14.2 Social Environment

14.2.1 Overview

Dung Quat Industrial Zone is planned to be established in 13 villages of Binh Son district and in 6 villages of Son Tinh district, Quang Ngai Province. The location of villages is shown in Figure 14.2.1.

According to an investigation, 19 villages of the two districts consist of 74 hamlets having a population of 139,513 and an area of 28,812 ha. The population is thin, for the average density is 486/km^2. The ratio of population growth in the project site in particular as in the overall province in general is unstable, fluctuates from 2 to 2.6%. On the average, each household has 5.16 inhabitants of which the male represents 50.4% and the female 49.6%. The ratio of labour age is 42.3% and over-age labour is 6.9%.

An overview of typical inhabitant status in there villages of Binh Son district (project site) can be summarized as shown in Table 14.2.1.

Table 14.2.1 Inhabitants Status at the Villages in the Project Area

Village	Inhabitant (Psn/inh)	Male (Psn/inh)	Female (Psn/inh)	Labor-age (Psn/inh)	Under-age (Psn/inh)	Over-age (Psn/inh)
Binh Thanh	5.0	2.8	2.2	2.5	2.0	0.5
Binh Dong	4.4	2.6	1.8	2.4	1.8	0.2
Binh Thuan	4.8	2.3	2.5	2.2	2.2	0.4
Binh Tri	5.5	2.6	2.9	2.9	2.3	0.3
Average	5.16	2.60	2.56	2.62	2.18	0.36

Source : Preliminary Report on Basic Investigation and Environment at Dung Quat Industrial Zone - 7/1996

Table 14.2.2 presents the administrative organization and the population distribution of the most relevant villages belonging to the project site.

Table 14.2.2 Population Distribution in the Project Area

No	Administration unit		Area* (ha)	Population* (persons)	Labor age* (persons)	No. of house**
	Village	Hamlet				
1	Binh Thanh	Trung An Vinh An Hai Ninh	1,369	9,726	3,740	2,207
2	Binh Dong	Tan Hy Thuong Hoa Son Tra	1,400	8,958	1,881	2,012
3	Binh Thuan	Tuyet Diem Dong Lo Thuan Phuoc	1,970	6,497	1,552	1,678
4	Binh Tri	Phuoc Hoa Le Thuy An Loc	1,659	5,719	2,540	1,271
5	Binh Hai	Phuoc Thien Thanh Thuy An Cuong Van Tuong	1,268	8,673	4,187	1,927

Source : * Preliminary Report on Basic Investigation and Environment at Dung Quat Industrial Zone - 7/1996

** Preliminary Report on Environmental Filed Survey (Phase I) Part III Dung Quat Area (Quang Ngai) / May, 1997

14.2.2 Socio-Economic Environment of Dung Quat

(1) Living Standard

Living standard of the people in the project site is still very low compared to the overall province. The average crop is around 300 kg of paddy (grain). The poor household represent 20-30%. Housing is mainly thatched (cottage). Table 14.2.3 shows data on facilities of the households at the project site.

Table 14.2.3 Facilities of the Households at the Project Area

Village	Electricity		Wells		Leaf cottage		Brick house		Concrete house	
	House holds	%	Hs	%	Hs	%	Hs	%	Hs	%
Binh Dong	0	0	5	100	3	60	2	40	0	0
Binh Thanh	10	48	13	62	4	19	13	62	4	19
Binh Thuan	4	27	7	47	5	33	9	60	1	7
Binh Hai	8	21	23	59	19	49	14	36	6	15

Source : Preliminary Report on Basic Investigation and Environment at Dung Quat Industrial Zone - 7/1996

Some detailed information about the population of two villages, Binh Dong and Binh Tri, belonging to Binh Son District, for reference, are:

- *Population and labor age structure*

Age	under 15	33.6%
	15-59	55.6%
	over 60	10.8%
Labor age	16-25	34.4%
	26-35	27.3%
	36-45	21.4%
	46-59	16.0%

The investigation shows that the labor age is concentrated in the families having 3-6 persons.

- *Household population level* : On the average, each household has 4.45 persons of which

1-2 persons	16.7%
3-4	33.4%
5-6	35.7%
over 7	14.2%

- *Literacy level*

Illiteracy	17.0%
Elementary education	38.6%
Primary school	36.1%
Secondary school	7.7%

- *Employment condition*

Out of work	15%	(at the age of 16-25)
Agriculture	42.5%	(25-59)
Fishery	22.9%	(16-25)
Artisan	7.1%	
Piece-worker	1.2%	

- *Household Utensil*

Articles	*% of households*
Black and white TV	1.6
Color TV	3.2
Radio-cassette player	33.9
Video tape player	1.9
Bicycle	70.0
Motorbike	6.8
Refrigerator	0.3

- *Household income:*

According to the report of the two villages, the average income is about VND 150,000 per capita per month, equivalent to 60 kg of paddy. The poor households have the income of 14 kg of paddy/m^2 represent 30%, and the very poor 5%. There exists 20 rich households approximately, having the income of VND 30 million per month and per

household. The investigation showed the households having combined agriculture with other jobs (artisanal work and trade) had better living standard.

A sample survey is carried out by the consultants of the JICA Team and the result is shown in Table 14.2.4.

Table 14.2.4 Income of Selected Households per Village in Dung Quat Port Area

Village	No. of selected households	No. of people	Income per capita per year (in 1000 VND)	Estimated in come per capita per year (in 1000 VND)
Binh Dong	20	93	1,800.0	
Binh Thanh	20	115	3,540.0	
Binh Thuan	20	103	4,116.0	
Total	60	311		3,152.0

Source : Preliminary Report on Environmental Filed Survey (Phase I) Part III Dung Quat Area (Quang Ngai) / May, 1997

The problems of large gap in income between rich and poor household in this area also exist. There are 51 households in Binh Thuan, which are starving and need subsidy. The lowest income per capita in the hinterland is VND 200,000 per capita/year (in Binh Dong), and the highest income is VND 12 million also in Binh Dong from the survey.

Table 14.2.5 Income of the People living in Binh Son District

(Unit : VND)

Village	Average income / capita / date
Average	3,559
Binh Dong	-
Binh Thanh	5,098
Binh Thuan	6,707
Binh Hai	2,005
Average income in agriculture sector	1,700
Average income in fishery sector	4,429
Average income in service sector	3,559

Source : Preliminary Report on Environmental Filed Survey (Phase I) Part III Dung Quat Area (Quang Ngai) / May, 1997

(2) Economic Structure

Table 14.2.6 shows the current status of economic structure at the project site area.

Table14.2.6 Economic Structure at the Project Area

Village	Economic sector		
	Fishery (%)	Agriculture(%)	Others(%)
Binh Thanh	32	65	3
Binh Dong	50	45	5
Binh Thuan	48	50	2
Binh Tri	4	95	1
Binh Hai	42	50	8
Binh Hoa	Mainly agro-forestry		

Source : Report on Basic Investigation at Dung Quat Industrial Zone 1996.7

(3) Industry

1) Agriculture

Agriculture is dominant, especially in rice and other cereals, industrial crops with short duration of growth (sugar-cane, peanut, maize, water-melon, etc.).

The land in this area is generally not suitable for agricultural production. In the total area of 4,758.5 ha, only 20.3% is under cultivation. Nearly 3% of agricultural land can be cultivated in three seasons. Most of the agricultural land is one- and two-seasonal (97%). Agricultural output is from 1.5 to 2 ton / ha / year. Table 14.2.7 shows the distribution of agricultural area in some villages.

Table 14.2.7 Area for Agriculture at the Project Area

Village	Area distribution (ha)
Binh Thanh	377
Binh Dong	310 in which 80 for fish-farming
Binh Hai	483 in which 68 for forest area

Source : People's Committee of Binh Son district, 1996

A source of income for agricultural households is breeding. However, due to low agricultural output per capita, the breeding is devoted mainly for fieldwork (cow-buffalo), for household need in food (poultry). Only in Binh Thanh there are 1,200 cows for beef.

A special product, currently introduced into production in Binh Thanh, is watermelon which brings two times higher income than groundnuts for agricultural households. This is a good direction of the village to increase income. However, the investment in this field is not decided yet, since the province announced the Dung Quat Project. Farmers dare not to invest without compensation later on as they do not know exactly when the project will start.

2) Fishery

Fishery is an occupation attracting most of households in the area. This is because the land for agriculture is limited and, according to elder people in villages, fishery can be done even in storm in the south-east of Dung Quat. The facilities for fishery is still simple, mainly for short-distance. The boat group of 13 villages near the seashore consists of about 900, having 10-45 horse-power each, and various basket-boats. Fishing productivity reaches 400-900 tons per year.

There is a tendency of some household in Binh Tannh to go to Phu Quoc and Con Son islands to do fishery as it brings large income. The highest income of a boat per trip to Con Son is about VN$30 million.

Following is an investigation on fishing equipment of Binh Dong and Binh Tri villages.

a. Binh Dong Village

There are 144 boats having the total power of 2,772 hp (horsepower).which include

Boat using plummet	60	2,664 hp
Off-shore boat	4	140 hp
Junk 1	4	40 hp
Junk 2	21	360 hp
Boat using fishing - line or rod	42	514 hp
Others	12	

In addition to various fishing boats, Binh Dong also use 165 boats for fishmongers.

b. Binh Tri Village

Mechanized fishing-boats	20 (12 - 18 hp)
Manual fishing-boats and some others	100

(4) Public Services and Infrastructure

1) Health service

Health care systems is the same as in other rural areas in the region. Each village has one infarmary with 5-8 beds. On the average, there is one closet for 16 houses.

In Binh Thanh, apart from ordinary medical post, there are also two family planning posts, which make Binh Thanh has the lowest birth rate in the province (1.8 % in the 1996).

2) Transportation

The site for harbor building / construction lies near the transnational railroad and highway axis. It is a favourable advantage, because it takes only 7 km from the harbor to Chu Lai Airport, 13 km to Binh Son Airport, and 35 km to Quang Ngai Airport .

There is an only main road, connecting Tam Ky town to the project area, passing through two villages. Only in Binh Thuan, located at the other end of the proposed port, public buses are available, two of which are owned by individuals in the village. None the less, the transportation between villages with the provincial town is significantly improved after project approval.

The number of private transportation means in the area is very high. Bicycle is the main means for residents to go to town and for children to go to 3rd level school.

3) Water Supply

Two systems are available : surface water from the Tra Bong River and underground water from the bored wells at 7m deep reaching clay layer and providing good water all the year round.

4) Electricity

Electricity can be supplied directly by the national electricity network (220kv) from the highway No.1 to the harbor (12.5 km far).

5) Communication System

Communication system can be linked directly to the transnational automatic telephone system. There is only post office in Binh Thanh. Telephone is not available in Binh Thuan. More exactly, there is a public phone, but not working.

6) Education

The existence of school system with eleven preschool classes, eight 1st level schools and three 2nd level schools has contributed to the high educational level of population in the area. In sixty households surveyed, all children in schooling age (3 to 17) go to school.

Table 14.2.8 Infrastructure of the Villages in Dung Quat Port Area

Infrastructure	Binh Dong	Binh Thanh	Binh Thuan
Education			
Pre-school	3	5	3
1st level (1-5 class)	2	3	3
2nd level (6-9 class)	1	1	1
3rd level (10-12 class)	0	0	0
Welfare			
Medical Post	1	3	0
Communication			
Telephone	Available	Available	0
Post Office	0	1	0
Transportation			
Cars	0	0	0
Public buses	0	0	3
Motorbikes	35	200	100
Boats	144	100	50
Commerce (markets)	1	1	1

Source : Preliminary Report on Environmental Filed Survey (Phase I) Part III Dung Quat Area (Quang Ngai) / May, 1997

14.2.3 Resettlement

There is a survey result of household opinion on displacement due to Dung Quat Industrial Zone Project, collected by the Agency for Science and Technology through direct contact with the householders. Although, the method of survey is not fully confirmed, the result shows that a high percentage of households expressed consent, subject to aides and compensation.

(1) Resettlement Sites

The resettlement sites for the people who have been living in the site of the Dung Quat Industrial Zone project have planned to be realized at the following three places :

1. Dong Lon, Tinh Hoa village, Son Tinh district.
2. Lang Ca, Tinh Hoa village, Son Tinh district.
3. Go Duong, Binh Thanh village, Binh Son district.

1) Dong Lon, Tinh Hoa Village, Son Tinh District

Area : 20 ha at Vinh Son hamlet, Tinh Hoa village, Son Tinh district :

The East borders on Binh Chau village, Binh Son district.
The West borders on Binh Tay village, Binh Son district.
The South borders on Tinh Hoa village, Son Tinh district.
The North borders on Binh Phu village, Binh Son district.

The center is 13 km away from Binh Son district in the east, 4 km from Sa Ky in the west-north-west, 15 km from Quang Ngai town in the east-north-east and 20km from Dung Quat Industrial Zone in the south-east. The total area is 340 ha. This site aims to stabilize 400 households of which 136 have already lived there, 64 from the extension of Tinh Hoa village, and 200 of Binh Thuan village where the petroleum refinery is planned to be constructed.

2) Lang Ca, Tinh Hoa Village, Son Tinh District

The area is about 20 ha with 650 m long from the east to the west and 310 m broad from the north to the south.

The north borders on Sa Ky eating house road.

The south borders on the Kenh Giang River.
The west borders on inhabitant site.

The east borders on inhabitant and shrimp aquaculture site.

This point is 14 km away from Quang Ngai town in the north-east along the automobile-road, and 3.5 km from Sa Ky port in the south-west along the automobile-road. The new in habitant site includes 367 households of which 357 come from the released site for the construction of petroleum refinery No.1 at Dung Quat.

3) Go Duong, Binh Thanh Village, Binh Son District

The total area is 20 ha at the agricultural cooperative site No.2, Binh Thanh village, Binh Son district.

The east borders on the agricultural cooperative No1.
The west borders on Binh Hiep village, Binh Son district.
The south borders on Tinh Phong village, Son Tinh district.
The north borders on Binh Hoa village, Binh Son district.

The centre is 8 km away from Binh Son district in the south-east, 18 km from Quang Ngai town in the north, and 17 km from the centre of Dung Quat Industrial zone in the south.

This settlement aims to stabilize over 1,000 agricultural households of which 630 are already in the site, 100 from the extension of the village, and 300 come from Dung Quat Industrial Zone.

In brief, the settlement project for the people who have been living in the planned site of Dung Quat Industrial Zone will be realized at 3 places belonging to 2 districts : Son Tinh (Dong Lon and Lang Ca, Tinh Hoa village) and Binh Son (Go Duong, Binh Thanh village).

(2) Disposition of the Settlement

1) Son Tinh District

The new settlement is planned to dispose under clusters having 11.56 ha area as follows :

1.	Chanh hamlet (Vinh tam)	37 households	1.51 ha
2.	Vinh Son	44	2.49
3.	Rung Lam	78	3.29
4.	Dong Lon	45	1.81
5.	Truong Ca	60	2.46

On the average, farming and inhabitant land will be 400 m^2 per household. Inhabitation land will be disposed along the main traffic lines.

2) Binh Son District

It is planned to dispose the inhabitation clusters as follows :

Ba Thin garden site :	70 households
Go Cong + Hoc Kem :	131
Cua Gao + Vuon Dinh :	67
Cross-road 7/5 - Ban Dong :	32
Go Thi :	60
Cua Duong :	40
Go Nga :	40

On the average, the area per household will be 400 m^2. The inhabitation land will be disposed along main traffic lines.

14.2.4 Historical Heritoge and Cultural Properties around the Project Area.

(1) Archaeological Relics

At the project site of Binh Son district, the Center for Development Research and Advice of the National Center for Social and Humane Sciences (1996) have carried-out a scientific survey on a great scale including 4 directions-archaeology, ethnology, economy and sociology that aims to make a statistics on historical traces and to identify archaeological vestige points to have a basis for exploitation planning before release of the platform. After the survey, the Center has recommended 8 following archeological vestiges to be exploited:

1- *Champa*, An Loc hamlet, Binh Tri village ;
2- *Sa Huynh*, Binh Chau village ;
3- *Mo Chum*, Ngoc Tri hamlet, Binh Chuong village ;
4- *Cham Tower*, Binh Tan village ;
5- *Dap Na*, Binh Nguyen village ;
6- *Hat Bau Luu*, Binh Thanh village ;
7- *Old citadel of Tay Son time* , Binh An village ;
8- *Go Thanh* (mound wall site), Binh Trung village.

There also exist some landscapes for tourism next to the project site such as Thien An mountain, Old Citadel of Chau Sa, and My Khe beach.

(2) Archaeological Survey

The consultants of the JICA Study Team carried out a survey to identify archaeological heritages. The main applied method is to interview cadres of commune, hamlet committee , old men and local teacher combining with direct observation of present conditions of some vestiges. Survey on history of ancestries and inhabitant changes in commune / hamlet has been carried out in order to gather further necessary information relating to historical cultural vestiges.

Surveying scope includes compass of 3 villages : Binh Thanh, Binh Dong and Binh Thuan (Binh Son-Quang Ngai). Historical cultural vestiges, are scattered in most quarters, hamlets of the 3 villages.

1) Binh Thanh Village

Binh Thanh village includes 3 quarters : Hai Ninh, Trung An, and Vinh An.

a. Hai Ninh quarter area

- *Hai Ninh Communal House*, started to build long time ago. Now collapsed, still having foundation and falling wall.
- *Hai Ninh pagoda*, started to build long time ago. Now restored, renewed.
- *Sir Fisherman Mausoleum*, set up from Gia Long Dynasty, collapsed many time, rebuilt in 1954 ; 1981, now on 20th March (lunar calendar), local inhabitants make celebration for forsaken spirits of strayed deadmen.
- *Nghia Tu*, ancient setting up, collapsed many times , recently rebuilt based on ancient architecture - Yearly, on 16th February, local inhabitants make a celebration forsaken spirits of strayed deadmen.
- *"Ba" Island* : Madame "Gia Hau" worshipping shrine is located there, set up by Gia Long Dynasty (before 19th century), still laterite till roof.
- *"Ong" Island* : Fisherman deity worshipping shrine is located there, ancient setting up, collapsed many times, now still trace foundation.
- Family ancestor-worshipping houses :
  "Dang" line of descent : at Tan Lap hamlet.
  "Tran " line of descent : at Tan Lap hamlet.
- Ancestor grave of " *Ho" descent line* : at Trung An hamlet.
- *Catholic Church* : set up in 1996, originally being religious school, then changing into cathedral.

Besides the above vestiges, in Hai Ninh quarter area, the local inhabitants still have information about what they had dug and been retold :

- At Madame Luu nook, next to fresh water lake of Tan Thanh hamlet, near Chu Lai airport, joining with Trung An - quarter, there is trace of gold stick, rolling of ancient cups, bowls were dug.
- Near "Ho" ancestor worshipping house, ancient cups, bowls were dug.

b. Trung An quarter area

- *Tu Lam pagoda* : ancient setting up, restored in 1967, 1968.
- *Phuoc Lam pagoda* : set up in 1960. Pagoda of Caodaism, Ben faction (South area - Viet Nam).
- *Ha Mai Mausoleum* : ancient setting up, maybe from Champa dynasty.

- *Worshipping temple* : At Tan An Phuoc An, Toan An Tay Thanh hamlet ancient setting up. Every year, on 15th February, (lunar calendar), local inhabitant make a celebration for forsaken spirits of strayed deadmen.

c. Vinh An Quarter area

- *Vinh An pagoda* : ancient setting up, now rebuilt to change into people committee house of Binh Thanh commune.
- *Vinh An Communal House* : ancient setting up, now rebuilt to change into worshipping shrine. Every year, on 15th February (lunar calendar), local inhabitant have celebrated worship for forsaken spirits of strayed deadmen.
- *"Fisherman" Worshipping Mausoleum,* started to build long time ago, collapsed, rebuilt, every year, local inhabitants have celebrated deity worship to pray for safe catching travel on the sea.
- *"Dat" mouton* : belonging to Tan An hamlet where there was a local inhabitant called Ngo who lived at Nai quarter (Vinh An) dug some round bars of gold there were buried under a big stone on side of mountain.

2) Binh Dong Village (formerly called Binh Giang)

There are 3 quarters in Binh Dong Commune : Tan Hy, Thuong Hoa, and Son Tra.

a. Tan Hy quarter area

- *Tan Hy pagoda,* also called *Linh Tien Tu pagoda,* started to build from Thanh Thai-Nguyen Dynasty, in the end of 19th century, on Dong Chua mountain, in 1961 moved to rebuild in the nowadays area under foot of mountain. Sandstone statue is called " Ba Voi" stature or Kyanyin. The scientific name of the statue which has human body and elephant head is ganessa, belonging to Hinduism. To oral tradition, this statue was found in 6 meter depth well behind this pagoda in 1964, then constructed to worship in this pagoda.
- *Tan Hy Communal House* : started to build long time ago, now collapsed into ruins, belonging to Vung Cam small village.
- *Tan Hy Mausoleum* : also call " Nam Hai" mausoleum (fisherman mausoleum), started to build less than 100 years go, by laterite. Every year on 15th (lunar calendar), local inhabitants have celebrated deity worship to pray for safe sea travel.
- *Worshipping shrine* : at Tan Hy quarter, there are many worshipping shrines which scatterly lie at Cong Hoi, Tan My, Ben Lang, Dong Chua, Cay Thon Hamlet, Cay Bang Hamlet (2 shrines), Vung Cam hamlet (2 shrines).

Every year on 24th February or 16th March (lunar calendar), local inhabitants make celebration for forsaken spirits of deadmen or disappeared men from the sea.

- *Family ancestor worshipping houses* : at Tan Hy quarter, there is Ho family ancestor worshipping house - Cong Hoi small village, Vo family worshipping house - Tan My small village, started to build from Thanh Thai dynasty, Nguyen family worshipping house at Cay Bang small village. Every year, descendants have celebrated their ancestor worship.

Besides, at Bau small village (Tan Hy quarter), to oral tradition here was Champa from Le Thanh Tong Dynasty threw this troops into Binh Dinh battle. There was also grindstone axes picked up at Hoc Moi (Suc Soc-Tan Hy).

b. Thuong Hoa quarter area

- *Thuong Hoa Communal House* : started to build in 1930, to oral tradition, it is located in the area of Champa pottery, then set up exchange and commercial market which called "Tau" market .
- *" Fisherman" Mausoleum* : started to build about 150 years ago by laterite. Every year, there is celebrations deity worship.
- *" Lanch" Mausoleum* : started to build a long time ago.
- *Worshipping shrine* : at Thuong Hoa quarter, there is a shrine worshipping Ban Giap, shrine next to Lang Mausoleum, another at Thuong small village. Every year on 15th February or 24th February (Lunar Calendar), there is a celebration of the souls of unknown deadmen or disappeared men from the sea.
- *Sir " Ca" hill* : there is a slab of stone engraving one human foot, end of these toes directs toward the South. Local inhabitants called it Buddhist footprint.
- *Chinese grave* : now still have stone steel with carved Chinese characters which is used as a bridge to link the road. According to the legend, it was of Chinese Duke.

c. Son Tra quarter area

- *Vuon Mieu Communal House* : started to build long time ago, now still has a foundation.
- Worshipping *Sir Fisherman mausoleum* : started to build about 70-80 years ago, still 1964 rebuilt. Every year, on 24th March (lunar calendar) there is a celebration of deity worship to pray for sea travel.
- *Local shrine* : started to build long time ago. Every year, on the occasion of Pure Light Day, local inhabitants make a celebration for forsaken spirits of disappeared deadmen.
- *Cay Khe shrine* : started to build long time ago from the time of using wooden barge. Every year, on 16th, 29th, 26th March (lunar calendar) there are celebrations of the souls of unknown and disappeared deadmen.

3) Binh Thuan Village

Binh Thuan village has 3 quarters : Tuyet Dien, Thuan Phuoc, and Dong Lo small village as well as 1, 2, 3, 4 small villages.

a. Tuyet Dien quarter area

- *Hon Coc shrine* : built after 1975, worshipping Sir Fisherman. Every year on 16th, 20th, 29th March (lunar calendar), there is celebration of deity worship to pray for safe sea travel.
- *Shrine of Deadmen Souls* : started to build after 1975. Every year, on the occasion of Pure Light Day, local inhabitants make celebration for forsaken spirits of deadmen.

b. Thuan Phuoc quarter area

- *Thuan Phuoc pagoda* : started to build after 1975.
- *Shrine of Deadmen Souls* : started build after 1975 in the area of 4,6 sergeant. Every year there is celebration of the souls of forsaken deadmen.

c. Dong lo quarter area

- *Dong Lo Communal House* : started to build long time ago, collapsed ; now still has one part of foundation.
- *Shrines of Deadmen Souls* : started to build long time ago, every year on the occasion of Pure Light Day, local inhabitants make a celebration for forsaken deadmen.

d. "1" small village area

At *"Dat Do"* market, local inhabitants dug many ancient cups.

e. "3 and 4 " small village area

- *Giong Cham* : called Gieng Lang and Giay Thung. At Gieng Thung, they dug many wooden standing boards used as well partition, at the bottom there is fine white sand.
- *Cham grave* : at the place called Trang Cha
- *Laterite grave* : has a stone Stella with carved ancient characters.
- *Chong (husband) Stone* : It is said that there was the residence of Champa people.
- *Gieng Lang market* : near Gieng Lang, many glass bead plates were found.

4) Notes

The cultural - historical heritages known through the survey and listed above consist of two different sections. One section is the heritages of Chum Thanh inhabitants and the other is those of Vietnamese Community.

The heritages of Chum Thanh inhabitants were almost collapsed or buried in the earth. They are old, living traces in Binh Thuan Commune (Binh Son - Quang Ngai)

In the situation of heritages like this, plans for continuing the survey are to be made. Then, if valuable and necessary, archaelogical excavation should be carried out before constructing facilities on them.

The historical cultural heritages of Vietnamese Community are rather popular with the rather large quantity. According to the memory of local people and according to genealogy (family register), there are many heritages built from two to three centuries ago, even four to five centuries ago. On the contrast, according to the architectural traces remained in some locations, most of them have the epoch of one to two centuries.

In practice, the heritages having the above - mentioned old epoch were destroyed a lot, especially, during two wars of French and American Resistance (1945 - 1975). After 1975, local people renovated, restored, or renewed some religious - cultural architectures one by one.

In the port development will be implemented, further study should be planned, and performed paying attention to the necessity of preservation and development of social - cultural environment identified above.

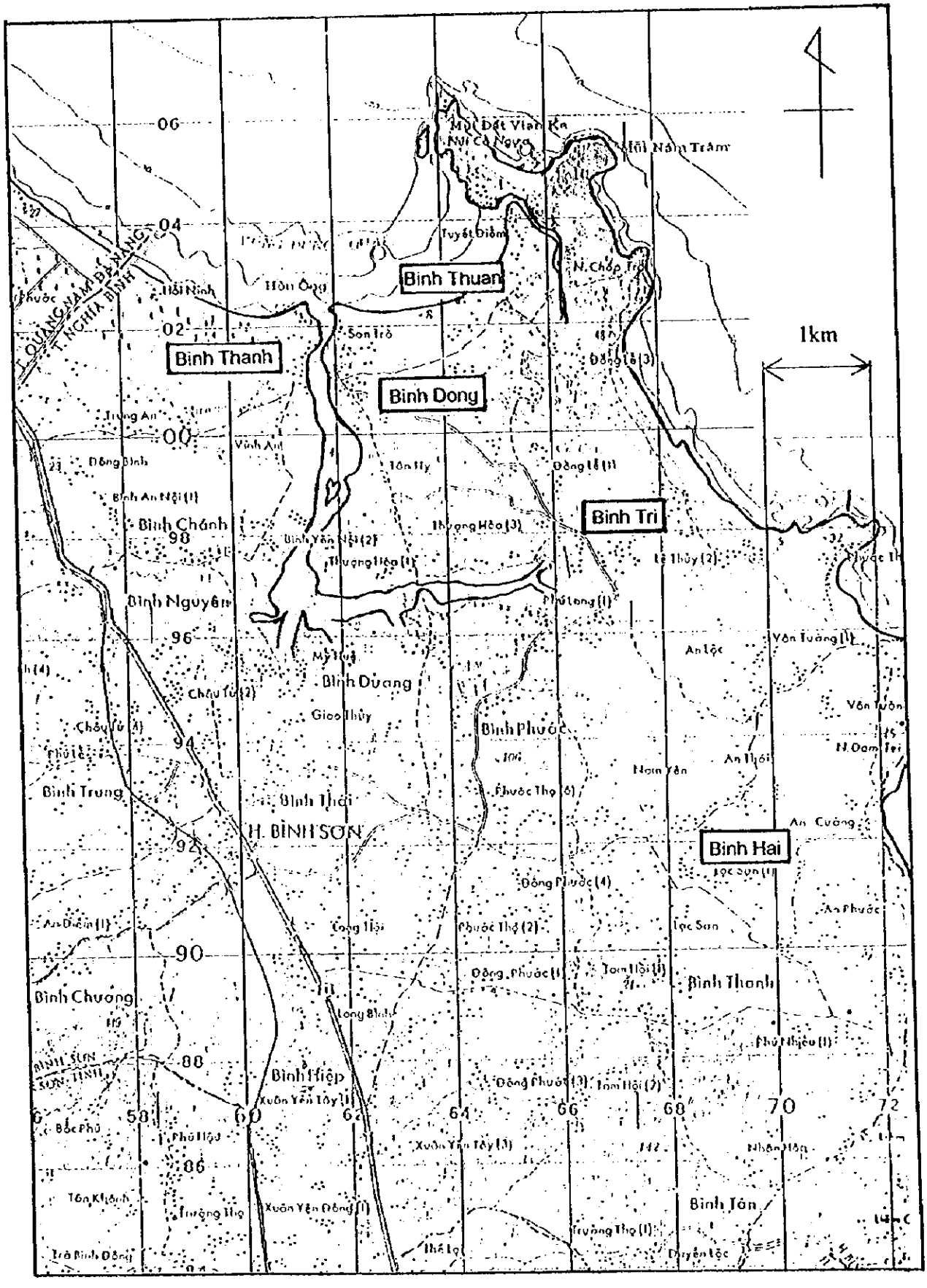


Figure 14.2.1 Location of Villages and Communes at Dung Quat, Quang Ngai

14.3 IEE Checklist

The law on Environmental Protection was passed by the National Assembly of Vietnam in December 1993 and came into force in 1994. Consequently, most of large projects such as the development of Chan May are subject to EIA studies. The law requires the investors, project managers or directors of the offices to conduct the assessment of environmental impact (Article 9). Article 11 of the law defines that the EIA shall be conducted in two phases, namely preliminary and detailed. Appraising power is given to the Ministry of Science, Technology and Environment (MOSTE) for large projects and to the provincial Department of Science, Technology and Environment for others. In case of the development of ports, all projects which may handle more than 500,000 m3 per year need to be appraised by MOSTE.

Major sources of adverse effects of port development can be categorized into three types: (a) location of port; (b) construction; and (c) port operation, including ship traffic and discharges, cargo handling and storage, and land transport. Location of port connotes the existence of structures or landfills, and the position of the development site. Construction implies construction activities in the sea and on land, dredging, disposal of dredged materials, and transport of construction materials. Port operation includes ship-related factors such as vessel traffic, ship discharges and emissions, spills and leakage from ships; and cargo-related factors such as cargo handling and storage, handling equipment, hazardous materials, waterfront industry discharges, and land transport to and from the port.

Environmental facets to be considered in relation to the development of the new port of Dung Quat are categorized into nine groups: (a) water quality; (b) coastal hydrology; (c) bottom contamination; (d) marine and coastal ecology; (e) air quality; (f) noise and vibration; (g) waste management; (h) visual quality; and (i) socio-cultural impacts.

Checklists of adverse effects of port development for IEE have been compiled by several organizations including the World Bank, the Asian Development Bank, the International Association of Ports and Harbors and Japan International Cooperation Agency. Based on the these checklists potential adverse effects are checked as listed in Table 14.3.1.

TABLE 14.3.1 Initial Environmental Examination Check List (Dung Quat)

Factors	Impacts
(1) WATER-RELATED ITEMS	
a. Dredging	
1) Toxic, harmful substances in water column; Sunlight penetration; Smothering bottom biota	Dredging will stir up bottom muds/sands. This will temporarily reduce sunlight penetration and smother some of the local bottom biota, but bottom habitat of particular high value/importance have not been detected.
2) Influence on tidal flows; Accelerated natural sediment deposition; Attraction of desirable or undesirable fisheries; Altered bottom biota	Dredging will alter bottom biota locally and may result in loss of fishery in the limited area of Dung Quat Bay. Influence on tidal flow and sediment deposition to be studied in EIA.
3) Change in current patterns; Shorezone and beach erosion; Accelerated sediment deposition shoaling	Impact of the reclamation and submersed structures to be studied in EIA
4) Loss of bottom habitat, shellfisheries, fishery food resources	Bottom habitat of particular high value/importance have not been detected.
5) Salt water intrusion; Accelerated groundwater flow to estuary	No dredging planned in river area
b. Dredged Material Disposal	
1) Selection of appropriate disposal site; Methods of dredging and dredged material transfer and related disposal impacts	Dumping site located offshore well away from known fishing areas and coral reefs.
2) Characteristics of dredged material	Sand and sandy silt
3) Disposal methods (Potential or requirements for capping; Alteration of current patterns; Accelerated shoaling)	Dredged material will be used for land reclamation as much as possible. Limited volume of marine dumping will take place at offshore disposal site carefully selected.
c. Landfills and Construction of Breakwaters	
1) Loss or displacement of shellfisheries, fishery food resources lost or displaced	Although there will be adverse effects on coral reefs and on possibly mangroves at Dung Quat, these reefs which are generally in poor condition are unlikely to be important/valuable shellfisheries or fishery food resources.

2) Desirable, undesirable species formed by structures (especially pilings and breakwaters)	Not detected in the past
3) Alter currents; Sediment deposition accelerated; Change required in harbor maintenance dredging practices	Changes in currents to be simulated.
4) Dispersal of suspended sediments	Areas likely to be adversely affected by dispersal of suspended sediments from landfills and breakwater construction do not contain any habitat or fisheries of particularly high value/importance, although these sediments are likely to adversely affect the mangroves and corals at Dung Quat.
d. Alteration of Harbor/Port Ship Traffic Patterns	
1) Relocation of navigation markers, moorings	Not required
e. Ship Discharges, Oily Ballast; Bilge Water; Sewage	
1) Regulations controlling cleaning procedures; Limitations on release of cargo and machinery space residues (Discharge limitations); Need for facilities to receive waste from ships; Means of storage and ultimate disposal of residual wastes	Potential impacts will be mitigated by developing site-specific waste management procedures to be employed at each site for collection, handling, treatment and disposal of cleaning wastes, including wash-waters and residues.
2) Importance to fishery resources; Water quality of rivers, bays, harbors	Monitoring is ongoing. Change in Water quality to be studied
3) Shore facilities for receiving ship generated sewage and garbage waste; Sanitary treatment facilities (Connection to special or municipal systems); Transfer and pumping facilities	Port Design will include on-shore sewage and garbage waste handling, storage and disposal facilities for ship-board wastes.
f. Detection and Clean-up of Spills	
1) Type of spills (oils, lubricants, hydraulic oils, fuels, liquid and solid chemicals); Frequent spill sources	Potential types of spills and assessment of spill risk will be identified during detailed port design phase.

2) Spill clean-up measures (regulations, clean-up equipment available); Spill detection routines; Contingency plan	Oil berth to be equipped with oil fences. Site-specific spill clean-up measures will be developed, including management procedures, equipment requirements, spill detection system and emergency response procedures as part of the site contingency plan.
3) Dry cargo releases (fugitive emissions, dust control, smoke density and effects)	Bulk (mining products, coal, clinker and others) operations will have little dust emission. Site-specific dust control measures will be adopted during detailed port design phase.
g. Waterfront Industry Discharges	
1) Sanitary wastes (sources, volumes, special contaminants) - Sanitary treatment facilities (existing, planned, proposed, capacity of each locations, discharge water quality, ability to handle shipping)	Direct discharges of sanitary wastes into port waters are not planned in Dung Quat. Sanitary treatment facilities and appropriate mitigation to be designed in the construction stage of waterfront industry.
2) Non-sanitary wastes (sources, volumes, toxins) - Discharge/treatment procedures (capacities, discharge points, limitations, residuals) - Discharges reaching harbor/river waters; Dispersion; Settling tendencies	Any requirements for non-sanitary waste discharge treatment facilities will be addressed in the site-specific design stage. Discharges from ship repair yard building yard to be studied in Dung Quat.
- Non-sanitary spillage from non-ship related activities (types of spills, frequency, volumes, how handled, retention/recovery systems)	Risk of non-sanitary spillage from non-ship related activities to be assessed during site-specific study
3) Heated process water discharges (electricity generation, industrial processes, LNG condensation)	Heated water discharges not detected
(2) LAND-RELATED ITEMS	
h. Excavation for Fill	
1) Shore sand/gravel excavation; Dust (fugitive emissions); Blasting	Gravel extraction areas and potential impacts associated with gravel extraction process and appropriate mitigation methods for these will be identified in the site-specific study.

2) Transportation to construction site	Potential environmental impacts from the transportation of fill materials will be identified and addressed with appropriate mitigation measures in the site-specific study.
i. Wetland Damage and Filling	
1) Ecological value of wetlands (use by domestic animals, use by other fauna, unique vegetation, irrigation water source, damage to flora)	Some mangrove wetland areas were identified in Song Tra Bong River and these would need further study to plan impact mitigation and protection measures during the site-specific investigation.
2) Runoff from ports and harbor facilities, Existing contamination input	Runoff collection and control measures will be designed at the detailed design stage with a view to minimizing the risk of future contamination of port and harbor waters.
j. Loss of Usable Uplands	
1) Types of land areas likely lost to waterfront use (residential areas, market centers, commercial areas)	The areas likely to be lost to waterfront use are currently low value, low productivity agricultural land.
2) Residential relocation; Replacement farmlands; Other replacement/relocation needs	Residential relocation of a few low quality houses and garden/farm land will be required at Dung Quat. Replacement of fishing village also required.
k. Noise from ports and harborside industry:	
1) Location of noise sources; Background noise level	Noise from port activities is limited. Port related traffic which would be sources of noise needs further study to plan impact mitigation along the main transportation routes.
l. Dust and Other Airborne Emissions	
1) Sources (industrial, construction), Raw material storage	Sources of dust and other airborne emissions will be identified and appropriate mitigation measures planned on a site-specific basis.

2) Smoke and other combustion products (ships, traffic, industry)	Port activities in Dung Quat area will generate no significant volume of smoke and other combustion products. Smoke from ship will be seen temporarily. Oil refinery will be a major source of smoke and other combustion products so that its adverse effects and mitigation measures to be studied in the refinery-specific study.
m. Traffic related items	
1) Existing traffic load (roadway network, traffic load, accident data)	Route No.1 is the major existing road and port-related traffic load will be studied in the site-specific investigation.
2) Projected traffic increases (roadway additions/improvements, important routes)	Port related road traffic will be identified and impact mitigation planned in the site-specific study.
n. Handling and Disposal of Solid Shore Generated Wastes	
1) Important sources (ships, waterfront industrial areas, residential areas)	Collection, handling and disposal of solid wastes generated from ships and port activities will be managed by port authorities and municipal agencies.
2) Means of transport/transfer (ship-to-shore, onshore)	Ship to shore transfer of ship generated wastes and onshore transport of these to treatment/disposal sites in an environmentally safe and secure manner will be carried out in accordance with the direction of port authority.
3) Disposal methods (incineration, landfills)	To be carried out in accordance with the direction of municipal agencies.
o. Runoff from Raw Material Storage	
1) Nature of materials (salt, sulfur, metal ores, refined concentrates)	Bulk cargo would be a potential runoff source. Preventive measures will be designed in the site-specific design stage.
2) Typical storage conditions, locations, storage time, health menace to workforce)	Storage of raw materials will be designed in the site-specific design stage with a view to reducing health menace to port workers.

p. Visual impacts	
Structure; Painting; Lighting; Attempts to blend with surroundings	Visual impact mitigation measures will be incorporated into the site development plans where this is practicable and warranted.
(3) AIR-RELATED ITEMS	
q. Background information	
1) Meteorological data (prevailing winds, seasonal weather patterns, storm tracks, frequency and severity, rainfall records, wind rose data)	Available in this report
2) Identify sensitive areas	None detected in Dung Quat area
r. Gases, Smoke, and Fumes	
1) Sources, components, controls (industrial contributions, ships, residential background, vehicle emissions, background from other areas)	Impact of the emission from ships and port-related vehicles will be examined in the site-specific study.
(4) HAZARDOUS MATERIALS/CARGOES	
s. Categories Gases, Liquids, Solids	Site-specific hazardous materials/cargoes management practices, including location and design of storage areas, handling procedures and collection/treatment/disposal of any hazardous wastes will be developed in the site-specific detailed design stage. These cargoes will be handled in a restricted area of the Port.
1) How stored; Location of storage areas; Shipping and handling procedures; Disposal of any hazardous wastes generated	
(5) SOCIO-CULTURAL ITEMS	
Tribal, cultural, ethnic, historical, religious aspects likely impacted by changes, including consequences of modernisation and industrialisation Preserving traditions with minimum loss and disturbance; Removal of graveyards, churches, etc.	Socio-cultural situation of Dung Quat area were studied and information is available in Chapter 14.2 of this report. Population to be relocated will be identified and assessed in the site-specific study.

15. Conclusions and Recommendations

15..1 Conclusions

(Findings on the region)

Central region of Vietnam is not enjoying the economic boom prevailing in the south and north region. To cope with this situation, the national government proposed or approved several projects in the region including the East West Transport Corridor, Dung Quat oil refinery, the South North Highway through Hai Van tunnel and industrial zone development as well as agricultural development. Transportation infrastructures including port facilities are in poor condition in the region to serve for the economic development.

(Port of Danang)

Port of Danang consists of two ports, i.e. Song Han port at the mouth of Han River and Tien Sa port on the west coast of Son Tra peninsula. Cargo throughput of Danang port was 870,000 tons in 1997, of which 70-80 % was handled at Tien Sa port. Existing two piers in Tien Sa port are deteriorated and require rehabilitation of its pile structure. Nguyen Van Troi bridge is used for port access, however, it allows only traffic under a weight of 13 tons. Upgrade of the bridge is also in urgently required.

(East West Transport Corridor)

East-West Transport Corridor Project is being studied by ADB and regional countries. The route No.9 and the second Thai-Lao Mekong bridge were selected for early implementation. This report assumed that R9 will be developed firstly followed by R18. R16 will have a low priority.

(International Transit Cargo)

Southern provinces of Lao PDR and northeast Thailand are deemed as the hinterland of the new port subject to the completion of R9 and Route R16/R18 of the East West Transport Corridor project. Projected cargo volumes in 2020 are 646,000 tons through R9 and 822,000 tons through R16/18. It is assumed that R9 will be developed firstly followed by R18. R16 is deemed to have a low development priority

(Natural Conditions)

Wind observations were also carried out in each project area throughout a year. The most frequent wind directions are ESE to SSE in Dung Quat.

Offshore waves were observed at two points on the coast of the central region. One ultrasonic wave recorder was placed on the seabed in the mouth of Danang Bay and the other one was positioned off the Ky Ha Cape in Quang Nam Province. The maximum waves observed were 5.7[1/] m at the Danang Bay mouth and 5.1[2/] m at the Ky Ha offshore observation point.

Based on the observations and statistical analysis of 30 historical typhoons, offshore wave height for the return period of 50 years was estimated at 9.7[3/] m in the deep sea off the Danang Bay and Chan May Cape, and at 8.8[3/] m in the deep sea off Dung Quat Bay. Design wave height for the main breakwater is 6.6[3/] m in Dung Quat.

(Seabed Soil Conditions)

Seabed soil in Dung Quat mainly consists of sand and sandy clay, which has enough bearing capacity to build heavy breakwater.

(Demand Forecast)

A considerable increase in cargo throughput is envisaged in the central region owing to the economic growth and industrial development. Projected seaborne dry cargo from/to the central region will reach to 10-20[4/] million tons in the year 2020. Expected cargo throughput in 2020 is about 30.6 million tons at Dung Quat.

(Master Plan for Dung Quat)

Dung Quat Port is planned to serve firstly for the oil refinery to be build in the hinterland. Requirements for the new port are two deep sea tanker berths, four berths for coastal shipping tankers, two deep sea bulk berths for scrap metals, and 10 berths for coastal shipping cargoes. Two oil dolphin berths with -13 m draft and three oil dolphin berths for coastal ships are designed along the main breakwater. East wharf has two alongside berths for general cargo trampers with a depth of 8 m and three oil dolphin berths for coastal tankers. West wharf is designed to cater to Panamax bulk carriers and general cargo trampers carrying mainly steel scrap, manufacturing goods, agricultural products, and other breakbulk cargoes. The main breakwater has a length of 1,660 m and the west breakwater is 2,170 m. Dredging of 5 million m^3 is required for the approach channel and turning basin with a depth of -13 m. Land reclamation is planned for the east and west wharves with a total area of 137 ha.

[1/] This height is the significant wave height ($H_{1/3}$), which is 9.0 m in the maximum wave height (H_{max}), caused by Typhoon Friz on 25 September 1997

[2/] $H_{1/3}$, H_{max} is 7.9 m, caused by Typhoon Friz

[3/] $H_{1/3}$

[4/] exclude crude oil and oil products

(Initial Stage Development Plan)

The development of Dung Quat Port is possible if industrial development of the hinterland is realized and the demand for a new port is confirmed. Since a new port development generally requires a large initial investment in breakwater and/or channel dredging at the first stage, a proper size of development is necessary to be a feasible project. ISP is proposed as a package plan for the first stage of development in Dung Quat.

To serve for the planned oil refinery in the hinterland, one dolphin berth for 50,000 DWT class tankers and four dolphin berths for coastal tankers are proposed for ISP as well as two conventional berths with an alongside depth of –8 m. A 970 m section of the main breakwater is planned for ISP, of which a 370 section can be developed for the urgent need for product oil transportation.

(Port Facility Design)

After comparing several designs of breakwater and quaywall, it was concluded that composite gravity type structure with hybrid caisson will be appropriate for deep sea breakwater and quaywall from the viewpoint of technical and economical aspects. In particular, the proposed structure will be suitable for the marine structure with high design wave heights and soft foundations.

(Cost Estimates for Dung Quat)

The costs of implementing the Master Plan are estimated at US$353 million in which the costs for ISP is US$119 million. Breakdowns are summarized in the table below.

(US$ million)	Cost of MP	ISP
Breakwaters, seawalls, groins and others:	87.4	33.5
Quaywalls and yard pavement:	149.3	35.8
Dredging:	25.3	3.9
Road, pipeline, and other utilities:	17.4	13.4
Oil loading equipment and navigation aids:	11.0	8.3
Engineering services, contingencies and tax:	62.9	24.3
Total:	353.2	119.2

(Economic Analysis)

The results of the economic analysis indicate that port development projects of Dung Quat are viable from the viewpoint of the national economy. Economic Internal Rate of Return of ISP is shown below including sensitivity tests.

	EIRR of ISP	Sensitivity tests[5/]
Dung Quat:	20.8 %	18.2 %

(Port Administration and Operations)

Although several port administration and management bodies are identified in Vietnam, such as Vinamarine, Vinalines, local government and the military, Vinamarine will be an adequate body for the development of the new commercial port in the central region. For the development of Dung Quat Port, it will be appropriate that dredging work and breakwater construction can be done under the public funds and oil related port facilities are build by Petrovietnam.

(Environmental Survey)

Field surveys covered waves, currents, water pollution, shoreline sediments, terrestrial flora and fauna, and local residents and cultural assets. Although coral reefs were found near the project area, their location is limited and generally in poor condition. Bottom habitat of particular high value/importance has not been detected. The hinterland is unfertile, low productivity farm land and the area likely to be lost to waterfront use is currently low value, low populated land.

(Initial Environmental Examination for Dung Quat Port)

Initial environmental examination indicated the need for a EIA study on changes in current patterns, disposal of dredged material, impacts on water quality, shoreline change, traffic load on access roads and relocation of inhabitants.

(Overall Evaluation of the Project)

Maritime transportation borne by the port development will greatly contribute to the development of the central region in terms of foreign currency earnings, job opportunities, trade promotion and industrial development. However, the development of a new port requires a fairly large capital investment in breakwaters and reclamation work in the deep sea area, so that financial feasibility is very critical in connection with construction cost and port revenues. As seen from EIRR, the port development projects in Dung Quat are economically effective and will have no particular difficulty in technical, environmental aspects. However, the timing of the development of Dung Quat Port should be carefully decided from the viewpoint of the implementation of the oil refinery project.

[5/] subject to 10% increase in development costs and 10% decrease in economic benefits

15.2 Recommendations

15.2.1 Basic Strategies on Development of the Key Area of the Central Region

As already recommended in the Study on the Integrated Regional Socio-Economic Development Master Plan for the Central Region of the Socialist Republic of Vietnam prepared by the JICA study team in March 1997, the Central Region has significant roles and development needs in the international, national, and regional context under the general understanding that accelerating economic growth of the Central Region is important for the economic unification of the country.

In the international context, the Central Region should form an economic network with inland countries and regions in the Greater Mekong Sub-region and become a trade processing center of the Sub-region. In the national context, it should achieve an accelerated economic growth to mitigate widening economic disparities among regions, thus contributing to the economic unification of the country. In the regional context, it should pursue development quality, which is socially and economically balanced and environmentally sustainable development.

While the above recommended concept is considered generally applicable to port development planning in the Central Region, following points need to be carefully considered to secure sound, steady and practical development.

(1) In order to avoid possible adverse impacts of drastic and random development, the target projects and their location need to be critically selected under careful coordination with the parties concerned.

(2) Development schedule should be appropriately controlled to be harmonized with local life and culture.

(3) Initial scale of the target projects should be down-sized as far as possible so as not to jeopardize national and regional financial soundness.

(4) Private sector participation in the development schemes is desirable in principle but needs to be controlled carefully to mitigate its adverse effects on the national and regional economy and society.

(5) Experiences in most advanced countries show that drastic industrialization is often harmful, if not properly controlled, to sound development. Vietnam should take advantage of its "latecomer" position and avoid the mistakes made by other countries.

15.2.2 Objectives and Basic Framework of Port Planning for the Area

While the detailed objectives of port planning vary widely depending on their type, coverage, time span, target facility and so on, the overall objectives of port planning for the region can be summarized as follows:

(1) to be a guideline for long-term investment and operational improvement schemes of the target ports.

(2) to be a base for short-term/urgent development plan of which contents are required to be consistent with total development scheme.

(3) to provide port users, investors, and other business entities concerned with the future prospect of a business environment and thus to guide the business behavior of the private sector in a proper direction consistent with the port development.

(4) to promote harmonized development of other infrastructures necessary to realize the proposed port development schemes.

(5) to be a component of the national port plan so that the port development of the Area can be appropriately coordinated with the overall concept of national port development.

(6) to be a base for consideration of various financing agencies in their investment or financial plan.

In order to achieve the above objectives and to satisfy various requirements of the Study, the port planning framework is designed as follows:

(1) Master Plan (MP) for port development in the three key areas with target year of 2020.

(2) Initial Stage Plan (ISP) of port construction for each site of the three key areas within the framework of the Master Plan.

(3) Feasibility Study (FS) on short-term port development plan for a selected site with target year of 2010

Among the above three types of planning, ISP has a unique function in particular to cope with the potential port development demand expected in the three sites, namely Chan May, Danang and Dung Quat. The objective of ISP is to propose a minimum reasonable package of port facilities to be developed at the initial stage of total development scheme under the proposed master plan for the ports. In an ISP, the schedule of port development including commencement timing and final target year is normally not indicated. ISP is, therefore, an appropriate way of planning for such a case as when confirmation of the exact timing and volume of potential cargo traffic is considered difficult due to the uncertain situation of background factors such as industrial location, public acceptance of the project, and so on. In case of Danang Port, ISP is identical to the short term development plan of which development schedule is clearly defined for the feasibility analyses in the study. On the other hand, only ISPs are proposed for Chan May

Port and Dung Quat Port, mainly because of the reasons stated in the above paragraphs. In any case, ISP is useful enough for further study for the projects.

15.2.3 Port Development Strategy for the Three Key Sites

The final goal is to realize well balanced national development by creating a third social and economic core of the country following the other two advanced areas, namely Hanoi and Ho Chi Minh City. For successful achievement of the above objectives, each of the ports to be developed in the three target sites namely Chan May, Danang, and Dung Quat, needs to have a clearly defined function, scale and development timing which is conceived to fit the original character of each development site. In this regard, the following are the most important points in developing ports in the region:

(1) With the view to avoiding possible unproductive competition among the ports, duplication of functions and facilities should be strictly checked. This is especially important for international container handling facilities at the initial stage of the project when the actual cargo demand of the region is relatively small and inadequate to attract the major container lines.

(2) Construction of port facilities for industrial cargoes to be originated mainly from the direct hinterland of the port should be started upon confirmation of actual location of planned industries in the site.

(3) Considering the severe financial position of Vietnam, the initial stage investment for the ports should be minimized to the extent possible.

(4) On the other hand, the full scale potential port development concepts need to be appropriately planned and authorized with a view to promoting overall regional development and attracting private sector investment in the hinterland of the ports.

(5) Financial resources for public port development should be diversified to promote participation not only of domestic/foreign private sector but of the relevant local provinces so that the port development concepts could reflect their will and desire in particular.

15.2.4 Functional Allotment to Ports in the Area

Functional allotment to ports in and around the area is proposed in the Conclusion of this Chapter. In connection with the proposed allotment, the following points are recommended:

(1) An international commercial hub port must be able to accommodate at least Panamax size container ships and have a large volume of cargo to enable shipping lines to make frequent calls at the port. When shipping lines call a port frequently, users generally enjoy such benefits as reasonable shipping freight rates, more options in selecting favorite shipping services, overall scale merit of cargo handling and so on. In this context, it is recommended that utmost efforts of the country should be concentrated in developing

commercial port functions with international standard container terminals at Danag Port Complex, which has historically served as a commercial port and is strategically located to become a transport junction. The port could attract an adequate number of ship calls as a hub port of the country and this may be very effective not only in attracting international transit cargoes from/to the neighboring countries, but in accelerating development of the industrial zone behind the site, through stimulating investment in various related infrastructures including the road network to the hinterland.

(2) In the long term, Chan May has the potential to be a multi-functional port due to its advantageous location, moderate natural conditions locally, prioritized industrial development schemes and active promotion policy of the province. In the short term, however, immediate and large scale commercial port development in this site may be relatively risky mainly due to the existence of Danang Port Complex, uncertain status of commercial cargo demand for the port, and the fact that industrial development in the hinterland is in the initial stage. Considering the above situation, the first stage of the development of this site shall be focused on promotion of industrial location of appropriate scale at the industrial park behind the Chan May Bay with timely construction of a feeder port for the province. Since the People's Committee of Thua Thien-Hue has designated development of the Chan May Port as a top priority project in the province as a means to raise living standards in this area, it is recommendable that the central government should consider to support, if possible and appropriate, the project financially or institutionally, because it could also have a vital role for future national economic development, provided that the project scale and construction timing are reasonably planned and selected.

(3) A large industrial zone with a full scale oil refinery is to be developed in the direct hinterland of Dung Quat Bay, which means that the expected major function of the port is to serve industrial cargoes from/to the industrial zone. While public port functions may be required in the long term, the initial development components of the port should be focused on such industry related facilities. Port development schedule of this site should accordingly be coordinated with the planned industrial development, so that timely construction and reasonable scale of the port facilities concerned can be secured.

15.2.5 Port Administration, Management and Operation

Chapter 13 of the Report illustrates the present system of Vietnamese port administration, management and operation which is formed mainly under domestic administrative requirements and considerations. While it is natural that an administration system of a certain sector of a country is established for her own benefit and convenience under the political and social system of the country, international requirements are an

important factor as well for the port sector administration concerned in particular. This is because the port facilities and its service activities should be designed and provided for the port users who have their own requirements for the benefit of their international business and global shipping economy. The port users, whether they are shippers, shipping lines and other port related entities, want to use a port which is managed and operated well under a simple and transparent administration system, so that they can coordinate their business activities easily with the direction of port sector development and management policy of the government. In this context, the current system of port administration of this country may need to be simplified under well coordinated institutional systems. Some suggestions in this regard are as follows.

(1) Generally speaking, the basic port sector development policy and nation wide port administration are to be under MOT for all commercial ports.

(2) While VINAMARINE is responsible for overall regulatory functions in the maritime sector and for some ship, port and shipyard operational management functions under MOT, VINALINES is engaged in comprehensive shipping and maritime related activities including the management and operation of Saigon Port, Haiphong Port and Cai Lan Port under direct supervision of the Prime Minister's office. This kind of administration may jeopardize consistent policy decision making in port sector affairs and effective utilization of maritime human resources. If the two organizations can not be amalgamated for some reason, further coordination by MOT may be required. Full privatization of the operation and management functions of VINALINES may be another alternative to promote overall economic efficiency of the major ports.

(3) If the situation allows, the administration of river ports should be simplified. Too many administrative organizations are involved in the river port affairs, which makes it difficult to keep a consistent and comprehensive port policy. Since the function of Vietnamese river ports is mainly limited to related local areas, it may be reasonable to let the local communities manage them under the overall supervision of MOT and/or IWB.

15.2.6 Procurement of Financing Source for Port Development and Private Sector Participation

Procurement strategy of financial resources is always one of the critical issues for successful port development which normally requires a large amount of investment. There may be several ways to procure funds for a port project. In recent years, it can be often observed in many developing countries that construction funds from private sector are

mobilized through privatization of a core function of a port. This selection, however, is not always successful nor appropriate from the public port development concept point of view. If the purpose of privatization is to improve efficiency of port operation through competition, this selection may be justified generally for any type of port development including a port of highly public function like the target port development of the Study. However, if the government wants (mainly because of heavy shortage of original funds) instant money for the project by simply selling to the private sector a vital part of the potential port development site and/or its function, such a policy should not be applied. Considering the aspect pointed out in the above paragraph, it may be better for the government to use its own funds for the projects (at least for the initial stage of the projects) including utilization of possible soft foreign loan or combination of public and private financing sources.

15.2.7 Attraction of International Transit Cargo

The potential international transit cargo traffic from/to the neighboring countries through the project ports can not be realized simply by increasing the cargo handling capacity of the ports. Several critical conditions as shown in the following paragraphs need to be satisfied. The most important and basic requirements are to provide fast, reliable and efficient services at a reasonable price, which is not easy to achieve, particularly for a newly developed port. Moreover, in order to compete successfully with other ports for such transit cargo, overall performance of total transit corridor from origin to destination including road network, cross border services, port and shipping performance should be sufficiently competitive.

(1) For the project ports in the Central Region, the international cross border facilities, custom clearance and documentation need to be improved and simplified in particular.

(2) Since scale merit on cost performance of cargo handling operation and shipping is significant the international container traffic, the newly developed container port in the Region should attract as many ship calls as possible, so that the port can establish its position as a international container hub port. This can be achieved by developing the relevant infrastructures and institutional systems of the port under coherent overall policy.

(3) Service level and tariff policy of the rival ports need to be studied and analyzed, so that overall performance of the corridor can be sufficiently competitive through constant improvement of service and careful adjustment of the tariff and charges of the port.

15.2.8 Engineering Surveys and Studies

Considering Vietnam's lack of experience in constructing large scale seaports with long and deep breakwaters and quays, it is important to collect the basic engineering data and information necessary for economical design and construction. To this end, following items are recommended to be included as apart of the engineering analyses.

(1) Wave observation over a period of at least three years at the appropriate offshore point of the project is essential for the analyses of anomalous high wave (for selection of design wave), and normal wave (for the study on calmness of sheltered water, sand drift, construction planning and so on).

(2) Annual shoreline survey and sounding at the project sites to check long term effect of possible topographic changes on shoreline and sea bottom is vital for assessing the impact of the completed project structures and for determining if countermeasures are necessary.

(3) The sedimentation/siltation phenomenon is still one of the difficult themes in port and coastal engineering. Discussions on this subject have been made at Lien Chieu in the Study within the limit of the Scope of Work which is in detail enough as an analyses for planning stage. In order to confirm the results of the Study and improve its accuracy, in particular on prediction of sedimentation volume in the approach channel and basins, however, it is recommended that the Study should be followed, if possible, by deeper survey and analyses, for example, measurement of salt water wedge, full scale computer simulation and site experiment by test pits. These data are also useful for control or improvement of safety and efficiency of ship navigation and berthing performance in a port.

15.2.9 Detail Design and Cost Estimates of the Project Structures

For the detail design of the project structures, following points need to be examined:

(1) In order to cope with the soft foundations observed at the construction sites of Lien Chieu and Chan May in particular, confirmation of stability of the structures, estimation of consolidation settlement of the reclaimed land and selection of effective countermeasures need to be carefully examined based on an adequate number of borings and minute sample testing.

(2) Since the design condition of wave protection facilities is quite severe due to the considerably high waves observed at the offshore points of the project sites, the project

breakwaters should carefully be designed referring to advanced technology and experiences of foreign countries.

(3) Type of the end section (final or temporary) of sea-wall or breakwater at the final stage of ISP needs to be carefully selected depending on the next stage construction schedule of the structures.

(4) In reviewing the proposed cost estimation of the projects, it is important to consider possible future inflation of price and changes in taxation policy.

15.2.10 Implementation of Port Construction Works

Following actions and cares are essential for safe, economical and efficient construction of the project structures under severe natural conditions and financial constraints.

(1) Careful construction planning and supervision are essential in preventing possible accidents and disasters due to the high waves during construction works. To this end, it is highly recommended to carry out the detailed weather and wave forecasts based on recorded observation of air pressure, wind velocity and wave height at the construction site.

(2) The offshore structures under construction are not strong enough against high waves. To avoid possible disaster by high waves, it is recommended to complete the structures leave the structures before the typhoon and north-east monsoon season.

(3) Since soft subsoil conditions are observed at the construction site in Lien Chieu and Chan May, removal and replacement of soft foundation and reclamation should carefully be executed on the basis of the deformation monitoring of the foundation.

(4) Since this is the first time for Vietnam to construct a deep sea port in the open sea area, it is recommendable to confirm any shoreline changes or channel siltation through parallel observation with actual progress of the construction works. If any countermeasures would be necessary, appropriate actions should be taken accordingly.

(5) The Study recommends a large scale caisson structure for construction of the breakwaters and wharves. In this case, it is important to prepare an appropriate base for construction works of such a large caisson, considering various factors including construction method of caisson, workability and economy.

15.2.11 Periodical Review of Port Plans

Periodical review of port plans is always required for proper promotion of port development, particularly under highly sensitive or unstable economic or social conditions. As already pointed out, cargo traffic demand in the region is expected to increase depending on economic development not only of the region but of the inland neighboring countries, and also on industrial location expected at the hinterland of the target ports. On the other hand, recent economic trend of the major Asian countries including Vietnam implies unstable/uncertain position of the total cargo flow demand to be generated by such sensitive situation of the regional economy. It should be clearly understood, therefore, that a certain level of uncertainty may creep into cargo traffic forecasts, and that there may be a certain gap between estimated potential cargo traffic demand and actual future cargo traffic to be served by the project port facilities.

Considering the above point, it is important to understand that the original plan might lead the development policy of the ports in an undesirable direction. In this sense, constant review and adjustment of the plans are essential to meet any contingency in the surrounding situation. For the three target ports in the Central Region, the recommended master plans should be carefully reviewed and adjusted, say, at least every five years.

15.2.12 Authorization of the Recommended Plans

How to realize the recommended development plan of the ports is another important point for effective implementation of the projects. There are many cases observed in developing countries where the project development as recommended in the studies fails to be successfully realized. The major reasons (apart from apparent failure in planning) for this type of failure can be summarized as follows:

(1) Lack of practicability, applicability or flexibility in proposed schemes
(2) Basic change in the government's policy for the target port development
(3) Shortage of funds for the development
(4) Failure in developing other port related infrastructure and facilities
(5) Lack of proper control by the government of related private sector activities.

In order to avoid the above mentioned failures, the plans should officially be authorized through proper procedure by laws, regulations or any other form applicable to the country concerned. This is particularly effective in securing public expenditure on a long-term basis for the projects themselves as well for other public works necessary for the projects. The plan also needs to be open to the public so that business activities concerned could be properly coordinated.

15.2.13 Human Resources Development Policy for Port Sector Development

The Vietnamese institutional and organizational structure and capability for port sector administration have been generally well developed so far. Considering the dramatic changes in various requirements of port sector administration and engineering in future, however, there would be substantial shortage and weakness in staff resources. Therefore, a systematic training strategy for port administration and management/operation staff and engineers should be established.

While on-the-job training is always one of the best ways to train the staff, this is not considered effective when they need to acquire special knowledge or capability for an advanced concept and technology or newly developed engineering systems. In this case, the government should organize specially designed training courses or promote positive participation in an appropriate ODA based technology transfer classes prepared by advanced foreign countries. Exchange of government officials among the other different ministries or agencies is another effective way to give the staff wider knowledge and experience which is considered vital for higher level administrative staff of the sector. Considering current and future administrative and engineering requirements, following subjects may be most recommendable for the Vietnamese port staff training.

(1) Overall mental attitude as public service personnel
(2) Instilling cost consciousness in the management and operation staff
(3) Coastal/port engineering and structural design for a river mouth and deep sea area (deep sea break water, quay, navigation channel/basin, and coastal protection etc.)
(4) Oceanographic surveys and analyses on wave, current, sand drift and so on
(5) Investment planning , legal and safety inspection for port operation staff
(6) Privatization policy and practice for headquarters staff
(7) Computerized operation for cargo handling, accounting, and statistics

15.2.14 Improvement of Port Statistics

Accurate and reliable port statistics including cargo handling volume, number of ships calling, port operation performances and other data/information are essential as a base of port planning, administration, management and operation. Although some port related data and statistics in Vietnam are well collected and compiled, following suggestions may be useful for further improvement of the port statistic system of the country.

(1) Since port statistics are recognized by major countries of the world as one of the most basic data sources not only for the port sector development but the national economic development policy making, the total systems for the statistics have been improved accordingly under the responsible government agencies. While it may be a difficult task to establish a complete port statistics system, which may sometimes be expensive, it is recommended to make further efforts for upgrading accuracy, reliability, consistency, coverage and contents of the statistics.

(2) With a view to achieving the above mentioned objectives, standardization of statistics forms under jurisdiction of MOT need to be established, which may require a practical proposal supported by an intensive study on the subject.

15.2.15 Natural and Social Environment Conservation

Based on the overall assessment conducted under the Study, it can be understood that development of port function itself does not generally have any serious adverse effects on the existing environment of the area. The possible increase of population with corresponding economic activities as a result of port development may, however, cause general increase of the basic load on the environment system. Under the situation, following suggestions may be useful for effective conservation and/or even upgrading of the environmental quality of the area:

(1) While the detailed environmental impact assessment is supposed to be officially conducted before commencement of the construction works, under the regulations concerned of the government, by the executing agency of the project for MOSTE approval, this procedure should not be considered as an objective of the port sector environment administration. It is more important, in this context, to understand that the final objective is to secure better quality of environment for the residents, workers and visitors of the port so all people can fully accept and enjoy the existence of the port and its activities.

(2) In order to achieve the above objective, it is essential to establish an environmental policy in respect to port development and institutional and organizational arrangements for effective port sector environmental administration. Preparation of an action program for environment conservation activities and provision of appropriate level of budget for execution of the policy are also vital accordingly.

(3) At the actual implementation stage of the project, following items needs to be considered:

1) Tracing surveys on the impact to water quality and marine life as a result of construction works need to be conducted throughout the construction period of the project facilities.

2) For the environmental factors such as water quality, heavy metal in the bottom materials and other hazardous materials, which may have some effects on human and marine life, need to be carefully checked in EIA not only at the port development sites but across wider areas including the industrial zones, urbanized areas and upstream lands of the rivers, so that a comparative assessment could be made among the different types of the areas.

3) Regarding relocation of residents in and around the project sites, it is important to pay maximum attention to their quality of life through appropriate measures including adequate compensation, creation of job opportunities, and so on.

15.2.16 Financial Status of Danang Port Development Project

As illustrated in Conclusion of the Report, the short term development plan of Lien Chieu area is considered financially viable although the calculated value of FIRR under the worst case (10% increase for the cost and 10% decrease for the income) is only slightly over the possible lowest interest rate of available funds for the project. While it appears that the financial position of the project may not be adequately sound under this estimation, this does not necessarily mean that the project would be financially risky, because some potential income sources and cost saving factors were not fully counted in the calculation under the principle of being on safe side. In this context, however, following suggestions may be useful in further strengthening the financial status of the project:

(1) EIRR of the project is substantially higher than the FIRR. This means that there may be considerable amount of external economy of the project, which could be internalized, for instance, by collecting a kind of special tax or charge from the direct external beneficiaries such as local port related industries and general private entities in a certain zone of Danang city. For the nation wide benefit of the project, it may sometimes be justified, if the situations allow, that an appropriate portion of the general income tax be used for a new port project at the initial stage of development in particular, when the financial position is normally weak and tight.

(2) With a view to increase the project income, one possible scheme is to rent for general commercial use a part of the available land and space created as a result of construction of the major project facilities. While the potential income from such an operation is not

included in calculating the FIRR of the project in the Study, the executing agency of the project could enjoy substantial benefits depending on its devises and will.

(3) While the cost estimates of the project are reasonably proposed in the Study, potential cost saving factors may still be found in the detail design and construction stage. Utmost efforts in this regard should be made in economic design, bidding process and procurement of construction materials.

15.2.17 Basic Development Concept for Dung Quat Port

The major objective of port development at Dung Quat is to construct the related port facilities for the oil refinery with necessary scale of public port function since it is normally difficult to provide sufficient port function for industrial complex to be located in its direct hinterland using only private funds of such industries. This is because this type of large industrial port require a considerable scale of the exclusive port facilities for both private and public sectors for industrial and general cargo traffic generated by various private/public activities at the hinterland. In order to cope with this situation, the project needs to be supported by public funds to the appropriate extent, so that the project could be financially sustainable and the industrial location could be successfully promoted.

As for the construction of the project facilities, it is important to start the initial development of the port and access road necessary for unloading construction materials of the project facilities at the earliest timing upon confirmation of location of the first industry at the site.

APPENDIX

List of Tables

List of Figures

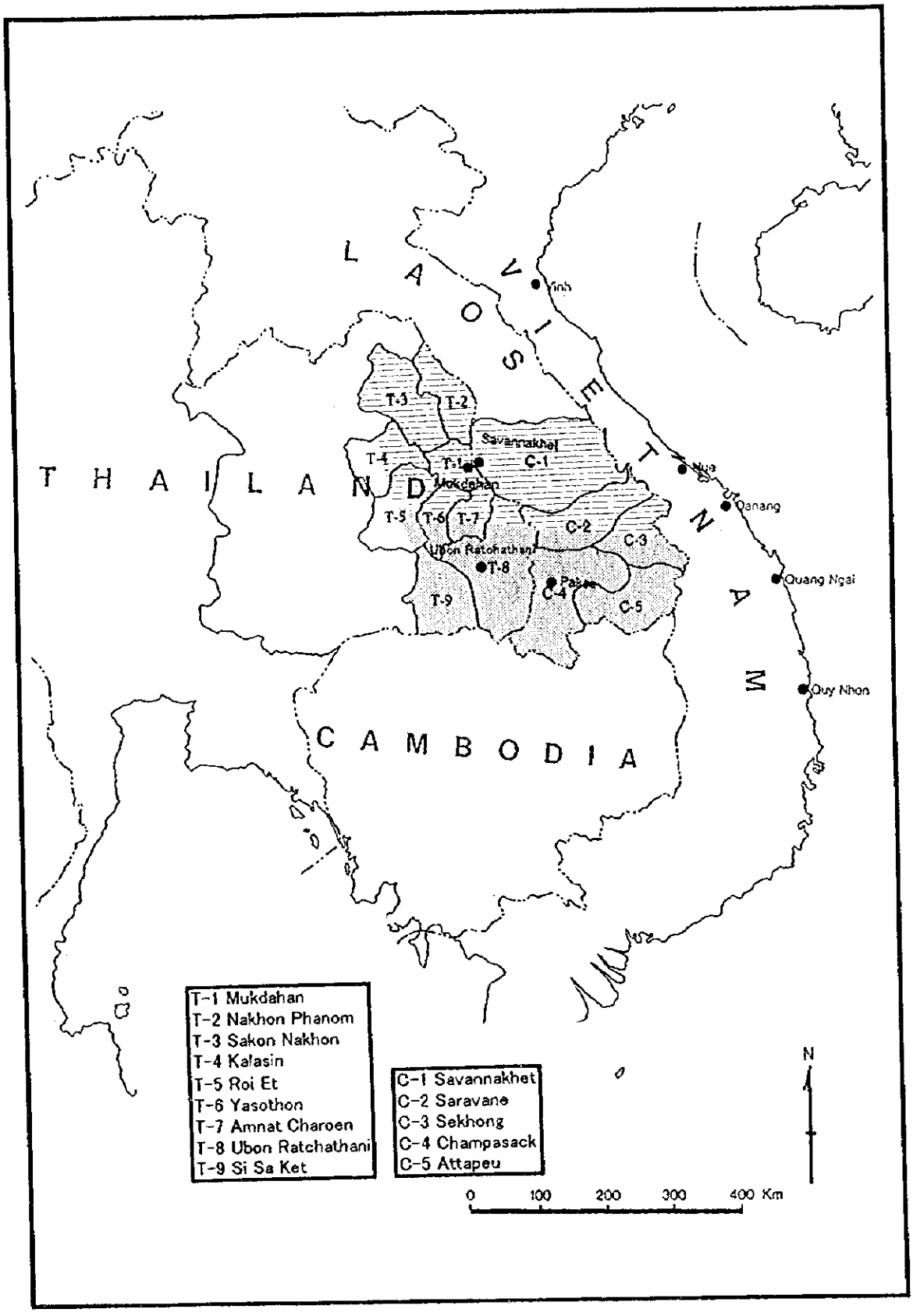


Figure A 2.2.2 Southern Lao and Northeast Thailand

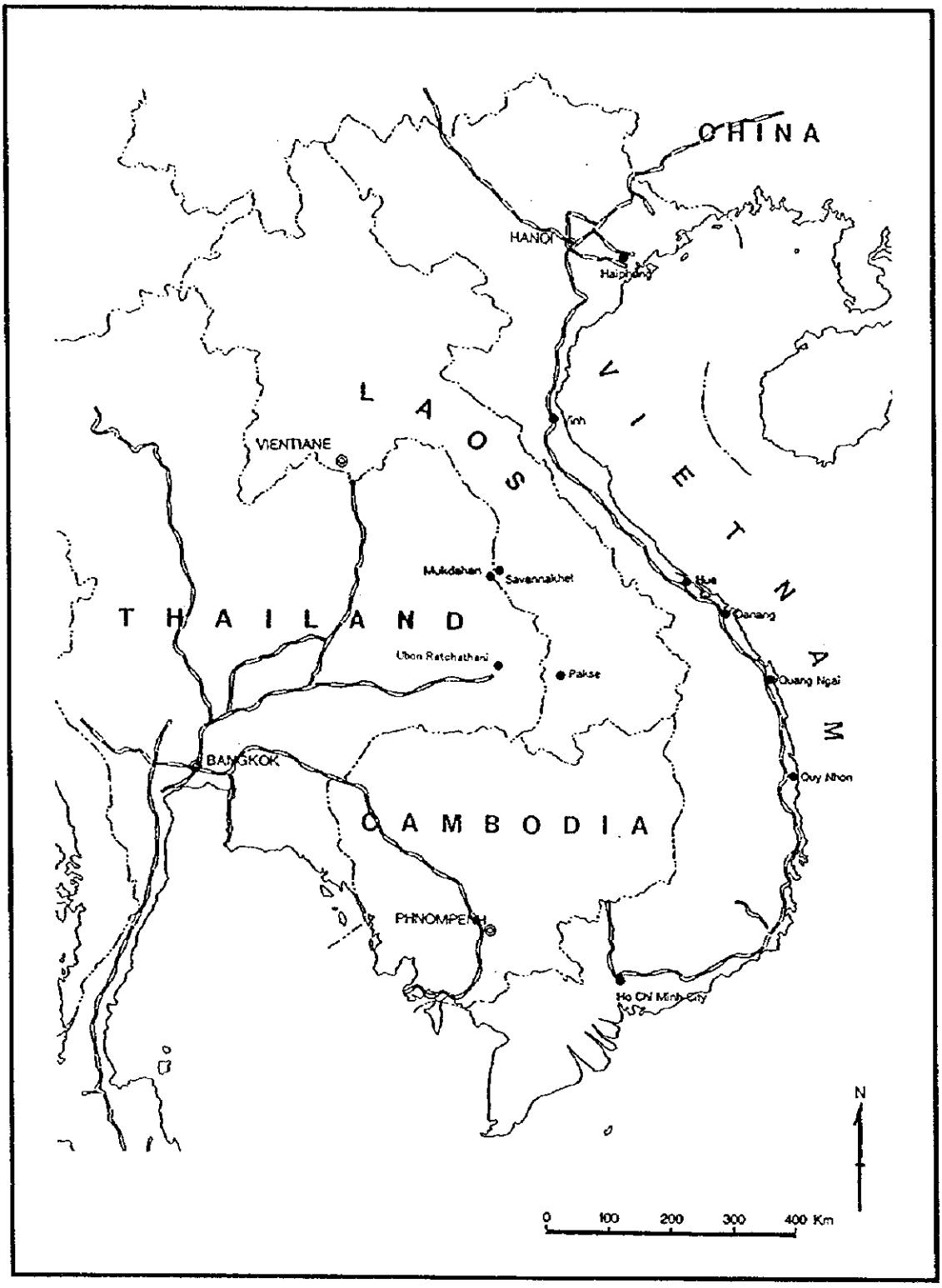
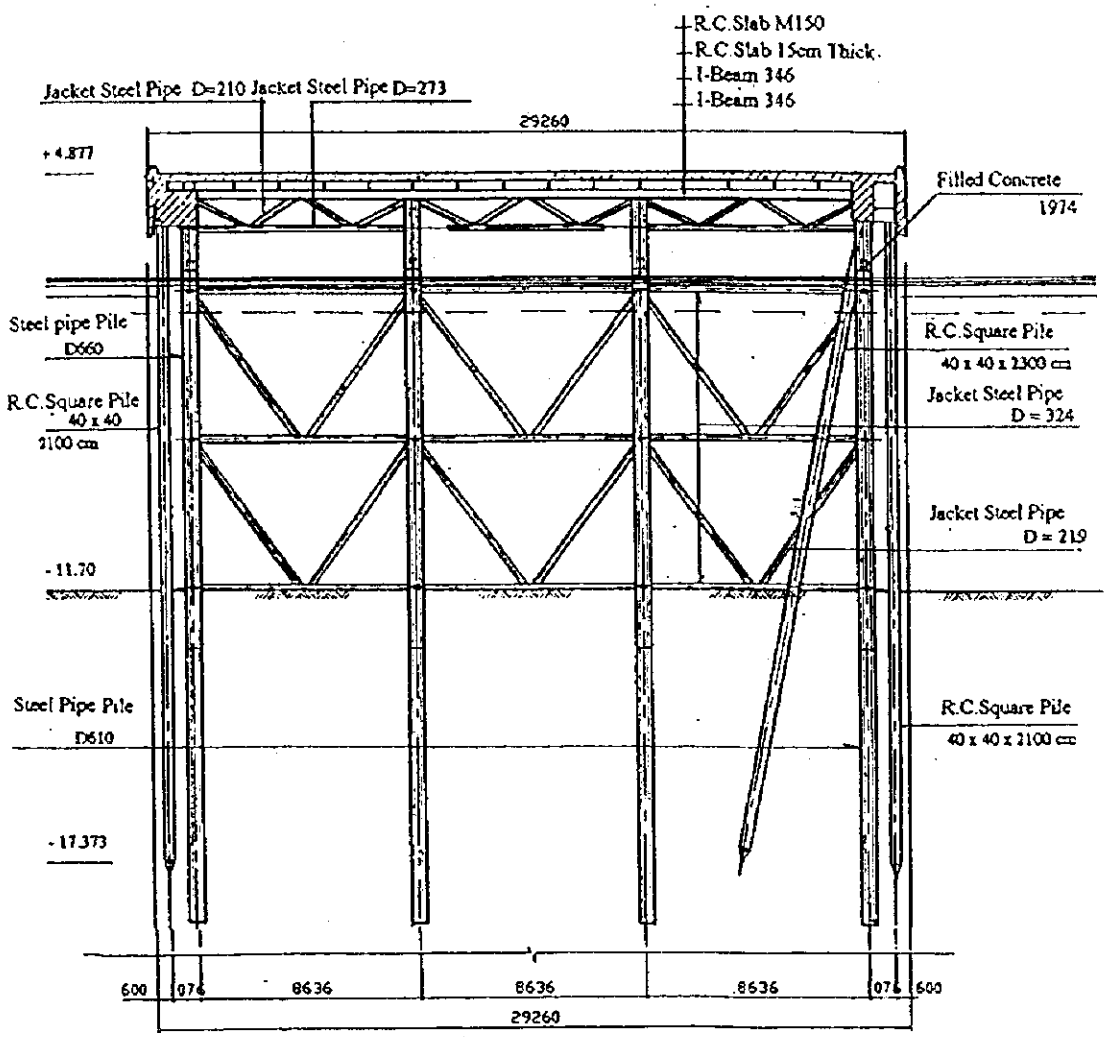
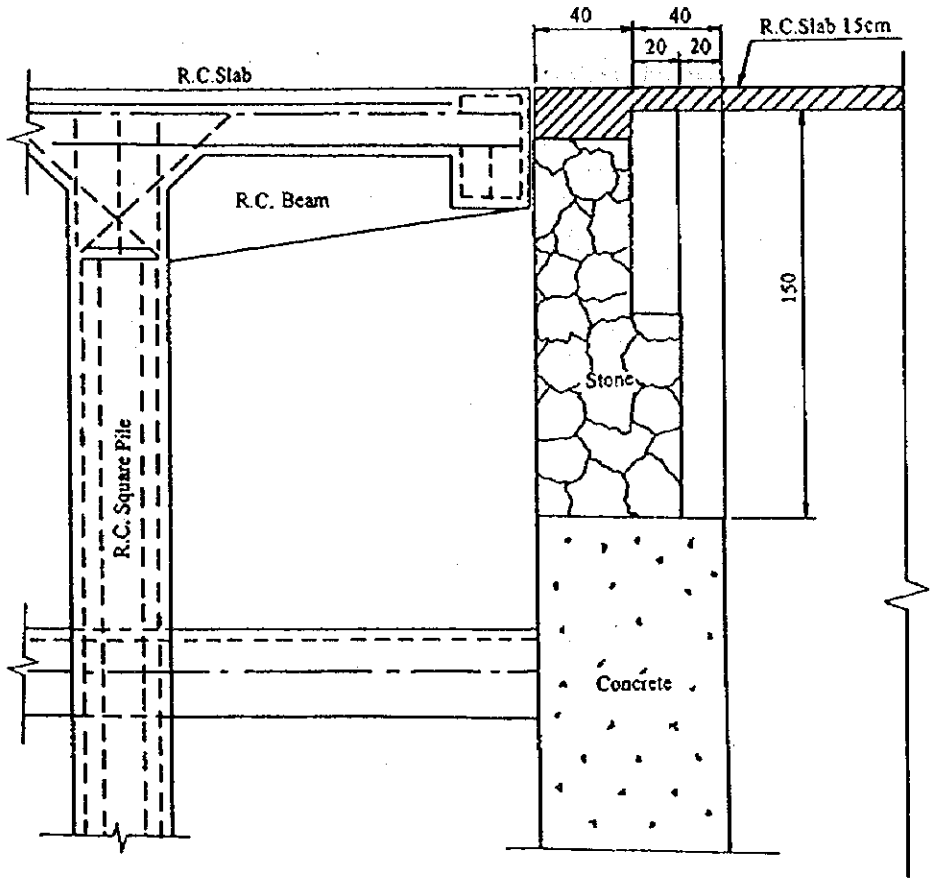


Figure A 2.3.3 Railway Map of Vietnam



Source: Marine Engineering in Hai Phong

Figure A3.1.1 The Typical Cross Section of No.1 and No.2 Jetty Piers



Source: Danang Port

Figure A3.1.2 Typical Cross Section of Wharf in Song Han Port

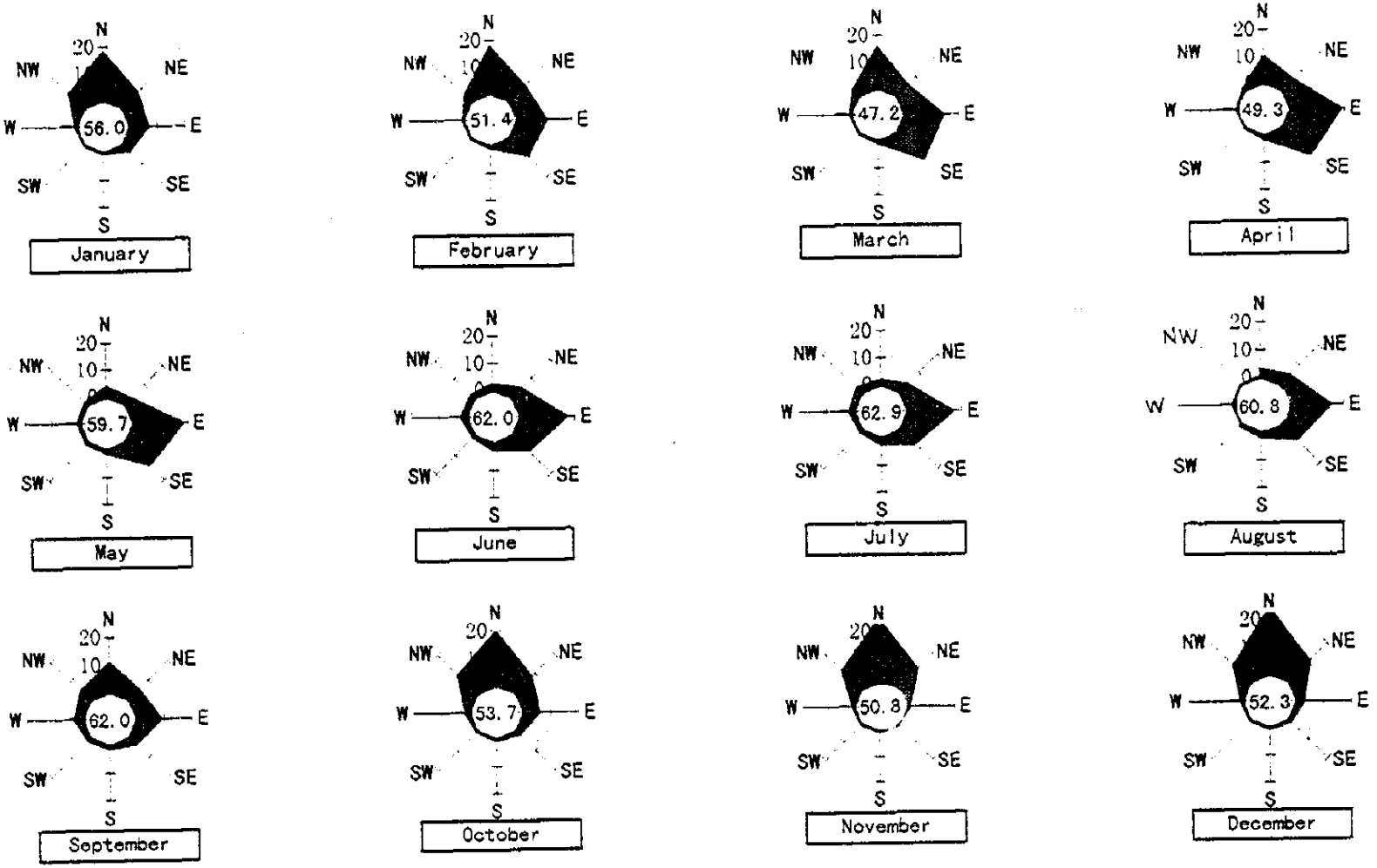
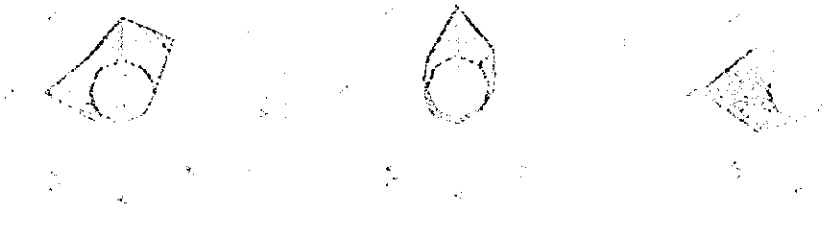
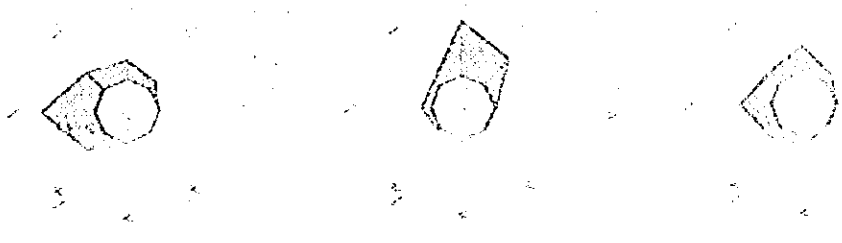


Figure A 4.2.1 Wind Roses at Observatories on the Land Quang Ngai Observatory

Data source: Institute of Meteorology and Hydrology





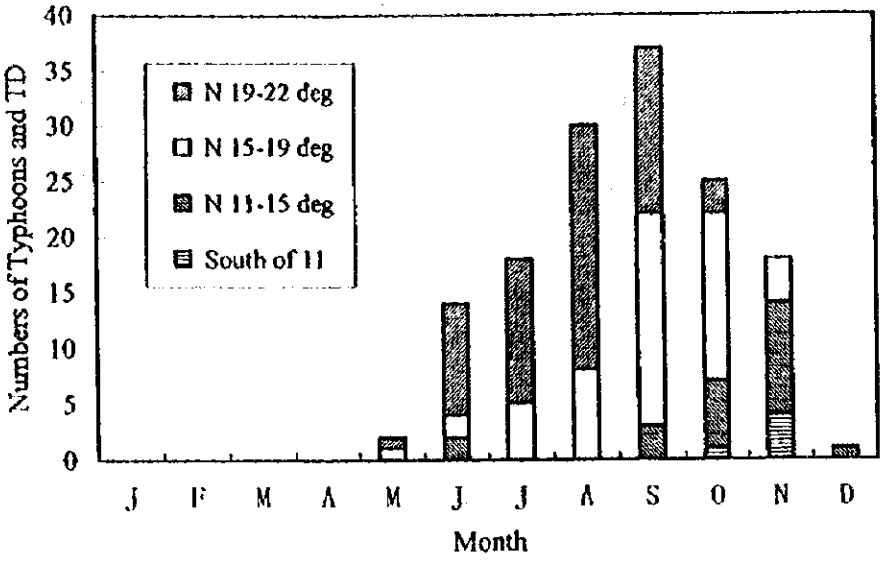


Figure A 4.2.2 Number of Typhoons by Region of Vietnam (1954-1980)

Data Source: MHMC "Report on Storm Characteristics" 1995

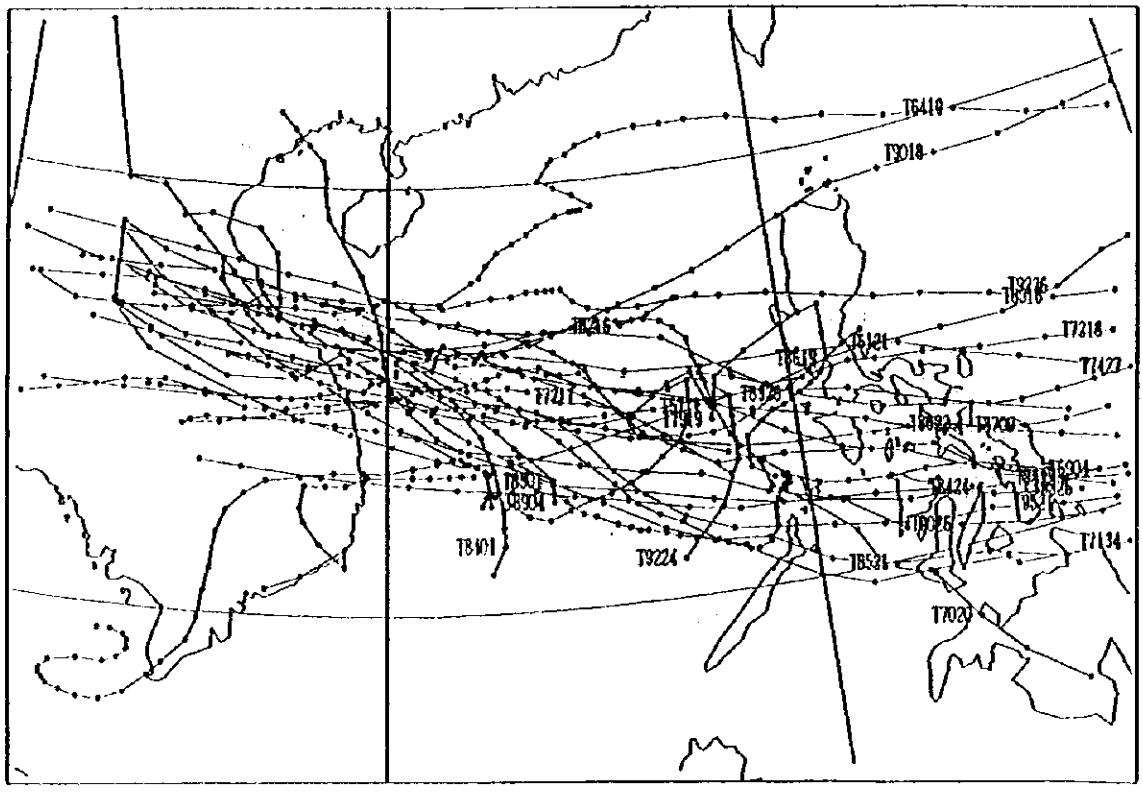


Figure A 4.2.3 Tracks of Typical Typhoons affected Central Vietnam

Table A 4.2.2 Typhoons Most Affected the Central Coast of Viet Nam (1961-1997)

No.	Typhoon No.	Name	Approach direction	Place landed**	Date landed	Pc* (hPa)	Wind*		Speed* U (km/hr)
							V (m/sec)	Direction	
1	9721	Fritz	E	DN-QN	25-Sep-97	980	24	NE	12
2	9622	Beth	ENE	DN-QN	22-Oct-96	1006	12	N	20
3	9521	**Zack**	**E**	South QN	1-Nov-95	965	34	N	13
4	9325	**Kyle**	E	South QN	23-Nov-93	960	44	NE	28
5	9226	Colleen	ESE	South QN	28-Oct-92	980	24	NNW	29
6	9224	Angela	NE	South QN	23-Oct-92	990	30	NW	10
7	9025	**Mike**	ESE	Offshore	16-Nov-90	970	20	NNE	12
8	9018	**Ed**	E, SE	Offshore	19-Sep-90	980	31	NNE	13
9	8926	**Dan**	ESE	North HU	13-Oct-89	965	40	-	25
10	8904	**Cecil**	E	DN-QN	24-May-89	980	22	-	12
11	8829	Skip	E, N	Offshore	12-Nov-88	995	16	NNW	10
12	8709	**Betty**	ESE	North HU	16-Aug-87	950	>40	NNE	18
13	8622	Georgia	ESE	South QN	22-Oct-86	990	20	-	18
14	8619	Dom	E	North HU	11-Oct-86	998	24	NNW	16
15	8521	**Cecil**	ESE	North HU	15-Oct-85	970	35	-	23
16	8424	**Agnes**	ESE	South QN	7-Nov-84	975	40	-	31
17	8401	Vernon	ESE	DN-QN	10-Jun-84	996	16	-	19
18	8316	Lex	E	North HU	26-Oct-83	985	40	-	20
19	8301	Sarah	SE	North HU	25-Jun-83	1000	14	-	15
20	8216	**Hode**	E	DN-QN	6-Sep-82	980	20	-	24
21	7919	Sarah	E	South QN	14-Oct-79	965	22	-	9
22	7427	**Faye**	E	South QN	4-Nov-74	992	26	-	23
23	7218	**Elsie**	NE	South QN	4-Nov-72	995	31	-	6
24	7217	Flossie	ENE	South QN	15-Sep-72	995	26	-	9
25	7134	**Hester**	**SE**	DN-QN	23-Oct-71	970	40	-	26
26	7112	**Harriot**	E	North HU	6-Jul-71	985	28	-	25
27	7020	Kate	E	DN-QN	25-Oct-70	990	33	-	19
28	6904	Tess	ESE	North HU	11-Jul-69	990	28	-	22
29	6419	Tilda	E	North HU	22-Sep-64	990	38	-	14
30	6121	Ruby	ESE	North HU	24-Sep-61	992	28	-	33

* Figures of wind are at the nearest in-land station. Pc, wind and speed are when the typhoon landed on the coast. Wind are maximum (gust) wind. (-) are lost data.

** DN-QN : Landed between Da Nang and Quang Ngai
South QN : Landed at south of Quang Ngai
North HU : Landed at north of Hue
Offshore : Passed offshore (not landed)

Data Source: Institute of Meteorogy and Hydrology, 1997

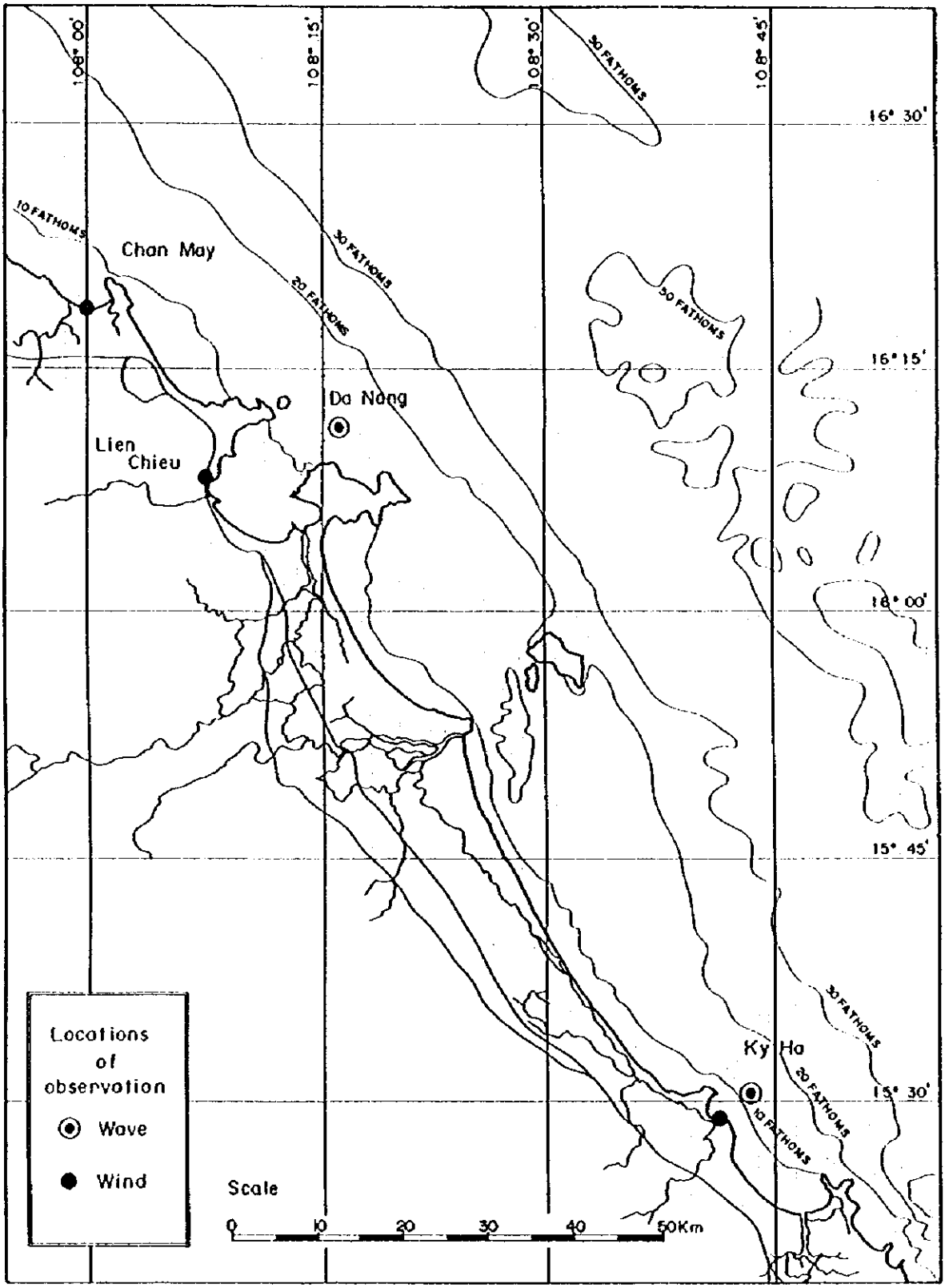
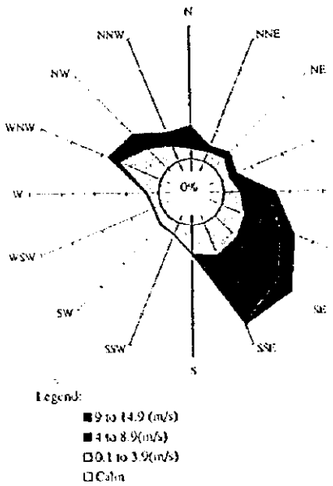


Figure A 4.2.4 Locations of Wind and Wave Observation by the JICA Study Team

April/1997



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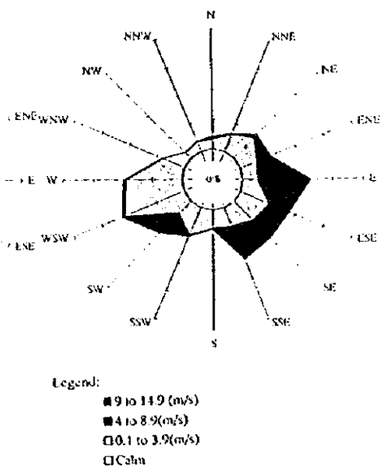

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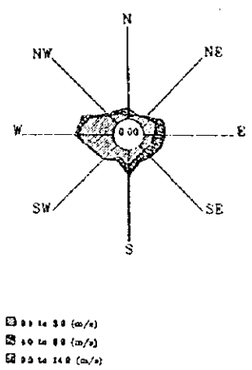

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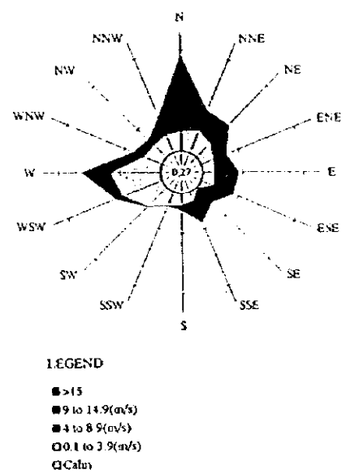
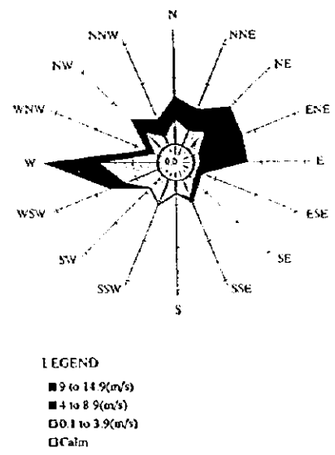


December/1997



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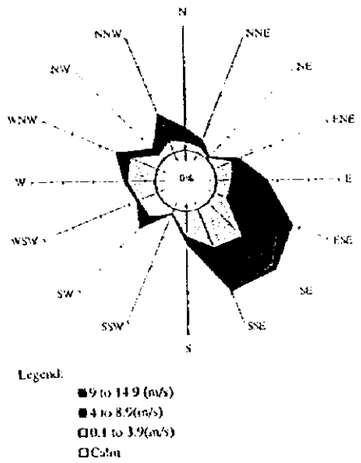
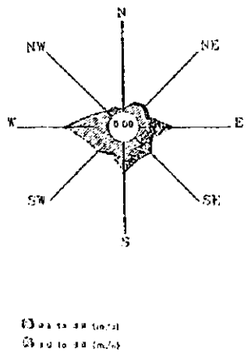


July/1997



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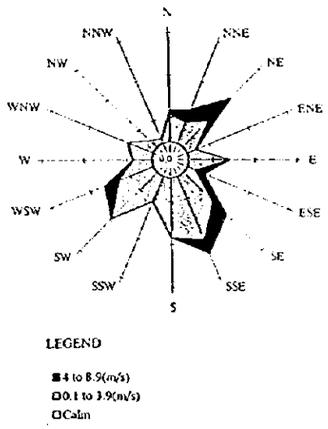

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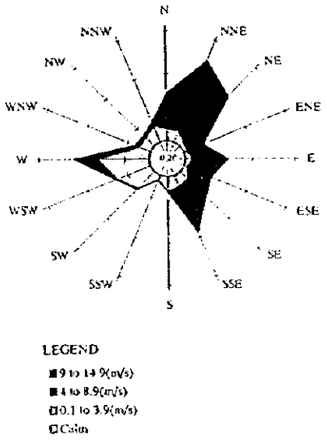


Figure A 4.2.5 Wind Observed at Ky Ha by the Study Team

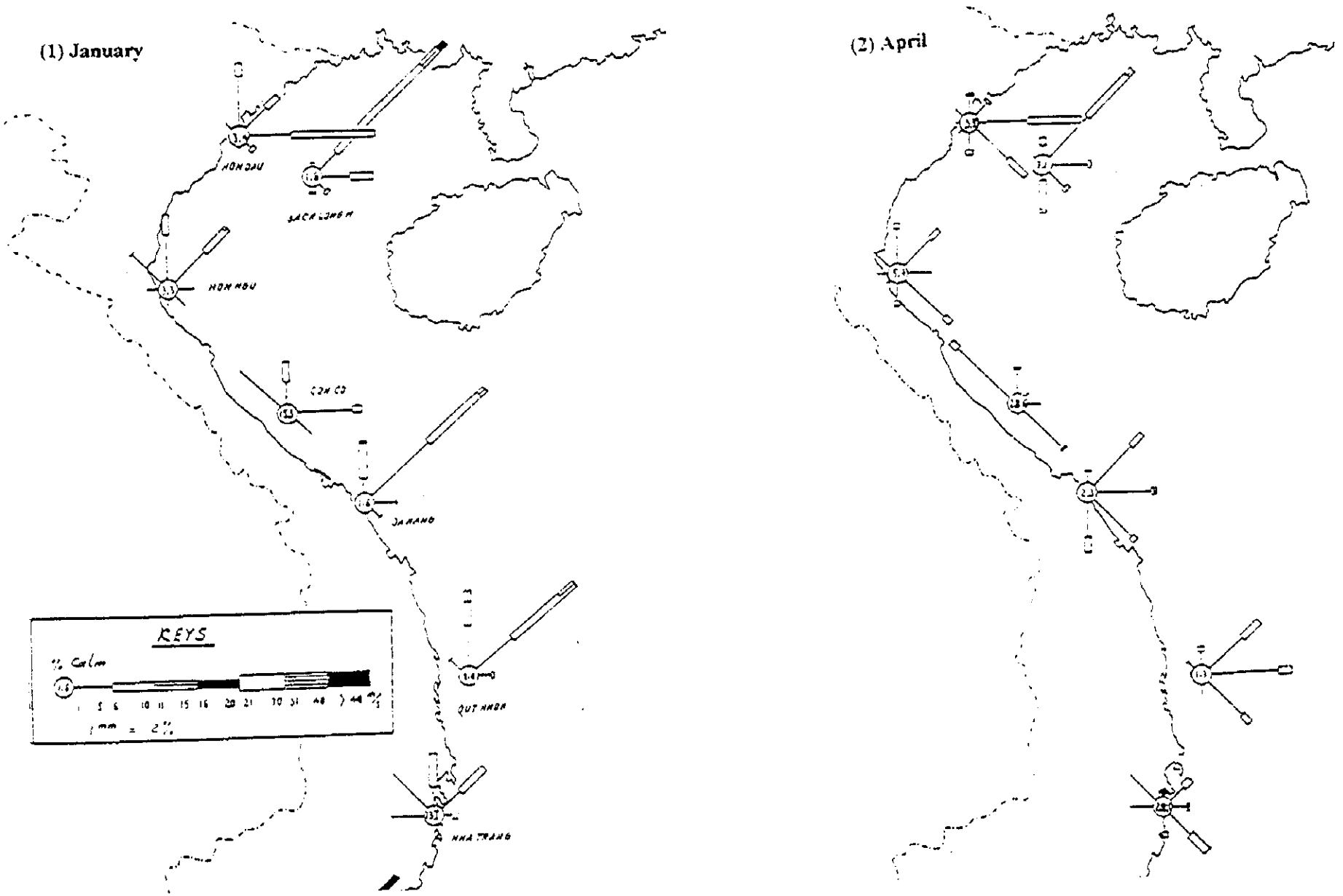


Figure A 4.3.1 Wave Roses at Northern and Central Stations on the Coast (1)

Source: MHMC "Report on Wave Statistics", July 1995

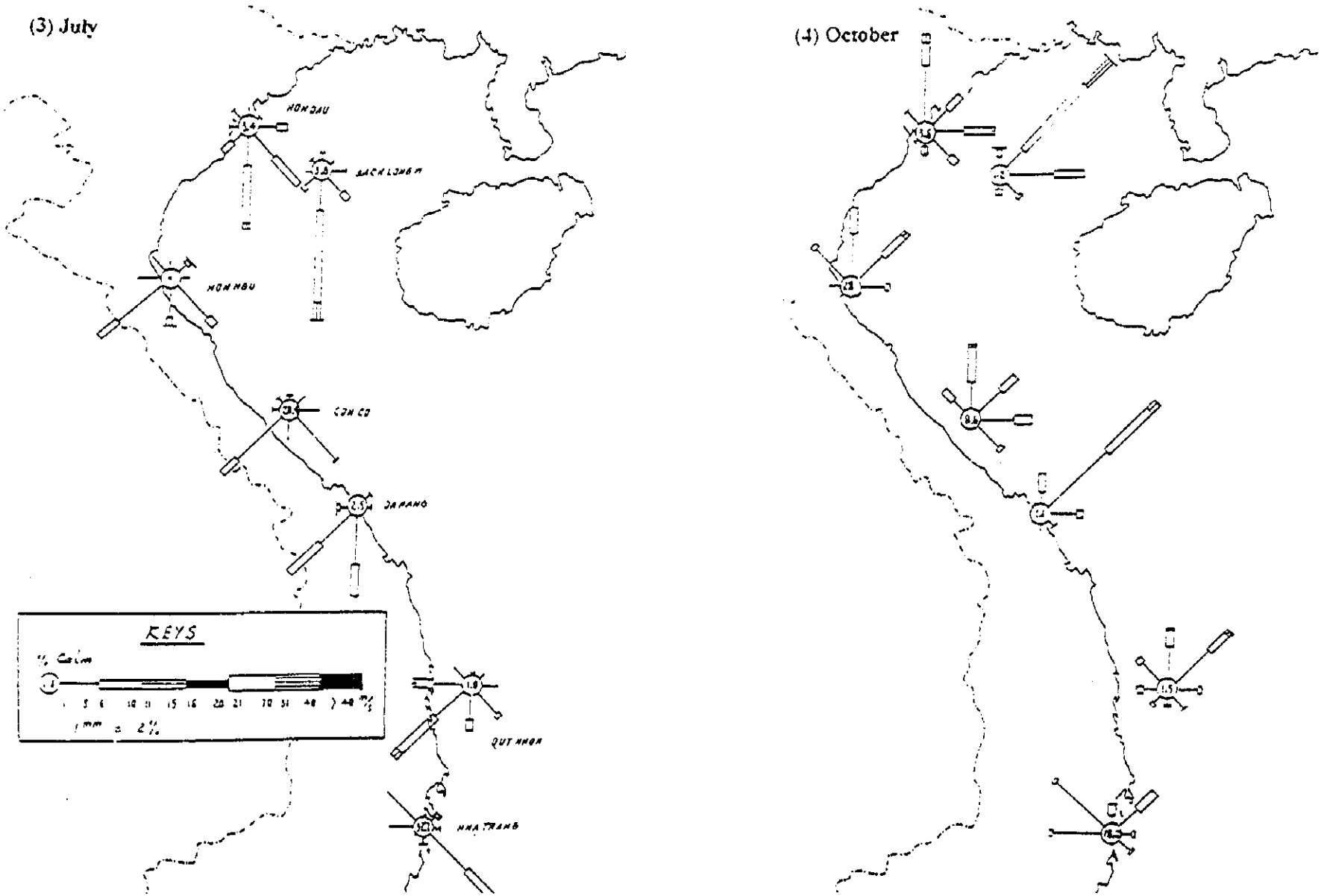


Figure A4.3.1 Wave Roses at Northern and Central Stations on the Coast (2)

Source: MHMC "Report on Wave Statistics", July 1995

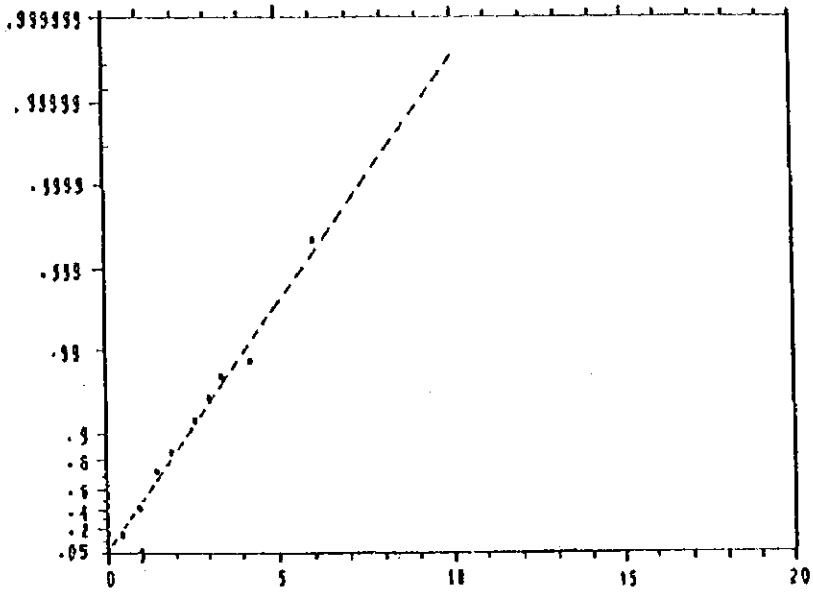


Figure A 4.3.2 Probability Distribution of Wave Height at Son Tra, Danang

* Source: MHMC "Report on Wave Characteristics", July 1995

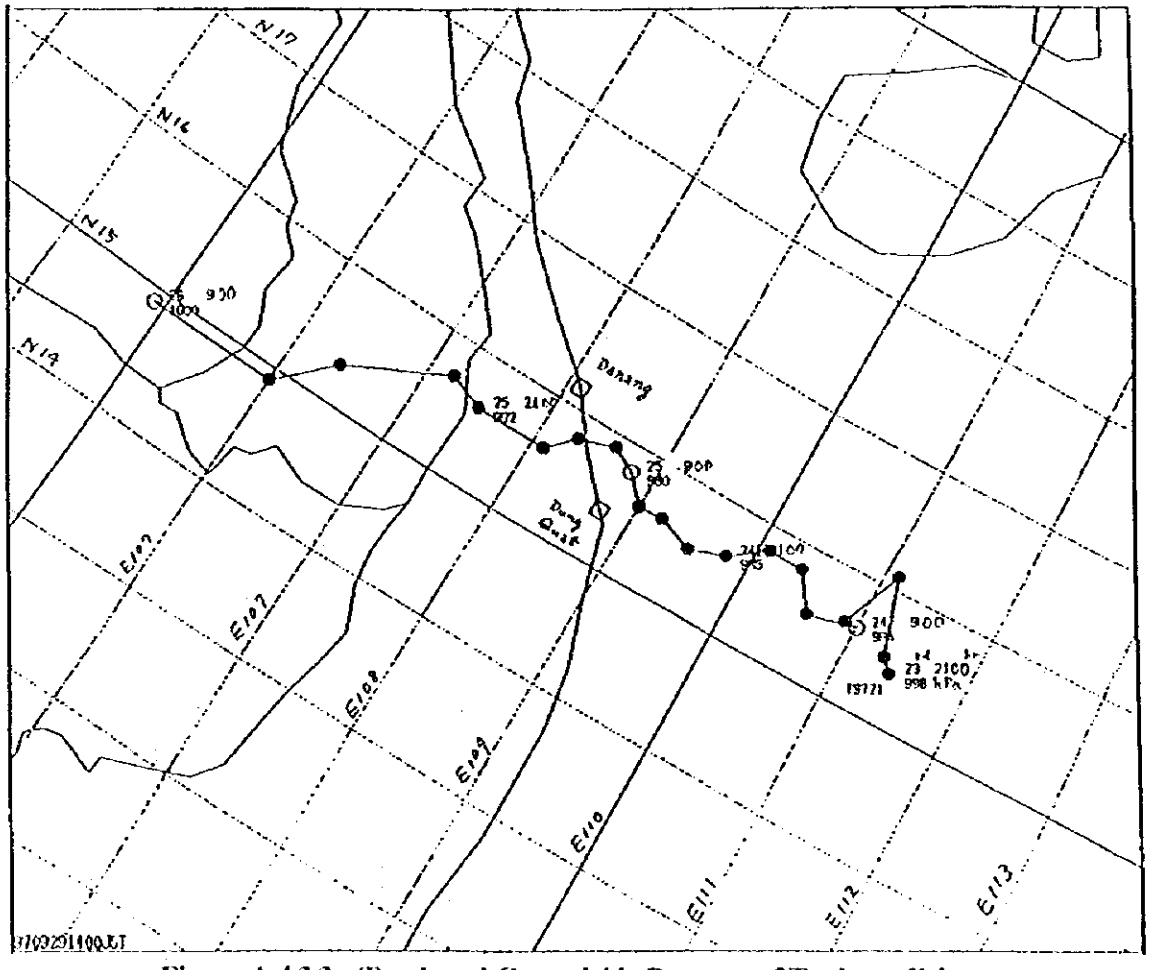


Figure A 4.3.3 Track and Central Air Pressure of Typhoon Fritz

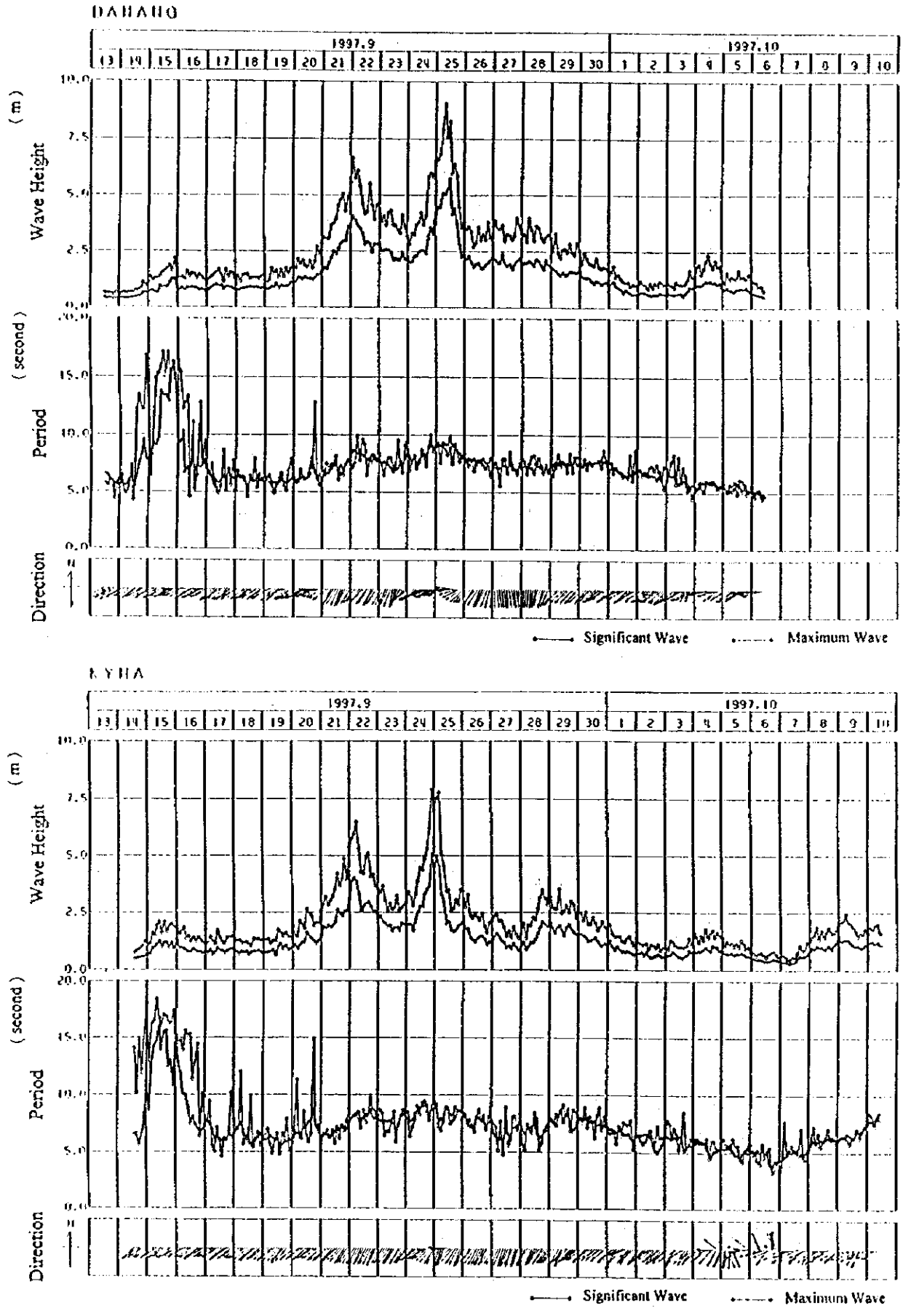
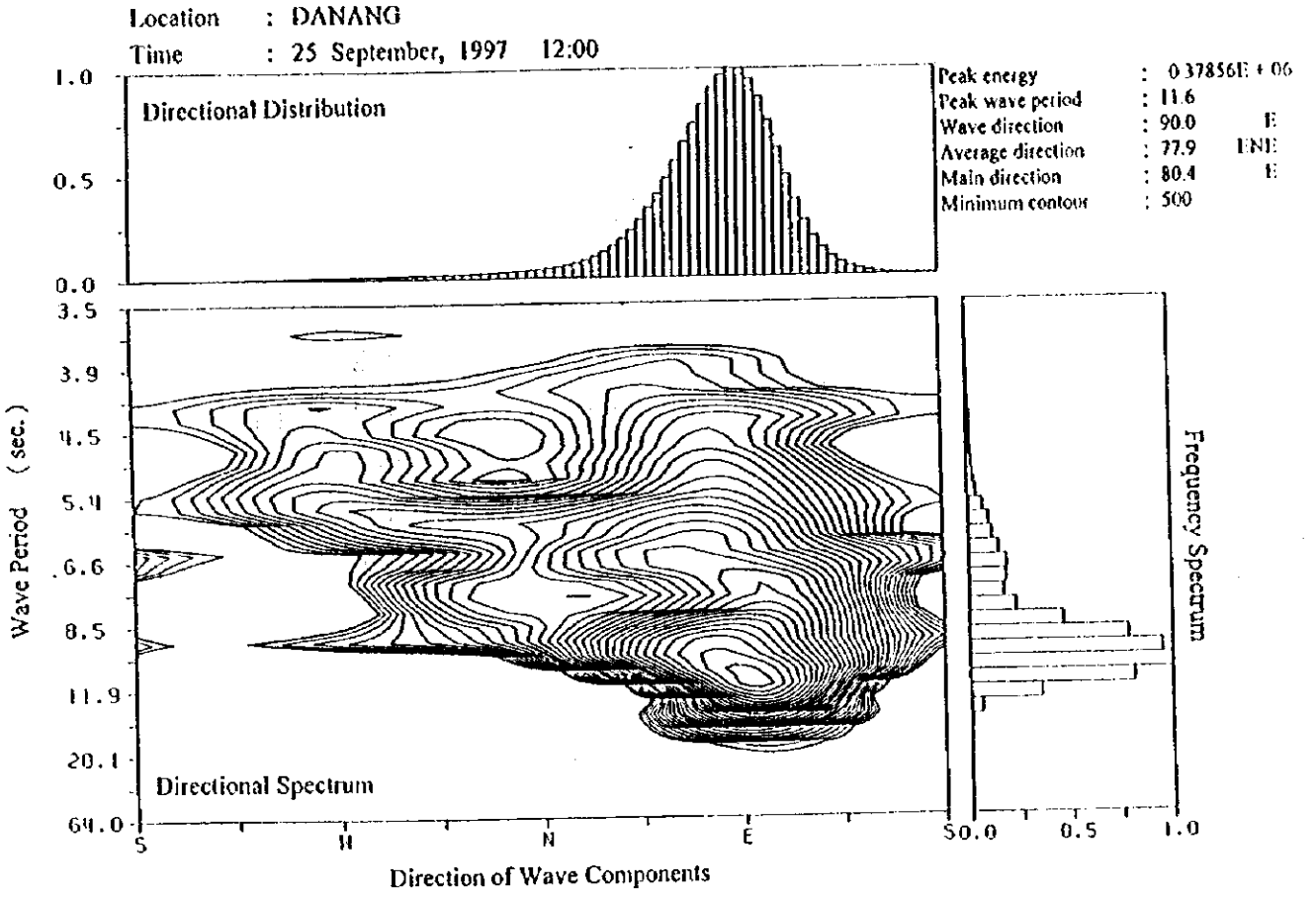


Figure A 4.3.4 Time Series of Wave Records at Danang and Ky Ha



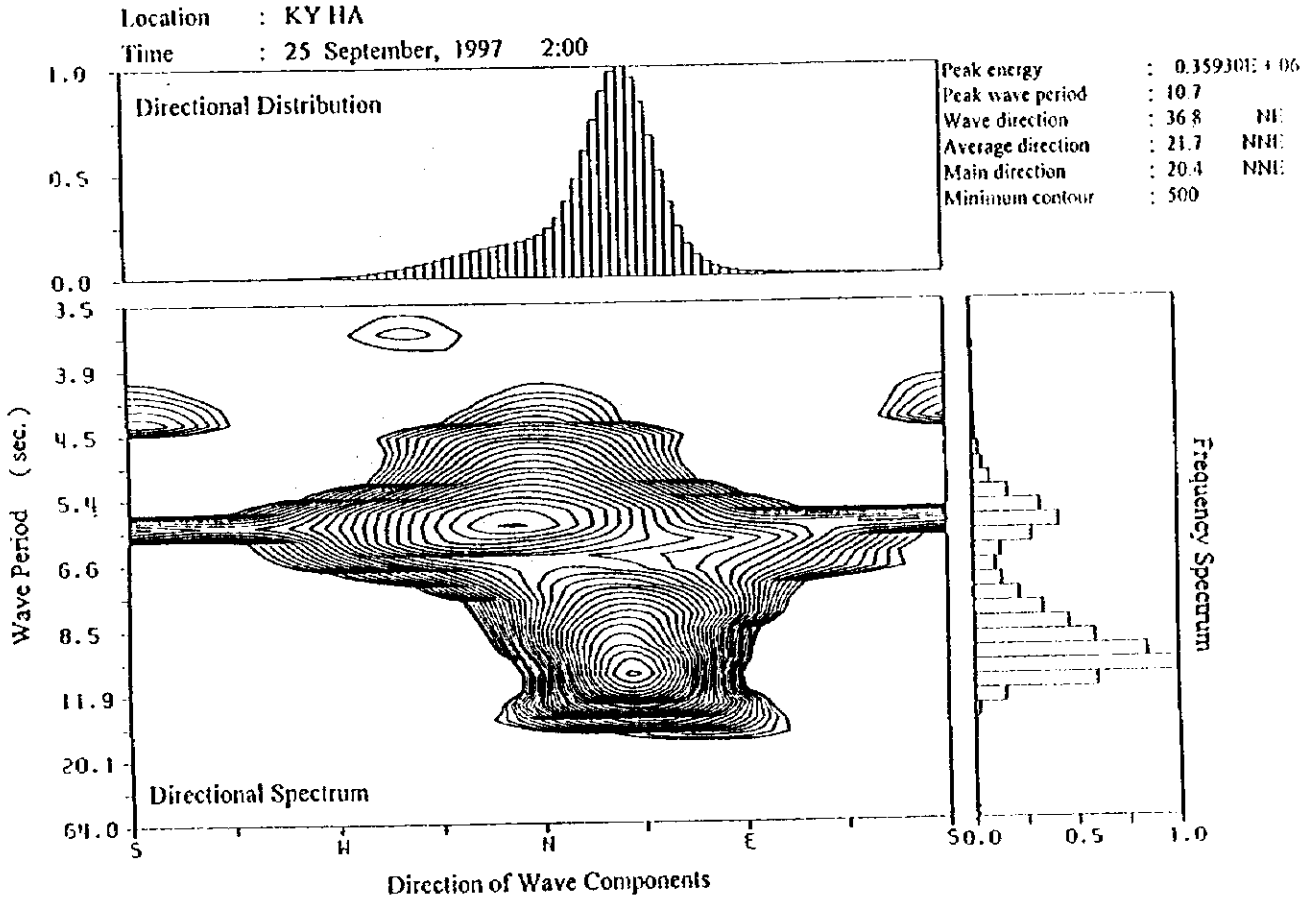


Figure A 4.3.5 Directional Spectra of Waves Generated by Typhoon Fritz

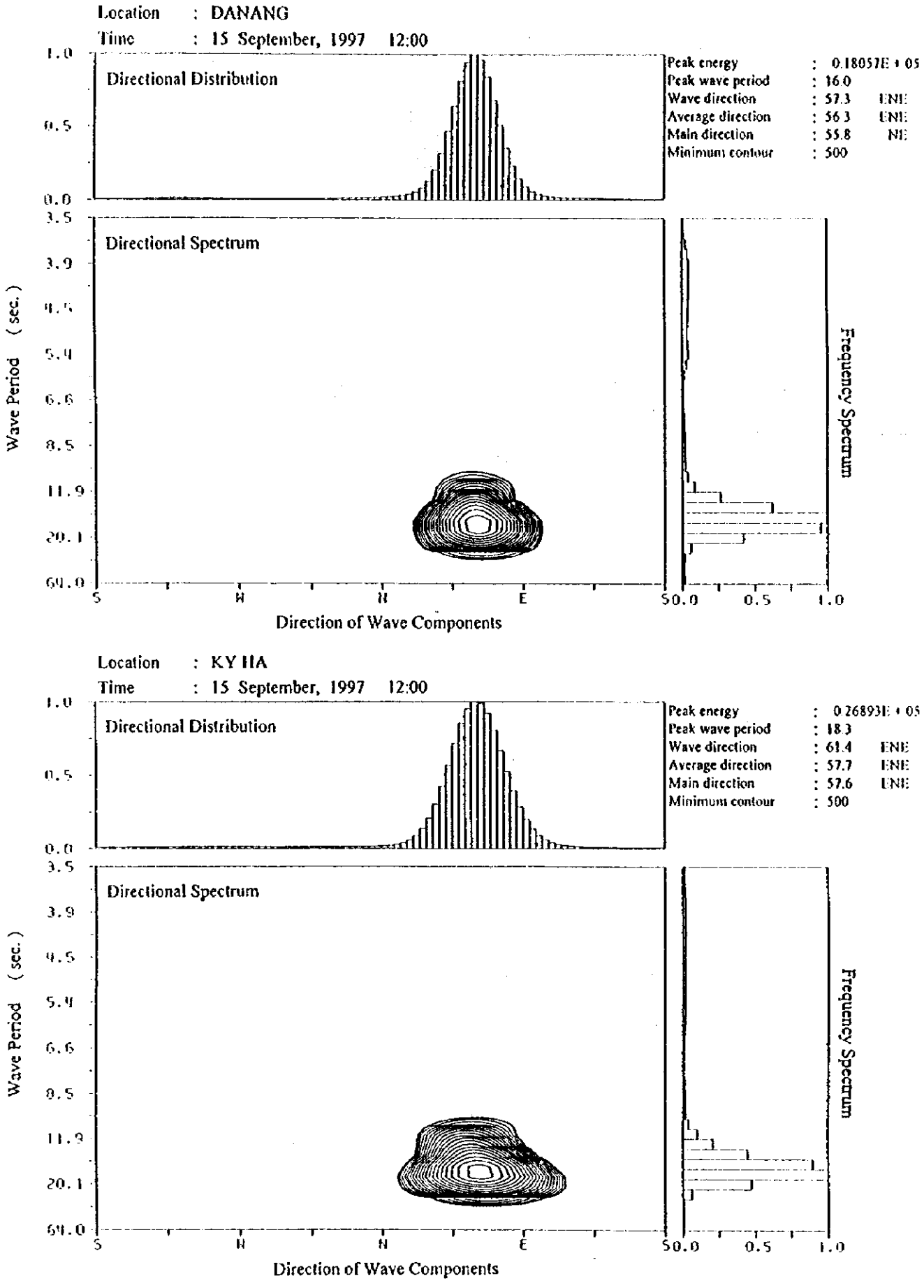
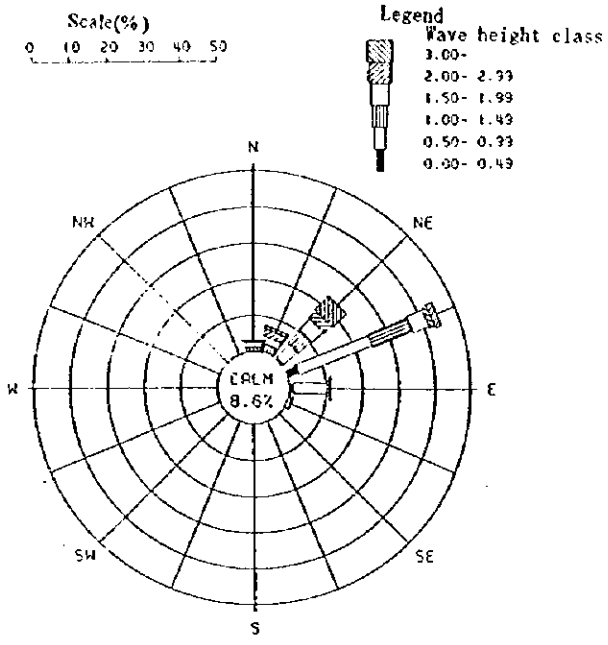
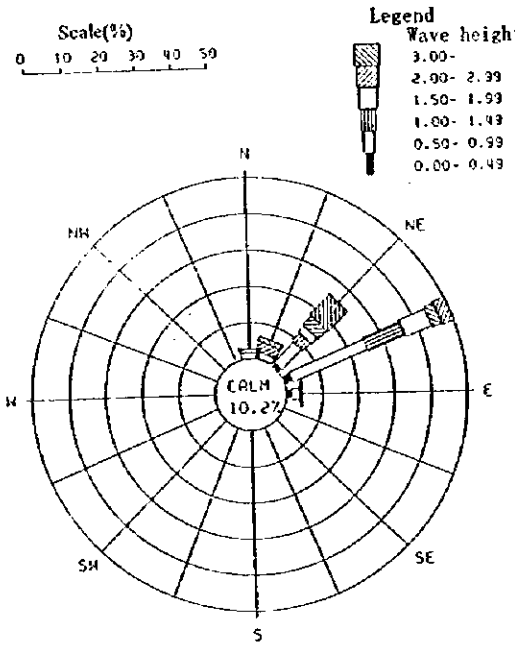


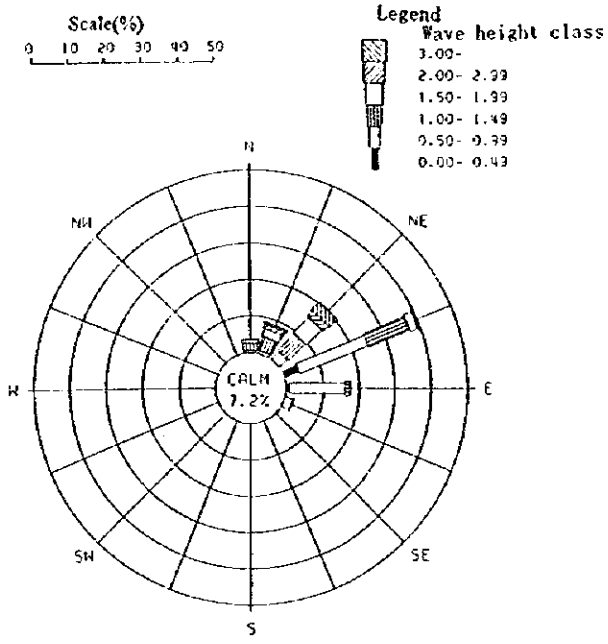
Figure A 4.3.6 Directional Spectra of Swells Propagated from Remote Typhoon



All period (Sep. 1997 ~ Feb. 1998)

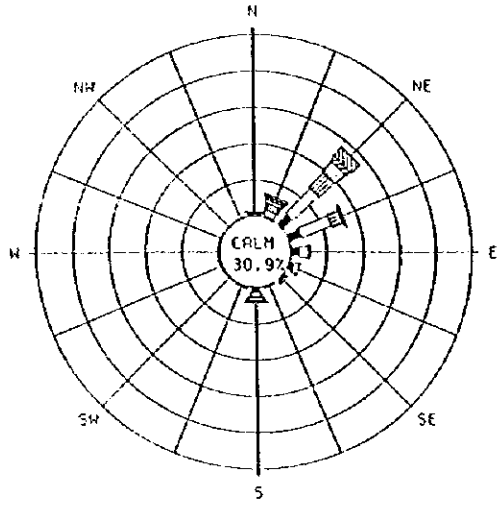


From Sep. to Nov. 1997

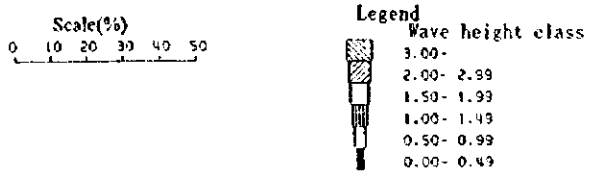


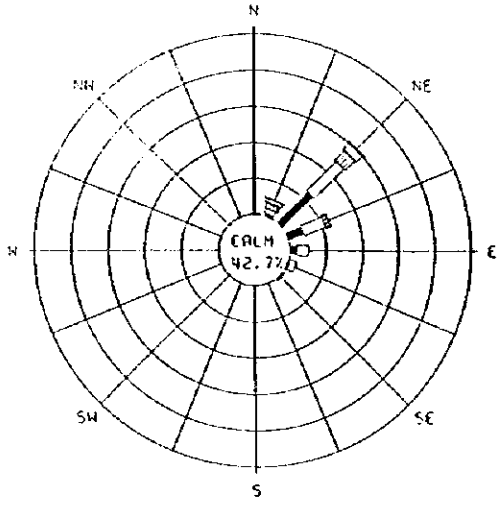
From Dec. 1997 to Feb. 1998

Figure A 4.3.7 Wave Roses of Observed Waves (1) Danang

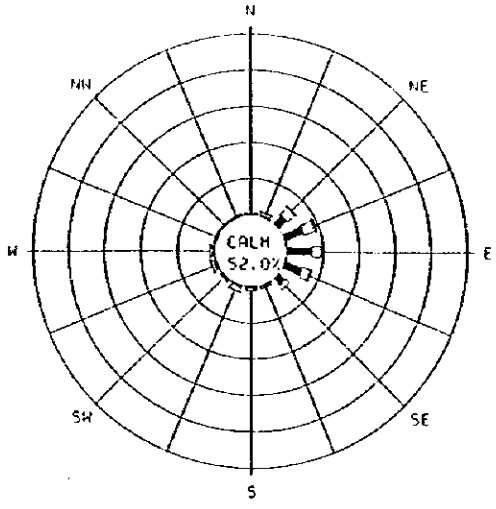


All period (Apr. 1997 ~ Feb. 1998)

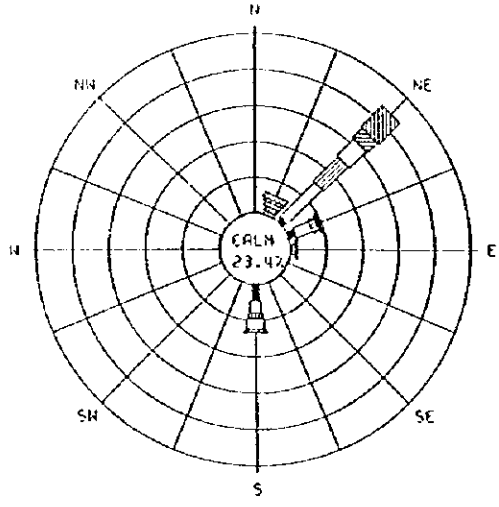




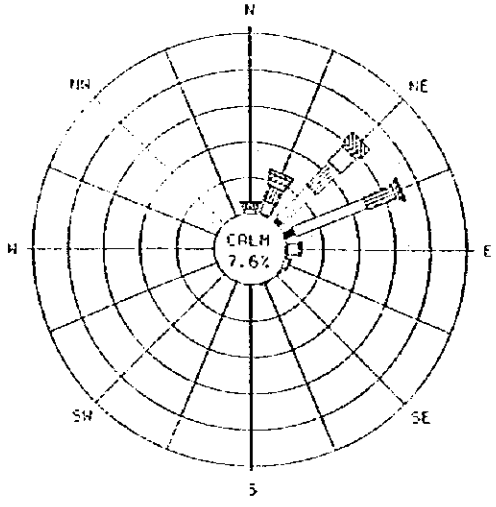
From Apr. to May. 1997



From Jun. To Aug. 1997



From Sept. to Nov. 1997



From Dec. 1997 to Feb. 1998

Figure A 4.3.7 Wave Roses of Observed Waves (2) Ky Ha

Table A 4.3.2 Frequency Distribution of Observed Waves by JICA Study Team

(1) Location : Mouth of Danang Bay

Total no. of data: 1,731 % of successful observation: 79.7 %

Unit: %

Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm*	Total
0.00-																		0.0
0.25-	0.1		0.6	3.4	1.3												2.8	8.2
0.50-		0.1	2.2	11.4	6.4	1.0	0.1										5.0	26.2
0.75-	0.3	0.5	2.9	10.1	2.5	0.2											0.8	17.3
1.00-	0.6	0.6	2.5	6.5	0.9	0.1												11.2
1.25-	0.4	1.4	2.3	5.3	0.1													9.5
1.50-	0.3	1.2	2.3	3.2												0.1		7.1
1.75-	1.0	0.8	1.8	1.6														5.2
2.00-	0.4	0.9	1.6	0.9														3.8
2.25-	0.1	1.1	1.2	0.5														2.9
2.50-	0.1	0.9	5.4	1.8	0.2													8.4
Total	3.3	7.5	22.8	44.7	11.4	1.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	8.6	100.0

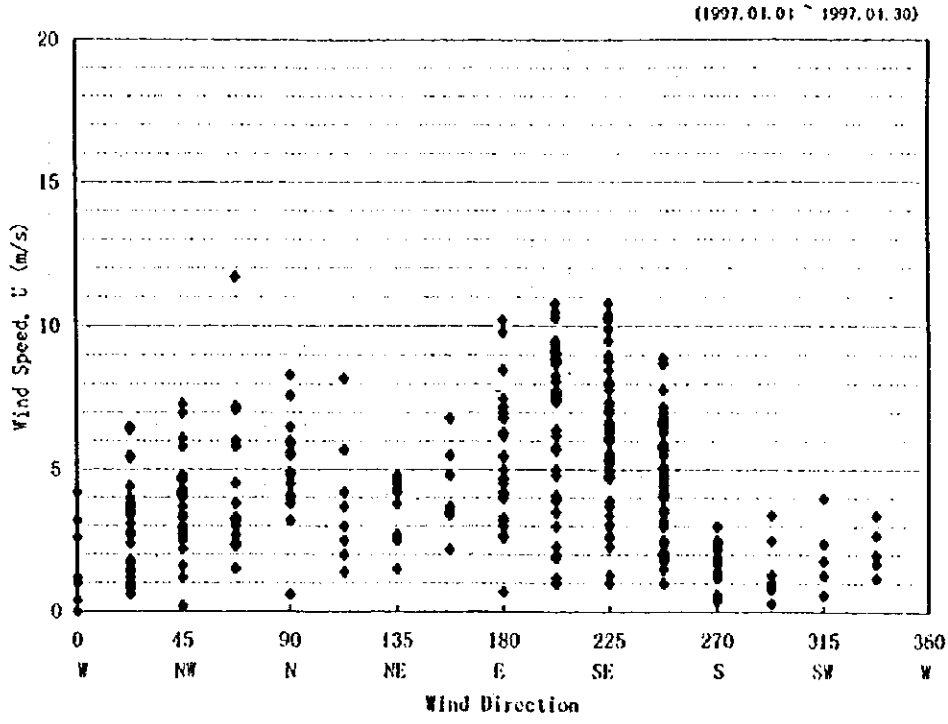
(2) Location : Ky Ha

Total no. of data: 3,794 % of successful observation: 94.8 %

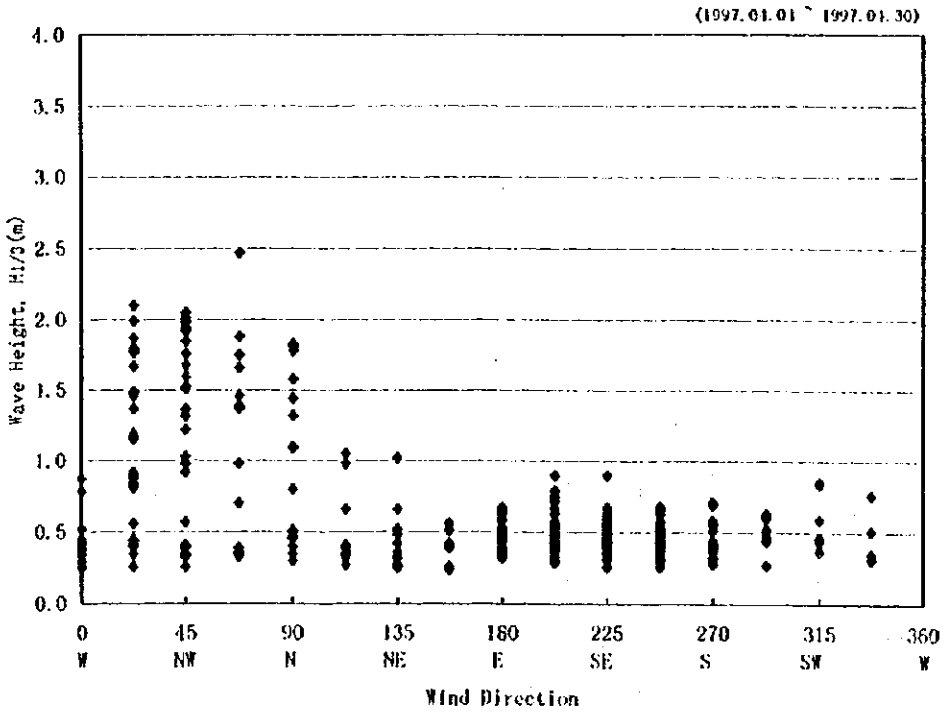
Unit: %

Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm*	Total
0.00-				0.1	0.1	0.0			0.0								2.2	2.4
0.25-	0.1	0.5	3.9	3.8	2.4	1.5	0.8	0.2	1.4	0.2	0.2	0.2	0.2	0.1		0.2	23.0	38.7
0.50-	0.3	0.9	4.9	5.6	1.9	1.3	0.5	0.3	0.7	0.2	0.1	0.2	0.1	0.0	0.0	0.2	4.8	22.0
0.75-	0.3	0.8	5.0	3.3	0.6	0.1	0.1	0.0	0.5	0.1	0.1	0.1	0.1	0.0	0.1		0.7	11.9
1.00-	0.3	0.9	3.1	2.5	0.1	0.1			0.2	0.1		0.1	0.0	0.0	0.0		0.2	7.6
1.25-	0.2	1.0	2.7	0.6	0.1				0.2									4.8
1.50-		0.4	1.8	0.3					0.4									2.9
1.75-		0.5	1.9	0.1	0.0				0.4									2.9
2.00-	0.1	0.5	0.8	0.1	0.0				0.2									1.7
2.25-	0.1	0.2	0.6	0.1					0.1									1.1
2.50-		0.7	3.3	0.1					0.1									4.2
Total	1.4	6.4	28.0	16.6	5.2	3.0	1.4	0.5	4.2	0.6	0.4	0.6	0.4	0.1	0.1	0.4	30.9	100.0

* "Calm" is defined by waves of which wave period is less than 5 seconds.



(1) Correlation between Wind Direction and Wind Speed



(2) Correlation Between Wind Direction and Wave Height

Figure A 4.3.8 Correlation of Wind and Waves observed at Ky Ha by JICA Study Team

Table A 4.3.3 Frequency Distribution of Hindcast Usual Wave Height by Direction (1993-1994)

(1) Location : N17.5 deg. E107.5 deg.

Total no. of data: 2,920
Unit: %

Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 -				0.5	0.9			0.0									1.4
0.5 -	0.1	0.0	0.2	22.3	13.1	1.0	2.8	1.6	1.3	1.9	2.0	0.3	0.1		0.0	0.0	46.7
1.0 -	0.5	0.3	0.3	18.7	3.7	2.1	2.6	0.3	0.1	0.3	1.9	1.5	0.1		0.0	0.2	32.5
1.5 -	0.6	0.3	0.0	5.8	3.2	0.1	0.1		0.0	0.1	0.1	0.2					10.7
2.0 -		0.3		2.2	2.7											0.0	5.2
2.5 -	0.1	0.1		0.8	1.6												2.6
3.0 -	0.0			0.5	0.5												1.0
4.0 -																	0.0
5.0 -																	0.0
Total	1.2	1.1	0.6	50.7	25.7	3.2	5.6	1.9	1.4	2.2	4.0	1.9	0.2	0.0	0.1	0.2	100.0

(2) Location : N15.0 deg. E110.0 deg.

Total no. of data: 2,920
Unit: %

Height (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0.0 -				0.1		0.0											0.1
0.5 -		0.3	1.4	21.3	0.1	0.1	1.4	4.0	5.0	2.3	1.3	0.1	0.1	0.0	0.0	0.0	37.6
1.0 -	0.3	2.0	5.0	15.9	0.1	0.1	1.0	6.3	5.5	2.4	1.5	0.3			0.1	0.1	40.5
1.5 -	0.6	2.0	2.3	5.7	0.1		0.1	0.5	0.3	0.1	0.3	0.0			0.0	0.1	12.2
2.0 -	0.6	1.2	0.9	1.5	0.1			0.0	0.0	0.0							4.3
2.5 -	0.3	1.1	0.3	0.9	0.1												2.8
3.0 -	0.3	1.0	0.2	0.8	0.0												2.3
4.0 -	0.2	0.0		0.0													0.2
5.0 -																	0.0
Total	2.3	7.6	10.1	46.3	0.5	0.2	2.5	10.9	10.8	4.9	3.1	0.4	0.1	0.0	0.1	0.2	100.0

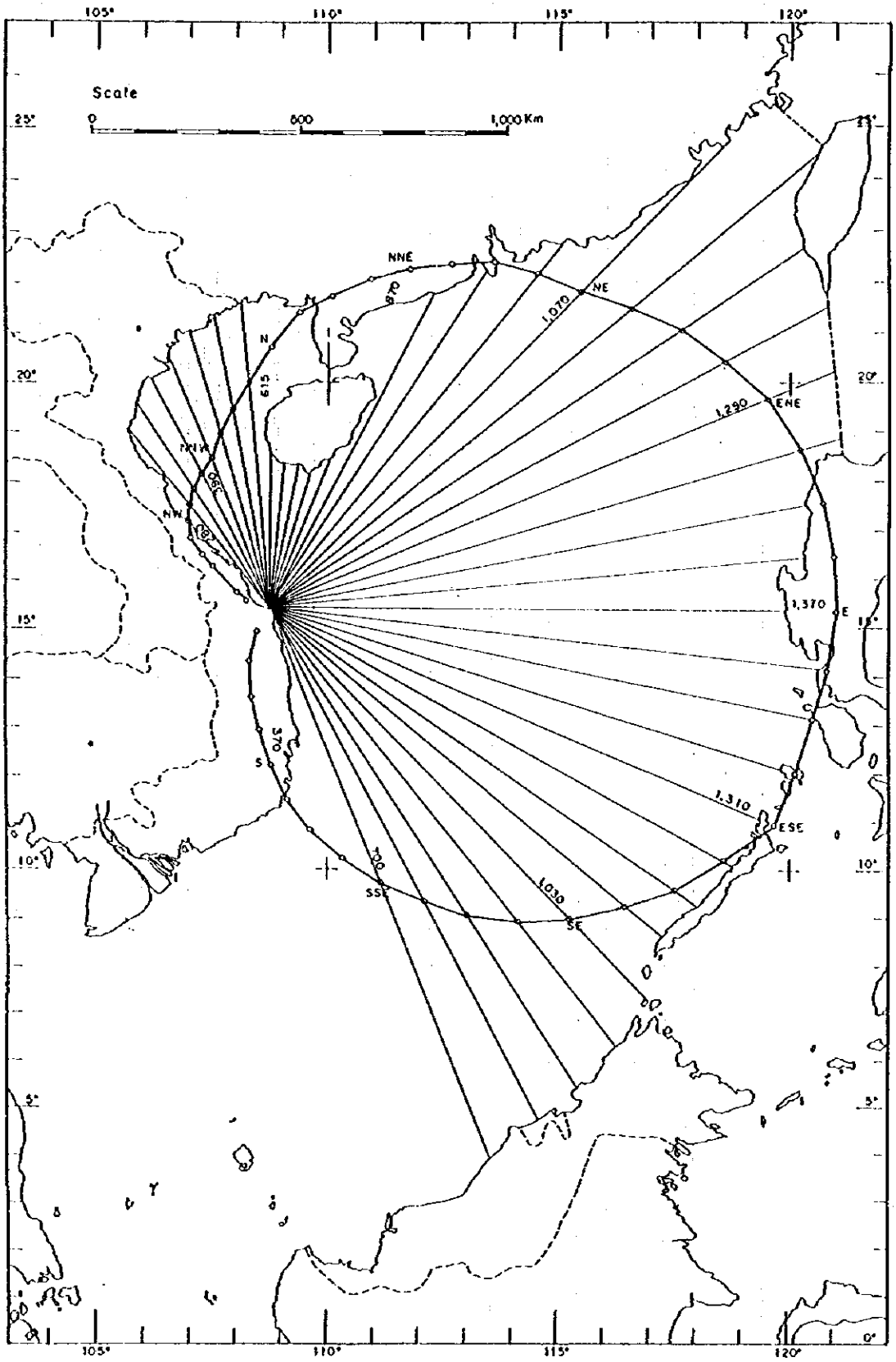
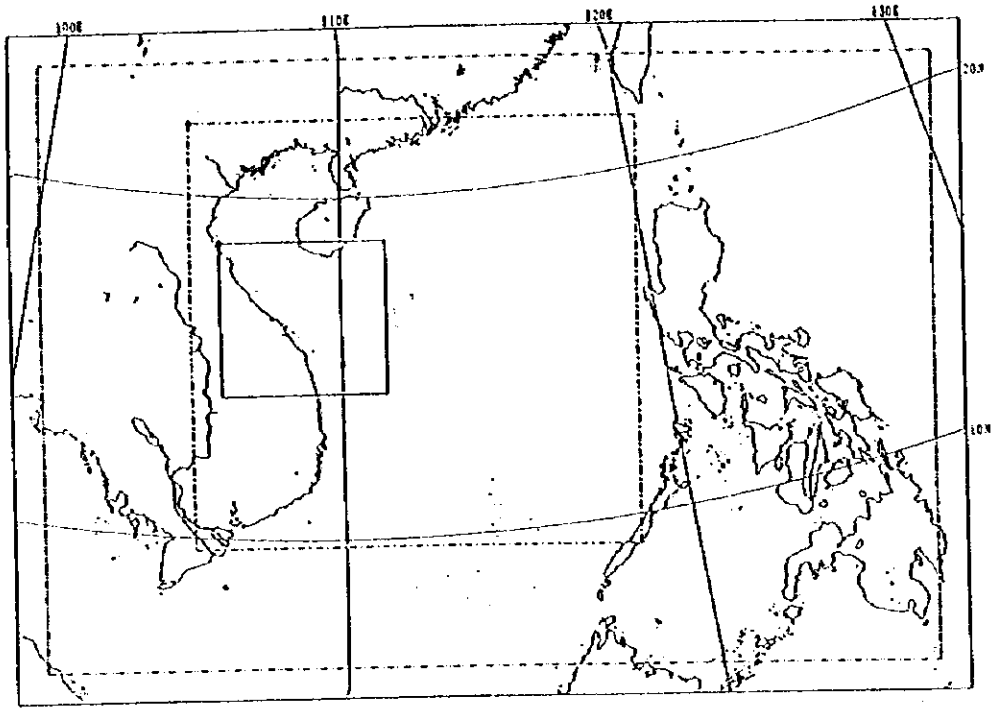


Figure A 4.3.9 Effective Fetch at Ky Ha / Dung Quat (Unit: km)

Source: JICA Study Team



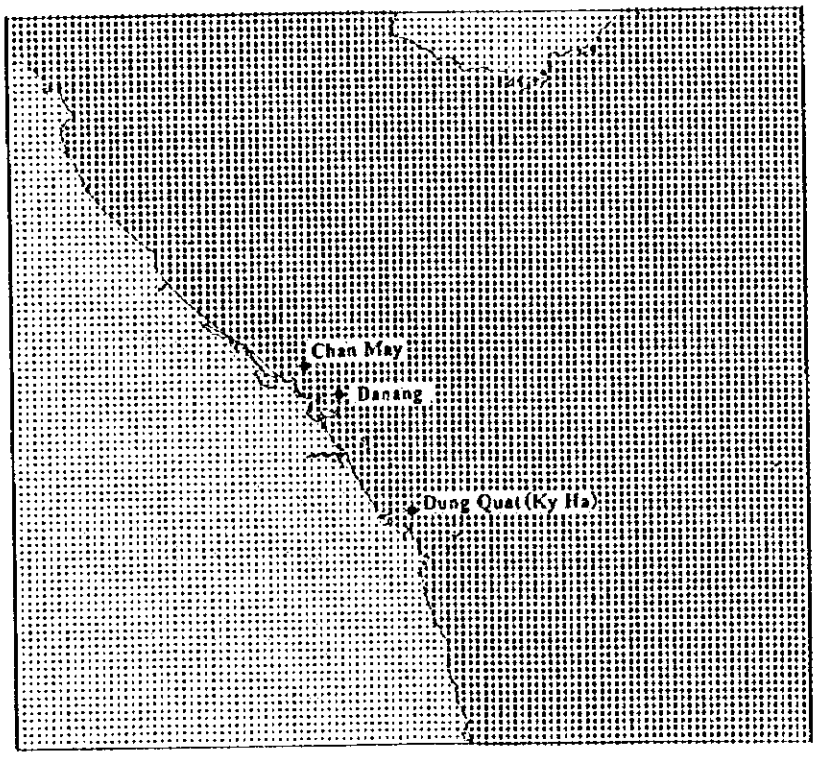
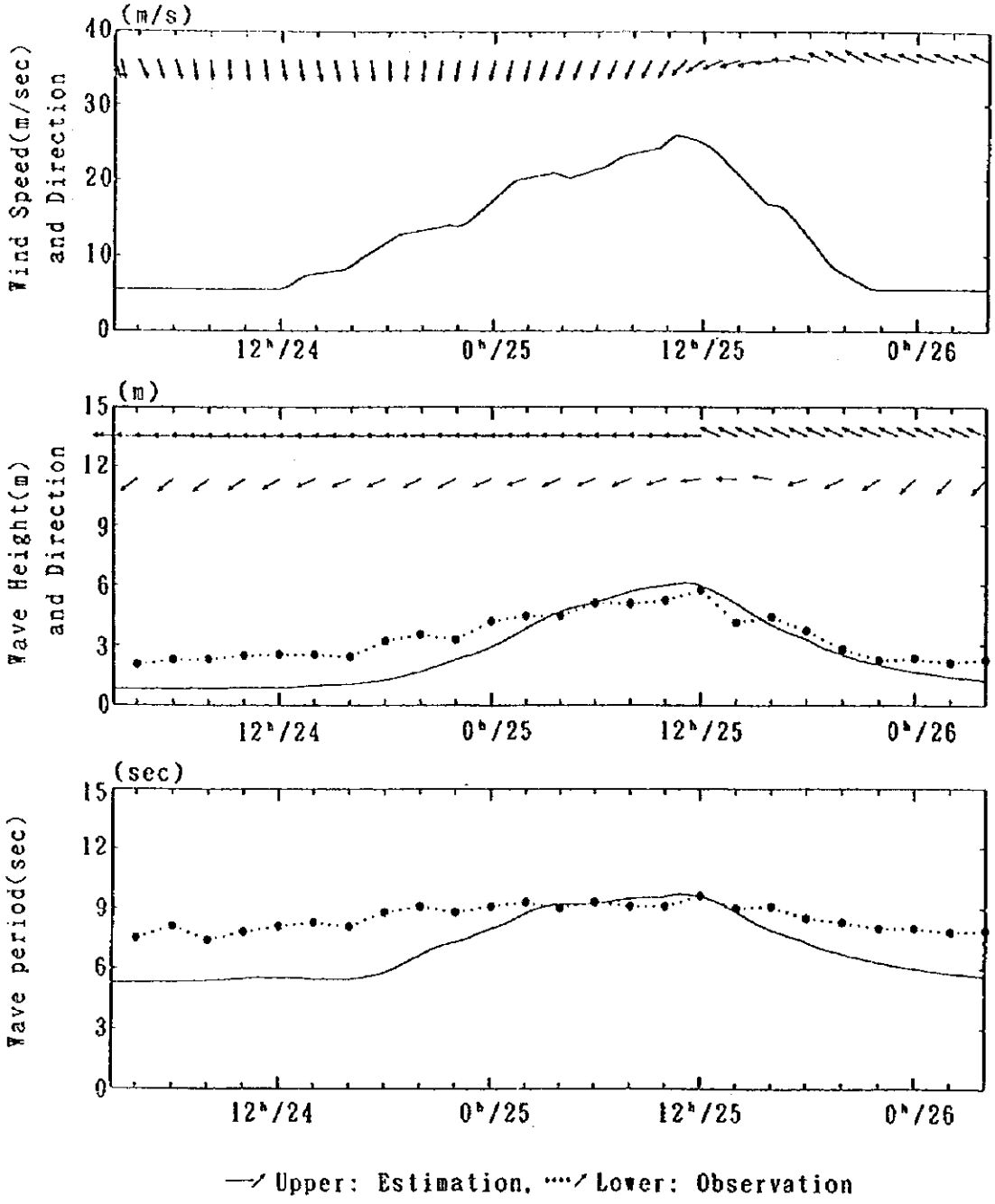


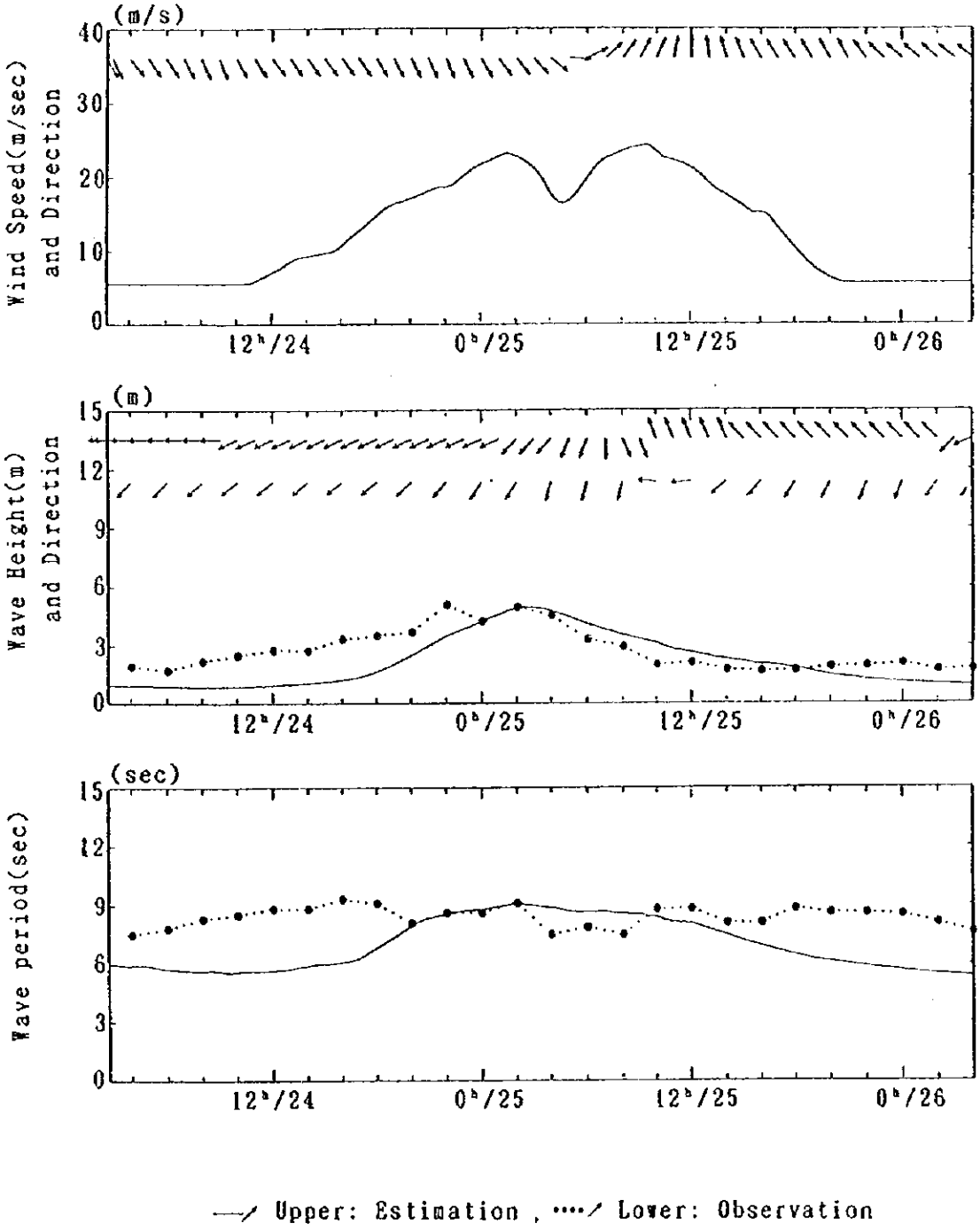
Figure A 4.3.10 Fields and Points of Wave Hindcast Calculation



	Maximum Values				
	Wind		Wave		
	Speed (m/s)	Direction	Height (m)	Period (sec)	Direction
Estimated	25.9	NE	6.1	9.7	E
Obseeved	–	–	5.7	9.7	E

Figure A 4.3.11 Comparison of Estimated and Observed Waves due to Typhoon Fritz

(1) Danang from 02:42 24 Sept. to 04:00 26 Sept., 1997



Maximum Values					
	Wind		Wave		
	Speed (m/s)	Direction	Height (m)	Period (sec)	Direction
Estimated	24.4	SSW	5.0	9.1	NE
Obseeved	—	—	5.1	8.7	NE

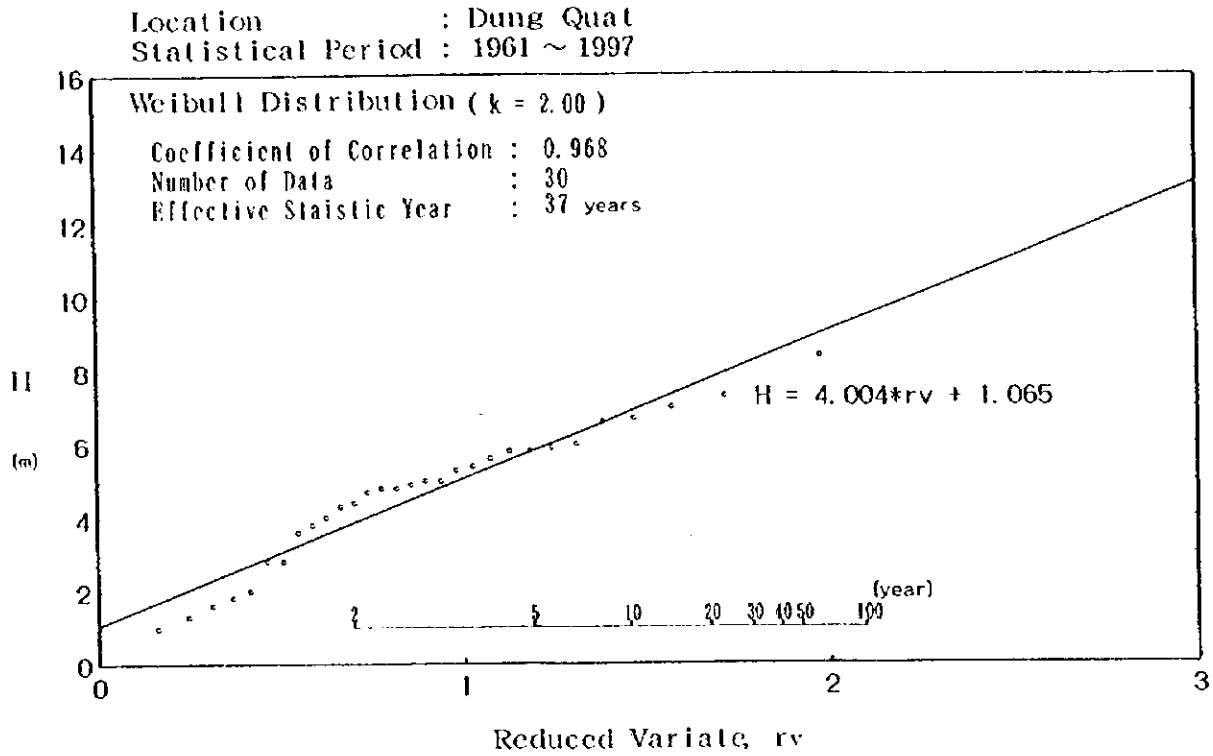
Figure A 4.3.11 Comparison of Estimated and Observed Waves due to Typhoon Fritz

(2) Dung Quat (Ky Ha) from 02:42 24 Sept. to 04:00 26 Sept., 1997

Table A 4.3.6 Hindcast Waves by Typhoons Affected the Central Coast of Viet Nam (1961-1997)

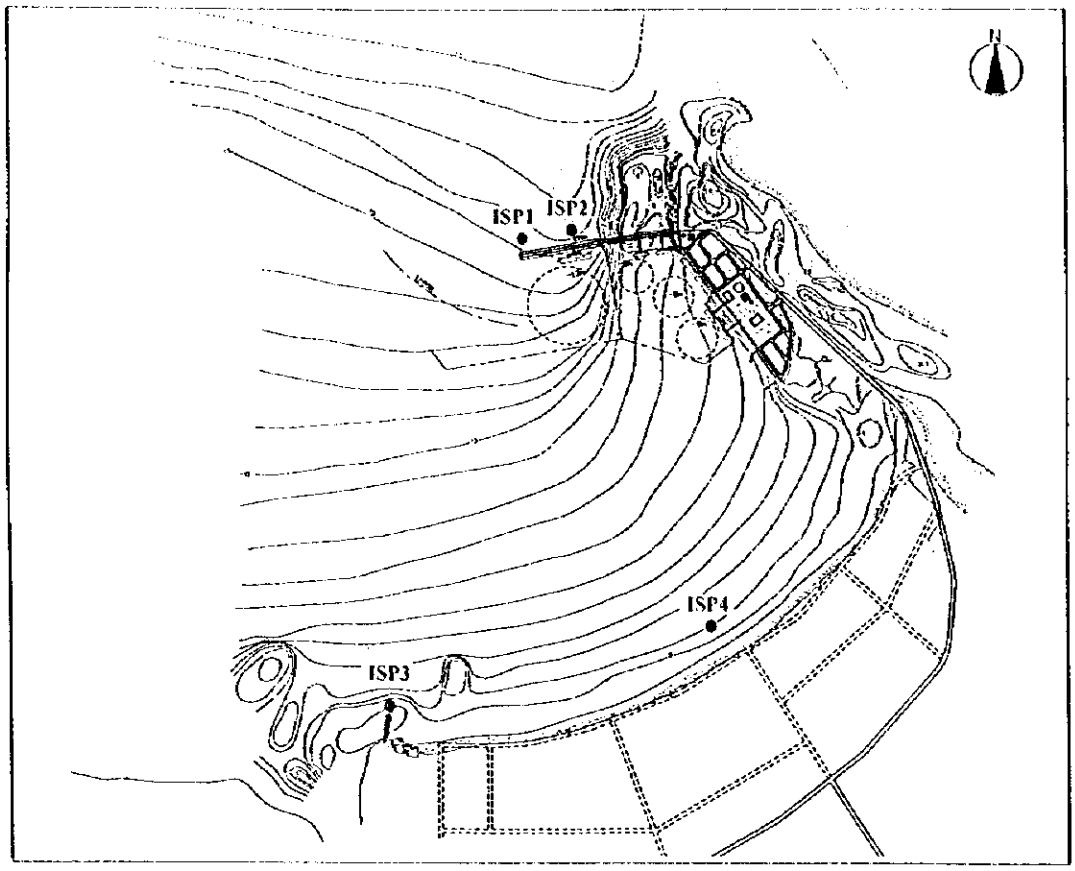
No.	Typhoon No.	Name	Chan May				Danang				Dung Quat (Ky Ha)			
			Time*	Height (m)	Period (sec)	Direction	Time*	Height (m)	Period (sec)	Direction	Time*	Height (m)	Period (sec)	Direction
1	9721	Fritz	09/25 11:12	5.8	9.5	E	09/25 11:12	6.1	9.7	E	09/25 02:42	5.0	9.0	NE
2	9622	Beth	10/21 02:30	1.2	8.8	ENE	10/21 05:00	1.3	8.7	ENE	10/21 04:42	1.3	9.1	ENE
3	9521	Zack	11/01 11:06	4.9	10.0	ESE	11/01 10:18	5.3	10.1	ESE	11/01 09:00	6.6	10.6	E
4	9325	Kyle	11/24 00:24	3.1	9.8	ESE	11/23 23:30	3.5	9.9	ESE	11/23 21:18	4.3	9.7	ESE
5	9226	Colleen	10/28 13:54	2.7	9.2	ESE	10/28 13:12	3.0	9.1	ESE	10/28 11:18	3.8	8.9	ESE
6	9224	Angela	10/23 10:42	2.8	8.2	ESE	10/23 10:12	3.1	8.4	ESE	10/23 03:48	3.6	8.1	ESE
7	9025	Mike	11/15 17:48	4.7	12.0	ESE	11/15 17:06	4.9	11.8	ESE	11/15 21:48	5.4	10.0	E
8	9018	Ed	09/18 14:48	6.0	9.9	ENE	09/18 13:36	5.9	9.9	ENE	09/18 07:00	5.3	9.8	NE
9	8926	Dan	10/13 06:00	4.8	10.7	ENE	10/13 05:12	4.8	10.7	NE	10/13 02:12	4.0	10.9	NE
10	8904	Cecil	05/25 01:12	6.5	9.9	ENE	05/24 23:00	6.2	9.7	ENE	05/24 15:12	4.7	9.1	NE
11	8829	Skip	11/12 23:00	1.4	6.1	ESE	11/12 23:00	1.6	6.1	E	11/11 23:24	1.6	7.2	E
12	8709	Betty	08/15 20:54	6.4	10.8	NE	08/15 18:36	6.3	10.9	NE	08/15 12:06	5.6	11.0	ENE
13	8622	Georgia	10/22 09:54	4.1	9.2	ESE	10/22 09:06	4.6	9.3	ESE	10/22 06:54	5.9	9.9	E
14	8619	Dom	10/11 06:12	1.5	6.9	NE	10/11 03:54	1.4	7.0	NE	10/10 23:24	1.0	7.7	NE
15	8521	Cecil	10/15 22:36	8.6	11.6	ENE	10/15 21:48	8.3	11.5	ENE	10/15 18:00	6.7	11.0	ENE
16	8424	Agnes	11/07 21:54	5.6	10.6	ESE	11/07 21:12	6.2	10.8	ESE	11/07 19:48	7.3	11.1	ESE
17	8401	Vernon	06/10 17:12	3.0	7.8	ESE	06/10 15:48	3.5	8.2	ESE	06/10 12:00	2.8	7.8	ENE
18	8316	Lex	10/26 02:30	2.6	8.3	NE	10/26 00:24	2.5	8.2	NE	10/25 18:42	2.0	9.1	NE
19	8301	Sarah	06/25 23:12	3.0	7.7	E	06/25 21:30	2.9	7.7	E	06/25 18:18	1.8	7.2	NE
20	8216	Hode	09/06 22:48	7.4	10.8	ENE	09/06 21:54	7.4	10.7	ENE	09/06 18:00	4.8	9.7	NE
21	7919	Sarah	10/11 23:48	2.5	8.7	ESE	10/12 08:24	2.6	8.8	ESE	10/12 04:54	2.8	8.3	ESE
22	7427	Faye	11/04 18:06	6.2	9.9	E	11/04 18:42	6.2	9.8	E	11/04 09:42	6.0	10.1	E
23	7218	Elsie	09/16 06:00	4.5	8.7	ESE	09/16 05:00	4.9	8.9	ESE	09/16 01:42	5.8	9.6	E
24	7217	Flossie	09/04 12:54	5.5	9.3	ESE	09/04 11:06	5.7	9.4	ESE	09/03 20:18	5.8	9.5	ENE
25	7134	Hester	10/23 16:30	5.4	9.6	ESE	10/23 15:12	5.8	9.8	ESE	10/23 11:36	7.0	10.5	ESE
26	7112	Harriot	07/06 04:48	10.6	12.9	ENE	07/06 04:00	10.8	13.0	ENE	07/06 02:36	8.4	12.9	NE
27	7020	Kate	10/25 11:54	6.0	9.8	E	10/25 10:30	6.1	9.8	ENE	10/25 05:42	4.8	9.1	NE
28	6904	Tess	07/11 09:36	5.9	10.0	E	07/11 08:12	5.8	10.1	ENE	07/11 04:30	4.9	10.1	ENE
29	6419	Tilea	09/22 01:12	6.5	10.6	NE	09/22 00:42	6.6	10.7	NE	09/21 21:48	5.0	10.7	NE
30	6121	Ruby	09/24 12:18	5.8	9.8	ENE	09/24 11:30	5.5	9.7	ENE	09/24 04:24	4.4	9.5	ENE

*[Month/day and Local time] when the waves in significant wave occured.



Return Period (year)	Non-exceeding Probability	Reduced Variate, rv	Wave Height (m)	Wave Period (sec)
100	0.988	2.097	9.5	14.0
50	0.975	1.924	8.8	13.5
40	0.969	1.865	8.5	13.3
30	0.959	1.786	8.2	13.0
20	0.938	1.669	7.7	12.7
10	0.877	1.447	6.9	11.9
5	0.753	1.183	5.8	11.0
2	0.383	0.695	3.8	8.9

Figure A 4.3.12 Statistical Analysis of Deepwater Waves Generated by Typhoons (Dung Quat)



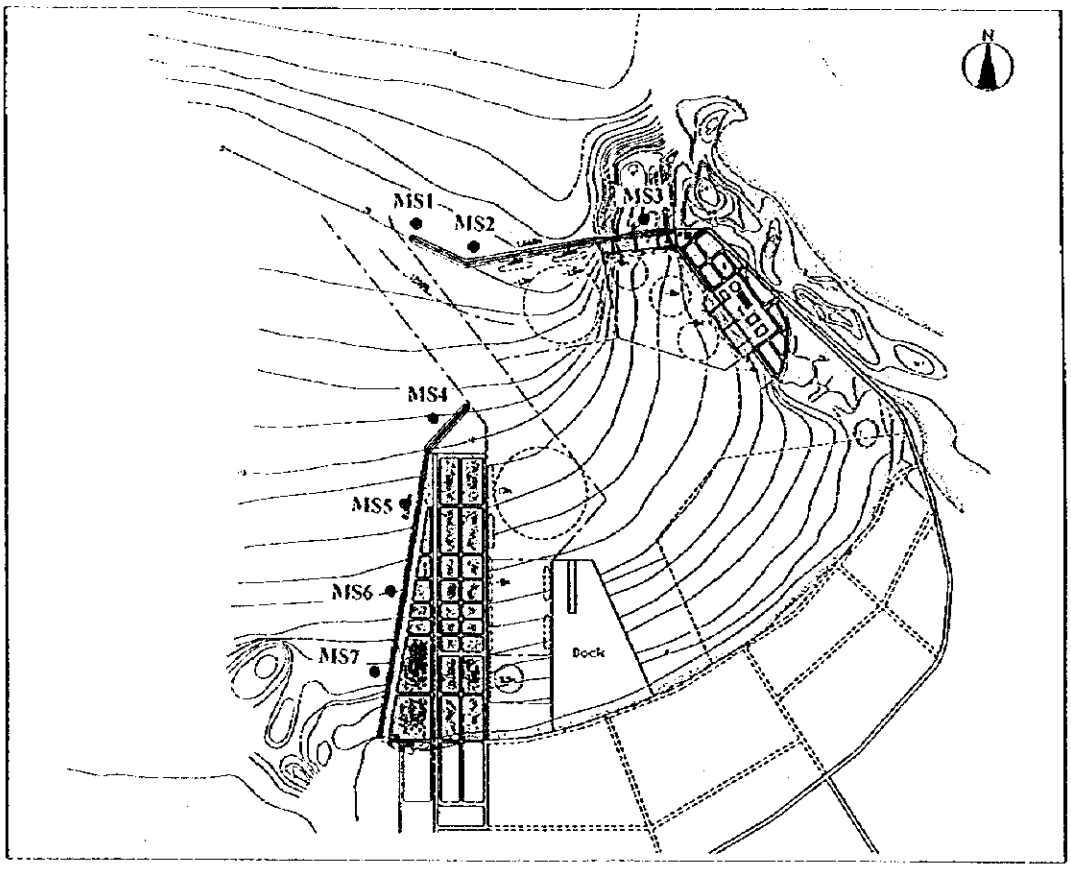


Figure A 4.3.13 Location of Wave Propagation Calculation (Dung Quat)