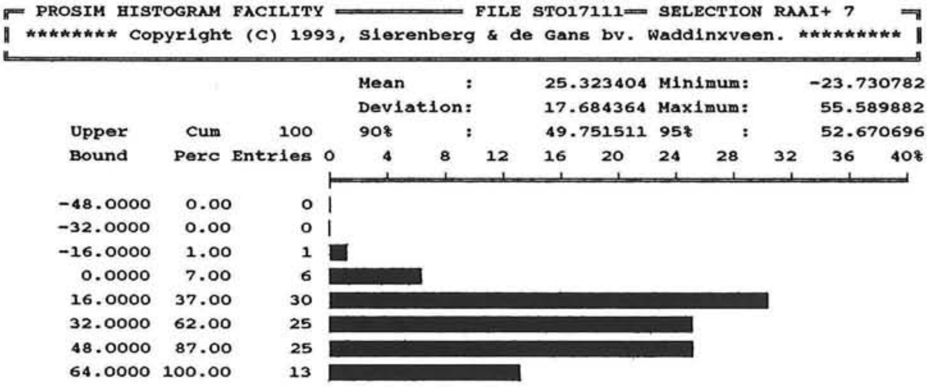


```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 6     -+
+------------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean             :         20.488693        Number of entries:   100
   St. deviation    :         18.043221
   Mn. deviation    :         14.337722        Minimum :        -34.719887
   Skewness         :         -0.520402        Maximum :         55.466610
   Alt. Skewness    :         -0.172973        Range   :         90.186497
   Kurtosis         :          3.024323        Midrange:         10.373362

   Confidence intervals for the mean:     90% (  17.489 -    23.488)
                                          95% (  16.904 -    24.074)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000       -3.732710
   Median:       23.609690
   90.000       40.319550
```



PROSIM STATISTICS: Port-side extremity on cross-section 7 (x = 1750 m)

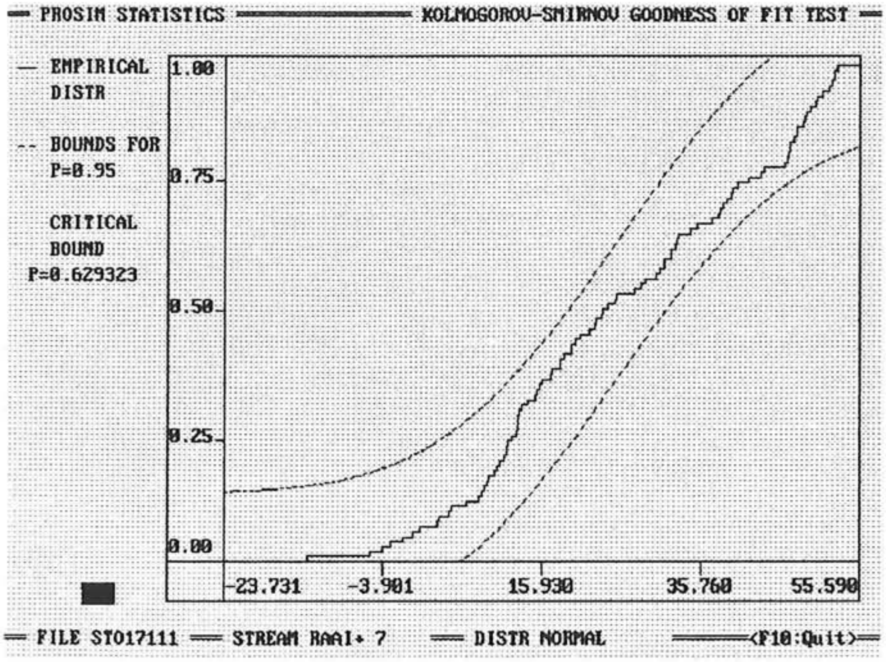


```
┌═ PROSIM HISTOGRAM FACILITY ══════════ FILE STO17111══ SELECTION RAAI+ 7     ═┐
║ ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* ║
└══════════════════════════════════════════════════════════════════════════════┘
                                 Mean      :        25.323404 Minimum:     -23.730782
                                 Deviation:         17.684364 Maximum:      55.589882
      Upper      Cum      100    90%       :        49.751511 95%     :     52.670696
      Bound      Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

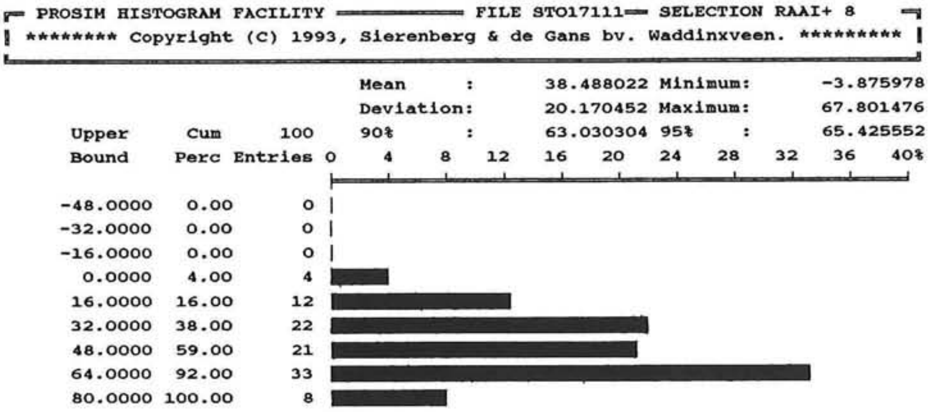
     -48.0000    0.00       0 |
     -32.0000    0.00       0 |
     -16.0000    1.00       1 █
       0.0000    7.00       6 ███████
      16.0000   37.00      30 ██████████████████████████████████
      32.0000   62.00      25 ████████████████████████████
      48.0000   87.00      25 ████████████████████████████
      64.0000  100.00      13 ███████████████
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 7      -+
+------------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean            :          25.323408        Number of entries:    100
   St. deviation   :          17.684364
   Mn. deviation   :          15.066344        Minimum :        -23.730782
   Skewness        :         -0.120181        Maximum :         55.589882
   Alt. Skewness   :           0.111936        Range   :         79.320663
   Kurtosis        :           2.250839        Midrange:         15.929550

   Confidence intervals for the mean:      90% (  22.383 -    28.264)
                                           95% (  21.810 -    28.837)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000         4.265896
   Median:        23.343884
   90.000        49.517975
```



PROSIM STATISTICS: Port-side extremity on cross-section 8 (x = 2000 m)

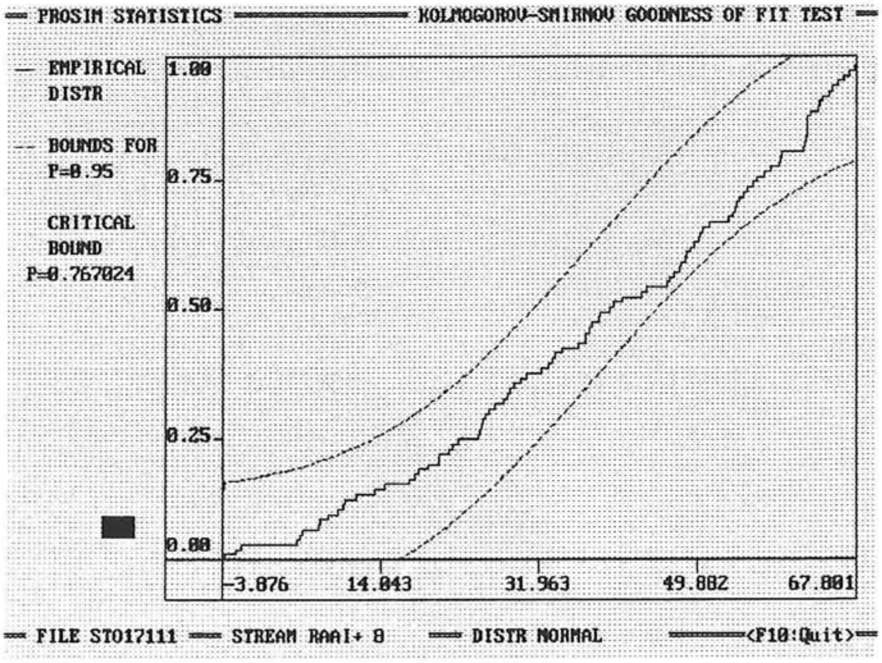


```
┌═ PROSIM HISTOGRAM FACILITY ════════════ FILE STO17111══ SELECTION RAAI+ 8    ═┐
| ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└═══════════════════════════════════════════════════════════════════════════════┘
                                Mean      :       38.488022 Minimum:        -3.875978
                                Deviation:        20.170452 Maximum:        67.801476
   Upper      Cum     100       90%       :       63.030304 95%     :       65.425552
   Bound      Perc Entries 0    4    8   12   16   20   24   28   32   36   40%

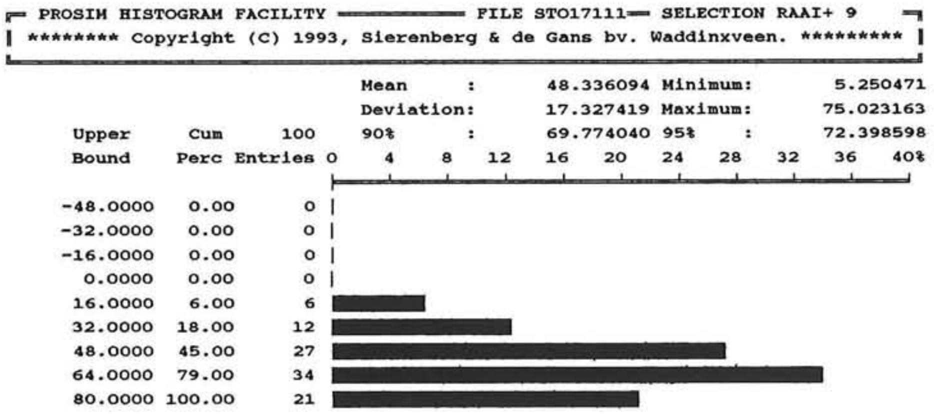
 -48.0000    0.00       0 |
 -32.0000    0.00       0 |
 -16.0000    0.00       0 |
   0.0000    4.00       4
  16.0000   16.00      12
  32.0000   38.00      22
  48.0000   59.00      21
  64.0000   92.00      33
  80.0000  100.00       8
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 8      -+
+-------------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean                :         38.488026        Number of entries:    100
   St. deviation       :         20.170452
   Mn. deviation       :         17.252375        Minimum :         -3.875978
   Skewness            :         -0.341573        Maximum :         67.801476
   Alt. Skewness       :         -0.048595        Range   :         71.677454
   Kurtosis            :          1.997104        Midrange:         31.962749

   Confidence intervals for the mean:      90% (  35.135 -     41.841)
                                           95% (  34.480 -     42.496)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        9.273119
   Median:       39.468201
   90.000       63.625122
```



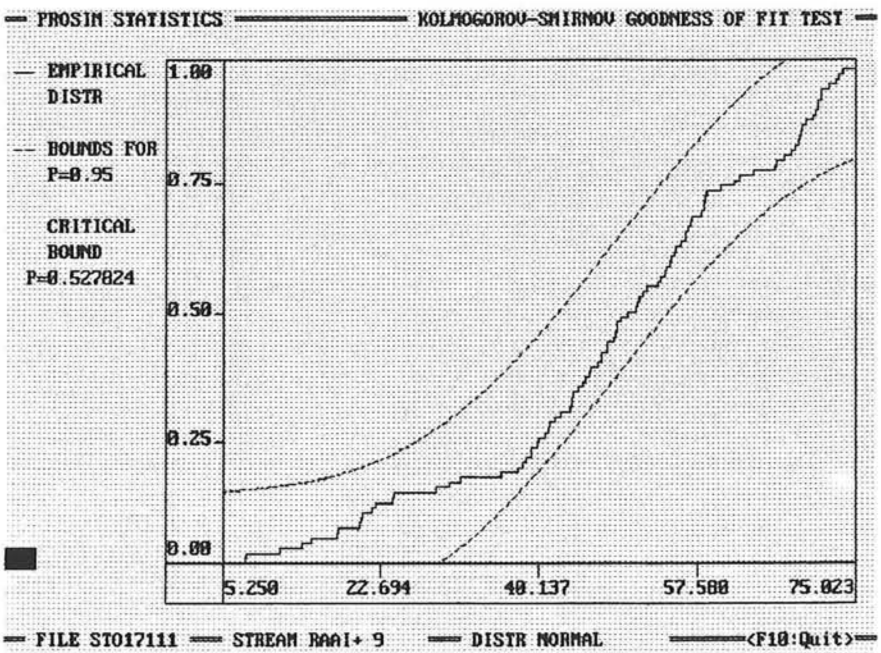
PROSIM STATISTICS: Port-side extremity on cross-section 9 (x = 2250 m)



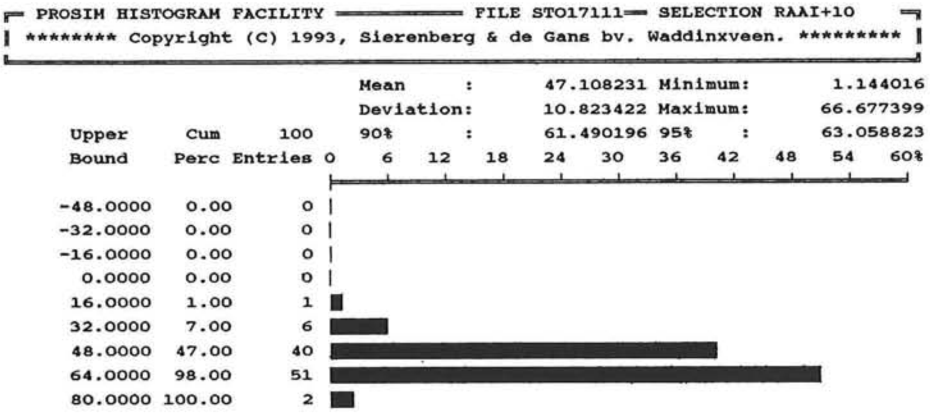
```
PROSIM HISTOGRAM FACILITY ──────── FILE STO17111── SELECTION RAAI+ 9
| ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
                                Mean      :       48.336094 Minimum:      5.250471
                                Deviation:        17.327419 Maximum:     75.023163
  Upper       Cum       100     90%       :       69.774040 95%     :    72.398598
  Bound       Perc Entries 0    4    8   12   16   20   24   28   32   36   40%
 -48.0000     0.00        0 |
 -32.0000     0.00        0 |
 -16.0000     0.00        0 |
   0.0000     0.00        0 |
  16.0000     6.00        6 
  32.0000    18.00       12 
  48.0000    45.00       27 
  64.0000    79.00       34 
  80.0000   100.00       21 
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+ 9     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean             :          48.336082        Number of entries:   100
   St. deviation    :          17.327421
   Mn. deviation    :          13.556810        Minimum :         5.250471
   Skewness         :          -0.593718        Maximum :        75.023163
   Alt. Skewness    :          -0.069979        Range   :        69.772692
   Kurtosis         :           2.712951        Midrange:        40.136817

   Confidence intervals for the mean:      90% (  45.455 -    51.217)
                                           95% (  44.893 -    51.779)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        20.682034
   Median:        49.548630
   90.000        70.601501
```



PROSIM STATISTICS: Port-side extremity on cross-section 10 (x = 2500 m)



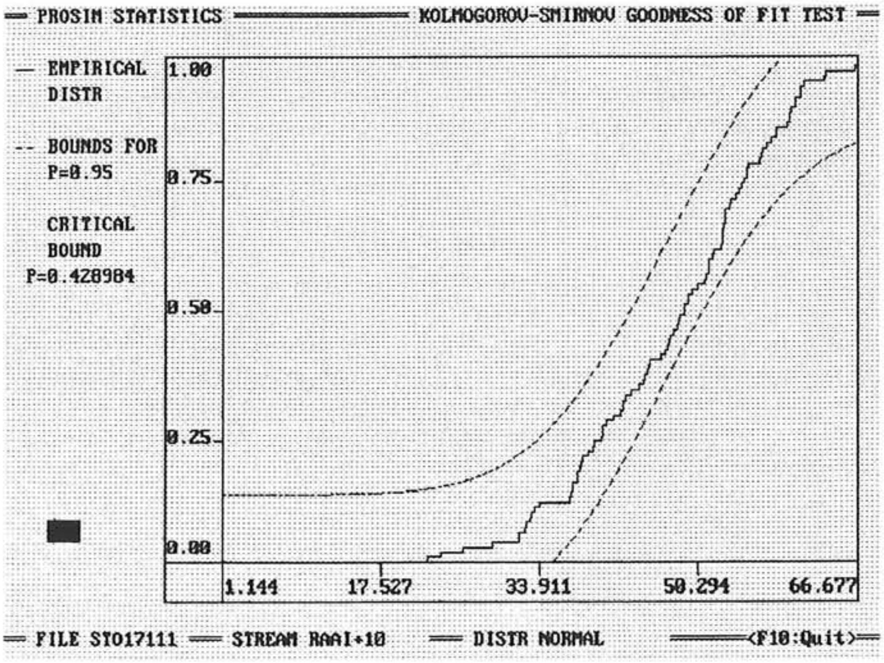
```
PROSIM HISTOGRAM FACILITY ============ FILE STO17111== SELECTION RAAI+10
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |

                          Mean       :      47.108231 Minimum:        1.144016
                          Deviation:        10.823422 Maximum:       66.677399
 Upper      Cum     100   90%        :      61.490196 95%     :      63.058823
 Bound      Perc Entries 0    6    12    18    24    30    36    42    48    54    60%

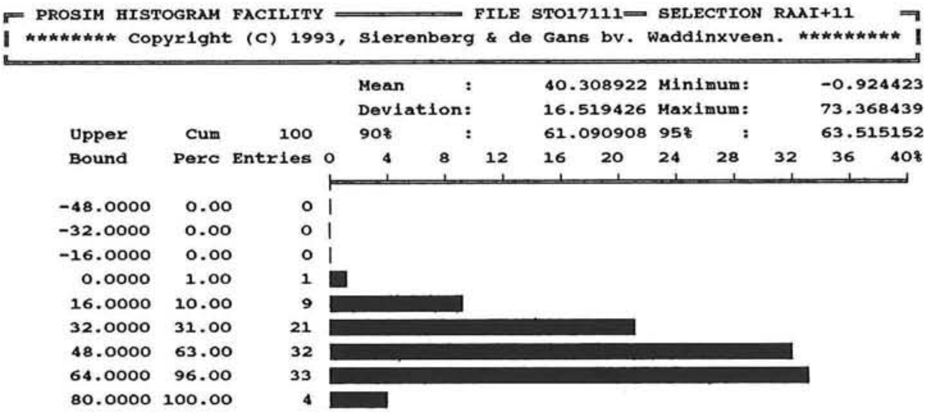
 -48.0000   0.00       0 |
 -32.0000   0.00       0 |
 -16.0000   0.00       0 |
   0.0000   0.00       0 |
  16.0000   1.00       1 
  32.0000   7.00       6 
  48.0000  47.00      40 
  64.0000  98.00      51 
  80.0000 100.00       2 
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+10     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean              :        47.108227          Number of entries:   100
   St. deviation     :        10.823421
   Mn. deviation     :         8.520121          Minimum :        1.144016
   Skewness          :        -0.935327          Maximum :       66.677399
   Alt. Skewness     :        -0.143796          Range   :       65.533382
   Kurtosis          :         4.937272          Midrange:       33.910707

   Confidence intervals for the mean:        90% (  45.309 -     48.908)
                                             95% (  44.958 -     49.259)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       33.107857
   Median:       48.664597
   90.000       59.843025
```



PROSIM STATISTICS: Port-side extremity on cross-section 11 (x = 2750 m)



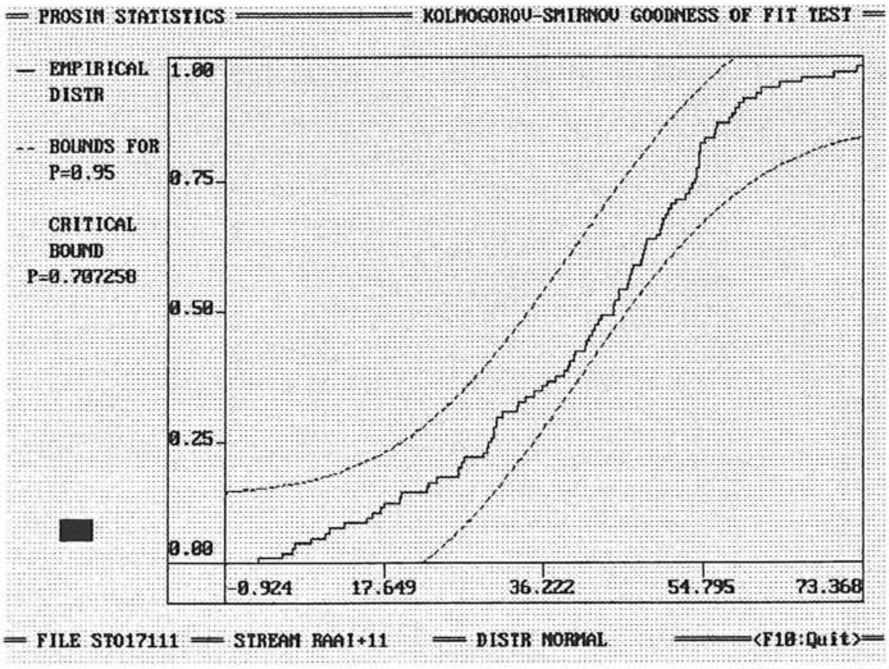
```
PROSIM HISTOGRAM FACILITY ========= FILE STO17111== SELECTION RAAI+11
********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                Mean       :      40.308922 Minimum:      -0.924423
                                Deviation:        16.519426 Maximum:      73.368439
  Upper      Cum      100       90%        :      61.090908 95%     :     63.515152
  Bound      Perc Entries 0    4    8   12   16   20   24   28   32   36   40%

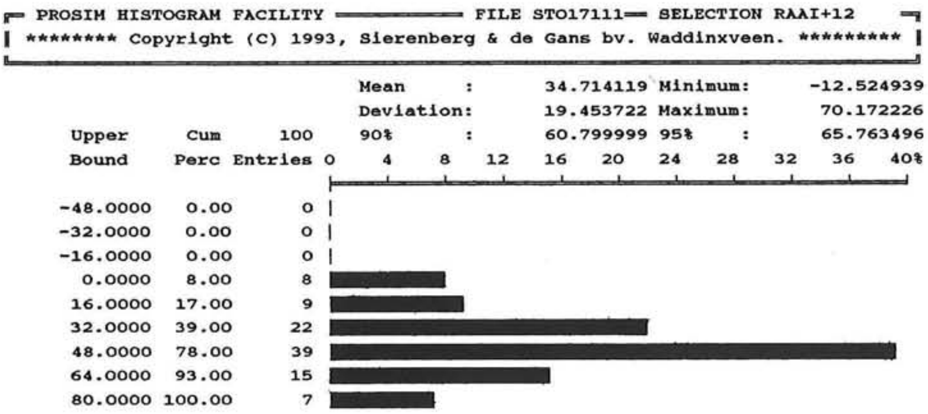
 -48.0000    0.00       0
 -32.0000    0.00       0
 -16.0000    0.00       0
   0.0000    1.00       1
  16.0000   10.00       9
  32.0000   31.00      21
  48.0000   63.00      32
  64.0000   96.00      33
  80.0000  100.00       4
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+11      -+
+-------------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean             :        40.308929        Number of entries:    100
   St. deviation    :        16.519426
   Mn. deviation    :        13.423966        Minimum :         -0.924423
   Skewness         :        -0.484027        Maximum :         73.368439
   Alt. Skewness    :        -0.202309        Range   :         74.292862
   Kurtosis         :         2.619887        Midrange:         36.222008

   Confidence intervals for the mean:      90% (  37.562 -     43.055)
                                           95% (  37.027 -     43.591)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        16.167503
   Median:        43.650963
   90.000        58.403019
```



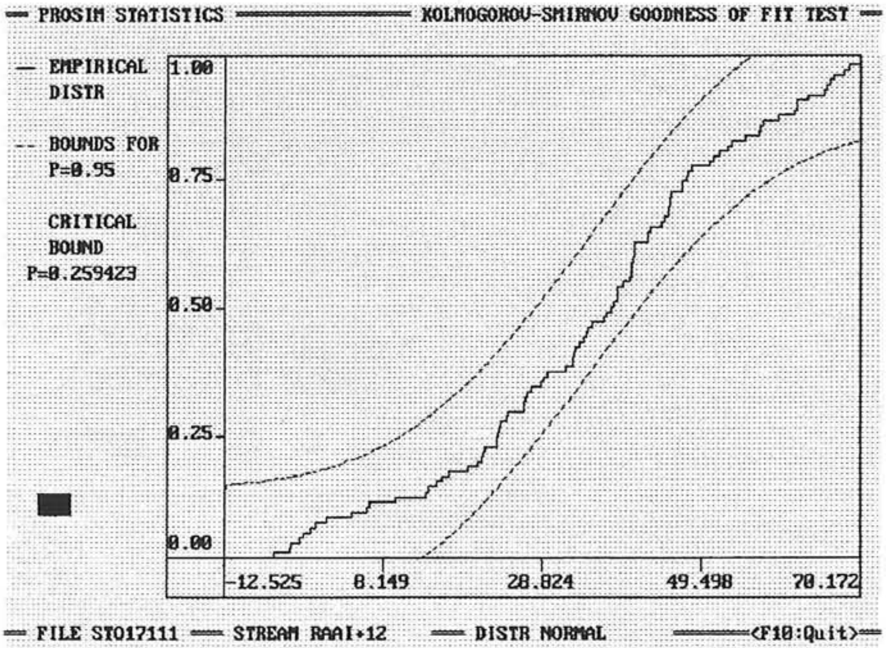
PROSIM STATISTICS: <u>Port-side extremity on cross-section 12</u> (x = 3000 m)



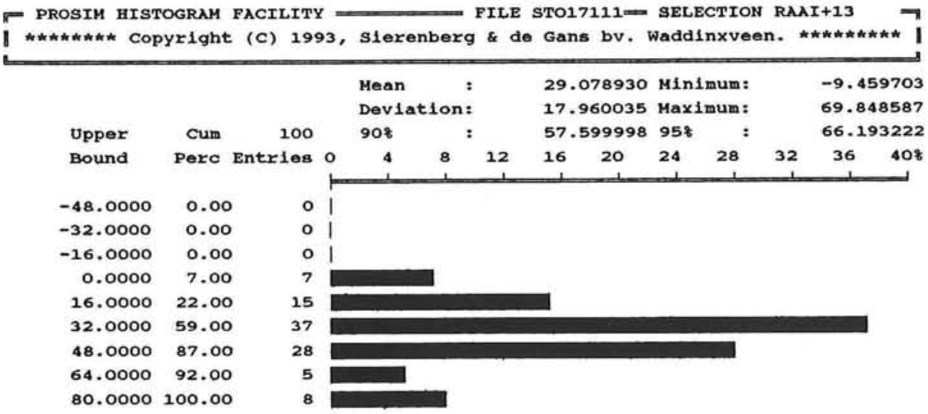
```
┌─ PROSIM HISTOGRAM FACILITY ══════════ FILE STO17111══ SELECTION RAAI+12     ═┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                           Mean       :        34.714119 Minimum:      -12.524939
                           Deviation:          19.453722 Maximum:       70.172226
 Upper       Cum      100  90%        :        60.799999 95%     :      65.763496
 Bound      Perc Entries 0    4    8   12   16   20   24   28   32   36   40%
                         ├────┴────┴────┴────┴────┴────┴────┴────┴────┴────┤
 -48.0000   0.00       0 |
 -32.0000   0.00       0 |
 -16.0000   0.00       0 |
   0.0000   8.00       8 ██████████
  16.0000  17.00       9 ███████████
  32.0000  39.00      22 ████████████████████████████
  48.0000  78.00      39 █████████████████████████████████████████████████
  64.0000  93.00      15 ███████████████████
  80.0000 100.00       7 █████████
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+12     -+
+-----------------------------------------------------------------------+
                            == BASIC STATISTICS ==
   Mean             :        34.714127        Number of entries:   100
   St. deviation    :        19.453722
   Mn. deviation    :        15.460448        Minimum :      -12.524939
   Skewness         :        -0.331285        Maximum :       70.172226
   Alt. Skewness    :        -0.137852        Range   :       82.697165
   Kurtosis         :         2.582995        Midrange:       28.823644

   Confidence intervals for the mean:      90% (  31.480 -   37.948)
                                           95% (  30.849 -   38.580)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000       5.987036
   Median:      37.395863
   90.000      62.032452
```



PROSIM STATISTICS: Port-side extremity on cross-section 13 (x = 3250 m)



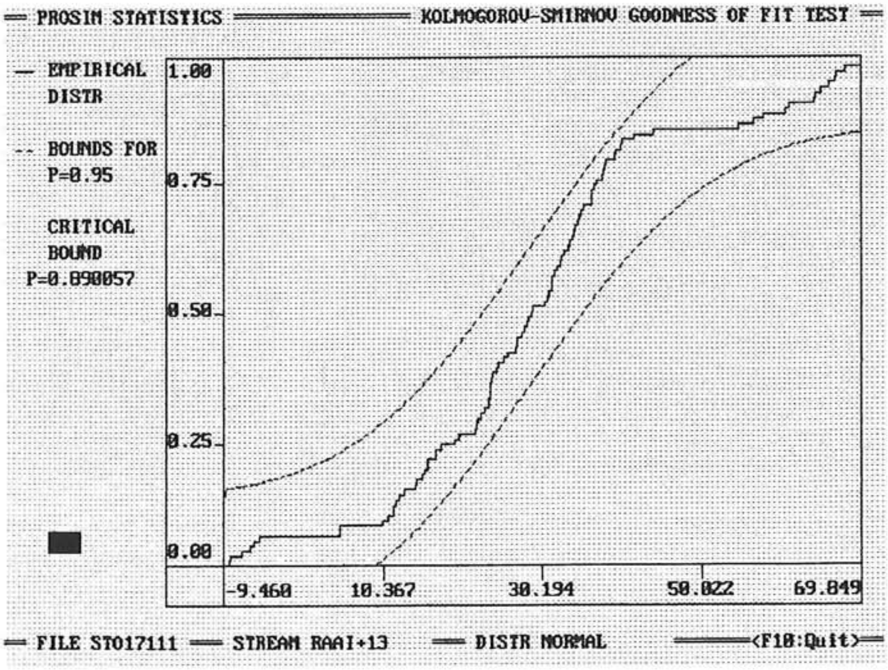
```
PROSIM HISTOGRAM FACILITY ============ FILE STO17111=== SELECTION RAAI+13
********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                  Mean       :    29.078930 Minimum:     -9.459703
                                  Deviation:      17.960035 Maximum:     69.848587
  Upper       Cum     100         90%        :    57.599998 95%    :     66.193222
  Bound       Perc  Entries 0     4     8    12    16    20    24    28    32    36    40%

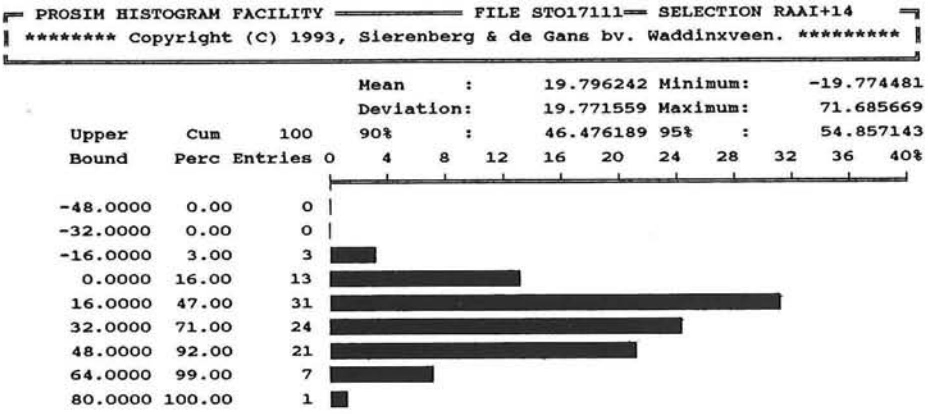
  -48.0000    0.00      0
  -32.0000    0.00      0
  -16.0000    0.00      0
    0.0000    7.00      7
   16.0000   22.00     15
   32.0000   59.00     37
   48.0000   87.00     28
   64.0000   92.00      5
   80.0000  100.00      8
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+13      -+
+-------------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean              :         29.078926         Number of entries:    100
   St. deviation     :         17.960037
   Mn. deviation     :         13.221277         Minimum :         -9.459703
   Skewness          :          0.216753         Maximum :         69.848587
   Alt. Skewness     :          0.026502         Range   :         79.308290
   Kurtosis          :          3.240190         Midrange:         30.194442

   Confidence intervals for the mean:      90% (  26.093 -     32.065)
                                           95% (  25.510 -     32.648)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       10.865482
   Median:       28.602955
   90.000       60.468189
```



PROSIM STATISTICS: Port-side extremity on cross-section 14 (x = 3500 m)



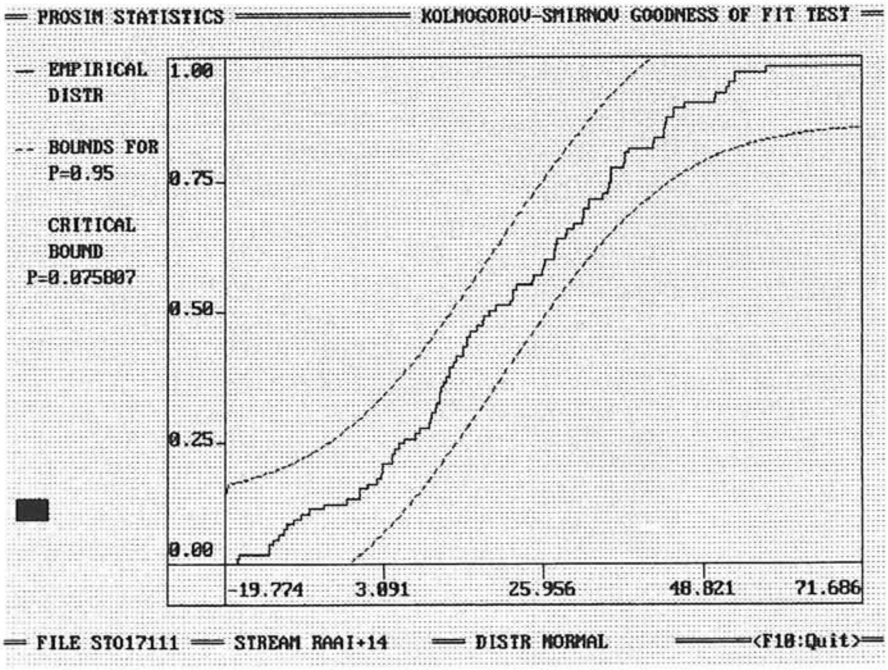
```
PROSIM HISTOGRAM FACILITY ============ FILE ST017111== SELECTION RAAI+14
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean      :      19.796242 Minimum:    -19.774481
                              Deviation:      19.771559 Maximum:      71.685669
Upper      Cum     100        90%       :      46.476189 95%    :     54.857143
Bound      Perc  Entries  0    4    8   12   16   20   24   28   32   36   40%

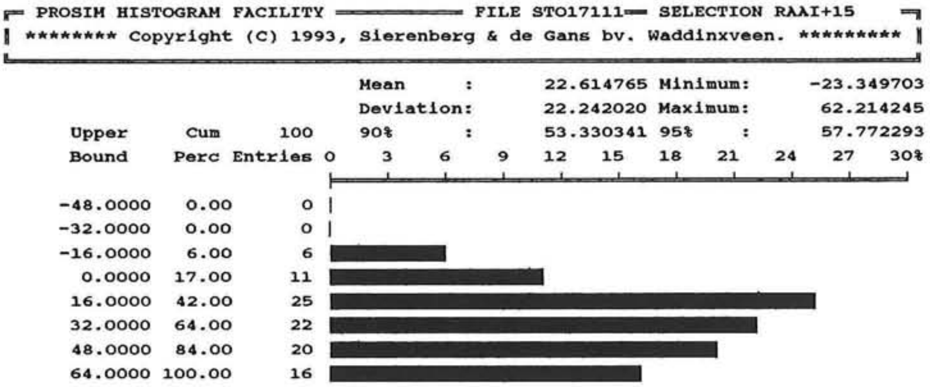
-48.0000    0.00     0
-32.0000    0.00     0
-16.0000    3.00     3
  0.0000   16.00    13
 16.0000   47.00    31
 32.0000   71.00    24
 48.0000   92.00    21
 64.0000   99.00     7
 80.0000  100.00     1
```

```
+- PROSIM STATISTICS --------------- FILE ST017111 - STREAM RAAI+14     -+
+-----------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean              :          19.796246         Number of entries:   100
   St. deviation     :          19.771557
   Mn. deviation     :          16.365490         Minimum :        -19.774481
   Skewness          :           0.051809         Maximum :         71.685669
   Alt. Skewness     :           0.097812         Range   :         91.460150
   Kurtosis          :           2.409557         Midrange:         25.955594

   Confidence intervals for the mean:        90% (  16.509 -    23.083)
                                             95% (  15.868 -    23.725)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        -8.934883
   Median:        17.862356
   90.000        44.548553
```



PROSIM STATISTICS: <u>Port-side extremity on cross-section 15</u> (x = 3750 m)



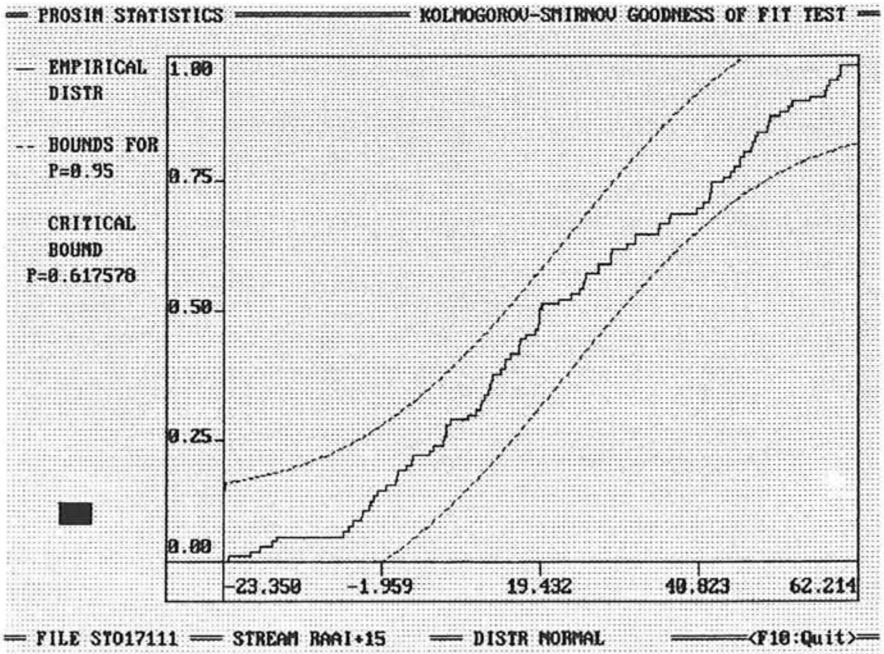
```
PROSIM HISTOGRAM FACILITY ============ FILE STO17111== SELECTION RAAI+15
 ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                             Mean      :       22.614765 Minimum:       -23.349703
                             Deviation:       22.242020 Maximum:        62.214245
 Upper      Cum      100     90%       :       53.330341 95%     :       57.772293
 Bound      Perc Entries 0     3     6     9    12    15    18    21    24    27    30%

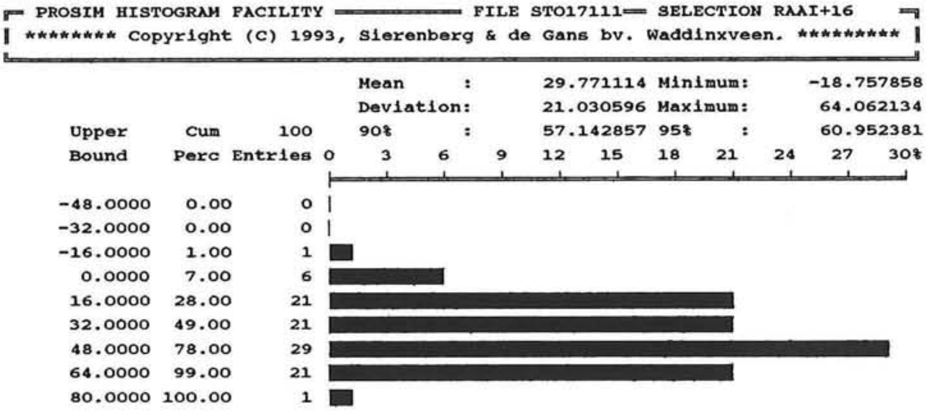
 -48.0000   0.00       0
 -32.0000   0.00       0
 -16.0000   6.00       6
   0.0000  17.00      11
  16.0000  42.00      25
  32.0000  64.00      22
  48.0000  84.00      20
  64.0000 100.00      16
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+15     -+
+------------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean              :        22.614765        Number of entries:    100
   St. deviation     :        22.242020
   Mn. deviation     :        18.808989        Minimum :       -23.349703
   Skewness          :        -0.027946        Maximum :        62.214245
   Alt. Skewness     :         0.148317        Range   :        85.563948
   Kurtosis          :         2.038538        Midrange:        19.432271

   Confidence intervals for the mean:       90% (  18.917 -    26.313)
                                            95% (  18.195 -    27.034)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -4.618099
   Median:       19.315901
   90.000       52.901367
```



PROSIM STATISTICS: Port-side extremity on cross-section 16 (x = 4000 m)



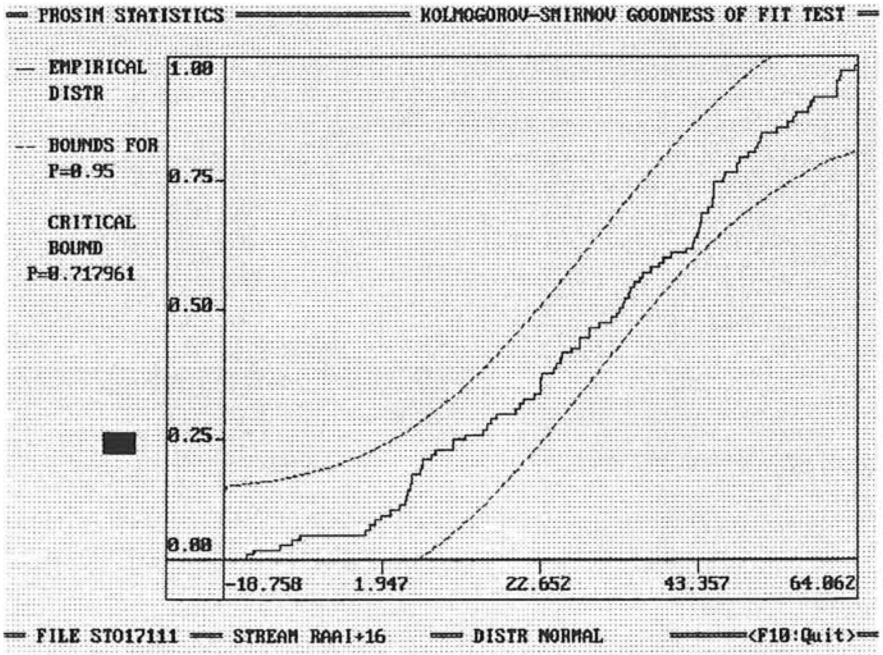
```
PROSIM HISTOGRAM FACILITY ──────── FILE STO17111══ SELECTION RAAI+16
 ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                  Mean      :        29.771114 Minimum:     -18.757858
                                  Deviation:         21.030596 Maximum:      64.062134
   Upper       Cum       100      90%       :        57.142857 95%     :     60.952381
   Bound       Perc  Entries 0    3     6     9    12    15    18    21    24    27    30%

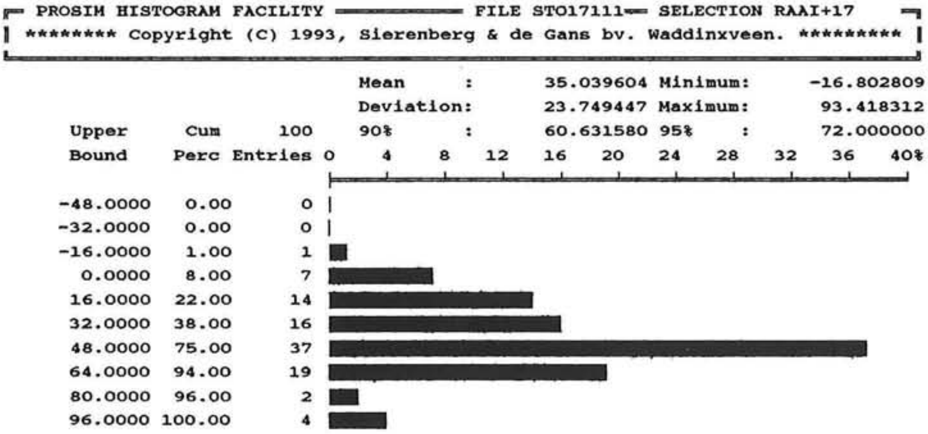
 -48.0000     0.00         0
 -32.0000     0.00         0
 -16.0000     1.00         1
   0.0000     7.00         6
  16.0000    28.00        21
  32.0000    49.00        21
  48.0000    78.00        29
  64.0000    99.00        21
  80.0000   100.00         1
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+16    -+
+-----------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean             :          29.771107        Number of entries:    100
   St. deviation    :          21.030596
   Mn. deviation    :          17.692024        Minimum :        -18.757858
   Skewness         :          -0.326141        Maximum :         64.062134
   Alt. Skewness    :          -0.145954        Range   :         82.819992
   Kurtosis         :           2.190137        Midrange:         22.652138

   Confidence intervals for the mean:       90% (  26.275 -    33.268)
                                            95% (  25.592 -    33.950)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        2.935593
   Median:       32.840607
   90.000       57.693703
```



PROSIM STATISTICS: Port-side extremity on cross-section 17 (x = 4250 m)



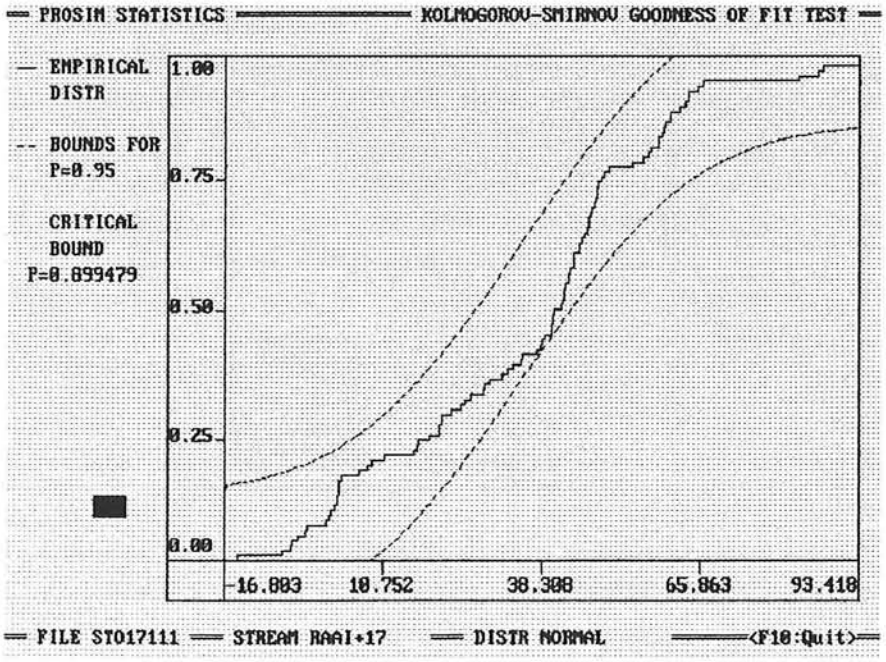
```
PROSIM HISTOGRAM FACILITY ========== FILE STO17111== SELECTION RAAI+17
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean       :     35.039604 Minimum:     -16.802809
                              Deviation:       23.749447 Maximum:      93.418312
  Upper        Cum     100    90%        :     60.631580 95%     :     72.000000
  Bound       Perc Entries 0     4     8   12    16    20   24    28    32    36    40%

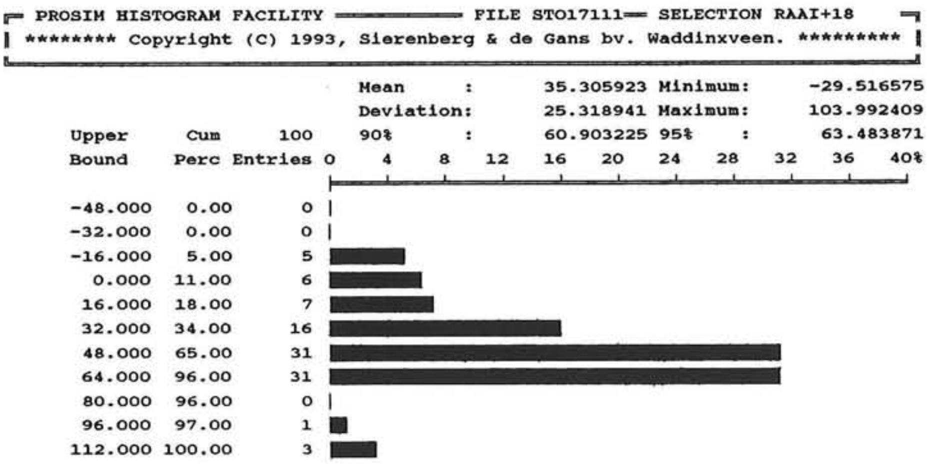
 -48.0000     0.00      0
 -32.0000     0.00      0
 -16.0000     1.00      1
   0.0000     8.00      7
  16.0000    22.00     14
  32.0000    38.00     16
  48.0000    75.00     37
  64.0000    94.00     19
  80.0000    96.00      2
  96.0000   100.00      4
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+17     -+
+------------------------------------------------------------------------+
                                     == BASIC STATISTICS ==
   Mean             :        35.039604        Number of entries:   100
   St. deviation    :        23.749447
   Mn. deviation    :        19.311493        Minimum :      -16.802809
   Skewness         :        -0.130382        Maximum :       93.418312
   Alt. Skewness    :        -0.223302        Range   :      110.221121
   Kurtosis         :         2.560425        Midrange:       38.307752

   Confidence intervals for the mean:      90% (  31.091 -    38.988)
                                           95% (  30.321 -    39.759)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000         1.610950
   Median:       40.342915
   90.000        62.352257
```



PROSIM STATISTICS: Port-side extremity on cross-section 18 (x = 4500 m)



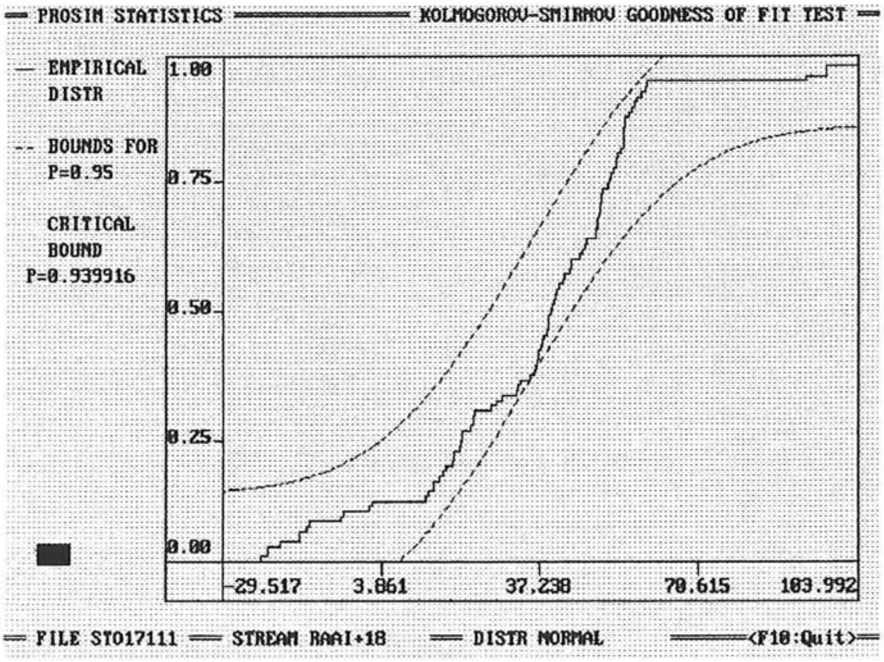
```
 PROSIM HISTOGRAM FACILITY ========== FILE STO17111== SELECTION RAAI+18
 ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                               Mean       :       35.305923 Minimum:      -29.516575
                               Deviation:         25.318941 Maximum:      103.992409
   Upper      Cum      100     90%        :       60.903225 95%     :      63.483871
   Bound      Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

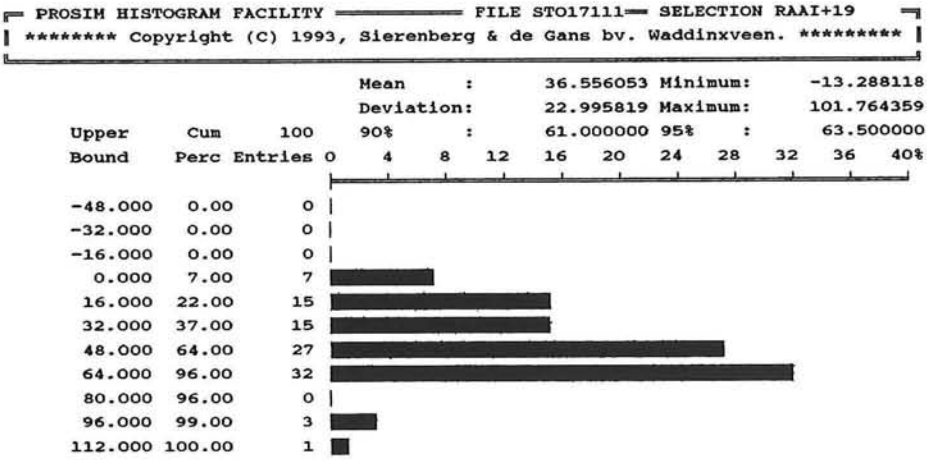
   -48.000    0.00       0 |
   -32.000    0.00       0 |
   -16.000    5.00       5
     0.000   11.00       6
    16.000   18.00       7
    32.000   34.00      16
    48.000   65.00      31
    64.000   96.00      31
    80.000   96.00       0 |
    96.000   97.00       1
   112.000  100.00       3
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI+18     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean             :         35.305931         Number of entries:    100
   St. deviation    :         25.318945
   Mn. deviation    :         19.025269         Minimum :       -29.516575
   Skewness         :         -0.297547         Maximum :        103.992409
   Alt. Skewness    :         -0.157831         Range   :        133.508984
   Kurtosis         :          3.739478         Midrange:        37.237917

   Confidence intervals for the mean:       90% (  31.097 -    39.515)
                                            95% (  30.275 -    40.337)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        -4.295151
   Median:        39.302044
   90.000        56.482441
```



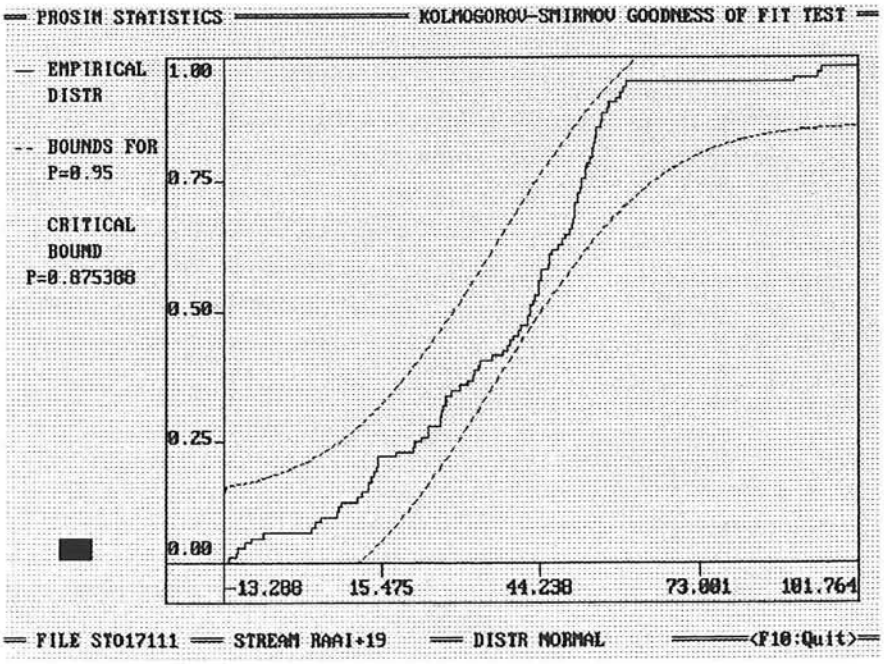
PROSIM STATISTICS: Port-side extremity on cross-section 19 (x = 4750 m)



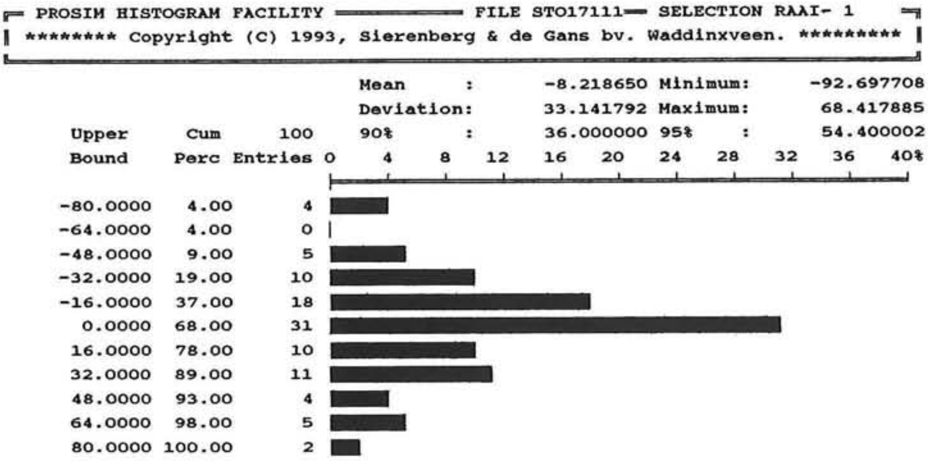
```
┌─ PROSIM HISTOGRAM FACILITY ════════════ FILE STO17111══ SELECTION RAAI+19    ═┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                              Mean      :      36.556053 Minimum:      -13.288118
                              Deviation:       22.995819 Maximum:      101.764359
    Upper      Cum     100    90%       :      61.000000 95%     :      63.500000
    Bound      Perc Entries 0    4    8   12   16   20   24   28   32   36   40%
                            ├────┴────┴────┴────┴────┴────┴────┴────┴────┴────┤
   -48.000     0.00       0 |
   -32.000     0.00       0 |
   -16.000     0.00       0 |
     0.000     7.00       7 █████████
    16.000    22.00      15 ███████████████████
    32.000    37.00      15 ███████████████████
    48.000    64.00      27 ██████████████████████████████████
    64.000    96.00      32 ████████████████████████████████████████
    80.000    96.00       0 |
    96.000    99.00       3 ████
   112.000   100.00       1 ██
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI+19     -+
+------------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean              :        36.556057      Number of entries:    100
   St. deviation     :        22.995821
   Mn. deviation     :        18.160006      Minimum :       -13.288118
   Skewness          :       -0.036959       Maximum :        101.764359
   Alt. Skewness     :       -0.248818       Range   :        115.052477
   Kurtosis          :         3.450550      Midrange:        44.238120

   Confidence intervals for the mean:     90% (   32.733 -    40.379)
                                          95% (   31.987 -    41.125)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        7.276495
   Median:      42.277821
   90.000       56.489563
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 1 (x = 250 m)



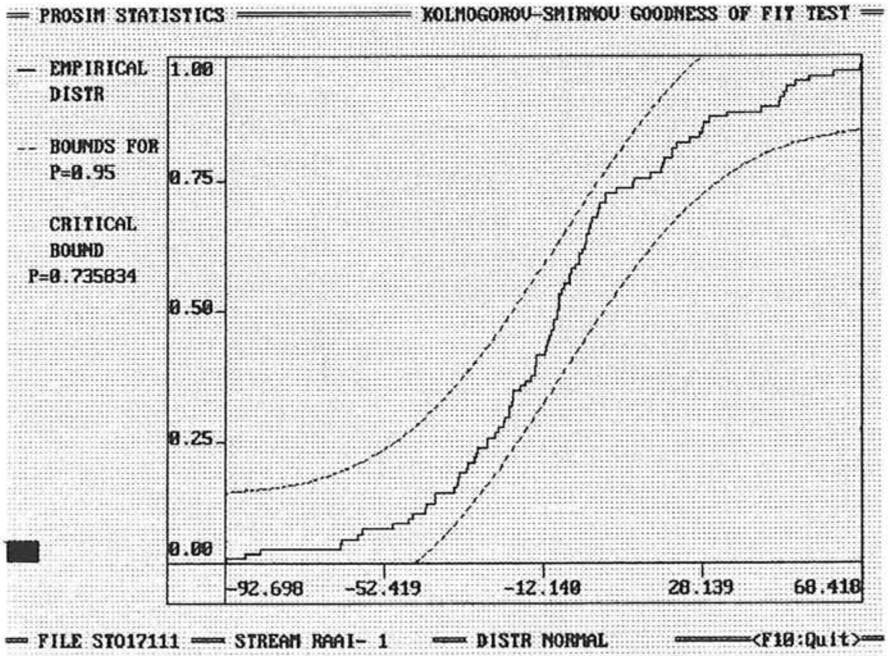
```
PROSIM HISTOGRAM FACILITY ========= FILE STO17111== SELECTION RAAI- 1
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean       :    -8.218650 Minimum:     -92.697708
                              Deviation:      33.141792 Maximum:      68.417885
  Upper     Cum      100      90%        :    36.000000 95%    :      54.400002
  Bound     Perc Entries 0    4    8    12   16   20   24   28   32   36   40%

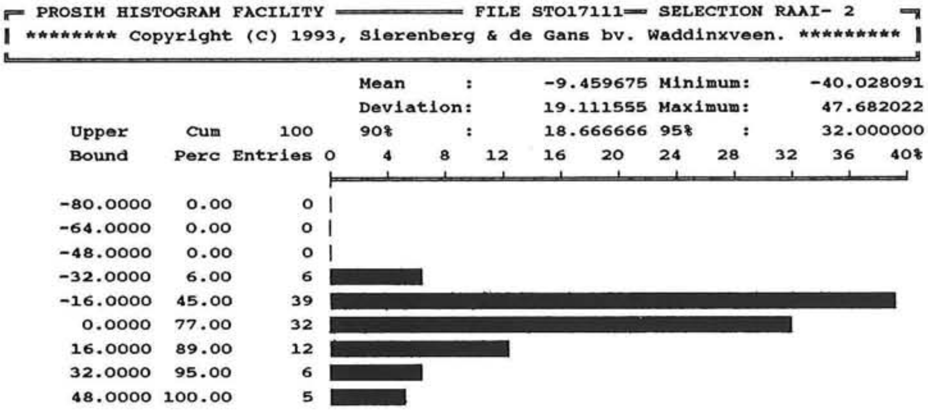
 -80.0000   4.00      4
 -64.0000   4.00      0
 -48.0000   9.00      5
 -32.0000  19.00     10
 -16.0000  37.00     18
   0.0000  68.00     31
  16.0000  78.00     10
  32.0000  89.00     11
  48.0000  93.00      4
  64.0000  98.00      5
  80.0000 100.00      2
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI- 1    -+
+---------------------------------------------------------------------+
                              == BASIC STATISTICS ==
   Mean             :       -8.218645        Number of entries:   100
   St. deviation    :         33.141792
   Mn. deviation    :         24.303265       Minimum :      -92.697708
   Skewness         :       -0.038321        Maximum :       68.417885
   Alt. Skewness    :         0.012143       Range   :       161.115593
   Kurtosis         :         3.378327       Midrange:      -12.139912

   Confidence intervals for the mean:      90% ( -13.729 -    -2.709)
                                           95% ( -14.804 -    -1.633)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -45.023376
   Median:        -8.621099
   90.000       43.037086
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 2 (x = 500 m)



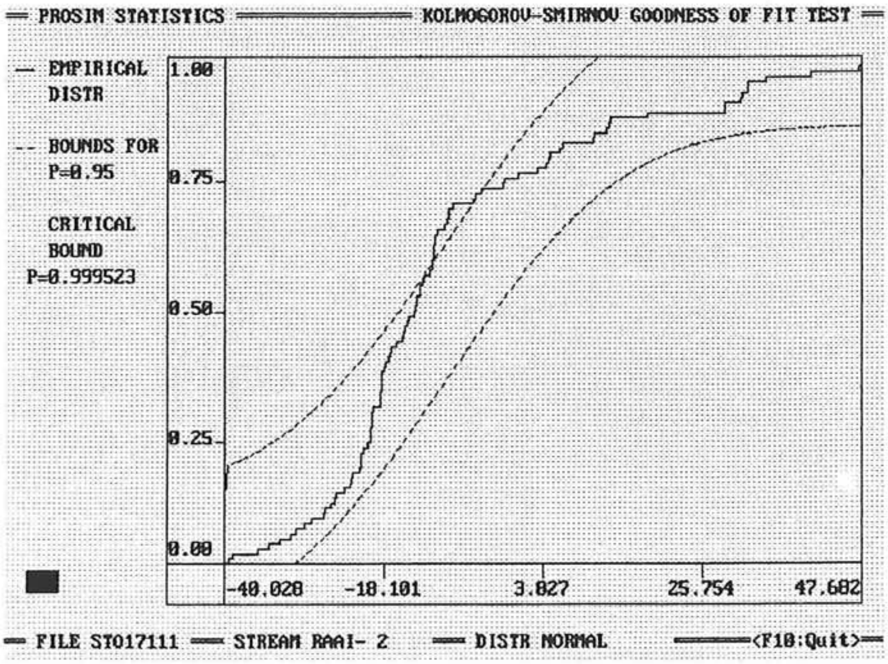
```
PROSIM HISTOGRAM FACILITY ========== FILE ST017111== SELECTION RAAI- 2
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                            Mean       :       -9.459675 Minimum:     -40.028091
                            Deviation:          19.111555 Maximum:      47.682022
  Upper      Cum     100    90%        :        18.666666 95%    :      32.000000
  Bound      Perc Entries 0      4    8    12   16   20   24   28   32   36   40%

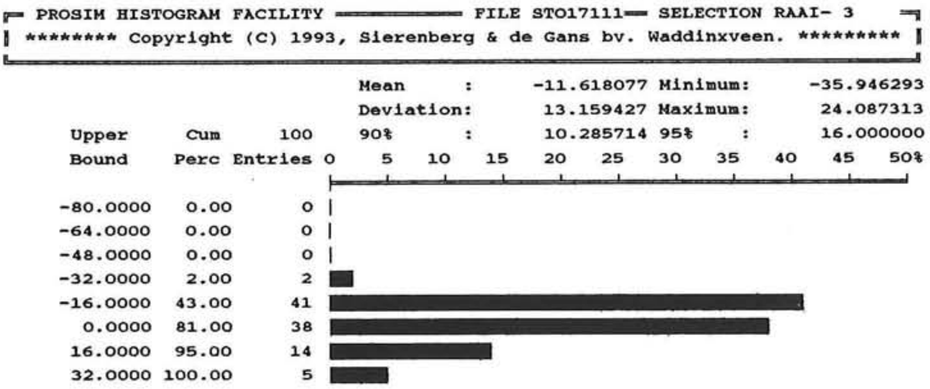
 -80.0000    0.00       0
 -64.0000    0.00       0
 -48.0000    0.00       0
 -32.0000    6.00       6
 -16.0000   45.00      39
   0.0000   77.00      32
  16.0000   89.00      12
  32.0000   95.00       6
  48.0000  100.00       5
```

```
+- PROSIM STATISTICS --------------- FILE ST017111 - STREAM RAAI- 2      -+
+------------------------------------------------------------------------+
                                      == BASIC STATISTICS ==
   Mean              :         -9.459675         Number of entries:    100
   St. deviation     :           19.111557
   Mn. deviation     :           14.177352       Minimum :        -40.028091
   Skewness          :           1.217045        Maximum :         47.682022
   Alt. Skewness     :           0.255625        Range    :        87.710114
   Kurtosis          :           4.046436        Midrange:         3.826965

   Confidence intervals for the mean:        90% ( -12.637 -    -6.282)
                                             95% ( -13.257 -    -5.662)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -26.429073
   Median:       -14.345072
   90.000       28.686100
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 3 (x = 750 m)



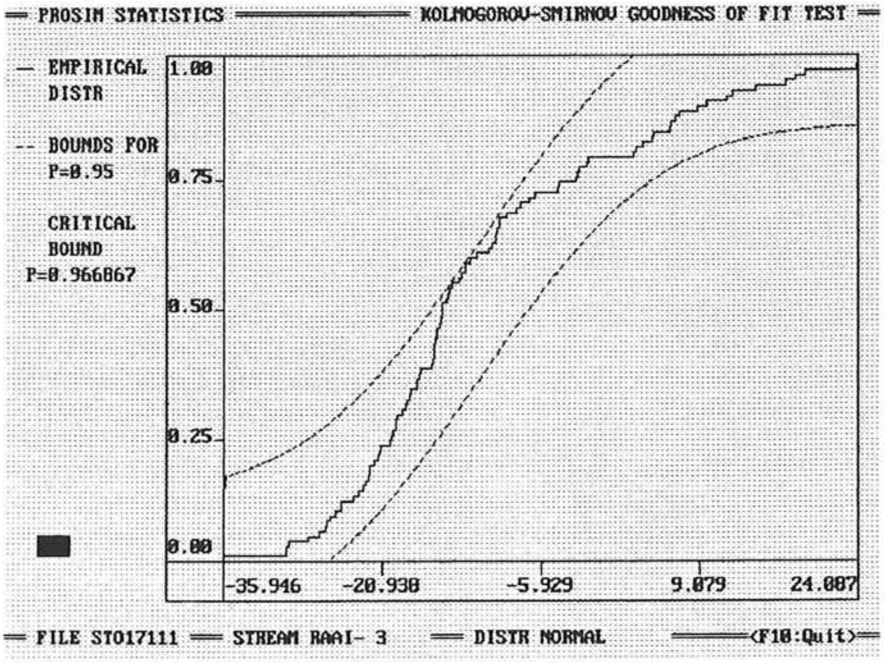
```
PROSIM HISTOGRAM FACILITY ============ FILE STO17111== SELECTION RAAI- 3
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                                 Mean      :      -11.618077 Minimum:     -35.946293
                                 Deviation:        13.159427 Maximum:      24.087313
  Upper       Cum     100        90%       :       10.285714 95%    :      16.000000
  Bound      Perc  Entries 0    5    10    15    20    25    30    35    40    45    50%

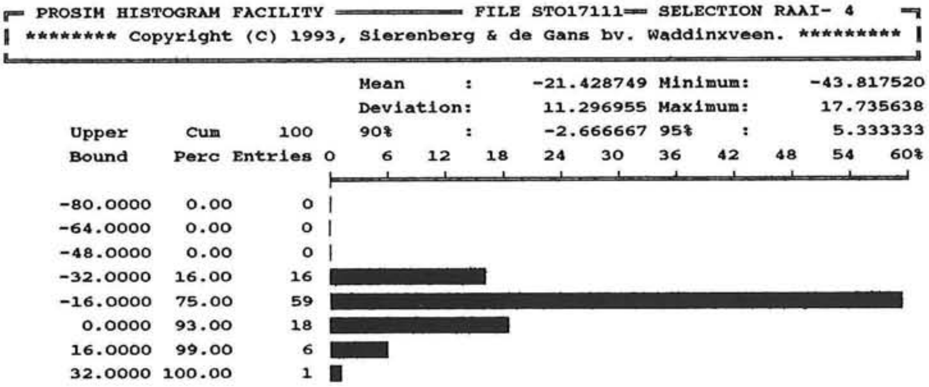
 -80.0000    0.00      0
 -64.0000    0.00      0
 -48.0000    0.00      0
 -32.0000    2.00      2
 -16.0000   43.00     41
   0.0000   81.00     38
  16.0000   95.00     14
  32.0000  100.00      5
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 3    -+
+-----------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean            :       -11.618076         Number of entries:   100
   St. deviation   :          13.159428
   Mn. deviation   :          10.316429       Minimum :        -35.946293
   Skewness        :          0.833696        Maximum :         24.087313
   Alt. Skewness   :          0.275561        Range   :         60.033606
   Kurtosis        :          3.160314        Midrange:         -5.929490

   Confidence intervals for the mean:     90% ( -13.806 -     -9.430)
                                          95% ( -14.233 -     -9.003)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -25.389523
   Median:       -15.244302
   90.000         8.770348
```



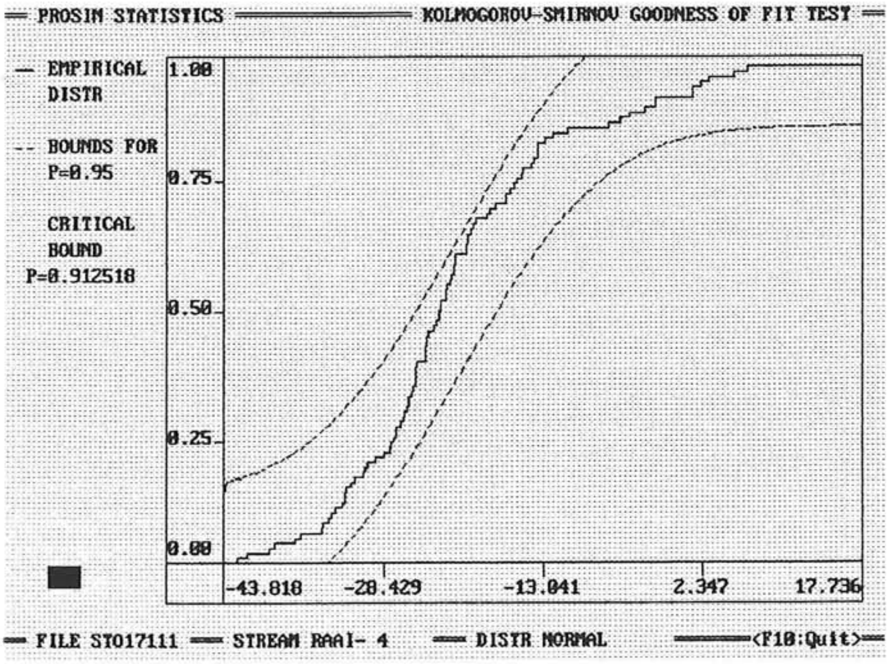
PROSIM STATISTICS: Starboard-side extremity on cross-section 4 (x = 1000 m)



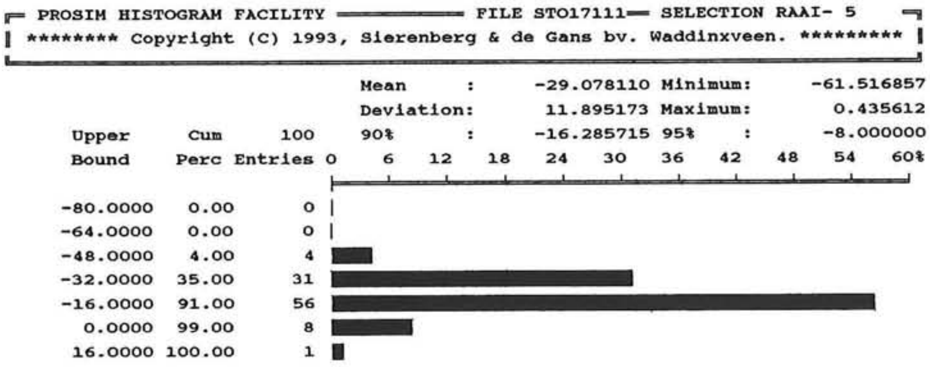
```
┌─ PROSIM HISTOGRAM FACILITY ════════════ FILE STO17111══ SELECTION RAAI- 4      ─┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                                Mean       :      -21.428749 Minimum:      -43.817520
                                Deviation:         11.296955 Maximum:       17.735638
    Upper        Cum      100   90%        :       -2.666667 95%     :       5.333333
    Bound        Perc Entries 0     6    12    18    24    30    36    42    48    54    60%
                              |-----------------------------------------------------------|
  -80.0000    0.00          0 |
  -64.0000    0.00          0 |
  -48.0000    0.00          0 |
  -32.0000   16.00         16 
  -16.0000   75.00         59 
    0.0000   93.00         18 
   16.0000   99.00          6 
   32.0000  100.00          1 
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 4     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean             :       -21.428753         Number of entries:    100
   St. deviation    :           11.296955
   Mn. deviation    :           8.336583       Minimum :         -43.817520
   Skewness         :           0.862122       Maximum :          17.735638
   Alt. Skewness    :           0.153648       Range   :          61.553158
   Kurtosis         :           4.020991       Midrange:         -13.040941

   Confidence intervals for the mean:      90% ( -23.307 -   -19.551)
                                           95% ( -23.673 -   -19.184)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -33.413223
   Median:      -23.164505
   90.000       -3.245993
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 5 (x = 1250 m)



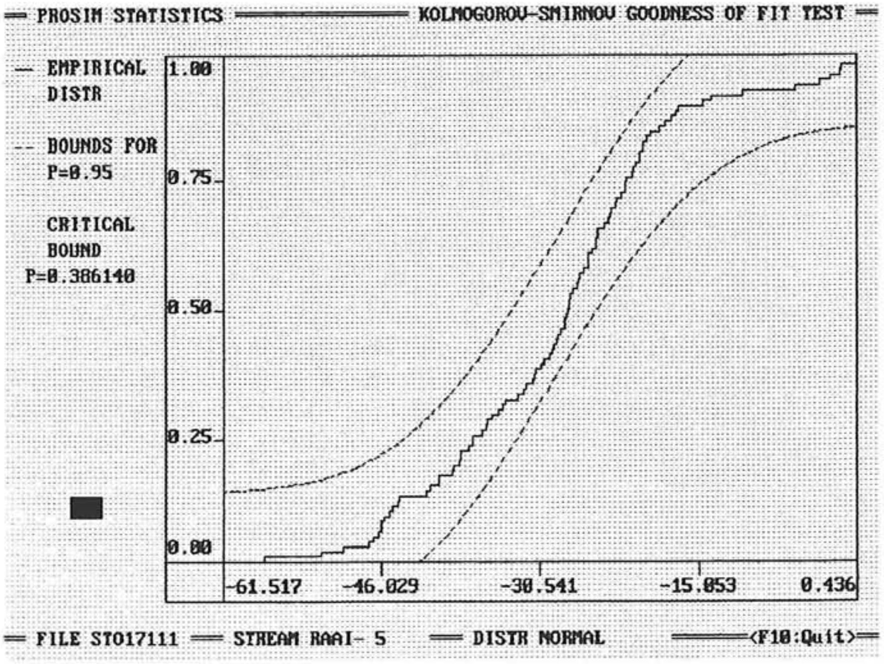
```
PROSIM HISTOGRAM FACILITY ════════ FILE STO17111══ SELECTION RAAI- 5
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean       :   -29.078110 Minimum:    -61.516857
                              Deviation:      11.895173 Maximum:      0.435612
  Upper      Cum     100      90%        :   -16.285715 95%    :     -8.000000
  Bound      Perc Entries 0     6    12    18    24    30    36    42    48    54    60%

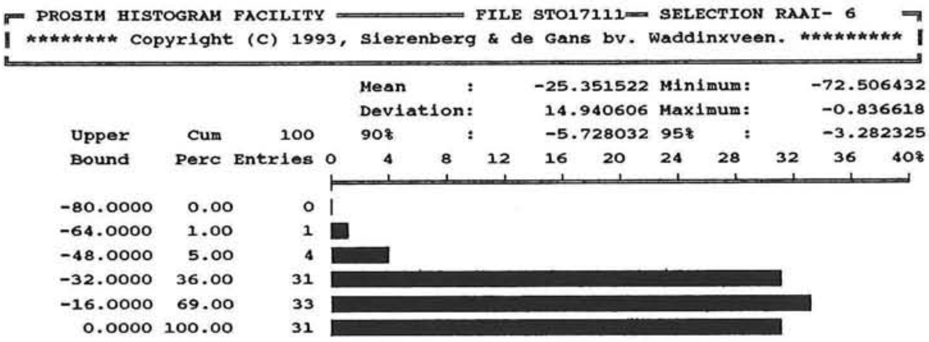
 -80.0000    0.00      0
 -64.0000    0.00      0
 -48.0000    4.00      4
 -32.0000   35.00     31
 -16.0000   91.00     56
   0.0000   99.00      8
  16.0000  100.00      1
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 5     -+
+-----------------------------------------------------------------------+
                                == BASIC STATISTICS ==
   Mean              :       -29.078114        Number of entries:   100
   St. deviation     :           11.895173
   Mn. deviation     :           9.008786        Minimum :       -61.516857
   Skewness          :           0.052109        Maximum :         0.435612
   Alt. Skewness     :        -0.098642        Range   :        61.952469
   Kurtosis          :           3.401606        Midrange:       -30.540623

   Confidence intervals for the mean:       90% ( -31.056 -   -27.100)
                                            95% ( -31.442 -   -26.715)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -45.197136
   Median:       -27.904753
   90.000      -17.018541
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 6 (x = 1500 m)

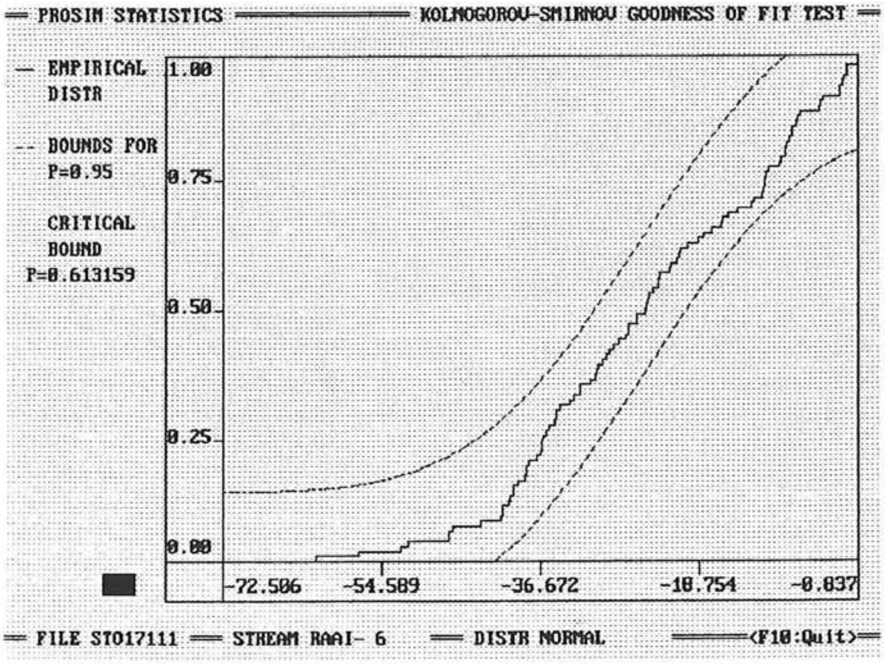


```
┌─ PROSIM HISTOGRAM FACILITY ─────────── FILE STO17111── SELECTION RAAI- 6      ┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                Mean      :       -25.351522 Minimum:       -72.506432
                                Deviation:        14.940606 Maximum:         -0.836618
   Upper       Cum       100    90%       :        -5.728032 95%     :       -3.282325
   Bound      Perc  Entries 0     4     8    12    16    20    24    28    32    36    40%

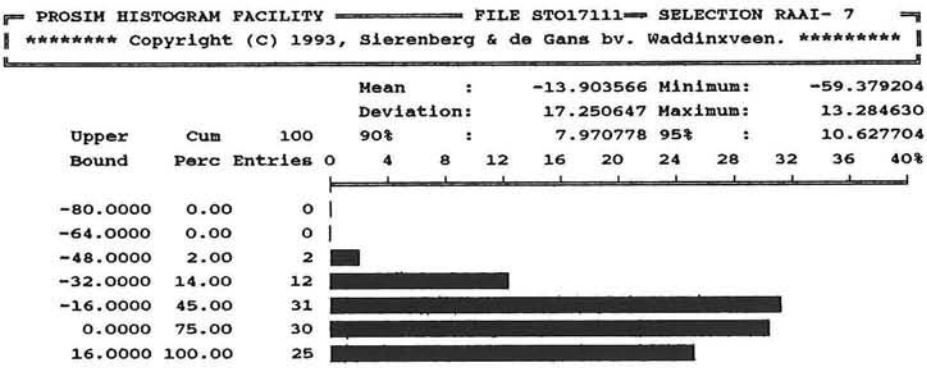
  -80.0000    0.00       0
  -64.0000    1.00       1
  -48.0000    5.00       4
  -32.0000   36.00      31
  -16.0000   69.00      33
    0.0000  100.00      31
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 6     -+
+------------------------------------------------------------------------+
                               == BASIC STATISTICS ==
   Mean              :       -25.351526        Number of entries:    100
   St. deviation     :           14.940608
   Mn. deviation     :           12.254753     Minimum :       -72.506432
   Skewness          :         -0.364885       Maximum :        -0.836618
   Alt. Skewness     :           0.005293      Range   :        71.669813
   Kurtosis          :           2.834352      Midrange:       -36.671525

   Confidence intervals for the mean:      90% ( -27.835 -   -22.868)
                                           95% ( -28.320 -   -22.383)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000        -41.026134
   Median:        -25.430613
   90.000         -5.168173
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 7 (x = 1750 m)



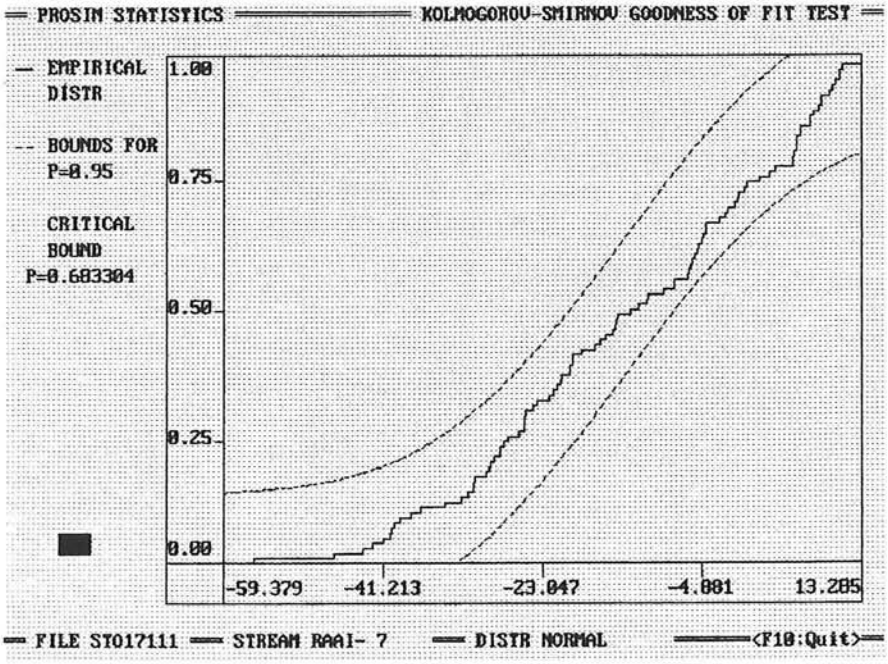
```
PROSIM HISTOGRAM FACILITY ============ FILE STO17111== SELECTION RAAI- 7
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                               Mean      :     -13.903566 Minimum:      -59.379204
                               Deviation:      17.250647 Maximum:       13.284630
 Upper      Cum     100        90%       :       7.970778 95%     :      10.627704
 Bound     Perc Entries 0    4     8    12    16    20    24    28    32    36   40%

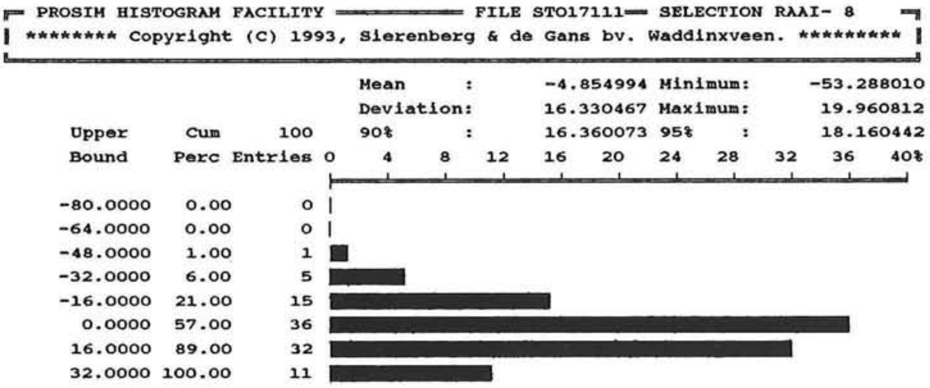
 -80.0000   0.00       0
 -64.0000   0.00       0
 -48.0000   2.00       2
 -32.0000  14.00      12
 -16.0000  45.00      31
   0.0000  75.00      30
  16.0000 100.00      25
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 7     -+
+-----------------------------------------------------------------------+
                              == BASIC STATISTICS ==
   Mean               :       -13.903565         Number of entries:    100
   St. deviation      :          17.250647
   Mn. deviation      :          14.665097       Minimum :      -59.379204
   Skewness           :        -0.337509         Maximum :       13.284630
   Alt. Skewness      :        -0.012063         Range   :       72.663834
   Kurtosis           :          2.275411        Midrange:      -23.047287

   Confidence intervals for the mean:      90% ( -16.772 -   -11.036)
                                           95% ( -17.331 -   -10.476)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -38.098213
   Median:       -13.695472
   90.000         8.461273
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 8 (x = 2000 m)

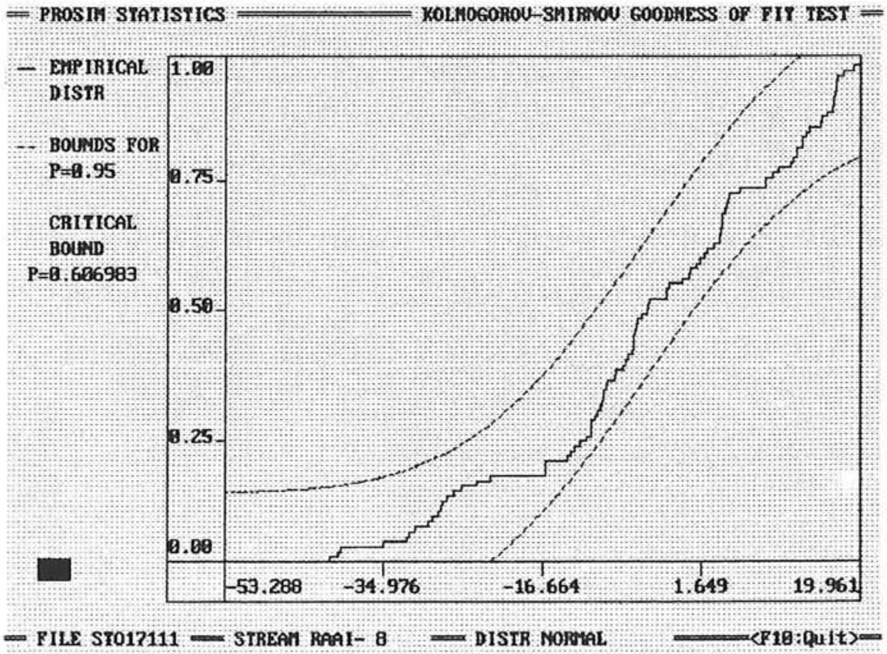


```
┌─ PROSIM HISTOGRAM FACILITY ──────────── FILE STO17111── SELECTION RAAI- 8     ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                              Mean       :       -4.854994 Minimum:      -53.288010
                              Deviation:        16.330467 Maximum:       19.960812
   Upper        Cum      100  90%        :       16.360073 95%      :      18.160442
   Bound       Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

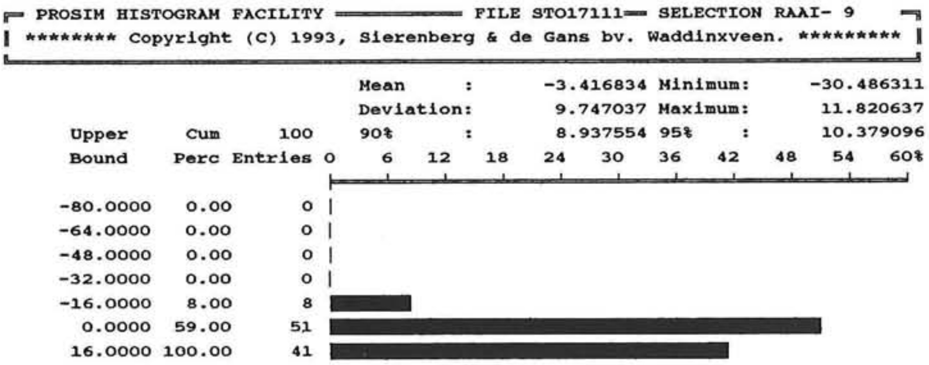
 -80.0000     0.00        0
 -64.0000     0.00        0
 -48.0000     1.00        1
 -32.0000     6.00        5
 -16.0000    21.00       15
   0.0000    57.00       36
  16.0000    89.00       32
  32.0000   100.00       11
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 8     -+
+-----------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean              :       -4.854994        Number of entries:   100
   St. deviation     :         16.330469
   Mn. deviation     :         12.936036        Minimum :        -53.288010
   Skewness          :       -0.576088        Maximum :         19.960812
   Alt. Skewness     :         0.006207        Range   :         73.248821
   Kurtosis          :         2.798794        Midrange:        -16.663599

   Confidence intervals for the mean:      90% (  -7.570 -    -2.140)
                                           95% (  -8.100 -    -1.610)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000       -28.674862
   Median:        -4.956351
   90.000        16.777733
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 9 (x = 2250 m)

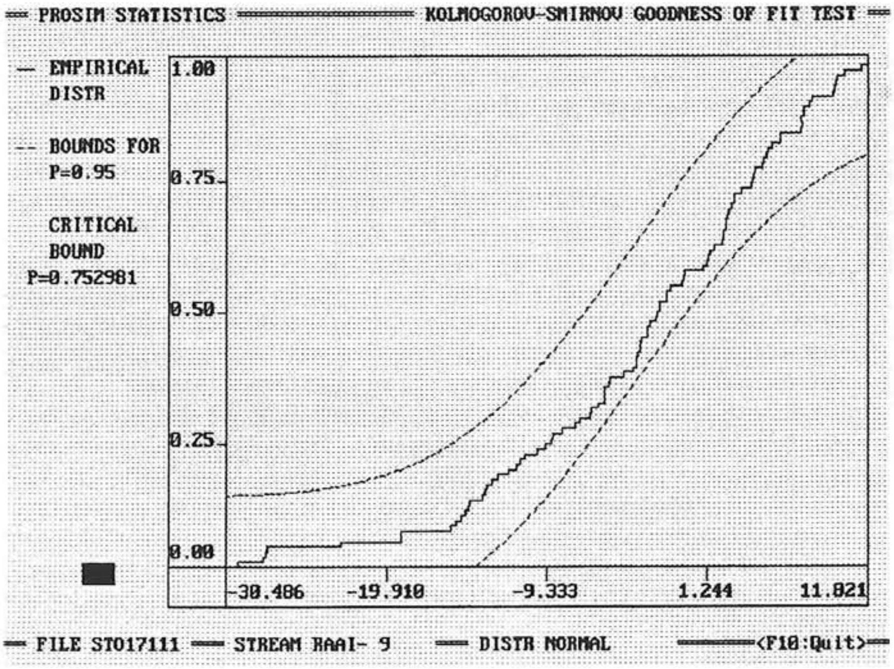


```
┌─ PROSIM HISTOGRAM FACILITY ══════════ FILE STO17111══ SELECTION RAAI- 9    ─┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                              Mean       :      -3.416834 Minimum:     -30.486311
                              Deviation:         9.747037 Maximum:      11.820637
 Upper      Cum      100      90%        :       8.937554 95%    :      10.379096
 Bound      Perc Entries 0    6   12   18   24   30   36   42   48   54   60%

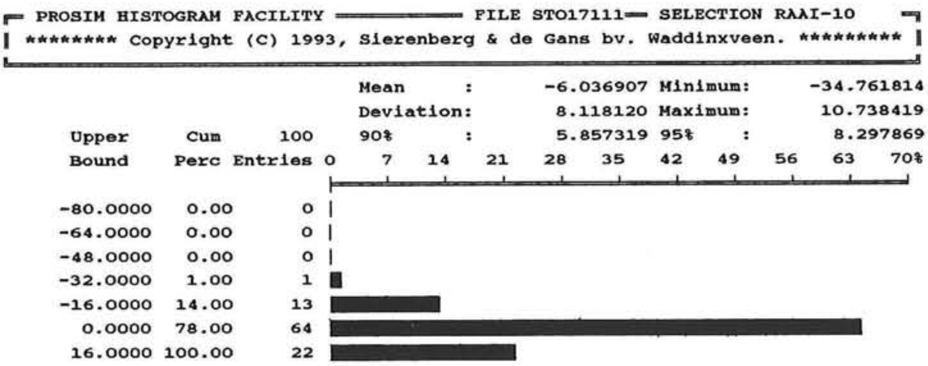
 -80.0000   0.00       0 |
 -64.0000   0.00       0 |
 -48.0000   0.00       0 |
 -32.0000   0.00       0 |
 -16.0000   8.00       8
   0.0000  59.00      51
  16.0000 100.00      41
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI- 9     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean              :         -3.416834        Number of entries:   100
   St. deviation     :          9.747037
   Mn. deviation     :          7.654809        Minimum :      -30.486311
   Skewness          :         -0.829113        Maximum :       11.820637
   Alt. Skewness     :         -0.134178        Range   :       42.306948
   Kurtosis          :          3.315292        Midrange:       -9.332837

   Confidence intervals for the mean:      90% (   -5.037 -    -1.796)
                                           95% (   -5.354 -    -1.480)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -14.962723
   Median:       -2.108994
   90.000        7.633495
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 10 (x = 2500 m)

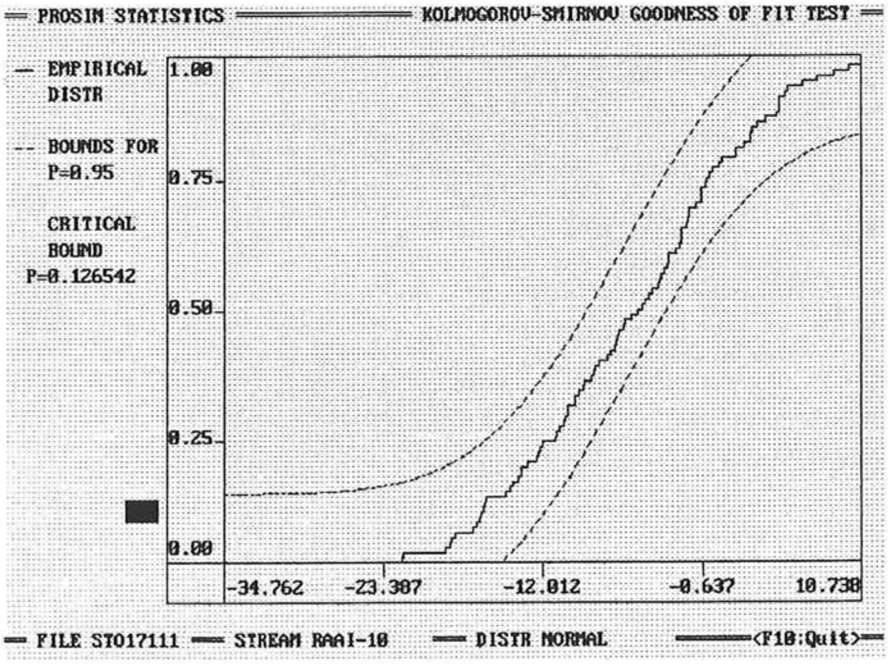


```
┌─ PROSIM HISTOGRAM FACILITY ────────── FILE STO17111── SELECTION RAAI-10   ─┐
| ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└────────────────────────────────────────────────────────────────────────────┘
                              Mean      :      -6.036907 Minimum:    -34.761814
                              Deviation:        8.118120 Maximum:     10.738419
  Upper      Cum      100     90%       :       5.857319 95%     :     8.297869
  Bound      Perc Entries 0     7    14    21    28    35    42    49    56    63    70%

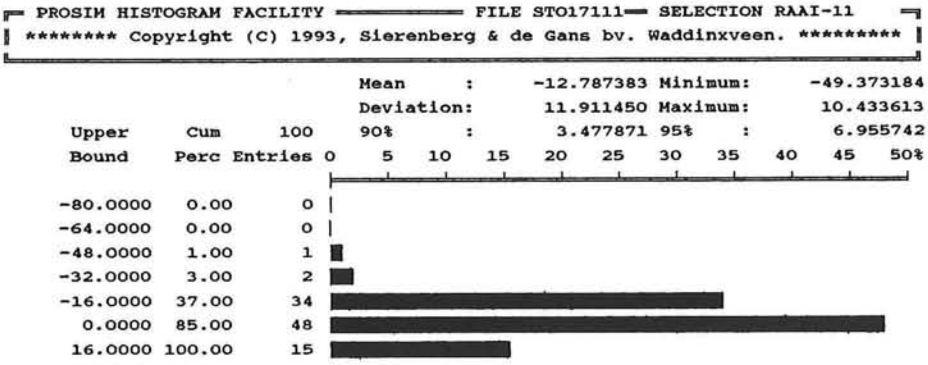
 -80.0000    0.00       0 |
 -64.0000    0.00       0 |
 -48.0000    0.00       0 |
 -32.0000    1.00       1
 -16.0000   14.00      13
   0.0000   78.00      64
  16.0000  100.00      22
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI-10    -+
+---------------------------------------------------------------------+
                                  == BASIC STATISTICS ==
   Mean              :          -6.036907        Number of entries:   100
   St. deviation     :          8.118120
   Mn. deviation     :          6.560740         Minimum :        -34.761814
   Skewness          :          -0.389076        Maximum :         10.738419
   Alt. Skewness     :          -0.065939        Range   :         45.500233
   Kurtosis          :           3.335947        Midrange:        -12.011698

   Confidence intervals for the mean:       90% (  -7.387 -    -4.687)
                                            95% (  -7.650 -    -4.424)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -16.397207
   Median:       -5.501604
   90.000        4.811993
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 11 (x = 2750 m)

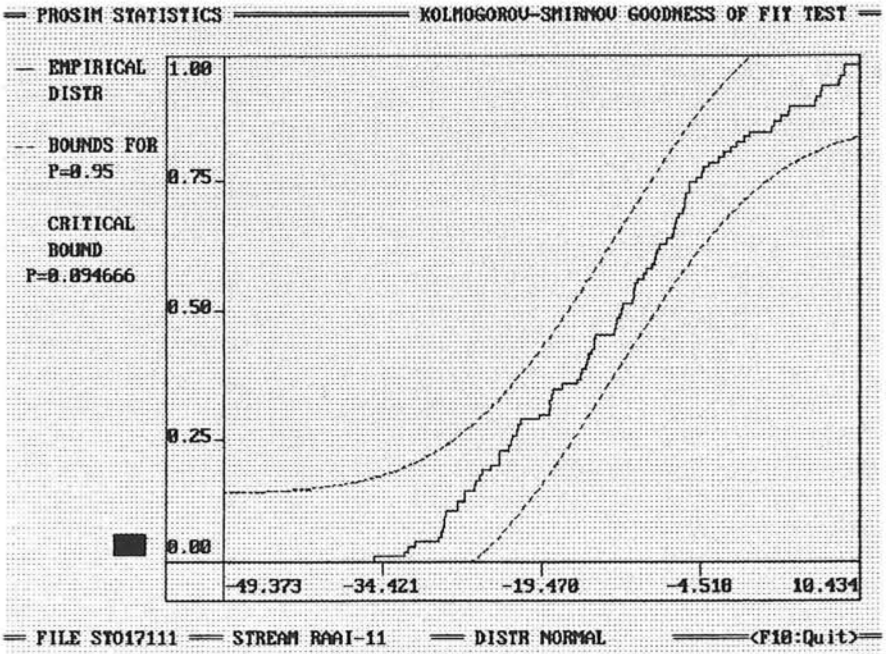


```
┌─ PROSIM HISTOGRAM FACILITY ────────── FILE ST017111── SELECTION RAAI-11   ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                 Mean      :    -12.787383 Minimum:     -49.373184
                                 Deviation:      11.911450 Maximum:      10.433613
     Upper      Cum      100     90%       :      3.477871 95%     :      6.955742
     Bound      Perc Entries 0     5    10    15    20    25    30    35    40    45    50%

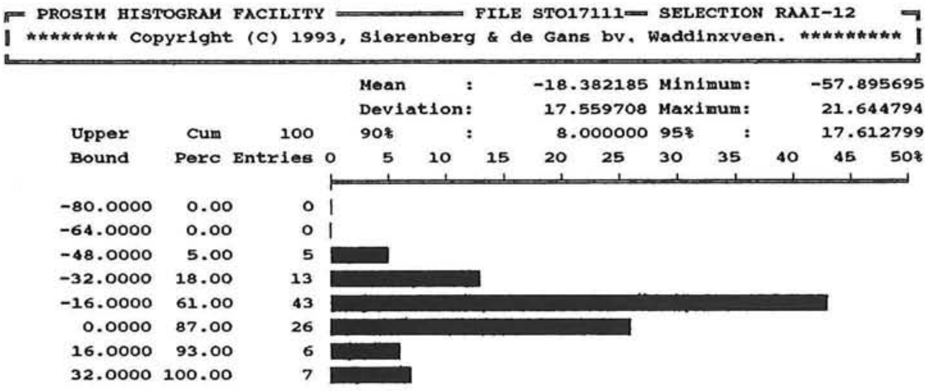
   -80.0000     0.00       0 |
   -64.0000     0.00       0 |
   -48.0000     1.00       1 
   -32.0000     3.00       2 
   -16.0000    37.00      34 
     0.0000    85.00      48 
    16.0000   100.00      15 
```

```
+- PROSIM STATISTICS -------------- FILE ST017111 - STREAM RAAI-11    -+
+----------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean              :      -12.787383        Number of entries:   100
   St. deviation     :     11.911450
   Mn. deviation     :     9.672441           Minimum :      -49.373184
   Skewness          :  -0.118181             Maximum :       10.433613
   Alt. Skewness     :  -0.060738             Range   :       59.806797
   Kurtosis          :     2.712068           Midrange:      -19.469786

   Confidence intervals for the mean:  90% ( -14.768 -   -10.807)
                                       95% ( -15.154 -   -10.421)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000     -28.525284
   Median:     -12.063901
   90.000       3.913279
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 12 (x = 3000 m)

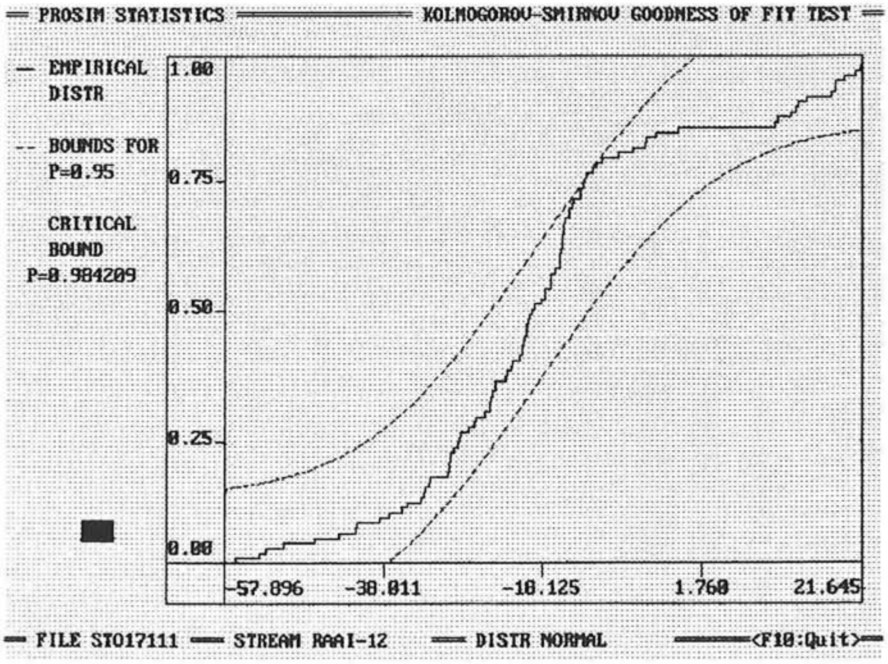


```
┌─ PROSIM HISTOGRAM FACILITY ─────────── FILE STO17111── SELECTION RAAI-12     ─┐
| ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                               Mean      :     -18.382185 Minimum:     -57.895695
                               Deviation:       17.559708 Maximum:      21.644794
  Upper      Cum      100      90%       :       8.000000 95%     :     17.612799
  Bound      Perc Entries 0     5    10    15    20    25    30    35    40    45   50%

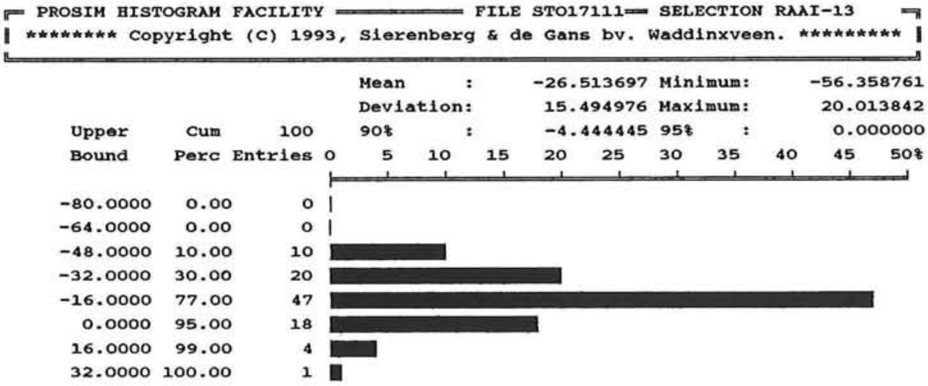
  -80.0000   0.00       0 |
  -64.0000   0.00       0 |
  -48.0000   5.00       5
  -32.0000  18.00      13
  -16.0000  61.00      43
    0.0000  87.00      26
   16.0000  93.00       6
   32.0000 100.00       7
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI-12      -+
+------------------------------------------------------------------------+
                                        == BASIC STATISTICS ==
   Mean              :      -18.382185          Number of entries:    100
   St. deviation     :     17.559706
   Mn. deviation     :     12.542837            Minimum :       -57.895695
   Skewness          :     0.434265             Maximum :        21.644794
   Alt. Skewness     :     0.074169             Range   :        79.540489
   Kurtosis          :     3.382326             Midrange:       -18.125450

   Confidence intervals for the mean:  90% ( -21.302 -   -15.463)
                                        95% ( -21.871 -   -14.893)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -37.367748
   Median:      -19.684576
   90.000       13.364908
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 13 (x = 3250 m)

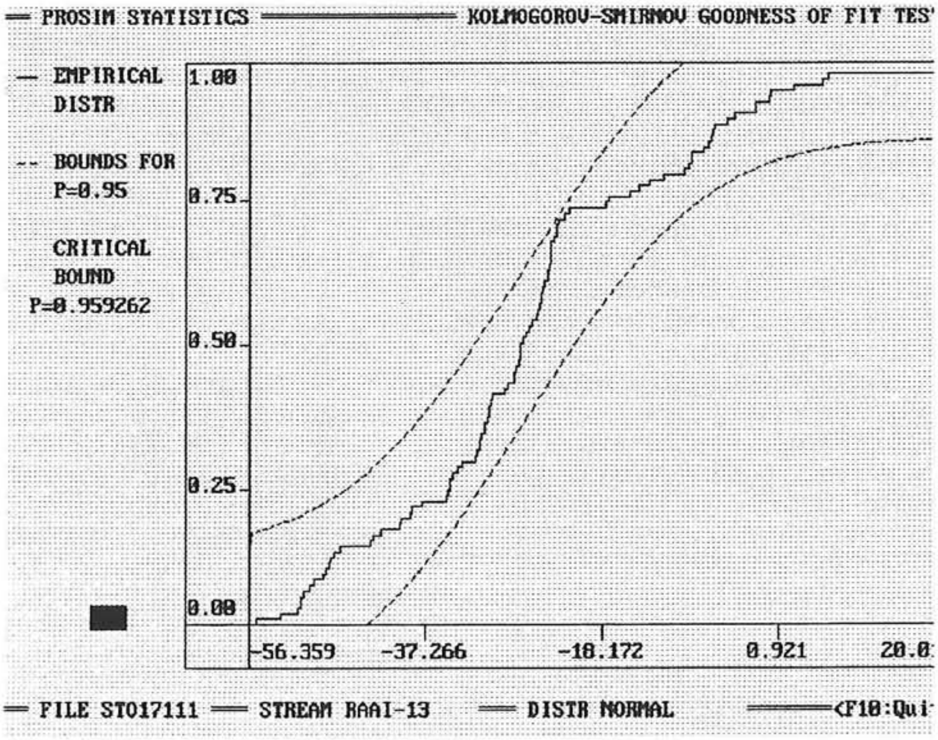


```
┌─ PROSIM HISTOGRAM FACILITY ═══════════ FILE STO17111══ SELECTION RAAI-13    ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                                 Mean      :     -26.513697 Minimum:      -56.358761
                                 Deviation:      15.494976 Maximum:       20.013842
   Upper      Cum      100       90%       :      -4.444445 95%     :      0.000000
   Bound      Perc Entries 0    5    10    15   20   25   30   35   40   45   50%

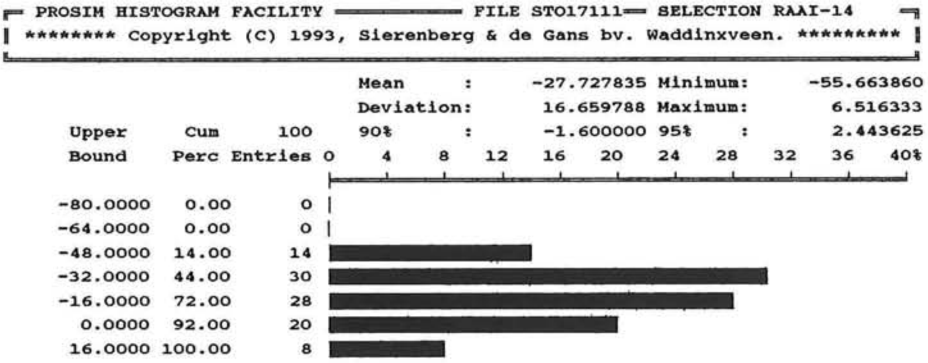
  -80.0000    0.00       0 |
  -64.0000    0.00       0 |
  -48.0000   10.00      10
  -32.0000   30.00      20
  -16.0000   77.00      47
    0.0000   95.00      18
   16.0000   99.00       4
   32.0000  100.00       1
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI-13    -+
+---------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean              :      -26.513695         Number of entries:   100
   St. deviation     :     15.494976
   Mn. deviation     :     11.652230           Minimum :      -56.358761
   Skewness          :     0.340335            Maximum :       20.013842
   Alt. Skewness     :     0.035970            Range   :       76.372602
   Kurtosis          :     2.927200            Midrange:      -18.172460

   Confidence intervals for the mean:  90% ( -29.090 -   -23.938)
                                       95% ( -29.593 -   -23.435)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :    20
   Percentiles
   10.000      -47.937725
   Median:      -27.071054
   90.000       -4.744144
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 14 (x = 3500 m)



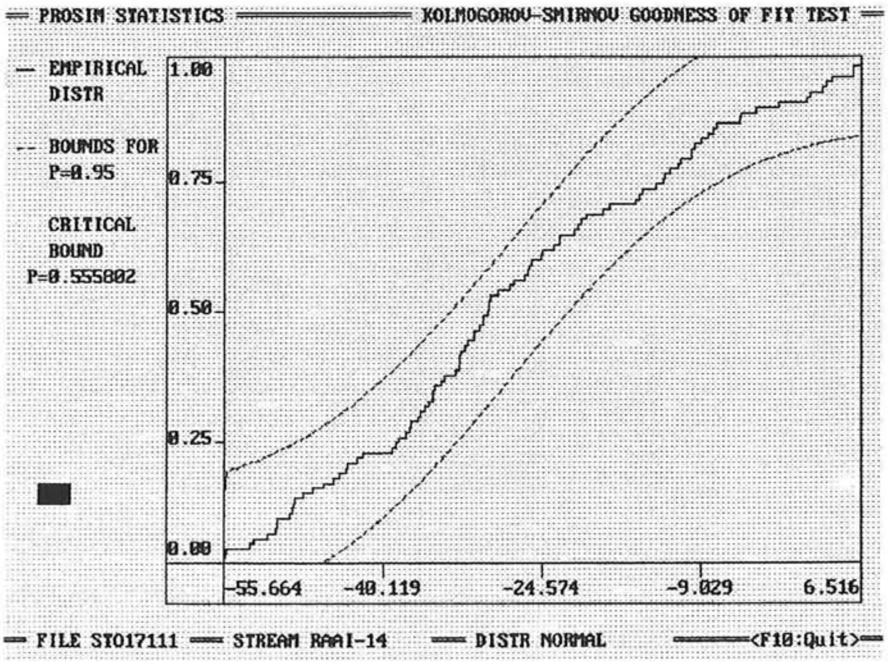
```
PROSIM HISTOGRAM FACILITY ————— FILE STO17111— SELECTION RAAI-14
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean       :      -27.727835 Minimum:     -55.663860
                              Deviation:         16.659788 Maximum:       6.516333
  Upper      Cum     100      90%        :       -1.600000 95%    :       2.443625
  Bound      Perc  Entries 0     4     8    12    16    20    24    28    32    36    40%

 -80.0000    0.00        0 |
 -64.0000    0.00        0 |
 -48.0000   14.00       14
 -32.0000   44.00       30
 -16.0000   72.00       28
   0.0000   92.00       20
  16.0000  100.00        8
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI-14     -+
+------------------------------------------------------------------------+
                                   == BASIC STATISTICS ==
   Mean           :      -27.727827           Number of entries:   100
   St. deviation  :      16.659788
   Mn. deviation  :      13.668772            Minimum :       -55.663860
   Skewness       :      0.270983             Maximum :         6.516333
   Alt. Skewness  :      0.143094             Range   :        62.180193
   Kurtosis       :      2.200360             Midrange:       -24.573764

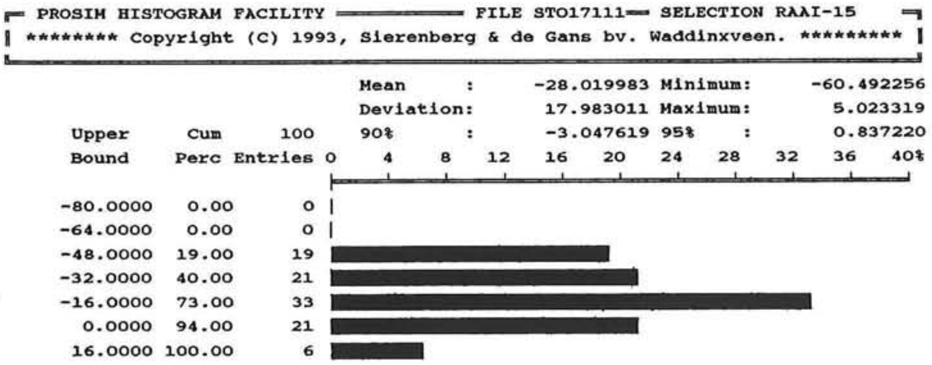
   Confidence intervals for the mean:  90% ( -30.498 -   -24.958)
                                       95% ( -31.038 -   -24.418)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -49.267651
   Median:      -30.111750
   90.000       -3.606663
```



== PROSIM STATISTICS ============ KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST ==

== FILE STO17111 == STREAM RAAI-14 == DISTR NORMAL ======<F10:Quit>==

PROSIM STATISTICS: Starboard-side extremity on cross-section 15 (x = 3750 m)



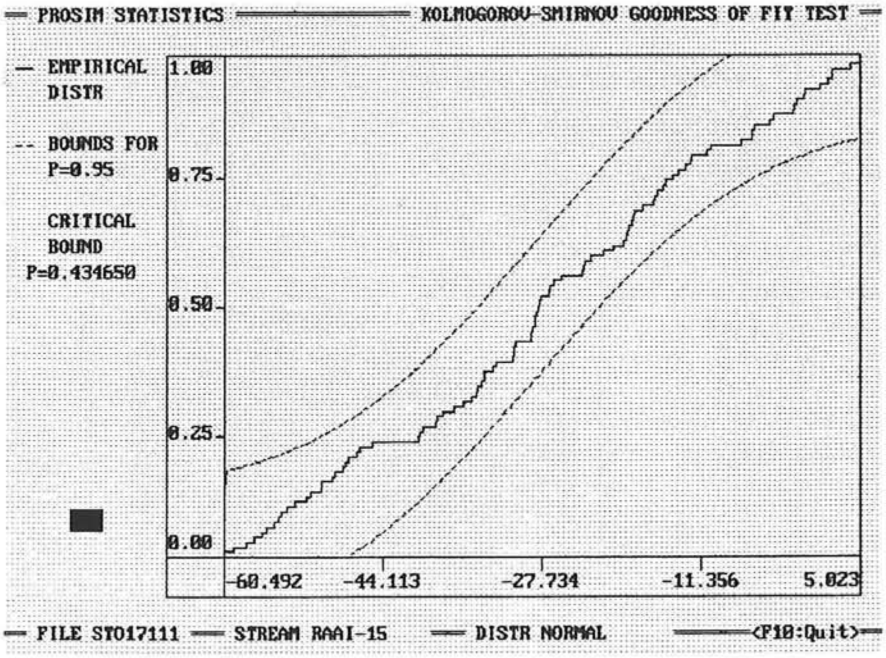
```
PROSIM HISTOGRAM FACILITY ========= FILE STO17111== SELECTION RAAI-15
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                              Mean      :    -28.019983 Minimum:    -60.492256
                              Deviation:      17.983011 Maximum:      5.023319
   Upper      Cum     100     90%       :     -3.047619 95%    :      0.837220
   Bound     Perc Entries 0    4    8   12   16   20   24   28   32   36   40%

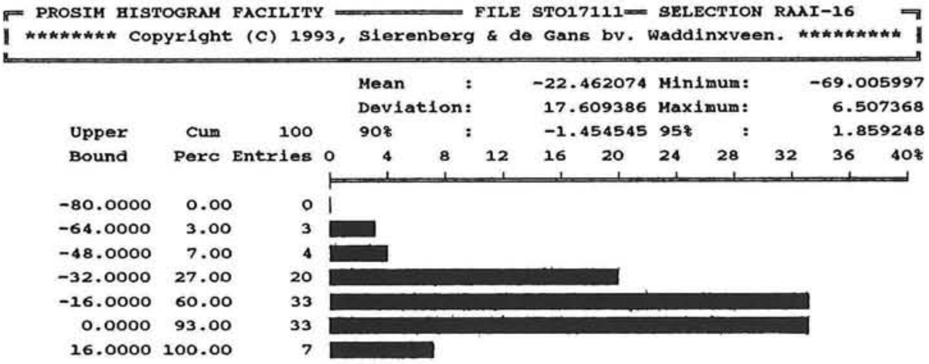
 -80.0000    0.00       0
 -64.0000    0.00       0
 -48.0000   19.00      19
 -32.0000   40.00      21
 -16.0000   73.00      33
   0.0000   94.00      21
  16.0000  100.00       6
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI-15     -+
+------------------------------------------------------------------------+
                                     == BASIC STATISTICS ==
   Mean             :      -28.019985         Number of entries:    100
   St. deviation    :    17.983011
   Mn. deviation    :    14.743757            Minimum :       -60.492256
   Skewness         :       -0.048548         Maximum :         5.023319
   Alt. Skewness    :    0.011964             Range   :        65.515575
   Kurtosis         :          2.036232       Midrange:       -27.734468

   Confidence intervals for the mean:  90% ( -31.010 -   -25.030)
                                       95% ( -31.593 -   -24.447)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -53.933914
   Median:      -28.235128
   90.000       -1.821228
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 16 (x = 4000 m)

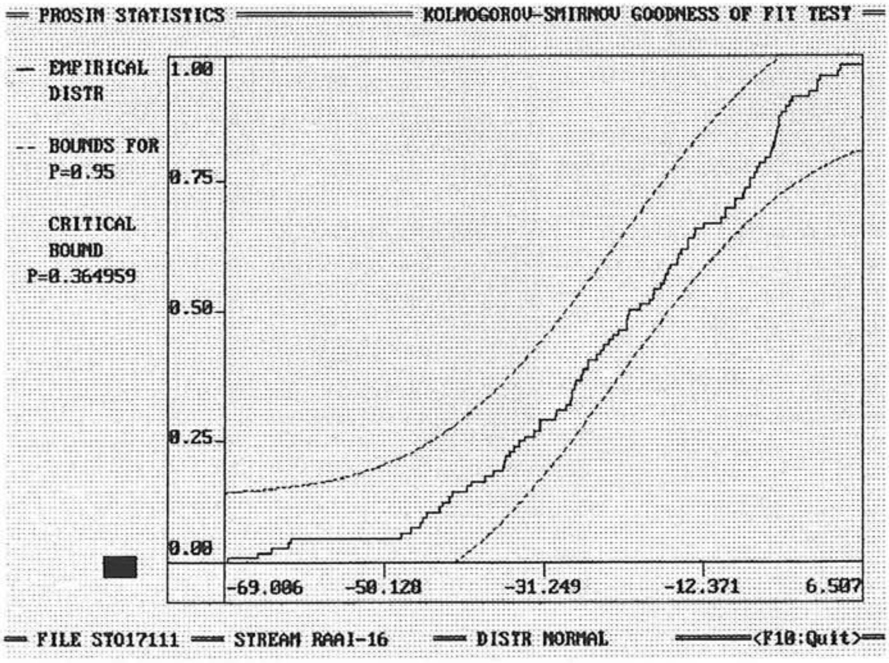


```
PROSIM HISTOGRAM FACILITY ——————— FILE ST017111— SELECTION RAAI-16
********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********
                                  Mean        :     -22.462074 Minimum:       -69.005997
                                  Deviation:         17.609386 Maximum:         6.507368
   Upper       Cum      100       90%         :      -1.454545 95%     :        1.859248
   Bound       Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

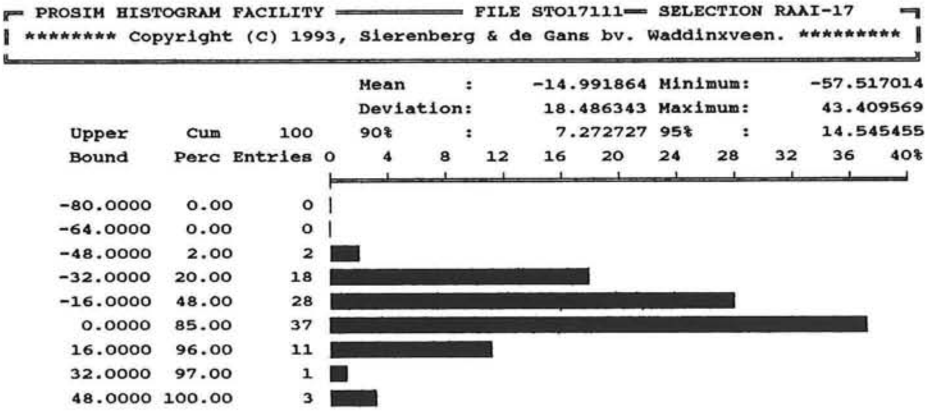
  -80.0000     0.00      0
  -64.0000     3.00      3
  -48.0000     7.00      4
  -32.0000    27.00     20
  -16.0000    60.00     33
    0.0000    93.00     33
   16.0000   100.00      7
```

```
+- PROSIM STATISTICS --------------- FILE ST017111 - STREAM RAAI-16     -+
+-----------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean             :      -22.462074         Number of entries:   100
   St. deviation    :     17.609386
   Mn. deviation    :     14.216700           Minimum :      -69.005997
   Skewness         :      -0.663001          Maximum :        6.507368
   Alt. Skewness    :        -0.070553        Range   :       75.513365
   Kurtosis         :          2.947540       Midrange:      -31.249314

   Confidence intervals for the mean:  90% ( -25.390 -   -19.534)
                                       95% ( -25.961 -   -18.963)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -45.059593
   Median:      -21.219685
   90.000       -2.530273
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 17 (x = 4250 m)

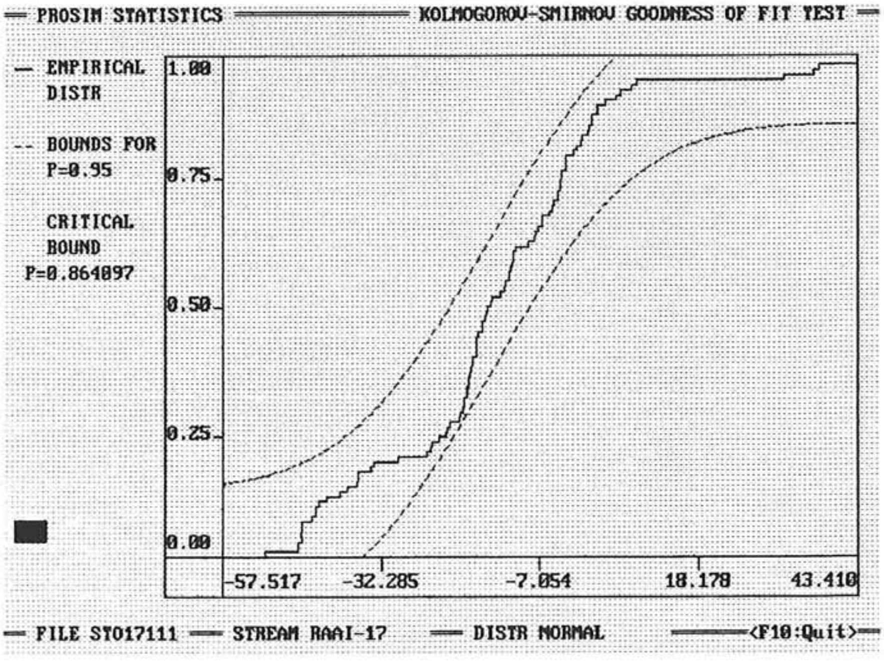


```
┌─ PROSIM HISTOGRAM FACILITY ══════════ FILE ST017111══ SELECTION RAAI-17    ─┐
│ ******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* │
└──────────────────────────────────────────────────────────────────────────────┘
                              Mean      :      -14.991864 Minimum:      -57.517014
                              Deviation:        18.486343 Maximum:       43.409569
   Upper      Cum     100     90%       :        7.272727 95%     :      14.545455
   Bound      Perc Entries 0     4    8   12   16   20   24   28   32   36   40%

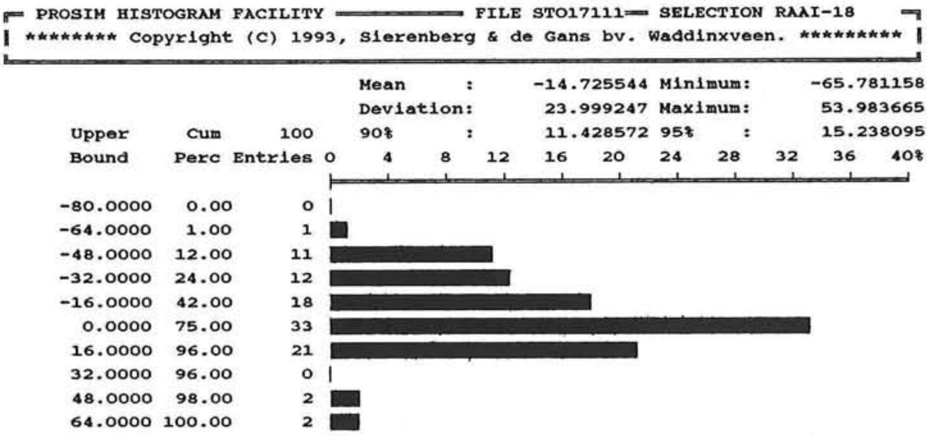
  -80.0000    0.00       0 |
  -64.0000    0.00       0 |
  -48.0000    2.00       2 
  -32.0000   20.00      18 
  -16.0000   48.00      28 
    0.0000   85.00      37 
   16.0000   96.00      11 
   32.0000   97.00       1 
   48.0000  100.00       3 
```

```
+- PROSIM STATISTICS --------------- FILE ST017111 - STREAM RAAI-17    -+
+-----------------------------------------------------------------------+
                                 == BASIC STATISTICS ==
   Mean             :        -14.991869          Number of entries:   100
   St. deviation    :       18.486343
   Mn. deviation    :       13.542649          Minimum :       -57.517014
   Skewness         :       0.350588           Maximum :        43.409569
   Alt. Skewness    :       0.024046           Range   :       100.926582
   Kurtosis         :       4.055932           Midrange:        -7.053722

   Confidence intervals for the mean:  90% ( -18.065 -   -11.918)
                                       95% ( -18.665 -   -11.319)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -42.742538
   Median:      -15.436384
   90.000        2.170578
```



PROSIM STATISTICS: Starboard-side extremity on cross-section 18 (x = 4500 m)



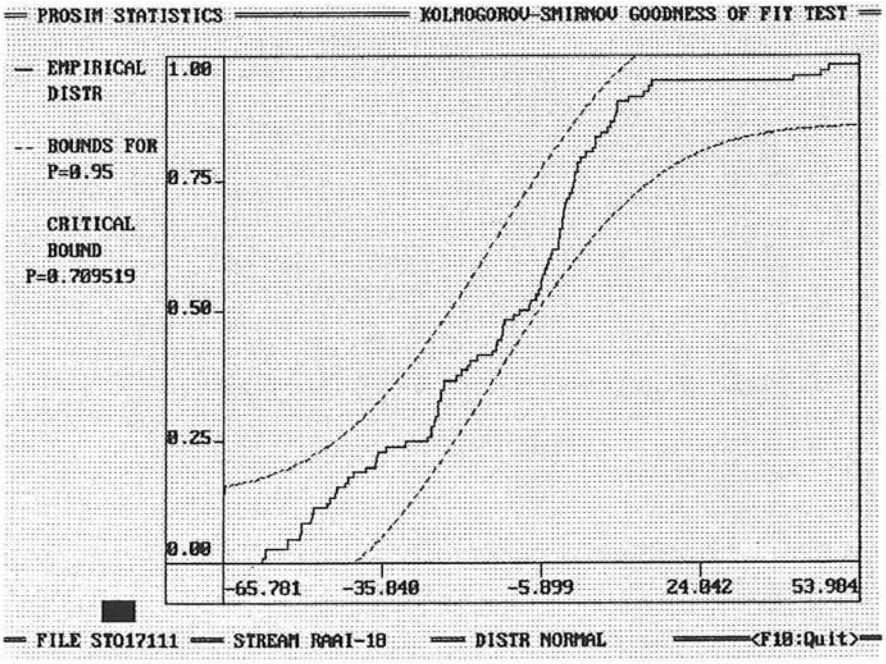
```
PROSIM HISTOGRAM FACILITY ---------- FILE STO17111-- SELECTION RAAI-18
******** Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. *********

                            Mean       :    -14.725544 Minimum:    -65.781158
                            Deviation:       23.999247 Maximum:     53.983665
  Upper      Cum     100    90%        :     11.428572 95%     :    15.238095
  Bound      Perc Entries 0     4     8    12    16    20    24    28    32    36    40%

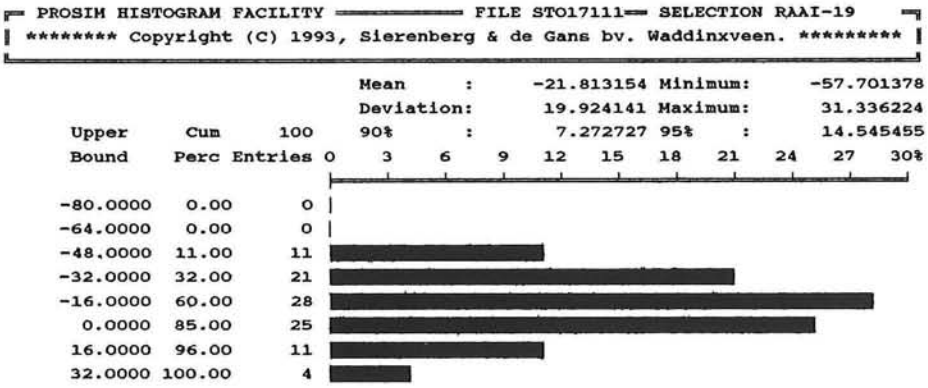
  -80.0000   0.00       0
  -64.0000   1.00       1
  -48.0000  12.00      11
  -32.0000  24.00      12
  -16.0000  42.00      18
    0.0000  75.00      33
   16.0000  96.00      21
   32.0000  96.00       0
   48.0000  98.00       2
   64.0000 100.00       2
```

```
+- PROSIM STATISTICS --------------- FILE STO17111 - STREAM RAAI-18     -+
+-----------------------------------------------------------------------+
                                    == BASIC STATISTICS ==
   Mean           :      -14.725541         Number of entries:   100
   St. deviation  :      23.999250
   Mn. deviation  :      19.171831          Minimum :      -65.781158
   Skewness       :      0.161743           Maximum :       53.983665
   Alt. Skewness  :   -0.175398             Range   :      119.764824
   Kurtosis       :      3.222666           Midrange:       -5.898746

   Confidence intervals for the mean:  90% ( -18.716 -  -10.736)
                                       95% ( -19.494 -   -9.957)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   Lags (max=  39) :   20
   Percentiles
   10.000      -49.097427
   Median:      -10.516122
   90.000       8.346180
```



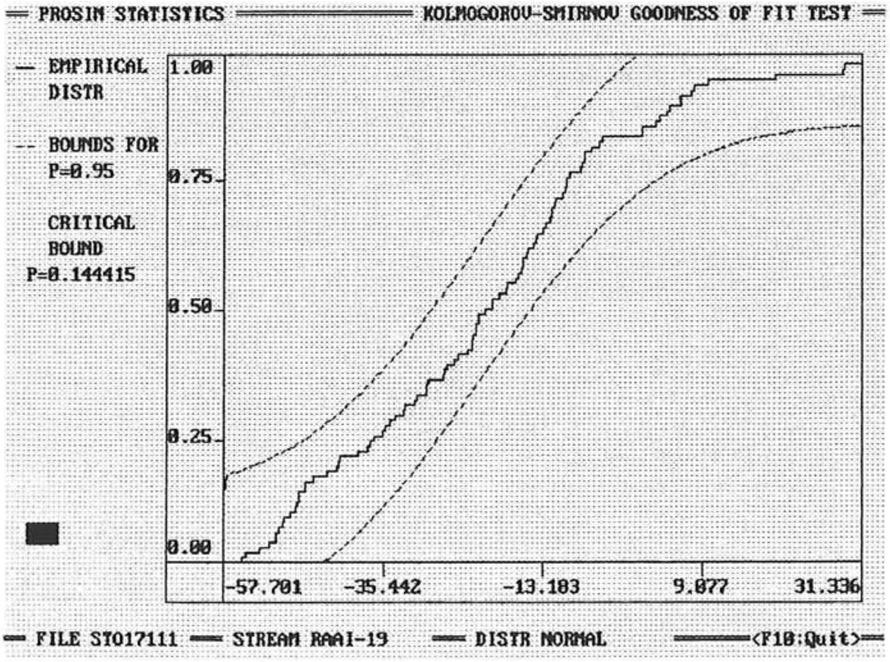
PROSIM STATISTICS: Starboard-side extremity on cross-section 19 (x = 4750 m)



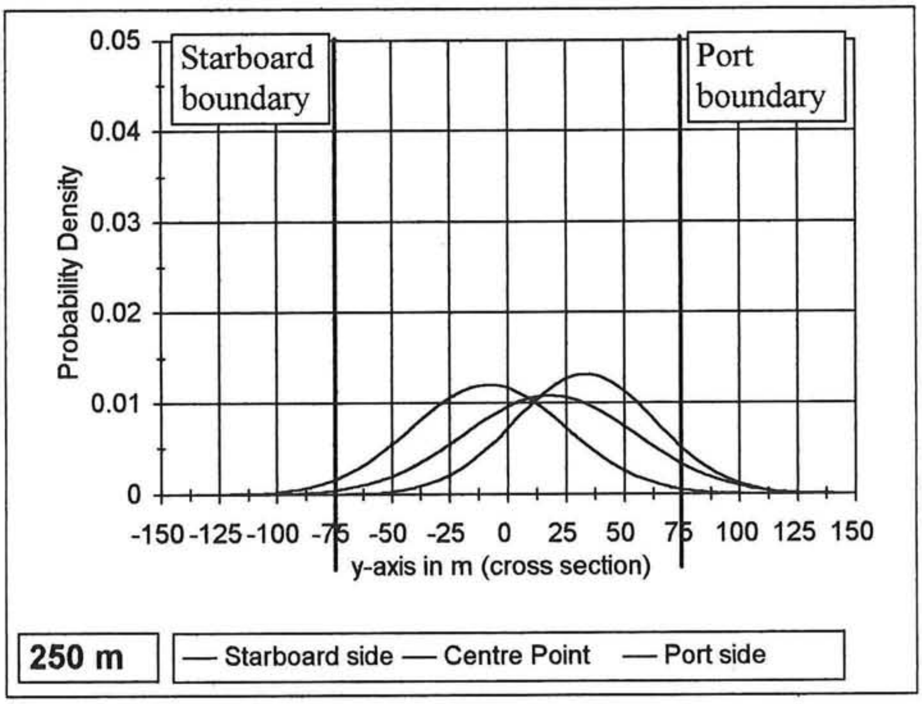
```
┌═ PROSIM HISTOGRAM FACILITY ══════════ FILE STO17111══ SELECTION RAAI-19    ═┐
| ********* Copyright (C) 1993, Sierenberg & de Gans bv. Waddinxveen. ********* |
└──────────────────────────────────────────────────────────────────────────────┘
                              Mean      :    -21.813154 Minimum:     -57.701378
                              Deviation:     19.924141 Maximum:      31.336224
  Upper      Cum      100     90%       :     7.272727 95%     :     14.545455
  Bound      Perc Entries 0    3    6    9   12   15   18   21   24   27   30%
                          |----|----|----|----|----|----|----|----|----|----|
  -80.0000   0.00       0 |
  -64.0000   0.00       0 |
  -48.0000  11.00      11 ███████████████████
  -32.0000  32.00      21 ███████████████████████████████████
  -16.0000  60.00      28 ███████████████████████████████████████████████
    0.0000  85.00      25 ██████████████████████████████████████████
   16.0000  96.00      11 ███████████████████
   32.0000 100.00       4 ███████
```

```
+- PROSIM STATISTICS -------------- FILE STO17111 - STREAM RAAI-19    -+
+----------------------------------------------------------------------+
                                     == BASIC STATISTICS ==
   Mean             :      -21.813148      Number of entries:   100
   St. deviation    :     19.924143
   Mn. deviation    :     15.916674        Minimum :      -57.701378
   Skewness         :     0.324492         Maximum :       31.336224
   Alt. Skewness    :     -0.005759        Range   :       89.037601
   Kurtosis         :     2.794265         Midrange:      -13.182577

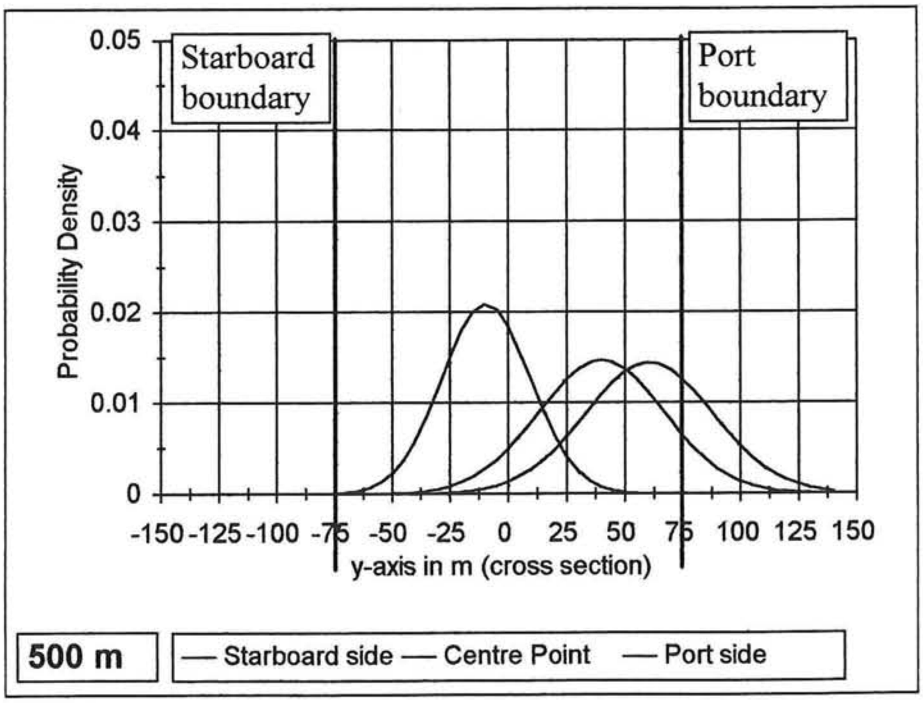
   Confidence intervals for the mean:  90% ( -25.126 -  -18.501)
                                       95% ( -25.772 -  -17.854)
   Correlation according to the independant
   Linear (Pearson): Independant series is constant
   Rank (Spearman) :
   lags (max=  39) :   20
   Percentiles
   10.000      -48.565170
   Median:       -21.698400
   90.000    4.469786
```



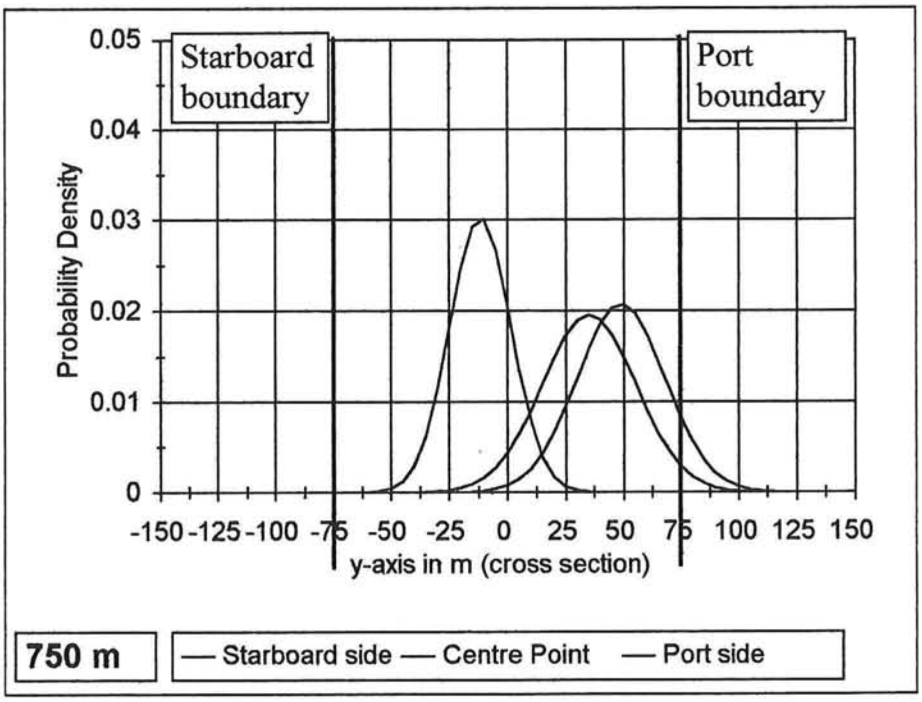
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 250 m



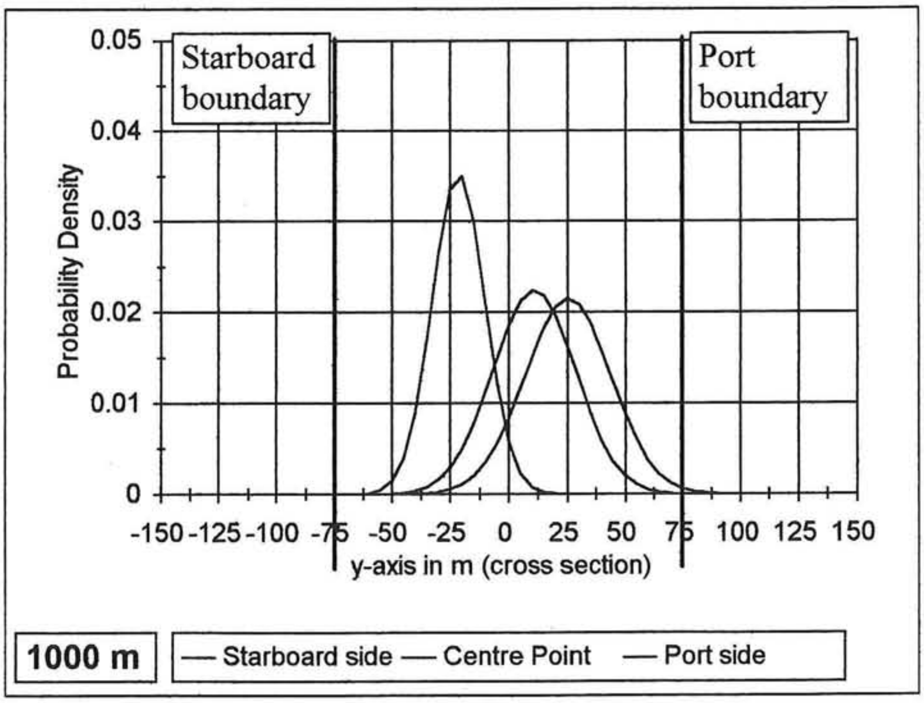
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 500 m



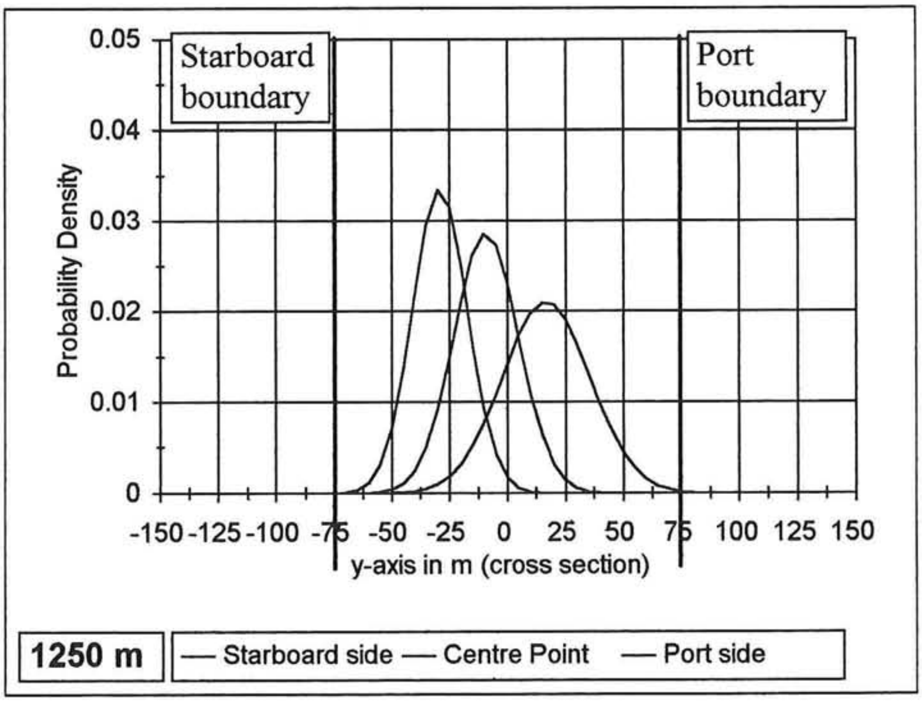
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 750 m



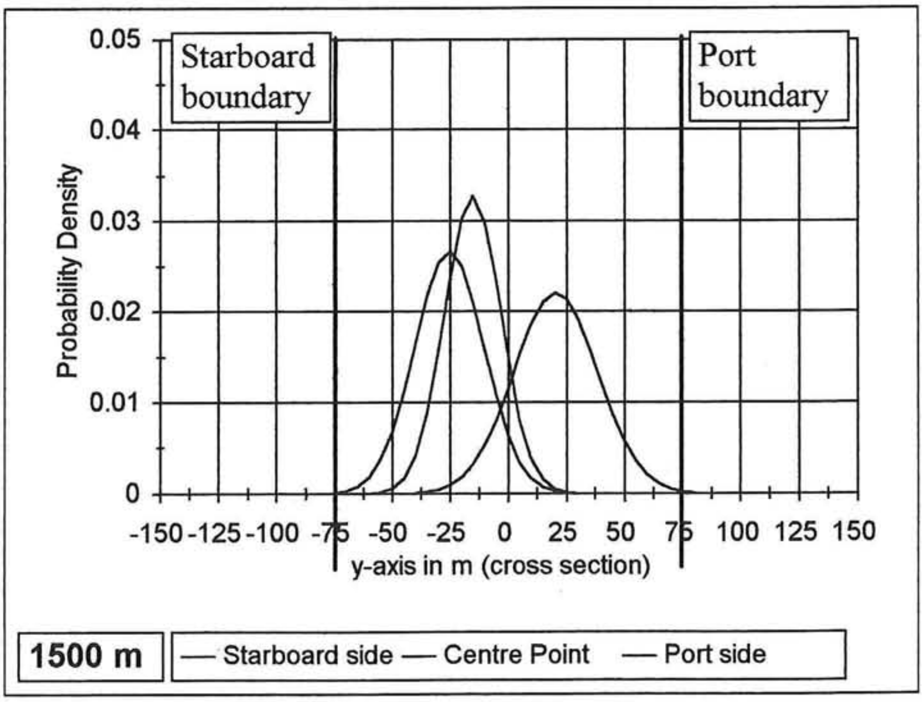
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 1000 m



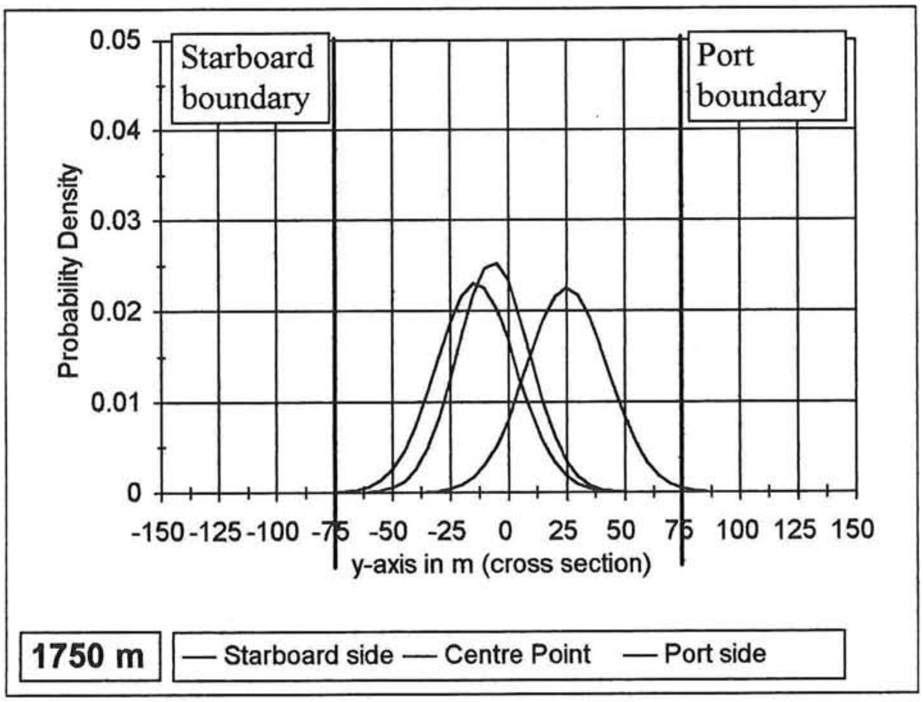
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 1250 m



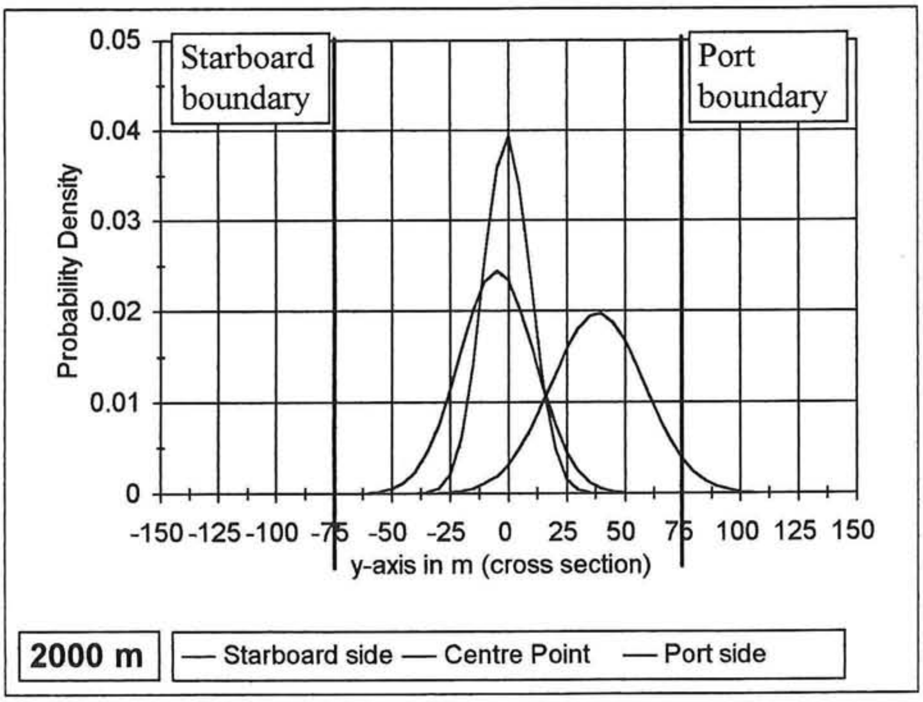
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 1500 m



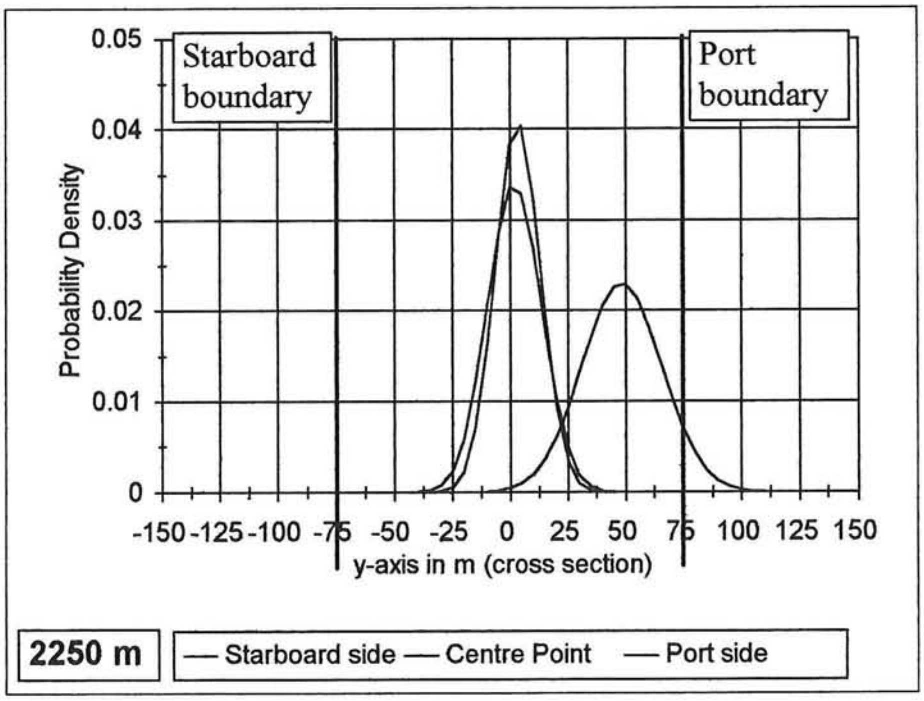
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 1750 m



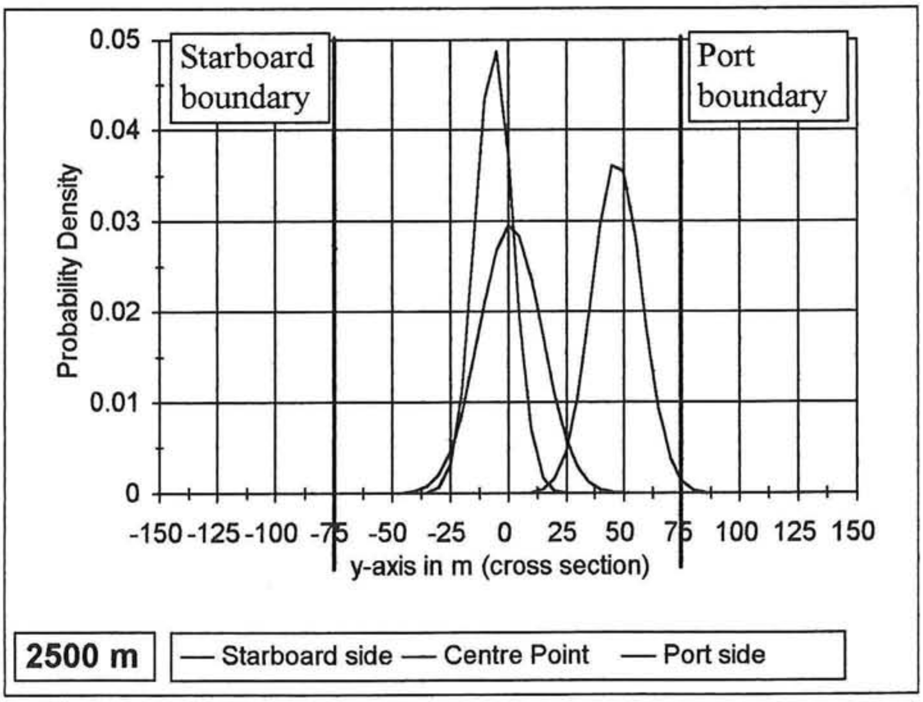
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 2000 m



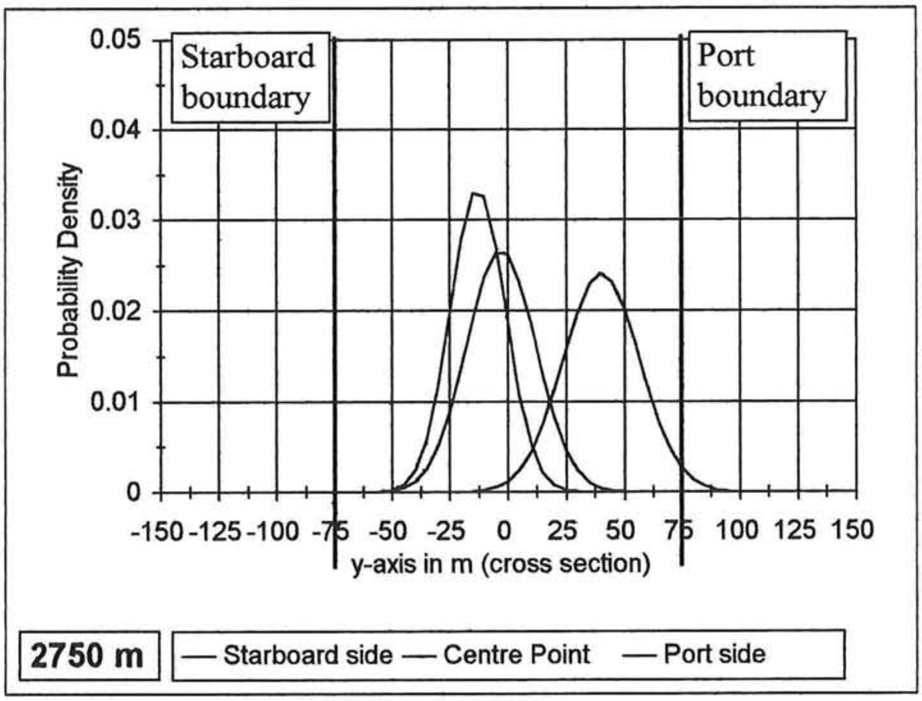
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 2250 m



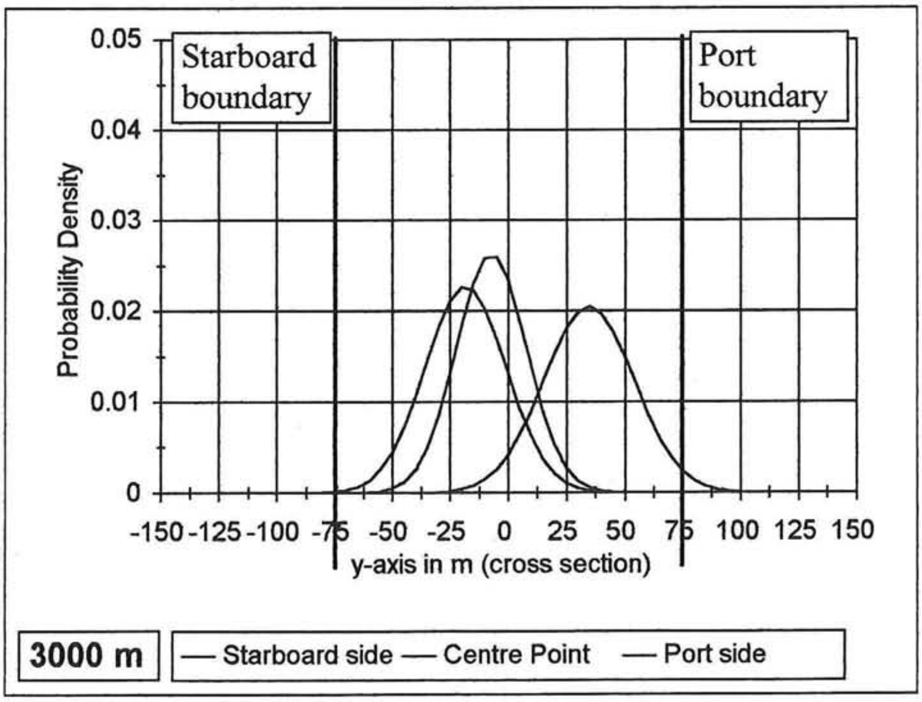
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 2500 m



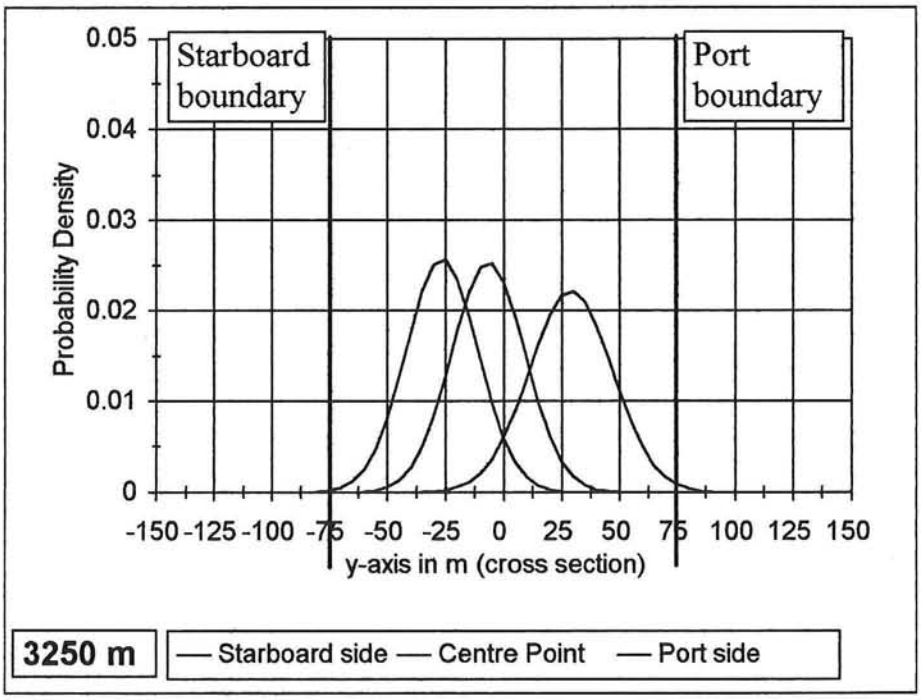
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 2750 m



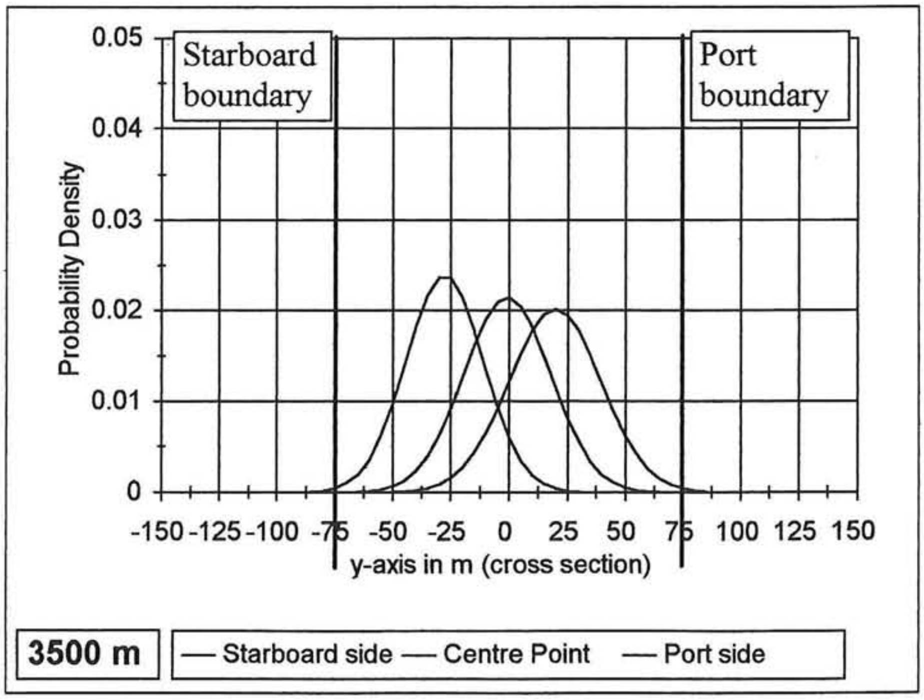
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 3000 m



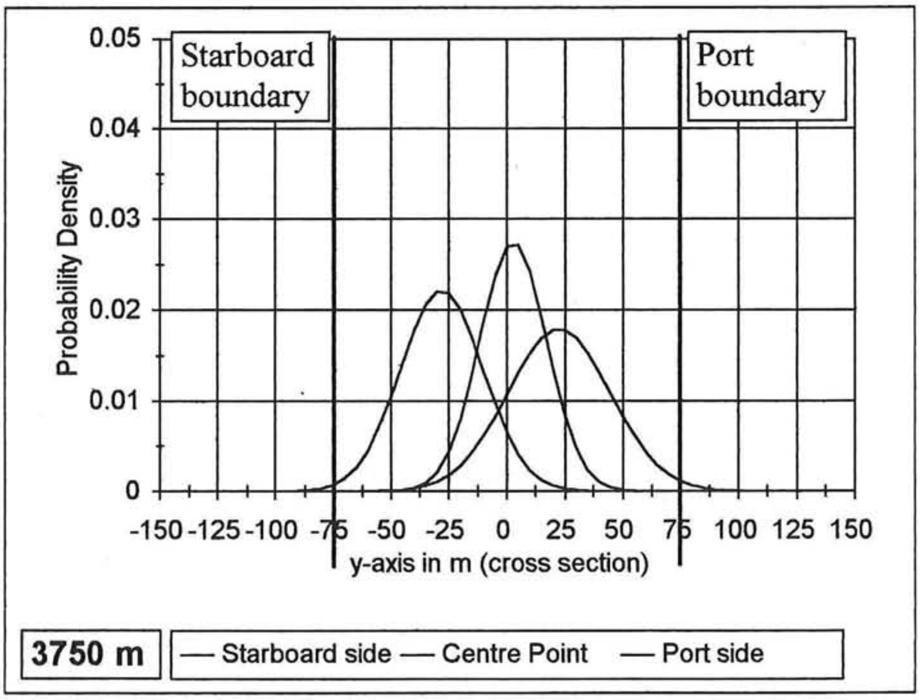
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 3250 m



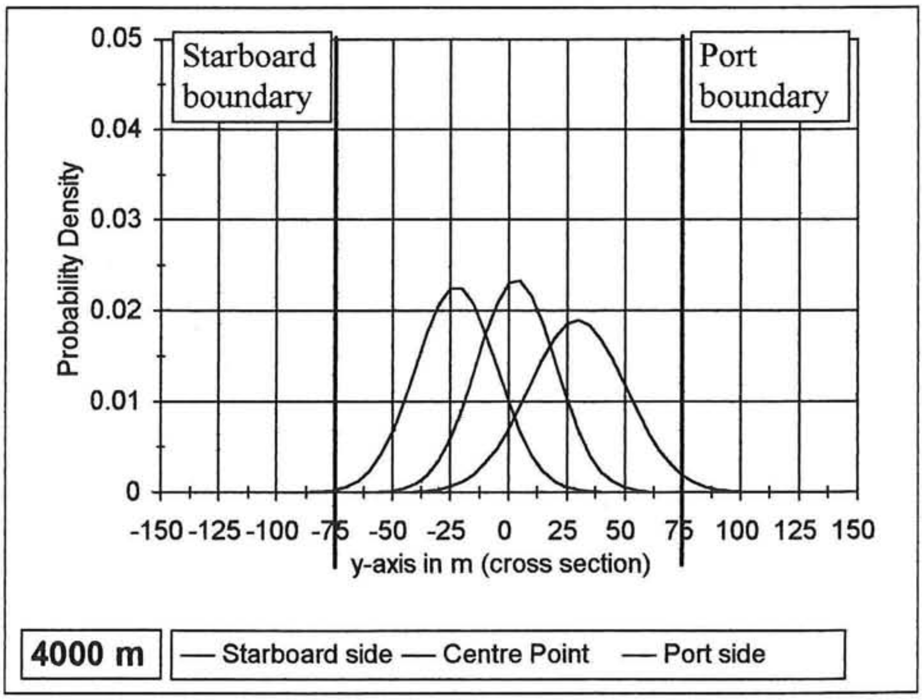
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 3500 m



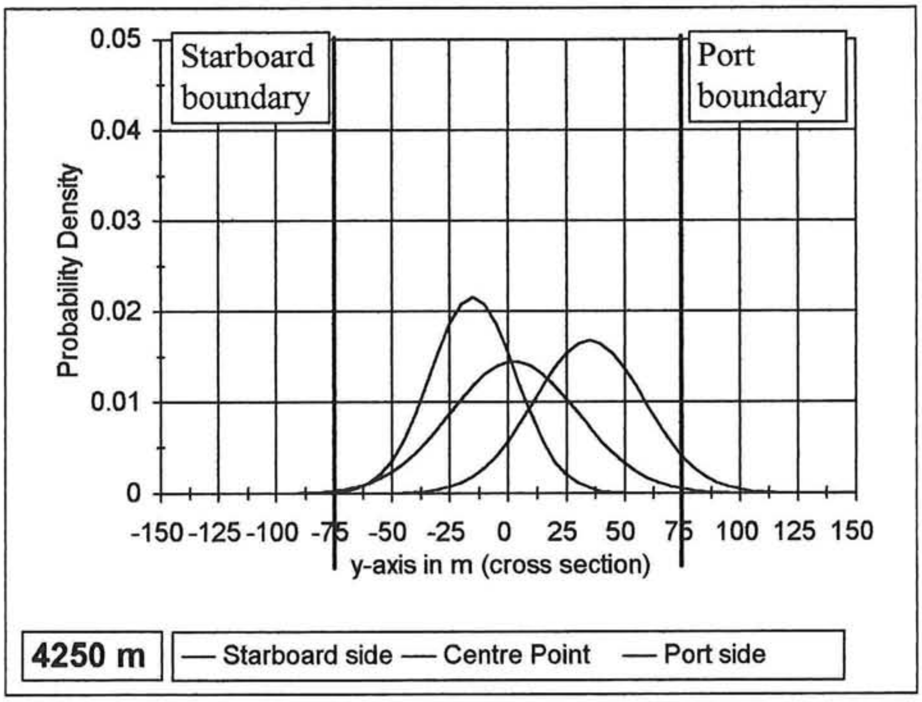
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 3750 m



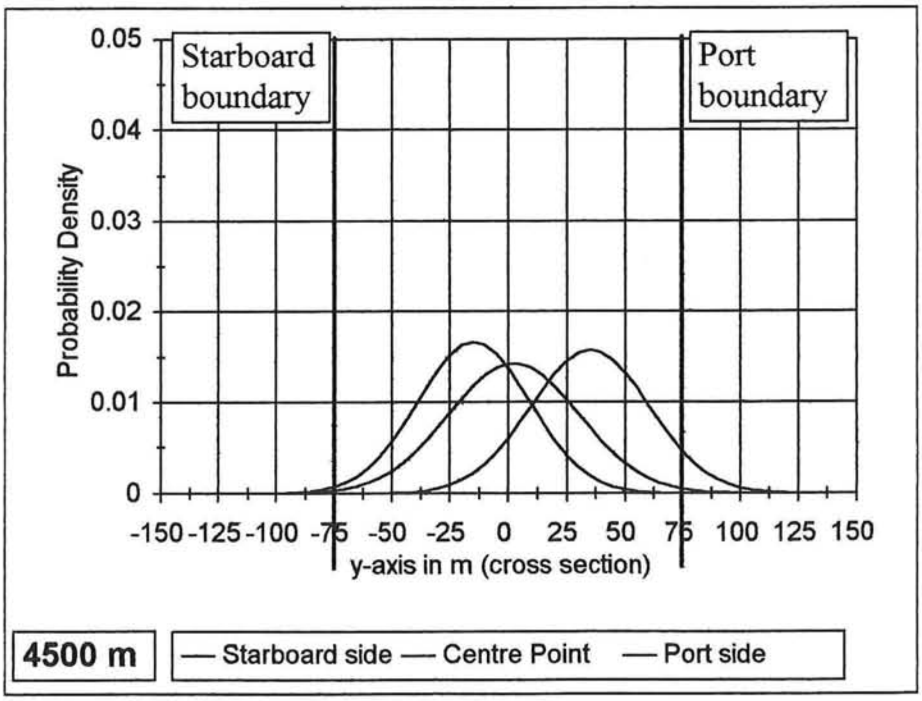
Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 4000 m



Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 4250 m



Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 4500 m



Normal distribution of the position of the ship's centre-of-gravity and extremities at the cross-section of x = 4750 m