Appendix-6 Supplementary Data on Natural Conditions

6-1. Tide

Table A-6-1-1 Results of Tide Harmonic Analysis (15 days)

Region: Egypt
Observatin Point: Maadia Fishing Port
Latitude: 31 16 20 N
Longitude: 30 10 40 E
Observation Period: October 23 to November 7, 1995

Harmonic Constants		
Component	Amplitude	Lag Angle
Tide	(m)	(°)
K1	0.016	273.0
O1	0.010	231.8
P1	0.005	273.0
Q1	0.012	315.1
M2	0.077	307.2
S2	0.054	309.7
K2	0.015	309.7
N2	0.010	345.7
M4	0.002	231.4
MS4	0.001	291.0
A0	2.774	

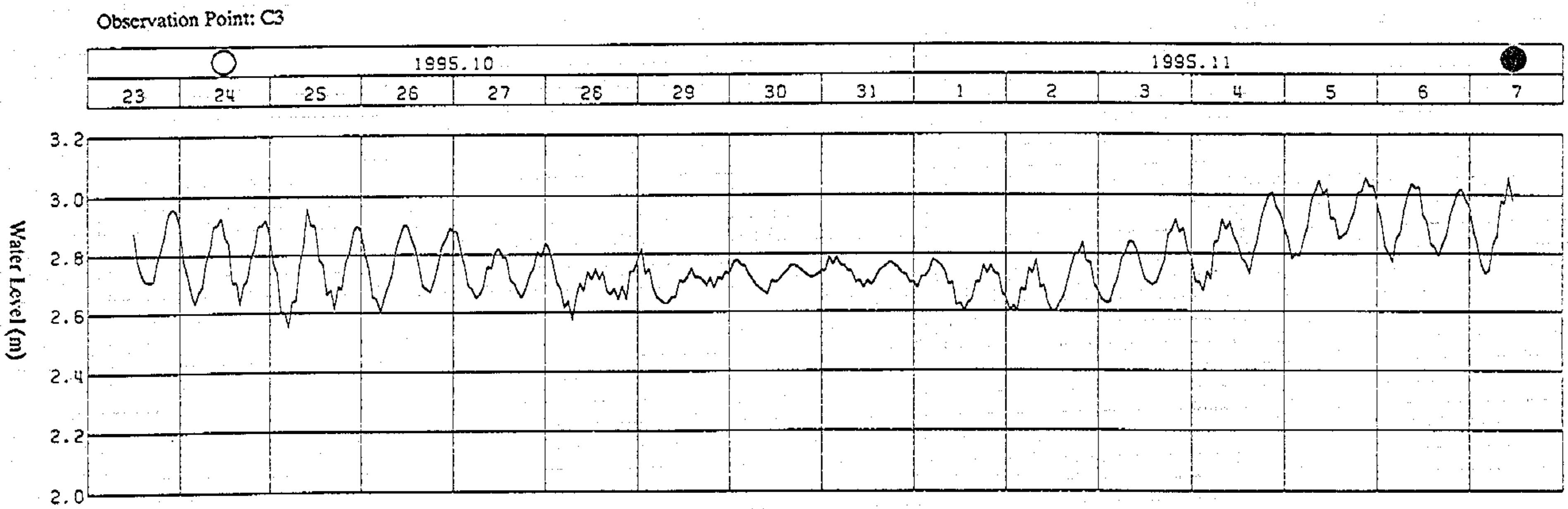


Figure A-6-1-1 Tide Curve

6-2. Waves

Based on the wind data recorded at the Alexandria Port and the Alexandria Airport, the design wave dimension at the ordinary and extraordinary conditions are hindcast as follows:

Where, for the hindcast of the ordinary waves, the wind data at the Alexandria Port were used to obtain the frequency of occurrence of waves by height and direction at the offshore and the project site (4 m depth), which will be referred by the computer simulation for the littoral drift and the calculation of the workable day rate of fishing port.

And for the hindcast of the extraordinary waves, the wind data at the Alexandria Airport were used to obtain the design waves by depth at the project site, which will be referred by structural calculation of the breakwaters and revetments.

The flow of the hindcast is summarized as follows:

(1) Calculation of Probability Wind Speed by means of extremal analysis such as Gumbel or Weibull Distribution Function (for extraordinary conditions)
(2) Hindcast of Offshore Design Waves by means of SMB Method (for ordinary and extraordinary conditions)
(3) Computation of Design Waves at the Site by means of Wave Deformation (for ordinary and extraordinary conditions)

The details are as follows:

(1) Calculation of Probability Wind Speed

1) Analysis of Wind Data

The wind data obtained in this study are the following 2 kinds.

a) The wind data more than the speed of 20 knot (10m/s) observed at the Alexandria Airport for the past 10 years from 1985 to 1994.
b) The wind data hourly observed at the Alexandria Port from 8 am to 8 pm for the past 5 years from 1990 to 1994.

Tables A-6-2-1 and A-6-2-2 show the frequency of occurrence of the said wind by speed and direction.

Table A-6-2-1 Frequency of Occurrence of Wind by Speed and Direction at Alexandria Airport (1985 to 1994) (Source: Meteorological Authority in Egypt)

Speed \ Direction	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total (%)
10.0~14.9	1.8	0.6	0.6	0.3	0.0	0.1	0.1	2.6	9.6	18.0	16.3	14.3	12.3	9.1	8.2	2.8	96.5
15.0~19.9	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.2	1.6	0.9	0.0	0.2	0.2	0.0	0.0	3.4
20.0~24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.0~29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
30.0m/s~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (%)	1.8	0.6	0.6	0.4	0.0	0.1	0.1	2.8	9.7	19.7	17.2	14.3	12.5	9.3	8.2	2.8	100.0

Table A-6-2-2 Frequency of Occurrence of Wind by Speed and Direction at Alexandria Port (1990 to 1994) (Source: Meteorological Authority in Egypt)

Speed \ Direction	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Calm	Total (%)
0.0~4.9	5.7	3.4	1.6	2.4	1.7	1.4	0.7	1.3	0.7	1.3	1.6	5.0	5.6	7.0	10.6	9.8	1.6	61.5
5.0~9.9	2.5	1.7	0.4	0.4	0.2	0.2	0.2	0.4	0.4	0.8	1.2	4.1	5.2	5.3	7.6	6.1	0.0	36.6
10.0~14.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.3	0.3	0.2	0.1	0.0	1.8
15.0~19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
20.0~24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.0~29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30.0m/s~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (%)	8.2	5.2	2.0	2.8	1.9	1.6	0.9	1.7	1.1	2.3	3.1	9.5	11.0	12.6	18.5	16.1	1.6	100.0
10.0m/s~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.3	0.3	0.2	0.1	0.0	1.9

Table A-6-2-3 shows the strongest 10 wind at the fastest speed order in wind data at Alexandria Airport.

Table A-6-2-3 Strongest 10 Wind at Fastest Speed Order (Alexandria Airport, 1985 to 1994)

No.	Year	Month	Day	Hour	Speed(m/s)	Direction
1	1986	12	27	3	28.8	SW
2	1992	2	3	16	18.5	NW
3	1988	2	1	9	17.5	SW
4	1994	1	28	0	17.0	WNW
5	1991	12	8	21	17.0	WSW
6	1985	1	17	17	16.5	SW
7	1993	3	13	1	15.4	S
8	1993	3	8	0	15.4	SW
9	1992	2	21	13	15.4	S
10	1989	1	9	13	15.4	SW

2) Calculation of Probability Wind Speed

a) Calculation Method

The probability wind speed were obtained as follows:

i) From the wind data more than the speed of 10 m/s observed at the Alexandria Airport, the strongest 10 wind at the fastest speed order by direction (W to NE) are picked up. Picking them up is executed with consideration of the conversion factor of wind speed ranging + 67.6° to − 67.5° against the main direction.

ii) Those strongest 10 wind are converted to the wind on sea by using the conversion factor, 1/0.7.

iii) The 30 and 50 years wind speeds are obtained by means of extremal analysis such as Gumbel and Weibull Distribution Function.

b) Calculation Results

The strongest 10 wind by direction picked up from the wind data at Alexandria Airport are shown in Table A-6-2-4.

From the application of extremal analysis feeding the data in Table A-6-2-4, the probability wind speeds are obtained as shown in Table A-6-2-5.

Table A-6-2-5 Probability Wind Speeds by Direction (unit: m/s)

Direction	30 Years	50 Years	Remarks
W	29.5	31.7	Weibull, $\kappa = 0.75$
WNW	25.8	27.2	Weibull, $\kappa = 0.85$
NW	27.3	29.4	Weibull, $\kappa = 0.85$
NNW	24.8	26.6	Weibull, $\kappa = 0.75$
N	19.7	20.0	Weibull, $\kappa = 2.00$
NNE	18.2	18.6	Weibull, $\kappa = 2.00$
NE	18.1	18.6	Weibull, $\kappa = 1.50$

Table A-6-2-4 Strongest 10 Wind by Direction

Direction		Year	Month	Day	Hour	Recorded Speed (m/s)	Speed on Sea (m/s)
W	1	1986	12	27	3	20.4	29.1
	2	1994	1	28	0	15.7	22.4
	3	1991	12	8	21	15.7	22.4
	4	1988	2	1	4	15.7	22.4
	5	1992	2	3	13	14.3	20.4
	6	1987	3	10	0	13.9	19.8
	7	1990	3	1	3	13.8	19.7
	8	1989	1	9	15	13.8	19.7
	9	1993	1	8	6	13.4	19.1
	10	1992	2	24	22	13.4	19.1
WNW	1	1992	2	3	16	17.1	24.4
	2	1994	1	28	0	17.0	24.3
	3	1994	3	11	8	13.4	19.1
	4	1992	12	14	12	13.4	19.1
	5	1992	2	24	14	13.4	19.1
	6	1989	1	15	16	13.4	19.1
	7	1987	2	9	15	13.4	19.1
	8	1988	2	1	16	13.3	19.0
	9	1987	3	10	0	12.8	18.3
	10	1986	12	26	23	12.4	17.7
NW	1	1992	2	3	16	18.5	26.5
	2	1994	1	28	0	15.7	22.4
	3	1989	1	15	17	13.9	19.8
	4	1994	3	11	9	13.4	19.1
	5	1988	3	9	12	13.4	19.1
	6	1989	1	15	18	12.9	18.4
	7	1992	12	15	7	12.8	18.3
	8	1992	2	24	14	12.4	17.7
	9	1988	12	25	8	12.4	17.7
	10	1987	2	9	15	12.4	17.7
NNW	1	1992	2	3	16	17.1	24.4
	2	1992	12	15	7	13.9	19.8
	3	1988	12	25	8	13.4	19.1
	4	1989	1	15	17	12.8	18.3
	5	1994	3	11	9	12.4	17.7
	6	1993	1	10	19	12.4	17.7
	7	1988	3	9	12	12.4	17.7
N	1	1993	1	10	19	13.4	19.1
	2	1992	2	3	16	13.1	18.7
	3	1992	12	15	7	12.8	18.3
	4	1988	12	25	8	12.4	17.7
	5	1991	5	13	15	11.8	16.9
NNE	1	1993	1	10	19	12.4	17.7
	2	1990	3	17	14	12.3	17.6
	3	1986	6	10	15	11.4	16.3
	4	1991	5	13	16	11.3	16.2
	5	1989	6	13	17	11.3	16.2
	6	1986	3	13	21	10.8	15.4
	7	1992	11	24	11	10.5	14.9
	8	1991	4	7	20	10.5	14.9
	9	1986	5	7	13	10.5	14.9
	10	1994	10	7	23	10.3	14.7
NE	1	1986	6	10	15	12.3	17.6
	2	1990	3	17	14	11.4	16.3
	3	1989	6	13	15	11.3	16.2
	4	1985	6	1	1	10.9	15.6
	5	1991	5	13	16	10.5	14.9
	6	1992	5	6	17	10.3	14.7
	7	1986	3	13	20	10.3	14.7
	8	1992	3	10	16	10.0	14.3
	9	1994	10	7	23	9.5	13.6
	10	1992	6	10	1	9.5	13.6

Note: Convertion factor to Speed on Sea is 0.7

(2) Hindcast of Offshore Design Waves

1) Effective Fetch by Wind Direction

The calculated results of effective fetch by wind direction are shown in Table A-6-2-6 with the 30 years wind speed to be referred for the hindcast of the design wave at the extraordinary condition. The typical example (NW direction) to calculate the effective fetch by wind direction is shown in Figure A-6-2-1.

Table A-6-2-6 Effective Fetch and 30 Years Wind Speed by Wind Direction

Direction	Effective Fetch F (km)	30 Years Wind Speed u (m/s)
W	430	29.5
WNW	570	25.8
NW	598	27.3
NNW	554	24.8
N	501	19.7
NNE	501	18.2
NE	483	18.1

2) Assumption of Relation between Duration and Wind Speed

Considering the blowing pattern of wind more than the speed of 15 m/s (approx. 21 m/s on sea) in the said wind data at Alexandria Airport and Alexandria Port and the blowing pattern of the ordinary wind in winter season, the relation in occurrence of the 30 years wind speed between the duration and the wind speed are assumed as follows:

a) From the blowing pattern of the ordinary wind in winter season, the wind speeds from 5 to 10 m/s (7 to 15 m/s on sea) ordinarily occur. Therefore it is assumed that the wind speed of 10 m/s on sea ordinarily occurs as the initial wind speed.

b) Since the duration of the wind more than the speed of 17.5 m/s (25 m/s on sea) is less than several hours, the duration of the peak is one hour.

c) The duration from the initial wind speed (5 to 10 m/s, around 10 m/s on sea) to the peak is assumed to be 12 hours.

The pattern of the relation between the above wind speed and duration is as shown in Figure A-6-2-2. The ordinary wind blowing pattern is adopted as it is.

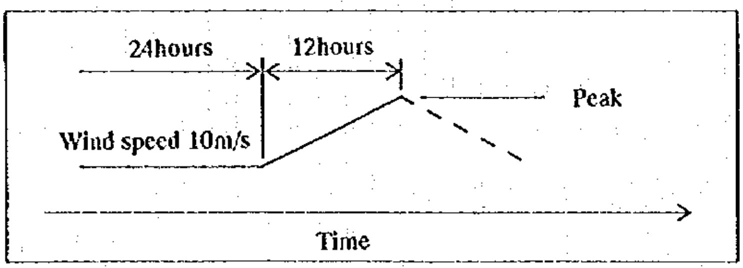
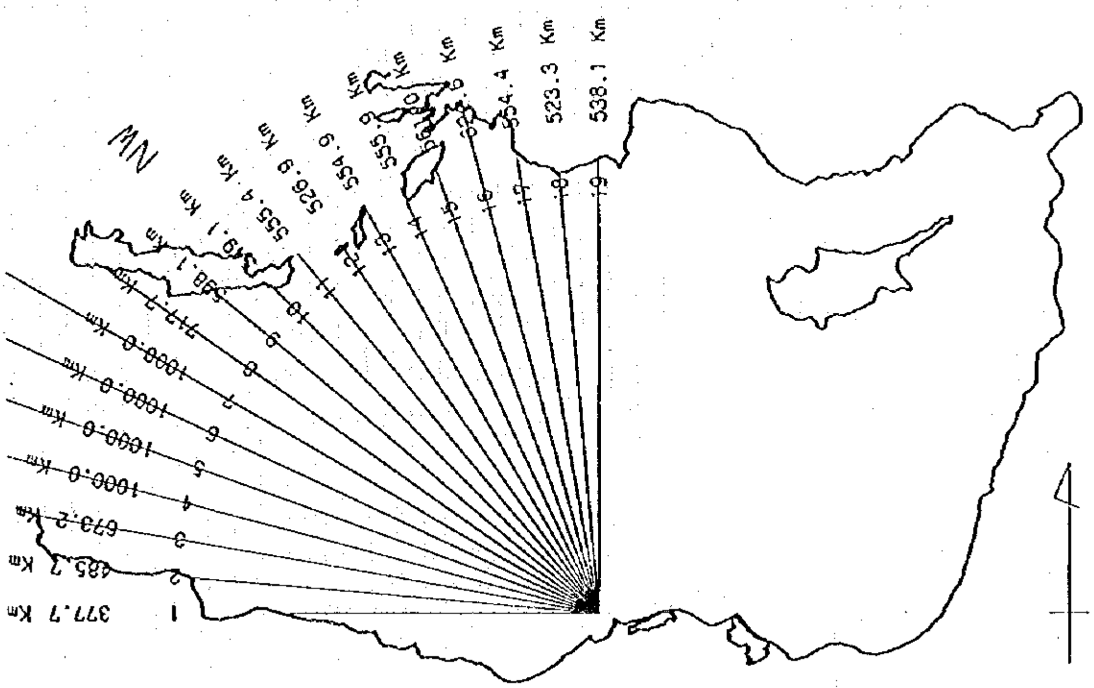


Figure A-6-2-2 Pattern of Hourly Change of Wind Speed



NO.	alp	FI	COS	COS2	FI*COS2
1	45.	377.7	0.707	0.500	188.846
2	40.	485.7	0.766	0.587	285.016
3	35.	673.2	0.819	0.671	451.702
4	30.	1000.0	0.866	0.750	750.000
5	25.	1000.0	0.906	0.821	821.394
6	20.	1000.0	0.940	0.883	883.022
7	15.	1000.0	0.966	0.933	933.013
8	10.	717.7	0.985	0.970	696.067
9	5.	598.1	0.996	0.992	593.537
10	0.	549.1	1.000	1.000	549.054
11	-5.	555.4	0.996	0.992	551.174
12	-10.	526.9	0.985	0.970	511.036
13	-15.	554.9	0.966	0.933	517.686
14	-20.	555.9	0.940	0.883	490.868
15	-25.	561.0	0.906	0.821	460.817
16	-30.	624.6	0.866	0.750	468.429
17	-35.	554.4	0.819	0.671	372.030
18	-40.	523.3	0.766	0.587	307.075
19	-45.	538.1	0.707	0.500	269.044
TOTLE			16.903		10099.808

Fe=597.5 (Km)

Figure A-6-2-1 Typical Example to Calculate the Effective Fetch by Wind Direction (NW Direction)

3) Hindcast by means of SMB method

a) Offshore Design Wave at Extraordinary Condition

The offshore design waves at extraordinary condition by direction were hindcast by means of the SMB Method by using the most influential 4 winds of W, NW, NNW and NE directions listed in Table A-6-2-6. The results of hindcast are shown in Table A-6-2-7.

Where, in the hindcast of these waves, it has been considered that the wave grows as the wind speed increases according to the wind blowing pattern assumed in the aforementioned section. The typical example for the process of the wave growth for the case of NW wind is shown in Figure A-6-2-3 and Table A-6-2-8.

Table A-6-2-7 Results of Hindcast of Offshore Design Waves at Extraordinary Condition

Wave Direction	W	NW	NNW	NE
Wave Height H o (m)	6.90	6.20	5.70	3.70
Wave Period T o (s)	9.90	9.50	9.10	7.70

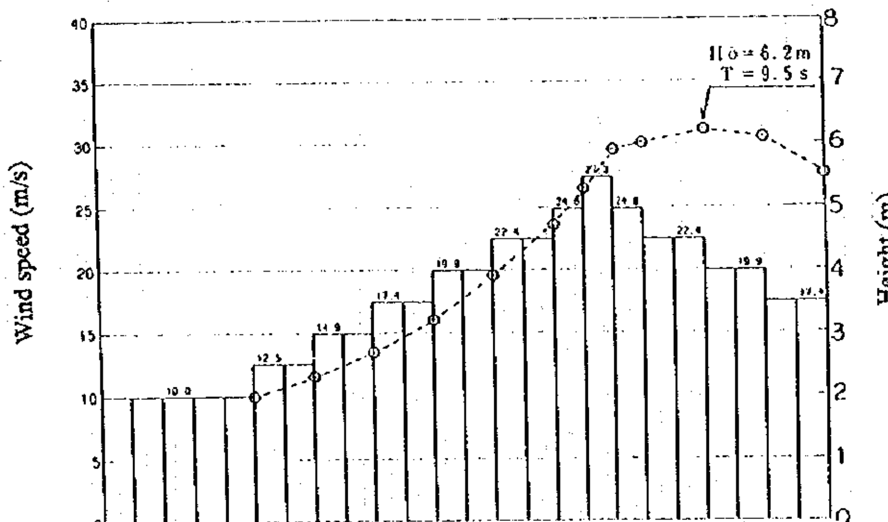


Figure A-6-2-3 Hourly Change Graph of Hindcast Wave Height with Change of Wind Speed, SMB Method (NW Wind)

Table A-6-2-8 Hourly Change of Hindcast Wave Dimension with Change of Wind Direction, SMB Method (NW Wind)

Time	Wind Speed (m/s)	Duration (hr)	Height (m)	Period (s)
-24~0	10.0	24.0	2.0	5.9
0~2	12.5	10.0 + 2.0 = 12.0	2.3	6.0
2~4	14.9	7.0 + 2.0 = 9.0	2.7	6.3
4~6	17.4	6.0 + 2.0 = 8.0	3.2	6.7
6~8	19.9	5.5 + 2.0 = 7.5	3.9	7.2
8~10	22.4	6.0 + 2.0 = 8.0	4.7	8.0
10~11	24.8	6.5 + 1.0 = 7.5	5.3	8.2
11~12	27.3	6.0 + 1.0 = 7.0	5.9	8.7
12~13	24.8	8.5 + 1.0 = 9.5	6.0	9.0
13~15	22.4	12.0 + 2.0 = 14.0	6.2	9.5
15~17	19.9	18.0 + 2.0 = 20.0	6.1	9.6
17~19	17.4	40.0 + 2.0 = 42.0	5.5	9.5

b) Offshore Design Wave at Ordinary Condition

The offshore design waves at ordinary condition were hindcast by means of the SMB Method the same as the extraordinary waves by using the daily and hourly wind data at the Alexandria Port (1990 to 1994). The results of hindcast are compiled as the frequency of occurrence of wind by height and direction as shown in Table A-6-2-9.

Table A-6-2-9 Frequency of Occurrence of Ordinary Waves Hindcast by Height and Direction

Height (m) \ Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm	Total (%)
0.00~0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.7
0.01~0.49	5.1	11.4	4.7	3.0	3.2	2.0	1.4	1.0	1.3	1.1	1.5	1.9	4.5	6.0	8.2	11.8	0.0	68.0
0.50~0.99	2.3	3.0	1.1	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.4	0.5	1.8	2.7	3.8	5.5	0.0	22.5
1.00~1.49	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.6	0.9	1.0	1.1	0.0	5.4
1.50~1.99	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.0	1.3
2.00~2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.0	0.6
2.50~2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3
3.00~3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
3.50~3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00~4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4.50~4.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00~5.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.50~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (%)	8.0	14.7	6.0	3.4	3.5	2.1	1.5	1.1	1.4	1.4	2.4	3.0	7.2	10.1	13.6	18.9	1.7	100.0

(3) Computation of Design Wave

1) Wave Deformation (Equivalent Deepwater Wave)

For the computation of design wave, the wave deformation method is applied to the offshore design waves in the wide and small area and then the equivalent deepwater waves are given. And these equivalent deepwater wave are converted to the design wave at the site by using the diagrams for the estimation of wave height in surf zone.

The wave deformation can be computed in plane area by using energy balance equation established by Karlsson for the random waves.

$$\frac{\partial}{\partial x}(D V_x) + \frac{\partial}{\partial y}(D V_y) + \frac{\partial}{\partial \theta}(D V_\theta) = 0 \qquad (1.1)$$

Where, D(f,) means wave energy density that is a function of the frequency and the angle of wave direction.

2) Conditions of Computation

a) Offshore Wave Conditions

The offshore wave conditions at extraordinary condition are as shown in Table A-6-2-10.

Table A-6-2-10 Offshore Wave Conditions at Extraordinary Condition

Direction	W	NW	NNW	NE
Height, Ho (m)	6.90	6.20	5.70	3.70
Period, To (s)	9.90	9.50	9.10	7.70
Wavelength, Lo (m)	153	141	129	92
Wave Steepness, Ho/Lo	0.045	0.044	0.044	0.040
Spreading Parameter Smax	10 (Wind Waves)	10 (Wind Waves)	10 (Wind Waves)	10 (Wind Waves)

b) Conditions of Computation for Wave Deformation

The wave deformation method was applied in the wide (108 km x 75 km) and small (21 km x 15 km) as shown in Figure A-6-2-4. The results of computation are shown in Table A-6-2-11.

Table A-6-2-11 Conditions of Computation for Wave Deformation

Item		Conditions
Grid Spacing ($\Delta X = \Delta Y$)	Wide Area	1000 m
	Small Area	100 m
Tide (H.W.L)		C.D.L + 0.39 m
Spreading Parameter		Smax = 10
Number of Spacing in Direction		36 ($\Delta\alpha = 5°$)
Number of Frequency Division		5

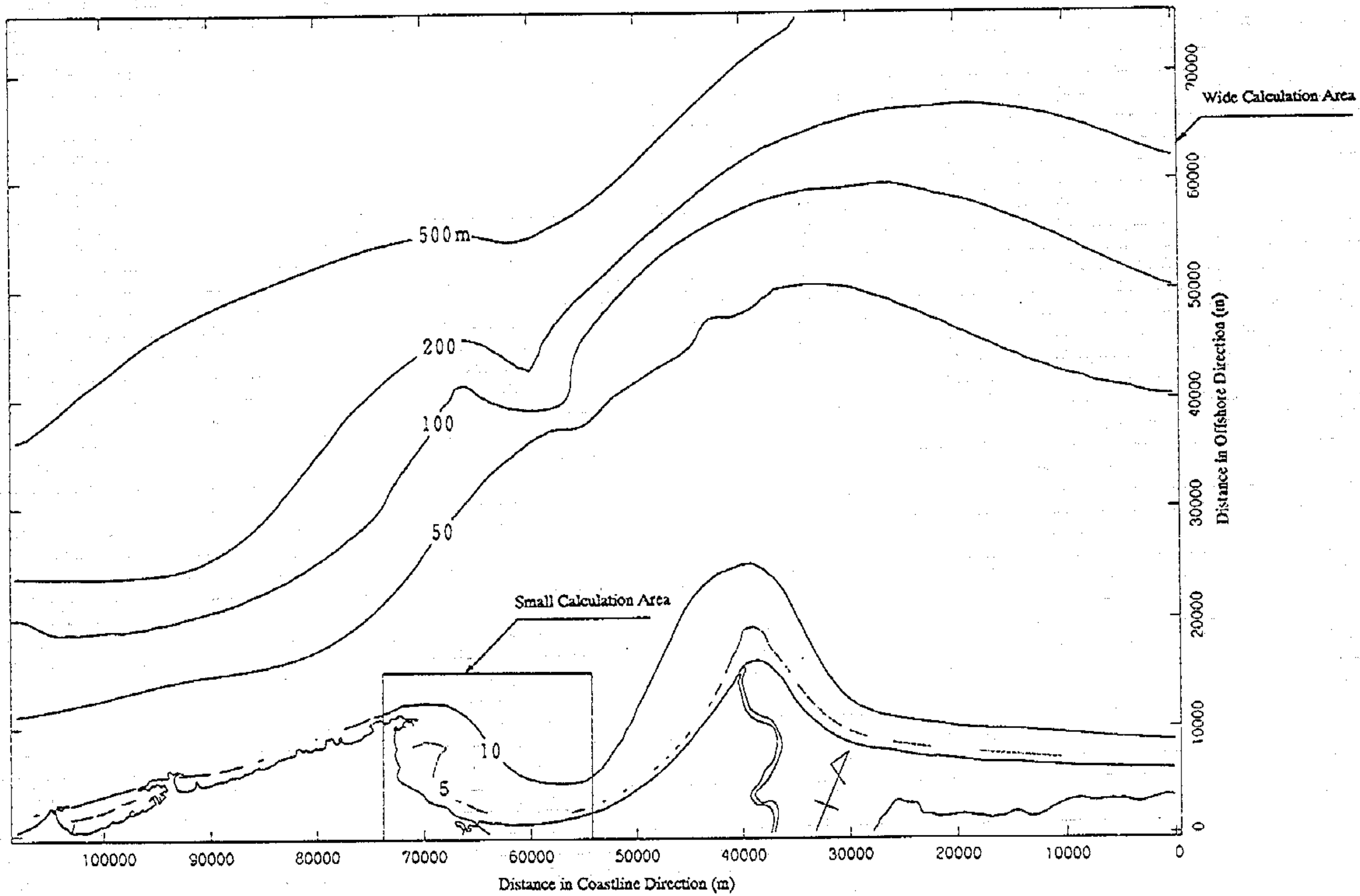


Figure A-6-2-4 Area of Computation for Wave Deformation

3) Results of Computation (Equivalent Deepwater Wave)

For the aforementioned offshore wave conditions (4 cases), the wave deformation was computed according to the computation conditions. The results are as shown in Table A-6-2-12. Among these cases, the typical example for the process of computation of NW offshore design wave is shown as follows:

a) Distribution of Wave Direction and Significant Wave Height in Wide Area:
Figure A-6-2-5 (1) to A-6-2-5 (2)

b) Distribution of Wave Direction and Significant Wave Height in Small Area:
Figure A-6-2-6 (1) to A-6-2-6 (2)

c) Distribution of Wave Direction, Refraction/Diffraction Coefficient and Equivalent Deepwater Wave Height in Extremely Small Area around Maadia Fishing Port:
Figure A-6-2-7 (1) to A-6-2-7 (3)

Table A-6-2-12 Dimensions of Equivalent Deepwater Waves by Direction at Extraordinary Condition

Wave Direction	W	NW	NNW	NE
Wave Height Ho (m)	6.9	6.2	5.7	3.7
Wave Period To (s)	9.9	9.5	9.1	7.7
Wave Length Lo (m)	152.90	140.79	129.18	92.49
Equivalent Deepwater Wave Height Ho ' (m)	5.20	5.00	4.20	2.40
Wave Steepness Ho ' /Lo	0.034	0.036	0.033	0.026

Applying the same method to the ordinary offshore wave data shown in Table A-6-2-9, the distribution of the equivalent deepwater wave was computed.

4) Estimation of Design Wave

The above-mentioned computed equivalent deepwater waves were converted to the design waves by depth at the site by using the diagram for the estimation of wave height in surf zone shown in Figure A-6-2-8.

The results of estimation are shown in Tables A-6-2-13 and A-6-2-14 for the extraordinary waves and in Table A-6-2-15 for the ordinary waves.

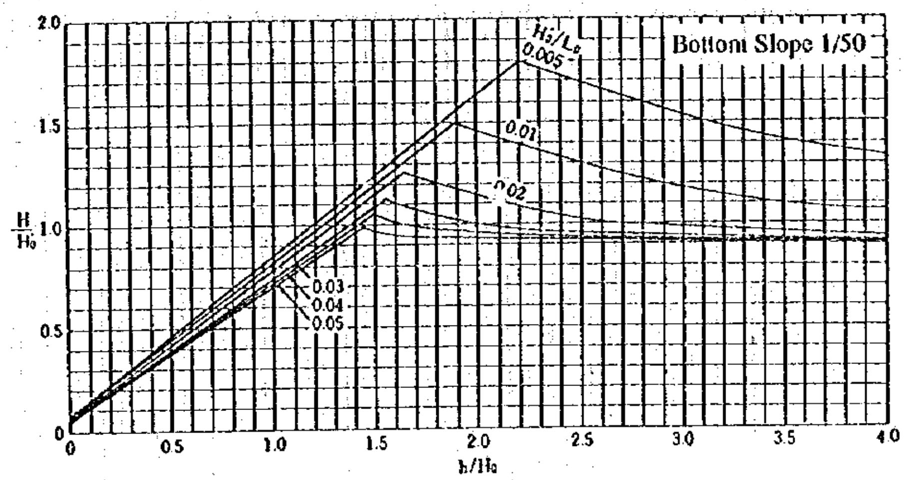


Figure A-6-2-8 Diagram for Estimation of Wave Height in Surf Zone

Table A-6-2-13 Wave Height by Depth at the Site at Extraordinary Condition

Unit: m

Depth	Offshore Wave Direction			
C.D.L	W	NW	NNW	NE
-1.00 m	1.25	1.25	1.22	1.13
-1.50 m	1.61	1.55	1.53	1.46
-2.00 m	1.92	1.90	1.89	1.82
-2.50 m	2.29	2.25	2.20	2.18
-3.00 m	2.60	2.60	2.57	2.52
-3.50 m	2.96	2.90	2.88	2.81
-4.00 m	3.28	3.25	3.23	2.64
-4.50 m	3.64	3.60	3.56	2.52
-5.00 m	3.95	3.90	3.91	2.42
-5.50 m	4.32	4.25	4.23	2.38

Table A-6-2-14 Wave Height 5 Waves ahead by Depth at the Site at Extraordinary Condition

Unit: m

Depth	Offshore Wave Direction		
C.D.L	W	NW	NNW
-1.00 m	1.35	1.30	1.30
-1.50 m	1.72	1.65	1.66
-2.00 m	2.08	2.05	2.02
-2.50 m	2.44	2.40	2.38
-3.00 m	2.76	2.75	2.75
-3.50 m	3.12	3.10	3.11
-4.00 m	3.48	3.45	3.46
-4.50 m	3.85	3.85	3.83
-5.00 m	4.21	4.20	4.18
-5.50 m	4.58	4.55	4.55

Table A-6-2-15 Frequency of Occurrence of Ordinary Wave by Height and Direction at the Site (4.0 m depth)

Height \ Direction	W	WNW	NW	NNW	N	NNE	NE	Total (%)
less than 0.3m	2.07	2.74	2.90	2.60	1.44	0.97	1.41	14.13%
less than 0.5m	3.47	4.57	4.84	4.34	2.40	1.61	2.35	23.58%
less than 0.7m	7.83	10.44	10.41	8.95	4.51	2.89	4.19	49.22%
less than 1.0m	11.33	16.95	18.95	17.22	7.86	4.38	5.64	82.33%
less than 1.5m	13.17	19.37	21.57	19.56	8.65	4.70	6.01	93.03%
less than 2.0m	13.56	20.11	22.81	20.85	9.06	4.80	6.06	97.25%

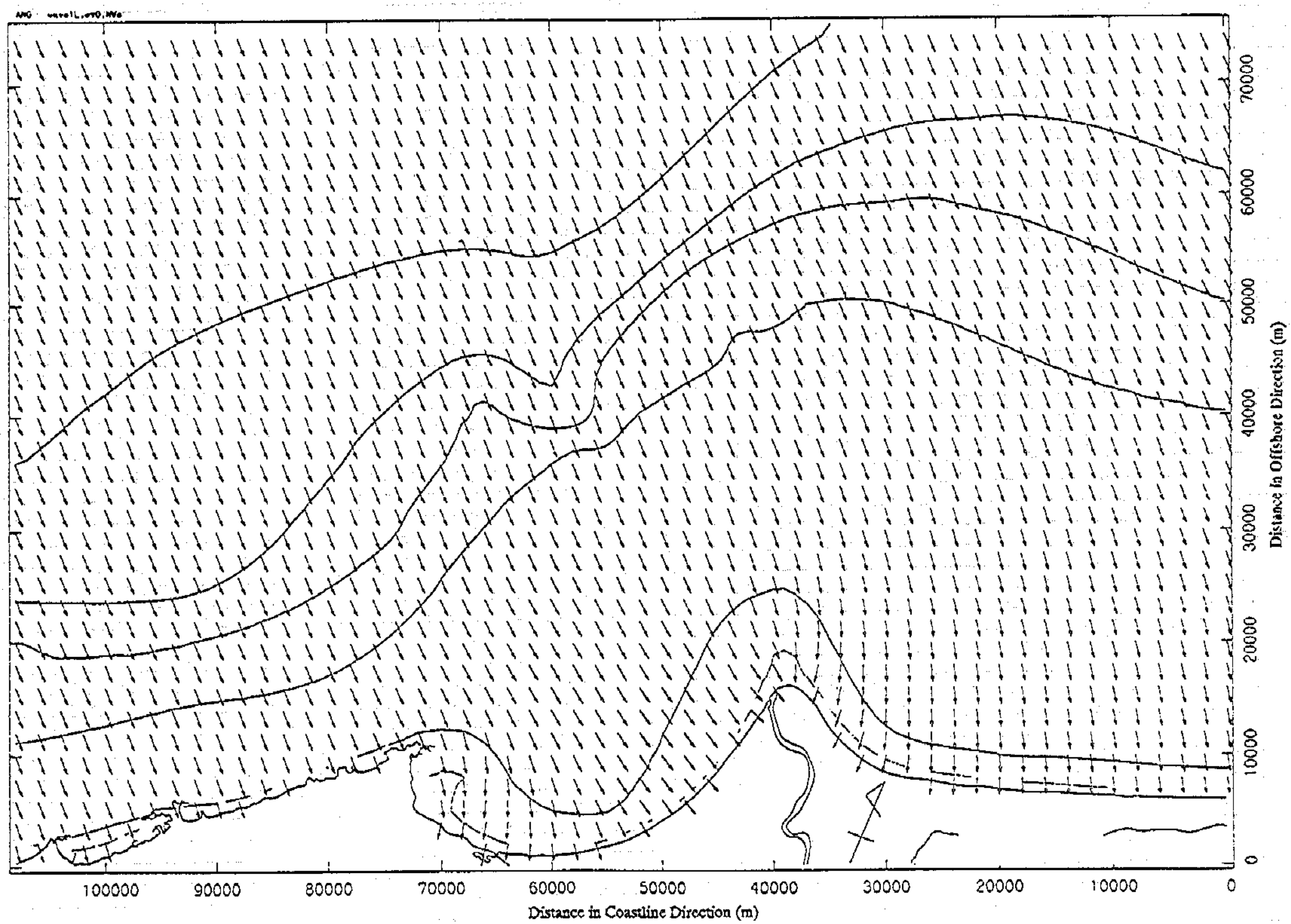


Figure A-6-2-5 (1) Distribution of Wave Direction in Wide Area (NW, Ho = 6.2 m, To = 9.5 s)

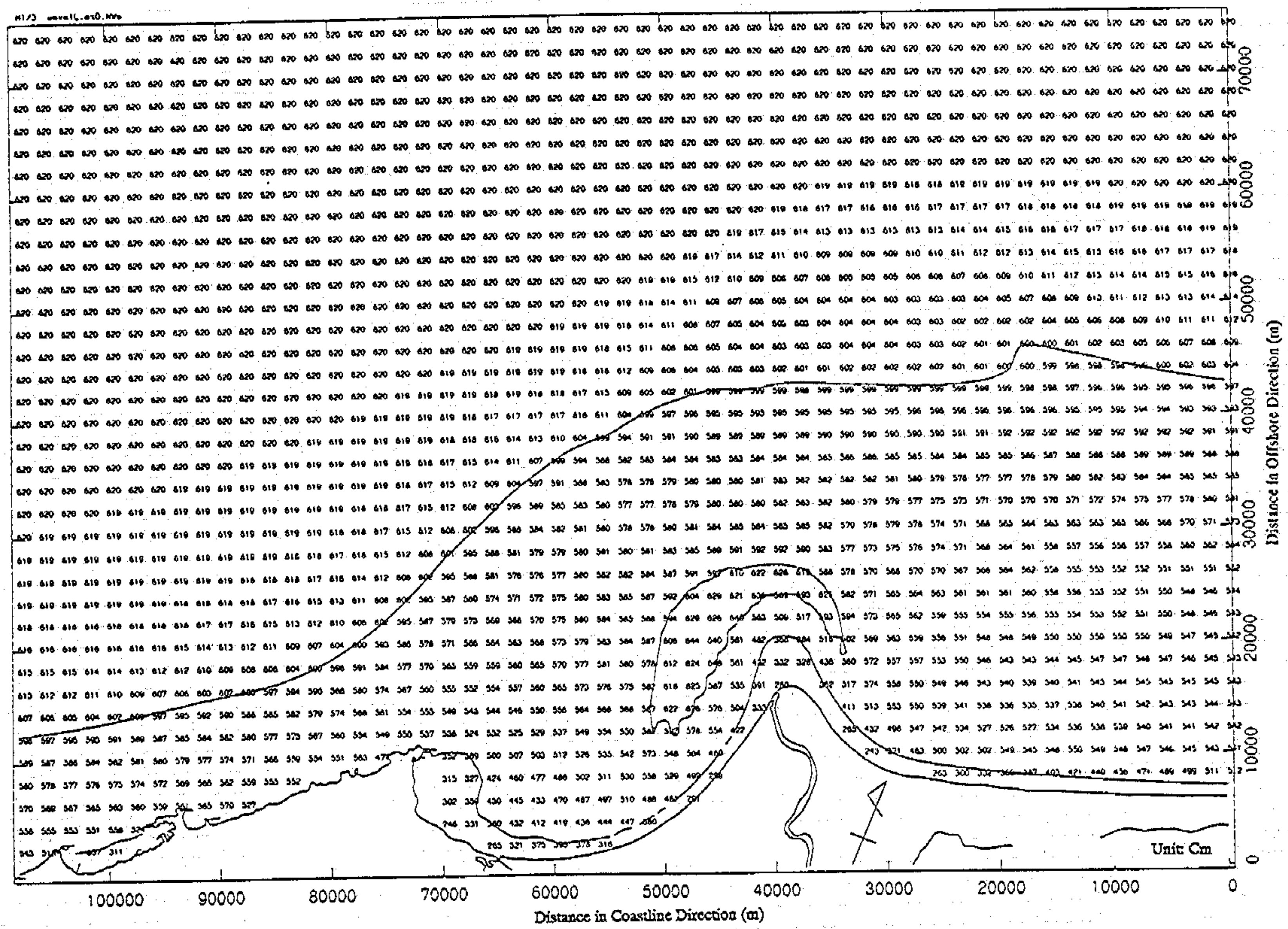


Figure A-6-2-5 (2) Distribution of Significant Wave Height in Wide Area (NW, Ho = 6.2 m, To = 9.5 s)

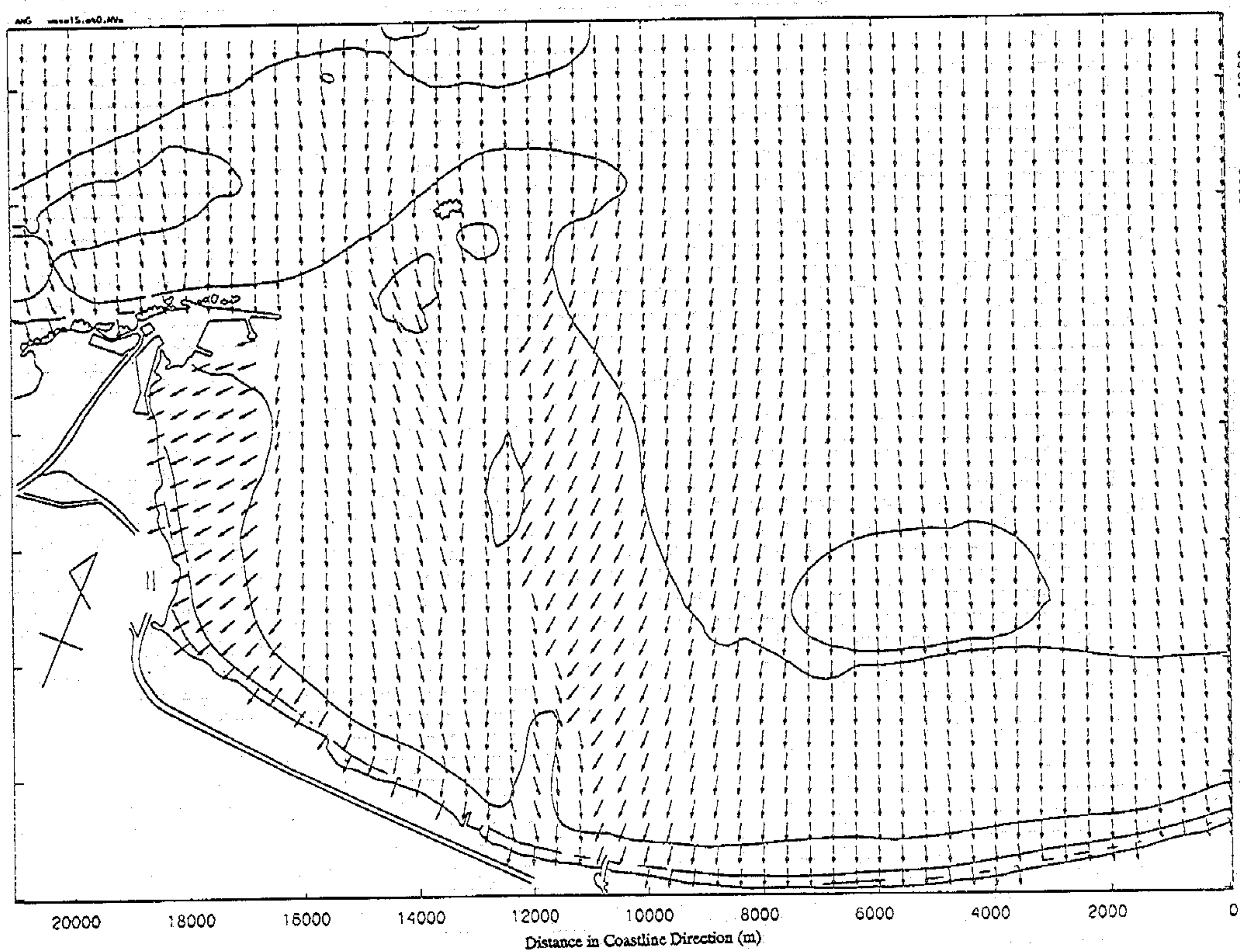


Figure A–6–2–6 (1) Distribution of Wave Direction in Small Area (NW, Ho = 6.2 m, To = 9.5 s)

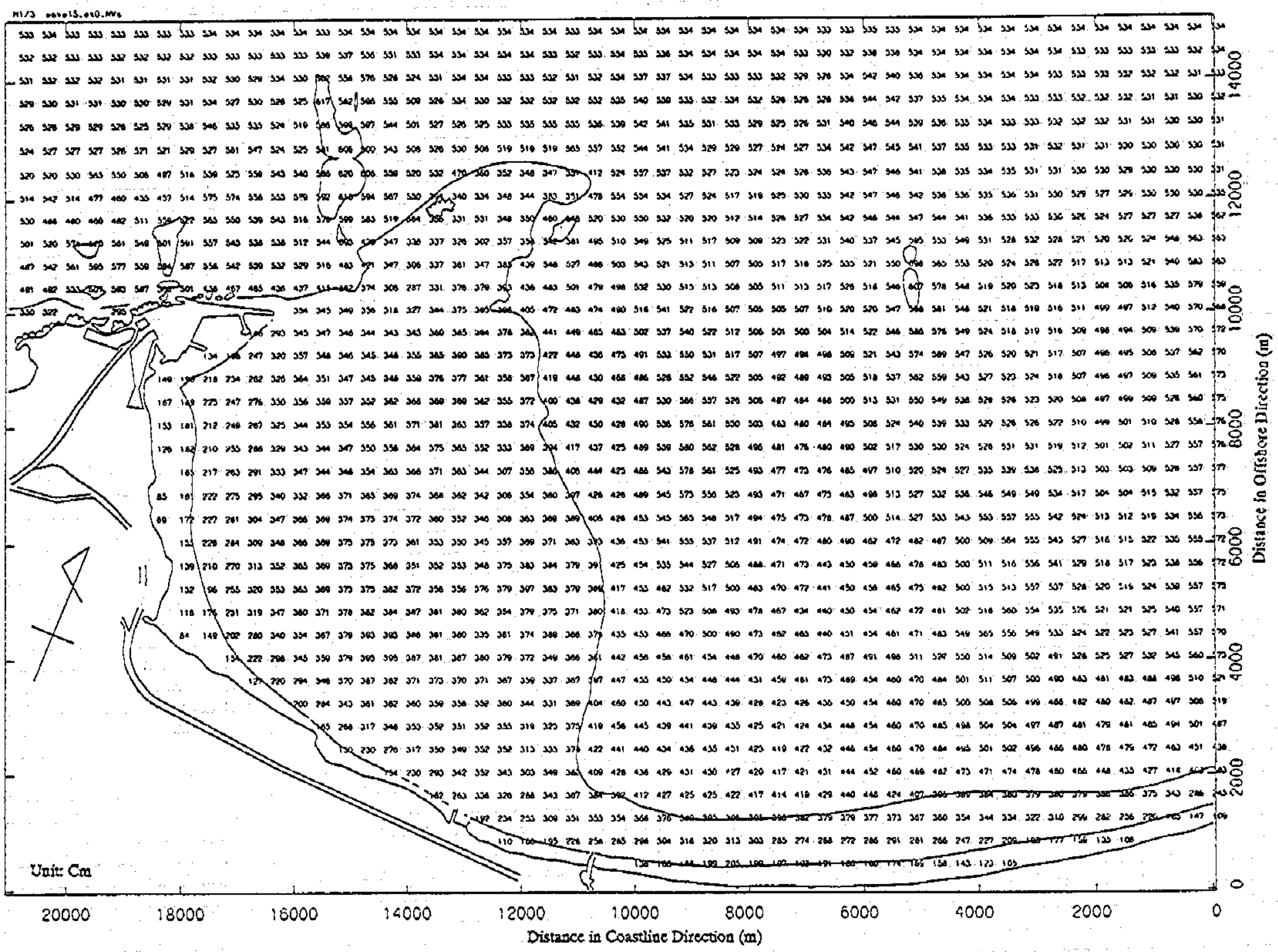


Figure A-6-2-6 (2) Distribution of Significant Wave Height in Small Area (NW, Ho = 6.2 m, To = 9.5 s)

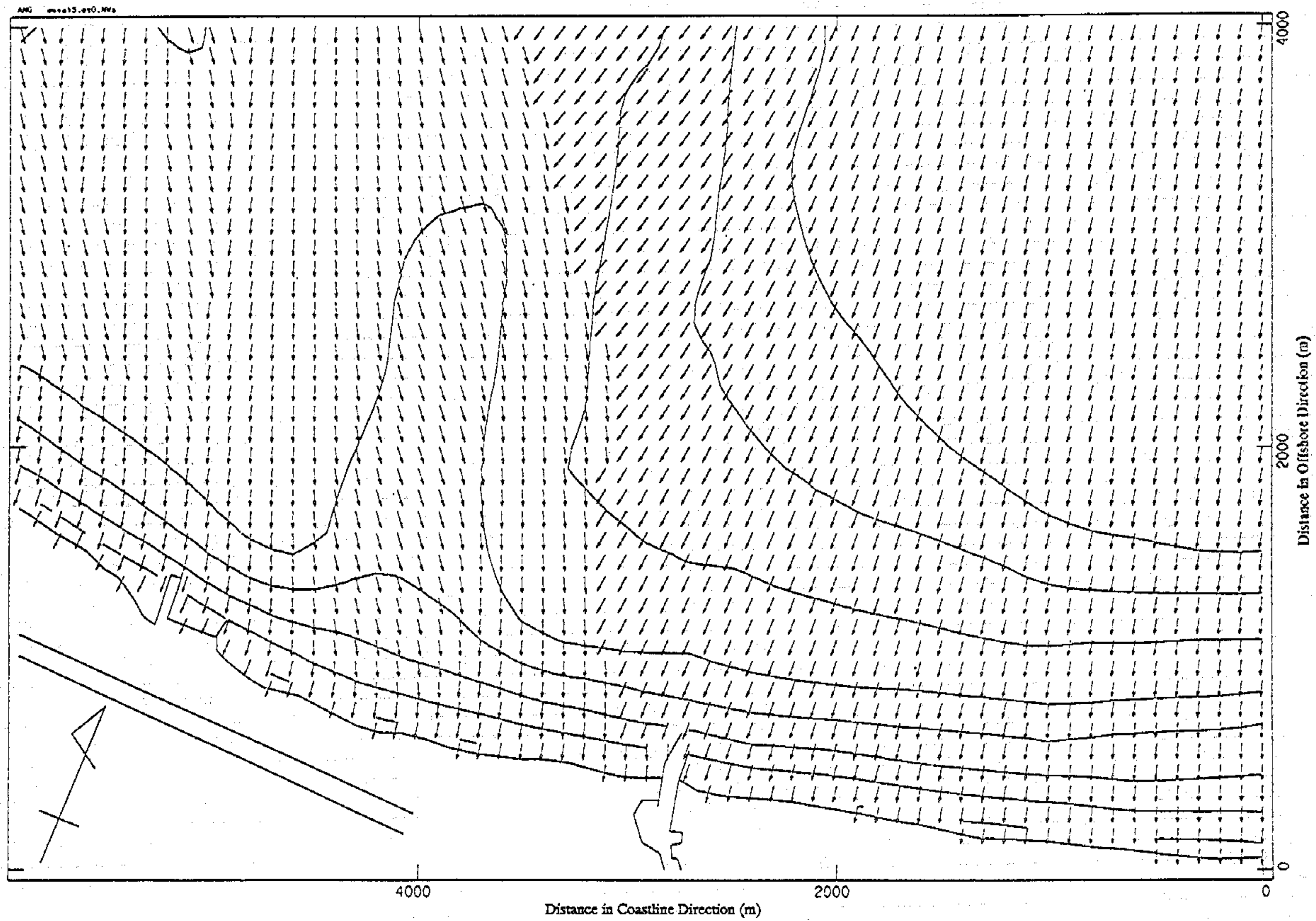


Figure A–6–2–7 (1) Distribution of Wave Direction in Extremely Small Area around Maadia Fishing Port (NW, Ho = 6.2 m, To = 9.5 s)

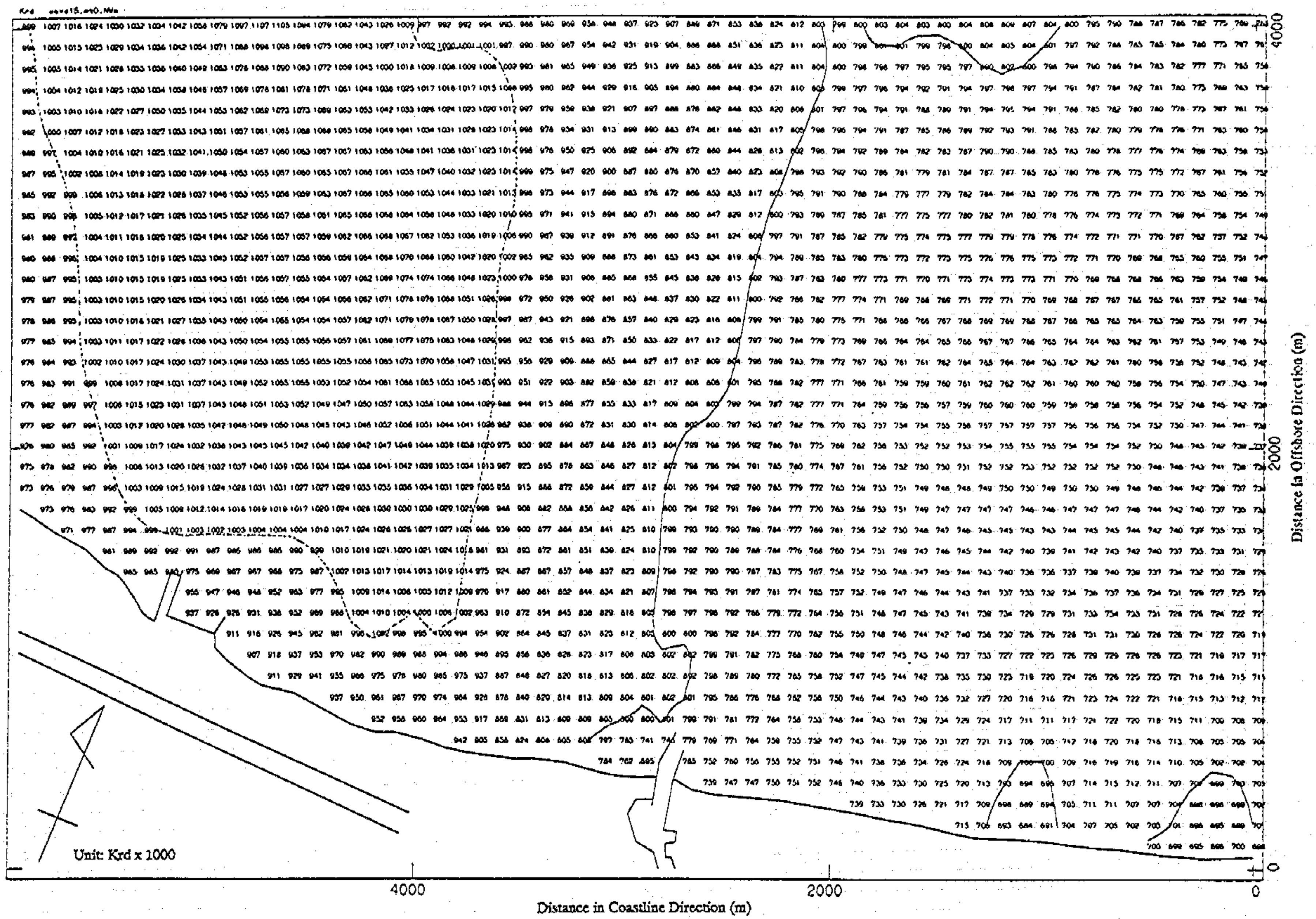


Figure A–6–2–7 (2) Distribution of Refraction/Diffraction Coefficient in Extremely Small Area around Maadia Fishing Port (NW, Ho = 6.2 m, To = 9.5 s)

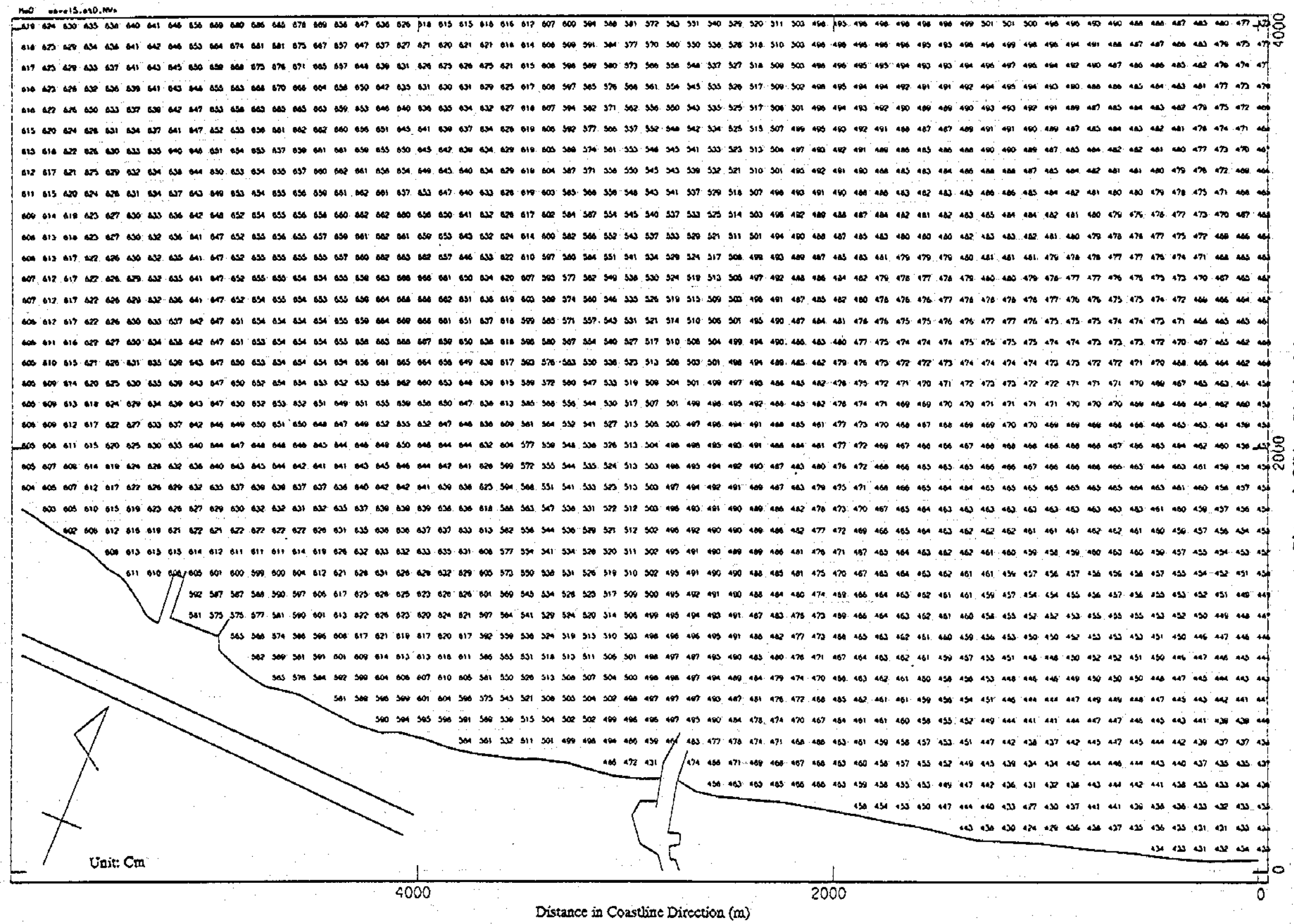


Figure A-6-2-7 (3) Distribution of Equivalent Deepwater Wave Height in Extremely Small Area around Maadia Fishing Port (NW, Ho = 6.2 m, To = 9.5 s)

6-3. Current

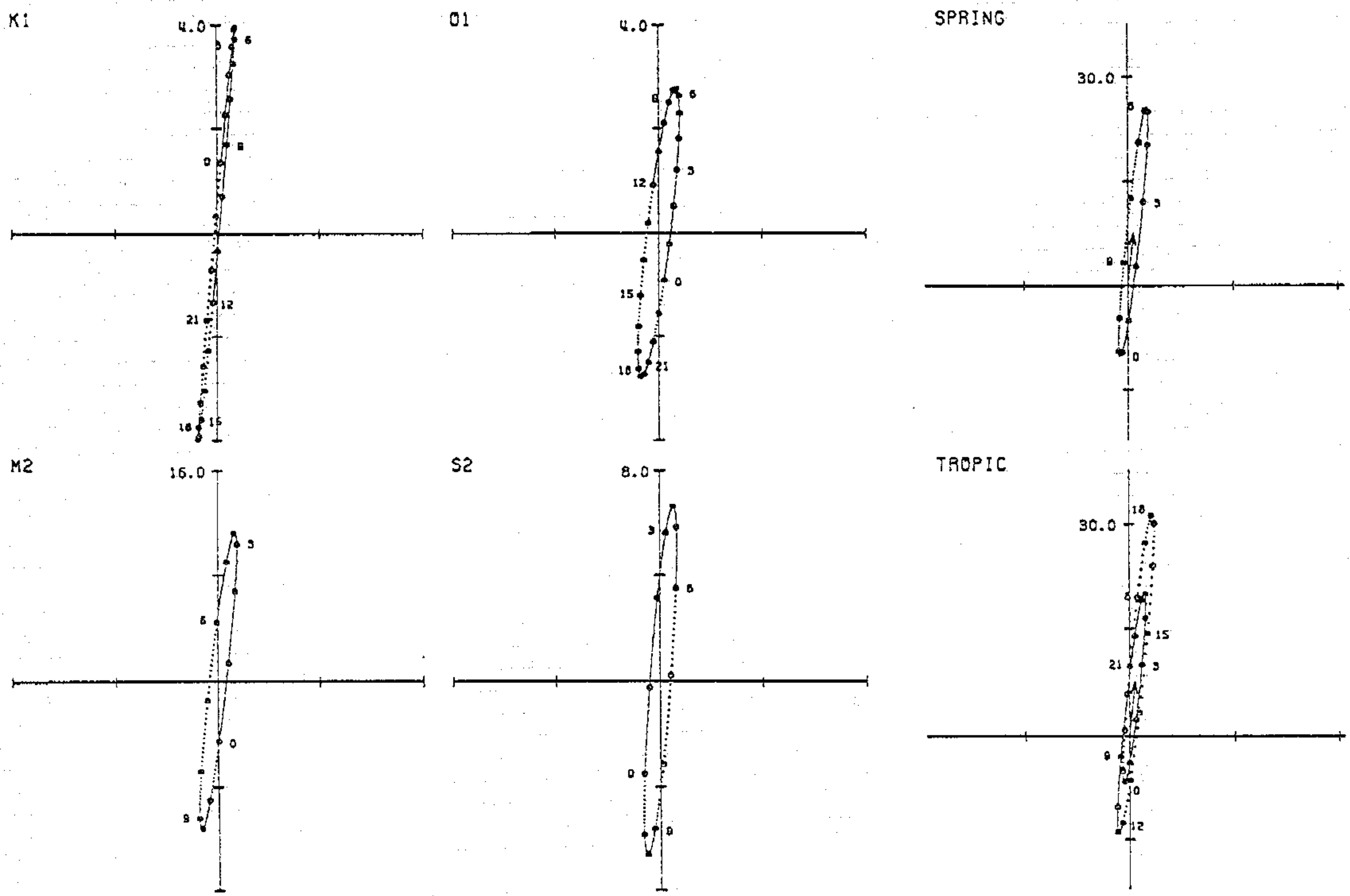
Table A-6-3-1 Results of Current Harmonic Analysis (15 days)

Region: Egypt
Observation Point: C3
Latitude: 31 16 20 N
Longitude: 30 10 40 E
Observation Period: October 23 to November 7, 1995
Obsevation Height: 0.7 m above sea botom

Component Tide	Component Velocity in Eastern Direction		Component Velocity in Eastern Direction		Elements of Current Ellipse						Principal Current Direction	
					Maximum Radius			Minimum Radius				
	Speed (cm/sec)	Lag (°)	Speed (cm/sec)	Lag (°)	Direction (°)	Speed (cm/sec)	Lag (°)	Direction (°)	Speed (cm/sec)	Lag (°)	Speed (cm/sec)	Lag (°)
K1	4.0	70.2	0.4	77.3	5.3	4.0	70.3	95.3	0.0	160.3	4.0	70.3
O1	2.8	109.2	0.4	75.0	6.9	2.8	108.7	96.9	0.2	18.7	2.8	108.8
P1	1.3	70.2	0.1	77.3	5.3	1.3	70.3	95.3	0.0	160.3	1.3	70.3
Q1	2.0	7.3	0.2	64.1	2.5	2.0	7.5	92.5	0.1	97.5	2.0	7.7
M2	11.3	113.1	1.5	87.2	7.0	11.4	112.7	97.0	0.7	22.7	11.4	112.8
S2	6.6	121.9	0.7	159.5	4.5	6.6	122.2	94.5	0.4	212.2	6.6	122.3
K2	1.8	121.9	0.2	159.5	4.5	1.8	122.2	94.5	0.1	212.2	1.8	122.3
N2	2.8	176.3	1.5	185.0	27.4	3.1	178.2	117.4	0.2	268.2	2.9	176.8
M4	1.3	8.2	0.1	308.6	1.5	1.3	8.1	91.5	0.1	278.1	1.3	7.9
MS4	2.2	210.5	0.4	216.3	11.2	2.3	210.7	101.2	0.0	300.1	2.3	210.6
Vo	7.8 cm/sec		0.8 cm/sec		7.8 cm/sec			5.9°			7.8 cm/sec	

Observation Point: C3
Observation Height: 0.7 m above sea bottom

Observation Period: October 23 to November 7, 1995
Unit: cm/sec



0 a.m. on Current Ellipse means Tansit of the Moon.

0 a.m. on Current Ellipse means High Water at Maadia.

Figure A-6-3-1 Current Ellipse

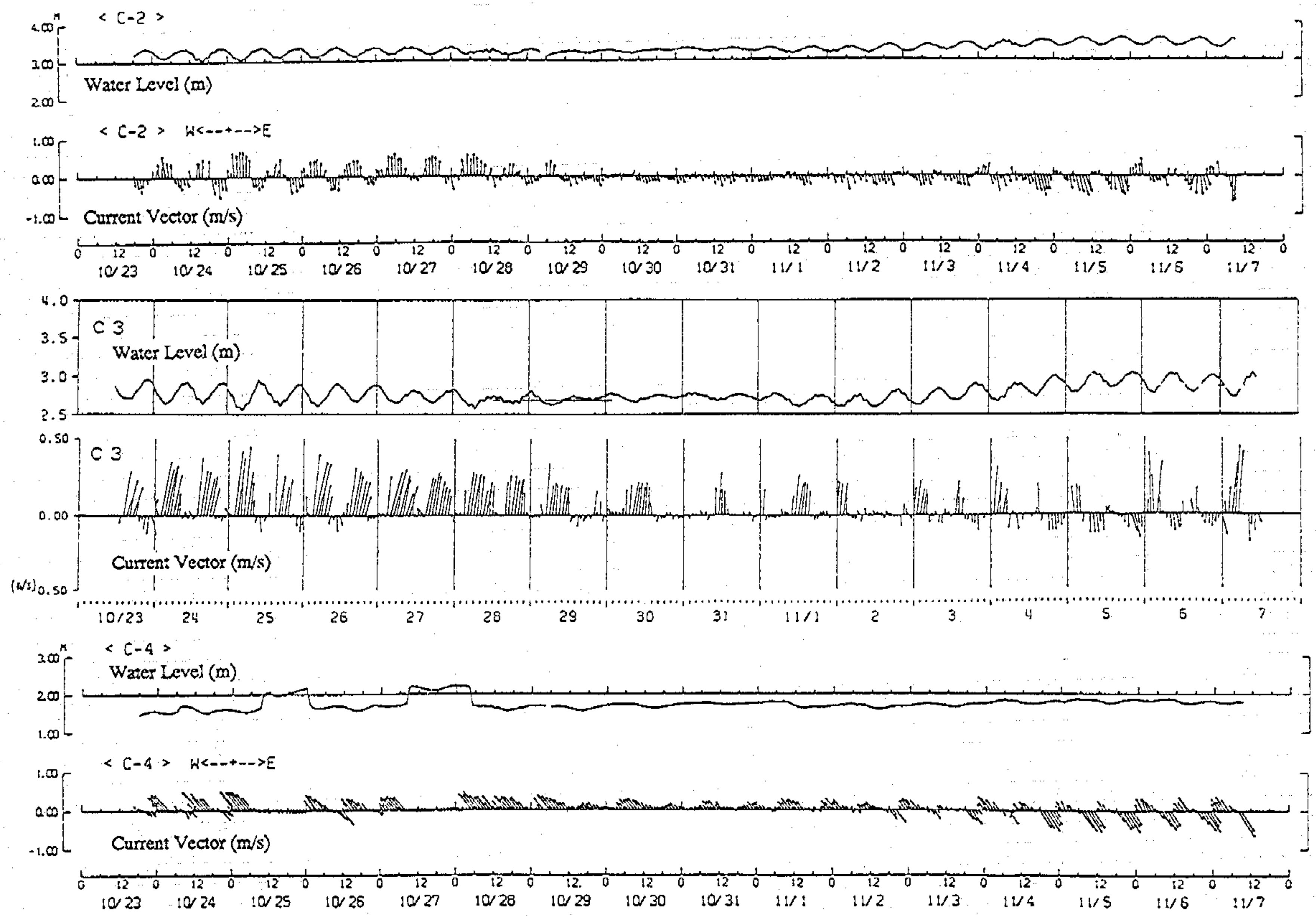


Figure A-6-3-2 (1) Hourly Changes of Water Level and Current Direction/Speed
(C2, C3 and C4: October 23 to November 7, 1995)

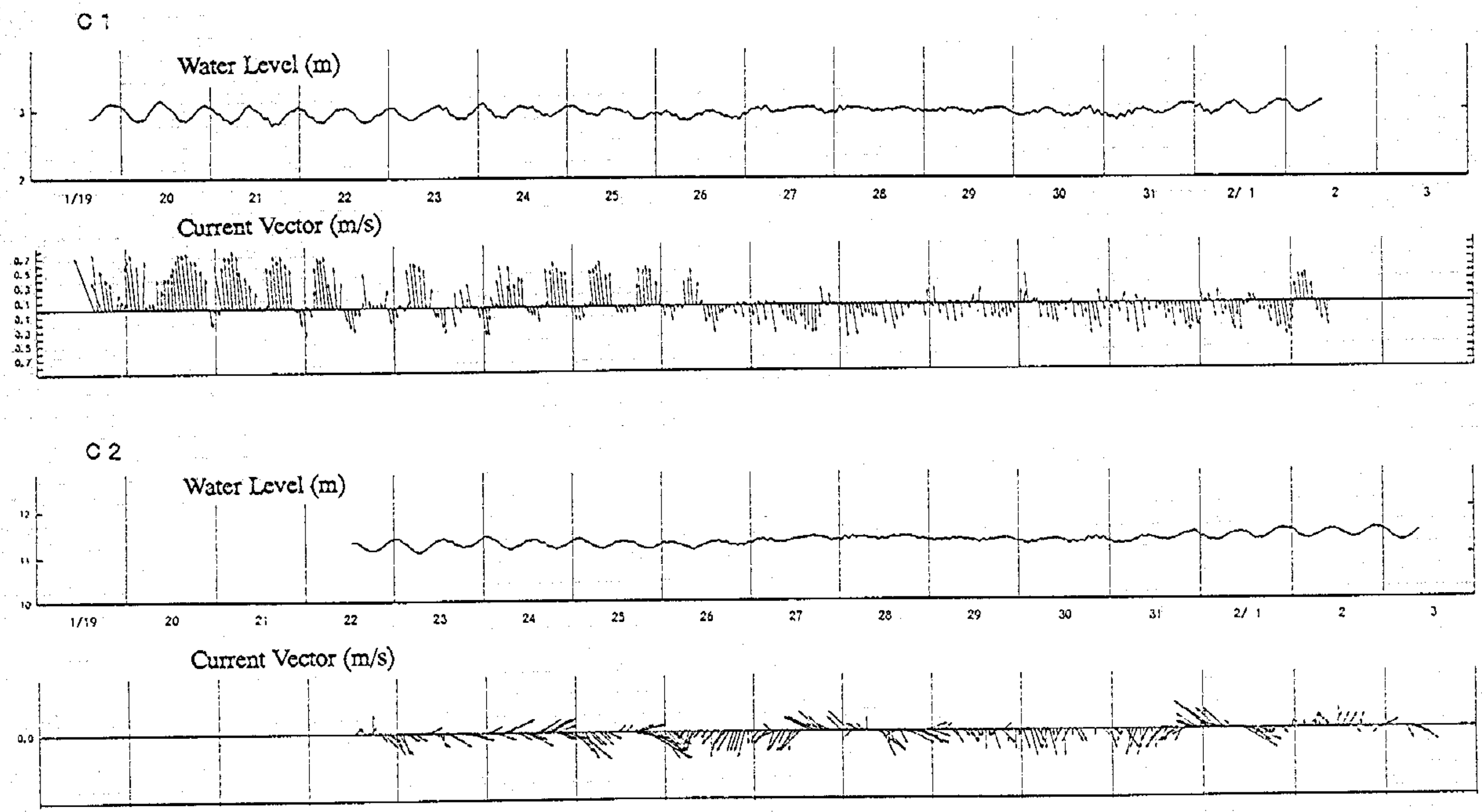


Figure A-6-3-2 (2) Hourly Changes of Water Level and Current Direction/Speed
(C1 and C2: January 19 to February 2, 1996)

Appendix-7 Data on Horbour Agitation Analysis

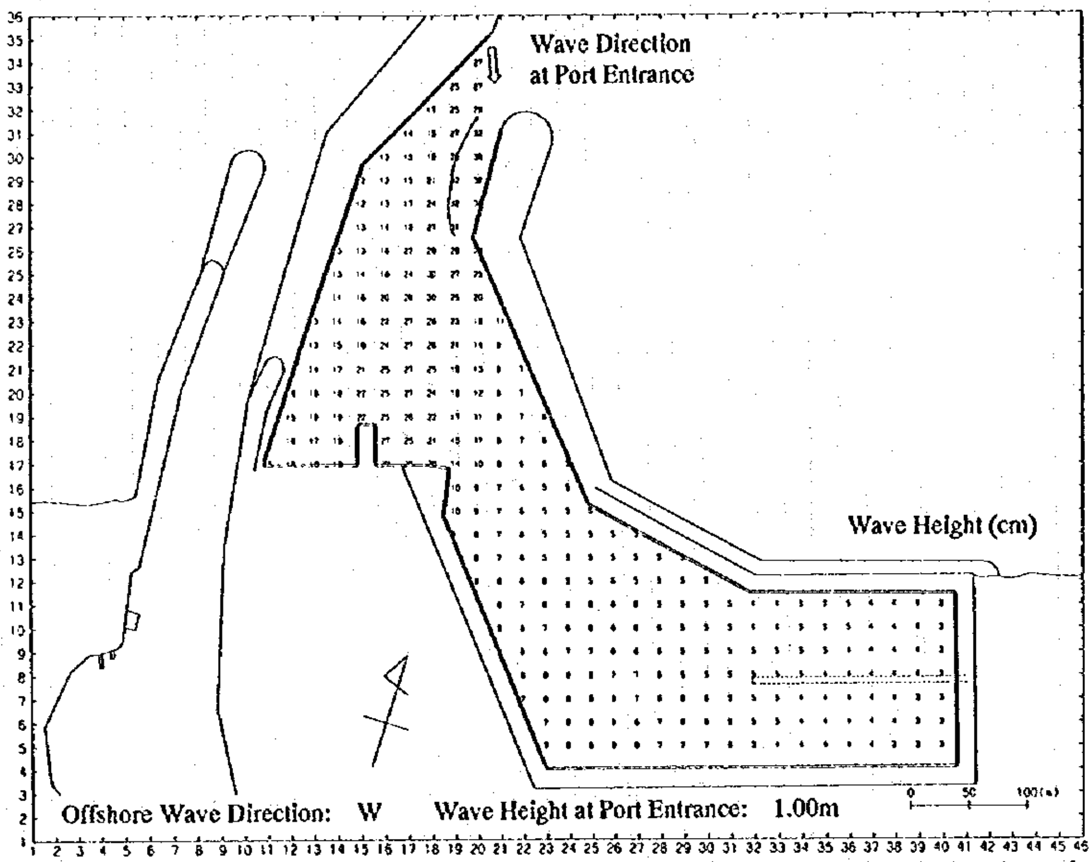


Figure-A-7-1(1) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Small Fishing Boats (W - Wave)

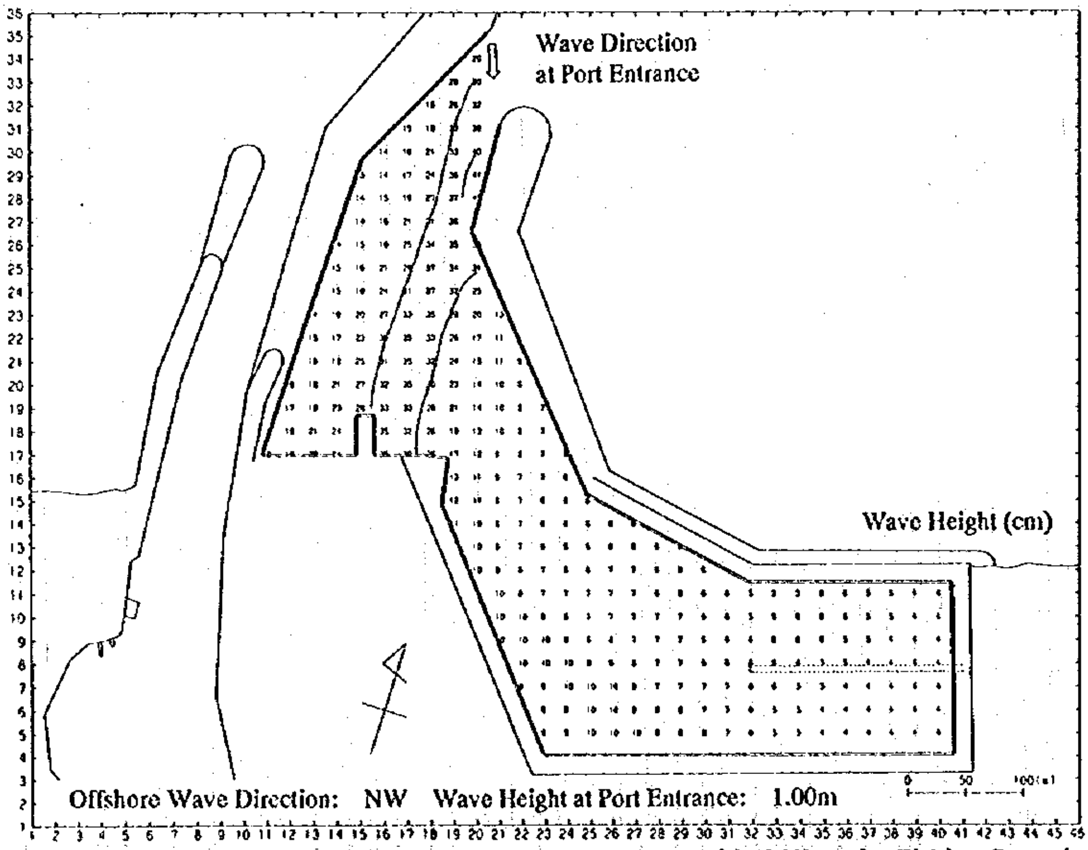


Figure-A-7-1(2) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Small Fishing Boats (NW - Wave)

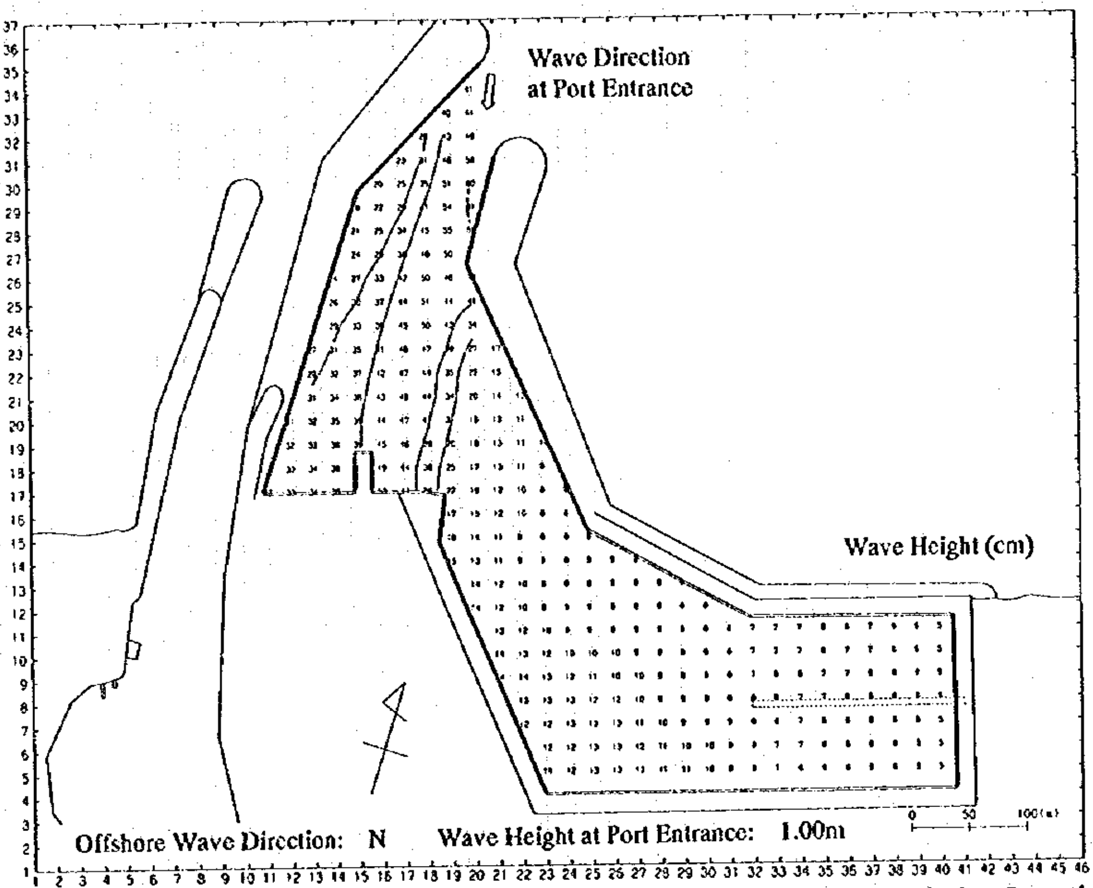


Figure-A-7-1(3) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Small Fishing Boats (N - Wave)

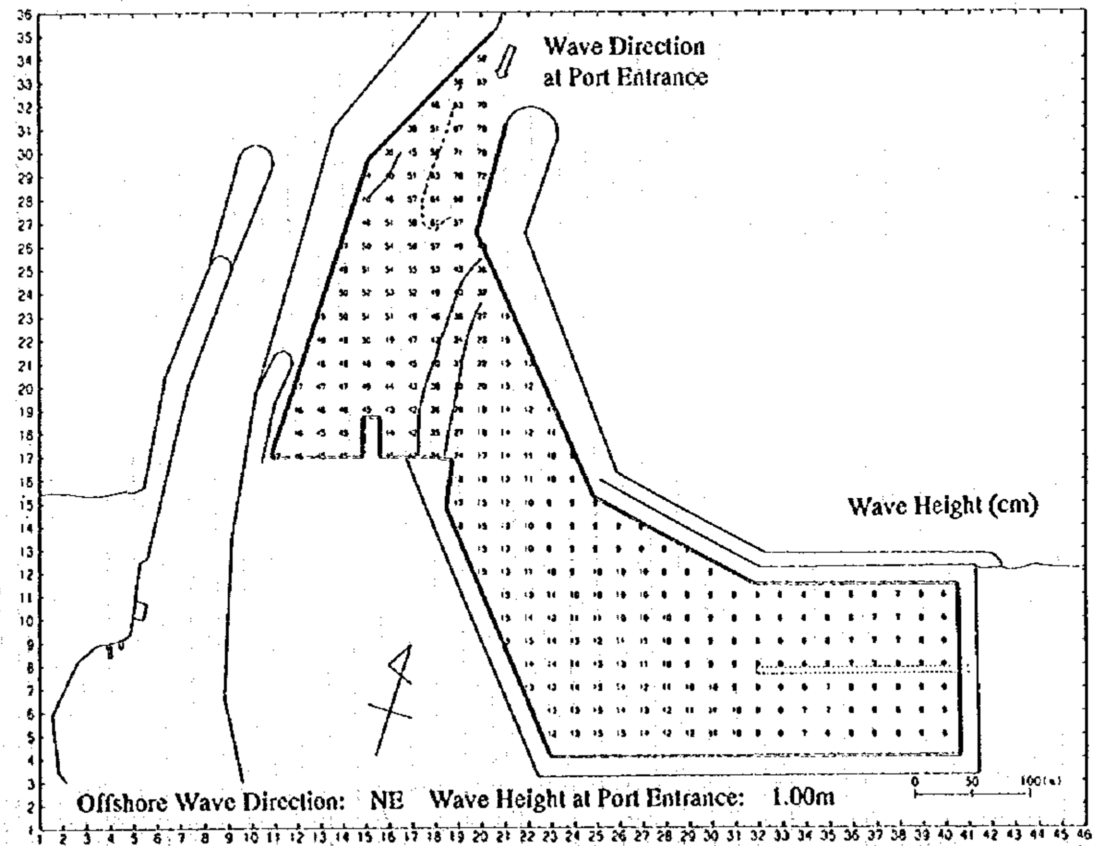
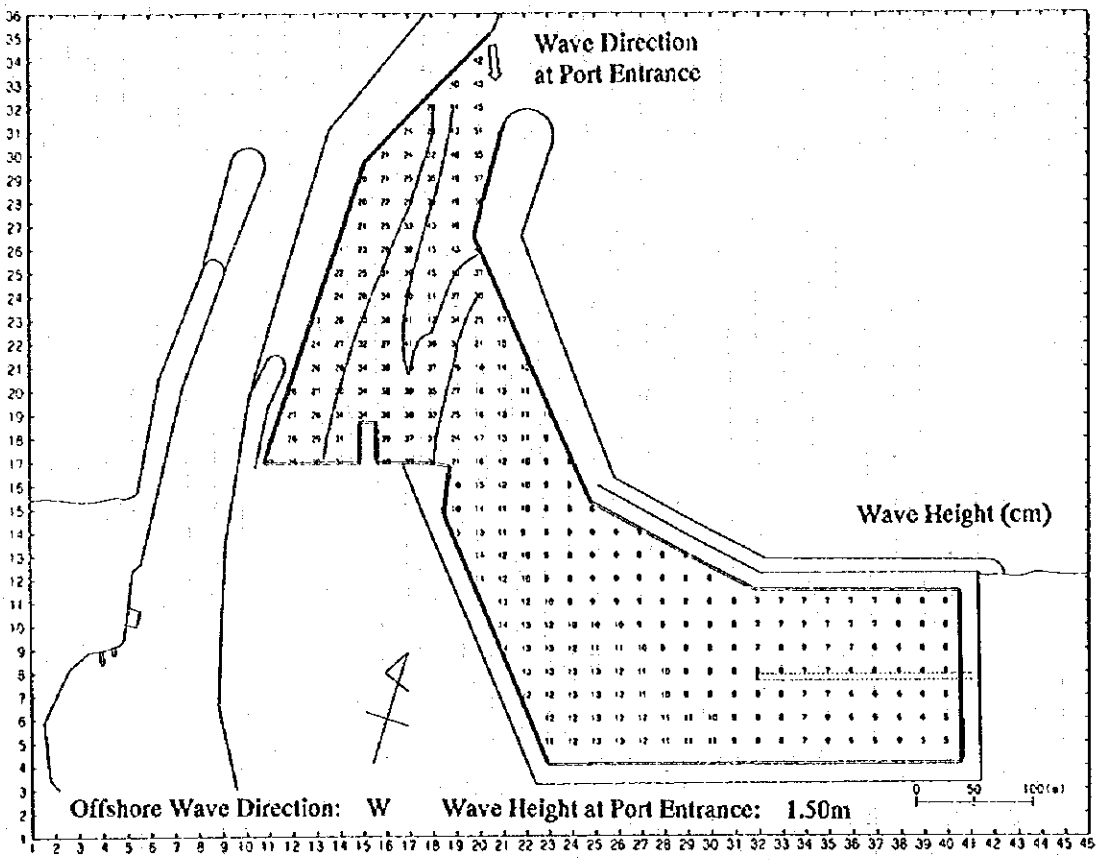
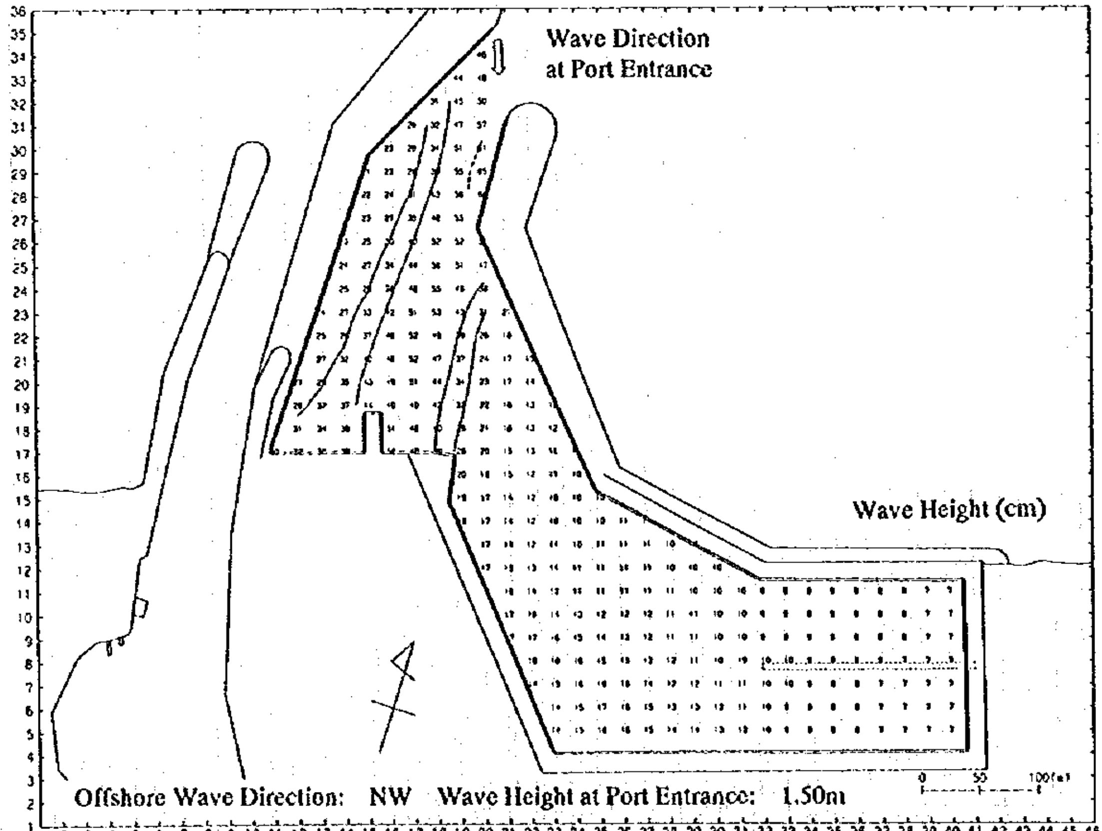


Figure-A-7-1(4) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Small Fishing Boats (NE - Wave)



Figure–A–7–2(1) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Large Fishing Boats (W – Wave)



Figure–A–7–2(2) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Large Fishing Boats (NW – Wave)

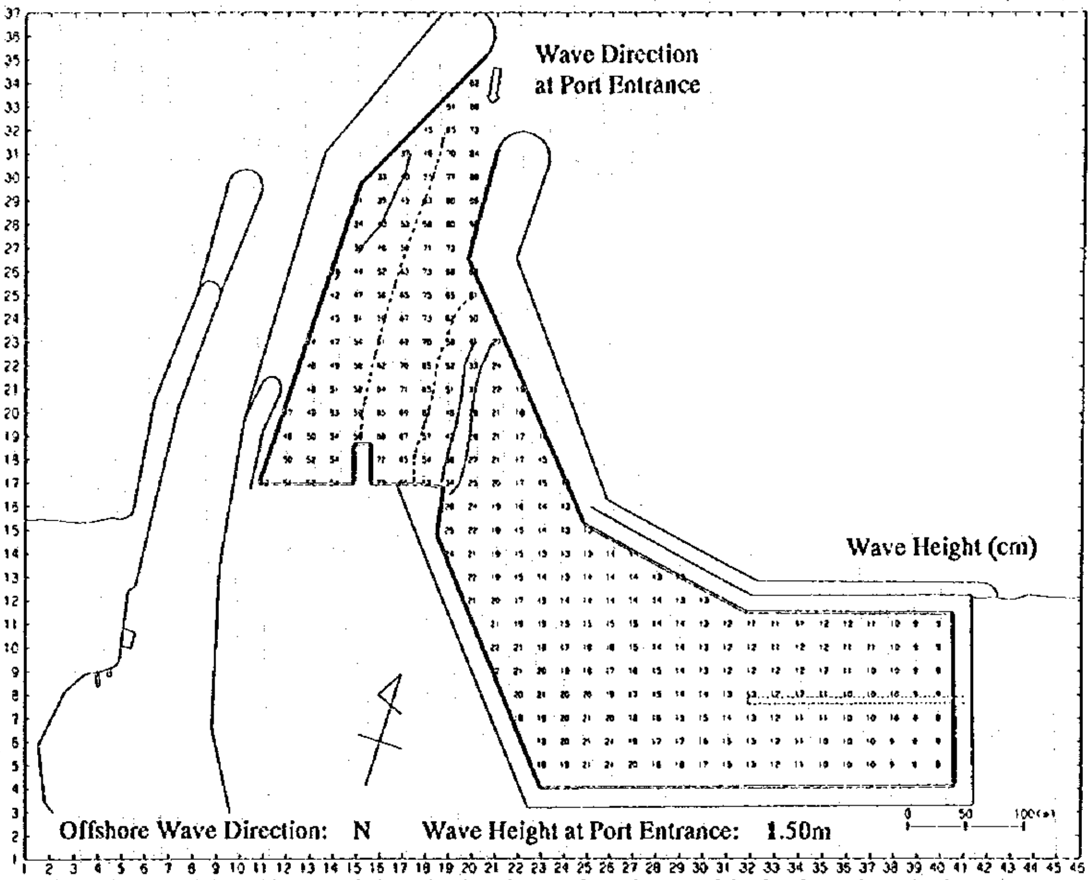


Figure-A-7-2(3) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Large Fishing Boats (N – Wave)

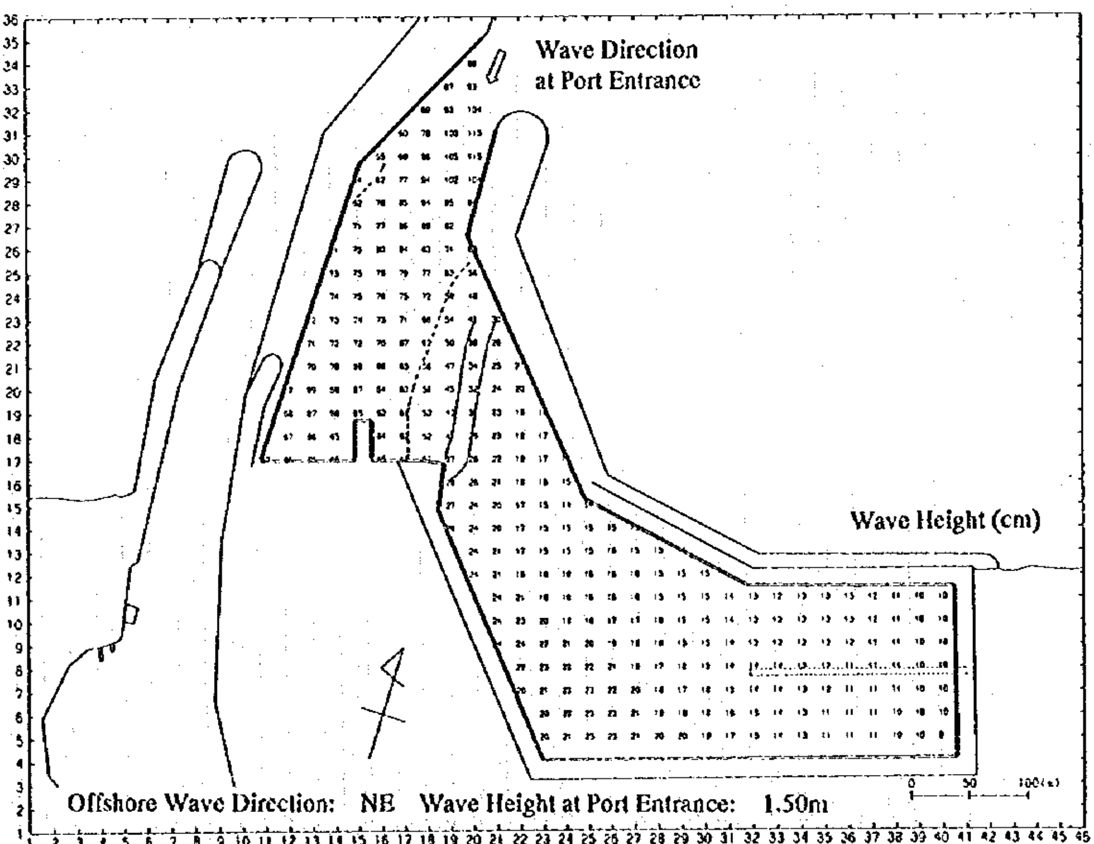


Figure-A-7-2(4) Wave Height Distribution Induced by Critical Wave for Fishing Operation of Large Fishing Boats (NE – Wave)

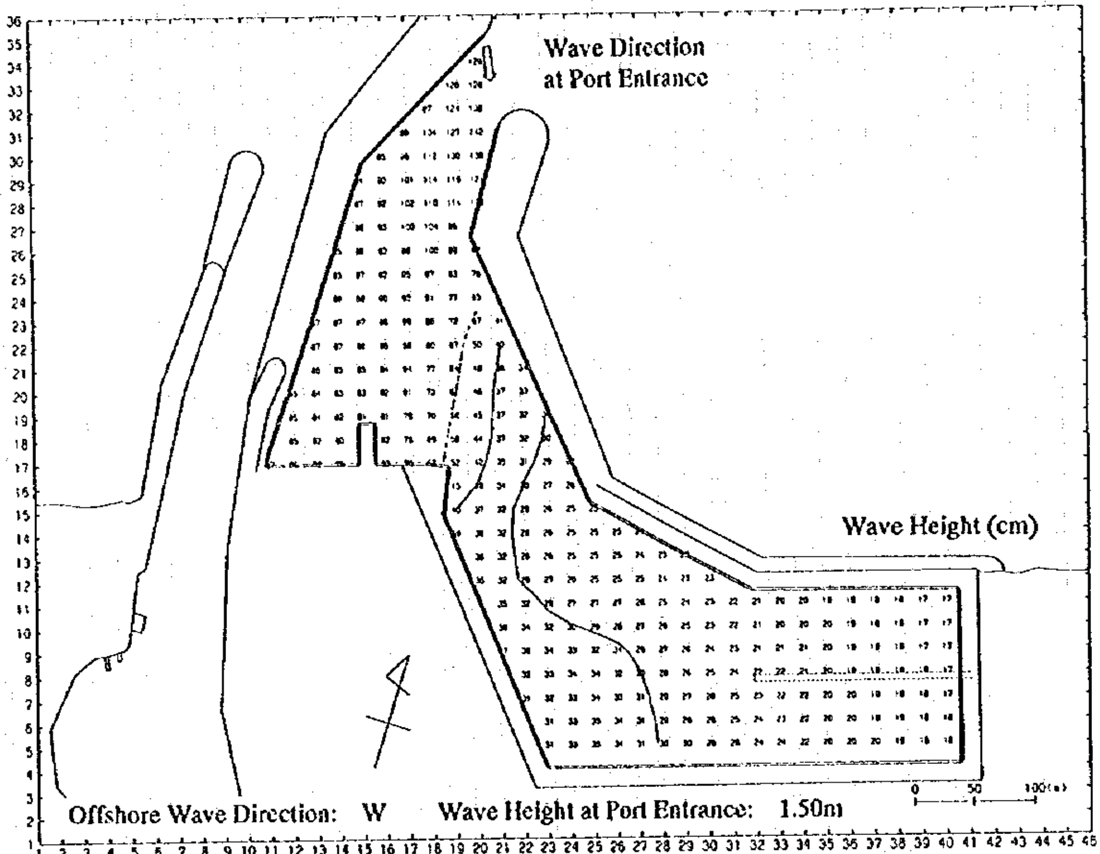


Figure-A-7-3(1) Wave Height Distribution Induced by Wave of 30 Year Return Period (W - Wave)

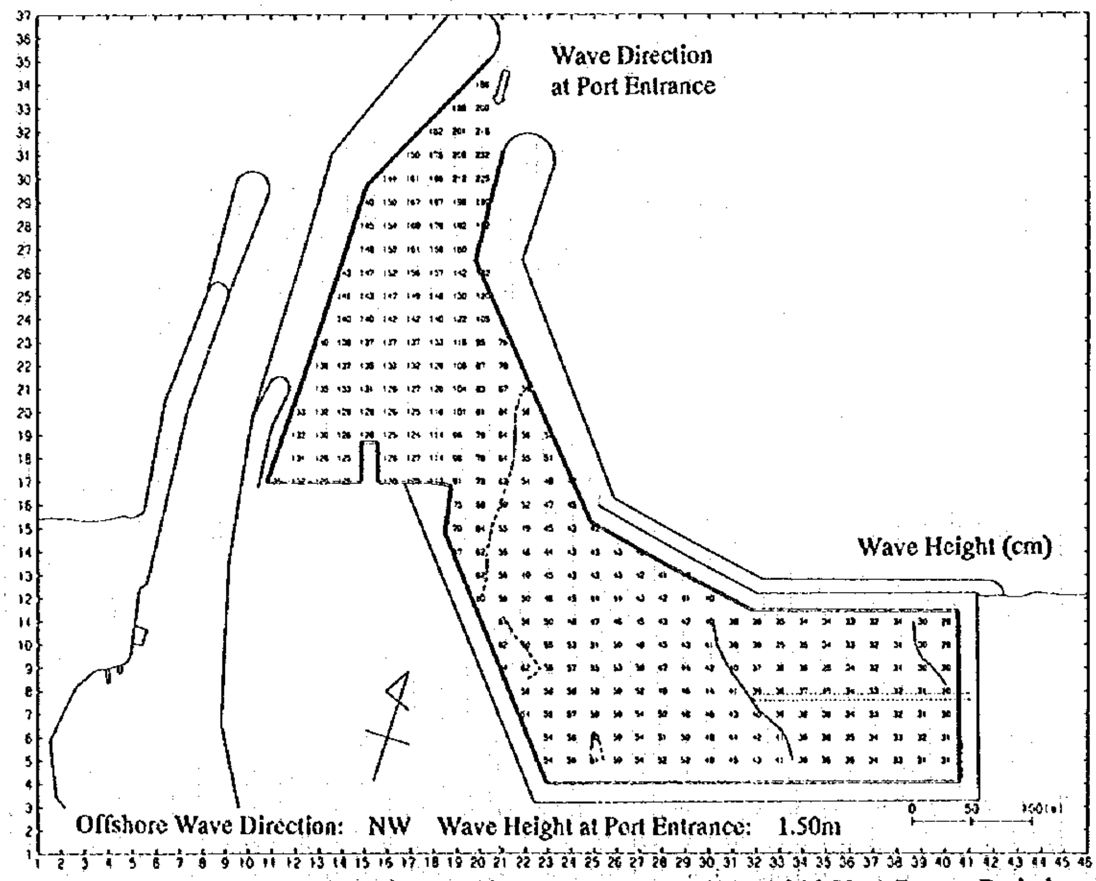


Figure-A-7-3(2) Wave Height Distribution Induced by Wave of 30 Year Return Period (NW - Wave)

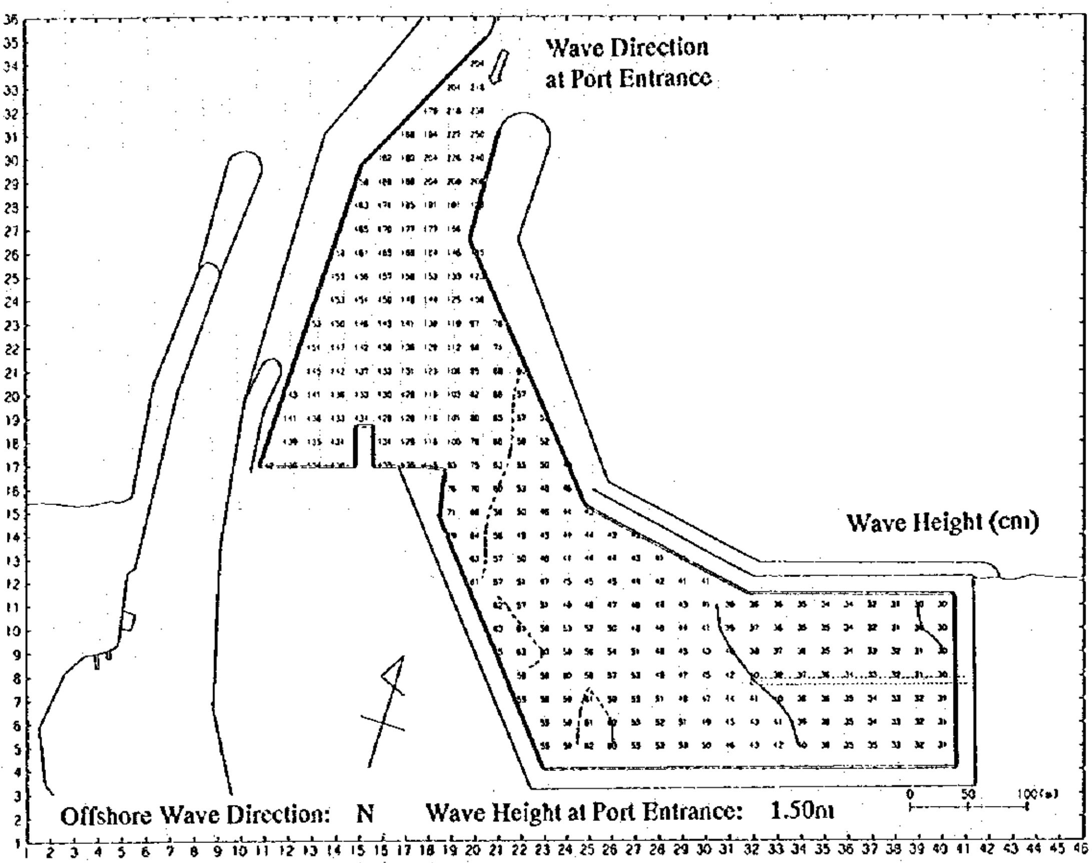


Figure-A-7-3(3) Wave Height Distribution Induced by Wave of 30 Year Return Period (N - Wave)

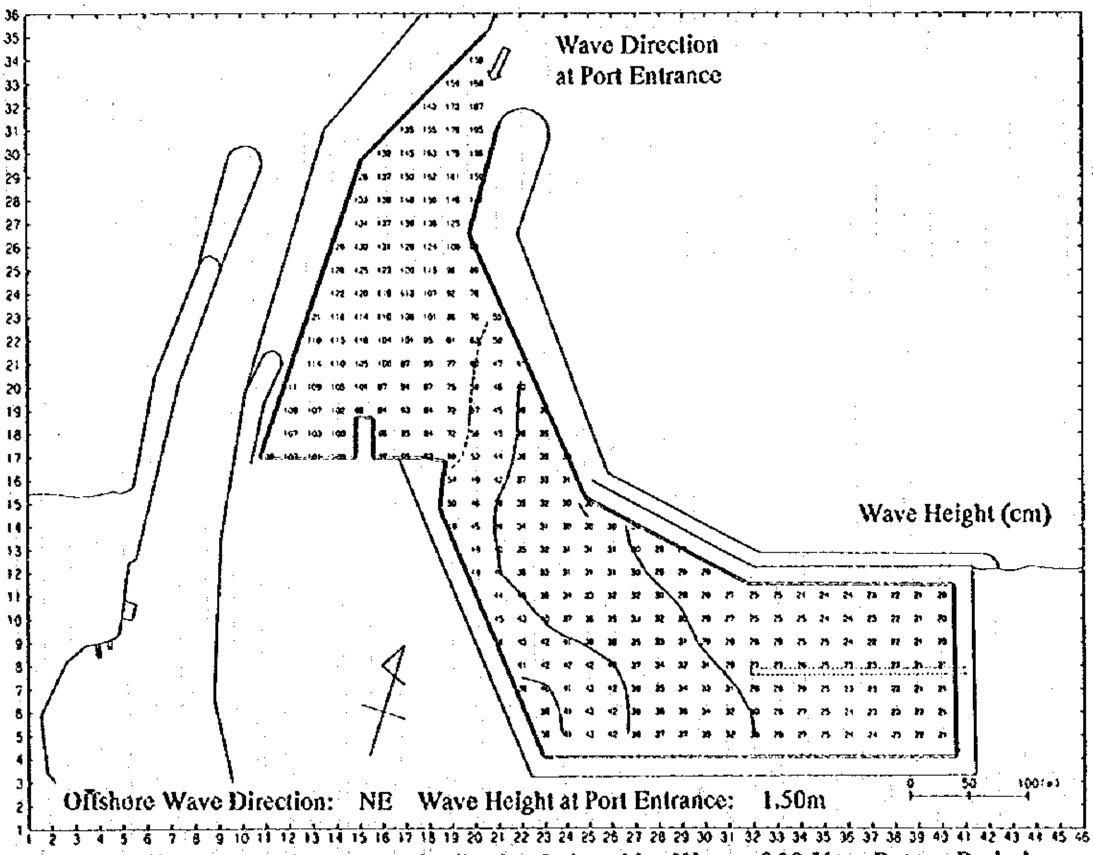


Figure-A-7-3(4) Wave Height Distribution Induced by Wave of 30 Year Return Period (NE - Wave)

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